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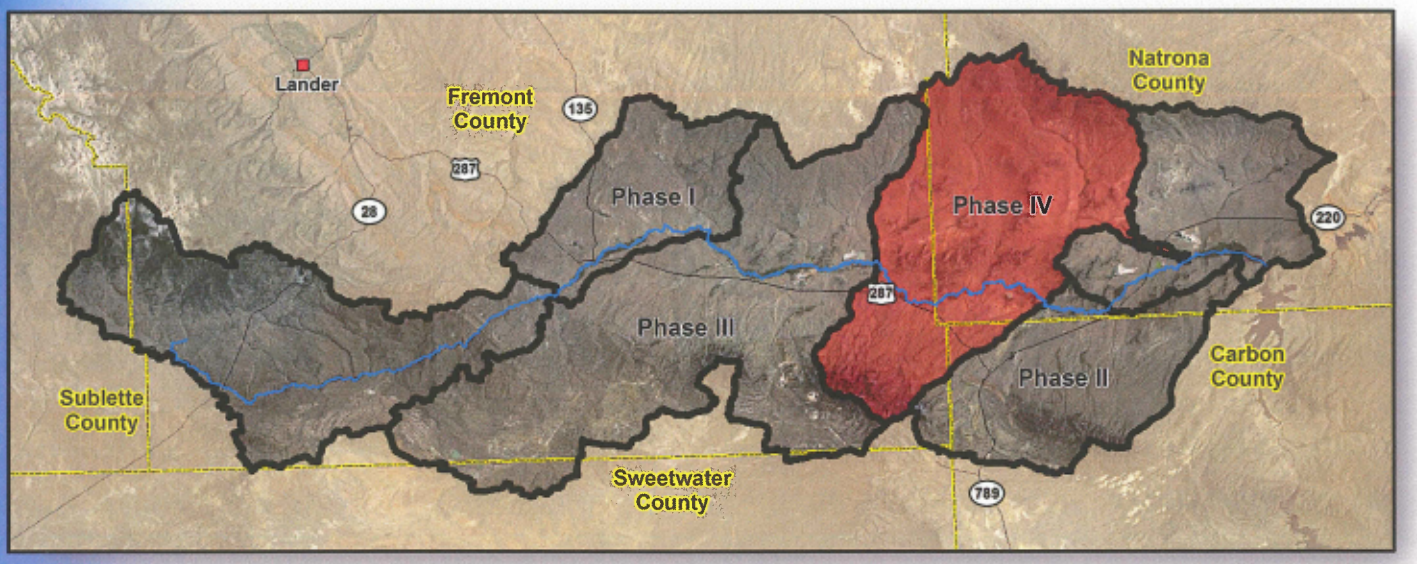
FINAL REPORT
FOR THE
SWEETWATER RIVER WATERSHED STUDY PHASE IV
WILLOW CREEK / SAGE HEN CREEK / DRY CREEK
WATERSHED MANAGEMENT PLAN

Prepared For:

Wyoming Water Development Commission
6920 Yellowtail Road
Cheyenne, WY 82002



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

April 20, 2012

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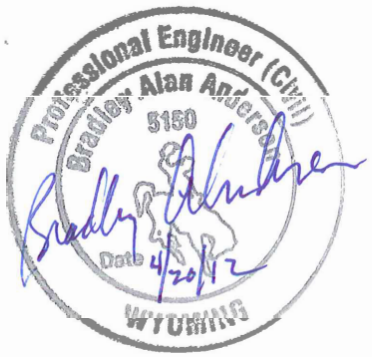

April 20, 2012

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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 IV 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

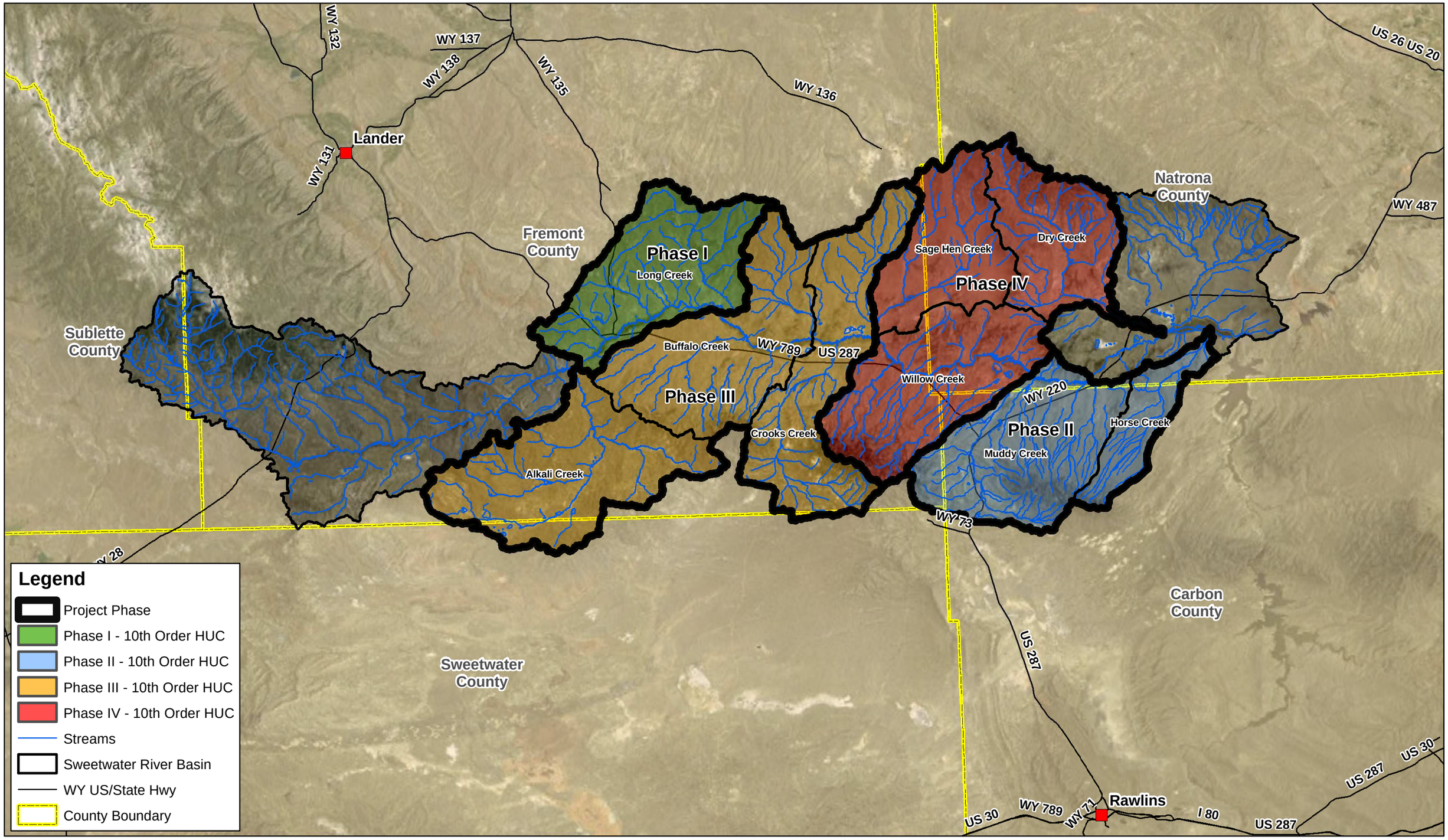


Figure 1.1 Sweetwater River Phase IV: Location Map

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
- Natrona County
- Popo Agie Conservation District

2.2 Land Use and Management

The total land area within the Phase IV study area is 395,361 acres (617.75 square miles). The distribution of land ownership within the watershed is shown on Figure 2.1. The bulk of the study area is federally owned; the BLM manages 75.89

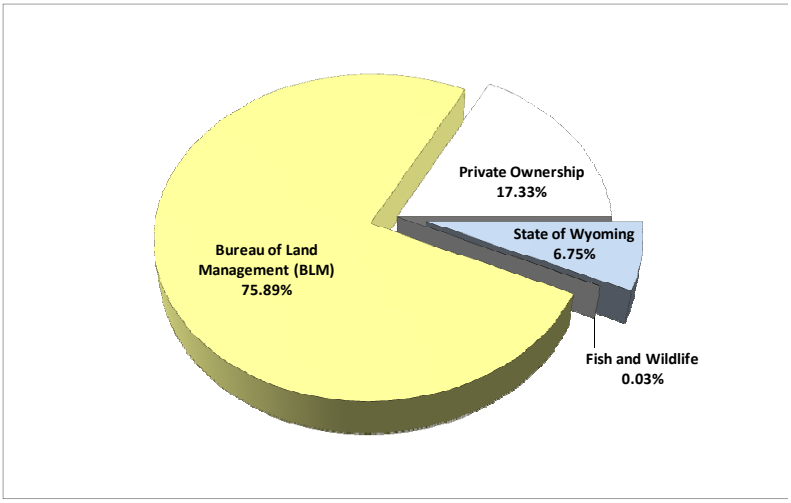


Figure 2.1 Distribution of Surface Ownership Within the Phase IV Study Area.

percent of the area (300,026 acres). Of the remaining portion of the study area, 17.33 percent (68,528 acres) are privately owned, and the State of Wyoming owns 6.75 percent (26,690 acres). In addition, the Fish and Wildlife Service manages an additional 0.03 percent (117 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

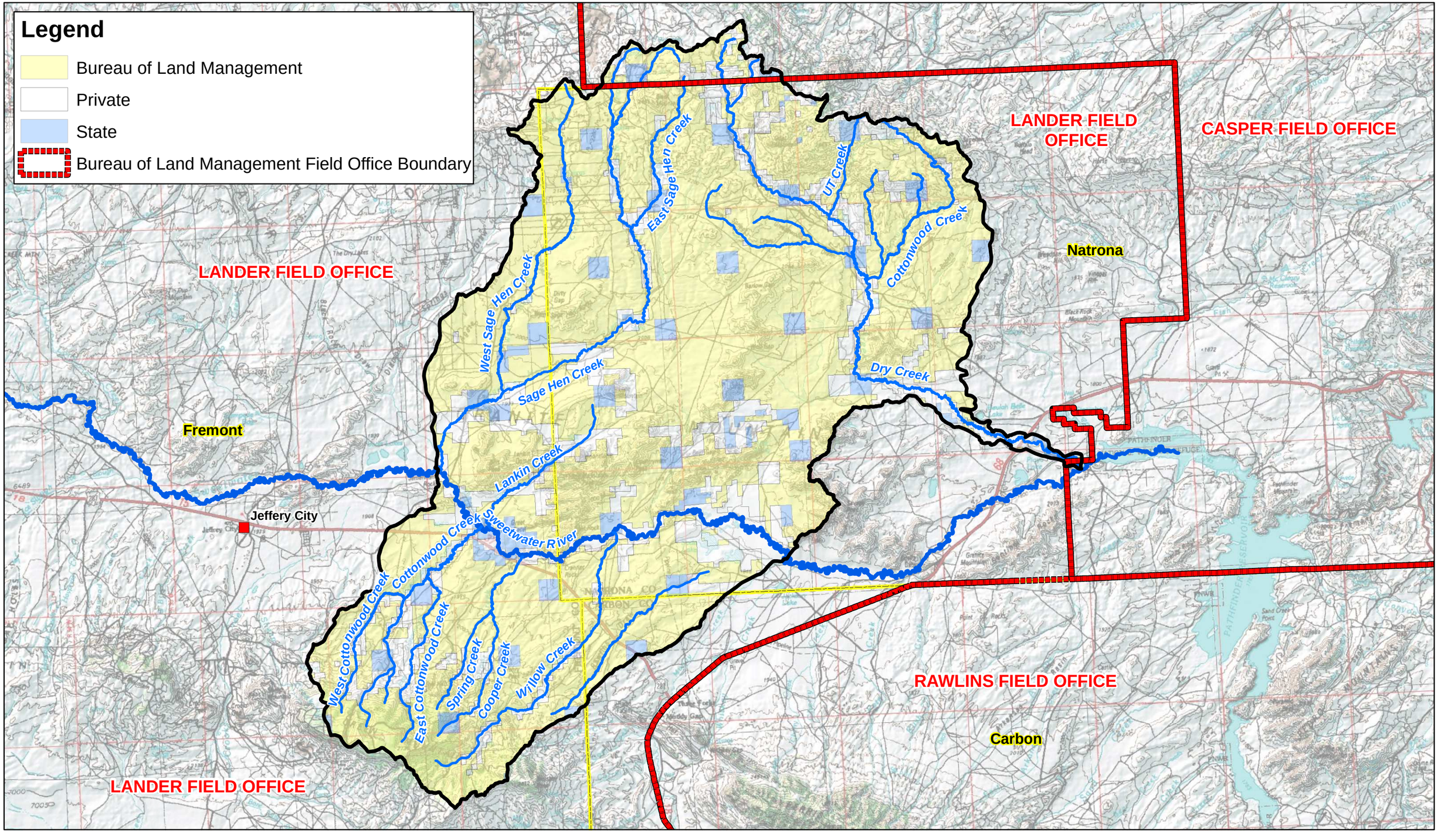
2.3.1 Overview

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 nearly 72% 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



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Legend

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

0 22,000 44,000

1 inch = 22,000 Feet

Figure 2.2 Sweetwater River Phase IV: Land Ownership and Management

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

Existing Vegetation Type	Acres	Percent of Watershed	Cummulative Percent
Inter-Mountain Basins Big Sagebrush Shrubland	224,802	56.9%	56.9%
Inter-Mountain Basins Big Sagebrush Steppe	59,634	15.1%	71.9%
Rocky Mountain Lower Montane-Foothill Shrubland	21,616	5.5%	77.4%
Artemisia tridentata ssp. vaseyana Shrubland Alliance	17,185	4.3%	81.8%
Western Great Plains Floodplain Systems	13,099	3.3%	85.1%
Rocky Mountain Foothill Limber Pine-Juniper Woodland	10,697	2.7%	87.8%
Inter-Mountain Basins Mountain Mahogany Woodland and Shrubland	6,982	1.8%	89.5%
Inter-Mountain Basins Mat Saltbush Shrubland	6,145	1.6%	91.1%
Inter-Mountain Basins Montane Sagebrush Steppe	5,444	1.4%	92.5%
Inter-Mountain Basins Semi-Desert Shrub-Steppe	4,398	1.1%	93.6%
Inter-Mountain Basins Semi-Desert Grassland	3,638	0.9%	94.5%
Wyoming Basins Low Sagebrush Shrubland	3,071	0.8%	95.3%
Rocky Mountain Subalpine/Upper Montane Riparian Systems	3,059	0.8%	96.1%
Agriculture-Pasture/Hay	2,890	0.7%	96.8%
Inter-Mountain Basins Greasewood Flat	2,450	0.6%	97.4%
Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Wood	1,670	0.4%	97.8%
Rocky Mountain Aspen Forest and Woodland	1,397	0.4%	98.2%
Developed-Open Space	1,123	0.3%	98.5%
Introduced Upland Vegetation - Annual and Biennial Forbland	1,085	0.3%	98.7%
Rocky Mountain Montane Riparian Systems	1,072	0.3%	99.0%
Northern Rocky Mountain Lower Montane-Foothill-Valley Grassland	996	0.3%	99.3%
Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland	604	0.2%	99.4%
Middle Rocky Mountain Montane Douglas-fir Forest and Woodland	528	0.1%	99.6%
Southern Rocky Mountain Ponderosa Pine Woodland	290	0.1%	99.6%
Inter-Mountain Basins Mixed Salt Desert Scrub	281	0.1%	99.7%
Rocky Mountain Poor-Site Lodgepole Pine Forest	202	0.1%	99.7%
Inter-Mountain Basins Juniper Savanna	179	0.05%	99.8%
Inter-Mountain Basins Sparsely Vegetated Systems	175	0.04%	99.8%
Rocky Mountain Subalpine-Montane Mesic Meadow	109	0.03%	99.9%
Developed-Low Intensity	108	0.03%	99.9%
Northern Rocky Mountain Subalpine Woodland and Parkland	102	0.03%	99.9%
Barren	97	0.02%	99.9%
Western Great Plains Depressional Wetland Systems	84	0.02%	100.0%
Open Water	69	0.02%	100.0%
Northwestern Great Plains Mixedgrass Prairie	27	0.01%	100.0%
Introduced Upland Vegetation - Annual Grassland	14	0.004%	100.0%
Colorado Plateau Pinyon-Juniper Woodland	11	0.003%	100.0%
Southern Rocky Mountain Montane-Subalpine Grassland	10	0.003%	100.0%
Rocky Mountain Gambel Oak-Mixed Montane Shrubland	7	0.002%	100.0%
Introduced Upland Vegetation - Perennial Grassland and Forbland	2	0.001%	100.0%
Rocky Mountain Subalpine-Montane Limber-Bristlecone Pine Woodland	2	0.0005%	100.0%
Northern Rocky Mountain Montane-Foothill Deciduous Shrubland	2	0.0004%	100.0%
Northern Rocky Mountain Subalpine-Upper Montane Grassland	1	0.0002%	100.0%
Agriculture-Cultivated Crops and Irrigated Agriculture	1	0.0002%	100.0%
Rocky Mountain Lodgepole Pine Forest	0	0.0001%	100.0%
Developed-Medium Intensity	0	0.0001%	100.0%

vegetation types present to a much lesser extent. For instance, the LANDFIRE data indicates that 1.1 percent (4,218 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).

In general, vegetation types within the Phase IV 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, limber pine 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.

2.3.2 Wetland – Riparian Vegetation

Wetland-riparian areas provide the highest vegetation production of plan communities within the study area yet comprise approximately 1.1 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.

Existing mapping of wetlands within the Phase IV 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 2,754 acres of wetlands exist within

1 - Basin exposed rock/soil
2 - Desert shrub
3 - Greasewood fans and flats
4 - Basin big sagebrush
5 - Wyoming big sagebrush
6 - Irrigated crops
7 - Shrub-dominated riparian
8 - Forest-dominated riparian
9 - Douglas fir
10 - Juniper woodland
11 - Limber pine and woodland
12 - Lodgepole pine

Fremont
Jeffery City
Natrona
Carbon
West Sage Hen Creek
East Sage Hen Creek
UT Creek
Cottonwood Creek
Dry Creek
Sage Hen Creek
Lankin Creek
Sweetwater River
West Cottonwood Creek
Cottonwood Creek
East Cottonwood Creek
Spring Creek
Cooper Creek
Willow Creek

N
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Legend

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

0 22,000 44,000

1 inch = 22,000 Feet

Figure 2.3 Sweetwater River Phase IV: Vegetative Cover 100K

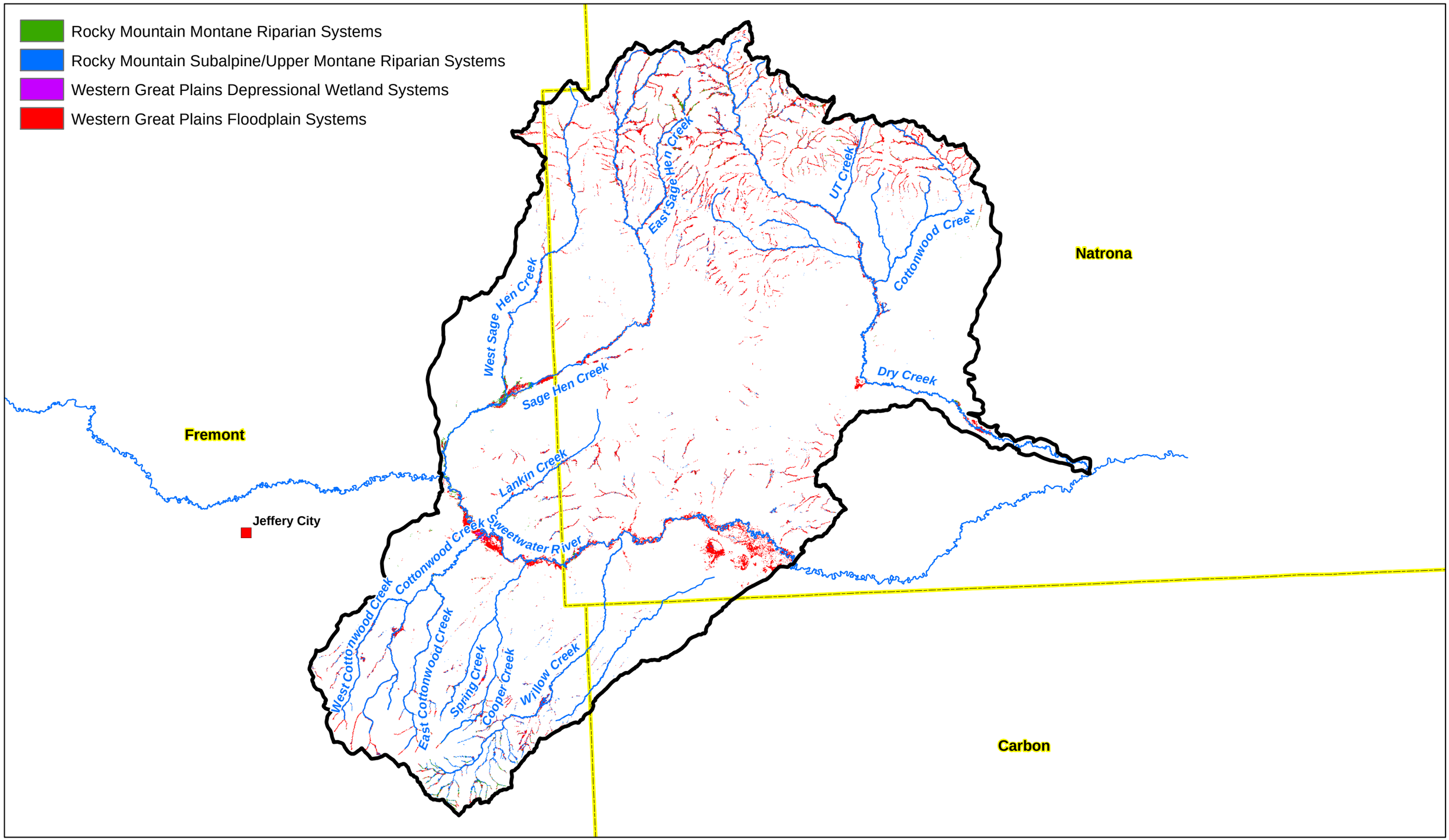
the watershed. It is generally understood by users of the NWI mapping that the data are suitable for broadscale planning efforts such as this Level I investigation, however, before design and completion of any project potentially affecting wetlands, detailed onsite delineation should be conducted.

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 (3,061 acres) and Rocky Mountain Montane Riparian Systems (1,073 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.

2.4 Wildlife

Much of the watershed 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 (82,319), elk (18,940 acres), mule deer (27,350 acres) and moose (6,291 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.

The Wyoming Natural Diversity Database (WYNDD) lists numerous non-game species of concern within the watershed, 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



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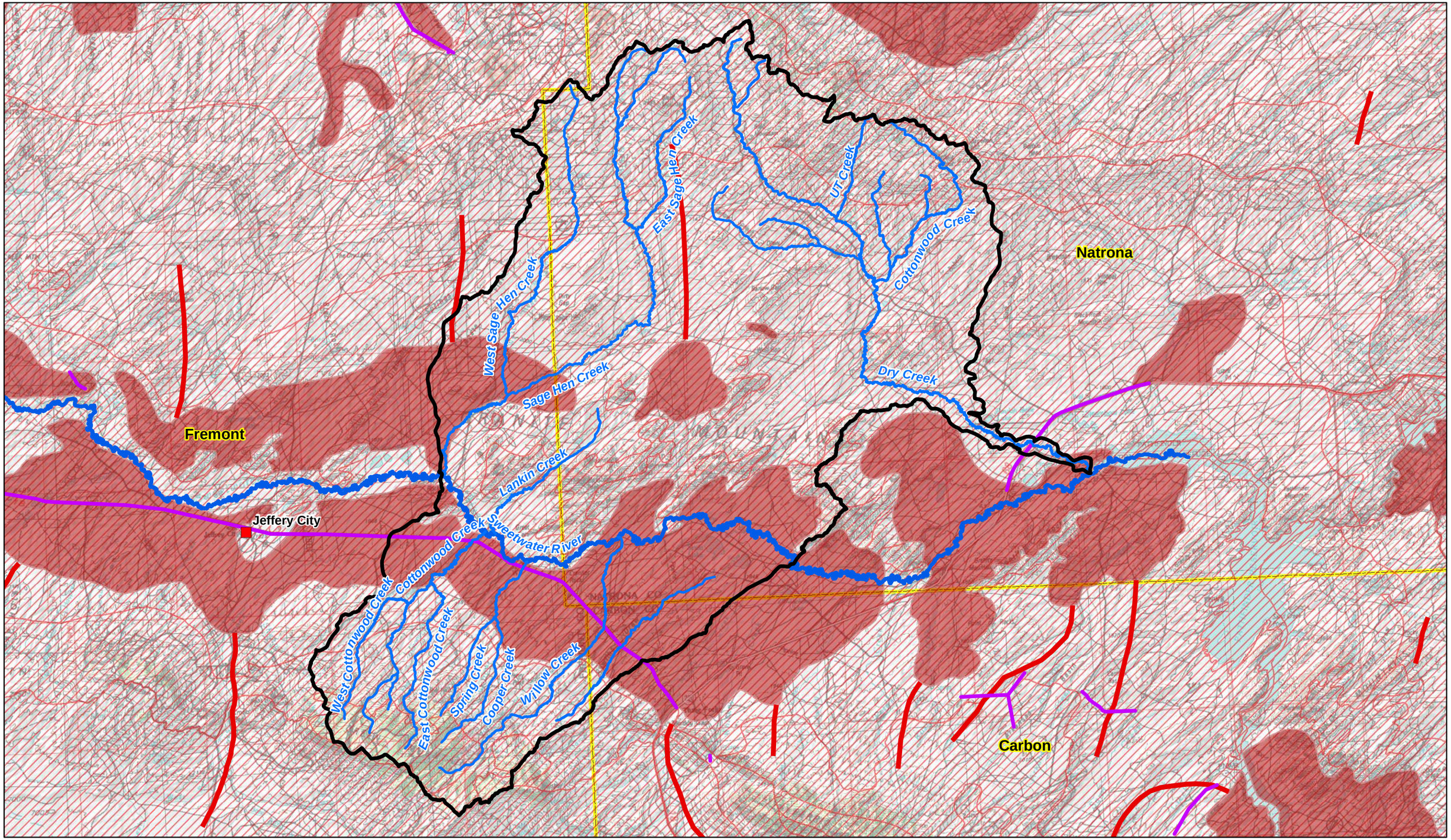
Legend

Streams - Phase IV Study Area
Cities
Phase IV Study Area
County Boundary

0 22,000 44,000

1 inch = 22,000 Feet

Figure 2.4 Sweetwater River Phase IV: LANDFIRE Riparian Areas



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Legend

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

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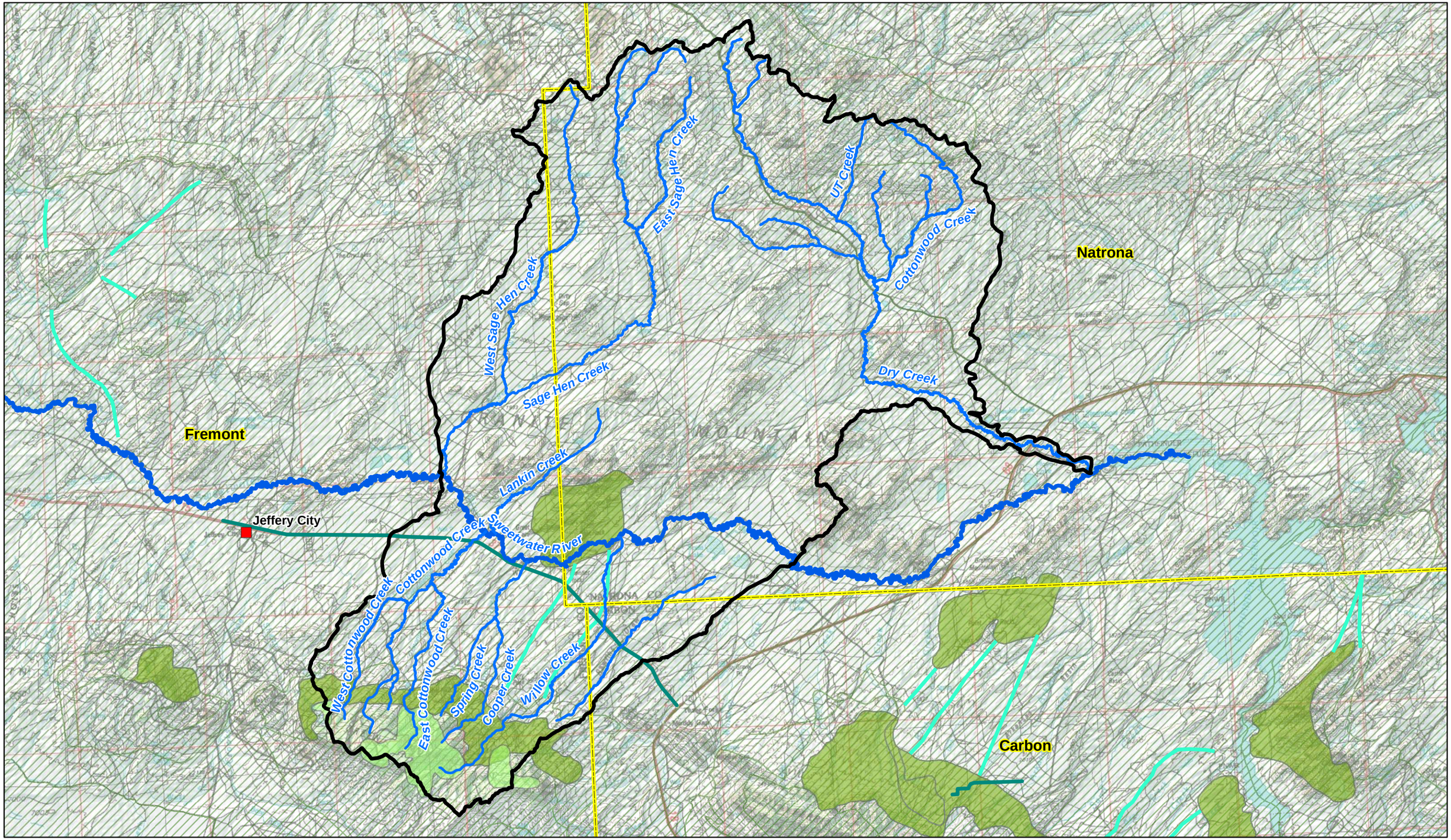
1 inch = 22,000 Feet

Figure 2.5 Sweetwater River Phase IV: Antelope Habitat



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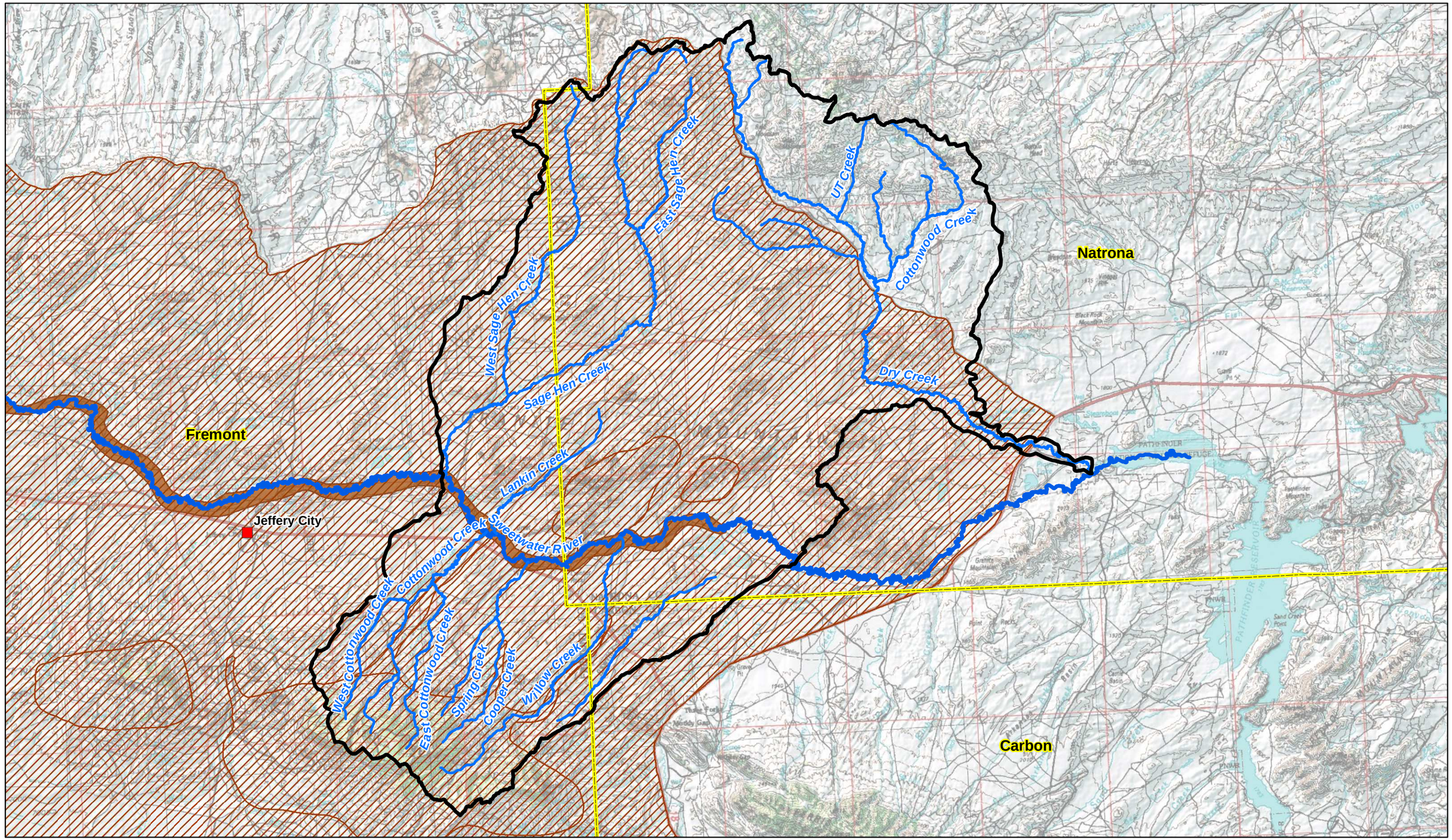
- Migration Barrier
- Migration Routes
- Crucial Range
- Parturition Area
- Seasonal Range
- Cities
- Sweetwater River
- Streams - Phase IV Study Area
- Phase IV Study Area
- County Boundary

0 22,000 44,000

1 inch = 22,000 Feet

Figure 2.6 Sweetwater River Phase IV: Elk Habitat



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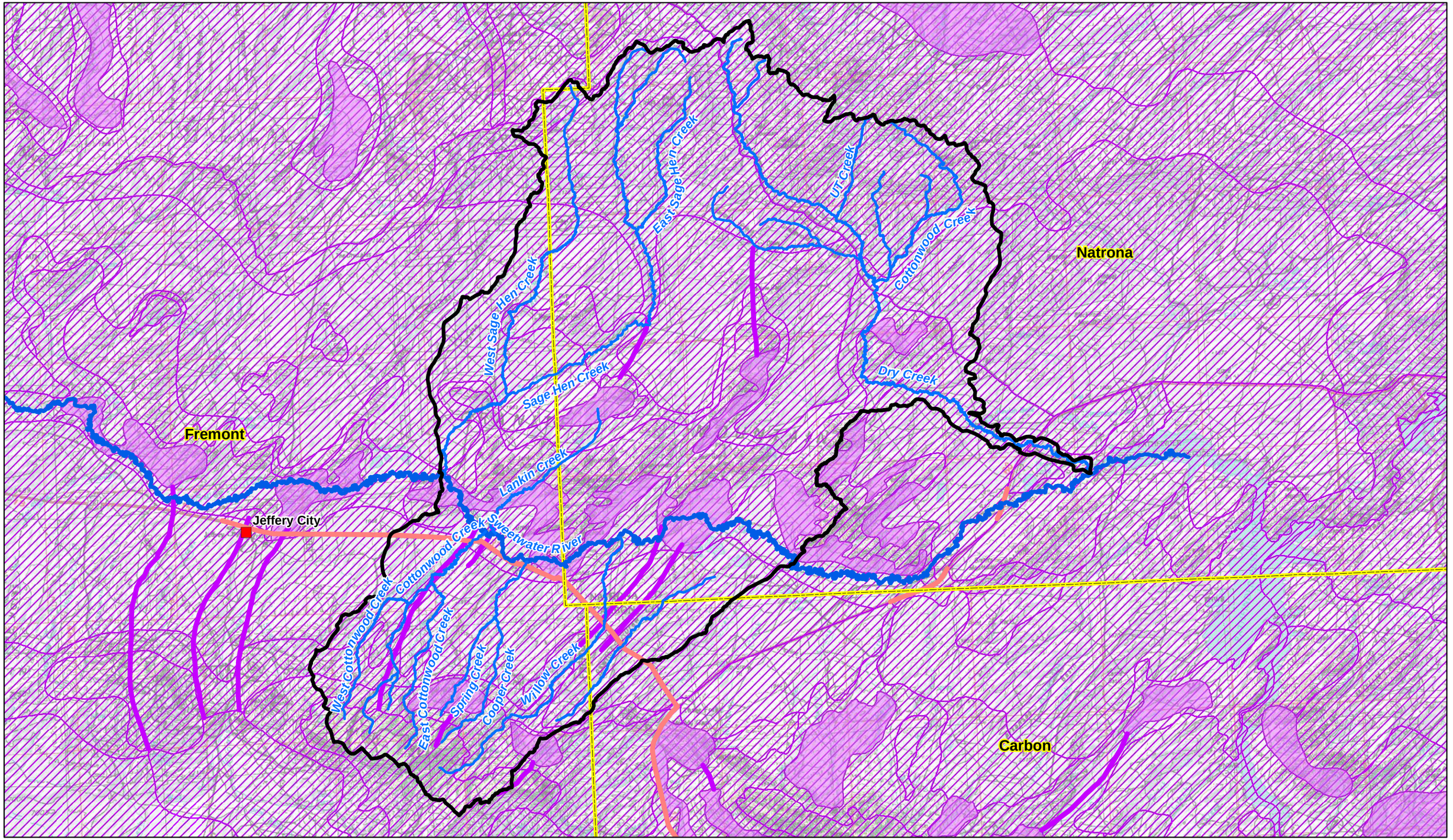
- Crucial Range
- Seasonal Range
- Sweetwater River
- Streams - Phase IV Study Area
- Phase IV Study Area
- County Boundary
- Cities

0 22,000 44,000

1 inch = 22,000 Feet

Figure 2.7 Sweetwater River Phase IV: Moose Habitat



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Legend

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

0 22,000 44,000

1 inch = 22,000 Feet

Figure 2.8 Sweetwater River Phase IV: Mule Deer Habitat

2.12

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

Scientific Name	Common Name	Listing Status	Tracked / Watched
Amphibians			
Ambystoma mavortium	Tiger Salamander		Watched
Lithobates pipiens	Northern Leopard Frog	Petitioned	Tracked
Spea intermontana	Great Basin Spadefoot		Tracked
Birds			
Accipiter gentilis	Northern Goshawk	Listing Denied	Tracked
Aechmophorus clarkii	Clark's Grebe		Tracked
Aquila chrysaetos	Golden Eagle		Watched
Asio flammeus	Short-eared Owl		Tracked
Athene cunicularia	Burrowing Owl		Tracked
Buteo regalis	Ferruginous Hawk		Tracked
Calcarius mccownii	Mccown's Longspur		Tracked
Centrocercus urophasianus	Greater Sage Grouse	Candidate	Tracked
Charadrius montanus	Mountain Plover	Listing Denied	Tracked
Falco peregrinus anatum	American Peregrine Falcon	Delisted	Tracked
Gavia immer	Common Loon		Tracked
Grus canadensis	Sandhill Crane		Watched
Haliaeetus leucocephalus	Bald Eagle	Delisted	Tracked
Lanius ludovicianus	Loggerhead Shrike		Tracked
Melanerpes lewis	Lewis' Woodpecker		Tracked
Oreoscoptes montanus	Sage Thrasher		Watched
Pandion haliaetus	Osprey		Watched
Pelecanus erythrorhynchos	American White Pelican (Breeding Colonies)		Tracked
Phalaropus lobatus	Red-necked Phalarope		Watched
Spizella breweri	Brewer's Sparrow		Watched
Mammals			
Brachylagus idahoensis	Pygmy Rabbit	Listing Denied	Tracked
Canis lupus	Gray Wolf	Threatened	Tracked
Cynomys leucurus	White-tailed Prairie Dog	Listing Denied	Tracked
Lasionycteris noctivagans	Silver-haired Bat		Watched
Mustela nigripes	Black-footed Ferret	Endangered	Tracked
Ovis canadensis	Bighorn Sheep		Watched
Spermophilus elegans	Wyoming Ground Squirrel		Watched
Sylvilagus floridanus	Eastern Cottontail		Watched

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 is the black-footed ferret (*Mustela nigripes*).

The potential exists for some of these species to occur within appropriate habitats within the watershed. 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 IV 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.

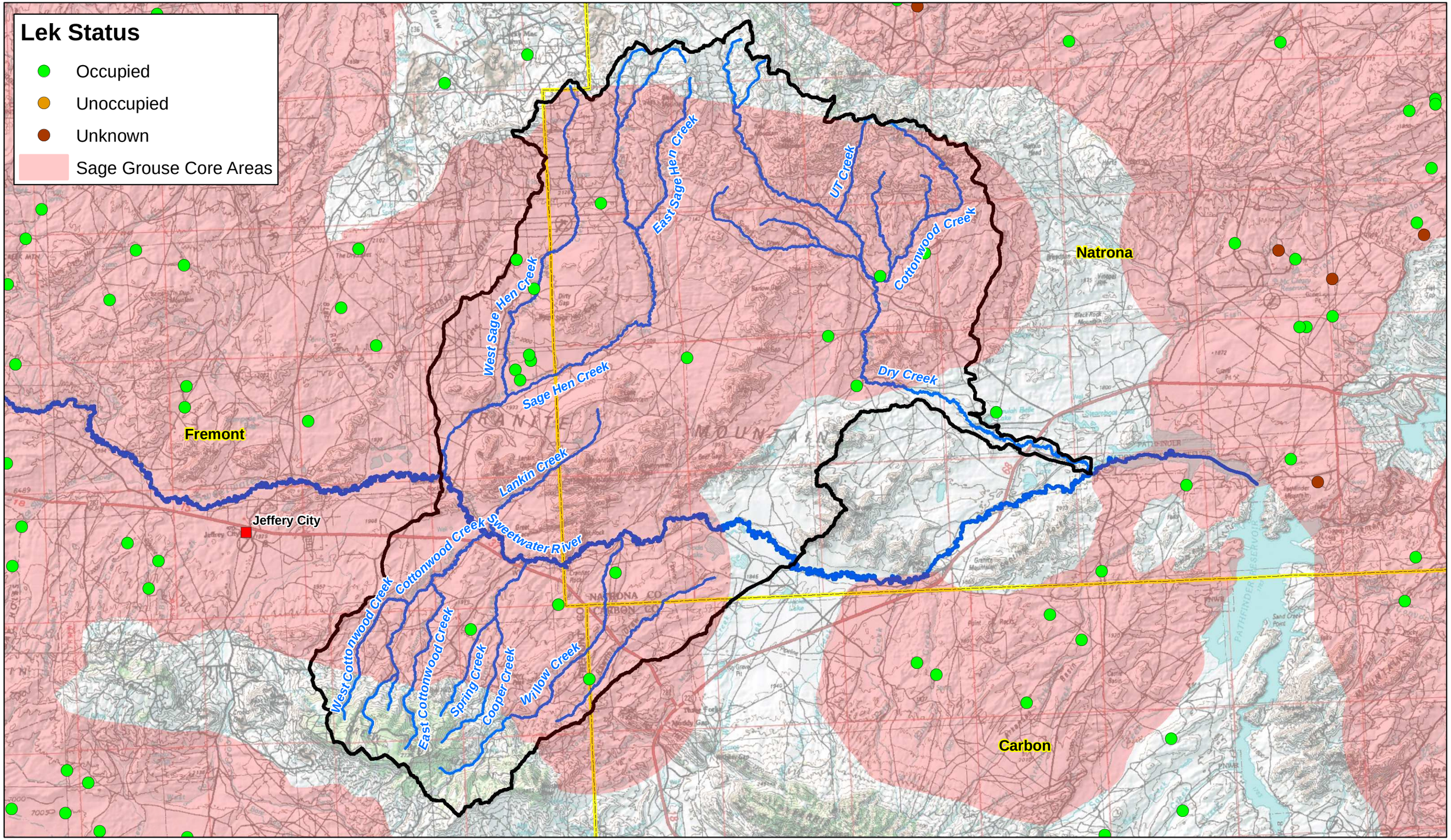
WGFD lists the greater sage grouse as: species that are widely distributed, with population status or trends unknown but suspected to be stable; habitat restricted or vulnerable but no recent or on-going significant loss; species likely sensitive to human disturbance. *The sage grouse are not listed 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.*

Wild horses frequent the Phase IV Study area within two 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):

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.



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

0 22,000 44,000

1 inch = 22,000 Feet

Figure 2.9 Sweetwater River Phase IV: Sage Grouse Leks

Horse Management Area outside of basin
Green Mountain; Muskrat Basin

Rock Creek
Muskrat Basin
Dishpan Butte
Fremont
Jeffery City
Crooks Mountain
Green Mountain
Natrona
Carbon

West Sage Hen Creek
East Sage Hen Creek
UT Creek
Cottonwood Creek
Sage Hen Creek
Dry Creek
Lankin Creek
Sweetwater River
West Cottonwood Creek
Cottonwood Creek
East Cottonwood Creek
Spring Creek
Cooper Creek
Willow Creek

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

0 22,000 44,000

1 inch = 22,000 Feet

Figure 2.10 Sweetwater River Phase IV: Wild Horse Management Areas

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. "

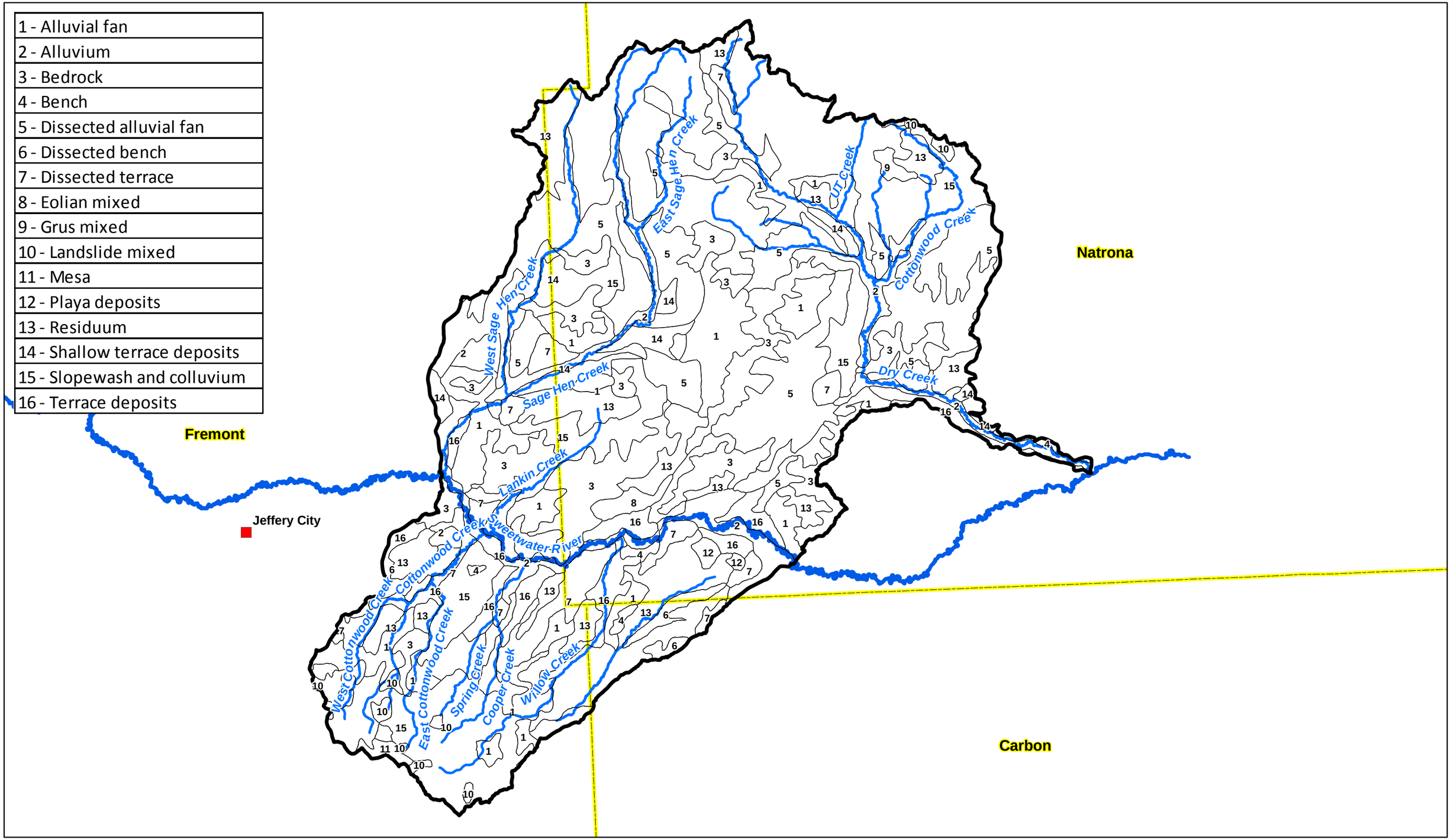
2.5 Geology and Soils

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 IV Study Area, detailed soils mapping were available through the NRCS for the majority of the area. This information is displayed in Figure 2.13.

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 - Playa deposits
13 - Residuum
14 - Shallow terrace deposits
15 - Slopewash and colluvium
16 - Terrace deposits



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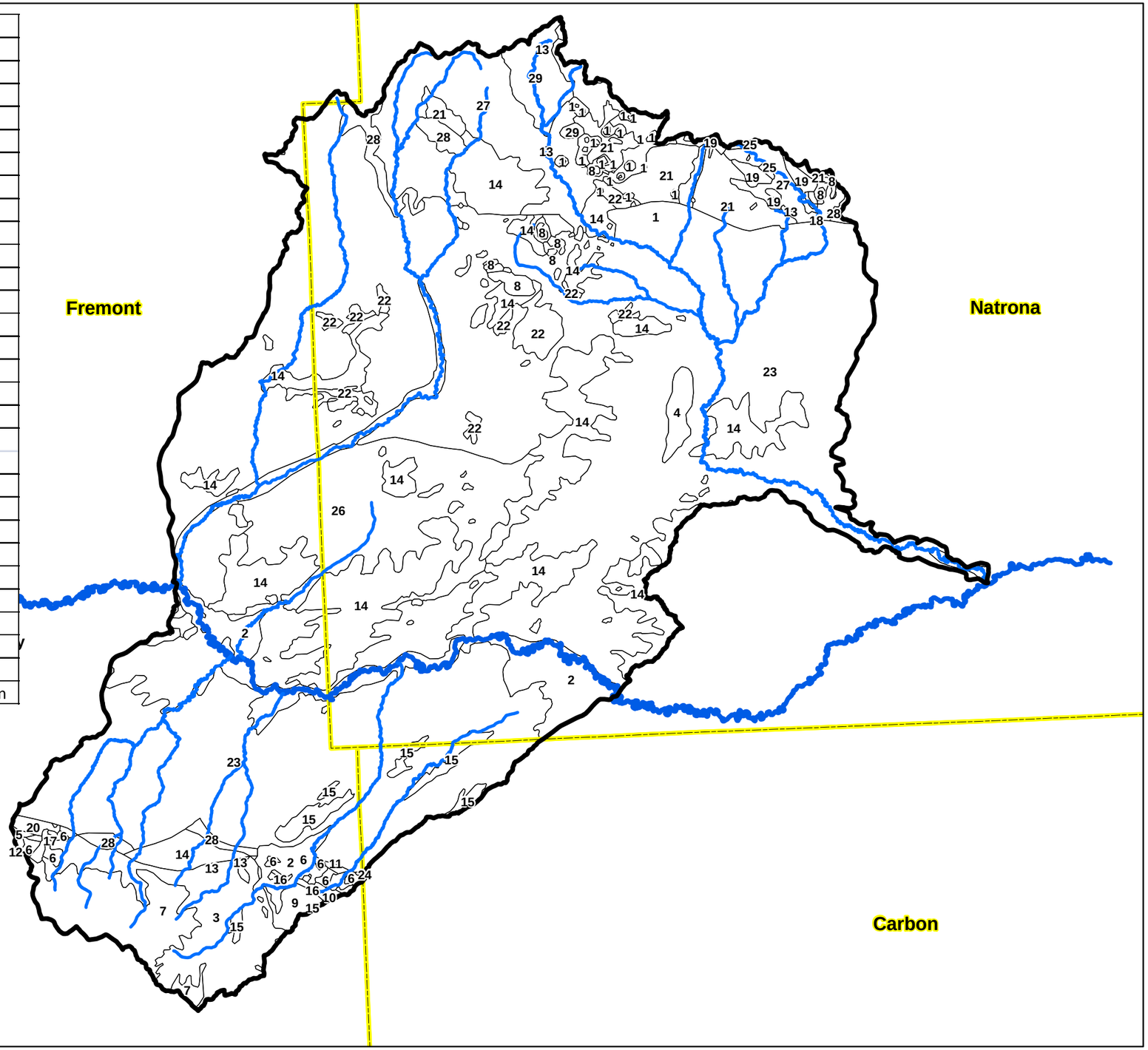
Sweetwater River
Streams - Phase IV Study Area
Phase IV Study Area
Cities
County Boundary

0 22,000 44,000

1 inch = 22,000 Feet

Figure 2.11 Sweetwater River Phase IV: Surficial Geology

1 - Alkalic intrusive and extrusive rocks
2 - Alluvium and colluvium
3 - Battle Spring formation
4 - Bug Formation (Pleistocene or Pliocene)
5 - Cloverly, Morrison, and Sundance formations
6 - Cody shale
7 - Crooks gap conglomerate
8 - Dacite and quartz latite intrusive and extrusive igneous rocks
9 - Fort Union formation
10 - Fox Hills sandstone and Lewis shale
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 - Lance formation
17 - Landslide deposits
18 - Madison limestone or group
19 - Madison limestone, Darby formation, Bighorn dolomite, Gallitin Limestone, GrosVentre formation and Flathead sandstone
20 - Mesozoic and Paleozoic Rocks
21 - Metamorphosed Mafic and Ultramafic Rocks
22 - Metasedimentary and Metavolcanic Rocks
23 - Miocene Rocks
24 - Peridotite Intrusive Rocks
25 - TenSleep sandstone and Amsden formation
26 - Upper Miocene Rocks
27 - Wagon Bed formation
28 - White River formation
29 - Wind River formation - at base locally includes equivalent of Indian Meadows formation



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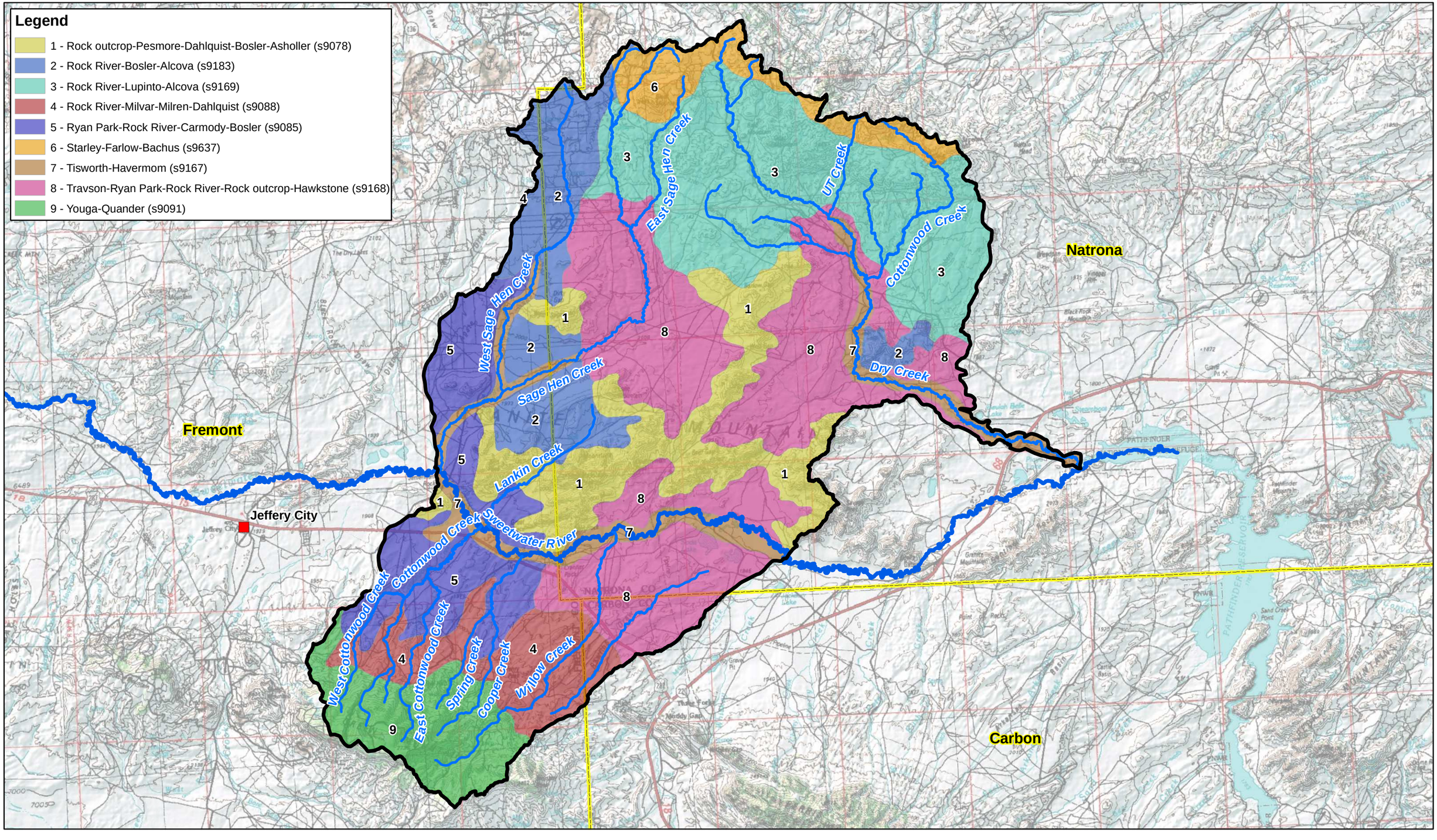
Sweetwater River
Streams - Phase IV Study Area
Phase IV Study Area
Cities
County Boundary

0 22,000 44,000

1 inch = 22,000 Feet

Figure 2.12 Sweetwater River Phase IV: Bedrock Geology



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

0 22,000 44,000

1 inch = 22,000 Feet

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

2.6 Hydrology

2.6.1 Surface Water Hydrology

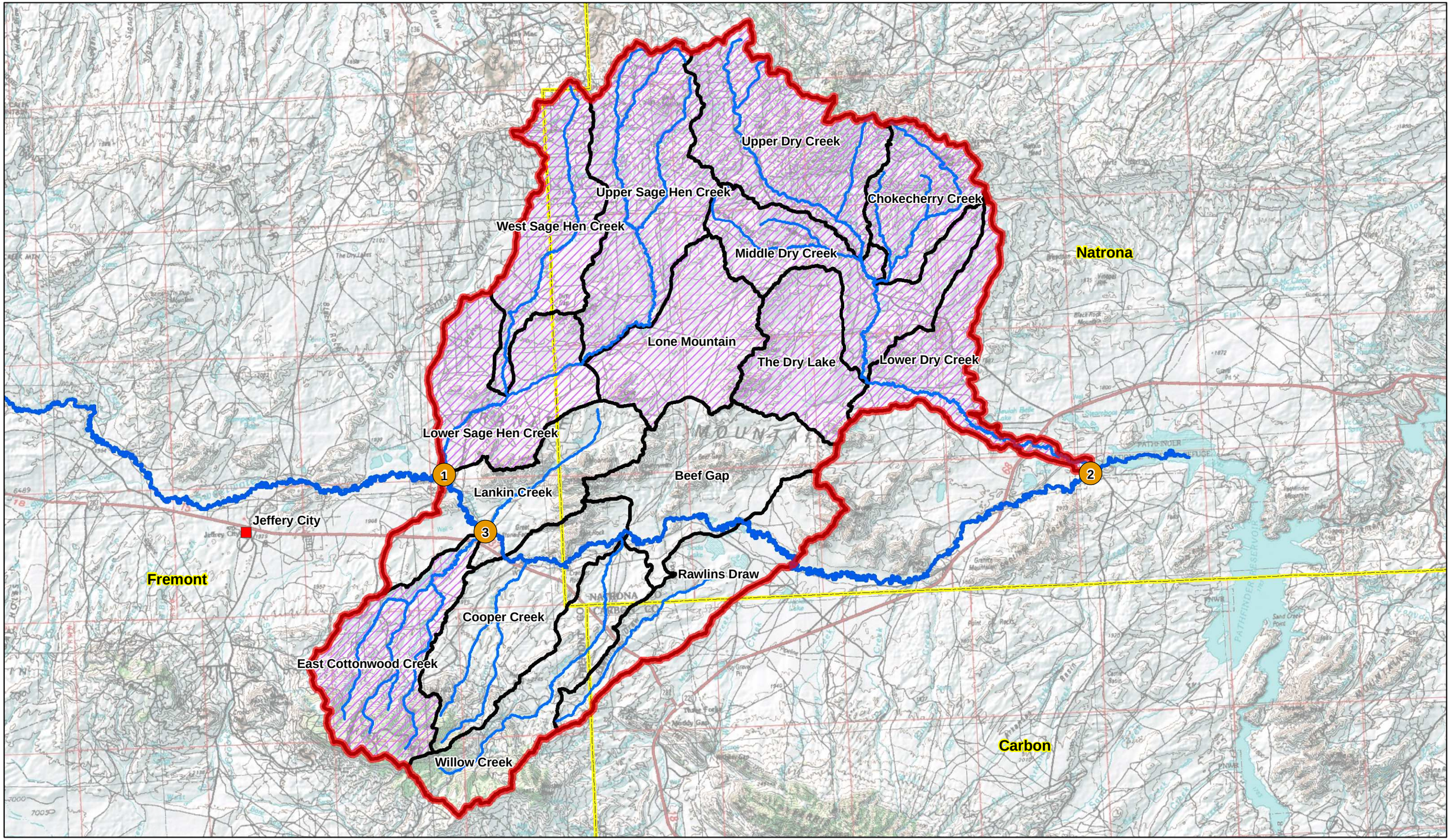
The location and extent of the watershed, the mainstem streams and significant tributaries are shown on Figure 2.14. Many of these streams tend to have perennial reaches in their upper basins. Springs provide year-round local sources of water and provide supplemental flow to surface waters. These streams 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.

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 IV 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 IV Study Area Streams.

	Sage Hen Creek	Dry Creek	Cotton Wood Creek
	Node 1 *	Node 2 *	Node 3 *
Basin Area (square miles)	178.0	180.8	41.5
latitude of basin outlet (decimal degrees)	42.525704	42.507854	42.486311
Flood Return Periods (years)	Peak Discharge (cfs)		
1.5	109	111	45
2	164	167	69
2.33	196	199	83
5	359	366	161
10	531	541	246
25	795	810	382
50	1021	1040	502
100	1272	1295	639

* See location on Figure 2.14



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1 Hydrologic Evaluation

Evaluated HUC Boundary

HUC Basin Boundary

Phase IV Study Area

Cities

County Boundary

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1 inch = 22,000 Feet

Figure 2.14 Sweetwater River Phase IV: Hydrologic Features

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 IV Study Area. Within the Phase IV 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 IV Study Area.

Stream	WDEQ Class
Sweetwater River below Alkali Creek	2AB
Dry Creek	2AB
Roberts Dr	3B
Cottonwood Creek	3B
Soda Lakes	3B
Willow Creek	2AB
Cooper Creek	2AB
Lankin Creek	2AB
Cottonwood Creek	2AB
Sage Hen Creek	2AB
Diamond Springs Draw	3B
West Sage Hen Creek	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.

2.6.2 Groundwater Resources

Groundwater in the Phase IV 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 one hundred twenty four (124) permitted water supply wells within the study area. This number includes springs for which water rights permits have been granted. Depths of water supply wells range from less than 50 feet for alluvial wells along the Sweetwater River to over one thousand feet (Meadow Draw Well located along Sage Hen Creek).

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. Typical study area wells are approximately 100 feet to 250 feet deep with reported yields less than 25 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.

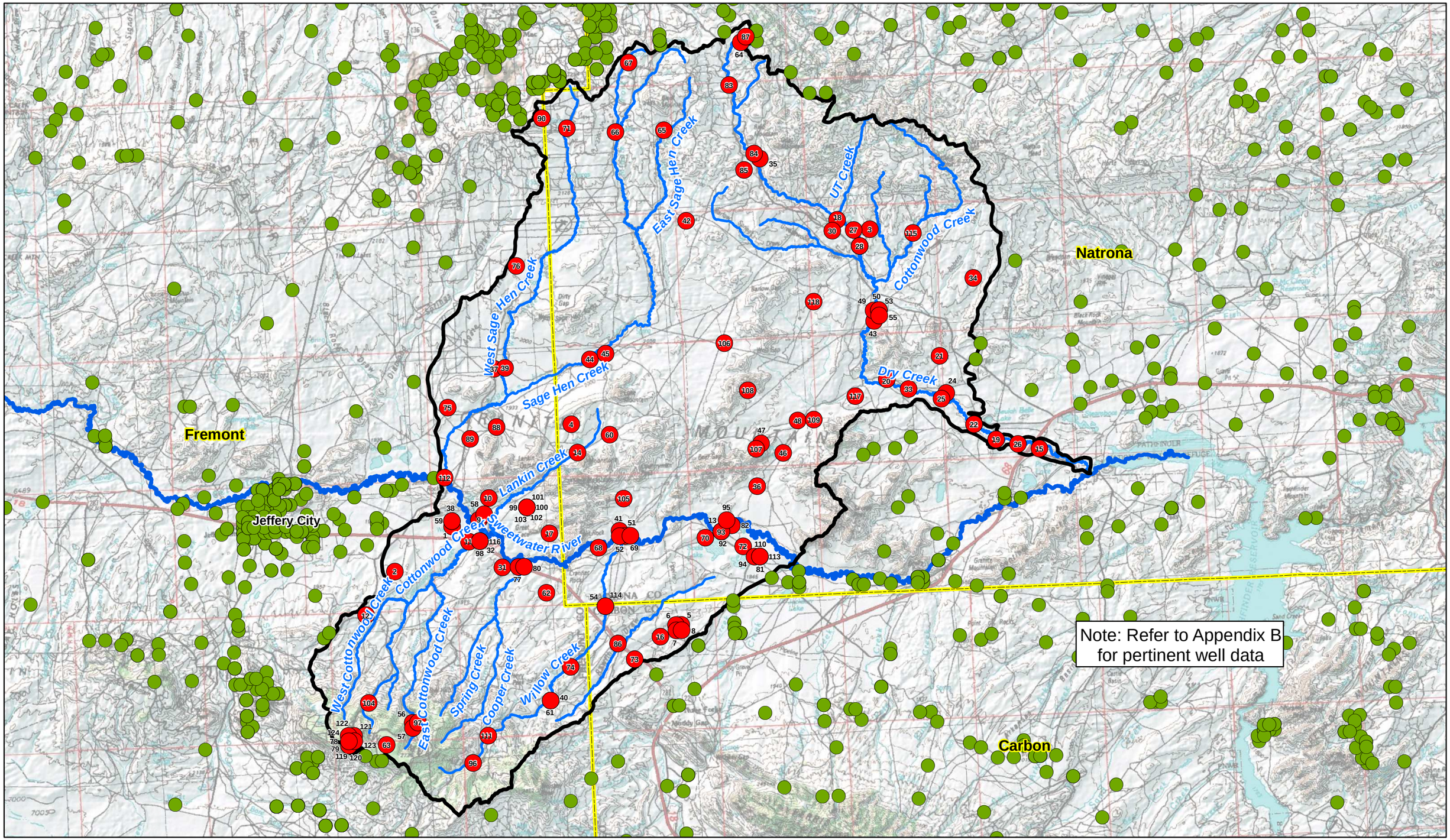
Springs are scattered throughout the study area as indicated in Figure 2.16.

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 IV 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



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

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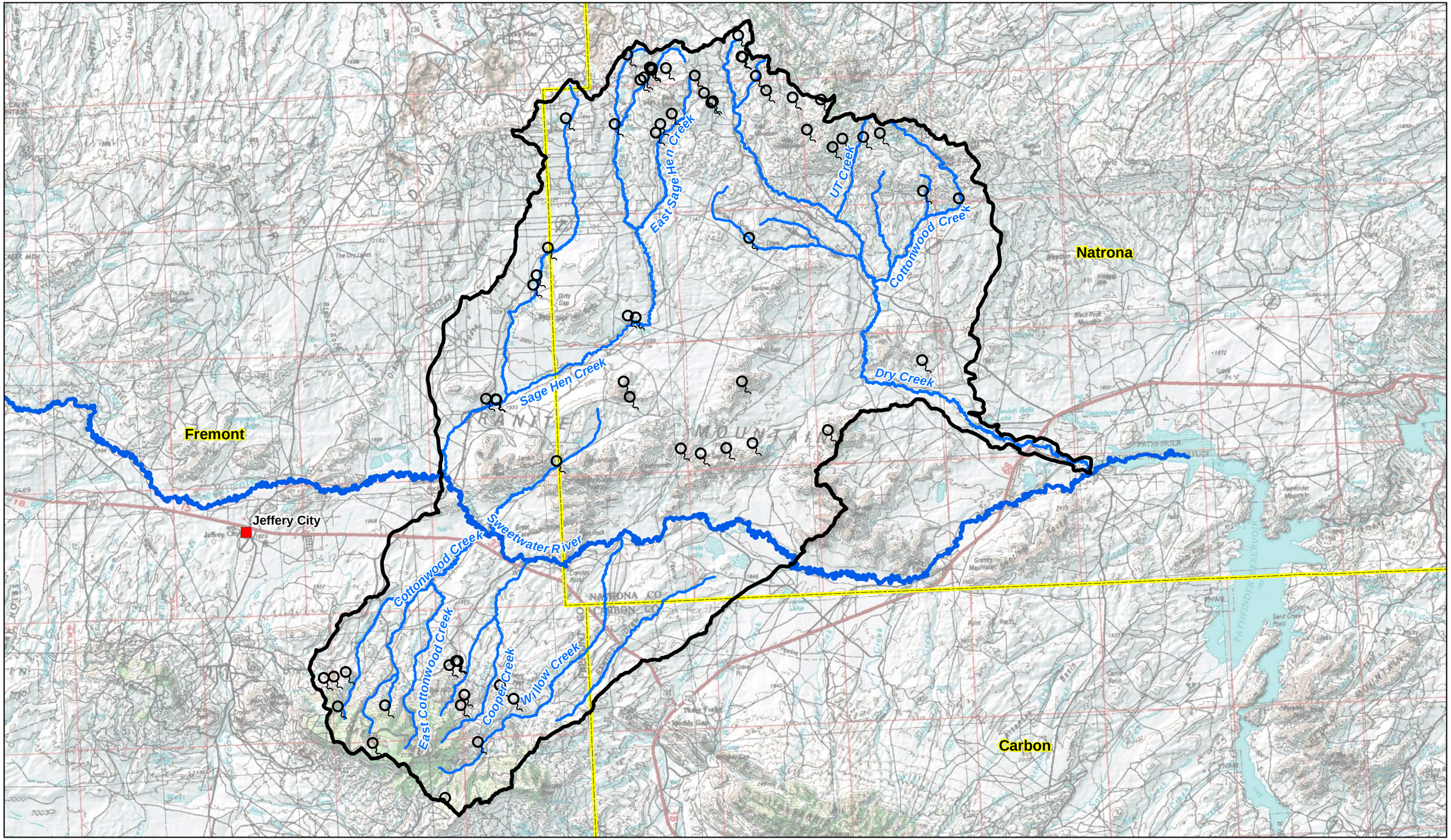
1 inch = 22,000 Feet

Figure 2.15 Sweetwater River Phase IV: Groundwater Wells



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- Springs
- Cities
- Sweetwater River
- Streams - Phase IV Study Area
- Phase IV Study Area
- County Boundary

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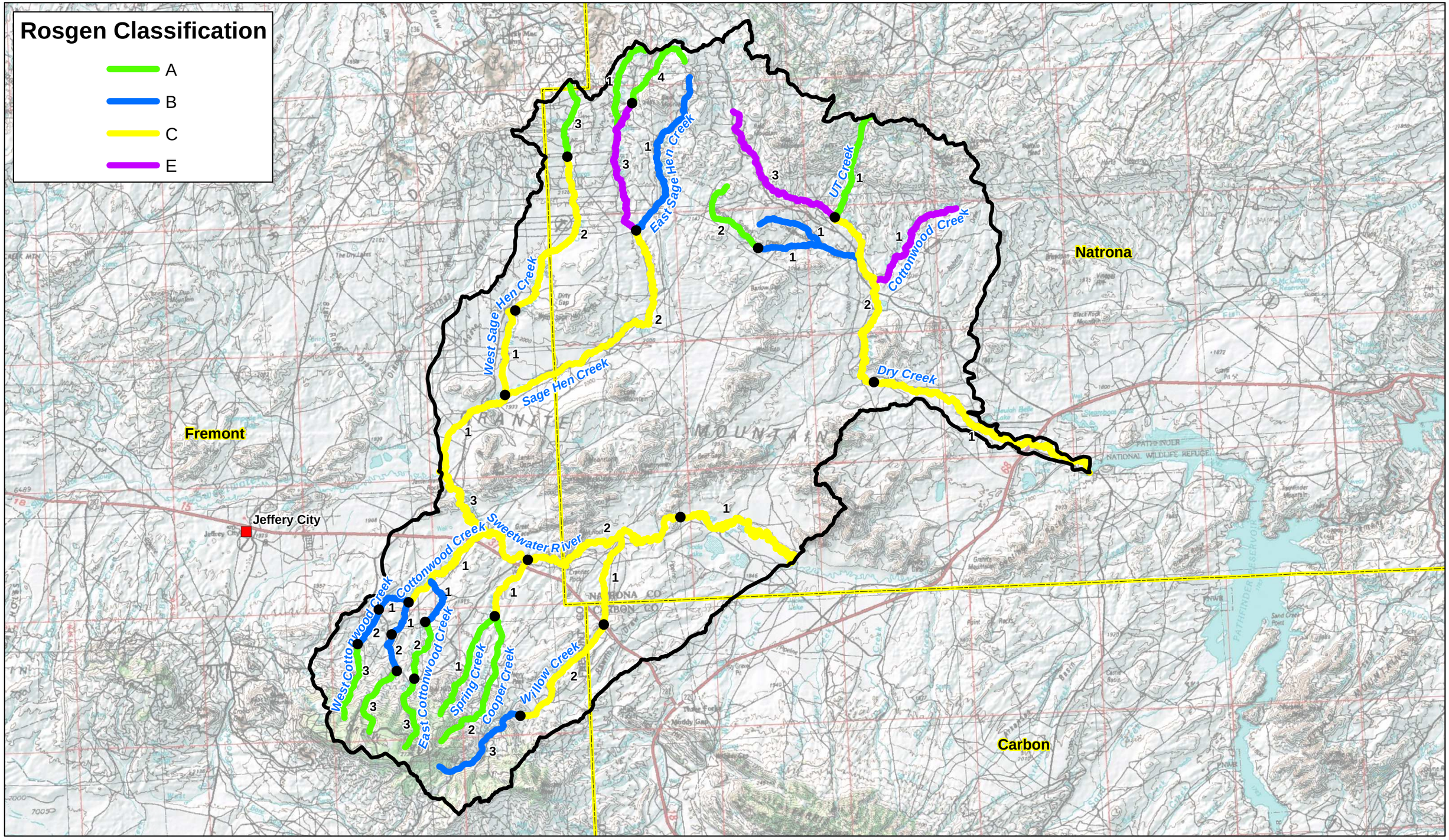
1 inch = 22,000 Feet

Figure 2.16 Sweetwater River Phase IV: Spring Locations



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Phase IV Study Area
County Boundary
Cities

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1 inch = 22,000 Feet

Figure 2.17 Sweetwater River Phase IV: Geomorphic Stream Classifications

Table 2.5 Summary of Geomorphic Parameters.

Stream	Reach Number	Station (Distance from Mouth)		Reach Length		Sinuosity	Slope	Rosgen
		Station Start (ft)	Station End(ft)					
Cooper Creek	1	0	20,400	20,400	3.87	1.23	0.009	C
	2	20,400	60,600	40,200	7.62	1.07	0.044	A
Cottonwood Creek	1	0	46,600	46,600	8.83	1.52	0.008	E
	2	46,600	85,200	38,500	7.30	1.24	0.028	B
Cottonwood Creek (Trib to Dry Creek)	1	0	44,000	44,000	8.33	1.63	0.005	E
Dry Creek	1	0	105,800	105,800	20.03	1.77	0.003	E
	2	105,800	192,400	86,700	16.41	1.80	0.005	E
	3	192,400	248,800	56,300	10.67	1.39	0.010	C
	4	248,800	279,200	30,400	5.76	1.48	0.012	B
East Cottonwood Creek	1	0	17,100	17,100	3.23	1.38	0.009	B
	2	17,100	34,500	17,500	3.31	1.10	0.035	A
	3	34,500	55,600	21,100	3.99	1.06	0.070	A
East Fork Middle Cottonwood Creek	1	0	9,900	9,900	1.88	1.08	0.117	A
East Fork Sage Hen Creek	1	0	55,400	55,400	10.49	1.28	0.017	B
Middle Cottonwood Creek	1	0	11,200	11,200	2.12	1.24	0.015	B
	2	11,200	22,600	11,400	2.16	1.15	0.031	B
Middle Fork Sage Hen Creek	1	0	25,800	25,800	4.89	1.12	0.019	A
Sage Hen Creek	1	0	47,900	47,900	9.07	1.74	0.003	C
	2	47,900	129,100	81,200	15.39	1.30	0.005	C
	3	129,100	183,700	54,600	10.34	1.55	0.008	E
	4	183,700	207,400	23,700	4.48	1.11	0.021	A
Spring Creek	1	0	31,000	31,000	5.87	1.08	0.053	A
West Cottonwood Creek	1	0	12,700	12,700	2.41	1.51	0.005	C
	2	12,700	26,000	13,300	2.51	1.28	0.016	B
	3	26,000	46,700	20,700	3.91	1.08	0.077	A
West Fork Middle Cottonwood Creek	1	0	20,200	20,200	3.83	1.05	0.085	A
West Sage Hen Creek	1	0	29,200	29,200	5.52	1.33	0.007	C
	2	29,200	89,200	60,100	11.38	1.35	0.009	C
	3	89,200	109,900	20,600	3.91	1.10	0.012	A
Willow Creek	1	0	29,000	29,000	5.50	1.25	0.009	C
	2	29,000	68,400	39,400	7.46	1.21	0.014	C
	3	68,400	97,600	29,200	5.53	1.08	0.035	B
Sweetwater River	1	0	78,800	78,800	14.92	2.31	0.001	C
	2	78,800	155,200	76,400	14.48	1.67	0.001	C
	3	155,200	219,500	64,300	12.18	1.80	0.001	C

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.

Downstream reaches of dominant mainstem channels are classified as Type C stream channels (ex. Willow Creek and the Sweetwater River). 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 Lower Sage Hen Creek within the Phase IV Study Area.

Reaches of several streams were classified as Type E stream channels. These include Upper Dry Creek, Upper Sage Hen Creek, Cottonwood Creek (tributary to Sweetwater River) and Cottonwood Creek (tributary to Dry 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 displays a photo of Upper Sage Hen Creek). 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 2.18 Example Type C Channel: Lower Sage Hen Creek.

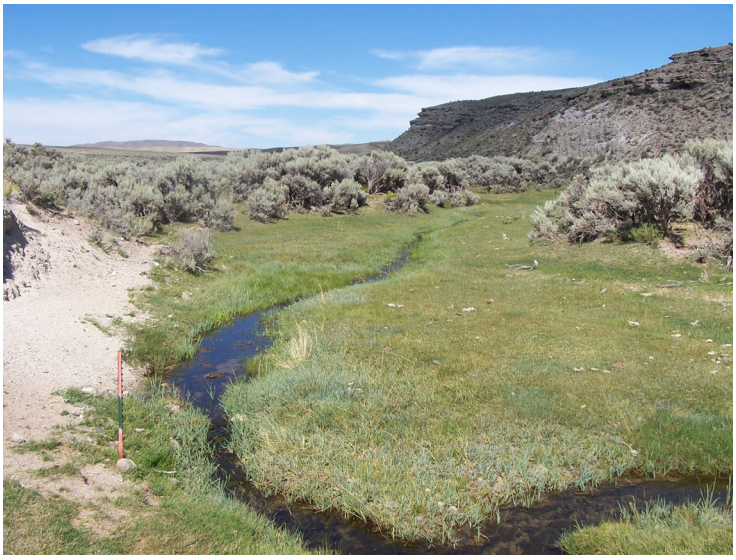


Figure 2.19 Example E-Type Channel: Upper Sage Hen Creek.

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 IV Study Area, the BLM conducted a limited number of PFC assessments on selected stream segments on public lands. Based upon information provided by the BLM, the assessments appear to have been conducted intermittently between 1995 and 2001 (Figure 2.20). 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.

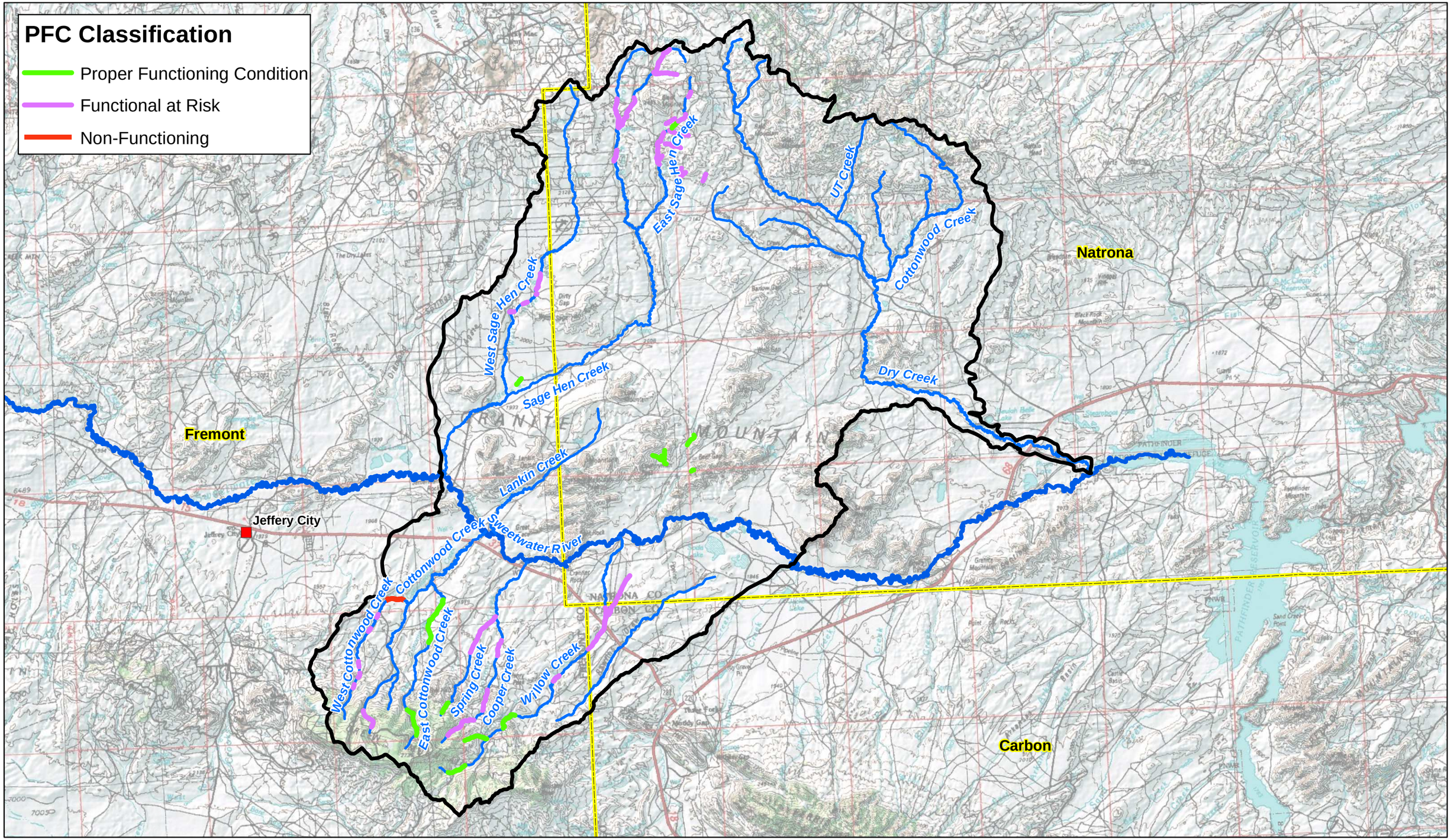
2.7.3 Impairments

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 2.21 displays a geomorphically stable portion of Sage Hen Creek exhibiting a lack of riparian vegetation and habitat.
- Riparian Degradation: Generally bank erosion and physical disturbance of stream banks. Figure 2.22 displays a photo of Dry Creek where stream banks have been disturbed by wildlife and livestock utilization. Figure 2.23 displays a photo of Lower Dry Creek where channel incision has resulted in over-steepened and unstable stream banks.

Figure 2.21 Loss of Riparian Vegetation and Habitat on Sage Hen Creek.

Figure 2.22 Stream Bank Disturbance On Upper Dry Creek.



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

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1 inch = 22,000 Feet

Figure 2.20 Sweetwater River Phase IV: Proper Functioning Condition

2.8 Ecological Site Descriptions

Figure 2.23 Stream Bank Instability on Lower Dry Creek.

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."*

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 Phase IV study area and the State of Wyoming.

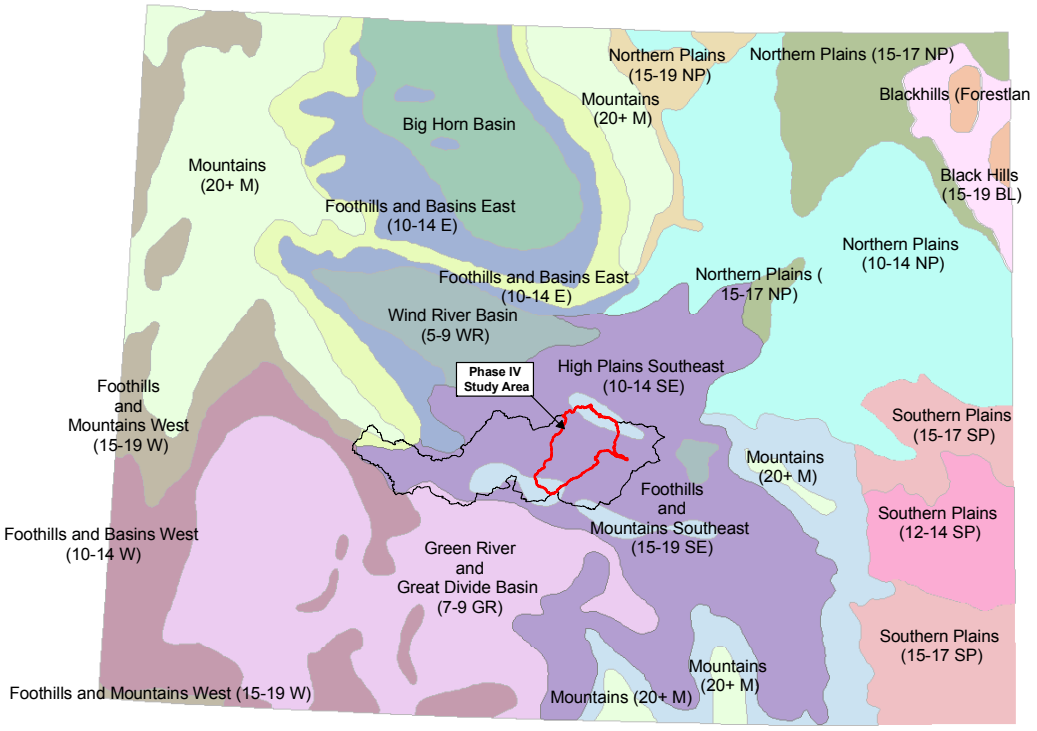


Figure 2.24 Wyoming Ecological Precipitation Zones.

Using database tools provided by the NRCS, the available soils mapping was evaluated and Ecological Sites defined within the study area (Table 2.6). Figure 2.25 displays their location within the study area.

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

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.

Table 2.6 Analysis of Ecological Site Distribution in Phase IV Study Area.

ESD	Identifier	ESD Name	Acres	Percent of Watershed	label
1	R034XY350WY	SANDY (10-14SE)	158,361.2	40.0	ESD-1 : SANDY (10-14SE)
2	R034XY322WY	LOAMY (10-14SE)	41,305.5	10.4	ESD-2 : LOAMY (10-14SE)
3	R034XY362WY	SHALLOW LOAMY (10-14 SE)	41,013.6	10.4	ESD-3 : SHALLOW LOAMY (10-14 SE)
4	R034XY366WY	SHALLOW SANDY (10-14SE)	29,388.8	7.4	ESD-4 : SHALLOW SANDY (10-14SE)
5	R049XY122WY	LOAMY (15-19SE)	17,410.3	4.4	ESD-5 : LOAMY (15-19SE)
6	R034XY342WY	SALINE SUBIRRIGATED (10-14SE)	11,941.2	3.0	ESD-6 : SALINE SUBIRRIGATED (10-14SE)
7	R034XY376WY	VERY SHALLOW (10-14SE)	8,725.1	2.2	ESD-7 : VERY SHALLOW (10-14SE)
8	R049XY108WY	COARSE UPLAND (15-19SE)	6,651.2	1.7	ESD-8 : COARSE UPLAND (15-19SE)
9	R034XY338WY	SALINE LOWLAND (10-14SE)	5,584.2	1.4	ESD-9 : SALINE LOWLAND (10-14SE)
10	R034XY308WY	COARSE UPLAND (10-14SE)	4,940.9	1.2	ESD-10 : COARSE UPLAND (10-14SE)
11	R034XY304WY	CLAYEY (10-14SE)	4,561.7	1.2	ESD-11 : CLAYEY (10-14SE)
12	R043XY322WY	LOAMY (15-19E)	3,788.2	1.0	ESD-12 : LOAMY (15-19E)
13	R034XY326WY	LOAMY OVERFLOW (10-14SE)	3,033.4	0.8	ESD-13 : LOAMY OVERFLOW (10-14SE)
14	R058BY146WY	SANDS (Sa) 10-14	2,931.5	0.7	ESD-14 : SANDS (Sa) 10-14
15	R034XY312WY	GRAVELLY (10-14SE)	2,911.7	0.7	ESD-15 : GRAVELLY (10-14SE)
16	R034XY374WY	SUBIRRIGATED (10-14SE)	1,372.5	0.3	ESD-16 : SUBIRRIGATED (10-14SE)
17	R032XY362WY	SHALLOW LOAMY (10-14E)	1,318.0	0.3	ESD-17 : SHALLOW LOAMY (10-14E)
18	R034XY346WY	SANDS (10-14SE)	944.3	0.2	ESD-18 : SANDS (10-14SE)
19	R034XY358WY	SHALLOW CLAYEY (10-14SE)	665.3	0.2	ESD-19 : SHALLOW CLAYEY (10-14SE)
20	R034XY378WY	WETLAND (10-14SE)	660.5	0.2	ESD-20 : WETLAND (10-14SE)
21	R049XY160WY	SHALLOW IGNEOUS (15-19SE)	645.1	0.2	ESD-21 : SHALLOW IGNEOUS (15-19SE)
22	R049XY108WY	COARSE UPLAND (10-14E)	556.9	0.1	ESD-22 : COARSE UPLAND (10-14E)
23	R032XY322WY	LOAMY (10-14E)	480.5	0.1	ESD-23 : LOAMY (10-14E)
24	R034XY344WY	SALINE UPLAND (10-14SE)	197.0	0.0	ESD-24 : SALINE UPLAND (10-14SE)
25	R043XY362WY	SHALLOW LOAMY (15-19E)	168.3	0.0	ESD-25 : SHALLOW LOAMY (15-19E)
26	R049XA174WY	SUBIRRIGATED(Sb) 15-19	110.3	0.0	ESD-26 : SUBIRRIGATED(Sb) 15-19
27	UNCLASS	UNCLASSIFIED	35,275.4	8.9	ESD-27 : UNCLASSIFIED
28	UNAVAILABLE	CARBON COUNTY (UNAVAILABLE)	10,688.6	2.7	ESD-28 : CARBON COUNTY (UNAVAILABLE)
		Grand Total	395,631.0	100.0	

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

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. "

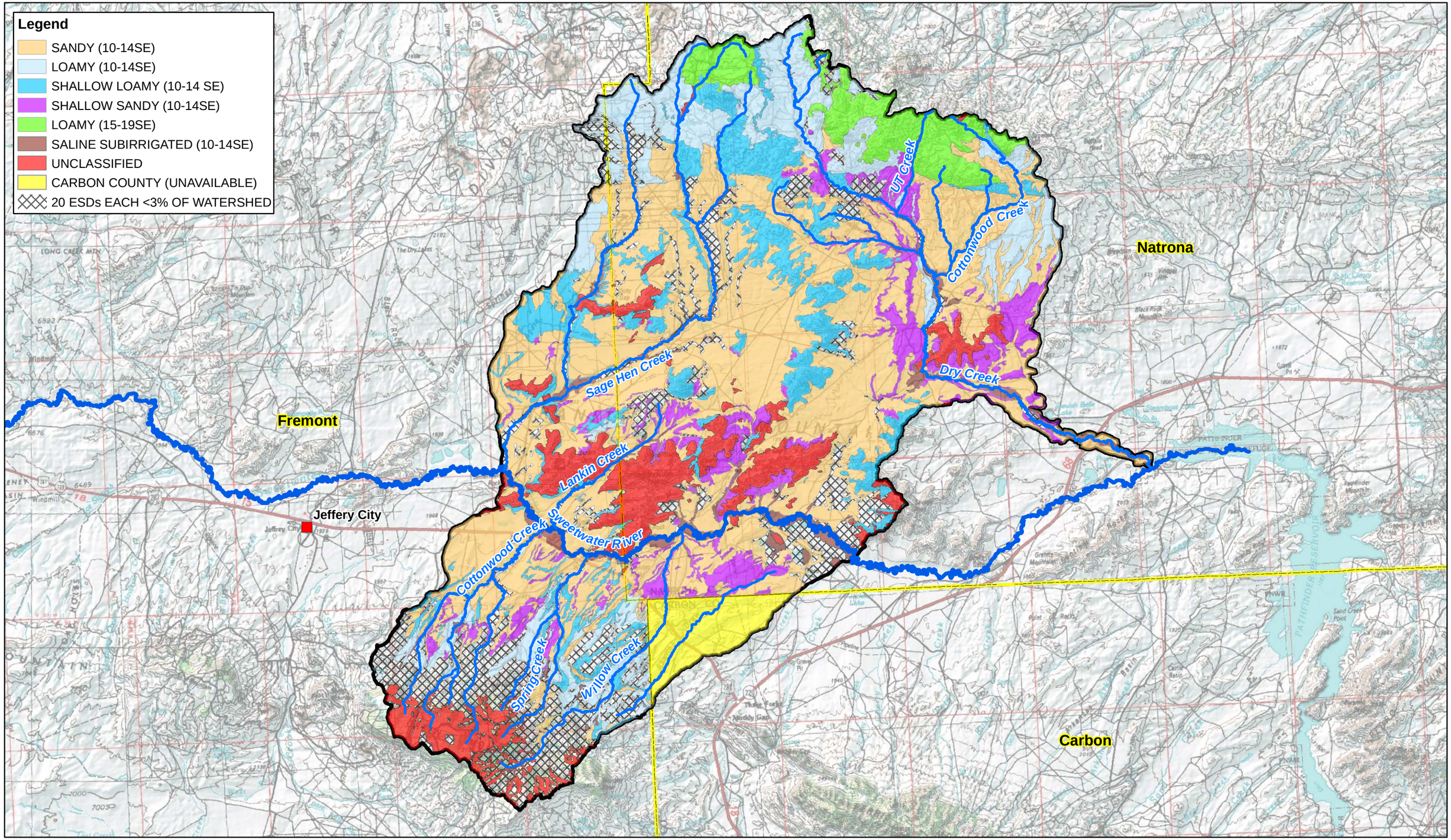


Figure 2.25 Sweetwater River Phase IV: Ecological Sites

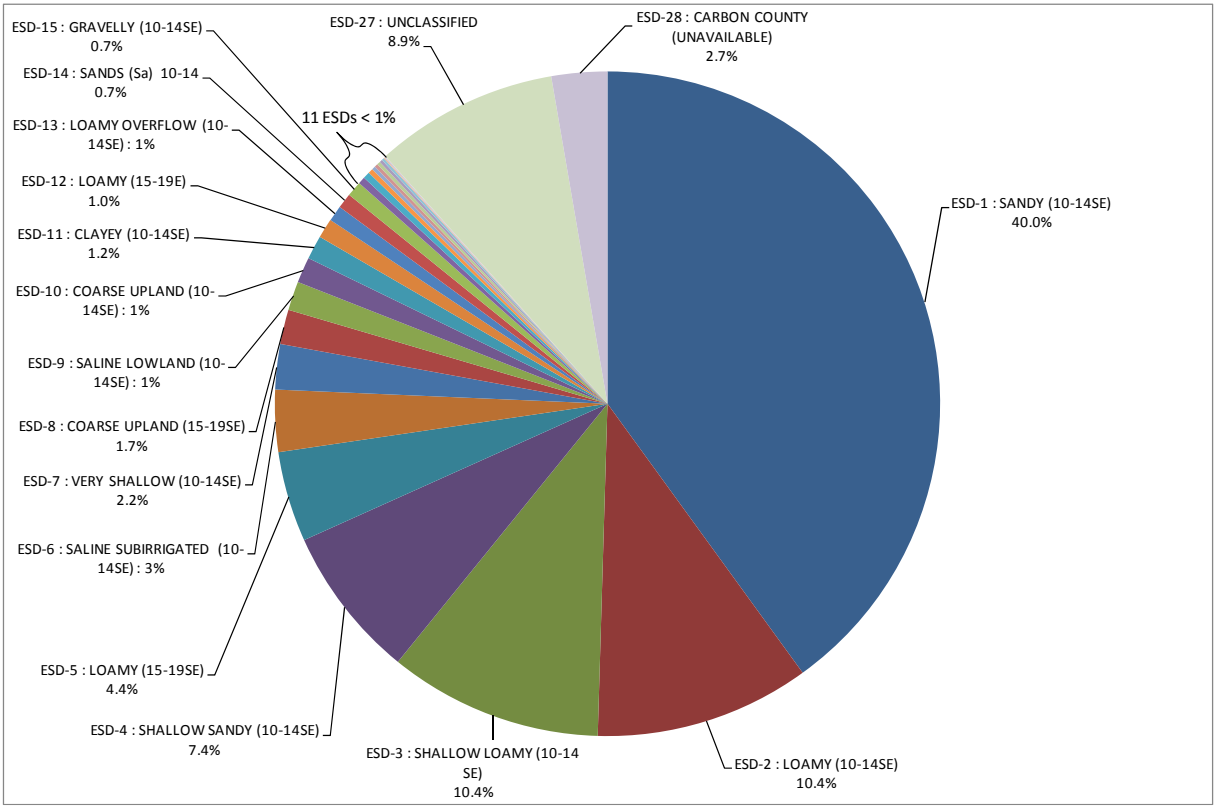


Figure 2.26 Distribution of Ecological Sites Within the Phase IV Study Area.

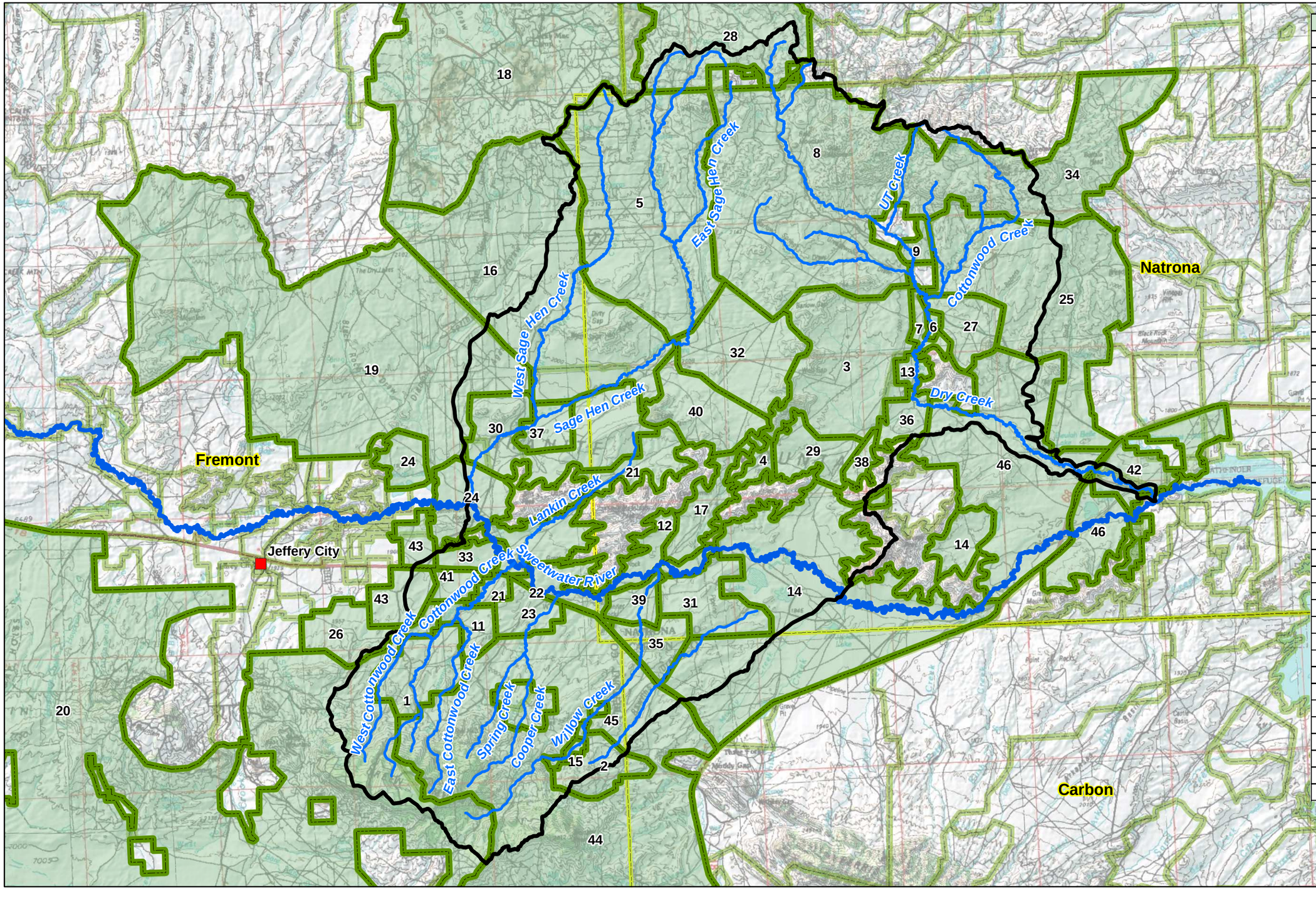
2.9 Grazing

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



ID	Allotment Name
1	46 PASTURE
2	ALMA GRIEVE PASTURE
3	BASIN PASTURE
4	BEEF GAP PASTURE
5	BLACKJACK RANCH
6	BUG LAKE
7	BUG MEADOWS PASTURES
8	CIRCLE BAR ALLOTMENT
9	CIRCLE BAR ALLOTMENT
10	COPPER CREEK
11	COTTONWOOD PASTURE
12	CROSS L PASTURES
13	DECKER PASTURE
14	DEVILS GATE
15	DIAMOND HOOK
16	DIAMOND SPRINGS
17	GAP PASTURE
18	GAS HILLS
19	GRANITE MOUNTAIN OPEN
20	GREEN MOUNTAIN CMN
21	HAT RANCH
22	HOME NORTH OF HWY
23	HOME SOUTH OF HWY
24	JAMERMAN PASTURES
25	KEESTER
26	LECKINBY PASTURE
27	LITTLE BUG PASTURE
28	MATADOR
29	MILLER SPRINGS PAST.
30	MURPHREE PASTURES
31	N/A
32	NORTH DOBIE FLAT
33	NORTH HAT PASTURE
34	NORTH OF DRIFT FENCE
35	NORTH WILLOW CREEK
36	RIDDLE PASTURE
37	SAGE HEN
38	SCHOOL PASTURE
39	SOUTH CROSS L
40	SOUTH DOBIE FLAT
41	SOUTH HAT PASTURE
42	STEAMBOAT LAKE
43	THREE CROSSINGS ALLOTMENT
44	WHISKEY PEAK INCOMM
45	WILLOW CREEK ALLOTME
46	WINTER PASTURES

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Grazing Allotments
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Sweetwater River
Streams - Phase IV Study Area
County Boundary
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1 inch = 22,000 Feet

Figure 2.27 Sweetwater River Phase IV: Grazing Alltoments

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.
- 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).

2.9.2 Existing Water Supply

The Phase IV study area is extensive and includes a significant amount of area receiving less than 11 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 to 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 60 stock reservoirs and ponds within the Phase IV 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.

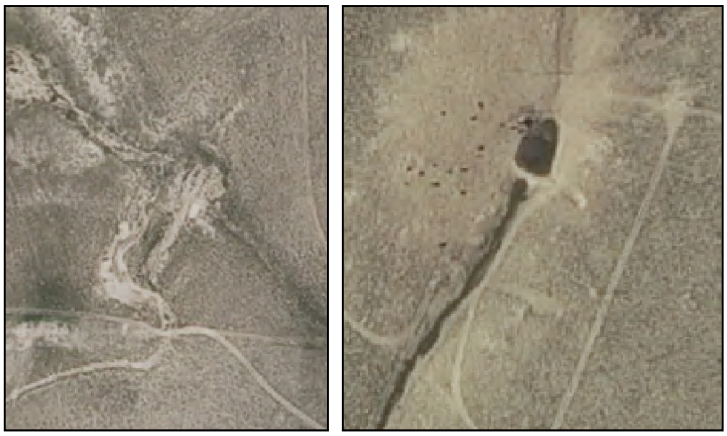


Figure 2.28 Example Stock Reservoir Evaluation Indicating a Breached Non-viable Stock Reservoir vs Reservoir Holding Water.

Based upon this analysis, it appears that a minimum of 34 stock reservoirs remain viable water sources. This analysis also indicates that 32 are either breached, sediment filled, or in need of site visits to determine their status. This figure also indicates the location of bird drinkers/guzzlers, developed springs, water gaps, and watering tanks.

Several water supply projects have been constructed previously within the study area. The most extensive of these is the Black Mountain Spring Pipeline which was built in approximately 2001. This system includes approximately 32 miles of buried pipeline and approximately twenty livestock / wildlife watering tanks (Figure 2.29). According to the allotment permittee, the system has performed well with minimal maintenance. Maintenance costs associated with the system have run approximately $1,000 per year. Pipeline projects in the study area generally include large bottomless concrete stock tanks (Figure 2.30).

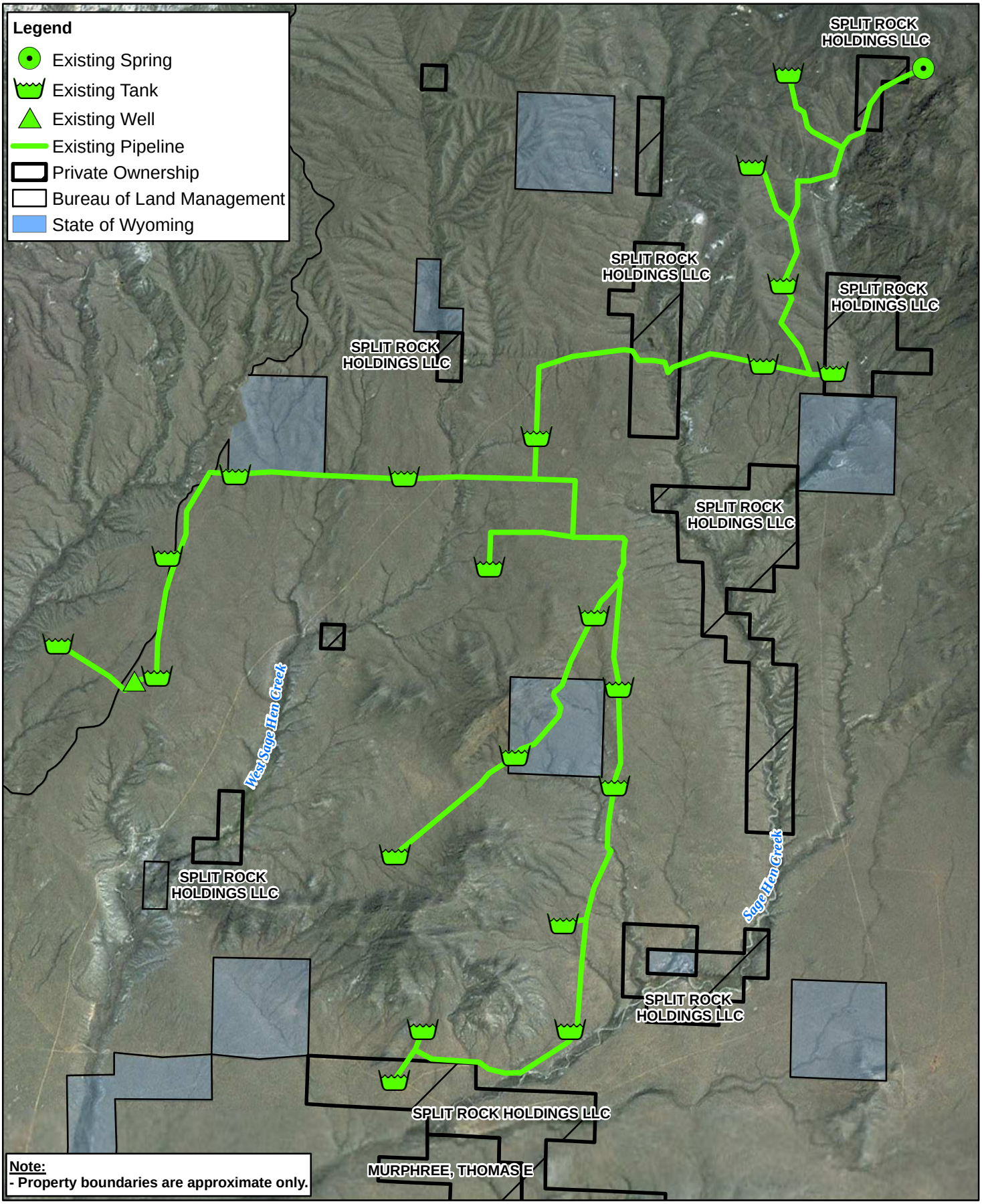


Figure 2.29: Black Mountain Spring Pipeline System

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:

Figure 2.30 30-Foot Diameter Concrete Bottomless Stock Tank.

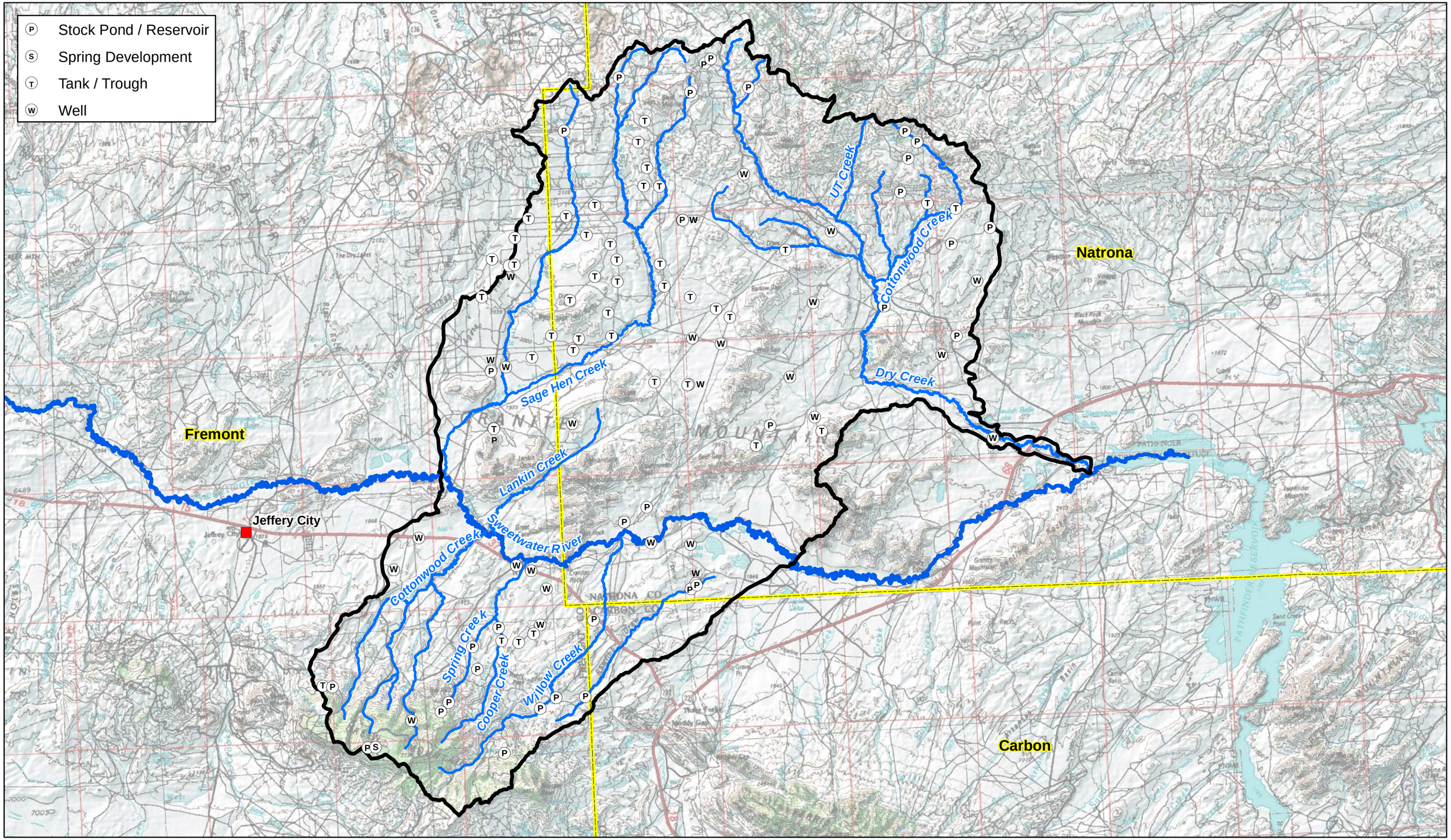
- Developed springs,
- Ponds and reservoirs,
- Wells, and
- Stock tanks, etc.

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

2.9.3 Range Conditions and Needs

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. 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



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

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1 inch = 22,000 Feet

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

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.

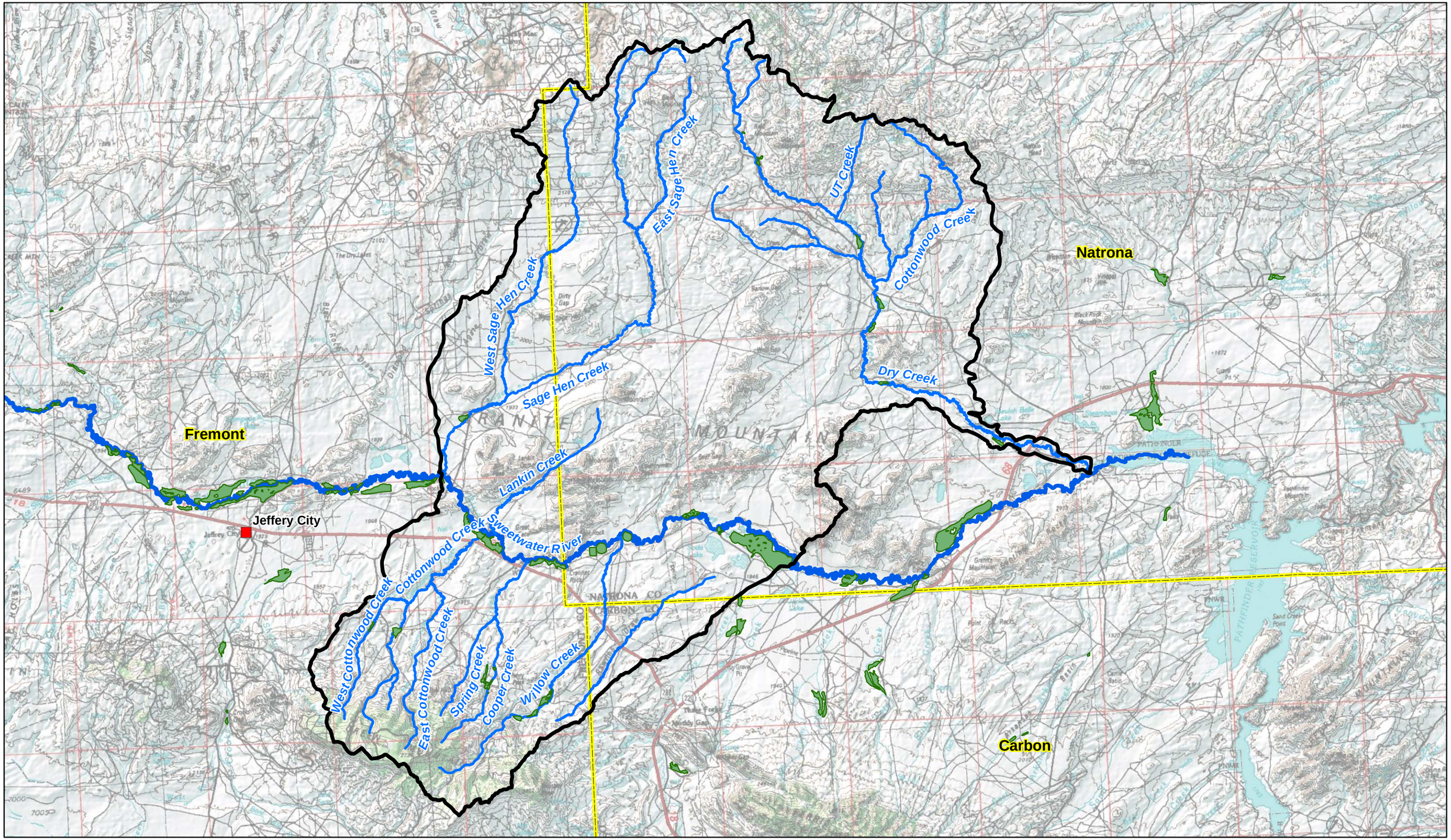
2.10 Irrigation

2.10.1 Irrigation Overview

Irrigation systems within the Phase IV 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. Appendix B summarizes the adjudicated surface water rights information available from the WSEO.

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
- Beaton Cranor Ditch failure



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- Irrigated Land
- Cities
- Sweetwater River
- Streams - Phase IV Study Area
- Phase IV Study Area
- County Boundary

0 22,000 44,000

1 inch = 22,000 Feet

Figure 2.32 Sweetwater River Phase IV: Irrigated Lands

2.10.2 McIntosh Ditch (Beaton) Diversion Structure

This diversion structure serves the McIntosh Ditch headgate on the Sweetwater River in Section 8, Township 29 North, Range 90 West (Figure 2.33). The McIntosh Ditch diverts water under Permit Nos. P1906 (priority date of July 14, 1898) and P981E (priority date of January 24, 1903). This permit originally had an appropriation of 5.25 cubic feet per second for irrigation of 327 acres.

Figure 2.33 McIntosh Ditch Diversion Structure on the Sweetwater River.

At the request of the landowner, the McIntosh Ditch diversion structure was inventoried. Figure 2.34 displays an aerial photo of the vicinity. According to the ditch owner, the structure is stable, however, during periods of low flow, diversion of irrigation water is difficult.

The following observations pertaining to the McIntosh diversion structure were recorded:

- The structure consists of a large boulders placed across the river to provide the water surface elevation necessary to divert water through the ditch headgate.
- Two 36-inch diameter culverts have been placed within the structure to consolidate flow during low flow periods. Based upon an interview with the ditch owner, it is our understanding that the culverts are in good condition although they were not visible due to high flow conditions.

Figure 2.34 Overview of the McIntosh Ditch Diversion Structure.

- During low flow periods, the culverts are blocked off in order to divert water at the headgate.

2.10.3 Cranor Ditch

The Cranor ditch provides irrigation water to approximately 50 acres in the vicinity of the Split Rock Ranch. Approximately 1,350 feet downstream of the ditch headgate on the Sweetwater River, the ditch is aligned immediately adjacent to the river (Figure 2.35). In early 2011, bank failure resulted in loss of the ditch through a length of approximately 150 feet (Figure 2.36). Due to the failure, conveyance of irrigation water in the ditch is impossible.

Figure 2.35 Overview of the Cranor Ditch Diversion and Failure Location.

Figure 2.36 Cranor Ditch Failure on the Sweetwater River.

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.

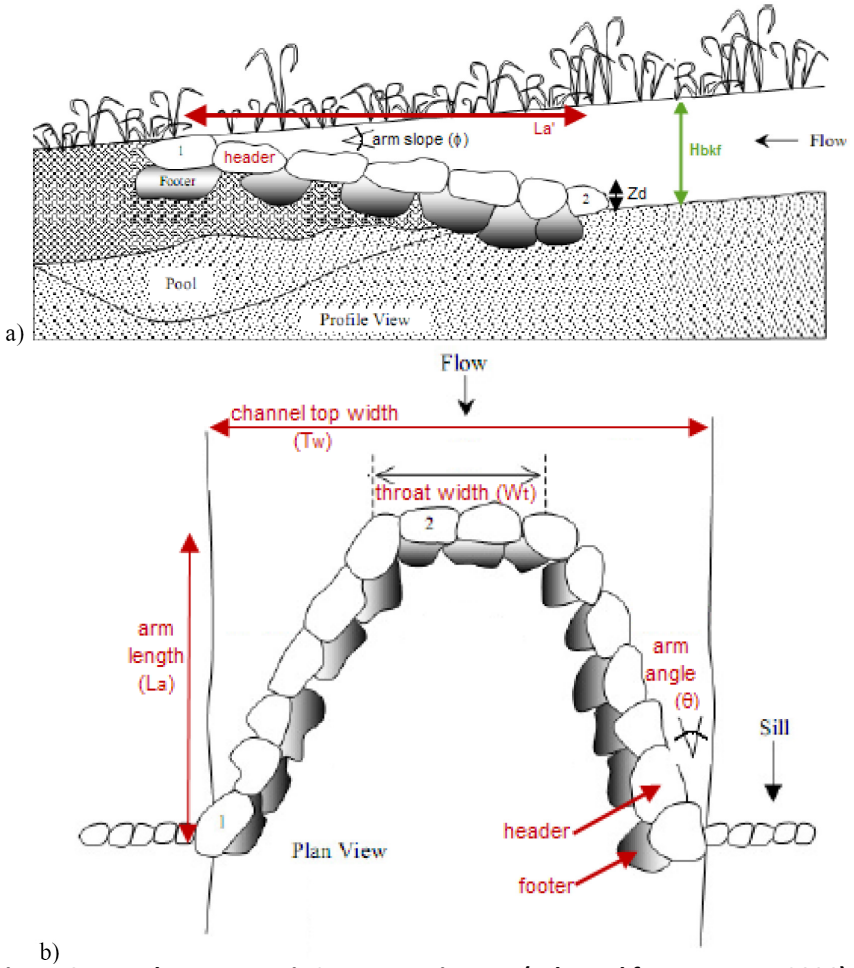


Figure 3.1 Rock Vortex Weir Structure Diagram (Adapted from Rosgen, 2006).

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

Figure 3.2 Stream Stabilization Structure: Rock Vortex Weir.

impairment that have resulted from overutilization of 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 Lower Dry Creek – stream bank erosion

S-2 Upper Dry Creek – stream bank erosion / riparian degradation

S-3 Lower Sage Hen Creek - stream bank erosion / riparian degradation

S-3 Upper Sage Hen Creek - stream bank erosion / riparian degradation

It must be noted that this list of stream reaches not an all-inclusive list of locations within the Phase IV Study Area which would benefit from rehabilitation planning.

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 McIntosh-Beaton Ditch Diversion Structure (Watershed Management Plan Component I-1)

The structure's owner described that during low-flow periods, diversion at the ditch headgate is difficult. Currently, low flows are conveyed through the dam via two 48-inch CMPs which have been incorporated within the existing rock diversion dam. According to the ditch owner, the ditch invert is too high to facilitate diversions during low flows, therefore he controls the upstream water surface elevation by placing check boards against the CMPs in the diversion dam. Consequently, a means of controlling flow through the pipes was suggested.

Alternatives involving incorporation of slide gates within the existing flow path of the Sweetwater would result in restriction of the river and therefore would be deemed undesirable because of the potential to cause erosion or channel degradation downstream. Consequently, a vortex weir is recommended for design and installation at this location.

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 properly designed rock weir would facilitate diversion of irrigation water by the McIntosh – Beaton Ditch, facilitate fish passage, provide a geomorphically stable structure within the river, and require no seasonal adjustments by the user as a gated structure would. 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.

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 should be constructed as depicted in Figure 3.4 such that the upstream apex of the new structure is roughly aligned with the existing structure's location.
- Existing rock should be utilized to the extent possible.
- The weir should be designed to provide water surface elevation to facilitate diversion by the McIntosh-Beaton Ditch.
- A rock w-weir or vortex weir would facilitate fish passage as well as performing providing the requisite water surface elevations for irrigation diversions.
- 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.

Table 3.2 Conceptual-Level Rehabilitation Plan: McIntosh-Beaton Ditch Diversion.

Rehabilitation Item Number	Description	Priority
I-1	Reconfigure/rehabilitate Existing Diversion Dam	2
I-2	Install measurement device on McIntosh-Beaton Ditch	3

Figure 3.4 McIntosh-Beaton Ditch Rehabilitation.

3.3.2 Cranor Ditch Failure Remediation (Watershed Management Plan Component I-2)

As discussed in Chapter 2, the Cranor Ditch failure occurred at a location where the ditch alignment was extremely close to the Sweetwater River. Bank erosion combined with likely ditch seepage resulted in failure of the river bank and consequently loss of the ditch. The extent of the failure is approximately 100 feet long. The recommended remediation action is to install a 24-inch PVC pipe and restore the failed bank with compacted fill.

The following components would be included in the plan as displayed Table 3.3 and in Figure 3.5:

- The extent of the failed ditch length would be cleared during the non-irrigation, low-streamflow season.
- Compacted fill (approx. 450 c.y.) would be placed within the extent of the failed bank to reconstruct the failed ditch section and support the proposed pipeline.

- Rock riprap (approx. 150 c.y.) would be installed along the streambank portion of the project to protect the reconstructed reach from erosion by the Sweetwater River. The riprap would be appropriately sized to resist movement by the river.
- Approximately 300 linear feet of 24-inch PVC pipeline would be installed within the reconstructed ditch alignment.
- Concrete headwalls/cutoff walls would be installed at the inlet and outlet of the pipeline.

The total cost of construction of this facility would be approximately $12,000.

Table 3.3 Conceptual-Level Rehabilitation Plan: Cranor Ditch.

Rehabilitation Item Number	Description	Priority
I-3	Rehabilitate Cranor Ditch failure	1
I-4	Install measurement device on Cranor Ditch	3

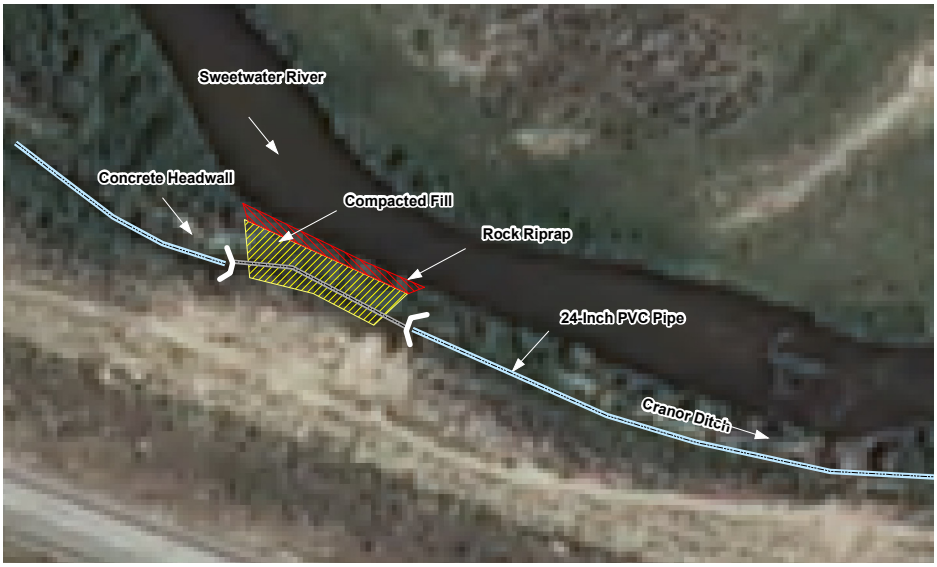


Figure 3.5 Proposed Cranor Ditch Rehabilitation Project.

3.4 Livestock / Wildlife Watering Opportunities

Given the relatively gentle topography throughout much of the Phase IV study area, 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 water sources discussed in Chapter 2 (Figure 3.6). Because an objective of the livestock / wildlife watering

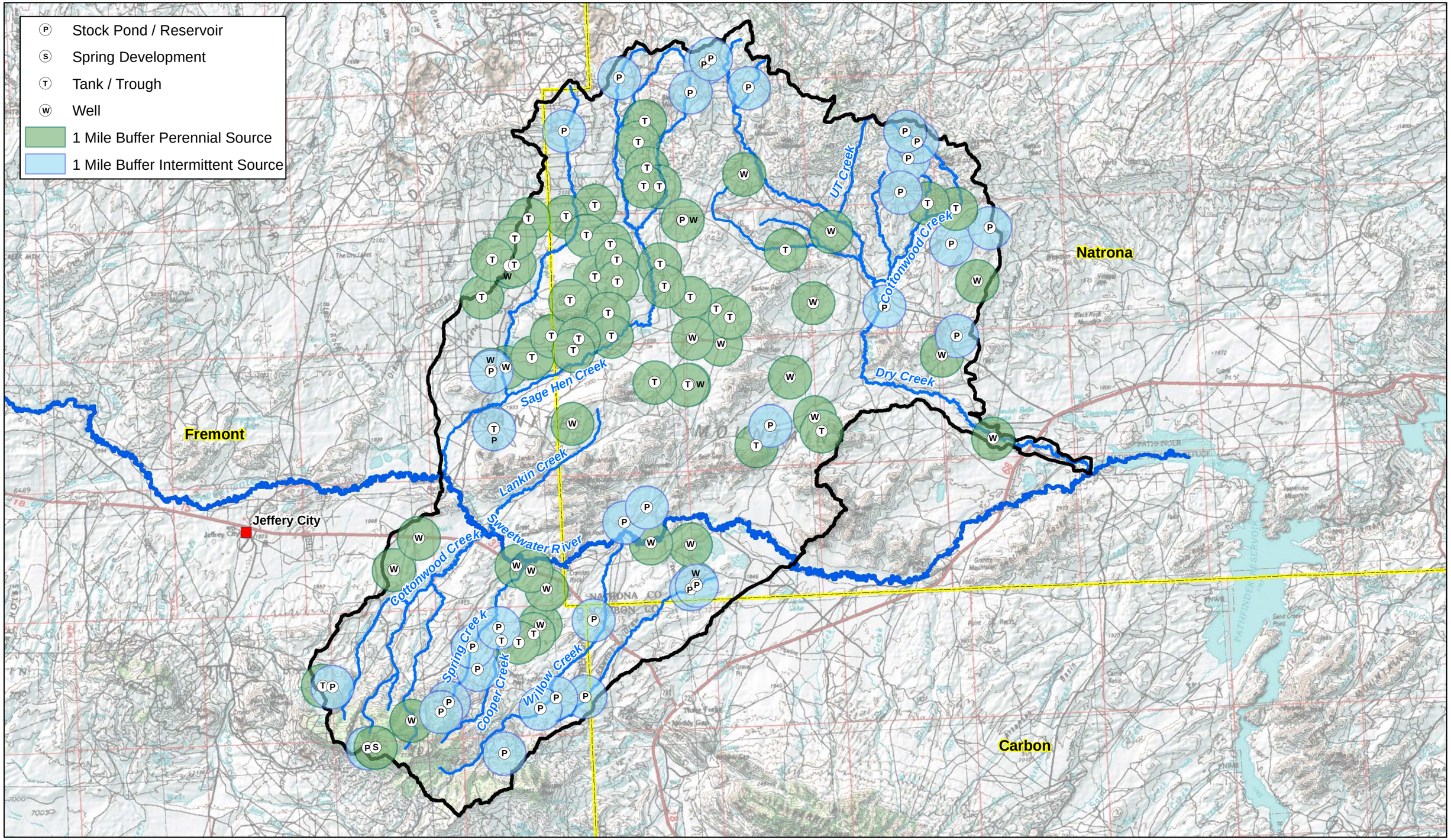


Figure 3.6 Sweetwater River Phase IV: Existing Wildlife / Livestock Water Sources with 1 Mile Buffers

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, 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.

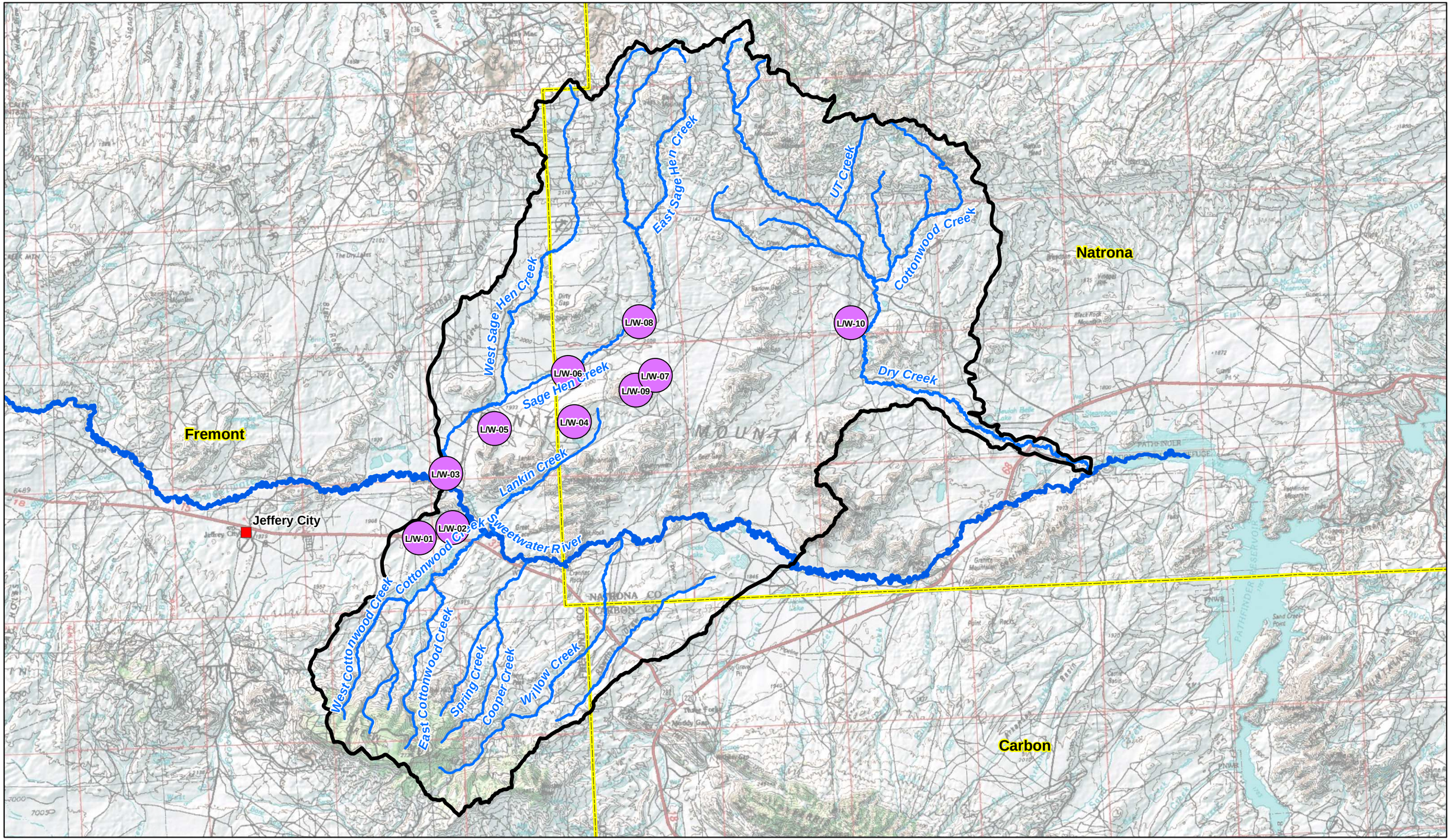
The proposed projects presented in this section were developed by the project team following interviews with individual allotment permittees, and private landowners. Figure 3.7 displays the locations of the proposed projects.

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 (e.g., construction of new wells) or development of existing sources (e.g., spring development). Conceptual designs are presented for pipeline projects.

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 well construction or spring development 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.

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 is 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



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Legend

L/W-02 Project Locations

Sweetwater River

Streams - Phase IV Study Area

Phase IV Study Area

Cities

County Boundary

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1 inch = 22,000 Feet

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

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. By incorporating closed storage tanks in a project design, greater use of existing water sources could be realized.

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

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

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.

3.4.1 Stock Tank Replacement Project (Plan Component L/W 01)

This project consists of improvements to an existing well located in Section 13, Township 29 North, Range 91 West (See Figure 3.7). An existing well (Permit number unknown) is currently equipped with a diesel powered generator. In order to make the well more efficient to manage 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 Hat Well #1 Improvement Project (Plan Component L/W 02)

This project consists of improvements to an existing well located in the vicinity of Section 18, Township 29 North, Range 90 West (See Figure 3.7). Livestock and wildlife watering opportunities in this section are limited. An existing well (Permit Number P14951P) 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.

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.

3.4.3 Jammerman Pastures Well Improvement Project (Plan Component L/W 03)

This project consists of improvements to an existing well located in the vicinity of Section 31, Township 30 North, Range 90 West (See Figure 3.7). An existing well (Permit Number P139095W) 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.

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.

Note that this alternative would involve privately-owned lands.

3.4.4 Lankin Well #0090 Well Improvement Project (Plan Component L/W 04)

This project consists of improvements to an existing well located in the vicinity of Section 24, Township 30 North, Range 90 West within the Murphree Pastures allotment (See Figure 3.7). According to the permittee, existing watering facilities, including an existing

storage tank, 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.

3.4.5 Nolan Pocket Spring Improvement Project L/W 05)

This project consists of improvements to an existing well located in the vicinity of Section 22, Township 30 North, Range 90 West within the Murphree Pastures allotment. According to the permittee, an existing spring flows to a small pond. Pending verification of adequate yield, the spring could be improved to provide a reliable source of livestock and wildlife water to a greater area. The existing spring and pond lies close to a hydrologic divide. A solar pump could be installed to pump water easterly over the divide to supply a livestock / wildlife water tank located in Nolan Pocket. Likewise, an additional pipeline could be installed to provide water to an arid region west of the spring. Figure 3.8 displays the conceptual design configuration of this proposed project.

Under this alternative, the following components would be employed:

- The existing spring would be redeveloped to enhance the potential yield of the system.
- A solar powered pump facility would be installed (solar panels, pump, batteries, and requisite connections).
- Approximately 13,900 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.

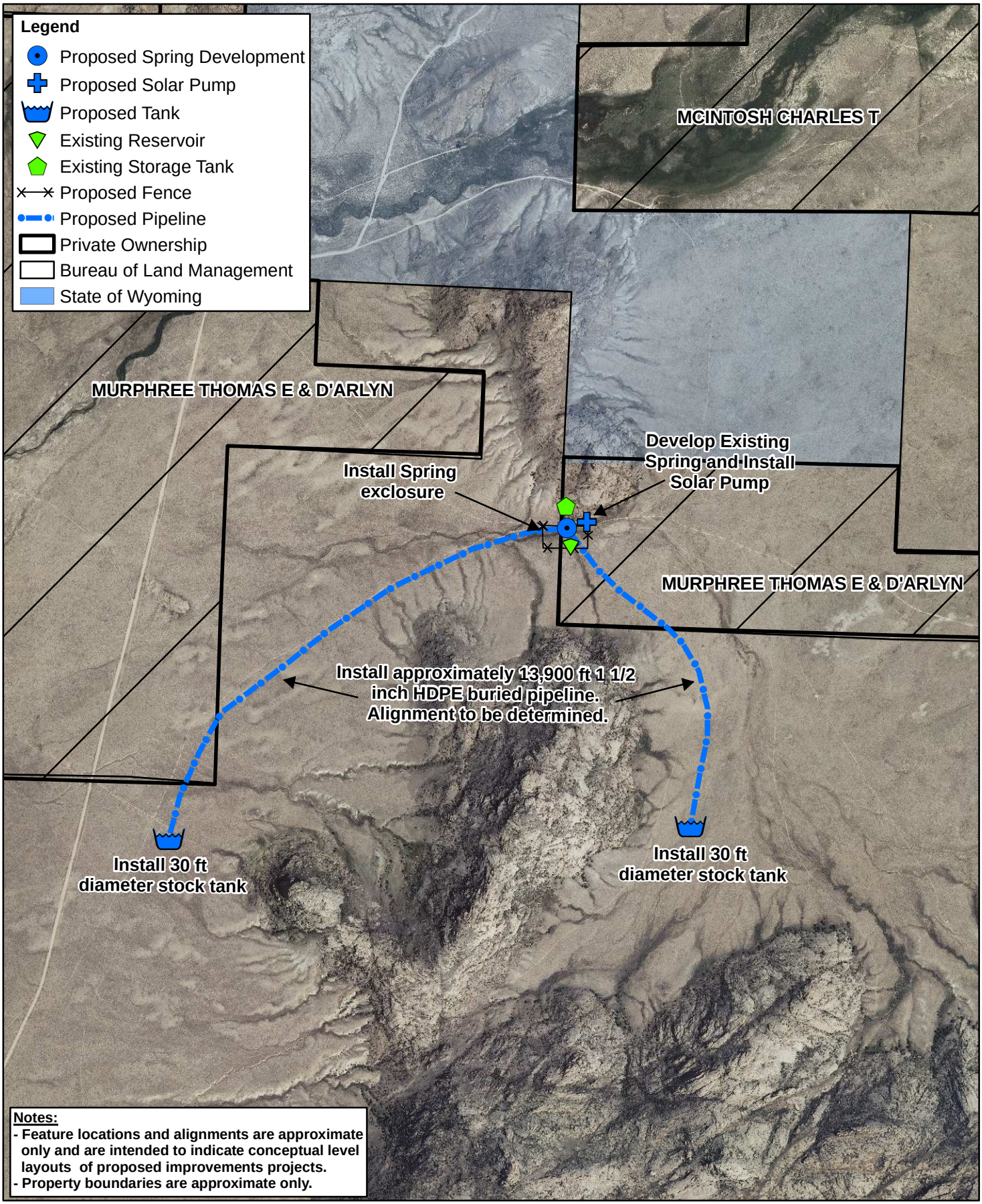


Figure 3.8 Conceptual Design: Nolan Pocket Spring Improvement Project (Project L/W-05)

- 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.

3.4.6 Sage Hen Creek Well Construction Project (Plan Component L/W 06)

This project consists of improvements to an existing well located in the vicinity of Section 7, Township 30 North, Range 89 West within the Murphree Pastures allotment. According to the permittee, the existing well has been 'pinched off' and is longer useable. A new well is proposed to provide a source of water for livestock and wildlife in this vicinity. A review of the Wyoming State Engineers Office database failed to provide well information associated with this well and there were no wells within a reasonable distance to use for estimation of the depth to which a new well would be drilled. Based upon the elevation of the project site above Sage Hen Creek, it is assumed that a well would need to be no deeper than 60 to 80 feet in this vicinity.

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. As discussed above, a well in this vicinity would likely require drilling to approximately 80 feet. For the purpose of this investigation and the uncertainty of the hydrogeologic conditions at the site, a depth of 100 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.

3.4.7 Starr Well Pipeline Extension Project (Plan Component L/W 07)

This project consists of constructing an extension to an existing well/pipeline project. As displayed in Figure 3.9, an existing well (Starr Well) located in Section 7, Township 30, Range 88 West has been used as the source of water for a buried pipeline and livestock/wildlife water trough. According to the permittee, an additional tank would be valuable. However, prior to final design of an extension to the existing pipeline, the well would need to be tested and its potential to provide adequate yield verified.

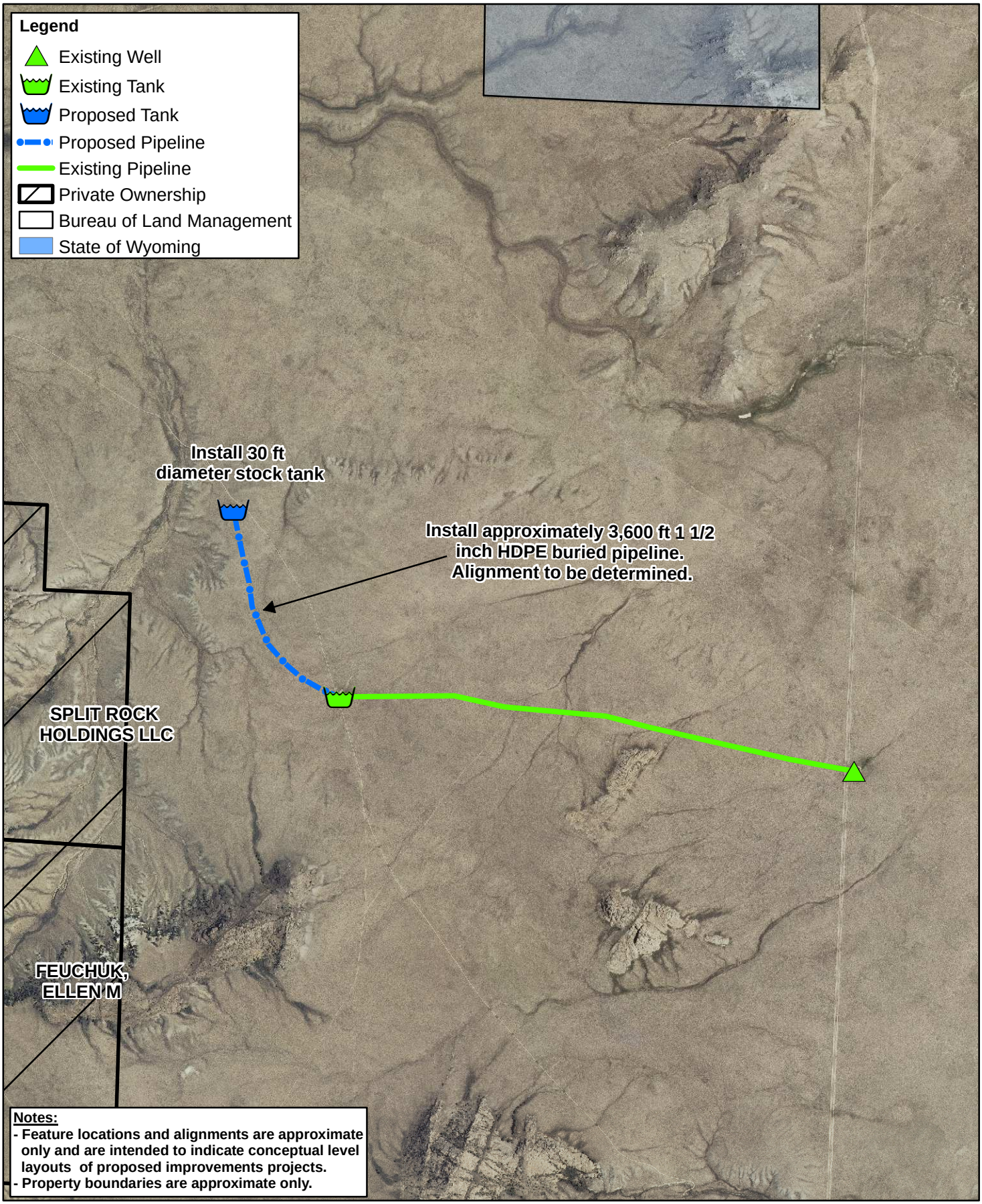


Figure 3.9 Conceptual Design: Starr Well Extension Project (Project L/W-07)

Under this alternative, the following components would be employed:

- Approximately 3,600 linear feet of buried HDPE pipe (1½-inch diameter) would be installed to extend the system to one or more additional livestock / wildlife watering troughs.
- Requisite valves and connections would be incorporated to ensure proper connection and anti-backflow.
- As configured under this alternative, one (1) 30-foot diameter bottomless concrete stock tank (10,000 gallon capacity) would be placed at a site determined during final design.

3.4.8 Sage Hen Springs Improvement Project (Plan Component L/W 08)

This proposed project involves the rehabilitation/redevelopment of two springs located at Sage Hen Springs. As indicated in Figure 3.10 four allotments administered by the BLM join at this location. According to the allotment permittee, the springs are in need of redevelopment. In addition, the existing fences preclude optimal utilization of the springs as they are currently configured.

Under this alternative, the following components would be employed:

- The existing springs would be redeveloped to improve collection of available water and to optimize usage.
- The existing fences would be realigned in order to facilitate access to water to livestock / wildlife in each of the four allotments. It is assumed that the actual spring area would be fenced to exclude livestock / wildlife.
- Two (2) 30-foot diameter bottomless concrete stock tanks (10,000 gallon capacity each) would be placed at the site.

3.4.9 Lone Mountain Springs Development Project (Plan Component L/W 09)

Wildlife and livestock in this portion of the Phase IV study area obtain water from a limited number of sources. The objective of the project would be to provide additional sources

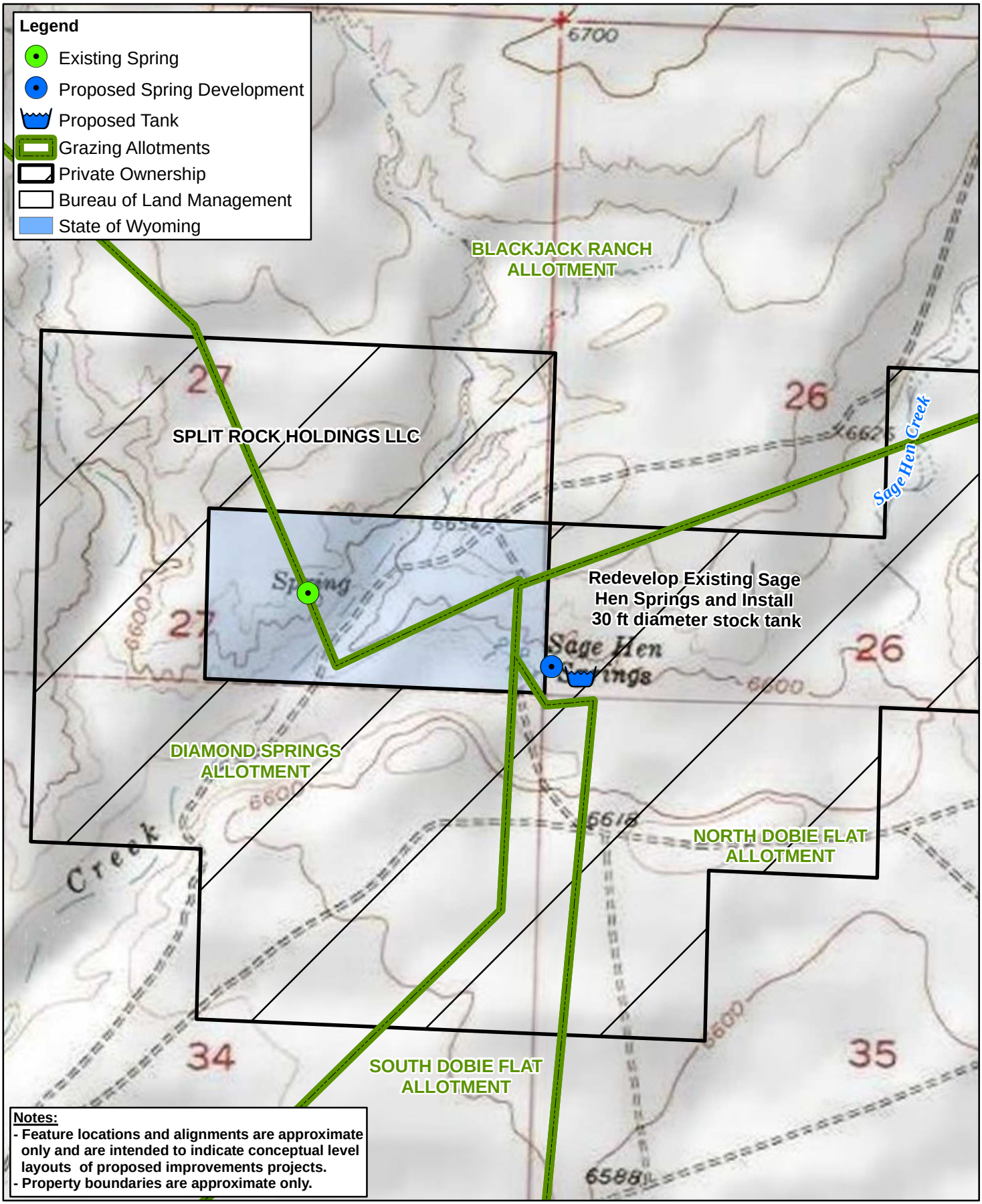


Figure 3.10 Conceptual Design: Sage Hen Springs Improvement Project (Project L/W-08)

through the evaluation and development of existing springs located near Lone Mountain in Sections 10 and 15, Township 30 North, Range 89 West within the South Dobie Flat Allotment. This project would involve construction of a spring development in one or more springs located at the foot of Lone Mountain.

Figure 3.11 displays a conceptual design of two spring development and livestock/wildlife water sources. Pending evaluation of the springs and determination of the potential yield of each, spring development could be completed and pipeline alignment and livestock/wildlife water tank placement determined. The configurations displayed in Figure 3.11 are presented as examples of typical projects which could be constructed.

As delineated, the projects involve privately-owned lands only.

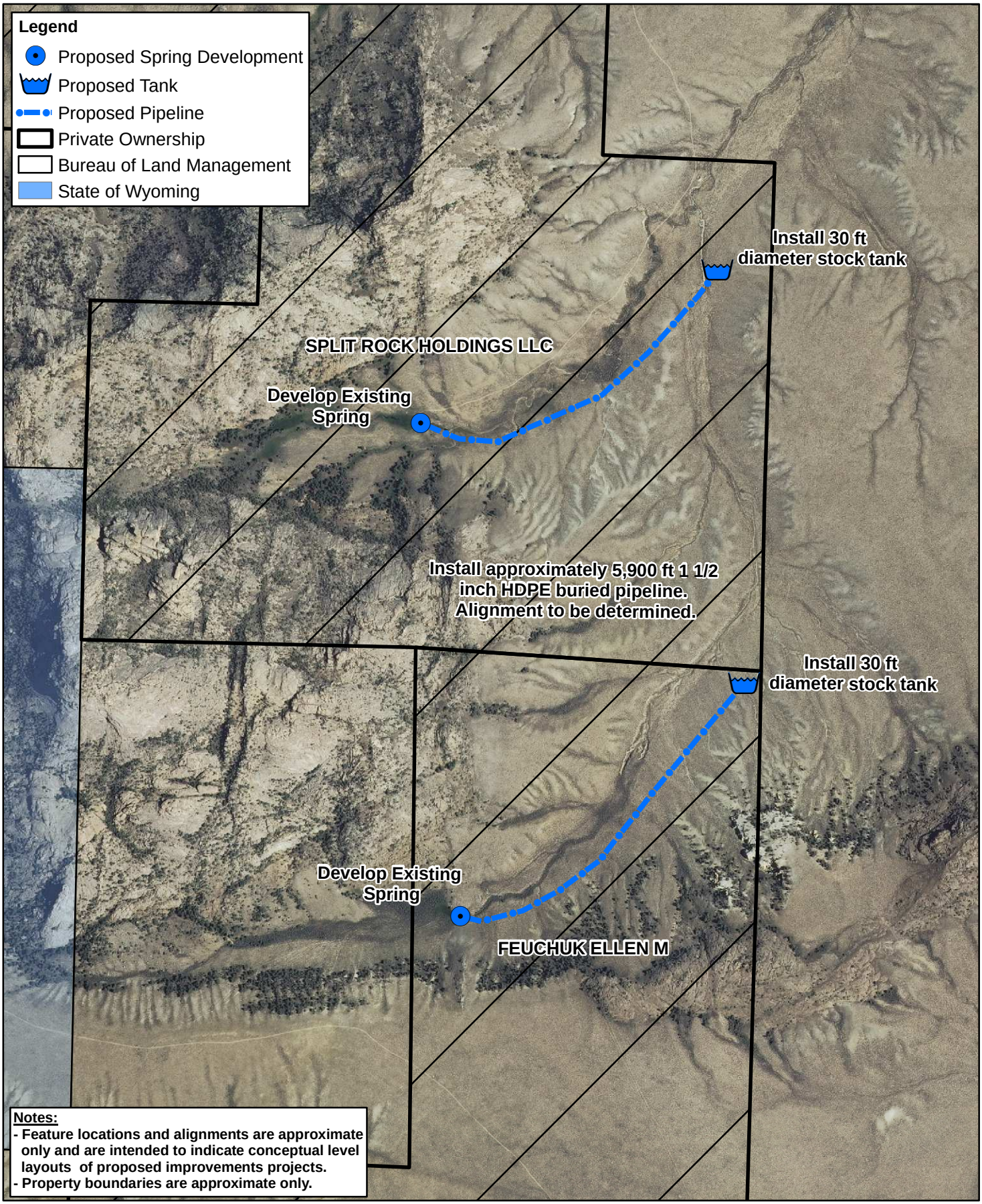
3.4.10 Dry Creek Pipeline Project (Plan Component L/W 10)

This alternative would take advantage of perennial surface water supplies available in Dry Creek in an effort to reduce pressures upon its riparian corridor and to provide upland sources of water to an area which appears to be lacking adequate sources based upon the evaluation discussed in Chapter 2. Figure 3.12 displays the general initial configuration of this alternative.

Under this alternative, the following components would be employed:

- A diversion facility would be constructed in Dry Creek. The facility would conceivably be installed on State lands in 16, Township 31 North, Range 87 West. The facility would consist of a buried gravel infiltration gallery and perforated pipe. Requisite valves 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. 46,800 feet) would be routed away from Warm Springs Draw to stock tanks located away from the riparian corridor.
- As configured under this alternative, seven (7) stock tanks (10,000 gallon capacity each) would be placed at sites determined during final design.

The initial alignment displayed in Figure 3.12 indicates the involvement of federal lands managed by the BLM; consequently BLM approval and evaluation of the proposed project would be required.



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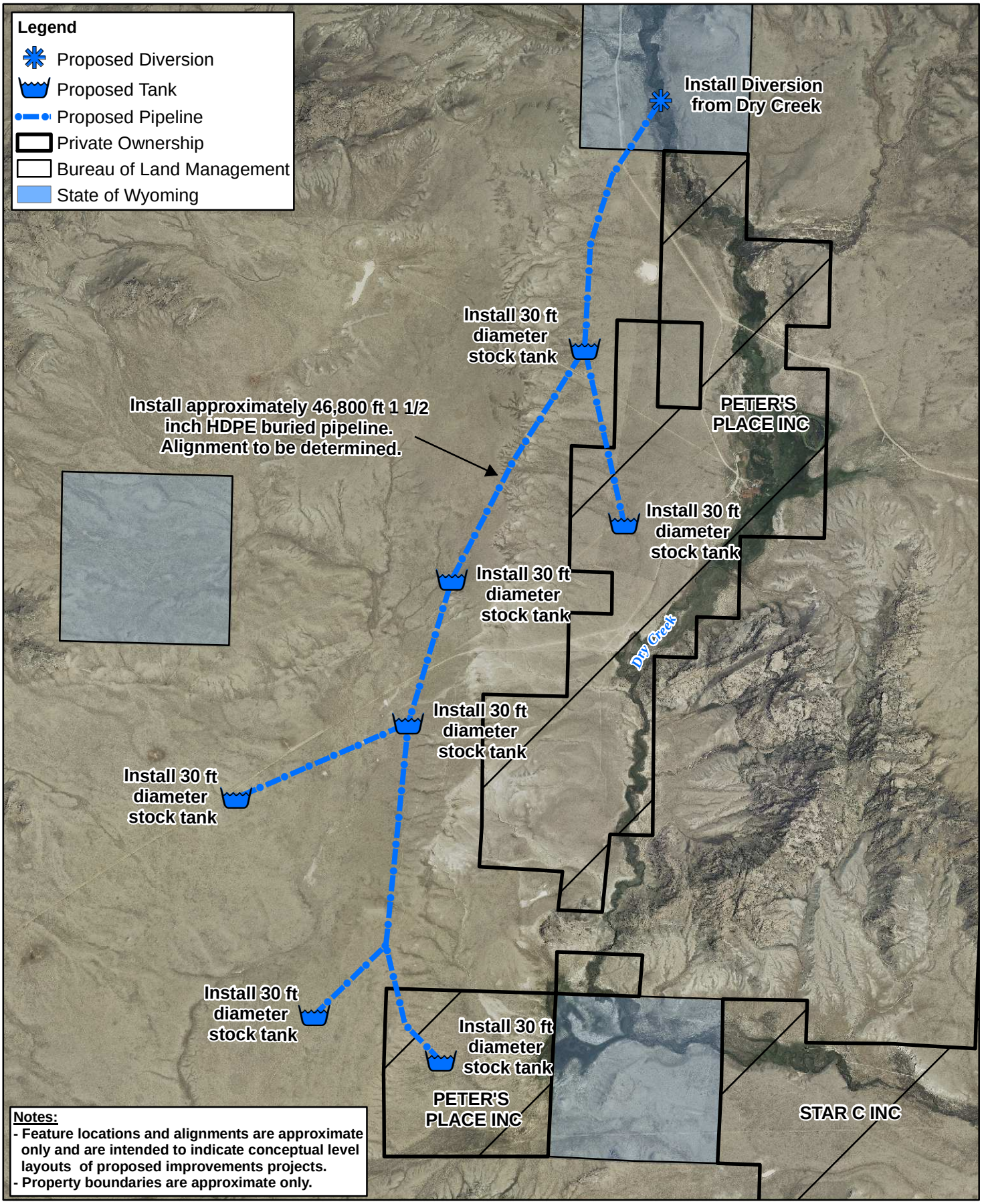
0 1,000 2,000

Figure 3.11 Conceptual Design: Lone Mountain Springs Development Project (Project L/W-09)



N
W E
S

0 4,000 8,000

Figure 3.12 Conceptual Design: Dry Creek Pipeline Project (Project L/W-10)

3.4.11 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 3.13 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 3.13 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.

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.

3.4.12 Cost Estimates: Upland Wildlife/Livestock Water

Conceptual level cost estimates for upland wildlife / livestock water opportunities are presented in Table 3.4.

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 3.4 Conceptual Cost Estimates: Livestock/Wildlife Water Supply Projects.

Project Component		L/W 01	L/W 02	L/W 03	L/W 04	L/W 05	L/W 06	L/W 07	L/W 08	L/W 09	L/W 10
		Stock Tank Replacement Project	Hat Well #1 Improvement Project	Jammerman Pastures Well Improvement Project	Lankin Well Improvement Project	Nolan Pocket Spring Development	Well Replacement	Starr Well Pipeline Extension	Sage Hen Springs Improvement Project	Lone Mountain Springs Development Project	Dry Creek Pipeline Project
Well Construction / Spring Development / Diversion	Mobilization	$500	$500	$500	$500	$500	$2,500	$250	$2,500	$2,500	$2,500
	Well / Spring	Tank Enlargement	Tank Enlargement	Tank Enlargement	Well Enhancement	Spring Development	Well Enhancement	Pipeline Extension	Spring Redevelopment and Improvement	Spring Development	New Diversion
	Units (each)					2	1		2		1
	Depth Each	NA	NA	NA	0	NA	100	0	0	0	
	Unit Cost ($/LF wells or $/EA springs)/diversion	$0	$0	$0	$40	$3,000	$5,000	$5,000	$3,000	$5,000	$4,000
	Well Screen (LF each well)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Well Screen ($/LF)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Component Subtotal	$500	$500	$500	$500	$6,500	$7,500	$250	$8,500	$2,500	$6,500
Stock Pond Construction	Mobilization										
	Units (EA)										
	Pond Unit Cost ($ EA)										
	Liner (SF each pond)										
	Liner Unit Cost ($/SF)										
	Liner Cost per Pond										
	Component Subtotal										
Pump	Units (EA)	0	0	0	1	0	0	0	0		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	$8,640	$0	$0	$0	$0	$0	$8,640
Pipeline	Units				1	1	1	1	1	1	1
	Units (LF)	0	0	0	300	13,900	300	3,600	300	5,900	46,800
	Unit Cost	$1.34	$1.34	$1.34	$1.34	$1.34	$1.34	$1.34	$1.34	$1.34	$1.34
	Component Subtotal	$0	$0	$0	$402	$18,626	$402	$4,824	$402	$7,906	$62,712
Additional: Storage Tanks	Units (EA)	$0.00	$0.00	$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	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	0	2	1	1	2	2	7
	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	$0	$14,000	$7,000	$7,000	$14,000	$14,000	$49,000
Fencing	Units (EA)	0	0	0	0	0	0	0	1	0	0
	Units (LF each)	600	600	600	600	600	600	400	5,280	600	600
	Unit Cost ($/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	$0.00	$13,200.00	$0.00	$0.00
Miscellaneous	Item	0	0	0	0	0	0	0		0	0
	Comment										
	Unit Cost										
	Component Subtotal	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Construction Subtotal		**$7,500**	**$7,500**	**$7,500**	**$9,542**	**$39,126**	**$14,902**	**$12,074**	**$36,102**	**$24,406**	**$126,852**
Engineering (10%)		$750	$750	$750	$954	$3,913	$1,490	$1,207	$3,610	$2,441	$12,685
Construction and Engineering Subtotal		**$8,250**	**$8,250**	**$8,250**	**$10,496**	**$43,039**	**$16,392**	**$13,281**	**$39,712**	**$26,847**	**$139,537**
Contingency (15%)		$1,238	$1,238	$1,238	$1,574	$6,456	$2,459	$1,992	$5,957	$4,027	$20,931
Total Construction Cost		**$9,488**	**$9,488**	**$9,488**	**$12,071**	**$49,494**	**$18,851**	**$15,274**	**$45,669**	**$30,874**	**$160,468**
Final Plans and Specs		$250	$250	$250	$500	$250	$500	$2,000	$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	$500	$1,000	$1,000
Total Project Cost		**$9,738**	**$9,738**	**$9,738**	**$13,571**	**$50,744**	**$20,351**	**$18,274**	**$48,169**	**$33,874**	**$163,468**

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

Figure 3.14 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.

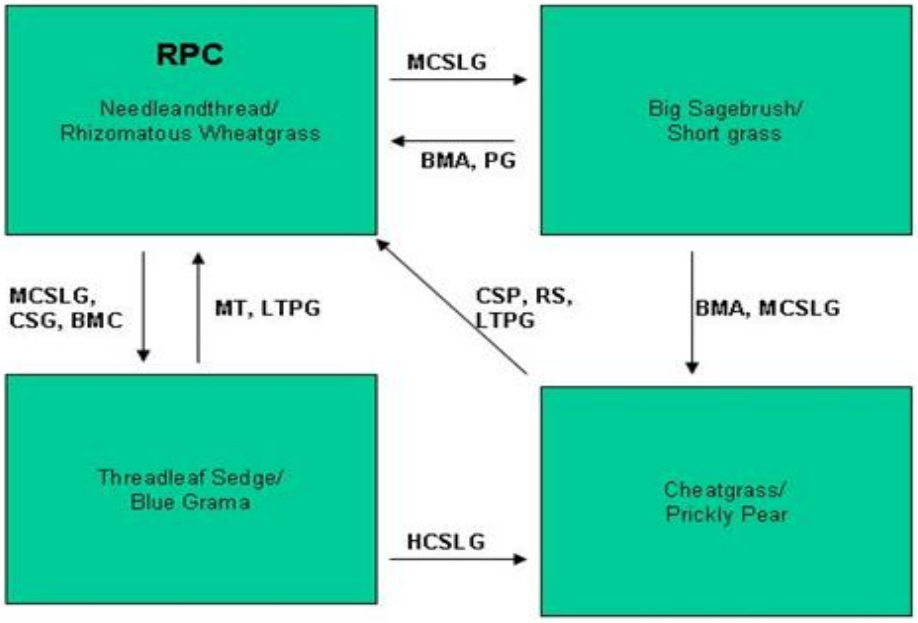
Big sagebrush will become dominant on some areas with an absence of fire. Wildfires are often actively controlled so chemical control using herbicides has replaced the historic role of fire on this site. Recently, prescribed burning has regained some popularity".

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.



BMA – Brush Management (all methods)
BMC – Brush Management (chemical)
BMF – Brush Management (fire)
BMM – Brush Management (mechanical)
CSP – Chemical Seedbed Preparation
CSLG – Continuous Season-long Grazing
DR – Drainage
CSG – Continuous Spring Grazing
HB – Heavy Browse
HCSLG – Heavy Continuous Season-long Grazing
HI – Heavy Inundation
LPG – Long-term Prescribed Grazing
MT – Mechanical Treatment (chiseling, ripping, pitting)
MCSLG – Moderate Continuous Season Long Grazing

NF – No Fire
NS – Natural Succession
NWC – Noxious Weed Control
NWI – Noxious Weed Invasion
NU – Nonuse
P&C – Plow & Crop (including hay)
PG – Prescribed Grazing
RPT – Re-plant Trees
RS – Re-seed
SGD – Severe Ground Disturbance
SHC – Severe Hoof Compaction
WD – Wildlife Damage (Beaver)
WF – Wildfire

Figure 3.14 State and Transition Model for the Sandy 10-14 Inch Precipitation Zone, High Plains Southeast Ecological Site.

- 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. According to the BLM (2003) and supported by local landowners, historic suppression of fires on Ferris Mountain and the vicinity has resulted in decadent vegetation and an abundance of non-desirable species.

3.7 The Sweetwater River Phase IV 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 IV study area, the watershed management plan consists of a compilation of the recommendations for each category. The plan is summarized in Table 3.5.

Table 3.5 Sweetwater River Phase IV Study Area Watershed Management Plan.

Irrigation System Components				
McIntosh-Beaton Ditch Diversion 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	$ 156,050
I-2	Install 2-ft Parshall flume at diversion structure	100	2	$ 4,045
Cranor Ditch Rehabilitation				
Rehabilitation Item Number	**Description**	**Station (feet from headgate)**	**Priority**	**Total Project Cost**
I-3	Rehabiliate Cranor Ditch failure	0.0	1	$ 17,430
I-4	Install 2-ft Parshall flume at diversion structure	100	3	$ 4,045
Wildlife / Livestock Water Supply Alternatives				
Recommended Alternative	**Recommended Alternative**		**Priority**	**Cost**
L/W-01	Stock Tank Replacement Project		2	$ 9,738
L/W-02	Hat Well #1 Improvement Project		2	$ 9,738
L/W-03	Jammerman Pastures Well Improvement Project		2	$ 9,738
L/W-04	Lankin Well Improvement Project		2	$ 13,571
L/W-05	Nolan Pocket Spring Development		2	$ 50,744
L/W-06	Well Replacement		2	$ 20,351
L/W-07	Starr Well Pipeline Extension		2	$ 18,274
L/W-08	Sage Hen Springs Improvement Project		2	$ 48,169
L/W-09	Lone Mountain Springs Development Project		2	$ 33,874
L/W-10	Dry Creek Pipeline Project		2	$ 163,468
Stream Channel Condition and Stability				
Recommended Alternative	**Recommended Alternative**		**Priority**	**Cost**
S-1	Lower Dry Creek – stream bank erosion		2	Cost contingent upon results of site-specific stream channel investigation
S-2	Upper Dry Creek – stream bank erosion / riparian degradation		2	
S-3	Lower Sage Hen Creek - stream bank erosion / riparian degradation		2	
S-4	Upper Sage Hen Creek - stream bank erosion / riparian degradation		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 Phase IV Study Area Watershed Management Plan.

Table 4.1 Funding Options

Primary Funding Sources / Program			Irrigation Rehab	Upland Water	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

Sweetwater River Watershed Study:
Phase IV Groundwater Permits

Map ID	Permit Number	Priority	Applicant	Facility Name	Permitted Uses	Reported Yield	Well Depth	Static Water Depth
1	P14851P	6/21/1941	DAVE & JENNIFER JAMERMAN	HAT WELL #1	STO	8	40	-1
2	P11152P	1/30/1943	UNITED STATES GOVERNMENT	VICTORY WELL #0120	STO	5	322	170
3	P12022P	12/31/1936	EVA L. FRANCE	SEVEN DEE #1	DOM,STO	5	160	-1
4	P11150P	6/30/1942	UNITED STATES GOVERNMENT	LANKIN WELL #0090	STO	7	310	210
5	P10699P	7/29/1943	BUREAU OF LAND MANAGEMENT	TURKEY TRACT WELL #241	STO	4	196	136
6	P10699P	7/29/1943	BUREAU OF LAND MANAGEMENT	TURKEY TRACT WELL #241	STO	4	196	136
7	P10699P	7/29/1943	BUREAU OF LAND MANAGEMENT	TURKEY TRACT WELL #241	STO	4	196	136
8	P10699P	7/29/1943	BUREAU OF LAND MANAGEMENT	TURKEY TRACT WELL #241	STO	4	196	136
9	P7438P	4/25/1929	BESSIE A. MCINTOSH	P BAR RANCH #1	DOM,STO	10	85	16
10	P8346P	12/31/1933	WM. M. MCINTOSH	BILL'S PEAK WELL #1	STO	5	-1	-1
11	P8347P	12/31/1934	WM. M. MCINTOSH	COTTONWOOD WELL #1	STO	5	100	22
12	P12584P	9/14/1954	U.S. GOVERNMENT	GREEN MOUNTAIN SPRING DEVELOPMENT #0	STO	10	3	-1
13	P8448P	12/31/1920	SUN LAND/CATTLE CO.	TURKEY TRACK HOUSE #1	DOM	10	100	40
14	P8596P	6/22/1939	JOHN P. MCINTOSH	PAINE #1	STO	8	265	40
15	P14496P	12/31/1955	SANFORD RANCHES INC.	FLEMING #1	STO	5	125	50
16	P8455P	12/31/1945	SUN LAND/CATTLE CO.	RAWLINS DRAW #1	STO	10	150	90
17	P14852P	5/31/1968	DAVE & JENNIFER JAMERMAN	HAT WELL #2	STO	6	100	-1
18	P22005P	12/31/1950	INC. RUSCO	CROS A HOUSE #1	DOM	25	15	10
19	P22006P	4/12/1958	INC. RUSCO	GREENWOOD #1	STO	10	100	75
20	P22007P	11/5/1956	INC. RUSCO	SPEAR HOUSE #1	DOM	10	44	12
21	P22009P	5/7/1953	INC. RUSCO	HORSESHOE #1	STO	10	162	105
22	P22010P	5/10/1953	INC. RUSCO	OIL CAN HOUSE #1	DOM	10	46	12
23	P22011P	5/14/1953	INC. RUSCO	OIL CAN CORRAL #1	STO	10	43	12
24	P22013P	4/24/1952	INC. RUSCO	DRY LAKE #1	STO	10	110	40
25	P22014P	8/31/1959	INC. RUSCO	KULAGE CORNER #1	STO	10	98	35
26	P22015P	4/25/1957	INC. RUSCO	SWEDE #1	STO	10	120	70
27	P12021P	3/20/1964	EVA FRANCE	SEVEN D #3	STO	10	133	120
28	P12023P	8/31/1963	EVA L. FRANCE	SEVEN D #2	DOM	7	110	15
29	P12087P	1/31/1968	EVA L. FRANCE	SEVEN DEE #4	DOM,STO	20	50	8
30	P12331P	9/11/1964	UNITED STATES GOVERNMENT	BEN-JOE-JAKE WELL #0761	STO	5	100	55
31	P3801W	12/22/1969	AMERICAN TELEPHONE & TELEGRAPH COMPA	A T & T MUDDY GAP #1	MIS	10	380	130
32	P8344P	4/30/1962	WM. M. MCINTOSH	HAT RANCH WELL #1	DOM	10	220	-1
33	P22016P	2/26/1961	INC. RUSCO	MIDDLE SPEAR #1	STO	25	85	30
34	P22018P	6/10/1961	INC. RUSCO	ROBERTS DRAW #1	STO	7	350	325
35	P3021W	9/10/1969	EVA L. FRANCE	CIRCLE BAR #1	DOM	10	120	15
36	P8457P	9/23/1967	SUN LAND/CATTLE CO.	I V BAR WELL #1	STO	10	130	60
37	P12657W	12/6/1971	U.S. BUREAU OF LAND MANAGEMENT	AGATE FLAT WELL #3507	STO	10	-1	-1
38	P14853W	7/31/1972	DAVE & JENNIFER JAMERMAN	B-J #1	DOM,STO	20	95	40
39	P24157P	8/13/1973	STATE OF WYOMING**MATADOR CATTLE COM	LANKIN BOME #26-1	STO	0	160	35
40	P24190P	8/13/1973	MATADOR CATTLE COMPANY	DIAMOND HOOK #34-1	DOM,STO	5	100	35

Sweetwater River Watershed Study:
Phase IV Groundwater Permits

Map ID	Permit Number	Priority	Applicant	Facility Name	Permitted Uses	Reported Yield	Well Depth	Static Water Depth
41	P12813W	2/7/1972	MATADOR CATTLE CO.**WYO BOARD OF LAN	CROSS ELL #1	STO	5	60	20
42	P11378W	12/9/1971	USDI BLM	BARLOW WELL #4103	STO	5	100	35
43	P23679W	8/2/1973	MATADOR CATTLE CO.	BUG #4	STO	6	60	20
44	P24180P	8/13/1973	MATADOR CATTLE CO.	LANKIN DOME #26-2	STO	5	180	25
45	P24181P	8/13/1973	MATADOR CATTLE COMPANY	LONE MT. #27-1	STO	5	165	35
46	P24182P	8/13/1973	MATADOR CATTLE COMPANY	MILLER SPRING #28-1	STO	5	160	40
47	P24183P	8/13/1973	MATADOR CATTLE COMPANY	MILLER SPRING #28-4	STO	5	8	-4
48	P24184P	8/13/1973	CPT. DELBERT W. FOOTE**MATADOR CATTL	MILLER SPRING #28-5	STO	5	150	25
49	P24185P	8/13/1973	MATADOR CATTLE COMPANY	BUG RANCH #29-1	DOM,STO	5	150	25
50	P24186P	8/13/1973	MATADOR CATTLE COMPANY	BUG RANCH #29-2	STO	5	75	25
51	P24188P	8/13/1973	MATADOR CATTLE COMPANY**WYO BOARD OF	CROSS L #32-1	DOM	5	150	45
52	P24189P	9/13/1973	MATADOR CATTLE COMPANY**WYO BOARD OF	CROSS L #32-2	STO	5	160	50
53	P24579W	9/19/1973	MATADOR CATTLE COMPANY	BUG #5	STO	6	60	20
54	P24187P	8/13/1973	MATADOR CATTLE COMPANY	SPLIT ROCK #31-1	STO	5	150	35
55	P28099W	10/7/1974	THE MATADOR CATTLE CO.	BUG #6	STO	10	60	20
56	P41773W	12/13/1977	USDI BLM, RAWLINS DISTRICT	COTTONWOOD CAMPGROUND #1	MIS	10	31	17
57	P41774W	12/13/1977	USDI BLM, RAWLINS DISTRICT	COTTONWOOD CAMPGROUND #2	MIS	10	60	29
58	P42355W	2/22/1978	JENNIFER MCINTOSH	P BAR WELL #2	DOM,STO	20	100	20
59	P42356W	2/22/1978	JENNIFER MCINTOSH	B J WELL #4	STO	20	-1	-1
60	P39371W	8/2/1977	WM. M. MCINTOSH	VICE WELL #1	STO	5	125	45
61	P44097W	7/10/1978	HUB & SPOKE RANCH CO.**M & D LAND CO	DIAMOND HOOK #2	DOM	20	180	60
62	P44098W	7/10/1978	HUB & SPOKE RANCH CO.**M & D LAND CO	DIAMOND HOOK #3	STO	5	120	60
63	P50129W	10/1/1979	THE ANACONDA COMPANY	GM-290	MON	0	3441	1050
64	P44802W	9/1/1978	MATADOR CATTLE COMPANY	RATTLESNAKE #7	STO	1	-4	-1
65	P46376W	8/14/1978	MATADOR CATTLE COMPANY	SAGE HEN #4	STO	25	5	-4
66	P46377W	8/14/1978	MATADOR CATTLE COMPANY	SAGE HEN #3	STO	1	2	-4
67	P46378W	8/14/1978	MATADOR CATTLE COMPNAY	SAGE HEN #1	STO	1	5	-4
68	P46563W	2/12/1979	MATADOR CATTLE COMPANY	CROSS L #1	STO	12	30	12
69	P46564W	2/12/1979	MATADOR CATTLE COMPANY		STO	10	80	50
70	P47190W	3/27/1979	SUN LAND & CATTLE COMPANY	Y Z #1	STO	15	120	10
71	P49333W	8/6/1979	MATADOR CATTLE COMPANY	BARREL SPRINGS #1	STO	1	4	-4
72	P6957W	11/10/1970	SUN LAND/CATTLE CO.	COYOTE #1	STO	10	80	20
73	P9645W	3/29/1971	WM. M. MC INTOSH	WHISKEY CREEK WELL #1	STO	10	265	110
74	P61511W	7/23/1982	DEPAD, STATE OF WYOMING	DEPAD TEST #16	MON	0	24	14.73
75	P63188W	2/1/1983	USDI BLM, RAWLINS DISTRICT	MEADOW DRAW WELL PROJECT #4789	STO	7	1080	-4
76	P63386W	3/9/1983	USDI BLM, RAWLINS DISTRICT	AGATE BUTTE PROJECT #4550	STO	6	235	125
77	P64105W	5/18/1983	USDI BLM, RAWLINS DISTRICT	CCC #5410	STO	14	120	33
78	P64607W	7/11/1983	PATHFINDER MINES CORPORATION	GREEN MOUNTAIN OBSERVATION #1	MON	0	2515	847
79	P64608W	7/11/1983	PATHFINDER MINES CORPORATION	GREEN MOUNTAIN OBSERVATION #2	MON	0	2686	667
80	P67272W	5/9/1984	JAMES D. BAKER	GRAVEL PIT WELL	STO	15	120	14
81	P60199W	4/2/1982	SUN LAND/CATTLE CO.	COYOTE #3	STO	10	60	25

Sweetwater River Watershed Study:
Phase IV Groundwater Permits

Map ID	Permit Number	Priority	Applicant	Facility Name	Permitted Uses	Reported Yield	Well Depth	Static Water Depth
82	P61513W	7/23/1982	DEPAD, STATE OF WYOMING	DEPAD TEST #18	MON	0	79	6.63
83	P62782W	11/29/1982	JOE FRANCE	F 2	STO	2	435	-1
84	P62783W	11/29/1982	JOE FRANCE	F 33	STO	2	278	-1
85	P62824W	11/29/1982	USDI, BLM**JOE FRANCE	33-6	STO	0	271	0
86	P61510W	7/23/1982	DEPAD, STATE OF WYOMING	DEPAD TEST #15	MON	0	380	33.17
87	P71756W	9/13/1984	CLEAR CREEK CATTLE CO.	LESMEISTER SPRING	STO	5	5	-4
88	P75762W	10/22/1987	THOMAS E. MURPHREE	MURPHREE #1	DOM	10	36	20
89	P75763W	10/22/1987	THOMAS E. MURPHREE	MURPHREE #2	STO	10	56	30
90	P106601W	7/1/1997	GOEMEX MINERALS, INC	PCHM097-1	MON	0	513	452
91	P106602W	7/1/1997	GOEMEX MINERALS, INC	PCHMP 97-1	MON	0	802	438
92	P101787W	3/21/1996	SUN LAND & CATTLE CO.	CALVING BARN WELL - SUN HORSE PASTUR	STO	8	120	17
93	P101788W	3/21/1996	SUN LAND & CATTLE CO.	T TRACK HORSE BARN - HORSE PASTURE W	STO	10	120	15
94	P101789W	3/21/1996	SUN LAND & CATTLE CO.	S.S. HILL WELL - SCHOOL SECTION WW #	DOM,STO	20	165	30
95	P105009W	2/13/1997	BERNARD/NORLINE SUN	GANTZ HOUSE #1	DOM,STO	8	110	13
96	P113245W	12/4/1998	JAMES D LUND	LUND #1	DOM	12	180	65
97	P113270W	12/4/1998	USDI BLM	COTTONWOOD CAMPGROUND WELL	MIS	1	70	3
98	P83810W	10/16/1990	WILLIAM M. MCINTOSH	HAT STOCKYARD	STO	25	110	18
99	P84339W	2/4/1991	AMOCO PRODUCTION COMPANY	MW 4889.13	MON	0	30	25
100	P84340W	2/4/1991	AMOCO PRODUCTION COMPANY	MW 4889.14	MON	0	30	26
101	P84341W	2/4/1991	AMOCO PRODUCTION COMPANY	MW 4889.15	MON	0	25	21
102	P84342W	2/4/1991	AMOCO PRODUCTION COMPANY	MW 4889.16	MON	0	23	18
103	P84343W	2/4/1991	AMOCO PRODUCTION COMPANY	MW 4889.17	MON	0	25	17
104	P85710W	4/26/1991	MR. AND MRS. WILLIAM L. MAIERS	MAIERS #1	DOM	4	7	3
105	P82017W	3/22/1990	JAMES D. BAKER	ROCK PASTURE	STO	6	132	80
106	P82018W	3/22/1990	USDI, BLM**JAMES D. BAKER	NORTH DOBIE FLAT	STO	10	200	64
107	P85405W	6/24/1991	WYO BOARD OF LAND COMMISSIONERS**PET	MILLER SPRING #1	STO	25	3	0
108	P85406W	6/24/1991	WYO BOARD OF LAND COMMISSIONERS**PET	PETERS SPRING #1	STO	1	4	-4
109	P97975W	12/1/1994	USDI BLM**USDI, BLM	MILLER SPRINGS WELL #1786	STO	10	170	145
110	37/7/493W	4/26/2005	TOBY WINGERT	TENA'S WELL NWNW-SEC 27-29N-88W	DOM			
111	P133959W	4/12/2001	DAVID E. LIEB	LIEB #1	DOM	8	150	40
112	P139095W	9/18/2001	CHARLES W. SYLVESTER	NT BAR # 2	STO	13	77	9
113	P150275W	4/3/2003	TOBY WINGERT/TENA SUN	TENAS WELL	STO			
114	P150273W	4/3/2003	SUN LAND CATTLE CO	SPEYERS WELL	STO			
115	P151198W	5/14/2003	BLM/WESTERN STAR AG RESOURCES, INC.*	EAST DRY CREEK # 1	STO	6	400	112
116	P168031W	6/2/2005	ELLEN M FOX	HAT RANCH BARN WELL	STO			
117	P170289W	10/13/2005	PETERS PLACES INC.	PETERS PLACES #1	DOM,STO			
118	P170225W	10/26/2005	USDI - BUREAU OF LAND MANAGEMENT	WOLF GAP WELL #2359	STO			
119	40/5/191W	6/5/2007	KENNECUTT URANIUM COMPANY** Bureau of Land Management	BE-002	TST			
120	40/5/195W	6/5/2007	KENNECUTT URANIUM COMPANY** Bureau of Land Management	BE-001	MIS			
121	40/1/191W	6/5/2007	KENNECUTT URANIUM COMPANY** Bureau of Land Management	BE-003	TST			
122	40/4/191W	6/5/2007	KENNECUTT URANIUM COMPANY** Bureau of Land Management	BE-006	TST			

Sweetwater River Watershed Study:
Phase IV Groundwater Permits

Map ID	Permit Number	Priority	Applicant	Facility Name	Permitted Uses	Reported Yield	Well Depth	Static Water Depth
123	40/2/191W	6/5/2007	KENNECUTT URANIUM COMPANY** Bureau of Land Management	BE-004	TST			
124	40/3/191W	6/5/2007	KENNECUTT URANIUM COMPANY** Bureau of Land Management	BE-005	TST			

APPENDIX B

SURFACE WATER RIGHTS

Sweetwater River Watershed Study: Phase IV Study Area

Tabulation of Surface Water Rights

Permit Number	Facility Name	Status	Location	Stream Name
C21/160A	HANES & CURRAN #2 DITCH	ADJ	T. 32 N., R. 88 W.	Springs
C29/281A	SPRING CREEK #2 DITCH	ADJ	T. 28 N., R. 90 W.	Spring Creek
C74/086A	COUNTRYMAN CANAL #2	ADJ	T. 29 N., R. 89 W.	Sweetwater River
C76/100A	W M CRANOR DITCH (enlarged)	ADJ	T. 29 N., R. 90 W.	Sweetwater River
C9/037A	MCINTOSH DITCH (enlarged)	AME	T. 29 N., R. 90 W.	Sweetwater River
P10195D	SIMPLOT DITCH	ADJ	T. 32 N., R. 88 W.	Dry Creek
P10196D	CIRCLE CROSS DITCH	ADJ	T. 32 N., R. 88 W.	Dry Creek
P1044E	WALES IRRIGATING #1 DITCH (enlarged)	ADJ	T. 28 N., R. 91 W.	East Cottonwood
P10584D	RIDDEL #2 DITCH	ADJ	T. 30 N., R. 87 W.	Dry Creek
P10647D	RIDDEL #3 DITCH	ADJ	T. 31 N., R. 87 W.	Dry Creek
P11881D	WASH #3 DITCH	ADJ	T. 28 N., R. 91 W.	West Cottonwood Creek
P11935D	JOHNSON #5 DITCH	ADJ	T. 28 N., R. 91 W.	Middle Cottonwood Creek
P12002D	MARGARET DITCH	ADJ	T. 32 N., R. 89 W.	Sage Hen Creek
P12533D	U T DITCH	ADJ	T. 31 N., R. 87 W.	U.T. Creek
P13058D	JOHNSON SUPPLY DITCH	ADJ	T. 28 N., R. 91 W.	East Cottonwood
P13072D	FISHER DITCH	ADJ	T. 30 N., R. 87 W.	Dry Creek
P1379D	JOHNSON #1 DITCH	ADJ	T. 28 N., R. 90 W.	Willow Creek (16-29-89)
P1379E	COUNTRYMAN DITCH & COUNTRYMAN DITCH #2	ADJ	T. 29 N., R. 89 W.	Sweetwater River
P1380D	JOHNSON #2 DITCH	ADJ	T. 28 N., R. 90 W.	Willow Creek (16-29-89)
P14078D	ENSPEAR DITCH	ADJ	T. 30 N., R. 87 W.	Dry Creek
P1467R	SPEYERER RESERVOIR	ADJ	T. 28 N., R. 89 W.	Willow Creek (16-29-89)
P1472D	COUNTRYMAN CANAL #2	ADJ	T. 29 N., R. 89 W.	Sweetwater River
P1484D	CIRCLE BAR #1 DITCH	ADJ	T. 32 N., R. 88 W.	Dry Creek
P1485D	CIRCLE BAR #2 DITCH	ADJ	T. 32 N., R. 88 W.	Dry Creek
P1489E	W M CRANOR DITCH (enlarged)	ADJ	T. 29 N., R. 90 W.	Sweetwater River
P1641R	LADY EMMA RESERVOIR	ADJ	T. 32 N., R. 88 W.	Brush Creek
P16627D	SAGE HEN DITCH	ADJ	T. 32 N., R. 89 W.	Middle Sage Hen Creek
P1703D	A R COWLEY #1 DITCH	ADJ	T. 29 N., R. 89 W.	Sweetwater River
P1731E	COOPER CREEK (enlarged)	ADJ	T. 28 N., R. 90 W.	Cooper 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
P17958D	WALSH DITCH	ADJ	T. 28 N., R. 91 W.	West Cottonwood Creek
P1873R	GRIEVE RESERVOIR	ADJ	T. 28 N., R. 90 W.	Willow Creek (16-29-89)
P1906D	MCINTOSH DITCH	ADJ	T. 29 N., R. 90 W.	Sweetwater River
P1954D	WASH DITCH	ADJ	T. 28 N., R. 91 W.	West Cottonwood Creek
P1955D	FRANTZEN DITCH	ADJ	T. 28 N., R. 90 W.	Cooper Creek
P1956D	JOHNSON #3 DITCH	ADJ	T. 28 N., R. 91 W.	Middle Cottonwood Creek
P1987D	MILLER DITCH	ADJ	T. 29 N., R. 89 W.	Sweetwater River
P1992D	SPRING CREEK DITCH	ADJ	T. 28 N., R. 90 W.	Spring Creek
P1993D	COOPER CREEK DITCH	ADJ	T. 28 N., R. 90 W.	Cooper Creek
P2080D	CRANER DITCH	ADJ	T. 29 N., R. 90 W.	Sweetwater River
P2190E	LATERAL WALES DITCH #1 (enlarged)	ADJ	T. 28 N., R. 91 W.	East Cottonwood

Sweetwater River Watershed Study: Phase IV Study Area

Tabulation of Surface Water Rights

Permit Number	Facility Name	Status	Location	Stream Name
P2224E	MILLER	ADJ	T. 31 N., R. 87 W.	Dry Creek
P2249E	WALES #1 DITCH (enlarged)	ADJ	T. 28 N., R. 91 W.	East Cottonwood
P2253E	JOHNSON #1 (enlarged)	ADJ	T. 28 N., R. 90 W.	Willow Creek (16-29-89)
P2254E	TULLY #5 DITCH (enlarged)	ADJ	T. 28 N., R. 90 W.	Willow Creek (16-29-89)
P2285E	FOUR V DITCH (enlarged)	ADJ	T. 32 N., R. 87 W.	Dry Creek
P2468D	SAGE HEN DITCH	ADJ	T. 30 N., R. 90 W.	Sage Hen Creek
P2502D	WALES IRRIGATING DITCH #1	ADJ	T. 28 N., R. 91 W.	East Cottonwood
P2518E	D. BARDELABEN DITCH (enlarged)	ADJ	T. 30 N., R. 90 W.	Sage Hen Creek
P2601D	ROBERTS DITCH	ADJ	T. 31 N., R. 87 W.	Dry Creek
P2649E	SAGE HEN (enlarged)	ADJ	T. 32 N., R. 89 W.	Sage Hen Creek
P2807R	DOME CREEK RESERVOIR	ADJ	T. 30 N., R. 90 W.	Sage Hen Creek
P30646D	#1 COOPER CREEK PIPELINE	ADJ	T. 28 N., R. 90 W.	Cooper Creek
P3271E	THREE CROSSING (enlarged)	ADJ	T. 29 N., R. 91 W.	Sweetwater River
P3389D	W M CRANOR DITCH	ADJ	T. 29 N., R. 90 W.	Sweetwater River
P3707D	ASBELL DITCH	ADJ	T. 32 N., R. 89 W.	Sage Hen Creek
P3735D	RIDDLE DITCH	ADJ	T. 30 N., R. 87 W.	Dry Creek
P3749D	JOHNSON #4 DITCH	ADJ	T. 28 N., R. 91 W.	Middle Cottonwood Creek
P4025D	TULLY DITCH	ADJ	T. 28 N., R. 90 W.	Willow Creek (16-29-89)
P4088D	HANES & CURRAN #1 DITCH	ADJ	T. 32 N., R. 88 W.	Springs
P4089D	HANES & CURRAN #2 DITCH	ADJ	T. 32 N., R. 88 W.	Springs
P453R	DOME ROCK RESERVOIR	ADJ	T. 30 N., R. 90 W.	Sage Hen Creek
P5468D	WALES #2 DITCH	ADJ	T. 28 N., R. 91 W.	East Cottonwood
P5709D	RESERVOIR DITCH	ADJ	T. 30 N., R. 90 W.	Sage Hen Creek
P5811D	ROBERTS #4 DITCH	ADJ	T. 30 N., R. 87 W.	Dry Creek
P6278D	WYOMING CENTRAL DITCH	ADJ	T. 29 N., R. 89 W.	Sweetwater River
P6284D	TULLY #5 DITCH	ADJ	T. 28 N., R. 90 W.	Willow Creek (16-29-89)
P6285D	TULLY #2 DITCH	ADJ	T. 28 N., R. 90 W.	Willow Creek (16-29-89)
P6338D	ELIZABETH DITCH	ADJ	T. 31 N., R. 87 W.	Dry Creek
P702E	MCINTOSH (enlarged)	ADJ	T. 29 N., R. 90 W.	Sweetwater River
P7261D	OLE #1 DITCH	ADJ	T. 28 N., R. 91 W.	West Cottonwood Creek
P7262D	OLE #2 DITCH	ADJ	T. 28 N., R. 91 W.	West Cottonwood Creek
P7755D	WASH #2 DITCH	ADJ	T. 28 N., R. 91 W.	West Cottonwood 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
P7759D	JOHNSON DITCH	ADJ	T. 29 N., R. 91 W.	Middle Cottonwood Creek
P7761D	WALES #2 DITCH	ADJ	T. 28 N., R. 91 W.	East Cottonwood
P8360D	MILLER DITCH	ADJ	T. 31 N., R. 87 W.	Dry Creek
P8919D	LENA SPEYERER #1 DITCH	ADJ	T. 28 N., R. 90 W.	Willow Creek (16-29-89)
P8920D	LENA SPEYERER #3 DITCH	ADJ	T. 28 N., R. 89 W.	Willow Creek (16-29-89)
P8921D	LENA SPEYERER #2 DITCH	ADJ	T. 28 N., R. 89 W.	Willow Creek (16-29-89)
P8992D	HOME #1 DITCH	ADJ	T. 28 N., R. 90 W.	West Cooper Creek

Sweetwater River Watershed Study: Phase IV Study Area

Tabulation of Surface Water Rights

Permit Number	Facility Name	Status	Location	Stream Name
P8993D	HOME DITCH	ADJ	T. 28 N., R. 90 W.	Cooper Creek
P8998D	EAST COTTONWOOD DITCH	ADJ	T. 28 N., R. 91 W.	East Cottonwood
P9135D	HENRY JOHNSON	ADJ	T. 29 N., R. 91 W.	West Cottonwood Creek
P9374D	LADY EMMA DITCH	ADJ	T. 32 N., R. 88 W.	Brush Creek
P9395D	ALLEY SPRINGS DITCH	ADJ	T. 31 N., R. 89 W.	Alley Springs
P9646D	SAGE HEN	ADJ	T. 32 N., R. 89 W.	Sage Hen Creek
P9823D	FOUR V DITCH	ADJ	T. 32 N., R. 87 W.	Dry Creek
P9940D	ROCK CUT DITCH	ADJ	T. 28 N., R. 91 W.	Middle Cottonwood Creek
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
P9943D	GRIEVE #1 DITCH	ADJ	T. 28 N., R. 90 W.	Willow Creek (16-29-89)
P9944D	GRIEVE #2 DITCH	ADJ	T. 28 N., R. 90 W.	Willow Creek (16-29-89)
T5669D	JOHNSON #1 DITCH	ADJ	T. 28 N., R. 91 W.	Middle Cottonwood Creek
T5670D	JOHNSON #2 DITCH	ADJ	T. 28 N., R. 91 W.	Middle Cottonwood Creek
T5716D	DEBARDELEBEN DITCH	ADJ	T. 30 N., R. 90 W.	Sage Hen Creek