FINAL REPORT
BITTER CREEK / EAST FLAMING GORGE
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. WYWDC38)

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

Hinckley Consulting

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Date 11/16/18
WYOMING

November 16, 2018

Disclaimer:

It is important to note that all project recommendations presented in this report are conceptual only and are intended to provide sufficient information to initiate projects, assess design/site constraints, understand costs, and to apply for funding through various funding mechanisms; implementation may require further engineering analysis and design. Also, there are no requirements that these projects be ultimately implemented; participation is totally voluntary. Furthermore, the Sweetwater County Conservation District has no obligation to participate as sponsor of projects for potential funding. Decisions to sponsor a project will be made by the SWCCD board on a case by case basis.

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I. INTRODUCTION AND OVERVIEW

1.1 Introduction

In 2016 the Sweetwater County Conservation District (SWCCD) requested funding from the Wyoming Water Development Commission (WWDC) for the completion of a watershed management plan for the Bitter Creek / East Flaming Gorge 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. The WWDC approved funding for the study and Anderson Consulting Engineers, Inc. (ACE) was ultimately contracted in June 2017 to complete the project.

1.2 Project Overview

The Bitter Creek / East Flaming Gorge Watershed Study is a comprehensive evaluation and an initial inventory of the water and land resources within the study area. This Level I study provides important information that the SWCCD (the study's local sponsor) and the WWDC could use in developing water resources and implementing conservation practices that address water- and land- resource concerns within the study area. This watershed study includes in-depth descriptions about recommended water-development projects that could provide economic, ecological, and social benefits to the state of Wyoming and its citizens. The intent of this report is to provide the results of the Study.

1.2.1 Study Area

The project study area lies within the Upper Green River basin and is defined as the Bitter Creek / East Flaming Gorge watershed, located in Sweetwater County, Wyoming (Figure 1.2-1). Bitter Creek itself is defined by the United States Geologic Survey (USGS) as the fourth order basin: Bitter Creek (Hydrologic Unit Code 14040105). In the interest of eliminating potential "gaps" between this study and areas covered in previous Level I investigations, Wyoming Water Development Office (WWDO) staff added the portion of the Upper Flaming Gorge HUC8 (Hydrologic Unit Code 14040106) lying east of Flaming Gorge Reservoir and north of the Wyoming / Colorado State line.

Consequently, the project study area consists of Bitter Creek and its principal tributaries: Antelope Creek, Salt Wells Creek, Patrick Draw, Sweetwater Creek, Tenmile Creek, and Killpecker Creek in addition to the east Flaming Gorge watershed which includes Sage Creek, Currant Creek and Red Creek (among others).

Bitter Creek generally flows west to the confluence with the Green River at the City of Green River, WY. The Green River flows south into the Flaming Gorge Reservoir, which defines the downstream limit of the study area. From Flaming Gorge Reservoir, the Green River continues south through Utah and eventually joins the Colorado River near Moab, Utah. Most of the Bitter Creek headwaters are south of I-80 except for Killpecker Creek which starts at the Killpecker Sand Dunes and joins Bitter Creek at Rock Springs, WY.

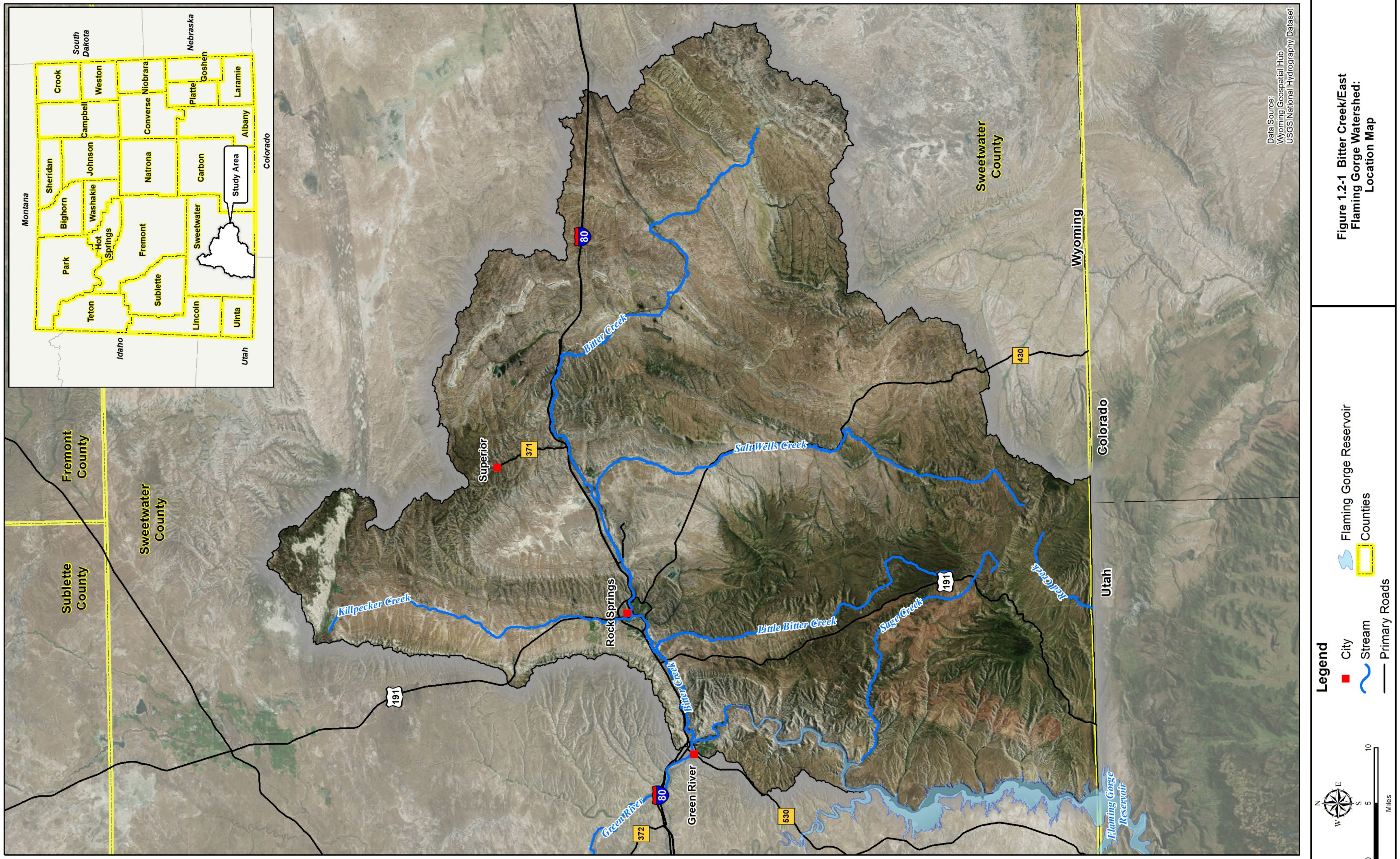


Figure 1.2-1 Bitter Creek/East Flaming Gorge Watershed: Location Map

The study area covers approximately 1.8 million-acres (2,853 sq. mi.) in southwest Wyoming. The watershed is located entirely within Sweetwater County. The cities, towns, and communities of Rock Springs, Superior, and Reliance lie within the watershed boundary. Most of the area's residents live in the City of Rock Springs and its vicinity. The remainder of the study area is sparsely populated and consists primarily of open range lands.

1.2.2 What is a Watershed Study?

The Operating Criteria of the Wyoming Water Development Program (Wyoming Water Development Commission, 2015) describes Level I watershed studies as preliminary analyses and comparison of development alternatives; although, the designation of a Level I study is also used for master plans, watershed improvement studies, and other water-planning studies. Specifically, the Operating Criteria of the Wyoming Water Development Program, (Wyoming Water Development Commission, 2015) describes watershed studies as:

> *"These studies provide a detailed evaluation of an individual watershed. The studies may identify water development and system rehabilitation projects as well as address erosion control, flood control or other non-water development related environmental issues. Watershed improvement studies are an integral part of the Small Water Project Program, which has its own specific criteria. The studies may identify projects that may be eligible for the New Development, Rehabilitation, or Dam and Reservoir Programs."*

While the WWDC's definition summarizes a watershed study in terms of their operating criteria, the general philosophy of a watershed study may perhaps be best explained in an article entitled "Conservation and Watershed Studies. What's the Connection?" which appeared in the WWDC's *Water Planning News* Fall 2009 newsletter (Wyoming Water Development Commission, 2009). In this article, a watershed study is described as follows:

> *"Today, conservation by watershed is an old concept with new horizons. Watersheds have long been recognized in the western United States for their significant natural resources and the interrelationships found contained in land areas connected by stream systems. These relationships were recognized by John Wesley Powell from his early expeditions of the west and resulted in proposed conservation, low density open grazing, irrigation systems and state boundaries based on watershed areas.*
>
> *The conservation concept developed over time to coalesce in the early 1930's with the formation of special districts whose boundaries were often based on watersheds. At that time the relationship between stream systems and landscape function was recognized. This relationship was broadened to embrace watershed condition and quality and its response to human influences. This further provided some understanding of the historic land use effect on watershed condition and how management and restoration needs to be based on local landscape characteristics.*

Today, these relationships are embraced by the Wyoming Water Development Commission and Office through a watershed study program. On behalf of a local community sponsor, a watershed study can provide a comprehensive evaluation, analysis and description of the resources associated with a watershed and the watershed's water development opportunities. It is best stated that information related to the physical sciences is incorporated into a biological system.

There are three prominent issues that are important considerations in a watershed information review and study. The first is surface water storage. Surface water storage is often of significant interest to a watershed community in order to address seasonal and/or annual shortages of water supply, augment late season stream flow to benefit riparian habitat, fisheries and wildlife, address flood impacts, enhance recreation opportunities, improve water quality and steam channel stability.

Second is the evaluation of irrigation infrastructure and development of information necessary to guide its rehabilitation and conservation. Of interest to local water users are ways to improve water delivery and on-farm irrigation efficiencies often timed to address annual or seasonal shortages of water supply or irrigation water delivery issues.

Third is the enhancement of upland water resources and distribution for livestock and wildlife that allows grazing management adjustments for range resource improvement. Benefits to the watershed, through plant community invigoration, reduction of erosion and stream channel stabilization, can be achieved from water development projects being strategically implemented over the watershed. Other issues and opportunities such as making beneficial use of produced water and removal of high water demand invasive species can also be important.

A watershed study, providing management and rehabilitation plans for water storage, irrigation systems and upland water development, can help empower a community to proactively enhance their watershed. Conservation by watershed can be an effective holistic approach to embracing the natural resource challenges and opportunities facing a community. A watershed study can provide the information to meet those challenges."

1.2.3 The Small Water Project Program (SWPP)

One of the purposes of this Level I watershed study is to provide the basis upon which the WWDC can make future decisions pertaining to state funding of water development projects. Potential projects identified in this study may be eligible for funding through the WWDC's Small Water Project Program, or SWPP. According to the operating criteria of the SWPP:

"The purpose of the Small Water Project Program (SWPP) is to participate with land management agencies and sponsoring entities in providing incentives for improving watershed condition and function. Projects eligible for SWPP grant funding assistance include the construction or rehabilitation of small reservoirs, wells, pipelines and conveyance facilities, springs, solar

platforms, irrigation works, windmills and wetland developments. Projects should improve watershed condition and function and provide benefit for wildlife, livestock and the environment. Projects may provide improved water quality, riparian habitat, habitat for fish and wildlife and address environmental concerns by providing water supplies to support plant and animal species or serve to improve natural resource conditions."

Projects eligible for funding through the SWPP include:

- small reservoirs
- wells
- solar platforms
- pipelines and conveyance facilities,
- springs developments,
- wetland developments,
- environmental projects (streambank stability, water quality improvements, etc.),
- irrigation projects,
- windmills,
- rural community fire suppression (supply and storage projects), and
- recreational.

According to the WWDC's recently revised operating guidelines, project priorities are as follows:

1. Source water development
2. Storage
3. Pipelines, conveyance facilities, solar platforms and windmills
4. Irrigation
5. Environmental
6. Recreational

Applicants can receive up to $35,000 towards these costs. Individuals would apply for funding through the SWCCD which would serve as the applicant's sponsor. Application deadlines are December 31st of the year for consideration.

In addition, projects that have completed permitting requirements, certified designs, agency notifications, land procurement and finalized other financial agreements (in other words, "shovel ready" projects) may be considered as a funding priority at the discretion of the WWDC. The SWPP and its operating criteria are discussed in greater detail in Chapter 8: Economic Analysis.

1.3 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, SWCCD contacts, and advertisements.*
- *Conduct an evaluation and description of the Bitter Creek / East Flaming Gorge 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.*

The study culminates in the delivery of a Watershed Management and Rehabilitation Plan (the Plan). It is the goal and objective of the sponsors and the WWDC to generate a plan that is not only technically sound, but also one that is practical and economically feasible. The plan also includes development of a database to facilitate the planning process and the evaluation/implementation of watershed improvements. To accomplish this task, the SWCCD, WWDC, and ACE addressed several key issues, including the following:

- *Utilization of grazing lands*
- *Water availability*
- *Channel stability/riparian restoration/enhancement*
- *Irrigation system assessment (to promote rehabilitation of existing facilities and provide opportunities for water conservation that would support an increase in water availability)*
- *Public participation and acceptance (intent is to focus on solutions, not compliance issues)*

During the completion of this Level I investigation, efforts were made to meet with as many landowners and stakeholders as possible and to help defining their individual water projects. These projects are then outlined as components of the Plan. Feasible projects not meeting criteria of the SWPP are included as recommendations in the Plan; they simply exceed the cost limitations of the program or are not project types listed in the WWDC criteria. For these projects, recommendations for future planning/implementation efforts may include recommendation for Level II funding and/or investigation of alternative funding sources.

1.4 Report Utilization

The remainder of this report is organized in a manner which we believe will provide the greatest utility to the reader, the WWDC, and the SWCCD. The major chapters are presented as follows:

Chapter 2 - Project Meetings: This chapter documents the public meetings, open houses, and Final Results Presentations which were conducted in support of the project. In addition, we document individual onsite meetings we completed with individual landowners to discuss their water resources issues.

Chapter 3 – Review of Existing Information: This chapter describes the data collection and management methods used in the project, as well as an overview of project GIS and Digital Library submitted along with this report.

Chapter 4 - Watershed Description and Inventory: This chapter provides a characterization of the study area and its resources. In this chapter, we provide and discuss the management implications of various watershed attributes and potential impacts upon watershed improvement recommendations. We also provide source references for data utilized so the SWCCD and WWDC can easily update information as needed during future planning efforts.

While completing this task, we met with numerous stakeholders, including private landowners, state agency representatives, and federal agency representatives to ascertain their specific resource-related concerns, needs and objectives. Our team contacted as many individuals as possible through phone calls, office visits and onsite ranch or farm visits. Potential projects were discussed which might help address concerns expressed.

Chapter 5 – Surface Hydrology: This chapter provides a summary of existing hydrology data, mean annual discharge estimations for each sub-watershed, peak flow estimations and flooding information pertinent to the study area, and a description of surface water availability and shortages.

Chapter 6 - Watershed Management Plan: This chapter describes the individual projects which together, comprise the Plan. The projects were, for the most part, conceptualized or documented through the effort discussed under the Watershed Inventory phase (Chapter 4). Projects fall into several broad categories:

- Surface Water Storage Opportunities
- Irrigation System Rehabilitation
- Upland Livestock/Wildlife Water Development
- Groundwater Recharge
- Wetland Development and Enhancement
- Grazing Management

In addition, we present discussions of potential benefits of the various components to the State of Wyoming and its residents.

Chapter 7 - Cost Estimates: In this section, we present conceptual level cost estimates of the Watershed Management Plan components and the methods and assumptions supporting them. This information can then be used by the SWCCD and project sponsors in future planning efforts.

Chapter 8 – Economic Analysis: This valuable portion of the report summarizes numerous funding programs provided by various local, state and federal entities as well as private organizations. This information can be used to determine optimized funding strategies including partnering with multiple funding sources

Chapter 9 – Permits: Most projects included in the Plan will require some sort of permit to be completed. In this section, we provide information to help guide the SWCCD through the permitting process and agency contact information.

Chapter 10 – Conclusions and Recommendations: Here we summarize the highlights of the Plan and make concise and feasible recommendations for further action on behalf of the WWDC and the SWCCD.

II. TASK 1: PROJECT MEETINGS

2.1 Meetings and Workshops

An integral part of the Bitter Creek / East Flaming Gorge Watershed Study was the public outreach and involvement effort. Meetings were orchestrated by Anderson Consulting Engineers (ACE) and typically included informal presentations conducted by ACE staff and the Wyoming Water Development Office (WWDO). The objectives of the meetings were to:

- Discuss the purpose, existing data, and available information for the watershed study
- Obtain input and opinions from residents and landowners about the study area
- Identify concerns and answer questions about the area's water and land resources
- Request participation in the study effort and coordinate inventory activities
- Present initial results and preliminary findings from the watershed study

At each of the meetings, ACE representatives were available to discuss the project one on one with landowners/stakeholders and to initiate development of watershed plan alternatives. The project GIS was demonstrated when appropriate to keep landowners up to date on the information which would ultimately be incorporated within it.

At the Project Workshops/ Open Houses, ACE staff were available to discuss the study one-on-one with landowners/stakeholders or the general public. These conversations typically ended with initiation of development of project plans or scheduling future on-site visits.

- July 16, 3017 — Project Scoping Meeting
- October 8, 2017 — Project Workshop / Open House
- March 6, 2018 — Project Workshop / Open House
- April 12, 2018 — Bitter Creek / Killpecker Creek Watershed Advisory Group
- July 12, 2018 — Bitter Creek / Killpecker Creek Watershed Advisory Group
- October 2, 2018 — Draft Results Presentation public meeting

Appendix 2A contains pertinent information regarding the Draft Results Presentation.

Meetings and workshops were advertised in advance in the Rocket Miner newspaper. In addition, a mailing list was generated using county assessor's information, the SWCCD mailing list, and input from SWCCD representatives. Letters were then sent to individual landowners/stakeholders, agency representatives, and other interested parties describing the project and inviting participation.

2.2 Field Trips and "Tailgate Talks"

Field investigations generally occurred in coordination with scheduled meetings for efficiency. Specific field efforts targeted irrigation inventory, upland livestock/wildlife water opportunities, and stream channel conditions observations.
Individual meetings with landowners and lease holders were scheduled at their residences and properties where discussions focused on land and water resource concerns and issues specific to the landowner. Usually, the landowner gave a tour of the property. During these property visits, initial planning and conceptual project designs were discussed for upland livestock/wildlife and irrigation water improvements. These informal interviews, often held spontaneously while in the field, have become dubbed "tailgate talks" and provide valuable insight into the overall assessment of the watershed. The project team reached out to approximately 60 contacts. Ultimately, a total of 26 individuals/agencies were interviewed; some on multiple occasions.

Throughout the watershed study, local ranchers, irrigators, and residents who invited the study team to visit their properties and discuss issues and concerns demonstrated extensive knowledge and valuable insight about the watershed. Because of the willingness of landowners to share information, insight, and direction, the study team was able to incorporate this knowledge and experience into the study and provide a more effective evaluation of the watershed.

III. TASK 2: REVIEW OF EXISTING INFORMATION

3.1 Collection of Existing Information

A significant amount of information and pertinent data were available from existing sources at the time this project was initiated. In an effort to collect and incorporate as much of this information as possible, the following sources were either contacted directly or information and documents procured via websites, libraries, or personal contacts:

- U.S. Bureau of Land Management (BLM)
- U.S. Geological Survey (USGS)
- U.S. Department of Agriculture/Natural Resources Conservation Service (NRCS)
- U.S. Department of Agriculture/Farm Service Agency (FSA)
- U.S. Department of Agriculture/Forest Service: Ashley National Forest (USFS)
- U.S. Environmental Protection Agency (EPA)
- U.S. Fish and Wildlife Service (FWS)
- U.S. Department of Interior (DOI)
- U.S. Department of Interior (DOI)/National Park Service Register of Historic Places (NPS)
- Wyoming Water Development Commission (WWDC)
- Wyoming Department of Environmental Quality (WDEQ)
- Wyoming Abandoned Mine Land Program (AML)
- Wyoming Game and Fish Department (WGFD)
- Wyoming State Historic Preservation Office (SHPO)
- Wyoming State Engineer's Office (WSEO)
- Wyoming Oil and Gas Conservation Commission (WOGCC)
- Wyoming State Geological Survey (WSGS)
- Wyoming Geographic Information Science Center (WyGISC)
- Wyoming Natural Diversity Database (WYNDD)
- Wyoming Landscape Conservation Initiative (WLCI)
- Wyoming Wildlife Federation (WWF)
- Water Resources Data System (WRDS)
- Sweetwater County Weed and Pest District
- Sweetwater County Assessor's Office
- Sweetwater County Engineer's Office
- Green River Basin Landscape Conservation Design
- Trout Unlimited (TU)

3.2 Previous WWDC-Funded Investigations

Several projects and studies have been completed through the Wyoming Water Development Commission within the study area. Figure 3.2-1 shows a map of these previous studies.

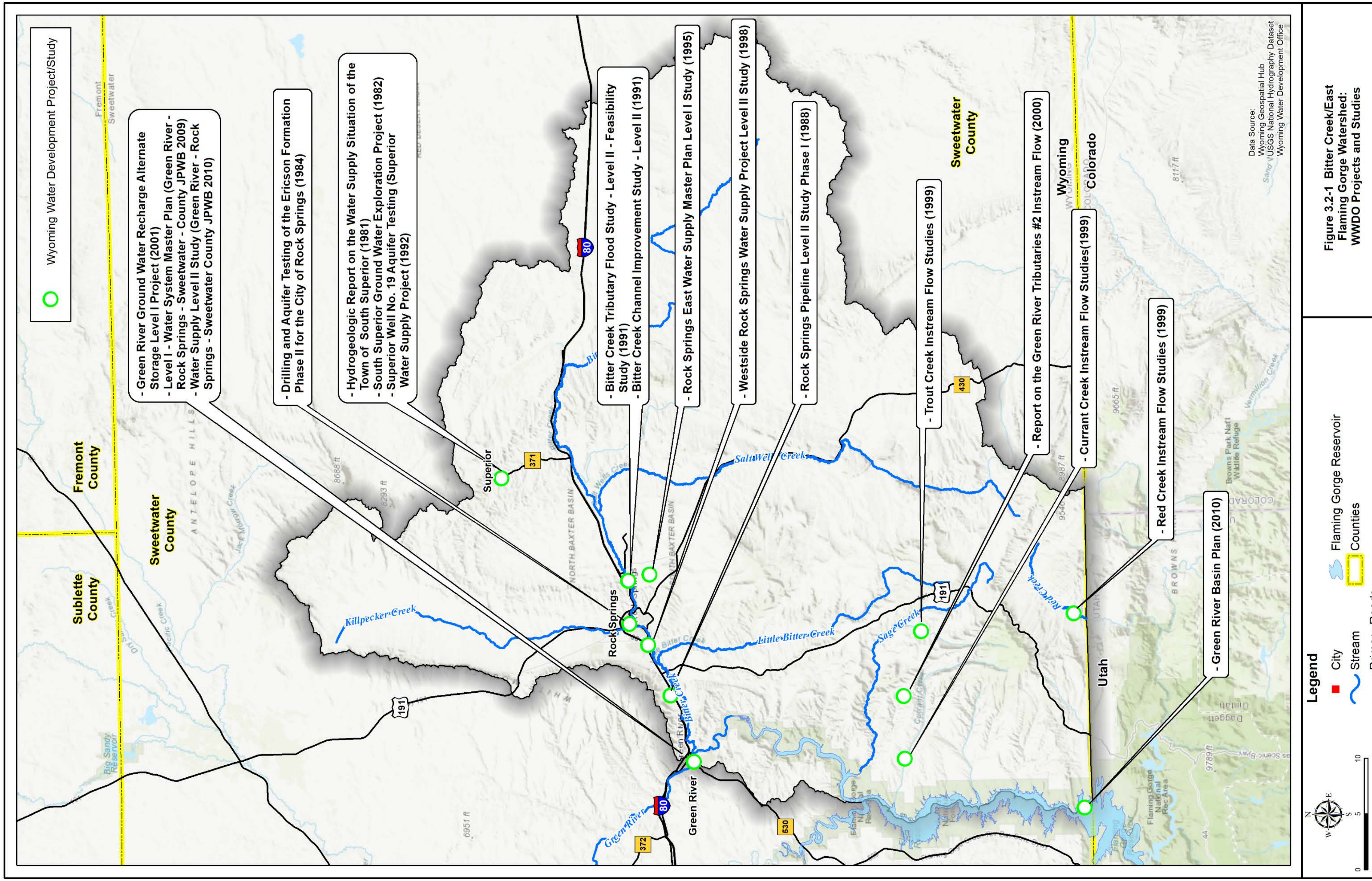


Figure 3.2-1 Bitter Creek/East Flaming Gorge Watershed: WWDO Projects and Studies
Wyoming Water Development Project/Study
- Green River Ground Water Recharge Alternate Storage Level I Project (2001)
- Level I - Water System Master Plan (Green River - Rock Springs - Sweetwater - County JPWB 2009)
- Water Supply Level II Study (Green River - Rock Springs - Sweetwater County JPWB 2010)
- Drilling and Aquifer Testing of the Ericson Formation Phase II for the City of Rock Springs (1984)
- Hydrogeologic Report on the Water Supply Situation of the Town of South Superior (1981)
- South Superior Ground Water Exploration Project (1982)
- Superior Well No. 19 Aquifer Testing (Superior Water Supply Project (1992)
- Bitter Creek Tributary Flood Study - Level II - Feasibility Study (1991)
- Bitter Creek Channel Improvement Study - Level II (1991)
- Rock Springs East Water Supply Master Plan Level I Study (1995)
- Westside Rock Springs Water Supply Project Level II Study (1998)
- Rock Springs Pipeline Level II Study Phase I (1988)
- Trout Creek Instream Flow Studies (1999)
- Report on the Green River Tributaries #2 Instream Flow (2000)
- Currant Creek Instream Flow Studies(1999)
- Red Creek Instream Flow Studies (1999)
- Green River Basin Plan (2010)
Sublette County
Fremont County
Sweetwater County
Wyoming
Colorado
Utah
Superior
Rock Springs
Green River
Killpecker Creek
Little Bitter Creek
Salt Wells Creek
Sage Creek
Red Creek
Bitter Creek
Green River
80
191
371
372
430
530
Legend
City
Stream
Primary Roads
Flaming Gorge Reservoir
Counties
Miles
0
5
10
Data Source:
Wyoming Geospatial Hub
USGS National Hydrography Dataset
Wyoming Water Development Office

3.3 Geographic Information System

A GIS can be thought of as a powerful three- dimensional mapping tool that can be used to evaluate and compare spatial data pertaining to a wide range of topics. Numerous maps can be "stacked" to overlay information; each map, or "theme", incorporates data, or "attributes" pertaining to the theme. For instance, a theme showing the location of stock reservoirs ditches could also include numerical data pertaining to each reservoir’s water rights and condition.

Available GIS data pertaining to the Study Area was collected from a wide range of sources and used to develop the characterization of the watershed presented in Chapters 4 and 5 of this report. The SuiteWater Web Service developed by the Wyoming Association of Conservation Districts (WACD) was a source for much of the general information. In addition, data was collected from various agencies and incorporated into the project GIS. In an effort to reduce redundancy of data and reduce data management requirements, any data available from SuiteWater was not incorporated into the project GIS delivered with this report.

The data that is included in the GIS deliverable is data that throughout the course of the project was generated through analysis and watershed plan development. This data represents “new” or “value added” data and does not currently exist in Suitewater and is not available from any other source. “New” data would include items such as: Rosgen stream classification results, identification of upland water sources, WWDO potential project locations, etc. “Value Added” data are data sets that already exist (i.e. through SuiteWater for example) but has been modified or has had attributes added with the results of an analysis conducted during this study. For example, the HUC 12 Hydrologic Units are an existing dataset distributed by the USGS and available through SuiteWater. During this study the dataset was used as a basis for hydrologic analyses. Mean annual runoff and peak discharges were computed using various regional methodologies. The results of this effort were incorporated within the HUC12 dataset as new attributes.

The delivered GIS geodatabase was built using a template geodatabase obtained from the Wyoming Water Development Office (WWDO). The geodatabase adheres to the GIS standards detailed in the Bear River Data Model Pilot Project, GIS Standards Technical Memorandum issued January 1, 2018.

The data in the delivered project GIS is stored in an ArcMap 10.5 File Geodatabase. The File Geodatabase format was chosen for a variety of reasons including; optimizing the GIS performance, customizing the data storage structure, and database compactness and portability. Contained within the BCEFG_Watershed.gdb (file geodatabase) is a series of feature datasets categorized by the agency who supplied the data (for example, BLM, AML, etc.). Within each feature dataset are feature classes representing the various geographic data supplied by the agency or developed during the project.

It is also important to note that data presented in the project GIS and within this report are subject to change with time as the agencies creating them continually update their databases. The user is encouraged to obtain the most current data available to meet the needs of future endeavors utilizing the project GIS.

3.4 Digital Library

The Digital Library is a collection of 270 documents, plats, maps, figures, spreadsheets, etc., pertaining to the project. Documents reviewed during the completion of this project were scanned and included in the Digital Library to the extent possible. Copyright protected documents were not included in the Library; however, documents published by public agencies were included where feasible. The Digital Library consists of a spreadsheet listing the available documents and links to each; it can be searched or sorted depending upon the user's needs. Individual document files can be directly accessed via the Digital Library or directly by "browsing" on any IBM based computer. Documents included in the Digital Library were obtained from the agencies listed in Table 3.4-1, among many others. The Digital Library table of contents has been included as Appendix 3A.

Table 3.4-1 Selected Sources of Information Included in the Digital Library.

USDI Bureau of Land Management
United States Army Corps of Engineers
United States Environmental Protection Agency
United States Fish and Wildlife Service
United States Forest Service
USDI United States Geologic Survey
Natural Resources Conservation Service
Wyoming Department of Environmental Quality
Wyoming Department of Game and Fish
University of Wyoming
Wyoming Water Development Commission
Wyoming Department of Environmental Quality
Wyoming Weed and Pest Council
Wyoming State Engineers Office
Wyoming State Geological Survey
United States Forest Service
Sweetwater County Conservation District
Miscellaneous

IV. TASK 3: WATERSHED DESCRIPTION AND INVENTORY

4.1 Introduction and Purpose

A considerable amount of information exists pertaining to the Bitter Creek/East Flaming Gorge Study Area and its resources. The data spans a wide variety of disciplines and includes basin hydrology, water quality, land use and ownership, geology and soils, and agricultural practices as typical examples. The primary objective of the watershed inventory phase of this project was to accomplish the following objectives:

1. collect, review, and compile pertinent information regarding the study area;
2. collate the data in a single database; and
3. assess the data to characterize the watershed and facilitate identification of existing issues and development of improvements to the watershed.

Throughout the remainder of this chapter, an overview of existing conditions of natural resources found within the study area are discussed. Included are summaries of numerous individual disciplines: vegetation, soils, wildlife, hydrology, ecologic site descriptions, etc. For each discipline, individual maps delineating the character and extent of that watershed attribute were generated within the project GIS. In conjunction with many of the map figures, summary tables have been prepared which tabulate various attributes of the pertinent watershed characteristics.

4.2 Physical Systems

4.2.1 Overview

Specific topics discussed in the following sections include the following:

- Climate
- Geology
- Groundwater Hydrology
- Surface Water Hydrology
- Geomorphology

4.2.2 Climate

Climate of the study area is broadly considered as desert and steppe. According to “Water Resources of Sweetwater County” (USGS, 2004):

> *“Areas identified as desert generally receive less than 10 inches (in.) of precipitation annually and are characterized by dryland vegetation such as saltbush, greasewood, and desert shrub. The areas identified as steppe are dominated by Wyoming big sage. Driese and others (1997) report a*

shift from grassland to shrub-dominated communities such as Wyoming big sage as summer precipitation decreases to less than 11.1 in."

Historic climate data for five NOAA Cooperative Weather Stations was obtained through the Western Regional Climate Center website (*http://www.wrcc.dri.edu/*). All the stations are within the Bitter Creek watershed, except for the Flaming Gorge station which is just south of the study area in Utah. This station was included since it represents the climate for the southeastern portion of the watershed which is more mountainous and higher in elevation. Table 4.2-1 presents the average temperature range and average total precipitation while Figure 4.2-1 displays the data graphically as bar charts. As indicated in the bar charts, summers are warm and dry throughout the study area, with July high temperatures averaging around 85 °F (29.4 °C). Summer nights are characterized by a rapid cool down; with mean summer lows averaging approximately 45-50°F. Winters are cold with average low temperatures below freezing from October through April.

Extreme fluctuations in temperatures from day to day and in annual precipitation from year to year are common. These climatic variations have strong effects on vegetation and in determining land capabilities and use. The USGS report (2004) states, "the climatic conditions alternate on an annual basis between having cold winter temperatures, which prevent substantial plant growth, and having summer water deficits". The NOAA Cooperative Weather Stations in the Bitter Creek watershed indicate that the average precipitation in the summer (June-August) is only about 0.7 inches per month.

Figure 4.2-2 displays the mean annual precipitation throughout the watershed. The data used to generate this figure were obtained from the Wyoming Geographic Information Center (WyGISC). These data represent the results of PRISM spatial climate data generated at the Oregon Climate Center, Oregon State University. As indicated in this figure, the mean annual precipitation varies significantly across the watershed. The western portion of the watershed only receives 6-7 inches of rain per year, while some small mountainous areas in the southeast can receive up to 20 inches. Table 4.2-1 shows that the Flaming Gorge gage receives approximately 12 inches of annual rainfall, while Bitter Creek, Rock Springs, and Green River only receive ~6-9 inches of annual rainfall.

The average "frost free period" can be used to approximate the growing season, as described by the NRCS below:

"The growing season is defined as that part of the year when soil temperatures at 50 cm (20 inches) below the soil surface are higher than biologic zero (5 degrees C, 41 degrees F). As this quantitative determination requires in-ground instrumentation which is not usually available, growing season can be estimated by approximating the number of frost free days. The growing season can be approximated as the period of time between the average date of the last killing frost in the spring to the average date of the first killing frost in the fall. This represents a temperature threshold of 28 degrees F or lower at a frequency of 5 years in 10."

Table 4.2-1 Summary of Monthly Climatic Data: Bitter Creek Watershed

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Bitter Creek 4 NE, Wyoming 480761: 9/14/1962 to 6/10/2016													
Average Max. Temperature (F)	32.4	35.8	44.5	54.8	65.7	76.3	84.4	82.5	72.7	59.4	43.4	33.5	57.1
Average Min. Temperature (F)	7.6	11.1	18.9	25.3	33	40.5	47.3	45.4	36.2	26.8	17	8.9	26.5
Average Total Precipitation (in.)	0.31	0.29	0.29	0.51	1.1	0.79	0.62	0.55	0.65	0.64	0.35	0.29	6.38
Rock Springs AP, Wyoming 487845: 1/1/1948 to 6/9/2016													
Average Max. Temperature (F)	29.3	33.4	42	52.9	63.6	74.6	83.5	81.1	70.7	57.2	40.5	30.8	55
Average Min. Temperature (F)	11.4	14.4	21.2	28.8	37.4	46	53.4	51.5	42.2	32	20.5	12.8	31
Average Total Precipitation (in.)	0.5	0.5	0.66	0.95	1.2	0.86	0.67	0.62	0.76	0.82	0.55	0.51	8.61
Rock Springs, Wyoming 487840: 11/1/1898 to 5/16/1979													
Average Max. Temperature (F)	31.7	36.7	43.8	55.2	66.8	77.4	86.2	83.7	73.6	61.3	44.8	34.7	58
Average Min. Temperature (F)	9.8	14.3	20.6	28.7	37.2	44.9	51	48.8	39.7	30	19.4	13.2	29.8
Average Total Precipitation (in.)	0.43	0.53	0.65	1.02	1.18	1.05	0.71	0.66	0.78	0.74	0.55	0.45	8.75
Green River, Wyoming 484065: 4/1/1897 ot 6/10/2016													
Average Max. Temperature (F)	32	37.1	46.2	57.2	68	78.4	87.2	85.3	75.3	62	45.4	34.1	59
Average Min. Temperature (F)	4.7	9.4	19.2	27.8	36.1	43.4	49.9	47.7	37.6	27.6	16.6	7	27.2
Average Total Precipitation (in.)	0.38	0.44	0.59	0.9	1.15	0.77	0.59	0.72	0.76	0.86	0.46	0.37	7.98
Flaming Gorge, Utah 422864: 12/1/1957 ot 5/23/2016													
Average Max. Temperature (F)	35.7	39.7	47.4	56.7	67.7	78.4	86.2	83.9	74.6	61.7	45.8	36.3	59.5
Average Min. Temperature (F)	9.6	13	20.9	28.3	36	43.4	50.4	48.8	40	30.4	20.5	11.8	29.4
Average Total Precipitation (in.)	0.44	0.58	0.96	1.43	1.47	1.14	0.99	1.19	1.16	1.29	0.71	0.57	11.94

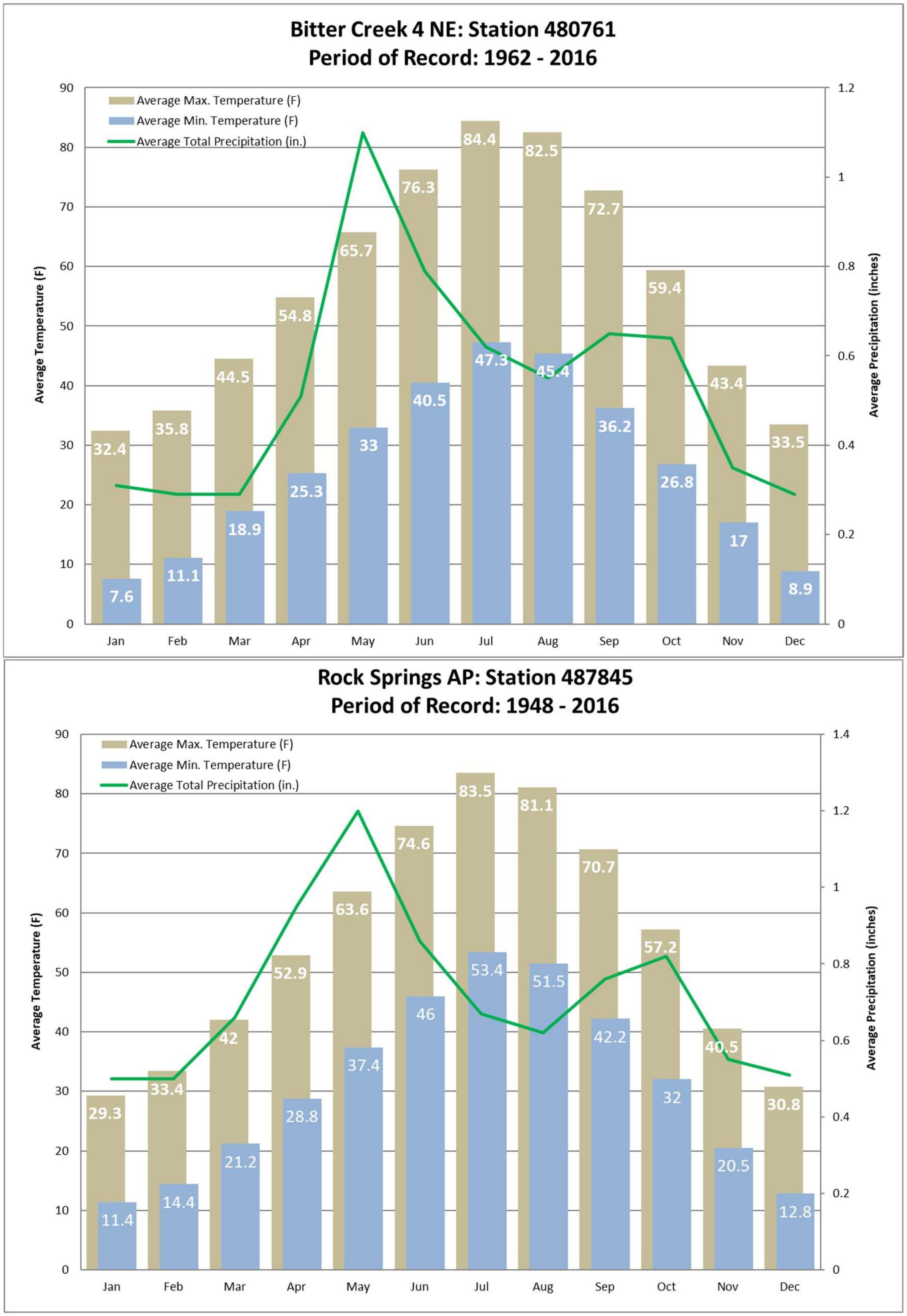
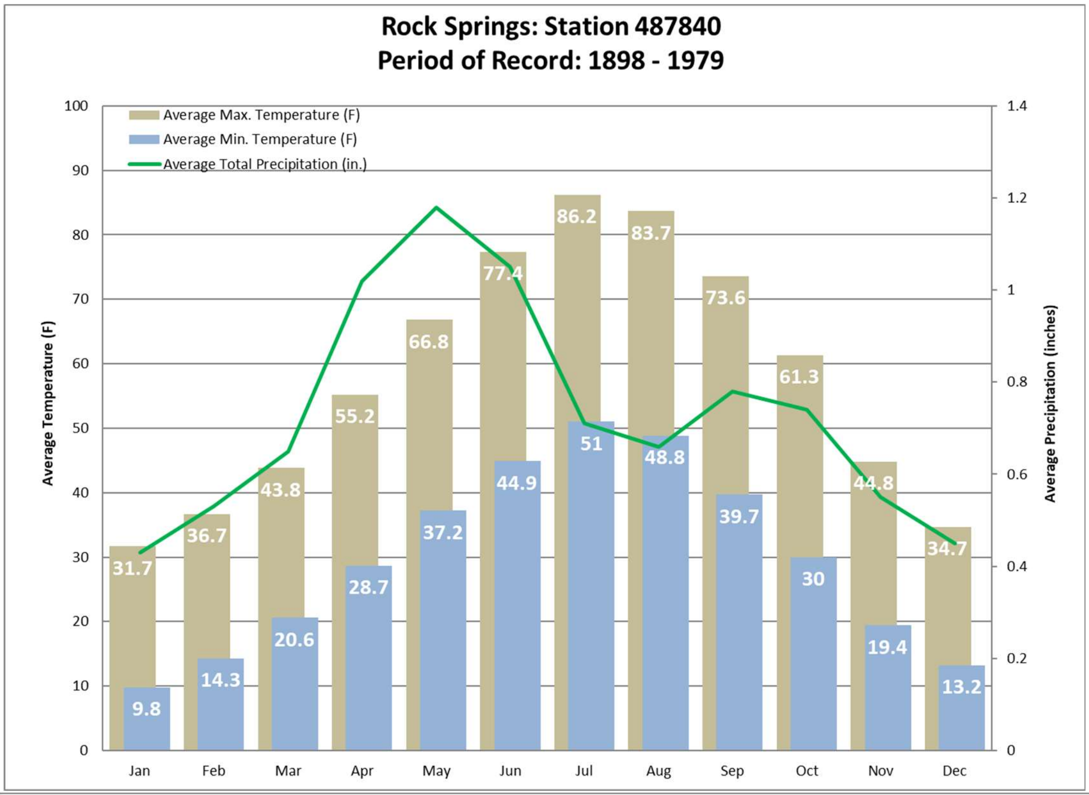


Figure 4.2-1 Mean Monthly Climatic Factors for Bitter Creek Watershed.



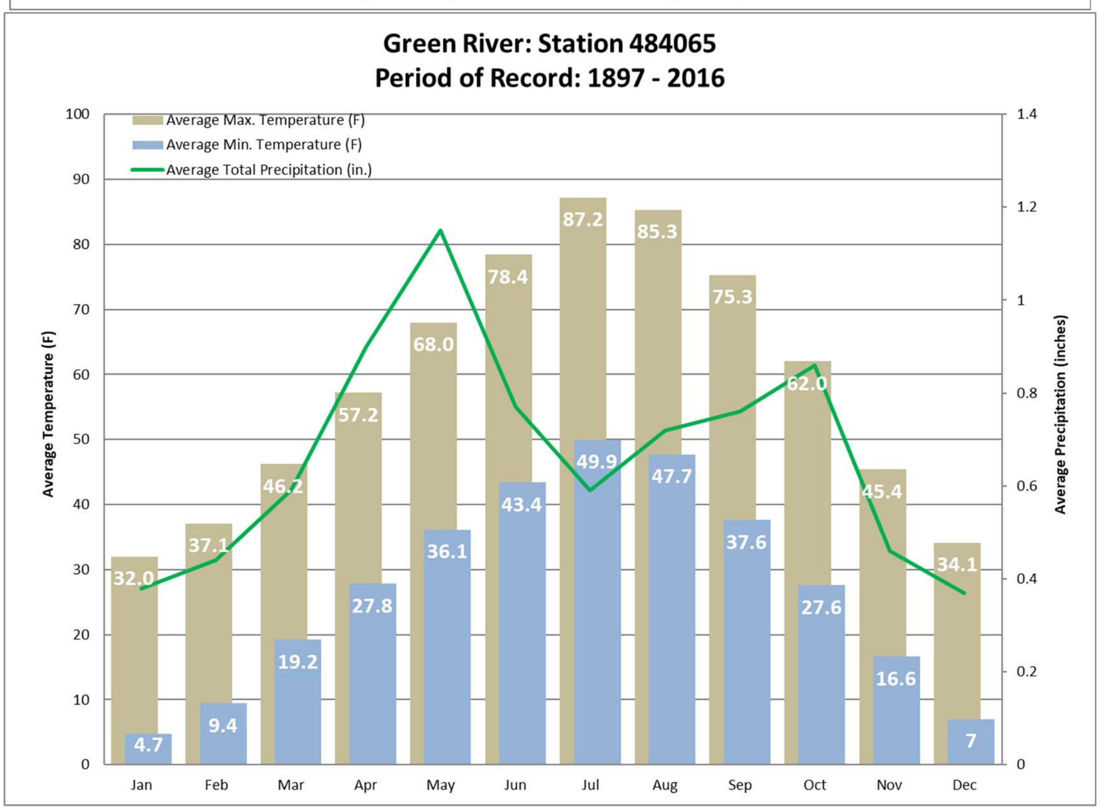


Figure 4.2-1 Mean Monthly Climatic Factors for Bitter Creek Watershed. (continued)

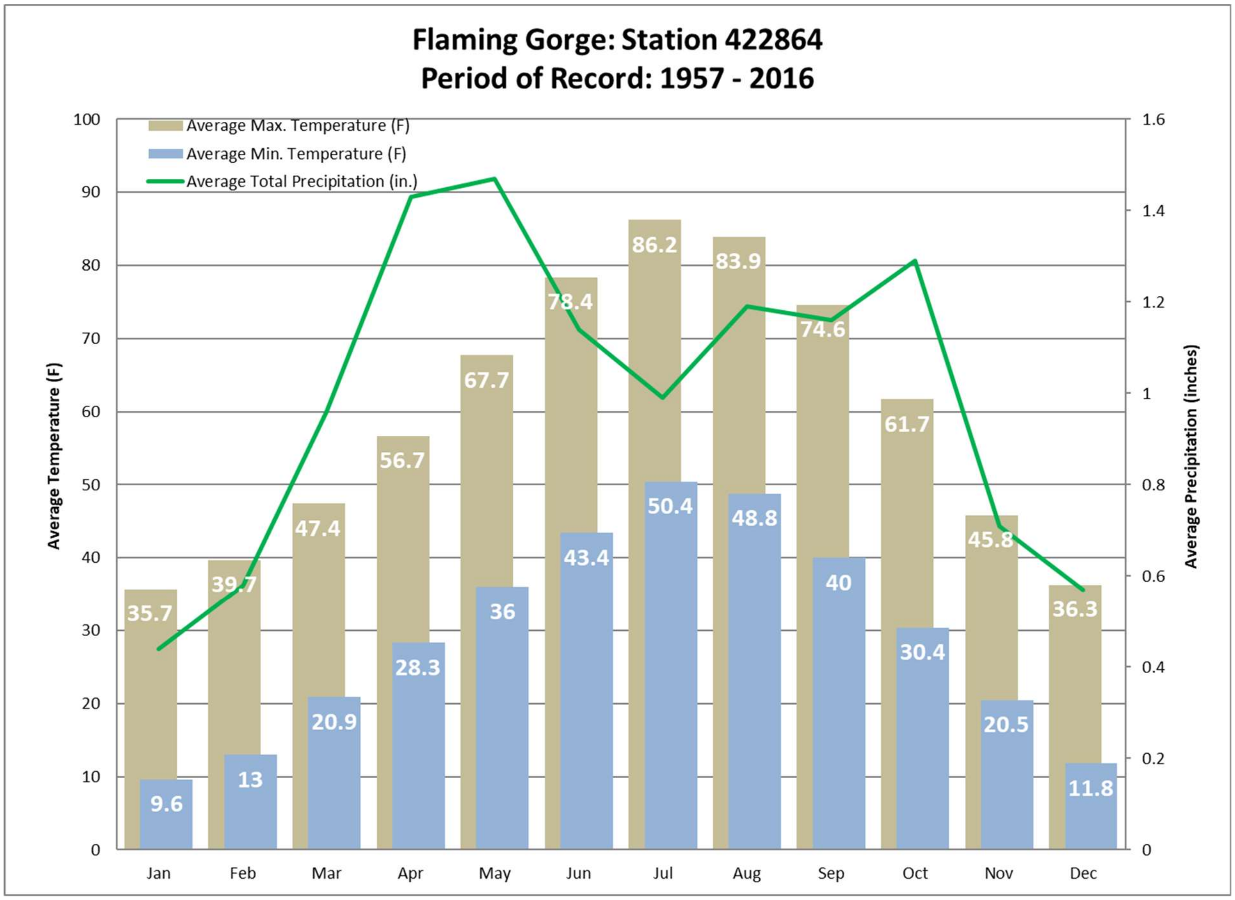


Figure 4.2-1 Mean Monthly Climatic Factors for Bitter Creek Watershed. (continued)

The average (50% probability) frost free period, spring last freeze dates, and fall first freeze dates at the NOAA Cooperative Weather Stations are shown in Table 4.2-2. The freeze-free periods are also shown graphically in Figure 4.2-3 for two threshold temperatures (28^{o}F and 32^{o}F). Temperatures between 32 and 28 degrees are considered a "light freeze" where tender plants are killed with little destructive effect on other vegetation, whereas temperatures below 28 degrees have a widely destructive effect on most vegetation.

Table 4.2-2 Average Frost-Free Periods at NOAA Cooperative Weather Stations.

Station	Period of Record	Threshold Temperature	Average Spring Last Freeze Date	Average Fall First Freeze Date	Average "Freeze Free" Period (days)
Bitter Creek 4 NE	1962-2016	28^{o}F	31-May	15-Sep	111
		32^{o}F	16-Jun	2-Sep	84
Rock Springs AP	1948-2016	28^{o}F	11-May	1-Oct	142
		32^{o}F	30-May	20-Sep	112
Rock Springs	1898-1979	28^{o}F	12-May	24-Sep	133
		32^{o}F	27-May	14-Sep	111
Green River	1897-2016	28^{o}F	17-May	20-Sep	126
		32^{o}F	1-Jun	11-Sep	100
Flaming Gorge	1957-2016	28^{o}F	16-May	22-Sep	127
		32^{o}F	6-Jun	15-Sep	103

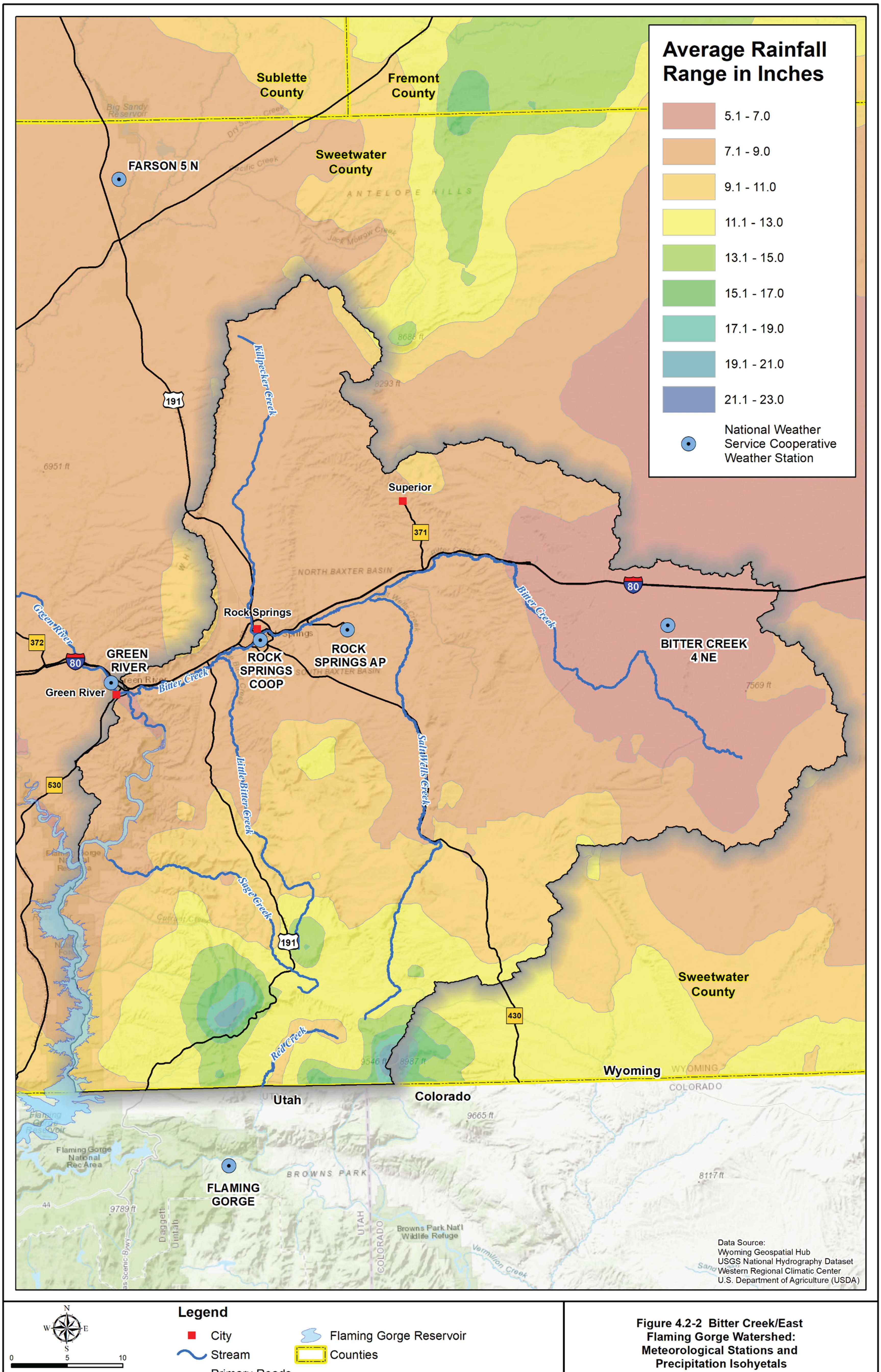


Figure 4.2-2 Bitter Creek/East Flaming Gorge Watershed: Meteorological Stations and Precipitation Isohyetals

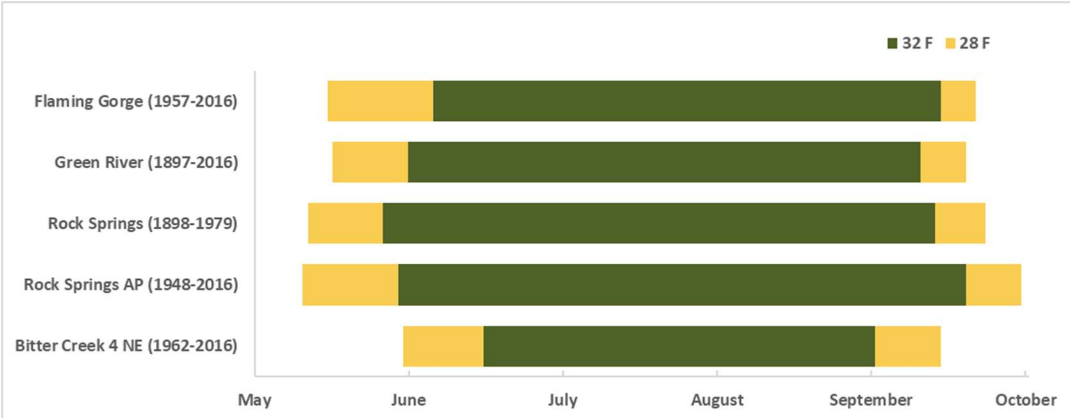


Figure 4.2-3 Average Frost-Free Periods at NOAA Cooperative Weather Stations.

The project area is subject to strong gusty winds, often accompanied by snow during the winter months, producing blizzard conditions and drifting snow. Wind direction and speed data have not been routinely collected within the project study area; however, a weather station at Black Butte Mine, audited by Inter Mountain Laboratories, monitored hourly wind speed and direction from 2015 to 2017. Figure 4.2-4 presents a wind rose generated from the Black Butte Mine data from January 1st, 2015 to August 9th, 2017. The wind rose depicts the relative directional frequency of the winds and the speed class. As indicated, the winds are predominately from the west approximately 34 percent of the time, with frequent winds also from the north-northeast and south. The mean wind speed is 8.4 miles per hour (3.75 meters per second).

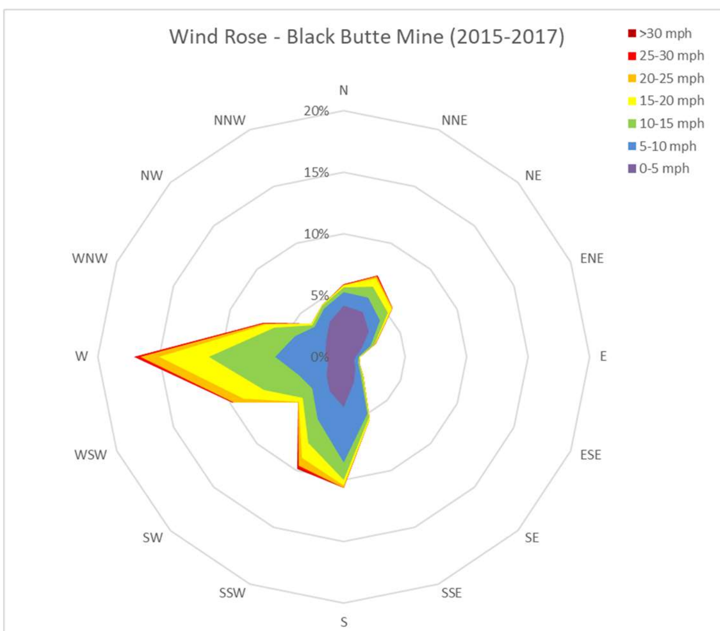


Figure 4.2-4 Wind Rose for Weather Station at Black Butte Mine (Jan 2015 – Aug 2017).

It must be kept in mind that this information must be viewed in light of the fact that climate changes are occurring and will likely continue to occur into the future. Causal relationships are open to debate, however, according to a recent publication of the University of Wyoming (Gray, S., C. Anderson, 2009):

> *"There is mounting evidence that the earth is experiencing a warming trend. Climate change has resulted in a 1° F increase in average global temperature in the past century, largely in the past 30 years (IPCC, 2007). The concern now is that climate change may increase the impact of droughts, just as population growth and other factors have greatly increased the West's vulnerability to water shortages. The impacts of these global changes on Wyoming's weather and river systems include altered precipitation patterns and changes to the timing of snowmelt and river flows, which together will significantly alter Wyoming's water supply."*

Management Implications:

Climatic changes will present unpredictable challenges for land managers; impacts of long-term climatic changes cannot be predicted at this time. Numerous guidance documents are available which provide guidance for conducting climate change vulnerability assessments, or CCVA's. The USEPA provides guidance documents worthy of review by land managers that target vulnerability assessment and planning to offset potential impacts. Many of these documents have been incorporated within the project Digital Library.

Data Sources:

Western Regional Climate Center: http://www.wrcc.dri.edu/
Oregon Climate Center, Oregon State University PRISM dataset

4.2.3 Geology

The foundation of the Bitter Creek watershed is, of course, the geology. The relative resistance to erosion of the geologic strata exposed at the surface defines every detail of the natural topography, with the hard sandstones of the Sand Butte bed of the Laney Member of the Green River forming the prominent cliffs of the Kinney Rim, and the soft shales of the Baxter Shale forming the eroded desert landscape around the Rock Springs airport. In concert with climatic conditions, the geology also controls the texture, chemistry, and overall character of the soils formed across the watershed. Finally, geologic conditions govern the accumulation of mineral deposits and the availability and quality of groundwater.

This section begins with brief discussion of the surficial geology, the materials found at the surface, intermediate between their bedrock source and their soil progeny. The bedrock geology is then presented in terms of "stratigraphy" - the character and distribution of the materials making up the subsurface strata - and "structure" - the geometry of how those initially flat-lying strata have been tilted (or not) and broken up over time.

4.2.3.1 Topography

Topography of the watershed is dominated by the Rock Springs Uplift. The uplift is a dissected, asymmetrical, doubly plunging anticline with north trending axis (See section 4.2.3.2 for a detailed discussion of the uplift and surface/bedrock geology of the study area). As described by Lowham, et al., (1981), the crest of the uplift has an average elevation of about 6,500 feet and is occupied by the Baxter Basin which is a relatively flat topographic basin eroded into soft shales of the uplift. Around the uplift, resistant sandstone beds form inward-facing escarpments that surround the basin.

Three remaining prominent topographic features exist within the study area: Quaking Aspen Mountain, Potter Mountain, and Pine Mountain. These features are remnant mesas left after erosion of what was once a continuous sedimentary layer extending over much of the southwest portion of Wyoming (Lowham, et al., 1981)

Geologic hazards (landslides, faults, etc.) which could affect watershed planning efforts are discussed in Section 4.2.3.4 of this report (Geologic Hazards- Landslides and Earthquakes).

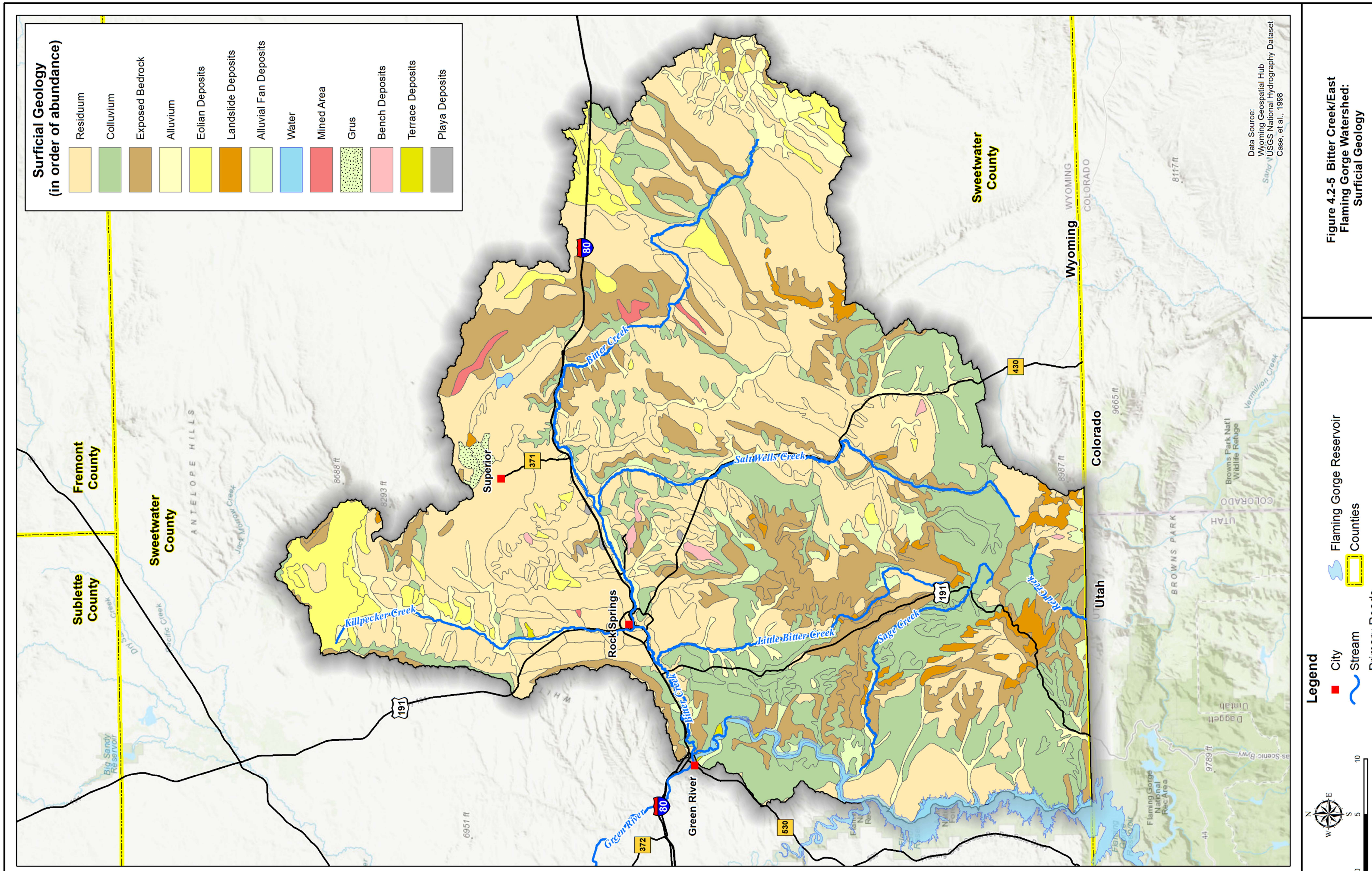
4.2.3.2 Surficial Geology

The surficial deposits mapped within the Bitter Creek watershed are presented on Figure 4.2-5. For the most part, the distinction between surficial and bedrock geology is that the former is the unconsolidated, weathered product of the latter. Each of these deposits will produce soils and vegetation as a function of its physical and chemical composition, slope, slope aspect, local precipitation and other climatic factors, age, etc. which vary widely across the study area.

The detailed mapping behind Figure 4.2-5 includes 50 individual units. These have been grouped into 12 broader categories for presentation here. The boundary lines within the major units on the map key reflect finer subdivisions, see the cited references for details.

The majority of the Bitter Creek watershed (45%) has been mapped simply as “residuum” This is the in-situ material formed from the weathering of the underlying bedrock. Soluble components of bedrock are partially removed by surface water and groundwater. The remaining, insoluble portions of the rock experience mechanical weathering from freeze-thaw and rain-drop impact with little to no transport. Residuum deposits within the study area may occur over any geologic substrate. Reflecting the ongoing weathering and erosion of underlying materials, these deposits are relatively thin compared to other surficial deposits. The distinction between “residuum” and “soil” is based on the chemical and biological modification of these weathering products. “Grus” is the coarse residuum associated with granitic bedrock.

Second to residuum in areal coverage is “colluvium” (22%) - the same origin and type of material, but which is judged to have moved downslope somewhat. Such movement may be slow, e.g. “soil creep”, or dramatic, e.g. landslides.


Surficial Geology
(in order of abundance)
Residuum
Colluvium
Exposed Bedrock
Alluvium
Eolian Deposits
Landslide Deposits
Alluvial Fan Deposits
Water
Mined Area
Grus
Bench Deposits
Terrace Deposits
Playa Deposits
Figure 4.2-5 Bitter Creek/East
Flaming Gorge Watershed:
Surficial Geology
Data Source:
Wyoming Geospatial Hub
USGS National Hydrography Dataset
Case, et al., 1998
Legend
City
Stream
Primary Roads
Flaming Gorge Reservoir
Counties
Miles
0
5
10
Sweetwater County
Fremont County
Sublette County
Wyoming
Colorado
Utah
Superior
Rock Springs
Green River
Bitter Creek
Salt Wells Creek
Killpecker Creek
Little Bitter Creek
Sage Creek
Red Creek
Green River
80
191
371
372
430
530

Third, at 17%, and the only other category with more than 10% coverage is "exposed bedrock", i.e. areas from which weathering products have been largely removed by erosion. Bedrock formations are further discussed in Section 4.2.3.3.

Other mapped surficial geology units include:

- "Alluvium" - the material associated with surface drainages and is produced by the action of a stream or river. It is of minor importance in the Bitter Creek watershed because of the limited presence and size of active streams. Where a substantial thickness of erosional material has developed at the mouth of an upland drainage, "alluvial fan" deposits are mapped. Where past alluvial activity has left stream deposits across the surface, "terrace" and "bench" deposits are mapped.
- "Eolian deposits" - wind-blown materials, i.e. sand dunes.
- "Landslide deposits" - these are indicative of geologic instability, discussed further in Sec. 4.2.3.3.
- "Playa deposits" - the fine-grained material forming the typically barren flats in small, undrained basins. In the Bitter Creek Watershed, these deposits have developed locally on the extensive, low-permeability outcrops of the Baxter Shale.
- "Mined areas" - in this watershed, the pits and spoil piles associated with the coal seams found, and open-pit mined, in the Fort Union Formation and, to a small extent, with the older, deep-mined coal seams in the Rock Springs Formation.

The surficial geology is primarily of importance with respect to the soils that form on those materials and as an indication of the stability of the landscape (e.g. landslides). With respect to water supply, the surficial geology plays little role, except for immediately along perennial streams, where streamflow may keep surficial deposits saturated, providing a natural filter for groundwater wells that are basically stream diversions. Surficial geology may also impact groundwater recharge rates, as precipitation will readily infiltrate an area of sand dunes and may run off with minimal infiltration where bedrock is exposed at the surface.

4.2.3.3 Bedrock Units

The following paragraphs outline the basic geology of the Bitter Creek watershed in terms of the geologic formations present (the "stratigraphy") and the geometry of how those formations are oriented, folded, and faulted (the "structure"). For the purposes of this planning investigation, the watershed geology is presented with respect to its general relevance to the development of useful water projects. A detailed description of the complexities of the study area's geology is beyond the scope of this investigation. A multitude of sources exist which provide additional details, site-specific geologic descriptions and mapping (e.g. see Mason and Miller, 2005; and Clarey et al., 2010 for copious discussion and bibliography.)

The geologic materials present at the surface and in the near subsurface have an obvious bearing on potentially relevant issues of slope stability, structural integrity (dams, buildings), and infiltration rates and are the foundation for the types and quality of soils present.

The character of geologic materials in the deeper subsurface is primarily of importance to this study with respect to groundwater development opportunities, i.e. the potential quantity and quality of groundwater available at various locations and depths across the watershed.

Figure 4.2-6 provides a bedrock geologic map of the study area developed from standard mapping by the US Geological Survey (USGS) at 1:500,000 scale (Love and Christiansen, 1985) and mapping compiled by the Geological Survey of Wyoming (WGS) at 1:100,000 scale (Jones and Scott, 2010; Roehler, 2004; Sutherland and Luhr, 2011). Discontinuities between the four quadrants of Figure 4.2-6 are a function of the mapping scale rather than of any change in geology. Only the map units with significant coverage are labeled. Appendix 4A expands on the figure key and provides basic descriptions of all geologic units mapped in the study area. The formations of the watershed are listed top-down from youngest to oldest on Figure 4.2-6 except for the Green River and Wasatch Formations, which overlap substantially in age.

Stratigraphy

The geologic formations that underlie the study area range in age from Precambrian (>600 million years old) to the alluvial deposits currently being laid down by the action of Bitter Creek and the Green River. Only rocks younger than approximately 100 million years old are exposed at the surface (and therefore appear on a geologic map). In the case of the Bitter Creek watershed, this presents the entire geologic section of interest, however, because the oldest formation mapped is the Baxter Shale. With a thickness of over 3,500 ft. and very little groundwater-production potential, the Baxter Shale effectively forms the base of the geologic column usefully available to ordinary groundwater projects. There are another 6,200 feet of sedimentary rock beneath the Baxter Shale, including such formations as the Cloverly Formation, the Nugget and Weber Sandstones, and the Madison Limestone, which can be very productive aquifers elsewhere in the state. Beneath the Bitter Creek watershed, the depth of these formations renders them very expensive to develop and produces water quality unlikely to be suitable for most purposes. See Lynds (2013) for a lithologic column and geophysical log for a test hole near Rock Springs that penetrated the entire sedimentary section.

Appendix 4A provides summary descriptions of the geologic strata of the Bitter Creek watershed, in age order (youngest to oldest) which is also the approximate order in which these formations would be encountered in a vertical drill hole. The complex strata of the Wasatch and Green River Formations are the widespread exceptions, for which individual beds and members extensively interfinger and replace one another. Figure 4.2-7 illustrates this complex layering beneath the Bitter Creek Watershed (Mason and Miller, 2005), illustrating the critical importance of local conditions if one is interested in these formations.

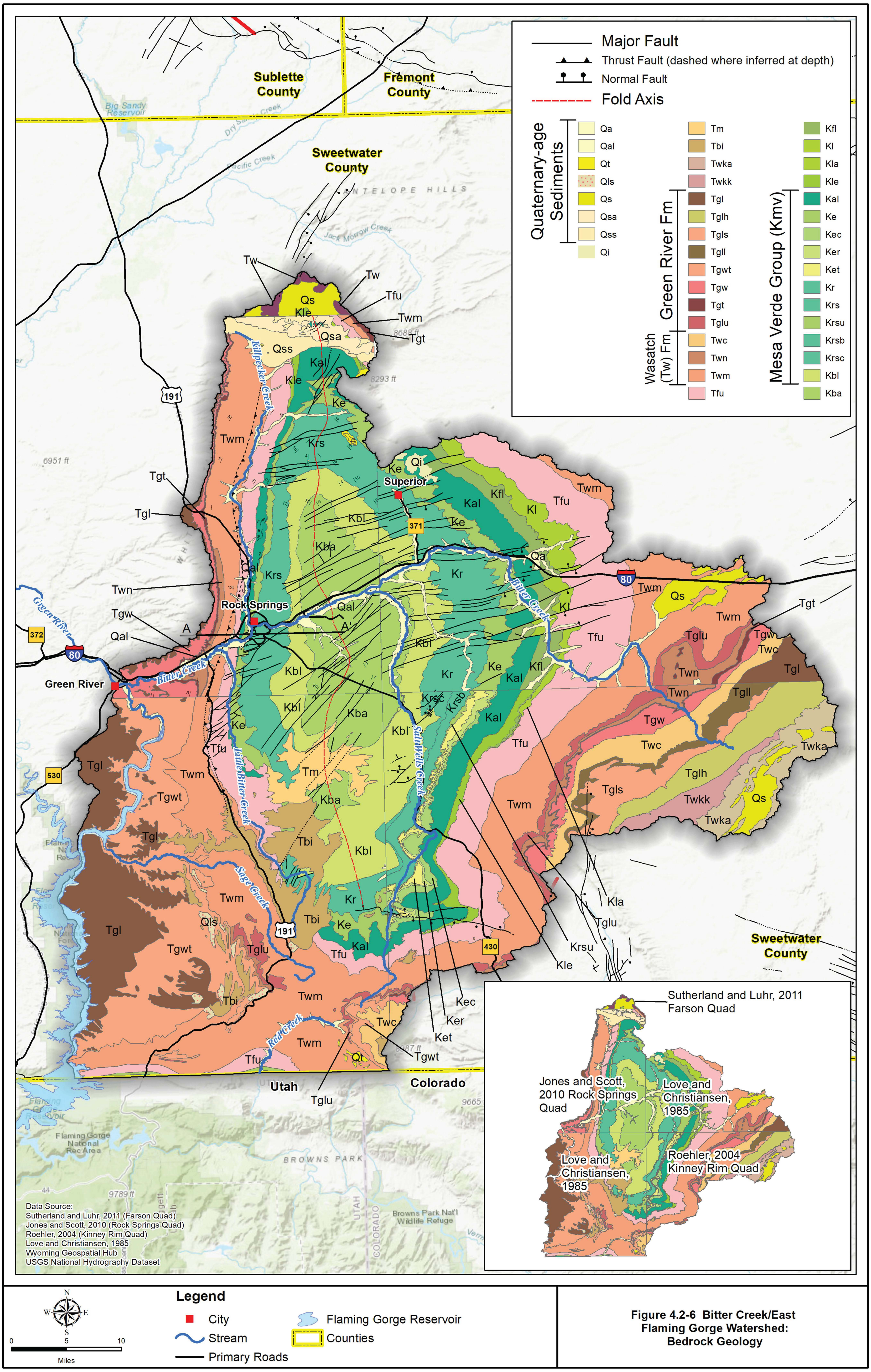


Figure 4.2-6 Bitter Creek/East Flaming Gorge Watershed: Bedrock Geology

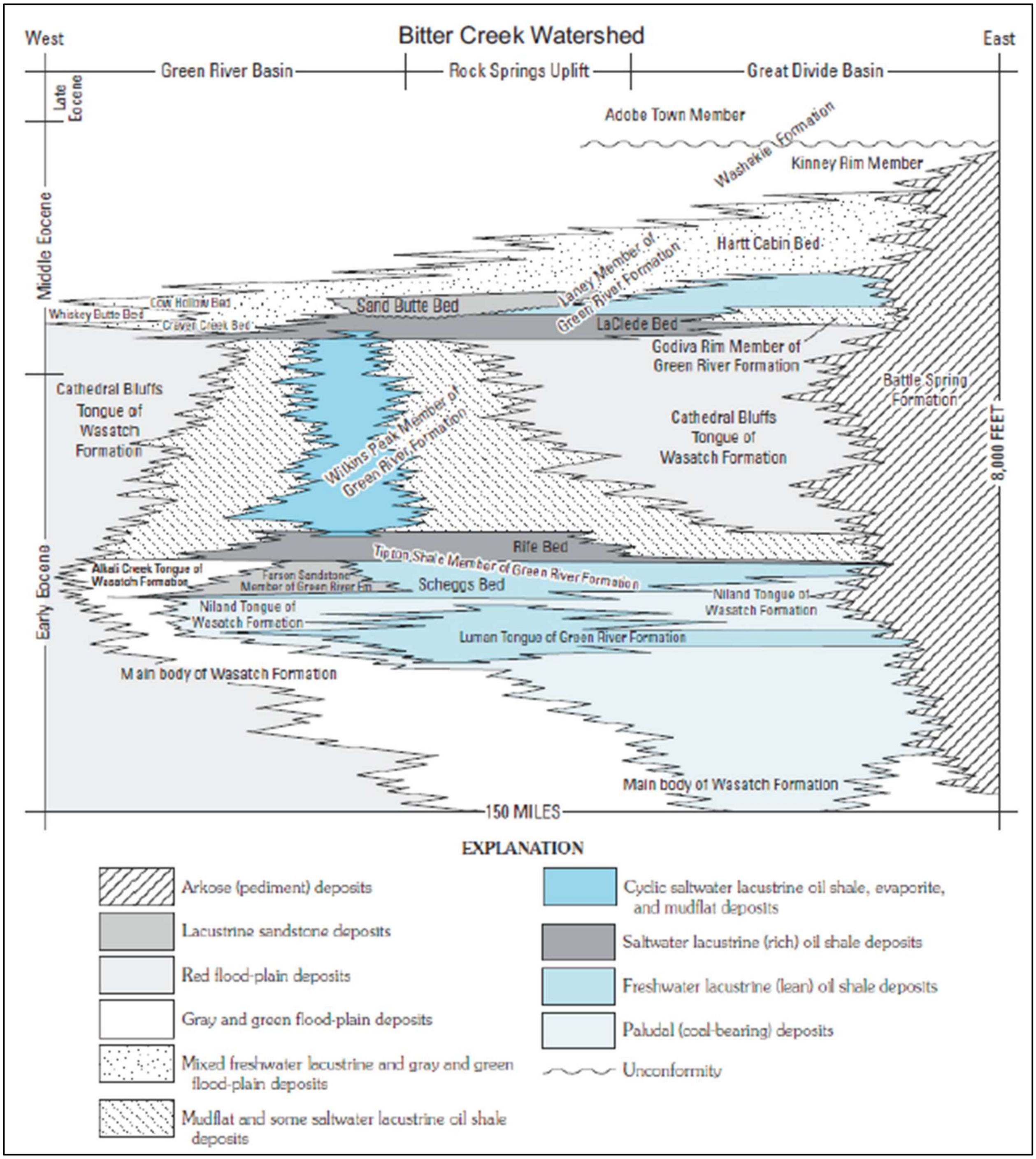


Figure 4.2-7 Bitter Creek Watershed Schematic Geologic Column.

With respect to groundwater-development potential, the strata of primary interest in the Bitter Creek watershed are sandstone units within the Mesa Verde Group and the Wasatch Formation. The Quaternary-age alluvium, which is commonly productive of high-quality groundwater in Wyoming where deposited adjacent to mountain fronts, is generally thin and in the Bitter Creek Watershed. The hydrogeology of the watershed is described below (Section 4.2.4).

Geologic Structure

In the case of the Bitter Creek watershed, the hydrologic basin, defined by surface topography, is nearly the inverse of the geologic structure, which is basically a dome. The dominant geologic feature of the watershed is the Rock Springs Uplift, centered on the outcrop of the Baxter Shale (“Kba” on Figure 4.2-6), where the oldest rocks are exposed at the center and successively younger strata dip away from that center in all directions. The strata in the center, which are the oldest, dip most steeply. The strata at the periphery, which are the youngest, dip more gently. Figure 4.2-8 provides a cross-section through the western side of the uplift.

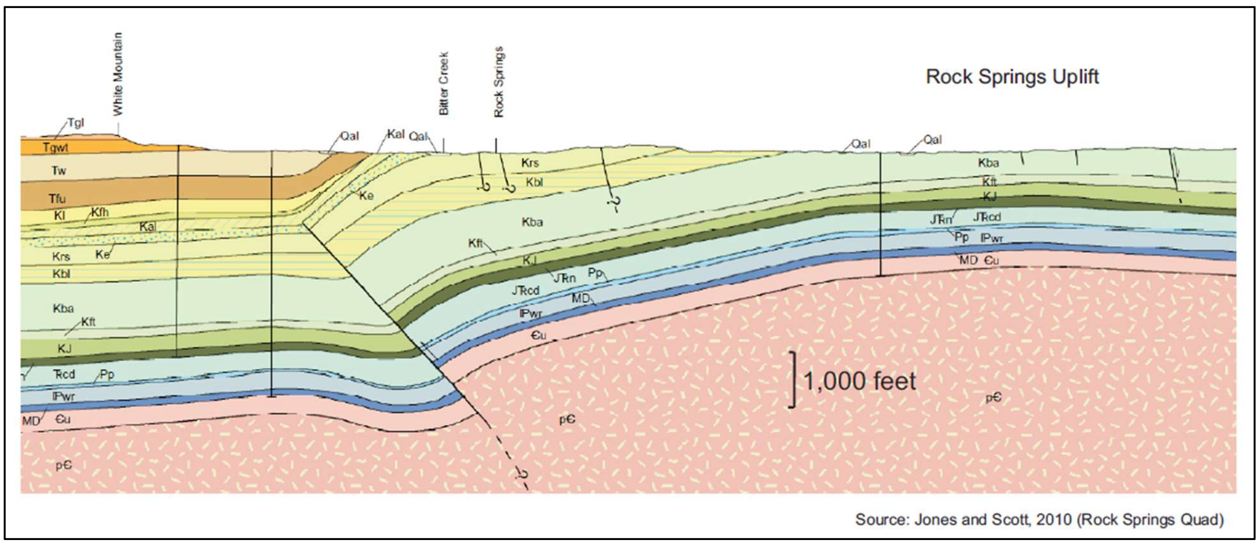


Figure 4.2-8 Bitter Creek Watershed Geologic Cross Section.

It’s as though the top half of an onion were sliced through, exposing the core of the onion in the middle (“Kba”) with successively outer layers running around that middle, dipping away, towards the outer edges. Thus, the outermost layer is the Adobe Town Member of the Washakie Formation (“Twka”) - appearing only along the southeast edge of the watershed. The exposed edge of each layer is the outcrop mapped on Figure 4.2-6. The outcrop bands are wider where the layers dip less steeply (e.g. to the southeast) and narrower where the layers dip more steeply (e.g. along the northwest edge of the watershed). As erosion has re-shaped the surface of this “slice through the onion”, successively deeper layers have been exposed to create the complex outcrop patterns seen on Figure 4.2-6.

Given the layered sequence of these formations, any formation older (further down the column on Figure 4.2-6) than that mapped at the surface is likely present at depth at that location. The depth depends upon the thickness of the overlying formation(s) and how steeply the formations are dipping. For example, the Ericson Sandstone (“Ke”) is present beneath the mapped outcrop of the Almond Formation (“Kal”) at all locations, at depths up to the full thickness of the Almond (600 to 900 ft.). The Ericson is progressively deeper beneath any formation younger than the Almond. The Baxter Shale could be reached at a depth of 6,000 feet beneath the outermost layer (Twka), in the southeast portion of the watershed.

Groundwater development potential is determined by depth to a water-bearing formation and zones of fracturing that develop where a rock layer is faulted or tightly folded. Such fractures can provide important pathways for groundwater flow to a well and are commonly critical to the development of large well yields. Faults and fractures are present at many scales in the Bitter Creek Watershed. Faults that have been mapped at a scale of 1:100,000 are included on Figure 4.2-6, and provide a general guide to the orientation and formations in which smaller, local features may be found.

The relative scarcity of faults in the “outer” layers of Figure 4.2-6 reflects the geologic history of the area. The older, central layers were more extensively deformed during the creation of the Rock Springs Uplift, the early stages of which occurred before or during the creation of the younger, outer, less-deformed layers.

With rare exceptions, deformation and faulting within the study area is the result of activity in the far-distant geologic past. Fracturing associated with faults can usefully enhance permeability and groundwater production or create problems in terms of seepage rates and landslide potential. Faults do not represent a constraint on development activity with respect to earthquakes.

4.2.3.4 Geologic Hazards - Landslides and Earthquakes

Figure 4.2-9 presents landslide information for the study area. Published landslide mapping is available as the "landslide deposits" mapped with bedrock geology (“Qls” on Figure 4.2-6), as the "landslide deposits" mapped with the surficial deposits (Figure 4.2-5), and as "landslides" mapped based on surface morphology, independent of geologic materials (WRDS, 2004). The three approaches produce very similar, although not identical results. In any case, landslides are relatively rare in this watershed.

Landslides occur where geology, slope, and moisture (pore pressure) combine to create unstable conditions. The interlayering of shales, mudstones, and sandstones in the Laney, Tipton Shale, and Wilkins Peak Members of the Green River Formation (“Tgl” and “Tgwt” on Figure 4.2-6), and the main body and Cathedral Bluffs Member of the Wasatch Formation (“Twm” and “Twc”), are conducive to landslides as groundwater accumulates in weak, low-permeability shales and mudstones beneath ridge-capping sandstones. Where stream erosion has created steep slopes, conditions further support landslide formation.

As shown on Figure 4.2-9, most of the landslides in the Bitter Creek watershed reflect these factors. The arcuate group of landslides on the southeast edge of the watershed clearly follows the Tgl/Tgw geologic contact. Those in the southern portion of the watershed are commonly associated with the Tgwt outcrops, with the dendritic pattern of small landslides to the west following steep-sided drainages. The group of landslides near the middle of the basin correspond to the erosion of softer units undercutting the Bishop Conglomerate (“Tbi”).

Future landslides are most likely to occur in association with areas of historical slope failure or where water infiltration is locally increased through development activity (e.g. canal construction, irrigation). Thus, while this potential hazard is not confined to the areas mapped, those areas and the associated formations merit heightened concern with respect to landslide potential.

The National Earthquake Information Center database (NEIC, 2018) lists three seismic events of greater than or equal to 3.0 magnitude, at the locations shown on Figure 4.2-9. A magnitude 3.0 earthquake is just into the range that can be felt; lower magnitudes are only discernable through seismograph monitoring. The two events to the northeast are both reported as “explosions”, presumably associated with overburden blasting at the Black Butte Coal Mine. The western event was an actual earthquake, of magnitude 3.0 (i.e. slightly less energy than the explosions), that occurred 7/8/2014.

4.2.4 Groundwater

The following sections provide an outline of groundwater relationships, the relative productivity of aquifers, the occurrence of springs and wells, and recommendations for site-specific evaluation of groundwater development opportunities in the Bitter Creek Watershed. For copious data, illustrations, and analysis of the entire Green River Basin, the reader is directed to the “Available Groundwater Determination - WWDC Green River Basin Water Plan II” (Clarey et al., 2010). For information specific to Sweetwater County, see Mason and Miller (2005). Groundwater information specific to the Bitter Creek Watershed are sparse, however, due to the low level of groundwater development.

4.2.4.1 Recharge and Discharge

Groundwater resources are one component of the overall hydrologic cycle. Groundwater originates when rainfall, snowmelt, streamflow, and, in some areas, irrigation water, infiltrate into geologic materials. This constitutes groundwater "recharge". Recharge rates are a complex function of elevation; rainfall/snowmelt distribution, intensity, duration, and seasonality; vegetation; soil moisture condition, and the infiltration characteristics of the soil and underlying bedrock.

Mason and Miller (2005) cite recharge studies that estimate the entire Bitter Creek watershed receives less than 0.5 inches of annual groundwater recharge. Component analysis by Hamerlinck and Arneson (1998) as part of a state-wide groundwater vulnerability study provides a similar value for most of the watershed but suggest local areas of higher recharge rates (Figure 4.2-10). The areas of highest estimated

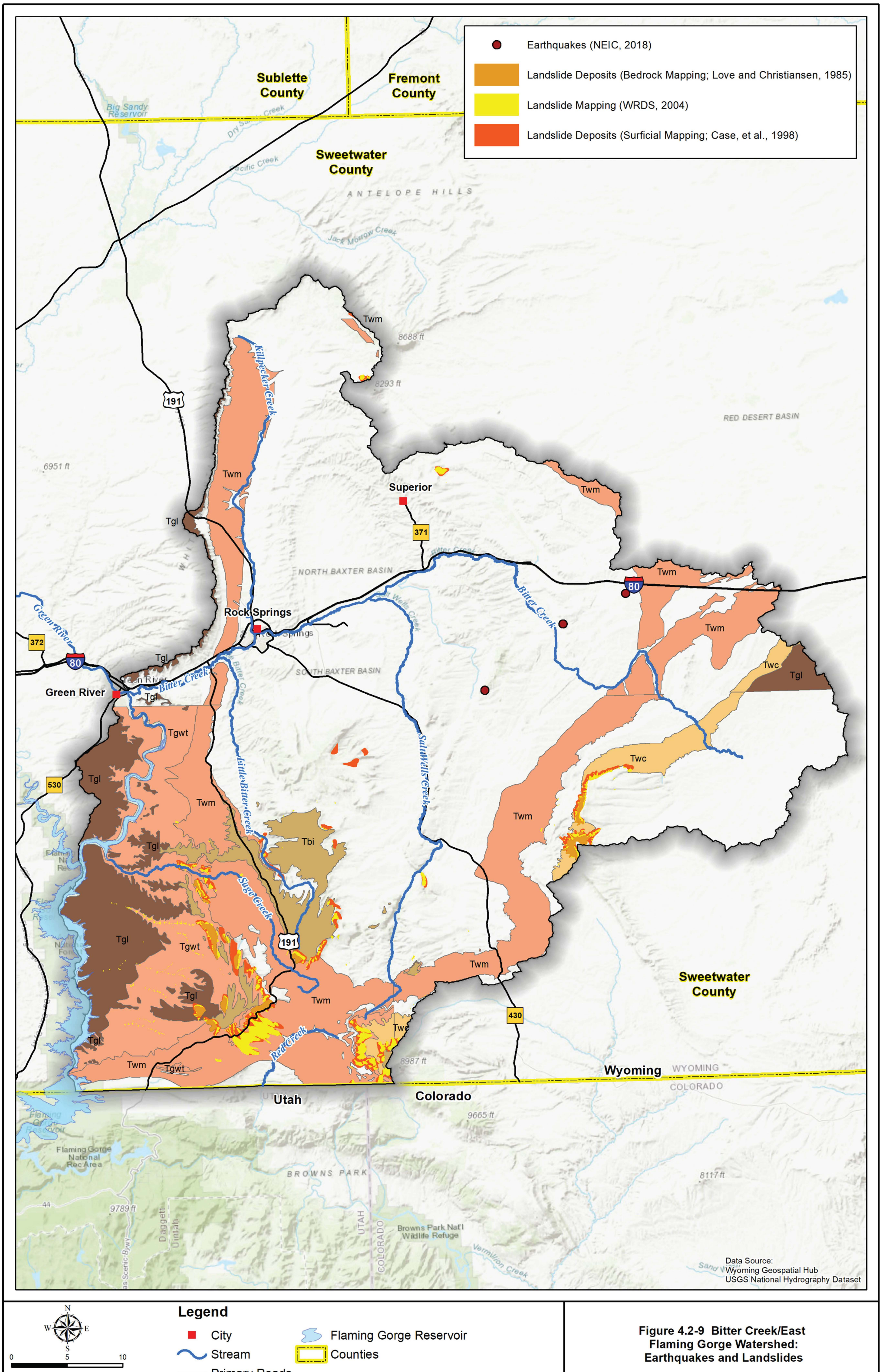


Figure 4.2-9 Bitter Creek/East Flaming Gorge Watershed: Earthquakes and Landslides

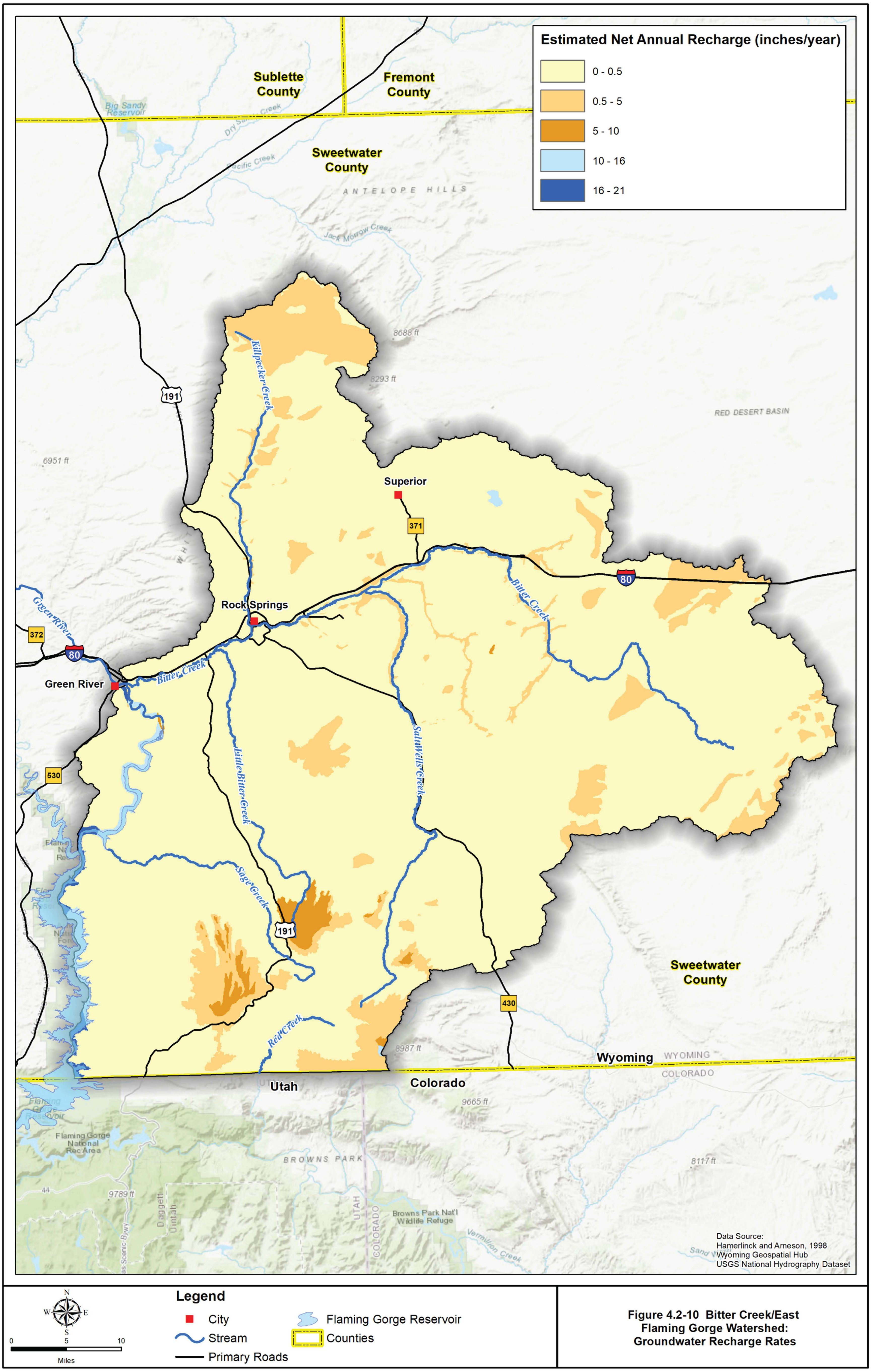


Figure 4.2-10 Bitter Creek/East Flaming Gorge Watershed: Groundwater Recharge Rates

recharge estimated by their method are understandably those of highest precipitation, which corresponds with the areas of highest elevation - 8,400 feet for Aspen Mountain south of Rock Springs, 9,000 feet for the Red Creek / Green River divide (west) and 9,500 feet for the Middle Mountain area (east) along the south boundary of the watershed.

Over days, years, centuries, or even millennia, where groundwater circulation is long and deep, this recharge travels through the ground and returns to the surface as discharge. Between the points of recharge and discharge, groundwater flow may be straightforward or quite complex. Because groundwater is continually returning to the surface as springs (discussed below) and, more importantly, as diffuse gains to most of Wyoming's perennial streams, streamflow volumes include large quantities of groundwater. In the absence of storm runoff or snowmelt, most of the flow in Wyoming's streams comes from groundwater discharge at some point upstream.

Like surface water, groundwater flows “downhill”, from areas of high head to areas of lower head. On the local scale, that creates springs and sustains the few perennial stream reaches in the Bitter Creek Watershed as local groundwater recharge to shallow aquifers drains into low spots. On the scale of the watershed and the deeper aquifers, groundwater flow is generally from beneath higher elevations to beneath lower elevations, with Bitter Creek and the Green River serving as the “base” elevations towards which both the surface water and groundwater flow.

Figure 4.2-11 includes perennial streams in the Bitter Creek watershed as mapped by the U.S. Geological Survey at a scale of 1:100,000. This mapping represents stream reaches where there is sufficient groundwater input - from zones both shallow and deep - to overcome evaporation, vegetation uptake, and infiltration. Where the latter factors dominate, streams cease to flow continuously and become primarily channels for storm water discharge. As can be seen on Figure 4.2-11, the balance between loss and gain can be tenuous across much of this watershed. Streamflow is discussed further in Sec. 4.2.5.

4.2.4.2 Springs

Groundwater is naturally discharged to the surface by springs and seeps, by evapotranspiration, and by discharge to streams and other aquifers. Springs and seeps occur when the water table intersects the land surface.

This commonly is the result of changes in lithology, faults and fractures, and/or surface topography. For example, where a sufficiently permeable geologic unit (e.g. a poorly-cemented sandstone or conglomerate) crops out in a swale or on a hillside at an elevation below the prevailing groundwater table in the bedrock unit at that location, a spring may develop. Similarly, a permeable geologic structure (e.g. an open joint, fracture or fault zone) may intersect the ground surface and serve as a conduit for the discharge of groundwater from deeper aquifers.

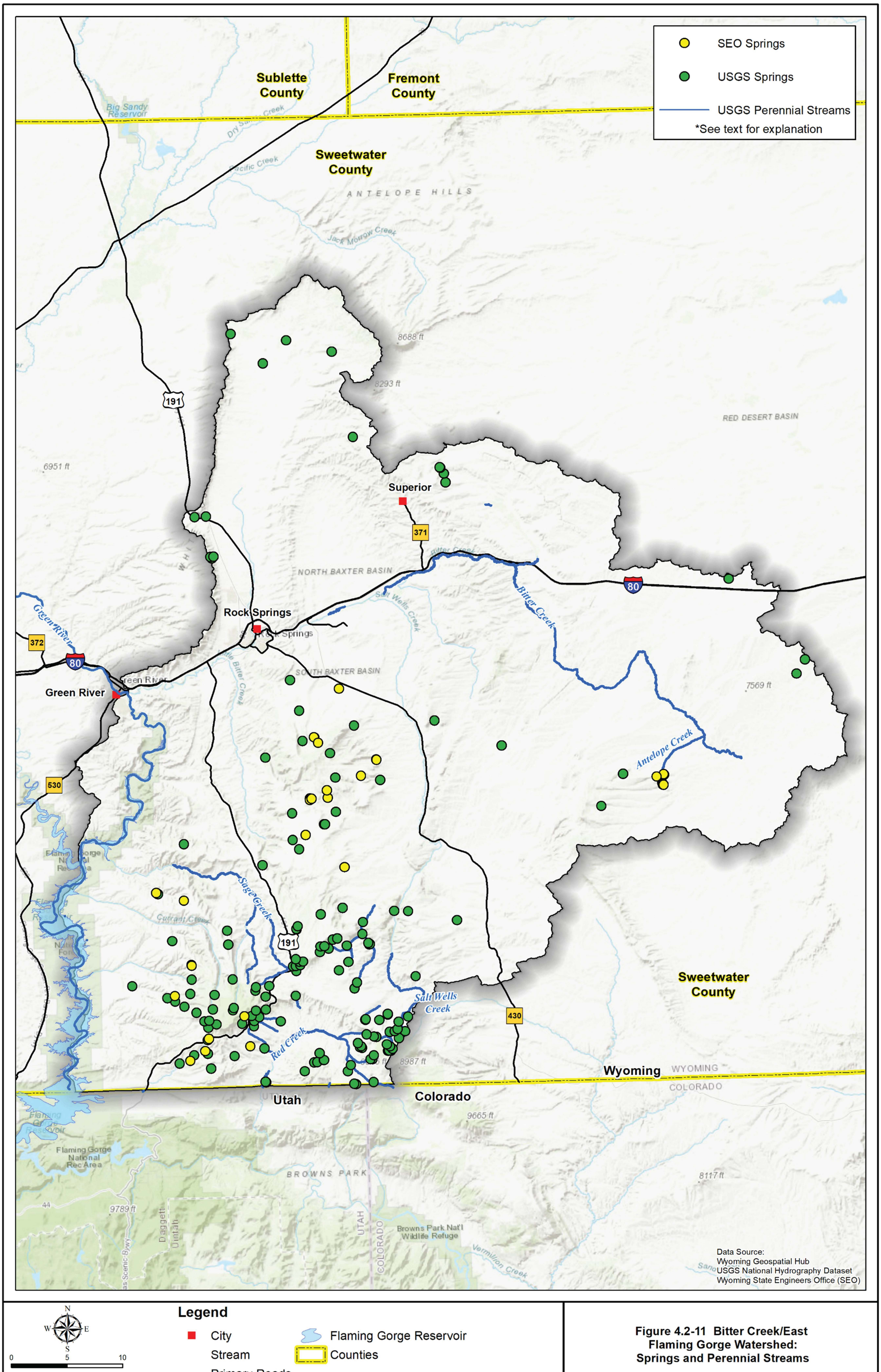


Figure 4.2-11 Bitter Creek/East Flaming Gorge Watershed: Springs and Perennial Streams

Spring flows vary widely due to the nature of the aquifer/structure discharging, the amount of seasonal recharge from snowmelt and rainfall, depletion of storage during periods of drought, and seasonally variable evaporation and evapotranspiration near the site of the spring. The flows can be concentrated or diffuse, again depending on the nature of the geologic conditions causing the spring.

Figure 4.2-11 presents mapped springs for the Bitter Creek watershed. Those marked as "USGS" were digitized by University of Wyoming personnel from standard USGS 1:24,000-scale topographic mapping, i.e. the word "spring" and/or a spring symbol on the printed topo map. These do not reflect all existing springs, as the USGS mappers typically worked from aerial photos and all springs do not express themselves conspicuously. However, the locations of these springs are likely quite accurate due to the manner in which they were compiled.

Those springs on Figure 4.2-11 marked as "SEO" were extracted from the GIS database of water rights maintained by the Wyoming State Engineer's Office. A groundwater permit was identified as being a spring based on minimal reported "depth", the word "spring" (or "spg", "spng", etc.) in the facility name, and a small reported "depth to water". A surface water permit was identified as being a spring by the word "spring" (or some variation) in the facility name, and "spring" being listed as the "facility type" or in the "stream source"

The locations of the "SEO" springs are a mix of precise locations based on reported GPS coordinates, and approximate locations based on the center of the permit-reported 1/4 1/4 Section. In the latter case, the actual location could be as much as 900 feet from the posted location (none of these locations have been field verified for this report). In many cases, the flow of a natural seep or spring with a state water right will have been enhanced through excavation or shallow well construction

The existence of a water right demonstrates a specific interest in putting a spring to a recognized "beneficial use". Undeveloped natural springs without attached water rights will not be identified through this process, but a substantial spring is likely to have attracted development interest. Large springs are necessarily associated with productive aquifers (discussed below), but small springs and seeps occur as a result of sometimes quite local conditions of recharge, topography, and aquifer permeability, in many geologic settings.

The most common springs in the Bitter Creek Watershed are where a sandstone unit overlies a shale/mudstone unit. Precipitation and snowmelt infiltrate into the permeable sandstone. That water migrates downward, creating a local aquifer, until a relatively impermeable mudstone layer is encountered. Groundwater then moves laterally on top of that mudstone unit until it emerges at the ground surface where the contact between the sandstone and the mudstone intersects a hillslope. The line of springs on the east side of Figure 4.2-11, for example, follow the contact between the Sand Butte Bed and the underlying LaClede Bed of the Laney Member of the Green River Formation.
Because many of the mapped geologic units of the Bitter Creek Watershed include beds of widely varying permeability (see Appendix 4A for descriptions) and because these units interfinger in complex ways,

watershed-level generalizations are difficult. The conditions for creating these “contact” springs are widespread across the watershed.

The relationship between springs and perennial streamflow provides an indication of the size of the springs. The cluster of springs at the head of Antelope Creek (in the eastern portion of the watershed) demonstrate enough flow to support this small creek. This is confirmed by the presence there of the largest spring water right in the watershed (0.29 cfs).

As can be seen by the distribution of springs across the watershed, a major control on the density of springs is simply the availability of precipitation to provide groundwater recharge. Springs are relatively common in the higher elevation, southern portion of the watershed, as are perennial streams. Elsewhere, isolated springs commonly amount to no more than the tiny discharge necessary to support a small patch of vegetation and provide a little drinking water for stock and wildlife.

Where groundwater discharges to the surface at discrete, observable points, a spring or seep is identified. However, groundwater also discharges directly to stream channels, creating the “base flow” that sustains streams in the absence of contemporaneous precipitation or snowmelt. Figure 4.2-11 includes streams with year-round flow (i.e. “perennial”) as determined by standard USGS mapping. As with the specific springs, perennial base flow is concentrated in the southwest portion of the watershed where precipitation is highest.

4.2.4.3 Aquifers

In many areas of Wyoming, the alluvial deposits associated with stream valleys are productive sources of good-quality groundwater. In the Bitter Creek watershed, however, the limited alluvial deposits are likely shallow and fine–grained given the nature of the source areas and the low-flow of the streams. Across most of the area of mapped Quaternary-aged deposits (map symbols beginning with “Q”), groundwater development potential is a function not of those deposits, but of the underlying bedrock material discussed below.

Groundwater exists in bedrock aquifers under unconfined, water table conditions (at atmospheric pressure) or under confined conditions where the aquifer is present at depth and pressures are sufficient to push water higher than the top of the formation, in some cases clear to the ground surface to create a flowing well.

Classification of a body of geologic material as an "aquifer" depends on how much water is needed for a specific user or purpose. A hydrogeologic unit capable of adequately supplying the modest water needs of a single rural residence may be entirely inadequate to meet the needs of an agricultural operation. Similarly, a groundwater quality suitable for livestock watering may be unacceptable for human consumption.

The 2007 Wyoming Framework Water Plan (WWC, 2007) offered general classifications of the strata of Wyoming as between "major", "minor" aquifers and aquicludes (formations that largely inhibit rather than provide groundwater flow). As discussed above in relation to the basic geology, however, the aquifer status in the Bitter Creek watershed is quite complicated and, as a result, highly localized. In Appendix 4A, rather than entire formations receiving a lithologic description, many are broken down into individual members, and even individual beds or "tongues" within members to facilitate meaningful descriptions of lithologic and hydrogeologic characteristics. Figure 4.2-7 provides a schematic of this complexity. Even at these finer divisions, however, there are still individual units for which the lithology includes "mudstone, and interbedded gray, fine- to coarse-grained, arkosic sandstone" (Twcu), "interbedded gray, fine-grained sandstone; brown oil shale; green mudstone; gray-green shale; and gray ostracodal, oolitic, and algal limestone" (Tglb); etc.

To assist in the assessment of groundwater development opportunities, Figure 4.2-12 provides a more detailed aquifer taxonomy than was appropriate for the statewide plan, in which each unit has been classified by its primary lithology:

1 - potentially significant aquifer: strata dominated by sandstone and/or conglomerate.
2 - minor aquifer: strata of mixed sandstone and siltstone/mudstone/shale
3 - marginal aquifer: strata dominated by siltstone/mudstone/shale or thin and poorly saturated
4 - major aquitard: regionally extensive shale strata.

The strata with the highest aquifer potential in the Bitter Creek Watershed are not stand-out aquifers on a statewide basis, but under favorable circumstances can provide up to several 100 gpm of good-quality groundwater. "Favorable circumstances" includes sufficient thickness or depth to be saturated (rather than drained), close enough to outcrop and with sufficient groundwater circulation to be of suitable quality, and ideally, with fractures to enhance permeability. The most consistently productive aquifer of suitable quality in the watershed is the Ericson Sandstone, which provides 300 gpm wells for the Town of Superior. The Superior wells present an exception to the "close to outcrop" desirability. Due to the mobility and deposition of radioactive minerals in the shallower zones, wells have been deliberately sited at deeper locations to avoid unacceptable levels of radioactivity. Other sandstone-dominated units in the Mesa Verde Group (see Figure 4.2-6) are also locally productive.

The two formations in the "major aquitard" group are the Lewis and Baxter Shales, which extend well beyond the Bitter Creek Watershed. As noted above, the Baxter Shale provides an effective base to the potentially useful aquifer system in this watershed.

4.2.4.4 Groundwater Quality

In general, the quality of groundwater in the Bitter Creek watershed is fair to poor. The nature of the geologic materials and the low recharge rates serve to produce higher salinities than are ideal for many uses. As stated by Mason and Miller (2005), "Shallow ground water is available throughout [Sweetwater]

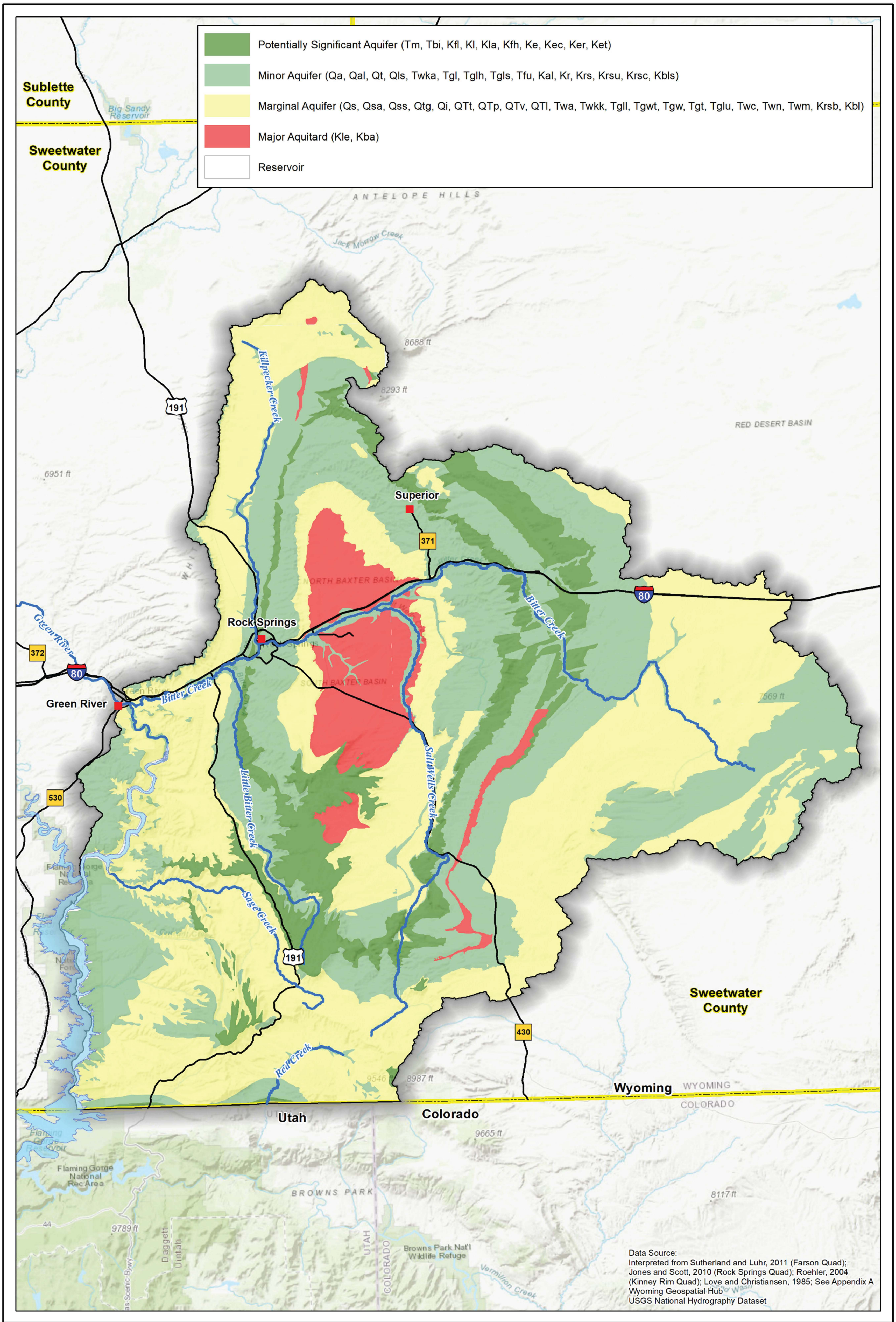


Figure 4.2-12 Bitter Creek/East Flaming Gorge Watershed: Aquifer Classification

county, although much of it is only marginally suitable or is unsuitable for domestic and irrigation uses mainly because of high total dissolved solids (TDS) concentrations. Suitable ground water for livestock use can be found in most areas of the county." and, "Ground-water quality in Sweetwater County is highly variable, even within a single hydrogeologic unit. Water quality in any given hydrogeologic unit tends to be better near outcrop areas where recharge occurs and deteriorates as the distance from these areas increases. The water quality of a given hydrogeologic unit also usually deteriorates with depth."

In general, groundwater quality tends to be better in the more productive aquifers because of the more active groundwater circulation and fewer soluble minerals.

Figure 4.2-13 presents Bitter Creek watershed groundwater-quality information compiled by Mason and Miller (2005), including the formation estimated to have produced the sample analyzed, the Total Dissolved Solids (TDS) concentration of the sample, and whether the sampling point is a well or a spring. As can be seen, water quality varies widely, even from the same formation. See Mason and Miller (2005) for the complete listing of groundwater quality parameters for these sampling points.

The EPA Secondary Drinking Water Standards are based on aesthetic factors - taste, color, odor - rather than human health). Many of the groundwater samples listed on Figure 4.2-13 exceed the TDS concentration threshold of 500 mg/l.

The use of groundwater for irrigation in Bitter Creek is often hindered by high sodium levels. The relationship between sodium and other dissolved minerals defines the sodium-adsorption ratio (SAR), a measure of the deleterious impact on soils of certain waters. More than half the groundwater analyses from the Wasatch Formation, for example, exceeded SAR values considered suitable for irrigation.

A special class of wells are presented on Figure 4.2-14, i.e. those permitted for coalbed methane (CBM) development. Primarily associated with the Fort Union Formation (Figure 4.2-6), these wells are deliberately designed to draw down water levels in methane producing coal seams. Thus, they provide a demonstration of a potentially important water-quality parameter - flammable natural gas - in certain aquifers of the Bitter Creek watershed. Coal-bearing strata are also common in the Mesa Verde Group.

4.2.4.5 Groundwater Use

Groundwater diversions differ from surface water diversions in timing, location, rate, volume, and quality. All diversions or extractions of water in Wyoming, both surface and groundwater, require permitting through the Wyoming State Engineer's Office (SEO). Thus, the history and distribution of groundwater permits provide an empirical picture of the groundwater resource to the extent this resource has been developed for human use.

A complete listing of SEO groundwater permits for the watershed are provided in Appendix 4B. Monitor wells and cancelled permits are not included. Additional details for these permits (total depth, water

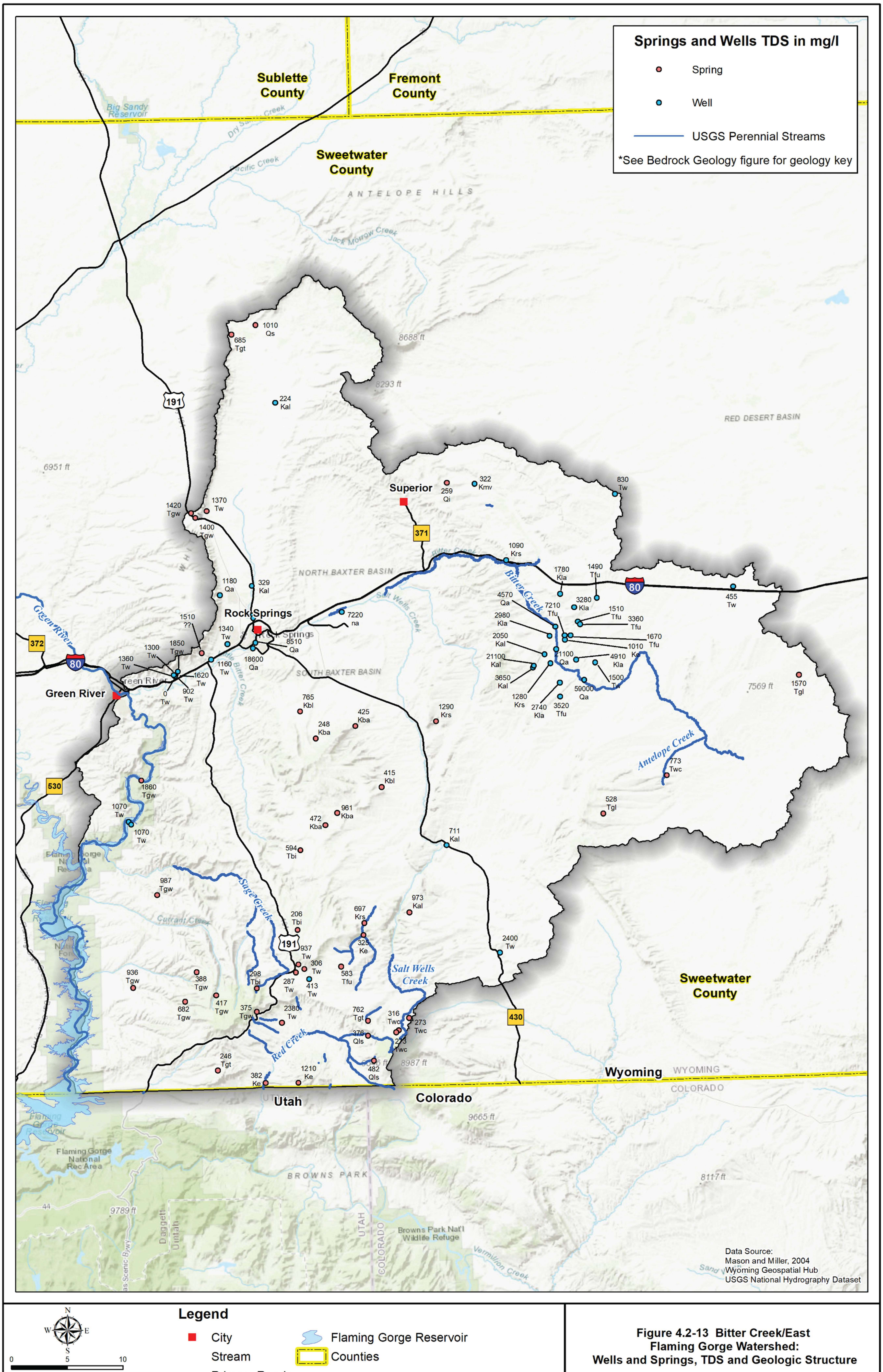


Figure 4.2-13 Bitter Creek/East Flaming Gorge Watershed: Wells and Springs, TDS and Geologic Structure

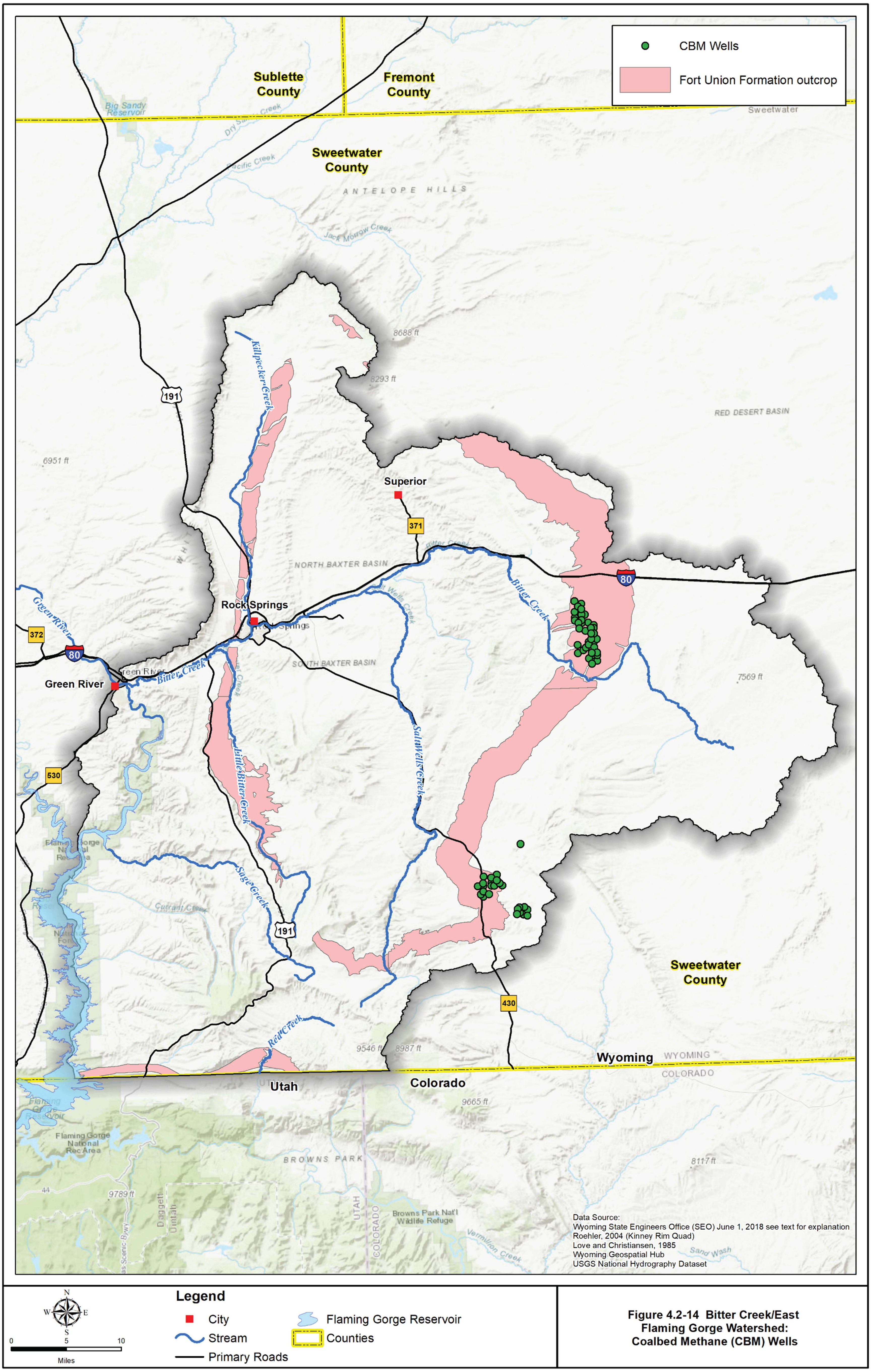


Figure 4.2-14 Bitter Creek/East Flaming Gorge Watershed: Coalbed Methane (CBM) Wells

level, lithology, use, etc.) may be available on the individual Statement of Completion, available electronically at: http://seoweb.wyo.gov/e-Permit/common/login.aspx?ReturnUrl=%2fe-Permit%2f

Figure 4.2-15 presents 101 SEO groundwater permits for the Bitter Creek watershed for which the permit-listed yield is greater than or equal to 100 gpm, sorted by depth range. Permit yields are the maximum discharge rate allowed and may or may not represent the actual yield available. Permit yields are rarely pumped on a sustained basis, and particularly for low-yield wells, may significantly overstate the groundwater actually available.

The highest-yield groundwater permit in the Bitter Creek watershed is a 2800 gpm permit for the dewatering of the mine pits at Bridger Coal. Thus, this is not a “well”, but represents the accumulation of groundwater from a large area of mine excavations. Mine dewatering is also the purpose of the next five largest groundwater permits by listed yield. These permits demonstrate the general presence of groundwater in the Fort Union Formation, but poorly reflect the production rates available from a single-point well.

The highest-yield actual well is permitted for 650 gpm. It is a 1,451 ft. well at the Bridger Coal Mine that flows 5 gpm at the surface, completed in the Ericson Formation. The Ericson is also the source for the 150 and 300 gpm municipal wells for the town of South Superior, identifying the Ericson as a major aquifer in this watershed. Note that due to the eastward dip of the formations in this northeast portion of the watershed, the Ericson (“Ke”) is found at the surface as indicated on Figure 4.2-6 and at increasing depth below the overlying formations as one moves to the northeast. As with any formation on the figure, the mapped outcrop is where the formation is present at the ground surface, but the formation is accessible by deeper drilling anywhere radially outward from the outcrop area (see Figure 4.2-8).

With the exception of the five Superior municipal wells, and a couple of 900-ft. wells for the community of Reliance, nearly all the wells in this group (greater than 100 gpm) are for industry-related purposes like pit dewatering. Thus, they reflect the occurrence of groundwater in association with coal seams or other mineral resources rather than opportunities for groundwater development for its own sake (e.g. note the association with the outcrop of the Fort Union Formation, Figure 4.2-6). Similar yields may be available at other locations in the watershed, although the range of well depths required to obtain these yields demonstrate that the required level of effort (expense) may be substantial.

Figure 4.2-16 presents the locations of the 747 groundwater permits with permit yields between 1 and 100 gpm to provide a broader picture of the availability of small quantities of groundwater in the watershed. Exclusion of lower-yield permits serves to filter out wells drilled for purposes other than groundwater development, e.g. contaminant monitoring. Forty percent of these 747 permits carry a nominal yield of 20 or 25 gpm, not because that was the realized groundwater production, but simply because that was the default appropriation for the requested type of use.

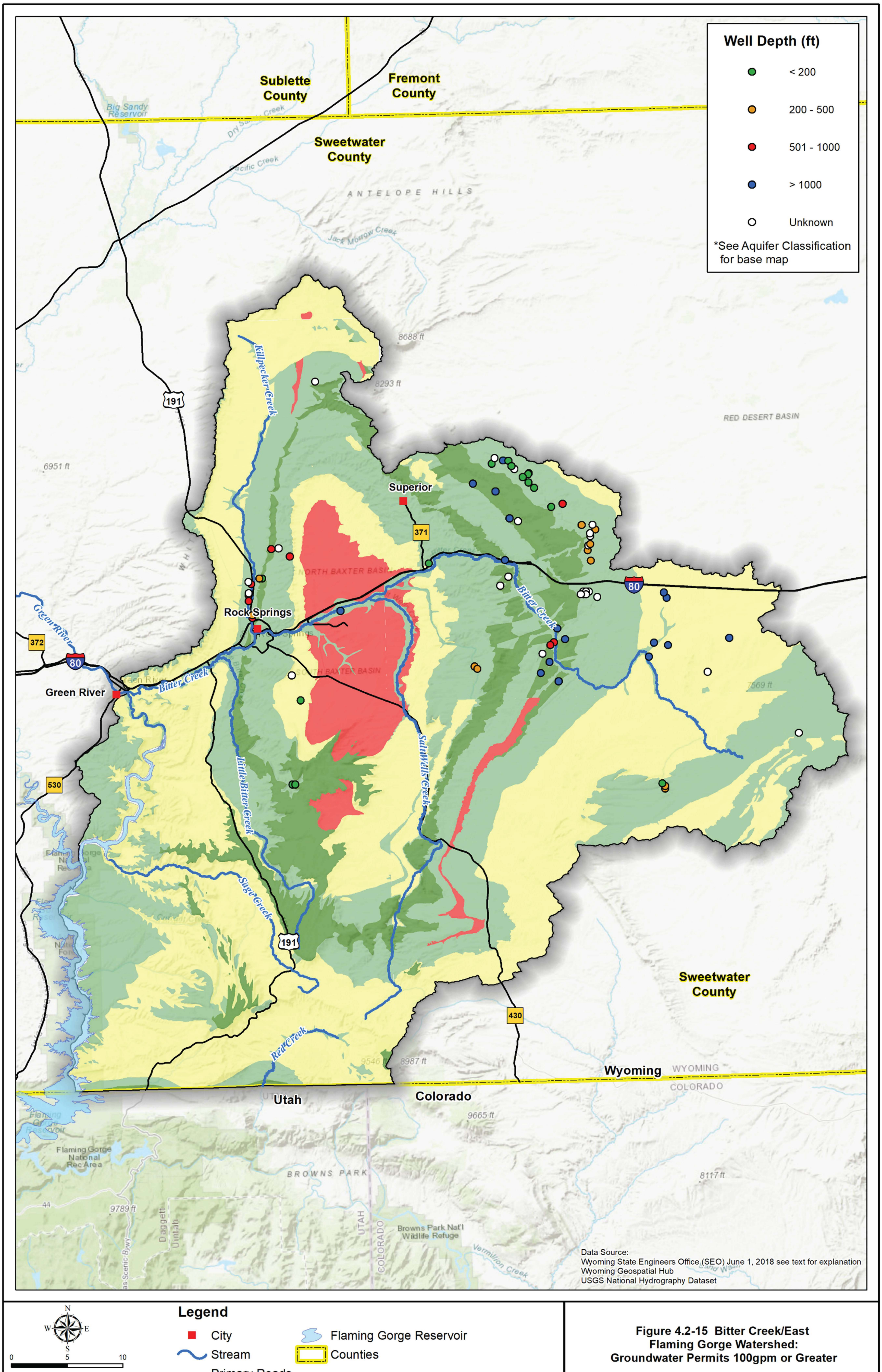


Figure 4.2-15 Bitter Creek/East Flaming Gorge Watershed: Groundwater Permits 100gpm or Greater

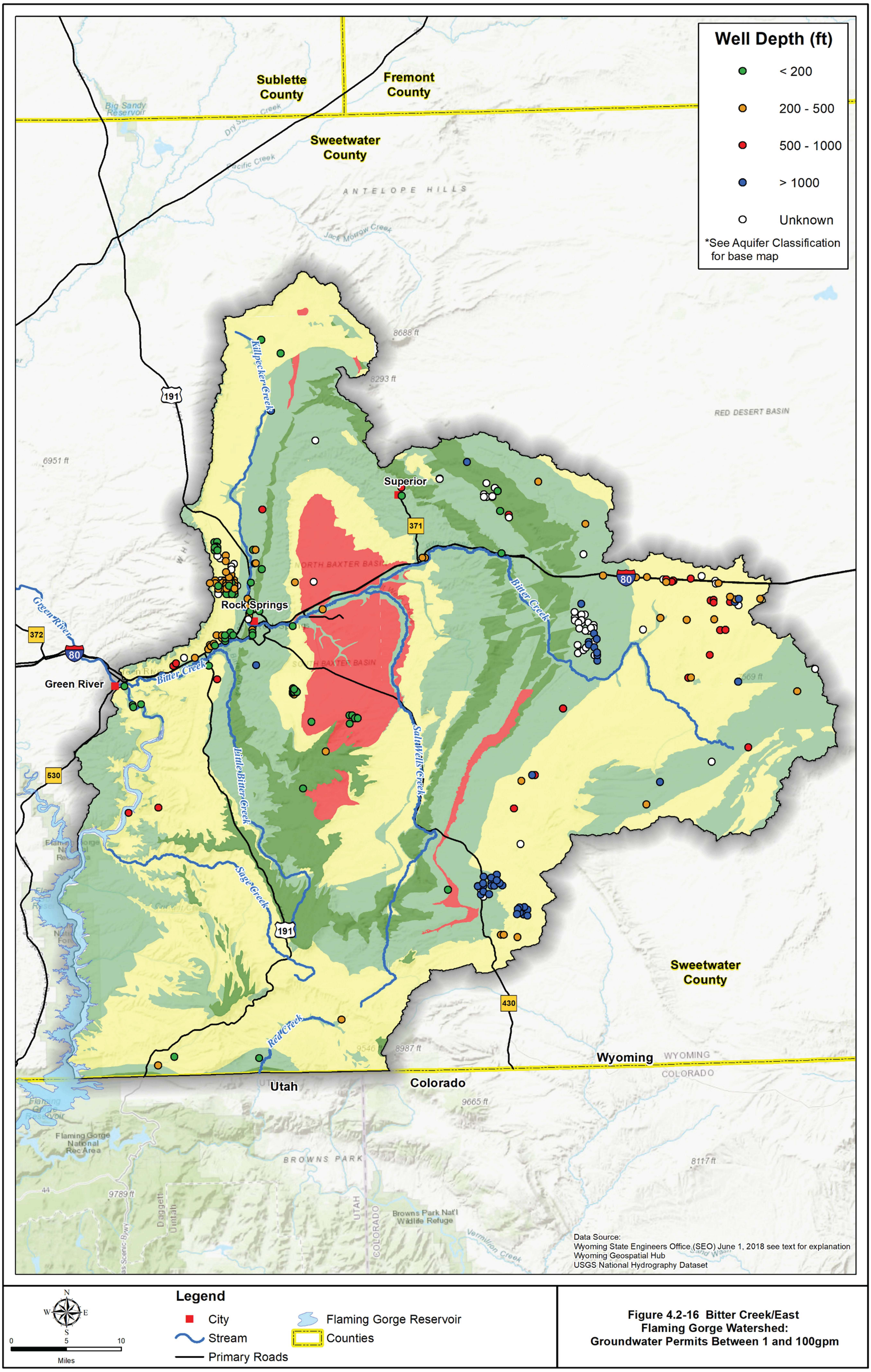


Figure 4.2-16 Bitter Creek/East Flaming Gorge Watershed: Groundwater Permits Between 1 and 100gpm

Groundwater permits for these low-yield applications are sparse outside the outcrop areas of the "potentially significant" and "minor" aquifers which indicates the paucity of groundwater development opportunity in the "marginal aquifer" and "aquitard" classes. However, the listing of only 25 groundwater permits in the watershed solely for stock watering purposes suggests the availability of small quantities of less-than-ideal quality groundwater has not been thoroughly explored.

Based on the basic geohydrology and the historical experience with actual groundwater development in the Bitter Creek watershed, small quantities of groundwater are likely available with sufficient well depth at most locations within or adjacent to the areas mapped as "potentially significant" or "minor" aquifers on Figure 4.2-12. Local conditions and careful site selection are likely to be critical, however, as one seeks a sufficient thickness of permeable sandstone strata, with recharge potential, and with minimum compromise of groundwater quality by adjacent high-salinity units.

The US Geological Survey has published 1:24,000-scale geologic mapping for select quadrangles in the study area. There are currently 18 such maps in the Bitter Creek watershed, primarily located south of I-80. These maps do not address groundwater conditions but provide additional local detail on the distribution and character of the geologic strata present. The available US Geological Survey Geologic Quadrangle mapping for the watershed is presented on Figure 4.2-17. Many of these individual maps are available for download from the USGS website at:

> https://ngmdb.usgs.gov/ngm-bin/ngm_search_dbi.pl?bc_ul=41.795401%2C-109.882043&bc_lr=40.850721%2C-107.643579

4.2.5 Surface Water

4.2.5.1 Hydrography

Streams are classified based upon the existence of streamflow and their runoff patterns. Very briefly, there are three flow regimes considered:

- Perennial streams are those that contain water year-round in normal years.
- Intermittent streams contain waters only a portion of the year, typically during winter and spring.
- Ephemeral streams carry water in direct response to precipitation events.

The majority of the Bitter Creek watershed would be considered ephemeral in nature. There are perennial and intermittent reaches within it, however, for the most part, runoff occurs primarily in association with response to precipitation events. The USGS has classified the streams in the study area and indicates their assessment on their published topographic maps. Figure 4.2-11 displays perennial streams in the watershed, and all other streams are assumed to be intermittent or ephemeral. As is clearly indicated in this figure, there are few perennial stream segments. Those that are classified as perennial are typically spring fed or a located in areas where the channel intersects ground water tables.

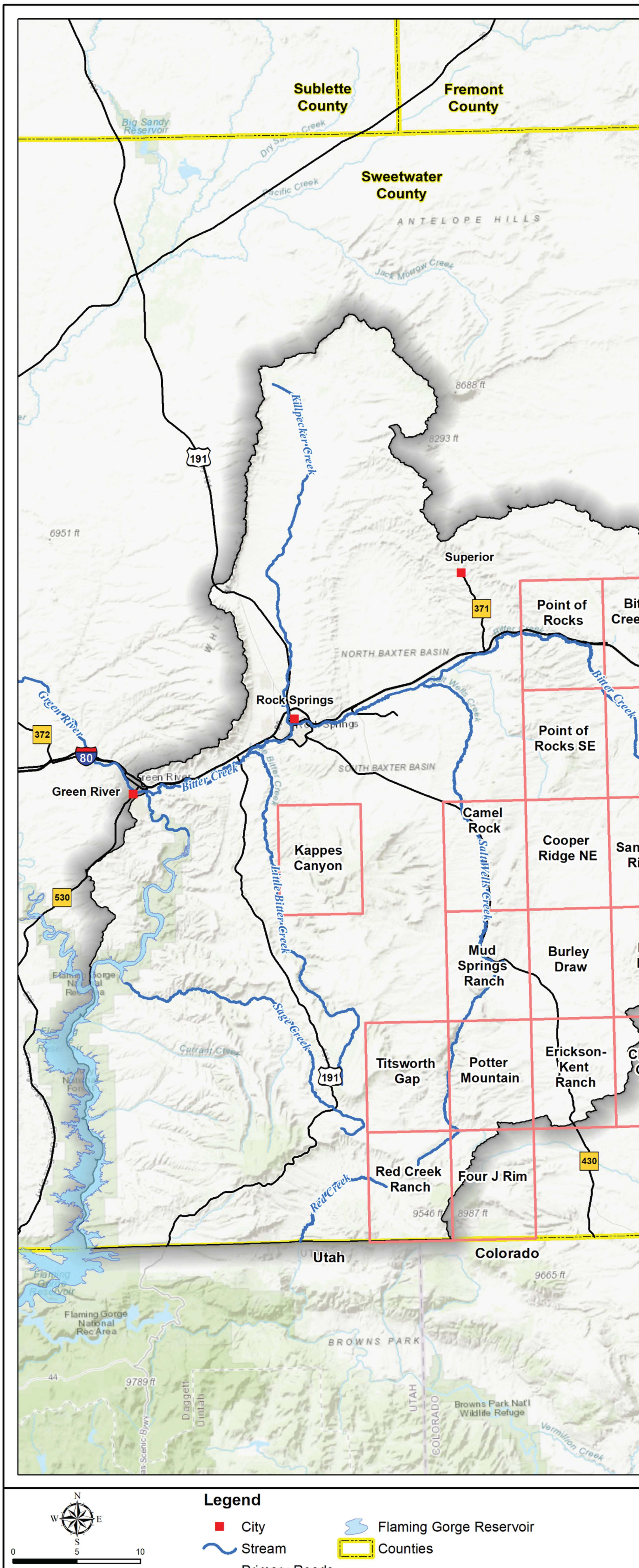


Figure 4.2-17 Bitter Creek/East Flaming Gorge Watershed: USGS Geologic Quadrangle Maps

The following paragraph was extracted from the Water Resources of Sweetwater County (Mason and Miller, 2004) and provides an excellent concise description of the typical flow patterns in the study area:

> *"Flow characteristics of streams in Sweetwater County are varied, influenced by the diverse physiography and climate of southwestern Wyoming, as well as anthropogenic factors. Moderate to large flows in major perennial streams are a result of runoff from snowmelt in mountainous areas mostly outside of and to the north, south, and west of the county. Reservoirs and diversions substantially alter flow characteristics of most of the major perennial streams. Because precipitation in the region is small, streams in much of the county are intermittent or ephemeral with most flows resulting from local and regional snowmelt and rainfall runoff. Flows in intermittent streams vary depending on reach characteristics. Snowmelt runoff, ground-water inflows, and (or) springs maintain streamflows throughout most years in some perennial reaches, while ephemeral reaches exist where streamflows are less than the losses to seepage, evaporation, and (or) diversions. Low flows, where present, in most streams are the result of ground-water discharges, irrigation return flows, and reservoir releases."*

Typical of many intermittent and ephemeral drainages, when runoff occurs it can be extremely 'flashy' or rising and falling very quickly. Consequently, due to the potential magnitude of these events, flooding can be an issue. In the City of Rock Springs and its surrounding area, flooding has long been an issue. Figure 4.2-18 displays the Federal Emergency Management Agency's (FEMA) mapping of Rock Springs clearly indicating when streamflow exceeds the channel conveyance capacity, out-of-bank flooding can cause extensive areas to be inundated. Flooding occurs primarily along Bitter Creek and Killpecker Creek, however, other tributaries also see out-of-bank flood conditions.

Several investigations documenting flood conditions and potential solutions have been completed, including those conducted by the US Army Corps of Engineers and several others funded by the WWDC. The following synopsis of the flood control study and planning process was extracted from the City of Rock Springs Document: Bitter Creek Reconstruction Plan & Design Report, 2007:

> "*A flood control study of Bitter Creek tributaries in Rock Springs was completed in 1989 ("Level II - Feasibility Study Phase IA Report - Rock Springs, Wyoming Flood Control Project Bitter Creek Tributaries" by Johnson-Fermelia Co. Inc. in association with Western Water Consultants, Inc. and Western Research Corporation, February 1989). The 1989 Flood Control Study investigated several different alternatives for flood control on Dead Horse Canyon Creek and Killpecker Creek.*
>
> *The study concluded that "an economically feasible flood control project could be constructed to control floodwater in excess of the safe carrying capacity of the existing stream channels." A summary of the preferred alternative for Dead Horse Canyon Creek and Killpecker Creek is provided below.*

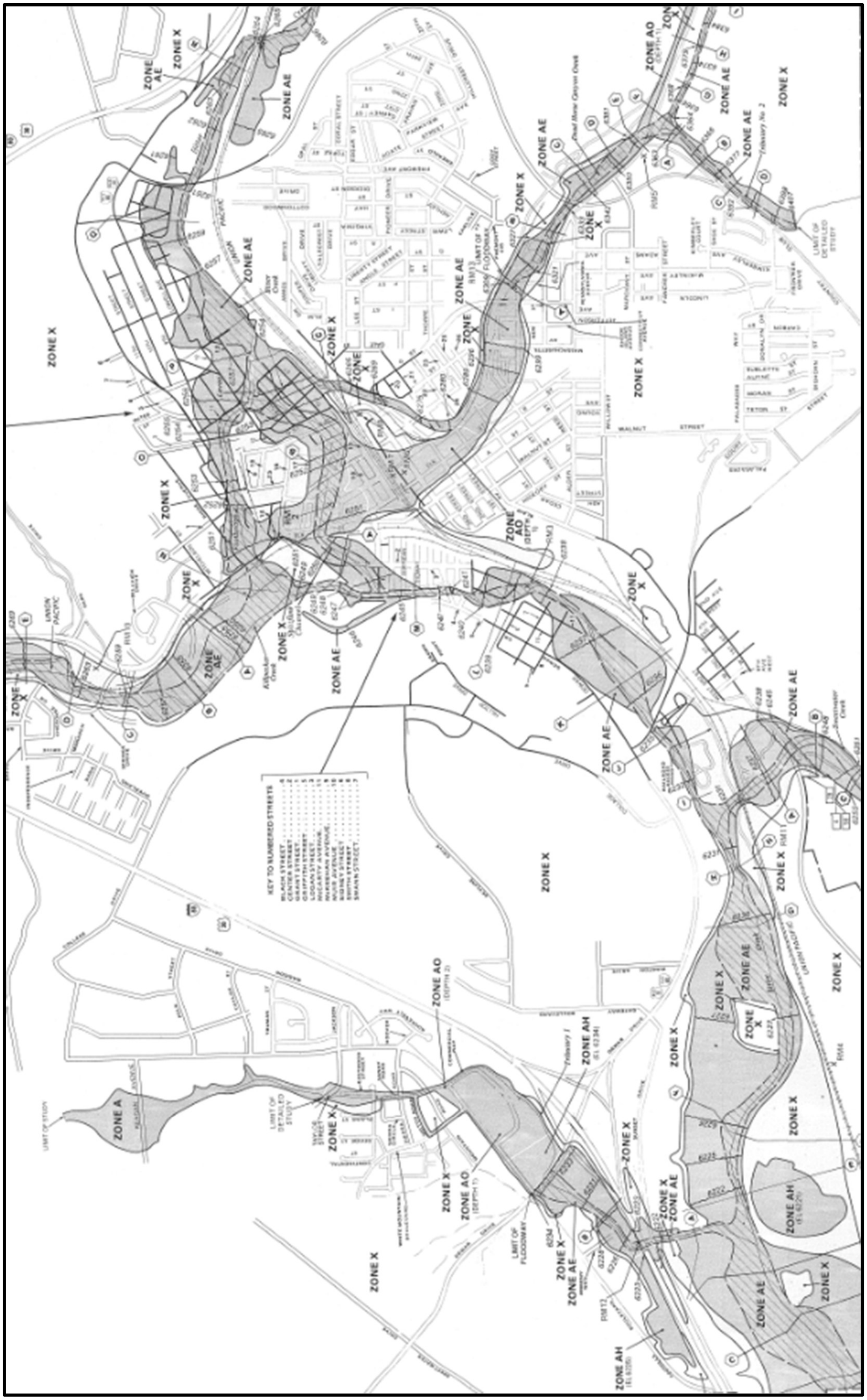


Figure 4.2-18 FEMA Map of Rock Springs Vicinity.

Dead Horse Canyon Creek: *The preferred alternative selected in the 1989 Flood Control Study included construction of two detention ponds (a 64 acre-foot pond and a 39 acre-foot pond) upstream of Highway 430 (see Figure 3, copy of Figure No. 32 from the 1989 Flood Control Study). The ponds are to be sized such that the sum of the pond outflow peaks and the local runoff peak from those areas below the ponds, will not exceed 1,100 cfs.*

Killpecker Creek: *The 1989 Flood Control Study found that Killpecker Creek channel capacity is about 1,000 cfs below I-80 and about 3,500 cfs above I-80 (compared to a 100-year flood flow of 6,300 cfs). The preferred alternative includes construction of two detention ponds (a 3,000 acre-foot pond and a 650 acre-foot pond) and construction of channel improvements. The larger detention pond (3,000 acre-feet) would be constructed above Yellowstone Road and the smaller detention pond (650 acre-feet) would be constructed above I-80. The channel improvements include improving channel capacity on Killpecker Creek below I-80 to increase the safe carrying capacity to 2,000 cfs."*

To date, several improvements have been completed essentially removing properties from the 100-year floodplain. According to the City's website at www.rswy.net :

- In 2011, construction was completed on two detention basins located along tributaries south of the City.
- By 2012, construction and levee improvements were completed along the Dead Horse Canyon Creek area, from the area near Connecticut Avenue to Pearl Park and the confluence with Bitter Creek.

Wyoming Department of Environmental Quality (WDEQ), Abandoned Mine Lands Program (AML) funding was awarded for construction of these projects.

The City of Rock Springs has committed to continuing channel improvements in an effort to reduce flood damages and enhance channel conditions. According to the City website, Bitter Creek improvement reach has been divided into four segments:

Segment 1 stretches from near the City's Dog Park to the South Side Belt Route bridge. This segment is now at 100% design completed and construction ready. Approximate cost to complete work on this segment is $3.8 million. Recreational benefits would include a new pedestrian trail connecting from Dewar Drive to the Dog Park, as well as a trailhead and parking area. The City has already acquired the trailhead area property.

Segment 2 stretches from the South Side Belt Route bridge to the Dewar Drive bridge. This segment is now at 25% design. Approximate cost to complete work on this segment is $10.6 million, removing approximately 62 properties from the floodplain. Recreational benefits would include a new pedestrian trail connecting Dewar Drive to the future Rahonce Park and the Dewar Drive greenbelt; another possible pedestrian connection could be made to Steven's Park.

Segment 3 stretches from the Dewar Drive bridge to N Street. This segment is now at 25% design. Approximate cost to complete work on this segment is $11.8 million, removing approximately 14 properties from the floodplain. Recreational benefits would include an improved pedestrian trail and landscaping along the North Side Belt Route, and a replacement pedestrian bridge connecting the North Side Belt Route to Soulsby Avenue.

Segment 4 stretches from N Street to the South Side Belt Route on the east side of town. This segment is now at 25% design. Approximate cost to complete work on this segment is $8.0 million, removing approximately 582 properties from the floodplain. Recreational benefits would include trail connections to O'Farrell Park and possible connection and expansion of Pearl Park.

4.2.5.2 Water Quality

Available descriptions of Bitter Creek water quality date to pre-settlement period when surveyors explored the area in search of routes for railroad construction. The following references to Bitter Creek were extracted from Historical Water Quality Report for the Bitter Creek Watershed prepared by Lost Iguana Consulting on behalf of the SWCCD.

From the journal of Major J. Lynde in 1850:

> *"took breakfast at the mouth of Bitter Creek… grass very scarce, it has a bitter brackish taste, wood is very scarce, nothing but greasewood and small sage"*
>
> *"the water is not fit for man to use, being at least 1/8 salt."*

From the journals of A. Howard Cutting in 1863:

> *[At Black Butte Station] "but the water in Bitter Creek, all we had yesterday and all we are likely to have today, is as strongly impregnated with alkali we can hardly drink it without adding Sartaric Acid or Vinegar in it. Tim Connell's horse sick from alkali water."*
>
> *[At Salt Wells] "Bitter Creek which runs directly past the well is almost unfit for any purpose. Seems to grow worse the further we travel on it."*
>
> *"Bitter Creek is too miserable a stream to have a name. The water grows worse, so bad now, that even whiskey won't help it…. It gives us a kind of pain in the stomach which is hard to bear."*

Stream Classifications

The Water Quality Division of the Wyoming Department of Environmental Quality (WDEQ) has classified water bodies in the state into two parts: primary bodies and secondary bodies. The primary bodies are listed in what is referred to as "Table A" and represent those water bodies either named on the USGS

1:500,000 scale hydrologic map or those specifically classified by the WDEQ. The secondary bodies listed in “Table B” are taken from the WGFD’s “Streams and Lakes Inventory” and are based on the presence or absence of fish species. Where there are differences in classification, "Table A" takes precedence. The water bodies are then classified based upon their use.

The Bitter Creek/East Flaming Gorge Watershed study area has 670 miles of streams and 0 reservoirs/lakes classified in the WDEQ's "Table A" and “Table B” as displayed in Figure 4.2-19. Table 4.2-3 presents the streams within the Bitter/Creek Flaming Gorge Watershed, extracted from the WDEQ’s “Table A”. Figure 4.2-20 summarizes the various stream classes and their associated use designations. Appendix 4C contains the WDEQ’s narrative descriptions of the classifications.

WYPDES Permitted Discharges

A database of permitted discharges under the National Pollution Discharge Elimination System (NPDES) was obtained from the Wyoming Department of Environmental Quality. As of the time this report was prepared, there were a total of 121 active (WYPDES) permitted discharges present within the study area. Table 4.2-4 summarizes pertinent information regarding the permits. The locations of these discharges are shown on Figure 4.2-19.

Waters Requiring TMDLs

A Total Maximum Daily Load (TMDL) is the amount of pollutant which a stream can accept and still meet its designated uses. TMDLs must be established for each pollutant which is a source of stream impairment. They must be measurable and must consider both point and nonpoint source pollutant loads, natural background conditions, and a margin of safety.

The term "303(d) list" is short for the list of impaired and threatened waters (stream/river segments, lakes) that the Clean Water Act requires all states to submit for Environmental Protection Agency (EPA) approval every two years on even-numbered years. Bitter and Killpecker Creeks are listed as impaired on the Wyoming Department of Environmental Quality (WDEQ) 303d List of Impaired Waters (WDEQ, 2018):

- Bitter Creek is listed as impaired for E. coli and chloride from the Green River to Point of Rocks, WY.
- Killpecker Creek is listed as impaired for E. coli from Bitter Creek to Reliance, WY.

In response to the listing, the SWCCD contracted EDE Consultants, of Sheridan, WY, to conduct a lengthy monitoring program with cooperation of the Wyoming Department of Environmental Quality. Their effort included water quality monitoring from 2004 through 2017 to verify and monitor the status of the impairment listings. Oversight of the project was provided by the Bitter and Killpecker Creek Watershed Advisory Group, or BKWAG. The BKWAG consists of individuals from both governmental and private interests within the watershed.

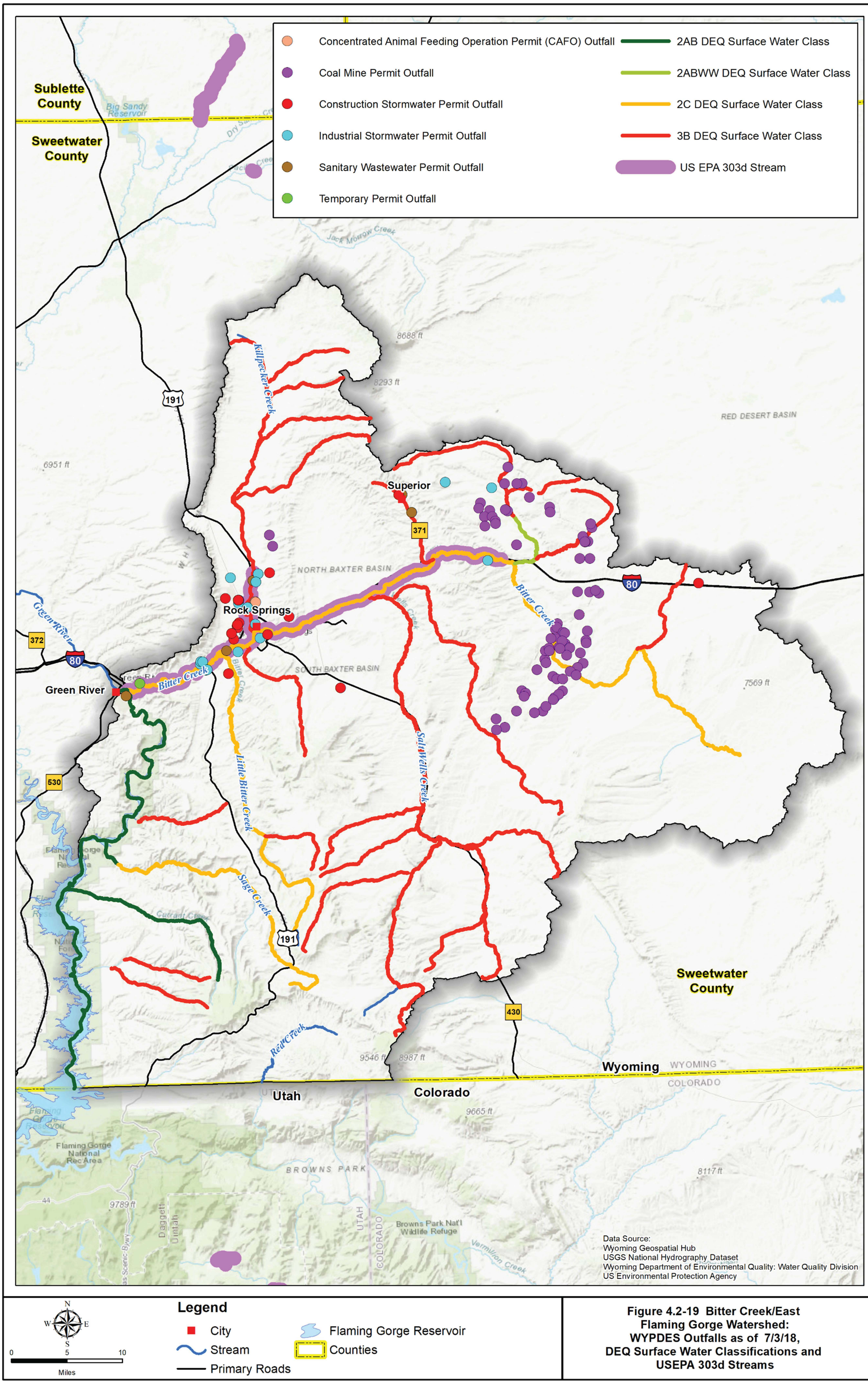


Figure 4.2-19 Bitter Creek/East Flaming Gorge Watershed: WYPDES Outfalls as of 7/3/18, DEQ Surface Water Classifications and USEPA 303d Streams

Table 4.2-3 Tabulation of Stream Classification in Bitter Creek / East Flaming Gorge Study Area.

Waters are listed within each drainage as they proceed upstream. An indented entry is tributary to the previous entry. All Class 2AB and 2B waters are designated as cold water game fisheries unless identified with a "ww" notation. All Class 2C waters are designated as warmwater fisheries. Waters designated for secondary contact recreation are identified by an "(s)". Classifications changed through the UAA process are identified by "(UAA)". UAAs that have been approved by the administrator, but not acted on by EPA are identified by an asterisk (*).

GREEN R (REMAINDER) 2AB				
	RED CR 2AB			
	SPRING CR 2AB			
FLAMING GORGE RES 2AB				
	SUGARLOAF MARSH 3B			
	WASHAM WASH 3B			
		BRINEGAR RES 2AB		
	CURRANT CR 2AB			
	SAGE CR (LOWER 3 MILES) 2AB			
	SAGE CR (REMAINDER) 2C			
	FIREHOLE CANYON CR 3B			
	BITTER CR 2C			
		LITTLE BITTER CR 2C		
			WORM CR 3B	
		SWEETWATER CR 3B		
		KILLPECKER CR 3B		
			LONG CANYON CR 3B	
			CEDAR CANYON CR 3B	
			PINE CANYON CR 3B	
			NITCH CR 3B	
		SALT WELLS CR 3B		
			PRETTY WATER CR 3B	
			JOYCE CR 3B	
			DANS CR 3B	
			E SALT WELLS CR 3B	

Table 4.2-3 Tabulation of Stream Classification in Bitter Creek / East Flaming Gorge Study Area (continued).

				ALKALI WASH 3B
				BROOKS DRAW 3B
		BLACK BUTTE CR 3B		
		HORSETHIEF CANYON CR 3B		
		DEADMAN WASH (AB BRIDGER PLANT) 3B		
		DEADMAN WASH (BL BRIDGER PLANT) 2ABWW		
			NINE MILE WASH 3B	
			NINE AND MILE WASH 3B	
			TEN MILE WASH 3B	
		PATRICK DRAW 3B		
		N FK BITTER CR 3B		
			ALKALINE CR 3B	
		S FK BITTER CR 3B		
			SAND CR 3B	
			PINE CR WASH 3B	
			TEN MILE WASH 3B	
		PATRICK DRAW 3B		

		Surface Water Classification												
		1	2AB	2A	2B	2C	2D	3A	3B	3C	3D	4A	4B	4C
Designated Use	Drinking Water	Yes	Yes	Yes	No	No	No	No	No	No	No	No	No	No
	Cold Water game fish	Yes	Yes	No	Yes	No	If Present	No	No	No	No	No	No	No
	Warm Water game fish	Yes	Yes	No	Yes	No	If Present	No	No	No	No	No	No	No
	Nongame Fish	Yes	Yes	No	Yes	Yes	If Present	No	No	No	No	No	No	No
	Fish Consumption	Yes	Yes	No	Yes	Yes	Yes	No	No	No	No	No	No	No
	Aquatic life other than fish	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No
	Recreation	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Wildlife	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Agriculture	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Scenic Value	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Class 2AB
- Lower Sage Creek
- Currant Creek
- Green River
- Deadman Wash* (Below Bridger Plant)

*Class 2ABWW - warm water fishery

Class 2C
- Bitter Creek
- Little Bitter Creek
- Upper Sage Creek

Class 3B
- Killpecker Creek
- Salt Wells Creek
- Black Butte Creek
- Horsethief Canyon
- Patrick Draw
- Sweetwater Creek
- Nitch Creek
- Joyce Creek
- Sugarloaf Marsh Creek
- Worm Creek
- Pretty Water Creek
- Dans Creek
- Long Canyon Creek
- Brooks Draw
- Alkali Wash
- Deadman Wash (Above Bridger Plant)
- Washam Wash
- Firehole Canyon
- Pine Canyon Creek
- Cedar Canyon Creek
- Ninemile Wash
- Tenmile Draw

Figure 4.2-20 WYDEQ Surface Water Classification and Use Designations.

Table 4.2-4 Summary of Active WYPDES Permitted Discharge Locations.

WY Permit Number	Receiving Water	Permittee	PermitType	Facility Name	Permit Expiration	Permit Status
WY0020443	Green River (2AB)	Green River, City of	Sanitary Wastewater	Green River Wastewater Lagoon	6/30/2021	In Effect
WY0021806	Unnamed ephemeral tributary to Horsethief Canyon Creek (both class 3B), Green River Basin	Superior, Town of	Sanitary Wastewater	Superior Wastewater Lagoon	9/30/2021	In Effect
WY0021806	Unnamed ephemeral tirbutary to Horsethief Canyon Creek (both class 3B), Green River Basin	Superior, Town of	Sanitary Wastewater	Superior Wastewater Lagoon	9/30/2021	In Effect
WY0021806	Potable drinking water intake for CRS Forum requirements.	Superior, Town of	Sanitary Wastewater	Superior Wastewater Lagoon	9/30/2021	In Effect
WY0022128	Killpecker Creek (3B), tributary to Bitter Creek (2C), eventually tributary to Green River (2AB)	Regency of Wyoming, Inc.	Sanitary Wastewater	B & R Mobile Home Village	3/31/2022	In Effect
WY0022357	Bitter Creek (2C), Green River Basin	Rock Springs, City of	Sanitary Wastewater	Rock Springs Water Reclamation Facility	3/31/2020	In Effect
WY0023825	Killpecker Creek (3B), tributary to Bitter Creek (Class 2C),Green River Basin	Rocky Mountain Coal Company, LLC	Coal Mine	Stansbury Mine	6/30/2018	In Effect
WY0023825	Killpecker Creek (3B), tributary to Bitter Creek (Class 2C), Green River Basin	Rocky Mountain Coal Company, LLC	Coal Mine	Stansbury Mine	6/30/2018	In Effect
WY0028886	Mac Creek (3B), Green River Basin	Black Butte Coal Company	Coal Mine	Leucite Hills Mine	9/30/2022	In Effect
WY0028886	B Draw (3B)	Black Butte Coal Company	Coal Mine	Leucite Hills Mine	9/30/2022	In Effect
WY0028886	Ninemile Wash via an unnamed drainage (all 3B)	Black Butte Coal Company	Coal Mine	Leucite Hills Mine	9/30/2022	In Effect
WY0028886	Humphrey Draw (3B)	Black Butte Coal Company	Coal Mine	Leucite Hills Mine	9/30/2022	In Effect
WY0028886	Humphrey Draw (3B)	Black Butte Coal Company	Coal Mine	Leucite Hills Mine	9/30/2022	In Effect
WY0028886	Humphrey Draw via an unnamed draw (3B)	Black Butte Coal Company	Coal Mine	Leucite Hills Mine	9/30/2022	In Effect
WY0028886	Humphrey Draw via an unnamed draw (3B)	Black Butte Coal Company	Coal Mine	Leucite Hills Mine	9/30/2022	In Effect
WY0028886	Coon Draw via an unnamed draw (all 3B)	Black Butte Coal Company	Coal Mine	Leucite Hills Mine	9/30/2022	In Effect
WY0028886	Deadman Wash via an unnamed drainage (3B)	Black Butte Coal Company	Coal Mine	Leucite Hills Mine	9/30/2022	In Effect
WY0030261	Bitter Creek (2C) via BB-203 Draw (3B), Green River Basin	Black Butte Coal Company	Coal Mine	Black Butte Mine	5/31/2021	In Effect
WY0030261	Bitter Creek (2C) via BB-204 Draw (3B)	Black Butte Coal Company	Coal Mine	Black Butte Mine	5/31/2021	In Effect
WY0030261	Bitter Creek (2C) via BB-100 Draw (3B) and Rock Creek (3B)	Black Butte Coal Company	Coal Mine	Black Butte Mine	5/31/2021	In Effect
WY0030261	Bitter Creek (2C) via BB-201 Draw (3B)	Black Butte Coal Company	Coal Mine	Black Butte Mine	5/31/2021	In Effect
WY0030261	Bitter Creek (2C) via an unnamed draw (3B)	Black Butte Coal Company	Coal Mine	Black Butte Mine	5/31/2021	In Effect
WY0030261	Bitter Creek (2C) via an unnamed draw (3B)	Black Butte Coal Company	Coal Mine	Black Butte Mine	5/31/2021	In Effect
WY0030261	Bitter Creek (2C) via BB-203 Draw (3B)	Black Butte Coal Company	Coal Mine	Black Butte Mine	5/31/2021	In Effect
WY0030261	Bitter Creek (2C) via an unnamed draw (3B)	Black Butte Coal Company	Coal Mine	Black Butte Mine	5/31/2021	In Effect
WY0030261	Bitter Creek (2C) via an unnamed draw (3B)	Black Butte Coal Company	Coal Mine	Black Butte Mine	5/31/2021	In Effect
WY0030261	Bitter Creek (2C) via BB-203 Draw (3B)	Black Butte Coal Company	Coal Mine	Black Butte Mine	5/31/2021	In Effect
WY0030261	Bitter Creek (2C) via John Boy Draw (3B) and BB-204 Draw (3B)	Black Butte Coal Company	Coal Mine	Black Butte Mine	5/31/2021	In Effect
WY0030261	Bitter Creek (2C) via Mut Draw and John Boy Draw (3B)	Black Butte Coal Company	Coal Mine	Black Butte Mine	5/31/2021	In Effect
WY0030261	Bitter Creek (2C) via IC-F8 Channel and pit 5 (3B)	Black Butte Coal Company	Coal Mine	Black Butte Mine	5/31/2021	In Effect
WY0030261	Bitter Creek (2C) via ID-DS1 Channel and BB-204 Draw (3B)	Black Butte Coal Company	Coal Mine	Black Butte Mine	5/31/2021	In Effect
WY0030261	Bitter Creek (2C) via Queen Draw and BB-204 Draw (3B)	Black Butte Coal Company	Coal Mine	Black Butte Mine	5/31/2021	In Effect
WY0030261	Bitter Creek (2C) via John Boy Draw and BB-204 Draw (3B)	Black Butte Coal Company	Coal Mine	Black Butte Mine	5/31/2021	In Effect
WY0030261	Bitter Creek (2C) via an unnamed draw and BB-204 Draw (3B)	Black Butte Coal Company	Coal Mine	Black Butte Mine	5/31/2021	In Effect
WY0030261	Bitter Creek (2C) via an unnamed draw and BB-204 Draw (3B)	Black Butte Coal Company	Coal Mine	Black Butte Mine	5/31/2021	In Effect
WY0030261	Bitter Creek (2C) via an unnamed draw and BB-203 Draw (3B)	Black Butte Coal Company	Coal Mine	Black Butte Mine	5/31/2021	In Effect
WY0030261	Bitter Creek (2C) via BB-203 Draw (3B)	Black Butte Coal Company	Coal Mine	Black Butte Mine	5/31/2021	In Effect
WY0030261	Bitter Creek (2C) via an unnamed draw and SP-H14 pond (3B)	Black Butte Coal Company	Coal Mine	Black Butte Mine	5/31/2021	In Effect
WY0030261	Bitter Creek (2C) via an unnamed draw (3B)	Black Butte Coal Company	Coal Mine	Black Butte Mine	5/31/2021	In Effect
WY0030261	Bitter Creek (2C) via Summer Draw (3B)	Black Butte Coal Company	Coal Mine	Black Butte Mine	5/31/2021	In Effect
WY0030261	Bitter Creek (2C) via Melissa Draw (3B)	Black Butte Coal Company	Coal Mine	Black Butte Mine	5/31/2021	In Effect
WY0030261	Bitter Creek (2C) via David Draw (3B)	Black Butte Coal Company	Coal Mine	Black Butte Mine	5/31/2021	In Effect
WY0030261	Bitter Creek (2C) via an unnamed draw (3B)	Black Butte Coal Company	Coal Mine	Black Butte Mine	5/31/2021	In Effect
WY0030261	Bitter Creek (2C) via an unnamed draw and SP-J1 pond (3B)	Black Butte Coal Company	Coal Mine	Black Butte Mine	5/31/2021	In Effect
WY0030261	Bitter Creek (2C) via an unnamed draw (3B)	Black Butte Coal Company	Coal Mine	Black Butte Mine	5/31/2021	In Effect
WY0030261	Bitter Creek (2C) via Lisa Draw (3B)	Black Butte Coal Company	Coal Mine	Black Butte Mine	5/31/2021	In Effect
WY0030261	Bitter Creek (2C) via an unnamed draw (3B)	Black Butte Coal Company	Coal Mine	Black Butte Mine	5/31/2021	In Effect
WY0030261	Bitter Creek (2C) via an unnamed draw (3B)	Black Butte Coal Company	Coal Mine	Black Butte Mine	5/31/2021	In Effect
WY0030261	Bitter Creek (2C) via an unnamed draw (3B)	Black Butte Coal Company	Coal Mine	Black Butte Mine	5/31/2021	In Effect
WY0030261	Bitter Creek (2C) via an unnamed draw (3B)	Black Butte Coal Company	Coal Mine	Black Butte Mine	5/31/2021	In Effect
WY0030261	Bitter Creek (2C) via an unnamed draw (3B)	Black Butte Coal Company	Coal Mine	Black Butte Mine	5/31/2021	In Effect
WY0030261	Bitter Creek (2C) via BB-202 Draw and pit 9 (3B)	Black Butte Coal Company	Coal Mine	Black Butte Mine	5/31/2021	In Effect
WY0030261	Bitter Creek (2C) via an unnamed draw (3B)	Black Butte Coal Company	Coal Mine	Black Butte Mine	5/31/2021	In Effect
WY0030261	Bitter Creek (2C) via an unnamed draw and pit 3 (3B)	Black Butte Coal Company	Coal Mine	Black Butte Mine	5/31/2021	In Effect
WY0030261	Bitter Creek (2C) via an unnamed draw (3B)	Black Butte Coal Company	Coal Mine	Black Butte Mine	5/31/2021	In Effect
WY0030261	Bitter Creek (2C) via an unnamed draw (3B)	Black Butte Coal Company	Coal Mine	Black Butte Mine	5/31/2021	In Effect
WY0030261	Bitter Creek (2C) via an unnamed draw (3B)	Black Butte Coal Company	Coal Mine	Black Butte Mine	5/31/2021	In Effect
WY0030261	Bitter Creek (2C) via B-2 Draw (3B)	Black Butte Coal Company	Coal Mine	Black Butte Mine	5/31/2021	In Effect
WY0030261	Bitter Creek (2C) via B-4 Draw (3B)	Black Butte Coal Company	Coal Mine	Black Butte Mine	5/31/2021	In Effect
WY0030261	Rock Creek (3B), Green River Basin	Black Butte Coal Company	Coal Mine	Black Butte Mine	5/31/2021	In Effect
WY0030261	unnamed drainage (3B), tributary to Bitter Creek	Black Butte Coal Company	Coal Mine	Black Butte Mine	5/31/2021	In Effect

Table 4.2-4 Summary of Active WYPDES Permitted Discharge Locations (continued).

WY Permit Number	Receiving Water	Permittee	PermitType	Facility Name	Permit Expiration	Permit Status
WY0030261	unnamed drainage (3B), tributary to Bitter Creek	Black Butte Coal Company	Coal Mine	Black Butte Mine	5/31/2021	In Effect
WY0030261	unnamed drainage (3B), tributary to Bitter Creek	Black Butte Coal Company	Coal Mine	Black Butte Mine	5/31/2021	In Effect
WY0030261	unnamed drainage (3B), tributary to Bitter Creek	Black Butte Coal Company	Coal Mine	Black Butte Mine	5/31/2021	In Effect
WY0030261	unnamed drainage (3B), tributary to Black Butte Creek	Black Butte Coal Company	Coal Mine	Black Butte Mine	5/31/2021	In Effect
WY0030261	unnamed drainage (3B), tributary to Black Butte Creek	Black Butte Coal Company	Coal Mine	Black Butte Mine	5/31/2021	In Effect
WY0030261	unnamed drainage (3B), tributary to Black Butte Creek	Black Butte Coal Company	Coal Mine	Black Butte Mine	5/31/2021	In Effect
WY0030350	Deadman Wash (3B)	Bridger Coal Company	Coal Mine	Jim Bridger Mine	4/30/2020	In Effect
WY0030350	Deadman Wash (3B) via Nine Mile Wash (3B) via an unnamed drainage (3B)	Bridger Coal Company	Coal Mine	Jim Bridger Mine	4/30/2020	In Process
WY0030350	Deadman Wash (3B) Nine & One Half Mile Wash (3B), via an unnamed drainage (3B)	Bridger Coal Company	Coal Mine	Jim Bridger Mine	4/30/2020	In Effect
WY0030350	Deadman Wash (3B)	Bridger Coal Company	Coal Mine	Jim Bridger Mine	4/30/2020	In Effect
WY0030350	Deadman Wash (3B)	Bridger Coal Company	Coal Mine	Jim Bridger Mine	4/30/2020	In Process
WY0030350	Deadman Wash (3B) via Nine Mile Wash (3B) via an unnamed drainage (3B)	Bridger Coal Company	Coal Mine	Jim Bridger Mine	4/30/2020	In Process
WY0030350	Deadman Wash (3B) via Nine Mile Wash (3B) via North Jackalope draw (3B)	Bridger Coal Company	Coal Mine	Jim Bridger Mine	4/30/2020	In Effect
WY0030350	Deadman Wash (3B) via Nine Mile Wash (3B) via an unnamed drainage (3B)	Bridger Coal Company	Coal Mine	Jim Bridger Mine	4/30/2020	In Effect
WY0030350	Deadman Wash (3B) via Ten Mile Wash (3B) via an Kerry Draw(3B)	Bridger Coal Company	Coal Mine	Jim Bridger Mine	4/30/2020	In Process
WY0030350	Deadman Wash (3B) via Ten Mile Wash (3B) via Kerry Draw(3B)	Bridger Coal Company	Coal Mine	Jim Bridger Mine	4/30/2020	In Effect
WY0030350	Deadman Wash (3B) via Ten Mile Wash (3B), Green River Basin	Bridger Coal Company	Coal Mine	Jim Bridger Mine	4/30/2020	In Process
WY0030350	Deadman Wash (3B) via Ten Mile Wash (3B)	Bridger Coal Company	Coal Mine	Jim Bridger Mine	4/30/2020	In Effect
WY0030350	Deadman Wash (3B) via Ten Mile Wash (3B) via an unnamed drainage (3B)	Bridger Coal Company	Coal Mine	Jim Bridger Mine	4/30/2020	In Process
WY0030350	Kerry Draw (3B), tributary to Ten Mile Draw (3B)	Bridger Coal Company	Coal Mine	Jim Bridger Mine	4/30/2020	In Effect
WY0030350	Ten Mile Draw (3B) via Deadman Wash (3B)	Bridger Coal Company	Coal Mine	Jim Bridger Mine	4/30/2020	In Process
WY0030350	Nine and One-Half Mile Wash (3B) via unnamed drainage (3B)	Bridger Coal Company	Coal Mine	Jim Bridger Mine	4/30/2020	In Process
WY0030350	Ten Mile Draw (3B) via unnamed drainage (3B)	Bridger Coal Company	Coal Mine	Jim Bridger Mine	4/30/2020	In Process
WY0094528	Lionkol Draw, tributary to Killpecker Creek (both class 3B), tributary to Bitter Creek (class 2C)	Bureau of Land Management	CAFO	BLM Rock Springs Wild Horse Facility	12/31/2018	In Effect
WY0094528	Lionkol Draw, tributary to Killpecker Creek (both class 3B), tributary to Bitter Creek (class 2C)	Bureau of Land Management	CAFO	BLM Rock Springs Wild Horse Facility	12/31/2018	In Effect
WYG740589	Green River (2AB)	COP Wyoming, LLC	Temporary	Rock Springs Water Transmission Line Replacement	2/4/2019	In Effect
WYR000409		Maxam US LLC	Industrial Stormwater	MSI - Point Of Rocks Plant	8/31/2022	In Effect
WYR001063	Killpecker Creek	Tuboscope, A National Oilwell Varco LP Company	Industrial Stormwater	Tuboscope Rock Springs Facility	8/31/2017	In Effect
WYR001107	Unnamed drainage to Killpecker Creek to Bitter Creek to the Green River	Rock Springs, City of	Industrial Stormwater	City of Rock Springs Streets Department Garage	8/31/2022	In Effect
WYR001252	Killpecker Creek	G & J Hot Oiling Inc.	Industrial Stormwater	G & J Hot Oiling Inc.	8/31/2017	In Effect
WYR001258	Bitter Creek	Homax Oil Sales, Inc.	Industrial Stormwater	Homax Oil Sales Inc.-Rock Springs Facility	2/28/2022	In Effect
WYR001285	Bitter Creek	Homax Oil Sales, Inc.	Industrial Stormwater	Homax Oil Sales Inc.-Rock Springs Blairtown Flaming Gorge Facility	2/28/2022	In Effect
WYR001401	Killpecker Creek	Schlumberger Technology Corporation	Industrial Stormwater	Rock Springs Oilfield Services	8/31/2022	In Effect
WYR001404	Bitter Creek	National Oilwell Varco	Industrial Stormwater	Rock Springs WY T3 Facility	8/31/2017	In Effect
WYR001408	Unnamed drainage to Green River.	Coastal Chemical Company, LLC	Industrial Stormwater	Coastal Chemical Co. LLC-Rock Springs	8/31/2022	In Effect
WYR001432	Killpecker Creek	Progress Rail Services	Industrial Stormwater	Progress Rail Service Rock Springs Car Shop	8/31/2017	In Effect
WYR001465	Bitter Creek	Coil Tubing Schlumberger	Industrial Stormwater	Coil Tubing Services	8/31/2017	In Effect
WYR001476	Killpecker Creek	High Desert Construction	Industrial Stormwater	High Desert Construction	8/31/2022	In Effect
WYR001478	Bitter Creek	Swanson Industries, Inc.	Industrial Stormwater	Morgantown Machine & Hydraulics of WY, Inc.	<Null>	In Process
WYR104333	Patrick Draw	Colorado Interstate Gas Company	Construction Stormwater	Desert Springs Compressor Station Abandonment and Removal Project	2/1/2020	In Effect
WYR104957	Bitter Creek	M&R Development, LLC	Construction Stormwater	City's Edge Subdivision	4/21/2019	In Effect
WYR104967	Unnamed drainage to Killpecker Creek.	WDEQ - AML Division	Construction Stormwater	AML Project 17G, Rock Springs No. 9 Mine Fire	4/21/2019	In Effect
WYR104993	Killpecker Creek via two unnamed ephemeral drainages	WDEQ - AML Program	Construction Stormwater	AML Project 62-P3-LA Reliance Coal Slack Reclamation	4/21/2019	In Effect
WYR105427	Summit Drive flood water control ditch	MJR Rentals LLC	Construction Stormwater	Summit Drive 30 Acres	8/31/2019	In Effect
WYR105458	Unnamed intermittent draws and perennial stream through Long Canyon	Wexpro Company	Construction Stormwater	Baxter Oil and Gas Production and Gathering System	2/1/2020	In Effect
WYR105497	Bitter Creek via Rock Springs Municipal Storm Sewer	Haden Construction, Inc.	Construction Stormwater	Gunsight Estates (Lots 16, 21, 23, 26, 27))	12/11/2019	In Effect
WYR105512	Bittercreek	Wing Shui Lew	Construction Stormwater	Gunsight Estates Subdivision Lot 33	1/24/2020	In Effect
WYR105599	Horse Thief Canyon	WDEQ - AML Division	Construction Stormwater	AML Project 17.6B-H2C, Superior Drainage Reclamation Project	2/1/2020	In Effect
WYR105621	Little Bitter Creek, Sweetwater Creek	Summit Line Construction	Construction Stormwater	Simplot Fertilizer Mfg. Plant 230kV Transmission Project	9/24/2018	In Effect
WYR105626	Bitter Creek via Rock Springs municipal storm sewer	Haden Construction, Inc.	Construction Stormwater	Temple Peak Lots #10 & #12	2/1/2020	In Effect
WYR105632	Killpecker Creek	Northpark, LLC	Construction Stormwater	Northpark Village, Phase 2 (2017-2020)	2/1/2020	In Effect
WYR105633	Killpecker Creek	L. M. Olson, Inc.	Construction Stormwater	Foothills Crossing Subdivision	11/1/2019	In Effect
WYR105640	Bitter Creek	Amundsen Construction Inc.	Construction Stormwater	Gunsight Estates Phase 2	2/1/2020	In Effect
WYR105654	Killpecker Creek	Mainline Construction	Construction Stormwater	Northpark Village, Phase 2 (2017-2020)	2/1/2020	In Effect
WYR105655	Killpecker Creek	Sweetwater County Landholdings LLC	Construction Stormwater	Northpark Village, Phase 2 (2017-2020)	2/1/2020	In Effect
WYR105719	Bitter Creek	W.W. Clyde & Co.	Construction Stormwater	Rock Springs Landfill, Phase 2	10/31/2018	In Effect
WYR105724	Reagan Detention Pond	Gunsight Properties, Inc.	Construction Stormwater	Gunsight Estates Phase III	12/31/2018	In Effect
WYR320482	Potash Wash	Searle Brothers Construction Company	Industrial Stormwater	Leucite Mine	3/31/2023	In Effect
WYR320620	Bitter Creek	Sweetwater County	Industrial Stormwater	Lagoon Road Yard	3/31/2023	In Effect
WYR320750	Potash Wash	Searle Brothers Construction Company	Industrial Stormwater	9 Mile Yard, Edgar Bobo Yard	3/31/2023	In Effect

At this time, the BKWAG and EDE have completed a TMDL investigation for Bitter Creek and Killpecker Creek and are in the process of determining the direction for future implementation strategies. The TMDL document discusses potential sources for the E. Coli which are contributed via three pathways: surface water runoff, direct deposition, or leaching into shallow groundwater and ultimately to Bitter Creek. Potential sources identified include livestock, wildlife, pets, and human (TetraTech, 2017). Numerous reports documenting the SWCCD's TMDL monitoring efforts and water quality planning are available on their website at: http://www.swccd.us/

4.2.6 Geomorphology

4.2.6.1 General

The field of fluvial geomorphology is the study of how land is formed under processes associated with running water. The balance between processes such as erosion, deposition, and sediment transport determine the character and condition of a stream. The objective of the geomorphic evaluation of the study area is to determine the nature of this balance, and where the balance has been upset.

The condition of a stream can be assessed with respect to its basic form (width, depth, slope, etc.), as well as its state of equilibrium, or geomorphic stability (Thorne, et al., 1996; Johnson, et al., 1999). *Stable* channels are generally defined as those that have achieved a balance between flow energy and sediment delivery, such that sediment is transported at the rate at which it is delivered, and the form and pattern of the channel is maintained (Thorne, et al., 1996). In geomorphically stable conditions, minor changes in either sediment supply or transport energy result in gradual adjustment of channel form to accommodate those changes (Lane, 1955). Channels destabilize when changes in those factors are extreme enough that rapid and dramatic alterations in pattern or form occur. Common indicators of channel instability include active downcutting and accelerated bank erosion, major changes in channel width/depth ratios, and increased flooding due to sediment deposition.

Dynamically stable channels are adjustable in nature, and "stability" does not preclude lateral migration and associated dynamics such as bank erosion and sediment deposition. A stream in dynamic equilibrium has adjusted its width, depth, and slope such that the channel is neither aggrading nor degrading. However, change may be occurring in the stream bank, erosion may result, and bank stabilization may be necessary even on the banks of a stream in dynamic equilibrium.

The equilibrium concept of streams discussed above can also be described by various qualitative relationships. One of the most widely used relationships is the one proposed by Lane (1955) which states that:

$$Q_s \cdot D_{50} \propto Q_w \cdot S$$

Where Qw is the water discharge, S is the slope, Qs is the bed material load, and D50 is the median size of the bed material. This relationship, commonly referred to as Lane's Balance, is illustrated in Figure 4.2-21.

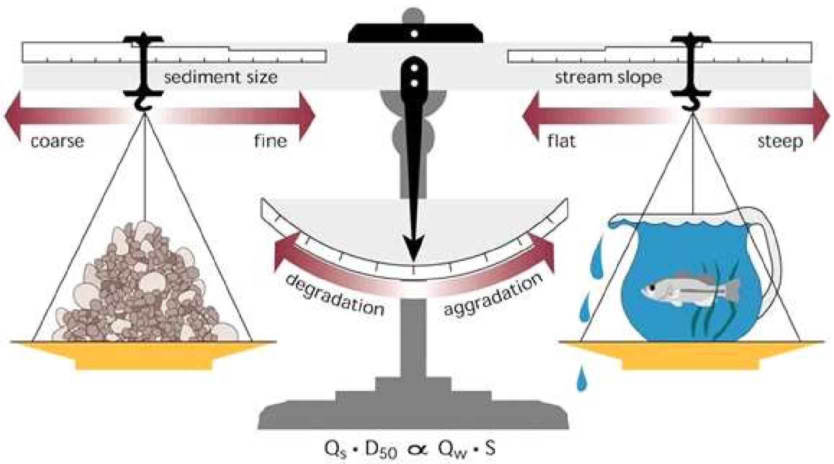


Figure 4.2-21 Lane's Balance.

This graphic indicates that a change in any of the four variables will cause a change in the others such that equilibrium is restored. When a channel is in equilibrium, it will have adjusted these four variables such that the sediment being transported into the reach is transported out, without significant deposition of sediment in the bed (aggradation), or excessive bed scour (degradation). It should be noted that by this definition of stability, a channel is free to migrate laterally by eroding one of its banks and accreting the one opposite at a similar rate.

In summary, a stable river, from a geomorphic perspective, is one that has adjusted its width, depth, and slope such that there is no significant aggradation or degradation of the stream bed or significant planform changes (meandering to braided, etc.). By this definition, a stable river is not in a static condition but rather is in a state of dynamic equilibrium where it is free to adjust laterally through bank erosion and bar building (Watson, et al, 1999).

Geomorphic function is achieved when a channel is in equilibrium, while undergoing processes such as lateral migration, sediment reworking, and occasional overbank flooding that effectively create and sustain quality aquatic and terrestrial habitat elements, such as bars, pool/riffles, step/pools, and healthy, regenerating riparian corridors. Impairments to geomorphic function reflect a significant loss of the functional potential of the river channel segment. These impairments are typically described in general, qualitative, terms and any rehabilitation of impaired channel segments requires a more thorough site-specific assessment of impacts, impairments, and feasible remedies.

4.2.6.2 Rosgen Classification System

The literature presents descriptions of numerous systems for classifying and evaluating stream systems. Of these, perhaps the most widely used today is the Rosgen classification system (Rosgen, 1996). This system, based upon the stream's existing channel morphology, was utilized in this study. Parameters such as the sinuosity, slope, width/depth ratio, and size of channel materials are evaluated and used to classify the stream into one of the various "types" included in the system.

There are four levels of classification in the Rosgen system, each being more detailed than the previous level. Figure 4.2-22 displays the hierarchy of the assessment levels and the general nature of effort associated with each. Much of the Level I geomorphic characterization is qualitative and utilizes aerial photography and topographic maps. Streams are divided into eight (8) broad types on the basis of their channel and floodplain geometry. Rosgen's classification system stream types can be thought of in their relative location within the watershed from the headwaters through the lowlands. The major stream types reflect their location in the watershed. For example, "A" type streams are located in headwaters; "C" & "E" stream types are located in meandering lowlands, etc. The Level II effort provides a more detailed description of the stream using measurements at selected locations. Stream types are further subdivided into 94 subtypes based upon degree of entrenchment, width-to-depth ratio, water surface slope, streambed materials, and sinuosity (Figure 4.2-23). Consequently, the Level II characterization is more quantitative than the Level I effort. Levels III and IV require more extensive data collection and quantification of stream characteristics. The Bitter Creek / East Flaming Gorge Watershed Study included a Level I evaluation of the mainstem streams and their principal tributaries.

Level I Methods

The purpose of the Level I geomorphic classification is to provide an inventory of the study area's overall stream morphology, character, and condition. It is intended to serve as an initial assessment for use in more detailed assessments and to determine the location and approximate percentage of stream types within the basin. The results of the Level I classification can be integrated directly into the project GIS providing a graphical "snapshot" of the basin. Based upon this initial effort, potential stream reference reaches can be identified for further study in Level II classification efforts. The end product of the Level I classification is the determination of the major stream types, A through G.

Figure 4.2-24 shows the major stream types within the Rosgen Classification System along with their relative locations within a typical watershed. Brief descriptions of the various stream types encountered in the watershed are presented in the following paragraphs.

A-Type Channels are relatively steep channels that form in headwater areas as well as within bedrock canyons. These channels are entrenched and confined by steep valley margins such that little to no floodplain area borders them. As the boundaries of A-type channels are typically highly resistant to erosion, these stream types are generally quite resilient with respect to human impacts. The most common cause of geomorphic change within A-type channels is due to large-scale sediment transport events, (landslides, debris flows, debris jam failure) that may result in blockage or deflection of channel flow.

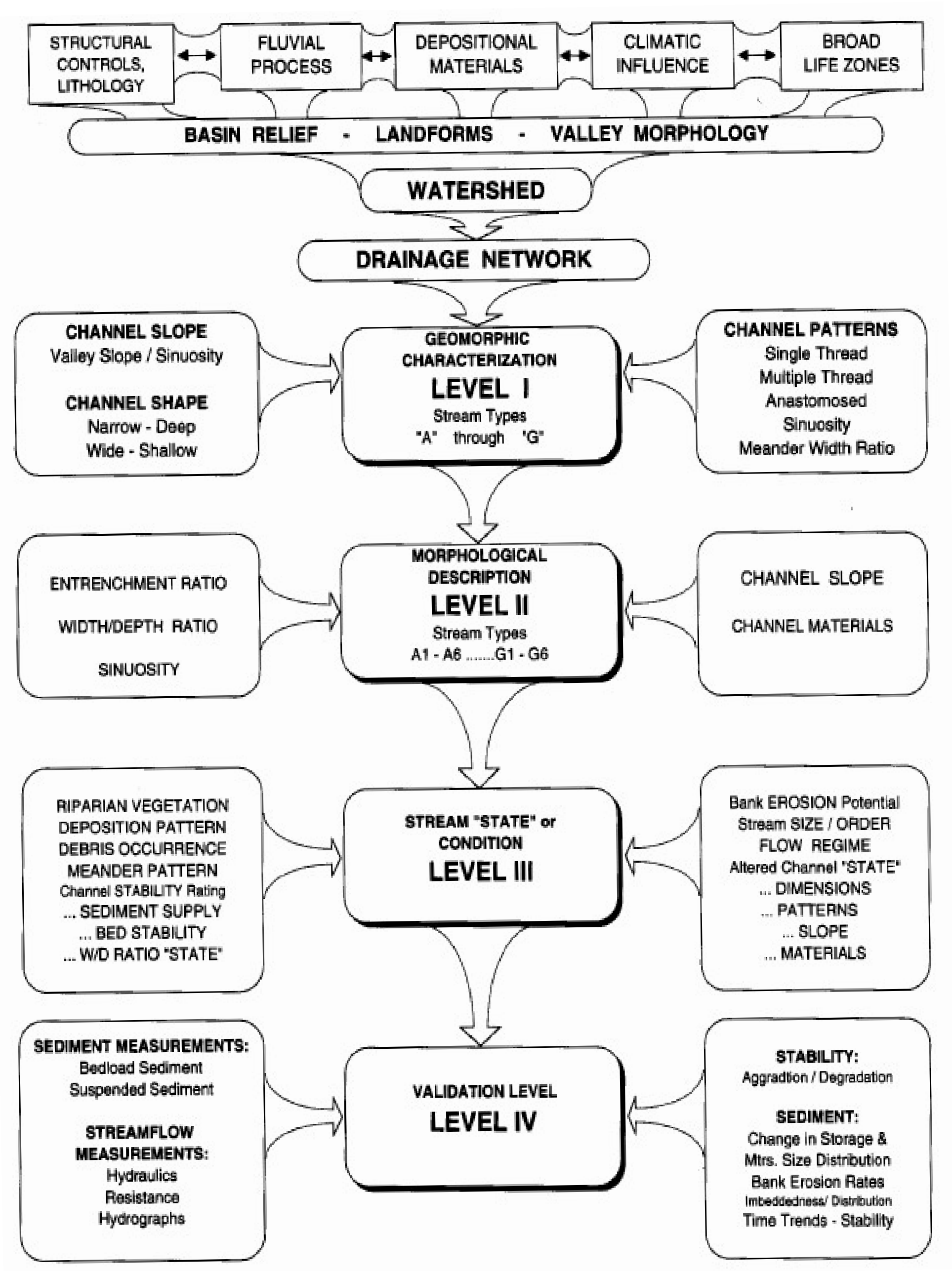


Figure 4.2-22 Hierarchy of the Rosgen Stream Classification System.

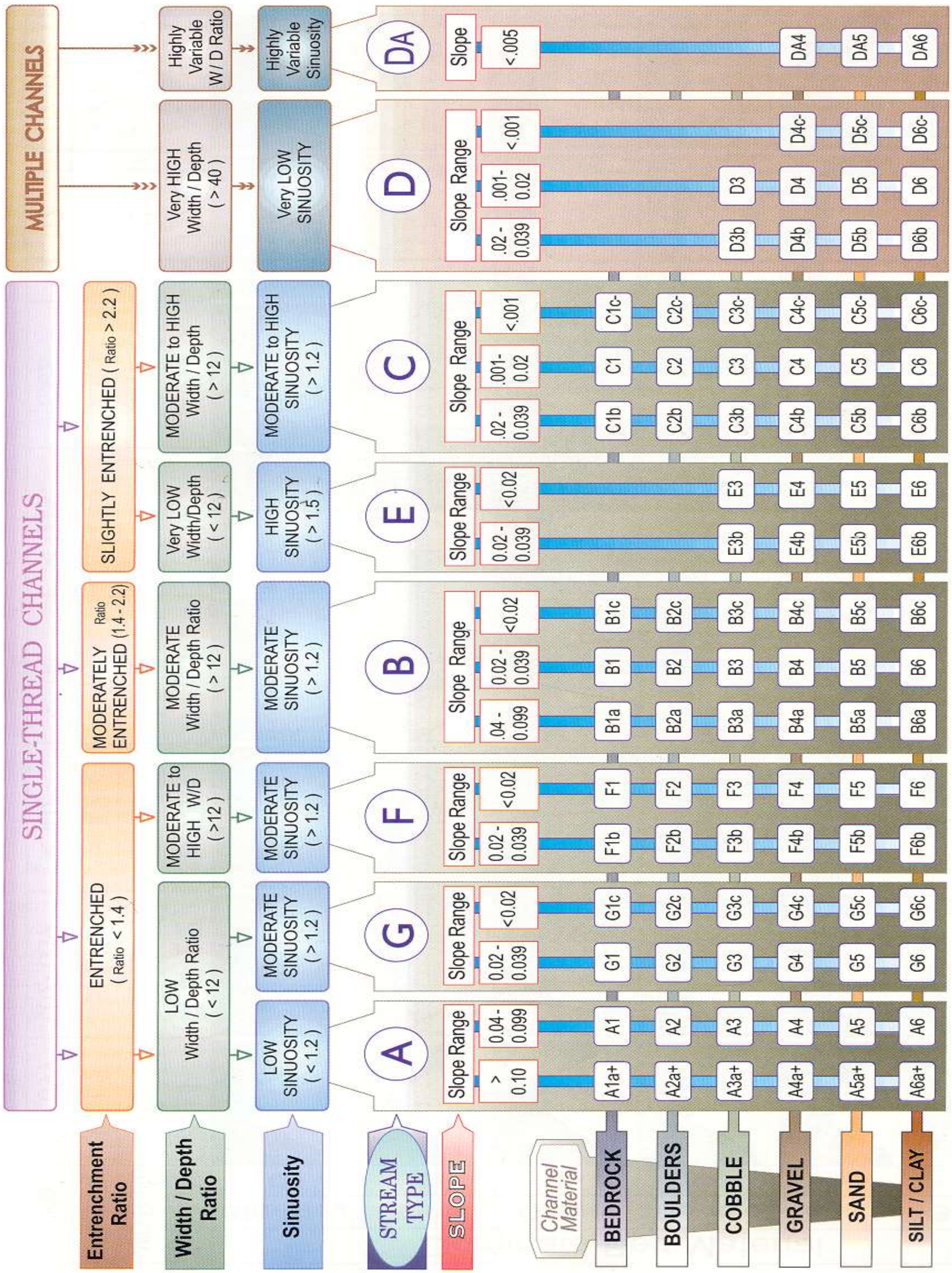


Figure 4.2-23 Rosgen Classification Matrix (Rosgen, 1996).

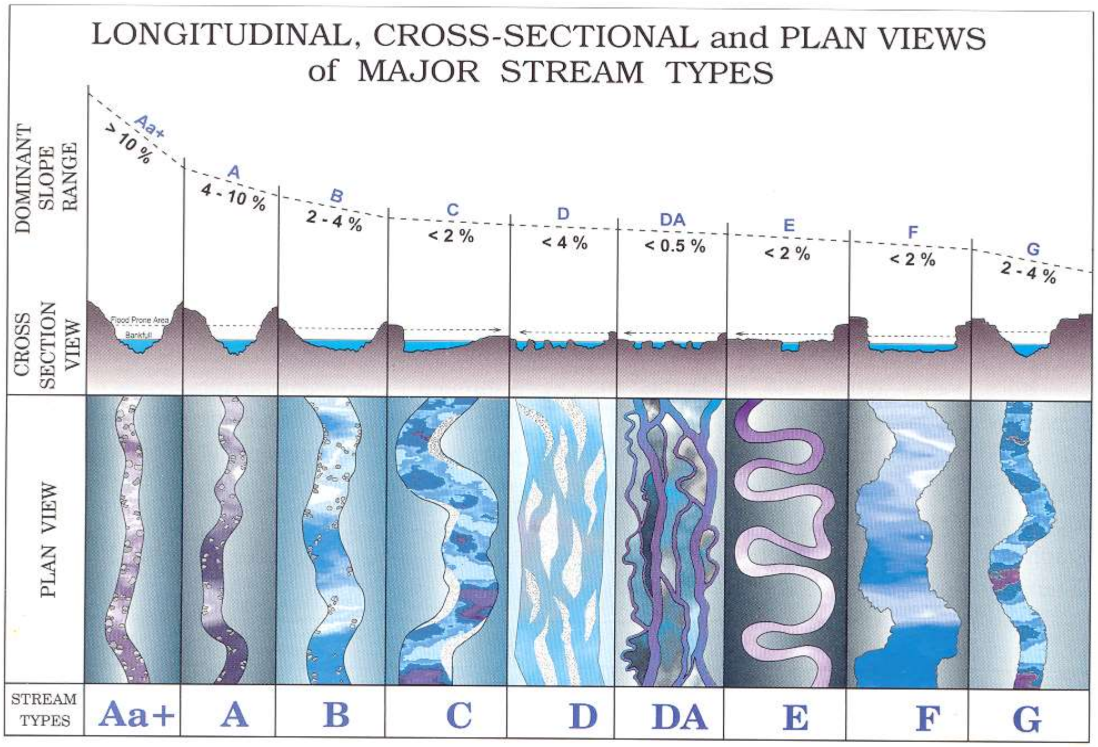


Figure 4.2-24 Major Stream Types within the Rosgen Classification System (Rosgen, 1996).

B-Type Channels tend to form downstream of headwater channels, in areas of moderate slope where the watershed transitions from headwater environments to valley bottoms (Figure 4.2-25). B-Type channels are characterized by moderate slopes, moderate entrenchment, and stable channel boundaries. Due to the relatively steep channel slopes and stable channel boundaries, B-channels are moderately resistant to human impacts, although, their reduced slopes relative to headwater areas can make them prone to sediment deposition and subsequent adjustment following a large sediment transport event such as an upstream landslide, debris flow, or flood.

Figure 4.2-25 Example Type B Channel: Segment of Black Butte Creek, WY.

C-Type Channels are typically characterized by relatively low slopes, meandering planforms (i.e., the shape one would see if viewing from above, as on a map or aerial photo), and pool/riffle sequences (Figure 4.2-26). The channels tend to occur in broad alluvial valleys, and they are typically associated with broad floodplain areas; they are not entrenched and still have 'access' to their floodplains. C channels tend to be relatively sinuous, as they follow a meandering course within a single channel thread. In stream systems in which the boundaries of C-type channels are composed of alluvial sediments, channels tend to be dynamic in nature, and susceptible to rapid adjustment in response to disturbance.

Figure 4.2-26 Example Type C Channel: Green River near Green River, WY.

F-Type Channels typically have relatively low slopes (<2%), similar to C and E channel types. The primary difference between C/E channels and F channels is with respect to entrenchment. F channels are entrenched, which means that the floodplain is quite narrow relative to the channel width. The entrenchment of alluvial F-type channels typically is an indicator of a historic downcutting event. F-type channels may form in resistant boundary materials (e.g., U-shaped bedrock canyons) and relatively erodible alluvial materials (e.g., arroyos). When the boundary materials are erodible, the steep valley walls are prone to instability, and channel widening commonly occurs within the entrenched channel cross section (Figure 4.2-27).

Figure 4.2-27 Example Type F Channel: Killpecker Creek near Rock Springs, WY.

G-Type Channels are narrow, steep entrenched gullies. G-Type channels typically have high bank erosion rates and a high sediment supply. Channel degradation and side slope rejuvenation processes are typical.

The Level I classification effort was conducted primarily using existing information incorporated into the project GIS. Several analytical tools were developed and integrated into the GIS which allowed the evaluation of various geomorphic parameters (sinuosity, slope, and stream station determination). The data collated and incorporated in the Project GIS include digital aerial photography, USGS topographic maps, Landsat color infrared imagery, a digital elevation model (DEM), and digitized hydrography information. The most current data available were used in the geomorphic evaluation. Because the DEM was limited to a 10-meter grid, elevations and subsequent slope calculations are approximate. Stream alignments were digitized using 2011 aerial photography and represent the best available estimate of current channel alignment.

The streams evaluated were divided into reaches based upon definable geographic factors (e.g. confluences with tributaries, major road crossings, etc.) or where their geomorphic character displayed changes. Each reach was evaluated in light of the characteristics required at the Level I classification. These parameters, as indicated in Figure 4.2-23, were channel slope, channel shape, channel patterns, and valley morphology. Note that in the Level I classification, these parameters are not typically quantified and the relative magnitude (i.e., “moderate”, “slightly”, etc.) is utilized to classify the stream.

Level I Classification

Results of the Level I classification effort are presented in Figure 4.2-28. This figure displays a map of the study area depicting the various stream types as well as the reach designations used in the classification effort.

The headwater reaches of most major streams within the basin are located in steeper terrain and are typically classified as A type channels transitioning to B downstream in a manner typical of the Rosgen classification scheme. As the headwater streams enter the lower valley reaches, their character changes. The widening valley floor reduces lateral confinement, sediment size tends to reduce, and boundary conditions typically weaken in conjunction with a change from narrow colluvial valleys to broad riparian alluvial valleys. The common stable stream type within these settings is the C channel type. However, within the Bitter Creek watershed, most channels have become entrenched to varying degree.

Some of the first-order tributaries in the lower portions of the basin can be classified as G-Type channels, or gullies. These channels are highly erosive, generate high sediment volumes, and can result in the loss of productive lands and destabilize upland conditions. These channels could be forming in response to one or more of numerous stimuli including but not necessarily limited to: channel realignment (straightening), road and culvert construction, range management practices, or base-level lowering associated with main channel incision.

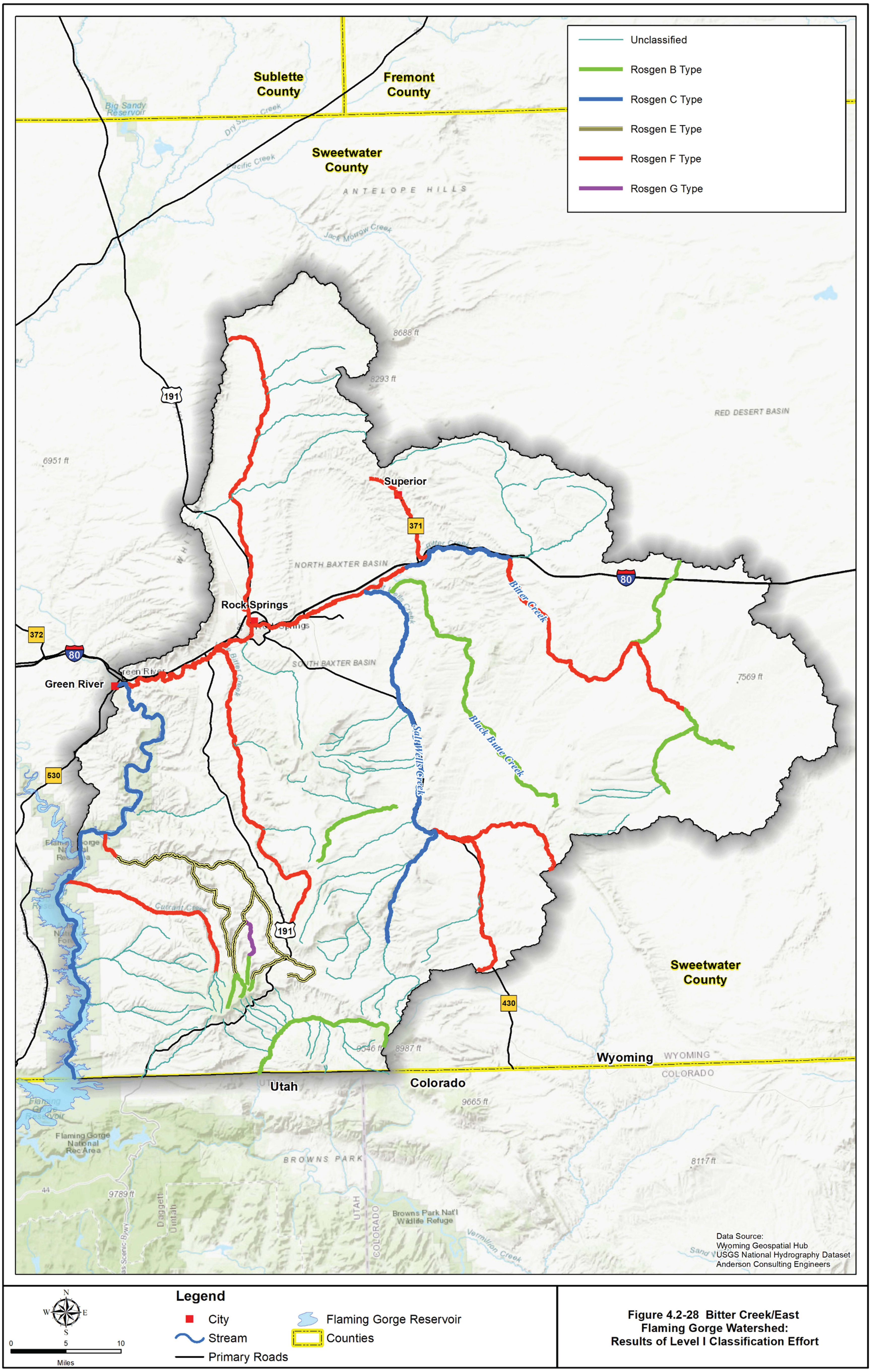


Figure 4.2-28 Bitter Creek/East Flaming Gorge Watershed: Results of Level I Classification Effort

4.2.6.3 Impairments

A large number of the streams evaluated and confirmed by field observation, appeared to be entrenched to some degree with some severely entrenched. Erosion appears to be occurring extensively in many stream reaches including active down cutting (degradation) accompanied by significant bank erosion. To some extent, the channel degradation and associated bank erosion appears systemic; it is pervasive throughout the Bitter Creek watershed. Impacts of this level of degradation are numerous and can include:

- Sediment transported to downstream reaches (ex. Green River)
- Loss of aquatic habitat
- Lowering of groundwater tables
- Degradation of water quality
- Loss or damage to infrastructure
- Base level lowering causing tributaries to degrade

Figure 4.2-29 Active Channel Degradation: Bitter Creek.

For example, Figure 4.2-29 displays a photo of Bitter Creek where stream banks are vertical, actively eroding and exceed 25 to 30 feet in height.
Causes are complex and cumulative; several factors likely come to play in this area and include:

- Changes in climate,
- Changes in base level, and
- Changes in land use

Historic changes in climate have been documented in research conducted in the Colorado River basin. Researchers evaluated tree rings and determined minimal winter moisture occurred between 1870 through 1905 and significant winter moisture occurred between 1906 and 1930 (Lowham, et al, 1982). Changes in the timing and distribution of runoff (i.e., from summer rainstorms to winter snowmelt) could upset the dynamic equilibrium discussed above initiating erosion.

Changes in base level, or the elevation at which a stream joins another water body, can result in significant and rapid changes to the stability of a stream channel. Head cuts or over-steepened reaches (nick zones) formed when base level of a stream is lowered tend to migrate upstream. As this occurs, not only is the initially affected stream impacted, but its tributaries experience the same phenomenon and can subsequently experience their own incision and so forth.

Base level of Bitter Creek appears to have been affected by historic changes to its alignment. Channelization conducted in conjunction with construction of the railroad and within the City of Rock Springs has resulted in replacement of a once sinuous channel alignment with straight reaches with higher stream energy. Essentially, the ends of a channelized reach are the same elevation but the channelized length is shorter. Consequently, the channelized slope is greater, stream energy increases, and the natural dynamic equilibrium is skewed and erosion occurs. Figures 4.2-30 and 4.2-31 display two examples of locations where segments of Bitter Creek have been channelized.

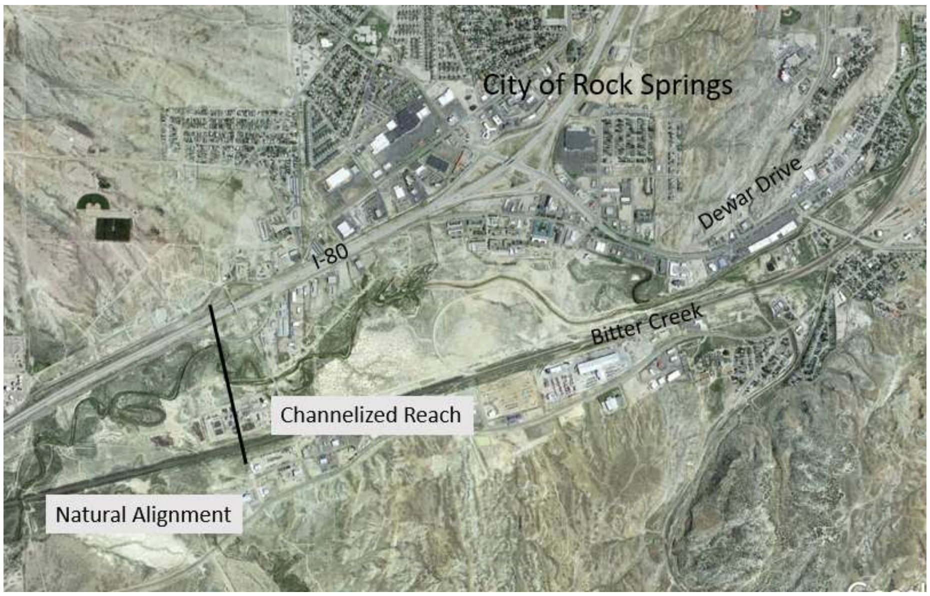


Figure 4.2-30 Stream Channelization: Bitter Creek at City of Rock Springs.

Figure 4.2-31 Stream Channelization: Bitter Creek at UP Railroad.

Killpecker Creek has also been extensively altered by construction activities from its confluence with Bitter Creek to an area approximately 4.5 miles upstream. Figure 4.2-32 displays a photo taken of an unnamed tributary to Killpecker Creek within this reach displaying significant bank erosion and severe incision.

Figure 4.2-32 Channel Incision: Killpecker Creek Tributary.

As an example of how incision of a stream can promulgate incision of its tributaries is found at the Union Pacific railroad crossing (Figure 4.2-33). At this location, incision of Bitter Creek has caused subsequent

Figure 4.2-33 Headcut Location: Tributary to Bitter Creek.

downcutting / incision of an unnamed tributary. The resulting headcut has migrated upstream to the railroad where UP has attempted to stabilize it with rock cobble (Figure 4.2-34). It appears that the cobble may have slowed its progression but streamflow can flank the rock during large events threatening its integrity. Given the value of the railroad's infrastructure, further stabilization would seem prudent.

At another location on Bitter Creek, the Pierotto Ditch diversion structure has played a vital role in maintaining the integrity of the channel upstream. The structure is in the process of being reconstructed by the SWCCD and partners in an attempt to maintain its integrity and thereby allow it to continue to function as a grade control structure. Downstream of the structure, Bitter Creek is deeply entrenched and has vertical banks in excess of 20-ft. At the structure, incision has been arrested and upstream conditions protected from upstream migration of the headcut. Figure 4.2-35 displays an aerial photo of the structure taken before initiation of the reconstruction project. The existing project has suffered several setbacks resulting from untimely flood events. However, at this time, it appears to be on track for successful completion in the Fall of 2018.

Elsewhere on Bitter Creek is a feature known as Big Pond which is a sediment-filled reservoir which has breached and now contributes sediment to Bitter Creek in a reach designated as "critical habitat" by Wyoming Game and Fish Department. Figure 4.2-36 displays an overview of the site and the extensive erosion which is occurring. It is our understanding that the pond was originally built in conjunction with the railroad as a source of surface water for steam engines. As indicated on the figure, based upon evaluation of historic aerial photography, progression of the headcut in the reservoir sediments has been rapid. It is estimated that between 2014 and 2017 over 35,000 tons of sediment were contributed to Bitter Creek.

Figure 4.2-34 Headcut at Union Pacific Railroad Crossing.

Figure 4.2-35 Pierotto Ditch Diversion Structure.

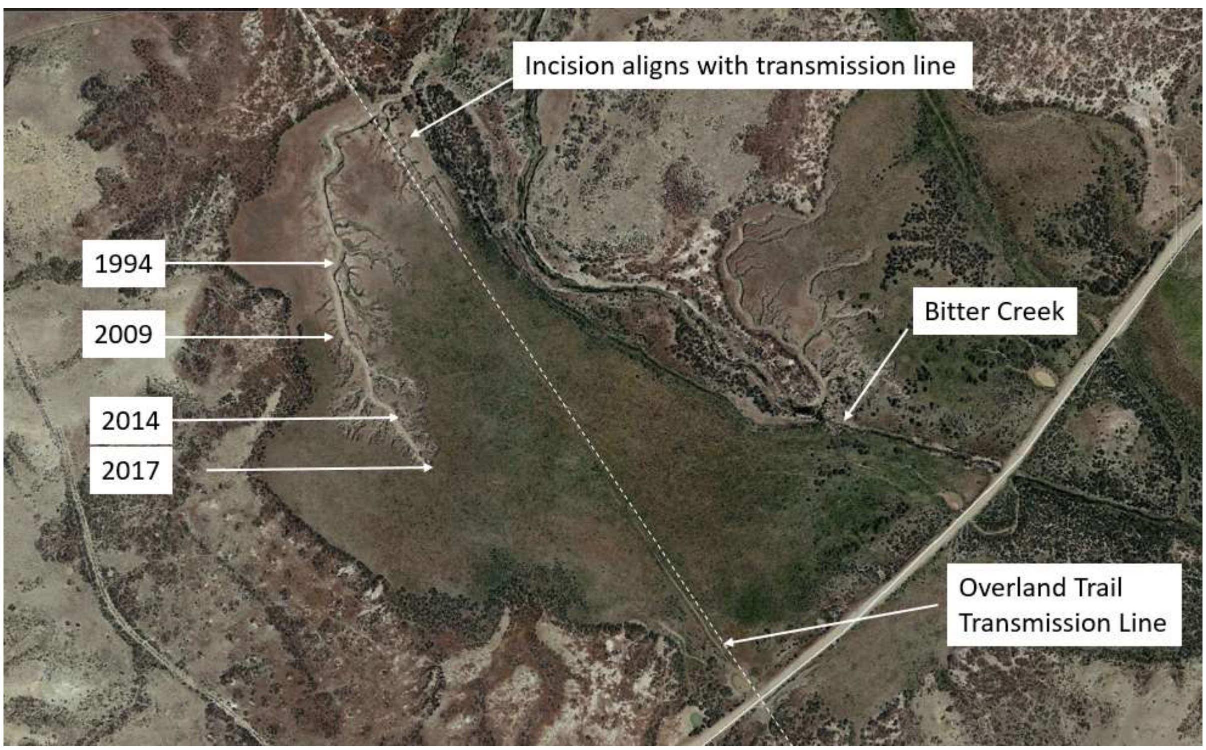


Figure 4.2-36 Big Pond Site on Bitter Creek.

Selected streams in the East Flaming Gorge area were evaluated by Wyoming Game and Fish Department in 2002 in conjunction with the Sage Creek Watershed WHAM Inventory (Green River Region Aquatic Habitat Management, 2002). Streams evaluated included:

Figure 4.2-37 displays a photo of the Big Pond headcuts. Note the height of the vertical bank is approximately 6 to 8 feet high. Failure of the feature may be associated with construction of a buried gas line through the area. Note in 4.2-37 how the tributary headcut feature aligns with the location of the buried pipeline.

Figure 4.2-37 Headcuts in Big Pond.

- Spring Creek,
- Trout Creek,
- Gooseberry Creek,
- Camp Creek, and
- Sage Creek

The report contains detailed discussion of the stream segments evaluated. Based upon a review of this document and field observations, it appears that many of the stream segments have become entrenched; some very deeply. Active headcuts exist and WGF in cooperation with Trout Unlimited (TU) have stabilized several problematic sites. However, at some locations, it appears that the streams have healed naturally from historic entrenchment and stable channels have formed with the entrenched canyons. Figure 4.2-38 displays a portion of Sage Creek where the channel appears to be forming a stable, meandering channel with a deeply entrenched floodplain.

Figure 4.2-38 Stable Channel Formed within Entrenched Stream Segment (Sage Creek).

Based upon this basin-wide overall review, study area history and existing or on-going studies, Impairments to stream channels within the study area appear to fall into the following broad and interrelated categories:

- Channel Stability and Bank Erosion: Pervasive instability throughout the watershed.
- Imbalance of Sediment Supply: Imbalance between stream capacity and sediment supply can lead to channel degradation or aggradation.
- Riparian Vegetation Degradation: Impaired riparian condition and habitat.
- Riparian Degradation: General bank erosion and physical disturbance of stream banks.
- Lowering of Local Groundwater Conditions: Magnitude of channel incision can result in lowering of local groundwater tables affecting vegetation vigor and species.

Management Implications:

The objective of a Rosgen classification is to provide insight into the inherent resiliency of the stream and where there may be stability issues. This insight can then be included in future planning efforts or consideration with project-specific designs.

For instance, type A and B channels are typically headwater streams and are inherently resilient to disturbance. Bedrock and valley-type typically contain the channels to a narrow corridor and migration is minimal and they're generally geomorphically stable. Management implications of these types of channels could be how to stabilize culverts, irrigation diversions, etc.

Type C channels (the Green River) are non-entrenched and have "access" to their floodplains. These channels migrate, we see oxbow features, bank erosion is a natural feature (within limits), etc. Management implications could include irrigation diversion design, bank stabilization, wetland creation / enhancement (i.e. oxbow wetlands), etc.

From a watershed planning perspective, knowing where the various types of channels lie and their extent all adds to the understanding of the watershed health and function. With an abundance of F-type channels (entrenched), systemic issues may be indicated. G channels (gullies) indicate other watershed health issues: over grazing, energy development, roads, etc. These all add to the understanding of sediment loading to the mainstems which affects habitat, receiving stream stability, etc.

Within the project study area, there do not appear to be systemic geomorphic issues associated with channel degradation. In general, streams appear to be relatively stable from a geomorphic standpoint and bank erosion and incision were evident, but not prevalent. There are areas where channel widening is evidenced by active bank erosion and high width depth ratios. For instance, Bitter Creek in the vicinity of Rock Springs has been modified by anthropogenic activities and appears to be in the process of recovering, particularly in consideration of recent channel improvement projects.

Tributaries to the system mainstems were observed to be degrading and would be classified as Type-G channels under the Rosgen system. However, again it is important to keep in mind that these channels do not appear to be associated with widespread systemic watershed rejuvenation as would be expected if the mainstems were degraded. In other words, there was not sufficient evidence of channel degradation in the tributaries to indicate instabilities associated with base-level lowering of the mainstems. The Type-G channels observed through the course of this project were likely caused by local land use practice.

4.2.6.4 Proper Functioning Condition

The BLM utilizes a procedure for assessing the health of a stream called Proper Functioning Condition assessment or PFC. PFC is described by the BLM as:

> *"A qualitative method for assessing the condition of riparian-wetland areas. The term PFC is used to describe both the assessment process, and a defined, on the-ground condition of a riparian-wetland area. The PFC assessment refers to a consistent approach for considering hydrology, vegetation, and erosion/deposition (soils) attributes and processes to assess the*

condition of riparian-wetland areas. A checklist is used for the PFC assessment, which synthesizes information that is foundational to determining the overall health of a riparian-wetland system" (BLM, 1998).

The PFC assessment terminates with the definition of one of three classes for a given stream segment as described below.

Proper Functioning Condition: A stream is said to be functioning properly when adequate vegetation, landform, or debris is present to:

- dissipate energies associated with wind action, wave action, and overland flow from adjacent sites, thereby reducing erosion and improving water quality;
- filter sediment and aid floodplain development;
- improve flood water retention and groundwater recharge;
- develop root masses that stabilize islands and shoreline features against cutting action;
- restrict water percolation;
- develop diverse ponding characteristics to provide the habitat and water depth, duration, and temperature necessary for fish production, water bird breeding, and other uses; and
- support greater biodiversity.

Functional At Risk: Riparian/wetland areas are classified as *functioning-at-risk* when they are in functioning condition but an existing soil, water, or vegetation attribute makes them susceptible to degradation. These areas are further distinguished based on whether or not they demonstrate an *upward*, *not apparent*, or *downward* trend.

Nonfunctioning: Riparian/wetland areas are classified as *nonfunctioning* when they clearly are not providing adequate riparian vegetation, physical structure, or large woody debris to dissipate stream energy associated with high flows.

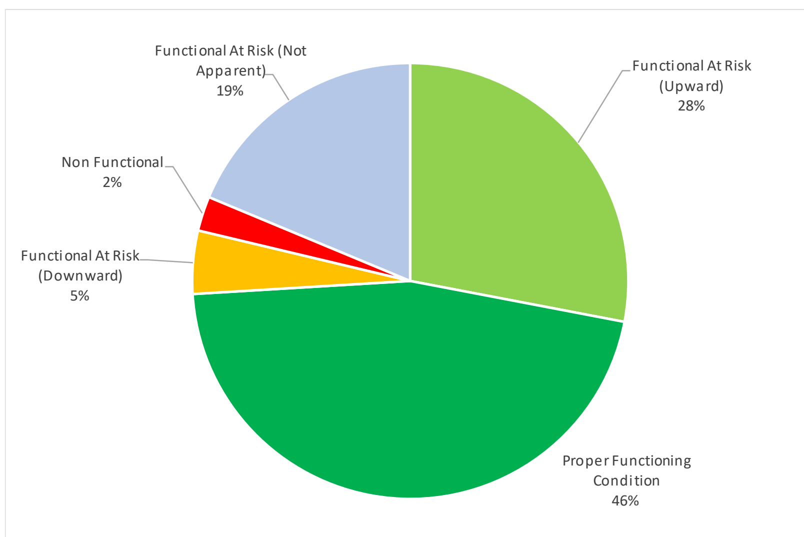


Figure 4.2-40 Summary of BLM PFC Assessments Completed in Project Study Area.

Results of PFC assessments completed on federal lands by BLM staff were obtained from the Rock Springs Field Office, BLM (Figure 4.2-39). Figure 4.2-40 displays a summary of the data. The stream segments evaluated totaled over 271 miles in length

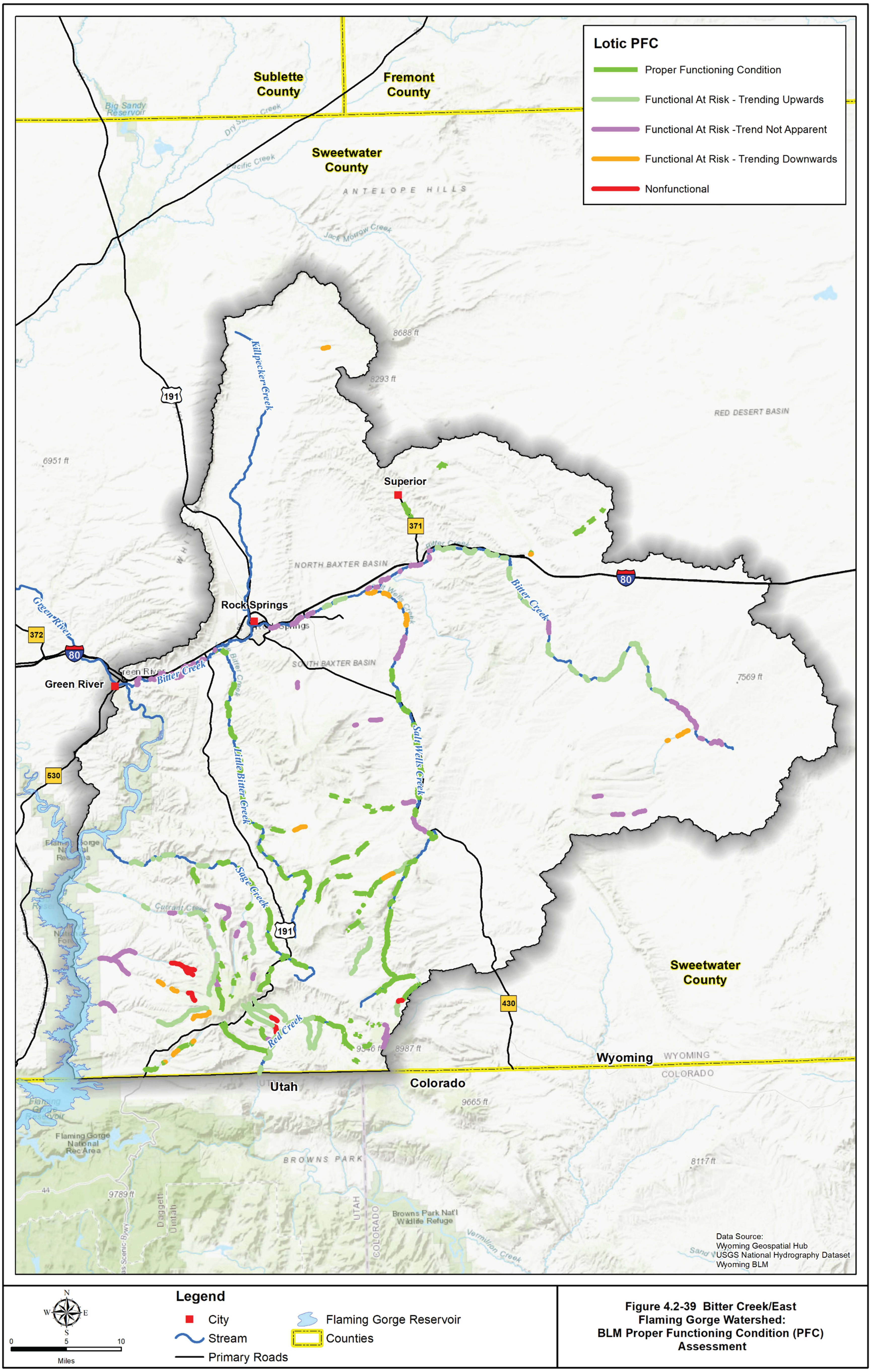


Figure 4.2-39 Bitter Creek/East Flaming Gorge Watershed: BLM Proper Functioning Condition (PFC) Assessment

with an average segment of approximately 1.5 miles. Of the segments evaluated, approximately 46 percent were determined to be Proper Functioning Condition and another 28 percent were determined to be Functional At Risk but with an Upward trend. Only about 2 percent were determined to be Non-Functional and another 5 percent were Functional At Risk with a Downward trend.

4.3 Biological Systems

4.3.1 Land Cover

4.3.1.1 Overview

Land cover within the watershed was evaluated using several databases; each with its own strengths and emphasis. The databases used to characterize land cover, vegetation, riparian areas and wetlands included:

National Land Cover Database (NLCD): We used the NLCD data to provide a general description of the watershed in terms of its ground cover (vegetation classification, urban, open water, etc.) The database is useful for large scale evaluations. The NLCD classifies cover into 16 categories.

The Landscape Fire and Resource Management Planning Tools Project, or LANDFIRE: This raster-based database was created at a 30-meter resolution. We used it to quantify and map riparian areas because of its resolution. This database is useful for evaluation of smaller areas but does not lend itself to map presentations. The LANDFIRE database provides more detailed classifications with 844 categories.
Wyoming GAP Analysis (GAP): The GAP data were used to characterize vegetation coverage because it has a greater number of vegetation classifications than the NLCD dataset and is better suited for map presentation and graphics than the LANDFIRE data.

National Wetlands Inventory (NWI): We used the NWI data, created by the US Fish and Wildlife Service, to quantify and map wetlands communities. The NWI data is a commonly used database, however, ground truthing is recommended.

It is important to keep in mind when reviewing the results of these analyses, that results can vary depending upon the database referenced. Different methodologies were used in their creation, accuracy and resolution vary, and they may use different vegetation and land use classes.

4.3.1.2 Vegetation and Plant Communities

The NLCD is distributed by the Multi-Resolution Land Characteristics Consortium (MRLC) and serves as the definitive Landsat-based, 30-meter resolution, land cover database for the Nation. NLCD provides spatial reference and descriptive data for characteristics of the land surface such as thematic class (for example, urban, agriculture, and forest), percent impervious surface, and percent tree canopy cover. NLCD supports a wide variety of Federal, State, local, and nongovernmental applications that seek to assess ecosystem status and health, understand the spatial patterns of biodiversity, predict effects of climate change, and develop land management policy. NLCD products are created by the Multi Resolution Land Characteristics (MRLC) Consortium, a partnership of Federal agencies led by the U.S. Geological Survey (Homer, C.H. et al., 2012). Table 4.3-1 presents the results of National Land Cover Database analysis for the study area.

In order to draw a clearer picture of the land cover within the watershed the vegetative cover within the study area was also evaluated using data obtained through the LANDFIRE project (*www.landfire.gov*). LANDFIRE (Landscape Fire and Resource Management Planning Tools Project) is an interagency vegetation, fire, and fuel characteristics mapping project. It is a shared project between the Department of Interior (DOI) and Forest Service Wildland Fire Management programs. The primary purpose of the LANDFIRE project is to collect the data necessary to develop wildland fire models. The data are generated using remote sensing techniques with on-the-ground truthing. Data products accessed for this project included 30-meter spatial resolution raster data sets describing vegetation type and cover. LANDFIRE vegetation map units are derived from NatureServe's Ecological Systems classification (Comer et al., 2003). While the geographic resolution (30-meter) of the LANDFIRE data is the same as the NLCD data discussed previously, the classification system used by the LANDFIRE dataset is more highly evolved than the NLCD data. This allows for a finer classification of the vegetative cover within the study area.

The LANDFIRE data describes numerous attributes pertinent to this study, including:

- Environmental Site
- Potential Biophysical Settings
- Existing Vegetation Type
- Existing Vegetation Height
- Existing Vegetation Cover

The LANDFIRE "existing vegetation type" (EVT) data were analyzed and the distribution of vegetation classes at the HUC12 scale is summarized in Appendix 4D. The LANDFIRE existing vegetation data indicate a diverse collection of vegetation types totaling 68 different vegetation classes within the Bitter Creek/East Flaming Gorge watershed.

As is clearly indicated in the data and as would be expected, the major sagebrush community (Inter-Mountain Basins Big Sagebrush Shrubland) dominates coverage of the watershed totaling over 50% of the study area. While the fact that the majority of the study area is covered in sagebrush comes as no surprise, the table presents valuable information pertaining to the vegetation types present to a much lesser extent. The bar chart Figure 4.3-1 shows the relative distribution of physiognomy (form/morphological structure of vegetation) for each HUC12 subwatershed (12 digit hydrologic units). The physiognomy field from the LANDFIRE database is more general than the "existing vegetation type" field, and thus is more presentable in graphical form. It is clear that "shrubland" holds the highest percentage of area in all 72 subwatersheds, while "grassland" and "exotic herbaceous" cover a good portion of the remainder. In

Table 4.3-1 National Land Cover Database Analysis for the Bitter Creek/East Flaming Gorge Watershed.

Bitter Creek/East Flaming Gorge Watershed : National Land Cover Database (NLCD)			
Classification	Description	Acres	Percent of Watershed
Shrub/Scrub	Areas dominated by shrubs; less than 5 meters tall with shrub canopy typically greater than 20% of total vegetation. This class includes true shrubs, young trees in an early successional stage or trees stunted from environmental conditions	1,622,980	88.97%
Grassland/Herbaceous	Areas dominated by gramanoid or herbaceous vegetation, generally greater than 80% of total vegetation. These areas are not subject to intensive management such as tilling, but can be utilized for grazing	123,745	6.78%
Barren land (Rock/Sand/Clay)	Areas of bedrock, desert pavement, scarps, talus, slides, volcanic material, glacial debris, sand dunes, strip mines, gravel pits and other accumulations of earthen material. Generally, vegetation accounts for less than 15% of total cover.	22,549	1.24%
Evergreen Forest	Areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. More than 75% of the tree species maintain their leaves all year. Canopy is never without green foliage	13,525	0.74%
Developed, Open Space	Areas with a mixture of some constructed materials, but mostly vegetation in the form of lawn grasses. Impervious surfaces account for less than 20% of total cover.	11,743	0.64%
Open Water	Areas of open water, generally with less than 25% cover of vegetation or soil.	10,090	0.55%
Developed, Low Intensity	Areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20% to 49% percent of total cover. These areas most commonly include single-family housing units.	5,817	0.32%
Emergent Herbaceous Wetlands	Areas where perennial herbaceous vegetation accounts for greater than 80% of vegetative cover and the soil or substrate is periodically saturated with or covered with water.	4,056	0.22%
Developed, Medium Intensity	Areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 50% to 79% of the total cover. These areas most commonly include single-family housing units.	3,226	0.18%
Woody Wetlands	Areas where forest or shrubland vegetation accounts for greater than 20% of vegetative cover and the soil or substrate is periodically saturated with or covered with water.	3,063	0.17%
Deciduous Forest	Areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. More than 75% of the tree species shed foliage simultaneously in response to seasonal change.	1,543	0.08%
Pasture/Hay	Areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops, typically on a perennial cycle. Pasture/hay vegetation accounts for greater than 20% of total vegetation	616	0.03%
Developed High Intensity	Highly developed areas where people reside or work in high numbers. Examples include apartment complexes, row houses and commercial/industrial. Impervious surfaces account for 80% to 100% of the total cover.	587	0.03%
Mixed Forest	Areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. Neither deciduous nor evergreen species are greater than 75% of total tree cover.	393	0.02%
Cultivated Crops	Areas used for production of annual crops (corn,soybeans,vegetables,tobacco,cotton) Also perennial woody crops (orchards,vineyards) Crop vegetation accounts for greater than 20% of total vegetation. Class includes land being actively tilled	142	0.01%
	Total	1,824,089	100.00%

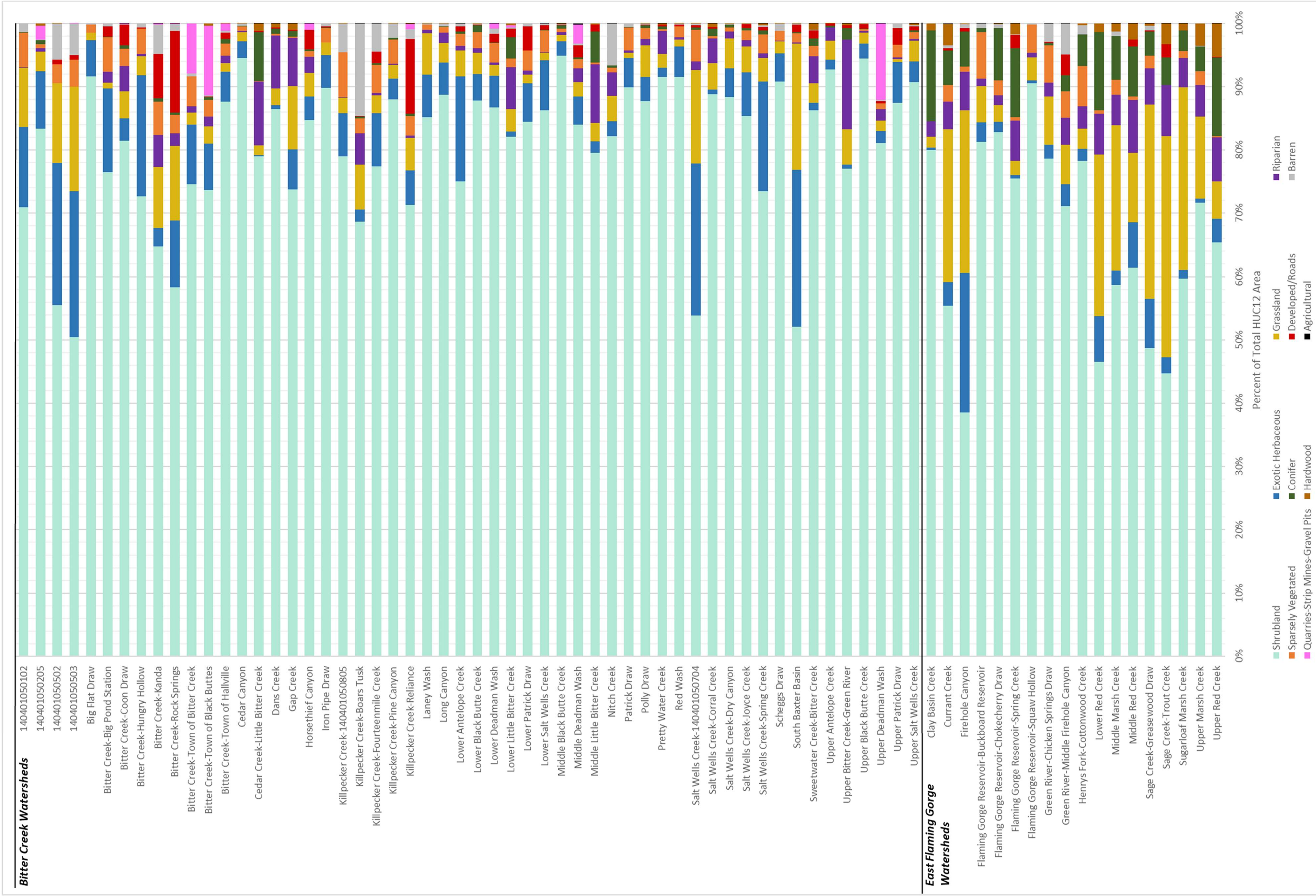


Figure 4.3-1 Bitter Creek/East Flaming Gorge Landfire Database Characterization.

general, the East Flaming Gorge watersheds have considerably greater abundance of grassland and non-shrubland types than the the Bitter Creek subwatershed.. East Flaming Gorge subwatersheds also have more coniferous land cover, more hardwood, more riparian areas, less development, and less quarries/strip mines/gravel pits than Bitter Creek.

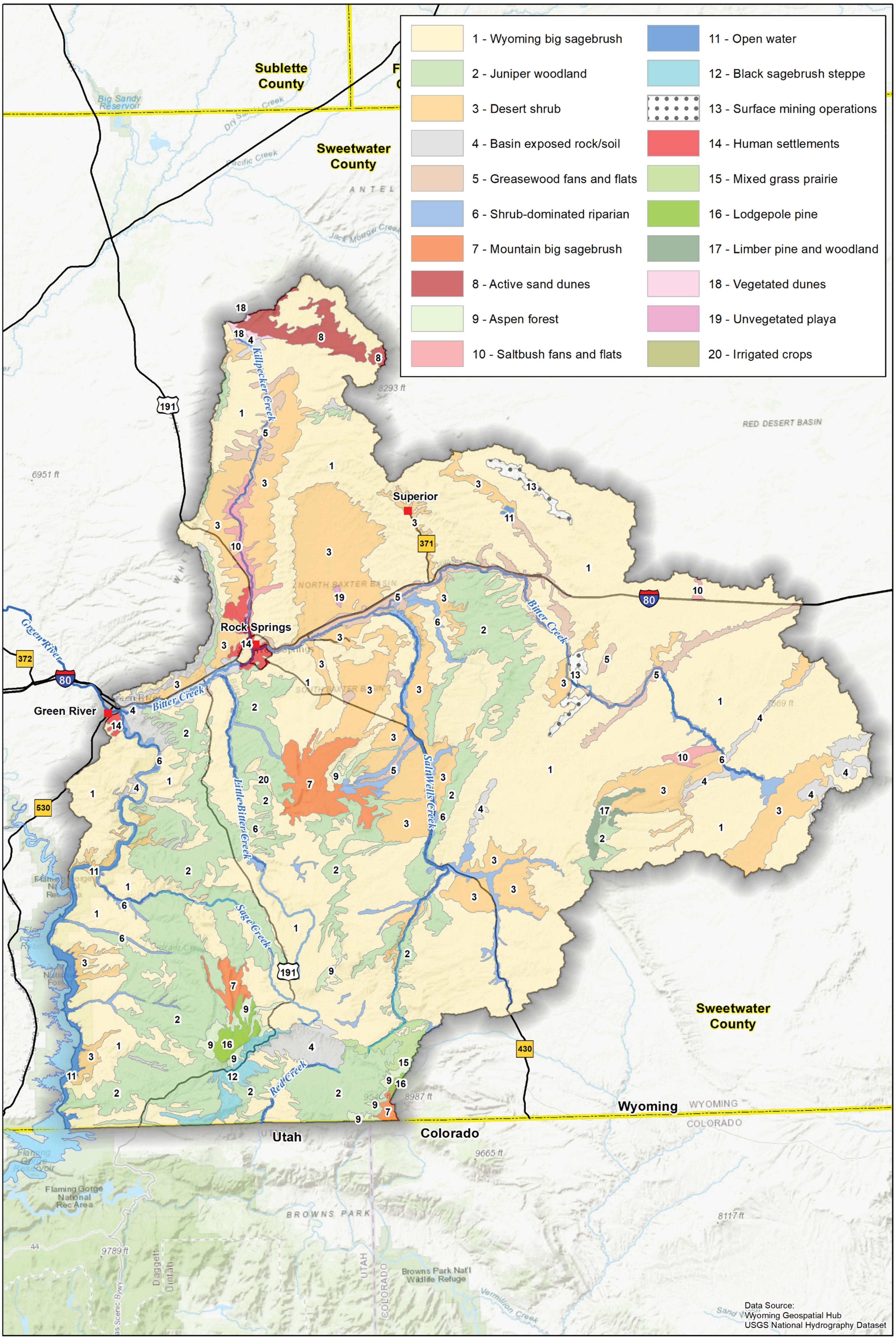
In order to aid in future analysis and enable the LANDFIRE data to be utilized as a land management/planning tool, the Existing Vegetation Type (EVT) data has been intersected with the HUC12 subwatersheds within the study area. The result of this analysis has been included in the project GIS and Digital Library delivered with this report. This data intersection will facilitate a more focused vegetation analysis based on the sub-watersheds within the study area. Analytical tools available within the project GIS facilitate use of the LANDFIRE data for regional watershed planning. For example, areas of the watershed identified as any of several juniper species communities can be identified and evaluated onsite to determine potential encroachment areas. Similar evaluations within the project GIS can be completed for wetland/riparian communities in order to determine areas where the SWCCD may concentrate future planning efforts.

While the LANDFIRE data provides valuable insight into watershed conditions, its display is difficult because of the fact the data are represented by a grid with 30-meter spacing. The LANDFIRE data set is included within the project GIS and available for use in subsequent projects and associated efforts.

The Wyoming GAP dataset was produced “with an intended application at the state or ecoregion level - geographic areas from several hundred thousand to millions of hectares in size. The data provide a coarse-filter approach to vegetation analyses, meaning that not every occurrence of habitat is mapped; only large, generalized distributions are mapped, based on the USGS 1: 100,000 mapping scale in both detail and precision. Therefore, this dataset can be used appropriately for coarse-scale (> 1: 100,000) applications, or to provide context for finer-level maps or applications” (Merrill et al., 1996).

For the purposes of this project however it is the most “display-friendly” vegetative dataset available and provides generalized distributions of the vegetative land cover located within the Bitter Creek/East Flaming Gorge. Figure 4.3-2 displays the Wyoming Gap Analysis results for the study area. Note that the classifications in the figure are listed in their order of abundance within the watershed. Of the 20 different GAP classifications present in the watershed, Wyoming Big Sagebrush dominates the landscape, making up 56% of the study area. Juniper Woodland and Desert Shrub are the next most abundant, making up 16% and 14% of the watershed, respectively.

Distinct plant communities within the study area are influenced by characteristics such as soil depth, texture, and salt content; climate variables, particularly temperature, total and seasonal distribution of precipitation, and wind; and topographic features, most importantly elevation, aspect, and slope. Plant communities respond to other environmental influences such as wildlife foraging, rodent burrowing, and ant hills. Plants themselves also influence soil chemistry and soil resistance to wind and water erosion. Vegetation management goals, objectives and actions related to the study area are available in the Rock Springs BLM Resource Management Plan (1997) located in the Digital Library delivered with this report.



Legend

- City
- Stream
- Primary Roads
- Flaming Gorge Reservoir
- Counties

0 5 10
Miles

Figure 4.3-2 Bitter Creek/East Flaming Gorge Watershed: Wyoming GAP Analysis

4.3.1.3 Riparian Areas

The LANDFIRE data includes a limited determination of riparian areas as well. The LANDFIRE data does not graphically represent well at the watershed scale, therefore the riparian vegetation communities in the dataset are presented in Table 4.3-2.

Table 4.3-2 LANDFIRE Riparian/Wetlands Classifications.

Bitter Creek/East Flaming Gorge Watershed : LANDFIRE Wetlands				
Existing Vegetation Type	Physiognomy (form/morphological structure of vegetation)	Acres	Percent of Watershed	Cumulative Percent
Western Great Plains Floodplain Forest and Woodland	Riparian	24046.2	1.3182%	1.32%
Rocky Mountain Montane Riparian Forest and Woodland	Riparian	12846.0	0.7042%	2.02%
Rocky Mountain Subalpine/Upper Montane Riparian Shrubland	Riparian	10925.8	0.5989%	2.62%
Western Great Plains Floodplain Herbaceous	Riparian	952.8	0.0522%	2.67%
Rocky Mountain Wetland-Herbaceous	Riparian	753.6	0.0413%	2.71%
Western Great Plains Depressional Wetland Systems	Riparian	592.6	0.0324%	2.75%
Western Great Plains Floodplain Shrubland	Riparian	104.7	0.0057%	2.75%
Rocky Mountain Subalpine/Upper Montane Riparian Forest and Woodland	Riparian	4.4	0.0002%	2.75%
Rocky Mountain Montane Riparian Shrubland	Riparian	2.7	0.0001%	2.75%

As this table clearly indicates, riparian areas in the study area are extremely limited in extent (2.75% of the watershed). Entities such as the Wyoming Landscape Conservation Initiative (WLCI) have completed riparian enhancement projects. Many of the WLCI projects target the removal of tamarix (tamarisk, salt cedar) which is an invasive species that consumes large amounts of water in riparian habitats. Tamarix is further discussed in Section 4.3.1.6. Recently completed WLCI projects include:

- Bitter Creek Restoration: Repair of a diversion structure which is preventing a head-cut from continuing downstream.
- Bitter Creek / Red Creek Tamarisk Control: Ongoing control of tamarisk (salt cedar) with both biological control agents (beetles) and chemical controls (herbicide)
- Flaming Gorge Invasives: Treatment of noxious weeds in the Flaming Gorge Reservoir such as pepperweed, black henbane, thistles, knapweeds, common reed, Russian olive and tamarisk.
- Little Mountain Riparian and Fish Habitat Project: Improvement of Colorado River cutthroat trout populations in Sage Creek, Currant Creek, and Red Creek drainages by increasing woody material available near streams, allowing better stream function, and improving fish passage.
- Red Creek Habitat Enhancement: Subalpine fir cuttings to reduce the expansion of conifers, protecting understory herbaceous species (e.g. aspen stands) and aquatic habitats.
- RSFO-Currant Creek Habitat Restoration (2012): Reduced unauthorized grazing of riparian vegetation by excluding unauthorized livestock from stream and adjacent meadows
- Sweetwater County Invasive Weed Control: Ongoing control of invasive species to minimize economic and ecological impacts

4.3.1.4 Wetlands

Existing mapping of wetlands within the study area consisted of the National Wetlands Inventory (NWI) created by the US Fish and Wildlife Service (USFWS). The NWI mapping was completed using aerial photographs within the GIS environment and digitizing by analysts, however due to the relatively limited extent of mapped wetlands in relation to the size of the watershed, the data does not lend itself to presentation at the watershed scale.

Based upon the NWI mapping, approximately 36,542 acres of wetlands exist within the watershed, which is only about 2% of the total study area. It is important to note that this estimate includes the surface area of Flaming Gorge Reservoir, which forms the western edge of the study area. If the reservoir is removed from the analysis, the total number of wetland acres is reduced to 25,253 acres, or about 1.4 percent of the watershed.

Figure 4.3-3 presents a pie chart showing the relative distribution of the general wetland types. Excluding Flaming Gorge Reservoir, the major contiguous wetlands in the watershed are reservoirs associated with the Jim Bridger Power Plant and the coal mines. Limited riverine wetlands are also found throughout the study area. Additionally, several ponds dot the landscape at the Killpecker Sand Dunes, located at the headwaters of Killpecker and Nitch Creek. Smaller other emergent wetlands exist in the highlands near Miller Mountain.

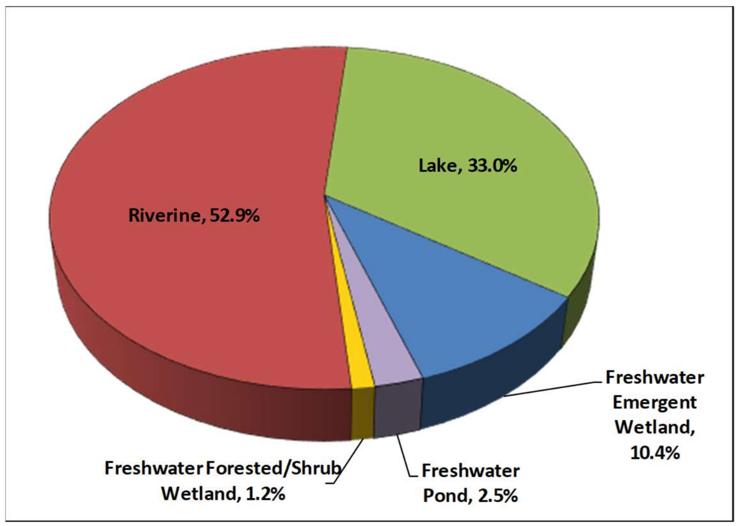


Figure 4.3-3 Percent of NWI Wetlands Types.

It is generally understood by users of the NWI mapping that the data are suitable for broad scale planning efforts such as this Level I investigation; however, before design and completion of any project potentially affecting wetlands, detailed onsite delineation should be conducted.

The Nature Conservancy utilized the existing NWI data as the basis for development of their 2010 Wetland Complex dataset in which they identified 221 wetland complexes in the State of Wyoming. The Green River Basin Wetland Complex (GRBWC) and six unnamed complexes exist within the study area (Figure 4.3-4).

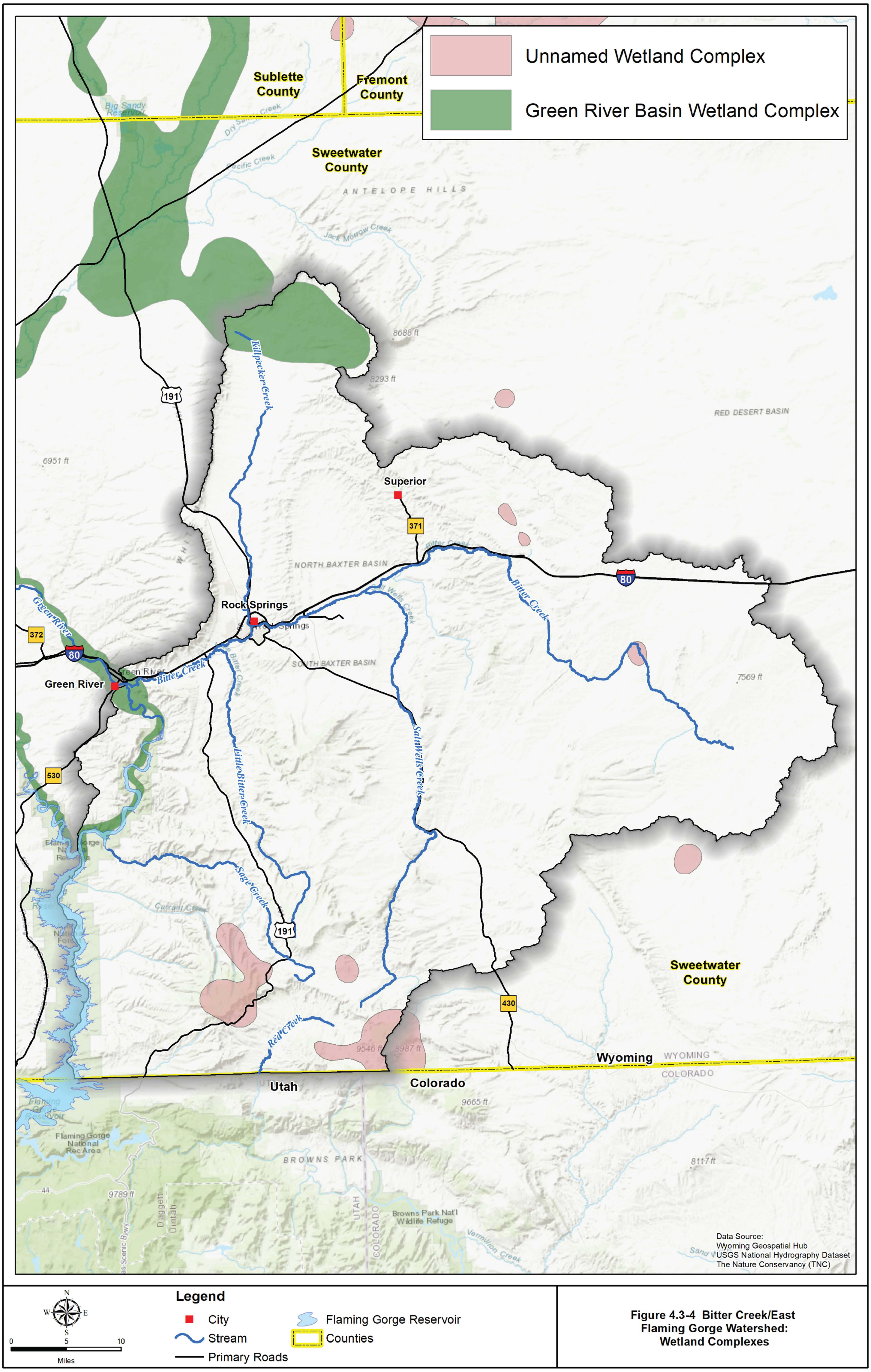


Figure 4.3-4 Bitter Creek/East Flaming Gorge Watershed: Wetland Complexes

The Wetland Complex dataset has been included in the project GIS and includes attributes such as:

- Number of Wyoming Species of Greatest Conservation Need (SGCN) in the complex.
- Number of rare species of Greatest Conservation Need (SGCN). See "Ecological Indicators" (Copeland et al., 2010) for a list of rare species.
- Biological diversity ranking of the complexes.
- Vulnerability of complexes to oil and gas development, residential development, and drought.

In 2014, the Wyoming Game and Fish department published a conservation plan with numerous objectives and conservation strategies within the GRBWC (WGF, 2014) such as:

- Strive for a no net loss of wetlands in the Green River Basin Wetland Complex with a focus on preserving remaining high-quality wetlands and riparian habitats.
- Work with local, state and federal government agencies to direct energy development outside of wetland and riparian areas, and to require restoration of sites that have been affected by past development
- Implement wetland and watershed "best management practices" to improve water quality and sustain/enhance wetland functions and values throughout the Green River Basin Wetland Complex.
- Secure additional funding to support ongoing and future wetlands conservation and enhancement through IMJV, WLCI, USFWS, NRCS, TNC, DU, WWNRT, WGFD, BLM, USFS and other partners.
- Provide additional public access opportunities for wetland-dependent recreation such as waterfowl hunting and wildlife viewing.

In 2015, the Nature Conservancy and the WGF published the results of an assessment of the Green River Basin Complex (WGF, 2015). A summary of the assessment was extracted and is presented below:

- Overall, results indicated that approximately 96% of wetlands in the basin are moderately to highly disturbed.
- Among wetland types, emergent marshes (generally higher elevation glacial pothole wetlands) were the least disturbed, followed by riparian woodland and shrublands. Wet meadows, mainly irrigated hayfields, were the most disturbed and hydrologically modified.
- The most widespread anthropogenic disturbances, or stressors, identified across all wetland types were agricultural practices associated with pastures and cattle grazing and hydrologic alterations.

4.3.1.5 Ecological Site Descriptions

The concept of "Ecological Sites" is described by the NRCS as follows:

> *"A distinctive kind of land with specific soil and physical characteristics that differs from other kinds of land in its ability to produce distinctive kinds and amounts of vegetation, and in its ability to respond similarly to management actions and natural disturbances."*

Ecological sites incorporate environmental factors such as climate, soils, landform, hydrology, vegetation, and natural disturbance regimes that together define the site and its relationships between these factors and how they influence plant community composition (Caudle et al., 2013). The characteristics differentiating ecological sites and their features are documented as an ecological site description (ESD), which includes the following:

- Data used to define the distinctive properties and characteristics of the sites;
- Biotic and abiotic characteristics that differentiate the site (i.e., climate, physiographic, soil characteristics, plant communities); and
- Ecological dynamics including how changes in climate, disturbance processes and management can affect the site.

An ESD includes interpretations about the land uses that a specific ecological site can support and management alternatives for achieving objectives. ESDs are valuable tools that can be used to help landowners and managers make decisions through evaluating the condition or health of a site. The ecological sites and associated descriptions were developed over many years of data collection and range site monitoring and are dependent on the location of a site within defined precipitation zones and existing soil characteristics.

ESD reports are available from the NRCS that describe the following for each Ecological Site:

- Site Characteristics: Identifies the site and describes the physiographic, climate, soil, and water features associated with the site.
- Plant Communities: Describes the ecological dynamics and the common plant communities comprising the various vegetation states of the site. The disturbances that cause a shift from one state to another are also described.
- Site Interpretations: Interpretive information pertinent to the use and management of the site and its related resources.
- Supporting Information: Provides information on sources of information and data utilized in developing the site description and the relationship of the site to other ecological sites.

ESDs are available from the NRCS at:

https://esis.sc.egov.usda.gov/Welcome/pgReportLocation.aspx?type=%20ESD

The ESDs can be used to compare what is growing on the rangeland with what each site is capable of growing. By comparing the present vegetative composition to the potential compositions, the relative health of the range resource can be evaluated. Production of each site is closely related to the ecological condition of the site. Ecological Sites are defined based upon their location within defined Ecological Precipitation Zones and soil characteristics. Figure 4.3-5 displays the ecological precipitation zones found in the watershed.

Detailed soils mapping which is necessary for development of ESDs, was available for only approximately 20% of the study area, therefore ESD's were not able to be produced for 80% of the watershed. Using database tools provided by the NRCS, the available soils mapping was evaluated, and Ecological Sites defined within the study area. Also, please note that even if there are soils data available there may not be an associated ESD that can be calculated. For example, the rock outcrop, mines, dumps, urban land, and water are all soil map unit values in the soils data for which ESD's cannot be calculated. Figure 4.3-6 displays the locations of the major ecological sites where the 1:24,000 soils mapping was available.

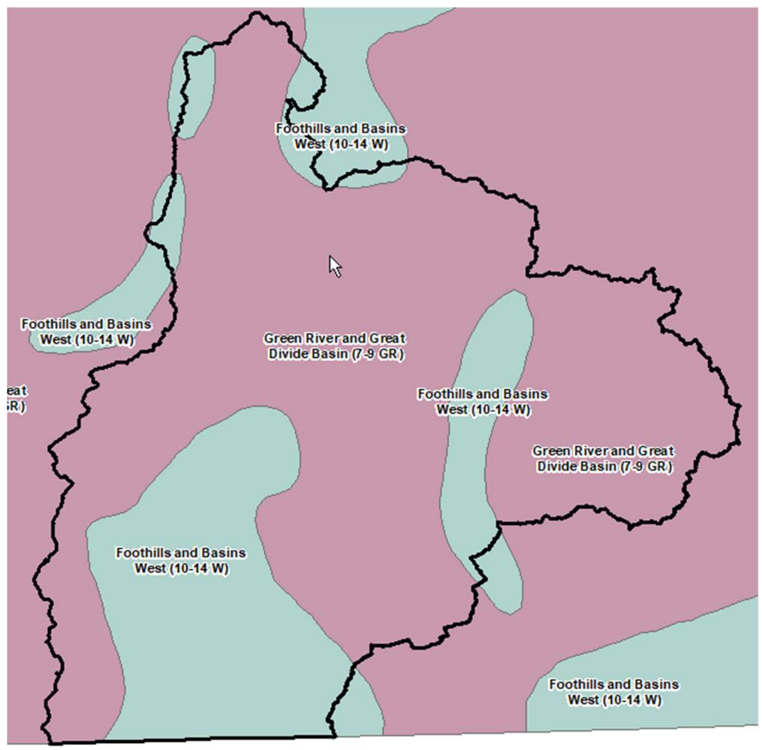


Figure 4.3-5 Ecological Precipitation Zones.

Within the areas where detailed soils mapping is available, the predominant ecological sites are:

- Shallow Sandy (SwSy) 7-9" Green River and Great Divide Basins
- Shallow Loamy (SwLy) 7-9" Green River and Great Divide Basins
- Saline Upland (SU) 7-9" Green River and Great Divide Basins

Specific on-site evaluation of local ESD type and condition is required prior to development of site specific management plans. Ecological Site Interpretations associated with these ESDs are extracted from the NRCS descriptions (NRCS, 2014) and available in the Digital Library delivered with this report.

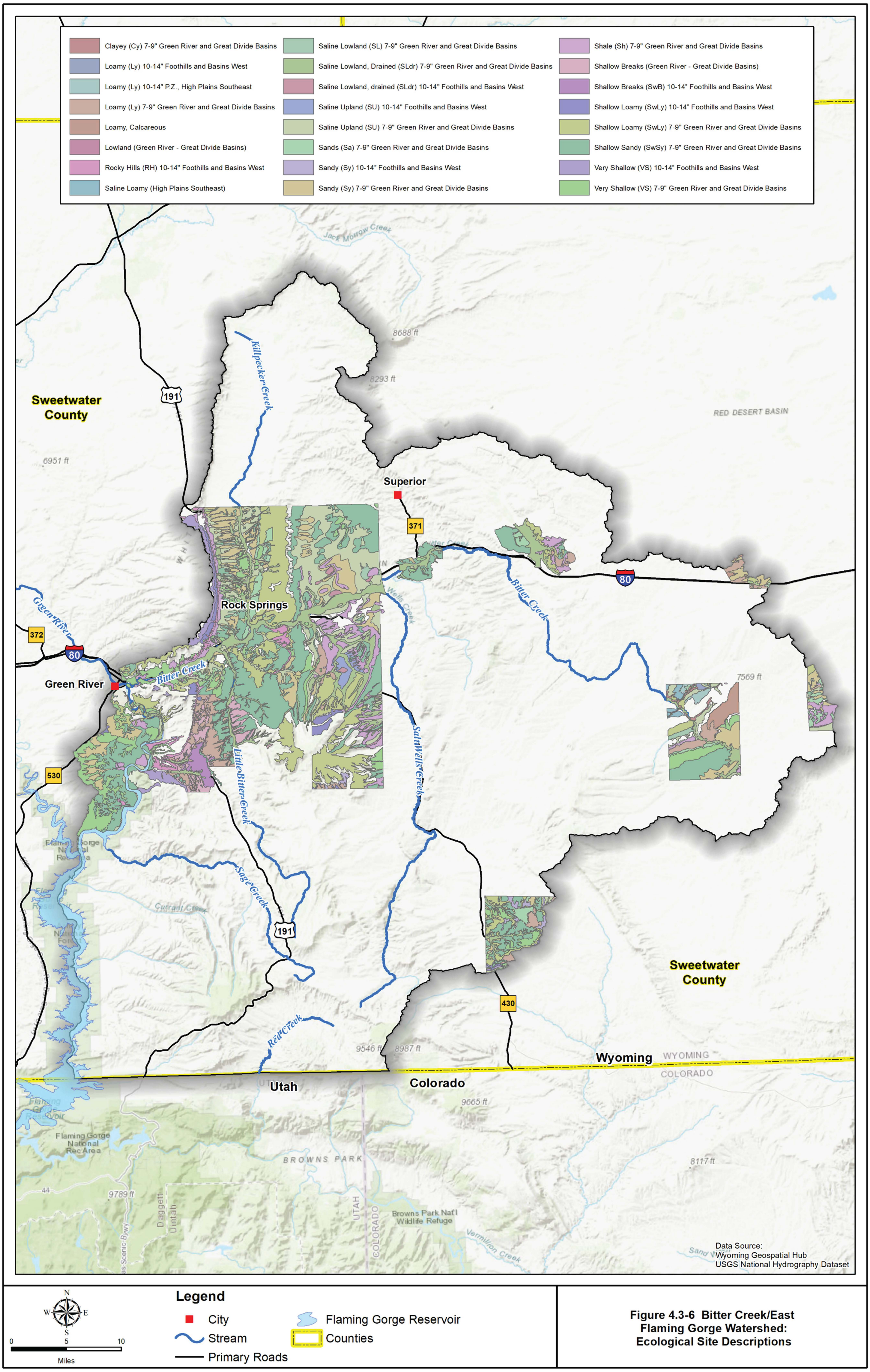


Figure 4.3-6 Bitter Creek/East Flaming Gorge Watershed: Ecological Site Descriptions

4.3.1.6 Weeds and Invasive Species

Vegetation of particular importance with respect to land use and habitat that were identified by the Wyoming Weed and Pest Council include:

Designated Noxious Weeds W.S. 11-5-102 (a) (xi). For more information, see: http://www.wyoweed.org/

- Field bindweed (Convolvulus arvensis L.)
- Canada thistle (Cirsium arvense L.)
- Leafy spurge (Euphorbia esula L.)
- Perennial sowthistle (Sonchus arvensis L.)
- Quackgrass (Elymus repens (L.) Gould.)
- Hoary cress (whitetop) (Cardaria draba & Cardaria pubescens (L.) Desv.)
- Perennial pepperweed (giant whitetop) (Lepidium latifolium L.)
- Ox-eye daisy (Leucanthemum vulgare Lam.)
- Skeletonleaf bursage (Ambrosia tomentosa Nutt.)
- Russian knapweed (Acroptilon repens L.)
- Yellow toadflax (Linaria vulgaris (P.) Mill)
- Dalmatian toadflax (Linaria dalmatica (L.) Mill.)
- Scotch thistle (Onopordum acanthium L.)
- Musk thistle (Carduus nutans L.)
- Common burdock (Arctium minus (Hill) Bernh.)
- Plumeless thistle (Carduus acanthoides L.)
- Dyer's woad (Isatis tinctoria L.)
- Houndstongue (Cynoglossum officinale L.)
- Spotted knapweed (Centaurea stoebe L. ssp. micranthos (Gugler) Hayek)
- Diffuse knapweed (Centaurea diffusa Lam.)
- Purple loosestrife (Lythrum salicaria L.)
- Saltcedar (Tamarix spp.)
- Common St. Johnswort (Hypericum perforatum L.)
- Common Tansy (Tanacetum vulgare)
- Russian olive (Elaeagnus angustifolia L.)
- Black Henban (Hyoscyamus niger)

Additionally, as of February 2017 the Wyoming Weed and Pest Council lists the following weeds as declared weeds by county. Weeds identified by Sweetwater County include:

- Common Reed (Phragmites australis)
- Foxtail barley (Hordeum jubatum L.)
- Lady’s bedstraw (Galium verum L.)

- Mountain thermopsis (Thermopis montana Nutt.)
- Wild licorice (Glycyrrhiza lepidota Pursh)
- Curlycup gumweed (Grindelia squarrosa (Pursh) Dunal)
- Showy milkweed (Asclepias speciosa Torr.)
- Curly dock (Rumex crispus L.)
- Bull thistle (Cirsium vulgare (Savi) Ten.)

"Designated noxious weed" is defined by the Wyoming Weed & Pest Control Act as follows:

> *"weeds, seeds or other plant parts that are considered detrimental, destructive, injurious or poisonous, either by virtue of their direct effect or as carriers of diseases or parasites that exist within this state, and are on the designated list, which is formed by joint resolution of the Wyoming Board of Agriculture and the Wyoming Weed and Pest Council. If a plant is listed as a Designated Noxious Weed, that listing provides statewide legal authority to regulate and manage it."*

"Declared weed" is defined as follows:

> *"any plant which the Wyoming Board of Agriculture and the Wyoming Weed and Pest Council have found, either by virtue of its direct effect, or as a carrier of disease or parasites, to be detrimental to the general welfare of persons residing within a district (county). If a plant is listed as a County Declared Weed, that listing provides that county with legal authority to regulate and manage it."*

The county Weed and Pest Districts actively conduct control measures to reduce the spread and reproduction of weed species. Interested landowners should contact the Sweetwater County Weed and Pest Districts for more information.

The discussion of vegetation and land cover would not be complete without addressing the mountain pine beetle epidemic occurring on the forested lands within the region. In the project study area, areas affected by beetle kill are relatively low in areal extent and not considered a management issue by the USFS. However, areas in the southern portion of the study area, including the Miller Mountain and Pine Mountain areas, have been impacted.

The following regarding the outbreak and its history is extracted from the USFS document:

Review of the Forest Service Response: The Bark Beetle Outbreak in Northern Colorado and Southern Wyoming (USDA, 2011).

This report is also included in the digital library delivered with this report.

A mountain pine beetle outbreak in three national forests in the Rocky Mountain Region (Region 2) of the U.S. Forest Service—the Arapaho-Roosevelt, Medicine Bow-Routt and White River—was initially detected in 1996. By 2010 it had spread to about four million acres.

Factors that helped set the stage for a large-scale outbreak included:

- Consecutive years of severe drought in the late 1990s and through the middle of the first decade of the 2000s, putting already densely populated stands under severe stress.
- Funding for pre-commercial and commercial thinning to reduce stand density during the decade leading up to and including the outbreak did not keep pace with the rate of bark beetle outbreak spread.
- Limited accessibility of terrain (only 25% of the outbreak area was accessible due to steep slopes, lack of existing roads, and land use designations such as Wilderness that precluded treatments needed to reduce susceptibility to insects and disease).
- Decline in public acceptance of large-scale timber management practices in the last part of the 20th century. This lack of public acceptance, compounded by national and international market forces and the relatively low commercial value of Lodgepole Pine, contributed to a corresponding decline in the timber industry. (The timber industry in the Rocky Mountain Region has declined by 63 percent since 1986).

Data Sources:

Wyoming Weed and Pest Council: http://www.wyoweed.org/

4.3.1.7 Sensitive Species

The Wyoming Natural Diversity Database (WYNDD) lists vegetative Species of Concern (SOC) or Species of Potential Concern (SOPC) which have been documented within the study area. The database was queried, identifying 31 plants as SOC or SOPC. The results are presented in Appendix 4E.

4.3.2 Fish and Wildlife

4.3.2.1 Fisheries

The Wyoming Game and Fish Department uses a stream classification system to identify and rank the most important coldwater recreational fisheries, and to assess the relative potential impacts of proposed development projects to streams. Categories are based on pounds of trout per mile based on the WYGFD population monitoring data and include:

- Blue Ribbon (national importance) >600 pounds per mile,
- Red Ribbon (statewide importance) 300 to 600 pounds per mile,
- Yellow Ribbon (regional importance) 50-300 pounds per mile,
- Green Ribbon (local importance) <50 pounds per mile.

Figure 4.3-7 shows the stream classifications within the Bitter Creek/East Flaming Gorge Watershed. Trout are present within the project study area because it includes the Green River, Flaming Gorge Reservoir,

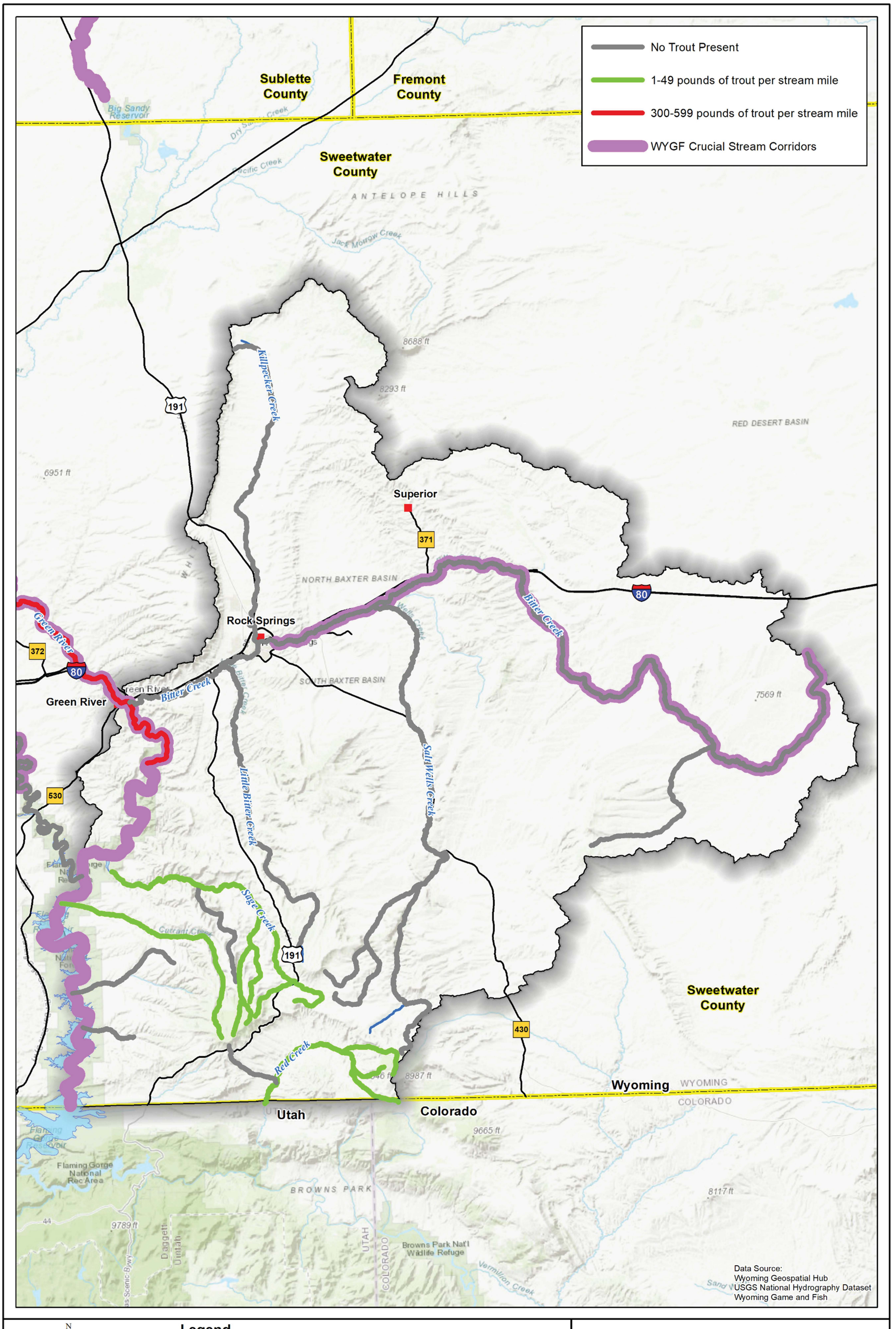


Figure 4.3-7 Bitter Creek/East Flaming Gorge Watershed: Wyoming Game and Fish Trout Stream Classifications and Crucial Stream Corridors

and tributaries to the reservoir. There are no trout in the Bitter Creek / Killpecker Creek watershed. The Green River is classified as a Red Ribbon stream (300 to 600 lbs/mile) and the tributaries to Flaming Gorge are classified as Green Ribbon waters (Red Creek, Sage Creek, and Currant Creek).

Crucial corridors were identified using professional judgement by considering uniqueness of the river corridor, species present, presence of and/or lack of migration barriers, degree of departure from historic conditions (some are presently functioning near their historic potential) and importance for providing connectivity between source and sink localities. Bitter Creek and Green River are identified as crucial stream corridors.

The Species of Greatest Conservation Need (SGCN) classification was developed as part of Element 1 of the Congressional guidelines for State Wildlife Action Plans (SWAPs). The SGCN designation is reserved for species whose conservation status warrants increased management attention, and funding, as well as consideration in conservation, land use, and development planning in Wyoming. The Bitter Creek/East Flaming Gorge Watershed is home to several fish species designated as SGCN (Figure 4.3-8), including the Flannelmouth sucker, Colorado River Cutthroat, and Bluehead Sucker. The SWAP reports for these three species and a document detailing the Wyoming SGCN designation can be found in the digital library submitted with this report.

Reservoir construction, water development, and drought have cut off migratory corridors, degraded habitat, and encouraged spread of non-native fishes. Wyoming's State Wildlife Action Plan (SWAP) reports:

> *Although flannelmouth sucker were once widespread throughout the Colorado River basin, they currently occupy approximately 45% of their historic range. Reasons for declines include dam construction and operation as well as predation, competition and hybridization with non-native fishes. The primary cause of declines in Wyoming is the risk of genetic introgression with widely distributed non-native suckers. Although genetically pure individuals still exist throughout the Green River drainage in Wyoming, upper Bitter Creek has the states' only remaining population of flannelmouth sucker that is isolated from non-native, hybridizing sucker species.*

The Pierotto Ditch diversion structure, which is currently in the process of being reconstructed, is serves as an incidental fish barrier, preventing the movement of non-native suckers and hybridization with the flannelmouth sucker population. Reconstruction of the structure has been problematic; however, completion is anticipated by Fall 2018.

4.3.2.2 Big Game

The Wyoming Game and Fish Department (WGFD) maps the seasonal ranges by herd unit for each big game species and makes special note of areas listed as crucial habitat and parturition (birthing areas). WGFD's Crucial habitat, or range, is defined as those seasonal ranges or habitats (mostly winter range)

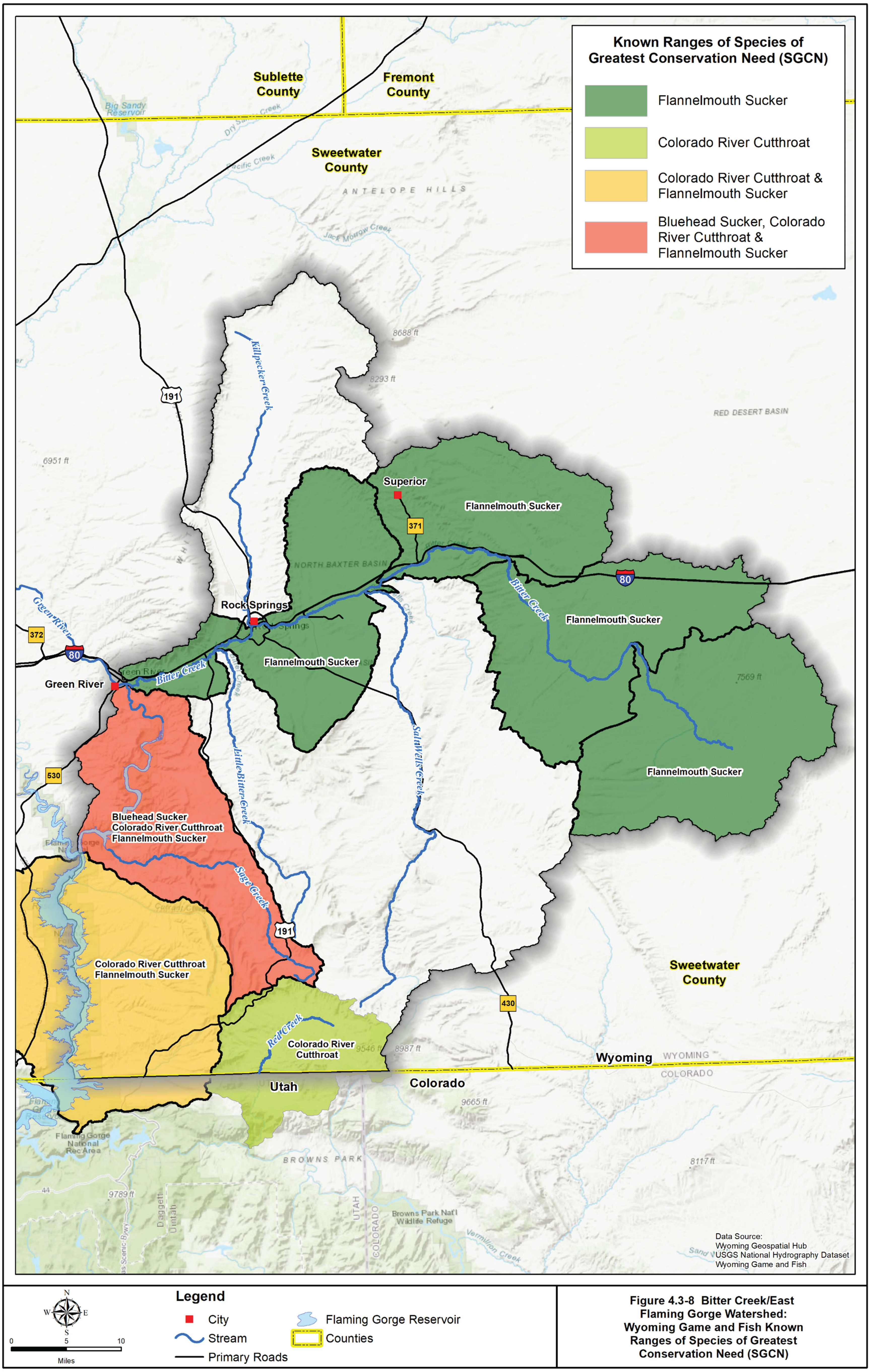


Figure 4.3-8 Bitter Creek/East Flaming Gorge Watershed: Wyoming Game and Fish Known Ranges of Species of Greatest Conservation Need (SGCN)

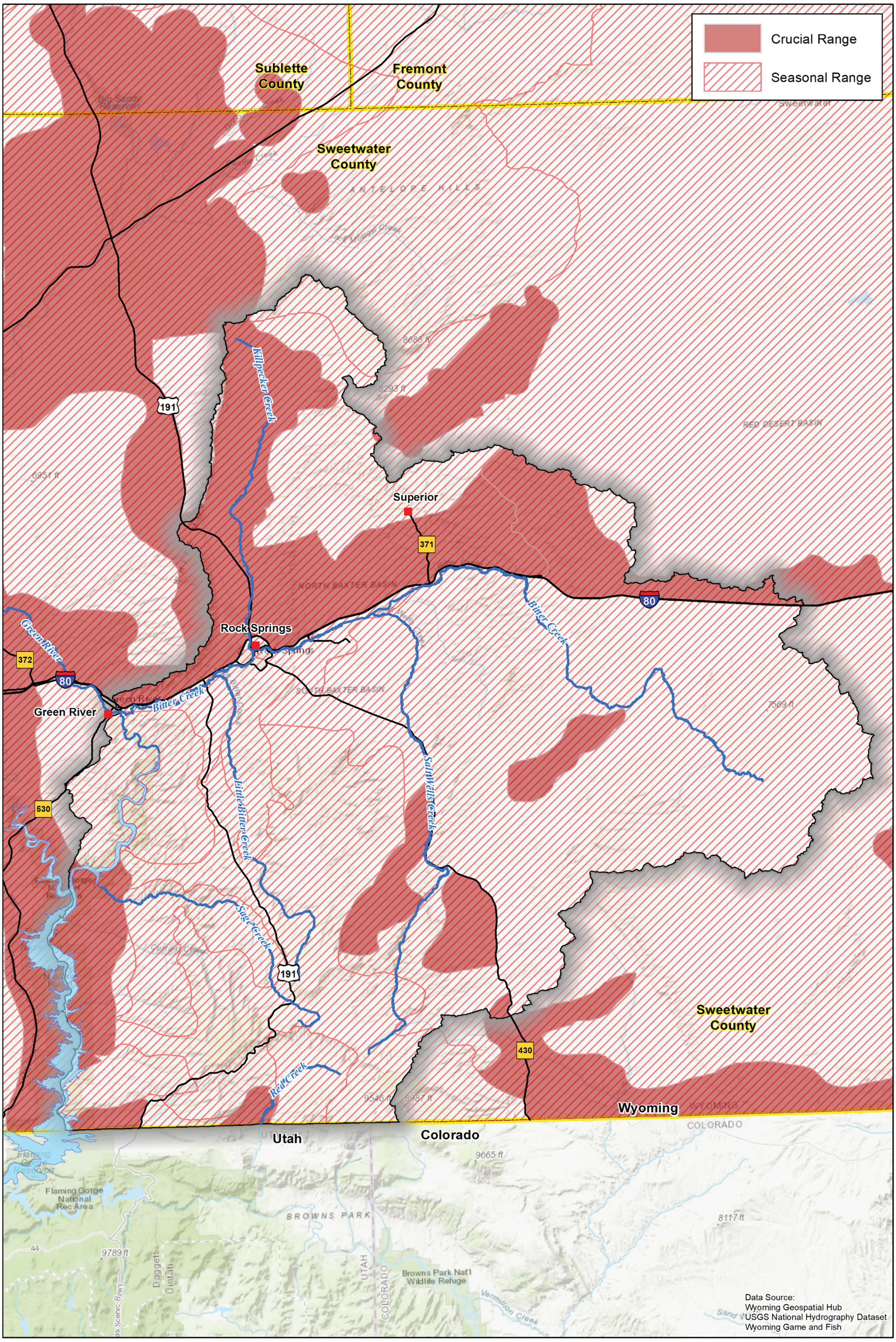
that have been documented as the determining factor in a population's ability to maintain itself at a certain level over a long period of time. In the Bitter Creek watershed, the primary big game present are pronghorn antelope, elk, and mule deer. Approximately 784,313 acres (roughly 43 percent of the study area) have been determined to be crucial habitat for one or more of antelope, elk, or mule deer. Of the big games species mapped by the WGFD, only elk and mule deer have parturition areas within the watershed. The parturition area totals only 67,207 acres (approximately 3.7% of the study area). According to the Game and Fish data provided, moose may utilize a small western portion of the study area, west of the Green River, but only as seasonal range.

Figures 4.3-9 through 4.3-11 display the WGFD seasonal range, crucial range, parturition areas, and migration corridors for antelope, elk, and mule deer, within and immediately adjacent to the study area. Examination of these figures shows that the majority of the watershed is classified as seasonal range for the big game species. The crucial ranges and parturition areas of the primary big game species within the watershed were aggregated individually and are shown in Figure 4.3-12. The figure shows that the crucial range of the three primary species is generally concentrated in the northern and southwestern portions of the watershed. The crucial ranges are located north of I-80 in the Leucite Hills and Killpecker Creek Basin, as well as east of Flaming Gorge Reservoir, and in the highlands near Potter Mountain. As previously mentioned, the crucial ranges tend to be winter range areas where foraging is easier due to lower snow depths, and the landscape provides some sort of thermal cover (BLM, 2008). The parturition areas for elk and mule deer are located in the highlands near Antelope Hills and Leucite Hills in the northernmost portion of the watershed. Elk have additional parturition areas in the highlands near Little Mountain and the O-Wi-Yu-Kuts Mountains on the south side of the watershed. These areas provide particularly good security cover and succulent forage (BLM, 2008). No parturition areas for antelope are located within the study area.

In an effort to address declining mule deer populations, the WGFD published "Recommendations for Managing Mule Deer Habitat in Wyoming" (2015) which is included with the digital library delivered with this report. The document provides management recommendations related to seasonal mule deer diet, important vegetation types, human disturbance (fences, roads), predators and invasive species. The Wyoming Wildlife Federation (WWF) has created a conservation and outreach program for the Red Desert to Hoback Basin migration corridor which is the longest mule deer route in the continental US. The program will work with private landowners and the public to conserve seasonal habitats and this vital migration corridor. Additionally, the Sublette deer migration corridor was formally designated under the Migration Corridor Strategy by the Wyoming Game and Fish Department in 2016. This will allow for an assessment and the development of proactive management actions in the corridor, improving permeability between winter and summer ranges.

4.3.2.3 WGFD Priority Areas

As part of the WGFD Strategic Habitat Plan Revision (2015), previously existing priority habitat areas within the state were refined into Goal 1 Crucial Priority Areas and Goal 2 Enhancement Priority Areas for



Legend

City
Stream
Primary Roads
Flaming Gorge Reservoir
Counties

0 5 10
Miles

Figure 4.3-9 Bitter Creek/East Flaming Gorge Watershed: Antelope Habitat

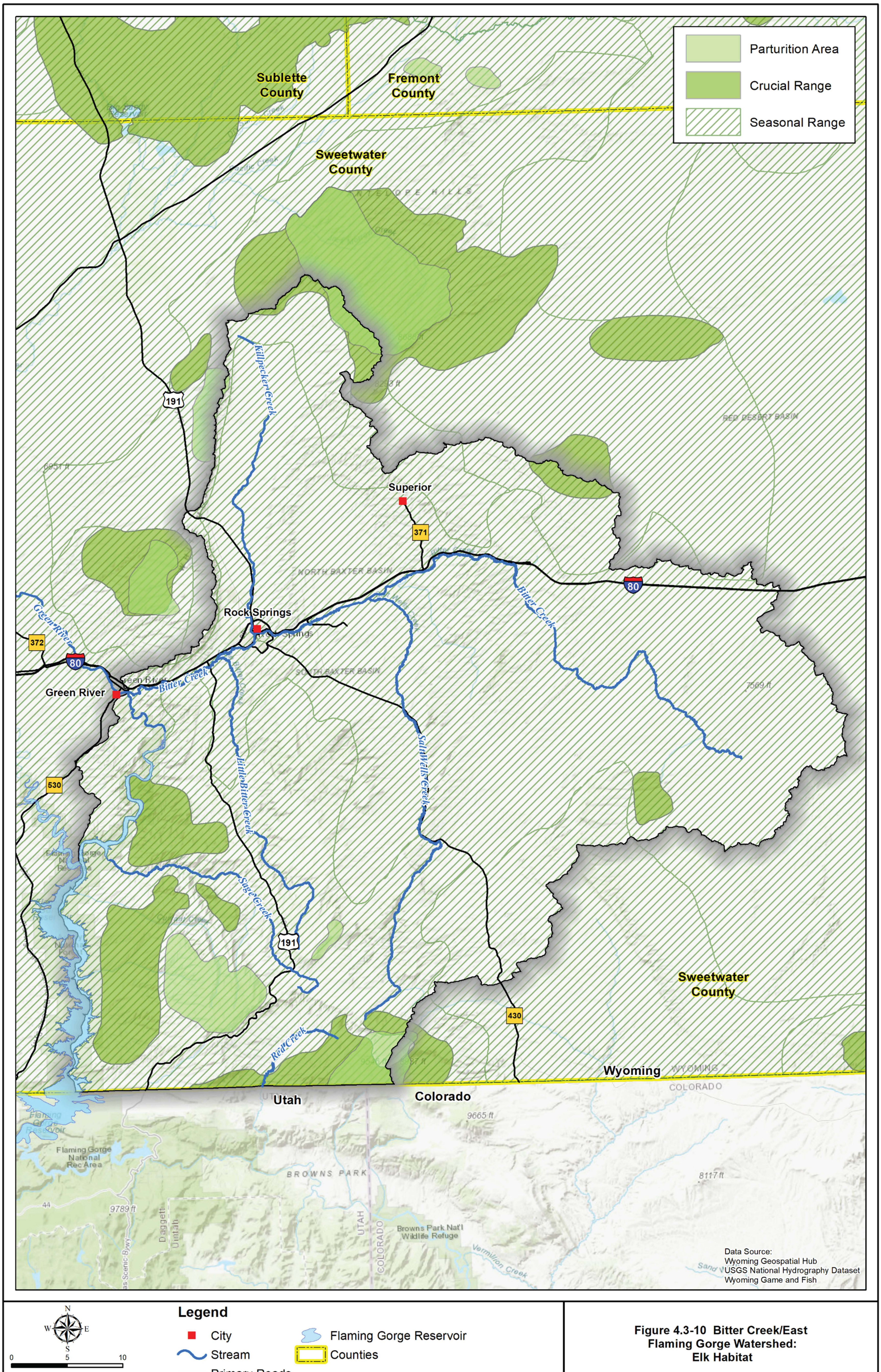
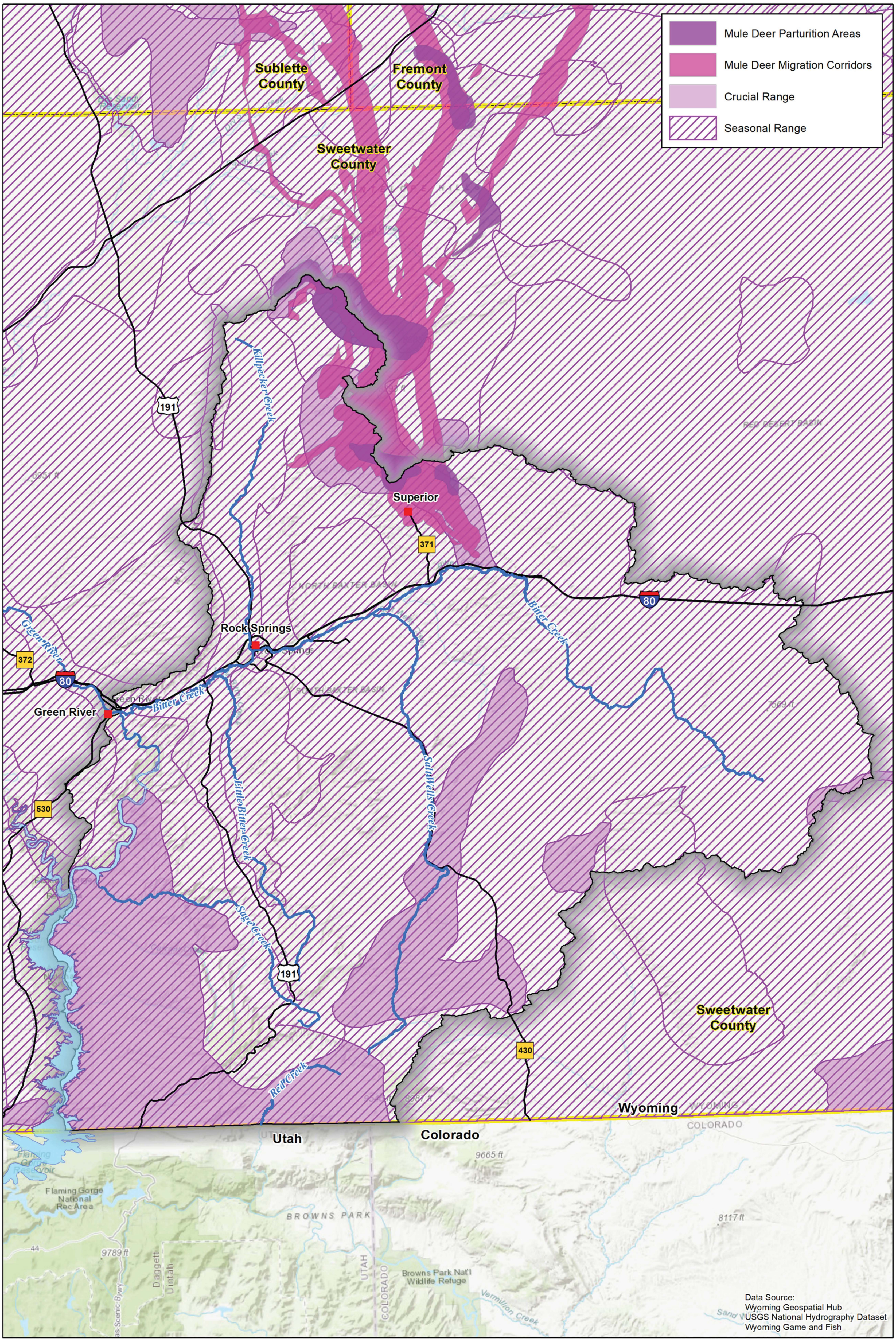
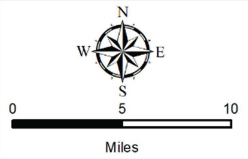


Figure 4.3-10 Bitter Creek/East Flaming Gorge Watershed: Elk Habitat

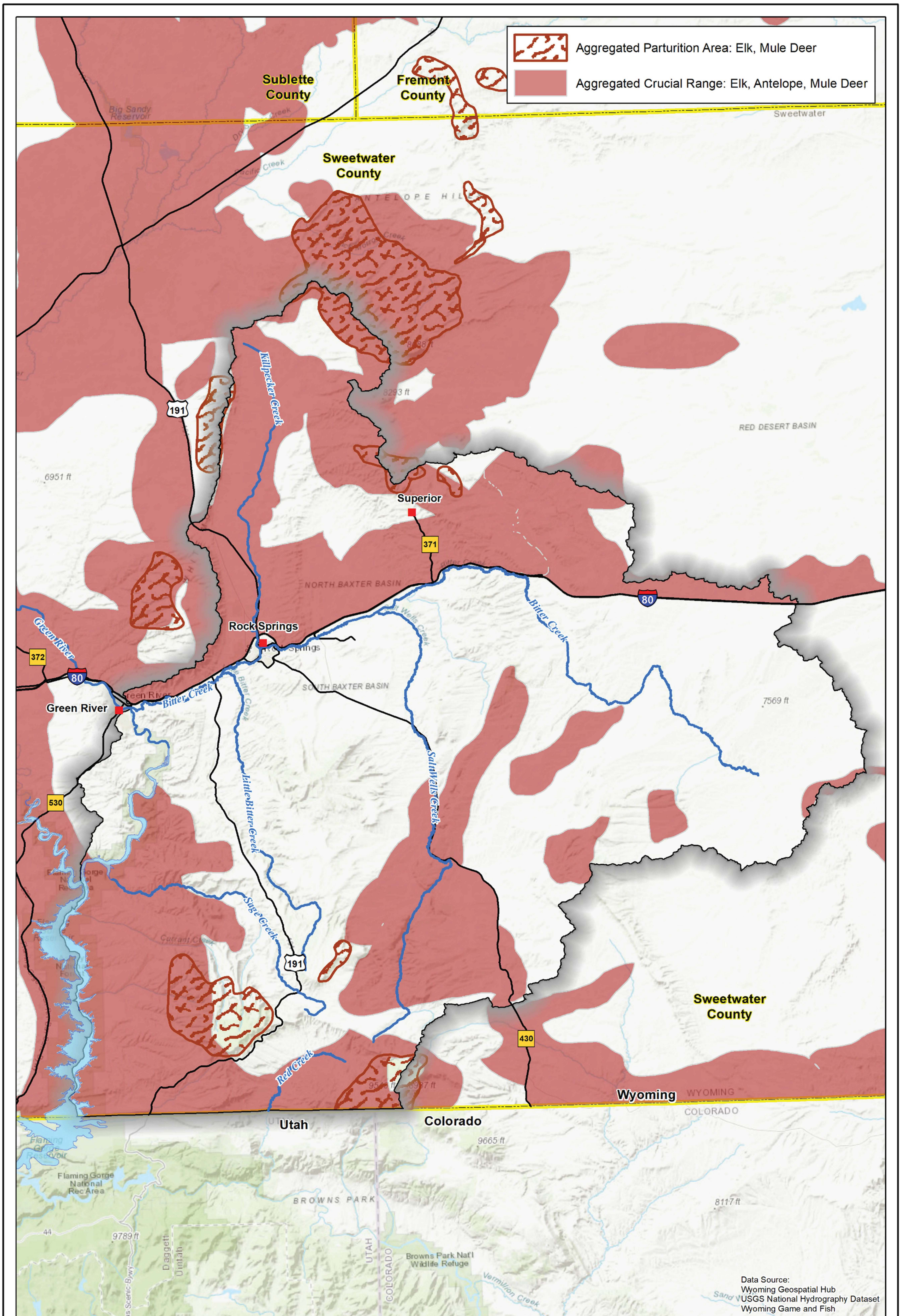




Legend

- City
- Stream
- Primary Roads
- Flaming Gorge Reservoir
- Counties

Figure 4.3-11 Bitter Creek/East Flaming Gorge Watershed: Mule Deer Habitat



Legend

- City
- Stream
- Primary Roads
- Flaming Gorge Reservoir
- Counties

Figure 4.3-12 Bitter Creek/East Flaming Gorge Watershed: Aggregated Parturition Area and Crucial Range for Antelope, Elk, and Mule Deer

both aquatic and terrestrial terrain (Figure 4.3-13). “Combined” areas were created where significant overlap occurred between aquatic and terrestrial areas. As defined by WGFD at: https://wgfd.wyo.gov/Habitat/Habitat-Plans/Habitat-Priority-Areas.

> *“Goal 1 Crucial Priority Areas are based on significant biological or ecological values. These are areas that need to be protected or managed to maintain viable healthy populations of terrestrial and aquatic wildlife for the present and future. They represent habitat values and identify where those values occur on the landscape. Examples of values include crucial winter range, sage grouse core area seasonal habitats, Species of Greatest Conservation Need (SGCN) diversity and uniqueness, quality and condition of vegetative communities, movement corridors, quality of watershed hydrologic function, etc. The Department will concentrate habitat protection and management activities in these areas.”*

> *“Goal 2 Enhancement Habitat Priority Areas represent those with a realistic potential to address wildlife habitat issues and to improve, enhance, or restore wildlife habitats. These areas offer potential for improving habitat and focusing Department habitat efforts. They may overlap crucial areas or be distinct from them. Enhancement areas are based on habitat issues. Like crucial areas where values are key, issues were identified by regional personnel and used to select enhancement habitat areas. Examples of issues include loss of aspen communities, habitat fragmentation, development, loss of connectivity, water quality effects, water quantity limitations, beetle killed conifer, lack of fish passage, loss of fish to diversions, degraded habitat, etc.”*

Review of the WGF Crucial Habitat Area Narratives (available at https://wgfd.wyo.gov/Habitat/Habitat-Priority-Areas/Statewide-Maps/Green-River) provides the following information regarding sensitive habitat within the study area. Full relevant habitat narratives have been downloaded and included with the Digital Library included with this report. The following paragraphs were extracted directly from the narratives provided by WGFD for crucial and enhancement priority areas:

Little Mountain and Flaming Gorge (Goal 1 Combined Crucial Area)

- **Habitat Value:**
  High value recreational sport fishery, unique reptile community, water quality, a large area of deep-water habitat with productive shorelines, Colorado River cutthroat trout habitat. Exceptionally diverse and productive vegetation communities. Important seasonal, yearlong, and crucial winter ranges for the South Rock Springs Elk, Deer and Pronghorn Herds and a portion of the Uinta Moose Herd. Year long sage grouse habitat, designated as a Governor’s Sage-grouse Implementation Team (GSGIT) sage-grouse core breeding area; contains a significant number of leks. Habitat for juniper obligate bird and mammal species. Habitat for a large assemblage of Species of Greatest Conservation Need (SGCN).

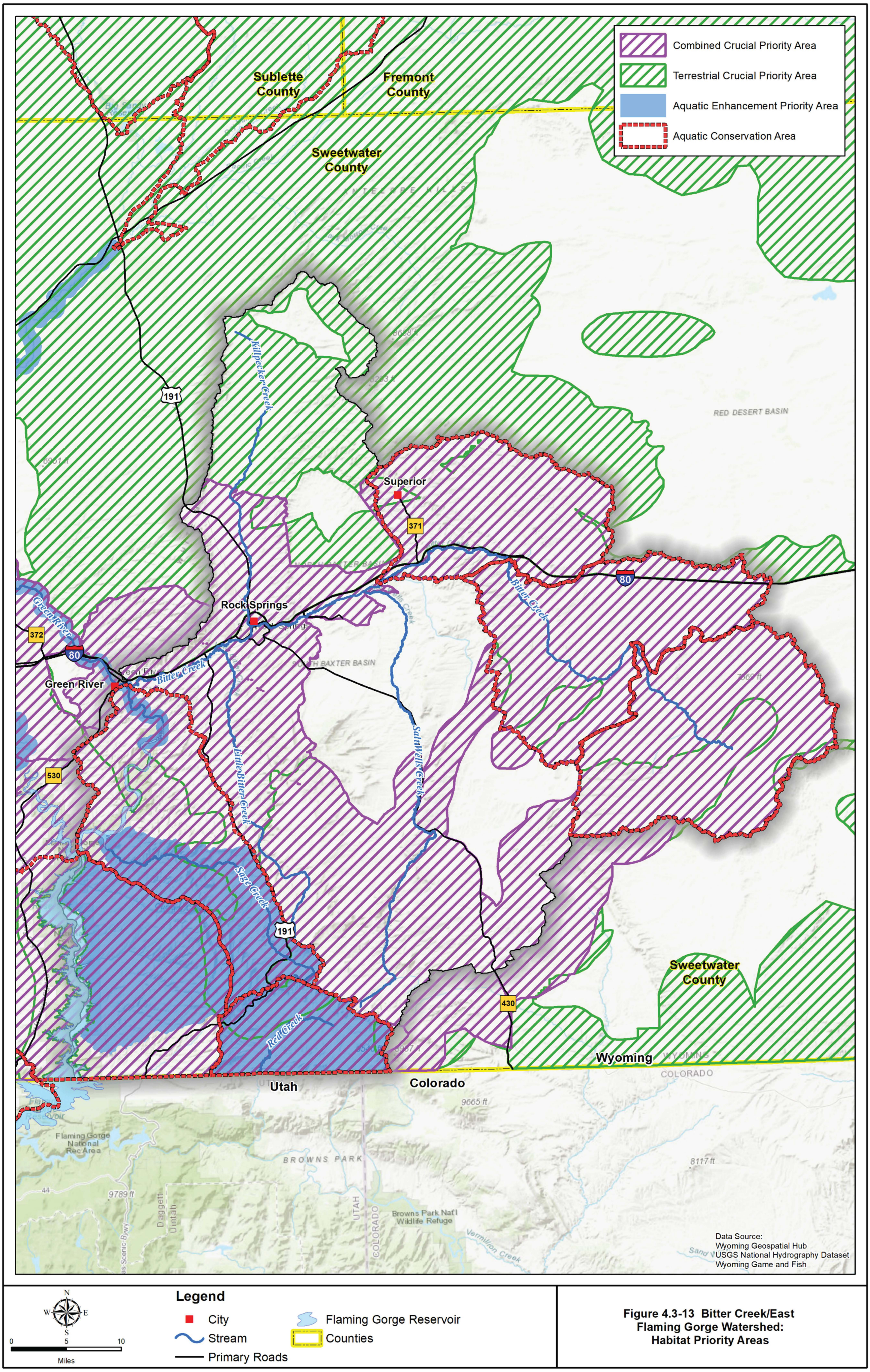


Figure 4.3-13 Bitter Creek/East Flaming Gorge Watershed: Habitat Priority Areas

- **Reason Selected:**
  Crucial winter range for elk, mule deer, pronghorn, a Governor's Sage-grouse Implementation Team (GSGIT) sage-grouse core breeding area and a large number of SGCN. Unique reptile community. Habitats in this area are extremely diverse and unique in Wyoming. Landscape scale ecosystem restoration efforts have been ongoing for the past 18 years.
- **Primary species or assemblages of species:**
  Colorado River cutthroat trout (NSS2), coldwater sportfish species, midget faded rattlesnake (NSS2), mule deer, elk, greater sage grouse
- **Solutions or actions (partial list):**
  - Advocate habitat protection and minimize habitat impacts from energy development activities.
  - Pursue and accept development-limited easements for private lands on the east side of Flaming Gorge Reservoir as a contributing strategy for protecting important habitats.
  - Promote sound livestock grazing practices. Investigate and develop opportunities for forage reserve grazing management on the east side of Flaming Gorge Reservoir.
  - Manage elk and moose population levels so that aspen, willow, water birch, currant, chokecherry, and other mountain shrubs are not inhibited or suppressed by excessive browsing. Ensure wildlife is managed so these vegetative communities are allowed to restore vigor and maintain diverse age class structure.
  - Enhance watershed segments that maintain potential for restoring woody riparian vegetation, and subsequently encourage expansion of beaver colonies into suitable habitat where populations can be sustained over the long term.
- **Additional Information (partial):**
  This is the only area in Wyoming inhabited by the midget faded rattlesnake. This area is under increasing threat from a variety of energy development proposals, including wind farms, oil and gas development, and major energy corridors. Heavy sediment and phosphorus loading of tributary rivers and streams entering Flaming Gorge Reservoir encourages eutrophic aquatic conditions and accelerates sediment deposition that buries or degrades important underwater structural habitat features.

Red Desert - Bitter Creek (Goal 1 Combined Crucial Area)

- **Habitat Value:**
  Upper Bitter Creek from Thayer Junction upstream to the headwaters area near Ft. La Clede supports a viable population of genetically pure flannelmouth suckers. Seasonal, yearlong, and crucial winter ranges for the Bitter Creek Pronghorn Herd, South Rock Springs Mule Deer Herd, and the Petition Elk Herd. Uplift areas provide especially important seasonal habitats for deer and elk. Year long sage grouse habitat, designated as a Governor's Sage-grouse Implementation Team (GSGIT) sage grouse core breeding area; contains a significant number of leks.

- **Reason Selected:**
  Upper Bitter creek supports one of the last native flannelmouth sucker populations remaining in Wyoming that have not yet experienced hybridization with white suckers, which warrants protection of the population and their habitat. Crucial winter range for elk, mule deer, pronghorn, a Governor's Sage-grouse Implementation Team (GSGIT) sage-grouse core breeding area and a large number of SGCN.
- **Primary species or assemblages of species:**
  Flannelmouth sucker (NSS1), midget faded rattlesnake (NSS2), elk, mule deer, pronghorn, greater sage-grouse (NSS2)
- **Solutions or actions (partial list):**
  - Coordinate with landowners to gain support and approval for installing a fish passage barrier/ grade control structure in Bitter Creek upstream of Rock Springs and near the confluence of Salt Wells Creek to facilitate future chemical treatments to expand the native fish assemblage in upper Bitter Creek.
  - Advocate habitat protection and minimize habitat impacts created by energy development activities.
  - Advocate sound livestock grazing practices.
- **Additional Information (partial):**
  Bitter Creek supports what is thought to be one of the last known native flannelmouth sucker populations remaining in Wyoming that have not yet experienced hybridization with white suckers.

Sage Grouse Core Areas (Goal 1 Terrestrial Crucial Area)

- **Habitat Value:** Sage-grouse core areas.
- **Reason Selected:** Sage-grouse core areas designated by the Governor's Office are described as those areas capable of maintaining habitats and viable populations of sage-grouse where they are most abundant. On a statewide basis, they include habitats and existing populations for at least two-thirds of the sage-grouse in Wyoming.
- **Primary species or assemblages of species:**
  Mule deer, pronghorn, elk, sage thrasher, sage sparrow, and Brewer's sparrow.
- **Solutions or actions (partial list):**
  - Maintain the functionality and integrity of sage-grouse core areas.
  - Seek opportunities for habitat enhancement, preservation and protection through partnerships and agreements with USFS, BLM, State Land Board and private landowners to maintain these areas. Possible actions include protecting and maintaining core area values through conservation easements, public/private land exchanges and federal land management agency management plans.
  - Habitat preservation and enhancement through management of WGFC property rights and implementation of existing management goals and objectives found in the Managed Land and Access Summaries for the WHMAs identified above.

- **Additional Information (partial):**
  Many natural or human-caused impacts can impact or even eliminate the functionality of these habitat components. These include wildfire, livestock grazing, invasive plants, and energy development. The core areas primarily reflect breeding habitats characterized by sagebrush communities associated with high lek densities.

Little Mountain (Goal 2 Aquatic Enhancement Area)

- **Habitat Issues:** Increasing demands for energy development and other land uses in the Green River watershed cumulatively threaten water quality and physical habitat in Flaming Gorge Reservoir. Potential energy development activities in the east side Flaming Gorge area threaten to fragment and degrade life stage habitat needs of numerous aquatic and terrestrial species including endemic reptiles. Excessive browsing of aspen regeneration by elk is suppressing or killing re-growth and threatening the long-term health or existence of aspen habitat.
- **Reason Selected:** Continued implementation of a landscape scale ecosystem restoration effort that has been ongoing for the past 24 years. Nearly 3 million dollars have been spent on this ecosystem restoration effort to date, and this landscape warrants protective measures to promote sound habitat function for the future
- **Primary species or assemblages of species:**
  Beaver, Colorado River cutthroat trout (NSS2), mountain sucker (NSS3), cold water sportfish species, midget faded rattlesnake (NSS2), ornate tree lizard (NSS2)
- **Solutions or actions (partial list):**
  - Advocate habitat protection and minimize habitat impacts created by energy development activities.
  - Pursue and accept development-limited easements for private lands on the east side of Flaming Gorge Reservoir as a contributing strategy for protecting important habitats.
  - Promote sound livestock grazing practices. Investigate and develop opportunities for forage reserve grazing management on the east side of Flaming Gorge Reservoir to maintain sound rangeland and watershed health.
  - Manage elk and moose population levels so that aspen, willow, water birch, currant, chokecherry, and other mountain shrubs are not inhibited or suppressed by excessive browsing. Ensure wildlife is managed so these vegetative communities are allowed to restore vigor and maintain diverse age class structure.
- **Additional Information (partial):**
  Enhancement strategies are centered on the concept that healthy riparian areas are a product of sound upland habitat, and together function as a basin-wide ecosystem.

Note that the “Solutions or actions” and “Additional information” in the sections above have been abbreviated. Individual priority area narratives were downloaded, and a complete version can be found in the Digital Library delivered with this report or online at the link mentioned above. The Sands and Big Game Goal 1 Crucial Terrestrial Areas, as well as the Lower Green River Corridor Aquatic Goal 2

Enhancement Area are also in the watershed, but individual priority area narratives were unavailable for these areas at the time of this report.

Management Implications:

While there may be regulations related to timing stipulations on activities within habitat priority areas (ex: no human disturbance November 15th to April 30th), the fact that a project proposed in Chapter 6 is within these priority areas does not preclude it from development. The priority areas are not so much a regulatory delineation, but more of a way for WGFD to determine the best locations to spend their money, time and energy. In fact, if a proposed project in a priority area enhances wildlife habitat, funding through WGFD Trust Fund and the Wyoming Wildlife and Natural Resource Trust (WWNRT) might be available.

4.3.2.4 Wild Horses

Following passage of the Wild, Free-Roaming Horse and Burro Act in 1971, BLM was charged with management of wild horses and burros in "herd management areas" (HMAs). The BLM's goal is to ensure and maintain healthy wild horse populations on healthy public lands. To do this, the BLM works to achieve what is known as the Appropriate Management Level (AML) – the point at which wild horse and burro herd populations are consistent with the land's capacity to support them. Each Herd Management Area (HMA) has its own AML. When AML is exceeded, the excess animals are to be removed and then prepared for adoption or sent to off-range pastures.

A majority of the project study area, is designated as an HMA, as indicated in Figure 4.3-14. The Salt Wells Creek HMA stretches from US 191 to the eastern boundary of the watershed, south of I-80. The Divide Basin HMA covers the land north of I-80 and east of Superior. The Wild Horse Holding Facility in Rock Springs is the only federal off-range corral and preparation facility in Wyoming and houses approximately 800 wild horses.

Laws driving the BLM's management are described in the "Environmental Assessment for Adobe Town, Salt Wells Creek, and the Great Divide Basin Herd Management Areas and Wild Horse Gather" (BLM, 2017):

> *43 CFR Section 1333(b) (2) of the Wild and Free Roaming Horse and Burro Act (WFRHBA, Public Law 92-195), as amended, section 302(b) of the Federal Land Policy and Management Act of 1976 (FLPMA, Public Law 94-579), and Section 2(b)(4) of the Public Rangelands Improvement Act of 1978 (PRIA, Public Law 95-514). The WFRHBA provides that the Department of the Interior "manage wild free-roaming horses and burros in a manner that is designed to achieve and maintain a thriving natural ecological balance on the public lands" (Section 1333(a), as amended). The WFRHBA also provides that "If wild free-roaming horses or burros stray from public lands onto privately owned land, the owners of such land may inform the nearest Federal marshal or agent of the Secretary, who shall arrange to have the animals removed" (Section 1334, as amended).*

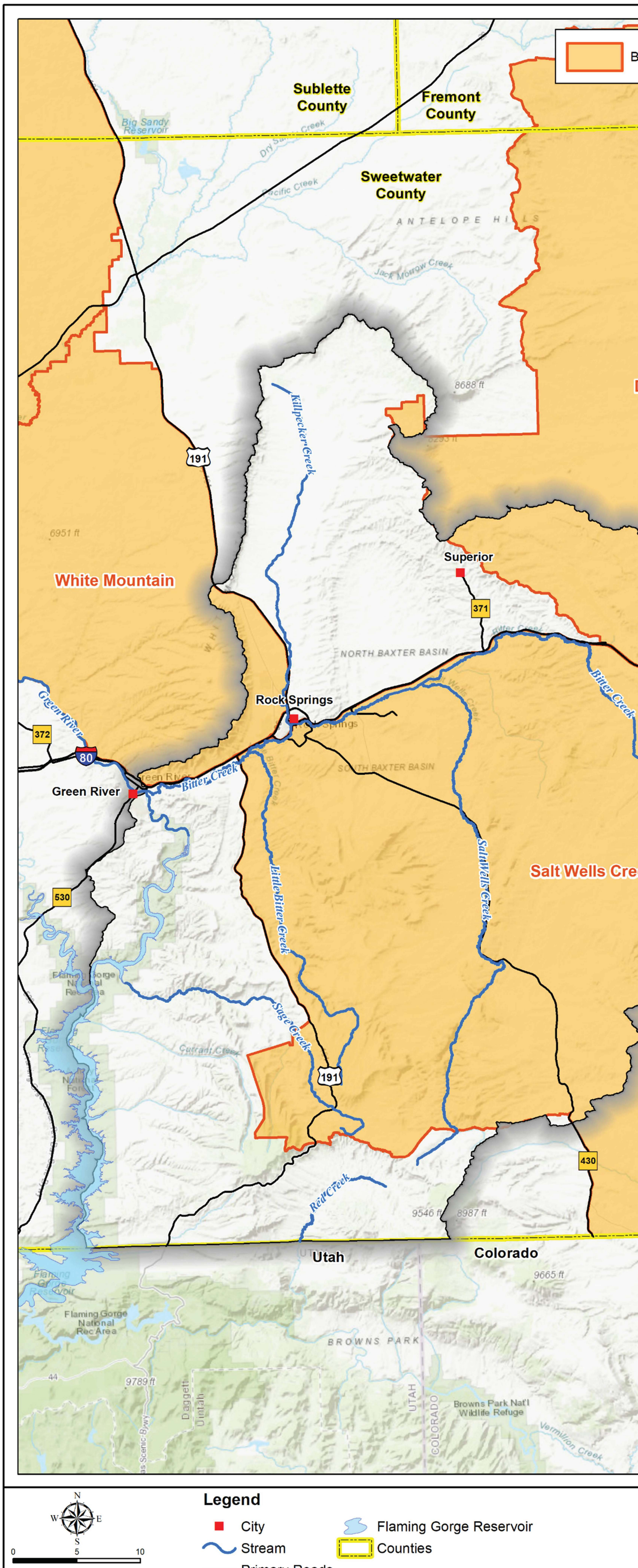


Figure 4.3-14 Bitter Creek/East Flaming Gorge Watershed: BLM Wild Horse and Burro Herd Management Areas (HMA)

Historically the BLM has encountered challenges with managing these HMAs due to the presence of a "checkerboard" landownership pattern, in which every other section is public lands, and the alternate sections are private and state-owned lands. While the Rock Springs Grazing Association (RSGA) (the primary private landowner in this area) had previously allowed wild horses to utilize their private lands, in 2011 they notified the BLM that wild horses were no longer welcome on their private lands and requested that the BLM remove them in accordance with Section 4 of the WFRHBA (16 U.S.C. 1334). This section of the Act requires the BLM to remove wild horses from private lands after receiving a written request from the landowner to do so.

This led to a legal challenge by the RSGA against the BLM in Rock Springs Grazing Association v. Salazar*, No. 11- CV-00263-NDF, (D. Wyo.). This proceeding was settled when on April 3, 2013, the United States District Court for Wyoming approved a Consent Decree and Joint Stipulation for Dismissal (hereafter referred to as the "Consent Decree"). The court found this decree to be a "fair, reasonable, equitable and adequate settlement of RSGA's claims against the BLM, and which does not on its face violate the law or public policy."*

In November 2013, the BLM conducted a gather in the Adobe Town and Salt Wells Creek HMAs to remove wild horses on public and private lands within the HMAs. During this gather the BLM removed 586 wild horses from private and public lands within these HMAs. The BLM treated 40 mares with Porcine Zona Pellucida-22 (PZP, a fertility control drug) and released them back into the Adobe Town HMA. Once wild horses had been removed to low AML, the BLM concluded gather operations leaving some wild horses still within the checkerboard portions of the HMA.

Following this gather the RSGA notified the BLM that they believed this gather was not conducted in accordance with the Consent Decree, which they felt required that the BLM remove all wild horses from the checkerboard lands. In response to this the BLM conducted a removal in September of 2014. The removal of all wild horses from the checkerboard was conducted solely under Section 4 of the WFRHBA. During this removal the BLM removed a total of 1,263 wild horses from the Adobe Town, Salt Wells Creek, and Great Divide Basin HMAs.

The decision to conduct the 2014 gather was challenged in American Wild Horse Preservation Campaign v. Jewell*, No 14-cv-152-NDF (D. Wyo.). On March 3, 2015, the U.S. District Court affirmed the BLM actions under the WFRHBA, but remanded the BLM actions under NEPA. The decision of the District Court was appealed to the United States Court of Appeals for the Tenth Circuit. On October 14, 2016, the Court of Appeals reversed the decision of the District Court, and held that BLM had violated both the WFRHBA and the Federal Land Management and Policy Act of 1976 (FLPMA). The Court of Appeals ruled that the BLM had erroneously relied on its authority to remove strayed animals on private lands under Section 4, to remove animals from public lands. The Court of Appeals also held that the BLM had violated FLPMA by failing to maintain AML within the HMAs.*

To comply with these decisions, BLM proposed in August 2017 to gather and remove excess wild horses to Low AML from the three HMAs. An Environmental Impact Assessment (EIS) was prepared in accordance with the National Environmental Policy Act (NEPA) to evaluate the environmental effects of the gather operations and population control methods to achieve and maintain the established AMLs. The EIS also evaluated the effects of removing horses from private lands outside of the HMA boundaries.

According to the Rawlins Resource Management Plan (BLM, 2008), the BLM's objectives are to:

> *1) Maintain wild horse populations within the AML of the HMA*
> *2) Manage wild horses to meet the Wyoming Standards for Healthy Rangelands*
> *3) Identify existing genotypes and phenotypes through recognized means of genetic evaluation and maintain genetic integrity*
> *4) Maintain the health of wild horse herds at a level that prevents adverse effects to domestic horse populations*
> *5) Maintain habitat for existing AMLs*
> *6) Conduct all activities in compliance with relevant court orders and agreements*

The BLM ultimately selected Alternative B: Remove Excess Animals to Lower Limit of AML without Fertility Control. Under this alternative (BLM, 2017):

> *Approximately 1,560 excess wild horses would be removed from the Adobe Town, Salt Wells Creek, and Great Divide Basin HMAs. Approximately 513 excess wild horses would be removed from the Adobe Town HMA, 725 excess wild horses would be removed from the Salt Wells Creek HMA and 322 excess wild horses would be removed from the Great Divide Basin HMA.*

According to the April 2017 census, the wild horse populations and HMA AMLs are as presented in Table 4.3-3. Additional information can be found in the complete BLM Environmental Assessment (Aug 2017) included in the digital library submitted with this report.

Table 4.3-3 Projected Population 2017.

2017 Statistically Corrected Census Counts		
HMA	**AML**	**April 2017 Census**
Adobe Town	610-800	1,123
Salt Wells Creek	251-365	976
Great Divide Basin	415-600	737
Total	1,276-1,765	2,836

[Table pulled directly from the BLM Environmental Assessment, August 2017]

4.3.2.5 Sage Grouse

The US Department of Interior decided in September of 2015 that the Greater Sage Grouse (Centrocercus urophasianus) does not require federal protection under the Endangered Species Act. However, it is still recognized as a sensitive species by the BLM and a Species of Greatest Conservation Need (SGCN) by WGFD. The sage grouse is not listed as a Threatened or Endangered species and does not receive any protections from the Endangered Species Act; however, BLM and WGFD have developed restrictions and recommendations to help protect the sage grouse.

In June 2008, Executive Order 2008-2 was signed by then Governor Freudenthal which stresses additional management consideration for sage grouse and sage grouse habitat statewide. This original executive order has been extended most recently by Executive Order 2015-4 signed by Governor Mead in July of 2015. The Order includes requirements of state agencies to encourage development outside of the Core areas and to focus management, to the greatest extent possible, on the maintenance and enhancements of habitat within them.

The most recently identified Core Sage Grouse Population Areas within the study area are delineated in Figure 4.3-15. According to WGFD, the overall goal of the Core Area delineations is to protect as many birds as possible while encompassing the least amount of acreage. This can cause occupied leks to fall outside of the identified Core Areas. As is evident in this figure, the Sage Grouse Core Areas affect a southern portion of the Bitter Creek watershed, east of Flaming Gorge Reservoir, and a small portion along the northern boundary. In total there are 429,680 acres of Sage Grouse Core Area located within the study area, making up 23.6% of the total watershed area. According to the 2017 lek data received from WGFD, there are a total of 40 occupied leks and 10 unoccupied leks within the Bitter Creek watershed study area. The regulations related to these leks are explained in Attachment B of Executive Order 2015-4 (included in the digital library of this report).

These regulations do not prevent project development within Core Areas. Core Area project developments could potentially have some restrictions to fall within the core area guidelines presented in Executive Order 2015-4, but the areas are not precluded from water development projects. Included in Appendix C of Executive order 2015-4 (included in the digital library delivered with this report) is a list of exemptions to core area regulations. Many of the water projects presented in this report fall under the exempted project types, with only minor seasonal construction restrictions if within proximity to an occupied lek. Exemptions pertinent to this study were extracted from Executive Order 2015-4 Appendix C and are listed below:

- *Drilling and outfitting of agricultural or residential water wells (including tank installation, pumps, and agricultural water pipelines) more than 0.6 miles from the perimeter of an occupied lek. Construction within 0.6 miles is allowed from July 1 through March 14, after a habitat evaluation has occurred, and provided development does not occur on the lek. New tanks shall have escape ramps.*
- *Construction of agricultural reservoirs, less than 10 surface acres and more than 0.6 miles from the perimeter of an occupied lek. Construction within 0.6 miles is allowed from July 1 through March 14, after a habitat evaluation has occurred, and provided that development does not occur on the lek.*

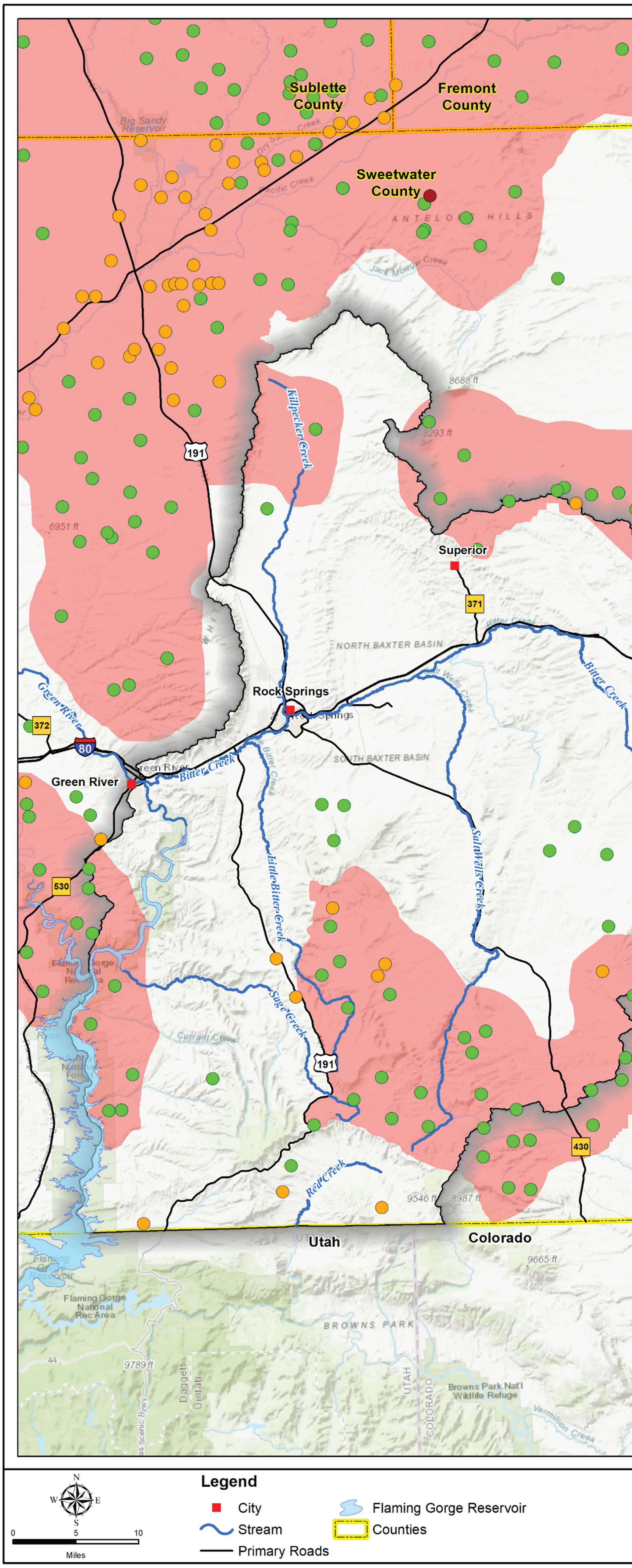


Figure 4.3-15 Bitter Creek/East Flaming Gorge Watershed: Sage Grouse Leks (2017) and Core Areas (Version 4)

- *Construction of aquatic habitat improvements, less than ten wetland or water surface acres, more than 0.6 miles from the perimeter of an occupied lek. Construction within 0.6 miles is allowed from July I through March 14, after a habitat evaluation has occurred, and provided development does not occur on the lek.*
- *Irrigation (excluding the conversion of sagebrush habitats to new irrigated lands).*
- *Spring development; if the spring is protected with fencing and enough water remains at the site to provide mesic (wet) vegetation. Fences should be constructed to be highly visible to Greater sage-grouse (i.e., buck-and-rail, steeljack, etc.) and/or marked to minimize collision potential.*

4.3.2.6 Sensitive Wildlife Species

The Wyoming Natural Diversity Database (WYNDD) lists numerous non-game species of concern within the watershed, including amphibians, birds, crustaceans, fish, insects, mammals, and reptiles. Originally initiated by the Nature Conservancy, the WYNDD became a research and service unit of the University of Wyoming in 1998. Appendix 4F presents the results of a database query conducted by the WYNDD for the watershed. Included in this list are all species of concern or species of potential concern which have been documented in the study area. The WYNDD lists several endangered species as being sighted within the watershed. The WYNDD database is a historic accumulation of information related to sightings within the study area. Most of the sightings of the black footed ferret are between 1979-1987, with one sighting in 2011. According to the WYNDD data collected this species is classified as "Listed Endangered – Nonessential Experimental Population (LEXN)". This status is given to species that have been reintroduced at some point at these locations. The regulations related to activities within areas with LEXN species are less stringent than within areas containing "Listed Endangered" species. Species that are "Listed Endangered" in this watershed include the Colorado Pikeminnow, Humpback Chub, Bonytail and Razorback Sucker.

Many of the SOC or SOPC are also identified by the Wyoming BLM as a Sensitive Species. The BLM definition of a Sensitive Species is as follows:

> *Species that could easily become endangered or extinct in the state, including:*
> *(a) species under status review by the FWS/National Marine and Fisheries Service;*
> *(b) species whose numbers are declining so rapidly that Federal listing may become necessary;*
> *(c) species with typically small or fragmented populations; and*
> *(d) species inhabiting specialized refuge or other unique habitats*

4.3.2.7 Areas of Critical Environmental Concern

The Wyoming BLM recognizes seven Areas of Critical Environmental Concern (ACEC) in the Bitter Creek/East Flaming Gorge Watershed (Figure 4.3-16). These areas are described by the BLM as follows:

> *"ACEC designations highlight areas where special management attention is needed to protect important historical, cultural, and scenic values or fish and wildlife or other natural resources.*

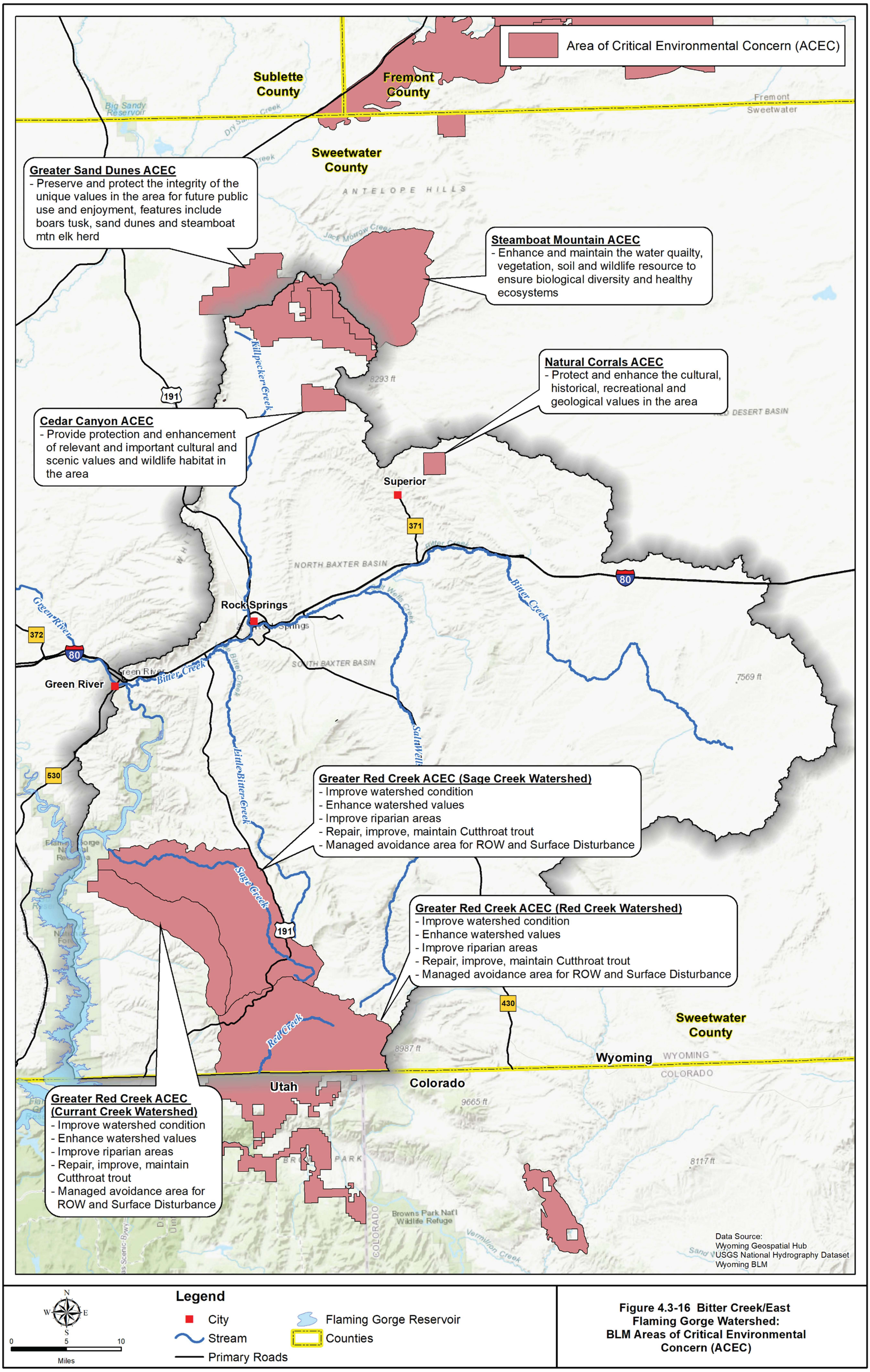


Figure 4.3-16 Bitter Creek/East Flaming Gorge Watershed: BLM Areas of Critical Environmental Concern (ACEC)

ACECs are areas within existing public lands that require special management to protect important and relevant values. ACECs are evaluated through land use planning using the best available information and extensive public involvement."

The protection measures, management strategies, and type of activities allowed within an ACEC depend on the resource or natural value the area is designated to protect. The ACEC areas within the Bitter Creek/East Flaming Gorge watershed are listed below. Additional details for each ACEC are shown in Figure 4.3-15.

- Greater Sand Dunes ACEC
- Steamboat Mountain ACEC
- Natural Corrals ACEC
- Cedar Canyon ACEC
- Greater Red Creek ACEC (Sage Creek Watershed)
- Greater Red Creek ACEC (Red Creek Watershed)
- Greater Red Creek ACEC (Currant Creek Watershed)

Data Sources:

U.S. Fish and Wildlife Service: https://www.fws.gov/
Wyoming Game and Fish Department: https://wgfd.wyo.gov/
Wyoming Natural Diversity Database: http://www.uwyo.edu/wyndd/
Wyoming BLM: https://www.blm.gov/office/rock-springs-field-office
Wyoming Wildlife Federation: https://wyomingwildlife.org/

4.4 Anthropogenic Systems

4.4.1 Agricultural Water Use

4.4.1.1 Irrigated Lands

Irrigation activities within the study area are primarily located in the southern portion of the watershed, as indicated on Figure 4.4-1. The irrigated acres are sparsely distributed along Sage Creek, Currant Creek, Salt Wells Creek, Little Bitter Creek, and their tributaries. Irrigated acres were digitized using 2015 aerial photography and included in the project GIS. Based upon this effort, the total irrigated acreage within the study area is approximately 2,564 acres, less than 1% of the watershed. The Wyoming State Engineer's Office (WSEO) reports 170 points of diversion in the study area. The USGS report, "Water Resources of Sweetwater County", states that irrigation is the largest water use in the county, accounting for more than 50 percent of total water use. Appendix 4G contains tabulated surface water rights within the study area.

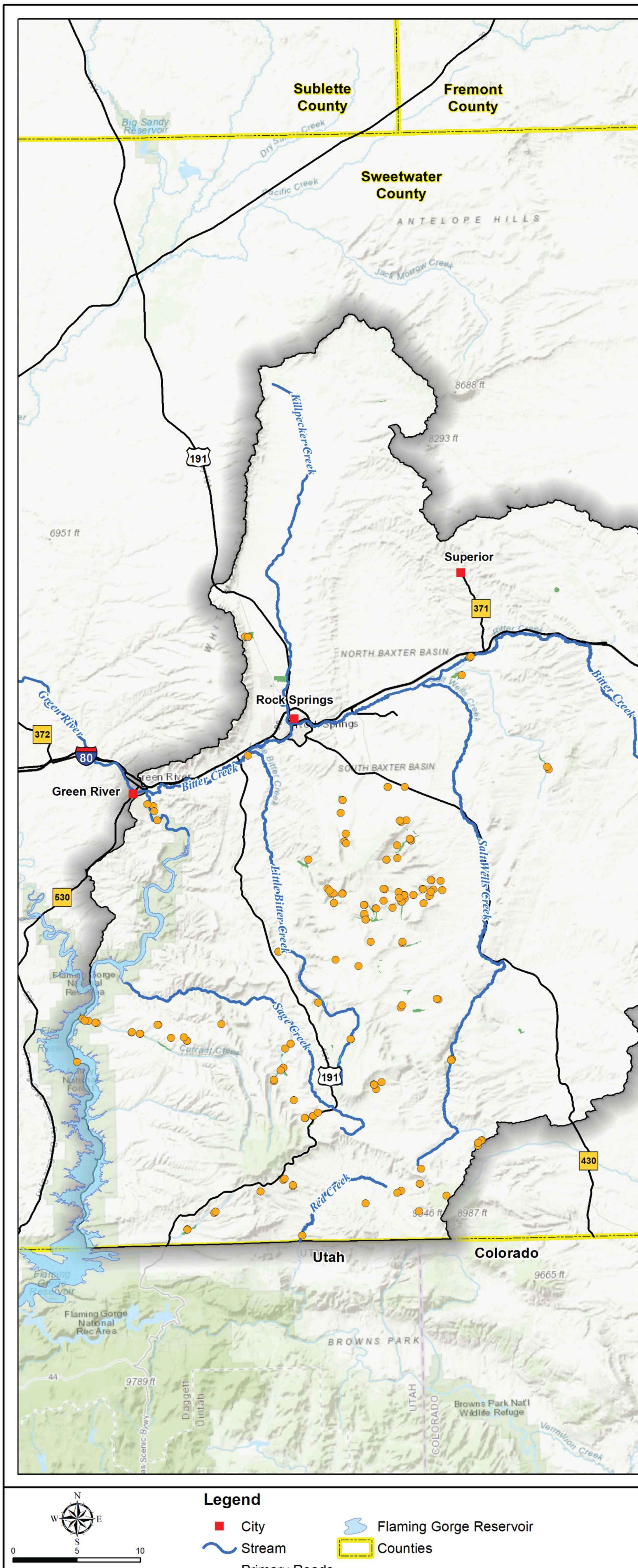


Figure 4.4-1 Bitter Creek/East Flaming Gorge Watershed: Points of Diversion and Irrigated Lands

The irrigated lands in the study area are predominantly in hay or irrigated pasture. According to Pochop (1992), the crop irrigation requirement is approximately 23.57 inches, or 1.97 feet. Therefore, the total crop irrigation requirement (CIR) in the study area is approximately 5,051 acre feet (2564 acres x 1.97 feet CIR = 5,051 acre feet). The irrigated lands mapping effort attributed 2,024 acres with flood irrigation (55% efficient) and the remaining 560 acres with various sprinkler irrigation methods (85%). The weighted average irrigation efficiency is therefore approximately 61%. Typical ditch efficiencies in the area are between 40% and 60%. Using an average ditch efficiency of 50% (i.e, half of the diverted water is lost to seepage and evaporation) and the irrigation efficiency of 61%, the estimated total irrigation usage is 16,560 acre feet (5,051 acre feet CIR / 0.61 irrigation efficiency / 0.50 ditch efficiency = 16,560)

Typically, the full growing season in most of the study area extends from mid-May to late September, with the period from mid-July to the end of September defined as late-season when irrigation water shortages frequently occur. Water supplies are more abundant in April, May and June in typical years because of high volumes of snow melt runoff. The supply of irrigation water in the basin is substantially reduced during late July, August, and September as snowmelt slows and ceases.

Wyoming water law normally allows the diversion of 1 cfs per 70 acres of irrigated land, although 2 cfs per 70 acres may be diverted during surplus water conditions subject to priority dates governing surplus water. Of course, there typically is enough water in the river to supply all the diversions. When the water supply is insufficient, water right priorities restrict diversions for junior priority ditches.

Because of return flows, the total volume of diversions along a stream can exceed the stream's natural flow, since the water is being recycled. Irrigation also directly affects a stream's hydrologic regime by reducing flows at times through diversions and increasing flows at other times with delayed irrigation returns.

4.4.1.2 Irrigated Systems

There are no irrigation districts within the study area, and very little extensive irrigation systems. There are, however, numerous small privately owned and maintained ditches serving a limited number of acres. Based upon a review of surface water rights in the study area, typical ditch systems have a conveyance capacity of 1 to 5 cubic feet per second (serving 70 to 350 acres). Structures observed during the completion of this study were typically small, aged and in poor to fair condition.

Data Sources:

Wyoming State Engineers Office (WSEO): *http://seo.wyo.gov/home*
Wyoming Water Development: Office (WWDO): *http://wwdc.state.wy.us/*
Pochop, 1992: Consumptive Use and Consumptive Irrigation Requirements in Wyoming

4.4.2 Domestic, Municipal, and Industrial Water Use

4.4.2.1 Potable Water Systems

Municipal and domestic uses are a relatively small portion of the water use in the Bitter Creek/East Flaming Gorge Reservoir Watershed since the area is sparsely populated.

According to the 2016 Wyoming Public Water System Survey Report provided by the Wyoming Water Development Commission (WWDC), the Green River/Rock Springs/Sweetwater County Joint Powers Water Board (JPWB) sells water to the cities of Green River, Rock Springs, three water and sewer districts, and Simplot Phosphates. The JPWB serves approximately 41,500 people and obtains their primary water supply from the Green River. The water is directly diverted from the river and treated at a conventional water treatment plant (ozone pretreatment, bio-filtration, and post chlorination). The treatment plant has a system capacity of 32 million gallons per day (97 acre-ft per day), and the JPWB has 20,500,000 gallons of treated water storage. A pipeline from the water treatment plant in Green River can carry a maximum of 15 million gallons per day (98.2 acre-ft per day) to Rock Springs, Reliance, White Mountain, Clearview, and Ten-Mile. The total annual water use by the system is 3,770,000,000 gallons, and the peak day demand is 23,500,000 gallons (WWDC, 2016). This converts to approximately 11,570 acre feet per year.

The town of Superior obtains their primary water supply from groundwater, namely the Erickson Sandstone aquifer. The system includes three groundwater wells with an approximate depth of 1,700-feet, and a conventional water treatment plant. The Town of Superior serves approximately 336 people, using 15,800,000 gallons per year (48.5 acre feet) with a peak day demand of 120,000 gallons. The system capacity is 430,000 gallons per day, and the town has a raw water storage capacity of 150,000 gallons (WWDC, 2016).

Domestic uses include rural homes, rural subdivisions, commercial establishments, parks, campgrounds, and other smaller uses which are not hooked up to municipal and industrial water supply systems. These small domestic establishments are almost exclusively supplied by groundwater. The number of people served by municipal water suppliers is deducted from county populations to estimate the population served by domestic groundwater wells or independent public water supply systems.

4.4.2.2 Industrial and Mining

[Power plants account for approximately 70 percent of industrial water use in the Study area. . The Jim Bridger Power Plant, owned and operated by PacifiCorp, is located east of Superior in the Bitter Creek watershed. The plant uses steam for power production and has its own water storage facilities. It also uses water in cooling, dust abatement, plant washdown, and domestic use. The Jim Bridger Power Plant is the largest industrial water user in the study area and uses approximately 28,560 acre-ft per year. Simplot Phophates (Rock Springs, WY) produces chemical fertilizer and obtains water from the JPWB, using approximately 605 acre-feet per year.

The remaining industrial water usage in the project study area is consumed by coal mining and the oil and gas industries. These industries obtain their primary water supply from groundwater. There are 131 groundwater right permits with industrial use listed as a permitted use in the project study area. , but there is no requirement to report actual water use on many of the permits The total potential groundwater withdrawal of these wells based upon the water right database is approximately 11,062 acre feet per year.

Data Sources:

USGS: Estimated Use of Water in the United States County-Level Data for 2015
Wyoming Water Development: Office (WWDO): *http://wwdc.state.wy.us/*

4.4.3 Water Storage

4.4.3.1 Reservoirs

A reservoir database was constructed by downloading reservoir storage rights from the Wyoming State Engineers ePermit system. The database was then incorporated into the project GIS for evaluation. Figure 4.4-2 displays the results of the effort. Included in this figure are all permitted reservoirs except for stock reservoirs which are evaluated in Section 4.4.3.2 of this report.

Except for Flaming Gorge Reservoir, which serves as the western boundary of the project study area, there are no major reservoirs, there are only three major reservoirs (greater than 500 ac-ft storage capacity) within the project. These are industrial reservoirs associated the Jim Bridger Power Plant.

There are only eleven (11) reservoirs permitted for irrigation usage. All are small with storage capacity ranging from less than one acre-foot to 17.6 acre-feet.

4.4.3.2 Upland Water Storage

There are numerous upland water supply sources (springs, wells, perennial streams, etc.) within the watershed, and many range improvement projects have been completed which utilize these sources. Typical projects include livestock/wildlife water tanks, livestock/wildlife reservoirs, spring developments with pipelines providing water to remote stock tanks, well construction, etc. Figure 4.4-3 displays a map of viable livestock/wildlife water sources. This GIS dataset shown in the figure was prepared by combining information from several sources:

1. Mapping of stock reservoirs and other watershed improvements (i.e., pipelines, and stock tanks) was obtained from the Rock Springs Field Office of the BLM and the USFS.
2. Stock reservoir locations were obtained from the Wyoming State Engineer's Office.
3. Well locations were obtained from the Wyoming State Engineer's Office (SEO). Wells designated for stock watering use were included in the database.

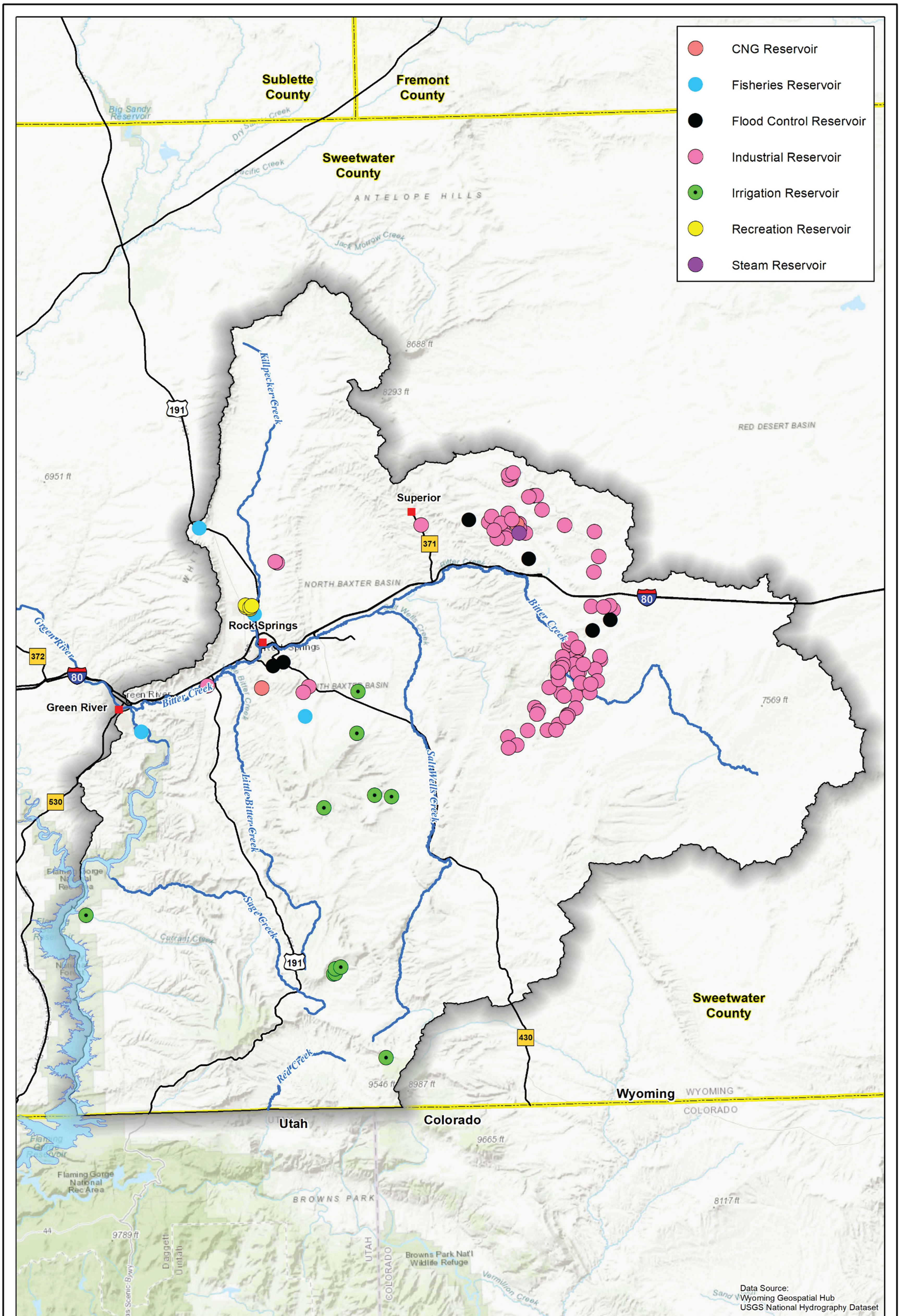
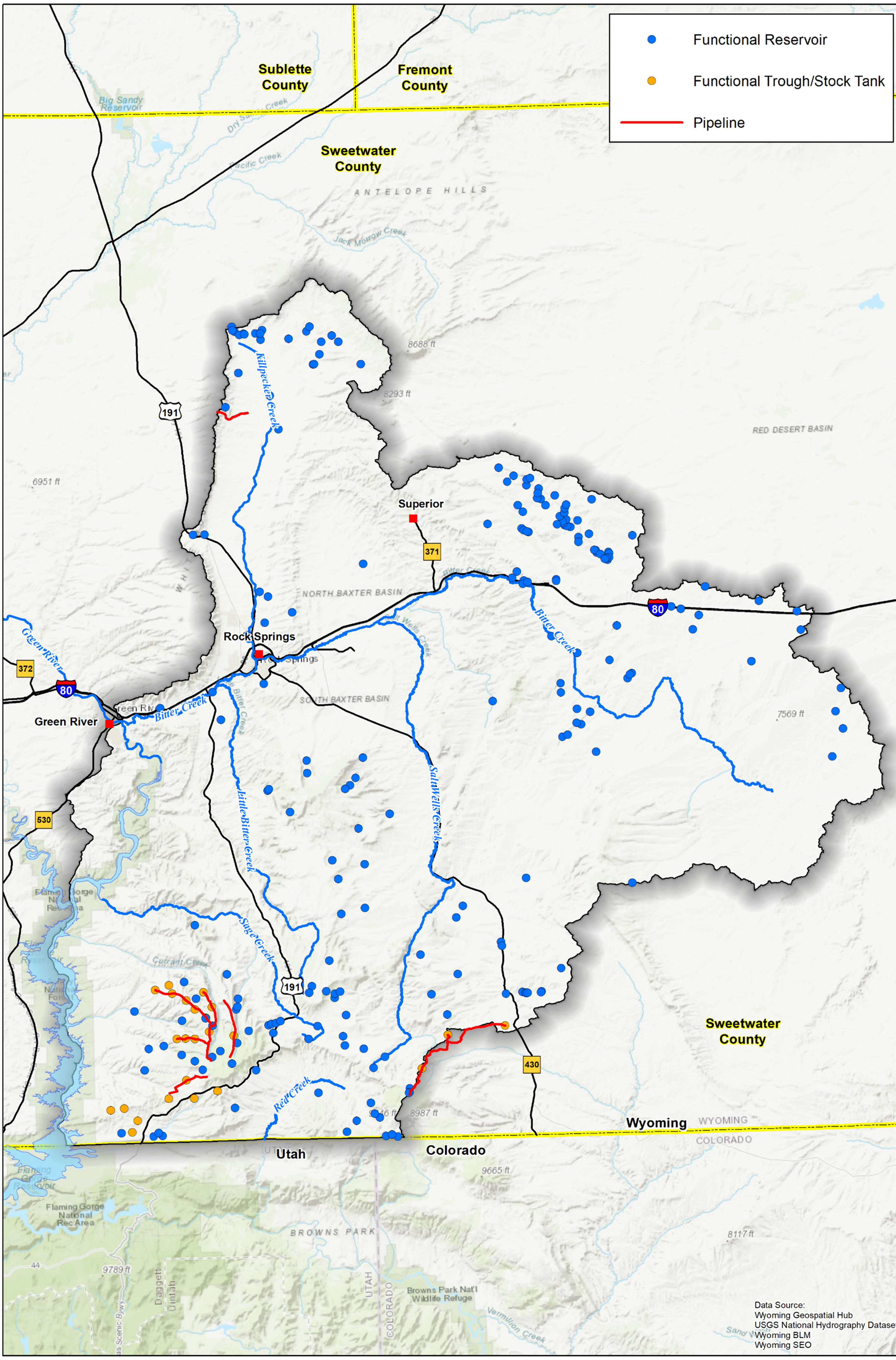


Figure 4.4-2 Bitter Creek/East Flaming Gorge Watershed: Non-Stock Reservoirs



Legend
- City
- Stream
- Primary Roads
- Flaming Gorge Reservoir
- Counties

Miles 0 5 10

Figure 4.4-3 Bitter Creek/East Flaming Gorge Watershed: Existing Functional Water Sources

5. Interviews with landowners were conducted during project meetings and in the field. During these interviews, locations of existing sources were documented, and the information was incorporated into the project GIS.
6. Aerial photography was reviewed within the GIS environment to document visible features (i.e. stock reservoirs) and give an initial assessment of their condition.

Mapping of springs was also obtained from both BLM and the USFS. These data include springs unpermitted by the WSEO. However, springs were not included in the upland water source dataset because there was insufficient information to determine if the spring provided a location where livestock/wildlife could physically drink or not. These data are, however, available within the Project GIS for later review, use, and analysis.

The results of this effort indicated there are 440 stock reservoirs/ponds in the watershed. Field inspection of these sites was beyond the scope and budget of this project; however, a reasonable estimate of the viability of the reservoirs and stock tanks was desired.

To refine and improve the quality of the stock reservoir features, an evaluation of each reservoir's viability was made by overlaying their locations on aerial photography (July-August 2009, July 2011, July-August 2012, and June-September 2015) and viewing the condition of each. Reservoirs containing water in multiple years of photography or showed no signs of physical breaches or sedimentation were determined to be functional water sources. Physical breaches were visible on several of the reservoirs resulting in a classification of "non-functional". Likewise, if a reservoir was visibly filled with sediment it also classified as "non-functional". Reservoirs containing water in one year of photography or showed no visible signs

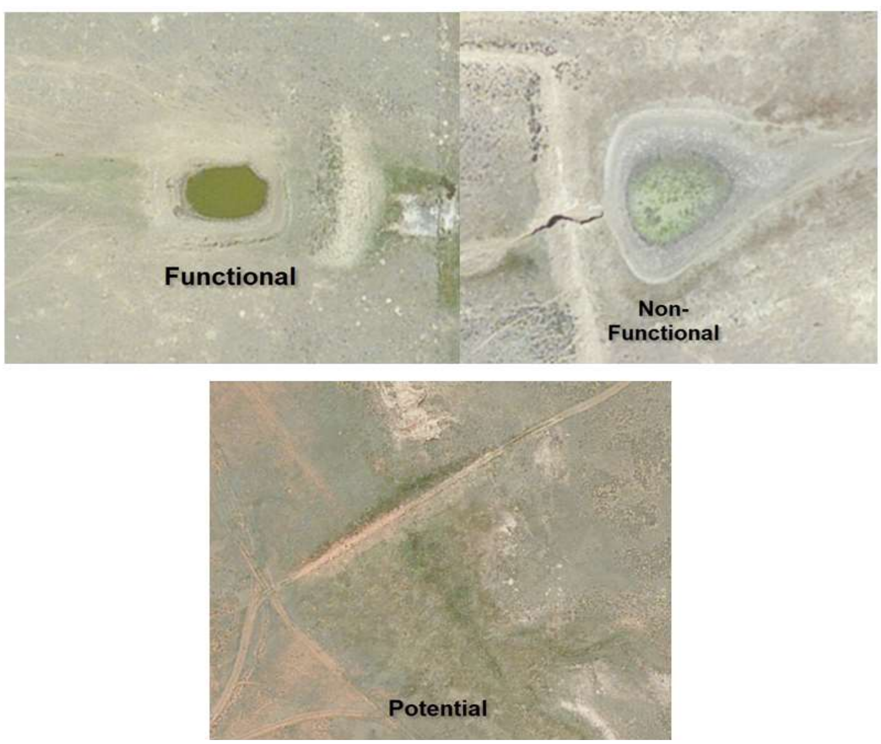


Figure 4.4-4 Evaluation of Stock Reservoirs within the GIS Environment.

of damage were classified as “potential” water sources, as firm conclusions on water reliability could not be drawn. Figure 4.4-4 displays an example of this process.

Based upon this analysis, it appears that of the 440 reservoirs identified:

- a minimum of 215 reservoirs are “working” water sources,
- 46 are “potential” water sources, and
- 179 reservoirs are “nonfunctional” water sources.

Figure 4.4-5 presents the results of this analysis and Appendix 4H presents the results in a tabular format.

Note that the dataset displayed in Figure 4.4-3 does NOT include surface water sources such as perennial streams, intermittent streams, or springs. A primary objective of this study is to evaluate opportunities to provide wildlife and livestock water in addition to those sources. Because they do not presently appear to provide sources of water to livestock or wildlife, reservoirs and stock tanks classified as “potential” or “non-functioning” are also not included in the figure.

This GIS dataset is not expected to be an exhaustive accounting of all available sources. Field mapping and validation of all sources within the watershed was beyond the scope and feasibility of this study.

4.4.4 Land

4.4.4.1 Land Use

Mine Permits

At the time of this report, there were twenty-two active mines within the study area on record with the WDEQ Land Quality Division (Table 4.4-1). Most of the active permits are associated with sand and/or gravel operations (15 permits). In addition to these, four Coal mines, one Leucite mine, one Scoria mine, and one Zeolite mine currently active within the study area. Figure 4.4-6 displays the locations of these mines. Active coal mines cover 78,813 acres in the study area (4.3% of the watershed).

Management Implications:

Mining and mineral extraction operations produce economic value to a community and region but can also contribute to ecological and environmental impacts. It is important to consider the locations of such disturbances for assignment of impairment load allocation and when assessing and evaluating current natural resource condition for design and implementation of conservation practices

Data Sources:

Wyoming Department of Environmental Quality Land Quality Division: http://deq.wyoming.gov/lqd/

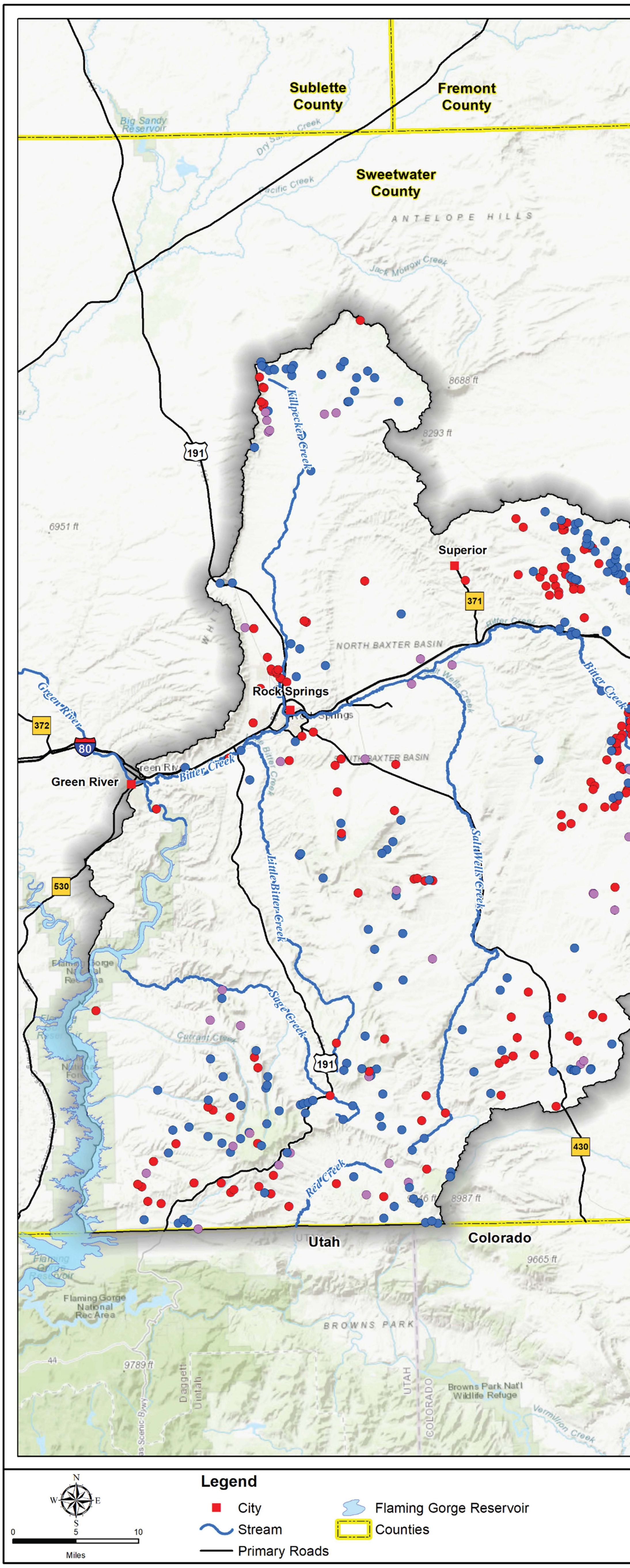


Figure 4.4-5 Bitter Creek/East Flaming Gorge Watershed: Reservoir Analysis

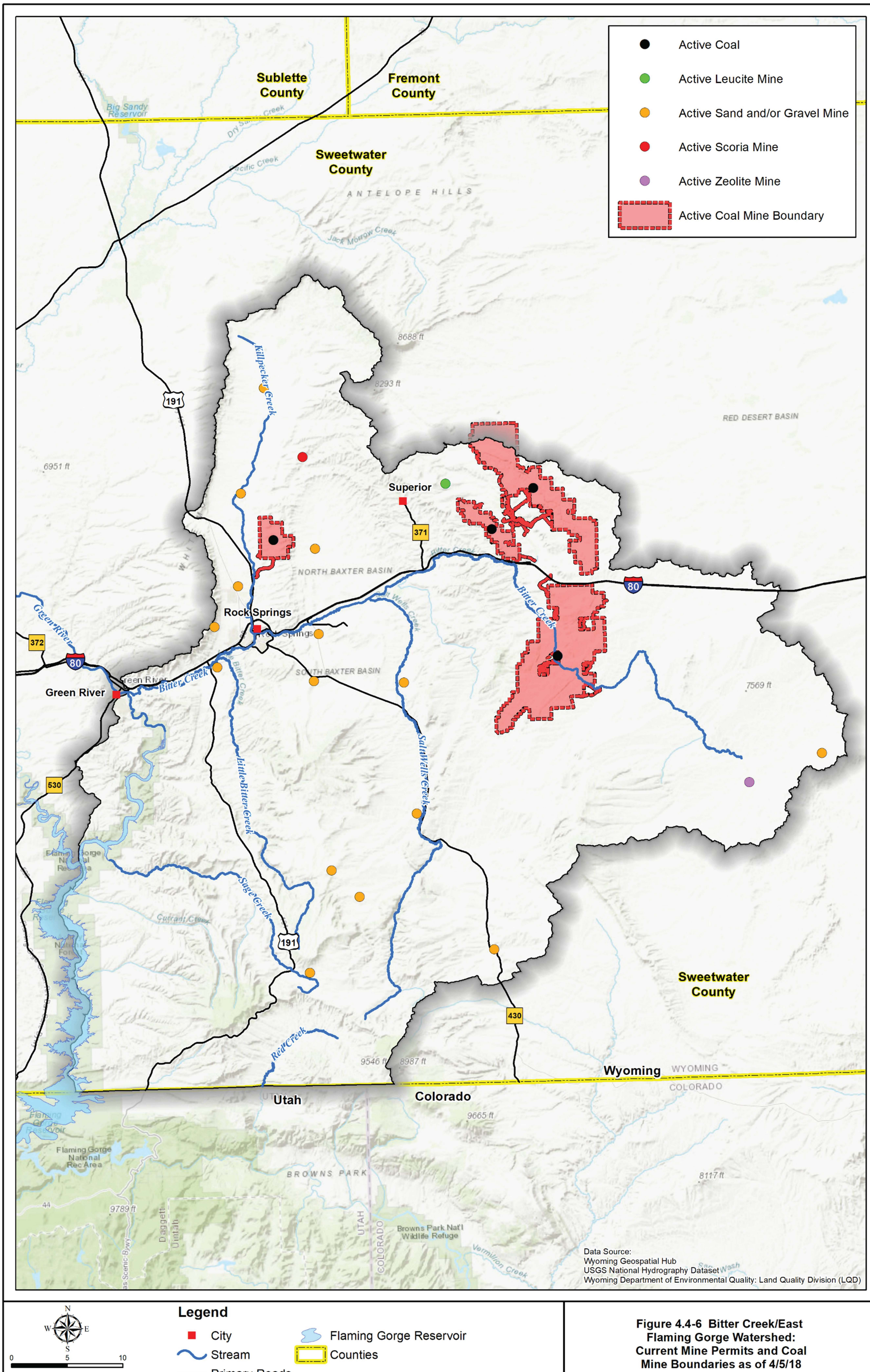


Figure 4.4-6 Bitter Creek/East Flaming Gorge Watershed: Current Mine Permits and Coal Mine Boundaries as of 4/5/18

Table 4.4-1 Tabulation of Existing Mine Permits (WDEQ, 2016).

Permit Number	Company Name	Mine Name	Mine Type	Mineral	Acres	Status
ET0959	WYLIE CONST INC	WYLIE	Limited Mine Operation (ET)	Sand & Gravel	5	Active
ET1226	BASIC ENERGY SERV LP	N/A	Limited Mine Operation (ET)	Sand & Gravel	10	Active
SP0812	SEARLE BROS CONSTRUCTION CO	LEUCITE	Small Mine (SP)	Leucite	96.11	Active
ET0941	SEARLE BROS CONST CO	N/A	Limited Mine Operation (ET)	Scoria	10	Active
SP0566	NEW MEXICO RESOURCES LLC	BITTER CREEK	Small Mine (SP)	Zeolite	90	Active
PT0467	BLACK BUTTE COAL CO	BLACK BUTTE	Large Mine (PT)	Coal	42420.9	Active
PT0264	ROCKY MOUNTAIN COAL CO LLC	STANSBURY	Large Mine (PT)	Coal	5501.2	Active
PT0338	BRIDGER COAL CO	JIM BRIDGER	Large Mine (PT)	Coal	28673.7	Active
PT0520	BLACK BUTTE COAL CO	LEUCITE HILLS	Large Mine (PT)	Coal	6728.73	Active
SP0455	Sweetwater County	15 MILE KNOLL	Small Mine (SP)	Sand & Gravel	N/A	Active
SP0455	Sweetwater County	BEAN SPRINGS	Small Mine (SP)	Sand & Gravel	N/A	Active
SP0455	Sweetwater County	BLUE RIM	Small Mine (SP)	Sand & Gravel	N/A	Active
SP0455	Sweetwater County	IVAN RAY	Small Mine (SP)	Sand & Gravel	N/A	Active
SP0455	Sweetwater County	JY ROAD	Small Mine (SP)	Sand & Gravel	N/A	Active
SP0455	Sweetwater County	LABARGE ROAD	Small Mine (SP)	Sand & Gravel	N/A	Active
SP0455	Sweetwater County	M.P. 430 SOUTH	Small Mine (SP)	Sand & Gravel	N/A	Active
SP0455	Sweetwater County	SALT WELLS ROAD	Small Mine (SP)	Sand & Gravel	N/A	Active
SP0455	Sweetwater County	SOUTH BAXTER	Small Mine (SP)	Sand & Gravel	N/A	Active
SP0455	Sweetwater County	JOYCE CREEK	Small Mine (SP)	Sand & Gravel	N/A	Active
SP0455	Sweetwater County	TITSWORTH GAP	Small Mine (SP)	Sand & Gravel	N/A	Active
SP0455	Sweetwater County	LONG CANYON 2	Small Mine (SP)	Sand & Gravel	N/A	Active
SP0455	Sweetwater County	MIDDLE BAXTER	Small Mine (SP)	Sand & Gravel	N/A	Active

Transportation, Energy and Communications Infrastructure

Primary paved transportation routes traversing the study area are shown on Figure 4.4-7. Interstate 80 (I-80) bisects the watershed, running east to west. US-191 travels along the western portion of the watershed from north to south, passing through the city of Rock Springs. Wyoming State Route 371 runs north from I-80 to the town of Superior. Wyoming State Route 430 travels from the southeast portion of the watershed, along Salt Wells Creek, to the city of Rock Springs.

There are several other improved roads within the watershed but much of the transportation network is made up of unimproved roads of varying quality. Access can be difficult throughout most of the study area during winter or wet conditions. The project GIS contains mapping of improved and unimproved roads in much greater detail than can be displayed at the scale of this figure.

Figure 4.4-7 also shows the railroad corridors within the watershed. The main active line is the Union Pacific line that runs east to west along Bitter Creek, sometimes parallel with I-80. There is also a railroad which follows Killpecker Creek north out of Rock Springs, and a railroad which serves the Jim Bridger Power Plant, east of Superior.

Communications towers are located throughout the watershed; however, they are clustered around Green River and Rock Springs, which are the major population centers within the study area.

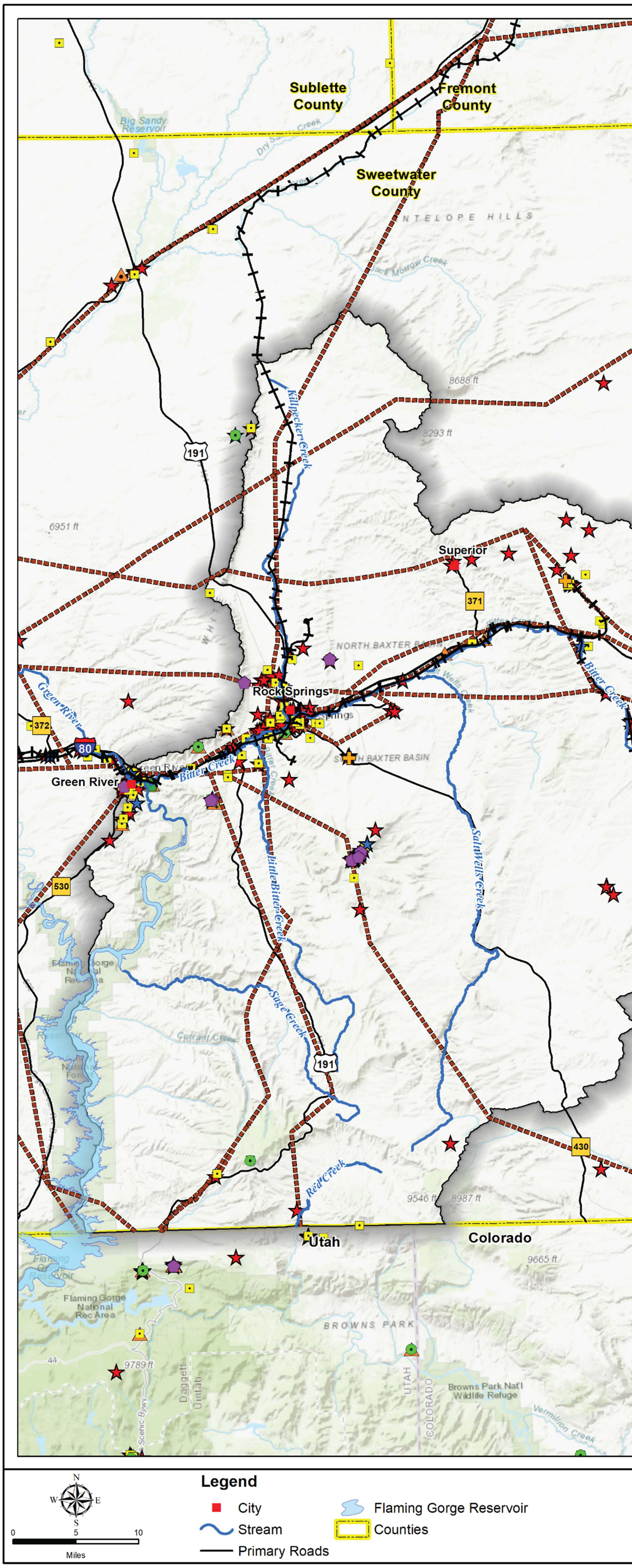


Figure 4.4-7 Bitter Creek/East Flaming Gorge Watershed: Transportation, Energy and Communications Infrastructure

There are two power generation facilities within the study area. The Jim Bridger Plant (east of Superior) is a coal power plant owned by Pacificorp that can generate 2,318 megawatts per hour with four units. The Simplot Phosphates coal power facility generates 11.5 megawatts per hour for internal use.

Several electric transmission corridors are located within the study area, primarily located in the northern and western portions of the watershed. Mapping of the lines provided by WyGISC is intentionally coarse in nature with poor accuracy; presumably for security reasons. Consequently, the lines indicated on Figure 4.4-7 are approximations of alignment only.

Using detailed mapping data obtained from the SWCCD, an analysis was performed to investigate the density of unpaved road distribution throughout the watershed. Figure 4.4-8 shows the road mileage per section (square mile), omitting hard paved roads, subdivision roads, the interstate, and supporting infrastructure. Paved roads were excluded from this evaluation because the focus of the effort was on potential sediment delivery to surface waters. Stormwater runoff from paved roads certainly has its own impacts in terms of higher runoff volumes and hydrologic impacts, water quality, etc.

Although population is very low in this watershed, a few sections have more than 10 miles of roads per square mile. There are several active and abandoned oil and gas wells in the watershed (further discussed below). High road density seems to correlate with the location of the wells. For example, several oil and gas wells are located on the east side of the watershed near I-80, where there are multiple sections with 8+ miles of road. There are also several sections between Little Bitter Creek and Salt Wells Creek and along US-191 where there is a high density of oil and gas wells.

The SWCCD, BLM, and other participating entities are currently addressing the issue of road density and redundancy in a proactive manner. According to the Rock Springs District, BLM:

"The BLM is completing a Comprehensive Travel and Transportation Management Plan concurrently with the Rock Springs Resource Management Plan revision. The BLM policy for travel and transportation management (BLM Manual 1626) focuses on providing access to and across public lands for a variety of users. Toward that end, the BLM compiled an inventory of routes within the Rock Springs Field Office and evaluated each route using an interdisciplinary team. More than 18,539 miles of inventory routes were identified and then split into more than 33, 919 segments for further evaluation. The BLM then added these route evaluations to the ongoing RMP revision and analyzed impacts under each alternative to determine the future management of these routes. The entire comprehensive travel management plan will be available with the RMP Draft Environmental Impact Statement, currently scheduled for public release in December 2018."

The issue of road closure is a complicated process and must involve land owners, land management agencies, and consideration of access, property rights, and land use in addition to environmental considerations. Unimproved and "unintentional" roads can lead to excess sediment delivery to surface waters and loss of vegetation, soil, and habitat resources.

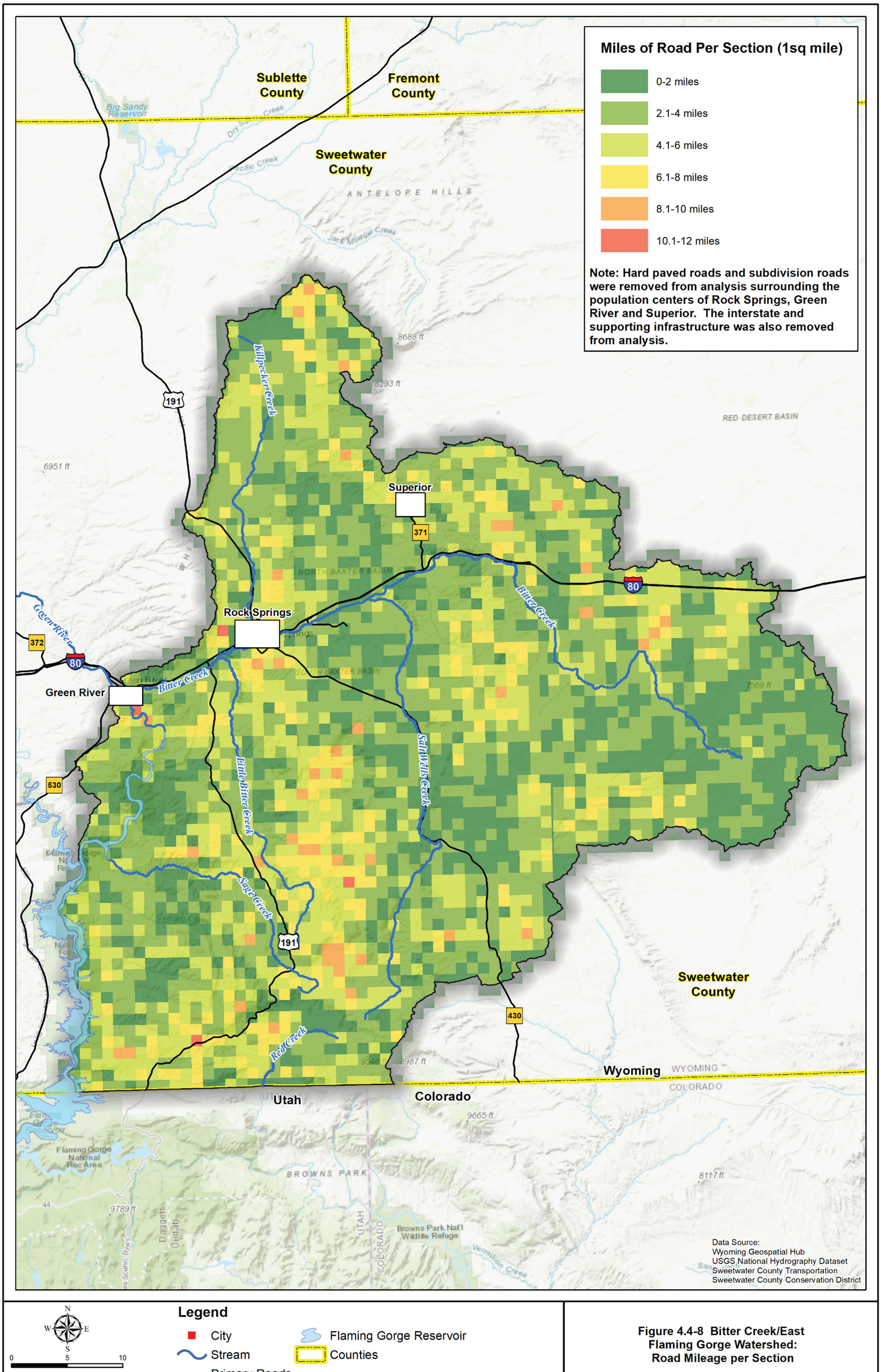


Figure 4.4-8 Bitter Creek/East Flaming Gorge Watershed: Road Mileage per Section

Management Implications:

Coordination with WYDOT and/or Sweetwater County Road and Bridge Department could be required for implementation of many watershed plan components. Crossing existing roads with pipelines or other improvements can be problematic with respect to permitting and can potentially add significant costs to a project. Coordination would be required to determine costs and methods of construction (i.e., trenching, boring, etc.).

Whenever possible, project conceptual designs have been developed with the intention of avoiding road and energy transmission line crossings to minimize costs and permitting issues. However, there will be cases where the greater effort and costs associated with crossing a road or a pipeline could provide significant benefits to the project owner.

Data Sources:

Wyoming Geographic Information Science Center (WyGISC- Geospatial Hub): *http://geospatialhub.org/*
Wyoming State Geological Survey (WSGS): *http://www.wsgs.wyo.gov/pubs-maps/gis*
Federal Communications Commission: *https://catalog.data.gov/dataset/fcc-geographic-information-systems*

Oil and Gas Production and Resources

There are numerous pipelines within the study area for natural gas and other fuel products. As shown on Figure 4.4-9, many of the pipelines are located along the main transportation route I-80, including the only product pipeline in the study area. Most of the pipelines are for natural gas, although there are some CO_2 and Crude oil pipelines as well. A CO_2 pipeline and Crude Oil pipeline cross the northernmost portion of the watershed, traveling in parallel. There is also a CO_2 pipeline along US-191, and a crude oil pipeline in the eastern portion of the watershed.

The locations of all active and permanently abandoned oil and gas wells were obtained from the Wyoming Oil and Gas Conservation Commission (WOGCC). Active wells and permanently abandoned wells within the study area are shown on Figure 4.4-10.

In 2012, USGS staff digitized the disturbed areas associated with well pads within the area in conjunction with the Wyoming Landscape Conservation Initiative (WLCI). Within the project study area, there were 1,780 “pad scars” averaging 2.5 acres and ranging from approximately 0.05 acres to 53.8 acres. These features include both active and inactive sites. Figure 4.4-11 displays a selected portion of the watershed near the Bitter Creek townsite where there is a predominance of well pads. The total area delineated was 4,443.8 acres in 2012. It is important to note that the USGS data layer depicts a “snapshot” in time and that today there are certainly more well pads as the energy industry continues to develop new wells. consists of well pad scars only; access roads and other infrastructure are not included.

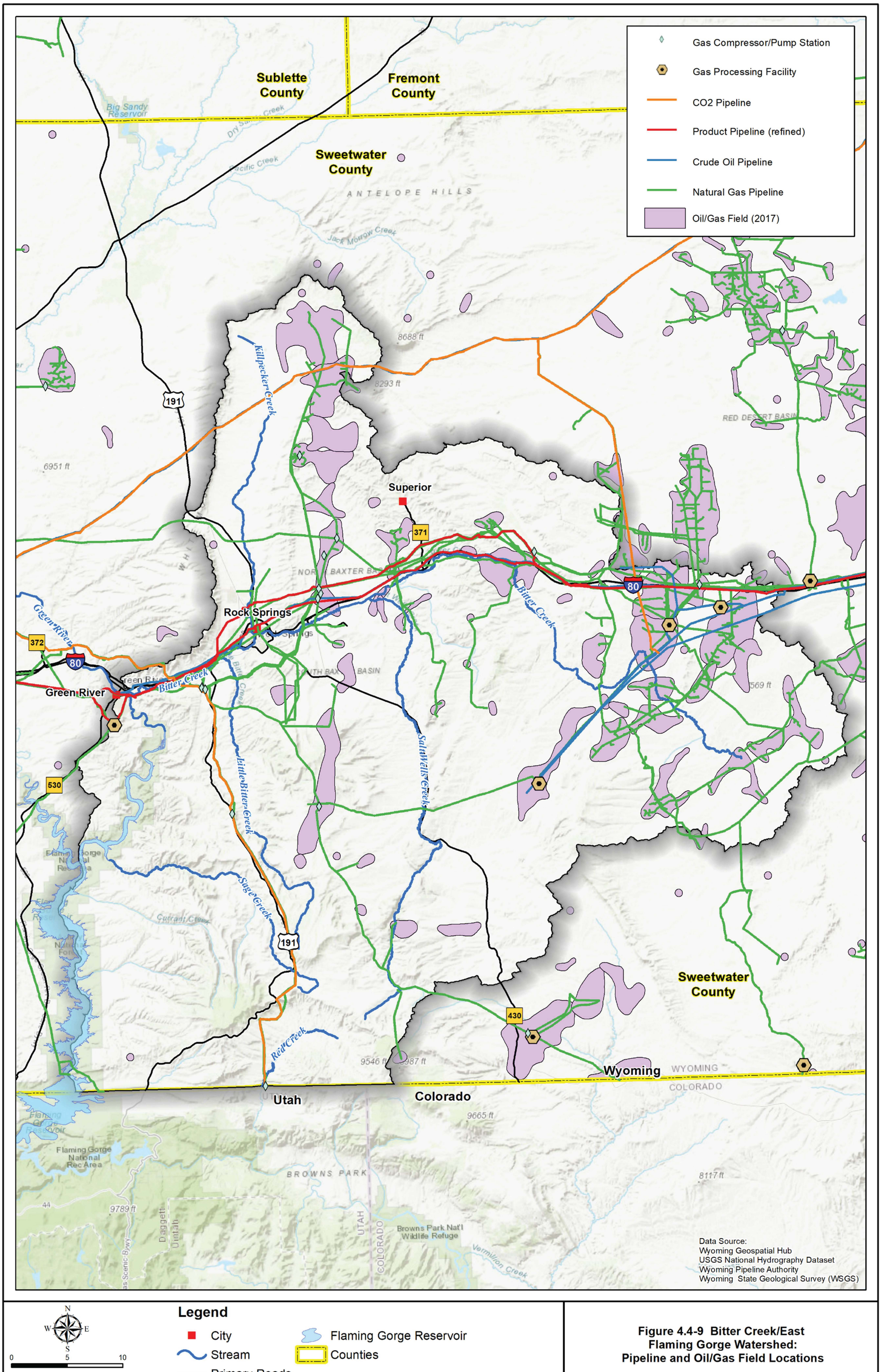


Figure 4.4-9 Bitter Creek/East Flaming Gorge Watershed: Pipeline and Oil/Gas Field Locations

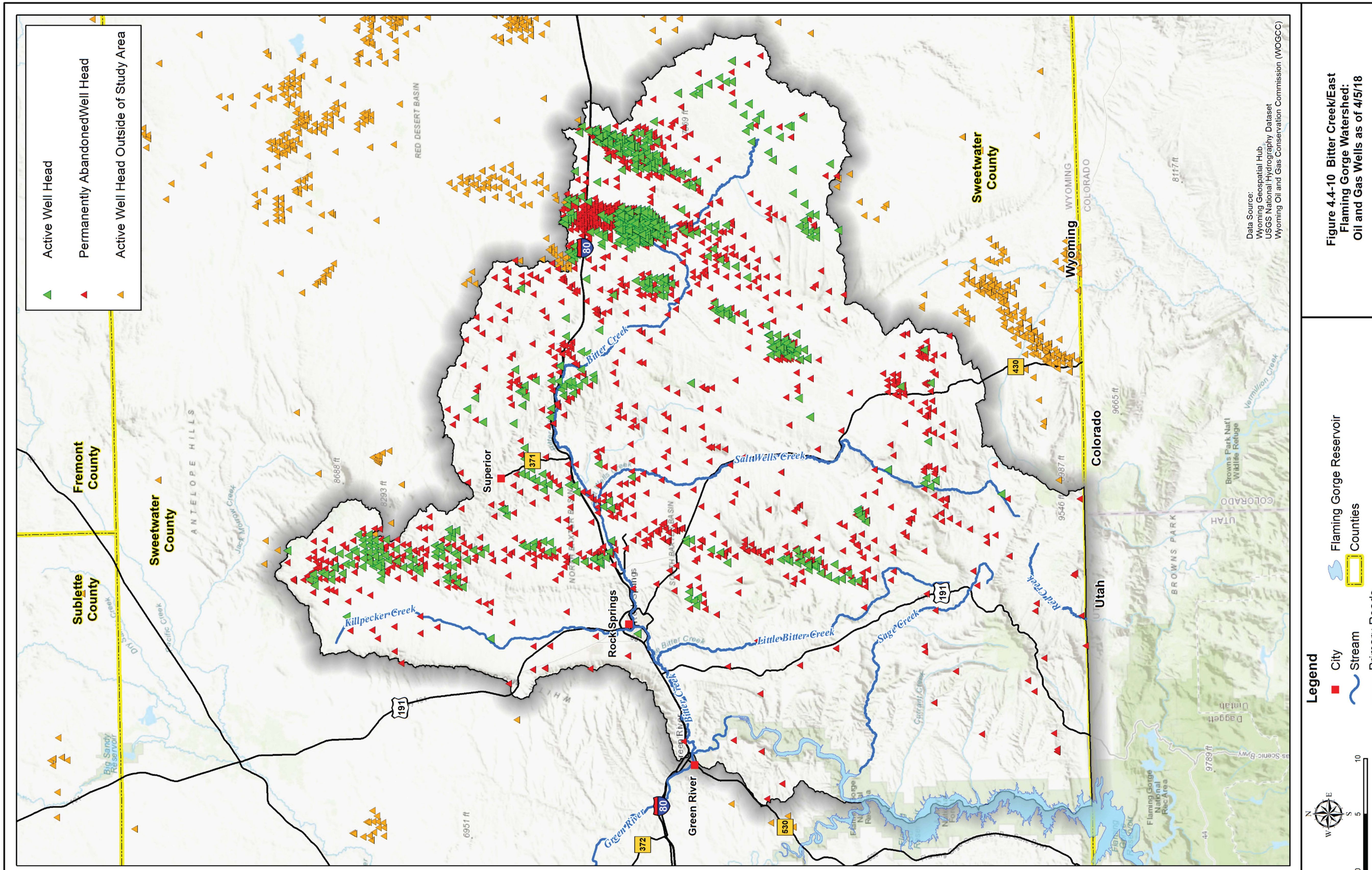


Figure 4.4-10 Bitter Creek/East Flaming Gorge Watershed: Oil and Gas Wells as of 4/5/18

Figure 4.4-11 Example of USGS Delineation of Oil and Gas Well Pad Scars.

The USGS then evaluated the vegetative cover on each well pad scar using satellite imagery and assessing various spectral layers to estimate the relative vegetative cover of each. Figure 4.4-12 displays a frequency histogram of the results. As indicated in this figure there is a range of vegetative cover on the well pad scars ranging from 0 percent vegetative cover to nearly 100 percent. The poorly vegetated well pad scars and the roads associated with the energy industry appear to present a significant source of sediment within the study area.

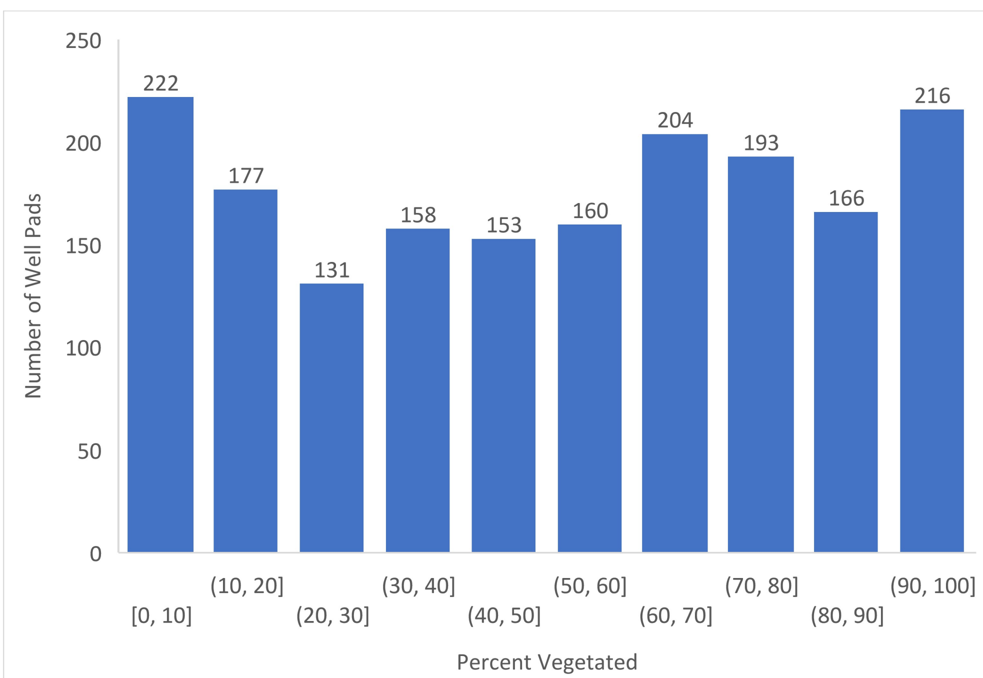


Figure 4.4-12 Frequency Histogram of Vegetative Cover on 2012 Well Pad Scars.

Data Sources:

United States Geological Survey: https://ngmdb.usgs.gov/
Wyoming Oil and Gas Conservation Commission: *http://wogcc.state.wy.us/*
Wyoming State Geological Survey (WSGS): *http://www.wsgs.wyo.gov/*

4.4.4.2 Land Ownership

The Bitter Creek/East Flaming Gorge study area is completely within Sweetwater County, WY. The total land area within the project study area is approximately 1,824,090 acres (2,850 square miles). Land ownership information was obtained from the Bureau of Land Management (BLM) and the Sweetwater County Assessor's office. Figure 4.4-13 presents a map indicating the various land ownership categories within the watershed. According to this data, lands managed by the Bureau of Land Management dominate the ownership profile (Figure 4.4-14):

- Bureau of Land Management: 1,584 square miles (55.6 percent of the study area),
- Private Lands: 1,104 square miles (38.7 percent of the study area),
- State of Wyoming: 102 square miles (3.6 percent of the study area),
- United States Forest Service: 42 square miles (1.5 percent of the study area),

(Note that the remaining 18 square miles or 0.6 percent of the study area is categorized as water bodies)

The project study area is centrally located in the area commonly referred to as the "checkerboard". The "checkerboard" is a pattern of land ownership represented by alternating sections of federal and private properties. This pattern is a remnant of the Union Pacific Act of 1862 with which Congress granted

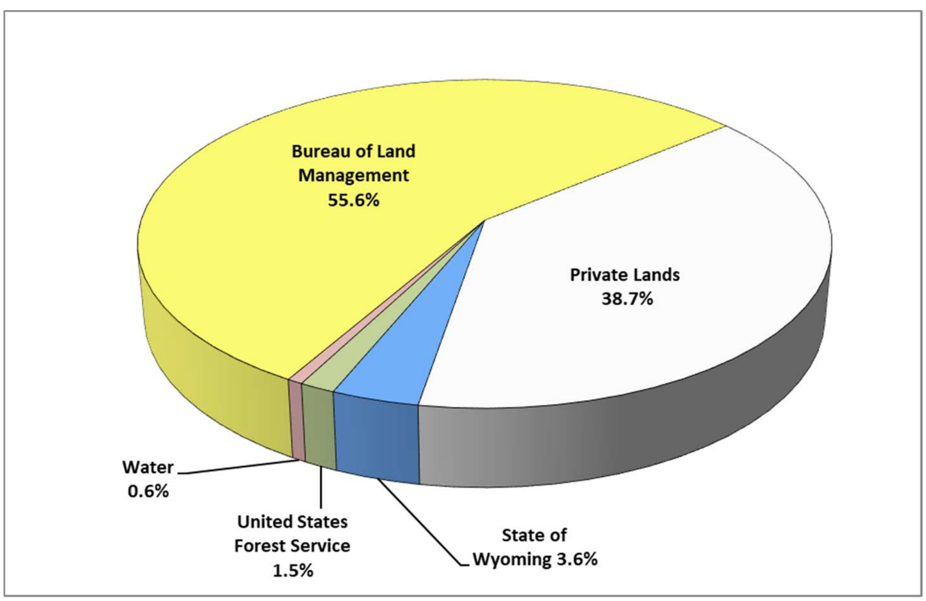
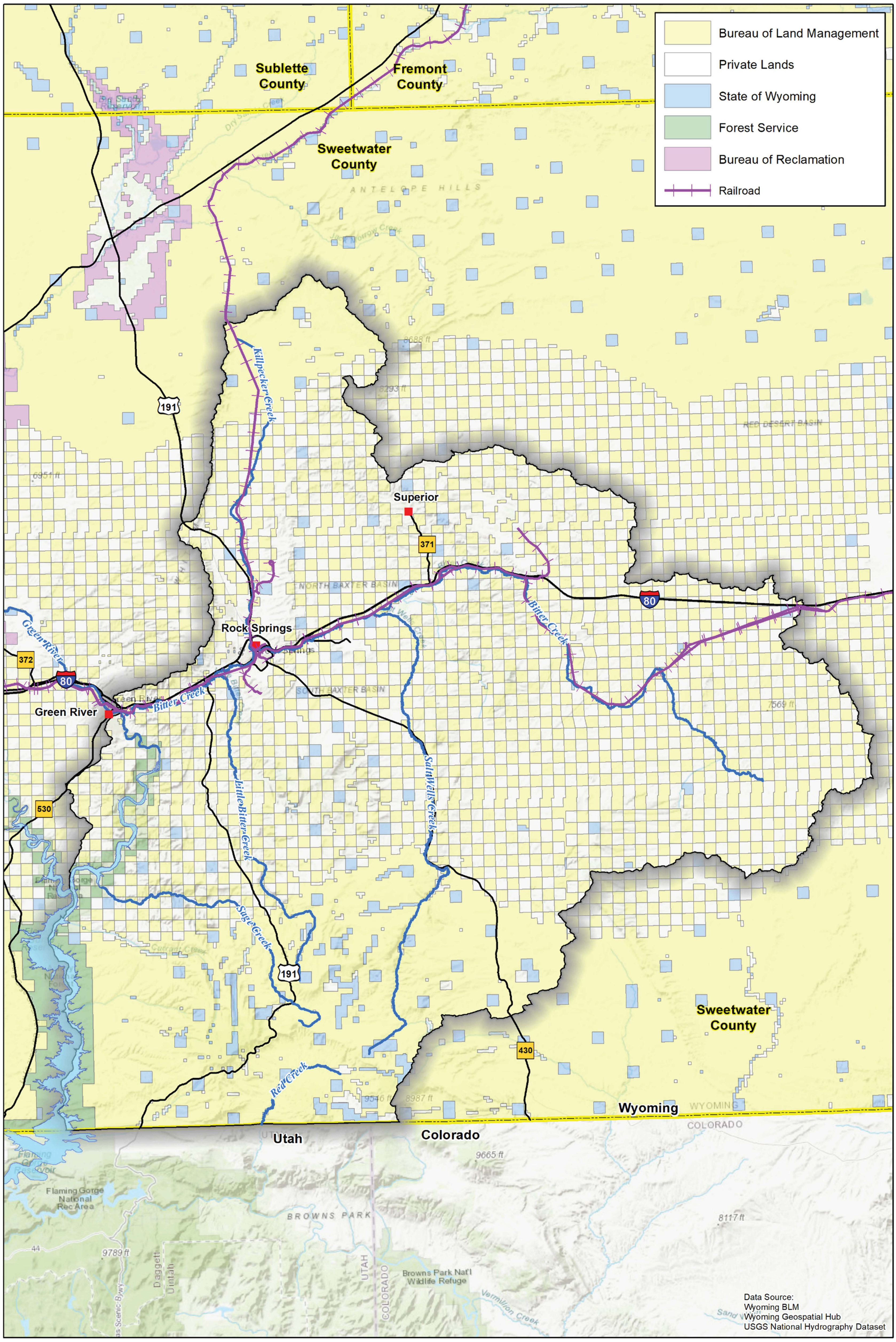


Figure 4.4-14 Distribution of Land Ownership within the Bitter Creek/East Flaming Gorge Study Area.



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Miles

Legend

- City
- Stream
- Primary Roads
- Flaming Gorge Reservoir
- Counties

Figure 4.4-13 Bitter Creek/East Flaming Gorge Watershed: Land Ownership

every other section (one square mile) of land within ten miles of the railroad to the Union Pacific, which tried to sell it to raise capital for railroad construction. The strip along the railroad was later extended to twenty miles. The premise was that land values would increase following railroad construction and that the railroad company could then sell the land at a profit (BLM, 2014 at www.blm.gov).

Management Implications:

Land ownership has direct implications to the watershed study and implementation of proposed watershed improvements. Most of the land within the study area (61%) is either federally or state owned, while the remaining 39% is privately owned. On the federally owned lands, project implementation will require coordination with the BLM, or USFS for permitting and easements. Depending upon the nature of the proposed project or management activity, the National Environmental Policy Act (NEPA) process may be initiated. Likewise, project implementation on State lands will require permitting through the Wyoming Board of State Lands and Investments. Proposed projects or management activities on private lands may simplify the permitting efforts. Chapter 9: Permitting provides descriptions of potential permitting requirements, application information, and agency contact tabulations.

Data Sources:

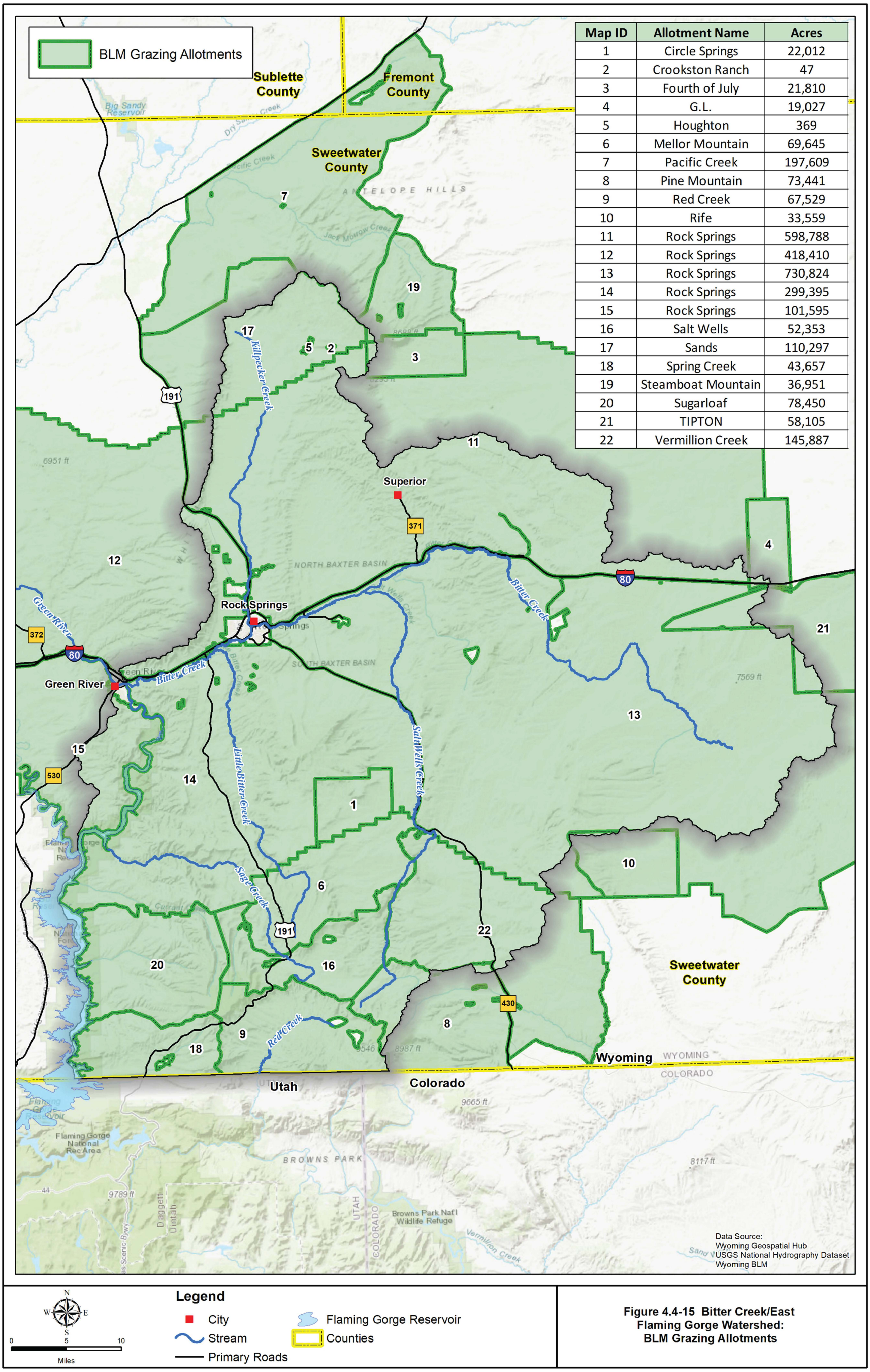
BLM Navigator: http://www.co.albany.wy.us/gis-map-property-data-download.aspx
Sweetwater County Assessors Data (Must contact assessor):
https://www.sweet.wy.us/departments/assessor/index.php

4.4.4.3 Land Management and Upland Water Resources

Grazing - Bureau of Land Management

Grazing on federal lands within the Bitter Creek watershed is administered by the Bureau of Land Management. The Rock Springs Resource Management Plan (RMP) provides a comprehensive framework for managing and allocating use of public lands and resources administered by the BLM. The RMP was approved in 1997, and it is currently in the process of being renewed and updated. The completion and approval date of the RMP is uncertain at this time. Until it is approved, the 1997 RMP governs BLM's management of the area.

There are 21 BLM allotments located within the study area as indicated in Figure 4.2-15. All these allotments are administered by the BLM Rock Springs Field Office except for one (Tipton) that is administered by the BLM Rawlins Field Office. The Sands Allotment, located in the upper reach of Killpecker Creek, is in an area that is primarily BLM lands. Mellor Mountain, Red Creek, Salt Wells, Sugarloaf and Vermillion Creek allotments in the southern part of the watershed study area are also primarily BLM lands. Circle Springs and the Rock Springs allotments, adjacent to the I-90 corridor, are in an area commonly referred to as the "checkerboard".



Map ID	Allotment Name	Acres
1	Circle Springs	22,012
2	Crookston Ranch	47
3	Fourth of July	21,810
4	G.L.	19,027
5	Houghton	369
6	Mellor Mountain	69,645
7	Pacific Creek	197,609
8	Pine Mountain	73,441
9	Red Creek	67,529
10	Rife	33,559
11	Rock Springs	598,788
12	Rock Springs	418,410
13	Rock Springs	730,824
14	Rock Springs	299,395
15	Rock Springs	101,595
16	Salt Wells	52,353
17	Sands	110,297
18	Spring Creek	43,657
19	Steamboat Mountain	36,951
20	Sugarloaf	78,450
21	TIPTON	58,105
22	Vermillion Creek	145,887

Figure 4.4-15 Bitter Creek/East Flaming Gorge Watershed: BLM Grazing Allotments

According to the BLM Allotment Information Report, the BLM manages rangelands throughout the west for the use of wildlife and livestock. These lands are divided into allotments and pastures for management purposes. The BLM produces a Rangeland Administration System (RAS) that provides grazing administrative support and management reports. These reports include allotment and operator information including allotment identification, size, amount of private, state and public land administered, amount of forage use authorize, proportion of forage in the allotment produced on public land, existence of an allotment management plans and identification of the grazing operator(s). Additional information includes authorization number, name, address and date the authorization was issued, expiration date, kind and number of livestock permitted, and period of use and forage amount authorized for use by the operator.

The 21 BLM allotments within this watershed study area involve approximately 3,180,000 acres of public land. They range in size from 47 acres (Crookston Ranch) to 2,149,000 acres (Rock Springs). There are over 164,000 Animal Use Months (AUM's) of livestock grazing authorized over this land area averaging 0.05 AUM/acre. In addition, there are feral horses and multiple species of wildlife that make use of the natural resources within the study area. Eight allotments have an issued Allotment Management Plan (AMP).

According to the 1997 RMP, BLM classifies grazing allotments with consideration given to their improvement potential and anticipated needs for intensive management. "Improve" allotments receive the highest priority and "Custodial" allotments receive the lowest priority. This classification system has reportedly become outdated. Until the 1997 RMP revisions are completed and adopted, the classification system remains the existing guideline for classifying allotments and documenting their overall conditions. As described in the 1997 RMP:

> *"Management will be implemented in "I" category allotments to maintain or improve wild horse, wildlife, watershed, vegetation, and soils resource conditions. Management in "M" category allotments will be directed toward maintenance of resource conditions. Management in "C" allotments will be directed towards monitoring resource conditions. All AMP's will incorporate desired plant community objectives and riparian objectives where such resources exist. Grazing systems will be designed to maintain or improve plant diversity and will be implemented on all I category allotments. AMPs will be written or modified for I category allotments. AMPs for M category allotments will not be modified unless monitoring and evaluation indicate a change in management is needed or riparian objectives need to be included. Riparian objectives will also be developed for C category allotments where riparian values exist."*

There are 11 allotments that are in an "Improve" category, 2 with a "Custodial" category, and 7 with a "Maintain" category.

The RMP provides a comprehensive framework for managing and allocating use of public lands and resources. Under the umbrella of this plan, management of BLM grazing allotments is carried out in accordance with the principles of multiple use and sustained yield embodied in the Federal Land Policy and Management Act (1976) and the Taylor Grazing Act (1934). More information describing the BLM's grazing management standards and guidelines can be found online at: [http://www.blm.gov/wy/st/en/programs/grazing.html.](http://www.blm.gov/wy/st/en/programs/grazing.html)

Within the Bitter Creek watershed study area, 11 of the 21 allotments are in Category A, 4 are in Category B, 1 in Category C, and 5 in Category D. These categories are in accordance with the following categorization schema:

- Category A – Rangelands meeting all standards or making significant progress toward meeting the standard.
- Category B – Rangelands not meeting all standards or making significant progress toward meeting the standards, but appropriate action has been taken to ensure significant progress toward meeting the standards (livestock is a significant factor).
- Category C – Rangelands not meeting standards or making significant progress toward meeting the standards, and no appropriate action has been taken to ensure significant progress toward meeting the standards (livestock is a significant factor).
- Category D – Rangelands not meeting all standards or making significant progress toward meeting the standards due to causes other than livestock grazing.

The BLM's grazing management guidelines which are pertinent for this watershed study include the following objectives (BLM, 1997):

- Ensure that conditions after grazing use will support infiltration, maintain soil moisture storage, stabilize soils, release sufficient water to maintain overall system function, and maintain soil permeability rates and other appropriate processes;
- Restore, maintain, or improve riparian plant communities to sustain adequate residual plant cover for sediment capture and groundwater recharge.
- Implement riparian improvements to maintain or enhance stream channel morphology.
- Develop springs, seeps, reservoirs, wells or other water development projects in a manner protective of watershed ecological and hydrological functions.

Grazing - Rock Springs Grazing Association

A significant portion of the Bitter Creek drainage is privately owned. Included in the "checkerboard", these private lands are owned and controlled by Rock Springs Grazing Association, (RSGA), Anadarko and other landowners. In the late 1800's and early 1900's, much of what is the "checkerboard" was being used as free range by migratory sheep bands. Local land owners and livestock operations recognized the need to manage these grazing lands through controlling livestock numbers and time of use. This resulted in incorporating into the RSGA.

Livestock are managed within a common allotment system where BLM and RSGA jointly manage livestock grazing. The winter grazing season is primarily RSGA use from December 1 to May 1 for sheep. Summer grazing is generally cattle associated with individual BLM permittees.

A management challenge in the area is to recognize species of concern such as sage grouse and the consideration of policy restrictions for stubble height requirements. With annual precipitation of less than 9 inches per year, achieving a forage growth height according to the regulation for sage grouse cover may be an unrealistic and challenging situation. Also, ability to affect change of use, or ability to modify BLM grazing permits from sheep to cattle or cattle to sheep, is an administrative action that is very difficult.

A significant issue for RSGA and BLM that has been of concern for decades within the watershed is feral horses. According to the BLM Decision Record from the 2017 Environmental Assessment, the Appropriate Management Level is 1,276 to 1,765 horses. This is the maintenance number established to achieve a Thriving Natural Ecological Balance for the Adobe Town, Salt Wells Creek and the Great Divide Basin Herd Management Areas (HMA). According to the Fall 2017 BLM Wild horse Census, there is an estimated 2,917 horses in the above mentioned HMA's. Wild horses graze year-round and concentrate and impact resource availability for livestock and wildlife. According to RSGA management:

> *"SGA was organized in 1909 for the purpose of providing winter grazing for the livestock owned by its shareholders from December 15 to May 1. Since its inception in 1909, RSGA has managed livestock to conserve rangeland resources, including reducing sheep grazing on its lands from 800,000 to 310,000 in its first ten years of existence. In order to achieve maximum forage growth, RSGA members grazed their livestock only in the winter, with the exception of a few inholders. By grazing only in the winter, the Checkerboard provides ample habitat for wildlife.*
> *Over the years, RSGA has bought or leased more than one million acres of private land within the Checkerboard that is generally the odd-numbered sections. Following the enactment of the Taylor Grazing Act ("TGA"), 43 U.S.C. §§315-315n (1934), RSGA qualified for the permits to graze the public lands of the Checkerboard, which consisted of the even-numbered sections. Thereafter RSGA has continued to implement its grazing system on both private and public lands within the Checkerboard, emphasizing conservation of rangeland resources.*
>
> *The Wild Free-Roaming Horse and Burros Act ("WHA"), 16 U.S.C. §§1331-1340 (1971), provided that wild horses would be "considered in the area where presently found, as an integral part of the natural system of the public lands." 16 U.S.C. §1331. However, BLM's continued failure to appropriately manage the wild horses across the Checkerboard has frustrated RSGA's conservative grazing management and caused ecological degradation across the range in southwestern Wyoming, on both public and private lands.*
>
> *RSGA routinely raises conservation issues with BLM as it has a direct interest in the protection of rangeland resources within the Checkerboard. Not only does RSGA care about the resources on the public lands where its shareholders graze pursuant to the RSGA permit, but because of the land ownership pattern, all decisions that BLM makes with regards to public lands directly impact*

the rangeland resources on RSGA's private lands, and vice versa. Fencing of private land in the Checkerboard land ownership pattern would unlawfully exclude others from the public land in violation of federal law. See Unlawful Enclosures of Public Lands Act, 43 U.S.C. §§1061-1066; 43 C.F.R. §9239.2-2 (prohibiting fences that enclose public lands). Even if it were not illegal, it is also impractical and would be prohibitively expensive to fence the privately-owned sections."

4.4.4.4 Cultural Resources

The Wyoming State Historic Preservation Office (SHPO) maintains an in-progress database of inventoried historic sites within the state. A determination of each site's eligibility for inclusion in the National Register of Historic Places (Register) is included in the database. SHPO also has created a spatial data file which "generalizes" the cultural resource inventory. This "location fuzzing" of the historically significant data is to protect the sites from unauthorized disturbance. The attributes recorded for each section of the Public Land Survey System include: site count, inventory acres, report numbers, and eligible site number. Figure 4.4-16 displays the results of the database retrieval in a graphical format. Each square mile section within the study area has been color coded based upon the number of sites within it determined to be eligible for inclusion on the Register.

The National Register of Historic Places (National Register) is the nation's official list of cultural resources worthy of preservation. It is administered on a federal level by the National Park Service and managed locally by the Wyoming State Historic Preservation Office (SHPO). The National Register is part of a program to coordinate and support both public and private efforts to identify, evaluate, and protect historic and archeological resources. The National Register recognizes the accomplishments of those who have contributed to the history and heritage of the United States, the state, and local communities.
Listing a property on the National Register of Historic Places is a form of acknowledgment and prestige, which places no restraints on the property. This classification does not restrict the rights of property owners to use, develop, or sell the property. Although placing a property on the National Register is intended to neither stop alterations to a building nor require owners to provide the public access to the property, it can provide the owner with eligibility for certain financial incentives (NPS, 2016 at *https://www.nps.gov/nr/national_register_fundamentals.htm*).

To date, 14 sites within the study area have been included in the National Register (see Table 4.4-2). Full descriptions of these sites are available from the National Park Service website located at: *http://npgallery.nps.gov/nrhp/*.

In addition to the historic places mentioned in Table 4.4-2, BLM has mapped the historic trails in Wyoming. Figure 4.4-17 displays the historic trails and sites listed on the National Registry of Historic Places within the study area. The Overland Trail enters the watershed from the east, and traverses through the center of the watershed, passing through the Rock Springs and Green River and intersecting two other historic trails. The Overland trail intersects the Cherokee Trail – Northern Route in Rock Springs and intersects the Point of Rocks/South Pass trail at the Point of Rocks Stage Station. The Cherokee Trail – Southern Route also crosses the southern portion of the watershed.

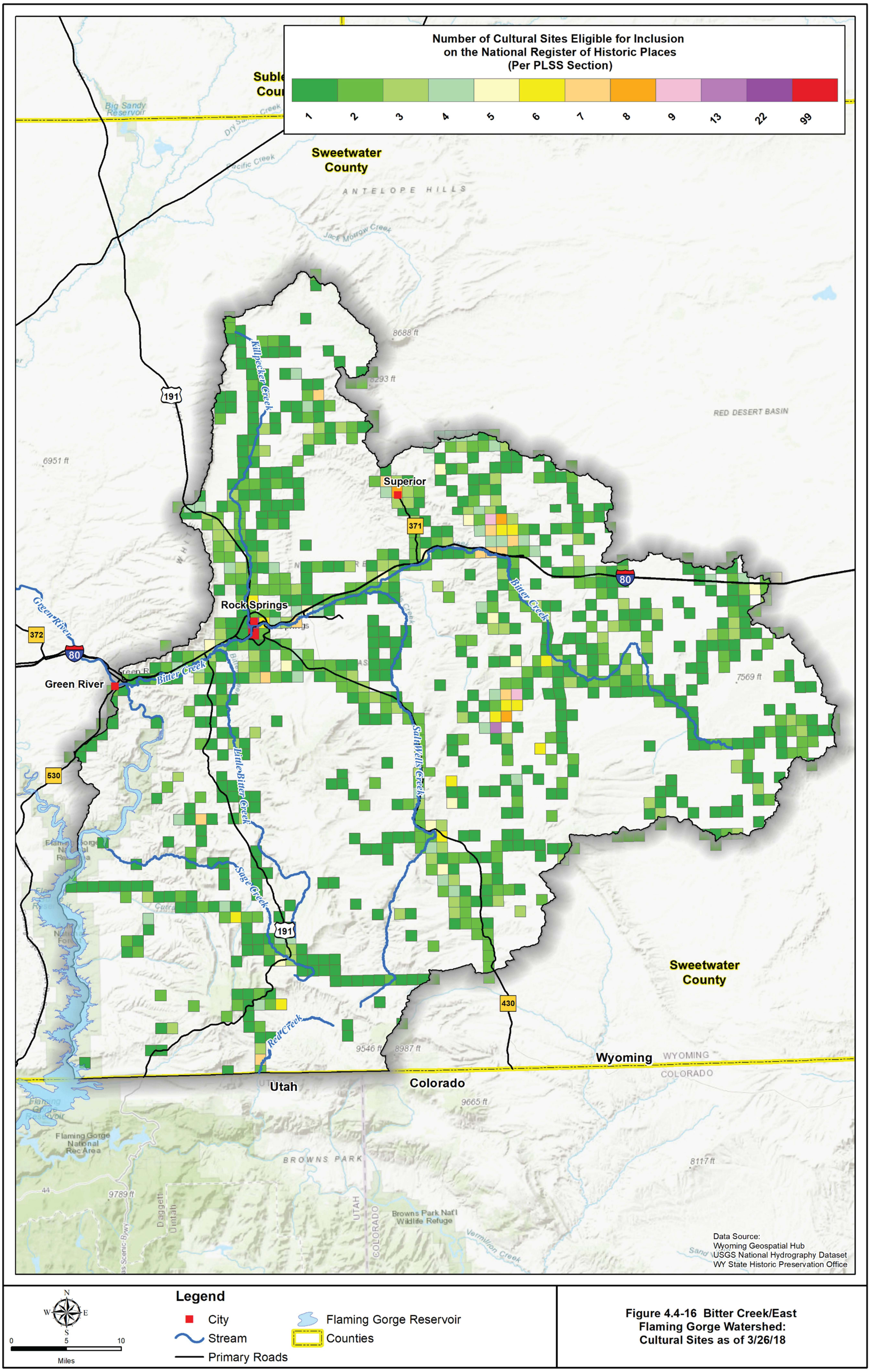


Figure 4.4-16 Bitter Creek/East Flaming Gorge Watershed: Cultural Sites as of 3/26/18

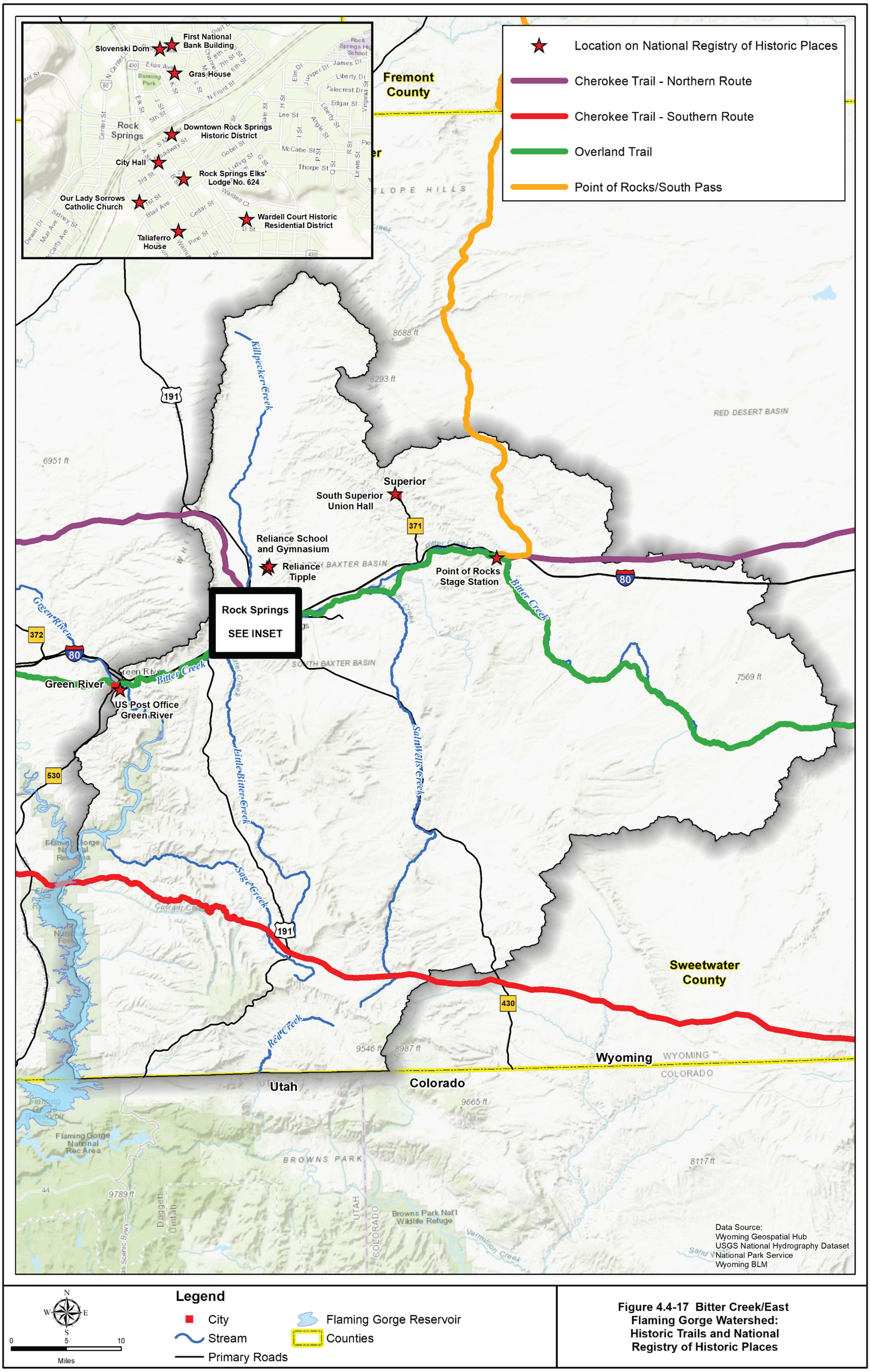


Figure 4.4-17 Bitter Creek/East Flaming Gorge Watershed: Historic Trails and National Registry of Historic Places

Table 4.4-2 National Register of Historic Places within the Bitter Creek/East Flaming Gorge Watershed.

Historic Place Name	National Registry Reference Number
Points of Rocks Stage Station	70000679
Wardell Court Historic Residential District	96001630
Downtown Rock Springs Historic District	93001492
South Superior Union Hall	83004305
City Hall	80004053
First National Bank Building	80004054
Gras House	86000355
Reliance Tipple	91000619
Rock Springs Elks' Lodge No. 624	93001383
Our Lady Sorrows Catholic Church	97001326
Slovenski Dom	97001601
US Post Office--Green River	97001535
Taliaferro House	98000909
Reliance School and Gymnasium	87002303

Management Implications:

The data presented above is only the data that is open to the public; there is also "sensitive data" that was not made available for this study. The Wyoming State Historic Preservation Office (SHPO) should be contacted before proceeding with any proposed project to obtain more detailed site-specific information.

If the BLM is involved in a proposed project and the project is within ¼ mile of a historic trail or within the visual horizon of the trail, stipulations put forth in the Rock Springs Resource Management Plan (RMP 1997) would be imposed. Most issues related to projects proposed in this report could be mitigated by following best management practices suggested by the BLM, such as low-profile water tanks and low-contrast paint to blend into the surroundings.

Data Sources:

Wyoming Bureau of Land Management (BLM): *http://www.blm.gov/wy/st/en.html*
Wyoming State Historic Preservation Office (SHPO): *http://wyoshpo.state.wy.us/Index.aspx*
National Park Service, National Registry of Historic Places: https://www.nps.gov/nr/

V. TASK 4: SURFACE HYDROLOGY

5.1 Overview

The USGS has assigned watersheds in the United States with numeric identifiers called Hydrologic Unit Codes, or HUCs. According to the USGS, "The United States is divided and sub divided into successively smaller hydrologic units which are classified into four levels: regions, sub-regions, accounting units, and cataloging units. The hydrologic units are arranged within each other, from the smallest (cataloging units) to the largest (regions). Each hydrologic unit is identified by a unique hydrologic unit code (HUC) consisting of two to eight digits based on the four levels of classification in the hydrologic unit system."

The first level of classification divides the nation into 21 major geographic areas, or regions. These geographic areas typically contain the drainage area of a major river, such as the Upper Colorado region. Eighteen of the regions make up the land area of the lower forty-eight states. As regions are subdivided, the HUC identifier is extended. At this time, the smallest subdivision is referred to as the Twelfth order HUC due to the fact that the identifier has 12 digits. The following information is provided as an example of the HUC system as it refers to one of the Bitter Creek tributaries: Nitch Creek.

Region:	14 Upper Colorado	(Second order HUC)
Subregion:	1404 Great Divide – Upper Green	(Fourth Order HUC)
Accounting Unit:	140401 Upper Green	(Sixth Order HUC)
Cataloging Unit:	14040105 Bitter	(Eighth Order HUC)
Sub-basin:	1404010508 Killpecker Creek	(Tenth Order HUC)
Sub-basin:	140401050802 Nitch Creek	(Twelfth Order HUC)

The Bitter Creek watershed study area was defined primarily by the eighth order HUC, 14040105 Bitter Creek, while the southwest portion of the study area is in 14040106 Upper Green – Flaming Gorge. Table 5.1-1 summarizes the HUC system as it pertains to the study area as indicated in Figure 5.1-1.

The stream reaches and tributaries in the study area range from perennial to ephemeral. Ephemeral streams are defined as those streams/reaches that flow only in response to direct precipitation events, and where any groundwater inflows are insufficient to sustain streamflow due to losses from evaporation, transpiration, and seepage. The hydrologic behavior of intermittent streams/reaches is transitional between perennial and ephemeral stream hydrology. Ephemeral streams tend to be extremely 'flashy', displaying very rapid rise to peak followed by a rapid recession in streamflow. Annual runoff is typically low for ephemeral streams.

The following streamflow description is an excerpt from the USGS report, "Hydrology of Salt Wells Creek—A Plains Stream in Southwestern Wyoming." Although the description is aimed specifically at Salt Wells Creek, it is generally valid for the entire Bitter Creek Watershed:

Table 5.1-1 Bitter Creek Watershed Study: Hydrologic Unit Code Breakdown.

HUC 2 Number / Name	HUC 4 Number / Name	HUC 6 Number / Name	HUC 8 Number / Name	HUC 10		HUC 12	
				Number	Name	Number	Name
Region 14: Upper Colorado	Subregion 1404: Great Divide - Upper Green	Accounting Unit 140401: Upper Green	Cataloging Unit 14040105: Bitter	1404010501	Bitter Creek-Antelope Creek	140401050101	Laney Wash
						140401050102	140401050102
						140401050103	Bitter Creek-Hungry Hollow
						140401050104	Iron Pipe Draw
						140401050105	Upper Antelope Creek
						140401050106	Lower Antelope Creek
						140401050107	Red Wash
						140401050108	Bitter Creek-Big Pond Station
				1404010502	Bitter Creek-Patrick Draw	140401050201	Lower Patrick Draw
						140401050202	Upper Patrick Draw
						140401050203	Bitter Creek-Town of Bitter Creek
						140401050204	Patrick Draw
						140401050205	140401050205
						140401050206	Bitter Creek-Town of Black Buttes
						140401050207	Bitter Creek-Town of Hallville
				1404010503	Bitter Creek-Tenmile Draw	140401050301	Lower Deadman Wash
						140401050302	Upper Deadman Wash
						140401050303	Middle Deadman Wash
						140401050304	Bitter Creek-Coon Draw
						140401050305	Horsethief Canyon
				1404010504	Black Butte Creek	140401050401	Upper Black Butte Creek
						140401050402	Middle Black Butte Creek
						140401050403	Lower Black Butte Creek
				1404010505	Bitter Creek-Sweetwater Creek	140401050501	Bitter Creek-Rock Springs
						140401050502	140401050502
						140401050503	140401050503
						140401050504	South Baxter Basin
						140401050505	Sweetwater Creek-Bitter Creek
						140401050506	Bitter Creek-Kanda
				1404010506	Upper Salt Wells Creek	140401050601	Salt Wells Creek-Corral Creek
						140401050602	Gap Creek
						140401050603	Dans Creek
						140401050604	Salt Wells Creek-Dry Canyon
						140401050605	Upper Salt Wells Creek
						140401050606	Scheggs Draw
						140401050607	Lower Salt Wells Creek
						140401050608	Polly Draw
						140401050609	Big Flat Draw
				1404010507	Lower Salt Wells Creek	140401050701	Salt Wells Creek-Joyce Creek
						140401050702	Pretty Water Creek
						140401050703	Salt Wells Creek-Spring Creek
						140401050704	Salt Wells Creek-140401050704
				1404010508	Killpecker Creek	140401050801	Killpecker Creek-Boars Tusk
						140401050802	Nitch Creek
						140401050803	Killpecker Creek-Pine Canyon
						140401050804	Cedar Canyon
						140401050805	Killpecker Creek-140401050805
						140401050806	Long Canyon
						140401050807	Killpecker Creek-Fourteenmile Creek
						140401050808	Killpecker Creek-Reliance
				1404010509	Little Bitter Creek	140401050901	Upper Bitter Creek-Green River
						140401050902	Middle Little Bitter Creek
						140401050903	Cedar Creek-Little Bitter Creek
						140401050904	Lower Little Bitter Creek
			Cataloging Unit 14040106: Upper Green - Flaming Gorge	1404010601	Upper Flaming Gorge Reservoir	140401060101	Green River-Middle Firehole Canyon
						140401060102	Green River-Chicken Springs Draw
						140401060103	Firehole Canyon
						140401060104	Sage Creek-Trout Creek
						140401060105	Sage Creek-Greasewood Draw
				1404010602	Middle Flaming Gorge Reservoir	140401060201	Flaming Gorge Reservoir-Buckboard Reservoir
						140401060202	Currant Creek
						140401060204	Flaming Gorge Reservoir-Squaw Hollow
						140401060205	Upper Marsh Creek
						140401060206	Sugarloaf Marsh Creek
						140401060207	Middle Marsh Creek
						140401060208	Henrys Fork-Cottonwood Creek
						140401060211	Flaming Gorge Reservoir-Chokecherry Draw
						140401060212	Flaming Gorge Reservoir-Spring Creek
				1404010608	Red Creek	140401060801	Upper Red Creek
						140401060802	Middle Red Creek
						140401060803	Lower Red Creek
						140401060804	Clay Basin Creek

"Salt Wells Creek is predominantly an intermittent stream. Although numerous springs cause perennial flows in several upstream tributaries, evaporation, freezeup, and seepage deplete these flows so that the downstream reach has only intermittent flows. Direct runoff occurs from both snowmelt and rainstorms. Rainstorm runoffs commonly have high peak flows; however, the duration of flow from rainfall is relatively short in comparison to snowmelt. The occurrence and amount of runoff is variable from year to year."

5.2 Surface Hydrology

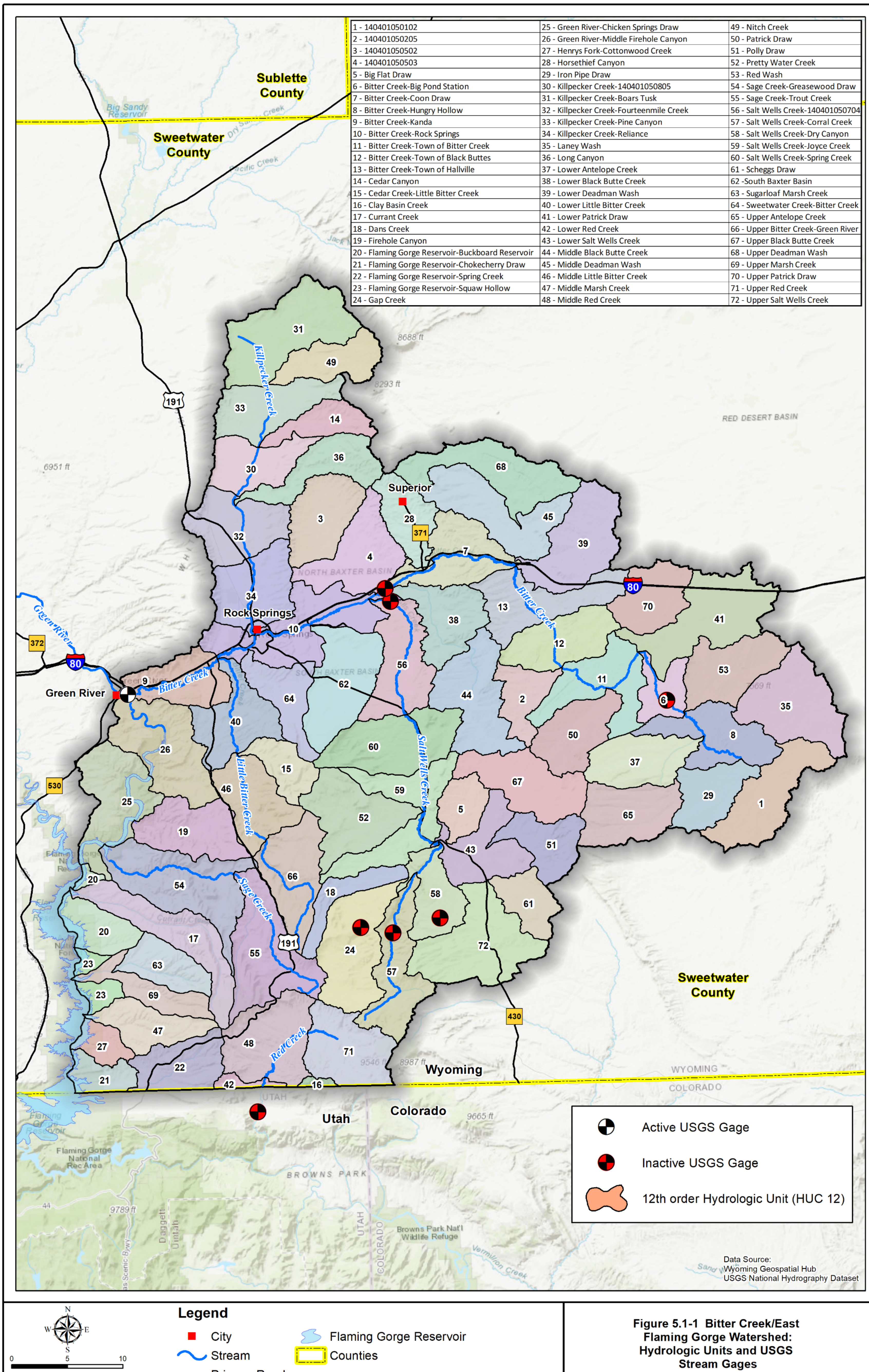
5.2.1 Summary of Existing Data

There is currently only one active USGS stream gaging station within the study area (Figure 5.1-1). It should be noted that the active gage is located within the East Flaming Gorge watershed, and there are no active gages in the Bitter Creek watershed. As indicated in Figure 5.2-1, historically, seven gages have been active within the study area. However, six of the gages have been discontinued by the USGS (the last one being discontinued in 1981), leaving the basin with only one active gage. The Wyoming State Engineers Office maintains additional gages on streams, irrigation canals/ditches and reservoirs, however, none are located within the study area.

In conjunction with the SWCCD's TMDL investigations (see section 4.2.5.2 Water Quality), hydrologic data were collected at various locations throughout the study area. These data typically included spot measurements collected in conjunction with water quality sampling events and in a few instances, continuous recording devices were installed for limited periods. These data were reviewed for consistency with the study but were not republished in this report. The reader is directed to the various TMDL documents and supporting data for specific information pertaining to that study.

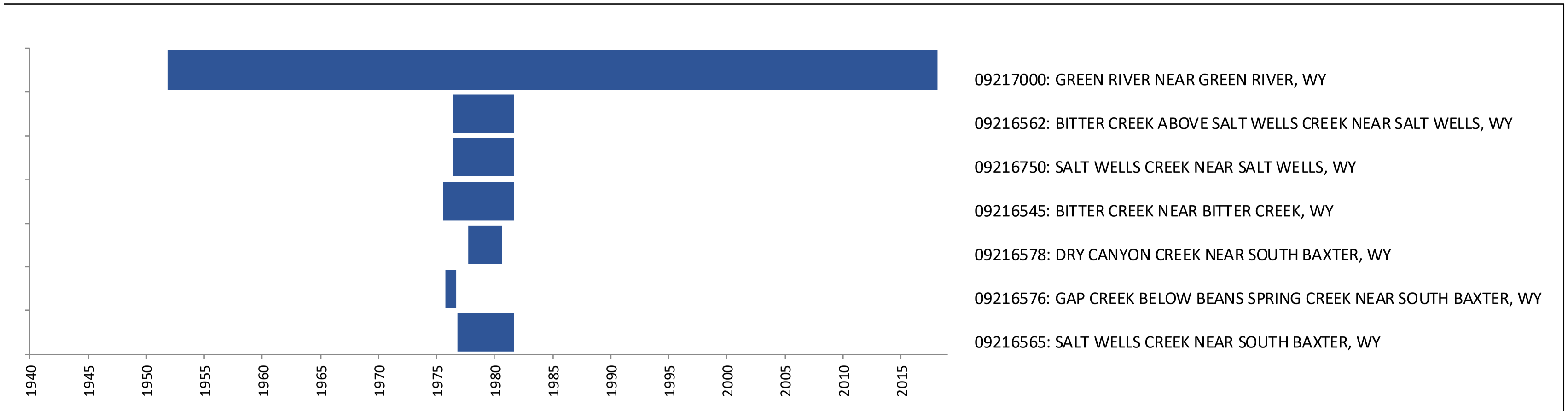
5.2.2 Mean Annual Discharge Estimation

Mean monthly discharges were computed using the available data from the active USGS gage on the Green River (USGS Gage 09217000), and two inactive gages in the Bitter Creek watershed (USGS Gages 09216562 and 09216750) and are presented in Table 5.2-1. The mean annual hydrograph at the Green River gage in the East Flaming Gorge watershed (Figure 5.2-2) reflects typical snowmelt driven runoff patterns, where the bulk of the annual runoff occurs between April and July. The late summer through fall months (August through October) see steep declines in streamflow as the streams return to baseflow conditions through the winter. The mean annual hydrographs for Bitter Creek and Salt Wells Creek shown in Figure 5.2-3 were calculated from five years of data between 1976-1981. The hydrographs show evidence of snowmelt from February to May, with runoff from late summer thunderstorms in July and August.



1 - 140401050102	25 - Green River-Chicken Springs Draw	49 - Nitch Creek
2 - 140401050205	26 - Green River-Middle Firehole Canyon	50 - Patrick Draw
3 - 140401050502	27 - Henrys Fork-Cottonwood Creek	51 - Polly Draw
4 - 140401050503	28 - Horsethief Canyon	52 - Pretty Water Creek
5 - Big Flat Draw	29 - Iron Pipe Draw	53 - Red Wash
6 - Bitter Creek-Big Pond Station	30 - Killpecker Creek-140401050805	54 - Sage Creek-Greasewood Draw
7 - Bitter Creek-Coon Draw	31 - Killpecker Creek-Boars Tusk	55 - Sage Creek-Trout Creek
8 - Bitter Creek-Hungry Hollow	32 - Killpecker Creek-Fourteenmile Creek	56 - Salt Wells Creek-140401050704
9 - Bitter Creek-Kanda	33 - Killpecker Creek-Pine Canyon	57 - Salt Wells Creek-Corral Creek
10 - Bitter Creek-Rock Springs	34 - Killpecker Creek-Reliance	58 - Salt Wells Creek-Dry Canyon
11 - Bitter Creek-Town of Bitter Creek	35 - Laney Wash	59 - Salt Wells Creek-Joyce Creek
12 - Bitter Creek-Town of Black Buttes	36 - Long Canyon	60 - Salt Wells Creek-Spring Creek
13 - Bitter Creek-Town of Hallville	37 - Lower Antelope Creek	61 - Scheggs Draw
14 - Cedar Canyon	38 - Lower Black Butte Creek	62 -South Baxter Basin
15 - Cedar Creek-Little Bitter Creek	39 - Lower Deadman Wash	63 - Sugarloaf Marsh Creek
16 - Clay Basin Creek	40 - Lower Little Bitter Creek	64 - Sweetwater Creek-Bitter Creek
17 - Currant Creek	41 - Lower Patrick Draw	65 - Upper Antelope Creek
18 - Dans Creek	42 - Lower Red Creek	66 - Upper Bitter Creek-Green River
19 - Firehole Canyon	43 - Lower Salt Wells Creek	67 - Upper Black Butte Creek
20 - Flaming Gorge Reservoir-Buckboard Reservoir	44 - Middle Black Butte Creek	68 - Upper Deadman Wash
21 - Flaming Gorge Reservoir-Chokecherry Draw	45 - Middle Deadman Wash	69 - Upper Marsh Creek
22 - Flaming Gorge Reservoir-Spring Creek	46 - Middle Little Bitter Creek	70 - Upper Patrick Draw
23 - Flaming Gorge Reservoir-Squaw Hollow	47 - Middle Marsh Creek	71 - Upper Red Creek
24 - Gap Creek	48 - Middle Red Creek	72 - Upper Salt Wells Creek

Figure 5.1-1 Bitter Creek/East Flaming Gorge Watershed: Hydrologic Units and USGS Stream Gages



Site Number	Site Name	Site Status	Beginning	End	Drainage Area (sq. miles)	Gage Elevation (ft, NGVD29)
09217000	GREEN RIVER NEAR GREEN RIVER, WY	Active	10/1/1951	4/2/2018	14000	6060
09216562	BITTER CREEK ABOVE SALT WELLS CREEK NEAR SALT WELLS, WY	Inactive	6/1/1976	9/30/1981	836	N/A
09216750	SALT WELLS CREEK NEAR SALT WELLS, WY	Inactive	6/1/1976	9/30/1981	526	N/A
09216545	BITTER CREEK NEAR BITTER CREEK, WY	Inactive	7/1/1975	9/30/1981	308	6760
09216578	DRY CANYON CREEK NEAR SOUTH BAXTER, WY	Inactive	10/1/1977	9/30/1980	3.69	N/A
09216576	GAP CREEK BELOW BEANS SPRING CREEK NEAR SOUTH BAXTER, WY	Inactive	10/1/1975	9/30/1976	35.9	N/A
09216565	SALT WELLS CREEK NEAR SOUTH BAXTER, WY	Inactive	10/1/1976	9/30/1981	34.7	N/A

Figure 5.2-1 Period of Record for Study Area Stream Gage.

Table 5.2-1 Mean Monthly Discharges for USGS Stream Gages.

USGS Gage	GREEN RIVER NEAR GREEN RIVER, WY	BITTER CREEK ABOVE SALT WELLS CREEK NEAR SALT WELLS, WY	SALT WELLS CREEK NEAR SALT WELLS, WY
USGS ID	09217000	09216562	09216750
Calculation Period	10/1/1951 to 3/31/2018	6/1/1976 to 8/31/1981	6/1/1976 to 8/31/1981
Month	**Mean Stream Discharge (cfs)**		
Jan	801	0.49	0
Feb	856	5.1	2.4
Mar	1060	15	4.4
Apr	1560	23	7.9
May	2400	15	14
Jun	4490	2.1	2.6
Jul	2990	4.8	5.6
Aug	1480	8.9	11
Sep	1090	0.67	0.45
Oct	957	1.5	2.6
Nov	872	1	0.04
Dec	781	0.83	0

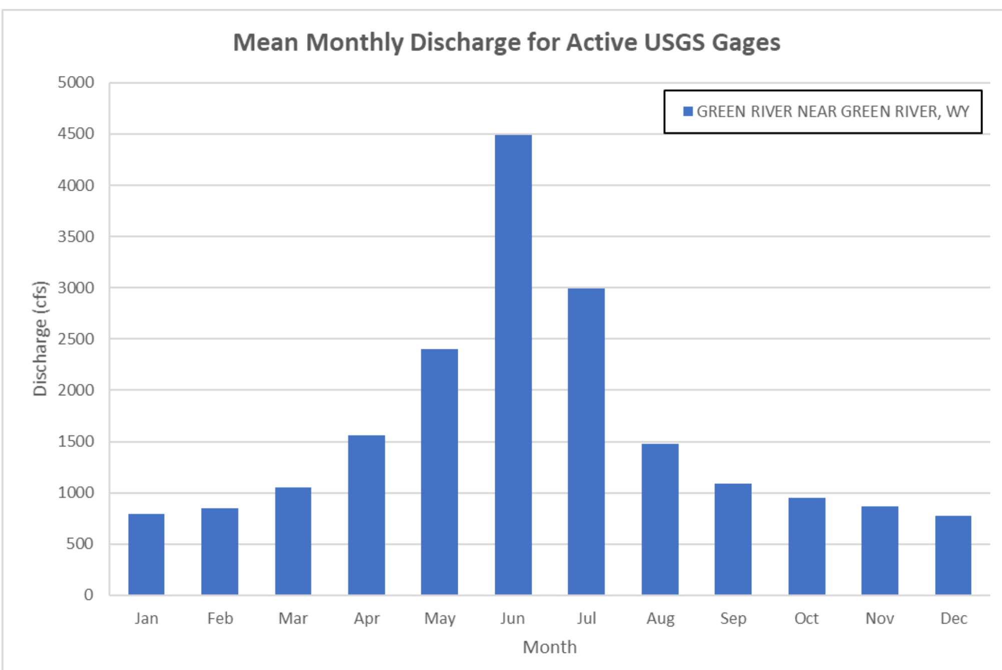


Figure 5.2-2 Mean Monthly Discharge at Active USGS Stream Gage on Green River.

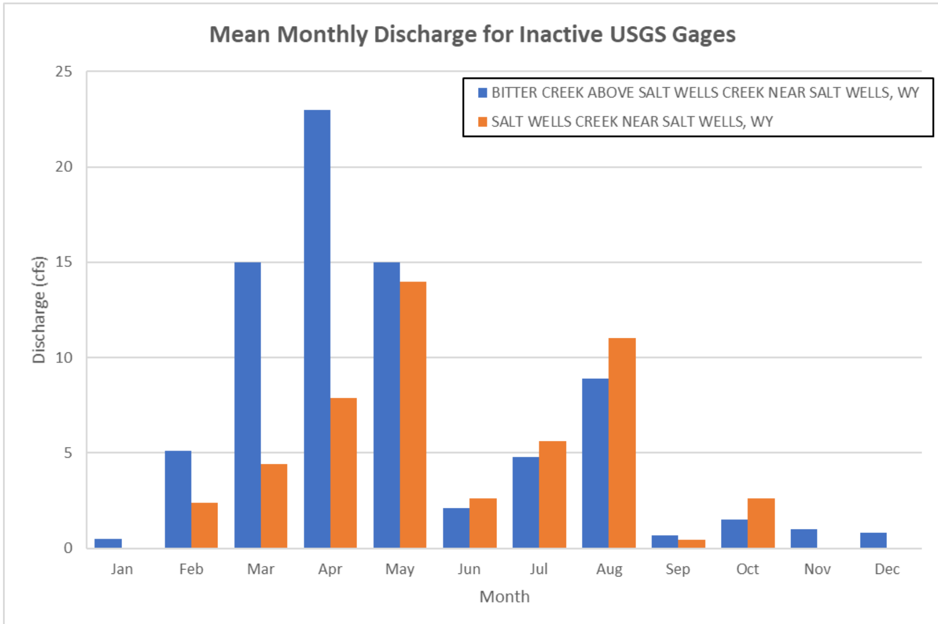


Figure 5.2-3 Mean Monthly Discharge at USGS Stream Gages in Bitter Creek Watershed.

Mean annual discharge was also computed for each of the 72 subwatersheds (HUC12) within the study area using regional methods described by Lowham (1988). The methodology used to compute these discharges relies upon statistical relationships between basin area, mean annual precipitation and measured stream discharge. Results of this analysis are presented in Figure 5.2-4. Using the available climate data, precipitation and mean annual discharge was also estimated for “wet” and “dry” years at each of the subwatersheds. Using the Rock Springs and Flaming Gorge climate stations, the annual precipitations recorded within the last 40 years were sorted and divided into “wet” (top 20%), “dry” (bottom 20%), and “normal” (middle 60%) years. Figure 5.2-5 and Figure 5.2-6 show this analysis for the Rock Springs station and Flaming Gorge station, respectively. The average “wet” and “dry” annual precipitation values were inserted into the Lowham equations to estimate “wet” and “dry” mean annual flow. Since the HUC12s in the southeastern portion of the watershed are higher in elevation and experience higher annual precipitation, they were associated with the Flaming Gorge climate station. Appendix 5A presents the results in a tabular format. These data can be used in planning potential water development projects such as stock reservoirs. Using the mean annual yield per square mile for the appropriate sub-basin, approximate yield can be pro-rated for a specific area.

5.2.3 Peak Flow Estimation and Flooding

Using regional methods described by the USGS (Miller, 2003), peak flow characteristics were calculated for each of the 72 subwatersheds (HUC12) within the study area. The methodology used to compute these discharges is based upon regression analyses of gaged data against various basin characteristics. These estimates are intended to be used for regional planning efforts only. Project-specific estimates would be required before design of future watershed projects (ex. reservoir storage). Appendix 5B presents the results of this effort.

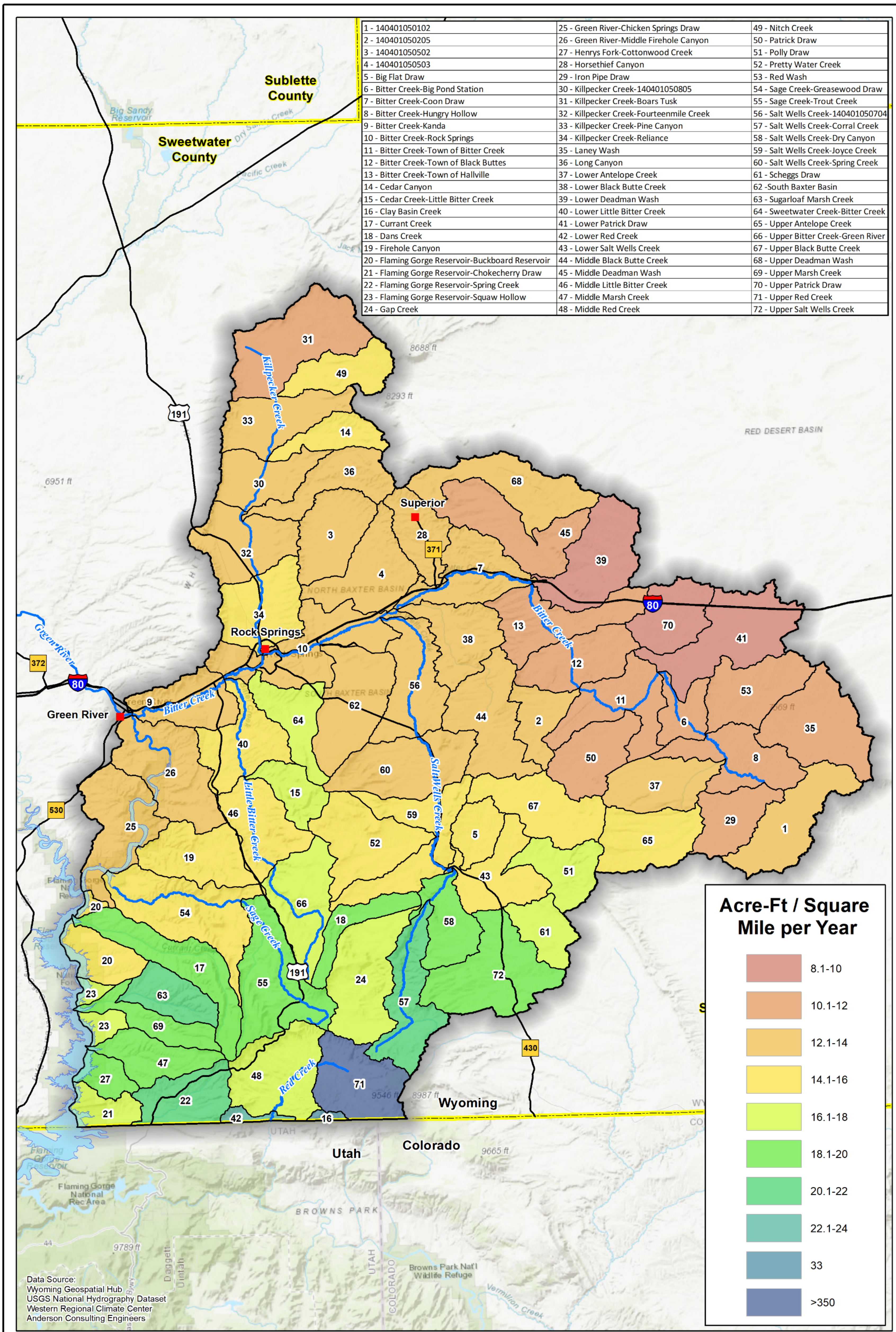


Figure 5.2-4 Bitter Creek/East Flaming Gorge Watershed: Mean Annual Runoff per HUC 12

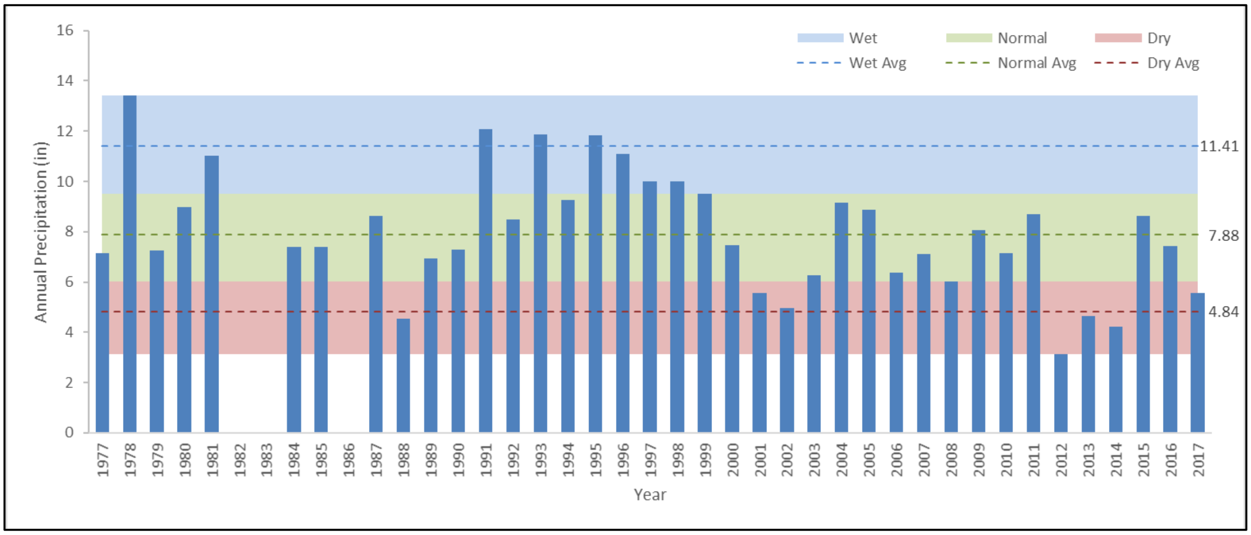


Figure 5.2-5 Rock Springs AP, WY Station (1977-2017) – Wet/Dry Classification

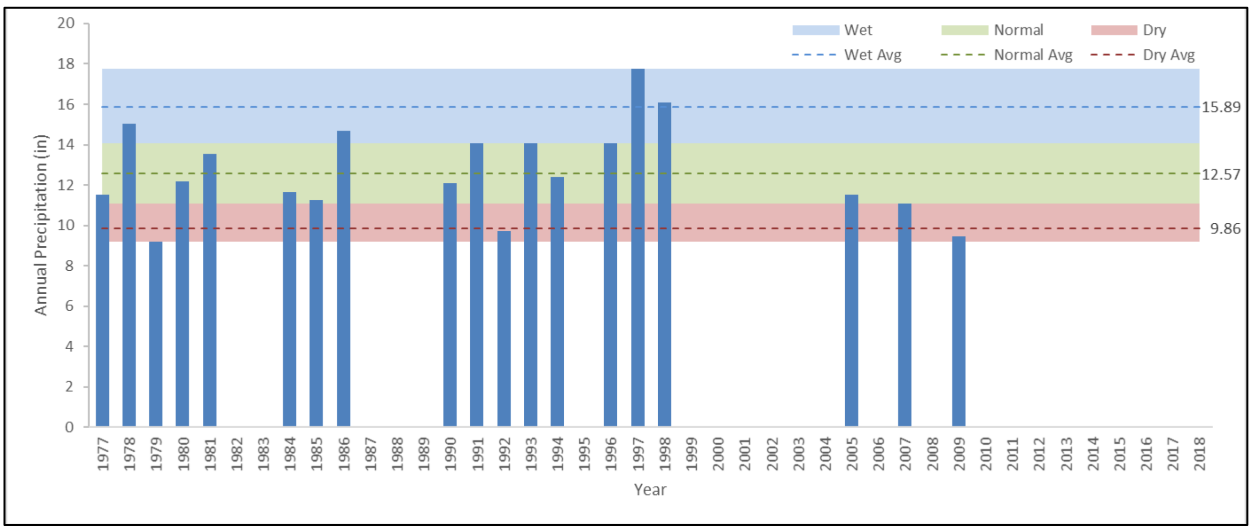
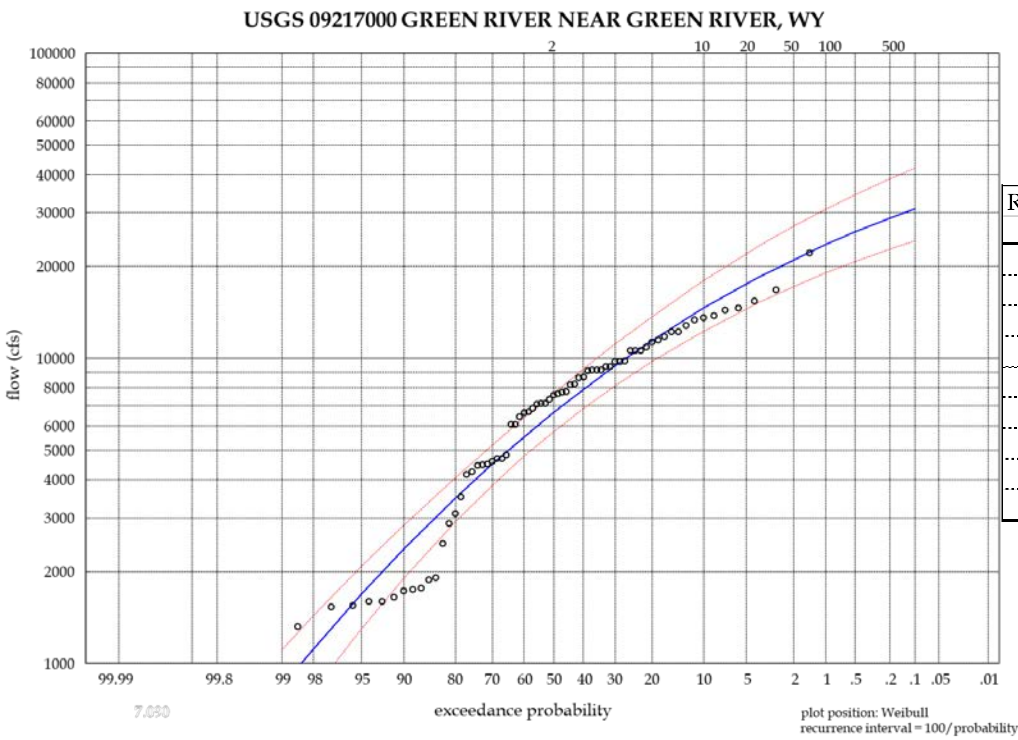


Figure 5.2-6 Flaming Gorge, UT Station (1977-2017)– Wet/Dry Classification

Flood frequency calculations were completed for the USGS stream gages with a sufficient period of record to complete the analysis (10 years). The Log-Pearson III methodology (Water Resources Council, 1977) was used to estimate peak discharge associated with the 2-year through the 500-year events. Figure 5.2-7 displays the results of the analysis for the USGS Gage 09217000 Green River near Green River, WY. Appendix 5C contains the results of this analysis. Since the only active gage is located within the East Flaming Gorge watershed, this analysis could not be completed for any gages inside of the Bitter Creek watershed. However, the annual peak streamflow for Bitter Creek and Salt Wells Creek was recorded by USGS for a few years while the 09216562 and 09216750 gages were active. These peak flows are shown in Table 5.2-2 and Figure 5.2-8.



Recurrence (years)	Q (cfs)
500	28,845
200	25,943
100	23,589
50	21,085
25	18,418
20	17,521
10	14,602
5	11,438
2	6,647

Figure 5.2-7 Flood Frequency Analysis: USGS Gage 09217000.

Table 5.2-2 Peak Flows for Bitter Creek and Salt Wells Creek from 1976-1981.

USGS Gage	BITTER CREEK ABOVE SALT WELLS CREEK NEAR SALT WELLS, WY	SALT WELLS CREEK NEAR SALT WELLS, WY
USGS ID	09216562	09216750
Water Year	**Peak Streamflow (cfs)**	
1976		1605
1977		829
1978		87
1979	888	204
1980	280	207
1981	483	260

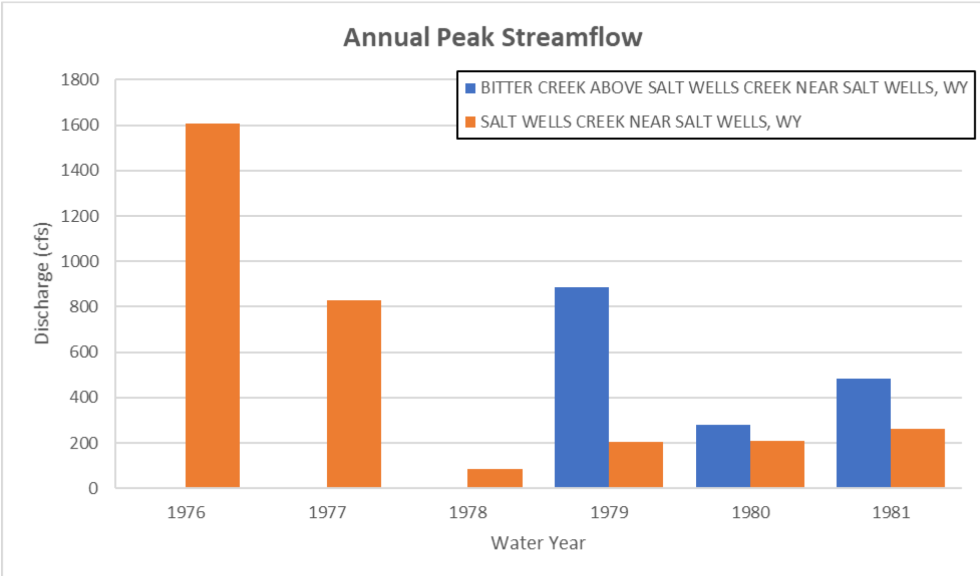


Figure 5.2-8 Peak Flows for Bitter Creek and Salt Wells Creek from 1976-1981.

5.2.4 Instream Flows

Wyoming water law is based on the "doctrine of prior appropriation" which states that the first to put the water to beneficial use has the first right ("first in time, first in right"). Whereas most water rights involve flows diverted from the natural channel, the Instream Flow law in 1986 allowed the State of Wyoming to hold a water right for the instream fisheries purposes. Instream flow is water that flows in a natural stream channel, and often refers to a minimum flow required to maintain tolerable water quality and aquatic habitat. According to the 1986 law, a new water right can be issued to allow water, when available, to remain in the stream channel and be protected for fisheries purposes according to its water right priority date. The 1986 law also recognizes instream flow for fisheries as a beneficial use.

Three instream flow filing segments are located in the study area: Currant Creek, Trout Creek, and Red Creek (Figure 5.2-9). The permitted flows are shown in Table 5.2-3.

Table 5.2-3 Permitted Instream Flows in Bitter Creek/East Flaming Gorge Watershed.

	Permitted Flows (cfs)												
Month	Oct	Nov	Dec	Jan	Feb	Mar	Apr		May	Jun	Jul	Aug	Sep
Dates	1 - 31	1 - 30	1 - 31	1 - 31	1 - 28	1 - 31	1 - 14	15 - 30	1 - 31	1 - 30	1 - 31	1 - 31	1 - 30
Currant Creek	1.2	1.2	1.2	1.2	1.2	1.2	1.2	11	11	11	3.6	3.6	3.6
Trout Creek	1.5	1.5	1.5	1.5	1.5	1.5	1.5	13	13	13	2.7	2.7	2.7
Red Creek	0.7	0.7	0.7	0.7	0.7	0.7	0.7	4.8	4.8	4.8	0.9	0.9	0.9

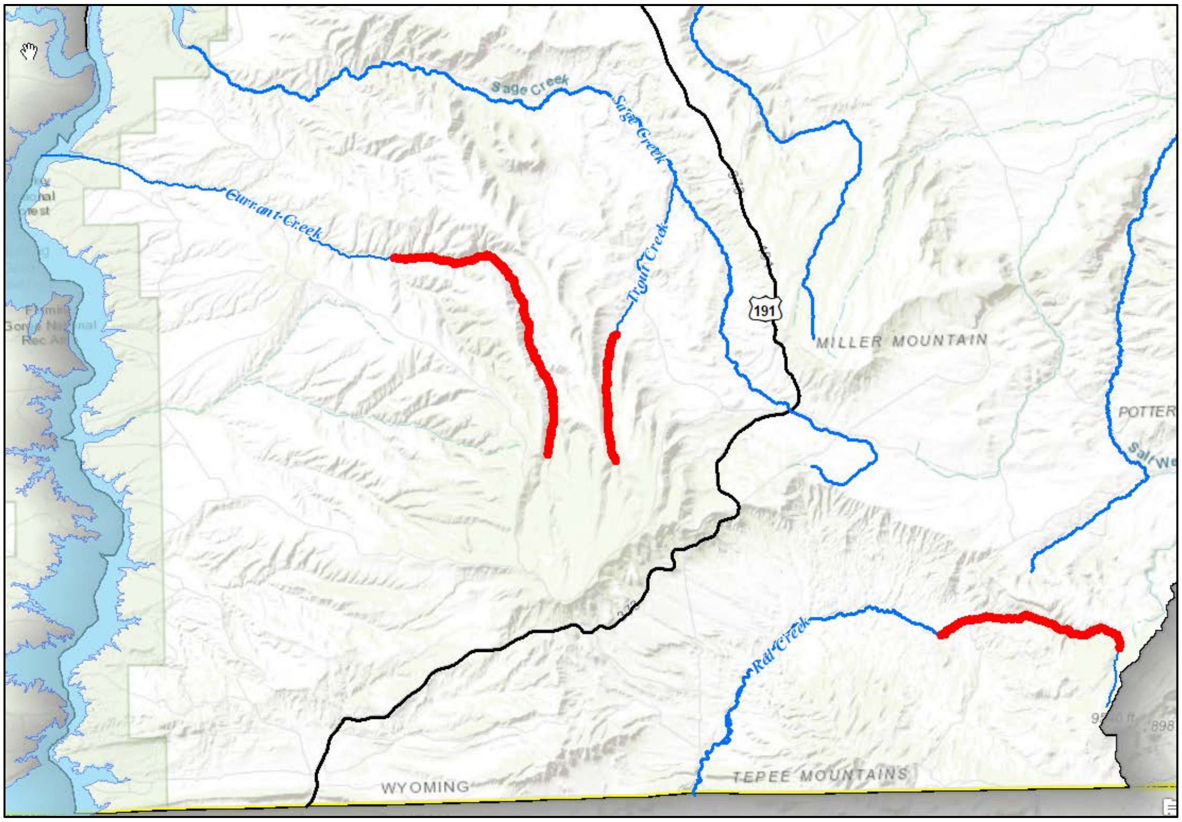


Figure 5.2-9 Instream Flow Filings in Bitter Creek / East Flaming Gorge Study Area.

5.2.5 Surface Water Availability and Shortages

The evaluation of flows available for potential storage projects versus irrigation shortages within the watershed was based upon results of the Wyoming Water Development Commission (WWDC) basin planning model developed for the Green River watershed (WWC Consulting, et al., 2010). Much of the discussion of the model, assumptions inherent to it, and its limitations was extracted from previous reports. It is included herein to provide the background necessary to interpret model results.

5.2.5.1 Green River Basin Model

The Green River Basin Model is a series of water accounting spreadsheets that incorporate multiple diversions, gaging stations, and other water resources data within the Green River Basin, of which Bitter Creek is a tributary sub-basin. One of the primary purposes of the model is to provide a planning tool for Green River Basin water users and the State of Wyoming for use in determining those river reaches in which flows may be available to Wyoming water users for future development.

In an ephemeral watershed such as the Bitter Creek watershed, water use is limited by its physical availability and corresponding lack of data. This is evident in the Green River Basin Model by virtue of the fact that the Bitter Creek watershed is represented by a single node: Bitter Creek at Salt Wells Creek.

Consequently, validity and utility of the model is extremely limited in this watershed. Because the spreadsheet model has been used to estimate water availability with the watershed, the following discussion of the model and how the estimates were determined is included.

For the purposes of this study, the spreadsheet model was utilized without modification. The Green River model consists of four individual spreadsheet models, each representing a specific subbasin of the watershed. The individual spreadsheet models are linked to enable data generated in one model to be “passed along” to subsequent models. Furthermore, models were generated to reflect each of three hydrologic conditions: dry, normal, and wet year water supply. The spreadsheets each represent one calendar year of streamflow data, on a monthly time step.

Each spreadsheet relies on a calibration model that reflects available historical data from the 1971 to 2007 study period to estimate the hydrologic conditions. Streamflow, consumptive use, diversions, and irrigation return flows are the basic input data to the model. For all of these data, average values drawn from the dry, normal, or wet subset of the study period were computed for use in the spreadsheets. The model does not explicitly account for water rights, reservoir operations, compact allocations, or the management of the basin water supply based on these legal constraints. It is assumed that the historic discharge data reflect effects of any limitations that may have been placed upon water users by water rights or compact restrictions as well as reservoir operations.

To mathematically represent the Green River system subbasins, each basin was first divided into reaches based primarily upon the location of USGS gaging stations. Each reach was then sub-divided by identifying a series of individual nodes representing locations where diversions occur, basin imports are added, tributaries converge, or other significant water resource features are located.

At each node, a water budget computation is completed to determine the amount of water that flows out of the node. Total flow into the node and diversions or other losses from the node are calculated. The difference between total inflow and diversions/losses is the amount of flow available to the next node

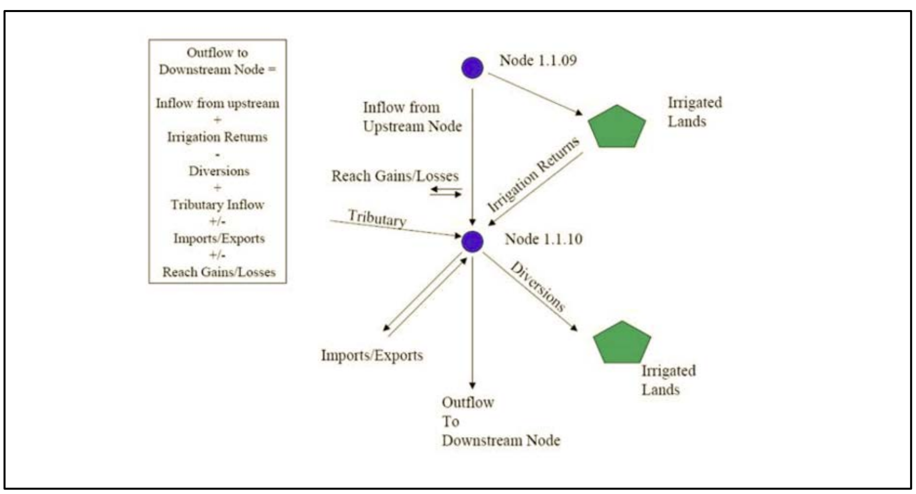


Figure 5.2-10 Diagram of Model Water Budget Computations.

downstream. Mass balance, or water budget calculations, are repeated for all nodes in a reach, with the outflow of the last node being the inflow to the beginning node in the next reach. Figure 5.2-10 displays a graphical representation of the water balance approach. For each reach, ungaged stream gains (e.g., ungaged tributaries, groundwater inflow, and return flows from unspecified diversions) and losses (e.g., seepage, evaporation, and unspecified diversions) are taken as the difference between average historical gage flows (or outflows) and model-predicted outflow from the reach. Stream gains are input at the top of a reach to be available for diversion throughout the reach and losses are subtracted at the bottom of each reach.

5.2.5.2 Model Limitations

There are several limitations to the model, which must be considered when reviewing the model and results generated by its use. These limitations and their implications with respect to a determination of water availability are discussed below.

- Use of a monthly time step in the river simulation may result in the exclusion of peak flows on ‘flashier’ systems. These peaks would be incorporated within the monthly average streamflows within the model; however, in instances where peaks exceed demand, the monthly time step could result in underestimation of available flows.
- The spreadsheet model does not explicitly account for diversions from the river in accordance with Wyoming water law and is not operated on these legal principals. Simply stated, this means that the model cannot forego a diversion to an upstream junior water appropriator to satisfy a downstream senior water right.
- The basin planning model was originally developed under the assumption that if this situation occurred historically, the diversion data would reflect this occurrence and the junior appropriator would incur a shortage.
- The model does not incorporate reservoir operational rules for release or storage of water. Consequently, evaluation of changes in practices that accompany reservoirs is problematic. For each simulation condition (normal-, dry- and wet-year conditions), reservoir releases do not deviate from historic releases. For example, releases from Viva Naughton Reservoir remain consistent with historic patterns despite changes to reservoir inflow and storage.
- The model uses data generated outside of the program in several instances. Consequently, evaluation of different water usage scenarios involving this data is cumbersome. For example, the model does not directly facilitate evaluation of effects of improvements to farm irrigation practices resulting in increased irrigation efficiency without recalculation of input data outside of the model environment.
- The spreadsheet model does not contain logic to evaluate impacts upon the state's obligations under the Colorado River Compact (Compact).
- Comparison of historic data with full supply diversion estimates indicates that irrigators typically operate under supply-limited conditions. The model simulates diversion data related to a multitude of uses (irrigation, municipal, industrial, etc.). Given the magnitude of the irrigation

diversions, however, special attention is devoted to the water requirements associated with irrigated lands. To fully understand this potential limitation, it is important to know that the spreadsheet model can be run in three different modes:

- *Calibration (Historical):* This mode simulates the historical diversions where data are available. This mode is typically used for model calibration because historic diversion data are utilized.
- *Full Supply for Existing Irrigated Lands:* This mode reflects full supply diversions, based on computed diversion requirements for existing irrigated lands (lands presently irrigated and mapped during the planning process).

5.2.5.3 Available Flows Analysis

To determine how much of the physical supply is actually available for storage at any given model node, "available water" was defined as that portion of the physically available streamflow that could be stored without causing a shortage to existing water users in any downstream river reach. In other words, the water available at any node was determined as the minimum of the physically available flow at that point or the minimum available flow at any node downstream in the system. As noted previously, this evaluation is made on a water budget basis (inherent to the Basin Plan model) and does not directly incorporate individual water rights. Results of the availability analyses at selected model nodes are summarized in Table 5.2-4

Table 5.2-4 Results of Green River Basin Model: Available Flows at Bitter Creek Node.

Node ID:	24.09		
Node Name:	Bitter Creek (09216562) and Salt Wells (09216750)		
	Available Flow (acre-ft)		
Hydrologic Condition:	Dry	Normal	Wet
Jan	30	30	30
Feb	431	431	431
Mar	1,169	1,169	1,169
Apr	1,823	1,823	1,823
May	1,838	1,838	1,838
Jun	282	282	282
Jul	635	635	635
Aug	1,201	1,201	1,201
Sep	102	102	102
Oct	254	254	254
Nov	62	62	62
Dec	51	51	51
Annual	7,877	7,877	7,877

As indicated in this table, results show that there is flow available for storage without incurring a shortage in the basin. It is also evident in this table that there was no differentiation between the three hydrologic conditions; each reflects identical results. This is presumably due to the lack of data at the two gages utilized in the model. Only 5 years of data were recorded at each, rendering determination of different hydrologic conditions difficult without a longer period of record. Results of the Green River Basin planning model indicate that despite the generally dry nature of the watershed, there could still be approximately 7,877 acre feet available to store.

Any availability evaluation must consider potential impacts of interstate compacts. The following excerpt from the Green River Basin Plan, Technical Memorandum: Available Surface Water Determination (AECOM, 2010) is presented. Note that this discussion and the numerical valued included within it pertain to the entire Green River within the context of the Colorado River Basin Compact:

> *"Compact considerations*
>
> *The "Total" values … far exceed the remaining developable allowance as limited by the Colorado River Compact and Upper Colorado River Basin Compact. "Remaining developable allowance" is a value that depends on assumptions behind the calculation of the State's entitlement under the Compact (allowance), and the estimate of current depletions.*
>
> *Wyoming's allowance has been estimated variously by the State and Federal government. The Wyoming Water Development Office recently estimated Wyoming's allowance as either 947,800 or 842,800 af/yr, depending on the Upper Basin State's obligation under the Mexico Treaty. Since the Upper Basin States currently maintain that they have no obligation under the Mexico Treaty, only the larger of these two numbers is shown as the Compact Allowance (WWDC Estimate) in Table 3 (*Table 5.2-5 in this report*). The U.S. Bureau of Reclamation calculated Wyoming's allowance as 834,400 af in its 2007 Hydrologic Determination report, executed in support of the Navajo-Gallup Water Supply Project as required to enable a contract for water from the Navajo Indian Irrigation Project. This value is shown as Compact Allowance (USBR Estimate) in Table 3 (*Table 5.2-5 in this report*). The increment between current basin use (computed in the Basin Use Profiles of this Green River Basin Plan update) and the Compact allowance is the amount of water that could be developed by Wyoming, strictly from the Compact perspective. These values are shown as Remaining Compact Allowance, for comparison with the available surface water estimation developed by way of the spreadsheet models.*
>
> *The spreadsheet models do not contain logic to operate curtailment to meet the state's obligations under the Upper Colorado River Basin Compact (the Compact). The models were developed to portray historical use over the study period 1971-2007. Never during that time, nor since the Compact was ratified, have diversions been curtailed pursuant to Article IV of the Compact. While the principles under which administration should be conducted are set forth in the Compact, actual details of their application have not been worked out by the Upper Colorado River Commission. Accordingly, simulation of curtailment was outside the scope of this effort."*

Table 5.2.5 Remaining Compact Allowance Compared with Available Flow From Spreadsheet Models.

	Dry Condition (af/yr)	Normal Condition (af/yr)	Wet Condition (af/yr)
Municipal Use (includes City of Cheyenne at 15,300 AF/Yr.)	n/a	22,800	n/a
Industrial Use	n/a	58,800	n/a
Agricultural Use[1]	n/a	396,200	n/a
Domestic	n/a	3,000	n/a
Evaporation - Main Stem	n/a	88,500	n/a
Evaporation - In State	n/a	32,800	n/a
Recreation Use		n/a	
Environmental Use	n/a	2,000 +/-	n/a
Total Use	n/a	604,100	n/a
Compact Allowance (USBR Estimate)[1]	n/a	834,400	n/a
Compact Allowance (WWDC Estimate)[1]	n/a	947,800	n/a
RemainingCompact Allowance (USBR Estimate)		**230,300**	
RemainingCompact Allowance (WWDC Estimate)		**343,700**	
Available Water (from Table 2)	**863,000**	**1,792,000**	**2,964,000**

[1]Water use values based upon normal year estimates of surface water and groundwater use

VI. TASK 5: MANAGEMENT AND REHABILITATION PLAN

6.1 Overview

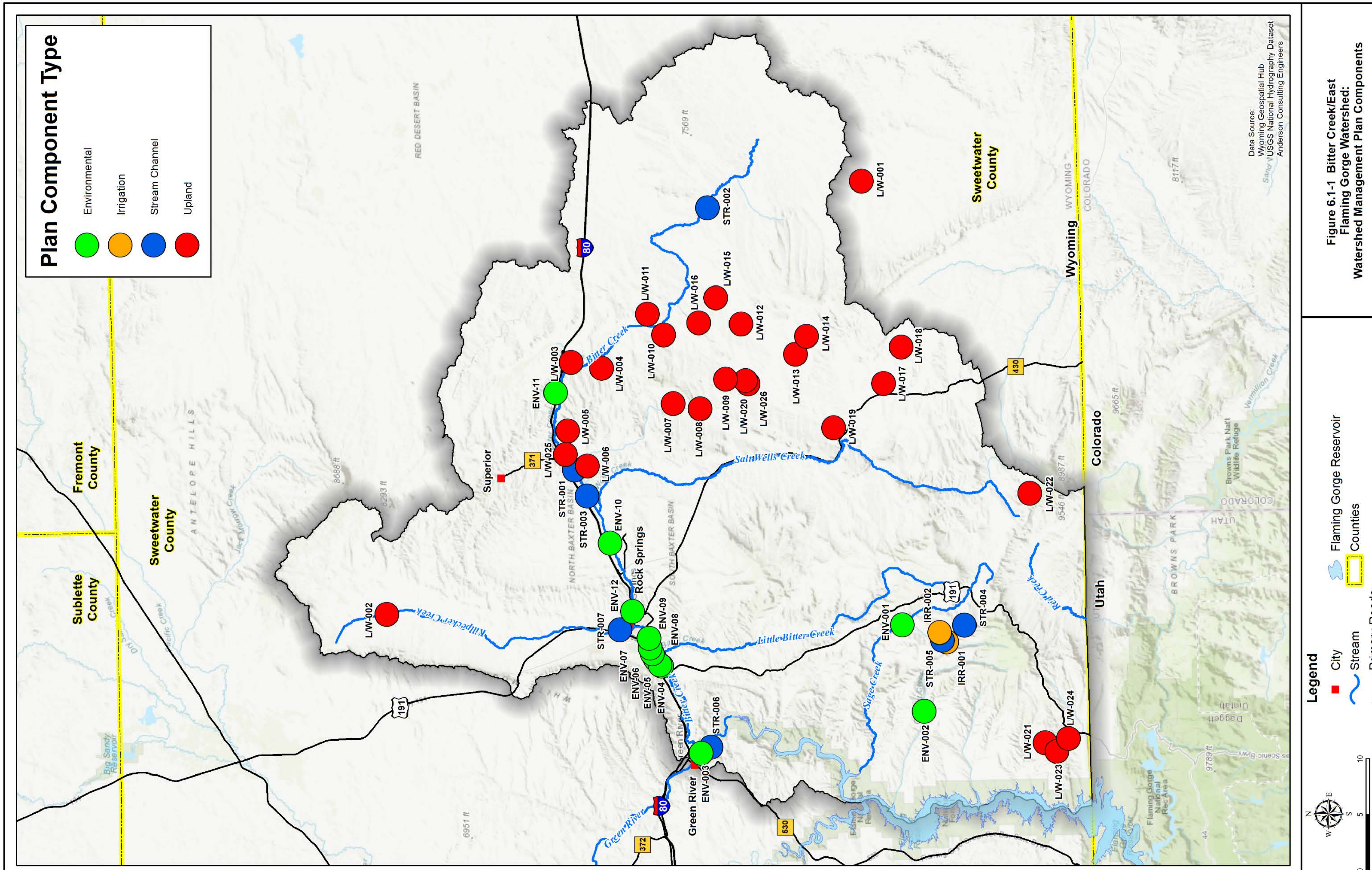
One of the principal objectives of this Level I study is to generate a watershed management and rehabilitation plan that is technically sound, practical in nature, and economically feasible. During the completion of the watershed inventory and characterization phase of the project, we met with as many landowners/stakeholders as possible to document their resource-related concerns and to develop the list of projects discussed in this chapter.

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.
- **Surface Water Storage Opportunities:** Results of previous investigations pertaining to development of water storage and opportunities identified during the project inventory phase of this investigation are incorporated.
- **Stream Channel Condition and Stability:** Stream channels within the watershed were characterized with respect to their condition and stability. Impaired channels were identified for further evaluation and alternative improvements developed.
- **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 environmental enhancement; including potential wetland development and fisheries-related opportunities.

Where pertinent, conceptual designs were prepared for the identified projects. These can be found in Appendix 6A of this document. These plans have been prepared to provide an overview of potential improvements that can partially or fully address the key issues identified within the watershed. Figure 6.1-1 displays the locations of the projects.

Disclaimer: It is important to note that all project recommendations presented in this report are conceptual only and are intended to provide sufficient information to initiate projects and to apply for funding through various funding mechanisms; implementation will require engineering analysis and design. Also, there are no requirements that these projects be ultimately implemented; participation is totally voluntary. Furthermore, the Sweetwater County Conservation District has no obligation to


Plan Component Type
Environmental
Irrigation
Stream Channel
Upland
Figure 6.1-1 Bitter Creek/East
Flaming Gorge Watershed:
Watershed Management Plan Components
Data Source:
Wyoming Geospatial Hub
USGS National Hydrography Dataset
Anderson Consulting Engineers
Legend
City
Stream
Primary Roads
Flaming Gorge Reservoir
Counties
Miles
Fremont County
Sublette County
Sweetwater County
Sweetwater County
Wyoming
Colorado
Utah
Superior
Rock Springs
Green River
Bitter Creek
Salt Wells Creek
Little Bitter Creek
Killpecker Creek
Sage Creek
Green River
RED DESERT BASIN
ANTELOPE HILLS
NORTH BAXTER BASIN
SOUTH BAXTER BASIN
BROWNS PARK
Browns Park Nat'l Wildlife Refuge
Flaming Gorge National Rec Area
L/W-001
L/W-002
L/W-003
L/W-004
L/W-005
L/W-006
L/W-007
L/W-008
L/W-009
L/W-010
L/W-011
L/W-012
L/W-013
L/W-014
L/W-015
L/W-016
L/W-017
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L/W-026
STR-001
STR-002
STR-003
STR-004
STR-005
STR-006
STR-007
ENV-001
ENV-002
ENV-003
ENV-04
ENV-05
ENV-06
ENV-07
ENV-08
ENV-09
ENV-10
ENV-11
ENV-12
IRR-001
IRR-002
80
191
371
372
430
530

participate as sponsor of projects for potential funding. Decisions to sponsor a project will be made by the SWCCD board on a case by case basis.

6.2 Irrigation System Components (IRR)

As presented in Chapter 4, the irrigation system inventory effort associated with this project consisted of the evaluation of structures and ditch conditions at the request of interested landowners and stakeholders. No ditch systems were inventoried in their entirety. Instead, and at the request of those individuals who came forward with requests to participate in the study, individual irrigation system components were inspected.

Because of numerous factors including watershed hydrology, soils, topography and climate, irrigated lands are extremely limited in areal extent; only about 2,564 17,498 acres were classified as irrigated lands. Review of water rights databases of the Wyoming State Engineer, there are approximately 170 points of diversions, or PODs in the area. Most of the diversions provide water to 80 to 100 or less. Based upon the infrastructure observed during the project, the majority of infrastructure is aged, in poor to fair condition, and there is ample opportunity for rehabilitation and improvement.

Despite the number of PODs, only one landowner came forward with a request for the project team to assess existing infrastructure (Appendix 6A). Table 6.2-1 tabulates the specific irrigation projects included in the watershed management plan. Consequently, it is obvious that the recommendations included herein are not all-inclusive; there will be additional irrigation structures located throughout the watershed in need of rehabilitation or replacement. Potential projects involving those structures may still be considered eligible for application funding through the WWDC Small Water Project Program (SWPP).

Table 6.2-1 Bitter Creek / East Flaming Gorge Watershed Plan: Irrigation Components.

Watershed Management Plan Component	Project Name	Description
Irrigation Rehabilitation Projects (IRR)		
IRR-001	Ramsay Pipeline	Conversion of open ditch to buried pipeline
IRR-002	Desert Claim Fencing	Fencing of irrigated acres

The specific types of improvements that comprise this component of the watershed management plan include:

- Rehabilitation/replacement of existing structures
- Mitigation of seepage losses
- Enhanced delivery of water
- Reduction in annual operation and maintenance costs
- Improvement in ditch management and efficiency through water measurement

6.3 Livestock/Wildlife Water Components (L/W)

6.3.1 Overview

Based upon the premise that existing water sources are capable of providing water to livestock within a one mile radius, buffers were drawn around existing water sources discussed in Chapter 4 (Figure 6.3-1). Note that this figure does not show buffers about perennial/intermittent streams, nor undeveloped springs. A general objective of this effort was to provide means of providing reliable sources of livestock/wildlife drinking water as alternative water supplies to riparian corridors. As indicated in this figure, portions of the study area appear to be adequately supplied with water sources. However, it is important to note that many of these sources are stock reservoirs located on intermittent/ephemeral channels and are consequently reliant upon uncertain runoff. Long-term or season-long utility is not always certain, consequently, these water sources can be considered somewhat unreliable.

Based upon this analysis, much of the study area may benefit by the development of upland water sources. Development of additional upland water sources must be completed in view of several complicating factors in this area of the state:

1. While development of upland water sources may generally be seen as beneficial to the grazing community, management of feral horse populations may be exacerbated. Horses tend to congregate at water sources and may contribute to resource impacts. For example, Figure 6.3-2 displays a photo of land surrounding an artesian well and stock tank in the study area damaged by horses.

Figure 6.3-2 Resource Damage from Feral Horse Congregation at a Water Source.

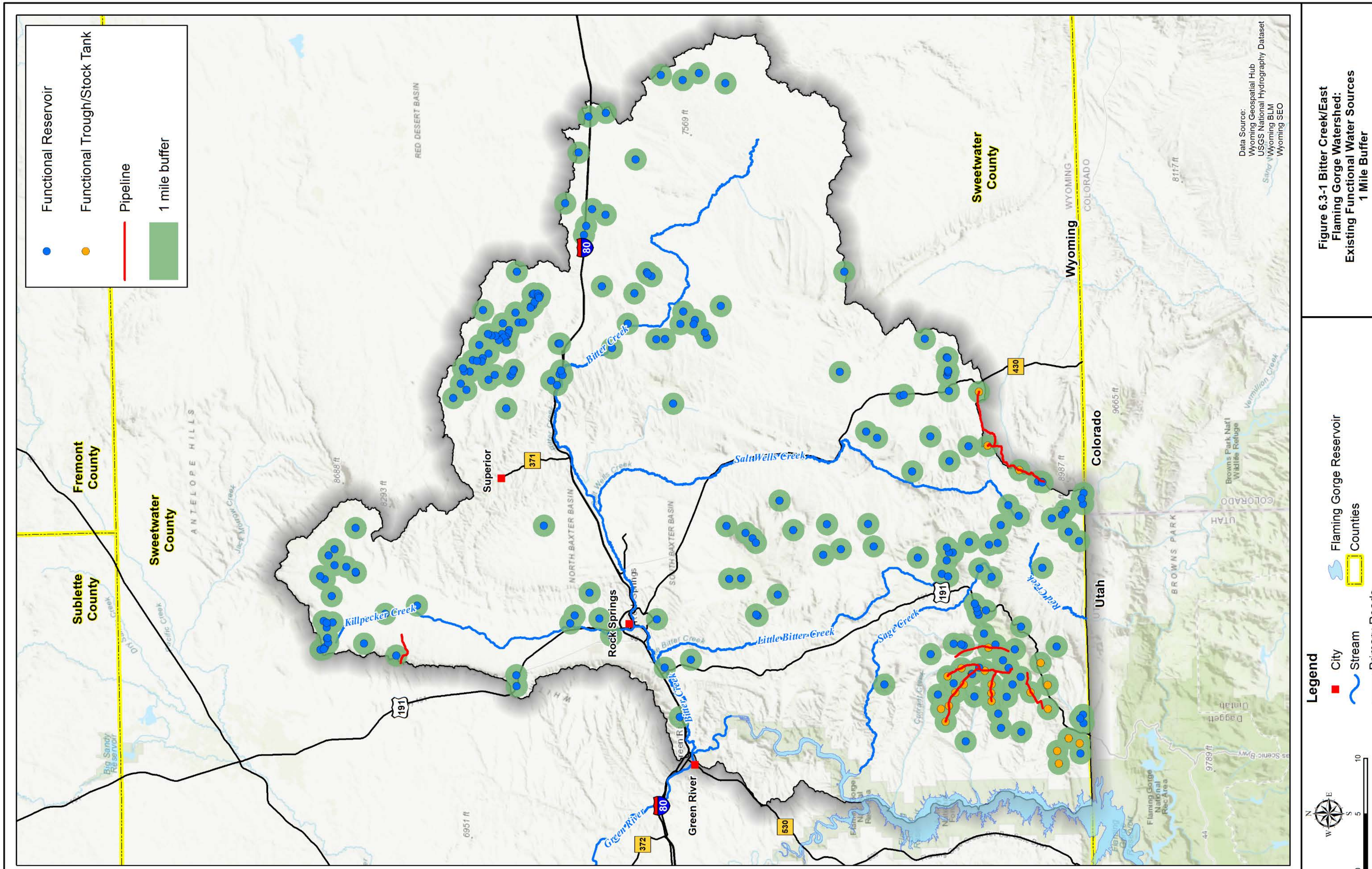
Figure 6.3-1 Bitter Creek/East Flaming Gorge Watershed:
Existing Functional Water Sources
1 Mile Buffer
Functional Reservoir
Functional Trough/Stock Tank
Pipeline
1 mile buffer
Legend
City
Stream
Primary Roads
Flaming Gorge Reservoir
Counties
Miles
0
5
10
Data Source:
Wyoming Geospatial Hub
USGS National Hydrography Dataset
Wyoming BLM
Wyoming SEO
Sweetwater County
Fremont County
Sublette County
Wyoming
Colorado
Utah
Superior
Rock Springs
Green River
Bitter Creek
Killpecker Creek
Salt Wells Creek
Little Bitter Creek
Sage Creek
Red Creek
Green River
Big Sandy Reservoir
RED DESERT BASIN
NORTH BAXTER BASIN
SOUTH BAXTER BASIN
ANTELOPE HILLS
BROWNS PARK
Browns Park Nat'l Wildlife Refuge
Flaming Gorge National Rec Area
Daggett
Uintah
80
191
371
372
430
530
7569 ft
8688 ft
8293 ft
6951 ft
9665 ft
8987 ft
8117 ft
9789 ft

Fencing water sources may be a solution, however in order to prevent destruction of the fence, 'steeljack'-type fence made with iron bars would be required (Figure 6.3-3) Implementation of steeljack fence would prevent access by feral horses but would also require management during periods of livestock use to enable access by cattle / sheep. ***Steeljack fencing was recommended for inclusion in any potential upland livestock/wildlife water supply project; its ultimate implementation would be determined on a case by case basis. It is also important to note that the WWDC can only fund fencing to protect water sources.***

Figure 6.3-3 Typical Steeljack Fence Source: Wyoming Game and Fish Department.

2. Development of springs to provide viable sources of upland water for livestock and wildlife could also result in loss of riparian habitat at those locations. By collecting water seeping from a spring into a pipeline and/or stock tank, existing vegetation relying on that source could suffer. The cumulative effects potentially resulting from numerous projects would need to be considered.

A list of interested land owners and allotment permittees was generated based upon input obtained at project meetings and information provided by the SWCCD. Individual meetings were scheduled and completed to obtain their input on the water needs of their respective geographical areas of interest. Based upon the results of these interviews and the information presented above pertaining to existing water supplies and areas in need of upland water development, several conceptual water development projects were identified. The general objective of this effort was to create a means of providing reliable sources of livestock / wildlife drinking water in water-short portions of the watershed as well as alternative water supplies to riparian corridors.

Land owners / stakeholders indicated locations where existing sources could benefit from enhanced or improved infrastructure. Conceptual plans and project descriptions were developed for 26 recommended projects as tabulated in Table 6.3-1. (See Appendix 6A for descriptions and conceptual designs). Typical projects include rehabilitation of existing stock reservoirs, spring developments and construction of pipeline/stock tank systems, and construction of new wells or rehabilitation of existing wells.

As presented in Chapter 4, there are numerous springs scattered throughout the study area. Many of these could conceivably be developed as upland water sources for wildlife and livestock. Prior to the design of any project, site-specific evaluation of the water source would be required to ensure adequate water yield and to develop environmental safeguards. Final design of any upland water projects would consequently require consideration of the yield of the water source and the number of animals the project is anticipated to serve. Appendix 6B contains information pertinent to the design and construction of livestock and wildlife water source improvements.

For the purposes of this project, watering facilities were assumed to consist of rubber tire stock tanks providing approximately 1,200 gallons of storage. This volume would facilitate the water needs of approximately 80 cattle per day assuming a water requirement of 15 gallons per day. A water source capable of providing 1 gallon per minute would be required to supply these facilities. By incorporating closed storage tanks in a project design, greater use of existing water sources could be realized.

It must be kept in mind that designs presented in this report are conceptual only. The indicated alignments of pipelines and placement of livestock / wildlife watering facilities are general and intended to represent the concept behind the alternatives if implemented, detailed design would be required.

In addition, environmental evaluations would be required for the impacts identified with each project. BLM typically conducts these evaluations when BLM lands are involved; however, the WGFD, NRCS or other agencies may provide input, particularly on archaeological or cultural resources issues. Consequently, implementation would be partially contingent upon BLM scheduling and manpower for completion of the requisite evaluation and documentation. It is our understanding that the facilities and thus requiring granting of easement for buried pipelines.

6.3.2 Water Rights Considerations

It must be noted that any water project involving a change in water use or location of water use would require a petition to the Board of Control. Proposals for new appropriations require an application for a permit from the Wyoming State Engineer prior to construction.

Several of the proposed upland wildlife/livestock water supply projects involved the potential conversion of existing sediment control or produced water reservoirs associated with existing mining activities to stock watering purposes. These water facilities are reliable sources of water in an area where livestock and wildlife water are both unreliable and often has considerable distance between locations. These conditions create significant challenges for those tasked with managing grazing resources and systems. As such, interest is raised as to gaining access to and use of those sites in the event the current producer shuts down production operations.

Prior to the reassignment of those facilities, there are conditions that would be necessary to meet in order to transfer the responsibility and use of those sites. Conversion and reclamation requirements are established in the Bureau of Land Management Surface operating Standards for Oil and Gas Development "Gold Book". Chapter 5 of that document deals with the reclamation and abandonment of wells, roads and containment ponds.

Table 6.3-1 Bitter Creek / East Flaming Gorge Watershed Plan: Livestock/Wildlife Water Supply Components.

Watershed Management Plan Component	Project Name	Description
Livestock / Wildlife Water Supply Projects (L/W)		
L/W-001	Kinney Spring Reservoir	Reconstruction of failed reservoir
L/W-002	Fifteenmile Knoll Reservoir	Reconstruction of breached embankment
L/W-003	Bitter Creek Springs	Development of existing springs / stock tanks
L/W-004	Well Rehabilitation	Refurbishing an existing well in need of repair
L/W-005	Upland Spring Development	Rehabiliitation of existing spring / stock tank
L/W-006	Upland Stock Reservoir Rehabilitation	Rehabilitation of a stock reservoir filled with sediment
L/W-007	Upland Stock Reservoir Rehabilitation	Rehabilitation of a stock reservoir filled with sediment
L/W-008	Well Rehabilitation	Rehabilitation of an existing well in need of repair
L/W-009	Upland Stock Reservoir Re-Permit	Conversion of mining-related reservoir to livestock / wildlife use
L/W-010	Upland Stock Reservoir Re-Permit	Conversion of mining-related reservoir to livestock / wildlife use
L/W-011	Upland Stock Reservoir Re-Permit	Conversion of mining-related reservoir to livestock / wildlife use
L/W-012	Upland Stock Reservoir Rehabilitation	Rehabilitation of a stock reservoir filled with sediment
L/W-013	Well Re-Permit	Conversion of mining-related well to livestock / wildlife use
L/W-014	Upland Stock Reservoir Rehabilitation	Conversion of mining-related reservoir to livestock / wildlife use
L/W-015	Upland Stock Reservoir Rehabilitation	Conversion of mining-related reservoir to livestock / wildlife use
L/W-016	Upland Stock Reservoir Re-Permit	Conversion of mining-related reservoir to livestock / wildlife use
L/W-017	Upland Stock Reservoir Rehabilitation	Rehabilitation of a stock reservoir filled with sediment
L/W-018	Upland Stock Reservoir Rehabilitation	Rehabilitation of a stock reservoir filled with sediment
L/W-019	Well Re-Permit	Conversion of mining-related reservoir to livestock / wildlife use
L/W-020	Spring Rehabilitation	Rehabilitation of a previously developed spring damaged by feral horses
L/W-021	Well Construction	Construction of a groundwater well in area void of other water sources for livestock / wildlife
L/W-022	Uncle Billy Pipeline Project	Spring development / pipeline / stock tank construction
L/W-023	Well Construction	Construction of a groundwater well in area void of other water sources for livestock / wildlife
L/W-024	Well Construction	Construction of a groundwater well in area void of other water sources for livestock / wildlife
L/W-025	Well Construction	Construction of a groundwater well in area void of other water sources for livestock / wildlife
L/W-026	Well Rehabilitation	Construction of a groundwater well in area void of other water sources for livestock / wildlife

For conversion of a well, it states that "*In some instances, the surface management agency or private landowner may wish to acquire a well that has encountered usable fresh water. Refer to 43 CFR Part 3162.3-4(b). In those cases, the operator has no further abandonment responsibility if the private landowner or surface management agency accepts all liability for the final plugging and reclamation of the water well and wellsite. Documentation of liability release will be issued to the responsible party".*

Also, there are bonding obligations that are required and must transfer from the production entity to an agency or private concern. As stated in the Code of Federal Regulations, §3104.1 Bond obligations, (a), "*Prior to the commencement of surface disturbing activities related to drilling operations, the lessee, operating rights owner (sublessee), or operator shall submit a surety or a personal bond, conditioned upon compliance with all of the terms and conditions of the entire leasehold(s) covered by the bond, as described in this subpart. The bond amounts shall be not less than the minimum amounts described in this subpart in order to ensure compliance with the act, including complete and timely plugging of the well(s), reclamation of the lease area(s), and the restoration of any lands or surface waters adversely affected by lease operations after the abandonment or cessation of oil and gas operations on the lease(s) in accordance with, but not limited to, the standards and requirements set forth in §§3162.3 and 3162.5 of this title and orders issued by the authorized officer."*

In addition, the reassignment of a water facility requires the receiver to also maintain a bond as established in §3104.8 Termination of period of liability**,** which states that *"The authorized officer shall not give consent to termination of the period of liability of any bond unless an acceptable replacement bond has been filed or until all the terms and conditions of the lease have been met."*

6.3.3 Well Siting and Design Considerations

As previously discussed in Chapter 4.2, while one can make generalizations about the availability and quality of groundwater in various formations, groundwater development is inherently both site specific and use specific. Because both the availability and quality of groundwater, and the specific requirements of a specific project with respect to these parameters, vary widely, generic identification of suitable and unsuitable locations for development are difficult. Any significant commitment of groundwater development funds should be preceded by an appropriate level of site-specific investigation.

The following guidelines may be helpful in that process:

- Performance from any bedrock aquifer is enhanced by fractures. In many cases, useful levels of fracturing may be associated with folds and faults that can be mapped at the surface (e.g. those on Figure 4.2-6).

- Groundwater quality limitations vary widely depending on the intended use; groundwater unsuitable for one use may be perfectly adequate for another. Less productive aquifers tend to have lower overall water quality, but groundwater quality, like quantitative productivity, can be critically site-specific

- Well siting should always look to take advantage of the experience of those who have gone before. The GIS products associated with this report contain information on permits developed through the Wyoming State Engineer's Office (SEO). Once a well is completed, the owner is required to file a Statement of Completion, which are now available electronically from the SEO website ([https://sites.google.com/a/wyo.gov/seo/)](https://sites.google.com/a/wyo.gov/seo/) under the groundwater permit number (listed for existing wells in Appendix 4B). In addition to basic information on owner, use, and depth, many of these statements describe the geologic materials encountered, at what depths groundwater was found, how the well was constructed, basic aquifer productivity test data and, sometimes, limited water-quality data

- Proximity to successful wells is always a valuable assessment approach, but should be tempered by consideration of whether or not the basic geology changes significantly between the reference and target locations. As depicted in Figures 4.2-6 and 4.2-8, geologic conditions can change dramatically over short distances.

- The classifications of Figure 4.2-12 provide a first-cut on the potential productivity of a specific area. Groundwater development in locations in the major aquitard classification (e.g. the Baxter Shale in the middle of the watershed) should be approached with the most caution.

- The geology of both Figures 4.2-6 and 4.2-12 has been generalized to a degree appropriate to the scale at which the referenced maps were published. While digital copies of mapping products are amenable to presentation at much larger scales, doing so cannot create pseudo-detail unsupported by the original mapping. Figure 4.2-6 was compiled from the best-available mapping at a watershed scale, but more detailed geologic investigations may be available for specific areas. Where the underlying geology is unclear, the most detailed sources should be consulted for site specific evaluations. The US Geological Survey has published 1:24,000-scale geologic mapping for select quadrangles in the study area. There are currently 18 such maps in the Bitter Creek watershed, primarily located south of I-80. These maps do not address groundwater conditions but provide additional local detail on the distribution and character of the geologic strata present. The available US Geological Survey Geologic Quadrangle mapping for the watershed is presented on Figure 4.2-17. Many of these individual maps are available for download from the USGS website at:
  https://ngmdb.usgs.gov/ngm-bin/ngm_search_dbi.pl?bc_ul=41.795401%2C-109.882043&bc_lr=40.850721%2C-107.643579

- With the exception of the complex interfingering between the Wasatch and Green River Formations in the Bitter Creek watershed (e.g. Figure 4.2-12), younger strata are underlain by all older strata (order is listed in Appendix 4A). For example, the Baxter Shale is present at depth beneath the entire area. Thus, while a marginal aquifer may be available via shallow well construction at a particular location, a preferable aquifer may be available at greater depth. This approach is complicated, however, by the potential deterioration in water-quality with depth and the potential diminution of aquifer permeability absent the active groundwater circulation near outcrop areas.

6.4 Storage Components (STO)

Construction of new water storage facilities in the watershed would be ***possible*** to complete within the framework of Wyoming water laws; however, water physically available is limited. No new reservoir storage projects were recommended during interviews with local landowners/stakeholders and agency representatives.

6.5 Stream Channel Components (STR)

The general condition of the principal stream channels and primary tributaries were evaluated during the geomorphic investigation which included:

- Classification of approximately 631 miles of stream channel within the GIS environment
- Field reconnaissance to verify the classifications.

These efforts and their results are presented in Chapter 4. During the evaluation of existing channel conditions, general classes of impairment were noted:

- Channel Stability and Bank Erosion: Pervasive instability throughout the watershed.
- Imbalance of Sediment Supply: Imbalance between stream capacity and sediment supply can lead to channel degradation or aggradation.
- Riparian Vegetation Degradation: Impaired riparian condition and habitat.
- Riparian Degradation: General bank erosion and physical disturbance of stream banks.
- Lowering of Local Groundwater Conditions: Magnitude of channel incision can result in lowering of local groundwater tables affecting vegetation vigor and species.

The scope of this Level I investigation precludes an in-depth evaluation of stream channel conditions. Locations where stability issues exist were documented largely through project workshops and word of mouth. Consequently, only a limited number of specific locations where stream channel or bank stabilization projects may be beneficial were noted. Given the magnitude of the extent of the study area, the complexity of the stream system, and the variety of land uses encompassed within it, there are certainly additional locations where further investigation may be warranted. The specific projects recommended in this watershed management plan, however, serve as examples of the types of local projects which could be completed and provide benefit to landowners and watershed health. Table 6.5-1 tabulates the specific stream channel rehabilitation projects identified in this study. Appendix 6A contains descriptions of each.

It is important to note that several of the recommended stream channel rehabilitation projects involve fencing of selected stream reaches in an effort to protect riparian areas from heavy wildlife grazing until stabilized. At that time the fencing would be presumably be moved to another location and the process repeated. ***The WWDC can only fund fencing to protect water sources, consequently these would likely not be eligible for funding through WWDC programs. Alternative funding may be available through other sources.***

Table 6.5-1 Bitter Creek / East Flaming Gorge Watershed Plan: Stream Channel Components.

Watershed Management Plan Component	Project Name	Description
Stream Channel Opportunities (STR)		
STR-001	Pierotto Ditch Diversion Structure Monitoring	Monitoring plan following completion of existing construction project
STR-002	Big Pond	Study design for mitigation of erosion and sedimentation feature
STR-003	UPRR Crossing Headcut	Stabilize active headcut at UPRR crossing
STR-004	Gooseberry Creek Wildlife/Livestock Exclosure	Continuation/modification of fence exclosure to promote stream stabilization
STR-005	Trout Creek Wildlife/Livestock Exclosure	Continuation/modification of fence exclosure to promote stream stabilization
STR-006	Green River Streambank (Scotts Bottom)	Stabilize active bank erosion on Green River
STR-007	Killpecker Creek Stabilization Project	Develop a stream stabilization plan

6.5.1 Channel Stabilization Strategies

Various approaches can be taken during channel restoration and stabilization efforts, including both "hard" engineering and "soft" approaches and combinations of the two.

Examples of "hard" approaches would include construction of channel structures or reconstruction of channels themselves. The selection of the appropriate mitigation/restoration technique depends upon site-specific information and critical review of hydrologic and hydraulic data. Installation of an inappropriate type of structure or improper installation could exacerbate conditions.

For instance, methods of restoring incised channels may include construction of gradient restoration facilities (i.e., drop structures, check structures) within the incised channel. Figure 6.5-1 displays a diagram of a

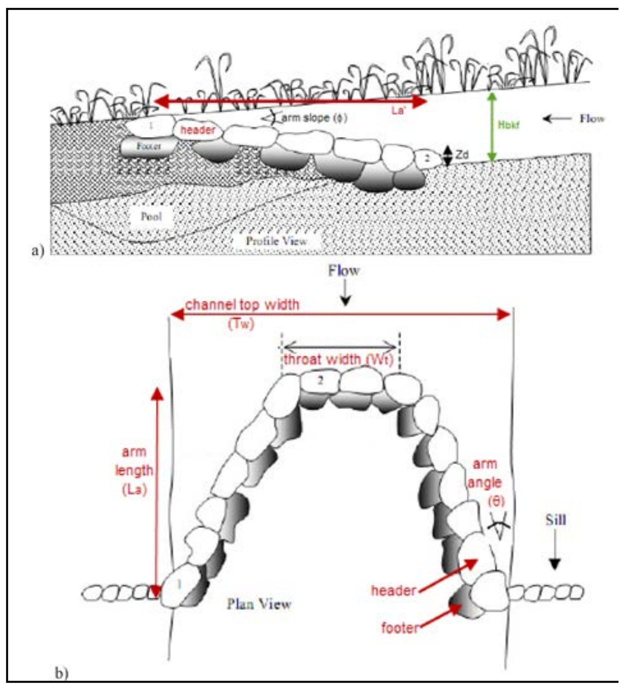

Figure 6.5-1 Rock Vortex Weir Structure Diagram (Adapted from Rosgen, 2006).

typical stream channel stabilization strategy for a small channel experiencing minor downcutting or bank erosion. A vortex weir can be placed within a problematic reach to serve as a grade control structure as well as directing and centralizing streamflow. Weir configuration can be varied to provide additional functions such as facilitating irrigation diversions. Figure 6.5-2 displays a photograph of a typical installation.

Re-establishment of pre-incision channel elevations can be accomplished by means of check dams. Figure 6.5-3 displays a photo of a large-scale check dam on Muddy Creek in the Little Snake River watershed near Baggs, Wyoming. This structure serves as a good example of how gradient restoration strategies can be utilized to restore diversion capabilities at irrigation headgates rendered inoperable by changes in channel configuration.

Figure 6.5-2 Stream Stabilization Structure: Rock Vortex Weir.

Figure 6.5-3 Channel Gradient Restoration Feature on Muddy Creek near Baggs, WY. Photo on left is viewed Downstream from the Dam at Incised Channel. Photo on the right is viewed Upstream at Restored Gradient.

Examples of "soft" approaches include a variety of Best Management Practices (BMPs). Examples of potentially applicable BMPs designed for channel restoration activities include those that result in reducing or, at least temporarily excluding wildlife and livestock from accessing designated riparian zones, establishment of riparian buffers, etc. The proposed wildlife/livestock water developments discussed previously (and others that may be identified in the future) can be considered elements of a range management BMP that will help restore, over time, those areas of channel impairment that have resulted from overutilization of riparian areas or adjacent upland range. Figure 6.5-4 displays a photo of willow fascine installation. This strategy could be employed on many of the perennial channels or intermittent where sufficient flow exists to support the vegetation, in an effort to restore riparian habitat and stabilize streambanks.

Figure 6.5-4 Stream Stabilization Measure: Willow Fascine Installation.

These examples of "hard" and "soft" approaches represent both extremes of the continuum of channel restoration strategies that exist. In practice, it must be kept in mind that it is generally a combination of strategies, integrated into a cohesive plan, that provides the most effective solution. Table 6.5-2 presents a summary of some of these channel restoration strategies which can be employed during future restoration efforts. Development of more specific projects and BMPs was beyond the scope of this Level I study. Such projects can be identified and developed on the basis of more detailed geomorphic analysis of impaired stream reaches.

As would be recommended with any similar project, monitoring of the success of the project(s) is highly recommended. At a minimum, monitoring should include visual inspection of rehabilitation features to determine the effectiveness and ability of the rehabilitation to withstand high flow events. Evidence of existing or induced erosion, movement of rehabilitation features (rock, root wads, etc.), sedimentation, vegetation establishment, etc. should be noted. In addition, long term monitoring of rehabilitation sites should include:

- Photographic documentation
- Cross sections
- Longitudinal profiles
- Bank surveys
- Bank erosion pins
- Scour chains
- Pebble counts

Table 6.5-2 Summary of Potential Stream Channel Stabilization/Restoration Techniques.

Flow-Redirection Techniques	**Biotechnical Techniques**
Vanes	Woody Plantings
Groins	Herbaceous Cover
Buried Groins	Soil Reinforcement
Barbs	Coir Logs
Engineered Log Jams	Bank Reshaping
Drop Structures	**Internal Bank-Drainage Techniques**
Porous Weirs	Subsurface Drainage Systems
Structural Techniques	**Avulsion-Prevention Techniques**
Anchor Points	Floodplain Roughness
Roughness Trees	Floodplain Grade Control
Riprap	Floodplain Flow Spreaders
Log Toes	**Other Techniques**
Roughened-Rock Toes	Channel Modifications
Log Cribwalls	Riparian-Buffer Management
Manufactured Retention Systems	Spawning-Habitat Restoration
	Fish Ladders/bypass structures
	Fish Screens/entrainment prevention

6.6 Grazing Management Opportunities (Watershed Management Plan Component)

In Chapter 4, the ecological sites found within the watershed were presented and the concept of the ecological site description (ESD) was introduced. The ESD for a given ecological site contains a wealth of information pertaining to the site and its community. Within each ESD is a State and Transition model.

State and transition models describe the patterns, causes, and indicators of transitions between communities within an ecological site based upon the ecological site description (ESD). In a graphical form, they display information obtained from literature supplemented by the knowledge and experience of range scientists and managers. Basically, they display the response of a given ecological site to various range management practices or disturbances. They help to distinguish changes in vegetation and soils that are easily reversible versus changes that are subject to thresholds beyond which reversal is costly or unlikely. By being aware of the predicted response of a given ecological site to a treatment, the land manager can use this knowledge to best prescribe land management practices or treatments to direct the transition in a desirable direction. For instance, land management strategies can be prescribed which could result in restoration of the Historic Climax Plant Community (HCPC) under the right circumstances. Based upon the assumptions presented in Chapter 3, the three dominant ecological sites found within the mapped portions of the Upper Laramie River Watershed study area are likely to be the following:

- Shallow Sandy (SwSy) 7-9" Green River and Great Divide Basins
- Shallow Loamy (SwLy) 7-9" Green River and Great Divide Basins
- Saline Upland (SU) 7-9" Green River and Great Divide Basins

It is important to note that other ecological sites will be encountered and that the list above is provided as an initial point for prescription of grazing practices. Prior to prescription of a grazing management plan, local site-specific conditions must be considered and the appropriate ESD determined.

As an example of ESD utilization, the management strategies for the Shallow Sandy (SwSY) 7 – 9" site is provided:

*"As this site deteriorates from improper grazing management, species such as rabbitbrush, low sage, needleleaf sedge, and Sandberg bluegrass will increase. Bunchgrasses such as Indian ricegrass and needleandthread will decrease in frequency and production. This site has relatively low productivity potential, and is not well suited to grazing improvement practices unless treated as part of a larger unit containing more productive areas. (*See Figure 6.5-5 for the State and Transition Model of this ecological site)

The Historic Climax Plant Community (description follows the plant community diagram) has been determined by study of rangeland relic areas, or areas protected from excessive disturbance. Trends in plant communities going from heavily grazed areas to lightly grazed areas, seasonal use pastures, and historical accounts have also been used.

The interpretive plant community for this site is the Historic Climax Plant Community. Potential vegetation is about 70% grasses or grass-like plants, 10% forbs, and 20% woody plants. The major grasses include needleandthread, Indian ricegrass, thickspike wheatgrass, and galleta.

Other grasses include Letterman needlegrass, Sandberg bluegrass, prairie junegrass, bluebunch wheatgrass, bottlebrush squirreltail, Salina wildrye, and needleleaf sedge. Green rabbitbrush is the major woody plant. Other woody plants include Wyoming big and low sagebrush, shadscale, and winterfat.

A typical plant composition for this state consists of needleandthread 15-30%, Indian ricegrass 15-30%, thickspike wheatgrass 5-15%, galleta 5-15%, other grasses and grass-like plants 10-20%, perennial forbs 5-10%, green rabbitbrush 5-10%, and 5-15% other woody species. Ground cover, by ocular estimate, varies from 10-20%.

The total annual production (air-dry weight) of this state is about 350 pounds per acre, but it can range from about 200 lbs./acre in unfavorable years to about 450 lbs./acre in above average years.

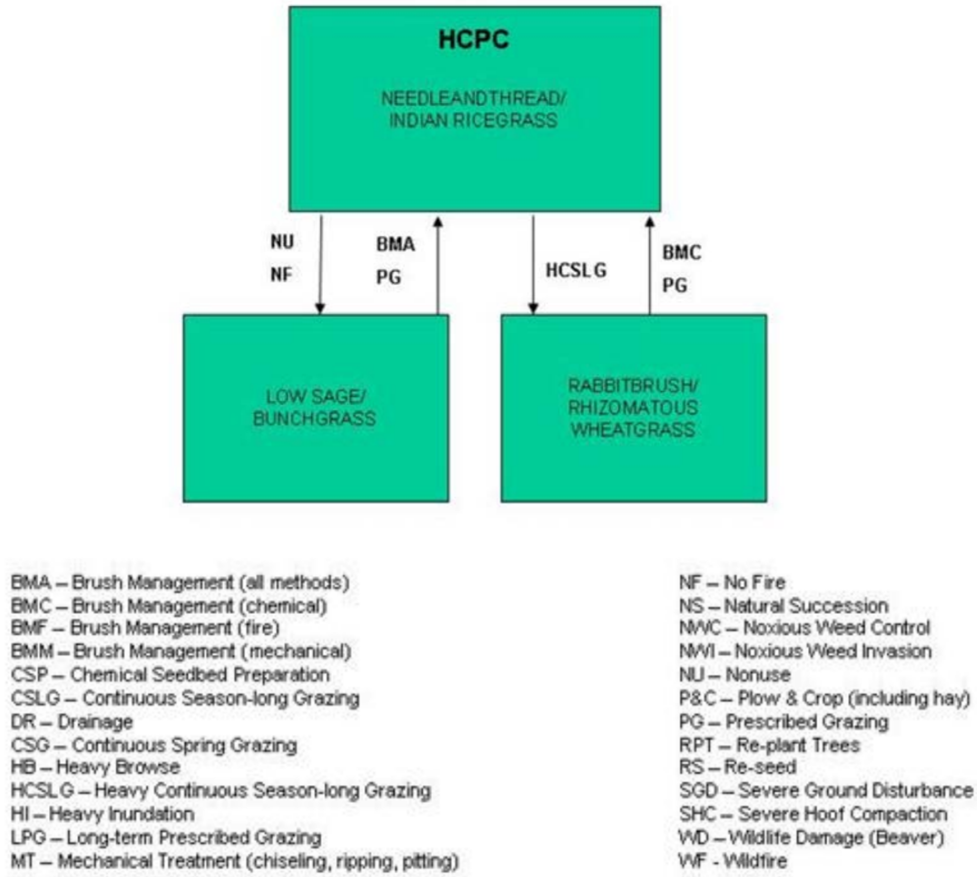

Figure 6.5-5 State and Transition Model: *Loamy (Ly) 10-14" P.Z., High Plains Southeast.*

The state is stable and well adapted to the Cool Central Desertic Plains and Plateaus climatic conditions. The diversity in plant species allows for high drought resistance. This is a sustainable plant community (site/soil stability, watershed function, and biologic integrity).

Transitions or pathways leading to other plant communities are as follows:

- *Nonuse and No Fire will convert this plant community to the Low Sagebrush/Bunchgrass State.*
- *Heavy Continuous Season-long Grazing will convert this plant community to the Rabbitbrush/Rhizomatous Wheatgrass State."*

The state and transition model for this ecological site is displayed in Figure 6.5-5. The transitions, or pathways, described above are presented in the figure. Despite the fact that detailed soils mapping, and consequently, determination of the ambient ecological sites, is limited in this study area, the ESDs

that are available provide valuable information. Site-specific grazing management recommendations are not included in this report and would require detailed on-site evaluation.

6.7 Environmental Enhancement Opportunities

Several projects were identified which were categorized as Environmental Enhancement Opportunities. Specific projects included fish barriers and water quality management of public water features. Appendix 6A contains descriptions of each. Table 6.7-1 tabulates the specific projects identified.

In addition to these specific projects brought forward by watershed stakeholders, the opportunity to potentially enhance or develop wetlands was recommended. Several sites were identified through evaluation of aerial photography, where oxbows could be developed into potential wetlands. Figure 6.7-1, displays locations where Bitter Creek could potentially be diverted into abandoned oxbows in an effort to establish a viable wetlands. Figure 6.7-2 displays an aerial view of the concept.

Prior to initiation of any project such as this, detailed site-specific information would be required; the projects are included in this report as conceptual only. Detailed on-site topography, hydrology, and soils information would be required. Land purchases or agreement with existing landowners would be required, hydraulic modeling of the project would need to be conducted to ensure it did not exacerbate existing flooding issues, and water rights permitting completed.

Table 6.7-1 Bitter Creek / East Flaming Gorge Watershed Study: Environmental Components.

Watershed Management Plan Component	Project Name	Description
Environmental Improvement Opportunities (ENV)		
ENV-001	Trout Creek Barrier	Fish population management
ENV-002	Currant Creek Barrier	Fish population management
ENV-003	Kid's Pond - Green River	Provide cleansing mechanism for public fishing pond
ENV-04	Oxbow / Wetland Enhancement	Sites identified where wetlands could potentially be created or existing wetlands enhanced
ENV-05		
ENV-06		
ENV-07		
ENV-08		
ENV-09		
ENV-10		
ENV-11		
ENV-12	Stormwater Quality Management / TMDL Plan	Incorporate projects developed in coordination with ongoing TMDL planning efforts

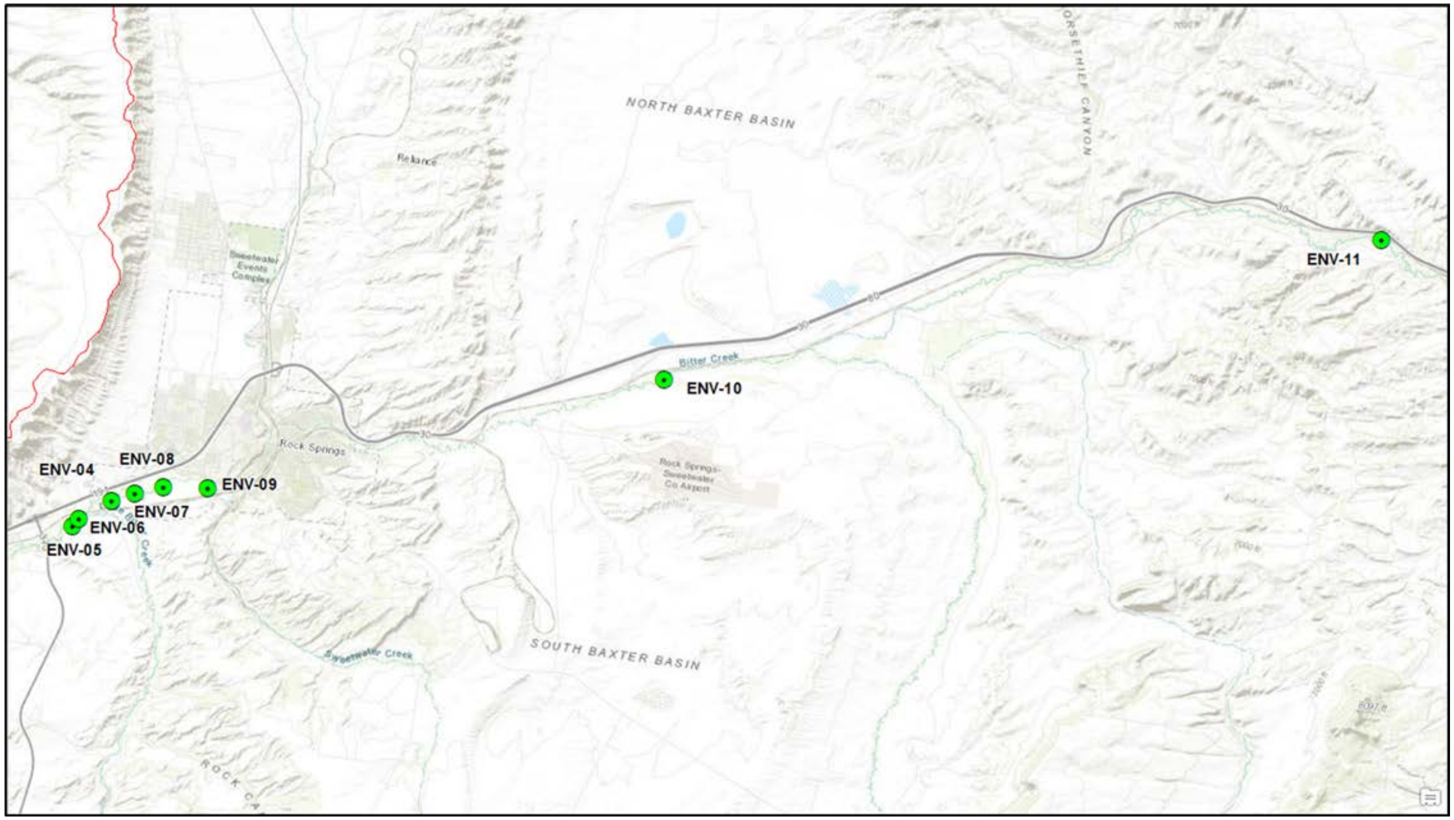

Figure 6.7-1 Potential Wetland Enhancement Opportunities.

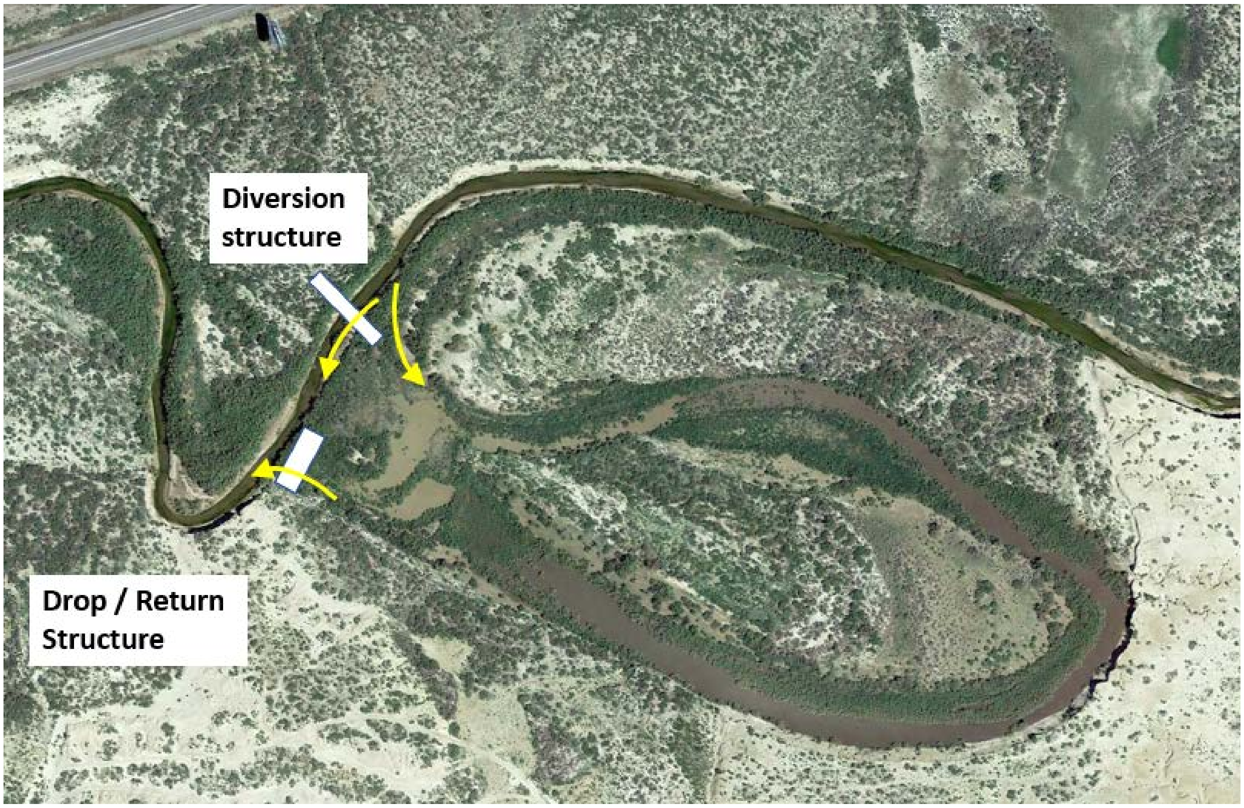

Figure 6.7-2 Example Wetland Enhancement / Establishment Conceptual Layout.

Finally, as discussed in Chapter 4 of this report, the SWCCD is currently in the process of developing a water quality management plan in coordination with WDEQ and EDE Consultants. The plan will include development of strategies to reduce fecal coliform contamination in Bitter Creek through implementation of various Best Management Practices (BMPs) and other strategies. As the plan develops and specific strategies are outlined, projects could be amended to the watershed management plan. Potential projects could include typical BMPs targeting water quality improvement of stormwater runoff from urban areas:

Retention ponds

Detention ponds

- Vegetated swales
- Wetlands
- Sediment traps
- Etc.

6.8 Bitter Creek / East Flaming Gorge Watershed Management Plan

The information presented in this chapter provides recommendations for improvements associated with:

- Irrigation system rehabilitation components
- Livestock / wildlife upland watering opportunities
- Grazing management opportunities
- Stream channel stability components
- Environmental enhancement opportunities

These improvements focus on potential mitigation of several key issues that presently exist within the watershed. For the Bitter Creek / East Flaming Gorge watershed, the watershed management plan consists of a compilation of the recommendations for each category. The plan is summarized in Table 6.8-1.

6.9 Project Prioritization Matrix

In an effort to help the LRCD and the WWDO prioritize projects for completion or funding, a prioritization matrix was prepared. The matrix consists of a tabulation of the individual components of the watershed management plan and various attributes for each. Each component of the plan was assigned a score for each attribute. Table 6.8-2 provides a summary of the attributes and the scoring criteria. Results of the prioritization are presented in Table 6.8-3.

Table 6.8-1 Bitter Creek / East Flaming Gorge Watershed Management Plan.

Watershed Management Plan Component	Project Name	Description
Irrigation Rehabilitation Projects (IRR)		
IRR-001	Ramsay Pipeline	Conversion of open ditch to buried pipeline
IRR-002	Desert Claim Fencing	Fencing of irrigated acres to reduce wildlife damages
Stream Channel Opportunities (STR)		
STR-001	Pierotto Ditch Diversion Structure Monitoring	Monitoring plan following completion of existing construction project
STR-002	Big Pond	Study design for mitigation of erosion and sedimentation feature
STR-003	UPRR Crossing Headcut	Stabilize active headcut at UPRR crossing
STR-004	Gooseberry Creek Wildlife/Livestock Exclosure	Continuation/modification of fence exclosure to promote stream stabilization
STR-005	Trout Creek Wildlife/Livestock Exclosure	Continuation/modification of fence exclosure to promote stream stabilization
STR-006	Green River Streambank (Scotts Bottom)	Stabilize active bank erosion on Green River
STR-007	Killpecker Creek Stabilization Project	Develop a stream stabilization plan
Storage Opportunities (STO)		
No project entailing construction of new storeage facilities or enhancement of existing facilities were identified		
Environmental Improvement Opportunities (ENV)		
ENV-001	Trout Creek Barrier	Fish population management
ENV-002	Currant Creek Barrier	Fish population management
ENV-003	Kid's Pond - Green River	Provide cleansing mechanism for public fishing pond
ENV-04	Oxbow / Wetland Enhancement	Sites identified where wetlands could potentially be created or existing wetlands enhanced
ENV-05		
ENV-06		
ENV-07		
ENV-08		
ENV-09		
ENV-10		
ENV-11		
ENV-12	Stormwater Quality Management / TMDL Plan	Incorporate projects developed in coordination with ongoing TMDL planning efforts

Watershed Management Plan Component	Project Name	Description
Livestock / Wildlife Water Supply Projects (L/W)		
L/W-001	Kinney Spring Reservoir	Reconstruction of failed reservoir
L/W-002	Fifteenmile Knoll Reservoir	Reconstruction of breached embankment
L/W-003	Bitter Creek Springs	Development of existing springs / stock tanks
L/W-004	Well Rehabilitation	Refurbishing an existing well in need of repair
L/W-005	Upland Spring Development	Rehabiliitation of existing spring / stock tank
L/W-006	Upland Stock Reservoir Rehabilitation	Rehabilitation of a stock reservoir filled with sediment
L/W-007	Upland Stock Reservoir Rehabilitation	Rehabilitation of a stock reservoir filled with sediment
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L/W-009	Upland Stock Reservoir Re-Permit	Conversion of mining-related reservoir to livestock / wildlife use
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L/W-019	Well Re-Permit	Conversion of mining-related reservoir to livestock / wildlife use
L/W-020	Spring Rehabilitation	Rehabilitation of a previously developed spring damaged by feral horses
L/W-021	Well Construction	Construction of a groundwater well in area void of other water sources for livestock / wildlife
L/W-022	Uncle Billy Pipeline Project	Spring development / pipeline / stock tank construction
L/W-023	Well Construction	Construction of a groundwater well in area void of other water sources for livestock / wildlife
L/W-024	Well Construction	Construction of a groundwater well in area void of other water sources for livestock / wildlife
L/W-025	Well Construction	Construction of a groundwater well in area void of other water sources for livestock / wildlife
L/W-026	Well Rehabilitation	Construction of a groundwater well in area void of other water sources for livestock / wildlife

Table 6.8-2 Project Prioritization Strategy.

Attribute	Prioritization Matrix Score		
	1	2	3
WWDC Priority[1]	WWDC Priority of 5 or 6	WWDC Priority 2, 3, or 4	WWDC Priority 1
Water Rights	Significant permitting effort	Routine permitting requirement: ex. WSEO Change in POD, water right	WSEO permit approved or not required
Relative Cost	Estimated project cost greater than SWPP limit of $135,000	Estimated project cost less than SWPP limit of $135,000	Estimated project cost less than $70,000 (i.e. SWPP 1:1 match)
Land Ownership	Potentially includes Federal Lands	Potentially includes State Lands but no Federal Lands	Potentially includes Private Lands only
Practical Implementation	Challenging effort	Moderate effort	Routine effort
Ease of Permitting	Federal permits/NEPA	Local or State permits	Permit(s) approved or No permit(s) required
Public Acceptability	Potential Non-acceptance Anticipated	Moderate Acceptance	Generally Accepted by Public
Ancillary Benefits	Negligible associated benefits	Moderate associated benefits	Multiple associated benefits
Number of Beneficiaries	1	2 to 8	9 or more

Note[1]

According to the WWDC's recently revised operating guildelines, project priorities are as follows:

1. Source water development
2. Storage
3. Pipelines, conveyance facilities, solar platforms and windmills
4. Irrigation
5. Environmental

Table 6.8-3 Prioritized Components of the Bitter Creek / East Flaming Gorge Watershed Management Plan.

Watershed Management Plan Component	Project Name	WWDC Priority	Water Rights	Relative Cost	Land Ownership	Practical Implementation	Ease of Permitting	Public Acceptability	Ancillary Benefits	Number of Beneficiaries	Score
Irrigation Rehabilitation Projects (IRR)											
IRR-001	Ramsay Pipeline	2	3	3	3	3	3	3	2	1	23
IRR-002	Desert Claim Fencing	1	3	3	3	2	2	2	2	1	19
Livestock / Wildlife Water Supply Projects (L/W)											
L/W-001	Kinney Spring Reservoir	3	1	2	3	2	2	3	2	3	21
L/W-002	Fifteenmile Knoll Reservoir	3	2	2	1	2	2	2	2	3	19
L/W-003	Bitter Creek Springs	3	1	3	2	2	2	3	1	3	20
L/W-004	Well Rehabilitation	3	2	3	2	1	2	3	1	3	20
L/W-005	Upland Spring Development	3	2	3	2	2	2	3	1	3	21
L/W-006	Upland Stock Reservoir Rehabilitation	3	2	3	2	2	2	3	1	3	21
L/W-007	Upland Stock Reservoir Rehabilitation	3	2	3	1	2	2	3	1	3	20
L/W-008	Well Rehabilitation	3	2	3	1	1	2	3	1	3	19
L/W-009	Upland Stock Reservoir Re-Permit	3	2	3	2	2	2	3	1	3	21
L/W-010	Upland Stock Reservoir Re-Permit	3	2	3	1	2	2	3	1	3	20
L/W-011	Upland Stock Reservoir Re-Permit	3	2	3	1	2	2	3	1	3	20
L/W-012	Upland Stock Reservoir Rehabilitation	3	2	3	1	2	2	3	1	3	20
L/W-013	Well Re-Permit	3	2	3	2	1	2	3	1	3	20
L/W-014	Upland Stock Reservoir Rehabilitation	3	2	3	1	2	2	3	1	3	20
L/W-015	Upland Stock Reservoir Rehabilitation	3	2	3	2	2	2	3	1	3	21
L/W-016	Upland Stock Reservoir Re-Permit	3	2	3	1	1	2	3	1	3	19
L/W-017	Upland Stock Reservoir Rehabilitation	3	2	3	1	2	2	3	1	3	20
L/W-018	Upland Stock Reservoir Rehabilitation	3	2	3	1	2	2	3	1	3	20
L/W-019	Well Re-Permit	3	2	3	3	1	2	3	1	3	21
L/W-020	Spring Rehabilitation	3	2	3	2	2	2	3	1	3	21
L/W-021	Well Construction	3	2	3	1	2	2	3	1	3	20
L/W-022	Uncle Billy Pipeline Project	3	2	3	1	2	2	3	1	3	20
L/W-023	Well Construction	3	2	3	1	2	2	3	1	3	20
L/W-024	Well Construction	3	2	3	1	2	2	3	1	3	20
L/W-025	Well Construction	3	2	3	3	2	2	3	1	3	22
L/W-026	Well Rehabilitation	3	2	3		2	2	3	1	3	19
Stream Channel Opportunities (STR)											
STR-001	Pierotto Ditch Diversion Structure Monitoring	1	1	3	3	3	3	3	2	3	22
STR-002	Big Pond Mitigation Study	1	1	1	2	3	3	2	2	3	18
STR-003	UPRR Crossing Headcut	1	1	2	2	1	1	2	3	3	16
STR-004	Gooseberry Creek Wildlife/Livestock Exclosure	1	1	3	1	3	2	3	2	3	19
STR-005	Trout Creek Wildlife/Livestock Exclosure	1	1	3	3	3	2	3	2	3	21
STR-006	Green River Streambank (Scotts Bottom)	1	1	1	2	3	2	3	2	3	18
STR-007	Killpecker Creek Stabilization Project	1	1	1	1	1	2	3	3	3	16
Environmental Improvement Opportunities (ENV)											
ENV-001	Trout Creek Barrier	1	1	3	3	2	2	3	2	3	20
ENV-002	Currant Creek Barrier	1	1	3	3	2	2	3	2	3	20
ENV-003	Kid's Pond - Green River	1	1	3	1	2	2	3	3	3	19
ENV-004 to ENV-011	Wetland Enhancement / Establishment Opportunities	1	1	1	1	1	1	3	3	3	15
ENV-012	Stormwater Quality Management / TMDL Plan	1	1	3	2	2	2	3	3	3	20

VII. TASK 6: COST ESTIMATES

Conceptual-level costs have been developed for each of the alternative potential projects identified and described in Chapter 6. The basis for these costs are described in the following subsections for each of the overall project categories. Cost estimates presented represent 2018 dollars. NRCS Fiscal Year (2018) Practice Payment Rates for EQIP Program costs data were used where feasible for typical design items. These values represent the amount of money typically paid to individuals for EQIP projects and not necessarily the actual cost of construction. Consequently, in order to best represent actual construction costs, the EQIP Payment Rates were inflated 25% for livestock projects and 33% for irrigation projects to better reflect actual construction costs; not reimbursement values.

7.1 Irrigation System Components

Costs associated with irrigation system components of the watershed management plan were estimated based upon current itemized unit costs for individual improvements. NRCS Fiscal Year (2018) Practice Payment Rates for EQIP Program costs cost data were used where feasible for typical design items. In Table 7.1-1 summarizes conceptual cost estimates for irrigation system components of the watershed management plan. Where feasible, NRCS EQIP components are itemized for most structures.

7.2 Upland Wildlife/Livestock Water Components

The anticipated costs associated with these components of the watershed management plan were based upon previous experience completing similar projects in the study area, current NRCS EQIP cost tables, and current costs of various other system components obtained from reliable sources.

Table 7.2-1 presents the estimated costs associated with each of the upland wildlife / livestock water source components of the watershed management plan. The following components are common to most of the systems and are itemized below for general reference.

Spring Developments: Typical costs range from $1,000 to $5,000 depending on size and yield of the spring. For the purposes of this Level I investigation a cost of $3,600 was used as a median value because site-specific information was not available.

Wells: Well construction costs were assumed to be approximately $40 per foot of depth. This value was determined based upon input from local drilling contractors.

Solar Pump Facility: A cost of $8,000 per solar pump facility was used. This cost was assumed to include the pump, solar arrays, and requisite controls and regulators. Actual price would vary based upon depth to water.

Table 7.1-1 Conceptual Cost Estimates: Irrigation System, Stream Channel Improvements, and Environmental Enhancement Components.

Watershed Management Plan Component	Project Description	Construction Subtotal	Engineering (10%)	Constuction and Engineering	Contingency (15%)	Total Construction Cost	Final Plans and Specs	Additional	Permitting / Legal Fees / Access and	Total Project Cost
IRR-001	Ramsay Pipeline	$85,000	$8,500	$93,500	$14,025	$107,525	$1,000	$0	$1,000	**$109,525**
IRR-002	Desert Claim Fencing	$25,000	$2,500	$27,500	$4,125	$31,625	$1,000	$0	$1,000	**$33,625**
STR-001	Pierotto Ditch Diversion Monitoring	$10,000	NA	$10,000	$1,500	$11,500	NA	$0	NA	**$11,500**
STR-002	Big Pond Rehabilitation Study	$15,000	NA	$15,000	$2,250	$17,250	NA	$0	NA	**$17,250**
STR-003	UPRR Crossing Stabilization	$50,000	$5,000	$55,000	$8,250	$63,250	$1,000	$0	$1,000	**$65,250**
STR-004	Gooseberry Creek Exclosure	$4,000	$400	$4,400	$660	$5,060	$1,000	$0	$1,000	**$7,060**
STR-005	Trout Creek Exclosure	$85,000	$8,500	$93,500	$14,025	$107,525	$1,000	$0	$1,000	**$109,525**
STR-006	Green River Streambank Stabilization	TBD								TBD
STR-007	Killpecker Creek Stabilization Project	$85,000	$8,500	$93,500	$14,025	$107,525	$1,000	$0	$1,000	**$109,525**
ENV-001	Trout Creek Fish Barrier	$75,000	$7,500	$82,500	$12,375	$94,875	$1,000	$0	$1,000	**$96,875**
ENV-002	Currant Creek Fish Barrier	$75,000	$7,500	$82,500	$12,375	$94,875	$1,000	$0	$1,000	**$96,875**
ENV-003	Kid's Pond - Green River	$185,000	$18,500	$203,500	$30,525	$234,025	$1,000	$0	$1,000	**$236,025**
ENV-004 to ENV-011	Wetland Enhancement Opportunities	TBD								TBD
ENV-012	Bitter Creek TMDL Implementation	TBD								TBD

Table 7.2-1 Summary of Conceptual Costs: Livestock / Wildlife Components.

		Watershed Component	Watershed Component	Watershed Component	Watershed Component	Watershed Component	Watershed Component	Watershed Component	Watershed Component	Watershed Component	Watershed Component	Watershed Component	Watershed Component	Watershed Component
		L/W-001	L/W-002	L/W-003	L/W-004	L/W-005	L/W-006	L/W-007	L/W-008	L/W-009	L/W-010	L/W-011	L/W-012	L/W-013
Description:		Stock Reservoir Rehabilitation	Stock Reservoir Rehabilitation / Outlet / Spillway	Spring Development / Stock Tank Construction	Solar platform and pump / Stock Tank / Water Quality Testing	Spring Development / Stock Tank Construction	Stock Reservoir Rehabilitation / Inlet and Outlet Installation	Stock Reservoir Rehabilitation / Inlet and Outlet Installation	Solar platform and pump / Stock Tank / Water Quality Testing	Verify and Modify Existing Water Rights	Verify and Modify Existing Water Rights	Verify and Modify Existing Water Rights	Stock Reservoir Rehabilitation / Inlet and Outlet Installation	Verify and Modify Existing Water Rights / Stock Tank Construction
Project Name:		Kinney Spring Reservoir	Fifteenmile Knoll Reservoir	Bitter Creek Springs	Well Rehabilitation	Spring Development	Stock Reservoir Rehabilitation	Stock Reservoir Rehabilitation	Well Rehabilitation	Stock Reservoir Repermit	Stock Reservoir Repermit	Stock Reservoir Repermit	Stock Reservoir Rehabilitation	Well Repermit
Water Source:		Kinney Spring	Killpecker Creek	Existing spring	Existing well	Existing spring	Black Butte Creek	Black Butte Creek	Existing well	Tributary to Black Butte Creek	Tributary to Black Butte Creek	John Boy Draw	Patrick Draw	Existing well
Mobilization		$1,000	$500	$500	$500	$500	$500	$500	$500	$0	$0	$0	$500	$0
Well Construction / Spring Development / Surface Diversion Well Rehabilitation	Units (each)	NA	NA	1	1	1	NA	NA	1	NA	NA	NA	NA	NA
	Depth Each			NA	NA	NA			NA					
	Unit Cost ($/LF wells or $/EA springs			$4,500	$15,000	$4,500			$15,000					
	Well Screen (LF each well)			NA	NA	NA			NA					
	Well Screen ($/LF)			NA	NA	NA			NA					
	Component Subtotal			$4,500	$15,000	$4,500			$15,000					
Stock Pond / Guzzler Construction / Rehabilitation	Units (each)	1	1	NA	NA	NA	1	1	NA	NA	NA	NA	1	NA
	Earthwork (Stock Pond)	$20,000	$95,000				$15,000	$15,000					$15,000	
	Agri-Drain Installation (Stock Pond)	$5,000	$10,000				$5,000	$5,000					$5,000	
	Rock Stabilization (Stock Pond)	NA	NA				NA	NA					NA	
	Bentonite Lining (Stock Pond)	NA	NA				NA	NA					NA	
	Guzzler Installation (Materials and Labor)	NA	NA				NA	NA					NA	
	Pond/ Guzzler Component Subtotal	$25,000	$105,000				$20,000	$20,000					$20,000	
Pump	Units (EA)	NA	NA	NA	1	NA	NA	NA	1	NA	NA	NA	NA	NA
	Type				Solar Pump / Platform				Solar Pump / Platform					
	Unit Cost (EA)				$8,500				$8,500					
	Component Subtotal				$8,500				$8,500					
Pipeline	Low Pressure 1 1/2 in Pipe Diameter:	NA	NA	1.5	1.5	1.5	NA	NA	1.5	NA	NA	NA	NA	NA
	Units (LF)			100	100	200			100					
	Unit Cost (EA)			$4.00	$4.00	$4.00			$4.00					
	Component Subtotal			$400	$400	$800			$400					
Livestock / Wildlife Water Tanks	Units (EA)	NA	NA	1		1	NA	NA		NA	NA	NA	NA	NA
	Size (gal)			1,200	1,200	1,200			1,200					
	Unit Cost			$3,200	$3,200	$3,200			$3,200					
	Component			$3,200	$0	$3,200			$0					
Fencing	Units (Each)	NA	NA	500	500	500	500	500	500	500	500	500	500	500
	Unit Cost ($/ea)			$19.00	$19.00	$19.00	$19.00	$19.00	$19.00	$19.00	$19.00	$19.00	$19.00	$19.00
	Component Subtotal			$9,500.00	$9,500.00	$9,500.00	$9,500.00	$9,500.00	$9,500.00	$9,500.00	$9,500.00	$9,500.00	$9,500.00	$9,500.00
Miscellaneous	Item	NA	NA	NA	Pump test, water quality test	NA	NA	NA	Pump test, water quality test	Water Rights Permitting	Water Rights Permitting	Water Rights Permitting	NA	Water Rights Permitting
	Units (Each)				1				1	1	1	1		1
	Unit Cost ($/ea)				$1,000.00				$1,000.00	$1,000.00	$1,000.00	$1,000.00		$1,000.00
	Component Subtotal				$1,000.00				$1,000.00	$1,000.00	$1,000.00	$1,000.00		$1,000.00
Construction Subtotal		$26,000	$105,500	$18,100	$34,900	$18,500	$30,000	$30,000	$34,900	$10,500	$10,500	$10,500	$30,000	$10,500
Engineering (10%)		$2,600	$10,550	$1,810	$3,490	$1,850	$3,000	$3,000	$3,490	$1,050	$1,050	$1,050	$3,000	$1,050
Constuction and Engineering Subtotal		$28,600	$116,050	$19,910	$38,390	$20,350	$33,000	$33,000	$38,390	$11,550	$11,550	$11,550	$33,000	$11,550
Contingency (15%)		$4,290	$17,408	$2,987	$5,759	$3,053	$4,950	$4,950	$5,759	$1,733	$1,733	$1,733	$4,950	$1,733
Total Construction Cost		$32,890	$133,458	$22,897	$44,149	$23,403	$37,950	$37,950	$44,149	$13,283	$13,283	$13,283	$37,950	$13,283
Final Plans and Specs		$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,500	$1,500	$1,000	$1,000	$1,500
Additional		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Permitting / Legal Fees / Access and Rights of Way		$0	$500	$500	$500	$500	$500	$500	$500	$2,500	$1,000	$500	$1,000	$1,000
Total Project Cost		**$33,890**	**$134,958**	**$24,397**	**$45,649**	**$24,903**	**$39,450**	**$39,450**	**$45,649**	**$17,283**	**$15,783**	**$14,783**	**$39,950**	**$15,783**

Table 7.2-1 Summary of Conceptual Costs: Livestock / Wildlife Components (Continued).

		Watershed Component	Watershed Component	Watershed Component	Watershed Component	Watershed Component	Watershed Component	Watershed Component	Watershed Component	Watershed Component	Watershed Component	Watershed Component	Watershed Component	Watershed Component
		L/W-014	L/W-015	L/W-016	L/W-017	L/W-018	L/W-019	L/W-020	L/W-021	L/W-022	L/W-023	L/W-024	L/W-025	L/W-026
Description:		Stock Reservoir Rehabilitation / Inlet and Outlet Installation	Stock Reservoir Rehabilitation / Inlet and Outlet Installation	Verify and Modify Existing Water Rights	Stock Reservoir Rehabilitation / Inlet and Outlet Installation	Stock Reservoir Rehabilitation / Inlet and Outlet Installation	Verify and Modify Existing Water Rights / Stock Tank Construction	Spring Development / Stock Tank Construction	Solar platform and pump / Stock Tank / Pipeline	Spring Development / Storage Tank / Stock Tanks / Pipeline	Solar platform and pump / Stock Tank / Pipeline	Solar platform and pump / Stock Tank / Pipeline	Solar platform and pump / Stock Tank / Pipeline	Spring Development / Stock Tank Construction
Project Name:		Stock Reservoir Rehabilitation	Stock Reservoir Rehabilitation	Stock Reservoir Repermit	Stock Reservoir Rehabilitation	Stock Reservoir Rehabilitation	Well Repermit	Spring Rehabilitation	Well Construction	Uncle Billy Pipeline Project	Well Construction	Well Construction	Well Construction	Spring Development
Water Source:		Tributary to Black Butte Creek	Patrick Draw	Hospital Draw and Flood Draw	Tributary to Scheggs Draw	Tributary to Scheggs Draw	Existing well	Existing spring	groundwater supply	Existing spring	groundwater supply	groundwater supply	groundwater supply	Existing Well
Mobilization		$500	$500	$0	$500	$500	$0	$500	$1,500	$1,000	$1,500	$1,500	$500	$500
Well Construction / Spring Development / Surface Diversion Well Rehabilitation	Units (each)	NA	NA	NA	NA	NA	NA	1	1	1	1	1	1	1
	Depth Each							NA	100	NA	300	350	250	NA
	Unit Cost ($/LF wells or $/EA springs							$3,600	$50	$4,500	$50	$50	$50	$15,000
	Well Screen (LF each well)							NA		NA				NA
	Well Screen ($/LF)							NA		NA				NA
	Component Subtotal							$3,600	$5,000	$4,500	$15,000	$17,500	$12,500	$15,000
Stock Pond / Guzzler Construction / Rehabilitation	Units (each)	1	1	NA	1	1	NA	NA	NA	NA	NA	NA	NA	NA
	Earthwork (Stock Pond)	$20,000	$20,000		$20,000	$20,000								
	Agri-Drain Installation (Stock Pond)	$5,000	$5,000		$5,000	$5,000								
	Rock Stabilization (Stock Pond)	NA	NA		NA	NA								
	Bentonite Lining (Stock Pond)	NA	NA		NA	NA								
	Guzzler Installation (Materials and Labor)	NA	NA		NA	NA								
	Pond/ Guzzler Component Subtotal	$25,000	$25,000		$25,000	$25,000								
Pump	Units (EA)	NA	NA	NA	NA	NA	NA	NA	1	NA	1	1	1	1
	Type								Solar Pump / Platform		Solar Pump / Platform	Solar Pump / Platform	Solar Pump / Platform	Solar Pump / Platform
	Unit Cost (EA)								$8,500		$8,500	$8,500	$8,500	$8,500
	Component Subtotal								$8,500		$8,500	$8,500	$8,500	$8,500
Pipeline	Low Pressure 1 1/2 in Pipe Diameter:	NA	NA	NA	NA	NA	NA	NA	1.5	1.5	1.5	1.5	1.5	1.5
	Units (LF)								100	97,000	100	100	100	100
	Unit Cost (EA)								$4.00	$4.00	$4.00	$4.00	$4.00	$4.00
	Component Subtotal								$400	$388,000	$400	$400	$400	$400
Livestock / Wildlife Water Tanks	Units (EA)	NA	NA	NA	NA	NA	NA	1	1	30	1	1	1	
	Size (gal)							1,200	1,200	1,200	1,200	1,200	1,200	1,200
	Unit Cost							$3,200	$3,200	$3,200	$3,200	$3,200	$3,200	$3,200
	Component							$3,200	$3,200	$96,000	$3,200	$3,200	$3,200	$0
Fencing	Units (Each)	500	500	500	500	500	500	500	500	500	500	500	500	500
	Unit Cost ($/ea)	$19.00	$19.00	$19.00	$19.00	$19.00	$19.00	$19.00	$19.00	$5.50	$19.00	$19.00	$19.00	$19.00
	Component Subtotal	$9,500.00	$9,500.00	$9,500.00	$9,500.00	$9,500.00	$9,500.00	$9,500.00	$9,500.00	$2,750.00	$9,500.00	$9,500.00	$9,500.00	$9,500.00
Miscellaneous	Item	NA	NA	Water Rights Permitting	NA	NA	Water Rights Permitting	NA	NA	Storage Tank	NA	NA	NA	Pump test, water quality test
	Units (Each)			1			1			10,000				1
	Unit Cost ($/ea)			$1,000.00			$1,000.00			$1.00				$1,000.00
	Component Subtotal			$1,000.00			$1,000.00			$10,000.00				$1,000.00
Construction Subtotal		$35,000	$35,000	$10,500	$35,000	$35,000	$10,500	$44,320	$28,100	$502,250	$38,100	$40,600	$34,600	$34,900
Engineering (10%)		$3,500	$3,500	$1,050	$3,500	$3,500	$1,050	$4,432	$2,810	$50,225	$3,810	$4,060	$3,460	$3,490
Constuction and Engineering Subtotal		$38,500	$38,500	$11,550	$38,500	$38,500	$11,550	$48,752	$30,910	$552,475	$41,910	$44,660	$38,060	$38,390
Contingency (15%)		$5,775	$5,775	$1,733	$5,775	$5,775	$1,733	$7,313	$4,637	$82,871	$6,287	$6,699	$5,709	$5,759
Total Construction Cost		$44,275	$44,275	$13,283	$44,275	$44,275	$13,283	$56,065	$35,547	$635,346	$48,197	$51,359	$43,769	$44,149
Final Plans and Specs		$1,500	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000
Additional		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Permitting / Legal Fees / Access and Rights of Way		$1,000	$1,000	$500	$500	$500	$500	$500	$500	$500	$500	$500	$500	$500
Total Project Cost		**$46,775**	**$46,275**	**$14,783**	**$45,775**	**$45,775**	**$14,783**	**$57,565**	**$37,047**	**$636,846**	**$49,697**	**$52,859**	**$45,269**	**$45,649**

***Pipelines**:* A cost of approximately $3.44 / lineal foot (installed) for 1.5-inch diameter pipe was used and is based upon information provided by the NRCS for "easily" installed pipeline. Areas where installation is more difficult (i.e, rough terrain, rocky, etc.) could result in higher costs. A cost of $5.15 per linear foot for pipeline installed below the frost line was assumed. Length of pipe associated with each project was approximated within the GIS environment.

Water Tanks (Stock and Storage): A cost of $3,200 per stock tank was used for a typical rubber-tire type tank. Cost of storage tanks were assumed to be approximately $1 per gallon of storage.

Stock Pond Construction. A cost of $21,000 per stock reservoir was used based upon summation of NRCS unit costs associated with a typical facility:

- Assumed embankment of approximately 2,800 cy (10 ft high, 10 crest width, 250 feet crest length) applied to a unit cost of approximately $5.50/cy earthwork
- Agridrain outlet facility: $5,000 installed

Fencing. A cost of $2.50 per linear foot was utilized for general fencing requirements (barbed or smooth wire). For sensitive areas / protected areas, a cost of $5.50 per linear foot was used. "Steeljack" fencing was assumed to cost $19.00 per linear foot based upon information provided by WGF from recent construction projects.

***Stock Pond Sealant*.** Unit cost of $10,000 per acre of inundated area was used based upon information presented in previous Level I watershed studies previous. This cost assumes incorporation of bentonite at appropriate application rates.

7.3 Stream Channel Improvements and Environmental Enhancement Opportunities

Costs associated with these plan components are included in Table 7.1-1. Estimates were completed using NRCS Fiscal Year (2018) Practice Payment Rates for EQIP Program costs, input from local agencies, previous experience, and regional information.

VIII. TASK 7: ECONOMIC ANALYSIS

8.1 Overview

Sources of funding and financing for proposed projects within the watershed and the associated technical support and assistance are available from various local, private, state, and federal entities. The widespread opportunities described in this Level I watershed study, watershed management plan, and resulting proposed projects and alternatives make identifying and obtaining potential project funding dependent on local coordination and voluntary cooperation.

Local coordination is crucial in developing viable financing approaches that could be developed in implementing proposed projects and realizing beneficial watershed improvements. Voluntary cooperation between landowners, managers, irrigators, residents, organizations, and agencies is essential in addressing the identified land and water resource concerns within the Bitter Creek / East Flaming Gorge Watershed. Land and water users and managers interested in voluntarily implementing conservation projects and programs should be aware of the partnership opportunities and program incentives available in successfully achieving their watershed improvement goals and objectives.

Local, state, and federal agencies, along with private organizations, provide technical assistance for watershed and conservation projects with a smaller group of these entities also providing financial assistance. Private contributions, such as in-kind provisions, are vital in developing and accomplishing a successful watershed or conservation project. Agencies and organizations with technical and financial assistance programs, which could potentially assist with proposed projects and alternatives, are provided in the subsequent sections. Funding and program information for potential conservation and watershed project and program assistance was obtained primarily from the following sources:

- **Water Management and Conservation Assistance Programs Directory**, is an overview of local, state, and federal programs with associated contact information. (*http://wwdc.state.wy.us/wconsprog/2014WtrMgntConsDirectory.html*)

- **Habitat Extension Bulletin No. 50 – Fisheries and Wildlife Habitat Cost Share Programs and Grants** is published by the Wyoming Game and Fish Department and provides a very comprehensive listing of potential funding sources for fisheries and wildlife habitat projects. The document is available at the following website: (https://wgfd.wyo.gov/WGFD/media/content/PDF/Habitat/Extension%20Bulletins/B50-Fisheries-and-Wildlife-Habitat-Cost-Sharing-Programs-and-Grants.pdf)

Additional information about potential funding sources were reviewed and incorporated from previous watershed studies completed on behalf of the WWDC and specifically included excerpts from the *Upper Laramie River Watershed Study, Level I* [Anderson Consulting Engineers, 2016]. These potential sources described in this chapter are certainly not an all-inclusive listing of the available opportunities for water management and conservation projects. Also, the available funding levels for these programs vary annually because they are subject to budget appropriations; spending authorizations; and in some instances, donation amounts for private organizations. Additionally, the contact information for these sources can and does change occasionally. Important contact information for local conservation organizations include, but are certainly not limited to, the following contacts:

- Sweetwater County Conservation District (307-362-5257)
- Rock Springs NRCS Field Office (307-362-3062 ext. 3)
- Bureau of Land Management/Rock Springs Field Office (307-352-0256)
- WGFD Green River Regional Office (307-875-3223)

Table 8.1-1 summarizes the potential funding sources mentioned in this section.

8.2 Local Agencies

8.2.1 Conservation Districts

The study area is located entirely in the Sweetwater County Conservation District. Conservation districts are locally led, locally elected county government entities. They function as representatives of local people with responsibility for natural resource issues. Local conservation district boards perform as a liaison between local landowners and resource users and state and federal government agencies. Conservation districts are providers of information and education at the local level. Districts also provide technical assistance as local resources, capacity, and expertise allow. They can assist in developing and implementing program and project design and funding through assistance in proposal preparation, presentation, and pursuit of grant assistance. Conservation districts can provide funding assistance, often through in-kind contributions such as staff time and technical aid. They can administer programs, projects, and grants on behalf of recipients of state and federal natural resource programs. Districts can assist with developing leveraged, partnered programs and projects. Additional information can be found on their website (*http://www.conservewy.com*) or through the contact below:

Sweetwater County Conservation District
79 Winston Drive, Suite 103
Rock Springs, WY 82901
(307) 362-5257

Table 8.1-1 Summary of Potential Funding Sources.

Agency/Entity	Program Name	Project Type(s)	Internet Site	Telephone	Email
Local					
Sweetwater County Conservation District	n/a	Liaison, in-kind administrative and technical assistance, program coordination/partnering	http://www.swccd.us/	307-362-5257	admin@swccd.us
NRCS Rock Springs Office	n/a	See Federal NRCS	https://www.nrcs.usda.gov/wps/portal/nrcs/detail/wy/contact/local/?cid=nrcs142p2_027324	307-362-3062 ext. 3	n/a
Sweetwater County Weed and Pest	n/a	Technical assistance, cost-share programs, inspection service	n/a	307-273-9683	n/a
State					
Wyoming Department of Environmental Quality - Water Quality Division	Nonpoint Source Implementation Grants (319 and 205j Programs)	Water quality BMPs	http://deq.wyoming.gov/wqd/non-point-source/resources/grant-resources/	Keith Guille 307-777-6105	Keith.Guille@wyo.gov
Wyoming Game and Fish Department	Habitat Trust Fund	improving wildlife habitat, promote human understanding and enjoyment of fish and wildlife	https://wgfd.wyo.gov/	Paul Dey 307-777-4559 Green River Regional Office 307-875-3223	paul.dey@wyo.gov
	Fish Passage Grants	create and improve upstream and downstream passage of all life stages of fish			
Wyoming Office of State Lands and Investments	Farm Loan Program	Projects involving most agricultural purposes	http://lands.wyo.gov/	Bridget Hill Director 307-777-6629	bridget.hill1@wyo.gov
	Joint Powers Act Loan Program	Aids cities, counties, and special districts in providing needed services			
Wyoming Water Development Commission	Wyoming Water Development Program	New development, dams and reservoirs, rehabilitation, water resources planning	http://wwdc.state.wy.us/	307-777-7626	Harry LaBonde, Jr, P.E. (Director) harry.labonde@wyo.gov
	Small Water Project Program	Small reservoirs and stock ponds, wells, pipelines/conveyance, spring developments, windmills, wetland			Jodie Pavlica, P.E. (Project Manager) jodie.pavlica@wyo.gov
Wyoming Wildlife and Natural Resource Trust	n/a	Aquatic and wildlife habitat improvement, including water developments, prescribed burns, invasive plant control, etc.	http://wwnrt.state.wy.us	Bob Budd, Executive Director 307-777-8024	bob.budd@wyo.gov
Federal					
Bureau of Land Management	Riparian Habitat Management Program	Projects to maintain, restore, improve, protect and expand riparian/wetland areas	https://www.blm.gov/wyoming/	307-828-4500 (Rock Springs FO)	Rock_Springs_WYMail@blm.gov
	Range Improvement Planning and Development	Reservoirs, pits, spring developments, wells, and associated distribution pipelines			
	Watershed and Water Quality Improvement	Watershed health assessments, BMP implementation			
Bureau of Reclamation	WaterSMART Grants Program	Water conservation, efficiency and marketing	http://www.usbr.gov/WaterSMART/grants.html	Carlie Ronca (Area Manager) 307-261-5671	sha-wya-areamanager@usbr.gov
Environmental Protection Agency	Urban Waters Small Grants	Helps communities restore urban waters	https://www.epa.gov/urbanwaters/urban-waters-small-grants	EPA Region 8 303-312-6312	https://www.epa.gov/urbanwaterspartners/forms/contact-us-about-urban-waters-partnership
	Healthy Watersheds Program	Consortium to support individual watershed protection projects	https://www.epa.gov/hwp/what-epa-doing-healthy-watersheds	Peter Ismert (Region 8) 303-312-6215	ismert.peter@epa.gov
USDA - Farm Service Agency (USDA-FSA)	Conservation Reserve Program (CRP)	Removal of highly erobible lands from production	https://www.fsa.usda.gov/programs-and-services/conservation-programs/index	Cindy Hottel Agricultural Program Specialist 307-261-5081	cindy.hottel@wy.usda.gov
	Farmable Wetlands Program	Restores wetlands and wetland buffer zones that are farmed			
	Grassland Reserve Program	Prevents grazing and pasture land from becoming cropland/urban			
	Emergency Conservation Program (ECP)	Emergency livestock watering conservation during severe drought			
	Source Water Protection Program (SWPP)	Protects surface and groundwater used as drinking water by rural residents			
Fish and Wildlife Service	Partners for Wildlife Habitat Restoration	Various fish and wildlife habitat restoration projects	http://www.fws.gov/partners/?viewPage=home	Mark J. Hogan 307-332-8719	Mark_J_Hogan@fws.gov
	Wildlife and Sport Fish Restoration (WSFR) Program	provides oversight and/or administrative support for projects related to conservation, enhancing fish/wildlife habitat	https://wsfrprograms.fws.gov/Subpages/AboutUs/AboutUs1.htm	Steve Jose Chief, Wildlife and Sport Fish Restoration Program 303-236-8185	steve_jose@fws.gov
	Cooperative Endangered Species Conservation Fund	Grants for voluntary conservation projects related to candidate,listed and proposed endangered species	https://www.fws.gov/endangered/grants/	Brian Hires 703-358-2191	brian_hires@fws.gov
	North American Wetlands Conservation Act Program	Various wetlands conservation projects	https://www.fws.gov/birds/grants/north-american-wetland-conservation-act.php	Intermountain West Joint Venture 406-549-0732	info@iwjv.org
	Fish and Wildlife Service's (FWS) Challenge Cost Share Program	Projects and partnerships benefitting refuges	https://www.fws.gov/mountain-prairie/challengecostshare/	Betsy Matten Mountain-Prarie Region 303- 236-4307	Betsy_Matten@fws.gov
USDA - Natural Resources Conservation Service (USDA-NRCS)	Emergency Watershed Protection (EWP)	See websites and/or local contacts for detailed information on these programs	http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/landscape/ewpp/	State Office 307-233-6750 Rock Springs Office 307-362-3062 ext. 3	astrid.martinez@wy.usda.gov
	Watershed Protection and Flood Prevention Operations Program (WFPO)		http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/landscape/wfpo/		
	Watershed Surverys and Planning		http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/landscape/wsp/		
	Environmental Quality Incentives Program (EQIP)		http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/eqip/		
	Conservation Stewardship Program (CSP)		http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/csp/		
	Regional Conservation Partnership Program (RCPP)		http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/farmbill/rcpp/		
	Agricultural Management Assistance (AMA)		http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/programs/financial/ama/?cid=stelprdb1242818		
	Conservation Innovation Grants (CIG) Program		https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/cig/		
	Agricultural Conservation Easement Program (ACEP)		http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/easements/acep/		
	Watershed Rehabilitation Program		https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/landscape/wr/		
	Sage Grouse Initiative (SGI)		http://www.sagegrouseinitiative.com/	Brian Jensen WY State Biologist 307-233-6740	brian.m.jensen@wy.usda.gov
US Army Corps of Engineers	See website for program names	Planning, Floodplain Mangement, Flood Damage, Aquatic Ecosystem Restoration	http://www.usace.army.mil/	Mike Happold 307-772-2300	Mike.T.Happold@usace.army.mil
USDA - Rural Development	See website for program names	Water & Environmental Programs	https://www.rd.usda.gov/programs-services/all-programs/water-environmental-programs	Lorraine Werner Program Director 307-233-6700	lorraine.werner@wy.usda.gov
Wyoming Landscape Conservation Initiative (WLCI)	See website for program names	habitat projects to improve aquatic habitats and terrain	http://www.wlci.gov/	307-352-0227	blm_wy_wlci_wymail@blm.gov
Private					
Ducks Unlimited	See website for program names	Waterfowl aquatic and upland habitat protection, restoration and enhancement	http://www.ducks.org/conservation/du-regional-offices	Great Plains Regional Office: 701-355-3500	http://www.ducks.org/about-du/contact-du-online
National Fish and Wildlife Foundation	Acres For America	Conserves lands of national significance, protects fish and wildlife habitat	http://www.nfwf.org/whatwedo/programs/Pages/home.aspx	Rocky Mountain Regional Office 303-222-6482	seth.gallagher@nfwf.org
	Bring Back the Natives Grant Program	Riverine habitat and aquatic species restoration projects			
	Conservation Partners Program	Targets Farm Bill funds toward top priority conservation objectives			
	Five-Star Urban Waters Restoration Grant Program	Supports community-based wetland and riparian restoration			
	Pulling Together Initiative	Long-term weed management projects			
	Environmental Solutions for Communities Initiative	Supports projects that link economic development to stewardship of the environment			
Trout Unlimited	See website for program names	Erosion control, fish habitat structures, willow and other riparian plantings, etc.	http://www.tu.org/	1-800-834-2419 (National Office)	trout@tu.org

8.2.2 County Weed and Pest Districts

The Sweetwater County Weed and Pest District also provides technical and financial assistance to landowners within the study area. These special-purpose districts deliver a wide range of support, including weed information, treatment education, field mapping, infestation control and eradication, early detection and response, and cost-share or discounted product incentives. Local contact information for the Weed and Pest Control Districts within the study area includes the following:

Sweetwater County
15B Hwy 28N
PO Box 173
Farson WY 82932
(307) 273-9683

Statewide weed and pest information can be obtained from: *http://www.wyoweed.org/*

8.3 State Programs

8.3.1 Wyoming Department of Environmental Quality

The WDEQ Water Quality Division administers the Nonpoint Source Program, which solicits funding proposals under Sections 319 and 205(j) of the Clean Water Act that address nonpoint sources of pollution within the state of Wyoming. Program funding depends upon federal budget appropriations and the annual fund allocation from the EPA to the state of Wyoming. Funded proposals usually address multiple program objectives such as BMP installation, agriculture and urban, information and education, and BMP effectiveness or water quality monitoring.

- **Section 319** grant funds are available to local, state, and federal agencies; nongovernmental organizations; and private individuals who implement projects that reduce nonpoint source pollution and improve the quality of surface water and groundwater.

- **Section 205(j)** funds are available to cities, towns, counties, and conservation districts for water quality management planning projects. These funds are not intended for construction or implementation of water quality controls, but rather, are to be targeted for water quality planning and assessment.

Information regarding program eligibility, priorities, and applications is available at the WDEQ Non-point Source Grant Resources website: *http://deq.wyoming.gov/wqd/non-point-source/resources/grant-resources/*

8.3.2 Wyoming Game and Fish Department

The following summary of funding assistance available from the Wyoming Game and Fish Department (WGFD) is quoted from the Water Management & Conservation Assistance Program Directory (WWDC, 2014). The full document can be accessed here:

http://wwdc.state.wy.us/wconsprog/2014WtrMgntConsDirectory.html

"The Wyoming Game and Fish Department may offer technical and funding assistance to help landowners, conservation groups, institutions, land managers, government agencies, industry, and non-profit organizations develop or maintain water sources for fish and wildlife. Assistance may also be provided for protecting or improving riparian areas/wetlands, restoring streams, and upgrading irrigation infrastructure in a manner that provides improved fish passage or diversion screening."

- **Habitat Trust Fund:** Funds can be used for acquiring, maintaining, or improving wildlife habitat; or for promoting human understanding and enjoyment of the fish and wildlife resource (habitat or information and education projects). Funds can be used for internal projects or paid as grants to an outside entity. All proposals must have a WGFD sponsor and be entered into a department proposal database by early January or early August annually. Project proposals will be prioritized for funding by department staff during January through March and the Wyoming Game and Fish Commission grants preliminary approval in March and final approval in July for funds available in July. No cost share is required but is strongly recommended. Projects should occur in priority habitats or watersheds. Approximately $600,000 to $1,200,000 is allocated annually to projects across Wyoming.

- **Fish Passage Grants:** Funds can be used for creating or improving upstream or downstream passage of all life stages of fish in Wyoming waterways and for screening diversions. Examples include developing fishways or fish ladders, assisting with the replacement of traditional push-up diversion dams with more fish-friendly options, and installing various screening technologies to keep fish from becoming entrained into irrigation ditches. All proposals must have a WGFD sponsor and be entered into a WGFD proposal database by early January annually. Project proposals will be prioritized for funding by department staff during January through March and the Wyoming Game and Fish Commission grants preliminary approval in March and final approval in July for funds available in July. No cost share is required but is strongly recommended. Projects should occur in priority habitats or watersheds. Approximately $25,000 to $90,000 is allocated annually to projects across Wyoming.

  For more information related to these funds, contact Paul Dey at Wyoming Game and Fish (*paul.dey@wyo.gov*).

Additionally, during its 2014 session, the Wyoming Legislature approved the Governor's budget request to support the local sage grouse working groups and fund conservation projects benefiting sage grouse and their habitat. Implementation of projects consistent with local sage-grouse conservation plans will assist in keeping the sage grouse from being listed under the federal Endangered Species Act. A detailed listing of sage grouse funding opportunities is available from the Wyoming Game and Fish department: https://wgfd.wyo.gov/WGFD/media/content/PDF/Habitat/Sage%20Grouse/SGC_FUNDINGOPPS_REVISED0414.pdf. Requests for Wyoming Sage Grouse Conservation funding directly through WGFD must be made on a separate project proposal form that has been included in the Digital Library delivered with this report. The project proposal form and more information related to sage grouse conservation is also available from the WGFD website located at: https://wgfd.wyo.gov/Habitat/Sage-Grouse-Management

8.3.3 Wyoming Office of State Lands and Investments (OSLI)

The OSLI is the administrative arm of the Board of Land Commissioners and the State Loan and Investment Board. It is the statutory responsibility of the OSLI to carry out the policy directives and decisions of these two boards. The organizational structure of OSLI consists of the Office of the Director and four divisions: Administrative Services Division, Trust Land Management Division, Field Service Division, and Wyoming State Forestry. Collectively, these divisions serve the trust beneficiaries–Wyoming's school children and state institutions; numerous clients in agriculture, mineral, timber, transportation, communication, public utility, recreation, tourism and other Wyoming industries; local government entities; state and federal agencies; and the resident and nonresident general public.

- The Farm Loan Program, established in 1921, provides long-term real estate loans to Wyoming's agricultural operators. The use of this program has been expanded over the years to also include irrigation loans, beginning agricultural producer and livestock enhancement loans, and most recently, hydropower development loans. These loans are made for a wide range of agricultural purposes, including as most applicable to the potential projects identified in Chapter 6, purchasing, constructing or installing equipment and/or improvements necessary to maintain or improve the earning capacity of the farming operation. Eligible applicants include individuals whose primary residence is in Wyoming and legal entities with a majority of the ownership meeting the individual residency requirements.

- Joint Powers Act Loan Program was established in 1974 and the Legislature authorized the Joint Powers Act Loan Program to benefit local communities for infrastructure needs. Funding for this program is set at $60 million and is provided from the Wyoming Permanent Fund. These programs are an aid to cities, counties and special districts in providing needed government services and public facilities.

A summary of Wyoming State Loan Programs available through the Office of State Lands and Investments is included in the Digital Library delivered with this report. More information is also available at: *https://sites.google.com/a/wyo.gov/osli/grantsloans*

8.3.4 Wyoming Water Development Commission

The WWDC is responsible for coordinating, developing, and planning Wyoming's water and related land resources. The Commission, which consists of ten members who are appointed by the governor with approval of the Senate, represents the four state water divisions and the Wind River Reservation. Clients served by the Commission include irrigation districts, conservancy districts, municipalities, water and sewer districts, joint powers boards, improvement and service districts, counties, and state agencies. It should be noted that on-farm improvements (e.g., gated pipe, side rolls, center pivots, and related facilities and/or equipment such as pumps and power lines) are excluded from WWDC funding.

The WWDC administers and develops financing recommendations for the Wyoming Water Development Program, which was defined as the following by W.S. 41-2-112(a):

> *Established to foster, promote and encourage the optimal development of the state's human, industrial, mineral, agricultural, water and recreational resources. The program shall provide, through the commission, procedures and policies for the planning, selection, financing, construction, acquisition and operation of projects and facilities for the conservation, storage, distribution and use of water, necessary in the public interest to develop and preserve Wyoming's water and related land resources. The program shall encourage development of water facilities for irrigation, for reduction of flood damage, for abatement of pollution, for preservation and development of fish and wildlife resources and for protection and improvement of public lands and shall help make available the waters of this state for all beneficial uses, including but not limited to municipal, domestic, agricultural, industrial, instream flows, hydroelectric power and recreational purposes, conservation of land resources and protection of the health, safety and general welfare of the people of the state of Wyoming.*

The primary Wyoming Water Development Program encompasses new development, rehabilitation, dams and reservoirs, small water projects, water resources planning, and management of funds obtained from the Bureau of Reclamation. Information described below was extracted from the Operating Criteria of the Wyoming Water Development Program (*http://wwdc.state.wy.us/opcrit/WWDPopCriteria.html*). Additional project application information is available at: *http://wwdc.state.wy.us/project_application_info/project_app_info.html*

8.3.4.1 Programs

New Development Program: The New Development Program develops presently unused and/or un-appropriated waters of Wyoming. This program provides an opportunity for sponsors to develop water supplies for existing and anticipated future needs to ensure that lack of water supply will not inhibit economic growth. The program encourages water development through state/local partnerships. New development projects can proceed as sponsored projects, state projects, or the sponsor can complete a water supply project with state funding assistance. The application and review process for new development projects is addressed further in section 6.3.4.2.

Rehabilitation Program: The purpose of the Rehabilitation Program is to provide funding assistance for the improvement of water projects completed and in use for at least fifteen (15) years. The program serves to assist project sponsors in keeping existing water supplies effective and viable, thereby preserving their use for the future. Rehabilitation projects can improve an existing municipal or rural domestic water supply system or an agricultural storage facility or conveyance system. The projects serve to ensure dam safety; decrease operation, maintenance, and replacement costs; and/or provide a more efficient means of using existing water supplies. Rehabilitation projects are initiated by an application from a project sponsor and are usually assigned a Level II status. The project sponsor must be willing and capable of financially supporting a portion of the project development costs plus all operation and maintenance costs. The application and review process for rehabilitation projects is addressed further in section 6.3.4.2.

Dam and Reservoir Program: Proposed new dams with storage capacity of 2,000 acre-feet or more and proposed expansions of existing dams of 1,000 acre-feet or more qualify for the Dam and Reservoir Program. Dams and reservoirs typically provide opportunities for many potential uses. While water supply is emphasized in developing reservoir operating plans, recreation, environmental enhancement, flood control, erosion control and hydropower uses should be explored as secondary purposes. The application and review process for dam/reservoir projects is addressed further in section 6.3.4.2.

Small Water Project Program: A small water project is a project in which the estimated construction or rehabilitation costs, permit procurement, construction engineering and project land procurement are $135,000 or less and the maximum WWDC contribution is $35,000 or less. Small water projects are addressed further in section 6.3.4.3.

Drinking Water State Revolving Fund: Water development account funds can provide 50% of the state's matching fund requirements for the federal Drinking Water State Revolving Loan Fund (DWSRF). The DWSRF program may be used to fund improvements to water treatment systems and other Safe Drinking Water Act compliance issues.

Water Resource Planning: The Wyoming Water Development Commission serves as the water planning agency for the state of Wyoming. In this capacity, the WWDC can provide the following assistance to project sponsors:

- **River Basin Plans:** The program serves to develop basin-wide plans for each of the state's major drainage basins.

- **Watershed Studies:** These studies incorporate technical information that describe and evaluate the watershed's existing conditions including hydrology, geology, geomorphology, geography, soils, vegetation, water conveyance infrastructure, and stream system data. Watershed Studies, developed through local public outreach, identify projects that are eligible for funding from WWDC and other sources. These projects help to improve or maintain watershed functions and systems.

- **Master Plans:** The program provides a service to municipalities, districts, and other entities to assist in preparing planning documents that serve as master plans for future water supply systems and improvements. The plans are a framework for the entities to establish project priorities and to perform the financial planning necessary to meet those priorities. These plans can assist entities in preparing the reports necessary to achieve federal funding assistance for water development and other water-related projects. Master plans provide information to users as to whether the resource can adequately service the existing and anticipated demands for water within a certain area and provide reconnaissance level information regarding costs and scheduling.

- **Research:** Water development issues and problems may encompass watersheds, river basins or include the entire state. In order to address these issues, non-project specific research and data collection is necessary. The legislature has assigned the Water Development Program the following research tasks:

    - Instream flow: The WWDC files water right applications with the State Engineer for permits to appropriate water for instream flows in those segments of stream recommended by the WGFD. They also must generate feasibility reports for all instream flow permit applications, quantify existing water rights above and within the stream segment, and determine whether instream flows may conflict with future water development opportunities.

    - Groundwater Grant Program**:** The primary purpose of the program is to inventory the available groundwater resources in the state. The program also serves to assist communities in the development of efficient water supplies. Municipalities and special districts that purvey drinking water are eligible to receive up to $400,000 in grant funds if 25 percent of the total project costs will be paid by local matching funds.

    - University of Wyoming's Office of Water Programs: The WWDC provides funding each year to the UW Office of Water Programs to fund non-project water related research. Selection Committee, made up of federal and state agency representatives, prioritizes topics and issues requests for proposals to address these areas of concern. From these requests, proposals are selected by the WWDC and SWC.

Upper Colorado River Basin Fund Memorandum of Agreement: The State of Wyoming has certain specified rights to apply for and recommend the expenditure of a percentage of collected revenues defined under the Colorado River Storage Project Act. Thus, the WWDC accepts applications and provides recommendations for projects to be funded by the Bureau of Reclamation in Wyoming.

Colorado River Basin States Salinity Control Program (BSP): The WWDC seeks Colorado River Basin Salinity Control Act funding from the Bureau of Reclamation to be used for salinity control projects in Wyoming. Once grant funds have been secured, the WWDC accepts applications from project sponsors to fund a portion of the projects. These funds are to be used for in-state salinity control projects that may not qualify for the basin wide salinity control project funding which is administered directly by the Bureau of Reclamation.

8.3.4.2 Application and Review of New Development, Rehabilitation, and Dam/Reservoir Projects

a) Sponsor Requirements

The project sponsor shall be a public entity that can legally receive state funds, incur debt, generate revenues to repay a state loan, hold title and grant a minimum of a parity position mortgage on the existing water system and improvements or provide other adequate security for the anticipated state construction loan. A project sponsor can be a municipality, irrigation district, joint powers board, or other approved assessment district, which will realize the major direct benefits of the project. The project sponsor must be willing and capable of financially supporting a portion of the project development costs and all operation and maintenance costs. Sponsors request project technical and financial assistance from the WWDC through the application process. The sponsor may request that a Level I or Level II study be conducted to identify solutions and alternatives for addressing water supply issues or they may request funds for a Level III construction project if it is determined the project is technically and economically feasible and serves to meet a water supply need or alleviate a water supply problem.

The WWDC may accept applications for Level I studies from applicants that are not public entities. Applicant may then know if there is a viable project before becoming a public entity. However, the applicant must be a public entity before applying for a Level II study. Under these circumstances, the Level I process will have a 2-year duration with the study being completed the first year and the sponsor forming the public entity the second year. If the WWDC is to consider waiving this requirement, a representative of the applicant shall be required to appear before the WWDC to make a formal presentation on the project and to answer questions regarding the application.

b) Application Process

Projects originate with sponsoring public entities and come to the WWDC through applications. Water development projects are defined with three levels. Project planning is performed in Levels I and II, and project construction is performed in Level III. Levels I and II are 100% State funded.

- Level I studies carry out necessary reconnaissance work
- Level II studies determine a project's feasibility
- Level III studies include project design, permitting, land acquisition, construction and construction engineering

Important procedures, deadlines and requirements for applications to the New Development, Rehabilitation, and Dam and Reservoir Programs include, but are not necessarily limited to, the following:

- A fee of $1,000 must be submitted with the initial project applications, with the exception of projects advancing in the Water Development Program from studies which were completed within the last 5 years. If the application is denied, then seventy-five percent (75%) of the application fee shall be refunded to the applicant.
- A certified original of a resolution passed by the governing body of the sponsoring entity must accompany a new program application. Applicants that are not public entities shall provide evidence of support for the application by providing letters or petitions from interested water users as a substitute for a resolution. If the applicant is not a public entity at the time of the application, a written description of all steps completed by the sponsor to become a public entity and proposed time line for completion of requirements to become a public entity. This shall include a listing of all landowners notified by the sponsor’s of the intent to submit a funding application and form a special district.
- Financial information such as the annual budget, existing balance, revenue sources, and funding obtained as well as a map of the area must be submitted with the application.
- Level III studies must also include a comprehensive financing plan, and written verification from any impacted city, county, or special district that they have been notified of the project and its potential impacts.
- The deadline for Level I and II project applications is March 1 of each year; the deadline for Level III project applications is September 1 of each year.

c) Special Procedures for Dam and Reservoir Program

Since the federal permitting process for dams and reservoirs is very complex and could ultimately impact the feasibility of the project, work that would normally be completed under the Level III construction process can be completed under Level II-Phase III for dam projects. This work includes final engineering design, reviews required by the National Environmental Policy Act, consultations required by the Endangered Species Act, and acquisition of state and federal permits.

In addition, the WWDC may accept applications related to the construction of dams and reservoirs from applicants that are not public entities. This will allow the applicant to know if the proposed reservoir is feasible prior to becoming a public entity. However, the applicant must be a public entity before applying for Level II, Phase III funding.

d) Financial Plan

The Commission will evaluate whether or not a project will be funded for Level III construction following review of the results of Level II studies. If the Commission determines that the project should not advance because of high repayment costs (as determined by an analysis of the sponsor's ability to pay and after other funding sources have been considered), the sponsor has the option of making a formal presentation to the WWDC relative to the sponsor's ability and willingness to pay. This presentation must address the need for the project, the direct and indirect benefits of the project, and any other information the sponsor believes is relevant to the Commission's final decision. The current standard terms of the Wyoming Water Development Program financial plan are summarized as follows:

- Typically, 67 percent grant to 33 percent loan mix (maximum grant is 75%)
- Minimum 4 percent loan interest rate (current rate is 4 percent, but legislature may increase the rate)
- Maximum 50-year term of loans; term shall not exceed the economic life of project.
- Payment of loan interest and principal may be deferred up to 5 years after substantial completion at WWDC's discretion under special circumstances.

e) Priorities

As previously discussed, the statutory guidelines are sufficiently broad to allow the program to address all types of projects involving water. However, in order to establish priorities and to utilize available program funds effectively and efficiently, it is necessary to develop priorities relative to the types of water projects the program should pursue. The WWDC has established eligible project priorities for each of the three Water Development Funds as shown in Tables 8.3-1 through 8.3-3.

f) Recommendation Process

The Water Development Commission uses the following process to generate funding recommendations for legislative consideration.

Table 8.3-1 Project Priority Ranking for New Development.

Project Priority	Project Description
1	Level III projects developing new storage
2	Level III projects developing unappropriated water – examples include wells & diversion structures requiring the issuance of new water rights
3	Level III transmission pipelines
4	Level III potable water storage tanks
5	Level III irrigation canals and structures serving new lands
6	Level II feasibility studies
7	Watershed Studies
8	Level I reconnaissance studies
9	Weather modification projects
10	River basin plans
11	Level II hydropower studies (level II studies only)
12	Level III raw water system controls and control valves
13	Level III water system controls and control valves
14	Previously approved subdivision improvements

Table 8.3-2 Project Priority Ranking for Rehabilitation.

Project Priority	Project Description
1	Level III rehabilitation of water diversion or control structures
2	Level III rehabilitation of existing irrigation canals
3	Level III replacement of existing transmission pipelines
4	Level III rehabilitation of existing water storage tanks
5	Level III rehabilitation of raw water storage facilities
6	Level III rehabilitation of existing reservoirs
7	Level II feasibility studies
8	Level I reconnaissance studies
9	Level III raw water systems to irrigate parks and lawns
10	Level III replacement of water system controls & control valves
11	Previously approved subdivision improvements
12	Level II hydropower studies (level II studies only)

Table 8.3-3 Project Priority Ranking for Dams and Reservoirs.

Project Priority	Project Description
1	Level III development of new storage in excess of 2000 AF
2	Level III development of storage enlargements in excess of 1000 AF
3	Purchase of existing storage as an alternative to building new storage
4	Level II feasibility studies
5	Level I reconnaissance studies

1) **Level I and II Applications**: Submitted on March 1st, documentation is reviewed and WWDC makes preliminary recommendations regarding applications at its November meeting.

2) **Level III Applications**: Submitted September 1st, consultant project reports are drafted by this date and are reviewed to determine whether the projects warrant advancement in the program.

3) **Preliminary Recommendations**: At the November WWDC meeting, the WWDO director presents funding recommendations for new applications and existing projects. Project sponsors are given the opportunity to present their requests. The WWDC takes preliminary action on the sponsor's request at this meeting.

4) **Public Meetings**: If a proposed Level I or Level II Study is of particular concern or controversy, the WWDC may solicit public input at a public meeting prior to finalizing its project recommendation.

5) **Public Hearings**: The Commission holds formal public hearings on all projects that are proposed for Level III Construction funding.

6) **Coordination with the Governor**: The WWDC provides the Governor with its preliminary recommendations and a financial report addressing impacts to the water development accounts. The Governor may provide input throughout the recommendation process.

7) **Final Recommendations**: The WWDC meets in December or early January to finalize its legislative recommendations on new applications and existing projects, considering public input and recommendations from the Governor. Sponsors and interested parties who disagree with the Commission's preliminary recommendation are provided the opportunity to address the Commission with their concerns.

8) **Select Water Committee**: Comprised of 6 senators and 6 representatives, the Committee provides legislative oversight for the program, and reviews the Commission's recommendations and budgets. Typically, the Select Water Committee serves as the sponsor for the Water Development Program legislation.

9) **Legislative Process**: The legislature must authorize the allocation of funds from the water development accounts to particular projects. This approval is solicited through the Omnibus Water Planning and Construction Bills.

8.3.4.3 Small Water Project Program (SWPP)

The SWPP is intended to be compatible with the conventional WWDC program described above. Small water projects are defined as providing multiple benefits, and where the total estimated project costs (including construction, permitting, construction engineering, and land procurement) are less than $135,000 and WWDC's maximum financial contribution is 50 percent of project costs or $35,000, whichever is less. SWPP funding is a "one-time" grant so that operation and maintenance costs are not included. Loans are not available under the SWPP.

Eligibility:

According to the WWDC's operating criteria, the following types of projects are eligible for funding through the SWPP:

1) **Small Reservoir:** A small reservoirs may be eligible.

2) **Well:** A well may be eligible for funding depending on the depth of the well and scope of the project. Projects that propose to drill into unproven aquifers, as determined by the WWDO, may be eligible for the SWPP at the discretion of the WWDC. Such discretion will be exercised in cases including, but not limited to, cases where the well does not meet the minimum requirements of the project in terms of quality and quantity.

   The determination of unproven aquifer status will be clearly communicated by the WWDO prior to the issuance of notice to proceed so the project sponsor may decide to cancel the project before funding is committed. If the sponsor decides to proceed with a well into an unproven aquifer they should be prepared to pay the drilling cost with the understanding that reimbursement for eligible.

3) **Solar Platforms:** Construction of solar platforms may be eligible for funding through the SWPP.

4) **Pipelines and conveyance facilities:** Rehabilitation of existing pipelines or conveyance facilities or construction of new pipelines or conveyance facilities may be eligible for funding through the SWPP.

5) **Springs:** Improving flows of existing springs and installation of collection facilities associated with springs may be eligible for funding through the SWPP.

6) **Wetland Development:** Development of wetlands where multiple benefits accrue may be eligible for funding through the SWPP.

7) **Environmental:** Projects that provide for stream bank stability, water quality improvements, or erosion protection may be eligible for funding through the SWPP.
8) **Irrigation:** Irrigation projects may be eligible for funding through the SWPP.

9) **Windmill:** Rehabilitation of existing windmills or construction of new windmills may be eligible for funding through the SWPP.

10) **Rural Community Fire Suppression:** Supply and storage projects for rural community fire suppression may be considered for funding through the SWPP.

11) **Recreational:** Projects for recreational purposes may be considered for SWPP funding.
Funding can only be provided to eligible public entities including but not necessarily limited to conservation districts, watershed improvement districts, water conservancy districts, and irrigation districts.

Application, Evaluation and Administration. Details of the application and evaluation process and program administrative procedures are provided in the Small Water Project Program Operating Criteria available online at: *http://wwdc.state.wy.us/small_water_projects/SWPPopCriteria.html* . Some key aspects of the process and procedures applicable to the potential projects identified in Chapter 6 include the following:

- Small water projects must adequately demonstrate a public benefit. Public benefit may be demonstrated for projects included in WWDC Watershed Studies. Eligible projects may be located on Federal, State, public, or private lands.

- Applications shall be received by January 1 of each calendar year. Applications meeting criteria requirements will be considered during the regularly scheduled WWDC meeting in March. Applications shall include a project application, sponsor project referral, project location map, project cost estimates, and any letters of authorization or commitment of participation that may be available from other funding sources.

- Projects that improve watershed condition and function, provide multiple benefits, and meet the funding criteria specified in W.S. 99-3-703(j)(vii) or W.S. 99-3-704(g)(vii), as described in B.4 herein, are eligible for consideration.

- The sponsoring entity will be required to address the WWDC and provide testimony and other additional supporting evidence that justifies SWPP funding whenever the public benefit documentation, submitted with the application, is deemed to be insufficient by the WWDC.

- Projects that have completed the following requirements prior to application will be classified as "Shovel Ready" and may be considered as a funding priority at the Commission's discretion.

    - Permit procurement

    - State and Federal agency notifications

    - Land procurement, right of way, or easement acquisition

    - Have finalized all other financial agreements

8.3.5 Wyoming Wildlife and Natural Resource Trust

The Wildlife and Natural Resource Trust, created in 2005, is an independent state agency governed by a nine-member citizen board appointed by the Governor. Funded by interest earned on a permanent account, donations, and legislative appropriation, the purpose of the program is to enhance and conserve wildlife habitat and natural resource values throughout the state. Any project designed to improve wildlife habitat or natural resource values is may be considered for funding.

Wildlife and Natural Resource Trust funding is available for a wide variety of projects throughout the state, including natural resource programs of other agencies. Some examples include the following:

- Projects that improve or maintain existing terrestrial habitat necessary to maintain optimum wildlife populations may include grassland restoration, changes in management, prescribed fire, or treatment of invasive plants.

- Preservation of open space by purchase or acquisition of development rights, contractual obligations, or other means of maintaining open space.

- Acquisition of terrestrial or aquatic habitat when existing habitat is determined crucial/critical, or is present in minimal amounts, and acquisition presents the necessary factor in attaining or preserving preferred wildlife or fish population levels.

- Mitigation of impacts detrimental to wildlife habitat, the environment, and the multiple use of renewable natural resources, or mitigation of conflicts and reduction of potential for disease transmission between wildlife and domestic livestock.

Allowable projects under this program that are potentially relevant to this watershed management plan study include:

- Improvement and maintenance of existing aquatic habitat necessary to maintain optimum fish populations.

- Conservation, maintenance, protection and development of wildlife resources, the environment, and Wyoming's natural resource heritage.

- Participation in water enhancement projects to benefit aquatic habitat for fish populations and allow for other watershed enhancements that benefit wildlife.

Non-profit and governmental organizations (including watershed improvement districts, conservation districts, etc.) are eligible for funding by WWNRT. The application form has been included in the digital library and more information on the application process is available here: https://sites.google.com/a/wyo.gov/wwnrt/how-to-apply

8.4 Federal Agencies

8.4.1 Bureau of Land Management (BLM)

- **Range Improvement Planning and Development** is a cooperative effort not only with the livestock operator but also with other outside interests including the various environmental/conservation groups. Water development, whether it be for better livestock distribution or improved wetland habitats for wildlife, is key to healthy rangelands and biodiversity. Before actual range improvement development occurs, an approved management plan must be in place. These plans outline a management strategy for an area and identify the type of range improvements needed to accommodate that management. Examples of these plans are Coordinated Resource Plans, Allotment Management Plans, and Wildlife Habitat Management Plans.

  All rangeland improvement projects on lands administered by the Bureau of Land Management require the execution of a permit. Although there are a couple of methods for authorizing range improvements on the public lands, Cooperative Agreement for Range Improvements form 4120-6 is the method most commonly used. This applies equally to range improvement projects involving water such as reservoirs, pits, springs, and wells including any associated pipelines for distribution. The major funding source for the Bureau of Land Management's share comes from the Range Improvement Fund which is generated from the grazing fees collected. There, too, is a limited amount of funding from the general rangeland management appropriations. If the cooperator is a livestock operator, their matching contributions come generally in the form of labor. There are times they also provide some of the material costs as well. Contributions from the conservation/environmental interests is monetary and often come in the form of grants. They also contribute labor on occasion.

- **BLM's Watershed and Water Quality Improvement** efforts are undertaken in a cooperative approach with the State of Wyoming, conservation districts, livestock operators and various conservation groups. Wyoming's BLM is partnering in the implementation of several Section 319 (EPA Clean Water Act) watershed plans state-wide.

  It is anticipated that as the Wyoming Department of Environmental Quality (WDEQ) continues the inventory of waters of the State and the identification of impaired and/or threatened water bodies, BLM will be partnering with the WDEQ to improve water quality in water bodies on public lands. In the course of developing watershed plans or Total Maximum Daily Loads (TMDL's) for these watersheds, BLM will be routinely involved in watershed health assessments, planning, project implementation and Best Management Practice (BMP) monitoring.

The goals of cooperative watershed projects are the restoration and maintenance of healthy watershed function. These goals will typically be accomplished through approved BMP's, e.g. prescribed burns, vegetation treatments, instream structures, enhancement of vegetation cover, controlling accelerated soil erosion, increasing water infiltration, and enhancement of stream flows and water quality.

Additionally, in response to the Clean Water and Watershed Restoration initiative and associated funding increases, BLM is expanding its efforts to address water quality and environmental concerns associated with abandoned mines. This work will also be accomplished, in cooperation with the State Abandoned Mine Lands Division, on a priority watershed basis and will employ appropriate BMP's to address identified acid mine drainage and runoff problems from mine tailings and waste rock piles.

- **BLM's Riparian Habitat Management Program** offers the opportunity to coordinate with outside interests on riparian improvement projects. The goal of BLM's riparian-wetland management is to maintain, restore, improve, protect, and expand these areas so they are in proper functioning condition for their productivity, biological diversity, and sustainability. The overall objective is to achieve an advanced ecological status, except where resource management objectives, including proper functioning condition, would require an earlier successional stage. The goal includes aggressive riparian-wetland information, inventory, training, and research programs as well as improving the partnerships and cooperative management processes.

  Partnerships have been available for riparian improvement projects and for research into riparian issues. Funding is available on an annual basis subject to budget allocations from Congress. All submitted cooperative projects compete for the funds available in the riparian program.

8.4.2 United States Bureau of Reclamation (USBR)

The USBR mission is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the public. The USBR has a major responsibility, in partnership with states, water users, and other interested parties, to help improve water resources and the water use efficiency in the western United States.

The USBR Sustain and Manage America's Resources for Tomorrow (WaterSMART) Program establishes a framework to provide federal leadership and assistance on the efficient use of water, integrating water and energy policies to support the sustainable use of all natural resources, and coordinating the water conservation activities of various department bureaus and offices. Through the WaterSMART Program, the department is working to achieve a sustainable water management strategy to meet the nation's water needs through projects that conserve and use water more efficiently, increase the use of renewable energy and improve energy efficiency, protect endangered and threatened species, facilitate water markets, or carry out other activities to address climate-related impacts on water or prevent any water-related crisis or conflict.

A major component of WaterSMART is the Water and Energy Efficiency Grant Program, through which USBR provides funding in two groups. In Funding Group I, up to $300,000 in federal funding is available per project, for smaller on-the-ground projects. In Funding Group II, up to $1 million in funding is available for larger, phased, on-the-ground projects that may take up to 3 years to complete. Water and Energy Efficiency Grants are awarded through a west-wide competitive process that requires a minimum 50 percent cost share by the recipient.

The Water Conservation Field Services Program (WCFSP), by contrast, provides smaller amounts of funding ($100,000 per project maximum) through local competitions within a region or area. The projects funded are generally smaller in scope than Water and Energy Efficiency Grant projects and are focused on fundamental conservation improvements as identified in water conservation plans developed by water users. Financial assistance provided through the WCFSP also requires a minimum 50 percent cost share by the recipient.

At the time of the report, the USBR was in the process of updating the Water Conservation Field Services Program and had issued a temporary Reclamation Manual Release to ensure consistency and efficiency when providing financial assistance as part of the Water Conservation Field Services Program. This TRMR provided that financial assistance will be available under the WCFSP for water conservation planning, development of system optimization reviews, designing water management improvements, and demonstration projects. The Reclamation was working on a permanent Water Conservation Field Services Program Directive and Standard, which would include an opportunity for public review. In the meantime, this TRMR was issued to ensure that some key program requirements were captured. Please visit http://www.usbr.gov/watersmart/ for more information or contact:

Josh German
303-445-2839
jgerman@usbr.gov

8.4.3 Environmental Protection Agency (EPA)

The EPA has several grant programs that could potentially provide funding opportunities for projects described in this report.

- **Urban Waters Program:** This program was established in 2012 to help local residents and their organizations, particularly those in underserved communities, restore their urban waters in ways that also benefit community and economic revitalization. The two types of grants available through this program are listed below:
    - **The Urban Waters Small Grants** are competed and awarded every two years. Since its inception in 2012, the program has awarded approximately $5.3 million in Urban Waters Small Grants to 92 organizations across the country, with individual award amounts of up to $60,000. Urban Waters Small Grants Program projects must address local water

quality issues related to urban runoff pollution, provide additional community benefits, actively engage underserved communities, and foster partnerships. Specific information pertaining to the types of projects funded was not available.

  - **The Five Star/Urban Waters Restoration Grant Program** projects include on-the-ground activities (for example: wetland or river habitat restoration), integrated education, outreach and training, measurable ecological and community benefits, and community partnership building emphasis. As this program is organized by the National Fish and Wildlife Foundation (NFWF), see Section 8.5.2 for more information.

- **Healthy Watersheds Program:** After decades of focusing almost exclusively on restoring impaired waters, EPA created the Healthy Watersheds Program to help address the "maintain" component of the "restore and maintain" goal intended by Congress in the 1972 Federal Water Pollution Control Act amendments. Through a multi-year cooperative agreement awarded in 2015, EPA is helping to support watershed protection via a healthy watershed grants consortium. This consortium brings together like-minded partners from all levels of government, private organizations and industry to support individual watershed protection projects through grants, using leveraged funding from government and non-government sources together. Details and contact information on healthy watersheds grants can be found at: *https://www.epa.gov/hwp/what-epa-doing-healthy-watersheds*

- **Section 319** was added to the Clean Water Act (CWA) in 1987 to establish a national program to address nonpoint sources of water pollution. Section 319(h) specifically authorizes EPA to award grants to states with approved Nonpoint Source Assessment Reports and Nonpoint Source Management Programs. The funds are to be used to implement programs and projects designed to reduce nonpoint source pollution. Grant funds are available to local, state, and federal agencies; nongovernmental organizations; and private individuals through the Wyoming Department of Environmental Quality (See Section 8.3.1).

8.4.4 Farm Service Agency

The FSA administers a variety of different programs that may be applicable to some of the alternative projects identified in Chapter 6. The FSA is a member agency of the USDA. Programs administered through the FSA are offered through local county committees. Technical assistance needed for implementing FSA programs is provided through the NRCS.

Several of the available programs are briefly discussed below and more information can be obtained from the FSA conservation program website (*https://www.fsa.usda.gov/programs-and-services/conservation-programs/index*):

- **Conservation Reserve Program (CRP**): The CRP offers agricultural producers annual rental payments to remove highly erodible cropland from production. Through the CRP, farmers and ranchers establish long-term conservation practices on erodible and environmentally sensitive land. In exchange, they receive 10–15 years of annual rental payments and cost-share assistance. The CRP is a voluntary program specifically for highly erodible lands currently in active production planted two of the five most recent crop years. Land offered for CRP is ranked according to environmental benefit for wildlife habitat, erosion control, water quality, and air quality. Land must meet the requirements of CRP and be determined by the NRCS to be eligible and suitable for the following:

Riparian buffers	Shelter belts	Salt tolerant vegetation
Filter strips	Living snow fences	Shallow water areas for wildlife
Grass waterways	Contour grass strips	Buffers for Wildlife Habitat
Wetlands Buffer	Wetland Restoration	

- **Emergency Conservation Program (ECP):** The ECP provides emergency funding and technical assistance for farmers and ranchers to rehabilitate farmland damaged by natural disasters and for carrying out emergency water conservation measures for livestock during periods of severe drought. Participants receive cost-share assistance of up to 75 percent of the cost to implement approved emergency conservation practices, as determined by county FSA committees. The FSA County Committee is able to approve applications up to $50,000 while $50,001 to $100,000 requires state committee approval. Some of the conservation practices included are removing debris, restoring fences and conservation structures, and providing water for livestock in drought situations.

- **Farmable Wetlands Program**: The Farmable Wetlands Program is designed to restore previously farmed wetlands and wetland buffer zones to improve both vegetation and water flow. FWP provides annual rental payments in return for restoring wetlands and establishing plant cover. Eligible land must have been used for agricultural purposes for 3 of the past 10 crop years.

- **Grassland Reserve Program**: The Grassland Reserve Program is designed to prevent grazing and pasture land from being converted to cropland, urban development, or other non-grazing uses. Participants in the program voluntarily limit future development of their grazing and pasture land, while still being able to use the land for livestock grazing and activities related to forage and seed production.

- **Source Water Protection Program (SWPP)**: The SWPP is designed to help prevent pollution of surface and ground water used as the primary source of drinking water by rural residents.

8.4.5 U.S. Fish and Wildlife Service

Technical and financial assistance are available to private landowners, for profit or nonprofit entities, public agencies and public-private partnerships under several programs addressing the management, conservation, restoration or enhancement of wildlife and aquatic habitat (including riparian areas, streams, wetlands and grasslands). These programs include, but are not necessarily limited to:

- **Partners for Fish and Wildlife Program:** The Partners for Fish and Wildlife Program serves as the primary tool for conservation delivery on privately owned land for the USFWS. The program provides technical and financial assistance to private landowners and tribes on a voluntary basis to help meet the habitat needs of federal trust species and conservation partner-designated species of interest. The program targets habitats that are in need of restoration or enhancement such as riparian areas, streams, wetlands, and grassland. Field biologists work one-on-one with landowners and partners to plan and implement a variety of projects, including grazing lands management, sage steppe enhancement, stream habitat improvement and fish passage, invasive species removal, and wetland establishment.

- **Wildlife and Sport Fish Restoration (WSFR) Program** works with states, and the District of Columbia to conserve, protect, and enhance fish, wildlife, their habitats, and the hunting, sport fishing, and recreational boating opportunities they provide. The WSFR Program provides oversight and/or administrative support for the following grant programs: Wildlife Restoration Grant Program, Sport Fish Restoration Grant Program, Boating Infrastructure Grant Program, State Wildlife Grant Program, Tribal Wildlife Grant Program, and Tribal Landowner Incentive Grant Program.

- **Cooperative Endangered Species Conservation Fund:** Cooperative Endangered Species Conservation Fund (Section 6 of the ESA) provides grants to states and territories to participate in a wide array of voluntary conservation projects for candidate, proposed, and listed species. The program provides funding to states and territories for species and habitat conservation actions on nonfederal lands. States and territories must contribute a minimum nonfederal match of 25 percent of the estimated program costs of approved projects, or 10 percent when two or more states or territories implement a joint project.

- **North American Wetlands Conservation Act (NAWCA) Grant Program:** This program promotes long-term conservation of wetlands ecosystems and the waterfowl, migratory birds, fish and wildlife that depend upon such habitat. Conservation actions supported are acquisitioning, enhancing, and restoring wetlands and wetlands-associated habitat. This program encourages voluntary, public-private partnerships. Public or private, profit or nonprofit entities, or individuals establishing public/private sector partnerships are eligible. Cost-share partners must at least match grant funds with non-federal monies.

- **Fish and Wildlife Service's (FWS) Challenge Cost Share Program:** This program started in 1988 as a way to enhance partnerships with state and local governments, individuals, and public and private groups. The program enables the FWS to manage cooperatively its natural and cultural resources and fulfill stewardship responsibilities to fish and wildlife management. Under this program, projects must occur on a refuge or directly benefit a refuge. The program encourages refuge managers to form partnerships and leverage allocated funds to complete the projects. Appropriated funds may be used to pay for no more than 50 percent of the cost of a project. Nonfederal sources, including state/local governments, private individuals/ organizations, business enterprises, and philanthropic and charitable groups provide the matching 50 percent cost share. The cooperator share may be a nonmonetary contribution. Cooperative agreements are signed with the cost-share partners

More information regarding these programs and others is available at: *http://www.fws.gov/grants/programs.html*

8.4.6 Natural Resources Conservation Service (NRCS)

The NRCS administers a number of funding and technical assistance programs applicable to many of the alternative projects, described below. The NRCS provides leadership in a partnership effort to help people voluntarily conserve, improve, and sustain natural resources on private lands. The purpose and mission of the agency is to help landowners treat their private property according to its needs and within its capability. The treatment includes a balance between the land use for economic return and protecting its ability to be productive from generation to generation.

Technical and cost-share assistance is available through the NRCS. This assistance includes designs, specifications, construction, and management and financial help for practice and system installation. Local people, individually and collectively, decide how to use NRCS capabilities in the natural resource conservation planning and application process. The role of NRCS is to support and facilitate these individual and local decisions based on good resource information, whether that is a grazing management plan or layout for an irrigation system. For example, the Conservation of Private Grazing Land (CPGL) **e**nsures that technical, educational, and related assistance is provided to those who own private grazing lands. This technical assistance will offer opportunities for: better grazing land management; protecting soil from erosive wind and water; using more energy-efficient ways to produce food and fiber; conserving water; providing habitat for wildlife; sustaining forage and grazing plants; using plants to sequester greenhouse gases and increase soil organic matter; and using grazing lands as a source of biomass energy and raw materials for industrial products.

NRCS administers the following Landscape Planning Programs:

- **Emergency Watershed Protection (EWP) Program:** This program assists in implementing emergency measures, including the purchase of floodplain easements, for runoff retardation and soil erosion prevention to safeguard lives and property from floods, drought, and the products of erosion on any watershed whenever fire, flood, or any other natural occurrence is causing or has caused a sudden impairment of the watershed.

- **Watershed Protection and Flood Prevention Operations (WFPO) Program:** This program provides technical and financial assistance to entities of state and local governments and tribes for planning and installing watershed projects.

- **Watershed Surveys and Planning (WSP):** The WSP authorizes the NRCS to cooperate with federal, state, and local agencies and tribal governments to protect watersheds from damage caused by erosion, floodwater, sediment, and to conserve and develop water and land resources.

- **Watershed Rehabilitation Program**: This program helps project sponsors rehabilitate aging dams that are reaching the end of their 50-year design lives. This rehabilitation addresses critical public health and safety concerns. Since 1948, NRCS has assisted local sponsors in constructing more than 11,800 dams.

NRCS administers the following 2014 Farm Bill programs:

- **Agricultural Management Assistance (AMA):** The AMA provides financial assistance to agricultural producers to address resource issues such as water management, water quality, invasive species control, and erosion control by incorporating conservation into their farming or ranching operations. The purpose of the AMA is to assist producers in reducing risk to their operation.

- **Conservation Stewardship Program (CSP):** The CSP encourages land stewards to improve their conservation performance by installing and adopting additional activities, and improving, maintaining, and managing existing activities on agricultural land and non-industrial private forest land.

- **Environmental Quality Incentives (EQIP):** Through EQIP, technical assistance, cost share, and incentive payments are available to agricultural producers to implement conservation practices that improve water quality, enhance grazing lands, and/or increase water conservation.

- **Regional Conservation Partnership Program (RCPP):** The RCPP promotes coordination between the NRCS and its partners to deliver conservation assistance to producers and landowners. The NRCS provides assistance to producers through partnership agreements and through program contracts or easement agreements. Assistance is delivered in accordance with the rules of EQIP, CSP, Agricultural Conservation Easement Program (ACEP), and HFRP and in certain areas the Watershed Operations and Flood Prevention Program.

- **Agricultural Conservation Easement Program (ACEP):** The ACEP provides financial and technical assistance to help conserve agricultural lands and wetlands and their related benefits. Under the Agricultural Land Easements (ALE) component, NRCS helps tribes, state and local governments, and nongovernmental organizations protect working agricultural lands and limit non-agricultural uses of the land. Under the Wetlands Reserve Easements (WRE) component, the NRCS helps to restore, protect and enhance enrolled wetlands.

Other NRCS Programs:

- **Conservation Innovation Grants (CIG) Program:** The CIG is intended to stimulate the development and adoption of innovative conservation approaches and technologies while leveraging federal investment in environmental enhancement and protection, in conjunction with agricultural production. Under CIG, EQIP funds are used to award competitive grants to nonfederal governmental or nongovernmental organizations, tribes, or individuals.

- **Sage Grouse Initiative (SGI):** The Sage Grouse Initiative is an organization of public and private entities conserving at-risk wildlife through voluntary cooperation, incentives, and community support. The Natural Resources Conservation Service launched SGI in 2010, applying the power of the Farm Bill to target lands where habitats are intact and sage grouse numbers are highest – covering 78 million acres across 11 western states. While private lands are the primary focus, the Initiative serves as a catalyst for public land enhancements. The Sage Grouse Initiative applies Farm Bill dollars and certifies conservation projects in the core areas for sage grouse with a dual goal of sustaining rangelands and sage grouse. In addition to directing dollars to private lands where 40 percent of sage grouse live, SGI dollars can be applied on public lands where ranchers have grazing leases. For more details related to funding opportunities, please contact your local NRCS office. Detailed information related to the Sage Grouse Initiative can be found at the following website: *http://www.sagegrouseinitiative.com/*

Information on all NRCS programs is available from the local contacts listed in Table 6.1-1.

8.4.7 US Army Corps of Engineers (USACE)

The USACE has civil responsibilities for flood damage reduction, hydroelectric power generation and navigational improvement as well as other water and land resource problems and needs including environmental preservation and enhancement, ecosystem management and comprehensive floodplain management. The Corps is responsible for a worldwide military construction program, an extensive environmental program and a broad national civil works program.

The Corps of Engineers is authorized to provide technical assistance to local communities, States and federally recognized Indian Tribes in support of their efforts to alleviate flooding impacts, reduce erosion and otherwise plan for the wise and prudent use of the nation's water and related land resources. They also have authority to construct certain water resources related projects and respond to water resource needs.

- **Planning Assistance to States:** This program provides for assistance in preparation of plans for the development, utilization and conservation of water and related land resources. The Corps provide technical planning assistance in all areas related to water resources development such as bank stabilization, sedimentation, water conservation, ecosystem and watershed planning and water quality. Assistance is limited to $500,000 per state and studies are cost-shared on a 50-50 basis with a non-federal sponsor such as a state, public entity or an Indian Tribe.

- **Floodplain Management Services:** This program provides technical services and planning guidance for support and promotion of effective floodplain management. Flood and flood plain data are developed and interpreted with assistance and guidance provided in the form of "Special Studies" on all aspects of floodplain management planning. All services are provided free of charge to local, regional, state, or non-federal public agencies. Federal agencies and private entities have to cover 100% of costs.

- **Flood Damage Reduction Projects:** This program provides structural and non-structural projects to reduce damages caused by flooding and focuses on solving local flood problems in urban areas, towns and villages. The Corps works with the project sponsor to define the flood problem, evaluate solutions, select a plan, develop the design, and construct a project. A feasibility study is conducted to identify potential projects with the first $100,000 of the cost Federal. Any cost above this amount is cost-shared 50-50 with the sponsor in the form of cash and in-kind services. Construction lands, easements, rights-of-way, relocations and disposal and 5% of the projects costs are the sponsor's responsibility. Operation and maintenance and a maximum of 50% of total project cost are the sponsor's responsibility.

- **Project Modification for Improvement of Environment:** The purpose of this program is to modify structures or operation of previously constructed water resources projects to improve environmental quality, especially fish and wildlife values. An initial study is 100% federally funded up to $100,000. All planning costs after the first $100,000 are cost shared 50/50. All design and construction costs are cost shared 75% Federal and 25% non-Federal. The Federal cost limit is $5,000,000. The non-Federal sponsor cost share can be a contribution of cash, Lands, Easements, Rights-of-way, Relocations, and Disposal areas (LERRDs), or work-in-kind. Work-in-kind may be provided subsequent to the execution of a Project Partnership Agreement (PPA), and the value may not exceed 80% of the non-Federal share.

- **Aquatic Ecosystem Restoration:** This effort is for restoration of historic habitat conditions to benefit fish and wildlife resources. This is primarily to provide structural or operational changes to improve the environment such as? river channel reconnection, wetland creation or improving water quality. Conditions are similar to the Project Modification program with sponsor cost-share being 35%.

- **Water Resources Projects:** The purpose of this program is to construct larger projects for flood damage reduction and to provide technical assistance in resolving more complex water resource problems. It is used to evaluate projects costing more than $10 million that include purposes of flood control, water supplies, water quality, environmental protection and restoration, sedimentation or recreation. This would include reservoirs, diversions, levees, channels or flood plain parks as examples. The Corps works with a non-federal sponsor to define the flood or water resource related problem or opportunity, evaluate flood control or solutions, select a plan, develop a design and construct a project. This requires special authorization and funding from Congress with a reconnaissance study being federal cost. A feasibility study to establish solutions is cost-shared 50% by the non-federal sponsor with 35 to 50% of construction cost the responsibility of the sponsor.

- **Support for Others Program:** This program provides for environmental protection and restoration or facilities and infrastructure. This includes Environmental Planning and Compliance, Economic and Financial Analyses, Flood Plain Management, Cultural Resources and General Planning. All costs for these programs are provided by the customer agency.

- **Regulatory Authority/Responsibility.** The Corps of Engineers has regulatory authority under the Clean Water Act and the River and Harbor Act. The purpose of these laws is to restore and maintain the chemical, physical and biological integrity of waters of the United States. Section 404 of the Clean Water Act authorizes the Corps to regulate the discharge of dredged or fill material into waters of the U.S. This would include dams and dikes, levees, riprap, bank stabilization and development fill. There are three kinds of permits issued by the Corps: They are Individual, Nationwide and Regional General permits.

The local contact for the USACE is:

Wyoming Regulatory Office
2232 Dell Range Blvd,
Suite 210
Cheyenne, Wyoming 82009
Ph: 307-772-2300

8.4.8 United States Department of Agriculture (USDA) Rural Development

The USDA Rural Development's Water & Environmental Program (WEP) is authorized to provide financial assistance for water and waste disposal facilities in rural areas and towns of up to 10,000 people. This

program is intended for non-profit corporations and public bodies such as municipalities, counties, and special purpose districts and authorities.

The applicant must have legal capacity to borrow and repay loans, to pledge security for loans and to operate and maintain the facilities. The applicant must be financially sound and able to manage the facility effectively as well as have a financially sound facility based upon taxes, assessments, revenues, fees or other satisfactory sources of income to pay costs of operating, debt service and reserve. Grants are also available and are used to supplement loans to reduce debt service where necessary to achieve reasonable user rates. Assistance is also available on how to assemble information concerning engineering, financing and management of proposed improvements.

Loans and grants may be used to construct, repair, improve, expand or modify rural water supplies and distribution facilities such as reservoirs, pipelines, wells and pumping stations, waste collection, pumping, treatment or other disposal facilities. This assistance may also be used to acquire a water supply or water right or finance facilities in conjunction with funds from other agencies or those provided by the applicant. These funds can be used to pay legal and engineering fees associated with the development of a facility or pay other costs related to development including rights-of-way or easements and relocation of roads or utilities. Loan terms are a maximum of 40 years, State Statute, or the useful life, whichever is less with interest rates based on current market yields for municipal obligations. More information can be found at: https://www.rd.usda.gov/programs-services/all-programs/water-environmental-programs.

8.4.9 Wyoming Landscape Conservation Initiative (WLCI)

The WLCI is a long-term science based effort to assess and enhance aquatic and terrestrial habitats at a landscape scale in southwest Wyoming, while facilitating responsible development through local collaboration and partnerships. The WLCI is composed of numerous committees and teams made up of representatives from the participating agencies. These agencies include: BLM, USGS, US Fish and Wildlife Service, US Forest Service, Wyoming Game and Fish Department, Wyoming Department of Agriculture, Southwest Wyoming County Commissions, Southwest Wyoming Conservation Districts, US National Park Service, NRCS, University of Wyoming, and the US Bureau of Reclamation.

Information gathered through scientific inventory and assessment of species and habitat is combined with local input and knowledge to develop and implement conservation projects. The WLCI conducts regular Local Project Development Team meetings, where public participation is needed and expected. If you have ideas for projects, they can be presented at these meetings or sent to the WLCI Coordination Team through the BLM High Desert District Office at (307) 352-0227 or *blm_wy_wlci_wymail@blm.gov.*

The project application form, project tracking and project ranking score sheet are available from the following website, and have been included in the digital library delivered with this report (*http://www.wlci.gov/lpdt-resources*).

8.5 Non-Profit and Other Organizations

8.5.1 Ducks Unlimited

Ducks Unlimited, Inc. (DU) is a potential funding source for wetlands and waterfowl restoration projects. Although direct grant funding is limited (to the extent that there is generally about $20,000 to $30,000 available annually statewide), in-kind assistance may be available from the local chapter of DU. Additional information on DU's funding programs and opportunities is available in the Water Management & Conservation Assistance Program Directory referenced previously.

DU offers a waterfowl habitat development and protection program called Matching Aid to Restore States Habitat (MARSH). This is a reimbursement program that provides matching funds for restoring, protecting, or enhancing wetlands. The financial extent of this program is dependent on DU's income within the state. MARSH projects must significantly benefit waterfowl. Projects receiving funding support must be on lands that can demonstrate at least a 30-year project life at a minimum. Groups requesting assistance must be able to demonstrate capacity to execute long-term habitat agreements, deliver and manage projects, and be willing to assume project liability. DU's goal is to match MARSH funds equally with private, state, or federal sources. Their objective is to obtain maximum leverage possible to maximize benefit to waterfowl. Therefore, leveraged projects have a greater likelihood of being approved. Specifics for proposal submission, budget preparation, project development, and receipt of funding can be further explained by the DU local coordinator.

Great Plains Regional Office
(701) 355-3500

8.5.2 National Fish and Wildlife Foundation (NFWF)

The National Fish and Wildlife Foundation (NFWF) is a private, non-profit, tax exempt organization chartered by Congress in 1984 to sustain, restore and enhance the Nation's fish, wildlife, plants and habitats. NFWF provides funding on a competitive basis to projects that sustain, restore, and enhance our nation's fish, wildlife, and plants and their habitats. The available programs and initiatives are listed and detailed here: *http://www.nfwf.org/whatwedo/programs/Pages/home.aspx*. The programs listed, support diverse projects for wildlife and habitat conservation across the county. The initiatives provided in this listing, each have a Board of Directors approved business plan developed by scientists and other experts. Grants are available to support the actions identified in the business plan.

Some of the grants/programs that may be applicable to potential projects in the Bitter Creek / East Flaming Gorge Watershed Study Area include, but are not limited to the following:

- **Acres for America:** Acres for America is one of the most effective public-private partnerships in the history of U.S. conservation efforts. The Acres for America program conserves lands of national significance, protects critical fish and wildlife habitat and benefits people and local economies.

- **Bring Back the Natives Grant Program:** This program invests in conservation activities that restore, protect, and enhance native populations of sensitive or listed fish species across the United States, especially in areas on or adjacent to federal lands. The program emphasizes coordination between private landowners and federal agencies, tribes, corporations, and states to improve the ecosystem functions and health of watersheds. The end result is conservation of aquatic ecosystems, increase of in-stream flows, and partnerships that benefit native fish species throughout the U.S. This funding opportunity also provides grants to implement the goals of the National Fish Habitat Action Plan.

- **Conservation Partners Program:** The primary goals of this program are targeting funds made available by the federal Farm Bill toward priority conservation objectives and maximizing the funds benefits. Through these regional grants, this conservation program has begun to place expert staff ("boots-on-the-ground") where they can maximize outreach to the private landowner.

- **Five-Star Urban Waters Restoration Grant Program:** This program provides financial assistance on a competitive basis to support community-based wetland, riparian, and coastal habitat restoration projects that build diverse partnerships and foster local natural resource stewardship through education, outreach and training activities. Projects seek to address water quality issues in priority watersheds, such as erosion due to unstable streambanks, pollution from stormwater runoff, and degraded shorelines caused by development. Funding levels are modest, from $10,000 to $40,000, with $20,000 as the average amount awarded per project. However, when combined with the contributions of partners, projects that make a meaningful contribution to communities become possible.

- **Pulling Together Initiative:** This program provides support on a competitive basis for the formation of local Weed Management Area (WMA) partnerships that engage federal resource agencies, state and local governments, private landowners, and other interested parties in developing long-term weed management projects within the scope of an integrated pest management strategy; minimum 1:1 nonfederal match is required.

- **Environmental Solutions for Communities Initiative:** This program was designed to support projects that link economic development and community well-being to the stewardship and health of the environment. Funding is available for projects that conserve critical land and water resources or improve local water quality. Another priority of this initiative is restoring and managing natural habitat, species and ecosystems that are important to community livelihoods.

Information about all of these and other NFWF grants/programs is available at their website: *http://www.nfwf.org/whatwedo/grants/pages/home.aspx*.

8.5.3 Trout Unlimited

The mission of the Wyoming Council of Trout Unlimited is to conserve, protect, and restore Wyoming's cold-water (trout) fisheries and their watersheds. The (TU) Council is made up of 11 chapters located throughout the state. While a majority of Trout Unlimited members are indeed enthusiastic anglers, their focus is not only on maintaining fisheries for the purpose of angling. Healthy trout fisheries are indicative of well-functioning, sound ecosystems and the work done towards restoring good trout habitat will ultimately benefit the overall environment.

Of special concern are Wyoming's four subspecies of native cutthroat trout that currently inhabit a tiny fraction of their historic range. Working with federal and state agencies, local officials and landowners, Wyoming Trout Unlimited is actively engaged in a battle to keep these fish from being listed under the Endangered Species Act. Trout Unlimited provides funding and volunteer labor for a variety of stream and watershed projects such as erosion control and fish habitat structures, willow and other riparian plantings, and stream protection fencing. Embrace-A-Stream grants are available for up to $10,000 per project. Partnerships are encouraged and can include local conservation districts and state and federal agencies. Those interested should contact the Council office.

IX. TASK 8: PERMITS

9.1 Overview

Implementation of any of the projects recommended in the watershed management plan (Chapter 4) will require some form of permit, agency review, easement, or procurement of access consent. Depending on the type of project and the land owner (federal, state, or private), the process can range from a negligible effort to potential road blocks requiring significant efforts to successfully complete. In this chapter, permitting information is provided for a variety of projects as follows:

- Section 9.2: Basic requirements and activities needed to be on the property, collect data and obtain easements are discussed
- Section 9.3: Project-specific permitting requirements are presented for typical projects eligible for funding through the WWDC's Small Water Projects Program (SWPP).
- Section 9.4: Environmental Permitting and Mitigation
- Section 9.5: Information pertaining to online tools and databases to help with the data collection and permitting is presented.

Appendix 9A contains additional information pertaining to each of the federal, state and local agencies.

9.2 Property Access, Easements, and Land Procurement

Permission must be obtained from the landowner, lessee, or management agency prior to any fieldwork on any proposed project area within the watershed. Verbal permission from landowners is sufficient for initial site visits; however, if project specific field data needs collected and potential project alternatives developed then written permission should be acquired. Other negotiations could be necessary for securing easements, rights-of-way (ROW), and property access for planning or construction activities associated with a proposed project.

The Enterprise Technology Services' (ETS) Wyoming Statewide Parcel Viewer can be accessed via the website (*http://gis.wyo.gov/parcels/*) to help determine ownership information for any parcels that may be involved with a proposed project. Permits or right-of-way access are required for the WYDOT and numerous utility and energy entities when project construction involves their properties. Information regarding state land parcels and surface leases can be accessed from the OSLI's State Land Access website:

(http://gis.statelands.wyo.gov/GIS/OSLIGIS/StateLandAccess/)

and OSLI's Search Surface Plat Book website:

(*http://statelands.wyo.gov/surfaceplatbook/*).

County parcel data could also be obtained from Sweetwater County via an online map:

https://maps.greenwoodmap.com/sweetwater/

Or by contacting the county at (307) 872-3732.

9.2.1 Trespassing to Collect Data

In 2015 and 2016, Senate File 12 and Senate File 75 (Trespassing to Collect Data), respectively, were passed by the Wyoming Legislature and signed into law by Governor Mead. These State laws protect landowners' property rights by allowing law enforcement officials to file criminal charges if an individual or entity trespasses onto private property for the purpose of collecting data. The state law also prohibits any information from being used by a government entity if it is collected by someone who trespassed on or across private land. However, if information was illegally collected and provided to a government agency, it will be expunged by the agency, but will be retained to use as evidence against the trespasser.

Because participation in the watershed study is voluntary, the project team worked with the WWDC, local sponsors, and landowners to gain verbal permission before entering private land. Obtaining landowner permission for collecting resource data for the watershed study is required in accordance with Wyoming Statute (W.S.) 6-3-414, Trespassing to Unlawfully Collect Resource Data. Consequently, the project team collected all field data on private lands in the company of the landowner or leasee. Also, global positioning system (GPS) units with 2015 parcel data and a GPS-enabled camera were used to collect field data, which ensures that field data collection occurred only on the participating landowners' properties.

9.2.2 Land Procurement, Right-of-Way, or Easement Acquisition

The proposed projects described in this study predominantly involve private lands and are situated within the parcel boundaries of the participating landowners. There are a small number of the proposed projects' components that would involve access to rights-of-way along a county road or access to irrigation district infrastructure and would require temporary or conditional use permits obtained from those entities. If a proposed project were to be located entirely or partially on federal lands, crossing federal lands, or funded by federal agencies or programs, additional requirements for compliance with NEPA would apply, which is described more in Section 9.5.

9.2.3 Utilities

Permits or right-of-way access are required for numerous utility and energy entities when project construction involves their easements and properties. In the state of Wyoming, the State's "Wyoming Underground Facilities Notification Act" requires everyone who owns underground facilities in the state to be a member of One-Call of Wyoming. Before any excavation begins, the excavator is required to provide advance notice (at least 2 business days before intending to dig) to the One-Call of Wyoming Notification

Center at 811 (or if calling from out-of-state, 1.800.849.2476) [Wyoming State Legislature, 2013]. For more information about One Call of Wyoming, please visit their website:

http://www.onecallofwyoming.com/

9.3 Permitting for Proposed Projects

In the following sections, the permit requirements of specific types of projects within the watershed management plan are presented, including:

- Livestock/wildlife projects
    - Water wells (and spring developments)
    - Stock reservoirs/Ponds
- Irrigation System projects
- Water Storage Projects

Table 9.3-1 presents a tabulation of permits that each of the various agencies may require. Appendix 9A contains additional information regarding the federal, state and local agencies which may require coordination.

9.3.1 Livestock/Wildlife Water Projects

Permits, clearances, and approvals that possibly need to be obtained for typical livestock/wildlife water projects for a typical project component such as a water well, stock reservoir/pond, solar panel and pump, pipeline, and stock tanks are identified in Sections 9.3.1.1 through 9.3.1.4 within this chapter. Additional requirements from various entities may also exist and involve further investigation for some of the proposed projects. The extent of involvement and the nature of coordination would be determined on a project-by-project basis. More detailed discussions of those requirements are included in Appendix 9A.

Table 9.3-1 Tabulation of Agencies and Pertinent Permit Requirements.

Agency	Potential Permit and/or Clearance
Federal	
U.S. Army Corps of Engineers (USACE)	Authorization of Permit for Discharge of Dredged or Fill Material (Section 404 permit) Requires further delineation of jurisdictional wetlands and a wetland mitigation plan.
U.S. Fish and Wildlife Service (USFWS)	Endangered Species Act, Section 7 and 10 consultations
Bureau of Land Management (BLM)	BLM clearance necessary if located or crossing BLM lands, NEPA review required

Table 9.3-1 Tabulation of Agencies and Pertinent Permit Requirements (Continued).

Forest Service (USFS)	USFS clearance necessary if located or crossing USFS lands, NEPA review required
Natural Resource Conservation Service (NRCS)	NRCS approval necessary if funded by Farm Bill or USDA, NEPA review may be required
State	
Wyoming State Engineer's Office (SEO)	Ground Water Division approval of Water Well Permits Ground or Surface Water Division approval of Spring Development Permits Surface Water Division Approval of Ditches, Pipelines, and Changes in Points of Diversion Surface Water Division Approval of Diversion or Headgates carrying 50 cfs Surface Water Division approval of Reservoir Permits Safety of Dams Approval of Dam Modifications
Wyoming State Historical Preservation Office (SHPO)	SHPO compliance letter for projects on federal land or that include a federal action
Wyoming Game and Fish Department (WGFD)	Coordination for terrestrial and aquatic wildlife under the NEPA, the ESA, Section 404 of the federal CWA, and the Federal Fish and Wildlife Coordination Act Greater Sage-Grouse Core Area Protection
Wyoming Department of Environmental Quality (WDEQ)	401 Certification for 404 Permits under the federal Clean Water Act WYPDES Construction General Permit (CGP) for Large Construction Activity (> 5 acres) or Small Construction Activity (between 1 acre and 5 acres) Applicable Water Quality Standards for Wells, Reservoirs, and Streams
Wyoming Office of State Lands and Investments (OSLI)	Construction of Improvements on State Land application approval
Wyoming Department of Fire Protection and Electrical Safety	Electrical Wiring Permit to install electrical equipment on new construction or remodeling Electrical installations must be performed by licensed electricians unless exempted
Local	
Sweetwater County	Permits for building structures, wind and solar energy systems, and floodplain development
Special Districts	Permits or clearances from special districts including water and sewer, sanitary and improvement, flood control, irrigation, road, and improvement/service districts

9.3.1.1 Water Well

Drilling a water well or rehabilitating an existing water well to provide a source of livestock/wildlife water are typical projects in the watershed management plan. In the state of Wyoming, any person drilling a water well must obtain a water right permit prior to constructing any well by making application to the SEO using their Application for Permit to Appropriate Ground Water (U.W. 5 Form). Work cannot begin until the permit is approved by the State Engineer in accordance with Title 41 Water, Chapter 3 Water Rights; Administration and Control (W.S. 41-3-930). Necessary groundwater applications, regulatory information, and form instructions can be accessed via the SEO's website:

https://sites.google.com/a/wyo.gov/seo/regulations-instructions

Also, the drilling and/or pump contactor and the well owner must comply with the requirements pursuant to the Rules and Instructions, Part III of the Water Well Minimum Construction Standards (W.S. 41-3-909), which can be obtained via the website:

https://sites.google.com/a/wyo.gov/seo/ground-water/water-well-construction

Additionally, the water quality of the completed well must be suitable for livestock and cannot exceed suitability constituents for any of the Class III Groundwater standards (Table I) of Chapter 8, Quality Standards for Wyoming Groundwaters (W.S. 35-11-302), which can be accessed at the website:

http://deq.wyoming.gov/wqd/groundwater/resources/rules-regs/

Spring developments (which can be technically considered wells) also need to be permitted by the SEO in accordance with either their ground water or surface water rules and regulations. If a spring is for stock and/or domestic use, yields 25 gallons per minute or less, includes a man-made development (i.e., no machinery used), and is identifiable as ground water, then the spring is permitted by making application to the SEO using their Application for Permit to Appropriate Ground Water (U.W. 5 Form). Work cannot begin until the permit is approved by the State Engineer in accordance with Title 41 Water, Chapter 3 Water Rights; Administration and Control (W.S. 41-3-930). If a spring development doesn't meet of the described conditions, then the spring is permitted by completing a surface water application via the SEO's website:

https://sites.google.com/a/wyo.gov/seo/regulations-instructions

9.3.1.2 Stock Reservoir/Pond

Some of the proposed projects within the watershed include constructing or rehabilitating a stock reservoir or pond to provide a source of livestock/wildlife water. In Wyoming, a permit from the SEO is required before commencing construction of a dam or reservoir involving the storage or impoundment of water. Stock reservoirs must not exceed 20 acre-feet in capacity, cannot have a dam height greater than 20 feet, and the use of the stored water should be for stock purposes only pursuant with Title 41 Water, Chapter 3 Water Rights; Administration and Control, Article 3 Reservoirs (W.S. 41-3-301). Any individual or entity intending to construct a stock reservoir or pond must make application to the SEO using their Application for Permit to Appropriate Surface Water (S.W.4 Form) and cannot commence construction until the permit is approved by the State Engineer in accordance with Title 41 Water, Chapter 3 Water Rights; Administration and Control, Article 3 Reservoirs (W.S. 41-3-301). Necessary surface water applications including the SW-4 Stock

Reservoirs and SW-4A Stock Reservoir Multiple Points of Storage forms, regulatory information, and form instructions can be accessed via the SEO's website:

https://sites.google.com/a/wyo.gov/seo/regulations-instructions

Wyoming's Safety of Dams legislation (W.S. 41-3-307 through 41-3-318), which is administered by the SEO, typically does not apply to stock reservoirs when the dam height is less than 20 feet high and reservoir capacity is less than 50 acre-feet. Additionally, the water quality of a completed stock reservoir or pond must be suitable for agriculture water supply including livestock watering and cannot exceed any of the Class 2D, Class 3D, and Class 4 surface water quality standards (Appendix B) of Chapter 1, Wyoming Surface Water Quality Standards (W.S. 35-11-101) found at the website:

http://deq.wyoming.gov/wqd/surface-water-quality-standards/

In addition, the construction or rehabilitation of a reservoir would typically involve the discharge of dredged or fill material into waters of the United States and could require a Section 404 permit under the federal Clean Water Act (CWA). Because numerous waterbodies and wetlands are considered waters of the United States, they are subject to the United States Army Corps of Engineers' (USACE) regulatory authority. Permit applications can be obtained by contacting the USACE Omaha District Wyoming Regulatory Office in Cheyenne by telephone (307) 772-2300 or website (http://www.nwo.usace.army.mil/Missions/Regulatory-Program/Wyoming/). As part of the 404 permitting process, when an applicant submits a pre-construction notification (PCN) to the USACE, the PCN is forwarded to the WDEQ for review under Section 401 of the CWA. WDEQ then determines compliance with Chapter 1, Wyoming Surface Water Quality Standards (W.S. 35-11-101). If the project is compliant, then the WDEQ issues a 401 Water Quality Certification. Information about the WDEQ's 401 Certification process can be obtained by visiting their website:
http://deq.wyoming.gov/wqd/401-certification/

9.3.2 Irrigation Projects

Rehabilitation of existing diversions, ditches, or pipelines for diverting irrigation water from a river, creek, or reservoir to irrigated lands are also typical projects in the watershed management plan. This type of a project requires verifying the applicable water rights to ensure the appropriation has been approved by the SEO pursuant with Title 41 Water, Chapter 3 Water Rights; Administration and Control, Article 1 Generally (W.S. 41-3-101). ***If the proposed project does not involve a change in the point of use, point of diversion, or an enlargement, additional approval from the SEO is not likely to be required. Before initiating any irrigation structure project, however, the SEO should be consulted for a final determination of their requirements.***

However, any enlargement or change in point of use of the structure or facility would require the submittal of an application and/or petition to the SEO and the Board of Control (BOC) for approval. Necessary application forms and instructions including the SW-2 Enlargement of Ditches, Pipelines and Change in Point of Diversion and Means of Conveyance petition examples can be obtained via the SEO's website (*https://sites.google.com/a/wyo.gov/seo/regulations-instructions*). Likewise, any individual or entity intending to construct a new diversion structure, ditch, or pipeline from a stream that does not use an existing, permitted structure or facility must make application to the SEO using their Application for Permit to Appropriate Surface Water (S.W.1 Form) and cannot commence construction until the permit is approved by the State Engineer in accordance with Title 41 Water, Chapter 3 Water Rights; Administration and Control, Article 1 Generally (W.S. 41-3-101). It is recommended that coordination with the SEO occur with any proposed project before rehabilitating an existing structure or constructing a new one. Moreover, there may be additional permission or approval necessary if the structure or facility supplies water to any other irrigators or water users.

In addition to the SEO requirements, the construction or rehabilitation of a diversion structure including a headgate, weir, or diversion dam along with any associated in-stream or streambank work would involve the discharge of dredged or fill material into waters of the United States and could require permitting under Section 404 of the CWA. It is recommended that coordination with the USACE occur to determine any agricultural exemptions from Section 404 regarding the construction or maintenance of irrigation ditches, including any construction or rehabilitation of siphons, pumps, headgates, wingwalls, weirs, screens, or other facilities as are appurtenant and functionally related to irrigation ditches. More information can be obtained by contacting the USACE's Wyoming Regulatory Office by telephone (307) 772-2300 or via the website:

http://www.nwo.usace.army.mil/Missions/Regulatory-Program/Wyoming/

Again, when an applicant submits a 404 permit PCN to the USACE, the PCN is forwarded to the WDEQ for review under Section 401 of the CWA to determine compliance surface water quality standards or total maximum daily loads (TMDLs). Information about the WDEQ's 401 Certification is available via the website:

http://deq.wyoming.gov/wqd/401-certification/

9.3.3 Water Storage Projects

9.3.3.1 Dam and Reservoir Permitting

Any individual or entity intending to construct a new reservoir or enlarge an existing reservoir exceeding 20 acre-feet in capacity or having a dam height greater than 20 feet must make application to the SEO using their Application for Permit to Appropriate Surface Water (S.W.3 Form) and cannot commence construction until the permit is approved by the State Engineer in accordance with Title 41 Water, Chapter 3 Water Rights; Administration and Control, Article 3 Reservoirs (W.S. 41-3-301). Applications and instructions for SW-3 Reservoirs and SW-3A Special Application Reservoirs can be obtained by accessing the website:

https://sites.google.com/a/wyo.gov/seo/applications-forms#Surface

Wyoming's Safety of Dams legislation (W.S. 41-3-307 through 41-3-318) requires that the State Engineer ensures the safety and structural integrity of water storage facilities within Wyoming. Consequently, any individual or entity proposing to construct, enlarge, repair, alter, or remove a dam with a height greater than 20 feet or a capacity of more than 50 acre-feet of water, or diversion system with headgates or diversion structures carrying 50 cubic feet per second (cfs) must have plans and specifications prepared by a Wyoming licensed Professional Engineer and shall be submitted to the State Engineer for approval pursuant to Title 41 Water, Chapter 3 Water Rights; Administration and Control, Article 3 Reservoirs (W.S. 41-3-308). On-site inspections of any new or rehabilitated facilities are conducted by the SEO personnel.

In addition to the SEO requirements, the construction or rehabilitation of a reservoir or pond typically involves the discharge of dredged or fill material into waters of the United States and could require permitting under Section 404 of the federal Clean Water Act (CWA). Because numerous waterbodies and wetlands within the study area are considered waters of the United States, they are subject to the USACE' Section 404 regulatory authority. Section 404 applications and instructions can be obtained by contacting the USACE's Wyoming Regulatory Office by telephone (307) 772-2300 or can be obtained by visiting the website:

http://www.nwo.usace.army.mil/Missions/Regulatory-Program/Wyoming/

Again, when an applicant submits a 404 permit PCN to the USACE, the PCN is forwarded to the WDEQ for review under Section 401 of the CWA to determine compliance surface water quality standards or TMDLs. Information about the WDEQ's 401 Certification is available via the website:
http://deq.wyoming.gov/wqd/401-certification/

9.3.3.2 National Environmental Policy Act Process for Water Storage Projects

Within the Green River Basin and this study area, federal regulations in accordance with the NEPA and the ESA dictate the permitting requirements and review process of water-related projects including water storage projects. These review processes are required because of the need for securing permits under the federal CWA and Section 7 consultation under the federal ESA. The timeframe for securing the necessary permits from federal agencies for water storage projects could take several years depending on the complexity of the proposed facility because of the requirements of the NEPA and the ESA. Federal regulations direct that the USACE evaluate practicable and reasonable alternatives under the NEPA. The issuance of a 404 permit for discharge must only be for the least environmentally damaging practicable alternative to the aquatic ecosystem and does not have other significant adverse environmental consequences.

Generally, the effort to comply with the NEPA on any proposed reservoir project would probably require the preparation of an environmental impact statement (EIS). The BLM or the USFS would likely be the lead agency for any water-storage project that is situated on federal land while the NRCS would likely be the lead agency for any reservoir project funded by USDA on private lands. For proposed reservoirs on private lands funded privately or by state programs, the permitting process still requires that NEPA be addressed and would be led by the appropriate local or state agency or landowner. Coordination with the USACE would be required prior to initiation of any water storage project. The most important aspect regarding the permitting process for a new dam and reservoir storage project is developing a valid purpose and demonstrable need for the project.

9.3.4 Other Project Types

Permit and clearance approvals for any the proposed projects ultimately depend on the site-specific project and its location. Generally, the permits, clearances, and approvals discussed in Sections 9.3 through 9.5 could also be applicable for any proposed municipal, rural domestic water, groundwater exploration, weather modification, pipelines and conveyance facilities, wetland development, environmental (streambank, water quality, erosion protection), and solar or windmill projects depending on the specific nature and/or location of the project.

9.3.5 Mitigation

Mitigation requirements may be necessary for a proposed project to address impacts to wetlands, riparian vegetation, stream-channel habitat, cultural resources, fish and wildlife resources, and possibly threatened or endangered species. In developing the proposed projects within this study report, a decided effort was made to avoid potential impacts by evaluating and considering these resources as part of the conceptual plans. When necessary, the plan designs were and should be adjusted accordingly; avoiding the need for mitigating significant impacts. Avoiding potential impacts to species of concern and their associated habitats could typically be accomplished by scheduling construction activities outside of the relevant nesting, parturition, breeding, or migration seasons. Sage grouse core area needs are discussed in Section 9.4.3.

9.4 Environmental Evaluation

9.4.1 National Environmental Policy Act Compliance

Compliance with the NEPA typically applies whenever a proposed project included in the Watershed Management Plan is located on federal lands, needs passage across federal lands, is funded entirely or partially by federal agencies or programs, or needs to secure a federal permit. The NEPA process is intended to help sponsors and agencies review the potential project effects and involve the public in making informed decisions about the environmental consequences of a project. If any proposed project occurs on BLM or USFS lands or would be a recipient of U.S. Department of Agriculture (USDA) Farm bill funding, the BLM, USFS, or NRCS would likely be considered the "lead or action agency" in the NEPA process.

The USACE usually has a role in reviewing proposed projects that involve impacting or enhancing a wetland, which would require a Section 404 permit. Typically, federal agencies have a Memorandum of Understanding (MOU) to outline responsibilities and roles of the agencies when a proposed project involves multiple agencies. Specifically, in regards to the NRCS providing technical assistance to conservation districts and landowners on any proposed project funded by the WWDC's Small Water Project Program (SWPP), the NRCS' National Environmental Compliance Handbook, Subpart D - The National Environmental Policy Act, 610.40 Overview of NEPA Requirements, 610.43 Federal Actions and Major Federal Actions states the following about federal actions:

A. Federal Actions

> (1*) NEPA compliance is triggered when NRCS proposes a Federal action. A Federal action occurs when NRCS has control or responsibility over the implementation of a proposed activity including technical or financial assistance. Most NRCS Federal actions involve financial assistance through Farm Bill and watershed programs, or approvals, but Federal actions also include activities such as granting compatible uses agreements for easements where NRCS exercises control.*
> *(2) Federal actions do not usually include situations in which NRCS is only providing technical assistance because NRCS cannot control what the client ultimately does with that assistance. However, there may be instances where a project can become "federalized" due to a substantial input of Federal resources in the form of technical assistance or when NRCS has some control or responsibility in the result. When NRCS provides technical designs, standards, or specifications, the RFO should evaluate and determine whether NRCS has control or responsibility over the action, thus making it a Federal action subject to NEPA.*
> *(3) Important note: NEPA only applies to Federal actions. It is NRCS policy and required by NRCS regulations to conduct an EE as a part of every planning activity, even if it is not considered a Federal action (highly erodible land and wetland determinations are technical determinations and not considered planning activities). The results of this process are documented on the NRCS-CPA-52 worksheet, to- (i) Inform the landowner of the plan's impacts.*
> *(ii) Provide a record that the EE was conducted.*

9.4.2 Proposed, Threatened, and Endangered Species

The following species have the potential to occur within the proposed project areas within the watershed study area [Wyoming Natural Diversity Database, 2016]:

Endangered:
- Bonytail (Gila elegans)
- Colorado Pikeminnow (Ptychocheilus Lucius)
- Humpback Chub (Gila cypha)
- Razorback Sucker (Xyrauchen texanus)
- Black-footed ferret* (Mustela nigripes)

**The black-footed ferret is listed as an Endangered - Nonessential Experimental Population*

9.4.3 Other Species of Concern

The Wyoming Natural Diversity Database (WYNDD) records and maintains a list of plant species in Wyoming that are thought to be rare or sensitive, as discussed in Section 4.3.1.8. Appendix 4F lists the tracked or watched status of 31 plant species of concern that potentially occur within the study area. Tracked species are those that are vulnerable to extirpation because of rarity, inherent vulnerability, or habitat threats. Watched species are those that appear to be presently secure but have limited distribution. Although some of these plant species could occur on a proposed project area, none of the species are currently protected by state or federal regulation but still deserve appropriate planning and implementation considerations.

Also, the WYNDD records and maintains a list of species for amphibians, birds, crustaceans, fish, insects, mammals, mollusks, and reptiles in Wyoming that are thought to be rare or sensitive, as discussed in Section 4.3.2.6. Appendix 4G lists the tracked or watched status of 3 amphibians, 74 birds, 1 crustacean, 11 fish, 2 insects, 32 mammals, and 6 reptiles [WYNDD, 2016]. Appendix 4G also shows that the Greater sage-grouse is classified as "Not Warranted for Listing," which reflects the U.S. Department of Interior's decision in September 2015 to withdraw the sage-grouse from the USFWS's candidate species list, which is discussed in Section 4.3.2.5.

The Greater sage-grouse is still recognized as a sensitive species/species of concern by the BLM and a species of concern by the WGFD. In June 2008, Executive Order 2008-2 was signed by the Governor which stresses additional management consideration to sage-grouse and sage-grouse habitat statewide. In July 2015, Executive Order 2015-4, Greater Sage-Grouse Core Area Protection, was signed by Governor Mead, which requires state agencies to encourage development outside of the core areas and to focus management to the greatest extent possible on the maintenance and enhancements of habitat within them. Additional information about Wyoming's sage grouse management including mitigation, de minimus activities, core area maps and data, and the Density Disturbance Calculation Tool (DDCT) can be found at the website:

https://wgfd.wyo.gov/Habitat/Sage-Grouse-Management

Sponsors for a proposed project within the watershed should contact the WGFD at least 60 days prior to submitting an application for a permit or project so any sage-grouse related issues could be identified and any stipulations could be incorporated before commencing project activities.

9.4.4 Fish Distribution, Wildlife Habitat Distribution, Sensitive/Endangered Species

Available information and geospatial data regarding fish distribution, wildlife habitat distribution, and sensitive and threatened/endangered plant and animal species (e.g., Greater sage-grouse) will be obtained, described, mapped, and incorporated into the study's ArcGIS geodatabase and digital library. Fish habitats within the study area could include perennial and intermittent streams, springs, lakes, ponds, and reservoirs that support fish through at least a portion of the year. Available fish survey and habitat investigations would be obtained from the WGFD, UW, and USFS and included as part of the study effort.

The WGFD geodata that shows hunt areas, herd units, seasonal range, crucial ranges, parturition areas, and migration routes and barriers for antelope, elk, mule deer, moose, and white-tailed deer within the watershed has already been collected. The project team would coordinate with the WWDO in requesting sensitive and threatened/endangered species information and data for the watershed from the Wyoming Natural Diversity Database (WYNDD). The WYNDD records and maintains a list of species in Wyoming that are thought to be rare or sensitive. Tracked species are those that are vulnerable to extirpation because of rarity, inherent vulnerability, or habitat threats. Watched species are those that appear to be presently secure but have limited distribution. The WGFD also maintains geodata for the Greater sage-grouse, including core areas, distribution, and habitat connectivity and corridors.

9.4.5 Fish Species

The Bitter Creek and its tributaries (Antelope Creek, Salt Wells Creek, Patrick Draw, Sweetwater Creek, Tenmile Creek, and Killpecker Creek), along with east Flaming Gorge reservoir, Sage Creek, Currant Creek and Red Creek, and small ponds or reservoirs, provide fish habitat and sport fishing opportunities. The alternatives for rehabilitating reservoirs, dam embankments, and inlet/outlet ditches may have impacts to the streams and reservoirs and associated fishery resources; therefore, coordination with the WGFD is recommended before proceeding with any of the proposed alternatives. Most of the other proposed projects such as livestock/wildlife water developments are expected to have no direct effect on fishery resources because they are off channel/upland projects.

9.4.6 Big-Game Species

The watershed contains portions of crucial big-game habitat for antelope, elk and mule deer managed by the WGFD and seasonal ranges for several big-game species as described in Section 4.3.2.2. Additionally, WGFD Crucial Habitat Priority Areas exist within the watershed that contains big-game crucial winter ranges and year-long ranges. Crucial habitats have biologically important features that need to be protected or managed to maintain viable, healthy wildlife populations and are where the WGFD concentrates their habitat protection and management activities. Typically, the proposed projects included in the Watershed Management Plan are implemented in a manner that improves or maintains these habitat features.

9.4.7 Wetlands Delineation

Site-specific wetland delineation and inventories were not part of the scope of the watershed study. Geospatial data for the mapped National Wetlands Inventory (NWI) areas were used in preparing conceptual proposed project plans listed in Section 6.3 for irrigation systems and in Section 6.4 for livestock/wildlife water to avoid impacts to wetland resources. The alternatives for rehabilitating reservoirs, dam embankments, and inlet/outlet ditches may also affect wetland resources depending on the specific provisions of the plans, designs, and construction specifications. Entities should consult with the USACE about any jurisdictional determinations when proposing any water-development projects with wetlands before implementing any proposed project. Specific mitigation measures would need to be formulated to compensate for wetland losses determined by certified wetland delineations.

9.5 Planning Resources and Tools

Sources of technical support and assistance for project planning and implementation within the watershed are primarily provided through partnerships between local landowners, conservation districts, the NRCS, BLM, USFS, WGFD, and/or the Nature Conservancy. In addition, online planning tools and publicly available maps are also available for planning efforts. These web-based mapping applications can help local sponsors with assisting landowners who are interested in moving forward with a conceptual project proposed in the Watershed Management Plan.

9.5.1 Wyoming Department of Enterprise Technology Services (ETS)

The Wyoming Department of ETS was established to increase the ability of state agencies to deliver quality cost-effective services to the Wyoming citizens. The ETS' "State Agency Map Portal", which can be accessed via the website (gis.wyo.gov), provides links for GIS web applications with publicly accessible maps, as shown in Table 9.5-1.

Table 9.5-1 Wyoming Department of Enterprise Technology Services State Agency Map Portal GIS Web Applications.

Agency	Address	Description
Enterprise Technology Services (ETS)	*http://gis.wyo.gov/parcels/*	Wyoming Statewide Parcels
	http://gis.wyo.gov/Wyofires/	Wyoming Current Fire Map
State Parks and Historic Trails	*http://gis.wyo.gov/WYOutsideResourceGuide/*	State Parks Events Info
Office of State Lands and Investment (OSLI)	*http://www.onanypc.com/statelandaccess/*	Public Access to State Lands
	http://www.onanypc.com/osligis/oilandgas/	State Oil and Gas Information
Wyoming Pipeline Authority (WPA)	*http://www.wyopipeline.com*	Pipeline Data
Public Service Commission (PSC)	*http://psc.state.wy.us/htdocs/Dwnload/CertMaps/electric.pdf*	Electric Utilities Areas Map
	http://psc.state.wy.us/htdocs/Dwnload/CertMaps/Gas.pdf	Gas Utilities Certificate Area Map
State Engineer's Office (SEO)	*http://seo.maps.arcgis.com/home/index.html*	State Engineer's Office Information
Wyoming Department of Environmental Quality (WDEQ)	*http://deq.state.wy.us/lqd_permit_public/*	Viewer of Active Mining Permits
Wyoming Game and Fish Department (WGFD)	*http://wisdom.wygisc.org/*	G&F decision support system
Wyoming State Geological Survey (WSGS)	*http://www.wsgs.uwyo.edu/data/maps/published.html*	Geologic Maps
	http://www.wsgs.uwyo.edu/Data/GIS/IMS-Projects.aspx	Various geologic mapping projects
	http://www.wsgs.uwyo.edu/Data/GIS/	Digital data by theme
Wyoming Geographic Information Science Center (WyGISC)	*http://www.uwyo.edu/wygisc/*	Home page for WyGISC
Wyoming Climate Office	*http://www.wrds.uwyo.edu/sco/data/PRISM/PRISM.html*	PRISM Climate Data Server
	http://ims2.wrds.uwyo.edu/Website/Statewide/	Water/Climate Map Server

9.5.2 Wyoming Association of Conservation Districts - SuiteWater

The Wyoming Association of Conservation Districts (WACD), in partnership with the Wyoming Geographic Information Science Center (WyGISC), have created SuiteWater: which is a web-based mapping application and planning tool developed by and for Wyoming conservation districts. SuiteWater provides users with integrated geospatial data, digital imagery, background information and documents, and user-generated data for developing natural resource plans. However, access to SuiteWater is limited to the conservation district boards and employees and WACD Directors, staff, and advisors. Requests for access to SuiteWater must be submitted to the WACD for approval.

http://suitewater.wygisc.org/

9.5.3 Natural Resources Conservation Service - Web Soil Survey

Local sponsors, landowners, managers, and water users can access soils information via the NRCS' Web Soil Survey (WSS).

http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm

The WSS provides soils information produced by the National Cooperative Soil Survey in updated soil maps and data. Soil mapping data and interpretations can be used for general or local planning. No online account is necessary unless datasets are downloaded from the website. Site-specific soil maps of an area can be created and customized using the online tools to customize a soil map report, measure distances, explore interpretations and ratings, and download associated geospatial data. Although the WSS is useful in analyzing soils data during project planning, on-site soil investigations are recommended for most implementation activities including but not limited to reservoir, irrigation, and wetland construction or rehabilitation projects.

9.5.4 Wyoming Cultural Resource Information System

The Wyoming State Historic Preservation Office (SHPO) has created online applications and web services for researching cultural resources within any proposed project area. The SHPO's online resources include the Natural Resource and Energy Explorer (NREX) via:

https://nrex.wyo.gov/

and the Cultural Resource Management Tracker (CRMTracker) via:

http://www.gnomon.com/CRMTracker/CRMTracker_AllOrg/CRMTrackerHome.aspx

NREX has replaced the Cultural Research Information Summary Program (CRISP) and is discussed further in the following section. Additional cultural resource web service information can be obtained by contacting the State Historic Preservation Office by telephone (307) 777-7697 or via the website:

http://wyoshpo.state.wy.us/OLResources/Index.aspx

9.5.5 Natural Resource and Energy Explorer

The Natural Resource and Energy Explorer (NREX) is a web GIS-based software tool that supports pre-planning development considerations by enabling discovery; energy analysis and assessment, environmental, cultural, socioeconomic, and infrastructural assets for user-defined, project-scale areas of interest in the state. The tool is designed to support the Energy Atlas concept within Governor Mead's Energy Strategy Initiative by providing public access to credible geographic data and information maintained by state agencies. NREX could be used by developers, conservationists, consultants, planners, policy makers, and managers for resource assessment. NREX can be accessed via the website:

https://nrex.wyo.gov

9.5.6 Wyoming State Engineer's Office e-Permit System

The Wyoming State Engineer's Office (SEO) e-Permit system facilitates the supervision and protection of surface water and groundwater for the purpose of appropriation, distribution, and application to beneficial use of water in Wyoming. The SEO's e-Permit system is a web-based, online application that allows registered users to submit applications, petitions, and other requests; search the SEO's database of water rights; track the application process; access water right related documents; and download streamflow and reservoir data. The SEO's e-Permit system can be accessed via the website:

http://seoweb.wyo.gov/e-Permit/

9.5.7 Wyoming Interagency Spatial Database and Online Management System

The Wyoming Interagency Spatial Database and Online Management (WISDOM) System is another online planning tool that allows individuals to access data about Wyoming's wildlife resources for use in developing project plans. WISDOM was developed as a partnership between the Western Governors' Association, WGFD, WyGISC, WYNDD, WDEQ, OSLI, WYDOT, NRCS, the Nature Conservancy, and USFWS. WISDOM provides users with landscape-level information for initial project planning phases; however, site-specific analysis with applicable agencies is still warranted regarding crucial wildlife habitat requirements and conservation potential. WISDOM preserves the confidentiality of sensitive data by displaying land ownership as federal, state, or private, and the records for certain species are generalized to prevent users from viewing specific location data. WISDOM is available online at:

http://wisdom.wygisc.org/

9.5.8 Wyoming Density and Disturbance Calculation Tool for Greater Sage-Grouse

The Wyoming Geographic Information Science Center (WyGISC), in partnership with the Wyoming Game and Fish Department (WGFD), the BLM, and the USFS created the Greater Sage-Grouse Online Density and Disturbance Calculation Tool (DDCT), which is a web-based application tool that calculates both the number of disruptive activities averaged per square mile and total surface disturbance within the DDCT assessment area for proposed projects in protected sage-grouse core areas. The DDCT web application is used by individuals in preparation of required permits for a development activities. Users must register before the web application can be used. The DDCT is available online at:

http://ddct.wygisc.org/

9.5.9 U.S. Fish and Wildlife Service Information for Planning and Conservation (IPaC)

The U.S. Fish and Wildlife Service's (USFWS) Information for Planning and Conservation (IPaC) is a web-based application that is available to anyone needing assistance in determining how their activities may impact sensitive natural resources such as migratory birds, species listed under the ESA, or wetlands. Information that users obtain from IPaC is produced by USFWS field offices and could help improve the efficiency of project planning, discussions, and recommendations.

IPaC is available online at:

https://ecos.fws.gov/ipac/

Additional assistance regarding IPaC or USFWS requirements can be obtained by contacting the Wyoming Ecological Services Field Office by telephone (307) 772-2374 or website:

https://www.fws.gov/wyominges/index.php

X. CONCLUSIONS AND RECOMMENDATIONS

A multidisciplinary inventory of the Bitter Creek / East Flaming Gorge watershed was conducted in an effort to identify and evaluate key resource issues and concerns related to watershed function and condition. A comprehensive Geographic Information System (GIS) was completed in conjunction with the inventory. The GIS incorporates the data collected and results generated during the study and collates it with information collected from a wide variety of sources. The GIS will be a valuable resource for the community and future studies which will likely be conducted in the watershed.

10.1 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 SWCCD staff. In previous chapters, the key issues and problems were identified and ultimately, project goals and objectives were formulated to address them. Specifically, plans were developed to address issues associated with the following broad categories:

- *Irrigation System Conservation and Rehabilitation,*
- *Livestock/Wildlife Upland Watering Opportunities,*
- *Surface Water Storage Opportunities,*
- *Stream Channel Condition and Stability,*
- *Grazing Management Opportunities, and*
- *Environmental Enhancement Opportunities.*

In summary, the following conclusions are provided.

10.1.1 Irrigation System Components

1. The extent of irrigated lands, and corresponding irrigation infrastructure is extremely limited within the project study area. There are no large scale irrigation systems within the area. However, there is a large number of privately owned systems irrigating anywhere from a few to a couple hundred acres. Although small in size, they are valuable to the user and should be considered for evaluation and improvement where necessary. During the completion of this project, the project team reached out to as many individuals as possible. Only one stakeholder ultimately met with the team to discuss his system.

2. 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.

3. 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 manage fisheries populations.

4. Many of the potential irrigation system improvements foreseen in the study area would require minor involvement or permitting from regulatory agencies to be completed. However, work completed within stream channels (waters of the US) would require coordination with the USACE. Rehabilitation activities would likely be exempted from Section 404 permitting due to the USACE's exclusion of irrigation system maintenance efforts. Construction of new facilities would likely require Section 404 permitting.

10.1.2 Livestock/Wildlife Upland Watering Opportunities

1. There appears to be 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 26 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. Many of the livestock / wildlife projects could be completed entirely on private lands. Consequently, permitting issues are greatly simplified. However, many will involve coordination with the Bureau of Land Management (BLM) through the Rock Springs Office. BLM consultation will be necessary in order to obtain the requisite permits and cultural clearances.

6. Several of the livestock / wildlife projects identified through conversations with stakeholders would involve re-permitting existing reservoirs constructed in conjunction with mining activities to livestock / wildlife usage. This effort would require coordination with the mining companies and the State Engineers Office in order to facilitate retention of the ponds following cessation of mining activities in accordance with the mining plan.

10.1.3 Surface Water Storage Opportunities

1. No new storage facility projects were identified in this study and no previous studies were found which identified any. Based upon the limited hydrologic data which is available and its incorporation into the WWDC's Green River Basin Plan spreadsheet model, there may be a limited amount of water available for storage. Because of the hydrologic regime in the area and water quality concerns, storage of potentially available water would appear problematic.

10.1.4 Stream Channel Condition and Stability

1. Based on the geomorphic assessment and input from the project Sponsor, the project team concluded that channel degradation appears to be systemic. Numerous factors likely have contributed to the existing conditions, including channel alterations due to railroad construction, city construction, historic mine dewatering, historic grazing practices, climatic changes and other factors. The categories of impairments identified include, but are not limited to:

    - Sediment transported to downstream reaches (ex. Green River)
    - Loss of aquatic habitat
    - Lowering of groundwater tables
    - Degradation of water quality
    - Loss or damage to infrastructure
    - Base level lowering causing tributaries to degrade

2. Channels in portions of the study area appear to have begun to heal from historic entrenchment and downcutting, particularly those streams in the southwest portion of the basin (East Flaming Gorge). For example, Sage Creek appears to be forming a stable E-type channel within a deeply entrenched floodplain.

3. Several specific stream channel stabilization projects were identified, including: Pierotto Ditch Stabilization Project Monitoring, Big Pond Stabilization Investigation, the UPRR headcut stabilization, and the Killpecker Creek Stabilization Study.

10.1.5 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 could be made on a particular area or allotment.

2. Development of reliable water sources and associated watering facilities can aid in distribution, timing, and frequency of grazing animals. However, additional measures such as cross-fencing,

low-stress herding, mineral/salting, and grazing 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 an undesirable to a desirable plant community.

10.1.6 Environmental Enhancement Opportunities

1. Several environmental enhancement opportunities were identified. Two of the projects involve construction 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 Little Snake River watershed which could potentially be implemented providing valuable wetland habitat.

3. A TMDL investigation has recently been completed on Bitter Creek and Killpecker Creek targeting fecal coliform and chloride. A water quality management plan is currently being initiated by the SWCCD and their consultant. The goal of the plan would be to reduce contaminant loading to Bitter Creek and Killpecker Creek through implantation of practical Best Management Practices (BMPs).

10.2 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, projects providing multiple benefits and for which total project cost are less than $135,000 are eligible for funding under this program. 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 (if total project cost meets SWPP criteria). Additional funding could 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 SWCCD and stakeholders regarding irrigation system improvements is highly recommended. Irrigation system infrastructure is generally eligible for funding through the WWDC'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 SWCCD 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, SWCC could include reference of project completion to demonstrate SWPP opportunities.

3. The Rock Springs Grazing Association (RSGA) controls the majority of the grazed lands either through ownership or lease through the BLM. The project team found many stakeholders seemingly reluctant to discuss potential watershed improvements because, they said "the RSGA would cover it." Consequently, continued communications between the RSGA and the SWCCD is highly recommended. It is our understanding (based upon our experience) that the RSGA attends SWCCD meetings and events and provides their input and comments. ***Because of the extent of their holdings, RSGA and Anadarko (the two major land owners in the study area) should be invited to share in the decision making for public agency decisions. Without their participation, management plans could potential fall short of expectations.***

4. Management of wild horse populations is a locally controversial and problematic issue for land managers. Many of the potential livestock / wildlife water supply projects recommended in the study would likely be beneficial in terms of easing pressures on riparian areas and helping to optimize grazing opportunities. However, due to the horse populations, conditions around water sources could be exacerbated. Consequently, steel jack fencing has been recommended for all

new water sources to protect the resource from damages related to horses. The fencing increases costs and should be considered on a case by case basis.

5. 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. In addition to providing direct benefits to the specific stream, ancillary benefits include education and community involvement. Specifically, Bitter Creek and Killpecker Creek clean up projects could be completed.

6. A large number of unimproved roads exist in the watershed; particularly in areas of energy development. Transportation Management Planning conducted in conjunction with the BLM's forthcoming revised Resource Management Plan is expected to contain strategies to address road density and redundancies. Coordination among participating parties should be encouraged to implement recommended strategies which could result in improved habitat, grazing conditions, and reduced erosion and sediment contribution to surface waters.

7. Numerous buried pipelines traverse the area. Field observations indicated that reclamation of the disturbed areas is frequently incomplete, unsuccessful or apparently non-existent. In addition, vehicular activity appears to have destroyed some reclamation attempts. Investigation of site-specific reclamation responsibility and obligations could lead to completed improvements.

8. Landowners or managers seeking to participate in the SWPP should consult and coordinate with the SWCCD, which is the eligible sponsor of SWPP applications and project agreements. Guidance and design from NRCS can help offset potential costs to the applicant.

9. The SWCCD is in the process of initiating a watershed management plan in conjunction with the TMDL efforts associated with Bitter Creek and Killpecker Creek. Implementation of BMPs associated with the plan when completed, could potentially be funded through the various mechanisms discussed in this report. In an effort to reduce confusion among landowners and stakeholders, we recommend the SWCCD refer to the TMDL effort's plan as the "Water Quality Management Plan" in an effort to differentiate it from this project.

10. The Bitter Creek / East Flaming Gorge 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 SWCCDs activities.

11. 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 benefits.

12. 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.

13. Every effort was made to provide information within this document to support the application for SWPP funding from the WWDC with SWCCD sponsorship. Project narratives, conceptual designs, cost estimates, and discussion of project benefits can all be incorporated directly into the SWPP application by the SWCCD.

14. 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 to apply 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.

15. The Bitter Creek / East Flaming Gorge Watershed Management plan was completed based primarily upon input obtained from the SWCCD and participating agencies, landowners, and stakeholders.

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APPENDIX 2A

DRAFT RESULTS PRESENTATION

LEVEL 1 WATERSHED STUDY PRESENTATION

A Level 1 Watershed Study results presentation on the Bitter Creek/East Flaming Gorge Watershed will be held on Tuesday October 2nd at 4:00 pm at the ***Sweetwater County Conservation District Office (SWCCD)*** 79 Winston Drive, Suite 103.

The study area covers 2,800 sq. miles of Bitter Creek, Killpecker Creek, Red Creek and tributary watershed to the east of Flaming Gorge Reservoir. The purpose of the study is to substantiate a watershed management plan that is technically sound, practical in nature, economically sound and cooperative with landowners.

WYOMING CONSERVATION DISTRICT LAW

It is hereby declared to be the policy of the legislature to provide for the conservation of the soil, and soil and water resources of this state, and for the control and prevention of soil erosion and for flood prevention or the conservation, development, utilization, and disposal of water, ***and thereby to stabilize ranching and farming operations,*** to preserve natural resources, ***protect the tax base,*** control floods, prevent impairment of dams and reservoirs, preserve wildlife, protect public lands, and protect and promote the health, safety and general welfare of the people of this state. Wyo. Stat. 11-16-103(b)

For more information you can contact SWCCD office 307-362-5257 or feel free to call Jay Schug, Project Manager with Anderson Consulting. Office number is 970-226-0120

Rocket Miner
9.25.18

MEETING SIGN-IN SHEET

Meeting: Level 1 Watershed Study Results **Meeting Date:** 10/2/2018

Facilitator: Mary Thoman **Place/Room:** SWCCD Office

Name	Phone	E-Mail
Karen Pechoney	362-5257	admin@swcd.us
Jenilynn Zanetti	362-5469	kzanetti@sweetwaterbsa.com
JAY SCHUG	970.226.0120	jay.schug@acewater.com
Ron Vane	307-640-5813	leronvane@gmail.com
Peter Gill	307-777-7626	peter.gill@wyo.gov
KEN REED	307-389-1459	WEREEDKR@GMAIL.COM
Michele [illegible]	307-870-5697	wyobluegal@wildblue.net
CRAIG THOMPSON	307 389 2715	cthompson@westernwyoming.edu
ISAAC SOTO	307 362 6508	[illegible]2@hotmail.com
Dennis Doncaster	307 352 0207	ddoncaster@blm.gov
Randy "Doc" Wendling	307 212 2936	wendlingr@sweet.wy.us
Mary Thoman	307 362-5252	marythoman@[illegible]
Tom Burris	307 362 3251	

SWEETWATER COUNTY CONSERVATION DISTRICT (SWCCD)
Level 1 Study Results Presentation
79 Winston Dr. Suite 103, Rock Springs, WY 82901

Level 1 Public Meeting – Tuesday, October 2, 2018 4:00 p.m.

Work Session

Attendees:

Mary Thoman, Tom Burris, Karen Pecheny, Jay Schug, Ron Vore, Peter Gil, Dennis Doncaster, Michele Irwin, Randy Wendling, Kenneth Reed, Kenilynn Zanetti, Craig Thompson, Isaac Soto

Level One Watershed Study Results

Jay Schug, Anderson Consulting, gave an update on the study area which including all of the area between East Flaming Gorge and Bitter Creek.

Project funded: Study funded by the Wyoming Water Development Commission.

Project Sponsor: Sweetwater County Conservation District

Project Study Area

STUDY AREA CHARACTERISTICS

- Size: ~2,853 square miles total
- Land Ownership: Checkerboard

~40% Private / 60% Federal & State

Numerous existing studies:

- Rainfall: 7 to 9 inches in most of the area

Data Collection Digital Library include:

Scanned documents referenced in the report.

- Reports prepared by:
- USGS,
- WWDO,
- NRCS/SCS,
- WYSEO,
- SWCCD,
- BLM,
- USFS,
- Engineering/Environmental Consultants,
- Etc.

Approximately 300 documents have been added

Purpose:

- To complete a comprehensive evaluation of the watershed,
- Develop a watershed management plan addressing issues identified

26 Projects that were identified

A. Spring Developments
B. Stock Reservoir Rehabilitation
C. Well Rehabilitation
D. Well Construction
E. Well Re-Permitting
F. Stock Reservoir Re-Permitting

Plan Development

Coordinate with the Conservation District for sponsorship

Coordinate with the BLM

For these projects to go forward:

- Coordination with SWCCD for sponsorship
- Coordination with NRCS / Engineer for technical assistance
- Coordination with BLM / Forest Service
- Potential Funding Opportunities
    - WWDC Small Watershed Project Program (SWPP)
    - WDEQ Nonpoint Source Program
    - (CWA 319)
    - NRCS EQIP

Plan Development

- Channel Stability and Rehabilitation
- Components.

7 specific project recommendation

A. Pierotto Ditch Diversion Post-Construction Monitoring
B. Big Pond Stabilization Investigation
C. Wildlife Enclosures / Fish Barriers
D. Green River Streambank Stabilization
E. Killpecker Creek Stabilization Plan Development

Big Pond Project

Plan Development

Channel Stability and Rehabilitation Components

- Channel Bed / Bank Protection
    - Structural Bank Protection
    - Bioengineered Protection
    - Integration of both structural / bioengineered
    - Land Management
- Identify / develop alternatives that enhance/maintain aquatic habitat

Plan Development

Irrigation Rehabilitation Components

- Irrigated lands extremely limited
- 1 irrigation rehabilitation project identified
- Projects identified in the future still will be eligible for funding through State programs

Plan Development

Storage Opportunity Components

- No medium / large reservoir opportunities identified
- Limited physical availability

Also Included:

- Watershed Description
- Individual Project Descriptions
- Conceptual Designs
- Conceptual Cost Estimates
- Permitting Guidance
- Project Prioritization
- Funding Sources

RECOMMENDATIONS

The majority of projects identified in the plan stem from landowner/stakeholder input, needs and recommendations. Completion is voluntary.

Existing investigations such as the Bitter Creek / Killpecker Creek TMDL and the Bitter Creek Reconstruction Plan should continue to progress. Recommendations from these projects can be incorporated into the planning process. This investigation is not intended to replace those efforts but to augment them.

Continued coordination with the RSGA is highly encouraged. The RSGA controls the majority of grazed lands. Consequently, RSGA participation is integral to watershed management objectives. *To include coordination with private landowners, state land lessees permittees and other local governments and coordination with cities and towns within the watershed.*

Wildhorse management and upland water source development can have conflicting consequences. Project developments should carefully be screened and coordination with WGF is encouraged.

Community sponsored stream channel / habitat improvement projects can provide multiple benefits.

Extensive road development, both planned and through uncontrolled use, has resulted in a dense network. Through coordination with the SWCCD and local entities (RSGA, BLM, County Engineering, etc.) selected un-necessary roads could be closed and either reclaimed/revegetated or allowed to recover on their own.

Buried pipelines / transmission lines should be evaluated for their reclamation success.

The SWCCD has established a valuable network of agency professionals (BLM, WGF, RSGA, etc.) with intimate knowledge of the area. Continued coordination through watershed group meetings is highly encouraged and continued participation of these staff and the public solicited.

Study projects could be eligible for funding available to stakeholders / SWCCD from the WWDC's SWPP and various other sources.

The SWPP can provide 50% grants up to $35,000 to individuals with the SWCCD as their project sponsor. Landowners/managers seeking to install water projects should consult and coordinate with the SWCCD.

Every effort was made to provide information within this document to support the application for SWPP funding from the WWDC with SWCCD sponsorship. Project narratives, conceptual designs, cost estimates, and discussion of project benefits can all be incorporated directly into the SWPP

Peter Gill, Wyoming Water Development Office - Send comments by the October 22 deadline to Peter Gill

Small Water Project Program (SWPP) deadline is December 30.

Two changes to the SWPP 50% up to 35k cost share

No longer need to be in the boundary, and no longer is a total cost CAP

Draft Report out August 17, 2018

Final draft completed - 11.16 2018

Applications are due by January 1, 2019

Projects on the ground in 2019 through the Small Water Project Program.

/submitted by Karen Pecheny/

Bitter Creek / East Flaming Gorge Watershed Study Level I

Results Presentation

October 2, 2018

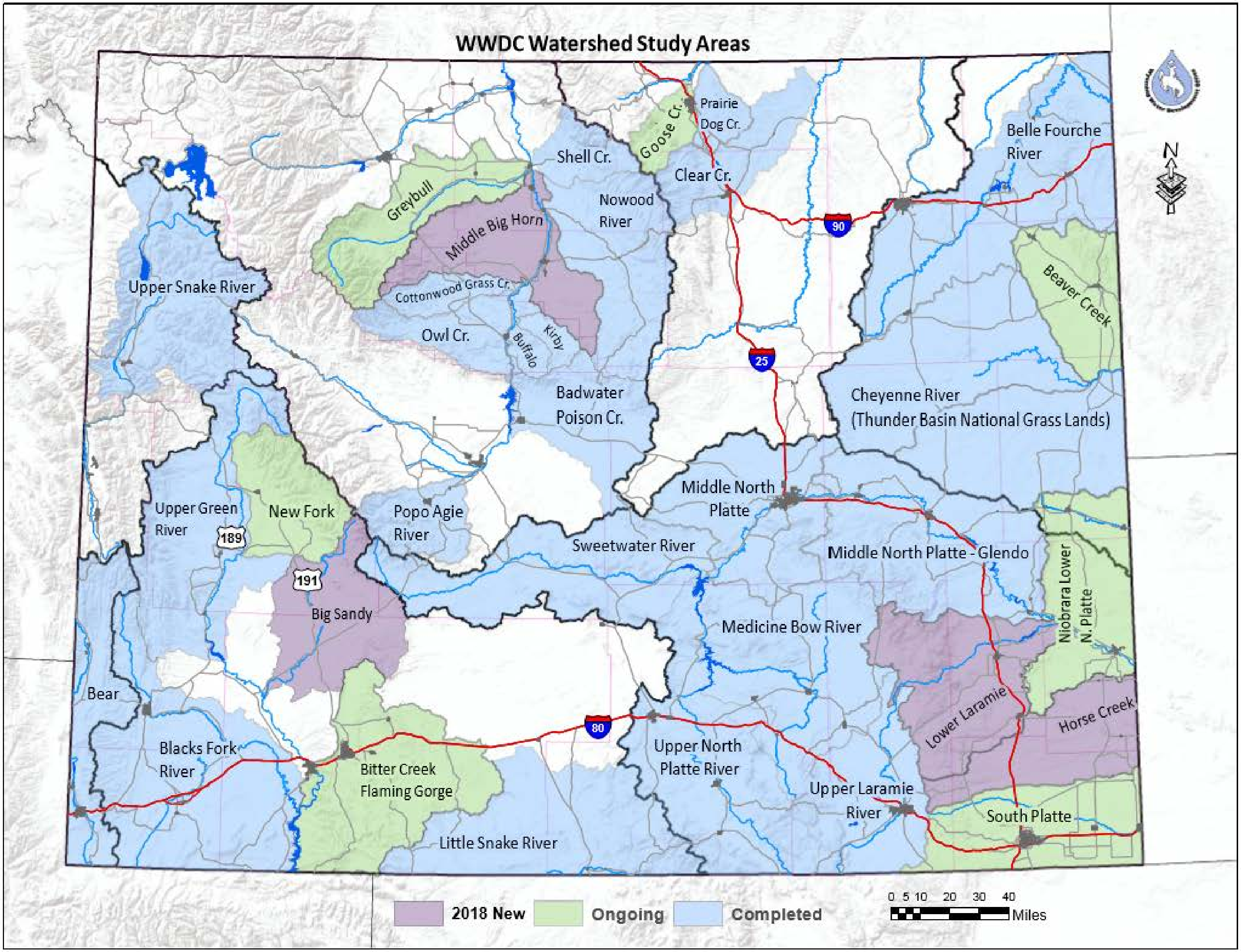
Anderson Consulting Engineers, Inc.

Project Funding:

- Wyoming Water Development Commission

Project Sponsors:

- Sweetwater County Conservation District

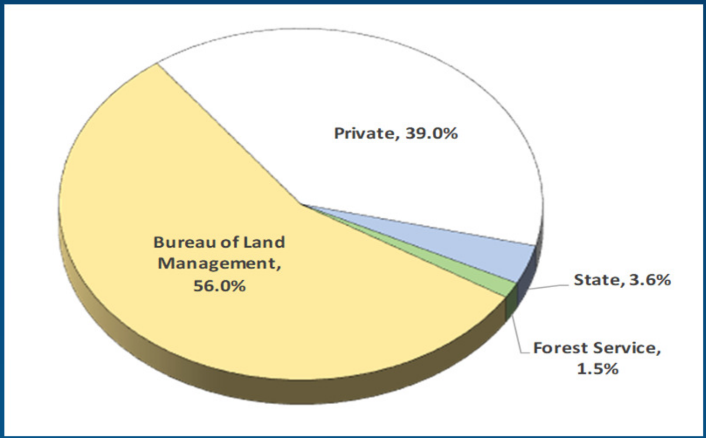


WWDC Watershed Study Areas
Prairie Dog Cr.
Goose Cr.
Belle Fourche River
Shell Cr.
Clear Cr.
Nowood River
Greybull
Middle Big Horn
Upper Snake River
Cottonwood Grass Cr.
Beaver Creek
Owl Cr.
Kirby
Buffalo
Badwater
Poison Cr.
Cheyenne River
(Thunder Basin National Grass Lands)
Middle North Platte
Upper Green River
New Fork
Popo Agie River
Sweetwater River
Middle North Platte - Glendo
Niobrara Lower N. Platte
Big Sandy
Medicine Bow River
Bear
Lower Laramie
Horse Creek
Blacks Fork River
Bitter Creek Flaming Gorge
Upper North Platte River
Upper Laramie River
South Platte
Little Snake River
2018 New
Ongoing
Completed
0 5 10 20 30 40
Miles
90
25
80
189
191

Project Study Area

STUDY AREA CHARACTERISTICS

- Size: ~2,853 square miles total
- Land Ownership: Checkerboard
  ~40% Private / 60% Federal & State
- Numerous Existing studies:
- Rainfall: 7 to 9 inches in most of area



Purpose:

- To complete a comprehensive evaluation of the watershed,
- Develop a watershed management plan addressing issues identified

Watershed Inventory:

- Literature Review
- Field Data Collection
- Public Input
- Resource Issue Identification

Geographic Information System

Watershed Management Plan

- Resource Issue Recommendations
- Irrigation Rehabilitation
- Stream Restoration
- Upland Water Opportunities
- Conceptual Designs
- Cost Estimates
- Permitting Requirements
- Funding Opportunities

Purpose:

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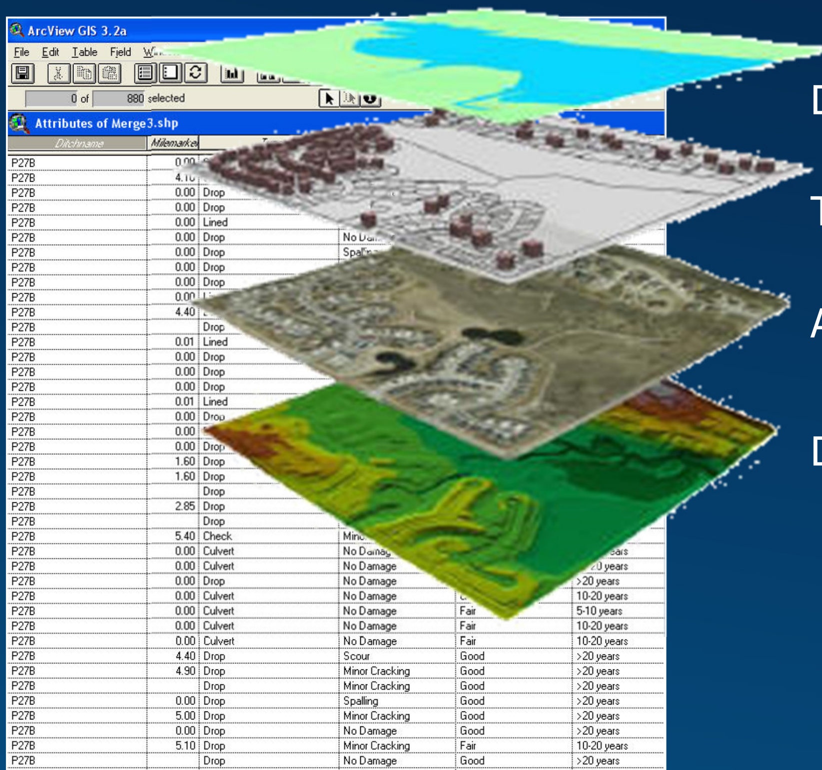
- Conceptual Designs
- Cost Estimates
- Permitting Requirements
- Funding Opportunities

Project Geographic Information System (GIS)



Dataset Themes: Ownership, Hydrography, Soils, etc.

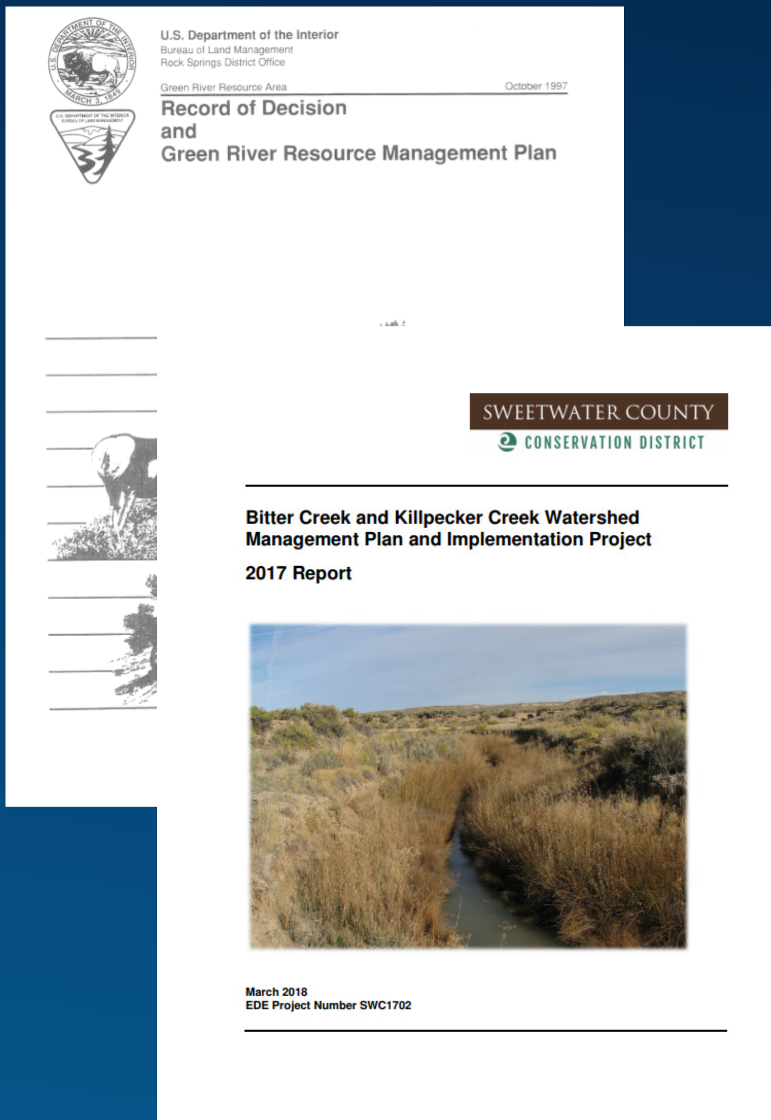
Topographic Mapping

Aerial Photography: true color, infra-red, historic

Digital Elevation Models: Base maps, Data Analysis

Databases and Attribute Tables

Data Collection:
Digital Library



U.S. Department of the Interior
Bureau of Land Management
Rock Springs District Office

Green River Resource Area October 1997

Record of Decision
and
Green River Resource Management Plan

SWEETWATER COUNTY
CONSERVATION DISTRICT

Bitter Creek and Killpecker Creek Watershed Management Plan and Implementation Project

2017 Report

March 2018
EDE Project Number SWC1702

- Scanned documents referenced in the report.
- Reports prepared by:

- USGS,
- WWDO,
- NRCS/SCS,
- WYSEO ,
- SWCCD,
- BLM,
- USFS,
- Engineering/Environmental Consultants,
- Etc.

Approximately 300 documents have been added

JS1

Purpose:

- To complete a comprehensive evaluation of the watershed,
- Develop a watershed management plan addressing issues identified

Watershed Inventory:

- Literature Review
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- Resource Issue Identification

Geographic Information System

<u>Watershed Management Plan</u>

- Resource Issue Recommendations
- Irrigation Rehabilitation
- Stream Restoration
- Upland Water Opportunities
- Conceptual Designs
- Cost Estimates
- Permitting Requirements
- Funding Opportunities

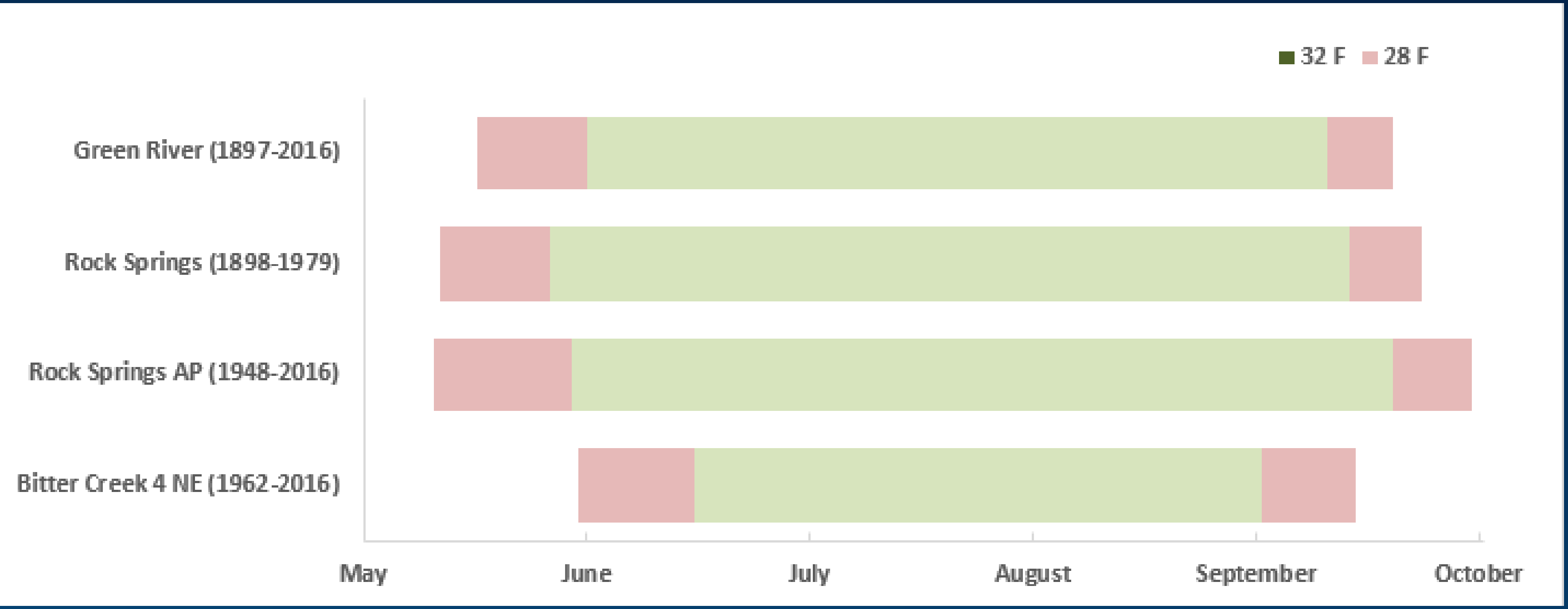
Watershed Inventory and Assessment

- Land Ownership
- Transportation, Energy and Communication Infrastructure
- Irrigation
- Range Conditions/Grazing Practices
- Grazing Allotments Administration
- Existing Water Supply
- Ecological Site Descriptions
- Range Conditions and Needs
- Oil and Gas Production and Resources
- Mining and Mineral Resources
- Fisheries and Wildlife
- Cultural Resources
- Natural Environment
- Climate
- Vegetation and Land Cover
- Overview
- Targeted Vegetation
- Wetlands

Watershed Inventory and Assessment provides an extensive amount of information for future permitting efforts, investigations, etc.

- Geology
- Surficial Units
- Bedrock Units
- Structure
- Geologic Hazards
- Soils
- Watershed Hydrology
- Groundwater
- Springs
- Alluvial Aquifers
- Bedrock Aquifers
- USGS Gaging Stations
- Stream Geomorphology
- Rosgen Classification System
- Ditch Characterization
- Water Quality
- Stream Classifications
- NPDES Permitted Discharges
- Waters Requiring TMDLs
- Water Storage and Retention
- Surface Water Availability and Shortages
- Available Flows Analysis
- Identification of Potential Sites
- Initial Screening of Storage Sites

Watershed Inventory and Assessment



Station	Period of Record	Threshold Temperature	Average Spring Last Freeze Date	Average Fall First Freeze Date	Average "Freeze Free" Period (days)
Bitter Creek 4 NE	1962-2016	28°F	31-May	15-Sep	111
		32°F	16-Jun	2-Sep	84
Rock Springs AP	1948-2016	28°F	11-May	1-Oct	142
		32°F	30-May	20-Sep	112
Rock Springs	1898-1979	28°F	12-May	24-Sep	133
		32°F	27-May	14-Sep	111
Green River	1897-2016	28°F	17-May	20-Sep	126
		32°F	1-Jun	11-Sep	100

Incorporation of existing data

Watershed Inventory and Assessment

		Surface Water Classification												
		1	2AB	2A	2B	2C	2D	3A	3B	3C	3D	4A	4B	4C
Designated Use	Drinking Water	Yes	Yes	Yes	No	No	No	No	No	No	No	No	No	No
	Cold Water game fish	Yes	Yes	No	Yes	No	If Present	No	No	No	No	No	No	No
	Warm Water game fish	Yes	Yes	No	Yes	No	If Present	No	No	No	No	No	No	No
	Nongame Fish	Yes	Yes	No	Yes	Yes	If Present	No	No	No	No	No	No	No
	Fish Consumption	Yes	Yes	No	Yes	Yes	Yes	No	No	No	No	No	No	No
	Aquatic life other than fish	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No
	Recreation	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Wildlife	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Agriculture	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Scenic Value	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Class 2AB
- Lower Sage Creek
- Currant Creek
- Green River
- Deadman Wash* (Below Bridger Plant)

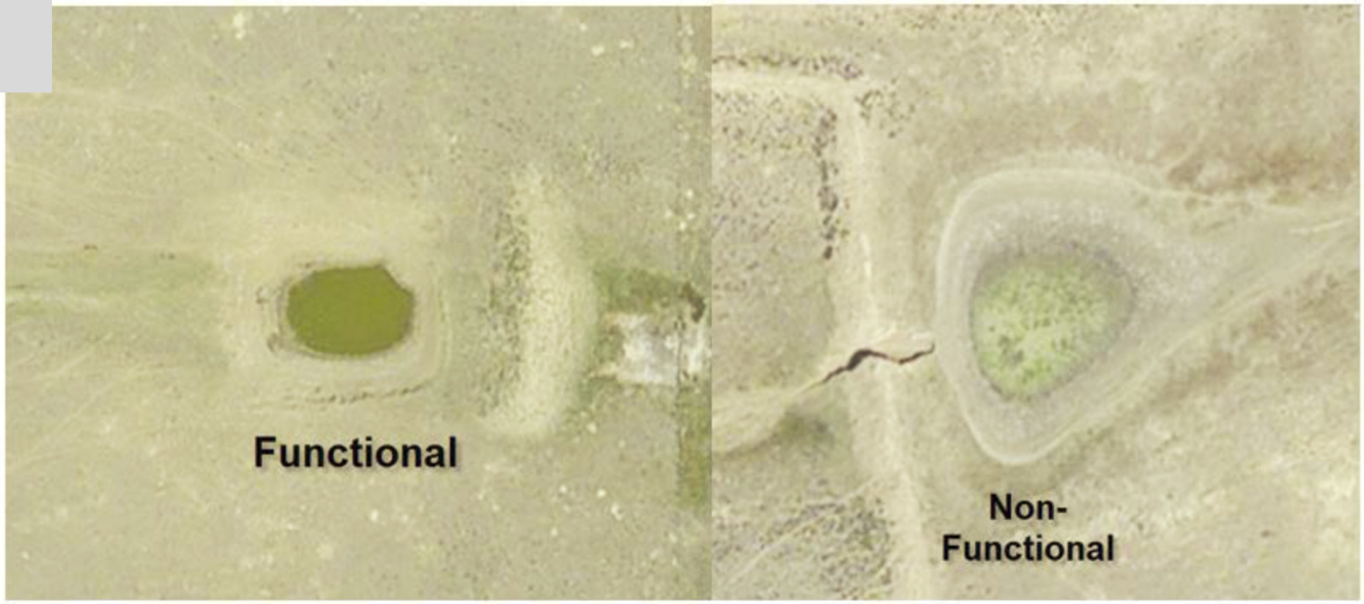
*Class 2ABWW - warm water fishery

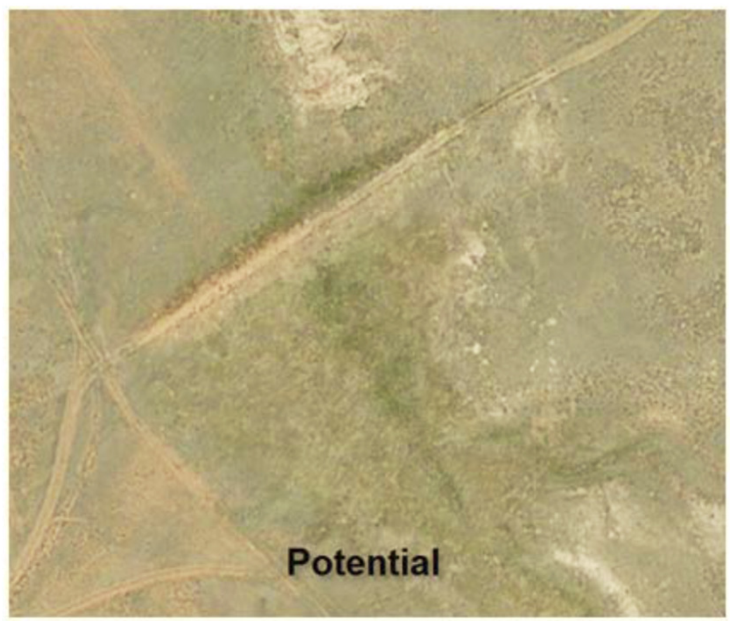
Class 2C
- Bitter Creek
- Little Bitter Creek
- Upper Sage Creek

Class 3B
- Killpecker Creek
- Salt Wells Creek
- Black Butte Creek
- Horsethief Canyon
- Patrick Draw
- Sweetwater Creek
- Nitch Creek
- Joyce Creek
- Sugarloaf Marsh Creek
- Worm Creek
- Pretty Water Creek
- Dans Creek
- Long Canyon Creek
- Brooks Draw
- Alkali Wash
- Deadman Wash (Above Bridger Plant)
- Washam Wash
- Firehole Canyon
- Pine Canyon Creek
- Cedar Canyon Creek
- Ninemile W
- Tenmile D

Incorporation of existing data

Stock Reservoir Assessment



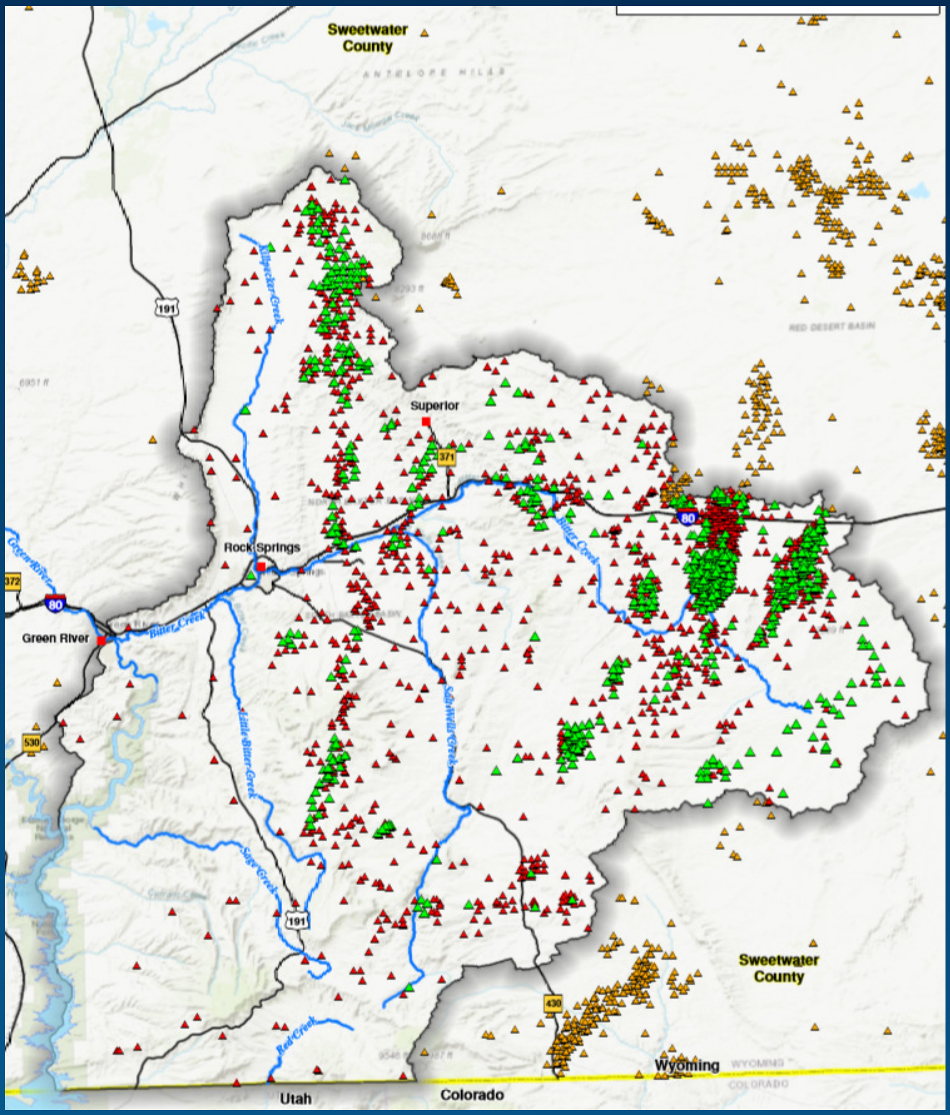


440 evaluated

- 215 functional
- 46 potential
- 179 nonfunctional

Watershed Inventory and Assessment Example

GIS Evaluation of Oil & Gas Well Reclamation

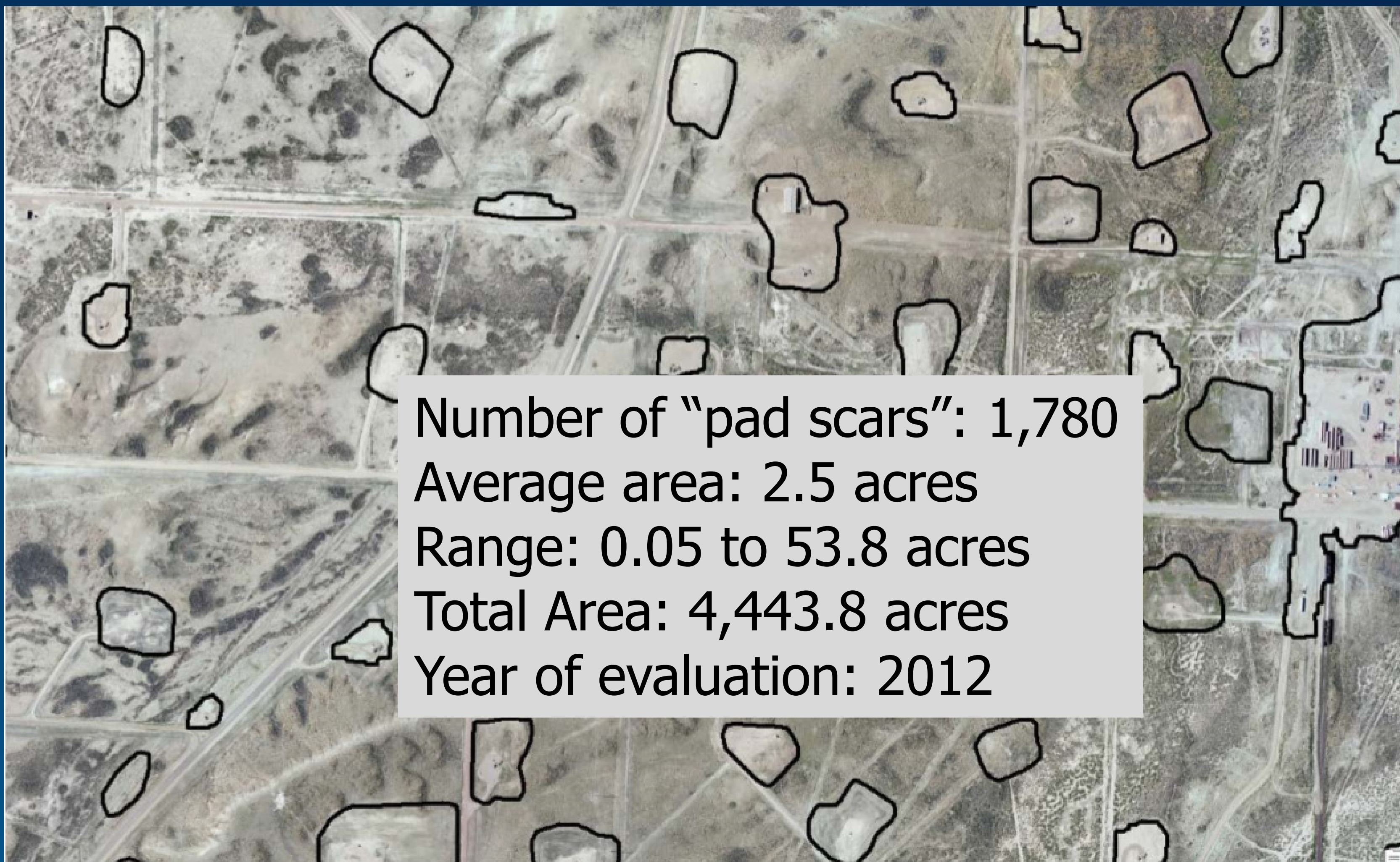


Watershed Inventory and Assessment Example

GIS Evaluation of Oil & Gas Well Reclamation

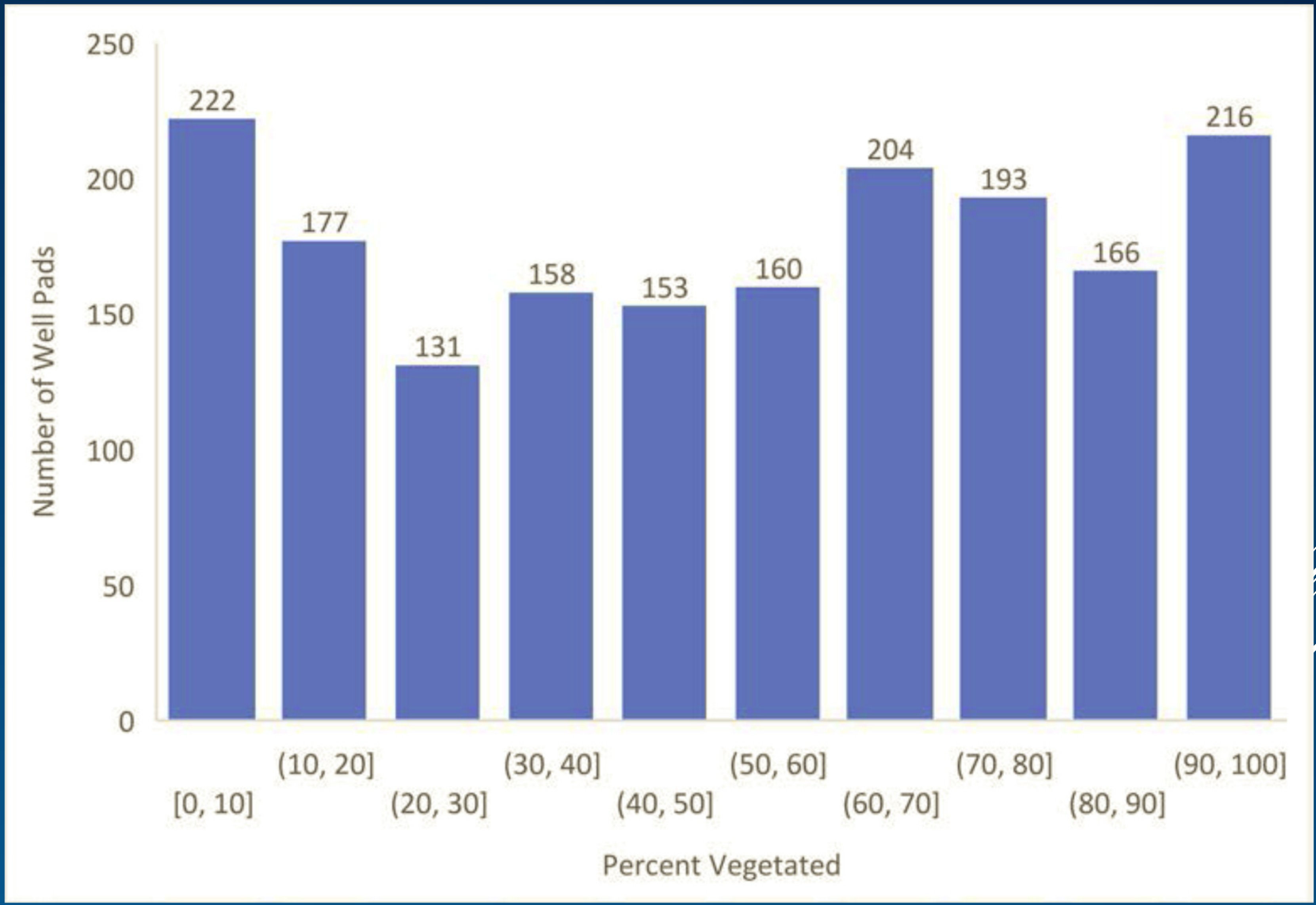
Watershed Inventory and Assessment Example

GIS Evaluation of Oil & Gas Well Reclamation

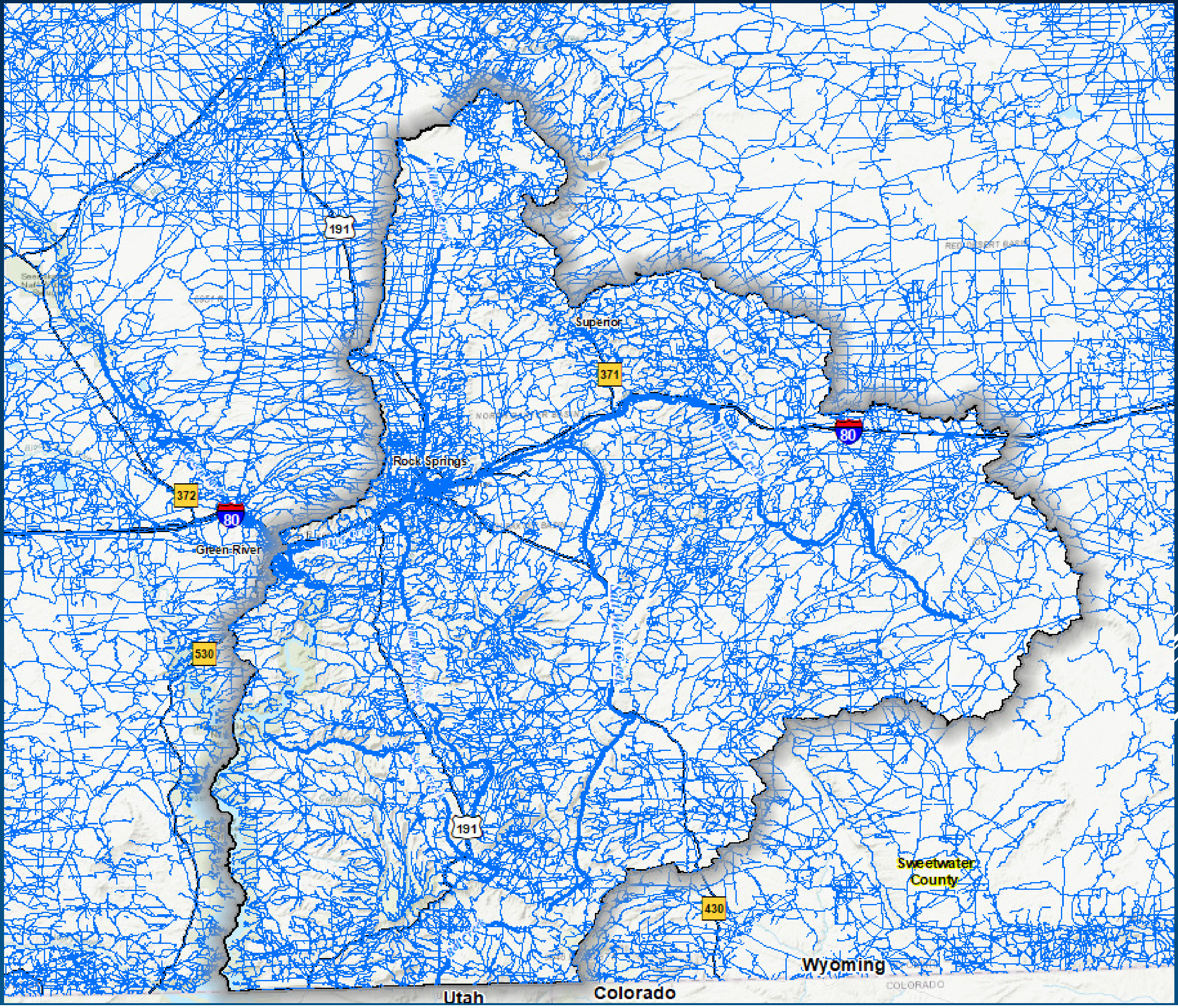


Watershed Inventory and Assessment Example

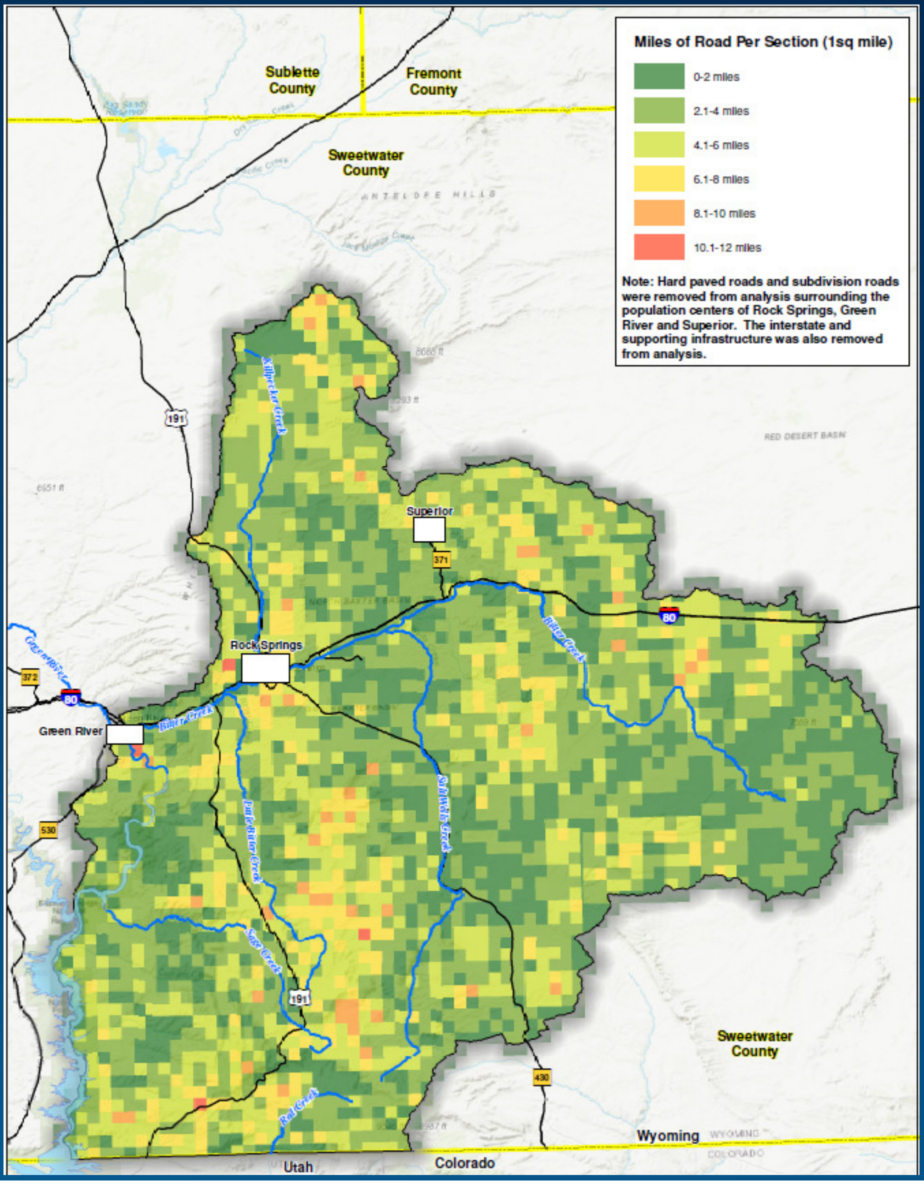
GIS Evaluation of Oil & Gas Well Reclamation



Watershed Inventory and Assessment:
Roads Evaluation



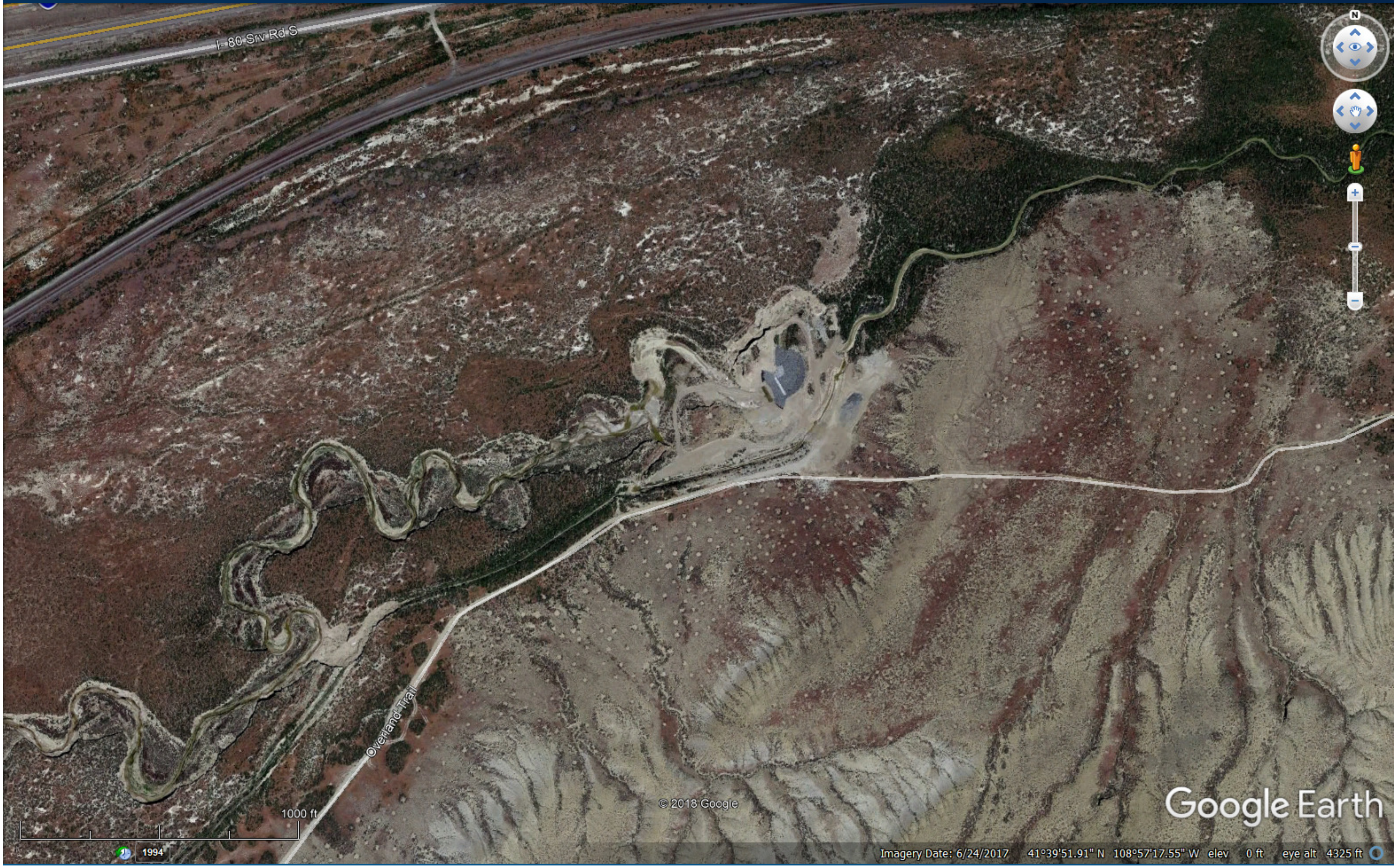
Watershed Inventory and Assessment: Roads Evaluation



Watershed Inventory and Assessment: Roads Evaluation

Watershed Inventory and Assessment: Roads Evaluation

Watershed Inventory and Assessment: Pierotto Ditch Project



Watershed Inventory and Assessment: Pierotto Ditch Project

Watershed Inventory and Assessment: Big Pond

Watershed Inventory and Assessment: Big Pond

Watershed Inventory and Assessment: Big Pond

Watershed Inventory and Assessment: Big Pond

Watershed Inventory and Assessment: Big Pond

Watershed Inventory and Assessment

Impairments:

- Both mainstems / many tributaries are at least partially entrenched
- Active headcutting on tributaries
- Bank erosion common
- Loss of riparian vegetation

Watershed Inventory and Assessment

Purpose:

- To complete a comprehensive evaluation of the watershed,
- Develop a watershed management plan addressing issues identified

Geographic Information System

Watershed Inventory:

- Literature Review
- Field Data Collection
- Public Input
- Resource Issue Identification

Watershed Management Plan

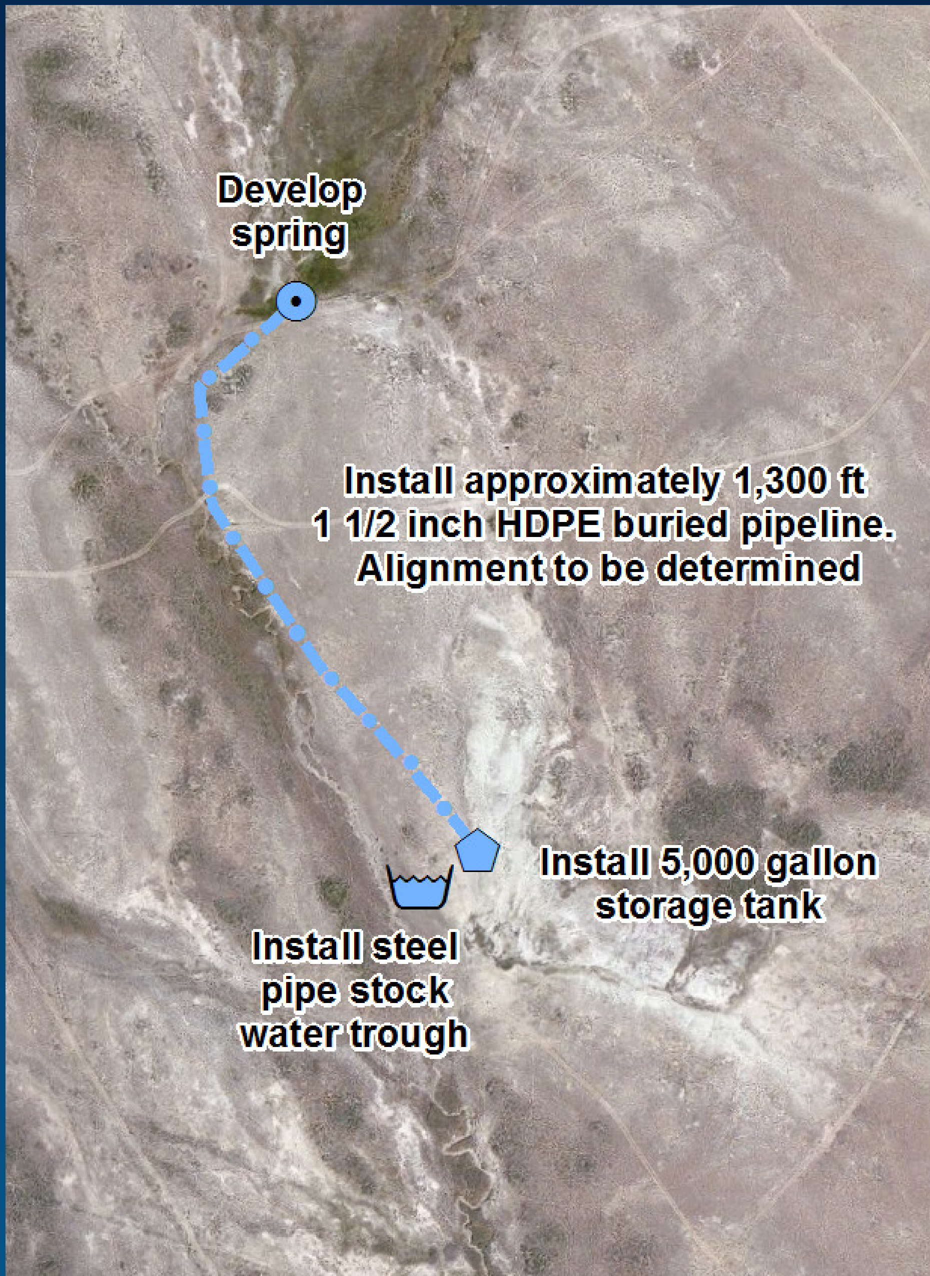
- Irrigation Rehabilitation
- Stream Restoration
- Upland Water Opportunities
- Conceptual Designs
- Cost Estimates
- Permitting Requirements
- Funding Opportunities

Plan Development

A. Upland Livestock / Wildlife
B. Channel Stability & Rehabilitation Alternatives
C. Irrigation Rehabilitation Requirements
D. Water Storage Components
E. Environmental Enhancements

26 Projects

A. Spring Developments
B. Stock Reservoir Rehabilitation
C. Well Rehabilitation
D. Well Construction
E. Well Re-Permitting
F. Stock Reservoir Re-Permitting



Project Phase		Phase I
		Watershed Component
		L/W-015
Description:		Spring Development / Pipeline / Storage and Stock Tank Construction
Project Name:		Oyster Ridge Pipeline Project
Water Source:		Existing Spring
Mobilization		$3,000
	Source:	Existing Spring
Well Construction / Spring Development	Units (each)	1
	Depth Each	NA
	Unit Cost ($/LF wells or $/EA springs	$3,600
	Well Screen (LF each well)	NA
	Well Screen ($/LF)	NA
	Component Subtotal	$3,600
Pipeline	**Low Pressure 1 1/2 in Pipe Diameter:**	1.5
	Units (LF)	1,300
	Unit Cost (EA)	$3.34
	Component Subtotal	$4,342
Additional Storage Tanks	Units (EA)	1
	Size (gal)	5000
	Unit Cost ($/gal)	$1
	Component Subtotal	$5,000
Livestock / Wildlife Water Tanks	Units (EA)	1
	Size (gal)	1,200
	Unit Cost	$3,000
	Component	$3,000
Miscellaneous	Item	Fencing
	Units (Each)	850
	Unit Cost ($/ea)	$5.00
	Component Subtotal	$4,250.00
Construction Subtotal		$23,192
Engineering (10%)		$2,319
Constuction and Engineering Subtotal		$25,511
Contingency (15%)		$3,827
Total Construction Cost		$29,338
Final Plans and Specs		$1,500
Additional		$0
Permitting / Legal Fees / Access and Rights of Way		$1,000
Total Project Cost		**$31,838**

Plan Development

Upland Livestock/Wildlife Watering Alternatives

For these projects to go forward:

- Coordination with SWCCD for sponsorship
- Coordination with NRCS / Engineer for technical assistance
- Coordination with BLM / Forest Service
- Potential Funding Opportunities
  - WWDC Small Watershed Project Program (SWPP)
  - WDEQ Nonpoint Source Program
  - (CWA 319)
  - NRCS EQIP

Plan Development

Channel Stability and Rehabilitation Components

7 Specific project recommendation

A. Pierotto Ditch Diversion Post-Construction Monitoring
B. Big Pond Stabilization Investigation
C. Wildlife Exclosures / Fish Barriers
D. Green River Streambank Stabilization
E. Killpecker Creek Stabilization Plan Development



Plan Development

Channel Stability and Rehabilitation Components

Plan Development

Channel Stability and Rehabilitation Components

- Channel Bed / Bank Protection
  - Structural Bank Protection
  - Bioengineered Protection
  - Integration of both structural / bioengineered
  - Land Management

Diversion Structure Alternatives

- Identify / develop alternatives that enhance/maintain aquatic habitat

Channel Gradient Restoration Alternatives

Plan Development

Irrigation Rehabilitation Components

- Irrigated lands extremely limited
- 1 irrigation rehabilitation project identified
- Projects identified in the future still will be eligible for funding through State programs

Plan Development

Storage Opportunity Components

- No medium / large reservoir opportunities identified
- Limited physical availability

Plan Development

Environmental Enhancements

- Potential for wetland establishment/enhancement

Plan Development

Environmental Enhancements

Also Included:

- Watershed Description
- Individual Project Descriptions
- Conceptual Designs
- Conceptual Cost Estimates
- Permitting Guidance
- Project Prioritization
- Funding Sources

RECOMMENDATIONS

- The majority of projects identified in the plan stem from landowner/stakeholder input, needs and recommendations. Completion is voluntary.
- Existing investigations such as the Bitter Creek / Killpecker Creek TMDL and the Bitter Creek Reconstruction Plan should continue to progress. Recommendations from these projects can be incorporated into the planning process. This investigation is not intended to replace those efforts but to augment them.
- Continued coordination with the RSGA is highly encouraged. The RSGA controls the majority of grazed lands. Consequently, RSGA participation is integral to watershed management objectives.
- Wildhorse management and upland water source development can have conflicting consequences. Project developments should carefully be screened and coordination with WGF is encouraged.

RECOMMENDATIONS

- Community sponsored stream channel / habitat improvement projects can provide multiple benefits.
- Extensive road development, both planned and through uncontrolled use, has resulted in a dense network. Through coordination with the SWCCD and local entities (RSGA, BLM, County Engineering, etc) selected un-necessary roads could be closed and either reclaimed/revegetated or allowed to recover on their own.
- Buried pipelines / transmission lines should be evaluated for their reclamation success.
- The SWCCD has established a valuable network of agency professionals (BLM, WGF, RSGA, etc.) with intimate knowledge of the area. Continued coordination through watershed group meetings is highly encouraged and continued participation of these staff and the public solicited

RECOMMENDATIONS

- Study projects could be eligible for funding available to stakeholders / SWCCD from the WWDC's SWPP and various other sources.

- The SWPP can provide 50% grants up to $35,000 to individuals with the SWCCD as their project sponsor. Landowners/managers seeking to install water projects should consult and coordinate with the SWCCD.

- Every effort was made to provide information within this document to support the application for SWPP funding from the WWDC with SWCCD sponsorship. Project narratives, conceptual designs, cost estimates, and discussion of project benefits can all be incorporated directly into the SWPP

that could potentially result in achievement of multiple benefits.

APPENDIX 3A

DIGITAL LIBRARY CONTENTS

Title	Description	Link	Document Date	Source	Type	Keywords	Author
2015 Bitter Creek and Killpecker Creek Watershed Project Summary Report	Provides an update of chloride and bacteria monitoring and other project work conducted during 2015 for the Bitter Creek and Killpecker Creek Watershed Management Plan and Implementation Project, for the Sweetwater County Conservation District (SWCCD)	Conservation Districts\Document\2015 BKW Project Report.pdf	3/18/16	Conservation Districts	Document	water quality, choride, bacteria	EDE Consultants
2015 Western Invasive Weed Summit Summary and Next Steps	Describes the importance of a durable campaign to arrest the spread of invasive annual plants in the sagebrush ecosystem and secure the ecological, economic and social values of this landscape for generations to come.	Western Association of Fish and Wildlife Agencies\Document\WIWS Summit Summary 11.17.15 FINAL V3.pdf	11/17/15	Western Association of Fish and Wildlife Agencies	Document	invasive species, weeds	WAFSA
2017 Species of Greatest Conservation Need	List of Wyoming 2017 SGCN species and their classifications.	Wy Game and Fish\Document\Wyoming-SGCN.pdf	1/1/16	Wy Game and Fish	Document	SGCN	Wy Game and Fish
A Citizen's Guide to the NEPA	Guidelines for the layman to the NEPA (National Environmental Policy Act) and how to effectively participate in Federal agencies' environmental review process.	Other\Document\Citizens_Guide_Dec07.pdf	12/1/07	Other	Document	NEPA	Council on Environmental Quality
A Geomorphological Approach to Restoration of Incised Rivers	Rosgen's discussion of use of a 'reference reach' in design of restorative measures for incised channels	Other\Document\A_Geomorphological_Approach_to_Restoration_of_Incised_Rivers.pdf	1/1/97	Other	Document	geomorphology, Rosgen, reference reach	Rosgen, D.L.
A Landscape-base Protocol to Identify Management Opportunities for Aquatic Habitats and Native Fishes on Public Lands, Phase I: Green River Basin, Wyoming	Evaluation of Trout Unlimited's Conservation Success Index (CSI) for its potential as a framework for informing BLM regional assessments and developing landscape-scale aquatic conservation strategies.	Trout Unlimited\Document\Landscape-base Protocol to Identify Management Opportunities for Aquatic Habitats.pdf	7/15/09	Trout Unlimited	Document	Trout Unlimited, Aquatic Habitats, conservation	Trout Unlimited
A Stream Channel Stablility Assessment Methodology	The stability assessment is conducted on reference reach (stable) reaches and a departure analysis is performed when compared to an unstable reach of the same stream type.	Other\Document\ROSGEN_CHANNEL_STABILITY_.pdf	1/1/01	Other	Document	stream stability	Rosgen, David L
A User Guide to Assessing Proper Functioning Condition and the Supporting Science for Lentic Areas	Provides guidance for assessing the condition of any riparian-wetland area other than a lotic (riverine) area.	NRCS\Document\PFC Lentic Areas Guide Final TR 1737-16 Revision_NRCS.pdf	1/1/03	NRCS	Document	PFC, Lentic, Wetland	NRCS
Addendum - Sweetwater County Conservation District Land and Resource Use Plan and Policy (2005)	Addendum of statutory and regulatory materials	Conservation Districts\Document\Sweetwater CD 2005 Land-Resource Plan_addendum.pdf	1/1/05	Conservation Districts	Document	SWCCD, resource plan and policy, addendum	Sweetwater County Conservation District
Agricultural Salinity and Drainage	Prepared by the University of California Irrigation Program to provide technical and practical information on salinity to the layperson	USDA\Document\HansonGrattan2006_0.pdf	1/1/06	USDA	Document	Agriculutral Salinity, Drainage,	Hanson, Blaine R. et al
An Approach for Assessing Wetland Functions Using Hydrogeomorphic Classification, Reference Wetlands, and Functional Indices	Wetlands research program technical report that outlines an approach for assessing wetland functions in the 404 Regulatory Program as well as other regulatory, planning, and management situations.	USACE\Document\USACE Wetland Assessment Approach wrpde9.pdf	10/1/95	USACE	Document	wetlands, army corps of engineers	USACE
Analysis of Greater Sage-grouse Lek Data: Trends in Peak Male Counts	Provides an independent analysis of the peak male lek attendance data collected across the range of sage-grouse, conducts a comparative review of previous analyses conducted, and recommendations for future data collection.	Western Association of Fish and Wildlife Agencies\Document\GRSG Report for WAFWA.pdf	9/30/15	Western Association of Fish and Wildlife Agencies	Document	sage-grouse, population trends, wildlife	WAFWA
Annual Report 2017	Summary of accomplishments in enhancing aquatic and terrestrial habitats based on the landscape priorities established in the WLCI Conservation Action Plan.	Other\Document\2017_WLCI_Annual_Report.pdf	1/1/17	Other	Document	WLCI, riparian habitat	Wyoming Landscape Conservation Initiative (WLCI)
Appendix A - Written Comments Summary (Rock Springs Resource Management Plan Final Scoping Report)	Written and oral comments received during the public scoping meeting as well as hard copy letters and emails.	BLM\Document\RS-RMP_Final-Scoping-Report_Appendix_A_CommentsSummary.pdf	3/1/18	BLM	Document	Public comments, NEPA, RMP	BLM
Application for Permit of Appropriate Surface Water (Currant Creek Instream Flow Segment No 1)	Water right permit issued by the Office of State Engineer for instream flows on Currant Creek. Priority Date: 6/8/2000, Approval Date: 1/9/2005	WWDC\Document\080-Current_Creek-PERMIT.pdf	1/9/05	WWDC	Document	instream flows, water rights	State of Wyoming
Application for Permit of Appropriate Surface Water (Red Creek Instream Flow Segment No 1)	Water right permit issued by the Office of State Engineer for instream flows on Red Creek. Priority Date: 12/6/1999, Approval Date: 1/9/2005	WWDC\Document\077-Red_Creek-PERMIT.pdf	1/9/05	WWDC	Document	instream flows, water rights	State of Wyoming
Application for Permit of Appropriate Surface Water (Trout Creek Instream Flow Segment No 1)	Water right permit issued by the Office of State Engineer for instream flows on Trout Creek. Priority Date: 12/6/1999, Approval Date: 1/9/2005	WWDC\Document\078-Trout_Creek-PERMIT.pdf	1/9/05	WWDC	Document	instream flows, water rights	State of Wyoming
Application for the Small Water Project Program	Application form for the SWPP which includes project description, public benefit, project participants, project readiness, and other general information	WWDC\Document\smallwaterprojectapp2015.docx	Unknown	WWDC	Document	SWPP, funding, application	WWDC
Arroyos and the Semiarid Cycle of Erosion	A description of discontinuous gullies and arroyos including their origin, and the cycle of semiarid erosion.	Other\Document\schumm and hadley 161.full.pdf	3/1/57	Other	Document	erosion, discontinuous gullies, arroyo cutting	Schumm, S. A. and Hadley, R. F. (American Journal of Science)
Assessing Channel Change and Bank Stability Downstream of a Dam, Wyoming	Evaluation of effects of a reservoir on the creek downstream.	Other\Document\Gilliam Assessing Channel Change and Bank Stability Downstream of a Dam Phd_UW.pdf	2011	Other	Document	Bank stability, channel change, dam	Gilliam, Elizabeth A.
Auxiliary Spillway Cross Section & Profile (378-08b)	NRCS Design Drawing for Wetland Standard Auxiliary spillway profile cross section and profile	NRCS\Document\NRCS Design Wetland Standard_Auxiliary spillway profile and cross section.pdf	5/1/18	NRCS	Document	auxiliary spillway, design drawing, wetland	NRCS
Auxiliary Spillway Cross Section & Profile Example (378-08b)	Example of completed "Auxiliary Spillway Cross Section & Profile" NRCS Wetland Standard Design Drawing	NRCS\Document\NRCS Design Wetland Standard_Auxiliary spillway profile and cross section example.pdf	5/1/18	NRCS	Document	auxiliary spillway, wetland, design drawing example	NRCS
Basic Seismological Characterization for Sweetwater County	Historic seismicity, Uniform Building Code, deterministic analyses of nearby active faults, an analysis of the maximum credible "floating earthquake", and current short- and long-term probabilistic seismic hazard analyses.	Wy State Geological Survey\Document\Basic Seismological Characterization for Sweetwater County.pdf	9/1/02	Wy State Geological Survey	Document	seismicity, earthquake, fault	Case, James C. et al
Beginner's Guide to Greater Sage-grouse	Provides key points about seasonal habitats, natural history and population trend analyses for the greater sage-grouse.	Western Association of Fish and Wildlife Agencies\Document\Primer 1 - SGBeginners guide.pdf	Unknown	Western Association of Fish and Wildlife Agencies	Document	sage-grouse, wildlife	WAFSA

Title	Description	Link	Document Date	Source	Type	Keywords	Author
Big Sandy/Salt Wells Oil and Gas Environmental Assesssment (Volume 1 - Draft)	Environmental assessment that analyzes impacts of oil and gas development, reviews existing practices, and develops additional measures to mitigate those impacts.	BLM\Document\bigsandysaltwell_EA_1981.pdf	12/15/81	BLM	Document	environmental assessment, oil and gas, salt wells	BLM
Big Sandy/Salt Wells Oil and Gas Environmental Assesssment (Volume 2 - Final)	Environmental assessment that analyzes impacts of oil and gas development, reviews existing practices, and develops additional measures to mitigate those impacts. Record of Decision also included.	BLM\Document\bigsandysaltwell_EA_1982.pdf	6/25/82	BLM	Document	environmental assessment, oil and gas, salt wells	BLM
Bitter and Killpecker Creeks Watershed Management Plan	A comprehensive natural resource management plan designed to improve water quality within the Bitter and Killpecker Creeks Watershed.	Conservation Districts\Document\BKWatershedPlanFINALDRAFT.pdf	6/1/06	Conservation Districts	Document	water quality, fecal coliform bacteria, chloride	Bitter/Killpecker Watershed Advisory Group and the Sweetwater County Conservation District
Bitter Creek and Killpecker Creek 2012 Bacteria and Chloride Spring Sampling Results Summary Report	Sampling in the Bitter Creek watershed for E. coli bacteria and chloride was conducted in the spring of 2012 by EDE Consultants so that the WDEQ could calculate Total Maximum Daily Loads (TMDLs) for both E. coli bacteria and chloride for the impaired reaches of Bitter and Killpecker Creeks	Conservation Districts\Document\2012_SWCCD_Spring_Sampling.pdf	8/24/12	Conservation Districts	Document	water quality, E. coli, choride	Environmental Design Engineering Consultants
Bitter Creek Channel Improvement Study (Level II)	Presents a combination of different design alternatives for flood control and channel improvements for the City of Rock Springs.	WWDC\Document\Bitter_Creek-Channel_Improvement_Level_II-Final_Report-1991.pdf	9/30/91	WWDC	Document	flood control, channel improvements, Rock Springs	Johnson Fermelia Co. Inc.
Bitter Creek Channel Improvement Study (Level II) Executive Summary	Executive summary for the Bitter Creek Channel Improvement Study which presents a combination of different design alternatives for flood control and channel improvements for the City of Rock Springs.	WWDC\Document\Bitter_Creek-Channel_Improvement-Executive_Summary-1991.pdf	9/30/91	WWDC	Document	flood control, channel improvements, Rock Springs	Johnson Fermelia Co. Inc.
Bitter Creek Reconstruction Plan & Design	A master plan for the reclamation and development of the Bitter Creek Drainage through Downtown Rock Springs, WY	Other\Document\BitterCreek_ReconPlanDesign_2007.pdf	12/14/07	Other	Document	flooding, Rock Springs, urban design	Landmark Design, Inc. and Hansen Allen & Luce, Inc.
Bitter Creek Tributary Flood Study (Level II - Feasibility Study, Phase II Report)	Includes additional mapping, dambreak analysis, permitting in land aquisition/easements, economic analysis, assessment of federal involvment, and refinement if hydrology and flood boundaries for selected flood control alternatives on the Bitter Creek Tributaries.	WWDC\Document\Bitter_Creek-Tributary_Flood_Feasibility_Level_II_Phase_II-Final_Report-1991.pdf	11/1/91	WWDC	Document	flood control, Rock Springs, feasibility	Johnson Fermelia Co. Inc.
Bitter Creek Tributary Flood Study (Level II - Feasibility Study, Phase II Report) - Executive Summary	Executive summary for Bitter Creek Tributary Level II, Phase II, Flood Study which includes additional mapping, dambreak analysis, permitting in land aquisition/easements, economic analysis, assessment of federal involvment, and refinement if hydrology and flood boundaries for selected flood control alternatives on the Bitter Creek Tributaries.	WWDC\Document\Bitter_Creek-Tributary_Flood_Feasibility_Level_II_Phase_II-Executive_Summary-1991.pdf	11/1/91	WWDC	Document	flood control, Rock Springs, feasibility	Johnson Fermelia Co. Inc.
Bitter Creek Tributary Flood Study: (Level II - Feasibility Study Phase IA Report)	Phase IA includes the Bitter Creek tributaries of Killpecker, Sweetwater, and Dead Horse Creeks. Determines feasibility and cost estimates for detaining flood waters, improving water conveyance, and non-structural solutions to flood problems in the Rock Springs area.	WWDC\Document\Bitter_Creek-Tributaries_Flood_Control_Feasibility_Level_II_Phase_IA-Final_Report-1989.pdf	3/3/89	WWDC	Document	flood control, Rock Springs, feasibility	Johnson Fermelia Co. Inc.
Bluehead Sucker SWAP	State Wildlife Action Plan (SWAP) for Bluehead Sucker: description of the species and its habitat, problems, conservation actions, monitoring/research, and recent developments.	Wy Game and Fish\Document\SWAP_Bluehead-Sucker.pdf	11/20/17	Wy Game and Fish	Document	bluehead sucker, SWAP, wildlife	Wy Game and Fish
C.M. Pipe Drop Inlet with Pond Drain	NRCS Design Drawing for CMP drop inlet pond	NRCS\Document\NRCS Design cmp drop inlet pond.pdf	7/1/14	NRCS	Document	design drawing, pipe drop	NRCS
Can Stormwater BMPs Remove Bacteria? New Findings from the International Stormwater BMP Database	Provides a brief background regarding bacteria in urban runoff, summarizes the bacteria data available in the BMP Databse, provides analysis results and suggests how these findings may affect the selection and design of BMPs to assist in meeting TMDL goals.	Other\Document\can-stormwater-bmps-remove-bacteria.pdf	6/1/08	Other	Document	bacteria, BMP, TMDL, water quality	Clary J. et al
Closing Remarks/Workshop Summay (Western Invasive Weed Summit)	Summarizes what is at stake if invasive plants are ignored, and the importance of mitigation efforts.	Western Association of Fish and Wildlife Agencies\Document\Western Invasive Weed Summit Walsh-Closing-Remarksvs.pdf	11/19/15	Western Association of Fish and Wildlife Agencies	Document	invasive species, weeds	Walsh, Noreen
CMP Water Control Structure (587-09)	NRCS Design Drawing for CMP Water Control Structure with two gated pipes	NRCS\Document\NRCS Design CMP Water Control Structure 587-09.pdf	5/1/18	NRCS	Document	water control structure, design drawing	NRCS
CMP Water Control Structure (587-10)	NRCS Design Drawing for CMP Water Control Structure	NRCS\Document\NRCS Design CMP Water Control Structure 587-10.pdf	5/1/18	NRCS	Document	water control structure, design drawing	NRCS
CMP Water Control Structure (587-11a and 587-11)	NRCS Design Drawing for CMP Water Control Structure	NRCS\Document\NRCS Design CMP_Water Control Structure 587-11_11a.pdf	5/1/18	NRCS	Document	water control structure, design drawing	NRCS
Colorado River Basin Salinity Control Program Federal Accomplishments Report for Fiscal Year 2009	Colorado River Basin Salinity Control Program accomplishments organized by agency (USDA, EPA, USFWS, USGS, BLM, BR)	USDA\Document\FedAccompRep-2009.pdf	10/1/09	USDA	Document	colorado river basin, salinity, salinity control program	USDA et al
Colorado River Cutthroat Trout SWAP	State Wildlife Action Plan (SWAP) for Colorado River Cutthroat Trout: description of the species and its habitat, problems, conservation actions, monitoring/research, and recent developments.	Wy Game and Fish\Document\SWAP_Colorado-River-Cutthroat.pdf	11/20/17	Wy Game and Fish	Document	colorado river cutthroat trout, SWAP, wildlife	Wy Game and Fish

Title	Description	Link	Document Date	Source	Type	Keywords	Author
Concrete Ditch Lining (428-01)	NRCS Design Drawing for concrete ditch lining for flows less than 1.5 cfs	NRCS\Document\NRCS Design Concrete ditch lining for flows less than 1.5 cfs.pdf	5/1/18	NRCS	Document	Design drawing, ditch lining	NRCS
Concrete Ditch Lining (428-02)	NRCS Design Drawing for concrete ditch lining for flows between 1.5 cfs and 2.5cfs	NRCS\Document\NRCS Design Concrete ditch lining for flows between 1.5 cfs and 2.5cfs.pdf	5/1/18	NRCS	Document	design drawing, concrete ditch lining	NRCS
Concrete Water Control Structure (587-07)	NRCS Design Drawing for 4'x4' Concrete box irrigation structure with two gated pipes	NRCS\Document\NRCS Design 4'x4' Concrete box irrigation structure 2 gated pipe.pdf	5/1/18	NRCS	Document	water control structure, design drawing	NRCS
Concrete Water Control Structure (587-08)	NRCS Design Drawing for 4'x4' Concrete box irrigation structure with one gated pipe	NRCS\Document\NRCS Design 4'x4' Concrete box irrigation structure 1 gated pipe.pdf	5/1/18	NRCS	Document	water control structure, design drawing	NRCS
Consumptive Use of Irrigation Water in Wyoming	Estimating water requirements and consumptive water use based on the Blaney-Criddle Method	Other\Document\No_05-Comsumptive_Use_of_Irrigation_Water_in_Wyoming-1970.pdf	7/1/70	Other	Document	consumptive use	Water Resources Research Institute
Crucial Habitat Area Narrative - Little Mountain Flaming Gorge (Combined)	Describes the habitat values, reason why it has been selected as a crucial habitat area, focal species and SWAP Tier 1 species in the area, and solutions/actions for conservation.	Wy Game and Fish\Document\GR_G1_C_LittleMountainFlamingGorge.docx	3/9/15	Wy Game and Fish	Document	crucial habitat area, narrative	Wy Game and Fish
Crucial Habitat Area Narrative - Red Desert Bitter Creek (Combined)	Describes the habitat values, reason why it has been selected as a crucial habitat area, focal species and SWAP Tier 1 species in the area, and solutions/actions for conservation.	Wy Game and Fish\Document\GR_G1_C_RedDesertBitterCreek.doc	3/9/15	Wy Game and Fish	Document	crucial habitat area, narrative	Wy Game and Fish
Crucial Habitat Area Narrative - Sage-Grouse Core Areas (Terrestrial)	Describes the habitat values, reason why it has been selected as a crucial habitat area, focal species and SWAP Tier 1 species in the area, and solutions/actions for conservation.	Wy Game and Fish\Document\GR_G1_T_SagegrouseCrucial.docx	1/1/14	Wy Game and Fish	Document	crucial habitat area, narrative	Wy Game and Fish
Currant Creek Instream Flow Studies	Determines instream flows necessary for maintaining Colorado River cuttroat trout habitat and populations.	WWDC\Document\080-Current_Creek_Instream_Flow_Biological_Assessment-1999.pdf	11/8/99	WWDC	Document	instream flows, colorado cutthroat trout, habitat, water rights	Day, Paul D. & Annear, Thomas C.
Decision of Record; Adobe Town, Salt Wells Creek and Great Divide Basin Herd Management Areas Wild Horse Gather	Record of decision to implement a wild horse gather to maintain HMAs within acceptable management levels (AML).	BLM\Document\HMA_WildHorseGather_DOR.pdf	8/29/17	BLM	Document	HMA, AML, wild horses	BLM
Development of Improved Hydrologic Models for Estimating Streamflow Characteristics of Mountainous Basins in Wyoming	Methods for estimating streamflow based on bankfull width and climatic variables.	University of Wyoming\Document\miselis hydrolog models mountainous wyoming_UW.pdf	4/19/99	University of Wyoming	Document	Hydrologic Models, mountainous basins, streamflow	Miselis, Daiva V
Ditch Rights and Easements	FAQ for legal aspects relating to ditch rights and easements	State of Wyoming\Document\Ditch Rights and Easements.pdf	1/16/13	State of Wyoming	Document	ditch rights, easements	State of Wyoming
Documentation for the 2008 Update of the United States National Seismic Hazard Maps	Explains the methodology and highlights important changes to the procedures and input parameters used in seismic hazard mapping	USGS\Document\USGS Geologic Hazard Mapping 2008 OF08-1128_v1.1.pdf	1/1/08	USGS	Document	Hazard Mapping, geologic	USGS
Drilling and Aquifer Testing of the Ericson Formation Phase II for the City of Rock Springs - Final Report	Additional testing of the Ericson aquifer south of Bitter Creek (as recommended in Phase I - 1984 report).	WWDC\Document\Rock_Springs-Drilling_and_Aquifer_Testing_Ericson_Formation_Phase_II-Final_Report-1986.pdf	4/14/86	WWDC	Document	groundwater, water supply, Rock Springs	Johnson-Fermelia Company Inc.
E. coli Total Maximum Daily Loads Bitter and Killpecker Creeks, Wyoming (Public Review Draft)	Summary of the water quality problem, its sources, and potential future actions. Written to satisfy the regulatory requirement of Section 303(d) of the Clean Water Act and the EPA's implementing regulations for total maximum daily loads (TMDL)	Other\Document\BitterCreek_TMDL_Public Draft_10_12_17.pdf	10/12/17	Other	Document	E. coli, water quality	Tetra Tech, Inc.
Early season utilization of mountain meadow riparian pastures	June cattle distribution was examined within 4 experimental pastures located along Stanley Creek, Sawtooth National Recreation Area, Sawtooth National Forest, in central Idaho.	Other\Document\MountainMeadowRiparianPastures_Clary1993.pdf	11/1/93	Other	Document	spring, grazing, riparian habitat	Warren P Clary and Gordon D. Booth
Earthquakes and Related Geologic Hazards in Wyoming	Causes, mechanisms, and measuremnet of earthquakes; history and earthquake potential in Wyoming; related geologic hazards	USGS\Document\Earthquakes and Related Geologic Hazards in Wyoming_WGS PIC-26.pdf	1/1/86	USGS	Document	earthquakes, geologic hazards	James C. Case
Ecological Site and State-and-Transition	ESD definition and significance. Summary and descriptions of predominant ESD's in study area	NRCS\Document\ESD_Summary and Descriptions.pdf	8/11/14	NRCS	Document	Ecological Site Desciption	NRCS
Ecological Site Description - Saline Upland (SU) 7-9" Green River and Great Divide Basins	Ecologic Site Description (ESD) of physiographic features, climatic features, soil features, and plant communities.	NRCS\Document\ESD_Saline Upland 7-9in Green River and Great Divide Basins.pdf	7/26/18	NRCS	Document	ecologic site description, ESD, soils, precipitation	NRCS
Ecological Site Description - Shallow Loamy (SwLy) 7-9" Green River and Great Divide Basins	Ecologic Site Description (ESD) of physiographic features, climatic features, soil features, and plant communities.	NRCS\Document\ESD_Shallow Loamy 7-9in Green River and Great Divide Basins.pdf	7/26/18	NRCS	Document	ecologic site description, ESD, soils, precipitation	NRCS
Ecological Site Description - Shallow Sandy (SwSy) 7-9" Green River and Great Divide Basins	Ecologic Site Description (ESD) of physiographic features, climatic features, soil features, and plant communities.	NRCS\Document\ESD_Shallow Sandy 7-9in Green River and Great Divide Basins.pdf	7/26/18	NRCS	Document	ecologic site description, ESD, soils, precipitation	NRCS
Economic Benefits of Watershed Restoration	Quantifying economic benefits that arise from watershed resotration	Other\Document\Hurd_Economic_Benefits_2009_0.pdf	1/1/09	Other	Document	economic benefits, watershed restoration	Hurd, Josh

Title	Description	Link	Document Date	Source	Type	Keywords	Author
Effects of a Wind Energy Development on Greater Sage-Grouse Habitat Selection and Population Demographics in Southeastern Wyoming	Discerns the relationship between sage-grouse nest, brood-rearing, and summer habitat selection patterns and survival parameters and the infrastructure of an existing wind energy facility.	Other\Document\NWCC Seven Mile Hill Greater Sage-Grouse Study January 2016.pdf	1/1/16	Other	Document	sage-grouse, wind energy development	National Wind Coordinating Collaborative (NWCC)
Embankment Pond Profile & Cross Section (378-08a)	NRCS Design Drawing for Wetland Standard Embankment Pond profile and cross section	NRCS\Document\NRCS Design Wetland Standard_Embankment profile and cross section.pdf	5/1/18	NRCS	Document	embankment pond, wetland, design drawing	NRCS
Embankment Pond Profile & Cross Section Example (378-08a)	Example of completed "Embankment Profile and Cross Section" NRCS Wetland Standard Design Drawing	NRCS\Document\NRCS Design Wetland Standard_Embankment profile and cross section example .pdf	5/1/18	NRCS	Document	embankment pond, wetland, design drawing example	NRCS
Embrace A Stream Grant Program - 2018 Instructions	Describes program overview, eligibility, review process, application procedures, other information, and a final checklist for EAS project proposals. The application form is at the end of the document.	Trout Unlimited\Document\Embrace-A-Stream-2018-Proposal-Guidelines.pdf	1/1/18	Trout Unlimited	Document	EAS, funding, grants, application	Trout Unlimited
Enhanced sediment delivery in a changing climate in semi-arid mountain basins: Implications for water resource management and aquatic habitat in the northern Rocky Mountains	Synthesizes existing data from central Idaho to explore (1) how sediment yields are likely to respond to climate change in semi-arid basins influenced by wildfire (2) the potential consequences for aquatic habitat and water resource infrastructure, and (3) prospects for mitigating sediment yields in forest basins.	Other\Document\Climate Change and Sediment Delivery Goode_et_al_2012.pdf	6/19/11	Other	Document	geomorphology, sediment, climate chnage, aquatic habitat	Goode, J. R. et al
Enhancement Habitat Area Narrative - Little Mountain (Aquatic)	Describes the habitat values, reason why it has been selected as an enhancement habitat area, focal species and SWAP Tier 1 species in the area, and solutions/actions for conservation.	Wy Game and Fish\Document\GR_G2_A_LittleMountain.docx	10/10/14	Wy Game and Fish	Document	enhancement habitat area, narrative	Wy Game and Fish
Environmental Assessment for Adobe Town, Salt Wells Creek, and Great Divide Basin Herd Management Areas Wild Horse Gather	Prepared in accordance with the National Environmental Policy Act (NEPA) to analyze the environmental effects of wild horse gather operations and potential population control methods to achieve and maintain the established Appropriate Management Level (AML)	BLM\Document\WildHorseGather_EA_BLM_2017.pdf	8/1/17	BLM	Document	Wild horse, population control, HMA, AML	BLM
Episodic Erosion in Steep Terrain	Summarizes a model study of episodic erosion in the Kraft Badlands in eastern Wyoming during the summer of 1978. Additionally, experimental studies of sediment movement, drainage network and channel changes were carried out in the Rainfall-Erosion Facility.	Other\Document\Schumm Erosion Steep Terrain a089205.pdf	8/19/80	Other	Document	geomorphology, sediment, erosion	Schumm, S. A.
ESIS User Guide NRCS	Introduction to Ecological Site Information System, ESD Application, and guidance for facilitating an ESD effort in your state	NRCS\Document\ESIS User Guide_NRCS.docx	1/4/11	NRCS	Document	Ecological Site Description, ESD, ESIS, NRCS	NRCS
Estimating Streamflow from Concurrent Discharge Measurements - Final Report	Details a method for estimating streamflows at ungaged sites in mountainous areas of Wyoming. Documentation and application of the technique was performed as part of an	WWDC\Document\Wyoming-Estimating_Streamflow_from_Concurrent_Discharge_Measurements_Final_Report_2009.pdf	5/21/09	WWDC	Document	streamflow, instream flow	Lowham Engineering LLC
Evaluation of the State-of-the-Art Stream Stabilization	Assembles and reviews the current literature on streambank stabilization techniques, and compiles a state-of-the-art streambank stabilization bibliography.	University of Wyoming\Document\StreamStabilizationTechniques.pdf	2/1/89	University of Wyoming	Document	streambank stabilization, erosion	Henszy, R. J. et al
Executive Order - Greater Sage-grouse Core Area Protection	Includes information on how the core areas were identified, and the permitting process and stipulations for development in core areas	State of Wyoming\Document\SageGrouseExecOrder2015-4.pdf	7/29/15	State of Wyoming	Document	sage grouse, executive order	State of Wyoming
Executive Order - Supplement to Greater Sage-grouse Suitable Habitat Definitions	States that wetlands and irrigated riparian meadows should be reclassified from disturbed to suitable habitat for conservation credit purposes. Areas beyond the 275 meter limitation should be reclassified (on a case-by case basis) from disturbed to suitable habitat if there is defensible proof that sage-grouse use the area	State of Wyoming\Document\Executive-Order-2017-2-Wetlands-and-Riparian-Areas.pdf	7/10/17	State of Wyoming	Document	sage-grouse, suitable habitat	State of Wyoming
Field Manual on Maintenance of Large Woody Debris for Municipal Operation and Maintenance Crews	Demonstrates how to manage an existing LWD structure in an environmentally friendly manner, as well as how to install a LWD structure for erosion control, bank stabilization, and habitat improvement	Other\Document\LWD-Manual-Final.pdf	Unknown	Other	Document	Large woody debris, stream stabilization, riparian habitat	Clinton River Watershed Council
Final Environmental Impact Statement Expanded Moxa Arch Area Natural Gas Development Project, Sweetwater, Lincoln, and Uinta Counties, Wyoming	EIS for Moxa Arch Area	BLM\Document\Final Environmental Impact Statement Expanded Moxa Arch Area Jan 1996.pdf	1/1/96	BLM	Document	EIS, Moxa Arch, Natural Gas	Utah State University
Final Programmatic Report - Native Fish Conservation in the Colorado River Basin	Strategically identifies a set of watersheds supported by agency partners that can serve as a funding framework for NFWF's Colorado River Basin Native Fishes Keystone Initiative.	Trout Unlimited\Document\NFWF_ColoradoNativeFish_FinalReport.pdf	7/30/10	Trout Unlimited	Document	colorado basin, native fish conservation	National Fish and Wildlife Foundation
Final Report for the Green River ASR and Alternate Storage Project - Church Reservoir Investigation	Determines the feasibility of Church Reservoir. This includes reservoir sizing, geotechnical investigation, preliminary design, and cost analysis.	WWDC\Document\Church_Reservoir-Green_River_ASR_and_Alternate_Storage_Investigation-Final_Report-2002.pdf	12/1/02	WWDC	Document	Church Reservoir, Feasibility, water storage	States West Water Resources Corporation

Title	Description	Link	Document Date	Source	Type	Keywords	Author
Fire and Fuels Managment Contributions to Sage-Grouse Conservation	Illustrates the type and responsiveness of efforts being made to manage vegetation and prevent wildland fires. Presents future options and a series of recommendations that may inform future policy and allocation decisions.	Western Association of Fish and Wildlife Agencies\Document\WAFWA_Fire Report v1.01.pdf	Unknown	Western Association of Fish and Wildlife Agencies	Document	sage-grouse, fire	WAFWA
Flannelmouth Sucker SWAP	State Wildlife Action Plan (SWAP) for Flannelmouth Sucker: description of the species and its habitat, problems, conservation actions, monitoring/research, and recent developments.	Wy Game and Fish\Document\SWAP_Flannelmouth-Sucker.pdf	11/20/17	Wy Game and Fish	Document	flannelmouth sucker, SWAP, wildlife	Wy Game and Fish
Funding Opportunities for Wyoming Sage-Grouse Conservation Efforts	A list of potential funding sources that can address various scales of projects ranging from the individual landowner to multi-state efforts.	Wy Game and Fish\Document\SGC_FUNDINGOPPS_REVISED0414.pdf	4/1/14	Wy Game and Fish	Document	sage-grouse, funding, financial assistance	Wy Game and Fish
FY 2018 Wyoming Program Guidance and Practice Payment Rates for Eligible Conservation Practices	Provides guidance or limitations for eligibility of conservation practices for program financial assistance.	NRCS\Document\FY_2018_Wyoming_Guidance_Document_and_Payment_Rates_for_Eligible_Conservation_Practices.pdf	5/1/18	NRCS	Document	funding, financial assistance, conservation	NRCS
GIS Standards Technical Memorandum	Provides the necessary guidelines for creators and managers of data that is produced for the WWDO. Supporting Geodatabase templates have also been created that should be used to prepare the core datasets to meet the contractual requirements for GIS data	WWDC\Document\GISStandardsTechMemo.pdf	1/1/18	WWDC	Document	GIS Standards	Trihydro
Greater Sage-grouse Comprehensive Conservation Strategy	Outlines the critical need to develop the associations among local, state, provincial, tribal, and federal agencies, non-governmental organizations, and individual citizens to design and implement cooperative actions to support robust populations of sage-grouse and the landscapes and habitats upon which they depend.	Western Association of Fish and Wildlife Agencies\Document\GreaterSage-grouseNationalConservationStrategy.pdf	12/1/06	Western Association of Fish and Wildlife Agencies	Document	sage-grouse, wildlife, conservation	WAFWA
Greater Sage-Grouse Conservation & the Sagebrush Ecosystem	Highlights selected recent accomplishments of federal agencies and partners in conserving the sagebrush ecosystem and the more than 350 species, including the Greater sage-grouse, as well as the human traditions and livelihoods that depend on it.	Western Association of Fish and Wildlife Agencies\Document\DOI Report-Greater Sage-Grouse Conservation & the Sagebrush Ecosystem.pdf	1/1/16	Western Association of Fish and Wildlife Agencies	Document	sage-grouse, sagebrush, conservation	DOI, USDA, WAFWA
Greater Sage-grouse Population Trends: An Analysis of Lek Count Databases	This report represents the most recent analysis of male-count data from 1965–2015 at the range-wide, management zone, and state scales	Western Association of Fish and Wildlife Agencies\Document\Lek Trend Analysis final 8-14-15.pdf	8/14/15	Western Association of Fish and Wildlife Agencies	Document	sage-grouse, population trends, wildlife	WAFWA
Green River Basin Plan	A basinwide perspective on water resources, use, projections, availability, and strategies/recommendation	WWDC\Document\Green_River_Basin_Plan.pdf	12/1/10	WWDC	Document	Green River Basin, water resources, water use, demand projections, funding	WWC Engineering, AECOM, ERO Resource Group
Green River Basin Project	Proposal for a water monitoring program to determine causes and sources of eutrophication and declining fishery in Flaming Gorge Reservoir.	WWDC\Document\Green_River_Basin_Water_Quality_Laboratory-Proposal-1982.pdf	7/6/82	WWDC	Document	flaming gorge, water quality, eutrophication, fisheries	Western Wyoming College Water Quality Lab
Green River Decision Support System Feasibility Study - Executive Summary	Executive Summary for GR DSS Feasibility Study which describes the need for a decision support system as a dynamic data analysis tool in water development planning. Also	WWDC\Document\Green_River-Decision_Support_System_Feasibility_Study-Executive_Summary-2011.pdf	3/22/11	WWDC	Document	DSS, Green River	Leonard Rice Engineers, Inc.
Green River Decision Support System Feasibility Study - Final Report	Describes the need for a decision support system as a dynamic data analysis tool in water development planning. Also includes a description of data and data management, DSS modeling components, and the total estimated cost, proposed recommendations, and implementation schedule for the Green River DSS.	WWDC\Document\Green_River-Decision_Support_System_Feasibility_Study-Final_Report-2011.pdf	3/22/11	WWDC	Document	DSS, Green River	Leonard Rice Engineers, Inc.
Green River Ground Water Recharge Alternate Storage Level I Project - Executive Summary	Focuses on Aquifer Storage Recovery (ASR), and investigates surface storage sites.	WWDC\Document\Green_River-Ground_Water_Recharge_Alternate_Storage_Level_I_Project-Executive_Summary-2001.pdf	12/1/01	WWDC	Document	ASR, water storage	States West Water Resources Corporation
Green River Resource Area Resource Management Plan and Final Environmental Impact Statement	Presents the Proposed RMP for managing the BLM administered public lands and resources in the resource area.	BLM\Document\GreenRiver_RMP_EIS.pdf	3/1/96	BLM	Document	RMP, EIS, Green River	BLM
Ground Water Development as an Alternative to the Proposed Sandston Project - Final Report	This report describes the methods and results of an investigation conducted to determine the feasibility of developing ground-water supplies as an alternative to the proposed	WWDC\Document\Sandstone-Ground_Water_Development_as_an_Alternative_to_Proposed_Project-Final_Report-1987.pdf	3/4/87	WWDC	Document	groundwater, Sandstone Dam and Reservoir, water supply	Stone & Webster Engineering Corporation
Guidelines for Determining Flood Flow Frequency (Bulletin #17B)	Provides revised procedures for weighting a station skew value with the results from a generalized skew study, detecting and treating outliers, making two station comparisons, and computing confidence limits about a frequency curve.	USGS\Document\Guidelines_FloodFlowFrequency.pdf	9/1/81	USGS	Document	flood flow frequency, peak flow, log-p	eragency Advisory Committee on Water D
Henrys Fork Salinity Control Project Plan and Final Environmental Impact Statement - Irrigation Improvements	Evaluates the cost effectiveness and potential environmental impacts if Colorado River salinity control funds are made available to the landowners in the Henrys Fork Salinity Control Projects	NRCS\Document\Henrys Fork Salinity control project Final EIS April 2013.pdf	4/1/13	NRCS	Document	irrigation improvements, henrys fork, salinity control	NRCS

Title	Description	Link	Document Date	Source	Type	Keywords	Author
Henrys Fork Salinity Control Project Record of Decision	Documents the decision by the USDA-NRCS to implement on-farm irrigation system improvements through producer's voluntary actions	NRCS\Document\Henrys Fork Salinity control project ROD June 2013.pdf	6/1/13	NRCS	Document	Salinity control, Henry's Fork, Record of Decision	NRCS
Hunting Sage-grouse, Impacts and Management	Reviews scientific information pertaining to impacts of regulated hunting on sage-grouse populations and describes measures states have taken to minimize potential impacts of	Western Association of Fish and Wildlife Agencies\Document\Hunting white paper WAFWA V1.1.pdf	7/18/17	Western Association of Fish and Wildlife Agencies	Document	sage-grouse, hunting	WAFWA
Hydrogeologic Report on the Water Supply Situation of the Town of South Superior- Final Report	Presents the ground-water supply status of the town of South Superior, evaluates existing wells and possible future developments. Impacts of present and proposed mining activities are examined and limitations are recommended. The geology of the area is	WWDC\Document\South_Superior-Water_Supply_Situation_Hydrogeologic-Final_Report-1981.pdf	10/9/81	WWDC	Document	Superior, water supply, groundwater, geology, mining	Willard Owens Associates Inc
Hydrology of Salt Wells Creek - A Plains Stream in Southwestern Wyoming	Summarizes results of a hydrologic study made during 1975-78 on the basin of Salt Wells Creek. The area is typical of arid and semiarid plains areas in southwestern Wyoming where mineral development is occuring.	USGS\Document\WRI 81-62 Salt Wells Creek.pdf	4/1/82	USGS	Document	hydrology, intermittent streams, sediment, geomorphology, runoff	Lowham, H. W. et al
Hydrology of the Upper Cheyenne River Basin	Includes two parts: A) Hydrology of Stock-Water Reservoirs in Upper Cheyenne River Basin, and B) Sediment Sources and Drainage-Basin Characteristics in Upper Cheyenne River Basin.	USGS\Document\hydrology of the upper cheyenne river basin schumm report.pdf	1/1/61	USGS	Document	stock reservoirs, water quality, geomorphology, runoff, sediment	Culler, R. C. et al
Identification and implementation of Native Fish Conservation Areas in the Upper Colorado River Basin	Identifies a network of potential NFCAs, intended to serve as a funding framework for a National Fish and Wildlife Foundation (NFWF) Keystone Initiative focused on Colorado River Basin native fishes	Trout Unlimited\Document\UCRB_NFCA_Fisheries_rev_Submitted.pdf	2/24/11	Trout Unlimited	Document	native fish conservation, upper colorado river basin	Dauwalter et al
Impact of WWDC Regional Water System Projects on Land Use: An Analysis of Two Case Studies - Final Report	Evaluates the relationship between regional water projects funded by the WWDC, and community and rural land development for two specific case studies, including the associated positive and negative impacts of water projects on development.	WWDC\Document\WY-Impacts_WWDC_Regnl_Water_Syst_Projects_Land_Use_Analysis_2_Case_Studies-Final_Report-2008.pdf	10/1/08	WWDC	Document	water development, land use	Ruckelshaus Institute of Environment and Natural Resources
Interagency Ecological Site Handbook for Rangelands	Provides a standardized method to be utilized by the BLM, FS, and NRCS to define, delineate, and describe terrestrial ecological sites on rangelands.	NRCS\Document\InteragencyEcolSiteHandbook_JAN 2013.pdf	1/1/13	NRCS	Document	ESD, Rangeland	BLM, USFS, NRCS (Caudle, Dan et al)
Invasive Plant Management and Greater Sage-Grouse Conservation	A review and status report with strategic recommendations for improvement	Western Association of Fish and Wildlife Agencies\Document\WAFWA Invasive Plant Management and Greater Sage Grouse Report FINAL 3-28-15.pdf	3/28/15	Western Association of Fish and Wildlife Agencies	Document	sage-grouse, invasive species	WAFWA
Irrigation Water Requirements: Crop Data Summaries (Sweetwater County, Wyoming)	Irrigation requirements for alfalfa hay, barley, grass hay, oats, and pasture (grass) based on weather stations in Rock Springs and Farson.	NRCS\Document\NRCS Irrigation Water Requirements 2016.pdf	1/22/16	NRCS	Document	irrigation requirements, crop data summary	NRCS
Land & Resource Use Plan & Policy 2015-2020	Identifies and applies goals, objectives, and policies to the state and federal regulatory framework that governs the management of private, state, and federal land and the	Conservation Districts\Document\LRUPP_2015_12.pdf	12/14/15	Conservation Districts	Document	Land use, resource management	Sweetwater County Conservation District
Land & Resource Use Plan and Policy (2011)	Identifies and applies goals, objectives, and policies to the state and federal land and the rangeland, soil, water and wildlife resources.	Conservation Districts\Document\Sweetwater CD 2011 Land-Resource Plan.pdf	2/3/11	Conservation Districts	Document	SWCCD, land and resource use plan and policy	Sweetwater
Level I - Water System Master Plan (Green River - Rock Springs - Sweetwater - County JPWB) - Final Project	Documents the first phase of the Master Plan, updating the City of Rock Springs and City of Green River hydraulic models to the extent allowed by time and budget.	WWDC\Document\Green_River-Rock_Springs_Sweetwater_Co_JPWB_Master_Plan_Level_I-Final_Report-2007.pdf	1/22/07	WWDC	Document	master plan, Rock Springs, Green River, JPWB	Nelson Engineering
Level I - Water System Master Plan Phase I (Green River - Rock Springs Sweetwater County JPWB) - Executive_Summary	Describes the general progression of Phase I work on a Task by Task basis in an abbreviated format. More detail is provided in the following reports: 1) "Final Report-Green River-Rock Springs-Sweetwater County Joint Powers Water Board Water System	WWDC\Document\Green_River-Rock_Springs_Sweetwater_Co_JPWB_Water_System_MP_Phase_I-Executive_Summary-2009.pdf	1/30/09	WWDC	Document	master plan, Rock Springs, Green River, JPWB	Nelson Engineering
Level I - Water System Master Plan Phase II (Green River - Rock Springs Sweetwater County JPWB) - Final Report	Covers System Analysis to determine needed improvements, Transient Analysis, Water Quality Modeling, establishment of Future Water Supply Needs, and Conceptual Design and Costing of the recommended improvements.	WWDC\Document\Green_River-Rock_Springs_Sweetwater_Co_JPWB_Water_System_MP_Phase_2-Final_Report-2009.pdf	1/30/09	WWDC	Document	master plan, Rock Springs, Green River, JPWB	Nelson Engineering
Little Mountain Habitat Improvement Projects	Summary map showing Little Mountain Ecosystem Habitat Projects such as conservation easements, woody riparian plantings, mechanical aspen/conifer treatments, and prescribed burns.	BLM\Document\LME project summary map.pdf	1/1/09	BLM	Document	Little Mountain Ecosystem, Habitat	BLM
Livestock Pipeline Appurtenances (516-01)	NRCS Design Drawing for livestock pipeline appurtenances	NRCS\Document\NRCS Design Livestock pipeline appurtenances.pdf	5/1/18	NRCS	Document	livestock pipeline appurtenances, design drawing	NRCS
Log Deflector	NRCS Design Drawing for Log Deflector	NRCS\Document\NRCS Design log deflector.pdf	8/1/14	NRCS	Document	Log Deflector, Design Drawing	NRCS
Male Greater Sage-Grouse Detectabiltiy in Leks	Describes factors that influence male sage-grouse detection probabilities during lek counts which will allow managers to more accurately estimate the number of males	Western Association of Fish and Wildlife Agencies\Document\Wildlife Management_Male Greater Sage-	10/4/15	Western Association of Fish and Wildlife Agencies	Document	sage-grouse, population	Fremgen, Aleshia L. et al

Title	Description	Link	Document Date	Source	Type	Keywords	Author
Manual and Land Cover Type Descriptions Oregon GAP Gap Analysis 1998 Land Cover for Oregon	Mapping of land cover based on vegetation patterns which reflect the environment, biological diversity patterns and habitat types.	BLM\Document\Oregon GAP gap_vegetation_BLM.pdf	1/1/99	BLM	Document	GAP Analysis, Land Cover Descriptions	Chris Kiilsgaard, Oregon Natural Heritage Program
Map to Accompany Application for Currant Creek Instream Flow Segment No. 1	Map of Currant Creek instream flow segment. Approved by state engineer in January 9, 2005	WWDC\Map\080-Current_Creek-MAP.pdf	11/8/99	WWDC	Map	instream flows, water rights	States West Water Resources Corporation Intermountain Professional
Map to Accompany Application for Red Creek Instream Flow Segment No. 1	Map of Red Creek instream flow segment. Approved by state engineer in January 9, 2005	WWDC\Map\077-Red_Creek-MAP.pdf	11/8/99	WWDC	Map	instream flows, water rights	States West Water Resources Corporation Intermountain Professional Services, Inc.
Map to Accompany Application for Trout Creek Instream Flow Segment No. 1	Map of Trout Creek instream flow segment. Approved by state engineer in January 9, 2005	WWDC\Map\078-Trout_Creek-MAP.pdf	11/8/99	WWDC	Map	instream flows, water rights	States West Water Resources Corporation Intermountain Professional Services, Inc.
Mapping breeding densities of greater sage-grouse: A tool for range-wide conservation planning	Sage Grouse breeding density and how it is measured	BLM\Map\BLM_Sage Grouse Mapping_Breeding_Density_2010.pdf	9/24/10	BLM	Map	Sage Grouse, Breeding Density	Doherty, Kevin E. et al
Memorandum of Understanding between WAFWA, USDA-FS, BLM, USFWS, USGS, NRCS, and USDA-FSA	Provides for cooperation among the participating State and federal land, wildlife management and science agencies in the conservation and management of Greater sage-	Western Association of Fish and Wildlife Agencies\Document\Sage-grouseConservationImplementationMOU.pdf	Unknown	Western Association of Fish and Wildlife Agencies	Document	sage-grouse, sagebrush	WAFWA
Memorandum: Statistical analysis for Fall 2017 horse survey of Rock Springs area horse populations	Fall 2017 wild horse census in the Rock Springs area based on aerial surveys and correction for systematic biases	BLM\Document\Fall2017_WildHorse_Census.pdf	1/30/18	BLM	Document	wild horse, population, HMA	BLM
Methodology for Identification of Intermittent and Perennial Streams and Their Origins	Manual and field form is intended to guide natural resource professionals in the identification of ephemeral, intermittent and perennial streams using geomorphic,	Other\Document\NC_2010_Methodology_identification_intermittent_perennial_streams.pdf	9/1/10	Other	Document	perennial, ephemeral, intermittent	North Carolina Division of Water Quality
Modified Pfankuch Channel Stability Rating Procedure Summary	Worksheet for quantifing channel stability based on slope, debris, vegetation, capacity, obstructions, scouring/deposition, etc.	BLM\Document\Pfankuch rating summary 7st9tabV10_BLM.pdf	1/1/76	BLM	Document	channel stability, rating	Pfankuch
Monitoring of Livestock Grazing Effects on Bureau of Land Management Land	Investigation of the availability of livestock grazing-related quantitative monitoring data and qualitative region-specific Land Health Standards (LHS) data across BLM grazing	USGS\Document\Monitoring of Livestock Grazing Effects on BLM Land_2014_REM.pdf	1/1/14	USGS	Document	BLM, livestock, grazing	Veblen et al (BioOne)
Near-Term Greater Sage-Grouse Conservation Action Plan	Evaluates risks to populations, conservation measures that address those risks, by area; expected outcomes and the resources needed to accomplish those conservation measures and prioritize those actions.	Western Association of Fish and Wildlife Agencies\Document\NTSGConservation Action Plan.pdf	9/11/12	Western Association of Fish and Wildlife Agencies	Document	sage-grouse, wildlife, conservation	WAFWA - Range-wide Interagency Sage-Grouse Conservation Team (RISCT)
NRCS Conservation Practice Standard Descriptions	Conservation practice standards for constructed wetland, dams, diversions, irrigation water management and conveyance, lined waterways, open channels, ponds, sediment basins, spring development, and more.	NRCS\Document\NRCS NED Descriptions.pdf	1/1/08	NRCS	Document	conservation, standards	NRCS
NRCS Design Steel Watering Tank with Concrete Base (614-01)	NRCS Design Drawing for steel watering tank with concrete base	NRCS\Document\NRCS Design Steel watering tank with concrete base.pdf	5/1/18	NRCS	Document	watering tank, design drawing	NRCS
Numerical Analysis of River Spanning Rock U-Weirs: Evaluating Effects of Strcuture Geometry on Local Hydraulics	3D numerical model simulations were used to examine the effects of variations in U-weir geometry on local hydraulics (upstream water surface elevations and downstreamvelocity	Other\Document\Holmquist-Johnson Christopher_Dissertation2011.pdf	9/14/11	Other	Document	Rock Weirs, structure geometry, hydraulics	Holmquist-Johnson
Operating Criteria of the Basin States Program of the Wyoming Water Development Program	The purpose of the BSP is to work with the Bureau of Reclamation to meet the objectives of the Colorado River Basin Water Quality Standards. This document provides the WWDC and the WWDO with general standards for evaluating and prioritizing applications for	WWDC\Document\Basin States Program Operating Criteria_2015.pdf	11/6/15	WWDC	Document	BSP, operating criteria, funding	WWDC
Operating Criteria of the Small Water Project Program of the Wyoming Water Development Program	Provides the Wyoming Water Development Commission (WWDC) and the Wyoming Water Development Office (WWDO) with general standards for evaluating and prioritizing applications for funding from the SWPP.	WWDC\Document\Small Water Project Program Operating Criteria 2017.pdf	Unknown	WWDC	Document	SWPP, operating criteria, funding	WWDC
Operating Criteria of the Upper Colorado River Basin Fund Memorandum of Agreement	Provides the Wyoming Water Development Commission (WWDC) and the Wyoming Water Development Office (WWDO) with general guidelines for evaluating and prioritizing applications for MOA program funding.	WWDC\Document\Upper Colorado River Basin Fund Operating Criteria 2015.pdf	11/6/15	WWDC	Document	MOA, funding, operating criteria	WWDC
Operation Plan (WLCI)	Includes guidance for establishing internal and external involvement in the WLCI, creating a process for planning and prioritizing projects, and identifying actions necessary to accomplish the stated goals of the WLCI.	Other\Document\WLCI_Operation_Plan_final.pdf	12/1/08	Other	Document	WLCI, operation plan	WLCI
Outcomes in Conservation Sage Grouse Initiative	Comprehensive evaluation of Sage Grouse Initiative (SGI). What has changed since sage-grouse was designated as a Candidate for listing in 2010, and with what certainty will conservation efforts continue beyond 2015.	NRCS\Document\NRCS_SGI_Report.pdf	2/1/15	NRCS	Document	Sage Grouse, wildlife, conservation	NRCS
Overview of Greater Sage-Grouse and Endangered Species Act Activities	A summary of the Endangered Species Act (ASA) petition process, outcome of the sage-grouse review.	Western Association of Fish and Wildlife Agencies\Document\Primer 4 SGOverview ESA Activities1.1.pdf	Unknown	Western Association of Fish and Wildlife Agencies	Document	sage-grouse, ESA	WAFWA

Title	Description	Link	Document Date	Source	Type	Keywords	Author
Part III: Detailed Narratives of Local Project Development Team Conservation Priorities and Actions	Addresses the issues identified by the Sweetwater LPDT and their past, current, and proposed conservation actions and projects. Part III of the WLCI Conservation Action Plan	Other\Document\Sweetwater_LPDT_CAP_Part_III_2015.pdf	1/1/15	Other	Document	WLCI, LPDT	WLCI
Peak-Flow Characteristics of Wyoming Streams	Water Resources Investigations Report on peak-flow characteristics and frequency relations for unregulated streams in Wyoming	USGS\Document\Miller Wyoming Peak Q USGS wri034107.pdf	1/1/03	USGS	Document	Wyoming Streams, Peak-Flow	Miller, Kirk A
Pesticides in groundwater - Uinta County, Wyoming	Description Wyoming's pesticide management plan, and summary of baseline and ongoing pesticide monitoring	USGS\Document\Pesticides in groundwater-Uinta County 2002-03.pdf	2/25/14	USGS	Document	pesticides, groundwater, Uinta County	USGS
Plan Layout - Embankment Pond (378-08)	NRCS Design Drawing for Wetland Standard Embankment Pond	NRCS\Document\NRCS Design Wetland Standard_Plan layout of project.pdf	5/1/18	NRCS	Document	embankment pond, wetland, design drawing	NRCS
Plan Layout - Embankment Pond Example (378-08)	Example of completed "Plan Layout - Embankment Pond" NRCS Wetland Standard Design Drawing	NRCS\Document\NRCS Design Wetland Standard_Plan layout example.pdf	5/1/18	NRCS	Document	embankment pond, wetland, design drawing example	NRCS
Pollutant Category Summary: Fecal Indicator Bacteria	Technical summary for the International Stormwater Best Management Practices (BMP) Database which summarizes regulatory context, sources of pathogens and fecal indicator	Other\Document\BMP Database Bacteria Paper Dec 2010.pdf	12/1/10	Other	Document	BMP, fecal indicator bacteria, pathogens, water quality	Wright Water Engineers, Inc., Geosyntec Consultants
Population and Habitat-based Approaches to Management of Sage-grouse	Describes the importance of protecting and improving sagebrush habitats and ecosystems in order to sustain and and enhance populations and distribution of sage-grouse	Western Association of Fish and Wildlife Agencies\Document\Population and habitat management WAFWA v1.1.pdf	7/18/17	Western Association of Fish and Wildlife Agencies	Document	sage-grouse, population, habitat, wildlife	WAFWA
Predator Control as a Conservation Measure for Sage-grouse	Description of previous studies that evaluate the efficacy of predator control programs, and possible issues that may arise with such programs.	Western Association of Fish and Wildlife Agencies\Document\Predator control white paper WAFWA V1.1.pdf	7/18/17	Western Association of Fish and Wildlife Agencies	Document	predator control, sage-grouse, conservation, wildlife	WAFWA
Preliminary Results from the Evaluation of Different Seasons and Intensities of Grazing on the Erosion of Intermittent Streams at the San Joaquin Experimental Range	Evaluates the effect of season and grazing intensity on erosion along intermittent streams. Comparison of five treatments: no grazing, dry season moderate, dry season heavy, wet season moderate, and wet season heavy.	USDA\Document\Grazing_ErosionOfIntermittentStreams_USDA1997.pdf	1/1/97	USDA	Document	grazing, erosion	Larsen R. E. et al
Proposed Practices for Economic Analysis of River Basin Projects	Report to the Inter-Agency Committee on Water Resources concerning cost-benefit analysis and project/program formulation	Other\Document\Proposed_Practices_for_Economic_Analysis_of_River_Basin_Projects5_58.pdf	5/1/58	Other	Document	Basin Projects, Economic Analysis, cost-benefit analysis	Subcommittee on Evaluation Standards
Public Water System Survey Report	A survey of all known municipal and non-municipal community public water systems in the State of Wyoming taken during the winter of 2015 into early 2016.	WWDC\Document\PublicWaterSystemSurveyReport.pdf	1/1/16	WWDC	Document	municipal, water use, public water systems	WWDC
Range-Wide Status of Colorado River Cutthroat Trout	Assessment of Colorado River Cutthroat Trout based on historical range, current distribution, genetic status, and foreseeable risks	Trout Unlimited\Document\FINAL_CRCTStatusReview_04042006.pdf	1/1/05	Trout Unlimited	Document	Colorado River Cutthroat	Hirsch, Albeke and Nesler
Recommendations for Managing Mule Deer Habitat in Wyoming	Contains habitat management recommendations focused primarily on diet/nutrition for mule deer in order to sustain and potentially increase populations throughout Wyoming.	Wy Game and Fish\Document\RecommendationsforManagingMuleDeerHabitatinWyoming.pdf	10/16/15	Wy Game and Fish	Document	mule deer, habitat, wildlife	Wy Game and Fish
Record of Decision and Approved Rawlins Resource Management Plan	The Record of Decision (ROD) approves the Rawlins Resource Management Plan (RMP). The RMP provides overall direction for management of all resources on BLM-administered land in the Rawlins Field Office Planning Area.	BLM\Document\Rawlins_ROD&RMP.pdf	12/1/08	BLM	Document	Record of Decision (ROD), Resource Management Plan (RMP)	BLM (Rawlins Field Office)
Record of Decision and Green River Resource Management Plan	Provides management direction for approximately 3.6 million acres of public land surface and 3.5 million acres of Federal mineral estate administered by the BLM in the Green River Resource Area.	BLM\Document\Rock Springs BLM Green River-RMP_1997.pdf	10/1/97	BLM	Document	ROD, RMP, Green River Resource Area, management, public lands	BLM
Record of Decision: Currant Creek - Instream Flow Segment No. 1	Includes a discussion based on public hearing, comment letters, reports and other documents submitted to the State Engineer, and the final decision by the State engineer to grant the water permit.	WWDC\Document\080-Current_Creek-ROD.pdf	1/9/05	WWDC	Document	instream flows, water rights, ROD	State of Wyoming
Record of Decision: Red Creek - Instream Flow Segment No. 1	Includes a discussion based on public hearing, comment letters, reports and other documents submitted to the State Engineer, and the final decision by the State engineer to grant the water permit.	WWDC\Document\077-Red_Creek-ROD.pdf	1/9/05	WWDC	Document	instream flows, water rights, ROD	State of Wyoming
Record of Decision: Trout Creek - Instream Flow Segment No. 1	Includes a discussion based on public hearing, comment letters, reports and other documents submitted to the State Engineer, and the final decision by the State engineer to grant the water permit.	WWDC\Document\078-Trout_Creek-ROD.pdf	1/9/05	WWDC	Document	instream flows, water rights, ROD	State of Wyoming
Red Creek Instream Flow Studies	Determines instream flows necessary for maintaining Colorado River cuttroat trout habitat and populations.	WWDC\Document\077-Red_Creek_Instream_Flow_Biological_Assessment-1999.pdf	11/8/99	WWDC	Document	instream flows, colorado cutthroat trout, habitat, water rights	Day, Paul D. & Annear, Thomas C.
Red Desert - Jack Morrow Hills Wetlands Complex	Regional Wetlands Conservation Plan which addresses wetland habitats and associated wildlife species, particularly sensitive avian species, in the Jack Morrow Hills area of the Greater Red Desert (Red Desert).	Wy Game and Fish\Document\Red-Desert-Jack-Morrow-Hills-Wetlands-Complex.pdf	7/25/14	Wy Game and Fish	Document	wetlands, wildlife, habitat	Wyoming Bird Habitat Conservation Partnership

Title	Description	Link	Document Date	Source	Type	Keywords	Author
Report on the Green River Tributaries #2 Instream Flow - Final Report Book 1 of 2	Evaluates the capability of segments in the Green River Tributaries to provide unappropriated direct flows necessary to meet the Wyoming Game and Fish Department (WGFD) instream flow request for segments on Gilbert, Little Gilbert, Sage, Currant, Trout,	WWDC\Document\Green_River_Tributaries-Number_Two_Instream_Flow_Book_1_of_2-Final_Report-2000.pdf	12/18/00	WWDC	Document	instream flows, green river tributaries	JFC Engineers and Surveyers
Report on the Green River Tributaries #2 Instream Flow - Final Report Book 2 of 2	Includes Maps, Exhibits, and Appendices for instream flow assessment of the Green River Tributaries.	WWDC\Document\Green_River_Tributaries-Number_Two_Instream_Flow_Book_2_of_2-Final_Report-2000.pdf	12/18/00	WWDC	Document	instream flows, green river tributaries	JFC Engineers and Surveyers
Resrouce Conservation and Development Memorandum	Describes Soil Conservation Service policy regarding interest rates to be used in evaluating federal and federally assisted water and related land resource projects.	NRCS\Document\Watersheds_Memorandum-92R5_9_75.pdf	11/21/75	NRCS	Document	water rates, usda	USDA
Review of the Forest Service Response: The Bark Beetle Outbreak in Northern Colorado and Southern Wyoming	Examines the ecological conditions and historical land use that contributed to the pine beetle outbreak, management response to the outbreak, suggested new and extended authorities for addressing the outbreak, and what we might expect as we look forward to	USDA\Document\BarkBeetleOutbreak_USDA.pdf	9/1/11	USDA	Document	pine beetle	USDA Forest Service
Riparian Area Management - Grazing Management for Riparian-Wetland Areas	Presents information from various land managers and researchers to guide livestock management in riparian areas	BLM\Document\Riparian Area Management TR 1737-14_1997.pdf	1/1/97	BLM	Document	Grazing, riparian, wetland, management	BLM
Rock Riprap Streambank Stabilization (580-06)	NRCS Design Drawing for rock riprap streambank stabilization	NRCS\Document\NRCS Design Rock riprap streambank stabilization.pdf	5/1/18	NRCS	Document	rock riprap, streambank stabilization, design drawing	NRCS
Rock Springs Aquifer Testing of Ericson Formation for the City of Rock Springs - Final Report	Determines the feasibility and potential of developing underground water to supplement the existing water supply for the City of Rock Springs.	WWDC\Document\Rock_Springs-Aquifer_Testing_of_Ericson_Formation-Final_Report-1984.pdf	3/30/84	WWDC	Document	groundwater, water supply, Rock Springs	Johnson-Fermelia & Crank Inc.
Rock Springs East Water Supply Master Plan Level I Study - Executive Summary	Executive summary of the Level I study which identifies water source supply alternatives, preliminary transmission, storage, treatment requirements, and budgetary costs for each alternative.	WWDC\Document\Rock_Springs_East-Water_Supply_Master_Plan_Level_I_Study-Executive_Summary-1995.pdf	11/1/95	WWDC	Document	water supply, Rock Springs, Master Plan	Kjellgren, Leon R
Rock Springs East Water Supply Master Plan Level I Study - Final Report	Identifies water source supply alternatives, preliminary transmission, storage, treatment requirements, and budgetary costs for each alternative.	WWDC\Document\Rock_Springs_East-Water_Supply_Master_Plan_Level_I_Study-Final_Report-1995.pdf	11/1/95	WWDC	Document	water supply, Rock Springs, Master Plan	Kjellgren, Leon R
Rock Springs Pipeline Level II Presentation to WWDC	Summary of problems, recommended improvements, budget, and cost-benefit analysis.	WWDC\Document\Rock_Springs-Pipeline_Level_II_Study-Presentation-1989.pdf	1/1/89	WWDC	Document	pipeline, Rock Springs, water supply, presentation,	Forsgren Associates, Inc
Rock Springs Pipeline Level II Study Phase I - Final Report	Examine the problems associated with the existing pipeline from Green River to Rock Spring and the feasibility of constructing a second pipeline.	WWDC\Document\Rock_Springs-Pipeline_Level_II_Study_Phase_I-Final_Report-1988.pdf	12/1/88	WWDC	Document	pipeline, water supply, Rock Springs	Forsgren Associates
Rock Springs Pipeline Level II Study Phase II - Executive Summary	Executive summary for the Level II study which contains two Phases: Phase I (Dec 1988) included an investigation of the existing pipeline and a feasibility study for a second	WWDC\Document\Rock_Springs-Pipeline_Level_II_Study_Phase_II-Executive_Summary-1989.pdf	1/1/89	WWDC	Document	pipeline, Rock Springs, water supply	Forsegren Associates, Inc.
Rock Springs Pipeline Level II Study Phase II - Final Report	Contains the Phase II findings along with pertinent and updated sections of the Phase I report. Phase I (Dec 1988) included an investigation of the existing pipeline and a feasibility study for a second pipeline. Phase II includes an economic analysis, conceptual design, and conceptual cost estimates for the selected alternative.	WWDC\Document\Rock_Springs-Pipeline_Level_II_Study_Phase_II-Final_Report-1989.pdf	1/1/89	WWDC	Document	pipeline, Rock Springs, water supply	Forsegren Associates, Inc.
Root Wad	NRCS Design Drawing for Root Wad	NRCS\Document\NRCS Design root wad.pdf	8/1/14	NRCS	Document	root wad, design drawing	NRCS
Rubber Tire Stock Tank Details (614-02)	NRCS Design Drawing for rubber tire watering tank with interior CMP or PE pipe inlet	NRCS\Document\NRCS Design Rubber tire watering tank_Interior CMP.pdf	5/1/18	NRCS	Document	watering take, design drawing	NRCS
Rubber Tire Stock Tank Details (614-03)	NRCS Design Drawing for rubber tire watering tank with frost free hydrant	NRCS\Document\NRCS Design Rubber tire watering tank_Frost Free Hydrant.pdf	5/1/18	NRCS	Document	watering tank, design drawing	NRCS
Rubber Tire Trough	NRCS Design Drawing for Tire Trough	NRCS\Document\NRCS Design rubber tire trough.pdf	Unknown	NRCS	Document	tire stock trough, design drawing	NRCS
Sage Creek Watershed WHAM Inventory	A Level-I Wyoming Habitat Assessment Methodology (WHAM) inventory was directed at main-stem Sage Creek to fill existing data gaps for the complete habitat condition	Wy Game and Fish\Document\2002_Spence_SageCreekWatershedWHAMInvent	8/30/02	Wy Game and Fish	Document	Sage Creek, habitat	Spence, Kevin
Sage Grouse Initiative 2.0 (Investment Strategy, FY 2015-2018)	Combines plans from 11 states into one cohesive, rangewide plan which describes priorities for reducing threats to sage grouse habitat and identifies locations for projects and cost estimates	NRCS\Document\SGI2.0_Final_Report.pdf	8/1/15	NRCS	Document	sage-grouse, wildlife, conservation	NRCS
Sage Grouse Initiative Strategic Watershed Action Team Quarterly Report	Reports on the accomplishments of the Sage Grouse Initiative (SGI) Stategic Watershed Action Team (SWAT) from October – December 2017.	Other\Document\SGI-SWAT-NRCS-Quarterly-Report-October-December-2017-PARTNER.pdf	2/2/18	Other	Document	sage grouse, wildlife, conservation	Intermountain West Joint Venture
Sage-grouse hate trees: A range-wide solution for increasing bird benfits through accelerated conifer remova	Maps invasive woody plants at regional scales to evaluate landscape level impacts, drive targeted restoration actions, and monitor restoration outcomes.	Western Association of Fish and Wildlife Agencies\Document\Sage-Grouse Hate Trees.pdf	Unknown	Western Association of Fish and Wildlife Agencies	Document	sage-grouse, habitat, canopy cover	Falkowski, Michel J. et al

Title	Description	Link	Document Date	Source	Type	Keywords	Author
Sage-grouse Mapping and Priority Habitats	Displays the historic and current range of sage-grouse, Sage-grouse Management Zones, and the breeding bird density map.	Western Association of Fish and Wildlife Agencies\Document\Primer 3 SGMapping & Priority Habitats1.2.pdf	Unknown	Western Association of Fish and Wildlife Agencies	Document	sage-grouse, wildlife, habitat	WAFWA
Sage-Grouse Project Summaries	A list of previous projects which have been awarded Wyoming Sage-Grouse Conservation Funds. Includes project descriptions, and the funding amount.	Wy Game and Fish\Document\SG_PROJECTSUMMARIES.pdf	4/26/18	Wy Game and Fish	Document	sage-grouse, funding	Wy Game and Fish
Science and Management Integration Plan	Provides guidance for research needs of the WLCI, and maintains adaptive management as the framework for WLCI processes.	Other\Document\SMIP_Final 0408.doc	4/10/08	Other	Document	WLCI, science and management	WLCI
Scoping Report for the Wyoming Sage-grouse RMP Amendments	Documents the public scoping process for the Bureau of Land Management's (BLM) Wyoming Field Office Programmatic Sage-grouse Resource Management Plan (RMP)	BLM\Document\Sage-grouse_RMP_Amendments_Final_Scoping_Report_BLM.pdf	7/5/11	BLM	Document	Sage-grouse, RMP Amendments	BLM
Scoping Report for the Wyoming Sage-grouse RMP Amendments - Appendices	Includes public comments, a federal register publication: notice of intent, press releases, project newsletter, scoping meeting materials/posters	BLM\Document\Sage-grouse_RMP_Amendments_Final_Scoping_Report_Appendices_BLM.pdf	1/1/11	BLM	Document	Sage-grouse, RMP Amendments	BLM
Seepage Protection Filter (378-07a)	NRCS Design Drawing for seepage protection filter	NRCS\Document\NRCS Design Seepage protection filter.pdf	5/1/18	NRCS	Document	seepage, design drawing	NRCS
Sheet Piling Structure Capacity and Quantity Computations	NRCS Design Drawing and calculation format for sheet piling structure	NRCS\Document\NRCS Design sheetpile dam.pdf	7/1/14	NRCS	Document	sheet pile dam, design drawing	NRCS
Sheet Piling Structure with Catwalk	NRCS Design Drawing for sheet piling structure with catwalk	NRCS\Document\NRCS Design sheetpile dam with catwalk.pdf	7/1/14	NRCS	Document	dheet pile dam, catwalk, design drawing	NRCS
Small Water Projects Program 101 (Slideshow)	Describes general SWPP concepts, eligibility, recent criteria changes, project timelines, and steps to project completion.	WWDC\Document\Small Water Projects Program Slideshow_2017.pdf	11/27/17	WWDC	Document	SWPP, funding	Pavlica, Jodie (WWDO)
Sodium Mineral Development Environmental Assessment (Draft)	Analyzes the environmental impacts due to the development of trona, a source of natural soda ash in the BLM Rock Springs District	BLM\Document\SodiumMineralDevelopment_EA.pdf	8/7/81	BLM	Document	trona, sodium mineral development, soda ash, mining	BLM
Solar Panel Well and Surface Installation (533-01)	NRCS Design Drawing for solar panel well and surface installation	NRCS\Document\NRCS Design Solar Panel Well and Surface Installation.pdf	5/1/18	NRCS	Document	solar panel, well, design drawing	NRCS
South Superior Ground Water Exploration Project Interim Report No. 2	Includes a detailed summary of the exploration drilling to determine groundwater quality in the South Superior area, as well as conclusions from the initial phases of the exploration	WWDC\Document\South_Superior-Ground_Water_Exploration_Project-_No_2_Interim_Report-	1/8/82	WWDC	Document	Superior, groundwater, water supply	Tudor Engineering Company
Southwest Wyoming Sage-grouse Conservation Plan	Identifies strategies and commitments for the purpose of improving sage-grouse numbers and contributing to the rangewide effort to preclude the need for listing under the ESA.	Other\Document\SG_SW_CONSERVPLAN.pdf	11/1/13	Other	Document	sage-grouse, wildlife, conservation	The Southwest Wyoming Local Sage-grouse Working Group
Spring Development (574-01)	NRCS Design Spring Development Box with gravity flow supply outlet	NRCS\Document\NRCS Design Spring Development Box with gravity flow supply outlet.pdf	5/1/18	NRCS	Document	spring box, design drawing	NRCS
Spring Development with Pump Manifold Outlet	NRCS Design Spring Development Box with pumping system outlet	NRCS\Document\NRCS Design Spring Development Box with pumping system outlet.pdf	5/1/18	NRCS	Document	spring box, design drawing	NRCS
State Water Planning Process Feasibility Report - Executive Summary	Executive summary for the feasibility study which conducts the following tasks: Wyoming statewide public opinion survey, a basin advisory group, statewide data inventory, and a	WWDC\Document\Wyoming-State_Water_Planning_Process_Feasibility_Report-	10/1/98	WWDC	Document	state water resources, planning process	Boyle Engineering Company
State Water Planning Process Feasibility Report - Final Report	Feasibility study which conducts the following tasks: Wyoming statewide public opinion survey, a basin advisory group, statewide data inventory, and a consultant feasibility study.	WWDC\Document\Wyoming-State_Water_Planning_Process_Feasibility_Report-Final_Report-1998.pdf	10/1/98	WWDC	Document	state water resources, planning process	Boyle Engineering Company
State Wildlife Action Plan 2017	State Wildlife Action Plans (SWAPs) are comprehensive wildlife conservation strategies to maintain the health and diversity of wildlife within a state, including preventing the need for future listings under the Endangered Species	Wy Game and Fish\Document\SWAP_2017_Revised11202017.pdf	11/20/17	Wy Game and Fish	Document	SWAP, wildlife	Wy Game and Fish
Stategic Habitat Plan (2015)	Defines how the WGFD will strive to meet its mission of *Conserving Wildlife and Serving People* by working together with external partners to conserve and improve habitat.	Wy Game and Fish\Document\SHP2015_Final.pdf	8/1/15	Wy Game and Fish	Document	Habitat Plan, wildlife	WY Game and Fish
Status of Roundtail Chub, Flannelmouth Sucker, and Bluehead Sucker	Summarizes taxonomy, physical characteristics, life history information, historical and recent distribution and abundance for three fish species in the Colorado River Basin	Trout Unlimited\Document\Bezzerides and Bestgen 2002.pdf	9/1/02	Trout Unlimited	Document	Roundtail Chub, Flannelmouth Sucker, Bluehead Sucker, Colorado River Basin	Bezzerides and Bestgen
Steet Sheet Pile Drop Structure	NRCS Standard design drawing for steel sheet pile drop structure	NRCS\Document\NRCS Design sheetpile drop structure.pdf	8/1/10	NRCS	Document	sheet pile drop structure, desing drawing	NRCS
Strategic Habitat Plan	Strategies to promote and maintain the availability of high quality habitat to sustain and enhance wildlife populations in the future.	Wy Game and Fish\Document\Strategic-Habitat-Plan.pdf	1/1/09	Wy Game and Fish	Document	wildlife, habitat	Wy Game and Fish

Title	Description	Link	Document Date	Source	Type	Keywords	Author
Strategic Habitat Plan (2016 Annual Report)	Detailed plan to promote and maintain the availability of high quality habitat to sustain and enhance wildlife populations	Wy Game and Fish\Document\SHPAnnualReport2016-Website.pdf	4/1/17	Wy Game and Fish	Document	Strategic habitat plan, wyoming wildlife, game, fish	Wyoming Game and Fish Dept
Strategic Plan (WLCI)	Describes the goals and objectives of the WLCI and the strategies needed to successfully accomplish a science-based, landscape-scale initiative.	Other\Document\WLCI_Strategic_Plan_final.pdf	12/1/08	Other	Document	WLCI, strategic plan	WLCI
Stream Bank Stablization Rock Riffle Details	NRCS Design Drawing for Rock Riffle Structure	NRCS\Document\NRCS Design rock riffle.pdf	10/1/13	NRCS	Document	Bank Stabilization, rock riffle, design drawing	NRCS
Stream Barbs (580-05)	NRCS Design Drawing for stream barbs	NRCS\Document\NRCS Design Stream Barbs.pdf	5/1/18	NRCS	Document	stream barb, bank protection, stream restoration, riprap, design drawing	NRCS
Stream channel and vegetation responses to late spring cattle grazing	Studies the effects on riparian habitat of no grazing, light grazing (20–25% utilization), and medium grazing (35–50%) during late June.	Other\Document\LateSpringCattleGrazing_Clary1999.pdf	5/1/99	Other	Document	grazing, riparian habitat, vegetation, erosion	Warren P. Clary (Journal of Range Management)
Stream Classification	Presentation on the Rosgen Stream Classification System.	Other\Document\AU-2016-2-Stream-Classification.pdf	7/30/18	Other	Document	rosgen, stream classification, geomorphology	Unknown
Stream Crossing and Livestock Access (578-01)	NRCS Design Drawing for stream crossing and livestock access	NRCS\Document\NRCS Design Stream crossing and livestock access.pdf	5/1/18	NRCS	Document	livestock stream crosssing, design drawing	NRCS
Stream Restoration Design NEH - Chapter 11 Rosgen Geomorphic Channel Design	Chapter 11 of the National Engineering Handbook. Outlines use of Rosgen's classification system and Natural Channel Design	NRCS\Document\RosgenNRCS_fulldocument.pdf	8/1/07	NRCS	Document	Rosgen, Natural Channel Design, geomorphology	NRCS
Streamflows and Channels of the Green River Basin, Wyoming	Describes streamflow and hydraulic characteristics of the Green River and its tributaries. Develops relations between channel features (width, depth, area) and flow magnitude.	USGS\Document\Lowham 1982 Streamflows and Channels of the Green River Basin, WY USGS Survey.pdf	5/1/82	USGS	Document	streamflow, channel geometry, solute-transport	Lowham, H. W.
Streamflows in Wyoming	A description of the occurrence and variability of surface waters in Wyoming is presented along with explanations of both streamflow data collection and methods for estimating streamflow characteristics at gaged and ungaged sites	USGS\Document\Lowham 1988 Streamflows in Wyoming.pdf	1/1/88	USGS	Document	streamflow, wyoming, ungaged site	Lowham, H.W.
Summary of State Loan Programs and Associated Loan Loss Reserve Funds	State loan program summaries and loan schedules.	State of Wyoming\Document\Summary of State Loan Program 2015.pdf	6/30/15	State of Wyoming	Document	funding, financial assistance, loans	State of Wyoming
Summary of the Analysis of the Management Situation - Rock Springs Resource Management Plan Revision	Analyzes available inventory data and other information to characterize a particular resource, portray its existing management situation, and identify	BLM\Document\RS-RMP_Summary-of-the-AMS.pdf	8/1/13	BLM	Document	resource management	BLM
Superior Well No. 19 Aquifer Testing (Superior Water Supply Project) - Final Report	Presents the data collected during the engineering, drilling and testing of an exploratory well in the Almond Formation near the town of Superior.	WWDC\Document\Superior-Well_No_19_Aquifer_Testing_Water_Supply_Project-Final_Report-1992.pdf	7/17/92	WWDC	Document	Superior, Almond Formation, groundwater, water supply	James M. Montgomery Consulting Engineers, Inc.
Supplement to Level II Report Bitter Creek Channel Improvement Study and Level II, Phase II, Report Bitter Creek Tributary Flood Study	Simultaneously asseses information in the Bitter Creek Channel Improvement Study (Sept 1991) with information and data presented in the Bitter Creek Tributary Flood Study (Nov 1991).	WWDC\Document\Bitter_Creek-Channel_Improvement_Level_II_Tributary_Flood_Level_II_Phase_II-Supplement-1991.pdf	11/1/91	WWDC	Document	Bitter Creek Channel Improvement, Bitter Creek Tributary Flood Study, supplement	Johnson Fermelia Co. Inc.
Sweetwater County Conservation District Land and Resource Use Plan and Policy (2005)	Identifies and applies goals, objectives, and policies to the state and federal land and the rangeland, soil, water and wildlife resources.	Conservation Districts\Document\Sweetwater CD 2005 Land-Resource Plan.pdf	1/1/05	Conservation Districts	Document	SWCCD, land and resource use plan and policy	Sweetwater County Conservation District
Technical Memo: Colorado River Basin Salinity Control Program (Green River Basin Plan - 2001)	Purpose and objectives of the Colorado River Basin Salinity Control Program as part of the Environmental Quality Incentives Program.	Other\Document\salinity_lores.pdf	4/21/01	Other	Document	colorado river basin, salinity	States West Water Resources Corp.
Technical Memo: Colorado River Basin Salinity Control Program (Green River Basin Plan II - 2009)	Purpose and objectives of the Colorado River Basin Salinity Control Program as part of the Environmental Quality Incentives Program.	Other\Document\GRB_Salinity.pdf	10/23/09	Other	Document	Colorado river basin, salinity	States West Water Resources Corp.
Technical Memorandum: Green River Basin Plan II - Major Reservoir Information	Descriptions, storage, net annual evaporation, and operating notes for each major reservoir in the Green River basin	WWDC\Document\GRB_Major_Reservoir.pdf	8/10/09	WWDC	Document	green river basin, major reservoirs	WWC Engineering
Technical Memorandum: Green River Basin Plan II - Surface Water Data Synthesis & Spreadsheet Model Development	User manual for surface water spreadsheet models	Other\Document\Green River Basin Plan Task3B_UserGuide[1].pdf	6/5/09	Other	Document	Spreadsheet Model, surface water	Meg Frantz, AECOM
Technical Notes: Watering Facility Wildlife Escape Structures	Provides approved designs for wildlife escape structures in watering facilities.	NRCS\Document\Wildlife Escape Structures_Bio_No_41_2008.pdf	3/1/08	NRCS	Document	wildlife, escape stuctures	USDA
Techniques for estimating streamflow characteristics of Wyoming streams	This report presents relations for estimating peak flows and mean annual flow for natural streams in Wyoming. Two separate techniques for estimating flow characteristics are	USGS\Document\Techniques for estimating streamflow in Wyoming streams Lowham 1976.pdf	1/1/76	USGS	Document	streamflow, Wyoming	Lowham, H.W.
The Cross-Vane, W-Weir and J-Hook Vane Structures. . . Their Description, Design and Application for Stream Stabilization and River Restoration	Includes descriptions, design specifications, placement locations, spacing and various applications of Cross-Vane, W-Weir and J-Hook Vane structures.	Other\Document\Rosgen Cross Vane Structures.pdf	1/1/01	Other	Document	cross-vane, river restoration, stream stabilization	Rosgen, D.L.

Title	Description	Link	Document Date	Source	Type	Keywords	Author
The Environmental and Recreational Water Use Handbook (Part II of The Environmental and Recreation Water Use Study)	Describes protocols for river basin planning efforts that are relevant to both environmental and recreational water demand estimation. Also includes detailed recommendations for addressing existing and future demands.	WWDC\Document\Wyoming-Environmental_and_Recreational_Water_Use_Handbook-Final_Report-2012.pdf	4/18/12	WWDC	Document	environmental water use, recreational water use, water demands	Harvey Economics
The Environmental and Recreational Water Use Study - Final Report	Part I: Current estimation of environmental and recreational water demands in the yoming river basin planning process. Part II: Environmental and Recreational Water Use Handbook	WWDC\Document\Wyoming-Environmental_and_Recreational_Water_Use_Study-Final_Report-2012.pdf	4/18/12	WWDC	Document	environmental water use, recreational water use, water demands	Harvey Economics
The Wyoming GAP Analysis Project Final Report	GIS-databases were produced to describe land cover, terrestrial vertebrate species distributions, land stewardship, and and management.	Other\Document\Wyoming_GAP_Analysis.pdf	12/1/96	Other	Document	GAP, land cover, vegetation, habitat	Merrill, E. H.
Trout Creek Instream Flow Studies	Determines instream flows necessary for maintaining Colorado River cuttroat trout habitat and populations.	WWDC\Document\078-Trout_Creek_Instream_Flow_Biological_Assessment-1999.pdf	11/8/99	WWDC	Document	instream flows, colorado cutthroat trout, habitat, water rights	Day, Paul D. & Annear, Thomas C.
Upper Green River Wetland Core Complex	Regional Wetland Conservation Plan which describes local and regional wetland and riparian resources, and related conservation work and identifies project opportunities and conservation strategies adapted to address specific threats and opportunities unique to	Wy Game and Fish\Document\Upper-Green-River-Wetland-Core-Complex_ConsPlan.pdf	2/6/14	Wy Game and Fish	Document	wetland, green river basin	Wy Game and Fish
Vortex Weir	NRCS Design Drawing for vortex weir	NRCS\Document\NRCS Design vortex weir.pdf	8/1/14	NRCS	Document	rock vortex weir, design drawing	NRCS
WAFWA Greater Sage-Grouse Management Zone II	Sage Grouse Breeding Density Map	BLM\Map\Sage Grouse Breeding Densities Region 2 2010.pdf	9/1/10	BLM	Map	breeding density map	Doherty, Kevin E. et al
Water Management & Conservation Assistance Programs 2014 Directory	An overview of local, state and federal incentive assistance programs	WWDC\Document\2014-WMCAP-Directory.pdf	1/1/14	WWDC	Document	funding, economic analysis	WWDC
Water Resources of Sweetwater County, Wyoming	Quantifies the availability and describes chemical quality of the surface-water and ground-water resources in Sweetwater County.	USGS\Document\Water Resources of Sweetwater County_sir20045214.pdf	1/1/96	USGS	Document	Water Resources, Lincoln County, Wyoming	Eddy-Miller, Cheryl A. et al
Water Supply Level II Study (Green River - Rock Springs - Sweetwater County JPWB) - Executive Summary	Provides executive summary for Water Supply Level II Study which is a feasibility study for 1) raw water storage supply at the water treatment plant, and 2) water transmission,	WWDC\Document\Green_River_Rock_Springs_Sweetwater_County_JPB-Water_Supply_Level_II-Executive_Summary-2010.pdf	7/1/10	WWDC	Document	JPWB, Green River Water Treatment Plant, water supply	Nelson Engineering
Water Supply Level II Study (Green River - Rock Springs - Sweetwater County JPWB) - Final Report	Feasibility study for 1) raw water storage supply at the water treatment plant, and 2) water transmission, storage, and distribution systems in Reliance, WY. Report is broken into two parts (Pg 4: Raw Water Supply; Pg 338: Reliance Water Supply).	WWDC\Document\Green_River_Rock_Springs_Sweetwater_County_JPB-Water_Supply_Level_II-Final_Report-2010.pdf	7/1/10	WWDC	Document	water supply, storage, treatment, distribution	Nelson Engineering
Weed and Pest Declared List (By County) Amended February 2017	Declared weeds and pests listed by county	Wy Weed and Pest\Document\2017_Declared_List.pdf	2/1/17	Wy Weed and Pest	Document	Weed, Pest	Wy Weed and Pest
Westside Rock Springs Water Supply Project Level II Study - Executive Summary	Executive summary for the Level II study which identifies water supply transmission components which will increase the current level of service to the area west of Rock	WWDC\Document\Westside_Rock_Springs-Water_Supply_Project_Level_II_Study-Executive_Summary-1998.pdf	10/21/98	WWDC	Document	Rock Springs, water supply	Nelson Engineering
Westside Rock Springs Water Supply Project Level II Study - Final Report	Identifies water supply transmission components which will increase the current level of service to the area west of Rock Springs.	WWDC\Document\Westside_Rock_Springs-Water_Supply_Project_Level_II_Study-Final_Report-1998.pdf	10/21/98	WWDC	Document	Rock Springs, water supply	Nelson Engineering
Wetland Profile and Condition Assessment of the Upper Green River Basin, Wyoming	Summarizes the results of the first basin-wide assessment of wetlands in the Upper Green River Basin (UGRB) based on rigorous randomly-sampled field survey methods.	Wy Game and Fish\Document\wy-wetlands-upper-green_Assessment.pdf	9/23/15	Wy Game and Fish	Document	wetland, upper greeen river basin	Tibbets, Teresa M et al (Nature Conservancy, WGFD, WYNDD)
Wetlands and Deepwater Habitats Classification	Chart used to classify wetlands and deepwater habitats by system, subsystem, class, and subclass	USACE\Document\Wetlands-and-Deepwater-Habitats-Classification-chart.pdf	1/1/79	USACE	Document	Wetlands, Classification	Cowardin et al
Where the Wild Lands Are: Wyoming	Importance of backcountry areas to wyoming fish, wildlife, hunting and angling	Trout Unlimited\Document\TU_Roadless_WYO_f.pdf	1/1/06	Trout Unlimited	Document	roadless, wild lands	Trout Unlimited
Who's on the Lek: a Guide to Players	A guide to some of the stakeholders that have either been important in the long-term management of sage-grouse and sagebrush, or are actively engaged in affecting	Western Association of Fish and Wildlife Agencies\Document\Primer 2 SGWho's on the Lek.pdf	Unknown	Western Association of Fish and Wildlife Agencies	Document	sage-grouse, wildlife, conservation	WAFWA
Wildfire and Invasive Species in the West: Challenges that Hinder Current and Future Management and Protection of the Sagebrush-steppe Ecosystem	Summarizes the policy, fiscal and science challenges that land managers encounter related to the control and reduction of the invasive plant/fire complex, especially as it relates to the threaten or endangered species listing status of the Greater sage-grouse.	Western Association of Fish and Wildlife Agencies\Document\Wildfire-Invasive-WG-Final-Gap-Analysis-Report-Final.pdf	12/1/13	Western Association of Fish and Wildlife Agencies	Document	sage-gouse, invasive species, fire	WAFWA
Wildlife Guzzler Type A (636-5)	NRCS Design Drawing for Type A Wildlife Guzzler	NRCS\Document\NRCS Design Wildlife Guzzler Type A.pdf	10/27/10	NRCS	Document	wildlife guzzler, design drawing	NRCS

APPENDIX 4A

GEOLOGIC UNIT DESCRIPTIONS

Appendix 4A - Geologic Units in the Bitter Creek Watershed
(compiled from Jones et al., 2010; Roehler, 2004; and Clarey et al., 2010)[1]

CENOZOIC GEOLOGIC UNITS
Quaternary geologic units

Qa Alluvium and colluvium (Holocene-Pleistocene) - Clay, silt, sand, and gravel present in flood plains, fans, terraces, and slopes.

Qal Alluvial deposits (Holocene-Pleistocene) - Alluvial deposits within flood plains, river channels, and lowest (Holocene) terrace deposits along major rivers and streams, may include minor alluvial fan deposits and colluvium. Thickness up to approximately 40 ft.

Qt Gravel, pediment, and fan deposits (Holocene-Pleistocene) - Mostly locally derived clasts; locally includes some Tertiary gravels.

Qls Landslide deposits (Holocene-Pleistocene) - Locally includes intermixed land-slide and glacial deposits, talus, and rock-glacier deposits.

Qs Sand Dunes (Pleistocene -Holocene) - Elongated dunes, stabilized by desert vegetation. Thickness 0 - 25 ft.

Qsa Active wind-blown deposits (Holocene) - Sand and minor amounts of silt in active sand dunes. Thickness variable.

Qss Stabilized wind-blown deposits (Holocene) - Sand and minor amounts of silt in stabilized sand dunes. Thickness variable.

Qtg Terrace deposits (Holocene, Pleistocene, and Pliocene?) - Unconsolidated and poorly consolidated stream-deposited gravel, sand, and silt; thickness variable.

Qi Alkalic extrusive and intrusive igneous rocks (Pleistocene) - Leucite- and nepheline-rich flows, scoria, and necks.

Quaternary and upper Tertiary igneous and volcanic units

QTt Lamproite talus and autobreccias

Qtp Lamproite pumice and scoria

Qtv Lamproite volcaniclastics

Qtl Lamproite lavas and flows
Upper Tertiary geologic units

[1]Thicknesses reported in 10-meter increments have been converted to the nearest 25 feet.

Tm Miocene-age rocks undivided - Pale-green to tan tuffaceous sandstone and claystone of Miocene(?) age. Conglomerate of uncertain correlation locally present at the base.

Tbp Browns Park Formation (Oligocene - Miocene) - Gray, fine- to coarse-grained, tuffaceous sandstone and interbedded gray to white tuff, gray siltstone, and gray and red Mudstone. Thickness 0 - 625 ft.

Tbi Bishop Conglomerate (Oligocene) - Reddish-brown conglomerate composed of angular to subrounded boulders, cobbles, and pebbles of granite, gneiss, quartzite, chert, sandstone, and limestone. Thickness 0 - 200 ft.

Lower Tertiary geologic units

Twl Washakie Formation

Twka - Adobe Town Member - Interbedded gray to gray-green, fine - to very coarse-grained, partly tuffaceous sandstone; gray and red, calcareous, tuffaceous siltstone; gray, green, or variegated mudstone; brown and gray, silty limestone; yellow-brown, silty dolomite; green, blue-green, and gray tuff; and tan and gray conglomerate. Thickness 975 ft.

Twkk - Kinney Rim Member - Interbedded gray, gray-green, or variegated mudstone; gray to graygreen, very fine- to medium-grained sandstone; yellow-gray, gray-brown, and gray-green tuff; tan-gray and gray-brown limestone; gray and gray-green tuffaceous siltstone; algal limestone; and thin, lenticular conglomerate. Thickness 0 to 975 ft.

Tg Green River Formation

Tgl Laney Member

Tglh - Hartt Cabin Bed - Interbedded gray and tan, fine- to coarse-grained sandstone; gray and brown siltstone; gray, brown, and green mudstone; gray and brown shale; brown oil shale; gray or white tuff; limestone; and dolomite. Thickness 0 to 700 ft.

Tgls - Sand Butte Bed - Interbedded tan to gray, partly tuffaceous, very fine- to coarse-grained sandstone; tan to gray, mostly tuffaceous siltstone; gray-green to gray-brown mudstone; gray limestone; gray, mollusk-bearing limestone; algal limestone; tan-gray and white tuff; and brown oil shale. Thickness 0 to 975 ft.

Tgll - LaClede Bed - Mostly brown to black oil shale. Some interbedded buff, tuffaceous siltstone, olive-gray marlstone, tan to gray tuff, gray and brown mudstone, graybrown and tan-brown dolomite, algal limestone, buff limestone, gray-green claystone, and gray-green, fine-grained sandstone. Thickness 450 to 600 ft.

Tglb - Basal unnamed tongue - Interbedded gray, fine-grained sandstone; brown oil shale; green mudstone; gray-green shale; and gray ostracodal, oolitic, and algal limestone. Thickness 50 ft.

Tgwt Wilkins Peak and Tipton Shale Members

Tgw Wilkins Peak Member - Green, brown, and gray tuffaceous sandstone, shale, and marlstone, with evaporites (halite, trona, nacholite, and related minerals) in subsurface sections. Thickness 0 - 1200 ft.

Tgt Tipton Shale Member - Gray to brown oil shale; interbedded gray-brown oolitic limestone, graybrown siltstone, and shale; tan to gray-brown algal limestone; and gray, fine-grained mollusk-bearing sandstone. Thickness 50 to 325 ft.

Tglu Luman Tongue - Mostly brown oil shale and thin, interbedded grey-brown coquinal limestone; gray fine-grained calcareous sandstone; gray siltstone; gray to gray-brown claystone and mudstone; brown to black carbonaceous shale; and brown-gray dolomite. Thickness 0 to 450 ft.

Tw Wasatch Formation

Twcu Upper unit of Cathedral Bluffs Tongue - Green, gray, and some variegated mudstone, and interbedded gray, fine- to coarse-grained, arkosic sandstone. Thickness 0 to 100 ft.

Twc Cathedral Bluffs Tongue - Grey, green, and variegated mudstone; interbedded fine- to coarse-grained, partly crossbedded sandstone; and minor thin beds of gray- brown sha1e, algal limestone, oolitic limestone, and gray calcareous siltstone . Thickness 550 to 1300 ft.

Twn Niland Tongue - Interbedded brown-gray shale; gray, fine-grained sandstone; gray limestone; brown and gray carbonaceous shale; coal; and brown oil shale. Thickness 0 to 425 ft.

Twm Main body - Interbedded gray claystone; gray, green, and variegated mudstone; gray and brown fossiliferous limestone; gray, fine- to medium·grained sandstone; gray calcareous siltstone; gray and brown carbonaceous shale; and coal. Thickness 1300 to 2125 ft.

Tfu Fort Union Formation - Gray shale; interbedded gray siltstone; gray, very fine- to coarse-grained sandstone: gray and brown carbonaceous shale; and coal. Thickness 1225 to1600 ft.

MESOZOIC GEOLOGIC UNITS

Upper Cretaceous geologic units

Kfl Lance and Fox Hills Formations

Kla/Kl Lance - Dark gray shale, inter-bedded gray, very fine-grained sandstone, dark gray carbonaceous shale, coal, and gray, silty dolomite. Thickness 0 to 200 ft.

Kfh Fox Hills - Gray, fine-grained sandstone, tan and gray siltstone, and interbedded dark gray shale. Thickness 0 to 250 ft.

Kle Lewis Shale (Upper Cretaceous) - Dark gray shale and thin interbedded gray siltstone and sandstone. Thickness 0 to 600 ft.

Kmv MESA VERDE GROUP

Kal Almond Formation - Gray, very fine-grained sandstone and interbedded gray shale, gray si ltstone, brown and gray carbollaceous shale, and coal. Thickness 625 to 925 ft.

Ke Ericson Sandstone

Kec - Canyon Creek zone - Light-gray, fine- to very coarse-grained, cross-bedded sandstone. Thickness 350 to 4 00 ft.

Ker - Rusty zone - Gray, fine- to medium-grained sandstone and interbedded gray, partly hematitic siltstone and gray, silty shale. Thickness 300 to 325 ft.

Ket - Trail zone - Light-gray, very fine- to fine-grained, cross bedded sandstone and sparse, thin, interbedded, gray, shaly siltstone. Thickness 450 to 550 ft.

Krs/Kr Rock Springs Formation

Krsu - Upper part - Gray, fine-grained sandstone; and interbedded gray calcareous siltstone, gray shale, gray and brown carbonaceous shale, and a few very thin beds of coal. Thickness 200 to 250 ft.

Krsb - Black Butte Tongue - Gray, silty shale; and very thin, interbedded gray siltstone and gray, very fine-grained sandstone. Thickness 750 to 925 ft.

Krsc - Chimney Rock Tongue - Gray, fi ne-grained sandstone and some interbedded gray siltstone and gray shale. Thickness 100 to 175 ft.

Kbl Blair Formation

Kbl - Main body - Gray shale and thin, interbedded gray siltstone and gray, fine-grained sandstone. Thickness 1400 to 1625 ft.

Kbls - Basal sandstone - Gray, very fine- to fine-grained sandstone and interbedded gray sillstone and gray silty shale. Thickness 350 to 400 ft.

Kba Baxter Shale Dark-gray shale intcrbedded with a few very thin beds of gray siltstone. Thickness 2300 ft.

APPENDIX 4B

WYOMING STATE ENGINEER GROUNDWATER PERMITS

Appendix 4B - Wyoming State Engineer's Office Groundwater Permits in the Bitter Creek Watershed

Permit No.	Priority	Status[1]	Twp	Rng	Sec	Qtr/Qtr	Applicant	Facility Name	Uses[2]	Yield (gpm)	Depth to Water[3] (ft)	Total Depth (ft)	Main Water-Bearing Zone	
													Top (ft)	Bottom (ft)
P71456.0W	6/13/1985	INC	12	105	15	SENW	CHEVRON CHEMICAL COMPANY	PO4 PUMP STATION FRENCH DRAIN	MIS	6	15	15		
P75744.0W	10/2/1987	INC	12	105	15	SENW	USDI - BLM / CHEVRON RESOURCES CO.	ENL PO 4 TRAILER PARK #1	MIS	0	32	180	130	167
P73062.0W	8/12/1986	FADJ	12	105	15	SENW	USDI - BLM / CHEVRON RESOURCES CO.	PO4 TRAILER PARK #1	MIS	25	32	180	130	167
P40388.0W	8/22/1977	COM	12	106	17	NWNE	WILLOW CREEK LAND AND LIVESTOCK INC.	DISHNER #1	DOM_GW	5	19	99	79	99
P86401.0W	10/14/1991	INC	12	106	18	SWSW	Willow Creek Land & Livestock	STEVENS #1	MIS	20	38	290	269	290
P95507.0W	6/6/1994	COM	13	104	35	NENE	LERRICK ADAM	RED CREEK #1	DOM_GW; STK	12	70	500	260	280
P165026.0W	1/18/2005	INC	14	101	6	NWNW	WARREN E & P INC	PRFED 14101 NW 6	CBM	50				
P168812.0W	6/23/2005	COM	14	101	10	SWSW	WARREN E & P INC	RR FED 14101-13-10	CBM	5	1316	4100	3094	3964
P168813.0W	6/23/2005	COM	14	101	10	NESW	WARREN E & P INC	RR FED 14101-11-10	CBM	5	1492	4425	3313	4176
P160343.0W	6/28/2004	COM	14	101	10	SWSE	WARREN E & P INC	RR FED 14101-15-10	CBM	5	1500	4330	3444	4330
P160344.0W	6/28/2004	COM	14	101	10	NESE	WARREN E & P INC	RR FED 14101-9-10	CBM	5	1592	4508	3556	4403
P168814.0W	6/23/2005	COM	14	101	10	SWNW	WARREN E & P INC	RR FED 14101-5-10	CBM	5	1613	4425	3413	4302
P168815.0W	6/23/2005	COM	14	101	10	NENW	WARREN E & P INC	RR FED 14101-3-10	CBM	5	1723	4505	3547	4468
P168816.0W	6/23/2005	COM	14	101	10	NENE	WARREN E & P INC	RR FED 14101-1-10	CBM	5	1784	4675	4111	4198
P160345.0W	6/28/2004	COM	14	101	11	SWSW	WARREN E & P INC	RR FED 14101-13-11	CBM	5	1670	4525	3652	4525
P160342.0W	6/28/2004	COM	14	101	11	SWNW	WARREN E & P INC	RR FED 14101-5-11	CBM	5	1678	4671	3668	4671
P99971.0W	8/7/1995	COM	14	101	20	NWSE	VERMILLION RANCH LIMITED PARTNERSHIP	WINTER RANCH #1	DOM_GW; STK	14	110	220	174	198
P56408.0W	3/17/1981	COM	14	101	20	NESE	MCKEE JR. CLYDE A.	EAST DRAW #1	DOM_GW; STK	3	150	380		
P190475.0W	6/3/2009	COM	14	101	22	SWSW	State Board of Land Comm/ Vermillion Ranch LP	EAST DRAW #1	STK	5	260	400	345	400
P102234.0W	5/7/1996	INC	14	103	10	SENE	ARAMBEL PETER & JOHN	PETE ARAMBEL #1	STK	0	-7	300		
P177009.0W	8/31/2006	INC	15	101	10	SWNE	WARREN E & P, INC.	RIFES RIM 7-10	CBM	30				
P160400.0W	6/28/2004	COM	15	101	29	NESW	WARREN E & P INC	PR FED 15101 SW29	CBM	9		3086	2554	2657
P160403.0W	6/28/2004	INC	15	101	29	SWSE	WARREN E & P INC	PR FED 15101 SE29	CBM	18		3160	2773	2849
P160401.0W	6/28/2004	COM	15	101	29	NENW	WARREN E & P INC	PR FED 15101 NW29	CBM	23		3210	2745	2876
P152872.0W	7/25/2003	COM	15	101	30	SWSW	WARREN E & P INC	PRFED 15101 SW30	CBM	12	-4	2320	1953	2045
P152873.0W	7/25/2003	COM	15	101	30	SESE	WARREN E & P INC	PRFED 15101 SE30	CBM	30	-4	2669	2326	2480
P160404.0W	6/28/2004	COM	15	101	30	SWNW	WARREN E & P INC	PR FED 15101 NW30	CBM	25		2709	2164	2249
P160405.0W	6/28/2004	COM	15	101	30	SENE	WARREN E & P INC	PR FED 15101 NE30	CBM	20		2985	2497	2614
P152874.0W	7/25/2003	COM	15	101	31	NWNW	WARREN E & P INC	PRFED 15101 MW31	CBM	23	-4	2120	1562	1950
P152875.0W	7/25/2003	COM	15	101	31	NWSW	WARREN E & P INC	PRFED 15101 SW31	CBM	13	-4	2262	1796	1938
P143038.0W	3/1/2002	COM	15	101	31	NENE	WARREN E & P, INC.	TRUE FEDERAL # 31-1	CBM	25	-4	2557	2341	2459
P152876.0W	7/25/2003	COM	15	101	31	SWSE	WARREN E & P INC	PRFED 15101 SE31	CBM	2	-4	2564	2102	2236
P152877.0W	7/25/2003	COM	15	101	32	NWNW	WARREN E & P INC	PRFED 15101 NW32	CBM	19	-4	2810	2467	2635
P160399.0W	6/28/2004	COM	15	101	32	NENE	WARREN E & P INC	PR FED 15101 NE32	CBM	32		3115	2656	2812
P160791.0W	6/22/2004	COM	15	102	33	SENE	Pine Mtn Evap & Reclam LLC/BLM/Wyo State Board of Land Comm	FORTY-1	MIS	35	40	75		
P204002.0W	6/1/2015	INC	15	102	33	SENE	ROCKY MOUNTAIN RECYCLE INC	FORTY-1	MIS	38				
P143040.0W	3/1/2002	COM	15	102	36	SESE	WARREN E & P, INC. / Wyo State Board of Land Commissioners	STATE #1-36	CBM	25	-4	1928	1835	1842
P152878.0W	7/25/2003	COM	15	102	36	NWNE	Wyo State Board of Land Commissioners / WARREN E & P INC	PR STATE 15102 NE36	CBM	12	-4	2046	1336	1713
P182222.0W	7/9/2007	INC	15	102	36	SENE	USDI - BLM/Wyo State Board of Land Comm/Hyland Enterprises, Inc	PINE MOUNTAIN #1	IND_GW; MIS	35				
P162578.0W	9/9/2004	INC	15	102	36	NWNE	BLM/Wyo State Board of Land Comm/Pine Mtn Evap & Reclam LLC	FORTY-2	MIS	35				
P201162.0W	9/18/2013	INC	15	102	36	NWNE		FORTY - 2	MIS	35				
P148463.0W	12/20/2002	INC	16	98	3	NWNW	BP America Production Co.	KINNEY SPRINGS #3-1	MIS	50				
P204709.0W	10/14/2015	INC	16	98	33	NENE		GRIZZLY ROSE APC	MIS	0				
P125.0C	12/3/1942	INC	16	99	3	SESE	Union Pacific Railroad	ANTELOPE SPRINGS #1	NULL	100	19	140	84	104
P127.0C	6/30/1942	INC	16	99	11	NWNW	Union Pacific Railroad	ANTELOPE SPRINGS #3	NULL	200	34	235	125	150
P126.0C	3/31/1942	INC	16	99	11	NWNW	Union Pacific Railroad	ANTELOPE SPRINGS #2	NULL	200	36	255	170	236
P128.0C	9/12/1943	INC	16	99	11	SWNW	Union Pacific Railroad	ANTELOPE SPRINGS #4	NULL	250	44	308	130	165
P142774.0W	2/20/2002	INC	16	99	11	NESW	BP America Production Co.	BITTER CREEK #11-1 WATER WELL	MIS	80	300	1350	1220	1240
P495.0G	10/9/1956	INC	16	99	22	NWSW	OIL COMPANY SHELL	BITTER CREEK UNIT 1	IND_GW	15	160	309	230	307
P119.0G	9/27/1951	INC	16	101	10	NESE	MOUNTAIN FUEL RESOURCES, INC.	W.T. NIGHTINGALE WATER WELL #1	NULL	67	285	335	285	230
P34713.0W	8/27/1976	INC	16	101	11	NENE	Champlin Petroleum Co.	ENL #1 BRADY GAS PLANT	IND_GW	17	300	2136	1630	1690
P29506.0W	6/25/1974	FADJ	16	101	11	NENE	Champlin Petroleum Co.	#1 BRADY GAS PLANT	MIS	3	300	2136	1630	1690
P23648.0W	5/25/1973	INC	16	101	12	NWNW	Champlin Petroleum Co.	BRADY UNIT #4	IND_GW	20	390	700	510	390
P26819.0W	3/25/1974	INC	16	101	27	NWNW	Champlin Petroleum Co.	#12 WATER	IND_GW	20	460	700	460	600
P10188.0W	9/7/1967	INC	16	104	6	NWSE	KAPPES HENRY CHARLES	KAPPES #2	IRR_GW; STK	250	25	60	30	60
P10187.0W	9/7/1967	INC	16	104	6	NESE	KAPPES HENRY CHARLES	KAPPES WELL #1	IRR_GW; STK	150	70	105		
P181.0C	9/29/1936	INC	16	104	8	SESE	MOUNTAIN FUEL RESOURCES, INC.	M.F. WHELAN WATER WELL #1	DOM_GW	42	78	120	100	120
P34232.0W	6/29/1976	COM	16	106	19	SWNE	ROCK SPRINGS GRAZING ASSOCIATION	ROCK SPRINGS GRAZING ASSOC. #1	STK	3		840		
P1036.0W	6/7/1963	FADJ	16	107	22	SESE	USDA - National Forest Service	FIREHOLE DEVELOPMENT #1	DOM_GW; MIS	10		990	890	990
P133244.0W	3/26/2001	INC	17	97	13	SWSW	BP America Production Co. / BP America Production Co.	CHAMPLIN 271 AMOCO "C" #1	MIS	150				
P177783.0W	9/7/2006	COM	17	97	29	SESW	USDI - BLM / BP America Production Co.	CHAMPLIN 271 AMOCO B #1 WATER WELL	MIS	50	15	640	440	640
P25965.0W	2/13/1974	INC	17	100	4	SWSE	Champlin Petroleum Co.	CHAMPLIN #14	IND_GW	20	670	700	465	670
P85441.0W	5/31/1991	COM	17	103	8	SWNE	GORDON RAY D.	GORDON 1	DOM_GW	25	4	80		
P128322.0W	7/27/2000	COM	17	103	8	NWNW	BEAN STEVE	BEAN #1	DOM_GW	25	5	45	24	45
P69982.0W	4/29/1985	COM	17	103	8	SENE	ARNETT WILLIAM L. & GLADYS F.	ARNETT #1	DOM_GW; STK	7	5	100	80	100
P174617.0W	5/10/2006	COM	17	103	8	SWNE	PEEL ANTHONY	PEEL #1	DOM_GW	12	8	60	45	60
P83621.0W	9/24/1990	COM	17	103	8	SENE	MITCHELL SANDRA L. / WOODWARD BRUCE D.	WOODWARD #1	DOM_GW	6	12	95	63	95
P37477.0W	4/22/1977	COM	17	103	8	SENE	WARREN GARY G.	ROSITA #1	DOM_GW	20	12	100	85	100
P85370.0W	6/12/1991	COM	17	103	8	SWNE	SPAIN ROBERT	SPAIN #1	DOM_GW	1	25	90	70	

Appendix 4B - Wyoming State Engineer's Office Groundwater Permits in the Bitter Creek Watershed

Permit No.	Priority	Status[1]	Twp	Rng	Sec	Qtr/Qtr	Applicant	Facility Name	Uses[2]	Yield (gpm)	Depth to Water[3] (ft)	Total Depth (ft)	Main Water-Bearing Zone	
													Top (ft)	Bottom (ft)
P60420.0W	4/26/1982	COM	17	103	8	SWSW	C. L. JONES DRILLING / ZIEGLER GARY D.	ZIEGLER #1	DOM_GW	7	40	80	65	80
P49135.0W	7/12/1979	COM	17	103	8	NENW	BURNETT RODNEY L. & LINDA L.	BURNETT #1	DOM_GW	25	50	100	85	100
P78666.0W	12/12/1988	COM	17	103	8	SWNE	SHAPIRO JUDITH L.	SCOTT #1	DOM_GW	8	60	100	60	100
P165482.0W	2/9/2005	INC	17	103	8	NENW	Leseberg Neal	LESEBERG #1	DOM_GW; MIS	25				
P194.0W	7/20/1959	INC	17	104	10	NWSE	QUASTAR PIPELINE COMPANY	STATE LAND WATER WELL #1	DOM_GW; MIS	6	-4	17	16	
P180.0C	9/3/1936	INC	17	104	26	SENE	MOUNTAIN FUEL RESOURCES, INC.	JOSEPH HAY WATER WELL #1	DOM_GW	30	140	222	148	178
P63286.0W	2/9/1983	COM	17	107	1	NENW	GREEN RIVER LIVESTOCK COMPANY / RADOSEVICH JOHN E.	S B F #1	DOM_GW; STK	25	14	18		
P111103.0W	7/27/1998	INC	17	107	1	NENW	GREEN RIVER LIVESTOCK	Taliaferro #1	DOM_GW	0				
P74149.0W	2/27/1987	COM	18	96	20	SESE	USDI - BLM / P. H. LIVESTOCK CO.	DELANY #1	STK	25				
P178994.0W	11/22/2006	COM	18	96	31	SWSW	PH LIVESTOCK CO.	ENL. CHAMPLIN 534 AMOCO A WATER WELL #1	MIS	80	188	308		
P153419.0W	8/20/2003	COM	18	96	31	SWSW	PH LIVESTOCK COMPANY	CHAMPLIN 534 AMOCO A WATER WELL #1	STK	10	188	308		
P27992.0W	9/3/1974	INC	18	97	30	SWSE	Texaco, Inc.	BRIDWELL #1	IND_GW	36	800	3015	2074	2915
P11.0C	10/3/1945	INC	18	98	1	NWNW	THE TEXAS COMPANY	TABLE ROCK UNIT WATER WELL #1	IND_GW	14	250	572	498	517
P26031.0W	1/22/1974	FADJ	18	98	1	NWNE	Texaco Production Dept.	TABLE ROCK UNIT WATER WELL #5	MIS	13	380	657	616	647
P142768.0W	10/26/2001	COM	18	98	1	NWNW	TEXACO EXPLORATION & PRODUCTION, INC.	TABLE ROCK UNIT WATER WELL NO. 1	MIS	180	400	2831	2330	2560
P53452.0W	8/20/1980	INC	18	98	14	SWNW	USDI - BLM / HOUSTON OIL & MINERALS CORPORATION	WSW #1-14	IND_GW	50	245	570	440	469
P154821.0W	11/4/2003		18	98	22	NWNW	USDI - BLM / Anadarko Petroleum	HIGGINS #17 WSW	MIS	100				
P32.0G	12/3/1948	INC	18	98	28	SENW	TEXAS CO.	SOUTHWEST TABLE ROCK UNIT WATER WELL #1	IND_GW	14	100	240	200	226
P26454.0W	4/10/1974	INC	18	98	28	SWNW	Champlin Petroleum Co.	HIGGINS #1 WATER	IND_GW	20	580	700	650	670
P1883.0W	3/23/1967	INC	18	99	1	NWSE	ANADARKO E & P COMPANY LP	MONELL WSW #3	IND_GW	468		4040	2481	3055
P205006.0W	12/4/2015	INC	18	99	1	NWSE		ENL. MONELL WSW #3	MIS	0				
P1881.0W	3/23/1967	INC	18	99	2	SENW	ANADARKO E & P COMPANY, LP	MONELL WSW #1	IND_GW	452	300	3685	2123	2608
P1882.0W	3/23/1967	INC	18	99	10	NESE	ANADARKO E & P COMPANY LP	MONELL WSW #2	IND_GW	475		3580	2203	2762
P133632.0W	1/3/2001	COM	18	100	1	NENW	INFINITY OIL AND GAS OF WYOMING	Pipeline # 1-1-18-100	CBM	0	73	2898	1048	1344
P139214.0W	8/31/2001	COM	18	100	1	SWSW	INFINITY OIL AND GAS OF WYOMING	PIPELINE # 1-9-18-100	CBM	6	82	1495	1180	1400
P139212.0W	8/31/2001	COM	18	100	1	NWNE	INFINITY OIL AND GAS OF WYOMING	PIPELINE # 1-7-18-100	CBM	10	92	1670	1324	1553
P139213.0W	8/31/2001	COM	18	100	1	NESE	INFINITY OIL AND GAS OF WYOMING	PIPELINE # 1-8-18-100	CBM	8	102	1905	1466	1768
P139211.0W	8/31/2001	COM	18	100	1	NENW	INFINITY OIL AND GAS OF WYOMING	PIPELINE # 1-6-18-100	CBM	0	181	2903	1353	2588
P133635.0W	1/3/2001	COM	18	100	1	SWSW	INFINITY OIL AND GAS OF WYOMING	Pipeline # 1-4-18-100	CBM	5	183	2979	2628	2936
P133636.0W	1/3/2001	COM	18	100	1	NESW	INFINITY OIL AND GAS OF WYOMING	Pipeline # 1-5-18-100	CBM	0	193	3154	2748	3028
P133633.0W	1/3/2001	COM	18	100	1	NWNE	INFINITY OIL AND GAS OF WYOMING	Pipeline # 1-2-18-100	CBM	1	200	3154	2647	2962
P133634.0W	1/3/2001	COM	18	100	1	NESE	INFINITY OIL AND GAS OF WYOMING	Pipeline # 1-3-18-100	CBM	1	209	3414	2980	3293
P154985.0W	10/23/2003	INC	18	100	1	SWSE	INFINITY OIL AND GAS OF WYOMING	PIPELINE #1-12-18-100	CBM	25				
P71453.0W	7/26/1985	INC	18	100	5	SWNW	Black Butte Coal Co.	ENL SQUAWFISH #1	MIS	0	-4	675	414	688
P90326.0W	10/30/1992	INC	18	100	5	SWNW	Black Butte Coal Co.	ENL SQUAWFISH #1	MIS	0	-4	675	414	688
P87589.0W	3/30/1992	INC	18	100	5	SWNW	Black Butte Coal Co.	ENL SQUAWFISH #1	MIS	0	-4	675	414	688
P87590.0W	3/30/1992	INC	18	100	5	NENW	Black Butte Coal Co.	ENL SQUAWFISH #2	MIS	0	-4	675	414	688
P70416.0W	5/9/1985	INC	18	100	5	SWNW	Black Butte Coal Co.	ENL SQUAWFISH #1	MIS	150	-4	675	414	688
P69248.0W	12/31/1984	INC	18	100	5	SWNW	Black Butte Coal Co.	SQUAWFISH #1	MIS	500	-4	675	414	688
P71454.0W	7/26/1985	INC	18	100	5	NENW	Black Butte Coal Co.	ENL SQUAWFISH #2	MIS	0	-4	760	545	785
P90327.0W	10/30/1992	INC	18	100	5	NENW	Black Butte Coal Co.	ENL SQUAWFISH #2	MIS	0	-4	760	545	785
P70417.0W	5/9/1985	INC	18	100	5	NENW	Black Butte Coal Co.	ENL SQUAWFISH #2	MIS	150	-4	760	545	785
P69249.0W	12/31/1984	INC	18	100	5	NENW	Black Butte Coal Co.	SQUAWFISH #2	MIS	500	-4	760	545	785
P87387.0W	1/15/1992	INC	18	100	7	NENW	Black Butte Coal Co.	PIT 8	MIS	600				
P6790.0W	9/28/1970	INC	18	100	8	SWSW	FOLKS L. B. & VIRGINIA A.	BAXTER WATER WELL #2	IRR_GW; STK	500	-4	2070	900	1200
P142810.0W	2/13/2002		18	100	11	NWSE	INFINITY OIL & GAS OF WYOMING, INC.	PIPELINE #11-3-18-100	CBM	25				
P142813.0W	2/13/2002		18	100	11	SENE	INFINITY OIL & GAS OF WYOMING, INC.	PIPELINE #11-7-18-100	CBM	25				
P142811.0W	2/13/2002		18	100	11	SWSW	INFINITY OIL & GAS OF WYOMING, INC.	PIPELINE #11-4-18-100	CBM	25				
P142815.0W	2/13/2002		18	100	11	SWSW	INFINITY OIL & GAS OF WYOMING, INC.	PIPELINE #11-9-18-100	CBM	25				
P142808.0W	2/13/2002		18	100	11	NWNW	INFINITY OIL & GAS OF WYOMING, INC.	PIPELINE #11-1-18-100	CBM	25				
P142814.0W	2/13/2002		18	100	11	NWSE	INFINITY OIL & GAS OF WYOMING, INC.	PIPELINE # 11-8-18-100	CBM	25				
P142812.0W	2/13/2002		18	100	11	NWNW	INFINITY OIL & GAS OF WYOMING, INC.	PIPELINE # 11-6-18-100	CBM	25				
P142809.0W	2/13/2002		18	100	11	SENE	INFINITY OIL & GAS OF WYOMING, INC.	PIPELINE #11-2-18-100	CBM	25				
P141038.0W	11/27/2001	COM	18	100	12	SESE	INFINITY OIL & GAS OF WYOMING, INC.	PIPELINE FEDERAL #12-3-18-100	CBM	1	-4	3570	3119	3476
P141036.0W	11/27/2001	COM	18	100	12	NWNW	INFINITY OIL & GAS OF WYOMING, INC.	PIPELINE FEDERAL #12-1-18-100	CBM	3		3150	2714	2772
P141039.0W	11/27/2001	COM	18	100	12	SESW	INFINITY OIL & GAS OF WYOMING, INC.	PIPELINE FEDERAL #12-4-18-100	CBM	1		3431	3018	3357
P141037.0W	11/27/2001	COM	18	100	12	SWNE	INFINITY OIL & GAS OF WYOMING, INC.	PIPELINE FEDERAL #12-2-18-100	CBM	2		3490	2714	2772
P145207.0W	6/3/2002	COM	18	100	13	SESW	INFINITY OIL & GAS OF WYOMING, INC.	PIPELINE #13-4R-18-100	CBM	0	-4	3400	2986	3317
P141004.0W	11/14/2001	COM	18	100	13	SWNW	INFINITY OIL & GAS OF WYOMING, INC.	PIPELINE # 13-1-18-100	CBM	1		3360	3185	3495
P141005.0W	11/14/2001	COM	18	100	13	NENE	INFINITY OIL & GAS OF WYOMING, INC.	PIPELINE #13-2-18-100	CBM	1		3620	3185	3495
P141006.0W	11/14/2001	COM	18	100	13	NESE	INFINITY OIL & GAS OF WYOMING, INC.	PIPELINE # 13-3-18-100	CBM	4		3740	3312	3637
P154986.0W	10/23/2003	INC	18	100	13	NWNE	INFINITY OIL AND GAS OF WYOMING	PIPELINE #13-12-18-100	CBM	25				
P30220.0W	5/6/1975	INC	18	100	18	SWSW	USDI - BLM / Black Butte Coal Co.	CHANDLER SIMPSON #1 BLACK BUTTE GOVERNMENT	IND_GW	250		4932	685	2070
P56050.0W	2/2/1981	INC	18	100	20	NESE	USDI - BLM / Black Butte Coal Co.	ENL OF DARTER #2	MIS	250	30	2000	1740	2000
P51015.0W	11/16/1979	INC	18	100	20	NESE	USDI - BLM / Black Butte Coal Co.	DARTER #2	MIS	350	30	2000	1740	2000
P32194.0W	1/26/1976	INC	18	101	13	NENW	Black Butte Coal Co.	BB 1773-75	MIS	0	71	102	70	85
P499.0C	12/31/1916	INC	18	101	18	NWNW	Brooks Isaac N.	BROOKS #1	DOM_GW; IRR_GW; STK	250	8	400	350	
P500.0C	12/31/1916	INC	18	101	18	SENW	Brooks Isaac N.	BROOKS #2	DOM_GW; IRR_GW; STK	250	8	400	350	
P69518.0W	2/21/1985	INC	18	104	17	NWSE	Chevron Chemical Co.	SEEPAGE COLLECTION DITCH	IND_GW; MIS	250				

Appendix 4B - Wyoming State Engineer's Office Groundwater Permits in the Bitter Creek Watershed

Permit No.	Priority	Status[1]	Twp	Rng	Sec	Qtr/Qtr	Applicant	Facility Name	Uses[2]	Yield (gpm)	Depth to Water[3] (ft)	Total Depth (ft)	Main Water-Bearing Zone	
													Top (ft)	Bottom (ft)
P1657.0W	3/3/1966	INC	18	104	28	SESW	SWEETWATER COUNTY	KOLMAN WELL #3	IRR_GW; STK	50	4	30	10	30
P1655.0W	3/3/1966	INC	18	104	28	SESW	SWEETWATER COUNTY	KOLMAN WELL #1	IRR_GW	5	4	35	10	35
P85905.0W	8/12/1991	FADJ	18	104	28	SESW	SWEETWATER COUNTY	ARROWHEAD PARK #3	MIS	100	15	60	25	30
P183474.0W	9/28/2007	COM	18	104	28	SESW	SWEETWATER COUNTY RECREATION BOARD	ARROWHEAD SPRINGS #3	MIS	45	15	140	35	115
P76442.0W	4/5/1985	INC	18	104	28	SESW	KOLMAN JR. ALBERT T.	KOLMAN #10	IRR_GW	5	18	35		
P1656.0W	3/3/1966	INC	18	104	28	SESW	SWEETWATER COUNTY	KOLMAN WELL #2	IRR_GW; STK	5	30	80	40	80
P89214.0W	8/21/1992	COM	18	104	28	NWSW	SCHOENFELD GEORGE W.	SCHOENFELD #1	DOM_GW	15	30	113	76	85
P72027.0W	3/19/1986	COM	18	104	28	NWSW	ROGERS JR. PETER H. AND PATRICIA L.	TRICIA #1	DOM_GW	25	30	200	160	175
P181548.0W	6/7/2007	COM	18	104	28	SESW	BORDERS MARK AND GRETCHEN	BORDERS #1	DOM_GW	12	30	200		
P101363.0W	1/26/1996	COM	18	104	28	SWSW	TAN LO-FU	KOLMAN #12	DOM_GW	10	33	110	90	100
P79634.0W	4/26/1989	COM	18	104	28	SWSW	HRUSKA RANDAL AND PAMELA	HRUSKA #1	DOM_GW	25	33	310	274	278
P71992.0W	3/5/1986	COM	18	104	28	NWSW	CHITWOOD BILL D.	CHITHOOK #1	DOM_GW	10	35	140	103	107
P94155.0W	12/20/1993	COM	18	104	28	SWSW	VAN BALEN DR. CLAY	VAN BALEN #1	DOM_GW	15	45	235	98	105
P72916.0W	7/14/1986	COM	18	104	28	NWSW	DUNDER JIM	ENL DUNDER #1	DOM_GW	2	50	130	99	106
P72161.0W	4/10/1986	COM	18	104	28	NWSW	DUNDER JIM	DUNDER #1	DOM_GW	10	50	130	99	106
P189132.0W	10/29/2008	COM	18	104	28	NWSW	DUNDER JAMES AND LYNN A.	DUNDER #2	DOM_GW	12	52	292	149	154
P74001.0W	11/6/1986	COM	18	104	28	NWSW	MOORE STEVEN L. AND KAY S.	MOORE #1	DOM_GW	5	52	300	280	285
P71799.0W	1/23/1986	COM	18	104	28	SWSW	STROHL RICHARD & KRISTINE	STROHL #1	DOM_GW	10	55	60	55	
P77590.0W	7/18/1988	COM	18	104	28	NWSW	PERZINSKI MARGARET & ARNOLD	ENL COTTONTAIL #1	DOM_GW	3	55	180	95	162
P75796.0W	9/25/1987	COM	18	104	28	NWSW	PERZINSKI MARGARET & ARNOLD	COTTONTAIL #1	DOM_GW	10	55	180	95	162
P73049.0W	8/7/1986	COM	18	104	28	NWSW	CINDA S LEVITT LIVING TRUST	ENL SANDERS #1	DOM_GW	3	57	265	252	257
P71779.0W	1/20/1986	COM	18	104	28	NWSW	CINDA S LEVITT LIVING TRUST	SANDERS #1	DOM_GW	10	57	265	252	257
P73906.0W	4/5/1985	COM	18	104	28	SWSW	Kolman, Jr. Albert T.	KOLMAN #9	STK	5	60	90		
P91686.0W	5/19/1993	COM	18	104	28	SWSW	CINDA S LIVING TRUST	GRIFFIN #1	DOM_GW	18	60	250	155	160
P180515.0W	3/26/2007	COM	18	104	28	NWSW	CARNAHAN KEITH	KEITH #1	DOM_GW	5	60	260	95	105
P73126.0W	8/13/1986	COM	18	104	28	NWSW	GOETSCH DAVID AND BARBARA	GOETSCH #1	DOM_GW	13	78	160	115	135
P93040.0W	9/22/1993	COM	18	104	28	SWSW	SPANN KENNETH N & TAMARA	SPANN #1	DOM_GW	10	80	160	110	115
P71960.0W	2/26/1986	COM	18	104	28	NWSW	EYRING CARL EDWARD & JENNIFER	EYRING #1	DOM_GW	14	80	260	187	260
P98144.0W	12/21/1994	COM	18	104	28	NWSW	STROHL RICHARD & KRISTINE	STROHL #1	DOM_GW; STK	14	110	230	180	190
P92725.0W	8/27/1993	COM	18	104	28	NWSW	CROSS KENDALL L. AND DENISE M.	CROSS #1	DOM_GW; STK	12	140	200	100	200
P193934.0W	8/25/2010	INC	18	104	28	SWSW	KOLMAN ALBERT	KOLMAN WELL NO. 7	MIS	10			55	60
P193933.0W	8/25/2010	INC	18	104	28	SWSW	KOLMAN ALBERT	KOLMAN WELL NO. 11	MIS	90			58	65
P193930.0W	8/25/2010	INC	18	104	28	SWSW	KOLMAN ALBERT	KOLMAN WELL NO. 4	MIS	25			240	260
P186163.0W	3/27/2008	INC	18	104	28	NWSW	SPANN KENNETH AND TAMARA	SPANN #2	DOM_GW	15				
P183372.0W	9/24/2007	INC	18	104	28	SWSW	DRAKE STEVE & KELLI	DRAKE #1	DOM_GW	25				
P189683.0W	2/20/2009	INC	18	104	28	NWSW	KOLMAN AL	WINEFRIDE	DOM_GW	25				
P193932.0W	8/25/2010	INC	18	104	28	SWSW	KOLMAN ALBERT	KOLMAN WELL NO. 6	MIS	8				
P193931.0W	8/25/2010	INC	18	104	28	SWSW	KOLMAN ALBERT	KOLMAN WELL NO. 5	MIS	10				
P76441.0W	4/5/1985	INC	18	104	33	NWNW	KOLMAN JR. ALBERT T.	KOLMAN #8	IRR_GW	40	10	210	10	195
P111427.0W	8/17/1998	INC	18	105	2	SWSE	AUSTIN MYLES & KAREN	Austin #1	TST	0				
P69860.0W	3/25/1985	FADJ	18	105	5	NENE	MCBRIDE WAYNE & LORALEE	WAYNES #1	DOM_GW; MIS	20	30	65	30	
P54825.0W	11/17/1980	FADJ	18	105	5	NENE	EALES FRED L.	EALES #1	MIS	20	60	120	100	120
P167000.0W	4/26/2005	COM	18	105	6	NESE	CONOCO PHILLIPS	ROCK SPRINGS TERMINAL INTERCEPTOR TRENCH	MIS	2	18	25		
P68788.0W	10/17/1984	FADJ	18	105	6	NWSE	VOLSEY JACK J. & NORMA J. / MASEK JOHN A.	MASEK #1	MIS	25	32	220	172	181
P45932.0W	11/17/1978	FADJ	18	105	6	NULL	Anselmi Rudolph/Huntly Freemen/Melinkovich Joseph/HMA Realty	ENL HMA #2	MIS	0	39	220	160	225
P2910.0W	8/28/1969	FADJ	18	105	6	SENE	HMA REALTY	HMA #1	MIS	20	40	230	40	
P45933.0W	11/17/1978	FADJ	18	105	6	SENE	Melinkovich Joseph/HMA Realty/Anselmi Rudolph/Huntly Freemen	ENL HMA #1	MIS	0	40	230		
P24388.0W	8/30/1973	FADJ	18	105	6	NULL	HMA REALTY	HMA #2	MIS	50	45	220	160	225
P10302.0W	9/7/1971	INC	18	105	6	SESW	VOLCIC FRANK W.	VOLCIC #2	DOM_GW; MIS	28	55	206	110	200
P1182.0W	4/15/1964	INC	18	105	14	SWNE	KEMMERER COAL CO	GUNN QUEALY #1	IND_GW	15	22	1420	1344	
P142886.0W	1/7/2002	INC	18	105	18	SENW	MARSHALL RICK	MARSHALL # 1	DOM_GW; MIS	7	160	190	160	180
P66542.0W	2/28/1984	FADJ	18	105	20	NWSW	USDI, BLM / SWEETWATER COUNTY	LANDFILL #1 WELL	MIS	25	52	900	480	900
P161340.0W	7/15/2004	INC	18	106	11	NWSW	HETLINGER REALTY	ZANETTI #2	MIS	25				
P66694.0W	3/26/1984	FADJ	18	106	12	NWSW	WARCO PUMP SERVICE	WARCO #1	MIS	15	60	240	193	210
P7829.0W	1/20/1971	INC	18	106	15	NENW	Union Pacific Railroad Co / U.S. Bureau of Mines	USBM SITE 6 WATER WELL	IND_GW	5	160	540	455	540
P20370.0W	1/31/1973	INC	18	106	15	SWNW	Union Pacific Railroad Co / USDI, Bureau of Mines	USBM SITE 9 WATER WELL	IND_GW	10	900	900	860	900
P43711.0W	6/8/1978	COM	18	106	31	SWSW	KELLEY WILLIAM JOHN & KATHY	KELLEY #2	DOM_GW	25	7	28		
P38978.0W	3/22/1977	COM	18	106	31	SWSW	KELLEY WILLIAM JOHN & KATHY	KELLEY #1	DOM_GW	25	8	29	8	18
P102115.0W	4/18/1996	COM	18	107	26	NWNE	OWENS O.D.	OWENS #1	STK	10	12	20		
P9442.0W	5/3/1971	FADJ	18	107	36	SESW	Green Acres Recreation Club	SCOTTS' BOTTOM WATER SYSTEM #1	MIS	25	7	12	7	12
P194162.0W	10/13/2010	COM	19	97	19	NWSE	CHEVRON U.S.A., INC.	TABLE ROCK UNIT BATTERY 3	IND_GW	12	1	6927		
P9630.0W	7/1/1971	COM	19	97	19	NWNW	Union Pacific Railroad	TABLE ROCK #1	DOM_GW	5	70	270	555	570
P50387.0W	10/22/1979	COM	19	97	19	SWNE	P H Livestock Co.	TABLE ROCK #2	STK	10	80	200		
P150183.0W	3/10/2003	INC	19	97	19	NWSW	Chevron USA INC / P & H Livestock / Anadarko E & P CO, LP	TABLEROCK UNIT 123 WSW	MIS	80	155	540	370	81
P194163.0W	10/13/2010	COM	19	97	19	SENE	CHEVRON U.S.A., INC.	TABLE ROCK UNIT #53	IND_GW	7	800	6876		
P194161.0W	10/13/2010	INC	19	97	19	SESE	CHEVRON U.S.A., INC.	TABLE ROCK UNIT #79	IND_GW	80				
P74518.0W	4/23/1987	COM	19	97	21	SENE	P H Livestock Co.	TABLE ROCK #3	STK	2	210	380	335	340
P110360.0W	6/12/1998	COM	19	98	7	NESW	ROCK SPRINGS GRAZING ASSOC.	ANGUS 1	STK	10	-4	230	180	
P31517.0P	7/28/1975	COM	19	98	7	SENW	ROCK SPRINGS GRAZING ASSOCIATION	PATRICK DRAW	STK	10	-4	550	245	550

Appendix 4B - Wyoming State Engineer's Office Groundwater Permits in the Bitter Creek Watershed

Permit No.	Priority	Status[1]	Twp	Rng	Sec	Qtr/Qtr	Applicant	Facility Name	Uses[2]	Yield (gpm)	Depth to Water[3] (ft)	Total Depth (ft)	Main Water-Bearing Zone	
													Top (ft)	Bottom (ft)
P17023.0P	6/4/1962	COM	19	98	7	NESE	Wyo State Dept. of Transportation	PATRICK DRAW #1	DOM_GW	25	45	697	330	335
P109002.0W	2/26/1998	INC	19	98	7	SWNW	Wyo State Dept. of Transportation	M.P. 146 #1	MIS	25				
P110812.0W	6/24/1998	INC	19	98	7	NENW	Wyo State Dept. of Transportation / Rock Springs Grazing Assoc	Enl. Patrick Draw Well	MIS; STK	0				
P191515.0W	8/18/2009	COM	19	98	8	NWSW	WYDOT	PATRICK DRAW #3	MIS	30	23	715	460	715
P191514.0W	8/18/2009	COM	19	98	8	NWSW	WYDOT	PATRICK DRAW #2	MIS	45			495	634
P42531.0W	3/16/1978	FADJ	19	98	9	SWNE	Colorado Interstate Gas	DESERT SPRINGS #1	MIS	25	38	750	482	690
P196458.0W	8/12/2011	INC	19	98	10	NWNE	BUREAU OF LAND MANAGEMENT / RED DESERT CATTLE CO.	TABLE ROCK #5	STK	25				
P64579.0W	5/31/1983	FADJ	19	98	11	SESE	Colorado Interstate Gas	ENL VILLAGE WELL #1	MIS	0			208	460
P64578.0W	5/31/1983	FADJ	19	98	11	SESE	Colorado Interstate Gas	ENL VILLAGE WELL #1	MIS	0			208	460
P62547.0W	9/20/1982	FADJ	19	98	11	SESE	Colorado Interstate Gas	ENL VILLAGE WELL #1	MIS	0			208	460
P62548.0W	9/20/1982	FADJ	19	98	11	SESE	Colorado Interstate Gas	ENL VILLAGE WELL #1-A	MIS	0			208	460
P35509.0W	10/12/1976	FADJ	19	98	11	SESE	Colorado Interstate Gas	VILLAGE WELL #1 A	MIS	50			208	460
P47143.0W	3/15/1979	FADJ	19	98	11	SESE	Colorado Interstate Gas	VILLAGE #1	MIS	75			208	460
P73017.0W	7/28/1986	FADJ	19	98	11	SESE	Colorado Interstate Gas	VILLAGE WELL #3	MIS	75			282	312
P42166.0W	1/31/1978	FADJ	19	98	11	SESE	Colorado Interstate Gas	ENL VILLAGE WELL #1-A	MIS	25			350	420
P196578.0W	7/27/2011	INC	19	98	11	NESE	WYDOT	TABLE ROCK #1	MIS	70				
P100873.0W	10/30/1995	FADJ	19	98	12	SWSW	TABLE ROCK STATION LLC	#1 REPLACEMENT WELL	DOM_GW; MIS	14	65	253	215	245
P34816.0W	8/23/1976	FADJ	19	98	23	SWNE	Rock Springs Grazing Assoc / Colorado Interstate Gas Co.	TABLE ROCK #1	IND_GW; MIS	50	60	601	310	370
P64759.0W	4/1/1983	INC	19	98	23	SWNE	Colorado Interstate Gas	ENL TABLE ROCK #1	MIS	0	60	601	310	370
P64760.0W	4/1/1983	FADJ	19	98	23	NWSE	Colorado Interstate Gas	ENL TABLE ROCK #2	MIS	0	60	603	392	470
P37252.0W	3/31/1977	FADJ	19	98	23	NWSE	Rock Springs Grazing Assoc / Colorado Interstate Gas Co.	TABLE ROCK #2	MIS	30	60	603	392	470
P169635.0W	9/6/2005	UNA	19	98	23	SENW	CHEVRON U.S.A. INC	TRP-WW6	MIS; MIS; MIS	60	65	620	340	600
P52803.0W	6/25/1980	FADJ	19	98	23	SWNE	CHEVRON USA INC	TABLE ROCK #4	IND_GW	50	85	610	430	540
P64762.0W	4/1/1983	FADJ	19	98	23	SWNE	Colorado Interstate Gas	ENL TABLE ROCK #4	MIS	0	85	610	430	540
P59378.0W	1/4/1982	FADJ	19	98	23	SWNE	CHEVRON USA INC	TABLE ROCK #5	IND_GW	55	114	634	512	544
P64763.0W	4/1/1983	FADJ	19	98	23	SWNE	Colorado Interstate Gas	ENL TABLE ROCK #5	MIS	0	114	634	512	544
P74517.0W	4/23/1987	COM	19	98	33	NWNW	P H Livestock Co.	BAR X #2	STK	5	90	340	180	185
P38641.0W	7/5/1977	COM	19	98	35	NWNE	P H LIVESTOCK COMPANY	TABLE ROCK #1	STK	10	100	350	220	230
P31518.0P	7/28/1975	COM	19	99	6	SWSE	ROCK SPRINGS GRAZING ASSOCIATION	ELECTRIC	STK	20	84	400	250	400
P79966.0W	5/30/1989	FADJ	19	99	10	NWNE	Wyo State Highway Dept.	BITTER CREEK #3	MIS	25	155	457	410	445
P70737.0W	7/23/1985	INC	19	99	10	NWNE	Wyo State Highway Dept.	BITTER CREEK #5	MIS	25	189	460		
P169890.0W	8/15/2005	FADJ	19	99	10	NWNE	USDI BLM / TRANSPORTATION COMMISSION OF WYOMING	BITTER CREEK #7	MIS	40				
P169889.0W	8/15/2005	FADJ	19	99	10	NWNE	USDI BLM / TRANSPORTATION COMMISSION OF WYOMING	BITTER CREEK #9	MIS	40				
P67971.0W	7/16/1984	FADJ	19	99	11	NWNE	Wyo State Highway Dept.	BITTER CREEK #2	MIS	25	56	400	330	360
P79967.0W	5/30/1989	FADJ	19	99	11	NWNE	Wyo State Highway Dept.	BITTER CREEK #4	MIS	25	340	378	322	359
P1796.0W	10/27/1966	INC	19	99	12	SESW	Forest Oil Corp.	ARCH UNIT W-12-1	IND_GW	120	500	3539	3201	3394
P1731.0W	8/12/1966	INC	19	99	13	SWNE	Forest Oil Corp.	ARCH UNIT W-13-1	IND_GW	120	300	3667	3273	3597
P160772.0W	6/21/2004	COM	19	99	25	SWSE	DUKE ENERGY FIELD SERVICES, LP	PD - #1 - DUKE WW	IND_GW; MIS	50		490	438	470
P151464.0W	5/5/2003		19	99	35	SWSW	ANADARKO	MONELL OFFICE WSW 35-1	MIS	80				
P168605.0W	6/23/2005	INC	19	99	35	SWSW	ANADARKO PETROLEUM CORP.	MONELL OFFICE WSW 35-1	MIS; STK	80				
P172986.0W	1/23/2006	INC	19	100	10	SESE	USDI - BLM / Black Butte Coal Co.	PIT 11 DEWATER WELLS	MIS	100				
P172990.0W	1/23/2006	INC	19	100	11	NWSW	USDI - BLM / Black Butte Coal Co.	PIT 11 DEWATER WELLS	MIS	100				
P172987.0W	1/23/2006	INC	19	100	11	SWSW	USDI - BLM / Black Butte Coal Co.	PIT 11 DEWATER WELLS	MIS	100				
P172989.0W	1/23/2006	INC	19	100	11	NESW	USDI - BLM / Black Butte Coal Co.	PIT 11 DEWATER WELLS	MIS	100				
P172988.0W	1/23/2006	INC	19	100	11	SESW	USDI - BLM / Black Butte Coal Co.	PIT 11 DEWATER WELLS	MIS	100				
P85363.0W	6/10/1991	INC	19	100	11	NWSE	Black Butte Coal Co.	RED HILL #1	MIS	200				
P85364.0W	6/10/1991	INC	19	100	11	NWSE	Black Butte Coal Co.	RED HILL #2	MIS	200				
P86584.0W	8/12/1991	INC	19	100	11	NESW	Black Butte Coal Co.	PIT 11	MIS	1000				
P86583.0W	8/12/1991	INC	19	100	13	NENW	BLACK BUTTE COAL CO.	PIT 10	MIS	1000				
P133640.0W	1/3/2001	COM	19	100	23	NESW	INFINITY OIL AND GAS OF WYOMING	Pipeline #23-4-19-100	CBM	1	130	2277	1864	2110
P133637.0W	1/3/2001	COM	19	100	23	NWNW	INFINITY OIL AND GAS OF WYOMING	Pipeline #23-1-19-100	CBM	1	133	2308	1912	2156
P133641.0W	1/3/2001	COM	19	100	23	NESW	INFINITY OIL AND GAS OF WYOMING	Pipeline #23-5-19-100	CBM	1	138	2377	1971	2210
P133639.0W	1/3/2001	COM	19	100	23	SWSE	INFINITY OIL AND GAS OF WYOMING	Pipeline # 23-3	CBM	0	138	2501	2136	2428
P133638.0W	1/3/2001	COM	19	100	23	SWNE	INFINITY OIL AND GAS OF WYOMING	Pipeline #23-2-19-100	CBM	1	147	2491	2113	2365
P142823.0W	2/13/2002		19	100	26	NWSW	INFINITY OIL & GAS OF WYOMING, INC.	PIPELINE FEDERAL #26-9-19-100	CBM	25				
P142821.0W	2/13/2002		19	100	26	SENE	INFINITY OIL & GAS OF WYOMING, INC.	PIPELINE FEDERAL #26-7-19-100	CBM	25				
P142817.0W	2/13/2002		19	100	26	SWNE	INFINITY OIL & GAS OF WYOMING, INC.	PIPELINE FEDERAL #26-2-19-100	CBM	25				
P142816.0W	2/13/2002		19	100	26	NWNW	INFINITY OIL & GAS OF WYOMING, INC.	PIPELINE FEDERAL #26-1-19-100	CBM	25				
P142822.0W	2/13/2002		19	100	26	SWSE	INFINITY OIL & GAS OF WYOMING, INC.	PIPELINE FEDERAL # 26-8-19-100	CBM	25				
P142818.0W	2/13/2002		19	100	26	SWSE	INFINITY OIL & GAS OF WYOMING, INC.	PIPELINE FEDERAL #26-3-19-100	CBM	25				
P142819.0W	2/13/2002		19	100	26	SWSW	INFINITY OIL & GAS OF WYOMING, INC.	PIPELINE FEDERAL #26-4-19-100	CBM	25				
P142820.0W	2/13/2002		19	100	26	NWNW	INFINITY OIL & GAS OF WYOMING, INC.	PIPELINE FEDERAL #26-6-19-100	CBM	25				
P67580.0W	5/29/1984	INC	19	100	29	SESE	Black Butte Coal Co.	ENL DARTER #1	MIS	200	80	2077	1770	2038
P45085.0W	9/19/1978	INC	19	100	29	SESE	Black Butte Coal Co.	DARTER #1	IND_GW; MIS	300	1770	2077	1770	2038
P69272.0W	1/17/1985	INC	19	100	29	SESE	Black Butte Coal Co.	ENL DARTER #1	MIS	0	1770	2077	1770	2038
P83660.0W	9/24/1990	INC	19	100	33	SESW	Black Butte Coal Co.	ENL BLUEBELL 13	MIS	0	-6	1219	929	1219
P204942.0W	2/26/1987	INC	19	100	33	SESW	Black Butte Coal Co.	BLUEBELL 13	MIS	230	-6	1219	929	1219
P142801.0W	2/13/2002		19	100	35	NWNE	INFINITY OIL & GAS OF WYOMING, INC.	PIPELINE #35-2-19-100	CBM	25				
P142805.0W	2/13/2002		19	100	35	NWNE	INFINITY OIL & GAS OF WYOMING, INC.	PIPELINE # 35-7-19-100	CBM	25				

Appendix 4B - Wyoming State Engineer's Office Groundwater Permits in the Bitter Creek Watershed

Permit No.	Priority	Status[1]	Twp	Rng	Sec	Qtr/Qtr	Applicant	Facility Name	Uses[2]	Yield (gpm)	Depth to Water[3] (ft)	Total Depth (ft)	Main Water-Bearing Zone	
													Top (ft)	Bottom (ft)
P142806.0W	2/13/2002		19	100	35	SESE	INFINITY OIL & GAS OF WYOMING, INC.	PIPELINE #35-8-19-100	CBM	25				
P142803.0W	2/13/2002		19	100	35	NESW	INFINITY OIL & GAS OF WYOMING, INC.	PIPELINE # 35-4-19-100	CBM	25				
P142800.0W	2/13/2002		19	100	35	NENW	INFINITY OIL & GAS OF WYOMING, INC.	PIPELINE #35-1-19-100	CBM	25				
P142802.0W	2/13/2002		19	100	35	SESE	INFINITY OIL & GAS OF WYOMING, INC.	PIPELINE #35-3-19-100	CBM	25				
P142804.0W	2/13/2002		19	100	35	NENW	INFINITY OIL & GAS OF WYOMING, INC.	PIPELINE #35-6-19-100	CBM	25				
P142807.0W	2/13/2002		19	100	35	NESW	INFINITY OIL & GAS OF WYOMING, INC.	PIPELINE # 35-9-19-100	CBM	25				
P145031.0W	5/28/2002		19	100	36	NWNW	INFINITY OIL & GAS OF WYOMING, INC.	PIPELINE STATE #36-6-19-100	CBM	25				
P145027.0W	5/28/2002		19	100	36	NWNW	INFINITY OIL & GAS OF WYOMING, INC.	PIPELINE STATE #36-1-19-100	CBM	25				
P145029.0W	5/28/2002		19	100	36	NWSE	INFINITY OIL & GAS OF WYOMING, INC.	PIPELINE STATE #36-3-19-100	CBM	25				
P145032.0W	5/28/2002		19	100	36	SWNE	INFINITY OIL & GAS OF WYOMING, INC.	PIPELINE STATE #36-7-19-100	CBM	25				
P145028.0W	5/28/2002		19	100	36	SWNE	INFINITY OIL & GAS OF WYOMING, INC.	PIPELINE STATE #36-2-19-100	CBM	25				
P145033.0W	5/28/2002		19	100	36	NWSE	INFINITY OIL & GAS OF WYOMING, INC.	PIPELINE STATE #36-8-19-100	CBM	25				
P145030.0W	5/28/2002		19	100	36	SWSW	INFINITY OIL & GAS OF WYOMING, INC.	PIPELINE STATE #36-4-19-100	CBM	25				
P145034.0W	5/28/2002		19	100	36	NESW	INFINITY OIL & GAS OF WYOMING, INC.	PIPELINE STATE #36-9-19-100	CBM	25				
P187975.0W	8/19/2008	INC	19	101	3	NENW	BLM/State Board of Land Comm/GMT Exploration Co	SHIPROCK #3-1	MIS	120				
P186993.0W	4/22/2008	INC	19	101	4	SWSE	USDI-BLM / GMT ENERGY CORP.	SHIPROCK FEDERAL #34-4	MIS	175				
P876.0W	6/15/1962	INC	19	103	18	SWSW	Baxter Water Co.	CHARLES E. STONE #1	IND_GW	350	-6	4120	4090	
P105620.0W	4/28/1997	INC	19	104	2	SWSW	USDI - BLM / WYOMING INTERSTATE GAS CO	BAXTER #1	MIS	25				
P89468.0W	9/10/1992	COM	19	104	4	SESW	BESSO MARGIE / BESSO MARTIN J. & BARBARA J.	BESSO #1	DOM_GW	12	170	450	385	400
P26151.0W	3/11/1974	COM	19	104	23	SENE	UNION PACIFIC RAILROAD COMPANY	BAXTER #1	DOM_GW	5	180	340	265	275
P89610.0W	10/5/1992	COM	19	104	28	SWSW	WEIMER JACK W. AND JEANIE L.	WEIMER #2	DOM_GW; STK	10	40	113	85	95
P83330.0W	8/21/1990	INC	19	104	30	SWSW	Wyo State Highway Dept.	EAST INTERCHANGE #1	MIS	0	38	420	234	270
P39801.0W	7/26/1977	INC	19	105	2	SESW	STARLITE JADE MINING COMPANY INC.	BIG MAX #1	DOM_GW; IND_GW; MIS	40	25	120	80	110
P443.0C	02/25/1947	INC	19	105	2	SWNW	PACIFIC POWER AND LIGHT COMPANY	RELIANCE 2A	MIS; MUN_GW	200	30	865	670	880
P442.0C	10/24/1945	INC	19	105	2	SWW	PACIFIC POWER AND LIGHT COMPANY	RELIANCE NO. 7	MIS; MUN_GW	200	30	880	780	880
P193098.0W	10/8/2009	INC	19	105	3	NENE	CITY OF ROCK SPRINGS	ENL. ROCK SPRINGS GOLF COURSE #7	MIS	100				
P196772.0W	9/9/2011	UNA	19	105	3	NENE	CITY OF ROCK SPRINGS	2ND. ENL. ROCK SPRINGS RECREATION WELL #7	MIS	425				
P183920.0W	10/15/2007	UNA	19	105	3	NENE	CITY OF ROCK SPRINGS	ROCK SPRINGS GOLF COURSE #7	MIS	600				
P65245.0W	8/31/1983	COM	19	105	4	SWSW	GUTHRIE ART & BONNIE	MELINKOVICH #1	DOM_GW	20	10	150		
P80976.0W	10/5/1989	COM	19	105	4	SWSW	GUNDERMAN WILLIAM G.	GUNDERMAN #1	DOM_GW; STK	25	45	300		
P23123.0P	9/6/1962	COM	19	105	4	NESE	MCKINNEY DENVER P.	DENVER #1	DOM_GW	25	50	202		
P62974.0W	1/13/1983	FADJ	19	105	4	SWSW	ARNOLDI WILLIAM J. & CARMAN J.	ARNOLDI #3	DOM_GW; MIS	25	70	345	285	291
P6625.0P	12/10/1965	COM	19	105	4	SWSE	RETEL JOE A.	BRENDA #1	DOM_GW	20	75	316		
P50408.0W	10/25/1979	COM	19	105	4	SWSW	HAGER JOHN A. & LUCINDA J.	HAGER #1	DOM_GW; STK	15	80	215	180	195
P20206.0P	3/30/1963	COM	19	105	4	SESE	SCHULTZ DONNA V.	SCHULTZ #1	DOM_GW	20	80	225	165	225
P52330.0W	6/5/1980	COM	19	105	4	SWSW	KIRBY CHARLES & CYNTHIA	KIRBY 1	DOM_GW	20	85	200	170	200
P69689.0W	3/25/1985	COM	19	105	4	NESW	JOHNSON KENNETH F. & CAROL L.	JOHNSON #1	DOM_GW	13	85	220	185	210
P73179.0W	8/11/1986	COM	19	105	4	SESW	RICH COULSON A. & CHERRIE L.	FORDE #1	DOM_GW	14	90	220	190	210
P84034.0W	11/15/1990	COM	19	105	4	NESW	ACKERMAN STANLEY L.	ACKERMAN #1	DOM_GW; STK	25	90	240	220	239
P49017.0W	7/5/1979	COM	19	105	4	NESW	BUCKENDORF MARVIN & LILLIAN	BUCKENDORF #1	DOM_GW	10	90	250	180	250
P72603.0W	5/27/1986	COM	19	105	4	SWSE	SHOEMAKER NICK & JANET	SHOEMAKER #1	DOM_GW	13	90	260	210	230
P51709.0W	3/27/1980	COM	19	105	4	NESW	PRUITT ROSETTA OR KEITH	PRUITT #1	DOM_GW	20	90	345	300	322
P10642.0W	7/22/1971	COM	19	105	4	SESW	GARCIA GILBERT & DENEISE SHUTTS	GARCIA #3 (DEEPENED)	DOM_GW	18	90	376	376	
P24202.0P	8/14/1968	COM	19	105	4	NESW	KOCIK PET	KOCIK #1	DOM_GW	20	94	240	140	170
P97503.0W	10/10/1994	COM	19	105	4	SESW	FLOR BOB JOE	ROCKIN BJ #1	DOM_GW; STK	15	95	110	90	110
P8591.0W	4/15/1971	COM	19	105	4	NULL	MOFFATI WILLIAM G. & CHRISTEEN	SHEDDEN #1	DOM_GW	24	95	210	110	210
P24644.0W	9/13/1973	COM	19	105	4	SESW	PATE CALLIE MACK	PATE #1	DOM_GW	17	100	208	135	200
P51713.0W	4/2/1980	COM	19	105	4	SESW	CHRISTENSEN KARL D. & VICKIE L.	CHRISTENSEN #1	DOM_GW; STK	21	105	240	220	230
P47532.0W	4/19/1979	COM	19	105	4	NESW	SPENCE CONSTRUCTION COMPANY / FOSTER STEVE	SPENCE #1	DOM_GW	10	108	200	170	200
P88814.0W	7/6/1992	COM	19	105	4	NESW	MEYER MICHAEL W. AND EVA L.	MEYER #1	DOM_GW	10	110	150	110	
P24861.0P	3/13/1963	COM	19	105	4	SESE	GOINGS J. D.	GOINGS #1	DOM_GW	20	110	225	170	180
P24406.0W	9/11/1973	COM	19	105	4	SESW	SERMON ELTON G.	SERMON #1	DOM_GW	6	110	240	110	240
P77229.0W	6/15/1988	COM	19	105	4	SWSW	NEWBY LOWELL & SUSAN	NEWBY #1	DOM_GW	25	114	280	252	263
P35870.0W	1/5/1977	COM	19	105	4	NESW	BORZEA JAMES M & LYDIA A.	BORZEA #1	DOM_GW	13	120	235	218	235
P87267.0W	3/3/1992	COM	19	105	4	SWSE	NAGEL CALVIN W.	NAGEL #1	DOM_GW	8	125	395		
P49539.0W	8/21/1979	COM	19	105	4	SWSE	KLI NAC	KLI NAC #109	DOM_GW	8	130	160	110	160
P6834.0P	7/31/1965	COM	19	105	4	SWSE	SMITH BARBARA D. / SMITH FRANK F.	SMITH #1	DOM_GW	25	130	255		
P57838.0W	8/6/1981	COM	19	105	4	NESW	DALTON GLENN & KATHY	DALTON #1	DOM_GW	15	135	400	280	400
P49536.0W	8/21/1979	COM	19	105	4	SWSE	KLI NAC	KLI NAC #10	DOM_GW	8	140	160	110	160
P59576.0W	3/3/1982	COM	19	105	4	SWSE	MUIR GRANT A.	MUIR #1	DOM_GW	20	140	220		
P26555.0W	4/17/1974	COM	19	105	4	SESE	SCHYLTZ LARRY A. & BETTY JEAN	SCHULTZ #2	DOM_GW	25	140	250		
P85360.0W	6/3/1991	INC	19	105	4	NWNE	ROCK SPRINGS HUMANE SOCIETY	RSHS #1	MIS	12	140	350	145	155
P57453.0W	7/9/1981	COM	19	105	4	NESW	PYZYNA PHILIP J. & DEBBIE L.	PYZYNA #1	DOM_GW	7	140	390	370	390
P128728.0W	8/29/2000	COM	19	105	4	SESW	CHEESEMAN MICHAEL & LINDE	CHEESE #1	DOM_GW; STK	25	140	485	220	450
P86328.0W	9/30/1991	COM	19	105	4	SESW	BAKER ROBERT J. & SUE	BAKER #1	DOM_GW	24	150	294	235	250
P30621.0W	7/31/1975	COM	19	105	4	SESW	FRIES MARTHA E.	FRIES #2	DOM_GW	25	160	220	180	220
P9500.0W	4/27/1971	COM	19	105	4	SWSW	CLARK GERALD R.	CLARK #1	DOM_GW	13	165	210	165	210
P20905.0W	4/30/1973	COM	19	105	4	SWSW	HORNSBY WILLIAM & DONA	WATER WELL #1	DOM_GW	25	170	220	180	186
P10641.0W	7/22/1971	INC	19	105	4	SWSW	GARCIA SAM	GARCIA #2	MIS	50	170	240	170	240

Appendix 4B - Wyoming State Engineer's Office Groundwater Permits in the Bitter Creek Watershed

Permit No.	Priority	Status[1]	Twp	Rng	Sec	Qtr/Qtr	Applicant	Facility Name	Uses[2]	Yield (gpm)	Depth to Water[3] (ft)	Total Depth (ft)	Main Water-Bearing Zone	
													Top (ft)	Bottom (ft)
P31300.0W	10/10/1975	COM	19	105	4	SESW	BONOMO CHUCK OR KAREN	BONOMO 1	DOM_GW	20	180	210	170	200
P57451.0W	7/6/1981	COM	19	105	4	SENW	LOPEZ EDDIE M.	HILLYER #2	DOM_GW	5	180	240		
P87787.0W	4/27/1992	COM	19	105	4	SENW	LOPEZ EDDIE M.	ENL HILLYER #2	STK	0	180	240		
P70791.0W	7/26/1985	COM	19	105	4	SWSE	HARKINS JAMES & MARTHA	MARTHA #1	DOM_GW	18	180	300	280	300
P33543.0W	2/27/1976	INC	19	105	4	NESW	REST HAVEN MEMORIAL GARDENS	MISS LEE #2	MIS	50	195	230		
P129468.0W	10/4/2000	INC	19	105	4	SWSE	VASE'S FUNERAL HOME	REST HAVEN WELL #3	MIS	45	200	470		470
P22470.0W	5/2/1973	COM	19	105	4	SESW	CLOUSE NORMAN & DELORES	CLOUSE #1	DOM_GW	25	210	310	570	310
P9638.0P	6/30/1968	COM	19	105	4	SESW	HOSKINS DAN	HOSKINS WELL #2	DOM_GW	25	250	270	230	270
P9637.0P	4/30/1967	COM	19	105	4	SESW	HOSKINS DAN	HOSKINS WELL #1	DOM_GW	25	250	300	250	300
P10640.0W	7/22/1971	INC	19	105	4	SWSW	GARCIA SAM	GARCIA #1	MIS	25	270	330	270	330
P49538.0W	8/21/1979	COM	19	105	4	NESW	KOVACH MICHAEL & SANDRA LARAE	KLI NAC #12	DOM_GW	10	280	320	280	320
P55671.0W	2/20/1981	COM	19	105	4	SWSE	MORGAN ORVAL R. & BETTY L.	MORGAN #1	DOM_GW	25	280	360	330	360
P25695.0W	1/25/1974	COM	19	105	4	NESW	BOZNER CARL J.	BOZNER #1	DOM_GW; STK	10		150		
P20184.0P	12/31/1964	COM	19	105	4	SESW	CLARK JOHN AND ALICE	ALL'S WELL	DOM_GW	25		220		
P23124.0P	5/31/1963	COM	19	105	4	NESE	MCKINNEY DENVER P.	DENVER #2	DOM_GW	25		250		
P27476.0W	7/24/1974	COM	19	105	4	SWSE	CLARK JOHN R. & ALICE	MY CUP RUNNETH OVER	DOM_GW	20		260	235	255
P7355.0P	9/4/1967	COM	19	105	4	SWSW	ANDERSON WILLIAM	FERRERO #1	DOM_GW; STK	18		270	205	220
P154174.0W	9/26/2003	COM	19	105	5	SWSE	GIBBENS JOHN LEE & MARGARET ANN	GIBBENS #1	DOM_GW; STK	20	80	320	180	240
P178776.0W	12/11/2006	COM	19	105	5	NESE	PARKER EUGENE DWIGHT	WMCE #29	DOM_GW; STK	20	105	405	301	325
P181667.0W	6/8/2007	COM	19	105	5	SESE	POYER JAMES C	WMCE #17	DOM_GW; STK	15	110	405	299	315
P178775.0W	12/11/2006	COM	19	105	5	SWSE	PARKER EUGENE DWIGHT	WMCE #18	DOM_GW; STK	25	110	405	299	315
P179120.0W	1/10/2007	COM	19	105	5	SWSE	KAAN DARYL	WHITE MOUNTAIN COUNTRY ESTATES #12	DOM_GW; STK	16	120	385	296	312
P143415.0W	4/1/2002	COM	19	105	5	NESE	MANNIKKO RANDY R.	MANNIKKO # 1	DOM_GW	25	130	570	175	556
P40189.0W	7/28/1977	COM	19	105	5	NWSW	LINDSTROM JONNIE KAY	LINDSTROM #1	STK	20	140	200	140	200
P44602.0W	8/9/1978	COM	19	105	5	SWSW	KENNISON ALLEN	KENNISON #1	DOM_GW	15	150	220	150	190
P43801.0W	6/16/1978	COM	19	105	5	NWSE	BUDDECKE ROBERT & MARIA / MESA INVESTMENTS INC.	KUNDERT #1	DOM_GW	20				
P204556.0W	9/14/2015	INC	19	105	5	SESE	PHILIP C AND RENEE KELLY SMITH	SMITH #1	DOM_GW	25				
P178774.0W	12/11/2006	INC	19	105	5	SWSE	D'EWART JAY & TERIE	WMCE #3D	DOM_GW; STK	25				
P49537.0W	8/21/1979	COM	19	105	6	SWSE	KLI NAC	KLI NAC #11	DOM_GW	10	270	340	270	340
P29502.0W	1/21/1975	FADJ	19	105	8	NENW	MCGREW ELWIN F. & ALICE P.	MCGREW #3	DOM_GW; MIS	6	15	75	55	70
P42670.0W	3/14/1978	FADJ	19	105	8	NENW	MCGREW ELWIN F. & ALICE P.	ENL MCGREW #2	DOM_GW; MIS	2	25	60		
P29504.0W	2/18/1975	FADJ	19	105	8	NENW	MCGREW ELWIN F. & ALICE P.	MCGREW #2	DOM_GW; MIS	3	25	60		
P26661.0W	5/16/1974	COM	19	105	8	NENW	MCGUIRE THOMAS P. & DOROTHY	MCGUIRE #1	DOM_GW	10	40	75	60	75
P31523.0W	10/29/1975	COM	19	105	8	SWNE	HAWLEY JOHN PAUL	PAUL HAWLEY #1	DOM_GW	25	60	180	60	180
P13983.0W	5/22/1972	COM	19	105	8	SWNE	MEGAHEY DAVID L.	MEGAHEY #12	DOM_GW	9	60	285	60	285
P13941.0W	5/18/1972	COM	19	105	8	SWNE	MEGAHEY G. KENNETH	MEGAHEY #1	DOM_GW	11	60	285	60	285
P23267.0W	7/9/1973	COM	19	105	8	SWNE	NOUSI TIM & GLORIA L	NOUSI #1	DOM_GW	12	70	200		
P26210.0W	3/27/1974	COM	19	105	8	SWNE	MARTIN CLEVE / WILCOX HENRY	BRENDA #2	DOM_GW	25	80	140		
P20903.0W	5/17/1973	COM	19	105	8	NENW	SEARLE MILES K.	SEARLE #1	DOM_GW	10	90	220	90	220
P89467.0W	8/27/1992	COM	19	105	8	SWNE	BODEN THOMAS C. & REBECCA L.	TOM BODEN #1	DOM_GW	18	90	300	270	290
P20642.0W	3/30/1973	COM	19	105	8	SWNE	DACK RAY M.	DACK #1	DOM_GW	20	100	220	200	220
P29503.0W	2/18/1975	FADJ	19	105	8	NENW	MCGREW ELWIN F. & ALICE P.	MCGREW #1	DOM_GW; MIS	1	100	240		
P20382.0W	1/22/1973	COM	19	105	8	NENE	WHICKER RAYMOND & MARY KAY	WHICKER #1	DOM_GW	25	105	195	160	195
P38435.0W	4/27/1977	FADJ	19	105	8	SENW	MCGREW ELWIN F. & ALICE P.	MCGREW #4	DOM_GW; MIS	6	115	260	240	260
P42669.0W	3/14/1977	FADJ	19	105	8	NENW	MCGREW ELWIN F. & ALICE P.	ENL MCGREW #1	DOM_GW; MIS	2	130	210		
P92100.0W	6/17/1993	FADJ	19	105	8	NENW	MCGREW ELWIN F. AND ALICE P.	MCGREW #7	MIS	6	130	360	250	360
P34247.0W	7/19/1976	COM	19	105	8	NWSE	MCGUIRE THOMAS P. & DOROTHY	TOM #1	DOM_GW	25	180	20	180	220
P60628.0W	4/27/1982	COM	19	105	8	NESW	MARTIN CLEVE & BRENDA	TRACY #2	DOM_GW	25	200	320	270	300
P60627.0W	4/27/1982	COM	19	105	8	SWNE	MARTIN CLEVE & BRENDA	KAYCEE #1	DOM_GW	25	220	300	280	300
P95602.0W	5/31/1994	COM	19	105	8	NENW	SEARLE NELLIE A	NEL #1	DOM_GW	15	240	490	395	403
P71621.0W	12/10/1985	FADJ	19	105	8	NENW	MCGREW ELWIN F. & ALICE P.	MCGREW #5	MIS	5	270	280	240	280
P13748.0W	4/25/1972	COM	19	105	8	SWNE	WILCOX HENRY / MARTIN CLEVE	BRENDA #1	DOM_GW	15	280	300	280	300
P71622.0W	12/10/1985	INC	19	105	8	NENW	MCGREW ELWIN F. & ALICE P.	MCGREW #6	MIS	5	310	320	290	320
P163373.0W	6/24/2004	COM	19	105	8	NENW	FOUTS THEODORE D	FOUTS #5	MIS	20				
P163374.0W	6/24/2004	COM	19	105	8	SESW	FOUTS THEODORE D	FOUTS #79	MIS	20				
P40866.0W	11/10/1977	COM	19	105	9	SESE	GORDON LEE A. & SUESEN	GORDON #1	DOM_GW	20	25	118	95	116
P45928.0W	11/16/1978	COM	19	105	9	SESW	RIDGEWAY JAMES E. / FLANAGAN ROBERT H.	FLANAGAN #1	DOM_GW	25	40	140	120	140
P29863.0W	5/2/1975	FADJ	19	105	9	SESE	MESA INVESTMENTS INC.	WHITE MOUNTAIN #2	MIS	15	40	160	75	153
P26137.0W	3/21/1974	COM	19	105	9	NWNW	GREER JEROLD L. & DONNA J.	GREER #1	DOM_GW	25	40	195	135	195
P34694.0W	7/9/1976	INC	19	105	9	SWSE	SEARLE BROTHERS CONST.	SEARLE BROS #2	DOM_GW; MIS	25	45	120	75	95
P31301.0W	10/10/1975	COM	19	105	9	SWNE	BRITT ROSS	BRITT #1	DOM_GW	13	45	190		
P29181.0W	2/24/1975	COM	19	105	9	SESW	MINES RODNEY	ORDS #1	DOM_GW	25	50	100		
P49528.0W	8/10/1979	COM	19	105	9	SESW	KLI NAC	KLI NAC #9	DOM_GW	10	50	112	70	110
P69339.0W	10/12/1984	COM	19	105	9	SWSE	SEARLE BROTHERS CONSTRUCTION INC.	SEARLE #11	DOM_GW	20	50	125	52	103
P66625.0W	3/7/1984	COM	19	105	9	SWSE	TODD NORMAN W.	TODD #1	DOM_GW; STK	10	50	180	108	120
P51479.0W	2/6/1980	COM	19	105	9	NESE	LITTLE KIM J/PEGGY A	LITTLE #1	DOM_GW	10	50	290	180	290
P47689.0W	4/26/1979	FADJ	19	105	9	SWSW	MCCALLISTER MONTE A. / MCCALLISTER GARY L.	MCCALLISTER #1	MIS	25	54	220	195	215
P76492.0W	3/28/1988	COM	19	105	9	SWSE	JACKSON D. VAN & DIANE	JACKSON #2	DOM_GW	25	54	230	195	230
P50276.0W	9/21/1979	INC	19	105	9	SESE	MESA INVESTMENTS INC.	MESA #3	MIS	10	55	120	70	120

Appendix 4B - Wyoming State Engineer's Office Groundwater Permits in the Bitter Creek Watershed

Permit No.	Priority	Status[1]	Twp	Rng	Sec	Qtr/Qtr	Applicant	Facility Name	Uses[2]	Yield (gpm)	Depth to Water[3] (ft)	Total Depth (ft)	Main Water-Bearing Zone	
													Top (ft)	Bottom (ft)
P70160.0W	5/28/1985	COM	19	105	9	SESW	WOLFE JIM	WOLFE #1	DOM_GW	19	55	240	180	210
P29584.0W	4/11/1975	FADJ	19	105	9	NENE	MESA INVESTMENTS INC.	MESA #1	MIS	15	56	180	130	180
P82082.0W	3/26/1990	COM	19	105	9	NENE	SULLIVAN JAMES D.	JIM-LIZ #1	DOM_GW	12	57	150		
P63940.0W	5/3/1983	COM	19	105	9	SESW	WRIGHT JARRELL O. / FROMAN LARRY D.	FROMAN #1	DOM_GW	10	60	100	65	75
P44846.0W	8/21/1978	COM	19	105	9	NESE	ADAMS JOE	JOE ADAMS #1	DOM_GW	20	60	120	60	120
P79134.0W	1/26/1989	COM	19	105	9	SWSE	GEI BANK INDUSTRIAL BANK	NASH #1	DOM_GW	13	60	120	100	110
P67141.0W	4/30/1984	COM	19	105	9	SWSE	HORTON MORRIS C.	MCH #4	DOM_GW	60	60	140	25	120
P27789.0W	8/19/1974	COM	19	105	9	NENW	RICHARDS KELLY B. AND DENISE Z.	TODD #2	DOM_GW	2	60	180		
P77721.0W	8/8/1988	COM	19	105	9	NWSW	WOODARD PAUL H. AND CHERYL L.	WOODARD #1	DOM_GW; STK	13	60	197	145	195
P39275.0W	7/26/1977	COM	19	105	9	NWSE	RUGGERA JAMES S.	RUGGERA #1	DOM_GW	20	60	200	180	195
P45737.0W	10/17/1978	COM	19	105	9	SESE	CAMPBELL SCOTT LEWIS & MARIE MCARTHUR	B & B #1	STK	15	60	210	180	185
P50683.0W	12/12/1979	FADJ	19	105	9	SWSW	MCCALLISTER MONTE A. / MCCALLISTER GARY L.	MCCALLISTER #2	MIS	25	60	220	180	200
P40870.0W	11/14/1977	COM	19	105	9	SESE	BUSTOS E. GABRIEL	BUSTOS #1	DOM_GW	20	60	260	220	80
P63556.0W	3/31/1983	COM	19	105	9	SWSW	DRILLING MUD INC.	ENL OF THE WHITE MOUNTAIN #1	DOM_GW	0	62	200	120	180
P29585.0W	4/14/1975	FADJ	19	105	9	SWSW	HUGHES DRILLING FLUIDS	WHITE MOUNTAIN #1	MIS	25	62	200	120	180
P35399.0W	11/3/1976	COM	19	105	9	NWSE	KADLECEK GEORGIA A.	GEO #1	DOM_GW	25	68	200	170	190
P38883.0W	6/23/1977	INC	19	105	9	SENE	FISCHER CARL E.	FISCHER #1	MIS	25	69	200	170	190
P45749.0W	11/3/1978	COM	19	105	9	NWSW	MCMURRY JAMES E. & MARY A.	MCMURRY #1	DOM_GW	10	70	120	70	120
P46148.0W	12/18/1978	COM	19	105	9	SESE	SMITH CLYDE A. & LILLIAN	SMITH #2	DOM_GW	25	70	120	80	120
P44773.0W	8/9/1978	COM	19	105	9	NESW	MASIMER WILLIAM F.	MASIMER #1	DOM_GW	25	70	169	130	160
P57224.0W	6/15/1981	COM	19	105	9	SESE	WRIGHT STEVEN M.	WRIGHT WAY #1	DOM_GW	20	70	180	165	175
P47510.0W	4/11/1979	COM	19	105	9	NWSE	SLEIGHT HOWARD	HOWARD SLEIGHT #1	DOM_GW	15	70	200	80	180
P42246.0W	3/6/1978	COM	19	105	9	SESE	PENNOCK LARRY J.	L J PENNOCK #1	DOM_GW	25	70	240		
P88548.0W	6/17/1992	COM	19	105	9	NWSW	HONAKER RICHARD H. & SHANNON C.	HONAKER #1	DOM_GW; STK	20	70	330	280	305
P42244.0W	3/3/1978	COM	19	105	9	NESW	WALKER VESS	WALKER #1	DOM_GW	20	72	120	89	110
P26619.0W	5/6/1974	COM	19	105	9	NENW	PRITCHARD RONALD ARTHUR	DB #1	DOM_GW	25	75	150		
P36712.0W	3/16/1977	COM	19	105	9	NESW	CHAPMAN MARK & SHERRIE	M. W. CHAPMAN #2	DOM_GW	25	75	180	150	170
P26556.0W	4/25/1974	COM	19	105	9	NWNW	SHANKS RONALD W.	PORTER #1	DOM_GW	5	75	350		
P39712.0W	8/10/1977	COM	19	105	9	NWSE	MOSES ROBERT G.	MOSES #3	DOM_GW	15	77	220	182	200
P35783.0W	1/10/1977	INC	19	105	9	SENE	MCHARDY BRYSON R.	ZANCANELLA #1	MIS	20	80	100	140	160
P85686.0W	7/12/1991	COM	19	105	9	SWSE	HITCHEN ROGER AND MELANIE	HITCHEN #1	DOM_GW; STK	25	80	110		
P44671.0W	8/29/1978	FADJ	19	105	9	SWSW	FRAC-TANKS INC.	FRAC TANKS WELL #1	MIS	25	80	118	92	118
P45561.0W	9/19/1978	COM	19	105	9	SWSW	BOWLES MARVIN	BOWLES #1	DOM_GW	10	80	120	80	120
P69739.0W	3/25/1985	COM	19	105	9	SESW	A. C. EGBERT WATER SERVICE INC.	EGBERT #2	DOM_GW	20	80	120	80	120
P36409.0W	3/2/1977	COM	19	105	9	SESE	SMITH CLYDE A. & LILLIAN G.	SMITH #1	DOM_GW	20	80	120	80	120
P33372.0W	3/26/1976	COM	19	105	9	SESW	AC Egbert Water Service, Inc.	EBGERT #1	DOM_GW	25	80	120	80	120
P78296.0W	8/8/1988	INC	19	105	9	SESE	SMITH CLYDE	ENL SMITH #1	IRR_GW	15	80	120	80	120
P41752.0W	2/6/1978	COM	19	105	9	NESW	MOON DONALD D. & WANDA A.	BLACK #12	DOM_GW	22	80	140	110	140
P37566.0W	4/28/1977	COM	19	105	9	SENW	HAGER WALTER	HAGER #1	DOM_GW	25	80	140	120	140
P42536.0W	3/20/1978	COM	19	105	9	SWNE	KNUDSEN BEATRICE / KNUDSEN MARTIN A.	KNUDSEN #1	DOM_GW	25	80	140	120	140
P37455.0W	3/25/1977	COM	19	105	9	NWSE	HOFER ROBERT D.	HOFER #1	DOM_GW	18	80	160	120	140
P34702.0W	8/3/1976	COM	19	105	9	SESW	CARMINE ROBERT G.	CARMINE #1	DOM_GW	16	80	160	120	150
P40390.0W	8/31/1977	COM	19	105	9	NENE	MILLER TIMOTHY J.	MILLER #1	DOM_GW	12	80	180	150	180
P55036.0W	12/16/1980	INC	19	105	9	NESW	BORING JAMES RICHARD	R BORING #1	DOM_GW	20	80	180	155	175
P38820.0W	6/22/1977	COM	19	105	9	NENW	BROWN VIVIAN L.	BROWN #1	DOM_GW	20	80	180	165	180
P32771.0W	4/12/1976	COM	19	105	9	SWNE	RADOSEVICH JOHN E.	RADOSEVICH #3	DOM_GW	15	80	180		
P82067.0W	9/2/1988	COM	19	105	9	SWNW	SUMMERALL JAMES E. & CATHERINE	SUMMERALL #1	DOM_GW	15	80	185	185	
P27679.0W	8/12/1974	COM	19	105	9	NWNW	JENNINGS PATRICK THOMAS	JENNINGS #1	DOM_GW	25	80	200	120	200
P34058.0W	6/11/1976	COM	19	105	9	SENW	LARSON CONST. INC.	LARSON #3	DOM_GW	25	80	200	125	200
P70435.0W	6/25/1985	COM	19	105	9	NWSW	JENNINGS J. R. OR HYON SU	338 TURRET DR	DOM_GW	12	80	200	140	156
P34706.0W	8/12/1976	COM	19	105	9	SWNE	MOSES ROBERT G.	MOSES #2	DOM_GW	15	80	200	160	180
P36407.0W	3/1/1977	COM	19	105	9	SENW	MOSES ROBERT W.	HERMAN #1	DOM_GW	15	80	220	180	200
P41209.0W	12/1/1977	COM	19	105	9	SWNW	CALLER LARRY J.	CALLER #50	DOM_GW	15	80	220	195	215
P39539.0W	7/12/1977	COM	19	105	9	NWSE	BANKO DAVID F. & NANCY A.	NANCY ANN #1	DOM_GW	25	80	240	200	240
P63637.0W	3/18/1983	INC	19	105	9	NWNE	REBEL RENTALS AND TESTERS	REBEL #1	MIS	25	80	250		
P30431.0W	7/3/1975	COM	19	105	9	NWNE	HASELMAN GORDON P. & SANDRA	HASELMAN #1	DOM_GW	25	80	260	230	255
P42966.0W	4/19/1978	COM	19	105	9	NWNE	DOAK IVAN / WATSON DOROTHY	D&W #1	DOM_GW	23	80	260	240	260
P84586.0W	3/7/1991	COM	19	105	9	NENW	BUEKER PATRICK & CONNIE	BUEKER #2	DOM_GW	15	80	273	185	210
P50407.0W	10/19/1979	FADJ	19	105	9	NENE	MESA INVESTMENTS INC.	MESA #2	MIS	15	80	280	220	250
P34384.0W	7/22/1976	INC	19	105	9	SENE	J & S INVESTMENTS	J & S INVESTMENTS #1	MIS	25	80	280	260	280
P93033.0W	9/16/1993	COM	19	105	9	NESE	DANA VIC R	DANA #1	DOM_GW; STK	5	80	290	80	85
P83059.0W	7/23/1990	COM	19	105	9	SWNE	CHALFANT MICHAEL V. AND SUSAN R.	CHALFANT #2	DOM_GW; STK	14	80	316	275	315
P39726.0W	8/23/1977	COM	19	105	9	NESE	GOODRICH KELLY	KELLY GOODRICH #1	DOM_GW	15	80	340	280	320
P50172.0W	9/26/1979	COM	19	105	9	SESE	JOHNSON WAYNE L.	WJ #1	DOM_GW	10	82	252	190	252
P65545.0W	9/22/1983	COM	19	105	9	SWNW	MADSEN DAVID W. OR KRISTINE L.	MADSEN #1	DOM_GW	25	83	200	160	200
P27780.0W	8/19/1974	COM	19	105	9	SESW	HILL LESTER L. & JUANITA G.	HILL #1	DOM_GW	25	85	100	85	100
P39543.0W	8/5/1971	COM	19	105	9	NESW	WARNOCK DOYLE	WARNOCK #1	DOM_GW	18	85	160	140	160
P40533.0W	4/11/1977	COM	19	105	9	SWSE	PITT TERRY R.	PITT #2 (DEEPENED)	DOM_GW	14	85	190	170	185
P54168.0W	10/8/1980	INC	19	105	9	NWSE	LOGAN BRETT D. & RETA MAE	BDL #2	MIS	25	85	200	175	200

Appendix 4B - Wyoming State Engineer's Office Groundwater Permits in the Bitter Creek Watershed

Permit No.	Priority	Status[1]	Twp	Rng	Sec	Qtr/Qtr	Applicant	Facility Name	Uses[2]	Yield (gpm)	Depth to Water[3] (ft)	Total Depth (ft)	Main Water-Bearing Zone	
													Top (ft)	Bottom (ft)
P97509.0W	10/17/1994	COM	19	105	9	SWSE	PITT CONSTRUCTION	PITT #3	DOM_GW	16	85	213	160	175
P76488.0W	3/22/1988	COM	19	105	9	SWSE	SEARLE STONEY	S SEARLE #12	DOM_GW	13	85	230	185	230
P37814.0W	5/9/1977	COM	19	105	9	SWSW	YARD FRANK A. & BEVERLY J.	YARD #2	DOM_GW	25	85	240	180	240
P38068.0W	5/26/1977	COM	19	105	9	NESE	WRIGHT WILBERT E. & BARBARA S.	WRIGHT ONE	DOM_GW	10	88	140	115	135
P45961.0W	11/22/1978	COM	19	105	9	NESW	WALKER A. J. & MARGARET K.	WALKER #1	DOM_GW	5	90	120	90	120
P76489.0W	3/22/1988	COM	19	105	9	SWSE	SEARLE GEORGE	SEARLE #13	DOM_GW	20	90	130	90	130
P31003.0W	9/2/1975	COM	19	105	9	SENW	HANSON WAYNE R. OR SANDRA F.	HANSON #1	DOM_GW	17	90	150	120	150
P47099.0W	3/20/1979	COM	19	105	9	SWSE	JACKSON D. VAN	JACKSON #1	DOM_GW	7	90	160	100	140
P36710.0W	3/14/1977	COM	19	105	9	NWNE	ROSALES JUAN M.	ROSALES #1	DOM_GW	18	90	180	140	170
P74333.0W	3/30/1987	COM	19	105	9	NWSW	MILLER JOHN C. & PENNEY J.	MILLER #4	DOM_GW; STK	13	90	180	140	175
P35658.0W	12/3/1976	COM	19	105	9	SENW	KRIEST RICHARD A. & RUTH H.	KRIEST #1	DOM_GW	25	90	180	140	180
P63163.0W	2/10/1983	COM	19	105	9	NESW	HALSTEAD L. ROGER & CAROLYN L.	HALSTEAD #1	DOM_GW	13	90	180	160	175
P74217.0W	3/9/1987	COM	19	105	9	NESW	ZUMPFE VICTOR J.	ZUMPFE #1	DOM_GW	15	90	180	165	175
P72766.0W	6/18/1986	COM	19	105	9	SENE	SCHOFILED WENDELL	W S #1	DOM_GW; STK	2	90	200	120	
P34059.0W	6/11/1976	COM	19	105	9	SENE	LARSON CONST. INC.	LARSON #2	DOM_GW	25	90	200	160	200
P42241.0W	3/3/1978	COM	19	105	9	NWSW	KLEIN RUSSELL	RUSSELL KLEIN #2	DOM_GW	20	90	200	165	185
P42242.0W	3/3/1978	COM	19	105	9	NWSW	KLEIN RUSSELL	RUSSELL KLEIN #3	DOM_GW	20	90	200	174	189
P36103.0W	1/24/1977	COM	19	105	9	SENW	LARSON CONST INC.	LARSON #5	DOM_GW	25	90	200	180	190
P75216.0W	7/16/1987	COM	19	105	9	SENW	JOHNSON GORDON R. & CHERI V.	JOHNSON #1	DOM_GW	20	90	200		
P71783.0W	2/3/1986	COM	19	105	9	SWNE	WILSON ELDON & JANET	CODASH #1	DOM_GW	13	90	210	190	205
P27006.0W	6/19/1974	COM	19	105	9	NENW	ZURN JOHN A.	ZURN #1	DOM_GW	20	90	215		
P36102.0W	1/24/1977	COM	19	105	9	SENW	TRAPP MARY	LARSON #4	DOM_GW	25	90	220	195	205
P32772.0W	4/12/1976	COM	19	105	9	SWSW	FRANK ARMAN & BEVERLY J. YARD	YARD #1	DOM_GW	25	90	240	180	220
P74965.0W	6/16/1987	COM	19	105	9	NWNW	KELLOGG MERWIN & JANET	KELLOGG #1	DOM_GW; STK	14	90	240	210	222
P75802.0W	10/28/1987	COM	19	105	9	NWNW	SLATON DARRELL W.	SLATON #1	DOM_GW	13	90	240	220	230
P59742.0W	3/8/1982	COM	19	105	9	NENW	GUENTHER WILHELM & PATRICIA A.	GUENTHER #1	DOM_GW	13	90	240	220	235
P80444.0W	8/4/1989	COM	19	105	9	NESW	PHILLIPS GRACE L. DUBIE AND HOWARD L.	DUBIE PHILLIPS #1	DOM_GW	25	90	260	235	255
P60331.0W	4/19/1982	COM	19	105	9	NWNE	TOMAN FRANK JULIUS	TOMAN #1	DOM_GW	10	90	260	240	255
P73775.0W	12/11/1986	INC	19	105	9	SENW	WILSON STEVE R.	WILSON #1	MIS	20	90	280	212	225
P63944.0W	4/29/1983	COM	19	105	9	NWSW	STOCKWELL FRED O. & KELLY J.	STOCKWELL #1	DOM_GW	12	90	300	90	250
P27090.0W	6/20/1974	COM	19	105	9	NENW	HENDERSON JOHN RAY & EVELANA	PEGGY #2 (DEEPENED)	DOM_GW	3	90	330	220	240
P25962.0W	2/20/1974	COM	19	105	9	NENW	LARSON THOMAS A.	LARSON #1	DOM_GW	25	91	227		
P40616.0W	10/17/1977	COM	19	105	9	SENW	GILBERT ALAN	GILBERT #1	DOM_GW	25	92	180	150	170
P45563.0W	9/19/1978	COM	19	105	9	NWSW	ROSS JEAN	ROSS #1	DOM_GW	15	95	140	95	115
P32926.0W	4/26/1976	COM	19	105	9	SENW	ROOKS ROBERT D. & CAROL S.	ROOKS #1	DOM_GW	25	95	155	100	155
P39279.0W	7/28/1977	COM	19	105	9	NWSE	FIFE WESLEY L. & NORENE D.	FIFE #1	DOM_GW	21	95	180	150	175
P31302.0W	10/10/1975	COM	19	105	9	SENE	BRITT ROSS	BRITT #2	DOM_GW	11	95	190	167	184
P89386.0W	9/8/1992	COM	19	105	9	NESE	GOICOLEA IGNACIO	ONDO #92	DOM_GW	20	95	193	130	165
P79633.0W	4/26/1989	COM	19	105	9	NWSE	HAGER CLARK G. OR BECKY A.	HAGER #1	DOM_GW; STK	10	95	340	300	320
P37481.0W	4/25/1977	COM	19	105	9	NESW	SCHMIDT WILLIAM H. AND CHARLOTTE L. (MR. & MRS.)	SAVAGE #1 (DEEPENED)	DOM_GW	10	95	360	335	358
P39489.0W	8/10/1977	COM	19	105	9	SENW	JOHNSON PAUL	P JOHNSON #1	DOM_GW	25	100	100	190	200
P47110.0W	3/26/1979	COM	19	105	9	SESE	MOSES ROBERT	MOSES #2	DOM_GW	15	100	140	100	127
P45562.0W	9/19/1978	COM	19	105	9	NWSW	HILL LESTER	HILL #1	DOM_GW	15	100	140	100	140
P75628.0W	10/1/1987	COM	19	105	9	SWNE	IRWIN STEVE G. & PEGGY R.	IRWIN #1	DOM_GW	25	100	150	110	150
P60125.0W	3/29/1982	COM	19	105	9	NWSW	JOHNSON FRANK A. & DEANIE H.	JOHNSON #1A	DOM_GW	18	100	160	140	160
P30108.0W	6/6/1975	COM	19	105	9	NENW	BARTO LOUIS F.	BARTO #1	DOM_GW	25	100	180	120	170
P51772.0W	4/9/1980	COM	19	105	9	NWSW	SHIFLAR DANNY W.	SHIFLAR #1	DOM_GW	22	100	180	140	160
P39939.0W	9/9/1977	COM	19	105	9	NWSE	ORESTER GEORGE L. OR LYNN M.	ORESTER #1	DOM_GW	12	100	180	150	170
P29865.0W	4/23/1975	COM	19	105	9	SWNW	NEIUWENHUIS ROELOF / MAJHANOVICH ROBERT	SHALOM #1	DOM_GW	25	100	180		
P39461.0W	4/8/1977	COM	19	105	9	NWNE	STANTON LOUIS HAROLD	STANTON #1	DOM_GW	20	100	200	175	190
P32770.0W	4/12/1976	COM	19	105	9	SWNE	RADOSEVICH JOHN E.	RADOSEVICH #2	DOM_GW	15	100	200		
P32769.0W	4/12/1976	COM	19	105	9	SENW	RADOSEVICH JOHN E.	RADOSEVICH #1	DOM_GW	15	100	200		
P48541.0W	5/21/1979	INC	19	105	9	SWSW	AMERICAN INDUSTRIAL LAUNDRY	AMERICAN #1	DOM_GW; MIS	8	100	210	140	210
P38294.0W	6/7/1977	COM	19	105	9	NWSW	JELOUCHAN JERRY FRANK	JELOUCHAN #1	DOM_GW	25	100	220	180	200
P27002.0W	6/18/1974	COM	19	105	9	NWNW	SMITH BENJAMIN W. & DEBRA D.	SMITH #1	DOM_GW		100	220		
P56807.0W	5/11/1981	COM	19	105	9	SWNW	VERMEULEN MIKE	VERMEULEN #5	DOM_GW	25	100	240	180	220
P43259.0W	5/8/1978	COM	19	105	9	NWNW	GOMEZ LEROY	GOMEZ #1	DOM_GW	25	100	240	190	215
P80634.0W	8/31/1989	COM	19	105	9	NENW	SAYLOR JAMES AND EILLEN	SAYLOR #1	DOM_GW; STK	3	100	240		
P74040.0W	2/11/1987	COM	19	105	9	NENW	BERRIER RICHARD K. & NANCY L.	BERRIER #1	DOM_GW; STK	11	100	260	220	250
P69340.0W	10/12/1984	COM	19	105	9	SWNE	SEARLE BROTHERS CONSTRUCTION INC.	SEARLE #10	DOM_GW	10	100	295	140	150
P30252.0W	6/23/1975	COM	19	105	9	NESW	KLEIN RUSSELL C. & JULIANNE H.	KLEIN #1	DOM_GW	25	100	300	240	300
P70159.0W	5/28/1985	COM	19	105	9	NWSE	SMITH BUEHL L. & BRENDA C.	SPRING #1	DOM_GW	20	100	300	265	282
P58199.0W	9/15/1981	COM	19	105	9	NENE	HALEY EARL J.	HALEY #2	DOM_GW	20	100	300	275	300
P47939.0W	5/11/1979	COM	19	105	9	SWSE	PURINTON DALE E. & ANN A.	MCCURDY #1	DOM_GW; STK	15	103	240	180	220
P28011.0W	9/20/1974	COM	19	105	9	NENW	MCGUIRE THOMAS CARL	MCGUIRE #3	DOM_GW	13	105	205		
P41967.0W	2/24/1978	COM	19	105	9	SWSW	YARD FRANK A.	YARD #3	DOM_GW	20	105	220	180	200
P28723.0W	12/16/1974	COM	19	105	9	NENW	DEMERS RICHARD R. & ANN	DEMERS #1	DOM_GW	18	105	220		
P48516.0W	6/5/1979	COM	19	105	9	NWNW	HANSEN MILTON E. & LALITA J.	HANSEN #1	DOM_GW	25	105	260		
P86854.0W	12/23/1991	COM	19	105	9	NESW	BAKER DANNY R.	BAKER #1	DOM_GW	14	105	335	293	310

Appendix 4B - Wyoming State Engineer's Office Groundwater Permits in the Bitter Creek Watershed

Permit No.	Priority	Status[1]	Twp	Rng	Sec	Qtr/Qtr	Applicant	Facility Name	Uses[2]	Yield (gpm)	Depth to Water[3] (ft)	Total Depth (ft)	Main Water-Bearing Zone	
													Top (ft)	Bottom (ft)
P25893.0W	2/2/1974	COM	19	105	9	NWNW	CAUDRON RICHARD K.	RC #1	DOM_GW	12	107	240		
P30103.0W	6/2/1975	COM	19	105	9	NWNW	DOMER BRUCE L. & LINDA K.	DOMER #1	DOM_GW	10	108	243	108	243
P47108.0W	3/26/1979	COM	19	105	9	NESW	BOZNER FRANK & CHARLENE	BOZNER #1 (DEPENED)	DOM_GW	14	110	140	110	130
P47111.0W	3/26/1979	COM	19	105	9	SWSE	SWEET MARK B.	M B SWEET #1	DOM_GW	2	110	140	110	140
P27001.0W	6/6/1974	COM	19	105	9	NENW	MARTIN ROBERT E. & RITA E.	MARTIN #1	DOM_GW	16	110	150	125	150
P47671.0W	4/2/1979	COM	19	105	9	NESE	CHAVEZ MARCELLO AND SAROCO	D F CHAPMAN #1	DOM_GW	25	110	160		
P53337.0W	8/12/1980	COM	19	105	9	SENE	SCHOFIELD LESLIE J.	SCHOFIELD #1	DOM_GW	15	110	220	130	
P99349.0W	5/26/1995	INC	19	105	9	SWSW	MCCALLISTER MONTE & GARY	MCCALLISTER #3	MIS	16	110	220	165	183
P45744.0W	10/31/1978	COM	19	105	9	SESE	CARNANON MICHAEL STANFORD	CARNAHAN #1	DOM_GW	14	110	220	175	200
P56642.0W	4/27/1981	COM	19	105	9	NWSE	GRISOM JERRY & CHARLENE	JG #1	DOM_GW	25	110	230	210	230
P86886.0W	1/9/1992	COM	19	105	9	SWNW	SCHARF CRAIG H. AND BONNIE J.	B.J. #1 (DEEPENED)	DOM_GW	3	110	250		
P109266.0W	3/16/1998	COM	19	105	9	NWSW	ELIZABETH A ELLIS LIVING TRUST	ELLIS #1	DOM_GW	16	110	270	230	245
P53448.0W	8/7/1980	COM	19	105	9	SENW	BROWN STEPHEN E. & DEBBIE	BROWN #1	DOM_GW	7	110	300	260	290
P83153.0W	7/23/1990	COM	19	105	9	NWSW	AVENT ANDREW J. & REBECCA S.	AVENT #1 (DEEPENED)	DOM_GW; STK	15	110	310	180	310
P49136.0W	6/17/1979	COM	19	105	9	NWNW	FLANSBURG ROBERT S. & CATHY J.	FLANSBURG 1979	DOM_GW	10	112	220	195	210
P54238.0W	10/29/1980	COM	19	105	9	SENW	ANGELOVIC TONY & TINA	ANGELOVIC #1	DOM_GW	10	118	250	180	220
P47109.0W	3/26/1979	COM	19	105	9	NESE	MOSES ROBERT	MOSES #4	DOM_GW	15	120	140		
P43260.0W	5/8/1978	COM	19	105	9	SENE	MCNEIL T. J.	QUALITY BLDR #1	DOM_GW	20	120	160	120	160
P49638.0W	8/24/1979	COM	19	105	9	NESW	DOLAN STEPEHEN K. & CANDACE A.	DOLAN #1	DOM_GW	20	120	160	120	160
P48831.0W	6/28/1979	COM	19	105	9	NWSW	WARNOCK DOYLE W. & PHYLLIS E.	WARNOCK #2	DOM_GW	23	120	160	120	160
P27310.0W	7/2/1974	COM	19	105	9	NWNW	SPANN CALVIN A. & SHIRLEY A.	SPANN #1	DOM_GW	20	120	165		
P44776.0W	8/16/1978	COM	19	105	9	NESW	SIMON OTTO	KLI NAC INC #4	DOM_GW	20	120	200	155	185
P34231.0W	6/29/1976	COM	19	105	9	SENW	GROVER MILTON C. & RUTH M.	FONATHON #1	DOM_GW	26	120	210	185	210
P76486.0W	3/15/1988	COM	19	105	9	NWNW	SLATON DARRELL	LUTES #1	DOM_GW	10	120	240	220	230
P77621.0W	7/22/1988	COM	19	105	9	SWNW	KOSHAR THOMAS & VIRGINIA	THE BIG HOLE #1	DOM_GW	20	120	276	256	276
P169988.0W	9/16/2005	COM	19	105	9	NESW	BLEDSOE MICHAEL T. AND PATRICIA J.	BLEDSOE #1	DOM_GW; STK	20	120	280	240	280
P91297.0W	4/27/1992	COM	19	105	9	NWNE	WALLEN TED	TED W. ONE	DOM_GW	18	120	300		
P86813.0W	12/16/1991	COM	19	105	9	SWNE	ACKERMAN DONALD C.	ACKERMAN #2	DOM_GW	25	120	315	253	285
P37485.0W	4/27/1977	COM	19	105	9	NWNW	DEPOYSTER JERRY/JOLYNN	COTNER #1	DOM_GW	25	120	344	264	324
P58376.0W	9/30/1981	COM	19	105	9	NESW	WARD RANDY MAC	R. M. WARD #1	DOM_GW	25	120	530	500	504
P87427.0W	3/23/1992	COM	19	105	9	SWNE	BAUGHMAN FRED & MARCI	BAUGHMAN #1	DOM_GW; STK	13	124	312	290	30
P43261.0W	5/8/1978	COM	19	105	9	NESE	NACCARATO VICTOR	KLI NAC #1	DOM_GW	20	125	180	125	180
P69595.0W	3/21/1985	COM	19	105	9	NWNE	DOAK IVAN R. & DOROTHY J.	DOAK #1	DOM_GW	21	126	275	220	240
P50404.0W	10/12/1979	INC	19	105	9	NENE	CILENSEK CARL	CILENSEK #1	MIS	14	130	160	110	135
P50405.0W	10/12/1979	INC	19	105	9	NENE	CILENSEK CARL	CILENSEK #2	MIS	15	130	160	110	140
P47935.0W	5/15/1980	COM	19	105	9	SWSE	CHASE TERYL	CHASE #1	DOM_GW	10	130	160	130	160
P50406.0W	10/15/1979	INC	19	105	9	SWSW	INSULATION INCORPORATED	WEIMER #1	MIS	3	130	164		
P34812.0W	9/14/1976	COM	19	105	9	SWNE	BUDDECKE ROBERT	ENL BUDDECKE #1	DOM_GW	5	130	170		
P33171.0W	5/10/1976	COM	19	105	9	SWNE	BUDDECKE ROBERT	BUDDECKE #1	DOM_GW	15	130	170		
P30104.0W	6/2/1975	COM	19	105	9	SWNE	HILLYER JACK	HILLYER #1	DOM_GW	25	130	180	120	180
P83709.0W	10/1/1990	COM	19	105	9	NWSE	FROMAN TRACY B. & MICHELLE D.	T. FROMAN #1	DOM_GW; STK	10	130	215	130	215
P64670.0W	7/1/1983	COM	19	105	9	NENE	SHIPMAN RANDY	KIDS #1	DOM_GW	18	130	220	180	220
P86979.0W	1/17/1992	COM	19	105	9	SESE	BOADLE JOHN C. & JEANETTE M.	BOADLE 1	DOM_GW; STK	25	130	275	232	240
P86518.0W	10/28/1991	COM	19	105	9	SWNW	COLE JAMES E. AND LAURA J.	COLE #1	DOM_GW	12	130	294	251	264
P67914.0W	7/9/1984	COM	19	105	9	NWNE	CASE DANIEL J. & PAM	CASE #1	DOM_GW	18	130	340	320	340
P87077.0W	2/10/1992	COM	19	105	9	SWNE	EGBERT MARTY AND NADINE	MARTY #1	DOM_GW	20	130	355	320	335
P76607.0W	4/22/1988	COM	19	105	9	SENW	ARAGON LEROY & SUSAN E.	ARAGON 5	DOM_GW; STK	15	130	362	350	
P85283.0W	6/24/1991	COM	19	105	9	NWNW	INGLE STAN AND TRACI	INGLE #1	DOM_GW	5	134	350	265	275
P33702.0W	6/2/1976	COM	19	105	9	NWNE	BANKS JACK R. & JULIE A.	BANKS #1	DOM_GW; STK	23	135	165	135	135
P29593.0W	4/21/1975	COM	19	105	9	SWNE	GROSS GARY W.	GROSS #1	DOM_GW; STK	25	135	240		
P86476.0W	11/4/1991	COM	19	105	9	NWNE	LIPARI JAMES A. AND DEBRA S.	LIPARI #1	DOM_GW	14	135	314	270	284
P47107.0W	3/26/1979	COM	19	105	9	SWSE	BARELA ALBINO R	BARELA #1	DOM_GW	20	140	160	140	160
P27313.0W	6/26/1974	COM	19	105	9	NWNW	NELSON JAMES D. & MARILYN	NELSON #1	DOM_GW	25	140	180	140	180
P47937.0W	5/10/1979	COM	19	105	9	SESE	KLI NAC	KLI NAC #9	DOM_GW	10	140	195	140	195
P45266.0W	9/27/1978	COM	19	105	9	NWSE	SWEAT BLAINE	SWEAT #610	DOM_GW	10	140	200	140	190
P32428.0W	8/8/1975	COM	19	105	9	NENE	SCHROEDER DANIEL L & CECILIA L	RISHLING #1	DOM_GW	10	140	200	150	200
P44775.0W	8/16/1978	COM	19	105	9	NESW	PFEIFED IVAN W.	KLI NAC INC #3	DOM_GW	25	140	200	155	185
P31828.0W	1/19/1976	COM	19	105	9	SENW	PARSON GORDON C.	PARSON #1	DOM_GW; STK	25	140	200	160	190
P39150.0W	7/12/1977	COM	19	105	9	NWSE	JESSOP JAMES R. & MARIAN A.	JESSOP #1	DOM_GW	18	140	220	180	220
P43322.0W	5/16/1978	COM	19	105	9	NWSW	ALLEN DANIEL E.	ALLEN #1	DOM_GW	20	140	220	180	220
P38819.0W	6/20/1977	COM	19	105	9	NESW	DAVIS ROBERT AND SHANNON	VANBEEK 1 (DEEPENED)	DOM_GW	12	140	240	112	122
P25963.0W	2/4/1974	COM	19	105	9	NWNW	MYERS TAYLOR E.	MYERS #1	DOM_GW		140	240	140	240
P44777.0W	8/16/1978	COM	19	105	9	NESW	LAMB RALPH	KLI NAC INC #6	DOM_GW	20	140	240	200	240
P29067.0W	1/23/1975	COM	19	105	9	NWNW	DELP CHARLES G/CONNIE S	LITTLEJOHN #1 (DEEPENED)	DOM_GW	15	140	313	220	285
P91164.0W	3/29/1993	COM	19	105	9	NENW	HAMILTON GREG S.	GREG #1	DOM_GW	15	140	313	270	285
P90783.0W	2/5/1993	COM	19	105	9	NWNE	LIPARI JAMES A. AND DEBRA S.	LIPARI #2	DOM_GW	16	140	330	290	305
P70959.0W	8/6/1985	COM	19	105	9	NWNE	GETZ JAY C.	MUSTANG #66	DOM_GW	14	140	340	296	324
P59128.0W	12/22/1981	COM	19	105	9	SWNW	SCHNAKENBURG ARNOLD L.	SCHNAKENBURG #1	DOM_GW	15	140	340	320	335
P38818.0W	6/20/1977	COM	19	105	9	NESW	HARDINE KENNETH D.	HARDINE #1	DOM_GW	15	141	200	191	200

Appendix 4B - Wyoming State Engineer's Office Groundwater Permits in the Bitter Creek Watershed

Permit No.	Priority	Status[1]	Twp	Rng	Sec	Qtr/Qtr	Applicant	Facility Name	Uses[2]	Yield (gpm)	Depth to Water[3] (ft)	Total Depth (ft)	Main Water-Bearing Zone	
													Top (ft)	Bottom (ft)
P47893.0W	5/8/1979	COM	19	105	9	NESW	DOAK ROBERT J. & DEBRA J.	DOAK #1	DOM_GW	13	145	170	145	
P42746.0W	3/30/1978	COM	19	105	9	NESE	MARTINEZ SR. RICHARD J. OR MARILYN C.	MARTINEZ #1	DOM_GW	25	145	180	145	160
P26751.0W	5/20/1974	COM	19	105	9	NWNW	BURRELL CURTIS G. & MARGRUITT WILSON	SPERRY #1 (DEEPENED)	DOM_GW	21	145	340	305	315
P82885.0W	6/26/1990	COM	19	105	9	NWNW	FRASER MICHAEL J. AND BRENDA P.	DOUGLAS 389	DOM_GW	15	147	300	267	284
P85648.0W	7/5/1991	COM	19	105	9	NWNW	SHAW WILLIAM	SHACO #1	DOM_GW	10	148	455	135	345
P91382.0W	4/26/1993	COM	19	105	9	SWNW	TEEPLES NEAL J. AND DONNA RAY	TEEPLES #1	DOM_GW	12	149	330		
P47936.0W	5/10/1979	COM	19	105	9	SESE	IVIE REX	REX IVIE #1	DOM_GW	10	150	180	150	180
P45016.0W	9/11/1978	COM	19	105	9	NWSW	TUNNELL KYLE	KLI NAC #5	DOM_GW	20	150	200	150	185
P47686.0W	4/26/1979	COM	19	105	9	NWSW	MOSES ROBERT	MOSES #3-4	DOM_GW	10	150	210	150	210
P37686.0W	5/11/1977	COM	19	105	9	NWNE	MECHEM GUY L.	MECHEM #1	DOM_GW	18	150	220	185	210
P26990.0W	5/23/1974	COM	19	105	9	NENW	GONZALES STEVE J. & ROSALINE M.	GONZALES #1	DOM_GW	25	150	240	200	240
P97604.0W	10/17/1994	COM	19	105	9	NENW	ANDERSON NEIL	ANDERSON #1	DOM_GW	14	150	290	245	260
P27993.0W	9/9/1974	COM	19	105	9	NWNW	GIBSON DONALD A. AND DANI L.	MOORE #1 (DEEPENED)	DOM_GW	10	150	314	245	285
P88653.0W	6/26/1992	COM	19	105	9	NENW	RICHARDS KELLY B. AND DENISE Z.	ENL TODD #2	DOM_GW	20	150	315	275	288
P91455.0W	4/26/1993	COM	19	105	9	SENW	GOLDMAN CLAY B.	CLAY #1	DOM_GW	10	150	315	280	290
P100319.0W	9/25/1995	COM	19	105	9	SWNE	CROY MICHAEL S/CHERYL H	CROY #1	DOM_GW	18	150	330	295	305
P86291.0W	9/25/1991	COM	19	105	9	SWNE	SMITH KALE AND MADELINE / HAYES III GUY A. AND MARY L.	GUY'S #1	DOM_GW	12	150	334	300	315
P85539.0W	7/11/1991	COM	19	105	9	NWSE	LAIR GARY	LAIR #1	DOM_GW	25	150	335	295	328
P89863.0W	10/16/1992	COM	19	105	9	SWNE	FRITZLER MICHEL	FRITZLER #1	DOM_GW	20	150	350	290	305
P129943.0W	10/12/2000	COM	19	105	9	SENW	HAGER RICHARD	RICHARD #1	DOM_GW	25	150	510	360	490
P26144.0W	2/28/1974	COM	19	105	9	NWNW	VOLSEY ROBERT L. AND RUTH E.	LINDA #1	DOM_GW	25	160	180	160	180
P27588.0W	8/2/1974	COM	19	105	9	SWNE	PITT TERRY	PITT #1	DOM_GW	15	160	195		
P50679.0W	11/16/1979	COM	19	105	9	SWNE	SCHWARTZ LARRY G.	SCHWARTZ #1	DOM_GW	10	160	200	160	180
P34237.0W	7/6/1976	COM	19	105	9	NWSW	SMITH KALE W. AND MADELINE L.	SMITH #1	DOM_GW	20	160	260	220	240
P29518.0W	4/15/1975	COM	19	105	9	NWNE	BUSH GLADYS L. / BUSH ARTHUR D.	BUSH #1	DOM_GW	25	160	260		
P38282.0W	4/18/1977	COM	19	105	9	SENW	STRAIGHT LAWRENCE	STRAIGHT #1	DOM_GW	18	160	280	250	280
P85378.0W	6/13/1991	COM	19	105	9	SWNE	BAER MIKE	BAER #1	DOM_GW	10	160	330	290	330
P85891.0W	8/19/1991	COM	19	105	9	SWNE	HAMILTON BART A.	BART #1	DOM_GW	15	160	350	290	310
P76487.0W	3/21/1988	COM	19	105	9	NENW	TRENARY PHILLIP	TRENARY #1	DOM_GW	16	160	375	358	372
P56160.0W	3/24/1981	COM	19	105	9	NENE	CRANOR CHERYL	CRANOR #1	DOM_GW	12	162	185	162	175
P54079.0W	10/3/1980	INC	19	105	9	NENW	CILENSEK CARL	CILENSEK BUILDING #3 WELL	MIS	10	168	245	215	230
P50306.0W	8/24/1979	INC	19	105	9	SWSW	LAY RITE PIPE COMPANY	LAY RITE #1	MIS	8	170	190	175	190
P47511.0W	4/11/1979	COM	19	105	9	SESE	CARDIFF JOHN L.	CARDIFF #1	DOM_GW	15	170	200	150	170
P39743.0W	7/11/1977	INC	19	105	9	SENE	PUTMAN B. R.	PUTMAN #1	MIS	25	170	200	170	200
P49636.0W	8/24/1979	COM	19	105	9	SWSW	MOSES ROBERT	MOSES #8	DOM_GW	10	170	200	180	200
P49772.0W	4/26/1979	INC	19	105	9	NESE	JOHNSON PAUL	PAUL JOHNSON #2	MIS	10	170	210	180	210
P58366.0W	9/18/1981	COM	19	105	9	NWNW	SANNER ELENA E. M.	SANNER #1	DOM_GW	25	170	300	280	300
P30702.0W	8/4/1975	COM	19	105	9	NWNW	CARPENTER EVERETTE C. AND-OR BESSIE	DAWN #1	DOM_GW	25	173	180		
P39490.0W	8/10/1977	COM	19	105	9	NWSE	LOGAN WILLIAM R. & BETTY J.	WILLY-BILL #1	DOM_GW	15	180	200	140	180
P39282.0W	7/29/1977	COM	19	105	9	NWSE	LOGAN BRETT D. & RETA MAE	BDL #1	DOM_GW; STK	15	180	200	160	200
P42243.0W	3/3/1978	INC	19	105	9	NWSW	KLEIN DRILLING	KLEIN DRILLING #1	MIS	25	180	200	180	195
P68157.0W	7/25/1984	COM	19	105	9	NWNW	ANSELMI JOSEPH JOHN	J. J. #1	DOM_GW	18	180	220	180	220
P45564.0W	9/19/1978	COM	19	105	9	NWSW	TREMBATH MICHAEL	VES WALKER #6	DOM_GW	20	180	220	180	220
P76157.0W	10/13/1987	COM	19	105	9	NWNW	JENNINGS SANDRA S.	JENNINGS #1	DOM_GW	25	180	220	189	195
P38442.0W	6/16/1977	COM	19	105	9	NWSE	BALL MARY	BALL #1	DOM_GW	20	180	240	180	200
P63462.0W	3/11/1983	COM	19	105	9	SENW	DOUGLAS SR. LAUREN H. & BOBBIE J.	DOUGLAS #1	DOM_GW	25	180	260	240	260
P55667.0W	9/8/1980	COM	19	105	9	SENW	Richards Island D/Teresa L/Emmanuel Baptist Church of Rock Springs	HELLER #1	DOM_GW	10	180	260		
P97400.0W	10/7/1994	COM	19	105	9	NESW	HUNGERFORD DENNIS S. & TERESA M.	HUNGERFORD #1	DOM_GW	21	180	280	180	280
P27156.0W	6/27/1974	COM	19	105	9	NWNW	LISKA FRANK A. & ROBERTA JUNE	JASON #1	DOM_GW	4	180	280		
P65761.0W	10/18/1983	COM	19	105	9	SWNW	JACKSON DAVID CARL	EMMA #1	DOM_GW	18	180	310	265	285
P52669.0W	6/27/1980	COM	19	105	9	NWNW	HEUERMANN ROBERT E. & ELIZABETH S.	HEUERMANN #1	DOM_GW	15	180	320	295	320
P91736.0W	5/21/1993	COM	19	105	9	NWNW	ETTER GARY	ETTER #1	DOM_GW	13	180	410	355	370
P48697.0W	6/19/1979	COM	19	105	9	NENE	MCMARTIN THOMAS & LILLIAN	MCMARTIN #1	DOM_GW	25	185	220	195	220
P118532.0W	8/23/1999	COM	19	105	9	NWNW	PETERS ROBERT C/MONALI	PETERS #1	DOM_GW	25	190	270	212	245
P37453.0W	3/16/1977	COM	19	105	9	NWNE	MIDWESTERN HOMES	MIDWESTERN HOMES #1	DOM_GW	20	190	300	270	290
P38436.0W	6/8/1977	COM	19	105	9	SWNW	SWEAT DERYL J.	NO SWEAT #1	DOM_GW	20	200	265	200	255
P38567.0W	4/13/1977	COM	19	105	9	SENW	BARNUM SAMMY J. & NONCY	BARNUM #1	DOM_GW	15	200	300	300	340
P42346.0W	3/3/1978	COM	19	105	9	NENE	JENKINS STEVEN M.	STEVE JENKINS #1	DOM_GW	20	200	320	280	300
P50678.0W	11/14/1979	COM	19	105	9	SWNW	RISLEY SILAS P. & GERALDINE C.	RISLEY #1	DOM_GW	3	210	270	240	260
P71196.0W	9/24/1985	COM	19	105	9	NWNE	GARDINER RON & DONNA	GARDINER 1	DOM_GW	13	210	300	270	300
P38325.0W	6/16/1977	COM	19	105	9	SWNW	ELTON DALE & LEANNE	ELTON #1	DOM_GW	13	220	280	220	240
P30835.0W	8/25/1975	COM	19	105	9	NWNE	MOSES ROBERT G.	MOSES #1	DOM_GW	10	220	300	220	280
P33397.0W	5/27/1976	COM	19	105	9	NWNE	ANDERSON JAMES M.	ANDERSON 1	DOM_GW	20	238	298	238	298
P34265.0W	7/27/1976	COM	19	105	9	SWNW	CHRISTENSEN, D.D.S. GRANT	CHRISTENSEN #1	DOM_GW; STK	5	240	280	180	220
P36617.0W	3/21/1977	COM	19	105	9	NWNW	JAMES MARK J. & NIOMA L	JAMES #1	DOM_GW	6	240	300	270	290
P33394.0W	5/25/1976	COM	19	105	9	NENW	BROWN RONALD L.	BROWN'S #1	DOM_GW; STK	12	246	329	246	
P27583.0W	7/31/1974	COM	19	105	9	NWNW	MAINS ROBERT L.	MAINS #1	DOM_GW	20	250	295		
P71987.0W	2/21/1986	COM	19	105	9	NWNE	COLSON THOMAS A.	COLSON #1	DOM_GW	25	250	320		
P36105.0W	2/7/1977	COM	19	105	9	NWNW	FARNWORTH MICHAEL D. & JO ANN	SQUIRT #1	DOM_GW	12	252	280		

Appendix 4B - Wyoming State Engineer's Office Groundwater Permits in the Bitter Creek Watershed

Permit No.	Priority	Status[1]	Twp	Rng	Sec	Qtr/Qtr	Applicant	Facility Name	Uses[2]	Yield (gpm)	Depth to Water[3] (ft)	Total Depth (ft)	Main Water-Bearing Zone	
													Top (ft)	Bottom (ft)
P32196.0W	1/30/1976	COM	19	105	9	NWNW	VERMEULEN MICHAEL	M V #1	DOM_GW	25	256	296	276	296
P57061.0W	5/27/1981	COM	19	105	9	NWNE	GRIFFIN DICK R. & CLAUDIA J.	CORY #1	DOM_GW	21	260	300		
P41208.0W	12/1/1977	COM	19	105	9	NWNE	MOSES ROBERT G.	MOSES #1	DOM_GW	10	280	300	280	300
P26998.0W	6/18/1974	COM	19	105	9	NENW	ROBINSON WILLIAM H. & JERRI L.	ROBINSON #1	DOM_GW; STK	25		150		
P26365.0W	4/15/1974	COM	19	105	9	NENW	TRACY ROBERT D. & JANICE L.	TRACY #1	DOM_GW	25		180		
P26457.0W	4/24/1974	COM	19	105	9	NWNW	RUSSELL GARY LEE	RUSSELL #1	DOM_GW	18		210	170	210
P28003.0W	9/9/1974	INC	19	105	9	SESW	MATLOCK DON F.	MATLOCK #1	DOM_GW	25		260	220	260
P27788.0W	8/19/1974	COM	19	105	9	NENE	HALEY EARL J.	HALEY #1	DOM_GW	25		295		
P182997.0W	8/20/2007	INC	19	105	9	SWSE	VASA RICHARD	VASA #1	DOM_GW	20				
P56161.0W	3/24/1981	INC	19	105	9	NENE	CRANOR CHERYL	CRANOR #2	DOM_GW	25				
P180552.0W	3/26/2007	INC	19	105	9	NESW	ANDERSON MARK A.	ANDERSON #2	DOM_GW	25				
P196568.0W	8/26/2011	INC	19	105	9	SWNW	HARLAND DAVID	HARLAND #1	DOM_GW	25				
P163081.0W	10/6/2004	INC	19	105	9	SWNW	FLETCHER CODY	CODY #1	DOM_GW	25				
P34255.0W	7/19/1976	COM	19	105	9	SESW	H B & R INC.	H B & R #1	DOM_GW	25				
P198498.0W	8/2/2012	INC	19	105	9	NWNW	GROSS STACEY	GROSS NUMBER ONE	DOM_GW; STK	25				
P203969.0W	6/1/2015	INC	19	105	9	NESW	JAKE AND JENNIFER BERG	BEARETT 1	STK	25				
P63916.0W	1/31/1983	FADJ	19	105	10	SESE	SWEETWATER COUNTY FAIR BOARD	ENL FAIRGROUNDS #1	MIS	0	30	905	845	905
P81876.0W	2/8/1990	INC	19	105	10	SESE	SWEETWATER COUNTY FAIRBOARD	FAIRGROUNDS #2	MIS	200	30	905	845	905
P40891.0W	10/4/1977	FADJ	19	105	10	SESE	Sweetwater County	FAIRGROUNDS #1	MIS	375	58	900	838	900
P82576.0W	5/10/1990	FADJ	19	105	10	SESE	SWEETWATER COUNTY FAIRGROUNDS	ENL FAIRGROUNDS #1	MIS	125	58	900	845	905
P46552.0W	1/23/1979	FADJ	19	105	10	SENE	CITY OF ROCK SPRINGS	ROCK SPRINGS RECREATION WELL #5	MIS	325	82	885	780	885
P45012.0W	7/7/1978	FADJ	19	105	10	NENE	ROCK SPRINGS CITY OF	ROCK SPRINGS RECREATION AREA WATER WELL #6	MIS	350			824	930
P10431.0W	9/15/1971	INC	19	105	10	NWNW	City of Rock Springs	ROCK SPRINGS REC WELL #1	DOM_GW; IRR_GW	50				
P193100.0W	4/29/2010	INC	19	105	10	NENE	CITY OF ROCK SPRINGS	ENL ROCK SPRINGS RECREATION WELL #6	MIS	0				
P193099.0W	4/29/2010	INC	19	105	10	SENE	CITY OF ROCK SPRINGS	ENL ROCK SPRINGS RECREATION WELL #5	MIS	0				
P196773.0W	9/9/2011	UNA	19	105	10	NENE	CITY OF ROCK SPRINGS	2ND. ENL. ROCK SPRINGS RECREATION WELL #6	MIS	130				
P10303.0W	9/9/1971	FADJ	19	105	14	SWSW	HAY LEONARD	WAREHOUSE #1	MIS	25	80	330		
P15250.0W	8/24/1972	COM	19	105	14	NESW	HAY LEONARD	WAREHOUSE #2	DOM_GW; STK	20	160	180	160	180
P27582.0W	7/31/1974	INC	19	105	14	NESW	Hay John W.	HAY #1	DOM_GW	25		200	180	200
P11389.0W	11/15/1971	COM	19	105	14	SWNW	USDI - BLM / JETT CHARLES C.	JETT #1	DOM_GW	25		300	180	300
P180231.0W	3/6/2007	COM	19	105	22	NENE	Wyo State Dept. of Environmental Quality	DPVE RS 19-7	MIS	1	5	26		
P180230.0W	3/6/2007	COM	19	105	22	NENE	Wyo State Dept. of Environmental Quality	DPVE RS 19-8	MIS	1	5	28		
P180232.0W	3/6/2007	COM	19	105	22	NENE	Wyo State Dept. of Environmental Quality	DPVE RS 19-6	MIS	1	5	28		
P180233.0W	3/6/2007	COM	19	105	22	NENE	Wyo State Dept. of Environmental Quality	DPVE RS 19-5	MIS	1	6	28		
P180234.0W	3/6/2007	COM	19	105	22	NENE	Wyo State Dept. of Environmental Quality	DPVE RS 19-4	MIS	1	6	28		
P180237.0W	3/6/2007	COM	19	105	22	NENE	Wyo State Dept. of Environmental Quality	DPVE RS 19-1	MIS	1	7	28		
P180227.0W	3/6/2007	COM	19	105	22	NENE	Wyo State Dept. of Environmental Quality	DPVE RS 19-11	MIS	1	7	28		
P180235.0W	3/6/2007	COM	19	105	22	NENE	Wyo State Dept. of Environmental Quality	DPVE RS 19-3	MIS	1	8	28		
P180292.0W	3/6/2007	COM	19	105	22	NENE	Wyo State Dept. of Environmental Quality	GWE RS 19-1	MIS	0	8	30		
P180291.0W	3/6/2007	COM	19	105	22	NENE	Wyo State Dept. of Environmental Quality	GWE RS 19-2	MIS	0	8	30		
P180236.0W	3/6/2007	COM	19	105	22	NENE	Wyo State Dept. of Environmental Quality	DPVE RS 19-2	MIS	1	9	28		
P180229.0W	3/6/2007	COM	19	105	22	NENE	Wyo State Dept. of Environmental Quality	DPVE RS 19-9	MIS	1	9	28		
P180228.0W	3/6/2007	COM	19	105	22	NENE	Wyo State Dept. of Environmental Quality	DPVE RS 19-10	MIS	1	9	28		
P180289.0W	3/6/2007	COM	19	105	22	NENE	Wyo State Dept. of Environmental Quality	GWE RS 19-4	MIS	0	9	29		
P180290.0W	3/6/2007	COM	19	105	22	NENE	Wyo State Dept. of Environmental Quality	GWE RS 19-3	MIS	0	9	30		
P73128.0W	8/13/1986	INC	19	105	23	NWNW	HADDOCKS INC.	RW 1	MIS	0	6	21	6	
P180293.0W	3/6/2007	COM	19	105	23	NWNW	Wyo State Dept. of Environmental Quality	DVPE RS 11-7	MIS	1	6	28		
P180304.0W	3/6/2007	COM	19	105	23	NWNW	Wyo State Dept. of Environmental Quality	DPVE RS 11-3	MIS	1	6	28		
P180303.0W	3/6/2007	COM	19	105	23	NWNW	Wyo State Dept. of Environmental Quality	DPVE RS 11-4	MIS	1	6	28		
P180287.0W	3/6/2007	COM	19	105	23	SWSW	Wyo State Dept. of Environmental Quality	GWE RS 5-6	MIS	0	6	30		
P180288.0W	3/6/2007	COM	19	105	23	SWSW	Wyo State Dept. of Environmental Quality	GWE RS 5-5	MIS	0	6	30		
P180307.0W	3/6/2007	COM	19	105	23	SWSW	Wyo State Dept. of Environmental Quality	GWE RS 5-1	MIS	0	6	30		
P180286.0W	3/6/2007	COM	19	105	23	SWSW	Wyo State Dept. of Environmental Quality	GWE RS 5-8	MIS	0	6	30		
P180306.0W	3/6/2007	COM	19	105	23	SWSW	Wyo State Dept. of Environmental Quality	GWE RS 5-2	MIS	0	6	30		
P180305.0W	3/6/2007	COM	19	105	23	NWNW	Wyo State Dept. of Environmental Quality	DPVE RS 11-2	MIS	1	7	28		
P180310.0W	3/6/2007	COM	19	105	23	NWNW	Wyo State Dept. of Environmental Quality	DPVE RS 11-9	MIS	1	8	27		
P180222.0W	3/6/2007	COM	19	105	23	NWNW	WYO STATE DEPT. OF ENVIRONMENTAL QUALITY	DPVE RS11-5	MIS	1	8	28		
P180248.0W	3/6/2007	COM	19	105	23	SWNW	Wyo State Dept. of Environmental Quality	DPVE RS 8-7	MIS	1	8	28		
P180295.0W	3/6/2007	COM	19	105	23	NWNW	Wyo State Dept. of Environmental Quality	DPVE RS 11-1	MIS	1	8	28		
P180311.0W	3/6/2007	COM	19	105	23	NWNW	Wyo State Dept. of Environmental Quality	DPVE RS 11-8	MIS	1	8	28		
P180257.0W	3/6/2007	COM	19	105	23	SWNW	Wyo State Dept. of Environmental Quality	GWE RS 8-4	MIS	0	8	30		
P180314.0W	3/6/2007	COM	19	105	23	NWNW	Wyo State Dept. of Environmental Quality	GWE RS 11-3	MIS	0	8	30		
P180249.0W	3/6/2007	COM	19	105	23	SWNW	Wyo State Dept. of Environmental Quality	DPVE RS 8-6	MIS	1	9	23		
P180250.0W	3/6/2007	COM	19	105	23	SWNW	Wyo State Dept. of Environmental Quality	DPVE RS 8-5	MIS	1	9	27		
P180224.0W	3/6/2007	COM	19	105	23	SWNW	Wyo State Dept. of Environmental Quality	GWE RS	MIS	0	9	28		
P180244.0W	3/6/2007	COM	19	105	23	SWNW	Wyo State Dept. of Environmental Quality	DPVE RS 8-11	MIS	1	9	28		
P180252.0W	3/6/2007	COM	19	105	23	SWNW	Wyo State Dept. of Environmental Quality	DPVE RS 8-3	MIS	1	9	28		
P180246.0W	3/6/2007	COM	19	105	23	SWNW	Wyo State Dept. of Environmental Quality	DPVE RS 8-9	MIS	1	9	28		
P180253.0W	3/6/2007	COM	19	105	23	SWNW	Wyo State Dept. of Environmental Quality	DPVE RS 8-2	MIS	1	9	28		

Appendix 4B - Wyoming State Engineer's Office Groundwater Permits in the Bitter Creek Watershed

Permit No.	Priority	Status[1]	Twp	Rng	Sec	Qtr/Qtr	Applicant	Facility Name	Uses[2]	Yield (gpm)	Depth to Water[3] (ft)	Total Depth (ft)	Main Water-Bearing Zone	
													Top (ft)	Bottom (ft)
P180247.0W	3/6/2007	COM	19	105	23	SWNW	Wyo State Dept. of Environmental Quality	DPVE RS 8-8	MIS	1	9	28		
P180245.0W	3/6/2007	COM	19	105	23	SWNW	Wyo State Dept. of Environmental Quality	DPVE RS 8-10	MIS	1	9	28		
P180254.0W	3/6/2007	COM	19	105	23	SWNW	Wyo State Dept. of Environmental Quality	DPVE RS 8-1	MIS	1	9	28		
P180251.0W	3/6/2007	COM	19	105	23	SWNW	Wyo State Dept. of Environmental Quality	DPVE RS 8-4	MIS	1	9	28		
P180243.0W	3/6/2007	COM	19	105	23	SWNW	Wyo State Dept. of Environmental Quality	TRCH RS 8-1	MIS	1	9	28		
P180242.0W	3/6/2007	COM	19	105	23	SWNW	Wyo State Dept. of Environmental Quality	TRCH RS 8-2	MIS	1	9	28		
P180241.0W	3/6/2007	COM	19	105	23	SWNW	Wyo State Dept. of Environmental Quality	TRCH RS 8-3	MIS	1	9	28		
P180256.0W	3/6/2007	COM	19	105	23	SWNW	Wyo State Dept. of Environmental Quality	GWE RS 8-5	MIS	0	9	30		
P180255.0W	3/6/2007	COM	19	105	23	SWNW	Wyo State Dept. of Environmental Quality	GWE RS 8-6	MIS	0	9	30		
P180294.0W	3/6/2007	COM	19	105	23	NWNW	Wyo State Dept. of Environmental Quality	GWE RS 11-2	MIS	0	9	30		
P180296.0W	3/6/2007	COM	19	105	23	SWSW	Wyo State Dept. of Environmental Quality	GWE RS 5-4	MIS	0	9	30		
P180302.0W	3/6/2007	COM	19	105	23	NWNW	Wyo State Dept. of Environmental Quality	DPVE RS 11-6	MIS	1	10	28		
P180259.0W	3/6/2007	COM	19	105	23	NWSW	Wyo State Dept. of Environmental Quality	GWE RS 7-10	MIS	0	10	30		
P180261.0W	3/6/2007	COM	19	105	23	NWSW	Wyo State Dept. of Environmental Quality	GWE RS 7-8	MIS	0	10	30		
P180260.0W	3/6/2007	COM	19	105	23	NWSW	Wyo State Dept. of Environmental Quality	GWE RS 7-9	MIS	0	10	30		
P180263.0W	3/6/2007	COM	19	105	23	NWSW	Wyo State Dept. of Environmental Quality	GWE RS 7-6	MIS	0	10	30		
P180265.0W	3/6/2007	COM	19	105	23	NWSW	Wyo State Dept. of Environmental Quality	GWE RS 7-4	MIS	0	10	30		
P180264.0W	3/6/2007	COM	19	105	23	NWSW	Wyo State Dept. of Environmental Quality	GWE RS 7-5	MIS	0	10	30		
P180262.0W	3/6/2007	COM	19	105	23	NWSW	Wyo State Dept. of Environmental Quality	GWE RS 7-7	MIS	0	10	30		
P453.0C	2/4/1946	INC	19	105	23	NWNW	Pacific Power Light Corp.	ROCK SPRINGS #12, #6 PUMPING PLANT	DOM_GW; IND_GW; MUN_GW	120	10	435	250	420
P180298.0W	3/6/2007	COM	19	105	23	SWSW	Wyo State Dept. of Environmental Quality	GWE RS 5-10	MIS	0	11	29		
P180258.0W	3/6/2007	COM	19	105	23	NWSW	Wyo State Dept. of Environmental Quality	GWE RS 7-11	MIS	0	11	30		
P180267.0W	3/6/2007	COM	19	105	23	NWSW	Wyo State Dept. of Environmental Quality	GWE RS 7-2	MIS	0	11	30		
P180266.0W	3/6/2007	COM	19	105	23	NWSW	Wyo State Dept. of Environmental Quality	GWE RS 7-3	MIS	0	11	30		
P180299.0W	3/6/2007	COM	19	105	23	SWSW	Wyo State Dept. of Environmental Quality	GWE RS 5-11	MIS	0	11	30		
P180297.0W	3/6/2007	COM	19	105	23	SWSW	Wyo State Dept. of Environmental Quality	GWE RS 5-9	MIS	0	13	30		
P180272.0W	3/6/2007	COM	19	105	23	SWSW	Wyo State Dept. of Environmental Quality	GWE RS 5-3	MIS	0	14	30		
P180301.0W	3/6/2007	COM	19	105	23	SWSW	Wyo State Dept. of Environmental Quality	GWE RS 5-7	MIS	0	14	30		
P180271.0W	3/6/2007	COM	19	105	23	SWSW	Wyo State Dept. of Environmental Quality	DPVE RS 5-1	MIS	1	18	28		
P180270.0W	3/6/2007	COM	19	105	23	SWSW	Wyo State Dept. of Environmental Quality	DPVE RS 5-2	MIS	1	19	28		
P452.0C	11/30/1937	INC	19	105	23	NWSW	Union Pacific Railroad	ROCK SPRINGS #11, #6 DIST.	DOM_GW; IND_GW; MUN_GW	75	23	184	36	184
P180269.0W	3/6/2007	COM	19	105	23	SWSW	Wyo State Dept. of Environmental Quality	DPVE RS 5-3	MIS	1	24	28		
P180300.0W	3/6/2007	COM	19	105	23	SWSW	Wyo State Dept. of Environmental Quality	DPVE RS 5-4	MIS	1	24	28		
P266.0G	6/18/1954	INC	19	105	23	SWNW	Pacific Power Light Corp.	ROCK SPRINGS #13 AT #6 PUMPING PLANT	DOM_GW; IND_GW; MUN_GW	120	25	550	352	547
P447.0C	12/31/1909	INC	19	105	23	SWSW	Union Pacific Railroad	ROCK SPRINGS #5, #6 DIST.	DOM_GW; IND_GW; MUN_GW	25	30	170	43	170
P448.0C	12/31/1909	INC	19	105	23	SWSW	Union Pacific Railroad	ROCK SPRINGS #6, #6 DIST.	DOM_GW; IND_GW; MUN_GW	20	30	175	43	175
P446.0C	12/31/1909	INC	19	105	23	SWSW	Union Pacific Railroad	ROCK SPRINGS #3, #6 DIST.	DOM_GW; IND_GW; MUN_GW	6	30	200	43	200
P445.0C	12/31/1909	INC	19	105	23	SWSW	Union Pacific Railroad	ROCK SPRINGS #2, #6 DIST.	DOM_GW; IND_GW; MUN_GW	15	30	206	43	206
P451.0C	7/31/1937	INC	19	105	23	SWSW	THE UNION PACIFIC COAL COMPANY	ROCK SPRINGS #10, #6 DIST.	DOM_GW; IND_GW; MUN_GW	20	30	245	43	245
P444.0C	12/31/1909	INC	19	105	23	SWSW	THE UNION PACIFIC COAL COMPANY	ROCK SPRINGS #1, #6 DIST.	DOM_GW; IND_GW; MUN_GW	20	30	250	43	250
P449.0C	12/31/1920	INC	19	105	23	NWSW	THE UNION PACIFIC COAL COMPANY	ROCK SPRINGS #8, #6 DIST.	DOM_GW; IND_GW; MUN_GW	12	35	170	48	170
P450.0C	12/31/1920	INC	19	105	23	NWSW	THE UNION PACIFIC COAL COMPANY	ROCK SPRINGS #9, #6 DIST.	DOM_GW; IND_GW; MUN_GW	26	40	250	53	250
P180308.0W	3/6/2007	COM	19	105	26	NWNW	Wyo State Dept. of Environmental Quality	GWE RS 4-3	MIS	0	6	30		
P180319.0W	3/6/2007	COM	19	105	26	NWNW	Wyo State Dept. of Environmental Quality	GWE RS 4-4	MIS	0	6	30		
P73338.0W	9/8/1986	INC	19	105	26	SWNW	Wyo State Highway Dept.	ENL ELK STREET #1	MIS	0	7	300	40	290
P180315.0W	3/6/2007	COM	19	105	26	NWNW	Wyo State Dept. of Environmental Quality	DPVE RS 4-2	MIS	1	8	28		
P180282.0W	3/6/2007	COM	19	105	26	SWNW	Wyo State Dept. of Environmental Quality	DPVE RS 1-1	MIS	0	10	28		
P180316.0W	3/6/2007	COM	19	105	26	NWNW	Wyo State Dept. of Environmental Quality	DPVE RS 4-1	MIS	1	10	28		
P180238.0W	3/6/2007	COM	19	105	26	NWNW	Wyo State Dept. of Environmental Quality	GWE RS 17-3	MIS	0	10	30		
P180284.0W	3/6/2007	COM	19	105	26	SWNW	Wyo State Dept. of Environmental Quality	GWE RS 1-5	MIS	0	10	30		
P180280.0W	3/6/2007	COM	19	105	26	NWNW	Wyo State Dept. of Environmental Quality	GWE RS 2-1	MIS	0	10	30		
P180283.0W	3/6/2007	COM	19	105	26	SWNW	Wyo State Dept. of Environmental Quality	GWE RS 1-6	MIS	0	10	30		
P180285.0W	3/6/2007	COM	19	105	26	SWNW	Wyo State Dept. of Environmental Quality	GWE RS 1-4	MIS	0	10	30		
P180226.0W	3/6/2007	COM	19	105	26	SWNW	Wyo State Dept. of Environmental Quality	GWE RS 1-3	MIS	1	10	30		
P180277.0W	3/6/2007	COM	19	105	26	NWNW	Wyo State Dept. of Environmental Quality	GWE RS 2-4	MIS	0	10	35		
P180281.0W	3/6/2007	COM	19	105	26	SWNW	Wyo State Dept. of Environmental Quality	DPVE RS 1-2	MIS	0	11	28		
P180240.0W	3/6/2007	COM	19	105	26	NWNW	Wyo State Dept. of Environmental Quality	GWE RS 17-1	MIS	0	11	30		
P180239.0W	3/6/2007	COM	19	105	26	NWNW	Wyo State Dept. of Environmental Quality	GWE RS 17-2	MIS	0	11	30		
P180279.0W	3/6/2007	COM	19	105	26	NWNW	Wyo State Dept. of Environmental Quality	GWE RS 2-2	MIS	0	11	30		
P180276.0W	3/6/2007	COM	19	105	26	NWNW	Wyo State Dept. of Environmental Quality	GWE RS 2-5	MIS	0	11	30		
P180278.0W	3/6/2007	COM	19	105	26	NWNW	Wyo State Dept. of Environmental Quality	GWE RS 2-3	MIS	0	11	30		
P180274.0W	3/6/2007	COM	19	105	26	NWNW	Wyo State Dept. of Environmental Quality	GWE RS 3-2	MIS	0	13	30		
P180275.0W	3/6/2007	COM	19	105	26	NWNW	Wyo State Dept. of Environmental Quality	GWE RS 3-1	MIS	0	13	30		
P180320.0W	3/6/2007	COM	19	105	26	NWNW	Wyo State Dept. of Environmental Quality	GWE RS 4-2	MIS	0	14	30		
P180273.0W	3/6/2007	COM	19	105	26	NWNW	Wyo State Dept. of Environmental Quality	GWE RS 3-3	MIS	0	15	30		
P180312.0W	3/6/2007	COM	19	105	26	SWNW	Wyo State Dept. of Environmental Quality	GWE RS 1-2	MIS	0	17	30		
P180313.0W	3/6/2007	COM	19	105	26	SWNW	Wyo State Dept. of Environmental Quality	GWE RS 1-1	MIS	0	18	30		
P180317.0W	3/6/2007	COM	19	105	26	NWNW	Wyo State Dept. of Environmental Quality	GWE RS 4-6	MIS	0	27	30		
P180318.0W	3/6/2007	COM	19	105	26	NWNW	Wyo State Dept. of Environmental Quality	GWE RS 4-5	MIS	0				

Appendix 4B - Wyoming State Engineer's Office Groundwater Permits in the Bitter Creek Watershed

Permit No.	Priority	Status[1]	Twp	Rng	Sec	Qtr/Qtr	Applicant	Facility Name	Uses[2]	Yield (gpm)	Depth to Water[3] (ft)	Total Depth (ft)	Main Water-Bearing Zone	
													Top (ft)	Bottom (ft)
P180309.0W	3/6/2007	INC	19	105	26	NWNW	Wyo State Dept. of Environmental Quality	GWE RS 4-1	MIS	5				
P15152.0W	7/17/1972	INC	19	105	32	NESE	KOBLER DEAN	KOBLER #1	MIS	30	25	165	100	165
P8643.0P	7/10/1961	COM	19	105	32	NESE	GOOKIN DEAN H.	GOOKIN #1	DOM_GW	10	30	120		
P9025.0W	2/12/1971	COM	19	105	32	NESE	STORTS A.L. / GOOKIN DEAN H.	GOOKIN #2	DOM_GW	15	30	120		
P13977.0W	5/9/1972	COM	19	105	32	NESE	GOOKIN DEAN H.	GOOKIN #3	DOM_GW	20	30	300	75	195
P29857.0W	5/14/1975	COM	19	105	32	NWSE	MARTIN JAMES L.	MARTIN #6	DOM_GW	25	40	277		
P10748.0W	10/19/1971	COM	19	105	32	SESE	GOOKIN LUCILLE	GOOKIN #1	DOM_GW	15	60	180	165	180
P37445.0W	5/18/1976	INC	19	105	32	NWSW	MARTIN JAMES L.	MARTIN #7	MIS	24	70	300	270	290
P37451.0W	3/15/1977	INC	19	105	32	NWSE	MARTIN JAMES L.	MARTIN WELL #8	MIS	23	70	320	290	315
P98146.0W	1/9/1995	COM	19	105	32	NESE	CREESE KENNETH E.	CREESE #1	DOM_GW	11	70	370	344	360
P47691.0W	2/13/1979	INC	19	105	32	SWSE	MARTIN JAMES L.	WELL #9	MIS	24	95	260	220	240
P42348.0W	3/3/1978	FADJ	19	105	32	NWSW	USDI - BLM / Sweetwater County Engineer	SWEETWATER TRAP CLUB #1	MIS	25	120	200	120	200
P20634.0W	4/24/1973	COM	19	105	32	NWSE	GUTIERREZ AVELINO	GUTIERREZ #2	DOM_GW	25	190	220	190	220
P20635.0W	4/24/1973	COM	19	105	32	NWSE	GUTIERREZ AVELINO	GUTIERREZ #3	DOM_GW	25	200	245	200	240
P61255.0W	6/21/1982	COM	19	105	33	SENW	WEBER RICHARD M. & CONNIE L.	WEBER #1	DOM_GW	18	12	80	65	80
P74488.0W	4/24/1987	INC	19	105	33	NWSE	CANADIAN COMMERCIAL BANK	CCB WELL #1	MIS	13	13	31		35
P97273.0W	9/15/1994	INC	19	105	35	NENW	Wyo State Dept. of Environmental Quality	WWC-MV7	MIS	40	-4	240	212	217
P80830.0W	9/18/1989	INC	19	105	35	SENW	Wyo State Dept. of Environmental Quality	WWC B7	MIS	2	7	33	27	33
P80832.0W	9/18/1989	INC	19	105	35	NESW	Wyo State Dept. of Environmental Quality	WWC L7	MIS	2	7	34	30	34
P80831.0W	9/18/1989	INC	19	105	35	SENW	Wyo State Dept. of Environmental Quality	WWC D1	MIS	2	7	36		37
P122089.0W	4/26/1999	COM	20	100	11	NWSW	Bridger Coal Co.	DW 99210	MIS	100	150	418		
P206695.0W	9/20/2016	INC	20	100	12	NWSW	BRIDGER COAL COMPANY	DWW16-01	MIS	200				
P206004.0W	8/1/2016	COM	20	100	13	NENW	BRIDGER COAL COMPANY	01DWW4	MIS	200	42	392	295	303
P148351.0W	6/6/2002	COM	20	100	13	NWNW	USDI - BLM / Bridger Coal Co.	02007W	MIS	30	49	377	355	376
P106980.0W	7/10/1997	INC	20	100	14	NESE	USDI - BLM / Bridger Coal Co.	WELL #9702	MIS	150				
P106981.0W	7/10/1997	INC	20	100	14	NESE	USDI - BLM / Bridger Coal Co.	WELL #9703	MIS	150				
P106979.0W	7/10/1997	INC	20	100	14	SENE	USDI - BLM / Bridger Coal Co.	WELL #9701	MIS	150				
P122087.0W	4/26/1999	COM	20	100	23	SENE	Bridger Coal Co.	DW 98223	MIS	100	90	368		
P193744.0W	3/29/2010	COM	20	100	23	SWSE	BLM / ANADARKO LAND CORP / BRIDGER COAL CO	PIT WELL #12	MIS	1000		285		
P203174.0W	11/17/2014	INC	20	100	23	SWNE	BRIDGER COAL COMPANY	DWW14-01	MIS	110				
P193745.0W	3/29/2010	COM	20	100	26	SESE	ANADARKO LAND CORP. / BLM / BRIDGER COAL CO	PITWELL #13	MIS	1000		320		
P182021.0W	5/18/2007	INC	20	100	26	SESE	Wyo State Board of Land Comm / USDI - BLM / Bridger Coal Co.	07 DWW01	MIS	90				
P6437.0W	9/3/1970	FADJ	20	101	3	SWSE	IDAHO POWER COMPANY / Pacific Power Light Corp.	JIM BRIDGER #1	IND_GW	650	-4	1451	720	1336
P198512.0W	8/2/2012	COM	20	101	3	NESW	PACIFICORP	JBRW-22	MIS	10	17	31	17	31
P109760.0W	4/27/1998	INC	20	101	3	NESW	PACIFICORP/JIM BRIDGER POWER PLANT	JBRW-22	MIS	0			17	31
P34385.0W	7/22/1976	FADJ	20	101	11	NWNW	Black Butte Coal Co.	COAL WATER #1	IND_GW; MIS	50	68	514	400	500
P81902.0W	2/27/1990	INC	20	101	11	SWNW	Union Pacific Land Resources Corp./Black Butte Coal Co.	BBCC RS 1	MIS	10			2	18
P79326.0W	4/4/1989	INC	20	101	11	NENW	Black Butte Coal Co.	DUSTY TRAILS #1	MIS	600			881	1101
P124.0C	4/21/1921	INC	20	101	27	NWSW	Union Pacific Railroad	POINT OF ROCKS #6	NULL	100	8	330	300	330
P12415.0P	12/31/1951	COM	20	101	27	NESW	POINT OF ROCKS MERCANTILE	OLD IRON #1	DOM_GW	11	15	90		
P122.0C	9/11/1917	INC	20	101	27	NWSW	Union Pacific Railroad	POINT OF ROCKS #4	NULL	100	15	480		
P121.0C	6/30/1905	INC	20	101	27	NWSW	Union Pacific Railroad	POINT OF ROCKS #3	NULL	100	17	1112	1000	1112
P12416.0P	5/31/1968	COM	20	101	27	NESW	POINT OF ROCKS MERCANTILE	SODA #2	DOM_GW	13	20	90		
P12508.0W	1/14/1972	INC	20	101	27	NESW	POINT OF ROCKS MERC.	DEEP WELL #3	DOM_GW; MIS	48	25	340	171	315
P13668.0W	4/6/1972	COM	20	101	27	NESW	DELAMBERT BURT H.	DELAMBERT #2	DOM_GW	15	30	305	259	334
P194948.0W	1/3/2011	COM	20	102	28	SWSW	Wyo Office of State Lands and Investments/WYDOT	MP 123	MIS	100	30	118	70	118
P35508.0W	10/8/1976	COM	20	102	28	SWSW	FREDERICKSON B. V. & MARGARET	B.V. FREDERICKSON #1	DOM_GW	20	45	240	214	240
P53950.0W	9/24/1980	COM	20	102	28	SWSW	SHAW WILLIAM	SHAW #2	DOM_GW	16	65	240	180	225
P135403.0W	6/4/2001	COM	20	102	28	SESW	MASTERS STANLEY ROSS	MASTERS #1	DOM_GW; STK	25	118	300	215	300
P35831.0W	10/25/1976	COM	20	102	28	SWSW	SHAW WILLIAM	MCCORMICK #1	DOM_GW	20	140	220	180	220
P64168.0W	6/1/1983	COM	20	102	28	SWSW	KUNIK KRIS & MARCIE	KUNIK #1	DOM_GW	25	160	240	210	240
P83329.0W	8/21/1990	INC	20	102	32	SENE	Wyo State Highway Dept.	SUPERIOR INTERCHANGE #1	MIS	0		100	40	100
P149551.0W	2/14/2003	INC	20	104	19	NWNE	New Stansbury Coal Co., LLC	STANSBURY # 1	MIS	500				
P101537.0W	3/8/1996	INC	20	104	20	SWSE	New Stansbury Coal Co., LLC	STANSBURY #3	MIS	150	668	728	688	728
P47527.0W	4/18/1979	COM	20	105	20	SESW	STAFFORD CLARK P. & BARBARA J.	JODIE #1	DOM_GW	25	20	60	7	35
P21876.0W	5/29/1973	COM	20	105	20	SESW	KNEZOVICH TONY	KNEZOVICH #1	DOM_GW	11	20	80		
P38293.0W	6/7/1977	COM	20	105	20	SWSW	STASSINOS HARRY H.	STASSINOS #1	DOM_GW; STK	12	20	100	18	
P67645.0W	6/13/1984	COM	20	105	20	NENW	SPROUSE ROBBY L. OR LAURA A.	SPROUSE #1	DOM_GW; STK	25	25	100	80	100
P65705.0W	10/13/1983	COM	20	105	20	SESW	STASSINOS HARRY	MCDONALD #1	DOM_GW	18	25	140	128	140
P67646.0W	6/13/1984	COM	20	105	20	NENW	ACKERMAN STANLEY L.	ACKERMAN #1	DOM_GW; STK	25	30	112		
P51485.0W	3/18/1980	COM	20	105	20	SESW	DOLAK JON M.	DOLAK #1	DOM_GW	2	30	120	80	105
P24400.0W	8/20/1973	COM	20	105	20	SESW	RAINES DAVID L.	RAINES #1	DOM_GW	13	30	120	100	110
P22482.0W	6/18/1973	COM	20	105	20	NESW	KNEZOVICH ANTHONY	KNEZOVICH #2	DOM_GW	11	30	145		
P24408.0W	8/20/1973	COM	20	105	20	SESW	JOHNSON DONALD JOE	JOHNSON #1	DOM_GW	5	30	160	120	160
P181364.0W	5/24/2007	COM	20	105	20	NESW	DENTON MARK AND KIMBERLY	DENTON #1	DOM_GW	16	50	300		
P57953.0W	8/13/1981	COM	20	105	20	SWSW	DOMAN MICHAEL D. & PEGGY J.	DOMAN #1	DOM_GW; STK	25	55	100	85	100
P85782.0W	8/1/1991	COM	20	105	20	SESW	WOLFE GARWOOD AND JANET	WOLFE #1	DOM_GW	8	56	170	158	165
P58509.0W	10/22/1981	COM	20	105	20	NESW	LARSON MARION & ROGER	LARSON WELL #2	DOM_GW	13	60	120	90	120
P52786.0W	6/30/1980	COM	20	105	20	NWSW	BURKART EDWARD L. & MARILYN L.	BURKART #1	DOM_GW	5	60	177	165	175

Appendix 4B - Wyoming State Engineer's Office Groundwater Permits in the Bitter Creek Watershed

Permit No.	Priority	Status[1]	Twp	Rng	Sec	Qtr/Qtr	Applicant	Facility Name	Uses[2]	Yield (gpm)	Depth to Water[3] (ft)	Total Depth (ft)	Main Water-Bearing Zone	
													Top (ft)	Bottom (ft)
P73761.0W	12/8/1986	COM	20	105	20	NWSW	BURKART EDWARD L.	BURKART #1B	DOM_GW	9	60	195	178	190
P72337.0W	4/24/1986	COM	20	105	20	NWSW	HILL MICHAEL L.	MLH #10	DOM_GW	8	70	110	70	105
P58211.0W	9/21/1981	COM	20	105	20	NESW	MCDARMENT VICTOR & DEE DEE	MCDARMENT #1	DOM_GW	25	75	170	150	165
P57876.0W	7/27/1981	COM	20	105	20	NWNW	CLINTON BEN	BARKER #1	DOM_GW	25	80	180	160	180
P37684.0W	5/9/1977	COM	20	105	20	NESW	CLINTON BEN OR AMELIA	CLINTON #2	STK	25	100	160	105	160
P20910.0W	5/3/1973	COM	20	105	20	SESW	BROWN LEWIS L.	BROWN #1	DOM_GW; STK	25	150	190	150	180
P37683.0W	5/9/1977	COM	20	105	20	NESW	CLINTON BEN OR AMELIA	CLINTON #1	DOM_GW; STK	25	160	220	180	220
P57998.0W	8/27/1981	COM	20	105	20	NESW	FLOWERS KAY / EACH GERALD	EACH #1	DOM_GW	25	168	180	168	180
P174877.0W	5/24/2006	INC	20	105	20	SWSW	STASSIONS JAMES	JIMBO II	DOM_GW	25				
P30225.0W	6/18/1975	COM	20	105	20	NESW	CLINTON BEN OR AMELIA	CLINTON #2	DOM_GW; STK	25				
P150566.0W	4/25/2003	COM	20	105	23	SESE	CHENOWETH JOE	KYLEE # 1	DOM_GW	20	60	130		
P100509.0W	10/12/1995	COM	20	105	23	SWSE	COLVIN SCOTT OWEN	COLVIN #1	DOM_GW; STK	25	65	155	100	145
P102012.0W	4/8/1996	COM	20	105	23	SESE	CHENOWETH JOSEPH/TREASA	CHENOWETH #1	DOM_GW; STK	10	68	200	138	158
P57678.0W	7/10/1981	COM	20	105	24	NENE	ROCKY MOUNTAIN COAL COMPANY, LLC	STANSBURY #2	MIS	180	540	700	696	700
P86980.0W	1/21/1992	COM	20	105	28	SWNW	JACKMAN JEANNE	JACKMAN #1	DOM_GW; STK	20	110	220		
P86981.0W	1/15/1992	COM	20	105	28	SWNW	JACKMAN JEANNE	JACKMAN #2	DOM_GW; STK	20	110	220		
P86982.0W	1/21/1992	COM	20	105	28	SWNW	JACKMAN JEANNE	JACKMAN #3	DOM_GW; STK	20	110	220		
P2054.0W	6/8/1967	FADJ	20	105	28	SWSW	KOS M.D. PAUL A.	BEEBS #1	STK	9	150	300	150	300
P45268.0W	9/28/1978	COM	20	105	28	SWSW	HILL DOUGLAS L. & LINDA M.	HILL #1	DOM_GW	25	160	260	160	260
P45269.0W	9/28/1978	COM	20	105	28	SWSW	HILL DOUGLAS L. & LINDA M.	HILL #2	STK	20	180	350	180	350
P133627.0W	4/2/2001	COM	20	105	29	NWNW	JONES NADINE	NEALE # 1	DOM_GW; STK	0	35	134	100	134
P175234.0W	5/26/2006	INC	20	105	29	SENW	WOLFF KENNETH & TAMMY	1 WELL	DOM_GW	20				
P169931.0W	8/15/2005	INC	20	105	29	NWSE	WARD LARRY D.	LARRY WARD #1	DOM_GW	25				
P98949.0W	4/21/1995	COM	20	105	33	SWSW	THIEL TERRANCE & MARY	THIEL #1	DOM_GW	4	140	450		
P200381.0W	5/30/2013	INC	20	105	33	NWSE	RONALD ROY	ROY WELL #1	DOM_GW	5				
P148938.0W	1/29/2003		20	105	33	NENE	HABERMAN JOHN	HABERMAN # 1	DOM_GW	25				
P151911.0W	6/9/2003	INC	20	105	33	SWNE	LYTLE BRIAN	LYTLE 1	DOM_GW	25				
P61721.0W	8/23/1982	FADJ	20	105	35	SESE	DIVISION OF UNIVAR VAN WATERS & ROGERS	ENL VW&R #1	MIS	0	15	250	170	210
P55677.0W	3/3/1981	INC	20	105	35	SESE	VAN WATERS & ROGERS DIVISION OF UNIVAR CORP.	VW & R #1	MIS	100	15	250	170	210
P96636.0W	8/10/1994	COM	20	105	35	NENE	FOSTER STEVEN R. & DIANE M.	FOSTER I	DOM_GW; STK	10	30	450	440	450
P181447.0W	5/21/2007	INC	20	105	35	NWNE	HATCH JESSE	HATCH #1	MIS	60	50	460		460
P161062.0W	8/2/2004	INC	20	105	35	NENE	FOSTER STEVEN R. & DIANE M.	FOSTER II	DOM_GW; STK	25				
P441.0C	12/31/1926	INC	20	105	36	SWSW	SOUTHERN WYOMING UTILITIES CO.	RELIANCE DUG WELL	MIS; MUN_GW	200	31	93	42	93
P159156.0W	5/20/2004	COM	20	105	36	NESW	MORTENSEN JOHN AND MERLEEN	JOHN #2 WATER WELL	DOM_GW	16	70	190	165	173
P66633.0W	2/7/1984	INC	21	100	7	SWNW	Bridger Coal Co.	MINE PIT WELL #10	MIS	500	50	115		
P69205.0W	9/8/1983	INC	21	100	7	SESW	USDI - BLM / Bridger Coal Co.	ENL MINE PIT WELL #2	MIS	250	86	90		
P54279.0W	10/9/1980	INC	21	100	7	SESW	USDI - BLM / Bridger Coal Co.	MINE PIT WELL #2	MIS	250	86	90		
P77228.0W	6/13/1988	INC	21	100	7	SESW	Bridger Coal Co.	DEADMAN SUMP #1	MIS	2800				
P65005.0W	7/5/1983	COM	21	100	17	NESE	NULL	ENL MINE PIT WELL #4	MIS	250	146	154		
P54281.0W	10/9/1980	COM	21	100	17	SESW	USDI - BLM / Bridger Coal Co.	MINE PIT WELL #4	MIS	250	146	154		
P191567.0W	8/6/2009	COM	21	100	17	NESE	PACIFICORP ENERGY	2ND ENL. MINE PIT WELL #4	IND_GW	0				
P205258.0W	2/9/2016	COM	21	100	17	NESE	BRIDGER COAL COMPANY	3RD ENL. MINE PIT WELL #4	IND_GW; MIS	300				
P69206.0W	9/8/1983	INC	21	100	18	NWNE	USDI - BLM / Bridger Coal Co.	ENL MINE PIT WELL #3	MIS	250				
P69080.0W	11/28/1984	INC	21	100	20	SENE	Bridger Coal Co.	ENL MINE PIT WELL #9	MIS	250	105	110		
P63215.0W	2/2/1983	INC	21	100	20	SENE	Bridger Coal Co.	MINE PIT WELL #9	MIS	250	105	110		
P54283.0W	10/9/1980	INC	21	100	21	SESW	USDI - BLM / Bridger Coal Co.	MINE PIT WELL #6	MIS	250	153	159		
P67969.0W	6/26/1984	INC	21	100	21	SESW	USDI - BLM / Bridger Coal Co.	ENL PIT WELL #6	MIS	250	153	159		
P75159.0W	7/16/1987	INC	21	100	21	SESW	Bridger Coal Co.	ENL MINE PIT WELL #6	MIS	1500	153	159		
P121584.0W	9/1/1998	COM	21	100	22	SESW	Bridger Coal Co.	DW 98322	MIS	50	253	500		
P121583.0W	9/1/1998	COM	21	100	22	SESW	Bridger Coal Co.	DW 98222	MIS	50	255	500		
P65004.0W	7/5/1983	INC	21	100	34	NESE	USDI - BLM / Bridger Coal Co.	ENL MINE PIT WELL #8	MIS	250	45	66		
P54285.0W	10/9/1980	INC	21	100	34	NESE	USDI - BLM / Bridger Coal Co.	MINE PIT WELL #8	MIS	250	45	66		
P122088.0W	4/26/1999	COM	21	100	35	SENE	Bridger Coal Co.	DW 99635	MIS	100	184	538		
P175203.0W	6/12/2006	COM	21	101	9	SESE	GMT EXPLORATION CO. LLC	SOUTH BLACK ROCK #44-9	MIS	85	500	1235	1170	1180
P67006.0W	4/11/1984	INC	21	101	11	NWSE	USDI - BLM / Bridger Coal Co.	ENL MINE PIT WELL #5	MIS	250	107	111		
P54282.0W	10/9/1980	COM	21	101	11	NENE	Bridger Coal Co. / USDI - BLM	MINE PIT WELL #5	MIS	250				
P155812.0W	11/14/2003	COM	21	101	12	SWNE	Bridger Coal Co. / USDI - BLM	BRIDGER COAL #1	IND_GW; MIS	550	233	3109	2470	3109
P173458.0W	3/8/2006	INC	21	101	13	NWNW	Bridger Coal Co.	BRIDGER COAL NO. 2	TST	0				
P181709.0W	6/26/2007	INC	21	101	13	NWNW	Bridger Coal Co.	BRIDGER COAL NO. 3	TST	0				
P200156.0W	4/12/2013	INC	21	101	19	SENW		LEUCITE #2	MIS	25				
P181448.0W	5/21/2007	INC	21	101	19	SENW	Anadarko Petroleum Corp. / SEARLE BROS. CONSTRUCTION	LEUCITE #1	MIS	25				
P197453.0W	1/25/2012	INC	21	101	19	SENW	ANADARKO E&P CO. / SEARLE BROS. CONSTRUCTION CO.	LEUCITE #2	MIS	25				
P459.0C	6/30/1943	INC	21	101	21	SENE	Union Pacific Railroad	SUPERIOR #14	MUN_GW	250	120	1200	789	1200
P460.0C	9/23/1943	INC	21	101	21	SENE	Union Pacific Railroad	SUPERIOR #15	MUN_GW	250	120	1235	787	1235
P193478.0W	3/29/2010	INC	21	101	23	SWSE	SEARLE BROS COSTRUCTION CO	BOBO #1	MIS	50				
P199658.0W	12/6/2012	COM	21	101	25	NWSE	PACIFICORP - JIM BRIDGER POWER PLANT	PB-4	MIS	3	13	110	64	100
P199657.0W	12/6/2012	COM	21	101	25	NESW	PACIFICORP - JIM BRIDGER POWER PLANT	PB-3	MIS	1	15	110		65
P199660.0W	12/6/2012	COM	21	101	25	NWSE	PACIFICORP - JIM BRIDGER POWER PLANT	PB-4B	MIS	3	15	140	62	140
P199661.0W	12/6/2012	COM	21	101	25	NWSE	PACIFICORP - JIM BRIDGER POWER PLANT	PB-5	MIS	2	17	110		

Appendix 4B - Wyoming State Engineer's Office Groundwater Permits in the Bitter Creek Watershed

Permit No.	Priority	Status[1]	Twp	Rng	Sec	Qtr/Qtr	Applicant	Facility Name	Uses[2]	Yield (gpm)	Depth to Water[3] (ft)	Total Depth (ft)	Main Water-Bearing Zone	
													Top (ft)	Bottom (ft)
P199655.0W	12/6/2012	COM	21	101	25	SENW	PACIFICORP - JIM BRIDGER POWER PLANT	PB-2	MIS	1	17	145		
P199662.0W	12/6/2012	COM	21	101	25	NESE	PACIFICORP - JIM BRIDGER POWER PLANT	PB-6	MIS	1	18	140	78	
P199656.0W	12/6/2012	COM	21	101	25	SWNW	PACIFICORP - JIM BRIDGER POWER PLANT	PB-1	MIS	1	33	145		
P199659.0W	12/6/2012	COM	21	101	25	NWSE	PACIFICORP - JIM BRIDGER POWER PLANT	PB-4A	MIS	3	92	150	68	150
P148629.0W	10/3/2002	COM	21	101	25	NESW	PACIFICORP ENVIR. REMEDIATION CO.	PB3	MIS	1				65
P148630.0W	10/3/2002	COM	21	101	25	NWSE	PACIFICORP ENVIR. REMEDIATION CO.	PB4	MIS	2			64	100
P148632.0W	10/3/2002	COM	21	101	25	NESE	PACIFICORP ENVIR. REMEDIATION CO.	PB6	MIS	1			78	
P148631.0W	10/3/2002	COM	21	101	25	NWSE	PACIFICORP ENVIR. REMEDIATION CO.	PB5	MIS	1				
P148641.0W	10/3/2002	COM	21	101	25	SWNW	PACIFICORP ENVIR. REMEDIATION CO.	PB-1	MIS	1				
P148633.0W	10/3/2002	COM	21	101	25	SESE	PACIFICORP ENVIR. REMEDIATION CO.	PB7	MIS	1				
P148628.0W	10/3/2002	COM	21	101	25	SENW	PACIFICORP ENVIR. REMEDIATION CO.	PB-2	MIS	2				
P153932.0W	9/2/2003	COM	21	101	25	NWSE	PACIFICORP ENVIR. REMEDIATION CO.	PB-4B	MIS	3				
P153933.0W	9/2/2003		21	101	25	NWSE	PACIFICORP ENVIR. REMEDIATION CO.	PB-4A	MIS	3				
P66540.0W	1/27/1984	INC	21	101	26	NENE	USDI - BLM / TOWN OF SOUTH SUPERIOR	WELL #17	MUN_GW	150	39	1720	1035	1678
P69481.0W	3/4/1985	INC	21	101	26	NENE	TOWN OF SOUTH SUPERIOR	SUPERIOR WELL #18	MUN_GW	300	44	1700	1030	1660
P45938.0W	11/20/1978	INC	21	101	26	SESE	IDAHO POWER CO. / Pacific Power Light Corp.	OW 561	MIS	0	71	87		
P196358.0W	7/21/2011	INC	21	101	26	SESW	JIM BRIDGER POWER PLANT	PB-3-9R	MIS	20				
P83437.0W	8/20/1990	INC	21	101	26	NENE	USDI, BLM / Town of South Superior	ENL SOUTH SUPERIOR #17	MUN_GW	250				
P45939.0W	11/20/1978	INC	21	101	35	NENE	Pacific Power Light Corp.	OW 562	MIS	0	44	80		
P196354.0W	7/21/2011	INC	21	101	35	NENW	JIM BRIDGER POWER PLANT	PB-3-1	MIS	15				
P196355.0W	7/21/2011	INC	21	101	35	NWNE	JIM BRIDGER POWER PLANT	PB-3-2	MIS	20				
P196356.0W	7/21/2011	INC	21	101	35	NWNE	JIM BRIDGER POWER PLANT	PB-3-3R	MIS	30				
P196357.0W	7/21/2011	INC	21	101	35	NENW	JIM BRIDGER POWER PLANT	PB-3-8R	MIS	50				
P64925.0W	7/11/1983	INC	21	101	36	NWNW	USDI - BLM / PACIFIC POWER & LIGHT COMPANY	583-WA	MIS	0	16	218		
P199664.0W	12/6/2012	COM	21	101	36	NWNW	PACIFICORP - JIM BRIDGER POWER PLANT	PB-12	MIS	10	30	200	170	200
P199663.0W	12/6/2012	COM	21	101	36	NWNW	PACIFICORP - JIM BRIDGER POWER PLANT	PB-11	MIS	10	36	170	140	170
P199665.0W	12/6/2012	COM	21	101	36	NWNW	PACIFICORP - JIM BRIDGER POWER PLANT	PB-13	MIS	10	40	155	125	155
P148642.0W	10/14/2002	COM	21	101	36	NWNW	PACIFICORP ENVIR. REMEDIATION CO.	PB-13	MIS	5			125	155
P148637.0W	10/3/2002	COM	21	101	36	NWNW	PACIFICORP ENVIR. REMEDIATION CO.	PB-11	MIS	5			140	170
P148638.0W	10/3/2002	COM	21	101	36	NWNW	PACIFICORP ENVIR. REMEDIATION CO.	PB-12	MIS	10			170	
P162195.0W	7/16/2004		21	101	36	NWNW	PACIFICORP ENVIR. REMEDIATION CO.	ENL. PB-13	MIS	10				
P162194.0W	7/16/2004		21	101	36	NWNW	PACIFICORP ENVIR. REMEDIATION CO.	ENL. PB-12	MIS	10				
P162193.0W	7/16/2004		21	101	36	NWNW	PACIFICORP ENVIR. REMEDIATION CO.	ENL. PB-11	MIS	10				
P87220.0W	2/26/1992	INC	21	102	28	NENE	TOWN OF SUPERIOR	SUPERIOR WELL #19	MUN_GW	60	-4	968	448	908
P160046.0W	6/7/2004	COM	21	102	28	SESE	HENEAGE DAVID S & NAOMI L	HENEAGE #2	MIS	12	15	27	15	27
P455.0C	12/31/1924	INC	21	104	33	SWSW	Union Pacific Railroad	WINTON #2	DOM_GW; IND_GW; MUN_GW; STK	40	250	434	405	431
P456.0C	12/31/1932	INC	21	104	33	SWSW	Union Pacific Railroad	WINTON #3	DOM_GW; IND_GW; MUN_GW; STK	40	272	485	405	431
P457.0C	12/31/1936	INC	21	104	33	SWSW	Union Pacific Railroad	WINTON #4	DOM_GW; IND_GW; MUN_GW; STK	40	280	510	405	431
P189951.0W	2/4/2009	INC	22	103	32	NWSW	USDI, BLM / SAMSON RESOURCE CO.	LEUCITE HILLS #1 WATER WELL	MIS	85				
P30251.0W	6/17/1975	COM	22	104	15	SWSW	ROCK SPRINGS GRAZING ASSOCIATION	CEDAR CANYON	STK	25	-4	2200		
P155537.0W	12/10/2003		23	103	31	SESE	SAMSON RESOURCES COMPANY	WEST PINE CANYON 40-31 WSW	MIS	120				
P16353.0P	8/31/1950	COM	23	104	16	SENW	USDI - BLM/Jamieson Josephine R. Dearth & Charles V. S.	DEARTH #3	STK	10	20	40		
P70927.0W	8/13/1985	COM	23	104	23	NWSW	USDI - BLM	MATTHEWS HILL	STK	5	36	68	36	48

[1]Status: COM = Complete (SEO has required UW forms 5 and 6 (and 8, if required)); INC = Incomplete (SEO does not have required UW forms 5 and 6 (and 8, if required); FADJ = Fully Adjudicated (SEO has all required Forms 5, 6, 8 and the Beneficial Use map)

[2]Uses: CBM = Coalbed Methane, DOM = Domestic, IND = Industrial, IRR = Irrigation, MIS = Miscellaneous, MUN = Municipal, STK = Stock, TST = Test

[3]Depth to Water: -4 means flowing well, -6 means artesian well, -7 means dry

APPENDIX 4C

WDEQ SURFACE WATER CLASSES AND USES

Appendix 4C. Surface Water Classes and Uses.

The definitions of the stream classes applicable to the watershed are quoted from the Water Quality Rules and Regulations, Chapter 1, Wyoming Surface Water Quality Standards (WDEQ, 2013) as follows:

The following water classes are a hierarchical categorization of waters according to existing and designated uses. Except for Class 1 waters, each classification is protected for its specified uses plus all the uses contained in each lower classification. Class 1 designations are based on value determinations rather than use support and are protected for all uses in existence at the time or after designation. There are four major classes of surface water in Wyoming with various subcategories within each class (see *Wyoming Surface Water Classification List* for current classifications).

(a) Class 1, Outstanding Waters. Class 1 waters are those surface waters in which no further water quality degradation by point source discharges other than from dams will be allowed. Nonpoint sources of pollution shall be controlled through implementation of appropriate best management practices. Pursuant to Section 7 of these regulations, the water quality and physical and biological integrity which existed on the water at the time of designation will be maintained and protected. In designating Class 1 waters, the Environmental Quality Council (council) shall consider water quality, aesthetic, scenic, recreational, ecological, agricultural, botanical, zoological, municipal, industrial, historical, geological, cultural, archaeological, fish and wildlife, the presence of significant quantities of developable water and other values of present and future benefit to the people.

(b) Class 2, Fisheries and Drinking Water. Class 2 waters are waters, other than those designated as Class 1, that are known to support fish and/or drinking water supplies or where those uses are attainable. Class 2 waters may be perennial, intermittent or ephemeral and are protected for the uses indicated in each subcategory listed below. There are five subcategories of Class 2 waters.

(i) Class 2AB. Class 2AB waters are those known to support game fish populations or spawning and nursery areas at least seasonally and all their perennial tributaries and adjacent wetlands and where a game fishery and drinking water use is otherwise attainable. Class 2AB waters include all permanent and seasonal game fisheries and can be either “cold water” or “warm water” depending upon the predominance of cold water or warm water species present. All Class 2AB waters are designated as cold water game fisheries unless identified as a warm water game fishery by a “ww” notation in the *Wyoming Surface Water Classification List*. Unless it is shown otherwise, these waters are presumed to have sufficient water quality and quantity to support drinking water supplies and are protected for that use. Class 2AB waters are also protected for nongame fisheries, fish consumption, aquatic life other than fish, recreation, wildlife, industry, agriculture and scenic value uses.

(ii) Class 2A. Class 2A waters are those that are not known nor have the potential to support fish but are used for public or domestic drinking water supplies, including their perennial tributaries and adjacent wetlands. Uses designated on Class 2A waters include drinking water, aquatic life other than fish, recreation, wildlife, industry, agriculture and scenic value.

(iii) Class 2B. Class 2B waters are those known to support or have the potential to support game fish populations or spawning and nursery areas at least seasonally and all their perennial tributaries and adjacent wetlands and where it has been shown that drinking water uses are not attainable pursuant to the provisions of Section 33. Class 2B waters include permanent and seasonal game fisheries and can be either "cold water" or "warm water" depending upon the predominance of cold water or warm water species present. All Class 2B waters are designated as cold water game fisheries unless identified as a warm water game fishery by a "ww" notation in the *Wyoming Surface Water Classification List*. Uses designated on Class 2B waters include game and nongame fisheries, fish consumption, aquatic life other than fish, recreation, wildlife, industry, agriculture and scenic value.

(iv) Class 2C. Class 2C waters are those known to support or have the potential to support only nongame fish populations or spawning and nursery areas at least seasonally including their perennial tributaries and adjacent wetlands. Class 2C waters include all permanent and seasonal nongame fisheries and are considered warm water. Uses designated on Class 2C waters include nongame fisheries, fish consumption, aquatic life other than fish, recreation, wildlife, industry, agriculture and scenic value.

(v) Class 2D. Effluent dependent waters which are known to support fish populations and where the resident fish populations would be significantly degraded in terms of numbers or species diversity if the effluent flows were removed or reduced. Class 2D waters are protected to the extent that the existing fish communities and other designated uses are maintained and that the water quality does not pose a health risk or hazard to humans, livestock or wildlife. Uses designated on Class 2D waters include game or nongame fisheries, fish consumption, aquatic life other than fish, recreation, wildlife, industry, agriculture and scenic value.

(c) Class 3, Aquatic Life Other than Fish. Class 3 waters are waters, other than those designated as Class 1, that are intermittent, ephemeral or isolated waters and because of natural habitat conditions, do not support nor have the potential to support fish populations or spawning, or certain perennial waters which lack the natural water quality to support fish (e.g. geothermal areas). Class 3 waters provide support for invertebrates, amphibians, or other flora and fauna which inhabit waters of the state at some stage of their life cycles. Uses designated on Class 3 waters include aquatic life other than fish, recreation, wildlife, industry, agriculture and scenic value. Generally, waters suitable for this classification have wetland characteristics, and such characteristics will be a primary indicator used in identifying Class 3 waters. There are four subcategories of Class 3 waters.

(i) Class 3A. Class 3A waters are isolated waters including wetlands that are not known to support fish populations or drinking water supplies and where those uses are not attainable.

(ii) Class 3B. Class 3B waters are tributary waters including adjacent wetlands that are not known to support fish populations or drinking water supplies and where those uses are not attainable. Class 3B waters are intermittent and ephemeral streams with sufficient hydrology to normally support and sustain communities of aquatic life including invertebrates, amphibians, or other flora and fauna which inhabit waters of the state at some stage of their life cycles. In general, 3B waters are characterized by frequent linear wetland occurrences or impoundments within or adjacent to the stream channel over its entire length. Such characteristics will be a primary indicator used in identifying Class 3B waters.

(iii) Class 3C. Class 3C waters are perennial streams without the natural water quality potential to support fish or drinking water supplies but do support wetland characteristics. These may include geothermal waters and waters with naturally high concentrations of dissolved salts or metals or pH extremes.

(iv) Class 3D. Effluent dependent waters which are known to support communities of aquatic life other than fish and where the existing aquatic habitat would be significantly reduced in terms of aerial extent, habitat diversity or ecological value if the effluent flows are removed or reduced. Class 3D waters are protected to the extent that the existing aquatic community, habitat and other designated uses are maintained and the water quality does not pose a health risk or hazard to humans, livestock or wildlife.

(d) Class 4, Agriculture, Industry, Recreation and Wildlife. Class 4 waters are waters, other than those designated as Class 1, where it has been determined that aquatic life uses are not attainable pursuant to the provisions of Section 33 of these regulations. Uses designated on Class 4 waters include recreation, wildlife, industry, agriculture and scenic value.

(i) Class 4A. Class 4A waters are artificial canals and ditches that are not known to support fish populations.

(ii) Class 4B. Class 4B waters are intermittent and ephemeral stream channels that have been determined to lack the hydrologic potential to normally support and sustain aquatic life pursuant to the provisions of Section 33(b)(ii) of these regulations. In general, 4B streams are characterized by only infrequent wetland occurrences or impoundments within or adjacent to the stream channel over its entire length. Such characteristics will be a primary indicator used in identifying Class 4B waters.

(iii) Class 4C. Class 4C waters are isolated waters that have been determined to lack the potential to normally support and sustain aquatic life pursuant to the provisions of Section 33(b)(i), (iii), (iv), (v) or (vi) of these regulations. Class 4C includes, but is not limited to, off-channel effluent dependent ponds where it has been determined under Section 33(b)(iii) that removing a source of pollution to achieve full attainment of aquatic life uses would cause more environmental damage than leaving the source in place.

(e) Specific stream segment classifications are contained in a separate document entitled *Wyoming Surface Water Classification List* which is published by the department and periodically revised and updated according to the provisions of Sections 4, 33, 34, 35 and Appendix A of this chapter. Class 1 waters are those waters that have been specifically designated by the council. Class 2AB, 2A, 2B and 2C designations are based upon the fisheries information contained in the Wyoming Game and Fish Department's *Streams and Lakes Database* submitted to the department in June 2000. This database represents the best available information and is considered conclusive. Class 2D and 3D designations are based upon use attainability analyses demonstrating that the waters are effluent dependent and do not pose a hazard to humans, wildlife or livestock. Class 4 designations are based upon knowledge that a water body is an artificial, man-made conveyance, or has been determined not to support aquatic life uses through an approved use attainability analysis. All other waters are designated as Class 3A, 3B or 3C. Section 27 of these regulations describes how recreation use designations are made for specific water bodies.

APPENDIX 4D

LANDFIRE DATABASE

APPENDIX 4D: LANDFIRE DATABASE

Bitter Creek/East Flaming Gorge Watershed : LANDFIRE						
Hydrologic Unit Code (HUC12) Name	**Existing Vegetation Type**	**Physiognomy (form/morphological structure of vegetation)**	**Hydrologic Unit Code (HUC12) Acres**	**Existing Vegetation Type Acres**	**Percent of HUC12**	**Cumulative Percent**
140401050102	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	31362.4	17736.73	56.55%	56.6%
140401050102	Introduced Upland Vegetation-Annual and Biennial Forbland	Exotic Herbaceous	31362.4	3954.13	12.61%	69.2%
140401050102	Inter-Mountain Basins Mat Saltbush Shrubland	Shrubland	31362.4	3308.53	10.55%	79.7%
140401050102	Inter-Mountain Basins Semi-Desert Grassland	Grassland	31362.4	2917.72	9.30%	89.0%
140401050102	Inter-Mountain Basins Sparsely Vegetated Systems	Sparsely Vegetated	31362.4	1724.69	5.50%	94.5%
140401050102	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	31362.4	582.07	1.86%	96.4%
140401050102	Barren	Barren	31362.4	450.34	1.44%	97.8%
140401050102	Inter-Mountain Basins Greasewood Flat	Shrubland	31362.4	343.93	1.10%	98.9%
140401050102	Other	Other	31362.4	344.22	1.10%	100.0%
Hydrologic Unit Code (HUC12) Name	**Existing Vegetation Type**	**Physiognomy (form/morphological structure of vegetation)**	**Hydrologic Unit Code (HUC12) Acres**	**Existing Vegetation Type Acres**	**Percent of HUC12**	**Cumulative Percent**
140401050205	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	15160.5	10375.95	68.44%	68.4%
140401050205	Artemisia tridentata ssp. vaseyana Shrubland Alliance	Shrubland	15160.5	912.01	6.02%	74.5%
140401050205	Introduced Upland Vegetation-Annual Grassland	Exotic Herbaceous	15160.5	863.44	5.70%	80.2%
140401050205	Inter-Mountain Basins Mat Saltbush Shrubland	Shrubland	15160.5	606.73	4.00%	84.2%
140401050205	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	15160.5	564.11	3.72%	87.9%
140401050205	Introduced Upland Vegetation-Annual and Biennial Forbland	Exotic Herbaceous	15160.5	518.94	3.42%	91.3%
140401050205	Inter-Mountain Basins Semi-Desert Grassland	Grassland	15160.5	333.40	2.20%	93.5%
140401050205	Quarries-Strip Mines-Gravel Pits	Quarries-Strip Mines-Gravel Pits	15160.5	321.37	2.12%	95.6%
140401050205	Other	Other	15160.5	664.53	4.38%	100.0%
Hydrologic Unit Code (HUC12) Name	**Existing Vegetation Type**	**Physiognomy (form/morphological structure of vegetation)**	**Hydrologic Unit Code (HUC12) Acres**	**Existing Vegetation Type Acres**	**Percent of HUC12**	**Cumulative Percent**
140401050502	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	25638.9	11039.71	43.06%	43.1%
140401050502	Introduced Upland Vegetation-Annual and Biennial Forbland	Exotic Herbaceous	25638.9	5735.91	22.37%	65.4%
140401050502	Inter-Mountain Basins Semi-Desert Grassland	Grassland	25638.9	3184.87	12.42%	77.9%
140401050502	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	25638.9	2574.28	10.04%	87.9%
140401050502	Barren	Barren	25638.9	1483.51	5.79%	93.7%
140401050502	Inter-Mountain Basins Sparsely Vegetated Systems	Sparsely Vegetated	25638.9	749.53	2.92%	96.6%
140401050502	Inter-Mountain Basins Mat Saltbush Shrubland	Shrubland	25638.9	449.12	1.75%	98.4%
140401050502	Other	Other	25638.9	421.98	1.65%	100.0%
Hydrologic Unit Code (HUC12) Name	**Existing Vegetation Type**	**Physiognomy (form/morphological structure of vegetation)**	**Hydrologic Unit Code (HUC12) Acres**	**Existing Vegetation Type Acres**	**Percent of HUC12**	**Cumulative Percent**
140401050503	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	29439.4	11530.87	39.17%	39.2%
140401050503	Introduced Upland Vegetation-Annual and Biennial Forbland	Exotic Herbaceous	29439.4	6783.50	23.04%	62.2%
140401050503	Inter-Mountain Basins Semi-Desert Grassland	Grassland	29439.4	4823.59	16.38%	78.6%
140401050503	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	29439.4	2770.67	9.41%	88.0%
140401050503	Barren	Barren	29439.4	1483.39	5.04%	93.0%
140401050503	Inter-Mountain Basins Sparsely Vegetated Systems	Sparsely Vegetated	29439.4	1239.65	4.21%	97.3%
140401050503	Inter-Mountain Basins Mat Saltbush Shrubland	Shrubland	29439.4	340.42	1.16%	98.4%
140401050503	Other	Other	29439.4	467.35	1.59%	100.0%

Hydrologic Unit Code (HUC12) Name	Existing Vegetation Type	Physiognomy (form/morphological structure of vegetation)	Hydrologic Unit Code (HUC12) Acres	Existing Vegetation Type Acres	Percent of HUC12	Cumulative Percent
Big Flat Draw	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	12541.4	9452.12	75.37%	75.4%
Big Flat Draw	Inter-Mountain Basins Mat Saltbush Shrubland	Shrubland	12541.4	1091.06	8.70%	84.1%
Big Flat Draw	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	12541.4	820.85	6.55%	90.6%
Big Flat Draw	Introduced Upland Vegetation-Annual and Biennial Forbland	Exotic Herbaceous	12541.4	704.05	5.61%	96.2%
Big Flat Draw	Inter-Mountain Basins Sparsely Vegetated Systems	Sparsely Vegetated	12541.4	159.59	1.27%	97.5%
Big Flat Draw	Inter-Mountain Basins Semi-Desert Grassland	Grassland	12541.4	129.02	1.03%	98.5%
Big Flat Draw	Other	Other	12541.4	184.74	1.47%	100.0%
Hydrologic Unit Code (HUC12) Name	Existing Vegetation Type	Physiognomy (form/morphological structure of vegetation)	Hydrologic Unit Code (HUC12) Acres	Existing Vegetation Type Acres	Percent of HUC12	Cumulative Percent
Bitter Creek-Big Pond Station	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	12412.0	7590.54	61.15%	61.2%
Bitter Creek-Big Pond Station	Introduced Upland Vegetation-Annual and Biennial Forbland	Exotic Herbaceous	12412.0	1609.50	12.97%	74.1%
Bitter Creek-Big Pond Station	Inter-Mountain Basins Mat Saltbush Shrubland	Shrubland	12412.0	1101.12	8.87%	83.0%
Bitter Creek-Big Pond Station	Inter-Mountain Basins Sparsely Vegetated Systems	Sparsely Vegetated	12412.0	669.64	5.40%	88.4%
Bitter Creek-Big Pond Station	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	12412.0	618.59	4.98%	93.4%
Bitter Creek-Big Pond Station	Rocky Mountain Subalpine/Upper Montane Riparian Shrubland	Riparian	12412.0	128.83	1.04%	94.4%
Bitter Creek-Big Pond Station	Other	Other	12412.0	693.75	5.59%	100.0%
Hydrologic Unit Code (HUC12) Name	Existing Vegetation Type	Physiognomy (form/morphological structure of vegetation)	Hydrologic Unit Code (HUC12) Acres	Existing Vegetation Type Acres	Percent of HUC12	Cumulative Percent
Bitter Creek-Coon Draw	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	27669.3	15126.91	54.67%	54.7%
Bitter Creek-Coon Draw	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	27669.3	4863.06	17.58%	72.2%
Bitter Creek-Coon Draw	Inter-Mountain Basins Mat Saltbush Shrubland	Shrubland	27669.3	1687.90	6.10%	78.3%
Bitter Creek-Coon Draw	Inter-Mountain Basins Semi-Desert Grassland	Grassland	27669.3	1152.57	4.17%	82.5%
Bitter Creek-Coon Draw	Introduced Upland Vegetation-Annual and Biennial Forbland	Exotic Herbaceous	27669.3	849.08	3.07%	85.6%
Bitter Creek-Coon Draw	Inter-Mountain Basins Sparsely Vegetated Systems	Sparsely Vegetated	27669.3	755.07	2.73%	88.3%
Bitter Creek-Coon Draw	Western Great Plains Floodplain Forest and Woodland	Riparian	27669.3	716.46	2.59%	90.9%
Bitter Creek-Coon Draw	Developed-Roads	Developed-Roads	27669.3	396.04	1.43%	92.3%
Bitter Creek-Coon Draw	Artemisia tridentata ssp. vaseyana Shrubland Alliance	Shrubland	27669.3	362.54	1.31%	93.6%
Bitter Creek-Coon Draw	Rocky Mountain Subalpine/Upper Montane Riparian Shrubland	Riparian	27669.3	312.09	1.13%	94.8%
Bitter Creek-Coon Draw	Other	Other	27669.3	1447.59	5.23%	100.0%
Hydrologic Unit Code (HUC12) Name	Existing Vegetation Type	Physiognomy (form/morphological structure of vegetation)	Hydrologic Unit Code (HUC12) Acres	Existing Vegetation Type Acres	Percent of HUC12	Cumulative Percent
Bitter Creek-Hungry Hollow	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	27039.8	15732.51	58.18%	58.2%
Bitter Creek-Hungry Hollow	Introduced Upland Vegetation-Annual and Biennial Forbland	Exotic Herbaceous	27039.8	5104.41	18.88%	77.1%
Bitter Creek-Hungry Hollow	Inter-Mountain Basins Mat Saltbush Shrubland	Shrubland	27039.8	2468.71	9.13%	86.2%
Bitter Creek-Hungry Hollow	Inter-Mountain Basins Sparsely Vegetated Systems	Sparsely Vegetated	27039.8	1051.35	3.89%	90.1%
Bitter Creek-Hungry Hollow	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	27039.8	1036.31	3.83%	93.9%
Bitter Creek-Hungry Hollow	Inter-Mountain Basins Semi-Desert Grassland	Grassland	27039.8	804.56	2.98%	96.9%
Bitter Creek-Hungry Hollow	Other	Other	27039.8	841.91	3.11%	100.0%
Hydrologic Unit Code (HUC12) Name	Existing Vegetation Type	Physiognomy (form/morphological structure of vegetation)	Hydrologic Unit Code (HUC12) Acres	Existing Vegetation Type Acres	Percent of HUC12	Cumulative Percent
Bitter Creek-Kanda	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	22431.0	8024.34	35.77%	35.8%
Bitter Creek-Kanda	Inter-Mountain Basins Mat Saltbush Shrubland	Shrubland	22431.0	2282.10	10.17%	45.9%
Bitter Creek-Kanda	Inter-Mountain Basins Semi-Desert Grassland	Grassland	22431.0	2110.05	9.41%	55.4%
Bitter Creek-Kanda	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	22431.0	1961.35	8.74%	64.1%
Bitter Creek-Kanda	Inter-Mountain Basins Greasewood Flat	Shrubland	22431.0	1122.40	5.00%	69.1%
Bitter Creek-Kanda	Inter-Mountain Basins Sparsely Vegetated Systems	Sparsely Vegetated	22431.0	1098.07	4.90%	74.0%

Bitter Creek-Kanda	Barren	Barren	22431.0	1012.69	4.51%	78.5%
Bitter Creek-Kanda	Developed-Roads	Developed-Roads	22431.0	714.07	3.18%	81.7%
Bitter Creek-Kanda	Western Great Plains Floodplain Forest and Woodland	Riparian	22431.0	552.70	2.46%	84.2%
Bitter Creek-Kanda	Introduced Upland Vegetation-Annual and Biennial Forbland	Exotic Herbaceous	22431.0	548.47	2.45%	86.6%
Bitter Creek-Kanda	Rocky Mountain Subalpine/Upper Montane Riparian Shrubland	Riparian	22431.0	516.47	2.30%	88.9%
Bitter Creek-Kanda	Developed-Low Intensity	Developed-Low Intensity	22431.0	426.02	1.90%	90.8%
Bitter Creek-Kanda	Wyoming Basins Dwarf Sagebrush Shrubland and Steppe	Shrubland	22431.0	348.68	1.55%	92.4%
Bitter Creek-Kanda	Inter-Mountain Basins Semi-Desert Shrub-Steppe	Shrubland	22431.0	261.31	1.16%	93.5%
Bitter Creek-Kanda	Other	Other	22431.0	1452.30	6.47%	100.0%
Hydrologic Unit Code (HUC12) Name	**Existing Vegetation Type**	**Physiognomy (form/morphological structure of vegetation)**	**Hydrologic Unit Code (HUC12) Acres**	**Existing Vegetation Type Acres**	**Percent of HUC12**	**Cumulative Percent**
Bitter Creek-Rock Springs	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	39947.5	16026.98	40.12%	40.1%
Bitter Creek-Rock Springs	Inter-Mountain Basins Semi-Desert Grassland	Grassland	39947.5	4652.29	11.65%	51.8%
Bitter Creek-Rock Springs	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	39947.5	4502.77	11.27%	63.0%
Bitter Creek-Rock Springs	Introduced Upland Vegetation-Annual and Biennial Forbland	Exotic Herbaceous	39947.5	4150.78	10.39%	73.4%
Bitter Creek-Rock Springs	Developed-Roads	Developed-Roads	39947.5	2077.15	5.20%	78.6%
Bitter Creek-Rock Springs	Inter-Mountain Basins Mat Saltbush Shrubland	Shrubland	39947.5	1791.26	4.48%	83.1%
Bitter Creek-Rock Springs	Inter-Mountain Basins Sparsely Vegetated Systems	Sparsely Vegetated	39947.5	1171.29	2.93%	86.0%
Bitter Creek-Rock Springs	Developed-Low Intensity	Developed-Low Intensity	39947.5	1057.85	2.65%	88.7%
Bitter Creek-Rock Springs	Developed-Medium Intensity	Developed-Medium Intensity	39947.5	991.71	2.48%	91.2%
Bitter Creek-Rock Springs	Barren	Barren	39947.5	434.82	1.09%	92.3%
Bitter Creek-Rock Springs	Other	Other	39947.5	3090.56	7.74%	100.0%
Hydrologic Unit Code (HUC12) Name	**Existing Vegetation Type**	**Physiognomy (form/morphological structure of vegetation)**	**Hydrologic Unit Code (HUC12) Acres**	**Existing Vegetation Type Acres**	**Percent of HUC12**	**Cumulative Percent**
Bitter Creek-Town of Bitter Creek	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	28545.0	18079.02	63.34%	63.3%
Bitter Creek-Town of Bitter Creek	Introduced Upland Vegetation-Annual and Biennial Forbland	Exotic Herbaceous	28545.0	2643.78	9.26%	72.6%
Bitter Creek-Town of Bitter Creek	Quarries-Strip Mines-Gravel Pits	Quarries-Strip Mines-Gravel Pits	28545.0	2270.65	7.95%	80.6%
Bitter Creek-Town of Bitter Creek	Inter-Mountain Basins Mat Saltbush Shrubland	Shrubland	28545.0	1904.78	6.67%	87.2%
Bitter Creek-Town of Bitter Creek	Inter-Mountain Basins Sparsely Vegetated Systems	Sparsely Vegetated	28545.0	1335.77	4.68%	91.9%
Bitter Creek-Town of Bitter Creek	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	28545.0	754.54	2.64%	94.5%
Bitter Creek-Town of Bitter Creek	Inter-Mountain Basins Semi-Desert Grassland	Grassland	28545.0	545.60	1.91%	96.5%
Bitter Creek-Town of Bitter Creek	Inter-Mountain Basins Greasewood Flat	Shrubland	28545.0	311.81	1.09%	97.6%
Bitter Creek-Town of Bitter Creek	Other	Other	28545.0	699.01	2.45%	100.0%
Hydrologic Unit Code (HUC12) Name	**Existing Vegetation Type**	**Physiognomy (form/morphological structure of vegetation)**	**Hydrologic Unit Code (HUC12) Acres**	**Existing Vegetation Type Acres**	**Percent of HUC12**	**Cumulative Percent**
Bitter Creek-Town of Black Buttes	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	25567.0	14265.06	55.79%	55.8%
Bitter Creek-Town of Black Buttes	Quarries-Strip Mines-Gravel Pits	Quarries-Strip Mines-Gravel Pits	25567.0	2807.94	10.98%	66.8%
Bitter Creek-Town of Black Buttes	Inter-Mountain Basins Mat Saltbush Shrubland	Shrubland	25567.0	1941.71	7.59%	74.4%
Bitter Creek-Town of Black Buttes	Introduced Upland Vegetation-Annual and Biennial Forbland	Exotic Herbaceous	25567.0	1724.17	6.74%	81.1%
Bitter Creek-Town of Black Buttes	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	25567.0	1669.85	6.53%	87.6%
Bitter Creek-Town of Black Buttes	Inter-Mountain Basins Sparsely Vegetated Systems	Sparsely Vegetated	25567.0	653.99	2.56%	90.2%
Bitter Creek-Town of Black Buttes	Inter-Mountain Basins Semi-Desert Grassland	Grassland	25567.0	628.14	2.46%	92.7%
Bitter Creek-Town of Black Buttes	Artemisia tridentata ssp. vaseyana Shrubland Alliance	Shrubland	25567.0	525.76	2.06%	94.7%
Bitter Creek-Town of Black Buttes	Other	Other	25567.0	1350.36	5.28%	100.0%
Hydrologic Unit Code (HUC12) Name	**Existing Vegetation Type**	**Physiognomy (form/morphological structure of vegetation)**	**Hydrologic Unit Code (HUC12) Acres**	**Existing Vegetation Type Acres**	**Percent of HUC12**	**Cumulative Percent**
Bitter Creek-Town of Hallville	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	29813.6	18824.39	63.14%	63.1%
Bitter Creek-Town of Hallville	Inter-Mountain Basins Mat Saltbush Shrubland	Shrubland	29813.6	3288.28	11.03%	74.2%

Bitter Creek-Town of Hallville	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	29813.6	2941.76	9.87%	84.0%
Bitter Creek-Town of Hallville	Introduced Upland Vegetation-Annual and Biennial Forbland	Exotic Herbaceous	29813.6	1244.06	4.17%	88.2%
Bitter Creek-Town of Hallville	Artemisia tridentata ssp. vaseyana Shrubland Alliance	Shrubland	29813.6	626.72	2.10%	90.3%
Bitter Creek-Town of Hallville	Inter-Mountain Basins Sparsely Vegetated Systems	Sparsely Vegetated	29813.6	563.18	1.89%	92.2%
Bitter Creek-Town of Hallville	Inter-Mountain Basins Semi-Desert Grassland	Grassland	29813.6	362.16	1.21%	93.4%
Bitter Creek-Town of Hallville	Quarries-Strip Mines-Gravel Pits	Quarries-Strip Mines-Gravel Pits	29813.6	335.96	1.13%	94.5%
Bitter Creek-Town of Hallville	Other	Other	29813.6	1627.09	5.46%	100.0%
Hydrologic Unit Code (HUC12) Name	**Existing Vegetation Type**	**Physiognomy (form/morphological structure of vegetation)**	**Hydrologic Unit Code (HUC12) Acres**	**Existing Vegetation Type Acres**	**Percent of HUC12**	**Cumulative Percent**
Cedar Canyon	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	14314.0	10041.23	70.15%	70.1%
Cedar Canyon	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	14314.0	1879.94	13.13%	83.3%
Cedar Canyon	Artemisia tridentata ssp. vaseyana Shrubland Alliance	Shrubland	14314.0	627.40	4.38%	87.7%
Cedar Canyon	Inter-Mountain Basins Mat Saltbush Shrubland	Shrubland	14314.0	559.00	3.91%	91.6%
Cedar Canyon	Introduced Upland Vegetation-Annual and Biennial Forbland	Exotic Herbaceous	14314.0	384.66	2.69%	94.3%
Cedar Canyon	Inter-Mountain Basins Greasewood Flat	Shrubland	14314.0	350.03	2.45%	96.7%
Cedar Canyon	Inter-Mountain Basins Semi-Desert Grassland	Grassland	14314.0	183.02	1.28%	98.0%
Cedar Canyon	Other	Other	14314.0	288.73	2.02%	100.0%
Hydrologic Unit Code (HUC12) Name	**Existing Vegetation Type**	**Physiognomy (form/morphological structure of vegetation)**	**Hydrologic Unit Code (HUC12) Acres**	**Existing Vegetation Type Acres**	**Percent of HUC12**	**Cumulative Percent**
Cedar Creek-Little Bitter Creek	Artemisia tridentata ssp. vaseyana Shrubland Alliance	Shrubland	13570.3	5206.11	38.36%	38.4%
Cedar Creek-Little Bitter Creek	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	13570.3	3385.55	24.95%	63.3%
Cedar Creek-Little Bitter Creek	Rocky Mountain Lower Montane-Foothill Shrubland	Shrubland	13570.3	810.09	5.97%	69.3%
Cedar Creek-Little Bitter Creek	Rocky Mountain Foothill Limber Pine-Juniper Woodland	Conifer	13570.3	739.83	5.45%	74.7%
Cedar Creek-Little Bitter Creek	Inter-Mountain Basins Greasewood Flat	Shrubland	13570.3	703.55	5.18%	79.9%
Cedar Creek-Little Bitter Creek	Rocky Mountain Montane Riparian Forest and Woodland	Riparian	13570.3	632.06	4.66%	84.6%
Cedar Creek-Little Bitter Creek	Western Great Plains Floodplain Forest and Woodland	Riparian	13570.3	400.61	2.95%	87.5%
Cedar Creek-Little Bitter Creek	Inter-Mountain Basins Montane Sagebrush Steppe	Shrubland	13570.3	395.09	2.91%	90.4%
Cedar Creek-Little Bitter Creek	Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland	Conifer	13570.3	288.90	2.13%	92.6%
Cedar Creek-Little Bitter Creek	Rocky Mountain Subalpine/Upper Montane Riparian Shrubland	Riparian	13570.3	209.97	1.55%	94.1%
Cedar Creek-Little Bitter Creek	Rocky Mountain Aspen Forest and Woodland	Hardwood	13570.3	162.23	1.20%	95.3%
Cedar Creek-Little Bitter Creek	Other	Other	13570.3	636.30	4.69%	100.0%
Hydrologic Unit Code (HUC12) Name	**Existing Vegetation Type**	**Physiognomy (form/morphological structure of vegetation)**	**Hydrologic Unit Code (HUC12) Acres**	**Existing Vegetation Type Acres**	**Percent of HUC12**	**Cumulative Percent**
Clay Basin Creek	Artemisia tridentata ssp. vaseyana Shrubland Alliance	Shrubland	1597.3	721.32	45.16%	45.2%
Clay Basin Creek	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	1597.3	153.60	9.62%	54.8%
Clay Basin Creek	Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland	Conifer	1597.3	142.13	8.90%	63.7%
Clay Basin Creek	Inter-Mountain Basins Montane Sagebrush Steppe	Shrubland	1597.3	135.41	8.48%	72.2%
Clay Basin Creek	Rocky Mountain Lower Montane-Foothill Shrubland	Shrubland	1597.3	111.72	6.99%	79.1%
Clay Basin Creek	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	1597.3	102.63	6.43%	85.6%
Clay Basin Creek	Wyoming Basins Dwarf Sagebrush Shrubland and Steppe	Shrubland	1597.3	45.45	2.85%	88.4%
Clay Basin Creek	Rocky Mountain Foothill Limber Pine-Juniper Woodland	Conifer	1597.3	38.77	2.43%	90.8%
Clay Basin Creek	Southern Rocky Mountain Ponderosa Pine Woodland	Conifer	1597.3	30.84	1.93%	92.8%
Clay Basin Creek	Western Great Plains Floodplain Forest and Woodland	Riparian	1597.3	25.89	1.62%	94.4%
Clay Basin Creek	Rocky Mountain Aspen Forest and Woodland	Hardwood	1597.3	17.76	1.11%	95.5%
Clay Basin Creek	Northern Rocky Mountain Lower Montane-Foothill-Valley Grassland	Grassland	1597.3	16.22	1.02%	96.5%
Clay Basin Creek	Other	Other	1597.3	55.52	3.48%	100.0%
Hydrologic Unit Code (HUC12) Name	**Existing Vegetation Type**	**Physiognomy (form/morphological structure of vegetation)**	**Hydrologic Unit Code (HUC12) Acres**	**Existing Vegetation Type Acres**	**Percent of HUC12**	**Cumulative Percent**

Currant Creek	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	31572.1	9069.96	28.73%	28.7%
Currant Creek	Inter-Mountain Basins Semi-Desert Grassland	Grassland	31572.1	6349.57	20.11%	48.8%
Currant Creek	Artemisia tridentata ssp. vaseyana Shrubland Alliance	Shrubland	31572.1	3742.84	11.85%	60.7%
Currant Creek	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	31572.1	1857.61	5.88%	66.6%
Currant Creek	Rocky Mountain Aspen Forest and Woodland	Hardwood	31572.1	1071.19	3.39%	70.0%
Currant Creek	Northern Rocky Mountain Lower Montane-Foothill-Valley Grassland	Grassland	31572.1	1066.42	3.38%	73.3%
Currant Creek	Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland	Conifer	31572.1	978.28	3.10%	76.4%
Currant Creek	Inter-Mountain Basins Greasewood Flat	Shrubland	31572.1	861.93	2.73%	79.2%
Currant Creek	Inter-Mountain Basins Sparsely Vegetated Systems	Sparsely Vegetated	31572.1	810.92	2.57%	81.7%
Currant Creek	Western Great Plains Floodplain Forest and Woodland	Riparian	31572.1	739.93	2.34%	84.1%
Currant Creek	Inter-Mountain Basins Montane Sagebrush Steppe	Shrubland	31572.1	712.43	2.26%	86.3%
Currant Creek	Introduced Upland Vegetation-Annual Grassland	Exotic Herbaceous	31572.1	654.48	2.07%	88.4%
Currant Creek	Rocky Mountain Foothill Limber Pine-Juniper Woodland	Conifer	31572.1	539.02	1.71%	90.1%
Currant Creek	Introduced Upland Vegetation-Annual and Biennial Forbland	Exotic Herbaceous	31572.1	487.24	1.54%	91.7%
Currant Creek	Rocky Mountain Lower Montane-Foothill Shrubland	Shrubland	31572.1	402.23	1.27%	92.9%
Currant Creek	Other	Other	31572.1	2228.09	7.06%	100.0%
Hydrologic Unit Code (HUC12) Name	**Existing Vegetation Type**	**Physiognomy (form/morphological structure of vegetation)**	**Hydrologic Unit Code (HUC12) Acres**	**Existing Vegetation Type Acres**	**Percent of HUC12**	**Cumulative Percent**
Dans Creek	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	12874.5	6172.41	47.94%	47.9%
Dans Creek	Artemisia tridentata ssp. vaseyana Shrubland Alliance	Shrubland	12874.5	3498.60	27.17%	75.1%
Dans Creek	Inter-Mountain Basins Montane Sagebrush Steppe	Shrubland	12874.5	747.81	5.81%	80.9%
Dans Creek	Western Great Plains Floodplain Forest and Woodland	Riparian	12874.5	597.37	4.64%	85.6%
Dans Creek	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	12874.5	313.58	2.44%	88.0%
Dans Creek	Rocky Mountain Subalpine/Upper Montane Riparian Shrubland	Riparian	12874.5	307.85	2.39%	90.4%
Dans Creek	Inter-Mountain Basins Semi-Desert Grassland	Grassland	12874.5	208.94	1.62%	92.0%
Dans Creek	Rocky Mountain Lower Montane-Foothill Shrubland	Shrubland	12874.5	197.47	1.53%	93.5%
Dans Creek	Other	Other	12874.5	830.47	6.45%	100.0%
Hydrologic Unit Code (HUC12) Name	**Existing Vegetation Type**	**Physiognomy (form/morphological structure of vegetation)**	**Hydrologic Unit Code (HUC12) Acres**	**Existing Vegetation Type Acres**	**Percent of HUC12**	**Cumulative Percent**
Firehole Canyon	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	26252.1	6591.31	25.11%	25.1%
Firehole Canyon	Introduced Upland Vegetation-Annual Grassland	Exotic Herbaceous	26252.1	5596.37	21.32%	46.4%
Firehole Canyon	Northern Rocky Mountain Lower Montane-Foothill-Valley Grassland	Grassland	26252.1	5539.17	21.10%	67.5%
Firehole Canyon	Inter-Mountain Basins Semi-Desert Grassland	Grassland	26252.1	1192.59	4.54%	72.1%
Firehole Canyon	Rocky Mountain Foothill Limber Pine-Juniper Woodland	Conifer	26252.1	1098.58	4.18%	76.3%
Firehole Canyon	Artemisia tridentata ssp. vaseyana Shrubland Alliance	Shrubland	26252.1	1056.71	4.03%	80.3%
Firehole Canyon	Rocky Mountain Montane Riparian Forest and Woodland	Riparian	26252.1	950.43	3.62%	83.9%
Firehole Canyon	Inter-Mountain Basins Greasewood Flat	Shrubland	26252.1	736.48	2.81%	86.7%
Firehole Canyon	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	26252.1	599.67	2.28%	89.0%
Firehole Canyon	Western Great Plains Floodplain Forest and Woodland	Riparian	26252.1	535.28	2.04%	91.0%
Firehole Canyon	Inter-Mountain Basins Mat Saltbush Shrubland	Shrubland	26252.1	491.63	1.87%	92.9%
Firehole Canyon	Rocky Mountain Lower Montane-Foothill Shrubland	Shrubland	26252.1	480.96	1.83%	94.7%
Firehole Canyon	Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland	Conifer	26252.1	307.55	1.17%	95.9%
Firehole Canyon	Other	Other	26252.1	1075.35	4.10%	100.0%
Hydrologic Unit Code (HUC12) Name	**Existing Vegetation Type**	**Physiognomy (form/morphological structure of vegetation)**	**Hydrologic Unit Code (HUC12) Acres**	**Existing Vegetation Type Acres**	**Percent of HUC12**	**Cumulative Percent**
Flaming Gorge Reservoir-Buckboard Reservoir	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	17908.2	11266.14	62.91%	62.9%
Flaming Gorge Reservoir-Buckboard Reservoir	Open Water	Open Water	17908.2	2706.54	15.11%	78.0%
Flaming Gorge Reservoir-Buckboard Reservoir	Inter-Mountain Basins Sparsely Vegetated Systems	Sparsely Vegetated	17908.2	1110.51	6.20%	84.2%

Flaming Gorge Reservoir-Buckboard Reservoir	Inter-Mountain Basins Semi-Desert Grassland	Grassland	17908.2	754.08	4.21%	88.4%
Flaming Gorge Reservoir-Buckboard Reservoir	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	17908.2	511.79	2.86%	91.3%
Flaming Gorge Reservoir-Buckboard Reservoir	Introduced Upland Vegetation-Annual and Biennial Forbland	Exotic Herbaceous	17908.2	311.67	1.74%	93.0%
Flaming Gorge Reservoir-Buckboard Reservoir	Other	Other	17908.2	1247.49	6.97%	100.0%
Hydrologic Unit Code (HUC12) Name	**Existing Vegetation Type**	**Physiognomy (form/morphological structure of vegetation)**	**Hydrologic Unit Code (HUC12) Acres**	**Existing Vegetation Type Acres**	**Percent of HUC12**	**Cumulative Percent**
Flaming Gorge Reservoir-Chokecherry Draw	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	10744.5	5129.25	47.74%	47.7%
Flaming Gorge Reservoir-Chokecherry Draw	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	10744.5	1309.30	12.19%	59.9%
Flaming Gorge Reservoir-Chokecherry Draw	Open Water	Open Water	10744.5	1058.69	9.85%	69.8%
Flaming Gorge Reservoir-Chokecherry Draw	Colorado Plateau Pinyon-Juniper Woodland	Conifer	10744.5	561.09	5.22%	75.0%
Flaming Gorge Reservoir-Chokecherry Draw	Inter-Mountain Basins Mat Saltbush Shrubland	Shrubland	10744.5	457.59	4.26%	79.3%
Flaming Gorge Reservoir-Chokecherry Draw	Rocky Mountain Lower Montane-Foothill Shrubland	Shrubland	10744.5	450.85	4.20%	83.5%
Flaming Gorge Reservoir-Chokecherry Draw	Inter-Mountain Basins Greasewood Flat	Shrubland	10744.5	426.44	3.97%	87.4%
Flaming Gorge Reservoir-Chokecherry Draw	Inter-Mountain Basins Sparsely Vegetated Systems	Sparsely Vegetated	10744.5	227.20	2.11%	89.5%
Flaming Gorge Reservoir-Chokecherry Draw	Inter-Mountain Basins Semi-Desert Grassland	Grassland	10744.5	209.03	1.95%	91.5%
Flaming Gorge Reservoir-Chokecherry Draw	Rocky Mountain Foothill Limber Pine-Juniper Woodland	Conifer	10744.5	123.94	1.15%	92.6%
Flaming Gorge Reservoir-Chokecherry Draw	Other	Other	10744.5	791.14	7.36%	100.0%
Hydrologic Unit Code (HUC12) Name	**Existing Vegetation Type**	**Physiognomy (form/morphological structure of vegetation)**	**Hydrologic Unit Code (HUC12) Acres**	**Existing Vegetation Type Acres**	**Percent of HUC12**	**Cumulative Percent**
Flaming Gorge Reservoir-Spring Creek	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	21811.2	6086.76	27.91%	27.9%
Flaming Gorge Reservoir-Spring Creek	Artemisia tridentata ssp. vaseyana Shrubland Alliance	Shrubland	21811.2	3988.39	18.29%	46.2%
Flaming Gorge Reservoir-Spring Creek	Rocky Mountain Lower Montane-Foothill Shrubland	Shrubland	21811.2	2053.04	9.41%	55.6%
Flaming Gorge Reservoir-Spring Creek	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	21811.2	1996.85	9.16%	64.8%
Flaming Gorge Reservoir-Spring Creek	Inter-Mountain Basins Greasewood Flat	Shrubland	21811.2	1373.17	6.30%	71.1%
Flaming Gorge Reservoir-Spring Creek	Colorado Plateau Pinyon-Juniper Woodland	Conifer	21811.2	865.77	3.97%	75.0%
Flaming Gorge Reservoir-Spring Creek	Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland	Conifer	21811.2	779.55	3.57%	78.6%
Flaming Gorge Reservoir-Spring Creek	Rocky Mountain Montane Riparian Forest and Woodland	Riparian	21811.2	673.15	3.09%	81.7%
Flaming Gorge Reservoir-Spring Creek	Western Great Plains Floodplain Forest and Woodland	Riparian	21811.2	502.46	2.30%	84.0%
Flaming Gorge Reservoir-Spring Creek	Rocky Mountain Foothill Limber Pine-Juniper Woodland	Conifer	21811.2	494.21	2.27%	86.3%
Flaming Gorge Reservoir-Spring Creek	Inter-Mountain Basins Montane Sagebrush Steppe	Shrubland	21811.2	455.35	2.09%	88.3%
Flaming Gorge Reservoir-Spring Creek	Rocky Mountain Aspen Forest and Woodland	Hardwood	21811.2	380.54	1.74%	90.1%
Flaming Gorge Reservoir-Spring Creek	Inter-Mountain Basins Semi-Desert Grassland	Grassland	21811.2	306.99	1.41%	91.5%
Flaming Gorge Reservoir-Spring Creek	Other	Other	21811.2	1854.95	8.50%	100.0%
Hydrologic Unit Code (HUC12) Name	**Existing Vegetation Type**	**Physiognomy (form/morphological structure of vegetation)**	**Hydrologic Unit Code (HUC12) Acres**	**Existing Vegetation Type Acres**	**Percent of HUC12**	**Cumulative Percent**
Flaming Gorge Reservoir-Squaw Hollow	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	8275.2	5415.10	65.44%	65.4%
Flaming Gorge Reservoir-Squaw Hollow	Open Water	Open Water	8275.2	1483.05	17.92%	83.4%
Flaming Gorge Reservoir-Squaw Hollow	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	8275.2	623.41	7.53%	90.9%
Flaming Gorge Reservoir-Squaw Hollow	Inter-Mountain Basins Sparsely Vegetated Systems	Sparsely Vegetated	8275.2	303.14	3.66%	94.6%
Flaming Gorge Reservoir-Squaw Hollow	Inter-Mountain Basins Semi-Desert Grassland	Grassland	8275.2	205.10	2.48%	97.0%
Flaming Gorge Reservoir-Squaw Hollow	Other	Other	8275.2	245.45	2.97%	100.0%
Hydrologic Unit Code (HUC12) Name	**Existing Vegetation Type**	**Physiognomy (form/morphological structure of vegetation)**	**Hydrologic Unit Code (HUC12) Acres**	**Existing Vegetation Type Acres**	**Percent of HUC12**	**Cumulative Percent**
Gap Creek	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	35573.1	14788.18	41.57%	41.6%
Gap Creek	Artemisia tridentata ssp. vaseyana Shrubland Alliance	Shrubland	35573.1	6832.27	19.21%	60.8%
Gap Creek	Northern Rocky Mountain Lower Montane-Foothill-Valley Grassland	Grassland	35573.1	2891.59	8.13%	68.9%
Gap Creek	Introduced Upland Vegetation-Annual Grassland	Exotic Herbaceous	35573.1	2136.77	6.01%	74.9%
Gap Creek	Western Great Plains Floodplain Forest and Woodland	Riparian	35573.1	1647.45	4.63%	79.5%

Gap Creek	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	35573.1	1544.76	4.34%	83.9%
Gap Creek	Inter-Mountain Basins Montane Sagebrush Steppe	Shrubland	35573.1	1048.82	2.95%	86.8%
Gap Creek	Rocky Mountain Lower Montane-Foothill Shrubland	Shrubland	35573.1	773.44	2.17%	89.0%
Gap Creek	Inter-Mountain Basins Semi-Desert Grassland	Grassland	35573.1	599.84	1.69%	90.7%
Gap Creek	Wyoming Basins Dwarf Sagebrush Shrubland and Steppe	Shrubland	35573.1	545.28	1.53%	92.2%
Gap Creek	Rocky Mountain Montane Riparian Forest and Woodland	Riparian	35573.1	544.93	1.53%	93.8%
Gap Creek	Inter-Mountain Basins Mat Saltbush Shrubland	Shrubland	35573.1	421.49	1.18%	94.9%
Gap Creek	Rocky Mountain Aspen Forest and Woodland	Hardwood	35573.1	369.85	1.04%	96.0%
Gap Creek	Other	Other	35573.1	1428.40	4.02%	100.0%
Hydrologic Unit Code (HUC12) Name	**Existing Vegetation Type**	**Physiognomy (form/morphological structure of vegetation)**	**Hydrologic Unit Code (HUC12) Acres**	**Existing Vegetation Type Acres**	**Percent of HUC12**	**Cumulative Percent**
Green River-Chicken Springs Draw	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	33526.6	18850.17	56.22%	56.2%
Green River-Chicken Springs Draw	Open Water	Open Water	33526.6	2582.39	7.70%	63.9%
Green River-Chicken Springs Draw	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	33526.6	2385.31	7.11%	71.0%
Green River-Chicken Springs Draw	Inter-Mountain Basins Semi-Desert Grassland	Grassland	33526.6	2181.05	6.51%	77.5%
Green River-Chicken Springs Draw	Inter-Mountain Basins Sparsely Vegetated Systems	Sparsely Vegetated	33526.6	1803.95	5.38%	82.9%
Green River-Chicken Springs Draw	Inter-Mountain Basins Mat Saltbush Shrubland	Shrubland	33526.6	1263.54	3.77%	86.7%
Green River-Chicken Springs Draw	Inter-Mountain Basins Greasewood Flat	Shrubland	33526.6	925.63	2.76%	89.5%
Green River-Chicken Springs Draw	Barren	Barren	33526.6	911.44	2.72%	92.2%
Green River-Chicken Springs Draw	Introduced Upland Vegetation-Annual and Biennial Forbland	Exotic Herbaceous	33526.6	679.78	2.03%	94.2%
Green River-Chicken Springs Draw	Western Great Plains Floodplain Forest and Woodland	Riparian	33526.6	378.29	1.13%	95.3%
Green River-Chicken Springs Draw	Other	Other	33526.6	1565.09	4.67%	100.0%
Hydrologic Unit Code (HUC12) Name	**Existing Vegetation Type**	**Physiognomy (form/morphological structure of vegetation)**	**Hydrologic Unit Code (HUC12) Acres**	**Existing Vegetation Type Acres**	**Percent of HUC12**	**Cumulative Percent**
Green River-Middle Firehole Canyon	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	37240.6	17239.94	46.29%	46.3%
Green River-Middle Firehole Canyon	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	37240.6	2585.16	6.94%	53.2%
Green River-Middle Firehole Canyon	Inter-Mountain Basins Mat Saltbush Shrubland	Shrubland	37240.6	2249.14	6.04%	59.3%
Green River-Middle Firehole Canyon	Inter-Mountain Basins Semi-Desert Grassland	Grassland	37240.6	2117.76	5.69%	65.0%
Green River-Middle Firehole Canyon	Barren	Barren	37240.6	1789.97	4.81%	69.8%
Green River-Middle Firehole Canyon	Inter-Mountain Basins Greasewood Flat	Shrubland	37240.6	1743.56	4.68%	74.4%
Green River-Middle Firehole Canyon	Inter-Mountain Basins Sparsely Vegetated Systems	Sparsely Vegetated	37240.6	1477.02	3.97%	78.4%
Green River-Middle Firehole Canyon	Introduced Upland Vegetation-Annual and Biennial Forbland	Exotic Herbaceous	37240.6	1239.59	3.33%	81.7%
Green River-Middle Firehole Canyon	Western Great Plains Floodplain Forest and Woodland	Riparian	37240.6	755.66	2.03%	83.8%
Green River-Middle Firehole Canyon	Open Water	Open Water	37240.6	742.39	1.99%	85.8%
Green River-Middle Firehole Canyon	Artemisia tridentata ssp. vaseyana Shrubland Alliance	Shrubland	37240.6	730.58	1.96%	87.7%
Green River-Middle Firehole Canyon	Rocky Mountain Foothill Limber Pine-Juniper Woodland	Conifer	37240.6	697.37	1.87%	89.6%
Green River-Middle Firehole Canyon	Rocky Mountain Lower Montane-Foothill Shrubland	Shrubland	37240.6	659.68	1.77%	91.4%
Green River-Middle Firehole Canyon	Developed-Roads	Developed-Roads	37240.6	516.01	1.39%	92.8%
Green River-Middle Firehole Canyon	Inter-Mountain Basins Semi-Desert Shrub-Steppe	Shrubland	37240.6	392.18	1.05%	93.8%
Green River-Middle Firehole Canyon	Rocky Mountain Subalpine/Upper Montane Riparian Shrubland	Riparian	37240.6	385.50	1.04%	94.8%
Green River-Middle Firehole Canyon	Other	Other	37240.6	1919.06	5.15%	100.0%
Hydrologic Unit Code (HUC12) Name	**Existing Vegetation Type**	**Physiognomy (form/morphological structure of vegetation)**	**Hydrologic Unit Code (HUC12) Acres**	**Existing Vegetation Type Acres**	**Percent of HUC12**	**Cumulative Percent**
Henrys Fork-Cottonwood Creek	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	8962.4	3488.55	38.92%	38.9%
Henrys Fork-Cottonwood Creek	Open Water	Open Water	8962.4	1264.77	14.11%	53.0%
Henrys Fork-Cottonwood Creek	Inter-Mountain Basins Mat Saltbush Shrubland	Shrubland	8962.4	690.04	7.70%	60.7%
Henrys Fork-Cottonwood Creek	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	8962.4	684.98	7.64%	68.4%
Henrys Fork-Cottonwood Creek	Inter-Mountain Basins Greasewood Flat	Shrubland	8962.4	503.00	5.61%	74.0%

Henrys Fork-Cottonwood Creek	Inter-Mountain Basins Sparsely Vegetated Systems	Sparsely Vegetated	8962.4	480.28	5.36%	79.3%
Henrys Fork-Cottonwood Creek	Rocky Mountain Lower Montane-Foothill Shrubland	Shrubland	8962.4	276.48	3.08%	82.4%
Henrys Fork-Cottonwood Creek	Inter-Mountain Basins Semi-Desert Grassland	Grassland	8962.4	241.13	2.69%	85.1%
Henrys Fork-Cottonwood Creek	Inter-Mountain Basins Mixed Salt Desert Scrub	Shrubland	8962.4	212.74	2.37%	87.5%
Henrys Fork-Cottonwood Creek	Inter-Mountain Basins Juniper Savanna	Conifer	8962.4	160.35	1.79%	89.3%
Henrys Fork-Cottonwood Creek	Western Great Plains Floodplain Forest and Woodland	Riparian	8962.4	153.80	1.72%	91.0%
Henrys Fork-Cottonwood Creek	Colorado Plateau Pinyon-Juniper Woodland	Conifer	8962.4	144.74	1.61%	92.6%
Henrys Fork-Cottonwood Creek	Introduced Upland Vegetation-Annual and Biennial Forbland	Exotic Herbaceous	8962.4	143.14	1.60%	94.2%
Henrys Fork-Cottonwood Creek	Artemisia tridentata ssp. vaseyana Shrubland Alliance	Shrubland	8962.4	130.01	1.45%	95.7%
Henrys Fork-Cottonwood Creek	Barren	Barren	8962.4	112.41	1.25%	96.9%
Henrys Fork-Cottonwood Creek	Rocky Mountain Montane Riparian Forest and Woodland	Riparian	8962.4	91.12	1.02%	97.9%
Henrys Fork-Cottonwood Creek	Other	Other	8962.4	184.84	2.06%	100.0%
Hydrologic Unit Code (HUC12) Name	**Existing Vegetation Type**	**Physiognomy (form/morphological structure of vegetation)**	**Hydrologic Unit Code (HUC12) Acres**	**Existing Vegetation Type Acres**	**Percent of HUC12**	**Cumulative Percent**
Horsethief Canyon	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	18345.5	12405.51	67.62%	67.6%
Horsethief Canyon	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	18345.5	1371.23	7.47%	75.1%
Horsethief Canyon	Artemisia tridentata ssp. vaseyana Shrubland Alliance	Shrubland	18345.5	1182.56	6.45%	81.5%
Horsethief Canyon	Inter-Mountain Basins Semi-Desert Grassland	Grassland	18345.5	659.46	3.59%	85.1%
Horsethief Canyon	Introduced Upland Vegetation-Annual and Biennial Forbland	Exotic Herbaceous	18345.5	594.60	3.24%	88.4%
Horsethief Canyon	Inter-Mountain Basins Mat Saltbush Shrubland	Shrubland	18345.5	420.85	2.29%	90.7%
Horsethief Canyon	Developed-Roads	Developed-Roads	18345.5	371.17	2.02%	92.7%
Horsethief Canyon	Western Great Plains Floodplain Forest and Woodland	Riparian	18345.5	264.15	1.44%	94.1%
Horsethief Canyon	Other	Other	18345.5	1075.93	5.86%	100.0%
Hydrologic Unit Code (HUC12) Name	**Existing Vegetation Type**	**Physiognomy (form/morphological structure of vegetation)**	**Hydrologic Unit Code (HUC12) Acres**	**Existing Vegetation Type Acres**	**Percent of HUC12**	**Cumulative Percent**
Iron Pipe Draw	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	19651.4	13958.45	71.03%	71.0%
Iron Pipe Draw	Inter-Mountain Basins Mat Saltbush Shrubland	Shrubland	19651.4	1967.28	10.01%	81.0%
Iron Pipe Draw	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	19651.4	1524.53	7.76%	88.8%
Iron Pipe Draw	Introduced Upland Vegetation-Annual and Biennial Forbland	Exotic Herbaceous	19651.4	1014.94	5.16%	94.0%
Iron Pipe Draw	Inter-Mountain Basins Sparsely Vegetated Systems	Sparsely Vegetated	19651.4	449.52	2.29%	96.3%
Iron Pipe Draw	Inter-Mountain Basins Semi-Desert Grassland	Grassland	19651.4	387.63	1.97%	98.2%
Iron Pipe Draw	Other	Other	19651.4	349.06	1.78%	100.0%
Hydrologic Unit Code (HUC12) Name	**Existing Vegetation Type**	**Physiognomy (form/morphological structure of vegetation)**	**Hydrologic Unit Code (HUC12) Acres**	**Existing Vegetation Type Acres**	**Percent of HUC12**	**Cumulative Percent**
Killpecker Creek-140401050805	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	21468.2	12046.38	56.11%	56.1%
Killpecker Creek-140401050805	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	21468.2	3807.15	17.73%	73.8%
Killpecker Creek-140401050805	Inter-Mountain Basins Sparsely Vegetated Systems	Sparsely Vegetated	21468.2	1513.62	7.05%	80.9%
Killpecker Creek-140401050805	Introduced Upland Vegetation-Annual and Biennial Forbland	Exotic Herbaceous	21468.2	1454.42	6.77%	87.7%
Killpecker Creek-140401050805	Barren	Barren	21468.2	971.49	4.53%	92.2%
Killpecker Creek-140401050805	Inter-Mountain Basins Mat Saltbush Shrubland	Shrubland	21468.2	748.52	3.49%	95.7%
Killpecker Creek-140401050805	Inter-Mountain Basins Semi-Desert Grassland	Grassland	21468.2	515.50	2.40%	98.1%
Killpecker Creek-140401050805	Other	Other	21468.2	411.16	1.92%	100.0%
Hydrologic Unit Code (HUC12) Name	**Existing Vegetation Type**	**Physiognomy (form/morphological structure of vegetation)**	**Hydrologic Unit Code (HUC12) Acres**	**Existing Vegetation Type Acres**	**Percent of HUC12**	**Cumulative Percent**
Killpecker Creek-Boars Tusk	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	42281.3	18241.64	43.14%	43.1%
Killpecker Creek-Boars Tusk	Barren	Barren	42281.3	6163.84	14.58%	57.7%
Killpecker Creek-Boars Tusk	Artemisia tridentata ssp. vaseyana Shrubland Alliance	Shrubland	42281.3	4138.57	9.79%	67.5%
Killpecker Creek-Boars Tusk	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	42281.3	4045.37	9.57%	77.1%

Killpecker Creek-Boars Tusk	Inter-Mountain Basins Semi-Desert Grassland	Grassland	42281.3	2977.56	7.04%	84.1%
Killpecker Creek-Boars Tusk	Inter-Mountain Basins Greasewood Flat	Shrubland	42281.3	1167.76	2.76%	86.9%
Killpecker Creek-Boars Tusk	Inter-Mountain Basins Mat Saltbush Shrubland	Shrubland	42281.3	1054.08	2.49%	89.4%
Killpecker Creek-Boars Tusk	Rocky Mountain Subalpine/Upper Montane Riparian Shrubland	Riparian	42281.3	998.16	2.36%	91.7%
Killpecker Creek-Boars Tusk	Inter-Mountain Basins Sparsely Vegetated Systems	Sparsely Vegetated	42281.3	968.64	2.29%	94.0%
Killpecker Creek-Boars Tusk	Introduced Upland Vegetation-Annual and Biennial Forbland	Exotic Herbaceous	42281.3	795.09	1.88%	95.9%
Killpecker Creek-Boars Tusk	Western Great Plains Floodplain Forest and Woodland	Riparian	42281.3	587.14	1.39%	97.3%
Killpecker Creek-Boars Tusk	Other	Other	42281.3	1143.44	2.70%	100.0%
Hydrologic Unit Code (HUC12) Name	**Existing Vegetation Type**	**Physiognomy (form/morphological structure of vegetation)**	**Hydrologic Unit Code (HUC12) Acres**	**Existing Vegetation Type Acres**	**Percent of HUC12**	**Cumulative Percent**
Killpecker Creek-Fourteenmile Creek	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	28381.3	14455.02	50.93%	50.9%
Killpecker Creek-Fourteenmile Creek	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	28381.3	4022.07	14.17%	65.1%
Killpecker Creek-Fourteenmile Creek	Introduced Upland Vegetation-Annual and Biennial Forbland	Exotic Herbaceous	28381.3	2403.18	8.47%	73.6%
Killpecker Creek-Fourteenmile Creek	Inter-Mountain Basins Mat Saltbush Shrubland	Shrubland	28381.3	2110.23	7.44%	81.0%
Killpecker Creek-Fourteenmile Creek	Inter-Mountain Basins Sparsely Vegetated Systems	Sparsely Vegetated	28381.3	1258.89	4.44%	85.4%
Killpecker Creek-Fourteenmile Creek	Barren	Barren	28381.3	1246.40	4.39%	89.8%
Killpecker Creek-Fourteenmile Creek	Inter-Mountain Basins Semi-Desert Grassland	Grassland	28381.3	705.55	2.49%	92.3%
Killpecker Creek-Fourteenmile Creek	Inter-Mountain Basins Semi-Desert Shrub-Steppe	Shrubland	28381.3	539.71	1.90%	94.2%
Killpecker Creek-Fourteenmile Creek	Inter-Mountain Basins Greasewood Flat	Shrubland	28381.3	446.01	1.57%	95.8%
Killpecker Creek-Fourteenmile Creek	Other	Other	28381.3	1194.18	4.21%	100.0%
Hydrologic Unit Code (HUC12) Name	**Existing Vegetation Type**	**Physiognomy (form/morphological structure of vegetation)**	**Hydrologic Unit Code (HUC12) Acres**	**Existing Vegetation Type Acres**	**Percent of HUC12**	**Cumulative Percent**
Killpecker Creek-Pine Canyon	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	26435.1	17863.01	67.57%	67.6%
Killpecker Creek-Pine Canyon	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	26435.1	3243.79	12.27%	79.8%
Killpecker Creek-Pine Canyon	Inter-Mountain Basins Mat Saltbush Shrubland	Shrubland	26435.1	1220.46	4.62%	84.5%
Killpecker Creek-Pine Canyon	Inter-Mountain Basins Sparsely Vegetated Systems	Sparsely Vegetated	26435.1	1012.47	3.83%	88.3%
Killpecker Creek-Pine Canyon	Introduced Upland Vegetation-Annual and Biennial Forbland	Exotic Herbaceous	26435.1	875.62	3.31%	91.6%
Killpecker Creek-Pine Canyon	Barren	Barren	26435.1	610.97	2.31%	93.9%
Killpecker Creek-Pine Canyon	Inter-Mountain Basins Semi-Desert Grassland	Grassland	26435.1	504.35	1.91%	95.8%
Killpecker Creek-Pine Canyon	Artemisia tridentata ssp. vaseyana Shrubland Alliance	Shrubland	26435.1	488.18	1.85%	97.7%
Killpecker Creek-Pine Canyon	Inter-Mountain Basins Greasewood Flat	Shrubland	26435.1	311.61	1.18%	98.8%
Killpecker Creek-Pine Canyon	Other	Other	26435.1	304.62	1.15%	100.0%
Hydrologic Unit Code (HUC12) Name	**Existing Vegetation Type**	**Physiognomy (form/morphological structure of vegetation)**	**Hydrologic Unit Code (HUC12) Acres**	**Existing Vegetation Type Acres**	**Percent of HUC12**	**Cumulative Percent**
Killpecker Creek-Reliance	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	28288.1	14453.96	51.10%	51.1%
Killpecker Creek-Reliance	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	28288.1	2902.33	10.26%	61.4%
Killpecker Creek-Reliance	Inter-Mountain Basins Mat Saltbush Shrubland	Shrubland	28288.1	2111.86	7.47%	68.8%
Killpecker Creek-Reliance	Introduced Upland Vegetation-Annual and Biennial Forbland	Exotic Herbaceous	28288.1	1527.48	5.40%	74.2%
Killpecker Creek-Reliance	Inter-Mountain Basins Semi-Desert Grassland	Grassland	28288.1	1446.04	5.11%	79.3%
Killpecker Creek-Reliance	Developed-Roads	Developed-Roads	28288.1	1135.27	4.01%	83.3%
Killpecker Creek-Reliance	Inter-Mountain Basins Sparsely Vegetated Systems	Sparsely Vegetated	28288.1	872.48	3.08%	86.4%
Killpecker Creek-Reliance	Western Cool Temperate Urban Herbaceous	Developed	28288.1	831.16	2.94%	89.4%
Killpecker Creek-Reliance	Developed-Low Intensity	Developed-Low Intensity	28288.1	711.19	2.51%	91.9%
Killpecker Creek-Reliance	Barren	Barren	28288.1	414.58	1.47%	93.3%
Killpecker Creek-Reliance	Developed-Medium Intensity	Developed-Medium Intensity	28288.1	317.64	1.12%	94.5%
Killpecker Creek-Reliance	Inter-Mountain Basins Greasewood Flat	Shrubland	28288.1	283.32	1.00%	95.5%
Killpecker Creek-Reliance	Other	Other	28288.1	1280.73	4.53%	100.0%

Hydrologic Unit Code (HUC12) Name	Existing Vegetation Type	Physiognomy (form/morphological structure of vegetation)	Hydrologic Unit Code (HUC12) Acres	Existing Vegetation Type Acres	Percent of HUC12	Cumulative Percent
Laney Wash	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	36056.7	20098.23	55.74%	55.7%
Laney Wash	Inter-Mountain Basins Mat Saltbush Shrubland	Shrubland	36056.7	7790.37	21.61%	77.3%
Laney Wash	Introduced Upland Vegetation-Annual and Biennial Forbland	Exotic Herbaceous	36056.7	2382.55	6.61%	84.0%
Laney Wash	Inter-Mountain Basins Semi-Desert Grassland	Grassland	36056.7	2313.14	6.42%	90.4%
Laney Wash	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	36056.7	1540.70	4.27%	94.6%
Laney Wash	Artemisia tridentata ssp. vaseyana Shrubland Alliance	Shrubland	36056.7	1043.25	2.89%	97.5%
Laney Wash	Other	Other	36056.7	888.50	2.46%	100.0%
Hydrologic Unit Code (HUC12) Name	Existing Vegetation Type	Physiognomy (form/morphological structure of vegetation)	Hydrologic Unit Code (HUC12) Acres	Existing Vegetation Type Acres	Percent of HUC12	Cumulative Percent
Long Canyon	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	22286.0	13054.18	58.58%	58.6%
Long Canyon	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	22286.0	2858.52	12.83%	71.4%
Long Canyon	Artemisia tridentata ssp. vaseyana Shrubland Alliance	Shrubland	22286.0	2604.33	11.69%	83.1%
Long Canyon	Introduced Upland Vegetation-Annual and Biennial Forbland	Exotic Herbaceous	22286.0	1132.39	5.08%	88.2%
Long Canyon	Inter-Mountain Basins Mat Saltbush Shrubland	Shrubland	22286.0	828.84	3.72%	91.9%
Long Canyon	Inter-Mountain Basins Semi-Desert Grassland	Grassland	22286.0	629.09	2.82%	94.7%
Long Canyon	Inter-Mountain Basins Greasewood Flat	Shrubland	22286.0	276.56	1.24%	96.0%
Long Canyon	Rocky Mountain Montane Riparian Forest and Woodland	Riparian	22286.0	259.53	1.16%	97.1%
Long Canyon	Other	Other	22286.0	642.52	2.88%	100.0%
Hydrologic Unit Code (HUC12) Name	Existing Vegetation Type	Physiognomy (form/morphological structure of vegetation)	Hydrologic Unit Code (HUC12) Acres	Existing Vegetation Type Acres	Percent of HUC12	Cumulative Percent
Lower Antelope Creek	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	24484.4	9909.11	40.47%	40.5%
Lower Antelope Creek	Inter-Mountain Basins Mat Saltbush Shrubland	Shrubland	24484.4	4773.44	19.50%	60.0%
Lower Antelope Creek	Introduced Upland Vegetation-Annual and Biennial Forbland	Exotic Herbaceous	24484.4	3794.39	15.50%	75.5%
Lower Antelope Creek	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	24484.4	2147.19	8.77%	84.2%
Lower Antelope Creek	Inter-Mountain Basins Semi-Desert Grassland	Grassland	24484.4	910.73	3.72%	88.0%
Lower Antelope Creek	Wyoming Basins Dwarf Sagebrush Shrubland and Steppe	Shrubland	24484.4	672.24	2.75%	90.7%
Lower Antelope Creek	Artemisia tridentata ssp. vaseyana Shrubland Alliance	Shrubland	24484.4	551.19	2.25%	93.0%
Lower Antelope Creek	Inter-Mountain Basins Sparsely Vegetated Systems	Sparsely Vegetated	24484.4	466.40	1.90%	94.9%
Lower Antelope Creek	Introduced Upland Vegetation-Perennial Grassland and Forbland	Exotic Herbaceous	24484.4	255.44	1.04%	95.9%
Lower Antelope Creek	Other	Other	24484.4	1004.25	4.10%	100.0%
Hydrologic Unit Code (HUC12) Name	Existing Vegetation Type	Physiognomy (form/morphological structure of vegetation)	Hydrologic Unit Code (HUC12) Acres	Existing Vegetation Type Acres	Percent of HUC12	Cumulative Percent
Lower Black Butte Creek	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	24141.1	15181.84	62.89%	62.9%
Lower Black Butte Creek	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	24141.1	3391.52	14.05%	76.9%
Lower Black Butte Creek	Inter-Mountain Basins Mat Saltbush Shrubland	Shrubland	24141.1	1819.49	7.54%	84.5%
Lower Black Butte Creek	Introduced Upland Vegetation-Annual and Biennial Forbland	Exotic Herbaceous	24141.1	937.61	3.88%	88.4%
Lower Black Butte Creek	Inter-Mountain Basins Semi-Desert Grassland	Grassland	24141.1	774.84	3.21%	91.6%
Lower Black Butte Creek	Inter-Mountain Basins Sparsely Vegetated Systems	Sparsely Vegetated	24141.1	606.73	2.51%	94.1%
Lower Black Butte Creek	Artemisia tridentata ssp. vaseyana Shrubland Alliance	Shrubland	24141.1	405.59	1.68%	95.8%
Lower Black Butte Creek	Other	Other	24141.1	1023.49	4.24%	100.0%
Hydrologic Unit Code (HUC12) Name	Existing Vegetation Type	Physiognomy (form/morphological structure of vegetation)	Hydrologic Unit Code (HUC12) Acres	Existing Vegetation Type Acres	Percent of HUC12	Cumulative Percent
Lower Deadman Wash	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	33989.9	19833.98	58.35%	58.4%
Lower Deadman Wash	Inter-Mountain Basins Mat Saltbush Shrubland	Shrubland	33989.9	5496.02	16.17%	74.5%
Lower Deadman Wash	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	33989.9	3377.83	9.94%	84.5%
Lower Deadman Wash	Introduced Upland Vegetation-Annual and Biennial Forbland	Exotic Herbaceous	33989.9	1499.81	4.41%	88.9%

Lower Deadman Wash	Inter-Mountain Basins Sparsely Vegetated Systems	Sparsely Vegetated	33989.9	1011.22	2.98%	91.8%
Lower Deadman Wash	Inter-Mountain Basins Semi-Desert Grassland	Grassland	33989.9	550.43	1.62%	93.5%
Lower Deadman Wash	Artemisia tridentata ssp. vaseyana Shrubland Alliance	Shrubland	33989.9	343.26	1.01%	94.5%
Lower Deadman Wash	Other	Other	33989.9	1877.33	5.52%	100.0%
Hydrologic Unit Code (HUC12) Name	**Existing Vegetation Type**	**Physiognomy (form/morphological structure of vegetation)**	**Hydrologic Unit Code (HUC12) Acres**	**Existing Vegetation Type Acres**	**Percent of HUC12**	**Cumulative Percent**
Lower Little Bitter Creek	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	26462.3	17009.33	64.28%	64.3%
Lower Little Bitter Creek	Artemisia tridentata ssp. vaseyana Shrubland Alliance	Shrubland	26462.3	1160.69	4.39%	68.7%
Lower Little Bitter Creek	Inter-Mountain Basins Greasewood Flat	Shrubland	26462.3	1121.57	4.24%	72.9%
Lower Little Bitter Creek	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	26462.3	934.21	3.53%	76.4%
Lower Little Bitter Creek	Inter-Mountain Basins Semi-Desert Grassland	Grassland	26462.3	875.06	3.31%	79.7%
Lower Little Bitter Creek	Rocky Mountain Lower Montane-Foothill Shrubland	Shrubland	26462.3	870.84	3.29%	83.0%
Lower Little Bitter Creek	Western Great Plains Floodplain Forest and Woodland	Riparian	26462.3	830.22	3.14%	86.2%
Lower Little Bitter Creek	Rocky Mountain Foothill Limber Pine-Juniper Woodland	Conifer	26462.3	767.07	2.90%	89.1%
Lower Little Bitter Creek	Rocky Mountain Subalpine/Upper Montane Riparian Shrubland	Riparian	26462.3	507.86	1.92%	91.0%
Lower Little Bitter Creek	Rocky Mountain Montane Riparian Forest and Woodland	Riparian	26462.3	414.92	1.57%	92.6%
Lower Little Bitter Creek	Inter-Mountain Basins Sparsely Vegetated Systems	Sparsely Vegetated	26462.3	349.91	1.32%	93.9%
Lower Little Bitter Creek	Inter-Mountain Basins Mat Saltbush Shrubland	Shrubland	26462.3	286.57	1.08%	95.0%
Lower Little Bitter Creek	Other	Other	26462.3	1334.06	5.04%	100.0%
Hydrologic Unit Code (HUC12) Name	**Existing Vegetation Type**	**Physiognomy (form/morphological structure of vegetation)**	**Hydrologic Unit Code (HUC12) Acres**	**Existing Vegetation Type Acres**	**Percent of HUC12**	**Cumulative Percent**
Lower Patrick Draw	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	39570.9	26299.56	66.46%	66.5%
Lower Patrick Draw	Inter-Mountain Basins Mat Saltbush Shrubland	Shrubland	39570.9	4069.14	10.28%	76.7%
Lower Patrick Draw	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	39570.9	2405.19	6.08%	82.8%
Lower Patrick Draw	Introduced Upland Vegetation-Annual and Biennial Forbland	Exotic Herbaceous	39570.9	2366.05	5.98%	88.8%
Lower Patrick Draw	Inter-Mountain Basins Sparsely Vegetated Systems	Sparsely Vegetated	39570.9	1245.46	3.15%	91.9%
Lower Patrick Draw	Western Cool Temperate Urban Shrubland	Developed	39570.9	1093.74	2.76%	94.7%
Lower Patrick Draw	Inter-Mountain Basins Semi-Desert Grassland	Grassland	39570.9	499.56	1.26%	96.0%
Lower Patrick Draw	Other	Other	39570.9	1592.20	4.02%	100.0%
Hydrologic Unit Code (HUC12) Name	**Existing Vegetation Type**	**Physiognomy (form/morphological structure of vegetation)**	**Hydrologic Unit Code (HUC12) Acres**	**Existing Vegetation Type Acres**	**Percent of HUC12**	**Cumulative Percent**
Lower Red Creek	Northern Rocky Mountain Lower Montane-Foothill-Valley Grassland	Grassland	3246.4	669.00	20.61%	20.6%
Lower Red Creek	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	3246.4	469.14	14.45%	35.1%
Lower Red Creek	Artemisia tridentata ssp. vaseyana Shrubland Alliance	Shrubland	3246.4	443.45	13.66%	48.7%
Lower Red Creek	Colorado Plateau Pinyon-Juniper Woodland	Conifer	3246.4	306.51	9.44%	58.2%
Lower Red Creek	Introduced Upland Vegetation-Annual Grassland	Exotic Herbaceous	3246.4	233.50	7.19%	65.4%
Lower Red Creek	Rocky Mountain Lower Montane-Foothill Shrubland	Shrubland	3246.4	222.24	6.85%	72.2%
Lower Red Creek	Inter-Mountain Basins Greasewood Flat	Shrubland	3246.4	213.05	6.56%	78.8%
Lower Red Creek	Inter-Mountain Basins Semi-Desert Grassland	Grassland	3246.4	146.10	4.50%	83.3%
Lower Red Creek	Rocky Mountain Montane Riparian Forest and Woodland	Riparian	3246.4	91.34	2.81%	86.1%
Lower Red Creek	Western Great Plains Floodplain Forest and Woodland	Riparian	3246.4	90.15	2.78%	88.9%
Lower Red Creek	Wyoming Basins Dwarf Sagebrush Shrubland and Steppe	Shrubland	3246.4	53.68	1.65%	90.5%
Lower Red Creek	Inter-Mountain Basins Mat Saltbush Shrubland	Shrubland	3246.4	51.11	1.57%	92.1%
Lower Red Creek	Rocky Mountain Foothill Limber Pine-Juniper Woodland	Conifer	3246.4	48.67	1.50%	93.6%
Lower Red Creek	Rocky Mountain Aspen Forest and Woodland	Hardwood	3246.4	46.54	1.43%	95.0%
Lower Red Creek	Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland	Conifer	3246.4	37.07	1.14%	96.2%
Lower Red Creek	Other	Other	3246.4	124.81	3.84%	100.0%

Hydrologic Unit Code (HUC12) Name	Existing Vegetation Type	Physiognomy (form/morphological structure of vegetation)	Hydrologic Unit Code (HUC12) Acres	Existing Vegetation Type Acres	Percent of HUC12	Cumulative Percent
Lower Salt Wells Creek	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	24516.5	18585.36	75.81%	75.8%
Lower Salt Wells Creek	Introduced Upland Vegetation-Annual and Biennial Forbland	Exotic Herbaceous	24516.5	1909.03	7.79%	83.6%
Lower Salt Wells Creek	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	24516.5	1164.05	4.75%	88.3%
Lower Salt Wells Creek	Inter-Mountain Basins Mat Saltbush Shrubland	Shrubland	24516.5	880.72	3.59%	91.9%
Lower Salt Wells Creek	Inter-Mountain Basins Sparsely Vegetated Systems	Sparsely Vegetated	24516.5	845.23	3.45%	95.4%
Lower Salt Wells Creek	Inter-Mountain Basins Semi-Desert Grassland	Grassland	24516.5	279.88	1.14%	96.5%
Lower Salt Wells Creek	Other	Other	24516.5	852.25	3.48%	100.0%
Hydrologic Unit Code (HUC12) Name	Existing Vegetation Type	Physiognomy (form/morphological structure of vegetation)	Hydrologic Unit Code (HUC12) Acres	Existing Vegetation Type Acres	Percent of HUC12	Cumulative Percent
Middle Black Butte Creek	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	33606.5	24774.45	73.72%	73.7%
Middle Black Butte Creek	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	33606.5	4229.06	12.58%	86.3%
Middle Black Butte Creek	Inter-Mountain Basins Mat Saltbush Shrubland	Shrubland	33606.5	1244.42	3.70%	90.0%
Middle Black Butte Creek	Artemisia tridentata ssp. vaseyana Shrubland Alliance	Shrubland	33606.5	1239.79	3.69%	93.7%
Middle Black Butte Creek	Introduced Upland Vegetation-Annual Grassland	Exotic Herbaceous	33606.5	394.50	1.17%	94.9%
Middle Black Butte Creek	Other	Other	33606.5	1724.33	5.13%	100.0%
Hydrologic Unit Code (HUC12) Name	Existing Vegetation Type	Physiognomy (form/morphological structure of vegetation)	Hydrologic Unit Code (HUC12) Acres	Existing Vegetation Type Acres	Percent of HUC12	Cumulative Percent
Middle Deadman Wash	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	32964.6	20599.48	62.49%	62.5%
Middle Deadman Wash	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	32964.6	3322.61	10.08%	72.6%
Middle Deadman Wash	Inter-Mountain Basins Mat Saltbush Shrubland	Shrubland	32964.6	1740.94	5.28%	77.9%
Middle Deadman Wash	Artemisia tridentata ssp. vaseyana Shrubland Alliance	Shrubland	32964.6	1195.98	3.63%	81.5%
Middle Deadman Wash	Quarries-Strip Mines-Gravel Pits	Quarries-Strip Mines-Gravel Pits	32964.6	963.64	2.92%	84.4%
Middle Deadman Wash	Introduced Upland Vegetation-Annual Grassland	Exotic Herbaceous	32964.6	722.05	2.19%	86.6%
Middle Deadman Wash	Introduced Upland Vegetation-Annual and Biennial Forbland	Exotic Herbaceous	32964.6	649.30	1.97%	88.6%
Middle Deadman Wash	Inter-Mountain Basins Semi-Desert Grassland	Grassland	32964.6	641.23	1.95%	90.5%
Middle Deadman Wash	Open Water	Open Water	32964.6	631.70	1.92%	92.4%
Middle Deadman Wash	Inter-Mountain Basins Sparsely Vegetated Systems	Sparsely Vegetated	32964.6	436.14	1.32%	93.7%
Middle Deadman Wash	Other	Other	32964.6	2061.56	6.25%	100.0%
Hydrologic Unit Code (HUC12) Name	Existing Vegetation Type	Physiognomy (form/morphological structure of vegetation)	Hydrologic Unit Code (HUC12) Acres	Existing Vegetation Type Acres	Percent of HUC12	Cumulative Percent
Middle Little Bitter Creek	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	25600.3	11693.85	45.68%	45.7%
Middle Little Bitter Creek	Artemisia tridentata ssp. vaseyana Shrubland Alliance	Shrubland	25600.3	4527.84	17.69%	63.4%
Middle Little Bitter Creek	Rocky Mountain Lower Montane-Foothill Shrubland	Shrubland	25600.3	1483.46	5.79%	69.2%
Middle Little Bitter Creek	Rocky Mountain Montane Riparian Forest and Woodland	Riparian	25600.3	1101.86	4.30%	73.5%
Middle Little Bitter Creek	Inter-Mountain Basins Greasewood Flat	Shrubland	25600.3	1084.16	4.23%	77.7%
Middle Little Bitter Creek	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	25600.3	1064.92	4.16%	81.9%
Middle Little Bitter Creek	Rocky Mountain Foothill Limber Pine-Juniper Woodland	Conifer	25600.3	989.38	3.86%	85.7%
Middle Little Bitter Creek	Rocky Mountain Subalpine/Upper Montane Riparian Shrubland	Riparian	25600.3	725.90	2.84%	88.6%
Middle Little Bitter Creek	Western Great Plains Floodplain Forest and Woodland	Riparian	25600.3	526.05	2.05%	90.6%
Middle Little Bitter Creek	Introduced Upland Vegetation-Annual Grassland	Exotic Herbaceous	25600.3	454.32	1.77%	92.4%
Middle Little Bitter Creek	Northern Rocky Mountain Lower Montane-Foothill-Valley Grassland	Grassland	25600.3	388.61	1.52%	93.9%
Middle Little Bitter Creek	Inter-Mountain Basins Semi-Desert Grassland	Grassland	25600.3	343.04	1.34%	95.2%
Middle Little Bitter Creek	Other	Other	25600.3	1216.96	4.75%	100.0%
Hydrologic Unit Code (HUC12) Name	Existing Vegetation Type	Physiognomy (form/morphological structure of vegetation)	Hydrologic Unit Code (HUC12) Acres	Existing Vegetation Type Acres	Percent of HUC12	Cumulative Percent
Middle Marsh Creek	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	19034.7	5411.96	28.43%	28.4%

Middle Marsh Creek	Inter-Mountain Basins Semi-Desert Grassland	Grassland	19034.7	3891.90	20.45%	48.9%
Middle Marsh Creek	Inter-Mountain Basins Greasewood Flat	Shrubland	19034.7	1501.01	7.89%	56.8%
Middle Marsh Creek	Artemisia tridentata ssp. vaseyana Shrubland Alliance	Shrubland	19034.7	1420.99	7.47%	64.2%
Middle Marsh Creek	Rocky Mountain Lower Montane-Foothill Shrubland	Shrubland	19034.7	774.09	4.07%	68.3%
Middle Marsh Creek	Inter-Mountain Basins Mat Saltbush Shrubland	Shrubland	19034.7	676.54	3.55%	71.9%
Middle Marsh Creek	Western Great Plains Floodplain Forest and Woodland	Riparian	19034.7	580.59	3.05%	74.9%
Middle Marsh Creek	Rocky Mountain Foothill Limber Pine-Juniper Woodland	Conifer	19034.7	552.11	2.90%	77.8%
Middle Marsh Creek	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	19034.7	502.72	2.64%	80.4%
Middle Marsh Creek	Colorado Plateau Pinyon-Juniper Woodland	Conifer	19034.7	455.42	2.39%	82.8%
Middle Marsh Creek	Inter-Mountain Basins Sparsely Vegetated Systems	Sparsely Vegetated	19034.7	441.23	2.32%	85.2%
Middle Marsh Creek	Introduced Upland Vegetation-Annual and Biennial Forbland	Exotic Herbaceous	19034.7	428.01	2.25%	87.4%
Middle Marsh Creek	Inter-Mountain Basins Montane Sagebrush Steppe	Shrubland	19034.7	340.74	1.79%	89.2%
Middle Marsh Creek	Northern Rocky Mountain Lower Montane-Foothill-Valley Grassland	Grassland	19034.7	255.15	1.34%	90.5%
Middle Marsh Creek	Rocky Mountain Aspen Forest and Woodland	Hardwood	19034.7	240.59	1.26%	91.8%
Middle Marsh Creek	Wyoming Basins Dwarf Sagebrush Shrubland and Steppe	Shrubland	19034.7	192.80	1.01%	92.8%
Middle Marsh Creek	Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland	Conifer	19034.7	192.18	1.01%	93.8%
Middle Marsh Creek	Other	Other	19034.7	1176.70	6.18%	100.0%
Hydrologic Unit Code (HUC12) Name	**Existing Vegetation Type**	**Physiognomy (form/morphological structure of vegetation)**	**Hydrologic Unit Code (HUC12) Acres**	**Existing Vegetation Type Acres**	**Percent of HUC12**	**Cumulative Percent**
Middle Red Creek	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	34018.6	7419.19	21.81%	21.8%
Middle Red Creek	Artemisia tridentata ssp. vaseyana Shrubland Alliance	Shrubland	34018.6	4590.84	13.50%	35.3%
Middle Red Creek	Rocky Mountain Lower Montane-Foothill Shrubland	Shrubland	34018.6	4146.07	12.19%	47.5%
Middle Red Creek	Northern Rocky Mountain Lower Montane-Foothill-Valley Grassland	Grassland	34018.6	3032.70	8.91%	56.4%
Middle Red Creek	Introduced Upland Vegetation-Annual Grassland	Exotic Herbaceous	34018.6	2409.31	7.08%	63.5%
Middle Red Creek	Inter-Mountain Basins Greasewood Flat	Shrubland	34018.6	2075.94	6.10%	69.6%
Middle Red Creek	Western Great Plains Floodplain Forest and Woodland	Riparian	34018.6	1992.16	5.86%	75.4%
Middle Red Creek	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	34018.6	1458.81	4.29%	79.7%
Middle Red Creek	Rocky Mountain Foothill Limber Pine-Juniper Woodland	Conifer	34018.6	1095.01	3.22%	83.0%
Middle Red Creek	Rocky Mountain Aspen Forest and Woodland	Hardwood	34018.6	867.23	2.55%	85.5%
Middle Red Creek	Colorado Plateau Pinyon-Juniper Woodland	Conifer	34018.6	816.32	2.40%	87.9%
Middle Red Creek	Inter-Mountain Basins Montane Sagebrush Steppe	Shrubland	34018.6	734.53	2.16%	90.1%
Middle Red Creek	Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland	Conifer	34018.6	622.69	1.83%	91.9%
Middle Red Creek	Rocky Mountain Montane Riparian Forest and Woodland	Riparian	34018.6	546.27	1.61%	93.5%
Middle Red Creek	Inter-Mountain Basins Semi-Desert Grassland	Grassland	34018.6	529.75	1.56%	95.1%
Middle Red Creek	Other	Other	34018.6	1681.74	4.94%	100.0%
Hydrologic Unit Code (HUC12) Name	**Existing Vegetation Type**	**Physiognomy (form/morphological structure of vegetation)**	**Hydrologic Unit Code (HUC12) Acres**	**Existing Vegetation Type Acres**	**Percent of HUC12**	**Cumulative Percent**
Nitch Creek	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	19066.5	10375.80	54.42%	54.4%
Nitch Creek	Artemisia tridentata ssp. vaseyana Shrubland Alliance	Shrubland	19066.5	2340.69	12.28%	66.7%
Nitch Creek	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	19066.5	2029.01	10.64%	77.3%
Nitch Creek	Barren	Barren	19066.5	1258.09	6.60%	83.9%
Nitch Creek	Inter-Mountain Basins Semi-Desert Grassland	Grassland	19066.5	748.79	3.93%	87.9%
Nitch Creek	Introduced Upland Vegetation-Annual and Biennial Forbland	Exotic Herbaceous	19066.5	454.64	2.38%	90.2%
Nitch Creek	Inter-Mountain Basins Mat Saltbush Shrubland	Shrubland	19066.5	425.16	2.23%	92.5%
Nitch Creek	Inter-Mountain Basins Greasewood Flat	Shrubland	19066.5	342.56	1.80%	94.3%
Nitch Creek	Western Great Plains Floodplain Forest and Woodland	Riparian	19066.5	297.21	1.56%	95.8%
Nitch Creek	Other	Other	19066.5	794.58	4.17%	100.0%

Hydrologic Unit Code (HUC12) Name	Existing Vegetation Type	Physiognomy (form/morphological structure of vegetation)	Hydrologic Unit Code (HUC12) Acres	Existing Vegetation Type Acres	Percent of HUC12	Cumulative Percent
Patrick Draw	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	23145.6	17327.49	74.86%	74.9%
Patrick Draw	Inter-Mountain Basins Mat Saltbush Shrubland	Shrubland	23145.6	1557.29	6.73%	81.6%
Patrick Draw	Introduced Upland Vegetation-Annual and Biennial Forbland	Exotic Herbaceous	23145.6	1085.00	4.69%	86.3%
Patrick Draw	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	23145.6	927.82	4.01%	90.3%
Patrick Draw	Inter-Mountain Basins Sparsely Vegetated Systems	Sparsely Vegetated	23145.6	851.40	3.68%	94.0%
Patrick Draw	Artemisia tridentata ssp. vaseyana Shrubland Alliance	Shrubland	23145.6	305.00	1.32%	95.3%
Patrick Draw	Wyoming Basins Dwarf Sagebrush Shrubland and Steppe	Shrubland	23145.6	274.95	1.19%	96.5%
Patrick Draw	Inter-Mountain Basins Greasewood Flat	Shrubland	23145.6	271.86	1.17%	97.6%
Patrick Draw	Other	Other	23145.6	544.78	2.35%	100.0%
Hydrologic Unit Code (HUC12) Name	Existing Vegetation Type	Physiognomy (form/morphological structure of vegetation)	Hydrologic Unit Code (HUC12) Acres	Existing Vegetation Type Acres	Percent of HUC12	Cumulative Percent
Polly Draw	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	18814.2	9869.38	52.46%	52.5%
Polly Draw	Inter-Mountain Basins Mat Saltbush Shrubland	Shrubland	18814.2	2708.52	14.40%	66.9%
Polly Draw	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	18814.2	2004.39	10.65%	77.5%
Polly Draw	Artemisia tridentata ssp. vaseyana Shrubland Alliance	Shrubland	18814.2	1464.46	7.78%	85.3%
Polly Draw	Inter-Mountain Basins Semi-Desert Grassland	Grassland	18814.2	699.11	3.72%	89.0%
Polly Draw	Introduced Upland Vegetation-Annual and Biennial Forbland	Exotic Herbaceous	18814.2	599.04	3.18%	92.2%
Polly Draw	Inter-Mountain Basins Sparsely Vegetated Systems	Sparsely Vegetated	18814.2	303.46	1.61%	93.8%
Polly Draw	Wyoming Basins Dwarf Sagebrush Shrubland and Steppe	Shrubland	18814.2	198.06	1.05%	94.9%
Polly Draw	Other	Other	18814.2	967.80	5.14%	100.0%
Hydrologic Unit Code (HUC12) Name	Existing Vegetation Type	Physiognomy (form/morphological structure of vegetation)	Hydrologic Unit Code (HUC12) Acres	Existing Vegetation Type Acres	Percent of HUC12	Cumulative Percent
Pretty Water Creek	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	32211.8	19920.32	61.84%	61.8%
Pretty Water Creek	Artemisia tridentata ssp. vaseyana Shrubland Alliance	Shrubland	32211.8	6127.18	19.02%	80.9%
Pretty Water Creek	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	32211.8	1708.03	5.30%	86.2%
Pretty Water Creek	Inter-Mountain Basins Mat Saltbush Shrubland	Shrubland	32211.8	814.76	2.53%	88.7%
Pretty Water Creek	Inter-Mountain Basins Semi-Desert Grassland	Grassland	32211.8	565.64	1.76%	90.5%
Pretty Water Creek	Western Great Plains Floodplain Forest and Woodland	Riparian	32211.8	524.89	1.63%	92.1%
Pretty Water Creek	Introduced Upland Vegetation-Annual and Biennial Forbland	Exotic Herbaceous	32211.8	454.35	1.41%	93.5%
Pretty Water Creek	Rocky Mountain Montane Riparian Forest and Woodland	Riparian	32211.8	326.26	1.01%	94.5%
Pretty Water Creek	Other	Other	32211.8	1770.39	5.50%	100.0%
Hydrologic Unit Code (HUC12) Name	Existing Vegetation Type	Physiognomy (form/morphological structure of vegetation)	Hydrologic Unit Code (HUC12) Acres	Existing Vegetation Type Acres	Percent of HUC12	Cumulative Percent
Red Wash	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	26455.3	15198.37	57.45%	57.4%
Red Wash	Inter-Mountain Basins Mat Saltbush Shrubland	Shrubland	26455.3	4551.77	17.21%	74.7%
Red Wash	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	26455.3	3314.96	12.53%	87.2%
Red Wash	Introduced Upland Vegetation-Annual and Biennial Forbland	Exotic Herbaceous	26455.3	1234.12	4.66%	91.9%
Red Wash	Artemisia tridentata ssp. vaseyana Shrubland Alliance	Shrubland	26455.3	652.99	2.47%	94.3%
Red Wash	Inter-Mountain Basins Sparsely Vegetated Systems	Sparsely Vegetated	26455.3	471.35	1.78%	96.1%
Red Wash	Other	Other	26455.3	1031.77	3.90%	100.0%
Hydrologic Unit Code (HUC12) Name	Existing Vegetation Type	Physiognomy (form/morphological structure of vegetation)	Hydrologic Unit Code (HUC12) Acres	Existing Vegetation Type Acres	Percent of HUC12	Cumulative Percent
Sage Creek-Greasewood Draw	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	42565.5	11786.19	27.69%	27.7%
Sage Creek-Greasewood Draw	Inter-Mountain Basins Semi-Desert Grassland	Grassland	42565.5	10984.55	25.81%	53.5%
Sage Creek-Greasewood Draw	Introduced Upland Vegetation-Annual Grassland	Exotic Herbaceous	42565.5	2877.55	6.76%	60.3%
Sage Creek-Greasewood Draw	Inter-Mountain Basins Greasewood Flat	Shrubland	42565.5	2505.14	5.89%	66.1%

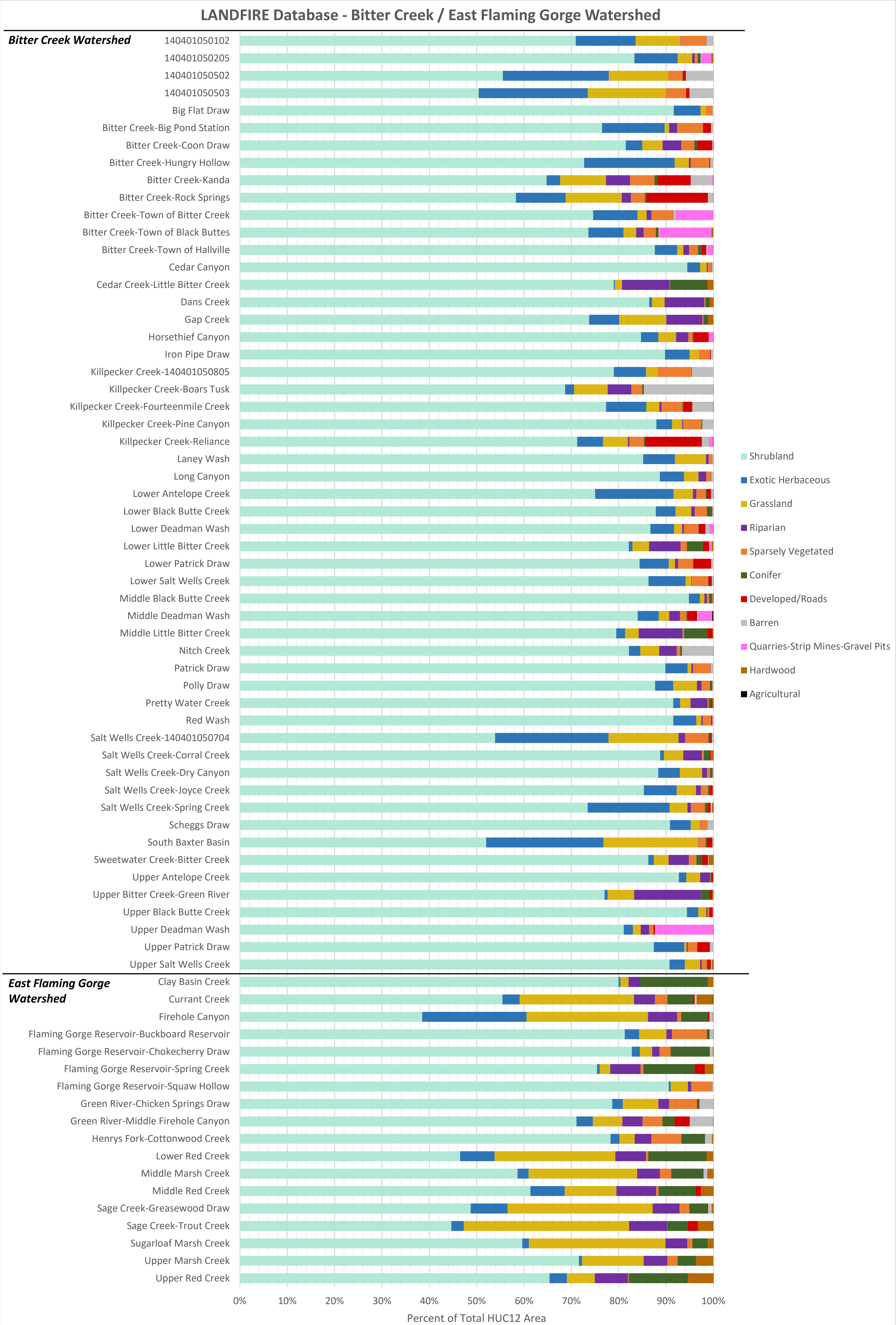
Sage Creek-Greasewood Draw	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	42565.5	2039.07	4.79%	70.9%
Sage Creek-Greasewood Draw	Northern Rocky Mountain Lower Montane-Foothill-Valley Grassland	Grassland	42565.5	1892.70	4.45%	75.4%
Sage Creek-Greasewood Draw	Artemisia tridentata ssp. vaseyana Shrubland Alliance	Shrubland	42565.5	1494.66	3.51%	78.9%
Sage Creek-Greasewood Draw	Rocky Mountain Foothill Limber Pine-Juniper Woodland	Conifer	42565.5	1300.15	3.05%	81.9%
Sage Creek-Greasewood Draw	Western Great Plains Floodplain Forest and Woodland	Riparian	42565.5	1188.11	2.79%	84.7%
Sage Creek-Greasewood Draw	Inter-Mountain Basins Mat Saltbush Shrubland	Shrubland	42565.5	1024.86	2.41%	87.1%
Sage Creek-Greasewood Draw	Rocky Mountain Montane Riparian Forest and Woodland	Riparian	42565.5	948.93	2.23%	89.4%
Sage Creek-Greasewood Draw	Inter-Mountain Basins Sparsely Vegetated Systems	Sparsely Vegetated	42565.5	858.78	2.02%	91.4%
Sage Creek-Greasewood Draw	Rocky Mountain Lower Montane-Foothill Shrubland	Shrubland	42565.5	802.65	1.89%	93.3%
Sage Creek-Greasewood Draw	Other	Other	42565.5	2862.20	6.72%	100.0%
Hydrologic Unit Code (HUC12) Name	**Existing Vegetation Type**	**Physiognomy (form/morphological structure of vegetation)**	**Hydrologic Unit Code (HUC12) Acres**	**Existing Vegetation Type Acres**	**Percent of HUC12**	**Cumulative Percent**
Sage Creek-Trout Creek	Inter-Mountain Basins Semi-Desert Grassland	Grassland	39078.0	11406.05	29.19%	29.2%
Sage Creek-Trout Creek	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	39078.0	6981.63	17.87%	47.1%
Sage Creek-Trout Creek	Artemisia tridentata ssp. vaseyana Shrubland Alliance	Shrubland	39078.0	6685.17	17.11%	64.2%
Sage Creek-Trout Creek	Northern Rocky Mountain Lower Montane-Foothill-Valley Grassland	Grassland	39078.0	1855.87	4.75%	68.9%
Sage Creek-Trout Creek	Western Great Plains Floodplain Forest and Woodland	Riparian	39078.0	1705.26	4.36%	73.3%
Sage Creek-Trout Creek	Rocky Mountain Aspen Forest and Woodland	Hardwood	39078.0	1270.84	3.25%	76.5%
Sage Creek-Trout Creek	Inter-Mountain Basins Montane Sagebrush Steppe	Shrubland	39078.0	1153.03	2.95%	79.5%
Sage Creek-Trout Creek	Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland	Conifer	39078.0	1096.98	2.81%	82.3%
Sage Creek-Trout Creek	Rocky Mountain Lower Montane-Foothill Shrubland	Shrubland	39078.0	964.24	2.47%	84.8%
Sage Creek-Trout Creek	Introduced Upland Vegetation-Annual Grassland	Exotic Herbaceous	39078.0	952.15	2.44%	87.2%
Sage Creek-Trout Creek	Rocky Mountain Montane Riparian Forest and Woodland	Riparian	39078.0	856.26	2.19%	89.4%
Sage Creek-Trout Creek	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	39078.0	852.87	2.18%	91.6%
Sage Creek-Trout Creek	Rocky Mountain Subalpine/Upper Montane Riparian Shrubland	Riparian	39078.0	412.42	1.06%	92.6%
Sage Creek-Trout Creek	Other	Other	39078.0	2885.19	7.38%	100.0%
Hydrologic Unit Code (HUC12) Name	**Existing Vegetation Type**	**Physiognomy (form/morphological structure of vegetation)**	**Hydrologic Unit Code (HUC12) Acres**	**Existing Vegetation Type Acres**	**Percent of HUC12**	**Cumulative Percent**
Salt Wells Creek-140401050704	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	29523.0	10730.86	36.35%	36.3%
Salt Wells Creek-140401050704	Introduced Upland Vegetation-Annual and Biennial Forbland	Exotic Herbaceous	29523.0	7025.77	23.80%	60.1%
Salt Wells Creek-140401050704	Inter-Mountain Basins Semi-Desert Grassland	Grassland	29523.0	4241.94	14.37%	74.5%
Salt Wells Creek-140401050704	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	29523.0	2975.21	10.08%	84.6%
Salt Wells Creek-140401050704	Inter-Mountain Basins Mat Saltbush Shrubland	Shrubland	29523.0	1798.37	6.09%	90.7%
Salt Wells Creek-140401050704	Inter-Mountain Basins Sparsely Vegetated Systems	Sparsely Vegetated	29523.0	1428.48	4.84%	95.5%
Salt Wells Creek-140401050704	Western Great Plains Floodplain Forest and Woodland	Riparian	29523.0	314.17	1.06%	96.6%
Salt Wells Creek-140401050704	Other	Other	29523.0	1008.21	3.41%	100.0%
Hydrologic Unit Code (HUC12) Name	**Existing Vegetation Type**	**Physiognomy (form/morphological structure of vegetation)**	**Hydrologic Unit Code (HUC12) Acres**	**Existing Vegetation Type Acres**	**Percent of HUC12**	**Cumulative Percent**
Salt Wells Creek-Corral Creek	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	29075.6	11606.88	39.92%	39.9%
Salt Wells Creek-Corral Creek	Artemisia tridentata ssp. vaseyana Shrubland Alliance	Shrubland	29075.6	6479.96	22.29%	62.2%
Salt Wells Creek-Corral Creek	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	29075.6	4420.81	15.20%	77.4%
Salt Wells Creek-Corral Creek	Wyoming Basins Dwarf Sagebrush Shrubland and Steppe	Shrubland	29075.6	1395.38	4.80%	82.2%
Salt Wells Creek-Corral Creek	Inter-Mountain Basins Mat Saltbush Shrubland	Shrubland	29075.6	823.88	2.83%	85.0%
Salt Wells Creek-Corral Creek	Inter-Mountain Basins Semi-Desert Grassland	Grassland	29075.6	785.97	2.70%	87.7%
Salt Wells Creek-Corral Creek	Inter-Mountain Basins Montane Sagebrush Steppe	Shrubland	29075.6	769.23	2.65%	90.4%
Salt Wells Creek-Corral Creek	Western Great Plains Floodplain Forest and Woodland	Riparian	29075.6	741.96	2.55%	92.9%
Salt Wells Creek-Corral Creek	Northern Rocky Mountain Lower Montane-Foothill-Valley Grassland	Grassland	29075.6	348.10	1.20%	94.1%
Salt Wells Creek-Corral Creek	Rocky Mountain Montane Riparian Forest and Woodland	Riparian	29075.6	294.41	1.01%	95.2%

Salt Wells Creek-Corral Creek	Other	Other	29075.6	1409.02	4.85%	100.0%
Hydrologic Unit Code (HUC12) Name	**Existing Vegetation Type**	**Physiognomy (form/morphological structure of vegetation)**	**Hydrologic Unit Code (HUC12) Acres**	**Existing Vegetation Type Acres**	**Percent of HUC12**	**Cumulative Percent**
Salt Wells Creek-Dry Canyon	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	19525.7	12892.59	66.03%	66.0%
Salt Wells Creek-Dry Canyon	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	19525.7	2116.58	10.84%	76.9%
Salt Wells Creek-Dry Canyon	Artemisia tridentata ssp. vaseyana Shrubland Alliance	Shrubland	19525.7	989.40	5.07%	81.9%
Salt Wells Creek-Dry Canyon	Introduced Upland Vegetation-Annual Grassland	Exotic Herbaceous	19525.7	774.43	3.97%	85.9%
Salt Wells Creek-Dry Canyon	Inter-Mountain Basins Mat Saltbush Shrubland	Shrubland	19525.7	689.80	3.53%	89.4%
Salt Wells Creek-Dry Canyon	Inter-Mountain Basins Semi-Desert Grassland	Grassland	19525.7	549.13	2.81%	92.2%
Salt Wells Creek-Dry Canyon	Northern Rocky Mountain Lower Montane-Foothill-Valley Grassland	Grassland	19525.7	358.13	1.83%	94.1%
Salt Wells Creek-Dry Canyon	Wyoming Basins Dwarf Sagebrush Shrubland and Steppe	Shrubland	19525.7	276.58	1.42%	95.5%
Salt Wells Creek-Dry Canyon	Other	Other	19525.7	879.08	4.50%	100.0%
Hydrologic Unit Code (HUC12) Name	**Existing Vegetation Type**	**Physiognomy (form/morphological structure of vegetation)**	**Hydrologic Unit Code (HUC12) Acres**	**Existing Vegetation Type Acres**	**Percent of HUC12**	**Cumulative Percent**
Salt Wells Creek-Joyce Creek	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	31416.6	20848.91	66.36%	66.4%
Salt Wells Creek-Joyce Creek	Introduced Upland Vegetation-Annual and Biennial Forbland	Exotic Herbaceous	31416.6	2158.21	6.87%	73.2%
Salt Wells Creek-Joyce Creek	Artemisia tridentata ssp. vaseyana Shrubland Alliance	Shrubland	31416.6	2002.46	6.37%	79.6%
Salt Wells Creek-Joyce Creek	Inter-Mountain Basins Mat Saltbush Shrubland	Shrubland	31416.6	1994.29	6.35%	86.0%
Salt Wells Creek-Joyce Creek	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	31416.6	1556.34	4.95%	90.9%
Salt Wells Creek-Joyce Creek	Inter-Mountain Basins Semi-Desert Grassland	Grassland	31416.6	1175.11	3.74%	94.6%
Salt Wells Creek-Joyce Creek	Inter-Mountain Basins Sparsely Vegetated Systems	Sparsely Vegetated	31416.6	479.43	1.53%	96.2%
Salt Wells Creek-Joyce Creek	Other	Other	31416.6	1201.90	3.83%	100.0%
Hydrologic Unit Code (HUC12) Name	**Existing Vegetation Type**	**Physiognomy (form/morphological structure of vegetation)**	**Hydrologic Unit Code (HUC12) Acres**	**Existing Vegetation Type Acres**	**Percent of HUC12**	**Cumulative Percent**
Salt Wells Creek-Spring Creek	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	35044.6	16282.49	46.46%	46.5%
Salt Wells Creek-Spring Creek	Introduced Upland Vegetation-Annual and Biennial Forbland	Exotic Herbaceous	35044.6	5993.88	17.10%	63.6%
Salt Wells Creek-Spring Creek	Inter-Mountain Basins Mat Saltbush Shrubland	Shrubland	35044.6	4269.73	12.18%	75.7%
Salt Wells Creek-Spring Creek	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	35044.6	2533.86	7.23%	83.0%
Salt Wells Creek-Spring Creek	Artemisia tridentata ssp. vaseyana Shrubland Alliance	Shrubland	35044.6	1516.49	4.33%	87.3%
Salt Wells Creek-Spring Creek	Inter-Mountain Basins Semi-Desert Grassland	Grassland	35044.6	1197.03	3.42%	90.7%
Salt Wells Creek-Spring Creek	Inter-Mountain Basins Sparsely Vegetated Systems	Sparsely Vegetated	35044.6	1007.98	2.88%	93.6%
Salt Wells Creek-Spring Creek	Wyoming Basins Dwarf Sagebrush Shrubland and Steppe	Shrubland	35044.6	408.60	1.17%	94.8%
Salt Wells Creek-Spring Creek	Other	Other	35044.6	1834.51	5.23%	100.0%
Hydrologic Unit Code (HUC12) Name	**Existing Vegetation Type**	**Physiognomy (form/morphological structure of vegetation)**	**Hydrologic Unit Code (HUC12) Acres**	**Existing Vegetation Type Acres**	**Percent of HUC12**	**Cumulative Percent**
Scheggs Draw	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	14961.5	9403.25	62.85%	62.8%
Scheggs Draw	Inter-Mountain Basins Mat Saltbush Shrubland	Shrubland	14961.5	1960.38	13.10%	76.0%
Scheggs Draw	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	14961.5	1495.69	10.00%	85.9%
Scheggs Draw	Introduced Upland Vegetation-Annual and Biennial Forbland	Exotic Herbaceous	14961.5	643.77	4.30%	90.3%
Scheggs Draw	Artemisia tridentata ssp. vaseyana Shrubland Alliance	Shrubland	14961.5	356.50	2.38%	92.6%
Scheggs Draw	Inter-Mountain Basins Semi-Desert Grassland	Grassland	14961.5	274.62	1.84%	94.5%
Scheggs Draw	Inter-Mountain Basins Sparsely Vegetated Systems	Sparsely Vegetated	14961.5	221.72	1.48%	96.0%
Scheggs Draw	Barren	Barren	14961.5	179.61	1.20%	97.2%
Scheggs Draw	Wyoming Basins Dwarf Sagebrush Shrubland and Steppe	Shrubland	14961.5	156.10	1.04%	98.2%
Scheggs Draw	Other	Other	14961.5	269.83	1.80%	100.0%
Hydrologic Unit Code (HUC12) Name	**Existing Vegetation Type**	**Physiognomy (form/morphological structure of vegetation)**	**Hydrologic Unit Code (HUC12) Acres**	**Existing Vegetation Type Acres**	**Percent of HUC12**	**Cumulative Percent**
South Baxter Basin	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	33983.8	12484.20	36.74%	36.7%

South Baxter Basin	Introduced Upland Vegetation-Annual and Biennial Forbland	Exotic Herbaceous	33983.8	8406.81	24.74%	61.5%
South Baxter Basin	Inter-Mountain Basins Semi-Desert Grassland	Grassland	33983.8	6581.57	19.37%	80.8%
South Baxter Basin	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	33983.8	2191.50	6.45%	87.3%
South Baxter Basin	Artemisia tridentata ssp. vaseyana Shrubland Alliance	Shrubland	33983.8	1532.19	4.51%	91.8%
South Baxter Basin	Inter-Mountain Basins Mat Saltbush Shrubland	Shrubland	33983.8	883.62	2.60%	94.4%
South Baxter Basin	Inter-Mountain Basins Sparsely Vegetated Systems	Sparsely Vegetated	33983.8	495.66	1.46%	95.9%
South Baxter Basin	Other	Other	33983.8	1408.24	4.14%	100.0%
Hydrologic Unit Code (HUC12) Name	**Existing Vegetation Type**	**Physiognomy (form/morphological structure of vegetation)**	**Hydrologic Unit Code (HUC12) Acres**	**Existing Vegetation Type Acres**	**Percent of HUC12**	**Cumulative Percent**
Sugarloaf Marsh Creek	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	17135.1	5322.85	31.06%	31.1%
Sugarloaf Marsh Creek	Inter-Mountain Basins Semi-Desert Grassland	Grassland	17135.1	4717.45	27.53%	58.6%
Sugarloaf Marsh Creek	Artemisia tridentata ssp. vaseyana Shrubland Alliance	Shrubland	17135.1	2140.48	12.49%	71.1%
Sugarloaf Marsh Creek	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	17135.1	903.54	5.27%	76.4%
Sugarloaf Marsh Creek	Inter-Mountain Basins Greasewood Flat	Shrubland	17135.1	780.40	4.55%	80.9%
Sugarloaf Marsh Creek	Western Great Plains Floodplain Forest and Woodland	Riparian	17135.1	497.65	2.90%	83.8%
Sugarloaf Marsh Creek	Rocky Mountain Foothill Limber Pine-Juniper Woodland	Conifer	17135.1	448.37	2.62%	86.4%
Sugarloaf Marsh Creek	Wyoming Basins Dwarf Sagebrush Shrubland and Steppe	Shrubland	17135.1	367.65	2.15%	88.6%
Sugarloaf Marsh Creek	Rocky Mountain Lower Montane-Foothill Shrubland	Shrubland	17135.1	295.16	1.72%	90.3%
Sugarloaf Marsh Creek	Northern Rocky Mountain Lower Montane-Foothill-Valley Grassland	Grassland	17135.1	225.78	1.32%	91.6%
Sugarloaf Marsh Creek	Inter-Mountain Basins Montane Sagebrush Steppe	Shrubland	17135.1	201.74	1.18%	92.8%
Sugarloaf Marsh Creek	Rocky Mountain Aspen Forest and Woodland	Hardwood	17135.1	187.70	1.10%	93.9%
Sugarloaf Marsh Creek	Rocky Mountain Montane Riparian Forest and Woodland	Riparian	17135.1	187.42	1.09%	95.0%
Sugarloaf Marsh Creek	Inter-Mountain Basins Sparsely Vegetated Systems	Sparsely Vegetated	17135.1	174.62	1.02%	96.0%
Sugarloaf Marsh Creek	Other	Other	17135.1	684.26	3.99%	100.0%
Hydrologic Unit Code (HUC12) Name	**Existing Vegetation Type**	**Physiognomy (form/morphological structure of vegetation)**	**Hydrologic Unit Code (HUC12) Acres**	**Existing Vegetation Type Acres**	**Percent of HUC12**	**Cumulative Percent**
Sweetwater Creek-Bitter Creek	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	19245.5	12387.60	64.37%	64.4%
Sweetwater Creek-Bitter Creek	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	19245.5	1375.44	7.15%	71.5%
Sweetwater Creek-Bitter Creek	Artemisia tridentata ssp. vaseyana Shrubland Alliance	Shrubland	19245.5	1335.64	6.94%	78.5%
Sweetwater Creek-Bitter Creek	Inter-Mountain Basins Semi-Desert Grassland	Grassland	19245.5	569.47	2.96%	81.4%
Sweetwater Creek-Bitter Creek	Western Great Plains Floodplain Forest and Woodland	Riparian	19245.5	397.40	2.06%	83.5%
Sweetwater Creek-Bitter Creek	Rocky Mountain Lower Montane-Foothill Shrubland	Shrubland	19245.5	336.90	1.75%	85.2%
Sweetwater Creek-Bitter Creek	Inter-Mountain Basins Greasewood Flat	Shrubland	19245.5	322.44	1.68%	86.9%
Sweetwater Creek-Bitter Creek	Wyoming Basins Dwarf Sagebrush Shrubland and Steppe	Shrubland	19245.5	309.20	1.61%	88.5%
Sweetwater Creek-Bitter Creek	Inter-Mountain Basins Sparsely Vegetated Systems	Sparsely Vegetated	19245.5	297.64	1.55%	90.1%
Sweetwater Creek-Bitter Creek	Inter-Mountain Basins Mat Saltbush Shrubland	Shrubland	19245.5	270.13	1.40%	91.5%
Sweetwater Creek-Bitter Creek	Rocky Mountain Subalpine/Upper Montane Riparian Shrubland	Riparian	19245.5	236.61	1.23%	92.7%
Sweetwater Creek-Bitter Creek	Other	Other	19245.5	1407.06	7.31%	100.0%
Hydrologic Unit Code (HUC12) Name	**Existing Vegetation Type**	**Physiognomy (form/morphological structure of vegetation)**	**Hydrologic Unit Code (HUC12) Acres**	**Existing Vegetation Type Acres**	**Percent of HUC12**	**Cumulative Percent**
Upper Antelope Creek	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	27140.0	14172.09	52.22%	52.2%
Upper Antelope Creek	Inter-Mountain Basins Mat Saltbush Shrubland	Shrubland	27140.0	4347.27	16.02%	68.2%
Upper Antelope Creek	Artemisia tridentata ssp. vaseyana Shrubland Alliance	Shrubland	27140.0	2779.58	10.24%	78.5%
Upper Antelope Creek	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	27140.0	2573.86	9.48%	88.0%
Upper Antelope Creek	Wyoming Basins Dwarf Sagebrush Shrubland and Steppe	Shrubland	27140.0	656.20	2.42%	90.4%
Upper Antelope Creek	Inter-Mountain Basins Montane Sagebrush Steppe	Shrubland	27140.0	566.99	2.09%	92.5%
Upper Antelope Creek	Northern Rocky Mountain Lower Montane-Foothill-Valley Grassland	Grassland	27140.0	393.65	1.45%	93.9%
Upper Antelope Creek	Western Great Plains Floodplain Forest and Woodland	Riparian	27140.0	340.82	1.26%	95.2%

Upper Antelope Creek	Other	Other	27140.0	1309.51	4.83%	100.0%
Hydrologic Unit Code (HUC12) Name	**Existing Vegetation Type**	**Physiognomy (form/morphological structure of vegetation)**	**Hydrologic Unit Code (HUC12) Acres**	**Existing Vegetation Type Acres**	**Percent of HUC12**	**Cumulative Percent**
Upper Bitter Creek-Green River	Artemisia tridentata ssp. vaseyana Shrubland Alliance	Shrubland	29314.9	14525.71	49.55%	49.6%
Upper Bitter Creek-Green River	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	29314.9	4830.55	16.48%	66.0%
Upper Bitter Creek-Green River	Rocky Mountain Subalpine/Upper Montane Riparian Shrubland	Riparian	29314.9	1741.46	5.94%	72.0%
Upper Bitter Creek-Green River	Rocky Mountain Lower Montane-Foothill Shrubland	Shrubland	29314.9	1688.05	5.76%	77.7%
Upper Bitter Creek-Green River	Rocky Mountain Montane Riparian Forest and Woodland	Riparian	29314.9	1508.17	5.14%	82.9%
Upper Bitter Creek-Green River	Northern Rocky Mountain Lower Montane-Foothill-Valley Grassland	Grassland	29314.9	1051.28	3.59%	86.5%
Upper Bitter Creek-Green River	Inter-Mountain Basins Montane Sagebrush Steppe	Shrubland	29314.9	923.44	3.15%	89.6%
Upper Bitter Creek-Green River	Western Great Plains Floodplain Forest and Woodland	Riparian	29314.9	741.40	2.53%	92.1%
Upper Bitter Creek-Green River	Inter-Mountain Basins Semi-Desert Grassland	Grassland	29314.9	560.83	1.91%	94.1%
Upper Bitter Creek-Green River	Rocky Mountain Foothill Limber Pine-Juniper Woodland	Conifer	29314.9	348.72	1.19%	95.2%
Upper Bitter Creek-Green River	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	29314.9	321.01	1.10%	96.3%
Upper Bitter Creek-Green River	Other	Other	29314.9	1074.29	3.66%	100.0%
Hydrologic Unit Code (HUC12) Name	**Existing Vegetation Type**	**Physiognomy (form/morphological structure of vegetation)**	**Hydrologic Unit Code (HUC12) Acres**	**Existing Vegetation Type Acres**	**Percent of HUC12**	**Cumulative Percent**
Upper Black Butte Creek	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	29749.0	20338.44	68.37%	68.4%
Upper Black Butte Creek	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	29749.0	3713.07	12.48%	80.8%
Upper Black Butte Creek	Inter-Mountain Basins Mat Saltbush Shrubland	Shrubland	29749.0	2667.47	8.97%	89.8%
Upper Black Butte Creek	Artemisia tridentata ssp. vaseyana Shrubland Alliance	Shrubland	29749.0	1102.24	3.71%	93.5%
Upper Black Butte Creek	Introduced Upland Vegetation-Annual and Biennial Forbland	Exotic Herbaceous	29749.0	585.87	1.97%	95.5%
Upper Black Butte Creek	Inter-Mountain Basins Semi-Desert Grassland	Grassland	29749.0	391.54	1.32%	96.8%
Upper Black Butte Creek	Other	Other	29749.0	950.37	3.19%	100.0%
Hydrologic Unit Code (HUC12) Name	**Existing Vegetation Type**	**Physiognomy (form/morphological structure of vegetation)**	**Hydrologic Unit Code (HUC12) Acres**	**Existing Vegetation Type Acres**	**Percent of HUC12**	**Cumulative Percent**
Upper Deadman Wash	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	32426.2	20554.85	63.39%	63.4%
Upper Deadman Wash	Quarries-Strip Mines-Gravel Pits	Quarries-Strip Mines-Gravel Pits	32426.2	3894.83	12.01%	75.4%
Upper Deadman Wash	Artemisia tridentata ssp. vaseyana Shrubland Alliance	Shrubland	32426.2	2409.65	7.43%	82.8%
Upper Deadman Wash	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	32426.2	1719.71	5.30%	88.1%
Upper Deadman Wash	Inter-Mountain Basins Mat Saltbush Shrubland	Shrubland	32426.2	1288.34	3.97%	92.1%
Upper Deadman Wash	Introduced Upland Vegetation-Annual and Biennial Forbland	Exotic Herbaceous	32426.2	611.33	1.89%	94.0%
Upper Deadman Wash	Inter-Mountain Basins Semi-Desert Grassland	Grassland	32426.2	428.35	1.32%	95.3%
Upper Deadman Wash	Other	Other	32426.2	1519.16	4.68%	100.0%
Hydrologic Unit Code (HUC12) Name	**Existing Vegetation Type**	**Physiognomy (form/morphological structure of vegetation)**	**Hydrologic Unit Code (HUC12) Acres**	**Existing Vegetation Type Acres**	**Percent of HUC12**	**Cumulative Percent**
Upper Marsh Creek	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	15306.8	5905.89	38.58%	38.6%
Upper Marsh Creek	Inter-Mountain Basins Semi-Desert Grassland	Grassland	15306.8	1880.41	12.28%	50.9%
Upper Marsh Creek	Artemisia tridentata ssp. vaseyana Shrubland Alliance	Shrubland	15306.8	1484.81	9.70%	60.6%
Upper Marsh Creek	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	15306.8	1225.28	8.00%	68.6%
Upper Marsh Creek	Inter-Mountain Basins Greasewood Flat	Shrubland	15306.8	684.00	4.47%	73.0%
Upper Marsh Creek	Rocky Mountain Aspen Forest and Woodland	Hardwood	15306.8	542.43	3.54%	76.6%
Upper Marsh Creek	Rocky Mountain Lower Montane-Foothill Shrubland	Shrubland	15306.8	452.37	2.96%	79.5%
Upper Marsh Creek	Wyoming Basins Dwarf Sagebrush Shrubland and Steppe	Shrubland	15306.8	431.19	2.82%	82.4%
Upper Marsh Creek	Rocky Mountain Foothill Limber Pine-Juniper Woodland	Conifer	15306.8	430.13	2.81%	85.2%
Upper Marsh Creek	Western Great Plains Floodplain Forest and Woodland	Riparian	15306.8	380.56	2.49%	87.7%
Upper Marsh Creek	Inter-Mountain Basins Sparsely Vegetated Systems	Sparsely Vegetated	15306.8	318.71	2.08%	89.7%
Upper Marsh Creek	Inter-Mountain Basins Montane Sagebrush Steppe	Shrubland	15306.8	269.56	1.76%	91.5%

Upper Marsh Creek	Open Water	Open Water	15306.8	255.92	1.67%	93.2%
Upper Marsh Creek	Inter-Mountain Basins Mat Saltbush Shrubland	Shrubland	15306.8	214.56	1.40%	94.6%
Upper Marsh Creek	Rocky Mountain Montane Riparian Forest and Woodland	Riparian	15306.8	197.92	1.29%	95.9%
Upper Marsh Creek	Rocky Mountain Subalpine/Upper Montane Riparian Shrubland	Riparian	15306.8	165.66	1.08%	96.9%
Upper Marsh Creek	Other	Other	15306.8	467.37	3.05%	100.0%
Hydrologic Unit Code (HUC12) Name	**Existing Vegetation Type**	**Physiognomy (form/morphological structure of vegetation)**	**Hydrologic Unit Code (HUC12) Acres**	**Existing Vegetation Type Acres**	**Percent of HUC12**	**Cumulative Percent**
Upper Patrick Draw	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	21870.4	15587.86	71.27%	71.3%
Upper Patrick Draw	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	21870.4	1881.57	8.60%	79.9%
Upper Patrick Draw	Introduced Upland Vegetation-Annual and Biennial Forbland	Exotic Herbaceous	21870.4	1368.57	6.26%	86.1%
Upper Patrick Draw	Inter-Mountain Basins Mat Saltbush Shrubland	Shrubland	21870.4	1319.49	6.03%	92.2%
Upper Patrick Draw	Inter-Mountain Basins Sparsely Vegetated Systems	Sparsely Vegetated	21870.4	443.72	2.03%	94.2%
Upper Patrick Draw	Other	Other	21870.4	1269.20	5.80%	100.0%
Hydrologic Unit Code (HUC12) Name	**Existing Vegetation Type**	**Physiognomy (form/morphological structure of vegetation)**	**Hydrologic Unit Code (HUC12) Acres**	**Existing Vegetation Type Acres**	**Percent of HUC12**	**Cumulative Percent**
Upper Red Creek	Artemisia tridentata ssp. vaseyana Shrubland Alliance	Shrubland	29141.6	8565.60	29.39%	29.4%
Upper Red Creek	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	29141.6	4158.63	14.27%	43.7%
Upper Red Creek	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	29141.6	1809.13	6.21%	49.9%
Upper Red Creek	Rocky Mountain Lower Montane-Foothill Shrubland	Shrubland	29141.6	1794.72	6.16%	56.0%
Upper Red Creek	Western Great Plains Floodplain Forest and Woodland	Riparian	29141.6	1755.61	6.02%	62.1%
Upper Red Creek	Rocky Mountain Aspen Forest and Woodland	Hardwood	29141.6	1540.39	5.29%	67.3%
Upper Red Creek	Inter-Mountain Basins Greasewood Flat	Shrubland	29141.6	1426.92	4.90%	72.2%
Upper Red Creek	Rocky Mountain Foothill Limber Pine-Juniper Woodland	Conifer	29141.6	1410.39	4.84%	77.1%
Upper Red Creek	Northern Rocky Mountain Lower Montane-Foothill-Valley Grassland	Grassland	29141.6	1373.21	4.71%	81.8%
Upper Red Creek	Introduced Upland Vegetation-Annual Grassland	Exotic Herbaceous	29141.6	1023.27	3.51%	85.3%
Upper Red Creek	Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland	Conifer	29141.6	1009.33	3.46%	88.8%
Upper Red Creek	Colorado Plateau Pinyon-Juniper Woodland	Conifer	29141.6	713.23	2.45%	91.2%
Upper Red Creek	Inter-Mountain Basins Montane Sagebrush Steppe	Shrubland	29141.6	666.73	2.29%	93.5%
Upper Red Creek	Wyoming Basins Dwarf Sagebrush Shrubland and Steppe	Shrubland	29141.6	555.02	1.90%	95.4%
Upper Red Creek	Other	Other	29141.6	1339.38	4.60%	100.0%
Hydrologic Unit Code (HUC12) Name	**Existing Vegetation Type**	**Physiognomy (form/morphological structure of vegetation)**	**Hydrologic Unit Code (HUC12) Acres**	**Existing Vegetation Type Acres**	**Percent of HUC12**	**Cumulative Percent**
Upper Salt Wells Creek	Inter-Mountain Basins Big Sagebrush Shrubland	Shrubland	41272.7	25827.82	62.58%	62.6%
Upper Salt Wells Creek	Inter-Mountain Basins Big Sagebrush Steppe	Shrubland	41272.7	4580.31	11.10%	73.7%
Upper Salt Wells Creek	Inter-Mountain Basins Mat Saltbush Shrubland	Shrubland	41272.7	2844.95	6.89%	80.6%
Upper Salt Wells Creek	Artemisia tridentata ssp. vaseyana Shrubland Alliance	Shrubland	41272.7	1841.96	4.46%	85.0%
Upper Salt Wells Creek	Wyoming Basins Dwarf Sagebrush Shrubland and Steppe	Shrubland	41272.7	1380.04	3.34%	88.4%
Upper Salt Wells Creek	Introduced Upland Vegetation-Annual and Biennial Forbland	Exotic Herbaceous	41272.7	1083.66	2.63%	91.0%
Upper Salt Wells Creek	Inter-Mountain Basins Semi-Desert Grassland	Grassland	41272.7	955.33	2.31%	93.3%
Upper Salt Wells Creek	Inter-Mountain Basins Sparsely Vegetated Systems	Sparsely Vegetated	41272.7	432.79	1.05%	94.4%


LANDFIRE Database - Bitter Creek / East Flaming Gorge Watershed
Bitter Creek Watershed
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140401050205
140401050502
140401050503
Big Flat Draw
Bitter Creek-Big Pond Station
Bitter Creek-Coon Draw
Bitter Creek-Hungry Hollow
Bitter Creek-Kanda
Bitter Creek-Rock Springs
Bitter Creek-Town of Bitter Creek
Bitter Creek-Town of Black Buttes
Bitter Creek-Town of Hallville
Cedar Canyon
Cedar Creek-Little Bitter Creek
Dans Creek
Gap Creek
Horsethief Canyon
Iron Pipe Draw
Killpecker Creek-140401050805
Killpecker Creek-Boars Tusk
Killpecker Creek-Fourteenmile Creek
Killpecker Creek-Pine Canyon
Killpecker Creek-Reliance
Laney Wash
Long Canyon
Lower Antelope Creek
Lower Black Butte Creek
Lower Deadman Wash
Lower Little Bitter Creek
Lower Patrick Draw
Lower Salt Wells Creek
Middle Black Butte Creek
Middle Deadman Wash
Middle Little Bitter Creek
Nitch Creek
Patrick Draw
Polly Draw
Pretty Water Creek
Red Wash
Salt Wells Creek-140401050704
Salt Wells Creek-Corral Creek
Salt Wells Creek-Dry Canyon
Salt Wells Creek-Joyce Creek
Salt Wells Creek-Spring Creek
Scheggs Draw
South Baxter Basin
Sweetwater Creek-Bitter Creek
Upper Antelope Creek
Upper Bitter Creek-Green River
Upper Black Butte Creek
Upper Deadman Wash
Upper Patrick Draw
Upper Salt Wells Creek
East Flaming Gorge Watershed
Clay Basin Creek
Currant Creek
Firehole Canyon
Flaming Gorge Reservoir-Buckboard Reservoir
Flaming Gorge Reservoir-Chokecherry Draw
Flaming Gorge Reservoir-Spring Creek
Flaming Gorge Reservoir-Squaw Hollow
Green River-Chicken Springs Draw
Green River-Middle Firehole Canyon
Henrys Fork-Cottonwood Creek
Lower Red Creek
Middle Marsh Creek
Middle Red Creek
Sage Creek-Greasewood Draw
Sage Creek-Trout Creek
Sugarloaf Marsh Creek
Upper Marsh Creek
Upper Red Creek
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Total HUC12 Area
Shrubland
Exotic Herbaceous
Grassland
Riparian
Sparsely Vegetated
Conifer
Developed/Roads
Barren
Quarries-Strip Mines-Gravel Pits
Hardwood
Agricultural

APPENDIX 4E

WYOMING NATURAL DIVERSITY DATABASE VEGETATION

Wyoming Natural Diversity Database: Wildlife Species of Concern in the Bitter Creek Watershed								
Common Name	**Scientific Name**	**USFWS Listing Status**	**WYBLM Sensitive Species**	**USFS Sensitive Species**	**WGFD Native Species Status**	**Global Heritage Rank**	**State Heritage Rank**	**WYNDD Status**
Plants								
Alkali Wildrye	Elymus simplex var. simplex					G3T2	S2	Species of Potential Concert (SOPC)
Cedar Rim thistle	Cirsium pulcherrimum var. aridum		Sensitive			G2QTNR	S2	Species of Concern (SOC)
Colorado bedstraw	Galium coloradoense					G4	S1	Species of Concern (SOC)
Comb-hair Whitlow-grass	Draba pectinipila					G1Q	S1	Species of Concern (SOC)
Compact Ipomopsis	Ipomopsis crebrifolia					G5	S3	Species of Potential Concert (SOPC)
Crandall's Rockcress	Boechera crandallii					G2	S1	Species of Concern (SOC)
crispleaf buckwheat	Eriogonum corymbosum var. corymbosum					G5T5	S1	Species of Concern (SOC)
Cutler's jointfir	Ephedra cutleri					G5	S1	Species of Concern (SOC)
dainty rockcress	Boechera gracilenta					G4?Q	S1	Species of Concern (SOC)
Dwarf Mountain Mahogany	Cercocarpus ledifolius var. intricatus					G5TNR	S1	Species of Concern (SOC)
dwarf ninebark	Physocarpus alternans					G4	S1	Species of Concern (SOC)
featherleaf cinquefoil	Potentilla multisecta					GNR	S1	Species of Concern (SOC)
fourpart phacelia	Phacelia tetramera					G4	S1	Species of Concern (SOC)
fullstem	Chamaechaenactis scaposa					G4	S2	Species of Concern (SOC)
Garrett's beardtongue	Penstemon scariosus var. garrettii					G4T3	S1	Species of Concern (SOC)
glandular phacelia	Phacelia glandulosa var. deserta					G4T2	S2	Species of Concern (SOC)
hoary phacelia	Phacelia incana					G3G4	S1	Species of Concern (SOC)
littleleaf mockorange	Philadelphus microphyllus var. microphyllus					G5?TNR	S1	Species of Concern (SOC)
Long-awned Alkali Wild-rye	Elymus simplex var. luxurians		Sensitive			G3TNR	S1S2	Species of Concern (SOC)
low greenthread	Thelesperma caespitosum	Not Warranted for Listing (NW)	Sensitive	USFS-R4		G2?	S1	Species of Concern (SOC)
manybranched ipomopsis	Ipomopsis polycladon					G4	S1	Species of Concern (SOC)
narrowstem cryptantha	Cryptantha gracilis					G5	S1	Species of Concern (SOC)
Nelson's milkvetch	Astragalus nelsonianus					G3	S3	Species of Potential Concert (SOPC)
Ownbey's thistle	Cirsium ownbeyi		Sensitive			G3	S2	Species of Concern (SOC)
Payson's beardtongue	Penstemon paysoniorum					G3	S3	Species of Potential Concert (SOPC)
Payson's tansymustard	Descurainia incisa var. paysonii					G5T3?	S2	Species of Concern (SOC)
persistent sepal yellowcress	Rorippa calycina		Sensitive			G3	S3	Species of Potential Concert (SOPC)
Rollins' cryptantha	Cryptantha rollinsii					G3	S1	Species of Concern (SOC)
spiny greasebush	Glossopetalon spinescens var. meionandrum					G5T3	S1	Species of Concern (SOC)
Wyoming Tansymustard	Descurainia torulosa	Not Warranted for Listing (NW)	Sensitive	USFS-R2, USFS-R4		G2	S2	Species of Concern (SOC)
Yampa River cryptantha	Cryptantha stricta					G3	S3	Species of Potential Concert (SOPC)

APPENDIX 4F

WYOMING NATURAL DIVERSITY DATABASE WILDLIFE

Wyoming Natural Diversity Database: Wildlife Species of Concern in the Bitter Creek Watershed								
Common Name	Scientific Name	USFWS Listing Status	WYBLM Sensitive Species	USFS Sensitive Species	WGFD Native Species Status	Global Heritage Rank	State Heritage Rank	WYNDD Status
Amphibian								
Great Basin Spadefoot	Spea intermontana		Sensitive		NSSU (U), Tier 1	G5	S3	Species of Concern (SOC)
Northern Leopard Frog	Lithobates pipiens	Not Warranted for Listing (NW)	Sensitive	USFS-R2	NSSU (U), Tier 3	G5	S3	Species of Concern (SOC)
Tiger Salamander	Ambystoma mavortium					G5	S4	Species of Potential Concern (SOPC)
Bird								
American Avocet	Recurvirostra americana					G5	S3B	Species of Potential Concern (SOPC)
American Bittern	Botaurus lentiginosus			USFS-R2	NSS3(Bb), Tier 2	G4	S3B	Species of Concern (SOC)
American Three-toed Woodpecker	Picoides dorsalis			USFS-R4	NSSU (U), Tier 2	G5	S3	Species of Concern (SOC)
American White Pelican	Pelecanus erythrorhynchos					G4	S1B	Species of Concern (SOC)
Ash-throated Flycatcher	Myiarchus cinerascens				NSS3(Bb), Tier 2	G5	S3B	Species of Potential Concern (SOPC)
Baird's Sparrow	Ammodramus bairdii	Not Warranted for Listing (NW)	Sensitive			G4	S1?B	Species of Concern (SOC)
Bald Eagle	Haliaeetus leucocephalus	Delisted, formally monitored (DM)	Sensitive	USFS-R2, USFS-R4	NSS2(Ba), Tier 1	G5	S3BS5N	Species of Concern (SOC)
Barrow's Goldeneye	Bucephala islandica				NSS3(Bb), Tier 2	G5	S4	
Black Tern	Chlidonias niger			USFS-R2	NSS3(Bb), Tier 2	G4	S1	Species of Concern (SOC)
Black-crowned Night-Heron	Nycticorax nycticorax				NSS3(Bb), Tier 2	G5	S3B	Species of Potential Concern (SOPC)
Black-necked Stilt	Himantopus mexicanus					G5	S3B	Species of Potential Concern (SOPC)
Black-throated Gray Warbler	Setophaga nigrescens					G5	S2	Species of Concern (SOC)
Blue Grosbeak	Passerina caerulea					G5	S3B	Species of Potential Concern (SOPC)
Bobolink	Dolichonyx oryzivorus				NSS4(Bc), Tier 2	G5	S2	Species of Concern (SOC)
Brewer's Sparrow	Spizella breweri		Sensitive	USFS-R2	NSS4(Bc), Tier 2	G5	S5	Species of Potential Concern (SOPC)
Bufflehead	Bucephala albeola					G5	S2B	Species of Potential Concern (SOPC)
Burrowing Owl	Athene cunicularia		Sensitive	USFS-R2	NSSU (U), Tier 1	G4	S4B	Species of Concern (SOC)
Bushtit	Psaltriparus minimus				NSS3(Bb), Tier 2	G5	S1	Species of Concern (SOC)
California Gull	Larus californicus					G5	S2B	Species of Potential Concern (SOPC)
Calliope Hummingbird	Selasphorus calliope					G5	S3	Species of Concern (SOC)
Canvasback	Aythya valisineria				NSS3(Bb), Tier 2	G5	S4B	
Canyon Wren	Catherpes mexicanus					G5	S2S3	Species of Potential Concern (SOPC)
Caspian Tern	Hydroprogne caspia				NSS3(Bb), Tier 2	G5	S1	Species of Concern (SOC)
Common Goldeneye	Bucephala clangula					G5	S3B	Species of Potential Concern (SOPC)
Common Loon	Gavia immer			USFS-R4	NSS1(Aa), Tier 1	G5	S1BS2N	Species of Concern (SOC)
Dark-eyed Junco	Junco hyemalis					G5	S5BS5N	Species of Concern (SOC)
Eastern Bluebird	Sialia sialis					G5	S2	Species of Potential Concern (SOPC)
Eastern Screech-Owl	Megascops asio					G5	S3	Species of Potential Concern (SOPC)
Ferruginous Hawk	Buteo regalis	Not Warranted for Listing (NW)	Sensitive	USFS-R2	NSSU (U), Tier 1	G4	S4BS5N	Species of Concern (SOC)
Forster's Tern	Sterna forsteri				NSS3(Bb), Tier 2	G5	S1	Species of Concern (SOC)
Franklin's Gull	Leucophaeus pipixcan				NSS3(Bb), Tier 2	G4G5	SHB	
Golden Eagle	Aquila chrysaetos					G5	S4BS4N	Species of Potential Concern (SOPC)
Golden-crowned Kinglet	Regulus satrapa					G5	S3BS4N	Species of Potential Concern (SOPC)
Grasshopper Sparrow	Ammodramus savannarum			USFS-R2	NSS4(Bc), Tier 2	G5	S4	Species of Potential Concern (SOPC)
Greater Sage-Grouse	Centrocercus urophasianus	Not Warranted for Listing (NW)	Sensitive	USFS-R2, USFS-R4	NSS2(Ba), Tier 1	G3G4	S3S4	Species of Concern (SOC)
Hammond's Flycatcher	Empidonax hammondii					G5	S4	Species of Potential Concern (SOPC)
Herring Gull	Larus argentatus					G5	SNA	Species of Potential Concern (SOPC)
Indigo Bunting	Passerina cyanea					G5	S3B	Species of Potential Concern (SOPC)

Wyoming Natural Diversity Database: Wildlife Species of Concern in the Bitter Creek Watershed								
Common Name	Scientific Name	USFWS Listing Status	WYBLM Sensitive Species	USFS Sensitive Species	WGFD Native Species Status	Global Heritage Rank	State Heritage Rank	WYNDD Status
Juniper Titmouse	Baeolophus ridgwayi				NSS3(Bb), Tier 2	G5	S1	Species of Concern (SOC)
Lark Bunting	Calamospiza melanocorys				NSS4(Bc), Tier 2	G5	S4B	
Lesser Scaup	Aythya affinis				NSS3(Bb), Tier 2	G5	S3BS4N	
Lewis's Woodpecker	Melanerpes lewis			USFS-R2	NSSU (U), Tier 2	G4	S2	Species of Concern (SOC)
Loggerhead Shrike	Lanius ludovicianus		Sensitive	USFS-R2		G4	S3	Species of Concern (SOC)
Long-billed Curlew	Numenius americanus		Sensitive	USFS-R2	NSS3(Bb), Tier 2	G5	S3B	Species of Concern (SOC)
McCown's Longspur	Rhynchophanes mccownii			USFS-R2	NSS4(Bc), Tier 2	G4	S2	Species of Concern (SOC)
Merlin	Falco columbarius				NSSU (U), Tier 3	G5	S3BS4N	Species of Potential Concern (SOPC)
Mountain Plover	Charadrius montanus	Not Warranted for Listing (NW)	Sensitive	USFS-R2	NSSU (U), Tier 1	G3	S2BS3N	Species of Concern (SOC)
Northern Goshawk	Accipiter gentilis	Not Warranted for Listing (NW)	Sensitive	USFS-R2, USFS-R4	NSSU (U), Tier 1	G5	S2BS3N	Species of Concern (SOC)
Northern Harrier	Circus hudsonius			USFS-R2		G5	S4BS5N	
Northern Pintail	Anas acuta				NSS3(Bb), Tier 2	G5	S5BS4N	
Olive-sided Flycatcher	Contopus cooperi			USFS-R2		G4	S4B	Species of Potential Concern (SOPC)
Osprey	Pandion haliaetus					G5	S3B	Species of Potential Concern (SOPC)
Peregrine Falcon	Falco peregrinus	Delisted, formally monitored (DM)	Sensitive	USFS-R2, USFS-R4	NSS3(Bb), Tier 2	G4	S2	Species of Concern (SOC)
Red-eyed Vireo	Vireo olivaceus					G5	S3B	Species of Potential Concern (SOPC)
Redhead	Aythya americana				NSS3(Bb), Tier 2	G5	S5BS4N	
Red-necked Phalarope	Phalaropus lobatus					G4G5	S3N	Species of Potential Concern (SOPC)
Ring-billed Gull	Larus delawarensis					G5	S2	Species of Potential Concern (SOPC)
Ring-necked Duck	Aythya collaris					G5	S4B	Species of Potential Concern (SOPC)
Sage Thrasher	Oreoscoptes montanus		Sensitive		NSS4(Bc), Tier 2	G5	S5	Species of Potential Concern (SOPC)
Sagebrush Sparrow	Artemisiospiza nevadensis		Sensitive	USFS-R2	NSS4(Bc), Tier 2	G5	S3	Species of Concern (SOC)
Sandhill Crane	Antigone canadensis				NSS4(Bc), Tier 3	G5	S3BS5N	Species of Potential Concern (SOPC)
Scott's Oriole	Icterus parisorum					G5	S1	Species of Concern (SOC)
Short-eared Owl	Asio flammeus				NSS4(Bc), Tier 2	G5	S2	Species of Concern (SOC)
Snowy Egret	Egretta thula				NSS3(Bb), Tier 2	G5	S3B	Species of Potential Concern (SOPC)
Swainson's Hawk	Buteo swainsoni				NSSU (U), Tier 2	G5	S4B	
Townsend's Warbler	Setophaga townsendi					G5	SNA	Species of Potential Concern (SOPC)
Trumpeter Swan	Cygnus buccinator	Not Warranted for Listing (NW)	Sensitive	USFS-R2, USFS-R4	NSS2(Ba), Tier 2	G4	S3BS3N	Species of Concern (SOC)
Tundra Swan	Cygnus columbianus					G5	S2N	Species of Potential Concern (SOPC)
Virginia's Warbler	Oreothlypis virginiae					G5	S1	Species of Concern (SOC)
Western Screech-Owl	Megascops kennicottii					G5	S2	Species of Potential Concern (SOPC)
White-faced Ibis	Plegadis chihi		Sensitive		NSS3(Bb), Tier 2	G5	S1B	Species of Concern (SOC)
White-winged Crossbill	Loxia leucoptera					G5	S2	Species of Potential Concern (SOPC)
Willow Flycatcher	Empidonax traillii				NSS4(Cb), Tier 3	G5	S4B	
Woodhouse's Scrub-Jay	Aphelocoma woodhouseii				NSS3(Bb), Tier 2	G5	S1	Species of Concern (SOC)
Crustacean								
Versatile Fairy Shrimp	Branchinecta lindahli				NSSU (U), Tier 3	G5	S4	Species of Concern (SOC)
Fish								
Bluehead Sucker	Catostomus discobolus		Sensitive	USFS-R2	NSS1(Aa), Tier 1	G4	S3	Species of Concern (SOC)
Bonytail	Gila elegans	Listed Endangered (LE)				G1	SX	Species of Concern (SOC)
Colorado Pikeminnow	Ptychocheilus lucius	Listed Endangered (LE)				G1	SX	Species of Concern (SOC)
Colorado River Cutthroat Trout	Oncorhynchus clarkii pleuriticus	Not Warranted for Listing (NW)	Sensitive	USFS-R2, USFS-R4	NSS2(Ba), Tier 1	G4T3	S1	Species of Concern (SOC)

Wyoming Natural Diversity Database: Wildlife Species of Concern in the Bitter Creek Watershed								
Common Name	**Scientific Name**	**USFWS Listing Status**	**WYBLM Sensitive Species**	**USFS Sensitive Species**	**WGFD Native Species Status**	**Global Heritage Rank**	**State Heritage Rank**	**WYNDD Status**
Flannelmouth Sucker	Catostomus latipinnis		Sensitive	USFS-R2	NSS1(Aa), Tier 1	G3G4	S3	Species of Concern (SOC)
Humpback Chub	Gila cypha	Listed Endangered (LE)				G1	SX	Species of Concern (SOC)
Mountain Sucker	Catostomus platyrhynchus			USFS-R2		G5	S5	Species of Potential Concern (SOPC)
Mountain Whitefish	Prosopium williamsoni				NSS4(Bc), Tier 2	G5	S5	Species of Potential Concern (SOPC)
Razorback Sucker	Xyrauchen texanus	Listed Endangered (LE)				G1	SX	Species of Concern (SOC)
Roundtail Chub	Gila robusta		Sensitive	USFS-R2	NSS1(Aa), Tier 1	G3	S3	Species of Concern (SOC)
Speckled Dace	Rhinichthys osculus					G5	S4	Species of Concern (SOC)
Insect								
A Bee	Perdita aff. knowltoni n. sp.					GNR	S3	Species of Concern (SOC)
A Mason Bee	Anthidium rodecki					GNR	S3	Species of Concern (SOC)
Mammal								
American Bison	Bos bison					G4	S1	Species of Concern (SOC)
Big Brown Bat	Eptesicus fuscus				NSS4(Cb), Tier 2	G5	S5	
Bighorn Sheep	Ovis canadensis			USFS-R2, USFS-R4	NSS4(Bc), Tier 2	G4	S3S4	Species of Potential Concern (SOPC)
Black-footed Ferret	Mustela nigripes	Endangered - Nonessential Experimental Population (LEXN)			NSS1(Aa), Tier 1	G1	S1	Species of Concern (SOC)
Bobcat	Lynx rufus	Not Warranted for Listing (NW)				G5	S5	
Canyon Deermouse	Peromyscus crinitus				NSS3(Bb), Tier 2	G5	S1	Species of Concern (SOC)
Cliff Chipmunk	Tamias dorsalis				NSS3(Bb), Tier 2	G5	S1	Species of Concern (SOC)
Eastern Cottontail	Sylvilagus floridanus					G5	S3	Species of Potential Concern (SOPC)
Feral Horse	Equus caballus - Feral	Not Warranted for Listing (NW)				GNATNR	SNA	
Fringed Myotis	Myotis thysanodes		Sensitive	USFS-R2	NSS3(Bb), Tier 2	G4	S2	Species of Concern (SOC)
Gray Wolf	Canis lupus	Delisted, formally monitored (DM)		USFS-R4		G4G5	S1	Species of Concern (SOC)
Great Basin Pocket Mouse	Perognathus mollipilosus				NSS3(Bb), Tier 2	G5	S2	
Hoary Bat	Lasiurus cinereus			USFS-R2		G5	S4	Species of Potential Concern (SOPC)
Little Brown Myotis	Myotis lucifugus	Petition Under Review (UR)			NSS4(Cb), Tier 2	G3	S3	Species of Potential Concern (SOPC)
Long-eared Myotis	Myotis evotis		Sensitive		NSS3(Bb), Tier 2	G5	S4	Species of Potential Concern (SOPC)
Long-legged Myotis	Myotis volans				NSS3(Bb), Tier 2	G5	S3B	Species of Potential Concern (SOPC)
Meadow Jumping Mouse	Zapus hudsonius					G5	S3	Species of Concern (SOC)
Northern River Otter	Lontra canadensis	Not Warranted for Listing (NW)		USFS-R2	NSSU (U), Tier 2	G5	S3	Species of Concern (SOC)
Pallid Bat	Antrozous pallidus				NSS3(Bb), Tier 3	G5	S1	Species of Concern (SOC)
Pygmy Rabbit	Brachylagus idahoensis	Not Warranted for Listing (NW)	Sensitive	USFS-R4	NSS3(Bb), Tier 2	G4	S1	Species of Concern (SOC)
Ringtail	Bassariscus astutus					G5	S1	Species of Potential Concern (SOPC)
Silver-haired Bat	Lasionycteris noctivagans					G5	S3B	Species of Potential Concern (SOPC)
Spotted Bat	Euderma maculatum		Sensitive	USFS-R2, USFS-R4	NSS3(Bb), Tier 2	G4	S3	Species of Concern (SOC)
Thirteen-lined Ground Squirrel	Ictidomys tridecemlineatus					G5	S5	Species of Concern (SOC)
Townsend's Big-eared Bat	Corynorhinus townsendii		Sensitive	USFS-R2, USFS-R4	NSS2(Ba), Tier 1	G3G4	S2	Species of Concern (SOC)
Uinta Chipmunk	Tamias umbrinus				NSS4(Bc), Tier 3	G5	S4S5	Species of Potential Concern (SOPC)
Uinta Ground Squirrel	Urocitellus armatus					G5	S3S4	Species of Potential Concern (SOPC)
Western Small-footed Myotis	Myotis ciliolabrum				NSS4(Cb), Tier 2	G5	S3B	Species of Potential Concern (SOPC)
White-tailed Prairie Dog	Cynomys leucurus	Not Warranted for Listing (NW)	Sensitive	USFS-R2		G4	S3	Species of Concern (SOC)
Wyoming Ground Squirrel	Urocitellus elegans					G5	S3S4	Species of Potential Concern (SOPC)
Wyoming Pocket Gopher	Thomomys clusius	Not Warranted for Listing (NW)	Sensitive	USFS-R2	NSS3(Bb), Tier 1	G2	S2	Species of Concern (SOC)

Wyoming Natural Diversity Database: Wildlife Species of Concern in the Bitter Creek Watershed								
Common Name	**Scientific Name**	**USFWS Listing Status**	**WYBLM Sensitive Species**	**USFS Sensitive Species**	**WGFD Native Species Status**	**Global Heritage Rank**	**State Heritage Rank**	**WYNDD Status**
Yuma Myotis	Myotis yumanensis					G5	S1	Species of Concern (SOC)
Reptile								
Great Basin Gophersnake	Pituophis catenifer deserticola				NSS2(Ba), Tier 2	G5T5	S3	Species of Potential Concern (SOPC)
Midget Faded Rattlesnake	Crotalus oreganus concolor		Sensitive		NSS1(Aa), Tier 1	G5T4	S1	Species of Concern (SOC)
Northern Tree Lizard	Urosaurus ornatus wrighti				NSS1(Aa), Tier 2	G5TNR	S2	Species of Concern (SOC)
Plains Short-horned Lizard	Phrynosoma hernandesi brevirostris				NSS4(Bc), Tier 3	G5TNR	SNR	
Plateau Fence Lizard	Sceloporus tristichus					G5	S1	Species of Concern (SOC)
Valley Gartersnake	Thamnophis sirtalis fitchi				NSSU (U), Tier 2	G5TNR	S2	Species of Potential Concern (SOPC)

APPENDIX 4G

WYOMING STATE ENGINEER
SURFACE WATER RIGHTS

WR Number	PriorityDate	Company	FirstName	LastName	FacilityName	Uses	Twn	Rng	Sec	Qtr-Qtr	Total Flow(CFS)/ Appropriation(GPM)	Stream Source	Longitude	Latitude
Bitter Creek														
P8165.0D	01/08/1908		ARCHIBALD	BLAIR	BLAIR WATER DITCH NO 1		016N	104W	16	NE1/4NE1/4	2	Circle Creek	-109.121719	41.371689
P8167.0D	01/08/1908		ARCHIBALD	BLAIR	BLAIR WATER DITCH NO 3		016N	104W	10	NE1/4SE1/4	0.14	Gulch	-109.105031	41.379931
CR CA03/161	12/31/1874		WILLIAM	KENT	KENT NO. 1 DITCH	IRR_SW	017N	104W	09	SE1/4NW1/4	0.43	Sweetwater Creek	-109.147231	41.466047
CR CA03/162	12/31/1883		BARNEY	SWEENEY	SWEENY DITCH	IRR_SW	017N	103W	19	NE1/4SW1/4	0.25	No Name Creek	-109.070567	41.436892
CR CA03/163	12/31/1886		ROBERT	ANDERSON	ANDERSON NO. 1 DITCH	IRR_SW	017N	103W	17	NW1/4NE1/4	0.15	No Name Creek	-109.050519	41.458450
CR CB03/151	05/31/1886		WILLIAM	MELLOR	MELLOR DITCH	IRR_SW	017N	105W	24	NE1/4SW1/4	0.72	Cedar Creek	-109.204717	41.437358
CR CB03/161	12/31/1885		WILLIAM	KENT	KENT NO. 3 DITCH	IRR_SW	017N	104W	16	SW1/4NE1/4	0.09	Sweetwater Creek	-109.147122	41.454767
CR CB03/162	12/31/1883		BARNEY	SWEENEY	SWEENY NO. 2 DITCH	IRR_SW	017N	103W	18	SE1/4NW1/4	1.06	No Name Creek	-109.070550	41.451392
CR CB03/163	12/31/1886		ROBERT	ANDERSON	ANDERSON NO. 2 DITCH	IRR_SW	017N	103W	17	NW1/4NE1/4	0.28	No Name Creek	-109.050928	41.458331
CR CC07/034	03/13/1902		JOHN	MAWLSON	MAWLSON DITCH	IRR_SW	016N	104W	01	SW1/4SE1/4	1.53	Burnt Canyon Creek	-109.069003	41.391597
CR CC17/031	03/21/1900		DAVID	MENGHINI	MENGHINI NO. 1 DITCH	IRR_SW	015N	104W	04	NE1/4NW1/4	0.92	Little Bitter Creek	-109.132819	41.314672
CR CC17/032	12/07/1903		DAVID	MENGHINI	MENGHINI NO. 2 DITCH	IRR_SW	015N	105W	13	SW1/4SW1/4	0.28	Little Bitter Creek	-109.194264	41.273864
CR CC25/112	11/07/1905		ROBERT	TAYLOR	TAYLOR DITCH	IRR_SW	017N	098W	06	SW1/4NE1/4	0.92	Bitter Creek	-108.494214	41.479125
CR CC26/447	08/24/1905		FRED	JACOB	NORTH LOEFF AND JACOB DITCH	IRR_SW	016N	104W	09	SE1/4NE1/4	0.62	Willow Creek	-109.122147	41.384397
CR CC26/448	10/17/1905		FRED	JACOB	SOUTH LOEFF AND JACOB DITCH	IRR_SW	016N	104W	09	SE1/4NE1/4	0.47	Willow Creek	-109.122242	41.384461
CR CC26/449	07/24/1906		JOSEPH	BROOKS	J. H. BROOKS DITCH	IRR_SW	018N	101W	18	NW1/4SE1/4	0.74	Black Butte Creek	-108.840008	41.537119
CR CC27/328	11/09/1904		ADAM	COOPER	COOPER DITCH	IRR_SW	016N	104W	25	SE1/4NE1/4	0.97	Pretty Water Creek	-109.065597	41.341472
CR CC27/329	09/12/1906		ADAM	COOPER	ADAM COOPER DITCH NO. 2		015N	104W	32	SW1/4SE1/4		Mellor Creek	-109.146807	41.231420
CR CC29/013	01/04/1908		ARCHIBALD	BLAIR	BLAIRS SOUTH SUPPLY DITCH	IRR_SW	016N	103W	04	NW1/4SW1/4		Gulch	-109.022994	41.392736
CR CC29/015	01/04/1908		ARCHIBALD	BLAIR	BLAIRS NORTH SUPPLY DITCH	IRR_SW	017N	103W	34	SW1/4NW1/4	0	Snow Spring	-109.019989	41.410731
CR CC29/017	01/07/1908		ARCHIBALD	BLAIR	BLAIRS OUTLET DITCH	IRR_SW	017N	103W	33	SE1/4SW1/4	1.67	Blair Creek	-109.032661	41.400808
CR CC29/018	01/07/1908		ARCHIBALD	BLAIR	BLAIRS MEADOW DITCH	IRR_SW	016N	103W	04	SW1/4NW1/4	0	Blair Creek	-109.021117	41.397728
CR CC29/022	09/12/1906		ADAM	COOPER	ADAM COOPER NO. 2 DITCH	IRR_SW	015N	104W	32	SW1/4SE1/4	0.38	Mellor Creek	-109.146700	41.231390
CR CC33/482	02/27/1908		DAVID	MENGHINEY	MENKINEY DITCH	IRR_SW	016N	105W	28	SW1/4SW1/4	0.67	Bacon Creek	-109.253011	41.332900
CR CC34/376	01/08/1908		ARCHIBALD	BLAIR	BLAIR WATER NO. 1 DITCH	IRR_SW	016N	104W	16	NE1/4NE1/4	2	Circle Creek	-109.122211	41.374017
CR CC34/378	01/08/1908		ARCHIBALD	BLAIR	BLAIR WATER NO. 3 DITCH	IRR_SW	016N	104W	10	NE1/4SE1/4	0.14	Gulch	-109.104194	41.379836
CR CC34/379	09/09/1903		W.	GOTTSCHE	GOTTSCHE DITCH	IRR_SW	015N	104W	24	SW1/4NE1/4	1.29	Dan's Creek	-109.067950	41.268839
CR CC37/673	10/18/1913		THOMAS	MCNANEY	MCNANEY NO. 2 DITCH	DOM_SW; IRR_SW	016N	082W	02	NE1/4NE1/4	0.21	South Fork Cedar Creek	-106.570450	41.393360
CR CC37/674	10/18/1913		THOMAS	MCNANEY	MCNANEY NO. 1 DITCH	DOM_SW; IRR_SW	016N	082W	01	NE1/4NW1/4	0.57	South Fork Cedar Creek	-106.564060	41.395090
CR CC40/668	05/13/1913		W.	GOTTSCHE	WASHUM NO. 1 DITCH	IRR_SW	014N	103W	10	NW1/4SE1/4	0.45	East Salt Wells Creek	-108.995683	41.204681
CR CC40/669	05/13/1913		W.	GOTTSCHE	WASHUM NO. 2 DITCH	IRR_SW	014N	103W	10	NW1/4SE1/4	1.04	East Salt Wells Creek	-108.995683	41.204681
CR CC41/085	09/24/1915		ANNIE	SWEENEY	SWEENEY NO. 1 DITCH	IRR_SW	017N	103W	06	NE1/4SE1/4	0.07	A Spring	-109.065236	41.479611
CR CC41/388	08/30/1915		JOHN	HAY	DRY LAKE DITCH	RES	018N	104W	24	SE1/4SE1/4	0	Wash	-109.082360	41.518280
CR CC41/389	12/22/1915		JOHN	HAY	DRY LAKE NO. 1 DITCH	RES	018N	103W	20	SW1/4SW1/4	0	Wash	-109.056610	41.517790
CR CC41/391	05/31/1916		W.	GOTTSCHE	LONGLAND DITCH	IRR_SW	017N	104W	24	NW1/4SE1/4	0.19	No Name Creek	-109.087097	41.435189
CR CC45/197	07/19/1924	PRODUCERS AND REFINERS CORPORATION			PRODUCERS AND REFINERS PIPELINE	DOM_SW; IND_SW; STO	017N	104W	36	SE1/4SW1/4	0.048	Burnt Canyon Creek	-109.092108	41.402267
CR CC46/446	10/30/1922	OHIO OIL CO.			BAXTER PIPE LINE	IND_SW	016N	104W	15	SW1/4NW1/4	0.3	Circle Creek	-109.120439	41.367494
CR CC52/500	07/20/1936	MOUNTAIN FUEL SUPPLY COMPANY			WORM CREEK WATER LINE PIPELINE	OIL	016N	104W	31	NW1/4SE1/4	0.2	Worm Creek	-109.167092	41.322536
CR CC52/502	11/12/1936		CHARLES	KAPPES	KAPPES NO. 3 DITCH	IRR_SW	016N	104W	07	NW1/4NE1/4	0.13	South Fork Cedar Creek	-109.167392	41.387233
CR CC52/503	11/12/1936	COOPER & BROOKS			COOPER AND BROOKS NO. 2 DITCH	IRR_SW; STO	016N	104W	01	NE1/4SE1/4	0.3	Burnt Canyon Creek	-109.064280	41.394370
CR CC52/504	11/12/1936	COOPER & BROOKS			COOPER AND BROOKS NO. 3 DITCH	IRR_SW; STO	016N	103W	06	SW1/4SW1/4	0.15	Burnt Canyon Creek	-109.060410	41.390430
CR CC52/505	11/12/1936		ADAM	COOPER	COOPER AND BROOKS NO. 4 DITCH	IRR_SW; STO	016N	103W	06	NW1/4SW1/4	0.05	Burnt Canyon Creek	-109.063130	41.394050
CR CC52/506	11/12/1936		ADAM	COOPER	MAWLSON NO. 2 DITCH	IRR_SW	016N	104W	12	NE1/4NE1/4	0.13	Burnt Canyon Creek	-109.065528	41.386875
CR CC52/507	11/12/1936		ADAM	COOPER	COOPER AND BROOKS NO. 2 DITCH	IRR_SW; STO	016N	103W	06	NW1/4SW1/4		South Spring Creek	-109.061410	41.394330
CR CC52/508	11/12/1936	COOPER & BROOKS			COOPER AND BROOKS NO. 1 DITCH	IRR_SW; STO	016N	104W	01	SW1/4NE1/4	0.19	North Spring Creek	-109.069400	41.398020
CR CC56/348	01/06/1908		W.	GOTTSCHE	DANS CREEK POOLS DITCH	STO	015N	103W	16	SW1/4SE1/4	0.1	Dan's Creek Pools	-109.015522	41.275311
CR CC59/366	11/19/1932		FRANZO	LEONARDI	RONER NO. ONE DITCH	IRR_SW	020N	105W	20	SW1/4SW1/4	0	Roner Draw	-109.289692	41.692642
CR CC59/367	11/19/1932		FRANZO	LEONARDI	RONER NO. TWO DITCH	IRR_SW	020N	105W	20	SW1/4SW1/4	0	Roner Draw	-109.289758	41.692725
CR CC62/427	06/01/1950	PIEROTTO BROTHERS			PIEROTTO DITCH	IRR_SW; STO	020N	102W	31	NW1/4SE1/4	0.57	Bitter Creek	-108.951992	41.664864
CR CC62/428	06/01/1950	PIEROTTO BROTHERS			BLACK BUTTE DITCH	IRR_SW	019N	103W	12	NE1/4NE1/4	0.64	Black Butte Wash	-108.966336	41.643822
CR CC67/112	11/16/1964	STATE BOARD OF LAND COMMISSIONERS			NORTH FORK DITCH	IRR_SW	014N	104W	23		0	North Fork Little Basin Creek	-109.101450	41.181730
CR CC67/114	11/16/1964	STATE BOARD OF LAND COMMISSIONERS			LITTLE BASIN DITCH NO. FOUR	IRR_SW	014N	104W	22		0	Middle Fork Little Basin Creek	-109.112890	41.179030
CR CC67/115	11/16/1964	STATE BOARD OF LAND COMMISSIONERS			LITTLE BASIN DITCH NO. THREE	IRR_SW	014N	104W	22	SE1/4NW1/4	0.11	McCabe Draw No. Seven	-109.113242	41.179264
CR CC67/117	11/16/1964	STATE BOARD OF LAND COMMISSIONERS			LITTLE BASIN DITCH NO. FIVE	IRR_SW	014N	104W	22		0	South Fork Little Basin Creek	-109.112910	41.179040
CR CC69/289	06/09/1964		ELZA	EVERSOLE	EVERSOLE DITCH	IRR_SW	017N	099W	35	SE1/4SE1/4	1.07	Antelope Creek	-108.526433	41.401347
CR CC69/550	09/11/1907	STATE BOARD OF LAND COMMISSIONERS			KAPPES NO. 1 DITCH	IRR_SW	016N	104W	05	SE1/4NW1/4	0.7	Cedar Creek	-109.154422	41.397592
CR CC69/551	09/11/1907	STATE BOARD OF LAND COMMISSIONERS			KAPPES NO. 2 DITCH	IRR_SW	016N	104W	06	SW1/4NE1/4	0.2	Springs Nos. 1 and 2	-109.168353	41.398386
CR CC71/493	11/15/1971	STATE BOARD OF LAND COMMISSIONERS			KAPPES SPRINKLER SYSTEM	IRR_SW	017N	104W	32	SW1/4SW1/4	0	Cedar Creek	-109.174036	41.401553
CR CC77/337	12/15/1989	LAZY VD LAND AND LIVESTOCK COMPANY			ENLARGED POTTER NO. 2 DITCH	IRR_SW; STO	013N	103W	13	SW1/4NE1/4	0.296	East Salt Wells Creek	-108.957969	41.110075
CR CC77/338	07/29/1913	LAZY VD LAND AND LIVESTOCK COMPANY			POTTER NO. 1 DITCH	IRR_SW	013N	103W	13	NE1/4NE1/4	0.67	East Salt Wells Creek	-108.953497	41.112481
CR CC77/339	07/29/1913	LAZY VD LAND AND LIVESTOCK COMPANY			POTTER NO. 2 DITCH	IRR_SW	013N	103W	13	SW1/4NE1/4	0.9	East Salt Wells Creek	-108.957969	41.110075
CR CC80/216	04/05/1985		ALBERT	KOLMAN	KOLMAN NO. 1 TANK AND PIPELINE SYSTEM	IRR_SW	018N	104W	28	SE1/4SW1/4	0.18	Sweetwater Creek	-109.150892	41.504258

WR Number	PriorityDate	Company	FirstName	LastName	FacilityName	Uses	Twn	Rng	Sec	Qtr-Qtr	Total Flow(CFS)/ Appropriation(GPM)	Stream Source	Longitude	Latitude
Sage Creek														
OR 07/495	12/31/1877		W	JOHNSON	JOHNSON NO. 1 DITCH	IRR_SW	015N	105W	30	SW1/4NW1/4	1.71	Sage Creek	-109.28953	41.25443
CR CA03/130	05/31/1884		JOHN	PAREA	PAREA DITCH	IRR_SW	014N	105W	4	SE1/4NW1/4	0.71	Trout Creek	-109.245675	41.222517
CR CA03/131	09/30/1885		ISABELLA	EDWARDS	CASSIDY DITCH	IRR_SW	014N	105W	4	NE1/4NE1/4	0.38	Trout Creek	-109.237417	41.227953
CR CA03/133	04/30/1889		ROBERT	RAMSEY	SPICER DITCH	IRR_SW	014N	105W	17	SW1/4SE1/4	0.07	Trout Creek	-109.263853	41.186689
CR CA03/175	06/03/1887		W A	JOHNSON	JOHNSON DITCH	IRR_SW	015N	106W	15	SE1/4NW1/4	0.11	Sage Creek	-109.341242	41.280506
CR CB03/129	05/31/1885		HENRY	BISSEL	BISSELL DITCH	IRR_SW	015N	106W	27	SE1/4NW1/4	1.14	Sage Creek	-109.341217	41.251536
CR CB03/130	05/31/1885		JOHN	PAREA	CASSIDY DITCH	IRR_SW	014N	105W	4	NE1/4NE1/4	0.19	Trout Creek	-109.237417	41.227953
CR CB03/132	03/10/1889		ROBERT	RAMSEY	HARRISON DITCH	IRR_SW	014N	105W	16	NW1/4NW1/4	0.21	Trout Creek	-109.253361	41.197792
CR CB03/133	07/31/1885		FRANK	BROWN	J G EDWARDS DITCH	IRR_SW	014N	105W	35	NE1/4SE1/4	0.71	Camp Creek	-109.198147	41.148567
CR CB03/174	12/31/1882		W A	JOHNSON	FAULKNER DITCH	IRR_SW	015N	106W	15	SW1/4NE1/4	1	Spring Creek	-109.3384	41.281844
CR CC00/073	12/31/1877		W	JOHNSON	JOHNSON NO. 1 DITCH	IRR_SW	015N	105W	30	SW1/4NW1/4	17.71	Sage Creek	-109.28953	41.25443
CR CC47/263	06/30/1887		ROBERT	RAMSEY	EDWARDS DITCH	IRR_SW	014N	105W	16	NW1/4NE1/4	0.25	Trout Creek	-109.24934	41.20061
CR CC47/264	06/30/1887		ROBERT	RAMSEY	EDWARDS DITCH	IRR_SW	014N	105W	16	NW1/4NE1/4	0.36	Trout Creek	-109.24935	41.20061
CR CC58/329	4/6/1931		BARBARA	RAMSAY	RAMSAY NO. ONE DITCH	IRR_SW	014N	105W	20	NW1/4NE1/4	1.72	Trout Creek	-109.263736	41.185478
CR CC65/486	4/28/1931	SALT WELLS LIVESTOCK COMPANY			MAXON NO. ONE DITCH	IRR_SW	013N	105W	3	NE1/4NE1/4	0.54	Camp Creek	-109.218125	41.142567
CR CC65/487	4/28/1931	SALT WELLS LIVESTOCK COMPANY			MAXON NO. TWO DITCH	IRR_SW	014N	105W	35	SW1/4SE1/4	0.23	Camp Creek	-109.205444	41.145083
CR CC73/141	12/3/1974	USDI, BUREAU OF LAND MANAGEMENT			BIG PASTURE SPRING PIPELINE	STO	015N	106W	28	SW1/4SE1/4	0.056	Big Pasture Spring	-109.358561	41.246258
CR CC73/142	12/3/1974	USDI, BUREAU OF LAND MANAGEMENT			GREASEWOOD SPRING PIPELINE	STO	015N	106W	30	NW1/4NW1/4	0.056	Greasewood Spring	-109.406122	41.2556

WR Number	PriorityDate	Company	FirstName	LastName	FacilityName	Uses	Twn	Rng	Sec	Qtr-Qtr	Total Flow(CFS)/ Appropriation(GPM)	Stream Source	Longitude	Latitude
Red Creek														
P770.0E	1/18/1902		Abiathar	Jones	Red Creek Ditch,, Jones Enlargement	IRR_SW	013N	103W	24	SE1/4SE1/4		Red Creek	-108.951525	41.085609
CR CC29/010	11/28/1905		WALTER	HANKS	THOMAS HANKS DITCH	IRR_SW	013N	105W	31	SE1/4SW1/4	0.97	Daniels Creek	-109.287128	41.059833
CR CC29/011	11/20/1905		WALTER	HANKS	HANKS SPRING DITCH	IRR_SW	012N	105W	4	SE1/4NW1/4	0.17	Spring Draw	-109.249556	41.052525
CR CC32/361	1/18/1902		W H	GOTTSCHE	ENLARGED RED CREEK DITCH	IRR_SW; STO	013N	103W	29	NW1/4NW1/4	2.41	Red Creek	-109.04491	41.08212
CR CC32/362	3/29/1909		JAMES	GREENHOW	GREENHOW DITCH	IRR_SW	013N	105W	33	SE1/4NE1/4	0.32	John Parea Creek	-109.238106	41.066433
CR CC32/363	3/29/1909		JAMES	GRAHAM	GRAHAM DITCH	IRR_SW	013N	105W	28	SW1/4SW1/4	0.17	John Parea Creek	-109.250525	41.074103
CR CC37/445	1/18/1902		W.	GOTTSCHE	JONES DITCH	IRR_SW	013N	103W	31	SE1/4NE1/4	2.14	South Fork Red Creek	-109.047369	41.064803
CR CC38/192	7/8/1908		LIZZIE	ERICKSON	JOHN ERICKSON DITCH	IRR_SW	013N	103W	32	SE1/4NE1/4	1.14	Springs	-109.028239	41.064794
CR CC40/667	8/5/1912		W.	GOTTSCHE	LITTLE RED CREEK DITCH	IRR_SW	012N	104W	1	NW1/4NW1/4	0.71	South Fork Red Creek	-109.081742	41.055325
CR CC47/524	8/25/1930		LIZZIE	KENT	KENT DITCH	IRR_SW	012N	103W	7		0.63	Lizzie Spring Creek	-109.048981	41.033767
CR CC49/321	10/5/1932		JOHN	ERICKSON	VIVIENE PIPE LINE	STKNDMS	012N	104W	15	NW1/4SW1/4	0.04	Vivienne Spring	-109.118981	41.0183
CR CC56/350	1/6/1908		W.	GOTTSCHE	CHARLIE SPRING DITCH	STO	013N	105W	20	SE1/4NE1/4	0.1	Charlie Spring	-109.258711	41.094772
CR CC56/351	1/28/1908		W.	GOTTSCHE	ELY SPRING DITCH	STO	013N	105W	25	NW1/4NW1/4	0.1	Ely Creek	-109.197403	41.085106
CR CR38/193	7/8/1908		LIZZIE	ERICKSON	JOHN ERICKSON RESERVOIR	IRR_SW; STO	013N	103W	32	SE1/4NE1/4		Springs	-109.028247	41.064792

WR Number	PriorityDate	Company	FirstName	LastName	FacilityName	Uses	Twn	Rng	Sec	Qtr-Qtr	Total Flow(CFS)/ Appropriation(GPM)	Stream Source	Longitude	Latitude
Currant Creek														
P10239.0D	9/19/1910		FRANK	TOW	FRANK TOW AND HOLMES DITCH		015N	108W	25	SW1/4NE1/4	0	Currant Creek	-109.529575	41.25533
OR 03/099	12/31/1884		L.	CHAMBERLIN	CHAMBERLIN NO. 1 DITCH						1.87	Currant Creek	-109.393431	41.233425
OR 03/099	12/31/1886		L.	CHAMBERLIN	CHAMBERLIN NO. 2 DITCH						0.43	Currant Creek		
OR 03/099	12/31/1887		L.	CHAMBERLIN	CHAMBERLIN NO. 8 DITCH						0.67	Currant Creek	-109.393431	41.233425
OR 09/046	12/31/1886		L.	CHAMBERLIN	CHAMBERLIN NO. 3 DITCH						0.4	Currant Creek		
CR CA03/156	12/31/1884		L M	CHAMBERLIN	CHAMBERLIN NO. 1 DITCH	IRR_SW	015N	107W	36	NE1/4SW1/4	1.87	Currant Creek	-109.417739	41.237111
CR CA03/157	12/31/1886		L.	CHAMBERLIN	CHAMBERLIN NO. 3 DITCH	IRR_SW	015N	107W	26	SE1/4NW1/4	0.4	Currant Creek	-109.43765	41.252381
CR CB03/156	12/31/1886		L.	CHAMBERLIN	CHAMBERLIN NO. 2 DITCH	IRR_SW	015N	107W	26	SE1/4NW1/4	0.43	Currant Creek	-109.436669	41.25215
CR CB03/157	12/31/1887		L.	CHAMBERLIN	CHAMBERLIN NO. 8 DITCH	IRR_SW	015N	106W	31	SE1/4NW1/4	0.67	Currant Creek	-109.398561	41.237369
CR CC38/163	10/5/1911		WALTER	HOLMES	RESCUE DITCH	IRR_SW	015N	108W	23	SW1/4SE1/4	0.17	Currant Creek	-109.5512	41.260625
CR CC38/164	9/19/1910		WALTER	HOLMES	FRANK TOW AND HOLMES DITCH	IRR_SW	015N	108W	25	SW1/4NE1/4	1.89	Currant Creek	-109.531822	41.255897
CR CC56/352	4/7/1937		W.	GOTTSCHE	RYE GRASS DITCH	IRR_SW	015N	107W	33	NE1/4NW1/4	0.26	Currant Creek	-109.47655	41.244308
CR CC56/353	4/7/1937		W.	GOTTSCHE	BATES NO. 1 DITCH	IRR_SW	015N	108W	26	NE1/4NE1/4	0.18	Currant Creek	-109.542353	41.257878
CR CC56/354	4/7/1937		W.	GOTTSCHE	BATES NO. 2 DITCH	IRR_SW	015N	108W	26	NW1/4NE1/4	0.23	Currant Creek	-109.547542	41.258492
CR CR38/165	9/19/1910		WALTER	HOLMES	FRANK TOW AND HOLMES RESERVOIR	IRR_SW	015N	108W	25	SW1/4NE1/4		Currant Creek	-109.528597	41.255217
Marsh Creek														
CR CC35/367	3/15/1911		W T	BRINEGAR	W T BRINEGAR DITCH	IRR_SW	014N	108W	36	NW1/4SE1/4	1.4	Springs	-109.52779	41.15024
CR CC56/346	1/6/1908		W H	GOTTSCHE	DEER SPRING DITCH	STO	014N	106W	33	NW1/4SE1/4	0.1	Deer Spring	-109.357781	41.147272
CR CC71/328	2/17/1969		PAUL J AND ELEEN	WILLIAMS	WILLIAMS PIPELINE	DOM_SW	013N	106W	26	NE1/4NE1/4	0.027	Paul Williams Spring	-109.314997	41.082328

APPENDIX 4H

STOCK RESERVOIR EVALUATION

ACE ID	Improvement Type	Source	Name	ACE_Notes	Water Source	Condition	Land_Owner	Lat	Long	HUC 12 Name	Allotment	T	R	S
1	Reservoir	ACE	Unknown	May be wet in 2012, berm on northeast	Potential	Not Working	Bureau of Land Management	41.001	-109.379	Flaming Gorge Reservoir-Spring Creek	Spring Creek	12N	106W	20
2	Reservoir	ACE	Unknown	Wet in 2012 and 2017	Yes	Working	Bureau of Land Management	41.008	-109.409	Flaming Gorge Reservoir-Spring Creek	Spring Creek	12N	107W	24
3	Reservoir	ACE	Unknown	Wet in 2012 and 2017	Yes	Working	Bureau of Land Management	41.013	-109.400	Flaming Gorge Reservoir-Spring Creek	Spring Creek	12N	106W	19
4	Reservoir	ACE	Unknown	Wet in 2012 and 2017	Yes	Working	State	41.026	-109.041	Upper Red Creek	Red Creek	12N	103W	17
5	Reservoir	ACE	Unknown	Wet in 2012 and 2017	Yes	Working	State	41.031	-109.050	Upper Red Creek	Red Creek	12N	103W	7
6	Reservoir	ACE	Unknown	Somewhat wet in 2012	Potential	Not Working	Private	41.037	-109.121	Upper Red Creek	Red Creek	12N	104W	10
7	Reservoir	ACE	Unknown	Berm evident	Potential	Not Working	State	41.050	-109.057	Upper Red Creek	Not in Allotment	12N	103W	6
8	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Bureau of Land Management	41.044	-109.055	Upper Red Creek	Not in Allotment	12N	103W	6
9	Reservoir	ACE	Unknown	Berm evident, may be breached	Potential	Not Working	Bureau of Land Management	41.067	-109.456	Middle Marsh Creek	Spring Creek	13N	107W	34
10	Reservoir	ACE	Unknown	Berm evident, but no water	Potential	Not Working	Private	41.073	-109.254	Middle Red Creek	Red Creek	13N	105W	28
11	Reservoir	ACE	Unknown	Berm evident, may be breached	Potential	Not Working	Bureau of Land Management	41.087	-109.236	Middle Red Creek	Red Creek	13N	105W	21
12	Reservoir	ACE	Unknown	Wet in 2012 and 2017	Yes	Working	Bureau of Land Management	41.087	-109.241	Middle Red Creek	Red Creek	13N	105W	21
13	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	State	41.096	-109.279	Sage Creek-Trout Creek	Red Creek	13N	105W	19
14	Reservoir	ACE	Unknown	Berm evident, but no water	Potential	Not Working	Bureau of Land Management	41.096	-109.323	Upper Marsh Creek	Sugarloaf	13N	106W	23
15	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	State	41.104	-109.311	Currant Creek	Sugarloaf	13N	106W	13
16	Reservoir	ACE	Unknown	Wet in 2012, 2017	Yes	Working	Bureau of Land Management	41.112	-109.298	Currant Creek	Sugarloaf	13N	106W	13
17	Reservoir	ACE	Unknown	Appears wet 2012 but unclear in other years	Potential	Not Working	Bureau of Land Management	41.111	-109.297	Currant Creek	Sugarloaf	13N	106W	13
18	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Bureau of Land Management	41.121	-109.271	Sage Creek-Trout Creek	Salt Wells	13N	105W	8
19	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	State	41.133	-109.211	Sage Creek-Trout Creek	Salt Wells	13N	105W	2
20	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Private	41.145	-109.206	Sage Creek-Trout Creek	Not in Allotment	14N	105W	35
21	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Private	41.147	-109.200	Sage Creek-Trout Creek	Not in Allotment	14N	105W	35
22	Reservoir	ACE	Unknown	Wet in 2009 and 2012	Yes	Working	Private	41.150	-109.360	Sugarloaf Marsh Creek	Sugarloaf	14N	106W	33
23	Reservoir	ACE	Unknown	Wet in 2009 and 2012	Yes	Working	State	41.163	-109.271	Sage Creek-Trout Creek	Salt Wells	14N	105W	29
24	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	State	41.166	-109.269	Sage Creek-Trout Creek	Salt Wells	14N	105W	29
25	Reservoir	ACE	Unknown	Wet in 2009, 2012	Yes	Working	State	41.176	-108.774	Upper Salt Wells Creek	Vermillion Creek	14N	101W	22
26	Reservoir	ACE	Unknown	Wet in 2012, but dry in 2009 and 2017	Potential	Not Working	Private	41.182	-108.789	Upper Salt Wells Creek	Vermillion Creek	14N	101W	21
27	Reservoir	ACE	Unknown	Wet in 2012, but dry in 2009 and 2017	Potential	Not Working	State	41.185	-108.785	Upper Salt Wells Creek	Vermillion Creek	14N	101W	21
28	Reservoir	ACE	Unknown	Wet in 2012 and 2017	Yes	Working	State	41.175	-108.774	Upper Salt Wells Creek	Vermillion Creek	14N	101W	22
29	Reservoir	ACE	Unknown	Wet in 2009, 2012, and 2017	Yes	Working	Private	41.176	-108.805	Upper Salt Wells Creek	Vermillion Creek	14N	101W	20
30	Reservoir	ACE	Unknown	Wet in 2009, 2017	Yes	Working	Private	41.175	-108.799	Upper Salt Wells Creek	Vermillion Creek	14N	101W	20
31	Reservoir	ACE	Unknown	Wet in 2009, 2017	Yes	Working	Private	41.174	-108.799	Upper Salt Wells Creek	Vermillion Creek	14N	101W	20
32	Reservoir	ACE	Unknown	Wet in 2012, 2017	Yes	Working	Private	41.175	-108.797	Upper Salt Wells Creek	Vermillion Creek	14N	101W	20
33	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Bureau of Land Management	41.182	-109.124	Gap Creek	Salt Wells	14N	104W	21
34	Reservoir	ACE	Unknown	Wet in 2012, 2017	Yes	Working	State	41.176	-109.268	Sage Creek-Trout Creek	Salt Wells	14N	105W	20
35	Reservoir	ACE	Unknown	Wet in 2012, 2017	Yes	Working	Bureau of Land Management	41.177	-109.336	Currant Creek	Sugarloaf	14N	106W	22
36	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	State	41.197	-109.355	Currant Creek	Sugarloaf	14N	106W	16
37	Reservoir	ACE	Unknown	Wet in 2009, 2017	Yes	Working	Bureau of Land Management	41.225	-108.969	Salt Wells Creek-Corral Creek	Vermillion Creek	14N	103W	2
38	Reservoir	ACE	Unknown	Evidence of a berm, but no water	Potential	Not Working	State	41.235	-109.308	Sage Creek-Greasewood Draw	Rock Springs	15N	106W	36
39	Reservoir	ACE	Unknown	Evidence of a berm, but no water	Potential	Not Working	Private	41.242	-109.354	Sage Creek-Greasewood Draw	Rock Springs	15N	106W	33
40	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Bureau of Land Management	41.267	-109.336	Sage Creek-Greasewood Draw	Rock Springs	15N	106W	22
41	Reservoir	ACE	Unknown	Berm, but no water	Potential	Not working	Private	41.277	-109.335	Sage Creek-Greasewood Draw	Rock Springs	15N	106W	15
42	Reservoir	ACE	Unknown	Wet in 2009, 2012	Yes	Working	State	41.284	-108.898	Lower Salt Wells Creek	Vermillion Creek	15N	102W	16
43	Reservoir	ACE	Unknown	Berm, but no water	Potential	Not Working	State	41.308	-109.012	Salt Wells Creek-Joyce Creek	Mellor Mountain	15N	103W	4
44	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Private	41.320	-109.100	Pretty Water Creek	Circle Springs	16N	104W	35
45	Reservoir	ACE	Unknown	Wet in 2009, 2017	Yes	Working	Private	41.343	-109.110	Pretty Water Creek	Circle Springs	16N	104W	27
46	Reservoir	ACE	Unknown	Wet in 2012, 2017	Yes	Working	Private	41.337	-109.057	Pretty Water Creek	Circle Springs	16N	103W	30

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47	Reservoir	ACE	Unknown	Wet in 2009, dry in other years	Potential	Not Working	Bureau of Land Management	41.379	-108.764	Upper Black Butte Creek	Rock Springs	16N	101W	10
48	Reservoir	ACE	Unknown	Wet in 2009, dry in other years	Potential	Not Working	Bureau of Land Management	41.378	-108.762	Upper Black Butte Creek	Rock Springs	16N	101W	10
49	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Private	41.381	-109.066	Pretty Water Creek	Circle Springs	16N	104W	12
50	Reservoir	ACE	Unknown	Evidence of a berm, but no water. May be silted in	Potential	Not Working	Private	41.387	-109.065	Pretty Water Creek	Circle Springs	16N	104W	12
51	Reservoir	ACE	Unknown	Wet in 2009, 2012	Yes	Working	Private	41.398	-109.014	Salt Wells Creek-Joyce Creek	Circle Springs	16N	103W	4
52	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Private	41.404	-109.177	Cedar Creek-Little Bitter Creek	Rock Springs	17N	104W	31
53	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Private	41.444	-109.068	Salt Wells Creek-Spring Creek	Rock Springs	17N	103W	19
54	Reservoir	ACE	Unknown	Wet in 2009, 2017	Yes	Working	Private	41.430	-109.213	Cedar Creek-Little Bitter Creek	Rock Springs	17N	105W	24
55	Reservoir	ACE	Unknown	Wet in 2009, 2017	Yes	Working	Private	41.432	-109.210	Cedar Creek-Little Bitter Creek	Rock Springs	17N	105W	24
56	Reservoir	ACE	Unknown	Wet in 2009, 2017	Yes	Working	State	41.451	-109.147	Sweetwater Creek-Bitter Creek	Rock Springs	17N	104W	16
57	Reservoir	ACE	Unknown	Berm evident but no water, may be breached in the middle	No	Breached	State	41.455	-109.147	Sweetwater Creek-Bitter Creek	Rock Springs	17N	104W	16
58	Reservoir	ACE	Unknown	Wet in 2009	Potential	Not Working	Bureau of Land Management	41.452	-108.535	Bitter Creek-Hungry Hollow	Rock Springs	17N	99W	14
59	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Private	41.454	-108.289	Laney Wash	Rock Springs	17N	97W	13
60	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Bureau of Land Management	41.469	-108.675	Patrick Draw	Rock Springs	17N	100W	10
61	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Private	41.468	-109.056	Salt Wells Creek-Spring Creek	Rock Springs	17N	103W	8
62	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Private	41.466	-109.148	Sweetwater Creek-Bitter Creek	Rock Springs	17N	104W	9
63	Reservoir	ACE	Unknown	Wet in 2012	Potential	Not Working	Private	41.475	-108.660	Patrick Draw	Rock Springs	17N	100W	3
64	Reservoir	ACE	Unknown	Wet in 2009, 2012	Yes	Working	Private	41.488	-108.271	Laney Wash	Tipton	18N	96W	31
65	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Bureau of Land Management	41.503	-108.698	Bitter Creek-Town of Bitter Creek	Rock Springs	18N	100W	28
66	Reservoir	ACE	Unknown	Wet in 2009, 2012	Yes	Working	Private	41.505	-108.705	Bitter Creek-Town of Bitter Creek	Rock Springs	18N	100W	29
67	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Private	41.518	-108.683	Bitter Creek-Town of Bitter Creek	Rock Springs	18N	100W	21
68	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Bureau of Land Management	41.522	-108.704	Bitter Creek-Town of Bitter Creek	Rock Springs	18N	100W	20
69	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Private	41.488	-108.729	Bitter Creek-Town of Bitter Creek	Rock Springs	18N	100W	31
70	Reservoir	ACE	Unknown	Wet in 2009, 2017	Yes	Working	Private	41.490	-108.720	Bitter Creek-Town of Bitter Creek	Rock Springs	18N	100W	31
71	Reservoir	ACE	Unknown	Wet in 2009, 2017	Yes	Working	Private	41.510	-108.282	Laney Wash	Rock Springs	18N	97W	25
72	Reservoir	ACE	Unknown	Berm evident, but may not have water	Potential	Not Working	Bureau of Land Management	41.521	-108.289	Laney Wash	Rock Springs	18N	97W	24
73	Reservoir	ACE	Unknown	Wet in 2017	Potential	Not Working	Bureau of Land Management	41.528	-108.672	Bitter Creek-Town of Bitter Creek	Rock Springs	18N	100W	22
74	Reservoir	ACE	Unknown	Wet in 2017	Potential	Not Working	Bureau of Land Management	41.520	-108.702	Bitter Creek-Town of Bitter Creek	Rock Springs	18N	100W	20
75	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Private	41.518	-109.286	Bitter Creek-Kanda	Not in Allotment	18N	105W	20
76	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Bureau of Land Management	41.534	-109.385	Bitter Creek-Kanda	Rock Springs	18N	106W	16
77	Reservoir	ACE	Unknown	Wet in 2009	Potential	Not Working	Private	41.539	-109.239	Sweetwater Creek-Bitter Creek	Rock Springs	18N	105W	15
78	Reservoir	ACE	Unknown	Wet in 2009, minimal water in other years	Potential	Not Working	Bureau of Land Management	41.540	-109.109	South Baxter Basin	Rock Springs	18N	104W	14
79	Reservoir	ACE	Unknown	Wet in 2012, 2017	Yes	Working	Bureau of Land Management	41.534	-108.842	Middle Black Butte Creek	Rock Springs	18N	101W	18
80	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Bureau of Land Management	41.543	-108.729	Bitter Creek-Town of Black Buttes	Rock Springs	18N	100W	18
81	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Bureau of Land Management	41.558	-108.620	Bitter Creek-Town of Black Buttes	Rock Springs	18N	100W	12
82	Reservoir	ACE	Unknown	Berm evident but no water	Potential	Not working	Private	41.557	-108.640	Bitter Creek-Town of Black Buttes	Rock Springs	18N	100W	11
83	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Private	41.554	-108.729	Bitter Creek-Town of Black Buttes	Rock Springs	18N	100W	7
84	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Private	41.553	-109.299	Bitter Creek-Kanda	Rock Springs	18N	105W	7
85	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Bureau of Land Management	41.564	-108.613	Bitter Creek-Town of Bitter Creek	Rock Springs	18N	99W	6
86	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Bureau of Land Management	41.563	-108.616	Bitter Creek-Town of Bitter Creek	Rock Springs	18N	99W	6
87	Reservoir	ACE	Unknown	Wet in 2009, 2012	Yes	Working	Private	41.574	-108.416	Lower Patrick Draw	Tipton	19N	98W	35
88	Reservoir	ACE	Unknown	Wet in 2009, but dry in other years	Potential	Not Working	Bureau of Land Management	41.581	-108.404	Lower Patrick Draw	Tipton	19N	98W	36
89	Reservoir	ACE	Unknown	Wet in 2009 and 2017	Yes	Working	Private	41.581	-108.649	Bitter Creek-Town of Black Buttes	Rock Springs	19N	100W	35
90	Reservoir	ACE	Unknown	Wet in 2009, but dry in other years	Potential	Not Working	Bureau of Land Management	41.573	-108.645	Bitter Creek-Town of Black Buttes	Rock Springs	18N	100W	2
91	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Private	41.590	-108.701	Bitter Creek-Town of Black Buttes	Not in Allotment	19N	100W	29

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92	Reservoir	ACE	Unknown	Wet in 2009, 2017	Yes	Working	Private	41.611	-108.334	Lower Patrick Draw	Tipton	19N	97W	21
93	Reservoir	ACE	Unknown	Wet in 2009, 2017	Yes	Working	Bureau of Land Management	41.615	-108.511	Upper Patrick Draw	Rock Springs	19N	99W	24
94	Reservoir	ACE	Unknown	Wet in 2009, 2017	Yes	Working	Bureau of Land Management	41.612	-108.743	Bitter Creek-Town of Hallville	Rock Springs	19N	101W	24
95	Reservoir	ACE	Unknown	Wet in 2009, 2017	Yes	Working	Private	41.622	-109.241	Killpecker Creek-Reliance	Rock Springs	19N	105W	15
96	Reservoir	ACE	Unknown	Evidence of berm, but may not have water	Potential	Not Working	State	41.625	-109.035	Bitter Creek-Rock Springs	Rock Springs	19N	103W	16
97	Reservoir	ACE	Unknown	Wet in 2009, 2017	Yes	Working	Private	41.623	-108.635	Bitter Creek-Town of Hallville	Rock Springs	19N	100W	13
98	Reservoir	ACE	Unknown	Wet in 2009, 2017	Yes	Working	Private	41.634	-108.340	Lower Patrick Draw	G.L.	19N	97W	9
99	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Private	41.633	-108.500	Upper Patrick Draw	Rock Springs	19N	98W	7
100	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Private	41.641	-108.530	Upper Patrick Draw	Rock Springs	19N	99W	11
101	Reservoir	ACE	Unknown	Wet in 2009, 2017	Yes	Working	Bureau of Land Management	41.644	-108.545	Upper Patrick Draw	Rock Springs	19N	99W	10
102	Reservoir	ACE	Unknown	Wet in 2009, dry in other years	Potential	Not Working	Private	41.646	-108.972	Lower Black Butte Creek	Rock Springs	19N	103W	12
103	Reservoir	ACE	Unknown	Wet in 2009, 2017	Yes	Working	Private	41.649	-109.166	Killpecker Creek-Reliance	Rock Springs	19N	104W	5
104	Reservoir	ACE	Unknown	Wet in 2017, dry in other years	Potential	Not Working	Private	41.654	-109.020	1.40401E+11	Rock Springs	19N	103W	3
105	Reservoir	ACE	Unknown	Wet in 2009, 2017	Yes	Working	Private	41.648	-108.402	Lower Patrick Draw	Rock Springs	19N	98W	1
106	Reservoir	ACE	Unknown	Wet in 2009, 2017	Yes	Working	Private	41.668	-108.489	Upper Patrick Draw	Rock Springs	20N	98W	31
107	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	State	41.669	-109.205	Killpecker Creek-Reliance	Not in Allotment	20N	105W	36
108	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Private	41.675	-109.219	Killpecker Creek-Reliance	Rock Springs	20N	105W	35
109	Reservoir	ACE	Unknown	Wet in 2009, 2017	Yes	Working	Bureau of Land Management	41.685	-108.804	Bitter Creek-Coon Draw	Rock Springs	20N	101W	28
110	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Private	41.677	-108.787	Bitter Creek-Coon Draw	Rock Springs	20N	101W	27
111	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Private	41.679	-108.779	Bitter Creek-Coon Draw	Rock Springs	20N	101W	27
112	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Bureau of Land Management	41.681	-108.732	Middle Deadman Wash	Rock Springs	20N	100W	30
113	Reservoir	ACE	Unknown	Wet in 2009, 2017	Yes	Working	Bureau of Land Management	41.680	-108.732	Middle Deadman Wash	Rock Springs	20N	100W	30
114	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Bureau of Land Management	41.704	-108.648	Lower Deadman Wash	Rock Springs	20N	100W	14
115	Reservoir	ACE	Unknown	Wet in 2009, 2017	Yes	Working	Private	41.692	-108.796	Bitter Creek-Coon Draw	Rock Springs	20N	101W	21
116	Reservoir	ACE	Unknown	Wet in 2017, dry in other years	Potential	Not Working	Private	41.695	-109.289	Killpecker Creek-Fourteenmile Creek	Not in Allotment	20N	105W	20
117	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Private	41.713	-108.665	Lower Deadman Wash	Rock Springs	20N	100W	15
118	Reservoir	ACE	Unknown	Wet in 2009, 2017	Yes	Working	Private	41.716	-108.667	Lower Deadman Wash	Rock Springs	20N	100W	15
119	Reservoir	ACE	Unknown	Wet in 2012, 2017	Yes	Working	Private	41.716	-108.669	Lower Deadman Wash	Rock Springs	20N	100W	15
120	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Bureau of Land Management	41.713	-108.646	Lower Deadman Wash	Rock Springs	20N	100W	14
121	Reservoir	ACE	Unknown	Wet in 2009, 2017	Yes	Working	Bureau of Land Management	41.712	-108.644	Lower Deadman Wash	Rock Springs	20N	100W	14
122	Reservoir	ACE	Unknown	Wet in 2009, 2012	Yes	Working	Private	41.711	-108.659	Lower Deadman Wash	Rock Springs	20N	100W	15
123	Reservoir	ACE	Unknown	Wet in 2009, 2017	Yes	Working	Bureau of Land Management	41.707	-108.645	Lower Deadman Wash	Rock Springs	20N	100W	14
124	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Bureau of Land Management	41.706	-108.649	Lower Deadman Wash	Rock Springs	20N	100W	14
125	Reservoir	ACE	Unknown	Wet in 2009, 2017	Yes	Working	Bureau of Land Management	41.705	-108.652	Lower Deadman Wash	Rock Springs	20N	100W	14
126	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Private	41.741	-108.776	Upper Deadman Wash	Rock Springs	20N	101W	3
127	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Bureau of Land Management	41.745	-108.787	Middle Deadman Wash	Rock Springs	21N	101W	36
128	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Private	41.743	-108.783	Middle Deadman Wash	Rock Springs	20N	101W	3
129	Reservoir	ACE	Unknown	Wet in 2009, 2017	Yes	Working	Private	41.741	-108.778	Upper Deadman Wash	Rock Springs	20N	101W	3
130	Reservoir	ACE	Unknown	Wet in 2009, 2017	Yes	Working	Private	41.736	-108.677	Lower Deadman Wash	Rock Springs	20N	100W	3
131	Reservoir	ACE	Unknown	Wet in 2009, 2017	Yes	Working	Private	41.733	-108.694	Middle Deadman Wash	Rock Springs	20N	100W	9
132	Reservoir	ACE	Unknown	Wet in 2009, 2017	Yes	Working	Private	41.727	-108.694	Middle Deadman Wash	Rock Springs	20N	100W	9
133	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Bureau of Land Management	41.733	-108.606	Lower Deadman Wash	Rock Springs	20N	99W	6
134	Reservoir	ACE	Unknown	Wet in 2009, 2017	Yes	Working	Private	41.753	-108.695	Middle Deadman Wash	Rock Springs	21N	100W	35
135	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Bureau of Land Management	41.745	-108.707	Middle Deadman Wash	Rock Springs	21N	100W	34
136	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Bureau of Land Management	41.748	-108.716	Middle Deadman Wash	Rock Springs	21N	100W	34
137	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Bureau of Land Management	41.747	-108.713	Middle Deadman Wash	Rock Springs	21N	100W	34

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138	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Bureau of Land Management	41.746	-108.712	Middle Deadman Wash	Rock Springs	21N	100W	34
139	Reservoir	ACE	Unknown	Wet in 2009, 2017	Yes	Working	Bureau of Land Management	41.750	-108.718	Middle Deadman Wash	Rock Springs	21N	100W	34
140	Reservoir	ACE	Unknown	Wet in 2009, 2017	Yes	Working	Bureau of Land Management	41.757	-108.720	Upper Deadman Wash	Rock Springs	21N	100W	34
141	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Bureau of Land Management	41.755	-108.713	Middle Deadman Wash	Rock Springs	21N	100W	34
142	Reservoir	ACE	Unknown	Wet in 2009, 2017	Yes	Working	Bureau of Land Management	41.753	-108.720	Middle Deadman Wash	Rock Springs	21N	100W	34
143	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Private	41.759	-108.724	Upper Deadman Wash	Rock Springs	21N	100W	27
144	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Private	41.763	-108.716	Upper Deadman Wash	Rock Springs	21N	100W	27
145	Reservoir	ACE	Unknown	Wet in 2009, 2017	Yes	Working	Private	41.749	-108.729	Middle Deadman Wash	Rock Springs	21N	100W	33
146	Reservoir	ACE	Unknown	Wet in 2012, 2017	Yes	Working	Private	41.752	-108.843	Middle Deadman Wash	Rock Springs	21N	101W	33
147	Reservoir	ACE	Unknown	Wet in 2009, 2017	Yes	Working	Private	41.746	-109.307	Killpecker Creek-Fourteenmile Creek	Not in Allotment	21N	105W	33
148	Reservoir	ACE	Unknown	Wet in 2009, 2017	Yes	Working	Private	41.765	-108.784	Upper Deadman Wash	Rock Springs	21N	101W	25
149	Reservoir	ACE	Unknown	Wet in 2009, 2017	Yes	Working	Private	41.769	-108.715	Upper Deadman Wash	Rock Springs	21N	100W	27
150	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Bureau of Land Management	41.773	-108.713	Upper Deadman Wash	Rock Springs	21N	100W	22
151	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Bureau of Land Management	41.781	-108.754	Upper Deadman Wash	Rock Springs	21N	100W	20
152	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Bureau of Land Management	41.782	-108.760	Upper Deadman Wash	Rock Springs	21N	100W	20
153	Reservoir	ACE	Unknown	Wet in 2009, 2017	Yes	Working	Bureau of Land Management	41.773	-108.747	Upper Deadman Wash	Rock Springs	21N	100W	20
154	Reservoir	ACE	Unknown	Wet in 2009, 2017	Yes	Working	Private	41.774	-108.792	Upper Deadman Wash	Rock Springs	21N	101W	24
155	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Bureau of Land Management	41.798	-108.777	Upper Deadman Wash	Rock Springs	21N	100W	18
156	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Private	41.794	-108.757	Upper Deadman Wash	Rock Springs	21N	100W	17
157	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Private	41.788	-108.759	Upper Deadman Wash	Rock Springs	21N	100W	17
158	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Private	41.805	-108.776	Upper Deadman Wash	Rock Springs	21N	100W	7
159	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Private	41.807	-108.771	Upper Deadman Wash	Rock Springs	21N	100W	7
160	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Bureau of Land Management	41.810	-108.798	Upper Deadman Wash	Rock Springs	21N	101W	12
161	Reservoir	ACE	Unknown	Wet in 2009, 2017	Yes	Working	Private	41.803	-108.809	Upper Deadman Wash	Rock Springs	21N	101W	11
162	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Private	41.820	-108.822	Upper Deadman Wash	Rock Springs	21N	101W	3
163	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Private	41.874	-109.182	Killpecker Creek-Pine Canyon	Rock Springs	22N	104W	15
164	Reservoir	ACE	Unknown	Wet in 2009, 2017	Yes	Working	Bureau of Land Management	41.902	-109.269	Killpecker Creek-Pine Canyon	Pacific Creek	22N	105W	11
165	Reservoir	ACE	Unknown	Berm evident, but no water	Potential	Not Working	Bureau of Land Management	41.920	-109.247	Killpecker Creek-Boars Tusk	Pacific Creek	22N	105W	1
166	Reservoir	ACE	Unknown	Berm evident, but no water	Potential	Not Working	State	41.921	-109.245	Killpecker Creek-Boars Tusk	Pacific Creek	23N	105W	36
167	Reservoir	ACE	Unknown	Berm evident, but no water	Potential	Not Working	State	41.933	-109.249	Killpecker Creek-Boars Tusk	Pacific Creek	23N	105W	36
168	Reservoir	ACE	Unknown	Wet in 2009, 2017	Yes	Working	Bureau of Land Management	41.944	-109.247	Killpecker Creek-Boars Tusk	Pacific Creek	23N	105W	25
169	Reservoir	ACE	Unknown	Berm evident but no water	Potential	Not Working	Bureau of Land Management	41.943	-109.251	Killpecker Creek-Boars Tusk	Pacific Creek	23N	105W	25
170	Reservoir	ACE	Unknown	Berm evident but no water	Potential	Not Working	Bureau of Land Management	41.939	-109.160	Nitch Creek	Pacific Creek	23N	104W	26
171	Reservoir	ACE	Unknown	Berm evident but no water	Potential	Not Working	Bureau of Land Management	41.940	-109.142	Nitch Creek	Pacific Creek	23N	104W	25
172	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Private	41.952	-109.045	Nitch Creek	Rock Springs	23N	103W	23
173	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Private	41.953	-109.123	Nitch Creek	Houghton	23N	103W	19
174	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Bureau of Land Management	41.953	-109.122	Nitch Creek	Houghton	23N	103W	19
175	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	State	41.965	-109.112	Nitch Creek	Houghton	23N	103W	18
176	Reservoir	ACE	Unknown	Wet in 2009, 2017	Yes	Working	Bureau of Land Management	41.984	-109.209	Killpecker Creek-Boars Tusk	Pacific Creek	23N	104W	8
177	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Bureau of Land Management	42.001	-109.256	Killpecker Creek-Boars Tusk	Pacific Creek	23N	105W	1
178	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Bureau of Land Management	41.995	-109.252	Killpecker Creek-Boars Tusk	Pacific Creek	23N	105W	1
179	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Bureau of Land Management	41.992	-109.237	Killpecker Creek-Boars Tusk	Pacific Creek	23N	104W	6
180	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Bureau of Land Management	41.991	-109.244	Killpecker Creek-Boars Tusk	Pacific Creek	23N	104W	6
181	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Private	41.993	-109.133	Killpecker Creek-Boars Tusk	Pacific Creek	23N	104W	1
182	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Private	41.999	-109.127	Killpecker Creek-Boars Tusk	Pacific Creek	23N	103W	6
183	Reservoir	ACE	Unknown	Wet in 2009, 2017	Yes	Working	Bureau of Land Management	41.980	-109.081	Killpecker Creek-Boars Tusk	Pacific Creek	23N	103W	9

ACE ID	Improvement Type	Source	Name	ACE_Notes	Water Source	Condition	Land_Owner	Lat	Long	HUC 12 Name	Allotment	T	R	S
184	Reservoir	ACE	Unknown	Wet in 2009, 2017	Yes	Working	Bureau of Land Management	41.980	-109.109	Killpecker Creek-Boars Tusk	Pacific Creek	23N	103W	8
185	Reservoir	ACE	Unknown	Wet in 2009, 2017	Yes	Working	Bureau of Land Management	41.988	-109.091	Killpecker Creek-Boars Tusk	Pacific Creek	23N	103W	8
186	Reservoir	ACE	Unknown	Wet in 2009, 2017	Yes	Working	Bureau of Land Management	41.985	-109.163	Killpecker Creek-Boars Tusk	Pacific Creek	23N	104W	11
187	Reservoir	ACE	Unknown	Wet in 2009, 2017	Yes	Working	Bureau of Land Management	41.996	-109.206	Killpecker Creek-Boars Tusk	Pacific Creek	23N	104W	4
188	Reservoir	ACE	Unknown	Wet in 2009, 2017	Yes	Working	Bureau of Land Management	41.992	-109.218	Killpecker Creek-Boars Tusk	Pacific Creek	23N	104W	5
189	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Bureau of Land Management	41.991	-109.236	Killpecker Creek-Boars Tusk	Pacific Creek	23N	104W	6
190	Reservoir	ACE	Unknown	Wet in 2009, 2012, 2017	Yes	Working	Bureau of Land Management	41.996	-109.255	Killpecker Creek-Boars Tusk	Pacific Creek	23N	105W	1
191	Reservoir	ACE	Unknown	Wet in 2009, 2017	Yes	Working	Bureau of Land Management	41.992	-109.209	Killpecker Creek-Boars Tusk	Pacific Creek	23N	104W	5
192	Reservoir	ACE	Unknown	Berm appears breached in middle	No	Breached	Bureau of Land Management	41.049	-109.285	Middle Red Creek	Red Creek	12N	105W	6
193	Pit	BLM	Hobbled Horse Pit	BLM evaluated condition	No	Not Working	Bureau of Land Management	41.235	-108.754	Scheggs Draw	Vermillion Creek	15N	101W	35
194	Reservoir	BLM	Unknown	BLM evaluated condition	Yes	Working	Private	41.002	-109.013	Upper Red Creek	Red Creek	12N	103W	21
195	Reservoir	BLM	Pete's Reservoir	BLM evaluated condition	Yes	Working	Private	41.003	-109.032	Upper Red Creek	Red Creek	12N	103W	20
196	Reservoir	BLM	Unknown	BLM evaluated condition	Yes	Working	Private	41.005	-109.022	Upper Red Creek	Red Creek	12N	103W	21
197	Pit	BLM	Steven's Pit	BLM evaluated condition	Yes	Working	Bureau of Land Management	41.009	-109.394	Flaming Gorge Reservoir-Spring Creek	Spring Creek	12N	106W	19
198	Reservoir	BLM	Unknown	BLM evaluated condition	Yes	Working	Bureau of Land Management	41.009	-109.095	Upper Red Creek	Red Creek	12N	104W	23
199	Pit	BLM	Richards Basin Pit	BLM evaluated condition	No	Not Working	Bureau of Land Management	41.025	-109.239	Middle Red Creek	Red Creek	12N	105W	16
200	Reservoir	BLM	Unknown	BLM evaluated condition	Yes	Working	Private	41.023	-109.079	Upper Red Creek	Red Creek	12N	104W	13
201	Reservoir	BLM	Gap Fire Reservoir	BLM evaluated condition	No	Not Working	Bureau of Land Management	41.031	-109.434	Flaming Gorge Reservoir-Spring Creek	Spring Creek	12N	107W	11
202	Reservoir	BLM	Unknown	BLM evaluated condition	No	Silted In	Private	41.034	-109.095	Upper Red Creek	Red Creek	12N	104W	11
203	Reservoir	BLM	Unknown	BLM evaluated condition	No	Breached	Private	41.040	-109.266	Middle Red Creek	Red Creek	12N	105W	8
204	Pit	BLM	Snow Pit Reservoir	BLM evaluated condition	Yes	Working	Private	41.041	-109.276	Middle Red Creek	Red Creek	12N	105W	7
205	Reservoir	BLM	Edmund Fitzgerald Reservoir	BLM evaluated condition	No	Not Working	Bureau of Land Management	41.043	-109.328	Flaming Gorge Reservoir-Spring Creek	Spring Creek	12N	106W	2
206	Pit	BLM	Pump Draw Pit	BLM evaluated condition	No	Not Working	State	41.046	-109.323	Flaming Gorge Reservoir-Spring Creek	Spring Creek	12N	106W	2
207	Reservoir	BLM	Unknown	BLM evaluated condition	No	Not Working	Bureau of Land Management	41.051	-109.463	Henrys Fork-Cottonwood Creek	Spring Creek	12N	107W	3
208	Reservoir	BLM	Wild Horse Reservoir	BLM evaluated condition	No	Silted In	Bureau of Land Management	41.054	-109.469	Henrys Fork-Cottonwood Creek	Spring Creek	12N	107W	4
209	Reservoir	BLM	NW TeePee Reservoir	BLM evaluated condition	No	Silted In	Bureau of Land Management	41.050	-109.166	Middle Red Creek	Red Creek	12N	104W	6
210	Pit	BLM	Whiskey Springs Pit	BLM evaluated condition	No	Not Working	Bureau of Land Management	41.054	-109.342	Flaming Gorge Reservoir-Spring Creek	Spring Creek	12N	106W	3
211	Pit	BLM	Big Sage Spring Pit	BLM evaluated condition	No	Not Working	Bureau of Land Management	41.054	-109.383	Flaming Gorge Reservoir-Spring Creek	Spring Creek	12N	106W	5
212	Reservoir	BLM	Hazel Creek Reservoir	BLM evaluated condition	Yes	Working	Bureau of Land Management	41.058	-109.140	Upper Red Creek	Red Creek	13N	104W	33
213	Reservoir	BLM	Wild Rye Pit	BLM evaluated condition	No	Not Working	Bureau of Land Management	41.061	-109.262	Middle Red Creek	Red Creek	13N	105W	32
214	Reservoir	BLM	Iron Mountain Reservoir	BLM evaluated condition	No	Silted In	Bureau of Land Management	41.080	-109.445	Middle Marsh Creek	Spring Creek	13N	107W	26
215	Pit	BLM	Iron Mountain Pit	BLM evaluated condition	Yes	Working	Bureau of Land Management	41.090	-109.422	Middle Marsh Creek	Sugarloaf	13N	107W	24
216	Reservoir	BLM	Unknown	BLM evaluated condition, no visible reservoir	No	Unknown	Bureau of Land Management	41.099	-109.285	Currant Creek	Red Creek	13N	105W	19
217	Reservoir	BLM	Antelope Pit	BLM evaluated condition	No	Silted In	Bureau of Land Management	41.100	-109.410	Middle Marsh Creek	Sugarloaf	13N	107W	13
218	Reservoir	BLM	Buckskin Basin Reservoir	BLM evaluated condition	Yes	Working	Bureau of Land Management	41.100	-109.340	Upper Marsh Creek	Sugarloaf	13N	106W	15
219	Reservoir	BLM	Buffalo Reservoir 1	BLM evaluated condition	Yes	Working	Bureau of Land Management	41.111	-109.065	Gap Creek	Salt Wells	13N	104W	13
220	Reservoir	BLM	Washam Reservoir	BLM evaluated condition	Yes	Working	Private	41.119	-109.389	Upper Marsh Creek	Sugarloaf	13N	106W	7
221	Pit	BLM	Gap Creek Pit	BLM evaluated condition	Yes	Working	Bureau of Land Management	41.116	-109.096	Gap Creek	Salt Wells	13N	104W	11
222	Reservoir	BLM	Buffalo Reservoir	BLM evaluated condition	No	Silted In	Bureau of Land Management	41.121	-109.034	Gap Creek	Salt Wells	13N	103W	8
223	Reservoir	BLM	Pipeline Reservoir	BLM evaluated condition	Yes	Working	Bureau of Land Management	41.124	-109.154	Sage Creek-Trout Creek	Salt Wells	13N	104W	8
224	Reservoir	BLM	Chicken Spring Pond	BLM evaluated condition	Yes	Working	State	41.127	-109.098	Gap Creek	Salt Wells	13N	104W	11
225	Reservoir	BLM	Unknown	BLM evaluated condition	No	Not Working	Bureau of Land Management	41.130	-109.327	Sugarloaf Marsh Creek	Sugarloaf	13N	106W	2
226	Reservoir	BLM	Unknown	BLM evaluated condition	No	Not Working	Bureau of Land Management	41.129	-108.998	Salt Wells Creek-Corral Creek	Pine Mountain	13N	103W	3
227	Reservoir	BLM	Gooseberry Reservoir	BLM evaluated condition	Yes	Working	Bureau of Land Management	41.136	-109.251	Sage Creek-Trout Creek	Salt Wells	13N	105W	4
228	Reservoir	BLM	Unknown	BLM evaluated condition	No	Not Working	Bureau of Land Management	41.138	-109.352	Sugarloaf Marsh Creek	Sugarloaf	13N	106W	4
229	Reservoir	BLM	Rife Rim Reservoir # 1	BLM evaluated condition	No	Silted In	Bureau of Land Management	41.134	-108.828	Upper Salt Wells Creek	Pine Mountain	13N	101W	6

ACE ID	Improvement Type	Source	Name	ACE_Notes	Water Source	Condition	Land_Owner	Lat	Long	HUC 12 Name	Allotment	T	R	S
230	Reservoir	BLM	Headwaters Sage Crk Reservoir	BLM evaluated condition	Yes	Working	Private	41.140	-109.139	Sage Creek-Trout Creek	Salt Wells	13N	104W	4
231	Reservoir	BLM	Unknown	BLM evaluated condition	Yes	Working	State	41.142	-109.219	Sage Creek-Trout Creek	Salt Wells	13N	105W	3
232	Reservoir	BLM	Little Mountain Pit Reservoir	BLM evaluated condition	No	Silted In	Bureau of Land Management	41.142	-109.360	Sugarloaf Marsh Creek	Sugarloaf	13N	106W	4
233	Reservoir	BLM	Unknown	BLM evaluated condition	Yes	Working	State	41.144	-109.214	Sage Creek-Trout Creek	Not in Allotment	14N	105W	35
234	Pit	BLM	Pipeline No. 2 Pit	BLM evaluated condition	No	Silted In	Bureau of Land Management	41.150	-109.027	Salt Wells Creek-Corral Creek	Salt Wells	14N	103W	32
235	Reservoir	BLM	Sage Creek Reservoir	BLM evaluated condition	No	Silted In	Private	41.152	-109.173	Sage Creek-Trout Creek	Salt Wells	14N	104W	31
236	Pit	BLM	West Draw Pit	BLM evaluated condition	No	Silted In	Bureau of Land Management	41.148	-108.912	Upper Salt Wells Creek	Vermillion Creek	14N	102W	32
237	Reservoir	BLM	Beans Spring Reservoir	BLM evaluated condition	Yes	Working	State	41.153	-109.093	Gap Creek	Salt Wells	14N	104W	35
238	Reservoir	BLM	East Potter Reservoir	BLM evaluated condition	Yes	Working	Bureau of Land Management	41.151	-108.928	Upper Salt Wells Creek	Vermillion Creek	14N	102W	32
239	Reservoir	BLM	Sugarloaf Marsh Creek Reservoir	BLM evaluated condition	Yes	Working	State	41.162	-109.437	Sugarloaf Marsh Creek	Sugarloaf	14N	107W	26
240	Reservoir	BLM	Little Basin Ranch Reservoir	BLM evaluated condition	Yes	Working	Private	41.174	-109.111	Gap Creek	Not in Allotment	14N	104W	22
241	Reservoir	BLM	Unknown	BLM evaluated condition	Yes	Working	Private	41.176	-108.953	Upper Salt Wells Creek	Vermillion Creek	14N	103W	24
242	Reservoir	BLM	Little Basin Spring	BLM evaluated condition	Yes	Working	Private	41.179	-109.110	Gap Creek	Salt Wells	14N	104W	22
243	Reservoir	BLM	Unknown	BLM evaluated condition	No	Not Working	State	41.186	-109.283	Sage Creek-Greasewood Draw	Salt Wells	14N	105W	19
244	Reservoir	BLM	Wapiti Reservoir	BLM evaluated condition	Yes	Working	State	41.182	-109.102	Gap Creek	Salt Wells	14N	104W	23
245	Pit	BLM	Unknown	BLM evaluated condition	No	Silted In	Bureau of Land Management	41.185	-108.914	Upper Salt Wells Creek	Vermillion Creek	14N	102W	20
246	Reservoir	BLM	Unknown	BLM evaluated condition	No	Not Working	State	41.189	-108.905	Upper Salt Wells Creek	Vermillion Creek	14N	102W	16
247	Reservoir	BLM	Unknown	BLM evaluated condition	No	Silted In	State	41.193	-108.892	Upper Salt Wells Creek	Vermillion Creek	14N	102W	16
248	Reservoir	BLM	Unknown	BLM evaluated condition	No	Not Working	Bureau of Land Management	41.198	-109.287	Sage Creek-Greasewood Draw	Salt Wells	14N	105W	18
249	Reservoir	BLM	Brooks Draw Reservoir	BLM evaluated condition	No	Silted In	Bureau of Land Management	41.194	-108.860	Upper Salt Wells Creek	Vermillion Creek	14N	102W	14
250	Reservoir	BLM	Unknown	BLM evaluated condition	Yes	Working	State	41.206	-109.285	Sage Creek-Greasewood Draw	Salt Wells	14N	105W	7
251	Reservoir	BLM	Scheggs Draw Reservoir	BLM evaluated condition	Yes	Working	Bureau of Land Management	41.204	-108.741	Scheggs Draw	Vermillion Creek	14N	101W	11
252	Reservoir	BLM	Pipeline Reservoir	BLM evaluated condition	No	Not Working	Private	41.213	-109.162	Upper Bitter Creek-Green River	Mellor Mountain	14N	104W	7
253	Pit	BLM	Sandstone Point Pit	BLM evaluated condition	No	Silted In	Bureau of Land Management	41.208	-108.793	Upper Salt Wells Creek	Vermillion Creek	14N	101W	9
254	Reservoir	BLM	Unknown	BLM evaluated condition	No	Silted In	State	41.216	-109.088	Gap Creek	Mellor Mountain	14N	104W	2
255	Reservoir	BLM	PIO Springs Reservoir	BLM evaluated condition	No	Not Working	Bureau of Land Management	41.214	-108.885	Salt Wells Creek-Dry Canyon	Vermillion Creek	14N	102W	10
256	Reservoir	BLM	Rocky Draw Reservoir	BLM evaluated condition	No	Silted In	Bureau of Land Management	41.214	-108.805	Upper Salt Wells Creek	Vermillion Creek	14N	101W	8
257	Reservoir	BLM	Pio Reservoir	BLM evaluated condition	No	Silted In	Private	41.238	-108.894	Salt Wells Creek-Dry Canyon	Vermillion Creek	15N	102W	33
258	Reservoir	BLM	4 Cows Pit Reservoir	BLM evaluated condition	No	Silted In	Bureau of Land Management	41.239	-108.769	Scheggs Draw	Vermillion Creek	15N	101W	34
259	Reservoir	BLM	Patrick Draw Reservoir No. 3	BLM evaluated condition	No	Silted In	Bureau of Land Management	41.259	-108.816	Scheggs Draw	Vermillion Creek	15N	101W	19
260	Pit	BLM	Pocket Pit	BLM evaluated condition	No	Silted In	Bureau of Land Management	41.266	-108.866	Lower Salt Wells Creek	Vermillion Creek	15N	102W	23
261	Reservoir	BLM	Sand Draw Pit	BLM evaluated condition	Yes	Working	Bureau of Land Management	41.270	-108.909	Salt Wells Creek-Dry Canyon	Vermillion Creek	15N	102W	21
262	Reservoir	BLM	Patrick Draw Reservoir No. 2	BLM evaluated condition	Yes	Working	Bureau of Land Management	41.316	-108.794	Lower Salt Wells Creek	Rock Springs	15N	101W	4
263	Reservoir	BLM	Sand Wash Reservoir # 2	BLM evaluated seasonal condition, no visible defects	Potential	Seasonal	Bureau of Land Management	41.359	-108.731	Upper Black Butte Creek	Rock Springs	16N	101W	24
264	Reservoir	BLM	Sand Wash Reservoir # 1	BLM evaluated condition	No	Silted In	Bureau of Land Management	41.385	-108.729	Upper Black Butte Creek	Rock Springs	16N	101W	12
265	Reservoir	BLM	Patrick Draw Reservoir No. 1	BLM evaluated seasonal condition, no visible defects	Potential	Seasonal	Bureau of Land Management	41.443	-108.706	Patrick Draw	Rock Springs	17N	100W	20
266	Reservoir	BLM	Bitter Creek Reservoir #2	BLM evaluated seasonal condition, no visible defects	Potential	Seasonal	Bureau of Land Management	41.567	-108.562	Lower Patrick Draw	Rock Springs	18N	99W	4
267	Reservoir	BLM	Bitter Creek Reservoir #3	BLM evaluated condition	No	Silted In	Bureau of Land Management	41.600	-108.566	Upper Patrick Draw	Rock Springs	19N	99W	28
268	Reservoir	BLM	White Mountain Reservoir No. 3	BLM evaluated condition, no visible reservoir	No	Unknown	Bureau of Land Management	41.624	-109.267	Killpecker Creek-Reliance	Rock Springs	19N	105W	16
269	Reservoir	BLM	Bitter Creek Reservoir #1	BLM evaluated seasonal condition, no visible defects	Potential	Seasonal	Bureau of Land Management	41.635	-108.518	Upper Patrick Draw	Rock Springs	19N	99W	12
270	Reservoir	BLM	Unknown	BLM evaluated condition	No	Silted In	Private	41.639	-108.605	Bitter Creek-Town of Hallville	Rock Springs	19N	99W	7
271	Reservoir	BLM	White Mountain Reservoir No. 4	BLM evaluated condition	No	Silted In	Bureau of Land Management	41.660	-109.255	Killpecker Creek-Reliance	Rock Springs	19N	105W	4
272	Reservoir	BLM	10 Mile Reservoir #3	Reservoir removed in 2017 NAIP	No	Seasonal	Bureau of Land Management	41.674	-108.637	Lower Deadman Wash	Rock Springs	20N	100W	36
273	Reservoir	BLM	White Mountain Reservoir No. 5	BLM evaluated condition	No	Silted In	Bureau of Land Management	41.693	-109.275	Killpecker Creek-Fourteenmile Creek	Rock Springs	20N	105W	20
274	Reservoir	BLM	North Baxter Basin Reservoir No. 1	BLM evaluated condition	Yes	Working	Private	41.706	-109.048	1.40401E+11	Rock Springs	20N	103W	17
275	Reservoir	BLM	14 Mile Reservoir	wet in 3 years of photography (2009,2012, 2017)	Yes	Working	Bureau of Land Management	41.746	-109.326	Killpecker Creek-Fourteenmile Creek	Not in Allotment	21N	105W	32

ACE ID	Improvement Type	Source	Name	ACE_Notes	Water Source	Condition	Land_Owner	Lat	Long	HUC 12 Name	Allotment	T	R	S
276	Reservoir	BLM	North Baxter Basin Reservoir No. 2	BLM evaluated condition	No	Silted In	Bureau of Land Management	41.745	-109.103	1.40401E+11	Rock Springs	21N	103W	32
277	Reservoir	BLM	Ten Mile Reservoir No. 4	BLM evaluated condition, no visible defects	Potential	Seasonal	Bureau of Land Management	41.744	-108.635	Lower Deadman Wash	Rock Springs	21N	99W	32
278	Reservoir	BLM	9 Mile Reservoir #2	BLM evaluated condition	Yes	Working	Bureau of Land Management	41.778	-108.671	Upper Deadman Wash	Rock Springs	21N	100W	24
279	Reservoir	BLM	Josephine Hay Reservoir No. 2	BLM evaluated condition	No	Not Working	Private	41.803	-108.857	Middle Deadman Wash	Rock Springs	21N	101W	9
280	Reservoir	BLM	Josephine Hay Reservoir No. 1	BLM evaluated condition, no visible reservoir	No	Unknown	Bureau of Land Management	41.813	-108.868	Upper Deadman Wash	Rock Springs	21N	101W	8
281	Reservoir	BLM	White Mountain Reservoir No. 1	BLM evaluated condition	No	Not Working	Bureau of Land Management	41.944	-109.249	Killpecker Creek-Boars Tusk	Pacific Creek	23N	105W	25
282	Reservoir	BLM	White Mountain Reservoir No. 3	BLM evaluated condition	No	Not Working	Bureau of Land Management	41.948	-109.254	Killpecker Creek-Boars Tusk	Pacific Creek	23N	105W	25
283	Reservoir	BLM	White Mountain Reservoir No. 2	BLM evaluated condition	No	Sanded In	Bureau of Land Management	41.952	-109.253	Killpecker Creek-Boars Tusk	Pacific Creek	23N	105W	24
284	Reservoir	BLM	White Mountain Reservoir No. 4	BLM evaluated condition	No	Not Working	Bureau of Land Management	41.955	-109.257	Killpecker Creek-Boars Tusk	Pacific Creek	23N	105W	24
285	Reservoir	BLM	White Mountain Reservoir No. 5	BLM evaluated condition	No	Sanded In	Bureau of Land Management	41.983	-109.259	Killpecker Creek-Boars Tusk	Pacific Creek	23N	105W	12
286	Reservoir	BLM	Essex Mountain Reservoir #5	BLM evaluated condition	No	Not Working	Bureau of Land Management	42.046	-109.101	Killpecker Creek-Boars Tusk	Pacific Creek	24N	103W	20
287	Pit	BLM	Wildhorse Basin Pit	BLM evaluated condition, no visible reservoir	No	Unknown	Bureau of Land Management	41.034	-109.454	Flaming Gorge Reservoir-Spring Creek	Spring Creek	12N	107W	10
288	Reservoir	BLM	WHITE MOUNTAIN RESERVOIR NO. 8	BLM evaluated condition	No	Sanded In	Bureau of Land Management	41.971	-109.254	Killpecker Creek-Boars Tusk	Pacific Creek	23N	105W	13
289	Reservoir	BLM	WHITE MOUNTAIN RESERVOIR NO. 9	BLM evaluated condition	No	Not Working	Bureau of Land Management	41.971	-109.252	Killpecker Creek-Boars Tusk	Pacific Creek	23N	105W	13
290	Reservoir	BLM	15 Mile Reservoir	BLM evaluated condition	Yes	Working	Bureau of Land Management	41.915	-109.196	Killpecker Creek-Pine Canyon	Pacific Creek	22N	104W	4
291	Reservoir	BLM	Elk Butte Reservoir	BLM evaluated condition	Yes	Working	State	41.200	-108.909	Salt Wells Creek-Dry Canyon	Vermillion Creek	14N	102W	16
292	Reservoir	BLM	Shearing Barns Reservoir	BLM evaluated condition	Yes	Working	Private	41.175	-108.832	Upper Salt Wells Creek	Vermillion Creek	14N	101W	19
293	Reservoir	BLM	Canyon Creek Rd Reservoir	BLM evaluated condition	Yes	Working	Bureau of Land Management	41.013	-109.461	Flaming Gorge Reservoir-Chokecherry Draw	Spring Creek	12N	107W	22
294	Reservoir	BLM	Lousy George Reservoir	BLM evaluated condition	Yes	Working	State	41.108	-109.361	Upper Marsh Creek	Sugarloaf	13N	106W	16
295	Reservoir	BLM	Sand Knoll Reservoir	BLM evaluated condition	Yes	Working	Bureau of Land Management	41.116	-109.414	Upper Marsh Creek	Sugarloaf	13N	107W	12
296	Reservoir	BLM	Harris Reservoir	BLM evaluated condition	Yes	Working	Bureau of Land Management	41.089	-109.327	Middle Marsh Creek	Sugarloaf	13N	106W	23
297	Reservoir	BLM	Big Ridge Reservoir	BLM evaluated condition	Yes	Working	Bureau of Land Management	41.143	-109.310	Currant Creek	Sugarloaf	13N	106W	1
298	Reservoir	BLM	Brinegar Reservoir	BLM evaluated condition	Yes	Working	Bureau of Land Management	41.152	-109.321	Sugarloaf Marsh Creek	Sugarloaf	14N	106W	35
299	Reservoir	BLM	State Reservoir	BLM evaluated condition	Yes	Working	State	41.189	-109.147	Dans Creek	Mellor Mountain	14N	104W	17
300	Reservoir	BLM	Curly Horse Reservoir	BLM evaluated condition	Yes	Working	State	41.181	-109.151	Dans Creek	Mellor Mountain	14N	104W	20
301	Reservoir	BLM	Wild Horse Reservoir	BLM evaluated condition	Yes	Working	Bureau of Land Management	41.220	-109.118	Dans Creek	Mellor Mountain	14N	104W	3
302	Reservoir	BLM	Joyce Creek Reservoir	BLM evaluated condition	Yes	Working	Private	41.277	-109.097	Salt Wells Creek-Joyce Creek	Mellor Mountain	15N	104W	14
303	Reservoir	BLM	Bulrush Reservoir	BLM evaluated condition	Yes	Working	Private	41.284	-109.058	Salt Wells Creek-Joyce Creek	Mellor Mountain	15N	103W	18
304	Reservoir	BLM	Unknown	BLM evaluated condition	Yes	Working	Private	41.306	-108.621	Upper Antelope Creek	Rife	15N	100W	1
305	Reservoir	BLM	Unknown	BLM evaluated condition	Yes	Working	State	41.238	-108.838	Upper Salt Wells Creek	Vermillion Creek	15N	102W	36
306	Reservoir	BLM	Unknown	BLM evaluated condition	Yes	Working	State	41.087	-109.050	Salt Wells Creek-Corral Creek	Pine Mountain	13N	103W	19
307	Reservoir	BLM	Unknown	BLM evaluated condition	Yes	Working	State	41.101	-109.031	Salt Wells Creek-Corral Creek	Pine Mountain	13N	103W	17
308	Reservoir	BLM	Unknown	BLM evaluated condition	Yes	Working	State	41.061	-108.992	Salt Wells Creek-Corral Creek	Pine Mountain	13N	103W	34
309	Reservoir	BLM	Unknown	BLM evaluated condition	Yes	Working	State	41.056	-108.992	Salt Wells Creek-Corral Creek	Pine Mountain	13N	103W	34
310	Reservoir	BLM	Unknown	BLM evaluated condition	Yes	Working	State	41.055	-108.993	Salt Wells Creek-Corral Creek	Pine Mountain	12N	103W	3
311	Reservoir	SEO	SP-B2 RESERVOIR	No SEO stock use	No	N/A	Private	41.629	-108.625	Bitter Creek-Town of Hallville	Rock Springs	19N	100W	13
312	Reservoir	SEO	SP-B4 RESERVOIR	No SEO stock use	No	N/A	Bureau of Land Management	41.635	-108.631	Bitter Creek-Town of Hallville	Rock Springs	19N	100W	12
313	Reservoir	SEO	SP-LH6 RESERVOIR	No SEO stock use	No	N/A	Bureau of Land Management	41.735	-108.809	Middle Deadman Wash	Rock Springs	20N	101W	4
314	Reservoir	SEO	SP-LH7 RESERVOIR	No SEO stock use	No	N/A	Private	41.727	-108.804	Middle Deadman Wash	Rock Springs	20N	101W	9
315	Reservoir	SEO	SP-LH8 RESERVOIR	No SEO stock use	No	N/A	Private	41.724	-108.804	Middle Deadman Wash	Rock Springs	20N	101W	9
316	Reservoir	SEO	SP-LH9 RESERVOIR	No SEO stock use	No	N/A	Private	41.724	-108.819	Middle Deadman Wash	Rock Springs	20N	101W	8
317	Reservoir	SEO	COLONY COAL MINES NO. 1 AND NO. 2 RESERVOIR	wet in 2010, 2017	Yes	Working	Private	41.562	-109.215	Bitter Creek-Rock Springs	Rock Springs	18N	105W	2
318	Reservoir	SEO	SETTLING POND SP-J1 RESERVOIR	No SEO stock use	No	N/A	Private	41.530	-108.680	Bitter Creek-Town of Bitter Creek	Rock Springs	18N	100W	15
319	Reservoir	SEO	STANSBURY MINE WATER RESERVOIR	No SEO stock use	No	N/A	Bureau of Land Management	41.699	-109.194	Killpecker Creek-Reliance	Rock Springs	20N	105W	24
320	Reservoir	SEO	STANSBURY SEDIMENTATION RESERVOIR	No SEO stock use	No	N/A	Bureau of Land Management	41.701	-109.198	Killpecker Creek-Reliance	Rock Springs	20N	105W	24

ACE ID	Improvement Type	Source	Name	ACE_Notes	Water Source	Condition	Land_Owner	Lat	Long	HUC 12 Name	Allotment	T	R	S
321	Reservoir	SEO	ROMR60 RESERVOIR	No SEO stock use	No	N/A	Private	41.697	-108.647	Lower Deadman Wash	Rock Springs	20N	100W	23
322	Reservoir	SEO	SP-F10 RESERVOIR	No SEO stock use	No	N/A	Private	41.551	-108.685	Bitter Creek-Town of Black Buttes	Rock Springs	18N	100W	9
323	Reservoir	SEO	RED CREEK RANCH NO 1 STOCK RESERVOIR	dry in all yeas of photography (2009, 2012,2017) but no visible defects	Potential	Working	Bureau of Land Management	41.073	-109.086	Upper Red Creek	Not in Allotment	13N	104W	26
324	Reservoir	SEO	BLAIR STORAGE RESERVOIR	No Visible Reservoir	No	N/A	Private	41.398	-109.009	Salt Wells Creek-Joyce Creek	Circle Springs	16N	103W	4
325	Reservoir	SEO	BLAIR SUPPLY RESERVOIR	No Visible Reservoir, another point named same thing downstream of this location	No	N/A	Private	41.400	-109.038	Salt Wells Creek-Joyce Creek	Rock Springs	16N	103W	5
326	Reservoir	SEO	ENL JIM BRIDGER PROJECT FGD SPENT LIQUOR POND NO 2 RESERVOIR	No SEO stock use	No	N/A	Private	41.755	-108.799	Middle Deadman Wash	Rock Springs	21N	101W	36
327	Reservoir	SEO	RP-B5 RESERVOIR	No SEO stock use	No	N/A	Bureau of Land Management	41.616	-108.630	Bitter Creek-Town of Black Buttes	Rock Springs	19N	100W	24
328	Reservoir	SEO	SP-LH10 RESERVOIR	No SEO stock use	No	N/A	Private	41.697	-108.766	Middle Deadman Wash	Rock Springs	20N	101W	23
329	Reservoir	SEO	GOOKINS NO. 1 STOCK RESERVOIR	No Visible Reservoir	No	N/A	Bureau of Land Management	41.584	-109.279	Bitter Creek-Rock Springs	Rock Springs	19N	105W	32
330	Reservoir	SEO	BLUE TANK STOCK RESERVOIR	wet in 2009, 2012, 2017	Yes	Working	State	41.233	-108.836	Upper Salt Wells Creek	Vermillion Creek	15N	102W	36
331	Reservoir	SEO	PIT 11 SEDIMENTATION POND SP-A2 DIVERSION CHANNEL DC-H1	No SEO stock use	No	N/A	Bureau of Land Management	41.634	-108.662	Bitter Creek-Town of Hallville	Rock Springs	19N	100W	10
332	Reservoir	SEO	HOLDING POND J STOCK RESERVOIR	wet in 2009, 2012 and 2017	Yes	Working	Private	41.784	-108.731	Upper Deadman Wash	Rock Springs	21N	100W	21
333	Reservoir	SEO	UNDERGROUND MINE FACILITY SEWAGE RESERVOIR	No SEO stock use	No	N/A	Private	41.799	-108.793	Upper Deadman Wash	Rock Springs	21N	101W	13
334	Reservoir	SEO	SEDIMENT POND SP-K7 RESERVOIR	No SEO stock use	No	N/A	Private	41.470	-108.809	Middle Black Butte Creek	Rock Springs	17N	101W	9
335	Reservoir	SEO	SEDIMENT POND SP-K1 RESERVOIR	No SEO stock use	No	N/A	Bureau of Land Management	41.507	-108.762	1.40401E+11	Rock Springs	18N	101W	26
336	Reservoir	SEO	SEDIMENT POND SP-K2 RESERVOIR	No SEO stock use	No	N/A	Bureau of Land Management	41.503	-108.757	1.40401E+11	Rock Springs	18N	101W	26
337	Reservoir	SEO	SEDIMENT POND SP-K3 RESERVOIR	No SEO stock use	No	N/A	Private	41.499	-108.759	1.40401E+11	Rock Springs	18N	101W	35
338	Reservoir	SEO	SEDIMENT POND SP-K4 RESERVOIR	No SEO stock use	No	N/A	Private	41.478	-108.775	1.40401E+11	Rock Springs	17N	101W	3
339	Reservoir	SEO	SEDIMENT POND SP-K5 RESERVOIR	No SEO stock use	No	N/A	Private	41.460	-108.795	Middle Black Butte Creek	Rock Springs	17N	101W	9
340	Reservoir	SEO	SEDIMENT POND SP-K6 RESERVOIR	No SEO stock use	No	N/A	Bureau of Land Management	41.456	-108.809	Middle Black Butte Creek	Rock Springs	17N	101W	16
341	Reservoir	SEO	JOHN ERICKSON RESERVOIR	No Visible Reservoir	No	N/A	State	41.065	-109.028	Upper Red Creek	Red Creek	13N	103W	32
342	Reservoir	SEO	BBCC P4-1 STOCK RESERVOIR	wet in 2017 imagery, no other years (2009,2012) but no visible defects	Potential	Working	Bureau of Land Management	41.572	-108.639	Bitter Creek-Town of Black Buttes	Rock Springs	18N	100W	2
343	Reservoir	SEO	SWEENEY RESERVOIR	No Visible Reservoir	No	N/A	Private	41.480	-109.065	South Baxter Basin	Rock Springs	17N	103W	6
344	Reservoir	SEO	DRY LAKE RESERVOIR	No SEO stock use	No	N/A	Bureau of Land Management	41.533	-109.062	South Baxter Basin	Rock Springs	18N	103W	18
345	Reservoir	SEO	DALEY DAM STOCK RESERVOIR	wet in 2009, 2012, and 2017	Yes	Working	Bureau of Land Management	41.538	-108.272	Laney Wash	Tipton	18N	96W	18
346	Reservoir	SEO	LITTLE BASIN RESERVOIR NO. 1	dry in all yeas of photography (2009, 2012,2017) but no visible defects	Potential	Working	Private	41.173	-109.113	Gap Creek	Salt Wells	14N	104W	22
347	Reservoir	SEO	ROCKY POINT INDEX NO 4348 STOCK RESERVOIR	No Visible Reservoir	No	N/A	Bureau of Land Management	41.502	-108.264	Laney Wash	Tipton	18N	96W	30
348	Reservoir	SEO	EVAPORATION POND EP-1 RESERVOIR	No SEO stock use	No	N/A	Bureau of Land Management	41.575	-108.699	Bitter Creek-Town of Black Buttes	Not in Allotment	19N	100W	32
349	Reservoir	SEO	EVAPORATION POND EP-2 RESERVOIR	No SEO stock use	No	N/A	Bureau of Land Management	41.566	-108.689	Bitter Creek-Town of Black Buttes	Rock Springs	18N	100W	4
350	Reservoir	SEO	EVAPORATION POND EP-8 RESERVOIR	No SEO stock use	No	N/A	Bureau of Land Management	41.564	-108.692	Bitter Creek-Town of Black Buttes	Rock Springs	18N	100W	4
351	Reservoir	SEO	EVAPORATION POND EP-6 RESERVOIR	No SEO stock use	No	N/A	Private	41.568	-108.700	Bitter Creek-Town of Black Buttes	Rock Springs	18N	100W	5
352	Reservoir	SEO	SETTLING POND SP-DS1 RESERVOIR	No SEO stock use	No	N/A	Bureau of Land Management	41.586	-108.702	Bitter Creek-Town of Black Buttes	Not in Allotment	19N	100W	32
353	Reservoir	SEO	SETTLING POND SP-DS2 RESERVOIR	No SEO stock use	No	N/A	Bureau of Land Management	41.589	-108.699	Bitter Creek-Town of Black Buttes	Not in Allotment	19N	100W	28
354	Reservoir	SEO	LOCFF AND JACOB RESERVOIR	No Visible Reservoir	No	N/A	Private	41.385	-109.124	Pretty Water Creek	Rock Springs	16N	104W	9
355	Reservoir	SEO	SETTLING POND SP-J2	No SEO stock use	No	N/A	Private	41.520	-108.692	Bitter Creek-Town of Bitter Creek	Rock Springs	18N	100W	21
356	Reservoir	SEO	SP-F1	No SEO stock use	No	N/A	Private	41.579	-108.686	Bitter Creek-Town of Black Buttes	Rock Springs	19N	100W	33
357	Reservoir	SEO	SP-F2	No SEO stock use	No	N/A	Bureau of Land Management	41.561	-108.698	Bitter Creek-Town of Black Buttes	Rock Springs	18N	100W	4
358	Reservoir	SEO	SETTLING PON SP-DN RESERVOIR	No SEO stock use	No	N/A	Private	41.593	-108.698	Bitter Creek-Town of Black Buttes	Not in Allotment	19N	100W	28
359	Reservoir	SEO	SP-F9 RESERVOIR	No SEO stock use	No	N/A	Bureau of Land Management	41.570	-108.691	Bitter Creek-Town of Black Buttes	Not in Allotment	18N	100W	4
360	Reservoir	SEO	SP-F3 RESERVOIR	No SEO stock use	No	N/A	Bureau of Land Management	41.563	-108.687	Bitter Creek-Town of Black Buttes	Rock Springs	18N	100W	4
361	Reservoir	SEO	SP-H6	No SEO stock use	No	N/A	Bureau of Land Management	41.566	-108.649	Bitter Creek-Town of Black Buttes	Rock Springs	18N	100W	2
362	Reservoir	SEO	JB-FP-1 RESERVOIR	No SEO stock use	No	N/A	Private	41.742	-108.781	Middle Deadman Wash	Rock Springs	20N	101W	3

ACE ID	Improvement Type	Source	Name	ACE_Notes	Water Source	Condition	Land_Owner	Lat	Long	HUC 12 Name	Allotment	T	R	S
363	Reservoir	SEO	RP-D1 RESERVOIR	No SEO stock use	No	N/A	Private	41.603	-108.660	Bitter Creek-Town of Black Buttes	Rock Springs	19N	100W	23
364	Reservoir	SEO	A B C AND D RESERVOIR	No SEO stock use	No	N/A	Private	41.730	-108.770	Middle Deadman Wash	Rock Springs	20N	101W	11
365	Reservoir	SEO	SWEETWATER COUNTY FAIRGROUNDS FISH PRESERVE RESERVOIR	No SEO stock use	No	N/A	Private	41.634	-109.235	Killpecker Creek-Reliance	Rock Springs	19N	105W	10
366	Reservoir	SEO	SP-J3 RESERVOIR	No SEO stock use	No	N/A	Bureau of Land Management	41.524	-108.668	Bitter Creek-Town of Bitter Creek	Rock Springs	18N	100W	22
367	Reservoir	SEO	SP-J4 RESERVOIR	No SEO stock use	No	N/A	Bureau of Land Management	41.497	-108.707	Bitter Creek-Town of Bitter Creek	Rock Springs	18N	100W	32
368	Reservoir	SEO	SP-H5 RESERVOIR	No SEO stock use	No	N/A	Bureau of Land Management	41.570	-108.650	Bitter Creek-Town of Black Buttes	Rock Springs	18N	100W	2
369	Reservoir	SEO	CONTAINMENT PONDS CP J1 CP J2 RESERVOIR	No SEO stock use	No	N/A	Bureau of Land Management	41.505	-108.693	Bitter Creek-Town of Bitter Creek	Rock Springs	18N	100W	28
370	Reservoir	SEO	JB-SRC-3 RESERVOIR	No SEO stock use	No	N/A	Private	41.736	-108.781	Middle Deadman Wash	Rock Springs	20N	101W	3
371	Reservoir	SEO	SP-H12 RESERVOIR	No SEO stock use	No	N/A	Bureau of Land Management	41.554	-108.659	Bitter Creek-Town of Black Buttes	Rock Springs	18N	100W	10
372	Reservoir	SEO	SP-F11 RESERVOIR	No SEO stock use	No	N/A	Bureau of Land Management	41.561	-108.695	Bitter Creek-Town of Black Buttes	Rock Springs	18N	100W	4
373	Reservoir	SEO	SP-E1 RESERVOIR	No SEO stock use	No	N/A	Bureau of Land Management	41.524	-108.717	1.40401E+11	Rock Springs	18N	100W	20
374	Reservoir	SEO	SP-E2 RESERVOIR	No SEO stock use	No	N/A	Bureau of Land Management	41.521	-108.712	1.40401E+11	Rock Springs	18N	100W	20
375	Reservoir	SEO	CHEVRON CLEAR WATER RESERVOIR	No SEO stock use	No	N/A	State	41.540	-109.145	Sweetwater Creek-Bitter Creek	Rock Springs	18N	104W	16
376	Reservoir	SEO	CHEVRON GYPSUM RESERVOIR	No SEO stock use	No	N/A	State	41.533	-109.155	Sweetwater Creek-Bitter Creek	Rock Springs	18N	104W	16
377	Reservoir	SEO	BOB GRAHAM RESERVOIR	No SEO stock use	No	N/A	Private	41.540	-109.225	Sweetwater Creek-Bitter Creek	Rock Springs	18N	105W	14
378	Reservoir	SEO	JB-FP-2 RESERVOIR	No SEO stock use	No	N/A	Private	41.742	-108.785	Middle Deadman Wash	Rock Springs	20N	101W	3
379	Reservoir	SEO	JB-27 RESERVOIR	No SEO stock use	No	N/A	Bureau of Land Management	41.777	-108.755	Upper Deadman Wash	Rock Springs	21N	100W	20
380	Reservoir	SEO	SP-F12 RESERVOIR	No SEO stock use	No	N/A	Private	41.550	-108.689	Bitter Creek-Town of Black Buttes	Rock Springs	18N	100W	9
381	Reservoir	SEO	SP-F8A RESERVOIR	No SEO stock use	No	N/A	Private	41.560	-108.678	Bitter Creek-Town of Black Buttes	Rock Springs	18N	100W	3
382	Reservoir	SEO	JB-26 RESERVOIR	No SEO stock use	No	N/A	Bureau of Land Management	41.777	-108.751	Upper Deadman Wash	Rock Springs	21N	100W	20
383	Reservoir	SEO	RP-J1 RESERVOIR	No SEO stock use	No	N/A	Private	41.478	-108.742	Bitter Creek-Town of Bitter Creek	Rock Springs	17N	101W	1
384	Reservoir	SEO	SP-J7 RESERVOIR	No SEO stock use	No	N/A	Bureau of Land Management	41.485	-108.723	Bitter Creek-Town of Bitter Creek	Rock Springs	17N	100W	6
385	Reservoir	SEO	SP-J6 RESERVOIR	No SEO stock use	No	N/A	Bureau of Land Management	41.478	-108.728	Bitter Creek-Town of Bitter Creek	Rock Springs	17N	100W	6
386	Reservoir	SEO	SP-J4A RESERVOIR	No SEO stock use	No	N/A	Bureau of Land Management	41.496	-108.706	Bitter Creek-Town of Bitter Creek	Rock Springs	18N	100W	32
387	Reservoir	SEO	SP F13 RESERVOIR	No SEO stock use	No	N/A	Private	41.537	-108.684	Bitter Creek-Town of Bitter Creek	Rock Springs	18N	100W	16
388	Reservoir	SEO	SP DS3 RESERVOIR	No SEO stock use	No	N/A	Private	41.582	-108.687	Bitter Creek-Town of Black Buttes	Not in Allotment	19N	100W	33
389	Reservoir	SEO	SP I4 RESERVOIR	No SEO stock use	No	N/A	Private	41.532	-108.737	1.40401E+11	Rock Springs	18N	101W	13
390	Reservoir	SEO	T D S POND-2 RESERVOIR	No SEO stock use	No	N/A	Private	41.776	-108.763	Upper Deadman Wash	Rock Springs	21N	100W	19
391	Reservoir	SEO	T D S POND-1 RESERVOIR	No SEO stock use	No	N/A	Bureau of Land Management	41.759	-108.741	Upper Deadman Wash	Rock Springs	21N	100W	28
392	Reservoir	SEO	SP-LH2 RESERVOIR	No SEO stock use	No	N/A	Private	41.745	-108.833	Middle Deadman Wash	Rock Springs	21N	101W	34
393	Reservoir	SEO	SP-H13 RESERVOIR	No SEO stock use	No	N/A	Bureau of Land Management	41.539	-108.655	Bitter Creek-Town of Bitter Creek	Rock Springs	18N	100W	14
394	Reservoir	SEO	SP-H14 RESERVOIR	No SEO stock use	No	N/A	Private	41.535	-108.667	Bitter Creek-Town of Bitter Creek	Rock Springs	18N	100W	15
395	Reservoir	SEO	ENL JIM BRIDGER POWER PLANT SUGE POND RESERVOIR	No SEO stock use	No	N/A	Bureau of Land Management	41.730	-108.782	Middle Deadman Wash	Rock Springs	20N	101W	10
396	Reservoir	SEO	SP-LH1 RESERVOIR	No SEO stock use	No	N/A	Bureau of Land Management	41.752	-108.828	Middle Deadman Wash	Rock Springs	21N	101W	34
397	Reservoir	SEO	SUPERIOR MUNICIPAL SEWAGE TREATMENT RESERVOIR	No SEO stock use	No	N/A	Bureau of Land Management	41.743	-108.948	Horsethief Canyon	Rock Springs	21N	102W	34
398	Reservoir	SEO	INTERCITY WASTEWATER TREATMENT	No SEO stock use	No	N/A	Private	41.544	-109.317	Bitter Creek-Kanda	Rock Springs	18N	106W	13
399	Reservoir	SEO	SP-LH3 RESERVOIR	No SEO stock use	No	N/A	Private	41.743	-108.812	Middle Deadman Wash	Rock Springs	20N	101W	5
400	Reservoir	SEO	SP-LH4 RESERVOIR	No SEO stock use	No	N/A	Private	41.735	-108.824	Middle Deadman Wash	Rock Springs	20N	101W	5
401	Reservoir	SEO	JIM BRIDGER PROJECT-FGD SPENT LIQUOR POND NO. 2 RESERVOIR	Industrial ponds for Jim Bridger Project,No SEO stock use	No	N/A	Private	41.756	-108.794	Middle Deadman Wash	Rock Springs	21N	101W	36
402	Reservoir	SEO	JIM BRIDGER PROJECT -EVAPORATION POND RESERVOIR	Industrial ponds for Jim Bridger Project,No SEO stock use	No	N/A	Private	41.747	-108.793	Middle Deadman Wash	Rock Springs	21N	101W	36
403	Reservoir	SEO	ARROWHEAD SPRINGS FISHING RESERVOIR	No SEO stock use	No	N/A	Private	41.503	-109.152	Sweetwater Creek-Bitter Creek	Rock Springs	18N	104W	28
404	Reservoir	SEO	SP-B1 RESERVOIR	No SEO stock use	No	N/A	Private	41.633	-108.641	Bitter Creek-Town of Hallville	Rock Springs	19N	100W	11

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405	Reservoir	SEO	SP-I5 RESERVOIR	No SEO stock use	No	N/A	Private	41.557	-108.722	Bitter Creek-Town of Black Buttes	Rock Springs	18N	100W	7
406	Reservoir	SEO	SP-I6 RESERVOIR	No SEO stock use	No	N/A	Private	41.546	-108.722	Bitter Creek-Town of Black Buttes	Rock Springs	18N	100W	7
407	Reservoir	SEO	TDS POND NO 3 RESERVOIR	No SEO stock use	No	N/A	Private	41.738	-108.704	Middle Deadman Wash	Rock Springs	20N	100W	5
408	Reservoir	SEO	RP-LH1 AND RP-LH2 RESERVOIR	No SEO stock use	No	N/A	Bureau of Land Management	41.748	-108.866	Middle Deadman Wash	Rock Springs	21N	101W	32
409	Reservoir	SEO	CP-J3A RESERVOIR	No SEO stock use	No	N/A	Bureau of Land Management	41.493	-108.709	Bitter Creek-Town of Bitter Creek	Rock Springs	18N	100W	32
410	Reservoir	SEO	SP-I1 RESERVOIR	No SEO stock use	No	N/A	Private	41.571	-108.713	Bitter Creek-Town of Black Buttes	Rock Springs	18N	100W	5
411	Reservoir	SEO	SP-I3 RESERVOIR	No SEO stock use	No	N/A	Private	41.561	-108.712	Bitter Creek-Town of Black Buttes	Rock Springs	18N	100W	5
412	Reservoir	SEO	SP-I7A RESERVOIR	No SEO stock use	No	N/A	Bureau of Land Management	41.542	-108.721	Bitter Creek-Town of Black Buttes	Rock Springs	18N	100W	18
413	Reservoir	SEO	SP-I2 RESERVOIR	No SEO stock use	No	N/A	Bureau of Land Management	41.557	-108.715	Bitter Creek-Town of Black Buttes	Rock Springs	18N	100W	8
414	Reservoir	SEO	CP-I1 RESERVOIR	No SEO stock use	No	N/A	Private	41.551	-108.721	Bitter Creek-Town of Black Buttes	Rock Springs	18N	100W	7
415	Reservoir	SEO	BLAIR STORAGE RESERVOIR	No Visible Reservoir	No	N/A	Bureau of Land Management	41.398	-109.021	Salt Wells Creek-Joyce Creek	Circle Springs	16N	103W	4
416	Reservoir	SEO	BLAIR SUPPLY RESERVOIR	Breached	No	Breached	Private	41.401	-109.033	Salt Wells Creek-Joyce Creek	Rock Springs	17N	103W	33
417	Reservoir	SEO	FRANK TOW AND HOLMES RESERVOIR	No Visible Reservoir	No	N/A	Private	41.255	-109.529	Currant Creek	Rock Springs	15N	108W	25
418	Reservoir	SEO	SWEETWATER COUNTY FAIRGROUNDS FISH PRESERVE RESERVOIR	No SEO stock use	No	N/A	Private	41.635	-109.236	Killpecker Creek-Reliance	Not in Allotment	19N	105W	10
419	Reservoir	SEO	LITTLE BASIN RESERVOIR NO. THREE	No Visible Reservoir	No	N/A	Private	41.179	-109.113	Gap Creek	Salt Wells	14N	104W	22
420	Reservoir	SEO	ROCKY POINT STOCK RESERVOIR	Wet in 2009, no other years, no visible defects	Potential	Unknown	Bureau of Land Management	41.504	-108.262	Laney Wash	Tipton	18N	96W	30
421	Reservoir	SEO	DEAD HORSE DETENTION BASIN RESERVOIR	No SEO stock use	No	N/A	Bureau of Land Management	41.572	-109.187	Bitter Creek-Rock Springs	Rock Springs	18N	104W	6
422	Reservoir	SEO	TRIBUTARY NO. 2 DETENTION BASIN RESERVOIR	No SEO stock use	No	N/A	Private	41.568	-109.205	Bitter Creek-Rock Springs	Not in Allotment	18N	105W	1
423	Reservoir	SEO	FP-3 RESERVOIR	No SEO stock use	No	N/A	Private	41.799	-108.796	Upper Deadman Wash	Rock Springs	21N	101W	13
424	Reservoir	SEO	FP-4 RESERVOIR	No SEO stock use	No	N/A	Bureau of Land Management	41.805	-108.797	Upper Deadman Wash	Rock Springs	21N	101W	12
425	Reservoir	SEO	FP-5 RESERVOIR	No SEO stock use	No	N/A	Bureau of Land Management	41.804	-108.797	Upper Deadman Wash	Rock Springs	21N	101W	12
426	Reservoir	SEO	FP-6 RESERVOIR	No SEO stock use	No	N/A	Bureau of Land Management	41.807	-108.789	Upper Deadman Wash	Rock Springs	21N	101W	12
427	Reservoir	SEO	GOLF COURSE- CLUBHOUSE POND	No SEO stock use	No	N/A	Private	41.641	-109.242	Killpecker Creek-Reliance	Not in Allotment	19N	105W	10
428	Reservoir	SEO	GOLF COURSE- FISHING POND	No SEO stock use	No	N/A	Private	41.643	-109.249	Killpecker Creek-Reliance	Not in Allotment	19N	105W	10
429	Reservoir	SEO	GOLF COURSE- POND NO 3	No SEO stock use	No	N/A	Private	41.646	-109.250	Killpecker Creek-Reliance	Not in Allotment	19N	105W	10
430	Reservoir	SEO	GOLF COURSE- POND NO 9	No SEO stock use	No	N/A	Private	41.643	-109.242	Killpecker Creek-Reliance	Not in Allotment	19N	105W	10
431	Reservoir	SEO	GOLF COURSE PONDS NO 1A 1B 1C 6 AND 7	No SEO stock use	No	N/A	Private	41.645	-109.239	Killpecker Creek-Reliance	Not in Allotment	19N	105W	10
432	Reservoir	SEO	LIONKOL STOCK RESERVOIR	Wet in 2015, 2017. Looks like it was created in 2012.	Yes	Working	Private	41.636	-109.211	Killpecker Creek-Reliance	Rock Springs	19N	105W	12
433	Reservoir	SEO	GOLF COURSE - PONDS NOS 1A 1B 1C 6 AND 7 RESERVOIR	No SEO stock use	No	N/A	Private	41.645	-109.239	Killpecker Creek-Reliance	Not in Allotment	19N	105W	10
434	Reservoir	SEO	TALIAFERRO	No SEO stock use	No	N/A	US Forest Service	41.487	-109.431	Green River-Middle Firehole Canyon	Not in Allotment	17N	107W	1
435	Reservoir	SEO	WILD HORSE	No Visible Reservoir	No	N/A	Bureau of Land Management	41.630	-109.226	Killpecker Creek-Reliance	Rock Springs	19N	105W	14
436	Reservoir	SEO	SWEENEY RANCH POND 2	wet in 2009, 2012,2017	Yes	Working	Private	41.435	-109.078	Salt Wells Creek-Spring Creek	Rock Springs	17N	103W	19
437	Reservoir	SEO	SWEENEY RANCH POND 3	wet in 2009, 2012,2017	Yes	Working	Private	41.431	-109.086	Salt Wells Creek-Spring Creek	Rock Springs	17N	104W	24
438	Reservoir	SEO	HOLDING POND R56	No SEO stock use	No	N/A	Private	41.729	-108.653	Lower Deadman Wash	Rock Springs	20N	100W	11
439	Reservoir	SEO	HOME POINT	wet in 2014, and 2017. Constructed after 2012 imagery?	Yes	Working	Private	41.681	-108.786	Bitter Creek-Coon Draw	Not in Allotment	20N	101W	27
440	Reservoir	SEO	HOLDING POND R61	No SEO stock use	No	N/A	Bureau of Land Management	41.678	-108.656	Lower Deadman Wash	Rock Springs	20N	100W	26

APPENDIX 5A

MEAN ANNUAL RUNOFF PER HUC 12 – LOWHAM METHOD

Appendix 5A - Mean Annual Runoff - Lowham Method

High Desert Region

$$Q = 0.0021 \cdot [A^{0.88}] \cdot [P^{1.19}]$$

Mountainous Region

$$Q = 0.013 \cdot [A^{0.93}] \cdot [P^{1.43}]$$

Where A is drainage area (sq mi), P is mean annual precipitation (in), Q is mean annual discharge (cfs)

HUC 12	Lowham Hydrologic Region	Precipitation Gage (for Wet/Dry Estimation)	Area (sq mi)	Mean Annual Precipitation (in)			Annual Runoff CFS			Acre-Ft/ year/sq mile			Notes
				Normal (PRISM)	Dry	Wet	Normal (PRISM)	Dry	Wet	Normal (PRISM)	Dry	Wet	
1 - 140401050102	High Desert Region	Rock Springs AP	49.0	8.65	4.84	11.41	0.84	0.42	1.17	12.5	6.3	17.4	
2 - 140401050205	High Desert Region	Rock Springs AP	23.7	8.11	4.84	11.41	0.41	0.22	0.62	12.7	6.8	19.0	
3 - 140401050502	High Desert Region	Rock Springs AP	40.1	8.56	4.84	11.41	0.70	0.35	0.98	12.7	6.4	17.8	
4 - 140401050503	High Desert Region	Rock Springs AP	46.0	8.50	4.84	11.41	0.78	0.40	1.11	12.4	6.3	17.5	
5 - Big Flat Draw	High Desert Region	Rock Springs AP	19.6	9.06	4.84	11.41	0.40	0.19	0.52	14.8	7.0	19.4	
6 - Bitter Creek-Big Pond Station	High Desert Region	Rock Springs AP	19.4	7.10	4.84	11.41	0.29	0.19	0.52	11.1	7.0	19.5	
7 - Bitter Creek-Coon Draw	High Desert Region	Rock Springs AP	43.2	8.35	4.84	11.41	0.72	0.38	1.05	12.2	6.4	17.7	
8 - Bitter Creek-Hungry Hollow	High Desert Region	Rock Springs AP	42.2	7.44	4.84	11.41	0.62	0.37	1.03	10.7	6.4	17.7	
9 - Bitter Creek-Kanda	High Desert Region	Rock Springs AP	35.0	8.73	4.84	11.41	0.63	0.31	0.87	13.2	6.5	18.1	
10 - Bitter Creek-Rock Springs	High Desert Region	Rock Springs AP	62.4	8.93	4.84	11.41	1.08	0.52	1.45	12.6	6.1	16.9	
11 - Bitter Creek-Town of Bitter Creek	High Desert Region	Rock Springs AP	44.6	7.14	4.84	11.41	0.62	0.39	1.08	10.1	6.3	17.6	
12 - Bitter Creek-Town of Black Buttes	High Desert Region	Rock Springs AP	39.9	7.17	4.84	11.41	0.56	0.35	0.98	10.3	6.4	17.8	
13 - Bitter Creek-Town of Hallville	High Desert Region	Rock Springs AP	46.6	7.56	4.84	11.41	0.68	0.40	1.12	10.7	6.3	17.5	
14 - Cedar Canyon	High Desert Region	Rock Springs AP	22.4	8.89	4.84	11.41	0.44	0.21	0.59	14.2	6.9	19.1	
15 - Cedar Creek-Little Bitter Creek	High Desert Region	Rock Springs AP	21.2	10.73	4.84	11.41	0.52	0.20	0.56	17.9	6.9	19.3	
16 - Clay Basin Creek	High Desert Region	Flaming Gorge	2.5	14.76	9.86	15.89	0.12	0.07	0.13	33.8	20.9	36.9	Partial watershed area, clipped to watershed boundary
17 - Currant Creek	High Desert Region	Flaming Gorge	49.3	12.63	9.86	15.89	1.33	0.99	1.74	19.6	14.6	25.8	
18 - Dans Creek	High Desert Region	Flaming Gorge	20.1	10.93	9.86	15.89	0.51	0.45	0.79	18.4	16.3	28.7	
19 - Firehole Canyon	High Desert Region	Rock Springs AP	41.0	9.94	4.84	11.41	0.85	0.36	1.00	15.1	6.4	17.8	
20 - Flaming Gorge Reservoir-Buckboard Reservoir	High Desert Region	Rock Springs AP	28.0	9.60	4.84	11.41	0.58	0.26	0.71	15.2	6.7	18.6	Partial watershed area, clipped to watershed boundary
21 - Flaming Gorge Reservoir-Chokecherry Draw	High Desert Region	Rock Springs AP	16.8	10.31	4.84	11.41	0.40	0.16	0.46	17.6	7.1	19.8	Partial watershed area, clipped to watershed boundary
22 - Flaming Gorge Reservoir-Spring Creek	High Desert Region	Flaming Gorge	34.1	12.59	9.86	15.89	0.95	0.71	1.26	20.4	15.3	27.0	Partial watershed area, clipped to watershed boundary
23 - Flaming Gorge Reservoir-Squaw Hollow	High Desert Region	Rock Springs AP	12.9	9.45	4.84	11.41	0.29	0.13	0.36	16.3	7.4	20.4	Partial watershed area, clipped to watershed boundary
24 - Gap Creek	High Desert Region	Flaming Gorge	55.6	11.52	9.86	15.89	1.32	1.10	1.94	17.3	14.4	25.4	
25 - Green River-Chicken Springs Draw	High Desert Region	Rock Springs AP	52.4	8.52	4.84	11.41	0.88	0.45	1.24	12.2	6.2	17.3	
26 - Green River-Middle Firehole Canyon	High Desert Region	Rock Springs AP	58.2	8.99	4.84	11.41	1.02	0.49	1.36	12.8	6.1	17.1	
27 - Henrys Fork-Cottonwood Creek	High Desert Region	Flaming Gorge	14.0	10.92	9.86	15.89	0.37	0.33	0.58	19.2	17.0	30.0	Partial watershed area, clipped to watershed boundary
28 - Horsethief Canyon	High Desert Region	Rock Springs AP	28.7	8.51	4.84	11.41	0.51	0.26	0.73	13.1	6.7	18.6	
29 - Iron Pipe Draw	High Desert Region	Rock Springs AP	30.7	7.78	4.84	11.41	0.49	0.28	0.77	11.7	6.6	18.4	
30 - Killpecker Creek-140401050805	High Desert Region	Rock Springs AP	33.5	8.79	4.84	11.41	0.61	0.30	0.84	13.4	6.6	18.2	
31 - Killpecker Creek-Boars Tusk	High Desert Region	Rock Springs AP	66.1	8.55	4.84	11.41	1.08	0.55	1.52	11.9	6.1	16.8	
32 - Killpecker Creek-Fourteenmile Creek	High Desert Region	Rock Springs AP	44.3	9.15	4.84	11.41	0.82	0.39	1.07	13.6	6.4	17.6	
33 - Killpecker Creek-Pine Canyon	High Desert Region	Rock Springs AP	41.3	8.42	4.84	11.41	0.70	0.36	1.01	12.4	6.4	17.8	
34 - Killpecker Creek-Reliance	High Desert Region	Rock Springs AP	44.2	9.53	4.84	11.41	0.86	0.38	1.07	14.2	6.4	17.6	
35 - Laney Wash	High Desert Region	Rock Springs AP	56.3	8.37	4.84	11.41	0.91	0.48	1.32	11.8	6.2	17.1	
36 - Long Canyon	High Desert Region	Rock Springs AP	34.8	8.94	4.84	11.41	0.65	0.31	0.87	13.6	6.5	18.1	
37 - Lower Antelope Creek	High Desert Region	Rock Springs AP	38.3	8.40	4.84	11.41	0.65	0.34	0.94	12.5	6.5	17.9	
38 - Lower Black Butte Creek	High Desert Region	Rock Springs AP	37.7	8.58	4.84	11.41	0.66	0.33	0.93	12.8	6.5	18.0	
39 - Lower Deadman Wash	High Desert Region	Rock Springs AP	53.1	7.21	4.84	11.41	0.73	0.45	1.25	10.0	6.2	17.2	
40 - Lower Little Bitter Creek	High Desert Region	Rock Springs AP	41.3	9.49	4.84	11.41	0.81	0.36	1.01	14.3	6.4	17.8	
41 - Lower Patrick Draw	High Desert Region	Rock Springs AP	61.8	6.68	4.84	11.41	0.76	0.52	1.43	9.0	6.1	16.9	

Appendix 5A - Mean Annual Runoff - Lowham Method

High Desert Region

$$Q = 0.0021 \cdot [A^{0.88}] \cdot [P^{1.19}]$$

Mountainous Region

$$Q = 0.013 \cdot [A^{0.93}] \cdot [P^{1.43}]$$

Where A is drainage area (sq mi), P is mean annual precipitation (in), Q is mean annual discharge (cfs)

HUC 12	Lowham Hydrologic Region	Precipitation Gage (for Wet/Dry Estimation)	Area (sq mi)	Mean Annual Precipitation (in)			Annual Runoff CFS			Acre-Ft/ year/sq mile			Notes
				Normal (PRISM)	Dry	Wet	Normal (PRISM)	Dry	Wet	Normal (PRISM)	Dry	Wet	
42 - Lower Red Creek	High Desert Region	Flaming Gorge	5.1	12.01	9.86	15.89	0.17	0.13	0.24	24.3	19.2	33.9	Partial watershed area, clipped to watershed boundary
43 - Lower Salt Wells Creek	High Desert Region	Rock Springs AP	38.3	9.49	4.84	11.41	0.76	0.34	0.94	14.4	6.5	17.9	
44 - Middle Black Butte Creek	High Desert Region	Rock Springs AP	52.5	8.56	4.84	11.41	0.88	0.45	1.24	12.3	6.2	17.3	
45 - Middle Deadman Wash	High Desert Region	Rock Springs AP	51.5	7.99	4.84	11.41	0.80	0.44	1.22	11.3	6.2	17.3	
46 - Middle Little Bitter Creek	High Desert Region	Rock Springs AP	40.0	9.93	4.84	11.41	0.83	0.35	0.98	15.1	6.4	17.8	
47 - Middle Marsh Creek	High Desert Region	Flaming Gorge	29.7	11.48	9.86	15.89	0.76	0.63	1.12	18.6	15.5	27.4	
48 - Middle Red Creek	High Desert Region	Flaming Gorge	53.2	11.79	9.86	15.89	1.31	1.06	1.86	17.9	14.5	25.6	
49 - Nitch Creek	High Desert Region	Rock Springs AP	29.8	9.57	4.84	11.41	0.61	0.27	0.75	15.0	6.7	18.5	
50 - Patrick Draw	High Desert Region	Rock Springs AP	36.2	7.96	4.84	11.41	0.58	0.32	0.89	11.8	6.5	18.1	
51 - Polly Draw	High Desert Region	Flaming Gorge	29.4	10.86	9.86	15.89	0.70	0.63	1.11	17.5	15.6	27.5	
52 - Pretty Water Creek	High Desert Region	Rock Springs AP	50.3	9.82	4.84	11.41	1.00	0.43	1.20	14.5	6.3	17.4	
53 - Red Wash	High Desert Region	Rock Springs AP	41.3	7.58	4.84	11.41	0.62	0.36	1.01	10.9	6.4	17.8	
54 - Sage Creek-Greasewood Draw	High Desert Region	Rock Springs AP	66.5	10.39	4.84	11.41	1.37	0.55	1.53	15.0	6.1	16.8	
55 - Sage Creek-Trout Creek	High Desert Region	Flaming Gorge	61.1	12.16	9.86	15.89	1.53	1.19	2.10	18.3	14.3	25.2	
56 - Salt Wells Creek-140401050704	High Desert Region	Rock Springs AP	46.1	8.52	4.84	11.41	0.78	0.40	1.11	12.4	6.3	17.5	
57 - Salt Wells Creek-Corral Creek	High Desert Region	Flaming Gorge	45.4	13.12	9.86	15.89	1.29	0.92	1.62	20.8	14.8	26.1	
58 - Salt Wells Creek-Dry Canyon	High Desert Region	Flaming Gorge	30.5	11.36	9.86	15.89	0.77	0.65	1.14	18.3	15.5	27.3	
59 - Salt Wells Creek-Joyce Creek	High Desert Region	Rock Springs AP	49.1	9.60	4.84	11.41	0.95	0.42	1.17	14.2	6.3	17.4	
60 - Salt Wells Creek-Spring Creek	High Desert Region	Rock Springs AP	54.8	9.16	4.84	11.41	0.99	0.46	1.29	13.2	6.2	17.2	
61 - Scheggs Draw	High Desert Region	Flaming Gorge	23.4	10.73	9.86	15.89	0.57	0.51	0.90	17.7	16.0	28.2	
62 -South Baxter Basin	High Desert Region	Rock Springs AP	53.1	9.10	4.84	11.41	0.96	0.45	1.25	13.2	6.2	17.2	
63 - Sugarloaf Marsh Creek	High Desert Region	Flaming Gorge	26.8	12.78	9.86	15.89	0.79	0.58	1.02	21.4	15.7	27.8	
64 - Sweetwater Creek-Bitter Creek	High Desert Region	Rock Springs AP	30.1	10.20	4.84	11.41	0.67	0.27	0.76	16.2	6.7	18.5	
65 - Upper Antelope Creek	High Desert Region	Rock Springs AP	42.4	9.93	4.84	11.41	0.87	0.37	1.03	15.0	6.4	17.7	
66 - Upper Bitter Creek-Green River	High Desert Region	Flaming Gorge	45.8	11.47	9.86	15.89	1.11	0.93	1.63	17.7	14.8	26.0	
67 - Upper Black Butte Creek	High Desert Region	Rock Springs AP	46.5	9.48	4.84	11.41	0.90	0.40	1.12	14.1	6.3	17.5	
68 - Upper Deadman Wash	High Desert Region	Rock Springs AP	50.7	8.45	4.84	11.41	0.84	0.43	1.20	12.1	6.3	17.3	
69 - Upper Marsh Creek	High Desert Region	Flaming Gorge	23.9	11.75	9.86	15.89	0.64	0.52	0.92	19.6	16.0	28.1	
70 - Upper Patrick Draw	High Desert Region	Rock Springs AP	34.2	6.38	4.84	11.41	0.43	0.31	0.85	9.1	6.6	18.2	
71 - Upper Red Creek	Mountainous Region	Flaming Gorge	45.5	15.31	9.86	15.89	22.43	0.92	1.63	359.5	14.8	26.1	
72 - Upper Salt Wells Creek	High Desert Region	Flaming Gorge	64.5	12.30	9.86	15.89	1.63	1.25	2.21	18.4	14.2	25.0	

APPENDIX 5B

PEAK FLOW PER HUC 12 –
MILLER (USGS) METHOD

Appendix 5B - Peak Flow - Miller (USGS) Method

Peak Flow Characteristics : Published Regression Coefficients

Recurrence Interval	A	B	C
1.5 yr	12.7	0.626	-1.18
2 yr	22.2	0.608	-1.24
2.33 yr	28.1	0.600	-1.26
5 yr	66.4	0.567	-1.35
10 yr	116	0.544	-1.40
25 yr	204	0.52	-1.44
50 yr	290	0.504	-1.46
100 yr	394	0.489	-1.47
200 yr	519	0.476	-1.48
500 yr	719	0.459	-1.49

Equation for Region 6: High Desert Region (Miller, 2003)

$$\boxed{Q = A \cdot [AREA^{B}] \cdot [LAT - 40]^{C}}$$

Q = peak discharge (cfs), AREA = total drainage area (sq mi), LAT = latitude of basin outlet

A, B, and C are coefficients that vary with recurrance interval (see table)

HUC12 Basin Name	Area (sq mi)	Latitude	Peak flows in cfs for various return periods										NOTES
			1.5 yr	2 yr	2.33 yr	5 yr	10 yr	25 yr	50 yr	100 yr	200 yr	500 yr	
1 - 140401050102	49.00	41.43	94.86	151.29	184.29	370.77	581.68	918.39	1217.92	1555.23	1940.56	2507.20	
2 - 140401050205	23.69	41.54	55.37	89.10	109.01	223.22	354.85	568.51	761.67	982.60	1236.82	1616.70	
3 - 140401050502	40.06	41.69	69.03	109.42	133.07	265.58	415.21	654.47	867.90	1109.82	1386.17	1794.16	
4 - 140401050503	46.00	41.64	77.81	123.23	149.79	298.35	465.61	732.30	969.51	1237.54	1543.35	1993.47	
5 - Big Flat Draw	19.60	41.31	59.22	96.51	118.64	247.94	399.00	646.22	871.16	1128.82	1426.62	1873.76	
6 - Bitter Creek-Big Pond Station	19.39	41.56	48.20	77.78	95.30	196.23	313.20	503.96	677.20	876.15	1105.58	1449.90	
7 - Bitter Creek-Coon Draw	43.23	41.64	74.65	118.35	143.92	287.20	448.80	706.85	936.71	1196.75	1493.66	1931.28	
8 - Bitter Creek-Hungry Hollow	42.25	41.48	83.54	133.37	162.56	327.78	515.26	815.47	1083.37	1386.11	1732.37	2243.21	
9 - Bitter Creek-Kanda	35.05	41.52	71.92	115.01	140.32	283.98	447.69	710.94	946.80	1214.43	1521.08	1975.33	
10 - Bitter Creek-Rock Springs	62.42	41.56	99.88	157.80	191.53	379.35	589.35	921.98	1215.90	1545.72	1921.01	2469.66	
11 - Bitter Creek-Town of Bitter Creek	44.60	41.54	82.27	130.88	159.33	319.50	500.56	789.87	1047.58	1338.66	1671.20	2161.11	
12 - Bitter Creek-Town of Black Buttes	39.95	41.60	73.21	116.41	141.73	284.20	445.48	703.67	934.15	1195.21	1493.64	1934.34	
13 - Bitter Creek-Town of Hallville	46.58	41.67	76.62	121.18	147.23	292.60	456.06	716.49	948.02	1209.64	1508.01	1947.02	
14 - Cedar Canyon	22.37	41.84	43.39	69.16	84.36	170.35	268.78	428.19	572.19	737.49	927.35	1211.22	
15 - Cedar Creek-Little Bitter Creek	21.20	41.44	55.99	90.63	111.14	229.81	367.52	591.98	795.61	1028.78	1297.70	1700.63	
16 - Clay Basin Creek	2.50	41.00	22.49	38.67	48.59	111.40	190.56	327.83	459.26	615.46	801.13	1092.71	Partial area, HUC 12 clipped to watershed boundary
17 - Currant Creek	49.33	41.27	110.23	177.09	216.25	439.82	694.19	1101.29	1463.94	1871.53	2337.91	3023.97	
18 - Dans Creek	20.12	41.27	62.60	102.19	125.67	263.19	424.00	687.18	926.60	1200.59	1517.31	1992.65	
19 - Firehole Canyon	41.02	41.35	90.91	145.97	178.27	362.67	572.97	910.64	1212.49	1553.35	1943.84	2520.51	
20 - Flaming Gorge Reservoir-Buckboard Reservoir	27.98	41.19	83.38	135.85	166.86	347.79	557.93	899.56	1208.22	1558.80	1962.92	2565.18	Partial area, HUC 12 clipped to watershed boundary
21 - Flaming Gorge Reservoir-Chokecherry Draw	16.79	41.00	73.91	122.77	151.92	326.97	535.23	879.52	1195.04	1556.28	1976.14	2609.38	Partial area, HUC 12 clipped to watershed boundary
22 - Flaming Gorge Reservoir-Spring Creek	34.08	41.00	115.68	189.76	233.51	491.14	791.14	1278.35	1717.51	2213.15	2784.58	3633.03	Partial area, HUC 12 clipped to watershed boundary
23 - Flaming Gorge Reservoir-Squaw Hollow	12.93	41.12	55.08	91.32	112.99	242.86	397.74	654.79	891.44	1164.17	1481.63	1962.95	Partial area, HUC 12 clipped to watershed boundary
24 - Gap Creek	55.58	41.27	118.30	189.61	231.30	468.45	737.23	1166.06	1546.97	1974.07	2462.10	3178.04	
25 - Green River-Chicken Springs Draw	52.39	41.30	111.51	178.72	218.03	441.70	695.43	1100.70	1461.09	1865.79	2328.42	3007.95	
26 - Green River-Middle Firehole Canyon	58.19	41.41	107.72	171.43	208.61	417.94	653.65	1028.46	1360.59	1733.24	2158.21	2780.73	
27 - Henrys Fork-Cottonwood Creek	14.00	41.06	62.05	103.09	127.62	275.03	450.92	742.67	1010.97	1319.47	1678.52	2222.08	Partial area, HUC 12 clipped to watershed boundary
28 - Horsethief Canyon	28.66	41.68	56.24	89.70	109.39	220.83	347.98	553.00	737.34	947.65	1188.83	1547.57	
29 - Iron Pipe Draw	30.71	41.41	71.99	115.89	141.74	289.96	460.15	735.12	982.48	1263.60	1586.50	2066.41	

HUC12 Basin Name	Area (sq mi)	Latitude	Peak flows in cfs for various return periods										NOTES
			1.5 yr	2 yr	2.33 yr	5 yr	10 yr	25 yr	50 yr	100 yr	200 yr	500 yr	
30 - Killpecker Creek-140401050805	33.54	41.77	58.24	92.33	112.34	224.52	351.56	555.40	737.89	945.62	1183.22	1535.33	
31 - Killpecker Creek-Boars Tusk	66.06	41.92	81.19	126.57	152.92	296.77	455.73	706.15	926.59	1174.52	1455.61	1865.69	
32 - Killpecker Creek-Fourteenmile Creek	44.35	41.69	73.30	115.95	140.89	280.19	436.95	686.97	909.47	1161.18	1448.35	1871.35	
33 - Killpecker Creek-Pine Canyon	41.30	41.84	63.71	100.42	121.89	241.20	375.24	589.05	779.45	995.42	1241.75	1605.04	
34 - Killpecker Creek-Reliance	44.20	41.59	78.71	125.00	152.07	304.14	475.83	750.02	994.22	1270.23	1585.44	2049.85	
35 - Laney Wash	56.34	41.43	103.51	164.67	200.36	401.24	627.47	987.37	1306.48	1664.84	2073.56	2672.68	
36 - Long Canyon	34.82	41.76	60.16	95.36	116.01	231.73	362.69	572.64	760.44	974.05	1218.30	1579.98	
37 - Lower Antelope Creek	38.26	41.44	80.53	128.96	157.38	319.00	503.13	798.87	1063.47	1362.97	1706.01	2213.30	
38 - Lower Black Butte Creek	37.72	41.64	68.55	108.95	132.64	265.87	416.77	658.57	874.63	1119.74	1400.02	1814.40	
39 - Lower Deadman Wash	53.11	41.67	83.17	131.23	159.27	315.16	489.75	767.00	1012.72	1289.66	1605.03	2067.68	
40 - Lower Little Bitter Creek	41.35	41.56	77.19	122.86	149.61	300.38	471.10	744.31	988.08	1263.90	1579.19	2044.48	
41 - Lower Patrick Draw	61.83	41.56	99.59	157.39	191.05	378.62	588.41	920.82	1214.61	1544.34	1919.58	2468.28	
42 - Lower Red Creek	5.07	41.00	35.01	59.43	74.25	166.26	279.78	473.19	655.39	868.98	1120.74	1510.32	Partial area, HUC 12 clipped to watershed boundary
43 - Lower Salt Wells Creek	38.31	41.31	90.09	145.08	177.38	362.60	574.58	915.74	1221.32	1566.72	1962.87	2548.87	
44 - Middle Black Butte Creek	52.51	41.57	89.14	141.24	171.64	341.77	532.95	837.06	1106.86	1410.70	1757.06	2265.43	
45 - Middle Deadman Wash	51.51	41.68	81.28	128.29	155.73	308.38	479.46	751.35	992.47	1264.41	1574.19	2028.93	
46 - Middle Little Bitter Creek	40.00	41.44	83.28	133.29	162.63	329.30	518.97	823.30	1095.31	1402.90	1755.07	2275.32	
47 - Middle Marsh Creek	29.74	41.10	94.78	154.97	190.53	399.06	641.72	1036.29	1392.63	1796.45	2262.11	2955.36	
48 - Middle Red Creek	53.15	41.01	150.12	244.08	299.20	619.30	986.69	1576.46	2102.40	2690.70	3365.43	4357.17	
49 - Nitch Creek	29.79	41.92	49.32	77.99	94.83	188.95	295.52	466.74	620.31	795.73	996.43	1294.56	
50 - Patrick Draw	36.16	41.51	73.78	117.95	143.88	291.02	458.58	727.82	968.89	1242.25	1555.36	2018.88	
51 - Polly Draw	29.40	41.31	76.95	124.55	152.63	314.93	502.28	805.82	1079.44	1390.31	1747.98	2280.22	
52 - Pretty Water Creek	50.33	41.36	103.02	164.78	200.91	405.88	638.15	1009.15	1339.20	1710.38	2134.60	2758.18	
53 - Red Wash	41.34	41.48	82.40	131.59	160.42	323.72	509.12	806.17	1071.39	1371.23	1714.26	2220.59	
54 - Sage Creek-Greasewood Draw	66.51	41.32	126.40	201.47	245.22	491.98	769.56	1210.07	1599.51	2034.83	2530.98	3255.73	
55 - Sage Creek-Trout Creek	61.06	41.28	124.48	199.09	242.65	489.61	768.61	1212.62	1606.11	2046.52	2549.17	3284.96	
56 - Salt Wells Creek-140401050704	46.13	41.63	78.28	124.00	150.73	300.30	468.70	737.22	976.06	1245.89	1553.76	2006.89	
57 - Salt Wells Creek-Corral Creek	45.43	41.28	103.74	166.84	203.83	415.40	656.64	1043.46	1388.67	1777.36	2222.48	2878.48	
58 - Salt Wells Creek-Dry Canyon	30.51	41.32	78.03	126.16	154.53	318.23	506.91	812.27	1087.25	1399.49	1758.53	2292.35	
59 - Salt Wells Creek-Joyce Creek	49.09	41.41	96.82	154.56	188.33	379.43	595.73	941.15	1248.48	1594.48	1989.82	2571.18	
60 - Salt Wells Creek-Spring Creek	54.76	41.48	97.80	155.36	188.96	377.64	589.98	927.79	1227.39	1564.21	1948.30	2511.62	
61 - Scheggs Draw	23.38	41.27	69.18	112.66	138.39	288.53	463.33	748.37	1006.79	1301.62	1641.86	2150.83	
62 -South Baxter Basin	53.10	41.60	87.53	138.48	168.20	334.15	520.38	816.39	1078.88	1374.51	1711.38	2205.63	
63 - Sugarloaf Marsh Creek	26.77	41.16	83.86	136.97	168.39	352.39	566.68	915.66	1231.42	1590.23	2004.21	2621.85	
64 - Sweetwater Creek-Bitter Creek	30.07	41.57	62.66	100.26	122.38	248.14	391.88	623.70	832.07	1069.35	1341.55	1746.12	
65 - Upper Antelope Creek	42.41	41.38	90.68	145.34	177.39	359.83	567.50	900.50	1197.89	1533.58	1917.88	2484.95	
66 - Upper Bitter Creek-Green River	45.80	41.32	99.92	160.31	195.70	397.44	627.00	994.72	1322.68	1692.08	2114.85	2737.70	
67 - Upper Black Butte Creek	46.48	41.43	91.79	146.53	178.57	359.89	565.30	893.66	1186.13	1515.85	1892.72	2447.59	
68 - Upper Deadman Wash	50.67	41.72	78.10	123.13	149.40	295.34	458.79	718.52	948.88	1208.87	1504.98	1939.79	
69 - Upper Marsh Creek	23.92	41.15	78.82	129.06	158.83	333.84	538.45	872.66	1175.89	1521.21	1920.18	2516.92	
70 - Upper Patrick Draw	34.17	41.59	67.05	106.96	130.41	263.05	413.98	656.59	873.98	1120.93	1403.78	1822.96	
71 - Upper Red Creek	45.53	41.07	127.78	207.66	254.59	527.07	840.46	1344.89	1796.06	2302.73	2884.40	3742.18	Partial area, HUC 12 clipped to watershed boundary
72 - Upper Salt Wells Creek	64.49	41.27	130.57	208.78	254.41	512.95	804.69	1268.48	1679.02	2137.91	2661.42	3426.82	

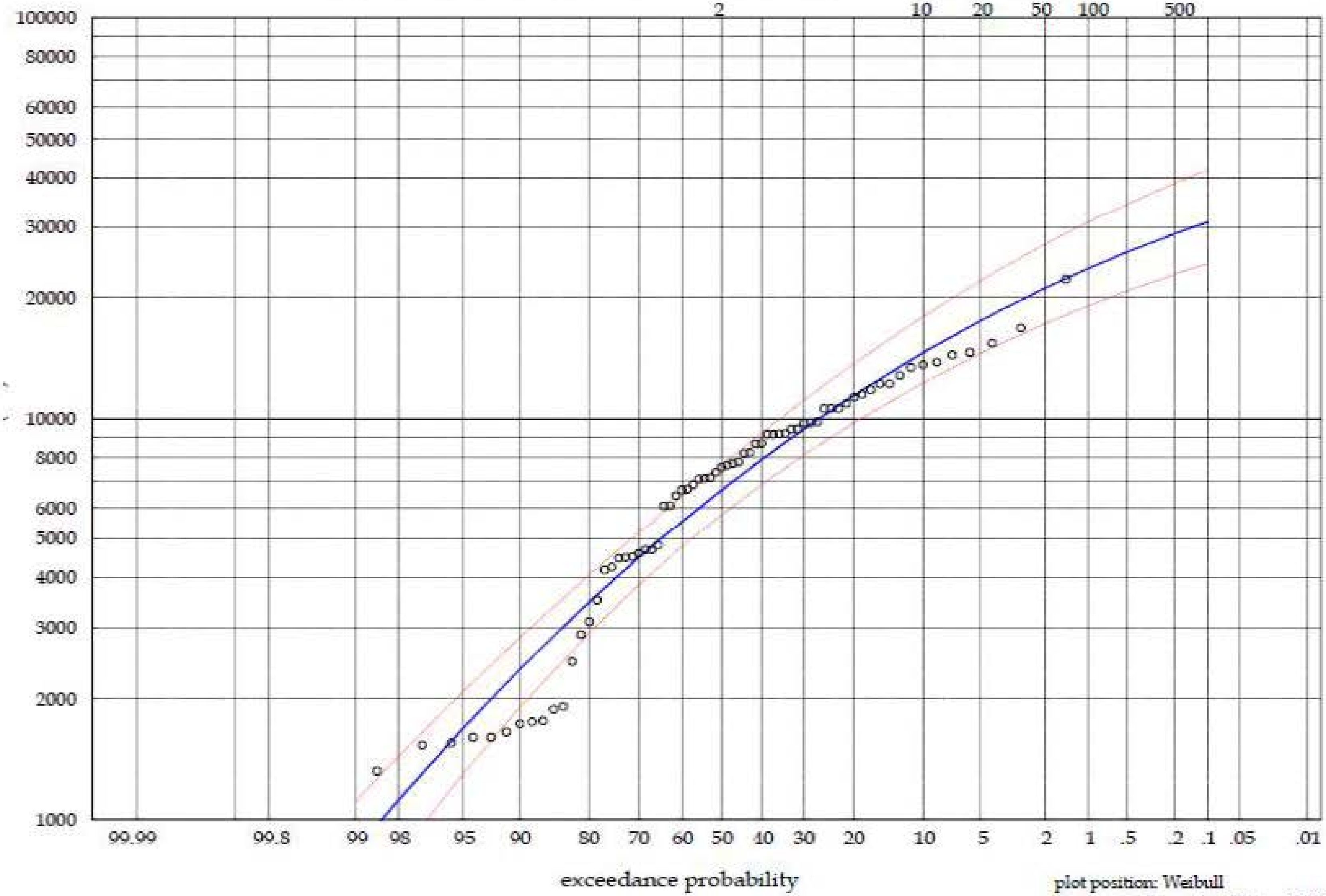
APPENDIX 5C

PEAK FLOW AT GAGED SITES –
LOG PEARSON III METHOD

USGS 09217000 GREEN RIVER NEAR GREEN RIVER, WY

recurrence (years)	Q (cfs)	Q5 (cfs)	Q95 (cfs)
1000	30,892	41,933	24,295
500	28,845	38,776	22,843
200	25,943	34,362	20,762
100	23,589	30,839	19,052
50	21,085	27,155	17,209
25	18,418	23,309	15,213
20	17,521	22,036	14,534
10	14,602	17,969	12,287
5	11,438	13,718	9,780
3.333	9,434	11,128	8,138
2.5	7,912	9,225	6,855
2	6,647	7,692	5,762
1.667	5,531	6,380	4,775
1.429	4,495	5,195	3,840
1.250	3,475	4,056	2,910
1.111	2,369	2,835	1,903
1.053	1,685	2,078	1,297
1.020	1,119	1,437	813
1.010	838	1,110	584

USGS 09217000 GREEN RIVER NEAR GREEN RIVER, WY



plot position: Weibull
recurrence interval = 100/probability

plot date: 4/2/2018
file: 09217000 Flood Frequency.xlsm

APPENDIX 6A

PROJECT DESCRIPTIONS

IRR-001: Ramsay Pipeline

This proposed project involves replacement of an existing open earthen ditch with a 12-inch diameter PVC pipeline to convey water to irrigate flood irrigated lands at the Ramsay Ranch. According to the land owner, water losses associated with the earthen ditch are substantial.

Project components would include:

- Installation of approximately 6,864 linear feet of 12-inch diameter PVC pipeline
- Burial of the pipeline along the alignment of the existing earthen ditch at a depth of 36 inches.
- Incorporation of fittings and junctions to facilitate irrigation of two separate fields.

Project Location:
The proposed project is located in:

Sections 16, 17 and 20 of Township 14 North, Range 105 West.

Land Ownership (Surface):

The facility is located on lands owned by:

- Privately-owned property,
- Department of Interior, Bureau of Land Management and the

Water Source:

Trout Creek, a tributary to Sage Creek which is tributary to the Green River at Flaming Gorge Reservoir.

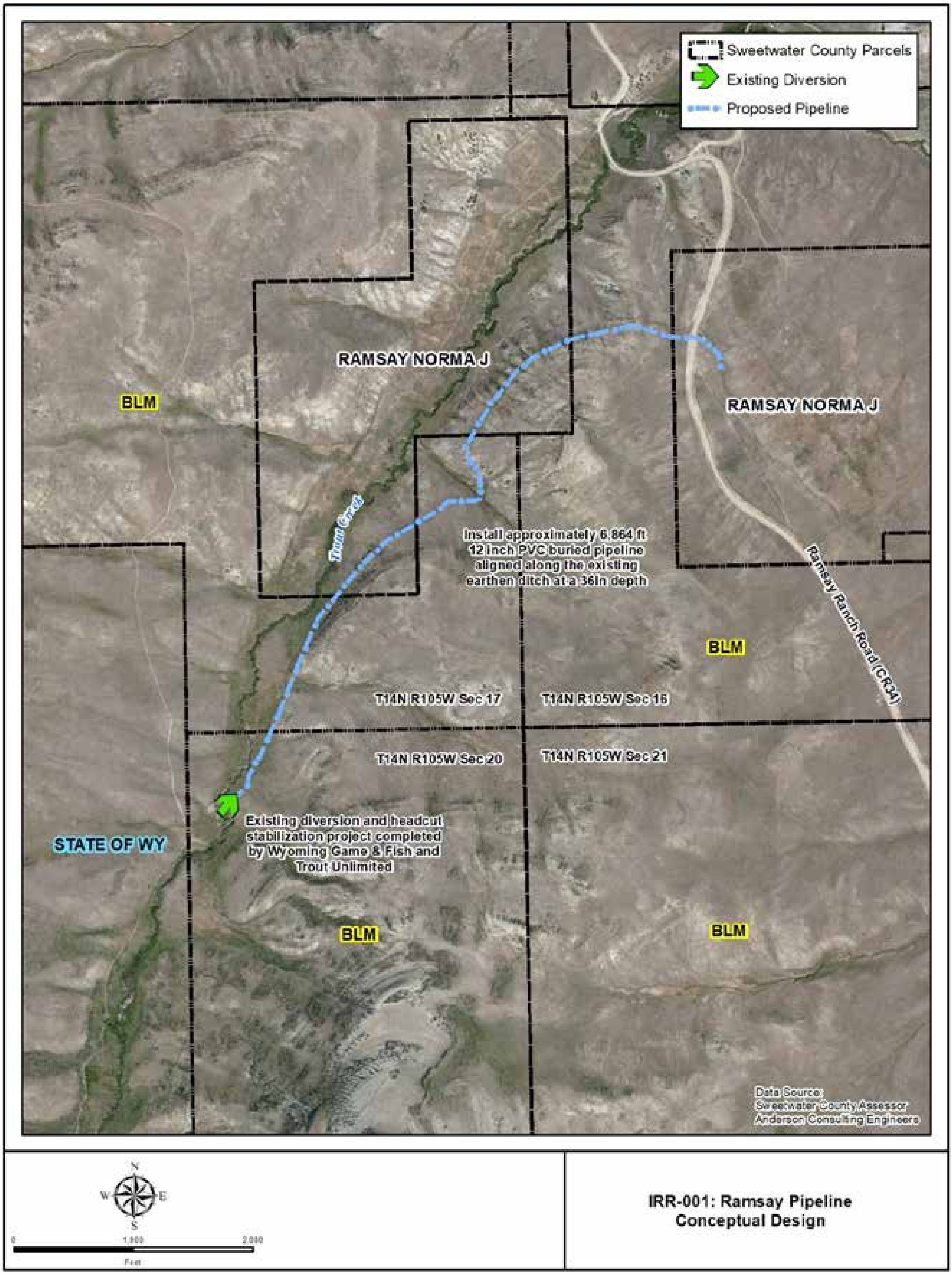
Water Rights:

Ramsay Ditch No. 1 (Permit Number P17911D, priority date April 6, 1931

Horse Management Area: Salt Wells Creek

Grazing Allotment: Salt Wells

Sage Grouse Core Area: Not Applicable


Sweetwater County Parcels
Existing Diversion
Proposed Pipeline
RAMSAY NORMA J
BLM
RAMSAY NORMA J
Trout Creek
Install approximately 6,864 ft
12 inch PVC buried pipeline
aligned along the existing
earthen ditch at a 36in depth
Ramsay Ranch Road (CR34)
BLM
T14N R105W Sec 17
T14N R105W Sec 16
T14N R105W Sec 20
T14N R105W Sec 21
Existing diversion and headcut
stabilization project completed
by Wyoming Game & Fish and
Trout Unlimited
STATE OF WY
BLM
BLM
Data Source:
Sweetwater County Assessor
Anderson Consulting Engineers
N
W
E
S
0
1,000
2,000
Feet
IRR-001: Ramsay Pipeline
Conceptual Design

IRR-002: Desert Claim Fencing

Project Summary:

This proposed project would involve construction of fencing to exclude wildlife from access to newly irrigated lands (Desert Claim – Ramsay). The proposed fence would be designed to exclude livestock and large ungulates (primarily elk) from an area where elk populations have historically been problematic due to their large numbers and accessible irrigated lands.. The property has historically been irrigated. At that time, management of elk in the area was problematic for WGF.

Irrigation of the property ceased with degradation of Trout Creek and loss of function of the ditch diversion facility. Recently, the structure has been reestablished with assistance from WGF and TU. Once the land becomes irrigated again, the elk management issue is expected to be exacerbated with greater irrigation efficiency likely leading to more extensive coverage and / or greater health and vigor of the hay crop.

Consequently, the proposed project would consist of approximately 5,000 linear feet of steel jack fencing designed to exclude the elk (and other large ungulates and livestock) from the irrigated property, thereby reducing costs to the State through payment for crop damages and labor associated with wildlife management at the site.

Project Location:
The proposed project is located in:

Section 16, Township 14 North, Range 105 West.

Land Ownership (Surface):

The facility is located entirely on privately-owned lands.

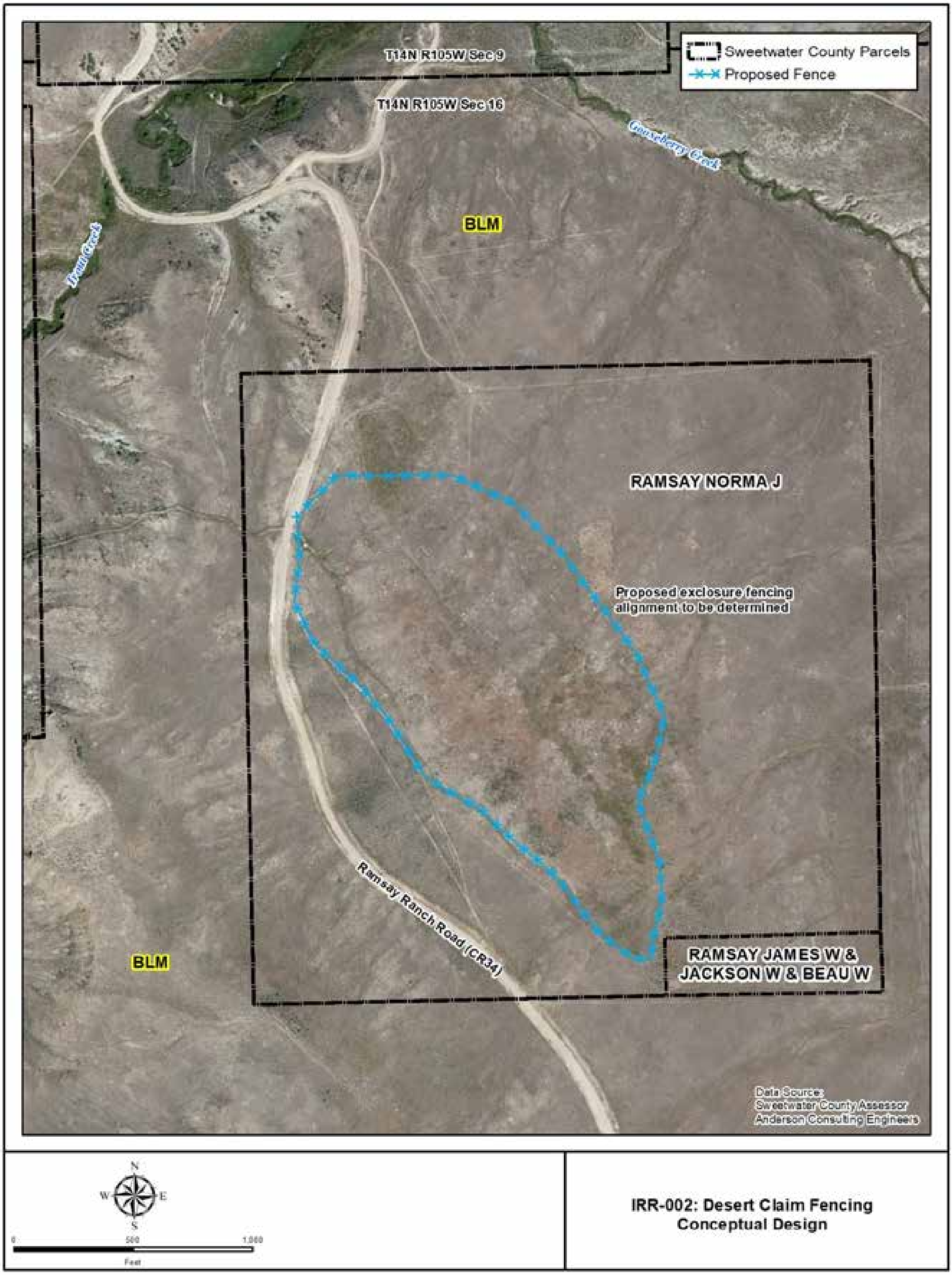
Water Source: Trout Creek, a tributary to Sage Creek which is tributary to the Green River at Flaming Gorge Reservoir.

Water Rights: Not Applicable

Horse Management Area: Salt Wells Creek

Grazing Allotment: Not Applicable

Sage Grouse Core Area: Not Applicable



IRR-002: Desert Claim Fencing Conceptual Design

L/W-001: Kinney Spring Reservoir

Project Summary:
This proposed project would involve reconstruction of stock reservoir to supply water to a portion of the watershed lacking adequate livestock/wildlife water sources.

Project Location:
The proposed project is located in:

Section 8, Township 15 North, Range 98 West.

Land Ownership (Surface):

The facility is located on privately-owned lands.

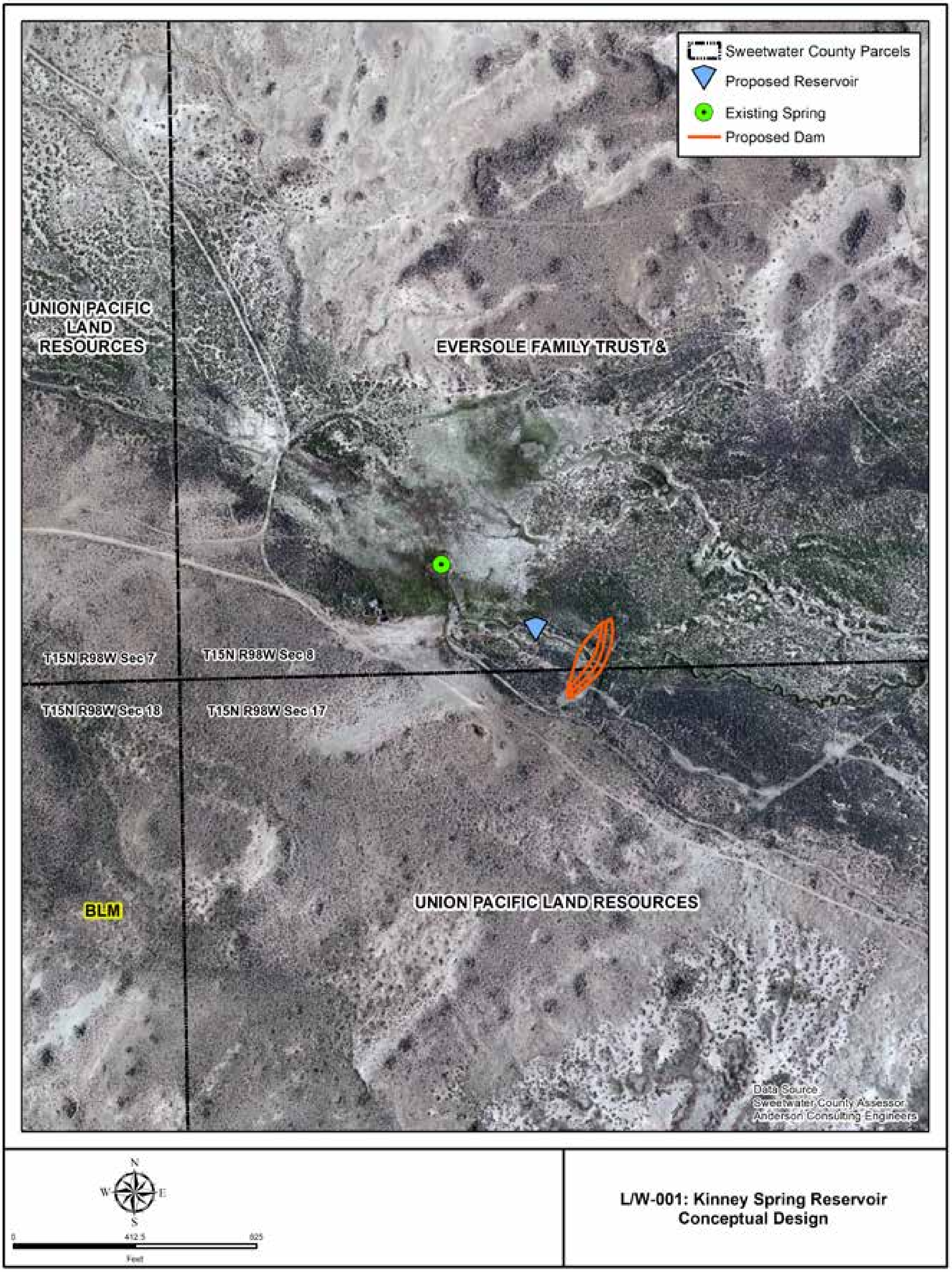
Water Source: Kinney Spring, tributary to Shell Creek which a tributary to the Little Snake River.

Water Rights: A permit to construct the reservoir and store water for livestock and wildlife usage has been secured by the project proponent. Permit P14456.0R permits storage of 6 acre feet of water.

Horse Management Area: Salt Wells Creek

Grazing Allotment: Rock Springs

Sage Grouse Core Area: Not Applicable


Sweetwater County Parcels
Proposed Reservoir
Existing Spring
Proposed Dam
UNION PACIFIC LAND RESOURCES
EVERSOLE FAMILY TRUST &
T15N R98W Sec 7
T15N R98W Sec 8
T15N R98W Sec 18
T15N R98W Sec 17
BLM
UNION PACIFIC LAND RESOURCES
Data Source
Sweetwater County Assessor
Anderson Consulting Engineers
N
W
E
S
0
412.5
825
L/W-001: Kinney Spring Reservoir
Conceptual Design

L/W-002: Fifteenmile Knoll Reservoir

Project Summary:
This proposed project would involve reconstruction of an existing stock reservoir to supply water to a portion of the watershed lacking adequate livestock/wildlife water sources. The existing reservoir has breached and is currently non-functional.

Completion of the project would include the following components:

- Evaluation of the rehabilitation needs associated with the reservoir embankment and completion of them.
- Incorporation of a reservoir outlet
- Incorporation of an emergency spillway
- Securing water rights permits for the facility

Project Location:
The proposed project is located in:

Section 4, Township 22 North, Range 104 West.

Land Ownership (Surface):

The facility is located entirely on federal lands managed by the Department of Interior, Bureau of Land Management.

Water Source: Killpecker Creek, a tributary to Bitter Creek which is tributary to the Green River.

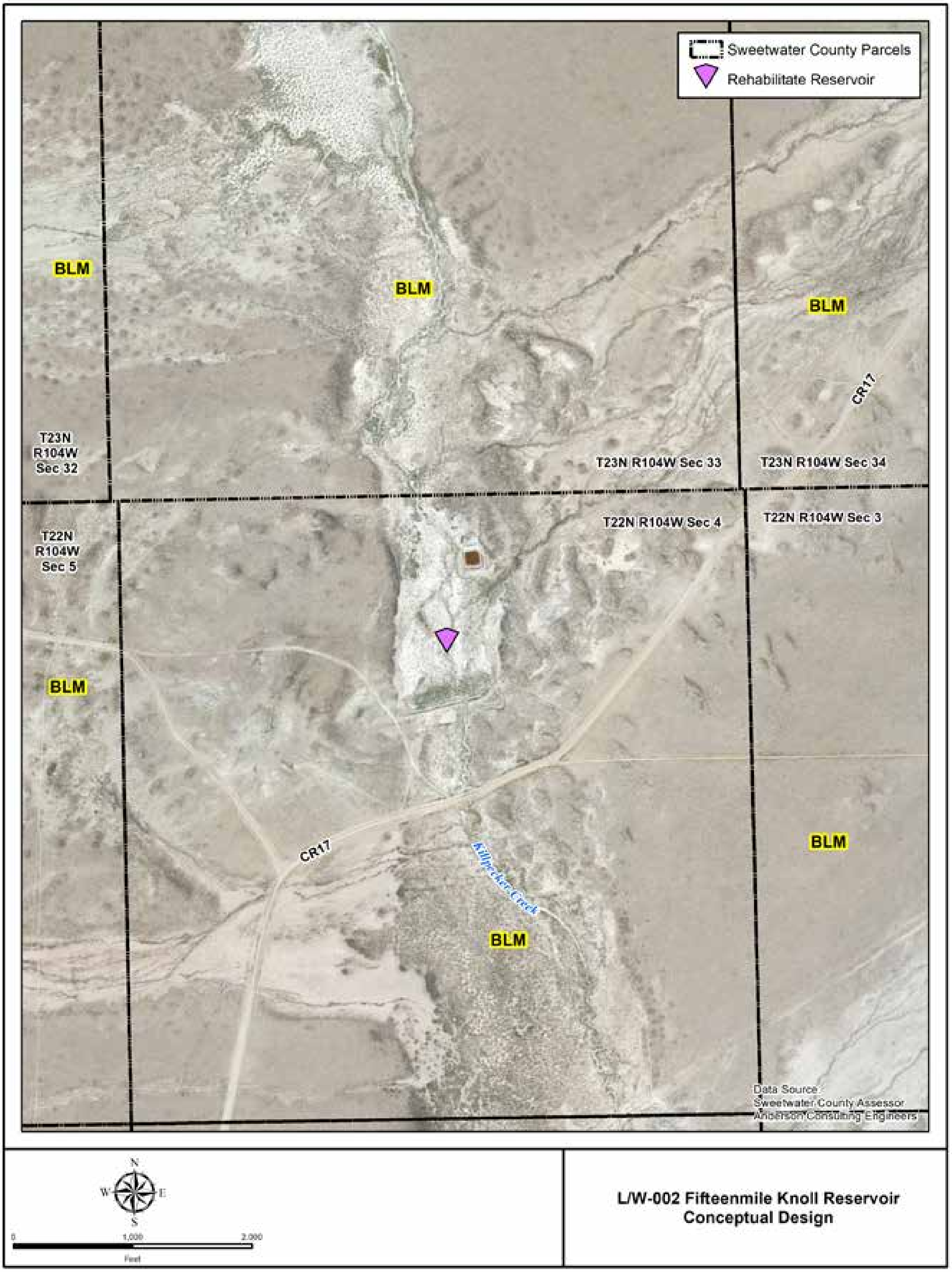
Water Rights: A search of the Wyoming State Engineers Office ePermit system failed to reveal water rights associated with the reservoir.

Horse Management Area: Salt Wells Creek

Grazing Allotment: Rock Springs

Sage Grouse Core Area: Not Applicable

Fifteenmile Reservoir embankment and breach



L/W-002 Fifteenmile Knoll Reservoir
Conceptual Design

L/W-003: Bitter Creek Springs

Project Summary

This alternative would involve the development and rehabilitation of an existing spring in the Bitter Creek drainage. The project would provide a reliable water supply to a portion of the watershed lacking adequate livestock and wildlife upland water sources.

Under this alternative, the following components would be employed:

- Application for a water right through the Wyoming State Engineers Office.
- An existing spring would be developed following NRCS spring development designs. A valve would be included for management of pipeline flows.
- A 1,200 gallon rubber tire stock tank could be installed
- Wildlife egress ramps would be installed in the proposed stock tank.
- The spring vicinity would be fenced with approximately 500 linear feet of steel jack fencing to prevent damage from livestock, wildlife and wild horses.

Project Location:

The proposed project is located in:

Section 35, Township 20 North, Range 101 West.

Land Ownership (Surface):

The facility is located entirely on privately-owned lands: Union Pacific Land Resources.

Water Source: Un-named springs, tributary to Bitter Creek which is tributary to the Green River.

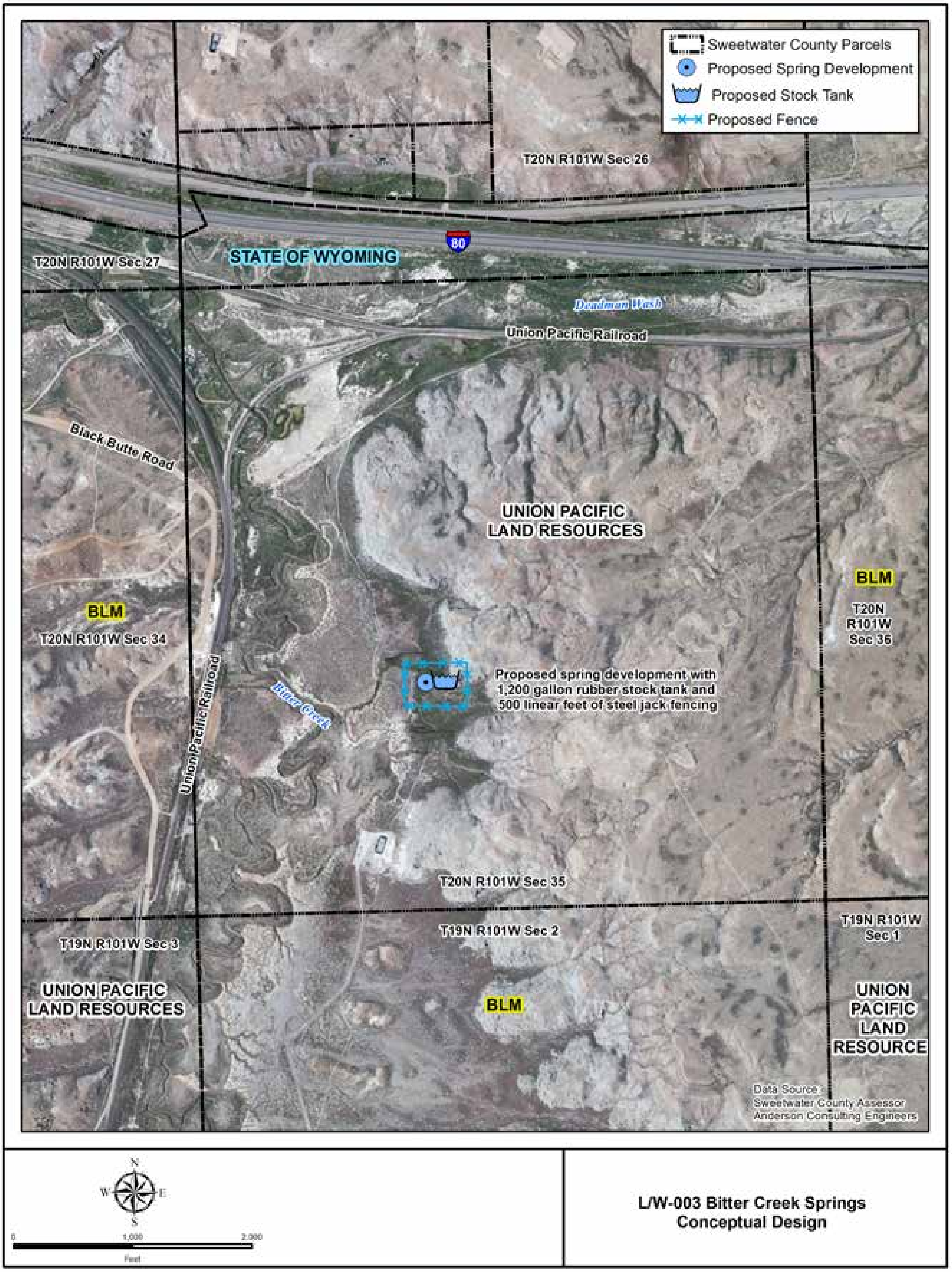
Water Rights: A search of the Wyoming State Engineers Office ePermit system failed to reveal water rights associated with the springs.

Note that the alignment of the pipeline and placement and number of stock tanks displayed is strictly to exemplify the potential development of the project. Details of the project would be determined at the time of project design.

Horse Management Area: Not Applicable

Grazing Allotment: Sands

Sage Grouse Core Area: Greater South Pass



L/W-003 Bitter Creek Springs
Conceptual Design

L/W-004: Well Rehabilitation

Project Summary

This alternative would involve the rehabilitation of an existing well in the Bitter Creek drainage. Completion of the project would provide a reliable water supply to a portion of the watershed lacking adequate livestock and wildlife upland water sources.

Under this alternative, the following components would be employed:

- Application for a water right through the Wyoming State Engineers Office.
- The well water quality would be tested to verify it suitability for wildlife and livestock usage.
- A pump with a solar power supply would be installed.
- A 1,200 gallon rubber tire stock tank could be installed
- Wildlife egress ramps would be installed in the proposed stock tank.
- The spring vicinity would be fenced with approximately 500 linear feet of steel jack fencing to prevent damage from livestock, wildlife and wild horses.

Project Location:

The proposed project is located in:

Section 15, Township 19 North, Range 101 West.

Land Ownership (Surface):

The facility is located entirely on privately-owned lands: Union Pacific Land Resources.

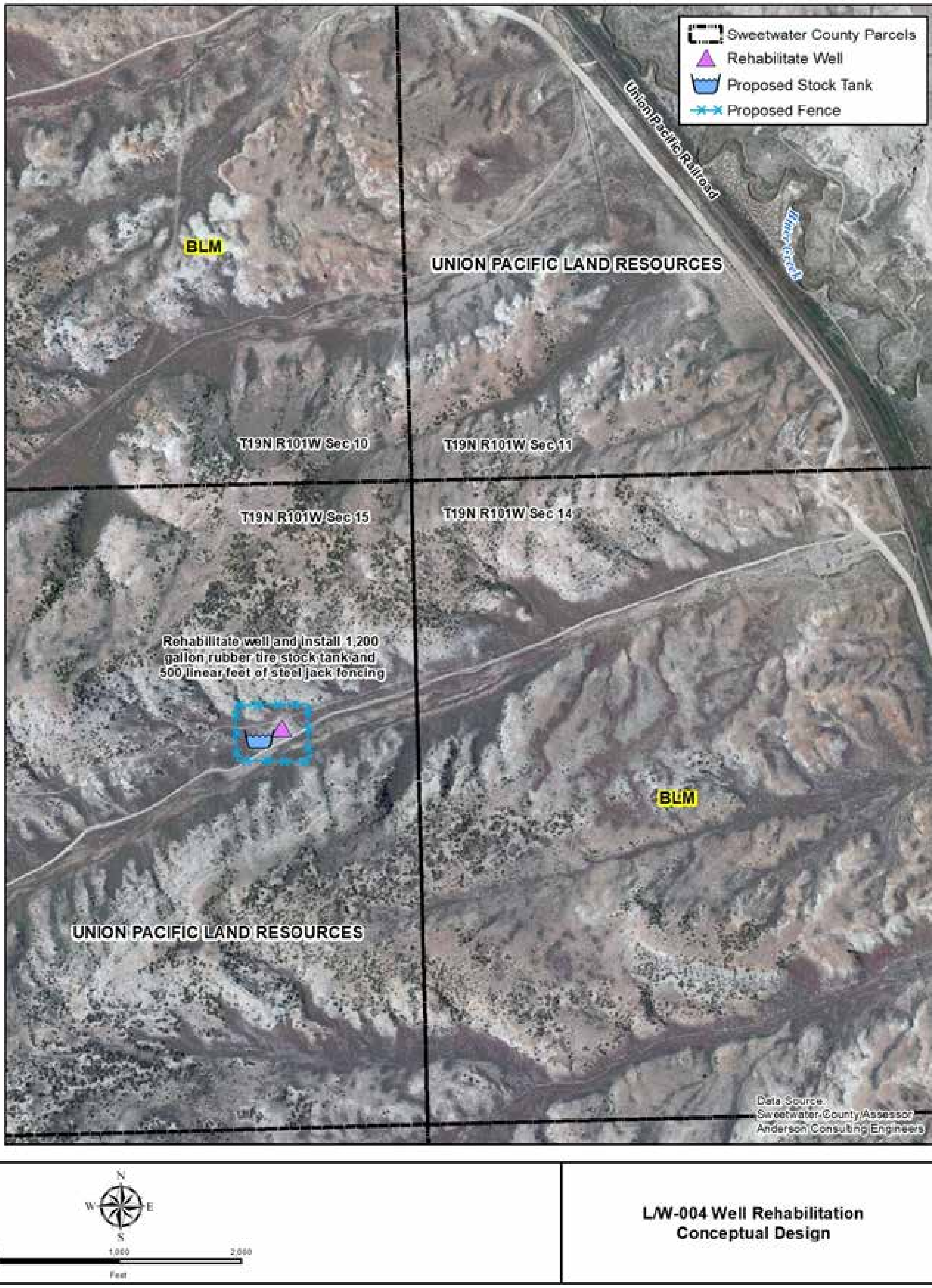
Water Source: un-named and un-permitted well, tributary to Bitter Creek which is tributary to the Green River.

Water Rights: A search of the Wyoming State Engineers Office ePermit system failed to reveal water rights associated with the well.

Horse Management Area: Salt Wells Creek

Grazing Allotment: Rock Springs

Sage Grouse Core Area: Not Applicable



L/W-004 Well Rehabilitation Conceptual Design

L/W-005: Upland Spring Development

Project Summary

This alternative would involve the development and rehabilitation of an existing spring in the Bitter Creek drainage. The project would provide a reliable water supply to a portion of the watershed lacking adequate livestock and wildlife upland water sources.

Under this alternative, the following components would be employed:

- Application for a water right through the Wyoming State Engineers Office.
- An existing spring would be developed following NRCS spring development designs. A valve would be included for management of pipeline flows.
- A 1,200 gallon rubber tire stock tank could be installed
- Wildlife egress ramps would be installed in the proposed stock tank.
- The spring vicinity would be fenced with approximately 500 linear feet of steel jack fencing to prevent damage from livestock, wildlife and wild horses.

Project Location:
The proposed project is located in:

Section 35, Township 20 North, Range 102 West.

Land Ownership (Surface):

The facility is located entirely on privately-owned lands: Union Pacific Land Resources.

Water Source: Un-named springs, tributary to Bitter Creek which is tributary to the Green River.

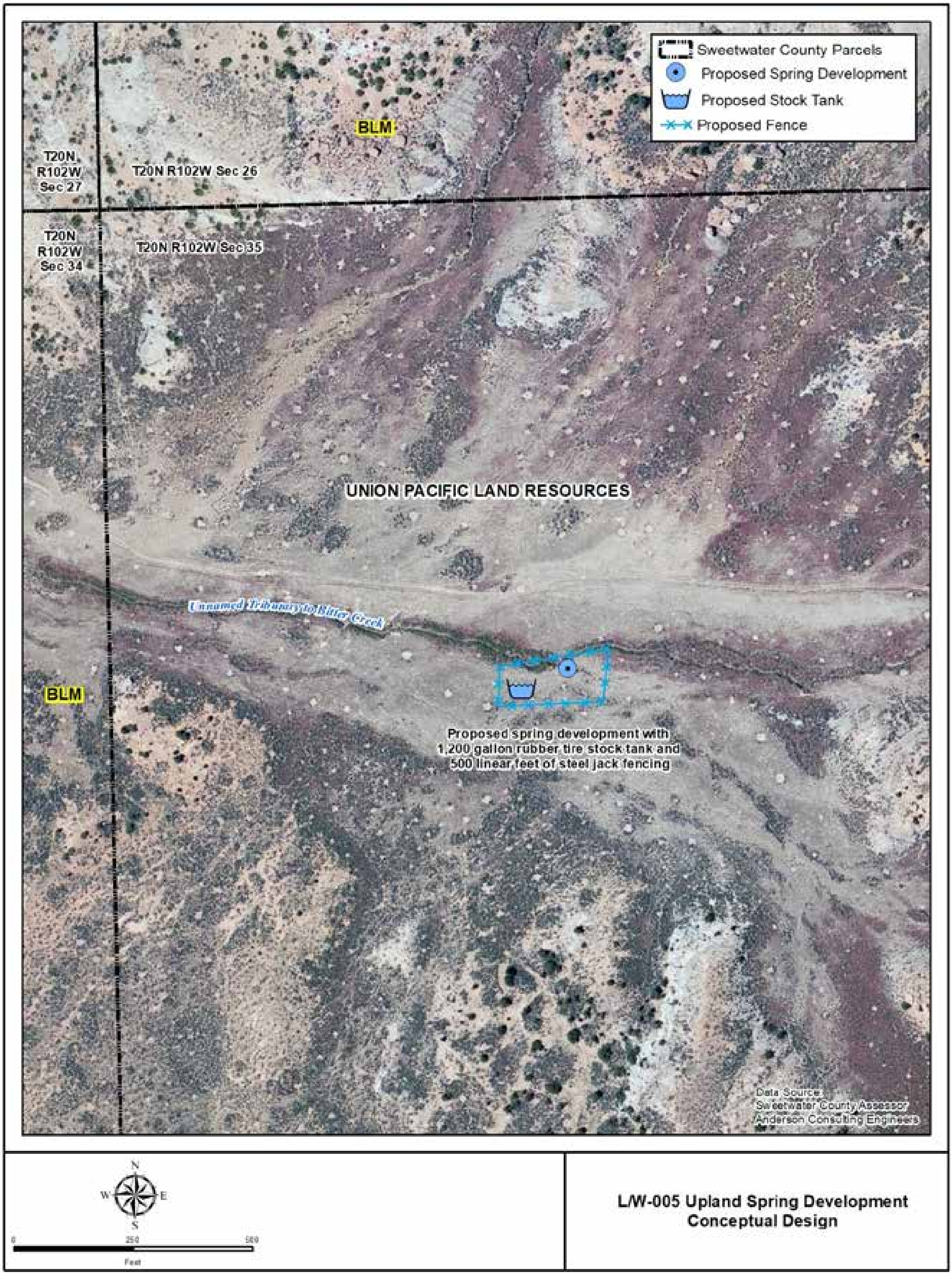
Water Rights: A search of the Wyoming State Engineers Office ePermit system failed to reveal water rights associated with the springs.

Note that the alignment of the pipeline and placement and number of stock tanks displayed is strictly to exemplify the potential development of the project. Details of the project would be determined at the time of project design.

Horse Management Area: Salt Wells Creek

Grazing Allotment: Rock Springs

Sage Grouse Core Area: Not Applicable



L/W-005 Upland Spring Development Conceptual Design

L/W-006: Upland Stock Reservoir Rehabilitation

Project Summary:
This proposed project would involve rehabilitating an existing stock reservoir to supply water to a portion of the watershed lacking adequate livestock/wildlife water sources. The existing reservoir is situated on Black Butte Creek, a tributary to the Bitter Creek, which is then tributary to the Green River. The existing facility has filled with sediment and has subsequently breached.

Project Location:

The reservoir embankment is located in:	Section 6, Township 19 North, Range 102 West.
The reservoir impoundment is located in:	Section 6, Township 19 North, Range 102 West and
	Section 5, Township 19 North, Range 102 West.

Land Ownership (Surface):

The reservoir embankment is located entirely on privately-owned land: Rock Springs Grazing Association.

The ponded area lies on privately-owned lands: Rock Springs Grazing Association and Union Pacific Land Resources

Water Source: Black Butte Creek

Water Rights: A search of the Wyoming State Engineers Office ePermit system failed to reveal water rights associated with the reservoir.

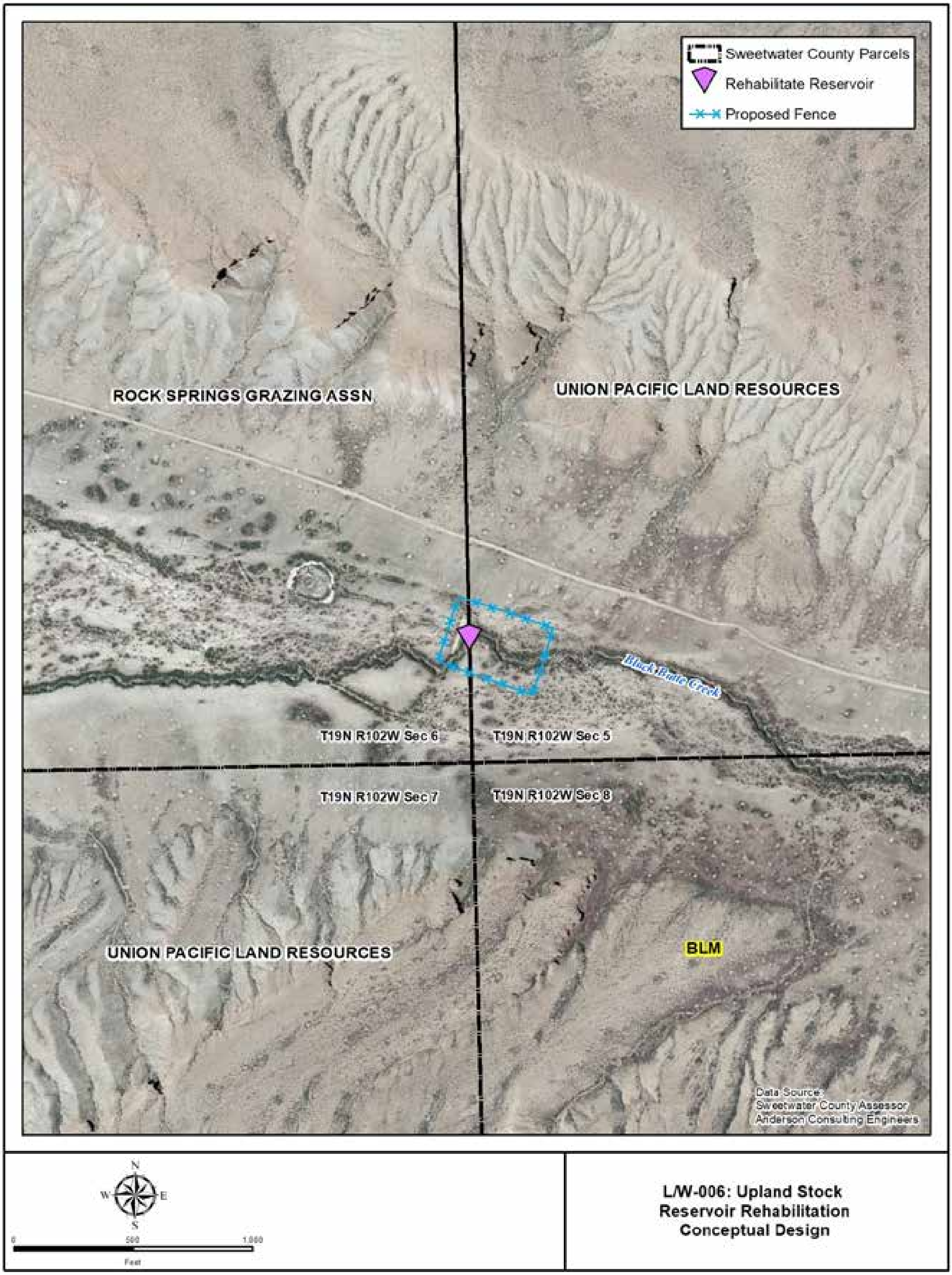
Improvements would involve:

- Verification of existing water rights. In the absence of WSEO permits, an application to the WSEO would be required.
- Inspecting the embankment and rehabilitation of the breach as needed.
- Removal of existing accumulated sediment.
- Installing an inlet and outlet pipe control structure in the reservoir embankment and stabilizing the installed structures and spillway with rock riprap.
- Installing an inlet and outlet control mechanism to control reservoir water levels. The installed structures would be stabilized with rock riprap.
- Construction of “steel jack” fencing capable of excluding wild horses when not in use yet allowing wildlife species to enter the facility.
- Additional engineering design, permits, water rights, clearances, and constructions specifications are required before commencing construction on this project.

Horse Management Area: Salt Wells Creek

Grazing Allotment: Rock Springs

Sage Grouse Core Area: Not Applicable


Sweetwater County Parcels
Rehabilitate Reservoir
Proposed Fence
ROCK SPRINGS GRAZING ASSN
UNION PACIFIC LAND RESOURCES
Black Butte Creek
T19N R102W Sec 6
T19N R102W Sec 5
T19N R102W Sec 7
T19N R102W Sec 8
UNION PACIFIC LAND RESOURCES
BLM
Data Source:
Sweetwater County Assessor
Anderson Consulting Engineers
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L/W-006: Upland Stock
Reservoir Rehabilitation
Conceptual Design

L/W-007: Upland Stock Reservoir Rehabilitation

Project Summary:
This proposed project would involve rehabilitating an existing stock reservoir to supply water to a portion of the watershed lacking adequate livestock/wildlife water sources. The existing reservoir is an off-channel reservoir adjacent to Black Butte Creek. The existing facility has filled with sediment and has subsequently breached.

Project Location:

The reservoir embankment and impoundment are located in:

Section 18, Township 18 North, Range 101 West.

Land Ownership (Surface):

The reservoir embankment and impounded areas are located entirely on federally owned and managed lands: Department of Interior, Bureau of Land Management.

Water Source: Black Butte Creek, a tributary to the Bitter Creek, which is then tributary to the Green River.

Water Rights: A search of the Wyoming State Engineers Office ePermit system failed to reveal water rights associated with the reservoir.

Improvements would involve:

- Verification of existing water rights. In the absence of WSEO permits, an application to the WSEO would be required.
- Inspecting the embankment and rehabilitation of the breach as needed.
- Inspection of the existing diversion facility on Black Butte Creek and rehabilitation as needed.
- Removal of existing accumulated sediment.
- Installing an inlet and outlet pipe control structure in the reservoir embankment and stabilizing the installed structures and spillway with rock riprap.
- Installing an inlet and outlet control mechanism to control reservoir water levels. The installed structures would be stabilized with rock riprap.
- Construction of “steel jack” fencing capable of excluding wild horses when not in use yet allowing wildlife species to enter the facility.
- Additional engineering design, permits, water rights, clearances, and constructions specifications are required before commencing construction on this project.

Horse Management Area: Salt Wells Creek

Grazing Allotment: Rock Springs

Sage Grouse Core Area: Not Applicable

L/W-007 Upland Stock Reservoir Rehabilitation Conceptual Design

L/W-008: Well Rehabilitation

Project Summary
This alternative would involve the rehabilitation of an existing well in the Bitter Creek drainage. Completion of the project would provide a reliable water supply to a portion of the watershed lacking adequate livestock and wildlife upland water sources.

Under this alternative, the following components would be employed:

- Application for a water right through the Wyoming State Engineers Office.
- The well water quality would be tested to verify it suitability for wildlife and livestock usage.
- A pump with a solar power supply would be installed.
- A 1,200 gallon rubber tire stock tank could be installed
- Wildlife egress ramps would be installed in the proposed stock tank.
- The spring vicinity would be fenced with approximately 500 linear feet of steel jack fencing to prevent damage from livestock, wildlife and wild horses.

Project Location:
The proposed project is located in:

Section 36, Township 18 North, Range 102 West.

Land Ownership (Surface):

The facility is located entirely on federally owned lands and managed by the Department of Interior, Bureau of Land Management.

Water Source: un-named and un-permitted well, tributary to Bitter Creek which is tributary to the Green River.

Water Rights: A search of the Wyoming State Engineers Office ePermit system failed to reveal water rights associated with the well.

Horse Management Area: Salt Wells Creek

Grazing Allotment: Rock Springs

Sage Grouse Core Area: Not Applicable

L/W-008: Well Rehabilitation Conceptual Design

L/W-009: Upland Stock Reservoir Re-Permit

Project Summary:
This proposed project would involve application to change Wyoming State Engineers permits associated with existing sediment reservoirs associated with the Black Butte Coal mine to stock water usage. It is our understanding that the existing reservoirs will likely be eliminated at some time when the mine either ceases operations or no longer needs the facilities. In an effort to maintain the facilities, re-permitting would be required. Several reservoirs currently exist.

Project Location:

The reservoir embankments and impoundments are located in:

Section 9, Township 17 North, Range 101 West.

Land Ownership (Surface):

The reservoir embankments and impounded areas are located on privately-owned lands (Union Pacific Land Resources).

Water Source: Un-named drainages tributary to Black Butte Creek, a tributary to the Bitter Creek, which is then tributary to the Green River.

Water Rights: Based upon a search of the Wyoming State Engineers Office ePermit system, water rights permits associated with the reservoirs are:

P13012.0R

P13024.0R.

Improvements would involve:

- Determination of ultimate reclamation responsibility and development of an agreement between Black Butte Mine ownership and local entities assuming ultimate responsibility for reservoir maintenance.
- Verification of existing water rights permits.
- Successful completion of steps necessary for modification of existing water rights permits through the WSEO (See Appendix 4B).
- Construction of “steel jack” fencing capable of excluding wild horses when not in use yet allowing wildlife species to enter the facility.

Horse Management Area: Salt Wells Creek

Grazing Allotment: Rock Springs

Sage Grouse Core Area: Not Applicable

L/W-009: Stock Reservoir Re-Permit
Conceptual Design

L/W-010: Upland Stock Reservoir Re-permit

Project Summary:
This proposed project would involve application to change Wyoming State Engineers permits associated with existing sediment reservoirs associated with the Black Butte Coal mine to stock water usage. It is our understanding that the existing reservoirs will likely be eliminated at some time when the mine either ceases operations or no longer needs the facilities. In an effort to maintain the facilities, re-permitting would be required. Several reservoirs currently exist.

Project Location:

The reservoir embankments and impoundments are located in:

Sections 7 and 18, Township 18 North, Range 100 West.

Land Ownership (Surface):

The reservoir embankments and impounded areas are located on both federally owned and managed lands (Department of Interior, Bureau of Land Management) and privately-owned lands (Union Pacific Land Resources).

Water Source: Un-named drainages tributary to Black Butte Creek, a tributary to the Bitter Creek, which is then tributary to the Green River.

Water Rights:

A search of the Wyoming State Engineers Office ePermit system failed to reveal water rights associated with the reservoirs.

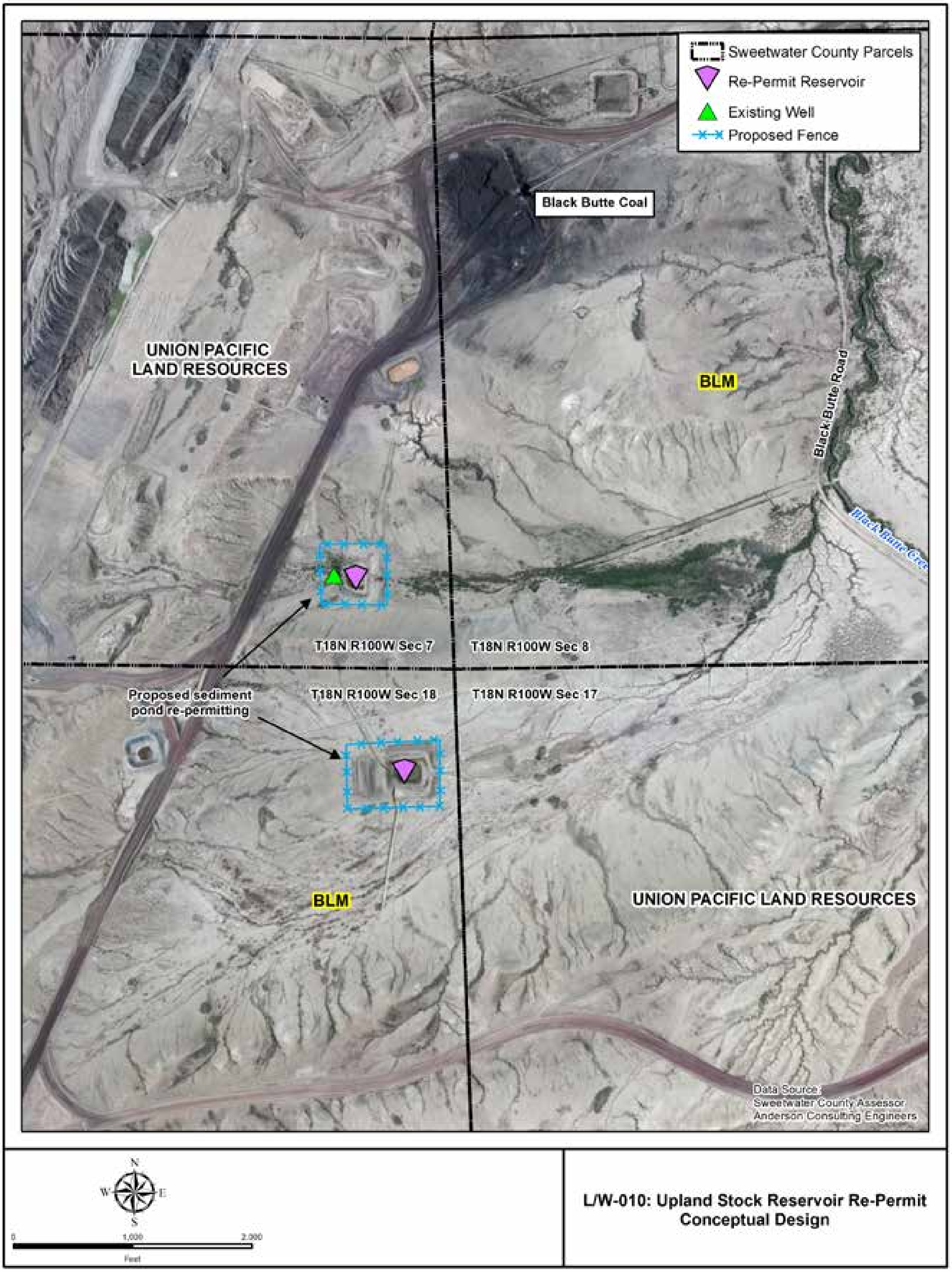
Improvements would involve:

- Determination of ultimate reclamation responsibility and development of an agreement between Black Butte Mine ownership and local entities assuming ultimate responsibility for reservoir maintenance.
- Verification of existing water rights permits.
- Successful completion of steps necessary for modification of existing water rights permits through the WSEO (See Appendix 4B).
- Construction of “steel jack” fencing capable of excluding wild horses when not in use yet allowing wildlife species to enter the facility.

Horse Management Area: Salt Wells Creek

Grazing Allotment: Rock Springs

Sage Grouse Core Area: Not Applicable


Sweetwater County Parcels
Re-Permit Reservoir
Existing Well
Proposed Fence
Black Butte Coal
UNION PACIFIC LAND RESOURCES
BLM
Black Butte Road
Black Butte Cre
T18N R100W Sec 7
T18N R100W Sec 8
T18N R100W Sec 18
T18N R100W Sec 17
Proposed sediment pond re-permitting
BLM
UNION PACIFIC LAND RESOURCES
Data Source:
Sweetwater County Assessor
Anderson Consulting Engineers
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L/W-010: Upland Stock Reservoir Re-Permit
Conceptual Design

L/W-011 Upland Stock Reservoir Re-permit

Project Summary:
This proposed project would involve application to change Wyoming State Engineers permits associated with two existing sediment reservoirs associated with the Black Butte Coal mine to stock water usage. It is our understanding that the existing reservoirs will likely be eliminated at some time when the mine either ceases operations or no longer needs the facilities. In an effort to maintain the facilities, re-permitting would be required.

Project Location:

The reservoir embankments and impoundments are located in:

Section 4, Township 18 North, Range 100 West.

Land Ownership (Surface):

Both reservoir embankments and impounded areas are located entirely on federally owned and managed lands (Department of Interior, Bureau of Land Management)

Water Source: John Boy Draw**,** tributary to Black Butte Creek, a tributary to the Bitter Creek, which is then tributary to the Green River.

Water Rights: Based upon a search of the Wyoming State Engineers Office ePermit system, water rights permits associated with the reservoirs appear to be:

P8387.0R

P8559.0R.

Improvements would involve:

- Determination of ultimate reclamation responsibility and development of an agreement between Black Butte Mine ownership and local entities assuming ultimate responsibility for reservoir maintenance.
- Verification of existing water rights permits.
- Successful completion of steps necessary for modification of existing water rights permits through the WSEO (See Appendix 4B).
- Construction of “steel jack” fencing capable of excluding wild horses when not in use yet allowing wildlife species to enter the facility.

Horse Management Area: Salt Wells Creek

Grazing Allotment: Rock Springs

Sage Grouse Core Area: Not Applicable


T19N R100W Sec 33
T18N R100W Sec 4
Sweetwater County Parcels
Re-Permit Reservoir
Proposed Fence
Black Butte Coal
BLM
Proposed sediment
pond re-permitting
Data Source:
Sweetwater County Assessor
Anderson Consulting Engineers
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L/W-011: Upland Stock Reservoirs Re-Permit
Conceptual Design

L/W-012: Upland Stock Reservoir Rehabilitation

Project Summary:
This proposed project would involve rehabilitating an existing stock reservoir to supply water to a portion of the watershed lacking adequate livestock/wildlife water sources. The existing reservoir is located on Patrick Draw. The existing facility has filled with sediment. Based upon review of available aerial photography, the embankment appears to be intact.

Project Location:

Sections 17 and 20, Township 17 North, Range 100 West.

Land Ownership (Surface):

The reservoir embankment spans lands owned by:

United States Department of Interior, Bureau of Land Management, and Union Pacific Land Resources

The impounded area spans lands owned by:

United States Department of Interior, Bureau of Land Management, and Union Pacific Land Resources

Water Source: Patrick Draw, a tributary to the Bitter Creek, which is then tributary to the Green River.

Water Rights: A search of the Wyoming State Engineers Office ePermit system failed to reveal water rights associated with the reservoir.

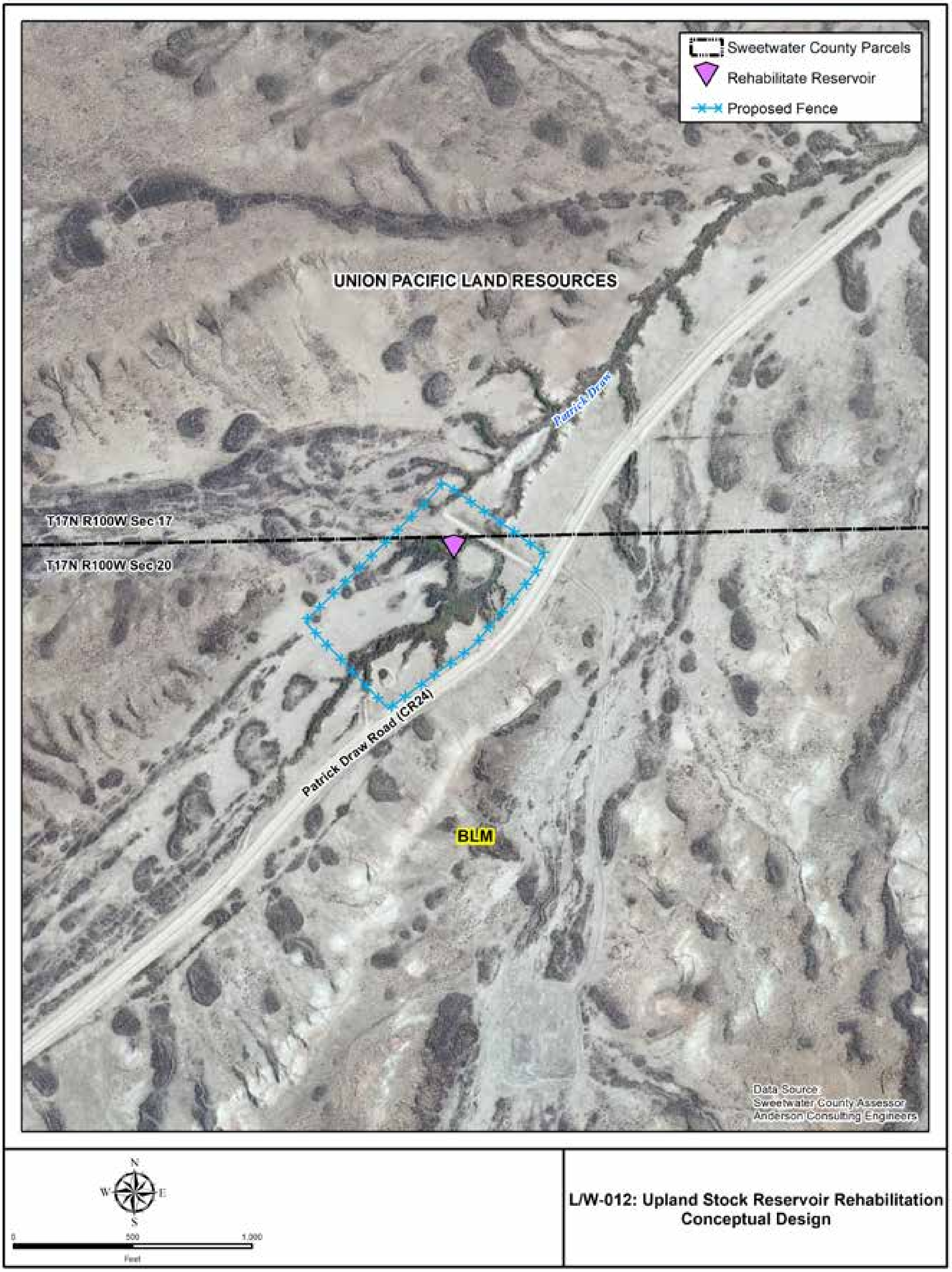
Improvements would involve:

- Verification of existing water rights. In the absence of WSEO permits, an application to the WSEO would be required.
- Inspecting the embankment and rehabilitation as needed.
- Inspection of the existing diversion facility on Patrick Draw and rehabilitation as needed.
- Removal of existing accumulated sediment.
- Installing an inlet and outlet pipe control structure in the reservoir embankment and stabilizing the installed structures and spillway with rock riprap.
- Construction of “steel jack” fencing capable of excluding wild horses when not in use yet allowing wildlife species to enter the facility.
- Additional engineering design, permits, water rights, clearances, and constructions specifications are required before commencing construction on this project.

Horse Management Area: Salt Wells Creek

Grazing Allotment: Rock Springs

Sage Grouse Core Area: Not Applicable



L/W-012: Upland Stock Reservoir Rehabilitation Conceptual Design

L/W-013: Well Re-Permit

Project Summary:
This proposed project would involve application to change Wyoming State Engineers permits associated with an existing well associated with energy exploration activities to stock water usage.

Project Location:

The existing well is located in:

Section 15, Township 16 North, Range 101 West.

Land Ownership (Surface):

The proposed project would involve only privately-owned lands: Union Pacific Land Resources.

Water Source: un-named well, tributary to Black Butte Creek, a tributary to the Bitter Creek, which is then tributary to the Green River.

Water Rights: A search of the Wyoming State Engineers Office ePermit indicates a cancelled permit (P16696W) for the site.

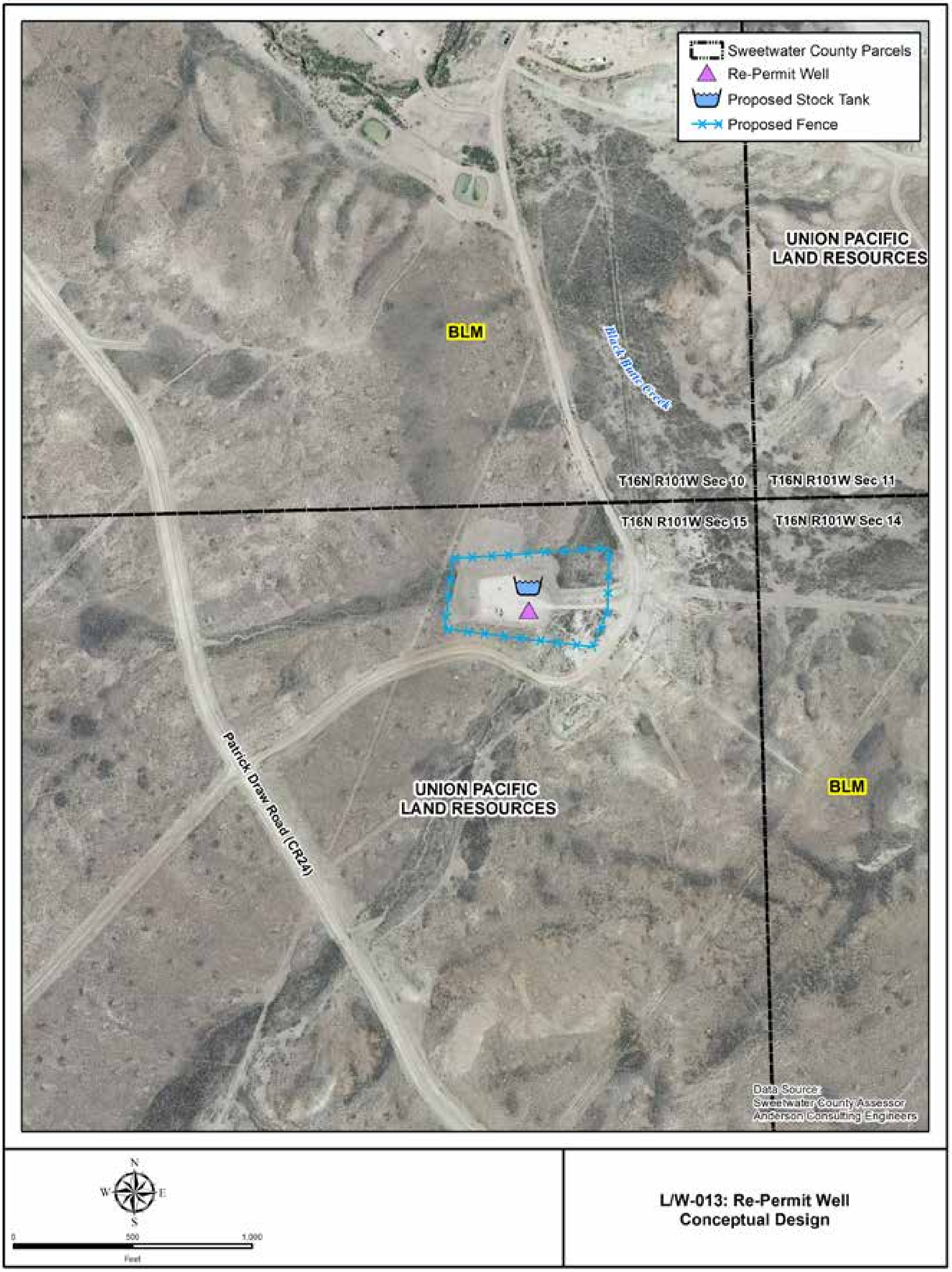
Improvements would involve:

- Verification of existing water rights permits.
- Successful completion of steps necessary for modification of existing water rights permits through the WSEO (See Appendix 4B).
- Installation of 1,200 gallon rubber tire stock tank.
- Construction of “steel jack” fencing capable of excluding wild horses when not in use yet allowing wildlife species to enter the facility.

Horse Management Area: Salt Wells Creek

Grazing Allotment: Rock Springs

Sage Grouse Core Area: Not Applicable



**L/W-013: Re-Permit Well
Conceptual Design**

L/W-014 Upland Stock Reservoir Rehabilitation

Project Summary:
This proposed project would involve rehabilitating an existing stock reservoir to supply water to a portion of the watershed lacking adequate livestock/wildlife water sources. The existing reservoir is located in the upper reaches of Black Butte Creek. The existing facility has filled with sediment. Based upon review of available aerial photography, the embankment appears to be intact.

Project Location:

Section 24, Township 16 North, Range 101 West.

Land Ownership (Surface):

The reservoir embankment and impounded area lie entirely upon lands owned by:

United States Department of Interior, Bureau of Land Management

Water Source: Un-named tributary to Black Butte Creek, a tributary to the Bitter Creek, which is then tributary to the Green River.

Water Rights: A search of the Wyoming State Engineers Office ePermit system failed to reveal water rights associated with the reservoir.

Improvements would involve:

- Verification of existing water rights. In the absence of WSEO permits, an application to the WSEO would be required.
- Inspecting the embankment and rehabilitation as needed.
- Inspection of the existing diversion facility on Patrick Draw and rehabilitation as needed.
- Removal of existing accumulated sediment.
- Installing an inlet and outlet pipe control structure in the reservoir embankment and stabilizing the installed structures and spillway with rock riprap.
- Construction of “steel jack” fencing capable of excluding wild horses when not in use yet allowing wildlife species to enter the facility.
- Additional engineering design, permits, water rights, clearances, and constructions specifications are required before commencing construction on this project.

Horse Management Area: Salt Wells Creek

Grazing Allotment: Rock Springs

Sage Grouse Core Area: Not Applicable

L/W-014: Upland Stock Reservoir Rehabilitation Conceptual Design

L/W-015 Upland Stock Reservoir Rehabilitation

Project Summary:
This proposed project would involve rehabilitating an existing stock reservoir to supply water to a portion of the watershed lacking adequate livestock/wildlife water sources. The existing reservoir is located on Patrick Draw. The existing facility has filled with sediment. Based upon review of available aerial photography, the embankment appears to be intact.

Project Location:

Section 3, Township 17 North, Range 100 West.

Land Ownership (Surface):

The reservoir embankment and impoundment are located entirely on privately-owned lands:

Union Pacific Land Resources

Water Source: Patrick Draw, a tributary to the Bitter Creek, which is then tributary to the Green River.

Water Rights: A search of the Wyoming State Engineers Office ePermit system failed to reveal water rights associated with the reservoir.

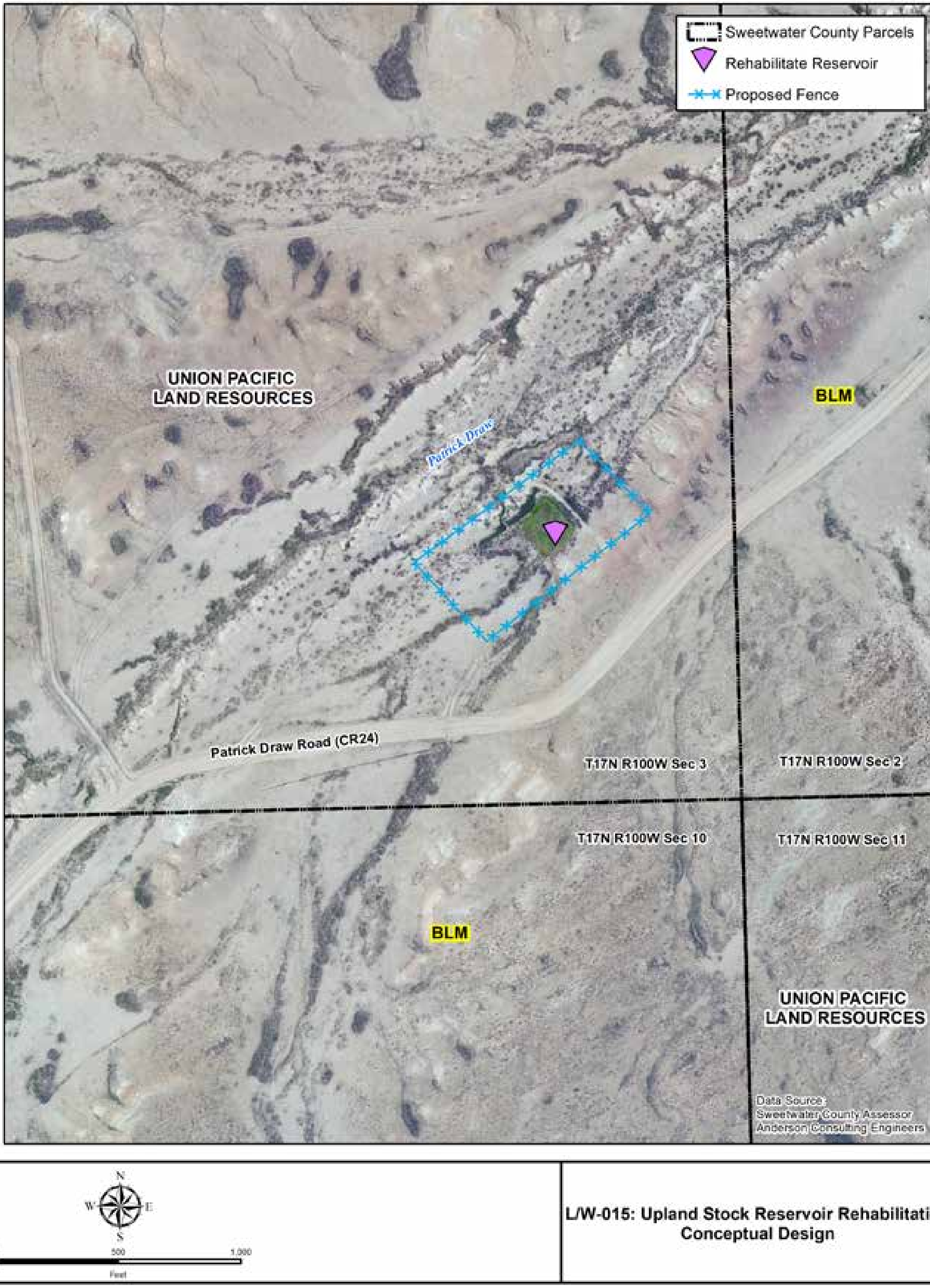
Improvements would involve:

- Verification of existing water rights. In the absence of WSEO permits, an application to the WSEO would be required.
- Inspecting the embankment and rehabilitation as needed.
- Inspection of the existing diversion facility on Patrick Draw and rehabilitation as needed.
- Removal of existing accumulated sediment.
- Installing an inlet and outlet pipe control structure in the reservoir embankment and stabilizing the installed structures and spillway with rock riprap.
- Construction of "steel jack" fencing capable of excluding wild horses when not in use yet allowing wildlife species to enter the facility.
- Additional engineering design, permits, water rights, clearances, and constructions specifications are required before commencing construction on this project.

Horse Management Area: Salt Wells Creek

Grazing Allotment: Rock Springs

Sage Grouse Core Area: Not Applicable



L/W-015: Upland Stock Reservoir Rehabilitation Conceptual Design

L/W-016: Upland Stock Reservoir Re-permit

Project Summary:
This proposed project would involve application to change Wyoming State Engineers permits associated with two existing mining-related reservoirs associated with the Black Butte Coal mine to stock water usage. It is our understanding that the existing reservoirs will likely be eliminated at some time when the mine either ceases operations or no longer needs the facilities. In an effort to maintain the facilities, re-permitting would be required.

Project Location:

The reservoir embankments and impoundments are located in:

Sections 28 and 32, Township 18 North, Range 100 West, and

Land Ownership (Surface):

The reservoirs (embankments and impounded areas) are located entirely on federally owned and managed lands:

Department of Interior, Bureau of Land Management

Water Source: Hospital Draw and Flood Draw**,** tributaries to Black Butte Creek, a tributary to the Bitter Creek, which is then tributary to the Green River.

Water Rights: Based upon a search of the Wyoming State Engineers Office ePermit system, water rights permits associated with the reservoirs appear to be:

P8650.0R

P9809.0R.

Improvements would involve:

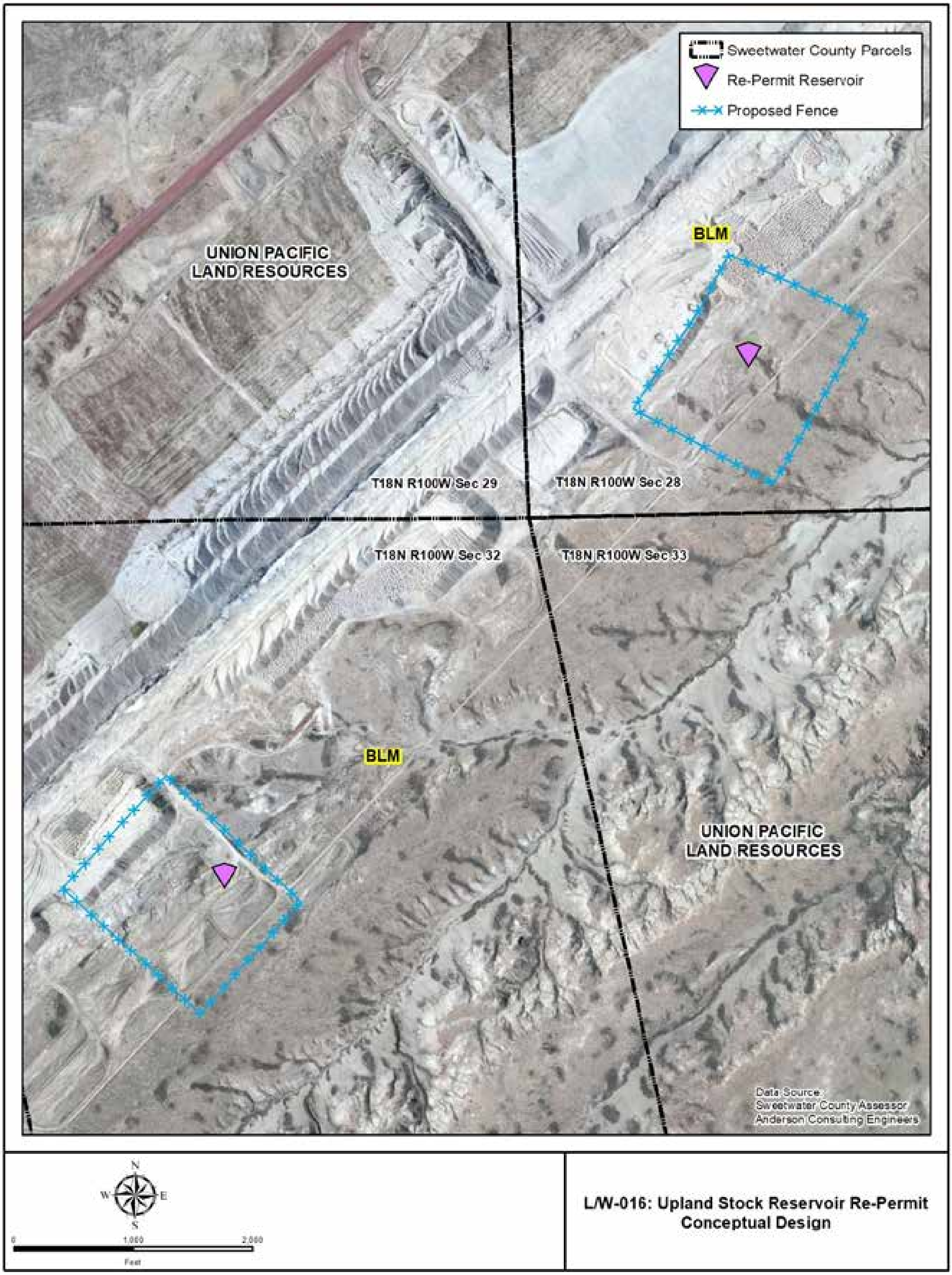
- Determination of ultimate reclamation responsibility and development of an agreement between Black Butte Mine ownership and local entities assuming ultimate responsibility for reservoir maintenance.
- Verification of existing water rights permits.
- Successful completion of steps necessary for modification of existing water rights permits through the WSEO (See Appendix 4B).
- Construction of “steel jack” fencing capable of excluding wild horses when not in use yet allowing wildlife species to enter the facility.

Horse Management Area: Salt Wells Creek

Grazing Allotment: Vermillion Creek

Sage Grouse Core Area: Not Applicable

Note: Progression of existing coal mining activities could potentially eliminate the reservoirs regardless of permit modifications.



L/W-016: Upland Stock Reservoir Re-Permit Conceptual Design

L/W-017: Upland Stock Reservoir Rehabilitation

Project Summary:
This proposed project would involve rehabilitating an existing stock reservoir to supply water to a portion of the watershed lacking adequate livestock/wildlife water sources. The existing reservoir is located on an un-named tributary to Scheggs Draw. The existing facility has filled with sediment. Based upon review of available aerial photography, the embankment appears to be intact.

Project Location:

Sections 19, 20, 29 and 30, Township 15 North, Range 101 West.

Land Ownership (Surface):

The reservoir embankment and impoundment are located entirely on federally owned and managed lands:

Department of Interior, Bureau of Land Management

Water Source: Un-named tributary to Scheggs Draw, a tributary East Salt Wells Creek, which is then tributary to Salt Wells Creek, Bitter Creek, and ultimately the Green River.

Water Rights: A search of the Wyoming State Engineers Office ePermit system failed to reveal water rights associated with the reservoir.

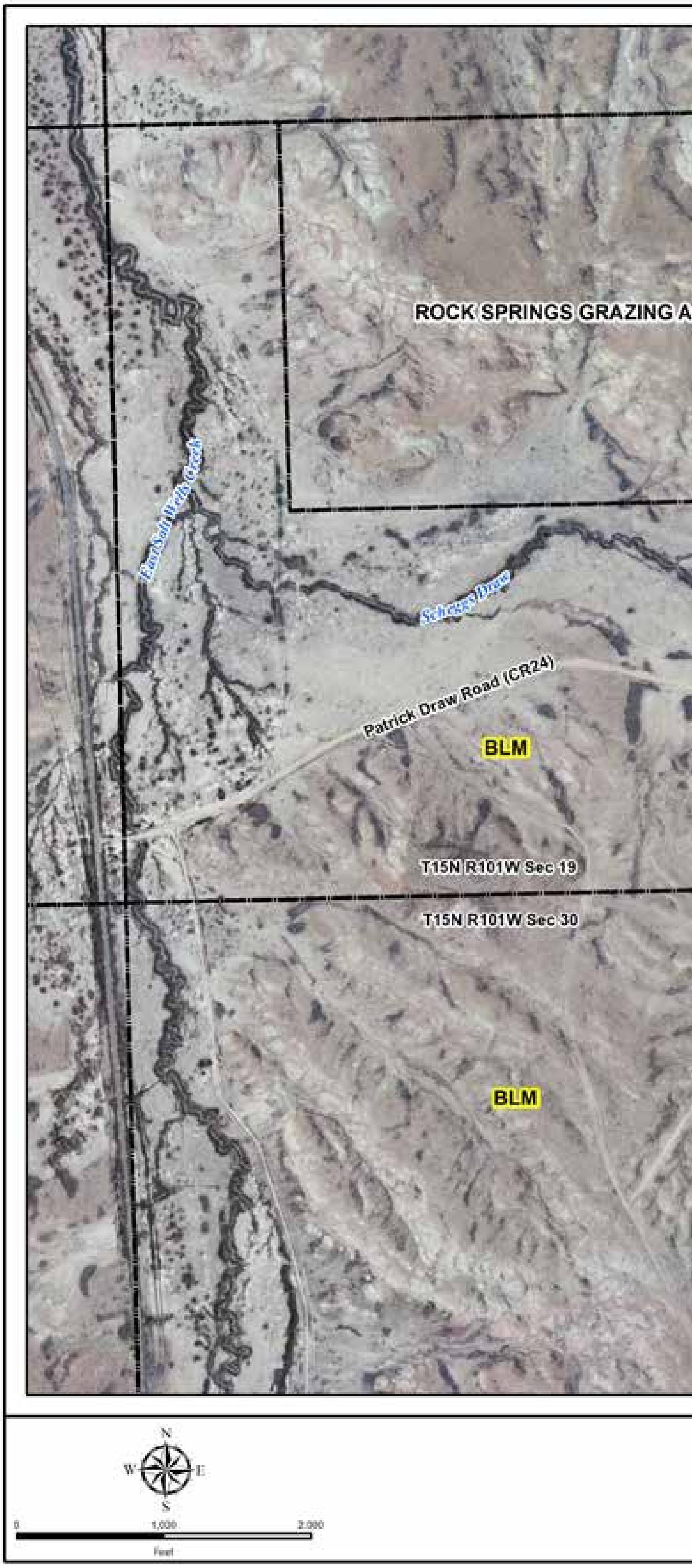
Improvements would involve:

- Verification of existing water rights. In the absence of WSEO permits, an application to the WSEO would be required.
- Inspecting the embankment and rehabilitation as needed.
- Removal of existing accumulated sediment.
- Installing an inlet and outlet pipe control structure in the reservoir embankment and stabilizing the installed structures and spillway with rock riprap.
- Construction of “steel jack” fencing capable of excluding wild horses when not in use yet allowing wildlife species to enter the facility.
- Additional engineering design, permits, water rights, clearances, and constructions specifications are required before commencing construction on this project.

Horse Management Area: Salt Wells Creek

Grazing Allotment: Vermillion Creek

Sage Grouse Core Area: Salt Wells



L/W-017: Upland Stock Reservoir Rehabilitation Conceptual Design

L/W-018 Upland Stock Reservoir Rehabilitation

Project Summary:
This proposed project would involve rehabilitating an existing stock reservoir to supply water to a portion of the watershed lacking adequate livestock/wildlife water sources. The existing reservoir is located on an un-named drainage tributary to Scheggs Draw. The existing facility has filled with sediment and has subsequently breached.

Project Location:

Section 35, Township 15 North, Range 101 West.

Land Ownership (Surface):

The reservoir embankment and impoundment are located entirely on federally owned and managed lands:

Department of Interior, Bureau of Land Management

Water Source:

Un-named tributary to Scheggs Draw, a tributary East Salt Wells Creek, which is then tributary to Salt Wells Creek, Bitter Creek, and ultimately the Green River.

Water Rights: A search of the Wyoming State Engineers Office ePermit system failed to reveal water rights associated with the reservoir.

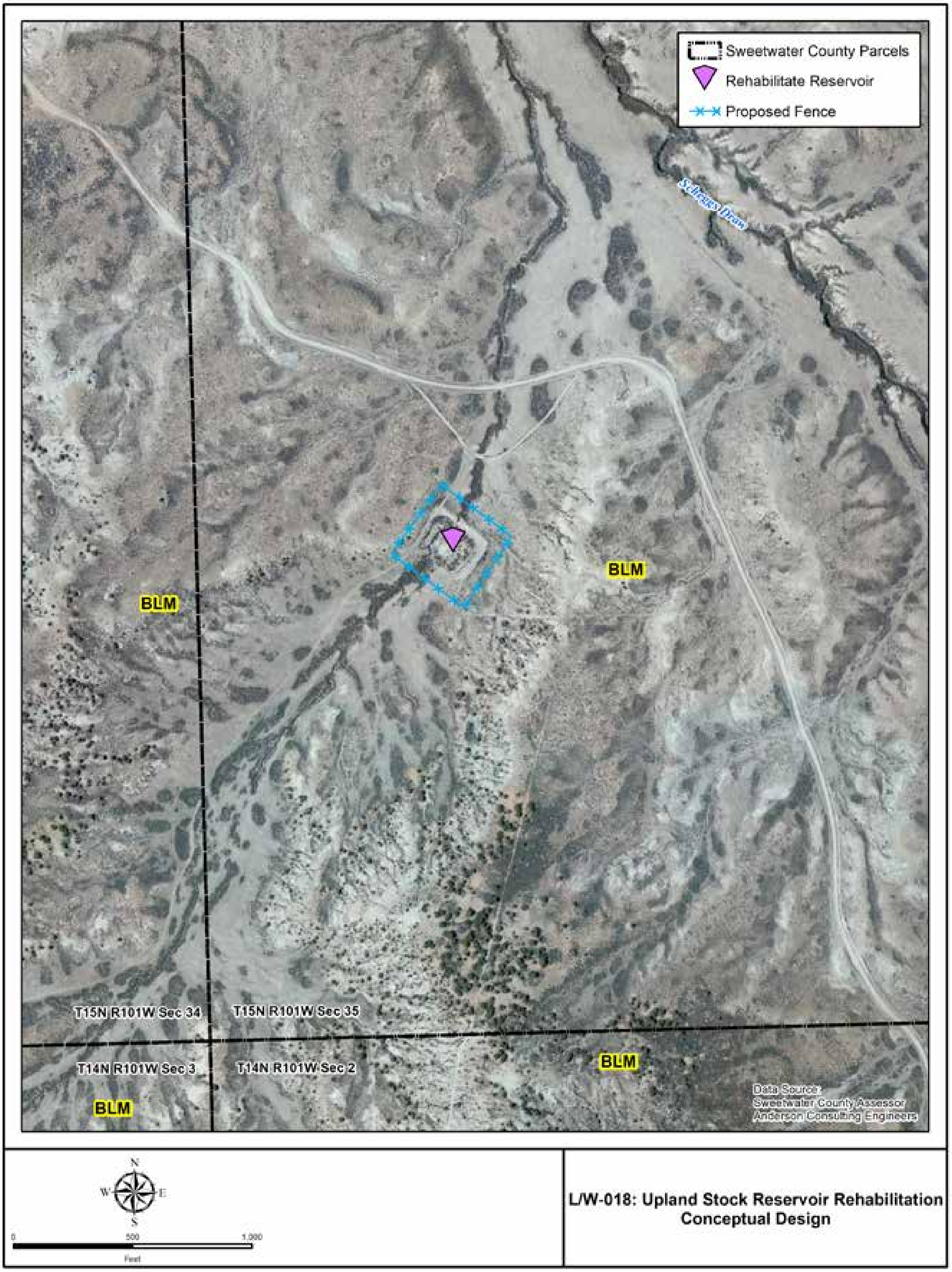
Improvements would involve:

- Verification of existing water rights. In the absence of WSEO permits, an application to the WSEO would be required.
- Inspecting the embankment and rehabilitation of the breach as needed.
- Removal of existing accumulated sediment.
- Installing an inlet and outlet pipe control structure in the reservoir embankment and stabilizing the installed structures and spillway with rock riprap.
- Construction of “steel jack” fencing capable of excluding wild horses when not in use yet allowing wildlife species to enter the facility.
- Additional engineering design, permits, water rights, clearances, and constructions specifications are required before commencing construction on this project.

Horse Management Area: Salt Wells Creek

Grazing Allotment: Rock Springs

Sage Grouse Core Area: Not Applicable



L/W-018: Upland Stock Reservoir Rehabilitation Conceptual Design

L/W-019: Well Re-Permit

Project Summary:
This proposed project would involve application to change Wyoming State Engineers permits associated with an existing well associated with energy development activities to stock water usage.

Project Location:

The existing well is located in:

Section 34, Township 16 North, Range 102 West.

Land Ownership (Surface):

The proposed project would involve only privately-owned lands.

Water Source: un-named well, tributary to Black Butte Creek, a tributary to the Bitter Creek, which is then tributary to the Green River.

Water Rights: A search of the Wyoming State Engineers Office ePermit system failed to reveal water rights associated with the reservoir.

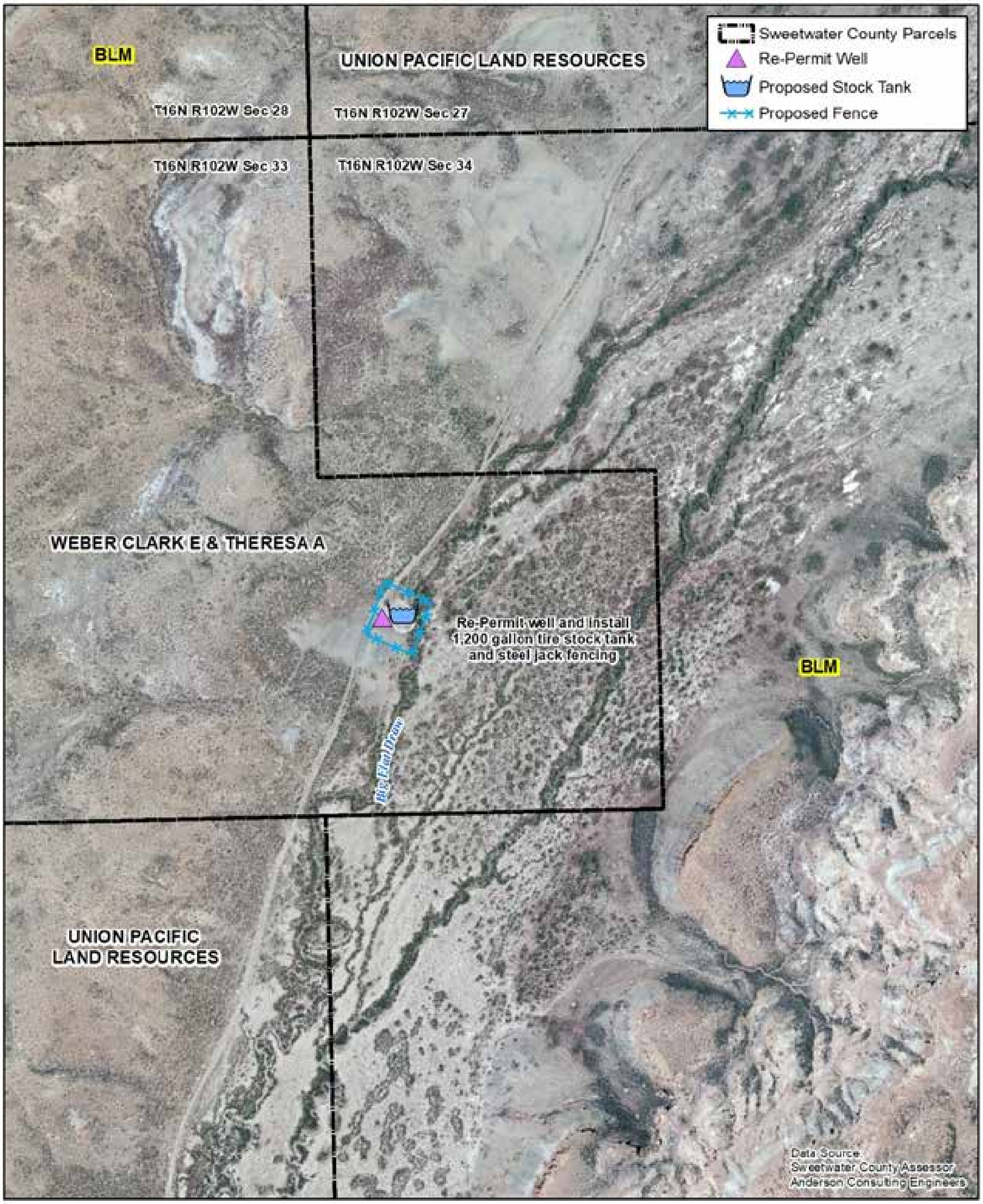
Improvements would involve:

- Verification of existing water rights permits.
- Successful completion of steps necessary for modification of existing water rights permits through the WSEO (See Appendix 4B).
- Installation of 1,200 gallon rubber tire stock tank.
- Construction of “steel jack” fencing capable of excluding wild horses when not in use yet allowing wildlife species to enter the facility.

Horse Management Area: Salt Wells Creek

Grazing Allotment: Rock Springs

Sage Grouse Core Area: Not Applicable



L/W-019: Re-Permit Well
Conceptual Design

L/W-020: Spring Rehabilitation

Project Summary:
This proposed project would involve rehabilitation of an existing spring heavily damaged by wild horse usage. Completion of the project would provide a viable source of water for wildlife and livestock in an area lacking adequate livestock and wildlife upland water sources.

Project Location:

The existing spring is located in:

Section 21, Township 17 North, Range 101 West.

Land Ownership (Surface):

The proposed project would involve only privately-owned lands: Union Pacific Land Resources.

Water Source: un-named spring**,** tributary to Black Butte Creek, a tributary to the Bitter Creek, which is then tributary to the Green River.

Water Rights: A search of the Wyoming State Engineers Office ePermit system failed to reveal water rights associated with the reservoir.

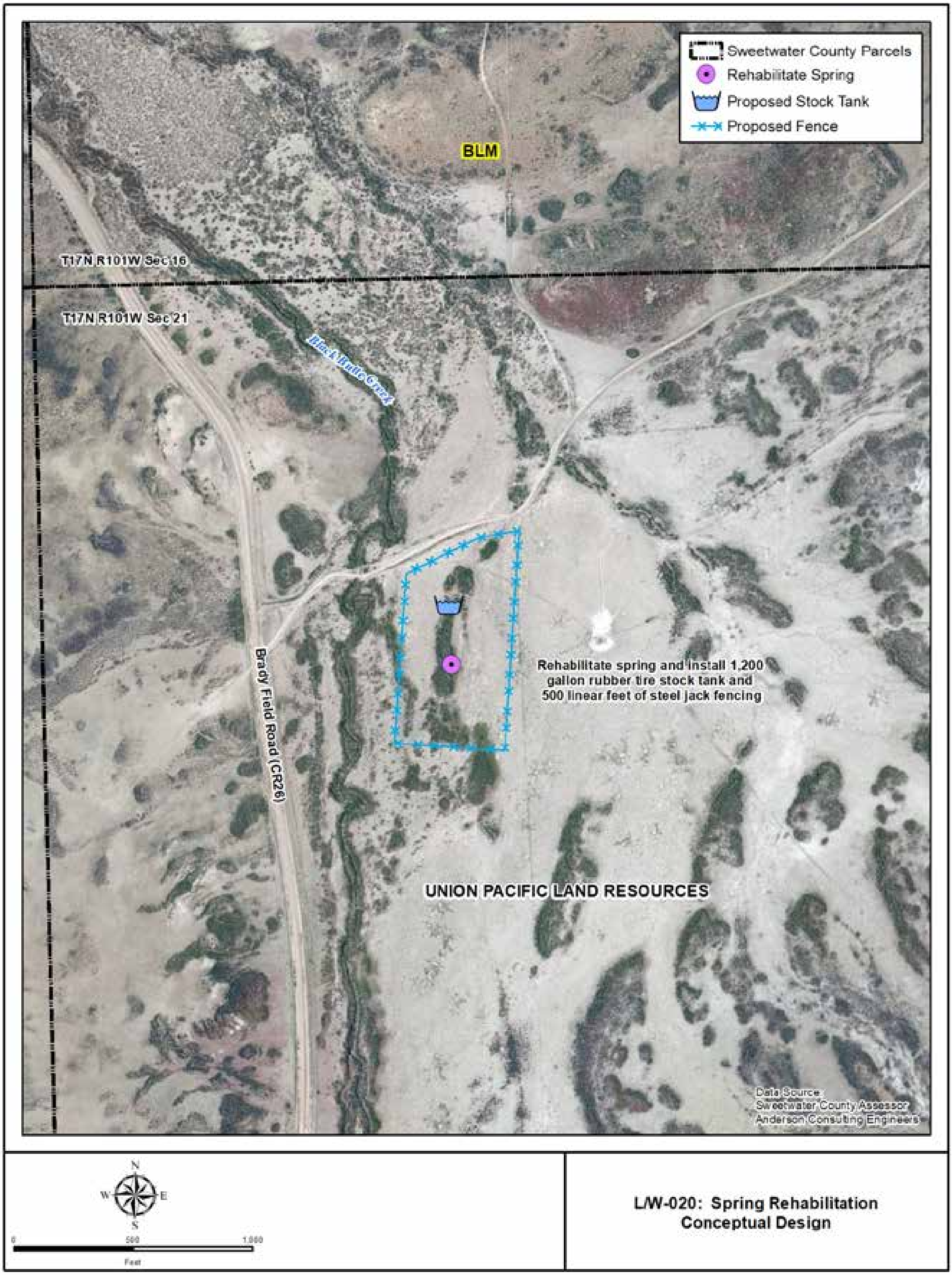
Improvements would involve:

- Application for a water right through the Wyoming State Engineers Office.
- The existing spring would be developed following NRCS spring development designs. A valve would be included for management of pipeline flows.
- A 1,200 gallon rubber tire stock tank could be installed
- Wildlife egress ramps would be installed in the proposed stock tank.
- The spring vicinity would be fenced with approximately 500 linear feet of steel jack fencing to prevent damage from livestock, wildlife and wild horses.

Horse Management Area: Salt Wells Creek

Grazing Allotment: Rock Springs

Sage Grouse Core Area: Not Applicable



L/W-020: Spring Rehabilitation
Conceptual Design

L/W-021: Well Construction Project Summary:

This project would involve drilling a new well (approximately 100 feet deep), installing a solar pump, and stock tank. The project would provide a source of water to a portion of the watershed lacking adequate alternative livestock and wildlife water sources. Currently, the allotment lease holder must haul water for livestock.

This site is located in T13N, R W, Sec. 35. There are no existing wells of record near this location. The site is underlain by the Wilkens Peak and Tipton Shale Members of the Green River Formations. These strata are dominated by fine-grained materials (shale, oil shale and mudstone) unlikely to produce more than a few gpm of groundwater and commonly contain evaporite beds (salt, trona, etc.) that may seriously compromise groundwater quality. Water suitable for human consumption is unlikely, but livestock have wider tolerance of salinity. Given the large thickness of these members, the only marginally-better lithology potentially available in the underlying Wasatch Formation, and the likely deterioration of water quality with depth, the potential for improving conditions by drilling deeper is small.

The best approach to groundwater development at this location is likely to be to attempt to capture whatever shallow, local recharge occurs through construction of a relatively shallow well (i.e. < 100 ft.) in the lowest part of drainage. Small quantities of fair quality groundwater may be available under favorable conditions

Under this alternative, the following components would be incorporated:

- A new well would be constructed. It would be assumed to be approximately 100 feet deep.
- The proposed well would be equipped with a solar pump facility
- Approximately 100 linear feet of buried 1 ½ inch HDPE low-pressure pipeline would be routed to a 1,200 gallon rubber tire stock tank.
- Requisite valves and fittings would be incorporated to facilitate management of flows and water levels.
- The well vicinity would be fenced with approximately 500 linear feet of steel jack fencing to prevent damage from livestock, wildlife and wild horses.
- Wildlife egress ramps would be installed in the proposed stock tank.

Project Location:

The proposed well is located in:

Section 35, Township 13 North, Range 107 West.

Land Ownership (Surface):

The proposed project would involve only federally owned and managed lands: Department of Interior, Bureau of Land Management.

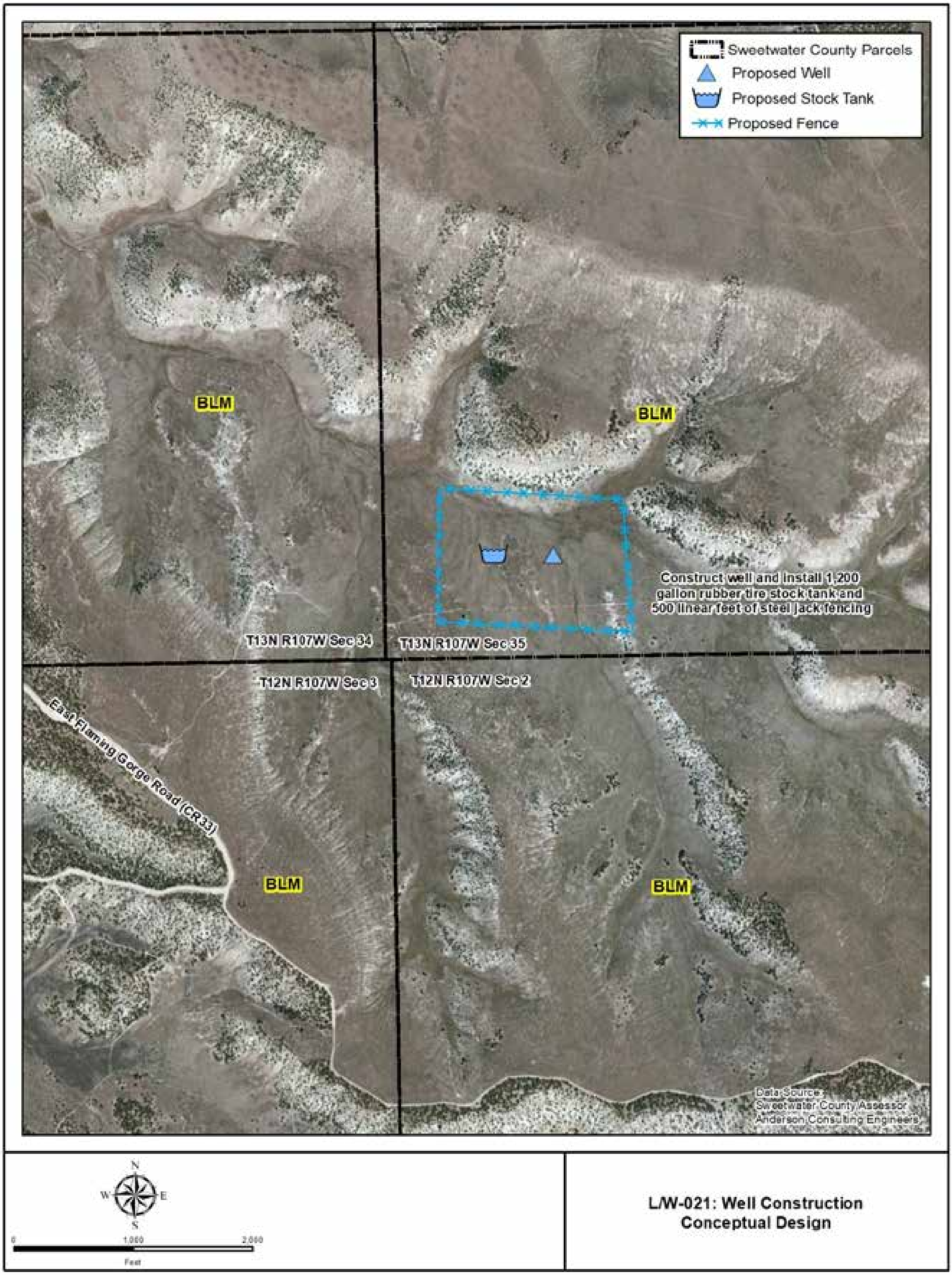
Water Source: proposed alluvial well in un-named drainage tributary to Middle Marsh Creek which is tributary to the Green River at Flaming Gorge Reservoir.

Water Rights: Application through the Wyoming State Engineers Office for water right would be required.

Horse Management Area: Not Applicable

Grazing Allotment: Spring Creek

Sage Grouse Core Area: Not Applicable



L/W-021: Well Construction Conceptual Design

L/W-022: Uncle Billy Pipeline Project

Project Summary:

This project would involve utilizing an existing undeveloped spring in the Red Creek subwatershed. Development of the spring would enable construction of an extensive pipeline / stock tank project providing reliable sources of water to an area where riparian sources are the primary existing source. Consequently, construction of the project would provide alternative sources of water to livestock and wildlife and reduce pressures on riparian zones.

Under this alternative, the following components would be incorporated:

- A previously undeveloped spring would be utilized as a source of water. Development would be completed using standard NRCS designs.
- From the spring, water would drain by gravity to a 10,000 gallon storage tank
- From the storage tank, water would drain by gravity to a series of thirty 1,200 gallon rubber tire stock tanks supplied by a total of approximately 97,000 linear feet of buried 1 ½ inch HDPE pipeline.
- Requisite valves and fittings would be installed to facilitate management and maintenance.
- Wildlife egress ramps would be installed in the proposed stock tanks
- The spring vicinity would be fenced to prevent spring development damage from livestock and wildlife.

Project Location:

The proposed spring is located in:

Section 4, Township 12 North, Range 103 West

Land Ownership (Surface):

The proposed project would involve all publicly owned lands; Department of Interior, Bureau of Land Management and the State of Wyoming

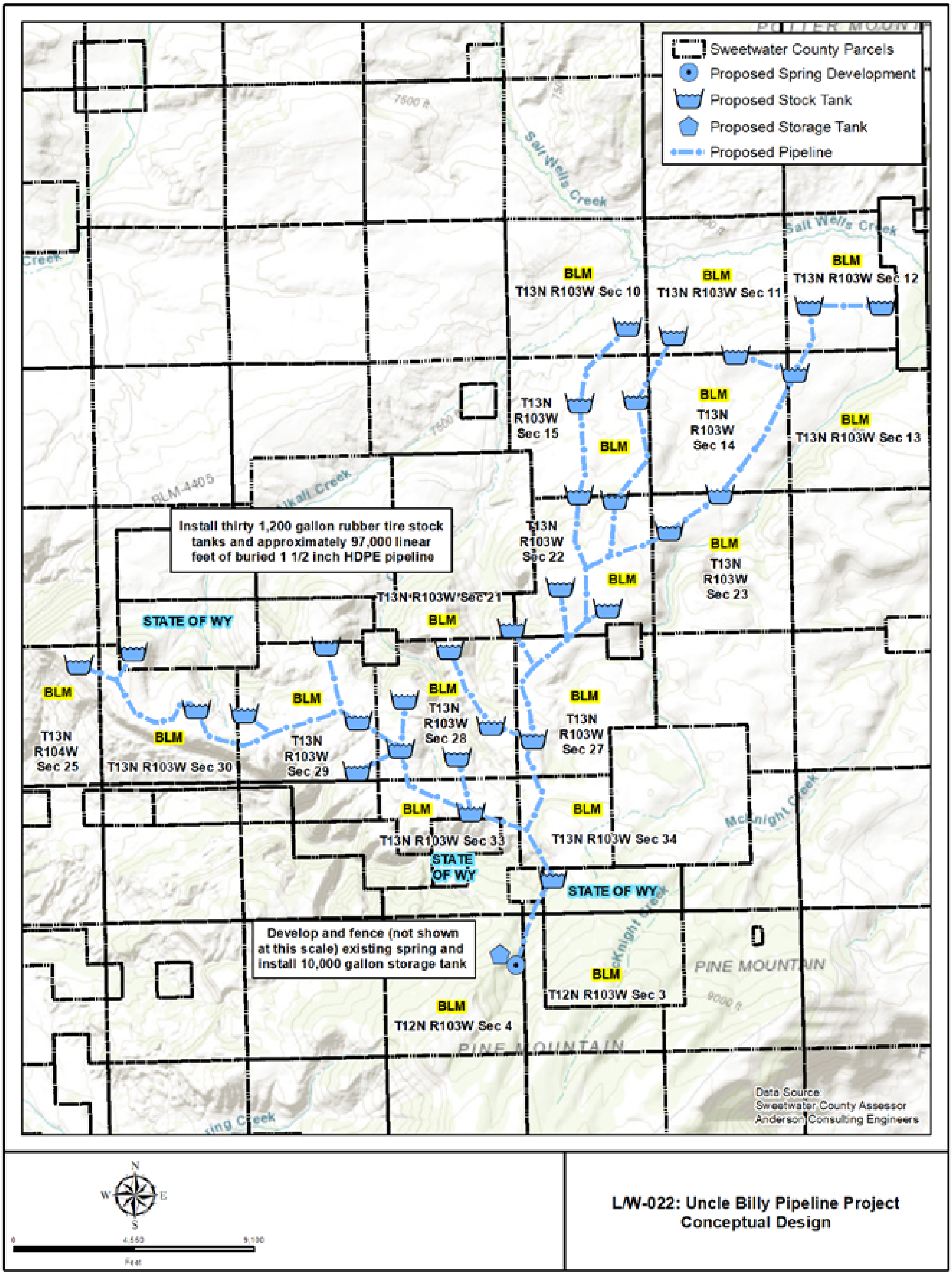
Water Source: Undeveloped spring in the Red Creek watershed.

Water Rights: Application through the Wyoming State Engineers Office for water right would be required.

Horse Management Area: Not Applicable

Grazing Allotment: Rock Springs

Sage Grouse Core Area: Not Applicable


Sweetwater County Parcels
Proposed Spring Development
Proposed Stock Tank
Proposed Storage Tank
Proposed Pipeline
Install thirty 1,200 gallon rubber tire stock tanks and approximately 97,000 linear feet of buried 1 1/2 inch HDPE pipeline
Develop and fence (not shown at this scale) existing spring and install 10,000 gallon storage tank
BLM
T13N R103W Sec 10
T13N R103W Sec 11
T13N R103W Sec 12
T13N R103W Sec 15
T13N R103W Sec 14
T13N R103W Sec 13
T13N R103W Sec 22
T13N R103W Sec 23
T13N R103W Sec 21
STATE OF WY
T13N R104W Sec 25
T13N R103W Sec 30
T13N R103W Sec 29
T13N R103W Sec 28
T13N R103W Sec 27
T13N R103W Sec 33
T13N R103W Sec 34
T12N R103W Sec 3
T12N R103W Sec 4
Salt Wells Creek
Alkali Creek
McKnight Creek
PINE MOUNTAIN
BLM-4405
Data Source:
Sweetwater County Assessor
Anderson Consulting Engineers
N
S
E
W
0
4,550
9,100
Feet
L/W-022: Uncle Billy Pipeline Project
Conceptual Design

L/W-023: Well Construction

This project would involve drilling a new well, installing a solar pump, and stock tank. The project would provide a source of water to a portion of the watershed lacking adequate alternative livestock and wildlife water sources. Currently, the allotment lease holder must haul water for livestock.

This site is at the contact between the Tipton Shale Member of the Green River and the main body of the Wastach Formation, i.e. drilling would penetrate the mixed lithologies of the latter. While the Wasatch has marginally better water-production potential than the overlying Green River strata, successful development is still hit-or-miss, and groundwater quality is likely to be poor.

Under this alternative, the following components would be incorporated:

- A new well would be constructed. For the purposes of this level I investigation and based upon the information presented above, the well would be assumed to be approximately 300 feet deep.
- The proposed well would be equipped with a solar pump facility
- Approximately 100 linear feet of buried 1 ½ inch HDPE low-pressure pipeline would be routed to a 1,200 gallon rubber tire stock tank.
- The well vicinity would be fenced with approximately 500 linear feet of steel jack fencing to prevent damage from livestock, wildlife and wild horses.
- Requisite valves and fittings would be incorporated to facilitate management of flows and water levels.
- Wildlife egress ramps would be installed in the proposed stock tank.

Project Location:

The proposed well is located in:

Section 3, Township 12 North, Range 107 West.

Land Ownership (Surface):

The proposed project would involve only federally owned and managed lands: Department of Interior, Bureau of Land Management.

Water Source: proposed alluvial well in Wild Horse Draw which is tributary to the Green River at Flaming Gorge Reservoir.

Water Rights: Application through the Wyoming State Engineers Office for water right would be required.

Horse Management Area: Not Applicable

Grazing Allotment: Pine Mountain

Sage Grouse Core Area: Salt Wells

L/W-023: Well Construction Conceptual Design

L/W-024: Well Construction

This project would involve drilling a new well, installing a solar pump, and stock tank. The project would provide a source of water to a portion of the watershed lacking adequate alternative livestock and wildlife water sources. Currently, the allotment lease holder must haul water for livestock.

This site is in the main body of the Wasatch Formation. There is an existing well (Permit 86401) in the Fort Union 1.5 miles to the southeast that reports a measured yield of 20 gpm over a 30-minute test, from which the water quality was designated "good". However, this well is 290 ft. deep. A well at this site would have to be deeper to encounter these same strata.

Under this alternative, the following components would be incorporated:

- A new well would be constructed. For the purposes of this Level I investigation, the well would be assumed to be approximately 350 feet deep.
- The proposed well would be equipped with a solar pump facility
- Approximately 100 linear feet of buried 1 ½ inch HDPE low-pressure pipeline would be routed to a 1,200 gallon rubber tire stock tank.
- The well vicinity would be fenced with approximately 500 linear feet of steel jack fencing to prevent damage from livestock, wildlife and wild horses.
- Requisite valves and fittings would be incorporated to facilitate management of flows and water levels.
- Wildlife egress ramps would be installed in the proposed stock tank.

Project Location:

The proposed well is located in:

Section 11 Township 12 North, Range 107 West.

Land Ownership (Surface):

The proposed project would involve only federally owned and managed lands: Department of Interior, Bureau of Land Management.

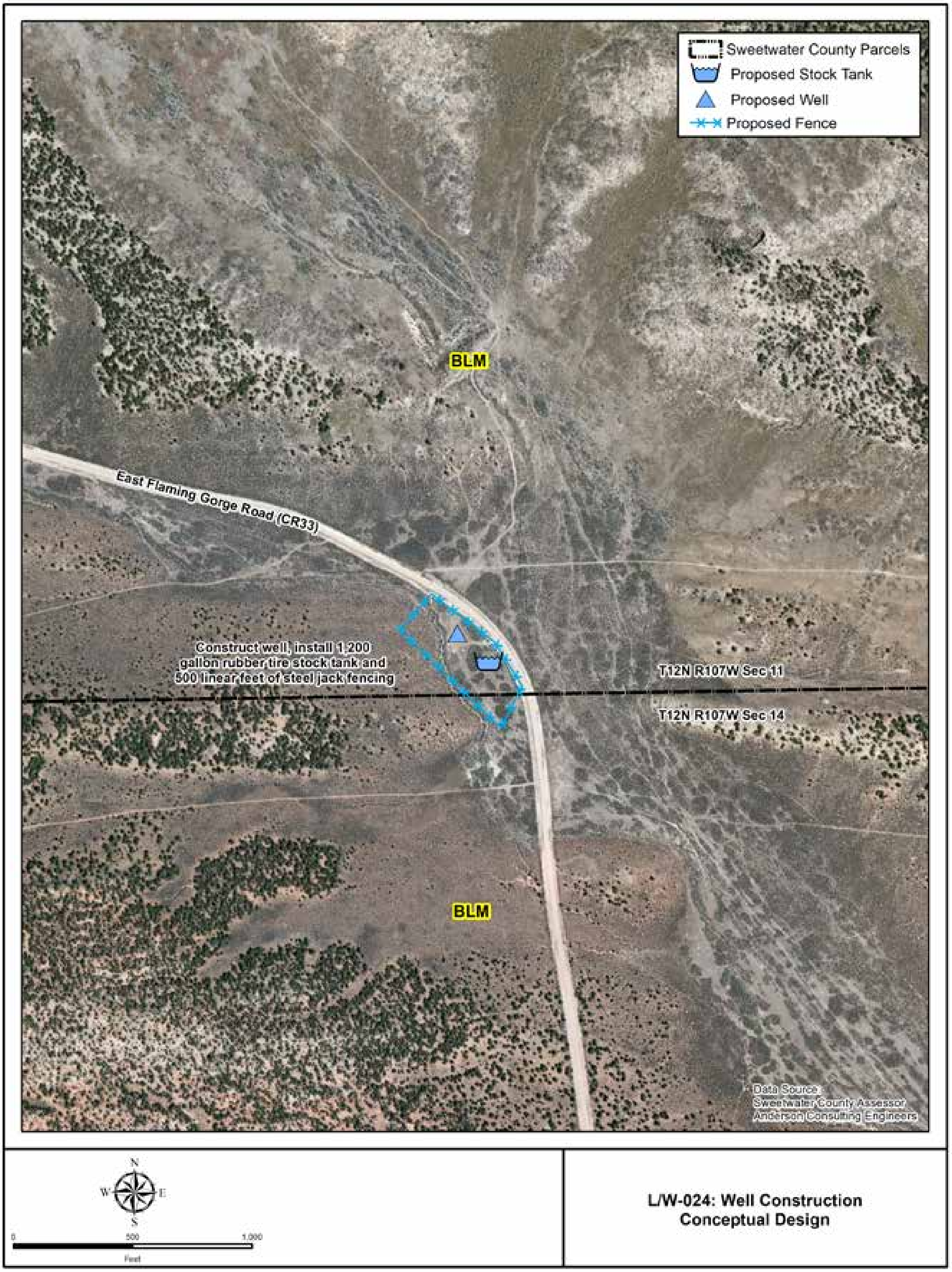
Water Source: groundwater supply

Water Rights: Application through the Wyoming State Engineers Office for water right would be required.

Horse Management Area: Not Applicable

Grazing Allotment: Spring Creek

Sage Grouse Core Area: Not Applicable



L/W-024: Well Construction Conceptual Design

L/W-025: Well Construction

This project would involve drilling a new well, installing a solar pump, and stock tank. The project would provide a source of domestic water to a portion of the watershed lacking adequate alternative sources. Currently, the resident must haul water from municipal suppliers.

The following well permit information was obtained for the surrounding area:

Permit	Yield	Water Level (ft)	Total Depth (ft)
194948	100	30	118
135403	25	118	300
64168	25	160	240
35831	20	140	220
35508	20	45	240
53950	16	65	225

Production potential varies over short distances, but useful water supplies are generally available with sufficient depth. Water quality is likely fair in terms of drinking water, but acceptable. If water quality is of concern, sampling from one of the existing wells in the area is recommended

A 100 ft. test well drilled by the Wyoming Highway Dept. at this location (83329) reported a yield of 2-3 gpm of “poor” quality water, and was abandoned. But the well drilled by WyDOT to 118 feet reported a measured 100 gpm for 8 hours.

Under this alternative, the following components would be incorporated:

- A new well would be constructed. For the purposes of this Level I investigation, well depth was assumed to be approximately 250 feet.
- The proposed well would be equipped with a solar pump facility
- Approximately 100 linear feet of buried 1 ½ inch HDPE low-pressure pipeline would be routed to a 1,200 gallon rubber tire stock tank.
- Requisite valves and fittings would be incorporated to facilitate management of flows and water levels.
- Wildlife egress ramps would be installed in the proposed stock tank.

Project Location:

The proposed well is located in:

Section 28 Township 20 North, Range 102 West.

Land Ownership (Surface):

The proposed project would involve only privately-owned lands.

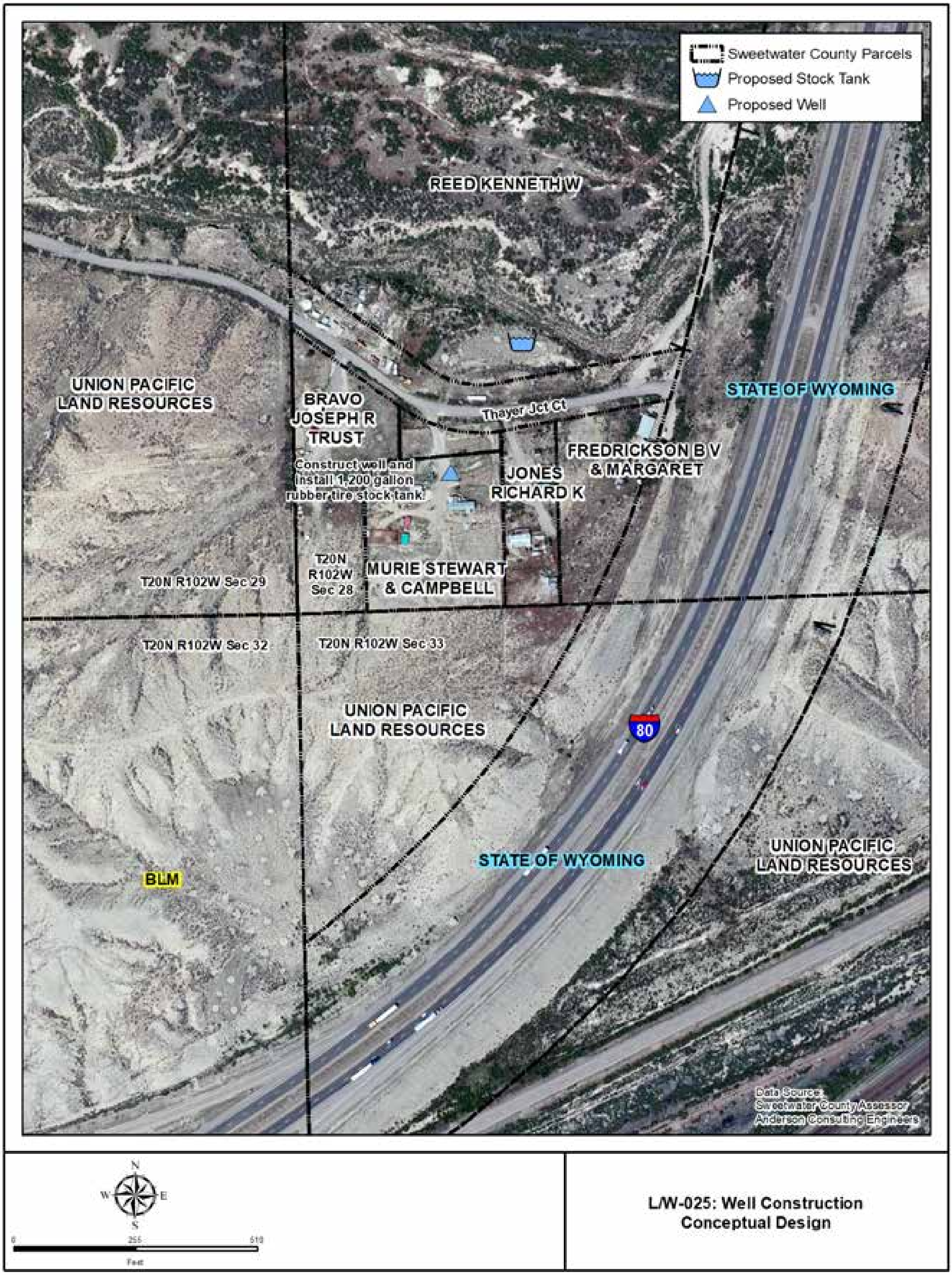
Water Source: groundwater supply

Water Rights: Application through the Wyoming State Engineers Office for water right would be required.

Horse Management Area: Not Applicable

Grazing Allotment: Spring Creek

Sage Grouse Core Area: Not Applicable


Sweetwater County Parcels
Proposed Stock Tank
Proposed Well
REED KENNETH W
UNION PACIFIC LAND RESOURCES
BRAVO JOSEPH R TRUST
Thayer Jct Ct
STATE OF WYOMING
FREDRICKSON B V & MARGARET
JONES RICHARD K
Construct well and install 1,200 gallon rubber tire stock tank
T20N R102W Sec 29
T20N R102W Sec 28
MURIE STEWART & CAMPBELL
T20N R102W Sec 32
T20N R102W Sec 33
UNION PACIFIC LAND RESOURCES
80
STATE OF WYOMING
BLM
UNION PACIFIC LAND RESOURCES
Data Source: Sweetwater County Assessor, Anderson Consulting Engineers
N
W
E
S
0
255
510
Feet
L/W-025: Well Construction Conceptual Design

L/W-026: Well Rehabilitation

Project Summary

This alternative would involve the rehabilitation of an existing well in the Black Butte Creek drainage. Completion of the project would provide a reliable water supply to a portion of the watershed lacking adequate livestock and wildlife upland water sources.

Under this alternative, the following components would be employed:

- Application for a water right through the Wyoming State Engineers Office.
- The well water quality would be tested to verify it suitability for wildlife and livestock usage.
- A pump with a solar power supply would be installed.
- A 1,200 gallon rubber tire stock tank could be installed
- Wildlife egress ramps would be installed in the proposed stock tank.
- The spring vicinity would be fenced with approximately 500 linear feet of steel jack fencing to prevent damage from livestock, wildlife and wild horses.

Project Location:

The proposed project is located in:

Section 21, Township 17 North, Range 101 West.

Land Ownership (Surface):

The proposed project would involve only privately-owned lands: Union Pacific Land Resources**.**

Water Source: un-named and un-permitted well, tributary to Bitter Creek which is tributary to the Green River.

Water Rights: A search of the Wyoming State Engineers Office ePermit system failed to reveal water rights associated with the well.

Horse Management Area: Salt Wells Creek

Grazing Allotment: Rock Springs

Sage Grouse Core Area: Not Applicable


Sweetwater County Parcels
Rehabilitate Well
Proposed Stock Tank
Proposed Fence
Brady Field Road (CR26)
Black Butte Creek
BLM
Rehabilitate well and install 1,200 gallon rubber tire stock tank and 500 linear feet of steel jack fencing
UNION PACIFIC LAND RESOURCES
T17N R101W Sec 20
T17N R101W Sec 21
Data Source:
Sweetwater County Assessor
Anderson Consulting Engineers
N
W
E
S
0
500
1,000
Feet
L/W-026: Well Rehabilitation
Conceptual Design

STR-001: Pierotto Ditch Diversion Structure Monitoring

Project Summary:

This proposed project would involve monitoring the Pierotto ditch diversion structure / headcut stabilization project upon its completion. The structure plays an important role in the stability of Bitter Creek and protection of the stream channel, riparian health, and aquatic conditions upstream. The SWCCD and partners have gone to great length to complete the stabilization project which has been complicated by damage causing floods during the process. Consequently, unanticipated remediation has been required as the channel bypassed the structure and formed a large erosional feature adjacent to the structure.

Due to the importance of the structure and its function, monitoring of the facility is recommended upon its completion. Monitoring efforts would include, but not be limited to, the following:

- Establishment of monumented photo-documentation points. Permanent points (survey monuments, rebar, etc.) should be established at critical locations around the facility. Photos should be taken annually at a minimum in addition to following large runoff events.
- Establishment of bank erosion monitoring monuments. Permanent points (survey monuments, rebar, etc.) should be established at critical locations about the facility. The monuments would be setback from the top of stream bank in areas of concern and the distance from the monument to the top of bank be monitored. Measurement should be recorded annually at a minimum in addition to following large runoff events.
- Vegetation should be visually monitored to verify reclamation success of the project and establishment of riparian vegetation.
- Riprap should be visually monitored to verify its integrity and stability. This effort should include documentation of movement, failure, and overall condition of placed riprap as well as bedding materials and geotextiles used during construction.

Project Location:

The project is located in Section 31, Township 20 North, Range 102 West

Land Ownership (Surface):

The project is located on lands currently owned by Sweetwater County.

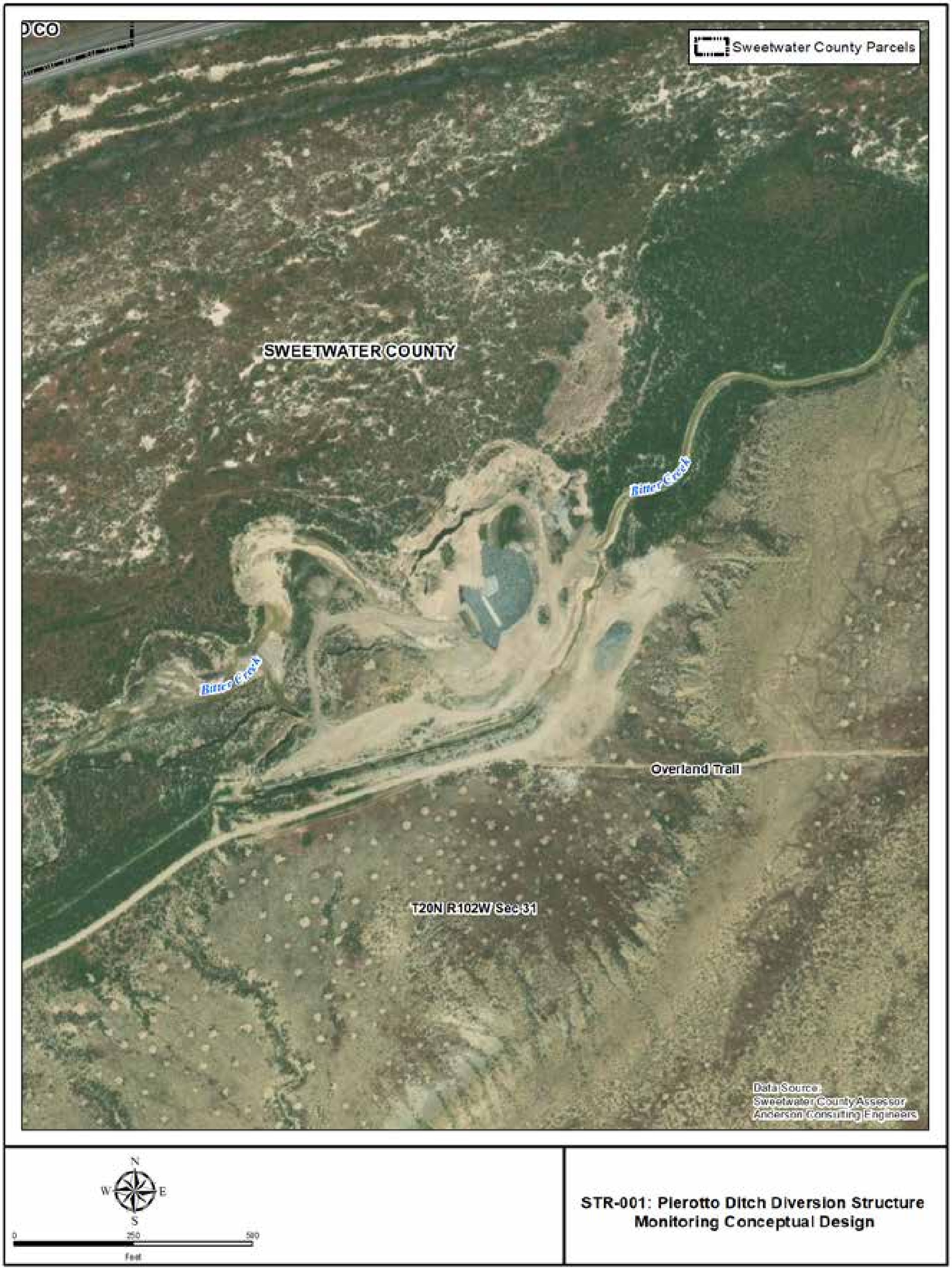
Water Source: Bitter Creek, a tributary to the Green River

Water Rights: The Pierotto Ditch has a priority date of June 1, 1950 under permit number P20375D.

Horse Management Area: Salt Wells Creek

Grazing Allotment: Rock Springs

Sage Grouse Core Area: Not Applicable



STR-001: Pierotto Ditch Diversion Structure Monitoring Conceptual Design

STR-002: Big Pond Rehabilitation Study

Project Summary:
This proposed project would involve monitoring and investigation of the Big Pond site on Bitter Creek. According to local landowners and agency representatives, the site was constructed by the Union Pacific Railroad as a source of water for steam engines. The Big Pond site was also a stop on the Overland Stage between Fort LaClede and Point of Rocks. The once functional reservoir has become full of sediment, breached, and now is a source of sediment to Bitter Creek. The affected reach lies within an area designated as a crucial stream corridor by Wyoming Game and Fish, partly due to the habitat of the flannel mouth sucker.

Before a rehabilitation design can be developed, the processes affecting the facility must be determined. Monitoring and investigation should include, but not be limited to the following:

- Establishment of shallow monitoring wells to determine the role of shallow groundwater in failure of sediment in the pond area. Monitoring wells should be equipped with pressure transducers and data loggers.
- Establishment of simple temporary stream gages in the vicinity of the site. The gages should be equipped with pressure transducers and data loggers.
- Visual monitoring during runoff events to determine flow patterns and distribution (if possible).

Objectives of the monitoring program would be to determine the nature and extent of Bitter Creek's out of bank flooding, failure mechanism of Big Pond sediments (surface flow or groundwater flow), and patterns and sources of water causing the erosive features. Following evaluation of a period containing several flow events, a rehabilitation could be developed.

Project Location:

Big Pond is located in:

Section 1, Township 17 North, Range 99 West, and

Section 6, Township 17 North, Range 98 West.

Land Ownership (Surface):

The facility is located entirely upon privately-owned lands:

Union Pacific Land Resources.

Water Source: Bitter Creek, Tributary to the Green River.

Water Rights: A search of the Wyoming State Engineers Office ePermit system failed to reveal water rights associated with the reservoir.

Horse Management Area: Salt Wells Creek

Grazing Allotment: Rock Springs

Sage Grouse Core Area: Not Applicable

Erosional features at Big Pond Site

STR-002: Big Pond Conceptual Design

STR-003: UPRR Crossing Headcut

Project Summary:

This proposed project would involve development of a stabilization structure to fortify an existing headcut on an un-named tributary to Bitter Creek which threatens a Union Pacific Railroad crossing. The existing feature consists of a vertical headcut, approximately 20 to 25 feet high. UPRR has protected the channel bed with asphalt and placed rock in the channel below the headcut. However, it appears that during runoff events, the rocks will be bypassed and deflect flows into the bank and exacerbate the situation.

Project Location:

The UPRR crossing is located in:

Section 2, Township 19 North, Range 103 West

Land Ownership (Surface):

The facility is located entirely upon federally owned and managed lands:

Department of Interior, Bureau of Land Management.

Note: the vertical portion of the site presumably lies within the UPRR easement. The channel downstream is outside of the right-of-way.

Water Source: Un-Named tributary to Bitter Creek, a tributary to the Green River.

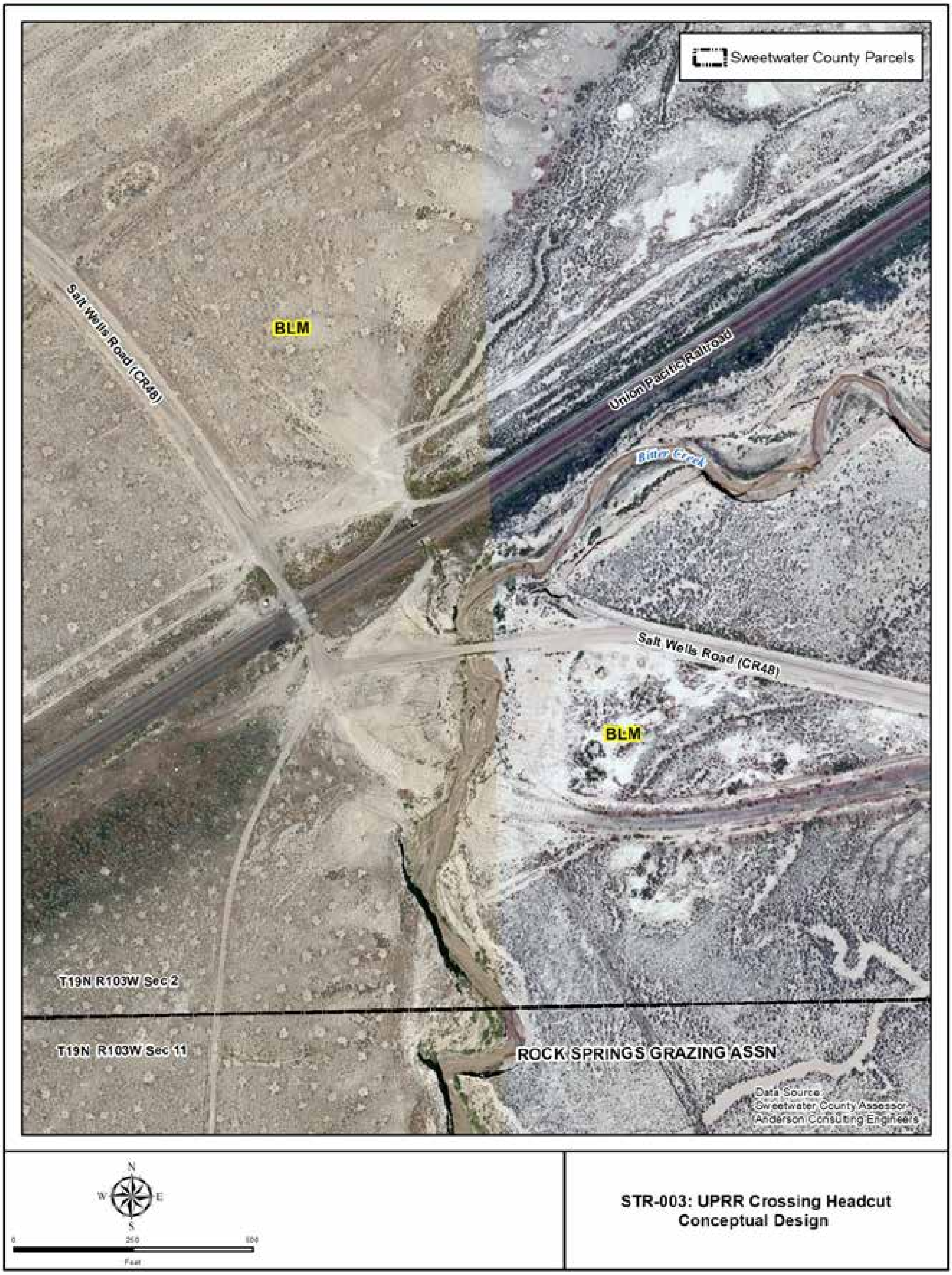
Water Rights: Not Applicable.

Horse Management Area: Salt Wells Creek

Grazing Allotment: Rock Springs

Sage Grouse Core Area: Not Applicable

Active Headcut at UPRR



STR-003: UPRR Crossing Headcut Conceptual Design

STR-004: Gooseberry Creek Wildlife/Livestock Exclosure

Project Summary:
This proposed project would involve modification to existing fencing (steel jack) exclosure constructed on Gooseberry Creek. The existing exclosure was constructed in coordination with Wyoming Game and Fish Department (WGF) and Trout Unlimited (TU). The purpose of the exclosure is to keep wild horses, large ungulates and livestock from the riparian corridor. The fencing is to be in place long enough for vegetation to recover from historic damages and eroded stream banks to recover.

Implementation of this project would involve moving the existing fence to one of two locations depending upon approval of the land owners / lease holder. Optimally, the fencing would be moved upstream to a degraded reach of Gooseberry Creek on lands owned by the State of Wyoming. Previous requests for consent from the lease holder were denied. In the event the lease changes hands, the new holder would be approached.

In the event consent is not secured, an alternative location downstream of the existing fence and within an existing livestock exclosure would be selected. In this case, the facility would be easily acceptable and could serve as a demonstration project for public view.

Proposed fencing would consist of "steel jack" fence designed to exclude livestock and large ungulates.

Project Location:
The proposed project is located in:

Section 27, 28 and 33 of Township 14 North, Range 105 West.

Land Ownership (Surface):

The facility is located on lands owned by the Department of Interior, Bureau of Land Management and the State of Wyoming.

Water Source: Gooseberry Creek, a tributary to the Green River at Flaming Gorge Reservoir.

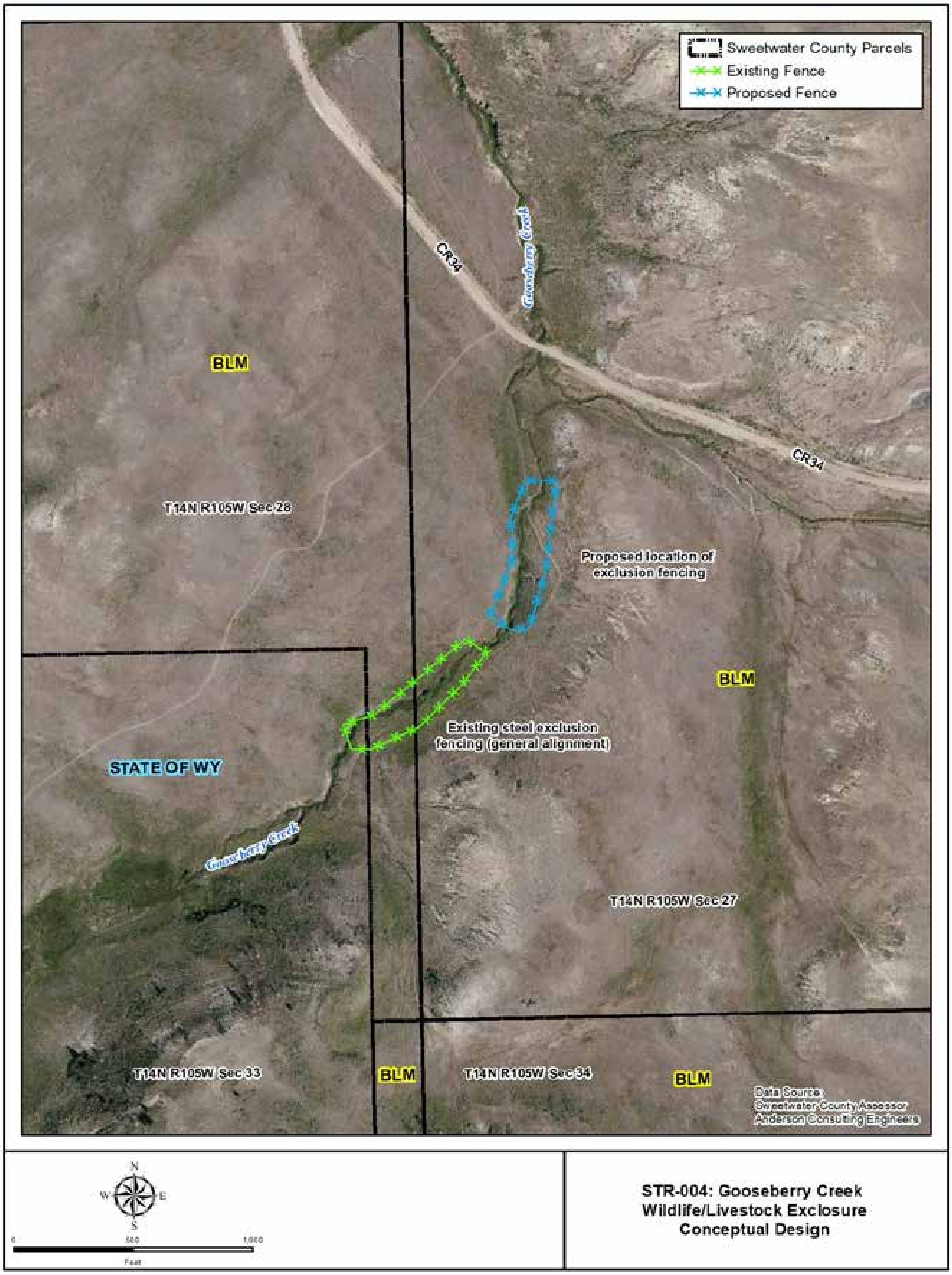
Water Rights: Not Applicable

Horse Management Area: Salt Wells Creek

Grazing Allotment: Salt Wells

Sage Grouse Core Area: Not Applicable

Typical Steeljack Fence


Sweetwater County Parcels
Existing Fence
Proposed Fence
CR34
Gooseberry Creek
BLM
T14N R105W Sec 28
CR34
Proposed location of exclusion fencing
BLM
Existing steel exclusion fencing (general alignment)
STATE OF WY
Gooseberry Creek
T14N R105W Sec 27
T14N R105W Sec 33
BLM
T14N R105W Sec 34
BLM
Data Source:
Sweetwater County Assessor
Anderson Consulting Engineers
N
W
E
S
0
500
1,000
Feet
STR-004: Gooseberry Creek
Wildlife/Livestock Exclosure
Conceptual Design

STR-005: Trout Creek Wildlife/Livestock Exclosure

Project Summary:
This proposed project would involve modification to existing fencing (steel jack) exclosure constructed on Trout Creek. The existing exclosure was constructed in coordination with Wyoming Game and Fish Department (WGF) and Trout Unlimited (TU). The purpose of the exclosure is to keep wild horses, large ungulates and livestock from the riparian corridor. The fencing is to be in place long enough for vegetation to recover from historic damages and eroded stream banks to recover.

Fencing consists of "steel jack" fence designed to exclude livestock and large ungulates.

Project Location:
The proposed project is located in:

Section 17, Township 14 North, Range 105 West.v

Land Ownership (Surface):

The facility is located entirely on privately-owned lands.

Water Source: Trout Creek, a tributary to Sage Creek which is tributary to the Green River at Flaming Gorge Reservoir.

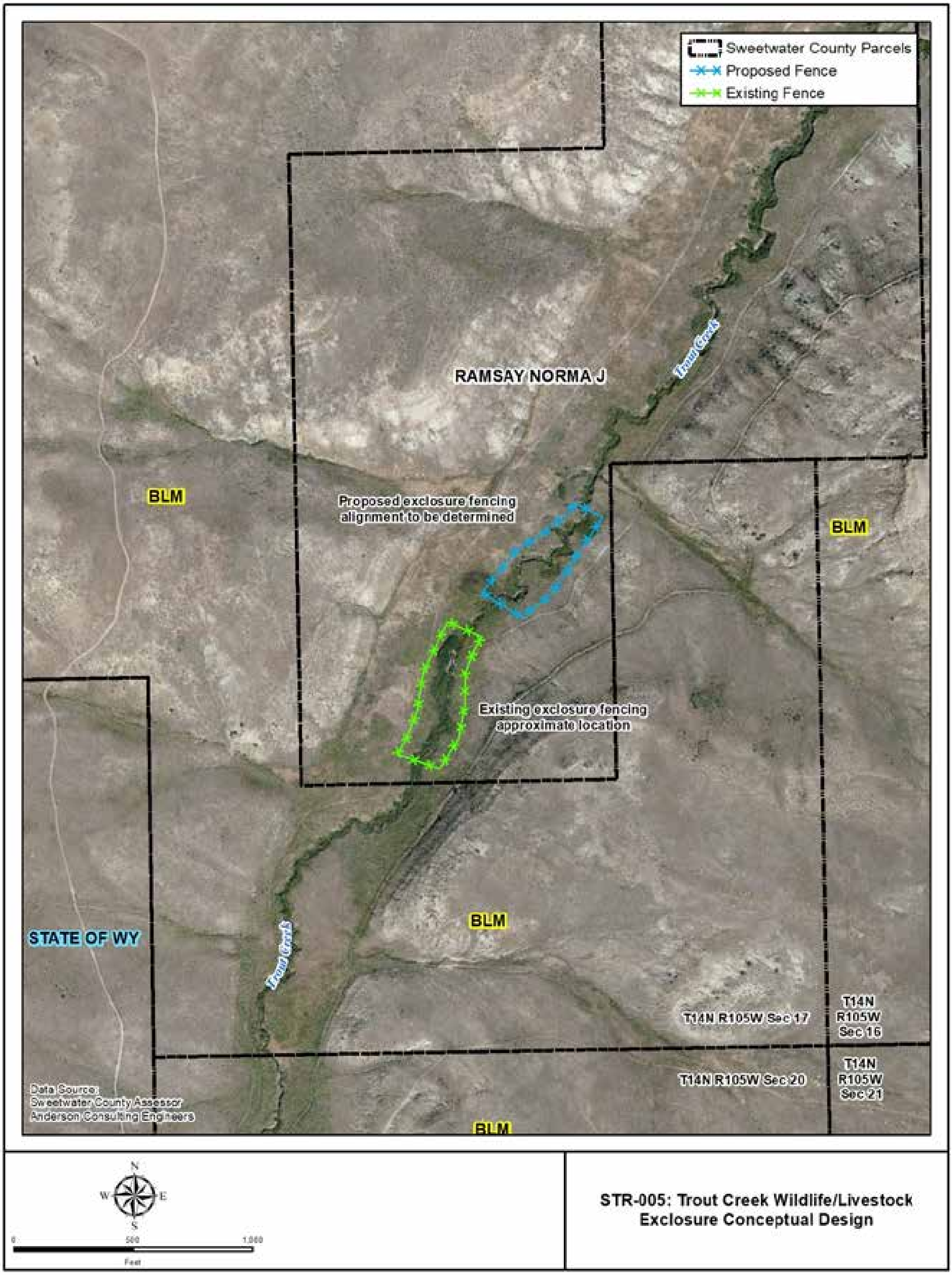
Water Rights: Not Applicable

Horse Management Area: Salt Wells Creek

Grazing Allotment: Salt Wells

Sage Grouse Core Area: Not Applicable

Typical Steeljack Fence



STR-005: Trout Creek Wildlife/Livestock Exclosure Conceptual Design

STR-006: **Green River Streambank (Scotts Bottom)**

Project Summary:

This proposed project would involve stabilization of Green River stream banks in the vicinity of Scotts Bottom Nature Area south of the City of Green River. Currently, both banks of the Green River are bare and unstable. Wyoming Game and Fish, in a cooperative effort with Trout Unlimited, has initiated design of the project which is intended to protect existing park features at FMC Park, protect the Scotts Bottom Road bridge, and to provide additional aquatic habitat. The design of the bank protection will include placement of large root wads and natural plantings.

Project Location:

The proposed project is located in:

Section 36, Township 18 North, Range 107 West.

Land Ownership (Surface):

The facility is located on lands owned by the City of Green River.

Water Source: Green River.

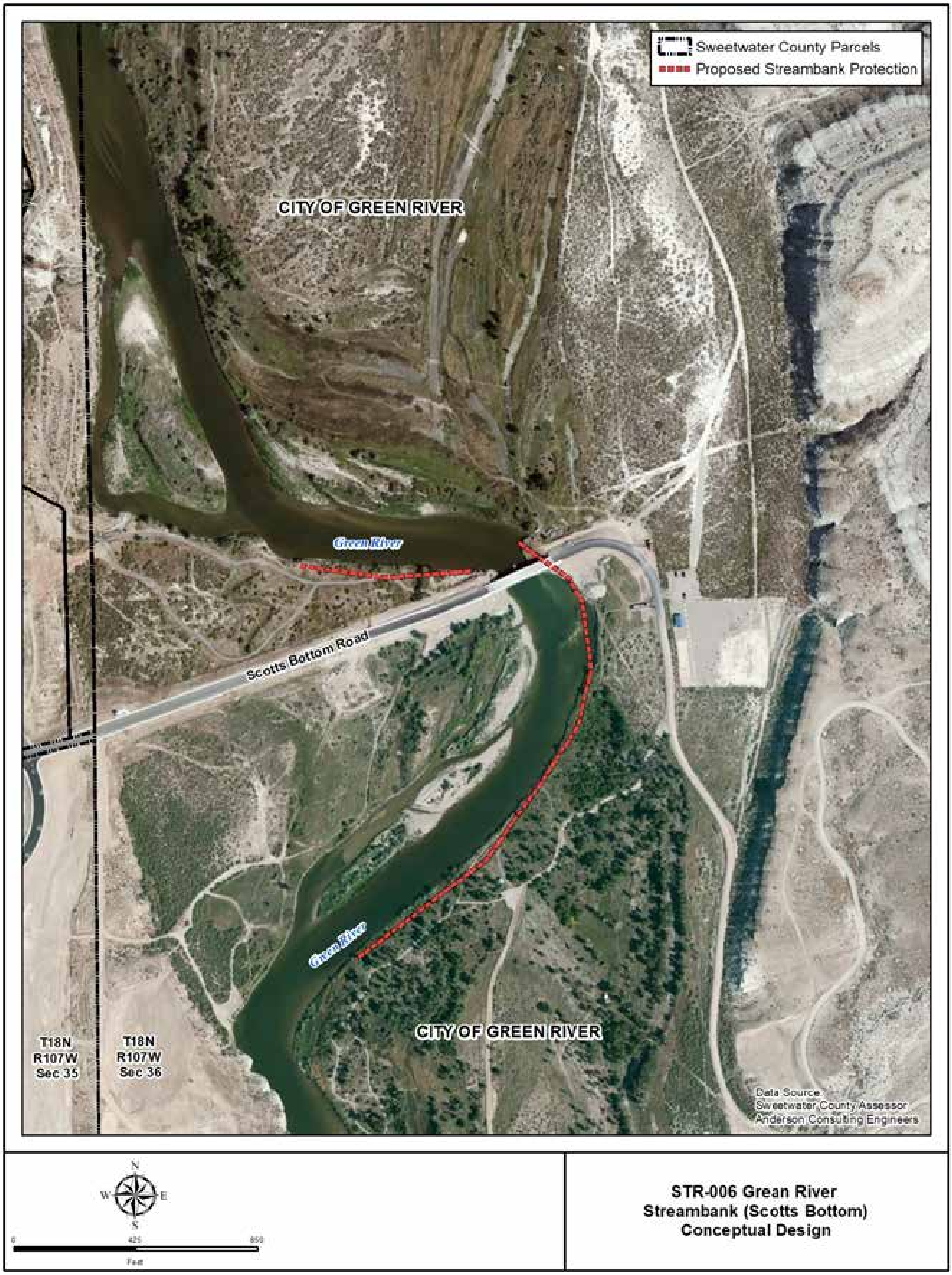
Water Rights: Not Applicable

Horse Management Area: Not Applicable

Grazing Allotment: Not Applicable

Sage Grouse Core Area: Not Applicable

Green River Bank Stabilization Project Location



**STR-006 Grean River
Streambank (Scotts Bottom)
Conceptual Design**

STR-007: Killpecker Creek Stabilization Project

Project Summary:

This project would involve evaluation of Killpecker Creek stream channel stability and development of a stream channel stabilization plan. Currently, Killpecker Creek is actively entrenched and bank erosion is severe. Consequently, significant quantities of sediment are likely contributed to Bitter Creek and ultimately to the Green River from the area. The proposed stabilization study/project would extend from the confluence of Killpecker Creek and Bitter Creek upstream approximately 12 miles to the Chilton Road Crossing.

Rehabilitation measures would include geomorphically stable measures including grade control, bank stabilization, vegetation establishment, and flood control potential.

Project Location:

The proposed project is located in:

Sections 10, 15, 22, 23, 26 and 35, Township 20 North, Range 105 West.

Sections 2, 11, 14, 15, 22, 23, 26 and 27 Township 19 North, Range 105 West

Land Ownership (Surface):

The proposed project would involve privately-owned lands, federally owned and managed lands (Bureau of Land Management) and lands owned by the City of Rock Springs and Sweetwater County.

Water Source: Killpecker Creek

Water Rights: Not applicable.

Horse Management Area: White Mountain

Grazing Allotment: Not Applicable

Sage Grouse Core Area: Not Applicable

Killpecker Creek Entrenchment

STR-007: Killpecker Creek Stabilization Project
Conceptual Design

ENV-001 Trout Creek Barrier

Project Summary:
This proposed project would involve construction of a fish barrier on Trout Creek upstream of County Road 34. The purpose of the barrier would be to prevent upstream movement of fishes and aquatic organisms in an effort to maintain desirable species upstream.

Project Location:
The proposed project is located in:

Section 34, Township 15 North, Range 105 West.

Land Ownership (Surface):

The facility is located on privately-owned lands.

Water Source: Trout Creek, a tributary to Sage Creek which is tributary to the Green River at Flaming Gorge Reservoir.

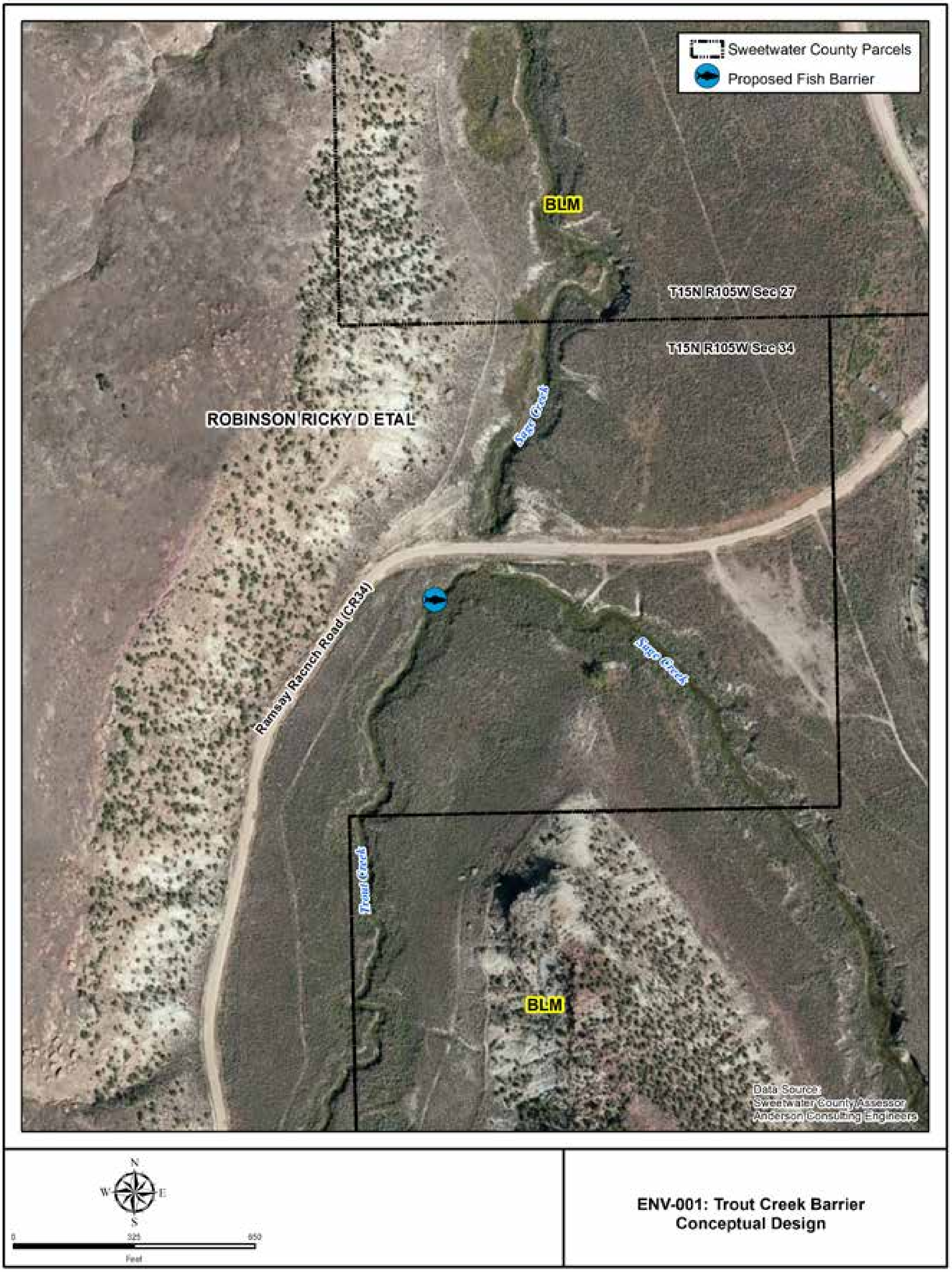
Water Rights: Not Applicable

Horse Management Area: Not Applicable

Grazing Allotment: Rock Springs

Sage Grouse Core Area: Not Applicable

Typical Fish Barrier



ENV-001: Trout Creek Barrier Conceptual Design

ENV-002: Currant Creek Barrier

Project Summary:
This proposed project would involve construction of a fish barrier on Currant Creek near its confluence with Dry Hollow. The purpose of the barrier would be to prevent upstream movement of fishes and aquatic organisms in an effort to maintain desirable species upstream.

Project Location:
The proposed project is located in:

Section 5, Township 14 North, Range 106 West.

Land Ownership (Surface):

The facility is located on privately-owned lands.

Water Source: Currant Creek, a tributary to the Green River at Flaming Gorge Reservoir.

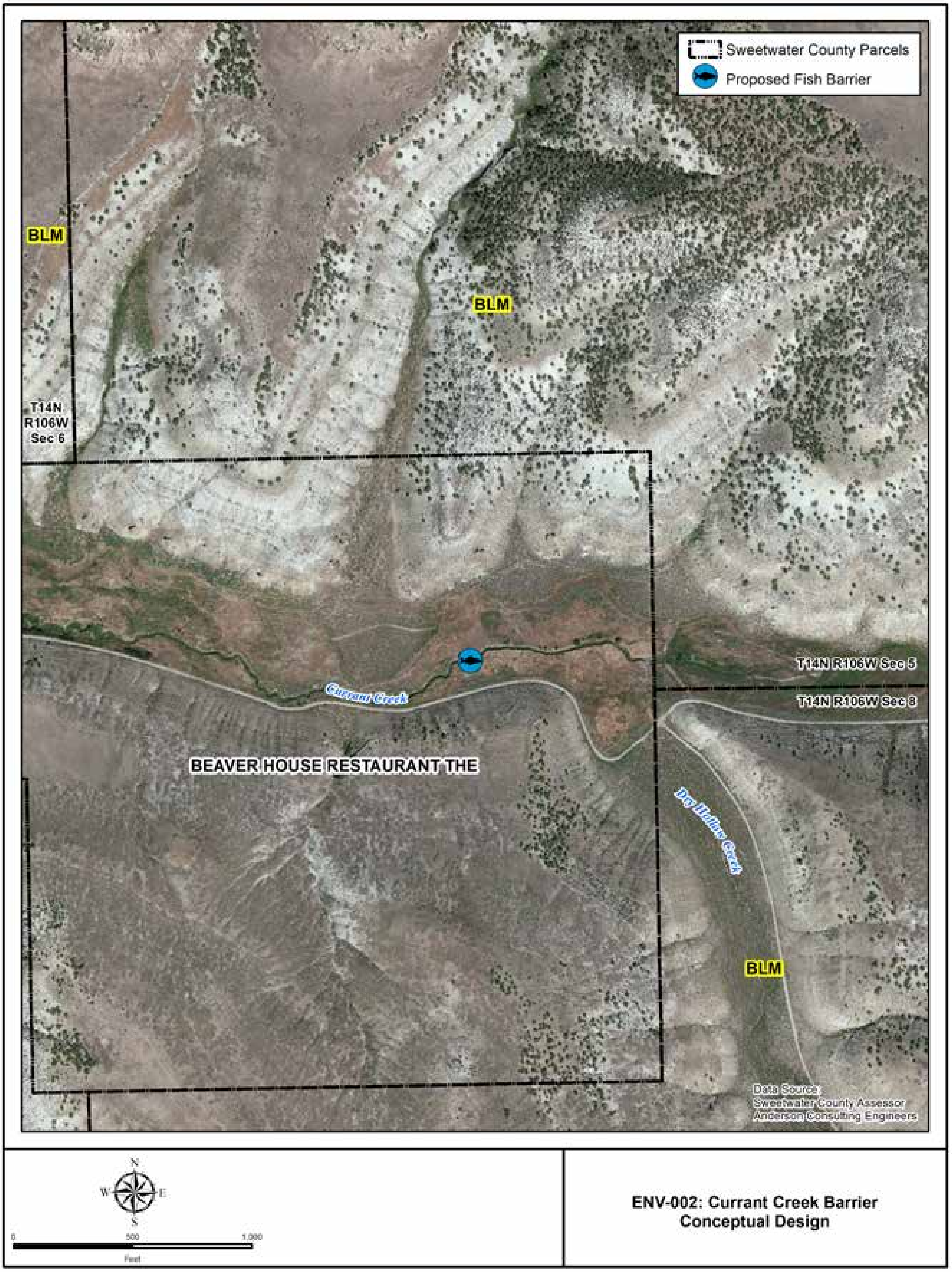
Water Rights: Not Applicable

Horse Management Area: Not Applicable

Grazing Allotment: Rock Springs

Sage Grouse Core Area: Not Applicable

Typical Fish Barrier


Sweetwater County Parcels
Proposed Fish Barrier
BLM
BLM
T14N
R106W
Sec 6
T14N R106W Sec 5
T14N R106W Sec 8
Currant Creek
BEAVER HOUSE RESTAURANT THE
Dry Hollow Creek
BLM
Data Source:
Sweetwater County Assessor
Anderson Consulting Engineers
N
W
E
S
0
500
1,000
Feet
ENV-002: Currant Creek Barrier
Conceptual Design

ENV-003: Kid's Pond - Green River

Project Summary:
This proposed project would involve design and construction of a flow pathways to improve water quality of a small pond located within FMC Park, south of the City of Green River. The objective of the project is to provide flushing flows in order to maintain consistent and improved water quality in support of the pond intended for children's fishing use.

Currently, the pond receives stormwater runoff with very poor quality from the urban area upstream and becomes too warm for fish during the periods between stormwater events. By eliminating the stormwater inflows and developing an alternative means of providing flushing flows, water quality would be improved, more 'fish friendly' temperatures managed, and use by City of Green River population increased.

Elimination of stormwater inflow could be achieved by reconstructing / improving existing stormwater conveyance channels in the area.
Flush flows could conceivably be provided by either pumping from the Green River or from a shallow alluvial well with windmill adjacent to the pond.

Project Location:
The proposed project is located in:

Section 26, Township 18 North, Range 107 West.

Land Ownership (Surface):

The facility is located on lands owned and managed by the Department of Interior, Bureau of Land Management.

Water Source: Currently, water is provide to the pond by stormwater flows originating in urban areas of the City of Green River. Upon completion of the project, flows would be provided by pumping from the Green River or from a newly constructed alluvial well.

Water Rights: Not Applicable

Horse Management Area: Not Applicable

Grazing Allotment: Not Applicable

Sage Grouse Core Area: Not Applicable

ENV-003: Kid's Pond-Green River Conceptual Design

ENV-4 through ENV-011 Wetland Enhancement / Establishment Opportunities

Project Summary

ACE identified several locations where wetland enhancement opportunities exist. These locations represent a variety of sites where wetlands could either be established, or existing wetlands could be enhanced through modification of hydrologic conditions.

Several of the sites consist of abandoned oxbows along Bitter Creek where diversion of water from the river would provide flushing flows to maintain the wetland integrity

Project components would include:

- Construction of a diversion / grade control structure at the oxbow inlet to facilitate diversion of required wetlands-supporting flows into the potential wetlands project while allowing remainder of flow to bypass the oxbow.
- Construction of an armored/stabilized drop structure at the downstream end of the oxbow to allow diverted water to return to the stream without causing further erosion.

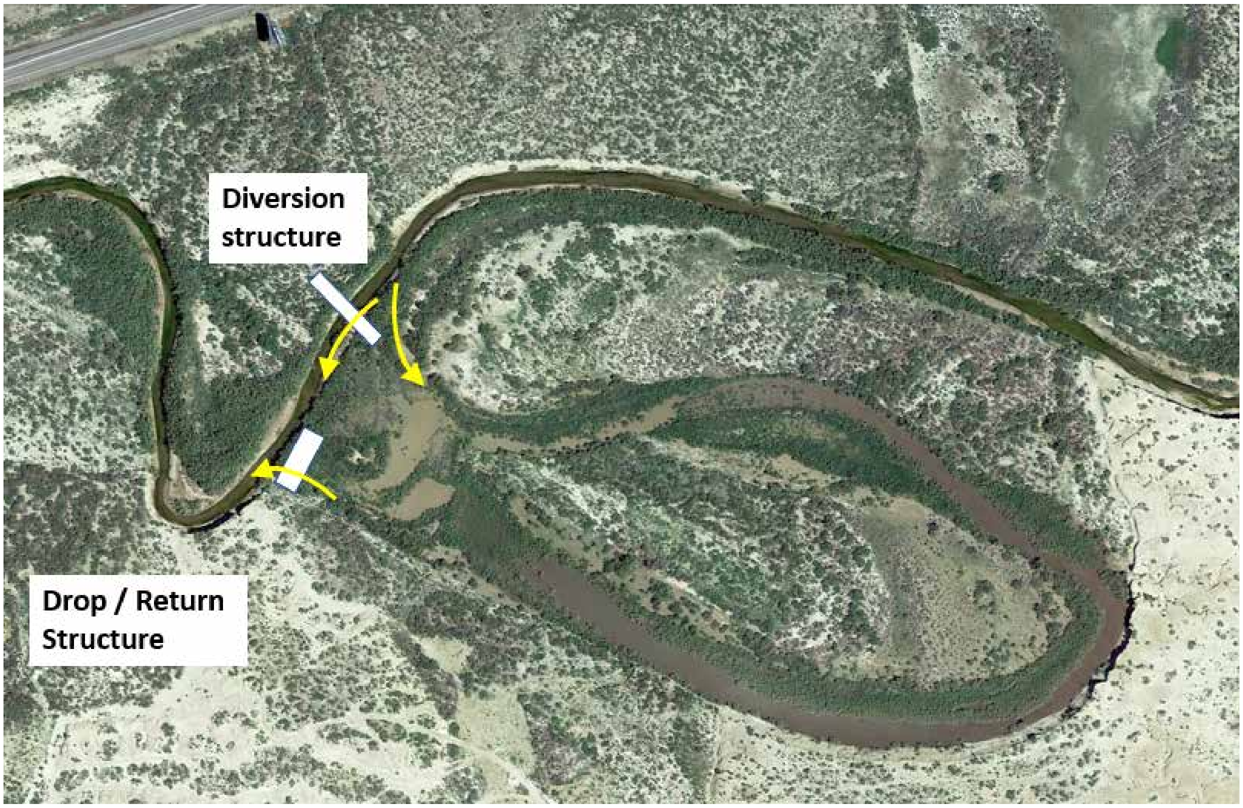
Water Source: Bitter Creek

Project Town / Range /Section	**Surface Ownership**	**Potential Acres**
ENV-04: T18N / R105W / Sec 5	Private	2.0
ENV-05: T18N / R105W / Sec 7	Private (Union Pacific Land Resources)	1.0
ENV-06: T18N / R105W / Sec 7	Private	0.3
ENV-07: T18N / R105W / Sec 5	Private	1.2
ENV-08: T18N / R105W / Sec 4	Private (Union Pacific Land Resources)	1.8
ENV-09: T18N / R105W / Sec 3	Private	1.1
ENV-10: T19N / R104W / Sec 13	Private (RSGA)	3.1
ENV-11: T20N / R101W / Sec 29	Private (Union Pacific Land Resources)	.2

Horse Management Area: All projects are located in the Salt Wells creek Herd Management Area.

Grazing Allotment: Projects ENV-04 through ENV-07, ENV-10, and ENV-11 are located within the Rock Springs grazing allotment.

Sage Grouse Core Area: None of the projects are located within a sage grouse core area.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APPENDIX 6B

LIVESTOCK AND WILDLIFE WATER SOURCE IMPROVEMENTS

APPENDIX 6B - LIVESTOCK AND WILDLIFE WATER SOURCE IMPROVEMENTS

6B.1 Spring Developments

Individual springs can be developed as local watering sites or supply sources to feed pipelines conveying flows to multiple tanks. The specific method(s) used to develop a spring or seep area depend on the site-specific conditions. In general, the following factors and recommendations should be considered and implemented/adopted as appropriate:

- Carefully examine the spring/seep to determine the source (or “eye”), and to determine if any known or potential sources of contamination exist.
- Observe the rate of flow (estimated or measured) during a dry season or the season of intended use to determine if flow rate will be sufficient or to guide design of the spring development.
- Remove obstructions to spring flow (fine grained soils, surficial deposits, dense vegetation, etc.).
- Remove phreatophytic vegetation that can significantly reduce the amount of spring flow via transpiration (in accordance with any necessary environmental analysis, permitting and mitigation).
- Collect the available flow by appropriate means/methods (perforated pipe; ditching; drainage trench/gallery; etc.).
- Construct a means to settle sediment, protect the spring flow from external debris or contaminants, and facilitate maintenance of the spring (e.g., a spring box).
- Consider lowering the outlet elevation of the spring to increase the head at the discharge and thereby increase the flow.
- Use of explosives for spring development is discouraged as this practice can result in lower instead of higher flows and is dangerous unless performed by fully qualified personnel.
- Protect the spring development from washout or sediment burial during periods of flooding by diking and ditching as appropriate.
- Construct and maintain fencing or other barrier around the source to minimize impact to the source by wildlife or livestock.

Detailed information on the occurrence and characteristics of springs and the design of spring development, collection and protection is included in Chapter 12 – Springs and Wells of the Engineering Field Handbook (NRCS, 1983). This reference may be downloaded at the following website:

http://www.info.usda.gov/CED/ftp/CED/EFHCh12.pdf.

Alternative guidance for the design, construction and maintenance of spring developments as published by USAID (1982) is available at the following website:

http://www.lifewater.org/resources/rural_water_supply.html.

Figure 6B.1 shows several typical spring development schemes abstracted from these two references.

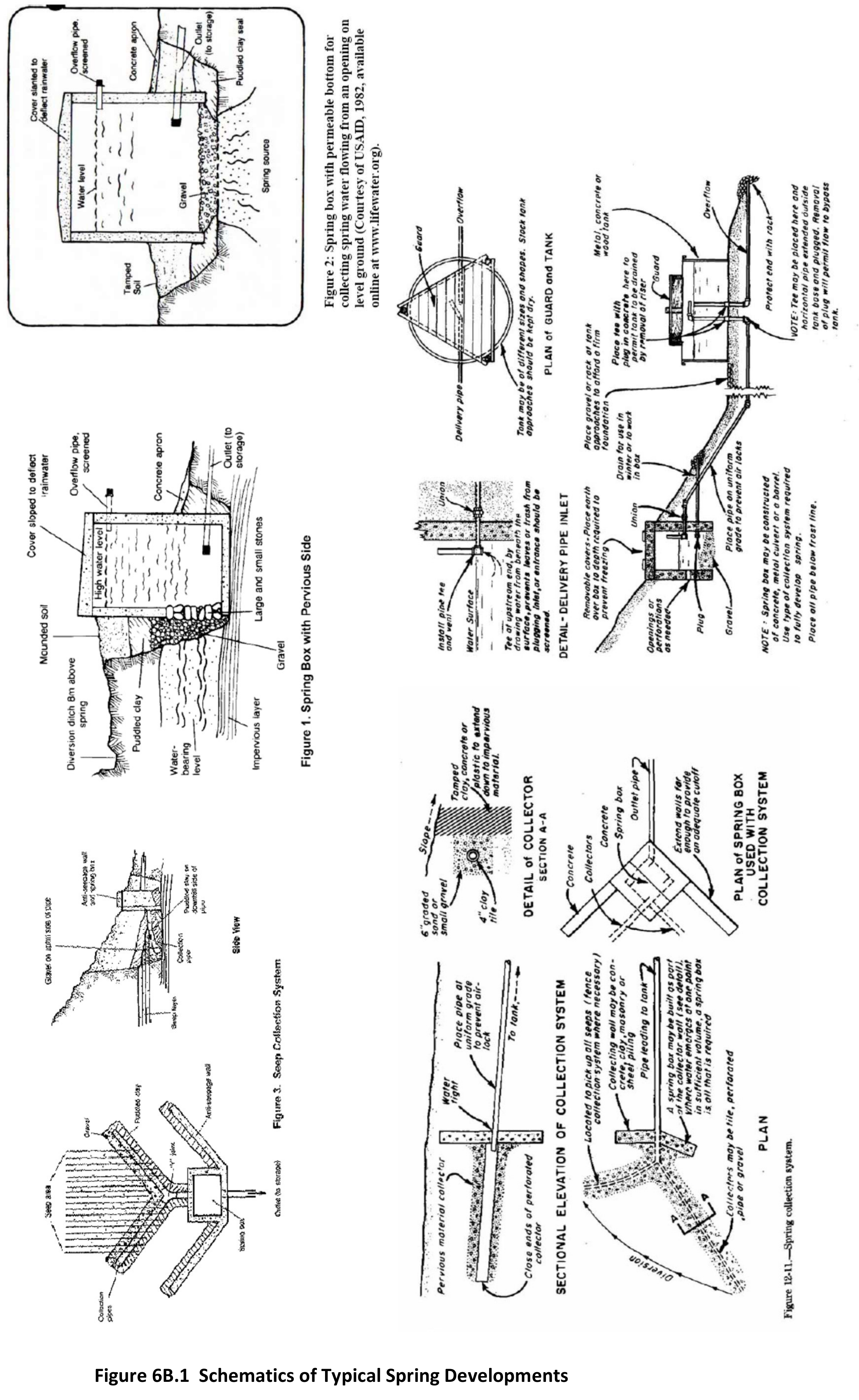


Figure 6B.1 Schematics of Typical Spring Developments

6B.2 Existing Wells with Conventional Windmills, Wind Turbines and Combined Solar/Wind Systems

Conventional Windmills. Windmills are a traditional method used to collect groundwater by means of a conventional well equipped with a mechanical pump powered by the wind-driven rotation of a set of high-torque, low-speed gears. Windmills are most typically used where: distance to power lines is greater than about a mile; reliability of supply is not crucial; high pumping rates are not required; ease of maintenance is important or desirable (i.e., no electrical and associated control components); and where cost per gallon of water produced needs to be low compared to other alternatives. Modern windmills are capable of pumping from depths up to about 1000 feet if needed (at low pumping rates); however, most applications are where relatively shallow groundwater is available (typically less than a few hundred feet). Pumping rates from shallow depths typically range from a less than 50 to as much as several thousand gallons per hour (gph) under favorable conditions. Mechanical single action piston pumps are most commonly used. Performance parameters for a high efficiency, modern-era Oasis 3 windmill manufactured by WINDTech International, LLC are presented on Figure 6B.2. Wind speeds necessary to drive modern windmills may be as low as about 5 miles per hour (mph) for highly efficient designs; more typically winds of at least 12 mph are needed, with efficiency increasing notably at wind speeds greater than about 18 mph. The life of a windmill is usually on the order of 20 years under a normal range of operating and environmental conditions.

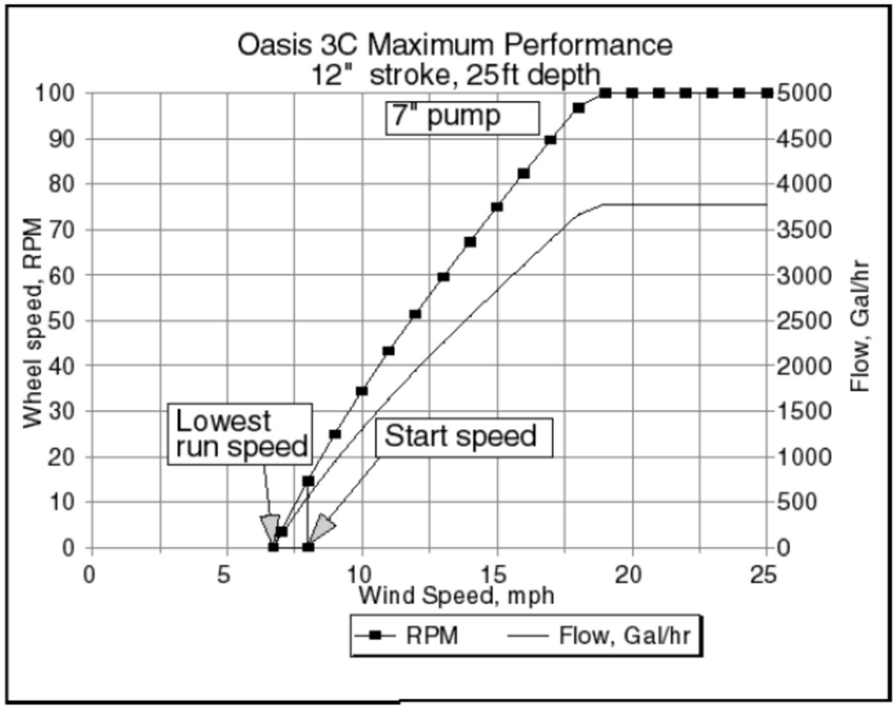
A windmill would normally fill a local tank and serve as a single point source of wildlife and livestock watering. A typical mechanical windmill set-up is shown schematically on Figure 6B.3.

Wind Turbines. A wind turbine can be used as an alternate source of power for a conventional pump installed in a groundwater well. In this type of system a wind turbine is mounted on a tower either at the site of the groundwater well or a more wind-suitable site near the well. The turbine converts wind energy to electrical energy through a generator or alternator that in turn powers a conventional submersible pump. If desired, storage batteries could be included in the system so that pumping could continue during times when the wind velocities are not sufficient. Information about wind turbines in a water pumping application is available from the U.S. Department of Energy Efficiency and Renewable Energy (EERE) website at:

http://www.eere.energy.gov/consumer/your_home/electricity/indeH.cfm/mytopic=10 890.

Information on commercial wind water pumping systems utilizing a Bergey wind turbine and Grundfos submersible pumps are available from Bitterroot Solar at: http://www.bitterrootsolar.com/pumping/windpump.htm. These particular systems range from 4,800 to 40,000 gal/day production with an 11 mph wind and a pumping/head of 100 feet. Additional technical and cost information for these systems is available at:

http://www.bergey.com/Products/XL1.html.



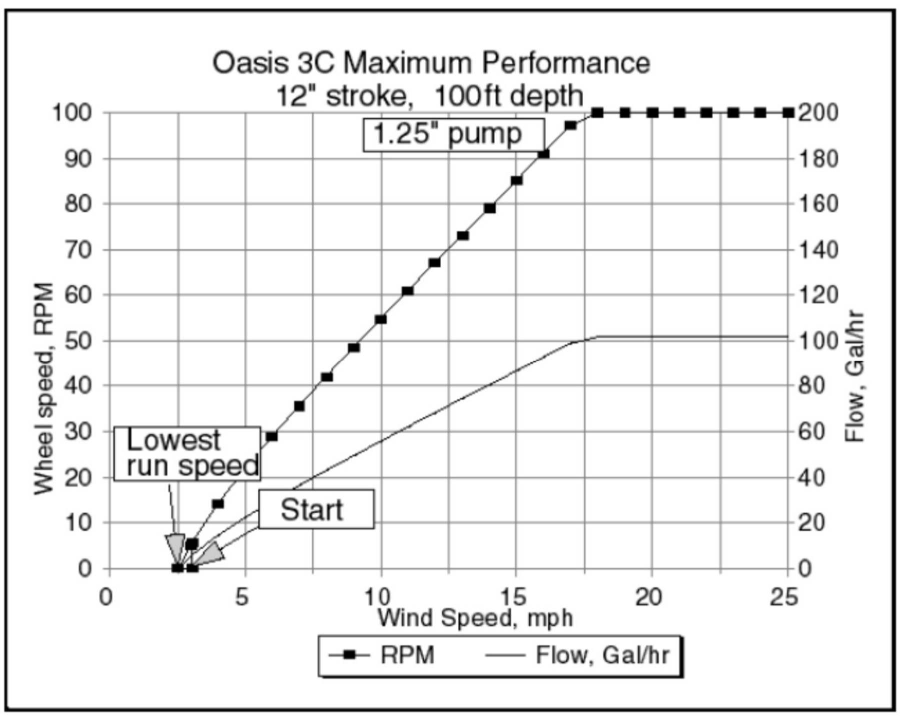


Figure 6B.2 Windmill Performance Curves

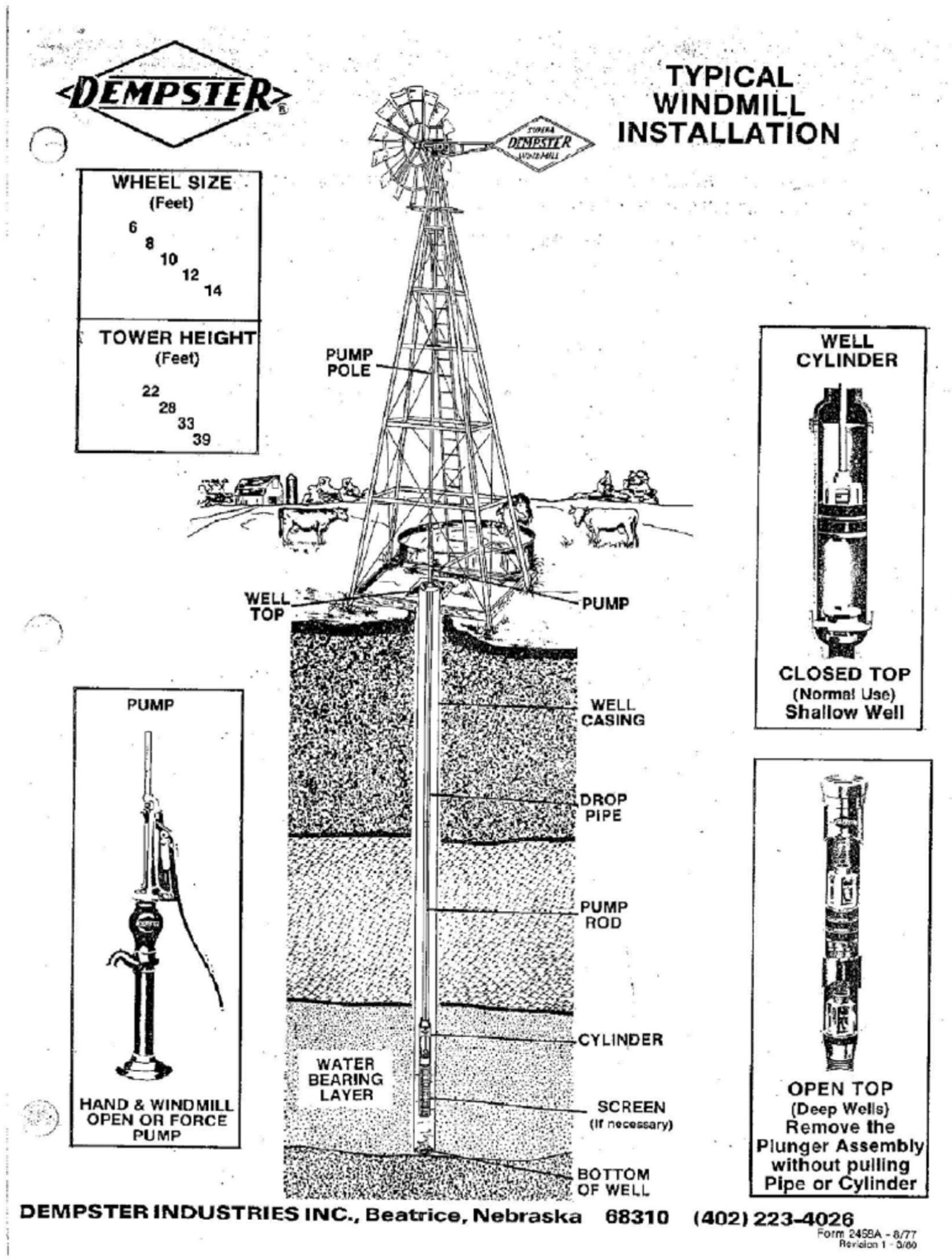


Figure 6B.3 Windmill Schematic

Combined Solar/Wind Powered Systems. An alternative to a conventional windmill or a wind turbine powered pumping system is a combined system that includes both a wind turbine and solar panels as power sources for a generator and conventional submersible water pump. This system allows the pump to be operated by solar power alone, wind power alone, or a combination of both sources depending on environmental conditions at the site at any given time. Although more expensive to install and maintain, this system provides more reliable power for stock water pumping than either single source alone. A commercially available source of this type of system is produced by Grundfos; information on this system is available at:

http://net.grundfos.com/doc/webnet/sqflex/home.htm.

6B.3 Wells

Wells are a potential source of water for wildlife and livestock watering. Because of the cost of drilling and completing a well and the unavoidable uncertainty as to the production that will be achieved (without very expensive prior site-specific exploration), a new well would usually only be considered as a source where no other more practical and cost-effective options are available. On the other hand, conversion of an existing well to serve as a source of wildlife/livestock watering may be very cost-effective. For this to be the case, some or all of the following conditions should be met:

- Located near an area in need of additional watering opportunities
- Sufficient capacity to serve this and any other existing uses (or potential to increase well yield through re-conditioning or possibly deepening)
- Capable of operation by wind or solar power (unless already served by a power line)

It may be possible to convert a dormant oil (or gas) well to water production; however, there are a number of factors that may render this impractical. First, the well must be open to at least the depth of the target aquifers(s). If open deeper, it may be necessary to plug the hole up to or for some distance below the base of the lowest target aquifer to minimize pumping residual oil and/or natural gas. Depending on the nature of the aquifer(s) (hydrocarbon content) it may be necessary to install a “treater” or “skimmer” at the surface to separate the hydrocarbons from the water. If the well is cased across the producing zone(s), it will have to be perforated, and depending on formation properties, protection against piping of the sidewall provided by some means. Unless conditions are generally favorable, the cost of conversion of an existing oil well may end up exceeding the cost of drilling and completing a new well. This is not to say that such opportunities do not exist or are always impractical. Oil wells have been reportedly successfully converted and serve as a year-round watering installation. Any such conversion opportunities should be carefully evaluated on a case-by-case basis.

Conditions most advantageous to use of a new well are summarized as follows:

- Shallow depth to aquifer(s) with adequate transmissivity to meet projected needs.

- Located where hydrogeologic conditions are reasonably well known from prior drilling and/or well installation.
- Either close to existing power lines or suitable for wind or solar operation.
- Location upgradient of an area or areas of significant wildlife/livestock watering
- Shortage.

If a new well is planned, it is recommended that a water well driller with substantial experience in the local area be utilized to take best advantage of prior experience with the relevant geologic units and conditions. Depending on the size (depth and anticipated yield) of the well, it may be worthwhile to consult a groundwater geologist with experience in this or similar geologic settings prior to finalizing a decision as to drilling a new well.

Information on the planning, design, drilling, completion, development of groundwater wells is available from many sources. One source of such information is available from the NRCS (1983) Engineering Field Handbook at the following website:

http://www.info.usda.gov/CED/ftp/CED/EFH-Ch12.pdf.

6B.4 Pipeline/Tank Systems

Pipeline/tank systems are generally considered to be the best method for conveyance of flows from any suitable source of water, since they can put the water where it is needed (at multiple locations), when it is needed. These systems can operate by gravity, be fed by a pumped source, or combine both gravity and pumping reaches (usually with a surge/storage tank in the system). Sources of water may include any of those described in this section, including a groundwater well, developed spring, pond, reservoir, or stream diversion.

Considerations in the layout and design of a pipeline/tank system include, but are not limited to the following:

- *Location of the source relative to the points of use* – ideally the water source will be located upgradient of the points of use so that all delivery can be by gravity
- *Temporary storage* - if necessary, one or more locations for temporary storage of pumped supply can be provided that then feed the remainder of the system by gravity; typically a 2-3 day supply for the wildlife and livestock using the system is provided
- *Terrain* – an alignment with some variation in grade is desirable to minimize problems with air-locking by installation of air relief valves at appropriate locations; very rugged terrain is less desirable due to the higher installation costs
- *Geologic conditions* – ideally pipeline alignments will be located where rock excavation and/or adverse soils conditions are avoided or minimized to the degree practical (adverse soils conditions may include landslides, areas of significant active erosion, etc.)

- *System length/size* – the longer the system and the more tanks planned or desired, the greater the flow capacity from the source required; friction losses in the pipe and through the fittings can be significant over long distances relative to the available energy of the source water
- *Property ownership* – systems may be designed to serve a single landowner; alternatively, there may be opportunities for cooperative projects in which the system is designed to serve two or more entities (see additional discussion later in this section)
- *Environmental conditions/issues* – it is necessary, to the extent feasible, to avoid impacts to the environment including but not limited to wetlands, riparian zones, high value sage grouse habitat, and cultural resources

The pipeline/tank systems planned and/or installed already in the watershed include some or all of the following elements/components:

- Spring development or well as water source
- HDPE piping
- Air release vents/valves
- Pipeline drains
- Tanks (with pressure reducing valves, rescue ladders, gate or ball valves, float valves, air and vacuum release or pressure relief valves, overflow piping, and pump manifold gages, valves and fittings)

There is a wide array of different wildlife/livestock watering tanks that can be used in a pipeline/tank system or with any of the other water sources described in this section. At present, converted heavy equipment tires appear to be the preferred tank type in the watershed. This is due to their relative availability, comparative cost effectiveness, durability, freeze-resistance, long-life, and ease of installation (with the proper equipment available). A typical 12-foot by 2.5-foot tire tank holds on the order of 1500 gallons when full. Other types of tanks that could be considered on a case-by-case basis include, but are not necessarily limited to:

- Cast-in-place or precast concrete tank or trough
- Bottomless corrugated metal tanks
- Pit/pond (sealed or lined where necessary)
- Fiberglass or galvanized tanks

The larger pipeline/tank systems are typically are designed to fill the tanks automatically as the contents are drawn down. There is provision for taking individual tanks out of service when necessary for maintenance or repair. Overflow drainage is provided in the event of malfunction.

6B.5 Ponds

Small ponds can provide seasonal watering opportunities to both wildlife and livestock. Watering can occur directly from the pond, or a pipeline can be fed from the pond to deliver water to one or more tanks downgradient. For purposes of this study, a watering ("stock") pond is defined as a reservoir or pit/dugout (excavation below original grade) with a maximum capacity of less than 20 acre-feet and a dam height less than 20 feet. Reservoirs/pits of this size qualify for application to the State Engineer's Office as "stock reservoirs" and thereby avoid the more restrictive and costly administrative, design, and construction requirements associated with permitting under the standard reservoir regulations.

A pond is typically created by excavation of soils in the pond area and placing the excavated soil as embankment fill to create a dam. This approach is most cost effective initially; however, it may be more cost-effective in the long run to secure soils from areas near but not immediately at the reservoir site depending on the properties of the soils. In particular, clay soils with dispersive properties or with significant percentages of soluble salts should not be used for embankment fill if other more suitable soils are available nearby. Embankment fill should be placed in relatively thin horizontal lifts, compacted with rubber-tired (versus tracked) equipment, and not placed too wet or too dry. This will result in a more erosion resistant embankment.

An overflow earthen spillway should be provided for ponds constructed in ephemeral or intermittent drainages and in swales with relatively large drainage areas. If possible, the spillway section should be excavated in or to rock. If this is not feasible, the spillway should be constructed with as broad a crest and as shallow a discharge channel as practical to lower flow velocities and thereby limit erosion during times of use. Revegetating the spillway with grasses will also increase its erosional resistance. The arrangement of the spillway relative to the dam embankment and the general configuration of the spillway are shown by the centerline profiles shown in Figure 6B.4. An outlet pipe is usually only included in this type of pond if it is needed to feed one or more tanks downgradient (supply pipe) or if there is enough spring-fed flow or intermittent runoff events to cause excessive use of the overflow spillway ("trickle tube"). A supply pipe is placed with its inlet near but not at the lowest point of the foundation (to allow for some sediment accumulation). Flow is controlled by a downstream valve (e.g., a float valve regulated by water level in the down-gradient tank or pipeline/tank system being supplied). The trickle tube is an appropriately sized open pipe installed through the embankment dam at an elevation slightly lower than the overflow crest elevation of the spillway.

If direct watering is intended (which allows for watering more animals at a time), then it is recommended that protection of the dam embankment, spillway (and outlet if present) be considered to reduce the need for and cost of future maintenance. Although initially more costly, consideration should also be given to armoring of the pond rim to lessen erosion and excessive sedimentation. This decision should be based on the site soils conditions, planned usage, and estimated cost of future maintenance in the absence of such protection. One alternative on larger ponds may be to selectively armor only portions of the rim and fence the remainder to exclude use by wildlife and livestock. If armoring is used it should consist of reasonably durable gravel (over larger rock if necessary) to encourage use by wildlife/livestock and minimize sloughing and erosion of the pond banks.

Information on the planning, design and construction of small ponds is available from the NRCS at: http://www.info.usda.gov/CED/ftp/CED/EFH-Ch11.pdf. The local NRCS staff in Thermopolis and Worland

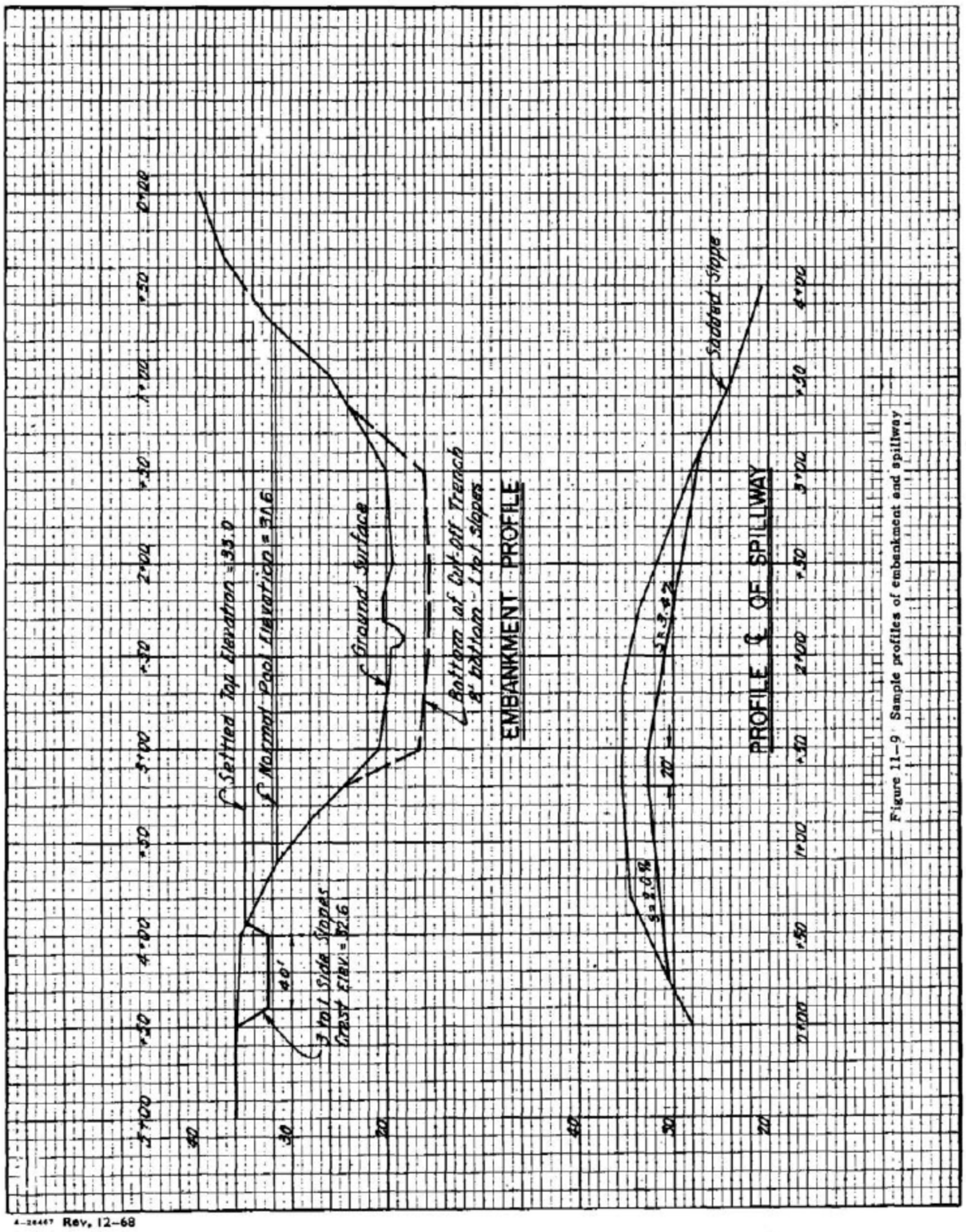


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Figure 6B.4 Pond Embankment and Spillway Profile Schematics

(and other staff they may contact) may also be able to provide technical assistance for projects to be constructed under an NRCS program.

6B.6 Reservoirs

A new surface water storage reservoir could serve as a source of supply to a wildlife/livestock watering system. This could involve direct gravity to one or more pipeline/tank systems arrayed downgradient of the reservoir. Alternatively, the reservoir could serve as the source for pumping water to one or more pipeline/tank systems.

Any new reservoir could also serve as a direct source of wildlife and livestock watering. Depending on the location of the reservoir relative to grazing locations, it may be appropriate to include one or several watering access sites around the reservoir rim. These sites should be sized to accommodate the anticipated or desired use, and designed with appropriate grades to and in the near-shore pool to facilitate watering. The access ramps and watering areas should be adequately armored as described above in the section above regarding stockponds.

6B.7 Guzzlers

A guzzler is a wildlife watering system utilizing direct precipitation as a source of supply, with a storage tank of capacity suitable to the watering need, and designed to discourage use and protect from damage by livestock. A complete guzzler system is comprised of the following components:

- Catchment apron – typically made of textured HDPE; secured with rocks placed on a suitable grid spacing, and protected by suitable fencing from trampling by wildlife or livestock (Figure 6B.5).
- Catchment outlet - pipe boot, clamps and well screen section.
- HDPE pipe – typically 1.5-2-inch, 160 psi, SDR 11.
- Catchment tank – HDPE tank sized to accommodate wildlife or livestock watering needs, with integral drinker (ideally with no float valve required), small animal escape ladder and overflow adapter (1800-gallon tank with patented features is available from Boss Tanks and Elko Bighorns Unlimited, Elko,Nevada).
- Overflow pipe – with erosion protection at discharge.

Figure 6B.5 Guzzler installed in the Cottonwood Creek watershed.

The guzzler operates by intercepting direct rainfall or snowmelt on the catchment, routing the captured water via a pipe to the tank, and controlling the tank level via a simple overflow outlet pipe. Figure 6B.6 shows a typical set up

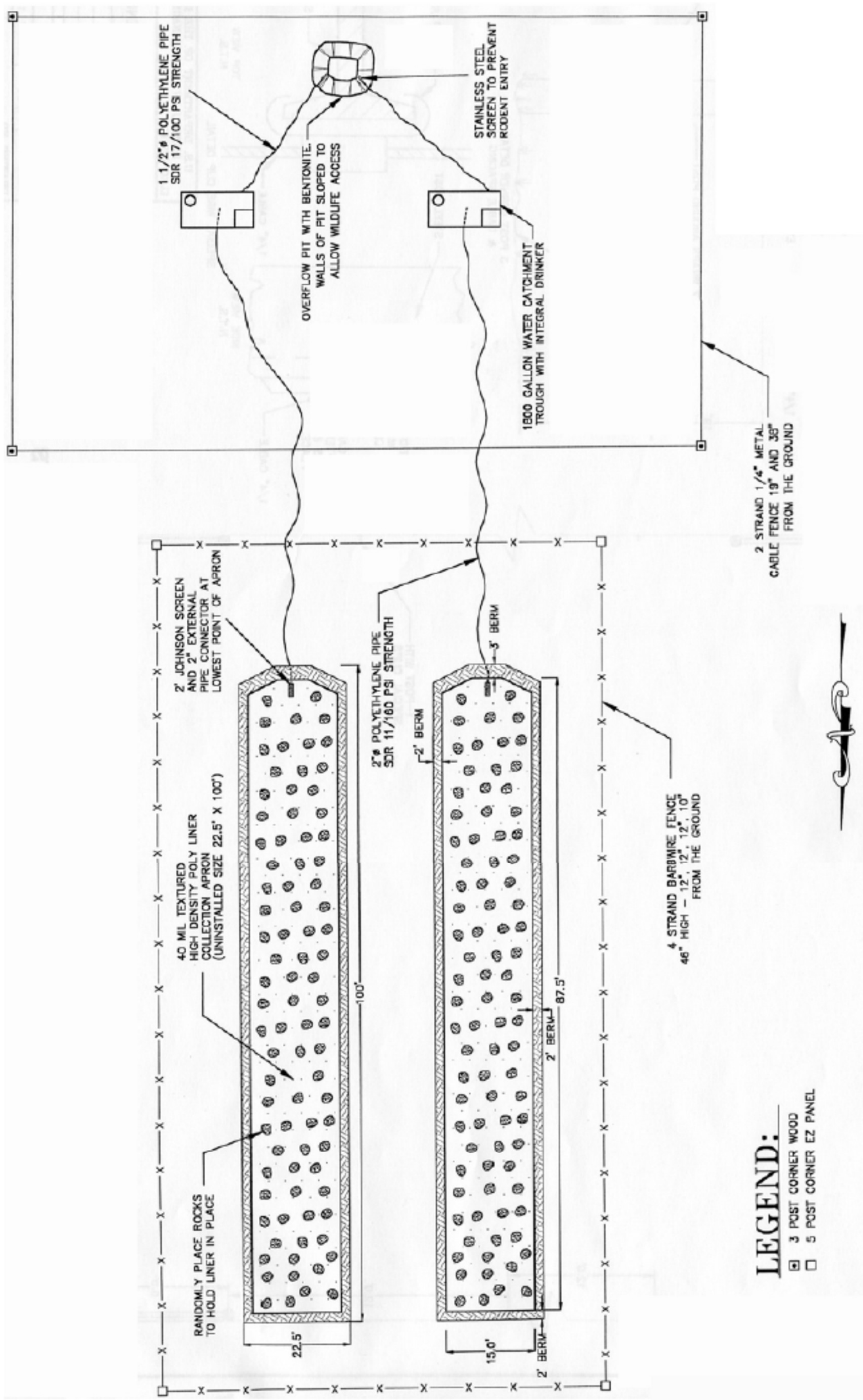


Figure 6B.6 Schematic of Typical Guzzler Installation

with dual catchments and tanks. Information on a commercially available system compatible with the design described above is available from Boss Tanks and Elkhorn Bighorns Unlimited at: http://www.bosstanks.com/guzzler.htm. A self contained guzzler is available from Wildlife Water Guzzler; information on this product line is available at: http://www.wildlifewaterguzzler.com/.

6B.8 Power Sources

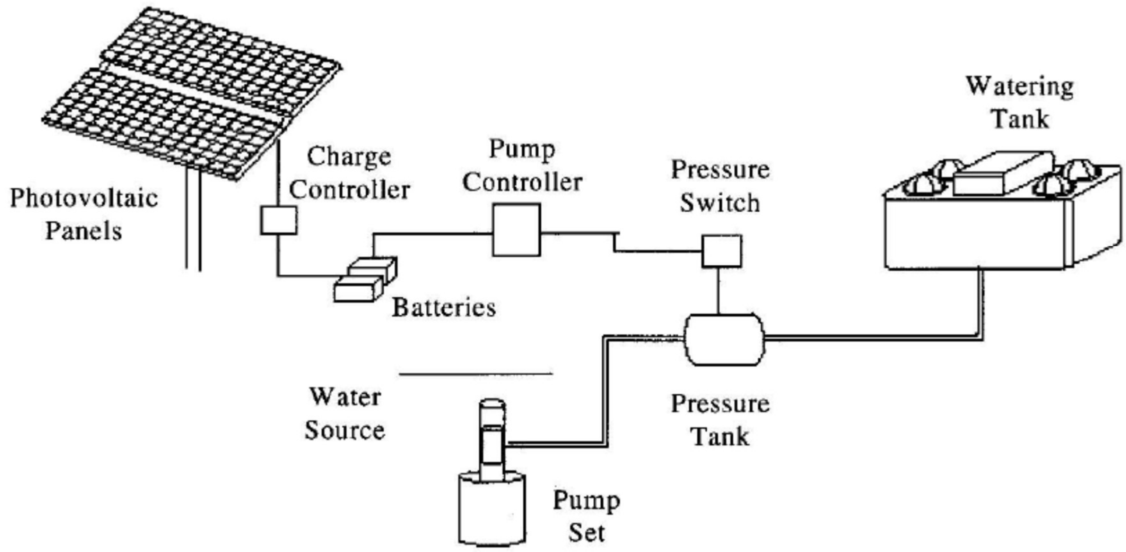
Conventional Electrical Service. In most cases the cost to bring overhead power to a single well or lift station site for wildlife/livestock watering would probably be prohibitive. This option should normally be considered only when the point of power use is close to existing service (usually less than about ¼ to ½ mile) or the power demands are higher than can be feasibly supplied by other sources (wind, solar).

Portable/Remote Generator. Although possible, the use of portable or remotely installed gasoline or diesel powered generators is generally not an economically feasible alternative to operate pumps to supply wildlife/livestock water. This type of power is usually only considered in temporary or emergency conditions. If used, special care is required to ensure safe transport, storage and use of fuel to prevent accidental fires and/or releases of fuel to the environment.

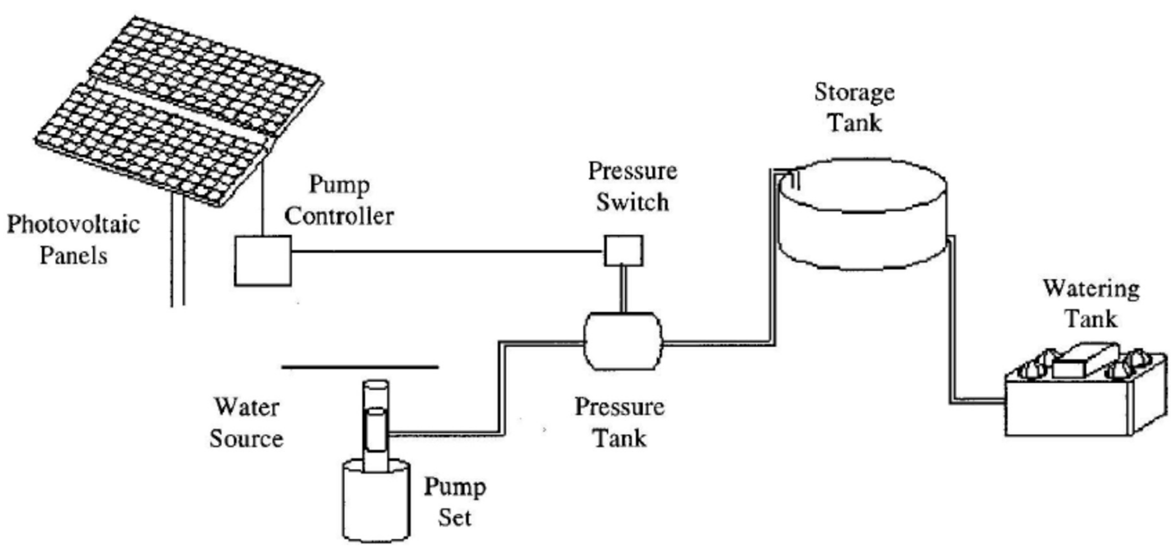
Solar Water Pump. Solar power can be an appropriate, efficient and long-term cost-effective means to power a pump used to extract groundwater from a well or to convey water upgradient from another source of supply (pond, spring, storage tank, etc.) to temporary storage or point of use (watering tank or pipeline/tanks system). This type of system is best suited to remote locations with sufficient sunlight, typical of conditions where additional wildlife/livestock watering is needed in the Nowood watershed. Solar water pump systems are typically comprised of one or more photovoltaic (PV) panels, sometimes a set of storage batteries, and a DC-capable pump. Figure 6B.7 shows two typical set-ups, one with storage batteries and direct delivery to the watering tank(s) and the other with a storage tank set above the watering tank(s) and without storage batteries. Other arrangements are also possible. Batteries are used where pumping during low-light and nighttime periods is necessary or desirable (e.g., to fill a storage tank or refill a watering tank overnight when watering demands are low).

Overall, solar water pump systems are relatively easy to install and maintain. However, the solar panels are relatively fragile and need to be mounted in a suitable location and well-secured against wind and livestock damage. The other components in the system (pump, controller, switches and possibly batteries) also need to be properly installed, protected from weather and incidental damage, and require some periodic maintenance and/or replacement.

Solar water pumps are specially designed to work efficiently with DC solar power, including during low-light (reduced voltage) conditions. Many different types of pumps can be used depending on the pumping head and flow rates for the particular application. These include positive displacement types (piston and jack pumps, diaphragm, vane and screw pumps) that maintain lift capacity at slow, varying speeds resulting from changing light conditions. In low-lift and/or high-volume applications, centrifugal-type pumps are often used. The pumping rates that can be achieved vary with the lift (head) from the



Battery-coupled solar watering system



Direct-coupled solar watering system

Figure 6B.7 Schematic of Typical Water Pump

pump to storage or point of use and the amount of power supplied by the solar system. At relatively low heads (say less than 100 feet) and with modest power (say less than 150 watts), pumping rates on the order of 150-200 gph (3.0-3.5 gpm) are possible. With greater available power at low heads (50-100 feet), pumping rates up to several thousand gph (25-75 gpm) are possible with centrifugal pumps. For high lifts (say 400-500 feet) and sufficient power, pumping rates of several hundred gph are attainable with helical rotor pumps.

APPENDIX 9A

AGENCY REQUIREMENTS AND NOTIFICATIONS

Appendix 9A AGENCY REQUIREMENTS AND NOTIFICATIONS

Several permits and clearances would need to be submitted to and approved by federal, state, and local agencies prior to the construction and/or installation of any of the proposed projects presented in the Watershed Management and Implementation Plan along with any future projects. The permits and clearances that could potentially be required from the associated agencies are listed in Table 9.3-1.

Appendix 9A.1 U.S. Army Corps of Engineers

The U.S. Army Corps of Engineers' (USACE) Wyoming Regulatory Office administers and enforces Section 404 of the CWA in Wyoming for the Omaha District. Under the CWA, a Section 404 permit is required for the discharge of dredged or fill material into waters of the United States. Because many waterbodies and wetlands are considered waters of the United States, they are subject to the USACE's regulatory authority. Permit applications can be obtained by contacting the USACE Wyoming Regulatory Office in Cheyenne by telephone (307) 772-2300 or via the website (http://www.nwo.usace.army.mil/Missions/Regulatory-Program/Wyoming/). Numerous nationwide permits have been developed as of 2012; the applicable permit depends upon the nature of the proposed activity.

Appendix 9A.2 U.S. Fish and Wildlife Service

The Endangered Species Act's (ESA) Section 7 requires federal agencies to conserve threatened and endangered species and ensure their actions do not adversely affect the listed species or its critical habitat. Informal and formal Section 7 consultations take place between a federal agency and the USFWS when that federal agency implements, finances, or approves a project that may affect a threatened or endangered species or its critical habitat. Typically, an informal consultation between the federal agency and the USFWS is conducted early in the planning of a project or program to ascertain if the agency's proposed project or program may affect the listed species. Normally, the federal agency completes a biological assessment to determine the proposed project's effect on the listed species. If the federal agency's biological assessment findings indicate that the listed species is likely to be adversely affected by the project or program, then the agency would request a formal consultation with the USFWS. After reviewing information about the proposed action and listed species, the USFWS issues an opinion about whether the proposed project would harm the existence of the listed species.

Also, a non-federal agency can be approved by the USFWS for an incidental take permit of threatened or endangered species under Section 10 of the ESA. However, the USFWS's approval is usually dependent upon a habitat conservation plan (HCP), which when followed would minimize the taking of the listed species to the maximum extent practicable. Information can be obtained by contacting the USFWS's Wyoming Ecological Services Field Office in Cheyenne by telephone (307) 772-2374 or website (https://www.fws.gov/wyominges/index.php). Additionally, the USFWS's Information for Planning and Conservation (IPaC) is web-based application and planning tool available to anyone who needs assistance in determining how their activity or project may affect migratory birds, ESA proposed or listed species, other sensitive resource. The IPaC can be accessed via the website (https://ecos.fws.gov/ipac/).

Appendix 9A.3 Wyoming State Engineer's Office

The majority of proposed projects included in this watershed study would require a permit from the Wyoming State Engineer's Office (WSEO). Proposed livestock/wildlife water, irrigation rehabilitation, and water storage projects would require obtaining or modifying a water right approved by the State Engineer in accordance with Title 41 Water, Chapter 3 Water Rights; Administration and Control, Article 1 Generally (W.S. 41-3-101). Any project that includes construction of a new dam and reservoir or the rehabilitation of an existing dam and reservoir exceeding 20 acre-feet in capacity or having a dam height greater than 20 feet cannot commence construction until a permit is approved by the State Engineer pursuant to Title 41 Water, Chapter 3 Water Rights; Administration and Control, Article 3 Reservoirs (W.S. 41-3-301).

The SEO also administers the Wyoming's Safety of Dams program (W.S. 41-3-307 through 41-3-318), which applies to reservoirs when the dam height is more than 20 feet high and reservoir capacity is more than 50 acre-feet. Any proposed construction, enlargement, major repair, alteration or removal of a dam or diversion system with headgates or diversion structures carrying 50 cfs must have plans and specifications prepared a Wyoming licensed registered professional engineer and shall be submitted to the state engineer for approval pursuant to Title 41 Water, Chapter 3 Water Rights; Administration and Control, Article 3 Reservoirs (W.S. 41-3-308). Necessary water right applications, regulatory information, and instructions can be accessed via the website (https://sites.google.com/a/wyo.gov/seo/regulations-instructions). SEO permits can also be accessed via the e-Permit website (http://seoweb.wyo.gov/e-Permit/).

Appendix 9A.4 Wyoming State Historic Preservation Office

Proposed projects within the watershed that are located on federal land, use federal funding, or need to secure a federal permit should have a review of cultural resources completed by the Wyoming State Historic Preservation Office (SHPO) in accordance with Section 106 of the National Historic Preservation Act of 1966 and the Wyoming Antiquities Act of 1935 (W.S. 35-1-114 to 116). The Wyoming State Historic Preservation Office reviews cultural resource reports, issues compliance letters for proposed projects, provides comments on activities potentially affecting historic properties or cultural resources, and recommends additional investigations if necessary. Additional SHPO compliance and review information can be obtained by contacting the State Historic Preservation Office by telephone (307) 777-6311 or via the website (http://wyoshpo.state.wy.us/Section106/Index.aspx).

Appendix 9A.5 Wyoming Game and Fish Department

The Wyoming Game and Fish Commission encourage project sponsors, permitting agencies, and land managers to coordinate with the WGFD in the initial planning stage of a proposed project. The WGFD's involvement is essential in avoiding adverse impacts to fish and wildlife during project development and implementation. The Commission adopted a mitigation policy in 2016 to provide an approach in avoiding impacts when possible and formulating mitigation measures when necessary. The Commission has directed the WGFD to resolve conflicts between land use activities and fish and wildlife and their habitats pursuant to Wyoming Statutes and in cooperation with the USFWS and other federal agencies under the NEPA, the ESA, Section 404 of the federal CWA, and the Federal Fish and Wildlife Coordination Act. WGFD's habitat information can be obtained via the website (https://wgfd.wyo.gov/habitat/habitat-information).

In July 2015, Executive Order 2015-4, Greater Sage-Grouse Core Area Protection, was signed by the Governor Mead, which requires state agencies to encourage development outside of the core areas and to focus management to the greatest extent possible on the maintenance and enhancements of habitat within them. Additional information about Wyoming's sage grouse management including mitigation, de minimus activities, core area maps and data, and the Density Disturbance Calculation Tool (DDCT) can be found at the website (https://wgfd.wyo.gov/Habitat/Sage-Grouse-Management). Sponsors for a proposed project within the watershed should contact the WGFD at least 60 days prior to submitting an application for a permit or project so any sage-grouse related issues can be identified and any stipulations could be incorporated before commencing project activities.

Appendix 9A.6 Wyoming Department of Environmental Quality

Appendix 9A.6.1 Section 401 Water Quality Certification

For a proposed project requiring a USACE Section 404 permit, a pre-construction notification (PCN) is submitted by the applicant to the USACE. The PCN is then forwarded to the WDEQ for review under Section 401 of the CWA to determine compliance with Chapter 1, Wyoming Surface Water Quality Standards (W.S. 35-11-101). If the project is compliant, the WDEQ issues a 401 Water Quality Certification. WDEQ could require special conditions to the certification in order to guarantee compliance with surface water quality standards or TMDLs. Information about the WDEQ's 401 Certification process can be obtained by visiting their website (http://deq.wyoming.gov/wqd/401-certification/).

Appendix 9A.6.2 Permit to Construct

Storm water discharges are regulated under the federal CWA by the WDEQ's Wyoming Pollutant Discharge Elimination System (WYPDES) Program. For any proposed project within the watershed, the project sponsor should contact the WDEQ to determine if a Large or Small Construction General Permit (CGP) is needed to construct the project components. WYPDES requires that construction activities disturbing 5 or more acres to obtain a Large Construction General Permit (LCGP) or construction activities disturbing at least one acre, but less than five acres to obtain a Small Construction General Permit (SCGP). In order to obtain a LCGP, the applicant must also complete a Storm Water Pollution Prevention Plan (SWPPP). Additionally, the WDEQ may authorize temporary increases in turbidity above the numeric criteria of Section 23, Chapter 1, Wyoming Surface Water Quality Standards (W.S. 35-11-101) for certain short-term, construction-related activities conducted in live waters. Proposed projects involving irrigation diversions or streambank work typically occur in flowing water and would require application for a temporary turbidity waiver. For additional information or to obtain a WYPDES CGP or a temporary turbidity waiver, please contact the WDEQ by telephone (307) 777-7781 or the WDEQ's Water Quality Division website (http://deq.wyoming.gov/wqd/).

Appendix 9A.7 Wyoming Office of State Lands and Investments

Some of the proposed projects within the watershed would be located on Wyoming State lands. When a project is on State land a grazing and agricultural lessee is required to obtain permission from the Board of Land Commissioners prior to construction in accordance with Title 36 State Lands, Chapter 2, Board of Land Commissioners Article 1, In General (W.S. 36-2-107). The lessee must submit an Application for Construction of Improvements on State Land to the Wyoming Office of State Lands and Investments (OSLI), which would include the location, value, construction date, type of improvement, federal aid received, and applicable water rights for the improvement. Applications can be obtained by contacting the OSLI by telephone (307) 777-7331 or via the website (http://lands.wyo.gov/lands/leasing/agricultural).

Appendix 9A.8 Wyoming Department of Fire Protection and Electrical Safety

For any proposed project within the watershed that includes installing electrical equipment, the project sponsor should contact the Wyoming Department of Fire Protection and Electrical Safety to determine if a wiring permit is required before commencing work. A wiring permit is required when installing electrical equipment in new construction or remodeling of a building, mobile home or premises and the electrical installation must be performed by licensed electricians in accordance with Title 35 Public Health and Safety, Chapter 9 Fire Protection, Article 1 Department of Fire Prevention and Electrical Safety (W.S. 35-9-120 and W.S. 35-9-123). There may be applicable exemptions to these for work done by an owner or lessee on their own property or on a farm or ranch of 40 acres or more on deeded land pursuant to Title 35 Public Health and Safety, Chapter 9 Fire Protection, Article 1 Department of Fire Prevention and Electrical Safety, Division 3 Electrical Licensing (W.S. 35-9-123). More information and the Application for Electrical Wiring Permit can be obtained by contacting the Wyoming Department of Fire Protection and Electrical Safety by telephone (307) 777-7119 or via the website (http://wsfm.wyo.gov/electrical-safety/wiring-permits).

Appendix 9A.9 Sweetwater County

Sweetwater County has adopted regulations for land use zoning, aquifer protection, wastewater, and floodplain development within the project area. The Sweetwater County Land Use Department issues permits for activities in the unincorporated areas of the county including but not limited to building structures, wastewater systems, wind energy systems, and aquifer protection. The project sponsor should contact the planning department to determine if any permits are needed to construct a proposed project within the watershed. More information and the permit applications can be obtained by contacting the Sweetwater County Land Use Department by telephone (307) 922-5430, via email (landuse@sweet.wy.us), or via the website (https://www.sweet.wy.us/departments/land_use/index.php).

Appendix 9A.10 Special Districts

There are special districts including water, sewer, sanitary, and improvement/service districts located within the watershed. If a project involves the property and/or facility of a special district, then permission or a permit should be obtained from the special district before commencing construction. Some of the special districts located within the project area are listed below.

- City of Green River, City of Rock Springs, Sweetwater County Joint Power Water Board
- Clearview Improvement & Service District

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