3.0 Affected Environment

3.1 Geology, Geologic Hazards, and Minerals

3.1.1 Geology

3.1.1.1 Physiography and Topography

The project area is located in the eastern Greater Green River Basin, which is part of the Wyoming Basin physiographic province (Howard and Williams 1972). The Greater Green River Basin covers much of southwestern Wyoming and extends into northeastern Utah and northwestern Colorado. Elevations in the project area range from 6,600 to over 7,000 feet above mean sea level (amsl). The area lies between the east flank of the Rock Springs Uplift and the west side of the Washakie Basin, one of several smaller sub-basins within the Greater Green River Basin. The topography consists of rolling plains and mesas bounded by prominent escarpments, referred to locally as rims. Where the plateaus are crossed by drainages, the topography is deeply incised.

3.1.1.2 Stratigraphy

Unconsolidated surficial deposits consist of alluvium, colluvium, and sand. The bedrock in the project area consists of portions of the Fort Union and Wasatch formations. The formations are Tertiary in age and largely consist of sandstones, claystone, shale, and coal (Love and Christensen 1985). Below the Fort Union formation are the Lance, Fox Hills Sandstone, Lewis Shale, and the Almond formations, all from the upper Cretaceous Period (**Table 3-1**). The primary oil and gas reservoirs in the Monell and Arch units are the UA5 and UA6 sandstones of the upper Almond Formation derived from barrier bar and shoreline deposits (Weimer 1966).

Table 3-1 Stratigraphic Chart of Tertiary and Upper Cretaceous Geologic Units

	Geologic Unit	Approximate Thickness (feet)	Description
Tertiary	Wasatch Formation (main body)	0 to 1,000	Mudstone with lenses of sandstone can contain beds of carbonaceous shale and coal.
	Fort Union Formation	900 to 1,800	Sandstone, shale, and coal.
Upper Cretaceous	Lance Formation	600 to 900	Carbonaceous shale, sandstone and siltstone with occasional coal beds near base above Fox Hills Sandstone.
	Fox Hills Sandstone	300	Mainly sandstone with inter-bedded clay.
	Lewis Shale	800 to 1,000	Marine shale, mainly black in color, with thin beds of siltstone, sandstone, and bentonite.
	Almond Formation	360 to 420	Sandstone, carbonaceous shale, and coal. The Monell and Arch units produce oil and gas from the upper sandstone interval composed of very fine- to fine-grained quartzose sandstone.

Sources: Anderson and Ryder 1978; Gaines 2008; Watson 1980; Weimer 1966.

There is a fairly thick sequence of sedimentary rocks that underlie the project area. The Washakie Basin may contain approximately 20,000 to over 30,000 feet of sedimentary rock (Kent 1972). The total stratigraphic section in the project area from the base of the Almond Formation to Precambrian basement may be up to 23,000 feet thick and consist of sedimentary rocks representing Cambrian to Tertiary periods. The Ordovician through Devonian Systems are not present in this area (Love et al. 1993). The Precambrian basement may consist of metamorphic rocks that may be billions of years old (Sims et al. 2001).

3.1.1.3 Geologic Structure

The Rock Springs Uplift is a large asymmetric anticline, with gentle southeast dips ranging from 5° to 7° (Weimer 1966). The proposed project is located on the east-dipping flank of the Rock Springs uplift. The sedimentary rocks continue to dip to the east to the structural axis of the Washakie Basin, generally 20 to 25 miles east of the project area (Skeeters and Hale 1972).

There are no apparent surface faults in the project area (Love and Christiansen 1985). Ryder et al. (1989) reported deep faults in the area mapped from seismic information; however, these faults are located outside of the project area and do not reach the surface.

3.1.2 Geologic Hazards

Potential geologic hazards include landslides and earthquakes. Landslides involve the mass movement of earth materials down slopes and can include debris flows, soil creep, and slumping of large blocks of material. There are no identified landslides in the project area (Wyoming State Geological Survey 2012).

Earthquakes occur when blocks of the earth's crust move along areas of weakness or faults releasing energy. There are no identified active faults in the project area (USGS 2006). An active fault is a fault that has demonstrated movement within the last 11,000 years. The project is located in an area of low risk from ground shaking, if a maximum credible earthquake (i.e., causing maximum ground motion) were to occur in the region (Petersen et al. 2008).

3.1.3 Mineral Resources

3.1.3.1 Leasable Minerals

Fluid Minerals

The major fluid minerals in the area are oil, natural gas, and coal bed methane. Geothermal energy also is considered a fluid mineral resource, but there are no identified geothermal resources in the project area.

Oil and Natural Gas. The Monell and Arch units are located in an area with abundant oil and natural gas resources. The Greater Green River Basin is estimated to contain undiscovered resources of 84 trillion cubic feet of natural gas and 131 million barrels of oil (USGS 2002). The proposed project is located in the vicinity of several oil and gas fields, which are listed in **Table 3-2**.

The Monell and Arch units were originally part of Patrick Draw Field that was discovered in 1959 (Weimer 1966). Oil and gas occurs in stratigraphic traps in sandstones of the upper Almond Formation. The Patrick Draw Field is comprised of two federal units, Arch and Monell. CO_2 injection EOR was implemented in 2003 at Monell Unit (Isaacs et al. 2009). Prior to CO_2 injection, production at Monell had dropped to 15 barrels of oil per day. As of August 2012, production at Monell was slightly more than 5,000 barrels per day (WOGCC 2012).

Table 3-2 Oil and Gas Fields in the Vicinity of the Monell-Arch EOR Project

Field Name/Location	Date Discovered/ Status	Producing Formation(s)[1]	Oil – Cumulative Production[2] (barrels)	Gas – Cumulative Production[2] (thousand cubic feet)
Antelope T17N, R100-101W	1970/Active	Almond Mesaverde	50,656	56,658,471
Arch T19N, R98W	1959/Active	Almond	37,086,077	184,891509
Brady North T17N, R100W	1978/Active	Dakota Entrada, Nugget Weber	8,626,362	21,414,697
Dead Man Wash T20N, R101W	1973/Active	Frontier Muddy Dakota	8,242	40,352,134
Delaney Rim T18N, R97W	1976/Active	Lewis Almond	1,518,511	11,075,456
Desert Springs T20 & 21N R98W	1958/Active	Fox Hills Lance Lewis Almond	2,609,571	508,729,568
Desert Springs West	1959/Active	Lewis Almond	2,700,797	39,189,742
Golden Wall T18N, R101W	1977/Abandoned	Dakota	220	2,906
Hallville T19N, R100W	1962/Abandoned	Almond	69,838	2,737
Higgins T17N; R98-99W	1969/Active	Almond, Lewis, Nugget, Weber	41,846	11,939,261
Masterson T20N, R101W	1970	Blair Mowry Muddy Dakota	1,652	2,522,675
Neff T18N, R98W	1968/Abandoned	Almond	255	32,795
Monell Unit T18 & 19N R98 & 99W	1959/Active	Fox Hills Lance Lewis Almond Ericson	14,273,106[3]	20,472,194[3]
Point of Rocks T19 & 20N, R101W	1963/Active	Blair Frontier	118,144	10,408,683
Red Hill T19N, R100W	1962/Abandoned	Almond Ericson	0	14,913

Table 3-2 Oil and Gas Fields in the Vicinity of the Monell-Arch EOR Project

Field Name/Location	Date Discovered/ Status	Producing Formation(s)[1]	Oil – Cumulative Production[2] (barrels)	Gas – Cumulative Production[2] (thousand cubic feet)
Sand Butte T17N; R99W	1960/Active	Mesaverde	0	4,740,828
Stage Stop T18N; R99W	1966/Active	Almond, Lance, Lewis, Wasatch, Fort Union	1,440,584	20,008,704
Table Rock	1945/Active	Ft. Union, Fox Hills, Lewis, Mesaverde, Frontier, Dakota, Morgan, Nugget, Weber, Madison	8,252,540	980,477,391
Table Rock Southwest T18N, R98W	1955/Active	Almond, Lewis, Mesaverde	19,455	37,711,150

[1] Formations from Wyoming Geological Association 1992.

[2] Production to end of 2011 as reported by WOGCC 2012. Includes pre-1978 production.

[3] Production to end of 2011. The production does not include pre-production numbers.

Coal Bed Methane. The total undiscovered coal bed methane resource of the Greater Green River Basin is estimated be about 1.5 trillion cubic feet of gas (USGS 2002). The project area is within an area of potential for production of coal bed methane from upper Cretaceous and Tertiary rocks. There are no operating coal bed projects in the vicinity of the project area. The Copper Ridge coal bed unit, located in T16N and T17N, R100W, had last reported production in 2007 (WOGCC 2012). North Copper Ridge Unit in T17N and T18N, R100W and R101W had no reported production. Another coal bed methane development pipeline, located in T18N and T19N, R100W, is largely abandoned after attempts to produce gas from coals in the Almond and Lance formations.

Solid Leasable Minerals

Solid leasable minerals include coal, trona, and oil shale. Coal and trona are produced in substantial quantities in the Green River Basin. Coal is mined from the Fort Union Formation at the Black Butte Coal Mine, about 6 miles west of the project area. Most of the mineable coal has been removed since mining began in 1980 (BLM 2005). There are no trona leases in the project area, but this mineral is mined in areas west and northwest of Rock Springs. The potential oil shale-bearing Green River Formation is present to the south of the project area (Love and Christensen 1985), but there are no oil shale-bearing strata in the project area.

3.1.3.2 Locatable Minerals

No locatable minerals or mining claims are present in the project area (BLM 1997).

3.1.3.3 Mineral Materials

There is moderate potential for mineral materials (sand and gravel), but there are no active sand and gravel pits in the project area (BLM 1997; WDEQ 2012a).

3.2 Paleontological Resources

3.2.1 Regulatory Structure

Federal legislative protection for paleontological resources stems from the Antiquities Act of 1906 (P.L. 59-209; 16 USC 431 et seq.; 34 Stat. 225), which calls for protection of historic landmarks, historic and prehistoric structures, and other objects of historic or scientific interest on federally administered lands. Federal protection for scientifically important paleontological resources would apply to construction or other related project impacts that would occur on federally owned or managed lands. The National Registry of Natural Landmarks provides protection to paleontological resources. The BLM manages paleontological resources (fossils) on federal lands under the following statutes and regulations (BLM 2012a).

- Federal Land Policy and Management Act of 1976 (P.L. 94-579);
- National Environmental Policy Act of 1969 (P.L. 91-190);
- Various sections of BLM's regulations found in Title 43 CFR that address the collection of invertebrate fossils and, by administrative extension, fossil plants; and
- The Paleontological Resources Preservation Act of 2009. The law authorizes the BLM and U.S. Forest Service (USFS) to manage and provide protection to fossil resources using "scientific principles and expertise" (BLM 2012a).

In addition to the statutes and regulations listed above, fossils on public lands are managed through the use of internal BLM guidance and manuals such as the BLM Manual 8270 and the BLM Handbook H-8270-1 (BLM 1998a,b). Various internal instructional memoranda have been issued to provide guidance to the BLM in implementing management and protection to fossil resources.

3.2.2 Potential Fossil Yield Classification

The BLM uses the Potential Fossil Yield Classification (PFYC) system to identify and classify fossil resources on federal lands (BLM 2007). Paleontological resources are closely tied to the geologic units (i.e., formations, members, or beds) that contain them. The probability for finding paleontological resources can be broadly predicted from the geologic units present at or near the surface. Therefore, geologic mapping can be used for assessing the potential for the occurrence of paleontological resources.

The PFYC system is a way of classifying geologic units based on the relative abundance of vertebrate fossils or scientifically significant fossils (plants and invertebrates) and their sensitivity to adverse impacts. A higher class number indicates higher potential. The PFYC is not intended to be applied to specific paleontological localities or small areas within units. Although significant localities may occasionally occur in a geologic unit, a few widely scattered important fossils or localities do not necessarily indicate a higher class; instead, the relative abundance of significant localities is intended to be the major determinant for the class assignment.

The PFYC system is meant to provide baseline guidance for predicting, assessing, and mitigating paleontological resources. The classification should be considered at an intermediate point in the analysis, and should be used to assist in determining the need for further mitigation assessment or actions. The BLM intends for the PFYC system to be used as a guideline as opposed to rigorous definitions. Descriptions of the potential fossil yield classes are summarized in **Table 3-3**.

Table 3-3 Potential Fossil Yield Classification

Class	Description	Basis	Comments
1	Igneous and metamorphic (tuffs are excluded from this category) geologic units or units representing heavily disturbed preservation environments that are not likely to contain recognizable fossil remains.	Fossils of any kind known not to occur except in the rarest of circumstances. Igneous or metamorphic origin. Landslides and glacial deposits.	The land manager's concern for paleontological resources on Class 1 units is negligible. Ground disturbing activities will not require mitigation except in rare circumstances.
2	Sedimentary geologic units not likely to contain vertebrate fossils or scientifically significant invertebrate fossils.	Vertebrate fossils known to occur very rarely or not at all. Age greater than Devonian. Age younger than 10,000 years before present. Deep marine origin. Aeolian origin. Diagenetic alteration.	The land manager's concern for paleontological resources on Class 2 units is low. Ground disturbing activities are not likely to require mitigation.
3	Fossiliferous sedimentary geologic units where fossil content varies in significance, abundance, and predictable occurrence. Also sedimentary units of unknown fossil potential.	Units with sporadic known occurrences of vertebrate fossils. Vertebrate fossils and significant invertebrate fossils known to occur inconsistently; predictability known to be low. Poorly studied and/or poorly documented. Potential yield cannot be assigned without ground reconnaissance.	The land manager's concern for paleontological resources on Class 3 units may extend across the entire range of management. Ground disturbing activities would require sufficient mitigation to determine whether significant paleontological resources occur in the area of a proposed action. Mitigation beyond initial findings would range from no further mitigation necessary to full and continuous monitoring of significant localities during the action.

Table 3-3 Potential Fossil Yield Classification

Class	Description	Basis	Comments
4	Class 4 geologic units are Class 5 units (see below) that have lowered risks of human-caused adverse impacts and/or lowered risk of natural degradation.	Significant soil/vegetative cover; outcrop is not likely to be impacted. Areas of any exposed outcrop are smaller than 2 contiguous acres. Outcrop forms cliffs of sufficient height and slope that most is out of reach by normal means. Other characteristics that lower the vulnerability of both known and unidentified fossil localities.	The land manager's concern for paleontological resources on Class 4 units is toward management and away from unregulated access. Proposed ground disturbing activities would require assessment to determine whether significant paleontological resources occur in the area of a proposed action and whether the action would impact the paleontological resources. Mitigation beyond initial findings will range from no further mitigation necessary to full and continuous monitoring of significant localities during the action.
5	Highly fossiliferous geologic units that regularly and predictably produce invertebrate fossils and/or scientifically significant invertebrate fossils, and that are at risk of natural degradation and/or human-caused adverse impacts.	Vertebrate fossils and/or scientifically significant invertebrate fossils are known and documented to occur consistently, predictably, and/or abundantly. Unit is exposed; little or no soil/vegetative cover. Outcrop areas are extensive; discontinuous areas are larger than 2 contiguous acres. Outcrop erodes readily; may form badlands. Easy access to extensive outcrop in remote areas. Other characteristics that increase the sensitivity of both known and unidentified fossil localities.	The land manager's highest concern for paleontological resources should focus on Class 5 units. Mitigation of ground disturbing activities is required and may be intense. Areas of special interest and concern should be designated and intensely managed.

Source: BLM 2008.

3.2.3 Fossil Resources in the Project Area

3.2.3.1 Wasatch Formation

The Wasatch Formation in southern Wyoming has a high potential for paleontological resources and is ranked as a PFYC 5 formation (BLM 2008). Along the east flank of the Rock Springs Uplift both the Niland Tongue and main body of the Wasatch Formation contain accumulations of fossil vertebrates (fish, turtles, crocodiles, birds, and mammals), invertebrates (snails and clams), and traces and tracks of these organisms and fossil plants (BLM 2003). Vertebrate remains include isolated bones and teeth and rarely articulated skeletal parts. The fossil mammals include primates, insectivores, marsupials, condylarths, (archaic hoofed animals), artiodactyls, perissodactyls, carnivores, creodonts, bats, rodents, arctocyonids, and tillodonts.

More than 250 fossil vertebrate localities have been identified in the Wasatch Formation along the east flank of the uplift (BLM 2003). Six fossil vertebrate localities occur in the Niland Tongue. At least two dozen fossil localities are known from the main body of the formation exposed along the east side of Patrick Draw Road. Thousands of cataloged specimens have come from sediments of the Wasatch Formation as exposed along the Patrick Draw Road (BLM 2003).

3.2.3.2 Fort Union Formation

Although considered a PFYC 3 formation, the Fort Union Formation exposed along the eastern flank of the Rock Springs Uplift has produced scientifically important fossils of vertebrates, invertebrates, and plants (BLM 2003). Fossil vertebrate remains are known from more than 50 fossil localities presently identified in the formation. Mammal fossils from these localities include at least 70 species of middle to late Paleocene age. The uppermost rocks of the formation contain fossil mammals that mark the transition of the Eocene epoch and document the appearance of modern mammalian families in North America as well as the disappearance of archaic forms. More than 1,500 vertebrate specimens have been collected from the Fort Union Formation along the east flank of the Rock Springs Uplift.

3.3 Soils

A variety of data sources were used to identify the baseline soil characteristics in the project area. Information on Major Land Resource Areas and Soil Types was obtained from Natural Resources Conservation Service (NRCS) literature or data, including the Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin, U.S. Department of Agriculture Handbook 296 (NRCS 2006), Order 3 draft soil survey data (NRCS 2012a), and the University of Wyoming (UW), Soils of Wyoming: A Digital Statewide Map at 1:500,000-Scale, data review and analyses (Munn and Arneson 1999). The Order 3 NRCS data Sweetwater, County, Wyoming (NRCS 2012a) is the primary source for the soils data, where available. Order 3 soil surveys are not intensively mapped, with map units delineated to cover between 4 and 16 acres, intended primarily for managing range land or broad community planning. The Order 3 soil survey data for both of these counties is provisional and is subject to change. Some locations within the project boundary did not have NRCS Order 3 mapping available. In locations where Order 3 data were unavailable, the UW Digital Statewide Map at 1:500,000-Scale was utilized.

3.3.1 Regional Overview

The proposed project area lies within one Major Land Resource Areas (MLRAs): MLRA 34A – Cool Central Desertic Basins and Plateaus. Soils in MLRA 34A are generally calcareous and shallow or moderately deep to sedimentary bedrock. Some of the soils formed in slope alluvium or residuum derived from shale or sandstone. Soils that formed in stream- or river-deposited alluvium are near the major waterways. The average annual precipitation is 7 to 12 inches and the freeze-free period ranges from 45 to 160 days. The dominant soil orders in this MLRA are Aridisols and Entisols. Aridisols are well developed soils that have a very low concentration of organic matter and form in an arid or semi-arid

climate. In contrast, Entisols are considered recent soils that lack soil development because erosion or deposition rates occur faster than the rate of soil development.

3.3.2 Soil Characteristics within the Project Area

A variety of soils occur within the project area. The soil variability stems primarily from a variety of parent materials as influenced by topography, aspect, elevation, vegetation, and differential rates of mineral weathering. The soils formed from alluvium, colluvium, residuum, and eolian parent materials primarily derived from sedimentary rocks. Shallow to moderately deep (20 to 40 inches deep) soils are common in the project area. Soil depths range from shallow (less than 20 inches) on ridges and hillslopes to very deep (greater than 60 inches) in valley bottoms with slopes ranging from 0 to 60 percent.

Several revegetation limitations are listed for the soil map units overlying the project area. These limitations include alkalinity, salinity, sodicity, lack of precipitation, water holding capacity, hydric soils, soil depth, rock fragment content, and erosion potential. Soil characteristics such as the susceptibility to erosion and the potential for revegetation are important to consider when planning for construction activities and stabilization of disturbed areas. These hazards or limitations for use are a function of many physical and chemical characteristics of each soil, in combination with the climate and vegetation. **Table 3-4** summarizes some important soil characteristics to be considered when evaluating the effects of surface-disturbing activities. Not all of the project area has provisional Order 3 data available (**Figure 3-1**). The areas without Order 3 data (approximately 9,044 acres) are not included in the table; however; a description of the soils based on the UW data follows the table. Explanations of the meanings of each column follow the table.

Water erosion is the detachment and movement of soil by water. Natural erosion rates depend on inherent soil properties, slope, soil cover, and climate. Wind erosion is the physical wearing of the earth's surface by wind. Wind erosion removes and redistributes soil. Small blowout areas may be associated with adjacent areas of deposition at the base of plants or behind obstacles, such as rocks, shrubs, fence rows, and roadbanks (NRCS-Soil Quality Institute 2001). Of the Order 3 mapped soils in the project area, approximately 22 acres of wind erodible soils occur.

Prime farmland is land that has the best combination of physical and chemical characteristics for producing crops and that is available for these uses. It has the combination of soil properties, growing season, and moisture supply needed to produce sustained high yields of crops in an economic manner if it is treated and managed according to acceptable farming methods. These soils have the capability to be prime farmland, but may have not yet been developed for irrigated agriculture uses. No prime farmland occurs within the project area, and therefore it is not discussed further.

Hydric soils are soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part. These soils are commonly associated with floodplains, lake plains, basin plains, and with riparian areas, wetlands, springs, and seeps. No hydric soils are mapped within the project area; however, due to the scale of mapping, small areas of hydric soils may not be captured.

Compaction and shrink/swell potential are related to the amount and type of clay in a soil and affect the soil's ability to support construction and be reclaimed. In soils with a high shrink/swell potential, rapid changes in volume can damage structures and roads. Soils with montmorillonite (smectite or bentonite) clays are considered to have a high shrink/swell potential (measured by linear extensibility). Soils with 28 percent or greater clay content are classified as compaction prone, specifically when moist or wet. Of the Order 3 mapped soils in the project area, approximately 45 acres of compaction prone (or clayey) soils occur.

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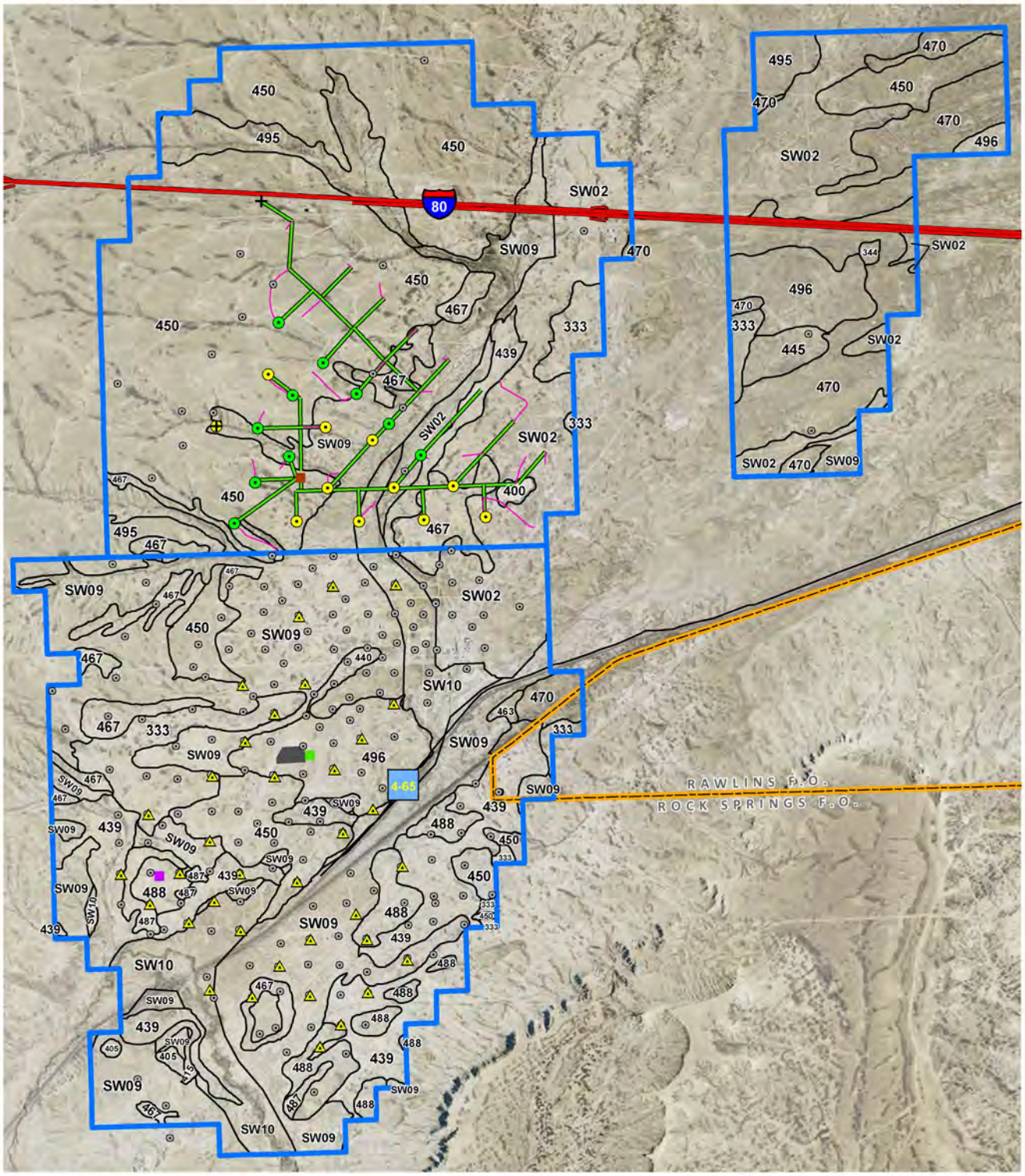

Figure 3-1

Soils within the Project Area

Table 3-4 Soil Characteristics in the Project Area

Map Unit Symbol	Map Unit Name	Surface Texture	Shrink-Swell Potential	Hydric	Compaction Prone	Wind Erosion	Shallow Bedrock	Doughty	Acres
333	Sagecreek-Sagecreek alkali complex, 0 to 4 percent slopes	fine sandy loam	Low	Not Hydric	No	Moderate	No	Droughty	717
344	Dines overflow, alkali, 0 to 3 percent slopes	silt loam	Moderate	Not Hydric	No	Low	No	No	16
400	Playas	Misc.	Misc. Area	Unknown Hydric	Misc. Area	Misc. Area	No	Misc. Area	31
405	Gravel and borrow pits	Misc.	Misc. Area	Not Hydric	Misc. Area	Misc. Area	No	Misc. Area	30
415	Cambarge-Pepal complex, 1 to 15 percent slopes	fine sandy loam	Low	Not Hydric	No	Moderate	No	Droughty	33
439	Dinco very fine sandy loam, 0 to 4 percent slopes	very fine sandy loam	Low	Not Hydric	No	Moderate	No	Droughty	1,663
440	Youjay-Westvaco complex, 0 to 6 percent slopes	sandy loam	Moderate	Not Hydric	Yes	Moderate	No	Droughty	45
445	Sagecreek loam, 2 to 6 percent	loam	Low	Not Hydric	No	Low	No	No	128
450	McCullen loams, 1 to 8 percent slopes	loam	Low	Not Hydric	No	Moderate	No	No	6,145
463	Kandaly-Youjay-Westvaco complex, 0 to 20 percent slopes	loam	Low	Not Hydric	No	Severe	No	No	22
467	Haterton-Rock outcrop, shale complex, 8 to 30 percent slopes	paragravel ly loam	Low	Unknown Hydric	No	Low	No	No	892
470	Leckman-Kandaly-Terada complex, 2 to 8 percent slopes	sandy loam	Low	Not Hydric	No	Moderate	No	Droughty	1,461
487	Pepton-Rock outcrop, sandstone complex, 6 to 30 percent slopes	sandy loam	Low	Unknown Hydric	No	Moderate	Yes	Droughty	119

Table 3-4 Soil Characteristics in the Project Area

Map Unit Symbol	Map Unit Name	Surface Texture	Shrink-Swell Potential	Hydric	Compaction Prone	Wind Erosion	Shallow Bedrock	Doughty	Acres
488	Mccullen very fine sandy loam, 2 to 5 percent slopes	loam	Low	Not Hydric	No	Low	No	No	534
495	Bittercreek-Sagecreek loams, 2 to 10 percent slopes	loam	Moderate	Not Hydric	No	Moderate	No	No	796
496	Sobson-Haterton complex, 2 to 6 percent slopes	fine sandy loam	Low	Not Hydric	No	Moderate	Yes	Droughty	980

Source: NRCS 2012a.

Soils that are droughty have physical characteristics that may limit plant growth due to low water holding capacity. In addition, the success of stabilization and restoration efforts in these areas may be limited unless additional treatments and practices are employed to offset the adverse physical characteristics of the soils. Of the Order 3 mapped soils in the project area, approximately 4,988 acres of droughty soils occur.

Soils with shallow depth to bedrock are those soils that contain lithic (hard) bedrock within 60 inches of the soil surface. Of the Order 3 mapped soils in the project area, approximately 1,099 acres of soils with shallow bedrock occur.

Biological soil crusts are considered an important component in dry arid ecosystems. They provide soil stability, prevent erosion, fix nitrogen, increase infiltration rates, and may reduce noxious weed migration. No site-specific data are available on soil crust coverage in the study area; however, research shows that biological soil crusts do best where sedimentary parent materials are found (Belnap et al. 2003).

Based on Munn and Arneson (1999), the soils that make up the remaining portion of the project area not covered by the NRCS (2012a) soil survey include the following:

- SW02 – Dune Land (Typic Torripsamments, mixed, frigid) – These soils are droughty, highly wind erodible, and frequently shifting. Generally vegetation and organic matter is sparse. They have low shrink-swell potential and are not hydric.
- SW02 – Typic Torriorthents, coarse-loamy, mixed (calcareous), shallow – These soils are shallow to bedrock, wind erodible, and droughty. They are calcareous (alkaline). They have low shrink-swell potential and are not hydric.
- SW09 – Typic Torriorthents, loamy, mixed (calcareous), frigid, shallow – These soils are shallow to bedrock and loamy. They are calcareous (alkaline). They have low shrink-swell potential and are not hydric.
- SW09 – Typic Haplocalcids, coarse-loamy, mixed, frigid – These soils are wind erodible and droughty. They have a calcic horizon that is enriched with secondary carbonates over a thickness of 15 cm or more. These soils have low shrink-swell potential and are not hydric.
- SW09 – Lithic Torriorthents, loamy-skeletal, mixed (calcareous), frigid – These soils are shallow to lithic bedrock and loamy. They have high rock fragment content. They are calcareous (alkaline).
- SW10 – Aquic Haplustolls, coarse-loamy, mixed, frigid – These soils have, in one or more horizons within 100 cm of the mineral soil surface, aquic (wet) conditions for some time in most years (or artificial drainage). They are wind erodible when dry.
- SW10 – Ustic Torriorthents, fine-loamy, mixed (calcareous), frigid – These soils are moderately water erodible.
- SW10 – Typic Fluvaquents, fine-loamy, mixed (calcareous), frigid –These soils are comprised of very young sediments due to frequent flooding. They typically occur in floodplains.

3.4 Water Resources

This section addresses surface water and groundwater resources that may be affected by the proposed Monell and Arch Units Project. The assessment of potential impacts to these resources was based on desktop analyses of existing information.

3.4.1 Surface Water

According to the Watershed Boundary Dataset, the majority of the project area is located in the Bitter Creek- Patrick Draw and Bitter Creek-Antelope Creek watersheds within the Upper Green Basin, and the

Salt Sage Draw Watershed within the Great Divide Closed Basin (U.S. Department of Agriculture [USDA]-NRCS et al. 2010). These watersheds do not contain any USEPA, state, or locally designated surface water protection areas (Medina 2011; USEPA 2011a; WDEQ 2004). **Table 3-5** describes the project area location and acreage by watershed.

Table 3-5 Project Area Acreage by Water Drainage Boundary

Region	Sub-region	Basin	Sub-basin	Watershed	Sub-watershed	Hydrologic Unit Code	Acres
Upper Colorado	Great Divide-Upper Green	Upper Green	Bitter Creek	Antelope Creek - Bitter Creek	Table Rock - Bitter Creek	140401050108	783
				Patrick Draw - Bitter Creek	Lower Patrick Draw	140401050201	8,918
					Upper Patrick Draw	140401050202	12,163
					Town of Bitter Creek -Bitter Creek	140401050203	575
		Great Divide Closed Basin	Great Divide Closed Basin	Salt Sage Draw	Lower Salt Sage Draw	140402000603	218

Source: USDA-NRCS et al. 2010.

Streams in the project area are classified by the National Hydrography Dataset (USGS 2011) as generally being intermittent; however, evidence through literature review and past field reconnaissance would indicate these waterways are likely ephemeral in nature, only flowing in direct response to runoff events caused by direct precipitation and seasonal events such as snowmelt and runoff. The one exception to this is the perennial-flowing Bitter Creek in the southwest portion of the project area.

Streams in the Patrick Draw-Bitter Creek Watershed generally flow to the south in the project area and meet Bitter Creek. Bitter Creek flows in the Bitter Creek-Antelope Creek and Patrick Draw-Bitter Creek watersheds toward the west and eventually joins the Green River over 60 miles downstream at the town of Green River, Wyoming. The Green River is part of the Colorado River system, and as such is monitored under the Colorado River Basin Salinity Control Program. Only two small, discontinuous waterways are identified that drain to the Salt Sage Draw Watershed (Great Divide Closed Basin).

3.4.1.1 Surface Water Quality

The CWA, Section 303(c), requires each state to review, establish, and revise water quality standards for all surface waters within the state. To comply with this requirement, Wyoming has developed a beneficial use classification system to describe state-designated use(s). Section 303(d) of the CWA also requires states to list all streams that do not meet their water use classifications, and are therefore considered impaired streams.

No streams in the project area are listed as impaired or threatened by the State of Wyoming (WDEQ 2012b); however, Bitter Creek's designated uses of recreation and aquatic life, non-game fish are not supported approximately 30 miles downstream from the project area due to fecal coliform and chloride concentrations, respectively, from unknown and/or natural sources (WDEQ 2012b).

Erosion caused by surface water runoff on existing roads within the project area may increase sediment delivery and turbidity levels below stream crossings and where roads are adjacent to drainages.

3.4.1.2 Surface Water Use

Water use of both surface water and groundwater in the State of Wyoming is administered by the WSEO. There are no surface water rights within the project area (WSEO 2012a).

3.4.2 Groundwater

The Upper Colorado River Basin regional aquifer system underlies an area of approximately 20,000 square miles in the southwestern part of Wyoming, which equates to approximately one-quarter the total area of the state (Whitehead 1996). This aquifer system, also referred to as the Colorado Plateaus aquifer system, extends extensively to the south into Colorado, Utah, New Mexico, and Arizona. The aquifer system underlies approximately 130,000 square miles in total (Robson and Banta 1995; Whitehead 1996), with approximately 15 percent of the total aquifer system area in Wyoming.

Surficial geologic mapping indicates that Quaternary-aged eolean sands are present on the surface in nearby areas (Case et al. 1998), which may constitute surficial aquifers of small aerial extent. The Tertiary-aged Wasatch-Fort Union formation is the shallowest principal aquifer that underlies the project site and is considered part of the Upper Colorado River Basin regional aquifer system by Whitehead (1996). Below the surficial and Wasatch-Fort Union aquifers are the Cretaceous-aged Fox-Hills and Mesaverde aquifers and the Jurassic-aged Cloverly aquifer (Whitehead 1996). The four named, more extensive aquifers are described in further detail below.

3.4.2.1 Wasatch-Fort Union Aquifer

The Wasatch-Fort Union aquifer is composed of two water-bearing zones, one in the Wasatch Formation, and the other in the Fort Union Formation. These zones are generally considered as one hydrostratic unit because of their direct hydrologic communication (Bartos and Hallberg 2010; Whitehead 1996). The Wasatch zone is composed of sandstone interbedded with fine grained sedimentary rocks approximately 1,000 feet thick, with groundwater flow direction generally to the northeast in the project area (Bartos and Hallberg 2010). The Fort Union zone is directly below the Wasatch zone and also comprised of sandstone and fine grained sedimentary rocks approximately 1,000 feet thick in the project area; groundwater flow direction is not well defined in the project area due to a lack of monitoring wells (Bartos and Hallberg 2010).

The Wasatch-Fort Union aquifer has been reported to be 11,000 feet thick near Pinedale, Wyoming, and approximately 7,000 feet thick in the center of the Great Divide Basin (Whitehead 1996), both of which are north of the project area. The Green River Formation acts as an overlying confining unit in the project area and over much of this aquifer (Roehler 1992; Whitehead 1996).

Depth to the top of the water bearing unit in shallower stock watering wells and domestic wells located in the project area (see Section 3.4.2.6, Groundwater Use) average approximately 180 feet below ground surface (bgs) with static water levels averaging approximately 36 feet (WSEO 2012b), indicating confined conditions in the shallow aquifer.

The Lance Formation is located below the Wasatch-Fort Union aquifer, separating it from the Fox Hills aquifer by approximately 600 to 900 feet of shale interbedded with sandstone, siltstone, and coal.

3.4.2.2 Fox Hills Aquifer

The Fox Hills aquifer is composed of sandstone interbedded with siltstone, shale, and coal. This aquifer generally downwarps and faults in the structural basins of Wyoming, and contains saline water in the deeper areas. Wells are reported to yield approximately 5 to 50 gallons per minute (gpm), but may be as high as 1,000 gpm in certain locations (Whitehead 1996). Well bore records indicate that the Fox Hills aquifer is approximately 5,000 feet bgs in the project area. The Lewis Shale is found below the Fox Hills

aquifer, and it hydraulically separates the Fox Hills from the underlying Mesaverde in this area with a thickness of approximately 1,000 feet (Roehler 1993).

3.4.2.3 Mesaverde Aquifer

The Mesaverde aquifer is composed of sandstone interbedded with shale. Both the Almond Formation and the Blair Formation are considered as part of the Mesaverde aquifer (Bartos and Hallberg 2010). The top of the Mesaverde formation is approximately 6,200 feet bgs in the project area (Roehler 1993).

3.4.2.4 Cloverly Aquifer

The Cloverly aquifer is the deepest aquifer in the project area, and is equivalent to the more-widely recognized Dakota aquifer (Whitehead 1996). It also is composed of sandstone that is confined by overlying and underlying confining units.

3.4.2.5 Groundwater Quality

Groundwater quality is classified and regulated by the WDEQ, Water Quality Division (WQD). Standards have been established, and waters are classified for application of these standards (Bartos et al. 2010). Water quality can generally be expected to deteriorate with increased depth (Bartos et al. 2010). The **Table 3-6** summarizes the classifications of groundwater quality as defined by WDEQ-WQD (2005).

Table 3-6 Wyoming Groundwater Use Classification

I	Class I Groundwater is suitable for domestic use. The ambient quality of underground water of this suitability includes not exceeding total dissolved solids concentrations of 500 milligrams per liter (mg/l), among other standards.
II	Class II Groundwater is suitable for agricultural use where soil conditions and other factors are adequate. The ambient quality of underground water of this suitability includes not exceeding total dissolved solid (TDS) concentrations of 2,000 mg/l, among other standards.
III	Class III Groundwater is suitable for livestock. The ambient quality of underground water of this suitability includes not exceeding TDS concentrations of 5,000 mg/l, among other standards.
A	Class Special (A) is suitable for fish and aquatic life. The ambient quality of underground water of this suitability includes the standards set for Class I, II, or III, and shall not contain any biological, hazardous, toxic, or potentially toxic materials or substances that would affect natural biota.
IV (A)	Class IV (A) Groundwater is suitable for industry. The ambient quality of underground water of this suitability includes not exceeding TDS concentrations of 10,000 mg/l.
IV (B)	Class IV (B) Groundwater is suitable for industry. The ambient quality of underground water of this suitability includes TDS concentrations in excess of 10,000 mg/l.
V	Class V Groundwater is closely associated with commercial deposits of hydrocarbons and/or other minerals, or is considered a geothermal resource. Discharge into Class V (Hydrocarbon Commercial) is to be used for oil and gas production but must not degrade, pollute, or waste other water resources.

Source: WDEQ 2005.

Water in the Wasatch-Fort Union aquifer is generally of good quality with areas of highly saline water where it is deeply buried (Whitehead 1996). Bartos et al. (2010) reports water quality in the Wasatch zone as having TDS of approximately 1,000 mg/l in the project area. This indicates that this aquifer may be a Class II Groundwater. However, other constituents exceed standards for domestic, agriculture, and livestock (Bartos et al. 2010), and would need to be considered in the classification of this aquifer.

Water in the Fox Hills aquifer is reported to have TDS concentrations ranging from 3,330 to 64,800 mg/l, with a median of nearly 15,000 mg/l in the region surrounding the project area. Other constituents exceed standards for domestic, agriculture, and livestock (Bartos et al. 2010). This indicates the aquifer would fall within the Class IV Groundwater designations.

Water in the Mesaverde aquifer is reported to have TDS concentrations exceeding 10,000 mg/l in the project area. Other constituents exceed standards for domestic, agriculture, and livestock (Bartos et al. 2010), indicating that the aquifer is a Class IV (B) Groundwater.

Water in the Cloverly aquifer is reported to have TDS concentrations ranging from 426 to 26,200 mg/l, with a median of 6,480 mg/l. Other constituents exceed standards for domestic, agriculture, and livestock (Bartos et al. 2010), indicating this aquifer also falls within the Class IV Groundwater designations.

3.4.2.6 Groundwater Use

Water use of both surface water and groundwater in the State of Wyoming is administered by the WSEO. WSEO records list 167 well permits on record in the project area. These wells have beneficial uses of monitoring (132), miscellaneous (16), coal-bed methane (8), stock watering (7), industrial (6), and domestic (4). The domestic and stock watering wells have total well depths ranging from 17 to 697 feet bgs, while the coal bed methane and industrial wells have total depths ranging from 421 to 4,040 feet bgs (WSEO 2012b).

The same records list 380 well permits within an arbitrarily selected 5-mile radius of the project area. Beneficial uses in this area include monitoring (217), coal-bed methane (86), miscellaneous (52), industrial (16), stock watering (12), and domestic (7) (WSEO 2012b). Domestic and stock watering wells within this radius of the project area report total depths from 17 to 697 feet bgs, while wells with industrial and coal-bed methane uses indicate a range from 240 to 6,927 feet bgs for the total depth, with an average of approximately 1,090 feet bgs (WSEO 2012b).

These records indicate that water used for consumption by humans or livestock is obtained from the surficial eolean sands or shallower Wasatch-Fort Union aquifer. Only water for industrial, miscellaneous, or monitoring purposes has its source from the Fox Hills aquifer or deeper.

3.5 Vegetation, Noxious Weeds, and Invasive Species

3.5.1 Vegetation Types

The project area is located at the Wyoming Basin USEPA level 3 ecoregion of south-central Wyoming. This ecoregion is characterized as a broad arid intermontane basin interrupted by hills and low mountains and dominated by grasslands and shrublands. Two USEPA level 4 ecoregions are located in the study area: the Rolling Sagebrush Steppe and the Salt Desert Shrub Basin. Within the Monell Unit are located the Rolling Sagebrush Steppe and the Salt Desert Shrub Basin. The Arch Unit is composed of only the Rolling Sagebrush Steppe subecoregion. The semiarid Rolling Sagebrush Steppe USEPA level 4 ecoregion is a vast region of rolling plains with hills, cuestas, mesas, terraces, and near the mountains, footslopes, ridges, alluvial fans, and outwash fans. The arid Salt Desert Shrub Basin USEPA level 4 ecoregion includes disjunct playas and sand dunes scattered throughout the Wyoming Basin.

Vegetation cover and land use types, acreage calculations, and community characterizations associated with the study area were compiled based on Wyoming subset of the Northwest Regional Gap Analysis Project (NW ReGAP) analysis and site characterizations (USGS 2004). Eight vegetation cover types occur within the project area and include barren, desert shrubland, grassland, sagebrush shrubland, wetland/riparian, and developed lands. Distribution and composition of each vegetation cover type varies based on landscape position, soil type, climatic conditions, moisture, elevation, aspect, and grazing and land management practices. Descriptions of the plant communities within each vegetation cover type are provided in the following text. Species nomenclature is consistent with the NRCS Plants Database

(NRCS 2012b), the Wyoming Natural Diversity Database (Wyoming Natural Diversity Database [WYNDD] 2007), and the Wyoming State Noxious Weed List (Wyoming Department Agriculture 2012). **Table 3-7** summarizes the vegetation cover types and associated acreage within the project area. **Figure 3-2** illustrates the vegetation cover types within the project area.

Table 3-7 Vegetation Cover Types within the Project Area

Vegetation Cover Type	Monell Unit		Arch Unit	
	Acreage	Percent of Monell Unit	Acreage	Percent of Arch Unit
Barren	1	<1	13	<1
Desert Shrubland	3,802	38	2,516	20
Developed	91	1	351	3
Dune	292	3	2,702	22
Grassland	25	<1	675	5
Greasewood Flat	586	6	8	<1
Sagebrush Shrubland	4,820	48	5,589	45
Wetland/riparian[1]	508	5	678	5
TOTAL	**10,124**	**100**	**12,533**	**100**

[1] Wetland and riparian acres are based on NW ReGAP (USGS 2004). Field surveys conducted as part of the 2006 Monell Enhanced Oil Recovery Project EA (BLM 2006a) found surface drainage features to predominantly consist of intermittent riverine systems and wetlands to be found only along Bitter Creek.

Source: USGS 2004.

3.5.1.1 Barren

The barren cover type is comprised of two vegetation classes: Intermountain Basins Cliff and Canyon and Intermountain Basins Shale Badland. The barren vegetation cover type comprises less than 1 percent of the vegetation within the each unit. The cliff/canyon component of this vegetation cover type includes barren and sparsely vegetated landscapes of steep cliff faces, narrow canyons, rocky outcrops, unstable scree and talus slopes that typically occur below cliff faces. This cover type is sparsely vegetated, with usually less than 10 percent vegetative cover. Typical species include dwarf shrubs such as Gardner saltbush (*Atriplex gardneri*), or birdsfoot sage (*Artemisia pedatifida*). Sparse herbaceous vegetation also may be present (USGS 2004).

3.5.1.2 Desert Shrubland

The desert shrubland vegetation type is comprised of two vegetation classes: Intermountain Basin Mat Saltbush Shrubland, and Intermountain Basin Mixed Salt Desert Scrub. The shrubland vegetation cover type comprises approximately 38 percent of the vegetation within the Monell Unit, and 20 percent of the Arch Unit. This type is most commonly found in broad basins, on plains, or in foothills. This cover type is dominated by Atriplex shrub species including mat saltbush (*Atriplex corrugate*), Gardner saltbush, and

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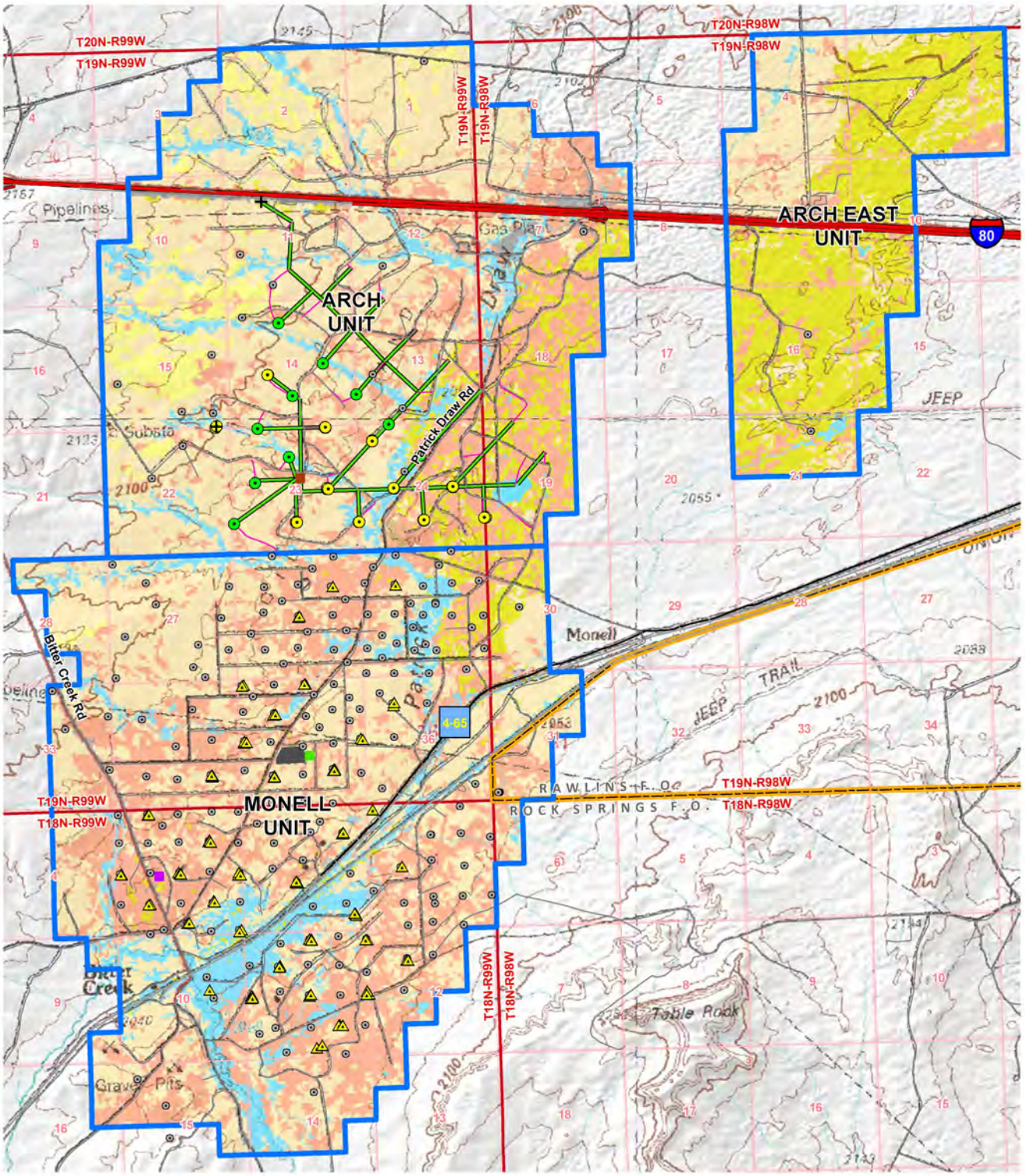

Legend

Proposed Wells (2013-2016)

Arch Unit Wells
- Single well Pad
- Multi-well Pad

Monell Unit Wells
- Multi-well Pad
- Proposed Pipeline
- Proposed Road

Conceptual Facilities
- Production
- Production/Header
- Production/ Compressor Station

Existing Facilities
- Production
- Existing Well
- Injection Well

Vegetation Classification
- Barren
- Developed
- Dune
- Grassland
- Sagebrush Shrubland
- Desert Shrubland
- Wetland/riparian

Source: USFWS 2012, USGS 2008

0 0.25 0.5 1 1.5 Miles

1:75,000

N

Figure 3-2

Vegetation and Wetlands in Project Area

shadscale saltbush (*Atriplex confertifolia*). Other associated shrub species can include Wyoming big sagebrush (*Artemisia tridentata* spp. *wyomingensis*), yellow rabbitbrush (*Chrysothamnus viscidiflorus*), birdfoot sage, longleaf wormwood (*Artemisia longifolia*), bud sagebrush (*Picrothamnus desertorum*), and winterfat (*Krascheninnikovia lanata*). The herbaceous layer varies from sparse to moderately dense and may include the following species: Indian ricegrass (*Achnatherum hymenoides*), blue grama (*Bouteloua gracilis*), squirreltail (*Elymus elymoides*), Western wheatgrass (*Pascopyrum smithii*), and Sandberg bluegrass (*Poa secunda*) (USGS 2004).

3.5.1.3 Developed

The developed cover type is comprised of three classes: Low Intensity Developed, Medium Intensity Developed, and Open Space Developed. The developed cover type comprises approximately 1 percent of the vegetation within the Monell Unit, and 3 percent within the Arch Unit. Developed areas include lands that have been disturbed by historic well field development including buildings, access roads, and well pads (USGS 2004).

3.5.1.4 Dune

The dune vegetation type is comprised of one vegetation class: Inter-Mountain Basins Active and Stabilized Dune. The dune vegetation cover type comprises approximately 1 percent of the vegetation within the Monell Unit and 22 percent of the Arch Unit. This habitat develops in environments subjected to high winds with sandy soils. Vegetation is sparse on active, moving dunes and moderate on more stabilized dunes. Early and mid-seral species occupying stabilized dune complexes may include basin big sagebrush, mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*), sand sagebrush (*Artemisia filifolia*), rubber rabbitbrush (*Ericameria nauseosa*), Indian rice grass, and alkali sacaton (*Sporobolus airoides*) (USGS 2004).

3.5.1.5 Grassland

The grassland vegetation type is comprised of two vegetation classes: Intermountain Basin Big Sagebrush Steppe and Intermountain Basin Montane Sagebrush Steppe. The grassland vegetation cover type comprises approximately less than 1 percent of the vegetation within the Monell Unit and 5 percent of the Arch Unit. The type is dominated by perennial grasses and forbs with various sagebrush species co-dominating the open to moderately dense shrub layer. Common grass species include Indian ricegrass, plains reedgrass (*Calamagrostis montanensis*), thickspike wheatgrass (*Elymus lanceolatus* ssp. *Lanceolatus*), Idaho fescue (*Festuca idahoensis*), rough fescue (*Festuca campestris*), prairie junegrass (*Koeleria macrantha*), Sandberg bluegrass, and bluebunch wheatgrass (*Pseudoroegneria spicata*). Common overstory shrub species include basin big sagebrush, Wyoming big sagebrush, big sagebrush (*Artemisia tridentata* ssp. *xericensis*), antelope bitterbush (*Purshia tridentata*), shadscale saltbush, rabbitbrush, horsebrush (*Tetradymia* spp.), and prairie sandwort (*Artemisia frigida*) (USGS 2004).

3.5.1.6 Sagebrush Shrubland

The sagebrush shrubland vegetation type is comprised of one vegetation class: Intermountain Basin Big Sagebrush Shrubland. The sagebrush shrubland vegetation cover type is the dominant vegetation cover type within the project area, comprising approximately 48 percent of the vegetation within the Monell Unit, and 45 percent of the Arch Unit. The type is dominated by big basin sagebrush, and Wyoming big sagebrush. Other associated shrub species include broom snakeweed (*Gutierrezia sarothrae*), sand sagebrush, spiny hopsage (*Grayia spinosa*), Atriplex (*Atriplex* spp.), yellow rabbitbrush, and prickly pear (*Opuntia* spp.). Herbaceous vegetation is predominantly grasses and cover less than 25 percent. Common species include Indian ricegrass, blue grama, Western wheatgrass, and Sandberg bluegrass.

3.5.1.7 Greasewood Flat

Greasewood flat is comprised of one vegetation class, Intermountain Basins Greasewood Flat. The greasewood flat vegetation cover type comprises approximately 6 percent of the Monell Unit, and less than 1 percent of the Arch Unit. This vegetation community type is defined as a mixed wetland and upland land cover type. Greasewood flats can cover large, flat areas, on broad expenses along lake shores and playas, on older alluvial terraces on broad or narrow floodplains, or on stream terraces along drainages. Sites typically have saline soils, a shallow water table and flood intermittently, but remain dry for most growing seasons. Despite salt accumulations, the water table remains high enough to maintain vegetation. The water table is typically shallow, and the soils are extremely saline. The vegetation cover is open to moderately dense shrublands that are typically halophytes (saline tolerant species) and can consist of both upland and wetland species. Typical species include greasewood species (*Sarcobatus* spp.), winter fat (*Kraschenkovia lanata*), and saltbush species (*Atriplex* spp.). Herbaceous species are salt tolerant and include salt grass (Distichlis spicata), common spikerush (*Eleocharis palustris*), and alkali sacaton (*Sporobolus airoides*).

3.5.1.8 Wetland/Riparian

See Section 3.6, Wetlands and Riparian Resources, for a discussion of the wetland and riparian areas in the project study area.

3.5.2 Noxious Weeds and Invasive Species

Noxious weeds have become a growing concern in the western U.S. based on their ability to increase in cover relative to surrounding native vegetation and exclude native plants from an area. The spread of noxious weeds has resulted in impacts to endangered native species, available forage for livestock and wildlife, and economic resources. Noxious and invasive weeds are a threat to native ecosystems and biological diversity based on their ability to increase in cover relative to surrounding vegetation and exclude native plants from an area. They impact the ability of the BLM to manage for multiple uses, contribute to the loss of rangeland productivity, cause increased soil erosion, reduce native species diversity, cause loss of wildlife habitat and, in some instances, are hazardous to human and animal health and welfare. The Federal Plant Protection Act of 2000 (formerly the Noxious Weed Act of 1974) and EO 13112 of February 3, 1999, requires cooperation with state, local, and other federal agencies in the application and enforcement of all laws and regulations relating to the management and control of noxious weeds. Recognizing these regulations, the BLM has established a goal that NEPA documents consider and analyze the potential for the spread of noxious weed species and provide preventative rehabilitation measures for each management action involving surface disturbance.

The State of Wyoming defines noxious weeds as weeds, seeds, or other plant parts that are considered detrimental, destructive, injurious or poisonous, either by virtue of their direct effect or as carriers of diseases or parasites that exist within the state, and are on the designated list by the Wyoming Statutes (Title 11, Chapter 5, Section 102.a.xi). Noxious and invasive weeds are threat to native ecosystems, and biological diversity based on their ability to increase in cover relative to surrounding vegetation and exclude native plants from an area.

In addition to the Wyoming state designated species, management is required for county-specific species for Sweetwater County, Wyoming (Wyoming Department of Agriculture 2012) and the RSFO. The state is required to manage weeds on the state and county lists. The BLM can only require management for the BLM-listed weed species on public lands. **Table 3-8** provides a list of designated noxious weed species and priority species as identified by the State of Wyoming, and Sweetwater County.

For the BLM, while the primary concern is the noxious weeds of concern identified by the State of Wyoming (BLM 2008), a secondary concern is the control of invasive species (e.g., halogeton, henbane, and cheatgrass) that can impede successful reclamation and impact management of livestock, wildlife, and human activities.

Table 3-8 Noxious and Invasive Weed Species Potentially Occurring within the Project Area

Common Name	Scientific Name	Wyoming Noxious Weed List	Sweetwater County, Wyoming Weed List	BLM Additional Management Species
Russian knapweed	*Acroptilon repens*	X		
Skeletonleaf bursage	*Ambrosia tomentosa*	X		
Common burdock	*Arctium minus*	X		
Cheatgrass	*Bromus tectorum*			X
Whitetop	*Cardaria draba* and *C. pubescens*	X		
Musk thistle	*Carduus nutans*	X		
Plumeless thistle	*Carduus acanthoides*	X		
Spotted knapweed	*Centaurea stoebe* spp. *micranthos*	X		
Diffuse knapweed	*Centaurea diffusa*	X		
Canada thistle	*Cirsium arvense*	X		
Field bindweed	*Convolvulus arvensis*	X		
Houndstongue	*Cynoglossum officinale*	X		
Russian olive	*Elaeagnus angustifolia*	X		
Quackgrass	*Elymus repens*	X		
Leafy spurge	*Euphorbia esula*	X		
Lady's bedstraw	*Galium verum*		X	
Wild licorice	*Glycyrrhiza lepidota*		X	
Halogeton	*Halogeton glomeratus*			X
Foxtail barley	*Hordeum jubatum*		X	
Black henbane	*Hyoscyamus niger*		X	
Common St. Johnswort	*Hypericum perforatum*	X		
Dyer's woad	*Isatus tinctoria*	X		
Perennial pepperweed	*Lepidium latifolium*	X		
Oxeye daisy	*Leucanthemum vulgare*	X		
Dalmation toadflax	*Linaria dalmatica*	X		
Yellow toadflax	*Linaria vulgaris*	X		
Purple loosestrife	*Lythrum salicaria*	X		
Scotch thistle	*Onopordum acanthium*	X		
Perennial sowthistle	*Sonchus arvensis*	X		
Saltcedar	*Tamarix* spp.	X		

Table 3-8 Noxious and Invasive Weed Species Potentially Occurring within the Project Area

Common Name	Scientific Name	Wyoming Noxious Weed List	Sweetwater County, Wyoming Weed List	BLM Additional Management Species
Common tansy	*Tanacetum vulgare*	X		
Mountain thermopsis	*Thermopis montana*		X	

Source: Wyoming Department of Agriculture 2012.

3.6 Wetland and Riparian Resources

Although wetlands and riparian areas comprise a very small percentage of the vegetation communities in the West, their importance to the surrounding ecosystems and associated species is disproportionately great. Most wildlife species use riparian areas at some point in their life cycles and some depend almost entirely on the health of these systems (e.g., many migratory birds during breeding season and amphibians). Riparian areas are the transition between water sources and uplands, and often are rich in vegetation diversity and structure. Riparian and wetland areas act as water purifiers, supply groundwater recharge, and aid in flood control, in addition to providing food, water, shade, and cover to wildlife and livestock.

The term “wetlands” has a regulatory definition defined in 33 CFR 328.7(b) as “those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas.” Under the USACE 1987 Wetland Delineation Manual, a “three-parameter” approach is required for delineating wetlands (USACE 1987). Based on this approach, areas are identified as wetlands if they exhibit hydrophytic plants, hydric soils, and at least periodically saturated conditions at some time during the growing season of the prevalent vegetation (USACE 1987; Wetland Training Institute 1995). Within the project area, an area would need to be saturated for a period of approximately 15 days to support vegetation adapted to saturated soils based on the average number of days above 32 degrees Fahrenheit (°F) (NRCS 2002). Final regulatory authority and delineation boundaries for wetlands within the project area lie with the USACE.

Based on NW ReGAP data, wetland and riparian areas are approximately 5 percent of the Monell Unit and 5 percent of the Arch Unit (**Table 3-7**). There are four wetland vegetation classes that compose the wetland and riparian vegetation type: Western Great Plains Floodplain, Western Great Plains Open Freshwater Depression Wetland, Western Great Plains Riparian Woodland and Shrubland, and Western Great Plains Saline Depression Wetland. Based on the USFWS National Wetland Inventory (NWI) data available, wetland types identified within the project area are listed in **Table 3-9** and shown in **Figure 3-2** (USFWS 2012a). The spatial extent of wetlands presented in this section is less than those presented above in Section 3.5.1.8, Wetland/Riparian, as a result of the use of two distinct datasets (i.e., NW ReGAP versus NWI). Field surveys were conducted in June and August 2005 for the Monell Enhanced Oil Recovery Project EA (BLM 2006a). These field surveys determined that surface drainage features predominantly consisted of intermittent riverine systems without wetland or riparian vegetation. Along Bitter Creek in the southern portion of the Monell Unit, herbaceous and aquatic bed wetlands were observed. Wetland vegetation along Bitter Creek includes Baltic rush (*Juncus arcticus*), spikerush (*Eleocharis* spp.), silverweed cinquefoil (*Argentina anserina*), Canada thistle (*Cirsium arvense*), narrowleaf willow (*Salix exigua*). Within the intermittent drainages Wyoming big sagebrush (*Artemisia tridentata* spp. *wyomingensis*), yellow rabbitbrush (*Chrysothamnus viscidiflorus*), greasewood (*Sarcobatus* spp.), and various upland grass and forb species are present.

Table 3-9 Wetland and Riparian Types within the Project Area

Vegetation Cover Type	Monell Unit		Arch Unit	
	Acreage	Percent of Total Project Area	Acreage	Percent of Total Project Area
Freshwater Emergent Wetland	34	<1	1	<1
Freshwater Pond	3	<1	5	<1
Other[1]	5	<1	32	<1
Total	**42**	**<1**	**38**	**<1**

[1] A variety of palustrine (wetland) habitats.

3.7 Wildlife and Aquatic Resources

The project area is composed of two units, Monell and Arch. Wildlife resources are discussed in three groups: big game, small game, nongame species and are described in Sections 3.7.1 through 3.7.3, respectively. Aquatic biological resources are discussed in Section 3.7.4. Due to the mobility of some of the wildlife groups, the analysis area for wildlife resources extends beyond the Monell and Arch units to include the Bitter Creek Pronghorn Herd Unit and the South Rock Springs and Baggs Mule Deer Herd units. As discussed in Section 3.5.1, Vegetation Types, the vegetation habitat types within the project area include desert shrubland, barren ground , developed lands, dunes, grassland, sagebrush shrubland, and wetland/riparian. Descriptions of resident and migratory species include those that have either been documented within the project area or those that may occur in the region based on habitat association. Wildlife species that would occur within the majority of the proposed project area are typical of the dune/grassland/shrubland communities of south-central Wyoming.

3.7.1 Big Game Species

Big game species that occur in the project area include pronghorn, mule deer, and elk (BLM 1997; WGFD 2010a, 2004). The project area occurs within the Petition Elk Herd Unit; however, elk presence would be limited to transient individuals. There is no elk crucial winter range known within five miles of the project area. Therefore, elk are not discussed further in the EA.

Pronghorn are common throughout the project area. Both the Monell and Arch units are designated as winter/yearlong pronghorn range and approximately 4,046 acres of antelope crucial winter range occurs within the units (**Table 3-10**, **Figure 3-3**). Pronghorn typically inhabit grasslands and semi-desert shrublands on flat to rolling topography and browse on shrubby plants, especially sagebrush, throughout the year. During winter, pronghorn tend to use areas of relatively high sagebrush densities and overall low snow accumulations, on south- and east-facing slopes. Pronghorn in the project area belong to the Bitter Creek Pronghorn Herd.

Table 3-10 Big Game Seasonal Ranges within the Project Area

Species	Seasonal Range Type	Acres
Pronghorn	Crucial Winter Range	4,046
Pronghorn	Winter/yearlong Range	18,611

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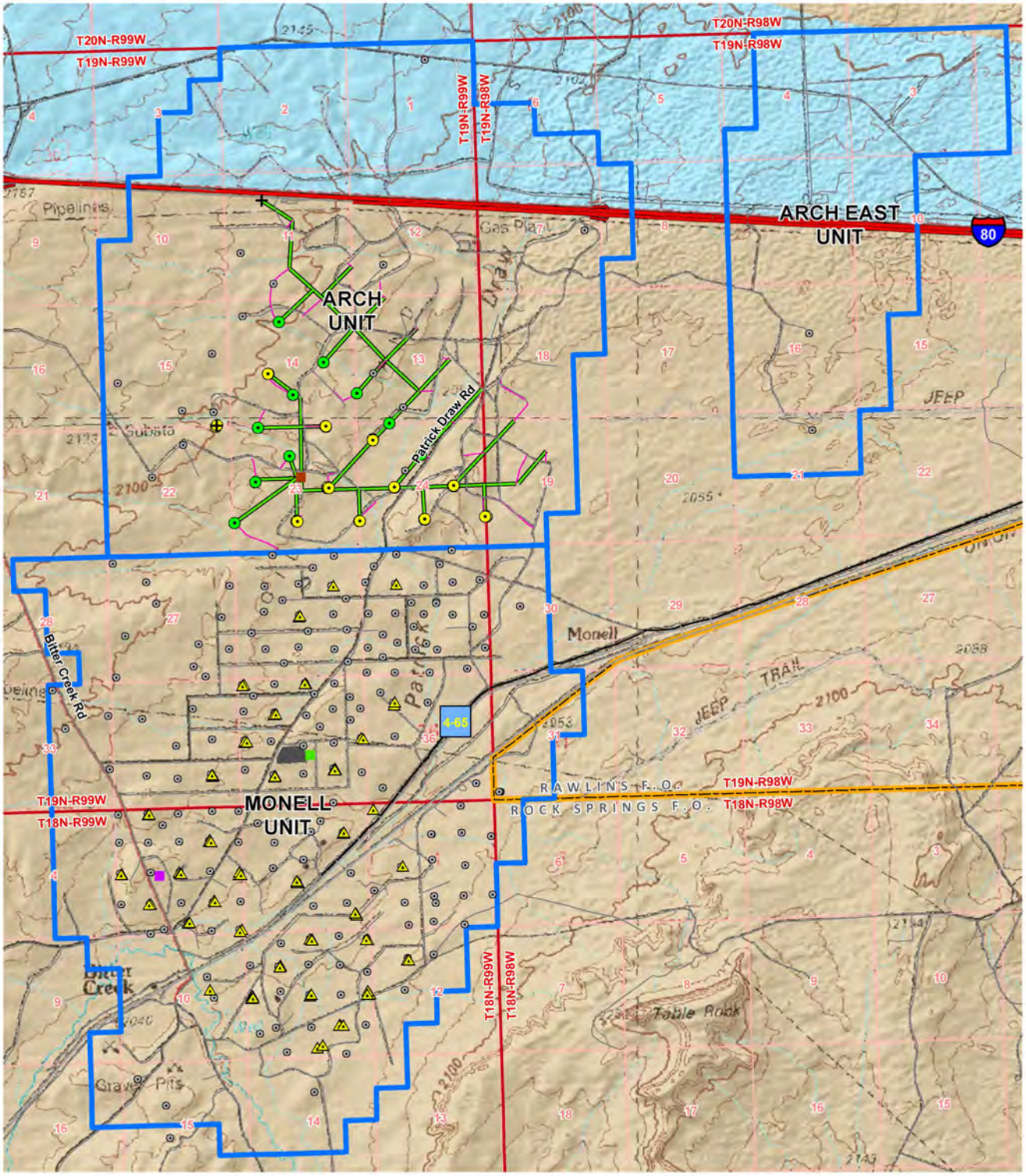

Legend

Existing Facilities
- Production
- Existing Well
- Injection Well

Proposed Wells (2013-2016)

Arch Unit Wells
- Single well Pad
- Multi-well Pad

Monell Unit Wells
- Multi-well Pad

- Proposed Pipeline
- Proposed Road

Conceptual Facilities
- Production
- Production/Header
- Production/ Compressor Station

Pronghorn Seasonal Ranges
- Winter/Yearlong
- Crucial Winter/Yearlong

Source: WGFD 2011.

Figure 3-3

Location of Pronghorn Seasonal Ranges

0 0.25 0.5 1 1.5 Miles

1:75,000

N

Mule deer also occur throughout the project area. They are generally found in rolling hills and drainages and feed on a wide variety of plants including forbs, grasses, sedges, shrubs, and trees. Winter habitat for mule deer occurs in areas of relatively high sagebrush densities and overall low snow accumulation, on south- and west-facing slopes. The project area does not contain any mule deer crucial winter range. Mule deer within the project area are part of the South Rock Springs and Baggs Mule Deer Herds.

3.7.2 Small Game Species

Small game species that occur within the project area include upland game birds, small mammals, and furbearers. This group does not reflect the WGFD's classifications of "small game species" used for hunting legislation and regulation.

Upland game birds that occur within the project area include greater sage-grouse and mourning dove. The greater sage-grouse is a federal candidate species as well as a BLM sensitive species. This species is discussed further in Section 3.8, Special Status Species. Mourning doves occur in a variety of habitats ranging from wetland/riparian to shrubland and grassland communities, often nesting in trees or shrubs near riparian areas or water sources (Stokes and Stokes 1996; WGFD 2010, 2004).

Small mammals regulated as game species that likely occur within the project area include desert cottontail and white-tailed jackrabbit. Furbearer species likely to occur within the project area include raccoon, striped skunk, long tailed weasel, short-tailed weasel, badger, bobcat, coyote, and red fox (BLM 1997; WGFD 2010, 2004). These species have a wide distribution in Wyoming and are found within a variety of habitat types including desert shrubland, sagebrush shrubland, grassland, dune, wetland/riparian, barren, and developed lands.

Due to a lack of waterbodies within the project area, no waterfowl or shorebird concentrations are known to occur. Smalls numbers of waterfowl could use the 3.3-mile perennial section of Bitter Creek.

3.7.3 Nongame Species

A diversity of nongame wildlife species (e.g., small mammals, raptors, passerines, amphibians, and reptiles) occupies a variety of trophic levels and habitat types within the project area. Common nongame species include small mammals such as bats, voles, squirrels, gophers, prairie dogs, woodrats, and mice. Most of these small mammals provide a significant prey base for predators in the project region including larger mammals (e.g., coyote, badger, bobcat); raptors (eagles, buteos, accipiters, owls); and reptiles (i.e., snakes).

The white-tailed prairie dog and Wyoming pocket gopher are BLM sensitive species and are discussed further in Section 3.8, Special Status Species. A number of bat species also occur within the project area including long-legged myotis, little brown myotis, big brown bat, and western small footed myotis. Additional BLM sensitive bat species are discussed further in Section 3.8, Special Status Species.

3.7.3.1 Raptors and Other Migratory Birds

The nongame bird designation encompasses a variety of passerine and raptor species including numerous migratory bird species that are protected under the MBTA (16 USC 703-711) and EO 13186 (66 Federal Register [FR] 3853). Pursuant to EO 13186, a Memorandum of Understanding (MOU) between the BLM and USFWS outlines a collaborative approach to promote the conservation of migratory bird populations. The purpose of the MOU is to strengthen migratory bird conservation by identifying and implementing strategies that promote conservation and avoid or minimize adverse impacts on migratory birds in coordination with state, tribal, and local governments. This MOU identifies specific activities where cooperation between the BLM and USFWS would contribute to the conservation of migratory birds and their habitat.

There are several raptor species that could potentially occur as residents or migrants within the project area including eagles (bald and golden eagles); buteos (e.g., red-tailed hawk, Swainson's hawk, ferruginous hawk); falcons (e.g., prairie falcon, American kestrel); accipiters (e.g., Cooper's hawk, sharp-shinned hawk); owls (e.g., great horned owl, burrowing owl, long-eared owl, short-eared owl); and northern harrier (BLM 1997; Stokes and Stokes 1996; WGFD 2010, 2004). BLM records indicate that no raptor nests have been documented within the project area; however, five ferruginous hawk nests were observed on the Arch Unit during the September 2012 surveys, none of which were active at the time (**Figure 3-4**) (AECOM 2012a). BLM records do indicate the presence of five additional nests within 1 mile of the project boundary including one of each for burrowing owl, ferruginous hawk, red-tailed hawk, prairie falcon, and an unknown raptor (BLM 2006). No raptors were observed on either the Monell or Arch Units during the September 2012 surveys.

A wide variety of passerines occurs within the project area throughout the year; however, they are most abundant during the spring/fall migration as well as during the breeding season, from May 15 to June 30 (Nicholoff 2003). Additional detail on BLM sensitive migratory bird species is presented in Section 3.8, Special Status Species.

3.7.3.2 Reptiles and Amphibians

The occurrence of reptile and amphibian species in a particular area is generally limited by their specific habitat requirements. Species that could potentially occur within the project area include the Great Basin spadefoot toad, eastern short-horned lizard, northern sagebrush lizard, Great Basin gopher snake, and wandering garter snake (Baxter and Stone 1980; BLM 1997; WGFD 2010, 2004). BLM sensitive reptile and amphibian species are discussed in Section 3.8, Special Status Species.

3.7.4 Aquatic Resources

The project study area for aquatic biological resources includes the intermittent and perennial drainages located within the Monell and Arch units. The only perennial drainage is Bitter Creek, which is located in the southern portion of the Monell Unit. Fish can occur in Bitter Creek from the headwaters to the confluence with the Green River wherever water is present. During high flow periods fish often move upstream and downstream to utilize a larger portion of the stream. The Pierotto Ditch headcut is a barrier for upstream fish movement. There is no restriction in downstream movement other than lack of water in intermittent sections during low flow periods. The lower section of Bitter Creek from Rock Springs to the Green River supports fish throughout the year.

Based on surveys conducted near the town of Bitter Creek, nongame native fish species such as flannelmouth sucker (*Catostomus latipinnis*) and speckled dace (*Rhinichthys osculus*) were collected. Habitat in the project portion of the stream consists of riffles, pools, and runs, with the deepest pools occurring in areas with beaver dams. Upstream sections of Bitter Creek also support mountain sucker (*Catostomus platyrhynchus*) along with flannelmouth sucker and speckled dace (WGFD 2012).

3.8 Special Status Species

3.8.1 Wildlife

Special status species are those species for which state or federal agencies afford an additional level of protection by law, regulation, or policy. Included in this category are federally listed and federally proposed species that are protected under the ESA, or are considered as candidates for such listing by the USFWS, and those species that are designated by the BLM State Director as sensitive (BLM 2001).

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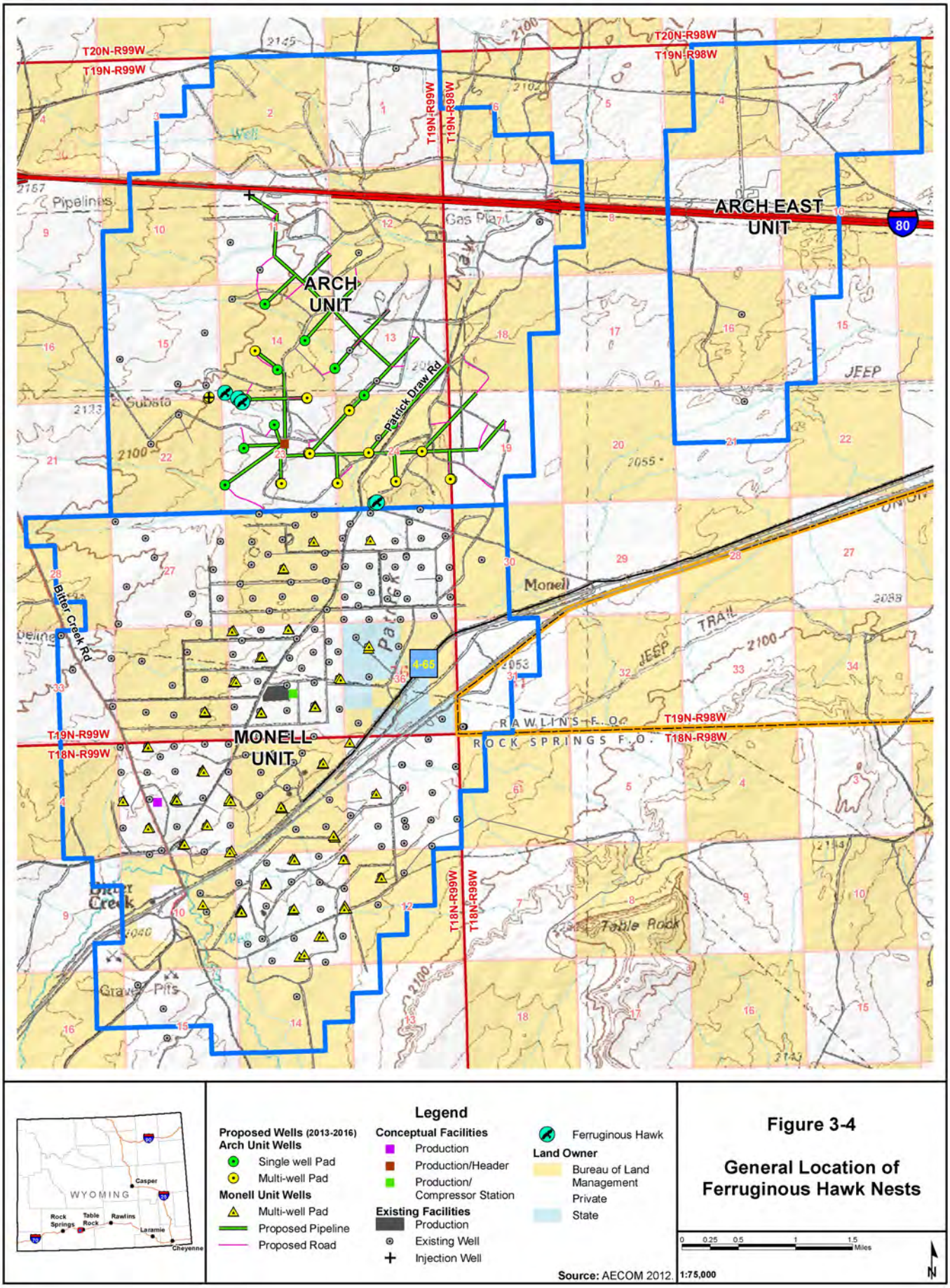

Legend

Proposed Wells (2013-2016)
Arch Unit Wells
- Single well Pad
- Multi-well Pad

Monell Unit Wells
- Multi-well Pad
- Proposed Pipeline
- Proposed Road

Conceptual Facilities
- Production
- Production/Header
- Production/ Compressor Station

Existing Facilities
- Production
- Existing Well
- Injection Well

- Ferruginous Hawk

Land Owner
- Bureau of Land Management
- Private
- State

Source: AECOM 2012.

Figure 3-4

General Location of Ferruginous Hawk Nests

0 0.25 0.5 1 1.5 Miles

1:75,000

N

In accordance with the ESA, the lead agency in coordination with the USFWS must ensure that any action they authorize, fund, or carry out would not adversely affect a federally listed threatened or endangered species. In addition, as stated in Special Status Species Management Policy 6840 (6840 Policy) (Rel. 6 121), it also is BLM policy "to conserve listed species and the ecosystems on which they depend, and to ensure that actions requiring authorization or approval by the BLM are consistent with the conservation needs of special status species and do not contribute to the need to list any special status species, either under the provisions of the ESA or other provisions" identified in the 6840 Policy.

3.8.1.1 Federally Listed Candidate Wildlife Species

Four wildlife species were evaluated based on review of the USFWS' Sweetwater County List (USFWS 2010). The potential occurrence of wildlife species within the project area was based on range, known distribution, and the presence of potentially suitable habitat within the project area (**Table 3-11**). Two wildlife species were eliminated from detailed analysis (Preble's meadow jumping mouse and western yellow-billed cuckoo), based on rationale presented in **Table 3-11**. The remaining two wildlife species that have the potential to occur within the project area are discussed below.

Table 3-11 Federally Listed Wildlife Species Potentially Occurring within the Project Area

Common Name ***Scientific Name***	**Status[1]**	**Habitat Association[1]**	**Potential for Occurrence within the Project Area[1]**	**Eliminated from Detailed Analysis (Yes/No)**
Mammals				
Preble's meadow jumping mouse *Zapus hudsonius preblei*	Threatened	Riparian vegetation along waterways. Typically found in tall grass near streams.	None. This species is not known to occur within the project area.	Yes. The project area is not within the known geographic range of the species.
Black-footed ferret *Mustela nigripes*	Endangered	Grasslands and shrublands with prairie dog colonies.	Low. The USFWS has block-cleared all white-tailed prairie dog colonies within the Monell and Arch units.	No.
Birds				
Greater sage-grouse *Centrocercus Urophasianus*	Candidate	Sagebrush shrublands.	High. Suitable habitat occurs within the project area.	No.
Western yellow-billed cuckoo *Coccyzus americanus*	Candidate	Lowland riparian areas west of the Continental Divide.	None. This species is not known to occur within the project area.	Yes. Suitable lowland riparian habitat does not occur within or near the project area.

[1] Status, habitat association, and potential for occurrence within the project area taken from USFWS 2012c; WGFD 2010; and WYNDD 2012.

Black-footed Ferret

The black-footed ferret (*Mustela nigripes*) is classified as a federally endangered species. The historic range of this species included the Rocky Mountain and western Great Plains regions of North America (Fitzgerald et al. 1994). This species utilizes semi-arid grasslands and mountain basins associated with prairie dog colonies. The only known populations of black-footed ferrets are either captive or have been reintroduced, with no natural wild populations known to occur. In Wyoming, the known distribution of this species is limited to a nonessential experimental population area within the Shirley Basin approximately 120 miles northeast of the project area (WGFD 2010).

The Black-footed Ferret Survey Guidelines for Compliance with the Endangered Species Act (USFWS 1989) defines potential black-footed ferret habitat as any white-tailed prairie dog colony or complex greater than 200 acres in size and meet or exceed a hole density of 20 burrows per hectare (8 burrows per acre).

Based on a reevaluation of the block clearance process for black-footed ferret, all white-tailed prairie dog colonies are considered to be “block cleared” by the USFWS (2013). Therefore, none of the prairie dog colonies on either of the Monell or Arch units would require surveys for black-footed ferrets.

A total of nine active white-tailed prairie dog colonies occur within the Monell Unit of the project area. Of the nine prairie dog colonies, seven of the colonies meet the USFWS habitat criteria to potentially support black-footed ferrets. These nine colonies and their approximate sizes and burrow densities within the project area boundary are presented in **Table 3-12**. Although potentially suitable habitat for the black footed ferret is defined by the size and density of active prairie dog colonies, it is assumed that all colonies that occur within the project boundary are associated with larger complexes and, therefore, meet the acreage and size criteria established by the 1989 guidelines. However, as previously discussed, the project area has been block cleared.

Table 3-12 White-tailed Prairie Dog Colonies within the Project Area

Prairie Dog Colony ID	UTM Coordinates[1,2]	Approximate Colony Size in Project Area (acres)[3,4]	Approximate Burrow Density (burrows/acre)[3,4]	Meet USFWS’ Ferrret Habitat Criteria
Arch 1	0706693 E 4610190 N	3,167	10	Yes
Arch 2	0708825 E 4610159 N	330	7	Yes
Monell 1	0703928 E 4604803 N	925	9	Yes
Monell 2	0706957 E 4603217 N	826	13	Yes
Monell 3	0703900 E 4602111 N	126	10	Yes
Monell 4	0704872 E 4602387 N	2	8	Yes
Monell 5	0704944 E 4602883 N	5	9	Yes

Table 3-12 White-tailed Prairie Dog Colonies within the Project Area

Prairie Dog Colony ID	UTM Coordinates[1,2]	Approximate Colony Size in Project Area (acres) [3,4]	Approximate Burrow Density (burrows/acre) [3,4]	Meet USFWS' Ferrret Habitat Criteria
Monell 6	0708361 E 4605047 N	15	11	Yes
Monell 7	0708562 E 4605957 N	21	6	No
Monell 8	0704415 E 4601626 N	15	6	No
Monell 9	0705782 E 4601463 N	11	11	Yes

[1] Point taken from the center of the white-tailed prairie dog colony.

[2] UTM coordinates in NAD 83, Zone 12, meters.

[3] Data for Arch prairie dog towns taken from results of September 2012 surveys.

[4] Data for Monell prairie dog towns taken from BLM GIS data.

Prairie dog colonies discovered within the Arch Unit of the project area have been block-cleared by the USFWS. Surveys conducted on September 12 and 13, 2012, documented two white-tailed prairie dog colonies totaling 3,497 acres in size (**Figure 3-5**). Details on the two white-tailed prairie dog colonies located within the Arch Unit portion of the project area are presented in **Table 3-12**.

Although prairie dog colonies within the project boundary could potentially support wild or introduced ferrets, the potential for species occurrence within the Monell Unit of the project area would be considered low given the considerable distance of the nearest black-footed ferret reintroduction site to the project area; furthermore, the last known wild population of ferrets was discovered near the Town of Meeteetse in northwest Wyoming in 1981.

Greater Sage-grouse

The greater sage-grouse (*Centrocercus urophasianus*) is classified as a federal candidate species as well as a BLM sensitive species. On March 5, 2010, the USFWS determined that the greater sage-grouse warrants protection under the ESA; however, the USFWS concluded that proposing the species for protection is precluded by the need to take action on other species facing more immediate and severe extinction threats. Therefore, greater sage-grouse in Wyoming continue to be managed by the WGFD. Conservation efforts for this species in Wyoming currently are coordinated by the WGFD in cooperation with the USFWS, BLM, and regional greater sage-grouse working groups in an attempt to increase population levels and avoid federal listing under the ESA. In an effort to prevent federal listing of greater sage-grouse, the WGFD completed a revised map of greater sage-grouse core population areas in Wyoming. Greater sage-grouse core population areas include habitat with the highest densities of breeding greater sage-grouse in the state, as well as areas important for connectivity between populations. The core population areas include roughly 25 percent of the state, but they comprise 83 percent of the greater sage-grouse population in the state. No greater sage-grouse core population areas are located within the project area. The nearest core population area is the Continental Divide core population area, which is approximately 4 miles northwest of the project area (**Figure 3-6**).

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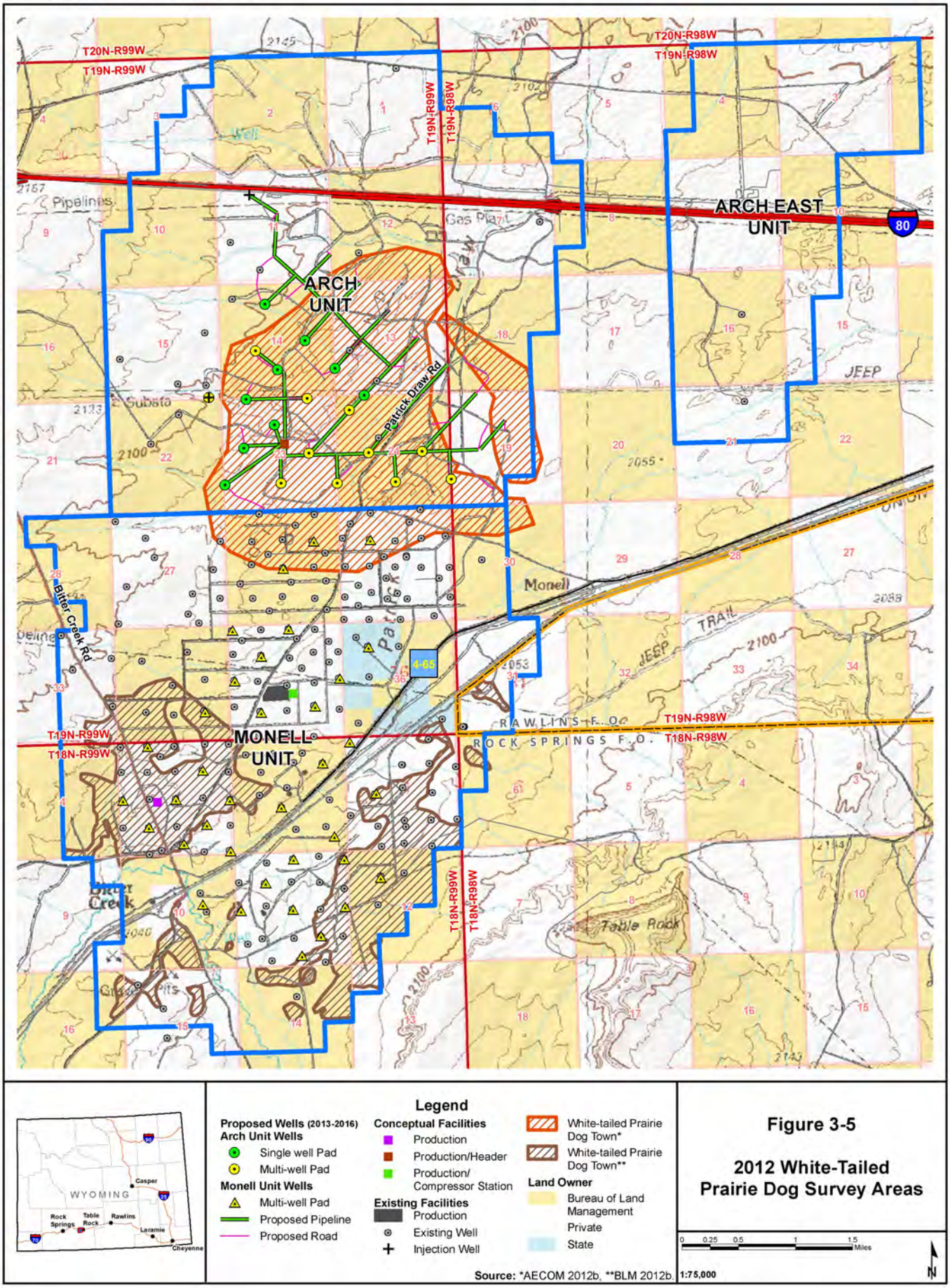

Figure 3-5

2012 White-Tailed Prairie Dog Survey Areas

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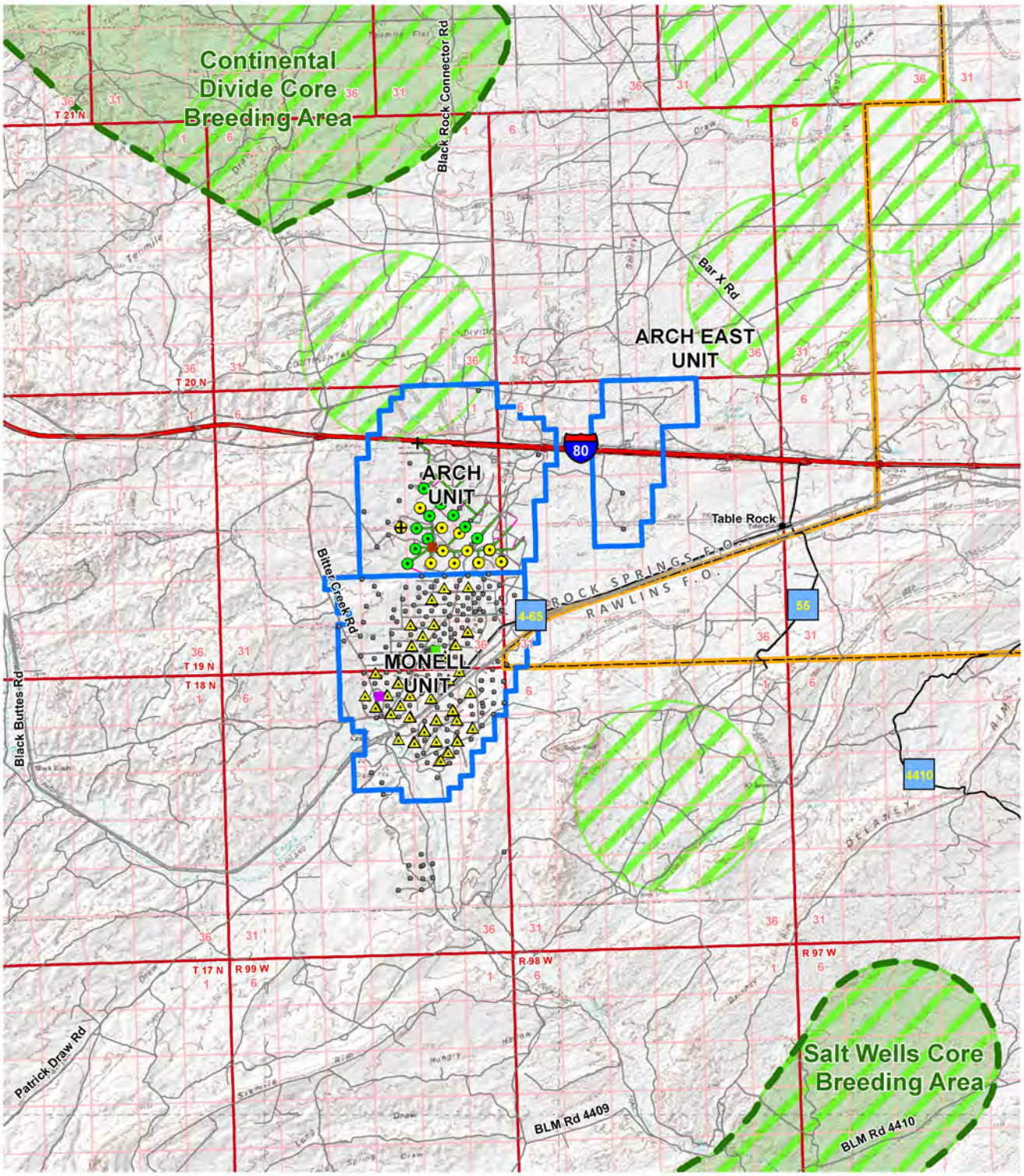

Legend

Existing Facilities
- Production
- Injection Well
- Existing Well

Proposed Wells (2013-2016)

Arch Unit Wells
- Single well Pad
- Multi-well Pad

Monell Unit Wells
- Multi-well Pad

Conceptual Facilities
- Production
- Production/Header
- Production/ Compressor Station
- Proposed Pipeline
- Proposed Road
- Greater Sage-grouse Nesting Habitat
- Greater Sage-grouse Core Breeding Area

Source: WGFD 2010b, BLM 2011b.

Figure 3-6

Greater Sage-grouse Nesting Habitat

0 1 2 4 Miles

1:200,000

N

Lekking/Nesting Habitat

The center of breeding activity for greater sage-grouse is referred to as a lek. Leks are characterized as flat, sparsely vegetated areas within large tracts of sagebrush (Connelly et al. 2004). Males begin to appear on leks in March, with peak attendance of Wyoming leks occurring in April (WGFD 2010). Greater sage-grouse nesting habitat is typically located near active leks and consists of medium to tall sagebrush with a perennial grass understory (Connelly et al. 2000). Studies have shown that taller sagebrush with larger canopies and more residual understory cover usually lead to higher nesting success (BLM 2011a; Connelly et al. 2004, 2000). No lek sites are known to occur within the project area. However, approximately 1,133 acres of suitable nesting habitat in non-core population areas is located within the project area, all of which occurs in the northern portion of the Arch Unit (**Figure 3-6**).

Brooding Habitat

The late spring and summer periods are when hens and broods are typically found in more lush habitats consisting of a high diversity of grasses and forbs that attract insects (Blomberg et al. 2012). These habitats include wet meadows, riparian areas, and irrigated farmland within or near sagebrush (Schroeder et al. 1999). Hens with broods would utilize these habitats until forbs desiccate and insect abundance decreases (BLM 2011a). Unsuccessful hens and cocks also utilize these same habitats; however, due to their nutritional flexibility, they are able to occupy a wider variety of habitats during the spring and summer months (Connelly et al. 2004). In many greater sage-grouse populations, high quality brooding habitat is often the limiting factor for population growth. Brooding habitat can often be adversely affected by drought, invasive weeds, and overgrazing associated with improper range management. Suitable brooding habitat is located within the extreme southeast portion of the project area along the Bitter Creek drainage and wet areas found near the adjacent nesting habitat presented in **Figure 3-6**.

Wintering Habitat

Depending on the severity of the winter, greater sage-grouse would move to south and east-facing slopes that maintain exposed sagebrush. Studies have shown that south-facing slopes with sagebrush at least 10 to 12 inches above the snow level are required for both food and cover. Windswept ridges, draws, and swales also may be used, especially if these areas are in close proximity to exposed sagebrush (Connelly et al. 2004). In years with harsh winter conditions (i.e., deep snow), greater sage-grouse would often gather in large flocks in areas with the highest quality winter habitat. It is suggested that high quality winter habitat is limited in portions of the greater sage-grouse's range (Connelly et al. 2000). While no winter concentration areas have been mapped within the project area, suitable sagebrush habitat for wintering greater sage-grouse is present within the project area.

Based on the presence of suitable nesting, brooding, and wintering habitat, the potential for this greater sage-grouse to occur within the project area is considered high.

3.8.1.2 BLM Sensitive Species

Twenty-four wildlife species were evaluated based on review of the BLM RSFO sensitive species list (BLM 2010). The potential occurrence of wildlife species within the project area was based on range, known distribution, and the presence of potentially suitable habitat within the project area (**Table 3-13**). Nine wildlife species were eliminated from detailed analysis (long eared myotis, Idaho pocket gopher, swift fox, trumpeter swan, white-faced ibis, bald eagle, northern goshawk, peregrine falcon, and midget faded rattlesnake), based on the rationale presented in **Table 3-13**. The remaining 15 wildlife species that have the potential to occur within the project area are discussed below.

Table 3-13 BLM Sensitive Wildlife Species Potentially Occurring within the Project Area

Common Name *Scientific Name*	Habitat Association[1]	Potential for Occurrence within the Project Area[1]	Eliminated from Detailed Analysis (Yes/No)
Mammals			
Long-eared myotis *Myotis evotis*	Montane forests. Caves and mines.	Low. No suitable roosting or foraging habitat occurs within the project area.	Yes. Occurrences would be limited to migrating individuals.
Fringed myotis *Myotis thysanodes*	Semi-desert shrublands, pinyon-juniper woodlands, and montane forests. Caves and mines.	High. Suitable foraging habitat occurs within the project area.	No.
Spotted bat *Euderma maculatum*	Cliffs; semi-desert shrublands, pinyon-juniper woodlands, and montane forests.	High. Suitable foraging habitat occurs within the project area.	No.
Townsend's big-eared bat *Corynorhinus townsendii*	Semi-desert shrublands, pinyon-juniper woodlands, and montane forests. Caves and mines.	High. Suitable foraging habitat occurs within the project area.	No.
Pygmy rabbit *Brachylagus idahoensis*	Sagebrush shrublands.	High. This species has been documented within the project area.	No.
White-tailed prairie dog *Cynomys leucurus*	Mountain basins; sagebrush shrublands; semi-desert grasslands.	High. Species has been documented within the project area.	No.
Idaho pocket gopher *Thomomys idahoensis*	Semi-desert grassland and sagebrush shrublands.	None. This species is not known to occur within the project area.	Yes. Project is outside the known range and distribution of this species in Wyoming.
Wyoming pocket gopher *Thomomys clusius*	Semi-desert grassland and sagebrush shrublands.	Low. Marginal habitat occurs within the project area.	No.
Swift fox *Vulpes velox*	Short-grass and mid-grass prairie.	None. This species is not known to occur within the project area.	Yes. Project is outside the known range and distribution of this species in Wyoming.

Table 3-13 BLM Sensitive Wildlife Species Potentially Occurring within the Project Area

Common Name *Scientific Name*	Habitat Association[1]	Potential for Occurrence within the Project Area[1]	Eliminated from Detailed Analysis (Yes/No)
Birds			
Trumpeter swan *Cygnus buccinators*	Lakes, ponds, marshes, rivers, wetlands.	None. This species is not known to occur within the project area.	Yes. Project is outside the known range and distribution of this species in Wyoming.
White-face ibis *Plegadis chihi*	Marshes, wet meadows, wetlands.	None. No suitable habitat occurs within the project area.	Yes. Occurrence would be limited to migrating individuals.
Bald eagle *Haliaeetus leucocephalus*	Large perennial waterbodies with suitable roosting trees.	Low. No suitable habitat occurs within the project area.	Yes. Occurrence would be limited to migrating and foraging individuals.
Northern goshawk *Accipiter gentilis*	Coniferous forests and aspen forests.	None. No suitable habitat occurs within the project area.	Yes. Occurrence would be limited to migrating individuals.
Ferruginous hawk *Buteo regalis*	Mountain foothills, badlands, semi-desert shrublands.	High. Five nest sites have been documented within the project area, including an active nest on a power line pole in the southern portion of the project area.	No.
Peregrine falcon *Falco peregrinus*	Cliffs near riparian areas and wetlands.	None. No suitable nesting habitat occurs within the project area.	Yes. Occurrence would be limited to migrating and foraging individuals.
Mountain plover *Charadrius montanus*	Prairie and shrublands.	High. Suitable habitat occurs within the project area.	No.
Long-billed curlew *Numenius americanus*	Wet meadows and grasslands.	Low. Marginal habitat occurs within the project area.	No.
Burrowing owl *Athene cunicularia hypugea*	Shrublands with suitable burrows for nesting and cover.	High. Suitable habitat occurs within the project area.	No.
Sage thrasher *Oreoscoptes montanus*	Sagebrush shrublands.	High. Suitable habitat occurs within the project area.	No.
Loggerhead shrike *Lanius ludovicianus*	Open habitat such as grasslands, shrublands, and agricultural areas.	High. Suitable habitat occurs within the project area.	No.

Table 3-13 BLM Sensitive Wildlife Species Potentially Occurring within the Project Area

Common Name *Scientific Name*	Habitat Association[1]	Potential for Occurrence within the Project Area[1]	Eliminated from Detailed Analysis (Yes/No)
Brewer's sparrow *Spizella breweri*	Sagebrush shrublands.	High. Suitable habitat occurs within the project area	No.
Sage sparrow *Amphispiza belli*	Sagebrush shrublands.	High. Suitable habitat occurs within the project area.	No.
Reptiles			
Midget faded rattlesnake *Crotalus viridis concolor*	Rocky outcrops in semi-desert shrublands.	None. This species is not known to occur within the project area.	Yes. Project is outside the known range and distribution of this species in Wyoming.
Amphibians			
Great Basin spadefoot *Spea intermontana*	Spring seeps, temporary wetlands, and playas.	Moderate. Marginal habitat occurs within the project area in ephemeral washes.	No.

[1] Status, habitat association, and potential for occurrence within the project area taken from USFWS 2012c; WGFD 2010; and WYNDD 2012.

Sensitive Bat Species (BLM Sensitive)

The Townsend's big-eared bat (*Corynorhinus townsendii*), spotted bat (*Euderma maculatum*), and fringed myotis (*Myotis thysanodes*) occur in a wide variety of habitats including semi-desert scrub, sagebrush shrubland, grassland, coniferous forest, and riparian areas. Roost sites consist of buildings, caves, mines, rock crevices, trees, and cliffs (Fitzgerald et al. 1994; WGFD 2010; WYNDD 2012). No roost sites have been identified within the project area; however, based on the presence of suitable foraging habitat, the potential for these species to occur within the project area is considered high.

Pygmy Rabbit (BLM Sensitive)

The pygmy rabbit (*Brachylagus idahoensis*) inhabits drainages within sagebrush shrublands and require tall, dense sagebrush canopies with deep soils with high clay content for burrowing (WGFD 2010; WYNDD 2012). According to the WYNDD pygmy rabbit distribution model (Keinath et al. 2010), 22,530 acres of medium probability, and 127 acres of high probability habitat occur within the project area, all of which are located in the eastern Arch Unit (**Figure 3-7**). Based on WYNDD occurrence data for this species within the project area, the potential for this species to occur within the project area is high.

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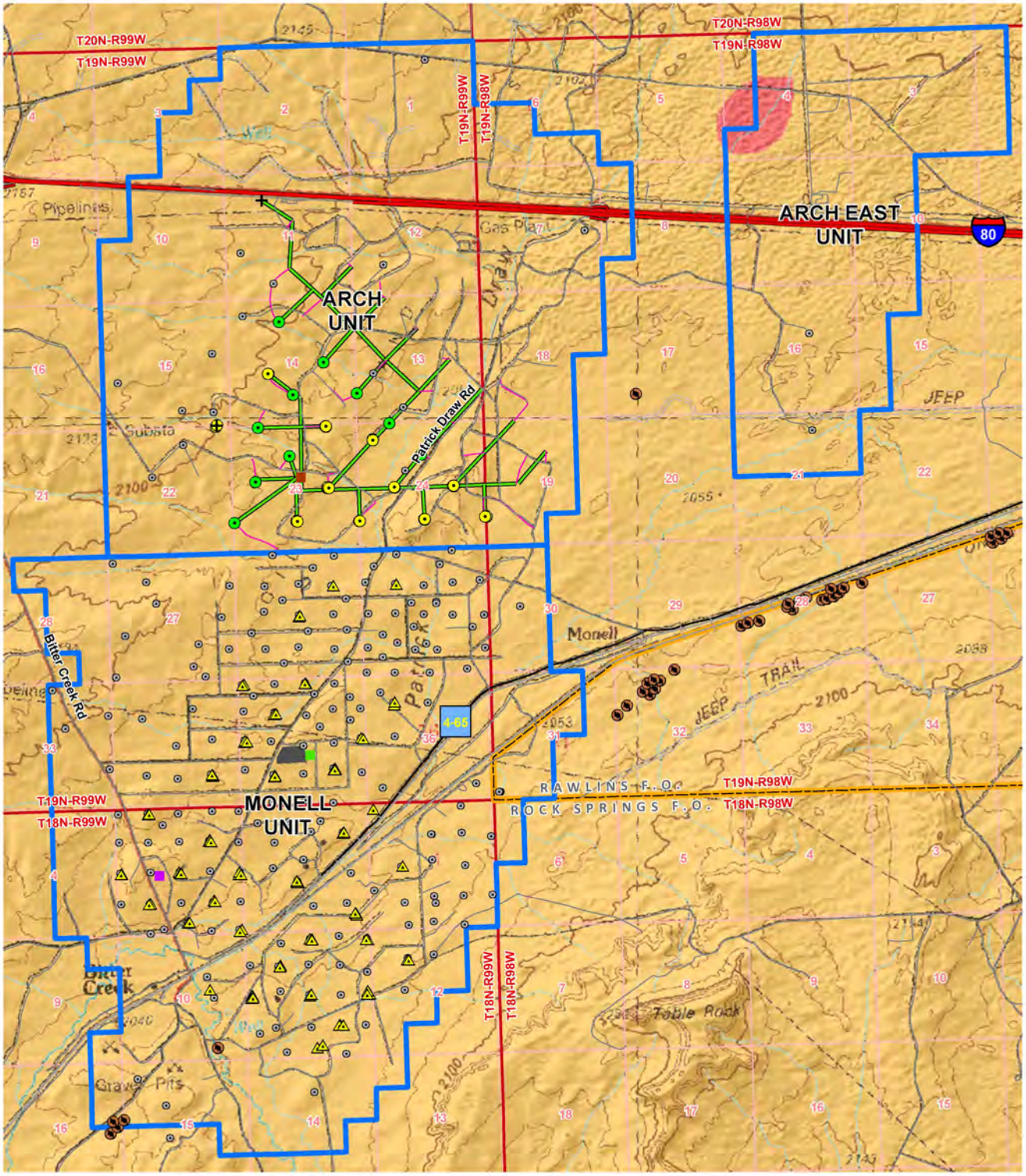

Legend

Proposed Wells (2013-2016)

Arch Unit Wells
- Single well Pad
- Multi-well Pad

Monell Unit Wells
- Multi-well Pad
- Proposed Pipeline
- Proposed Road

Conceptual Facilities
- Production
- Production/Header
- Production/ Compressor Station

Existing Facilities
- Production
- Existing Well
- Injection Well

- Pygmy Rabbit Occurrence

Pygmy Rabbit Predicted Probability of Occurrence
- High Probability
- Medium Probability

Source: BLM 2011, Keinath et al. 2010.

Figure 3-7

Pygmy Rabbit Predicted Probability of Occurrence

0 0.25 0.5 1 1.5 Miles

1:75,000

N

White-tailed Prairie Dog (BLM Sensitive)

The white-tailed prairie dog (*Cynomys leucurus*) inhabits xeric sites with mixed shrubs and grasses. This species is often associated with sagebrush and saltbrush and maintain burrow densities less than the black-tailed prairie dog (WGFD 2010; WYNDD 2012). In Wyoming, the white-tailed prairie dog is found in the western two-thirds of the state, excluding the areas near Yellowstone and Grand Teton National parks (WGFD 2010). White-tailed prairie dog surveys were conducted on September 12 and 13, 2012, to determine location, size, and density of active colonies located within the Arch Units of the project area. Surveys documented two white-tailed prairie dog colonies totaling 3,497 acres, while previous surveys conducted in the Monell Unit discovered nine prairie dog colonies totaling 1,946 acres (**Figure 3-5**, **Table 3-12**) for a combined total of 5,443 acres across the entire project area. Based on the results of these surveys, this species occurs within the project area.

Wyoming Pocket Gopher (BLM Sensitive)

The Wyoming pocket gopher (*Thomomys clusius*) prefer dry, gravelly, shallow-soil ridge tops within greasewood plant communities. Burrow systems associated with pocket gophers range from 6 inches to 1 foot below the surface, typically consisting of a network of feeding tunnels connected to a smaller and deeper system of chambers that are used for nesting and food storage (WGFD 2010). According to the WYNDD Wyoming pocket gopher distribution model (Griscom et al. 2010); 21,405 acres of low probability, 1,122 acres of medium probability, and 130 acres of high probability habitat occur within the project area (**Figure 3-8**). Historic records from the WYNDD indicate two Wyoming pocket gophers observations occurred within or near the southern boundary of the Monell Unit. Based on these occurrences and the WYNDD habitat distribution model, the potential for this species to occur within the project area is moderate.

Ferruginous Hawk (BLM Sensitive)

The ferruginous hawk (*Buteo regalis*) breeds from the Canadian Prairie Provinces south to Oregon, Nevada, Arizona, and Oklahoma. It winters from the central and southern portions of its breeding range south into Baja California and central Mexico. This species inhabits semiarid open country, primarily grasslands, basin-prairie shrublands, and badlands. It requires large tracts of relatively undisturbed rangeland and nests on rock outcrops, the ground, knolls, cliff ledges, or trees (Johnsgard 1990; WGFD 2010; WYNDD 2012). In Wyoming, this species is found throughout the state, although it is most common in the south-central portion of the state (WGFD 2010). Five ferruginous hawk nests are known to occur within the project area and one additional nest is located within a mile of the project area; no nests were active during the September surveys (**Figure 3-4**). Therefore, the potential for this species to occur within the project area is considered high.

Burrowing Owl (BLM Sensitive)

The burrowing owl (*Athene cunicularia*) breeds from south-central British Columbia, south through most of the western U.S. and Mexico (WGFD 2010). The burrowing owl typically inhabits level, open areas in heavily grazed or low-stature desert vegetation, with available burrows for nesting and cover (Johnsgard 1988; WGFD 2010). Nesting habitat consists of abandoned mammal burrows on flat, dry, and relatively open terrain (Johnsgard 1988). Based on the habitats present within the project area, and the existing burrowing owl nest located within 1 mile of the project area, the potential for this species to occur within the project area is considered high.

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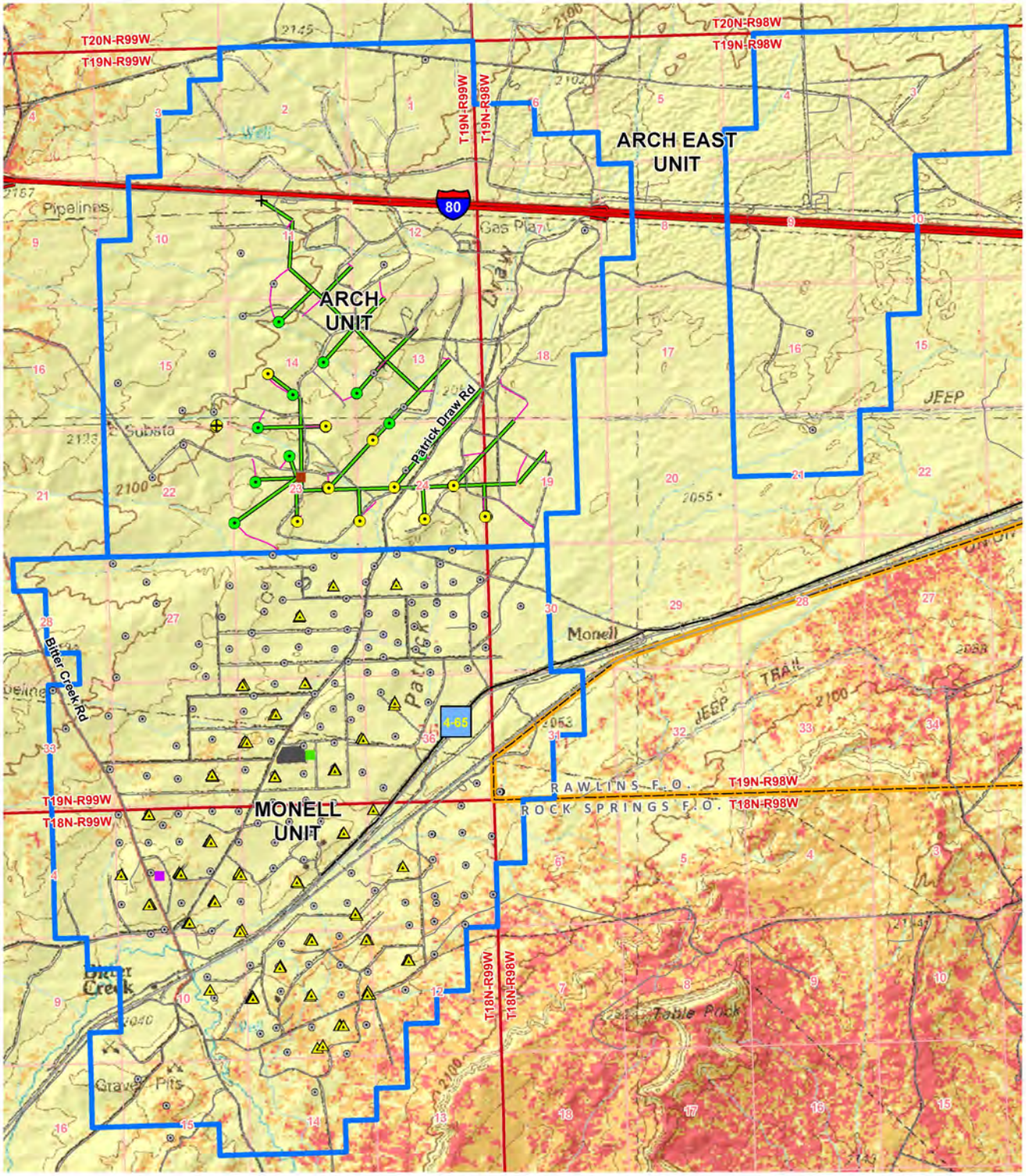

Legend

Proposed Wells (2013-2016)
Arch Unit Wells
- Single well Pad
- Multi-well Pad

Monell Unit Wells
- Multi-well Pad
- Proposed Pipeline
- Proposed Road

Conceptual Facilities
- Production
- Production/Header
- Production/ Compressor Station

Existing Facilities
- Production
- Existing Well
- Injection Well

WY Pocket Gopher Predicted Probability of Occurrence
- High Probability
- Medium Probability
- Low Probability

Source: Griscom et al. 2010.

Figure 3-8

Wyoming Pocket Gopher Predicted Probability of Occurrence

0 0.25 0.5 1 1.5 Miles

1:75,000

N

Mountain Plover (BLM Sensitive)

The mountain plover's (*Charadrius montanus*) historic breeding range of the mountain plover included short-grass prairies from extreme southern Canada, south through the Great Plains of the U.S. (WGFD 2010). Currently, mountain plovers only nest in isolated areas throughout their range. In Wyoming, the breeding range of this species is widespread and relatively common in favored habitat; however, population levels and trends are not known (WGFD 2010). Breeding habitat for this species appears to vary geographically. However, throughout its range, suitable breeding habitat is characterized primarily by shortgrass prairie grassland where grazing is intensive, or in areas of fallow fields or active prairie dog towns (WGFD 2010; WYNDD 2012). According to the WYNDD mountain plover distribution model (Keinath et al. 2010), 4,000 acres of low probability, 8,615 acres of medium probability, and 10,042 acres of high probability habitat occur within the project area (**Figure 3-9**). Based the results of the WYNDD distribution model, the potential for this species to occur within the project area is high.

Long-billed Curlew (BLM Sensitive)

The long-billed curlew (*Numenius americanus*) breeds in southern Canada south into portions of most of the western U.S. It winters in California, Arizona, Mexico, Texas, Louisiana, and South Carolina. The long-billed curlew occurs and breeds throughout a majority of Wyoming. This species inhabits a variety of grassland types ranging from moist meadow grasslands to agricultural areas to dry prairie uplands, usually near water. This species prefers a complex of shortgrass prairies, agricultural fields, wet and dry meadows and prairies, and grazed mixed-grass and scrub communities (WGFD 2010). Based on the presence of marginal habitat, the potential for this species to occur within the project area is considered low.

Sage Thrasher, Loggerhead shrike, Brewer's sparrow, and Sage sparrow (BLM Sensitive)

The sage thrasher (*Oreoscoptes montanus*), loggerhead shrike (*Lanius ludovicianus*), Brewer's sparrow (*Spizella breweri*), and sage sparrow (*Amphispiza belli*) typically found in open habitats including grassland, sagebrush shrubland, semi-desert scrub, and agricultural areas (WYNDD 2012; WGFD 2010). Based on the presence of suitable habitat, as well as WYNDD occurrence data, the potential for these species to occur within the project area is high.

Great Basin Spadefoot Toad (BLM Sensitive)

The Great Basin spadefoot toad (*Spea intermontana*) ranges from southern British Columbia south through the Great Basin to northern Arizona and New Mexico. Great Basin spadefoots prefer sagebrush communities below 6,000 feet amsl, although they have been found at elevations of 9,200 feet amsl. This species requires loose soil for burrowing. In Wyoming, this species is most abundant west of the Continental Divide in the Wyoming Basin and the Green River Valley, but in the center of the state, it crosses the Divide into Fremont and Natrona counties (WGFD 2010). Potential habitat occurs within the project area in ephemeral washes.

3.8.2 Aquatic

3.8.2.1 Federally Listed Fish Species

As part of the evaluation of potential water depletions on federally endangered fish in the Upper Colorado River Basin, background information is provided on four species, Colorado pikeminnow (*Ptychocheilus lucius*), razorback sucker (*Xyrauchen texanus*), humpback chub (*Gila cypha*), and bonytail (*Gila elegans*), which occur downstream of the project area in the Green River. The most upstream occurrence for any of these species is below Flaming Gorge near Jensen, Utah. These four species are included in the affected environment section because of a requirement to analyze the potential effects of water use that could affect flows in the Upper Colorado River Basin. A brief summary of species occurrence is provided below.

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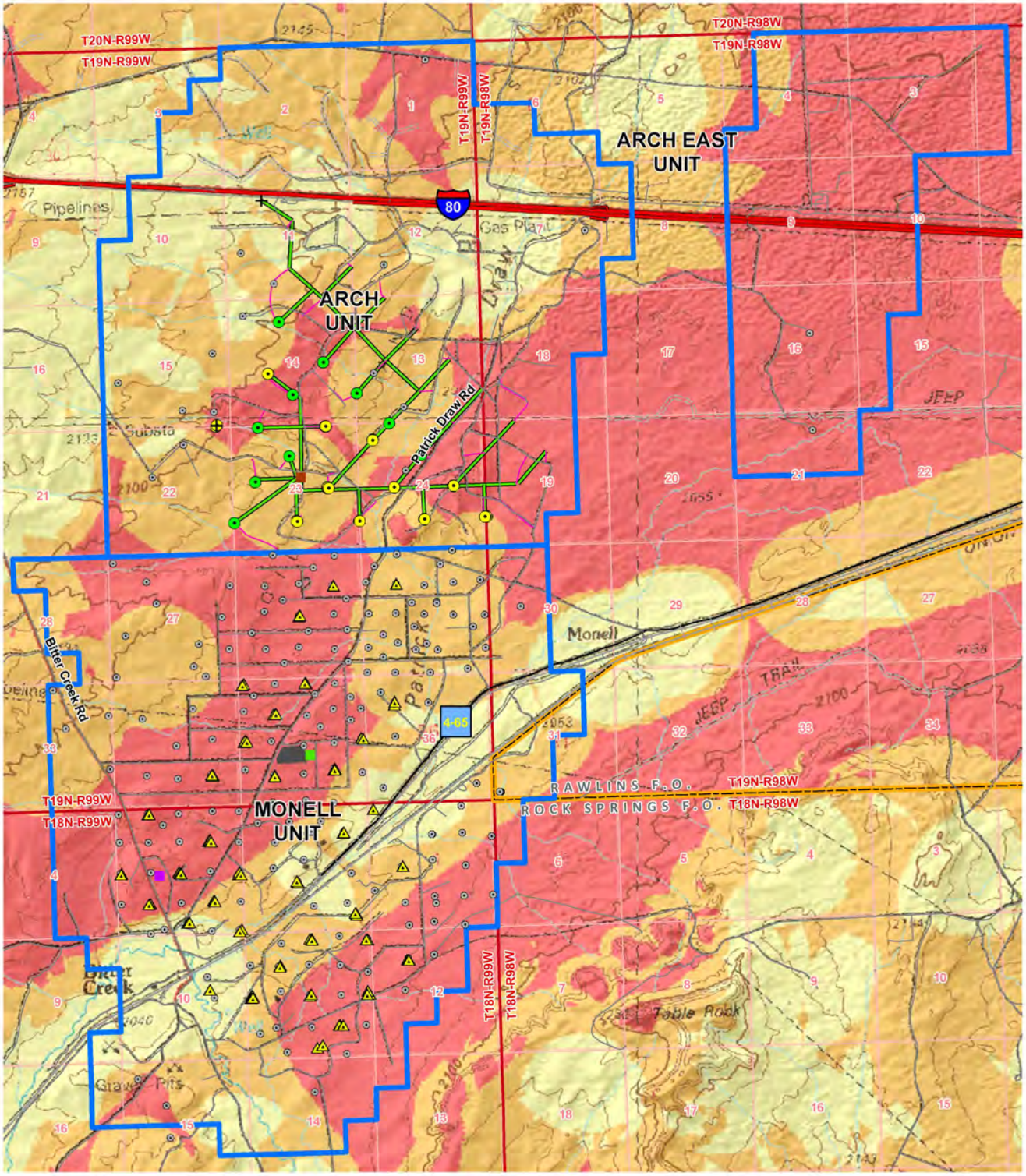

Legend

Proposed Wells (2013-2016)
Arch Unit Wells
- Single well Pad
- Multi-well Pad

Monell Unit Wells
- Multi-well Pad
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Conceptual Facilities
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- Production/ Compressor Station

Existing Facilities
- Production
- Existing Well
- Injection Well

Mountain Plover Predicted Probability of Occurrence
- High Probability
- Medium Probability
- Low Probability

Source: Keinath et al. 2010.

Figure 3-9

Mountain Plover Predicted Probability of Occurrence

0 0.25 0.5 1 1.5 Miles

1:75,000

N

Bonytail

The USFWS determined the species to be endangered in 1980 (45 FR 27710). In 1994, the USFWS designated seven reaches of the Colorado River system, including portions of the Colorado, Green, and Yampa Rivers in the Upper Basin and the Colorado River in the Lower Basin, totaling 312 miles of critical habitat for the species (59 FR 13374). A recovery plan was published for bonytail in 2002 (USFWS 2002a). The upper basin recovery subunit is composed of the Green River and upper Colorado basin and the lower basin recovery subunit includes the mainstem and tributaries of the Colorado River from Lake Mead downstream to the southerly International Boundary with Mexico. Known occurrence includes the Yampa River in Dinosaur National Monument, the Green River in Gray and Desolation canyons, the Colorado River near Black Rocks (Kaeding et al. 1986) and Cataract Canyon (59 FR 13374), Lake Mohave near the Arizona-Nevada border, and Lake Havasu in Arizona and California (USFWS 2002a).The general types of habitat used by bonytail include mainstem riverine areas and impoundments in the Colorado River system. Deep pools and eddies with slow to fast currents are characteristic of the riverine habitat (Kaeding et al. 1986). It is assumed that spawning occurs in June or July (Maddux et al. 1993).

Colorado Pikeminnow

This species (originally named Colorado squawfish) was listed as endangered under the ESA on March 11, 1967 (32 FR 4001). With the 1973 passage of the ESA, the fish retained its endangered status. On March 21, 1994 the USFWS designated six reaches of the Colorado River system, including portions of the Colorado, Green, Yampa, White, and San Juan Rivers, totaling 1,148 miles of critical habitat for the species (59 FR 13374). Two reintroduced Colorado pikeminnow populations have been designated as Nonessential Experimental under Section 10(j) of the ESA (50 FR 30188). A recovery plan for this species was published in 2002 (USFWS 2002b). The entire population of the Colorado pikeminnow has been reduced to three recovery subunits in the upper Colorado River Basin: the Green River, the upper Colorado River, and the San Juan River subbasins. Colorado pikeminnow occurs within three subbasins and includes the following rivers: Green River subbasin (Green, Yampa, Little Snake, White, Price, and Duchesne), Upper Colorado subbasin (Upper Colorado, Gunnison, and Dolores), and San Juan (San Juan River). Habitat requirements of Colorado pikeminnow vary depending on the life stage and time of year. Young-of-the-year and juveniles prefer shallow backwaters, while adults use pools, eddies, and deep runs (Miller et al. 1982). During peak runoff in the spring and early summer, fish usually move into backwater areas of flooded riparian zones to avoid swift velocities, feed, and prepare for the upcoming spawning period. Adults are highly mobile during the spawning period, which occurs after peak runoff in mid-June to mid-August.

Humpback Chub

The dates for listing humpback chub are the same as discussed for Colorado pikeminnow. On March 21, 1994 the USFWS designated seven reaches of the Colorado River system including portions of the Colorado, Green, and Yampa Rivers in the Upper Basin and portions of the Colorado and Little Colorado Rivers in the Lower Basin, totaling 379 miles of critical habitat for the species (59 FR 13374). The current recovery plan for the humpback chub was published in 1990 and amended in 2002 (USFWS 2002c). Currently, there are six known self-sustaining populations. Five occur in the Upper and one on the Lower Basin Recovery Units. The Upper Recovery Unit consists of populations on the Colorado River (Black Rocks and Westwater Canyon in Utah and Cataract Canyon in Colorado), one population on the Yampa River (Yampa Canyon in Colorado), and on the Green River (Desolation/Gray Canyons in Utah). Humpback chub mainly occurs in river canyons where they utilize a variety of habitats including deep pools, eddies, upwells near boulders, and areas near steep cliff faces. Young and spawning adults are generally found in sandy runs and backwaters. Spawning occurs in May through July after peak spring flows.

Razorback Sucker

The razorback sucker was first proposed for listing as a threatened species under the ESA in 1978 (43 FR 17375). In 1980, the USFWS withdrew the proposal because it was not finalized within the 2-year

time limit from the initial publication in the Federal Register (45 FR 35410). In 1989, the USFWS received a petition requesting that the razorback sucker be added to the list of endangered species. A positive finding was made and subsequently published by the USFWS in 1991 (56 FR 54957). In 1994, the USFWS designated 15 reaches of the Colorado River system, including portions of the Green, Yampa, Duchesne, Colorado, White, Gunnison, and San Juan rivers in the Upper Basin and portions of the Colorado, Gila, Salt, and Verde rivers in the Lower Basin, totaling 1,724 miles of critical habitat for the species (59 FR 13374). The current recovery plan for the humpback chub was published in 1998 and amended in 2002 (USFWS 2002d). The upper basin recovery subunit is composed of the Green River, upper Colorado River, and San Juan River subbasins and the lower basin recovery subunit includes the mainstem and tributaries of the Colorado River from Lake Mead downstream to the southerly International Boundary with Mexico. In the Upper Colorado River Basin, razorback suckers are considered extant in four locations: Westwater and Cataract Canyons and the Utah-Colorado state line on the Colorado River, Desolation/Gray Canyons of the Green River, and a population in northeastern Colorado on the Yampa River. Habitat requirements for this species reflect both riverine and reservoir environments. General habitats used by adults include eddies, pools, and backwaters during the non-breeding period (July through March) (Maddux et al. 1993). Seasonal habitat use includes pools and eddies from November through April, runs and pools from July through October, runs and backwaters in May, and backwaters and flooded gravel pits during June. Juveniles prefer shallow water with minimal flow in backwaters, tributary mouths, off-channel impoundments, and lateral canals (Maddux et al. 1993). Spawning usually occurs in April through mid-June. They migrate long distances and congregate in large numbers at spawning sites.

3.8.2.2 Sensitive Species

The Bitter Creek drainage within and adjacent to the project area supports the only known population of pure flannelmouth suckers in Wyoming that are not sympatric with introduced white suckers. The WGFD has categorized the flannelmouth sucker as a Status 1 species, which is defined as a species that is physically isolated and/or exist at extremely low densities throughout their range, and habitat conditions are declining or vulnerable (WGFD 2012). These fish are the only known Wyoming population that is genetically unaltered, and therefore, they represent an important source for future restoration efforts. The population in Bitter Creek inhabits approximately 24 miles of habitat between the Town of Bitter Creek and a point just downstream of the La Clede Gage Station (WGFD 2012). The project area overlaps with approximately 3.3 miles of the segments that support flannelmouth sucker or 14 percent of known habitat in Bitter Creek and also showed the highest catch rates for this species in recent surveys.

Sampling efforts have collected this species at two locations upstream of the town of Bitter Creek (Keith et al. 2003, as cited in BLM 2006a). Habitat for this species mainly consists of pools in streams and large rivers (Baxter and Simon 1970). Spawning typically occurs in May through early August. A conservation strategy has been developed for flannelmouth sucker, bluehead sucker, and roundtail chub for the Colorado River Basin including the Green River and its tributaries (Utah Department of Natural Resources 2006).

3.8.3 Plants

Special status plant species are those species for which state or federal agencies afford an additional level of protection by law, regulation, or policy. Included in this category are federally listed species that are protected under the ESA, species of concern as identified by the USFWS, and species designated as state sensitive by the BLM. There are no known occurrences or suitable habitat for federal, state, or county listed plant species for the study area.

3.9 Air Quality and Climate Change

Air quality in a given location is defined by pollutant concentrations in the atmosphere (generally expressed in units of parts per million [ppm] or micrograms per cubic meter [$\mu g/m^3$]) and visibility. Weather fluctuations are considered part of the air quality analysis because they control dispersion and

affect ambient air concentrations. To ensure that normal climatic fluctuations would not affect overall results, it is important to take into account both long-term and short-term meteorological data sets. The physical effects of air quality depend on the characteristics of the receptors (human or environmental) and the type, amount, and duration of exposure. This section describes the existing air quality resource of the region and the applicable air regulations that would apply to the proposed project.

This ambient air quality conditions characterize an area located in southwestern Wyoming, near Rock Springs in Sweetwater County. This section describes the existing air quality resource of the region and the applicable air regulations and standards that would apply to the Proposed Action and No Action alternatives.

3.9.1 Air Quality Regulatory Framework

The CAA of 1970 (42 USC 7401 et seq.) as amended in 1977 and 1990 is the basic federal statute governing air pollution. Provisions of the CAA of 1970 that potentially are relevant to the project are listed below.

- National Ambient Air Quality Standards (NAAQS)
- Prevention of Significant Deterioration (PSD)
- New Source Performance Standards (NSPS)
- National Emission Standards for Hazardous Air Pollutants
- Conformity Requirements
- Federal Operating Permits Program
- Greenhouse Gas (GHG) Tailoring Rule
- GHG Reporting Rule

In addition to federal regulations, the CAA provides states with the authority to regulate air quality within state boundaries. The State of Wyoming has enacted additional Ambient Air Quality Standards (Wyoming Ambient Air Quality Standards [AAQS]) that are applicable to the project area. In addition, the WDEQ has established mitigation measures that are required for oil and gas producers in this region. These mitigation measures are referred to as Wyoming BACT and are applicable to the project. The regulations are outlined in the WDEQ's Oil and Gas Production Facilities, Chapter 6, Section 2, Permitting Guidance (March 2010). The federal and Wyoming state regulations that potentially are relevant to the project are discussed in the following sections.

3.9.1.1 National and State Ambient Air Quality Standards

The federal CAA amendments of the 1990s require all states to control air pollution emission sources so that NAAQS are met and maintained. In addition to these requirements, the National Park Service (NPS) Organic Act requires the NPS to protect the natural resources of the lands it manages from the adverse effects of air pollution.

The NAAQS establishes maximum acceptable concentrations for nitrogen dioxide (NO_2), CO, sulfur dioxide (SO_2), particulate matter with an aerodynamic diameter of 2.5 microns or less ($PM_{2.5}$), particulate matter with an aerodynamic diameter of 10 microns or less (PM_{10}), ozone (O_3), and lead; known as criteria pollutants. Given the extremely low levels of lead emissions from project sources, the lead standards are not addressed in this analysis. The NAAQS are established by the USEPA and are outlined in 40 CFR 50. Wyoming AAQS also establish maximum acceptable concentrations of H_2S. These standards represent the maximum allowable atmospheric concentrations that may occur to protect public health and welfare, and include a reasonable margin of safety to protect the more sensitive individuals in the population. The air quality impacts in the air quality study area must meet the NAAQS, which are promulgated by the USEPA and apply nationwide. An area that does not meet the NAAQS is

designated as a nonattainment area on a pollutant-by-pollutant basis. Applicable federal and state criteria are presented in **Table 3-14**.

Table 3-14 Applicable Ambient Air Quality Standards

Pollutant (Units)	Averaging Period	Ambient Air Quality Standards[1]	
		National[2]	Wyoming[3]
NO_2 (ppb or ppm)	1-hour	100 ppb[12]	100 ppb
	Annual[4]	0.053 ppm	53 ppb
PM_{10} (µg/m^3)	24-hour[5]	150	150
	Annual[4]	--[13]	50
$PM_{2.5}$ (µg/m^3)	24-hour[6]	35	35
	Annual[4]	12	15
SO_2 (ppb or ppm)	1-hour[7]	75 ppb	75 ppb
	3-hour[8]	0.5 ppm	0.5 ppm
	24-hour[8]	--[14]	--[15]
	Annual[4]	--[14]	--[15]
CO (µg/m^3)	1-hour[8]	40,000	40,000
	8-hour[8]	10,000	10,000
O_3 (ppm)	8-hour[9]	0.075	0.075
H_2S (µg/m^3)	30-minute[10]	--	70
	30-minute[11]	--	40

1 Due to the lack of an identified regional issue for lead, it will not be analyzed as part of this study.
2 Source: USEPA 2011a.
3 Source: WDEQ 2012c (new Chapter 2 – updated December 19, 2012).
4 Not to be exceeded.
5 Not to be exceeded more than once per year on average over 3 years.
6 24-hour average of the 98th percentile concentrations (effective December 17, 2006).
7 The 3-year average of the 99th percentile of the daily maximum 1-hour average must not exceed this standard.
8 Not to be exceeded more than once per year.
9 To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average O_3 concentrations measured at each monitor within an area over each year must not exceed 0.075 ppm.
10 Not to be exceeded more than 2 times per year. Note that the ambient air quality models do not produce results for less than a 1-hour averaging period. Therefore, the 1-hour average impact for H_2S will be compared to the standard.
11 Not to be exceeded more than 2 times in any 5 consecutive days. Note that the ambient air quality models do not produce results for less than a 1-hour averaging period. Therefore, the 1-hour average impact for H_2S will be compared to the standard.
12 The 3-year average of the 98th percentile of the daily maximum 1-hour average is not to exceed this standard.
13 The annual PM_{10} NAAQS of 50 µg/m^3 was revoked by USEPA on September 21, 2006; see FR volume 71, number 200, 10/17/06.
14 The 24-hour and annual SO_2 NAAQS was revoked by USEPA on June 2, 2010.
15 The 24-hour and annual SO_2 Wyoming AAQS were revoked by WDEQ on December 19, 2012.

µg/m^3 = micrograms per cubic meter
ppb = parts per billion
ppm = parts per million
NO_2 = nitrogen dioxide
PM_{10} = particulate matter with an aerodynamic diameter of 10 microns or less
$PM_{2.5}$ = particulate matter with an aerodynamic diameter of 2.5 microns or less
SO_2 = sulfur dioxide
CO = carbon monoxide
O_3 = ozone
H_2S = hydrogen sulfide

3.9.1.2 Prevention of Significant Deterioration

New emissions sources in an attainment area are required to follow PSD regulations, which restrict the degree of ambient air quality deterioration allowed. These PSD regulations apply to proposed new or modified major stationary sources located in an attainment area that have the potential to emit criteria pollutants in excess of predetermined *de minimis* values (40 CFR Part 51). As defined in 40 CFR 51, a source is a major stationary source if it:

1. Can be classified in one of the 28 named source categories listed in Section 169 of the CAA and it emits or has the potential to emit 100 tons per year (tpy) or more of any pollutant regulated by the CAA; or
2. Is any other stationary source that emits or has the potential to emit 250 tpy or more of any pollutants regulated by the CAA (USEPA 1990); or
3. Is any other stationary source that emits or has the potential to emit 100,000 tpy or more of carbon dioxide equivalent (CO_2e).

The upstream oil and gas sources that are anticipated to be operated as part of the project are not listed as one of the 28 named source types in Section 169 of the CAA; therefore, 250 tpy of criteria pollutants is the threshold for major source status for the project. The PSD applicability is determined for each individually permitted source. Given that this level of detail is not available for this study, the project was conservatively assumed to have the potential of being a PSD major source when considering its overall potential to emit CO_2e.

Allowable deterioration to air quality can be expressed as the incremental increase to ambient concentrations of criteria pollutants, or PSD increment. The PSD increments for criteria pollutants are based on the PSD classification of the area. Classification of areas falls into three categories. Class I area status is assigned to federally protected wilderness areas and allows the lowest amount of permissible deterioration, Class II designations allow a higher level of increment consumption relative to Class I areas, and Class III applies to heavy industrial use areas. There are no designated Class III or heavy industrial use areas in the U.S.

A project's PSD increment consumption is typically determined through the use of an air quality model. Atmospheric concentrations of NO_2, SO_2, $PM_{2.5}$, and PM_{10} predicted by the air quality model are compared with allowable PSD increments. The allowable PSD increments for Class I and Class II areas are given in **Table 3-15**. For NEPA analyses, a comparison of project impacts to PSD Class II increments does not represent an official regulatory PSD increment consumption analysis because:

1. Increment consumption is not evaluated for regulatory purposes under NEPA; and
2. An official increment consumption analysis requires a special set of emissions data not available for this NEPA analysis.

Table 3-15 Increments for Class I and Class II Areas

PSD Class	Pollutant	Allowable Increment ($\mu g/m^3$)		
		Annual Arithmetic Mean	24-hour Maximum	3-hour Maximum
Class I	NO_2	2.5	-	-
	SO_2	2	5	25
	$PM_{2.5}$	1	2	-
	PM_{10}	4	8	-

Table 3-15 Increments for Class I and Class II Areas

PSD Class	Pollutant	Allowable Increment (µg/m^3)		
		Annual Arithmetic Mean	24-hour Maximum	3-hour Maximum
Class II	NO_2	25	-	-
	SO_2	20	91	512
	$PM_{2.5}$	4	9	-
	PM_{10}	17	30	-

The project area is located within a PSD Class II area. PSD Class I and other sensitive Class II areas also are located within the project air quality study area. The closest PSD Class I area is Bridger Wilderness Area, which is approximately 70 miles northwest of the project area. The PSD Class I areas and sensitive Class II areas in proximity to the project area are shown in **Figure 3-10**. Those areas that are analyzed as part of in the air quality analysis include:

- Bridger Wilderness Area, Wyoming (Class I)
- Fitzpatrick Wilderness Area, Wyoming (Class I)
- Savage Run Wilderness Area, Wyoming (Federal Class II, Wyoming Class I)
- Mount Zirkel Wilderness Area, Colorado (Class I)
- Rawah Wilderness Area, Colorado (Class I)
- Popo Agie Wilderness Area, Wyoming (Class II)
- Wind River Roadless Area, Wyoming (Class II)
- Dinosaur National Monument, Colorado-Utah (Federal Class II, Colorado Class I [SO_2 only])

In addition to more stringent PSD increments, Class I areas are protected by Federal Land Managers (FLMs) who track and manage air quality related values (AQRVs) such as visibility and atmospheric deposition. Though not a regulatory program under PSD, FLMs review the issuance of a PSD permit for any impacts that exceed guideline thresholds for these parameters. In addition to visibility and atmospheric deposition analyses, the change in the acid neutralizing capacity (ANC) of sensitive lakes is assessed by FLMs. The lakes that have been designated as acid sensitive and are located within the sensitive PSD Class I and Class II Wilderness areas include:

- Deep Lake in the Bridger Wilderness Area, Wyoming
- Black Joe Lake in the Bridger Wilderness Area, Wyoming
- Hobbs Lake in the Bridger Wilderness Area, Wyoming
- Upper Frozen Lake in the Bridger Wilderness Area, Wyoming
- Lazy Boy Lake in the Bridger Wilderness Area, Wyoming
- Ross Lake in the Fitzpatrick Wilderness Area, Wyoming
- Lower Saddlebag Lake in the Popo Agie Wilderness Area, Wyoming
- Lake Elbert in the Mount Zirkel Wilderness Area, Colorado
- Seven Lakes in the Mount Zirkel Wilderness Area, Colorado

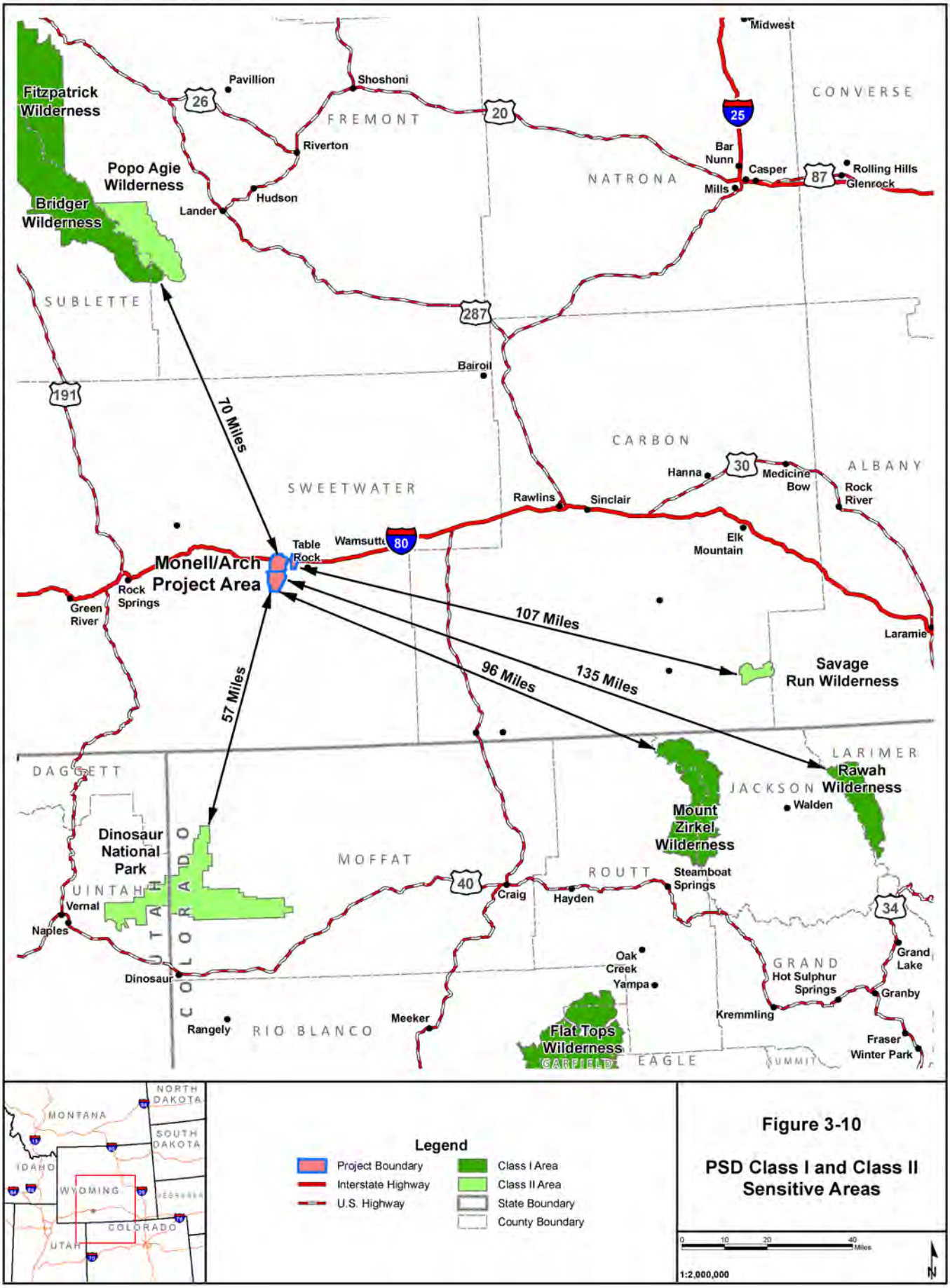

Figure 3-10

PSD Class I and Class II Sensitive Areas

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- Summit Lake in the Mount Zirkel Wilderness Area, Colorado
- Island Lake in the Rawah Wilderness Area, Colorado
- Rawah Lake #4 in the Rawah Wilderness Area, Colorado.

3.9.1.3 New Source Performance Standards

The regulation of new sources was an important step taken by the CAA. NSPS apply to all new, modified, or reconstructed sources within a given category, regardless of geographic location or the existing ambient air quality. The standards define emission limitations that would be applicable to a particular source group. The NSPS potentially applicable to the project include the following subparts of 40 CFR Part 60:

- Subpart A – General Provisions
- Subpart Kb – Standards of Performance for Volatile Organic Storage Vessels
- Subpart IIII – Standards of Performance for Stationary Compression Ignition Internal Combustion Engines
- Subpart JJJJ – Standards of Performance for Stationary Spark-Ignition Internal Combustion Engines
- Subpart KKKK – Standards of Performance for Stationary Combustion Turbines
- Subpart OOOO – Standards of Performance for Crude Oil and Natural Gas Production, Transmission, and Distribution

3.9.1.4 National Emission Standards for Hazardous Air Pollutants

Under the National Emission Standards for Hazardous Air Pollutants, the USEPA promulgated Maximum Achievable Control Technology (MACT) standards pursuant to Section 112 of the 1990 CAA Amendments and these rules are provided in 40 CFR 63. The MACT standards that potentially would be applicable to the proposed project include the following:

- Subpart A – General Provisions
- Subpart HH – Oil and Natural Gas Production Facilities
- Subpart VV – National Emission Standards for Oil-Water Separators and Organic-Water Separators
- Subpart HHH – Natural Gas Transmission and Storage Facilities
- Subpart EEEE – National Emission Standard for Hazardous Air Pollutants: Organic Liquids Distribution (Non-Gasoline)
- Subpart ZZZZ – Stationary Reciprocating Internal Combustion Engines
- Subpart DDDDD – Industrial, Commercial, and Institutional Boilers and Process Heaters

3.9.1.5 Wyoming Best Available Control Technology

The project area is located in the Concentrated Development Area (CDA) designated by the WDEQ. As such, the project must install and operate the presumptive BACT requirements for CDA facilities set forth by the WDEQ (WDEQ 2010). This requires installation of control equipment for flashing, dehydration units, pneumatic pumps, pneumatic controllers, well completions, produced water tanks, blow down/venting, and specified limits for internal combustion engines. Wyoming BACT requirements will be followed as part of the applicant-committed measures (ACMs). Project emissions calculations include controls stipulated by Wyoming BACT.

3.9.1.6 Conformity for General Federal Actions

According to Section 176I of the CAA (40 CFR 51.853), a federal agency must make a conformity determination in the approval of a project having air emissions that exceed specified thresholds in nonattainment and/or maintenance areas. The proposed project is not located in a nonattainment or maintenance area; therefore, a general conformity analysis is not required.

3.9.1.7 Federal Operating Permits Program

A Title V operating permit is required for all major stationary sources under the Federal Operating Permits Program outlined in 40 CFR Part 70 of the CAA. Whether a source meets the definition of "major" depends on the type and amount of air pollutants it emits and, to some degree, on the overall air quality in its vicinity. Generally, major sources are industrial facilities and large commercial operations which include stationary facilities that emit 100 tons or more per year of a regulated air pollutant including compounds such as CO, PM_{10}, $PM_{2.5}$, volatile organics, SO_2, and NO_X. Major sources of toxic air pollutants (i.e., any source that emits more than 10 tpy of an individual toxic air pollutant or more than 25 tpy of any combination of toxic air pollutants) also are covered under the Federal Operating Permits Program. Major sources of GHG emissions also are covered under the Federal Operating Permits Program. The proposed project would be a major source with respect to the Federal Operating Permits Program; therefore, a Title V operating permit will be required.

3.9.1.8 Carbon Dioxide and Other Greenhouse Gases

CO_2 and other GHGs are naturally occurring gases in the atmosphere whose status as a pollutant is not related to their toxicity, but to the added long-term impacts they may have on climate due to their increased levels in the earth's atmosphere. Because they are non-toxic and non-hazardous at normal ambient concentrations, CO_2 and other naturally occurring GHGs do not have applicable ambient standards or emission limits under the major environmental regulatory programs.

On October 30, 2009, the USEPA issued the final mandatory reporting rule for major sources of GHG emissions (40 CFR Part 98). The rule requires a wide range of sources and source groups to record and report selected GHG emissions, including CO_2, methane (CH_4), nitrous oxide, and some halogenated compounds. Various oil and gas operations are required to monitor and report GHG emissions under this regulation.

On June 3, 2010, the USEPA issued the Prevention of Significant Deterioration and Title V Greenhouse Gas Tailoring Rule. The rule tailors the applicability criteria that determine which stationary sources become subject to permitting requirements for GHG emissions under the PSD and Title V programs of the CAA. Under the rule, new facilities with GHG emissions of at least 100,000 tpy CO_2e and existing facilities with at least 100,000 tpy CO_2e making changes that would increase GHG emissions by at least 75,000 tpy CO_2e are required to obtain PSD permits. Facilities seeking to obtain a PSD permit to cover other regulated pollutants, also must address GHG emissions increases of 75,000 tpy CO_2e or more. New and existing sources with GHG emissions above 100,000 tpy CO_2e also must obtain operating permits.

Although this project will probably entail major source permitting and monitoring, recordkeeping and reporting of GHG emissions, the USEPA rules do not require any controls or establish any standards related to GHG emissions or impacts. Therefore, there is no evident requirement at this time that would affect development of the proposed project under the USEPA rules.

3.9.1.9 Wyoming Air Quality Standards and Regulations

The project will be required to comply with applicable Wyoming Air Quality Standards and Regulations (WAQSR) including those pertaining to fugitive dust control. Specifically, WAQSR Chapter 3, Section 2(f)(i)(A) requires that sources operating within the State of Wyoming control fugitive dust emissions. Approved control measures for minimizing fugitive dust from construction/demolition activities

(specifically clearing or leveling of land, earthmoving, excavation, or movement of trucks or construction equipment over access haul roads or cleared land) may include watering and/or chemical stabilization.

3.9.2 Regional Air Quality

Ambient air quality in a given location is defined by pollutant concentrations in the atmosphere and is generally expressed in units of ppm or µg/m^3. Representative ambient background levels provide an estimate of current levels of pollutants measured in the area of interest. For the project, background information for Sweetwater and Teton counties in Wyoming were used and are shown in **Table 3-16**. Data for this table were obtained from the USEPA Air Monitoring Network (USEPA 2012a) except where as noted as being from the WDEQ.

Table 3-16 Ambient Air Quality Background Values

Pollutant	Averaging Period	Ranking[1]	Year	Concentration	Units	Number of Exceedences	Monitor/ County
NO_2	1-hour	H1H	2009	0.045	ppm	0	Sweetwater (Wamsutter Station)
		H1H	2010	0.059	ppm	0	Sweetwater (Wamsutter Station)
		H1H	2011	0.057	ppm	0	Sweetwater (Wamsutter Station)
	Annual[2]	H1H	2009	0.0052	ppm	0	Sweetwater (Wamsutter Station)
		H1H	2010	0.0048	ppm	0	Sweetwater (Wamsutter Station)
		H1H	2011	0.0044	ppm	0	Sweetwater (Wamsutter Station)
CO	1-hour	H2H	2009	1.80	ppm	0	Teton (Yellowstone Station)
		H2H	2010	1.90	ppm	0	Teton (Yellowstone Station)
		H2H	2011	1.20	ppm	0	Sweetwater (Tata Station)

Table 3-16 Ambient Air Quality Background Values

Pollutant	Averaging Period	Ranking[1]	Year	Concentration	Units	Number of Exceedences	Monitor/ County
CO (Cont.)	8-hour	H2H	2009	0.50	ppm	0	Teton (Yellowstone Station)
		H2H	2010	0.50	ppm	0	Teton (Yellowstone Station)
		H2H	2011	0.90	ppm	0	Sweetwater (Tata Station)
SO_2	1-hour	H1H	2009	0.007	ppm	0	Sweetwater (Wamsutter Station)
		H1H	2010	0.040	ppm	0	Sweetwater (Moxa Station)
		H1H	2011	0.030	ppm	0	Sweetwater (Moxa Station)
	3-hour[2]	H2H	2009	0.004	ppm	0	Sweetwater (Wamsutter Station)
		H2H	2010	NA	ppm	0	Sweetwater (Moxa Station)
		H2H	2011	0.001	ppm	0	Sweetwater (Moxa Station)
	24-hour	H2H	2009	0.002	ppm	0	Sweetwater (Wamsutter Station)
		H2H	2010	0.004	ppm	0	Sweetwater (Moxa Station)
		H2H	2011	0.005	ppm	0	Sweetwater (Moxa Station)
	Annual	H1H	2009	0.0003	ppm	0	Sweetwater (Wamsutter Station)
		H1H	2010	NA	ppm	0	Sweetwater (Moxa Station)
		H1H	2011	0.0006	ppm	0	Sweetwater (Moxa Station)

Table 3-16 Ambient Air Quality Background Values

Pollutant	Averaging Period	Ranking[1]	Year	Concentration	Units	Number of Exceedences	Monitor/ County
PM_{10}	24-hour	H2H	2009	68	µg/m^3	0	Sweetwater (Wamsutter Station)
		H2H	2010	52	µg/m^3	0	Sweetwater (Wamsutter Station)
		H2H	2011	62	µg/m^3	0	Sweetwater (Wamsutter Station)
	Annual	H1H	2009	14.9	µg/m^3	0	Sweetwater (Wamsutter Station)
		H1H	2010	14	µg/m^3	0	Sweetwater (Wamsutter Station)
		H1H	2011	12.3	µg/m^3	0	Sweetwater (Wamsutter Station)
$PM_{2.5}$	24-hour	H2H	2009	NA	µg/m^3	0	Sweetwater (Rock Springs Station)
		H2H	2010	12.8	µg/m^3	0	Sweetwater (Rock Springs Station)
		H2H	2011	14.1	µg/m^3	0	Sweetwater (Rock Springs Station)
	Annual	H1H	2009	6.0	µg/m^3	0	Sweetwater (Rock Springs Station)
		H1H	2010	5.9	µg/m^3	0	Sweetwater (Rock Springs Station)
		H1H	2011	5.1	µg/m^3	0	Sweetwater (Rock Springs Station)

Table 3-16 Ambient Air Quality Background Values

Pollutant	Averaging Period	Ranking[1]	Year	Concentration	Units	Number of Exceedences	Monitor/ County
O_3	8-hour	H1H	2009	0.066	ppm	0	Sweetwater (Wamsutter Station)
		H1H	2010	0.073	ppm	0	Sweetwater (Wamsutter Station)
		H1H	2011	0.066	ppm	0	Sweetwater (Wamsutter Station)

[1] H1H = Highest value recorded and H2H = second highest value recorded.

[2] Values from the WDEQ 2012d.

3.9.2.1 Air Quality Attainment Status

As of July 2012, the USEPA has designated Sublette County, the northeastern corner of Lincoln County and the northwestern corner of Sweetwater County as marginal non-attainment for the ozone. The project is approximately 49 miles from this non-attainment area. The project area is considered in attainment or unclassifiable for all pollutants.

3.9.2.2 Air Quality Related Values

An AQRV is defined by the NPS (NPS 2011) as:

> "a resource as identified by the Federal Land Manager for one or more federal areas, that may be adversely affected by a change in air quality. The resource may include visibility or a specific scenic, cultural, physical, biological, ecological, or recreational resource identified by the Federal Land Manager for a particular area."

AQRVs include changes in visibility or atmospheric deposition of pollutants to soil and bodies of water. Regional haze is visibility impairment caused by the cumulative air pollutant emissions from numerous sources over a wide geographic area. Visibility impairment is caused by particles and gases in the atmosphere which scatter, distort, or absorb light. The primary cause of regional haze in many parts of the country is light scattering resulting from fine particles (i.e., $PM_{2.5}$) in the atmosphere. Additionally, coarse particles between 2.5 and 10 microns in diameter can contribute to light extinction. Coarse particulates and $PM_{2.5}$ can be naturally occurring or the result of human activity. The natural levels of these species result in some level of visibility impairment, in the absence of any human influences, and will vary with season, daily meteorology, and geography (Malm 1999).

The visibility at Bridger Wilderness Area, the Class I area that is closest to the project area, is one of the best, or least impaired, in the nation. The regional haze baseline period selected spanned from 2000 through 2004,and the average total light extinction for the top 20 percent best days was 3.4 inverse megameter (Mm^{-1}), for the worst 20 percent days it was 22.6 Mm^{-1}, and averaged over the whole baseline period it was 10.75 Mm^{-1} (IMPROVE 2012). Mm^{-1} is the direct measurement unit for visibility impairment data. It is the amount of light scattered and absorbed as it travels over a distance of 1 million meters. Most of the particulate matter at Bridger Wilderness Area is composed of organic material, sulfates, and soil. The relative fractions of each component vary seasonally. Typically May and early fall are when Bridger Wilderness Area experiences the greatest reduction in visible range (IMPROVE 2012).

Background total nitrogen and sulfur deposition data are collected at National Acid Deposition Program National Trends Network (wet deposition) and Clean Air Status and Trends Network (dry deposition) monitoring locations near Centennial and Pinedale, Wyoming, as well as Murphy Ridge, Utah. The most recent available background nitrogen and sulfur deposition data are shown in **Table 3-17**.

Table 3-17 Background N and S Deposition Values

Site Location	Nitrogen Deposition		Sulfur Deposition		Year of Monitoring	
	Wet[2]	Dry[3]	Wet[2]	Dry[3]	Wet[2]	Dry[3]
Pinedale (WY)	2.34	0.342	1.34	0.140	2011	
Murphy Ridge (UT)	1.78		1.13		2011	
Centennial (WY)		0.571		0.156	2011	

[1] Values expresses as kilograms per hectare per year.

[2] National Atmospheric Deposition Program 2012.

[3] USEPA 2012b.

The ANC values that were currently available, and the number of samples used in the calculation of the lowest 10th percentile ANC values, are provided in **Table 3-18**. Of the 12 lakes listed in **Table 3-18**, 2 lakes (Lazy Boy and Upper Frozen) are considered by the USFS as extremely sensitive to atmospheric deposition since the background ANC values are less than 28 micro equivalents per liter (µeq/l).

Table 3-18 Background ANC Values for Acid Sensitive Lakes[1]

Wilderness Area	Lake	Latitude (Deg-Min-Sec)	Longitude (Deg-Min-Sec)	10th Percentile Lowest ANC Value (µeq/l)[2]	Number of Samples
Bridger	Black Joe	42º44'22”	109º10'16”	70.6	72
Bridger	Deep	42º43'10”	109º10'15”	61.1	62
Bridger	Hobbs	43º02'08”	109º40'20”	69.8	76
Bridger	Lazy Boy	43º19'57”	109º43'47”	27.8	1
Bridger	Upper Frozen	42º41'13”	109º09'39”	13.2	3
Fitzpatrick	Ross	43º22'41”	109º39'30”	54.0	55
Mount Zirkel	Lake Elbert	40º38'3”	106º42'25”	52.0	61
Mount Zirkel	Seven Lakes	40º53'45”	106º40'55”	39.9	18
Mount Zirkel	Summit Lake	40º32'43”	106º40'55”	48.0	102
Popo Agie	Lower Saddlebag	42º37'24”	108º59'38”	55.5	54

Table 3-18 Background ANC Values for Acid Sensitive Lakes[1]

Wilderness Area	Lake	Latitude (Deg-Min-Sec)	Longitude (Deg-Min-Sec)	10th Percentile Lowest ANC Value (µeq/l)[2]	Number of Samples
Rawah	Island	40º37'38"	105º56'28"	71.9	25
Rawah	Rawah Lake #4	40º37'38"	105º56'28"	41.5	24

[1] From USFS 2011.

[2] 10th percentile lowest ANC values reported.

3.9.3 Climate and Climate Change Overview

3.9.3.1 Regional Climate and Effects on Air Quality

The climate in the region is characterized as arid, with cold winters and moderate summers. Annual precipitation (rainfall and snowfall) in the region ranges from 7 to 10 inches. A climate summary for Green River, Wyoming, for 1897 to 2012, which is reasonably representative of climate conditions in the project area, is presented in **Table 3-19**.

Table 3-19 Monthly Climate Summary for Green River, Wyoming

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Avg. Max. Temp. (°F)	32.0	37.1	46.2	57.2	68.0	78.4	87.2	85.3	75.3	62.0	45.4	34.1	59.0
Avg. Min. Temp. (°F)	4.7	9.4	19.2	27.8	36.1	43.4	49.9	47.7	37.5	27.6	16.6	7.0	27.2
Avg. Total Precip. (inches)	0.38	0.44	0.59	0.90	1.15	0.77	0.59	0.72	0.76	0.85	0.46	0.37	7.98
Avg. Total Snow Fall (inches)	4.4	4.9	4.7	3.8	0.9	0	0	0	0.2	2.1	3.8	4.2	29.0
Avg. Snow Depth (inches)	1	1	0	0	0	0	0	0	0	0	0	1	0

Source: Western Regional Climate Center 2012.

Three important meteorological factors influence the dispersion of pollutants in the atmosphere: mixing height, stability, and wind (speed and direction). Mixing height is the vertical distance above ground within which the air is well mixed due to wind-induced turbulence or buoyancy from surface heating. A relatively high mixing height allows the surface-level pollutants to be mixed into a deeper layer, thereby diluting the concentration and reducing the ambient air quality impact from those emissions. Mixing heights vary by several factors: 1) time of day due to the sun's angle of incidence and consequent heating of the surface inducing buoyant mixing within that layer and the cooling at night; 2) terrain features that may inhibit and distort flow; 3) cloud cover that inhibits daily heating and cooling; 4) turbulence from winds in relation the surface roughness; and 5) the passage of weather systems and large-scale convection that act to mix air vigorously. In the project area, average morning mixing heights are approximately 1,000 feet and annual mean afternoon mixing heights are more than 7,800 feet

(Holzworth 1972). Mean morning mixing heights tend to be lowest in the summer and fall, and highest in the spring months.

Atmospheric stability patterns are related to the temperature gradient above the surface and also are affected by surface winds. If the temperature decreases rapidly with height, the atmosphere tends to be unstable and the pollutants are well mixed. If temperature increases with height (a temperature inversion), the atmosphere is considered to be stable, which inhibits the dispersion of pollutants. As related to the mixing heights, the atmosphere is more unstable in afternoon hours due to solar heating of the surface, and tends to be more stable late at night and early morning due to surface cooling. The atmosphere generally is most stable on clear, cold, winter mornings with calm winds and on days with snow cover at the surface. In and around the project area, the typically dry atmosphere leads to increased instability in the afternoons with extended periods of sunshine, and the dry conditions lead to stable conditions in the early morning because of the clear skies and strong night-time surface cooling. Stable conditions also develop along lower lying terrain features, such as valleys, due to the sinking of colder air into those valleys, with warmer air aloft. Thus, the topography plays a role in development of localized atmospheric stability conditions. The dispersion of pollutants also is related to local wind speeds and changing wind direction. The more turbulent the atmospheric layer (caused by topography, high wind speed, fluctuating wind direction, or veering/baking wind with height) the more enhanced dispersion can be expected to be. The project area lies within the prevailing westerly wind belt, and within that belt, the associated large-scale storm systems that pass through the area act to enhance dispersion of pollutants. The local terrain also contributes to a westerly wind direction in the project vicinity

3.9.4 Climate Change and Greenhouse Gas Emissions

Anthropogenic (man-made) GHG emissions and changes in biological carbon sequestration due to land management activities on global climate have been identified as the likely causes of the increased rate of average surface temperature of the planet. Through complex interactions on a regional and global scale, these GHG emissions and net losses of biological carbon sinks cause a net warming effect of the atmosphere, primarily by impeding the rate of heat energy radiated by the earth back into space. Although GHG levels naturally exhibit cyclical patterns over the millennia, recent industrialization and burning of fossil carbon sources have caused CO_2e concentrations to increase dramatically, and are likely to contribute to overall global climatic changes. Several activities contribute to the phenomena of climate change, including emissions of GHGs (especially CO_2 and CH_4) from fossil fuel development, large wildfires, activities using combustion engines, changes to the natural carbon cycle, and changes to radiative forces and reflectivity (albedo) of the earth-atmosphere system. It is important to note that GHGs would have a sustained climatic impact over different temporal scales. For example, recent emissions of CO_2 may influence climate for 100 years. The Intergovernmental Panel on Climate Change (IPCC) recently concluded that warming of the climate system is unequivocal to past cycles and most of the observed increase in globally average temperatures, since the mid-20th century very likely is due to the observed increase in anthropogenic GHG concentrations (IPCC 2007).

Global mean surface temperatures increased nearly 1.8°F from 1890 to 2006. Models indicate that average temperature changes are likely to be greater in the Northern Hemisphere. Northern latitudes (above 24°N) have exhibited temperature increases of nearly 2.1°F since 1900, with nearly a 1.8°F increase since 1970. Without additional meteorological monitoring systems, it is difficult to determine the spatial and temporal variability and subsequent alteration of climatic conditions, but increasing concentrations of GHGs are likely to accelerate the rate of climate change.

In 2001, the IPCC projected that by the year 2100, global average surface temperatures could increase by 2.5 to 10.4°F above 1990 levels. The National Academy of Sciences (2010) has confirmed these projections, but also has indicated that there are uncertainties regarding how climate change may affect different regions. Computer model predictions indicate that increases in temperature would not be equally distributed, but are likely to be accentuated at higher latitudes. Warming during the winter months is expected to be greater than during the summer, and increases in daily minimum temperatures have

been observed to increase in the region during the last few decades, while there are no strong indications of increases in daily maximum temperatures. Although large-scale spatial shifts in precipitation distribution may occur, these changes are more uncertain and difficult to predict.

As with any field of scientific study, there are uncertainties associated with the science of climate change; however, this does not imply that scientists do not have confidence in many aspects of climate change science. Some aspects of the science are known with virtual certainty because they are based on well-known physical laws and documented trends (USEPA 2011b).

It may be difficult to discern whether climate change is already affecting resources globally, let alone those in the vicinity of the proposed project. In most cases, there is little information about potential or projected effects of global climate change on resources. It is important to note that projected changes are likely to occur over several decades to a century. Therefore, many of the projected changes associated with climate change may not be measurably discernible within the reasonably foreseeable future. Existing climate prediction models are global in nature; therefore, they are not at the appropriate scale to estimate potential impacts of climate change on the project area and vicinity.

3.10 Land Use and Special Designations

Land use is currently comprised of livestock grazing, recreation, and oil and gas leases with well sites and associated infrastructure. Due to the nature of the existing land uses, portions of the project area are highly disturbed. There are no areas with wilderness characteristics within or near the project area. The nearest special designation is the Monument Valley Management Area, located over 15 miles south from the boundary of the project area. The management objective for the Monument Valley area is to provide protection of wildlife, geologic, cultural, watershed, scenic, and scientific values.

As shown in **Table 3-20**, the federal lands administered by the BLM and private lands make up the majority of the project area. Private lands are owned by the Union Pacific Land Resources (UPLR) and Rock Springs Grazing Association. The Wyoming Office of State Lands and Investments manages state trust land. Revenues generated by trust lands and minerals are reserved for the exclusive benefit of public schools and certain other designated public institutions in Wyoming such as the Wyoming State Hospital (Wyoming Office of State Lands and Investments 2011). The surface ownership pattern within and adjacent to the project area is checkerboard, typically where even-numbered sections are owned by the federal government and odd-numbered sections are privately owned, mostly by the UPLR and a livestock company.

Table 3-20 Land and Mineral Ownership

Ownership	Surface		Minerals	
	Percent	Acres	Percent	Acres
Federal Lands	48	10,922	44	9,991
State Lands	2	365	56	12,667
Private Lands	50	11,370		
Total	**100**	**22,657**	**100**	**22,658**

There are two designated utility corridors within the project area, one of which includes the Union Pacific rail lines, and the other includes the I-80 highway corridor. Both run in an east-west direction. There also are numerous ROWs within the project area consisting of multiple pipelines from existing oil and gas operations, overhead utilities, and the previously stated interstate ROW and Union Pacific co-located railroad ROWs. **Figure 3-11** depicts ROWs and special designations in and around the project area.

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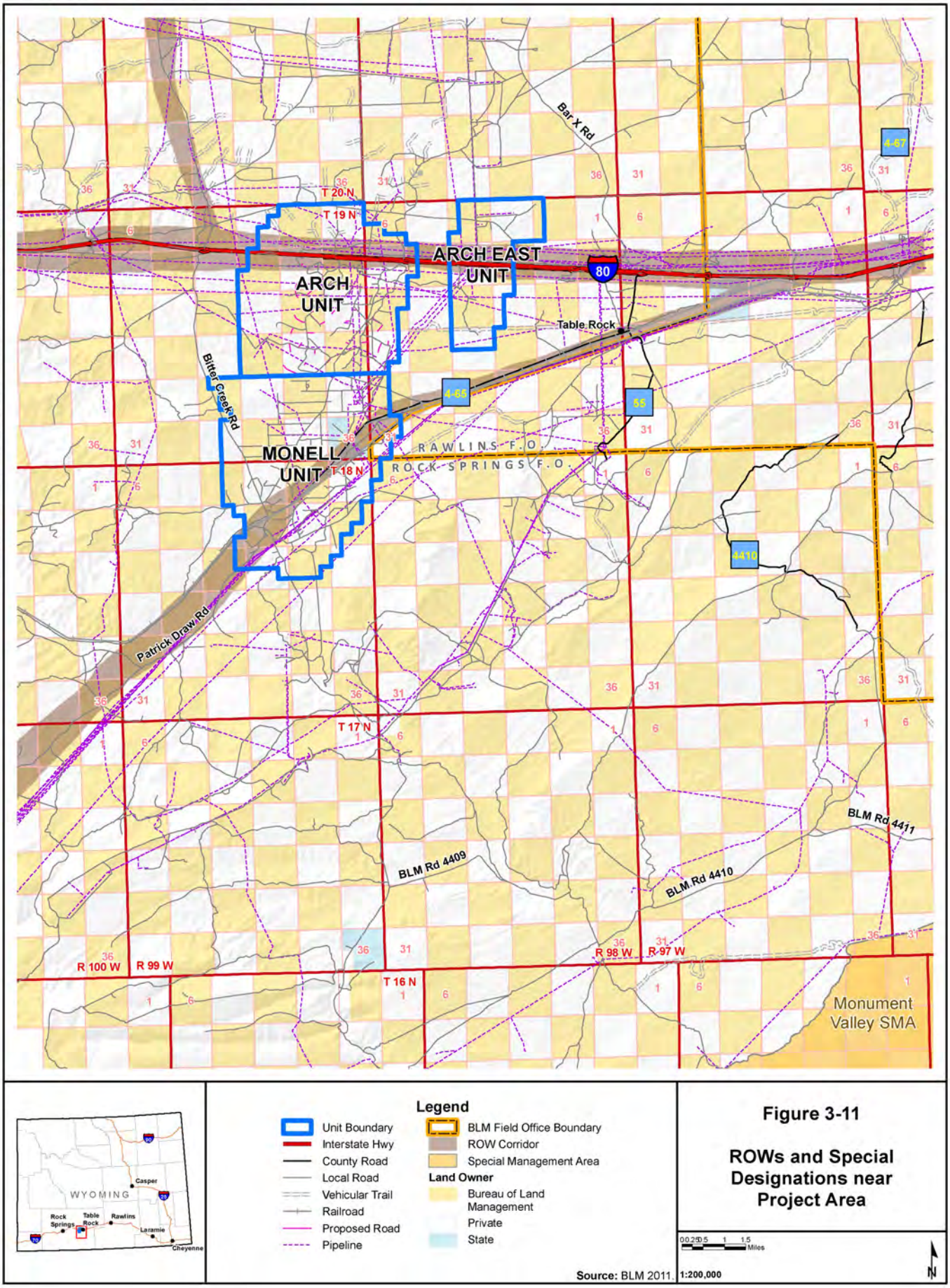


Figure 3-11

ROWs and Special Designations near Project Area

3.11 Transportation

The project area is transected by one interstate highway (I-80) and multiple county (CR), BLM, and private gravel roads and unimproved access roads. The majority of the roads within the project area are CRs, BLM-maintained access roads, and roads associated with oil and gas development, but there also are a number of secondary unmaintained two-track roads. Access to the project area is provided by I-80, Sweetwater CR 24 (Patrick Draw Road), and Sweetwater 19S (Bitter Creek Road).

Traffic volumes on I-80 near the project area are listed on **Table 3-21**. Traffic on I-80 in the vicinity of the project area has increased approximately 12 percent since 2000. The interchange at Patrick Draw Road and I-80 is a "diamond" interchange, which should provide adequate egress from the interstate for all oil and gas development and operations vehicles. The interchange at Patrick Draw Road and I-80 is a "jughandle," with a 15-mile per hour exit speed, which could make exiting from I-80 more difficult for large vehicles and heavy equipment. Both Patrick Draw and Bitter Creek Roads transects the project area in a north-south direction. **Figure 3-12** depicts the road network in and around the project area.

Table 3-21 Current Interstate Traffic Volume Near the Project Area

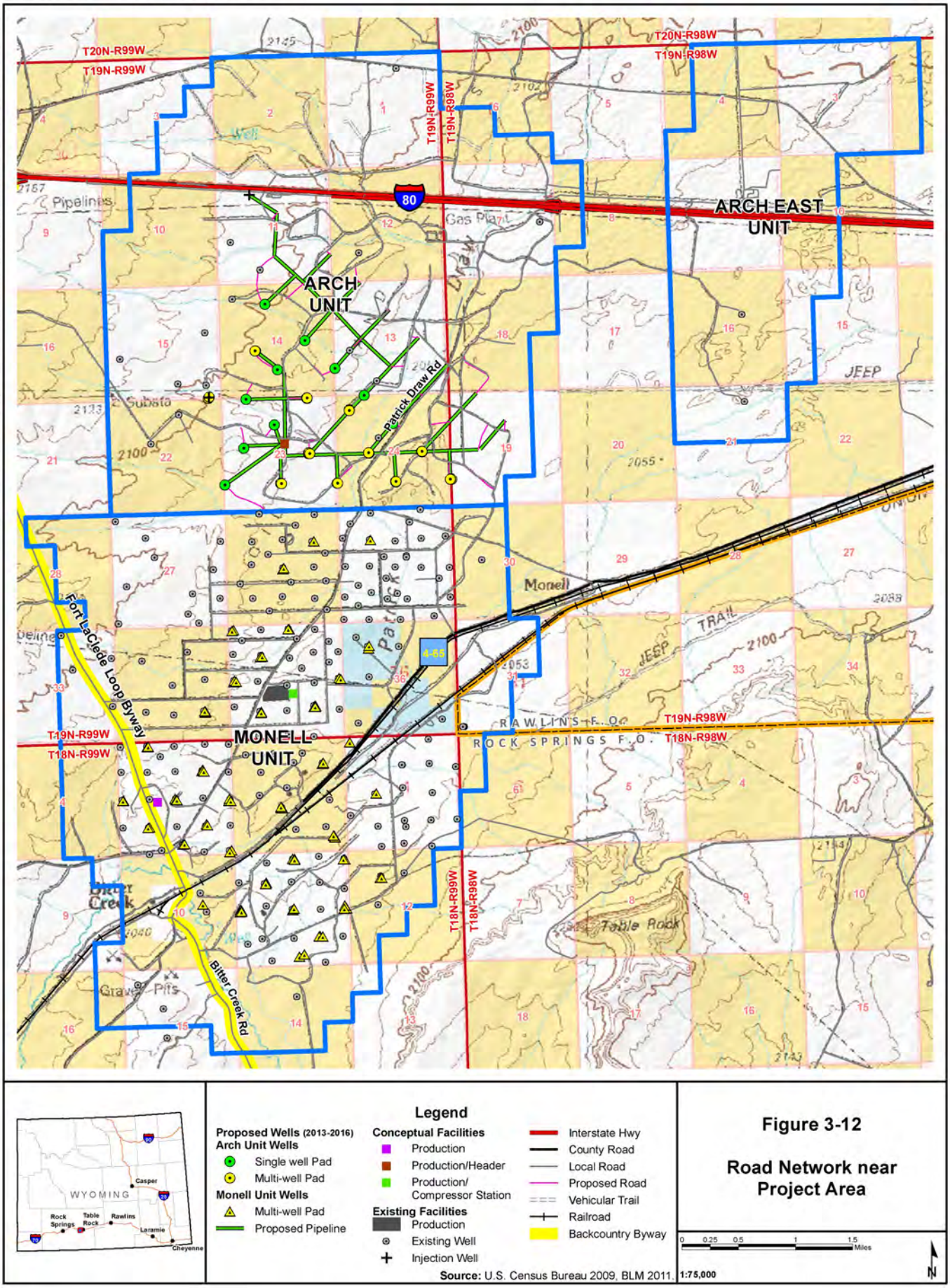
Route	2000 All Vehicles	2000 Trucks	2009 All Vehicles	2009 Trucks	2010 All Vehicles	2010 Trucks
I-80 at Patrick Draw (CR 24)	5,450	3,200	6,052	3,269	6,070	3,339
I-80 at Bitter Creek (CR 19S)	5,450	3,150	6,092	3,272	6,110	3,342

Source: Wyoming Department of Transportation 2011.

Table 3-22 shows the mileage of existing roads within the project area. The majority of roads in the project area are designated as oil and gas access roads associated with existing extraction activities, followed by local roads, CRs, an interstate, and four-wheel drive roads. There are approximately 8 miles of railway transecting the project area.

Table 3-22 Existing Project Area Road Mileage

Road Type	Approximate Miles within Project Area
Interstate	11
County Road	16
4WD Trail	1
Existing Oil and Gas Access Roads	83
Local Roads	45
Total Road Mileage	**156**



Legend

Proposed Wells (2013-2016)
Arch Unit Wells
- Single well Pad
- Multi-well Pad

Monell Unit Wells
- Multi-well Pad
- Proposed Pipeline

Conceptual Facilities
- Production
- Production/Header
- Production/ Compressor Station

Existing Facilities
- Production
- Existing Well
- Injection Well

- Interstate Hwy
- County Road
- Local Road
- Proposed Road
- Vehicular Trail
- Railroad
- Backcountry Byway

Source: U.S. Census Bureau 2009, BLM 2011.

Figure 3-12

Road Network near Project Area

0 0.25 0.5 1 1.5 Miles

1:75,000

N

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3.12 Recreation

Recreation in the project area is currently comprised of big-game hunting opportunities, as well as photography, pleasure driving, off-road use, and hiking. The most common big-game species hunted is pronghorn, followed by, to a lesser extent, mule deer. All BLM-administered lands in the RSFO and Rawlins Field Office (RFO) are designated limited, open, or closed to off-highway vehicle activities. All of the BLM-administered land in the project area is designated as limited to existing roads and vehicle routes (BLM 2008, 1997). The Ft. LaClede Loop Back-Country Byway intersects the southwest portion of the Monell Unit and may be used for pleasure driving. Given the checkerboard landownership pattern, the controlled nature of the property, and the availability of other more potentially appealing areas in the general area, these secondary recreational opportunities appear to receive limited use in the project area. There are no developed recreation areas within or adjacent to the project area.

The area is designated as Roaded Natural, a definition used in the Recreation Opportunity Spectrum by the BLM. The typical setting for Roaded Natural is moderate to high human contact on roads; low to moderate human contact on trails; and access is typically within 1 mile of improved roads. It also is characterized as a natural setting with easily noticed to dominant modifications.

3.13 Visual Resources and Noise

3.13.1 Visual Resources

The project area is located in the Wyoming Basin physiographic province, which is characterized by eroded elevated plains with isolated low mountains. Vegetation is dominated by Wyoming big sagebrush, saltbrush, greasewood, and grasses. Human modifications to the natural landscape include oil and gas development, transportation ROWs, sparsely scattered ranch buildings, and unpaved roads.

The BLM is responsible for managing the public lands for multiple uses, while ensuring that the scenic values of public lands are considered before allowing uses that may have adverse visual impacts. The BLM accomplishes this management objective through categorizing areas according to its Visual Resource Management (VRM) system, which involves inventorying scenic values, based on line, form, color, and texture, and establishing management objectives for those values. BLM then evaluates proposed activities to determine whether they conform to the management objectives and to recommend measures that minimize impacts to the viewshed.

VRM classes are based on visual ratings of inventoried lands. Each class describes the degree of modification allowed to the basic elements of the landscape. The following are the minimum management objectives for each class, based on BLM Handbook H-8410-1, Visual Resource Inventory.

- Class I: Natural ecological changes and very limited management activity are allowed. Any contrast created within the characteristic landscape must not attract attention. This classification is applied to Visual Areas of Critical Environmental Concern, wilderness areas, wild and scenic rivers, and other relatively undisturbed landscapes.
- Class II: Changes in any of the basic elements (form, line, color, texture) caused by a management activity should not be evident in the landscape. A contrast may be seen but should not attract attention.
- Class III: Changes should repeat the basic elements found in the predominant natural features of the characteristic landscape. Contrasts to the basic elements caused by a management activity may be evident and begin to attract attention in the landscape. The changes, however, should remain subordinate in the existing landscape.
- Class IV: Contrasts may attract attention and be a dominant feature in the landscape in terms of scale. However, the changes should repeat the basic elements of the landscape.

The project area meets the definition of both Class III and IV designations, in which the level of change of the characteristic landscape can be moderate to high. Management activities may dominate the view and be the primary focus of viewer attention. However, every attempt should be made to minimize the impact of activities through careful location of facilities, minimal disturbance, and repetition of the basic landscape elements of color, form, line, and texture. Approximately 82 percent of the project area is designated VRM Class IV, with the remainder designated Class III. **Figure 3-13** depicts the extent of VRM Classes within the project area.

3.13.2 Noise

Background noise levels can be affected by atmospheric conditions, wind levels, topography, vegetation, time of day, wildlife activity, and human activity. Existing noise sources in this setting are predominantly natural background levels from wind and wildlife in combination with occasional human activity associated with nearby well fields, the Union Pacific Railroad (UPRR), and traffic on I-80, Patrick Draw, and Bitter Creek roads. The BLM has estimated that an average noise level in Wyoming rural areas is between 30 and 40 decibels on the A-weighted scale (dBA) (BLM 1997). Noise-sensitive receptors in the study areas mainly involve wildlife. Few inhabited residences are located near the project area, the nearest being approximately 10 miles to the northwest of the project area at Point of Rocks.

3.14 Livestock Grazing and Wild Horses

3.14.1 Livestock Grazing Allotments

Approximately 99 percent of the project area is currently utilized by livestock on two grazing allotments (Tipton and Rock Springs). The federally managed portion is administered by the BLM under the Taylor Grazing Act of 1934, the FLPMA of 1976, and the Public Rangelands Improvement Act of 1978. Permitted livestock consists of cattle, horses (only in the Rock Spring Allotment west of the Green River), and sheep. The 1 percent portion of the project area not utilized as a grazing allotment is the I-80 corridor that runs adjacent to the Arch Unit (see **Figure 3-14**).

The project area occupies portions of the Rawlins and Rock Springs BLM field offices in Sweetwater County that manage the two grazing allotments. The Tipton allotment is managed by the RFO and is overlapped by the Monell Unit. The portion of the Tipton Allotment that is overlapped by the project area is located on privately owned land. The Rock Springs allotment is managed by the RSFO and is overlapped by both the Monell and Arch units. The portion that overlaps the Rock Springs Allotment consists of land ownership that includes both federal and private land in a checkerboard pattern. Within the Rock Springs allotment, approximately half of the private land is owned or leased by the Rock Springs Grazing Association. **Table 3-23** provides current information for the individual allotments (GeoCommunicator 2012). A total of 22,416 acres of designated grazing allotments are located within the project area. This area produces an estimated 1,980 animal unit months (AUMs) that would be grazed by cattle and sheep. One AUM is the amount of forage needed to feed one cow/calf pair, or five sheep for one month. Average daily consumption is approximately 26 pounds of dry matter forage daily or 800 pounds monthly (Alberta Agriculture and Food 2007).

Natural and artificial water sources are used by livestock in the project area. **Table 3-24** lists all water sources within the project area that are utilized by livestock.

Information regarding vegetation cover types can be found in Section 3.5, Vegetation. Throughout most of the project area, the spread of halogeton is becoming a concern because it competes with quality livestock forage and is poisonous to many forms of livestock. Toxic amounts of sodium, potassium, and calcium oxalates contained in halogeton can have a strong affect on sheep and death can occur in less than 12 hours. Due to a history of unsuccessful reclamation efforts on previously disturbed lands, livestock operators are becoming increasingly concerned with the issue of invasive and noxious weeds.

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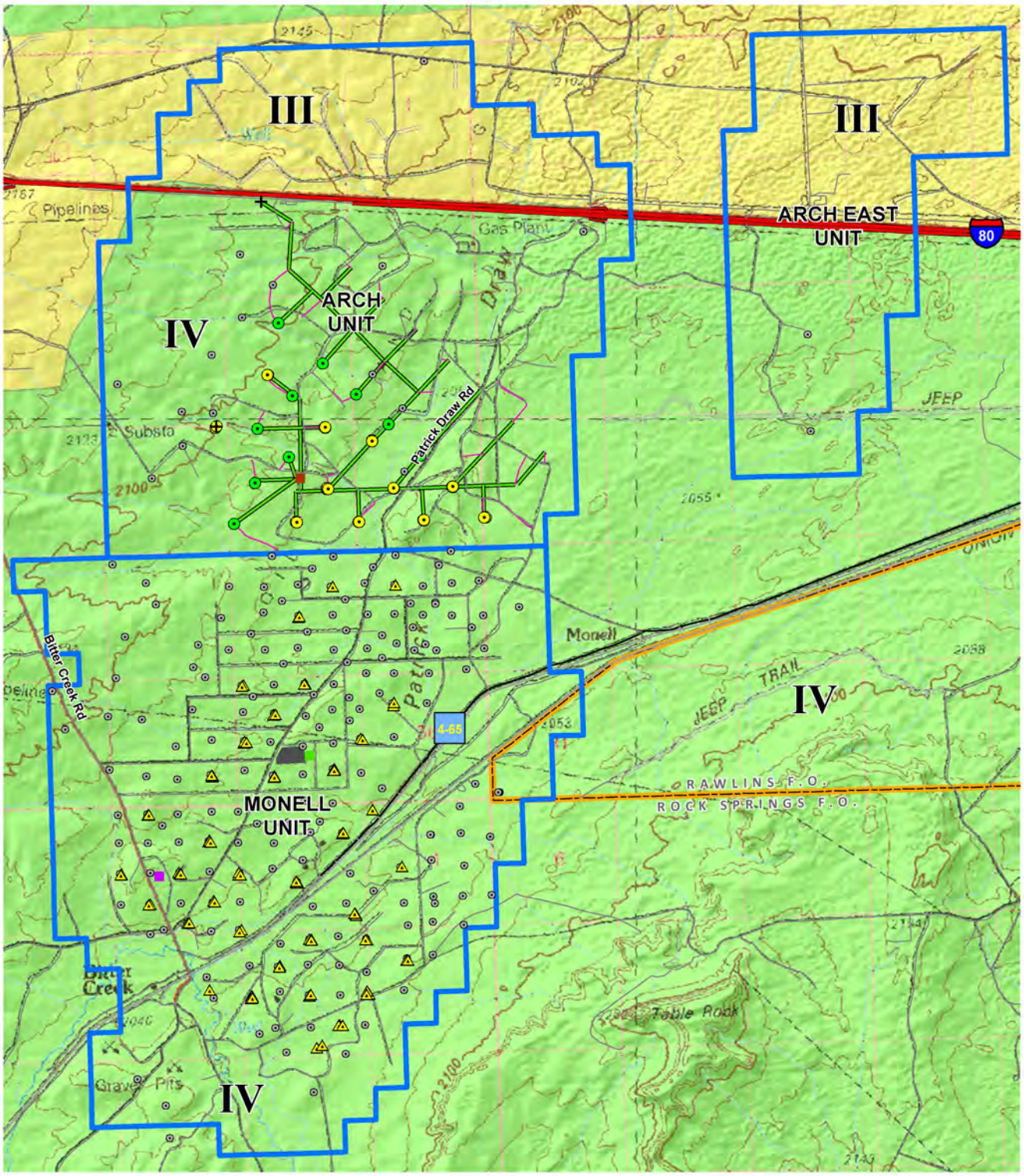

Legend

Proposed Wells (2013-2016)
Arch Unit Wells
- Single well Pad
- Multi-well Pad

Monell Unit Wells
- Multi-well Pad

- Proposed Pipeline
- Proposed Road

Conceptual Facilities
- Production
- Production/Header
- Production/ Compressor Station

Existing Facilities
- Production
- Existing Well
- Injection Well

VRM Class
- VRM Class III
- VRM Class IV

Source: BLM 2008a, 2012c.

Figure 3-13

VRM Classes within the Project Area

0 0.25 0.5 1 1.5 Miles

1:75,000

N

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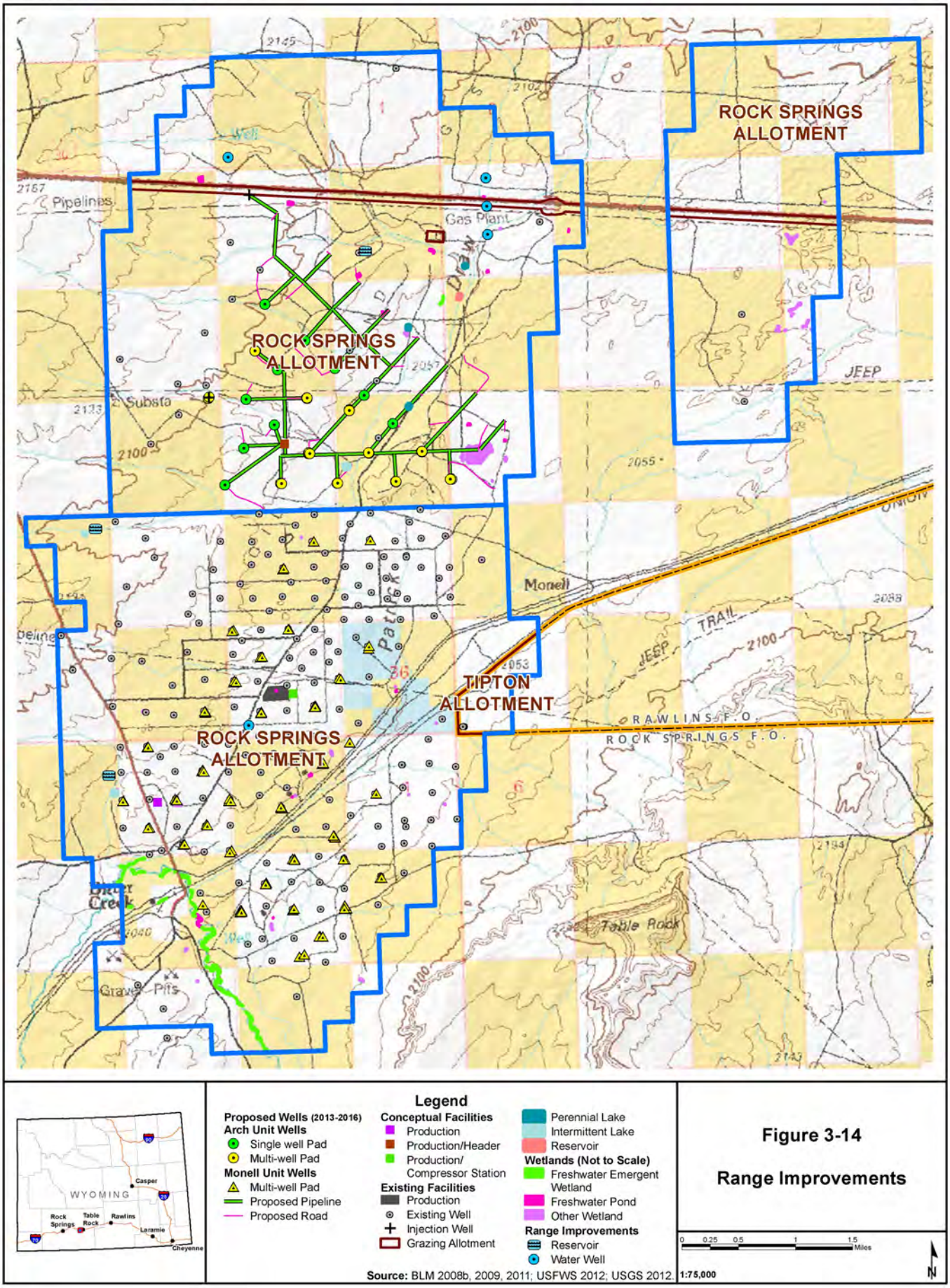

Figure 3-14

Range Improvements

Table 3-23 Grazing Allotments within the Project Area[1]

Allotment Name	Total Acres	Acres within Project Area	Portion of Allotment (Percent)	Average Acre/AUM[2]	AUMs in Project Area[3]/ Percent of Total	Livestock Class	Season of Use
Rock Springs	2,061,062	22,215	1	13.9	1,598 / 1%	Cattle, sheep, horse	90%: 12/1 – 5/15; 10%: 5/1 – 12/5
Tipton	58,201	201	<1	6.4	31 / <1%	Cattle	3/1 – 2/28
Total	**2,119,263**	**22,416**			**1,980**		

[1] Acreage data was taken from 2011 Geographic Information System (GIS) files provided by the BLM.

[2] Average acres/AUM derived from GeoCommunicator 2012.

[3] AUMs for project area based on dividing acres within project area by average acres/AUM.

Table 3-24 Natural and Artificial Water Sources within the Project Area

Unit	Allotment	Perennial Streams (mi)	Intermittent Streams (mi)	Perennial Lake (ac)	Intermittent Lake (ac)	Reservoirs	Wells
Arch	Rock Springs	0	43.0	0.8	0.7	1	3
Monell	Rock Springs	3.3	48.6	0	0.7	2	1
	Tipton	0	1.3	0	0	0	0
Total		**3.3**	**92.8**	**92.8**	**1.4**	**3**	**4**

Source: BLM GIS data.

3.14.2 Wild Horse Herd Management Areas

The portion of the project area that is within the Rock Springs Grazing Allotment also overlaps with the Salt Wells Creek Herd Management Area (HMA). Management of wild horses on BLM administrated lands is regulated under the Wild Free-Roaming Horses and Burros Act of 1971 (Act) and the multiple use objectives of the FLPMA. The Act requires that wild horse populations are managed at levels that allow for the preservation and maintenance of a thriving ecosystem that are in balance. Methods used to control wild horse populations and maintain ecosystem health and balance include gathering and removing wild horses to maintain their populations within the Appropriate Management Level (AML). In addition, some mares were injected with a fertility control vaccine and released back to the range. Currently, the Salt Wells Creek HMA is above the desired AML.

The AML for the Salt Wells Creek HMA is set at 251 to 365 horses. The entire HMA consists of 1,173,000 acres, with 22,215 acres (2 percent) overlapping with the project area. The most beneficial forage vegetation within the HMA includes grass species such as needlegrass, Indian ricegrass, wheatgrass, and various sedges. During a census flight in 2010, it was determined that the wild horse population was higher than the AML range. A gather was conducted in October of 2010 to remove horses from the range.

Wild horses would utilize most of the same water sources as livestock. Water sources within the project area are discussed in the Livestock Grazing Allotment section above and are listed in **Table 3-24**.

The threat from invasion and spread of noxious weed species within the project area portion of the Salt Wells Creek HMA is the same the area identified for the Rock Springs Allotment. The native forage vegetation consumed by wild horses is threatened by the spread of halogeton. The areas of concern include disturbed lands that received unsuccessful reclamation.

3.15 Cultural Resources and Native American Concerns

3.15.1 Cultural Resources

Section 106 of the NHPA, as amended, requires that federal agencies take into account the effect of their undertakings on historic properties, and to afford the Advisory Council on Historic Preservation a reasonable opportunity to comment. Historic property refers to "any prehistoric or historic district, site, building, structure, or object included in or eligible for inclusion in the National Register of Historic Places (NRHP)." For the purposes of this analysis, cultural resources eligible for the NRHP are synonymous with historic properties, and both terms may be used.

The study area for cultural resources is the area of potential effect (APE), which is defined as "the geographic area or areas within which an undertaking may directly or indirectly cause changes in the character or use of historic properties, if any such properties exist. Additionally, the APE is influenced by the scale and nature of an undertaking and may be different for different kinds of effects caused by the undertaking (36 CFR 800.16[d])." For this project, the APE for direct effects includes all proposed disturbance areas (i.e., well locations, access roads, pipelines, and power lines) within the project boundary. The APE for visual impacts includes a 3-mile buffer around segments of a historic trail or highway (e.g., Lincoln Highway) that contribute to the historic highway or trail's overall eligibility and from which the project is visible.

In October 2012, Western Archaeological Services (WAS) conducted a file search through the Wyoming Cultural Resources Information System (WYCRIS) to identify previously recorded cultural resources within the project boundary. In addition, WAS reviewed their in-house site records and Government Land Office (GLO) plats. As a result of the files and record searches and GLO plat review, a total of 158 previously recorded cultural resources were identified within the project boundary; 112 in the Monell Unit and 46 in the Arch Unit. Of the 112 cultural resources in the Monell Unit, 91 are prehistoric, 16 are historic, and 5 are multi-component containing both prehistoric and historic components (**Table 3-25**). For the Arch Unit, 34 of the 46 cultural resources are prehistoric, 9 are historic, and 3 are multi-component (**Table 3-25**). Approximately 22 percent of the Monell and Arch units have been previously inventoried. Overall site density is 0.31 sites per acre.

Table 3-25 Previously Recorded Sites within the Project Boundary

	Prehistoric	Historic	Multi-component	Totals
Monell Unit	91	16	5	112
Arch Unit	34	9	3	46
Totals	125	25	8	158

Source: WAS 2012.

The majority of cultural resources identified within the project boundary are prehistoric sites and consist of open camps, lithic scatters, and secondary lithic procurement sites. Historic resources consist of debris scatters, trails, wagon roads, cairns, and a railroad and associated facilities. Of the historic

resources, five are linear features: Lincoln Highway, UPRR Mainline, Rife's Road to Bitter Creek, Desert Springs Road, and the UPRR Telegraph and Signal Line.

Of the 158 total cultural resources previously identified in the project boundary, 3 are recommended as eligible for the NRHP and 18 are eligible with concurrence from the State Historic Preservation Office (SHPO). The majority of eligible cultural resources are prehistoric lithic scatters and camps. Eligible historic sites include the Lincoln Highway, UPRR Mainline, and the UPRR Telegraph and Signal Line. **Table 3-26** provides a breakdown of the NRHP-eligibility of the cultural resources previously recorded within the project boundary.

Table 3-26 Eligibility of Previously Recorded Sites within the Project Boundary

	Eligible	Not Eligible	Unevaluated
Monell Unit	16 (14 with SHPO concurrence)	57 (41 with SHPO concurrence) [waiting on response from WAS]	39 (19 with SHPO concurrence)
Arch Unit	5 (4 with SHPO concurrence)	24 (10 with SHPO concurrence)	17 (none with SHPO concurrence)

Source: WAS 2012.

In August 2012, WAS conducted an historical assessment of a 29.1-mile-long section of the NRHP-eligible Lincoln Highway, which crosses the northern extent of the Arch Unit (Johnson 2012). The assessment was conducted to identify and assess which segments of this 29.1-mile stretch of the highway contribute to its overall NRHP-eligibility. There are three distinct phases of the Lincoln Highway in southern Wyoming: the 1913 Lincoln Highway, the 1920s Lincoln Highway, and the 1930s Lincoln Highway. The 1913 phase is based on the date when the route was defined by the Lincoln Highway Association. When established in 1913, the highway consisted primarily of existing wagon roads, recently abandoned Union Pacific railroad grades, and city streets. In the 1920s, the highway was significantly upgraded to 24-foot-wide gravel-surfaced boulevards. By the 1930s, a more modern two-lane paved highway replaced the earlier 1920s version.

The historical assessment of the Lincoln Highway involved a files search through the WYCRIS, and a review of the Wyoming State Highway Department Plan View and Profile drawings, pertinent historic maps, and aerial photographs. Following the files and map review, an intensive pedestrian inspection of the highway corridor was conducted to locate and evaluate physical remnants of the highway. As a result of the field inspection, a total of 10 segments of the Lincoln Highway were recorded or relocated. Of these 10 segments, three segments (3.2 miles) were evaluated as contributing to the NRHP-eligibility of the highway and seven segments (25.8 miles) were evaluated as non-contributing. The three contributing segments are associated with the 1920s Lincoln Highway variant, while the non-contributing segments include five 1920s variants and two 1930s variants. None of the contributing segments are located within the Arch Unit. The closest contributing segment is approximately 0.5 mile from the unit.

The NRHP-eligible UPRR Mainline track runs northeast to southwest through the Monell and Arch units. Early development of coal mining, ranching, and the urban centers of southern Wyoming were largely a result of the UPRR (Stainbrook 2012). The mainline track was built in 1868, and a second track was constructed in 1917. Modern surfacing and tie replacements occurred in the 1960s and 1970s. Although the UPRR Mainline is recommended as eligible for the NRHP, the segment within the project boundary previously has been determined as non-contributing to the site's overall NRHP eligibility (Stainbrook 2012).

The NRHP-eligible UPRR Telegraph and Signal Line was identified on the 1912 GLO survey plat and is located immediately south of the UPRR Mainline track. Historic documentation indicates that the line was constructed in conjunction with the mainline track. The segment of the telegraph line located within the project boundary previously has been determined as non-contributing to the site's overall NRHP eligibility (Stainbrook 2012).

The Overland Trail, which is eligible for the NRHP, is located outside of the project boundary but within the 3-mile visual APE. Located approximately 2.5 miles south of the project boundary, the trail was a major wagon and stage route through southern Wyoming from the late 1850s to 1869. Prior to the 1850s, the trail was used by mountain men, Indians, and explorers. Although the Overland Trail is eligible for the NRHP, the setting of the segment of the trail from which the project area is visible has been compromised by extensive oil and gas development; therefore, it is considered as non-contributing to the trail's overall NRHP eligibility (Stainbrook 2012).

At this time, no Class III pedestrian inventories have been conducted for the project. Once the locations of the well pads, access roads, and associated facilities have been verified, an intensive Class III inventory of those locations would be conducted to determine if any historic properties are located in the APE. A combination of inventory and consultation would be used to determine the presence of historic properties within the APE. Native American tribes would be consulted to establish the locations and significance of properties of traditional religious and cultural importance to the tribes. The BLM would be responsible to review the results of inventory, determine NRHP eligibility, assess effects, and seek resolution of adverse effects in consultation with the Wyoming SHPO and interested Native American tribes.

3.15.2 Native American Consultation

As a federal agency, the BLM is mandated to consult with Native American tribes concerning the identification of cultural values, religious beliefs, and traditional practices of Native American people that may be affected by actions on federal lands. This consultation includes the identification of places (i.e., physical locations) of traditional cultural importance to Native American tribes. Places that may be of traditional cultural importance to Native American people include, but are not limited to, locations associated with the traditional beliefs concerning tribal origins, cultural history, or the nature of the world; locations where religious practitioners go, either in the past or the present, to perform ceremonial activities based on traditional cultural rules or practice; ancestral habitation sites; trails; burial sites; and places from which plants, animals, minerals, and waters possessing healing powers or used for other subsistence purposes, may be taken. Additionally, some of these locations may be considered sacred to particular Native American individuals or tribes. Under the auspices of the American Indian Religious Freedom Act, EO 13007 (Sacred Sites), the Native American Graves Protection and Repatriation Act, and the NHPA, as amended, the BLM must take into account the effects on these types of locations.

In compliance with federal mandates, the BLM sent letters on November 27, 2012, to the following Native American tribes: Eastern Shoshone Tribe of the Wind River Reservation, Shoshone-Bannock Tribes of the Fort Hall Reservation, Arapaho Tribal Business Council, and the Ute Tribe of the Uintah and Ouray Reservation. The letters were sent to inform the tribes of the project and to solicit any concerns or issues the tribes may have regarding places of traditional religious and cultural importance. Formal government-to-government consultation would be initiated based on the types of cultural resources identified during the Class III inventories, and the location of the resources relative to proposed disturbance areas. The Class III inventories would be conducted after the well site locations have been verified. If a cultural resource site of traditional cultural importance to the tribes is located within the vicinity of a well, an associated facility (e.g., power line, pipeline), or a new access road, letters would be sent to the listed Native American tribes soliciting their concerns/comments regarding the site. The tribes would be offered the opportunity for a site visit.

3.16 Socioeconomics and Environmental Justice

Area socioeconomic conditions include the local economy (primarily mining and processing, and other natural resource development); population; employment and income; housing; community facilities, law enforcement, and emergency management; and local, state, and federal government fiscal conditions.

3.16.1 Population

After staying relatively flat during the 1990s, the population in Sweetwater County accelerated rapidly in the latter part of the 2000s, now reaching over 40,000 residents. The trend of increasing population is associated with expanded natural resource extraction activities. Carbon County has seen a net decline in population from 1990 to 2011, although there was a slight increase from 2000 to 2011. **Table 3-27** summarizes the population characteristics of the State of Wyoming, Sweetwater County, and Carbon County, Wyoming, as well as the cities of Rawlins, Rock Springs, and Wamsutter, from 1990 to 2011.

Table 3-27 Population Change for Wyoming, Sweetwater County, Carbon County, and Selected Cities

Jurisdiction	1990	2000	2010	2011 (estimate)	Total Change in Population 1990-2011 (%)
Wyoming	**453,588**	**493,782**	**563,626**	**568,158**	**25.3**
Carbon County	**16,659**	**15,639**	**15,885**	**15,786**	**-5.2**
Rawlins	9,380	8,538	9,259	9,203	-1.9
Sweetwater County	**38,823**	**37,613**	**43,806**	**44,175**	**13.8**
Rock Springs	19,050	18,708	23,036	23,229	21.9
Wamsutter	240	261	451	NA	87.9*

* Percent change is from 1990 to 2010.

Source: U.S. Census Bureau 2012a,b, 2000.

3.16.2 Economic Conditions

Median household income for Sweetwater and Carbon counties were both above the Wyoming state average. Sweetwater County recorded a median household income that was 30 percent greater than the Wyoming state average, while Carbon County was 5 percent higher than the state average. **Table 3-28** summarizes the income characteristics for Carbon County, Sweetwater County, and the State of Wyoming.

The major source of employment in Sweetwater County is mineral and energy resource extraction and processing, retail, services, and government. Major sources of employment in Carbon County are construction, retail, services, and government. From 1990 to 2010 in Sweetwater County, there were large increases in employment in the mining, retail, service, and manufacturing sectors. The majority of the mining sector growth occurred from 2000 to 2010. During the 1990 to 2008 time period in Carbon County, employment in the mining, services, and transportation sectors declined, while the retail sector increased. As in Sweetwater County, mining employment in Carbon County increased from 2000 to 2010. **Table 3-29** summarizes the employment characteristics by sector for Carbon and Sweetwater counties from 1990 to 2010.

Table 3-28 Income Characteristics for Sweetwater County, Carbon County, and the State of Wyoming, 2010

Parameter	Sweetwater County	Carbon County	Wyoming
Median household income, 2006-2010	$69,828	$56,565	$53,802
Personal per capita money income, 2006-2010	$30,961	$26,122	$27,860
Persons below poverty, %. 2006-2010	8.2	8.2	9.8
Median Hourly Wage (all industries, all occupations)	$20.41	$16.62	$17.60

Source: U.S. Census Bureau 2012a; Wyoming Department of Employment 2012.

Table 3-29 Employment Changes by Sector for Sweetwater and Carbon Counties

	Number of Jobs							
	Carbon County				Sweetwater County			
Employment Sector	1990	2000	2005	2010	1990	2000	2005	2010
Farm employment	538	509	375	370	220	203	222	267
Agricultural services, forestry, fishing and other	105	247	140	(D)	78	182	48	(D)
Mining (coal, metal, nonmetal, oil and gas)	940	309	(D)	488	5,031	3,692	5,158	5,754
Construction	507	689	773	827	1,507	1,489	2,304	2,258
Manufacturing	681	637	(D)	(D)	747	1,643	1,225	1,385
Transportation, Communication, and Public Utilities (TCPU)	735	594	606	618	1,981	1,779	1,492*	1,640*
Wholesale trade	171	177	232	80	645	610	(D)	(D)
Retail trade/accommodation and food services	1,667	1,709	2,073	1943	3,689	4,385	5,257	5,562
Finance, insurance, and real estate	521	523	656	720	1,126	1,127	1,504	1,972
Services	1,820	2,113	1,642*	1,355*	3,700	4,678	4,295*	4,894*
Federal, civilian	249	147	213	246	262	266	238	261
Federal, military	97	89	86	92	227	215	213	252
State government	486	524	520	549	278	269	279	272
Local government	1,317	1,279	1,253	1,319	3,258	3,538	3,530	4,031
Total full-time and part-time employment	9,834	9,546	9,578	9,919	22,749	24,076	27,153	29,611

(D) = not shown to avoid disclosure of confidential information, but the estimates for this item are included in the totals. U.S. Bureau of Economic Analysis (BEA) does not provide this information.

* Data has been omitted to avoid disclosure of confidential information.

Source: BEA 2012a, 2010a.

From 2000 to 2010, there were large increases in income from the construction, mining, manufacturing, service, and state and local government sectors for both Carbon and Sweetwater counties. When adjusted for inflation, mining income rose approximately 52 percent in Carbon County and 86 percent in Sweetwater County for the 2000 to 2010 time period. **Table 3-30** summarizes the income characteristics by sector for Carbon and Sweetwater counties in 2000, 2005, and 2010.

Table 3-30 Income Characteristics by Sector for Sweetwater and Carbon Counties

Employment Sector	Income in $ thousands					
	Carbon County			Sweetwater County		
	2000	2005	2010	2000	2005	2010
Farm employment	5,707	6,611	5,613	629	1,142	1,801
Agricultural services, forestry, fishing and other	917	909*	(D)*	583	340*	(D)
Mining (coal, metal, nonmetal, oil and gas)	13,921*	(D)	26,710	264,747	403,756	625,003
Construction	15,789	24,983	49,096	49,106	100,178	152,661
Manufacturing	24,789	(D)	(D)	114,015	109,928	141,810
TCPU	28,309	30,716	41,698	95,860*	79,983*	118,448*
Wholesale trade	5,172	9,932	2,825	20,871	(D)	(D)
Retail trade/accommodation and food services	23,132	31,464	48,459	67,380	107,023	134,386
Finance, insurance, and real estate	5,536	7,170	11,990	18,085*	40,947	63,130
Services	27,125	31,148*	39,446*	78,647	107,641*	188,886*
Federal, civilian	8,448	14,547	18,889	16,579	18,039	22,337
Federal, military	1,342	3,356	4,378	3,226	8,320	12,044
State government	18,766	24,813	34,241	9,506	13,076	17,594
Local government	39,887	47,540	67,259	113,368	145,175	219,226

* Total does not include data that has been omitted to avoid disclosure of confidential information.

(D) = not shown to avoid disclosure of confidential information, but the estimates for this item are included in the totals. BEA does not provide this information.

Source: BEA 2012b, 2010b.

In Carbon County, the labor force has declined since 2000, from near 8,000 to slightly more than 7,800 in 2010, a 3.3 percent decrease. Sweetwater County has seen the opposite trend, with the labor force growing 21.3 percent from 2000 to 2010. Unemployment has varied between 3.0 and 4.2 percent in 2000 and 2005 in Carbon and Sweetwater counties; however, poor economic conditions have notched the unemployment rate to above 5 percent in Sweetwater County and above 6 percent Carbon County. **Table 3-31** summarizes the labor force characteristics in Sweetwater and Carbon counties, and the State of Wyoming in 2000, 2005, and 2010.

Table 3-31 Labor Force Characteristics for Sweetwater and Carbon Counties

Category	Carbon County			Sweetwater County			Wyoming		
	2000	2005	2011	2000	2005	2011	2000	2005	2011
Labor Force	8,094	7,657	7,827	20,716	22,128	25,138	265,667	278,233	304,242
Employment	7,757	7,351	7,320	19,897	21,464	23,867	255,312	267,936	286,131
Unemployment	337	306	507	819	664	1,271	10,355	10,297	18,111
Unemployment Rate (%)	4.2	4.0	6.5	4.0	3.0	5.1	3.9	3.7	6.0

Source: U.S. Bureau of Labor Statistics 2012.

Construction and mineral extraction occupations in this area typically pay more than the median hourly and annual wage for all other occupations. **Table 3-32** summarizes the median hourly and annual wage characteristics for the construction and extraction occupations as compared to all occupations in Sweetwater and Carbon counties.

Table 3-32 Wage Characteristics for Sweetwater and Carbon Counties

Hourly Median Wage	Annual Median Wage
2012 Median Hourly Wage for All Occupations for Sweetwater County	
$20.41	$42,444
2012 Median Hourly Wage for Construction and Extraction Occupations for Sweetwater County	
$22.53	$46,861
2012 Median Hourly Wage for All Occupations for Carbon County	
$16.62	$34,557
2012 Median Hourly Wage for Construction and Extraction Occupations for Carbon County	
$18.78	$39,067

Source: Wyoming Department of Employment 2012.

The nature of oil and gas development construction activities (relatively short-term tasks performed by contracted labor) results in a demand for temporary housing resources such as motel rooms, mobile home parks, and recreational vehicle parks. There also is the potential for new permanent employees involved with ongoing operations and maintenance of the project facilities to seek longer-term housing resources.

As of 2011, Rock Springs has approximately 17 motels with nearly 1,500 rooms. Rawlins has approximately 10 motels with nearly 650 rooms. Both cities have numerous mobile home and recreational vehicle parks (Wyoming Tourism 2011).

Historically, population pressures associated with oil and gas activities have created demand for housing in Carbon and Sweetwater counties. During “bust” cycles, there is less demand for housing, creating vacancies. **Table 3-33** shows vacancy rates, an indication of capacity for temporary housing, and other

housing characteristics for Sweetwater and Carbon counties as well as the cities of Rock Springs and Rawlins.

Table 3-33 Housing Characteristics for Sweetwater County, Carbon County, and the State of Wyoming

Housing and Vacancies	Sweetwater County	Rock Springs	Carbon County	Rawlins	State of Wyoming
Housing units, 2010	18,735	10,070	8,576	3,960	255,096
Housing units, 2000	15,921	8,359	8,307	3,860	223,854
Housing units, net change, 2000 to 2010	2,814	1,711	269	100	31,242
Housing units, percent change, 2000 to 2010	18	20	3	3	14
Vacant units for rent, 2010*	934	365	365	517	7,304
Vacancy rental rate (%), 2010	16.8	16.5	16.5	16.6	6.4
Vacancy rental rate (%), 2000	16.2	12.1	26.2	14.0	9.7
Median value of owner-occupied housing units, 2005-2010	$169,500	$170,600	$129,100	$128,600	$174,000
Median value of owner-occupied housing units, 2000	$104,200	$103,900	$76,500	$73,700	$96,900
Median value of owner-occupied housing units, net change, 2000 to 2005-2010	$65,300	$66,700	$52,600	$54,900	$77,100
Median value of owner-occupied housing units, percent change, 2000 to 2005-2010	63	64	69	74	80

* This data was not available for 2000.

Source: U.S. Census Bureau 2012c, 2003.

In 2010 there were nearly twice as many housing units in Sweetwater County than in Carbon County and almost three times as many housing units in Rock Springs than in Rawlins. Sweetwater and Carbon counties as well as the cities of Rock Springs and Rawlins all recorded rental vacancy rates in 2010 that were very similar. Median house value of owner-occupied housing in Sweetwater County averaged $169,500 during the 2005 to 2010 timeframe. Median house value of owner-occupied housing in Carbon County averaged over $129,000 during the 2005 to 2010 time period.

3.16.3 Community Facilities, Law Enforcement, and Emergency Management

Populations in Sweetwater County and Rock Springs, as well as Carbon County and Rawlins are slightly above historic levels found in the 1990s and the early 2000s, indicating that county and municipal infrastructure is, in general, is adequate to serve a larger population than currently exists. The growth in population has not translated into a proportional increase in new students enrolled at local schools, as

mostly single males or married males who choose not to move their families to the region are attracted by jobs in the oil and gas sector.

Law enforcement is provided by the Sweetwater County Emergency Management Agency (SCEMA), which operates under Federal Emergency Management Agency and USEPA guidelines. SCEMA is the agency designated by the Sweetwater County Commissioners to analyze potential hazards, assess emergency response capabilities, and mitigate the effects of emergencies or disasters. SCEMA coordinates with response agencies, industry, elected officials and volunteer agencies. Law enforcement in Carbon County is provided by the Carbon County Sheriff's Department and emergency response is coordinated by the Carbon County Emergency Management Agency.

Sweetwater and Carbon counties are served by emergency response organizations located in Rock Springs and Rawlins. Routine injuries are treated at Memorial Hospital of Sweetwater County and Memorial Hospital of Carbon County. Cases requiring specialized treatment are transported to Salt Lake City by services dispatched from Salt Lake City, Utah, or Craig or Grand Junction in Colorado.

3.16.4 Local Government Facilities and Services

The State of Wyoming does not levy a personal or corporate income tax or a tax on intangible assets such as bank accounts, stocks, or bonds either. In addition, Wyoming does not assess any tax on retirement income earned and received from another state. **Table 3-34** summarizes most local, county, and state taxes in the area.

Table 3-34 Summary of Local, County, and State Taxes (2011)

Type of Tax	Sweetwater County	Rock Springs	Carbon County	Rawlins	State of Wyoming
Real Property	12 mill	8 mill	N/A	N/A	None
Sales	1%	None	2%	None	4%
Lodging (Bed)	2%	None	2%	None	None
School	None	43.6 mills	N/A	N/A	None

N/A = Not Available.

Source: Wyoming Department of Administration and Information 2011; Wyoming Department of Revenue 2011.

Property taxes levied by Sweetwater County were approximately $143 million in fiscal year 2010 and approximately $170 million in fiscal year 2011 (Wyoming Department of Revenue 2011). Sweetwater County lodging taxes for fiscal 2010 totaled approximately $520,586, while sales tax revenues for that same period totaled approximately $59.7 million. Carbon County lodging taxes for fiscal 2010 totaled approximately $380,133, while sales tax revenues for that same period totaled approximately $14.9 million (Wyoming Department Administration and Information 2011).

Oil and gas companies pay ad valorem taxes on production and facilities. Natural gas is assessed on the previous year's production. The Sweetwater County 2010 natural gas assessed valuation was approximately $801.2 million, up from the previous year's valuation of $580.4 million (Wyoming Department of Revenue 2011).

3.16.5 Environmental Justice

As required by EO 12898 “Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations,” the proposed project must be evaluated for any disproportionately high and adverse human health or environmental effects on minority communities and low-income communities.

The environmental justice study area encompasses Sweetwater and Carbon counties.

3.16.5.1 Minority Populations

Of the total population of Carbon and Sweetwater counties, the large majority classify themselves as White. The second largest ethnic/racial group is Hispanic or Latino, followed by those who classify themselves as American Indian or Alaska Native, Black, and Asian. **Table 3-35** summarizes the racial composition and low-income populations of Carbon and Sweetwater counties.

3.16.5.2 Low-Income Populations

Approximately 8.2 percent of households in both Carbon and Sweetwater County fall below the poverty level. The poverty level for both counties was less than the Wyoming state average.

Table 3-35 Racial Composition and Low-Income Populations, 2011 (estimate)

	White (%)	Black (%)	American Indian and Alaska Native (%)	Asian (%)	Hispanic or Latino (%)	Below the Poverty Level (%)
Wyoming	93.5	1.1	2.6	0.9	9.1	9.8
Carbon County	94.9	1.0	1.6	0.9	16.7	8.2
Sweetwater County	94.9	1.2	1.3	0.9	15	8.2

Source: U.S. Census Bureau 2012a.