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BROOK MINING CO., LLC.
BROOK MINE
VOLUME 3 OF 12
TFN 6 2/025

Brook Mine
Permit Application
Volume III

Appendix D1
Appendix D2
Appendix D3
Appendix D4

DEQ Exhibit 4

RAMACO

Brook Mine
Application
Volume III
BROOK MINING CO., LLC.
BROOK MINE
VOLUME 3 OF 12
TFN 6 2/025

VOLUME III

Appendix D1 – D4

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VOLUME I	Adjudication 1 of 3	
VOLUME IA	Adjudication 2 of 3	
VOLUME II	Adjudication 3 of 3	
VOLUME III	Appendix D1	Land Use
	Appendix D2	History
	Appendix D3	Archeological and Paleontological Resources
	Appendix D4	Climatology
VOLUME IV	Appendix D5	Topography, Geology and Overburden Assessment
VOLUME V	Appendix D6	Hydrology
VOLUME VI	Appendix D7	Soil Resources Assessment
VOLUME VII	Appendix D8	Vegetation Inventory
VOLUME VIII	Appendix D9	Wildlife
VOLUME IX	Appendix D10	Wetlands
VOLUME X	Appendix D11	Alluvial Valley Floors
VOLUME XI	Mine Plan	
VOLUME XII	Reclamation Plan	

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6/025

RAMACO

February 2016

APPENDIX D1 TOC

TABLE OF CONTENTS

D1 LAND USE D1-1
D1.1 General Setting Past and Present D1-1
D1.2 Definitions D1-1
D1.3 Past Land Use D1-1
D1.3.1 Grazingland D1-2
D1.3.2 Developed Water Resources D1-2
D1.3.3 Industrial Commercial D1-2
D1.3.4 Recreational D1-3
D1.3.5 Residential D1-3
D1.4 Present Land Use D1-3
D1.4.1 Grazingland D1-4
D1.4.2 Developed Water Resources D1-5
D1.4.3 Industrial Commercial D1-5
D1.4.4 Recreational D1-6
D1.4.5 Residential D1-8
D1.5 Unsuitable for Mining within & and Adjacent to Proposed Permit Boundary D1-9
D1.6 Previous Surface and Underground Mined Areas D1-9
D1.7 References D1-11

LIST OF TABLES

Table D1.3-1. Oil and Gas Wells within 2 Miles of the Permit Area D1-T1

Table D1.4-1. Nearby Recreation Areas D1-T10

Table D1.4-2. Distance to Nearest Residence for Each Compass Sector D1-T11

LIST OF FIGURES

Figure D1.1-1. General Location Map D1-F1

LIST OF EXHIBITS

Exhibit D1.1-1 Land Use

TFN 6 2/025
RECD JUL 30,2015

DEQ 4-005

APPENDIX D1 TEXT

LAND USE

Appendix D1

Prepared by:
WWC Engineering

July 2015

TFN 6 2/025
RECD JUL 30, 2015

D1 LAND USE

Land use for RAMACO's Brook Mine was prepared by WWC Engineering of Sheridan, Wyoming.

D1.1 General Setting Past and Present

The permit area of RAMACO's Brook Mine is located east of the Bighorn Mountains in north-central Sheridan County, Wyoming (see Figure D1.1-1). It is approximately 6 miles south of the Wyoming-Montana State Border. The centroid of the permit area is approximately 8 air miles northwest of Sheridan (2012 population est. 17,698), 6 air miles east of Ranchester (2012 population est. 898), 11 air miles east-northeast of Dayton (2012 population est. 777), and 50 air miles south-southeast of the Little Bighorn Battlefield National Monument (U.S. Department of Commerce: Census Bureau, 2012). The permit boundary is adjacent to the historic mining towns, or camps, of Acme, Kleenburn, Monarch, and Kooi. The approximate locations of the historic towns are presented on Exhibit D1.1-1. Surface ownership within the permit area is private (see Adjudication). The permit area lies adjacent to Interstate-90 (I-90) and State Highway 345.

D1.2 Definitions

Definitions used in this Appendix are taken from Definitions in Chapter 1 Section 2 of WDEQ/LQD Coal Rules and Regulations and the Wyoming Environmental Quality Act.

D1.3 Past Land Use

Past land uses within the permit area are described in the following subsections in detail. The permit area is located on multi-usage land, meaning the same land can be used for multiple purposes. Therefore, the permit area cannot be accurately divided into specific acreages used for one reason.

Historic land use in the area is closely tied to agricultural purposes, such as grazingland, developed water resources, industrial commercial (such as oil

TFN 6 2/025
RECD JUL 30, 2015

DEQ 4-008

ornatural gas), recreational and residential. The lands around Acme, Monarch, Kleenburn (called Carneyville initially), and Kooi were utilized for coal mining beginning in the early 1890s, and coal continued to be mined until 1953 (Knapp, 2013).

D1.3.1 Grazingland

The primary land use within the permit area is grazingland. Agricultural activities such as grazing, limited non-irrigated hay meadows or cropland, and other associated ranching activities have a long history within the area along with supporting ranching activities. The land by its very nature also supports several species of wildlife in much the same way it supports livestock. In addition, reclaimed mined lands (vegetation community reclaimed) are now being used as Grazingland. Section 1.6 of this Appendix describes past and present mining activities that have or are occurring within the permit boundary and adjacent areas. Exhibit D1.1-1 depicts past and present grazingland locations.

D1.3.2 Developed Water Resources

Several developed water resources existed/exist throughout the permit area. These surface water resources take the form of ditches and reservoirs. These water resources were primarily used for stock watering, fire protection, flood control and general water supply. The Tongue River and its tributaries serve as the source of developed surface water resources. Refer to Appendix D6 for a detailed description of reservoirs and other surface water features within the mine permit boundary. Refer to Adjudication File for water rights and water right statuses.

D1.3.3 Industrial Commercial

The permit area was used extensively for industrial purposes in the past. These have primarily been mineral extraction including drilling for oil and natural gas. Refer to Section D1.6 of this Appendix for past and present mining

TFN 6 2/025
RECD JUL 30, 2015

activities that have or are occurring within the permit boundary and adjacent areas.

Oil and natural gas drilling has occurred extensively in the area. Much of this type of mineral development began in the area after the coal mines shut down. A search of the Wyoming Oil and Gas Conservation Commission's database revealed over 200 natural gas and oil wells past and present exist within the permit boundary and the adjacent 2 miles. These well names, numbers, operators, classes, statuses, and locations are shown in Table D1.3-1.

D1.3.4 Recreational

While recreational activities may have been conducted through-out the permit area and adjacent lands, it doesn't appear that lands were wholly dedicated to recreational land use in the past. The area has been used for less intensive recreation activities such as hiking.

D1.3.5 Residential

Residential sites throughout the permit and surrounding areas existed in the past. Many of these residences served as support locations for miners working in the several historic mining camps surrounding the area. Please refer to Section D1.6 of this report for more information regarding the historic mining camps surrounding the proposed mining area.

D1.4 Present Land Use

Existing land uses (described in the following subsections in detail) within the permit area are shown on Exhibit D1.1-1. The permit area is located on multi-usage land, meaning the same land can be used for multiple purposes. Therefore, the permit area cannot be accurately divided into specific acreages used for one reason.

RECD JUL 30, 2015

Present land use in the area is closely tied to agricultural purposes, such as grazingland; other land uses include developed water resources, industrial commercial (such as oil, natural gas, and stone quarries), and residential.

Additionally, recreation has been prevalent to the area including, but not limited to, hunting, fishing, hiking, and off-road vehicle usage.

D1.4.1 Grazingland

The primary land use within the permit area in recent history has been grazingland. This land use designation covers land uses such as grazing, non-irrigated hay meadows and other associated ranching activities. The upper hills within the permit boundary are typical rangeland for Wyoming suitable for livestock grazing. However, the dry, hilly nature of these areas does not lend itself to other forms of agriculture, such as irrigated cropland. Portions of the permit area abut the Tongue River Valley. Bottomland adjacent to the Tongue River is suitable for irrigating hay meadows and cropland through the use of center pivot irrigation, lateral move irrigation (side rolls or wheel lines), and flood irrigation (natural and artificial). See Exhibit D1.1-1 for a representation of grazingland land locations.

Agriculture is important to the economy of Sheridan County. Of Sheridan County's 1,620,552 acres, 1,224,625 acres are land in farms (76%). The most recent census of agriculture data states that $48.66 million were generated in 2007 from agricultural products sold. Of this, $42.82 million (88%) were generated from livestock sales while $5.85 million (12%) were generated from crop sales. In 2007, there were 71,560 cattle and calves, 4,608 horses and ponies, and 4,287 sheep and lambs. By far, the majority of acreage in cropland is forage, or land used for hay and haylage, grass silage, and green chop. A total of 64,101 acres is land reserved for forage growth while 65,471 acres are reserved for any cropland which, in addition to forage, includes wheat for grain, oats for grain, and barley for grain (USDA, NASS, 2007).

TFN 6 2/025
RECD JUL 30, 2015

DEQ 4-011

D1.4.2 Developed Water Resources

Several permitted reservoirs and ditches through the Wyoming State Engineer's Office (WYSEO) are within the permit boundary, and in the vicinity. The reservoirs and ditches are of a variety of sizes and uses. The primary uses of reservoirs are, and have been, related to stock watering. Reservoir uses have included fire protection, wildlife watering, irrigation, wetlands, combined uses, and miscellaneous surface water uses (WYSEO, 2013). Ditches have been primarily associated with irrigation and stock uses. The priority date of these water resources varies from late 1800's up to current times. Refer to Appendix D6 for a detailed description of reservoirs and other surface water features within the mine permit boundary. Refer to Adjudication for water rights and water right statuses. See Exhibit D1.1-1 for a representation of reservoir locations within the permit boundary.

D1.4.3 Industrial Commercial

The permit area and adjacent areas have been used for industrial purposes in the past and currently. These have primarily been mineral extraction including drilling for oil and natural gas, as well as rock quarrying. Refer to Section D1.6 of this Appendix for past and present mining activities that have or are occurring within the permit boundary and adjacent areas.

Oil and natural gas drilling has occurred extensively in the area. Table D1.3-1 displays well names, numbers, operators, classes, statuses, and locations of over 200 natural gas and oil wells obtained from the Wyoming Oil & Gas Conservation Commission's database. The majority of these wells are permanently abandoned; however, some of these wells are still producing.

Two rock quarries exist in the permit area and adjacent areas, see Exhibit D1.1-1. These quarries primarily produce landscape and construction materials. One quarry is located within the proposed permit area, and another quarry is located adjacent to the permit area. Taylor Investments, LLC is located in the NE¼, SE¼, Section 13, T57N, R85W. Taylor Investments, LLC

TFN 6 2/025
RECD JUL 30,2015

primarily produces construction sand and gravel. Tongue River Stone, Inc. is located in the vicinity to the permit boundary in Section 21, T57N, R84W, and is accessed by the Kleenburn Road. Tongue River Stone, Inc. supplies landscaping rock, screened rock, boulders, chips for road surfacing, and road base.

Sheridan County's Comprehensive Plan (adopted December 2008) specifically states the County's desire to promote the establishment of heavy industry in appropriate areas. Sheridan County desires the establishment of future industry to provide job opportunities and improve local economy. Criteria for heavy industry locations include:

a. Away from developed communities and residential areas, such that noise, vibrations, and visual impacts will not disturb existing or future uses.

b. With access to major transportation facilities and utilities – railroad or interstate roads and necessary water. Industry will pay costs associated with improving county roads.

c. Must consider topography, groundwater vulnerability, and other environmental factors (i.e., Class 5 Groundwater Vulnerable Areas and riparian corridors) (Sheridan County, 2008).

Additionally, Sheridan County's Comprehensive Plan designates heavy industry to be near Acme as long as it is balanced with recreational objectives, such as the Kleenburn Recreation Area discussed in Section D1.5.5. The location of the permit area meets the requirements of Sheridan County's future land use plan and goals. The permit area is away from developed communities and recreational areas; has access to several major transportation facilities; and is located near Acme in the pre-designated heavy industry development area.

D1.4.4 Recreational

Present recreational opportunities within the permit area are typical for Wyoming rangeland. Such opportunities include, but are not limited to, hunting, horseback riding, hiking, wildlife watching, and off-road vehicle (ORV)

TFN 6 2/025
RECD JUL 30, 2015

usage and other undeveloped recreational uses. The Tongue River provides fishing and canoeing opportunities. The area includes Wyoming Game and Fish hunter management walk-in areas (WIA). These areas are privately owned lands which are open to hunters during certain seasons. These management areas allow people to park their vehicles at a specified location and walk into the area for sporting purposes. Two Sheridan County WIAs are within or adjacent to the permit boundary: WIA 1 and WIA 6. WIA 1 encompasses approximately 1,865 acres. WIA 6 encompasses approximately 400 acres. These WIAs abut public lands that provide additional hunting and recreational opportunities. The approximate boundaries of the WIAs are represented on Exhibit D1.1-1.

The Kleenburn Recreation Area is adjacent to the permit boundary on the south side of the Tongue River in Sections 20 and 21, T57N, R84W and is approximately 15 acres. This area was the site of the historic mining camp Carneyville (later named Kleenburn). The Kleenburn Recreation Area includes what was a surface mine. Mining activities left two pits and multiple associated spoil piles adjacent to the Tongue River. The two pits from mining activities had filled with water, and are known as the Kleenburn Ponds. The spoil piles had steep slopes and have been used extensively by ORV riders. Additionally, unrestricted use of the area included target shooting, swimming, fishing, and camping. In 2009, reclamation of the area was conducted to reduce spoil pile slopes for safety and to replicate pre-existing topography; revegetated bare ground; provided an Americans with Disabilities Act (ADA)-compliant walking path; opened a channel between the two pits to create a better fishery; constructed a pedestrian bridge across the new channel; installed fencing to restrict access; constructed a parking area and access road; and constructed wetlands (Trihydro, 2012). The area is walk-in only, and firearms are prohibited. Fishing and non-motorized boats are allowed.

The Black Diamond Historic Mine Trail is a cultural and historic resource that instructs visitors of the history regarding northern Sheridan

TFN 6 2/025
RECD JUL 30,2015

County's mines and mining camps. Four of the trail's sites are adjacent to the permit area. These are at the historic mining locations of Acme, Kleenburn, Monarch, and Kooi. The trail was dedicated on September 29, 2012 at the Kleenburn Recreation Area (Trihydro, 2012). The Black Diamond Historic Mine Trail provides an interactive way for visitors to appreciate the historic, cultural, and social significance of mining in Sheridan County. Historic mining and the Black Diamond Historic Mine Trail are discussed in greater detail in Appendix D2.

A search of the Public Lands Information Center revealed multiple recreational sites within 50 miles of the permit area that provide opportunities for, but not limited to, biking, boating, camping, caving, climbing, fishing, hiking, backpacking, horseback riding, hunting, ORV usage, picnicking, scenic driving, wildlife viewing, winter sports, visitor centers, exhibits, interpretive programs, and cultural and historic sites. These recreational opportunities are available at places such as the Bighorn National Forest in the Bighorn Mountains west of the permit area, the Cloud Peak Wilderness, the Kerns Wildlife Management Area, Lake De Smet, and Tongue River Reservoir. Several historic sites with visitor centers and cultural resources are in the vicinity including the Connor Battlefield, the Bozeman Trail, the Trail End State Historic Site at the Kendrick Mansion, the Little Bighorn Battlefield National Monument in Montana, and others. Table D1.4-1 lists some of the major recreation areas, the activities available at each, and their distance and direction from the permit area. Appendix D2 describes the significance of the aforementioned historic sites.

D1.4.5 Residential

Several residences are in proximity to the permit area. There are no residences within the permit boundary. However, multiple rural residences are along the Tongue River and Wyoming State Highway 345 south of the permit area. Several more residences are near the permit boundary south of the Tongue River across the Kleenburn Road from the Kleenburn Recreation Area

TFN 6 2/025
RECD JUL 30, 2015

DEQ 4-015

in Sections 20 and 21, T57N, R84W in the town of Model formed by Amalgamated Development Corp. The centroid of the permit area is approximately six miles east of the incorporated town of Ranchester, and the western boundaries of the permit area are approximately three miles east of the incorporated town of Ranchester. Table D1.4-2 lists the distance to the nearest residence and to the nearest site boundary from the centroid of the permit area for each of the 22½ degree sectors centered on each of the 16 compass points. The centroid of the permit area is in the NW¼, NE¼, Section 18, T57N, R84W. Locations of residences are depicted on Exhibit D1.1-1.

D1.5 Unsuitable for Mining within & and Adjacent to Proposed Permit Boundary

There are no known areas unsuitable for mining within the permit area.

D1.6 Previous Surface and Underground Mined Areas

Coal mining within the region began in the 1880s when settlers mined exposed coal seams in small quantities for personal use. Industrial coal mining on a large scale began in the early 1890s. These mines were established due to the arrival of the Burlington Railroad. The coal mines along the Tongue River led to the establishment of several small towns, or coal camps, and a population explosion north of Sheridan that included more people than in Sheridan itself. In the early twentieth century, five major mines were in the area: Dietz, Kooi, Monarch, Acme, and Carneyville (Kleenburn). Kooi, Monarch, Acme, and Kleenburn were all within or adjacent to the permit boundary. Exhibit D2.3-1 shows the location of the historic mines and Appendix D2 provides the history of mining in the area. Dietz was southeast of the permit area. The coal resources in Sheridan County in the early twentieth century were considered some of the most abundant resources in the United States at the time. In 1909, the Wyoming Coal Mine Inspector stated that Sheridan County "contains more tons of coal than any coal field in the United States west of the Mississippi River" (Knapp, 2013). The underground coal mines continued to operate until the last one, Monarch, closed in 1953. Into

TFN 6 2/025
RECD JUL 30, 2015

DEQ 4-016

recent years, subsidence due to underground mining has been evident on the surface in several locations. Some of these locations have been reclaimed recently. Though the last underground mine was closed in 1953, coal mining in the area continued with Peter Kiewit and Sons' new open pit mine, or strip mine. It was known as the Big Horn Coal Mine and continued to operate until the 1990s although reclamation activities still continue today (Toxey Mcmillan Design Associates, LLC, 2012). This mine is located immediately east of the permit area, see Exhibit D1.1-1.

TFN 6 2/025
RECD JUL 30, 2015

D1.7 References

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TFN 6 2/025
RECD JUL 30, 2015

DEQ 4-018

APPENDIX D1 TABLES

Table D1.3-1. Oil and Gas Wells within 2 Miles of the Permit Area

Well Name	Application Number	Well Operator	Well Class	Well Status	Township	Range	Section	Qtr-Qtr
WELCH 1	49-033-05062	Kenneth W Nickerson	O	PA	57N	84W	4	NW NW
PRENTICE & PADLOCK 1-B	49-033-05061	LP Swepi	O	PA	57N	84W	5	SW NW
PERRY 1	49-033-05057	MKM Oil Company	O	PA	57N	84W	5	SW SW
PERRY 1	49-033-05059	King-Stevenson Gas & Oil Co	O	PA	57N	84W	6	NW SE
SHERIDAN COAL 4	49-033-05053	CM & W Drilling	O	PA	57N	84W	7	SW NW
MONARCH 2	49-033-05050	Sheridan-Wyoming Oil	O	PA	57N	84W	7	SE SE
SHERIDAN COAL 3	49-033-05055	CM & W Drilling	O	PA	57N	84W	9	NW NE
A W LONABAUGH 1	49-033-05054	Shamrock Oil & Gas	O	PA	57N	84W	10	SW NW
SCHREIBEIS 1	49-033-05051	Petroleum Inc	O	PA	57N	84W	12	NW SW
KIEWIT 43M/C-1374	49-033-25543	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	13	NE SE
KIEWIT 43D2/3-1374	49-033-25558	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	13	NE SE
KIEWIT 43D1-1374	49-033-25559	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	13	SW SE
KIEWIT 34/D1-1374	49-033-25544	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	13	SW SE
KIEWIT 34M/C-1374	49-033-25545	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	13	SW SE
KIEWIT 34D2/3-1374	49-033-25557	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	13	SW SE
COAL A-3	49-033-05043	Phillips Petroleum Company	O	PA	57N	84W	15	NW SE
STATE 16-1	49-033-05048	Extreme Petroleum Technology	O	PA	57N	84W	16	NE NE
N SHERIDAN STATE 1-16	49-033-20175	ANR Production Company	O	PA	57N	84W	16	SE SE
SHERIDAN COAL 2-A	49-033-05039	Phillips Petroleum Company	O	PA	57N	84W	17	SE SE
MONARCH 1	49-033-05047	Sheridan-Wyoming Oil	O	PA	57N	84W	18	NW NE
SHERIDAN COAL 1	49-033-05040	CM & W Drilling	O	PA	57N	84W	18	SE SE
SHERIDAN COAL CO 2	49-033-05034	CM & W Drilling	O	PA	57N	84W	21	SE SE
PADLOCK 24-21S	49-033-20275	Sonat Exploration Co	ST	SR	57N	84W	21	SE SW
SHERIDAN-WYO 1	49-033-05035	Extreme Petroleum Technology	O	PA	57N	84W	22	NE SE
KIEWIT 41C-2374	49-033-24171	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	23	NE NE
KIEWIT 32C-2374	49-033-22028	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	23	SW NE
DELAPP 21C-2374	49-033-24170	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	23	NE NW

TFN 6 2/025
RECD JUL 30, 2015

Table D1.3-1. Oil and Gas Wells within 2 Miles of the Permit Area (Continued)

Well Name	Application Number	Well Operator	Well Class	Well Status	Township	Range	Section	Qtr-Qtr
WHITNEY 22-23S	49-033-20277	Sonat Exploration Co	ST	SR	57N	84W	23	SE NW
DELAPP 12C-2374	49-033-24173	Fidelity Exploration & Production Co	G	PA	57N	84W	23	SW NW
DELAPP 12C2-2374	49-033-24361	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	23	SW NW
STATE 43D3-2374	49-033-22021	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	23	NE SE
STATE 43C-2374	49-033-22022	Fidelity Exploration & Production Co	G	SI/PA	57N	84W	23	NE SE
STATE 34M-2374	49-033-22023	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	23	SW SE
STATE 34C-2374	49-033-22027	Fidelity Exploration & Production Co	G	SI/PA	57N	84W	23	SW SE
STATE 23M-2374	49-033-22026	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	23	NE SW
STATE 23C-2374	49-033-22029	Fidelity Exploration & Production Co	G	SI/PA	57N	84W	23	NE SW
STATE 24C-2374	49-033-20290	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	23	SE SW
STATE 14M-2374	49-033-22025	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	23	SW SW
STATE 14C-2374	49-033-22030	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	23	SW SW
KIEWIT 41D2/3-2474	49-033-23343	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	24	NE NE
KIEWIT 41D1-2474	49-033-23362	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	24	NE NE
KIEWIT 41M/C-2474	49-033-23403	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	24	NE NE
KIEWIT 32SM/D1-2474	49-033-23382	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	24	SW NE
KIEWIT 32M/C-2474	49-033-23366	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	24	SW NE
KIEWIT 32D2/3-2474	49-033-23348	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	24	SW NE
KIEWIT 21M/C-2474	49-033-25546	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	24	NE NW
KIEWIT 21D2/3-2474	49-033-25554	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	24	NE NW
KIEWIT 43/D1-2474	49-033-21711	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	24	NE SE
KIEWIT 43MCX-2474	49-033-21712	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	24	NE SE
KIEWIT 43D2/3-2474	49-033-25570	Fidelity Exploration & Production Co	G	SR	57N	84W	24	NE SE

TFN 6 2/025
RECD JUL 30, 2015

Table D1.3-1. Oil and Gas Wells within 2 Miles of the Permit Area (Continued)

Well Name	Application Number	Well Operator	Well Class	Well Status	Township	Range	Section	Qtr-Qtr
KIEWIT 34M/C-2474	49-033-25550	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	24	SW SE
KIEWIT 34D2/3-2474	49-033-25551	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	24	SW SE
KIEWIT 34SM/D1-2474	49-033-25542	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	24	SW SE
KIEWIT 23MC-2474	49-033-21716	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	24	NE SW
KIEWIT 23D2/3-2474	49-033-25552	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	24	NE SW
KIEWIT 14M/C-2474	49-033-25547	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	24	SW SW
KIEWIT 14D2/3-2474	49-033-25556	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	24	SW SW
ST ROMAIN 41SM/D1-2574	49-033-25522	Fidelity Exploration & Production Co	G	SI/PA	57N	84W	25	NE NE
ST ROMAIN 41M/C-2574	49-033-25523	Fidelity Exploration & Production Co	G	SI/PA	57N	84W	25	NE NE
ST ROMAIN 41D2/3-2574	49-033-25524	Fidelity Exploration & Production Co	G	SI/PA	57N	84W	25	NE NE
ST ROMAIN 32SM/D1-2574	49-033-25525	Fidelity Exploration & Production Co	G	SI/PA	57N	84W	25	SW NE
ST. ROMAIN 32C-2574	49-033-22945	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	25	SW NE
ST. ROMAIN 32M-2574	49-033-22932	Fidelity Exploration & Production Co	G	SI/PA	57N	84W	25	SW NE
ST ROMAIN 32D2/3-2574	49-033-25519	Fidelity Exploration & Production Co	G	SI/PA	57N	84W	25	SW NE
KIEWIT 21D2/3-2574	49-033-25553	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	25	NE NW
KIEWIT 21M/C-2574	49-033-25572	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	25	NE NW
KIEWIT 12M/C-2574	49-033-24169	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	25	SW NW
KIEWIT 12D2/3-2574	49-033-25569	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	25	SW NW
ST ROMAIN 43SM/D1-2574	49-033-25521	Fidelity Exploration & Production Co	G	SI/PA	57N	84W	25	NE SE
ST ROMAIN 43M/C-2574	49-033-25517	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	25	NE SE

TFN 6 2/025
RECD JUL 30, 2015

Table D1.3-1. Oil and Gas Wells within 2 Miles of the Permit Area (Continued)

Well Name	Application Number	Well Operator	Well Class	Well Status	Township	Range	Section	Qtr-Qtr
ST ROMAIN 43D2/3-2574	49-033-25518	Fidelity Exploration & Production Co	G	SI/PA	57N	84W	25	NE SE
SHANNON 34SM/D1-2574	49-033-22408	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	25	SW SE
SHANNON 34M/C-2574	49-033-22409	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	25	SW SE
SHANNON 34D2/3-2574	49-033-25573	Fidelity Exploration & Production Co	G	PS/SR	57N	84W	25	SW SE
HUTTON/KIEWIT 23D2/3-2574	49-033-25555	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	25	NE SW
HUTTON/KIEWIT 23M/C-2574	49-033-25548	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	25	NE SW
SHANNON 14M-2574	49-033-22411	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	25	SW SW
SHANNON 14D3-2574	49-033-22412	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	25	SW SW
SHANNON 14C-2574	49-033-22414	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	25	SW SW
BARBULU 1	49-033-05032	Montegna Bruno	O	PA	57N	84W	25	SW SW
STATE 41M-2674	49-033-22019	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	26	NE NE
STATE 41C-2674	49-033-22020	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	26	NE NE
STATE 31C-2674	49-033-20298	Fidelity Exploration & Production Co	G	SI/PA	57N	84W	26	NW NE
STATE 42C-2674	49-033-20296	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	26	SE NE
STATE 32C-2674	49-033-20297	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	26	SW NE
STATE 32M-2674	49-033-22772	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	26	SW NE
STATE 21M-2674	49-033-22773	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	26	NE NW
STATE 21C-2674	49-033-20287	Fidelity Exploration & Production Co	G	SI/PA	57N	84W	26	NE NW
STATE 11C-2674	49-033-20289	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	26	NW NW
STATE 22M-2674	49-033-20327	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	26	SE NW
STATE 22C-2674	49-033-20286	Fidelity Exploration & Production Co	G	SI/PA	57N	84W	26	SE NW
STATE 12C-2674	49-033-20288	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	26	SW NW
STATE 12M-2674	49-033-22774	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	26	SW NW

TFN 6 2/025
RECD JUL 30, 2015

Table D1.3-1. Oil and Gas Wells within 2 Miles of the Permit Area (Continued)

Well Name	Application Number	Well Operator	Well Class	Well Status	Township	Range	Section	Qtr-Qtr
RICE & SONS 43C-2674	49-033-21549	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	26	NE SE
RICE & SONS 43M-2674	49-033-22018	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	26	NE SE
RICE & SONS 33C-2674	49-033-20292	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	26	NW SE
RICE & SONS 33M-2674	49-033-20317	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	26	NW SE
RICE & SONS 34M-2674	49-033-22401	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	26	SW SE
RICE & SONS 34C-2674	49-033-22402	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	26	SW SE
RICE & SONS 23M-2674	49-033-20319	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	26	NE SW
RICE & SONS 23C-2674	49-033-20294	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	26	NE SW
RICE & SONS 13C-2674	49-033-20295	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	26	NW SW
RICE & SONS 13M-2674	49-033-20318	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	26	NW SW
RICE & SONS 24M-2674	49-033-20316	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	26	SE SW
RICE & SONS 24C-2674	49-033-20293	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	26	SE SW
WHITNEY STRAT 41-27S	49-033-20283	Sonat Exploration Co	ST	SR	57N	84W	27	NE NE
RICE & SONS 44-27S	49-033-20281	Jolen Operating Company	ST	PA	57N	84W	27	SE SE
COAL A 1	49-033-05033	Phillips Petroleum Company	O	PA	57N	84W	28	NW SE
PADLOCK 33-28S	49-033-20273	Sonat Exploration Co	ST	SR	57N	84W	28	NW SE
JORGENSON 13K-28 57-84	49-033-22802	Storm Cat Energy USA Operating Corp	G	PA	57N	84W	28	SW SW
JORGENSON 1-29	49-033-20102	Luff Exploration	O	PA	57N	84W	29	SE SW
RICE & SONS 43M-3374	49-033-23826	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	33	NE SE
RICE & SONS 41C-3474	49-033-23940	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	34	NE NE
RICE & SONS 41M-3474	49-033-25142	Fidelity Exploration & Production Co	G	PA	57N	84W	34	NE NE
RICE & SONS 42-34S	49-033-20278	Fidelity Exploration & Production Co	ST	ND	57N	84W	34	SE NE
RICE RANCH FEE 1-34	49-033-20219	Collins & Ware Inc	O	PA	57N	84W	34	NE NW
RICE & SONS 43M-3474	49-033-25144	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	34	NE SE
RICE & SONS 43C-3474	49-033-23939	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	34	NE SE

TFN 6 2/025
RECD JUL 30, 2015

Table D1.3-1. Oil and Gas Wells within 2 Miles of the Permit Area (Continued)

Well Name	Application Number	Well Operator	Well Class	Well Status	Township	Range	Section	Qtr-Qtr
RICE & SONS 23M-3474	49-033-23004	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	34	NE SW
RICE & SONS 23M-3474	49-033-25189	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	34	NE SW
RICE & SONS 14M-3474	49-033-25143	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	34	SW SW
RICE & SONS 41C-3574	49-033-21538	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	35	NE NE
RICE & SONS 41M-3574	49-033-21539	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	35	NE NE
RICE & SONS 41D3-3574	49-033-22209	Fidelity Exploration & Production Co	G	SI/PA	57N	84W	35	NE NE
RICE & SONS 32C-3574	49-033-21542	Fidelity Exploration & Production Co	G	SI/PA	57N	84W	35	SW NE
RICE & SONS 32M-3574	49-033-21543	Fidelity Exploration & Production Co	G	SI/PA	57N	84W	35	SW NE
RICE & SONS 32D3-3574	49-033-22207	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	35	SW NE
RICE & SONS 32M2-3574	49-033-25778	Fidelity Exploration & Production Co	G	SI/PA	57N	84W	35	SW NE
RICE & SONS 21D2-3574	49-033-22233	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	35	NE NW
RICE & SONS 21C-3574	49-033-21546	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	35	NE NW
RICE & SONS 21M-3574	49-033-21547	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	35	NE NW
RICE & SONS 43C-3574	49-033-21536	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	35	NE SE
RICE & SONS 43M-3574	49-033-21537	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	35	NE SE
RICE & SONS 43D2-3574	49-033-22210	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	35	NE SE
RICE & SONS 34C-3574	49-033-21540	Fidelity Exploration & Production Co	G	SI/PA	57N	84W	35	SW SE
RICE & SONS 34M-3574	49-033-21541	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	35	SW SE
RICE & SONS 34D3-3574	49-033-22208	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	35	SW SE
RICE & SONS 34C2-3574	49-033-23647	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	35	SW SE
RICE & SONS 23D3-3574	49-033-22234	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	35	NE SW
RICE & SONS 23M-3574	49-033-21544	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	35	NE SW
RICE & SONS 23C-3574	49-033-21545	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	35	NE SW

TFN 6 2/025
RECD JUL 30, 2015

Table D1.3-1. Oil and Gas Wells within 2 Miles of the Permit Area (Continued)

Well Name	Application Number	Well Operator	Well Class	Well Status	Township	Range	Section	Qtr-Qtr
RICE & SONS 14M-3574	49-033-21535	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	35	SW SW
RICE & SONS 14D3-3574	49-033-22232	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	35	SW SW
RICE & SONS 14C-3574	49-033-21548	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	35	SW SW
STATE 41M-3674	49-033-21877	Fidelity Exploration & Production Co	G	SI/PA	57N	84W	36	NE NE
STATE 41C-3674	49-033-21884	Fidelity Exploration & Production Co	G	SI/PA	57N	84W	36	NE NE
STATE 41D1/2/3-3674	49-033-22217	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	36	NE NE
STATE 41M2-3674	49-033-25777	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	36	NE NE
STATE 32M-3674	49-033-21875	Fidelity Exploration & Production Co	G	SI/PA	57N	84W	36	SW NE
STATE 32D1/2/3-3674	49-033-22215	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	36	SW NE
STATE 32C-3674	49-033-21882	Fidelity Exploration & Production Co	G	SI/PA	57N	84W	36	SW NE
STATE 32M2-3674	49-033-25780	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	36	SW NE
STATE 21C-3674	49-033-21880	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	36	NE NW
STATE 21D1/2/3-3674	49-033-22213	Fidelity Exploration & Production Co	G	PS/PA	57N	84W	36	NE NW
STATE 21M-3674	49-033-21873	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	36	NE NW
STATE 12M-3674	49-033-21871	Fidelity Exploration & Production Co	G	SI/PA	57N	84W	36	SW NW
STATE 12M2-3674	49-033-25779	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	36	SW NW
STATE 12C-3674	49-033-21879	Fidelity Exploration & Production Co	G	PS/PA	57N	84W	36	SW NW
STATE 12D3-3674	49-033-22211	Fidelity Exploration & Production Co	G	SI/PA	57N	84W	36	SW NW
STATE 43D1/2/3-3674	49-033-22218	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	36	NE SE
STATE 43M-3674	49-033-21869	Fidelity Exploration & Production Co	G	SI/PA	57N	84W	36	NE SE
STATE 43C-3674	49-033-21870	Fidelity Exploration & Production Co	G	PS/PA	57N	84W	36	NE SE
STATE 34M-3674	49-033-21876	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	36	SW SE
STATE 34C-3674	49-033-21883	Fidelity Exploration & Production Co	G	SI/PA	57N	84W	36	SW SE
STATE 34D3-3674	49-033-22216	Fidelity Exploration & Production Co	G	SI/PA	57N	84W	36	SW SE

TFN 6 2/025
RECD JUL 30, 2015

Table D1.3-1. Oil and Gas Wells within 2 Miles of the Permit Area (Continued)

Well Name	Application Number	Well Operator	Well Class	Well Status	Township	Range	Section	Qtr-Qtr
STATE 23D3-3674	49-033-22214	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	36	NE SW
STATE 23C-3674	49-033-21881	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	36	NE SW
STATE 23M-3674	49-033-21874	Fidelity Exploration & Production Co	G	SI/PA	57N	84W	36	NE SW
STATE 14M-3674	49-033-21872	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	36	SW SW
STATE 14C-3674	49-033-21878	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	36	SW SW
STATE 14D3-3674	49-033-22212	Fidelity Exploration & Production Co	G	SI/PA	57N	84W	36	SW SW
ZIMMERMAN 1	49-033-05046	The Wood Company	O	PA	57N	85W	18	NE NW
KANE 1	49-033-20159	Davis Oil Company	O	PA	57N	85W	32	NE SW
LEGERSKI 1	49-033-05031	Smith Perl	O	PA	57N	85W	36	SE NE
RICE & SONS 41M-464	49-033-23822	Fidelity Exploration & Production Co	G	SI/SR	56N	84W	4	NE NE
RICE & SONS 32M-464	49-033-25139	Fidelity Exploration & Production Co	G	SI/SR	56N	84W	4	SW NE
RICE & SONS 21M-464	49-033-23820	Fidelity Exploration & Production Co	G	SI/SR	56N	84W	4	NE NW
RICE & SONS 43M-464	49-033-23819	Fidelity Exploration & Production Co	G	SI/SR	56N	84W	4	NE SE
RICE RANCH PATENTED	49-033-05027	MKM Exploration	O	PA	56N	84W	4	SW SE
RICE & SONS 34M-464	49-033-25141	Fidelity Exploration & Production Co	G	SI/SR	56N	84W	4	SW SE
RICE & SONS 23M-464	49-033-23821	Fidelity Exploration & Production Co	G	SI/SR	56N	84W	4	NE SW
RICE & SONS 14M-464	49-033-23009	Fidelity Exploration & Production Co	MW	SI/PA	56N	84W	4	SW SW
STATE SC 5-1-5684	49-033-27794	Stephens Production Company	G	TA/PA	56N	84W	5	NE NE
STATE SC 5-3-5684	49-033-27796	Stephens Production Company	G	TA/PA	56N	84W	5	NE NW
STATE SC 5-9-5684	49-033-27795	Stephens Production Company	G	TA/PA	56N	84W	5	NE SE
STATE SC 5-11-5684	49-033-27797	Stephens Production Company	G	TA/PA	56N	84W	5	NE SW
SHREVE FEE 1-5	49-033-20161	Reading & Bates Petroleum	O	PA	56N	85W	5	SW SE
J HALLWORTH 1	49-033-05068	Swepi LP	O	PA	58N	R84W	31	NE NE
J HALLWORTH 1-9	49-033-05089	Beartooth Oil & Gas Co	O	PR/PO	58N	R84W	31	NE NE
J HALLWORTH 3	49-033-05069	Beartooth Oil & Gas Co	O	DR	58N	R84W	31	NW NE
J HALLWORTH 8	49-033-05075	Beartooth Oil & Gas Co	O	SI/PO	58N	R84W	31	SE NE

TFN 6 2/025
RECD JUL 30, 2015

Table D1.3-1. Oil and Gas Wells within 2 Miles of the Permit Area (Continued)

Well Name	Application Number	Well Operator	Well Class	Well Status	Township	Range	Section	Qtr-Qtr
J HALLWORTH 2	49-033-05079	Beartooth Oil & Gas Co	D	AI	58N	R84W	31	SW NE
J HALLWORTH 10	49-033-05086	Beartooth Oil & Gas Co	D	PR/AI	58N	R84W	31	NE NW
J HALLWORTH 6	49-033-05077	Beartooth Oil & Gas Co	D	SI	58N	R84W	31	SE NW
J HALLWORTH 12	49-033-05078	Swepi LP	O	PA	58N	R84W	31	SW NW
J HALLWORTH 7	49-033-05070	Beartooth Oil & Gas Co	D	AI	58N	R84W	31	NE SE
J HALLWORTH 5	49-033-05071	Beartooth Oil & Gas Co	O	PR/PO	58N	R84W	31	NW SE
PRENTICE PADLOCK A 1	49-033-05067	Swepi LP	O	PA	58N	R84W	31	SE SE
SCOTT PATENTED 1	49-033-05065	Harry T Thorson	O	PA	58N	R84W	31	SW SE
J HALLWORTH 4	49-033-05064	Swepi LP	O	PA	58N	R84W	31	SE SW
J V STATE B 2 0	49-033-05088	Swepi LP	O	PA	58N	R84W	32	NE NW
JV STATES B 1	49-033-05087	Beartooth Oil & Gas Co	O	PR/PO	58N	R84W	32	NW NW
SHERIDAN W-03795 2	49-033-05073	Swepi LP	O	PA	58N	R84W	32	SE NW
SHERIDAN W-03795 1	49-033-05080	Swepi LP	O	PA	58N	R84W	32	SW NW
PADLOCK RANCH 1	49-033-05066	Paul G Benedum	O	PA	58N	R84W	32	SW SE
J HALLWORTH 9	49-033-05074	Swepi LP	O	PA	58N	R84W	32	NW SW
GLENN MOCK-A 1	49-033-05091	Miami Oil Producers Inc	O	PA	58N	R84W	33	NE NE
SCHREIBEIS 1	49-033-05076	Oil & Realty Developments Inc	O	PA	58N	R84W	33	SW NW
SCHREIBEIS 1	49-033-20163	Davis Oil Company	O	PA	58N	R84W	33	NE SW
SCOTT 2A	49-033-05063	Phillips Petroleum Company	O	PA	58N	R85W	34	SE SW
HAWKINS STATE 1	49-033-05072	Gulf Oil Corporation	O	PA	58N	R85W	36	NE SW

Source: Wyoming Oil and Gas Conservation Commission (2013)

Status Codes for Well Files
PO = Producing Oil Well
PG = Producing Gas Well
DH = Dry Hole
SI = Shut - In
TA = Temporarily Abandoned
PA = Permanently Abandoned
AI = Active Injector
DR = Dormant
NI = Notice of Intent to Abandon
SR = Subsequent Report of Abandonment
AP = Permit to Drill
SP = Well Spudded
WP = Waiting on Approval
UNK = Unknown
NR = No Report
SO = Suspended Operations

Classification Codes:
O = Oil Well
G = Gas Well
C = Condensate
I = Injector Well
S = Source Well
AP = Active Permit
D = Disposal
M = Monitor Well
MW = Monitor Well (Not for Form 2 Reporting)
ST = Strat Test
GS = Gas Storage
GO = Gas Orphaned
OO = Oil Orphaned
DO = Disposal Orphaned
IO = Injector Orphaned
MO = Monitor Well Orphaned

Form 2 Reporting Classification Codes:
O = Oil Well
G = Gas Well
C = Condensate
I = Injector Well
S = Source Well
D = Disposal
M = Monitor Well

TFN 6 2/025
RECD JUL 30, 2015

Table D1.4-1. Nearby Recreation Areas

Recreation Area	Activities Available	Distance from Permit Area (miles)	Direction
Bighorn National Forest	Biking, Boating, Camping, Caving, Climbing, Fishing, Hiking/Backpacking, Horseback Riding, Hunting, Off Highway Vehicles, Picnicking, Scenic Driving, Wildlife Viewing, Winter Sports, Visitor Centers, Exhibits, Interpretive Programs, Cultural-Historic Sites	16 [1]	WSW
Cloud Peak Wilderness	Camping, Climbing, Fishing, Hiking/Backpacking, Horseback Riding, Hunting, Wildlife Viewing, Winter Sports	35	SSW
Connor Battlefield	Camping, Fishing, Hiking/Backpacking, Picnicking, Cultural-Historic Sites	7	W
Trail End State Historic Site	Exhibits, Interpretive Programs, Cultural-Historic Sites	9	SSE
Fort Phil Kearny State Historic Site	Picnicking, Visitor Center, Exhibits, Cultural-Historic Sites	28	SSE
Kerns Wildlife Management Area	Camping, Fishing, Hiking/Backpacking, Hunting, Wildlife Viewing	26	WNW
Lake De Smet	Boating, Fishing, Picnicking, Camping, Water Sports	33	SSE
Tongue River Reservoir	Biking, Boating, Camping, Fishing, Picnicking, Water Sports, Wildlife Viewing	16	NE
Little Bighorn Battlefield National Monument, Montana	Hiking/Backpacking, Picnicking, Scenic Driving, Visitor Center, Exhibits, Cultural-Historic Sites	50	NNW

Note: [1] Approximate distance to the nearest entry into the Bighorn National Forest.
Source: Public Lands Information Center (2013)

TFN 6 2/025
RECD JUL 30,2015

DEQ 4-029

Table D1.4-2. Distance to Nearest Residence for Each Compass Sector

Sector	Distance from Project Center to Nearest Site Boundary (miles)	Distance from Site Boundary to Nearest Residence (miles)	Distance from Project Center to Nearest Residence (miles)
N	0.19	3.25	3.44
NNE	0.19	2.82	3.61
NE	0.83	5.10	6.27
ENE	1.24	2.85	5.26
E	1.35	0.25	2.60
ESE	1.37	1.38	4.95
SE	1.21	0.29	1.75
SSE	0.73	0.37	1.56
S	0.67	0.33	0.99
SSW	0.67	0.19	0.89
SW	0.74	0.44	1.44
WSW	0.97	0.30	1.93
W	1.74	0.72	3.45
WNW	0.35	0.08	1.92
NW	0.23	5.79	7.43
NNW	0.19	3.83	4.03

TFN 6 2/025
RECD JUL 30,2015

DEQ 4-030

Table D1.3-1. Oil and Gas Wells within 2 Miles of the Permit Area (Continued)

Well Name	Application Number	Well Operator	Well Class	Well Status	Township	Range	Section	Qtr-Qtr
RICE & SONS 31-35	49-033-20447	Jolen Operating Company	G	EP	57N	84W	35	NW NE
RICE & SONS 42-35	49-033-20449	Jolen Operating Company	G	EP	57N	84W	35	SE NE
RICE & SONS 32C-3574	49-033-21542	Fidelity Exploration & Production Co	G	SI/PA	57N	84W	35	SW NE
RICE & SONS 32M-3574	49-033-21543	Fidelity Exploration & Production Co	G	SI/PA	57N	84W	35	SW NE
RICE & SONS 32D3-3574	49-033-22207	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	35	SW NE
RICE & SONS 32M2-3574	49-033-25778	Fidelity Exploration & Production Co	G	SI/PA	57N	84W	35	SW NE
RICE & SONS 21D2-3574	49-033-22233	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	35	NE NW
RICE & SONS 21D3-3574	49-033-23732	Fidelity Exploration & Production Co	G	EP	57N	84W	35	NE NW
RICE & SONS 21C-3574	49-033-21546	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	35	NE NW
RICE & SONS 21M-3574	49-033-21547	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	35	NE NW
RICE & SONS 11-35	49-033-20443	Jolen Operating Company	G	EP	57N	84W	35	NW NW
RICE & SONS 22-35	49-033-20445	Jolen Operating Company	G	EP	57N	84W	35	SE NW
RICE & SONS 43C-3574	49-033-21536	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	35	NE SE
RICE & SONS 43M-3574	49-033-21537	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	35	NE SE
RICE & SONS 43D2-3574	49-033-22210	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	35	NE SE
RICE & SONS 33-35	49-033-20448	Jolen Operating Company	G	EP	57N	84W	35	NW SE
RICE & SONS 44-35	49-033-20450	Jolen Operating Company	G	EP	57N	84W	35	SE SE
RICE & SONS 34C-3574	49-033-21540	Fidelity Exploration & Production Co	G	SI/PA	57N	84W	35	SW SE
RICE & SONS 34M-3574	49-033-21541	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	35	SW SE
RICE & SONS 34D3-3574	49-033-22208	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	35	SW SE
RICE & SONS 34C2-3574	49-033-23647	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	35	SW SE
RICE & SONS 23D3-3574	49-033-22234	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	35	NE SW
RICE & SONS 23M-3574	49-033-21544	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	35	NE SW
RICE & SONS 23C-3574	49-033-21545	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	35	NE SW

TFN 6 2/025
RECD NOV 14, 2014

Table D1.3-1. Oil and Gas Wells within 2 Miles of the Permit Area (Continued)

Well Name	Application Number	Well Operator	Well Class	Well Status	Township	Range	Section	Qtr-Qtr
RICE & SONS 13-35	49-033-20444	Jolen Operating Company	G	EP	57N	84W	35	NW SW
RICE & SONS 24-35	49-033-20446	Jolen Operating Company	G	EP	57N	84W	35	SW SW
RICE & SONS 14M-3574	49-033-21535	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	35	SW SW
RICE & SONS 14D3-3574	49-033-22232	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	35	SW SW
RICE & SONS 14C-3574	49-033-21548	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	35	SW SW
STATE 41M-3674	49-033-21877	Fidelity Exploration & Production Co	G	SI/PA	57N	84W	36	NE NE
STATE 41C-3674	49-033-21884	Fidelity Exploration & Production Co	G	SI/PA	57N	84W	36	NE NE
STATE 41D1/2/3-3674	49-033-22217	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	36	NE NE
STATE 41M2-3674	49-033-25777	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	36	NE NE
STATE 31-36	49-033-20439	Sonat Exploration Co	G	EP	57N	84W	36	NW NE
STATE 42-36	49-033-20435	Sonat Exploration Co	G	EP	57N	84W	36	SE NE
STATE 32M-3674	49-033-21875	Fidelity Exploration & Production Co	G	SI/PA	57N	84W	36	SW NE
STATE 32D1/2/3-3674	49-033-22215	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	36	SW NE
STATE 32C-3674	49-033-21882	Fidelity Exploration & Production Co	G	SI/PA	57N	84W	36	SW NE
STATE 32M2-3674	49-033-25780	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	36	SW NE
STATE 21C-3674	49-033-21880	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	36	NE NW
STATE 21D1/2/3-3674	49-033-22213	Fidelity Exploration & Production Co	G	PS/PA	57N	84W	36	NE NW
STATE 21M-3674	49-033-21873	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	36	NE NW
STATE 11-36	49-033-20441	Sonat Exploration Co	G	EP	57N	84W	36	NW NW
STATE 22-36	49-033-20440	Sonat Exploration Co	G	EP	57N	84W	36	SE NW
STATE 12M-3674	49-033-21871	Fidelity Exploration & Production Co	G	SI/PA	57N	84W	36	SW NW
STATE 12M2-3674	49-033-25779	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	36	SW NW
STATE 12C-3674	49-033-21879	Fidelity Exploration & Production Co	G	PS/PA	57N	84W	36	SW NW
STATE 12D3-3674	49-033-22211	Fidelity Exploration & Production Co	G	SI/PA	57N	84W	36	SW NW

TFN 6 2/025
RECD NOV 14, 2014

Table D1.3-1. Oil and Gas Wells within 2 Miles of the Permit Area (Continued)

Well Name	Application Number	Well Operator	Well Class	Well Status	Township	Range	Section	Qtr-Qtr
STATE 43D1/2/3-3674	49-033-22218	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	36	NE SE
STATE 43M-3674	49-033-21869	Fidelity Exploration & Production Co	G	SI/PA	57N	84W	36	NE SE
STATE 43C-3674	49-033-21870	Fidelity Exploration & Production Co	G	PS/PA	57N	84W	36	NE SE
STATE 33-36	49-033-20438	Sonat Exploration Co	G	EP	57N	84W	36	NW SE
STATE 44-36	49-033-20436	Sonat Exploration Co	G	EP	57N	84W	36	SE SE
STATE 34M-3674	49-033-21876	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	36	SW SE
STATE 34C-3674	49-033-21883	Fidelity Exploration & Production Co	G	SI/PA	57N	84W	36	SW SE
STATE 34D3-3674	49-033-22216	Fidelity Exploration & Production Co	G	SI/PA	57N	84W	36	SW SE
STATE 23D3-3674	49-033-22214	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	36	NE SW
STATE 23C-3674	49-033-21881	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	36	NE SW
STATE 23M-3674	49-033-21874	Fidelity Exploration & Production Co	G	SI/PA	57N	84W	36	NE SW
STATE 13-36	49-033-20442	Sonat Exploration Co	G	EP	57N	84W	36	NW SW
STATE 24-36	49-033-20437	Sonat Exploration Co	G	EP	57N	84W	36	SE SW
STATE 14M-3674	49-033-21872	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	36	SW SW
STATE 14C-3674	49-033-21878	Fidelity Exploration & Production Co	G	SI/SR	57N	84W	36	SW SW
STATE 14D3-3674	49-033-22212	Fidelity Exploration & Production Co	G	SI/PA	57N	84W	36	SW SW
ZIMMERMAN 1	49-033-05046	The Wood Company	O	PA	57N	85W	18	NE NW
KANE 1	49-033-20159	Davis Oil Company	O	PA	57N	85W	32	NE SW
LEGERSKI 1	49-033-05031	Smith Perl	O	PA	57N	85W	36	SE NE
RICE & SONS 41M-464	49-033-23822	Fidelity Exploration & Production Co	G	SI/SR	56N	84W	4	NE NE
RICE & SONS 32M-464	49-033-25139	Fidelity Exploration & Production Co	G	SI/SR	56N	84W	4	SW NE
RICE & SONS 21M-464	49-033-23820	Fidelity Exploration & Production Co	G	SI/SR	56N	84W	4	NE NW
RICE & SONS 43M-464	49-033-23819	Fidelity Exploration & Production Co	G	SI/SR	56N	84W	4	NE SE
RICE RANCH PATENTED	49-033-05027	MKM Exploration	O	PA	56N	84W	4	SW SE
RICE & SONS 34D3-464	49-033-25140	Fidelity Exploration & Production Co	G	EP	56N	84W	4	SW SE

TFN 6 2/025
RECD NOV 14, 2014

Table D1.3-1. Oil and Gas Wells within 2 Miles of the Permit Area (Continued)

Well Name	Application Number	Well Operator	Well Class	Well Status	Township	Range	Section	Qtr-Qtr
RICE & SONS 34M-464	49-033-25141	Fidelity Exploration & Production Co	G	SI/SR	56N	84W	4	SW SE
RICE & SONS 23M-464	49-033-23821	Fidelity Exploration & Production Co	G	SI/SR	56N	84W	4	NE SW
RICE & SONS 14M-464	49-033-23009	Fidelity Exploration & Production Co	MW	SI/PA	56N	84W	4	SW SW
STATE SC 5-1-5684	49-033-27794	Stephens Production Company	G	TA/PA	56N	84W	5	NE NE
STATE SC 5-3-5684	49-033-27796	Stephens Production Company	G	TA/PA	56N	84W	5	NE NW
STATE SC 5-9-5684	49-033-27795	Stephens Production Company	G	TA/PA	56N	84W	5	NE SE
STATE SC 5-11-5684	49-033-27797	Stephens Production Company	G	TA/PA	56N	84W	5	NE SW
SHREVE FEE 1-5	49-033-20161	Reading & Bates Petroleum	O	PA	56N	85W	5	SW SE
J HALLWORTH 1	49-033-05068	Swepi LP	O	PA	58N	R84W	31	NE NE
J HALLWORTH 1-9	49-033-05089	Beartooth Oil & Gas Co	O	PR/PO	58N	R84W	31	NE NE
J HALLWORTH 3	49-033-05069	Beartooth Oil & Gas Co	O	DR	58N	R84W	31	NW NE
J HALLWORTH 8	49-033-05075	Beartooth Oil & Gas Co	O	SI/PO	58N	R84W	31	SE NE
J HALLWORTH 2	49-033-05079	Beartooth Oil & Gas Co	D	AI	58N	R84W	31	SW NE
J HALLWORTH 10	49-033-05086	Beartooth Oil & Gas Co	D	PR/AI	58N	R84W	31	NE NW
J HALLWORTH 6	49-033-05077	Beartooth Oil & Gas Co	D	SI	58N	R84W	31	SE NW
J HALLWORTH 12	49-033-05078	Swepi LP	O	PA	58N	R84W	31	SW NW
J HALLWORTH 7	49-033-05070	Beartooth Oil & Gas Co	D	AI	58N	R84W	31	NE SE
J HALLWORTH 5	49-033-05071	Beartooth Oil & Gas Co	O	PR/PO	58N	R84W	31	NW SE
PRENTICE PADLOCK A 1	49-033-05067	Swepi LP	O	PA	58N	R84W	31	SE SE
SCOTT PATENTED 1	49-033-05065	Harry T Thorson	O	PA	58N	R84W	31	SW SE
J HALLWORTH 4	49-033-05064	Swepi LP	O	PA	58N	R84W	31	SE SW
J V STATE B 2 0	49-033-05088	Swepi LP	O	PA	58N	R84W	32	NE NW
JV STATES B 1	49-033-05087	Beartooth Oil & Gas Co	O	PR/PO	58N	R84W	32	NW NW
SHERIDAN W-03795 2	49-033-05073	Swepi LP	O	PA	58N	R84W	32	SE NW
SHERIDAN W-03795 1	49-033-05080	Swepi LP	O	PA	58N	R84W	32	SW NW
PADLOCK RANCH 1	49-033-05066	Paul G Benedum	O	PA	58N	R84W	32	SW SE
J HALLWORTH 9	49-033-05074	Swepi LP	O	PA	58N	R84W	32	NW SW
GLENN MOCK-A 1	49-033-05091	Miami Oil Producers Inc	O	PA	58N	R84W	33	NE NE
SCHREIBEIS 1	49-033-05076	Oil & Realty Developments Inc	O	PA	58N	R84W	33	SW NW

TFN 6 2/025
RECD NOV 14, 2014

Table D1.3-1. Oil and Gas Wells within 2 Miles of the Permit Area (Continued)

Well Name	Application Number	Well Operator	Well Class	Well Status	Township	Range	Section	Qtr-Qtr
SCHREIBEIS 1	49-033-20163	Davis Oil Company	O	PA	58N	R84W	33	NE SW
DELAPP 41C-3484	49-033-21782	Fidelity Exploration & Production Co	G	EP	58N	R84W	34	NE NE
DELAPP 41M-3484	49-033-21787	Fidelity Exploration & Production Co	G	EP	58N	R84W	34	NE NE
WILSON FED 7A-34 58-84	49-033-23830	Huber JM Corp	G	EP	58N	R84W	34	SW NE
WILSON FED 7MK-34 58-84	49-033-23831	Huber JM Corp	G	EP	58N	R84W	34	SW NE
DELAPP 21M-3484	49-033-21761	Fidelity Exploration & Production Co	G	EP	58N	R84W	34	NE NW
DELAPP 21C-3484	49-033-21762	Fidelity Exploration & Production Co	G	EP	58N	R84W	34	NE NW
PADLOCK 13T-34 58-84	49-033-24001	Huber JM Corp	G	EP	58N	R84W	34	SW SW
SCOTT 2A	49-033-05063	Phillips Petroleum Company	O	PA	58N	R85W	34	SE SW
HAWKINS STATE 1	49-033-05072	Gulf Oil Corporation	O	PA	58N	R85W	36	NE SW
Source: Wyoming Oil and Gas Conservation Commission (2013)								

Status Codes for Well Files

PO = Producing Oil Well
PG = Producing Gas Well
DH = Dry Hole
SI = Shut - In
TA = Temporarily Abandoned
PA = Permanently Abandoned
AI = Active Injector
DR = Dormant
NI = Notice of Intent to Abandon
SR = Subsequent Report of Abandonment
EP = Expired Permit
AP = Permit to Drill
SP = Well Spudded
WP = Waiting on Approval
UNK = Unknown
NR = No Report
SO = Suspended Operations

Classification Codes:

O = Oil Well
G = Gas Well
C = Condensate
I = Injector Well
S = Source Well
AP = Active Permit
D = Disposal
M = Monitor Well
MW = Monitor Well (Not for Form 2 Reporting)
ST = Strat Test
GS = Gas Storage
GO = Gas Orphaned
OO = Oil Orphaned
DO = Disposal Orphaned
IO = Injector Orphaned
MO = Monitor Well Orphaned

Form 2 Reporting Classification Codes:

O = Oil Well
G = Gas Well
C = Condensate
I = Injector Well
S = Source Well
D = Disposal
M = Monitor Well

TFN 6 2/025
RECD NOV 14, 2014

Table D1.4-1. Nearby Recreation Areas

Recreation Area	Activities Available	Distance from Permit Area (miles)	Direction
Bighorn National Forest	Biking, Boating, Camping, Caving, Climbing, Fishing, Hiking/Backpacking, Horseback Riding, Hunting, Off Highway Vehicles, Picnicking, Scenic Driving, Wildlife Viewing, Winter Sports, Visitor Centers, Exhibits, Interpretive Programs, Cultural-Historic Sites	16 [1]	WSW
Cloud Peak Wilderness	Camping, Climbing, Fishing, Hiking/Backpacking, Horseback Riding, Hunting, Wildlife Viewing, Winter Sports	35	SSW
Connor Battlefield	Camping, Fishing, Hiking/Backpacking, Picnicking, Cultural-Historic Sites	7	W
Trail End State Historic Site	Exhibits, Interpretive Programs, Cultural-Historic Sites	9	SSE
Fort Phil Kearny State Historic Site	Picnicking, Visitor Center, Exhibits, Cultural-Historic Sites	28	SSE
Kerns Wildlife Management Area	Camping, Fishing, Hiking/Backpacking, Hunting, Wildlife Viewing	26	WNW
Lake De Smet	Boating, Fishing, Picnicking, Camping, Water Sports	33	SSE
Tongue River Reservoir	Biking, Boating, Camping, Fishing, Picnicking, Water Sports, Wildlife Viewing	16	NE
Little Bighorn Battlefield National Monument, Montana	Hiking/Backpacking, Picnicking, Scenic Driving, Visitor Center, Exhibits, Cultural-Historic Sites	50	NNW

Note: [1] Approximate distance to the nearest entry into the Bighorn National Forest.
Source: Public Lands Information Center (2013)

TFN 6 2/025
RECD NOV 14, 2014

DEQ 4-036

Table D1.4-2. Distance to Nearest Residence for Each Compass Sector

Sector	Distance from Project Center to Nearest Site Boundary (miles)	Distance from Site Boundary to Nearest Residence (miles)	Distance from Project Center to Nearest Residence (miles)
N	0.19	3.25	3.44
NNE	0.19	2.82	3.61
NE	0.83	5.10	6.27
ENE	1.24	2.85	5.26
E	1.35	0.25	2.60
ESE	1.37	1.38	4.95
SE	1.21	0.29	1.75
SSE	0.73	0.37	1.56
S	0.67	0.33	0.99
SSW	0.67	0.19	0.89
SW	0.74	0.44	1.44
WSW	0.97	0.30	1.93
W	1.74	0.72	3.45
WNW	0.35	0.08	1.92
NW	0.23	5.79	7.43
NNW	0.19	3.83	4.03

TFN 6 2/025
RECD NOV 14,2014

DEQ 4-037

APPENDIX D1 FIGURES

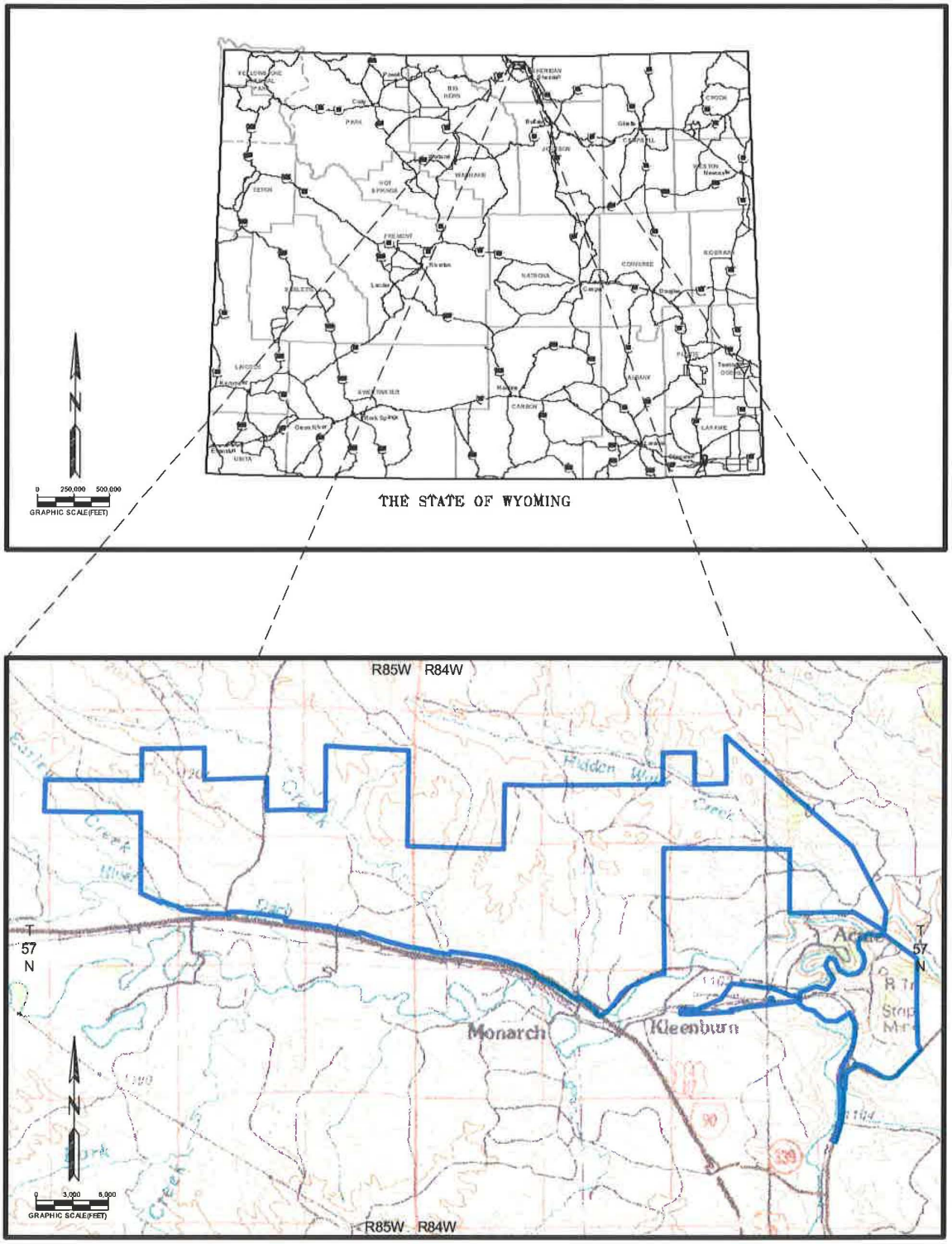
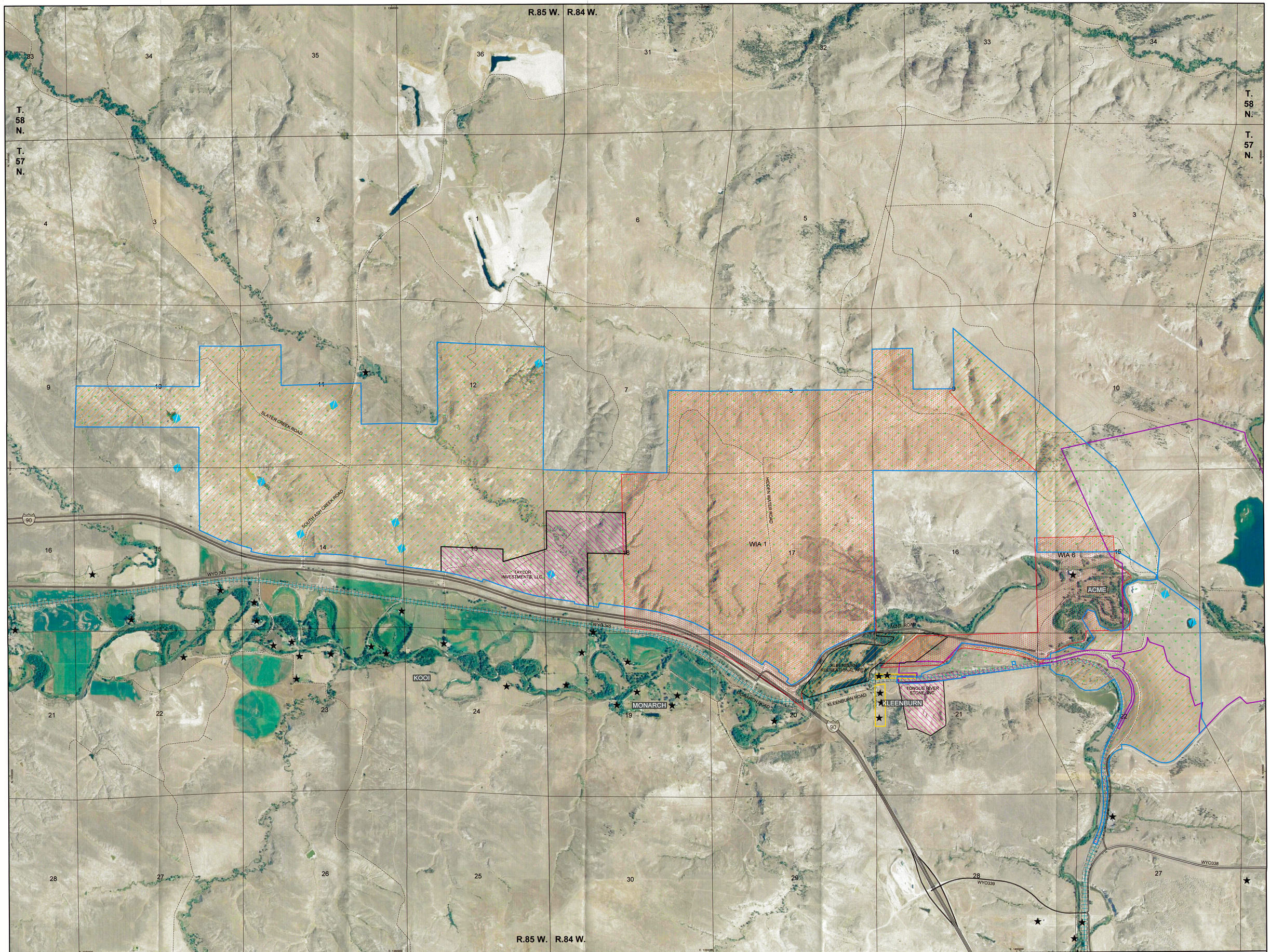


Figure D1.1-1. General Location Map

TFN 6 2/025
RECD NOV 14, 2014

DEQ 4-039

APPENDIX D1 EXHIBITS



LEGEND

- BROOK MINE PERMIT BOUNDARY
- BIG HORN COAL PERMIT BOUNDARY (PERMIT NO. 213-T7)
- TAYLOR QUARRY PERMIT BOUNDARY (PERMIT NO. SP-757)
- TOWN OF MODEL (AMALGAMATED DEVELOPMENT CORP)
- PRESENT INDUSTRIAL COMMERCIAL USE AREA
- PRESENT RECREATIONAL USE AREA
- PAST AND PRESENT GRAZING LAND USE AREA WITHIN PERMIT BOUNDARY
- WYOMING GAME AND FISH HUNTER MANAGEMENT WALK-IN AREAS (WIAs)
- PAVED ROADS
- MINOR ROADS
- RAILROAD
- EXISTING RESERVOIR LOCATION
- EXISTING RESIDENCES
- MONARCH — HISTORIC TOWN APPROXIMATE LOCATION

N

0 500 1,000 1,500 2,000
GRAPHIC SCALE (FEET)

RAMACO

BROOK MINE
SHERIDAN COUNTY, WY

1101 SUGARVIEW DR, STE. 201
SHERIDAN, WY 82801

REVISIONS	
Date	Description
06/15	ROUND 1 COMMENTS

EXHIBIT D1.1-1

LAND USE

TFN 6 2/025
RECD JUL 30,2015

Drawn By:	RAV
Checked By:	JGB
Date:	10/09/14

WWC ENGINEERING
www.wwcengineering.com

FILE: D1_LANDUSE.dwg

K:\Brooks\RAMACO\11\RAMCAD_WY\REC\DWGS_D1_RESPONSE\D1_LANDUSE.dwg 11/13/2015 2:12:45 PM dave johnson

APPENDIX D2 TOC

TABLE OF CONTENTS

D2 HISTORY D2-1
D2.1 Sites on the National Register of Historic Places D2-1
D2.2 History of Brook Mine Area D2-1
D2.3 History of Mining in the Brook Mine Area D2-7
D2.4 References D2-12

LIST OF TABLES

Table D2.1-1. List of Sites in Sheridan County (NRHP) D2-T1

LIST OF FIGURES

Figure D2.2-1. General Location Map D2-F1

LIST OF EXHIBITS

Exhibit D2.3-1 Historic Mine Locations

TFN 6 2/025
RECD NOV 14, 2014

DEQ 4-043

APPENDIX D2 TEXT

HISTORY

Appendix D2

Prepared by:
WWC Engineering

October 2014

TFN 6 2/025
RECD NOV 14, 2014

D2 HISTORY

History of the area of RAMACO's Brook Mine was prepared by WWC Engineering of Sheridan, Wyoming.

D2.1 Sites on the National Register of Historic Places

A search of the National Register of Historic Places (NRHP) was conducted to investigate the vicinity of resources near the Brook Mine. The search was narrowed to Sheridan County, Wyoming for resources listed in the NRHP from 1966 to 2013. The search yielded the resources listed in Table D2.1-1 (National Park Service, U.S. Department of the Interior, 2013). No site currently listed in the NRHP is within the Brook Mine Permit Boundary.

D2.2 History of Brook Mine Area

RAMACO's Brook Mine is located in north-central Sheridan County, Wyoming. It is east of the Bighorn Mountains, approximately 8 air miles northwest of Sheridan, Wyoming, and six miles south of the Wyoming-Montana State Border. Sheridan is located in the Goose Creek Valley, a tributary to the Tongue River. See Figure D2.2-1 for a general location map of the mine area.

Hunter and gatherer societies appear to have inhabited the northeastern portion of Wyoming for more than 13,000 years. These highly mobile inhabitants utilized a wide variety of resources including available flora and fauna to sustain life.

The Northwestern Plains early history is generally divided into six cultural periods: from early to late into the Paleoindian, Early Plains Archaic, Middle Plains Archaic, Late Plains Archaic, Late Prehistoric, and Protohistoric periods. A chronological order of these periods, before the present time (B.P.), is listed below (Frison, 1978, 1991).

- Paleoindian period (13,000 to 7,000 years B.P.)
- Early Plains Archaic period (7,000 to 5,000-4,000 years B.P.)
- Middle Plains Archaic period (5,000-4,000 to 3,000 years B.P.)

TFN 6 2/025
RECD NOV 14, 2014

DEQ 4-046

- Late Plains Archaic period (3,000 to 1,850 years B.P.)
- Protohistoric period (400 to 250 years B.P.)
- Historic period (250 to 120 years B.P.)

The outline of the periods is generally reflected by a shift in the climate conditions causing a change in the areas of occupation and/or the procurement of subsistence. These patterns of transformation due to climate effects continued until the Protohistoric period when it is believed the first Euro-American visitors arrived and brought forth a strong European influence that included the introduction of the horse and European trade goods to the area.

The first Native American tribe of the Protohistoric period to live in the Powder River Basin, the Bighorns, and northern Wyoming were the Snake, or Shoshone. The ancestors of these people lived in the area for thousands of years. The Crows, or Absarokas, drove the Shoshone out in the early 1800s. Subsequently, the Crow were driven out by the Arapaho, Sioux, and Cheyenne by the mid-1800s. Likely, the first Euroamerican visitor to see the Bighorns was François-Antoine Larocque of the Northwest Company in 1805 (Farquhar, Sheridan County, Wyoming, 2013). During the first half of the nineteenth century, the only Euroamerican visitors to the Powder River Basin were the occasional trappers or expeditionary forces. During the 1840s and 1850s, trading migrated toward the Sweetwater and Platte areas of Wyoming leaving much of northern Wyoming uninhabited by Euroamerican people (Farquhar, Johnson County, Wyoming, 2012).

Beginning in the early 1860s, gold prospectors started entering the Montana and Idaho territories. This encouraged John Jacobs and John M. Bozeman to establish a new trail based on old Indian and trapper trails in 1863. The trail diverted north from the Oregon Trail in present-day central Wyoming to Virginia City in Montana Territory. The trail was named the Bozeman Trail, and it traveled through today's Sheridan and Johnson Counties, or the heart of the Powder River Basin. This enraged the Lakota

TFN 6 2/025
RECD NOV 14, 2014

DEQ 4-047

Sioux, Arapaho, and Cheyenne who used the Powder River Basin for premier hunting lands. Between 1864 and 1865, approximately 2,000 pioneers used the Bozeman Trail, despite increasing attacks by the Native Americans (Farquhar, Johnson County, Wyoming, 2012). In the summer of 1865, Brigadier General Patrick E. Connor commanded the Powder River Expedition to attack the Indians in retribution for attacking those settlers using the Bozeman Trail. On August 29, 1865, General Connor attacked an Arapaho village of about 500 people on the Tongue River next to present-day Ranchester, Wyoming. Though only 33 Arapaho were killed in the attack, several hundred horses and most of the lodges were lost. The attack dealt a severe blow to that particular Arapaho tribe, causing the resources to be drained of several Arapaho tribes, and ultimately resulting in the Arapahos being allied with the Lakota and Cheyenne tribes (WyomingHeritage.org, 2011).

The military attempted to negotiate a treaty in the spring of 1866 at Fort Laramie for a right-of-way along the Bozeman Trail. Before the negotiations could finish, a 700-man force led by Colonel Henry B. Carrington arrived at Fort Laramie with orders to restaff Fort Reno in southern Johnson County and build two additional forts along the Bozeman Trail. Ogalala Sioux warrior Red Cloud was enraged by the arrival of the force with orders to build the forts prior to being granted permission by the Indians. The Native Americans left negotiations promising to kill any whites that entered the Powder River Basin. This began what was known as Red Cloud's War (Farquhar, Johnson County, Wyoming, 2012).

Colonel Carrington continued to restaff Fort Reno and build the two additional forts along the Bozeman Trail: Fort Phil Kearny in present-day northern Johnson County, Wyoming and Fort C.F. Smith in southern Montana. The Native Americans continually harrassed Carrington's force as the soldiers constructed the forts. Captain William J. Fetterman arrived at Fort Phil Kearny in November 1866. Captain Fetterman was a brash Civil War hero, and would proclaim that he could ride through the Sioux Nation with 80 men. On December 21, 1866, a wood train (a detachment of soldiers to gather wood) left

TFN 6 2/025
RECD NOV 14,2014

Fort Phil Kearny and was attacked by a small force of Native Americans. Captain Fetterman left the fort with a force of 80 men to relieve the wood train. Colonel Carrington ordered Captain Fetterman three times that under no circumstances should he pursue the Indians over Lodge Trail Ridge. Captain Fetterman disobeyed orders, pursued the Indians, and encountered a force of up to 2,000 Sioux, Cheyenne, and Arapaho. Captain Fetterman and his entire force were killed (McCune & Hart, 1997). The Native Americans continued their harassment of the military. Near Fort Phil Kearny and the site of the Fetterman Massacre, the Wagon Box Fight occurred though the soldiers were not massacred this time due, in large part, to their new breech-loading rifles. Finally in March 1868, General U.S. Grant ordered that all three forts along the Bozeman Trail be abandoned. The Native American burned the forts to the ground. Red Cloud signed a peace treaty on November 6, 1868, and white people were not allowed to enter the Powder River Basin without the Indians' consent (Farquhar, Johnson County, Wyoming, 2012).

Little conflict occurred in the northern Wyoming Territory during the early 1870s. However, Lieutenant Colonel George A. Custer led an expeditionary force into the Black Hills of Dakota and Wyoming to confirm the rumored presence of gold in 1874. The expedition did confirm the rumor and found gold as well as other minerals. The government encouraged a purchase of the Black Hills and the Powder River country from the Native Americans, but the Native Americans refused. The tribes would not submit to move to reservations, and the result was the Great Sioux War of 1876. This included Custer's defeat at the Little Bighorn in June 1876, approximately 50 miles north-northwest of RAMACO's permit area (Farquhar, Johnson County, Wyoming, 2012). The Goose Creek Valley (the location of present-day Sheridan) served as a staging area for General Crook during the campaign. By 1877, the tribes surrendered and submitted to living on reservations (Farquhar, Sheridan County, Wyoming, 2013).

Following the extradition of the American Indians onto reservations in 1877, the northern parts of Wyoming Territory were open for settlement. When

TFN 6 2/025
RECD NOV 14, 2014

Wyoming Territory was originally organized in 1869, it was composed of four vast county units which were continuously split into smaller units as new settlers desired county seats closer to their place of residency. Present-day Sheridan County was the northern portion of Johnson County. The first community founded in present-day Sheridan County was Big Horn City in 1878 by U.S. Army scout Oliver Hanna (Farquhar, Sheridan County, Wyoming, 2013). A trapper named George Mandel built a cabin and post office near the forks of Goose Creek. He decided to leave, and sold his 40 acres to John D. Loucks. In 1882, Loucks imagined, planned for, and established a town in the Goose Creek Valley. He named it "Sheridan" in honor of Union General Phil Sheridan who he served under during the Civil War. Sheridan was officially incorporated in 1884, and Loucks took office as the first mayor. In 1888, the Johnson County residents north of Piney Creek moved to reorganize their district as Sheridan County. The bill passed in the Wyoming Territorial Legislature, and Sheridan received the winning votes to become county seat over Big Horn and Dayton (Nickerson, 2011).

The arrival of the Burlington and Missouri Railroad to Sheridan in 1892 ensured Sheridan's dominance as an economic and industrial leader in the region. Coal mines opened along the Tongue River and Goose Creek at Dietz, Carneyville (later named Kleenburn), Acme, Monarch, and Kooi, as well as several other small "wagon mines." Mining is discussed in more detail in Section D2.3. The coal mining around Sheridan set off an economic boom through the late nineteenth and early twentieth century, and caused a significant population explosion (Nickerson, 2011).

William F. "Buffalo Bill" Cody invested in the Sheridan Inn, and used it as headquarters for tryouts in finding cowboys and cowgirls for his Wild West Show. A few locals that joined the show included George Gardner and his wife, Tode Bard, Jim Jennings and his wife, and Paul Case (Nickerson, 2011).

In 1911, Sheridan had the only long-distance electric trolley in the state. The trolley was paid for entirely by outside capital. The investors asked for

TFN 6 2/025
RECD NOV 14, 2014

DEQ 4-050

nothing from the town of Sheridan other than the use of the right-of-way. A fare was collected from the riders. The trolley travelled north to the coal camps, and it provided a mode of transportation for miners to come into Sheridan, or to send the miners' children to school. It also provided a method for merchants in Sheridan to ship their goods to mines for sale to the miners and their families (Knapp, 2013).

Sheridan was a melting pot of nationalities, due in large part to the mines. The population included African Americans, Hispanics, and many immigrants from Europe, Asia, and the Middle East (Nickerson, 2011). It was reported that there were at least 23 separate nationalities in the coal mining communities. Some of the individual nationalities included American, Polish, Italian, Hungarian, Welsh, Scottish, English, Irish, Czech, Slovak, Bulgarian, Bohemian, Austrian, German, Serbian, Silesian, Montenegrin, Slovakian, Japanese, French, Greek, Swedish, Russian, and Croatian (Toxey McMillan Design Associates LLC, 2012). Primarily, the immigrants were Polish. Polish culture became engrained in the Sheridan area, and is still evident. Many descendants of the early Polish immigrants continue to live in Sheridan and the area today (Knapp, 2013).

John B. Kendrick was the most influential cattle rancher in the area. He owned land from the Tongue River to the Powder River. Kendrick first came to Wyoming in 1879 with a herd of Texas cattle. He moved to Sheridan in 1889, and founded the Kendrick Cattle County. He began constructing his 14,000 square foot mansion, Trail End, in 1908. The home was finally completed in 1913. Trail End is one of the few buildings of Flemish Revival architecture in the western United States. Several modern conveniences were installed at the time of construction including indoor plumbing, electricity, an intercom system, and an in-house stationary vacuum cleaner. Kendrick would not enjoy his home long, as he was elected governor of Wyoming in 1914, and two years later was chosen to serve as a United States Senator. He continued to hold his position as senator until his death in 1933 (Georgen, 2012). His mansion, Trail End, still stands, and is now the Trail End State Historic Site and museum.

TFN 6 2/025
RECD NOV 14,2014

The Sheridan area attempted to promote and increase tourism through dude ranches, the airport, and the Sheridan WYO Rodeo in the 1930s. Sheridan became famous for its polo ranches which started in the late nineteenth century, and continue today. For a time after World War I, the Circle V Polo Company in Big Horn was recognized as the best polo operation in the world. Queen Elizabeth II and Prince Phillip even visited Sheridan to purchase polo ponies in 1984.

Sheridan College was opened in 1948. At about the same time, several industries closed down including the Holly Sugar Mill. The last underground coal mine (Monarch) closed in 1953. The passenger rail service stopped in the 1960s, and the Sheridan Inn closed in the 1960s. But the 1960s also brought Interstate-90. New coal mines were opened nearby in Montana due to the Arab Oil Crisis of 1973. This improved the local economy, but the 1980s brought on a labor strike at the Montana mines that split the community and slackened the economy through the 1980s. The 1990s brought a boom back to the community because of coal-bed methane production. Sheridan is a retail and service center for Sheridan County, Johnson County and southern portions of Big Horn County, Montana and Montana's Tongue River Region (Nickerson, 2011). Much of the area today is oriented toward agriculture and tourism (Farquhar, Sheridan County, Wyoming, 2013).

D2.3 History of Mining in the Brook Mine Area

Though Sheridan, Wyoming's image is that of being a "cowboy" and agricultural town, Sheridan likely owes its early development more to coal mining than to agriculture. In the early 1880s, Sheridan's settlers began mining coal. Exposed coal outcrops existed in the vicinity of Sheridan and mining of these outcrops was known as "wagon mining" because a horse and wagon could be driven to the site and coal loaded into the wagon after directly mining coal from the surface. However, the market for these exposed coal seams could hardly compete with the numerous timber resources in the area due to the limited resources of the exposed coal seams. Initially, firewood was

TFN 6 2/025
RECD NOV 14, 2014

DEQ 4-052

used on a wider basis by the residents of Sheridan County. Because of the numerous timber resources and the limited methods of transportation (wagon), there was not an extensive market for the underground coal resources (Knapp, 2013).

On November 22, 1892, the Burlington and Missouri Railroad (known as the Burlington) came to Sheridan. With the arrival of the railroad, a new market for the underground coal resources came to life. The Burlington Railroad purposely routed its way through Sheridan County due to the extensive coal resources, and the manageable topography (Knapp, 2013). The coal resources of Sheridan County were important enough to the Burlington Railroad that the company reengineered its locomotives to run on the subbituminous coal of the Powder River Basin (Toxey McMillan Design Associates LLC, 2012). With the arrival of the railroad and the new market for coal, coal camps were constructed north of Sheridan near the Tongue River to accommodate coal miners. In turn, this attracted thousands of immigrants and their families to move to the coal camps for employment and housing (Knapp, 2013).

Approximately 100 people lived in what is now Sheridan County in 1880. They lived along the Tongue River, Soldier Creek, and Goose Creek and its two main branches. Sheridan was founded in 1882. In 1900, the population of Sheridan was reported as being 1,559. In 1910, the population was 8,408. The mining communities north of Sheridan, however, had a combined population of approximately 10,000 people in 1908. Therefore, the mining communities more than doubled the population of Sheridan County in the early twentieth century (Knapp, 2013).

The extensive coal deposits warranted the population explosion. In 1909, the Wyoming Coal Mine Inspector stated that Sheridan County "contains more tons of coal than any coal field in the United States west of the Mississippi River." There were also extensive coal deposits in the southern part of Wyoming along the Union Pacific Railroad. Wyoming was split into two coal

TFN 6 2/025
RECD NOV 14,2014

DEQ 4-053

districts: District 1 and District 2. District 1 was along the Union Pacific, and District 2 was along the Burlington and Missouri Railroad. District 1 more-or-less had a monopoly on the coal market whether or not District 1 had greater coal reserves. Therefore, District 2's primary responsibility was to supplement coal shipments whenever District 1 couldn't meet demand. In 1910, District 2 produced nearly 2 million tons of coal. By 1920, District 2 produced nearly 3 million tons of coal per year (Knapp, 2013).

To more efficiently utilize labor, the mining companies established towns, or coal camps, to house and provide services to the miners and their families near the site of the mine. The first of these was built in 1893 in association with the Sheridan Fuel Company, which was formed by several investors including C.H. Grinnell (businessman, cattle-baron, and contractor), J.R. Phelan, George T. Beck (partner of William F. Cody), and Anson Higby. The initial mine and camp were located four miles north of Sheridan, and was initially named Higby. However, when Gould Dietz became the treasurer of the company, the name of the town was changed to Dietz. The operation expanded, and at its peak the Dietz community was composed of two permanent camps of miners that operated eight mines. In 1905, Dietz employed approximately 400 miners during the summer and 800 miners during the winter when fuel demands were higher (Knapp, 2013). In 1908, the Dietz mines employed 1,000 miners, and accommodated approximately 3,000 people in the camp (Toxey McMillan Design Associates LLC, 2012).

By 1907, five major mines were in the area: Dietz, Kooi, Monarch, Acme, and Carneyville (later named Kleenburn). Kooi, Monarch, Acme, and Carneyville were all within, or in the immediate vicinity of, RAMACO's proposed permit boundary. Each mine had a camp that provided housing, supplies, and entertainment to the miners. Dietz continued to be the leading mine in production until Carneyville and Monarch overtook Dietz shortly after 1909. Coal production boomed from 1914 to 1918 due to World War I demands. Even with the large mines, the wagon mines continued to prosper through the boom years and after World War I. Some of the wagon mines included

TFN 6 2/025
RECD NOV 14,2014

Riverside, Schreibeis, Old Acme Mine, Custer Coal Company, Hart Mine, Star Mine, and Welch Mine. The Welch Mine was very prosperous, and even continued to prosper after the last of the railroad mines shut down being the main supplier of coal to Montana-Dakota Utilities' power plant (Knapp, 2013).

After World War I, Dietz workers were some of the first to unionize in Wyoming. Miners from all the major camps attempted to follow suit in December 1919, but dozens were arrested by the National Guard and held at Fort Mackenzie for trying to convince other miners to stop working, and the governor had ordered that no assemblies would take place within 25 miles of a mine. This more-or-less ended attempts of labor organization in the Sheridan County mines in the early twentieth century (Knapp, 2013).

Most of the small mines were incorporated into the Sheridan Wyoming Coal Company in 1920. Soon afterwards, Peabody Coal Company purchased the larger mines. The Dietz mines were shut down by 1922, though some miners continued to live in the camp and commute to other mines. Dietz was completely abandoned by 1937. In the 1930s, technologic advances and mechanization reduced the need for laborers. However, the cost of underground mining increased which started to make surface mining, or strip mining, a more attractive option. World War II caused another boom in coal demand. Yet, the boom subsided with the end of the war, and the end of the war coincided with the development of diesel locomotives. This decreased the demand for coal significantly. The wagon mines and the coal camps began to shut down in Sheridan County. Most of the buildings at the coal camps were sold, abandoned, or disassembled. Monarch was the last and largest underground coal mine in the region and it shut down in 1953. Several houses from the camps were moved into Sheridan and are still inhabited. A former church, water towers, mine portals, cemetaries, and the Acme power plant all remain as reminders of the historic and economic importance of the Sheridan County coal mines and their camps (Toxey McMillan Design Associates LLC, 2012). Exhibit D2.3-1 shows the locations of historic mines in relation to the permit area (National Geological Map Database, 2014).

TFN 6 2/025
RECD NOV 14,2014

Around the same time as Monarch's closing, Peter Kiewit and Sons introduced open pit mining (also called strip mining and surface mining) to the Sheridan area. This first mine was called the Big Horn Coal Mine and continued operation on a modest scale until the 1970s. After the oil embargo instilled by the Organization of the Petroleum Exporting Countries (OPEC) in 1973, oil prices tripled making coal a more affordable energy option than oil. This sparked another coal boom continuing today in the Powder River Basin that resulted in the opening of more open pit mines around Sheridan and Gillette (Toxey McMillan Design Associates LLC, 2012).

TFN 6 2/025
RECD NOV 14, 2014

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TFN 6 2/025
RECD NOV 14, 2014

DEQ 4-057

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TFN 6 2/025
RECD NOV 14, 2014

DEQ 4-058

APPENDIX D2 TABLES

Table D2.1-1. List of Sites in Sheridan County (NRHP)

Reference Number	Resource Name	Address	State	County	City	Primary Certdate	Multiple Property Name
85000432	CKW Bridge over Powder River	US 14/16	WYOMING	Sheridan	Arvada	2/22/1985	Vehicular Truss and Arch Bridges in Wyoming TR
85000433	EAU Arvada Bridge	Cty. Rd. CN3-38	WYOMING	Sheridan	Arvada	2/22/1985	Vehicular Truss and Arch Bridges in Wyoming TR
84003701	Johnson Street Historic District	Johnson, 1st, and 2nd Sts.	WYOMING	Sheridan	Big Horn	4/9/1984	
80004052	Odd Fellows Hall	Jackson St.	WYOMING	Sheridan	Big Horn	12/9/1980	
76001961	Quarter Circle A Ranch	2 mi. SW of Big Horn	WYOMING	Sheridan	Big Horn	8/10/1976	
84003698	Clearmont Jail	Water St.	WYOMING	Sheridan	Clearmont	5/14/1984	
05001338	Dayton Community Hall	410 Bridge St.	WYOMING	Sheridan	Dayton	11/25/2005	
84003703	Wissler, Susan, House	406 Main St.	WYOMING	Sheridan	Dayton	3/8/1984	
85000434	EBF Bridge over Powder River	Cty. Rd. CN3-269	WYOMING	Sheridan	Leiter	2/22/1985	Vehicular Truss and Arch Bridges in Wyoming TR
85000436	ECR Kooi Bridge	Cty. Rd. CN3-93	WYOMING	Sheridan	Monarch	2/22/1985	Vehicular Truss and Arch Bridges in Wyoming TR
71000891	Connor Battlefield	City park on the Tongue River	WYOMING	Sheridan	Ranchester	8/12/1971	
74002031	Big Goose Creek Buffalo Jump	Address Restricted	WYOMING	Sheridan	Sheridan	2/12/1974	
85000435	ECS Bridge over Big Goose Creek	Cty. Rd. CN3-93	WYOMING	Sheridan	Sheridan	2/22/1985	Vehicular Truss and Arch Bridges in Wyoming TR
81000612	Fort MacKenzie	N of Sheridan on WY 337	WYOMING	Sheridan	Sheridan	6/18/1981	
13000212	Holy Name Catholic School	121 South Connor St.	WYOMING	Sheridan	Sheridan	4/23/2013	Educational Facilities in Wyoming, 1850-1960 MPS
97001534	Mount View	610 S. Jefferson St.	WYOMING	Sheridan	Sheridan	12/8/1997	
82001836	Sheridan County Courthouse	Burkett and Main St.	WYOMING	Sheridan	Sheridan	11/15/1982	
11000533	Sheridan County Fairgrounds Historic District	1753 Victoria St.	WYOMING	Sheridan	Sheridan	8/10/2011	
97001533	Sheridan Flouring Mills, Inc.	2161 Coffeen Ave.	WYOMING	Sheridan	Sheridan	12/8/1997	
66000762	Sheridan Inn	Broadway and 5th St.	WYOMING	Sheridan	Sheridan	10/15/1966	
82001837	Sheridan Main Street Historic District	Main St. from Burkitt to Mandel Sts.	WYOMING	Sheridan	Sheridan	11/9/1982	
04001234	Sheridan Railroad Historic District	201-841 Broadway, 508-955 N. Gould	WYOMING	Sheridan	Sheridan	11/12/2004	
13000266	St. Peter's Episcopal Church	1 South Tschirgi	WYOMING	Sheridan	Sheridan	5/8/2013	
70000675	Trail End	400 Clarendon Ave.	WYOMING	Sheridan	Sheridan	2/26/1970	
84000437	Big Red Ranch Complex	Off U.S. 14/16	WYOMING	Sheridan	Ucross	10/11/1984	

TFN 6 2/025
RECD NOV 14, 2014

APPENDIX D2 FIGURES

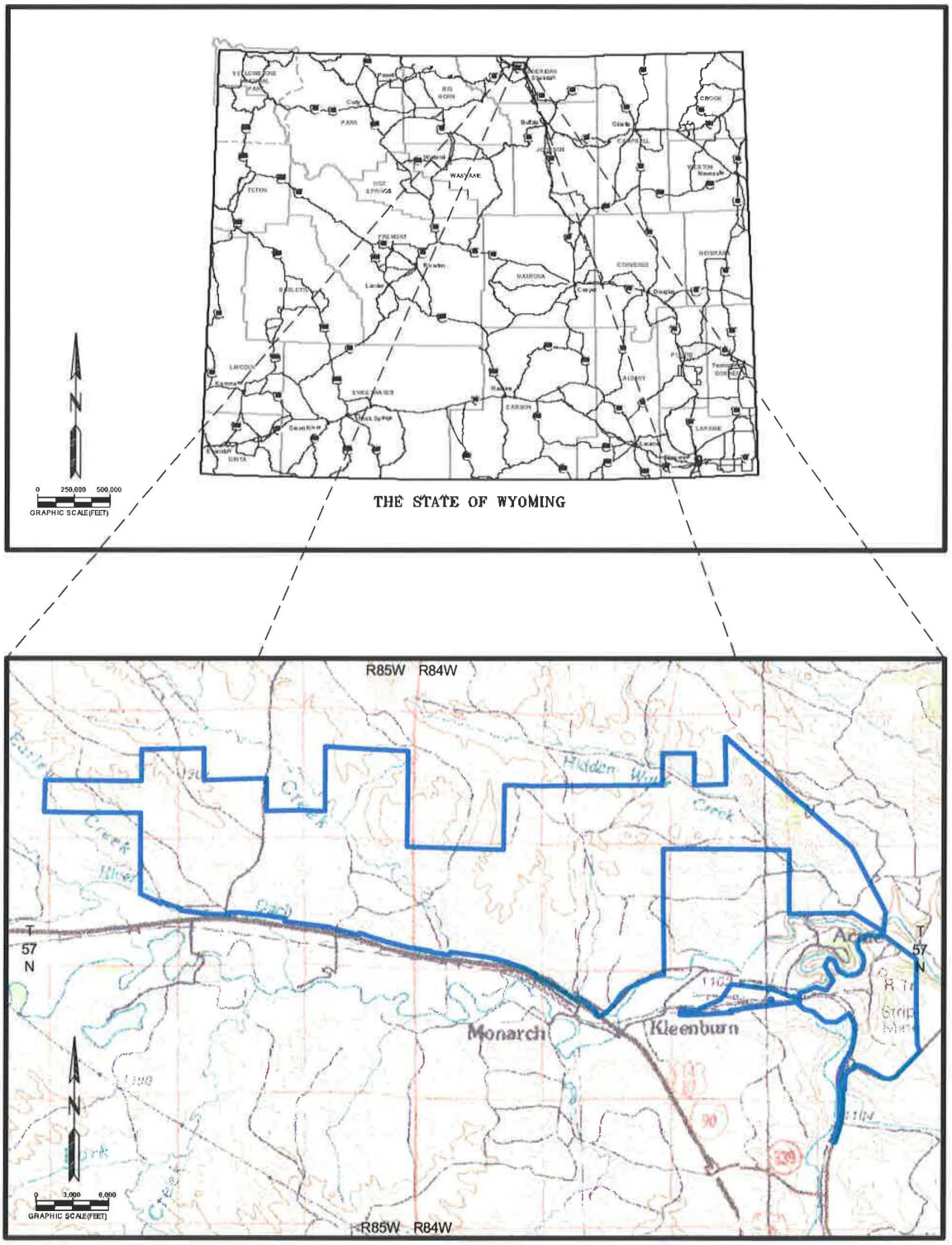
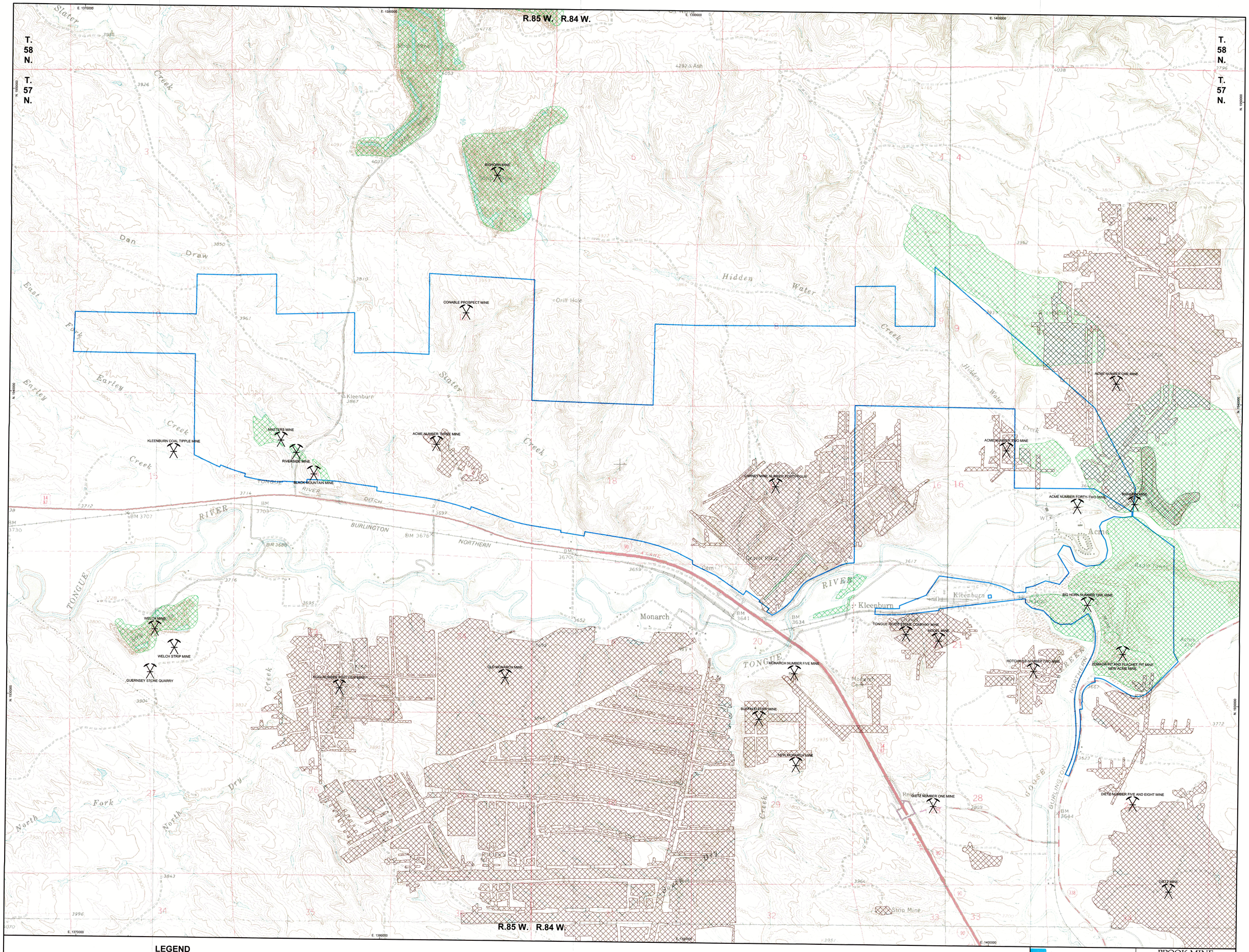


Figure D2.2-1. General Location Map

TFN 6 2/025
RECD NOV 14, 2014

DEQ 4-062

APPENDIX D2 EXHIBITS



LEGEND

- BROOK MINE PERMIT BOUNDARY
- DIETZ MINE — HISTORIC MINE LOCATION
- MINED OUT UNDERGROUND
- MINED OUT SURFACE

REF: -NATIONAL GEOLOGICAL MAP DATABASE
-WYOMING DEPARTMENT OF ENVIRONMENTAL QUALITY ABANDONED MINE LANDS DIVISION

N

0 500 1,000 1,500 2,000
GRAPHIC SCALE (FEET)

RAMACO

BROOK MINE
SHERIDAN COUNTY, WY

1101 SUGARVIEW DR. STE. 201
SHERIDAN, WY 82801

REVISIONS

Date	Description

EXHIBIT D2.3-1

TFN 6 2/025
RECD NOV 14, 2014

HISTORIC MINE LOCATIONS

Drawn By: CIG
Checked By: JGB
Date: 10/07/14

WWC ENGINEERING
www.wwcengineering.com

FILE: D2-1_HIS_MINES.dwg

K:\Sheridan\RAMACO\13\BROOK_WY\BROOK\D2_SERIES\D2-1_HIS_MINES.dwg 10/13/2014 4:28:25 PM dave johnson

APPENDIX D3 TOC

TABLE OF CONTENTS

D3 CULTURAL AND PALEONTOLOGICAL RESOURCES D3-1
D3.1 Cultural and Paleontological Resources D3-1

LIST OF FIGURES

Figure D3.1-1. General Project Location D3-F1

LIST OF ADDENDA

Addendum D3-1 Wyoming DEQ Cultural Resources Policy and Notice of Adoption of Noncoal Rules Memorandum

TFN 6 2/025
RECD NOV 14,2014

DEQ 4-066

APPENDIX D3 TEXT

ARCHEOLOGICAL AND PALEONTOLOGICAL RESOURCES

Appendix D3

Prepared by:
WWC Engineering

October 2014

TFN 6 2/025
RECD NOV 14, 2014

D3 CULTURAL AND PALEONTOLOGICAL RESOURCES

Cultural and paleontological sections for RAMACO's Brook Mine were prepared by WWC Engineering (WWC) of Sheridan, Wyoming.

D3.1 Cultural and Paleontological Resources

In accordance with current Wyoming DEQ/LQD policies and rules, cultural and paleontological resources surveys for RAMACO's Brook Mine were not conducted. Refer to Addendum D3-1 Cultural Resources Memorandum for Cultural Resources Policy dated October 2, 2012 signed by the Administrator of LQD. See Figure D3.1-1 for a general location map of the mine area.

TFN 6 2/025
RECD NOV 14, 2014

DEQ 4-069

APPENDIX D3 FIGURES

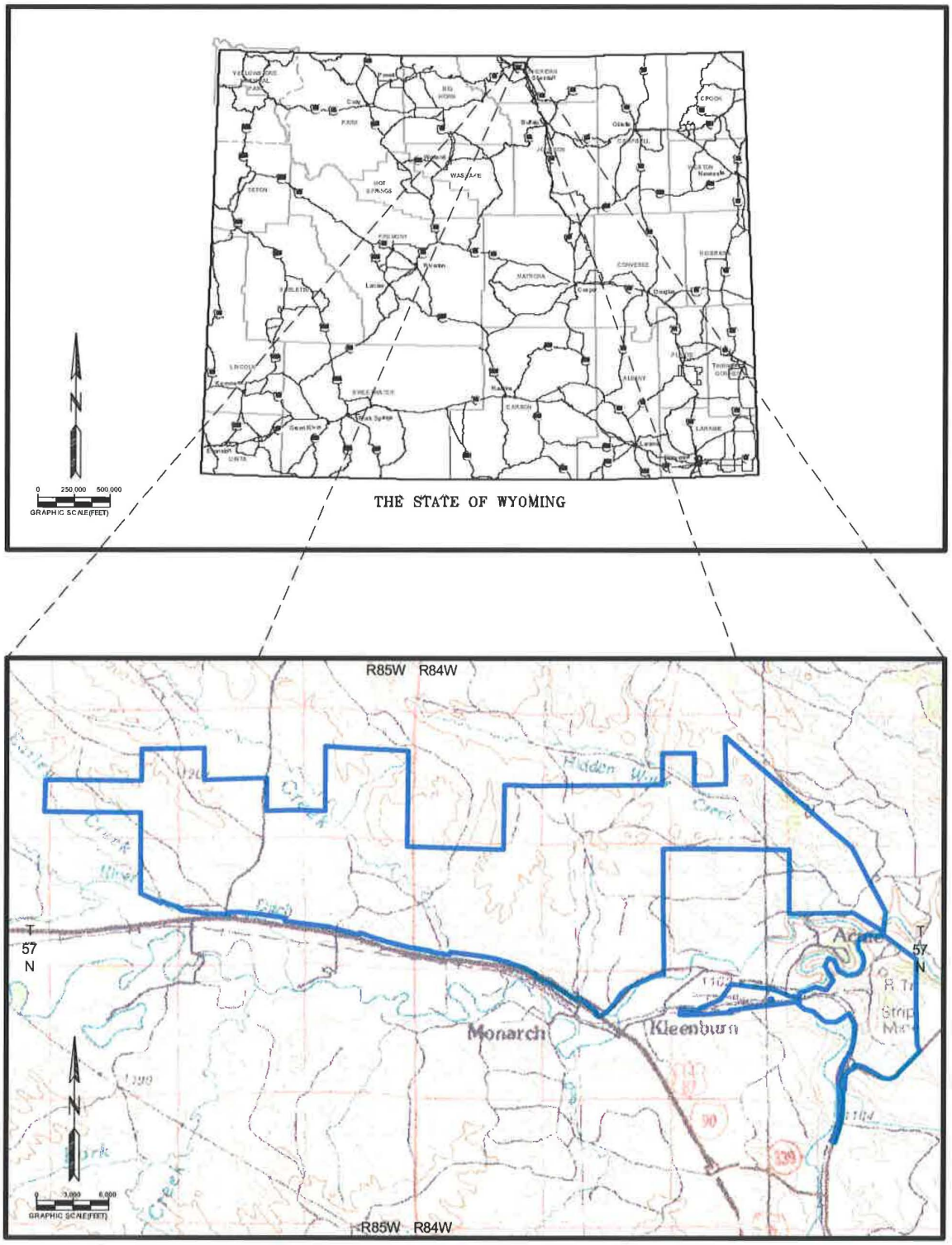


Figure D3.1-1. General Location Map

TFN 6 2/025
RECD NOV 14, 2014

DEQ 4-071

ADDENDUM D3-1

ADDENDUM D3-1

Wyoming DEQ Cultural Resources Policy and Notice of Adoption of Noncoal Rules Memorandum

TFN 6 2/025
RECD NOV 14,2014

DEQ 4-073

Department of Environmental Quality

To protect, conserve and enhance the quality of Wyoming's environment for the benefit of current and future generations.

Matthew H. Mead, Governor

John Corra, Director

October 2, 2012

Dear Interested Person,

RE: Cultural Resources Policy and Notice of Final Adoption of Noncoal Rules Department of Environmental Quality, Land Quality Division

Cultural Resources Policy for All Mining Operations

As a result of recent discussions with the State Historic Preservation Office, the Department of Environmental Quality, Land Quality Division (LQD) will no longer require cultural or paleontological surveys to be conducted or included in mine permit applications for lands where *the surface and mineral ownership are held privately.* The LQD is currently revising, *Guideline 11 – Reporting Cultural and Paleontological Resources within Mine Permit Areas*, to clarify these procedures. A revised guideline will be made available on the LQD's website as soon as it is published.

Revised Noncoal Rules

The LQD has adopted amended rules for noncoal mining. These rules were approved by the Environmental Quality Council on July 13, 2012 and were filed with the Wyoming Secretary of State (SOS) on September 26, 2012. The LQD has amended Chapters 8, 9 and 10 of the LQD Noncoal Rules and Regulations. The revised rules in:

Chapter 8

- Clarify plugging and sealing requirements for drill holes and provide detailed guidance on acceptable "sealant materials".
- Clarify and revise exploration by drilling procedures and codify provisions for baseline groundwater monitoring and test wells.
- Revise bonding requirements to cover the estimated cost of drill hole abandonment and surface reclamation and to allow for partial release following drill hole plugging.

Chapter 9

- Reorganize and clarify application requirements for small mining operations.
- Clarify methods to be used to evaluate reclamation success.
- Add additional detail regarding requirements for conversion of a small mine permit to a regular mine permit.

TFN 6 2/025
RECD NOV 14, 2014

Herschler Building · 122 West 25th Street · Cheyenne, WY 82002 · http://deq.state.wy.us

ADMIN/OUTREACH	ABANDONED MINES	AIR QUALITY	INDUSTRIAL SITING	LAND QUALITY	SOLID & HAZ. WASTE	WATER QUALITY
(307) 777-7758	(307) 777 6145	(307) 777-7391	(307) 777-7369	(307) 777-7756	(307) 777-7752	(307) 777-7781
FAX 777 7682	FAX 777 6462	FAX 777-5616	FAX 777 6937	FAX 777-5864	FAX 777-5973	FAX 777 5973

Chapter 10

- Clarify the proximity limitations for Limited Mining Operations (LMO)
- Clarify who may operate an LMO
- Clarify that an operator may establish a second LMO within 6-mile radius if reclamation is complete.

Previous versions of Chapters 8, 9 and 10 have been superseded. **Please remove the old Chapters in your copy of the LQD Noncoal Rules and Regulations and replace them with the new Chapters 8, 9 and 10.** Copies of the revised rules are posted on the LQD's webpage at: http://deq.state.wy.us/lqd/recentapprovedrules.asp or may be obtained through the Wyoming SOS webpage at http://soswy.state.wy.us/Rules/default.aspx. For more information on specific rule changes please consult the Final Statement of Principal Reasons for Adoption at: http://deq.state.wy.us/lqd/recentapprovedrules.asp. Attached is a Certification Page for the rulemaking that should be inserted behind the front cover of your copy of the rules and it includes details on the rulemaking process.

For further information regarding the rule changes or cultural resource questions, please contact Craig Hults at (307) 777-7066 or email craig.hults@wyo.gov.

Sincerely,

Nancy Nuttbrock
Administrator
Land Quality Division

Enclosures: Certification Page for revised Chapters 8, 9 and 10
Xc: Noncoal Rule Binder, Rules Chron

TFN 6 2/025
RECD NOV 14, 2014

APPENDIX D4 TOC

TABLE OF CONTENTS

D4 CLIMATOLOGY D4-1
D4.1 Climatology D4-1
D4.2 Regional Climatology Overview D4-2
D4.2.1 Temperature D4-2
D4.2.2 Wind Patterns D4-4
D4.2.3 Precipitation D4-4
D4.2.4 Evaporation D4-6
D4.2.5 Relative Humidity D4-6
D4.2.6 Cooling, Heating, and Growing Degree Days D4-7
D4.3 Brook Mine Climatology Overview D4-8
D4.4 References D4-10

LIST OF TABLES

Table D4.1-1. Meteorological Stations Included in Climate Analysis D4-T1

Table D4.2-1. Annual and Monthly Temperature Statistics for the Region D4-T2

Table D4.2-2. Average Monthly Wind Speeds for the Sheridan Area D4-T3

Table D4.2-3. Recorded Peak Wind Gusts D4-T4

Table D4.2-4. Sheridan Field Station Average Monthly Pan Evaporation (1920 to 2000) D4-T5

Table D4.2-5. Gross Lake Evaporation Estimates Using the Kohler-Nordenson-Fox Equation with a Coefficient of 0.70 ..... D4-T6

Table D4.2-6. Average Values of Relative Humidity (%) for Sheridan, Wyoming (1961-1990) D4-T7

Table D4.2-7. Average Values of Relative Humidity (2007-2013) D4-T8

LIST OF FIGURES

Figure D4.1-1. Meteorological Station Locations D4-F1

Figure D4.2-1. Regional Average Monthly Temperatures D4-F2

TFN 6 2/025
RECD JUL 30, 2015

DEQ 4-077

TABLE OF CONTENTS (Continued)

Figure D4.2-2. Regional Minimum and Maximum Recorded Temperatures D4-F3

Figure D4.2-3. Sheridan County Airport 10-Year Average Diurnal Temperatures (2003-2012) D4-F4

Figure D4.2-4. Regional Average Annual Minimum Temperatures D4-F5

Figure D4.2-5. Regional Average Annual Maximum Temperatures D4-F6

Figure D4.2-6. Average Wind Rose for Sheridan Area (1961-1990) D4-F7

Figure D4.2-7. Average Monthly Precipitation D4-F8

Figure D4.2-8. Regional Average Annual Precipitation D4-F9

Figure D4.2-9. Average Monthly Snowfall D4-F10

Figure D4.2-10. Daily Variations in Relative Humidity during the Year D4-F11

Figure D4.2-11. Average Monthly Cooling, Heating, and Growing Degree Days D4-F12

TFN 6 2/025
RECD JUL 30,2015

DEQ 4-078

APPENDIX D4 TEXT

CLIMATOLOGY

Appendix D4

Prepared by:
WWC Engineering

July 2015

TFN 6 2/025
RECD JUL 30, 2015

D4 CLIMATOLOGY

Baseline meteorological and climatological studies for RAMACO's Brook Mine were conducted by WWC Engineering (WWC) of Sheridan, Wyoming.

D4.1 Climatology

The Brook Mine is located in a semi-arid, or steppe, climate. The region is characterized seasonally by cold harsh winters, hot dry summers, and relatively warm moist springs and autumns. Temperature extremes range from roughly -25°F in the winter to 100°F in the summer. The "last freeze" occurs during late spring and the "first freeze" occurs in early fall. The average growing season in Wyoming (freeze-free period) is approximately 125 days.

Yearly precipitation totals are typically between 12 and 18 inches. The region is prone to severe thunderstorm events throughout the spring and early summer months, and much of the precipitation is attributed to these events. In a typical year, the area will see 34 thunderstorm days. Autumn stratiform rain events also contribute to precipitation totals, but to a lesser degree. Snow frequents the region throughout winter months (35 to 60 inches per year), but generally provides less moisture than rain events.

Windy conditions are common to Wyoming in general. However, the Sheridan area tends to be one of the less windy locations in the state. Annual wind speeds average around 8 mph. The predominant wind direction is the northwest. Higher average wind speeds are encountered during the winter months while summer months experience lower average wind speeds.

For the regional analysis, meteorological data were compiled for five sites surrounding the Brook Mine. Data were acquired through the Western Regional Climate Center (WRCC), the National Climatic Data Center administered by the National Oceanic and Atmospheric Administration (NOAA), Inter-Mountain Labs (IML Air Science, 2015) and the Wyoming Climate Atlas (Curtis & Grimes, 2004). Table D4.1-1 provides the station identification, coordinates, and period

TFN 6 2/025
RECD JUL 30,2015

DEQ 4-081

of operation for the sites used to develop this Appendix. Figure D4.1-1 provides the locations for meteorological stations.

These sites have been analyzed collectively to provide a regional climatic temperature and precipitation analysis that includes the proposed project area. The meteorological sites used for the regional analysis are all within a 15-mile radius of the project area.

- SHERIDAN CO AIRPORT, WY US, roughly 10 miles south-southeast of the project site
- SHERIDAN FIELD STATION, WY US, roughly 10 miles east-southeast of the project site
- DECKER, MT US, roughly 10 miles northeast of the project site
- DAYTON, WY US, roughly 12 miles west-southwest of the project site
- IML Demo Weather Station, roughly 10 miles south-southeast of the project site

The regional overview includes a discussion of the maximum and minimum temperature, a brief discussion of wind patterns, annual precipitation including snowfall estimates, severe weather related to precipitation, evaporation, relative humidity, and cooling, heating, and growing degree days. A combination of stations and sources is analyzed for each of the topics, depending upon the information available from each.

D4.2 Regional Climatology Overview

D4.2.1 Temperature

The annual average temperature for the area is approximately 43°F to 45°F. Table D4.2-1 lists monthly and annual temperature statistics for the four meteorological stations.

July has the highest average monthly temperature of approximately 70°F, followed by August at approximately 68°F. January tends to be the coldest month with average temperatures at 20°F, and December follows with average temperatures at 21°F. Table D4.2-1 also shows minimum and

TFN 6 2/025
RECD JUL 30, 2015

maximum monthly temperatures for each of the four sites. The table shows that the low temperature during the respective recording periods reaches around -48°F at Decker, and high temperatures reaches 109°F at the Sheridan Field Station. Figure D4.2-1 displays the average temperature over the course of a year for each of the four stations. Figure D4.2-2 shows the annual minimum and maximum temperature trends at the four stations. As illustrated, temperatures from the four sites exhibit remarkable agreement.

Large diurnal temperature variations are found in the region due in large part to its high altitude and low humidity. Figure D4.2-3 depicts the monthly average diurnal temperature variation for Sheridan County Airport from 2003 to 2012. Diurnal temperature variations average between 12°F and 29°F over the course of the year. Daily variations of nearly 30°F are common in July, August, and September. Less daily variation is observed during the cooler portions of the year such as December, January, and February with average variations of 12 to 14°F. The maximum temperature of the day tends to occur around 1500 hours local time (3 p.m.), and the minimum temperature of the day tends to occur between 0500 and 0800 hours local time (5 a.m. to 8 a.m.) (NOAA, 2013).

Lesser variation in daily temperature can be attributed to the more stable atmospheric conditions in the region during the fall and winter months. Stable periods have much lower mixing heights and accompanying lapse rates allowing for less temperature variation. At this latitude, the winter sun provides much less daytime heating due to its lower angle and shorter daylight.

Daily minimum temperatures in the project region average approximately 31°F at the Sheridan County Airport and 26°F at the Sheridan Field Station and daily maximum temperatures in the project region average approximately 59°F at the Sheridan County Airport and 52°F at the Sheridan Field Station. Isotherms of interpolated annual average minimum and maximum temperatures are shown in Figure D4.2-4 and Figure D4.2-5, respectively.

TFN 6 2/025
RECD JUL 30, 2015

DEQ 4-083

D4.2.2 Wind Patterns

Year-round wind speed in the Sheridan area average around 7.8 mph (WRCC, 1997). Based on hourly wind speed data from 1961 to 2013, the greatest wind speed tend to occur during the late winter to early spring, or from mid-February to early May. The highest wind speed will generally occur between 1000 and 1800 hours local time (10 a.m. and 6 p.m.). The lowest wind speed tends to occur from early May to mid-November, which will occur between 0100 to 0900 hours local time (1 a.m. to 9 a.m.) and 2000 to 0100 hours local time (8 p.m. to 1 a.m.) (Curtis & Grimes, 2004). The prevailing wind direction for Sheridan is the northwest. Recorded maximum gusts have reached 78 mph (WRCC, 1997; NOAA, 2015). Table D4.2-2 summarizes the average monthly wind speed and prevailing wind direction. Table D4.2-3 lists recorded peak gust speeds for each month, and the year and direction from which the gusts occurred. Figure D4.2-6 displays an average wind rose for the Sheridan area from windspeed data collected from 1961 to 1990 (Curtis & Grimes, 2004).

D4.2.3 Precipitation

The region is characterized by moderately dry conditions. The Sheridan area receives measurable precipitation (>0.01 inch) approximately 107 days out of the year (WRCC, 1997). Average annual precipitation in the region for the four aforementioned meteorological stations ranges from 12 to 18 inches per year with both the Sheridan County Airport and the Sheridan Field Station averaging around 14 inches per year. Spring showers and thunderstorms produce over half of the precipitation. Figure D4.2-7 shows that May and June tend to be the months with the highest monthly precipitation. Total precipitation during these months typically ranges between 2.5 and 3 inches. December and January are normally the driest months of the year. Precipitation during these months averages around 0.5 inch. The winter months (December through February) typically account for 10% to 15% of the annual precipitation totals. Figure D4.2-8 illustrates regional average precipitation in relation to geographic location.

TFN 6 2/025
RECD JUL 30, 2015

DEQ 4-084

Severe weather occurs throughout the region, but is somewhat limited. In general, Wyoming's life and property losses due to severe weather are among the lowest in the United States of America. The Sheridan area averages 34 thunderstorm days per year with July typically having the greatest number of thunderstorm days (Curtis & Grimes, 2004). Property damage in Wyoming is usually caused by hail or damaging wind events. On average, the Sheridan region has 1 or 2 hail events per year. Tornadoes can occur, but are rare. Wyoming averages six tornado days per year. Based on wind speed probability, any location within the eastern third of the state can expect a tornado every 10,000 to 100,000 years, and any location within the middle third of the state can expect a tornado every 100,000 to 1,000,000 years. Only one killer and significant F2 tornado has been recorded in Sheridan County. It occurred on May 31, 1923 in the southeast corner of the county, killing 1 person and injuring 2 (Curtis & Grimes, 2004).

Average annual snowfall in the region varies between 35 and 60 inches per year depending upon the gage site's vicinity to the Bighorn Mountains. Closer proximity to the Bighorn Range generally results in a greater annual snowfall. This is due to orographic lifting of the flowing air. Three record snow events have occurred at Burgess Junction in the Bighorn Mountains west of the project area. These were the greatest recorded 3-day snowfall, 4-day snowfall, and 5-day snowfall. The snow fell continuously for the specified periods of time (3, 4, and 5 days), and resulted in total snowfall depths of 52, 54, and 58 inches, respectively. Major snowstorms (more than five inches per day) are relatively infrequent and only occur 0 to 3 times per year in the lower elevations around the Brook Mine. The Wyoming Climate Atlas (Curtis & Grimes, 2004) indicates that annual snowfall in the project vicinity will vary between 36 and 77 inches per year. This is comparable to the data from the Sheridan County Airport, the Sheridan Field Station, and Dayton. Figure D4.2-9 shows the average monthly snowfall for the region based on the three aforementioned sites. The Decker station lacked substantial snowfall data.

TFN 6 2/025
RECD JUL 30, 2015

D4.2.4 Evaporation

Low relative humidity, a high percentage of sunshine, and high average wind speeds are all contributing factors to Wyoming's high evaporation rate. Evaporation is difficult to measure from natural conditions. Therefore, evaporation is generally measured using a Class A evaporation pan. The change in water level in the pan is measured to estimate evaporation, taking precipitation into account. Since most Class A pans are installed above ground, radiation affects the side-walls and heat exchange from the pan tends to increase the evaporation rate. The total pan evaporation is generally adjusted by multiplying it by an adjustment of 0.7 to 0.8 to approximate evaporation from natural surfaces such as shallow lakes, wet soil, or other moist natural surfaces. Pan evaporation is oftentimes not measured during winter months. Table D4.2-4 lists the average monthly pan evaporation for the Sheridan Field Station from 1920 to 2000.

Pan evaporation is not typically measured; therefore, equations have been developed to estimate evaporation. The Kohler-Nordenson-Fox equation is likely the most widely used method to pan estimate evaporation. Table D4.2-5 summarizes the monthly estimates of gross lake evaporation using the Kohler-Nordenson-Fox equation with a coefficient of 0.7. Should a coefficient of other than 0.7 be desired to estimate lake evaporation, the evaporation estimates can be divided by 0.7 to achieve pan evaporation, and then multiplied by the desired coefficient (Curtis & Grimes, 2004). Though evaporation for the Sheridan area tends to be low for Wyoming, evaporation still exceeds precipitation.

D4.2.5 Relative Humidity

Relative humidity (RH) is a temperature-based calculation that reflects the fraction of moisture present in the air relative to the amount of possible moisture in saturated air at the same temperature. Wyoming's relative humidity, in general, is rather low. The Sheridan area tends to be one of the more humid locations in Wyoming. The data for the Sheridan area represented

TFN 6 2/025
RECD JUL 30, 2015

DEQ 4-086

in this analysis reflects the periods from 1961 to 1990 and 2007 to 2013. Both periods of data reflect the same general trends. August tends to be the driest month with the RH averaging 48% to 49%. December and January tend to be the most humid months with the relative humidity averaging 67% to 75%. July is generally the month with the greatest diurnal variation in relative humidity with a range of 40% between the maximum and the minimum relative humidity values. January tends to be the month with the least variation in relative humidity with a range of 8% between the maximum and the minimum diurnal values. The most humid time of day tends to be in the morning around 0400 local time (4:00 a.m.) with an annual average of 73% at that time of day. The driest time of day is in the afternoon around 1700 local time (5:00 p.m.) with an annual average of 48% at that time of day (WRCC, 1997). The overall annual average for all months and times of day is 60% to 64%. Table D4.2-6 summarizes averages during the period of 1961 to 1990 for several times of day during every month of the year (WRCC, 1997). The table also summarizes average maximum and average minimum values of relative humidity, and the range, for each month. Table D4.2-7 summarizes the average monthly relative humidity for the period of 2007 to 2013 (IML Air Science, 2015). Figure D4.2-10 provides a visual representation of the variation in relative humidity at different times of day over the course of the year.

D4.2.6 Cooling, Heating, and Growing Degree Days

Cooling, heating, and growing degree days are a quantitative measure of the number of degrees above or below a specified base temperature. Typically, cooling and heating degree days are a measure of the number of degrees a home would need to be cooled or heated over the course of a month. Growing degree days are a measure of the degrees that are optimum for plant growth over the course of a month. Figure D4.2-11 summarizes the monthly cooling, heating, and growing degree days for the Sheridan area based on the averages of three long-term datasets. As shown on the figure, the three sites are very similar, therefore, the data are assumed to be indicative of the proposed project area due to its close proximity and comparable elevation.

TFN 6 2/025
RECD JUL 30, 2015

The heating and cooling degree days are included to show deviation of the average daily temperature from a predefined base temperature. In this case, 65°F has been selected as the base temperature because it is the most familiar base temperature for these calculations. The WRCC, NOAA, and the *Wyoming Climate Atlas* (Curtis & Grimes, 2004) all used 65°F as the base temperature for degree day calculations. The number of heating degree days is computed by taking the average of the high and low temperature occurring that day and subtracting it from the base temperature. The number of cooling degree days is computed by subtracting the base temperature from the average of the high and low temperature occurring that day. The number of growing degree days is calculated the same as cooling degree days, but the high and low temperatures are limited to 86°F maximum and 50°F minimum. Temperatures above or below these values are set to 86°F or 50°F, respectively(i.e., 92°F would be reset to 86°F and 49°F would be reset to 50°F for growing degree calculations). . This is due to temperatures above 86°F are not always beneficial to plant growth (and can be stressful to the plant) while temperatures below 50°F reduce the heat energy available to the plant (Curtis & Grimes, 2004). Negative values are disregarded for all three calculations.

As expected, the graphs of heating degree days and cooling degree days are inversely related. Growing degree days and cooling degree days are similar, but not identical. The maximum number of heating degree days occurs in January and December at approximately 1,400 degree days. July has the greatest number of cooling degree days at approximately 180 degree days (WRCC, 1997). July also has the greatest number of growing degree days at approximately 550 degree days.

D4.3 Brook Mine Climatology Overview

Due to the close proximity of the project area to the four regional meteorological station locations discussed above and that the climatology within the project area is similar to these stations, baseline climatology data at the project site was not collected. A meteorological station within the proposed

TFN 6 2/025
RECD JUL 30, 2015

permit area will be established at the beginning of operations to assist with air quality monitoring.

TFN 6 2/025
RECD JUL 30, 2015

D4.4 References

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IML Air Science. (2015, June). *Sheridan Weather: Historical Data.* Retrieved June 2015, from Inter-Mountain Labs (IML): Your Environmental Monitoring Partner: http://www.imlairscience.com/DemoEDD/History.aspx?id=1

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National Oceanic and Atmospheric Administration (NOAA). (2015, June). *NNDC Climate Data Online: Surface Data Hourly Global.* Retrieved June 2015, from NOAA Satellite and Information Service: http://www7.ncdc.noaa.gov/CDO/cdoselect.cmd

Western Regional Climate Center (WRCC). (1997). *Sheridan, Wyoming: Normals, Means, and Extremes.* Retrieved July 2013, from Local Climate Data Summaries: http://www.wrcc.dri.edu/summary/lcd.html

TFN 6 2/025
RECD JUL 30,2015

APPENDIX D4 TABLES

Table D4.1-1. Meteorological Stations Included in Climate Analysis

Station Name	Station Identification (GHCND)	Latitude	Longitude	Elevation (ft amsl)	Years Operation
SHERIDAN CO AIRPORT, WY US	USW00024029	44.769	-106.969	3944	1948-2013
SHERIDAN FIELD STATION, WY US	USC00488160	44.840	-106.838	3750	1920-2013
DECKER, MT US	USC00242266	45.012	-106.864	3520	1904-1911, 1950-2004
DAYTON, WY US	USC00482399	44.873	-107.266	3947	1951-1958, 1991-2013
IML Demo Weather Station	N/A	44.781	-106.965	3894	2007-2013

Source: NOAA, 2013; IML Air Science, 2015

TFN 6 2/025
RECD JUL 30, 2015

DEQ 4-092

Table D4.2-1. Annual and Monthly Temperature Statistics for the Region

	Average Temperature (°F)				Minimum Recorded Temperature (°F)				Maximum Recorded Temperature (°F)			
Month	**Sheridan County Airport**	**Sheridan Field Station**	**Decker**	**Dayton**	**Sheridan County Airport**	**Sheridan Field Station**	**Decker**	**Dayton**	**Sheridan County Airport**	**Sheridan Field Station**	**Decker**	**Dayton**
Jan	21.7	19.4	15.0	23.7	-35.0	-40.0	-34.1	-26.0	70.0	70.0	55.9	66.0
Feb	26.3	23.3	20.4	24.5	-32.1	-38.0	-47.9	-22.0	75.9	80.1	64.0	63.0
Mar	33.8	32.0	32.9	36.4	-23.1	-24.0	-26.0	-15.0	80.1	80.1	73.0	77.0
Apr	43.6	43.0	42.2	41.8	-2.0	-14.1	6.1	3.9	86.0	88.0	84.9	84.9
May	52.9	52.8	50.7	50.1	12.9	7.0	24.1	17.1	95.0	102.9	90.0	93.9
Jun	61.9	61.4	60.8	60.0	27.0	28.0	33.1	28.0	105.1	106.0	93.0	100.0
Jul	70.3	69.8	70.6	69.8	35.1	28.0	30.9	39.0	107.1	109.0	100.9	100.9
Aug	69.0	68.2	66.1	67.5	32.0	28.9	32.0	37.9	106.0	105.1	100.9	100.9
Sep	58.2	57.1	58.0	57.9	6.1	3.9	27.0	27.0	102.9	104.0	95.0	96.1
Oct	46.6	45.6	47.0	45.1	-9.0	-18.0	5.0	1.9	93.0	95.0	86.0	90.0
Nov	33.0	31.9	31.1	33.6	-25.1	-26.0	-18.0	-17.0	81.0	84.9	70.0	77.0
Dec	24.0	22.6	17.9	19.8	-36.9	-44.0	-29.9	-23.1	72.0	78.1	63.0	63.0
Annual	45.1	43.9	42.7	44.2	-36.9	-44.0	-47.9	-26.0	107.1	109.0	100.9	100.9

TFN 6 2/025
RECD NOV 14, 2014

Table D4.2-2. Average Monthly Wind Speeds for the Sheridan Area

	January	February	March	April	May	June	July	August	September	October	November	December	Annual
Average Wind Speed (mph)	7.5	7.8	8.9	9.7	8.9	7.8	7.0	7.0	7.1	7.3	7.4	7.5	7.8
Prevailing Direction	NW	NW	NW	NW	NW	NW	NW	NW	NW	NW	NW	NW	NW

Source: WRCC, 1997; NOAA, 2015

TFN 6 2/025
RECD JUL 30, 2015

Table D4.2-3. Recorded Peak Wind Gusts

	January	February	March	April	May	June	July	August	September	October	November	December
Recorded Peak Gust (mph)	71	78	68	69	69	63	66	66	57	64	73	69
Direction	NW	NW	SW	NW	NW	S	NW	W	NW	W	SW	SW
Year	1988	2007	1988	1987	2001	2011	2008	2013	1992	1985	1994	1987

Source: WRCC, 1997; NOAA, 2015

TFN 6 2/025
RECD JUL 30, 2015

Table D4.2-4. Sheridan Field Station Average Monthly Pan Evaporation (1920 to 2000)

Month	January	February	March	April	May	June	July	August	September	October	November	December	Annual
Pan Evaporation (inches)	--	--	--	3.55	6.19	7.8	10.16	9.65	6.45	--	--	--	43.80

Source: Curtis & Grimes, 2004

TFN 6 2/025
RECD NOV 14, 2014

DEQ 4-096

Table D4.2-5. Gross Lake Evaporation Estimates Using the Kohler-Nordenson-Fox Equation with a Coefficient of 0.7

Month	January	February	March	April	May	June	July	August	September	October	November	December	Annual
Mean (in)	0.7	0.9	1.8	3.3	4.7	5.6	7.2	6.3	4.0	2.6	1.2	0.8	39.1
Standard Deviation (in)	0.2	0.3	0.4	0.7	0.7	0.9	0.7	0.7	0.6	0.6	0.4	0.3	2.6
High (in)	1.5	1.9	2.5	4.6	6.7	7.7	8.5	7.9	5.0	3.6	2.2	2.0	44.2
Low (in)	0.3	0.4	1.3	2.0	3.6	3.6	5.7	4.9	2.4	1.7	0.5	0.4	36.5

Source: Curtis and Grimes, 2004

TFN 6 2/025
RECD NOV 14, 2014

Table D4.2-6. Average Values of Relative Humidity (%) for Sheridan, Wyoming (1961-1990)

	Hour									
	0400	**0500**	**0100**	**1600**	**1700**	**2200**	**Monthly Avg.**	**Maximum**	**Minimum**	**Range**
January	70	69	62	64	64	70	67	70	62	8
February	71	72	60	59	60	71	66	72	59	13
March	74	73	53	50	50	70	62	74	50	24
April	74	73	49	44	43	67	58	74	43	31
May	77	76	48	46	46	70	61	77	46	31
June	78	77	46	45	44	71	60	78	44	34
July	73	72	38	35	33	62	52	73	33	40
August	68	68	35	31	30	57	48	68	30	38
September	71	71	41	37	38	63	54	71	37	34
October	70	70	47	46	45	67	58	70	45	25
November	73	73	57	62	61	72	66	73	57	16
December	71	70	61	65	65	71	67	71	61	10
Annual Avg.	73	72	50	49	48	68	60			

Sources: WRCC, 1997; Curtis & Grimes, 2004

TFN 6 2/025
RECD NOV 14, 2014

Table D4.2-7. Average Values of Relative Humidity (2007-2013)

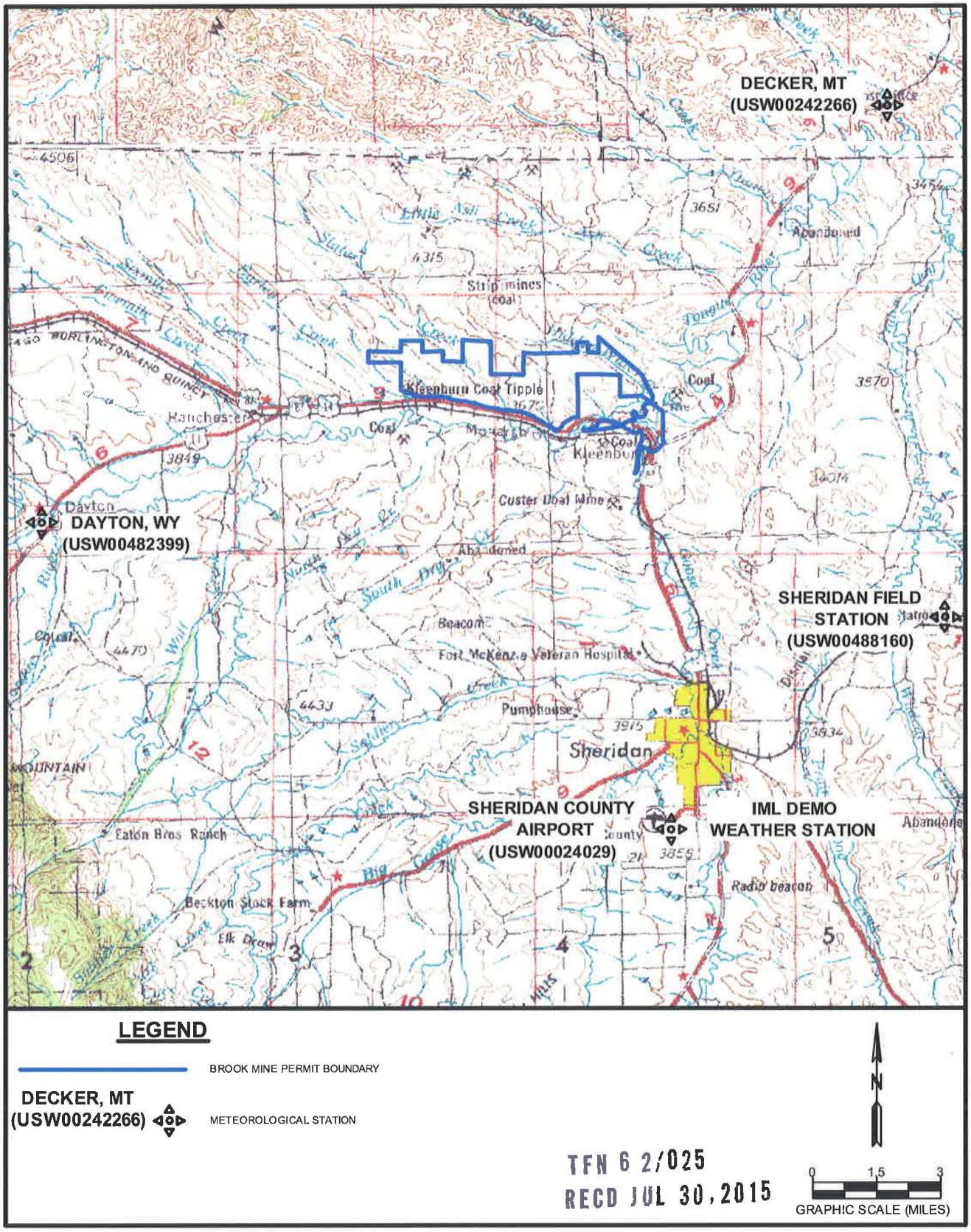
	Average (%)
January	72
February	72
March	65
April	64
May	65
June	61
July	52
August	49
September	57
October	69
November	70
December	75
Annual Average	64

Source: IML Air Science, 2015

TFN 6 2/025
RECD JUL 30, 2015

DEQ 4-099

APPENDIX D4 FIGURES



TFN 6 2/025
RECD JUL 30, 2015

Figure D4.1-1. Meteorological Station Locations

DEQ 4-102

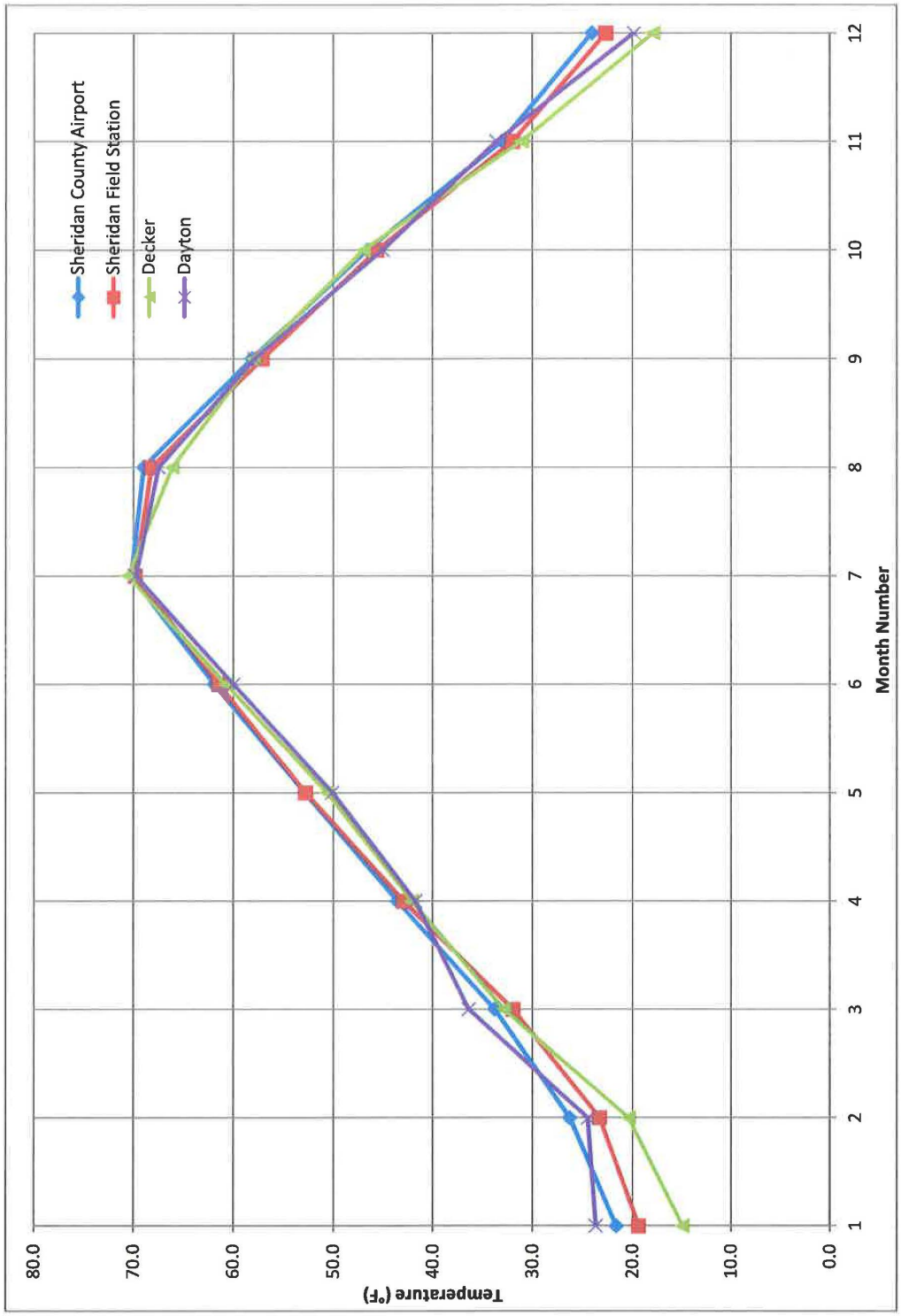


Figure D4.2-1. Regional Average Monthly Temperatures

TFN 6 2/025
RECD NOV 14, 2014

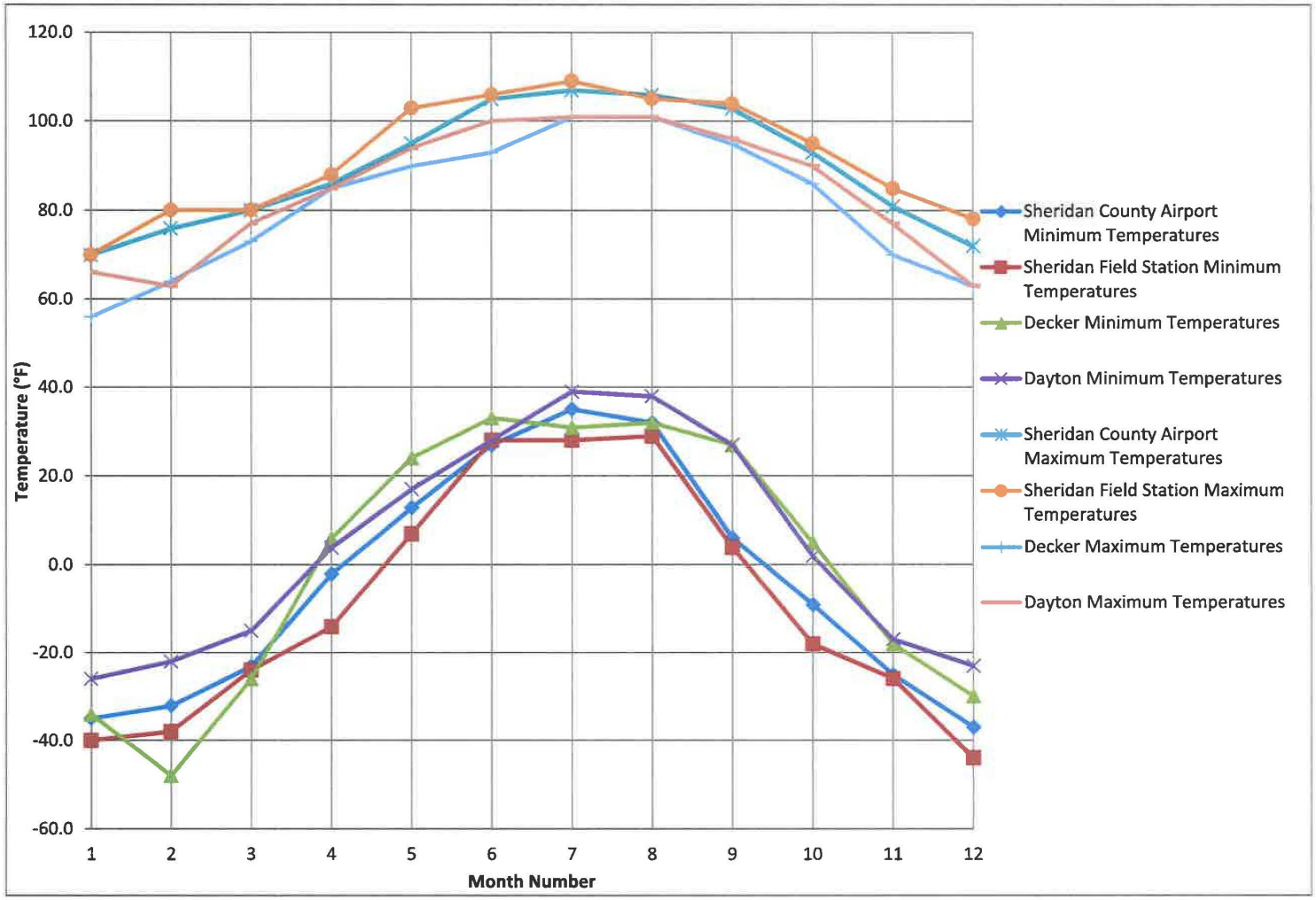


Figure D4.2-2. Regional Minimum and Maximum Recorded Temperatures

TFN 6 2/025
RECD NOV 14, 2014

DEQ 4-104

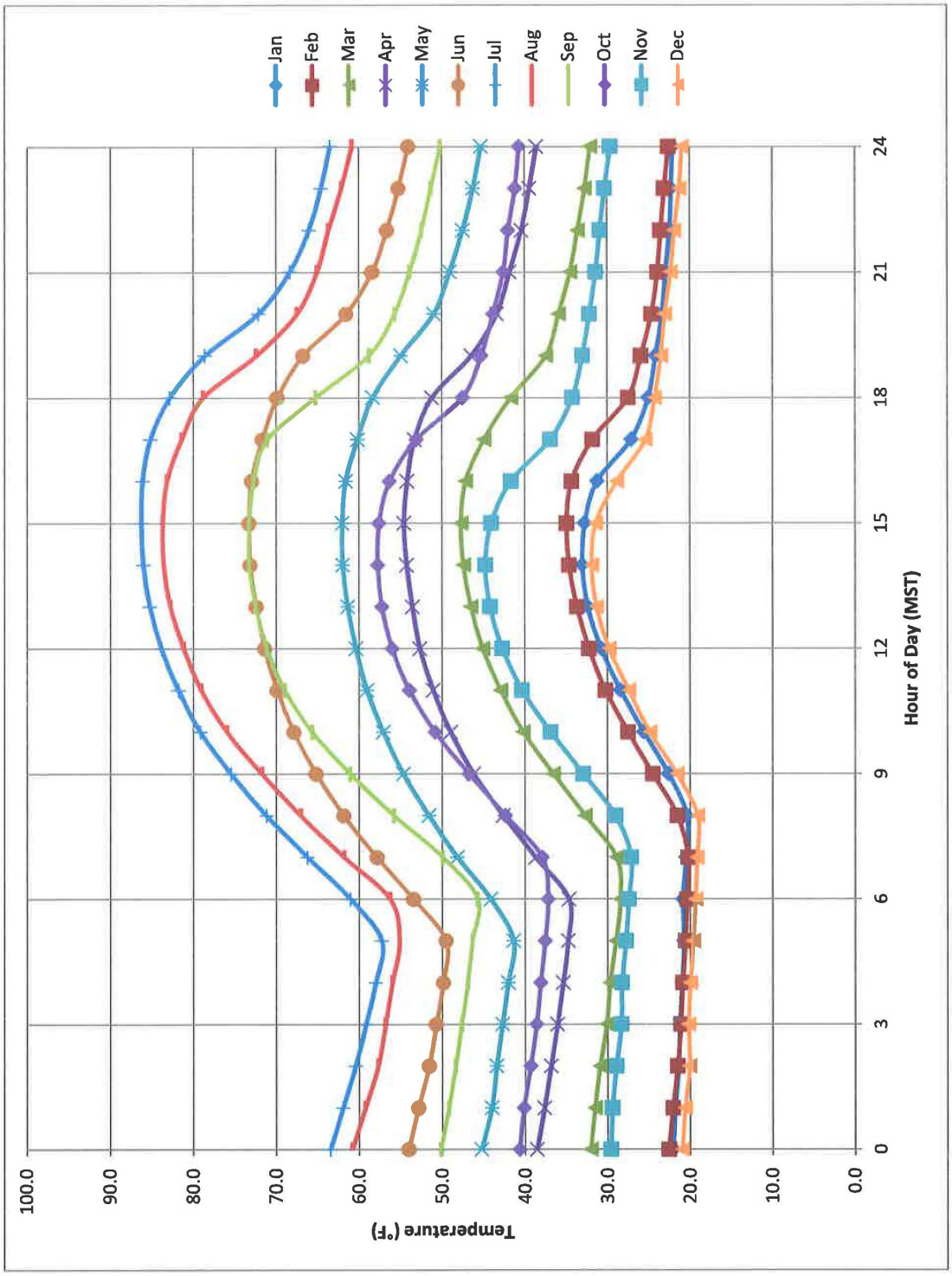


Figure D4.2-3. Sheridan County Airport 10-Year Average Diurnal Temperatures (2003-2012)

TFN 6 2/025
RECD NOV 14, 2014

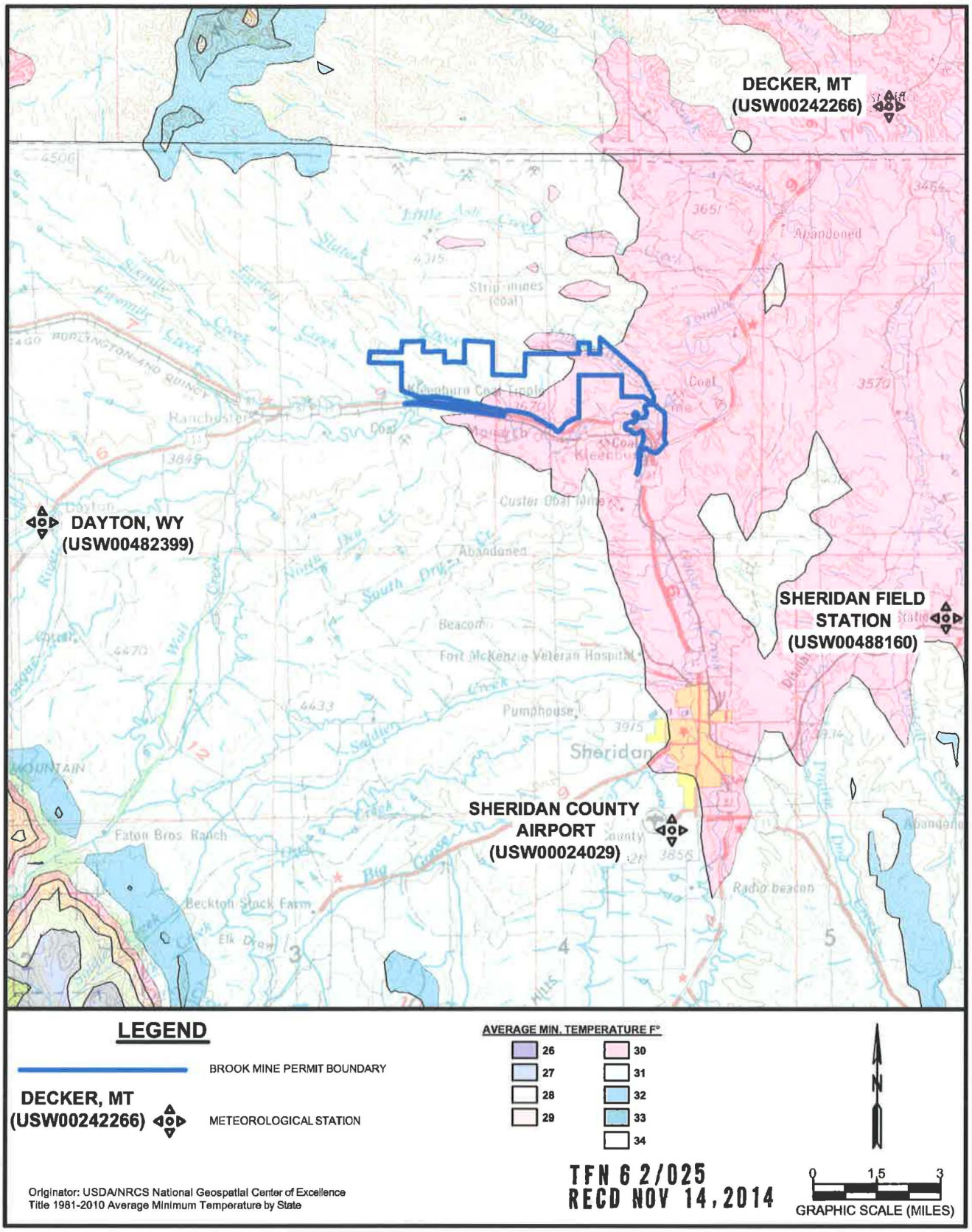


Figure D4.2-4. Regional Average Annual Minimum Temperatures

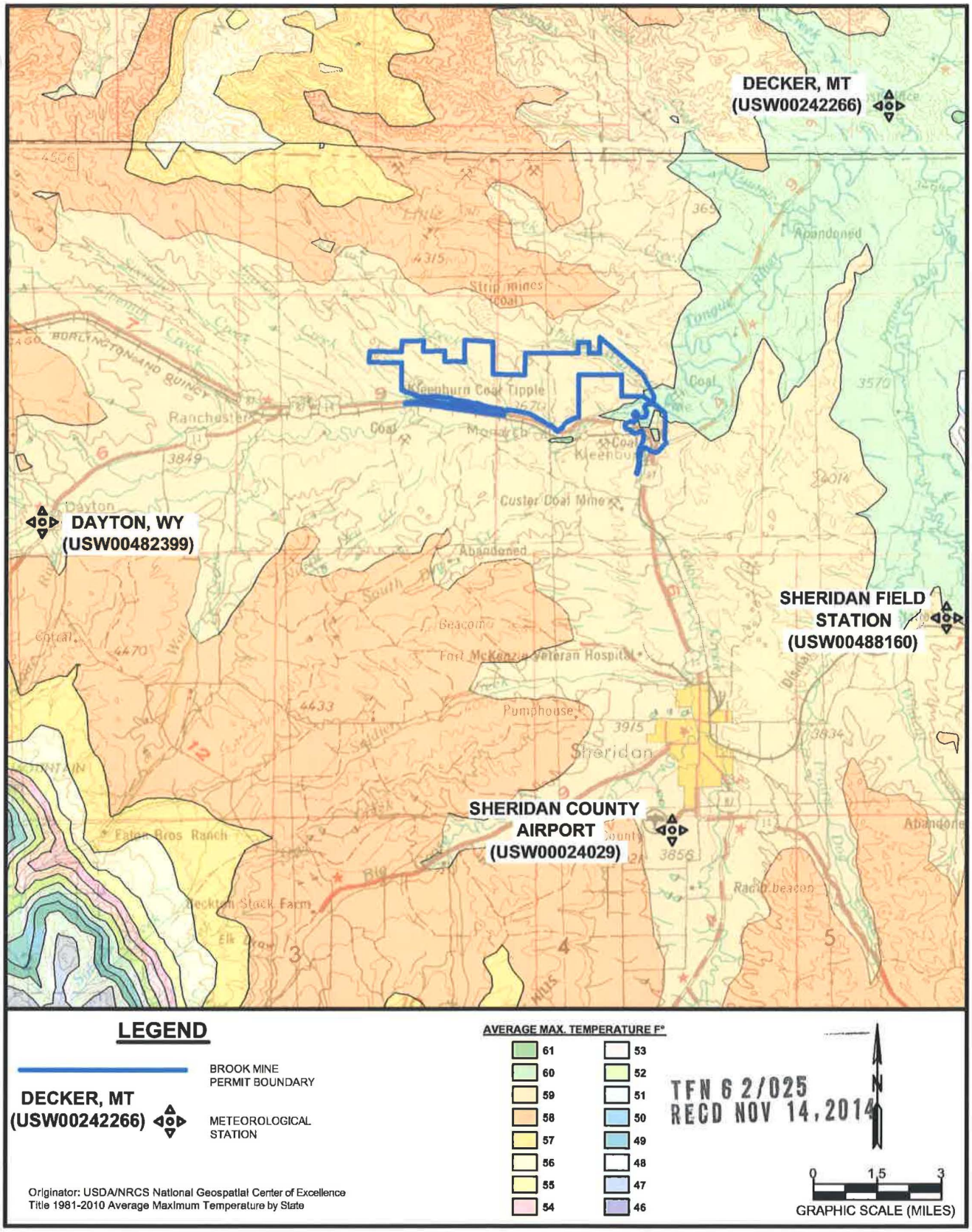


Figure D4.2-5. Regional Average Annual Maximum Temperatures

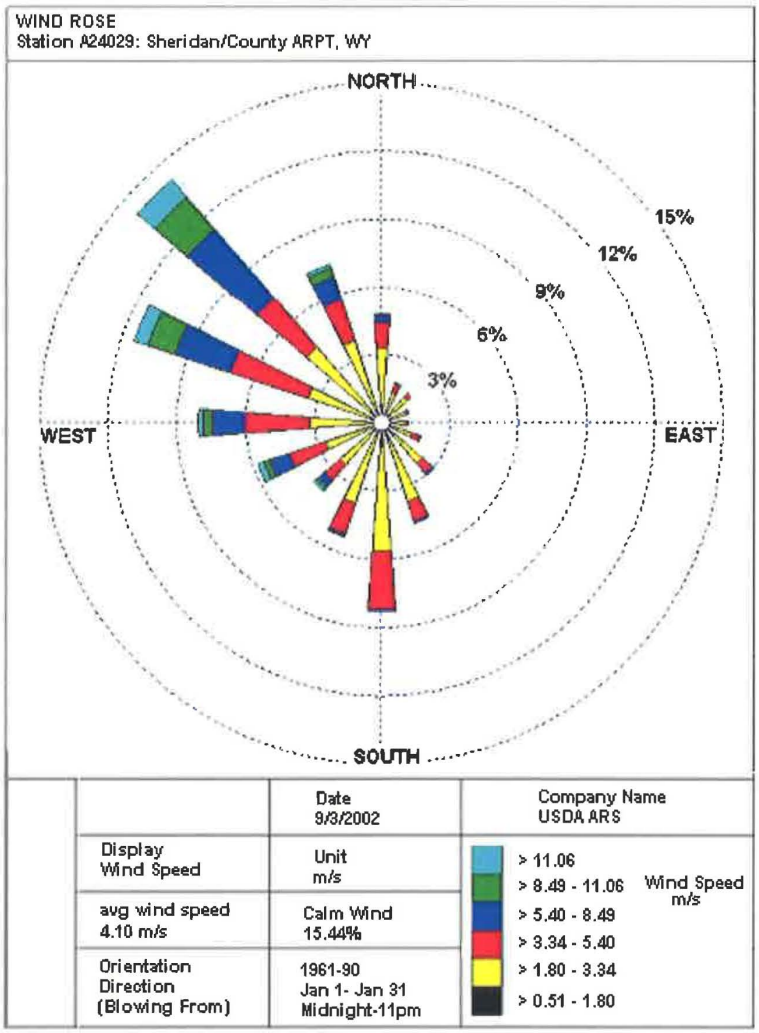


Figure D4.2-6. Wind Rose for Sheridan Area (1961-1990)

Source: Curtis and Grimes, 2004

TFN 6 2/025
RECD NOV 14, 2014

DEQ 4-108

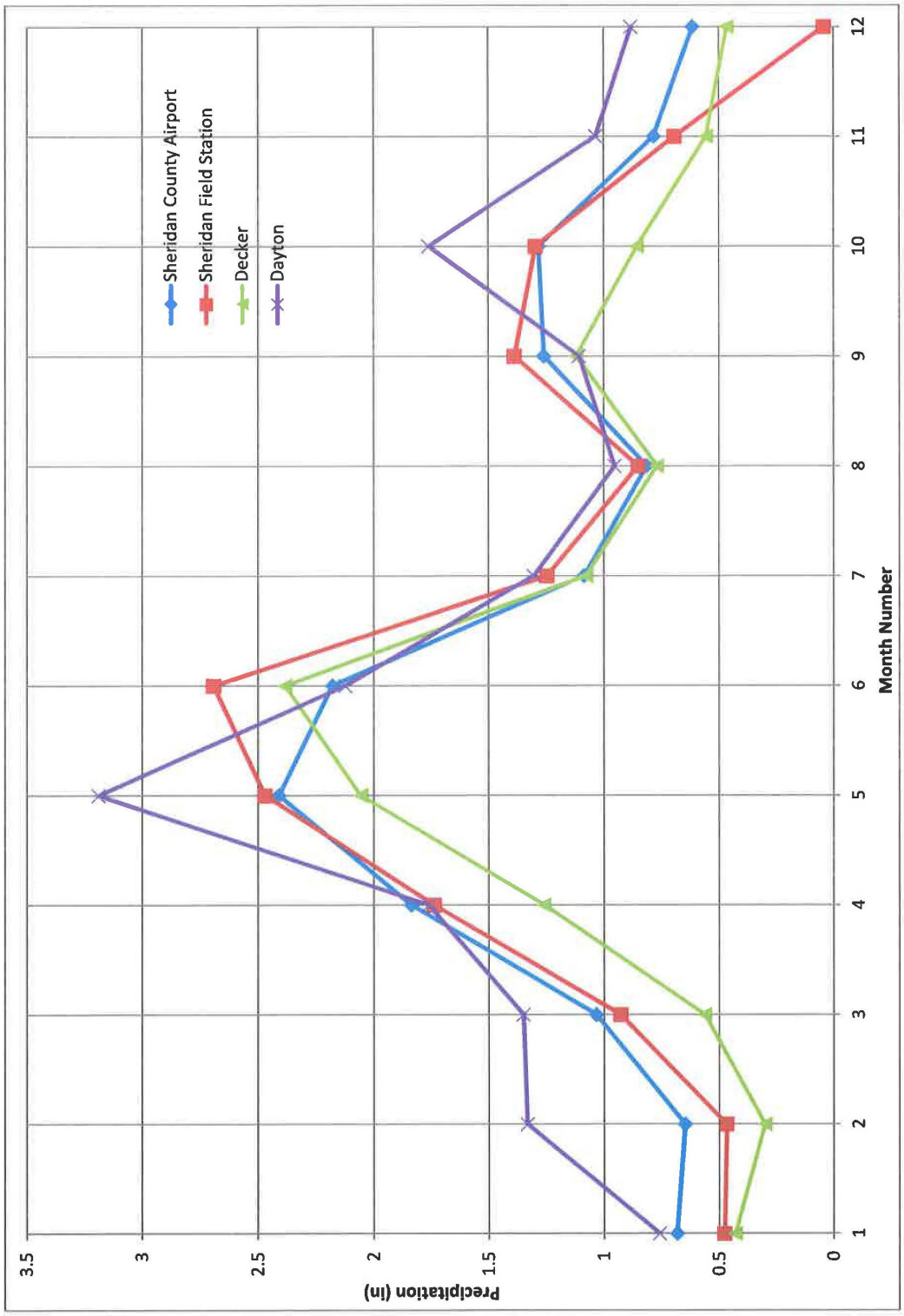


Figure D4.2-7. Average Monthly Precipitation

TFN 6 2/025
RECD NOV 14, 2014

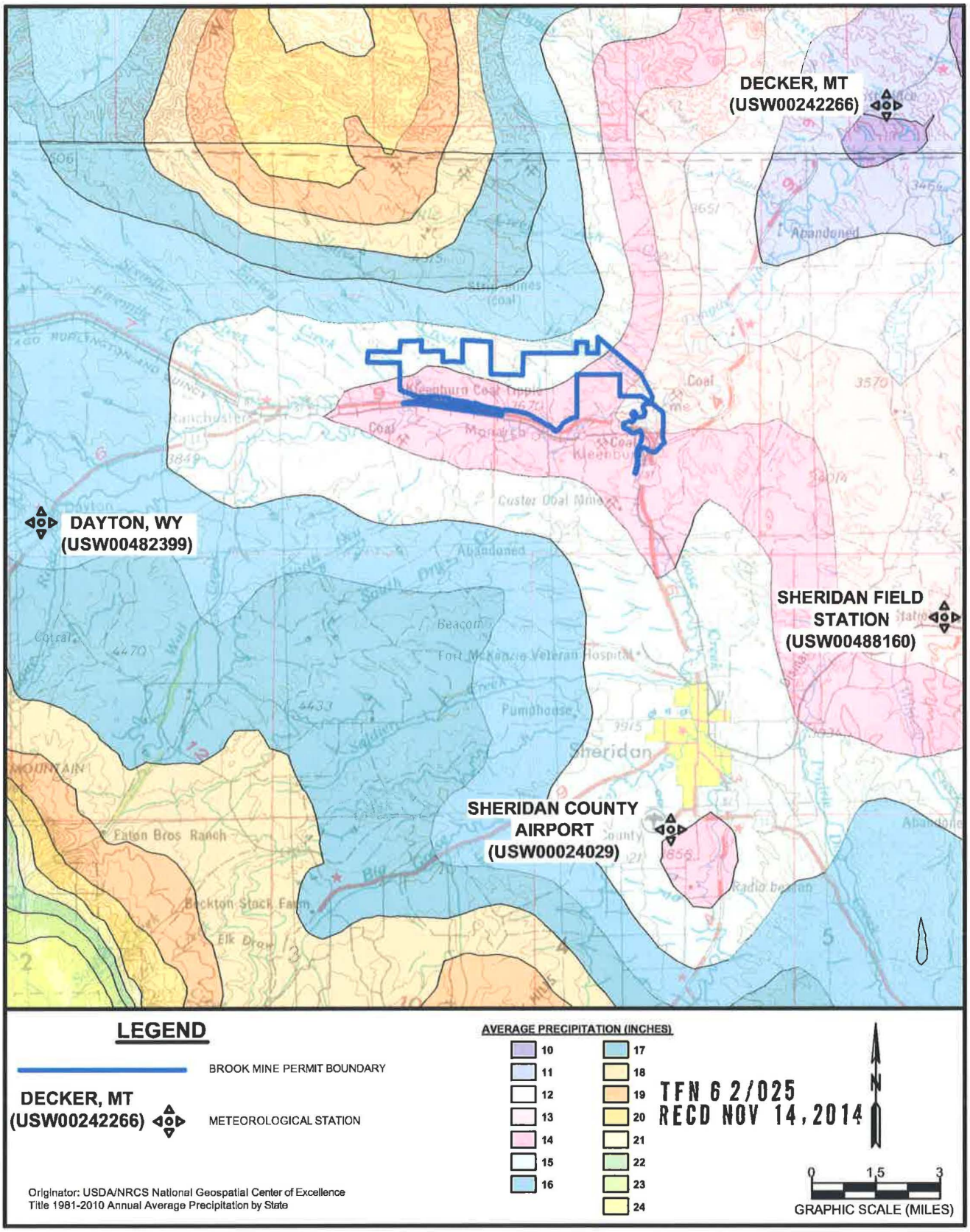


Figure D4.2-8. Regional Average Annual Precipitation

DEQ 4-110

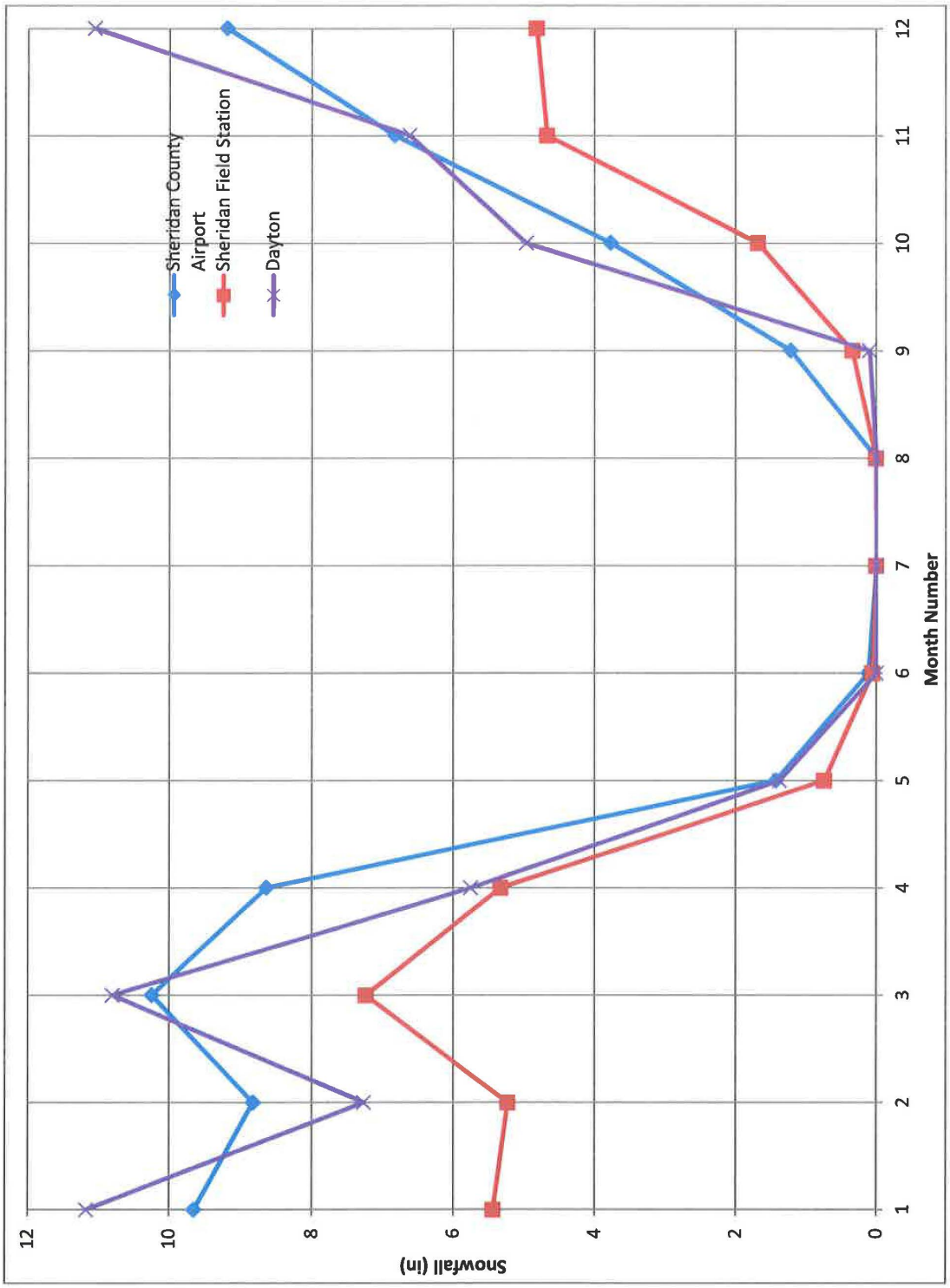


Figure D4.2-9. Average Monthly Snowfall

TFN 6 2/025
RECD NOV 14, 2014

DEQ 4-111

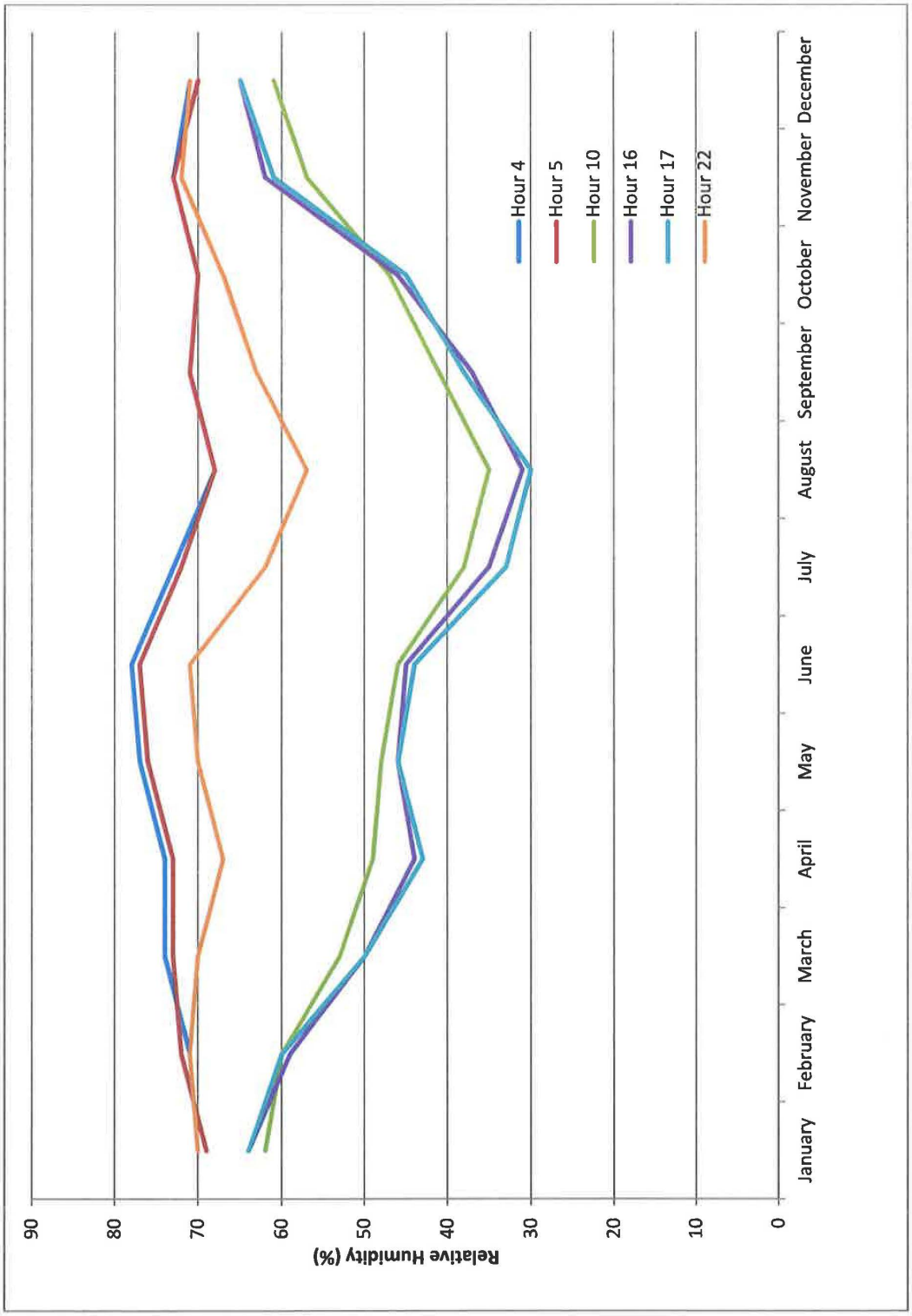


Figure D4.2-10. Daily Variations in Relative Humidity during the Year

TFN 6 2/025
ECD NOV 14, 2014

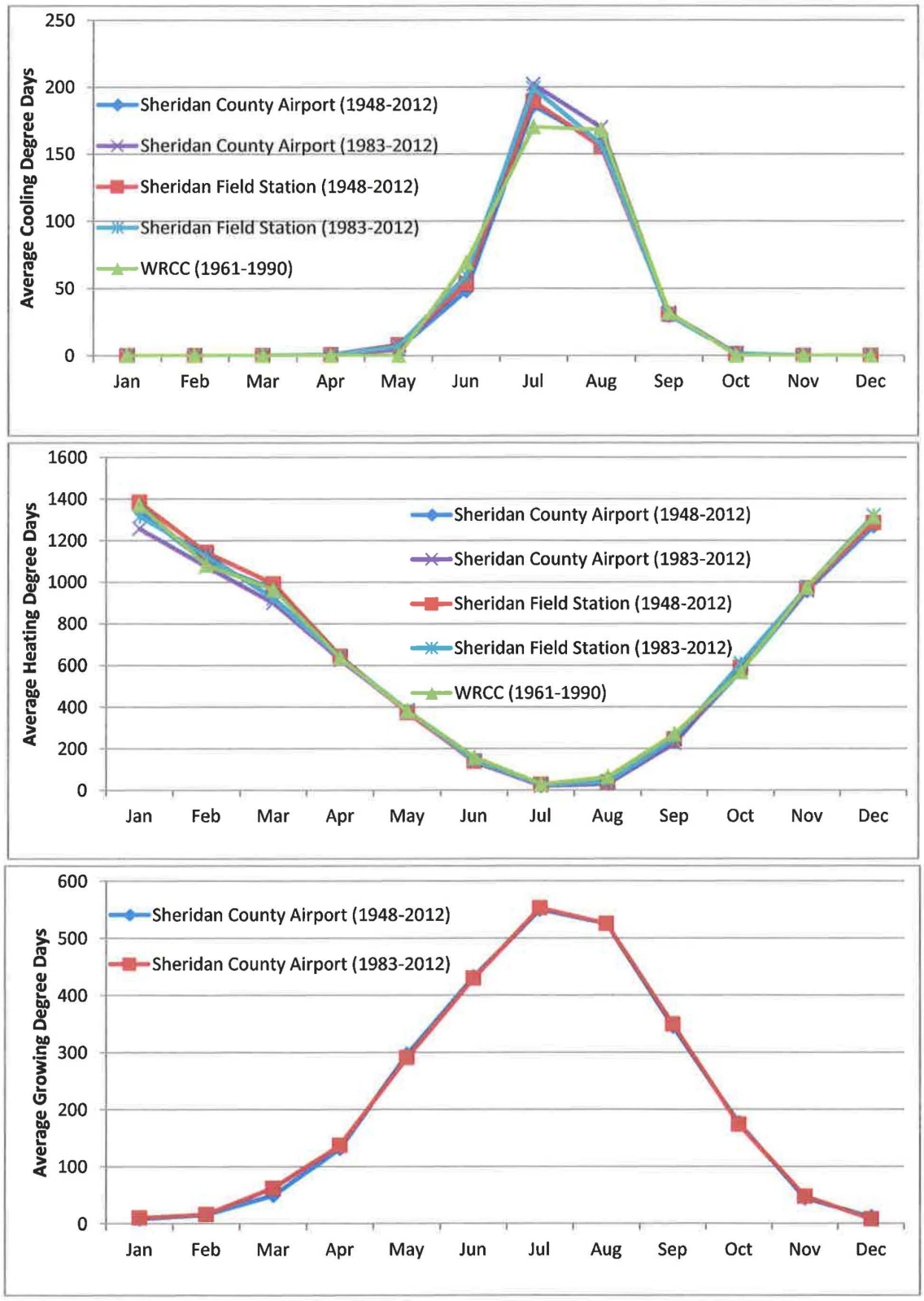


Figure D4.2-11. Average Monthly Cooling, Heating, and Growing Degree Days

TFN 6 2/025
RECD JUL 30, 2015