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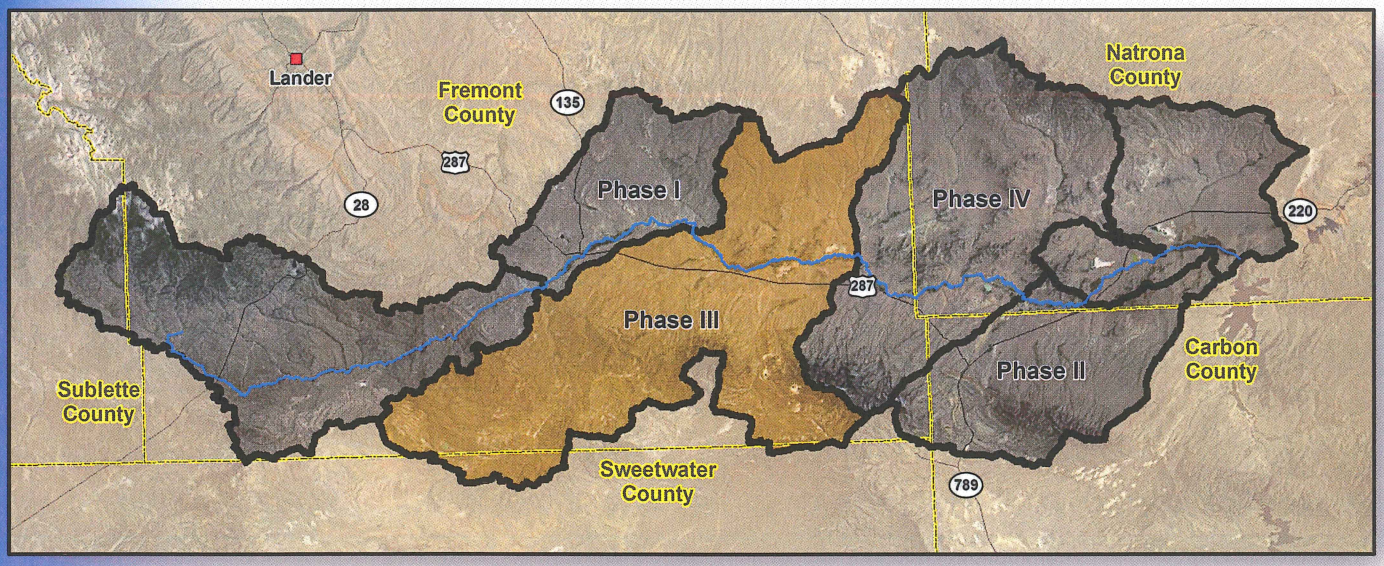
FINAL REPORT
FOR THE
SWEETWATER RIVER WATERSHED STUDY PHASE III
ALKALI CREEK / CROOKS CREEK / BUFFALO CREEK
WATERSHED MANAGEMENT PLAN

Prepared For:

Wyoming Water Development Commission
6920 Yellowtail Road
Cheyenne, WY 82002



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(ACE Project No. WYWDC26)

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

April 20, 2012

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I. INTRODUCTION AND OVERVIEW

I. INTRODUCTION AND OVERVIEW

In 2005 the Popo Agie Conservation District (PACD) requested funding from the Wyoming Water Development Commission (WWDC) for the completion of a watershed management plan for the Sweetwater River watershed. The intent 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 project and Anderson Consulting Engineers, Inc. (ACE) was ultimately contracted in June, 2006 to complete the project.

Briefly, the overall objective of the watershed study is to generate a watershed management and irrigation rehabilitation plan for the Sweetwater River watershed that is not only technically sound, but also one that is practical and economically feasible.

Due to the vast extent of the Sweetwater watershed and the range of conditions found within it, as well as varying level of interest and willingness to participate among stakeholders, it was determined that ACE would focus upon the development of watershed management plans at the subwatershed level. This strategy was selected to promote stakeholder participation and the development of plans more detailed and practical than would be afforded at the larger scale.

Following a series of initial public meetings, landowners and stakeholders within the Long Creek basin expressed high levels of interest and participation. For these reasons, and at the direction of the Steering Committee, the Popo Agie Conservation District (PACD) and the Wyoming Water Development Office (WWDO), Long Creek watershed was selected for the first phase of this effort.

Four phases of the project were ultimately completed which focused a subwatershed approach that ranged in areal extent from one to three of the 10^{th} order Hydrologic Units defined by the United States Geologic Survey (USGS). (The hydrologic units delineated by the USGS are designated a hydrologic unit code, or HUC as discussed at the following website: http://water.usgs.gov/GIS/huc.html).

Upon completion of the four phases addressing subwatersheds within the Sweetwater River basin, a fifth phase entitled "Sweetwater River Watershed Study: Basin-wide Summary" was completed which summarizes the results of the individual phases as well as providing a description of the entire Sweetwater River Watershed. Table 1.1 summarizes the various phases of the project and Figure 1.1 displays their locations. Each of the five phases have been published as separate and stand-alone documents.

This report presents the results of the Phase III investigation.

Table 1.1 Sweetwater River Watershed Investigation, Level 1: Project Phases.

Phase	Hydrologic Unit Code	HUC Order	Watershed Name
Phase I:	HUC 1018000604	10th Order	Long Creek
Phase II:	HUC 1018000609	10th Order	Muddy Creek
	HUC 1018000611	10th Order	Horse Creek (Arkansas Creek subbasin only)
Phase III:	**HUC 1018000603**	**10th Order**	**Alkali Creek**
	HUC 1018000606	**10th Order**	**Crooks Creek**
	HUC 1018000605	**10th Order**	**Buffalo Creek**
Phase IV:	HUC 1018000607	10th Order	Sage Hen Creek
	HUC 1018000610	10th Order	Dry Creek
	HUC 1018000608	10th Order	Willow Creek
Basin-Wide	HUC 10180006	8th Order	Sweetwater River Watershed

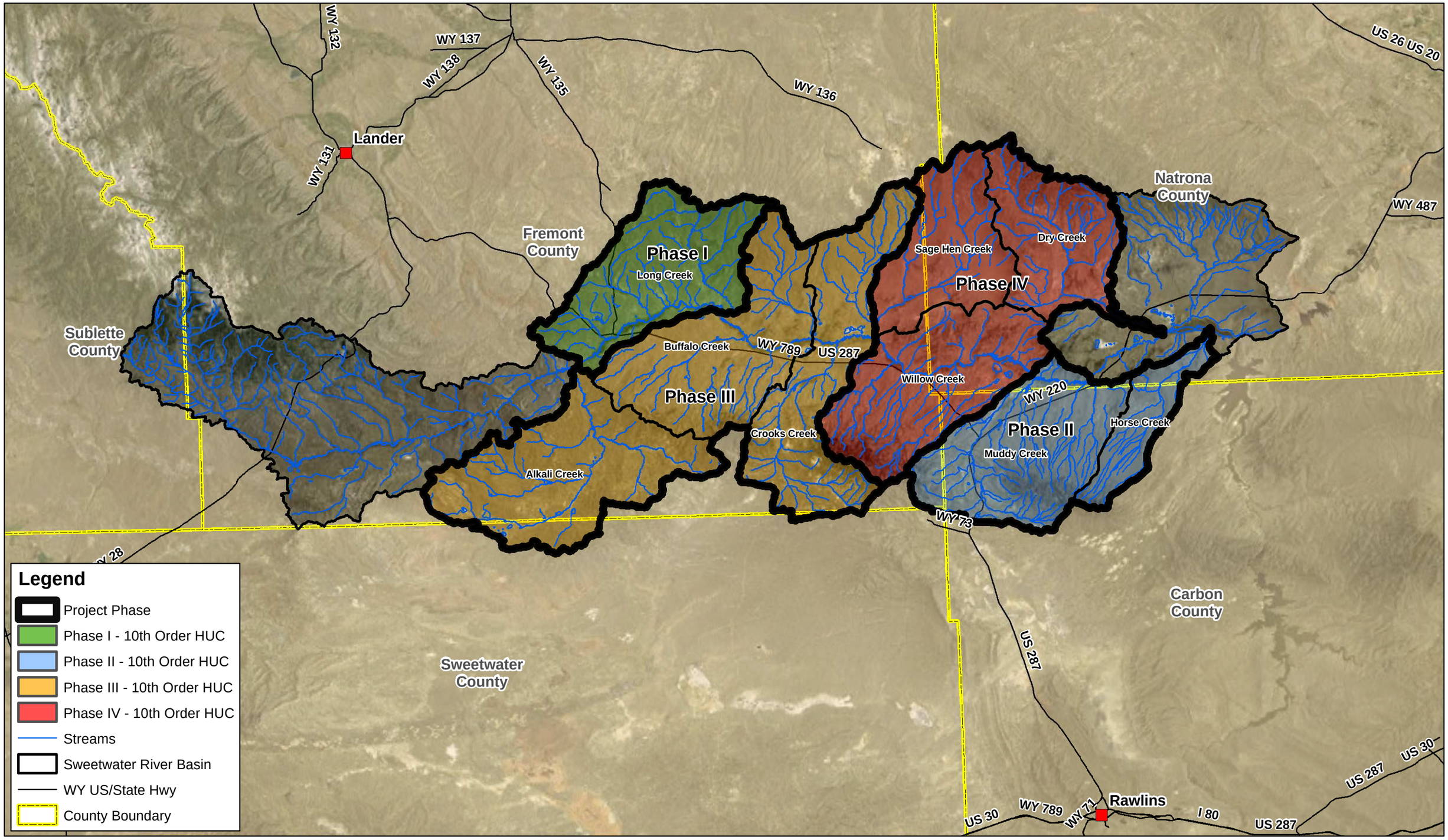

Figure 1.1 Sweetwater River Phase III: Location Map

II. WATERSHED DESCRIPTION AND INVENTORY

II. WATERSHED DESCRIPTION AND INVENTORY

2.1 Data Collection

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. Environmental Protection Agency (EPA)
- U.S. Fish and Wildlife Service (FWS)
- Wyoming Water Development Commission (WWDC)
- Wyoming Department of Environmental Quality (WDEQ)
- Wyoming Game and Fish Department (WGFD)
- Wyoming State Engineer's Office (WSEO)
- Wyoming Oil and Gas Conservation Commission (WOGCC)
- Wyoming State Geological Survey (WSGS)
- Wyoming Geographic Information Science Center (WyGISC)
- Fremont County
- Popo Agie Conservation District

2.2 Land Use and Management

The total land area within the Phase III study area is 530,601 acres (829.1 square miles). The distribution of land ownership within the watershed is shown on Figure 2.1. The bulk of the

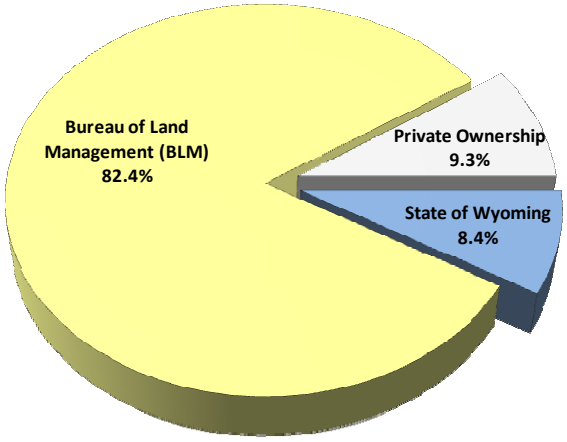

Figure 2.1 Distribution of Surface Ownership Within the Phase III Study Area.

study area is federally owned; the BLM manages 82.4 percent of the area (436,959 acres). Of the remaining portion of the study area, 9.3 percent (49,170 acres) are privately owned, and the State of Wyoming owns 8.4 percent (44,472 acres). As is evident in Figure 2.2, the privately owned lands are located primarily along the riparian corridors.

The study area lies within administrative boundary of the Lander District of the BLM as indicated in Figure 2.2.

2.3 Vegetation

2.3.1 Overview

Vegetative cover within the watershed was 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 United States Forest Service (USFS) 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 and others, 2003).

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 summarized in Table 2.1. The LANDFIRE existing vegetation data indicate 46 different vegetation classes within the watershed. As is clearly indicated in this table, the Inter-Mountain Basins Big Sagebrush Shrubland community dominates coverage of the study area with a total cover of

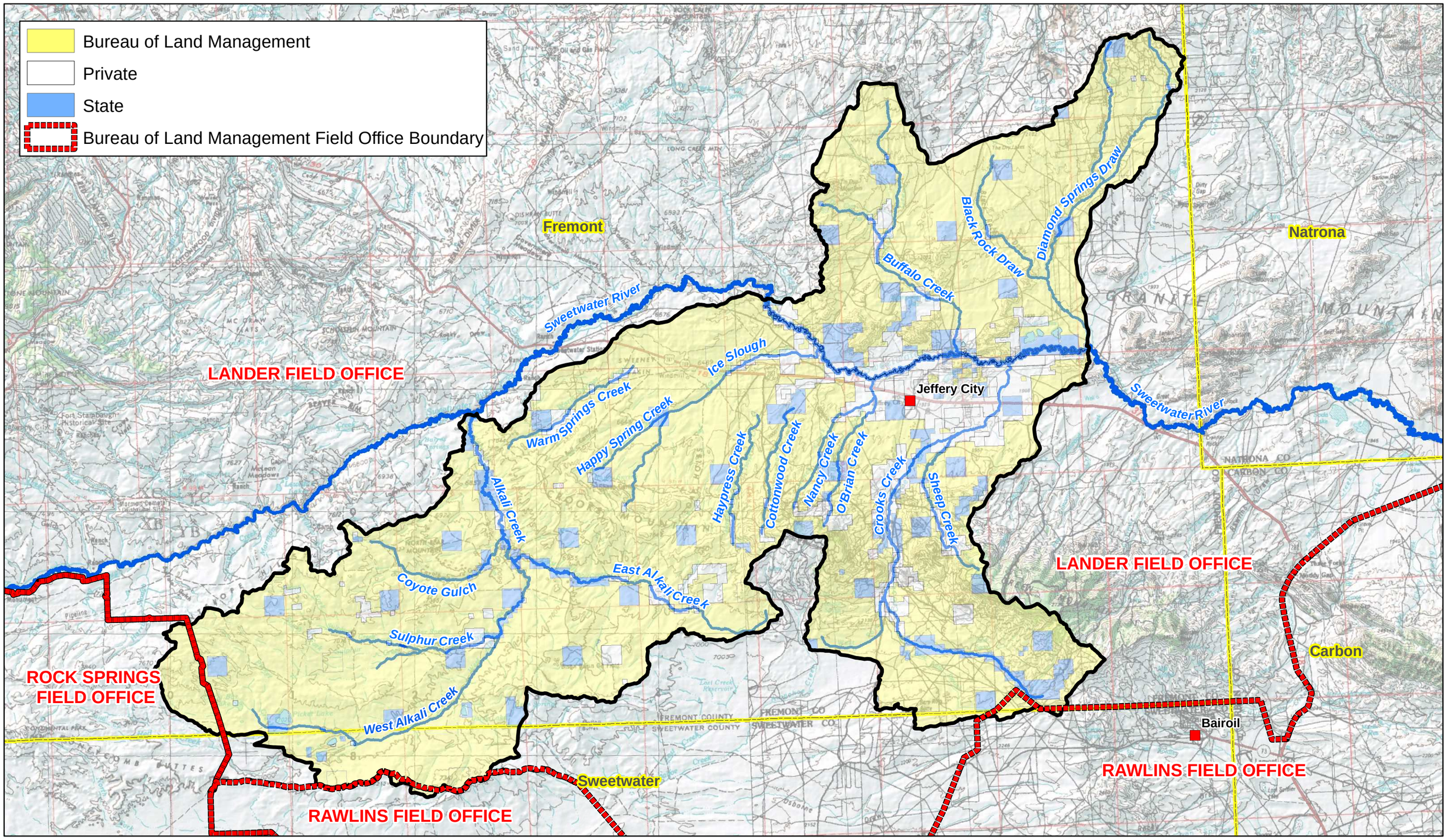

Figure 2.2 Sweetwater River Phase III: Land Ownership and Management

2.3

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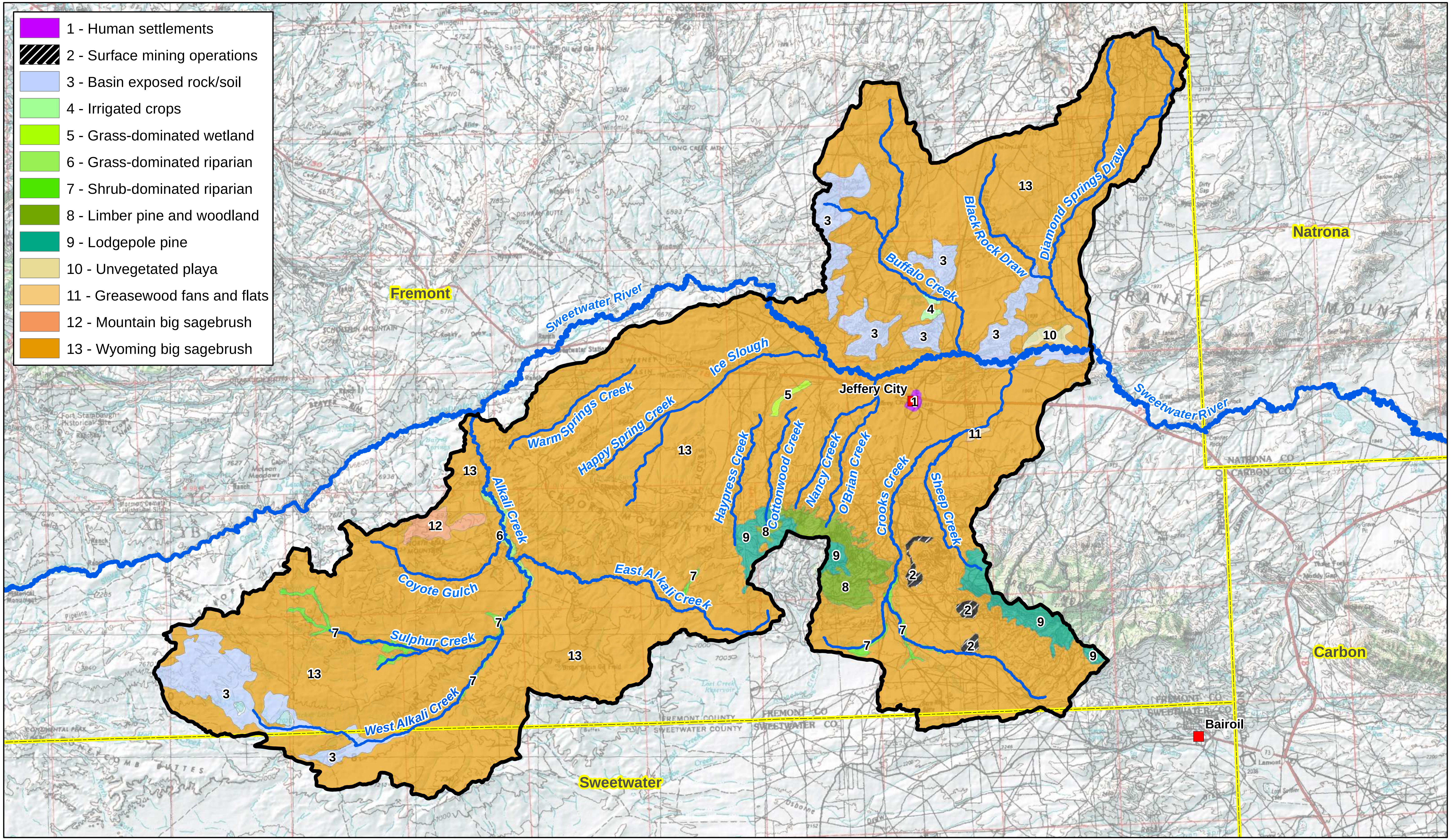
Table 2.1 Tabulation of LANDFIRE data available within the Phase III Study Area.

Existing Vegetation Type	Acres	Percent of Watershed	Cummulative Percent
Inter-Mountain Basins Big Sagebrush Shrubland	343,463	64.5%	64.5%
Inter-Mountain Basins Mat Saltbush Shrubland	49,808	9.4%	73.9%
Inter-Mountain Basins Big Sagebrush Steppe	37,181	7.0%	80.9%
Artemisia tridentata ssp. vaseyana Shrubland Alliance	20,018	3.8%	84.7%
Western Great Plains Floodplain Systems	11,142	2.1%	86.8%
Inter-Mountain Basins Greasewood Flat	10,916	2.1%	88.8%
Rocky Mountain Lower Montane-Foothill Shrubland	8,508	1.6%	90.4%
Wyoming Basins Low Sagebrush Shrubland	7,888	1.5%	91.9%
Inter-Mountain Basins Semi-Desert Grassland	6,898	1.3%	93.2%
Rocky Mountain Subalpine/Upper Montane Riparian Systems	5,689	1.1%	94.3%
Inter-Mountain Basins Montane Sagebrush Steppe	4,273	0.8%	95.1%
Rocky Mountain Foothill Limber Pine-Juniper Woodland	3,820	0.7%	95.8%
Introduced Upland Vegetation - Annual and Biennial Forbland	3,320	0.6%	96.4%
Inter-Mountain Basins Semi-Desert Shrub-Steppe	3,227	0.6%	97.0%
Agriculture-Pasture/Hay	3,020	0.6%	97.6%
Inter-Mountain Basins Mountain Mahogany Woodland and Shrubland	2,983	0.6%	98.1%
Rocky Mountain Montane Riparian Systems	2,591	0.5%	98.6%
Developed-Open Space	1,293	0.2%	98.9%
Barren	1,257	0.2%	99.1%
Northern Rocky Mountain Lower Montane-Foothill-Valley Grassland	955	0.2%	99.3%
Inter-Mountain Basins Mixed Salt Desert Scrub	668	0.1%	99.4%
Open Water	570	0.1%	99.5%
Rocky Mountain Aspen Forest and Woodland	427	0.1%	99.6%
Inter-Mountain Basins Sparsely Vegetated Systems	384	0.1%	99.7%
Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland	303	0.1%	99.7%
Western Great Plains Depressional Wetland Systems	302	0.1%	99.8%
Developed-Low Intensity	253	0.0%	99.8%
Inter-Mountain Basins Juniper Savanna	241	0.0%	99.9%
Eighteen (18) assorted classes, each less than 200 acres	707	0.1%	100.0%

over 64% of the watershed. While the fact that the majority of the study area is covered in sagebrush types comes as no surprise, the table presents valuable information pertaining to the vegetation types present to a much lesser extent. For instance, the LANDFIRE data indicates that 1.6 percent (8,582 acres) exist as some form of riparian vegetation (Rocky Mountain Subalpine/Upper Montane Riparian Systems, Rocky Mountain Montane Riparian Systems, plus Western Great Plains Depressional Wetland Systems).

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. For graphical purposes, data obtained through the Wyoming Gap Analysis program are shown on Figure 2.3 (http://www.wygisc.uwyo.edu/wbn/gap.html).

The 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 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" (University of Wyoming, Spatial Data Visualization Center, 1996).



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Streams- Phase III Study Area
Sweetwater River
Cities
Phase III Study Area
County Boundary

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1 inch = 24,000 Feet

Figure 2.3 Sweetwater River Phase III: Vegetation

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In general, vegetation types within the Phase III Study Area vary greatly but generally consist of meadow, grass, sagebrush, mountain shrubs, conifer, and deciduous trees. Wyoming big sagebrush is the dominant shrub. Grass plants found within upland range communities include western wheatgrass, bluebunch wheatgrass, threadleaf sedge, prairie junegrass, and needle-and-thread grass. Conifers are generally limited to higher elevations (above 7,000 feet) and consist of lodgepole and mixed lodgepole-spruce stands. Discontinuous juniper stands are found throughout the lower elevations. Deciduous trees consist primarily of willows and cottonwoods along the perennial creeks and water birch and aspen at higher elevations.

2.3.2 Wetland – Riparian Vegetation

Wetland-riparian areas provide the highest vegetation production of plan communities within the study area yet comprise approximately 1.6 percent of the total area based upon the Landfire data analysis discussed above. Consequently, these areas receive high utilization by wildlife, wild horses, and livestock. Field observations of riparian areas confirmed heavy utilization of some of these areas. However, generally rapid recovery was observed in areas where adequate protection / fencing have been established.

Existing mapping of wetlands within the Phase III Study Area available for this study 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 this scale. Based upon the NWI mapping, approximately 6,063 acres of wetlands exist within the study area. It is generally understood by users of the NWI mapping that the data are suitable for broadscale 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.

In addition to the NWI mapping, the LANDFIRE data includes limited determination of wetlands as well. Based upon the LANDFIRE data analysis, there are approximately 302 acres of Western Great Plains Depressional Wetlands with the watershed. Other types of wetlands are not included in the LANDFIRE data, however, two riparian vegetation categories are found within the watershed: Rocky Mountain Subalpine/Upper Montane Riparian Systems (5,689 acres) and Rocky Mountain Montane Riparian Systems (2,591 acres). 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. Figure 2.4 displays the available wetlands mapping data. Note that due to the limited extent of wetland mapping units, presentation of a background topographic map as is present in other figures, is not feasible.

2.3.3 Vegetation Issues

2.3.3.1 Invasive Species

With respect to invasive species within the GMCA portion of the study area, the following description was extracted from the 2011 GMCA EA:

> *"The BLM Lander Field Office contracts annually with the Fremont County Weed and Pest Control District (WPCD) for control (i.e., inventory, spraying, releasing insect vectors, and monitoring) of weeds on BLM-administered lands. This is done as a cooperative effort with private landowners who are engaged in weed control programs on their own lands. Without these precautionary actions, untreated federal lands could serve as a seed source of weeds for invading private lands that have weed control programs.*
>
> *The Fremont County portion of the allotment also lies within the Popo Agie Weed Management Area (PAWMA), the boundaries of which correspond to those of the Popo Agie Conservation District, which in this area is the county line. The PAWMA is a group of local, state, and federal agencies that work through a Memorandum of Understanding with the Fremont County WPCD to assist the landowners in the area with controlling noxious weeds.*
>
> *Wyoming state law (W.S. 11-5-101 through 11-5-119) requires landowners to control noxious weed infestations on their property or face penalties including quarantining of products from infested properties.*
>
> *The following noxious weeds are present in or nearby the GMCA (see Map 18): While noxious weeds are not an extensive problem in the GMCA, they are present and diligent control work by BLM, Fremont Co. W&PCD, and the minerals industry serve to keep things in check. If these cooperative efforts were not taking place, noxious weeds would be a greater problem.*
>
> - *Russian knapweed (Centaurea repens) occurs primarily in the western half of the allotment along the Bison Basin road, the far southwest portion of the allotment associated with the lakes, and along the Sweetwater River just outside the allotment. The U.S. Highway 287 right-of-way also has isolated infestations of Russian knapweed within it.*
> - *Perennial pepperweed (Lepidium latifolium), or whitetop, occurs sporadically along the Sweetwater River outside the allotment.*
> - *Canada thistle (Cirsium arvense) occurs sparsely along some roads and riparian areas within the allotment boundary.*

Rocky Mountain Montane Riparian Systems
Rocky Mountain Subalpine/Upper Montane Riparian Systems
Western Great Plains Depressional Wetland Systems
Western Great Plains Floodplain Systems

Fremont
Natrona
Carbon
Sweetwater
Jeffery City
Bairoil
Sweetwater River
Buffalo Creek
Black Rock Draw
Diamond Springs Draw
Ice Slough
Warm Springs Creek
Happy Spring Creek
Alkali Creek
Haypress Creek
Cottonwood Creek
Nancy Creek
O'Brian Creek
Crooks Creek
Sheep Creek
East Alkali Creek
Coyote Gulch
Sulphur Creek
West Alkali Creek

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Streams- Phase III Study Area
Phase III Study Area
County Boundary

0 24,000 48,000

1 inch = 24,000 Feet

Figure 2.4 Sweetwater River Phase III: LANDFIRE Riparian Areas

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- *Spotted knapweed (Centaurea maculosa) occurs in the U.S. Highway 287 right-of-way, the Sweetwater River just southwest of Sweetwater Station, and some of the drainages and land rehabilitation projects on Green Mountain.*
- *Leafy spurge (Euphorbia esula) is found along Alkali Creek, just outside the allotment along the Sweetwater River at the far western reaches of the GMCA, and near Split Rock in both Fremont and Natrona Counties.*
- *Diffuse knapweed (Centaurea diffusa) is found in the Cooper Creek and Willow Creek drainages on the northeast slopes of Green Mountain.*
- *Musk thistle (Carduus nutans) is distributed along the U.S. Highway 287 right-of-way and on Crooks Creek, just inside the GMCA boundary.*
- *Tamarisk (Tamarix spp.) or Salt cedar has been treated near Sweetwater Station and occurs at Lost Creek Reservoir in the Great Divide Basin.*
- *Hoary cress (Cardaria draba and C. pubescens) is found along the Sweetwater River and U.S. Highway 287 right-of-way, and several roads in the central and western portions of the allotment.*
- *Plumeless thistle (Carduus acanthoides) has been found on well pads and roads on Green Mountain.*
- *Russian olive (Elaeagnus angustifolia) occurs outside the allotment along the Sweetwater River just north of Sweetwater Station, and also inside the allotment boundary along Crooks Creek.*
- *Field bindweed is found just outside the allotment near Sweetwater Station.*
- *Quackgrass occurs along the Sweetwater River just outside the northwestern boundary of the allotment.*
- *Black henbane (Hyoscyamus niger) is not a State of Wyoming-designated noxious weed, but it is a poisonous weed of concern associated with oilfield roads in the Happy Spring Oilfield area, the Uranium Mine Road along the side of Green Mountain, and the Three Forks-Atlantic City Road. It is also found on disturbed ground and pipeline rights-of-way.*

Though not designated as noxious by the state, weedy annuals like cheat grass (Bromus tectorum), halogeton (Halogeton glomeratus), and Russian thistle (Salsola tragus), and the biennial black henbane (Hyoscyamus niger), are quick to invade disturbed soils in the allotment, and can hinder rehabilitation efforts. Two of these weeds are poisonous, and only the cheatgrass is of very limited forage use for grazing animals. "

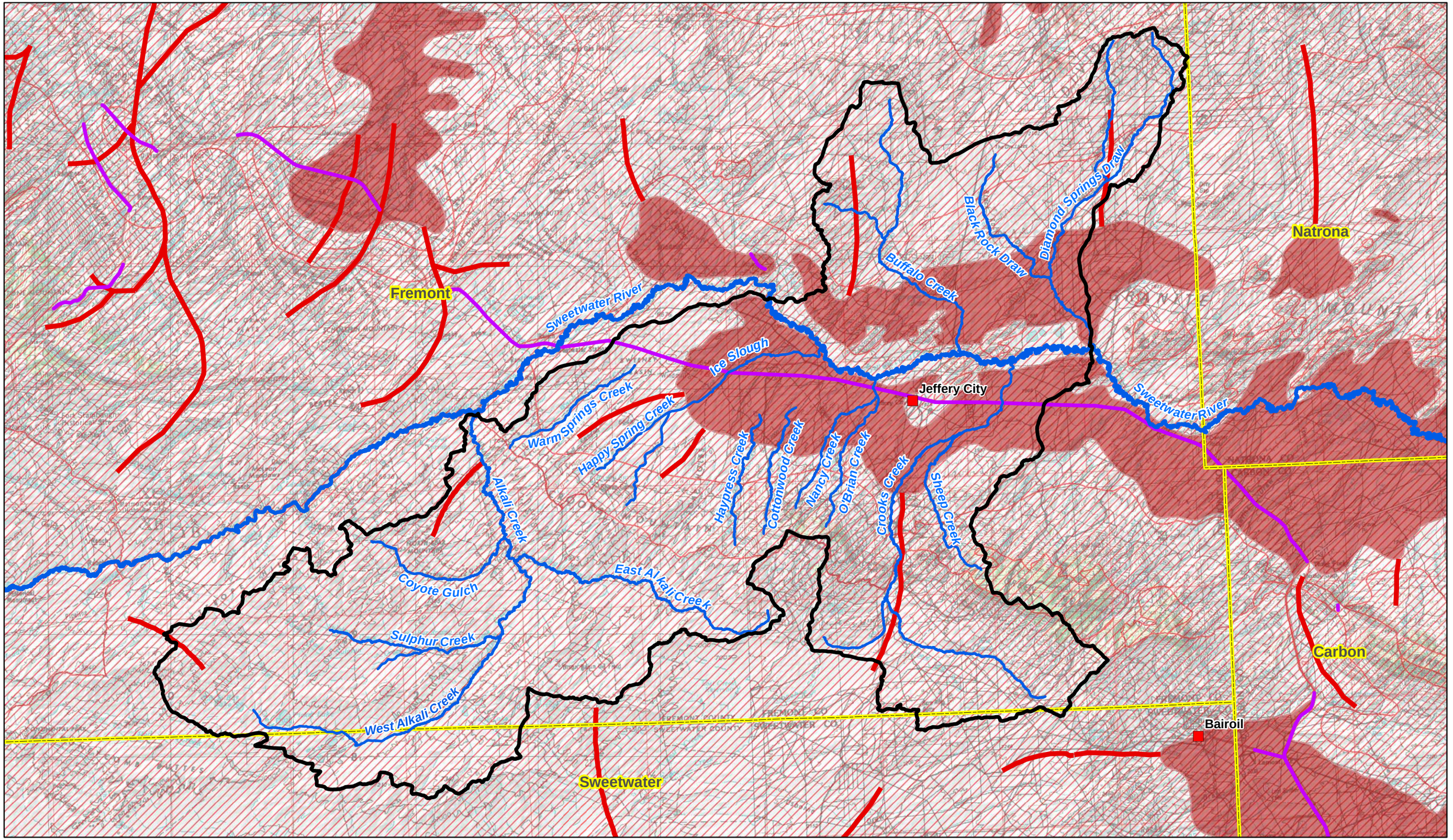
2.4 Wildlife

Much of the study area has been mapped by the Wyoming Game and Fish Department (WGFD) as crucial habitat for big game species. Specifically, the entire study area has been identified as seasonal habitat for mule deer and antelope and extensive portions of the area are seasonal habitat for elk and moose. In addition, crucial habitat has been mapped for antelope (87,178 acres), elk (7,206 acres), mule deer (9,970 acres) and moose (8,456 acres). The 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). Crucial habitat or range is defined as those seasonal ranges or habitats (mostly winter range) 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. Figures 2.5 through 2.8 display the seasonal range, crucial range, parturition range, and migration corridors for big game species in the study area: antelope, elk, moose, and mule deer.

With respect to wildlife habitat within the GMCA portion of the study area, the following description was extracted from the 2011 GMCA EA:

> *"Historically, approximately 30 elk traveled extensively throughout this area, generally centering near Cyclone Rim. The South Wind River Elk Herd Unit occurs only in a small portion on the allotment north of the Sweetwater River. In the past, approximately 50 elk inhabited this area in the Sweetwater River Canyon. During recent years, up to 400 elk have been observed in this portion of the allotment during the late fall, winter, and early spring. These elk are believed to be migrating from the Wind River Mountains to the west. Elk populations of the Green Mountain, Steamboat, and South Wind River herd units have exceeded population objectives for the past five years. For further discussions of elk habitat, movements, and food habitats, refer to the Affected Environment chapter of the Green Mountain Grazing EIS.*
>
> *Habitats preferred by mule deer in the allotment include woody riparian, shrubland, juniper woodland, and aspen habitats. These habitats typically have adequate cover and extensive stands of browse species available. During severe winters, deer are restricted to areas where cover and browse are still relatively accessible. On many deer winter ranges, riparian habitats provide the only available cover and most of the available forage. These riparian habitats also provide important forage and fawning areas during the spring and summer. Forage competition between livestock, wild horses, and elk in these riparian habitats has reduced the amount of forage available to deer. Mule deer population estimates for the Sweetwater, Steamboat, and South Wind River herd units have been below objective for a number of years.*
>
> *The Red Desert Pronghorn Herd Unit utilizes the largest proportion of the allotment during the spring, summer, and fall period. Pronghorn generally migrate to the south and out of the allotment as a result of snow and colder temperatures. During most winters, a reduced number of antelope can be found along the southern boundary of the allotment from the Rocky Crossing Road to Eagles Nest Draw. The Beaver Rim Pronghorn Herd Unit occurs in the northern one-fourth of the allotment, which extends from the mouth of Alkali Creek along the Crooks Mountain divide to the area immediately southwest of Jeffrey City. Antelope movements in this herd unit are generally from south and west to northeast, with pronghorn wintering in the vicinity of Ice Slough and outside of the allotment to the east. A small portion of habitat of the Sublette Pronghorn Herd Unit (about 300 acres) occurs in the extreme western portion of the allotment, where pronghorn occur during the spring, summer, and fall. The five-year average estimated population for all herds is currently below population objectives, as a result of the cumulative impacts from long-term summer drought, which began in the late 1980s and persisted through the mid-1990s. The drought has dramatically reduced fawn survival, yearling recruitment, and, ultimately, herd size for these populations. The severe winter of 1992-93 also negatively impacted these populations.*
>
> *Moose habitat in the allotment generally occurs in forested or riparian habitats containing willow, cottonwood, or aspen species. Although moose occur in the allotment yearlong, the greatest numbers enter the allotment from the west as they migrate away from the Shoshone National Forest due to deep snow. Preferred forage for moose is willow, aspen, and other vegetative growth commonly found in riparian habitats. Forage competition among other animals, including livestock, has adversely impacted the availability of forage and cover for moose".*



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- Migration Barrier
- Migration Routes
- Crucial Range
- Seasonal Range
- Streams- Phase III Study Area
- Sweetwater River
- Cities
- Phase III Study Area
- County Boundary

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1 inch = 24,000 Feet

Figure 2.5 Sweetwater River Phase III: Antelope Habitat

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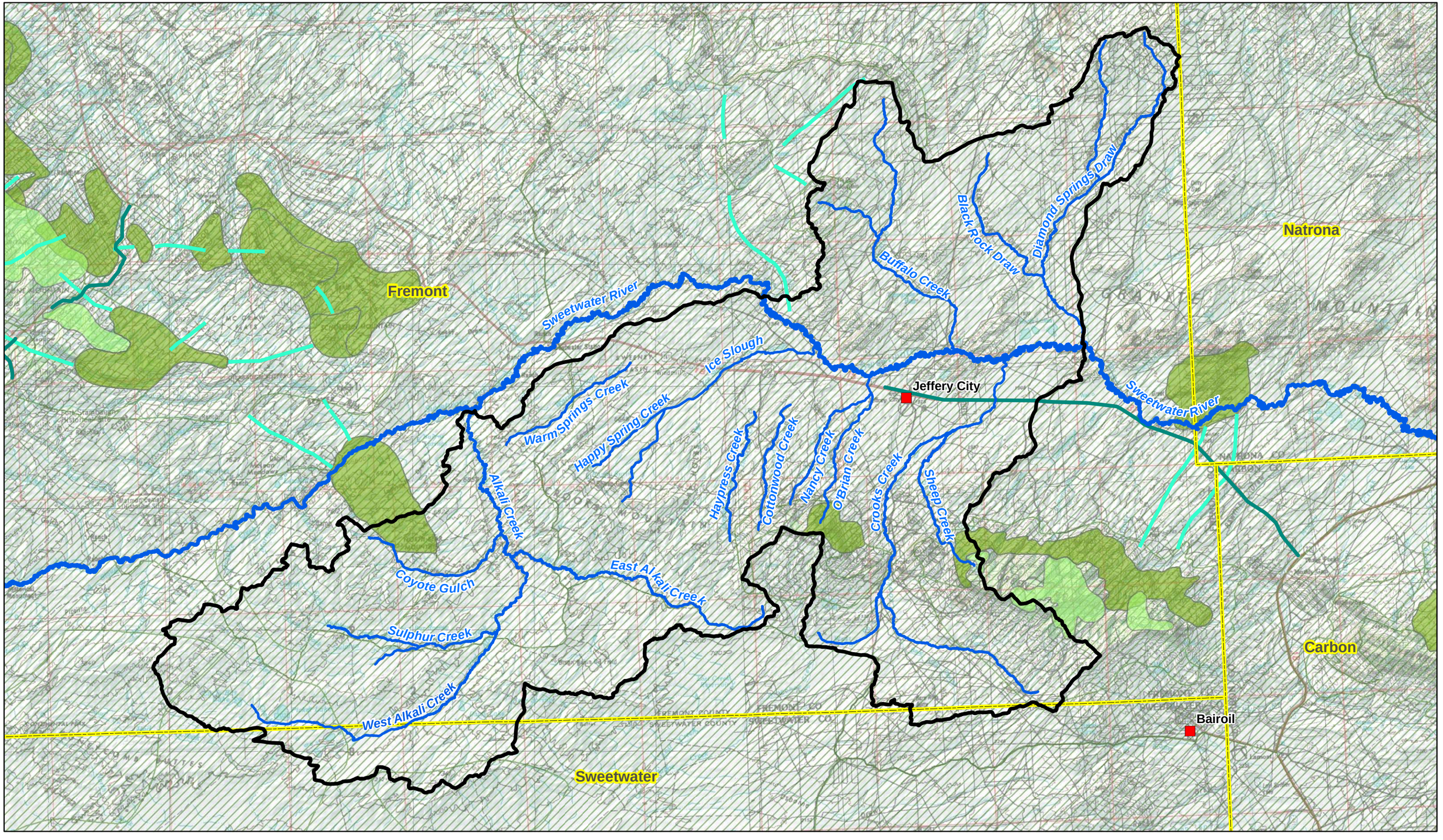

Legend

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- Migration Barrier
- Migration Routes
- Crucial Range
- Parturition Area
- Seasonal Range
- Cities
- Streams- Phase III Study Area
- Sweetwater River
- Phase III Study Area
- County Boundary

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1 inch = 24,000 Feet

Figure 2.6 Sweetwater River Phase III: Elk Habitat

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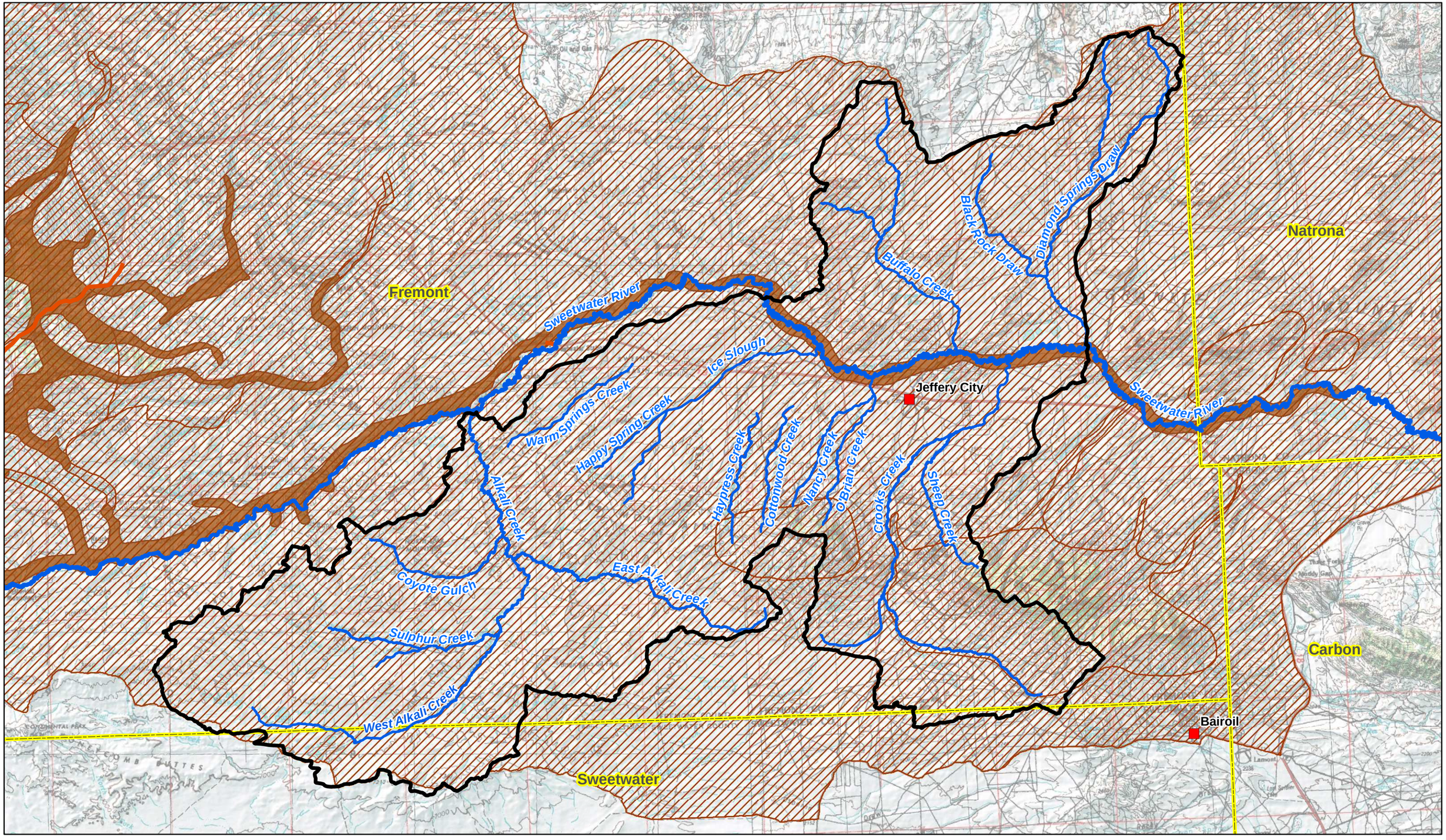

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Legend

- Migration Barrier
- Crucial Range
- Seasonal Range
- Cities
- Streams- Phase III Study Area
- Sweetwater River
- Phase III Study Area
- County Boundary

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1 inch = 24,000 Feet

Figure 2.7 Sweetwater River Phase III: Moose Habitat

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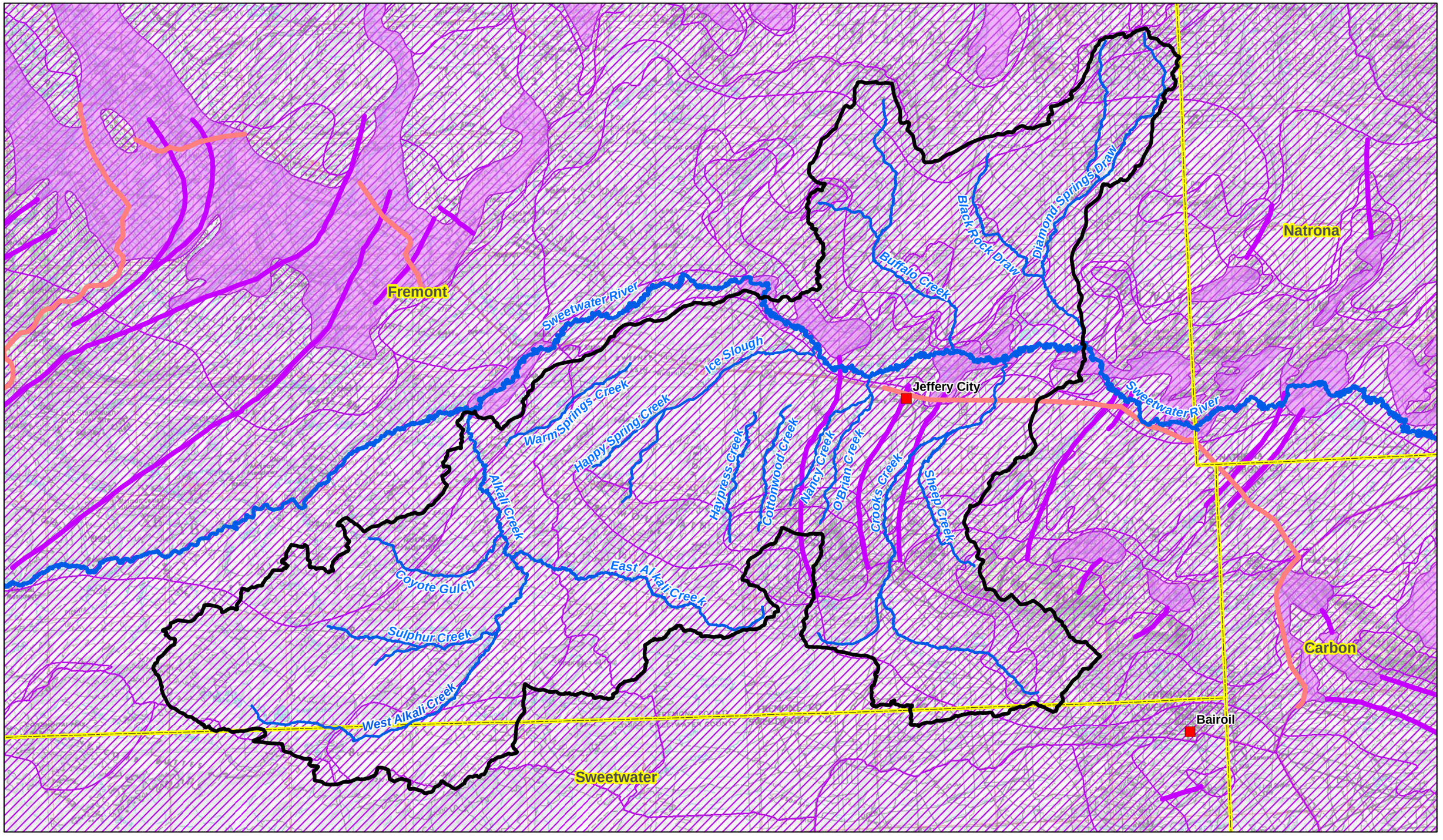

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Legend

- Migration Barrier
- Migration Routes
- Crucial Range
- Seasonal Range
- Streams- Phase III Study Area
- Sweetwater River
- Cities
- Phase III Study Area
- County Boundary

0 24,000 48,000

1 inch = 24,000 Feet

Figure 2.8 Sweetwater River Phase III: Mule Deer Habitat

2.14

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The Wyoming Natural Diversity Database (WYNDD) lists numerous non-game species of concern within the study area, including amphibians, birds, and mammals. No fish or reptiles were apparent in the database. Table 2.2 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. Review of the list shows that the endangered species known to have been observed within the study area are the black-footed ferret (*Mustela nigripes*), and the whooping crane (Grus ameicana). The only threatened species is the grey wolf (*Canis lupus*).

The potential exists for some of these species to occur within appropriate habitats within the study area. For example, areas of known greater sage grouse (*Centrocercus urophasianus*) leks are displayed in Figure 2.9. The sage grouse does not receive federal or state protection at this time; however, it is recognized as a sensitive species / species of concern by the BLM and a species of concern by WGFD. In August 2008, Executive Order 2008-2 was signed by the Governor which stresses additional management consideration to sage grouse and sage grouse habitat statewide. 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 Core Sage Grouse Population Areas and known leks within the Phase III study area are delineated in Figure 2.9.

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.

WGFD lists the greater sage grouse as: species that are widely distributed, with population status or trends unknown but suspected to be stable; habitat restricted or vulnerable but no recent or on-going significant loss; species likely sensitive to human disturbance. *The sage grouse are 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/recommendations to help protect the sage grouse.*

With respect to sage grouse within the GMCA portion of the study area, the following description was extracted from the 2011 GMCA EA:

> *"Livestock grazing has impacted sage-grouse in the allotment by the removal of herbaceous plants (grasses and forbs) that occur around the base of sagebrush plants. The*

Table 2.2 Wyoming Natural Diversity Database: Wildlife Species in the Sweetwater River Watershed Phase III Study Area.

Scientific Name	Common Name	Listing Status	Trackes / Watched
Amphibians			
Ambystoma tigrinum	Tiger Salamander		Watched
Lithobates pipiens	Northern Leopard Frog	Petitioned	Tracked
Scaphiopus intermontanus	Great Basin Spadefoot Toad		Tracked
Birds			
Accipiter gentilis	Northern Goshawk	Listing Denied	Tracked
Aegolius funereus	Boreal Owl		Tracked
Ammodramus savannarum	Grasshopper Sparrow		Watched
Amphispiza belli	Sage Sparrow		Tracked
Aquila chrysaetos	Golden Eagle		Watched
Asio flammeus	Short-eared Owl		Tracked
Athene cunicularia	Burrowing Owl		Tracked
Bucephala albeola	Bufflehead		Watched
Buteo regalis	Ferruginous Hawk		Tracked
Calcarius mccownii	Mccown's Longspur		Tracked
Centrocercus urophasianus	Greater Sage Grouse	Candidate	Tracked
Charadrius montanus	Mountain Plover	Petitioned	Tracked
Charadrius montanus	Mountain Plover	Petitioned	Tracked
Cygnus buccinator	Trumpeter Swan	Listing Denied	Tracked
Cygnus columbianus	Tundra Swan		Watched
Egretta thula	Snowy Egret		Watched
Falco columbarius	Merlin		Watched
Falco peregrinus anatum	American Peregrine Falcon	Delisted	Tracked
Gavia immer	Common Loon		Tracked
Grus americana	Whooping Crane	Endangered	Tracked
Grus canadensis	Sandhill Crane		Watched
Haliaeetus leucocephalus	Bald Eagle	Delisted	Tracked
Himantopus mexicanus	Black-necked Stilt		Watched
Lanius ludovicianus	Loggerhead Shrike		Tracked
Larus californicus	California Gull (Breeding Colonies)		Watched
Larus delawarensis	Ring-billed Gull (Breeding Colonies)		Watched
Leucosticte atrata	Black-rosy Finch		Tracked
Numenius americanus	Long-billed Curlew		Tracked
Oreoscoptes montanus	Sage Thrasher		Watched
Pelecanus erythrorhynchos	American White Pelican (Breeding Colonies)		Tracked
Phalaropus lobatus	Red-necked Phalarope		Watched
Plegadis chihi	White-faced Ibis		Tracked
Recurvirostra americana	American Avocet		Watched
Spizella breweri	Brewer's Sparrow		Watched
Spizella pallida	Clay-colored Sparrow		Watched
Tympanuchus cupido	Greater Prairie Chicken		Watched
Mammals			
Bos bison	American Bison (Free-ranging Herds)	Petitioned	Tracked
Brachylagus idahoensis	Pygmy Rabbit	Listing Denied	Tracked
Canis lupus	Gray Wolf	Threatened	Tracked
Corynorhinus townsendii townsendii	Townsend's Western Big-eared Bat		Tracked
Cynomys leucurus	White-tailed Prairie Dog	Listing Denied	Tracked
Lutra canadensis	River Otter		Tracked
Mustela nigripes	Black-footed Ferret	Endangered	Tracked
Ovis canadensis	Bighorn Sheep		Watched
Sciurus aberti	Abert's Squirrel		Watched
Spermophilus elegans	Wyoming Ground Squirrel		Watched
Thomomys clusius	Wyoming Pocket Gopher	Listing Denied	Tracked

Lek Status

- Occupied
- Unoccupied
- Unknown
- Sage Grouse Core Areas

Fremont
Natrona
Jeffery City
Carbon
Bairoil
Sweetwater
Sweetwater River
Buffalo Creek
Black Rock Draw
Diamond Springs Draw
Ice Slough
Warm Springs Creek
Happy Spring Creek
Alkali Creek
Hayspress Creek
Cottonwood Creek
Nancy Creek
O'Brian Creek
Crooks Creek
Sheep Creek
East Alkali Creek
Coyote Gulch
Sulphur Creek
West Alkali Creek
FREMONT CO
SWEETWATER COUNTY
NATRONA CO
CARBON CO

N
W E
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Legend

- Streams- Phase III Study Area
- Sweetwater River
- Cities
- Phase III Study Area
- County Boundary

0 24,000 48,000

1 inch = 24,000 Feet

Figure 2.9 Sweetwater River Phase III: Sage Grouse Core Areas

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removal of these plants permits predators to prey upon sage-grouse eggs by reducing the hiding cover around the nest. Livestock grazing practices have also impacted sage-grouse by reducinghabitat quality in riparian habitats used for brood rearing. Continual livestock grazing during the growing season has caused most riparian habitats in the allotment to be in a low seral stage. These low seral riparian vegetation stages do not support the vegetative cover to hide sage-grouse from predators or to provide insect populations required for raising sage-grouse chicks. Energy exploration and development within the GMCA further impacts sage-grouse habitat as a result of road and well pad construction. The net result is that sage-grouse habitat is fragmented by roads, pipelines, and utilities associated with these new and existing developments.

The GMCA has some of the highest lek density in the state of Wyoming. However, there are currently 37 leks within the GMCA boundary (34 on BLM surface). Map 23 shows the locations of these strutting/nesting complexes (leks). Six of the 37 leks have been inactive since 1996 or earlier although they are still considered occupied by WGFD.

Analyses of male sage grouse populations counted on 25 leks in the GMCA over the past 20 years (Wyoming Game and Fish data) indicates that they are cyclic. Because of inconsistencies in the number of times that leks were surveyed during any given year, it is not possible to determine trend data. For instance, the highest sage grouse counts occurred during a 4 year period from 2005 to 2008 and averaged 55 males during this period. This higher average count may be due, at least in part, to increased efforts to count males on more than one occasion during the breeding season. The average number of male sage grouse counted on these leks during this period was 29 and ranged from a low of 9 males in 1996 to a high of 65 males in 2006. The highest count on an individual lek was 234 males on the Soap Holes lek in 2006."

Wild horses frequent the Phase III Study area within four different herd management areas (HMA's) as indicated in Figure 2.10. The descriptions of the respective HMAs were extracted from the BLM website at:

(http://www.blm.gov/wy/st/en/field_offices/Lander/wh.html):

"Antelope Hills HMA

The Antelope Hills HMA encompasses 57,000 acres, of which 54,600 are BLM-administered public lands. The AML for this HMA is 60-82 adult horses. The area is located approximately 15 miles south/southeast of Atlantic, City, Wyoming. Elevations in the HMA range from 7,100 to 7,250 feet along Cyclone Rim. The HMA is bisected by the Continental Divide National Scenic Trail. The area receives 5-7 inches of precipitation annually. The predominate vegetation type is sagebrush/grass. Riparian zones are infrequent but very important to wild horses, wildlife, and livestock. The topography ranges from rolling flatlands south of Cyclone Rim, uplifted ridges along Cyclone Rim, and abrupt rocky zones interspersed with rolling lands north of the rim to the Sweetwater River.

Horse Management Area within basin

Horse Management Area outside of basin

Conant Creek

Rock Creek

Muskrat Basin

Dishpan Butte

Natrona

Fremont

Buffalo Creek

Black Rock Draw

Diamond Springs Draw

Sweetwater River

Ice Slough

Jeffery City

Warm Springs Creek

Happy Spring Creek

Alkali Creek

Crooks Mountain

Haypress Creek

Cottonwood Creek

Nancy Creek

O'Brian Creek

Crooks Creek

Sheep Creek

Sweetwater River

Coyote Gulch

East Alkali Creek

Sulphur Creek

Green Mountain

Carbon

Antelope Hills

West Alkali Creek

Divide Basin

Bairoil

Sweetwater

Stewart Creek

Lost Creek

N

W E

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Legend

Streams- Phase III Study Area

Sweetwater River

Cities

Phase III Study Area

County Boundary

0 24,000 48,000

1 inch = 24,000 Feet

Figure 2.10 Sweetwater River Phase III: Wild Horse Management Areas

Crooks Mountain HMA

The Crooks Mountain HMA is located directly southeast of Sweetwater Station, Wyoming, and encompasses about 51,000 acres. The AML for this HMA is 65-100 adult horses. Elevations in the HMA range from 6,900 to 8,100 feet. The lower elevations receive approximately 10-14 inches of precipitation annually, and the upper elevations receive 15-20 inches annually. The major vegetation types are sagebrush/grass, woodland, and riparian. Topography within the HMA is generally rolling hills and slopes to the north and south of Crooks Mountain. The Crooks Mountain portion of the herd area is quite steep and broken with mountainous terrain. The area supports significant wildlife populations of elk, deer, and antelope. Livestock graze the area from May to December.

Muskrat Basin, Conant Creek, Rock Creek & Dishpan Butte HMAs

These four HMAs are located in southeast Fremont County. They encompass about 375,000 acres of land, of which about 90% are BLM-administered public lands. While the four HMAs are managed with recognized individual populations, there is no geographic separation of the HMAs and the gates between them remain open a significant part of the year. As a result, the horses move regularly among the HMAs, helping to ensure the overall genetic health of the horses. Topography of the area includes high ridges and steep terrain with grand vistas. Elevations in the HMAs range from 5,300 to 7,200 feet. The area receives 5 to 12 inches of precipitation a year, depending on the elevation, most of it in the form of snow.

The AML for these HMAs is 320 horses. A full range of colors is present. Most horses are solid in color. The horses range from 11 to 15 hands and 750-1000 pounds mature weight. Health is good with few apparent problems. Domestic cattle and sheep utilize the area during spring, summer, and fall. Vegetation is dominated by various sage and grass species. Elk, deer, and antelope also inhabit this area.

Green Mountain HMA

The Green Mountain HMA encompasses 88,000 acres, of which 74,000 acres are BLM-administered public lands. Topography within the herd area is generally gently rolling hills and slopes north and south of Green Mountain. Green Mountain itself is quite steep with mountainous terrain and conifer/aspen forests. Elevations range from 6,200 to 9,200 feet with grand vistas of the Red Desert, Sweetwater Rocks, and Oregon Trail from the higher elevations. Precipitation ranges from 10-14 inches at the lower elevations to 15-20 inches at the upper elevations. Most of the precipitation is in the form of snow.

The AML for this HMA is 300 horses. A full range of colors is present. Most horses are solid in color, but a noticeable number of tobiano paints are present. The horses range from 11 to 15 hands and 750-1000 pounds mature weight. Health is good with few apparent problems. Domestic cattle and sheep utilize the area in all seasons with summer cattle use predominating. Vegetation around the mountain is dominated by various sage, grass, woodland, and riparian species. The area supports significant wildlife populations of elk, deer, antelope, and moose. "

With respect to wild horses specifically within the GMCA portion of the study area, the following description was extracted from the 2011 GMCA EA:

"Wild horses in these HMA's breed in the summer and fall. Their numbers increase by about 15-20 percent annually. Recent drought conditions have allowed almost year-round

breeding, with colts being observed in almost every month of the year. The horses appear to be in excellent health. Injured, sick, or emaciated wild horses are rarely seen. Because the GMCA is relatively remote and unvisited, the wild horses can generally be viewed in a very natural setting. The horses are not greatly alarmed by visitors and can usually be approached to within a few hundred yards.

Crucial winter habitat for wild horses exists in the Green Mountain HMA in the vicinity of Crooks Creek, east of Whiskey Peak, and North of the Green Mountain. Crucial winter habitat exists in the Crooks Mountain HMA in the vicinity of Ice Slough, and also in the Antelope Hills HMA in the vicinity of Picket Lake. Also, a summer concentration area has been identified in the Soap Holes vicinity of the Crooks Mountain HMA. The areas of horse use are somewhat dependent upon water availability, although it is not uncommon to see wild horses more than five miles from water. Most movement to and from water occurs in the early mornings and late evenings. In late summer when water supplies are limited, herd movements are less common. The bands prefer to feed on upland areas that provide a good field of vision for escape. In the winter, the horses are often found in groups of two to five horses on exposed ridges which are blown free of snow and can be used to forage on."

2.5 Geology and Soils

Surface geology mapping completed by the United States Geologic Survey was obtained from the Wyoming Geographic Information and Science Center (WyGISC) and incorporated into the project GIS. The distribution of surficial geologic deposits within the watershed is displayed in Figure 2.11.

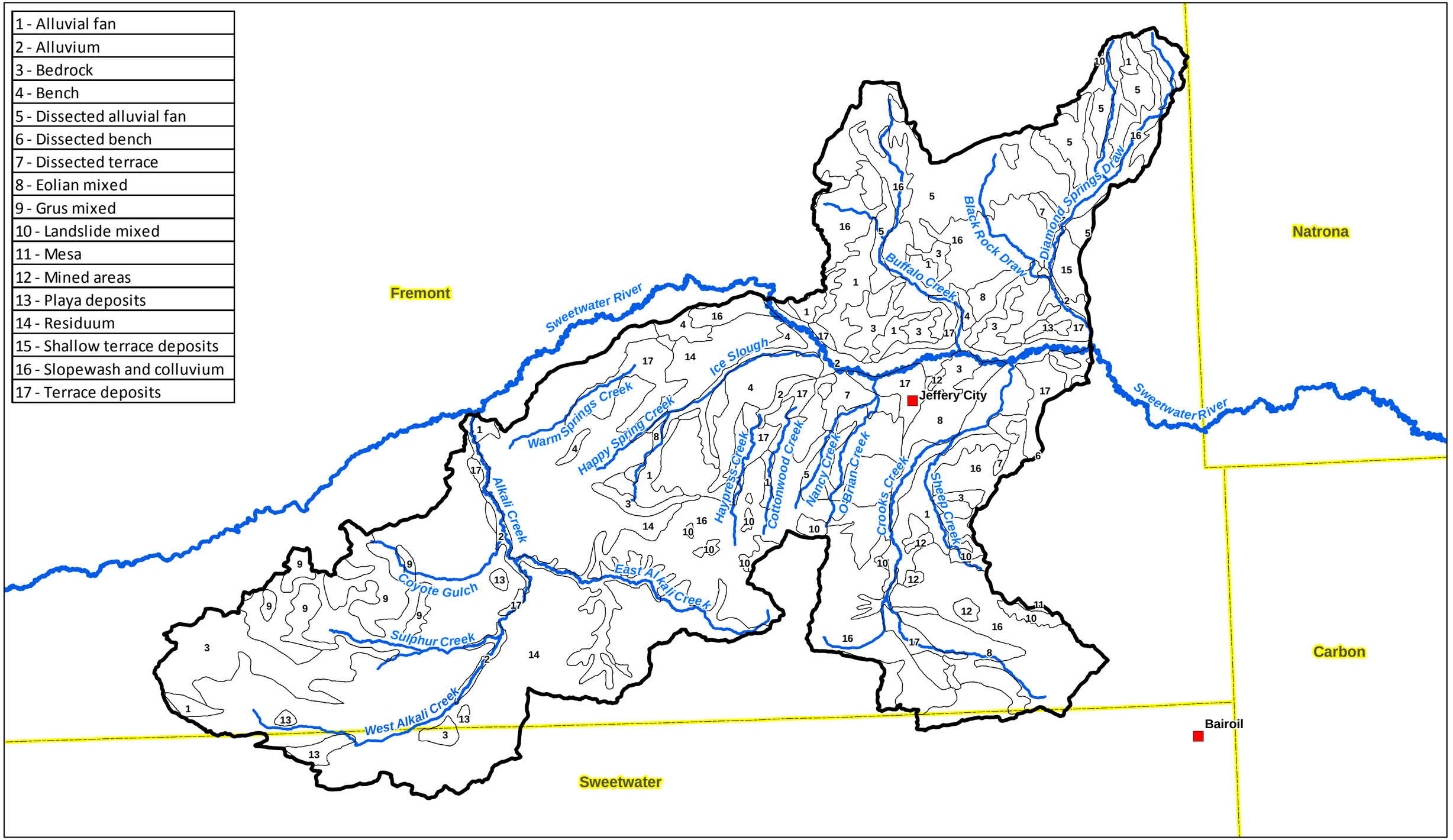
Mapping of bedrock geology was also completed by the USGS and obtained through WyGISC. Figure 2.12 shows the distribution of outcropping or near surface bedrock (and the major surficial geologic units) within the watershed.

Within the Phase IIII Study Area, detailed soils mapping were available through the NRCS for the majority of the area; there was no detailed mapping for the Sweetwater County portion of the study area. This information is displayed in Figure 2.13.

With respect to soil conditions within the GMCA portion of the study area, the following description was extracted from the 2011 GMCA EA:

"The GMCA contains diverse kinds of soils, from cold, sub-humid mountain soils to warm and cool, semiarid soils on dunes. Precipitation patterns directly impact soil resources. The bulk of annual precipitation occurs in the spring, typically beginning in late March, peaking in May, and finally declining rapidly in June. A minor but important second peak occurs during the fall period, September through November. This fall moisture can initiate a second period of growth for cool-season grasses, but more importantly, it will ensure a good frost seal for the soils. This pre-wetting seal allows for the deep permeation of spring precipitation into the soil profile for use by the more desirable, deeper-rooted native grasses and shrubs. Storing moisture deep in the soil profile will ensure its availability for later use. These are the same reasons farmers and ranchers

1 - Alluvial fan
2 - Alluvium
3 - Bedrock
4 - Bench
5 - Dissected alluvial fan
6 - Dissected bench
7 - Dissected terrace
8 - Eolian mixed
9 - Grus mixed
10 - Landslide mixed
11 - Mesa
12 - Mined areas
13 - Playa deposits
14 - Residuum
15 - Shallow terrace deposits
16 - Slopewash and colluvium
17 - Terrace deposits



Legend

Surficial Geology
Streams- Phase III Study Area
Sweetwater River
Cities
Phase III Study Area
County Boundary

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1 inch = 24,000 Feet

Figure 2.11 Sweetwater River Phase III: Surficial Geology

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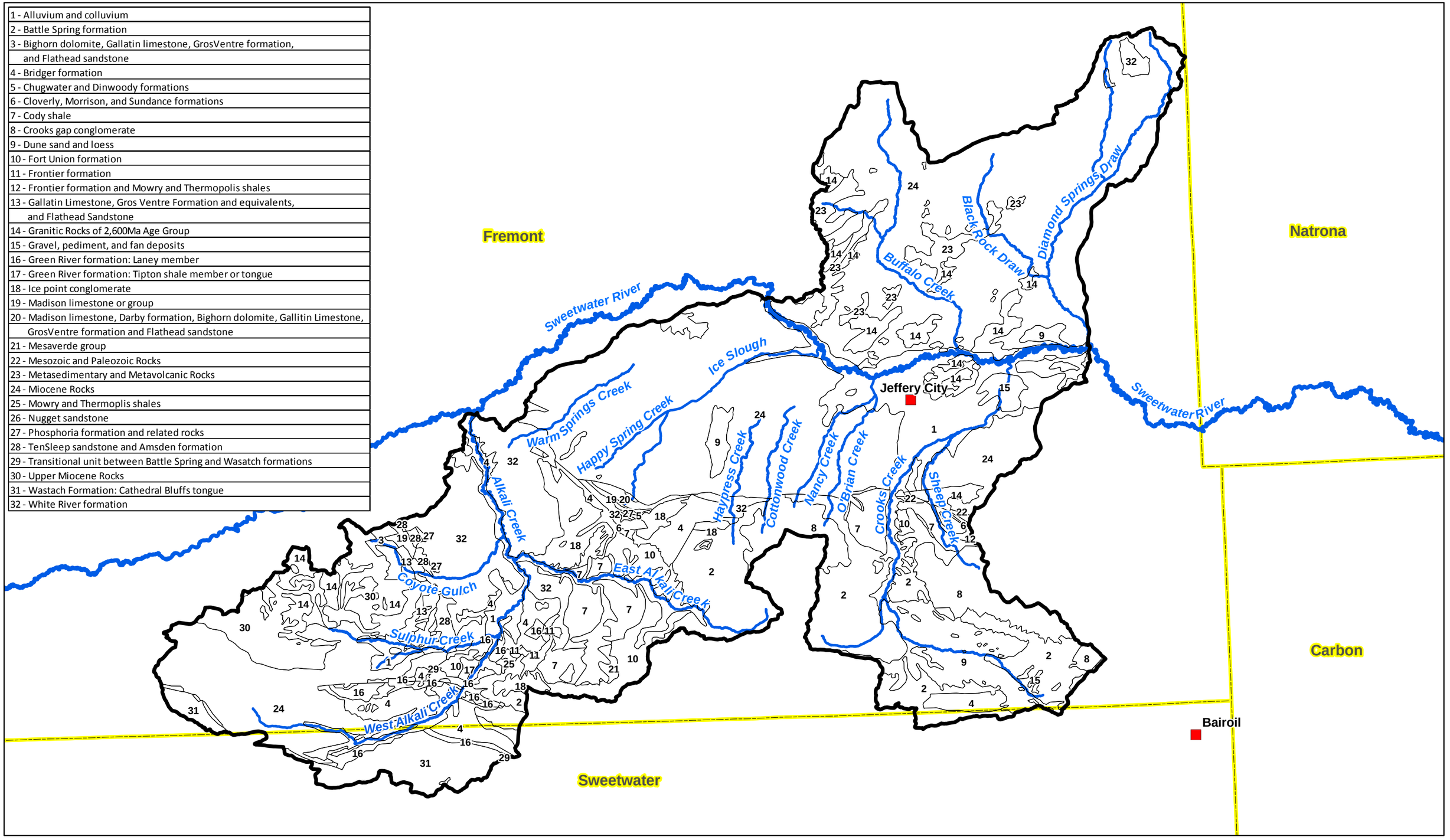
1 - Alluvium and colluvium
2 - Battle Spring formation
3 - Bighorn dolomite, Gallatin limestone, GrosVentre formation, and Flathead sandstone
4 - Bridger formation
5 - Chugwater and Dinwoody formations
6 - Cloverly, Morrison, and Sundance formations
7 - Cody shale
8 - Crooks gap conglomerate
9 - Dune sand and loess
10 - Fort Union formation
11 - Frontier formation
12 - Frontier formation and Mowry and Thermopolis shales
13 - Gallatin Limestone, Gros Ventre Formation and equivalents, and Flathead Sandstone
14 - Granitic Rocks of 2,600Ma Age Group
15 - Gravel, pediment, and fan deposits
16 - Green River formation: Laney member
17 - Green River formation: Tipton shale member or tongue
18 - Ice point conglomerate
19 - Madison limestone or group
20 - Madison limestone, Darby formation, Bighorn dolomite, Gallitin Limestone, GrosVentre formation and Flathead sandstone
21 - Mesaverde group
22 - Mesozoic and Paleozoic Rocks
23 - Metasedimentary and Metavolcanic Rocks
24 - Miocene Rocks
25 - Mowry and Thermoplis shales
26 - Nugget sandstone
27 - Phosphoria formation and related rocks
28 - TenSleep sandstone and Amsden formation
29 - Transitional unit between Battle Spring and Wasatch formations
30 - Upper Miocene Rocks
31 - Wastach Formation: Cathedral Bluffs tongue
32 - White River formation



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Legend

- Bedrock Geology
- Streams- Phase III Study Area
- Sweetwater River
- Cities
- Phase III Study Area
- County Boundary

0 24,000 48,000

1 inch = 24,000 Feet

Figure 2.12 Sweetwater River Phase III: Bedrock Geology

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1 - Havre-Forelle-Elkol-Absher
2 - Lymanson-Irigul-Hoodle
3 - Poposhia-Forelle-Carmody-Blazon-Blackhall
4 - Rock outcrop-Cryluha-Coutis-Conpeak
5 - Rock outcrop-Lymanson-Hoodle-Gelkie
6 - Rock outcrop-Pesmore-Dahlquist-Bosler-Asholler
7 - Rock River-Bosler-Alcova
8 - Rock River-Milvar-Milren-Dahlquist
9 - Rock River-Rentsac-Forelle-Diamondville-Cushool-Carmody
10 - Ryan Park-Rock River-Carmody-Bosler
11 - Tisworth-Havermom
12 - Venapass-Silas-Lander variant-Lander
13 - Wint-Westvaco-Teagulf-Tasselman-Rogrube-Huguston-Haterton
14 - Youga-Quander
15 - Zeomont-Ryark-Ryan Park

Fremont
Natrona
Carbon
Sweetwater
Jeffery City
Bairoil
Sweetwater River
Buffalo Creek
Black Rock Draw
Diamond Springs Draw
Ice Slough
Warm Springs Creek
Happy Spring Creek
Alkali Creek
Haypress Creek
Cottonwood Creek
Nancy Creek
O'Brian Creek
Crooks Creek
Sheep Creek
Coyote Gulch
Sulphur Creek
East Alkali Creek
West Alkali Creek

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Legend

Streams- Phase III Study Area
Sweetwater River
Cities
Phase III Study Area
County Boundary

0 24,000 48,000

1 inch = 24,000 Feet

Figure 2.13 Sweetwater River Phase III: Soils Mapping at 1:250,000

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irrigate fields in the fall after harvest, and also why surge irrigation is used to slowly wet a field on a gradient from the highest end to the lowest. This pre-wetting of the soil helps to improve water infiltration instead of running off as waste and/or leading to erosion.

Soils in the western portion of the allotment are commonly underlain by granitic rocks. This portion of the allotment contains the most rock outcrops. Elevations in this area range from 7,000 to 8,500 feet. Slopes vary from nearly level to steep (zero to 65 percent slope). Soils are well-drained, very shallow (less than 10 inches) to moderately deep (20 to 40 inches), and are loamy or gravelly/loamy in texture. These soils are mostly associated with hills, ridges, escarpments, fan aprons, and pediments. Numerous seeps, springs, and wet meadows can be found here, unlike the majority of the allotment (except for the Green Mountains). Water erosion exists as the dominant form of erosion in this area. The annual precipitation in this part of the allotment is 10 to 14 inches, but effective precipitation is lower due to desiccating winds. The growing season remains short, with 60 to 90 frost-free days.

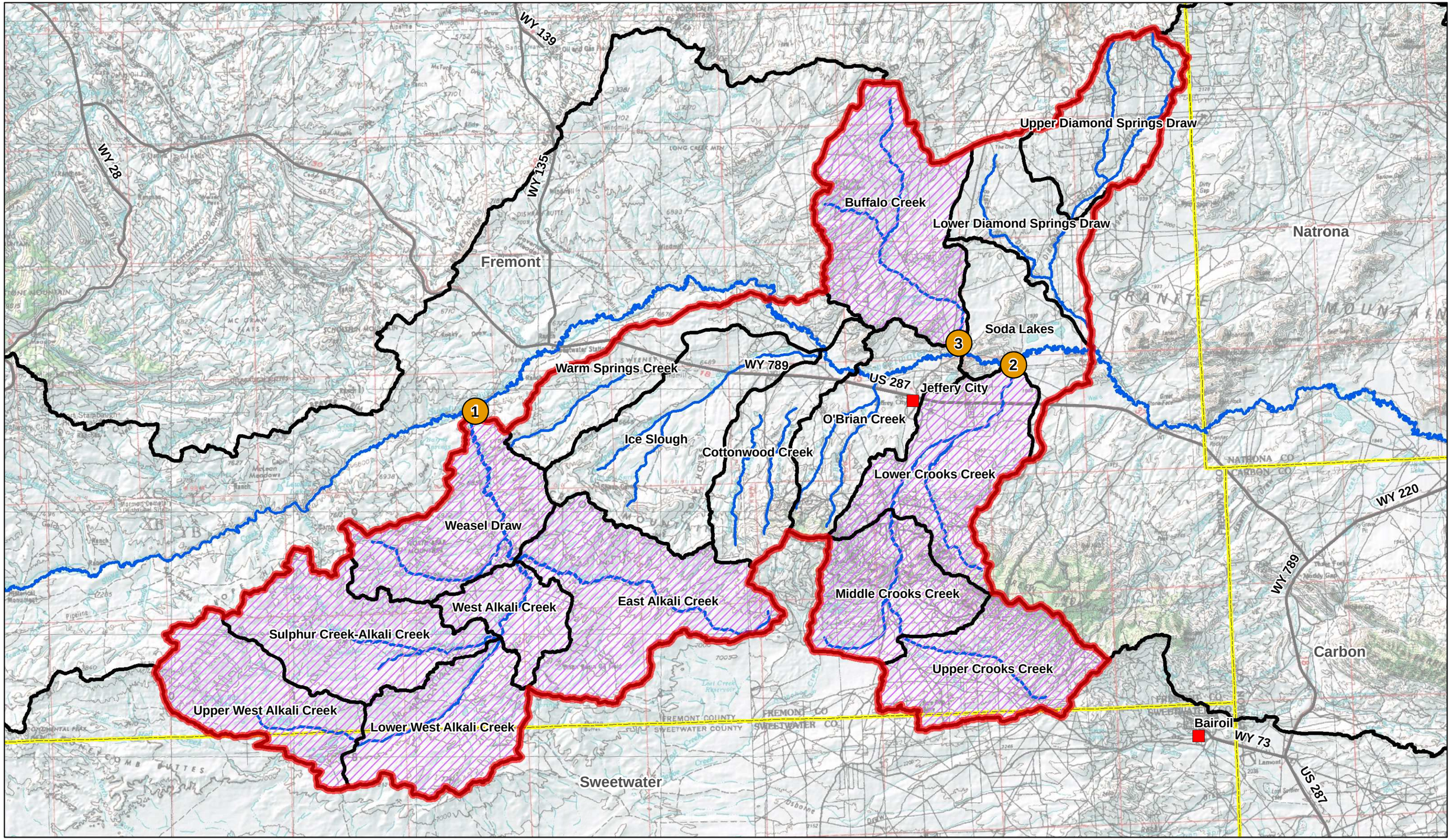
South of Cyclone Rim, the soils have formed in a Wasatch Formation member that is comprised of variegated claystones and lenticular sandstones, some of which may be conglomeritic. Elevations in this area range from 6,300 to 7,500 feet. Slopes vary from nearly level and gently sloping to very steep. These soils are generally well-drained and very deep (greater than 60 inches). Soil textures are loamy, and these soils commonly occur on floodplains, terraces, toe slopes, and fan aprons. Here, both wind and water are effective agents of erosion. The annual precipitation is seven to 14 inches, but effective precipitation is significantly less. The frost-free growing season is 80 to 110 days.

Green Mountain and Crooks Mountain are covered by a thick layer of giant boulder conglomerate; as a result, many of the soils here possess a large percentage of coarse fragments (i.e., gravels, cobbles, stones, and boulders). Elevations range from 7,500 to about 9,000 feet. Slopes typically vary from nearly level to very steep (zero to 75 percent slope). Soils here are well-drained, but can be poorly drained in the less-sloping areas on top of the mountains. Textures vary from cobbly loam, loamy, or gravelly loam. Water erosion is the dominant form of erosion on Green Mountain. Annual precipitation on the tops of these mountains is 18 to 22 inches, and the frost-free period ranges from 40 to 60 days."

2.6 Hydrology

2.6.1 Surface Water Hydrology

The location and extent of the watershed, the mainstem streams, and principal tributaries are shown on Figure 2.14. Many of these streams tend to have perennial reaches in their upper basins. Springs provide year-round local sources of water and provide supplemental flow to surface waters. These streams generally flow for portions of the year, generally drying up during drier summer / fall months (August / September). Peak runoff typically occurs in May to June.



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Legend

1 Hydrologic Evaluation

Evaluated HUC Basin Boundary

HUC Basin Boundary

Phase III Study Area

Cities

WY US/State Hwy

County Boundary

0 24,000 48,000

1 inch = 24,000 Feet

Figure 2.14 Sweetwater River Phase III: Hydrologic Features

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There are no stream gages located within the watershed nor have there been any gages reported in the past. Within the State of Wyoming, there are several published regional hydrologic methods which rely upon regressional relationships between measured discharge and basin physical characteristics (area, slope, precipitation, etc). For the Phase III study area, methods presented by the USGS (Miller, 2003) were utilized which rely upon the ungaged watershed's area in square miles and the latitude of the watershed's outlet. Using these techniques, the peak discharges associated with a range of recurrence intervals were estimated for each of the three principal subbasins (Table 2.3). It must be recognized that these estimates are provided as an approximation only.

Table 2.3 Summary of Hydrologic Estimates for Principal Phase III Study Area Streams.

	Alkali Creek	Crooks Creek	Buffalo Creek
	Node 1*	Node 2*	Node 3*
Basin Area (square miles)	201.8	147.7	73.27
Latitude of Basin Outlet (decimal degrees)	42.491436	42.517148	42.526953
Flood Return Period (years)	**Peak Discharge (cfs)**		
1.5	120	97	63
2	180	147	96
2.33	215	176	115
5	393	324	217
10	580	482	328
25	866	725	501
50	1,110	934	652
100	1,380	1,167	823

* See location on Figure 2.14.

Surface waters of the State of Wyoming are placed by WDEQ into subclasses under one of the appropriate four classes of water quality. Detailed descriptions of the various classes and subclasses can be found at: http://deq.state.wy.us. The classes can be briefly characterized as follows:

- **Class 1:** These are those high quality waters in which no further degradation of water quality will be allowed.
- **Class 2:** These waters are waters other than those designated as Class 1 that presently support, or have the potential to support, game fish or drinking water supplies.
- **Class 3:** These waters are waters other than those designated as Class 1 that are intermittent, ephemeral, or isolated waters that do not have the potential to support

fish. These waters do provide support for invertebrates, amphibians, or other flora and fauna which inhabit waters of the state at some stage in their life cycles.

- **Class 4:** These waters are waters other than those designated as Class 1, where it has been determined that aquatic uses are not attainable pursuant to provisions of WDEQ regulations. Uses designated on Class 4 waters include recreation, wildlife, industry, agriculture, and scenic value. Ditches and canals also have this designation.

Table 2.4 summarizes the classification of streams within the Phase III Study Area. Within the Phase III study area, there are no stream segments classified as WDEQ Class 1. However, the Sweetwater River upstream of Alkali Creek (and outside of the physical limits of the study area), is designated as Class 1. The remainder of the streams are designated as either Class 2AB, 2C, or 3B.

Table 2.4 Summary of WDEQ Stream Classifications for Streams within the Phase III Study Area.

Stream	WDEQ Class
Sweetwater River above Alkali Creek	1
Sweetwater River below Alkali Creek	2AB
Crooks Creek	2AB
Fourth Cr	2AB
Sheep Creek	2AB
Buffalo Creek	3B
O'Brian Creek	3B
Nancy Creek	3B
Haypress Creek	3B
Alkali Creek	2AB
Coyote Gulch	3B
East Alkali Creek	2C
West Alkali Creek	3B
Sulphur Creek	2AB
Picket Creek	3B
Picket Lake	2AB

Class 2AB waters are a subclass of Class 2 waters and 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 3B waters are a subclass of Class 3 waters characterized as 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.

In addition, Crooks Creek has been listed by the WDEQ an impaired waterbody for oil and grease contamination just outside the GMCA boundary. According to the 305[b] Report of 2010, ambient monitoring of Crooks Creek, revealed a significant amount of oil in sediments, a violation of water quality standards. The source of oil is unknown at this time, but this stream is a targeted water on Table A of the 303[d] (Impaired Waterbody) list (p.55 of the list).

2.6.2 Groundwater Resources

Groundwater in the Phase III Study Area occurs in both shallow (alluvial) and deeper (bedrock) aquifers. According to records provided by the Wyoming State Engineers Office (WYSEO), there are approximately two hundred forty (240) permitted water supply wells within the study area. This number includes springs for which water rights permits have been granted. Well depths range from less than 50 feet to a maximum of 3,636 feet for an industrial in the Buffalo Basin.

Existing groundwater development in the study area generally consists of relatively shallow, low-yield wells constructed for stock and domestic use and the similar, limited development of small springs. With the exception of deep wells associated with oil field production, typical study area wells are approximately 100 feet to 250 feet deep with reported yields than 30 gpm. Depth to water is typically from ten (10) to two hundred (200) feet. Figure 2.15 displays the location of wells within the WYSEO database. Appendix A summarizes pertinent information on the wells.

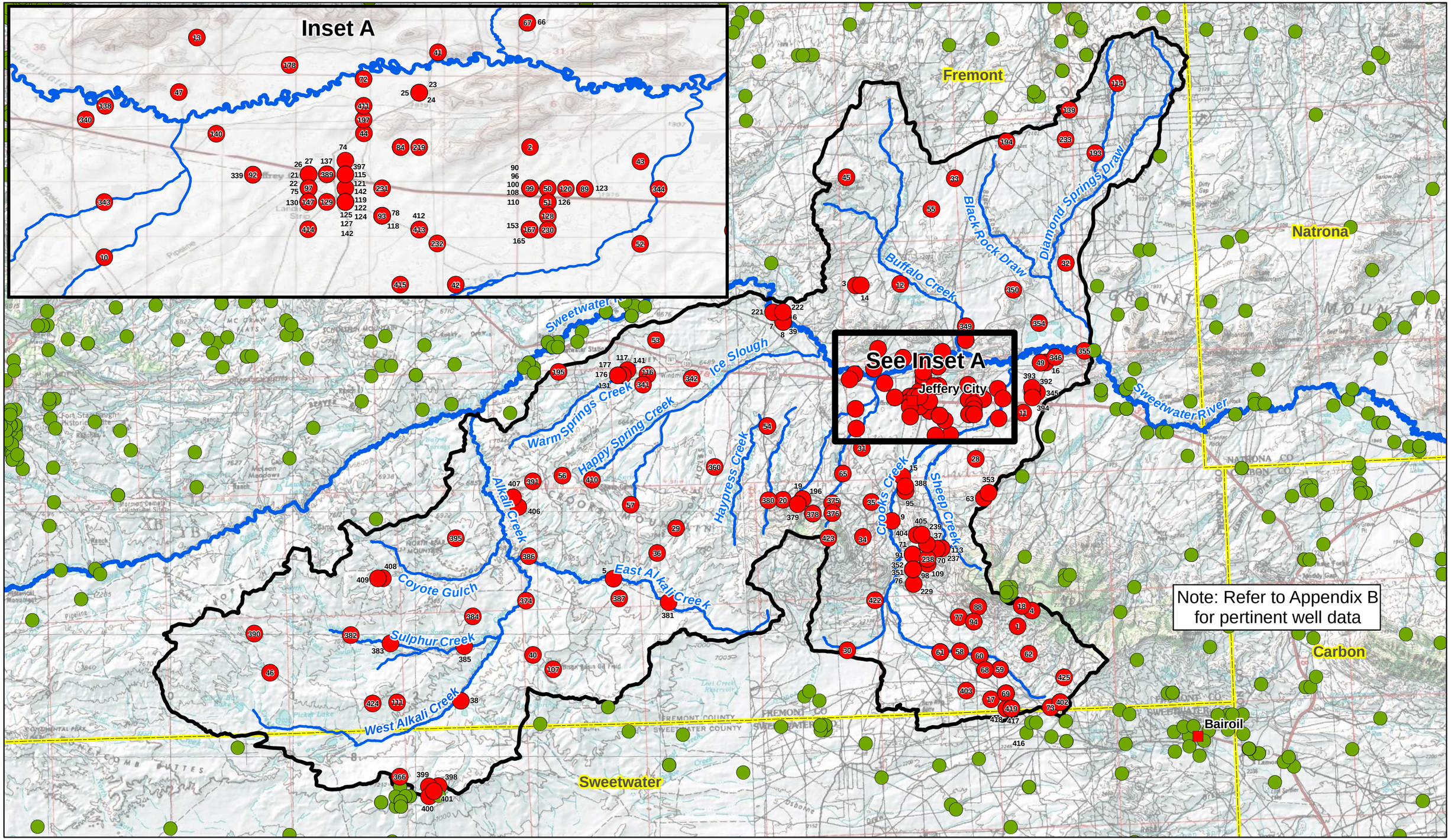
Springs are scattered throughout the study area as indicated in Figure 2.16.

2.7 Stream Channel Conditions

2.7.1 Rosgen Level I Classification

The purpose of the Level I geomorphic classification is to provide an inventory of the Phase III 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 Geographic Information System (GIS) providing a graphical "snapshot" of the basin. The end product of the Level I classification is the determination of the major stream types, A through G.

Table 2.5 presents a tabulation of geomorphic parameters quantified within the GIS environment. Figure 2.17 displays the results of the Rosgen Level I classification effort. Brief descriptions of the various stream types encountered in the watershed are presented in the following paragraphs. In addition, results of previous channel assessments conducted by the BLM using the Proper Functioning Condition (PFC) methods have been incorporated into the evaluation of stream channel conditions.



Legend

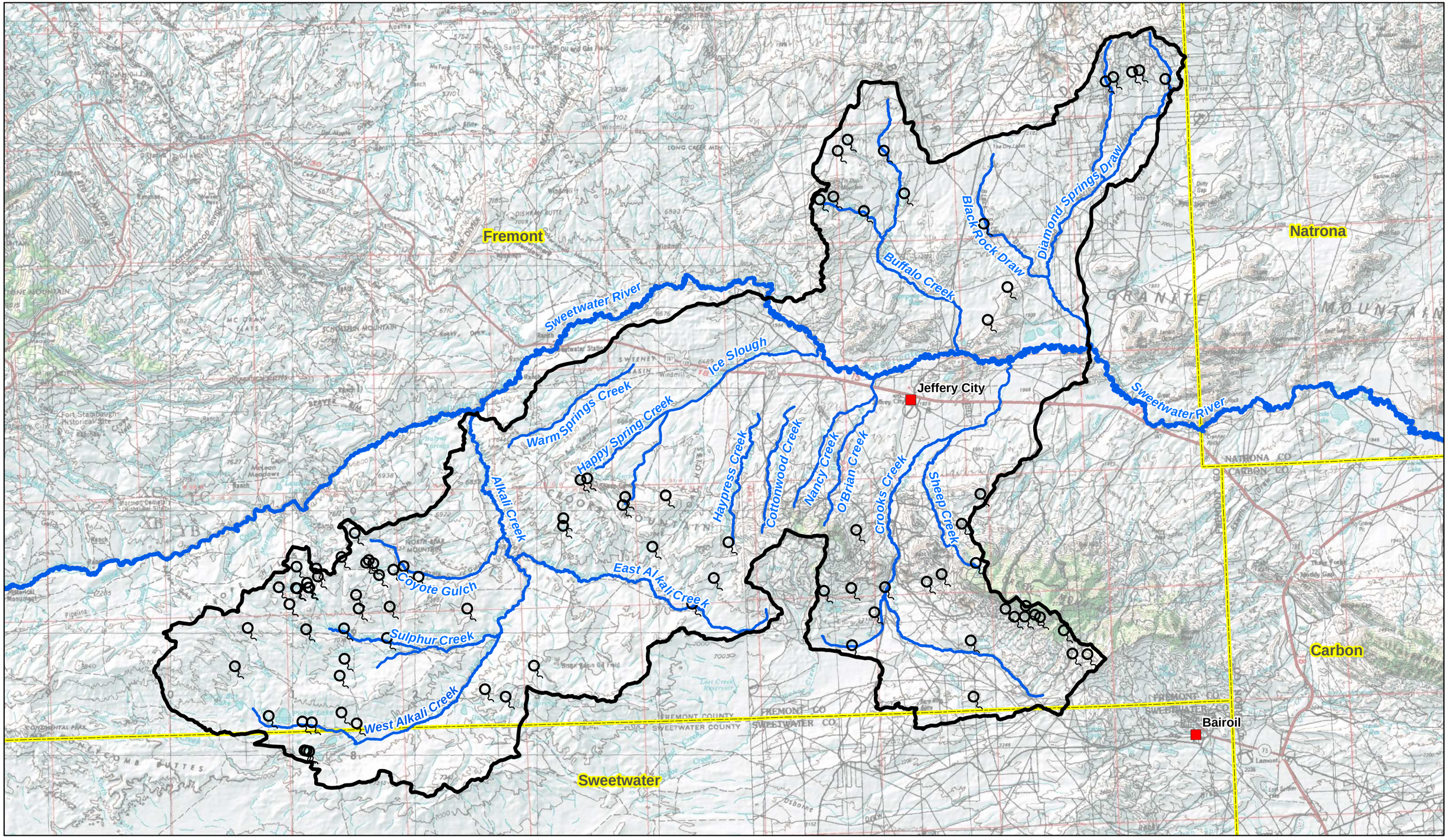
- Wells - Phase III Study Area
- Wells - Surrounding Area
- Streams- Phase III Study Area
- Sweetwater River
- Cities
- Phase III Study Area
- County Boundary

N W E S

0 24,000 48,000

1 inch = 24,000 Feet

Figure 2.15 Sweetwater River Phase III: Groundwater Wells



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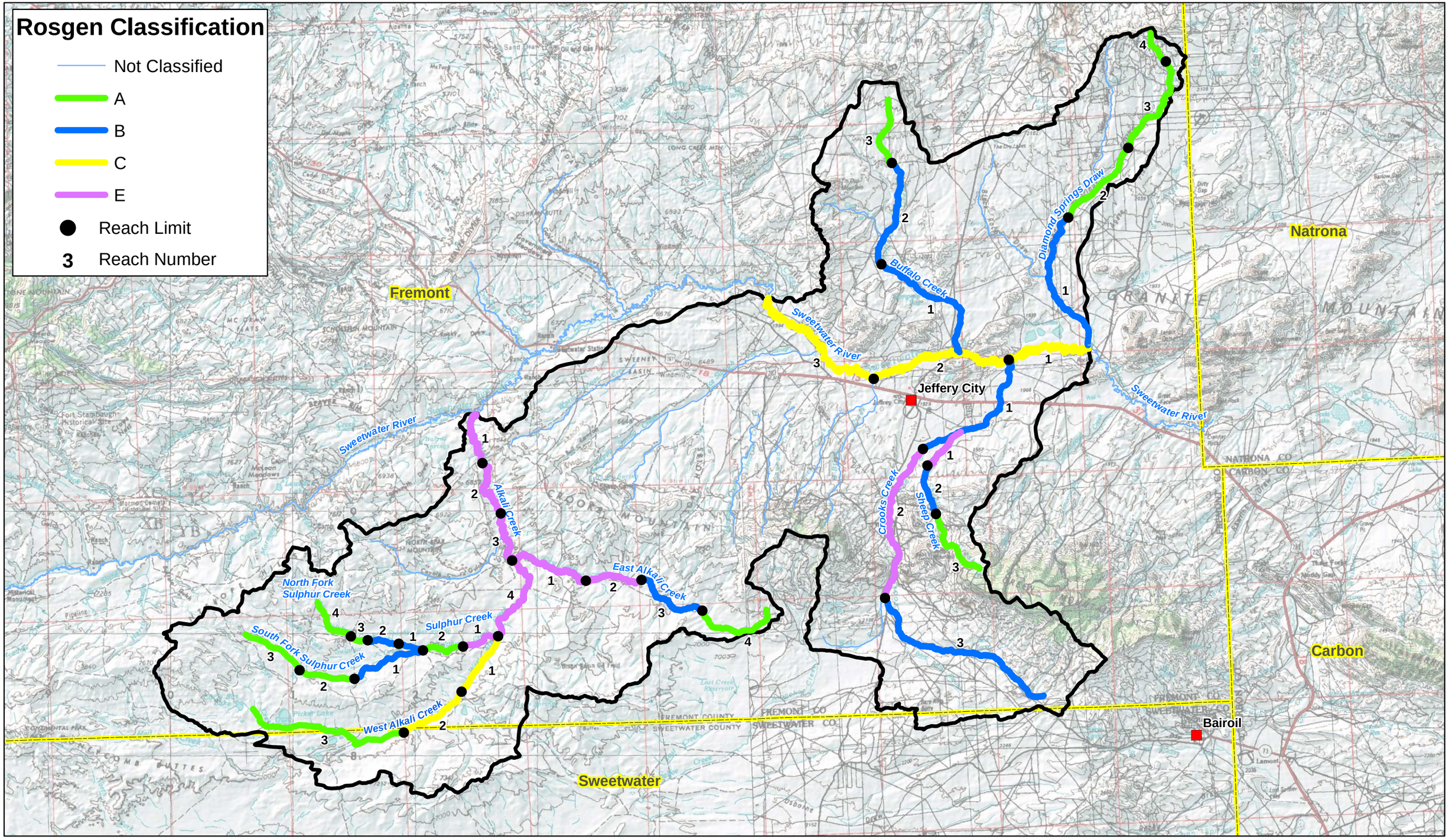
Legend

- Spring
- Cities
- Streams- Phase III Study Area
- Sweetwater River
- Phase III Study Area
- County Boundary

0 24,000 48,000

1 inch = 24,000 Feet

Figure 2.16 Sweetwater River Phase III: Spring Locations



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W E
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Legend

Cities
Phase III Study Area
County Boundary

0 24,000 48,000

1 inch = 24,000 Feet

Figure 2.17 Sweetwater River Phase III: Geomorphic Stream Classifications

Table 2.5 Summary of Geomorphic Parameters.

Stream	Reach Number	Station (Distance from Mouth)		Reach Length(mi)	Sinuosity	Slope	Rosgen Level I Classification
		Station Start(mi)	Station End(mi)				
Alkali Creek	1	0.0	4.5	4.5	1.54	0.0026	E
	2	4.5	11.0	6.4	1.90	0.0017	E
	3	11.0	15.8	4.9	1.75	0.0019	E
	4	15.8	23.2	7.4	1.47	0.0023	E
Buffalo Creek	1	0.0	8.2	8.2	1.18	0.0054	B
	2	8.2	15.4	7.2	1.26	0.0103	B
	3	15.4	19.7	4.3	1.21	0.0138	A
Crooks Creek	1	0.0	8.2	8.2	1.18	0.0032	B
	2	8.2	20.2	12.0	1.47	0.0053	E
	3	20.2	33.0	12.8	1.22	0.0111	B
Diamond Springs Draw	1	0.0	9.2	9.2	1.21	0.0057	B
	2	9.2	14.5	5.3	1.12	0.0079	A
	3	14.5	21.6	7.0	1.35	0.0113	A
	4	21.6	23.4	1.9	1.06	0.0258	A
East Alkali Creek	1	0.0	7.2	7.2	1.69	0.0024	E
	2	7.2	11.6	4.3	1.40	0.0032	E
	3	11.6	16.7	5.1	1.28	0.0039	B
	4	16.7	21.4	4.8	1.08	0.0077	A
North Fork Sulphur Creek	1	0.0	1.2	1.2	1.06	0.0002	B
	2	1.2	3.7	2.4	1.39	0.0031	B
	3	3.7	4.7	1.0	1.15	0.0017	A
	4	4.7	8.4	3.7	1.37	0.0114	A
Sheep Creek	1	0.0	3.8	3.8	1.52	0.0045	E
	2	3.8	6.7	2.9	1.16	0.0228	B
	3	6.7	11.2	4.5	1.11	0.0702	A
South Fork Sulphur Creek	1	0.0	4.5	4.5	1.14	0.0022	B
	2	4.5	7.8	3.3	1.14	0.0073	A
	3	7.8	11.4	3.6	1.06	0.0108	A
Sulphur Creek	1	0.0	3.2	3.2	1.54	0.0048	E
	2	3.2	5.6	2.4	1.05	0.0043	A
Sweetwater River	1	0.0	10.9	10.9	2.51	0.0001	C
	2	10.9	27.0	16.1	2.25	0.0012	C
	3	27.0	42.2	15.3	2.08	0.0004	C
West Alkali Creek	1	0.0	4.6	4.6	1.32	0.0018	C
	2	4.6	9.2	4.7	1.27	0.0016	C
	3	9.2	18.4	9.1	1.05	0.0025	A

Downstream reaches of dominant mainstem channels (West Alkali Creek and the Sweetwater River) are classified as Type C stream channels. These channels are typically characterized by relatively low slopes, meandering planforms (i.e., the shape one would see if viewing from above, as in a map or aerial photo), and pool/riffle sequences. C-type channels tend to occur in broad alluvial valleys, and they are typically associated with broad floodplain areas. C-type channels tend to be relatively sinuous, as they follow a meandering course within a single channel thread. As a result, the channels are laterally stable, and geomorphically resilient**.** Figure 2.18 displays a photo of the Sweetwater River within the Phase III Study Area.

Figure 2.18 Example Type C Channel: Sweetwater River.

Lower reaches of several streams were classified as Type E stream channels. These include Alkali Creek, East Alkali Creek, Sheep Creek, and Sulphur Creek. Type E stream channels are somewhat similar to C channels, as they form as single threads with defined, accessible floodplain areas (Figure 2.19). However, E-Type channels are different in that they tend to have fine-grained channel margins, which provide cohesion and support dense bankline vegetation. The fine-grained, vegetation-reinforced banklines allow for the development of steep banks, very sinuous planforms, and relatively deep, U-shaped channel cross sections. E-Type channels commonly form in low gradient areas with fine-grained source areas, mountain meadows, and in beaver-dominated environments. E-Type channels tend to have very stable planforms, and efficient sediment transport capacities due to low width/depth ratios.

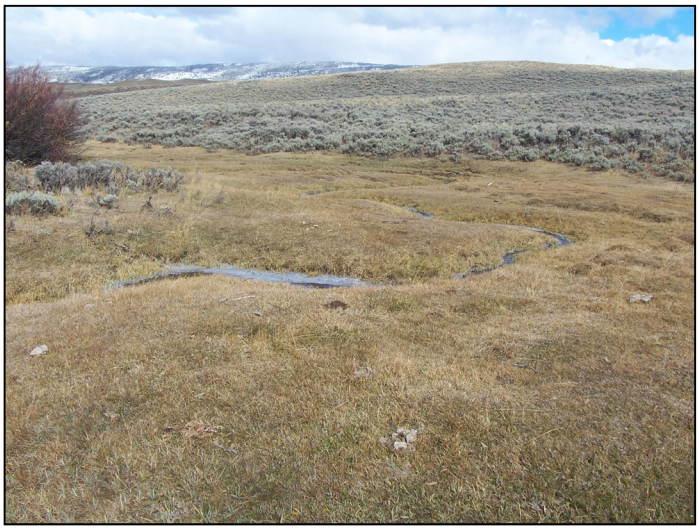


Figure 2.19 Example E-Type Channel: East Alkali Creek.

Upper reaches of most channels were classified as Type B stream channels. *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. B-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 disturbance, 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.

2.7.2 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.

Within the Phase III Study Area, the BLM conducted PFC assessments on selected stream segments on public lands intermittently between 1994 and 2001 (Figure 2.20). A

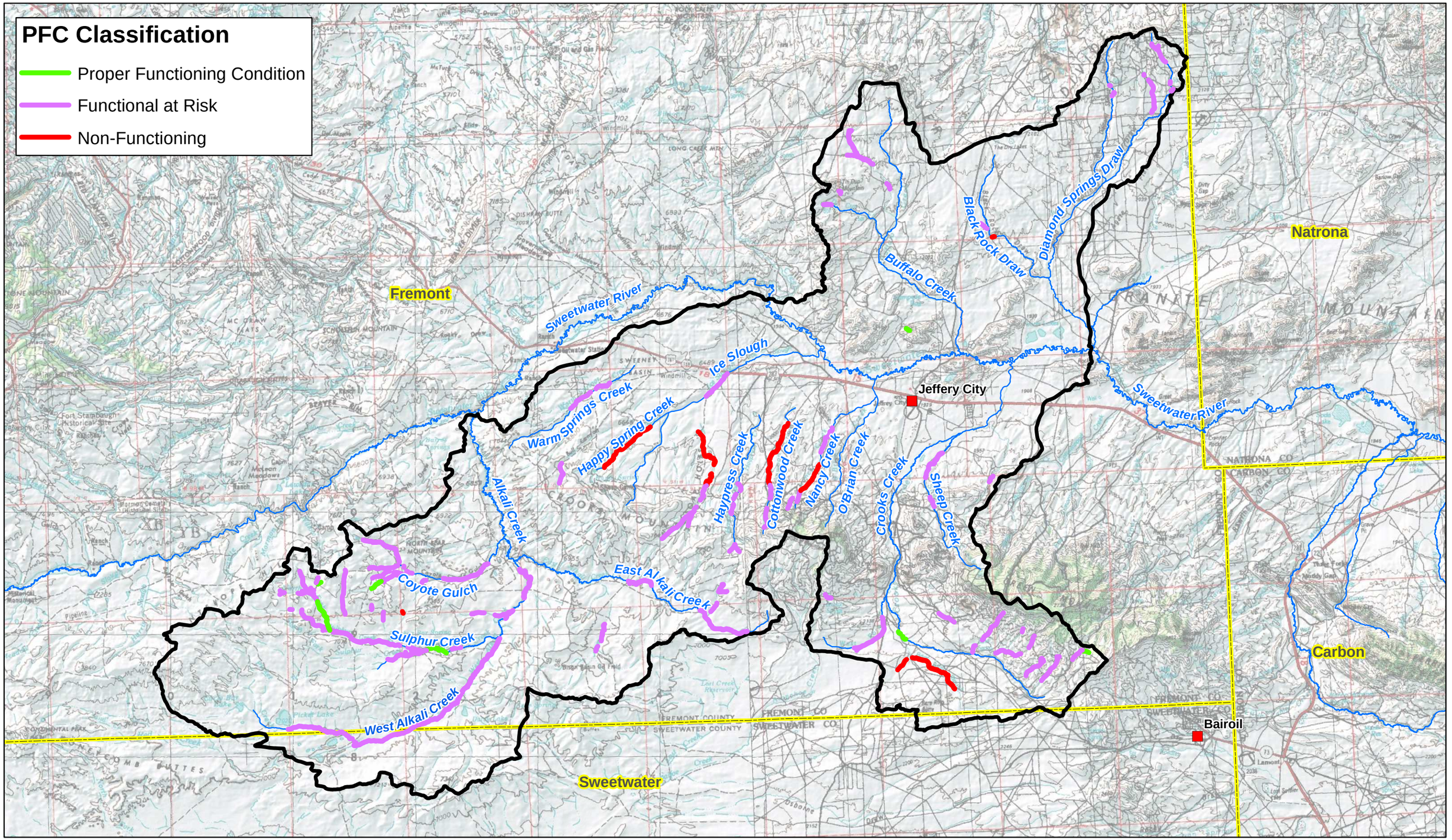


Figure 2.20 Sweetwater River Phase III: Proper Functioning Condition

summary of the assessments presented in the 2011 GMCA EA indicate that the majority of reaches evaluated within the GMCA were classified as being either Functional-at-Risk or Non-Functional (Table 2.6). Reaches designated as being in Proper Functional Condition were limited to 22.5 percent of the lentic acres, 12.4 percent of the lotic miles and 8.1 percent of the lotic acres (Figure 2.21). A qualitative review of the field data forms completed by BLM personnel indicates a considerable amount of variability exists in channel condition throughout the study area. Observer notes indicate the predominate factors contributing to a reach being classified as anything other than PFC were degradation of riparian vegetation or stream channel and bank degradation / erosion. A qualitative review of PFC data collected in other portions of the Phase III Study Area (i.e., lands outside of the GMCA), indicate a similar relationship.

Table 2.6 Summary of BLM PFC Assessments within the GMCA.

	Proper Functioning Condition		Functional-at-Risk		Non-Functional	
	Total	Percent	Total	Percent	Total	Percent
Lentic Acres (Standing Water)	352.38	22.5	1018.86	65.1	193.03	12.4
Lotic Miles (Running Water)	11.34	12.5	55.77	61.4	23.65	26.1
Lotic Acres (Running Water)	42.58	8.1	448.68	85.1	36.13.	6

[1] Total Riparian Acres – 2092 (includes 90.8 miles of lotic habitat).

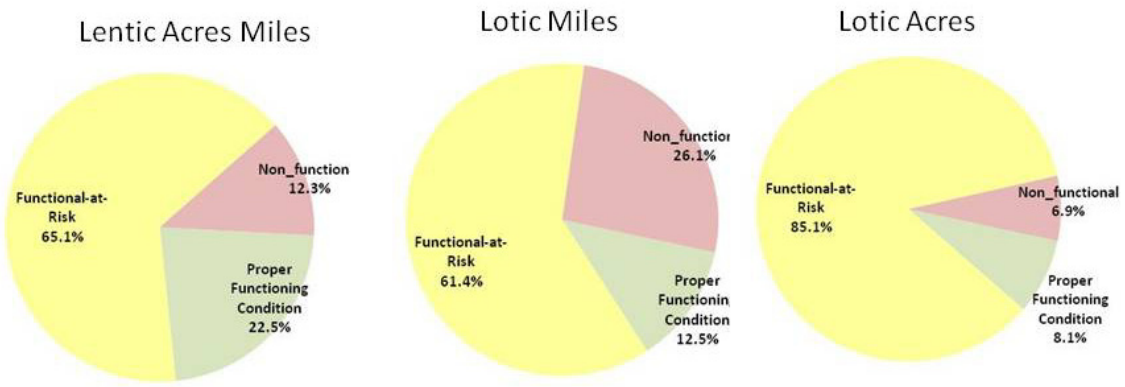


Figure 2.21 Summary of PFC Data Collected by BLM between 1994 and 2001 within the GMCA.

2.7.3 Impairments

Current impairments to stream channels within the study area appear to fall into two broad and interrelated categories:

- Riparian Vegetation Degradation: Impaired riparian condition and habitat. Figure 2.22 displays a geomorphically stable portion of Crooks Creek where vegetation conditions have been degraded.
- Riparian Degradation: Generally bank erosion and physical disturbance of stream banks. Figure 2.23 displays a photo of East Alkali Creek where stream banks have been disturbed.

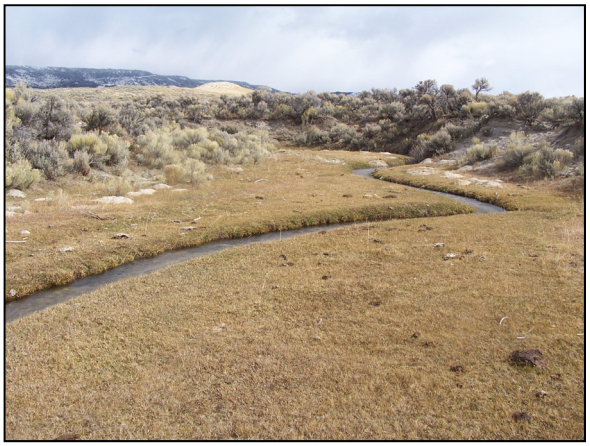


Figure 2.22 Loss of Riparian Vegetation and Habitat on Crooks Creek.

2.8 Ecological Site Descriptions

The concept of "Ecological Sites" are 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."*

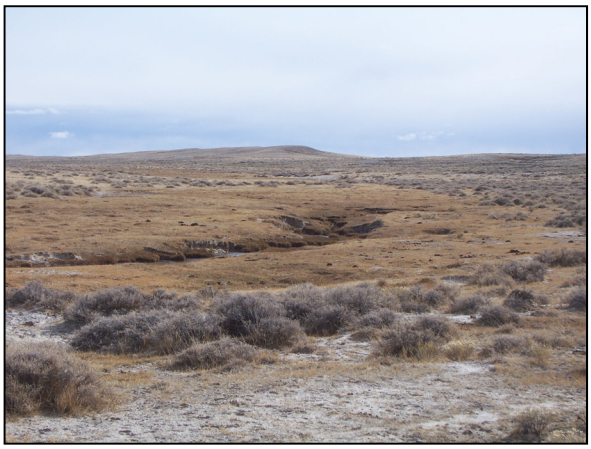


Figure 2.23 Stream Bank Disturbance on East Alkali Creek.

Ecological Site Descriptions (ESDs) are reports 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 (NRCS, 2009).

More information regarding ESDs and their application is available at: http://esis.sc.egov.usda.gov/ESIS/About.aspx.

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 2.24 displays the ecological precipitation zones found in the Muddy Creek study area and the State of Wyoming.

Using database tools provided by the NRCS, the available soils mapping was evaluated and Ecological Sites defined within the study area (Table 2.7). Figure 2.25 displays their location within the study area.

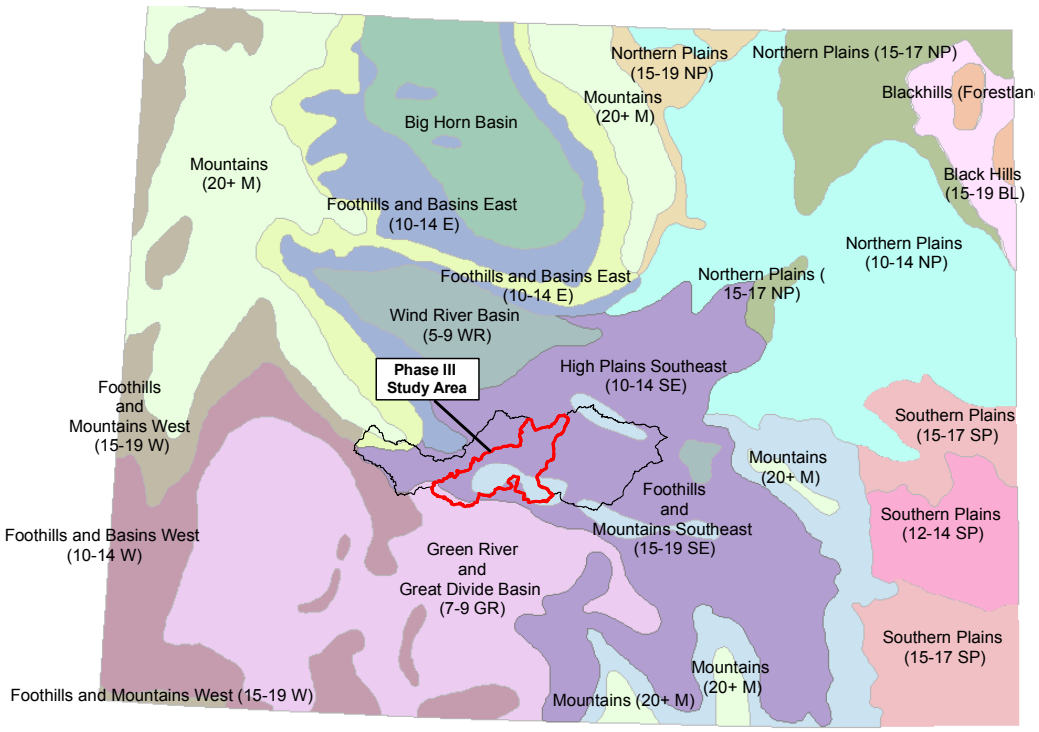


Figure 2.24 Wyoming Ecological Precipitation Zones.

Table 2.7 Analysis of Ecological Site Distribution in Phase III Study Area.

ESD	ESD Name	Identifier	Acres
1	SANDY (10-14SE)	R034XY350WY Total	200,930.9
2	SHALLOW LOAMY (10-14 SE)	R034XY362WY Total	68,539.2
3	LOAMY (10-14SE)	R034XY322WY Total	45,582.5
4	LOAMY OVERFLOW (10-14SE)	R034XY326WY Total	31,989.8
5	SHALLOW SANDY (10-14SE)	R034XY366WY Total	30,334.8
6	GRAVELLY (10-14SE)	R034XY312WY Total	25,785.4
7	CLAYEY (10-14SE)	R034XY304WY Total	12,703.7
8	COARSE UPLAND (10-14SE)	R034XY308WY Total	12,213.2
9	SALINE SUBIRRIGATED (10-14SE)	R034XY342WY Total	10,572.5
10	SHALLOW LOAMY (10-14E)	R032XY362WY Total	9,637.0
11	SHALLOW IGNEOUS (10-14W)	R034XY260WY Total	8,833.0
12	SANDS (10-14SE)	R034XY346WY Total	7,688.0
13	COARSE UPLAND (15-19SE)	R049XY108WY Total	7,584.9
14	SALINE UPLAND (10-14SE)	R034XY344WY Total	6,471.2
15	LOAMY (15-19E)	R043XY322WY Total	5,290.2
16	COARSE UPLAND (10-14E)	R032XY308WY Total	3,683.4
17	SHALLOW CLAYEY (10-14SE)	R034XY358WY Total	3,362.8
18	SALINE LOWLAND (10-14SE)	R034XY338WY Total	1,516.5
19	IMPERVIOUS CLAY (10-14SE)	R034XY318WY Total	1,277.9
20	WETLAND (10-14SE)	R034XY378WY Total	757.0
21	LOAMY (10-14E)	R032XY322WY Total	404.3
22	SUBIRRIGATED (10-14SE)	R034XY374WY Total	49.8
23	IMPERVIOUS CLAY (5-9WR)	R032XY218WY	27.3
24	Water		536.5
25	Unclassified		12,967.2
26	Sweetwater County - Not Available		21,862.1
		Grand Total	530,601.0

Source: GIS data layers provided by the NRCS were evaluated within the GIS environment to determine the quantities presented in this table.

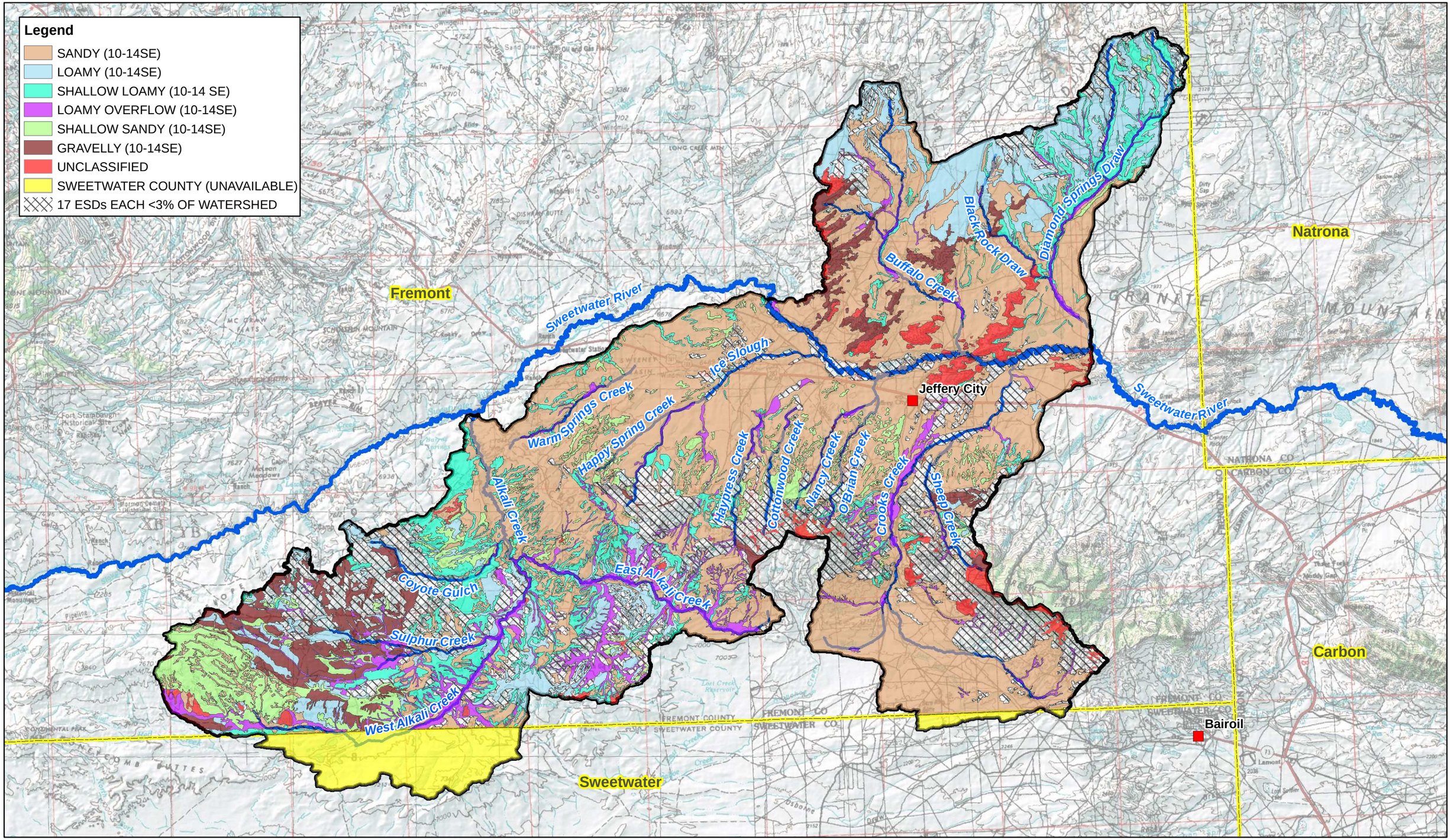
The relative distribution of the sites is displayed in Figure 2.26. As is evident in this figure, the Sandy 10–14 inch precipitation zone, High Plains Southeast ecological site potentially comprises nearly 38 percent of the area.

The following description of the Historic Climax Plant Community (HCPC) associated with this ESD was extracted from the NRCS descriptions (NRCS, 2008).

Sandy (Sy) 10 – 14 Inch PZ High Plains Southeast:

The NRCS Ecological Site Description for this site can be found at:

http://esis.sc.egov.usda.gov/Welcome/pgESDWelcome.aspx



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Legend

- Streams- Alkali Creek Study Area
- Sweetwater River
- Cities
- Alkali Creek Study Area
- County Boundary

0 24,000 48,000

1 inch = 24,000 Feet

Figure 2.25 Sweetwater River Phase III: Ecological Sites

2.41

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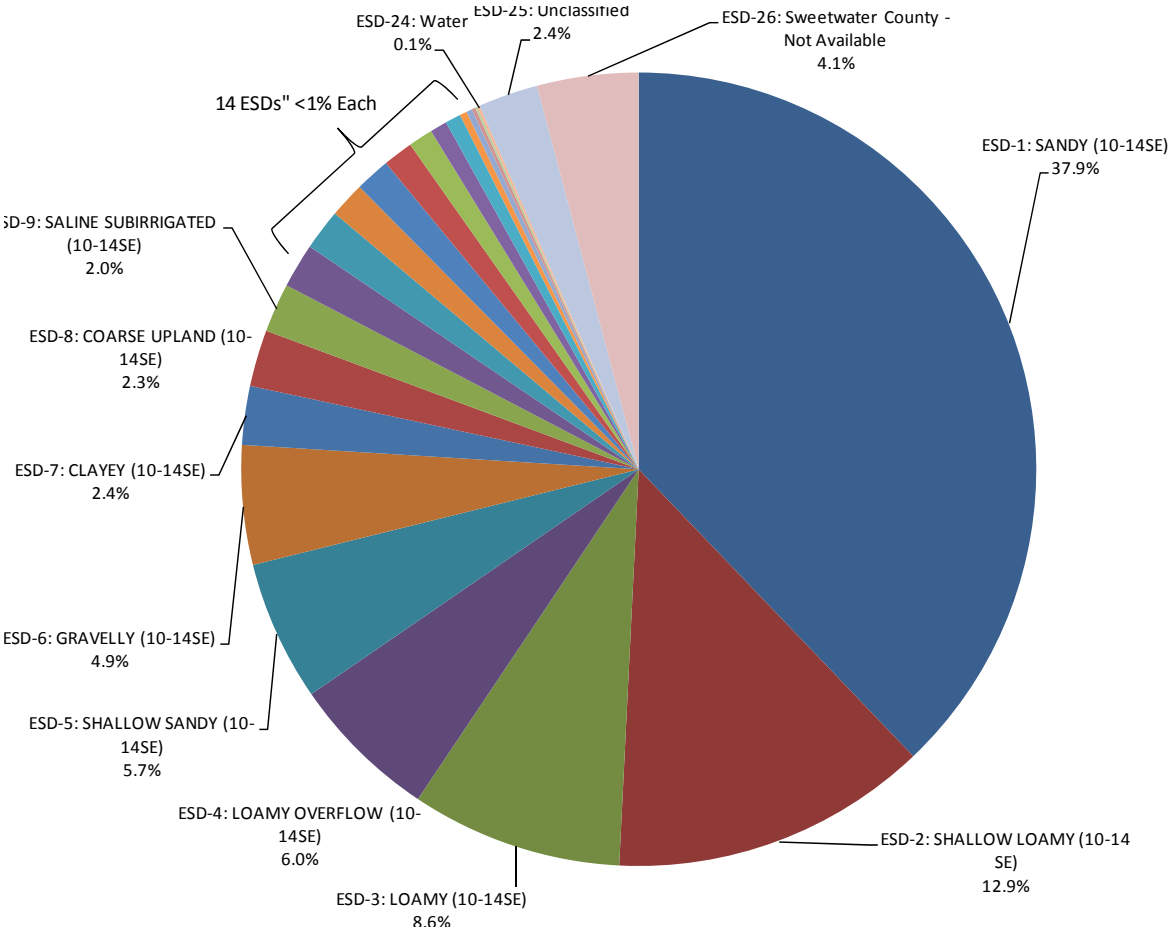


Figure 2.26 Distribution of Ecological Sites Within the Phase III Study Area.

The following information was extracted directly from that description:

"The interpretive plant community for this site is the Reference Plant Community. Potential vegetation is estimated at 75% grasses or grass-like plants, 10% forbs and 15% woody plants. The major grasses include needleandthread, Indian ricegrass, and rhizomatous wheatgrass. Big and silver sagebrush are the major woody plants.

A typical plant composition for this state consists of needleandthread 20-50%, rhizomatous wheatgrass 15-25%, Indian ricegrass 10-20%, perennial forbs 5-10%,and shrubs 5-10%. Ground cover, by ocular estimate, varies from 35-45%.The total annual production (air-dry weight) of this state is about 1200 pounds per acre, but it can range from about 700 lbs/acre in unfavorable years to about 1500 lbs/acre in above average years.

This state is extremely stable and well adapted to the Cool Central Desertic Basins and Plateaus climate. 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:

As this site deteriorates from improper grazing management, woody species such as big sagebrush and silver sagebrush will increase. Bunchgrasses such as Indian ricegrass and needleandthread will decrease in frequency and production.

Big sagebrush will become dominant on some areas with an absence of fire. Wildfires are often actively controlled so chemical control using herbicides has replaced the historic role of fire on this site. Recently, prescribed burning has regained some popularity. "

2.9 Grazing

2.9.1 Grazing Administration

Grazing on federal lands within the study area is administered by the Bureau of Land Management. The BLM-administered allotments typically include intermingled private, state, and federally-administered lands used for grazing. Figure 2.27 displays the grazing allotments found within the study area.

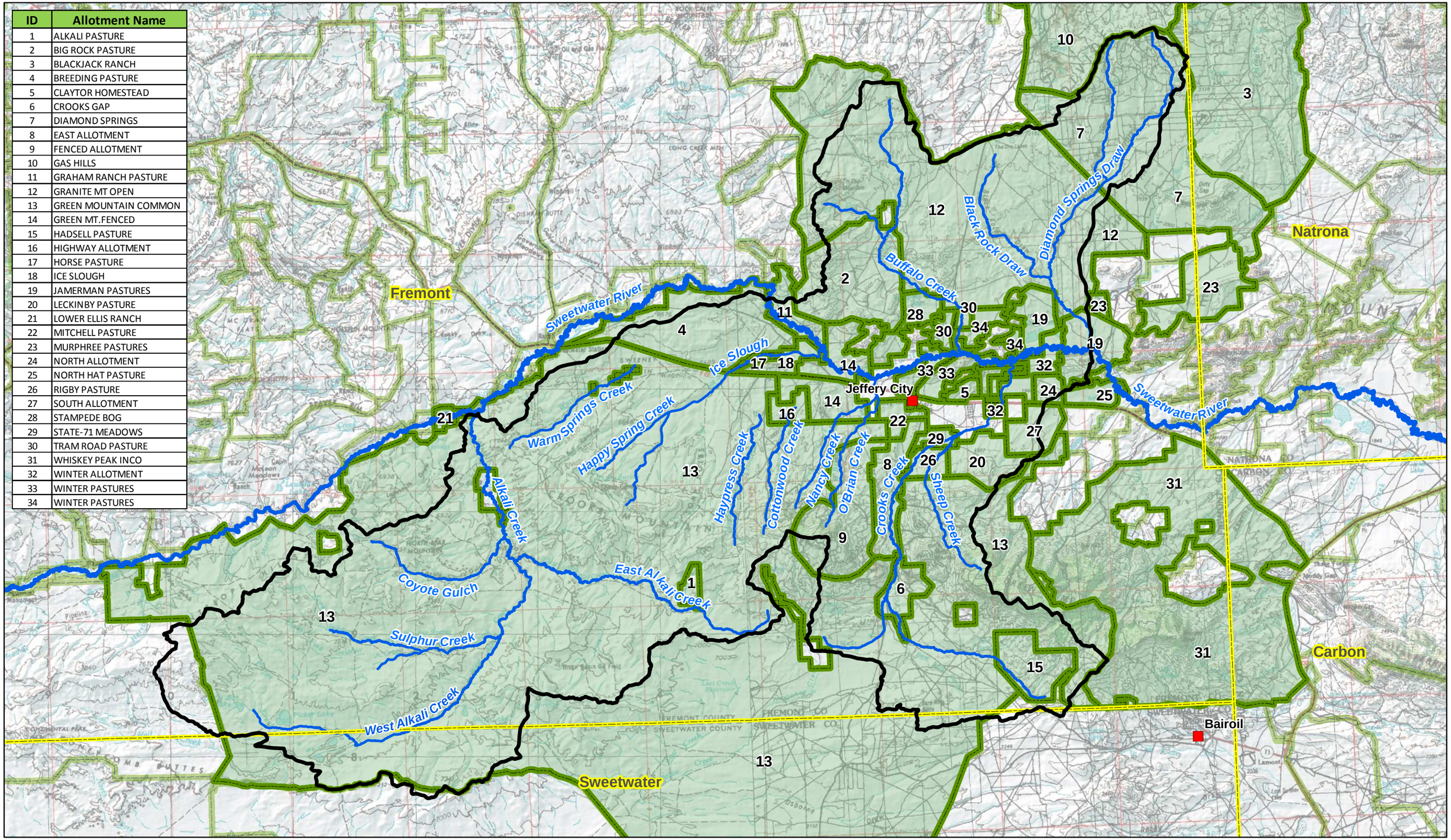
Under the umbrella of the Lander Resource Management Plan, management of grazing allotments are prioritized based on the classification of the allotments into one of three management categories: Improve (I), Maintain (M), and Custodial (C). These categories broadly define management objectives of the BLM administered public lands in the allotment (BLM, 2008).

Livestock grazing is managed is 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). BLM's specific objectives and procedures for managing livestock grazing are contained in the agency's grazing regulations. BLM's grazing regulations were revised in 1995 to ensure that livestock grazing is conducted in a manner that will sustain or improve the fundamental ecological health of public rangelands.

Grazing on BLM lands to meet these requirements is managed under the Standards for Healthy Rangelands and Guidelines for Livestock Grazing Management for the Public Lands Administered by the BLM in the State of Wyoming (BLM, 2007). Among the full suite of grazing management guidelines, those most applicable to this watershed study are summarized as follows:

- 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.

ID	Allotment Name
1	ALKALI PASTURE
2	BIG ROCK PASTURE
3	BLACKJACK RANCH
4	BREEDING PASTURE
5	CLAYTOR HOMESTEAD
6	CROOKS GAP
7	DIAMOND SPRINGS
8	EAST ALLOTMENT
9	FENCED ALLOTMENT
10	GAS HILLS
11	GRAHAM RANCH PASTURE
12	GRANITE MT OPEN
13	GREEN MOUNTAIN COMMON
14	GREEN MT.FENCED
15	HADSELL PASTURE
16	HIGHWAY ALLOTMENT
17	HORSE PASTURE
18	ICE SLOUGH
19	JAMERMAN PASTURES
20	LECKINBY PASTURE
21	LOWER ELLIS RANCH
22	MITCHELL PASTURE
23	MURPHREE PASTURES
24	NORTH ALLOTMENT
25	NORTH HAT PASTURE
26	RIGBY PASTURE
27	SOUTH ALLOTMENT
28	STAMPEDE BOG
29	STATE-71 MEADOWS
30	TRAM ROAD PASTURE
31	WHISKEY PEAK INCO
32	WINTER ALLOTMENT
33	WINTER PASTURES
34	WINTER PASTURES



Legend

Grazing Allotments
Streams- Phase III Study Area
Cities
County Boundary
Sweetwater River
Phase III Study Area

0 24,000 48,000

1 inch = 24,000 Feet

Figure 2.27 Sweetwater River Phase III: Grazing Allotments

P:\WYWDC26 Sweetwater River\GIS_new\Alkali_Creek_Study_Area\Figures\Alkali_Creek_Allotments.mxd

- Restore, maintain, or improve riparian plant communities to sustain adequate residual plant cover for sediment capture and groundwater recharge.
- Implement riparian improvements (e.g., instream structures, water troughs, etc.) to maintain or enhance appropriate stream channel morphology; develop springs, seeps, reservoirs, wells or other water development projects in a manner protective of watershed ecological and hydrological functions; and implement range improvements away from riparian areas to avoid conflicts in achieving or maintaining riparian function.
- Adopt management practices and implement range improvements that protect vegetative cover and thereby maintain, restore or enhance water quality. A set of six standards have been established to meet the above guidelines (BLM, 2007). Each standard sets a specific objective, explains the function and importance of the objective, and provides indicators to assess the attainment of the objective.
- Implementation of appropriate range management practices and/or improvements is carried out under an activity or implementation plan, including allotment management plans (AMPs).

As discussed in Chapter 1 of this Phase III report, the Green Mountain Common Allotment (GMCA) dominates the physical and management landscape of the study area. The GMCA is the focal point of a lengthy legal battle between the BLM and private interest groups regarding the BLM's management of the allotment. At the time this report is being written, the BLM has recently completed the revised Final Environmental Assessment Green Mountain Common Allotment Proposed Grazing Management (WY-050-EA11-5). The decision was made by the BLM to split (without fencing) the existing GMCA into four new allotments: Antelope Hills, Arapahoe Creek, Alkali Creek Sheep and Mountain.

Final Decision documents were prepared by the Lander Field Manager for each of the three main subdivided allotments (a final decision is not yet prepared for the Mountain allotment). In each, the Lander Field Office manager describes the decision to implement the Proposed Action (Alternative Two) of the Environmental Assessment (EA). The following text was extracted from the Alkali Allotment Final Decision and is included herein for its description of the decision. The Lander Field Office Acting Manager wrote:

> *"My final decision is to implement the Proposed Action (Alternative Two) described in EA No. WY-050-EA11-5. Specifically, my final decision is described below:*
>
> *The 2011 livestock grazing use and management for the GMCA will be governed by the Lander Field Manager's Final Decision of August 31,1999 (1999 Decision) until such time as my Final Decision is implemented.*

1. This decision will split the existing GMCA into four smaller allotments with a total of 19 pastures. The four new allotments are: Antelope Hills, Arapahoe Creek, Alkali Creek Sheep and Mountain using the 1999 Decision use area boundaries. These allotments will not be separated by fences.

2. The 2011-2020 livestock (cattle and sheep) grazing use and management will be governed by this proposed plan which implements spring and fall seasonal grazing on the new Alkali Creek Sheep Allotment (ACSA).

3. Upland vegetation goals for the allotment relate primarily to maintaining the vigor and health of cool season bunchgrasses such as needle-and-thread, Indian ricegrass, bluebunch wheatgrass, and squirreltail. The livestock grazing management is designed to avoid a shift in the herbaceous vegetation from cool season bunchgrasses to smaller but more grazing resistant species such as threadleaf or needleleaf sedge, Sandberg bluegrass, or rhizomatous wheatgrasses. In riparian areas, the goals relate to maintaining or increasing the abundance, vigor and health of wetland sedges. The livestock grazing management is designed to avoid a shift in the vegetation community from wetland sedges to more grazing resistant species such as Kentucky bluegrass, mat muhly, and rose pussytoes. Measurable objectives will be developed cooperatively once a comprehensive monitoring program is established, and baseline data is available.

4. Prior to the implementation of riparian fences on the adjacent Antelope Hills and Arapahoe Creek Allotments, management will be based on rigid adherence to stubble heights standards measured at key areas (Table 1) (NOTE: This table is referenced herein as Table 2.8). *The observation of stubble heights will be used to determine the appropriate time to move livestock. If use levels are heavy (61%-80%), or the stubble heights are not met, the Authorized Officer will close portions of the allotment or the entire allotment if necessary. Prior to the beginning of the next grazing season, permitted use numbers will be re-evaluated and reduced to meet stubble height objectives.*

The rotation indicator requires a minimum of 6 full inches. That means the average of the heights measured within the key area must be at least 6.0 inches.

Residual cover standards shown in the above Table will apply to all pastures at the end of grazing season. The actual cover measurements will be presented and discussed at the post season BLM meeting to be held before January 31st each year.

5. In addition to the stubble height criteria shown in Table 1, the use levels on willows and stream bank trampling will also be observed. Table 2 (NOTE: This table is referenced herein as Table 2.9) *summarizes the monitoring protocol that will be used under this final decision:*

In addition to stubble height, willow utilization and stream bank stability the BLM will monitor trend, actual use and precipitation data, in cooperation and consultation with the grazing permittees and interested publics.

6. Upon construction of the riparian pastures and the implementation of the grazing strategies, stubble height measurements will be taken at the end of the grazing season for each pasture. Monitoring will occur throughout the grazing season to ensure that use levels do not exceed acceptable levels. The objective is to observe stubble height levels over 3-5 years and determine an average stubble height over the analysis period rather than attempt to address every pasture - every year - while the cattle are still present. If use levels are heavy (61-81%), and there is no longer reason to believe that stubble height objectives will be achieved over the analysis period, the Authorized Officer will accelerate the evaluation schedule to revise the long term

management, including reductions in season of use, numbers, or grazing management strategies to occur no later than the next grazing season.

Table 2.8 Forage Utilization Levels/Rotation Indicators (BLM's Table 1).

Plant Community Type and Monitoring Method	*Forage Utilization Standard*	*When Will Standard be Implemented?*
Riparian Vegetation (Stubble Height Method)	*6 inch greenline stubble height within key areas*	*At the end of the season of use for each pasture. Monitoring will occur periodically throughout the grazing season to ensure use levels do not exceed acceptable limits.*
Riparian Vegetation (Stubble Height Method)	*4 inch first terrace stubble height within key areas*	*At the end of the season of use for each pasture. Monitoring will occur periodically throughout the grazing season to ensure use levels do not exceed acceptable limits.*
Upland Vegetation (Stubble Height Method)	*6 inch residual herbaceous cover** within key areas*	*At the end of the season of use for each pasture. Monitoring will occur periodically throughout the grazing season to ensure use levels do not exceed acceptable limits.*

***The rotation indicator for the residual herbaceous cover will be measured as "droop height"; the highest naturally growing portion of the plant (Connelly, et.al. 2000) for the key management grass species. The key species are bluebunch wheatgrass, Indian rice grass, squirreltail and needle-and-thread grass. This means that the "droop height" includes leaves, culms, and/or seed heads (seed stalks) of these four key management species. (Connelly, et. al. 2003).*

Table 2.9 Monitoring Protocol To Be Used Until Fences and Water Developments Are Completed (BLM's Table 2).

Key Site	*Monitoring Timeframe*	*Protocol Used*	*Trigger Point*
Willows	*Approximately Every 15 days*	*Browse Method*	*35% use on leader growth*
Stream Bank Trampling	*Approximately Every 15 days*	*Stream Bank Alteration Method*	*When stream bank alteration exceeds 15%*

7. These 12 decision points and the "additional terms and conditions" listed later in this decision will become terms and conditions on this new permit. They will serve as the functional equivalent of an allotment management plan (AMP) in accordance with 43 CFR subpart 4120.2(e). A separate AMP will not be developed as part of this decision. The grazing management is based on this decision and will be implemented through the annual operating plan. This decision is designed to meet the letter and spirit of the BLM's commitment to develop an allotment management plan.

8. The new Alkali Creek Sheep Allotment (ACSA) will be authorized for one sheep permit only. Please refer to the attached Final Permitted Use Summary for the Alkali Creek Grazing Association, LLC's final permitted use. The Table reflects a 45 percent reduction of the current permitted use to accelerate attainment of the rangeland health standards.

9. In the Alkali Creek Sheep Allotment (ACSA) sheep will graze in the spring and fall, for 30 days each season, generally in April and October. This use period does not include the hot season where riparian issues are important. It does include use in late April where, in some years, the

critical growing season for cool season bunchgrasses such as needle & thread begins. Health of the large cool season bunchgrasses is the primary goal in upland environments. However, in most cases this critical season is only beginning in this allotment by the end of April, and the cool season bunchgrasses will be able to complete their growth cycle in the absence of livestock grazing beginning May 1st. The majority of livestock use will occur on grass species such as Sandberg bluegrass that green up prior to the cool season bunchgrasses. Early season forbs will also be utilized.

10. The proposed sheep grazing plan will require that lambing areas on East Alkali Creek be rotated each year with camps located a minimum of 1.5 miles from water sources. Sheep camps will be moved every seven days to prevent overutilization of the vegetation in any given location.

11. This decision will be implemented for at least three years following completion of the riparian pasture fences and water developments proposed for the adjacent Antelope Hills and Arapahoe Creek Allotments, and then evaluated. The grazing plan will be adjusted as necessary. Increasing sheep permitted use depends on permittee commitment to stewardship including, meeting rangeland health standards, effective control of the sheep

2.9.2 Existing Water Supply

The Phase III study area is extensive and includes a significant amount of area receiving less than 14 inches of precipitation per year. Stream channels are, for the most part, intermittent or ephemeral in nature, neither of which provides year round water sources for livestock or wildlife. The riparian corridors associated with the perennial and intermittent channels and to a lesser degree the ephemeral channels, are heavily utilized by livestock and wildlife and frequently exhibit indicators of heavy usage: trampled stream banks, loss of riparian vegetation, etc. Springs are scattered throughout the watershed and may provide additional sources of water depending upon local flow conditions.

Mapping of existing range improvement projects was obtained from the Lander Field Office of the BLM. This mapping indicated the presence of approximately 131 stock reservoirs and ponds within the Phase III Study Area. Field inspection of the sites was beyond the scope and budget of this project; however, a reasonable estimate of the viability of the reservoirs was needed. It is our understanding that many of the reservoirs have either failed or have filled with sediment and are no longer viable sources of livestock and wildlife water.

Using the project GIS, mapping of the reservoirs sites was overlain on recent high resolution aerial photography. Each reservoir was examined in the GIS to determine its status at the time of the photography (2009). Those containing water were determined to be viable sources. Physical breaches were visible on many of the reservoirs resulting in a classification of "non-viable". Likewise, many were visibly filled with sediment and also classified as "non-viable". Others were simply empty and firm conclusions could not be drawn. These sites could

have been dry at the time of the photography but remain viable sources following precipitation events. Figure 2.28 displays an example of this process.

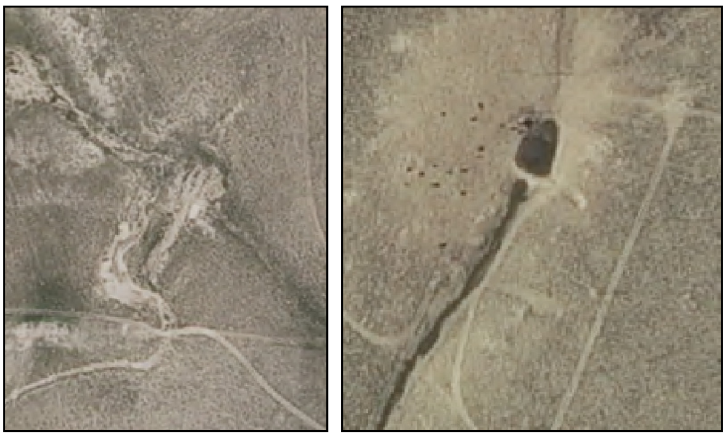


Figure 2.28 Example Stock Reservoir Evaluation Indicating a Breached Non-viable Stock Reservoir vs Reservoir Holding Water.

Based upon this analysis, it appears that a minimum of 96 stock reservoirs remain viable water sources. This analysis also indicates that 35 are either breached, sediment filled, or in need of site visits to determine their status. This figure also indicates the location of developed springs, water gaps, and watering tanks.

Numerous additional water supply projects have been developed throughout the study area in support of livestock and wildlife. These include construction of wells, spring developments, etc. These generally incorporate some sort of livestock watering facility such as large bottomless concrete stock tanks (Figure 2.29). Field observations of many of these features indicated that design may be inadequate and that optimal use of the water resource (i.e., springs) may not be attained. For example, the stock tank shown in Figure 2.30 is too small to provide an adequate water source to more than a few animals at one time.

Figure 2.29 30-Foot Diameter Concrete Bottomless Stock Tank.

Based upon mapping data obtained from the BLM, existing water sources are displayed in Figure 2.31. Note that this feature does NOT include surface water sources such as perennial streams, intermittent streams, or undeveloped springs because a primary objective of this study is to reduce reliance upon these sources.

Consequently this figure indicates the location of:

- Developed springs,
- Ponds and reservoirs,

- Wells, and
- Stock tanks, etc.

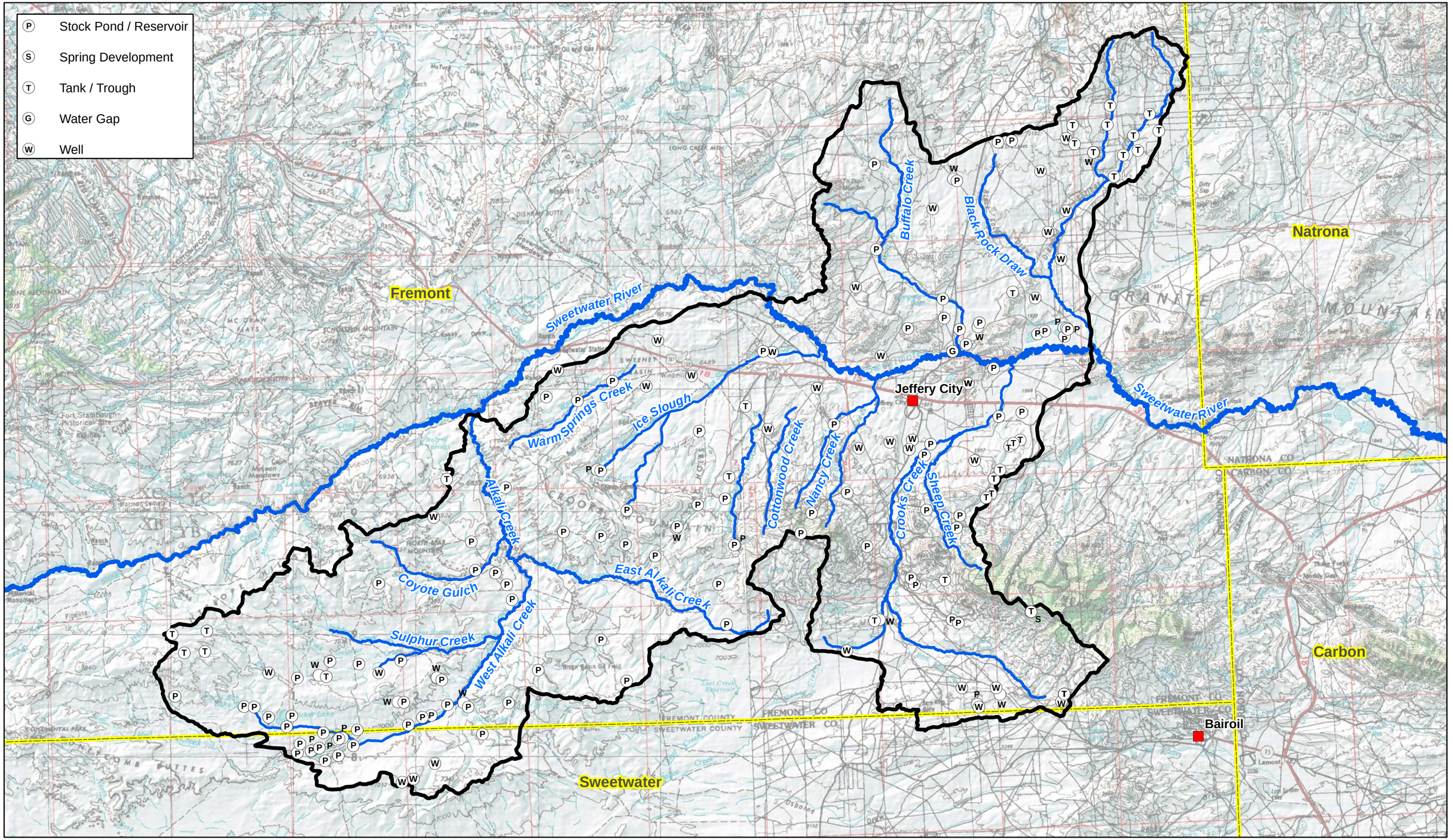
Reservoirs which appeared to be either breached, filled with sediment, or otherwise nonviable, are not included in this figure.

Figure 2.30 Undersized Livestock / Wildlife Watering Tank.

2.9.3 Range Conditions and Needs

Information presented in the GMCA EA summarizes results of the BLM's 2010 evaluation update of vegetation conditions. In August 1999, the BLM established eight permanent point/line intercept monitoring transects which were subsequently reevaluated in 2010. The following general conclusions regarding rangeland health were reached by the BLM based upon the 1999 and 2010 vegetation data:

> *"1. Many upland sites immediately adjacent to riparian areas are not meeting the standard. An earlier estimate placed this acreage at 3-5 percent (15-25,000 acres) of the GMCA. An exact acreage is very difficult to determine as it requires calculating riparian zone width and steepness of the adjacent slopes. Those affected upland areas on mountain slopes will be narrower and on the flatter areas they will be wider. Recent analysis, based on a 300-foot buffer around all riparian zones has yielded a figure of 9,050 acres of heavily grazed adjacent uplands which is 1.9% of GMCA.*
>
> *2. Approximately 47 percent (244, 000 acres) of the upland ecological (range) sites are meeting the standard.*
>
> *3. The status of the remaining approximately 48-50 percent (253-263,000) of the upland ecological (range) sites still needs to be determined using Indicators of Rangeland Health protocol. However, at the present time, it is the BLM's judgment that they are generally meeting the standard. This judgment is based on the substantially lower levels of livestock actual use since 2002 and BLM staff field observations of adequate residual cover remaining after the livestock grazing season for watershed protection and plant maintenance requirements.*
>
> *4. Rangeland health assessments (BLM Technical Reference 1734-6) including indicators of upland erosion condition, vegetative cover, and desired plant community need to be conducted and developed. Allotment field inspections will continue and additional monitoring studies need to be established to assess the remaining area."*



N
W E
S

Legend

- Streams- Phase III Study Area
- Sweetwater River
- Cities
- Phase III Study Area
- County Boundary

0 24,000 48,000

1 inch = 24,000 Feet

Figure 2.31 Sweetwater River Phase III: Existing Wildlife / Livestock Water Sources

The scope of this project did not facilitate detailed evaluation and assessment of rangeland conditions. However, during site visits and other project related activities within the study area, general observations were conducted. Conclusions drawn from these observations are generally consistent with the BLM assessment described above and also discussed within the GMCA EA. Numerous riparian areas appear to be degraded. Upland rangeland conditions in areas adjacent to the riparian zones are generally in fair to low good ecological condition and vigor. Extensive areas of the allotment are in high fair to good ecological condition. These areas are generally farther from water or in higher precipitation areas.

An important factor needed to facilitate improved grazing management and thereby achieve the associated benefits to the watershed is well distributed, reliable water. Despite the relative ample water supplies within the watershed, good grazing systems control both the time (amount of time spent in an area), and the timing (the time of the year) that the livestock spend in a pasture. Grasses and other plants need to recover from the last grazing event before being grazed again. This is because food reserves in the roots must be utilized for new plant growth. If they do not get to replace these root reserves, the plants are weakened and may eventually die. Less desirable plants eventually take over and plant densities decrease. Without well distributed livestock water, areas near water (frequently riparian areas) are grazed heavily while many other areas are under-utilized. Livestock water must also be reliable so that each pasture can be used as needed in a grazing rotation. Otherwise, the same pastures with reliable water get grazed repeatedly at the same crucial time of the year.

In the event that grazing management dictates large herd grazing, adequate quantities of water are needed to provide for the water requirements of the grazing animals. Development of adequate water supplies and the infrastructure to provide water to grazing animals should take into consideration the volumes of water available and the potential to construct or install adequate infrastructure. Consideration may be given to the potential for development of reliable water source infrastructure and corresponding stocking sized to fit that supply capacity. Smaller herds of livestock, sized to maintain light to light/moderate stocking rates, strategically oriented to existing limited upland water developments may be considered.

In addition to restoration of more healthy conditions in currently impacted riparian areas, continuing adjustments in overall range management will contribute to the maintenance, recovery or improvement of a variety of interrelated aspects of watershed function, including but not necessarily limited to:

- Improved infiltration of snowmelt and rainfall;
- Retention of soil moisture;

- Groundwater recharge;
- Sustained release of soil moisture and groundwater as seeps/springs; and
- Stabilization of soils against erosion into streams.

In general, most range improvement practices which improve watershed and livestock values also improve wildlife habitat values. With important and sensitive species such as sage grouse, care must be taken to ensure that practices are beneficial rather than detrimental to their habitat values. Examples of this include the need for mixed age stands of sagebrush, adequate vegetative residues, wildlife escape ramps from livestock tanks, and provisions for wildlife water.

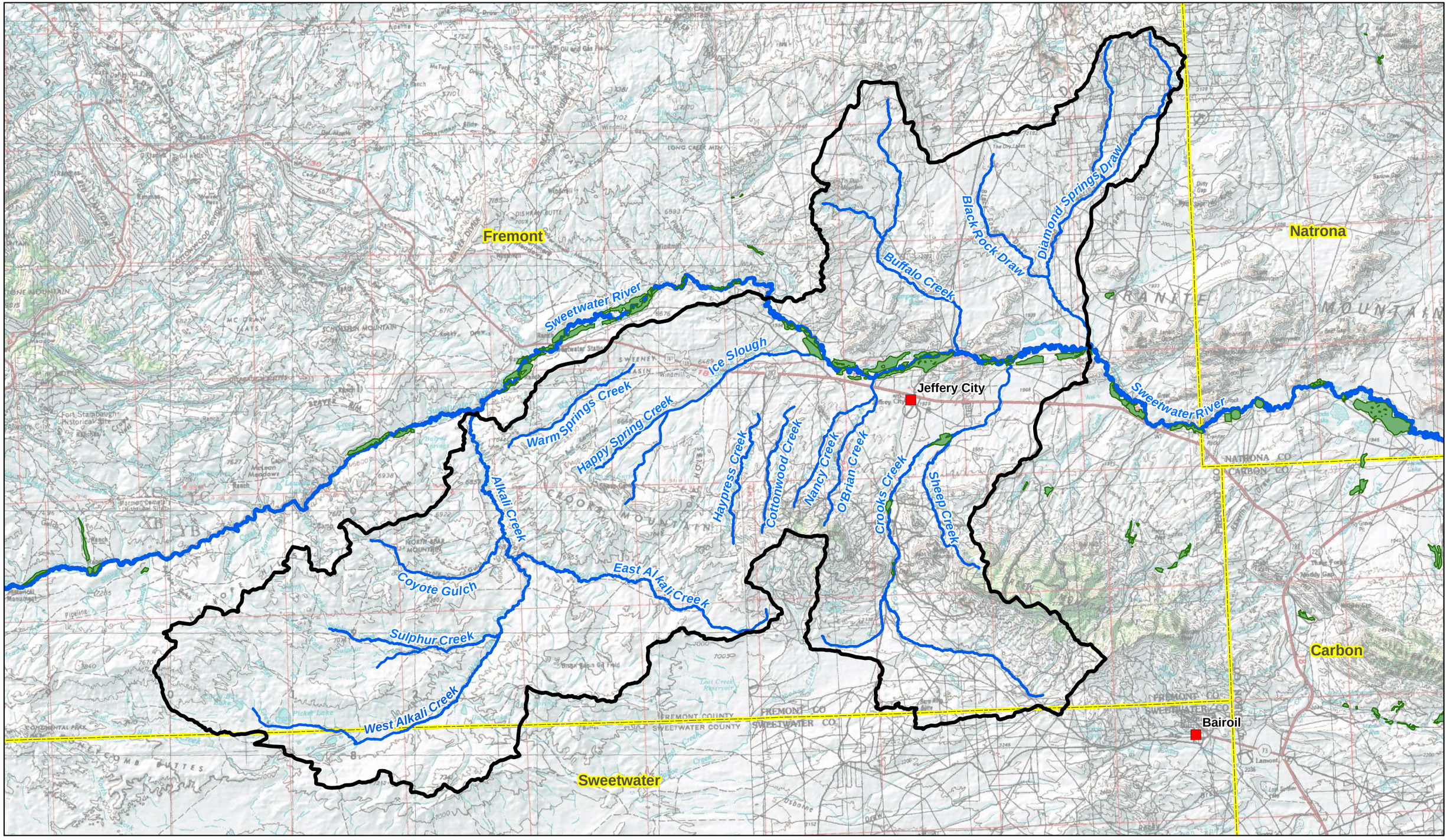
Alternatives to address the need for additional wildlife/livestock watering sites are presented in Section 3.3. Potential management practices and improvements to address other rangeland/grazing related issues are included in Section 3.

It is important to consider that to be cost-effective any range improvement practices/facilities that may be implemented must be followed up with an appropriate and effective grazing system. Otherwise, any short term gains will be lost, and often made worse. Since the key to any good grazing system is usually a reliable livestock water system, this usually is the most cost-effective practice to initiate the process. The best value for the investment of resources usually occurs on the more productive land. Land that is too steep or shallow can only show limited returns on investments. Finally, to be effective, any change in range management must be supported by the land user.

2.10 Irrigation

2.10.1 Irrigation Overview

Irrigation systems within the Phase III Study Area are limited to a handful of small privately owned ditches. Total irrigated acres within the watershed were determined to be approximately 2,797 acres based upon spatial data available through the WWDO. As displayed in Figure 2.32, these lands lie primarily along the Sweetwater River although there is a scattering of small irrigated parcels located along several tributaries; particularly Crook's Creek. Appendix B summarizes the adjudicated surface water rights information available from the WSEO.



N
W E
S

Legend

- Irrigated Lands
- Phase III Study Area
- Streams- Phase III Study Area
- Sweetwater River
- Cities
- County Boundary

0 24,000 48,000

1 inch = 24,000 Feet

Figure 2.32 Sweetwater River Phase III: Irrigated Lands

Irrigators were interviewed at project meetings and during field investigations to determine their level of interest in participating in the irrigation inventory phases of the project. Given the relative paucity of irrigation infrastructures in the study area, only one irrigator indicated an interest in participating in the irrigation inventory phase of the project. The irrigation inventory associated with this phase of the study consisted of:

- Point of Rocks Ditch / Emigrant Road Ditch Diversion Structure

2.10.2 Point of Rocks Ditch / Emigrant Road Ditch Diversion Structure

Figure 2.33 Point of Rocks / Emigrant Road Diversion Structure on the Sweetwater River.

This diversion structure serves the Point of Rocks Ditch (north bank) and Emigrant Ditch (south bank) headgates on the Sweetwater River in Section 6, Township 29 North, Range 92 West (Figure 2.33). The Point of Rocks Ditch diverts water under Permit No. P7876 (priority date of May 20, 1907). This permit has an appropriation of 4.11 cubic feet per second for irrigation of 288.5 acres. The Emigrant Road Ditch diverts water under permit number P9756D with a priority date of April 25, 1910 (0.77 cubic feet per second for 54 acres) and Permit No. 4222E with a priority date of June 20, 1921 (0.53 cubic feet per second for 37 acres).

At the request of the landowner, the Point of Rocks Ditch headgate and Rongis Ditch / The Jacob Ditch diversion structure were inventoried. Figure 2.34 displays an aerial photo of the vicinity.

The following observations pertaining to the Point of Rocks Ditch / Emigrant Ditch diversion structure were recorded:

- The structure consists of a concrete sill spanning the river and four concrete abutments supporting two pairs of check boards. During low flow periods, check boards placed between abutments back the water to an adequate elevation to enable diversion.
- Rubble and local materials must be placed over the sill to add additional diversion capability.

- Following high flow conditions in 2009 and 2010, damage to the structure was noted. The concrete abutments show significant deterioration.
- Scour of the right bank (southern) downstream of the structure has resulted in considerable widening of the channel at that location.
- According to the landowner, the structure is currently ineffective and design of a new structure is desirable. Previous design alternatives presented by the NRCS involved replacement of the existing structure with a cost-prohibitive low-head concrete dam facility.

Figure 2.34 Point of Rocks / Emigrant Road Ditch Diversion Structure Overview.

III. WATERSHED MANAGEMENT AND REHABILITATION PLAN

III. WATERSHED MANAGEMENT AND REHABILITATION PLAN

3.1 Overview

As stated previously, the objective of this study is to generate a watershed management plan that is not only technically sound, but also one that is practical and economically feasible. In conjunction with the development of a database for the watershed, the investigative phase of this study focused on an assessment of the study area and the identification and evaluation of improvements to address those issues/problems described in Chapter 2. Potential improvements were developed and categorized into the following:

- 3.1 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

- 3.2 Irrigation System Conservation and Rehabilitation. The inventory and evaluation of the existing infrastructure was completed and improvements identified for the rehabilitation or replacement of existing structures.

- 3.3 Livestock / Wildlife 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.

- 3.4 Grazing Management Opportunities. Based upon a review of the pertinent Ecological Site Descriptions (ESDs) and the ambient vegetation and soil conditions, grazing management strategies are presented.

- 3.5 Other Upland Management Opportunities. Additional watershed management alternatives were identified.

Rehabilitation plans have been developed for each category, and are presented in the following portions of this chapter. These plans have been prepared to provide an overview of potential improvements that can partially or fully address the key issues/problems identified within the watershed.

In the remainder of this chapter, the individual plans developed within each discipline are described and evaluated with respect to providing benefits to range conditions and utilization, improvement of riparian conditions, and improving the existing water supply through conservation. In summary, this chapter provides the PACD with a plan that can be

used to guide future efforts to enhance the water and range resources within the Phase III Study Area.

For the purposes of tracking individual components of the watershed management plan, each component was designated a unique project or 'improvement' number. The prefixes for each improvement describe the category of the watershed management plan it falls under. The prefixes are as follows:

Project Components "S"	Stream channel stability components
Project Components "I"	Irrigation system rehabilitation components
Project Components "W/L"	Wildlife / Livestock watering opportunities
Project Components "G"	Grazing management opportunities
Project Components "O"	Other management components

3.2 Stream Channel Condition and Stability

3.2.1 Stream Channel Restoration Strategies

The general condition of the principal stream channels and primary tributaries were evaluated during the geomorphic investigation presented in Chapter 2. During the evaluation of existing channel conditions, several impaired reaches were identified and two general classes of impairments noted. The general two categories of impairments were classified as indicated below:

- Channel degradation/incision; and
- Riparian degradation (vegetation loss).

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 3.1 displays a diagram of a 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 3.2 displays a photograph of a typical installation.

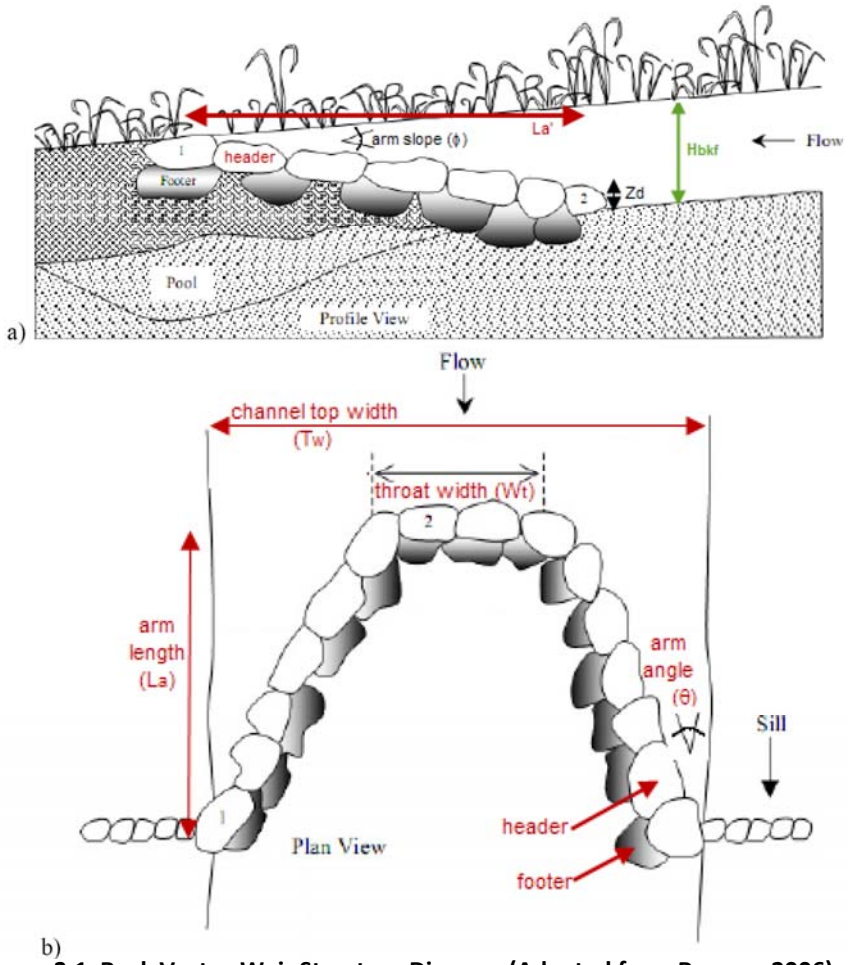


Figure 3.1 Rock Vortex Weir Structure Diagram (Adapted from Rosgen, 2006).

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

Figure 3.2 Stream Stabilization Structure: Rock Vortex Weir.

riparian areas or adjacent upland range. Figure 3.3 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.

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 3.1 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.

Figure 3.3 Stream Stabilization Measure: Willow Fascine Installation.

3.2.2 Stream Channel Components of the Watershed Management Plan

Based on the information presented above, the following items are presented for inclusion in the Phase III Study Area watershed management plan:

- Installation of stream channel degradation/incision mitigation measures based upon site-specific evaluation of conditions. Appropriate mitigation measures could be 'hard' engineering, 'soft' approaches, or combinations of both.
- Installation of stream bank erosion mitigation measures based upon site-specific evaluation of conditions. Appropriate mitigation measures could be 'hard' engineering, 'soft' approaches, or combinations of both.

Table 3.1 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

Several stream reaches were identified which would benefit from site-specific stream restoration strategies. These include:

S-1 Coyote Gulch
S-2 Sulfur Creek
S-3 Upper East Alcali Creek
S-4 Crooks Creek

3.3 Irrigation System Conservation and Rehabilitation

In this section of the watershed management plan, conceptual rehabilitation plans are typically presented for the inventoried irrigation structures. The rehabilitation plan represents the integration of individual measures to mitigate problems identified in the inventory phase of the project. Specifically, the improvements that comprise the rehabilitation plan focus on:

- 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
- Economic practicality
- Physical feasibility

The plan is intended to provide the ditch owners an assessment of conditions associated with the ditch and its associated hydraulic structures. The irrigator can use the plan as a "resource or wish list" from which they can select projects for potential future funding assistance from sources such as the WWDC Small Water Project Program or NRCS EQIP.

In an effort to assist the ditch owner in prioritizing potential improvements to each ditch, relative priorities were defined as follows:

Priority 1: Install, replace, or rehabilitate aging infrastructure critical to the diversion and delivery of water.

Priority 2: Install, replace, or rehabilitate aging infrastructure critical to the operation, measurement, and management of the irrigation diversions.

Priority 3: Install, replace, or rehabilitate aging infrastructure to provide improvements in on-farm efficiency and conservation.

3.3.1 Point of Rocks Diversion Structure (Watershed Management Plan Component I-1)

The structure's owner described that previous design alternatives presented by the NRCS proved to be too costly to be implemented for the ditch which serves only a limited number of acres. It is our understanding that the previous designs incorporated a concrete structure spanning the Sweetwater River which would provide vertical and lateral stability to the channel while facilitating control of water surface elevations. Given the existing circumstances which limit the cost of a proposed structure, a lower cost alternative is provided.

Briefly, a rock weir is recommended as a replacement for the existing concrete/rock structure. Under this alternative, the existing structure would be removed and existing rock salvaged. It is assumed that a local source of additional rock for completion of the structure could be obtained which would reduce transportation costs. Ideally, the source could be located within the ditch owner's properties to simplify acquisition.

Construction of a rock weir would facilitate diversion of irrigation water by the Point of Rock and Emigrant Ditches, facilitate fish passage, and be a lower cost alternative. Design of

the structure would require consideration of optimal elevations to facilitate diversions for a range of discharges, appropriate sizing of rock to be placed in the Sweetwater River and weir configuration to provide the greatest stability and optimal hydraulic function.

Based upon the results of the field inventory, the conceptual rehabilitation plan was developed and is presented in Table 3.2 and graphically in Figure 3.4.

Table 3.2 Conceptual-Level Rehabilitation Plan: Point of Rocks Ditch.

Rehabilitation Item Number	Description	Priority
I-1	Remove existing structure and Install Vortex Weir / W-Weir	1
I-2	Replace existing Point of Rocks Headgate	2

Figure 3.4 Point of Rocks Diversion Structure Conceptual Design.

The following improvements are included in the plan:

- The existing diversion structure should be removed and the rock currently placed in the river salvaged for use in a replacement structure.
- Streambanks downstream of the structure would be stabilized with backfill and rock placement.
- A rock W-Weir or Vortex weir (Figure 3.5) should be constructed upstream of the existing structure.
- Existing rock should be utilized to the extent possible.
- The weir should be designed to provide water surface elevation to facilitate diversion by the Point of Rocks Ditch.
- A rock w-weir or vortex weir would facilitate fish passage as well as providing the requisite water surface elevations for irrigation diversions.

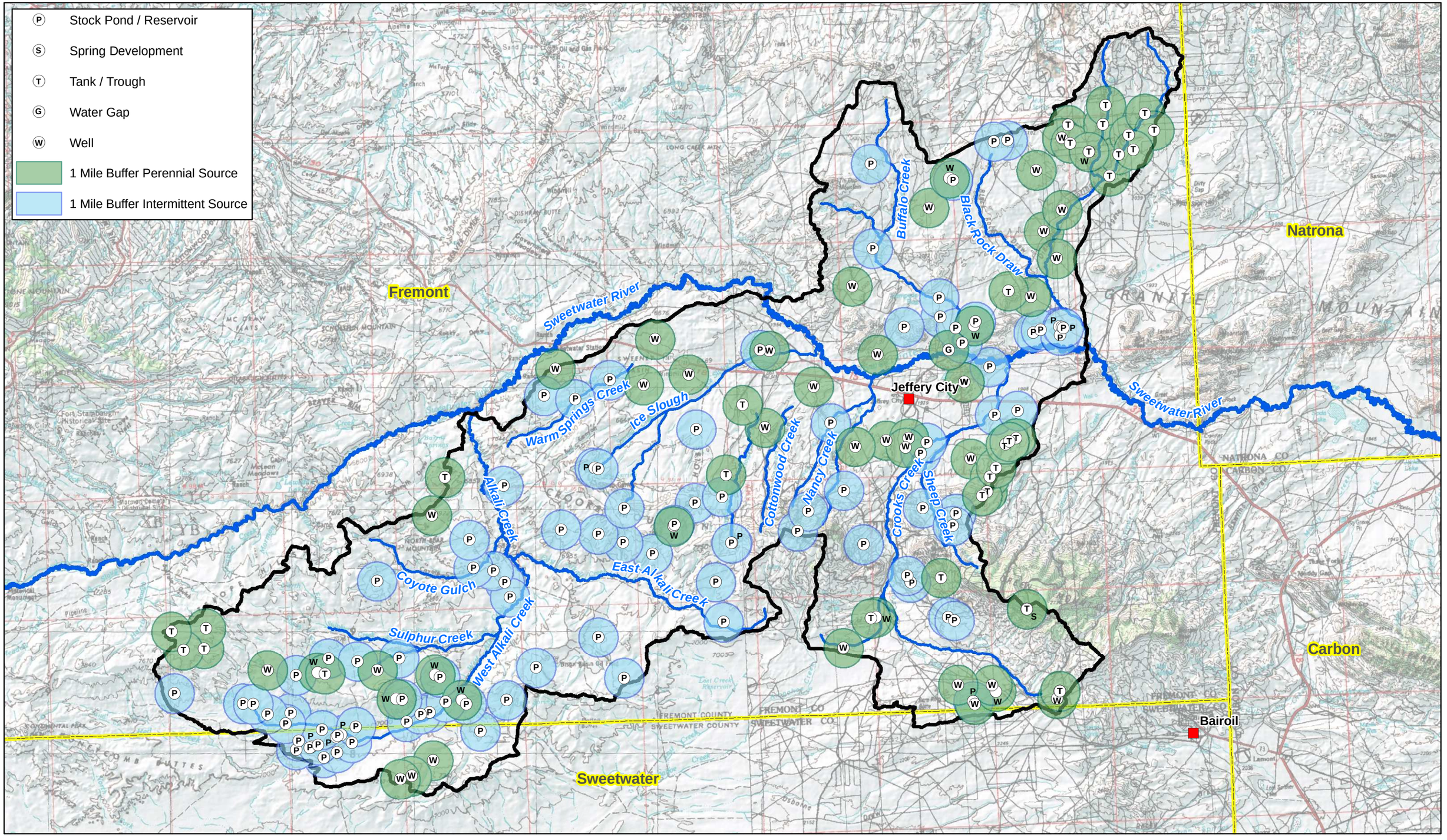
Figure 3.5 Rock Vortex Weir Installed to Facilitate Diversion of Irrigation Water.

- A Parshall Flume (24-inch) is recommended for placement on each ditch in the vicinity of the diversion.

The total cost of construction of this facility (assuming a local source of rock) would be approximately $120,000.

3.4 Livestock / Wildlife Watering Opportunities (L/W Components)

Given the relatively gentle topography throughout most of the watershed, existing water sources were assumed to be capable of providing water to livestock within a one-mile radius. Based upon this premise, buffers were drawn around existing the water sources discussed in Chapter 2 (see Figure 3.6). Because an objective of the livestock / wildlife watering investigation was to evaluate alternative upland water supplies, this figure does not show buffers about perennial / intermittent streams, nor springs. As indicated in this figure,



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Streams- Phase III Study Area
Sweetwater River
Cities
Phase III Study Area
County Boundary

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1 inch = 24,000 Feet

Figure 3.6 Sweetwater River Phase III: Existing Wildlife / Livestock Water Sources with 1 Mile Buffers

much of the study area appears 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. Based upon this analysis, much of the study area may benefit by the development of upland water sources. In addition, allotment permittees indicated locations where existing sources could benefit from enhanced or improved infrastructure.

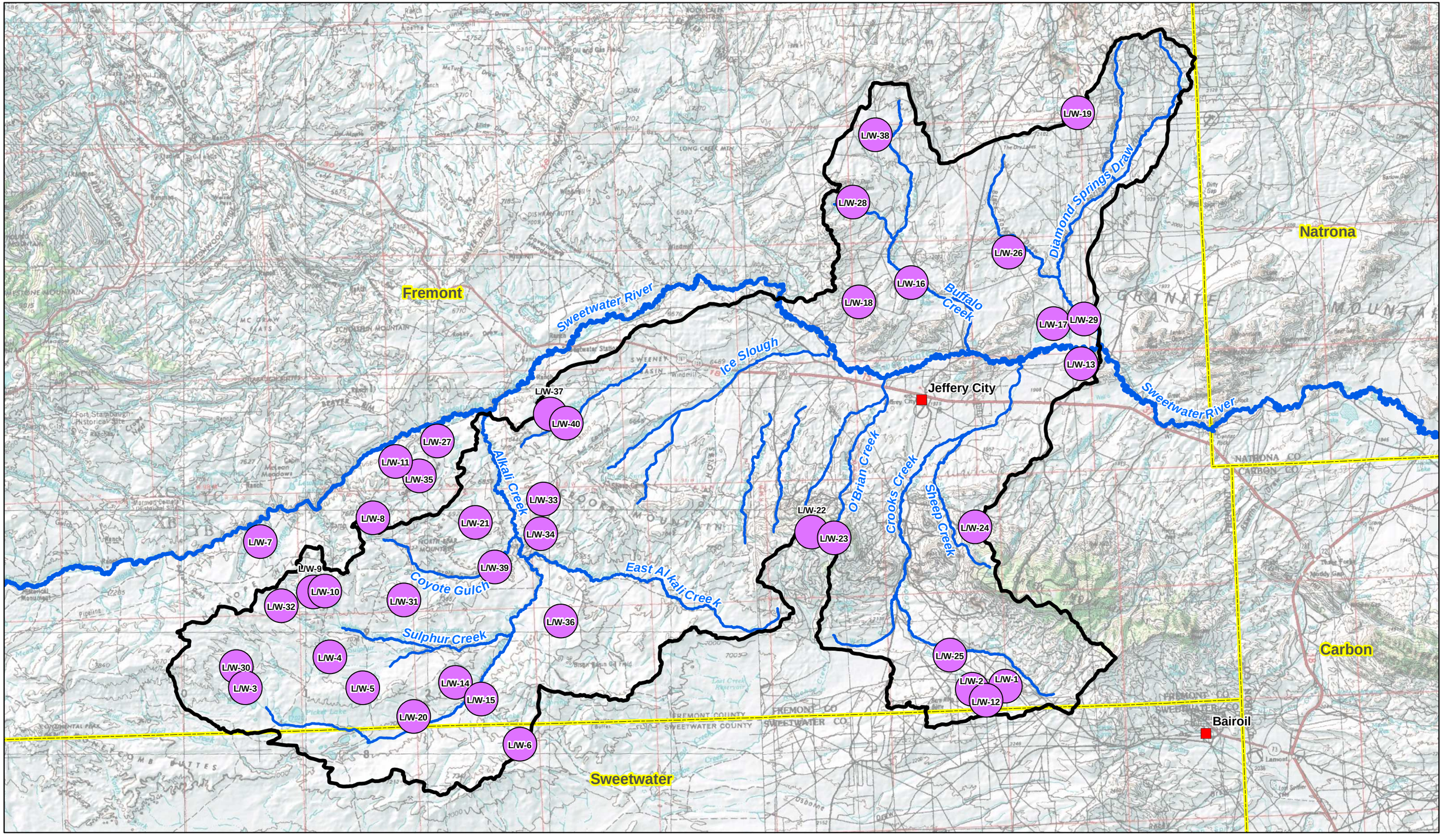
Based upon the information presented above and interviews with representatives of the BLM and allotment permittees, conceptual water development projects were identified. Figure 3.7 displays the locations of the proposed projects.

A general objective of this effort was to provide 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. In the following paragraphs, several alternatives or upgrades are presented at the conceptual level. Many of these projects represent improvements to existing systems which would make them more serviceable and efficient. Others represent development of new sources (eg., construction of new wells) or development of existing sources (eg., spring development). Conceptual designs are presented for pipeline projects.

For discussion purposes, the proposed livestock / wildlife water source projects are presented in the following categories which are presented separately in the paragraphs which follow:

1. Projects proposed by the BLM and presented in the GMCA EA (L/W 1 through 12).
2. Projects involving improvements to existing water source infrastructure (L/W 13 through 24).
3. Projects involving new development of springs and wells (L/W 25 through 28).
4. Projects involving new well construction (L/W 29 through 38).
5. Surface water diversion projects (L/W 39 through 40).

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.



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- L/W-14 Project Locations
- Streams- Phase III Study Area
- Sweetwater River
- Cities
- Phase III Study Area
- County Boundary

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1 inch = 24,000 Feet

Figure 3.7 Sweetwater River Phase III: Locations of Proposed Wildlife and Livestock Water Supply Projects

Also, the reader should note that the names associated with the following components of the watershed plan were organized by the project team to assist in their identification. They are generally based upon a project's location or named water source where appropriate.

3.4.1 Livestock / Wildlife Alternatives Proposed by the BLM (Projects L/W 1 through 12)

In the GMCA EA, the BLM proposed twelve (12) water development projects which fall within the Phase 3 study area. Their objective is to improve livestock distribution by "having cattle and sheep use more of the upland range land and take grazing pressure off of sensitive riparian areas. These projects are needed to assure that the designated pastures are able to support the approved livestock use for the number of days designated in the grazing management strategy". Table 3.3 itemizes the BLM's recommended project names, types, and whether the project is a new development or reconstruction of an existing facility.

Table 3.3 Summary of Range Improvement Projects Proposed in GMCA EA (BLM, 2011).

Plan Component	Project Name	Type of Improvement	New Development or Reconstruction
L/W-01	Cameco Well	Water Well	Existing Well - Equip
L/W-02	Bare Ring Butte Well	Water Well	Existing Well - Equip
L/W-03	Circle Bar Well	Water Well	New Construction
L/W-04	North Horse Track Well	Water Well	New Construction
L/W-05	Monument Well	Water Well	New Construction
L/W-06	Smiley Well	Water Well	New Construction
L/W-07	Granite Spring	Spring Protection Fence	New Construction
L/W-08	Upper Ladysmith Spring	Spring Protection Fence	New Construction
L/W-09	Lower Wager Meadows Spring	Spring Protection Fence	New Construction
L/W-10	Twin Springs	Spring Protection Fence	New Construction
L/W-11	Mud Spring	Spring Protection Fence	New Construction
L/W-12	Fuzzy Reservoir	Livestock Reservoir	Existing Reservoir - Reconstruction

Note that detailed descriptions or cost estimates were not made available by the BLM.

3.4.2 Improvements of Existing Facilities (L/W 13 through 24)

The proposed projects presented in this section were developed by the project team following interviews with individual allotment permittees, representatives of the BLM, and private landowners. These alternatives involve upgrades to existing infrastructure or

rehabilitation of existing facilities. Components associated with these proposed projects include:

- replacement of existing undersized or otherwise inferior stock tanks with larger 30-foot diameter bottomless tanks,
- replacement of gasoline fueled electrical generators with solar powered sources,
- reservoir outlet improvements;
- redevelopment of springs; and
- replacement of aging infrastructure.

The majority of these proposed projects consist of simple upgrades to existing facilities and development of conceptual designs is not necessary to adequately describe the improvement. Table 3.4 itemizes the proposed improvement projects and the individual components of each.

Table 3.4 Tabulation of Proposed Improvements to Existing Facilities (L/W 13 through 24).

Project Plan Component	Project Name (if applicable)	Proposed Action / Improvement
L/W-13	Tank Improvement Project	Install 30-ft diameter (10,000 gallon) stock tank
L/W-14	West Alkali Well Improvement Project	Install 30-ft diameter (10,000 gallon) stock tank
L/W-15	Daley Lake Well Improvement Project	Install 30-ft diameter (10,000 gallon) stock tank
L/W-16	Stampede Well Improvement	Install 30-ft diameter (10,000 gallon) stock tank
L/W-17	Soda Lakes Well Improvement	Replace existing generator with solar pump
L/W-18	Fletcher Gap Well Improvement	Install pump and stock tanks
L/W-19	Pump Replacement Project	Install solar pump for existing pipeline
L/W-20	Grassy Lake Well Improvement Project	Utilize an existing abandoned oil field well with artesian condtions
L/W-21	Mitten Flat Well Improvement Project	Install pipeline and stock tank
L/W-22	Woods Gulch Pond Rehabilitation	Reservoir Rehabilitation Project
L/W-23	Green Mountain Unnamed Spring Redevelopment	Existing Spring Redevelopment
L/W-24	Unnamed Spring Sheep Creek Improvement Project	Existing Spring Redevelopment

Final design of any improvement project will require consideration of the number of animals to be served. For the purposes of this project and based upon feedback provided by area ranchers, 30-foot diameter bottomless concrete tanks have generally been recommended. This size of tank is recommended in order to provide adequate water storage and a large enough facility to accommodate a large number of animals. This size tank may not be appropriate in all locations. Decisions of tank size and the number of each would ultimately be required based upon the anticipated herd sizes.

3.4.2.1 Stock Tank Replacement Project (Plan Component L/W 13)

This project consists of improvements to an existing well located in Section 2, Township 29 North, Range 91 West. Livestock and wildlife watering opportunities in this section are limited to the Sweetwater River and irrigation water. An existing well (Permit No. P8594P) is reported by the WSEO to be 40 feet deep with a yield of approximately 8 gallons per minute. In order to make the well more efficient for livestock and wildlife watering purposes, an enlarged tank is recommended.

Under this alternative, the following components would be employed:

- A 30-foot diameter bottomless concrete stock tank (10,000 gallon capacity) would be installed.
- Wildlife egress ramps would be installed.

3.4.2.2 West Alkali Well Improvement Project (Plan Component L/W 14)

This project consists of improvements to an existing well located in the vicinity of Section 20, Township 27 North, Range 96 West. Livestock and wildlife watering opportunities in this section are limited. An existing well in this vicinity is reported by permittee to be in need of an enlarged watering facility to make the well more efficient for livestock and wildlife watering purposes. Review of well location data provided by the WSEO indicated the presence of several wells in this general vicinity. Prior to construction, the precise location must be determined and a memorandum of agreement must be obtained for use of the well.

Under this alternative, the following components would be employed:

- A 30-foot diameter bottomless concrete stock tank (10,000 gallon capacity) would be installed.
- Wildlife egress ramps would be installed.

3.4.2.3 Daley Lake Well Improvement Project (Plan Component L/W 15)

This project consists of improvements to an existing well located in the vicinity of Section 28, Township 27 North, Range 96 West. Livestock and wildlife watering opportunities in this section are limited. An existing well in this vicinity is reported by permittee to be in need of an enlarged watering facility to make the well In order to make the well more efficient for livestock and wildlife watering purposes. Review of well data provided by the WSEO indicated the presence of several wells in this general vicinity; the actual well to be utilized could not be determined based upon the information available. Prior to construction, the precise location must be determined and a memorandum of agreement must be obtained for use of the well.

Under this alternative, the following components would be employed:

- A 30-foot diameter bottomless concrete stock tank (10,000 gallon capacity) would be installed.
- Wildlife egress ramps would be installed.

3.4.2.4 Stampede Well Improvement Project (Plan Component L/W 16)

This project consists of improvements to an existing well located in the vicinity of Section 16, Township 30 North, Range 92 West within the Big Rock Pasture allotment. Enlargements to existing watering facility are recommended In order to make the well more efficient for livestock and wildlife watering purposes.

Under this alternative, the following components would be employed:

- A 30-foot diameter bottomless concrete stock tank (10,000 gallon capacity) would be installed.
- Wildlife egress ramps would be installed.

3.4.2.5 Soda Lakes Well Improvement Project (Plan Component L/W 17)

This project consists of improvements to an existing well located in the vicinity of Section 27, Township 30 North, Range 91 West within the Jammerman Pastures allotment. This area is a winter pasture for the allotment permittee. According to the permittee, existing watering facilities are adequate, however, power to the well is currently supplied by a gas powered generator. Solar powered pumping facilities would provide a year round, lower-maintenance power supply. In addition, an existing storage tank has not been connected to the system.

Under this alternative, the following components would be employed:

- The existing generator would be replaced with a solar powered pump facility (solar panels, pump, batteries, and requisite connections).
- The existing storage tank would be incorporated by making the necessary connections to pump water from the well to the storage tank for subsequent release to the livestock/wildlife water tank as needed.

3.4.2.6 Fletcher Gap Well Improvement Project (Plan Component L/W 18)

This project consists of improvements to an existing well located in the vicinity of Section 18, Township 30 North, Range 92 West within the Big Rock Pasture allotment (Permit No. P11151P). The well is reported be equipped with an adequate electrical power supply, however watering facilities are inadequate. .

Under this alternative, the following components would be employed:

- Two 30-foot diameter bottomless concrete stock tanks (10,000 gallon capacity) would be installed.
- Wildlife egress ramps would be installed.

3.4.2.7 Diamond Springs Draw Pipeline Improvement Project (Plan Component L/W 19)

Under this proposed alternative, an existing pipeline and stock tank project located in the Diamond Springs allotment would be extended. As displayed in Figure 3.8, the system

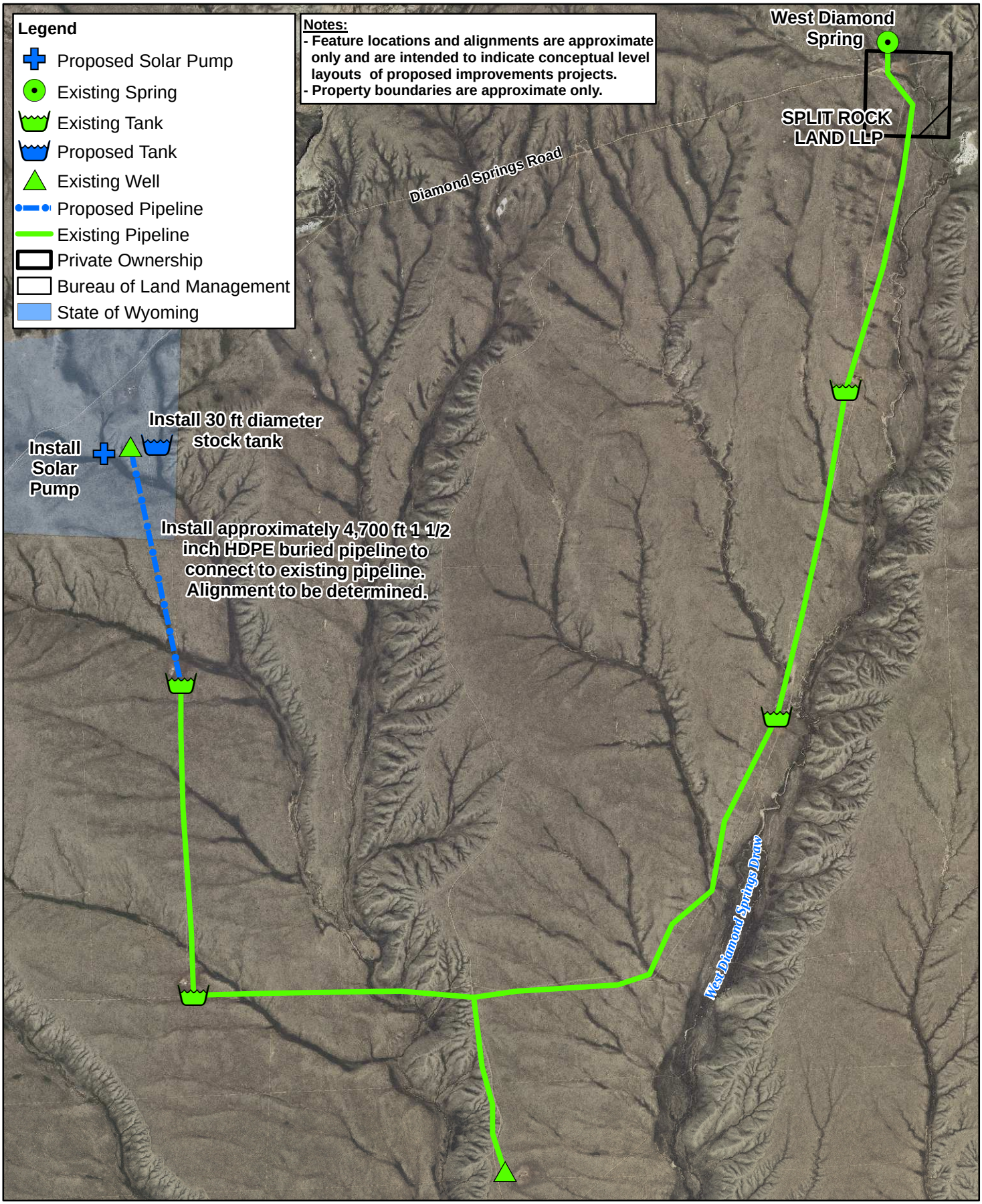

Figure 3.8: Proposed Improvements to the Diamond Springs Pipeline Project (Project L/W 19)

currently is supplied by a spring located in Section 29, Township 32 North, Range 90 West. The system consists of approximately 30,000 linear feet of buried pipeline and five stock tanks. According to the allotment permittee, the spring occasionally does not provide sufficient flow to supply the system and a more reliable supply source would be beneficial. Consequently a well located in Section 36, Township 32 North, Range 91 West could be utilized as an additional source for the pipeline system (Permit P50224W). Based upon information provided in the WSEO water rights database, the well is named the Adams #1 well and is permitted for livestock usage. The well is approximately 400 feet deep and the static water level is approximately 250 feet below the ground surface. Prior to completion of this alternative, the yield of the well would need to be tested and verified.

Under this alternative, the following components would be employed as indicated in Figure 3.8:

- The existing windmill would be disconnected and replaced with a solar powered pump facility (solar panels, pump, batteries, and requisite connections).
- Approximately 4,700 linear feet of buried HDPE pipe (1½-inch diameter) would be installed to connect the well to the pipeline system.
- Requisite valves and connections would be incorporated to ensure proper connection, pressure relief, and anti-backflow.

3.4.2.8 Grassy Lake Well Improvement Project (Plan Component L/W 20)

This project involves improvements to a reported flowing well in the vicinity of Grassy Lake in the southwestern portion of the Phase III study area and within the GMCA. Improvements to the well could result in a reliable source of water for livestock and wildlife water to State lands located in the upper reaches of the Alkali Creek watershed. This project was suggested by area ranchers familiar with the area who state the well flows reliably. Review of the WSEO water rights database did not verify the presence of a permitted well in the vicinity, consequently, verification of well location and yield would be required prior to final design of the project. Pending approval of water rights permits and / or a memorandum of agreement with the well owner, the proposed project could incorporate the following components as shown in Figure 3.9:

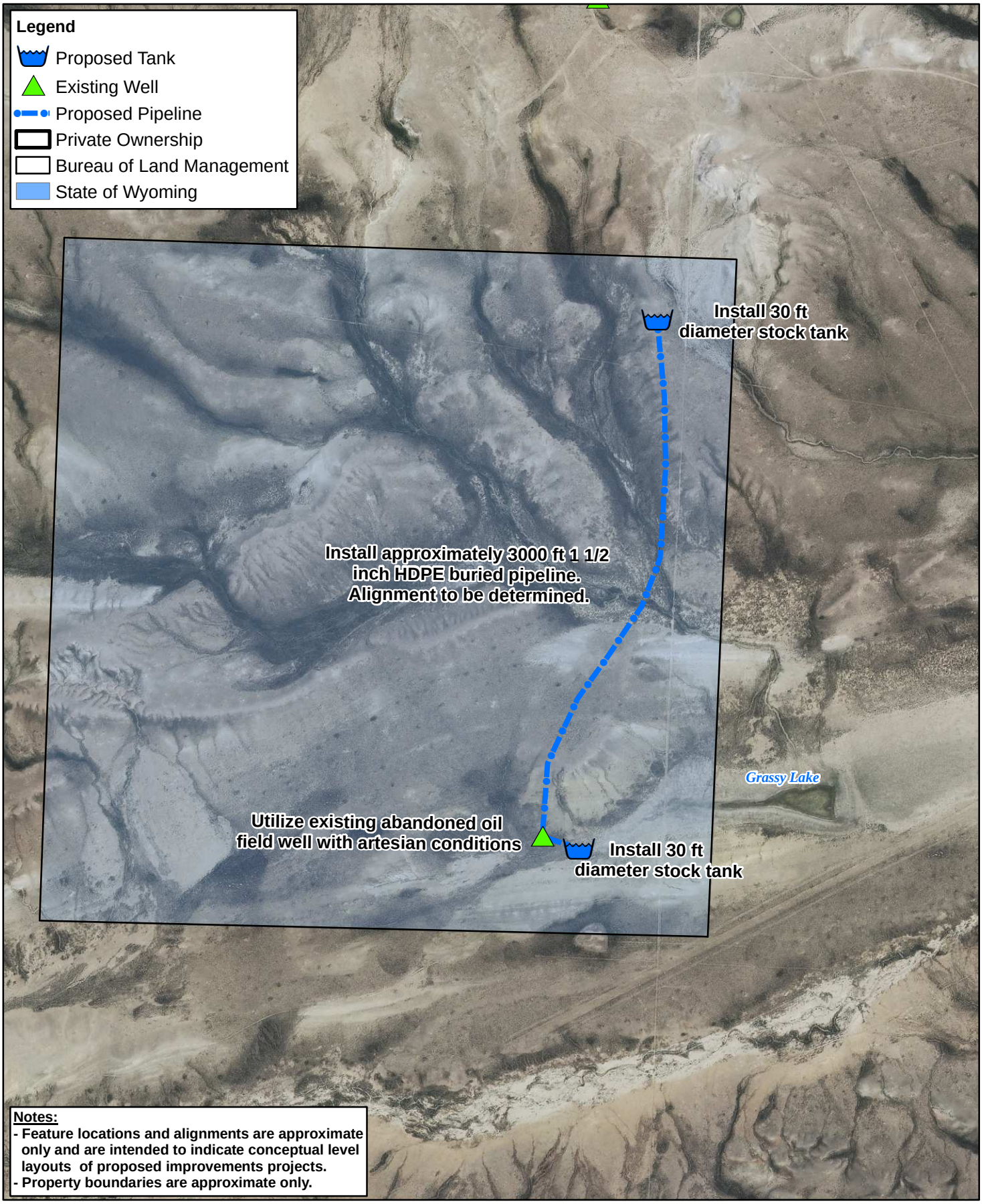

Figure 3.9: Proposed Improvements to the Grassy Lake Well (Project L/W 20)

- Approximately 3,000 feet of buried HDPE pipeline (1½-inch diameter) would be installed.
- Two 30-foot diameter bottomless concrete stock tanks would be installed (one at the well and the other at the pipeline's northerly end).

Note that this project, as delineated, lies within the proposed Antelope Hills allotment of the divided GMCA and would only involve lands owned by the State of Wyoming.

3.4.2.9 Mitten Flat Well Improvement Project (Plan Component L/W 21)

This project involves improvements to an existing well (WSEO Permit P159178W) located on lands owned by the State of Wyoming (Section 16, Township 28 North, Range 96 West). The well has been reported to have adequate yield to provide a livestock and wildlife water supply in addition to the existing stock tank located adjacent to it. Pending approval of use of the well, the project could incorporate the following components as shown in Figure 3.10:

- Approximately 15,600 feet of buried HDPE pipeline (1½-inch diameter) would be installed.
- Two 30-foot diameter bottomless concrete stock tanks would be installed. The first would be located at the northern limits of State lands and the second at the pipelines north end.

Note that this project lies within the proposed Antelope Hills allotment of a divided GMCA and would involve lands owned and administered by the State of Wyoming and the BLM. As an alternative project configuration, the project could terminate at the stock tank located on State lands.

3.4.2.10 Woods Gulch Pond Rehabilitation (Plan Component L/W 22)

This project involves rehabilitation to an existing pond located on land owned by the State of Wyoming on Green Mountain in Section 16, Township 28 North, Range 93 West. A preliminary search of records maintained by the Wyoming State Engineers Office failed to

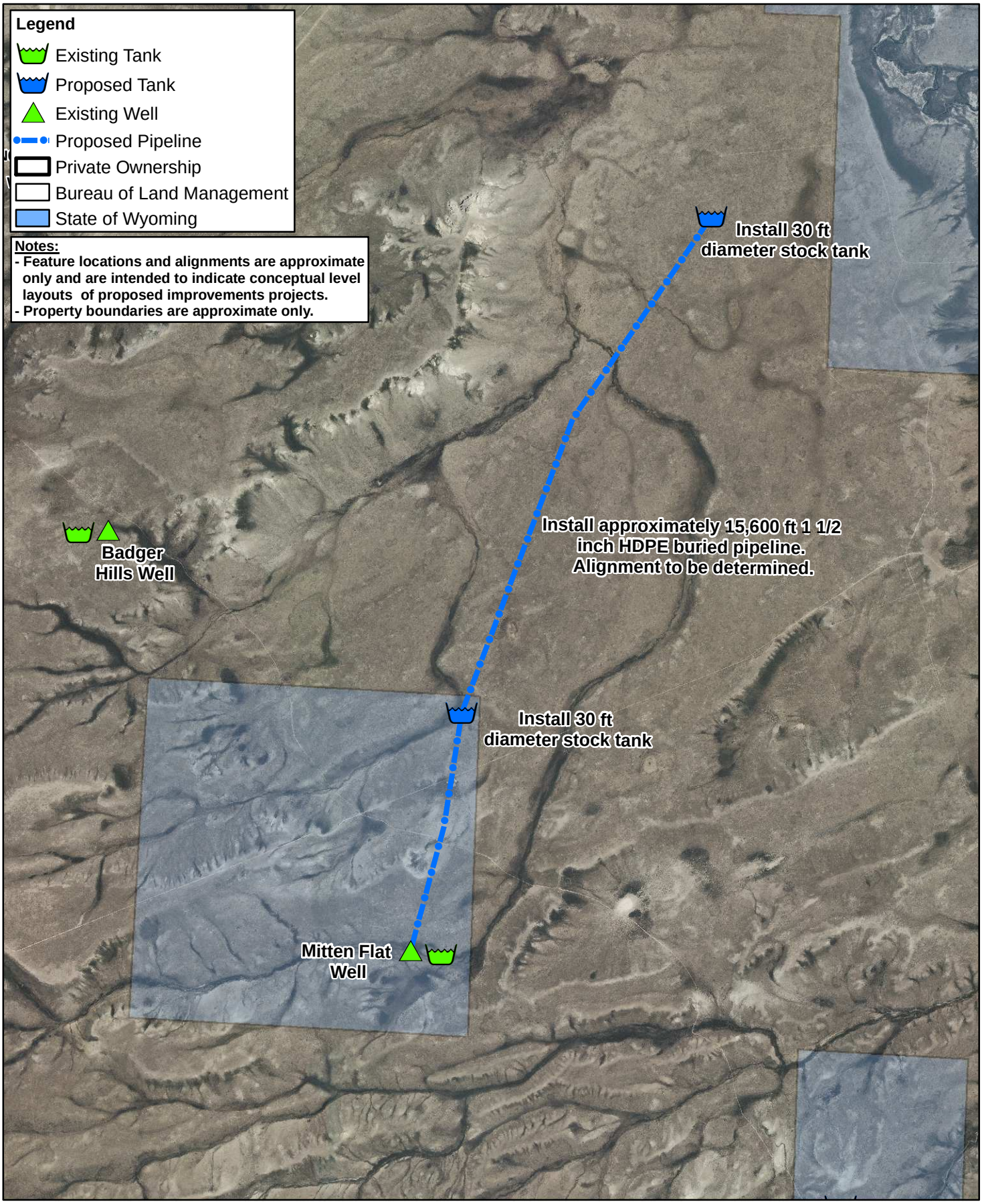

Figure 3.10: Proposed Improvements to the Mitten Flat Well (Project L/W 21)

provide any data pertaining to the reservoir. The USGS 1:24,000 topographic maps refer to the reservoir as Woods Gulch Pond. The existing outlet from the reservoir appears to be undersized and the embankment consists of what appears to be uncompacted fill (Figure 3.11).

Figure 3.11 Woods Gulch Pond Reservoir Embankment and Outlet.

Components of this project would include the following:

- Determination of reservoir permit status and determination of permitting needs for its rehabilitation.
- Removal of existing uncompacted fill
- Construction of a compacted fill reservoir embankment and emergency spillway.
- A properly sized reservoir outlet such as those commercially available through Agri Drain Corporation (www.agridrain.com) should be installed.

3.4.2.11 Green Mountain Unnamed Spring Redevelopment Project (Plan Component L/W 23)

This project involves the redevelopment of an unnamed spring located near the top of Green Mountain in Section 15, Township 28 North, Range 93 West). According the allotment permittee, the spring needs to be redeveloped to capture adequate flow. As shown in Figure 3.12, the project would incorporate the following components:

- Redevelopment of an existing spring to facilitate diversion to a gravity pipeline.
- A 1,200 gallon stock tank would be installed downslope of the spring.
- The spring vicinity would be fenced to prevent trampling by livestock and wildlife.

3.4.2.12 Unnamed Sheep Creek Oil Field Spring Rehabilitation Project (Plan Component L/W 24)

This project involves the redevelopment of an unnamed spring located near the Sheep Creek Oil Field in Section 14, Township 28 North, Range 92 West). The spring has been

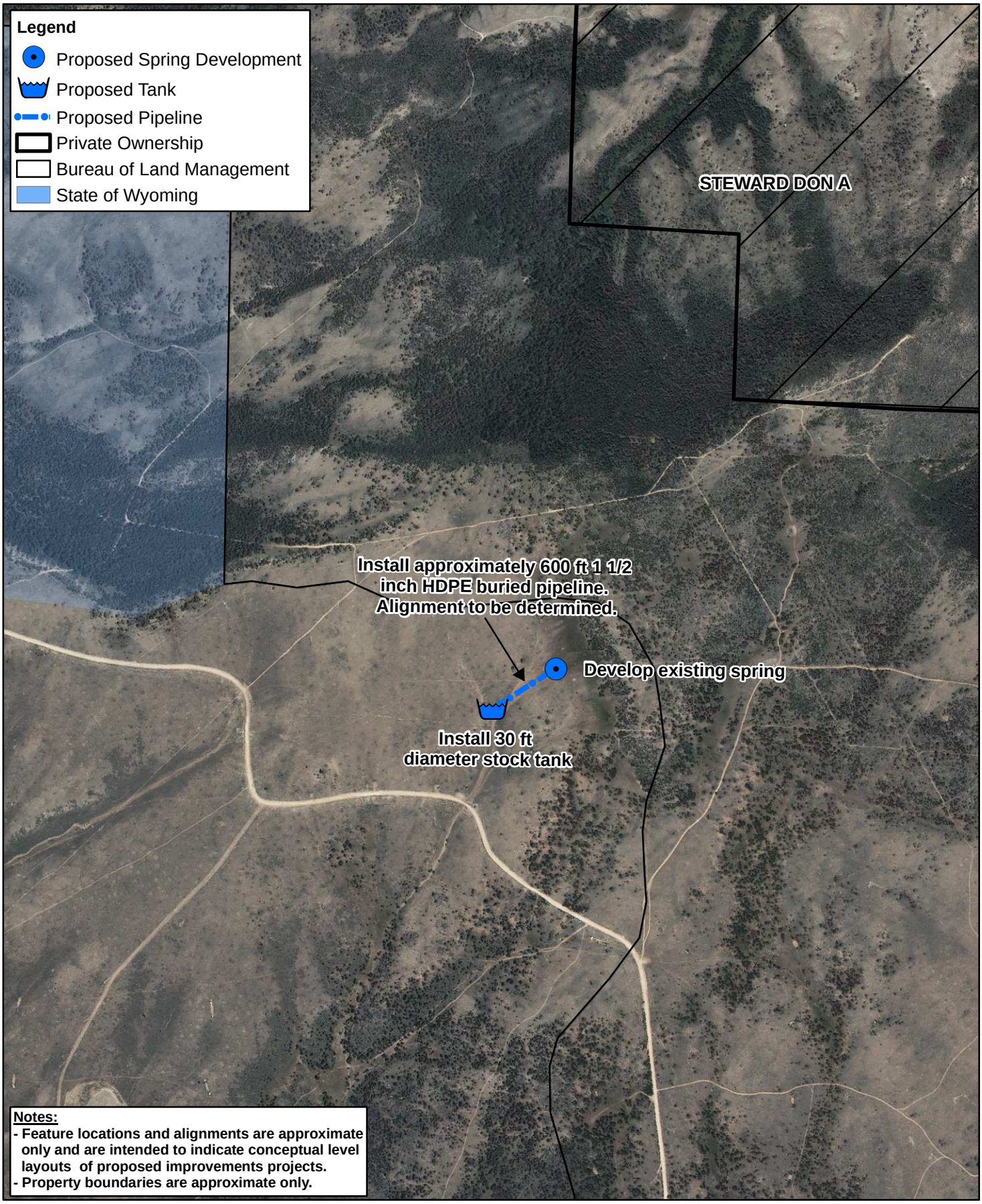

Figure 3.12: Proposed Improvements to Unnamed Green Mountain Spring (Project L/W 23)

previously developed and equipped with a livestock/wildlife water tank. However, the existing tank is undersized and provides an inefficient watering opportunity. As indicated in Figure 3.13, under this alternative, the following components would be employed:

- Redevelopment of an existing spring to facilitate diversion to a gravity pipeline.
- A 30-foot diameter bottomless concrete stock tank (10,000 gallon capacity) would be installed.
- Wildlife egress ramps would be installed.
- The spring vicinity would be fenced to prevent trampling by livestock and wildlife.

3.4.3 Development of Existing Springs and Wells (L/W 25 through 28)

The proposed projects presented in this section were developed by the project team following interviews with individual allotment permittees, representatives of the BLM, and private landowners. As presented in Chapter 2, there are numerous springs scattered throughout the Phase III 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. Sizing of water facilities cannot be determined at this time due to the uncertainties associated with the grazing management plan proposed by the BLM. For the purposes of this project, watering facilities were assumed to consist of 30-foot diameter, bottomless concrete stock tanks providing approximately 10,000 gallons of storage. This volume would facilitate the water needs of approximately 667 cattle per day assuming a water requirement of 15 gallons per day. A water source capable of providing 7 gallons per minute would be required to supply these facilities. For proposed projects consisting of multiple water facilities, a correspondingly larger source would be necessary. By incorporating closed storage tanks in a project design, greater use of existing water sources could be realized.

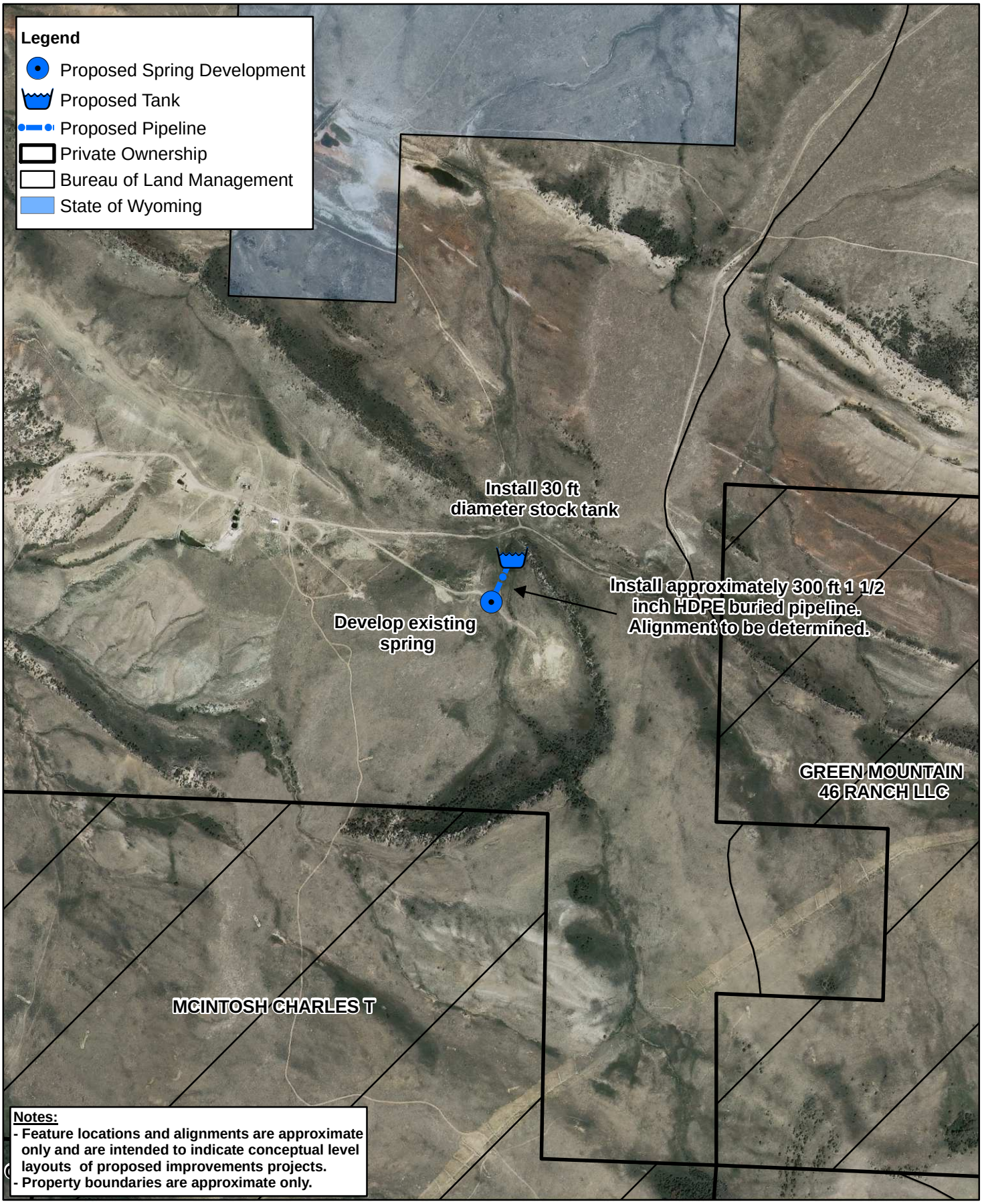

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Figure 3.13: Proposed Improvements to Sheep Creek Stock Tank (Project L/W 24)

3.4.3.1 Bare Ring Slough Well Improvement Project (Plan Component L/W 25)

Wildlife and livestock in this portion of the study area currently obtain water primarily from existing surface water sources; consequently riparian corridors may be heavily utilized. An existing well, located on State lands in Section 17, Township 27 North, Range 92 West could potentially be used as a source of wildlife and livestock water within the Crooks Creek portion of the Phase III study area. The well's origin is uncertain at this time, however, a search of the groundwater permits database maintained by the Wyoming State Engineers Office indicates the well's permit (P76533W) has been cancelled. Utilization of this well would therefore require coordination with the WSEO and the permit applicants for usage (BLM, State of Wyoming, and Green Mountain Energy).

According to the WSEO database, the well is 150 feet deep and has an actual yield of approximately 12 gallons permit under artesian conditions. Field observation of this well are consistent with these parameters, however, well testing was not conducted.

This well could potentially be used as a water source for a pipeline project serving several wildlife and livestock watering facilities. As shown in Figure 3.14, a water storage tank (15,000 gallons) could be placed on State lands at an elevation of approximately 7,000 feet. A solar pump located at the well would pump water from the well to the storage facility. A gravity-fed pipeline system could then be designed to supply water to up to four or more 30-foot diameter stock tanks located downslope.

In lieu of displaying specific pipeline and watering facilities alternatives, the general area potentially served by the well has been delineated for illustrative purposes.

Under this alternative, the following components would be employed:

- An existing well in the Bare Ring Slough drainage would be tested and its yield quantified.
- Pending adequate water yield, a storage tank (15,000 gallons) would be placed on State land approximately 300 feet southwest of the well.
- The well would be equipped with a solar pump to pump water from the well to the storage tank.
- A buried HDPE pipeline would be aligned to supply livestock / wildlife watering facilities located at locations to be determined downslope.

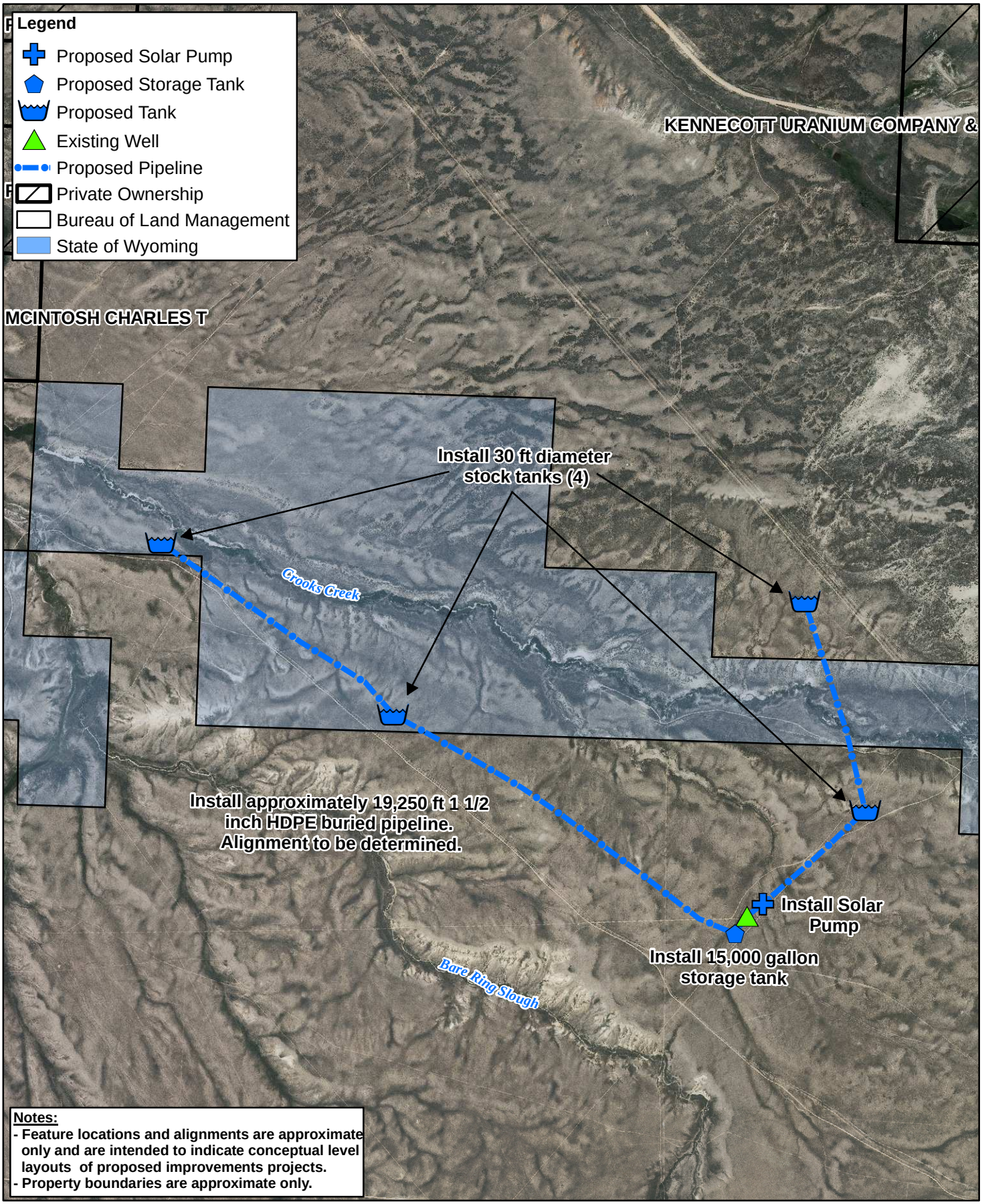

Figure 3.14: Proposed Bare Ring Slough Project (Project L/W 25)

3.4.3.2 Livestock / Wildlife Alternative 26: Black Rock Springs Pipeline Project

Wildlife and livestock in this portion of the Phase III study area obtain water from Black Rock Draw which is fed by Black Rock Spring. Due to limited water sources in this area, the riparian area of Black Rock Draw is heavily utilized by both wildlife and livestock. In an effort to relieve pressures upon the riparian corridor, this project is proposed. The objective of the project would be to provide an alternative water source to the stream and to encourage livestock usage of the upland areas within the Granite Mountain Allotment. This project would involve construction of a spring development in Black Rock Draw, a buried pipeline, and a several stock tanks located outside of the riparian corridor. Figure 3.15 displays the general configuration of this alternative.

Under this alternative, the following components would be employed:

- A diversion facility would be constructed in Black Rock Draw. The facility would consist of a buried gravel infiltration gallery and perforated pipe. A valve would be included for management of pipeline flows.
- The buried HDPE pipeline (1.5-inch diameter) would be routed in a southerly alignment to facilitate gravity flow. The length of the pipeline, as delineated, would be approximately 27,000 linear feet.
- As delineated, three 30-foot diameter stock tanks (10,000 gallon capacity each) would be installed at locations to be determined.

Note that as delineated, the proposed project would involve construction on private lands as well as on federally owned lands administered by the BLM.

3.4.3.3 Livestock / Wildlife Alternative 27: Barras Springs Protection Project

This project involves fencing the Barras Springs, located in Section 21, Township 29 North, Range 96 West. The objective of this project is to protect the existing springs from over-utilization by wildlife and livestock. The project would involve placement of approximately two miles of fence in an alignment to be determined. Note that this project would involve privately owned lands (Nature Conservancy) and possibly federally-owned lands administered by the BLM depending upon fencing configuration.

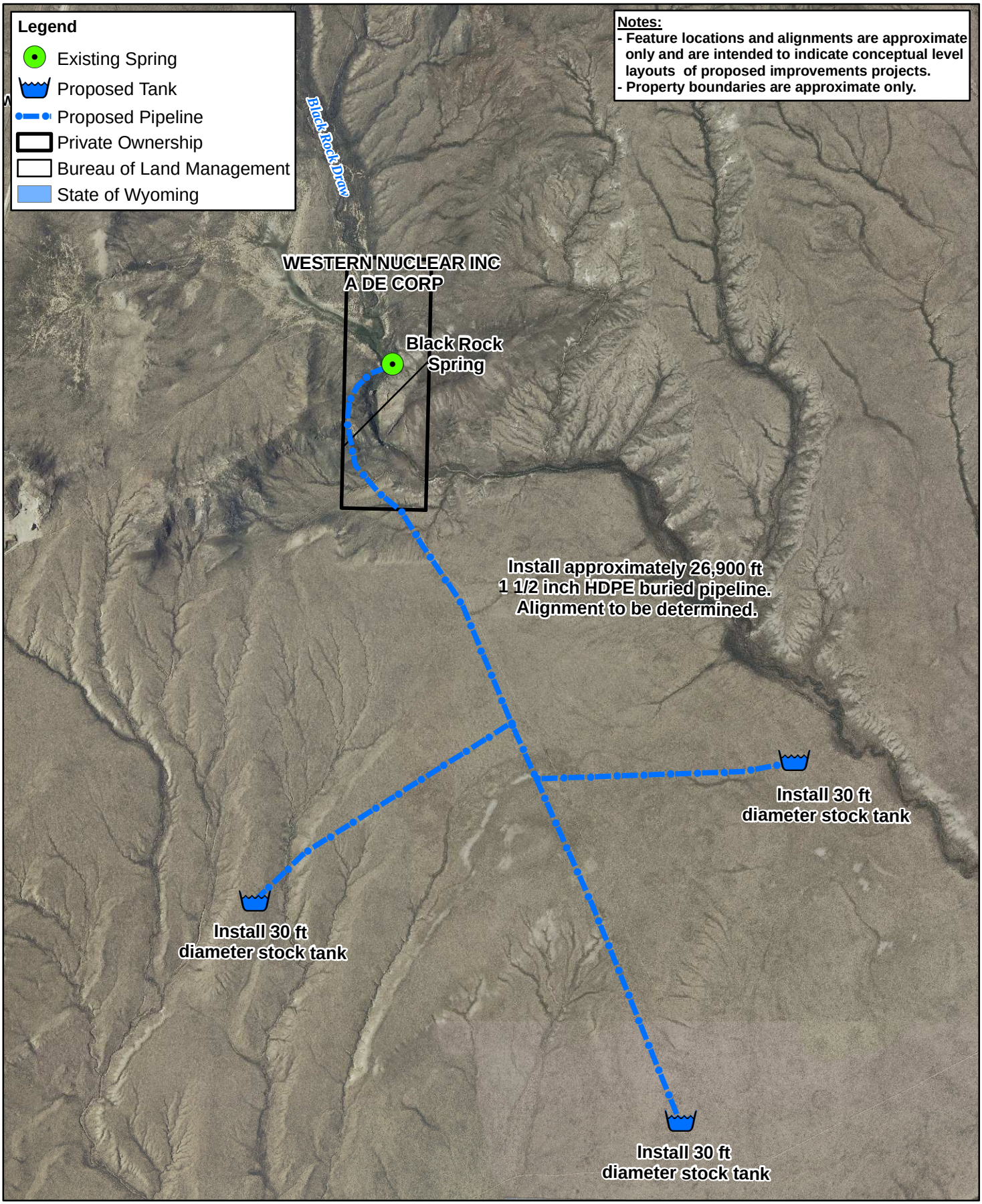

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Figure 3.15: Proposed Black Rock Springs Pipeline Project (Project L/W 26)

3.4.3.4 Livestock / Wildlife Alternative 28: Tincup Spring Development

Wildlife and livestock in this portion of the Phase III study area obtain water from Tin Cup Creek which is fed by Tin Cup Spring. Due to limited water sources in this area, the riparian area of Black Rock Draw is heavily utilized by both wildlife and livestock. In an effort to relieve pressures upon the riparian corridor, this project is proposed. The objective of the project would be to provide an alternative water source to the stream and to encourage livestock usage of the upland areas within the Jammerman Pastures Allotment. This project would involve construction of a spring development in Tin Cup Creek (Section 20, Township 31 North, Range 92 West), a buried pipeline, and at least one stock tank located outside of the riparian corridor. Figure 3.16 displays the general configuration of this alternative.

Under this alternative, the following components would be employed:

- A diversion facility would be constructed in Tin Cup Creek. The facility would consist of a buried gravel infiltration gallery and perforated pipe. A valve would be included for management of pipeline flows.
- The spring area would be fenced to relieve pressures on the riparian corridor.
- The buried HDPE pipeline (1.5-inch diameter) would be routed in an easterly alignment to be determined to optimize range utilization and to facilitate gravity flow. The length of the pipeline, as delineated, would be approximately 17,000 linear feet under the configuration displayed.
- As delineated, one 30-foot diameter stock tank (10,000 gallon capacity) would be installed at a location to be determined.

The spring originates on lands owned by the State of Wyoming; riparian areas on lands downstream and lands under the potential pipeline alignment are federally owned and administered by the BLM.

3.4.4 New Well Construction Projects (L/W 29 through 37)

The proposed projects presented in this section were developed by the project team following interviews with individual allotment permittees, representatives of the BLM, and private landowners. These projects involve construction of new wells in areas where development of alternatives is not practical.

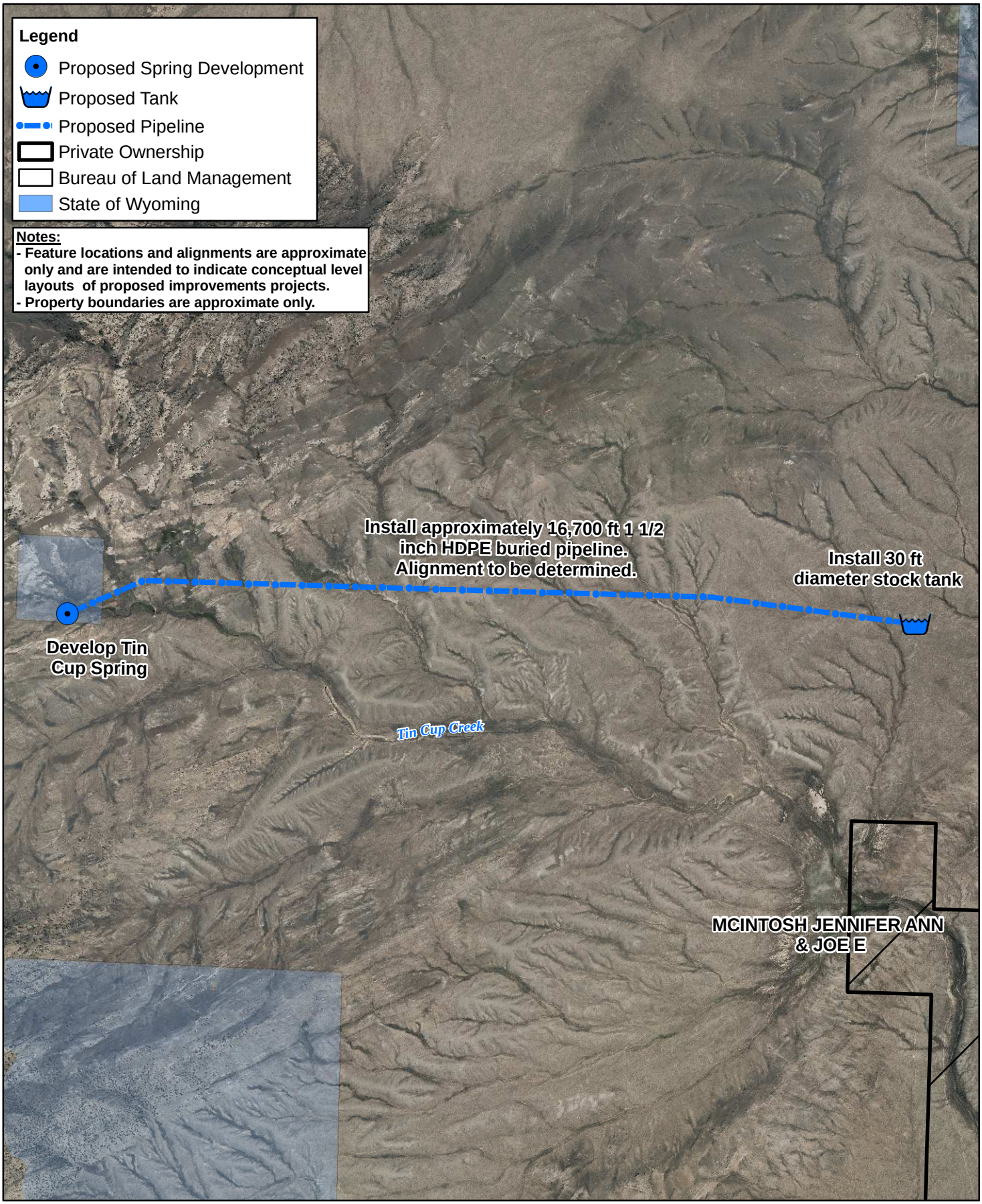

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Figure 3.16: Proposed Tin Cup Spring Pipeline Project (Project L/W 28)

Final design of any well construction project will require detailed analysis of geologic and hydrogeologic conditions which were beyond the scope of this project. For the purpose of this investigation, well depths of proposed wells were assumed to be commensurate with surrounding wells. Also, adequate well yield would be required to provide a reliable source of water for any proposed project.

3.4.4.1 Soda Lakes Well Project (L/W 29)

This alternative involves the completion of a well near the Soda Lakes area north of the Sweetwater River in Section 25, Township 30 North, Range 91 West. Currently, Soda Lakes provide water for livestock and wildlife in this area, however, water quality of the source is poor. Consequently, construction of new well may provide a reliable source of water of adequate quality.

Under this alternative, the following components would be employed:

- A well would be constructed in the vicinity of the location shown on Figure 3.7. Based upon the completion depth of nearby wells, a well in this vicinity would likely require drilling to approximately 100 feet. For the purpose of this investigation and the uncertainty of the hydrogeologic conditions at the site, a depth of 150 feet was used for cost estimating purposes.
- The proposed well would be equipped with a solar pump.
- One 30-foot diameter stock tank (10,000 gallon capacity) would be installed at the well.

Note that this alternative would involve federally-owned lands administered by the BLM.

3.4.4.2 Picket Creek Well Project (L/W 30)

This alternative would involve completion of a new well in the vicinity of the Picket Creek located in Section 16, Township 27 North, Range 98 West. This area was identified as an area which would benefit from additional upland water supplies. The alternative would involve construction of a new well in the vicinity indicated in Figure 3.17 and utilization of a solar pump.

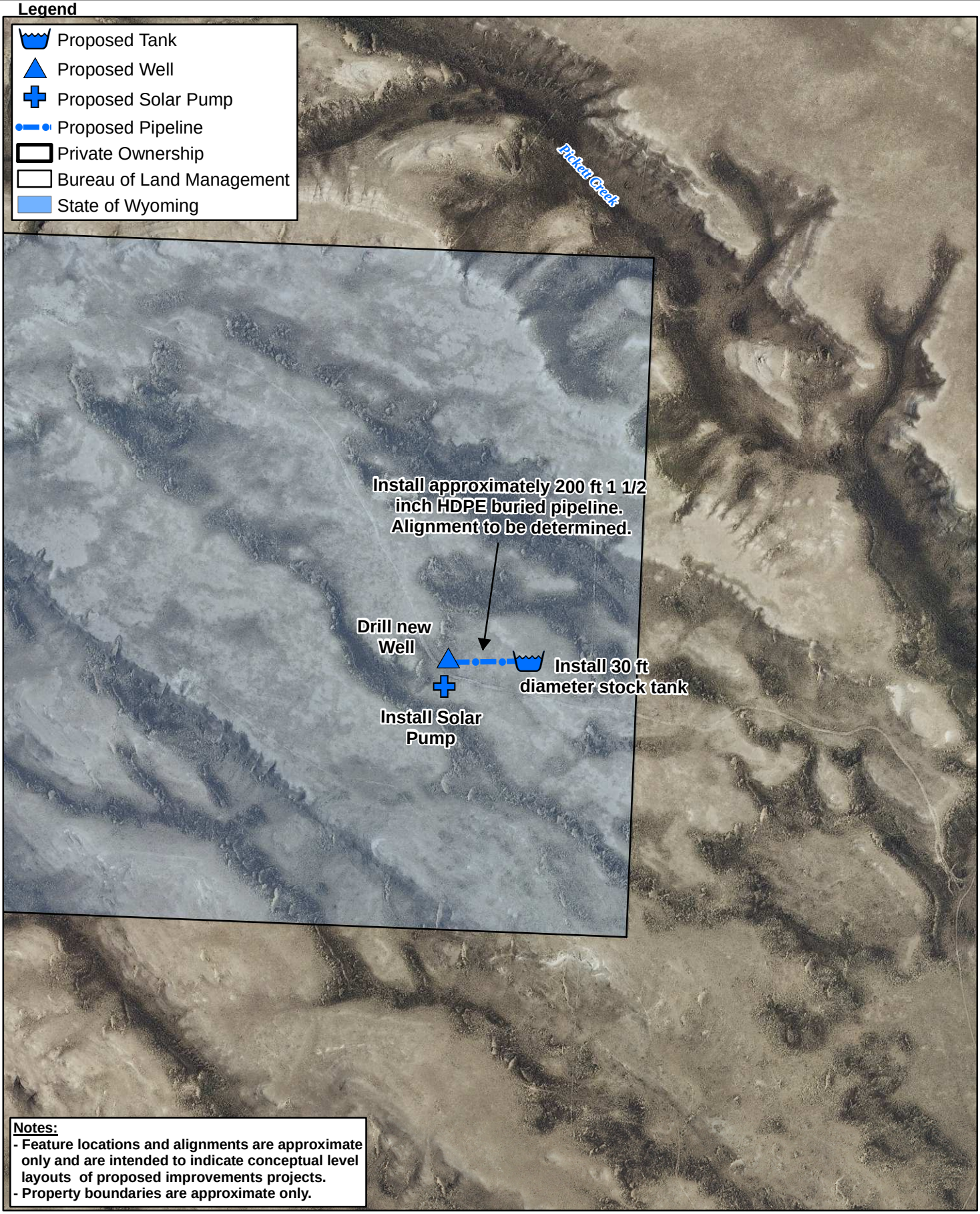

Figure 3.17: Proposed Pickett Creek Well Project (Project L/W 30)

The objective of the alternative is to provide a viable source of upland water to livestock and wildlife in an area identified as benefiting from additional upland water sources. The project would be located within the proposed Antelope Hills Allotment of a divided GMCA.

Under this alternative, the following components would be utilized:

- A new well with submersible pump would be constructed. The new well is assumed to be approximately 250 to 300 feet deep based upon reported depth of nearby wells.
- One 30-foot diameter stock tank (10,000 gallon capacity) would be installed at the well.
- A solar pump facility would be incorporated (submersible pump, solar panels, batteries, and connections).

This alternative as presented would involve only lands owned by the State of Wyoming. Extension of the project by means of a buried pipeline supplying additional stock tank(s) could potentially be completed pending BLM approval and sufficient yield of the proposed well.

3.4.4.3 Mitten Springs Area Well Project (L/W 31)

This alternative would involve completion of a new well in the vicinity of Mitten Springs located in Section 36, Township 28 North., Range 97 West. This area was identified as an area which would benefit from additional upland water supplies. The alternative would involve construction of a new well in the vicinity indicated in Figure 3.7 and utilization of a solar pump.

The objective of the alternative is to provide a viable source of upland water to livestock and wildlife in an area identified as benefiting from additional upland water sources. The project would be located within the proposed Antelope Hills Allotment of a divided GMCA.

Under this alternative, the following components would be utilized:

- A new well with submersible pump would be constructed in the vicinity indicated in Figure 3.7. The new well is assumed to be approximately 200 feet deep based upon reported depth of nearby wells.
- A solar pump facility would be incorporated (submersible pump, solar panels, batteries, and connections).
- One 30-foot diameter stock tank (10,000 gallon capacity) would be installed at the well.

This alternative as presented would involve only lands owned by the State of Wyoming. Extension of the project by means of a buried pipeline supplying additional stock tank(s) could potentially be completed pending BLM approval and sufficient yield of the proposed well.

3.4.4.4 Upper Middle Fork Sulphur Creek Well Project (L/W 32)

This alternative would involve completion of a new well in the vicinity of Middle Fork Sulphur Creek located in Section 36, Township 28 North., Range 98 West. This area was identified as an area which would benefit from additional upland water supplies. The alternative would involve construction of a new well in the vicinity indicated in Figure 3.7 and utilization of a solar pump.

The objective of the alternative is to provide a viable source of upland water to livestock and wildlife in an area identified as benefiting from additional upland water sources. The project would be located within the proposed Antelope Hills Allotment of the divided GMCA.

Under this alternative, the following components would be utilized:

- A new well with submersible pump would be constructed in the vicinity indicated in Figure 3.7. The new well is assumed to be approximately 200 to 250 feet deep based upon reported depth of nearby wells.
- A solar pump facility would be incorporated (submersible pump, solar panels, batteries, and connections).
- One 30-foot diameter stock tank (10,000 gallon capacity) would be installed at the well.

This alternative as presented would involve only lands owned by the State of Wyoming. Extension of the project by means of a buried pipeline supplying additional stock tank(s) could potentially be completed pending BLM approval and sufficient yield of the proposed well.

3.4.4.5 Alkali Creek Tributary Well Project No. 1 (L/W 33)

This alternative would involve completion of a new well in Section 6, Township 28 North., Range 94 West This area was identified as an area which would benefit from additional upland water supplies. The alternative would involve construction of a new well in the vicinity indicated in Figure 3.7 and utilization of a solar pump.

The objective of the alternative is to provide a viable source of upland water to livestock and wildlife in an area identified as benefiting from additional upland water sources. The project would be located within the proposed Antelope Hills Allotment of the divided GMCA.

Under this alternative, the following components would be utilized:

- A new well with submersible pump would be constructed in the vicinity indicated in Figure 3.7. The new well is assumed to be approximately 200 to 250 feet deep based upon reported depth of nearby wells.
- A solar pump facility would be incorporated (submersible pump, solar panels, batteries, and connections).
- One 30-foot diameter stock tank (10,000 gallon capacity) would be installed at the well.

This alternative involves federally-owned lands administered by the BLM.

3.4.4.6 Alkali Creek Tributary Well Project No. 2 (L/W 34)

This alternative would involve completion of a new well in Section 18, Township 28 North, Range 95 West. This area was identified as an area which would benefit from additional upland water supplies. The alternative would involve construction of a new well in the vicinity indicated in Figure 3.7 and utilization of a solar pump.

The objective of the alternative is to provide a viable source of upland water to livestock and wildlife in an area identified as benefiting from additional upland water sources. The project would be located within the proposed Antelope Hills Allotment of a divided GMCA.

Under this alternative, the following components would be utilized:

- A new well with submersible pump would be constructed in the vicinity indicated in Figure 3.7. The new well is assumed to be approximately 200 to 250 feet deep based upon reported depth of nearby wells.
- A solar pump facility would be incorporated (submersible pump, solar panels, batteries, and connections).
- One 30-foot diameter stock tank (10,000 gallon capacity) would be installed at the well.

This alternative involves federally-owned lands administered by the BLM.

3.4.4.7 Ladysmith Draw Well Project (L/W 35)

This alternative would involve completion of a new well in Section 32, Township 29 North, Range 96 West This area was identified as an area which would benefit from additional upland water supplies. The alternative would involve construction of a new well in the vicinity indicated in Figure 3.7 and utilization of a solar pump.

The objective of the alternative is to provide a viable source of upland water to livestock and wildlife in an area identified as benefiting from additional upland water sources. The project would be located within the proposed Antelope Hills Allotment of the divided GMCA.

Under this alternative, the following components would be utilized:

- A new well with submersible pump would be constructed in the vicinity indicated in Figure 3.7. The new well is assumed to be approximately 200 to 250 feet deep based upon reported depth of nearby wells.
- A solar pump facility would be incorporated (submersible pump, solar panels, batteries, and connections).
- One 30-foot diameter stock tank (10,000 gallon capacity) would be installed at the well.

This alternative involves federally-owned lands administered by the BLM.

3.4.4.8 Alkali Creek Tributary Well Project No. 3 (L/W 36)

This alternative would involve completion of a new well in Section 5, Township 27 North, Range 95 West This area was identified as an area which would benefit from additional upland water supplies. The alternative would involve construction of a new well in the vicinity indicated in Figure 3.7 and utilization of a solar pump.

The objective of the alternative is to provide a viable source of upland water to livestock and wildlife in an area identified as benefiting from additional upland water sources. The project would be located within the proposed Antelope Hills Allotment of a divided GMCA.

Under this alternative, the following components would be utilized:

- A new well with submersible pump would be constructed in the vicinity indicated in Figure 3.7. The new well is assumed to be approximately 400 to 450 feet deep based upon reported depth of nearby wells.
- A solar pump facility would be incorporated (submersible pump, solar panels, batteries, and connections).

- One 30-foot diameter stock tank (10,000 gallon capacity) would be installed at the well.

This alternative involves federally-owned lands administered by the BLM.

3.4.4.9 North Immigrant Well Project (L/W 37)

This alternative would involve completion of a new well in the vicinity of Warm Springs Creek located in Section 16, Township 29 North., Range 95 West. This area was identified as an area which would benefit from additional upland water supplies. The alternative would involve construction of a new well in the vicinity indicated in Figure 3.7 and utilization of a solar pump.

The objective of the alternative is to provide a viable source of upland water to livestock and wildlife in an area identified as benefiting from additional upland water sources. The project would be located within the proposed Antelope Hills Allotment of the divided GMCA.

Under this alternative, the following components would be utilized:

- A new well with submersible pump would be constructed in the vicinity indicated in Figure 3.7. The new well is assumed to be approximately 200 to 250 feet deep based upon reported depth of nearby wells.
- A solar pump facility would be incorporated (submersible pump, solar panels, batteries, and connections).
- One 30-foot diameter stock tank (10,000 gallon capacity) would be installed at the well.

This alternative as presented would involve only lands owned by the State of Wyoming. Extension of the project by means of a buried pipeline supplying additional stock tank(s) could potentially be completed pending BLM approval and sufficient yield of the proposed well.

3.4.5 Surface Water Diversion Projects (L/W 38 and L/W 40)

3.4.5.1 Upper Buffalo Creek Pipeline Project (L/W 38)

Wildlife and livestock in this portion of the Phase III study area obtain water from Buffalo Creek. Due to limited water sources in this area, the riparian area of Buffalo Creek is heavily utilized by both wildlife and livestock. In an effort to relieve pressures upon the riparian corridor, this project is proposed. The objective of the project would be to provide an

alternative water source to the stream and to encourage livestock usage of the upland areas within the Granite Mountain Open Allotment. This project would involve construction of a diversion facility in Buffalo Creek, a buried pipeline, and stock tanks located outside of the riparian corridor. Figure 3.18 displays the general configuration of this alternative. Note that the alignment presented is conceptual to display the general intent of the proposed alternative. Final alignment of the pipeline and locations/numbers of stock reservoirs would be determined during final design.

Under this alternative, the following components would be employed:

- A diversion facility would be constructed in Buffalo Creek. The facility would consist of a buried gravel infiltration gallery and perforated pipe. A valve would be included for management of pipeline flows.
- A solar pump would be incorporated to pump diverted water via a buried HDPE pipeline (1½-inch diameter) to a storage tank (15,000 gallons) located north of the diversion.
- A buried HDPE pipeline (1.5-inch diameter) would be routed easterly and westerly on an alignment selected to optimize range utilization and to facilitate gravity flow from the storage tank. The length of the pipeline, as delineated, would be approximately 39,000 linear feet under the configuration displayed.

As delineated, four 30-foot diameter stock tanks (10,000 gallon capacity) would be installed at locations to be determined.

3.4.5.2 Coyote Gulch Pipeline Project (L/W 39)

This alternative would take advantage of perennial surface water supplies available in upper Coyote Gulch in an effort to reduce pressures upon its riparian corridor. The alternative would supply water to a portion of the watershed lacking adequate alternative livestock and wildlife upland water sources. Figure 3.19 displays the general configuration of this alternative.

Under this alternative, the following components would be employed:

- A diversion facility would be constructed in Coyote Gulch. The facility would conceivably be installed in Section 23, Township 28 North, Range 96 West The facility would consist of a buried gravel infiltration gallery and perforated pipe. A valve would be included for management of pipeline flows.
- A solar pump would be installed at the diversion facility.

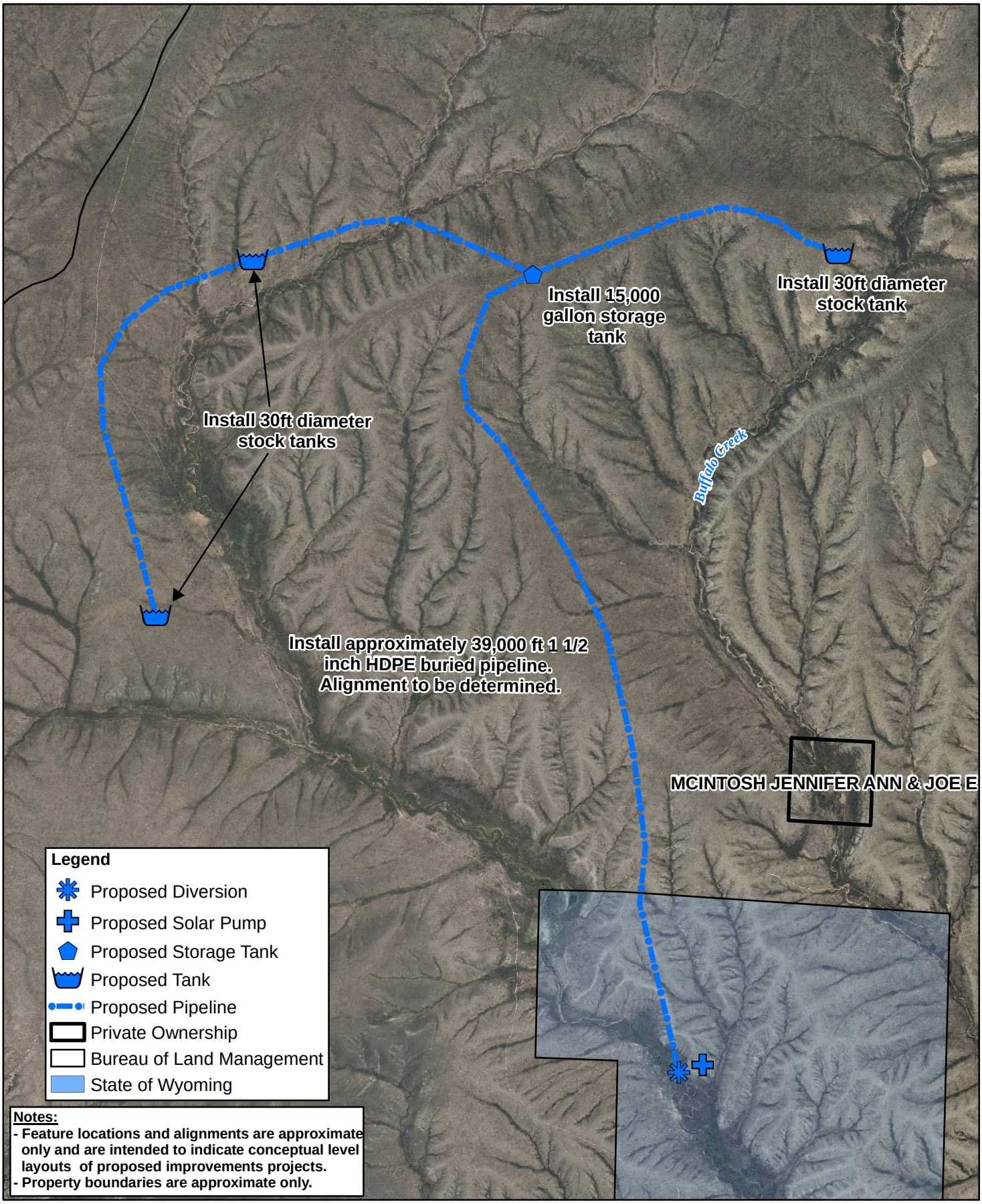

Figure 3.18: Proposed Buffalo Creek Pipeline Project (Project L/W 38)

- The buried HDPE pipeline (a total of approx. 6,500 feet) would be routed away from Coyote Gulch to stock tanks located outside of the riparian corridor.
- The portion of the Coyote Gulch riparian corridor which is heavily utilized would be fenced (approximately 21,000 lf).
- As configured under this alternative, two (2) 30-foot diameter bottomless concrete stock tanks (10,000 gallon capacity each) would be placed at sites determined during final design.

The initial design displayed in Figure 3.19 indicates the potential of designing the project such that it involves only lands owned by the State of Wyoming. Extension of the project would be feasible pending BLM approval.

3.4.5.3 Warm Springs Pipeline Project (L/W 40)

This alternative would take advantage of perennial surface water supplies available in Warms Springs Draw in an effort to reduce pressures upon its riparian corridor. The alternative would supply water to a portion of the watershed lacking adequate alternative livestock and wildlife upland water sources. Figure 3.20 displays the general configuration of this alternative.

Under this alternative, the following components would be employed:

- A diversion facility would be constructed in Warms Springs Draw. The facility would conceivably be installed in Section 25 or 16, Township 29 North, Range 95 West. The facility would consist of a buried gravel infiltration gallery and perforated pipe. A valve would be included for management of pipeline flows.
- A solar pump would be installed at the diversion facility.
- The buried HDPE pipeline (a total of approx. 12,800 feet) would be routed away from Warm Springs Draw to stock tanks located away from the riparian corridor.
- The portion of the Warm Springs Draw riparian corridor which is heavily utilized would be fenced (approximately 29,000 lf).
- As configured under this alternative, two (2) stock tanks (10,000 gallon capacity each) would be placed at sites determined during final design.

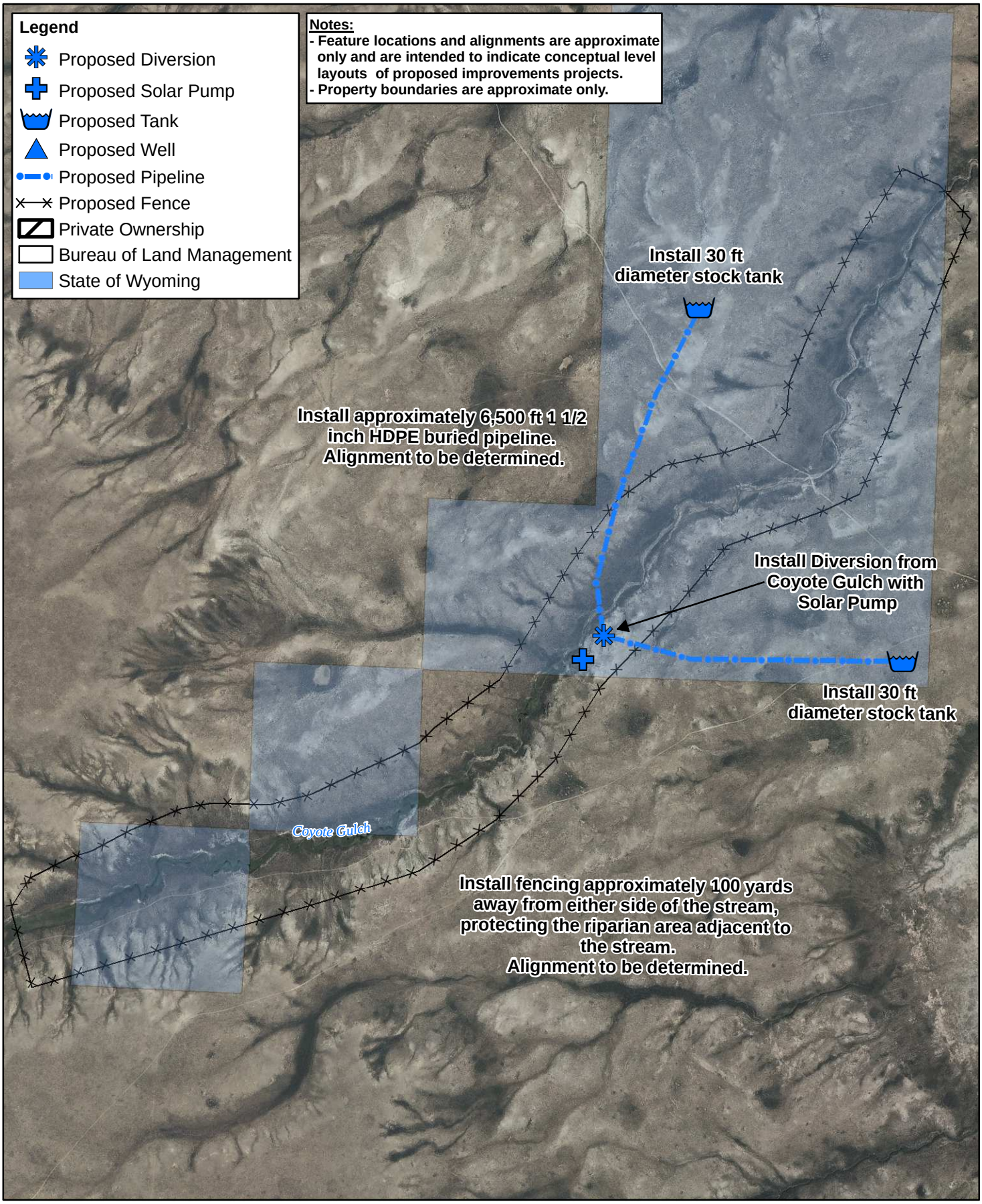

Figure 3.19: Proposed Coyote Gulch Pipeline Project (Project L/W 39)

The initial design displayed in Figure 3.20 indicates the potential of designing the project such that involves only lands owned by the State of Wyoming and private lands. Extension of the project would be feasible pending BLM approval.

3.4.6 Additional Upland Management Opportunities

Guzzlers are artificial catchments providing sources of water in remote areas for wildlife. Larger systems could be employed for livestock watering purposes. They rely entirely upon direct precipitation; therefore, their reliability is only as good as can be expected in a water short region. Figure 3.21 displays a photo of a guzzler installed in the Cottonwood Creek watershed near Thermopolis, Wyoming. The option of installing a guzzler type water collection system with watering facilities may be considered in areas where wildlife water is needed, and alternative options are not available.

Figure 3.21 Wildlife Guzzler.

Guzzler watering systems utilize direct precipitation as a source of supply, with a storage tank of capacity suitable to the watering need. Wildlife guzzlers are typically designed to maximize use by wildlife and discourage use 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,
- 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, and
- Overflow pipe – with erosion protection at discharge.

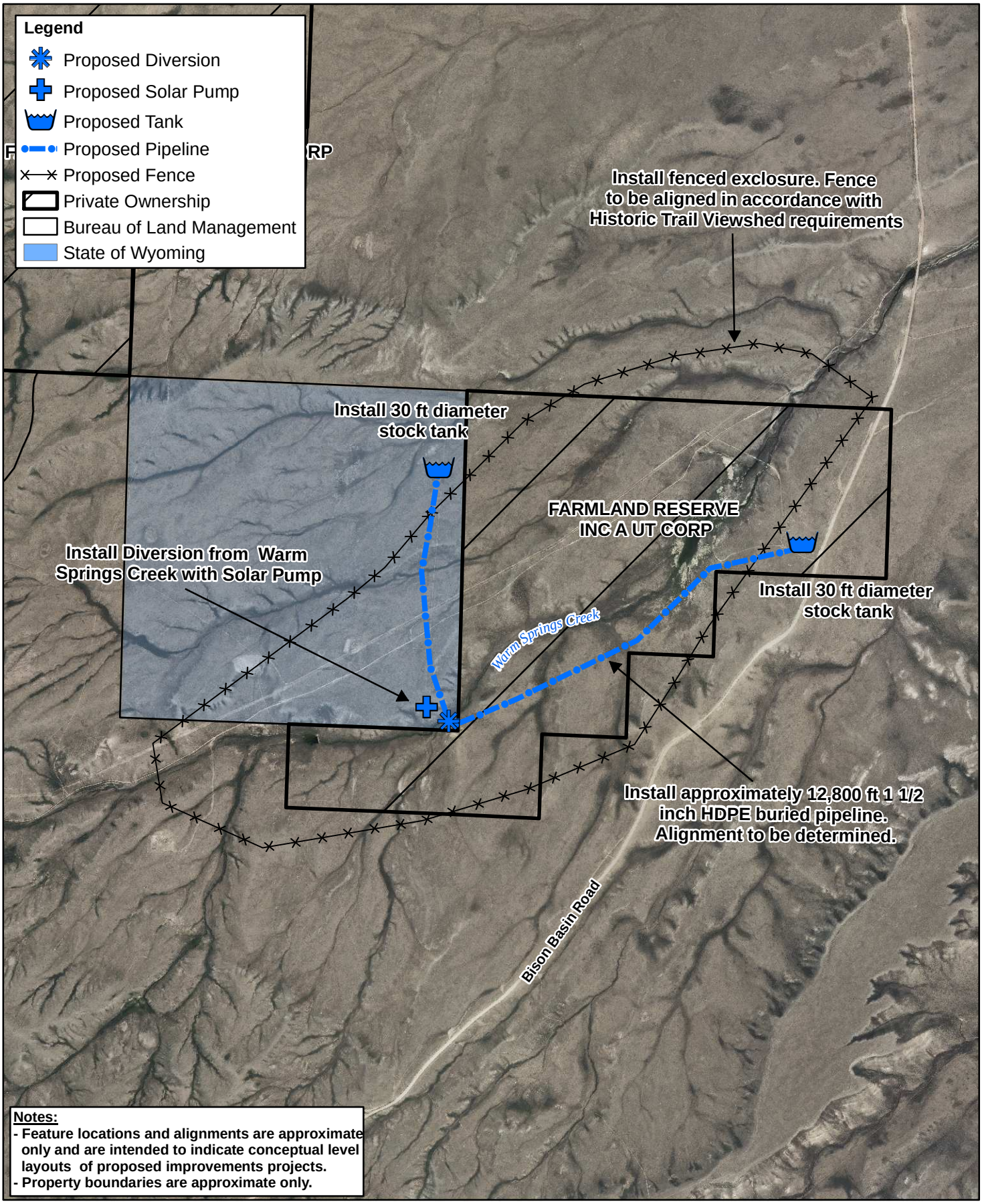

Figure 3.20: Proposed Warm Springs Pipeline Project (Project L/W 40)

These guzzlers would be installed at locations to be determined. 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. Complete guzzler systems are commercially available.

3.4.7 Cost Estimates: Upland Wildlife/Livestock Water

Conceptual level cost estimates for upland wildlife / livestock water opportunities are presented in Table 3.5.

3.5 Grazing Management Opportunities

3.5.1 State and Transition Models

In Chapter 2, 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 analysis presented in Chapter 2, the dominant ecological site is:

- Sandy (Sy) 10-14 inch precipitation zone, High Plains Southeast.

This ecological site comprises over 37.8% of the entire watershed.

Table 3.5 Conceptual Cost Estimates: Livestock/Wildlife Water Supply Projects.

Project Component		L/W 1	L/W 2	L/W 3	L/W 4	L/W 5	L/W 6	L/W 7	L/W 8	L/W 9	L/W 10
		BLM Recommendations: Cameco Well	**BLM Recommendations: Bare Ring Butte Well**	**BLM Recommendations: Circle Bar Well**	**BLM Recommendations: North Horse Track Well**	**BLM Recommendations: Monument Well**	**BLM Recommendations: Smiley Well**	**BLM Recommendations: Granite Spring**	**BLM Recommendations: Upper Ladysmith**	**BLM Recommendations: Lower Wager Meadows**	**BLM Recommendations: Twin Springs**
Well Construction / Spring Development / Diversion	Mobilization	Unspecified improvements to an existing well. Costs for the proposed improvement were presented in Table 4-2, of the GMCA EA (BLM, 2011)	Unspecified improvements to an existing well. Costs for the proposed improvement were presented in Table 4-2, of the GMCA EA (BLM, 2011)	New Well Construction. Costs for the proposed improvement were presented in Table 4-2, of the GMCA EA (BLM, 2011)	New Well Construction. Costs for the proposed improvement were presented in Table 4-2, of the GMCA EA (BLM, 2011)	New Well Construction. Costs for the proposed improvement were presented in Table 4-2, of the GMCA EA (BLM, 2011)	New Well Construction. Costs for the proposed improvement were presented in Table 4-2, of the GMCA EA (BLM, 2011)	Spring Protection Fencing Buck and Pole Construction Costs for the proposed improvement were presented in Table 4-2, of the GMCA EA (BLM, 2011)	Spring Protection Fencing Buck and Pole Construction Costs for the proposed improvement were presented in Table 4-2, of the GMCA EA (BLM, 2011)	Spring Protection Fencing Buck and Pole Construction Costs for the proposed improvement were presented in Table 4-2, of the GMCA EA (BLM, 2011)	Spring Protection Fencing Buck and Pole Construction Costs for the proposed improvement were presented in Table 4-2, of the GMCA EA (BLM, 2011)
	Well / Spring										
	Units (each)										
	Depth Each										
	Unit Cost ($/LF wells or $/EA springs)/diversion										
	Well Screen (LF each well)										
	Well Screen ($/LF)										
	Component Subtotal										
Stock Pond Construction	Mobilization										
	Units (EA)										
	Pond Unit Cost ($ EA)										
	Liner (SF each pond)										
	Liner Unit Cost ($/SF)										
	Liner Cost per Pond										
	Component Subtotal										
Pump	Units (EA)										
	Type										
	Unit Cost (EA)										
	Component Subtotal										
Pipeline	Units										
	Units (LF)										
	Unit Cost										
	Component Subtotal										
Additional: Storage Tanks	Units (EA)										
	Size (gal)										
	Unit Cost ($1/gal)										
	Component Subtotal										
Water Tanks	Units (EA)										
	Size (gal)										
	Unit Cost										
	Component Subtotal										
Fencing	Units (EA)										
	Units (LF each)										
	Unit Cost ($/LF)										
	Component Subtotal										
Miscellaneous	Item										
	Comment										
	Unit Cost										
	Component Subtotal										
Construction Subtotal		**$10,180**	**$10,180**	**$33,088**	**$33,088**	**$33,088**	**$33,088**	**$7,362**	**$7,362**	**$7,362**	**$7,362**
Engineering (10%)		$1,018	$1,018	$3,309	$3,309	$3,309	$3,309	$736	$736	$736	$736
Construction and Engineering Subtotal		**$11,198**	**$11,198**	**$36,397**	**$36,397**	**$36,397**	**$36,397**	**$8,098**	**$8,098**	**$8,098**	**$8,098**
Contingency (15%)		$1,680	$1,680	$5,460	$5,460	$5,460	$5,460	$1,215	$1,215	$1,215	$1,215
Total Construction Cost		**$12,878**	**$12,878**	**$41,856**	**$41,856**	**$41,856**	**$41,856**	**$9,313**	**$9,313**	**$9,313**	**$9,313**
Final Plans and Specs		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Additional Geotechnical Services											
Permitting / Legal Fees / Acces and Rights of Way		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Project Cost		**$12,878**	**$12,878**	**$41,856**	**$41,856**	**$41,856**	**$41,856**	**$9,313**	**$9,313**	**$9,313**	**$9,313**

Table 3.5 Conceptual Cost Estimates: Livestock/Wildlife Water Supply Projects (Continued).

Project Component		L/W 11	L/W 12	L/W 13	L/W 14	L/W 15	L/W 16	L/W 17	L/W 18	L/W 19	L/W 20
		BLM Recommendations: Mud Spring	BLM Recommendations: Fuzzy Reservoir	Tank Improvement 4	West Alkali Well Improvement Project	Daley Lake Well Improvement Project	Stampede Well Improvement	Soda Lakes Well Improvement	Fletcher Gap Well Improvement	Diamond Springs Pipeline Improvement Project	Grassy Lake Well Improvement Project
Well Construction / Spring Development / Diversion	Mobilization	Spring Protection Fencing Buck and Pole Construction Costs for the proposed improvement were presented in Table 4-2, of the GMCA EA (BLM, 2011)	Reconstruction of Existing Reservoir. Costs for the proposed improvement were presented in Table 4-2, of the GMCA EA (BLM, 2011)	$500	$500	$500	$500	$500	$250	$500	$500
	Well / Spring			Well Enhancement	Well Enhancement	Well Enhancement	Well Enhancement	Well Enhancement	Well Improvement	Pipeline Improvement	Well Improvement
	Units (each)										
	Depth Each			NA	NA	NA	NA	0	0	0	0
	Unit Cost ($/LF wells or $/EA springs)/diversion			$0	$0	$0	$0	$5,000	$5,000	$5,000	$5,000
	Well Screen (LF each well)			NA	NA	NA	NA	NA	NA	NA	NA
	Well Screen ($/LF)			NA	NA	NA	NA	NA	NA	NA	NA
	Component Subtotal			$500	$500	$500	$500	$500	$250	$500	$500
Stock Pond Construction	Mobilization										
	Units (EA)										
	Pond Unit Cost ($ EA)										
	Liner (SF each pond)										
	Liner Unit Cost ($/SF)										
	Liner Cost per Pond										
	Component Subtotal										
Pump	Units (EA)			0	0	0	0	1		1	
	Type			Solar	Solar	Solar	Solar	Solar	Solar	Solar	Solar
	Unit Cost (EA)			$8,640	$8,640	$8,640	$8,640	$8,640	$8,640	$8,640	$8,640
	Component Subtotal			$0	$0	$0	$0	$8,640	$0	$8,640	$0
Pipeline	Units							1		1	1
	Units (LF)			0	0	0	0	300	100	4,700	3,000
	Unit Cost			$1.34	$1.34	$1.34	$1.34	$1.34	$1.34	$1.34	$1.34
	Component Subtotal			$0	$0	$0	$0	$402	$0	$6,298	$4,020
Additional: Storage Tanks	Units (EA)			$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
	Size (gal)			15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000
	Unit Cost ($1/gal)			$1.00	$1.00	$1.00	$1.00	$1.00	$1.00	$1.00	$1.00
	Component Subtotal			$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Water Tanks	Units (EA)			1	1	1	1	0	2	1	2
	Size (gal)			10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
	Unit Cost			$7,000	$7,000	$7,000	$7,000	$7,000	$7,000	$7,000	$7,000
	Component Subtotal			$7,000	$7,000	$7,000	$7,000	$0	$14,000	$7,000	$14,000
Fencing	Units (EA)			0	0	0	0	0	0	0	0
	Units (LF each)			600	600	600	600	600	400	600	600
	Unit Cost ($/LF)			$2.50	$2.50	$2.50	$2.50	$2.50	$2.50	$2.50	$2.50
	Component Subtotal			$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Miscellaneous	Item			0	0	0	0	0	0		0
	Comment										
	Unit Cost										
	Component Subtotal			$0	$0	$0	$0	$0	$0	$0	$0
Construction Subtotal		**$7,362**	**$7,636**	**$7,500**	**$7,500**	**$7,500**	**$7,500**	**$9,542**	**$14,250**	**$22,438**	**$18,520**
Engineering (10%)		$736	$764	$750	$750	$750	$750	$954	$1,425	$2,244	$1,852
Construction and Engineering Subtotal		**$8,098**	**$8,400**	**$8,250**	**$8,250**	**$8,250**	**$8,250**	**$10,496**	**$15,675**	**$24,682**	**$20,372**
Contingency (15%)		$1,215	$1,260	$1,238	$1,238	$1,238	$1,238	$1,574	$2,351	$3,702	$3,056
Total Construction Cost		**$9,313**	**$9,660**	**$9,488**	**$9,488**	**$9,488**	**$9,488**	**$12,071**	**$18,026**	**$28,384**	**$23,428**
Final Plans and Specs		$0	$0	$250	$250	$250	$250	$500	$2,000	$2,000	$2,000
Additional Geotechnical Services											
Permitting / Legal Fees / Acces and Rights of Way		$0	$0	$0	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000
Total Project Cost		**$9,313**	**$9,660**	**$9,738**	**$10,738**	**$10,738**	**$10,738**	**$13,571**	**$21,026**	**$31,384**	**$26,428**

Table 3.5 Conceptual Cost Estimates: Livestock/Wildlife Water Supply Projects (Continued).

Project Component		L/W 21	L/W 22	L/W 23	L/W 24	L/W 25	L/W 26	L/W 27	L/W 28	L/W 29	L/W 30
		Mitten Flat Well Improvement Project	Woods Gulch Pond Rehabilitation	Green Mountain Unnamed Spring Redevelopment	Unnamed Spring Sheep Creek Improvement Project	Bare Ring Slough Well Improvement Project	Black Rock Spring Pipeline Project	Barras Spring Projection Project	Tincup Spring Development	Soda Lakes Well Project	Picket Creek Well Construction Project
Well Construction / Spring Development / Diversion	Mobilization	$500	$3,000	$500	$500	$1,000	$1,000	$0	$0	$3,000	$3,000
	Well / Spring	Well Improvement	Stock Reservoir Rehabilitation	Spring Redevelopment	Spring Redevelopment	Pipeline Project	Pipeline Project	Spring Protection	Spring Development	Spring Development	New Well Construction
	Units (each)			1	1					1	1
	Depth Each	0	0	0	0	0	0	NA	0	100	300
	Unit Cost ($/LF wells or $/EA springs)/diversion	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$40	$40
	Well Screen (LF each well)	NA	NA	NA	NA	NA	NA	NA	NA	50	50
	Well Screen ($/LF)	NA	NA	NA	NA	NA	NA	NA	NA	$50	$50
	Component Subtotal	$500	$3,000	$5,500	$5,500	$1,000	$1,000	$0	$0	$7,500	$15,500
Stock Pond Construction	Mobilization		$3,000								
	Units (EA)		1								
	Pond Unit Cost ($ EA)		$150,000								
	Liner (SF each pond)										
	Liner Unit Cost ($/SF)										
	Liner Cost per Pond										
	Component Subtotal		$150,000								
Pump	Units (EA)			0	0	1				1	1
	Type	Solar	Solar	Solar	Solar	Solar	Solar	Solar	Solar	Solar	Solar
	Unit Cost (EA)	$8,640	$8,640	$8,640	$8,640	$8,640	$8,640	$8,640	$8,640	$8,640	$8,640
	Component Subtotal	$0	$0	$0	$0	$8,640	$0	$0	$0	$8,640	$8,640
Pipeline	Units	1		1	1	1	1		1		1
	Units (LF)	15,600	33,000	300	300	19,250	27,000	0	17,000	21,600	200
	Unit Cost	$1.34	$1.34	$1.34	$1.34	$1.34	$1.34	$1.34	$1.34	$1.34	$1.34
	Component Subtotal	$20,904	$0	$402	$402	$25,795	$36,180	$0	$22,780	$0	$268
Additional: Storage Tanks	Units (EA)	$0.00	$0.00	$0.00	$0.00	$1.00	$0.00	$0.00	0	0	0
	Size (gal)	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000
	Unit Cost ($1/gal)	$1.00	$1.00	$1.00	$1.00	$1.00	$1.00	$1.00	$1.00	$1.00	$1.00
	Component Subtotal	$0.00	$0.00	$0.00	$0.00	$15,000.00	$0.00	$0.00	$0.00	$0.00	$0.00
Water Tanks	Units (EA)	2	0	1	1	4	3	0	1	1	1
	Size (gal)	10,000	10,000	1,200	10,000	10,000	10,000	10,000	10,000	10,000	10,000
	Unit Cost	$7,000	$7,000	$3,500	$7,000	$7,000	$7,000	$7,000	$7,000	$7,000	$7,000
	Component Subtotal	$14,000	$0	$3,500	$7,000	$28,000	$21,000	$0	$7,000	$7,000	$7,000
Fencing	Units (EA)	0	0	0	0	0	0	1	1	0	0
	Units (LF each)	600	600	600	600	600	600	2,000	2,000	600	600
	Unit Cost ($/LF)	$2.50	$2.50	$2.50	$2.50	$2.50	$2.50	$2.50	$2.50	$2.50	$2.50
	Component Subtotal	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$5,000.00	$5,000.00	$0.00	$0.00
Miscellaneous	Item	0	1	0	0	0	1	0	1	0	0
	Comment		Agri Drain Outlet				Diversion Facility		Diversion Facility		
	Unit Cost						$5,000		$5,000		
	Component Subtotal	$0	$5,000	$0	$0	$0	$5,000	$0	$5,000	$0	$0
Construction Subtotal		**$35,404**	**$158,000**	**$9,402**	**$12,902**	**$78,435**	**$58,180**	**$5,000**	**$34,780**	**$23,140**	**$31,408**
Engineering (10%)		$3,540	$15,800	$940	$1,290	$7,844	$5,818	$500	$3,478	$2,314	$3,141
Construction and Engineering Subtotal		**$38,944**	**$173,800**	**$10,342**	**$14,192**	**$86,279**	**$63,998**	**$5,500**	**$38,258**	**$25,454**	**$34,549**
Contingency (15%)		$5,842	$26,070	$1,551	$2,129	$12,942	$9,600	$825	$5,739	$3,818	$5,182
Total Construction Cost		**$44,786**	**$199,870**	**$11,894**	**$16,321**	**$99,220**	**$73,598**	**$6,325**	**$43,997**	**$29,272**	**$39,731**
Final Plans and Specs		$2,000	$2,000	$500	$500	$2,000	$2,000	$500	$1,500	$2,000	$2,000
Additional Geotechnical Services											
Permitting / Legal Fees / Acces and Rights of Way		$1,000	$4,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000
Total Project Cost		**$47,786**	**$205,870**	**$13,394**	**$17,821**	**$102,220**	**$76,598**	**$7,825**	**$46,497**	**$32,272**	**$42,731**

Table 3.5 Conceptual Cost Estimates: Livestock/Wildlife Water Supply Projects (Continued).

Project Component		L/W 31	L/W 32	L/W 33	L/W 34	L/W 35	L/W 36	L/W 37	L/W 38	L/W 39	L/W 40
		Mitten Springs Area Well Construction Project	Upper Middle Fork Sulphur Creek Well Construction Project	Alkali Creek Tributary Well Construction Project No. 1	Alkali Creek Tributary Well Construction Project No. 2	Flats North of Ladysmith Draw Well Construction Project	Unnamed Alkali Tributary Well Pipeline Project No. 2	North Immigrant Well Construction Project	Upper Buffalo Creek	Coyote Gulch Pipeline Project	Warm Springs Pipeline Project
Well Construction / Spring Development / Diversion	Mobilization	$3,000	$3,000	$3,000	$3,000	$3,000	$3,000	$3,000	$3,000	$3,000	$3,000
	Well / Spring	New Well Construction	New Well Construction	New Well Construction	New Well Construction	New Well Construction	New Well Construction	New Well Construction	New Diversion	New Diversion	New Diversion
	Units (each)	1	1	1	1	1			1	1	1
	Depth Each	250	250	250	250	250	450	250	NA	NA	NA
	Unit Cost ($/LF wells or $/EA springs)/diversion	$40	$40	$40	$40	$40	$40	$40	4,000	4,000	4,000
	Well Screen (LF each well)	50	50	50	50	50	50	50	NA	NA	NA
	Well Screen ($/LF)	$50	$50	$50	$50	$50	$50	$50	NA	NA	NA
	Component Subtotal	$13,500	$13,500	$13,500	$13,500	$13,500	$21,500	$13,500	$7,000	$7,000	$7,000
Stock Pond Construction	Mobilization										
	Units (EA)										
	Pond Unit Cost ($ EA)										
	Liner (SF each pond)										
	Liner Unit Cost ($/SF)										
	Liner Cost per Pond										
	Component Subtotal										
Pump	Units (EA)	1	1	1	1	1	1	1	1	1	1
	Type	Solar	Solar	Solar	Solar	Solar	Solar	Solar	Solar	Solar	Solar
	Unit Cost (EA)	$8,640	$8,640	$8,640	$8,640	$8,640	$8,640	$8,640	$8,640	$8,640	$8,640
	Component Subtotal	$8,640	$8,640	$8,640	$8,640	$8,640	$8,640	$8,640	$8,640	$8,640	$8,640
Pipeline	Units	1	1	1	1	1	1	1	1	1	1
	Units (LF)	200	200	200	200	200	200	200	39,000	6,500	12,800
	Unit Cost	$1.34	$1.34	$1.34	$1.34	$1.34	$1.34	$1.34	$1.34	$1.34	$1.34
	Component Subtotal	$268	$268	$268	$268	$268	$268	$268	$52,260	$8,710	$17,152
Additional: Storage Tanks	Units (EA)	0	0	0	0	0	0	0	0	0	0
	Size (gal)	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000
	Unit Cost ($1/gal)	$1.00	$1.00	$1.00	$1.00	$1.00	$1.00	$1.00	$1.00	$1.00	$1.00
	Component Subtotal	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Water Tanks	Units (EA)	1	1	1	1	1	1	1	4	2	2
	Size (gal)	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
	Unit Cost	$7,000	$7,000	$7,000	$7,000	$7,000	$7,000	$7,000	$7,000	$7,000	$7,000
	Component Subtotal	$7,000	$7,000	$7,000	$7,000	$7,000	$7,000	$7,000	$28,000	$14,000	$14,000
Fencing	Units (EA)	0	0	0	0	0	0	0	1	1	1
	Units (LF each)	600	600	600	600	600	600	600	21,000	21,000	29,000
	Unit Cost ($/LF)	$2.50	$2.50	$2.50	$2.50	$2.50	$2.50	$2.50	$2.50	$2.50	$2.50
	Component Subtotal	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$52,500.00	$52,500.00	$72,500.00
Miscellaneous	Item	0	0	0	0	0	0	0	1	1	1
	Comment								Diversion Facility	Diversion Facility	Diversion Facility
	Unit Cost								$5,000	$5,000	$5,000
	Component Subtotal	$0	$0	$0	$0	$0	$0	$0	$5,000	$5,000	$5,000
Construction Subtotal		**$29,408**	**$29,408**	**$29,408**	**$29,408**	**$29,408**	**$37,408**	**$29,408**	**$148,400**	**$90,850**	**$119,292**
Engineering (10%)		$2,941	$2,941	$2,941	$2,941	$2,941	$3,741	$2,941	$14,840	$9,085	$11,929
Construction and Engineering Subtotal		**$32,349**	**$32,349**	**$32,349**	**$32,349**	**$32,349**	**$41,149**	**$32,349**	**$163,240**	**$99,935**	**$131,221**
Contingency (15%)		$4,852	$4,852	$4,852	$4,852	$4,852	$6,172	$4,852	$24,486	$14,990	$19,683
Total Construction Cost		**$37,201**	**$37,201**	**$37,201**	**$37,201**	**$37,201**	**$47,321**	**$37,201**	**$187,726**	**$114,925**	**$150,904**
Final Plans and Specs		$3,000	$3,000	$3,000	$3,000	$3,000	$3,000	$3,000	$2,000	$3,000	$3,000
Additional Geotechnical Services											
Permitting / Legal Fees / Acces and Rights of Way		$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000
Total Project Cost		**$41,201**	**$41,201**	**$41,201**	**$41,201**	**$41,201**	**$51,321**	**$41,201**	**$190,726**	**$118,925**	**$154,904**

3.5.1.1 Sandy (Sy) 10-14 Inch Precipitation Zone, High Plains Southeast

Figure 3.22 displays the State and Transition model for the Sandy 10-14 inch Precipitation Zone High Plains Southeast. The following description of the ecological site was extracted from the NRCS ESD for the site:

> *"This state is extremely stable and well adapted to the Cool Central Desertic Basins and Plateaus climate. 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:*
>
> *As this site deteriorates from improper grazing management, woody species such as big sagebrush and silver sagebrush will increase. Bunchgrasses such as Indian ricegrass and needleandthread will decrease in frequency and production.*
>
> *Big sagebrush will become dominant on some areas with an absence of fire. Wildfires are often actively controlled so chemical control using herbicides has replaced the historic role of fire on this site. Recently, prescribed burning has regained some popularity".*

3.5.2 Range and Grazing Management Considerations

Based on the information presented above, the following items are presented for inclusion in the Phase III study area watershed management plan:

- Acceptance of management alternatives by permittees and landowners is paramount for the success of any range management improvement strategy. Without participation, even the best of plans will fail. Commitment is required of those involved to implement a plan and to continue to maintain any infrastructure which may be incorporated.
- Construction of water supply projects must be completed before alternative management strategies will be efficient.
- Water developments can be used to expand grazing distribution to areas that do not currently have reliable water. Fencing of riparian areas is desired to optimize the utilization of the non-riparian facilities. In other words, the mere presence of upland water sources will not keep livestock and wildlife from preferring riparian areas. Riparian area plant community condition can be enhanced by development of water into upland areas.
- Fencing to control livestock can enable a rest-rotation grazing system.

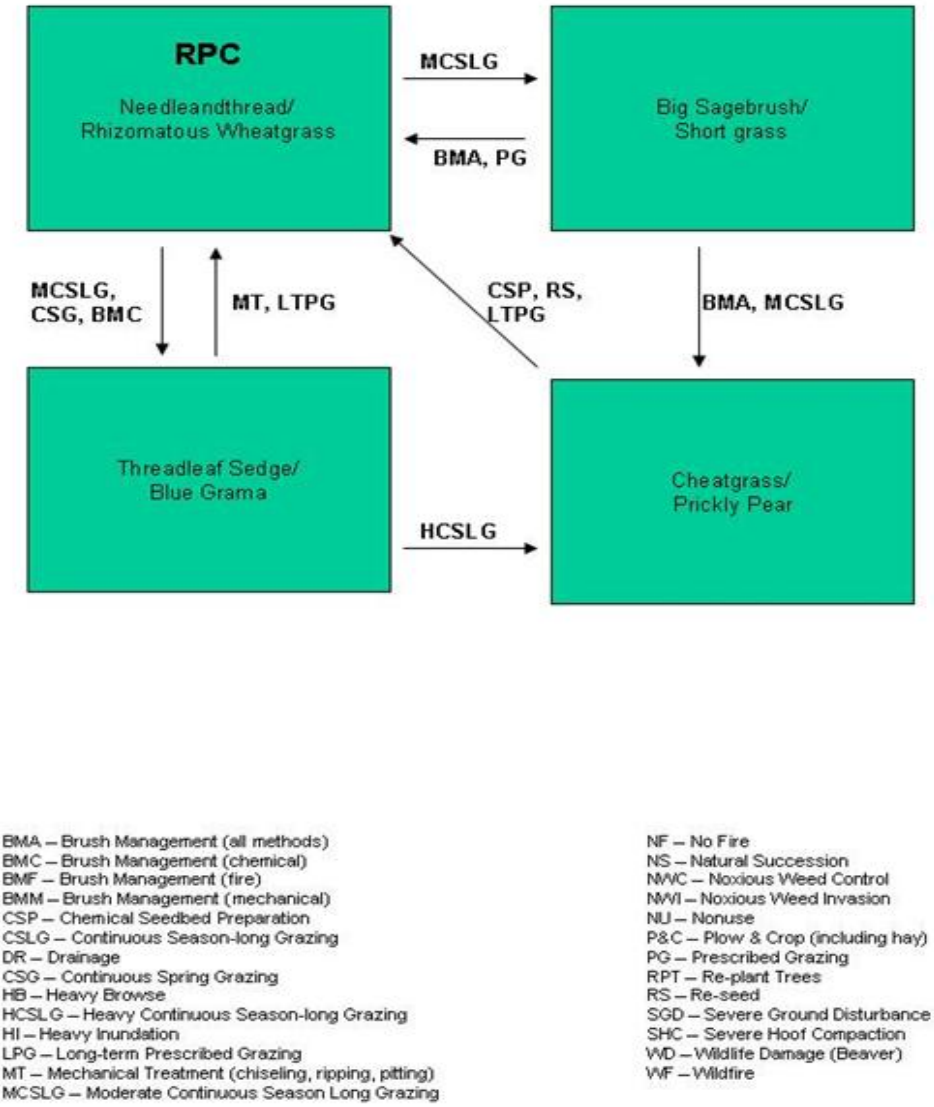

Figure 3.22 State and Transition Model for the Sandy 10-14 Inch Precipitation Zone, High Plains Southeast Ecological Site

- Fencing combined with low-stress herding can be used to discourage use of riparian areas.
- Riparian areas can be fenced to exclude livestock and wildlife (i.e., wild horses) as well as facilitating utilization for short term grazing pastures. Riparian pastures should generally be large enough to permit grazing as appropriate to their needs.
- Strategic salting and herding are other tools that can be used to enhance grazing distribution.
- Most range improvement practices which improve watershed condition, may also improve wildlife habitat. Wildlife needs should be considered when installing practices

such as wildlife friendly fences, wildlife escape ramps from tanks, and wildlife watering facilities.

- Proposed range management strategies associated with the GMCA may result in a single large herd of livestock. Consequently, water supply alternatives must incorporate adequate infrastructure to facilitate use by a large number of animals at any given time. That is, water supply necessary to meet demand and larger stock tanks will enable more animals to use the facility at one time and will minimize the amount of time animals linger in the vicinity.
- Strategies recommended in the state and transition models associated with NRCS descriptions of the ecological sites found within the watershed should be adopted and employed to optimize range conditions through prescribed grazing management and best management practices.

3.6 Other Upland Management Opportunities

Prescribed fire can be used as a tool to restore conditions promoting desirable range species and reduction of invasive species and other species affecting rangeland production and watershed function. As a result of these treatments production of desirable forage increases, benefiting both livestock and wildlife. Watershed values improve overall by decreasing bare ground, decreasing runoff, and improving infiltration, again to the benefit of wildlife and stock. Base flows in creeks sustained by groundwater discharges can extend later into the summer, benefiting the riparian environment and aquatic habitat in these reaches.

3.7 The Sweetwater River Phase III Study Area Watershed Management Plan

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

- Irrigation System Rehabilitation,
- Stream Channel Restoration Opportunities,
- Upland Wildlife/Livestock Water Opportunities,
- Grazing Management Opportunities, and
- Other Management Opportunities.

These improvements focus on potential mitigation of several key issues that presently exist within the watershed. For the Phase III study area, the watershed management plan consists of a compilation of the recommendations for each category. The plan is summarized in Table 3.6.

Table 3.6 Sweetwater River Phase III Study Area Watershed Management Plan.

Irrigation System Components				
Point of Rocks DitchDiversion Structure				
Rehabilitation Item Number	**Description**	**Station (feet from headgate)**	**Priority**	**Total Project Cost**
I-1	Install rock weir structure in Sweetwater River	0.0	1	$ 120,000
I-2	Install 2-ft Parshall flume at diversion structure	100	2	$ 3,000
Wildlife / Livestock Water Supply Alternatives				
Recommended Alternative	**Recommended Alternative**		**Priority**	**Cost**
L/W-01	BLM Recommendations: Cameco Well		2	$ 12,877.70
L/W-02	BLM Recommendations: Bare Ring Butte Well		2	$ 12,877.70
L/W-03	BLM Recommendations: Circle Bar Well		2	$ 41,856.32
L/W-04	BLM Recommendations: North Horse Track Well		2	$ 41,856.32
L/W-05	BLM Recommendations: Monument Well		2	$ 41,856.32
L/W-06	BLM Recommendations: Smiley Well		2	$ 41,856.32
L/W-07	BLM Recommendations: Granite Spring		2	$ 9,312.93
L/W-08	BLM Recommendations: Upper Ladysmith Spring		2	$ 9,312.93
L/W-09	BLM Recommendations: Lower Wager Meadows Spring		2	$ 9,312.93
L/W-10	BLM Recommendations: Twin Springs		2	$ 9,312.93
L/W-11	BLM Recommendations: Mud Spring		2	$ 9,312.93
L/W-12	BLM Recommendations: Fuzzy Reservoir		2	$ 9,659.54
L/W-13	Tank Improvement 4		2	$ 9,737.50
L/W-14	West Alkali Well Improvement Project		2	$ 10,737.50
L/W-15	Daley Lake Well Improvement Project		2	$ 10,737.50
L/W-16	Stampede Well Improvement		2	$ 10,737.50
L/W-17	Soda Lakes Well Improvement		2	$ 13,570.63
L/W-18	Fletcher Gap Well Improvement		2	$ 21,026.25
L/W-19	Diamond Springs Pipeline Improvement Project		2	$ 31,384.07
L/W-20	Grassy Lake Well Improvement Project		2	$ 26,427.80
L/W-21	Mitten Flat Well Improvement Project		2	$ 47,786.06
L/W-22	Woods Gulch Pond Rehabilitation		2	$ 205,870.00
L/W-23	Green Mountain Unnamed Spring Redevelopment		2	$ 13,393.53
L/W-24	Unnamed Spring Sheep Creek Improvement Project		2	$ 17,821.03
L/W-25	Bare Ring Slough Well Improvement Project		2	$ 102,220.28
L/W-26	Black Rock Spring Pipeline Project		2	$ 76,597.70
L/W-27	Barras Spring Projection Project		2	$ 7,825.00
L/W-28	Tincup Spring Development		2	$ 46,496.70
L/W-29	Soda Lakes Well Project		2	$ 32,272.10
L/W-30	Picket Creek Well Construction Project		2	$ 42,731.12
L/W-31	Mitten Springs Area Well Construction Project		2	$ 41,201.12
L/W-32	Upper Middle Fork Sulphur Creek Well Construction Project		2	$ 41,201.12
L/W-33	Alkali Creek Tributary Well Construction Project No. 1		2	$ 41,201.12
L/W-34	Alkali Creek Tributary Well Construction Project No. 2		2	$ 41,201.12
L/W-35	Flats North of Ladysmith DraW-Well Construction Project		2	$ 41,201.12
L/W-36	Unnamed Alkali Tributary Well Pipeline Project No. 2		2	$ 51,321.12
L/W-37	North Immigrant Well Construction Project		2	$ 41,201.12
L/W-38	Upper Buffalo Creek		2	$ 190,726.00
L/W-38	Coyote Gulch Pipeline Project		2	$ 118,925.25
L/W-39	Warm Springs Pipeline Project		2	$ 154,904.38
Stream Channel Condition and Stability				
Recommended Alternative	**Recommended Alternative**		**Priority**	**Cost**
S-1	Coyote Gulch Rehabilitation Project		2	Cost contingent upon results of site-specific stream channel investigation
S-2	Sulphur Creek Rehabilitation Project		2	
S-3	Upper East Alkali Creek Rehabilitation Project		2	
S-4	Crooks Creek Rehabilitation Project		2	

IV. FUNDING SOURCES

IV. FUNDING SOURCES

Project funding/financing is a critical aspect associated with the implementation of watershed improvement projects. Given the scope of the investigation and the perceived projects which may be pursued as part of any watershed plan, there may be a large variety of funding sources which may be available to provide funding for future watershed improvements**.**

Table 4.1 is presented as a brief synopsis of some of the various options available for different components of the Sweetwater River Watershed Study, Phase III Study Area Watershed Management Plan.

Table 4.1 Funding Options.

Primary Funding Sources / Program			Irrigation Rehab	Upland Water	Storage	Other Range Management
Local:						
PACD	–	Rangeland Management Program Irrigation Water Management Program	✓	✓		✓
State:						
WWDC	–	Small Water Project Program	✓	✓		✓
	–	New Development Program	✓	✓	✓	
WGFD	–	Riparian Habitat Improvement Grant		✓		✓
	–	Walter Development / Maintenance Habitat		✓		✓
SLIB	–	Small Water Development Project Loans	✓	✓		
Federal:						
NRCS	–	EQIP	✓	✓		✓
FSA	–	Conservation Reserve Program (CRP)		✓		✓
BLM	–	Range Betterment Funds		✓		✓
EPA	–	Targeted Watershed Grants Program		✓		✓
USFWS	–	Landowner Incentive Program		✓		✓
	–	North American Wetlands Conservation Act		✓		✓
Other:						
TU	–	Watershed Restoration	✓	✓	✓	✓
Weed & Pest	–	Assistance				✓

V. REFERENCES

V. REFERENCES

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APPENDIX A

GROUNDWATER PERMITS

Tabulation of Groundwater Permits Within the Phase III Study Area

Permit No.	Priority	Status	Applicant	Facility Name	Permitted Uses	Reported Yield	Well Depth	Static Water Depth
P22193P	12/31/1914	GST	JAMES M. GRAHAM	GRAHAM RANCH, INC. #4	DOM	25	42	35
P7439P	5/15/1929	GST	BESSIE A. MCINTOSH	LAZY C S #1	DOM,STO	10	280	20
P22190P	12/31/1931	GST	EDWARD T. GRAHAM	GRAHAM RANCH, INC. #1	DOM	25	10	6
P7011P	4/30/1933	GST	STATE OF WYOMING** HOLY CROSS CATTLE	SCHOOL SECTION 16	STO	20	50	12
P7014P	12/31/1933	GST	GRIEVE LAND & CATTLE CO.	JIGGS WELL #1	STO	25	50	18
P7010P	12/31/1937	GST	HOLY CROSS CATTLE CO.	BLODGETT HOME WELL #1	STO	16	50	-1
P8594P	5/11/1940	GST	JOHN P. MC INTOSH	RODIE #3	DOM,STO	8	40	4
P8595P	6/15/1940	GST	STATE OF WYOMING**JOHN P. MC INTOSH	BARON BUTE #1	DOM,STO	8	105	20
P7016P	9/29/1942	GST	GRIEVE LAND & CATTLE CO.	MICROWAVE TOWER WELL #1	STO	20	145	113
P11151P	12/21/1942	GST	UNITED STATES GOVERNTMENT	FLETCHER GAP WELL #0116	STO	10	145	113
P12968P	9/4/1943	GST	U.S. GOVERNMENT	SAGEBRUSH PARK SPRING #0146	STO	3	4	-1
P11126P	12/21/1943	GST	USDI, BLM	VI WELL #121	STO	5	70	35
P409C	7/31/1945	UNA	SINCLAIR REFINING CO.	CROOKS GAP STATION WATER WELL	IND	15	215	10
P22192P	12/31/1945	GST	INC. GRAHAM RANCH	GRAHAM RANCH, INC. #3 (BARN)	STO	17	10	6
P21366P	7/31/1947	GST	FREMONT SHEEP CO.	FREMONT #3	DOM,STO	10	180	100
P7013P	7/20/1948	GST	GRIEVE LAND & CATTLE CO.	BUFFALO CREEK #1	STO	7	50	20
P12585P	9/11/1954	GST	U.S. GOVERNMENT	GREEN MTN SPRING DEVELOPMENT #2 #047	STO	5	3	-1
P8320P	4/30/1955	GST	WALTER IRVIN**FRANCES IRVIN	CABIN CAMP WELL #1	DOM	7	40	20
P541G	2/12/1957	UNA	JEFFREY CITY WATER & SEWER DISTRICT	SPLIT ROCK TOWNSITE #1	MUN	80	90	25
P542G	2/12/1957	UNA	LOST CREEK OIL & URANIUM CO.	LOST CREEK OIL & URANIUM CO.MILL TES	IND	200	230	10
P686G	7/15/1957		WESTERN NUCLEAR CORP.	MILL WELL #3	IND	1100	159	6
P692G	7/25/1957	UNA	WESTERN NUCLEAR CORP.	MILL WELL #3	IND	1100	159	6
P8321P	7/31/1957	GST	WALTER IRVIN**FRANCES IRVIN	TRAILER #2	DOM	19	50	20
P52W	8/20/1958	UNA	JEFFREY CITY WATER & SEWER DISTRICT	JEFFREY CITY TOWNSITE #1	MUN	175	152	35
P294W	2/12/1959	UNA	AMOCO PRODUCTION COMPANY	HAPPY SPRINGS WATER WELL #1	IND,DOM	0	102	88
P295W	2/12/1959	UNA	AMOCO PRODUCTION COMPANY	HAPPY SPRINGS UNIT WATER WELL #2	IND,DOM	0	169	151
P506W	3/29/1961		GULF OIL CORPORATION	BISON-FEDERAL #1	IND	28	3414	500
P12975P	7/5/1962	GST	U.S. GOVERNMENT	KIRK SPRINGS #0638 (A)	STO	5	3	-1
P12976P	7/5/1962	GST	U.S. GOVERNMENT	KIRK SPRINGS #0638 (B)	STO	3	6	-1
P7009P	6/13/1963	GST	GRIEVE LAND & CATTLE CO.	MEADOW WINDBREAK #1	STO	25	50	12
P7440P	8/20/1963	GST	BESSIE A. MCINTOSH	LAZY CS #2	DOM,STO	10	290	18
P8597P	7/8/1964	GST	MR. & MRS. MICHAEL J. KELLEY	KELLEYS KACHE #1	DOM,STO	10	57	27
P8598P	7/8/1964	GST	JOHN P. MC INTOSH	ERK SON #2	DOM,STO	10	59	26
P12441P	10/20/1964	GST	U.S. GOVERNMENT	GRIEVE WELL #0764	STO	10	172	80
P7017P	10/25/1964	GST	HOLY CROSS CATTLE CO.	MAC WELL #1	STO	10	172	96
P12439P	4/14/1965	GST	U.S. GOVERNMENT	AGATE FLATS WELL #0733	STO	20	250	160
P1490W	5/6/1965	UNA	U.S. ENERGY-CRESTED CORP.	GOLDEN GOOSE WATER WELL #1	IND,DOM	5	800	-1
P12978P	8/31/1965	GST	U.S. GOVERNMENT	GERAUD SPRING #0720	STO	4	4	-1
P12427P	2/5/1966	GST	U.S. GOVERNMENT	CROOKS MTN. WELL #1 #0782	STO	25	180	-1
P8593P	8/12/1966	GST	JOHN P. MC INTOSH	RODIE #2	DOM,STO	10	65	21

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Permit No.	Priority	Status	Applicant	Facility Name	Permitted Uses	Reported Yield	Well Depth	Static Water Depth
P8592P	8/20/1966	GST	JOHN P. MC INTOSH	RODIE #1	DOM,STO	10	85	18
P12428P	8/29/1966	GST	U.S. GOVERNMENT	CLAYTOR WELL #0773	STO	6	233	160
P12425P	11/30/1966	GST	U.S. GOVERNMENT	CROOKS MTN. WELL #3 #0821	STO	25	600	-1
P12423P	3/31/1967	GST	U. S. GOVERNMENT	MILLIE WELL #0774	STO	1	250	200
P8599P	7/21/1967	GST	JOHN P. MC INTOSH	GREEN #1	DOM,STO	15	75	25
P2126W	2/23/1968		UNION CARBIDE CORPORATION	CYCLONE #1	IND,DOM	20	290	105
P7236P	10/3/1968	GST	BUREAU OF LAND MANAGEMENT	N. PICKETT LAKE WELL #4312	STO	12	294	-6
P22191P	12/31/1968	GST	E. THOMAS GRAHAM	GRAHAM RANCH, INC. #2	DOM	25	28	10
P7015P	4/13/1969	GST	HOLY CROSS CATTLE CO.	SAND PASTURE WELL #1	STO	8	50	15
P7008P	4/15/1969	GST	WESTERN NUCLEAR, INC	J J RANCH WELL #1	DOM	2	20	7
P7012P	4/17/1969	GST	HOLY CROSS CATTLE CO.	CRANDELL WELL #1	STO	4	40	28
P4158W	1/12/1970	UNA	U.S. ENERGY-CRESTED CORP.	YELLOWSANDS #1	IND,DOM	12	500	200
P5821W	6/17/1970	GST	BESSIE A. MC INTOSH	LAZY WATER WELL #2	DOM,STO	10	100	100
P11158W	11/16/1971	GST	UNITED STATES GOVERNMENT	SCARLETT WELL #4042	STO	25	300	156
P11159W	11/16/1971	GST	UNITED STATES GOVERNMENT	HAYPRESS WELL #4087	STO	0	0	0
P11160W	11/16/1971	GST	USDI BLM	BRONCO WELL #4059	STO	5	55	36
P11380W	12/9/1971		UNITED STATES GOVERNMENT - BLM	BULL CANYON SPRING #4052	WIL,STO	5	5	2
P11382W	12/9/1971	UNA	UNITED STATES GOVERNMENT - BLM	FREMONT SPRING #4053	WIL,STO	5	5	2
P14775W	6/28/1972	UNA	AMOCO PRODUCTION COMPANY** WYOMING B	BATTLE SPRINGS WATER SUPPLY #1	IND	391	2080	10
P14776W	6/28/1972	UNA	AMOCO PRODUCTION COMPANY** WYOMING B	BATTLE SPRINGS WATER SUPPLY #2	IND	346	2084	152
P14777W	6/28/1972	UNA	AMOCO PRODUCTION COMPANY** WYOMING B	BATTLE SPRINGS WATER SUPPLY #3	IND	388	2010	58
P14793W	7/24/1972	UNA	AMOCO PRODUCTION COMPANY** WYOMING B	BATTLE SPRINGS WATER SUPPLY #4	IND	419	2043	18
P14794W	7/24/1972	EXP	USDI BLM**INC. PASCO	BATTLE SPRINGS WATER SUPPLY #5	IND	0	0	0
P16758W	11/29/1972	GST	BUREAU OF LAND MANAGEMENT	BOULDER SPRING #4039	STO	10	8	-1
P21885W	6/8/1973		WY BOARD OF LAND COMMISSIONERS** STA	WWPP TEST HOLE #2	MIS	0	360	187
P24693W	10/22/1973	GST	COLLINS JAMERMAN	CORRAL #1	STO	5	18	13
P24813P	10/22/1973	GST	COLLINS JAMERMAN	HOUSE WELL #1	DOM	25	13	5
P26762W	5/8/1974	UNA	AMOCO PRODUCTION COMPANY** UNITED ST	BATTLE SPRING WATER SUPPLY #6	IND	588	2010	132
P26764W	5/8/1974	UNA	AMOCO PRODUCTION COMPANY** UNITED ST	BATTLE SPRINGS WATER SUPPLY #8	IND	513	2002	112
P28674W	8/27/1974		USDI, BLM**U.S. ENERGY-CRESTED CORP.	SHEEP MOUNTAIN #1 WATER	IND	10	1360	-1
P28675W	8/27/1974	ADJ	U.S. ENERGY-CRESTED CORP.	GOLDEN GOOSE II WATER	IND	7	500	-1
P28783W	11/29/1974		INC. MAPCO	MAPCO WHISKEY PEAK UNIT #1-33	IND,MIS	25	500	30
P28734W	12/10/1974	GST	DAVE JAMERMAN	JAMERMAN #1	STO	20	200	8
P30515W	7/28/1975	GST	BILL W. & CHRISTINE E. WICKSTROM	HEATHER #1	DOM	25	28	10
P31835W	11/6/1975	UNA	JEFFREY CITY WATER & SEWER DISTRICT	JEFFREY CITY TOWNSITE #3	MUN	500	241	27
P33910W	5/18/1976	ADJ	U.S. ENERGY-CRESTED CORP.**WILLIAM M	MCINTOSH WELL #2	MIS	5	250	160
P34829W	8/18/1976		INC. GREEN MOUNTAIN MOBILE HOME PARK	GREEN MOUNTAIN #1	MIS	145	226	45
P34440W	8/19/1976	UNA	GREEN MOUNTAIN MINING VENTURE	ROCK WELL #1	MIS	0	358	17
P41033W	4/15/1977	ADJ	GREEN MOUNTAIN MINING VENTURE	ZENITH #1	MIS	60	850	210
P39315W	6/16/1977		WESTERN NUCLEAR INC.	WN 7 HB	MIS	0	384	32

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Permit No.	Priority	Status	Applicant	Facility Name	Permitted Uses	Reported Yield	Well Depth	Static Water Depth
P42150W	9/28/1977	ADJ	GREEN MOUNTAIN MINING VENTURE	DOMINO #1	MIS	15	190	20
P41594W	10/3/1977	ADJ	JEFFREY CITY WATER & SEWER DISTRICT	LUCK MC #JC 101	MIS	250	312	117
P41566W	1/25/1978	GST	RICHARD & MARY JANE BRINDA	BRINDA #5	DOM,STO	5	60	30
P41978W	2/20/1978	UNA	INC. GREEN MOUNTAIN VILLAGE	GREEN MOUNTAIN VILLAGE #2	MIS	175	300	45
P43197W	5/9/1978	GST	STEPHEN & LINDA BORDEN	BORDENS WELL #101	DOM,STO	12	235	140
P43694W	6/8/1978	GST	GAIL & SHERRIL LARSON	#1	DOM	25	50	30
P43808W	6/8/1978	UNA	JEFFREY CITY WATER & SEWER DISTRICT	JEFFREY CITY TOWNSITE #4	MUN	50	300	24
P43954W	6/14/1978	ADJ	U.S. ENERGY-CRESTED CORP.**WILLIAM M	MCINTOSH WELL #3	MIS	25	300	1207
P44145W	6/22/1978		GULF OIL CORPORATION**USDI, BLM	BISON BASIN UNIT FEDERAL WATER SUPPL	IND	122	3636	1000
P44064W	6/28/1978	GST	MIX FUNKHOUSER**MONTE FUNKHOUSER	WILLY MAX 1	DOM	20	75	20
P44065W	6/28/1978	GST	MIX FUNKHOUSER**MONTE FUNKHOUSER	WILLY MAX 2	DOM	20	75	25
P44469W	7/17/1978	UNA	U.S. ENERGY-CRESTED CORP.	SD 18 16	MIS	20	1410	757
P44422W	8/1/1978	GST	ROGER R. VEACH**AVIS H. VEACH	VEACH #2	DOM	10	75	24
P44491W	8/3/1978	GST	M. V. & J. M. BERRYMAN	BALD EAGLE #1	DOM	20	52	21
P44886W	8/21/1978	UNA	USDI, BLM**U.S. ENERGY-CRESTED CORP.	PL 21A	MIS	35	1410	675
P44853W	8/23/1978		OGLE PETROLEUM INC.	303 I 1	MIS	5	772	228
P45525W	9/21/1978	UNA	JEFFREY CITY LAND COMPANY	JC #1	MIS	25	280	20
P45592W	10/18/1978	GST	NORMAN AND JUDY HUNTSMAN	HUNTSMAN #1	DOM,STO	12	80	55
P45504W	10/20/1978	GST	USDI, BLM	WEST DIAMOND #2	STO	0	0	0
P45596W	10/26/1978	GST	HOWARD C. BOYD	BOYD #1	DOM,STO	10	95	45
P46491W	12/18/1978		INC. GREEN MOUNTAIN VILLAGE	ENL GREEN MOUNTAIN VILLAGE #2	MIS	75	300	45
P41567W	1/25/1979	GST	ALVIN L. & BEVERLY A. GRABILL	RED MULE #1	DOM	5	80	30
P46630W	2/20/1979	GST	RAYMOND HEWITT	HEWITT #1	DOM	11	100	19
P46867W	3/12/1979	GST	MICHAEL & MILA SMITH	SMITH #1	DOM	10	48	35
P47302W	4/6/1979	GST	INC. DUBOIS CATV	CATV #1	DOM	10	90	60
P48473W	6/5/1979	GST	RAYMOND HEWITT	HEWITT #2	DOM,STO	13	260	37
P48615W	6/15/1979	GST	RAYMOND HEWITT	HEWITT #3	DOM	10	260	35
P48616W	6/15/1979	GST	RAYMOND HEWITT	HEWITT #4	DOM	10	60	35
P48567W	6/22/1979	GST	DONALD O. FOX	FOX 1	DOM	12	90	20
P49238W	7/25/1979	GST	JAMES D. & LORETTA J. MINAHAN	MINAHAN #1	DOM	6	80	30
P49678W	7/25/1979	GST	RAY G. HEFLIN	HEFLIN #1	DOM	25	100	45
P49290W	7/30/1979	GST	RAYMOND HEWITT	HEWITT #5	DOM	15	160	35
P49291W	7/30/1979	GST	RAYMOND HEWITT	HEWITT #6	DOM	10	80	20
P49404W	8/15/1979	GST	MARILOU MUSIC	STANLEY #2310	DOM,STO	16	300	50
P49405W	8/15/1979	GST	STANLEY & MARY LYNN WEGNER	STANLEY #2310	DOM,STO	18	160	40
P49985W	9/10/1979	GST	HEINOLD RANCHES OF WYOMING	WELCH #2	DOM,STO	15	101	30
P49908W	9/13/1979	GST	HAROLD J. THOMPSON	HOME #1	DOM	10	200	25
P50224W	10/5/1979	ADJ	WY BOARD OF LAND COMMISSIONERS** THE	ADAMS #1	STO	4	400	250
P51044W	1/30/1980	GST	WILLIAM R. & CAROL S. LEWIS		DOM,STO	10	80	38
P51055W	2/12/1980	GST	RAYMOND HEWITT	HEWITT #7	DOM	8	80	35

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Permit No.	Priority	Status	Applicant	Facility Name	Permitted Uses	Reported Yield	Well Depth	Static Water Depth
P52072W	5/8/1980	GST	JAMES H. SWICK	JAMES 4249	DOM	14	120	50
P53533W	9/8/1980	GST	ROBERT & CAROL VANDERWEGE	VAN #1	DOM			
P59413W	2/4/1981	GST	JOHN & FAY GILMORE	GILMORE #1	DOM	10	80	45
P59414W	2/4/1981	GST	JOHN & FAY GILMORE	GILMORE #2	DOM	10	80	50
P57072W	5/18/1981	GST	WARREN L. REFFETT**CAROLYN M. HERBER	R H #1	DOM	25	80	15
P57400W	7/1/1981	GST	HARRY & BONNIE DURBEN	DURBEN #1	DOM	15	80	65
P59591W	3/1/1982	GST	WM. M. MCINTOSH	EMMIGRANT ROAD	STO	7	300	50
P63189W	2/1/1983	GST	USDI BLM, RAWLINS DISTRICT	HAYPRESS WELL-PROJECT #2505	STO	12	181	124
P63385W	3/9/1983	GST	USDI BLM, RAWLINS DISTRICT	WEST DIAMOND PROJECT #4548	STO	15	290	275
P64313W	6/9/1983	GST	USDI BLM, RAWLINS DISTRICT	BEAVER RIM #5093	STO	4	280	152
P64314W	6/9/1983	GST	USDI BLM, RAWLINS DISTRICT	OREGON TRAIL #5097	STO	7	310	192
P66278W	1/3/1984		AMOCO PRODUCTION COMPANY	FREE WATER KNOCK-OUTHAPPY SPRINGS UN	IND	60	-1	-1
P66874W	4/11/1984		WESTERN NUCLEAR INC.	WN 27	IND,MIS	225	260	15.9
P72404W	3/11/1985		WESTERN NUCLEAR INC.	WNI A	IND,MIS	45	253.2	11.68
P72406W	3/11/1985		WESTERN NUCLEAR INC.	WNI C	IND,MIS	35	209.75	6.3
P71036W	8/29/1985	UNA	WY BOARD OF LAND COMMISSIONERS** TOW	ENL BATTLE SPRINGS #1	MIS,MUN	0	2080	10
P71037W	8/29/1985	UNA	WY BOARD OF LAND COMMISSIONERS** TOW	ENL BATTLE SPRINGS #2	MIS,MUN	0	2084	152
P71038W	8/29/1985	UNA	WY BOARD OF LAND COMMISSIONERS** TOW	ENL BATTLE SPRINGS #3	MIS,MUN	0	2010	58
P71039W	8/29/1985	UNA	WY BOARD OF LAND COMMISSIONERS** TOW	ENL BATTLE SPRINGS #4	MIS,MUN	0	2043	18
P71040W	8/29/1985	UNA	WY BOARD OF LAND COMMISSIONERS** TOW	ENL BATTLE SPRINGS #6	MIS,MUN	0	2010	132
P71041W	8/29/1985	UNA	WY BOARD OF LAND COMMISSIONERS** TOW	ENL BATTLE SPRINGS #8	MIS,MUN	0	2002	112
P71270W	8/29/1985	UNA	WY BOARD OF LAND COMMISSIONERS** AMO	ENL BATTLE SPRINGS #1	MIS	0	2080	10
P71271W	8/29/1985		WY BOARD OF LAND COMMISSIONERS** AMO	ENL BATTLE SPRINGS #2	MIS	0	2084	152
P71272W	8/29/1985	UNA	WY BOARD OF LAND COMMISSIONERS** AMO	ENL BATTLE SPRINGS #3	MIS	0	2010	58
P71273W	8/29/1985		WY BOARD OF LAND COMMISSIONERS** AMO	ENL BATTLE SPRINGS #4	MIS	0	2043	18
P71274W	8/29/1985	UNA	WY BOARD OF LAND COMMISSIONERS** AMO	ENL BATTLE SPRINGS #6	MIS	0	2010	132
P71275W	8/29/1985	UNA	WY BOARD OF LAND COMMISSIONERS** AMO	ENL BATTLE SPRINGS #8	MIS	0	2002	112
P71709W	12/16/1985		AMOCO PRODUCTION COMPANY	ENL BATTLE SPRINGS #1	MIS	0	2080	10
P71710W	12/16/1985		AMOCO PRODUCTION COMPANY	ENL BATTLE SPRINGS #2	MIS	0	2084	152
P71711W	12/16/1985	UNA	AMOCO PRODUCTION COMPANY	ENL BATTLE SPRINGS #3	MIS	0	2010	58
P71712W	12/16/1985		AMOCO PRODUCTION COMPANY	ENL BATTLE SPRINGS #4	MIS	0	2043	18
P71713W	12/16/1985	UNA	AMOCO PRODUCTION COMPANY	ENL BATTLE SPRINGS #6	MIS	0	2010	132
P71714W	12/16/1985	UNA	AMOCO PRODUCTION COMPANY	ENL BATTLE SPRINGS #8	MIS	0	2002	112
P73788W	5/21/1986	UNA	AMOCO PRODUCTION COMPANY	ENL BATTLE SPRING #1	MIS	0	2080	10
P73789W	5/21/1986		AMOCO PRODUCTION COMPANY	ENL BATTLE SPRING #2	MIS	0	2080	10
P73790W	5/21/1986	UNA	AMOCO PRODUCTION COMPANY	ENL BATTLE SPRING #3	MIS	0	2010	58
P73791W	5/21/1986	UNA	AMOCO PRODUCTION COMPANY	ENL BATTLE SPRING #4	MIS	0	2043	18
P73792W	5/21/1986	UNA	AMOCO PRODUCTION COMPANY	ENL BATTLE SPRING #6	MIS	0	2010	132
P73793W	5/21/1986	GST	AMOCO PRODUCTION COMPANY	ENL BATTLE SPRING #8	MIS	0	2002	112
P73150W	8/18/1986	GST	GRAHAM RANCH INC.	GRAHAM RANCH CORRAL #1	STO	10	50	15

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Permit No.	Priority	Status	Applicant	Facility Name	Permitted Uses	Reported Yield	Well Depth	Static Water Depth
P73151W	8/18/1986	GST	GRAHAM RANCH INC.	GRAHAM RANCH CORRAL #2	STO	10	110	50
P74066W	2/23/1987	UNA	U.S. ENERGY-CRESTED CORP.**WILLIAM M	MCINTOSH PIT #1	RES,STO,MIS			
P74924W	6/19/1987	GST	ROBERT E. & DEBORAH L. DERBISH	ROB #1	DOM	25	56	18
P75196W	7/22/1987	GST	RAYMOND & SHIRLEY WHITE	WHITE #1	DOM	3	59	45
P75520W	9/14/1987	UNA	U.S. ENERGY CORP.	U S E G #2	MIS			
P75565W	9/16/1987	GST	LONNIE J. CLAYTOR	SAMS	STO	10	69	40
P77596W	8/2/1988	GST	USDI BLM**JAMES D. BAKER	WEST DIAMOND WELL #2	STO	2	340	130
P92844W	9/7/1993	GST	BLM**COLLINS JAMERMAN	COLLINS #1	STO	5	50	8
P92845W	9/7/1993	GST	WY BOARD OF LAND COMMISSONERS**COLLI	RITA #1	STO	1	0	0
P94242W	11/17/1993	UNA	SHEEP MOUNTAIN PARTNERS**U.S.A., BLM	SUN HEALD "A" PORTAL	MIS,DEW	5	33	20
P94243W	11/17/1993	UNA	SHEEP MOUNTAIN PARTNERS**U.S.A., BLM	BIG SHEEP DECLINE #1	MIS,DEW,RES	10	39	31
P98528W	9/12/1994	GST	JAMES L. MCINTOSH	BUTTE SPRINGS #2	STO	3	50	0
P100619W	5/8/1995	UNA	USDI, BLM** SHEEP MOUNTAIN PARTNERS	SHEEP #1 SHAFT	MIS	300	1800	625
P100620W	5/8/1995	UNA	USDI, BLM** SHEEP MOUNTAIN PARTNERS	SHEEP #2 SHAFT	MIS	300	1400	500
P100621W	9/14/1995	UNA	USDI, BLM** SHEEP MOUNTAIN PARTNERS	GOLDEN GOOSE #1 SHAFT	MIS	60	860	859
P105365W	4/4/1997	UNA	LONNIE J. CLAYTOR** USDI, BUREAU OF	SAB-6	STO,MON	5	75	20
P112115W	10/5/1998	GST	LEE D/RAMONA R WILLERT	Willert Well #1	STO	3	90	51
P113241W	12/4/1998	GST	ROBERT L/LEE D WHITLOCK	WATER GAP WELL #1	DOM,STO	6	112	15
P113267W	12/4/1998	GST	USDI BLM	WARM SPRINGS WELL #1 #1841	STO	5	103	65
P113268W	12/4/1998	GST	USDI BLM	WARM SPRINGS WELL #2 #1917	STO	5	50	10
P113397W	12/31/1998	GST	LEE/ROBERT WHITLOCK	WHITLOCK #1	STO	5	98	65
P121276W	12/9/1999	GST	WESTERN NUCLEAR INC.	Hoffmeister #1	STO	2	32	23
P121277W	12/9/1999	GST	WESTERN NUCLEAR INC.	Hoffmeister #2	STO	1	30	18
P121278W	12/9/1999	GST	WESTERN NUCLEAR INC.	Hoffmeister #3	STO	4	22	10
P134844W	5/22/2001	GST	Charles W. Sylverter	Albert's Homestead # 1	STO	10	100	16
P139094W	9/18/2001	GST	CHARLES W. SYLVESTER	NT BAR # 1	STO	12	56	8
P143418W	4/1/2002	GSI	ROBERT L/JUDY F WHITLOCK** WY STATE	SOAP HOLE WELL #1	STO			
P145384W	6/12/2002	GSI	HUDSON GROUP, LLC** USDI, BUREAU OF	PICKET LAKE # 5	STO,MIS			
P147992W	11/1/2002	GST	STANLEY/LINDA COLE	WEST ALKALI SPRING	DOM,STO	4	4	-4
P147993W	11/1/2002	GST	STANLEY/LINDA COLE	O'BRIAN SPRING # 2	DOM,STO	5	4	-4
P147994W	11/1/2002	GST	STANLEY/LINDA COLE	O'BRIAN SPRINGS #1	DOM,STO	25	4	-4
P147995W	11/1/2002	GST	STANLEY/LINDA COLE	WOODS DRAW SPRING #1	DOM,STO	3	3.5	-4
P147995W	11/1/2002	GST	STANLEY/LINDA COLE	WOODS DRAW SPRING #1	DOM,STO	3	3.5	-4
P147996W	11/1/2002	GST	STANLEY/LINDA COLE	NANCY CREEK SPRING #1	DOM,STO	5	2	-4
P147997W	11/1/2002	GST	STANLEY/LINDA COLE	COTTONWOOD #1 SPRING	DOM,STO	5	2.5	-4
P147998W	11/1/2002	GST	STANLEY/LINDA COLE	EAST ALKALI # 1	DOM,STO	25	4	-4
P147999W	11/1/2002	GST	STANLEY/LINDA COLE	HORSE TRACK SPRING	DOM,STO	20	4	-4
P148000W	11/1/2002	GST	STANLEY/LINDA COLE	SULPHUR BAR SPRING	DOM,STO	25	1.5	-4
P148001W	11/1/2002	GST	STANLEY/LINDA COLE	ARNOLD SPRING	DOM,STO	25	1	-4
P148002W	11/1/2002	GST	STANLEY/LINDA COLE	TROUT SPRING	DOM,STO	25	4	-4

Tabulation of Groundwater Permits Within the Phase III Study Area

Permit No.	Priority	Status	Applicant	Facility Name	Permitted Uses	Reported Yield	Well Depth	Static Water Depth
P148003W	11/1/2002	GST	STANLEY/LINDA COLE	EAST ALKALI # 3	DOM,STO	25	3	-4
P148004W	11/1/2002	GSI	STANLEY/LINDA COLE	HAPPY SPRING	DOM,STO			
P148684W	12/3/2002	GST	CHARLES MCINTOSH	RIGBY PASTURE NO. 1	DOM,STO	25	100	40
P154664W	10/22/2003	GSE	RICHARD L AYERS	SPLITROCK OIL & ENERGY #1	DOM			
P156054W	1/26/2004	GST	ARMSTRONG RANCH, INC** USDI, BUREAU	ANTELOPE HILLS WELL	STO	5	170	124
P156382W	2/23/2004	GSI	FARMLAND RESERVE, INC.	6TH CROSSING RANCH RESIDENCE	DOM,STO			
P157199W	3/22/2004	GSI	DEREK L KELLEY	KELLEY'S CACHE #2	DOM			
P157200W	3/22/2004	GSI	DEREK L KELLEY	KELLEY'S CACHE #3	STO			
P157879W	4/15/2004	GST	WESTERN NUCLEAR, INC.	HOFFMEISTER #4	STO	14	120	44
P159178W	5/26/2004	GSI	MITTEN RANCH & LIVESTOCK COMPANY** W	MITTEN FLATS WELL	STO			
P163767W	9/10/2004	GSI	ANSBRO PETROLEUM CORPORATION	HADSELL RANCH 12-34	MIS			
P168543W	6/15/2005	GSI	VAMPIRE SYSTEMS, INC.	VAMPIRE SYSTEMS NO. 1 WELL	DOM			
P170167W	8/24/2005	GSI	State of Wyoming, State Lands & Inve	PZ7	STO			
P169632W	9/2/2005	GSI	ENCANA OIL & GAS (USA) INC.** USDI,	BRB WATER WELL #1	MIS			
P169786W	9/7/2005	GSI	W.S. BALDWIN** USDI, BUREAU OF LAND	HADSELL RANCH 12-34	STO			
P170767W	10/25/2005	GST	W. BEN ITURRIAN** USDI, BUREAU OF LA	BEN'S FIRST DRAW 1	STO	20	6	4
P170768W	10/25/2005	GST	W. BEN ITURRIAN** USDI, BUREAU OF LA	BEN'S CANYON SPRING 25	STO	25	4	2
P170769W	10/25/2005	GST	W. BEN ITURRIAN** USDI, BUREAU OF LA	BEN'S SPRING 26	STO	20	6	4
P170770W	10/25/2005	GST	W. BEN ITURRIAN** USDI, BUREAU OF LA	BEN'S HORSE PASTURE 1	STO	25	6	4
P172609W	12/14/2005	GSI	U.S. ENERGY CORP. / CREST CORP.** WY	CONGO PIT NO. 1 WELL	MIS			
38/4/492W	3/2/2006	GSI	Hudson Group, LLC	SCOTTY LAKE 11-20	CBM			
38/5/492W	3/2/2006	GSI	Hudson Group, LLC	SCOTTY LAKE 44-18	CBM			
38/6/492W	3/2/2006	GSI	Hudson Group, LLC	SCOTTY LAKE 24-17	CBM			
38/7/492W	3/2/2006	GSI	Hudson Group, LLC	SCOTTY LAKE 42-19	CBM			
38/2/509W	3/14/2006	UNA	STANLEY/LINDA COLE	HAPPY SPRING	DOM,STO			
39/6/405W	11/8/2006	UNA	JOE E. & JENNIFER MCINTOSH	WN-22	STO			
39/2/416W	11/14/2006	UNA	CHRISTOPHER ANDERSON	SAB-2	STO			
39/3/416W	11/14/2006	UNA	CHRISTOPHER ANDERSON	SAB-5	STO			
39/1/458W	12/18/2006	UNA	LONNIE J. CLAYTOR	SEB-1	STO			
39/10/457	12/18/2006	UNA	LONNIE J. CLAYTOR	SAB-3	STO			
40/4/206W	6/8/2007	UNA	GREEN MOUNTAIN MINING VENTURE** BUREAU	ENL. ZENITH #1 WELL	MIS			
40/6/206W	6/8/2007	UNA	KENNECUTT URANIUM COMPANY** Bureau of L	BE-009/P-3	TST			
40/7/206W	6/8/2007	UNA	KENNECUTT URANIUM COMPANY** Bureau of L	BE-10/P-4	TST			
40/8/206W	6/8/2007	UNA	KENNECUTT URANIUM COMPANY** Bureau of L	BE-008/P-5	TST			
40/9/206W	6/8/2007	UNA	KENNECUTT URANIUM COMPANY** Bureau of L	BE-007/P10	MIS			
40/1/274W	7/23/2007	UNA	GREEN MOUNTAIN MINING VENTURE	ENL. DOMINO #1 WELL	MIS			
40/5/274W	7/23/2007	UNA	JOHN H. OSBORNE** BUREAU OF LAND MGT	CLAYTON CORRAL WELL	STO			
40/4/324W	8/31/2007	UNA	NFU WYOMING LLC	RSW1	MIS			
41/5/77W	5/9/2008	UNA	USDI - BLM	WHE-1	IND			
41/6/203W	7/17/2008	UNA	JAMES D. & JILL W. SMITH	HADSELL RANCH NW27	STO			

APPENDIX B

SURFACE WATER RIGHTS

Sweetwater River Watershed Study: Phase III Study Area
Tabulation of Adjudicated Surface Water Rights

Permit Number	Facility Name	Status	Location	Stream Name
C26/151A	STOUGH DITCH	ADJ	T. 29 N., R. 96 W.	Alkali Creek (drainage of)
C29/281A	SPRING CREEK #2 DITCH	ADJ	T. 28 N., R. 90 W.	Spring Creek
C41/576 A	GREEN #3 DITCH	ADJ	T. 29 N., R. 100 W.	Spring Gulch Creek
C56/032A	TROUT DITCH	ADJ	T. 32 N., R. 92 W.	Stampede Springs
C64/495A	UPPER ROCK CREEK RESERVOIR	ADJ	T. 30 N., R. 100 W.	Sweetwater River
C76/100A	W M CRANOR DITCH (enlarged)	ADJ	T. 29 N., R. 90 W.	Sweetwater River
C79/013A	SUPPLY DITCH #4 (AS CHANGED IN PART TO KIRK #1)	ADJ	T. 28 N., R. 92 W.	Crook's Creek
C9/051A	SOUTH DITCH	ADJ	T. 29 N., R. 92 W.	Crook's Lake
C9/052A	NORTH DITCH	ADJ	T. 29 N., R. 92 W.	Crook's Lake
C9/056A	STEVENS #3 DITCH	ADJ	T. 28 N., R. 92 W.	Crook's Lake
P10006D	WAGERS DITCH	ADJ	T. 28 N., R. 97 W.	Spring
P10067S	WEST DIAMOND SPRINGS	ADJ	T. 32 N., R. 90 W.	West Diamond Spring Draw
P10068S	BIG DIAMOND SPRINGS STOCK RESERVOIR	ADJ	T. 32 N., R. 90 W.	Diamond Springs Draw
P10069S	EAST DIAMOND SPRINGS #1	ADJ	T. 32 N., R. 90 W.	East Diamond Springs Draw
P10070S	EAST DIAMOND SPRINGS #2	ADJ	T. 32 N., R. 90 W.	Natmont Draw
P10071S	EAST DIAMOND SPRINGS #3	ADJ	T. 32 N., R. 90 W.	Little East Diamond Springs Draw
P1067D	RIVERSIDE DITCH	ADJ	T. 28 N., R. 101 W.	Sweetwater River
P10776D	NT- DITCH	ADJ	T. 30 N., R. 91 W.	Sweetwater River
P11271D	MILLER DITCH	ADJ	T. 29 N., R. 95 W.	Sweetwater River
P1155E	THREE CROSSINGS DITCH (enlarged)	ADJ	T. 30 N., R. 91 W.	Sweetwater River
P1156D	RUSSELL CANAL	ADJ	T. 30 N., R. 95 W.	Sweetwater River
P11639D	ALGER #1 DITCH	ADJ	T. 29 N., R. 91 W.	Crook's Creek
P11640D	ALGER #2 DITCH	ADJ	T. 29 N., R. 91 W.	Crook's Creek
P11641D	ALGER #3 DITCH	ADJ	T. 29 N., R. 91 W.	Crook's Creek
P1178D	JAMERMAN DITCH	ADJ	T. 30 N., R. 91 W.	Sweetwater River
P11949D	GREEN #3 DITCH	ADJ	T. 29 N., R. 99 W.	Spring Gulch Creek
P1262D	GRAHAM & FARNSLEY #1 DITCH	ADJ	T. 29 N., R. 95 W.	Sweetwater River
P1263D	GRAHAM & FARNSLEY #2 DITCH	ADJ	T. 29 N., R. 95 W.	Sweetwater River
P1264D	GRAHAM DITCH	ADJ	T. 30 N., R. 93 W.	Sweetwater River
P1271E	MCDOWELL (enlarged)	ADJ	T. 28 N., R. 101 W.	Sweetwater River
P1275D	CROOKS CREEK DITCH	ADJ	T. 28 N., R. 92 W.	Crook's Creek
P1308E	JAMERMAN DITCH (enlarged)	ADJ	T. 30 N., R. 91 W.	Sweetwater River
P14089D	SUCKER DITCH	ADJ	T. 27 N., R. 96 W.	Sulphur Creek
P1417D	NORTH DITCH	ADJ	T. 29 N., R. 92 W.	Crook's Creek
P1418D	SOUTH DITCH	ADJ	T. 29 N., R. 92 W.	Crook's Creek
P14574D	ELLIS DITCH	ADJ	T. 29 N., R. 96 W.	Barrass Spring
P1489E	W M CRANOR DITCH (enlarged)	ADJ	T. 29 N., R. 90 W.	Sweetwater River
P15248D	BAR E H	ADJ	T. 27 N., R. 92 W.	Crook's Creek
P15549D	HARRIS DITCH	ADJ	T. 28 N., R. 92 W.	Crook's Creek
P15570D	KIRK #1 DITCH	ADJ	T. 28 N., R. 92 W.	Crook's Creek
P1563D	RIGBYS #1 DITCH	ADJ	T. 29 N., R. 92 W.	Crook's Creek
P1564D	RIGBYS #2 DITCH	ADJ	T. 29 N., R. 92 W.	Crook's Creek
P1565D	RIGBY RESERVOIR SUPPLY DITCH	ADJ	T. 29 N., R. 92 W.	Crook's Creek

Sweetwater River Watershed Study: Phase III Study Area
Tabulation of Adjudicated Surface Water Rights

Permit Number	Facility Name	Status	Location	Stream Name
P16025D	INDEPENDENT DITCH	ADJ	T. 30 N., R. 95 W.	Sweetwater River
P16687D	BRANNAN #4	ADJ	T. 27 N., R. 98 W.	Dry Water Course
P16964D	BURNT GULCH 2" WATER LINE	ADJ	T. 28 N., R. 93 W.	Burnt Gulch Spring
P16964D	BURNT GULCH 2" WATER LINE	ADJ	T. 28 N., R. 93 W.	Burnt Gulch Spring
P17019D	SHEEP CREEK PIPELINE #1	ADJ	T. 28 N., R. 92 W.	Sheep Creek
P17020D	SHEEP CREEK PIPELINE #2	ADJ	T. 28 N., R. 92 W.	Spring
P17021D	SHEEP CREEK PIPELINE #3	ADJ	T. 28 N., R. 92 W.	Spring
P17025D	CROOKS CREEK 2" WATER LINE	ADJ	T. 28 N., R. 92 W.	Crook's Creek
P1703E	NATIONAL DITCH (enlarged)	ADJ	T. 30 N., R. 95 W.	Sweetwater River
P17176D	JACOB DITCH	ADJ	T. 30 N., R. 93 W.	Sweetwater River
P17409D	SUPPLY DITCH #4 (AS CHANGED IN PART TO KIRK #1)	ADJ	T. 28 N., R. 92 W.	Crook's Creek
P17809D	DESERT #1 DITCH	ADJ	T. 28 N., R. 90 W.	Sweetwater River
P17810D	DESERT #2 DITCH	ADJ	T. 28 N., R. 90 W.	Sweetwater River
P17926D	FLADER PIPELINE	ADJ	T. 29 N., R. 99 W.	Flader Spring
P18301D	TROUT DITCH	ADJ	T. 31 N., R. 92 W.	Stampede Springs
P18301D	TROUT DITCH	ADJ	T. 31 N., R. 92 W.	Stampede Springs
P18303D	GUSTAVSEN WATER WORKS DITCH	ADJ	T. 29 N., R. 100 W.	Timba Bah Spring
P18785D	KOEHLER DITCH	ADJ	T. 30 N., R. 94 W.	Sweetwater River
P1906D	MCINTOSH DITCH	ADJ	T. 29 N., R. 90 W.	Sweetwater River
P19129D	CARPENTER PIPELINE	ADJ	T. 29 N., R. 100 W.	Tabor Springs
P19695D	HAPPY SPRING DITCH	ADJ	T. 29 N., R. 95 W.	Happy Springs
P1992D	SPRING CREEK DITCH	ADJ	T. 28 N., R. 90 W.	Spring Creek
P2080D	CRANER DITCH	ADJ	T. 29 N., R. 90 W.	Sweetwater River
P21717D	WELLS #1 DITCH	ADJ	T. 29 N., R. 94 W.	Warm Springs Creek
P21718D	WELLS #2 DITCH	ADJ	T. 29 N., R. 94 W.	Warm Springs Creek
P21718D	WELLS #2 DITCH	ADJ	T. 29 N., R. 94 W.	Warm Springs Creek
P22091D	MCDOWELL DITCH	ADJ	T. 28 N., R. 101 W.	Sweetwater River
P22528D	GEORGE HOTCHKISS DOM WATER SUPPLY PIPELINE	ADJ	T. 29 N., R. 100 W.	Hotchkiss Spring
P23144D	W H D PIPE LINE	ADJ	T. 30 N., R. 100 W.	Swabes Spring
P23457D	BROWN PIPELINE	ADJ	T. 29 N., R. 100 W.	Brown Spring
P2492D	MCKINNEY #2 DITCH	ADJ	T. 30 N., R. 93 W.	Sweetwater River
P2493D	MCKINNEY #1 DITCH	ADJ	T. 30 N., R. 93 W.	Sweetwater River
P2515D	SHEEHAN DITCH	ADJ	T. 29 N., R. 92 W.	Sweetwater River
P2526E	NATIONAL DITCH (enlarged)	ADJ	T. 30 N., R. 95 W.	Sweetwater River
P2731E	SHEEP CREEK DITCH (enlarged)	ADJ	T. 29 N., R. 91 W.	Sheep Creek
P2804D	TABOR PIPE LINE	ADJ	T. 29 N., R. 100 W.	Tabor Springs
P28924D	BIG DIAMOND SPRING PIPELINE	ADJ	T. 32 N., R. 90 W.	Big Diamond Spring
P2990D	SOUTH SIDE DITCH	ADJ	T. 29 N., R. 92 W.	Sweetwater River
P3190E	POINT OF ROCKS DITCH (enlarged)	ADJ	T. 29 N., R. 92 W.	Sweetwater River
P3194D	STEVENS #2 DITCH	ADJ	T. 28 N., R. 93 W.	Chute Creek
P3195D	STEVENS #3 DITCH	ADJ	T. 28 N., R. 92 W.	Crook's Creek
P3197D	SHEEP CREEK #2 DITCH	ADJ	T. 28 N., R. 92 W.	Sheep Creek
P3202E	BEAVER DAM DITCH (enlarged)	ADJ	T. 28 N., R. 99 W.	Sweetwater River

Sweetwater River Watershed Study: Phase III Study Area
Tabulation of Adjudicated Surface Water Rights

Permit Number	Facility Name	Status	Location	Stream Name
P3271E	THREE CROSSING (enlarged)	ADJ	T. 29 N., R. 91 W.	Sweetwater River
P3314D	OVERLAND SPRINGS	ADJ	T. 29 N., R. 98 W.	Spring
P3389D	W M CRANOR DITCH	ADJ	T. 29 N., R. 90 W.	Sweetwater River
P3448D	CANYON DITCH	ADJ	T. 30 N., R. 94 W.	Sweetwater River
P3488D	MCDOWELL	ADJ	T. 28 N., R. 101 W.	Sweetwater River
P3568R	KIRK RESERVOIR	ADJ	T. 29 N., R. 92 W.	Crook's Creek
P3568R	KIRK RESERVOIR	ADJ	T. 29 N., R. 92 W.	Dry Wash
P3571E	MILLER (enlarged)	ADJ	T. 29 N., R. 95 W.	Sweetwater River
P3605E	GRAHAM & FARNSLEY #1 DITCH (enlarged)	ADJ	T. 29 N., R. 95 W.	Sweetwater River
P3628D	BURNT RANCH DITCH (enlarged)	ADJ	T. 28 N., R. 100 W.	Sweetwater River
P367E	JAMERMAN DITCH (enlarged)	ADJ	T. 30 N., R. 91 W.	Sweetwater River
P3724E	BROWN DITCH (enlarged)	ADJ	T. 29 N., R. 96 W.	Sweetwater River
P3782E	MEYERS DITCH (enlarged)	ADJ	T. 30 N., R. 95 W.	Sweetwater River
P3790R	SULPHUR CREEK RESERVOIR	ADJ	T. 27 N., R. 96 W.	Sulphur Creek
P3819E	MILLER	ADJ	T. 29 N., R. 95 W.	Sweetwater River
P3882D	RIGBYS SHEEP CREEK	ADJ	T. 29 N., R. 92 W.	Sheep Creek
P3883D	RIGBYS RESERVOIR DITCH	ADJ	T. 29 N., R. 92 W.	Crook's Creek
P3931D	STOUGH DITCH	ADJ	T. 29 N., R. 96 W.	Alkali Creek (drainage of)
P3937R	BRANNAN #4 RESERVOIR	ADJ	T. 27 N., R. 98 W.	Dry Water Course
P393E	SALMON	ADJ	T. 30 N., R. 93 W.	Sweetwater River
P394E	GRAHAM (enlarged)	ADJ	T. 30 N., R. 93 W.	Sweetwater River
P4025R	PACIFIC #1 RESERVOIR	ADJ	T. 27 N., R. 102 W.	Sweetwater River
P403R	RIGBY'S RESERVOIR	ADJ	T. 29 N., R. 92 W.	Crook's Creek
P4222E	EMIGRANT ROAD DITCH (enlarged)	ADJ	T. 29 N., R. 92 W.	Sweetwater River
P4499E	INDEPENDENT DITCH (enlarged)	ADJ	T. 30 N., R. 95 W.	Sweetwater River
P4500E	MCDOWELL DITCH (enlarged)	ADJ	T. 28 N., R. 101 W.	Sweetwater River
P481E	RONGIS DITCH (enlarged)	ADJ	T. 30 N., R. 93 W.	Sweetwater River
P5097D	THREE CROSSINGS DITCH	ADJ	T. 30 N., R. 91 W.	Sweetwater River
P5453D	BUTTE SPRINGS	ADJ	T. 28 N., R. 92 W.	Butte Spring
P5458D	DEITCH #1	ADJ	T. 27 N., R. 92 W.	Gold Springs
P5458D	DEITCH #1	ADJ	T. 27 N., R. 92 W.	Gold Springs
P5600D	SPRING CREEK DITCH	ADJ	T. 27 N., R. 92 W.	Spring Creek
P5759D	SHEEP CREEK #1 DITCH	ADJ	T. 28 N., R. 92 W.	Sheep Creek
P5961E	FREDERICK DITCH (enlarged)	ADJ	T. 30 N., R. 95 W.	Sweetwater River
P6288R	WELLS RESERVOIR	ADJ	T. 29 N., R. 94 W.	Warm Springs Creek
P6288R	WELLS RESERVOIR	ADJ	T. 29 N., R. 94 W.	Warm Springs Creek
P6979D	NATIONAL DITCH	ADJ	T. 30 N., R. 95 W.	Sweetwater River
P702E	MCINTOSH (enlarged)	ADJ	T. 29 N., R. 90 W.	Sweetwater River
P7585D	SPRING	ADJ	T. 31 N., R. 91 W.	Black Rock Springs
P7714D	RIDDET DITCH	ADJ	T. 29 N., R. 95 W.	Warm Springs Creek
P7756D	WILLOW SPRING DITCH	ADJ	T. 28 N., R. 90 W.	Sweetwater River
P7757D	SPRING CREEK #2 DITCH	ADJ	T. 28 N., R. 90 W.	Spring Creek
P7758D	SPRING CREEK #3 DITCH	ADJ	T. 28 N., R. 90 W.	Spring Creek

Sweetwater River Watershed Study: Phase III Study Area
Tabulation of Adjudicated Surface Water Rights

Permit Number	Facility Name	Status	Location	Stream Name
P7774D	CROOKS CREEK	ADJ	T. 28 N., R. 92 W.	Crook's Creek
P7817D	SHEEP CREEK #1 DITCH	ADJ	T. 28 N., R. 92 W.	Sheep Creek
P7823D	SHEEP CREEK #2 DITCH	ADJ	T. 28 N., R. 92 W.	Sheep Creek
P7876D	POINT OF ROCKS DITCH	ADJ	T. 29 N., R. 92 W.	Sweetwater River
P8104S	MCINTOSH #2	ADJ	T. 28 N., R. 92 W.	Quaking Asp Creek
P82R	RIGBY RESERVOIR	ADJ	T. 29 N., R. 92 W.	Crook's Creek
P8611S	VERLA IRENE	ADJ	T. 30 N., R. 92 W.	Jade Draw
P8757D	RIZZI DITCH	ADJ	T. 28 N., R. 100 W.	Springs
P8760D	FREDERICK DITCH	ADJ	T. 30 N., R. 95 W.	Sweetwater River
P8994D	SHEEP CREEK #4	ADJ	T. 28 N., R. 92 W.	Sheep Creek
P9134D	BASCO DITCH	ADJ	T. 28 N., R. 100 W.	Dickie Spring Creek
P9136D	SHEEP CREEK #3 DITCH	ADJ	T. 28 N., R. 92 W.	Sheep Creek
P9392D	BEAVER DAM DITCH	ADJ	T. 28 N., R. 99 W.	Sweetwater River
P946E	SOUTH SIDE DITCH (enlarged)	ADJ	T. 29 N., R. 92 W.	Sweetwater River
P9756D	EMIGRANT ROAD DITCH	ADJ	T. 29 N., R. 92 W.	Sweetwater River
P979D	CALLAHAN DITCH	ADJ	T. 29 N., R. 96 W.	Sweetwater River
P990E	CANYON (enlarged)	ADJ	T. 30 N., R. 94 W.	Sweetwater River
P9942D	CRANOR EXTENSION	ADJ	T. 29 N., R. 90 W.	Sweetwater River
P9942DE	W M CRANOR DITCH (enlarged)	ADJ	T. 29 N., R. 90 W.	Sweetwater River
P9954D	JACOB DITCH	ADJ	T. 30 N., R. 95 W.	Sweetwater River
P9955D	MEYERS DITCH	ADJ	T. 30 N., R. 95 W.	Sweetwater River
T5615D	RONGIS DITCH	ADJ	T. 30 N., R. 93 W.	Sweetwater River
T5620D	BROWN DITCH	ADJ	T. 29 N., R. 96 W.	Sweetwater River
T5622D	ARNOLD #2 DITCH	ADJ	T. 29 N., R. 97 W.	Sweetwater River
T5623D	ARNOLD #1 DITCH	ADJ	T. 29 N., R. 97 W.	Sweetwater River
T5650D	GRANYEA DITCH	ADJ	T. 29 N., R. 100 W.	Tabor Springs
T5652D	SULPHER SPRINGS DITCH	ADJ	T. 29 N., R. 96 W.	Sulphur Springs