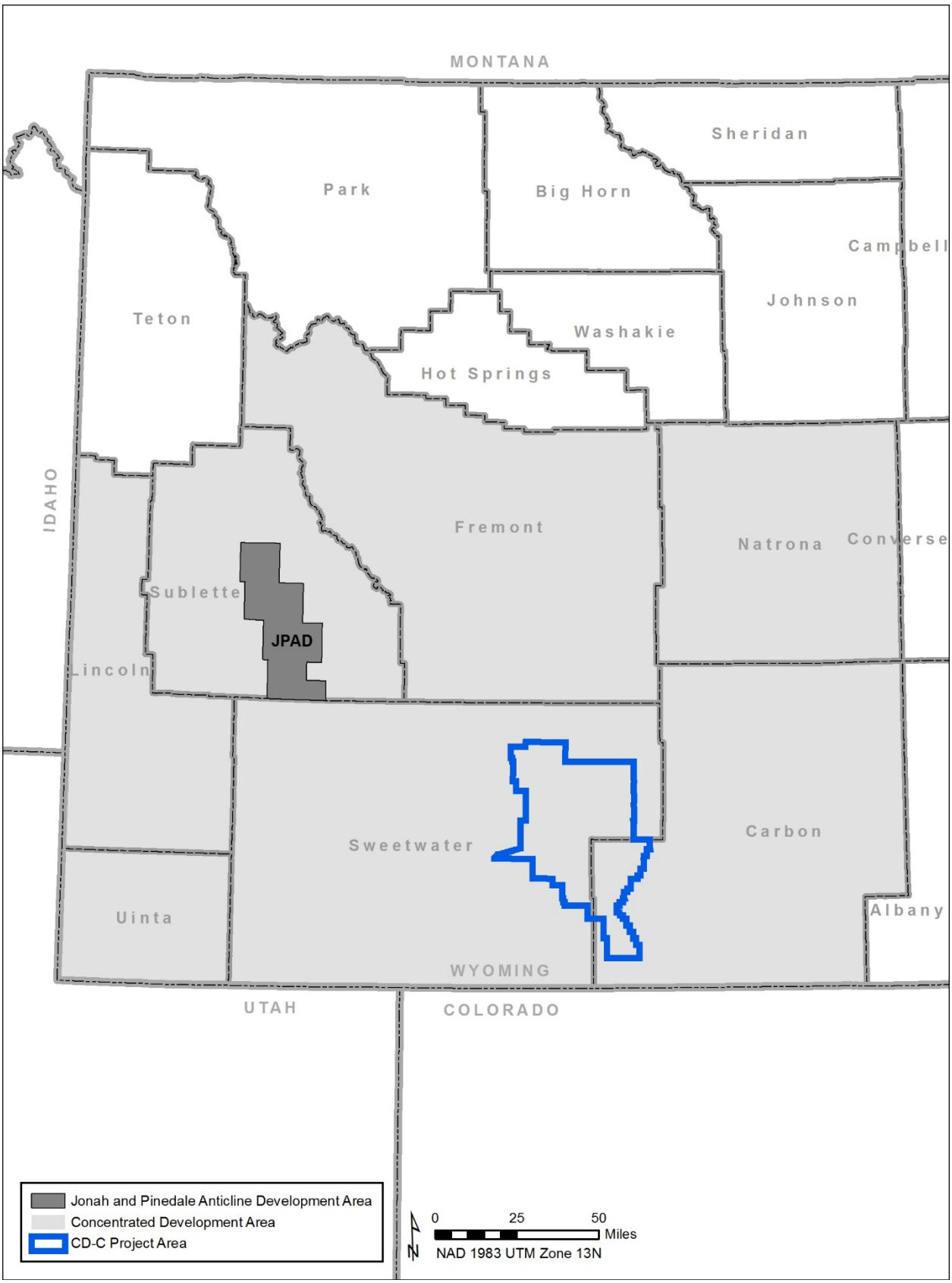


Map 3.5-1. The concentrated development area (from WDEQ–AQD, 2010)

No warranty is made by the BLM for use of the data for purposes not intended by the BLM.

3.5.2.8 Waste Prevention, Production Subject to Royalties, and Resource Conservation; Proposed Rule

The BLM has proposed new regulations to reduce waste of natural gas from venting, flaring, and equipment leaks during oil and natural gas production activities on onshore federal and Indian leases (BLM 2016). The Mineral Leasing Act requires the BLM to ensure that operators "use all reasonable precautions to prevent waste of oil or gas," and the BLM believes there are economical, cost-effective, and reasonable measures that operators should take to minimize waste. These proposed regulations would also reduce VOC and methane emissions. Whereas the proposed EPA NSPS Subpart OOOOa (EPA 2015c) would regulate VOC and methane emissions from new and modified oil and gas production facilities, the proposed BLM rule would apply to new, modified, and existing sources. The proposed BLM rule also introduces provisions to reduce flaring during normal production operations, which are not part of the proposed EPA NSPS regulations. In addition, the proposed BLM rule would require operators to implement an instrument-based leak detection and repair (LDAR) program to find and repair leaks. Operators could use infrared cameras or other methods approved by the BLM.

3.5.2.9 Greenhouse Gases and Climate Change

Climate change is a statistically-significant and long-term change in climate patterns. The terms climate change and "global warming" are often used interchangeably, although they are not the same thing. Climate change is any deviation from the average climate, whether warming or cooling, and can result from both natural and human (anthropogenic) sources. Natural contributors to climate change include fluctuations in solar radiation, volcanic eruptions, and plate tectonics. Global warming refers to the apparent warming of climate observed since the early 20th century and is primarily attributed to human activities such as fossil fuel combustion, industrial processes, and land use changes.

The natural greenhouse effect is critical to the discussion of climate change. The greenhouse effect refers to the process by which greenhouse gases (GHGs) in the atmosphere absorb heat energy radiated by Earth's surface and re-radiate some of that heat back toward Earth, causing temperatures in the lower atmosphere and on the surface of Earth to be higher than they would be without atmospheric GHGs. These GHGs trap heat that would otherwise be radiated into space, causing Earth's atmosphere to warm and making temperatures suitable for life on Earth. Without the natural greenhouse effect, the average surface temperature of Earth would be about 0˚F. Higher concentrations of GHGs amplify the heat-trapping effect resulting in higher surface temperatures. Water vapor is the most abundant GHG, followed by carbon dioxide, methane, nitrous oxide, and several trace gases. Water vapor, which occurs naturally in the atmosphere, is often excluded from the discussion of GHGs and climate change since its atmospheric concentration is largely dependent upon temperature rather than being emitted by specific sources. Other GHGs, such as carbon dioxide and methane, occur naturally in the atmosphere and are also emitted into the atmosphere by human activities.

Atmospheric concentrations of naturally-emitted GHGs have varied for millennia and Earth's climate has fluctuated accordingly. However, since the beginning of the industrial revolution around 1750, human activities have significantly increased GHG concentrations and introduced man-made compounds that act as GHGs in the atmosphere. The atmospheric concentrations of carbon dioxide, methane, and nitrous oxide have increased to levels unprecedented in at least the last 800,000 years. From pre-industrial times until today, the global average concentrations of carbon dioxide, methane, and nitrous oxide in the atmosphere have increased by around 40 percent, 150 percent, and 20 percent, respectively (IPCC [Intergovernmental Panel on Climate Change] 2013).

Human activities emit billions of tons of carbon dioxide every year. Carbon dioxide is primarily emitted from fossil fuel combustion, but has a variety of other industrial sources. Methane is emitted from oil and natural gas systems, landfills, mining, agricultural activities, and waste and other industrial processes.

Nitrous oxide is emitted from anthropogenic activities in the agricultural, energy-related, waste and industrial sectors. The manufacture of refrigerants and semiconductors, electrical transmission, and metal production emit a variety of trace GHGs including hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride. These trace gases have no natural sources and come entirely from human activities. Carbon dioxide, methane, nitrous oxide, and the trace gases are considered well-mixed and long-lived GHGs.

Several gases have no direct effect on climate change, but indirectly affect the absorption of radiation by impacting the formation or destruction of GHGs. These gases include carbon monoxide, oxides of nitrogen, and non-methane volatile organic compounds. Fossil fuel combustion and industrial processes account for the majority of emissions of these indirect GHGs. Unlike other GHGs, which have atmospheric lifetimes on the order of decades, these gases are short-lived in the atmosphere.

Atmospheric aerosols, or particulate matter (PM), also contribute to climate change. Aerosols directly affect climate by scattering and absorbing radiation (aerosol-radiation interactions) and indirectly affect climate by altering cloud properties (aerosol-cloud interactions). Particles less than 10 micrometers in diameter (PM_{10}) typically originate from natural sources and settle out of the atmosphere in hours or days. Particles smaller than 2.5 micrometers in diameter ($PM_{2.5}$) often originate from human activities such as fossil fuel combustion. These so-called "fine" particles can exist in the atmosphere for several weeks and have local, short-term impacts on climate. Aerosols can also act as cloud condensation nuclei, the particles upon which cloud droplets form.

Light-colored particles, such as sulfate aerosols, reflect and scatter incoming solar radiation, having a mild cooling effect, while dark-colored particles (often referred to as "soot" or "black carbon") absorb radiation and have a warming effect. There is also the potential for black carbon to deposit on snow and ice, altering the surface albedo (or reflectivity), and enhancing melting. There is high confidence that aerosol effects are partially offsetting the warming effects of GHGs, but the magnitude of their effects contributes the largest uncertainly to our understanding of climate change (IPCC 2013).

Our current understanding of the climate system comes from the cumulative results of observations, experimental research, theoretical studies, and model simulations. The IPCC Fifth Assessment Report (AR5) (IPCC 2013) uses terms to indicate the assessed likelihood of an outcome ranging from *exceptionally unlikely* (0–1 percent probability) to *virtually certain* (99–100 percent probability) and level of confidence ranging from *very low* to *very high*. The findings presented in AR5 indicate that warming of the climate system is unequivocal and many of the observed changes are unprecedented over decades to millennia. It is *certain* that Global Mean Surface Temperature has increased since the late 19th century and *virtually certain* (99–100 percent probability) that maximum and minimum temperatures over land have increased on a global scale since 1950. The globally averaged combined land and ocean surface temperature data show a warming of 1.5°F. Human influence has been detected in warming of the atmosphere and the ocean, in changes in the global water cycle, in reductions in snow and ice, in global mean sea-level rise, and in changes in some climate extremes. It is *extremely likely* (95–100 percent probability) that human influence has been the dominant cause of the observed warming since the mid-20th century (IPCC 2013). Findings from AR5 and reported by other organizations, such as the NASA Goddard Institute for Space Studies (NOAA 2013), also indicate that changes in the climate system are not uniform and regional differences are apparent.

National Assessment of Climate Change

The U.S. Global Change Research Program released the third U.S. National Climate Assessment in May 2014. The Assessment summarizes the current state of knowledge on climate change and its impacts throughout the U.S. It was written by climate scientists and draws from a large body of peer-reviewed scientific research, technical reports, and other publicly available sources. The Assessment documents climate change impacts that are currently occurring and those that are anticipated to occur throughout this century. It also provides region-specific impact assessments for key sectors such as energy, water, and human health.

The Assessment summarizes their conclusions in a number of Key Messages (NCA, 2014a), several of which are excerpted here:

- *Global climate is changing and this change is apparent across a wide range of observations. The global warming of the past 50 years is primarily due to human activities.*
- *Global climate is projected to continue to change over this century and beyond. The magnitude of climate change beyond the next few decades depends primarily on the amount of heat-trapping gases emitted globally, and how sensitive the Earth's climate is to those emissions.*
- *U.S. average temperature has increased by 1.3°F to 1.9°F since record keeping began in 1895; most of this increase has occurred since about 1970. The most recent decade was the nation's warmest on record. Temperatures in the United States are expected to continue to rise. Because human-induced warming is superimposed on a naturally varying climate, the temperature rise has not been, and will not be, uniform or smooth across the country or over time.*
- *Average U.S. precipitation has increased since 1900, but some areas have had increases greater than the national average, and some areas have had decreases. More winter and spring precipitation is projected for the northern United States, and less for the Southwest, over this century.*
- *Global sea level has risen by about 8 inches since reliable record keeping began in 1880. It is projected to rise another 1 to 4 feet by 2100.*
- *The oceans are currently absorbing about a quarter of the carbon dioxide emitted to the atmosphere annually and are becoming more acidic as a result, leading to concerns about intensifying impacts on marine ecosystems.*

The Assessment provided analysis of projected climate change by region, and the CD-C project is part of the Great Plains region. The Key Messages for this region (NCA, 2014b) are as follows:

- *Rising temperatures are leading to increased demand for water and energy. In parts of the region, this will constrain development, stress natural resources, and increase competition for water among communities, agriculture, energy production, and ecological needs.*
- *Changes to crop growth cycles due to warming winters and alterations in the timing and magnitude of rainfall events have already been observed; as these trends continue, they will require new agriculture and livestock management practices.*
- *Landscape fragmentation is increasing, for example, in the context of energy development activities in the northern Great Plains. A highly fragmented landscape will hinder adaptation of species when climate change alters habitat composition and timing of plant development cycles.*
- *Communities that are already the most vulnerable to weather and climate extremes will be stressed even further by more frequent extreme events occurring within an already highly variable climate system.*
- *The magnitude of expected changes will exceed those experienced in the last century. Existing adaptation and planning efforts are inadequate to respond to these projected impacts.*

Project Greenhouse Gas Emissions and Climate Change

GHGs projected to be emitted by CD-C project sources are carbon dioxide, methane, and nitrous oxide. In 2007, the U.S. Supreme Court ruled in *Massachusetts v. EPA* that the EPA has the authority to regulate GHGs such as methane and carbon dioxide as air pollutants under the Clean Air Act. The ruling did not, however, require the EPA to create any emission control standards or ambient air quality standards for GHGs. At present there are no ambient air quality standards for GHGs. However, New Source

Performance Standards currently proposed by EPA (EPA 2015b) would limit methane emissions from oil and gas emission sources and, once final, these methane emission limits would apply to the sources developed under the CD-C project alternatives. In addition there are applicable reporting requirements under the EPA's Greenhouse Gas Reporting Program. These GHG emission reporting requirements, finalized in 2010 under 40 CFR Part 98, will require the Operators to develop and report annual methane and carbon dioxide emissions from equipment leaks and venting, and emissions of carbon dioxide, methane, and nitrous oxide from flaring, onshore production stationary and portable combustion emissions, and combustion emissions from stationary equipment.

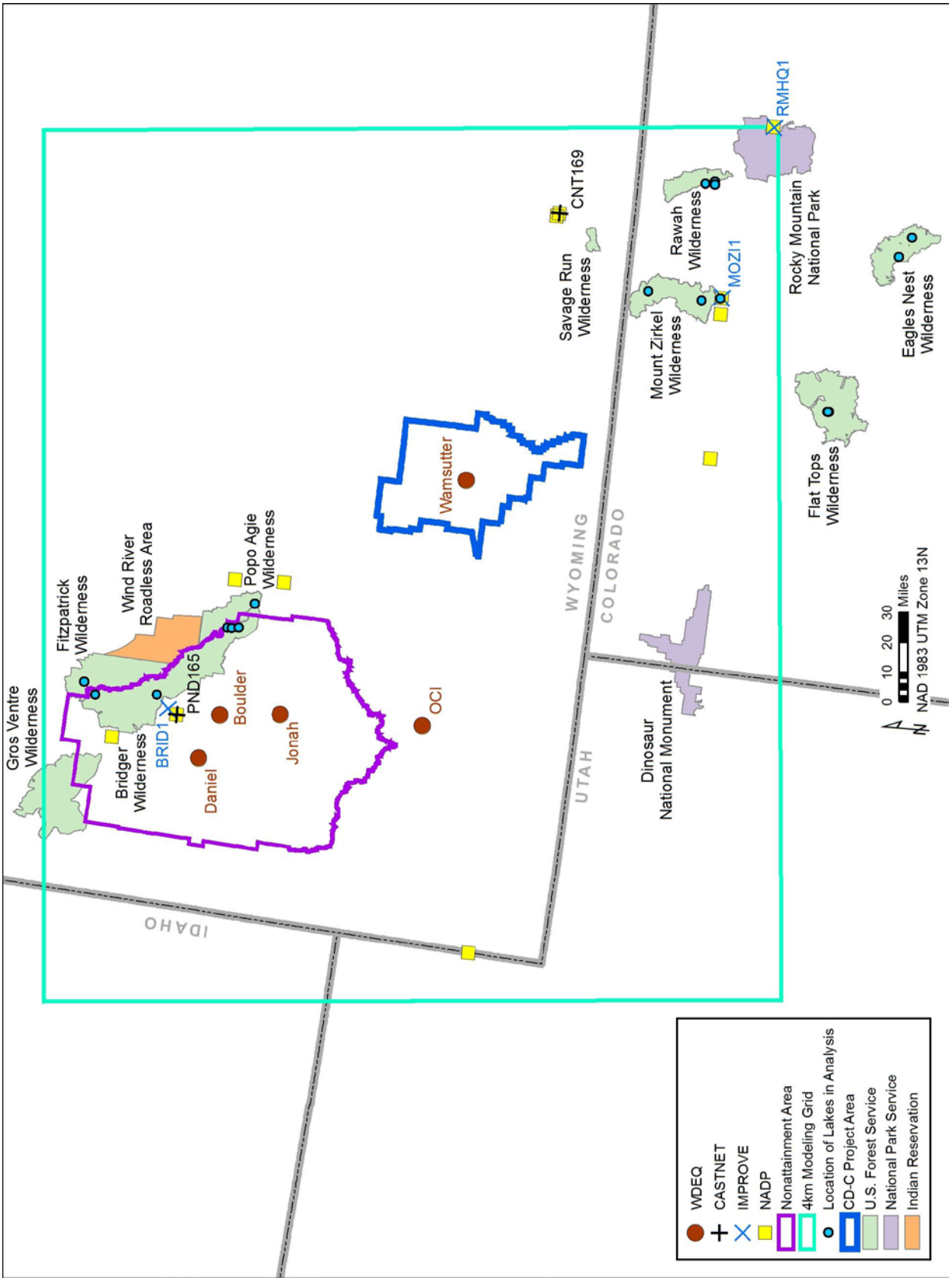
The Council on Environmental Quality (CEQ) recently released draft guidance for federal agencies on consideration of GHGs and the effects of climate change in NEPA documents (CEQ 2014). While the guidance provides federal agencies with significant discretion on how to consider the effects of GHG emissions and climate change in their evaluation of proposals for federal act, it also provides an expectation of what should be considered and disclosed. Agencies are directed to consider two separate issues when addressing climate change: (1) the effects of a proposed action on climate change as indicated by its GHG emissions; and (2) the implications of climate change for the environmental effect of a proposed action. Agencies should consider the climate change effects of a proposal by comparing the GHG emissions of the proposed action and the reasonable alternatives. The effects of climate change on the proposed action and alternatives should be considered during the analysis of the affected environment. Land managers should consult the CEQ guidance for information on direct, indirect, and cumulative impact analyses, among other topics.

Renewable and nonrenewable resource management actions have the potential to impact climate change due to GHG emissions and other anthropogenic effects. However, the assessment of GHG emissions and climate change is extremely complex because of the inherent interrelationships among its sources, causation, mechanisms of action, and impacts. Emitted GHGs become well-mixed throughout the atmosphere and contribute to the global atmospheric burden of GHGs. Given the global and complex nature of climate change, it is not possible to attribute a particular climate impact in any given region to GHG emissions from a particular source. The uncertainty in applying results from Global Climate Models to the regional or local scale (a process known as downscaling) limits our ability to quantify potential future impacts from GHGs emissions at this scale. When further information on the impacts of local emissions to climate change is known, such information would be incorporated into the BLM's planning and NEPA documents as appropriate.

The environmental impacts of GHG emissions from oil and gas refining and from consumption, such as from vehicle operations, are not effects of BLM actions related to oil and gas development as defined by the CEQ because they do not occur at the same time and place as the action. Thus, GHG emissions from refining and consumption of oil and gas do not constitute a direct effect that is analyzed under NEPA. Nor are refining and consumption an indirect effect of oil and gas production because production is not a proximate cause of GHG emissions resulting from refining and consumption. However, emissions from refining and consumption and other activities are accounted for in the cumulative effects analysis (BLM 2014b).

3.5.3 Monitored Air Pollutant Concentrations

Monitoring of air pollutant concentrations has been conducted within both the CD-C project area and the study area. **Map 3.5-2** presents the locations of the ambient air monitoring sites in relation to the CD-C project area and surrounding PSD sensitive areas. These monitoring sites are part of several monitoring networks overseen by state and federal agencies, including: WDEQ (State of Wyoming), Clean Air Status and Trends Network (CASTNET), Interagency Monitoring of Protected Visual Environments (IMPROVE), and the National Acid Deposition Program (NADP) National Trends Network.



Map 3.5-2. CD-C study area and air quality monitoring stations within the 4 km modeling domain

No warranty is made by the BLM for use of the data for purposes not intended by the BLM.

Air pollutants monitored at these sites include carbon monoxide, nitrogen dioxide, ozone, particulate matter less than 10 microns in effective diameter (PM_{10}), particulate matter less than 2.5 microns in effective diameter ($PM_{2.5}$), and sulfur dioxide. Background concentrations of these pollutants define ambient air concentrations in the region and establish existing compliance with ambient air quality standards. The most representative monitored regional background concentrations available for criteria pollutants as identified by WDEQ–AQD (WDEQ–AQD 2011) are shown in **Table 3.5-8**.

Table 3.5-8. Background ambient air quality concentrations (μg/m^3)

Pollutant	Averaging Period	Measured Background Concentration
Carbon monoxide[1]	1-hour 8-hour	1,026 798
Nitrogen dioxide[2]	1-hour Annual	75 9.1
Ozone[3]	8-hour	126.1
PM_{10}[4]	24-hour Annual	56 13.5
$PM_{2.5}$[5]	24-hour Annual	9.2 4.2
Sulfur dioxide[6]	1-hour 3-hour 24-hour Annual	19.7 11.5 4.2 3.8

[1] *Data collected during 2008 at Murphy Ridge, Wyoming; concentrations are maximum values.*

[2] *Data collected at Wamsutter, Wyoming: 1-hour concentration is the three year average (2008-2010) of daily maximum 98th percentile 1-hour concentrations, annual value is for 2010.*

[3] *Data collected at Wamsutter, Wyoming: 8-hour concentration is the three year average (2008-2010) of the fourth-highest daily maximum 8-hour concentrations.*

[4] *Data collected at Wamsutter, Wyoming during 2010, 24-hour value is maximum concentration.*

[5] *Data collected at Cheyenne, Wyoming: 24-hour value is the three year average (2008-2010) of daily maximum 98th percentile 24-hour concentrations, annual value is three year average of annual means (2008-2010).*

[6] *Data collected at Wamsutter, Wyoming: 1-hour value is the three year average (2007-2009) of daily maximum 98th percentile 1-hour concentrations, 3-hour, 24-hour and annual concentrations were collected during 2009, 3-hour and 24-hour data are maximum values.*

The study area shown in **Map 3.5-2** encompasses eight Class I areas and four sensitive Class II areas. The eight Class I areas located within the CD-C study area are the Bridger, Fitzpatrick, Mount Zirkel, Savage Run, Rawah, Eagles Nest, and Flat Tops Wilderness Areas and Rocky Mountain National Park. The four sensitive Class II areas are Gros Ventre and Popo Agie Wilderness Areas, Dinosaur National Monument, and Wind River Roadless Area.

3.5.4 Monitored Visibility

Visibility conditions can be measured as standard visual range, the farthest distance at which an observer can just see a black object viewed against the horizon sky; the larger the standard visual range, the cleaner the air. Visibility for the region is considered to be very good. Continuous visibility-related optical background data have been collected in the PSD Class I Mount Zirkel and Bridger Wilderness Areas (the closest Class I areas to the project area), as part of the IMPROVE program. The average standard visual range at the both the Mount Zirkel and Bridger Wilderness Areas is over 200 kilometers (Visibility Information Exchange Web System [VIEWS] 2014a).

3.5.5 Monitored Atmospheric Deposition

Atmospheric deposition refers to the processes by which air pollutants are removed from the atmosphere and deposited on terrestrial and aquatic ecosystems, and it is reported as the mass of material deposited on an area per year (kg/ha-yr). Air pollutants are deposited by wet deposition (precipitation) and dry deposition (gravitational settling of pollutants). The chemical components of wet deposition include sulfate (SO_4), nitrate, and ammonium; the chemical components of dry deposition include sulfate, sulfur dioxide, nitrate, ammonium, and nitric acid.

The NADP and the National Trends Network (NTN) station monitors wet atmospheric deposition and the CASTNET station monitors dry atmospheric deposition at sites near Centennial/Brooklyn Lake (station CNT169) and Pinedale (station PND165), which are approximately 65 miles east-southeast and 95 miles northwest, respectively, of the project area. The total annual nitrogen and sulfur deposition (wet and dry) derived from CASTNET and NADP/NTN measurements for the monitoring period of record (1990 through 2012) are shown in **Figures 3.5-2a, 3.5-2b, 3.5-3a,** and **3.5-3b**.

Figure 3.5-2a. Annual nitrogen deposition (kg/ha-yr) at Centennial, CNT169 (1990–2012)

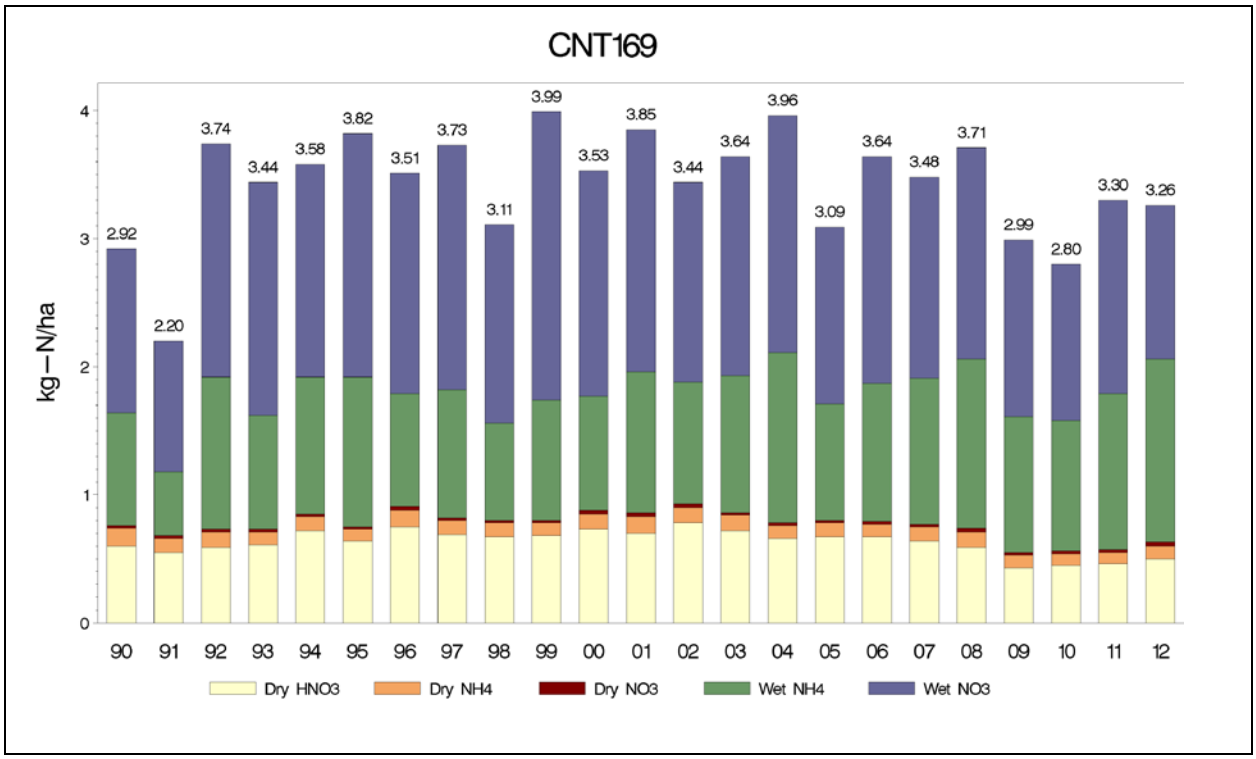
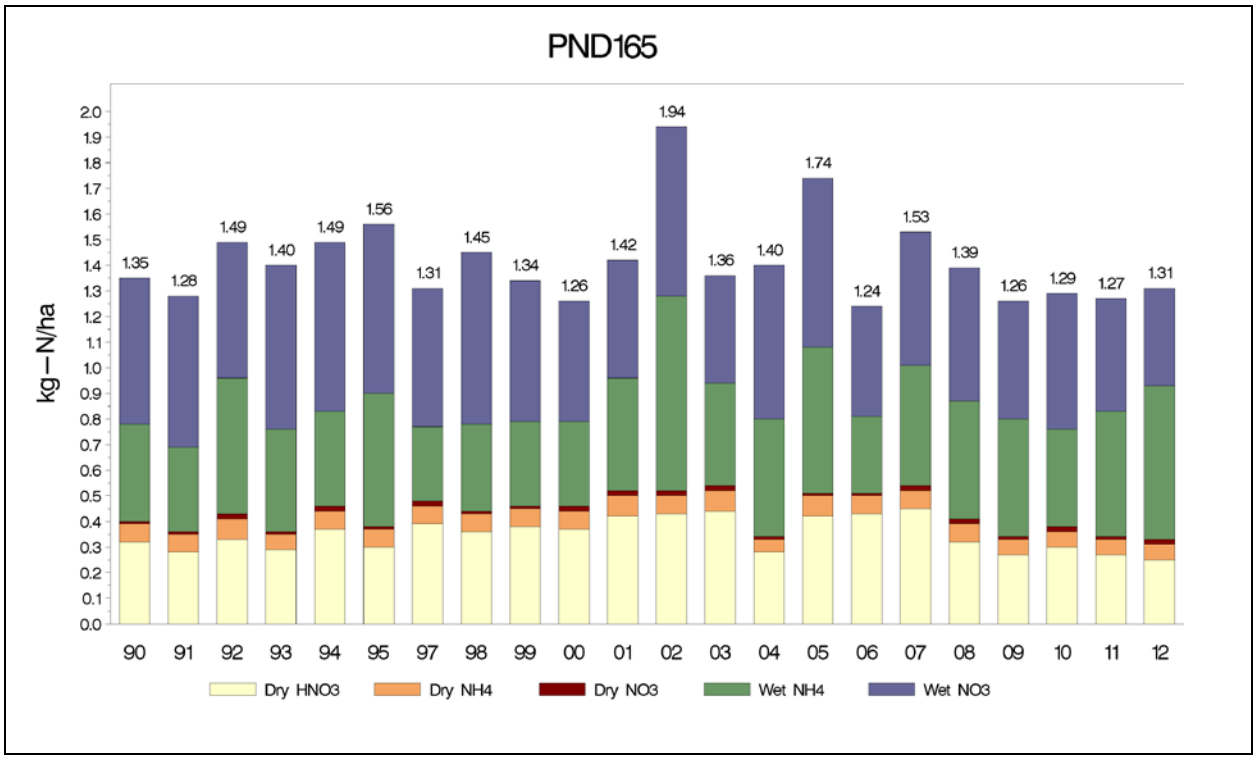


Figure 3.5-2b. Annual nitrogen deposition (kg/ha-yr) at Pinedale, PND165 (1990–2012)



Source: EPA (2014). http://java.epa.gov/castnet/epa_jsp/sites.jsp.

Figure 3.5-3a. Annual sulfur deposition (kg/ha-yr) at Centennial, CNT169 (1990–2012)

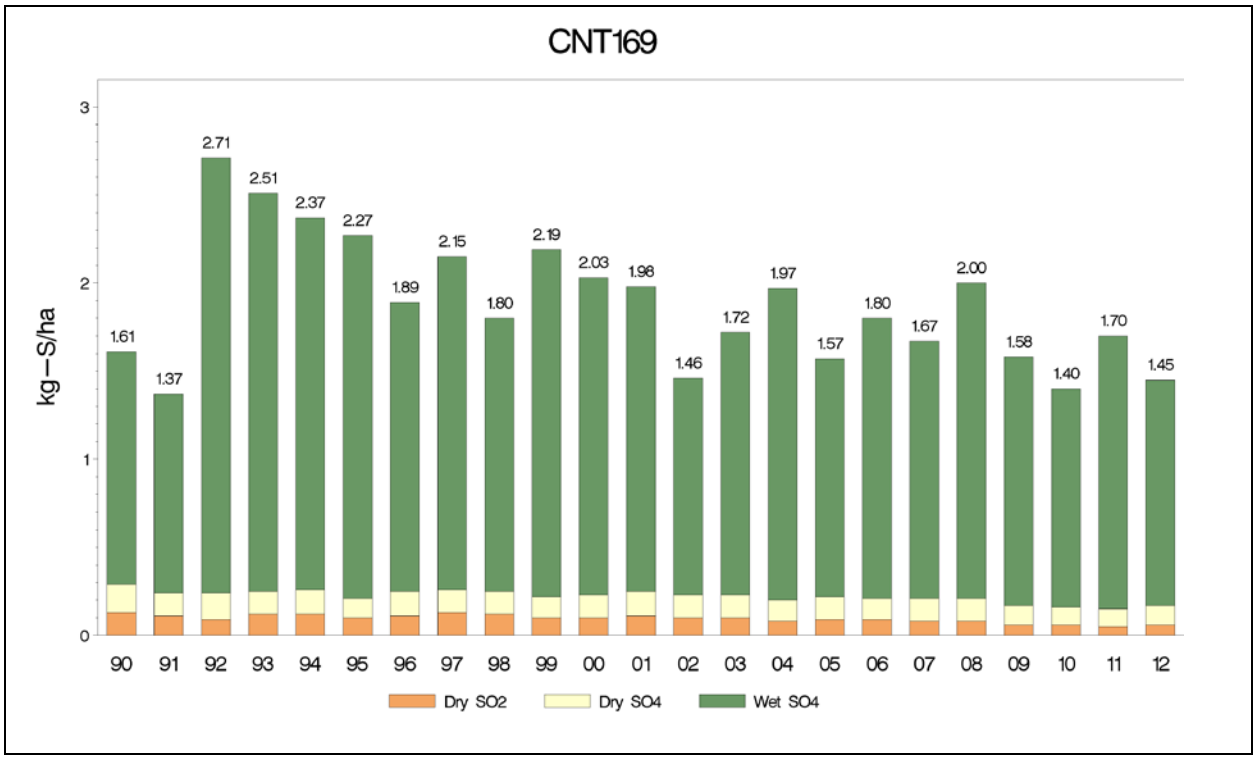
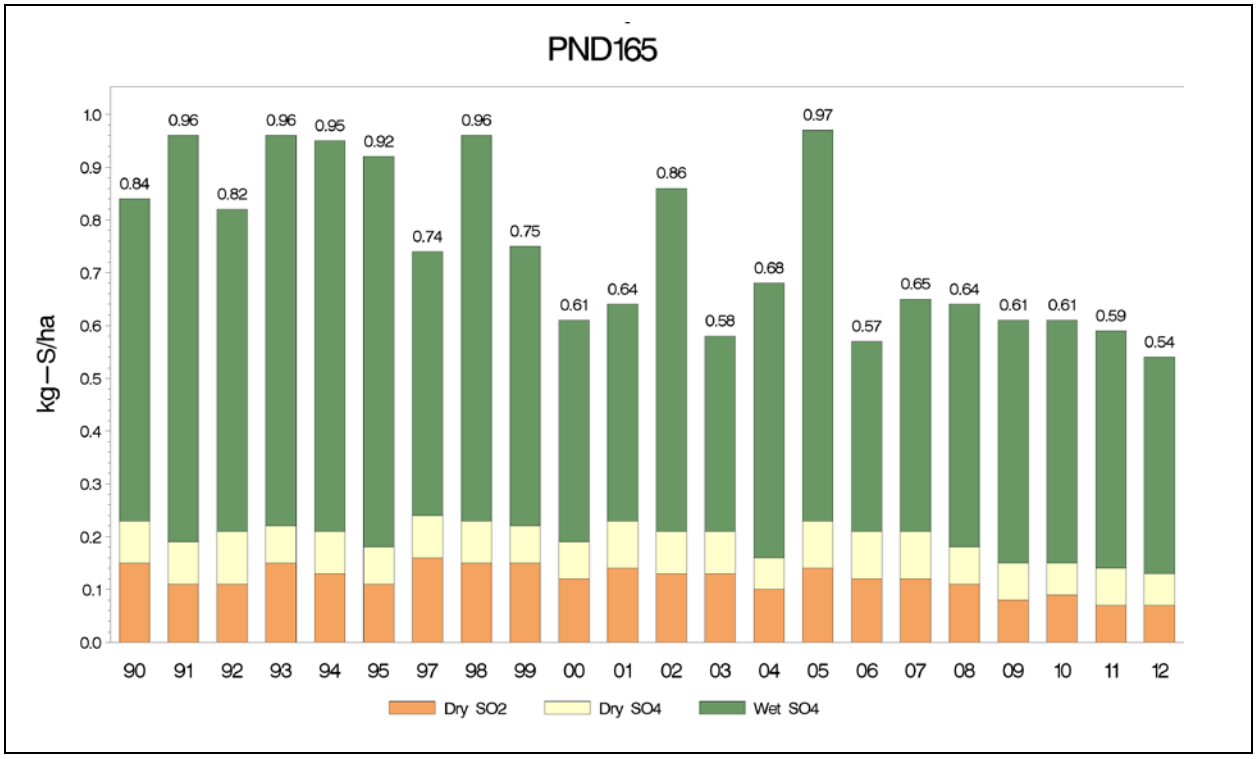


Figure 3.5-3b. Annual sulfur deposition (kg/ha-yr) at Pinedale, PND165 (1990–2012)



Source: EPA 2014c. http://java.epa.gov/castnet/epa_jsp/sites.jsp

3.5.6 Monitored Acid Neutralizing Capacity of Sensitive Lakes

Table 3.5-9 presents a list of 19 lakes within the study area that have been identified as acid sensitive. The most recent lake chemistry background ANC data for these lakes were obtained from the Visibility Information Exchange Web System (VIEWS, 2014b). Following procedures provided by the USFS, the 10th percentile lowest ANC values were calculated and are presented in Table 3.5-9, along with the years for which monitoring data is available and the number of samples used in the calculation. Potential changes in the ANC of the lakes due to atmospheric deposition is assessed by following USFS methodologies.

Of the 19 lakes listed in **Table 3.5-9**, three (Lazy Boy, Upper Frozen, and Upper Ned Wilson) are considered by the USFS as extremely sensitive to atmospheric deposition since the background ANC values are less than 25 µeq/l.

Table 3.5-9. Background ANC values for acid-sensitive lakes

Wilderness Area	Lake	Latitude (Deg-Min-Sec)	Longitude (Deg-Min-Sec)	10th Percentile Lowest ANC Value (µeq/l)	No. of Samples	Monitoring Period
Bridger	Black Joe	42º44'22"	109º10'16"	62.6	78	1984-2009
Bridger	Deep	42º43'9"	109º10'19"	57.7	68	1984-2009
Bridger	Hobbs	43º02'06"	109º40'23"	69.9	80	1984-2009
Bridger	Lazy Boy	43º19'57"	109º43'44"	9.1	5	1997-2009
Bridger	Upper Frozen	42º41'13"	109º09'40"	7.5	12	1997-2009
Eagles Nest	Booth	39º41'55"	106º18'18"	86.8	49	1993-2010
Eagles Nest	Upper Willow	39º38'45"	106º10'29"	134.1	52	1990-2011
Fitzpatrick	Ross	43º23'35"	109º39'29"	53.0	61	1989-2010
Flat Tops	Ned Wilson	39º57'41"	107º19'26"	39.0	191	1981-2007
Flat Tops	Upper Ned Wilson	39º57'46"	107º19'25"	12.9	143	1983-2007
Flat Tops	L. Packtrail Pothole	39º58'5"	107º19'27"	29.7	96	1987-2007
Flat Tops	U. Packtrail Pothole	39º57'56"	107º19'26"	48.7	96	1987-2007
Mount Zirkel	Lake Elbert	40º38'3"	106º42'25"	56.6	67	1985-2007
Mount Zirkel	Seven Lakes	40º53'45"	106º40'55"	36.2	67	1985-2007
Mount Zirkel	Summit Lake	40º32'43"	106º40'55"	48.0	107	1985-2007
Popo Agie	Lower Saddlebag	42º37'24"	108º59'42"	54.6	64	1989-2010
Rawah	Island	40º37'38"	105º56'28"	71.0	30	1995-2010
Rawah	Kelly	40º37'32"	105º57'34"	179.9	30	1995-2010
Rawah	Rawah Lake #4	40º40'16"	105º57'28"	41.3	30	1995-2010

Source: Views (2014b).

■ BIOLOGICAL ENVIRONMENT

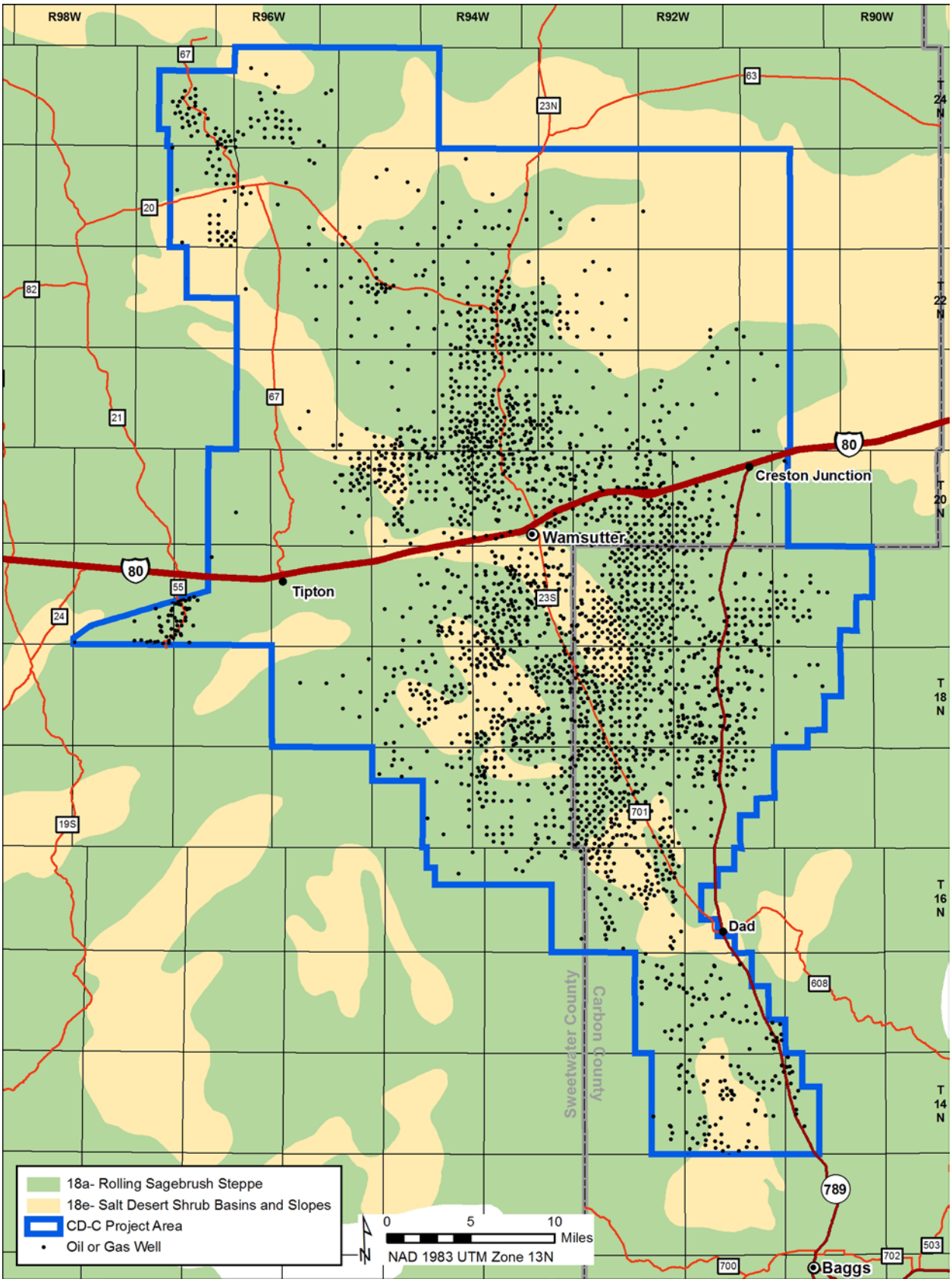
3.6 VEGETATION

3.6.1 Introduction

The CD-C project area is located within the Omernik Level III "Wyoming Basin" Ecoregion 18 (Omernik 1987). This ecoregion is described as a broad intermontane basin dominated by arid grasslands and shrublands and interrupted by high hills and low mountains. Ecoregion 18 is further divided into seven smaller Level IV Ecoregions (18a through 18g) to provide a better description of local diversity within the Wyoming Basin (Chapman *et al*. 2004). Two of these Level IV Ecoregions are present within the project area: 18a (Rolling Sagebrush Steppe) and 18e (Salt Desert Shrub Basins). The approximate boundaries of these two ecoregions within the project area are shown in **Map 3.6-1**.

Ecoregion 18a is described as a semiarid, vast region of rolling plains, alluvial and outwash fans, hills, cuestas (a ridge with a gentle slope on one side and a cliff on the other), mesas, and terraces. Average annual precipitation in this ecoregion ranges from 10–12 inches depending upon elevation and proximity to mountains. The dominant vegetation in this ecoregion is sagebrush (*Artemisia* spp.), often associated with various wheatgrasses (*Agropyron* spp.) or fescue (*Festuca* spp.). Elevation, aridity, slope, aspect, snow accumulation, prevailing winds, and other factors all affect the species composition, morphology, and density of sagebrush communities in the ecoregion. Ecotones between sagebrush steppe and adjacent mountain ecoregions may appear at elevations as high as 9,800 feet (Omernik 1987). The ecoregion is also interspersed with desert shrublands, dunes, and barren area in more arid regions (e.g., Red Desert); and with mixed-grass prairie at the eastern limit of the ecoregion (Knight 1994). Streams originating in the ecoregion are usually incised with a low gradient with fine gravel substrates derived from shales. Small streams are ephemeral or weakly intermittent with sand or platy shale substrates (EPA 2003, 2004).

The Salt Desert Shrub (18e) ecoregion includes disjunct playas and isolated sand dunes. The plains, terraces, and rolling alluvial fans of Ecoregion 18e have soils that tend to be more alkaline and less permeable than soils in the Rolling Sagebrush Steppe (18a). Vegetation is a sparse cover of xeric-adapted species such as shadscale (*A. confertifolia*), greasewood (*Sarcobatus vermiculatus*), and Gardner's saltbush (*Atriplex gardneri*). Areas with stabilized sand dunes are dominated by alkali cordgrass (*Spartina gracilis*), Indian ricegrass (*Achnatherum hymenoides*), blow-out grass (*Redfieldia flexuosa*), alkali wildrye (*Leymus simplex*), and needle-and-thread (*Hesperostipa comata*). This arid region is sensitive to grazing pressure, which may promote the spread of invasive weeds such as Russian thistle (*Salsola kali*), cheatgrass (*Bromus tectorum*), and halogeton (*Halogeton glomeratus*). Land use is primarily rangeland and wildlife habitat (Omernik 1987). Streams are incised and flow into playa areas which are usually seasonal and have high levels of soluble salts (e.g., Chain Lakes area). Substrate is commonly fine-textured material or platy shale gravels (EPA 2003, 2004).



Map 3.6-1. General location of Level IV Ecoregions within the CD-C project area

No warranty is made by the BLM for use of the data for purposes not intended by the BLM.

3.6.2 Primary Cover Types

Native plants in the project area are predominantly drought-tolerant low shrub, grass, and flowering forb species that are generally distributed according to the biological, chemical, and physical properties of the parent soils of the area, as well as elevation, slope, aspect, and water availability.[1]

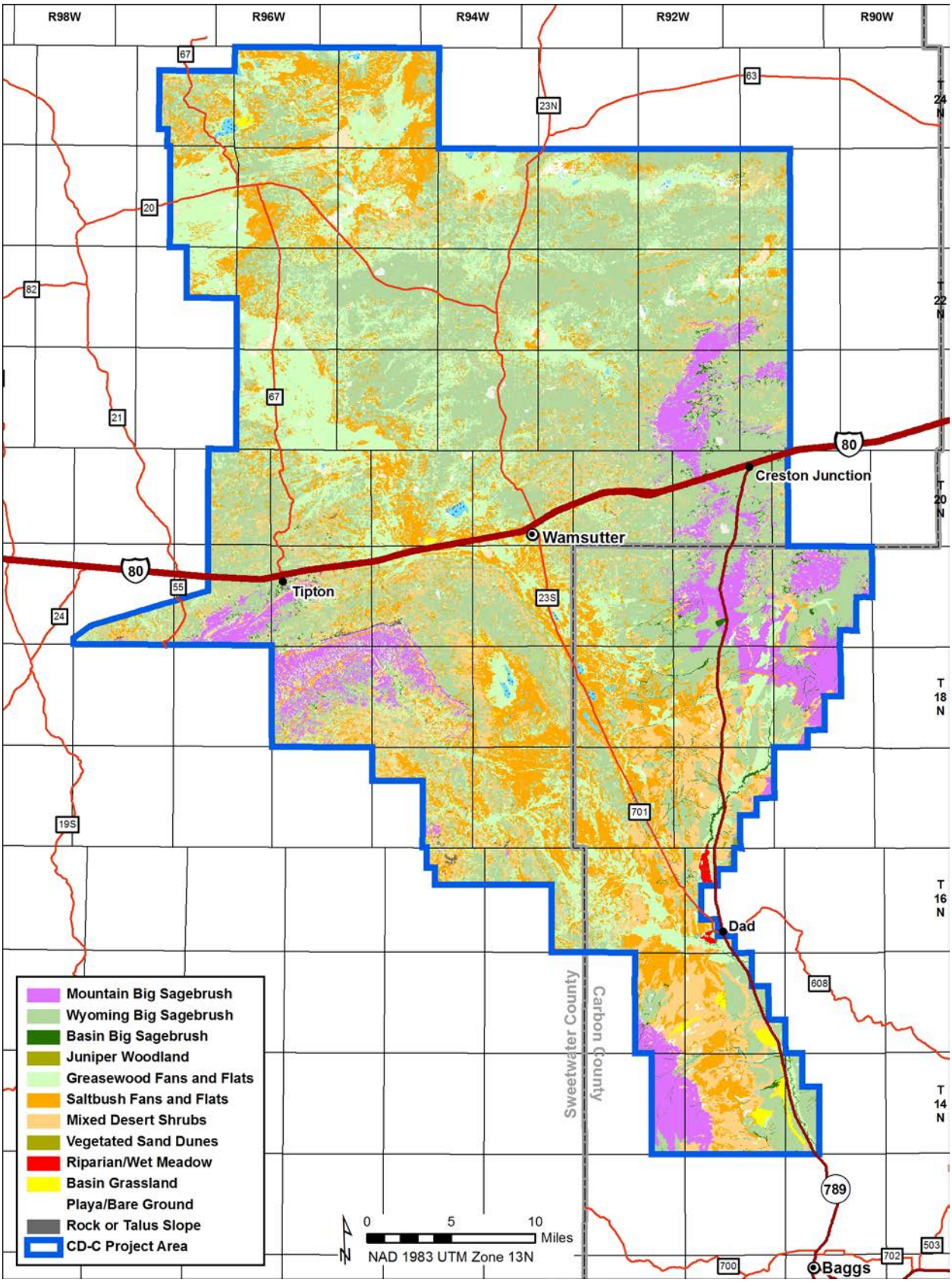
Fourteen primary cover types were identified and classified in the project area using the digitized data that were field-verified throughout the 2007 growing season. Ten of the 14 cover types are vegetation cover types and the remaining four are non-vegetated (bare ground, water, rock or talus slopes, and playas). **Table 3.6-1** shows the Geographic Information System (GIS)-derived acreage of each vegetation and non-vegetated cover type. The distribution of the various cover types on the project area is shown on **Map 3.6-2**.

Table 3.6-1. Primary cover types within the project area

Primary Cover Type	Acres	Percent of Total Project Surface Area
Wyoming Big Sagebrush	417,572.7	39.00
Greasewood flats and fans	246,272.7	23.00
Saltbush flats and fans	172,698.7	16.10
Mixed desert shrub	142,062.6	13.30
Mountain Big Sagebrush	54,605.9	5.10
Basin Big Sagebrush	7,157.1	0.70
Basin grassland	5,122.2	0.50
Bare ground	4,117.5	0.40
Water	2,128.5	0.20
Rock or talus slope	1,033.9	0.10
Riparian/wet meadow	1,003.7	0.10
Juniper woodland	536.0	0.05
Vegetated sand dunes	275.5	0.03
Playa	124.3	0.01

Extended drought conditions throughout southwestern and south-central Wyoming have adversely impacted many native shrub communities and several drought-related die-backs and die-offs are evident throughout the project area. The greatest mortality appears to occur in *Artemisia* species and subspecies that are more adapted to mesic sites, e.g., basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*) (ATT) and mountain big sagebrush (*A.t.* spp. *vaseyana var. vaseyana* and *var. pauciflora*). The majority of shrub mortality appears to be localized within and along the many draws (e.g., Barrel Springs Draw, Red Wash Draw) and ephemeral drainages within the project area that, in a normal precipitation year, retain enough moisture through the summer months to support the water requirements of these taxa. The more xeric-adapted Wyoming big sagebrush (*A.t. wyomingensis*) (ATW) subspecies and Gardner's saltbush communities have been least affected. However, many ATW plants exhibit individual stem death which is common for this subspecies under severe moisture stress (Fisser 1987). Seed production of ATW and Gardner's saltbush has been minimal over the past several years as a result of drought stress. Plant mortality is also evident in several greasewood and shadscale stands in the southern portion of the project area (e.g., south of I-80).

[1] The baseline data for the primary vegetation cover types were provided by Aero-graphics, Inc. (Salt Lake City, UT). The sub-meter aerial photographs were acquired with a fixed-wing aircraft flying at an altitude of 12,000 feet above ground level during the week of June 19–23, 2006. The aerially-acquired data were digitized and ortho-rectified by Aero-graphics. The final digitized data were processed by Hayden-Wing Associates LLC using ArcGIS® Version 9.1.



Map 3.6-2. Major land cover types within the CD-C project area

No warranty is made by the BLM for use of the data for purposes not intended by the BLM.

3.6.2.1 Mountain Big Sagebrush Cover Type and Subtype Inclusions

In the past, studies have identified *Artemisia tridentata* spp. *vaseyana* as mountain big sagebrush. However, recent investigations (Goodrich *et al*. 1999, Tart and Winward 1996) recognize two varieties of this subspecies, *vaseyana* and *pauciflora*. Numerous field investigations by Hayden-Wing Associates LLC (HWA) throughout Wyoming have found these two varieties are similar in growth form and are usually intermixed in the same habitat. Therefore, in the project area, these two varieties have been mapped as one type and will be hereafter referred to as mountain big sagebrush (ATVP). ATVP occupies approximately 54,606 acres within the project area, or about 5.1 percent of the project's total land surface area (**Table 3.6-1**).

Throughout the Intermountain West, ATVP is found at elevations from 3,500–9,800 feet and occurs from foothills to subalpine zones. Annual precipitation in these zones ranges from 12–30 inches. Soils on which mountain big sagebrush grows range from slightly acid to slightly alkaline and are generally well-drained. Soil moisture is usually favorable throughout the growing season. A large number of grass, forb, and shrub species grow in association with this shrub and usually produce an abundance of forage. Open stands with good, diverse understory are essential to Sage-Grouse (*Centrocercus urophasianus*), and such sites can be used in treatment projects to maintain sufficient shrub density and cover for Sage-Grouse.

The lower-elevation range of ATVP on the project area is about 6,500–6,800 feet. ATVP plant density (stems per unit area) increases and plant form becomes more robust at about 6,900 feet. These attributes are more noticeable on the leeward side of north/south-oriented ridgelines and hogbacks where topographic features are favorable for extensive snow deposition and retention. The more robust stands appear to be closely associated with the higher elevations along the west rim of the Continental Divide which bisects the project area near Wamsutter, and in the Flat Top Mountain complex in the southern portion of the project area.

The southern and southwestern portions of the project area include the Flat Top Mountain complex and Robbers Gulch areas, where higher elevations and a greater moisture regime provide suitable habitats for ATVP and mountain mixed-shrub communities. North Flat Top Mountain in the NW ¼ Section 2, T14N: R93W is the highest topographic feature in the project area with an altitude of 7,822 feet. It is at these greater elevations with deeper soils that ATVP can grow to over 40 inches tall and become so dense that it is difficult to walk through the stand.

Common grass species associated with the ATVP cover type include:

- Bluebunch wheatgrass (*Pseudoroegneria spicata*)
- Bottlebrush squirreltail (*Elymus elymoides*)
- Green needlegrass (*Nassella viridula*)
- Idaho fescue *(Festuca idahoensis)*
- Little bluegrass (*Poa secunda*)
- Mutton bluegrass (*Poa fendleriana*)
- Needle-and-thread (*Hesperostipa comata*)
- Oniongrass (Melica bulbosa)
- Prairie junegrass (*Koeleria cristata*)
- Spike fescue (*Leucopa kingii*)
- Thickspike wheatgrass (*Elymus macrourus*)

Common understory shrubs may include green (Douglas) rabbitbrush (*Chrysothamnus viscidiflorus*), gray (rubber) rabbitbrush (*Ericameria nauseosa*), and snowberry (*Symphoricarpus oreophilus*), with lesser densities of antelope bitterbrush (*Purshia tridentata*) and serviceberry (*Amelanchier alnifolia*). The increased average annual precipitation at these ATVP sites provides suitable habitat for a diverse and abundant forb component. Frequently observed forb species include the following:

- Arrowleaf balsamroot (*Balsamorhiza sagittata*)
- Beardtongue (*Penstemon* spp.)
- Bluebells (*Mertensia* spp.)
- False dandelion (*Agoseris glauca*)
- Geranium *(Geranium richardsonii)*
- Groundsel (*Senicio* spp.)
- Indian paintbrush (*Castilleja* spp.)

- Phlox *(Phlox multiflora)*
- Sego lily *(Calochortus nuttallianum)*
- Silky lupine (*Lupinus sericeus*)
- Sulphur buckwheat (*Eriogonum umbellatum*)
- Wild onion (*Allium* spp.)

The mixed mountain-shrub cover type is similar to the mountain big sagebrush described above, with the distinction that mountain-shrub species must comprise 5 percent or more of the canopy cover to be classified as a mixed mountain-shrub cover type. Mixed mountain-shrubs occur in the Flat Top Mountain complex, especially on the north and east aspects, but ATVP is the dominant shrub species at all these locations.

Chemical treatment of late successional, dense stands of ATVP in the project area has been conducted by the RFO to reduce sagebrush density and increase herbaceous production. Thinning of ATVP with low rates of the herbicide tebuthiuron has been demonstrated to enhance herbaceous plant production, community structure, ecosystem functioning, and biodiversity (Olson and Whitson 2002). The concept of sagebrush "thinning" was developed at the University of Wyoming and has been shown to have broad applications in rangeland environments, including restoration projects.

Wildfires and prescribed fires both occur in the ATVP cover type. Mountain big sagebrush is highly susceptible to injury from fire, and plants are readily killed in all seasons, even by light-severity fires (Blaisdell 1953, Blaisdell *et al*. 1982, Neuenschwander 1980). Lesica *et al*. (2007) examined 38 sites in southwestern Montana and found that average post-fire time to full recovery for mountain big sagebrush was about 32 years. Monitoring of prescribed burns of ATVP with rest or deferment after burning in the RFO indicates sagebrush recovery may take up to 50 years to reach pre-burn levels (Warren 2004).

3.6.2.2 Wyoming Big Sagebrush Cover Type and Subtype Inclusions

Wyoming big sagebrush (ATW) is the dominant vegetation cover type in the project area and occupies approximately 417,572 acres or about 39 percent of the project's total land surface area (**Table 3.6-1**). The ATW subspecies can be found throughout the Intermountain West on xeric sites, foothills, valleys, and mesas between 2,500 and 7,000 feet. Annual precipitation in these zones varies from 7–15 inches. Soils on which ATW occur are usually well-drained, gravelly to stony, and may have low water-holding capacity. Soils are shallow, usually less than about 18 inches deep. Fewer herbaceous species are associated with Wyoming big sagebrush than with ATT or ATVP. Native bunchgrasses are often important understory species in ATW communities.

ATW occurs in a great variety of vegetation communities and associations. Since the plants are almost totally dependent upon moisture received through infiltration and percolation of snow or rain water, their size and productivity responds as a direct result to moisture availability as influenced by soil, chemical, or other site criteria. The ATW communities with vigorous and productive plants are often located in depressions/swales protected from wind. These sites have relatively deep and porous soil. Open, wind-blown sites normally have a thin, A Horizon topsoil layer. The plants are sparse, small in stature, and exhibit limited productivity. Fisser (1972) identified three recognizable ATW sub-community classifications based on obvious plant heights:

1. Arid – average height about 10–12 inches;
2. Intermediate – average height about 12–18 inches; and
3. Mesic – average height about 18–24 inches.

Healthy and vigorous ATW plants located in ideal growing sites can attain a height of 40 inches.

An estimate of the elevation range for ATW in the project area indicates it is the dominant sagebrush subspecies below an elevation of about 6,500 feet. This elevation is about the same as the lower-elevation limit of ATVP. Therefore, it becomes apparent that in most cases, the transition zone between these two

taxa is not well-defined and may occur over a distance of several miles depending mainly on parent-soil characteristics, snow-deposition patterns, slope, and aspect.

The most common grasses associated with the ATW cover type include the following:

- Bottlebrush squirreltail
- Indian ricegrass *(Achnatherum hymenoides)*
- Little bluegrass
- Needle-and-thread
- Thickspike wheatgrass
- Western wheatgrass (*Pascopyrum smithii*)
- Threadleaf sedge (*Carex filifolia*)

Other shrubs often associated with this cover type are typically as follows:

- Broom snakeweed *(Gutierrezia sarothrae)*
- Cotton horsebrush (*Tetradymia canescens*)
- Gray rabbitbrush
- Green rabbitbrush
- Shadscale
- Spiny hopsage (*Grayia spinosa*)
- Plains prickly-pear cactus (*Polyacantha opuntia*)
- Winterfat *(Krascheninnikovia lanata)*

Forbs are less common than in other sagebrush communities due to the more arid environment. However, the most frequently observed species include the following:

- Beardtongue (*Penstemon* spp.)
- Goldenweed (*Happlopappus* ssp.)
- Hood's phlox (*Phlox hoodii*)
- Hollyleaf clover *(Trifolium gymnocarpum)*
- Hooker's sandwort (*Arenaria hookeri*)
- Locoweeds (*Oxytropis* spp.)
- Long-leaf phlox (*Phlox longiloba*)
- Low buckwheat *(Erigonum ovalifolium)*
- Spring parsley (*Cymopterus acaulis*)
- Wild onion (*Allium* spp.)

An *Artemisia* taxon closely related to ATW (Winward 1991a) was identified north of the Chain Lake Flats area. This currently undescribed taxon is tentatively known as Gosiute big sagebrush and is thought to be a hybrid between ATW and ATV var. *pauciflora* (Winward 1999). The distribution of this hybrid *Artemisia* is believed to be closely associated with the shoreline soils of the ancient paleolake Gosiute in Wyoming (Winward 1999). A map of the approximate shoreline of Lake Gosiute during the Eocene (Dyni 1996) indicates the eastern extent of its shoreline was approximately near Creston Junction and extended northwest into Sweetwater County, crossing the Chain Lakes area. At its maximum extent, Lake Gosiute covered about 15,000 square miles (Dyni 1996). Gosiute big sagebrush has many unique characteristics that are described more fully by Bennett (2004).

On gravelly to rocky, shallow sites, both bluebunch wheatgrass and black sagebrush (*A. nova*) are found in addition to a greater density of cushion plants. This subtype inclusion may be observed at certain locations along Red Creek Road in the northern portion of the project area. The black sagebrush present is the light form of the genus. Other sub-type inclusions in the ATW cover type include small, open areas dominated by bud sagebrush (*Picrothamnus desertorum*) such as that found on the plateau area north of Lost Creek Basin. The most diverse ATW sub-type inclusions observed are associated with the many small, stabilized sand dunes that occur in the western and northern portions of the project area. These dunes are associated with similar dunes found in the Sand Hills, Ferris Mountains, and the Killpecker Sand Dune areas. When the dune is oriented perpendicular to the westerly winter wind, it is not uncommon to observe arid-adapted species such as ATW, spiny hopsage, and prickly-pear cactus on the western aspect of the dune slope and mesic forms such as basin big sagebrush and greasewood on the leeward side where snow deposition provides greater water availability. The dune sites with the greatest vegetation diversity occur near the south shore of the several small lakes in the Chain Lakes area where it is not uncommon to observe budsage, ATW, Wood's rose, shadscale, spiny hopsage, fringed sage (*A. filifolia*), greasewood, and green rabbitbrush growing together, intermixed with grasses and forbs in a very small area.

The value of ATW as an important winter browse species cannot be overemphasized. Mule deer preference for sagebrush species as winter forage is well-documented (Sheehy and Winward 1981, Wambolt 2004). Nelson *et al*. (1994) found that in the Baggs Habitat Unit ATW comprised approximately 74 percent of the total winter diet of mule deer. DeBolt (2000) found ATW made up more than 70 percent of mule deer diets on winter ranges west of WY 789. ATW is also an important food item for Greater Sage-Grouse and taller stands have been shown to serve as severe winter relief habitat for these birds during winters of record-breaking snowfall such as occurred during the winter of 2000–01 (HWA 2004) and 2010–11 (WRCC 2014).

The sagebrush "thinning" concept discussed in the mountain big sagebrush sub-section (**3.6.2.1**) has also been employed by the RFO to reduce ATW density and increase herbaceous production in the Tipton and Flat Top areas of the CD-C project area.

Wildfire is not common in the ATW cover type due to the low quantity of fine fuels in the shrub's interspaces that can support and carry a fire. However, in extreme weather conditions (e.g., low humidity, high temperatures, and strong winds) such as was common during the 2000 fire season, fire was observed to carry rapidly through a sparse ATW stand west of Medicine Bow, Wyoming (Bennett 2004).

Following fire or other major disturbance, herbaceous species will dominate the treatment site and recovery to 20 percent canopy cover may take more than 40 years (Young and Evans 1989, Winward 1991b). Site reestablishment is by seed bank, seed production from remnant plants, and seeds from adjacent plants outside of the burn area. Discontinuity of fuels in ATW communities usually results in mosaic burn patterns, leaving remnant plants for seed (Bushey 1987). Overall fire return intervals in ATW appear to have ranged from 10 to 240 years or more (Winward 1991b, Bunting *et al*. 1987, Young and Evans 1989). Reviewers for the Rapid Assessment Reference Condition Model component of the LANDFIRE project (http://www.landfire.gov) have stated that mean fire return intervals in the ATW vegetation group of 90 to 140 years were probably realistic (Schmidt *et al*. 2002).

3.6.2.3 Basin Big Sagebrush Cover Type

Basin big sagebrush (ATT) occupies approximately 7,157 acres within the project area or about 0.7 percent of the project's total land surface area (**Table 3.6-1**). ATT typically occurs on the deeper, well-drained soils usually found along ephemeral and intermittent drainages, floodplains, and leeward slopes where water availability is greater than on adjacent uplands. It is often co-dominant with greasewood at certain sites and may occur as small inclusions in the ATW and ATVP cover types. Bennett (2004) found that heights of ATT are a good measure of site suitability. More arid sites produce plants that average about 23 inches in height, intermediate sites about 29 inches and mesic sites greater than 62 inches. At ideal sites such as found along the Muddy Creek drainage, ATT often grows to 10 feet in height, and plants attaining 13 feet in height have been recorded along the Green River in Sublette County (Bennett 2004). Palatability of ATT is generally considered lower than ATW (Rosentreter 2005). This phenomenon was observed by the Rawlins BLM staff during the harsh winter of 1983–84 in the Muddy Creek area. They found that mule deer use of ATW was severe compared to marginal use of ATT, even though animals were starving and winter mortality reached 50 percent in some Herd Units (Warren 2004).

Common understory species in the ATT cover type include the following:

- Aster
- Basin wildrye (*Leymus cinereus*)
- Bluebell
- Buttercup
- False dandelion
- Golden currant (*Ribes aureum*)
- Gray rabbitbrush
- Green rabbitbrush
- Kentucky bluegrass (*Poa pratensis*)
- Little bluegrass
- Locoweed
- Lupine
- Louisiana sagewort (*A. ludovicianna*)
- Povertyweed (*Iva axillaris*)
- Snowberry
- Thickspike wheatgrass
- Violet
- Wild onion
- Wood's rose (*Rosa woodsii*)

Wildfires and prescribed burns both occur in this cover type. Where other species are uncommon or without post-burn grazing management, sagebrush cover may return to pre-treatment levels in 15–20 years. However, monitoring of prescribed burns with rest or deferment after treatment indicate ATT recovery may take up to 50 years to attain pre-treatment levels.

The recent prolonged drought in south-central Wyoming has had a severe effect on ATT. The majority of the sagebrush die-backs and die-offs observed at present in the project area occur in ATT and ATVP stands, both of which depend on perennial mesic conditions for growth, reproduction, and survival. The heaviest mortality has been observed to occur along ephemeral channels in heavier soils where water availability is usually good to excellent in normal years. The most robust plants are currently associated with higher-elevation sandy loam soils on the leeward (usually east) side of slopes where snowdrifts accumulate, thereby increasing water availability. The same beneficial effect can be seen on the leeward side of the many snow fences in the project area, especially along I-80 and WY 789.

3.6.2.4 Juniper Woodland Cover Type

The juniper woodland cover type occupies about 536 acres of the project area or about 0.05 percent of the project's total land surface area (**Table 3.6-1**). Utah juniper (*Juniperus osteosperma*) is the dominant tree within this cover type. The preferred habitat of Utah juniper is usually associated with shallow, rocky soil with a fractured rock substrate, where the tree can root down to and take advantage of collected water. Juniper will also encroach into adjacent sagebrush stands. This can be seen west of the Bluffs in the extreme southern end of the project area, north of Baggs along the west side of WY 789. In April 2007, several hundred mule deer were seen daily on the cuesta west of the bluffs. They appeared to be using the tree area for bedding and thermal cover during the day and then trailing down the slopes to the Muddy Creek drainage for food and water at night. The dominant sagebrush taxon on the cuesta is ATVP, which is ranked as more palatable than ATW and ATT (Rosentreter 2005).

Common understory species associated with this cover type include the following:

- Beardtongue
- Bitterbrush
- Black sagebrush
- Bluebunch wheatgrass
- Canby bluegrass (*Poa canbyi*)
- Goldenweed
- Groundsel
- Indian ricegrass
- Little bluegrass
- Miner's candle (*Cryptantha* ssp.)
- Phlox
- Twin bladderpod (*Physaria* ssp.)

When stands of Utah juniper become too dense, the understory of native grasses and forbs dies out and is usually replaced by invasive species such as downy brome (*Bromus tectorum*) and annual forbs. Fire can be a useful tool in reducing juniper overstory and maintaining understory cover and composition. Where the understory is too sparse to carry a fire, some form of mechanical treatment may be required to restore species diversity. A great number of Utah juniper in this area were logged to produce charcoal for the Union Pacific Railroad smelters in Rawlins in the 1870s–80s (Bennett 2004).

3.6.2.5 Greasewood Flats and Fans

The greasewood cover type occupies approximately 246,273 acres within the project area or about 23 percent of the project's total land surface area (**Table 3.6-1**). Greasewood is a native, deciduous perennial shrub and can attain heights of 8 feet under ideal growing conditions.

Greasewood inhabits a wide range of plant communities within the project area. Plants are typically found growing in saline soils that can be quite moist (wet saline meadows) to dry uplands. Greasewood is often the dominant species in the plant community, but plants are also found associated with saltbush, saltgrass, shadscale, and ATT and ATW sagebrush communities. Ideal habitat for greasewood within the project area is often located on saline valley bottoms (e.g., Muddy Creek floodplain) and on salt-bearing shale outcrops in canyons and on foothills. Sites vary with respect to soil texture and availability of groundwater. Some sites are wet with high water tables, and others are dry with well-drained soils. Greasewood occurs in the project area as smaller, mixed stands to large, monotypic stands. The latter were observed in several large saline basins located in the northern portion of the project area (e.g. Lost Creek and Red Desert Basins). Greasewood can be found at all elevations of the project area. It often encroaches into the big sagebrush and saltbush cover types, especially where additional moisture is available, such as on the many vegetated sand dunes in the southwestern portion of the project area (e.g., north of Mexican Flats).

Greasewood is the dominant shrub associated with the large, vegetated sand-dune complex extending west to east across the northern portion of the area. The most extensive vegetated dune complex is located in T23N:R97W and T23N:R96W. Within this complex, several active dunes are also present. The established greasewood in this sandy area serve as a valuable soil stabilizer by decreasing wind and water erosion. Black greasewood is also the dominant shrub species in the Chain Lakes region in the northern portion of the project area. An unusual greasewood growth form was observed in the vicinity of the several small lakes in this area. The usual upright stature of the plant has been replaced by a low, prostrate, spreading form which rarely exceeds 10–12 inches in height. It is unknown at the present time if this is an ecotypic adaptation or if the plants represent a different subspecies. Greasewood distribution and abundance in the southern portion of the project area is greatest along portions of the Muddy Creek floodplain corridor and in a large, flat basin immediately north of the Mexican Flats area.

The palatability of greasewood in Wyoming is reported as fair for cattle, domestic sheep, horses, pronghorn, mule deer, and small mammals, and as poor for elk, white-tailed deer, small non-game birds and waterfowl (Dittberner & Olson 1983). Poisonous oxalates, found in the leaves, have caused mortality in sheep. Cattle are rarely poisoned, but spines are reported to puncture the rumen (the first chamber of the alimentary canal). Greasewood understory composition is not as diverse as in the big sagebrush cover types.

Common understory species in the black greasewood cover type include the following:

- Basin wildrye
- Biscuitroot
- Bottlebrush squirreltail
- Gardner's saltbush
- Inland saltgrass (*Distichlis spicata*)
- Little bluegrass
- Western wheatgrass
- Wild onion

3.6.2.6 Saltbush Flats and Fans and Sub-type Inclusions

Gardner's saltbush (saltbush) is a native, spreading, low-growing, evergreen perennial sub-shrub and grows from 8–20 inches in height (McArthur *et al*. 1978). Saltbush is the third-largest primary cover type of the project area following the ATW and black greasewood cover types at 172,699 acres or about 16 percent of the project's total land surface area (**Table 3.6-1**).

This cover type is found on saline soils in small to large openings or can occur as "stringer" inclusions within the ATW or greasewood primary cover types. These saltbush stands are sparsely vegetated and

bare soil often exceeds 60 percent of the total ground cover. Average vegetative stem height of saltbush in the project area ranges from 4–10 inches but several robust plants in the 16- to 18-inch range were observed south of the Chain Lakes area along Riner Road. Saltbush reproductive stems were observed to be particularly abundant during the 2007 growing season at all sites within the project area.

The largest monotypic saltbush communities within the project area are located in the Mexican Flats area. However, the northern portion of the project area also contains several sizable communities, and mountain plovers (*Charadrius montanus*) were observed at all locations where this cover type was dominant. The most common sub-type inclusion in this cover type is birdfoot sagebrush (*A. pedifidita*) which may occur as a pure stand or, more typically, intermixed with the saltbush plants.

The persistent leaves of saltbush provide nutritious winter forage for livestock and wildlife species throughout its range (Nord *et al.* 1969). It is particularly important for domestic sheep because it provides the minimum nutritional maintenance requirement for gestating ewes (Fisser & Joyce 1984).

Other common plant species associated with this cover type include the following:

- Biscuitroot
- Western wheatgrass
- Bottlebrush squirreltail
- Little bluegrass
- Indian ricegrass
- Plains prickly-pear cactus
- Threadleaf sedge (most common associate of the project area)
- Wild onion
- Winterfat

Commonly observed inclusions in the saltbush and desert shrub vegetation types are cushion plant communities. Cushion-plant vegetation is found on suitable sites scattered across much of the project area. In the cushion growth form, stems and leaves are densely aggregated near ground level, probably to reduce the stresses of severe environmental conditions (e.g. cold, high winds, desiccation). Cushion-plant vegetation has been divided into two broad categories—alpine and lowland—with completely different species compositions (Knight 1994). The lowland type is found within the project area.

According to Jones (2005), a "cushion-plant" is typically defined as a prostrate, acaulescent (having no stem or only a very short stem), tap-rooted forb that typically grows in a dense mat. Examples can be found in a number of plant families and include *Arenaria hookeri* (Caryophyllaceae), *Astragalus spatulatus* (Fabaceae), *Erigeron composites* (Asteraceae), *Eriogonum acaule* (Polygonaceae), *Draba oligosperma* (Brassicaceae), and *Phlox muscoides* (Polemoniaceae). Cushion-plant vegetation is the short, often sparse vegetation on rims and outcrops formed in resistant bedrock, where cushion plants contribute a major proportion of the plant canopy cover. *Arenaria hookeri* and *Pseudoroegneria spicata* are almost always present in the cushion-plant vegetation and often contribute a substantial amount of the canopy cover. At many sites, these species are joined by *Phlox muscoides* (a cushion plant) as a dominant or co-dominant. Elsewhere, *P. muscoides* is absent, and a number of other cushion plants (*Astragalus spatulatus*, *Astragalus simplicifolius*, *Tetraneuris acaulis*, *Stenotus armerioides*) or non-cushion forbs (especially *Phlox hoodii*) are regularly present and sometimes contribute much of the canopy cover (Jones 2005).

The concept of cushion-plant vegetation usually excludes sparse vegetation dominated by non-cushion forbs or sub-shrubs (such as *Atriplex nuttallii* or *Artemisia pedatifida*) that occurs on soft bedrock. The Wyoming Natural Diversity Database (WYNDD) defines cushion-plant vegetation as vegetation in which cushion-plants are estimated to contribute at least 50 percent of the canopy cover and the grasses and shrubs common in the surrounding shrub-steppe vegetation contributes less than 50 percent of the canopy cover (Jones 2005).

3.6.2.7 Mixed Desert-Shrub

The mixed desert-shrub cover type occupies approximately 142,062 acres on the project area or about 13 percent of the project's total land surface area (**Table 3.6-1**). The mixed desert shrub cover type as

described in this document is a mixture of shrubs and sub-shrubs occurring in dry, saline upland habitats. Shrub cover is often dominated by shadscale but can be a mixture of saltbush, black greasewood and/or desert cushion plants. Several small sites were observed in the northern portion of the project area along Red Creek Road where bud sage (*Picrothamnus desertorum*) is the dominant shrub with plants reaching 10 inches in height with a robust form which is unusual for this species in Wyoming. A herbaceous understory of forbs and grasses is usually present within this cover type and biological soil crusts are usually present on the soil surface. This cover type exhibits three phases including: (1) sites dominated by sagebrush, (2) sites dominated by saline-tolerant shrubs such as greasewood and saltbush, and (3) discontinuous areas devoid of woody shrubs, but with the same herbaceous understory components characteristic of shrub-covered areas. As with the saltbush vegetation cover type, cushion plant communities are often observed in the mixed desert shrub cover type.

Common herbaceous ground-cover species in desert shrub communities include the following:

- Bluebunch wheatgrass
- Buckwheat
- Common yarrow *(Achillea millefolium)*
- Indian paintbrush (*Castilleja* spp.)
- Indian ricegrass
- Needle-and-thread grass
- Plains prickly-pear
- Sandberg bluegrass
- Threadleaf sedge
- Western wheatgrass

In addition to sagebrush, other shrubs commonly observed in this cover type often include the following:

- Gray rabbitbrush
- Green rabbitbrush
- Shadscale
- Spiny hopsage
- Spiny horsebrush

3.6.2.8 Vegetated Sand Dunes

Vegetated sand dunes occupy approximately 276 acres within the project area, or about 0.03 percent of the project's total land surface (**Table 3.6-1**). The largest sand-dune complex in the project area is in the northern portion of the project area and primarily located in T23N:R97W and T23N:R96W in Sweetwater County, north of County Road (CR) 67 and CR 20. Several dunes in this complex are currently active and vegetation is absent. Many smaller, vegetated dune sites are located throughout the west-central portion of the project area west of Dad and near the southern edge of the Chain Lakes area. Greasewood is the dominant shrub on many of these dunes and serves as a valuable soil stabilizer by decreasing wind and water erosion. A recent investigation of the Killpecker sand dune area in southwest Wyoming by Mayer and Mahan (2004) found that the age of eolian sand (15,000 years before present [B.P.]), combined with those of Folsom (12,950–11,950 years B.P.) and Agate Basin artifacts (12,600–10,700 years B.P.) overlying eolian sand, indicates the dune field existed at least during the late Pleistocene.

These unique sites provide micro-environments that allow for greater plant diversity than adjacent upland sites. Steidtmann (1973) found that snow may become incorporated in eolian sand dunes of southwestern Wyoming when snow cornices on dune crests begin to melt, slide down the lee slope, and are covered by sand during subsequent lee-slide deposition. In some cases burial is rapid enough to provide the insulation necessary to preserve the ice and snow within the dune throughout the year. The smaller dunal areas such as those found west of Dad are predominantly oriented perpendicular to the westerly prevailing winter wind, forming natural snow-breaks that trap snow on their leeward side. It is not uncommon to observe ATW (arid form), spiny hopsage, and prickly-pear cactus on the western aspect and ATW (mesic form), ATT, and greasewood on the leeward side of these smaller, stabilized sand dunes.

The small dune sites south of the Chain Lakes complex often occur within other primary cover types (e.g., ATW and saltbush) and form hummocks covered with a diverse shrub and herbaceous understory very different than the surrounding vegetation. At several sites it was observed that a combination of budsage,

ATW, shadscale, spiny hopsage, fringed sage, greasewood, and green rabbitbrush intermixed with grasses and forbs were all occupying these small hummocks.

3.6.2.9 Riparian Cover Types

The riparian/wet-meadow cover type occupies about 1,004 acres on the project area or about 0.10 percent of the project's total land surface area (**Table 3.6-1**). Riparian sites often occur as narrow corridors traversing many different plant zones. Streams and drainages often occupy very small but important sites within major land types. The vegetation and habitat provided by the riparian zone is extremely important to the management of associated lands. Riparian sites attract and sustain livestock and wildlife and are particularly important during the midsummer months. The recent extended drought has concentrated the use of riparian sites by livestock, wildlife, and wild horses—usually with deleterious effects. Since evaluations in 1998-2000 fencing and off-site water development have been installed at many of these sites (BLM 2001).

Riparian communities often provide diversity to otherwise rather barren and exposed wildlands. Riparian habitat within the project area occurs along perennial and intermittent drainages, around seeps and springs, and around man-made reservoirs. Although small in extent, these areas are the most productive of all vegetation types and therefore are extremely important for wildlife habitat and livestock forage.

The major drainage in the southern portion of the project area is Muddy Creek (HUC 14050004). Muddy Creek is described as a high-elevation, cold-desert stream originating in the Sierra Madre Range east of the project area and terminating at its confluence with the Little Snake River near Baggs, Wyoming. Upstream from this confluence, numerous unnamed ephemeral and intermittent channels and named draws flow into Muddy Creek.

The northern portion of the project area generally drains into the Great Divide Basin (HUC 14040200) via Separation Creek. The Great Divide Basin is a closed basin bounded by the Continental Divide on all sides and has no surficial hydrologic outlet (Seaber *et al*. 1987). The Great Divide Basin is a relatively shallow depression with isolated buttes, pan-like depressions, and sparse vegetation. Numerous ephemeral streams flow toward the center of the Basin before disappearing into the soil or man-made impoundments. The Chain Lakes complex is located approximately 32 miles northwest of Rawlins. Two large lakes and several small lakes extend from west to east across the flats. This general area supports Greater Sage-Grouse, migratory waterfowl, and shorebirds, and provides winter habitat for pronghorn. Small bands of wild horses from the Lost Creek Herd Management Area (HMA) are commonly observed in this part of the project area.

Riparian/wetland habitat within the project area can be defined and described in the following groups: desert springs and seeps, and streams supported by them; playa lakebeds; wetlands in the Chain Lakes area; and man-made wetlands around artesian wells. Streams in the area generally flow short distances supporting riparian vegetation before turning into ephemeral/intermittent drainages that do not support riparian vegetation. A good example is Lost Creek which is fed by Eagle's Nest Spring. Riparian conditions exist above the Red Creek Road culvert before the stream disappears underground. However, from the culvert and continuing to Lost Lake, the creek's stream bed is normally dry and its riparian corridor supports mainly greasewood and non-riparian vegetation. The Lost Creek drainage corridor was observed to provide excellent pygmy rabbit habitat and appears to be a major travel route and bedding area for elk from the Red Desert Migratory Elk Herd. Three to seven head of elk were consistently seen in this area during April–May, 2007. The Lost Creek streambed below Eagle's Nest Spring was documented by HWA to contain persistent sepal yellowcress (*Rorippia calcycina*), a BLM-designated Special Status plant species (HWA 2008a).

Riparian grassland habitat types are the most common forms of vegetation found within riparian areas in the project area. Riparian grasslands are wetland-, stream-, or spring-associated grass and grass-like

communities, which are maintained by a water table within rooting depth during most of the growing season. Common species include the following:

- Alkali sacaton *(Sporobolus airoides)*
- Asters
- Baltic rush *(Juncus balticus)*
- Basin wildrye
- Beaked sedge (*C. utriculata*)
- Cinquefoil *(Dasiphora floribunda)*
- Horsetail *(Equisetum arvense)*
- Inland saltgrass (*Distichlis spicata*)
- Kentucky bluegrass
- Liddon sedge (*C. petasata*)
- Mat muhly *(Muhlenbergia richardsonis)*
- Mint (*Mentha* spp.)
- Nebraska sedge (*Carex nebrascensis*)
- Redtop *(Agrostis stolonifera)*
- Spike sedge (*C. nardina*)
- Thistle
- Tufted hairgrass *(Deschampsia caespitosa)*
- Wheatgrass

The majority of the project area consists of ephemeral drainages (washes, draws, gullies) which flow only in response to snowmelt in early spring or as a result of summer precipitation events which are usually of short but intense duration.

The most prominent natural wetland system in the northern portion of the project area is the Chain Lakes complex. These lakes and adjacent habitats support riparian grassland and open aquatic-emergent wetland habitats. Within these alkaline wetlands, the shallow pools where salts accumulate are the harshest growing environment for plants. Plants must tolerate not only standing water in spring, but also dry and extremely alkaline soils in late summer. Stunted, scattered plants of arrowgrass (*Triglochin* spp.), an exceedingly salt-tolerant, grass-like forb, are frequently the sole inhabitants of these highly alkaline depressions. Alkali plantain (*Plantago eriopoda*) and inland saltgrass can survive in less alkaline depressions. Like most halophytes (plants adapted to grow on salty soils) these plants have the ability to accumulate higher concentrations of salts in their cell sap than salt concentrations in the soil water. By concentrating salts, these halophytes can draw soil water into their roots, since water generally flows from areas of low salt concentration to areas of higher salt concentrations

Plant species in these areas are saline/alkali tolerant and may include:

- Alkali plantain
- Alkali saltgrass (*Distichlis stricta*)
- American bulrush *(Schoenoplectus americanus)*
- Arrowgrass
- Baltic rush
- Buttercup
- Cinquefoil (*Potentilla* spp.)
- Greasewood
- Hairy goldaster *(Heterotheca villosa)*
- Nuttal's alkaligrass (*Puccinellia nuttalliana*)
- Rocky Mountain glasswort (*Salicornia rubra*)
- Sea milkwort (*Glaux maritima*)
- Slim sedge *(Carex praegracilis)*
- Tufted hairgrass *(Deschampsia caespitosa)*

The Chain Lakes wetlands also provide habitat for meadow milkvetch (*Astragalus diversifolius* var. *diversifolius*), recently discovered in 2008 by the Wyoming Natural Diversity Database (Heidel 2008). The species has now been documented in three extant occurrences in south-central Wyoming, totaling approximately 8,000 plants within about 187 acres near the Chain Lakes region of the project area (Heidel 2009) and was recently added to the BLM sensitive plant list (BLM 2010) (see **Section 3.9.2.3 Sensitive Plant Species**).

Man-made wetlands and reservoirs occur primarily next to artesian wells and reservoirs or pits. Wetlands supported by artesian wells are mostly composed of sedges, bulrushes, and several grass species. Many

reservoirs and pits in the project area do not hold water on a year-long basis and the perennial drought that began with the 2000 growing season has had negative effects on water-storage capabilities and wetland vegetation health.

An extensive wetland complex known as the George Dew/Red Wash Wetland Complex is located near Dad about 25 miles north of Baggs, west of and adjacent to WY 789. This site encompasses approximately 6 miles of willow-dominated (*Salix* sp.) riparian corridor along Muddy Creek with associated floodplain and meadows ranging from 0.25 to 0.75 mile wide, constructed and natural impoundments, and adjacent upland sites dominated by greasewood, sagebrush, and Gardner saltbush. The George Dew/state land wetlands project is within the Muddy Creek Wetland Complex. The wetland component of this project was designed to protect and enhance about 1,100 acres of existing wetlands and create 125 acres of new wetlands (Wyoming Riparian Association 1997).

3.6.2.10 Basin Grassland

The basin grassland vegetation cover type occupies approximately 5,122 acres within the project area or about 0.5 percent of the project's total land surface area (**Table 3.6-1**). This cover type is found in scattered park-like patches throughout the project area. Shrubs such as the native rabbitbrushes, winterfat, and various sagebrush species and subspecies may be present and may occupy up to 25 percent of the total ground cover. Herbaceous species often include western wheatgrass, blue grama, needle-and-thread, threadleaf sedge, Sandberg bluegrass, and prairie junegrass. Plains prickly-pear is also commonly observed in this cover type.

3.6.2.11 Non-vegetated Cover Type—Bare Ground

Bare ground on the project area accounts for approximately 4,117 acres or about 0.4 percent of the project's total land surface area (**Table 3.6-1**). Bare ground, as defined in this EIS, contains less than 7.5 percent vegetated ground cover. The soils in these relatively low-production areas and underlying parent materials are very soft and highly erosive, and the landscape is cut with a large number of drainage channels. Vegetation, if present in these sites, is sparse and may include various species ranging from stunted shrub forms to scattered bunchgrasses (e.g., Indian ricegrass and needle-and-thread).

3.6.2.12 Non-vegetated Cover Type—Water

This non-vegetated cover type occupies approximately 2,129 acres or about 0.2 percent of the project area (**Table 3.6-1**).

3.6.2.13 Non-vegetated Cover Type—Rock or Talus Slope

This non-vegetated cover type occupies approximately 1,034 acres or about 0.1 percent of the project area (**Table 3.6-1**), and includes naturally occurring areas of bare rock such as canyon cliffs, spires, rock outcrops, and talus fields.

3.6.2.14 Non-vegetated Cover Type—Playa

Playas occupy approximately 124 acres in the project area (**Table 3.6-1**). Playas are characterized as water catchments that are most often ephemeral, sometimes intermittent, drain internally, accumulate sediment, and serve as recharge points to underground aquifers. While playas themselves are usually devoid of vegetation, they are commonly ringed by greasewood, shadscale, saltbush, and other salt-tolerant plants that provide critical winter forage for livestock and other herbivores. In Wyoming, playas, when flooded, are important sources of habitat for wildlife including waterfowl such as ducks and geese, along with sandhill cranes, shorebirds, and amphibians such as frogs, toads, and salamanders. Haukos and Smith (1992) have identified seven orders of invertebrates comprised of 33 families that are closely associated with playa lakes.

In most years playas are dry or water may only cover the lowest portion, the portion near a water source such as a spring, or the portion where an ephemeral stream discharges onto the playa surface. Between wet periods the surface of the playa typically dries out completely and may even become desiccated, forming polygonal cracks and fissures in clay-rich sediments. In playas where the groundwater table is at or near the surface, soluble salts will precipitate, forming ephemeral crusts that may or may not survive subsequent wetting episodes. The high salt and clay content of playa surface mud, and the dry and hot conditions that prevail most of the year, usually prevent plants from becoming established.

3.6.3 Watershed-Based Land Health Assessment

In 2008 the RFO finished conducting Standards and Guidelines Assessments for all the watersheds within the field office. These are watershed-based land health assessments mandated by the Director of the BLM on a 10-year basis. From 1998 through 2000, the RFO conducted Standards and Guidelines Assessments on an allotment basis; however, in 2001 to meet this 10-year timeframe, larger-scale watershed-based reports were undertaken. The Upper Colorado River and the Great Divide Basin were the first two watershed reports completed (2002 and 2003 respectively). The Upper Colorado River Basin was reassessed in 2011 (BLM 2012i) and the Great Divide Basin was reassessed in 2012 (BLM 2013b)Management progress as well as range improvements resulted in substantially meeting standards and guidelines in these watersheds within the CD-C project area. An exception is noted in the Upper Colorado River Basin assessment.

Standard 3, Upland Vegetation, states that "vegetation on each ecological site consists of plant communities appropriate to the site which are resilient, diverse, and able to recover from natural and human disturbance." Standard 3 is considered to be met if plant communities are sustaining themselves under existing conditions and management. The Upper Colorado River Basin assessment found, however, that some aspen stands, although healthier than they appeared ten years ago, still do not meet the standard for vegetation health because of their reduced acreage. In addition, sagebrush, mountain shrub, and juniper plant communities within mule deer CWR between Horse Mountain west to Poison Basin and north along Muddy Creek, still do not meet this standard due to continued encroachment of juniper into shrublands, continued decline in shrub canopy, heavy utilization in mountain shrub communities, and continued low diversity in big sagebrush stands. Portions of this CWR are found in the extreme eastern and southern parts of the CD-C project area. While livestock grazing was found to be a component in the management scenario of these plant communities, it is not the principal factor in non-attainment of this Standard.

3.6.4 Fugitive Dust Effects on Vegetation

The EPA states that the largest single source of fugitive dust in the U.S. is from unpaved roads which contribute about 10 million tons of particulate matter (PM) air pollution each year (EPA 1998). Dust from roads can contain very fine particles known as PM_{10} and $PM_{2.5}$. Ten microns equals about 1/7th the diameter of a human hair. Of greatest concern are the $PM_{2.5}$ particles that make up part of a dust cloud.

Dust deposits on plants can have important effects on plant life. These effects may include (but are not limited to):

- Reduced photosynthesis due to reduced light penetration through the leaf surface. This may cause stunting and/or reduced growth rates and plant vigor.
- Increased incidence of plant pests and disease. Dust deposits can act as a medium for the growth of fungal diseases.
- Reduced efficacy of herbicide sprays due to reduced penetration of the herbicide through the leaf surface.
- Reduced productivity and changes in community structure (the species of plants present) (Farmer 1993).

- Increased leaf temperatures and water loss, with decreasing carbon dioxide uptake (Eller 1977, Hirano *et al.* 1995, Ricks and Williams 1974, Fluckinger *et al*. 1979, Thompson *et al*. 1984).
- Decreased palatability and avoidance by wildlife and livestock.
- Increased tooth wear for herbivores.
- Greater biomass of annual plants within the dust-plume-affected area. Phenological differences (see **Glossary**) among the vascular plants are possibly due to differences in soil temperature on and off the dust-plume area early in the growing season (Spencer and Tinnin 1997).
- Susceptibility of vegetation in proximity to roads to chronic diseases affiliated with photosynthesis and growth, which may eventually lead to accelerated erosion problems from lack of adequate roadside vegetation, reduction in quality and quantity of available browse for livestock and wildlife, and creation of new sites for noxious weed infestations (Gebbhart and Hale 1996).
- Potential contamination of native wildflowers and their blossoms, altering patterns of pollen dispersal (and thus gene flow) among plants by altering the foraging behavior of pollinating insects. This impact could be important in habitats in proximity to unpaved roads occupied by USFWS or BLM Special Status plant species of concern.

GIS analysis of the road system within the project area indicates a total of about 5,736 miles of roads within the project's boundaries. This total includes: about 126 miles of paved roads (mainly I-80 and WY 789), about 2,055 miles of improved maintained exotic (e.g. graveled/rocked) roads, about 86 miles of improved maintained natural (e.g., natural surface) roads, and about 3,469 miles of unimproved, unmaintained natural (e.g., two-track) roads. These totals indicate that the total mileage of paved roads within the project area represents only about 2.2 percent of the total road system. **Section 3.16 Transportation and Access** describes the local and regional transportation network associated with the project area.

The primary factors that generate dust on unpaved roads include (Bolander 1999, Addo and Sanders 1993):

- Vehicle speed
- Number of wheels per vehicle
- Number of vehicles
- Vehicle weight
- Particle size distribution (gradation) of the surface material
- Restraint of the surface fines (compaction, cohesiveness/bonding)
- Durability of the road surface

A 1993 U.S. Department of Transportation study cites a 1983 Forest Service estimate that for every vehicle traveling one mile of unpaved roadway once a day, every day for a year, one ton of dust is deposited along a corridor extending 500 feet on either side of the roadway (Addo and Sanders 1993). In a study conducted in Australia, McCrea (1984) estimated the potential losses in crop productivity for various rates of dust deposition. The main focus of the report was on horticultural crops grown alongside unpaved roads, and in this case the losses occurred within about 656 feet of the source.

To estimate the acreage of the project area that could be affected by road-generated fugitive dust, a GIS-generated mileage total for all improved exotic and improved natural surface roads within the project area was calculated and then buffered on each side of the road centerline by 578 feet to equal the average total width from the above-mentioned studies (1,156 feet). The two-track road mileage was not included in the calculations because of their minimal use. The results indicate that approximately 260,483 acres could be affected by road-generated fugitive dust deposition, or about 24.3 percent of the project's total land-surface area. This total, at any given time, would be dependent upon season of use, the primary factors listed in this section, and weather-related factors, especially the timing and amount of precipitation events (or lack thereof).

3.6.5 Biological Soil Crusts

Biological soil crusts (BSCs), also referred to as cryptogamic, microbiotic, cryptobiotic, and microphytic crusts, are a complex assemblage of organisms including cyanobacteria, green algae, mosses, lichens, microfungi, and other bacteria that colonize the first few millimeters of the soil surface. Soil crusts are found in all hot, cool, and cold arid and semi-arid regions and may constitute up to 70 percent of the living cover in some plant communities (Belnap 1994). The functions of BSCs in rangeland ecosystems include retention of soil moisture by serving as a living mulch on the soil surface, reduction of wind and water erosion, fixing atmospheric nitrogen, and contributing to soil organic matter (Eldridge and Greene 1994).

The primary environmental factors that influence the distribution of BSCs include elevation, precipitation volume, timing of precipitation, physical and chemical properties of the soil, topography, and disturbance regimes (Belnap 2001). The historic and current distribution of BSCs in the project area is largely unknown. However, field work conducted by HWA during May and June of 2007 found soil crusts at several locations within the project area, with moss crusts the most frequently encountered. Moss crusts were found growing within cacti aggregations or underneath shrub canopies, and less frequently in the open plant interspaces. Moss crusts were also observed in several plant communities including those dominated by Wyoming big sagebrush, mountain big sagebrush, saltbush, and greasewood. Cyanobacterial crusts were observed in portions of the project area where the soils were less stable (e.g., sandy areas) or the crusts were re-establishing after disturbance. Lichen crusts were observed less frequently than moss or cyanobacterial crusts. The Creston grazing exclosure within the project area was observed to have a well-established lichen crust, including: *Aspicilia, Caloplaca, Collema, Xanthoparmelia*, and *Psora*. The most common moss was *Tortula*. Crustal development was greatest underneath shrub canopies or on the edges of bunchgrasses and less so in the plant interspaces. The assemblage of species present at this Wyoming big sagebrush site indicates a late-successional stage of crust development. This provides evidence that mature and diverse soil crusts have the potential to occur within the project area, given suitable environmental conditions.

3.7 INVASIVE, NON-NATIVE PLANT SPECIES

Generally, the term “weed” can be used for any unwanted plant. Terms such as aliens, exotics, and invasives are used interchangeably to describe specific weeds. All these descriptions have a common concept: plants introduced into an area in which they did not evolve that have the potential to cause noticeable economic and/or ecological impacts. When weeds become so widespread that they threaten crops, livestock, or native species, they may become more than just a “weed.” They might then be termed “noxious weed,” “invasive species,” “exotic species,” “alien species,” or some similar term as set forth in law by each governing body or land-management agency.

Invasive plant species pose a threat to the long-term productivity, diversity, and aesthetic values of lands within the RFO. Recent extended drought conditions in Wyoming, in conjunction with unprecedented energy development and other construction activities in western Wyoming, have favored the establishment and spread of invasive weed species. This has occurred not only in disturbed habitats, but also in native rangeland where the stress of drought has resulted in decreased vigor, annual production, resilience, and competitive capabilities of native grassland and shrub communities, thus creating an ideal environment for invasion and establishment of aggressive and invasive weedy species.

The principal invasive weeds known to occur in or near, or which have been treated within, the project area include (BLM 2002) Russian knapweed (*Centaurea repens*), houndstongue (*Cynoglossum officinale*), halogeton (*Halogeton glomeratus*), hoary cress (whitetop) (*Cardaria draba* and *Cardaria pubescens*), perennial pepperweed (giant whitetop) (*Lepidium latifolium*), spotted knapweed (*Centaurea maculosa*), common burdock (*Arctium minus*), and saltcedar (*Tamarix* spp.). The primary impact of these

invasive species to the range resource is their ability to out-compete native species; in addition to their competitive nature, Russian knapweed, halogeton, and houndstongue are poisonous to some wildlife and/or some livestock.

Many of these invasive species are associated with disturbed areas such as road/pipeline rights-of-way and well pads. Other common invasive weed species observed in the project area include cheatgrass (*Bromus tectorum*), Russian thistle (*Salsosa kali*), bull thistle (*Cirsium vulgare*), black henbane (*Hyoscyamus niger*), common mullein (*Verbascum thapsus*), clasping pepperweed (*Lepidium perfoliatum*), and kochia (*Kochia scoparia*).

Of the invasive plant species found in the project area, halogeton represents an ecological and economic threat to the area due to its unparalleled rapid infestation and widespread establishment. Prior to the onset of extended drought conditions in Wyoming beginning in 2000, halogeton was present at low densities in southwest and south-central Wyoming but its presence was primarily restricted to range sites degraded over time by heavy livestock concentrations near feed-grounds, corrals, and travel-ways (Whitson et al. 1996, Stubbendieck et al. 1997) or disturbed sites such as the reclaimed Santa Fe Browning gravel pit near Wild Horse Butte (Bennett 2004). Extensive invasive weed surveys conducted by HWA during the 2007 growing season indicated that approximately 13,353 acres, or about 1.2 percent of the surface area of the project area, were infested with halogeton. This is a conservative estimate based upon surveys at specific sites such as well pads and road/pipeline rights-of-way (HWA 2008b).

Although not quantified, the actual surface area infested by halogeton could be greater based on field observations that halogeton spreads laterally from infested road/pipeline rights-of-way into adjoining native rangeland. Observations made during the 2007 growing season, especially along the major north/south-oriented roads (e.g., Wamsutter Road) indicated that the lateral spread of halogeton was usually minimal (± 15–20 feet) on the windward (west) side of the road but could extend as far as 0.25 mile on the leeward side (east) of the road right-of-way. The direction of the prevailing winds during October and November when the plants are in the seed-drop stage is probably the dominant variable that controls dispersal direction. Halogeton seed is extremely light and fluffy and easily transported by even a slight breeze. If the same criteria are used as with fugitive dust impacts (**Section 4.7.3.1**), it is evident that as many as 260,000 total acres of disturbed and native rangeland in the project area may be at risk of infestation with halogeton.

3.8 WILDLIFE

3.8.1 Terrestrial Wildlife

Information concerning current and historical wildlife observations and distribution within and near the CD-C project area were obtained from a variety of sources including BLM, USFWS, WGFD, WYNDD, and information compiled from personal communications and unpublished data from BLM, WGFD, and USFWS biologists. The WGFD Wildlife Observation System and WYNDD are the primary repositories for wildlife information in the state of Wyoming and contain records of wildlife observations for birds, mammals, herptiles (amphibians and reptiles), fish, and species of special concern. Wildlife information for the project area was supplemented with survey data collected by Hayden-Wing Associates, LLC (HWA) during 2006–2007 as part of the baseline and monitoring data requirements for the EIS.

At least 396 wildlife species occur in and around the project area including: 77 mammal, 273 bird, six amphibian, and ten reptile species (**Appendix H**). All wildlife species are important members of a functioning ecosystem and wildlife community, but most are common and have wide distributions in the region. Consequently, the relationships of most of these species to the proposed project are not discussed in the same depth as species that are Threatened, Endangered, rare, of special concern, of special economic interest, or otherwise of high interest or unique value.

3.8.1.1 Wildlife Habitat

A wide variety of wildlife habitats and associated species occur in the project area. Wildlife habitats that would be affected by the project include the areas that would be physically disturbed by the construction of gas wells, related roads, pipelines, and production facilities, as well as zones of influence surrounding them. Zones of influence are defined as those areas surrounding or associated with project activities where impacts to a given species or its habitat could occur. The shape and extent of such zones varies with species and circumstances.

The project area is located in the Wyoming Basin Omernik Level III Ecoregion (18) and includes portions of the Rolling Sagebrush Steppe (18a) and Salt Desert Shrub Basins (18e) Level IV Ecoregions (Chapman *et al*. 2004). Topography in the project area is characterized by rolling plains interrupted by hills and strike-dip ridges dissected by alluvial and outwash fans that empty into broad, level basins. Ridges, hills, and rolling plains support vast areas of mixed-grass prairie and Wyoming, mountain, and basin big sagebrush communities. Active and stabilized sand dunes, as well as disjunct playas and alkaline flats, are interspersed throughout the project area where existing conditions are favorable for their formation. Vegetation communities in the poorly drained, alkaline basins are dominated by arid-land shrubs like greasewood, shadscale, and Gardner's saltbush. Riparian and wetland habitats are scarce and found only at a few locations in the project area. Freshwater wetlands in the northern portion of the project area occur along Riner Road (BLM 3203) in the Chain Lakes area, and along Luman Road (i.e., SCR 20) north of Horseshoe Bend where a flowing well supplies year-round water to an enclosed water impoundment surrounded by emergent vegetation. A few large water impoundments along Muddy Creek create a series of connected semi-permanent wetlands in moist years in the southeastern portion of the project area. Detailed descriptions of vegetation community types within the project area are discussed in **Section 3.6 Vegetation**.

3.8.1.2 Big Game

Three big game species occur in the project area, including pronghorn (*Antilocapra americana*), mule deer (*Odocoileus hemionus*), and elk (*Cervus elaphus*). Big game populations are managed by the WGFD within areas designated as Herd Units (**Maps 3.8-2, 3.8-4, and 3.8-6**). Herd size and viability of big game populations are dependent on the combination, availability, and quality of seasonal ranges, which overlap among species and fulfill different requirements for resident and migratory big game populations. **Table 3.8-1** shows Herd Unit population sizes and parameters within the project area from WGFD Job Completion Reports. Herd population objectives are set by WGFD each year based on a variety of factors including, but not limited to, the carrying capacity of the habitat, weather (e.g. drought), habitat fragmentation, and competition with other ungulates.

The extreme variability in weather affecting wildlife and forage vegetation in the CD-C project area was generalized in the various WGFD Job Completion Reports for herd units listed below, as follows: "Extreme drought occurred in the Green River Basin from 2000–2004, lessened in 2005, and then returned again in 2006 and 2007. Higher-than-normal snowfall during the winter of 2007–2008 increased winter mortality above normal. The winters of 2008–2009 and 2009–2010 were mild and drier than normal and winter mortalities were few. The springs of 2009 and 2010 saw above-average precipitation and seasonable temperatures resulting in above-average forage production." The reports conclude that, "Within the past several years extreme weather conditions, especially winter weather events and extreme drought, have resulted in very poor fawn production and survival in this herd unit, some of the lowest in Wyoming. In 2010–11 moisture levels were at record highs with high snow levels, followed in 2011–12 with record drought conditions and low snow levels (Bitter Creek Pronghorn Herd Unit, WGFD 2013a)."

Table 3.8-1. Big game Herd Unit population parameters within the CD-C project area

Species	Herd Unit (number)	Herd Unit total acreage	Percent within project area	Acreage within project area	Population Trend 2007-20012	Population Estimate 2012	WGFD Population Objective	Fawn:Doe Ratio 2012
Pronghorn	Baggs (438)	890,200	9.2	81,530	Slight increase	8,674	9,000	58:100
	Bitter Creek (414)	183,6992	23.3	428,104	Slight decrease	10,557	25,000	23:100
	Red Desert (615)	2,167,952	25.9	560,439	Decrease	11,081	15,000	42:100
Mule Deer	Baggs (427)	2,142,656	23.8	509,650	Decrease	16,600	18,700	78:100
	Steamboat (430)	2,567,106	13.4	343,863	Decreasing	2,717	4,000	40:100
	Chain Lakes (650)	699,626	30.9	216,560	Decreasing	Not available	500	Not available
Elk	Sierra Madre (425)	363,651	22.7	82,511	Decreasing to meet objective	11,469	4,200	38:100
	Steamboat (426)	2,533,733	13.6	343,765	Decreasing to meet objective	982	1,200	47:100
	Petition (430)	1,838,167	23.3	427,496	Stable	Not available	300	Not available
	Shamrock (643)	699,477	30.9	216,301	Decreasing to meet objective	Not available	75	Not available

Source: WGFD 2013a

Pronghorn are the most abundant big game within the project area. The project area includes portions of five Hunt Areas (53, 55, 57, 60, and 61) and three Herd Units (**Table 3.8-1**; **Map 3.8-1**). All three Herd Units extend beyond the boundary of the CD-C project area, with 26 percent of the Red Desert Herd Unit, 23 percent of the Bitter Creek Herd Unit, and 9 percent of the Baggs Herd Unit acreages contained within the project area. Herd numbers can be affected by several factors including weather events (drought and severe winters), the impacts of excess population numbers (over acceptable management levels) upon habitat, hunting quotas, human disturbance and disruptive activities, habitat fragmentation and disease. Meeting population objectives can depend upon the availability of human resources, the accuracy of wildlife information collected, weather variables, disease, and hunter harvest rates. Refer to **Section 3.12 Recreation** for a detailed discussion of hunting activities. Pronghorn seasonal ranges within the project area include spring/summer/fall (3.3 percent), winter/yearlong (88.3 percent), and crucial winter/yearlong (8.4 percent) (**Table 3.8-2**; **Map 3.8-2**). Although over a dozen pronghorn migratory movements have been documented within the project area, the corridors are broad and poorly defined (**Map 3.8-2**).

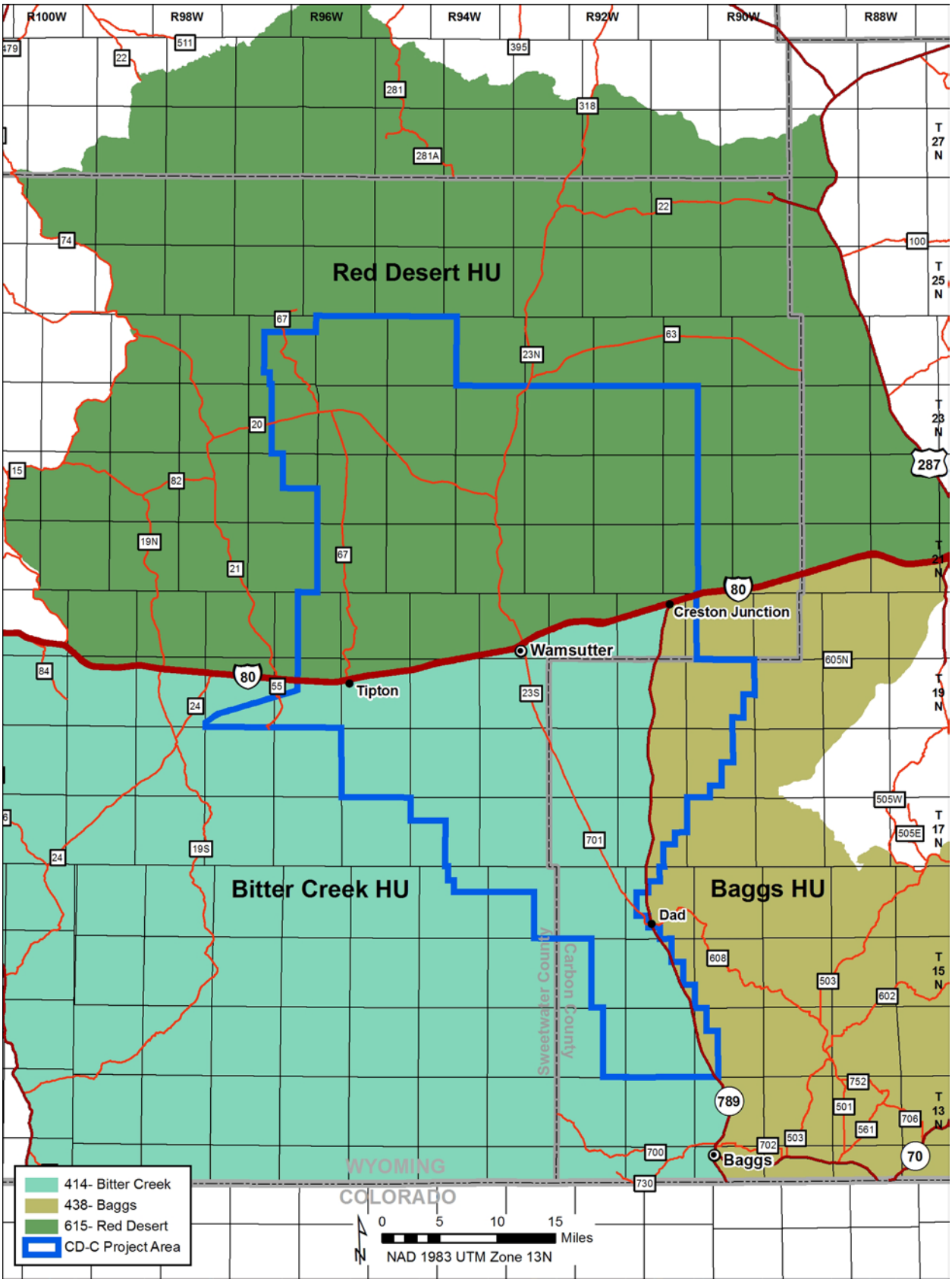
Table 3.8-2. Big game seasonal ranges (acres) within the project area

Species	SEASONAL RANGE[1]							
	CW	CW/Y	W	W/Y	Y	S/S/F	OUT	UND
Pronghorn	--	90,077	--	944,678	--	35,085	--	--
Mule Deer	3,973	13,876	--	491,800	89,039	--	471,385	--
Elk	--	--	26,894	--	64,797	--	550,343	428,039

[1] *Seasonal ranges include: Crucial Winter (CW) and Crucial Winter/Year-long (CW/Y) and describe ranges that have been identified as a determining factor in a population's ability to maintain itself at a specified level (theoretically at or above the population objective) over the long term. Not all habitats within designated CWR are of equal quality. Areas with higher quantity and quality of forage and areas that provide cover from extreme winter weather conditions provide the best-quality CWR habitat. Crucial ranges are typically used 8 out of 10 winters; Winter (W) are used by a substantial number of animals during winter months (December through April; WGFD 2011c); Winter/Year-long (W/Y) ranges are occupied throughout the year but during winter they are used by additional animals that migrate from other seasonal ranges; Year-long (Y) ranges are occupied throughout the year but additional animals do not migrate to this type of seasonal range during winter; Spring/Summer/Fall (S/S/F) ranges are used before and after winter conditions persist; Non-use areas (OUT) contain habitats of limited or no importance to the species; Undetermined use areas (UND) are areas or habitats which are expected to or do support a population or portion of a population of animals, but for which the distribution and importance of the area has not been sufficiently documented to designate a seasonal range.*

Only 16 percent of the crucial winter range[1] (CWR) for the Red Desert, Bitter Creek, and Baggs Herd Units occurs within the project area. In the springs of 2007, 2008 and 2010, a pronghorn CWR habitat assessment was conducted to attempt to define current conditions and identify factors that may be limiting the pronghorn population within the project area. CWR has long been established, and is accepted, as the most limiting factor for overall pronghorn populations within the state of Wyoming. However, several other factors can affect population trends including severe drought, winter severity, hunter harvest, or the impacts of excess individuals (over acceptable management levels) on habitat. For this assessment, the focus was placed on the identified CWRs within the project area which also serve as yearlong habitat for pronghorn. Therefore, an assessment was performed to determine the relative condition of the CWRs as both winter and yearlong range. In coordination with the WGFD, seven locations were identified to conduct the condition-class studies. Standard 100-foot line-intercept transects were used to gather vegetation quality and quantity data. The Extensive Browse method was used to gather utilization, age-class, and form-class information, and density board measurements were used to gather vertical cover and vegetation height estimates. The above data were then analyzed by two separate methods. The first method employed a Habitat Suitability Index model developed in Wyoming specifically for analysis of pronghorn winter ranges (Allen et al. 1984). The second is a BLM-accepted method for analysis of yearlong pronghorn range (BLM 1980). The results from these utilization analyses establish a baseline for future year-to-year comparisons and trends at these sample points (**Table 3.8-3**).

[1] Crucial winter range (CWR) for pronghorn and mule deer includes both crucial winter (CW) and crucial winter/yearlong (CW/Y) ranges.



Map 3.8-1. Pronghorn Herd Units in and around the CD-C project area

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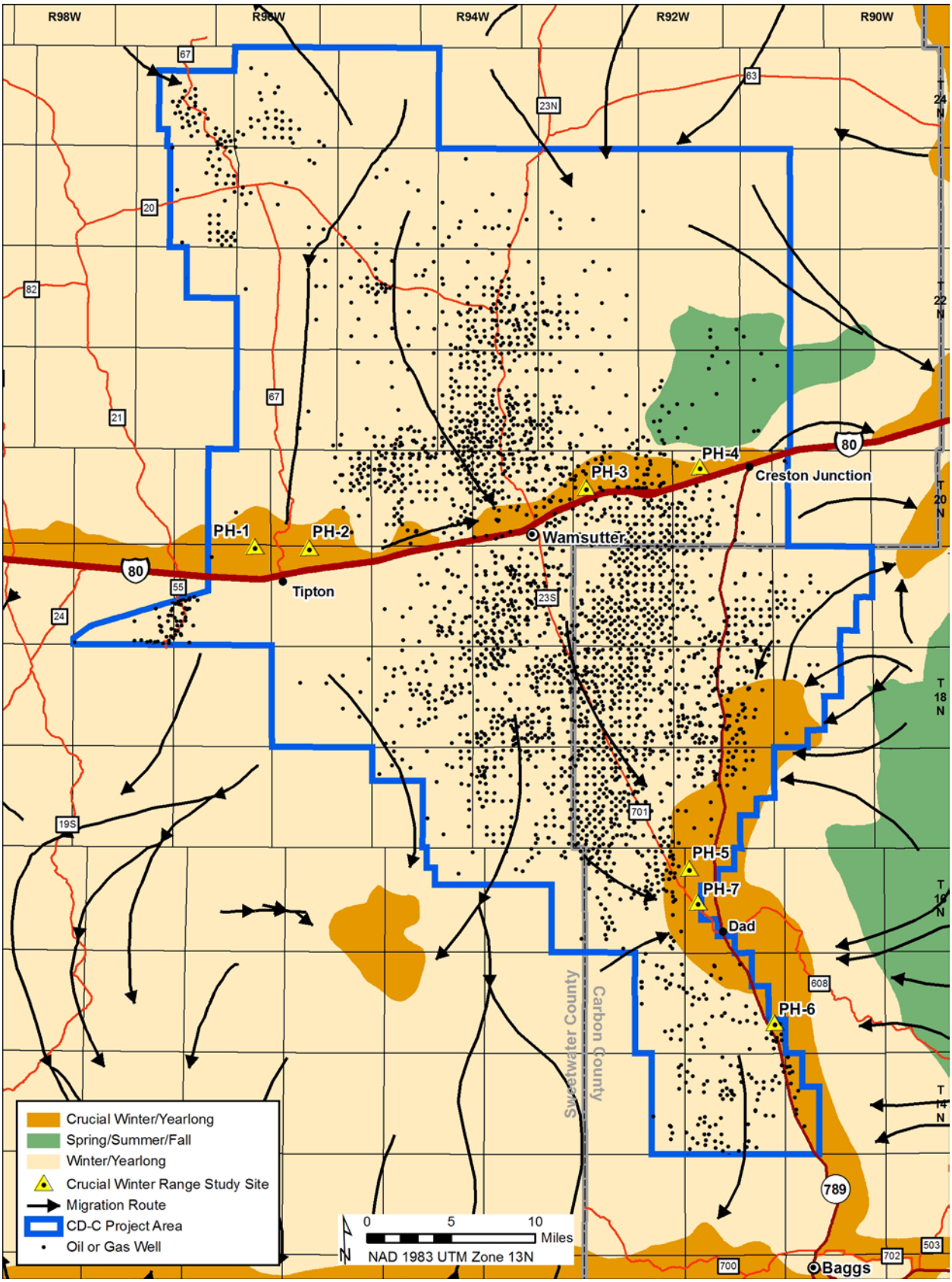

Map 3.8-2. Pronghorn seasonal ranges and migratory movements in and around the CD-C project area

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Table 3.8-3. Pronghorn Crucial Winter Range condition assessment results, 2007, 2008, and 2010

Study site (Map 3.8-2)	Year	Crucial Winter Range Rating[1]	Crucial Winter Range Score [1]
PH-1	2007 2008 2010	Fair Fair Fair	45 33 33
PH-2	2007 2008 2010	Fair Fair NA	32 26 0
PH-3	2007 2008 2010	Fair Fair Poor	30 26 20
PH-4	2007 2008 2010	Fair Fair Fair	43 45 43
PH-5	2007 2008 2010	Fair Fair Fair	30 33 43
PH-6	2007 2008 2010	Poor Poor Fair	24 24 31
PH-7	2007 2008 2010	Poor Fair Fair	19 26 28

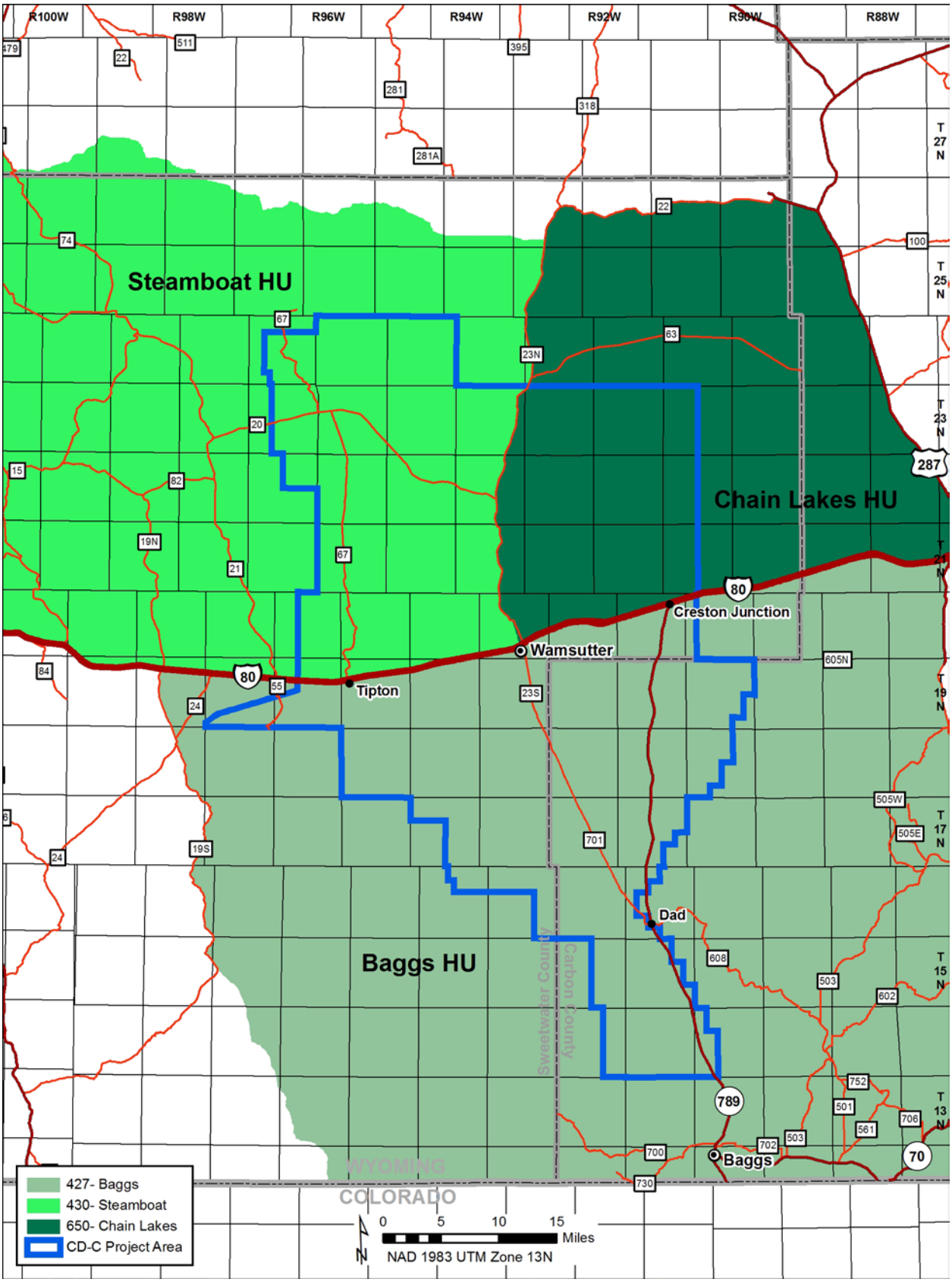
[1] *CWR score is the calculated WFCI (Winter food/cover index) Wyoming pronghorn winter range habitat suitability index, Allen et al. (1984).*
[2] *Fair, poor, and good are all relative ratings as defined by the BLM based on the numerical outcome of the condition assessment.*

The data provided in **Table 3.8-3** indicates conditions of pronghorn CWR are rated as "fair," reflecting the moderate use of mature stands of Wyoming and mountain big sagebrush. In addition, CWRs north of I-80 are experiencing slightly less use than the CWRs along WY 789. That said, the 2012 Red Desert Pronghorn JCR (WGFD 2013a) indicates poor forage conditions, stating, "Body condition of most pronghorn harvested from these areas in 2012 was poor, especially lactating does. Given the poor condition of animals at the end of fall, mortality is expected to be above average during the 2012-13 winter, despite moderate winter conditions."

WGFD personnel have also expressed concern about energy development and fencing affecting pronghorn herd units in the CD-C project area, stating that, "Habitat issues in this herd unit include continued gas field development, coalbed natural gas development, opening of an in-situ uranium mine with other mines proposed and possible development of shale oil. Many miles of sheep-tight fences exist in the herd unit, impeding pronghorn movements and migrations, and increasing losses during severe winters" (Red Desert Pronghorn Herd Unit, WGFD 2013a). The pronghorn CWR within CD-C is already disturbed to a level deemed "High" by WGFD. (Refer to **Section 4.8.1** for a discussion of WGFD impact definitions.)

Mule Deer are common year-round residents within the project area. The project area supports resident and migratory mule deer populations, and includes portions of five Hunt Areas (82, 84, 98, 100, and 131) and three Herd Units (**Table 3.8-1, Map 3.8-3**). Refer to **Section 3.12 Recreation** for a detailed discussion of hunting activities.

The majority of the CD-C is classified as yearlong or winter yearlong habitat for mule deer, with very small areas of crucial and crucial yearlong habitat having been identified in the Baggs Herd Unit, along the southeastern border of the project area. Only 6.3 percent of CWR acreage for the Baggs Herd Unit occurs within CD-C.



Map 3.8-3. Mule Deer Herd Units in and around the CD-C project area

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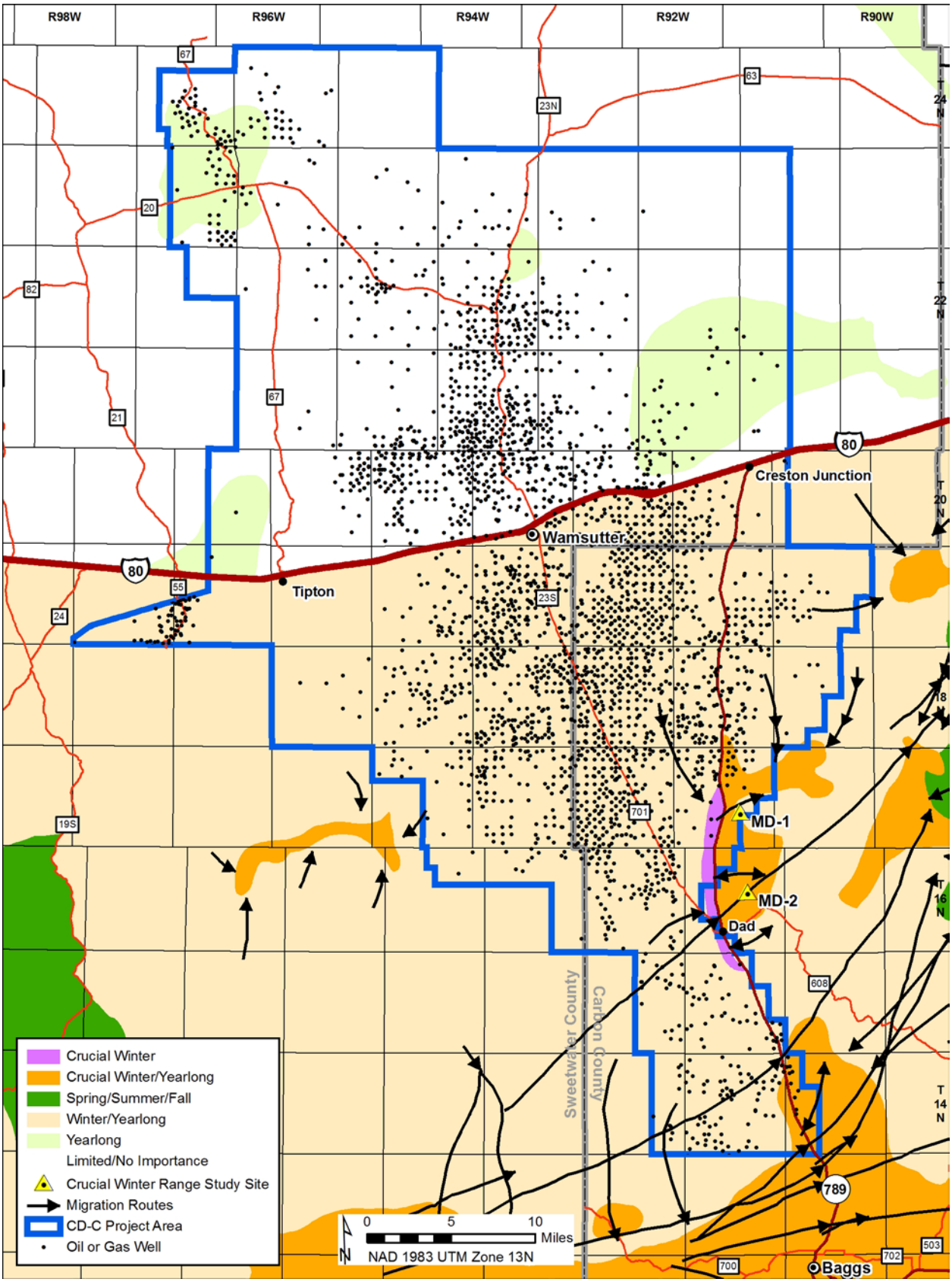

Map 3.8-4. Mule deer seasonal ranges and migratory movements in and around the CD-C project area

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Limited, and somewhat dated, information is available relative to the condition of mule deer preferred forage in the CWR identified within the CD-C (**Map 3.8-4**); information from these two studies is discussed below. Assessments conducted in 2001 determined that mule deer CWR located along and near the far southeastern edge of the project area was not meeting Standard #4 – Wildlife Habitat Health (BLM 2002). Juniper and sagebrush dominance, declining shrub communities, over-browsing of favored shrub species, and low forb composition were some of the habitat concerns cited (BLM 2002). Although this site may not be meeting the standard, broader areas within the landscape may be ecologically functional.

A second series of mule deer CWR habitat assessments were conducted concurrent with pronghorn CWR habitat assessments conducted in 2007, 2008, and 2010. As with pronghorn, mule deer CWR, including accessibility of migratory corridors, is the most limiting factor for populations within the state of Wyoming. In coordination with the WGFD, two locations were identified to conduct the condition-class studies and three years of data were collected and evaluated (HWA 2008). The results from these utilization analyses establish a baseline for future year-to-year comparisons and trends at these sample points (**Table 3.8-4**). Data are available for only two sites and may indicate that variable forage conditions likely exist across the analysis area. Current forage conditions in mule deer CWR associated with the project area were similar to those of pronghorn; however, heavier use was evident at mule deer sites.

Table 3.8-4. Mule deer Crucial Winter Range condition assessment results, 2007, 2008, and 2010

Study site (Map 3.8-4)	Year	Crucial Winter Range Rating[1]	Crucial Winter Range Score[1, 2]
MD-1	2007	Fair	54.39
	2008	Poor	42.63
	2010	Fair	54.39
MD-2	2007	Good	64.68
	2008	Good	61.74
	2010	Good	63.21

[1] *Fair, poor, and good are all relative ratings as defined by the BLM based on the numerical outcome of the condition assessment.*

[2] *Mule deer CWR score and rating calculated by BLM (2008c).*

At least a dozen mule deer migratory movements have been documented in the southern portion of the project area (**Map 3.8-4**). In addition, a telemetry study has revealed migratory movements through the southeastern portion of the project area (Sawyer 2007). As discussed above (see Pronghorn), animal movements along known migratory routes in the southeastern portion of the project area are compromised by WY 789, energy development, and numerous rangeland and highway fences (Feeney et al. 2004, WGFD 2010a). Mule deer use of the underpasses constructed under WY 789 has been well documented using remote cameras (WYDOT 2012). The range condition data provided in **Table 3.8-4** is indicative of the forage condition within migration routes. Although current conditions of mule deer CWR associated with the project area were similar to those of pronghorn, heavier use was evident at mule deer sites. Nevertheless, results indicated that mule deer CWR sites have mature stands of big sagebrush with adequate canopy cover and overall production. However, WGFD biologists have expressed concern that "herbaceous forage production is expected to have been minimal due to record drought." (WGFD 2013a) This concern applies equally to shrub leader growth.

WGFD personnel have expressed frustration with energy development and other resources that compete with big game herds and the potential impact of these activities on herd populations. The 2012 Job Completion Report (WGFD 2013a) for mule deer in the Baggs Herd Unit states, "Oil and gas development associated with the Atlantic Rim Project continues to impact this deer population, and impacts are increasing as the size of this development increases. Additionally, within 2 years, we expect to see the development of the largest wind energy project in North America, the Chokecherry-Sierra Madre Wind Project. A recently published study clearly outlines negative impacts of the increase in oil

and gas development activities on migrating mule deer within the Baggs herd unit (WGFD 2013a). The study found that mule deer migrated quicker through areas with high levels of development and spend less time in stop over sites. In addition to the Atlantic Rim project, many parcels of public land on the west side of the Sierra Madre mountain range have been leased for oil and gas development, as has the bulk of this population's winter ranges. Energy developments and proposals in this herd unit range from traditional oil and gas developments to coalbed methane, in-situ uranium, and wind energy developments. In addition, elk and feral horse use of winter range habitats is increasing, potentially to the detriment of this species." The mule deer CWR within CD-C it is already disturbed to a level deemed "High" by WGFD. (Refer to Section 4.8.1 for a discussion of WGFD impact definitions.)

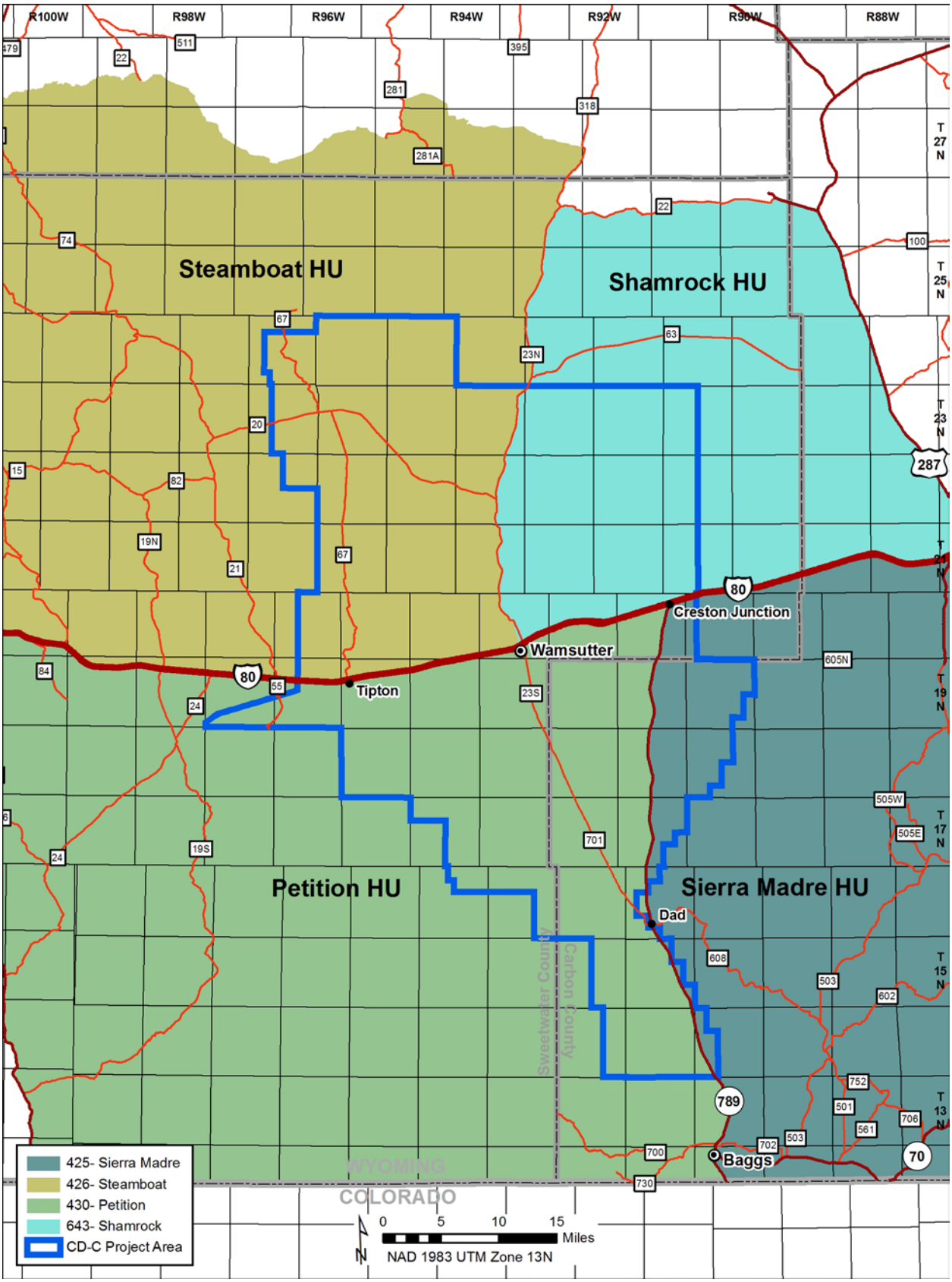
Elk are locally common in certain areas within the project area. The project area includes portions of five Hunt Areas (21, 100, 108, 118, and 124) and four Herd Units (**Table 3.8-1, Map 3.8-5**). Refer to **Section 3.12 Recreation** for a detailed discussion of hunting activities.

Elk seasonal ranges located within the project area include yearlong (6.1 percent), winter (2.5 percent), non-use (51.4 percent), and undetermined use areas (40.0 percent; **Table 3.8-2, Map 3.8-6**). No elk CWR has been designated or elk migration routes documented within the project area (Map 3.8-6). Therefore no elk CWR site-sampling was conducted. Although no elk migration routes have been mapped in the project area, they may be present. Elk do migrate from the Sierra Madre mountain range to winter range along the Atlantic and Red Rims east of the project area (Map 3.8-6), and elk have been documented using the Baggs/WY 789 underpasses (WYDOT 2012).

Big Game Summary

The project area is used by pronghorn, mule deer, and elk, although the areas and season of use vary by species. CWR and CW/Y of pronghorn and mule deer collectively comprise approximately 92,842 acres (8.7 percent) of the project area (**Map 3.8-7**). The Rawlins RMP (BLM 2008a) states that habitat quality would be functionally maintained within areas of overlapping big game CWR. Overlapping pronghorn and mule deer CWRs comprise 15,314 acres (1.4 percent) of the project area (Map 3.8-7). CWR for both pronghorn and mule deer, and therefore the area of overlapping CWR within CD-C, is already disturbed to a level deemed "High" by WGFD. (Refer to **Section 4.8.1** for a discussion of WGFD impact definitions.)

The project area also hosts wild horses, which over time may result in direct (competitive displacement) and indirect (resource-sharing) competition with pronghorn, mule deer, and elk (see **Section 3.10 Wild Horses**). Wild horse populations may impact ungulate habitat over an extended period of time.



Map 3.8-5. Elk Herd Units in and around the CD-C project area

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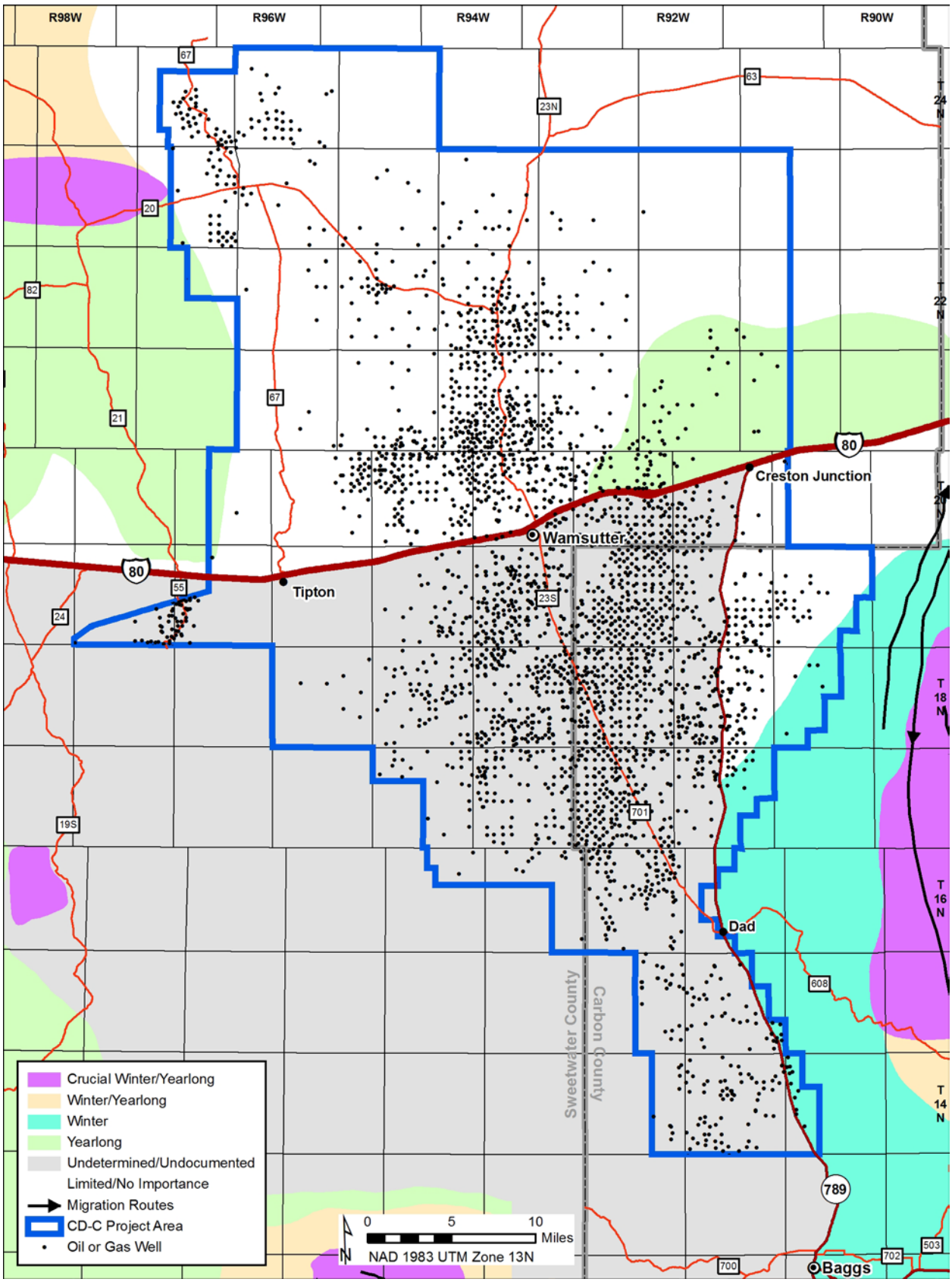

Map 3.8-6. Elk seasonal ranges and migratory movements in and around the CD-C project area

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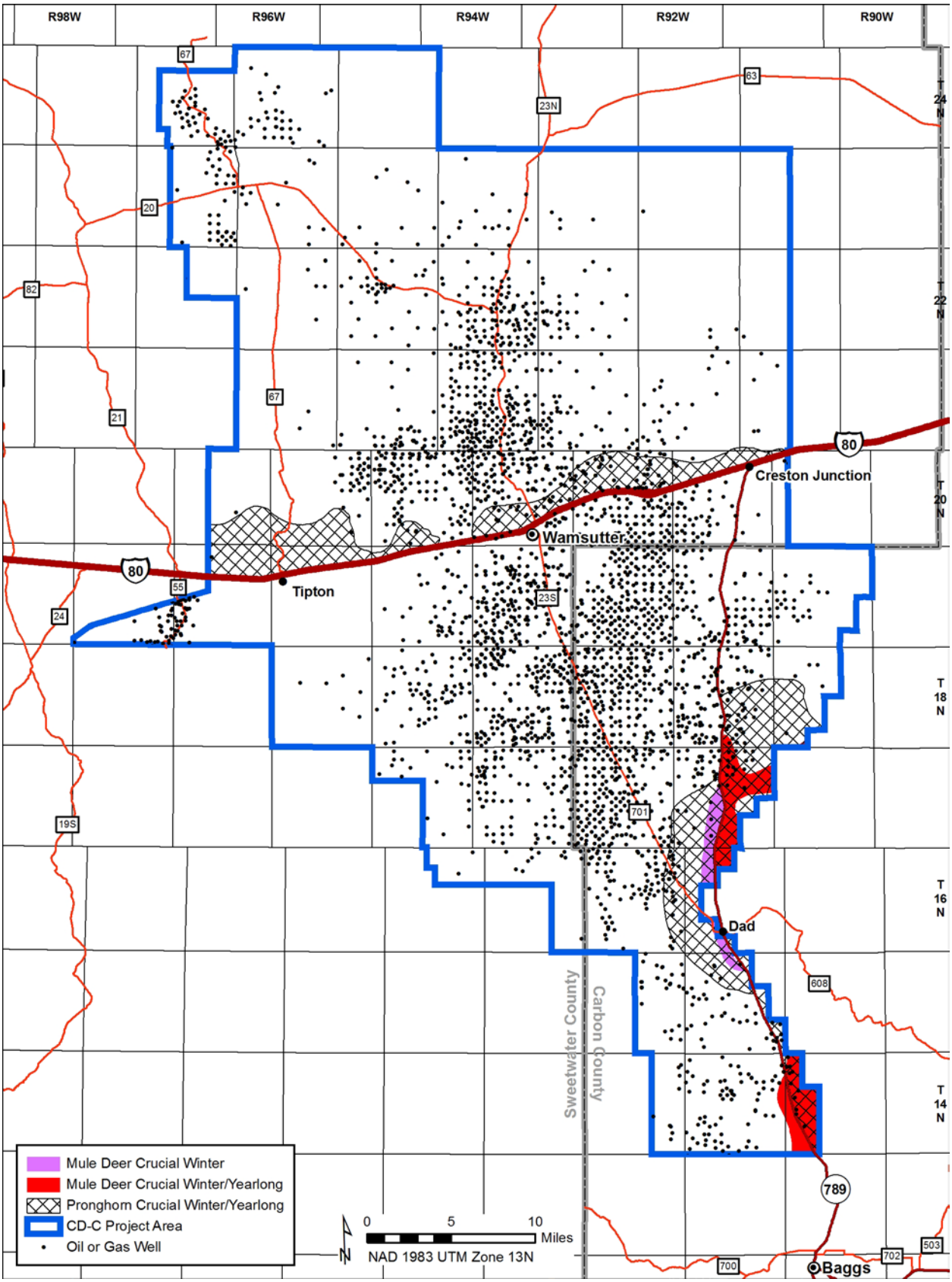

Map 3.8-7. Big game Crucial Winter Ranges in the CD-C project area

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3.8.1.3 Upland Game Birds

Two species of upland game birds occur within the project area: Greater Sage-Grouse (*Centrocercus urophasianus*) and mourning dove (*Zenaida macroura*) (WGFD 2004a). The Greater Sage-Grouse, a BLM Sensitive Species, is discussed in **Section 3.9, Special Status Species**. The mourning dove, which occupies a wide variety of habitats, is found in sagebrush-grassland, mountain shrub, and riparian vegetation communities within the project area. The species breeds within and migrates through the project area (WGFD 2004a). Mourning doves harvested within the project area account for a very small percentage of the state total (WGFD 2005b).

Suitable habitat is not present within the project area for chukar (*Alectoris chukar*), Columbian sharp-tailed grouse (*Tympanuchus phasianellus columbianus*), gray partridge (*Perdix perdix*), ring-necked pheasant (*Phasianus colchicus*), blue grouse (*Dendragapus obscurus*), ruffed grouse (*Bonasa umbellus*), or wild turkey (*Meleagris gallopavo*), although these species are present in surrounding areas (WGFD 2004a).

WGFD manages upland game birds within Upland Game Management Areas (UGMAs). The CD-C project area includes portions of three UGMAs: Red Desert UGMA 9; Bitter Creek UGMA 10; and Sierra Madre UGMA 25.

3.8.1.4 Raptors

Twenty-six raptor species are known to occur in or around the project area, including fourteen that breed or potentially breed, two that over-winter, and ten that have been recorded as transients or migrants (**Table 3.8-5**). Five species are designated as sensitive by the BLM and are discussed in detail in **Section 3.9 Special Status Species**.

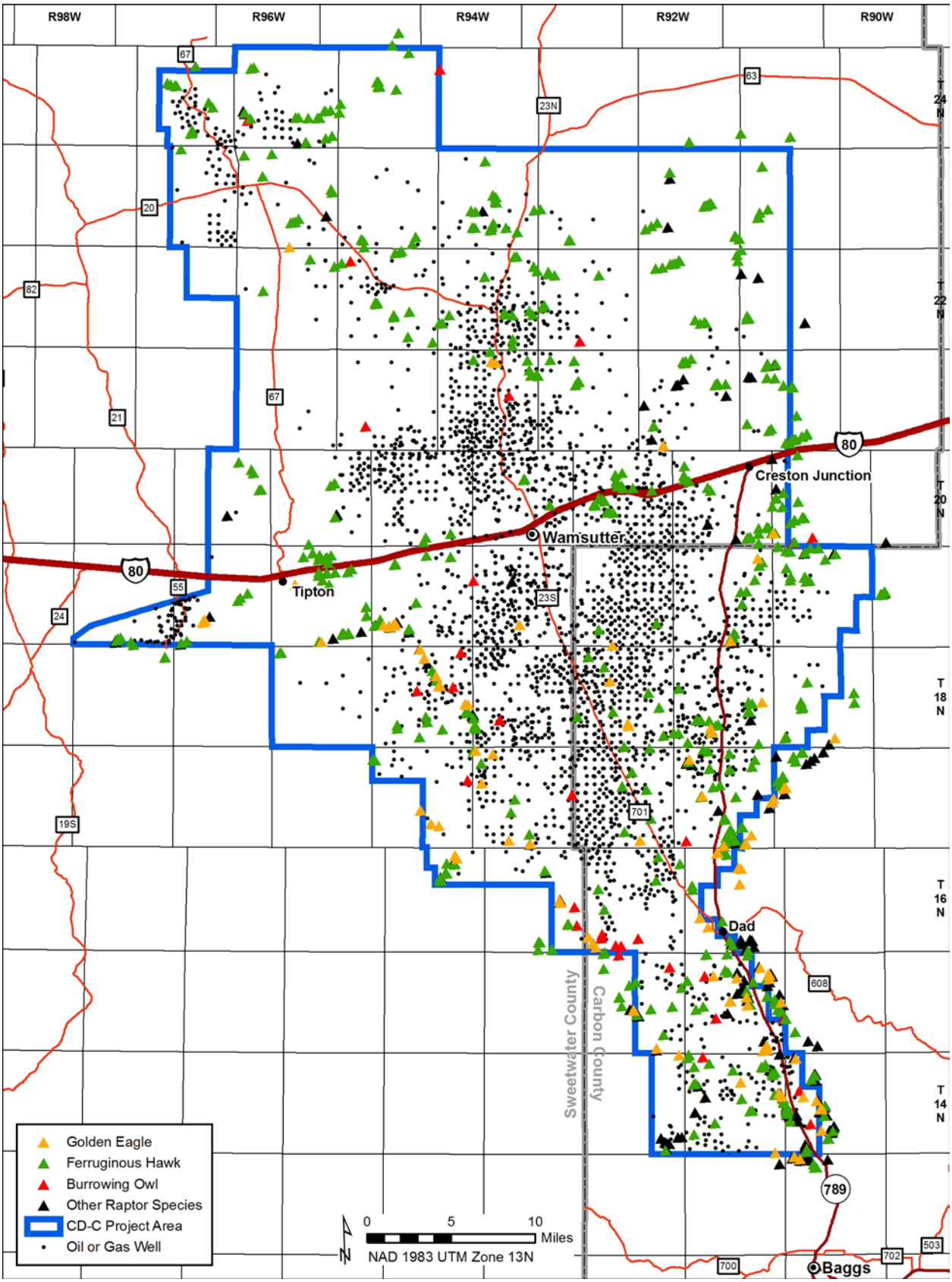
A variety of raptor breeding, hunting, and winter habitats occur within the project area. Grasslands, shrublands, trees and shrubs in riparian areas, and cliffs, low bluffs, rocky outcrops, and badland breaks all provide suitable nest substrates throughout the project area. Muddy Creek and drainages that support trees and other riparian vegetation provide habitat for tree-nesting species and provide potential roosting sites for wintering raptors. Agency and contract wildlife biologists have located at least 938 raptor nests belonging to at least 11 species in or within one mile of the project area (BLM 2007a; **Table 3.8-5**; **Map 3.8-8**). The raptor species utilizing 79 of these nest sites are unknown.

Table 3.8-5. Occurrence potential and documented nest sites of raptor and vulture species within the CD-C project area

Common Name	Scientific Name	Occurrence Potential[2]	Documented Nest Sites
American kestrel	*Falco sparverius*	B	18
Bald eagle[1]	*Haliaeetus leucocephalus*	t	--
Barn owl	*Tyto alba*	t	--
Broad-winged hawk	*Buteo platypterus*	t	--
Burrowing owl[1]	*Athene cunicularia*	B	31
Cooper's hawk	*Accipiter cooperii*	B	4
Ferruginous hawk[1]	*Buteo regalis*	B	577
Golden eagle	*Aquila chrysaetos*	B	108
Great horned owl	*Bubo virginianus*	B	15
Gyrfalcon	*Falco rusticolus*	t	--
Long-eared owl	*Asio otus*	B	1
Merlin	*Falco columbarius*	W	--
Northern goshawk[1]	*Accipiter gentilis*	t	--
Northern harrier	*Circus cyaneus*	B	9
Northern pygmy owl	*Glaucidium gnoma*	t	--
Northern saw-whet owl	*Aegolius acadicus*	t	--
Osprey	*Pandion haliaetus*	t	--
Peregrine falcon[1]	*Falco peregrinus*	t	--
Prairie falcon	*Falco mexicanus*	B	34
Red-tailed hawk	*Buteo jamaicensis*	B	48
Rough-legged hawk	*Buteo lagopus*	W	--
Sharp-shinned hawk	*Accipiter striatus*	pB	--
Short-eared owl	*Asio flammeus*	pB	--
Snowy owl	*Bubo scandiacus*	t	--
Swainson's hawk	*Buteo swainsoni*	B	14
Turkey vulture	*Cathartes aura*	pB	--

[1] *Special-status species*
[2] *Occurrence potential of raptor species includes: known breeding (B); known to be present during breeding season and potentially breed (pB); known to over-winter (W); and known transient or migrant (t)*

It is possible that some of the older documented raptor nests may have deteriorated beyond being suitable for raptor nesting and the nest sites are no longer available or used by breeding raptors. Nevertheless, nest sites with nests in suitable condition have the potential to be active in any given year. Moreover, each year new nests are built. All raptors and their nests are protected from take or disturbance under the Migratory Bird Treaty Act (16 USC, §703 *et seq.*) and Wyoming [Revised] Statute (WRS 23-1-101 and 23-3-108). Golden and bald eagles also are afforded additional protection under the Bald and Golden Eagle Protection Act, amended in 1973 (16 USC, §669 *et seq.*).



Map 3.8-8. Raptor nest site locations in or within one mile of the CD-C project area

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3.8.1.5 Neotropical Songbirds

Many species of neotropical songbirds utilize the project area for breeding, feeding, migration, and as year-round habitats (**Appendix H, Occurrence Potential of Wildlife in the CD-C project Area**). All habitats throughout the project area are used to some degree by these species, but especially sagebrush-grassland, mountain shrub, and riparian vegetation communities. The Migratory Bird Treaty Act (16 USC, §703 *et seq.*) protects 836 migratory bird species (to date) and their eggs, feathers, and nests from disturbances. Several migratory raptors and songbird species are also listed as BLM Sensitive Species (**Section 3.9.2**).

3.8.2 Fish

Almost all of the CD-C project area drains into two basins: the Little Snake River Basin (a component of the Colorado River system) and the Great Divide Basin. A very small proportion of the far western part of the project area drains into Bitter Creek, also a component of the Colorado River system. The Little Snake River Basin is fed by Muddy Creek, which drains the southeastern portion of the project area. The majority of the northern part of the project lies within the Great Divide Basin. The Great Divide Basin is closed, with no eventual outflow to an ocean (**Map 3.4-1**).

3.8.2.1 Fish Habitat

Due to limited precipitation, the majority of drainages within the project area are ephemeral or intermittent. Ephemeral water tables are always below the stream channel, only flowing in direct response to precipitation or snow-melt. Ephemeral waters occur only in response to localized rainfall or snowmelt. They only support limited aquatic communities for short periods when surface flow is present, although some ephemeral streams in the project area may be used for spawning. Intermittent channels provide flowing water during certain times of the year, when groundwater provides water for stream flow. The largest stream within the project area is Muddy Creek, a high-elevation, cold desert stream that is designated as class 2AB by the WDEQ, and supports game and non-game species. Muddy Creek exhibits perennial flow for the majority of its length, and in some drier, low-runoff years, flows intermittently as a result of irrigation water removal south of the George Dew/Red Wash wetlands complex. In years with high runoff amounts, Muddy Creek flows perennially throughout its length. Streamflow varies with location along the drainage.

About 286 reservoirs and ponds (<1–960 acres) are present within the project area (**Section 3.4.2.1**). Some of the ponds and reservoirs that currently exist within the project area are fed by waters recovered from wells drilled at upstream locations, while others are impoundments on small drainages. These man-made impoundments are generally designed to supply water for livestock and wildlife use. Only one of these, Little Robbers Gulch Reservoir, is stocked annually with Colorado River cutthroat trout (*Oncorhynchus clarkii pleuriticus*) by the WGFD. None of the others are known to sustain fisheries.

3.8.2.2 General Fish

About 30 species of fish may occur in the project area or in streams upstream or downstream of the project area (**Table 3.8-6**), including ten game-fish species and 20 non-game fish species. This information is based upon species potentially found in the Great Divide and Little Snake River Basins, plus four Threatened and Endangered species present downstream in the Colorado River System. About 14 of the 30 species, including six native species, are likely to be present within the project area. Four of the 30 species are Threatened or Endangered (**Section 3.9.1.3**) and four are BLM Sensitive Species (**Section 3.9.2.3**).

No fish have been collected from any streams within the Great Divide Basin. Consequently, all of the fish present within streams in the project area are found within the Muddy Creek watershed. Some impoundments in the Great Divide Basin portion of the project have been stocked with fish in the past, but none are known to sustain fisheries at the present.

Table 3.8-6. Fish species observed within, or that may potentially occur immediately upstream or downstream of, the CD-C project area

Common Name	Scientific Name	Game or Non-game	Basin[1]	Present in project area	Native	WYNDD	FOW	BLM	MCBMP	WSAM	WGFD	Beatty 2005
Black bullhead	*Ameiurus melas*	Non-game	LSR									x
Bluehead sucker	*Catostomus discobolus*	Non-game	LSR	Yes	Yes	X	X	X	X	X		
Bonytail	*Gila elegans*	Non-game	CR		Yes							
Brook trout	*Salvelinus fontinalis*	Game	LSR, GDB	Yes			X	X	X	X		
Brown trout	*Salmo trutta*	Game	LSR				X					
Channel catfish	*Ictalurus punctatus*	Game	LSR				X					
Colorado pikeminnow	*Ptychocheilus lucius*	Non-game	LSR, CR		Yes		X	X				
Colorado River cutthroat trout	*Oncorhynchus clarki pleuriticus*	Game	LSR		Yes	X	X	X	X	X		
Common carp	*Cyprinus carpio*	Game	LSR, GDB				X	X				
Creek chub	*Semotitus atromaculatus*	Non-game	LSR	Yes			X	X	X	X		X
Fathead Minnow	*Pimephales promelas*	Non-game	LSR	Yes				X				X
Flannelmouth sucker	*Catostomus latipinnis*	Non-game	LSR	Yes	Yes	X	X	X	X	X		
Humpback chub	*Gila cypha*	Non-game	CR		Yes							
Iowa darter	*Etheostoma exile*	Non-game	LSR				X	X	X	X		
Longnose dace	*Rhinichthys cataractae*	Non-game	LSR	Yes			X		X	X		
Longnose sucker	*Catostomus catostomus*	Non-game	LSR				X					
Mottled sculpin	*Cottus bairdi*	Non-game	LSR	Yes	Yes		X	X	X	X		
Mountain sucker	*Catostomus platyrhynchus*	Non-game	LSR	Yes	Yes		X	X	X	X		
Mountain whitefish	*Prosopium williamsoni*	Game	LSR		Yes		X		X	X		
Northern Pike	*Esox lucius*	Game	LSR								X	
Rainbow trout	*Oncorhynchus mykiss*	Game	LSR, GDB	Yes			X		X	X		
Razorback sucker	*Xyrauchen texanus*	Non-game	CR		Yes							
Red Shiner	*Cyprinella lutrensis*	Non-game	LSR									X
Redside shiner	*Richardsonius balteatus*	Non-game	LSR	Yes			X	X	X	X		X
Roundtail chub	*Gila robusta*	Non-game	LSR	Yes	Yes	X	X	X	X	X		
Sand Shiner	*Notropis stramineus*	Non-game	LSR	Yes								X
Speckled dace	*Rhinichthys osculus*	Non-game	LSR	Yes	Yes		X	X	X	X		
Walleye	*Stizostedion vitreum*	Game	LSR							X	X	
White sucker	*Catostomus commersoni*	Non-game	LSR	Yes			X	X				X

[1] *Basins:*
LSR = Little Snake River Basin
GDB = Great Divide Basin
CR = These species are downstream residents of the Colorado River system.

Data Sources:
- WYNDD 2003
- Fishes of Wyoming (FOW) (Baxter and Stone 1995)
- Muddy Creek Basin Management Plan (MCBMP) (WGFD 1998)
- M. Fowden, pers. comm. 2004
- BLM (BLM 2001)
- Warm water Stream Assessment Manual (WSAM) (WGFD 2004b)
- BLM 2001
- Beatty 2005

3.9 SPECIAL STATUS SPECIES

Special Status species include: (1) Threatened, Endangered, Proposed, Candidate, or those petitioned for listing as Threatened or Endangered by the USFWS under the ESA, as amended; and (2) those designated by the BLM Wyoming State Director as sensitive (BLM 2010a).

3.9.1 Threatened, Endangered, Proposed, or Candidate Species of Wildlife, Fish, and Plants

The USFWS lists six species that may be found in the CD-C project area as Threatened or Endangered pursuant to the ESA (**Table 3.9-1**). Of these, only the Threatened Ute ladies'-tresses is potentially present within the project area (USFWS 2011). Four Endangered fish species are found downstream of the project area in the Colorado River system and may be impacted if water depletions occur. The Threatened Canada Lynx is very unlikely to occur in the project area. No Proposed or Candidate species occur within the project area.

Four Special Status species found within the RFO—black-footed ferret (*Mustela nigripes)*, yellow-billed cuckoo (*Coccyzus americanus*), Wyoming toad (*Bufo baxteri*), and blowout penstemon (*Penstemon haydenii*)—are not found nor do they have habitat within or near the CD-C project area; therefore they are not discussed in this document.

Table 3.9-1. Occurrence potential of Threatened, Endangered, Proposed, and Candidate species within or near the CD-C project area

Species	Scientific Name	Occurrence Potential within the project area[2]	Status
Mammals			
Canada lynx	*Lynx Canadensis*	VU	Threatened
Fish			
Bonytail[1]	*Gila elegans*	PAD	Endangered
Colorado pikeminnow[1]	*Ptychocheilus lucius*	PAD	Endangered
Humpback chub[1]	*Gila cypha*	PAD	Endangered
Razorback sucker[1]	*Xyrauchen texanus*	PAD	Endangered
Plants			
Ute ladies'-tresses	*Spiranthes diluvialis*	pp	Threatened

[1] *Present in the Colorado River system downstream of the project area*

[2] *Occurrence potential: present (P); potentially present (pp); unlikely (U); very unlikely (VU); and potentially affected downstream (PAD).*

3.9.1.1 Threatened or Endangered Wildlife Species

Canada lynx is a medium-sized cat with long legs, large, well-furred paws, long tufts on the ears, and a short, black-tipped tail. The winter coat of the lynx is dense and has a grizzled appearance with grayish-brown mixed with buff or pale brown fur on the back, and grayish-white or buff-white fur on the belly, legs and feet. Summer pelage of the lynx is more reddish to gray-brown. Adult males average 22 pounds in weight and 33.5 inches in length (head to tail), and females average 19 pounds and 32 inches. The lynx's long legs and large feet make it highly adapted for hunting in deep snow (USFWS 2013b).

The distribution of lynx in North America is closely associated with the distribution of North American boreal forest. In Canada and Alaska, lynx inhabit the classic boreal forest ecosystem known as the taiga. The range of lynx populations extends south from the classic boreal forest zone into the subalpine forest of the western United States, and the boreal/hardwood forest ecotone in the eastern United States. Forests with boreal features extend south into the contiguous United States along the North Cascade and Rocky Mountain Ranges in the west, the western Great Lakes Region, and northern Maine. Within these general

forest types, lynx are most likely to persist in areas that receive deep snow and have high-density populations of snowshoe hares, the principal prey of lynx (USFWS 2013b).

In 1999, the Colorado Department of Wildlife (CDOW) began reintroducing the Canada Lynx into the San Juan Mountains of southwest Colorado. Subsequent radio and satellite tracking has demonstrated reproduction and dispersal of individuals from the southern Colorado re-introduction area through the Colorado Rockies and into the Medicine Bow National Forest in south-central Wyoming, continuing northwest into the Greater Yellowstone Area (GYA), supporting the possibility of dispersal through the project area (CDOW 2010).

The Wyoming BLM issued a Statewide Programmatic Biological Assessment for Canada lynx (BLM 2005f) which provides support for the concept of CD-C project area riparian corridors potentially serving as travel linkages for the species, "The Rawlins FO does, however, have non-delineated potential travel linkage and movement corridors that may be of value to lynx. These include: 1) a number of riparian corridors coming out of the Sierra Madre range; 2) the low-elevation, sparsely forested lodgepole and ponderosa pine and juniper stands between the Medicine Bow and Sierra Madre ranges may be useful for movement between the two mountain ranges; and 3) a potential corridor along the Shirley, Seminoe and Ferris mountains, which (along with the Green and Crooks mountains) form a linkage between the Medicine Bow Range and the Wind River Range." This biological assessment also provides direction for "an action plan delineating these three linkage corridors and determining any management restrictions needs to be developed to further the conservation of the lynx"; however, this plan has not yet been developed.

The GYA is identified as Unit 5 of designated critical habitat for Canada lynx in the lower 48 states. It comprises Yellowstone National Park and surrounding lands in southwest Montana and northwest Wyoming including Park, Teton, Fremont, Sublette, and Lincoln Counties in Wyoming. Unit 5 is the southernmost of the designated critical habitat areas and does not extend into the CD-C project area. (A map of Unit 5, **Map 4-2,** is found in **Appendix Q1, Biological Assessment.**). This area was occupied by lynx at the time of listing and is currently occupied by the species. The area contains the physical and biological features essential to the conservation of the lynx. The GYA is naturally marginally lynx habitat with highly fragmented foraging habitat (USFWS 2009). No critical habitat for the species has been designated in Colorado or south-central Wyoming.

Although Wyoming comprises part of the species' historic geographical range, no historical lynx sightings have been documented within the project area; the closest historical sighting was six miles from the project area (WGFD 2007, WYNDD 2007). Although it is possible that the availability of alternate prey, such as jackrabbits (*Lupus* spp.) or ground squirrels (*Spermophilus* spp.), may attract lynx into shrub steppe habitats, it is not known whether these habitats are important or used opportunistically in the southern extent of their range (Ruggiero *et al.* 2000). In a collaborative effort, the BLM and WYNDD completed a lynx habitat suitability map for the State of Wyoming (Beauvais *et al.* 2001). According to the model, lands within the project area provide low- to poor-quality lynx habitat. It is very unlikely that Canada lynx occur in or near the project area due to lack of suitable habitat.

3.9.1.2 Threatened or Endangered Fish Species

Four federally Endangered fish species may occur as downstream residents of the Colorado River System: Colorado pikeminnow (*Ptychocheilus lucius*), bonytail (*Gila elegans*), humpback chub (*Gila cypha*), and razorback sucker (*Xyrauchen texanus*) (USFWS 2004). The Colorado pikeminnow, bonytail, and humpback chub are all members of the minnow family (*Cyprinidae*). The razorback sucker is a member of the sucker family (*Catostomidae*). All four of these fish species share similar habitat requirements and historically occupied the same river systems. Declines in populations of these species are mainly attributed to impacts of water development (e.g. dams and reservoirs) on natural temperature and flow regimes, creation of migration barriers, habitat fragmentation, the introduction of competitive and

predatory non-native fishes, and the loss of inundated bottom lands and backwater areas (Minckley and Deacon 1991, USFWS 1993).

The last sighting of any of these fish species in the Little Snake River was of a single Colorado pikeminnow in 1990. No critical habitat for these species has been designated in Wyoming (Upper Colorado River Endangered Fish Recovery Program 1999). However, the potential for project-related reductions in water quantity and/or quality to these tributaries to the Colorado River warrant their inclusion in this document.

Bonytail. Habitat of the bonytail is primarily limited to narrow, deep, canyon-bound rivers with swift currents and whitewater areas (Valdez and Clemmer 1982, Archer *et al.* 1985, Upper Colorado River Endangered Fish Recovery Program 1999). With no known reproducing populations in the wild today, the bonytail is thought to be the rarest of the Endangered fishes in the Colorado River System.

The bonytail historically inhabited portions of the upper and lower Colorado River basins. Today in the upper Colorado River Basin, only small, disjunct populations of bonytail are thought to exist in the Yampa River in Dinosaur National Monument, in the Green River at Desolation and Gray canyons, in the Colorado River at the Colorado/Utah border, and in Cataract Canyon (Upper Colorado River Endangered Fish Recovery Program 1999).

Colorado pikeminnow. The Colorado pikeminnow is the largest member of the minnow family and occurs in swift, warm waters of the Colorado River basins. The species was once abundant in the mainstem of the Colorado River and most of its major tributaries throughout Wyoming, Colorado, Utah, New Mexico, Arizona, Nevada, California, and Mexico. It was known to occur historically in the Green River of Wyoming at least as far north as the City of Green River. In 1990, one adult was collected from the Little Snake River in Carbon County, Wyoming (Baxter and Stone 1995). Subsequent survey attempts to collect Colorado pikeminnow from this area of the Little Snake River by WGFD personnel failed to yield any other specimens.

Humpback chub. Habitat of the humpback chub is also limited to narrow, deep, canyon-bound rivers with swift currents and whitewater areas (Valdez and Clemmer 1982, Archer *et al.* 1985, Upper Colorado River Endangered Fish Recovery Program 1999).

The humpback chub was historically found throughout the Colorado River System and its tributaries, which are used for spawning (Valdez *et al.* 2000). It is estimated that the humpback chub currently occupies 68 percent of its original distribution in five independent populations that are thought to be stable (Valdez *et al.* 2000).

Razorback sucker. The razorback sucker is an omnivorous bottom-feeder and is one of the largest fishes in the sucker family. Adult razorback sucker habitat use varies depending on season and location. This species was once widespread throughout most of the Colorado River Basin from Wyoming to Mexico. Today in the Colorado River Basin, populations of razorback suckers are only found in the upper Green River in Utah, the lower Yampa River in Colorado, and occasionally in the Colorado River near Grand Junction (Upper Colorado River Endangered Fish Recovery Program 1999).

3.9.1.3 Threatened, Endangered, Proposed, Candidate, or Experimental Plant Species

Ute ladies'-tresses (*Spiranthes diluvialis*) was designated by the USFWS as a Threatened plant species throughout its range in 1992. The USFWS, Wyoming Ecological Field Office, has determined that Ute ladies'-tresses may occur in suitable habitats within Carbon and Sweetwater counties, where the CD-C project is located (**Table 3.9-1**). The species is endemic to moist soils near wetland meadows, springs, lakes, and perennial streams with an elevation range of known occurrences from 4,200 to 7,000 feet (although no known populations in Wyoming occur above 5,500 feet). Ute ladies'-tresses is not known to occur within the CD-C project area and the likelihood of occurrence is low for the following reasons: (1) much of the project area is very arid and there are few perennial streams; (2) the elevation of the project area is near the upper limit for the species; (3) very few moist riparian area meadows are present; (4)

where moist soils are present, the transition from stream margins to upland vegetation is abrupt; and (5) in Wyoming, the species has only been located in the eastern and southeastern portions of the state, in Converse, Goshen, Laramie, and Niobrara Counties (Fertig 2000).

Field surveys were conducted during the 2006 and 2007 growing seasons to locate and map Special Status plant populations identified by the RFO and the USFWS (HWA 2008a). Ute ladies'-tresses was included in the surveys. These surveys failed to document the presence of Ute ladies'-tresses or any suitable habitat within the CD-C project area. The survey indicated that the likelihood of finding suitable habitat for Ute-ladies tresses within the project area is minimal based on an assessment using USFWS-defined disqualifying factors (USFWS 1995) of potential habitat. Potential Ute ladies'-tresses habitat areas surveyed met six of the ten disqualifying factors defined by the USFWS and the remaining four were not applicable. Critical Habitat for the Ute ladies'-tresses within the project area has not been designated by the USFWS.

3.9.2 BLM Sensitive Species

BLM Sensitive Species present on public lands in Wyoming (**Table 3.9-3**) include species that are not listed as Threatened or Endangered by the USFWS but that may be rare or declining in the state. The objective of the Sensitive Species designation is to ensure that any actions taken on public lands consider the overall welfare of these species and do not contribute to the need to list the species under the provisions of the ESA. The intent of this policy is to emphasize inventory, planning consideration, management implementation, monitoring, and information exchange for these species. The Sensitive Species list is meant to be dynamic and is reviewed and updated annually, considering recommendations from the BLM and appropriate non-BLM authorities (BLM 2010a).

Twenty-nine BLM Sensitive Species that occur in the RFO may occur in or near the CD-C project area.

Table 3.9-3. Occurrence potential and habitat associations of BLM Sensitive Species within or near the CD-C project area

Common Name	Scientific Name	Occurrence Potential[1]	Habitat Association[2]
Mammals			
Fringed myotis	*Myotis thysanodes*	pp	Caves, forest, shrublands
Long-eared myotis	*Myotis evotis*	P	Caves, forest, shrublands
Pygmy rabbit	*Brachylagus idahoensis*	P	Sagebrush
Spotted bat	*Euderma maculatum*	pp	Cliffs, sagebrush
Swift fox	*Vulpes velox*	pp	Grasslands
Townsend's big-eared bat	*Corynorhinus townsendii*	pp	Caves, forest, shrublands
White-tailed prairie dog	*Cynomys leucurus*	P	Sagebrush-grasslands
Wyoming pocket gopher	*Thomomys clusius*	P	Sagebrush-grasslands
Birds			
Bald eagle	*Haliaeetus leucocephalus*	P	Rivers, stream and lakes
Brewer's Sparrow	*Spizella breweri*	P	Sagebrush
Burrowing owl	*Athene cunicularia*	P	Grasslands
Ferruginous hawk	*Buteo regalis*	P	Sagebrush-grasslands
Greater Sage-Grouse	*Centrocercus urophasianus*	P	Sagebrush
Loggerhead shrike	*Lanius ludovicianus*	P	Shrublands
Long-billed curlew	*Numenius americanus*	P	Grasslands
Mountain plover	*Charadrius montanus*	P	Grasslands
Peregrine falcon	*Falco peregrinus*	U	Cliffs, rivers
Sage sparrow	*Amphispiza belli*	P	Sagebrush
Sage thrasher	*Oreoscoptes montanus*	P	Sagebrush

Common Name	Scientific Name	Occurrence Potential[1]	Habitat Association[2]
Amphibians			
Great Basin spadefoot	*Spea intermontana*	P	Sagebrush
Northern leopard frog	*Rana pipiens*	pp	Plains and foothills ponds
Fish			
Roundtail chub	*Gila robusta*	P	Rivers, stream and lakes
Bluehead sucker	*Catostomus discobobulus*	P	All waters
Flannelmouth sucker	*Catostomus latipinnis*	P	Rivers, stream and lakes
Colorado River cutthroat trout	*Onchorhynchus clarki pleuriticus*	pp	Mountain streams
Plants			
Meadow milkvetch	*Astragalus diversifolius*	P	Moist, salt-accumulating habitats such as alkaline meadows and playa shorelines
Cedar Rim thistle	*Cirsium aridum*	pp	Barren, chalky hills, gravelly slopes, and fine textured, sandy-shaley draws
Gibben's beardtongue	*Penstemon gibbensii*	pp	Barren south-facing slopes on loose sandy-clay derived from Brown's Park formation
Persistent sepal yellowcress	*Rorippia calcycina*	P	River banks and shorelines

[1] *Occurrence potential: present (P), potentially present (pp), unlikely (U), and very unlikely (VU);(Abernethy et al 2013, Griscom et al. 2012, WGFD 2004a; HWA, unpublished data).*

[2] *WGFD 2004a.*

3.9.2.1 Sensitive Wildlife Species

Twenty-one terrestrial species and four fish species designated as BLM Sensitive occur in the RFO and may occur in or near the CD-C project area (**Table 3.9-3**; BLM 2010, WGFD 2007, WYNDD 2007).

Eight BLM Sensitive wildlife species found in the RFO—black-tailed prairie dog (*Cynomys ludovicianus)*, Baird's sparrow (*Ammodramus bairdii*), Columbian sharp-tailed grouse (*Tympanuchus phasianellus columbianus)*, northern goshawk (*Accipiter gentilis)*, trumpeter swan (*Cygnus buccinator*), white-faced ibis (*Plegadis chichi)*, hornyhead chub (*Nocomis biguttatus*), and boreal toad (*Bufo boreas* boreas)—are not found nor do they have habitat within or near the CD-C project area. These species are not discussed in this document.

Mammals

Fringed myotis. This bat species occupies primarily sagebrush steppe and open forests of the mountain foothills in Wyoming (Griscom *et al.* 2012). It is considered uncommon in the project area, likely because of its association with conifer forests; however, it has been documented in the project area (Griscom *et al.* 2012). This species could potentially utilize the project area for feeding; roosting sites may occur in the project area, as suitable habitat is present.

Long-eared myotis has been documented in the CD-C project area and predicted to be most common in foothills areas with conifer and deciduous trees and cliffs and rugged terrain (Abernethey *et al.* 2012, Griscom *et al.* 2012).

Pygmy rabbit. A sagebrush obligate, the pygmy rabbit requires tall sagebrush and deep, soft soil for burrowing. Therefore, it is not distributed uniformly across the sagebrush shrub-steppe ecosystem. The species occurs in eight western states (California, Idaho, Montana, Nevada, Oregon, Utah, Washington and Wyoming), and has been documented throughout western Wyoming including Carbon and Sweetwater counties. It should be noted that the Columbia Basin Distinct Population Segment in

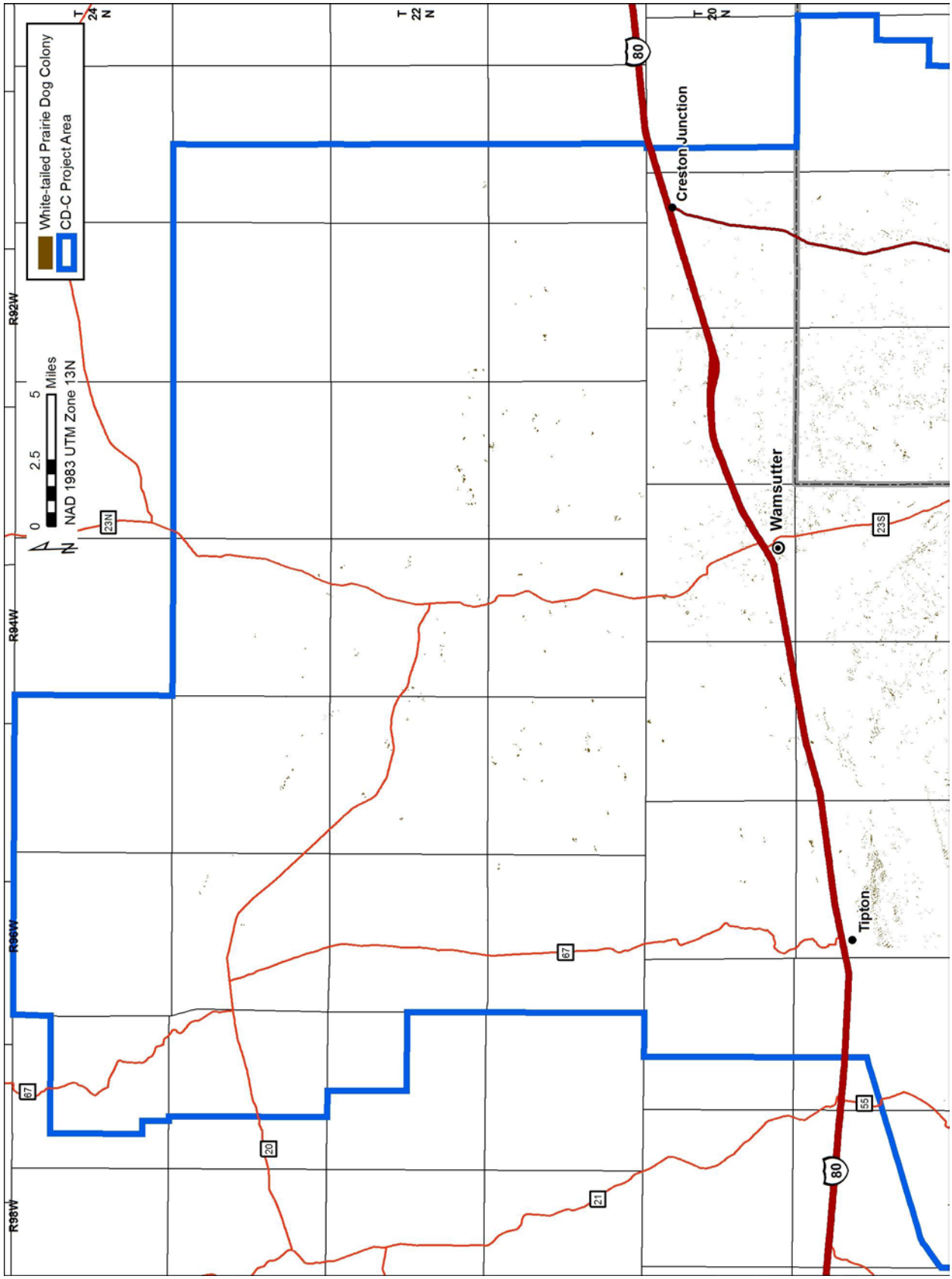
Washington State is managed differently and is currently listed as Endangered under the ESA. In September 2010, the USFWS released its 12-month finding on a petition to list the pygmy rabbit as Endangered or Threatened range-wide under the ESA and found that listing was not warranted. Although listing was not warranted, the USFWS acknowledged several threats to pygmy rabbit habitat including sagebrush conversion for agricultural purposes, livestock grazing, and energy development. Suitable pygmy rabbit habitat is patchily distributed but abundant in the Continental Divide Basin and surrounding areas. Pygmy rabbits have been documented throughout the project area (WYNDD 2007, HWA unpublished data).

Spotted bat. Although it occurs sporadically as a summer resident across the western United States, the spotted bat has not been documented in the project area (Abernethy *et al.* 2013, Griscom *et al.* 2012, WGFD 2007, WYNDD 2007). Spotted bat is associated with juniper shrublands and desert-sagebrush grasslands in Wyoming (WGFD 2004a). The species may occur in the project area. Roosting habitat such as cliffs is present although perennial water is lacking.

Swift fox. The swift fox inhabits short-grass and mixed-grass prairies over most of the Great Plains, including eastern Wyoming (Clark and Stromberg 1987). Studies have documented swift fox in Carbon and Sweetwater Counties within the project area and the species potentially may occur (Woolley *et al.* 1995). However, no swift fox have been documented in Sweetwater County in recent years (WGFD 2007, WYNDD 2007).

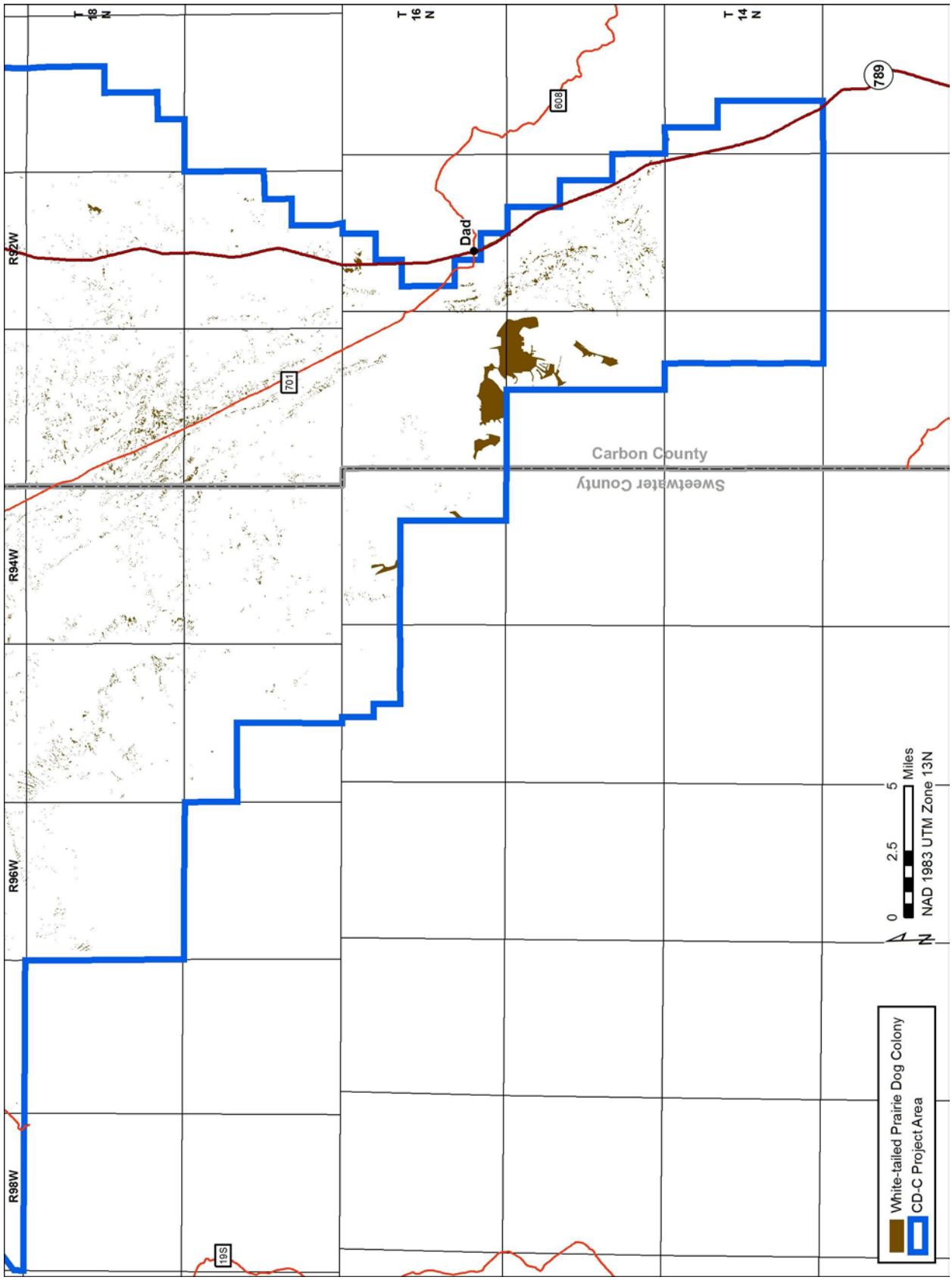
Townsend's big-eared bat can be found throughout Wyoming (Clark and Stromberg 1987) and has been found in the project area (Abernethy *et al.* 2012). The most critical and restrictive feature of Townsend's big-eared bat ecology is the requirement for large cavern-like structures for roosting during all stages of its life-cycle (Griscom *et al.* 2012), which is lacking in the CD-C project area. The species forages primarily along edge habitats (e.g., forest edges, intermittent streams), but also in forests and along vegetated stream corridors (Griscom *et al.* 2012).

White-tailed prairie dog. This species occupies grassland, sagebrush, and arid shrubland habitats in central and western Wyoming (Clark and Stromberg 1987) and is found in scattered colonies throughout the project area. Approximately 8,818 acres of white-tailed prairie-dog colonies have been mapped within the project area to date (**Maps 3.9-1a and 3.9-1b**; BLM RFO unpublished data; HWA unpublished data). This species has been observed using areas of man-made disturbance for colony expansion (Read 2012b; HWA unpublished data).



Map 3.9-1a. White-tailed prairie-dog colonies within the CD-C project area (north)

No warranty is made by the BLM for use of the data for purposes not intended by the BLM.



Map 3.9-1b. White-tailed prairie-dog colonies within the CD-C project area (south)

No warranty is made by the BLM for use of the data for purposes not intended by the BLM.

Wyoming pocket gopher. Endemic to southeastern Sweetwater County and southwestern Carbon County, the Wyoming pocket gopher has been documented within the project area (Griscom *et al.* 2010, HWA 2008c and 2009). Another population has been recorded in Carbon County approximately 20 miles east of the project area near Bridger's Pass, and the species may occur elsewhere (Clark and Stromberg 1987). In August 2007, the Wyoming pocket gopher was petitioned for listing under the ESA. The rationale for petitioning the species included a lack of knowledge regarding its taxonomy, abundance, population trends, distribution, habitat requirements, and the potential effects from energy development within their range. In April 2010, the USFWS determined the Wyoming pocket gopher did not warrant protection as a threatened or endangered species under the ESA.

As part of the survey efforts for the 12-month status review, HWA biologists collaborated with the BLM-RFO and WYNDD to conduct an extensive trapping effort during 2008 and 2009. The objective of the study was to capture Wyoming pocket gophers to genetically verify its status as a separate species, and to collect additional information on its distribution within the project area and across its predicted range in general. In 2008, 10 Wyoming pocket gophers and 20 northern pocket gophers were trapped in 351 trap-nights within the project area. Capture locations were concentrated within 15 miles southwest of Wamsutter on the plateaus above Wamsutter and Delaney Rims (HWA 2008c).

In 2009, ten Wyoming pocket gophers and 12 northern pocket gophers were trapped in 550 trap nights within the project area. Capture locations were distributed throughout the project area, including eight captures approximately 20 miles southwest of Creston Junction (I-80 and WY 789) and two captures 10 miles north of Creston Junction (HWA 2009). Wyoming and northern pocket gophers appear to be sympatric (have overlapping ranges) within the project area.

The 2010 WYNDD report (Griscom *et al.* 2010) provides the following habitat information for the species, "Despite extensive surveying, the range of the Wyoming pocket gopher appears to be limited to south-central Wyoming. Habitat analyses suggest that this species occurs predominantly on gentle slopes where Gardner's saltbush and winterfat are present and big sagebrush is absent or subdominant. Wyoming pocket gopher sites also tend to have less grass, rock, and litter cover when compared to control sites and those occupied by the more common northern pocket gopher." Predictive range mapping found in Griscom *et al.* 2010 indicates the species could be found in suitable habitat throughout much of the CD-C project area.

Birds

Bald eagle. This large North American eagle is normally found near water. It is found throughout North America, but primarily breeds in Canada, Alaska, the Pacific Northwest, the Rocky Mountains, and the Great Lakes region. Bald eagles have been observed in the project area primarily from November through April (WGFD 2004a, HWA unpublished data). The species may forage within the project area during the winter months because of carrion associated with pronghorn, mule deer, and elk winter ranges (**Maps 3.8-2**, **3.8-4**, and **3.8-6**). No bald eagle nests or nesting habitat (mature, large diameter trees near open water) occur within the project area. The nearest potential nesting habitat occurs along the Little Snake River approximately nine miles south of the project area.

Brewer's sparrow. A sagebrush obligate, Brewer's sparrow breeds throughout the intermountain west of the United States and winters in southern portions of California, Arizona, New Mexico, and western Texas, and south through the central part of Mexico (Rotenberry *et al.* 1999, Sibley 2000). Brewer's sparrows will breed in a variety of shrubland habitats, but prefer areas dominated by big sagebrush (*Artemisia tridentata*; Rotenberry *et al.* 1999). It prefers to nest in shrubs that are taller and denser than average (Petersen and Best 1985). This species may be particularly sensitive to habitat fragmentation, and appears to be affected more by changes at the landscape level than at the local level (Knick and Rotenberry 1995). Brewer's sparrow is expected to breed and has been observed within the project area (WGFD 2004a, WYNDD 2007, HWA unpublished data).

Burrowing owl. The burrowing owl is found throughout the plains and prairies of the western United States during the spring, summer, and fall (Haug *et al.* 1993). While the species has the capacity to

excavate its own burrow, it seldom does, relying instead on mammals such as prairie dogs, ground squirrels, and badgers (Thomsen 1971). The burrowing owl's close association with burrowing mammals suggests dependence on them (Haug *et al.* 1993). Knowles (1999) suggested that the burrowing owl is a near prairie-dog obligate species because its distribution is so closely tied to that of prairie dogs. Burrowing owls also use isolated ground-squirrel and badger burrows in hillsides, and road borrow ditches.

Burrowing owl is listed as a species of special concern across Wyoming, as a consequence of long-term population declines (Haug *et al.* 1993). Because of the strong association between burrowing owls and prairie dogs, declines in the burrowing-owl population have been linked to many of the same factors associated with declining prairie-dog populations (i.e., rodent-eradication programs and habitat loss). Furthermore, long-term conservation of the burrowing owl will likely be closely linked to the conservation and preservation of prairie-dog complexes, and other burrowing mammals. Burrowing owl occurs and breeds within the project area (BLM 2007a, WGFD 2004a, WYNDD 2007, HWA unpublished data).

Ferruginous hawk. Primarily found in mixed-grass prairie and sagebrush steppe habitats during the spring, summer, and fall, the ferruginous hawk generally builds nests on rock outcrops, the ground, or cliff ledges. Although a small population overwinters in Wyoming, most individuals migrate south for the winter. Ferruginous hawks are common in south-central Wyoming and breed within the project area (BLM 2007a, WGFD 2007, WYNDD 2007). The western two-thirds of Carbon County hosts one of the highest nesting densities of ferruginous hawks within Wyoming (BLM 2007a). BLM records document the occurrence of 577 ferruginous hawk nest sites (**Table 3.8-5**; BLM unpublished data) in or within one mile of the project area.

Greater Sage-Grouse are found entirely in the western United States and Canada, primarily in the Intermountain West. Wyoming contains more Sage-Grouse than all other states combined. The species remains common in Wyoming because its habitat is relatively intact compared to other states. In south-central Wyoming, the harsh climate has limited habitat loss and conversion to settlements and agriculture. Historically, disturbance to Greater Sage-Grouse habitat in south-central Wyoming has occurred as a result of livestock grazing, associated sagebrush-control treatments, and oil and gas development. Landscape-scale disturbance to this habitat has resulted more recently from the increased development of a variety of energy resources, including renewable energy resources. The Greater Sage-Grouse is considered a sagebrush ecosystem umbrella species; conserving its habitat will benefit other species of conservation concern that share the same habitat (i.e., pygmy rabbit, sage thrasher, and sage sparrow; Rowland *et al.* 2006).

Sage-Grouse are considered a sagebrush obligate species and are dependent upon sagebrush habitats for their year-round survival. This dependency includes using sagebrush for forage, nesting habitat, brood-rearing habitat, and winter thermal cover. Typically, strutting/breeding grounds, or leks, are located in open patches within sagebrush habitat and the surrounding area is considered potential nesting habitat. Nesting habitat tends to have higher sagebrush density, taller live and residual grasses, more live and residual grass cover, and little bare ground (Connelly *et al.* 2004). Mesic habitats are also important for brood-rearing during the summer and fall months. The proximity of nesting habitat to brood-rearing habitat increases its value for broods, but may increase risk for nests (Dzialak *et al*. 2013a).

In February 2013, the USFWS published the Greater Sage-Grouse Conservation Objectives Final Report (the COT Report, USFWS 2013c). The report identified threats to the Greater Sage-Grouse throughout its range and conservation measures that would best address those threats in order to conserve the species. Although the COT Report recommended that impacts to all Sage-Grouse habitat be avoided, it also identified Priority Areas for Conservation (PACs) as "key areas across the landscape that are necessary to maintain redundant, representative, and resilient populations" of the species. The report describes maintaining the integrity of PACs as "the essential foundation for sage-grouse conservation." The Wyoming portion of the Wyoming Basin Greater Sage-Grouse population is identified in the report as low risk given the size of the population; the presence of large, contiguous habitats; and regulatory

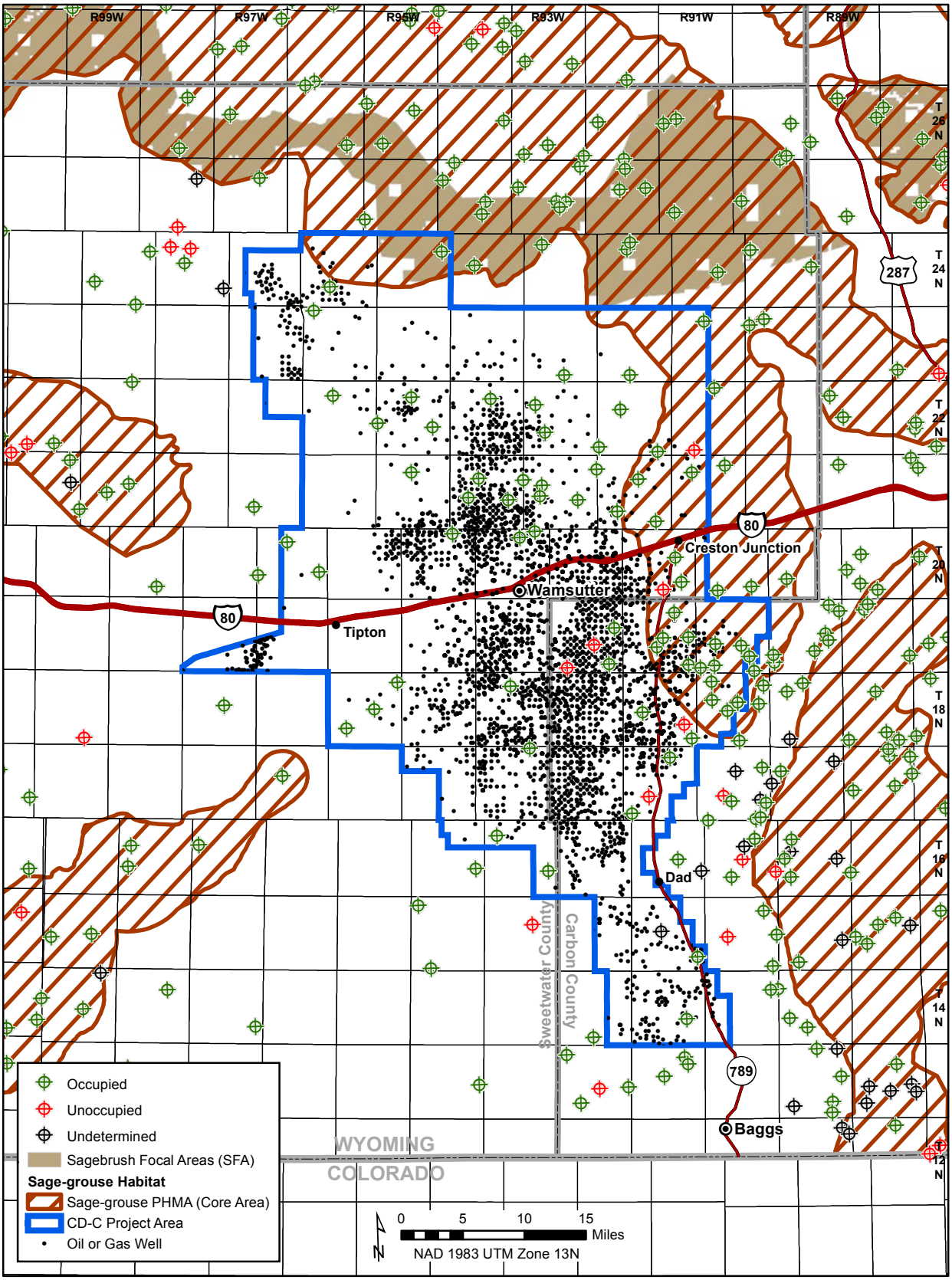
measures providing habitat protection. While all of the approximately 1.1 million acres of the CD-C project area is considered Sage-Grouse habitat, only an estimated 15 percent, about 160,000 acres, is considered a PAC.

This area is the only PHMA within the project area and is part of the Greater South Pass Core Area. The PHMA includes approximately 96,605 acres on BLM-managed land and 63,237 acres of state or private lands (**Map 3.9-1**), overlapping the CD-C project area boundary in two places. A Sagebrush Focal Area (SFA), of which 11,413 acres overlap the CD-C project area, is also located within the Greater South Pass Core Area. The remainder of the project area, 931,000 acres (85 percent), is GHMA.

While all of the approximately 1.1 million acres of the CD-C project area is considered Sage-Grouse habitat, only an estimated 15 percent, about 160,000 acres, is considered a PAC, as described in the COT Report. The only PAC, or PHMA, within the project area is known as the Greater South Pass Core Area. CD-C affected PHMA includes approximately 96,605 acres on BLM-managed land and 63,237 acres of state or private lands (**Map 3.9-1**). A Sagebrush Focal Area (SFA), of which 11,413 acres overlap the CD-C project area, is also located within the Greater South Pass Core Area. The remaining 85 percent of the project area, 931,000 acres, is GHMA.

Sage-Grouse exhibit site fidelity to leks, winter and summer areas, and nesting areas (Schroeder *et al.* 1999). They may be affected by sagebrush community disturbance and removal. Sage-Grouse tend to avoid areas that may provide perching or roosting opportunities for raptors (i.e., fence posts, power lines, and other structures) (Connelly *et al.* 2000 and 2004). Human activity during the breeding season may disrupt lek attendance and affect local breeding success.

Greater Sage-Grouse leks are assigned an annual status of *active*, *inactive*, or *unknown*, and based on those assignments, leks are given a management status of *occupied*, *unoccupied* (destroyed or abandoned), or *undetermined*. According to the 2015 WGFD database, 72 known leks are located in the CD-C project area; 65 are occupied, 6 are unoccupied, and 1 has an undetermined status (**Map 3.9-2**, WGFD 2015). Twenty-two occupied leks are located in the CD-C project area's PHMA. The 0.6-mile NSO buffers around these leks compromise approximately 15,946 acres (1.5 percent of the project area), which includes 8,390 acres of BLM-administered lands, 26 acres of state lands, and 7,530 acres of private lands. There are 43 occupied leks and one undetermined lek located in the CD-C project area's GHMA. The quarter-mile NSO buffers around these 44 leks comprise approximately 6,597 acres (0.56 percent of the project area), which includes 3,039 acres of BLM-administered, 279 acres of state, and 3,279 acres of private lands. **Section 2.2.7.9, Management of Greater Sage-Grouse**, describes the regulatory significance of lek protection buffers.



Map 3.9-2. Greater Sage-Grouse leks, PHMAs and SFAs

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A Sage-Grouse population trend analysis (**Figure 3.9-1**) was conducted to compare Sage-Grouse populations associated with the CD-C project area to other related Sage-Grouse populations in south-central Wyoming and in the state as a whole. Specifically, the populations compared include (1) the Statewide Core areas, (2) the statewide population, (3) the CD-C project area leks, and (4) the Greater South Pass (GSP) Core Area leks. The WGFD Sage-Grouse database (WGFD 2015) was used for this analysis. Average peak male attendance is used as an index of overall population health because the information is the most comprehensive and readily available.

The year 1990 was chosen as a beginning point of the comparison analysis to demonstrate the cyclical nature of the species. Also during this period, throughout the state, Sage-Grouse survey and count protocols were improved and more consistently applied. As demonstrated in **Figure 3.9-1**, the population trend in all study groups is similar regardless of the size of the populations involved or their exposure to oil and gas development or production activities. This comparison of four different groups of Sage-Grouse leks removes the question of local weather conditions affecting the population or the level of survey effort or of any one sub-set of leks affecting or controlling the overall trend. Greater Sage-Grouse populations across the west have declined from historic levels due to a wide range of factors, including drought, habitat loss, and habitat degradation (Connelly and Braun 1997, Braun 1998, Connelly *et al.* 2000 and 2004). Figure 3.9-1 indicates the strength of the Greater South Pass (GSP) Core Area population in south-central Wyoming, shown in green.

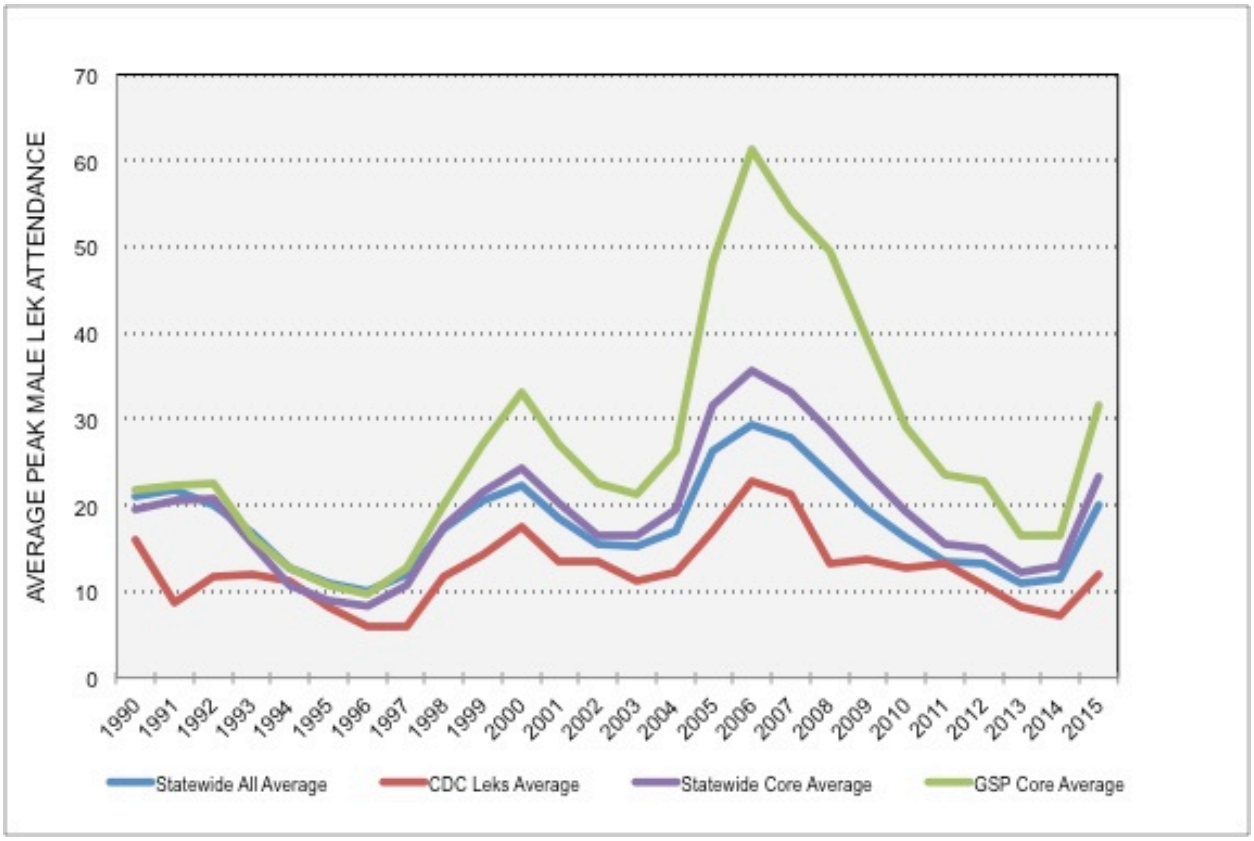


Figure 3.9-1. Average peak observed male attendance for leks associated with the project area

(WGFD 2015)

As can be seen in **Figure 3.9-1**, all Sage-Grouse populations analyzed experienced similar increases and decreases in numbers of individuals observed. It is generally agreed (Connelly 2004) that Sage-Grouse populations are cyclical; Figure 3.9-1 indicates an apparent 7-year cycle. Fedy and Doherty (2011) analyzed the apparent cyclical nature of the cottontailed rabbit and the Greater Sage-Grouse, two completely unrelated species, and found they exhibit very similar cycles. They concluded, "the

broad spatial distribution of the correlations in this study at the individual management unit level (i.e. 100–500 km) demonstrated that correlations are not an isolated phenomenon in Wyoming and lend support to a broad-scale causal influence (e.g., climate)."

Loggerhead shrike. This species breeds and winters throughout the United States in a wide variety of open habitats with some shrub or scattered-tree component. A summer resident, it usually builds its nest within large shrubs such as sagebrush, bitterbrush, or greasewood (Woods and Cade 1996). Loggerhead shrike populations have experienced declines across much of the species' range primarily due to loss of habitat. Livestock grazing in combination with drought is a major factor in the decline. In addition, the loggerhead shrike is prone to the negative effects of pesticide use because its diet consists largely of insects. The species is expected to breed and has been observed within the project area (WGFD 2007, WYNDD 2007, HWA unpublished data).

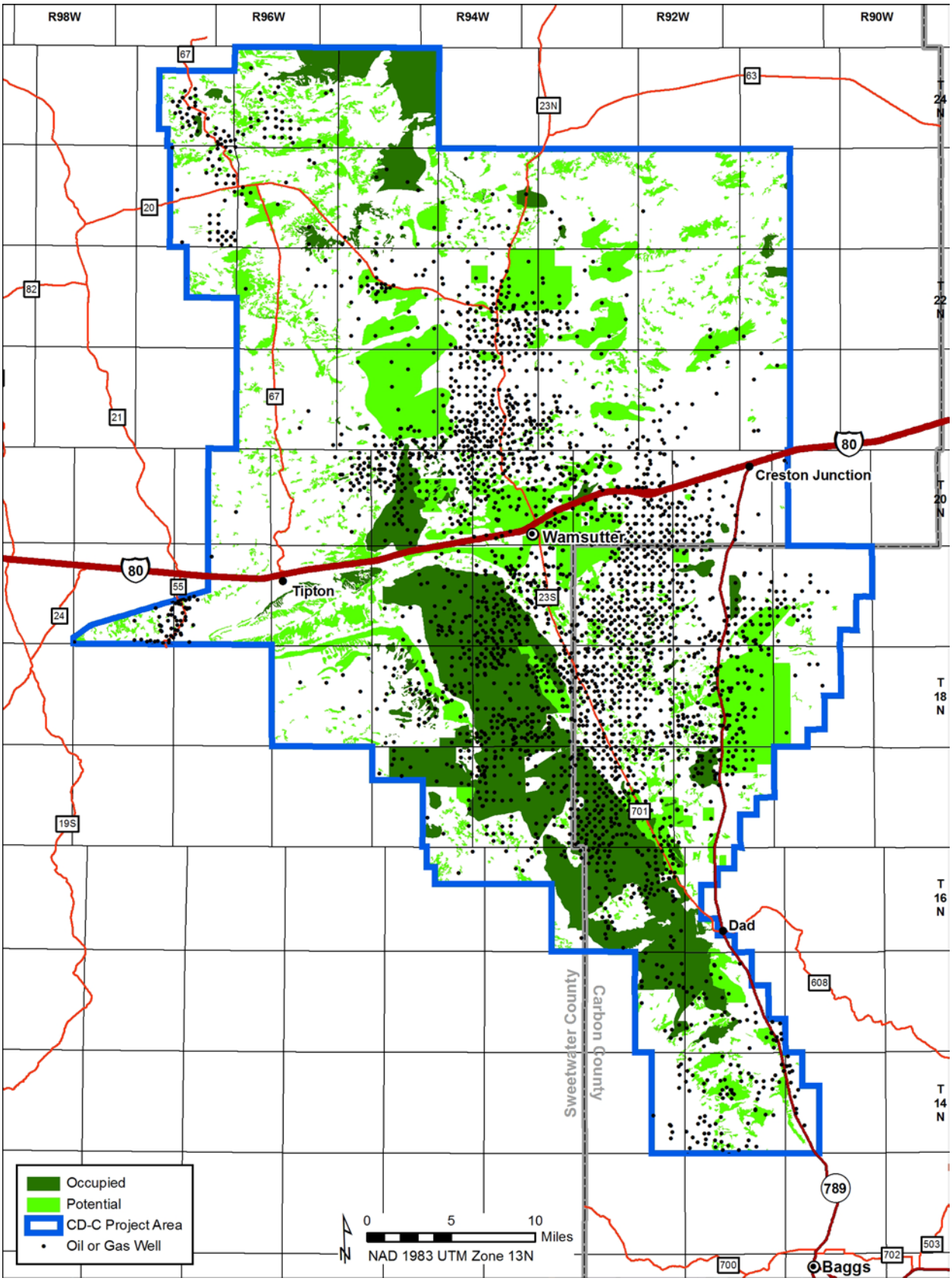
Long-billed curlew. A locally common summer resident of Wyoming (WGFD 2004a), the long-billed curlew prefers gentle, rolling topography in native grasslands, sagebrush, and agricultural lands that can be arid as long as a water source is relatively nearby. One observation of a long-billed curlew has been documented in the extreme south of the project area (WGFD 2007). It is unlikely the species breeds in the project area because suitable breeding habitat and water are limited.

Mountain plover. The mountain plover is dependent on short-grass prairie and also is frequently associated with prairie-dog towns (Knowles *et al*. 1982). The species nests on the ground in large grassland areas with short, sparse vegetation and substantial amounts of bare ground. In May 2011 the USFWS determined that the mountain plover is not threatened or endangered throughout all or a significant portion of its range. Numerous observations of mountain plovers have been recorded within the project area (WGFD 2007, BLM unpublished data, HWA unpublished data). Approximately 342,393 acres of occupied or potential mountain plover habitat have been mapped, comprising approximately 32 percent of the project area (**Map 3.9-3**; HWA unpublished data).

Peregrine falcon. The peregrine falcon breeds throughout North America, including the Arctic, the Pacific coast, the Rocky Mountains, and scattered areas across the eastern United States. Although populations of avian prey species in and around the project area may be abundant and diverse enough to support the species, breeding is unlikely due to the lack of high cliffs suitable for nesting. Nevertheless, peregrine falcons may be present within the project area during migration.

Sage sparrow. A sagebrush obligate found throughout much of the western United States, the sage sparrow breeds in sagebrush expanses from the northern edges of the Great Basin west of the Rocky Mountains to the chaparral and sagebrush scrub in Baja California (Martin and Carlson 1998). Suitable sagebrush habitat is widespread and abundant within the project area. The sage sparrow is expected to breed and has been observed within the project area (WGFD 2007, WYNDD 2007, HWA unpublished data).

Sage thrasher. A sagebrush obligate found throughout the intermountain west, the sage thrasher builds nests in shrub-steppe communities dominated by sagebrush. Suitable sagebrush habitat is widespread and abundant within the project area. The sage thrasher is expected to breed and has been documented within the project area (WGFD 2007, WYNDD 2007, HWA unpublished data).



Map 3.9-3. Occupied and potential mountain plover habitat within the CD-C project area

No warranty is made by the BLM for use of the data for purposes not intended by the BLM.

Amphibians

Great Basin spadefoot. An occupant of sagebrush and greasewood communities as well as playas below 6,000 feet, the Great Basin spadefoot deposits eggs in springs or flooded areas formed by heavy rains (WGFD 2004a). Its life history requires suitable foraging areas, ephemeral breeding ponds, and overwintering sites. In the winter this species digs its own burrow and will overwinter underground, sometimes as deep as 15 feet. The Great Basin spadefoot has been documented in Sweetwater, Lincoln, Fremont, and Natrona Counties, and has been documented within the project area (Baxter and Stone 1992, WGFD 2007, WYNDD 2007). Playas and riparian areas within the project area likely support this species.

Northern leopard frog. This frog species is usually found close to wetlands, cattail marshes, and along vegetated shorelines during summer, but will venture several hundred meters along wet drainages during wet periods (Werner *et al.* 2004). A member of the true frog family (*Ranidae*), the northern leopard frog is an obligate of permanent water in the plains, foothills, and montane zones of Wyoming up to 9,000 feet above sea level (WGFD 2004a). This species has been documented within six miles of the project area and has a high probability of occurring in any area having perennial water (WYNDD 2007). The northern leopard frog was petitioned for listing under the ESA; in October 2011 the USFWS determined at listing was not warranted.

3.9.2.2 Sensitive Fish Species

Fish species that are not listed as Endangered or Threatened by the USFWS, but that may be rare or declining in the state, have been included on the BLM's Wyoming Sensitive Species List. The intent of the sensitive species status is to ensure that actions on BLM-administered lands consider the welfare of these species and do not contribute to the need to list any other species under the provisions of the ESA (BLM 2001).

Four BLM Wyoming State sensitive fish species are known to occur in portions of streams on or adjacent to the project area. These include the roundtail chub (*Gila robusta*), bluehead sucker (*Catostomus discobolus*), flannelmouth sucker (*Catostomus latipinnis*), and Colorado River cutthroat trout (*Oncorhynchus clarkii pleuriticus*) (WYNDD 2003, BLM 2001). The three non-game fish species (roundtail chub, bluehead sucker, flannelmouth sucker) have been found within Muddy Creek downstream, within, and upstream of the project area, and in Bitter Creek downstream of the project area (WGFD 1998, 2004b, 2007a). All of Muddy Creek within the project area is considered to be habitat for these three non-game, sensitive fish species. In general, all three species are associated with hard substrates and deep pool habitat (Bower 2005).

The Muddy Creek watershed is one of the few stream systems in Wyoming where these three native, non-game fish species exist together (WGFD 2004b) and the only watershed where these species and Colorado River cutthroat trout are known to coexist. It has also been designated as Aquatic Crucial Habitat by the WGFD because the area addresses Goal 1 of the WGFD Strategic Habitat Plan (WGFD 2009). Because of the high conservation value of Muddy Creek for these species, multiple studies have been conducted to increase understanding of their ecology in the creek. The BLM is a signatory to the range-wide (Wyoming and other states) conservation agreement and strategy for roundtail chub, bluehead sucker, and flannelmouth sucker where these three non-game species are present. The BLM, WGFD, and University of Wyoming completed a study to better characterize the abundance, distribution, behavior, habitat requirements and genetics of the three non-game sensitive species within the Muddy Creek watershed, which included part of the project area (Beatty 2005). The following is a summary of those study results for 2004.

Man-made structures have resulted in three fragmented stream segments in the lower Muddy Creek watershed (Beatty 2005, **Map 3.9-4**). The farthest downstream segment (segment 1) begins at the confluence of Muddy Creek with the Little Snake River and extends upstream to a wetland complex with

water-control structures that inhibit fish movement. The farthest downstream segment experiences periods of no surface flow with isolated pools and was dominated by non-native fishes in 2004. The middle segment (segment 2) consists of a wetland complex with numerous water-control structures and was dominated by non-native species, particularly the fathead minnow (*Pimephales promelas*). The upstream segment (segment 3) extended from upstream of the wetland complex to a headcut stabilization structure that prevents upstream movement by fish. The upstream segment was dominated by two native species: roundtail chub (*Gila robusta*) and speckled dace (*Rhinichthys osculus*). Constructed wetlands and barriers to upstream movements by fishes appear to influence native fishes and the structure of fish communities in lower Muddy Creek, similar to the effects of fragmentation and intermittent stream flows in other areas of the Colorado River Basin.

Compton (2007) completed a study on the effects of barriers on these three sensitive species in Muddy Creek upstream of the wetland complex. Instream structures prevented or severely limited upstream movements, but downstream movements over structures occurred. Within each segment in this study area, roundtail chubs were most abundant and flannelmouth suckers were least abundant among the three native species. A core population of the three native species existed in one segment and supported the highest densities of juveniles and adults and the broadest length ranges. Non-native white suckers, *Catostomus commersoni,* were the most abundant species in the study area. Their highest densities occurred in altered habitat. Substantial hybridization with the two native catostomid species was evident. Compton (2007) concluded that native fish populations in the most upstream segment may be at risk of extirpation due to low abundance and reproduction. Connectivity among habitats is required to carry out the life-cycles of native fishes and fragmentation by man-made structures is affecting their abundance and distribution patterns.

WGFD (2007a) sampled these three species in the Muddy Creek and Bitter Creek watersheds in 2006 as part of a study of these species within the Green River watershed in Wyoming. Of the three species, only roundtail chubs were found in lower Muddy Creek. However, flannelmouth sucker-white sucker hybrids were found there. In upper Muddy Creek within the CD-C project area, all three species were found as well as flannelmouth sucker-white sucker hybrids and bluehead sucker-white sucker hybrids. Flannelmouth suckers also were found in the headwaters of Bitter Creek. WGFD (2007a) concluded that perhaps the biggest threat to native bluehead and flannelmouth suckers in the Green River drainage of Wyoming is the occurrence of and subsequent hybridization with non-native white sucker.