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DEQ Exhibit 2

RAMACO

February 2016

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LAND USE

Appendix D1

Prepared by:
WWC Engineering

July 2015

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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

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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

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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.

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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).

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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

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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)

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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

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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

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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

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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.

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D1.7 References

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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

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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

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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

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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

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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

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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

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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

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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

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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

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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)

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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

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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

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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

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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

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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

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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

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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)

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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

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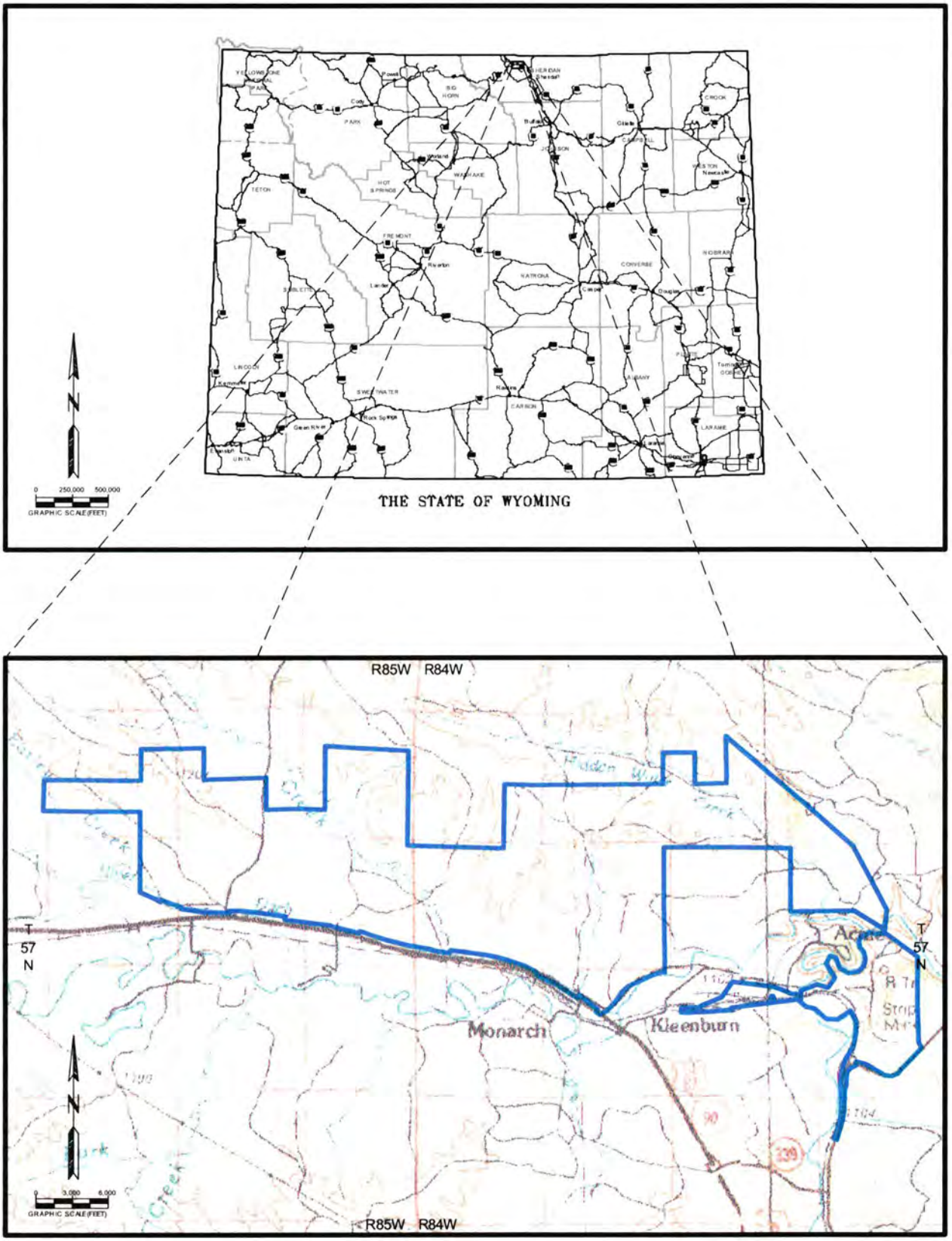

Figure D1.1-1. General Location Map

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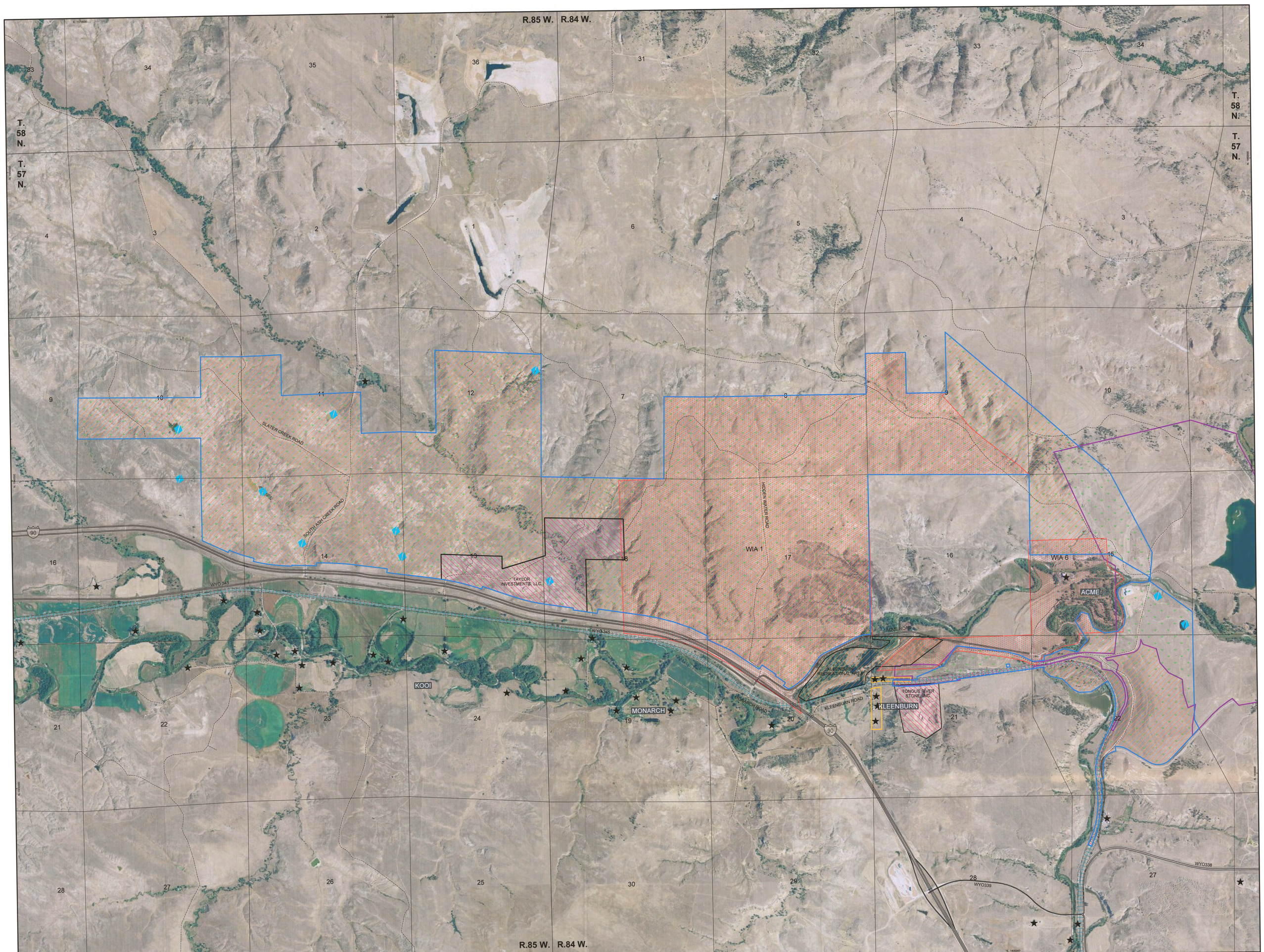

LEGEND

- 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

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

WWC ENGINEERING
www.wwcengineering.com

FILE: D1_LANDUSE.dwg

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HISTORY

Appendix D2

Prepared by:
WWC Engineering

October 2014

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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.)

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- 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

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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

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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

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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

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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.

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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

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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

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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

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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).

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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).

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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	

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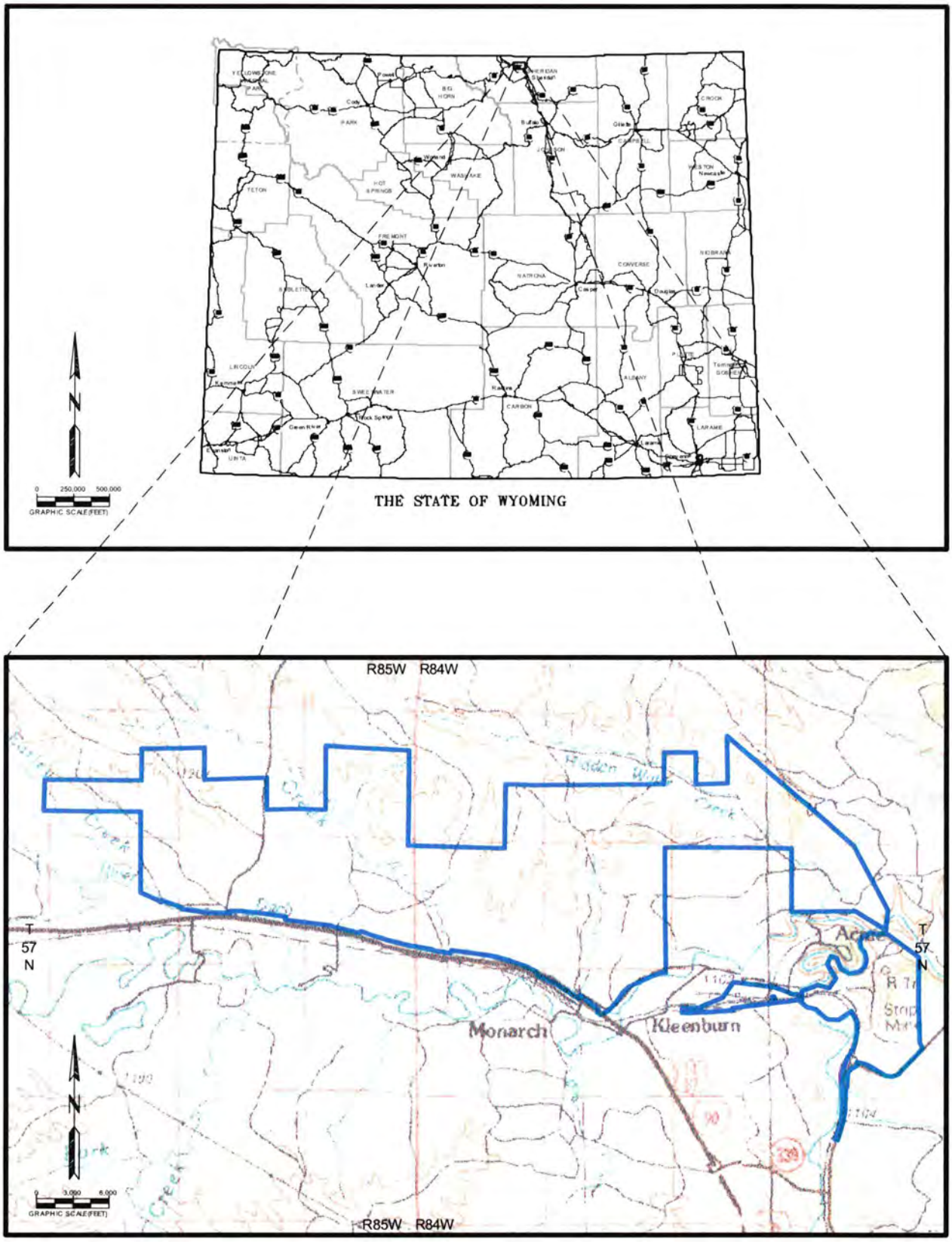

Figure D2.2-1. General Location Map

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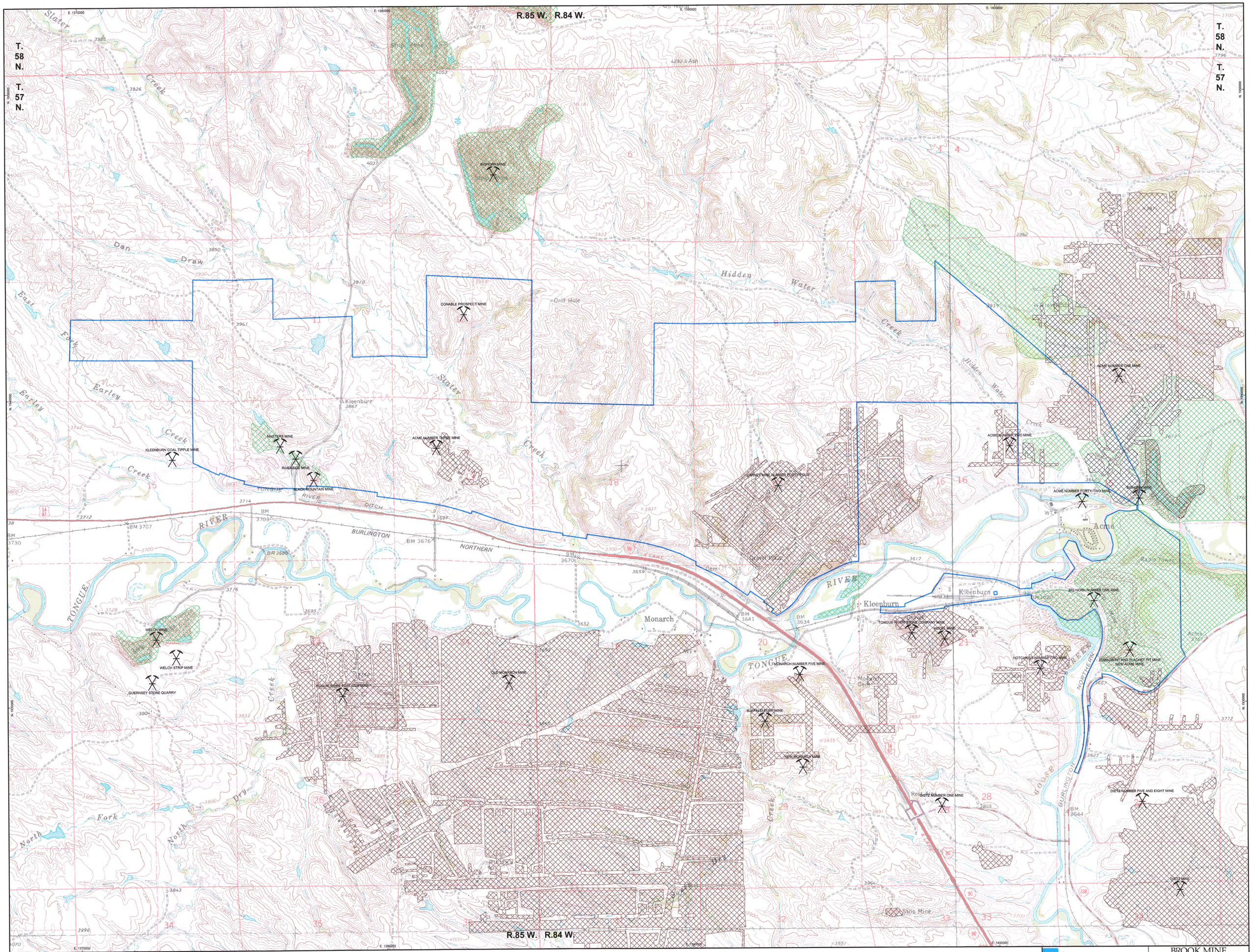

LEGEND

- 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)

DEQ Ex. 2-052

RAMACO

BROOK MINE
SHERIDAN COUNTY, WY

1101 SUGARVIEW DR, STE. 201
SHERIDAN, WY 82801

REVISIONS	
Date	Description

EXHIBIT D2.3-1

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HISTORIC MINE LOCATIONS

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

WWC ENGINEERING
www.wwcengineering.com

FILE: D2-1_HIS_MINES.dwg

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LIST OF ADDENDA

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

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ARCHEOLOGICAL AND PALEONTOLOGICAL RESOURCES

Appendix D3

Prepared by:
WWC Engineering

October 2014

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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.

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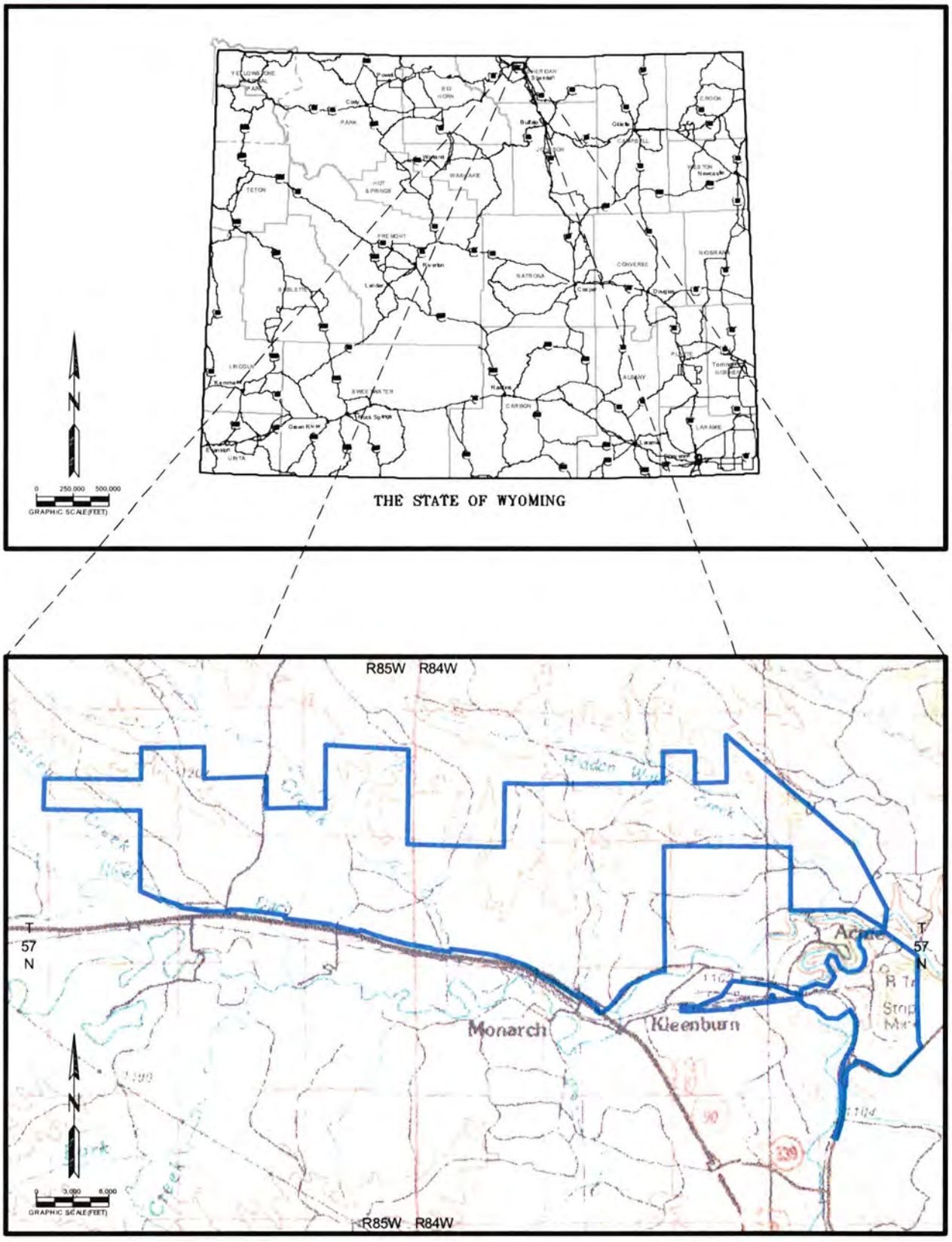

Figure D3.1-1. General Location Map

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ADDENDUM D3-1

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

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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.

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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	[illegible]	[illegible]-5864	FAX 777-5973	FAX 777 5973

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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 Nutbrock
Administrator
Land Quality Division

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

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CLIMATOLOGY

Appendix D4

Prepared by:
WWC Engineering

July 2015

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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

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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

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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.

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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.

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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.

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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

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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.

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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

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

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D4.4 References

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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

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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

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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

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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	67	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

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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

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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

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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

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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

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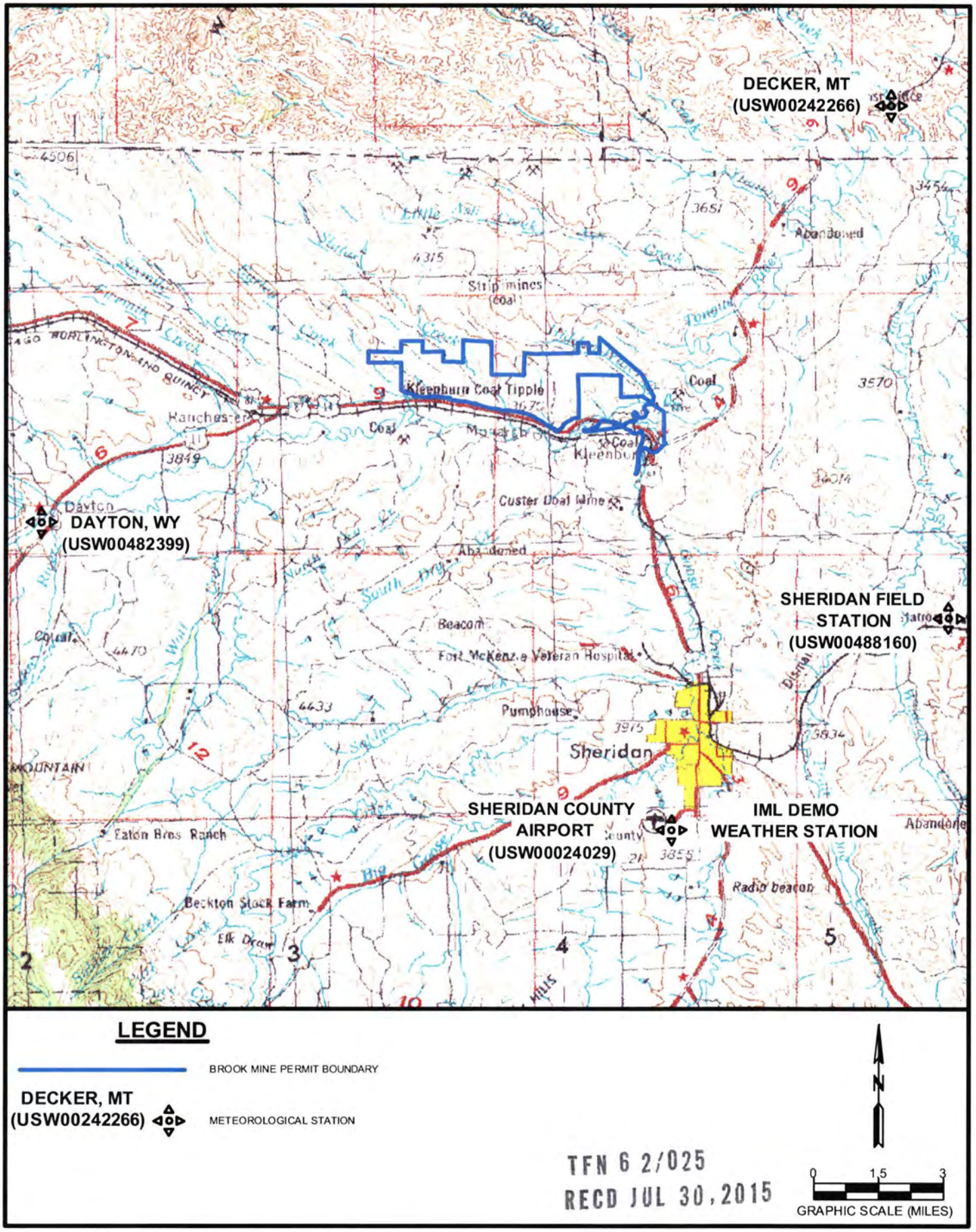

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Figure D4.1-1. Meteorological Station Locations

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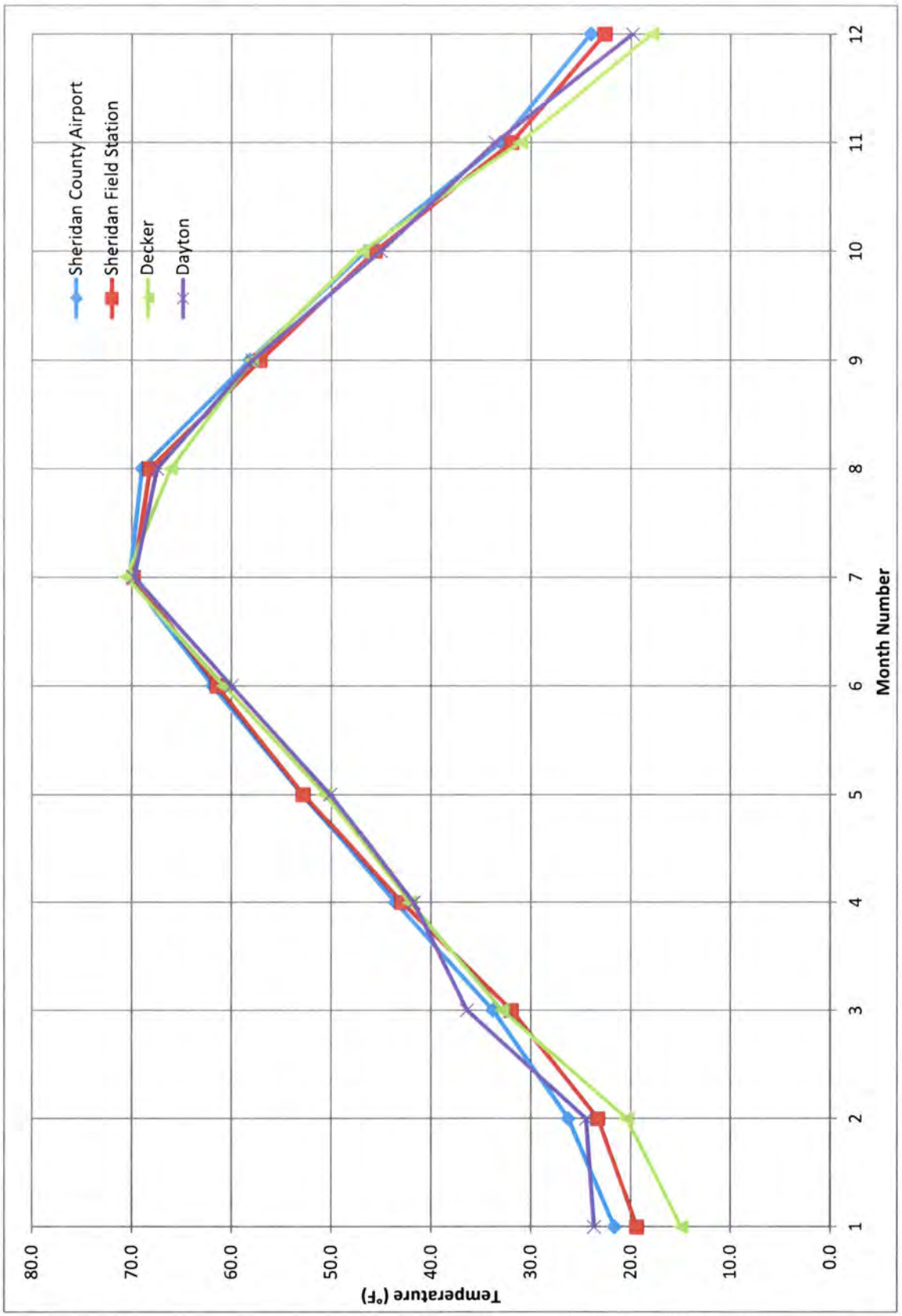

Figure D4.2-1. Regional Average Monthly Temperatures

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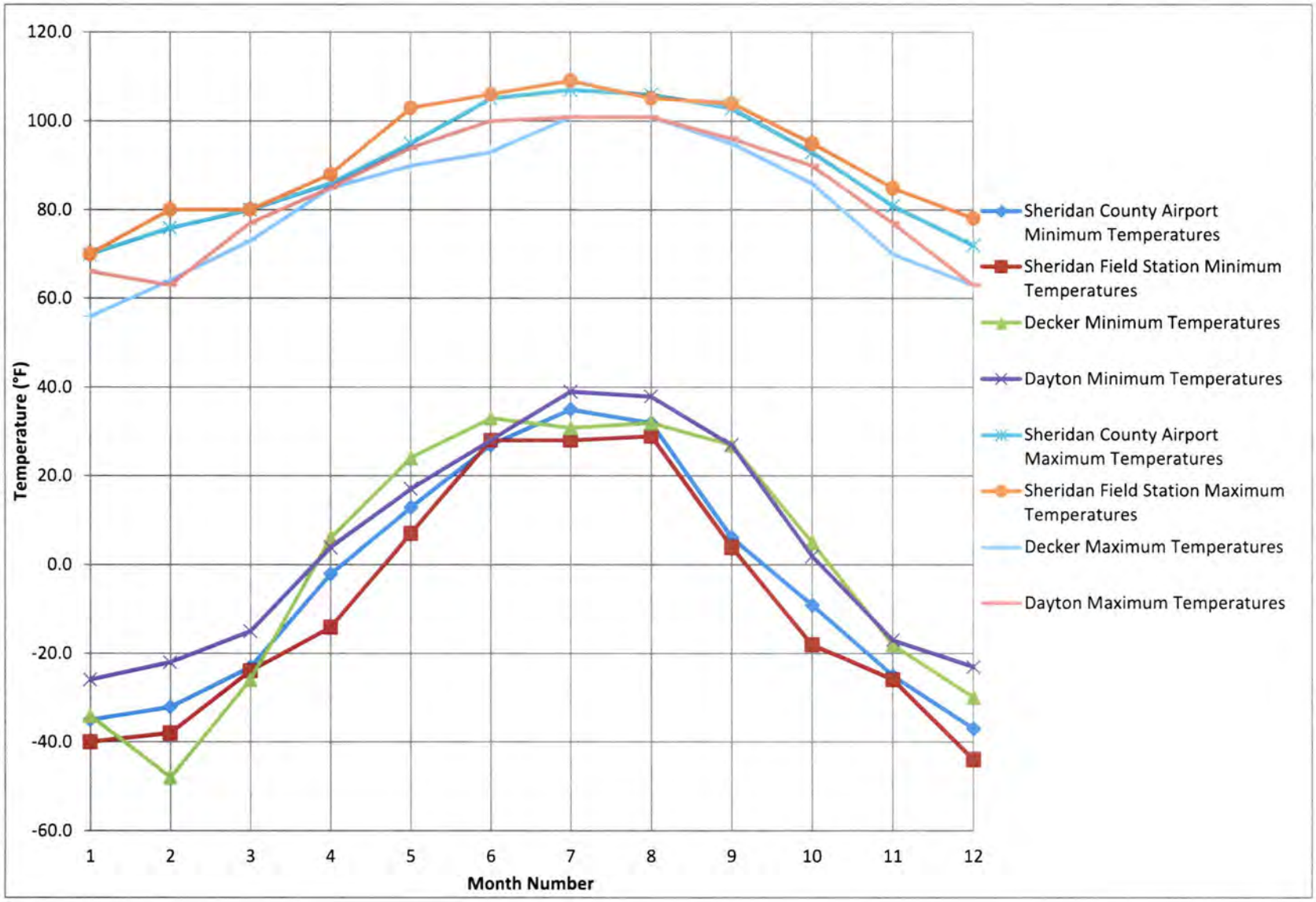

Figure D4.2-2. Regional Minimum and Maximum Recorded Temperatures

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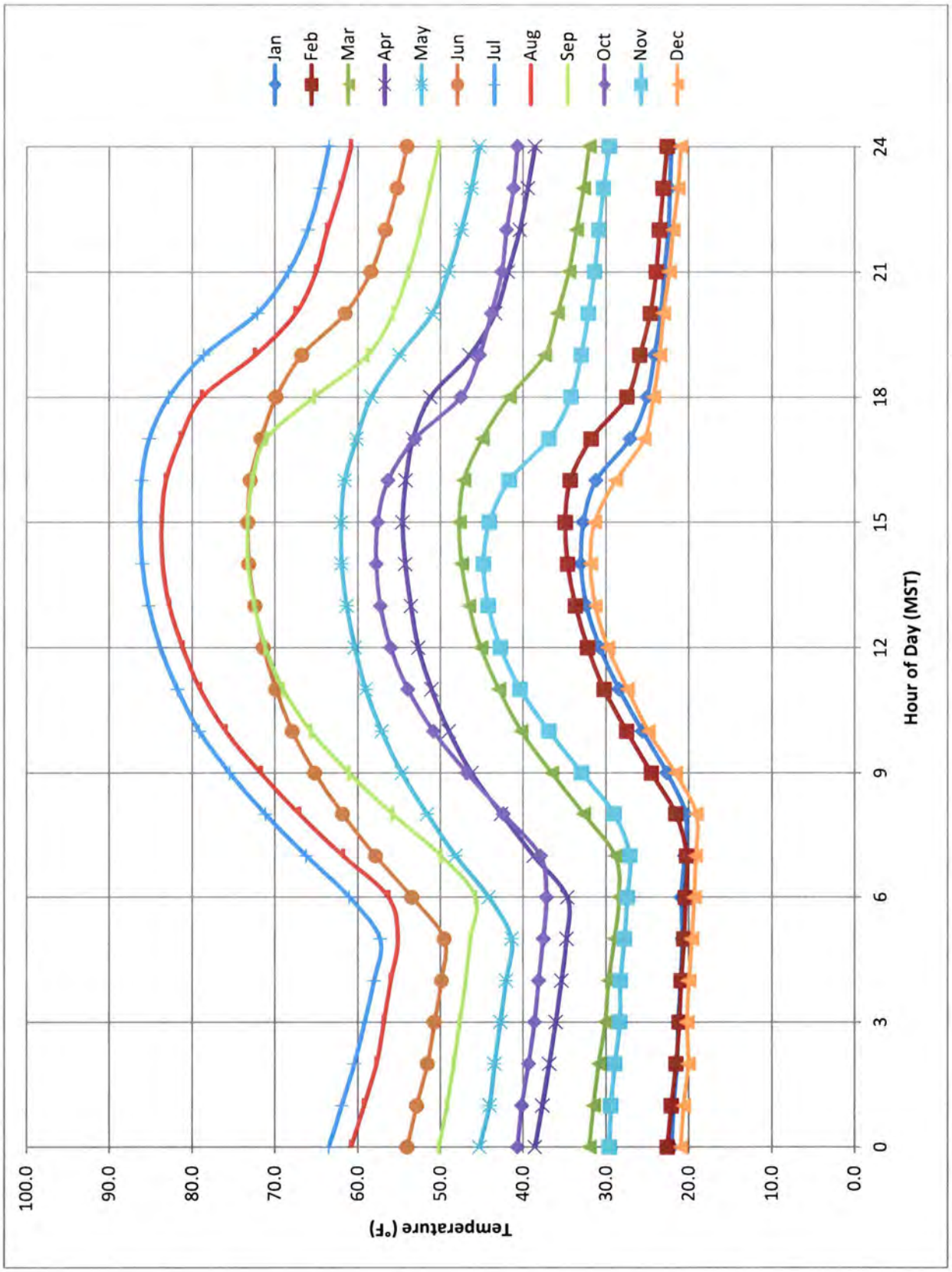

Figure D4.2-3. Sheridan County Airport 10-Year Average Diurnal Temperatures (2003-2012)

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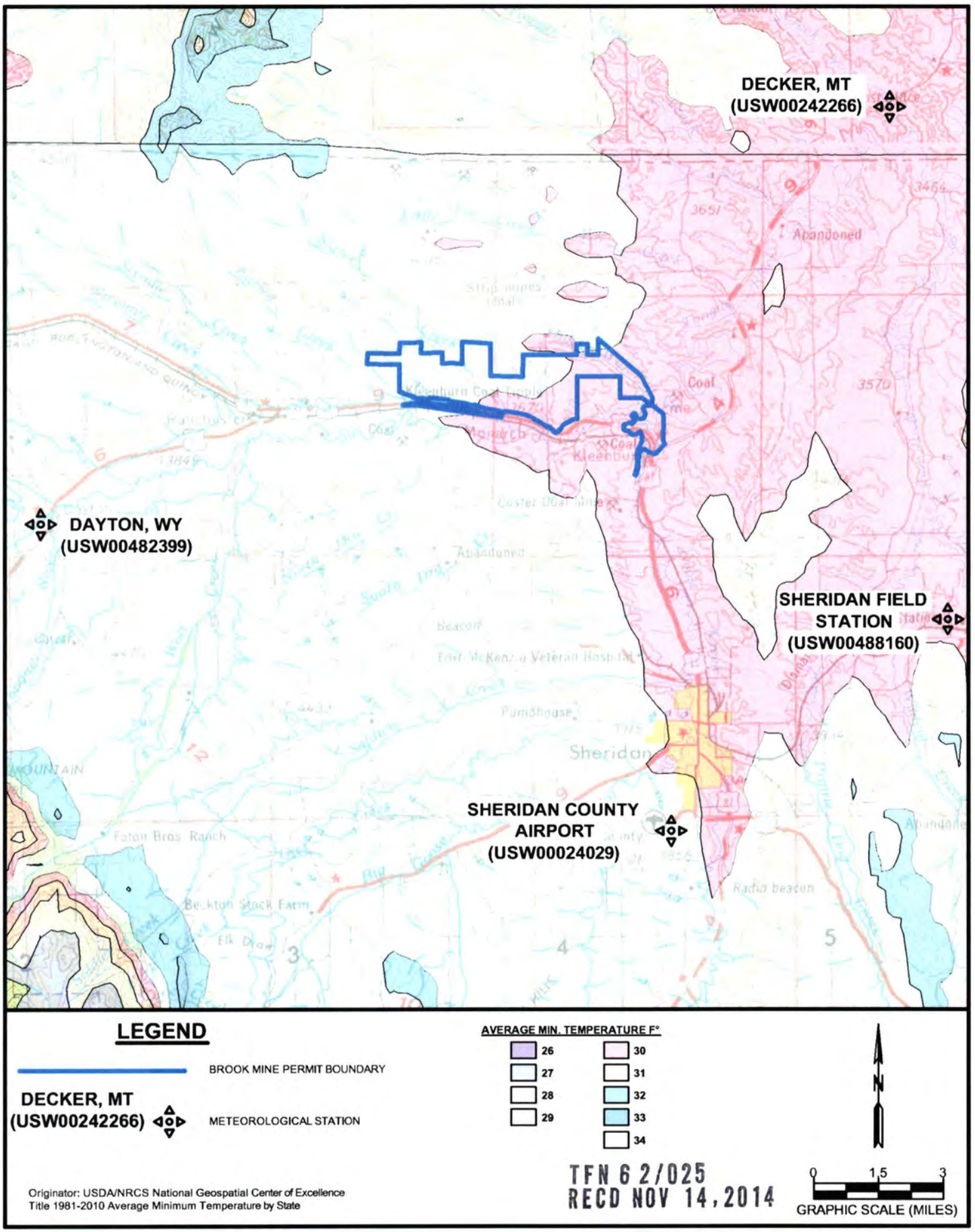

Figure D4.2-4. Regional Average Annual Minimum Temperatures

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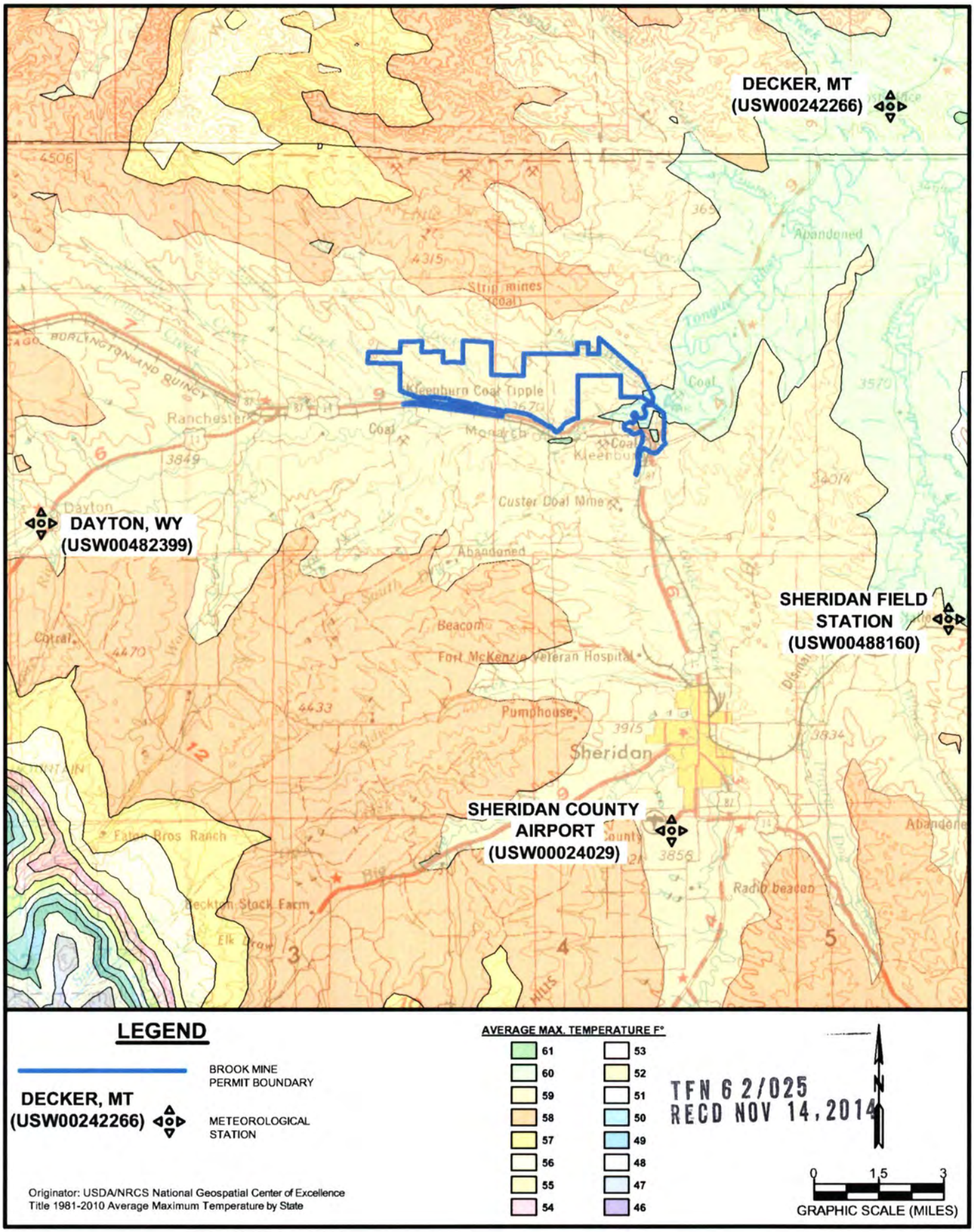

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Figure D4.2-5. Regional Average Annual Maximum Temperatures

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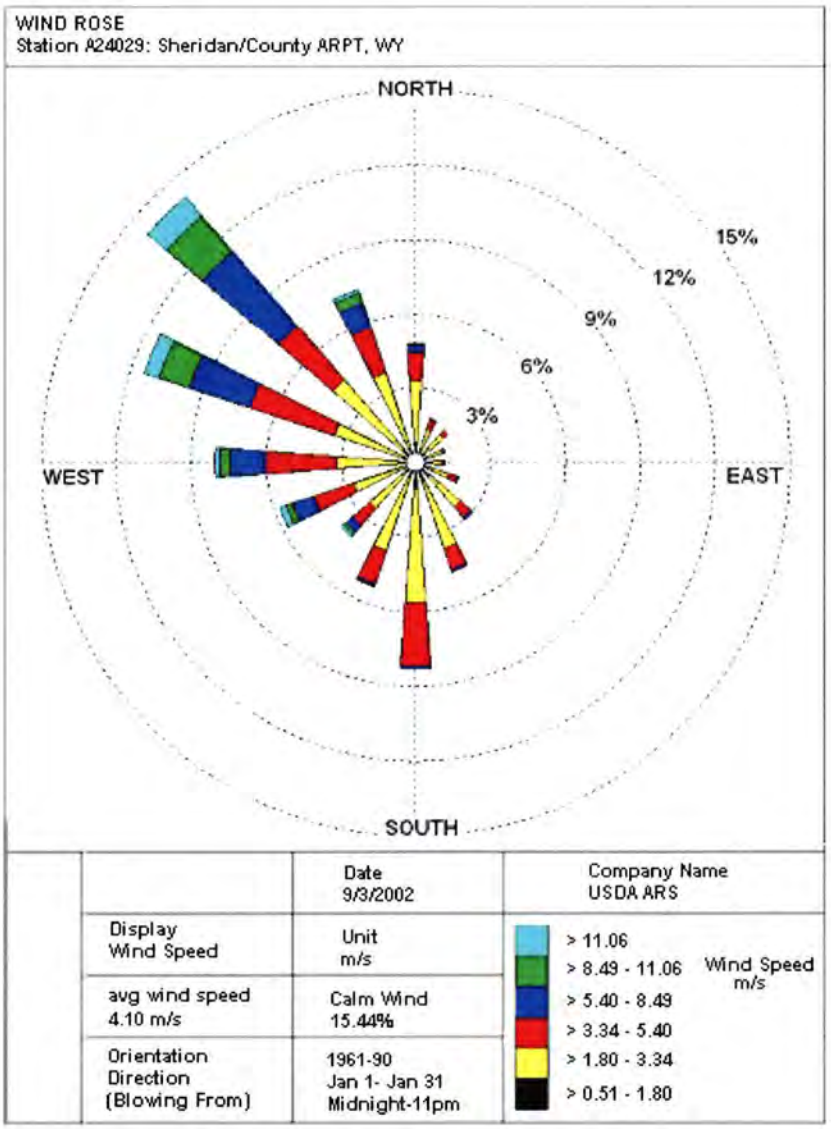

Figure D4.2-6. Wind Rose for Sheridan Area (1961-1990)

Source: Curtis and Grimes, 2004

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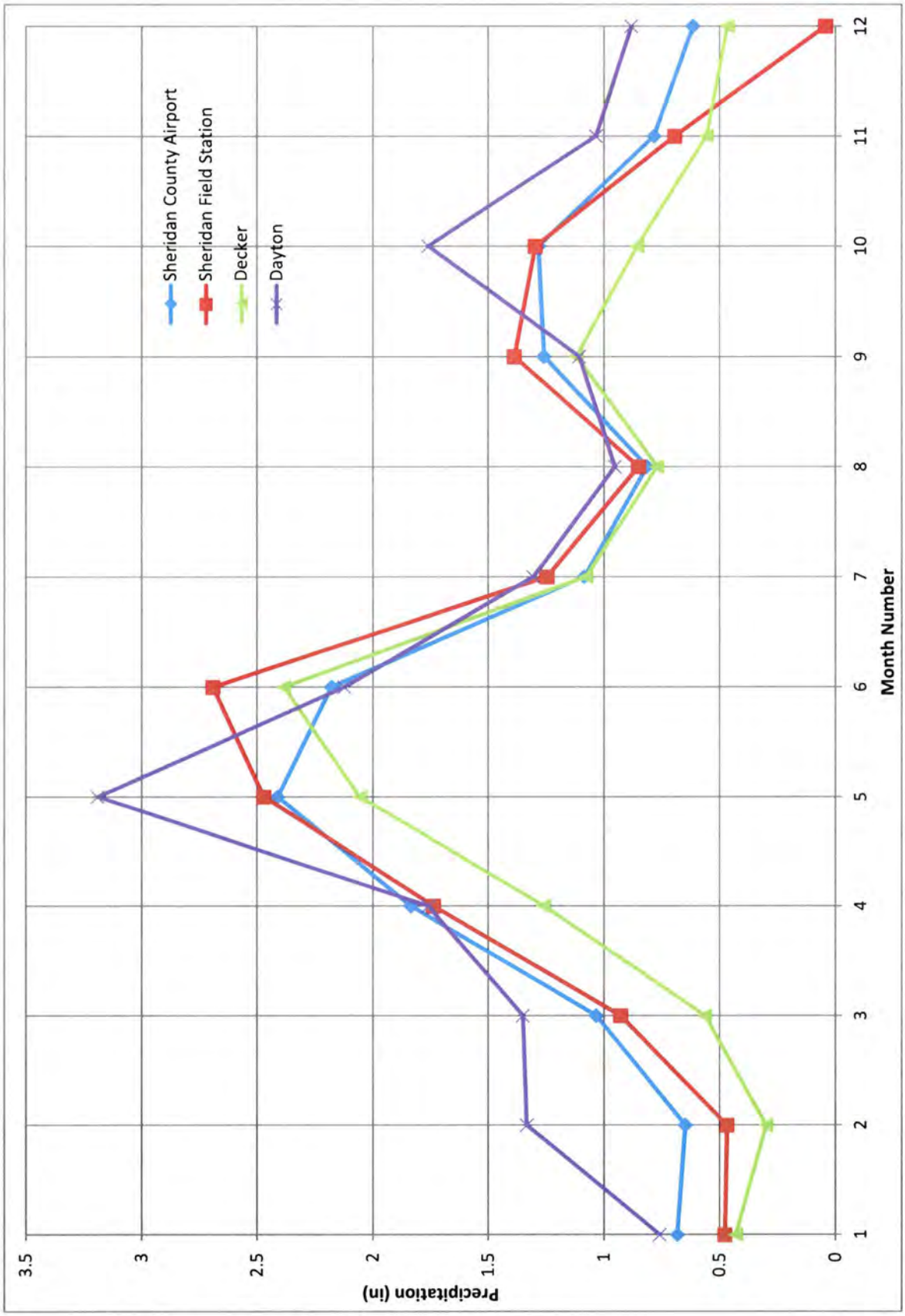

Figure D4.2-7. Average Monthly Precipitation

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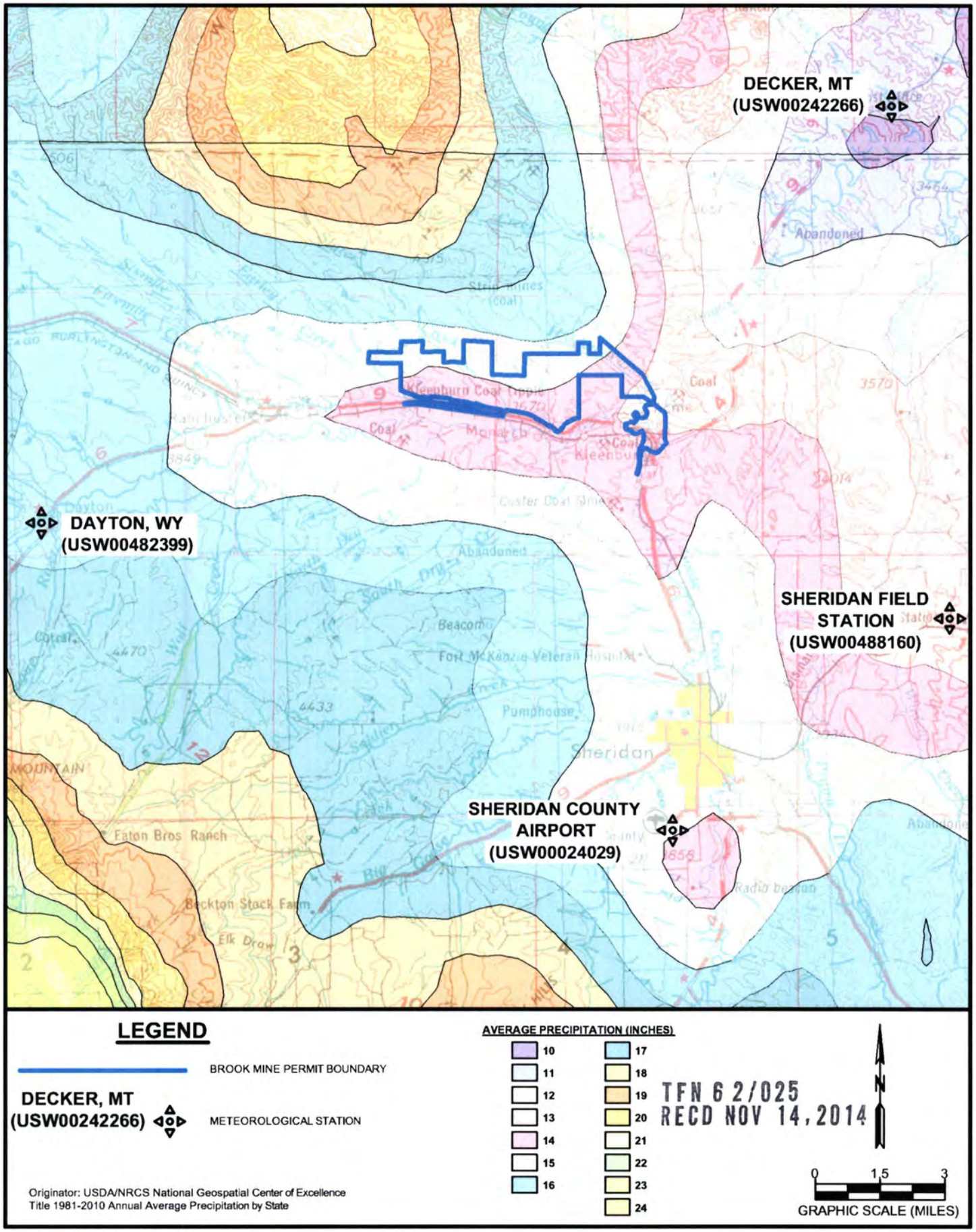

Figure D4.2-8. Regional Average Annual Precipitation

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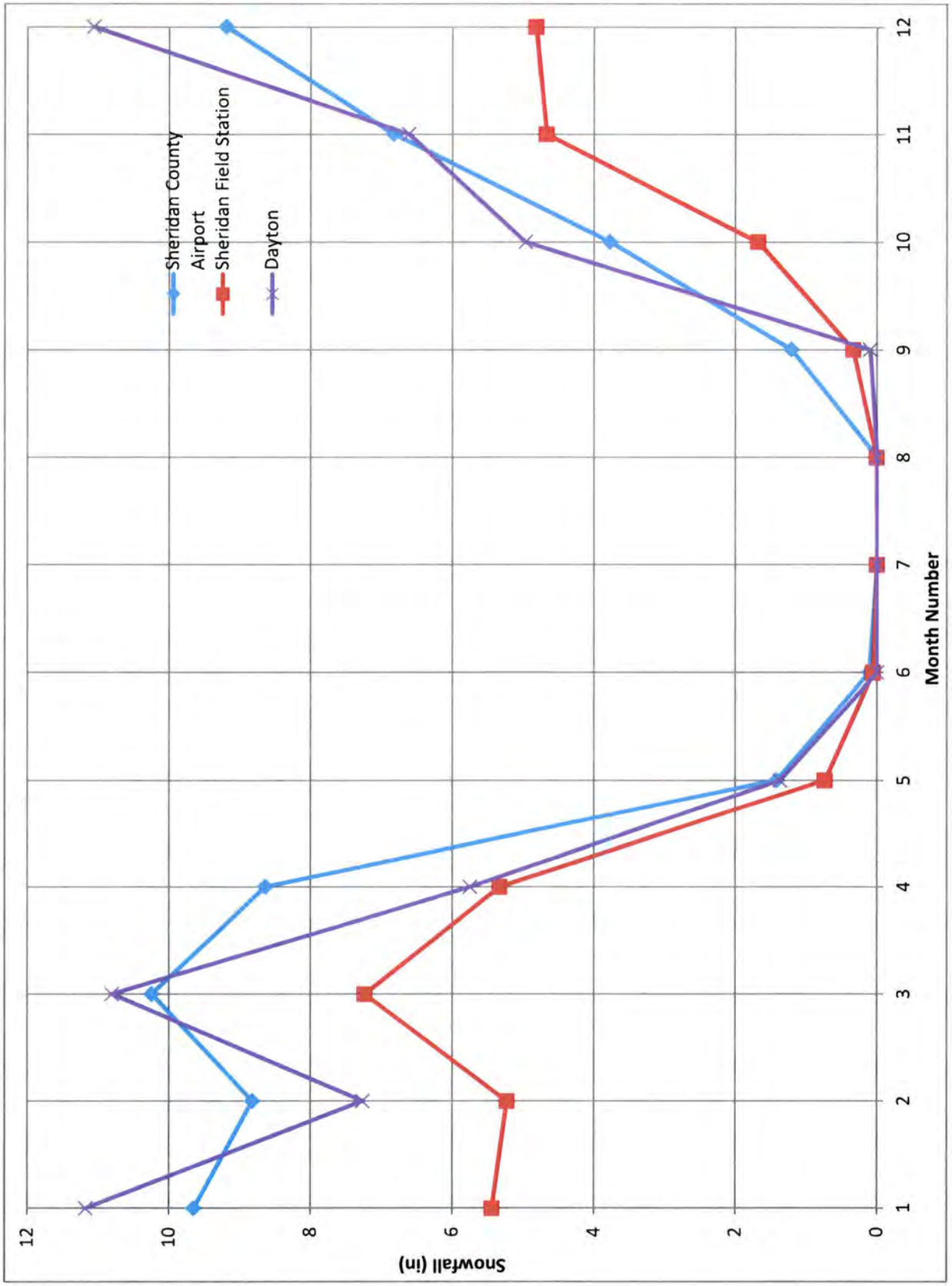

Figure D4.2-9. Average Monthly Snowfall

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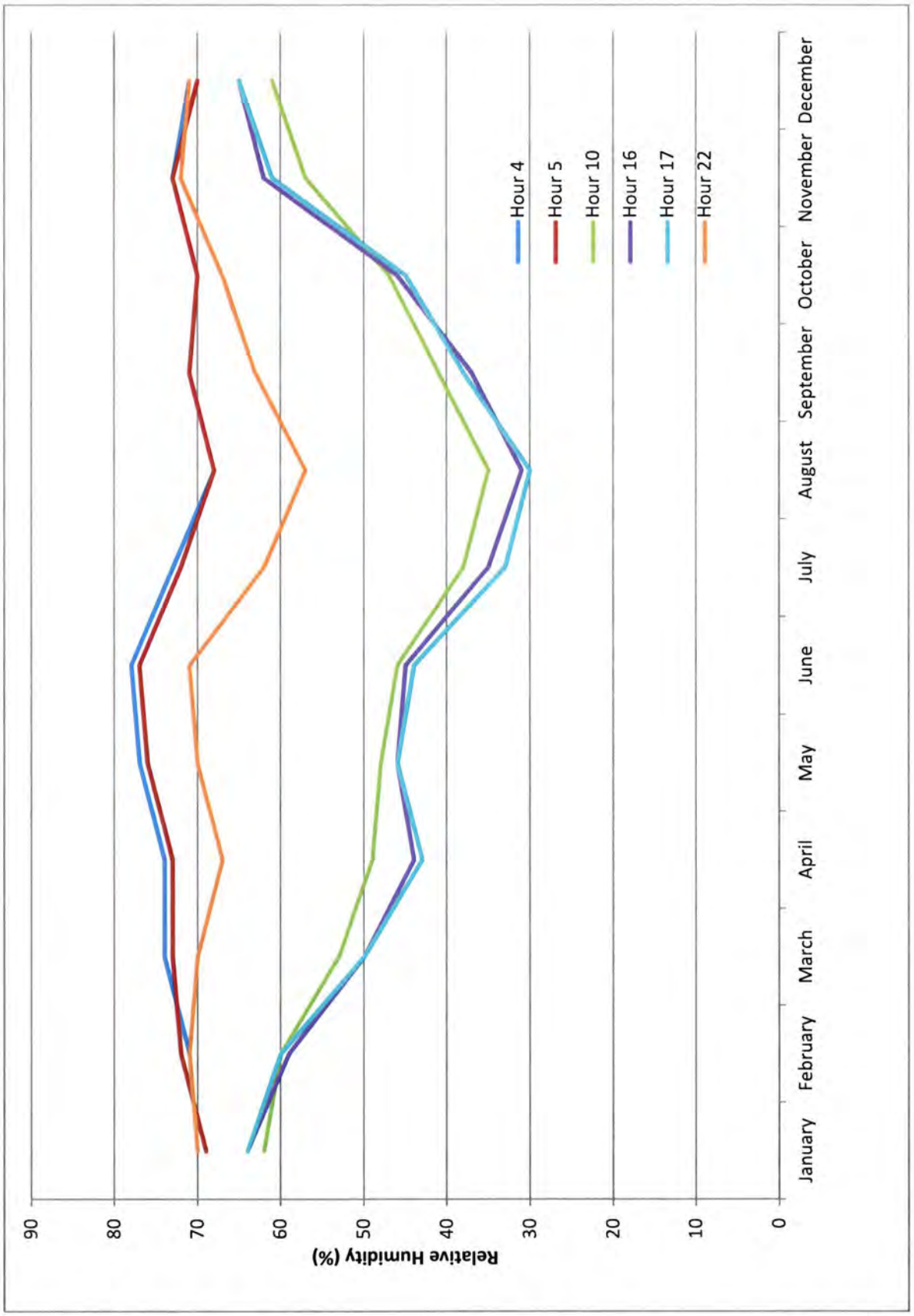

Figure D4.2-10. Daily Variations in Relative Humidity during the Year

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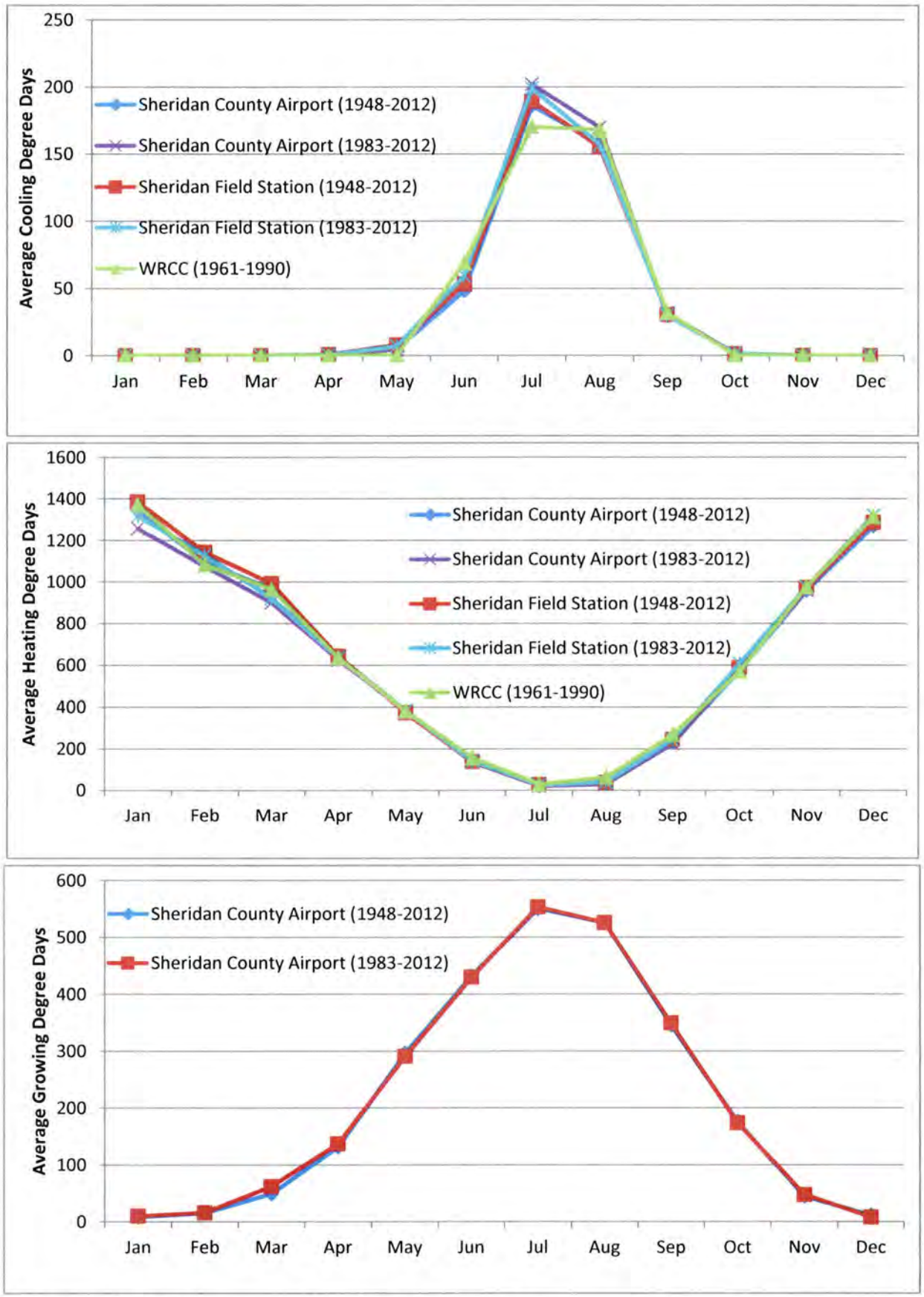

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TOPOGRAPHY, GEOLOGY AND OVERBURDEN ASSESSMENT

Appendix D5

Prepared by:

WWC Engineering

December 2019

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D5 GEOLOGY, OVERBURDEN, UNDERBURDEN, AND MINERAL ASSESSMENT

D5.1 Introduction

Geology, Overburden, Underburden, and Mineral Assessment sections for RAMACO's Brook Mine were prepared by WWC Engineering (WWC) of Sheridan, Wyoming.

D5.1.1 General

This appendix describes the topography, geology, and overburden characteristics of the Brook Mine Area which is located in in the Sheridan Coal Field of the Powder River Basin near the Montana – Wyoming state line. The proposed permit area is located approximately 8 air miles northwest of Sheridan, Wyoming and lies along the north side of Interstate 90 corridor between the Acme interchange and Ranchester, Wyoming.

The coal seams of interest within the proposed permit boundary include the Carney and Masters seams which vary from less than 1 to over 20 feet in thickness within the permit area boundary. These seams were deposited in the Paleocene, Fort Union Formation and are interbedded with claystone, siltstone, and sandstone as well as isolated bands of thin local coal seams. Across much of the mine area the overlying Monarch coal seam is burned, resulting in large scoria deposits and rugged terrain. The lithology of the overburden and other materials within the minable sequence are herein chemically and physically described. Special emphasis is given to the identification of any toxic or acid-forming strata.

D5.1.2 Topography

The landscape of the Powder River Basin (PRB) consists of broad deflated plains, and low hills and tablelands. Incised stream valleys create most of the topographic relief. Generally, the topography changes from open hills with 500

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to 1,000 feet of relief in the northern part of the basin to plains and tablelands with 300 to 500 feet of relief in the southern part (Keefer, 1974).

Like much of the northern PRB, the permit area contains significant topographical relief typified by open hills, narrow erosional channels and steep scoria capped buttes and ridges separated by relatively short, incised, ephemeral drainages which ascend steeply from the valley floor of the Tongue River and its local tributaries. Surface elevations within the permit boundary range from 3,590 feet where the Tongue River crosses the permit in the east portion of the permit area in Section 15 of Township 57N, Range 84W and the highest of 4,110 feet above mean sea level (amsl) in Section 7 of Township 57N, Range 84W.

The principle watershed in the area is the Tongue River. Although it does not overlay any significant portion of the mine area, the Tongue River flowing along the southern portion of the permit boundary represents the lowest and most distinctive topographical feature in the area. Further description of characteristics of the Tongue River is provided in Appendix D11.

Additional relief is created locally by the Hidden Water and Slater Creek drainages, tributaries of the Tongue River. The Hidden Water drainage runs northwest to southeast along the northeast portion of the permit and enters the Tongue River near its confluence with Goose Creek. The Hidden Water drainage is typified by a narrow valley floor surrounded by relatively steep scoria capped buttes on the north side and rolling hills on the south. The Slater Creek drainage is also a northwest-southeast trending drainage with a slightly larger valley floor bounded on the northeast by steep scoria capped buttes and ephemeral drainages and on the southwest by rolling hills with a lesser scoria presence.

Mine subsidence features from previous underground coal mining are also evident on the topographic surface within and adjacent to the permit area.

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Additionally, Big Horn Coal's (Permit No. 213-T7) post-mine reclamation makes up a portion of the topography in the southeast portion of the mine area.

D5.1.3 Slope Assessment

Statistical analyses of the slope data were performed for both premining and postmining conditions within the mine area. The postmining analysis and comparison to the premining slopes are presented in Reclamation Plan Section RP.3.

Topographic grid files for use in the slope study were developed using the premining contours. The slope analysis was conducted using the slope zone analysis routine in the Carlson® software packages. Elevations for the premining and postmining topography were determined for 100 x 100-foot grid cells over the entire permit area. The gridded elevations were then used by the Carlson® software program to calculate slope values for each cell and hatch the cell according to the slope zone. The program then determines the aerial extent of the slope zones and prepares a summary table.

Slope class intervals were utilized in the analyses to provide better discrimination in the shallow slope ranges. The average, maximum and minimum slopes for each case were also determined and are presented on Exhibit D5.1-1 for the mine area which also presents the area for each slope zone using colored hatching.

D5.2 Regional Geology

D5.2.1 General

The proposed Brook Mine is located near the western edge of the Powder River structural and topographic basin that occupies portions of northeastern Wyoming and southern Montana in the Sheridan Coal Field. The basin is generally described as a broad northwest-southeast trending asymmetric syncline defined by the Black Hills on the east, the Casper Arch, Laramie Mountains, and the Hartville uplift on the south, the Bighorn Mountains on the

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west, and the Miles City arch in Montana to the north as depicted on the Figures D5.2-1 and D5.2-2. The basin's synclinal axis lies near the western margin. Flanking dips are typically gentle on the eastern limb but dip steeply into the Big Horn Mountains on the western limb.

D5.2.2 Structural Geology

The Powder River Basin was formed during the Laramide Orogeny along with the Black Hills, the Casper Arch, Laramie Mountains, Hartville Uplift and the Big Horn Mountains. Upper Cretaceous and Tertiary sedimentary rocks settled within the fluvial system of the basin that comprises the coal formations of the Lance, Wasatch, and Fort Union Formations. The coal-bearing rocks within the Powder River Basin dip more than 20 degrees along the western edge of the basin and around 2-5 degrees along the eastern edge (Flores, 2004). The deepest axis within the basin is found along the southwestern side of basin. Figure D5.2-1 depicts the regional tectonic setting of the basin.

Faulting occurs in many localities in the Powder River Basin, especially around the basin edge in association with folding. Vertical displacements can be several hundred feet. Faulting is more common on the western limb of the basin syncline than on the eastern limb. Figure D5.2-3 illustrates the distribution of faults interpreted by (Barnum, 1983) in the Brook Mine Permit Area.

D5.2.3 Stratigraphy

Coal seams of the Powder River basin are of Tertiary age within the Fort Union and Wasatch Formations. Coal seams are interbedded with claystone, shale, siltstone and sandstone units across much of the basin. The lithologic units are often interbedded, inter-fingered, discontinuous, and generally poorly consolidated, with some well-cemented sand and siltstone beds. Coals of interest within the proposed permit boundary are found in the upper-most member of the Paleocene age Fort Union Formation known as the Tongue River Member. The Tongue River Member is underlain conformably by the Lebo and

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Tullock Members of the Fort Union, which in turn are conformably underlain by the Lance Formation of Upper Cretaceous age. Figure D5.2-4 depicts a stratigraphic column for the Powder River Basin.

The Tongue River Member ranges from 0 to 200 feet thick in the mine area, as large portions of it have been eroded, but thickens to the east. The Carney and Masters coal sequence is typically understood to represent the Tongue River – Lebo contact. The Lebo and Tullock together make up approximately 2,000 to 2,500 feet in the Sheridan Coal Field area. Sands within the Fort Union Formation in the area are thin and typically lack areal continuity. Siltstone is slightly more common; however, it also lacks areal continuity and generally possesses poor aquifer characteristics. Below the Fort Union, the Upper Cretaceous Lance and Fox Hills Formations make up approximately 500-800 feet of interbedded sand and shale.

As evident from Figure D5.2-5, the region is typified by the Fort Union Formation and Wasatch Formation. The Tongue River and Lebo Members of the Fort Union Formation and the scoria residuum associated with the Tongue River Member coals make up a large majority of the bedrock/surficial geology within the mine area. Although the overlying Wasatch Formation has been entirely removed by erosion within the permit area, uplands east of the Brook Mine contain Wasatch outcrops of similar lithology to the local Fort Union Formation.

Quaternary alluvial and slope-wash deposits covering the principle drainage valley floors and associated tributaries make up the remainder of the surficial geology within the region. Please refer to Appendix D11 for further discussion and mapping of stream-laid deposition.

D5.2.4 Depositional Environment

The PRB's Paleocene age Fort Union Formation is generally understood to have been deposited as the Big Horn Mountains were uplifted to the west dropping fluvial sediments in the subsiding Powder River Basin. Low energy

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lacustrine and back-water swamp environments within the basin were often dissected by shifting stream channels and split by overbank, crevasse splay deposits and deltaic lenses on the basin margins. This resulted in a system of interbedded sandstone, siltstone, claystone, mudstone and coal intervals on a regional scale. Further interpretation of the Fort Union Formation's depositional environment is discussed in exhaustive detail in various sources including but not limited to, Ayers 1986, Flores 1983, Seeland 1992 and other coal mine permit applications in the Powder River Basin.

D5.3 Geology of Mine Area

D5.3.1 Surficial Geology

Surficial geology in the proposed permit boundary is composed of Fort Union bedrock (Tongue River and Lebo Members), clinker (locally known as scoria), remnants and quaternary alluvium and colluvium across the valley floors of the principle drainages and associated tributaries. On the eastern edge of the permit area, backfill material from Big Horn Coal's historic open-pit operations makes up a portion of the surficial topography. The surficial geology surrounding the mine area is depicted in Exhibit D5.3-1.

D5.3.2 Structural Geology

The geology of the mine area is consistent with regional structural trends and exhibits some evidence of structural deformation in the form of faulting and folding. The strike of the formations within the permit area is in an east-northeast direction, and the dip is approximately 2 degrees in a south-southeast direction.

As previously noted, the Powder River Basin is a large north to northwest trending asymmetric syncline. As the Brook Mine is located on the western margin of the basin, the structural axis of the syncline is generally east of the permit area, and the regional dip of the formations in the area is east-northeast, perpendicular to the synclinal axis of the basin. However, the mine area is located on the southern flank of the Ash Creek anticline which in

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combination with differential compaction of softer coals, appears to have locally shifted the dip of the formations in the permit boundary to the southeast as depicted on the USGS Monarch Quadrangle (Barnum, 1983).

Several low amplitude anticlines and synclines have been mapped as well as several en echelon normal faults with traces oriented along the strike direction and with fault displacements ranging between 20 and 150 feet. These sub-parallel northeast – southwest trending faults were identified by B.E. Barnum, as shown on Figure D5.2-3 with alternating displacements similar to a horst and graben system. Barnum's contours suggest that fault displacement is generally on the order of 50 feet within the mine area (Barnum, 1983).

D5.3.3 Stratigraphy

The permit area lies in the Sheridan Coal Field of Wyoming, a stratified deposit where the coal beds are interbedded with mudstones, siltstones, and sandstones. Coal beds of interest primarily exist in the Paleocene age Fort Union Formation, Tongue River Member. The Carney-Master coal sequence generally represents the base of this member in the vicinity of the Monarch, Wyoming USGS quadrangle mapped by B.E. Barnum (Barnum, 1983). Below the Tongue River Member lays the Lebo Shale Member which is largely mudstone with few thin coal stringers. Strata of the Fort Union Formation are mainly comprised of mudstone, siltstone to fine-grained sandstone, and coals of varying thickness. Aquifer materials, such as sandstone as desired for developing groundwater resources, are relatively scarce and generally thin.

As part of the permitting process, a drilling program was implemented to further investigate the stratigraphy and coal within the permit area. A complete tabulation of drill holes is presented in Addendum D5-1. The complete geophysical logs with the typical coal logging suite including a log header, density, resistivity, gamma and caliper logs associated with RAMACO are provided in Addendum D5-2. Cross-sections of the permit area, developed from

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the logs, are included in Addendum D5-3 and structure isopach maps included in Addendum D5-4. Please note that the logs used in the cross-sections have been adapted from the gamma ray log ASCII standard (LAS) text files provided by the logging company for scaling and presentation purposes.

In the geologic cross-sections (Addendum D5-3) were expanded in response to comments that resulted from the EQC hearing. The cross-sections were extended outside of the proposed permit boundary to the south across the Tongue River to the southern valley wall. Cross sections D-D', E-E', F-F', G-G', I-I' and L-L' now include completion information from private wells that are on file with the Wyoming State Engineer (SEO). The SEO completion forms (Form U.W. 6) for wells used in the cross sections are housed in Addendum D5-8. The quality of the data presented on the U.W. 6 Forms are highly variable; in some instances, the forms provide detailed drill cutting descriptions, while in some cases there is no lithologic information presented. Some wells are completed only in the Tongue River alluvium while other wells penetrate the alluvium and underlying bedrock. Due to the number of private wells in the area between the proposed permit boundary and southern valley wall, only those wells that are on the cross sections are presented. Most of the geologic cross sections demonstrate there is no hydraulic connection between the targeted coals and the Tongue River. However, there is a possibility that the Tongue River alluvium may be in communication with the Carney coal where it potentially intersects the Tongue River alluvium. The potential Carney coal outcrop line is shown on Addendum D5-3 Exhibit 1 and the potential area of communication occurs in the immediate vicinity of the Tongue River and Carney coal outcrop intersection.

As evident from Exhibit D5.3-1, the Fort Union Formation and its scoria derivatives form most of the surface of the permit area and much of the exposed Tongue River Member has been baked and fused from coal beds burned in place. The burnt coal has had a large adverse effect on the remaining coal resources, mainly north of the Tongue River Valley. Strata from the Lebo Member are mainly mudstone. A description of stratigraphic nomenclature used is provided in Table D5.3-1.

D5.3.3.1 Alluvial

Quaternary deposits including stream-laid alluvial material as well as slope-wash colluvial material is present near the principle drainages within the mine area as depicted on

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Exhibit D5.3-1. Stream-laid deposits (alluvium), fan deposits, and contiguous deposits of colluvium and slope wash, all of Holocene age, cover broad, flat areas of the Tongue River valley floor. These unconsolidated deposits were transported and distributed by fluvial and mass wasting processes onto surfaces that were being contemporaneously eroded in the landscape of the Fort Union and Wasatch Formations.

Alluvial material associated with the Tongue River is regionally understood to be medium to coarse, rounded sands and gravels. Recent exploration drilling through the Tongue River alluvial material near the mine area demonstrates local alluvial composition is similar to regional trends (see the lithologic log for R13-026 in Addendum D5-2).

Drill cutting samples were analyzed during the installation of monitoring wells along the Slater Creek drainage. These cuttings appeared colluvial as they were largely scoria based with abundant coal chips in a clayey silt matrix. However, sub-rounding of the clinker present in the cuttings suggests water driven deposition of limited extent, has occurred. Quaternary fill in the Slater Creek valley floor averages approximately 20 feet in thickness. Often where coal seams lie under or in contact with these Quaternary deposits they are saturated.

D5.3.3.2 Overburden and Underburden

The majority of the Carney overburden within the permit area is composed of claystone (grey), although intermittent, less continuous, moderately to well cemented, siltstone and sandstone lenses are also present. On the northeast and east of the mine area the percentage of siltstone and sandstone increases and is often very well cemented. Where these sandstone intervals underlie the valley floors of the principle drainages they are often saturated. Carney overburden depths are generally dictated by the geomorphic features within the permit area with thin sections occurring along drainage areas and areas of thickening occurring along the high ridges defining the local tributaries. The thickness of Carney overburden increases in the southeast corner of the permit area as the Carney and Masters coal seams merge together. Local, thin, rider coal stringers are present in much of the overburden. Where the overlying Monarch coal was

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burned, there are significant clinker remnants. See geologic cross-sections in Addendum D5-3 for overburden thickness.

The underburden between the Carney and Masters coal seams is predominately claystone with thin, discontinuous sandstone and siltstone lenses in some areas; however it is generally understood to be an aquitard as demonstrated by substantially different cluster monitor well water elevations as described in Appendix D6. The underburden ranges in thickness from less than one foot on the eastern boundary of the permit area, to over 50 feet and averages 24 feet thick. On the western half of the permit area the Carney has been split by a grey claystone parting which varies from nothing at the split boundary to in excess of 30 feet, as shown on the cross-sections (Addendum D5-3) and isopachs (Addendum D5-4).

Addendum D5-5 presents results from a splitting tensile strength test by method of Brazilian Disk ASTM D3967. This method gages tensile strength by subjecting a circular disk sample with a thickness to diameter ratio between 0.2 and 0.75 to diametral line compression to the point of failure.

Due to the proposed auger mine method, roof and floor samples were obtained for structural analysis from locations within the mine area during coal exploration coring. Laboratory strength analysis was conducted on four samples from two locations (R13-019 and R13-023) and results provided in Addendum D5-5. These specific sample sites were chosen due to their central locality to the permit area. It is understood that due to the nature of the area and the strike and dip of the coal seams and the ever-changing overburden and underburden thicknesses that these samples will not represent all conditions encountered by the continuous miner. Prior to initiation of auger mining activity, samples will be collected and strength testing will be conducted on those samples in order to satisfy the requirements of the MSHA ground control plan, which must be approved prior to mining. The future testing results and analysis in preparation of the MSHA ground control plan will be provided to WDEQ/LQD.

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The results of the tensile strength tests will be utilized to size both the web pillars and barrier pillars to achieve a factor of safety as set by the MSHA ground control plan to conduct mining and minimize the risk of subsidence.

D5.3.3.3 Coal

Across the majority of the permit area there are two coal seams within the planned minable sequence, the Carney (includes the Upper and Lower Carney) and the Masters, which have been mapped by historic drilling as well as recent and ongoing exploration efforts by RAMACO. Lithologic and geophysical logging data are available in Addendum D5-2. The Carney lies above the Masters which together generally mark the bottom of the Tongue River Member of the Fort Union Formation. Fragments of the overlying Monarch seam exist within isolated portions of the mine area as shown on the geologic cross-sections in Addendum D5-3 and may present a secondary target; however, a large percentage of the seam was burned or eroded and minable remnants are relatively small and discontinuous. The location of exploration drilling and historic mining surrounding the permit area is presented, along with geologic cross-section locations, on Addendum D5-3 Exhibit 1.

The Carney coal in the eastern portion of the mine area ranges from 15-20 feet thick and generally becomes thinner to the west as depicted on the cross-sections. The overburden material above the Carney coal seam increases to the southeast following the general dip of the coal seam. Localized faulting throughout the permit area also increases/decreases the depth of the overburden material depending on the direction of the faulting as depicted by the cross sections in Addendum D5-3. A clay parting cuts the Carney into upper and lower beds generally perpendicular to the dip of the formation in a northwest-southeast trending interface near the center of the proposed permit boundary as depicted on the Carney isopach maps. The Upper Carney on the western half of the mine area ranges from two to six feet in thickness and generally thins to the west; coal quality for the seam is noted in Table D5.3-2. The Lower Carney ranges from four to ten feet thick across the western half ofthe

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permit area, also thins towards the west, but typically exhibits better quality than its upper counterpart. In small portions of the north-central region of the permit area the Carney seam has been further split by additional clay partings to a degree that no economically minable sequence is present.

The underlying Masters coal seam ranges between four and six feet thick across the permit area with the exception of those areas where the coal has potentially been removed by erosion as depicted on the geologic cross-sections in Addendum D5-3. The total material thickness above the Masters seam including the combination of overburden, the Carney seam, and the Carney seam underburden generally tends to increase as the Masters seam dips toward the southeast portion of the permit area. The total material thickness above the Masters seam is at a minimum in the northwest portion of the permit area in lowland areas where the Masters coal seam begins to daylight.

Within the permit boundaries there are additional coal seams shown in the geologic cross-sections provided in Addendum D5-3. The Dietz seams are located above the Monarch seam and were targeted by Big Horn Coal Company (Glass & Jones, 1992). The Monarch coal seam ranges in depth from zero to 25 feet across the permit area with an average thickness of around 11 feet. The coal seam tends to dip from the northwest towards the southeast. The overburden material above the top of the Monarch coal seam increases as the coal dips towards the southeast. The Monarch seam, throughout the permit area, generally shows up as areas of burn except in highland areas and areas in the southeast corner of the permit area.

As seen on the cross sections of Addendum D5-3 coal stringers with unknown names are located throughout the permit area below the Masters seam. These coal stringers are likely partings of other coal seams with differing sediment deposited on them over time. The coal stringer locations and depths from ground surface vary throughout the permit area with changes occurring due to varying deposition and faulting. The coal stringers are generally less

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than three feet in thickness and are interbedded by mostly claystone and siltstone.

Coal isopachs provided in Addendum D5-4 show some erratic, broken or discontinuous isopach lines due to outcrop, sub-crop, faulting, seam parting, historic mining, and the limited capabilities of the modeling software. However, they generally provide a general understanding of coal continuity and thickness within the permit area. See geologic cross-sections provided in Addendum D5-3 for seam thickness and depth below surface for all coal seams in the permit area.

D5.3.4 Geologic Hazards

Seismic and other geologic hazards are considered very low for the mine area. Historic seismic occurrences for Wyoming are shown in Figure D5.3-1 only four of which have been recorded in Sheridan County. Uniform Building Code requires structural design in accommodation of the 2,500 year earthquake event; contours of the expected ground acceleration of the 2,500 year seismic event for Wyoming are provided in Figure D5.3-2. Within the permit area the estimated acceleration of the 2,500 year event is approximately 12%g, comparable to a category VI earthquake on the Modified Mercalli Intensity Scale (Case, 2002). No active faults with a surficial expression are present in Sheridan County and the risk of structural failure due to seismic events is minimal and can be adequately addressed with prudent structural design (Case et al., 2002).

Some subsidence associated with historic coal removal is apparent in portions of the surface topography and represents a potential geologic hazard; however, detailed mapping of the historic mines is available; general underground mines locations are provided in Addendum D5-3. Structural or other geologic issues associated with subsidence are location specific and can be addressed by avoiding these areas, prudent structural design, or ultimately, reclamation.

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Landslides are also a geologic hazard in Sheridan County; however, this risk is associated predominately with steep terrain in the Big Horn Mountains. Historic data suggests that no substantial landslides have occurred within the permit area or surrounding area; therefore, risk to mining operations on the permit area is expected to be relatively low (Hitty, 2013).

D5.3.5 Historic Exploration/Development Activities

Drill records indicate that past mineral exploration by drilling methods were conducted on the permit area between 1966 and 1979 during various drilling campaigns run by Big Horn Coal and possibly other unidentified parties. Early exploration by Big Horn Coal was concentrated on the east side of the permit area near where Big Horn Coal developed a surface mine in the Dietz and Monarch coal seams. Records for more than 425 individual drill holes exist for these early drilling efforts; however, much of the historic data is of poor or incomplete quality, is difficult to integrate into ongoing resource evaluation efforts and was largely left out of cross-sections in Addendum D5-3.

More recent drill exploration by RAMACO and Ambre Energy has occurred predominately on the westernside of the mine area north of the Tongue River Valley and in areas of interest or sparse data locations. Spot-core drilling methods were used to collect rock and coal samples and holes were geophysical logged. This information represents the primary data cited in the evaluation of the coal resources within the mine area. The procedure for RAMACO's exploration program included a combination of air or mud/foam rotary (as necessary) drilling and diamond coring. A pilot hole was first advanced through the entire minable sequence using air/mud rotary and logged. After the appropriate intervals were selected from the geologist and geophysical logs, a twin hole was advanced to the top of the zone of interest and samples were obtained using a 3-inch core barrel.

Several historic underground mines were developed within the mine area. Most notably, the Carney Mine, an underground mine covering most of

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the south half of T57N R87W Section 17 and portions of Sections 16 and 20, was developed and operated during the early 1900s. The mapped extents of this historic mine are presented of Addendum D5-3 and Addendum D5-4. Further details of historic mining are presented in Appendix D2.

In addition to the coal mineral exploration, public-record oil and gas holes have also been drilled on and adjacent to the mine area.

D5.4 Overburden Assessment, Permit Area

An assessment of the quality of the non-coal material within the mineable sequence was prepared based on samples collected during the 2012 and 2013 coring programs. The sample frequency was reduced from Guideline 1, based on agreement with WDEQ (Addendum D5-6). Results of the laboratory testing can be found in Addendum D5-7 and the tabulated locations of each core location can be found in Addendum D5-1. These results are summarized in Section D5.4.1. All of the overburden samples collected can be described as chip samples. Typically overburden samples are composited in 5-foot intervals; however, sample in the permit area were collected in 10-foot intervals. With three exceptions, R12-001, R12-002 and R12-003, the boreholes penetrated the entire minable sequence and seven holes provided underburden samples as well.

As the proposed mining method for the Brook Mine disturbs a narrow slot of overburden for access of auger mining equipment, RAMACO requested to reduce the overburden sampling density outlined by WDEQ/LQD's Guideline No. 1 to one sample per 80 acres (eight per section) so long as samples reasonably represent the area where the slot/highwall is to be constructed for auger mining access. This request was sent to WDEQ/LQD in a letter on August 26, 2013, which is included in Addendum D5-6. Overburden samples were collected from twenty-five (25) locations within the permit area, samples from seventeen (17) of which were submitted to the laboratory for testing based on proximity to minable coal. These sample locations amply characterize the

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overburden near the proposed slot access locations as depicted in Addendum D5-6.

D5.4.1 Overburden Quality

Table D5.4-1 provides a summary of overburden strata chemical quality criteria outlined by WDEQ/LQD Guideline No. 1. The textural quality of the Project Area ranges from sand to clay but is predominately silty/clay loam to clay. Table D5.4-2 identifies zones within the non-coal minable sequence exceeding analyte concentrations for surficial reclamation and aquifer restoration.

During reclamation overburden will be returned to the slot in approximately the same order in which it was removed, therefore the material and associated analyte exceedences will be ordered similar to pre-mining conditions. Also, the proposed slot overburden removal method will minimize the area of disturbed overburden and the potential for contamination of surficial strata or groundwater aquifers. Prudent handling and mixing of zones of concern to meet WDEQ/LQD Guidelines will eliminate postmining contamination problems and aid reclamation efforts. For these reasons, RAMACO believes that overburden analyte exceedences will not pose a significant problem to meet WDEQ/LQD reclamation standards. Postmine monitoring procedures may be found in the Reclamation Plan.

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D5.5 References

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Table D5.3-1. Stratigraphic Nomenclature within the Project Area

Formation	**Member**	**Coal Seam**
Wasatch		
Fort Union	Tongue River	Dietz 2 and 3 Coal Seams (DTZ)
		Monarch (Canyon) Coal Seam (MON)
		Carney Coal Seam (CRN)
		Upper Carney (U-CRN)
		Lower Carney (L-CRN)
		Masters Coal Seam (MST)
	Lebo Member	Wall Coal Seam (WALL)
	Tullock Member	
Lance Formation		
Fox Hills Sandstone		

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Table D5.3-2. Coal Quality Characteristics

Seam	Btu/lb[1]	Ash[1]	Water Content[2]	Total Sulfur[1]
Carney	11,358	13.9	23.2	1.48
Carney-Upper	11,078	16.5	21.7	2.06
Carney-Lower	11,430	11.5	24.5	0.58
Masters	11,248	14.4	23.3	1.73
Monarch	9,265	5.75	23.8	0.7

[1] Results from analysis of "Dry" samples.
[2] Results from analysis of "As Received" samples.

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Table D5.4-1. Criteria to Establish Topsoil and Overburden Suitability Adapted from WDEQ/LQD Guideline No. 1 Table I-2 and I-4

		Surface (potential root zone) and Topsoil		Aquifer Restoration
Parameter	**Suitable**	**Marginal 1/**	**Unsuitable**	**Unsuitable**
pH	5.5-8.5	5.0-5.5; 8.5-9.0	<5.0; >9.0	<5.0
EC (Conductivity) mmhos/cm	0-8	8-12	>12	Depends on premine levels
Saturation Percentage	25-80	<25; >80		
Texture		c,sic,s		
SAR 2/	0-10	10-12; 3/; 10-15	>12 3/; >15	Depends on premine levels
Selenium	<0.3 ppm	>0.3-0.8 ppm, 5/	6/	Depends on premine levels
Boron	<5.0 ppm		>5.0ppm	Depends on premine levels
Nitrate/Nitrogen				>50ppm
Molybdenum	<1.0ppm	>1.0ppm		
Acid/base Pot. 4/	>-5		<-5	<-5
Arsenic	<2.0ppm	>2.0ppm		
Organic Carbon	<10%		>10%	

1/ Evaluated on an individual basis for suitability.
2/ As an alternative to SAR calculations, ESP (exchangeable sodium percentage) can be determined. ESP should be determined if suitable SAR value is exceeded.
3/ For fine textured soils (Clay 40%).
4/ Record as Acid pot., Neutralization pot. and acid-base potential in + tons $CaCO_3$ equivalent/1000 tons.
5/ The marginal value for selenium is keyed to sampling vegetation at bond release. Vegetation > 5 ppm Se is considered unsuitable.
6/ Depends on premining water quality and overburden quality.

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Table D5.4-2. WDEQ/LQD Guideline No. 1 Overburden Reclamation/Restoration Analyte Exceedance Summary

	Sample Range (ft)			pH (s.u.)			EC[1] (dS/m)			Saturation %			SAR[2]			Se (ppm)			Boron (ppm)			NO_3-NO_2 (ppm)			Molybdenum (ppm)			ABP[3] (t/1000t)			Arsenic (ppm)			TOC[4] (%)		
Hole No.	from	to	n	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min
R-12019D	0	140	9	6.3	8.2	5.7	2.5	3.6	1.0	60.2	75.4	36.0	3.0	5.5	1.4	0.02	0.02	0.0	0.8	0.9	0.8	92.5	118.0	66.9	0.2	0.4	0.1	46.2	191.0	4.7	0.3	0.6	0.1	3.6	25.8	0.2
R-12005	0	105	10	7.1	8.5	6.3	1.2	3.0	0.6	54.2	70.8	33.9	4.4	7.6	2.8	0.06	0.11	0.0	0.5	2.4	0.1	0.6	1.1	0.5	0.4	1.0	0.1	31.2	131.0	19.1	0.2	0.8	0.1	3.1	23.1	0.5
R-12002	0	134	13	5.4	8.2	4.3	2.1	4.2	1.1	53.2	76.5	31.5	4.2	8.6	2.1	0.09	0.57	0.0	0.8	3.6	0.1	0.7	1.8	0.3	0.3	1.1	0.1	20.4	54.6	27.4	0.3	3.1	0.1	3.2	10.4	0.1
R-12003	0	108	11	5.9	8.7	5.0	1.7	2.8	0.5	64.3	76.7	34.0	4.1	6.1	2.7	0.15	0.27	0.0	0.9	5.5	0.1	1.3	3.8	0.4	0.4	1.3	0.1	16.9	61.4	19.7	0.4	1.6	0.1	3.0	14.5	0.4
R-12001	0	69	6	6.6	8.2	6.2	1.3	2.3	0.8	59.2	75.8	39.1	2.5	5.0	1.0	0.07	0.13	0.0	1.2	2.8	0.4	4.1	17.1	0.4	0.3	0.9	0.1	26.9	81.2	-0.4	0.2	0.7	0.2	2.4	5.9	0.5
AMBRE-04	0	96	9	7.2	8.4	6.6	1.1	1.8	0.8	36.1	53.5	27.6	1.4	5.0	0.8	0.03	0.12	0.0	0.2	0.9	0.1	0.4	0.8	0.3	0.4	0.9	0.1	112.2	245.0	2.2	0.2	1.0	0.1	0.9	4.4	0.3
AMBRE-03	0	88	8	7.2	8.3	6.4	1.6	3.0	0.8	41.9	78.1	25.3	1.9	6.2	1.0	0.06	0.23	0.0	0.4	1.6	0.1	0.4	0.7	0.1	0.4	2.1	0.1	110.2	205.0	13.9	0.3	2.9	0.1	0.9	6.7	0.2
R-12006	0	125	8	7.7	8.3	7.3	0.7	1.2	0.3	55.3	64.4	39.5	1.0	1.5	0.3	0.05	0.09	0.0	0.2	0.5	0.1	0.6	0.9	0.2	0.3	0.6	0.2	32.5	80.1	3.0	0.1	0.2	0.1	0.8	1.8	0.1
R13-012	0	163	16	7.5	8.8	6.6	0.9	2.8	0.3	44.6	77.1	32.0	0.9	4.6	0.4	0.05	0.16	0.1	0.6	1.8	0.3	0.5	2.1	0.3	0.2	1.3	0.1	36.2	164.0	-7.1	0.1	0.4	0.1	1.4	7.8	0.1
R13-018	0	130	10	7.8	8.3	7.3	1.2	4.0	0.4	55.2	75.5	32.5	1.5	5.2	0.5	0.02	0.09	0.1	0.3	1.0	0.1	0.6	1.7	0.2	0.1	0.4	0.1	82.5	193.0	14.3	0.1	0.2	0.1	0.4	1.8	0.1
R13-019	0	151.5	16	7.7	8.3	7.2	1.5	2.8	0.6	47.0	60.6	35.3	2.9	4.3	0.9	0.03	0.11	0.0	0.5	1.5	0.2	4.4	26.0	0.2	0.3	1.0	0.1	86.3	248.0	10.7	0.2	0.7	0.1	1.0	5.8	0.1
R13-023	0	170	16	7.8	8.4	7.1	0.9	1.3	0.4	48.8	81.4	36.0	2.9	9.3	1.0	0.06	0.21	0.1	0.5	1.8	0.2	0.2	0.6	0.1	0.4	1.1	0.1	44.2	181.0	5.7	0.2	0.7	0.1	1.3	5.2	0.2
R13-011	0	182	17	7.8	8.7	7.0	0.8	1.3	0.5	45.3	103.0	28.9	2.9	10.4	0.5	0.05	0.27	0.0	0.8	1.4	0.4	0.4	0.9	0.2	0.4	1.0	0.1	37.5	119.0	-7.3	0.3	0.8	0.1	1.5	8.4	0.1
R-12007	0	138.6	14	7.6	8.9	6.7	0.7	1.2	0.4	52.4	70.4	33.0	3.2	7.4	0.3	0.05	0.24	0.0	0.4	2.2	0.1	0.8	2.3	0.3	0.3	0.8	0.1	28.2	96.6	-8.4	0.1	0.5	0.1	1.9	12.7	0.2
R-12004	0	184	17	4.9	8.5	3.8	1.5	3.1	0.5	61.0	82.2	29.1	4.4	9.1	2.8	0.12	0.38	0.0	1.5	5.3	0.2	24.6	115.0	0.3	0.7	2.5	0.1	25.8	173.0	37.9	0.5	2.9	0.1	4.7	19.0	0.2
R-12020	0	142	13	5.0	8.2	3.9	1.7	4.8	0.6	61.0	81.2	41.7	4.4	7.4	2.1	0.07	0.17	0.0	1.1	4.2	0.1	7.3	62.1	0.4	0.9	7.2	0.1	35.7	95.6	-5.5	0.2	1.0	0.1	3.7	22.6	0.1
AMBRE-02	0	29.8	3	7.1	8.2	6.7	5.4	7.9	1.8	45.3	50.4	40.5	3.0	4.9	0.7	0.13	0.20	0.1	1.2	1.5	1.0	1.0	1.4	0.3	0.5	1.0	0.1	65.6	111.0	39.0	0.1	0.4	0.4	1.7	5.1	0.1
BH166-76	0	311	30	8.1	9.1	6.9	1.5	3.8	0.4	45.6	98.3	18.2	6.5	21	1.3	0.2	0.2	0.2	0.4	1.6	0.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BE326-78	0	31	7	4.5	7.9	3.7	5.8	8.8	3.3	42.1	78.4	19.5	5.7	9.9	1.8	0.2	0.2	0.2	1.2	3.5	0.2	33.8	69.4	12.6	3.4	4.0	2.4	88.3	108.6	71.6	NA	NA	NA	NA	NA	NA

[1] Electrical Conductivity
[2] Sodium Adsorption Ratio
[3] Acid Base Potential (ton $CaCO_3$ per 1000 ton material)
[4] Total Organic Carbon
NA: No data available.

Unsuitable for Surface Reclamation (WDEQ/LQD Guideline No. 1)
Unsuitable for Aquifer Restoration(WDEQ/LQD Guideline No. 1)
Marginally suitable (WDEQ/LQD Guideline No. 1)

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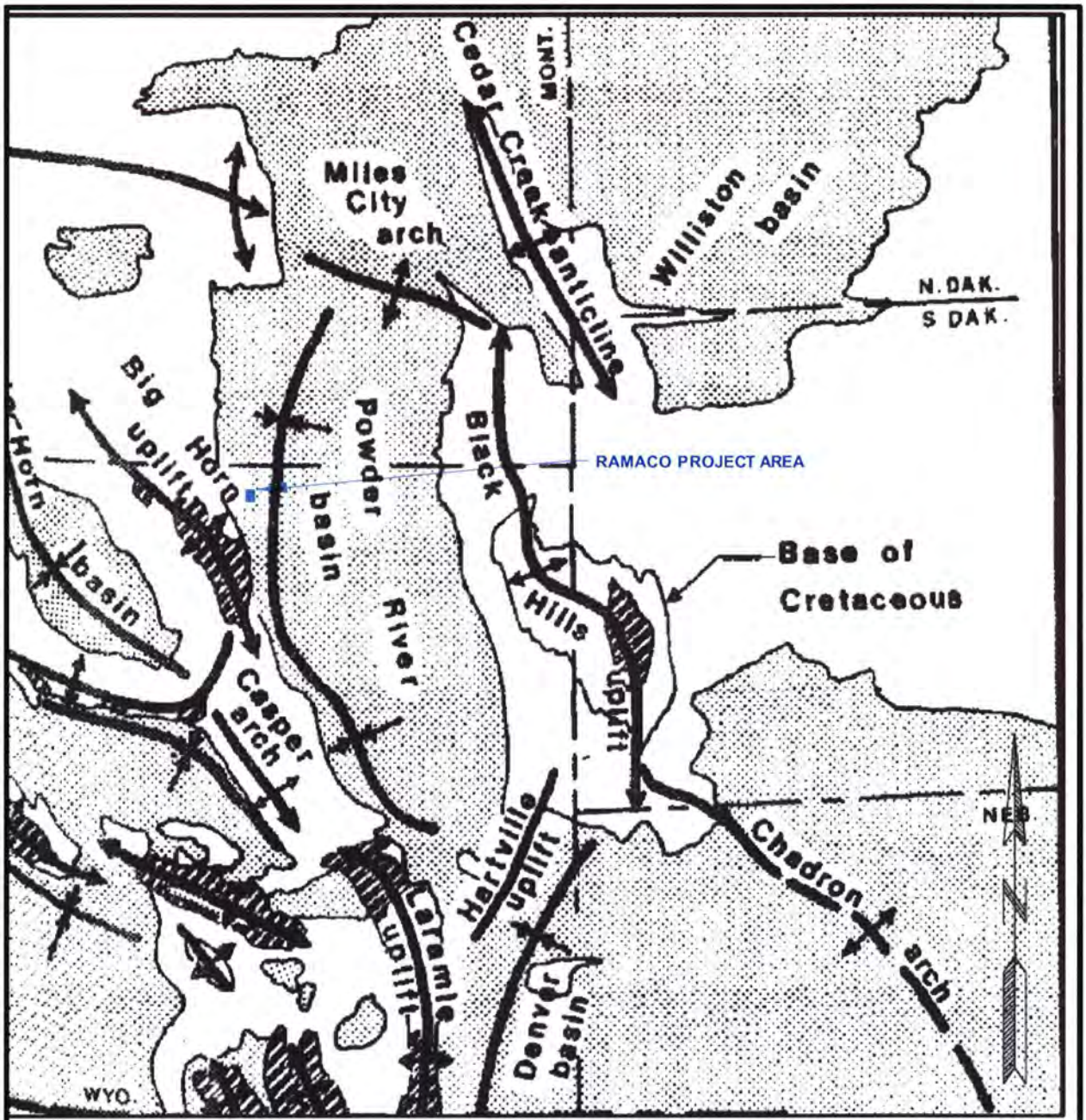

0 35 70 140
GRAPHIC SCALE (MILES)

Information modified from Figure 2 in Lisenbee (1978).

Regional tectonic setting of the Black Hills uplift at the easternmost margin of the Wyoming province. Diagonal pattern indicates Tertiary deposits. Approximate location of axes of uplifts and basins shown with heavy line.

Figure D5.2-1. Regional Tectonic Setting

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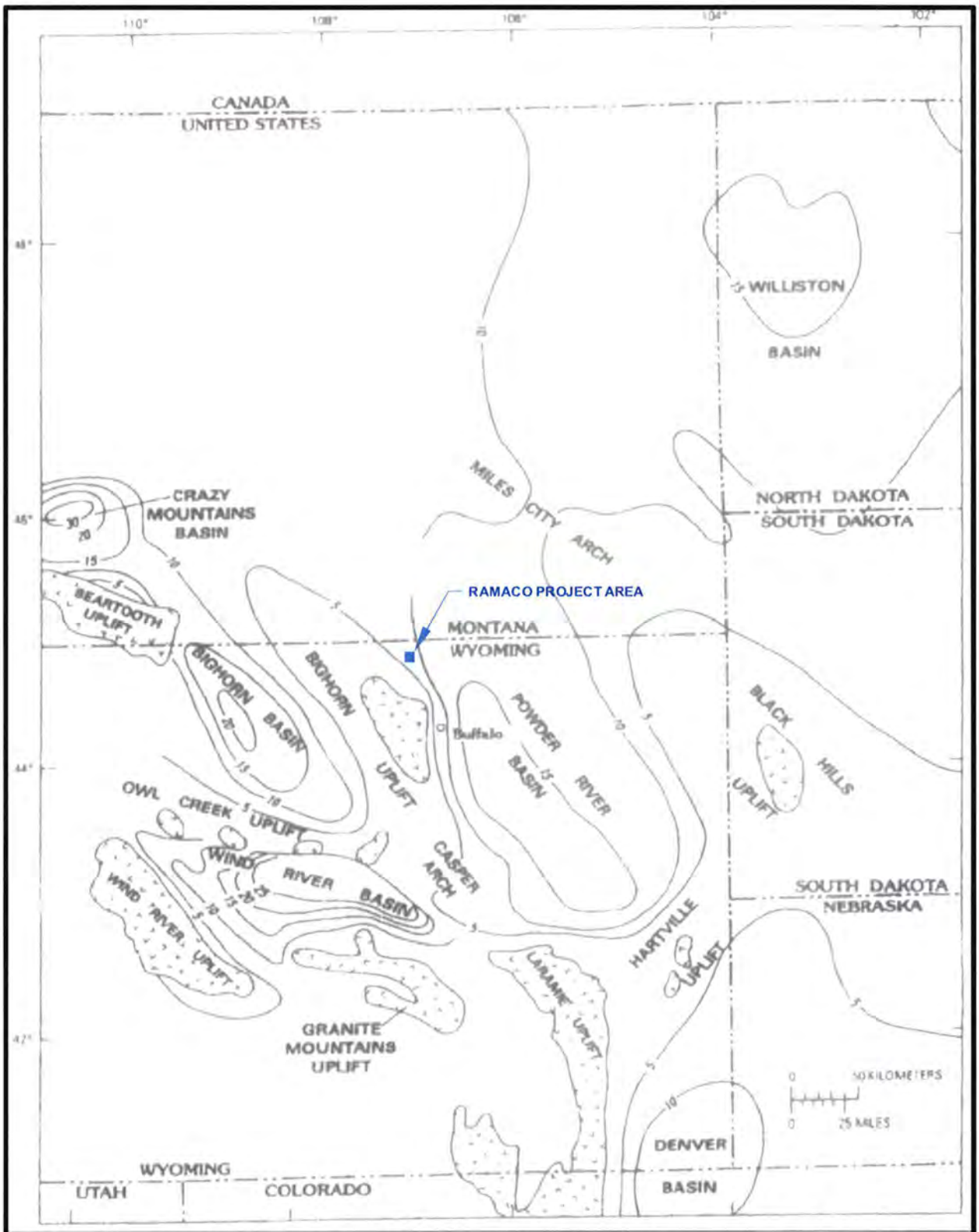

Structure contours on top of the Precambrian below mean sea level. Contour interval is 5,000 ft. (after Seeland, 1992).

Figure D5.2-2. Generalized Geologic Structures in and near the Powder River Basin

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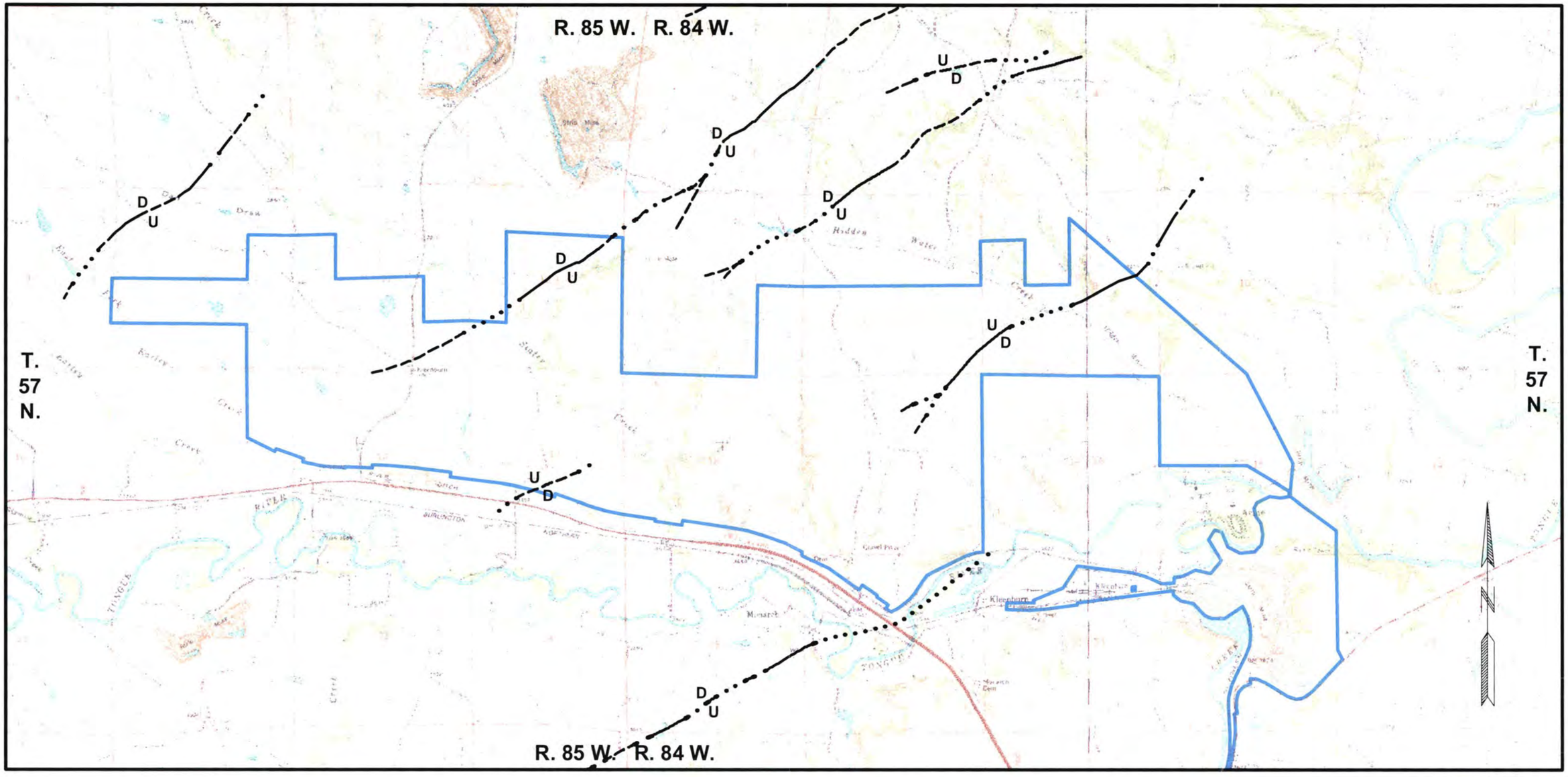

LEGEND

- BROOK MINE PERMIT BOUNDARY
- FAULT LOCATION - APPROXIMATE
- FAULT LOCATION - INFERRED
- FAULT LOCATION - CONCEALED

Adapted from:
PRELIMINARY GEOLOGIC MAP OF THE SHERIDAN AREA, NORTHWESTERN POWDER RIVER BASIN, WYOMING (S.P. Kanizay, 1978)
GEOLOGIC AND STRUCTURE MAPS OF THE MONARCH QUADRANGLE, SHERIDAN COUNTY, WYOMING, AND BIG HORN COUNTY, MONTANA (B.E. Barnum, 1983)

Drawing Coordinates: WY83ECF

0 1,500 3,000 4,500 6,000
GRAPHIC SCALE (FEET)

RAMACO

BROOK MINE
SHERIDAN COUNTY, WY
1101 SUGAR VIEW DR STE. 201
SHERIDAN, WY 82801

REVISIONS

Date	Description

FIGURE D5.2-3

FAULTS

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Drawn By: MBM
Checked By: SMR
Date: 10/08/14

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FILE: D5_GEO_FAULTS

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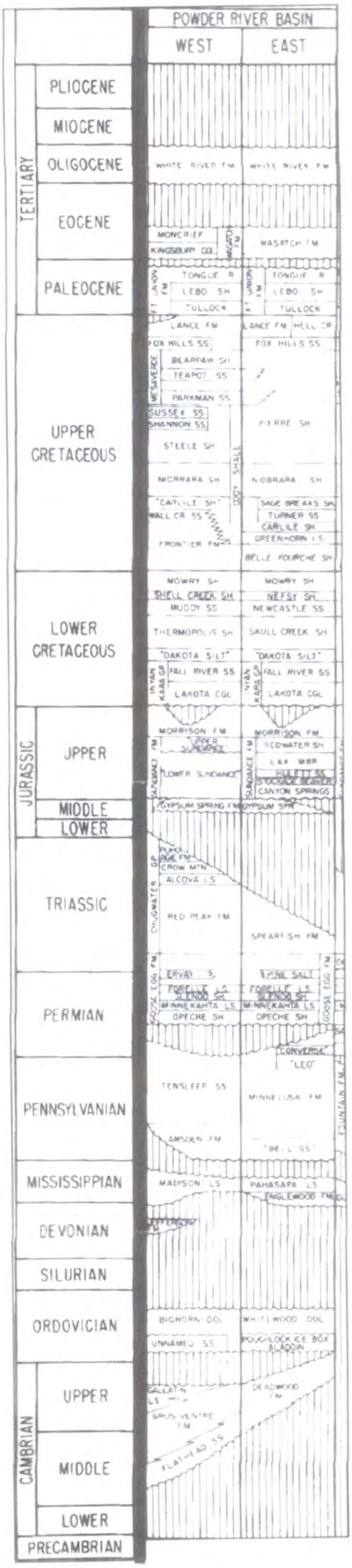
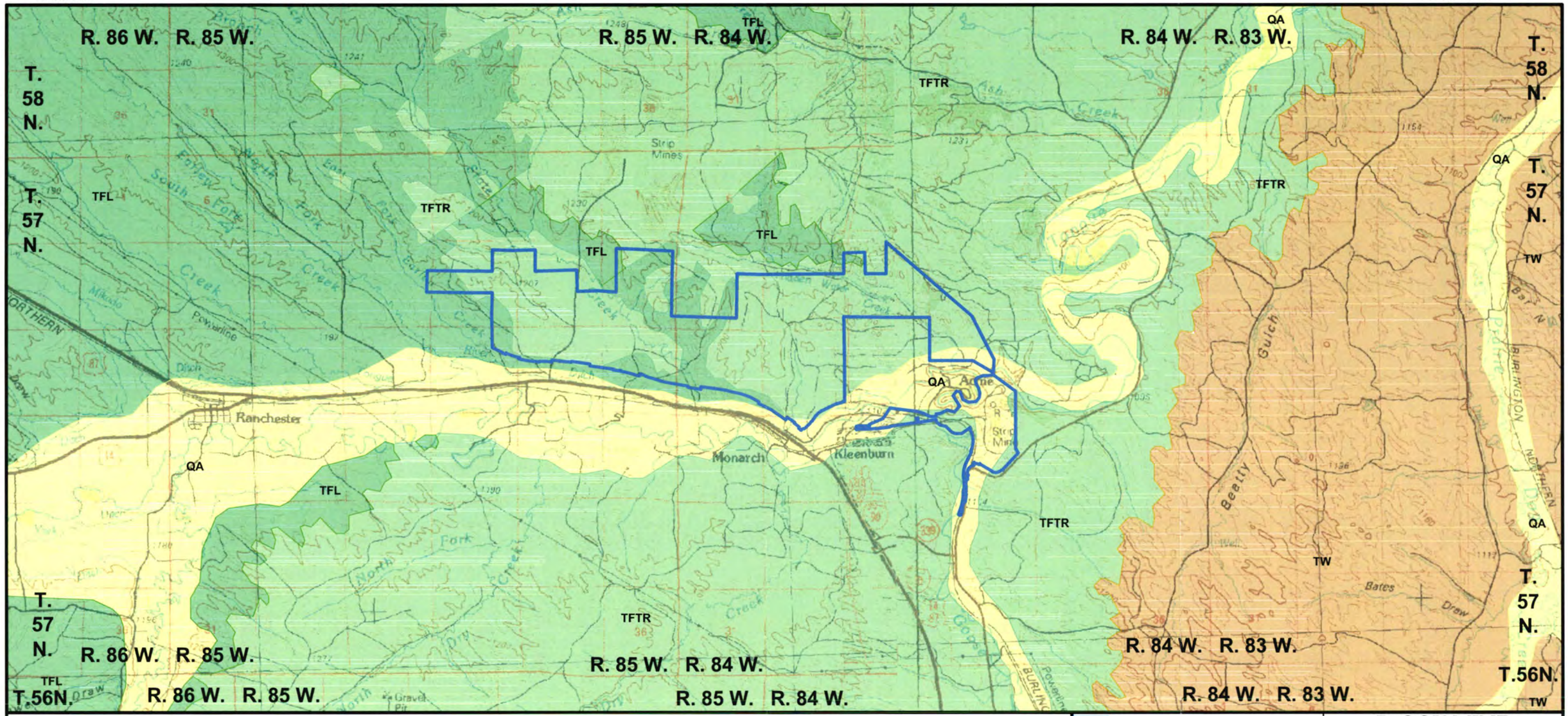


Figure D5.2-4. Regional Stratigraphic Column Modified from WGA Guidebook for 28th Annual Field Conference (1976)

TFN 6 2/025
RECD NOV 14, 2014

DEQ Ex. 2-121



LEGEND

- BROOK MINE PERMIT BOUNDARY
- QA - ALLUVIUM AND COLLUVIUM (ALLUVIAL)
- TFL - FORT UNION FORMATION: LEBO MEMBER (EARLY TERTIARY)
- TFTR - FORT UNION FORMATION: TONGUE RIVER MEMBER (EARLY TERTIARY)
- TW - WASATCH FORMATION (EARLY TERTIARY)

Scanned, 02/27/2020

SOURCE: WYGISC AT UNIVERSITY OF WYOMING

0 3,000 6,000
GRAPHIC SCALE (FEET)

RAMACO

BROOK MINE
SHERIDAN COUNTY, WY

1101 SUGARVIEW DR STE. 201
SHERIDAN, WY 82801

REVISIONS	
Date	Description

FIGURE D5.2-5

RAMACO PROJECT AREA
BEDROCK GEOLOGY

TFN 6 2/025
RECD NOV 14, 2014

Drawn By:	CIG
Checked By:	JGB
Date:	10/08/14

FILE: FIG_D5_2-5_BED_GEO.dwg

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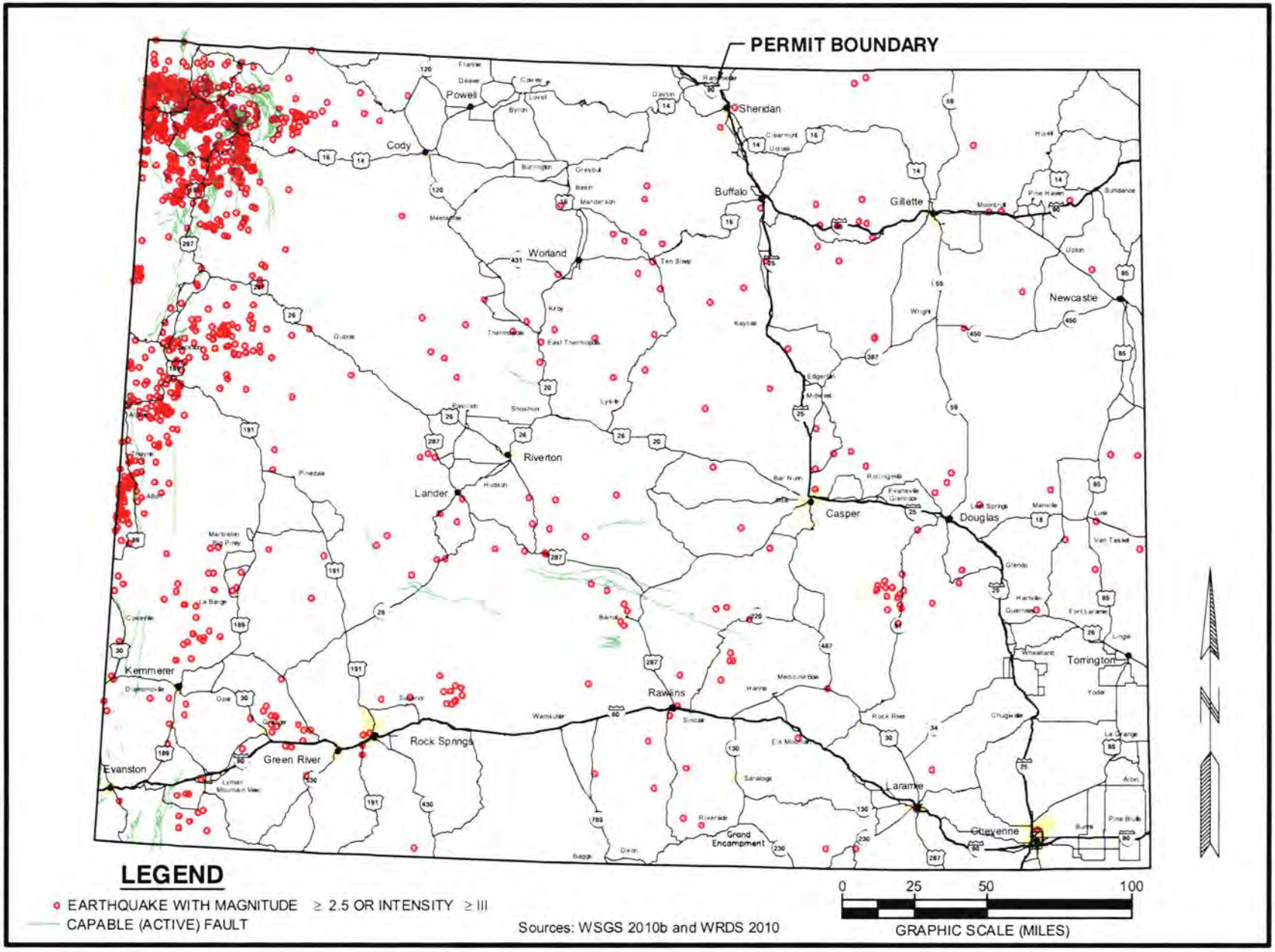
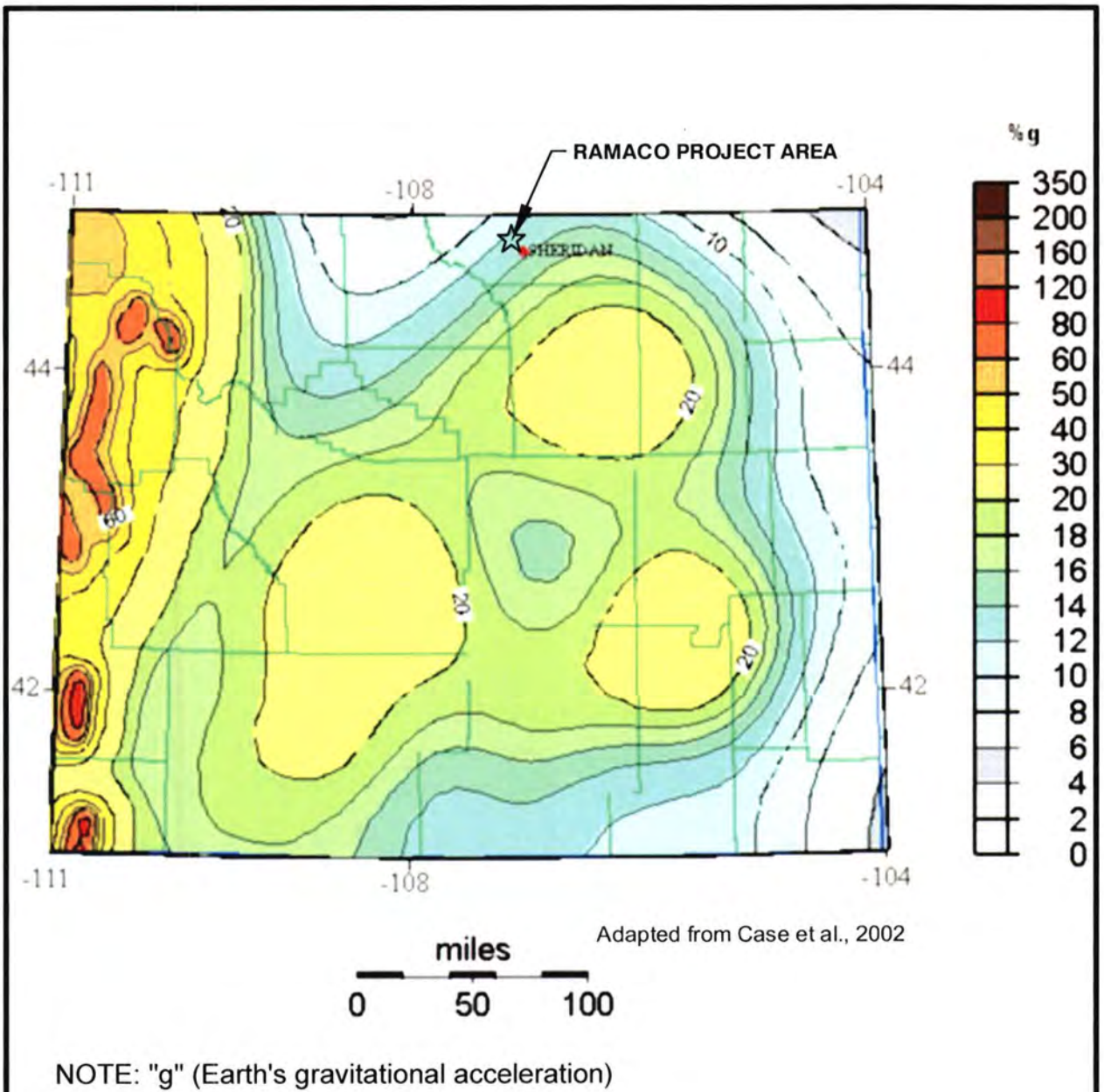


Figure D5.3-1. Historic Earthquakes in Wyoming

TFN 6 2/025
RECD NOV 14, 2014

DEQ Ex. 2-123

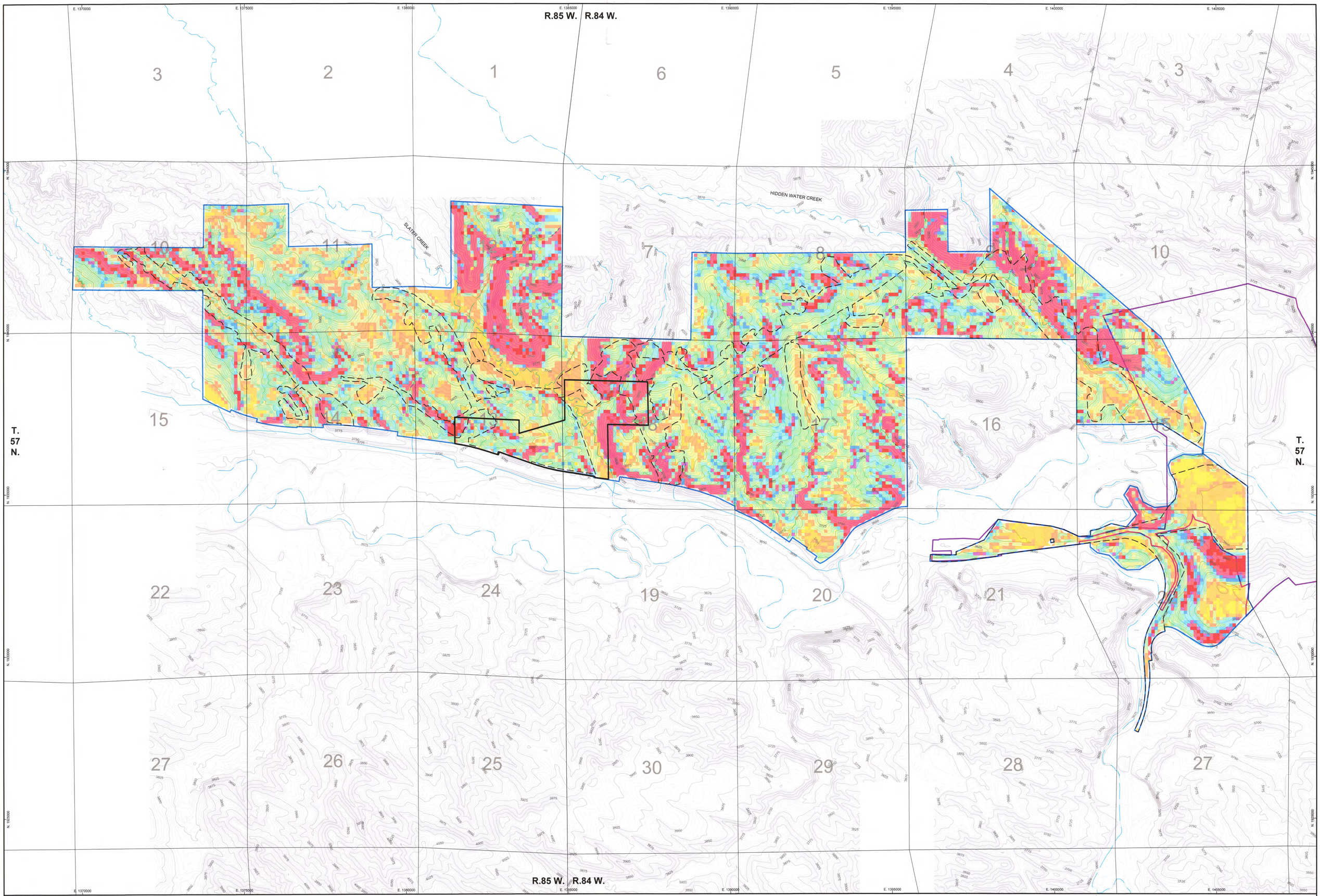
Scanned, 02/27/2020



NOTE: "g" (Earth's gravitational acceleration)

Figure D5.3-2. Expected Ground Acceleration of 2,500 Year Earthquake Event.

TFN 6 2/025
RECD JUL 30, 2015

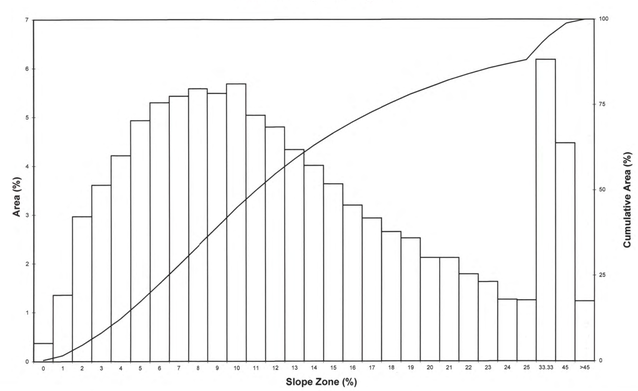


Drawing Coordinates: WY83ECF

Slope Zone (percent)	Area (acres)	Percent of Total (percent)	Accumulated Percent (percent)
0	16.30	0.37	0.37
1	59.46	1.36	1.73
2	130.05	2.97	4.69
3	158.40	3.61	8.30
4	184.92	4.22	12.52
5	216.25	4.93	17.45
6	232.32	5.30	22.75
7	238.06	5.43	28.18
8	244.84	5.58	33.76
9	240.70	5.49	39.25
10	249.20	5.68	44.93
11	220.96	5.04	49.97
12	210.29	4.79	54.76
13	189.97	4.33	59.09
14	175.74	4.01	63.10
15	159.21	3.63	66.73
16	140.04	3.19	69.93
17	128.44	2.93	72.85
18	116.05	2.65	75.50
19	110.31	2.52	78.02
20	92.63	2.11	80.13
21	92.63	2.11	82.24
22	77.94	1.78	84.02
23	70.94	1.62	85.63
24	55.10	1.26	86.89
25	54.64	1.25	88.14
33.33	270.78	6.17	94.31
45	195.71	4.46	98.77
>45	53.83	1.23	100.00

Average Slope: 13.50%
Minimum Slope: 0.00%
Maximum Slope: 69.50%

Premine Slope Histogram



LEGEND

- BROOK MINE PERMIT BOUNDARY
- BIG HORN COAL PERMIT BOUNDARY (PERMIT NO. 213-T7)
- TAYLOR QUARRY PERMIT BOUNDARY (PERMIT NO. SP-757)
- AFFECTED AREA BOUNDARY

SLOPE RANGES (%)

- 0.00 to 1.00
- 1.00 to 2.00
- 2.00 to 3.00
- 3.00 to 4.00
- 4.00 to 5.00
- 5.00 to 6.00
- 6.00 to 7.00
- 7.00 to 8.00
- 8.00 to 9.00
- 9.00 to 10.00
- 10.00 to 11.00
- 11.00 to 12.00
- 12.00 to 13.00
- 13.00 to 14.00
- 14.00 to 15.00
- 15.00 to 16.00
- 16.00 to 17.00
- 17.00 to 18.00
- 18.00 to 19.00
- 19.00 to 20.00
- 20.00 to 25.00
- 25.00 to 33.33
- 33.33 to 45.00
- > 45.00

CERTIFICATE OF ENGINEER

I, Jeffrey G. Barron, hereby certify that this drawing was prepared by myself or by engineers under my direct supervision and that it correctly represents the conditions described in the accompanying application which is designed to meet the requirements of the Wyoming Environmental Quality Act and its accompanying regulations.

Professional Engineer (Civil) JEFFREY G. BARRON 13035 STATE OF WYOMING
9/20/2019

0 500 1,000 1,500 2,000
GRAPHIC SCALE (FEET)
C.I. = 5'

RAMACO

BROOK MINE
SHERIDAN COUNTY, WY

1101 SUGARVIEW DR. STE. 201
SHERIDAN, WY 82801

REVISIONS	
Date	Description
08/18	ROUND 7 COMMENTS
09/19	ROUND 10 COMMENTS

EXHIBIT D5.1-1

TFN 6 2/025
RECD 09-20-19

PREMINE SLOPE ANALYSIS

Drawn By: DCJ
Checked By: JGB
Date: 10/08/14

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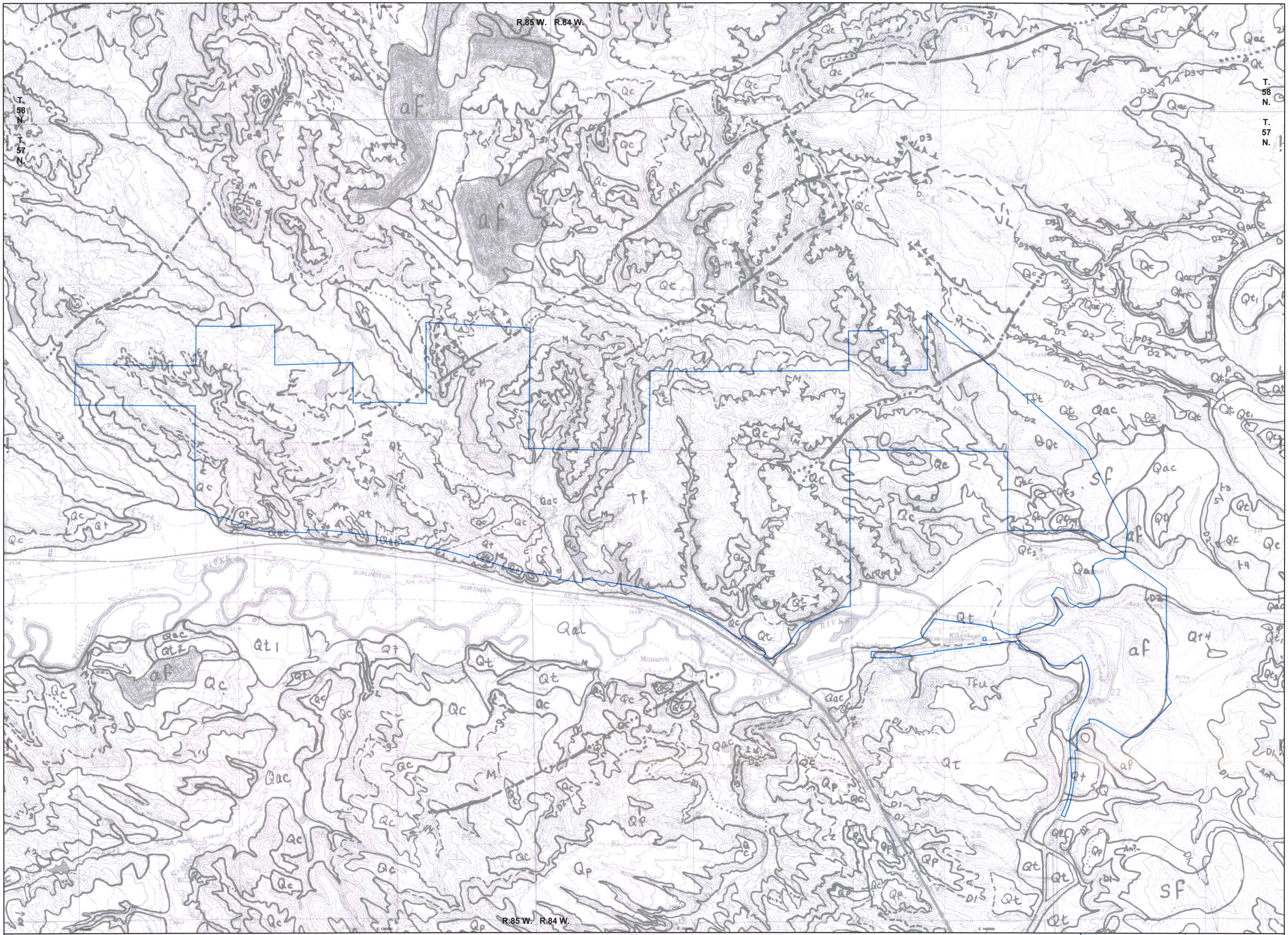

Basemap::
GEOLOGIC STRUCTURE MAPS OF THE MONARCH QUADRANGLE, SHERIDAN COUNTY, WYOMING (S.P. Kanisay, 1978), AND BIG HORN COUNTY, MONTANA By B.E.Barnum (1983)

LEGEND

BROOK MINE PERMIT BOUNDARY

af ARTIFICIAL FILL (HOLOCENE) - Mainly spoil from coal mine stripping

sf Subsidence features - Related to old underground coal mines; extent unknown

SURFICIAL DEPOSITS (HOLOCENE AND PLEISTOCENE)

Qal Alluvium - Unconsolidated clay, silt, and sand; locally includes lenses of gravel and contains much organic matter

Qc Colluvium - Unconsolidated heterogeneous aggregates of rock detritus deposited on steep to gentle slopes, usually thick enough to obscure underlying bedrock. Includes slope wash and talus

Qac Alluvium and Colluvium undifferentiated

Qls Landslide deposits - Unconsolidated masses of clay, silt, and sand which have moved downslope as slumps and slides. May include exotic blocks of limestone, sandstone, and conglomerate

Qt Stream terrace deposits uncorrelated

Qt_1 Stream terrace deposits - Unconsolidated stratified and crossbedded silt, sand, and gravel. Divided into 6 deposits (Qt_1, Qt_2, Qt_3, Qt_4, Qt_5, and Qt_6); Qt_1 deposits are lowest topographically and youngest in age

Qat Stream terrace deposits and alluvium undifferentiated - Includes alluvium and gravel deposits on terraces about 12 ft (3.6 m) above present stream levels

Qtc Stream terrace deposits and colluvium undifferentiated - upslope or downslope colluvial material which is gradational with terraces and not distinct on airphotos

Qp Pediment deposits - Unconsolidated silt, sand, and gravel locally derived, stratified and crossbedded. Surfaces usually wedge against Tensleep Sandstone (Pt) to west. Gradient of deposits decrease basinward and merges with stream terraces at intermediate levels

Tw WASATCH FORMATION (EOCENE) - Lenticular interbeds of gray to light-brown, fine to coarse-grained, locally conglomeratic, feldspathic to arkosic, crossbedded sandstone; dark to light-gray or brown or greenish-gray shale, claystone, and siltstone; and subbituminous and lignitic coal beds which grade laterally into carbonaceous shales. Locally coal beds have burned, altering the overlying units to distinctive, dusky-red, resistant clinker outcrops. Base of formation overlies Roland Coals. About 1,000 ft (305 m) exposed east of Little Goose Creek

Tfu FORT UNION FORMATION (PALEOCENE) - Not divided into members south of tongue River where the coals are interbedded with carbonaceous shale and are not as well exposed. In Beaver Creek area west of Bighorn, Wto., several 6 ft (1.8 m) thick conglomerate beds consisting chiefly of carbonate cobble are considered basal Fort Union and appear to be correlative with basal Fort Union of the Mowry Basin area to the south. Contact with the underlying Lance and Bearpaw Formations (Klb) in conformable.

Tft Tongue River Member - Top is marked by Roland coal beds. Pale yellowish-gray sandstone, fine to medium-grained, lenticular, and crossbedded, with light-gray shale and mudstone. Coal and carbonaceous shale common. Extensive burning of coal has produced characteristic fused red clinker and pink to red baked shale beds north and east of the Tongue River

Tfl Lebo Shale and Tullock Members undivided - Lebo Member at top light olive-gray and greenish-gray shale, mudstone, and siltstone interbedded with pale yellowish-brown, fine to medium-grained, lenticular and crossbedded thin sandstone layers. Coal and carbonaceous shale beds are not as well developed. Tullock Member at base is pale yellowish-brown, fine to medium-grained, thick-bedded, massive sandstone and has lenticular thin coal seams and carbonaceous shale

Klb LANCE FORMATION BEARPAW SHALE UNDIVIDED (UPPER CRETACEOUS) - Shales and interbedded sandstone, siltstones, and mudstones. Shales, light olive gray and greenish gray, containing carbonaceous seams and lenses. Siltstone and mudstone, light gray and brown, thin to medium bedded. Sandstone, calcareous, light gray, fine grained, massive, lenticular, and crossbedded. In west central part of map area Bearpaw occurs as slope-valley former between more resistant teapot Sandstone Member of Mesaverde and massive sandstone of Lance. Contact with overlying Fort Union Formation placed at base of cobble conglomerate in Jackson-beaver Creek area and near top of massive crossbedded sandstone at Wolf Creek. Fox Hills Sandstone is mapped with the Lance Formation

Kmv MESAVERDE FORMATION (UPPER CRETACEOUS) - Characteristically consists of two sandstone units separated by shale. Upper member, the Teapot Sandstone Member is very light gray, speckled, medium grained, thick bedded, massive, crossbedded. Middle unit is an unnamed greenish-gray shale. lower member, the Parkman Sandstone Member in yellowish gray, medium grained, thick bedded, massive, crossbedded; contains limonitic concretions. Outcrops of steeply dipping sandstones form knobs along strike. Thickness 700-1,000 ft (213-305 m)

Kcf CODY SHALE AND FRONTIER FORMATION UNDIVIDED (UPPER CRETACEOUS) - Consists chiefly of gray and brown shales; poorly exposed. A 60 ft (18m) zone of bentonitic shale at base, grayish, yellow, green to very light gray. Minor sandstone; 3 ft (1 m) septarian concretions. and black chert pebbles weather out in lower part. Forms major topographic lowland between Mowry Shale (km) and Mesaverde Formation (kmv). Thickness 4,000 ft (1,220 m)

Km MOWRY SHALE (LOWER CRETACEOUS) - Upper part is a light-gray, resistant, brittle, fissile, siliceous shale; weathers silvery gray; contains few thin light-gray to yellowish-gray bentonite beds and commonly fish scales. Lower part is a black nonresistant shale; locally conains thin beds of ligh-gray bentonite. Thickness 300 ft (90 m)

Kt THERMOPOLIS SHALE (LOWER CRETACEOUS) - Mainly olive-black, grayish-red, dusky-yellowish-brown, and dark-gray shale. Variegated claystone 15 ft (6 m) thick, very fine to medium grained, about 265 ft (80 m) below top of formation, is correlated with the Muddy Sandstone in central Wyoming and Newcastle Sandstone in eastern Wyoming. Grayish-black ironstone concretions; cone-in-cone and spherulitic dahllite concretions, 1.5 in. (38 mm) in diameter in lower middle of formation. The base of the Thermopolis is taken at Cloverly Formation (kcv) overlying the Morrison (Jm) at Wolf Creek. Thus, the zone of dahllite concretions is placed in the Thermopolis Formation; Ramsey (1955) also placed the dahllite in Buffalo, Wyo., area (Mapel, 1959); however, shows the zone of dahllite concretions assigned to the Cloverly (Kcl). Thickness approximately 700 ft (215 m); Ramsey (1955 measured 726 ft (221 m)

Kcl CLOVERLY FORMATION (UPPER JURASSIC) - Consists of a 44 ft (13m) thick very light gray sandstone at top, weathers yellowish gray; cherty, crossbedded, lenticular, thick bedded; local thin coal seams. Lower part gray and brown shale and mudstone, poorly exposed. Forms hogback. Thickness 100 ft (30 m)

Jm MORRISON FORMATION (UPPER JURASSIC) - Dominatly varicolored, light-gray, red, green, and purplish-gray claystone and shale with a 32 ft (10m) thick prominent sandstone near base, light gray, fine grained, angular to subangular, crossbedded, friable. Thickness 200 ft (60 m)

Js SUNDANCE FORMATION (UPPER AND MIDDLE JURASSIC) - Grayish-green calcareous shale and sandy shale interbedded with light yellowish-gray to white glauconitic, fine-grained, calcareous sandstone and gray fossiliferous oolitic limestone. Forms valleys below Cloverly (Kcl) hogback with minor ridges of limestone and sandstone. Thickness 290 ft (88 m)

Jgs GYPSUM SPRING FORMATION (MIDDLE JURASSIC) - Reddish brown shale, claystone, and siltstone, thin and medium bedded, with interbeds of thin, light-gray, gypsiferous, vuggy, argillaceous limestone; in places the gypsum is replaced by a brown limestone breccia. Conformable with overlying Sundance Formation (Js). Thickness 174 ft 953 m)

Tc CHUGWATER FORMATION (UPPER AND LOWER TRIASSIC) - Reddish-brown to dusky-red lenticular shale, siltstone, and fine to medium-grained, poorly sorted, crossbedded sandstone. Thickness 613 ft (187 m)

Pge GOOSE EGG FORMATION (PERMIAN) - Interbedded gypsum, red shale, siltstone, and thin beds of light-gray limestone. Upper part is dominantly gypsum with interbedded red siltstone. Mostly covered by soil and colluvium. Thickness 250 ft (76 m)

Pt TENSLEEP SANDSTONE (PENNSYLVANIAN) - Grayish-orange-pink, very fine to medium-grained, well-sorted, thick-bedded, massive to crossbedded, quartz sandstone with thin beds of pink or grayish-yellow dolomite containing nodules and stringers of chert in lower part. Forms prominent upturned flatirons along flanks of Bighorn Mountains. Thickness 190 ft (58 m)

Pa AMSDEN FORMATION (PENNSYLVANIAN) - Upper part consists chiefly of very light gray cherty dolomite, light-brown sandstone, and pale-red shale. Includes at top a unit of medium-crystalline, pale red-purple dolomite. Lower part is light-gray dolomite and red shale. Dolomite contains abundant red, gray and brown chert nodules and stringers. Basal few feet is pale reddish-brown sandstone and siltstone. Thickness 275 ft (84 m)

Mm MADISON LIMESTONE (UPPER AND LOWER MISSISSIPPIAN) - Light-gray, finely crystalline, locally bioclastic, thin-bedded but mainly massive, cavernous, cliff-forming limestone, dolomitic limestone, and dolomite with abundant gray chert nodules in upper part. Basal few feet is light-gray, sandy, dolomitic limestone. Thickness 1,150 ft (350 m)

Ob BIGHORN DOLOMITE (UPPER AND MIDDLE ORDOVICIAN) - Upper part is light-gray to white, massive to medium-bedded, finely crystalline, fossiliferous dolomite and dolomitic limestone. About 300 ft (91 m) thick, cliff forming, contains chert nodules and lenses, weathers to rough, pitted surface. The lower part, about 90 ft (27 m) thick, includes 35 ft (11 m) of light-gray to white, relatively nonresistant, mostly very fine grained, crossbedded quartz sandstone. Lower contact of the sanstone sharp; upper contact grads ino the massive dolomite. Thickness 400 ft (122 m)

Cg GALLATIN AND GROS VENTRE FOMATION UNDIVIDED (UPPER AND MIDDLE CAMBRIAN) - The upper unit, about 150 ft (46 m) thick, is mainly resistant, very pale orange, medium-crystalline, slabby, silt, glauconitic, thick bedded and massive. The lower unit is slope forming, about 430 ft (131 m) thick, of dominantly grayish green micaceous shale with interbedded thin, light-gray, silty, ripple-marked, flat-pebble limestone conglomerate and limestone. Thickness 680 ft (207 m) measured by Ramsey (1955)

Cf FLATHEAD SANDSTONE (MIDDLE CAMBRAIN) - Light-brown to pale yellowish-orange, greenish-gray, fine to coarse-grained, friable but locally quartzitic, thin to thick-bedded, crossbedded quartz sandstone, glauconitic, follliferous; thin interbeds of green micaceous siltstone and shale. The basal unit is a pebbly arkosic conglomerate. Thickness 532 ft (162 m) measured by Ramsey (1955)

pCr PRECAMBRIAN ROCKS - Dominantly red and gray granitic gneisses cut by dikes of aplite, diabase, olivine gabbro, hornblende diorite and peridotite

CONTACT - Approximately located; dotted where concealed

FAULT - Dashed where approximately located; dotted where concealed. U, upthrown side; D, downthrown side

ANTICLINE - Approximately located

SYNCLINE - Approximately located

STRIKE AND DIP BEDS
Normal
Vertical
Apparent - Strike undetermined

COAL MINE

GRAVEL PIT OR CLINKER QUARRY

SHALLOW DRILL HOLE, CORED - Drilled in Sheridan, Wyo., by USGS. (Farrow, written commun., 1976)

VERTEBRATE FOSSIL LOCALITIES

COAL BED OR ZONE OUTCROP, SHOWING NAME SYMBOL
Approximately located, barbed where outcrop has burned. Names of beds in descending stratigraphic order are abbreviated as follows: U_2, Lower Ulm bed; D, Dow bed; Ar, Arkansas bed; PK, PK bed; N, Bar N bed; B, Burgess bed; H, Heppner bed; W, Wyarno bed; DT, Double top bed; RB, Roland bed (of Baker 1929); SC, Squirrel Creek bed; RT, Roland bed (of Taff, 1909); AS, Above Smith 1 bed; S, Smith bed; An, Anderson bed; D_1, Dietz 1 bed (highest); D_2, Deitz 2 bed; D_3, Deitz 3 bed; M, Monarch bed; M1, Monarch bed, lower bench; S1, Slater Creek bed; C, Carney bed; g, g bed; f, f bed; e, e bed; d, d bed; b, b bed; a, a bed; L, local bed; and cz, carbonaceous shale

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 D5.3-1

TFN 6 2/025
RECD NOV 14, 2014

SURFICIAL GEOLOGY

Drawn By: RAV
Checked By: JGB
Date: 10/08/14

FILE: D5_3-1_SURF_GEO.dwg

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K:\Sheridan\RAMACO\13139\ACAD_WY83EC\DWGS_D5\D5_3-1_SURF_GEO.dwg 10/9/2014 11:43:27 AM dave johnson

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ADDENDUM D5-1

Drill Hole Tabulations
(State Plane Coordinates)

TFN 6 2/025
RECD JUL 30,2015

Scanned, 02/27/2020

Drill Hole Tabulations

Type	ID	Easting	Northing	Elevation
RAMACO	R-13011	1394131.5	1938441.2	3840.5
RAMACO	R-13012	1391382.1	1939174.4	3925.9
RAMACO	R-13016	1391088.2	1941970.2	3956.1
RAMACO	R-13018	1394423.1	1941802.4	3887.9
RAMACO	R-13019	1394584.1	1940622.6	3918.5
RAMACO	R-13020	1386372.2	1939535.7	3952.6
RAMACO	R-13023	1389612.6	1937608.6	3908.5
RAMACO	R-13024	1378388.6	1941541.7	3885.4
RAMACO	R-13026	1394418.4	1932436.3	3630.6
RAMACO	R-12001	1371570.8	1941932.5	3964.7
RAMACO	R-12002	1375017.6	1942450.2	3966.7
RAMACO	R-12003	1374801.9	1939566.4	3867.7
RAMACO	R-12004	1376944.0	1941064.1	3930.3
RAMACO	R-12005	1378455.3	1938704.5	3806
RAMACO	R-12006	1387298.2	1936982.2	3894.1
RAMACO	R-12007	1378677.2	1939958.6	3872.4
RAMACO	R-12008	1379699.7	1940365.9	3835.3
RAMACO	R-12009A	1382752.8	1937903.5	3836.1
RAMACO	R-12010	1382178.4	1941264.3	3781.4
RAMACO	R-12011	1382200.3	1938556.8	3778.1
RAMACO	R-12012	1382640.4	1943192.9	3939.9
RAMACO	R-12013	1383201.7	1940382.7	3974.8
RAMACO	R-12014	1383638.0	1941970.4	3953.5
RAMACO	R-12015	1384648.9	1936994.1	3774.3
RAMACO	R-12018	1379220.9	1940645.4	3854.7
RAMACO	R-12019	1384228.7	1936985.5	3798.2
RAMACO	R-12020	1380767.5	1939247.6	3873.5
RAMACO	AMB-02	1396481.9	1941968.4	3762.5
RAMACO	AMB-03	1398010.1	1941665.9	3733.2
RAMACO	AMB-04	1399137.3	1940708.4	3705.4
RAMACO	AMB-05	1403477.8	1930125.6	3776.4
Monitor Well	578510-CRN-1	1371807.2	1941542.1	3962.4
Monitor Well	578511-CRN-1	1377926.5	1940246.5	3893.8
Monitor Well	578512-CRN-1	1382757.0	1943160.0	3931.0
Monitor Well	578513-CRN-1	1381665.6	1938329.3	3847.7
Monitor Well	578418-CRN-1	1387102.2	1936927.8	3882.4
Monitor Well	578409-CRN-1	1399549.2	1940097.5	3710.1
Monitor Well	578409-CRN-OB	1399537.8	1940108.4	3710.3
Monitor Well	578415-CRN/MST	1404291.8	1936077.6	3611.4
Monitor Well	578510-MST-1	1371823.0	1941558.1	3962.4
Monitor Well	578511-MST-1	1377944.7	1940243.6	3894.0
Monitor Well	578512-MST-1	1382742.6	1943171.6	3930.9
Monitor Well	578513-MST-1	1381680.6	1938341.4	3848.4
Monitor Well	578418-MST-1	1387130.9	1936922.9	3883.6
Monitor Well	578409-MST-1	1399559.3	1940087.6	3709.8

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6/2/2025
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Drill Hole Tabulations

Type	ID	Easting	Northing	Elevation
Monitor Well	578409-MST-UB	1399568.3	1940076.6	3709.7
Monitor Well	578409-MST-OB	1399546.6	1940084.5	3710.3
Monitor Well	578512-AL-1	1381530.1	1940880.3	3758
Monitor Well	578513-AL-1	1383970.4	1938633.9	3721.9
Monitor Well	578418-AL-1	1386058.5	1935962.2	3687.5
Monitor Well	578408-MST	1394423.0	1941802.0	3887.9
Monitor Well	578408-CRN	1394416.0	1941810.0	3887.7
Monitor Well	578417-MST	1939175.0	1391382.0	3925.9
Monitor Well	578417-CRN	1391364.0	1939152.0	3926.4
Monitor Well	578421-3-MAS	1399293.0	1934005.0	3643
Monitor Well	578513-OVB-1	1384801.5	1936206.4	3753.2
Monitor Well	578415-SPL-1	1404656.3	1934126.6	3603.7
Monitor Well	578415-SPL-2	1404635.8	1935618.5	3611.5
Oil/CBM	OG-01	1399801.0	1926113.0	3796.4
Oil/CBM	OG-02	1394785.7	1934957.5	3764.3
Oil/CBM	OG-03	1389613.5	1935237.5	3810.6
Oil/CBM	OG-04	1387995.6	1939460.0	3960.8
Oil/CBM	OG-05	1389596.6	1941239.2	4022.2
Oil/CBM	OG-06	1385957.1	1943389.5	4053.7
Oil/CBM	OG-07	1401341.7	1943034.4	3833.0
Oil/CBM	OG-08	1390503.4	1945403.9	3948.6
Oil/CBM	OG-09	1392277.0	1924812.8	3779.1
Oil/CBM	OG-10	1400010.5	1935231.0	3625.8
Oil/CBM	OG-11	1399454.1	1926211.1	3811.4
Oil/CBM	OG-12	1410524.1	1926173.9	3809.6
Oil/CBM	OG-13	1411779.4	1927537.6	3812.4
Oil/CBM	OG-14	1410380.4	1919547.3	3828.8
Oil/CBM	OG-15	1409091.3	1923580.9	3867.3
Oil/CBM	OG-16	1413144.3	1922240.1	3925.8
Oil/CBM	OG-17	1413015.2	1919428.5	3966.4
Oil/CBM	OG-18	1407648.0	1918295.1	3772.6
Oil/CBM	OG-19	1413028.6	1924747.9	3924.2
Oil/CBM	OG-20	1396224.0	1924633.9	3915.0
Oil/CBM	OG-21	1404265.1	1918690.2	3659.6
Oil/CBM	OG-22	1401178.8	1920705.8	3742.6
Oil/CBM	OG-23	1402366.4	1919442.2	3709.4
Historic	103-74	1405985.0	1931487.0	3777.0
Historic	105-74	1405833.0	1934466.0	3791.0
Historic	116-74	1407505.0	1932647.0	3755.0
Historic	123-74	1399453.0	1944771.0	3887.0
Historic	126-74	1402611.0	1938147.0	3651.0
Historic	127-74	1398674.0	1939523.0	3776.0
Historic	134-74	1400364.0	1944120.0	3867.0
Historic	141-74	1396958.0	1929954.0	3890.0
Historic	158-74	1406275.0	1938395.0	3617.0

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Type	ID	Easting	Northing	Elevation
Historic	178-76	1406438.0	1933268.0	3784.0
Historic	203-76	1397182.0	1939075.0	3866.0
Historic	214-76	1406063.0	1932880.0	3768.0
Historic	216-76	1406133.0	1931707.0	3740.0
Historic	22-66	1395858.1	1941902.5	3824.0
Historic	239-77	1406914.0	1932325.0	3750.0
Historic	240-77	1399564.8	1940074.7	3707.0
Historic	242-77	1389756.0	1941751.0	4052.0
Historic	243-77	1392278.0	1938103.0	3845.0
Historic	244-77	1388977.0	1935810.0	3899.0
Historic	264-78	1381129.3	1938513.6	3841.0
Historic	265-78	1384195.0	1936861.6	3799.0
Historic	26-71	1402669.0	1927237.0	3631.0
Historic	270-78	1381359.9	1937410.6	3849.0
Historic	273-78	1383233.8	1938277.9	3745.0
Historic	274-78	1379179.0	1941151.0	3854.0
Historic	28-71	1403130.3	1929375.7	3625.0
Historic	32-66	1395355.0	1934772.0	3619.0
Historic	330-78	1384467.9	1936735.2	3790.0
Historic	332-78	1383408.5	1936153.0	3812.0
Historic	34-66	1393883.0	1932793.0	3626.0
Historic	354-78	1406465.2	1918114.0	3656.0
Historic	54-72	1405243.1	1938357.5	3620.0
Historic	55-72	1405438.1	1937849.5	3619.0
Historic	56-72	1405388.1	1937212.5	3614.0
Historic	97-72	1405120.0	1938343.0	3620.0
Historic	98-72	1405792.0	1937997.0	3633.0
Historic	B188-76	1401116.5	1938762.2	3675.0
Historic	B190-76	1401178.1	1938743.5	3675.0
Historic	B226-76	1395447.9	1931462.0	3654.0
Historic	B329-78	1383401.0	1936908.4	3828.0
Historic	B-359-78	1399094.0	1930856.0	3820.0
Historic	B-360-78	1400672.6	1929937.9	3808.0
Historic	B-361-78	1400362.3	1930608.9	3817.0
Historic	B-362-78	1400264.0	1930627.0	3817.0
Historic	B-364-78	1400394.0	1930480.0	3817.0
Historic	B-365-78	1401482.4	1928689.7	3801.0
Historic	B-366-78	1401528.0	1928600.0	3801.0
Historic	B-368-78	1400563.8	1929222.4	3812.0
Historic	B-369-78	1402156.0	1931659.0	3813.0
Historic	B-370-78	1400105.3	1928315.3	3795.0
Historic	B-372-78	1398863.0	1929830.0	3826.0
Historic	B-373-78A	1399661.8	1926647.2	3799.0
Historic	B-374-78	1406954.0	1936772.0	3600.0
Historic	B-377-78	1406780.0	1936154.0	3595.0

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Type	ID	Easting	Northing	Elevation
Historic	B-378-78	1407272.0	1936291.0	3595.0
Historic	B-379-78	1407114.0	1936508.0	3595.0
Historic	B-380-78	1407033.0	1936323.0	3595.0
Historic	B-381-78	1406976.0	1936081.0	3595.0
Historic	B-382-78	1406992.0	1936168.0	3595.0
Historic	B-385-78	1398890.5	1929729.0	3836.0
Historic	B-386-78	1399436.0	1929356.0	3823.0
Historic	B-387-78	1397029.3	1930152.4	3911.0
Historic	B-388-78	1397110.0	1930068.0	3909.0
Historic	B-390-79	1401559.0	1938533.0	3690.0
Historic	B-408-79	1400739.9	1942100.1	3957.0
Historic	B-409-79	1401122.7	1941644.3	3947.0
Historic	B-410-79	1400989.9	1941919.2	3959.0
Historic	B-411-79	1401094.9	1942215.5	3948.0
Historic	B-412-79	1401364.8	1941433.8	3932.0
Historic	B-413-79	1401491.4	1941746.8	3938.0
Historic	B-414-79	1401564.0	1942123.6	3941.0
Historic	B-415-79	1401871.9	1942088.8	3919.0
Historic	B-416-79	1401850.2	1941677.8	3923.0
Historic	B-417-79	1401861.5	1941312.5	3908.0
Historic	B-418-79	1402327.0	1941637.0	3900.0
Historic	B-419-79	1402131.1	1941821.9	3910.0
Historic	B-420-79	1402655.4	1941820.9	3884.0
Historic	B-421-79	1402546.0	1942153.8	3842.0
Historic	B-422-79	1401765.0	1942458.0	3872.0
Historic	B-423-79	1402352.7	1941973.4	3854.0
Historic	B-424-79	1403138.8	1941588.7	3827.0
Historic	B-425-79	1402621.9	1941082.1	3874.0
Historic	B-426-79	1402197.5	1940979.1	3842.0
Historic	B-427-79	1401600.7	1941026.0	3870.0
Historic	B-428-79	1400879.5	1941310.9	3902.0
Historic	B-429-79	1400627.9	1943129.0	3885.0
Historic	B-430-79	1402900.7	1941656.1	3847.0
Historic	B-431-79	1402530.0	1941318.2	3866.0
Historic	B-432-79	1401528.5	1941201.1	3897.0
Historic	B-433-79	1400992.6	1941496.2	3939.0
Historic	B-434-79	1400128.0	1932944.0	3671.0
Historic	B-435-79	1398901.0	1932398.0	3744.0
Historic	B-436-79	1405075.0	1918399.0	3660.0
Historic	B-437-79	1398280.8	1944479.9	3930.0
Historic	B-438-79	1398750.0	1943429.9	3897.0
Historic	B-439-79	1399438.0	1942917.0	3866.0
Historic	B-440-79	1400871.3	1944252.7	3878.0
Historic	B-441-79	1400029.4	1939778.9	3690.0
Historic	B-442-79	1402077.0	1941166.0	3885.0

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Type	ID	Easting	Northing	Elevation
Historic	B-443-79	1398896.5	1943790.8	3966.0
Historic	B-444-79	1399380.0	1944183.4	3898.0
Historic	B-445-79	1400217.1	1944447.2	3877.0
Historic	B-446-79	1399277.6	1944693.2	3889.0
Historic	B-447-79	1400005.1	1943281.6	3943.0
Historic	B-448-79	1400313.2	1943628.1	3871.0
Historic	B-449-79	1400419.7	1943406.8	3874.0
Historic	BA104-74	1405963.6	1933552.7	3806.0
Historic	BA108-74	1404633.0	1934540.4	3815.0
Historic	BA109-74	1404910.1	1934176.1	3811.0
Historic	BA110-74	1405622.6	1932579.1	3809.0
Historic	BA113-74	1405668.9	1933192.1	3800.0
Historic	BA114-74	1405833.2	1932862.5	3803.0
Historic	BA115-74	1405698.2	1931712.5	3785.0
Historic	BA12-71	1405538.1	1934249.5	3798.0
Historic	BA13-71	1404863.1	1934727.5	3777.0
Historic	BA209-76	1405549.1	1933805.9	3779.0
Historic	BA210-76	1405533.3	1933779.1	3779.0
Historic	BA212-76	1405871.5	1933195.0	3768.0
Historic	BA219-76	1405946.8	1934289.5	3780.0
Historic	BA221-76	1405962.6	1934324.2	3781.0
Historic	BA2-66	1405778.1	1934952.5	3591.0
Historic	BA3-66	1405020.1	1935282.5	3600.0
Historic	BB10-71	1404908.1	1936039.5	3592.0
Historic	BB11-71	1405408.1	1935602.5	3596.0
Historic	BB16-71	1404333.1	1936163.5	3593.0
Historic	BB17-71	1404373.1	1936015.5	3595.0
Historic	BB18-71	1404390.1	1935877.5	3598.0
Historic	BB20-71	1405008.1	1935872.5	3592.0
Historic	BB21-71	1405113.1	1935559.5	3596.0
Historic	BB22-71	1405903.1	1935432.5	3592.0
Historic	BB23-71	1404088.1	1935549.5	3599.0
Historic	BB35-71	1403990.1	1936552.5	3611.0
Historic	BB37-71	1405088.1	1938677.5	3627.0
Historic	BB4-71	1405463.1	1935137.5	3592.0
Historic	BB6-71	1404636.1	1935242.5	3598.0
Historic	BB7-71	1404293.1	1934723.5	3689.0
Historic	BB81-72	1403608.1	1935763.5	3595.0
Historic	BB90-72	1404468.1	1935607.5	3598.0
Historic	BB91-72	1405450.1	1935167.5	3591.0
Historic	BB94-72	1404533.1	1938337.5	3634.0
Historic	BB95-72	1404523.1	1935612.5	3598.0
Historic	BB96-72	1405158.1	1935517.5	3595.0
Historic	BB9-71	1403968.1	1935802.5	3600.0
Historic	BC159-74	1407683.1	1937127.5	3748.0

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Type	ID	Easting	Northing	Elevation
Historic	BC167-76	1406060.0	1937324.5	3621.0
Historic	BC168-76	1408512.7	1936455.0	3716.0
Historic	BC169-76	1407766.8	1937578.1	3740.0
Historic	BC170-76	1407101.6	1938932.6	3608.0
Historic	BC171-76	1406505.7	1939202.7	3613.0
Historic	BC172-76	1407379.6	1935385.0	3587.0
Historic	BC173-76	1406292.7	1935589.7	3592.0
Historic	BC174-76	1406708.2	1935125.1	3592.0
Historic	BC179-76	1406993.0	1937483.7	3613.0
Historic	BC180-76	1408193.6	1937217.2	3712.0
Historic	BC181-76	1408053.1	1936582.5	3739.0
Historic	BC182-76	1407821.7	1936335.5	3732.0
Historic	BC183-76	1408448.7	1935876.4	3663.0
Historic	BC184-76	1408504.9	1937577.4	3691.0
Historic	BC185-76	1408175.6	1938130.9	3688.0
Historic	BC186-76	1408181.9	1938099.7	3688.0
Historic	BC187-76	1406070.1	1937074.5	3622.0
Historic	BC192-76	1407798.8	1934568.9	3589.0
Historic	BC193-76	1407534.5	1935206.0	3592.0
Historic	BC194-76	1407838.0	1934551.3	3589.0
Historic	BC198-76	1407067.4	1934990.3	3589.0
Historic	BC199-76	1408296.5	1934980.6	3587.0
Historic	BC200-76	1408130.2	1935531.8	3587.0
Historic	BC201-76	1406783.4	1936219.8	3592.0
Historic	BC204-76	1407429.6	1935889.1	3592.0
Historic	BC206-76	1407380.9	1935355.0	3587.0
Historic	BC207-76	1406909.3	1935864.0	3591.0
Historic	BC208-76	1407489.7	1935967.4	3593.0
Historic	BC230-76	1406627.0	1937363.4	3601.0
Historic	BC231-76	1406476.4	1937383.6	3602.0
Historic	BC232-76	1407031.5	1938540.6	3607.0
Historic	BC233-76	1406867.9	1938533.3	3630.0
Historic	BC234-77	1405745.2	1938702.6	3617.0
Historic	BC235-77	1405966.5	1939611.1	3627.0
Historic	BC258-77	1405883.4	1939400.8	3624.0
Historic	BC46-71	1405928.1	1939802.5	3631.0
Historic	BC57-72	1405828.1	1939022.5	3617.0
Historic	BC58-72	1404561.1	1938282.5	3634.0
Historic	BC59-72	1404486.1	1937607.5	3627.0
Historic	BC60-72	1404463.1	1937082.5	3623.0
Historic	BC61-72	1404587.1	1937172.5	3623.0
Historic	BC62-72	1403703.1	1936082.5	3596.0
Historic	BC77-72	1405626.1	1935029.5	3592.0
Historic	BC78-72	1404738.1	1935802.5	3597.0
Historic	BC79-72	1403523.1	1935034.5	3603.0

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Type	ID	Easting	Northing	Elevation
Historic	BC80-72	1401861.6	1935814.6	3605.0
Historic	BE124-74	1400006.5	1943362.9	3943.0
Historic	BE125-74	1398440.9	1945054.7	3931.0
Historic	BE245-77	1396269.1	1942124.9	3762.0
Historic	BE268X-78	1398555.8	1941328.8	3717.0
Historic	BE277-78	1388235.7	1938562.1	3961.0
Historic	BE278-78	1388728.3	1939482.9	4036.0
Historic	BE279-78	1391186.4	1937303.5	3982.6
Historic	BE280-78	1402495.4	1937408.0	3643.0
Historic	BE281-78	1402351.3	1937386.6	3641.0
Historic	BE282-78	1402325.2	1937099.0	3639.0
Historic	BE284-78	1402696.7	1937887.9	3671.0
Historic	BE285-78	1402791.3	1938058.6	3649.0
Historic	BE286-78	1402614.8	1938250.8	3651.0
Historic	BE287-78	1402617.3	1938062.2	3652.0
Historic	BE289-78	1401695.9	1938363.9	3709.0
Historic	BE294-78	1401393.3	1937491.5	3687.0
Historic	BE295-78	1401262.7	1938238.0	3707.0
Historic	BE297-78	1401576.2	1938125.1	3696.0
Historic	BE298-78	1401441.0	1938110.6	3703.0
Historic	BE299-78	1401356.9	1938136.6	3697.0
Historic	BE300-78	1401181.8	1938013.1	3707.0
Historic	BE301-78	1401464.1	1937709.2	3676.0
Historic	BE302-78	1401283.1	1937797.5	3691.0
Historic	BE315-78	1401131.1	1937989.8	3709.0
Historic	BE316-78	1400837.0	1938038.0	3717.0
Historic	BE318-78	1392349.6	1940163.4	3937.0
Historic	BE319-78	1390657.3	1939121.7	4004.0
Historic	BE320-78	1387565.6	1937027.5	3912.0
Historic	BE322-78	1401020.9	1938370.8	3702.0
Historic	BE323-78	1401696.4	1937863.3	3689.0
Historic	BE324-78	1401140.9	1937314.8	3694.0
Historic	BE327-78	1401610.0	1938385.6	3711.0
Historic	BE328-78	1402274.0	1938057.3	3678.0
Historic	BE337-78	1401445.2	1938439.4	3690.0
Historic	BE338-78	1401871.9	1938518.7	3692.0
Historic	BE339-78	1402076.8	1938162.3	3688.0
Historic	BE340-78	1401780.0	1938333.0	3690.0
Historic	BE341-78	1401869.5	1938056.8	3677.0
Historic	BE342-78	1401833.9	1938158.2	3688.0
Historic	BE344-78	1401545.5	1938281.9	3696.0
Historic	BE345-78	1402085.1	1938559.8	3661.0
Historic	BE346-78	1402038.0	1938541.6	3667.0
Historic	BE347-78	1401971.5	1938482.8	3686.0
Historic	BF252-77	1401227.6	1934102.6	3607.0

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Type	ID	Easting	Northing	Elevation
Historic	BF253-77	1400072.0	1934480.4	3631.0
Historic	BF33-66	1393513.1	1933462.4	3641.0
Historic	BF35-66	1395273.1	1933342.4	3619.0
Historic	BF36-66	1396359.2	1933052.4	3621.0
Historic	BF37-66	1397917.2	1933502.4	3629.0
Historic	BF38-66	1398278.2	1934252.4	3615.0
Historic	BF41-66	1401121.1	1935882.5	3607.0
Historic	BF42-71	1396873.1	1934487.4	3617.0
Historic	BF43-71	1396328.1	1933537.4	3621.0
Historic	BF45-71	1398785.2	1934197.4	3643.0
Historic	BF46-71	1398195.2	1933767.4	3644.0
Historic	BH166-76	1405621.1	1934251.4	3792.0
Historic	BH353-78	1408128.2	1920939.8	3753.0
Historic	BH470-79	1403934.0	1922766.0	3697.0
Historic	BH471-79	1404180.0	1923259.0	3711.0
Historic	BH472-79	1404558.0	1923646.0	3724.0
Historic	BH473-79	1405025.0	1923897.0	3791.0
Historic	BH474-79	1405410.0	1924044.0	3796.0
Historic	BH475-79	1405651.0	1924095.0	3806.0
Historic	BH476-79	1405903.0	1924148.0	3815.0
Historic	BH477-79	1406162.0	1924206.0	3829.0
Historic	BH478-79	1406384.0	1924258.0	3842.0
Historic	BH479-79	1406648.0	1924323.0	3841.0
Historic	BH480-79	1406865.0	1924361.0	3833.0
Historic	BH481-79	1407262.0	1924460.0	3822.0
Historic	BH482-79	1407671.0	1924551.0	3809.0
Historic	BJ122-74	1397180.4	1929838.4	3891.0
Historic	BJ139-74	1398685.6	1930483.5	3810.0
Historic	BJ140-74	1399787.7	1929970.6	3827.0
Historic	BJ247-77	1399856.7	1926580.9	3800.0
Historic	BJ248-77	1400977.5	1928263.6	3790.0
Historic	BJ249-77	1399521.1	1929379.1	3820.0
Historic	BJ250-77	1396553.9	1931382.5	3855.0
Historic	BJ251-77	1396666.5	1930875.1	3865.0
Historic	BJ261-77	1397025.1	1930056.7	3903.0
Historic	BJ293-78	1400904.6	1927113.1	3745.0
Historic	BJ336-78	1382863.6	1937347.6	3845.0
Historic	BJSW01-48	1396946.0	1930387.2	3895.0
Historic	BS162-74	1406988.2	1927152.4	3725.0
Historic	BS163-74	1406988.2	1929117.4	3755.0
Historic	BS176X-76	1407203.7	1928542.0	3718.0
Historic	BS217-76	1406442.2	1929092.0	3766.0
Historic	BS24-71	1403288.2	1927592.4	3637.0
Historic	BS25-71	1404428.2	1928197.4	3658.0
Historic	BS29-71	1405938.2	1928092.4	3666.0

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DEQ Ex. 2-135

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Drill Hole Tabulations

Type	ID	Easting	Northing	Elevation
Historic	BS30-71	1405028.2	1928102.4	3667.0
Historic	BS31-71	1403458.2	1928902.4	3626.0
Historic	BS41-71	1403968.2	1928817.4	3626.0
Historic	BS42-71	1403788.2	1928332.4	3633.0
Historic	BS43-71	1402958.2	1927992.4	3629.0
Historic	BS49-71	1402988.2	1929925.4	3625.0
Historic	BS50-71	1403708.2	1929397.4	3620.0
Historic	BSW-30-48	1393993.2	1930162.4	3840.0
Historic	BSW-31-48	1393568.1	1930332.4	3860.0
Historic	D-19	1396541.0	1923678.0	3895.0
Historic	D-22	1386682.0	1922419.0	3880.0
Historic	D-7	1403148.0	1945343.0	3750.0
Historic	D-8	1404013.0	1946530.0	3763.0
Historic	DH-13	1387552.0	1945225.0	3924.0
Historic	DH-16	1388141.0	1944514.0	3900.0
Historic	DH-17	1390198.0	1945069.0	3883.0
Historic	DH-19	1390936.3	1942425.6	3954.0
Historic	DH-20	1400473.0	1939345.0	3687.0
Historic	DH-25	1394572.7	1942058.8	3863.0
Historic	DH-26	1398379.0	1941713.0	3720.0
Historic	DH-29	1398798.0	1936251.0	3607.0
Historic	DH-7	1385828.0	1944358.0	3939.0
Historic	P-1	1387209.0	1941396.0	4023.0
Historic	P-24	1385604.0	1937934.0	3713.0
Historic	P-40	1394882.0	1925469.0	3910.4
Historic	P-48	1396558.0	1941606.0	3781.0
Historic	P-7	1381715.0	1939756.0	3772.0
Historic	P-8	1394325.6	1943277.1	3800.0
Historic	P-8B	1400186.0	1925672.0	3748.0
Historic	PS-1	1375917.0	1931366.0	3725.0
Historic	S-145	1406839.0	1919632.0	3767.0
Historic	S-161	1397731.0	1923463.0	3900.0
Historic	S-286	1395909.0	1923515.0	3960.0
Historic	S-289	1386237.0	1921770.0	3900.0
Historic	S-292	1389213.0	1922094.0	3870.0
Historic	S312	1407909.0	1926864.0	3770.0
Historic	S314	1409041.0	1926834.0	3725.0
Historic	S316	1410712.0	1926823.0	3795.0
Historic	S325	1412094.0	1926925.0	3910.0
Historic	SW	1395853.0	1928549.0	3866.0
Historic	SW-18	1394657.0	1928475.0	3912.0
Historic	US129-76	1399054.0	1930675.0	3810.0
Historic	WW	1390203.0	1932165.0	3680.0

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ADDENDUM D5-2

Lithologic and Geophysical Logs

TFN 6 2/025
RECD JUL 30, 2015

DEQ Ex. 2-137

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CERTIFICATION STATEMENT

I, Richard Michael Wolf, certify that the following drilling and coring logs were prepared by me or under my direct supervision and are accurate to the best of my knowledge and belief.

PROFESSIONAL GEOLOGIST
RICHARD MICHAEL WOLF
PG 614
WYOMING

Richard Michael Wolf
Date 9/12/13

TFN 6 2/025
RECD JUL 30,2015

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Hole/Well No.: R12-001	Recorded By: M. Wolf WYPG #614	Drilling Co.: A-3 Services; Shawn Ankney Depth: 0 To 121 CORED: 15-30'; 50-80' See Page 2
Company: RAMACO	Geophysical Log Type: Coal suite	
Project: Brook Mine	Hole Type: Pilot & cored coal intervals	Date Drilled: 12-6-12
County: Sheridan WY		
Township: 57N Range: 85W	Water: Dry	
Location: NESW Section: 10	NAD 1983, East Central Zone	
N: 1,942,411.1 E: 1,371,896.6		
Elevation:3964.9		

DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
0	7	Siltstone; yellow buff, bright	7.0	ST		
7	17	Siltstone; buff-orange, carbonaceous, loose	10.0	ST		
17	19.5	Claystone; grey, firm	2.5	CL		
19.5	23.5	Coal; soft interbedded with clay bands, poor	4.0	CØ	Local	Dry
23.5	26	Claystone; grey with coal and dark clay	2.5	CL		
26	32	Siltstone; orange to brown, firm, fissile	6.0	ST		
32	34	Claystone; dark grey, carbonaceous	2.0	CL/OH		
34	40	Claystone; grey	6.0	CL		
40	46	Siltstone; light grey, fissile, coal bands at 41' and at 44'-45'	6.0	ST		
46	55.5	Claystone; grey, firm, fissile	9.5	CL		
55.5	60.5	Coal; black, hard	5.0	CØ	U Carney	Dry
60.5	66	Claystone; light grey	5.5	CL		
66	69	Claystone; dark grey, carbonaceous	3.0	CL/OH		
69	76	Coal; black, hard, moderate bright	7.0	CØ	L Carney	
76	83	Claystone; light grey, fissile	7.0	CL		
83	108	Claystone; very light grey	25.0	CL		
108	121	Claystone; very light, silty, very firm	13.0	CL		Dry
		E-Log Picks: 19.5'-23.5'=4.0' Local, Very poor, soft no core! 55.5'-60.5'=5.0' U Carney 69'-76'=7.0' L Carney				
		Think Masters bed may still be present below				
		P&A: Pilot 30 bags chips Core 19 bags chips				

ABBREVIATIONS

BGL – Below Ground Level
DBS – Disturbed Bulk Sample
GPM – Gallon Per Minute
GS – Geochemical Sample
LA – Laboratory Analysis
SWL – Static Water Level
ZP – Ziplock Bag Sample

TFN 6 2/025
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DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)
		Core #1 15'-30'=15'; recovered 11.5' 8:07 – 9:30
15	17.9	Claystone; grey – orange bands
17.9	19.5	Claystone; grey, becomes carbonaceous at coal contact
19.5	23.5	Recovered 1.2' of dull boney coal, very poor, weathered, washed away rest of bed, very soft, punky, no sample
23.5	26.2	Siltstone; buff- orange, mottled, Fe-oxidized, staining
26.2	28	Claystone; grader to dark at coal band below
28	28.4	Coal; dull, high ash, yellow streaks, very oxidized
28.4	30	Coal; claystone; little coaly
		"No samples for analysis"
		Core #2 50'-65'=15'; recovered 12' 9:57-10:47
50	55.8	Claystone; grey grades to carbonaceous at 55.4'-55.8'
55.8	56.7	Coal; dull; high ash!
56.7	57.1	Claystone; dark with detrital coal
57.1	58	Coal; hard, bright, good
58	58.3	Claystyone, dark with detrital coal
58.3	58.5	Bone coal; very high ash, hard
58.5	60.5	Coal; hard, black, bright, good
60.5	62	Claystone; grey, sticky, plugged cutting shoe
62	65	Lost core; plugged shoe groundwater
		Samples: 55.8'-56.5', 56.5'-58.5', 58.5'-60.5'
		Core #3 65'-80'=15'; recovered 11.2' 10:55-11:37
65	68.7	Claystone; grey – dark grey, firm
68.7	69	Carbonaceous claystone; very carbonaceous
69	76.2	Carbonaceous, black, hard, bright, moderately good, high ash band (clay) at 75.2'-75.4'
76.2	80	Lost core, clay below coal slide out
		Samples: 69'-71', 71'-73', 73'-75', 75'-76.2'

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TFN 6 2/025
RECD JUL 30, 2015

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Century WIRELINE SERVICES

GAMMA-RES-DENSITY

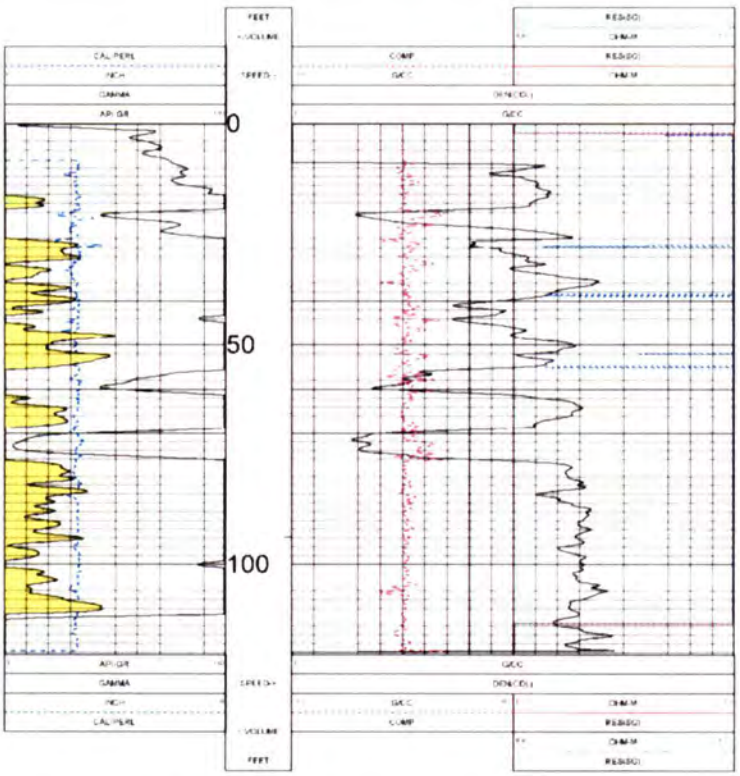
R-12001

COMPANY	RAMACO	OTHER SERVICES	
WELL	R-12001		NA
FIELD	NA		NA
COUNTY	SHERMAN		NA
STATE	WYOMING		
LOCATION	NE SW		
SECTION	16		
TOWNSHIP	52N		
RANGE	84W		
API NO	NA		
LICENSE NO.	NA		
PERMANENT DATUM	GL		
LOG MEASURED FROM	GL		
DRL MEASURED FROM	GL		
DATE	12/06/12		
DEPTH-DRILLER	121		
BIT SIZE	5.63		
LOG TOP	0.00		
LOG BOTTOM	123.00		
CASING-DD	NA		
CASING BOTTOM	NA		
CASING TYPE	NA		
BOREHOLE FLUID	AIR		
RM TEMPERATURE	NA		
RM DENS	NA		
RM VISC	NA		
MAX RECORDED TEMP	NA		
RECORDED BY	J. CENCZO		
WITNESSED BY	NA		
REMARKS 1	NA		
REMARKS 2			
ELEVATION KB	NA		
ELEVATION DF	NA		
ELEVATION GL	NA		
LOGGER TD	123.00		
ARRIVAL TIME	14:00		
DEPARTURE TIME	14:01		
CREW STORED	NA		

5 INCH LOG, DENSITY R-12001 12/06/12

LOG PARAMETERS

MATRIX DENSITY 2.65	NEUTRON MATRIX SANDSTONE	MATRIX DELTA T 54
MAGNETIC DECL NA	ELECT CUTOFF 99999	BIT SIZE 5.63
PRESENTATION NAME/DATE = 9239 Ramaco Std CDL 5inch 5-31-12 0 11/28/2012		VERSION = 3.64KF



5 INCH LOG, DENSITY R-12001 12/06/12

LOG PARAMETERS

MATRIX DENSITY 2.65	NEUTRON MATRIX SANDSTONE	MATRIX DELTA T 54
MAGNETIC DECL NA	ELECT CUTOFF 99999	BIT SIZE 5.63
PRESENTATION NAME/DATE = 9239 Ramaco Std CDL 5inch 5-31-12 0 11/28/2012		VERSION = 3.64KF

TOOL CALIBRATION R 12001 12/06/12 13:53
TOOL 9239CL TM VERSION 2825
SERIAL NUMBER 2563

	DATE	TIME	SENSOR	STANDARD		RESPONSE	
1	Oct02.12	07:36:43	GAMMA	0.000	API GR	1.000	CPS
	Oct02.12	07:36:43	GAMMA	340.000	API GR	310.000	CPS
2	Oct02.12	07:36:45	VOLTAGE	0.000	MV	12480.000	CPS
	Oct02.12	07:36:45	VOLTAGE	2000.000	MV	282262.000	CPS
3	Oct02.12	07:36:48	CALIPER	4.000	INCH	221144.000	CPS
	Oct02.12	07:36:48	CALIPER	8.000	INCH	534300.000	CPS
4	Dec03.12	12:36:41	DEN(LS)	1.820	G/CC	4122.000	CPS
	Dec03.12	12:36:41	DEN(LS)	2.612	G/CC	993.000	CPS
5	Dec03.12	12:36:49	DEN(SS)	1.990	G/CC	14792.000	CPS
	Dec03.12	12:36:49	DEN(SS)	2.580	G/CC	5895.000	CPS
6	Dec03.12	12:36:50	CALIPER1	5.000	INCH	29200.000	CPS
	Dec03.12	12:36:50	CALIPER1	11.250	INCH	49910.000	CPS
7	Oct02.12	07:36:59	CURRENT	0.000	MA	6960.000	CPS
	Oct02.12	07:36:59	CURRENT	387.249	MA	26083.000	CPS
8	Oct03.12	07:36:03	X	Default	CPS		

TFN 6 2/025
RECD JUL 30,2015

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ole/Well No.: R12-002	Recorded By: M. Wolf WYPG #614	Drilling Co. A-3 Services; Shawn Ankney Depth: 0 To 162'
Company: RAMACO	Geophysical Log Type: Coal suite	CORED: 55-70 and 110-140
Project: Brook Mine	Hole Type: Pilot & coal core	Date Drilled: 12-5-12
County: Sheridan WY		
Township: 57N Range: 85W	NAD 1983, East Central Zone	
Location: NWSW Section: 11		
N: 1,942,916.2 E: 1,375,331.9		
Elevation: 3,967.0		

DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
0	5	Sandy silt, yellow grey	5.0	ST		
5	17	Sandstone; orange, very fine	12.0	SS		
17	20	Siltstone; buff	3.0	ST		
20	26	Sandstone; buff	6.0	SS		
26	35	Siltstone; grey – orange interbedded	9.0	ST		
35	38	Siltstone; grey, firm	3.0	ST		
38	52	Claystone; grey, firm	14.0	CL		
52	55	Coal; hard, thin	3.0	CO	Rider	
55	59	Claystone; dark grey, carbonaceous	4.0	CL/OH		
59	66	Coal; hard, fairly, good	7.0	CO	L-Monarch	
66	102	Claystone; medium grey, fissile	36.0	CL		
102	103.5	Coal; hard	1.5	CO	Carney-UU	
103.5	110	Claystone; dark, carbonaceous	6.5	CL/OH		
110	115	Coal; moderate hard, black	5.0	CO	Carney-LU	
115	125	Claystone; grey, fissile, firm	10.0	CL		
125	133	Coal; hard, good	8.0	CO	Carney-Lower	
133	162	Claystone; grey, firm, fissile, hard 147'-149'	29.0	CL		
		E-Log Picks: 59'-66'=7' Upper Upper Carney 110'-115'=5' Lower Upper Carney 125'-133'=8' Lower Carney				
		P&A: Pilot Hole 39 sacks chips Core Hole 34 sacks chips				

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ZP – Ziplock Bag Sample

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DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)
		Core #1 55'-70'=15'; recovered 12.0' bottom slide out
55	56.1	Claystone; dark grey with detrital coal fragments
56.1	56.4	Coal; poor
56.4	56.8	Carbonaceous claystone
56.8	59.2	Claystone; dark grey, moderate carbonaceous with detrital coal pieces
59.2	64.7	Coal; dark
64.7	65.1	Bone coal; high ash
65.1	66	Coal; hard, good
66	67	Claystone; dark grey, moderately carbonaceous
67	70	Claystone; slide out – lost
		Samples: 59.2'-61', 61'-63', 63'-65', 65'-66'
		Core #2 110'-125'=15'; recovered 15.0'
110	110.4	Coal
110.4	110.7	Claystone; dark grey, detrital coal
110.7	114.2	Coal; black, hard, good
114.2	115.5	Claystone; dark grey
115.5	115.8	Coaly carbonaceous claystone; very dark grey
115.8	122	Claystone; grey, little detrital coal
122	123	Siltstone; grey, firm
123	123.8	Claystone; grey, firm
123.8	124.4	Large piece of detrital coal at 45° angle
124.4	125	Claystone; dark grey, abundant detrital coal
		Samples: 110'-112', 112'-114.2'
		Core #3 125'-140'=15'; recovered 9.0' slide out bottom
125	132.7	Coal; black, hard, mostly bright
132.7	133.8	Claystone; dark grey, carbonaceous, little coaly
133.8	134	Coal; band, crushed
134	140	Claystone; lost slippery core, slid out bottom
		Samples: 125'-127', 127'-129', 129'-131', 131'-132.7'

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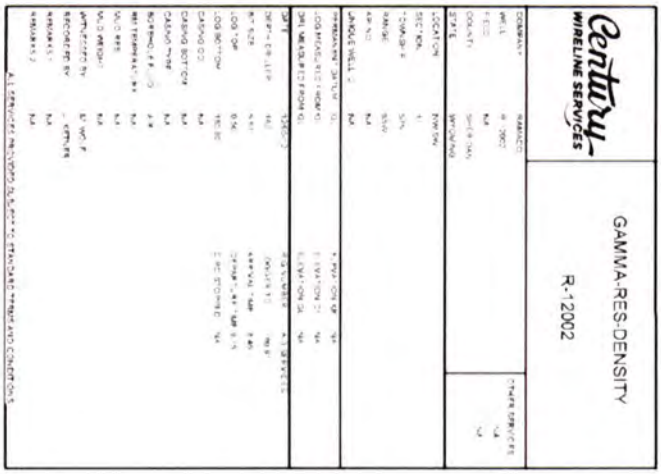

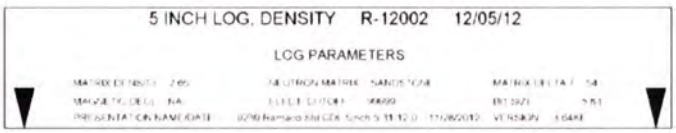

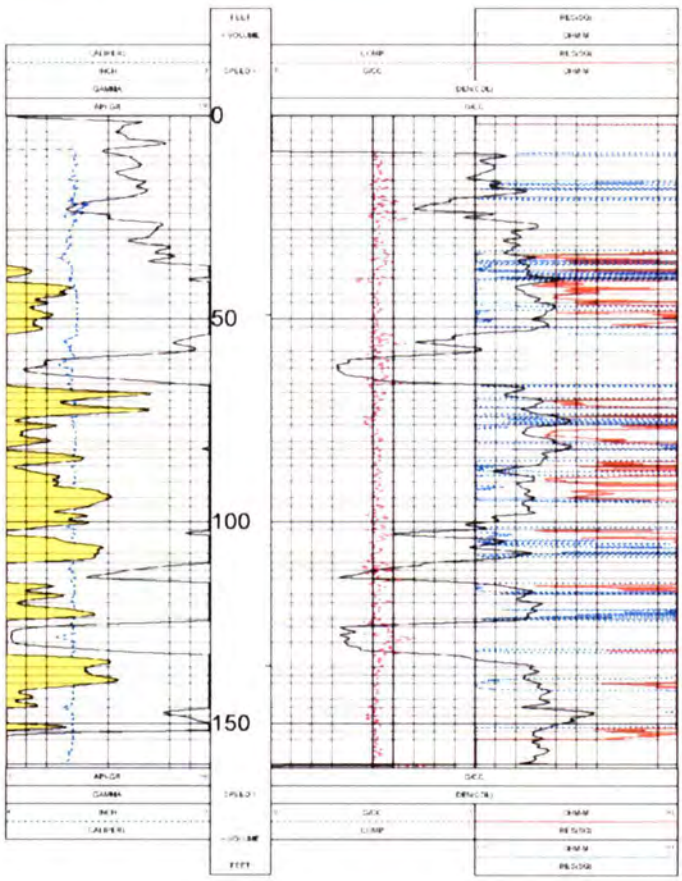

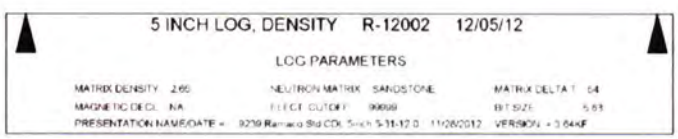

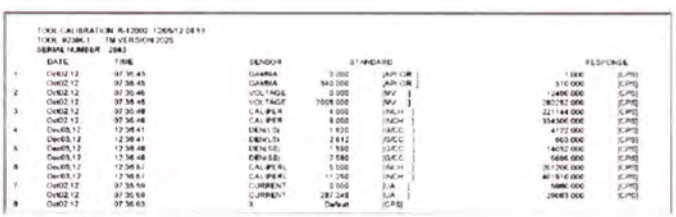

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Hole/Well No.: R12-003	Recorded By: M. Wolf WYPG #614	Drilling Co.: A-3 Services; Shawn Ankney Depth: 0 To 142 CORED: 55-77 and 105-115
Company: RAMACO	Geophysical Log Type:	
Project: Brook Mine	Hole Type: Plug, E-log & Twin for Coal	Date Drilled: 12-7-12
County: Sheridan WY		
Township: 57N Range: 85W	NAD 1983, East Central Zone	
Location: NENE Section: 14		
N: 1,940,026.9 E: 1,375,144.3		
Elevation: 3867.7		

DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
0	5	Siltstone	5.0	ST		
5	12	Sandstone; very fine grained, buff	7.0	SS		
12	15	Siltstone	3.0	ST		
15	16	Siltstone; hard, orange	1.0	ST		
16	20	Siltstone, buff	4.0	ST		
20	28	Siltstone; grey – buff interbedded	8.0	ST		
28	40	Claystone; grey	12.0	CL		
40	41.5	Carbonaceous claystone; dark fissile	1.5	CL/OH		
41.5	42.5	Coal; hard thin	1.0	CØ	Local	
42.5	53	Claystone; grey	9.5	CL		
53	59	Carbonaceous, interbedded clay, see core	6.0	CØ	U Carney	
59	65.5	Claystone; grey, firm	6.5	CL		
65.5	73.5	Coal; hard, bright, good	8.0	CØ	L Carney	
73.5	86	Claystone; grey	12.5	CL		
86	108	Siltstone; light grey, firm	22.0	ST		
108	113	Coal; black, hard, bright	5.0	CØ	Masters	
113	120	Claystone; grey	7.0	CL		
120	132	Siltstone; light grey, firm	12.0	ST		
132	133	Coal; thin	1.0	CØ	Local	
133	142	Siltstone; light grey, very hard, 118'-121'	9.0	ST		
		E-Log Picks: 41'-43'=2.0' Top U Carney 56'-59'=3.0' Bottom U Carney 66'-73'=7.0' Lower Carney 108'-112.5'=4.5' Masters				
		P&A: Pilot 33 sacks chips Core 30 bags chips				

ABBREVIATIONS

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DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)
		Core #1 55'-67'=12.0'; recovered 12.0'
55	55.4	Coal; black, hard, bright, thin according to e-log
55.4	56.5	Claystone; dark, moderate detrital coal
56.5	57.4	Coal; dull
57.4	57.7	Claystone; parting
57.7	59.5	Coal; black, bright, hard
59.5	65.1	Claystone; grey, some detrital coal
65.1	65.9	Very coaly claystone; detrital coal bands
65.9	67	Coal; crushed, mixed clay
		Samples: 56.5'-57.7', 57.7'-59.5', 65.9'-67'
		Core #2 67'-77'=10.0'; recovered 9.0' lost off bottom
67	67.1	Claystone; dark grey, detrital coal
67.1	73.1	Coal; black, hard, dull, high ash from 72'-73.1'
73.1	76	Claystone; light grey, firm, broken at bottom and sticky, bit plugged
76	77	Lost core; sticky clay from bottom
		Samples: 67.1'-69.1', 69.1'-71.1', 71.1'-73.1'
		Core #3 105'-115'=10'; recovered 8.0'
105	105.5	Coal; hard, bright
105.5	107	Siltstone; grey
107	108	Claystone; dark grey
108	108.3	Carbonaceous claystone; coaly
108.3	113	Coal; hard, bright
113	115	Lost core, slid out bottom
		Samples: 108.3'-110', 110'-112', 112'-113'
		P&A Core Hole : 30 sacks chips

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Century GEOPHYSICAL CORP.

century-geo.com

GAMMA-RES-DENSITY

R-12003

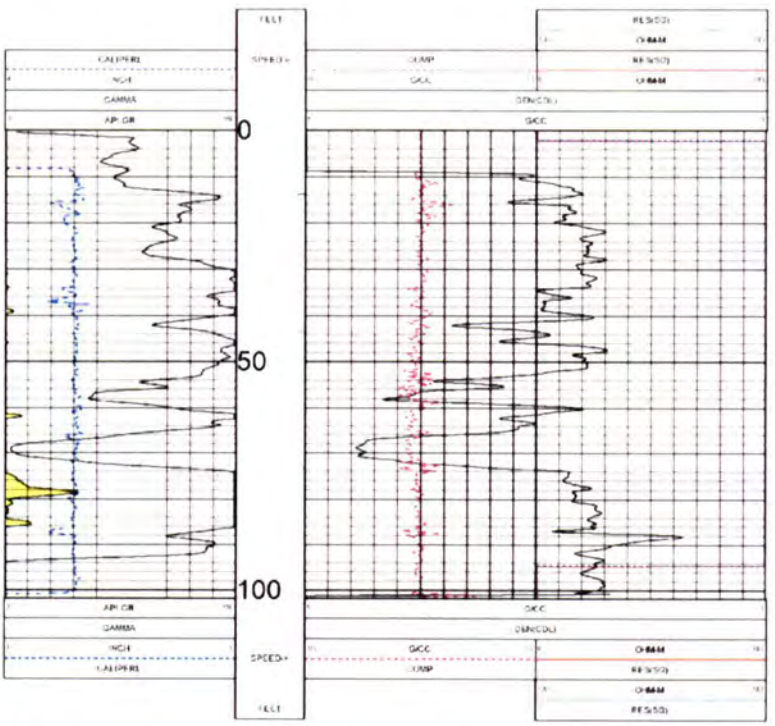
COMPANY	RAMACO LLC	OTHER SERVICES	
WELL	R-12003	NA	
FIELD	NONE	NA	
COUNTY	SPERIGAN	NA	
STATE	WY	NA	
LOCATION	SPERIGAN COAL FIELD		
SECTION	15		
TOWNSHIP	57N		
RANGE	85W		
API NO	NA		
UNIQUE WELL ID	NA		
PERMANENT DATUM	GL	ELEVATION OF PERM. DATUM	NA
LOG MEASURED FROM	GL	ELEVATION OF KB	NA
DRL MEASURED FROM	GL	ELEVATION OF DF	NA
DATE	12/7/12	ELEVATION OF GL	NA
DEPTH-DRILLER	102	RIG NUMBER	A-3 SERVICES
BIT SIZE	5.625	LOGGING UNIT	10-19
LOG TOP	ESC	ARRIVAL TIME	1500
LOG BOTTOM	101.RC	DEPARTURE TIME	1530
CASING OD	NA	CREW CONTACT	NA
CASING BOTTOM	NA		
CASING TYPE	NA		
BORE-HOLE FLUID	WATER		
MAX TEMPERATURE	NA		
VOLTAGE	NA		
VOLTAGE WEIGHT	NA		
WITNESSED BY	M. WOLF		
RECORDED BY	J.CAMPBELL		
REMARKS	NA		
REMARKS 2	NA		

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS

5 INCH LOG, DENSITY R-12003 12/07/12

LOG PARAMETERS

MATRIX DENSITY 2.65	NEUTRON MATRIX SANDSTONE	MATRIX DELTA T 54
MAGNETIC DECL 10	ELECT. CUTOFF 99999	BIT SIZE 5.625
PRESENTATION NAME/DATE 9239 Ramaco Std CDL 5inch 5.31.12.0 11/28/2012		VERSION 3.64KF



5 INCH LOG, DENSITY R-12003 12/07/12

LOG PARAMETERS

MATRIX DENSITY 2.65	NEUTRON MATRIX SANDSTONE	MATRIX DELTA T 54
MAGNETIC DECL 10	ELECT. CUTOFF 99999	BIT SIZE 5.625
PRESENTATION NAME/DATE 9239 Ramaco Std CDL 5inch 5.31.12.0 11/28/2012		VERSION 3.64KF

TOOL CALIBRATION R-12003 12/07/12 13:25
TOOL: 9239C1 TM VERSION 2025
SERIAL NUMBER 2740

	DATE	TIME	SENSOR	STANDARD		RESPONSE	
1	Sep05,12	07:38:00	GAMMA	0.000	[API-GR]	1.000	[CPS]
	Sep05,12	07:38:00	GAMMA	340.000	[API-GR]	327.000	[CPS]
2	Sep04,12	08:20:34	VOLTAGE	1.000	[MV]	10823.000	[CPS]
	Sep04,12	08:20:34	VOLTAGE	2023.000	[MV]	26280.000	[CPS]
3	Feb06,12	07:57:24	CALIPER	4.000	[INCH]	258508.000	[CPS]
	Feb06,12	07:57:24	CALIPER	6.000	[INCH]	368967.000	[CPS]
4	Nov28,12	10:50:31	DENS(L)	1.820	[GICC]	5245.000	[CPS]
	Nov28,12	10:50:31	DENS(S)	2.612	[GICC]	706.000	[CPS]
5	Nov28,12	15:47:08	DENSST	1.500	[GICC]	18328.000	[CPS]
	Nov28,12	15:47:08	DENSSI	2.680	[GICC]	6811.000	[CPS]
6	Nov28,12	11:08:27	CALIPER1	6.000	[INCH]	258112.094	[CPS]
	Nov28,12	11:08:27	CALIPER1	11.350	[INCH]	454362.688	[CPS]
7	Sep04,12	08:21:19	CURRENT	0.000	[UA]	5183.000	[CPS]
	Sep04,12	08:21:19	CURRENT	200.000	[UA]	28622.000	[CPS]
8	Jan23,12	14:37:15	X	Default	[CPS]		
9	Jan23,12	14:37:15	X	Default	[CPS]		

TFN 6 2/025
RECD JUL 30,2015

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ole/Well No.: R12-004	Recorded By: M. Wolf WYPG #614	Drilling Co.: A-3 Services; Shawn Ankney Depth: 0 To 240
Company: RAMACO	Geophysical Log Type: Coal suite	CORED: See page 2. 35-60, 95-110, 130-145 and 175-186.5
Project: Brook Mine	Hole Type: Plug & Twin for coal core	Date Drilled: 12-3-12
County: Sheridan WY		
Township: 57N Range: 85W	NAD 1983, East Central Zone	
Location: SESW Section: 11		
N: 1,941,540.0 E: 1,377,268.1		
Elevation: 3930.2		

DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
0	5	Claystone; brown, soft	5.0	CL		
5	7	Claystone; grey, firm	2.0	CL		
7	12	Siltstone; grey, hard at 9'	5.0	ST		
12	39	Claystone; grey	27.0	CL		
39	55	Coal; soft, weathered, harder near bottom inject H_2O at 35'	16.0	CØ	Monarch	
55	70	Claystone; grey, firm	15.0	CL		
70	80	Siltstone; very hard, very light, very silty	10.0	ST		
80	102	Claystone; grey, fissile	22.0	CL		
102	106	Coaly at 102', hard but some interbedded clay	4.0	CØ	U Carney	
106	112	Claystone; grey to dark grey	6.0	CL		
112	125	Siltstone; light grey, firm	13.0	CL		
125	133	Claystone, grey	8.0	CL		
133	141	Coaly, black, hard, reasonably good	8.0	CØ	L Carney	
141	166	Claystone, grey, fissile	25.0	CL		
166	180	Silty claystone; some thin coals, hard 174'-175', cemented	14.0	ST		
180	184	Coal; hard, brittle, good	4.0	CØ	Masters	
184	208	Claystone; very silty, hard at 100', very hard at 128'-201' & 202'-202'	24.0	CL		
208	210	Coal; hard, bright, thin	2.0	CØ		
210	240	Claystone; grey, occasional very thin coal stringers	3.0	CL		
		Water level at approximately 220 following drilling				
		E-Log Picks: 38'-54'=16' Monarch 102'-10'6=4' U Carney 133'-141'=8' L Carney 180'-184'=4' Masters 208'-210'=2' Local Bed				
		P&A: Plug Pilot Hole with 57 sacks chips Plug Coal Core Hole with 50 sacks chips				
		Coal 39'-55', 102'-106', 133'-141', & 180'-184'				

ABBREVIATIONS

BGL – Below Ground Level
DBS – Disturbed Bulk Sample
GPM – Gallon Per Minute
GS – Geochemical Sample
LA – Laboratory Analysis
SWL – Static Water Level
ZP – Ziplock Bag Sample

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DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)
		Core #1 35'-50'=15'; recovered 2.5' lost soft coal
35	39	Claystone
39	40	Coal; ground soft coal from base
		Lost 40'-48' soft coal
48	49.6	Claystone, parting
49.6	50	Recovered 0.3' of soft coal, lost 5' soft coal
		Core #2 50'-60'=10.0'; recovered 9.2'
50	50.8	Lost, soft coal
50.8	55	Coal; poor soft, base coal carbonaceous clay, gradational base
55	60	Claystone; little carbonaceous, firm, solid core
		Samples: 49.6'-50', 50.8'-53', Lost 50'-50.8', 53'-55'
		Core #3 95'-110'=15'; recovered 13.0', slid out bottom
95	95.5	Claystone; grey
95.5	96.5	Coal; dull, poor, high ash
96.5	98.8	Claystone
98.8	99.4	Coaly claystone
99.4	101.4	Claystone, light
01.4	102.2	Coal; dull, clay rich
02.2	102.7	Claystone; black, carbonaceous
102.7	106	Coal; hard, mostly bright
106	107.9	Claystone; grey
107.9	110	Slid out, lost core
		Samples: 102.7'-104', 104'-107.9'
		Core #4 130'-145'=15'; recovered 12.0', slid out bottom
130	133	Claystone; grey, firm
133	140.7	Coal; hard, bright, good
104.7	142	Claystone; carbonaceous
142	145	Lost core, slid out
		Samples: 133'-135', 135'-137', 137'-139', 139-140.7
		Core #5 175'-186.5'=11.5'; recovered 9.0'
175	179.3	Claystone
179.3	179.7	Claystone; very dark, carbonaceous, little coaly
179.7	184	Coal; high ash 181.3'-181.4'
184	186.5	Claystone; slid out
		CØ Samples: 179.7'-182'

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TFN 6 2/025
RECD JUL 30, 2015

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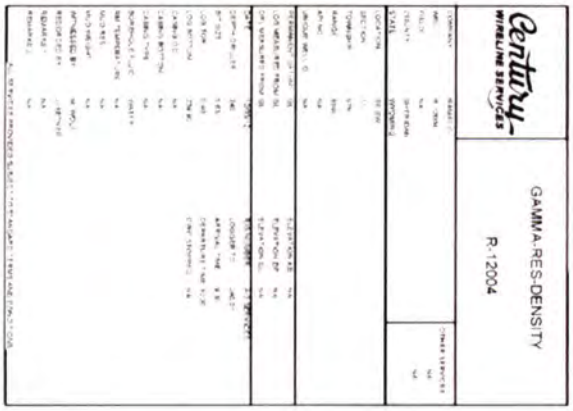

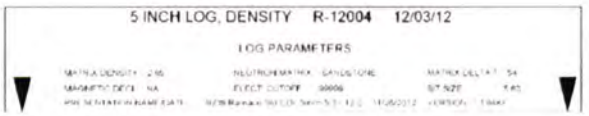

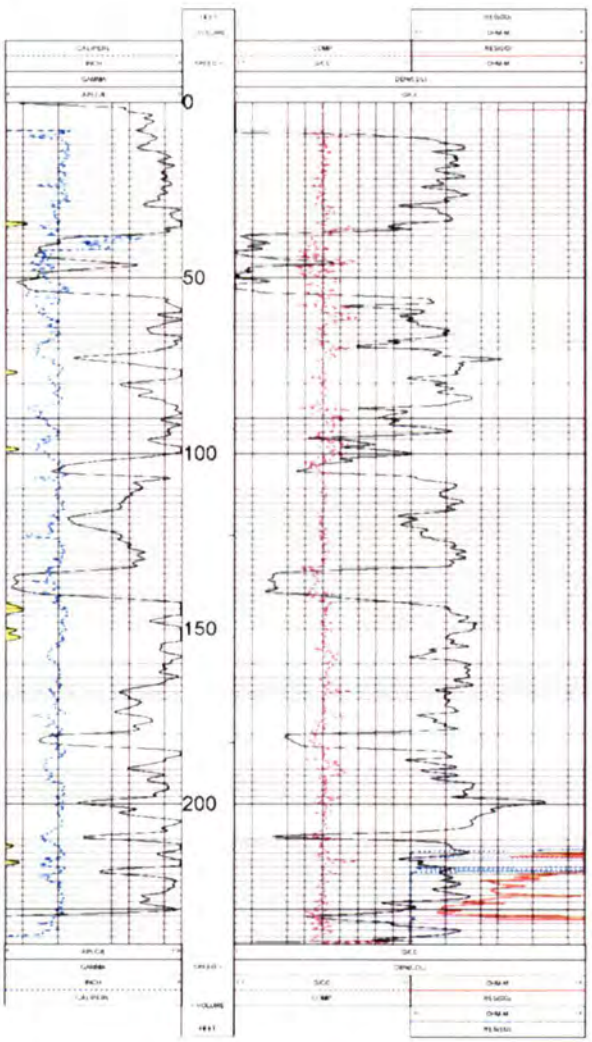

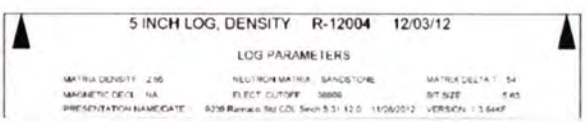

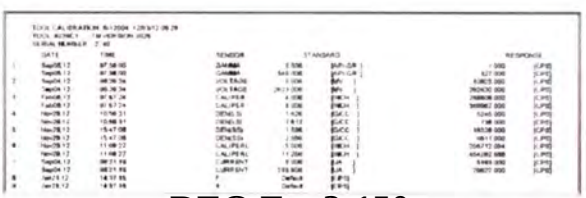

TFN 6 2/025
RECD JUL 30, 2015

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Hole/Well No.: R12-005	Recorded By: M. Wolf WYPG #614	Drilling Co.: A-3 Services; Shawn Ankney Depth: 0 To 240
Company: RAMACO	Geophysical Log Type: Coal suite	CORED: See page 2. 45-80 and 95-110
Project: Brook Mine	Hole Type: Pilot Hole, E-Log, & Core Coal	Date Drilled: 12-5-12
County: Sheridan WY		
Township: 57N Range: 85W	NAD 1983, East Central Zone	
Location: NENE Section: 14		
N: 1,939,175.0 E: 1,378,777.7		
Elevation: 3805.9		

DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
0	17	Siltstone; buff, several very hard streaks	17.0	ST		
17	32	Sandy siltstone; band at 3'-4',7'-7.5', 10'-10.5' & 30'-34'	15.0	ST/SS		
32	47	Claystone; grey, firm, fissile, silty interbeds; hard 30'-32', 36'-38'	15.0	CL		
47	48.5	Coal	1.0	CØ	Rider	
48.5	53	Claystone; dark, carbonaceous	4.5	CL/OH		
53	56.3	Coal; black, hard	3.3	CØ	U Carney	
56.3	65.5	Claystone; grey, carbonaceous	9.2	CL/OH		
65.5	74	Coal; black, hard, thin ash band (66.2-67.1)	8.5	CØ	L Carney	
74	83	Claystone; grey, firm, fissile	9.0	CL		
83	93	Siltstone; grey	10.0	ST		
93	98.5	Claystone; grey, firm	5.5	CL		
98.5	103	Coal; black, hard, good core	4.5	CØ	Masters	
103	105	Claystone; grey, fissile	2.0	CØ		
105	108	Sandstone; grey, silty, very light	3.0	SS		
108	122	Siltstone; grey, firm	14.0	ST		
		E-Log Picks: 53'-56.'5=3.5' U Carney 66'.5-74'=7.5' L Carney 98'.5-103'=4.5' Masters				
		P&A: Pilot Hole with 25 sacks chips Core Hole with 26 sacks chips				
		Coal 39'-55', 102'-106', 133'-141', & 180'-184'				

ABBREVIATIONS

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ZP – Ziplock Bag Sample

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RECD OCT 23, 2015

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DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)
		Core #1 45'-60'=15'; recovered 11.3' slid out bottom
45	45.9	Coal
45.9	49.1	Claystone; dark, carbonaceous
49.1	50.5	Claystone; light grey
50.5	52	Coaly carbonaceous claystone; very dark
52	53	Claystone; grey – brown, little coaly, detrital pieces
53	56.3	Coal; black, hard
56.3	60	Lost core, thick slippery claystone, slid out
		Samples: 53'-55', 55'-56.3'
		Core #2 65'-80'=15'; recovered 9.5', slid out bottom
65	65.5	Claystone; grey
65.5	66.2	Coal; black, dull, high ash
66.2	67.1	Claystone; dark, high ash, carbonaceous, little coaly
67.1	74	Coal; hard, black, ash band at 72'-72.3'
74	74.5	Claystone; dark, carbonaceous
		Samples: 67.1'-68', 68'-70', 70'-72', 72'-74'
		Core #3 95'-110'=15'; recovered 15.0'
95	96	Claystone; light grey, firm
96	98.7	Claystone; medium – dark grey, firm, fissile
98.7	103	Coal, hard, black, dull for last foot 102'-103'
103	106.5	Claystone; light grey, very firm, silty
106.5	110	Sandstone; very light grey, very fine grained, firm but slightly friable
		Samples: 98.7'-101', 101'-103'

ABBREVIATIONS

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RECD JUL 30, 2015

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Century WIRELINE SERVICES

GAMMA-RES-DENSITY

R-12005

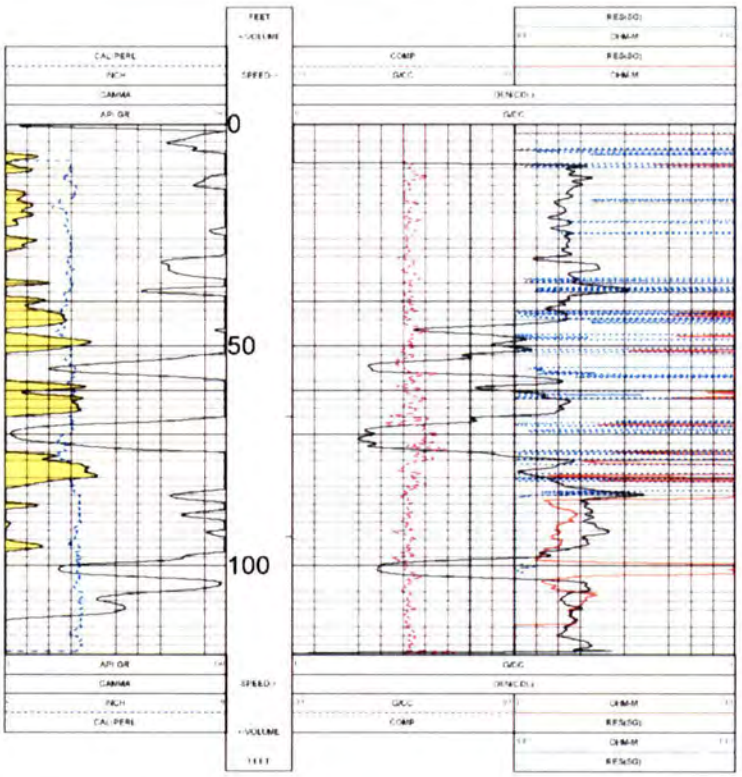
COMPANY	RAMACO	OTHER SERVICES	
WELL	R-12005		NA
FIELD	NA		NA
COUNTY	SHERMAN		NA
STATE	WYOMING		
LOCATION	NEWE		
SECTION	14		
TOWNSHIP	57N		
RANGE	89W		
API NO	NA		
UNIQUE WELL ID	NA		
PERMANENT DATUM	GL	ELEVATIONS	NA
LOG MEASURED FROM	GL	ELEVATION KB	NA
DRL MEASURED FROM	GL	ELEVATION DF	NA
		ELEVATION GL	NA
DATE	12/05/12	RECORDED BY	ANI SERVICES
DEPTH DRILLER	122	LOGGER TD	120.35
BIT SIZE	5.63	ARRIVAL TIME	1403
LOG TOP	0.00	DEPARTURE TIME	1505
LOG BOTTOM	120.35	CREW STATION	NA
CASING DS	NA		
CASING BOTTOM	NA		
CASING TYPE	NA		
BORE FLUID	AIR		
MAX TEMPERATURE	NA		
MUD RES	NA		
MUD WEIGHT	NA		
WITNESSED BY	V. WOLF		
RECORDED BY	J. KENZIE		
REMARKS 1	NA		
REMARKS 2	NA		

* SERVICES PROVIDED SUBJECT TO SCHLUMBERGER'S STANDARD TERMS AND CONDITIONS ONLY

5 INCH LOG, DENSITY R-12005 12/05/12

LOG PARAMETERS

MATRIX DENSITY 2.65	NEUTRON MATRIX SANDSTONE	MATRIX DELTA T 54
MAGNETIC DECL NA	ELECT. CUTOFF 99999	BIT SIZE 5.63
PRESENTATION NAME/DATE 9239 Ramaco Std CDL 5inch 5.31 12.0 11/28/2012		VERSION 3.64KF



5 INCH LOG, DENSITY R-12005 12/05/12

LOG PARAMETERS

MATRIX DENSITY 2.65	NEUTRON MATRIX SANDSTONE	MATRIX DELTA T 54
MAGNETIC DECL NA	ELECT. CUTOFF 99999	BIT SIZE 5.63
PRESENTATION NAME/DATE 9239 Ramaco Std CDL 5inch 5.31 12.0 11/28/2012		VERSION 3.64KF

TOOL CALIBRATION R 12005 12/06/12 14:33
TOOL 9239.1 TM VERSION 2025
SERIAL NUMBER 2843

	DATE	TIME	SENSOR	STANDARD		RESPONSE	
1	Oct02,12	07:36:43	GAMMA	0.000	[API GR]	1.000	[CPS]
	Oct02,12	07:36:43	GAMMA	340.000	[API GR]	310.000	[CPS]
2	Oct02,12	07:36:46	VOLTAGE	0.000	[MV]	12490.000	[CPS]
	Oct02,12	07:36:46	VOLTAGE	2005.000	[MV]	282252.000	[CPS]
3	Oct02,12	07:36:48	CALIPER	4.000	[INCH]	221144.000	[CPS]
	Oct02,12	07:36:48	CALIPER	6.000	[INCH]	334360.000	[CPS]
4	Dec03,12	12:36:41	DENSS)	1.800	[GCC]	4127.000	[CPS]
	Dec03,12	12:36:41	DENSS)	2.617	[GCC]	803.000	[CPS]
5	Dec03,12	12:36:48	DENSS)	1.580	[GCC]	14032.000	[CPS]
	Dec03,12	12:36:48	DENSS)	2.680	[GCC]	6686.000	[CPS]
6	Dec03,12	12:36:57	CALIPER1	5.000	[INCH]	201200.000	[CPS]
	Dec03,12	12:36:57	CALIPER1	11.250	[INCH]	491910.000	[CPS]
7	Oct02,12	07:36:59	CURRENT	0.000	[UA]	6860.000	[CPS]
	Oct02,12	07:36:59	CURRENT	287.249	[UA]	26065.000	[CPS]
8	Oct02,12	07:36:05	X	Default	[CPS]		

TFN 6 2/025
RECD JUL 30, 2015

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Hole/Well No.: R12-006	Recorded By: M. Wolf WYPG #614	Drilling Co. : A-2 Services; Shawn Ankney Depth: 0 To 300 CORED:136.4- See Core Description 161 and 176-191
Company: RAMACO	Geophysical Log Type: Coal Suite	
Project: Brook Mine	Hole Type: plug, e-log, & twin for coal core	Date Drilled: 1-3-13; 1-4-13; 1-7-13; 1-8-13
County: Sheridan WY		
Township: 57N Range: 84W	NAD 1983, East Central Zone	
Location: NWSE Section: 14		
N: 1,937,429.8 E: 1,387,634.4		
Elevation:3895.3		

DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
0	64	Burn red, hard, losing circulation at 15', set mud pit and begin mixing bentonite jel, intermittent circulation, OB samples insufficient and contaminated with bentonite	64.0	BURN		Base XXX Set 68' of 6" PVC Casing
64	109	Claystone; grey, fissile, firm	45.0	CL		
109	132	Siltstone; grey to light grey, firm, few hard streaks	23.0	ST		
132	139	Claystone; grey, fissile, firm, washed out at 136'-138'!	7.0	CL		
139	144	Coal; black, hard, Upper Carney	5.0	CØ	U Carney	H_2O < ½ GPM
144	145	Claystone	1.0	CL	Parting	
145	154.5	Coal; black, hard	9.5	CØ	L Carney	H_2O < ½ GPM
154.5	179	Claystone; grey, fissile, hard ledge at 166'-168.5', very firm at 170'	24.5	CL		
179	185	Coal; black, hard	6.0	CØ	Masters	
185	190	Claystone; grey, firm, fissile	5.0	CL		
190	192	Carbonaceous claystone; dark	2.0	OH		
192	202	Claystone; grey	10.0	CL		
202	204	Coal; black, hard	2.0	CØ		
204	225	Claystone; grey	21.0	CL		
225	274	Siltstone; grey, interbedded claystone, hard streaks! at 230'-231.5', 252'-255', 271'-273'	49.0	ST		
274	300	Claystone; grey, firm, fissile	26.0	CL		
		Water after drilling at approximately 275', slow recovery (water level after weekend at 93' with 160' total depth)				
		E-Log Picks:				
		139' – 154.8' = 15.8' carney with 0.7 foot clay parting				
		179' – 184.5' = 5.5' Masters				
		202' – 204'=2.0' Local Coal?				
		Coal Thickness:				
		Carney 139 – 154.8'=15.8' with 0.7' parting				
		Masters 179 – 184.5'=5.5'				

ABBREVIATIONS

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DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)
		Core #1 136.4' – 151.4'; recovered 15.0'
136.4	137.5	Siltstone; grey, firm
137.5	137.8	Coal; black, hard
137.8	139	Claystone; grey, little detrital coal
139	139.4	Coal; black, hard, moderately bright
139.4	139.7	Coaly clay; dull, very high ash
139.7	139.9	Coal; black, hard, bright
139.9	140.4	Clayey coal; dull, high ash
140.4	144	Coal; hard, good, bright
144	144.7	Claystone parting; light grey
144.7	151.4	Coal
		Samples: 139'-140.4', 140.4'-142.4', 142.4'-144.0', 144'-144.7', 144.7'-149.7', 149.7'-151.4' = 1.7'
		Core #2 151.4 – 161 = 9.6; recovered
151.4	154.8	Coal; black, hard, bright
154.8	156.5	Carbonaceous claystone; dark brown
156.5	161	Siltstone; grey – light grey, very firm
		Samples: 151.4-153.4, 153.4-154.8
		Core #3 176 – 191 = 15'; recovered 15.0
176	179	Claystone; grey, moderate detrital coal, very soft carbonaceous clay content
179	179.4	Coal; dull
179.4	184.5	Coal; black, moderate bright
184.5	184.6	Carbonaceous claystone; dark
184.6	187.3	Claystone; very light, very silty, very firm
187.3	189.2	Claystone; darks, moderate carbonaceous
189.2	190.4	Claystone; light
190.4	191	Claystone; dark, carbonaceous
		Samples: 179'-181', 181'-183', 183'-184.5'
		Rock core: 137'-139'=2.0' Carney Roof 154.8'-156.8'=2.0' Carney Floor 177'-179'=2.0' Masters Roof 184.5'-186.5'=2.0' Masters Floor

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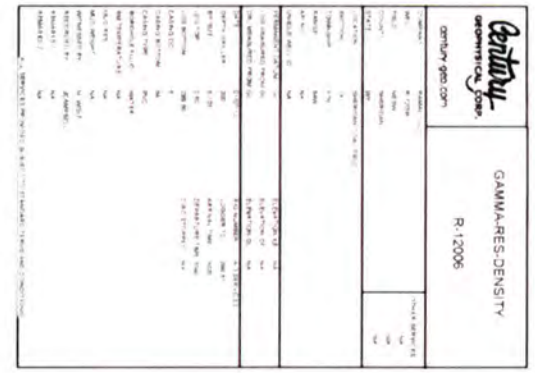
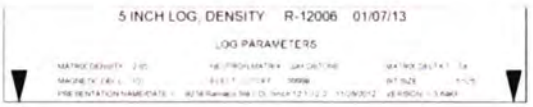
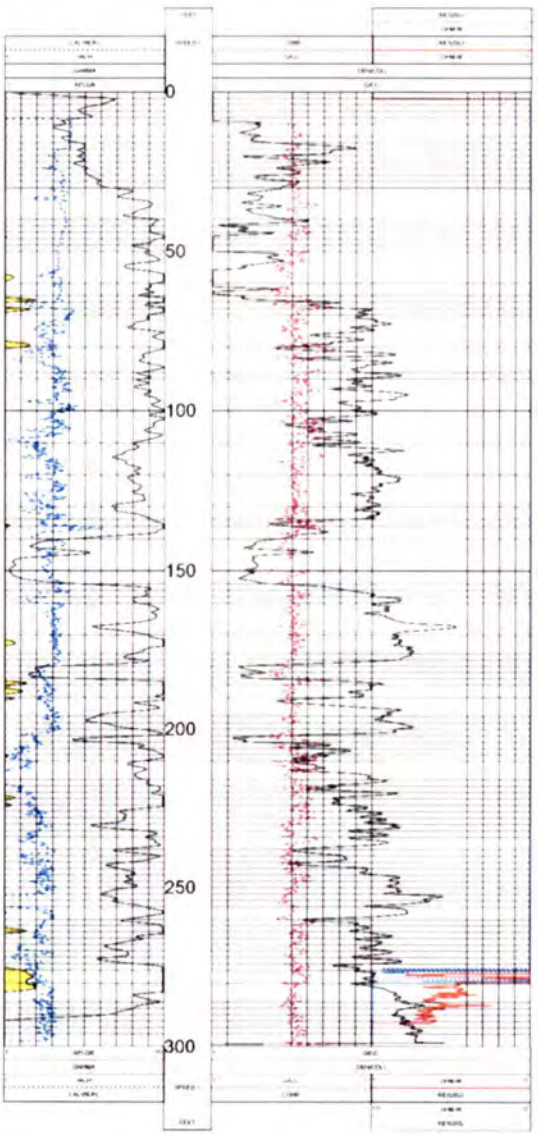
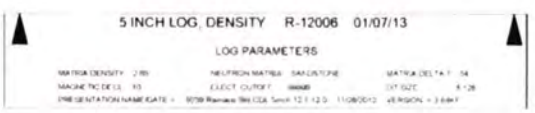
TFN 6 2/025
RECD JUL 30, 2015

Scanned, 02/27/2020









TFN 6 2/025
RECD JUL 30, 2015

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WWC Engineering

DRILLING LOG

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Hole/Well No.: R12-007	Recorded By: M. Wolf WYPG #614	Drilling Co.: A-3 Services; Shawn Ankney Depth: 0 To 39 CORED: See page 2 60-68.5, 95-110 and 130-140
Company: RAMACO	Geophysical Log Type: Coal suite	
Project: Brook Mine	Hole Type: Pilot & Twin for coal core 5 ⅝"	Date Drilled: 11-29-12
County: Sheridan WY		
Township: 57N Range: 85W	NAD 1983, East Central Zone	
Location: NENE Section: 14		
N: 1,940,426.0 E: 1,379,028.5		
Elevation: 3872.0		

DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
0	24	Burn-scoria; very hard, losing circulation, injected H_2O and soap, change to drag bit – hand change to 8¾ tri-core KD=221, 12' trying to lose circulation, 10:30 make connection at 221. Won't go down; redrill, bit hanging up at approximately 18'-19'; fight burn until 12:15, driller's thinks burn making water!	24.0	CL		H_2O in base burn!
24	27	Claystone; grey, sat surface casing (approximately 30') to 27', claystone; split casing hanging onto bit, casing settled below surface, add 4 more feet of casing	3.0	CL		
27	54	Claystone; medium grey, firm	27.0	CL		
54	63	Claystone; dark, carbonaceous and interbedded thin coal	9.0	CL/OH		
63	67	Coal; black, dull, hard	4.0	COAL	U Carney	
67	96	Claystone; grey, firm hard 77'-79'	29.0	CL		
96	103.5	Coal; black, hard, moderately bright	7.5	COAL	L Carney	
103.5	132	Claystone; grey with occasional very thin coal stringers, firm	28.5	CL		
132	137	Coal; black, hard	5.0	COAL	Masters	
137	160.5	Claystone; grey, firm, few stringers	23.5	CL		
160.5	162	Coal; hard, thin, carbonaceous above	1.5	COAL	? Local	
162	170	Claystone; grey, firm, carbonaceous, little coaly	8.0			
170	188	Siltstone; light grey, firm	18.0	ML		
188	200	Sandstone; light, very fine grained, think contains little water	12.0	SM		
200	204	Claystone; grey, firm, thin CØ stringers	4.0	CL		
204	206.5	Coal; moderately hard	2.5	COAL	Local	
206.5	239	Claystone; grey, with thin coal stringers and hard streaks!	32.5	CL		
		DTW 11/30/12 at 7:13=119.3				
		P&A: Plug Pilot Hole with 54 sacks chips Plug Coal Core Hole with 39 sacks chips				
		E-Log Picks: 63'-67'=5' U Carney 96'-103.5'=7.5' L Carney 132'-137'=5' Masters 160.5'-162'=1.5' Local 204'-206.5'=2.5' Local				

ABBREVIATIONS

GL – Below Ground Level
DBS – Disturbed Bulk Sample
GPM – Gallon Per Minute
GS – Geochemical Sample
LA – Laboratory Analysis
SWL – Static Water Level
ZB – Ziplock Bag Sample

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DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)
		Core #1 60' -68.5' = 8.5'; recovered 7.3'
		ground off top & little clay at bottom
60	61.2	Coal and carbonaceous clay; very poor
61.2	62.8	Claystone; grey, firm graduates to dark carbonaceous at base
62.8	63.5	Coal; bright, hard
63.5	63.9	Clay with detrital coal
63.9	64.8	Coal; black, hard, bright
64.8	65	Brown coal; high clay content
65	67	Coal; black, hard, bright, best coal
67	67.2	Claystone; soft, coaly, plugged bit at 67.2'
67.2	68.5	Lost soft claystone
		Samples: 62.8'-63.9', 63.9'-65', 65'-67'
		Core #2 95' -110' = 15'; recovered 14'
95	95.8	Claystone; grey, firm
95.8	103.2	Coal; very hard, bright, abundant pyrite in cleat
103.2	103.9	Coaly clay; dark, dull, very poor, separate bag, but very poor – No Analysis!
103.9	109	Claystone; grey, sticky, bit plugged, lost off bottom
109	110	Lost core, sticky claystone
		Samples: 95.8'-98', 98'-100', 100'-102', 102'-103.2'
		Core #3 130' -140' = 10'; recovered 10'
130	133	Claystone; grey, hard
133	133.5	Claystone; dark, grey, grading to carbonaceous at CØ coated
133.5	137.6	Coal; hard, mostly bright, chattered, brittle
137.6	140	Siltstone; light grey
		Samples: 133.5'-135.5', 135.5'-137.6'

ABBREVIATIONS

BGL – Below Ground Level
DBS – Disturbed Bulk Sample
GPM – Gallon Per Minute
GS – Geochemical Sample
LA – Laboratory Analysis
SWL – Static Water Level
ZP – Ziplock Bag Sample

TFN 6 2/025
RECD JUL 30, 2015

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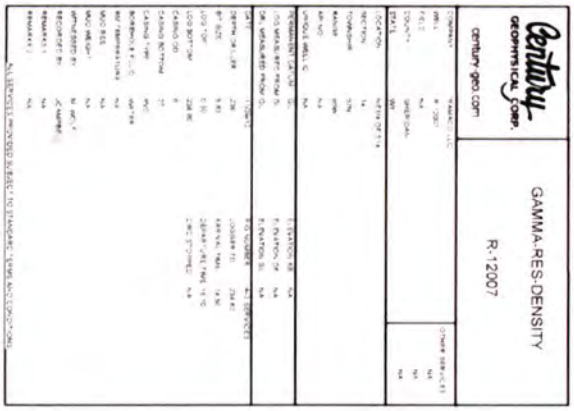

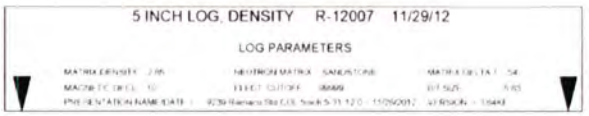

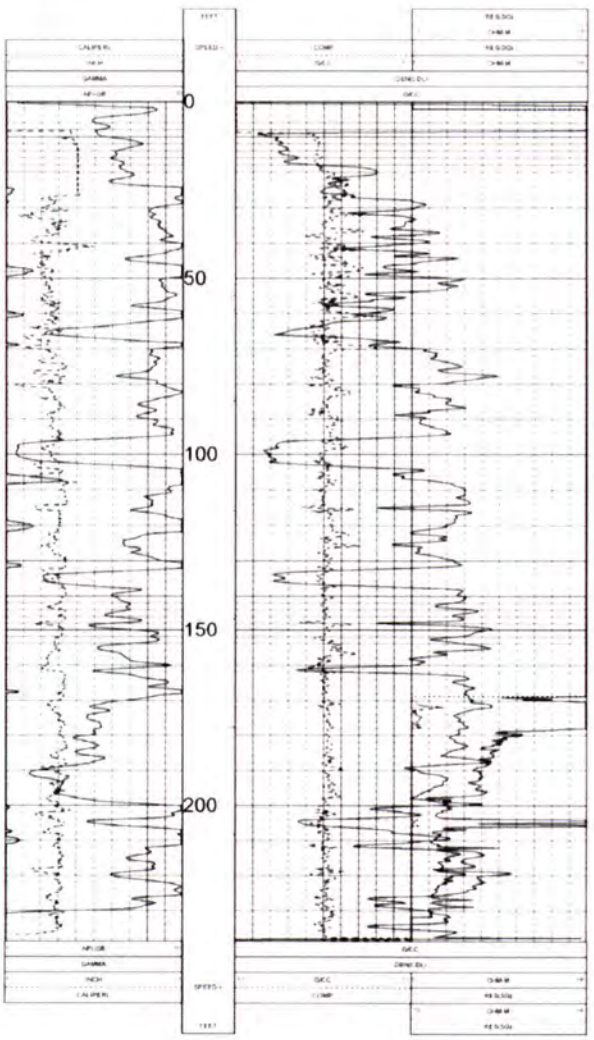

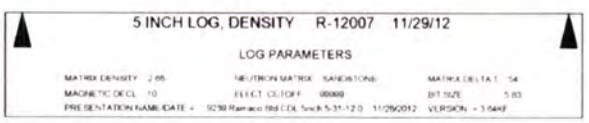

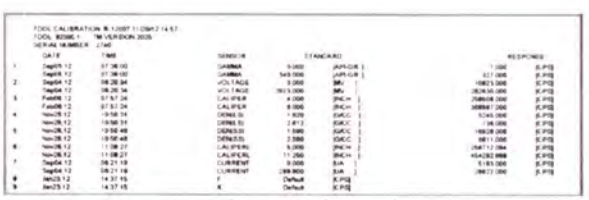

TFN 6 2/025
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Hole/Well No.: R12-008	Recorded By: M. Wolf WYPG #614	Drilling Co: A-3 Services; Shawn Ankney Depth: 0 To 201 Cored: 35-60 and 81-91
Company: RAMACO	Geophysical Log Type: Coal Suite	
Project: Brook Mine	Hole Type: e-log; & coal core	Date Drilled: 12-11-12
County: Sheridan WY		
Township: 57N Range: 85W	NAD 1983, East Central Zone	
Location: SESE Section: 11		
N: 1,940,826.2 E: 1,380,027.6		
Elevation:3835.7		

DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
0	2	Fill, slope wash, poorly sorted	2.0	FILL		
2	4	Claystone; buff, silty	2.0	CL		
4	14	Siltstone; orange – buff	10.0	ST		
14	16	Claystone; grey	2.0	CL		
16	24	Siltstone; buff, very hard at 18'-19', 20'-21'	8.0	ST		
		Moved rig back to avoid drilling metal. Broke tooth off claw bit tooth				
35	36	Coal; hard, stringer	1.0	CØ		
36	40	Claystone; grey	4.0	CL		
40	45	Coal	5.0	CØ	U Carney	
45	48	Claystone; parting	3.0	CL		
48	56.5	Coal; hard, bright	8.5	CØ	L Carney	
56.5	62	Claystone	5.5	CL		
62	76	Siltstone	14.0	ST		
76	83	Claystone	7.0	CL		
83	89	Coal; hard, bright	6.0	CØ	Masters	
89	119	Siltstone/claystone; several coal stringers 110'-119'	30.0	ST/CL		Water level 150
119	144	Siltstone	25.0	ST		
144	146	Claystone	2.0	CL		
146	156	Claystone; with coal stringers	10.0	CL/CO		
156	201	Claystone/siltstone; interbedded	45.0	CL/ST		
		Water level following drilling approximately 170'				
		E-Log Picks: 34'-36'=2.0' U U Carney 40'-44.5'=4.5' U Carney 48'-57'=9.0' L Carney 83'-88'=5.0' Masters				
		P&A: Pilot Hole = 29 sacks Core Hole = 21 sacks				

ABBREVIATIONS

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TFN 6 2/025
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DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)
		Core #1 35' -50' = 15'; recovered 15.0'
35	38.9	Claystone; dark, carbonaceous
38.9	40.0	Claystone; light grey, abundant detrital coal
40	40.8	Coal; dull, hard, poor
40.8	41.2	Claystone; parting, dark grey
41.2	44.6	Coal; black, hard, more bright
44.6	45.9	Claystone; grey, firm
45.9	46.7	Coal; dull, high clay content
46.7	48	Claystone; grey
48	50	Coal; hard, bright
		Samples: 40'-41.2' poor, 41.2'-42.6', 42.6'-44.6', 44.6'-48', 48'-50'
		Core #2 50' -60' = 10'; recovered 8.3' lot clay off bottom
50	58	Coal; hard, bright
58	58.3	Claystone; dark, carbonaceous
58.3	60	Lost core, slippery claystone "slid out bottom"
		Samples: 50'-52', 52'-54', 54'-56', 56'-58'
		Core #3 81' -91' = 10.0'; recovered 8.6' slide out bottom
81	83	Claystone; light grey, firm, fissile
83	88.2	Coal; top hard, bright, bottom half notably dull
88.2	91	Lost core; slide out bottom – claystone
		Samples: 83'-85', 87'-88.2'

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TFN 6 2/025
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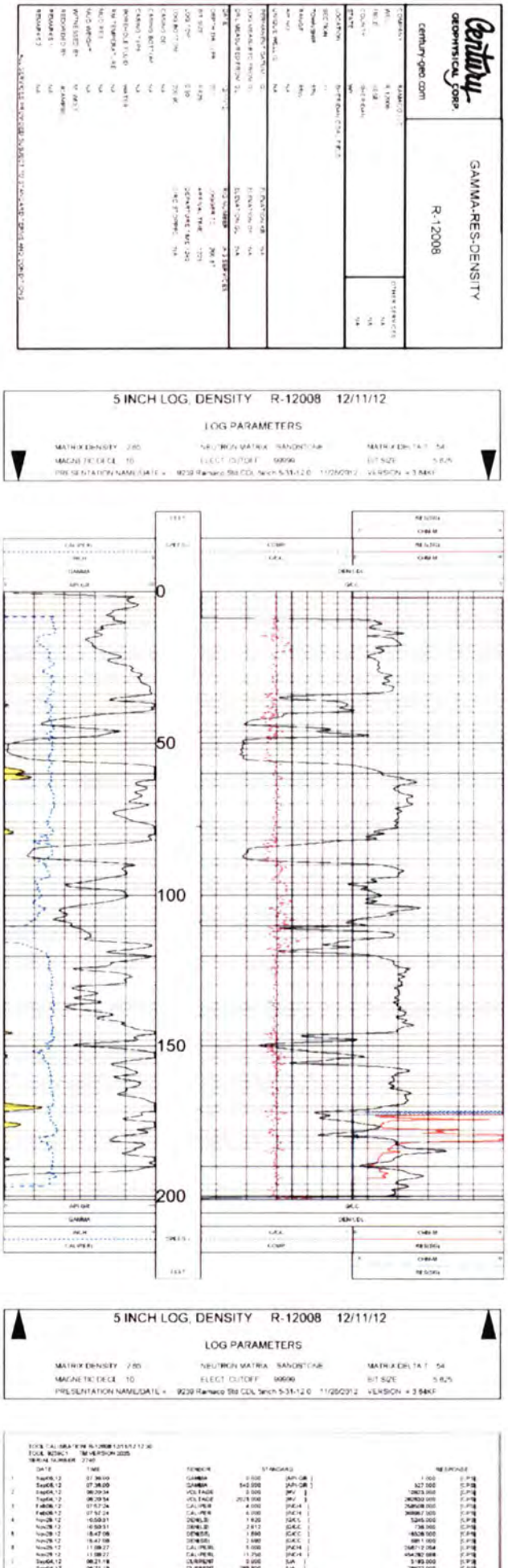

TFN 6 2/025
RECD JUL 30, 2015

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Hole/Well No.: R12-009-A	Recorded By: M. Wolf WYPG #614	Drilling Co: A-3 Services; Shawn Ankney Depth: 0 To 65
Company: RAMACO	Geophysical Log Type: Coal Suite	
Project: Brook Mine	Hole Type: e-log; & twin for coal core	Date Drilled: 12-12-12
County: Sheridan WY		
Township: 57N Range: 85W	NAD 1983, East Central Zone	
Location: SWNW Section: 13		
N: 1,937,903.5 E: 1,382,752.8		
Elevation:3836.1		

DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
0	5	Siltstone; buff, hard at 2.5'-3.5'				
5	9	Claystone; dark, occasional orange, silty streaks				
9	11	Siltstone; buff alternating with grey				
11	25	Claystone, grey, fissile, hard at 13'-14', 17.58'-20'				
25	29	Drilling blind; no circulation				
29	38	Coal zone, driller hit 4' void				
38	47	Void – no circulation				
		Move Rig 18'-20' North, try again				
		Hole B North				
		Hard at 49'-50'				
55	58	Coal; losing circulation				
58	65	Losing circulation, very soft stop 9:47				
		Shovel cutting into holes				
		Water level after drilling approximately 35' according to E-Log				
		E-Log Picks: 18.5'-27'=8.5' 47'-52.5'=5.5'				
		Note: Hole A encountered mine voids; Hole B lost circulation at 65'				
		P&A: Pilot Hole with 17 bags chips Second Hole with 20 bags chips				

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TFN 6 2/025
RECD JUL 30, 2015

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Hole/Well No.: AMBRE-03	Recorded By: M. Wolf WY PG #614	Drilling Co.: A-3 Services Depth: 0′ To 96′
Company: RAMACO	Geophysical Log Type: Coal Suite	CORED: 51-96′
Project: Brook Mine	Hole Type: core coal intervals indicated in plan	Date Drilled: 01-10-13
County: Sheridan WY		
Township: 57N Range: 84W	Water:	
Location: NWSW Section: 9		
N:1,941,775.3 E:1,398,109.2		
Elevation: 3726.8		

DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
0	5	Fill; fine, few pebbles	5.0	ML/SP		
5	7	Coarse clinker; gravel	2.0	QAL		
7	9	Very coarse, big hard slabs?	2.0	QAL		
9	20	Coarse pebble; gravel, very little water at base. Set 21′ of 6" PVC casing (washout 15′-20′)	11.0	QAL		
20	46	Siltstone; light grey, firm	26.0	ST		
46	52	Claystone; grey, little detrital coal	6.0	CL		
52	68.9	Coal; black, hard, framboidal pyrite on cleat	16.9	CØ	CARNEY	Bottom poor!
68.9	81	Claystone; grey, firm, fissile, carbonaceous zones near base that part relatively easily on bedding	12.1	CL		
81	85.9	Coal; black, hard, framboidal pyrite	4.9	CØ	MASTERS	
85.9	90.8	Claystone; grey, sparse, carbonaceous sands	4.9	CL		
90.8	92.5	Coal; hard, fractures spread split barrel & plugged to grind core off bottom	1.7	CØ	RIDER	
92.5	92.7	Claystone; black, coaly	0.2	CL/OH		
92.7	95.0	Siltstone; light grey, very firm	2.3	ST		
95	96	Lost core; bit plugged, ground up	1.0	-		Lost core
		E-Log Picks 52′-68.9′=16.9′, bottom 0.5′ very poor Carney Masters 81′-85.9′=4.9′ 90.8′-92.5′=1.7′			CARNEY MASTERS THIN RIDER	
		Core #1 51.0′-66.0′ = 15′ recovered 14.5′				
51.0	52	Claystone; grey-dark grey, pyrite chunks, lost top ½′				
52	66	Coal; black, hard, moderately pyrite, broken at top 0.3′				
		Samples: 52′-54′; 54′-56′; 56′-61′; 61′-66′				

ABBREVIATIONS

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TFN 6 2/025
RECD OCT 23, 2015

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Hole/Well No.: R12-010	Recorded By: M. Wolf WYPG #614	Drilling Co.: A-3 Services; Shawn Ankney Depth: 0 To 120 CORED: No Core
Company: RAMACO	Geophysical Log Type:	
Project: Brook Mine	Hole Type: e-log; & twin for coal core	Date Drilled: 12-12-12
County: Sheridan WY		
Township: 57N Range: 85W	NAD 1983, East Central Zone	
Location: SWSW Section: 12		
N: 1,941,732.1 E: 1,382,511.5		
Elevation:3781.4		

DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
0	9	Fill colluvium / slope wash	9.0	FILL		
9	16	Claystone; light brown	7.0	CL		
16	27	Siltstone; yellow	11.0	ST		
27	36	Claystone; grey, very hard at 32'-33.5', 36'-36'	9.0	CL		
36	38	Coal; hard, bright, thin	2.0	CØ		
38	53	Claystone; grey, very hard at 47'-49'	15.0	CL		
53	56	Coal; soft, blowing out in big chunks, making good water	3.0	CØ		
56	61	Claystone; dark, carbonaceous	5.0	CL		
61	62	Coal; hard, thin	1.0	CØ		
62	70	Claystone; grey	8.0	CL		
70	80	Siltstone; grey, firm	10.0	ST		
80	91	Claystone; grey	11.0	CL		
91	92	Coal; hard, thin	1.0	CØ		
92	98	Claystone; grey	6.0	CL		
98	99	Coal; hard, thin	1.0	CØ		
99	110	Siltstone; light grey	11.0	ST		
110	120	Claystone; grey	10.0	CL		
		E-Log Picks: 36'-38'=2.0' Local 53'-56'=3.0' Local 61'-62'=1.0' Local Thin Beds Below Carney/Masters 91'-92'=1.0' Local 98'-99'=1.0' Local				
		Note: Beds of insufficient thickness to justify coal core "No Coal Core"				
		P&A: Pilot Hole 24 sacks				

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ZP – Ziplock Bag Sample

TFN 6 2/025
RECD JUL 30, 2015

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Century WIRELINE SERVICES

GAMMA-RES-DENSITY

R-12010

COMPANY RAMACO

WELL R-12010

FIELD NA

COUNTY SHERIDAN

STATE WYOMING

OTHER SERVICES

NA

NA

NA

LOCATION SW SW

SECTION 12

TOWNSHIP 57N

RANGE 85W

PERMANENT DATUM GL

LOG MEASURED FROM GL

DRILL MEASURED FROM GL

API NO NA

LINCOLN WELL ID NA

ELEVATION GL NA

DATE 12/12/12

DEPTH DRILLER 121

BIT SIZE 5.63

DOC TOP 0

LOG BOTTOM 119.25

CASING OD NA

CASING BOTTOM NA

CASING TYPE NA

BORING FLUID NA

RM TEMPERATURE NA

VISC NA

WL WEIGHT NA

RECORDED BY SCHLEIN

WITNESSED BY NA

REMARKS NA

RUN NUMBER A3 SERVICES

LOGGER TD 119.25

ARRIVAL TIME 1930

DEPARTURE TIME 2100

CREW STORED NA

A SERVICES PROVIDED SUBJECT TO CENTURY'S TERMS AND CONDITIONS

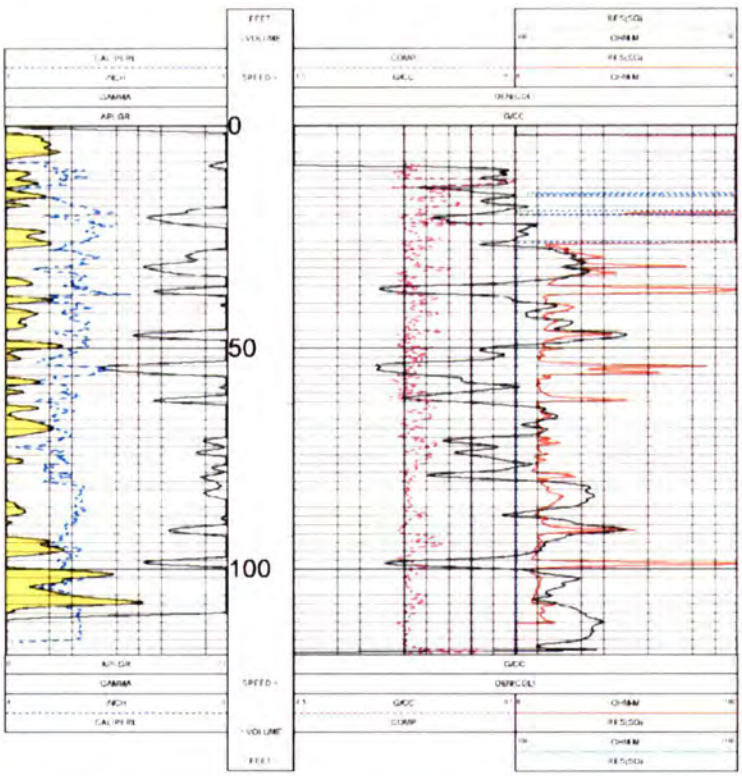
5 INCH LOG, DENSITY R-12010 12/12/12

LOG PARAMETERS

MATRIX DENSITY 2.65 NEUTRON MATRIX SANDSTONE MATRIX DELTA T 54

MAGNETIC DECL NA ELECT CUTOFF 99999 BIT SIZE 5.63

PRESENTATION NAME/DATE = 9239 Ramaco Sfd CDL Sinch 5-31-12 0 11/28/2012 VERSION = 3.64KP



5 INCH LOG, DENSITY R-12010 12/12/12

LOG PARAMETERS

MATRIX DENSITY 2.65 NEUTRON MATRIX SANDSTONE MATRIX DELTA T 54

MAGNETIC DECL NA ELECT CUTOFF 99999 BIT SIZE 5.63

PRESENTATION NAME/DATE = 9239 Ramaco Sfd CDL Sinch 5-31-12 0 11/28/2012 VERSION = 3.64KP

TOOL CALIBRATION # 12010 12/12/12 14:52

TOOL 9230C1 TN VERSION 2905

SERIAL NUMBER 7843

	DATE	TIME	SENSOR	STANDARD		RESPONSE	
1	Dec02,12	07:36:43	GAMMA	0.000	[API-GR]	1.000	[CPS]
	Dec02,12	07:36:43	GAMMA	340.000	[API-GR]	310.000	[CPS]
2	Dec02,12	07:36:45	VOLTAGE	0.000	[MV]	12490.000	[CPS]
	Dec02,12	07:36:45	VOLTAGE	2905.000	[MV]	282252.000	[CPS]
3	Dec02,12	07:36:48	CALIPER	4.000	[INCH]	221144.000	[CPS]
	Dec02,12	07:36:48	CALIPER	8.000	[INCH]	334300.000	[CPS]
4	Dec03,12	12:36:41	DENS(S)	1.100	[G/CC]	4122.000	[CPS]
	Dec03,12	12:36:41	DENS(S)	2.617	[G/CC]	603.000	[CPS]
5	Dec03,12	12:36:48	DEN(SS)	1.180	[G/CC]	14032.000	[CPS]
	Dec03,12	12:36:48	DEN(SS)	2.580	[G/CC]	6686.000	[CPS]
6	Dec03,12	12:36:52	CALIPER(L	5.000	[INCH]	201200.000	[CPS]
	Dec03,12	12:36:52	CALIPER(L	11.250	[INCH]	401910.000	[CPS]
7	Dec02,12	07:36:58	CURRENT	0.000	[UA]	5880.000	[CPS]
	Dec02,12	07:36:58	CURRENT	287.249	[UA]	29083.000	[CPS]
8	Dec02,12	07:36:59	X	0.000	[UFT]		

TFN 6 2/025
RECD JUL 30,2015

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ole/Well No.: R12-011	Recorded By: M. Wolf WYPG #614	Drilling Co.: A-3 Services, Shawn Ankney Depth: 0 To 92
Company: RAMACO	Geophysical Log Type: Coal Suite	CORED: 15-28 and 46-52
Project: Brook Mine	Hole Type: e-log; & twin for coal core	Date Drilled: 12-12-12
County: Sheridan WY		
Township: 57N Range: 85W	NAD 1983, East Central Zone	
Location: NENW Section: 13		
N: 1,939,008.5 E: 1,382,528.0		
Elevation:3779.7		

DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
0	4	Colluvium, gravelly	4.0	QC		
4	6.5	Claystone; grey, silty	2.5	CL		
6.5	7	Coal	0.5	CØ		
7	18	Claystone; light grey, silty, fractured	11.0	CL		
18	27	Coal; dull, weathered, poor	9.0	CØ	Carney	
27	32	Claystone; light grey	5.0	CL		
32	42	Siltstone; very light grey	10.0	ST		
42	47	Claystone; grey, hard at 39'-40'	5.0	CL		
47	53	Coal; black, hard, moderate bright, water, good water 5-10 gpm	6.0	CØ	Masters	
53	64	Claystone; grey, interbedded silt	11.0	CL		
64	92	Siltstone; grey – light grey, firm	28.0	ST		
		Water level 24.7' BGL at 15:15				
		E-Log Picks: 18.5'-27'=8.5' Carney 47'-53'=6.0' Masters 77'-78'=1.0' Local				
		P&A: Pilot Holes = 17 sacks Core Holes = 14 sacks				
		E-Log Picks 18.5'-27'; 47'-52.5'				

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TFN 6 2/025
RECD JUL 30,2015

Scanned, 02/27/2020

DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)
		Core #1 15' -25 = 10'; recovered 3.3' lost circulation in coal
15	15.5	Lost soft silty claystone
15.5	18.7	Claystone; light grey, silty, fractured
18.7	19.3	Coal; dull, soft, poor! Weathered!
19.3	25	Lost core; very soft, coal washed away
		Samples: very poor, soft, "do not analyze"
		Core #2 25' -28' = 3'; recovered 3.0'
25	25.3	Coal; dull, banded
25.3	26.7	Claystone; very dark grey, carbonaceous
26.2	27.8	Coal; crushed, soft weathered
27.8	29.4	Claystone; dark grey, very soft sticky
29.4	29.7	Coal; soft, crushed
27.7	30	Claystone; dark grey, moderate carbonaceous, very poor, crushed coal "No sample"
		Core #3 46' - 52' = 7.0'; recovered 5.7' all coal
46	47	Lost core; ground up soft clay on top coal
47	52.7	Coal; dull, especially at top little pyrite
52.7	53.0	Lost core, assume beneath coal
		Samples: 47'-49', 49'-51', 51'-52.7'

ABBREVIATIONS

BGL – Below Ground Level
DBS – Disturbed Bulk Sample
GPM – Gallon Per Minute
GS – Geochemical Sample
LA – Laboratory Analysis
SWL – Static Water Level
ZP – Ziplock Bag Sample

TFN 6 2/025
REC'D JUL 30, 2015

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Century GEOPHYSICAL CORP.

century-geo.com

GAMMA-RES-DENSITY

R-12011

COMPANY	RAMACO LLC	OTHER SERVICES	
WELL	R-12011	NA	
FIELD	NEWN	NA	
COUNTY	SHERIDAN	NA	
STATE	WY		
LOCATION	SHERIDAN COAL TRC		
SECTION	15		
TOWNSHIP	57N		
RANGE	85W		
API NO	NA		
UNIQUE WELL ID	NA		
PERMANENT DATUM	GL	ELEVATION	NA
LOG MEASURED FROM	GL	ELEVATION KB	NA
DRILL MEASURED FROM	GL	ELEVATION GL	NA
DATE	20-DEC-12	RUN NUMBER	ALL SERVICES
DEPTH DRILLER	82	LOGGER TD	81.80
BIT SIZE	5.625	ARRIVAL TIME	10:05
LOG TOP	0.50	DEPARTURE TIME	11:05
LOG BOTTOM	81.80	CIRC STOPPED	NA
CASING OD	NA		
CASING BOTTOM	NA		
CASING TOP	NA		
BOREHOLE FLUID	WATER		
RM TEMPERATURE	NA		
MAX TEMP	NA		
MUD WEIGHT	NA		
WITNESSED BY	M. WOLF		
RECORDED BY	JCAMPBELL		
REMARKS 1	NA		
REMARKS 2	NA		

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS

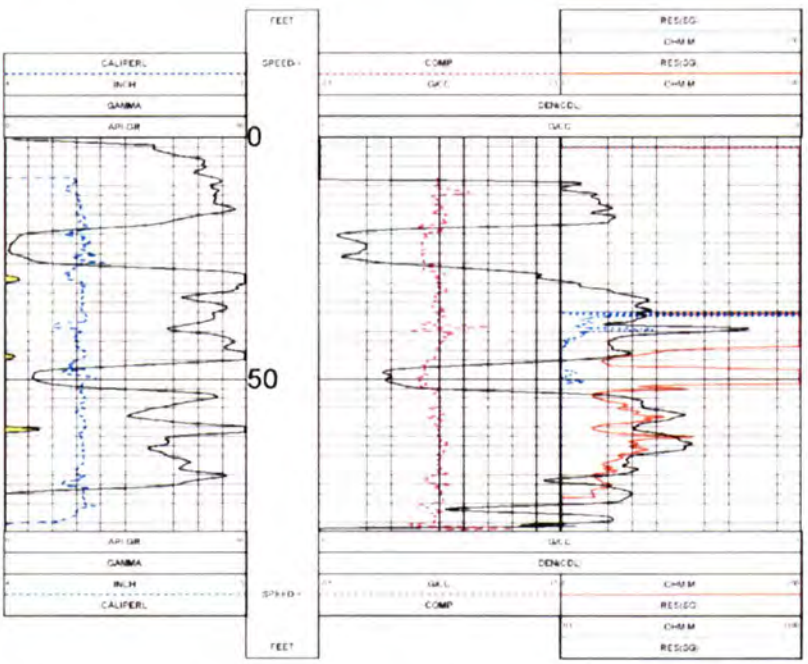
5 INCH LOG, DENSITY R-12011 12/12/12

LOG PARAMETERS

MATRIX DENSITY 2.65 NEUTRON MATRIX SANDSTONE MATRIX DELTA T 54

MAGNETIC DECL 10 ELECT CUTOFF 99999 BIT SIZE 5.625

PRESENTATION NAME/DATE = 9239 Ramaco Std CDL 5 inch 12-1-12 0 11/28/2012 VERSION = 3.64KF



5 INCH LOG, DENSITY R-12011 12/12/12

LOG PARAMETERS

MATRIX DENSITY 2.65 NEUTRON MATRIX SANDSTONE MATRIX DELTA T 54

MAGNETIC DECL 10 ELECT CUTOFF 99999 BIT SIZE 5.625

PRESENTATION NAME/DATE = 9239 Ramaco Std CDL 5 inch 12-1-12 0 11/28/2012 VERSION = 3.64KF

TOOL CALIBRATION R-12011 12/12/12 10:68
TOOL 9239C1 TM VERSION 2025
SERIAL NUMBER 2143

	DATE	TIME	SENSOR	STANDARD		RESPONSE	
1	Sep05,12	07:36:00	GAMMA	0.000	[API-GR]	1.000	[CPS]
	Sep05,12	07:36:00	GAMMA	340.000	[API-GR]	327.000	[CPS]
2	Sep04,12	09:29:34	VOLTAGE	0.000	[MV]	10823.000	[CPS]
	Sep04,12	09:29:34	VOLTAGE	2923.000	[MV]	280830.000	[CPS]
3	Feb06,12	07:57:24	CALIPER	4.000	[INCH]	258608.000	[CPS]
	Feb06,12	07:57:24	CALIPER	8.000	[INCH]	588667.000	[CPS]
4	Nov29,12	13:50:31	DENLSS	1.520	[G/CC]	5245.000	[CPS]
	Nov29,12	13:50:31	DENLSS	2.612	[G/CC]	734.000	[CPS]
5	Nov29,12	15:47:08	DENSSS	1.590	[G/CC]	18329.000	[CPS]
	Nov29,12	15:47:08	DENSSS	2.590	[G/CC]	6811.000	[CPS]
6	Nov29,12	11:08:27	CALIPERL	5.000	[INCH]	256712.094	[CPS]
	Nov29,12	11:08:27	CALIPERL	11.250	[INCH]	454282.688	[CPS]
7	Sep04,12	09:21:19	CURRENT	0.000	[UA]	5183.000	[CPS]
	Sep04,12	09:21:19	CURRENT	289.900	[UA]	20622.000	[CPS]
8	Jan23,12	14:37:15	F	Default	[CPS]		
9	Jan23,12	14:37:15	X	Default	[CPS]		

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Hole/Well No.: R12-012	Recorded By: M. Wolf WYPG #614	Drilling Co. A-3 Services; Shawn Ankney Depth: 0 To 136 CORED: 115-125 See core details
Company: RAMACO	Geophysical Log Type: Coal Suite	
Project: Brook Mine	Hole Type: pilot for e-log; twin for coal core	Date Drilled: 12-18-12 9:25
County: Sheridan WY		
Township: 57N Range: 85W	NAD 1983, East Central Zone	
Location: NESE Section: 12		
N: 1,943,651.0 E: 1,382,975.3		
Elevation:3939.8		

DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
0	4	Silt; buff	4.0			
4	10	Scoria, bed, very hard, set mud pit 9:55, decide to move location to avoid burn in center of drainage	6.0			
10	15	Colluvium/slope wash New Location	5.0			
15	18	Claystone; grey – brown, silty, friable	3.0			
18	29	Claystone/siltstone; light grey to buff, streaks some hard at 23' – 24.5', Siltstone; brown – buff, friable	11.0			
29	35	Claystone; medium dark grey, fissile	6.0			
35	48	Burn; turning red, hard, washout – losing circulation	13.0		Carney	Assume Lower Carney Burn
48	64	Siltstone; light grey, firm	16.0			
64	116	Claystone; grey to medium light grey	52.0			
116	121.5	Coal; black, bright, feels hard, washout on e-log!	5.5	CØ	Masters	
121.5	128	Claystone; dark, carbonaceous, very thin interbedded coal streaks	6.5			
128	136	Siltstone; light grey with very hard thin ledges at 125'-125.5'; 127'-128'; 135'-136'	8.0			
	136	Siltstone; very light, very hard, well cemented, making moderate water at 108 immediately following drilling				
		11:15 total depth; 11:20 out of hole set up E-Log				
		E-Log Picks: 116'-121.5'=5.5' Masters				
		Core Hole: 20 bags chips before pulling 60' casing!				
		P&A: Pilot Hole – 10 sacks coved at burn? Core Hole – 40 sacks				

ABBREVIATIONS

BGL – Below Ground Level
DBS – Disturbed Bulk Sample
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SWL – Static Water Level
ZP – Ziplock Bag Sample

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DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)
		Core #1 115' -125' = 10'; recovered 8.6'
115	115.8	Lost core; washed away claystone, laminated
115.8	116	Claystone; grey, thinly laminated coaly lams, firm
116	119.7	Coal; hard, bright
119.7	121.6	Coal; dull, black, lessor quality
121.6	123.7	Claystone; grey, fissile
123.7	124.5	Siltstone, very light, very hard, very well cemented
124.5	125	Lost core; soft clay or silt?
		Sample: 116'-118', 118'-120', 120'-121.6'
		Water level at 121.2' BGL

ABBREVIATIONS

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TFN 6 2/025
RECD JUL 30, 2015

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Century WIRELINE SERVICES

GAMMA-RES-DENSITY

R-12012

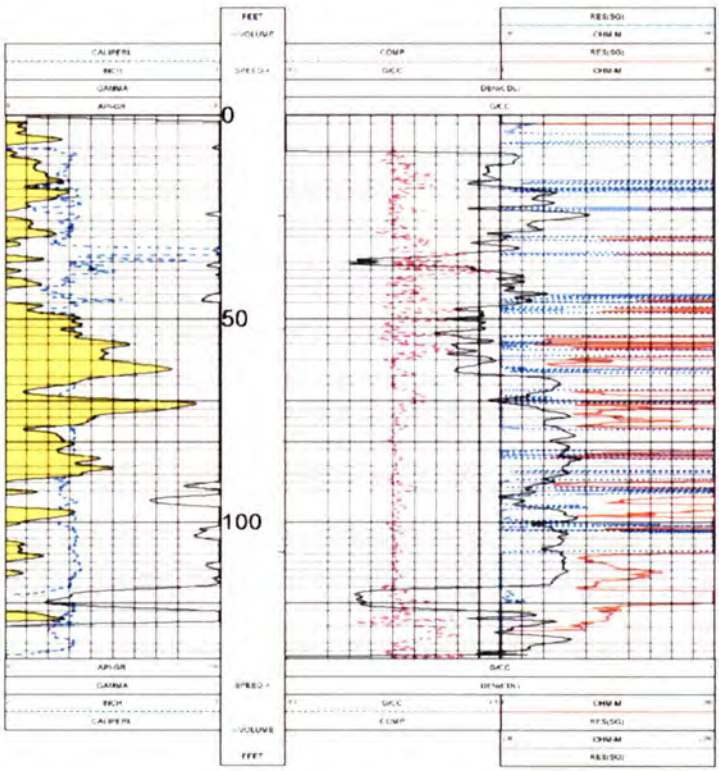
5 INCH LOG, DENSITY R-12012 12/18/12

LOG PARAMETERS

MATRIX DENSITY 2.65 NEUTRON MATRIX SANDSTONE MATRIX DELTA-T 54

MAGNETIC DECL NA ELECT CUTOFF 99999 BIT SIZE 5.63

PRESENTATION NAME/DATE = 9239 Ramaco Stil COL Sarch 5-31-12 0 11/28/20 VERSION = 3.64KF



5 INCH LOG, DENSITY R-12012 12/18/12

LOG PARAMETERS

MATRIX DENSITY 2.65 NEUTRON MATRIX SANDSTONE MATRIX DELTA-T 54

MAGNETIC DECL NA ELECT CUTOFF 99999 BIT SIZE 5.63

PRESENTATION NAME/DATE = 9239 Ramaco Stil COL Sarch 5-31-12 0 11/28/20 VERSION = 3.64KF

TOOL CALIBRATION R-12012 12/18/12 11:38
TOOL 9239CS TM VERSION 2025
SERIAL NUMBER 2843

	DATE	TIME	SENSOR	STANDARD		RESPONSE	
1	Oct02,12	07:35:43	GAMMA	3.000	[API GR]	1.300	[CPS]
	Oct02,12	07:35:43	GAMMA	342.000	[API GR]	212.300	[CPS]
2	Oct02,12	07:35:45	VOLTAGE	0.000	[MV]	12490.300	[CPS]
	Oct02,12	07:35:45	VOLTAGE	7905.000	[MV]	28252.300	[CPS]
3	Oct02,12	07:35:48	CALIPER	4.000	[INCH]	221144.300	[CPS]
	Oct02,12	07:35:48	CALIPER	8.000	[INCH]	334300.300	[CPS]
4	Dec08,12	12:35:41	DENS(S)	1.630	[GCC]	4123.300	[CPS]
	Dec08,12	12:35:41	DENS(S)	2.612	[GCC]	600.300	[CPS]
5	Dec08,12	12:35:48	DENS(B)	1.590	[GCC]	74032.300	[CPS]
	Dec08,12	12:35:48	DENS(B)	2.590	[GCC]	5690.300	[CPS]
6	Dec08,12	12:35:57	CALIPER1	5.000	[INCH]	261290.300	[CPS]
	Dec08,12	12:35:57	CALIPER1	11.250	[INCH]	401910.300	[CPS]
7	Oct02,12	07:35:59	CURRENT	3.000	[UA]	5860.300	[CPS]
	Oct02,12	07:35:59	CURRENT	267.245	[UA]	79085.300	[CPS]
8	Oct02,12	07:36:03	X	Default	[CPS]		

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Hole/Well No.: R12-013	Recorded By: M. Wolf WYPG #614	Drilling Co. : A-3 Services; Shawn Ankney Depth: 0 To 300 CORED: No Core Collected
Company: RAMACO	Geophysical Log Type: Coal Suite	
Project: Brook Mine	Hole Type: pilot, e-log, & core if justified	Date Drilled: 12-19-12, 12-20-12, 12-26-12
County: Sheridan WY		
Township: 57N Range: 85W	NAD 1983, East Central Zone	
Location: SWSE Section: 12		
N: 1,940,850.3 E: 1,383,535.0		
Elevation:3974.8		

DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
0	60	Burn; pink to red, soft 20' then hard, set 70' of 6" surface casing	60.0	BURN		Monarch Burn
60	92	Claystone; grey, fissile, firm	32.0	CL		
92	120	Silty claystone; grey, firm, pink 94'-96'	28.0	ST/CL		
120	135	Burn; pink to red, "baked"	15.0	BURN		Carney Burn
135	178	Claystone; grey, fissile, firm	43.0	CL		
178	204	Siltstone; grey, interbedded claystone	28.0	ST		
204	211.5	Claystone	7.5	CL		
211.5	212.5	Coal; black hard	1.0	CØ		Thin Coal Below Carney and Masters
212.5	222.5	Claystone; grey – dark grey	10.0	CL		
222.5	225	Coal; hard, black	2.5	CØ		
225	228	Claystone; grey, carbonaceous	3.0	CL		
228	229.5	Coal; black	1.5	CØ		
229.5	246	Claystone; grey	16.5	CL		
246	252	Claystone; dark carbonaceous, coal stringer	6.0	CL		
252	254	Coal; black, hard	2.0	CØ		
254	261	Claystone; grey, fissile, firm	7.0	CL		
261	266	Claystone; dark, carbonaceous	5.0	CL		
266	266.5	Coal	.5	CØ		
266.5	275	Siltstone; grey, firm	8.5	ST		
275	300	Claystone; grey, fissile	25.0	CL		
		No good coal greater than 4' thick: No core intervals				
		P&A: 51 sack chips then pull 70' casing out and finish with 43 sack chips				

ABBREVIATIONS

BGL – Below Ground Level
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TFN 6 2/025
RECD JUL 30, 2015

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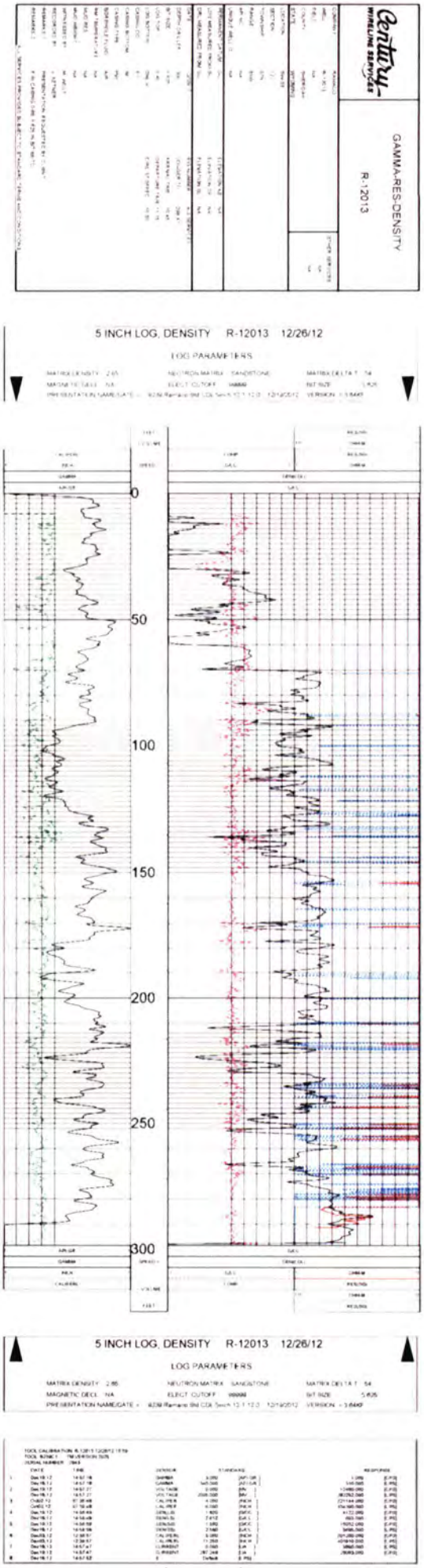

TFN 6 2/025
RECD JUL 30, 2015

Scanned, 02/27/2020

Hole/Well No.: R12-014	Recorded By: M. Wolf WYPG #614	Drilling Co. : A-3 Services; Shawn Ankney Depth: 0 To 220 CORED: NO CORE
Company: RAMACO	Geophysical Log Type: Coal Suite	
Project: Brook Mine	Hole Type: pilot, e-log, & twin for coal core	Date Drilled: 12-19-12
County: Sheridan WY		
Township: 57N Range: 85W	NAD 1983, East Central Zone	
Location: NESE Section: 12		
N: 1,942,438.4 E: 1,383,971.4		
Elevation:3953.5		

DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
0	23	Burn – scoria, very hard	23.0	BURN		Carney Burn?
23	32	Claystone; buff, soft	9.0	CL		
32	68	Siltstone; grey	36.0	ST		
68	86	Claystone, grey, firm, fissile	18.0	CL		
86	152	Siltstone; grey, to light grey, very firm	66.0	ST		
152	153	Coal; black, hard, firm	1.0	CØ	?	Assume Carney Bed Spilt Maybe Local Coals Beneath Carney
153	160	Claystone; dark grey, carbonaceous	7.0	CL/OH		
160	161	Coal; black, hard, thin	1.0	CØ	?	
161	163	Claystone; dark grey, carbonaceous	2.0	CL/OH		
163	166	Coal; black, hard, moderately thin	3.0	CØ	?	
166	169.5	Claystone; dark grey, carbonaceous	3.5	CL/OH		
169.5	171	Coal; black, hard, thin	1.5	CØ	?	
171	180	Claystone; grey, firm	9.0	CL		
180	181	Coal; black, hard, thin	1.0	CØ	?	
181	185	Claystone; grey, firm, fissile	4.0	CL		
185	186.5	Coal; black, hard, thin	1.5	CØ	?	Water level at 217 after drilling
186.5	198	Claystone; grey, firm	11.5	CL		
198	200	Coal; black, hard, thin	2.0	CØ	?	
200	208	Siltstone; light grey, firm	8.0	ST		
208	220	Claystone; grey, firm	12.0	CL		
		Note: Because of lack of coal › 4' thick. No core at this time!				
		E-Log Pick: 0'-23' Burn/Scoria 152'-153'=1.0' 160'-161'=1.0' 163'-166'=3.0' 169'.5-171'=1.5' 180'-181'=1.0' 185'-186.5'=1.5' 198'-200'=2.0'				
		Pink Cuttings 120-140 "Burn or Baked"				
		Pilot hole blows approximately 1-2 gpm?				
		Plug & Abandon Hole: 25 sacks then pull 40' casing and 37 more sacks chips. Total 62 sacks bentonite chips				

ABBREVIATIONS

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TFN 6 2/025
RECD JUL 30, 2015

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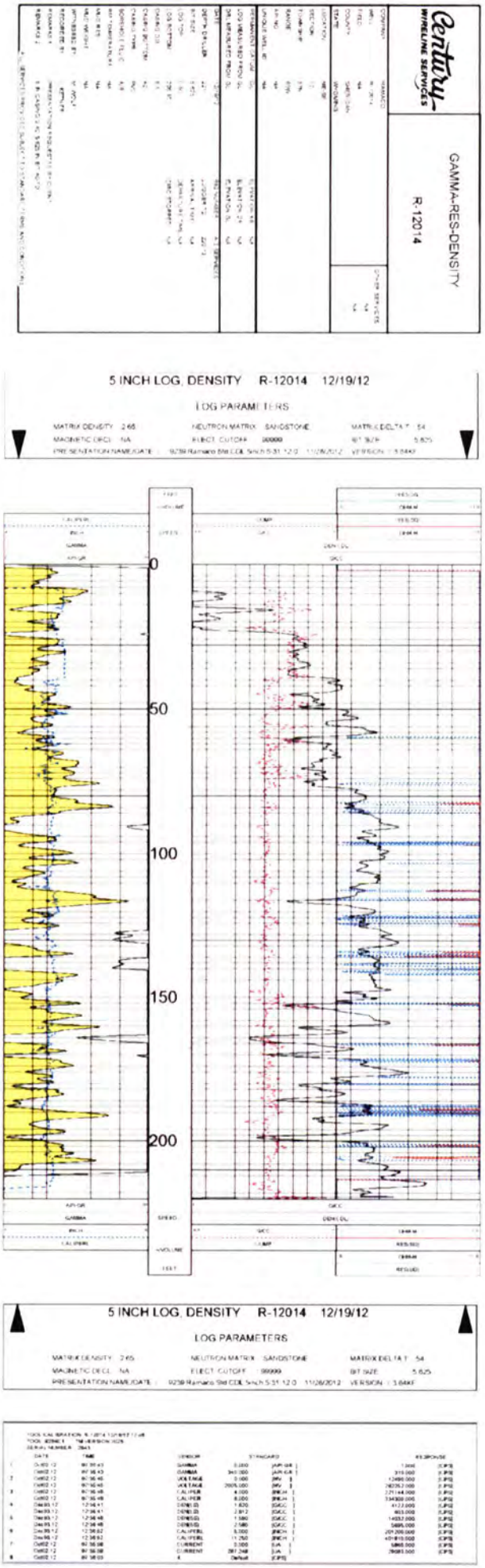

TFN 6 2/025
RECD JUL 30, 2015

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Iole/Well No.: R12-015	Recorded By: M. Wolf WYPG #614	Drilling Co.: A-3 Services; Shawn Ankney Depth: 0 To 221
Company: RAMACO	Geophysical Log Type: Coal suite	CORED: 39.5-64.5, 145-175, 192-202,
Project: Brook Mine	Hole Type: Pilot & Twin for Coal Core 5 5/8"	Date Drilled: 11-28-12
County: Sheridan WY		
Township: 57N Range: 85W	NAD 1983, East Central Zone	
Location: NWSE Section: 13		
N: 1,937,470.2 E: 1,384,975.5		
Elevation: 3774.6		

DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GMP
0	6	Sand with pebble gravel	6.0	SP		Maybe Qual
6	20	Sandy silt; buff, eolian/slope wash?	14.0	SM		
20	21	Burn, hard, red, could be gravel (alluvium)	1.0	BURN		Monarch Burn
25	34	Coal; dull, soft, dry, poor – very poor, soft	9.0	CØ	MU	Remnant "very soft"
34	40	Claystone; grey, fissile, parting	6.0	CL		
40	60	Coal; better, hard, Monarch	20.0	CØ	ML	
60	146	Claystone; grey with siltstone interbedded	86.0	CL		
146	150	Coal; hard, water! Carney upper	4.0	CØ	CR-U	Carney-Upper
150	159	Claystone; parting	9.0	CL		
159	169	Coal; hard, Carney lower	10.0	CØ	CR-L	Carney-Lower
169	194	Claystone	25.0	CL		
194	200	Coal; hard	6.0	CØ	Masters	
200	221	Claystone – siltstone; hard at 210'	21.0	CL/ST		
		Water level at 10:25 = 106'BGL				
		E-Log Picks: 25'-35'=10' Upper Monarch "Poor" 40'-60'=20' Lower Monarch 146.3'-150.4'=4.1' Upper Carney 159'-169'=10' Lower Carney 194'-199'=6' Masters				
		P&A: Plug Pilot Hole with 39 sacks chips Plug Coal Core Hole with 37 sacks chips Core Hole DTW on 11-29-12 at 7:30 AM = 105.5' BGL				
		Core Hole:				
25	35	Omit soft weathered U Monarch Remnant at 25'-35' "very soft"	10	POOR COAL	U Monarch	

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DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GMP
		Core #1 39.5' - 54.5' = 15'; recovered 15' Lower Monarch				
39.5	59.2	Good hard coal	19.7	HARD COAL	L Monarch	
		Core #2 54.5' - 64.5' = 10.0'; recovered 10'				
54.5	59.2	Coal; Lower Monarch				
59.2	64.5	Silt sandstone; with detrital coal				
		Core #3 145' - 160' = 15'; recovered 15'				
145	146.3	Coaly claystone; discard				
146.3	150.4	Coal	4.1	COAL	U Carney	Hard CØ
150.4	158.8	Claystone with carbonaceous bands				
158.8	167.3	Coal; hard, bright	8.5	COAL	L Carney	Hard CØ
167.3	168.9	Coal; dull, poor, high ash	1.6	COAL	L Carney	Hard CØ
168.9	170.2	Claystone; grey				
170.2	170.8	Coal; hard, bright				
170.8	173	Claystone; grey				
173	175	Sandy siltstone; grey				
		Core #4 160' – 175' = 15'; recovered 15'				
		Core #5 192' – 202' = 10'; recovered 8.0'				
192	194	Claystone; grey				
194	200	Coal; hard, Masters	6.0	COAL	Masters	Hard CØ
200	202	Claystone; slid out bottom				
		E-Log Picks: 25'-35'=10' U Monarch – Weathered! 29.5'-59.5'=20' L Monarch – Hard Coal 146'-151'=5' U Carney – Hard Coal 160'-169'=9' L Carney – Hard Coal 194'-200'=6' Masters – Hard Coal				
		Note: All core of L Monarch has notable framboidal pyrite on cleat surfaces!				

ABBREVIATIONS

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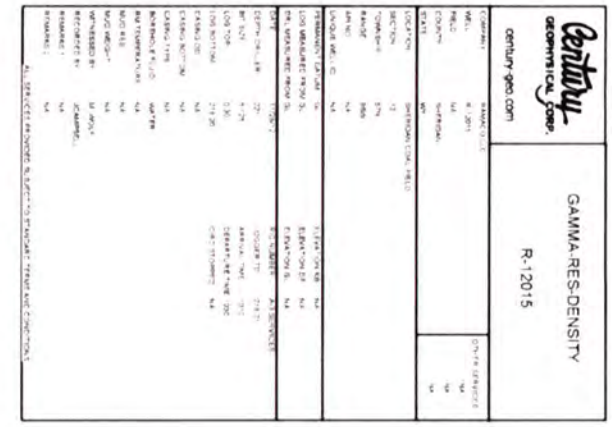
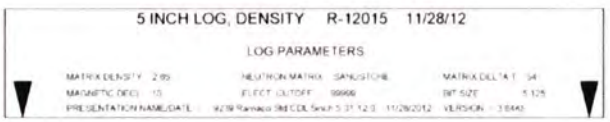
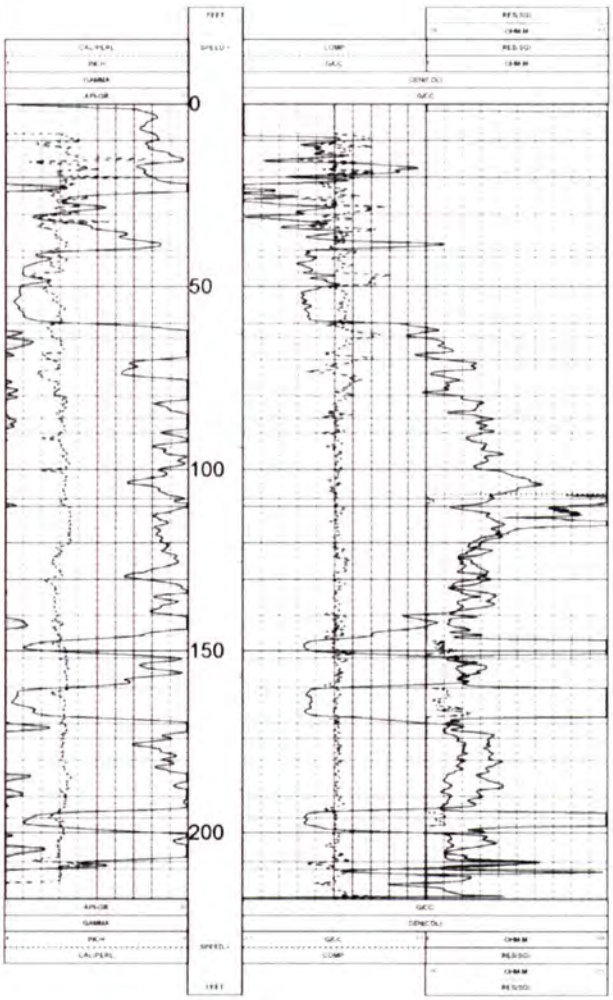
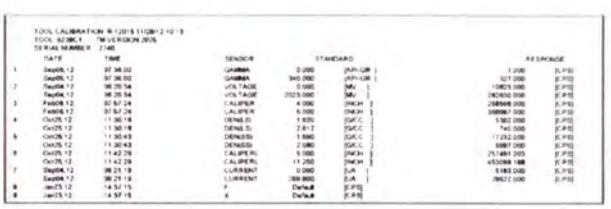
TFN 6 2/025
RECD JUL 30, 2015







5 INCH LOG, DENSITY R-12015 11/28/12
LOG PARAMETERS
MATRIX DENSITY 2.65
NEUTRON MATRIX SANDSTONE
MATRIX DELTA T 54
MAGNETIC DECL 10
ELECT CUTOFF 99999
BIT SIZE 5.125
PRESENTATION NAME/DATE
VERSION



Scanned, 02/27/2020

TFN 6 2/025
RECD JUL 30, 2015

Scanned, 02/27/2020

Hole/Well No.: R12-018D	Recorded By: M. Wolf WYPG #614	Drilling Co. A-3 Services; Shawn Ankney Depth: 0 To 142
Company: RAMACO	Geophysical Log Type: Coal suite	
Project: Brook Mine	Hole Type: Pilot hole, e-log, core intervals less than 4' in thickness	Date Drilled: 12-10-12
County: Sheridan WY		
Township: 57N Range: 85W	NAD 1983, East Central Zone	
Location: SESE Section: 11		
N: 1,941,102.6 E: 1,379,570.3		
Elevation:3854.7		

DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
0	9	Claystone; grey, silty	9.0	CL		
9	10	Siltstone, orange	1.0	ST		
10	10.5	Siltstone; orange – buff	0.5	ST		
10.5	18	Carbonaceous claystone	7.5	CL/OH		
18	20	Siltstone; buff	2.0	ST		
20	30	Claystone; grey, silty, fissile	10.0	CL		
30	40	Siltstone, buff, hard, 31'-34' light grey	10.0	ST		
40	51	Claystone; grey, firm, fissile	11.0	CL		
51	52	Coal; hard, bright	1.0	CØ		
52	57	Claystone; grey, fissile	5.0	CL		
57	62	Coal; black, hard	5.0	CØ	U Carney	Upper Carney
62	66	Claystone; grey, silty	4.0	CL		
66	74	Coal; black, hard, bright	8.0	CØ	L Carney	Lower Carney
74	93	Siltstone; light grey, firm, 85'-86' very hard	19.0	ST		
93	97	Claystone and siltstone; 92'-93' very hard	4.0	CL/ST		
97	103	Siltstone; interbedded, coal, black, hard, bright	6.0	CØ	Masters	
103	108	Claystone; grey, fissile	5.0	CL		
108	120	Siltstone; light grey, firm	12.0	ST		
120	122	Claystone; grey	2.0	CL		
122	124	Tag coal at 122', go 1' more joint	2.0	CØ		
124	142	Siltstone; grey, clay rich	18.0	ST		
		Water in bottom of hole, XXX in Masters coal, very little water!				
		E-Log Picks: 51'-52'=1.0' 57'-62'=5.0' Carney upper 62'-66'=4.0' Claystone 66'-74'=8.0' Carney lower 97'-102'=5.0' Masters 122'-124'=2.0' Local				
		Plugging and Abandon Pilot Hole 31 sacks chips Core Hole 25 sacks chips				

ABBREVIATIONS

BGL – Below Ground Level
DBS – Disturbed Bulk Sample
GPM – Gallon Per Minute
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ZP – Ziplock Bag Sample

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DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)
		Core #1 55' -70' = 15'; recovered 14.6'
55	55.4	Lost soft carbonaceous clay, Ground up!
55.4	55.8	Claystone; carbonaceous
55.8	56.7	Coal; dull, crushed
56.7	57.1	Claystone; dark grey
57.1	60.4	Coal; hard, bright
60.4	62	Claystone; grey
62	62.2	Coal; hard, bright
62.2	64.5	Claystone; grey, little detrital coal
64.5	70	Coal; black, hard, bright
		Samples: 57.1'-58.4', 58.4'-60.4', 64.5'-66', 66'-68', 68'-70'
		Core #2 70' -75' = 5.0'; recovered 4.0', lost off bottom
70	73.3	Coal; black, mostly hard
73.3	74.0	Claystone; very hard, carbonaceous
74	75	Bit plugged ground off bottom"lost"
		Samples: 70'-72', 72'-73.3'
		Core #3 95' -105' = 10'; recovered 10.0'
95	97	Claystone; grey, grades darker to contact with coal
97	101.8	Coal; black, dull, good solid core
101.8	102.8	Claystone; grey
102.8	105	Siltstone; light grey, sandy, very firm
		Samples: 97'-99', 99'-101', 101'-106.8' = 4.7'

ABBREVIATIONS

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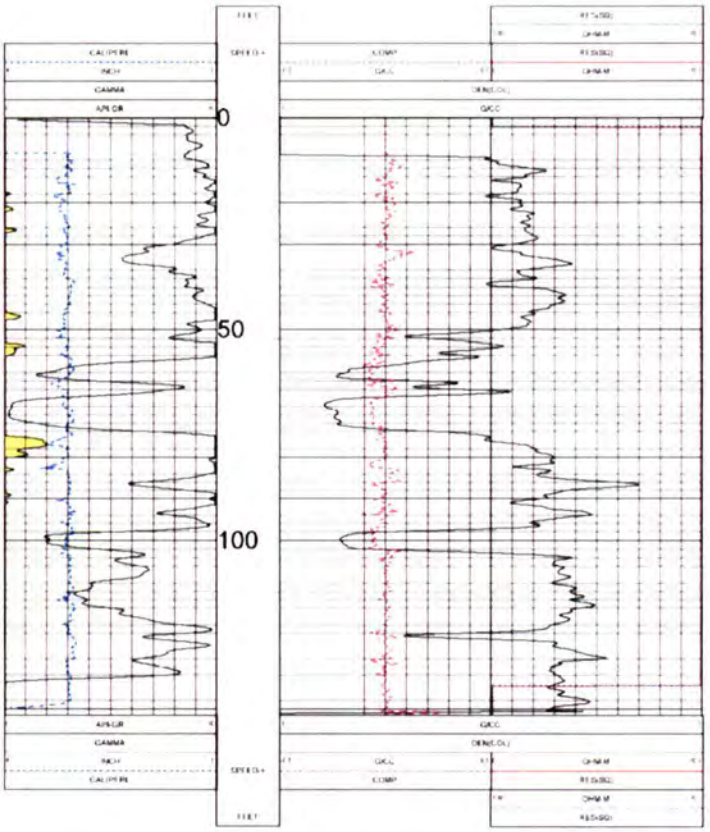
GAMMA-RES-DENSITY
R-12018D

5 INCH LOG, DENSITY R-12018D 12/10/12

LOG PARAMETERS

MATRIX DENSITY 2.65 NEUTRON MATRIX SANDSTONE MATRIX DELTA T 54
MAGNETIC DECL 10 EFFECT CUTOFF 99999 BIT SIZE 5.825
PRESENTATION NAME/DATE = 9239 Ramaco Std CDL 5inch 5-31-12 0 11/28/2012 VERSION = 3.64KF



5 INCH LOG, DENSITY R-12018D 12/10/12

LOG PARAMETERS

MATRIX DENSITY 2.65 NEUTRON MATRIX SANDSTONE MATRIX DELTA T 54
MAGNETIC DECL 10 EFFECT CUTOFF 99999 BIT SIZE 5.825
PRESENTATION NAME/DATE = 9239 Ramaco Std CDL 5inch 5-31-12 0 11/28/2012 VERSION = 3.64KF

TOOL CALIBRATION R-12018D 12/10/12 11:41
TOOL 9239C1 TM VERSION 2925
SERIAL NUMBER 2740

	DATE	TIME	SENSOR	STANDARD		RESPONSE	
1	Sep06,12	07:36:00	GAMMA	0.000	[API-GR]	1.000	[CPS]
	Sep06,12	07:36:00	GAMMA	346.000	[API-GR]	327.000	[CPS]
2	Sep04,12	06:29:34	VOLTAGE	0.000	[MV]	1.000	[CPS]
	Sep04,12	06:29:34	VOLTAGE	7025.000	[MV]	390850.000	[CPS]
3	Feb08,12	07:67:24	CALIPER	4.000	[INCH]	250608.000	[CPS]
	Feb08,12	07:67:24	CALIPER	6.000	[INCH]	358867.000	[CPS]
4	Nov29,12	15:50:31	DENS Sh	1.629	[G/C.C]	5245.000	[CPS]
	Nov29,12	15:50:31	DENS Sh	2.612	[G/C.C]	798.000	[CPS]
5	Nov29,12	15:47:08	DENS Ss	1.580	[G/C.C]	10129.000	[CPS]
	Nov29,12	15:47:08	DENS Ss	2.680	[G/C.C]	981.000	[CPS]
6	Nov29,12	11:09:27	CALIPER L	6.000	[INCH]	2541.12.094	[CPS]
	Nov29,12	11:09:27	CALIPER L	11.250	[INCH]	454282.888	[CPS]
7	Sep04,12	06:21:18	CURRENT	0.000	[UA]	5183.000	[CPS]
	Sep04,12	06:21:18	CURRENT	200.000	[UA]	29622.000	[CPS]
8	Jan23,12	14:37:15	F	Default	[CPS]		
9	Jan23,12	14:37:15	X	Default	[CPS]		

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Hole/Well No.: R12-019D	Recorded By: M. Wolf WYPG #614	Drilling Co.: A-3 Services; Shawn Ankney Depth: 0 To 140 CORED: 45 To 96
Company: RAMACO	Geophysical Log Type: Coal suite	
Project: Brook Mine	Hole Type: Pilot & Twin for coal core	Date Drilled: 11-27-12
County: Sheridan WY		Spud Date: 11-27-12 5 5/8'
Township: 57N Range: 85W	NAD 1983, East Central Zone	
Location: NWSE Section: 11		
N: 1,937,442.1 E: 1,384,568.3		
Elevation: 3798.4		

DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
0	3	Baked pink – red, siltstone	3.0	QT		Terrace Gravel
3	5	Sandy silt, brown, dry	2.0	ML		
5	8	Siltstone; brown	3.0	ST		
8	10	Siltstone; light brown	2.0	ST		
10	12	Claystone; grey – brown, silty, moist	2.0	CL		
12	21	Claystone; grey to dark grey	9.0	CL		
21	22	Very hard; well cemented	1.0	ROCK		
22	40	Claystone; grey	18.0	CL		
40	50	Siltstone; grey	10.0	ST		
50	56	Coal; soft, poor, weathered	6.0	CØ	U Mon	
56	59	Coal; harder	3.0	CØ	U Mon	
59	60	Claystone	1.0	CL		See Core Log
60	66	Coal; with little partings	6.0	CØ	U Mon	
66	72	Claystone; grey	6.0	CL		
72	91	Coal; hard out at 91'	19.0	CØ	L Mon	See core log
91	95	Claystone; dark grey	4.0	CL/OH		
95	102	Claystone; light grey	7.0	CL		
102	106	Very hard, very light	4.0	ROCK		
106	109	Silty, light grey	3.0	ST		
109	114	Carbonaceous coaly claystone	4.0	CL/OH		
116	119	Very hard streaks, very light	3.0	CL/		Hard Streaks
119	128	Claystone; very light grey	8.0	CL		
128	131	Claystone, very hard, well cemented	3.0	CL		
131	140	Claystone, light grey	9.0	CL		
		11/28/12 Check for water, caved to approximately 60'				
		No water level, E-Log shows 16'				
		Pull surface casing and abandon with chips				

ABBREVIATIONS

BGL – Below Ground Level
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TFN 6 2/025
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DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
		P&A: Pilot hole with 19 sacks chips Core Hole with 26 sacks chips				
		Notes: P&A, plug with 9 sacks bentonite chips; core hole took 26 bags				
		E-Log Picks: 49-54=5' soft coal 54-72=18' poor coal with abundant clay partings 72-91=19' hard coal				Monarch Coal
		Back rig up approximately 10' and drill Twin for core to 45', set 40' 6" PVC casing 3¾ bit				

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TFN 6 2/025
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DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
		Core #1 45' – 56' = 11.0'; recovered 4.0', soft top – Lost Core				
45	52	Lost core; soft, ground up weathered coal from	7.0	-		
52	52.5	Claystone; grey – brown "parting" omit from analysis!	0.5	CL		
52.5	54	Coal; black, hard, dull, salts on cleat	1.5	CØ		
54	56	Coal; black, hard, more bright, pyrite on cleat	2.0	CØ		
		Core #2 56' – 71' =15'; recovered 11.6', lost soft top!				
56	59.4	Lost core, soft, weathered coal	3.4	-		
59.4	60.1	Coal; dull, soft, poor	0.7	CØ		
60.1	60.5	Claystone; detrital coal fragments "parting"	0.4	CL		
60.5	65.5	Coal; black, hard, relatively good coal	5.0	CØ		
65.5	65.7	Claystone "parting"	0.2	CL		
65.7	67.7	Coal; hard	2.0	CØ		
67.7	68.5	Poor coal with high clay	0.8	POOR		
68.5	69.3	Coal	0.8	CØ		
69.3	69.5	Claystone; "parting"	0.2	CL		
69.5	69.7	Coal	0.2	CØ		
69.7	69.9	Dull – high ash coal	0.2	CØ DULL		
69.9	70.3	Coal	0.4	CØ		
70.3	70.7	Claystone; "parting"	0.4	CL		
70.7	71	Coal; hard, dull	0.3	CØ		
		Core #3 71' – 86' = 15'; recovered 15.0'				
71	71.5	Claystone; "parting"	0.5	CL		
71.5	86	Coal; black, hard, good	14.5	CØ		
		Core #4 86' -96' = 10'; recovered 10.0'				
86	91	Coal; black, hard, dull, coal at base	5.0	CØ		
91	96	Claystone; grey, firm, silty	5.0	CL		
		Note: Approximately 80' of burn in adjacent scoria pit				

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GAMMA-RES-DENSITY
R-12019D

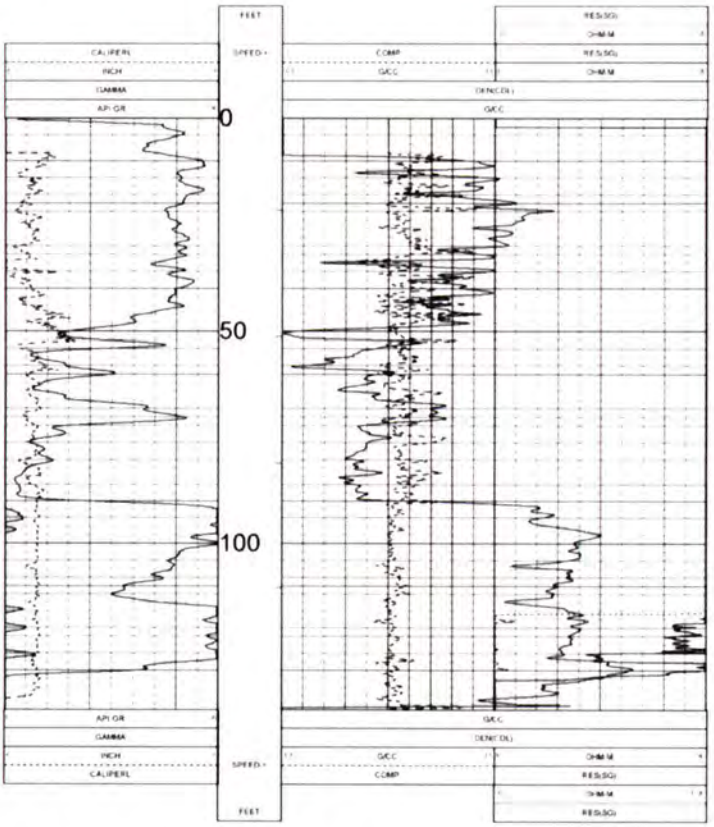
COMPANY	RAMACO LLC	OTHER SERVICES	
WELL	R-12019D	N/A	
FIELD	N/A	N/A	
COUNTY	SHERIDAN	N/A	
STATE	WY		
LOCATION			
SECTION	13		
TOWNSHIP	57N		
RANGE	85W		
API NO	N/A		
UNIQUE WELL ID	N/A		
PERMANENT DATUM	GL	ELEVATION K.B.	N/A
LOG MEASURED FROM	GL	ELEVATION D.F.	N/A
DR. MEASURED FROM	GL	ELEVATION G.L.	N/A
DATE	11-27-12	RUN NUMBER	R-3 SERVICES
DEPTH DRILLER	140	LOGGER TD	136.23
BIT SIZE	5.125	ARRIVAL TIME	1110
LOG TOP	FW	DEPARTURE TIME	1130
LOG BOTTOM	136.23	DIRECTIONS	N/A
CASING OD	N/A		
CASING BOTTOM	N/A		
CASING TYPE	N/A		
BOREHOLE FLUID	WATER		
RM TEMPERATURE	N/A		
MUD RES	N/A		
MUD WEIGHT	N/A		
WITNESSED BY	M. WOLF		
RECORDED BY	JCAMPBELL		
REMARKS 1	N/A		
REMARKS 2	N/A		

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS

5 INCH LOG, DENSITY R-12019D 11/27/12

LOG PARAMETERS

MATRIX DENSITY 2.65	NEUTRON MATRIX SANDSTONE	MATRIX DELTA T 54
MAGNETIC DECL 10	ELECT CUTOFF 99999	BIT SIZE 5.125
PRESENTATION NAME/DATE = 9239 Ramaco Std CDL 5inch 5-31-12 0 05/31/2012		VERSION = 3.64KF



5 INCH LOG, DENSITY R-12019D 11/27/12

LOG PARAMETERS

MATRIX DENSITY 2.65	NEUTRON MATRIX SANDSTONE	MATRIX DELTA T 54
MAGNETIC DECL 10	ELECT CUTOFF 99999	BIT SIZE 5.125
PRESENTATION NAME/DATE = 9239 Ramaco Std CDL 5inch 5-31-12 0 05/31/2012		VERSION = 3.64KF

TOOL CALIBRATION R-12019D 11/27/12 11:12
TOOL 9239C1 TM VERSION 2025
SERIAL NUMBER 2740

	DATE	TIME	SENSOR	STANDARD		RESPONSE	
1	Sep06,12	07:36:00	GAMMA	0.000	[API GR]	1.000	[CPS]
	Sep06,12	07:36:00	GAMMA	340.000	[API GR]	527.000	[CPS]
2	Sep04,12	08:20:34	VOLTAGE	0.000	[MV]	10823.000	[CPS]
	Sep04,12	08:20:34	VOLTAGE	2023.000	[MV]	282830.000	[CPS]
3	Feb08,12	07:57:24	CALIPER	4.000	[INCH]	254958.000	[CPS]
	Feb08,12	07:57:24	CALIPER	8.000	[INCH]	368867.000	[CPS]
4	Oct25,12	11:30:18	DEN(LS)	1.820	[G/CC]	5362.000	[CPS]
	Oct25,12	11:30:18	DEN(LS)	2.612	[G/CC]	148.000	[CPS]
5	Oct25,12	11:30:43	DEN(SS)	1.580	[G/CC]	17232.000	[CPS]
	Oct25,12	11:30:43	DEN(SS)	2.580	[G/CC]	6887.000	[CPS]
6	Oct25,12	11:42:29	CALIPER1	5.900	[INCH]	257491.203	[CPS]
	Oct25,12	11:42:29	CALIPER1	11.250	[INCH]	453089.188	[CPS]
7	Sep04,12	08:21:19	CURRENT	0.000	[UA]	5183.000	[CPS]
	Sep04,12	08:21:19	CURRENT	299.800	[UA]	28802.000	[CPS]
8	Jan23,12	14:37:15	F	Default	[CPS]		
9	Jan23,12	14:37:15	X	Default	[CPS]		

TFN 6 2/025
RECD JUL 30, 2015

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ole/Well No.: R12-020	Recorded By: M. Wolf WYPG #614	Drilling Co.: A-3 Services; Shawn Ankney Depth: 0 To 494
Company: RAMACO	Geophysical Log Type: Coal Suite	CORED: 95-125 and 140-150
Project: Brook Mine	Hole Type: e-log; & offset core coal	Date Drilled: 12-13-12
County: Sheridan WY		
Township: 57N Range: 85W	NAD 1983, East Central Zone	
Location: NWNW Section: 13		
N: 1,939,725.9 E: 1,381,096.8		
Elevation:3873.1		

DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
0	10	Gravel, alluvium, medium, -coarse, sandy pebble gravel	1.00	ALLUVIUM		
10	19	Coal; very soft, very weathered, very poor	9.0	CØ	Monarch	
19	40	Siltstone/claystone; grey – brown, soft, interbedded	21.0	ST/CL		
40	60	Claystone; grey, firm	20.0	CL		
60	84	Siltstone; light grey, firm, moderate friable	24.0	ST		
84	93	Claystone; grey	9.0	CL		
93	94	Coal; hard, thin	1.0	CØ		
94	98	Claystone; grey, parting	4.0	CL		
98	104	Coal; interbedded at top then good hard coal in base	6.0	CØ	U Carney	
104	108	Claystone; dark grey-brown	4.0	CL	Parting	
108	115	Siltstone; grey, firm	7.0	ST	Parting	
115	123	Coal; black, bright, hard	8.0	CØ	L Carney	
123	130	Siltstone; grey	7.0	ST		
130	142	Claystone; grey, firm, fissile, siltstone, light grey	12.0	CL		
142	147	Coal; soft, little wet	5.0	CØ	Masters	
147	156	Claystone; grey	9.0	CL		
489	494	Siltstone; light grey	5.0	ST		
		Set 27' 6" PVC casing through gravel & soft rock				
		E-Log Picks: 93'-94'=1.0' Top U Carney 99'-104'=5.0' U Carney 115'-123'=8.0' L Carney 142'-147'=5.0' Masters				
		P&A: Pilot Hole 43 sacks chips Core Cole 41 sacks chips Chip holes to base of casing, pull casing, complete filling with chips upper hole				
		Coals at 100'-104', 115'-123', 142'-147'				

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TFN 6 2/025
RECD JUL 30, 2015

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DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)
		Core #1 95' – 110' = 15'; recovered 15.0'
95	98.6	Claystone; very carbonaceous and coaly
98.6	99	Coal; hard, bright
99	100	Carbonaceous claystone; very high clay, coaly
100	103.8	Coal; hard, black, bright
103.8	104.2	Claystone; coaly, dark
104.2	104.8	Coal; hard, bright
104.8	110	Claystone; grey, carbonaceous bank at 107.7'
		Samples: 100'-102', 102'-103.8', 103.8'-104.8'
		Core #2 110' – 125' = 15'; recovered 13.2' lost core off bottom
110	115	Claystone; grey, firm
115	118.8	Coal; black, bright, relatively good
118.8	118.9	Clay rich coaly laminated band
118.9	122.5	Coal; hard, black, mostly bright
122.5	123.1	Coal; dull, high ash
123.1	123.3	Claystone; very dark, very carbonaceous, very high ash
123.3	125	Last core; slid out assume claystone
		Samples: 115'-117', 117'-119', 119'-121', 121'-122.5', 122.5'-123.1'
		Core #3 140' – 150' = 10.0'; recovered 6.8' lost off bottom
140	142	Claystone; grey, little detrital coal
142	145.7	Coal; black, hard, bright
145.7	146.8	Coal; dull, high ash
146.8	150	Last core, slid out bottom, assume claystone
		Samples: 142'-144', 144'-145.7', 145.7'-146.8'

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GS – Geochemical Sample
LA – Laboratory Analysis
SWL – Static Water Level
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TFN 6 2/025
RECD JUL 30, 2015

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Century WIRELINE SERVICES

GAMMA-RES-DENSITY

R-12020

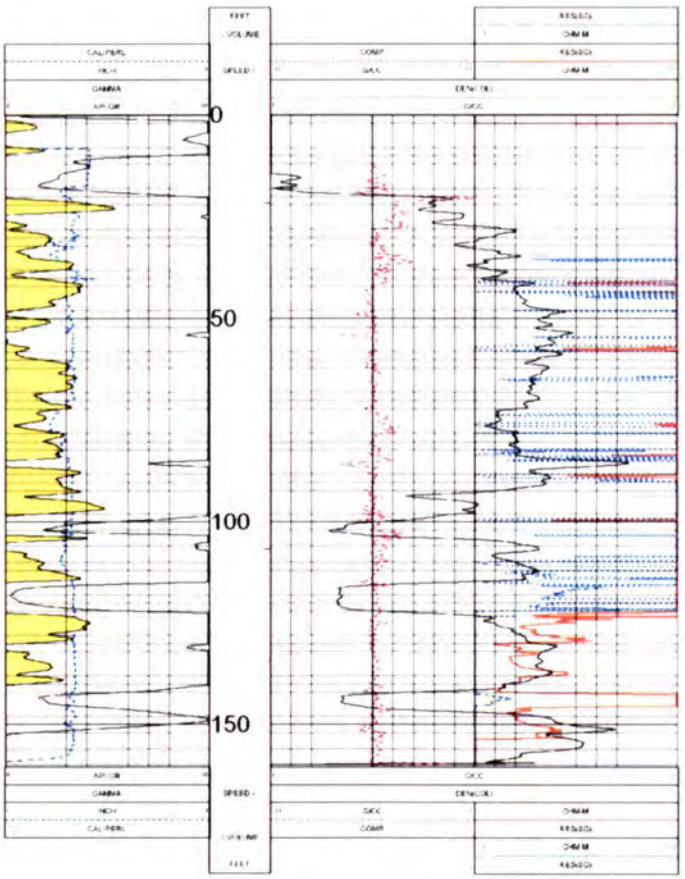
5 INCH LOG, DENSITY R-12020 12/13/12

LOG PARAMETERS

MATRIX DENSITY 2.65 NEUTRON MATRIX SANDSTONE MATRIX DELTA T 54

MAGNETIC DECL NA EFECT CUTOFF 99999 BIT SIZE 5.50

PRESENTATION NAME/DATE 9239 Ramaco Std CDL 5-inch 5.31.12.0 11/28/2012 VERSION 3.64KF



5 INCH LOG, DENSITY R-12020 12/13/12

LOG PARAMETERS

MATRIX DENSITY 2.65 NEUTRON MATRIX SANDSTONE MATRIX DELTA T 54

MAGNETIC DECL NA EFECT CUTOFF 99999 BIT SIZE 5.50

PRESENTATION NAME/DATE 9239 Ramaco Std CDL 5-inch 5.31.12.0 11/28/2012 VERSION 3.64KF

TOOL CALIBRATION R-12020 12/13/12 11:27
TOOL 9238C1 FM VERSION 3025
SERIAL NUMBER 2843

	DATE	TIME	SENSOR	STANDARD		RESPONSE	
1	Oct/02/12	07:35:43	GAMMA	0.000	API-GR	-1.000	(CPS)
	Oct/02/12	07:35:43	GAMMA	340.000	API-GR	310.000	(CPS)
2	Oct/02/12	07:35:45	VOLTAGE	0.000	MV	12486.000	(CPS)
	Oct/02/12	07:35:45	VOLTAGE	2000.000	MV	282262.000	(CPS)
3	Oct/02/12	07:35:48	CALIPER	4.000	INCH	321144.000	(CPS)
	Oct/02/12	07:35:48	CALIPER	8.000	INCH	334300.000	(CPS)
4	Dec/05/12	12:38:41	DENSITY	1.820	G/CC	412.000	(CPS)
	Dec/05/12	12:38:41	DENSITY	2.817	G/CC	953.000	(CPS)
5	Dec/05/12	12:38:48	DENSITY	1.890	G/CC	14052.000	(CPS)
	Dec/05/12	12:38:48	DENSITY	2.580	G/CC	6896.000	(CPS)
6	Dec/05/12	12:39:07	CALIPER	5.000	INCH	261200.000	(CPS)
	Dec/05/12	12:39:07	CALIPER	11.760	INCH	401815.000	(CPS)
7	Oct/02/12	07:35:58	CURRENT	0.000	UA	5896.000	(CPS)
	Oct/02/12	07:35:58	CURRENT	267.244	UA	39065.000	(CPS)
8	Oct/02/12	07:36:00	X	Default	(CPS)		

TFN 6 2/025
RECD JUL 30, 2015

Scanned, 02/27/2020

Hole/Well No.: AMBRE-02	Recorded By: M. Wolf WY PG #614	Drilling Co.: A-3 Services Depth: 0′ To 120′ CORED: 20-50', 65-75', 90-100'
Company: RAMACO	Geophysical Log Type: No	
Project: Brook Mine	Hole Type: core coal intervals indicated in plan	Date Drilled: 01-09-13
County: Sheridan WY		
Township: 57N Range: 84W	Water:	
Location: NWSW Section: 9		
N: 1,942,111.9 E: 1,396,276.4		
Elevation: 3767.2		

DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
0	15	Fill; silty clay with scoria pebbles, wet at base, sticky, little H_2O	15.0	CL/ML		
15	23	Moderate coarse alluvium with scoria, ream with 8¾", set 22' of 6" PVC casing	8.0	QAL		second hole gravel 23'
20	50	See Core #1 & #2 Description – Page 2				
29.8	47.2					
50	65	Claystone; grey, little detrital coal	15.0	CL		
65	75	See Core #3 Description – Page 2				
66.5	72.2	Washout below Masters Bed				
75	90	Claystone; grey with detrital coal and thin coal at 83'-85'	15.0	CL		
90	100	See Core #4 Description – Page 2				
100	112.5	Claystone; grey with hard streaks of siltstone ledges & thin coals	12.5	CL		
112.5	120	Claystone; grey, firm, fissile	7.5	CL		

ABBREVIATIONS

GL – Below Ground Level
BS – Disturbed Bulk Sample
GPM – Gallon Per Minute
GS – Geochemical Sample
LA – Laboratory Analysis
SWL – Static Water Level
ZP – Ziplock Bag Sample

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DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
		Core #1 20'-35' = 15' recovered 14.0' lost top				
20	21	Lost core; soft weathered claystone	1.0	CL		
21	23.6	Claystone; yellow, weathered, little detrital coal, silty in part	2.6	CL		
23.6	24.1	Coaly claystone; dull with bright bands	0.5	CL/OH		
24.1	28.7	Claystone; grey, little detrital coal, fissile	4.6	CL		
28.7	29.2	Coal; dull & bright, poorly high ash	0.5	CØ		
29.2	29.8	Coaly claystone; light to dark, gradational top	0.6	CL/OH		
29.8	35	Coal; black, hard, pyrite in all	5.2	CØ	CARNEY	
		Samples: 29.8'-31.8'; 31.8'-33.8', 3.8'-28.8'				
		Core #2 35'-50' = 15' recovered 15.0'				
35	45.9	Coal; black, hard bright, pyrite "framboidal" in all	10.9	CØ	CARNEY	
45.9	47.2	Clayey coal; very dull	1.3	CØ/OH		
47.2	49	Claystone; light grey, firm				
49	50	Siltstone; very light grey, very firm				
		Samples: 38.8'-43.8'; 43.8'-45.9'; 45.9'-47.2'				
		Note: two beds below Carney found by pilot ahead for e-log				
		Core #3 65'-75' = 10' recovered 10.0'				
65	66	Claystone; grey, soft, sticky				
66	66.5	Carbonaceous claystone with abundant laminated coal, poor roof separates on bedding				
66.5	71.75	Coal; black, hard, mostly bright, little pyrite throughout, top more dull	5.25	CØ	MASTERS	
71.75	73.0	Claystone; grey, fire laminations, firm				
73.0	75	Siltstone; light grey, firm				
		Samples: 66.5'-68.5'; 68.5'-70.5'; 70.5'-71.75'				
		Core #4 90'-100' = 10' recovered 10.0'				
90	92.2	Claystone, grey & dark grey, interbedded carbonaceous & noncarbonaceous, fissile				
92.2	92.5	Carbonaceous claystone, very coaly				
92.5	96.0	Coal; black, hard, mostly bright	3.5	CØ	LOCAL	
9.60	96.5	Claystone; grey fissile, fine laminations				
96.5	97	Carbonaceous clay; very dark, moderately coaly, separates on bedding				
97	100	Clay & carbonaceous clay interbedded, coal at base				
		Rock Core: 27.8'-29.8' Roof, 47.2'-49.2' Floor Carney Bed; 65'-66.5' Roof; 71.75'-73.75' Masters Floor				
		Samples: 92.5'-94'; 94'-96'				

ABBREVIATIONS

BGL – Below Ground Level
BS – Disturbed Bulk Sample
GPM – Gallon Per Minute
GS – Geochemical Sample
LA – Laboratory Analysis
SWL – Static Water Level
ZP – Ziplock Bag Sample

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DEPTH		DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
rom	To					
		E-Log Picks:				
		Carney Bed 29.8-45.9' = 16.1'				
		Masters Bed 66.5-71.75' = 5.25'				
		Samples: 92.5'-94'; 94'-96'				

ABBREVIATIONS

BGL – Below Ground Level
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GPM – Gallon Per Minute
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TFN 6 2/025
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GAMMA-RES-DENSITY
AMBRE-02

COMPANY RAMACO LLC
WELL AMBRE-02
FIELD NONE
COUNTY SHERIDAN
STATE WY

OTHER SERVICES
NA
NA
NA

LOCATION SHERIDAN TOWN 1 LLC
SECTION 1
TOWNSHIP 57N
RANGE 83W
API NO NA

PERMANENT DATUM GL
LOG MEASURED FROM GL
DRL MEASURED FROM GL

ELEVATION 1304.0
ELEVATION GL NA
ELEVATION KB NA

DATE 10-Nov-12
DEPTH DRILLER 120
BIT SIZE 5.125
LOG TOP 0.0
LOG BOTTOM 119.00
CASING OD 4
CASING BOTTOM 20
CASING TYPE PVC
CONTROL UNIT GR119
RM TEMPERATURE NA
MAX TEMP NA
LOGGED BY V. WOLF
RECORDED BY J.CAMPBELL
REMARKS NA
REMARKS NA

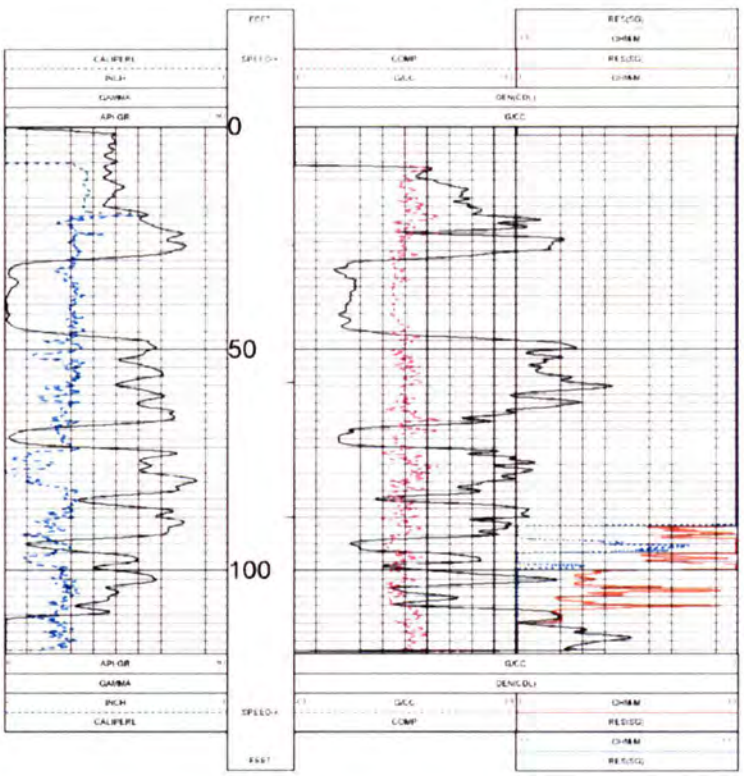
DATA SOURCE DIGITAL
LOGGER TD 119.94
MAX VAL MEM 1500
OPERATOR'S WITNESS
CRC STORED NA

A. STANDARD GEOPHYSICAL SERVICES TRANSMITTED CONDITIONS

5 INCH LOG, GAMMA-RES-DENSITY AMBRE-02 01/09/13

LOG PARAMETERS

MATRIX DENSITY 2.65 NEUTRON MATRIX SANDSTONE MATRIX DELTA T 54
MAGNETIC DECL 10 ELECT CUTOFF 99999 BIT SIZE 5.125
PRESENTATION NAME/DATE = 9239 Ramaco Std COL 5inch 12-1-12 0 01/09/2013 VERSION = 3.64KF



5 INCH LOG, GAMMA-RES-DENSITY AMBRE-02 01/09/13

LOG PARAMETERS

MATRIX DENSITY 2.65 NEUTRON MATRIX SANDSTONE MATRIX DELTA T 54
MAGNETIC DECL 10 ELECT CUTOFF 99999 BIT SIZE 5.125
PRESENTATION NAME/DATE = 9239 Ramaco Std COL 5inch 12-1-12 0 01/09/2013 VERSION = 3.64KF

TOOL CALIBRATION AMBRE-02 01/09/13 13:57
TOOL 9239C1 IM VERSION 2025
SERIAL NUMBER 2740

	DATE	TIME	SENSOR	STANDARD		RESPONSE	
1	Sep06,12	07:36:00	GAMMA	0.000	[API-GR]	1.000	[CPS]
	Sep06,12	07:36:00	GAMMA	340.000	[API-GR]	327.000	[CPS]
2	Sep04,12	08:20:34	VOLTAGE	0.000	[MV]	10823.000	[CPS]
	Sep04,12	08:20:34	VOLTAGE	2023.000	[MV]	282630.000	[CPS]
3	Feb06,12	07:52:24	CALIPER	4.000	[INCH]	258538.000	[CPS]
	Feb06,12	07:52:24	CALIPER	8.000	[INCH]	568667.000	[CPS]
4	Nov29,12	10:50:31	DENSL	1.020	[GCC]	5246.000	[CPS]
	Nov29,12	10:50:31	DENSL	2.612	[GCC]	736.000	[CPS]
5	Nov29,12	10:42:08	DENSSI	1.580	[GCC]	18328.000	[CPS]
	Nov29,12	10:42:08	DENSSI	2.580	[GCC]	6811.000	[CPS]
6	Nov29,12	11:08:27	CALIPER1	5.000	[INCH]	254712.084	[CPS]
	Nov29,12	11:08:27	CALIPER1	11.250	[INCH]	454282.688	[CPS]
7	Sep04,12	08:21:19	CURRENT	0.000	[UA]	5183.000	[CPS]
	Sep04,12	08:21:19	CURRENT	289.800	[UA]	28822.000	[CPS]
8	Jan23,12	14:32:15	X	Default	[CPS]		
9	Jan23,12	14:32:15	X	Default	[CPS]		

TFN 6 2/025
RECD JUL 30, 2015

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Hole/Well No.: AMBRE-03	Recorded By: M. Wolf WY PG #614	Drilling Co.: A-3 Services Depth: 0′ To 96′
Company: RAMACO	Geophysical Log Type: Coal Suite	CORED: 51-96′
Project: Brook Mine	Hole Type: core coal intervals indicated in plan	Date Drilled: 01-10-13
County: Sheridan WY		
Township: 57N Range: 84W	Water:	
Location: NWSW Section: 9		
N:1,941,775.3 E:1,398,109.2		
Elevation: 3726.8		

DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
0	5	Fill; fine, few pebbles	5.0	ML/SP		
5	7	Coarse clinker; gravel	2.0	QAL		
7	9	Very coarse, big hard slabs?	2.0	QAL		
9	20	Coarse pebble; gravel, very little water at base. Set 21′ of 6" PVC casing (washout 15′-20′)	11.0	QAL		
20	46	Siltstone; light grey, firm	26.0	ST		
46	52	Claystone; grey, little detrital coal	6.0	CL		
52	68.9	Coal; black, hard, framboidal pyrite on cleat	16.9	CØ	CARNEY	Bottom poor!
68.9	81	Claystone; grey, firm, fissile, carbonaceous zones near base that part relatively easily on bedding	11.1	CL		
81	85.9	Coal; black, hard, framboidal pyrite	4.9	CØ	MASTERS	
85.9	90.8	Claystone; grey, sparse, carbonaceous sands	4.9	CL		
90.8	92.5	Coal; hard, fractures spread split barrel & plugged to grind core off bottom	1.7	CØ	RIDER	
92.5	92.7	Claystone; black, coaly	0.2	CL/OH		
92.7	95.0	Siltstone; light grey, very firm	2.3	ST		
95	96	Lost core; bit plugged, ground up	1.0	-		Lost core
		E-Log Picks 52′-68.9′=16.9′, bottom 0.5′ very poor Carney Masters 81′-85.9′=4.9′ 90.8′-92.5′=1.7′			CARNEY MASTERS THIN RIDER	
		Core #1 51.0′-66.0′ = 15′ recovered 14.5′				
51.0	52	Claystone; grey-dark grey, pyrite chunks, lost top ½′				
52	66	Coal; black, hard, moderately pyrite, broken at top 0.3′				
		Samples: 52′-54′; 54′-56′; 56′-61′; 61′-66′				

ABBREVIATIONS

BGL – Below Ground Level
DBS – Disturbed Bulk Sample
GPM – Gallon Per Minute
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LA – Laboratory Analysis
SWL – Static Water Level
ZP – Ziplock Bag Sample

TFN 6 2/025
RECD JUL 30, 2015

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DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
		Core #2 66'-81' = 15' recovered 12.5'				
66	68.4	Coal; black, dull, top broken				
68.4	68.7	Claystone; black, bone, very high ash, soft				
68.7	68.9	Coal; hard, fractured				
68.9	69.1	Carbonaceous claystone; very dark, soft, crumbly				
69.1	78.5	Claystone; grey, fissile, firm				
78.5	81	Lost core; bit plugged, ground off bottom				
		Samples: 66'-68.4'; 68.4'-68.9'				
		Core #3 81'-96' = 15' recovered 14.0', lost off bottom				
81	85.9	Coal; black, hard, chattered, pyrite				
85.9	90.8	Claystone; grey, little carbonaceous & coaly bands				
90.8	92.5	Coal; hard, fractured, spread in core barrel				
92.5	92.7	Claystone; black, coaly				
92.7	95	Siltstone; very light grey, very firm				
95	96	Lost core; ground off bottom, split barrel plugged				
		Samples: 81'-83'; 83'-85'; 85'-85.9'				

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TFN 6 2/025
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GAMMA-RES-DENSITY
AMBRE-03

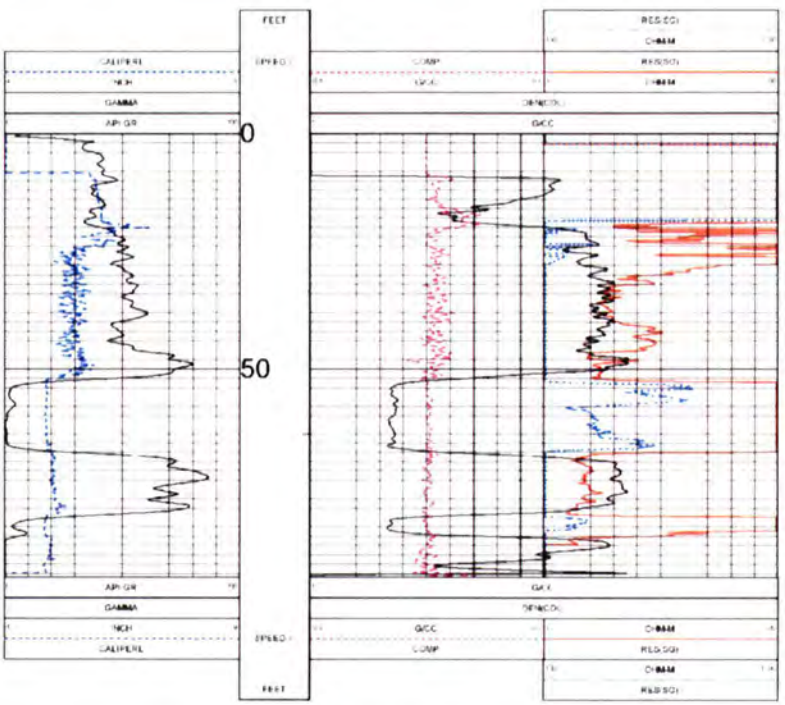
COMPANY	RAMACO LLC	OTHER SERVICES	
WELL	AMBRE-03	NA	
FIELD	NEW	NA	
COUNTY	SHERIDAN	NA	
STATE	WY	NA	
LOCATION	SHERIDAN COA TYPE 3		
SECTION	6		
TOWNSHIP	57N		
RANGE	84W		
API NO	NA		
UNIQUE WELL ID	NA		
PERMANENT DATUM	GL	ELEVATION KB	NA
LOG MEASURED FROM	GL	ELEVATION DF	NA
DRL MEASURED FROM	GL	ELEVATION GL	NA
DATE	01/10/13	REC NUMBER	A-3 SERVICES
DEPTH DRILLER	98	LOGGED FT	94.95
BIT SIZE	5.125	ARRIVAL TIME	1500
LOG TOP	0.80	DEPARTURE TIME	1515
LOG BOTTOM	94.95	ENG STOPPED	NA
CASING OD	6		
CASING BOTTOM	20		
CASING TYPE	PVC		
BORE-HOLE FLUID	WATER		
BHT/TEMPERATURE	NA		
MUD RES	NA		
MUD WEIGHT	NA		
MPH/TRUCK NO	N WELT		
RECORDED BY	JCAMPS		
REMARKS	NA		
REMARKS	NA		

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS

5 INCH LOG, GAMMA-RES-DENSITY AMBRE-03 01/10/13

LOG PARAMETERS

MATRIX DENSITY 2.65 NEUTRON MATRIX SANDSTONE MATRIX DELTA T 54
MAGNETIC DECL 10 ELECT CUTOFF 99999 BIT SIZE 5.125
PRESENTATION NAME/DATE 9299 Ramaco Std CDL 5inch 12-1-12 0 01/09/2013 VERSION 3.64KF



5 INCH LOG, GAMMA-RES-DENSITY AMBRE-03 01/10/13

LOG PARAMETERS

MATRIX DENSITY 2.65 NEUTRON MATRIX SANDSTONE MATRIX DELTA T 54
MAGNETIC DECL 10 ELECT CUTOFF 99999 BIT SIZE 5.125
PRESENTATION NAME/DATE 9299 Ramaco Std CDL 5inch 12-1-12 0 01/09/2013 VERSION 3.64KF

TOOL CALIBRATION AMBRE-03 01/10/13 15:33
TOOL 9299CT TM VERSION 2026
SERIAL NUMBER 2743

	DATE	TIME	SENSOR	STANDARD		RESPONSE	
1	Sep06,12	07:38:00	GAMMA	0.000	[API-GR]	1.000	[CPS]
	Sep06,12	07:38:00	GAMMA	340.000	[API-GR]	327.000	[CPS]
2	Sep04,12	06:20:34	VOLTAGE	0.000	[MV]	10823.000	[CPS]
	Sep04,12	06:20:34	VOLTAGE	2023.000	[MV]	282430.000	[CPS]
3	Feb06,12	07:57:24	CALIPER	4.000	[INCH]	258908.000	[CPS]
	Feb06,12	07:57:24	CALIPER	8.000	[INCH]	368947.000	[CPS]
4	Jan10,13	12:39:35	DEN(LS)	1.620	[G/CC]	5299.000	[CPS]
	Jan10,13	12:39:35	DEN(LS)	2.612	[G/CC]	734.000	[CPS]
5	Jan10,13	12:39:49	DEN(SS)	1.680	[G/CC]	17131.000	[CPS]
	Jan10,13	12:39:49	DEN(SS)	2.680	[G/CC]	4924.000	[CPS]
6	Jan10,13	12:55:40	CALIPER1	5.000	[INCH]	258933.000	[CPS]
	Jan10,13	12:55:40	CALIPER1	11.250	[INCH]	456367.000	[CPS]
7	Sep04,12	06:21:19	CURRENT	0.000	[UA]	5183.000	[CPS]
	Sep04,12	06:21:19	CURRENT	269.800	[UA]	28672.000	[CPS]
8	Jan23,12	14:37:15	F	Default	[CPS]		
9	Jan23,12	14:37:15	X	Default	[CPS]		

TFN 6 2/025
RECD JUL 30, 2015

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Hole/Well No.: AMBRE-04	Recorded By: M. Wolf WY PG #614	Drilling Co.: A-3 Services Depth: 0' To 120'
Company: RAMACO	Geophysical Log Type: Coal Suite	CORED: 60-105'
Project: Brook Mine	Hole Type: core coal intervals indicated in plan	Date Drilled: 01-15-13
County: Sheridan WY		
Township: 57N Range: 84W	Water:	
Location: SWSE Section: 9		
N:1,940,744.4 E:1,399,157.5		
Elevation: 3707.5		

DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
0	5	Sandy Silt; buff, few small, inject H_20 at 101, clinker predominant	5.0	SM		
5	14	Clinker; gravel, red	9.0	QAL		
14	28	Siltstone; grey, firm, very hard, 28' to 42'	14.0	ST		
28	58	Sandstone; very light grey, very fine, moderately hard, salt & pepper, very hard, 28'-42'	30.0	SS		
58	71.7	Claystone; grey, occasional carbonaceous bands	13.7	CL		
71.7	90	Coal; black, hard, framboidal pyrite	18.3	CØ	CARNEY	H_2O
90	97	Claystone; grey	7.0	CL		
97	101.9	Coal; black, hard	4.9	CØ	MASTERS	H_2O
101.9	105.5	Claystone; grey, firm, fissile	3.6	CL		
05.5	106.5	Coal; rider	1.0	CØ	LOCAL	
106.5	120	Claystone; grey, firm	13.5	CL		
		Water at approximately 70' following drilling				
		E-Log Picks:				
		72'-90'=18' Carney Masters 97'-101.9'=4.9'			CARNEY MASTERS	

ABBREVIATIONS

BGL – Below Ground Level
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GPM – Gallon Per Minute
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LA – Laboratory Analysis
SWL – Static Water Level
ZP – Ziplock Bag Sample

TFN 6 2/025
RECD OCT 23, 2015

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DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
		Core #1 60-75=15'; recovered 15'				
60	62	Claystone; very light grey, firm, 90° fracture at 60.6' & 61.2'				
62	62.2	Coal; hard, broken				
62.2	62.8	Claystone; dark, very carbonaceous, very fissile				
62.8	70.7	Claystone; light grey, hard zone 66'-67.2'				
70.7	71.1	Coal; bright, bottom contact 30°-45° fractures & slicks "photo #1"				
71.1	71.7	Carbonaceous clay; very dark, moderately coaly chunks, 45° fracture at 73'				
71.7	75	Coal; black, hard, non-fractured				
		Samples: 71.7'-73', 7'3-75'				
		Core #2 75'-90'=15'; recovered 15.0'				
75	88.7	Coal; black, hard				
88.7	89.5	Coal; dull, high ash, poor				
89.5	90	Claystone; grey, firm				
		Samples: 75'-80', 80'-85', 85'-87', 87'-88.7', 88.7'-89.5'				
		Core #3 90'-105'=15' recovered 11.1' bottom slid out, photos				
90	96.1	Claystone; grey, firm, detrital pieces at 91' & 91.6' soft zones,				
96.1	96.2	Carbonaceous Claystone; very dark, very fissile				
96.2	101.1	Coal; hard, black, moderately dull, non-fractured				
101.1	105	Lost core; think slid out below contact, parts on bedding				
		Samples: 96.2'-98', 98'-100', 100-101.1'				

ABBREVIATIONS

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GPM – Gallon Per Minute
GS – Geochemical Sample
LA – Laboratory Analysis
SWL – Static Water Level
ZP – Ziplock Bag Sample

TFN 6 2/025
RECD JUL 30, 2015

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Century GEOPHYSICAL CORP.

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GAMMA-RES-DENSITY

AMBRE-04

COMPANY	RAMACO LLC
WELL	AMBRE-04
FIELD	BWSI
COUNTY	SHERIDAN
STATE	WY
LOCATION	SHERIDAN COAL FIELD
DIRECTION	
TOWNSHIP	57N
RANGE	84W
API NO	N/A
UNIQUE WELL ID	N/A
PERMANENT DATUM	GL
LOG MEASURED FROM	GL
DRL MEASURED FROM	GL
ELEVATION KB	N/A
ELEVATION DF	N/A
ELEVATION GL	N/A
DATE	01/15/13
DEPTH DRILLER	105
BIT SIZE	5.625
LOG TOP	GL
LOG BOTTOM	116.96
CASING CD	5
CASING BOTTOM	23
CASING TYPE	PVC
BOREHOLE FLUID	WATER
FLUID LEVEL	N/A
MUD WEIGHT	N/A
WITNESSED BY	P. WOLF
RECORDED BY	JCAMPBELL
REMARKS 1	N/A
REMARKS 2	N/A

ALL SERVICES RENDERED SUBJECT TO STANDARD TERMS AND CONDITIONS

LOGGER TD	116.96
ARR VAL TIME	1140
DEPARTURE TIME	210
DIRECTIONAL	N/A

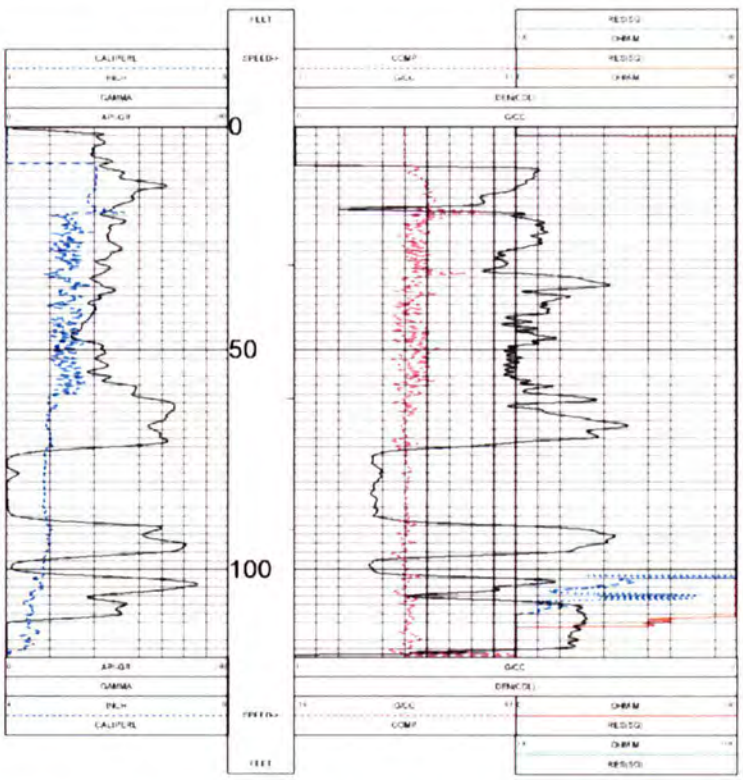
5 INCH LOG, GAMMA-RES-DENSITY AMBRE-04 01/15/13

LOG PARAMETERS

MATRIX DENSITY 2.65 NEUTRON MATRIX SANDSTONE MATRIX DELTA T 54

MAGNETIC DECL 10 ELECT CUTOFF 99999 BIT SIZE 5.625

PRESENTATION NAME/DATE = 9239 Ramaco SM COL 5inch 12-1-12 0 01/09/2013 VERSION = 3.64KF



5 INCH LOG, GAMMA-RES-DENSITY AMBRE-04 01/15/13

LOG PARAMETERS

MATRIX DENSITY 2.65 NEUTRON MATRIX SANDSTONE MATRIX DELTA T 54

MAGNETIC DECL 10 ELECT CUTOFF 99999 BIT SIZE 5.625

PRESENTATION NAME/DATE = 9239 Ramaco SM COL 5inch 12-1-12 0 01/09/2013 VERSION = 3.64KF

TOOL CALIBRATION AMBRE-04 01/15/13 11:45
TOOL 9239G1 SM VERSION 2625
SERIAL NUMBER 2140

	DATE	TIME	SENSOR	STANDARD		RESPONSE	
1	Sep05,12	07:56:00	GAMMA	0.000	[API-GR]	1.000	[CPS]
	Sep05,12	07:56:00	GAMMA	340.000	[API-GR]	327.000	[CPS]
2	Sep04,12	08:26:54	VOLTAGE	0.000	[MV]	10823.000	[CPS]
	Sep04,12	08:26:54	VOLTAGE	2023.000	[MV]	282630.000	[CPS]
3	Feb08,12	07:57:24	CALIPER	4.000	[INCH]	258938.000	[CPS]
	Feb08,12	07:57:24	CALIPER	6.000	[INCH]	388667.000	[CPS]
4	Jan10,13	12:38:35	DENS(L)	1.620	[GACC]	5298.000	[CPS]
	Jan10,13	12:38:35	DENS(L)	2.612	[GACC]	134.000	[CPS]
5	Jan10,13	12:38:49	DENS(S)	2.500	[GACC]	11151.000	[CPS]
	Jan10,13	12:38:49	DENS(S)	2.540	[GACC]	9804.000	[CPS]
6	Jan10,13	12:56:40	CALIPER(L)	6.000	[INCH]	358653.000	[CPS]
	Jan10,13	12:56:40	CALIPER(L)	11.250	[INCH]	458597.000	[CPS]
7	Sep04,12	08:21:19	CURRENT	0.000	[UA]	5193.000	[CPS]
	Sep04,12	08:21:19	CURRENT	289.900	[UA]	28922.000	[CPS]
8	Jan23,12	14:37:15	F	Default	[CPS]		
9	Jan23,12	14:37:15	K	Default	[CPS]		

TFN 6 2/025
RECD JUL 30, 2015

Scanned, 02/27/2020

LOG OF BOREHOLE	BOREHOLE # AMBRE-05	Page 1 of 4
PROJECT: Brook Mine Sheridan, WY	**DRILLER:** Shawn Ankney A-3 Services, LLC	**DATE:** 1/23/13 & 1/24/13
CLIENT: RAMACO, LLC	**RIG:** Gardiner Denver 1500	**START:** 9:10 1/23/13
LOCATION: SWSW T57N, R84W	**BIT(S):** 8¾" Tri-Core to 35' 5⅝" button spade to TD	**FINISH:** 16:00 1/24/13
GROUND ELEVATION: 3776.4		
COORDINATES: **N:** 1,930,125.6 **E:** 1,403,477.8	**FLUID:** Mud & Polymer	**TOTAL DEPTH:** 385'
SURVEYED: Yes	**LOG BY:** Mike Wolf WYPG #614	**HOLE DIAMETER:** 5⅝"

DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
0	3	Gravel; Goose Creek Alluvium Terrace – coarse, sandy gravels	3.0	QAL		
3	143	Siltstone; light buff, hard, cemented zones, alternating orange, yellow & light grey, set 6' 6" surface casing, 28-37 very hard	140.0	ST		
143	149	Claystone; grey, mostly competent	6.0	CL		
149	161	Coal; black, hard, mostly bright, E-Log shows "Wash Out"	12.0	COAL	DIETZ 2 B	DTW ~150
161	168	Claystone; grey, firm, competent	7.0	CL		
168	171	Siltstone; light, sandy, hard	3.0	ST		
'1	176	Claystone; grey, soft, incompetent	5.0	CL		
.76	180	Coal; black, hard	4.0	COAL	DIETZ 2 C	
180	215	Claystone; grey to dark grey, with coal stringers (see E-Log)	35.0	CL		
215	242	Coal; hard with numerous, high ash bands	27.0	COAL	DIETZ 3	
242	263	Coal; hard, bright to very bright	21.0	COAL	MONARCH	
263	290	Claystone; grey, firm, fissile	27.0	CL		
290	348	Siltstone; light grey with claystone interbeds, hard streaks	58.0	ST		
348	357	Claystone; grey, fissile, some zones very incompetent, sticky, very hard 290-300'	109.0	CL		
357	378	Coal; black, hard, mostly bright	21.0	COAL	CARNEY MASTERS	
358	384	Claystone; grey, soft, platy, very incompetent	26.0	CL		
384	385	Siltstone; light grey, very firm much more competent	1.0	ST		
		Parting between Carney-Masters was at 372.9-373.3 in core				
		E-Log Picks:				
		149-161=12 Dietz 2 B				
		176-180=4 Dietz 2 C				
		215-242=27 Dietz 3				
		242-263=21 Monarch				
		357-378=21 Carney-Masters				
		Plug & abandon boring with 98 sacks chips, 1 sack concrete				

ABBREVIATIONS

BGL – Below Ground Level
DBS – Disturbed Bulk Sample
GPM – Gallon Per Minute
GS – Geochemical Sample
LA – Laboratory Analysis
SWL – Static Water Level
ZP – Ziplock Bag Sample

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DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)	ASTM D2487 SYMBOL	TEST, SAMPLES, OR NOTES
		Core #1 82-97=15'; recovered 15'		
82	88.2	Siltstone; orange-yellow		
88.2	97	Siltstone; grey, fracture at 89.6 has Fe Oxs on both sides		
		Samples: 87-89, 89-91, 91-93, 93-95, 95-97		
		Core #2 97-112=15'; recovered 15'		
97	112	Siltstone; grey to orange, mostly competent, Fe Oxs, claystone, fissile at 99.5-101		
		Samples: 102-104, 104-106, 106-108, 108-110, 110-112		
		Core #3 112-127=15'; recovered 15'		
112	127	Siltstone; alternating yellow/grey, yellow to 116, then grey to 120.2, yellow 120.2-120.4, grey to 122.5, yellow to 123.7, grey to 126.2, then yellow to 127 at end becoming little coaly, save wafers of core for OB analysis 110, 115, 120, 125, 130		
		Core #4 127-142=15'; recovered 13.8'		
127	128.2	Lost; soft oxidized sandstone		
128.2	132.6	Sitly Sandstone; oxidized, friable		
132.6	142	Siltstone; grey, firm, fairly competent, however, parts on bedding		
		Core #5 142-155.5=13.5'; recovered 15', picked up 1.5' from previous core run		
142	142.9	Siltstone; grey, clay rich, finely laminated		
142.9	149.1	Claystone; grey to dark grey, firm, competent, parts on bedding		
149.1	155.5	Coal; black, hard, mostly bright		
		Samples: 149.151, 151-153, 153-155.5		
		Rock: 143-145, 145-147, 147-149.1		
		Core #6 155.5-167=165'; recovered '10.5		
155.5	161.9	Coal; black, hard, bright		
161.9	166	Claystone; grey, firm, competent		
166	167	Slid out!		
		Samples: 155.5-158, 158-160, 160-161.9		
		Core #7 167-182=15'; recovered 14.5', bottom slid out		
167	196	Claystone; grey, firm, competent		
169	170.8	Claystone; coal ~30° dips, disrupted, incompetent		
170.8	173.5	Siltstone; grey, sandy, hard lenses		
173.5	177.4	Claystone; grey, soft, fissile, incompetent above contact		
177.4	181.5	Coal; black, hard		
181.5	182	Lost – slid out		
		Samples: (175.4-177.4 rock), coal 177.4-179.4, 179.4-181.5		

ABBREVIATIONS

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TFN 6 2/025
RECD JUL 30, 2015

Scanned, 02/27/2020

DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)	ASTM D2487 SYMBOL	TEST, SAMPLES, OR NOTES
		Core #8 200-215=15'; recovered 15'		
200	200.1	Claystone; grey, soft		
200.1	201.8	Coal; black, poor, base contact ~30° angle		
20138	202.4	Claystone; grey, soft, fissile		
202.4	204.1	Coal; dull, high ash, amber		
204.1	208.2	Claystone; grey, coaly, soft at hose contact, incompetent, fissile		
208.2	210.6	Coal; hard, both contacts grade to clay rich		
210.6	214.4	Claystone; grey to dark grey, detrital coal, soft, sticky, incompetent, platty		
214.4	215	Coal; hard, dull, poor		
		Samples: Rock 204.4-206.4, 206.4, 208.4, 208.4-210.4, 210.4-212.4, 212.4-214.4 Coal 214.4-216		
		Core #9 215-230=15'; recovered 15'		
215	220	Coal; black, hard		
220	220.2	Clay; black, soft, crushed		
220.2	230	Coal; black, hard, mostly bright		
		Samples: 214.4-216, 216-218, 218-222, 222-227, 227-232		
		Core #10 230-245=15'; recovered 15'		
30	233.5	Coal; black, hard, mostly bright, fine pyrite on cleat		
233.5	233.7	Coal; very dull, high ash		
233.7	237.5	Coal; black, hard, mostly bright, fine pyrite on cleat		
237.5	237.7	Coal/Clay; very high ash		
237.7	240	Coal; black, hard, mostly bright, fine pyrite on cleat		
240	240.2	Coal; dull, high wash zone, poor		
240.2	240.7	Coal; bright, hard		
240.7	241.2	Coal; very dull		
241.2	242.6	Coal; bright, hard		
242.6	242.8	Coal; very dull, very high ash		
242.8	245	Coal; bright, hard		
		Samples: 232-237, 237-242, 242-247		
		Core #11 245-260=15'; recovered 15'		
245	260	Coal; black, hard, mostly bright, ash band at 250.7		
		Samples: 247-252, 252-257, 257-260		

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TFN 6 2/025
RECD JUL 30, 2015

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DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)	ASTM D2487 SYMBOL	TEST, SAMPLES, OR NOTES
		Core #12 260-270=10'; recovered 10'		
260	263.1	Coal; black, hard, bright, slight pyrite		
263.1	263.3	Coal; very dull		
263.3	264.1	Claystone; dark grey, carbonaceous		
264.1	265.1	Coal; band, bright		
265.1	270	Siltstone; light grey, very firm, pyrite nodules at 267.8-268.4		
		Samples: 260-262, 262-263.1, 263.1, 265.1		
		Driller though tagged coal at 340-stop to core		
		Core # 13 240-255=15'; recovered 15'		
340	346	Siltstone; grey, hard, competent, some parting on bedding, no coal		
346	355	Claystone; grey, hard, competent, some parting on bedding		
		Core #14 355-370=15'; recovered 15'		
355	355.7	Claystone; grey, hard		
355.7	357.2	Claystone; black, very carbonaceous, very fissile, very incompetent		
357.2	370	Coal; black, hard, mostly bright		
		Samples: Coal 357.2-359, 359-361, 361-366, 366-370		
		Rock: 355-357.2		
		Core #15		
370	378.3	Coal; black, hard, bright, high ash parting at 372.9-373.3=0.4		
378.3	380	Claystone; very dark, very carbonaceous, very fissile, very incompetent, platty		
380	380.6	Claystone; dark grey, more competent		
380.6	383.8	Claystone; dark grey, very fissile, very incompetent, sticky		
383.8	385	Siltstone; light grey, very firm, competent		
		Samples: 370-375, 375-377, 377-378.3		

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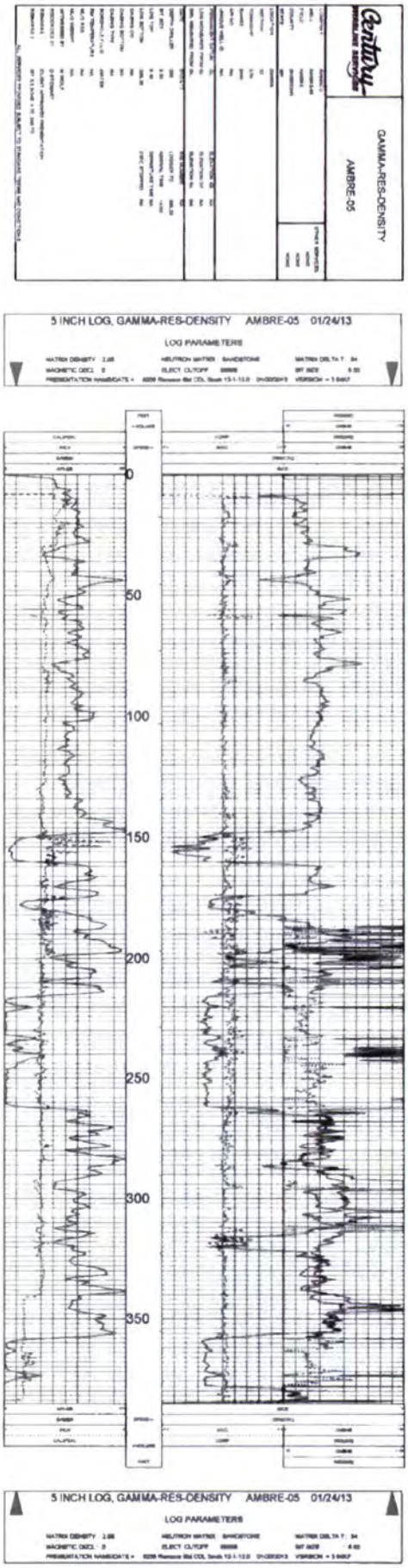
TFN 6 2/025
RECD JUL 30,2015

Scanned, 02/27/2020



TFN 6 2/025
RECD JUL 30, 2015

Scanned, 02/27/2020

Hole/Well No.: R13-011	Recorded By: M. Wolf WYPG #614	Drilling Co.: A-3 Services Depth: 0′ To 222′ CORED: 122′-147′ = 25′
Company: RAMACO	Geophysical Log Type: Coal Suite, gamma, density, RES, CAL	
Project: Brook Mine	Hole Type: 5 5/8"	Date Drilled: 08-22-13
County: Sheridan WY		P&A 8-23-13
Township: 57N Range: 84W	Water:	
Location: NENE Section: 17		
N: 1,938,441 E: 1,394,131		
Elevation: 3840.5		

DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
0	3	Fill; loose, clinker and sandy clay	3.0	FILL		
3	18	Sandstone; buff, fine, loose	15.0	SS		
18	26	Siltstone; light buff, soft	8.0	ST		
26	28	Burn; red-pink, hard	2.0	BURN		
28	32	Claystone; gray, fissile	4.0	CL		
32	55	Silty claystone; gray	23.0	ST/CL		
55	60	Sandy siltstone; light gray, hard to very hard	5.0	SS/ST		
60	124	Claystone; gray with interbedded siltstone, 74'-76', 84'-88', 99'-104', 110'-118'; hard 72'-74'	64.0	CL		
124	140	Coal; black, hard, little water	16.0	COAL	Carney	Little H_20
140	148	Claystone; gray, fissile	8.0	CL		
148	164	Silty sandstone; very fine, gray	16.0	ST/SS		
164	175	Claystone; gray, fissile	11.0	CL		
175	180.5	Coal; hard, motley dull, little pyrite	5.5	COAL	Masters	
180.5	222	Claystone; with coal and carbonaceous coal interbeds at 187'-188', 192'-195', 198'-199': Local rider coals	41.5	CL/COAL		
		E-Log Picks: 124'-140' = 16' Carney				
		175'-180.5' = 5.5' Masters				
		Plug and abandon Pilot Hole 51 sacks				
		Plug and abandon Core Hole				

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TFN 6 2/025
RECD JUL 30, 2015

Scanned, 02/27/2020

DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)
		Core #1 122'-137' = 15' Recovered 14.6'
122	122.4	Lost core; thin soft, very fissile, claystone
122.4	123.9	Claystone; gray, very fissile, very washed, "separated" on bedding
123.9	124.2	Coal; black, hard, mostly bright
124.2	125.1	Clayey coal; banded, very high ash, abundant pyrite on bedding
125.1	137	Coal; black, hard, mostly bright, clay band/fractured at 129.5'-129.7', notable pyrite framboids on cleat
		Samples: 125.1'-126'; 126'-128'; 128'-133'; 133'-137'
		Core #2 137'-147' = 10' - Recovered 9.8'
137	141.4	Coal; black, hard, mostly bright, some dull bands, some pyrite
141.4	142.5	Carbonaceous claystone; very dark, little coaly, very soft, crumbly, very fissile, "omit from sample analysis"
142.5	146.8	Siltstone; very light gray, little sandy, very firm
146.8	147	Lost core; broke off bottom
		Samples: 137'-139'; 139'-141.4'
		Core #3 173.5'-183.5' = 10' Recovered 8.5'
173.5	175.5	Claystone; gray, fissile, crumbly zones
175.5	175.8	Coal; black, dull, high ash, very poor quality, "omit from samples"
175.8	181.3	Coal; black, bright to 180' then dull, from 180'-181.3' some pyrite
81.3	182.0	Claystone; gray t dark gray, soft, fissile, crushed at base
182	183.5	Lost core; slid out bottom! "Crushed" – fissile
		Samples: 175.8'-178'; 178'-180'; 180'-181.3'
		Set 30' 6" PVC Surface Casing to 28' depth

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TFN 6 2/025
RECD JUL 30, 2015

Scanned, 02/27/2020

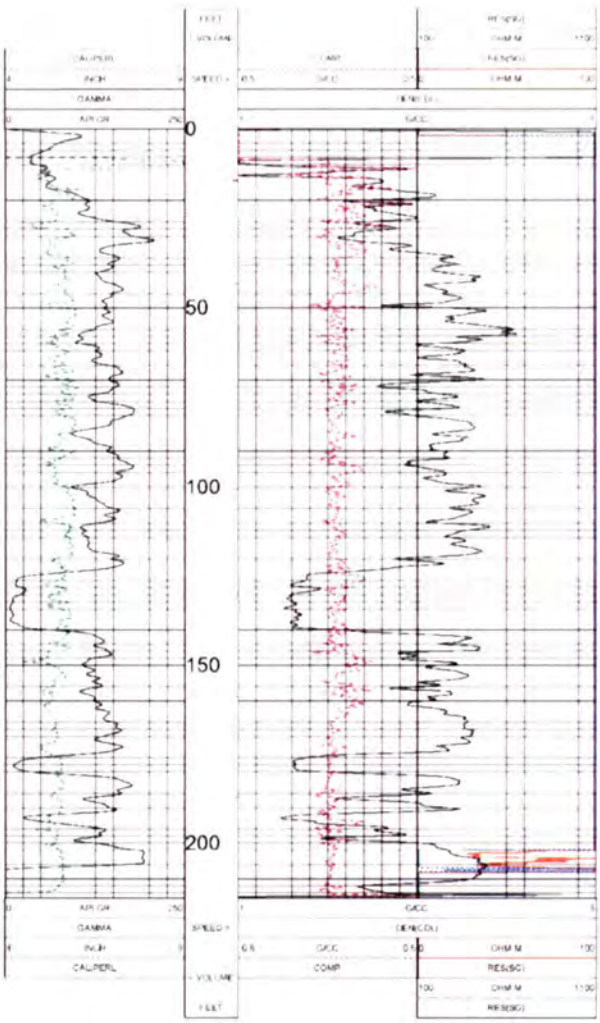
Century WIRELINE SERVICES

GAMMA-RES-DENSITY

R13-011

5 INCH LOG, GAMMA-RES-DENSITY R13-011 08/22/13

LOG PARAMETERS



5 INCH LOG, GAMMA-RES-DENSITY R13-011 08/22/13

LOG PARAMETERS

MATRIX DENSITY 2.65 NEUTRON MATRIX SANDSTONE MATRIX DELTA T 54

MAGNETIC DECL 0 ELECT CUTOFF 30000 BIT SIZE 5.93

PRESENTATION NAME/DATE 9218 Ramaco Std COL Scan 12.1.12.0 06/04/2013 VERSION 5.64KF

TOOL CALIBRATION R13-011 08/22/13 11:45
TOOL 9239C1 TM VERSION 2.05
SERIAL NUMBER 905

	DATE	TIME	SENSOR	STANDARD		RESPONSE	
1	Aug14 13	13 11 57	GAMMA	1.000	[API GR]	0.000	[CPS]
	Aug14 13	13 11 57	GAMMA	340.000	[API GR]	324.000	[CPS]
2	Aug14 13	13 11 51	VOLTAGE	0.000	[MV]	5050.000	[CPS]
	Aug14 13	13 11 51	VOLTAGE	2308.000	[MV]	112284.000	[CPS]
3	Jun11 13	09 58 31	CALIPER	5.000	[INCH]	0.000	[CPS]
	Jun11 13	09 58 31	CALIPER	11.250	[INCH]	0.000	[CPS]
4	Aug14 13	13 29 47	DENS(S)	1.400	[G/CC]	4434.000	[CPS]
	Aug14 13	13 29 47	DENS(S)	2.612	[G/CC]	853.000	[CPS]
5	Aug14 13	15 13 29	DENS(S)	1.560	[G/CC]	14827.000	[CPS]
	Aug14 13	15 13 29	DENS(S)	2.580	[G/CC]	5721.000	[CPS]
6	Aug14 13	13 12 23	CALIPER	5.000	[INCH]	56825.000	[CPS]
	Aug14 13	13 12 23	CALIPER	11.250	[INCH]	82890.000	[CPS]
7	Aug14 13	13 12 04	CURRENT	0.000	[UA]	4966.000	[CPS]
	Aug14 13	13 12 04	CURRENT	[illegible]	[illegible]	38011.000	[CPS]
8	Aug14 13	13 12 10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
9	Aug14 13	13 12 17	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

TFN 6 2/025
RECD JUL 30, 2015

Scanned, 02/27/2020

Hole/Well No.: R13-012	Recorded By: M. Wolf WYPG #614	Drilling Co.: A-3 Services Depth: 0′ To 202′
Company: RAMACO	Geophysical Log Type: Multiple	CORED:
Project: Brook Mine	Hole Type: Pilot	Date Drilled: 08-08-13
County: Sheridan WY		16:00 – 17:10
Township: 57N Range: 84W	Water:	17:15 – e-Log, gr-res-CDL
Location: NWNW Section: 17		
N: 1,939,174 E: 1,391,382		Logs: GR-RES-CDL; OTV, ATV and Sonic
Elevation: 3,925.9		

DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
0	18	Fill; clinker and angular rock	18.0	FILL		DRY
		SET 21. of 6" SDR-17 PVC				
18	28	Siltstone; light buff to pink??, to gray, firm but a little friable	10.0	ST		
28	64	Claystone; gray, firm, moderately silty, 45-46 dark	36.0	CL		Washout 39′-40′, soft, red
64	74	Siltstone; very light to moderately hard streaks, some friable	10.0	ST/CL		Dry, washout 64′-71′
74	94	Siltstone with sandstone interbeds; some hard ledges (90-92) (97-98) and some soft	20.0	ST		
94	104	Sandstone; fine, soft, (washout 98-99) friable	10.0	SS		
104	124	Claystone; gray to dark gray, some them carbonaceous interbeds, washout 112-122	20.0	CL/OH		Wet ~120′
124	140	Coal; black, hard, high ash near top 124-130	16.0	C0	Carney	
140	156.4	Claystone; dark gray, firm but fissile	16.4			
156.4	162	Coal; black, moderately hard, dull	5.6	C0	Masters	
162	172	Claystone; gray to dark gray, fissile	10.0			
172	174	Coal; black, hard	2.0	C0	Local	
174	178	Claystone; gray, firm but fissile	4.0	CL		
178	180.5	Coal; black, hard	2.5	C0	Local	
180.5	184	Claystone; dark gray, little carbonaceous	3.5	CL/OH		
184	185	Coal; black, hard	1.0	C0	Local	
185	194	Claystone; gray to dark gray, fissile	9.0	CL		
194	202	Siltstone; grey, firm, little friable	8.0	ST		
		08-09-13 – Open hole DTW = 80.5 at 23:25				

ABBREVIATIONS

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SWL – Static Water Level
ZP – Ziplock Bag Sample

TFN 6 2/025
RECD OCT 23, 2015

Scanned, 02/27/2020

DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)
		Core #1 123.5-136 = 12.5 Recovered 12.5' 100%
123.5	124.1	Coal; dull, high ash
124.1	128.8	Coal; black, hard, mostly bright, some pyrite
128.8	129.1	Clay; parting, gray
129.1	136	Coal; hard, black
		Samples: 123.5-124.1; 124.1-126; 126-131; 131-136
136	151	Core #2 136-151 = 15 Recovered 14.0
136	140	Coal; black, hard, bright
140	141.5	Coaly claystone; black, very high, poor
141.5	142.8	Claystone; gray, firm
142.8	143	Crushed claystone with slicken sides
143	143.5	Claystone; gray
143.5	143.9	Crushed claystone with slicken sides
143.9	150	Claystone; gray, some washed out areas, soft 147.7-148.6
150	151	Lost core; slid out bottom
		Samples: 136-138; 138-140; 140-141.5
		Core #3 151′-163′ = 12′ Recovered 12.5′
150	151	Picked up claystone/siltstone from above
151	154	Claystone
154	154.5	Claystone; gray, very fissile, weak
154.5	156.5	Claystone; grading dark gray
156.5	162	Coal; black, hard, dull, banded, pyrite from framboids
162	162.4	Claystone; gray, fissile
162.4	163	Lost core; friable claystone, loose
		Samples: 156.5′-158′; 158′-160′; 160′-162′

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TFN 6 2/025
RECD JUL 30, 2015

Scanned, 02/27/2020

Century WIRELINE SERVICES

GAMMA-RES-DENSITY

R13-012

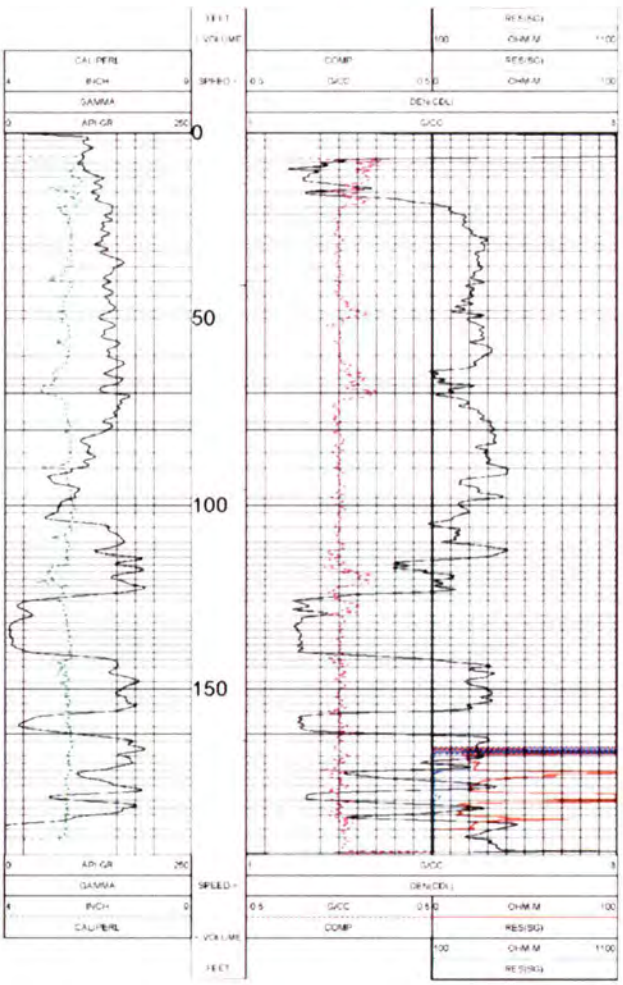
5 INCH LOG, GR-RES-CDL R13-012 08/08/13

LOG PARAMETERS

MATRIX DENSITY 2.65 NEUTRON MATRIX SANDSTONE MATRIX DELTA T 54

MAGNETIC DECL 0 ELECT. CUTOFF 99999 BIT SIZE 5.63

PRESENTATION NAME/DATE 9239 Ramaco Std CDL.Sech 12.1.12.0 08/08/13 VERSION 3.84F



5 INCH LOG, GR-RES-CDL R13-012 08/08/13

LOG PARAMETERS

MATRIX DENSITY 2.65 NEUTRON MATRIX SANDSTONE MATRIX DELTA T 54

MAGNETIC DECL 0 ELECT. CUTOFF 99999 BIT SIZE 5.63

PRESENTATION NAME/DATE 9239 Ramaco Std CDL.Sech 12.1.12.0 08/08/13 VERSION 3.84F

TOOL CALIBRATION R13-012 08/08/13 17:29
TOOL 923MC1 TM VERSION 2025
SERIAL NUMBER 965

	DATE	TIME	SENSOR	STANDARD		RESPONSE	
1	Jul11,13	08:28:12	GAMMA	1.000	[API GR]	0.000	[CPS]
	Jul11,13	08:28:12	GAMMA	340.000	[API GR]	324.000	[CPS]
2	Jul11,13	09:37:38	VOLTAGE	0.000	[MV]	1056.000	[CPS]
	Jul11,13	09:37:38	VOLTAGE	2309.000	[MV]	113264.000	[CPS]
3	Jul11,13	09:58:31	CALIPER	1.000	[INCH]	0.000	[CPS]
	Jul11,13	09:58:31	CALIPER	11.250	[INCH]	0.000	[CPS]
4	Aug08,13	17:29:03	DEN(LS)	1.620	[G/CC]	4276.000	[CPS]
	Jul11,13	09:37:04	DEN(LS)	2.612	[G/CC]	983.000	[CPS]
5	Jul11,13	09:37:31	DEN(SS)	1.590	[G/CC]	18648.000	[CPS]
	Jul11,13	09:37:31	DEN(SS)	2.580	[G/CC]	8446.000	[CPS]
6	Jul11,13	08:38:09	CALIPER	1.000	[INCH]	56563.000	[CPS]
	Jul11,13	08:38:09	CALIPER	11.250	[INCH]	52056.000	[CPS]
7	Jul11,13	08:28:29	[illegible]	[illegible]	[illegible]	4690.000	[CPS]
	Jul11,13	08:28:29	[illegible]	[illegible]	[illegible]	35211.000	[CPS]
8	Jul11,13	08:28:32	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
9	Jul11,13	08:28:35	K	Default	[CPS]		

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ole/Well No.: R13-016	Recorded By: M. Wolf WY PG #614	Drilling Co.: A-3 Services Depth: 0' To 904' CORED:
Company: RAMACO	Geophysical Log Type: Coal Suite, Gamma, Den Res, caliper	
Project: Brook Mine	Hole Type: 5⅝" below 100 feet	Date Drilled: 08-28-13
County: Sheridan WY		
Township: 57N Range: 84W	Water:	
Location: SWSE Section: 8		
N: 1,941,970 E: 1,391,088		
Elevation: 3,956.1		

DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
0	2	Colluvium/slopewash; clinker & rock in silty clay matrix	2.0	FILL		
2	7	Sandstone; light buff, very hard 2'-4'	5.0	SS		
7	24	Siltstone; light buff to orange	17.0	ST		
24	40	Siltstone with sandy interbeds	16.0			
40	50	Carbonaceous claystone; dark, fissile	10.0	CL/OH		
50	58	Burn; red-pink, hard	8.0	BURN	CARNEY	Top Burned
58	69	Coal; black, soft, weathered, dry, "lost circulation at 64' in coal"	11.0	CO	CARNEY	"Very Soft"
69	93	Silty claystone; no circulation, very hard 84'-87'	24.0	CL/ST		
93	98	Coal; black, soft, weathered "set 100' surface easing to regain circulation." Struggle to seal annular space!	5.0	CO	MASTERS	
98	124	Siltstone; light grey with hard sandy lenses 108'-110' & 114'-116'	26.0	ST		
124	130	Claystone; grey, fissile	6.0	CL		
130	165	Carbonaceous claystone; with coal stringers, coal at 131'-132.5', 135'-138', 143'-144', 149'-151', 153.5'-155', 163'-164'	35.0	CO/OH		
165	198	Claystone; grey with silty interbeds	33.0	CL		
198	223	Sandstone; light grey, very fine, some hard streaks	25.0	SS		
223	622	Claystone/siltstone; with carbonaceous claystone & many thin coals at 248'-252', 288'-290', 347'-349.5', 382'-384', 489'-490', 576'-578', 609'-613'	399.0	CL/ST		
622	650	Sandstone; light grey, very fine	28.0	SS		
650	657	Claystone; dark grey, carbonaceous	7.0	CL/OH		
657	666	Coal; black, hard, good!	9.0	CO	WALL	
666	756	Siltstone; light grey with clay & sparse sandy interbeds	90.0	ST/CL		
756	759	Claystone; grey, fissile	3.0	CL		
759	764.5	Coal; black, hard	5.5	CO	PAWNEE-U	
764.5	776	Claystone; dark carbonaceous	11.5	CL/OH		
776	779	Coal; hard, black	3.0	CO	PAWNEE-L	
779	783	Claystone; grey	4.0	CL		
783	784	Coal; hard	1.0	CO		
784	904	Alternating light & dark claystone & siltstone	120.0	CL/ST		

ABBREVIATIONS

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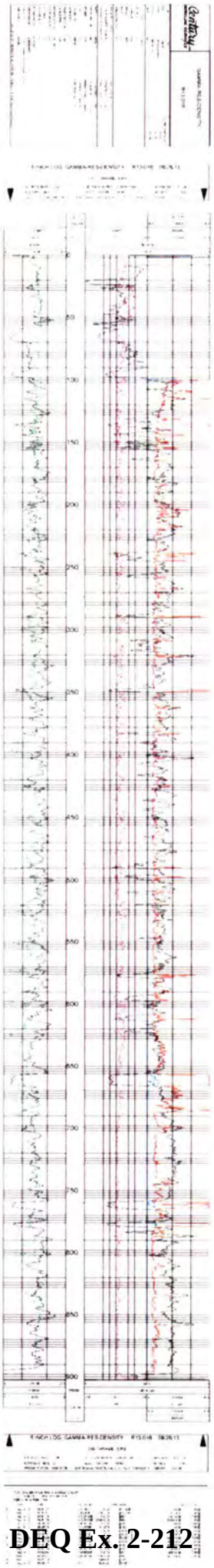

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ole/Well No.: R13-018	Recorded By: M. Wolf WY PG #614	Drilling Co.: A-3 Services Depth: 0' To 141' CORED:
Company: RAMACO	Geophysical Log Type: Coal Suite, Gamma, Den Res, caliper	
Project: Brook Mine	Hole Type: 8 ¾" to 35' 5 ⅝" button spade to TD	Date Drilled: 08-30-13
County: Sheridan WY		
Township: 57N Range: 84W	Mud and Polymer	
Location: NESE Section: 8		
N: 1,941,802 E: 1,394,423		
Elevation: 3,887.9		

DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
0	5	Silty terrace/slopewash fill with clinker fragments	5.0	FILL		
5	24	Siltstone; very light buff to orange, hard 15'-17'	19.0	ST		
24	36	Claystone; grey to dark grey, carbonaceous, sticky	12.0	CL/OH		
36	62	Siltstone; buff, orange, little grey, hard 42'-48', orange streaks 55'-60'	26.0	ST		
62	67	Siltstone; light grey, firm	5.0	ST		
67	69	Sandstone; red, very fine	2.0	SS		
69	74	Sandstone; red, hard, well cemented ledges, baked porcellanite, more hard in core hole	5.0	SS		4 Carney burned!
74	85	Claystone; siltstone, red to pink	11.0	CL/ST		
85	86	Soft coal; contact with burn above	1.0	COAL	POOR COAL	
86	96	Coal; black, moderately hard	10.0	COAL	LOWER CARNEY	
96	111	Claystone; silty, firm, hard 103'-104'	15.0	CL		
111	116.5	Coal; black, mostly hard	5.5	COAL	MASTERS	
116.5	122	Claystone; grey, firm, fissile	5.5	CL		
122	141	Siltstone; grey, clay rich, firm	19.0	ST		
		more ~ 10' north and set 85' of 6" SCH 40 PVC surface casing for Core Hole				
		Core #1, 85'-100'=15'; recovered 15.0'				
85	86.4	Coal; black, little soft, water picked up from drilling!				
86.4	94.5	Coal; black, hard, mostly bright, abundant pyrite framboids				
94.5	94.7	Claystone; black, coaly, carbonaceous, very fissile, vertical cleat 88.1' to 91.7'				
94.7	100	Siltstone; light grey, firm, banded				
		Samples: Coal: 85'-86.4', 86.4'-91', 9'1-93.3', 93.3'-94.5'				

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DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)
		Core # 2, 100'-115'=15'; recovered 15.0'
100	109.3	Siltstone; light grey, banded, clay-rich, sandy 106.2'-109.3'
109.3	110.5	Claystone; grey, fissile, soft
110.5	111	Carbonaceous claystone; coaly
111	115	Coal, black, hard, mostly bright
		Samples: Coal: 111'-113', 113'-115', 115'-116.3'
		Rock: 100'-102', 102'-104', 104'-106', 106'-108', 108'-110', 110'-111'
		Core #3, 115'-124'=9'; recovered 9
115	116.3	Coal; black, hard, dull, moderate pyrite on cleat surfaces
116.3	117	Claystone; grey
117	117.7	Sandy siltstone; light grey, very firm
117.7	119.3	Claystone; grey, firm, fissile
119.3	124	Siltstone; light grey, firm, massive
		Samples: Coal: 115'-116.3'
		Rock: 116.3'-118.3'
		E-Log Picks: 86'-96'=10' Lower Carney
		111'-116.5'=5.5' Masters
		Masters Well DTW at 14:11 on 8/30/13 = 108.70 BTOC

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Century WIRELINE SERVICES

GAMMA-RES-DENSITY

R13-018

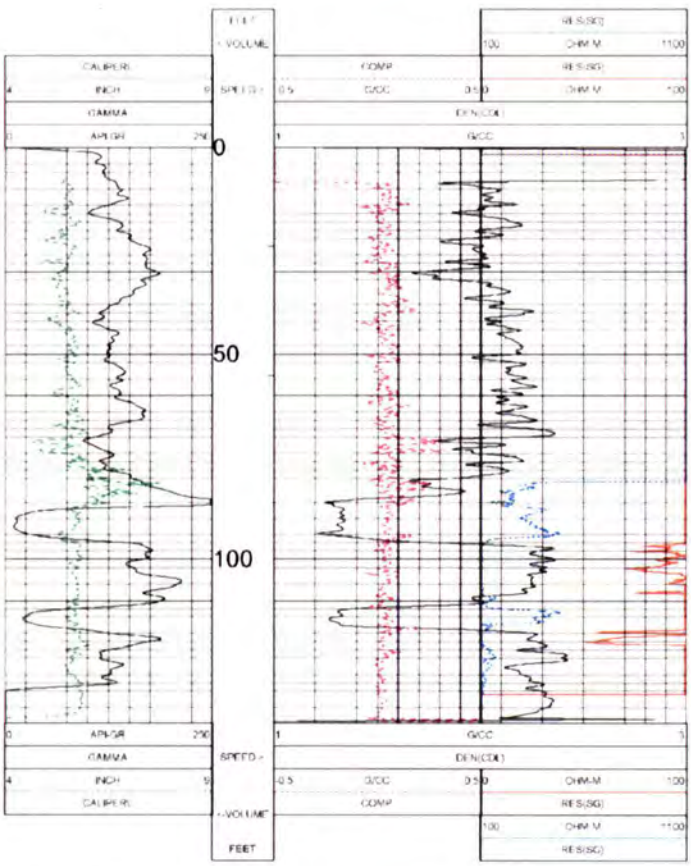
5 INCH LOG, GAMMA-RES-DENSITY R13-018 08/30/13

LOG PARAMETERS

MATRIX DENSITY 2.65 NEUTRON MATRIX SANDSTONE MATRIX DELTA T 54

MAGNETIC DECL 0 ELECT CUTOFF 99999 BIT SIZE 5.63

PRESENTATION NAME/DATE 9239 Ramaco Std CDL 5inch 12.1.12.0 08/08/2013 VERSION 3.64KF



5 INCH LOG, GAMMA-RES-DENSITY R13-018 08/30/13

LOG PARAMETERS

MATRIX DENSITY 2.65 NEUTRON MATRIX SANDSTONE MATRIX DELTA T 54

MAGNETIC DECL 0 ELECT CUTOFF 99999 BIT SIZE 5.63

PRESENTATION NAME/DATE 9239 Ramaco Std CDL 5inch 12.1.12.0 08/08/2013 VERSION 3.64KF

TOOL CALIBRATION R13-018 08/30/13 08:30
TOOL 9239C1 TM VERSION 2025
SERIAL NUMBER 996

	DATE	TIME	SENSOR	STANDARD		RESPONSE	
1	Aug14 13	13:11:57	GAMMA	1.000	[API GR]	0.000	[CPS]
	Aug14 13	13:11:57	GAMMA	340.000	[API GR]	324.000	[CPS]
2	Aug14 13	13:11:51	VOLTAGE	0.000	[MV]	5056.000	[CPS]
	Aug14 13	13:11:51	VOLTAGE	2509.000	[MV]	113254.000	[CPS]
3	Jun11 13	09:58:31	CALIPER	5.000	[INCH]	0.000	[CPS]
	Jun11 13	09:58:31	CALIPER	11.250	[INCH]	0.000	[CPS]
4	Aug14 13	13:29:47	DEN(LS)	1.620	[G/CC]	4434.000	[CPS]
	Aug14 13	13:29:47	DEN(LS)	2.612	[G/CC]	653.000	[CPS]
5	Aug14 13	15:13:29	DEN(SS)	1.580	[G/CC]	14627.000	[CPS]
	Aug14 13	15:13:29	DEN(SS)	2.580	[G/CC]	6321.000	[CPS]
6	Aug14 13	13:12:23	CALIPER(L	5.000	[INCH]	56930.000	[CPS]
	Aug14 13	13:12:23	CALIPER(L	11.250	[INCH]	62590.000	[CPS]
7	Aug14 13	13:12:04	CURRENT	0.000	[U/A]	4990.000	[CPS]
	Aug14 13	13:12:04	[illegible]	[illegible]	[illegible]	38011.000	[CPS]
8	Aug14 13	13:12:10	[illegible]	[illegible]	[illegible]		
9	Aug14 13	13:12:17	X	Default	[CPS]		

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ole/Well No.: R13-019	Recorded By: M. Wolf WY PG #614	Drilling Co.: A-3 Services Depth: 0' To 210' CORED: 135'-210'
Company: RAMACO	Geophysical Log Type: Coal Suite, Gamma, Den, Res, caliper	
Project: Brook Mine	Hole Type: 5⅝" pilot through coal & e-log, offset to core coal	Date Drilled: 09-03-13 core
County: Sheridan WY		
Township: 57N Range: 84W	Water: Minimal; <1 gpm	
Location: SESE Section: 8		
N: 1,940,622 E: 1,394,584		
Elevation: 3,918.5		

DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
0	3	Fill; sandy silt with clinker fragments	3.0	FILL		
3	40	Siltstone; buff, occasional hard streaks	37.0	ST		
40	50	Siltstone; red, burn or Fe OX	10.0	ST/RED		
50	64	Claystone; grey, hard silt 58'-60'	14.0	CL		
64	89	Siltstone; light grey, little interbedded clay, hard 70'-72'	25.0	ST		
89	98	Claystone; grey to dark grey, fissile, moderately crumbly	9.0	CL		
98	132	Siltstone; light grey, very fine, sand in part, hard 108'-109', very hard 126'-127' and 130'-131'	34.0	ST		
132	151.5	Claystone; grey to dark grey, fissile, coarsening up	19.5	CL		
151.5	168	Coal; black, hard, mostly bright	16.5	COAL	Carney	
168	177	Siltstone & claystone; light grey to grey, firm, to fissile	9.0	ST/CL		
177	180	Sandstone; very light grey, very fine predominantly quartz, very well cemented, very, very hard	3.0	SS		
180	187	Siltstone & claystone; grey	7.0	ST/CL		
187	192.5	Coal; black, hard, dull	5.5	COAL	Masters	
192.5	194.3	Claystone; grey, fissile	.8	CL		
194.3	204	Siltstone; grey, clay rich	9.7	ST		
204	210	Claystone; grey, fissile, parts on bedding	6.0	CL		
		E-Log Picks: 151.5'-168'=16.5' Carney 187'-192.5'=5.5' Masters				
		P&A: Pilot Hole 53 50# sacks medium chips Core hole 40 50# sacks medium chips				
		Offset & core rock & coal; set 60' 6" PVC surface casing				

ABBREVIATIONS

"GL – Below Ground Level
3S – Disturbed Bulk Sample
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DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)
		Core #1 135'-150'=15'; recovered 15'
135	137.1	Silty claystone; light grey, hard interbedded fissile claystone & brown siliceous nodules
137.1	139.3	Claystone; grey, fissile, soft, washed, separates on bedding
139.3	143.6	Siltstone; light grey banded, washed on bedding
143.6	145.1	Claystone; grey, soft fissile, part on bedding
145.1	150	Siltstone; grey to light grey, clay rich, banded, fossil leaves, firm
		Samples: 135'-136', 136'-138', 138'-140', 140'-142', 142'-144', 144'-146', 146'-148', 148'-150'
		Core #2 150'-165'=15'; recovered 15'
150	150.5	Claystone; dark grey, laminated, little carbonaceous, firm
150.5	150.7	Carbonaceous claystone; dark grey brown, fissile, little soft
150.7	151.1	Coal; black, hard, poor
151.1	151.5	Claystone; dark, fissile, very weak on bedding
151.5	152	Coal; dull, hard, amber blebs, firm
152	156.7	Coal; black, hard, competent, mostly bright
156.7	156.9	High ash, clay rich band
156.9	165	Coal; black, hard, competent, mostly bright
		Samples: Rock: 150'-152'; Coal: (152'-153' Geotech), 153'-159', 159'-164', 164'-167'
		Core #3 165'-180'=15'; recovered 14.8', lost off bottom
165	167	Coal; black, hard, mostly bright
167	168	Coal; dull, clay rich
168	168.5	Claystone; very dark, carbonaceous, soft, fissile, parts easily on bedding
168.5	178.5	Siltstone; light grey, very firm, massive, clay rich, little washed on bedding
178.5	180	Siltstone; very light, sandy, extremely hard, well cemented, little calcareous
		Samples: Coal: 164'-167', (167'-168' poor, Geotech); Rock 168'-169', 169'-170', 170'-172', 172'-174', 174'-176', 176'-178', 178'-180'
		Core #4 180'-195'=15; recovered 14.5'
180	180.5	Lost core
180.5	185.1	Siltstone; grey, firm, clay rich & interbedded claystone; 45° fracture at 184.2', occasional detrital coal fragments
185.1	186.9	Claystone; grey, soft, very fissile, weak bedding 185.4'-185.9'
186.9	187.3	Claystone; dark, carbonaceous, coaly fractured, slickensides, very crumbly and sticky
187.3	191.1	Coal; black, hard, dull, high ash band at 188.7'-188.8', firm, competent coal
191.1	192.1	Coal; dull band at top
192.1	192.4	Coal; massive pyrite, nodule contact at base irregular & fractured

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DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)
192.4	193.3	Claystone; grey, very soft, fissile, weak on bedding at upper & lower contact, sticky clay!
193.3	195	Siltstone; light grey, sandy, very firm to hard
		Samples: Rock: 180'-182', 182'-184', 184'-186', 186'-187.3' Geotech; Coal: 187.3'-188', 188'-190', 190'-192.1'; Rock: 192.1'-194', 194'-195', 180'-195' photo index out of order "Before Core #5" Rename! (to 57A)
		Core #5 195'-210'=15'; recovered 15.0'
195	202.2	Siltstone; light grey, firm, little sandy, slightly banded with carbonaceous content
202.1	203.7	Sandstone; very light grey, very fine, very hard, well cemented, slightly calcareous
203.7	210	Siltstone; grey to light grey, clay rich, very firm, bottom 1.6' of core slid out shoe, driller broke off and discarded
		Samples: Rock: 195'-196', 196'-198', 198'-200', 200'-202', 202'-204', 204'-206', discard 206'-210'
		Blows less than 1 gpm

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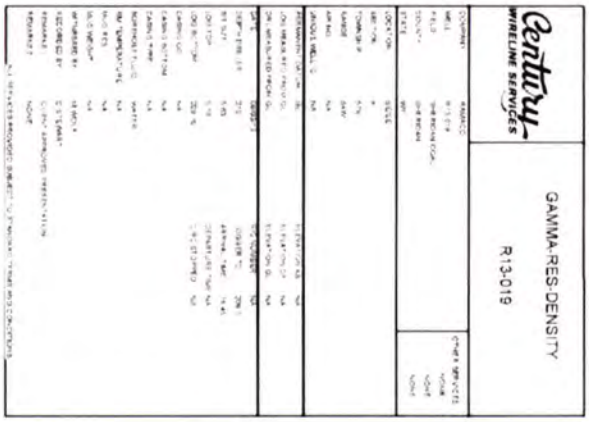

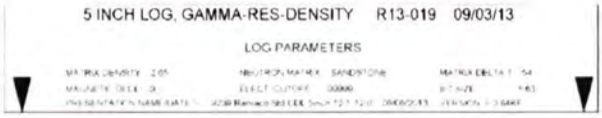

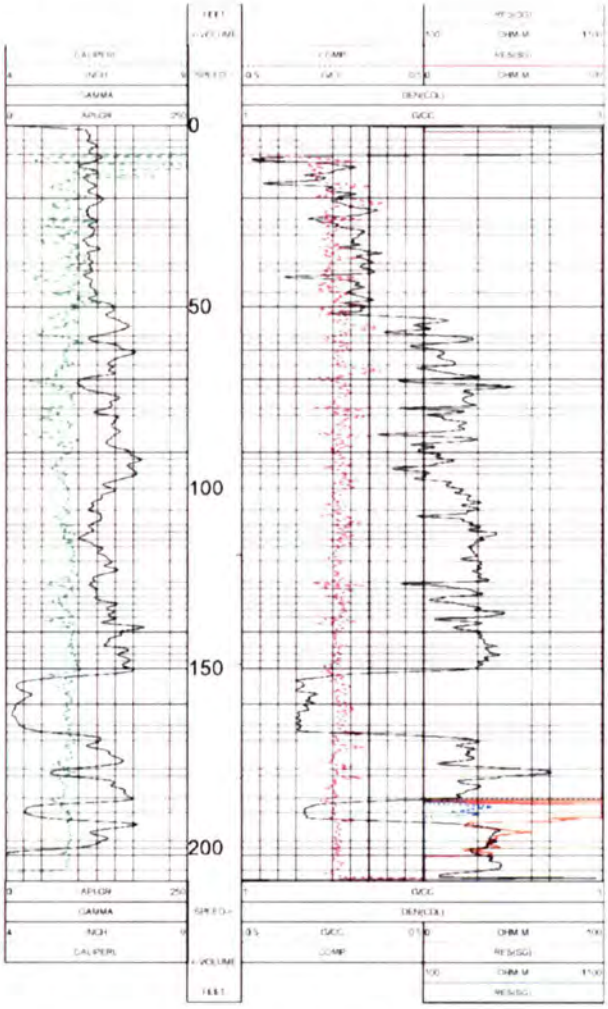

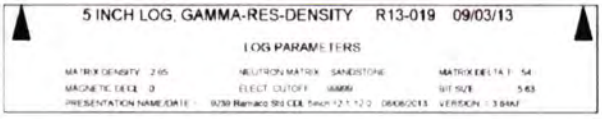

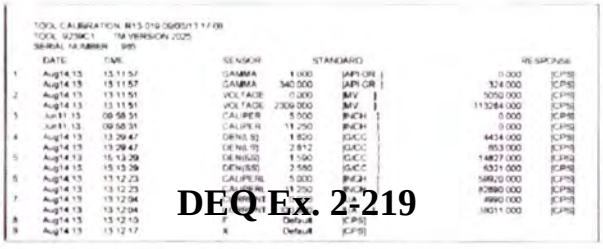

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ole/Well No.: R13-020	Recorded By: M. Wolf WYPG #614	Drilling Co.: A-3 Services Depth: 0′ To 302′
Company: RAMACO	Geophysical Log Type: GR-RES-CDL	CORED: No Core
Project: Brook Mine	Hole Type: Pilot with 5 5/8"	Date Drilled: 08-08-13
County: Sheridan WY		
Township: 57N Range: 84W	Water: Saturated in burn ground	
Location: NENW Section: 18	Thin coals below 160	
N: 1,939,535 E:1, 386,372		
Elevation: 3,952.6		

DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
0	77	Burn; clinker/porcellanite, red-pink, hard	77.0	BURN	ASSUME CARNEY	Burn "Dry"
		SET 80' to 6" SDR-17 PVC to 79'				
77	87	Claystone; dark gray, moderately carbonaceous, soft	10.0	CL		Moist-soft
87	105	Siltstone; gray, firm to medium friable	17.0	ML		Dry
105	135	Siltstone-claystone; intermittent pink to gray, soft	30.0	ML/CL		Burn zone
135	148	Claystone; gray, occasional pink, medium soft	13.0	CL		
148	158	Siltstone; light gray, firm	10.0	ML		Dry
158	160	Siltstone; very light gray, very hard, little sandy	2.0	ML/ROCK		Inject with H_2O at 165
160	220	Claystone; gray to dark gray, occasional carbonaceous and pink interbeds indicating oxidation coal at 194'-196'	60.0	CL/OH		Thin coal stringers
220	234	Siltstone; gray, firm, fissile	14.0	CL		Making little water
234	238	Claystone; gray, fissile	4.0			
238	244	Claystone and coal stringers; gray to black	60.0	CL/OH		
244	252	Claystone; gray, firm	8.0	CL		
252	254	Siltstone; light gray, hard	2.0	ML		
254	258	Siltstone; gray, firm	4.0	ML		
258	268	Claystone; gray, firm, fissile	10.0	CL		
268	272	Siltstone; gray, firm	6.0	ML		
272	302	Claystone; gray, firm, fissile	30.0	CL		
		Note: Coal thickness not sufficient to justify coal core or additional e-logs!				
		OB Samples not submitted to lab for preparation				

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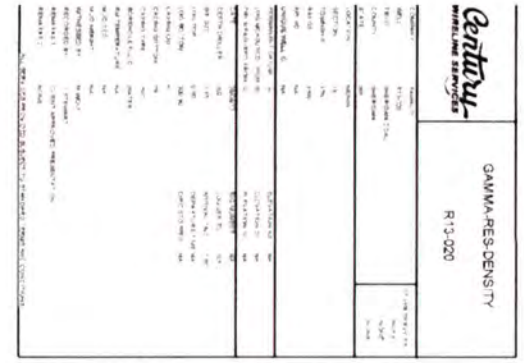

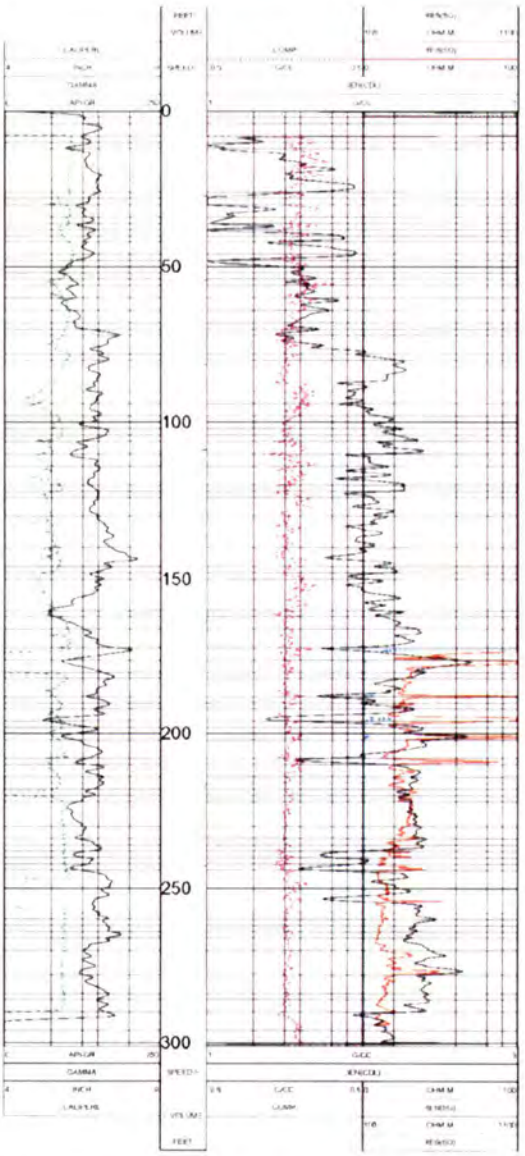

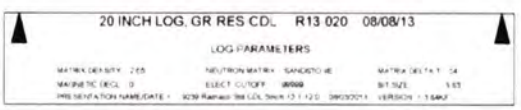

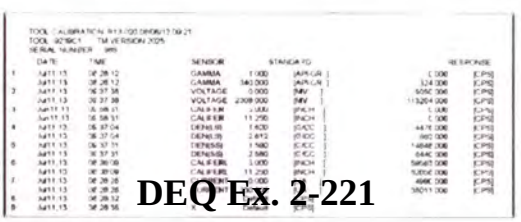

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ole/Well No.: R13-023	Recorded By: M. Wolf WY PG #614	Drilling Co.: A-3 Services Depth: 0' To 202' CORED: 100-180'
Company: RAMACO	Geophysical Log Type: Coal Suite, Gamma, Den Res, caliper	
Project: Brook Mine	Hole Type: 5⅝" pilot, e-log, offset & core coal	Date Drilled: 09-05-13 and 09-06-13
County: Sheridan WY		
Township: 57N Range: 84W	Water: "Minimal"	
Location: SENE Section: 18		
N: 1,937,608 E: 1,389,612		
Elevation: 3,908.5		

DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
0	35	Burn; hard, red & grey, vitreous porcellanite	35.0	BURN	Monarch	
35	50	Claystone; grey, soft, fissile	15.0	CL		
50	85	Siltstone; grey, firm, very hard 50'-56'	35.0	ST		
85	102	Sandstone; light grey, very fine ground, silty	17.0	SS		
102	112	Siltstone; grey, clay rich	10.0	ST		
112	118	Claystone; dark grey, fissile, carbonaceous	6.0	CL		
118	124	Coal; black, hard	6.0	CØ	U. Carney	
124	124.5	Claystone; dark grey, parting	0.5	CL		
124.5	134.5	Coal; black, hard	10.0	CØ	L. Carney	
134.5	146	Claystone-Siltstone; grey	11.5	CL/ST		
146	152	Sandstone; very light grey, very fine, very well sorted, mostly hard	6.0	SS		
152	162.5	Claystone; silty, grey, fissile	11.0	CL/ST		
162.5	168	Coal; black, hard, dull	5.5	CØ	Masters	
168	181	Claystone; grey to dark grey	13.0	CL		
181	184	Coal; black, hard	3.0	CØ	Local	
184	190	Claystone; grey fissile	6.0	CL		
190	192	Siltstone; light grey, very hard	2.0	ST		
192	202	Claystone-siltstone; grey to light grey	10.0	CL/ST		
		E-Log Picks: 118'-134.5'=16.5' Carney 162.5'-168'=5.5 Masters				
		P&A: Pilot Hole 37 50# bags medium chips Core Hole 26 50# bags medium chips				

Notes: Losing circulation at 10', begin inject heavy soap (foam) set 40' of 6" SCH-40 PVC through burn

ABBREVIATIONS

GL – Below Ground Level
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DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)
		Offset 10' east and core 100'-180'
		Core #1 100'-115' = 15'; recovered 13.8', slid out bottom
100	107.5	Siltstone; light grey with abundant soft claystone bands that part easily on bedding
107.5	111.1	Siltstone; light grey, hard, calcareous, 2 mechanical breaks on bedding at 109.0 & 110.5
111.1	111.7	Siltstone; dark grey, hard
111.7	112.2	Claystone; dark grey, firm
112.2	113.8	Claystone; very dark, carbonaceous, little coaly, several breaks on bedding
		Samples: 100-102', 102-104', 104-106', 106-108', 108-110', 110-112', 112-113.8', 113.8-115' – lost off bottom
		Picked up 1.0' on next run!
113.8	115	Siltstone: light grey with clay bands, soft
		Core #2 115'-129'= 14'; recovered 15'
		Picked up 1.0' from last run
115	115.9	Siltstone; light grey, friable in part
115.9	116.1	Carbonaceous coal band
116.1	116.7	Siltstone; dark, banded, firm
16.7	117.5	High ash; dull, coal
117.5	122.1	Coal; black, hard, mostly bright
122.1	122.7	Claystone; brown, soft, fracture at base
122.7	129	Coal; black hard, mostly bright
		Samples: 117.5'-118' save Geotech; Coal: 118'-119', 119'-121.5', 121.5'-123.5', 123.5'-129', Rock: 114'-115.5', 115.5'-117.5'
		Core #3 129'-144'=15'; recovered 15.0'
129	133.2	Coal; black, hard, mostly bright
133.2	133.4	Coaly carbonaceous claystone; dull, soft, parts on bedding
133.4	134.85	Silty carbonaceous claystone; very dark, coaly, firm but parts on bedding
134.85	135.3	Siltstone; light grey
135.3	135.6	Siltstone; light, crushed
135.6	144	Siltstone; light grey, sandy, very firm, massive
		Samples: Coal; 129'-132', 132'-133.2', Rock: 133.2'-135', 135'-137', 137'-139', 139'-141', 141'-143', 143'-144'

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DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)
		Core #4 144'-159'=15'; recovered 13.5' plugged, ground up
144	148.8	Siltstone; grey, finely laminated firm, occasional detrital coal fragments, crushed 144.8'-145.0' slickensides
148.8	149.9	Siltstone; light grey, very hard, calcareous, little sandy
149.9	152.5	Siltstone; grey, clay rich, notable detrital coal fragments, firm but parts easily on bedding
152.5	157.5	Claystone; grey, silty, little detrital coal, fractures, 45° at 155-9', 156.8', 157.2' & 157.4'
157.5	159	Lost core; bit plugged, ground off bottom
		Samples: 144'-146', 146'-148', 148'-150', 150'-152', 152'-154', 154'-156', 156'-157.5'
		Core #5 159'-169'=10'; recovered 10.0'
159	159.4	Claystone; grey, badly broken
159.4	161.4	Claystone; grey, firm, little silty, soft for 0.1 at lower contact
161.4	161.8	Coal; dull, high ash
161.8	166.75	Coal; black, dull, little notable pyrite, hard, competent
166.75	168	Claystone; grey banded, soft, crumbly, detrital coal, some slickensides, contact 45° with hard nodule below
168	169	Siliceous nodule; very hard, broken, bit plugged "stopped drilling"
		Samples: Rock: 159'-161', 161'-161.4', Coal: 161.4'-162.4', 162.4'-164.5', 164.5'-166.75'; Rock: 166.75'-168', 168'-169'
		Core #6 169'-180'=11'; recovered 8.4'
169	169.35	Siltstone nodule; light brown, very hard, very well cemented "siliceous?"
169.35	169.7	Clay; grey, very soft, incompetent
169.7	170.9	Claystone; very dark, very carbonaceous, coaly, very soft on fissile bedding
170.9	172.2	Claystone; grey, firm, parts easily on bedding, soft 171.9'-172.2'
172.2	173.9	Coal; black, dull, hard, poor
173.9	174.7	Claystone; very dark, carbonaceous, coaly, firm, but parts easily on bedding
174.7	176.8	Siltstone; light grey-brown, hard, very competent, massive
176.8	177.4	Siltstone; light brown, extremely hard, siliceous nodule, very well cemented, broken 45° 177.2', 177.4' slickensides
177.4	180	Lost core; bit plugged, ground core off bottom
		Samples: 169'-171', 171'-172.3', 172.3'-174', 174'-175', 175'-177'

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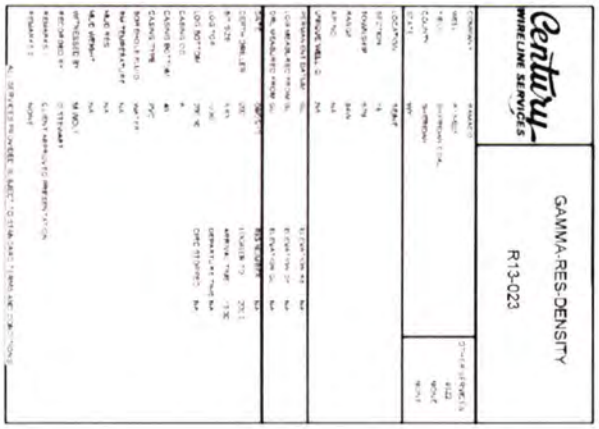

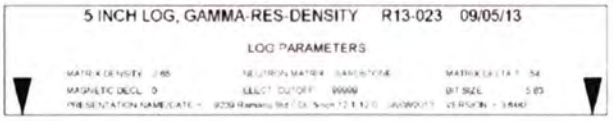

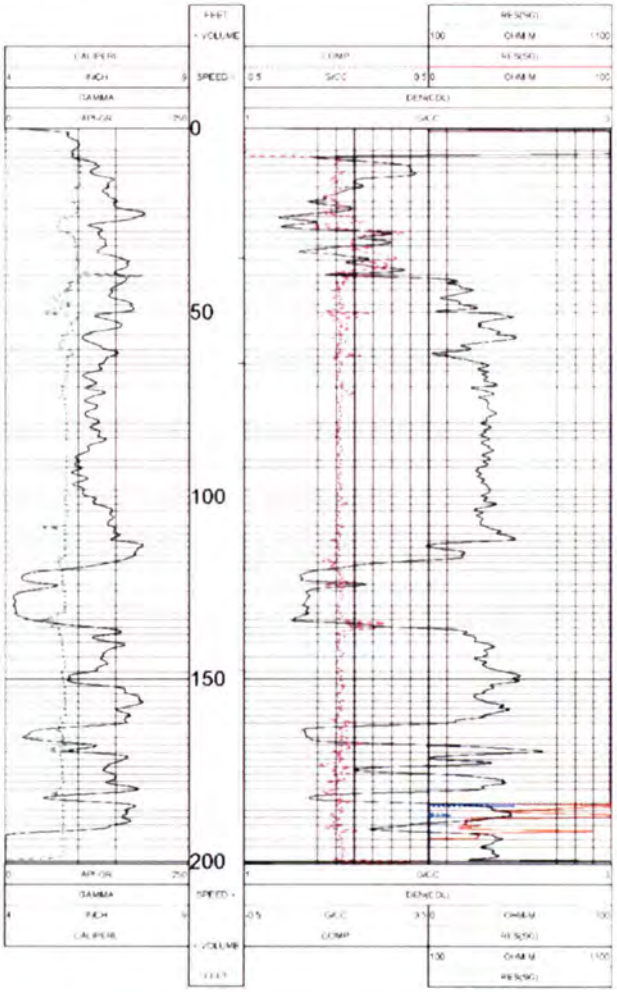

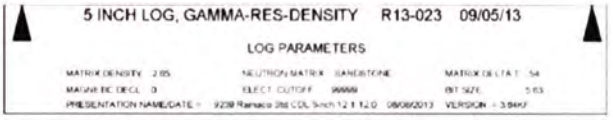

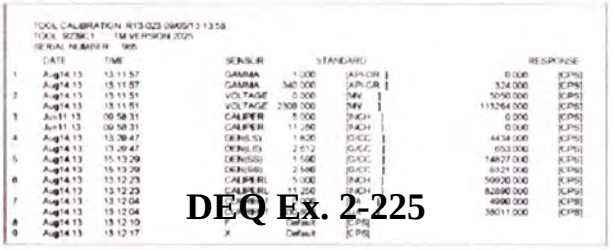

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Hole/Well No.: R13-024	Recorded By: M. Wolf WY PG #614	Drilling Co.: A-3 Services Depth: 0' To 983'
Company: RAMACO	Geophysical Log Type:	CORED:
Project: Brook Mine	Hole Type: 8 ¾" Tri-Core to 35' 5⅝" button spade to TD	Date Drilled: 11-12-13
County: Sheridan WY		
Township: 57N Range: 85W	Water: Mud & Polymer	
Location: NWSE Section: 11		
N: 1,941,541 E: 1,378,388		
Elevation: 3,885.4		

DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
0	4	Terrace gravel; medium to coarse, poorly sorted, clinker gravels, Slater Creek alluvium 2'-4' thickness, irregular base	4.0	GW		Dry
4	6.5	Silty claystone; buff-brown, soft	2.5	ML/CL		
6.5	19	Coal; black, very soft, very weathered, punky!	12.5	COAL	U. CARNEY	
19	24	Claystone; dark brown, carbonaceous, very soft	5	CL/OH		
24	60	Claystone; light-grey, little silty, soft, sticky	36.0	CL		
60	68	Claystone; dark grey-brown, carbonaceous, coaly, very fissile	8.0	CL/OH		
68	81	Coal; black, hard, mostly bright, clay parting 71'-73'	13.0	COAL	L. CARNEY	
81	105	Claystone; light-grey, little silty	24.0	CL		Water ~75'
105	114.5	Coaly claystone; dark grey-brown, carbonaceous, fissile	9.5	CL/OH		
114.5	119	Coal; black, hard, dull, little pyrite noted on cleat surfaces	4.5	COAL	MASTERS	
119	130	Claystone; grey, silty, firm	11.0	CL		
130	146	Siltstone; light-grey, firm, little friable, clay-rich	16.0	ST		
146	148	Coal; black, hard	2.0	COAL	LOCAL	
148	160	Claystone; grey, fissile	12.0	CL		
160	174	Silty claystone; grey to light grey, firm	14.0	CL/ML		
174	200	Siltstone; light grey with interbedded coal at 176'-178', 184'-185', 192'-193'	26.0	ML/OH	COALY	
200	212	Siltstone; light grey, firm, moderately friable	12.0	ML		
212	230	Claystone; grey, fissile	18.0	CL		
230	232.5	Coal; black, hard	2.5	COAL		
232.5	281	Siltstone; light grey, firm but moderately friable	48.5	ML		
281	362	Clayey siltstone; light grey, coaly at 287'-301', 321'-322', 342'-344'	81.0	ML/CL		
362	364	Coal; black, hard	2.0	COAL		
364	408	Siltstone; light grey, firm but moderately friable	44.0	ML		
408	420	Sandstone; very light grey, very fine grained, well sorted little silty	12.0	SM		
420	464	Siltstone; light grey with some clay and coal at 437'-439'	44.0	ML		
464	500	Siltstone; light grey, clay rich, interbedded soft	36.0	ML		

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DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
500	510	Sandy siltstone; light grey, clean water bearing	10.0	SM		Water
579	579	Siltstone; light grey, clay rich, interbedded claystone	0.0	ML		
579	596	Claystone; carbonaceous, coaly laminations	17.0	CL/OH		
596	700	Siltstone; light grey, carbonaceous 660'-668'	104.0	ML/OH		
700	764	Claystone; grey, carbonaceous 712'-735'	64.0	CL/OH		
764	788	Silty sandstone; light grey, very, very fine poorly consolidated, water bearing, carbonaceous 780'-790'	24.0	SM		
788	796	Claystone; grey, firm, fissile	8.0	CL		
796	800.5	Coal; black, hard	4.5	COAL		
800.5	812	Silty sandstone; light grey, soft, water bearing	11.5	SM		
812	882	Siltstone; grey, clay rich, interbedded, badly washed out	70.0	ML		
882	887	Claystone; grey to dark grey, carbonaceous	5.0	CL/OH		
887	897	Coal; black, hard, dull, very fissile	10.0	COAL		
897	897	Claystone; grey, fissile	0.0	CL		
897	909	Siltstone; grey, clay rich	12.0	ML		
909	930	Claystone; grey, fissile	21.0	CL		
930	942	Siltstone; light grey, firm, little friable	12.0	ML		
942	958	Sandstone; very light grey, very fine grained, soft, friable, water bearing	16.0	SP/SM		
958	966	Siltstone; grey	8.0	ML		
66	983	Claystone; grey, firm, fissile	17.0	CL		
		E-Log Picks: 6.5'-19'=12.5' Upper Carney (poor weathered coal)!!				
		68'-81'=13' Lower Carney				
		114.5'-119'=4.5' Masters				
		146'-148'=2.0' Local				
		795'-800.5'=5.5' Unknown				
		888'-902'=4' Unknown				
		11/14/13 Plug and abandon hole with grout				
		Mix 3-400 gallon batches of grout with 11 sacks grout in each batch				
		Pump through drill pipe from bottom-up				
		Finish off top 40'with 16-50# sacks bentonite chips				
		Backfill and grade cuttings pit and re-seed				
		Note: Caliper log indicates numerous washed out zones				

ABBREVIATIONS

L – Below Ground Level
S – Disturbed Bulk Sample
GPM – Gallon Per Minute
GS – Geochemical Sample
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ZP – Ziplock Bag Sample

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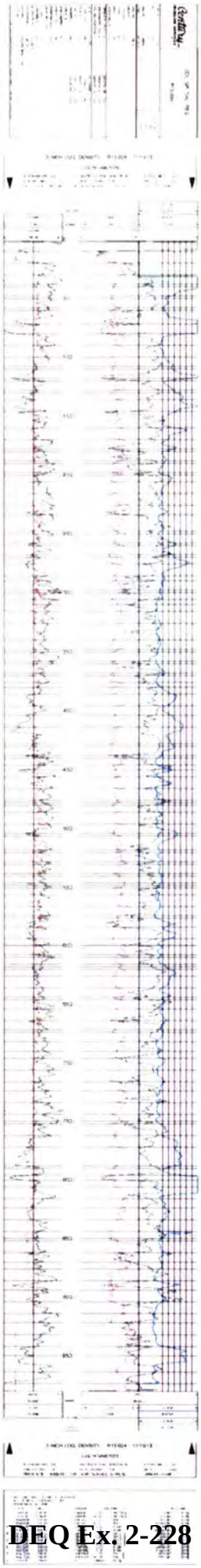

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ole/Well No.: R13-026	Recorded By: M. Wolf WY PG #614	Drilling Co.: A-3 Services Depth: 0' To 842' Pilot Hole Cored 701-716'
Company: RAMACO	Geophysical Log Type: Coal Suite, Gamma, Den Res, caliper	
Project: Brook Mine	Hole Type: 5⅝" pilot, e-log, offset & core coal	Date Drilled: 11-20-13 and 11-22-13
County: Sheridan WY		
Township: 57N Range: 84W	Water: "Minimal"	
Location: SENE Section: 20		
N: 1,932,436 E: 1,394,418		
Elevation: 3,630.6		

DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
0	8	Sandy clay; brown, overbank deposits, Quaternary Alluvium	8.0	SC		Dry
8	21	Sandy gravel; medium to coarse, Tongue River Alluvium	13.0	GW		Wet at base
21	32	Silty claystone; light grey, very soft, moderately fissile	11.0	CL/ML		
32	38.5	Claystone; grey, fissile	6.5	CL		
38.5	43	Coal; black, soft at top, harder with depth	4.5	COAL	U. CARNEY	
43	44	Claystone; grey, parting	1.0	CL		Parting
44	54	Coal; black, hard, mostly bright	10.0	COAL	L. CARNEY	
54	89	Siltstone light grey, clay rich, fissile, very hard 67'-69'	35.0	ML		
89	94	Claystone; grey, firm, fissile	5.0	CL		
94	99	Coal; black, hard	5.0	COAL	MASTERS	
99	112	Claystone; dark, carbonaceous, little coaly, moderately soft	13.0	CL/OH		
112	119.5	Claystone; grey, fissile	7.5	CL		
119.5	122	Coal; black, hard	2.5	COAL		
122	130	Claystone; grey, firm, fissile	8.0	CL		
130	155	Siltstone; light grey, firm, clay rich	25.0	ML		
155	161	Claystone; dark grey, carbonaceous, coaly	6.0	CL/OH		
161	166	Claystone; grey, fissile	5.0	CL		
166	187	Claystone; dark grey, carbonaceous, little thin coals	21.0	CL/OH		
187	204	Siltstone; light grey, little very fine grained sand	17.0	ML/SM		
204	339	Claystone; grey, little interbedded siltstone, thin coals 270'-336'	135.0	CL		
339	352	Siltstone; light grey, firm, little very fine sand	13.0	ML/SM		
352	456	Claystone; grey to light grey, little interbedded silt, sparse thin coal	104.0	CL		Coal 377'-379' Coal 401'-402'
456	473	Sandstone; very light grey, very fine grained, silty	17.0	SP		
473	482	Siltstone; light grey, carbonaceous coal at 475'-477'	9.0	ML		
482	498	Sandstone; very light grey, very fine grained, silty	16.0	SP		
498	561	Claystone; grey to dark grey, carbonaceous, thin coals at 519', 530', 537' & 544'	63.0	CL		
561	570	Siltstone; light grey, firm	9.0	ML		
570	582	Claystone; grey, fissile	12.0	CL		
582	605	Sandstone; very light grey, very fine grained, silty, hard 585'-587'	23.0	SP		

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DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
605	656	Claystone; grey, fissile, little interbedded siltstone	51.0	CL		
656	667	Claystone; dark grey, carbonaceous, coaly	11.0	CL		
667	703.5	Claystone; grey, fissile, little silty, this coal 696.5'-698'	36.5	CL		
703.5	712.7	Coal; black, hard, mostly bright	9.2	COAL	WALL	
712.7	716	Claystone; grey, fissile	3.3	CL		
716	722	Siltstone-Sandstone; very light grey, very fine, very hard at 719'-722'	6.0	ML/SM		
722	735	Claystone; grey, fissile	13.0	CL		
735	746	Siltstone; light grey, firm	11.0	ML		
746	784	Sandstone; very light grey, very fine, moderately friable, very hard 749'-752'	38.0	SP		
784	798	Claystone; grey, fissile	14.0	CL		
798	802	Coal; black, hard	4.0	COAL	U. PAWNEE	
802	806	Claystone; grey, firm, fissile	4.0	CL		
806	809	Coal; black, hard	3.0	COAL	L. PAWNEE	
809	842	Claystone; grey to light grey, firm, fissile	33.0	CL		
		Plug and Abandon Holes				
		Pilot Hole: Pump 2 – 500 gallon batches (31 - 50# sacks) of bentonite grout in stages into hole (Wyo-Ben Enviroplug Grout)				
		Tag at 183'; plug with 39 sacks (50#) bentonite chips and 1 sack redi-mix concrete				
		Core Hole: pump 1 – 500 gallon batch (12 – 50# sacks) bentonite grout from bottom up				
		Add 106 - 50# sacks medium bentonite chips to surface and 1 sack redi-mix concrete				
		Core hole located approximately 10 feet west of pilot hole				
		Difficult setting 34'of 6" PVC surface – gravels caving!!				
		Mix more mud and try again to set casing.				
		Finally set casing. Pour 10 sacks chips in annulus				
		Gravel still falling into hole from lower gravel zone				
		Add 3 sacks chips inside casing and let swell then squeeze bentonite up base of PVC annulus with paper sack plug inside casing. Successful in preventing further rocks from entering hole.				

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DEPTH From	DEPTH To	DESCRIPTION OF MATERIALS (ASTM D2488)
		11/25/13 Resume drilling for core collection.
		Core #1 701'-716' = 15.0'; recovered 15.0'
701	702.4	Claystone; grey, firm, moderately fissile, slight separation on bedding
702.4	703.3	Claystone; dark grey, carbonaceous, soft and washed at 702.9'
703.3	709.5	Coal; black, hard, mostly bright, challered surface, little pyrite
709.5	709.8	Pyrite; massive, hard, convoluted bedding, very coaly
709.8	710.2	Coal; black, dull, high ash content
710.2	712.75	Coal; black hard, mostly bright, little notable pyrite abrupt basal contact on underlying siltstone
712.75	716	Siltstone; light grey, very firm to hard, finely laminated, competent, good floor stability
		Samples collected:
		Rock: 701'-703.3', 712.75'-714', 714'-716'
		Coal: 703.3'-705', 705'-707', 707'-709.5', 709.5'-710.2', 710.2'-712.75'
		"Total Coal Thickness = 9.45'
		Plug and abandon immediately following core collection
		Pump 500 gallon batch (12 sacks grout) into hole = bottom up
		Followed by pouring 94 sacks medium
		50# sacks bentonite chips, tag at 64'
		Attempt to pull 6" casing, broke off below ground level. Finish seal with 12-50# sacks bentonite chips and one sack redi-mix concrete for surface seal.

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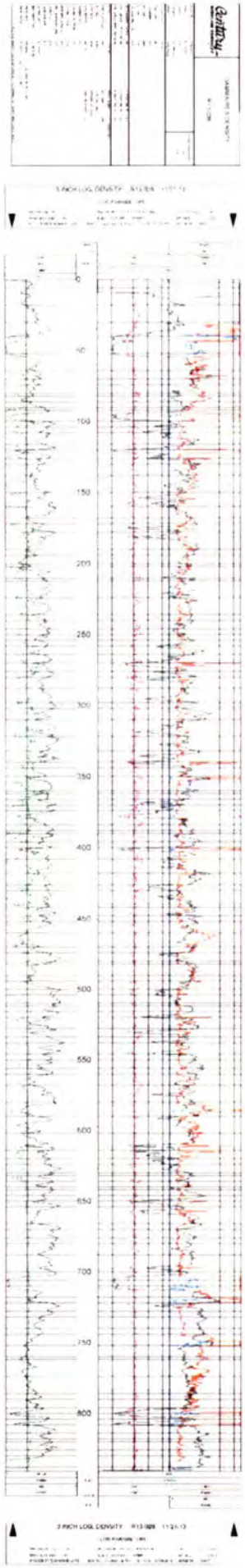

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PETER KIEWIT SONS' CO.

EXPLORATION AND DEVELOPMENT DEPARTMENT

RECEIVED JAN 1983 Land Quality Div. DIST. IV

Locate hole correctly, giving distance in feet from N. or S. and E. or W. line of section; when hole is not vertical, give direction and angle.

OVERBURDEN & COAL CORE

LOG OF PROSPECT ~~BORE~~ HOLE No. ~~C-166-76~~

Lessee or permittee: Big Horn Coal Company

Address: Sheridan County, Wyoming

Driller: L. Reed

Commenced drilling: 26 January 1976 Finished: 29 January 1976

Sec. 23 T. 57N R. 84W M. State Wyoming

Method of drilling: Logged by: Giere, Kristiansen, Taylor

Surface Owner:

(SIGNED) R. A. Giere

DATE 2-18-76

(TITLE) Geologist

FORMATION RECORD

DEPTH From— Feet Inches	DEPTH To— Feet Inches	Thickness of stratum Feet Inches	Geologic formations; character of rock; oil, gas and water horizons; coal and other mineral occurrences
0.0	11.0	11.0	Drilled out - sandstone, yellow, fine grained, soft, saved in bag
11.0	21.0	10.0	CORE # 1 Cored 10'; Recovered 9.5'
11.0	11.5	0.5	Lost
11.5	14.5	3.0	Sandstone, buff to tan, medium grain, hard
14.5	15.6	1.1	Sandstone, buff, medium grained, soft, friable
15.6	21.0	5.4	Shale, tan to gray, soft, silty
21.0	31.0	10.0	CORE # 2 Cored 10'; Recovered 9.4'
21.0	21.5	0.5	Shale, yellow, soft
21.5	23.0	1.5	Shale, gray, soft
23.0	24.3	1.3	Shale, yellow, ironstaining, moderately hard
24.3	30.4	6.1	Shale, gray, moderately hard, silty
30.4	31.0	0.6	Lost

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Continued

(Attach continuation sheets if necessary)

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PETER KIEWIT SONS' CO.

EXPLORATION AND DEVELOPMENT DEPARTMENT

Brook Mine

DATE 2-18-76

AREA Big Horn

PAGE No. 2 of HOLE No. C-166-76

FORMATION RECORD

DEPTH From— Feet Inches	DEPTH To— Feet Inches	Thickness of stratum Feet Inches	Geologic formations; character of rock; oil, gas and water horizons; coal and other mineral occurances
31.0	41.0	10.0	CORE #3 Cored 10'; Recovered 9.8'
31.0	31.2	0.2	Lost
31.2	33.9	2.7	Shale, gray, hard, silty
33.9	41.0	7.1	Shale, gray, soft
41.0	51.0	10.0	CORE # 4 Cored 10'; Recovered 9.5'
41.0	50.5	9.5	Shale, gray, moderately hard, some small, scattered
			shells, few random silty lenses
50.5	51.0	0.5	Lost
51.0	61.0	10.0	CORE # 5 Cored 10'; Recovered 10'
			Shale, gray, moderately hard, some thin random lenses
			of carbonaceous material
61.0	71.0	10.0	CORE # 6 Cored 10'; Recovered 10'
61.0	67.3	6.3	Shale, gray, moderately hard
67.3	68.3	1.0	Sandstone, gray, fine grained soft
68.3	68.8	0.5	Shale, yellow, soft, silty
68.8	69.7	0.9	Shale, gray, soft, silty
69.7	70.4	0.7	Sandstone, yellow, fine grained, soft
70.4	70.6	0.2	Shale, gray, moderately hard
70.6	71.0	0.4	Sandstone, yellow, fine grained, moderately well cemented

TEN 6 2/025
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Continued

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EXPLORATION AND DEVELOPMENT DEPARTMENT

Brook Mine

DATE 2-18-76

AREA Big Horn

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FORMATION RECORD

DEPTH From— Feet Inches	DEPTH To— Feet Inches	Thickness of stratum Feet Inches	Geologic formations; character of rock; oil, gas and water horizons; coal and other mineral occurances
71.0	81.0	10.0	CORE # 7 Cored 10' Recovered 10'
71.0	71.8	0.8	Sandstone, buff to tan, fine grained, moderately hard, silty
71.8	72.0	0.2	Shale, gray, hard
72.0	73.5	1.5	Sandstone, buff to tan, fine grained, medium hard, silty
73.5	73.7	0.2	Shale, gray, hard
73.7	74.9	1.2	Sandstone, tan to buff, fine grained, silty, medium hard, thin lenses of carbonaceous material
74.9	75.0	0.1	Shale, gray, hard
75.0	75.9	0.9	Sandstone, buff to tan, fine grained, silty and shaley
75.9	76.1	0.2	Shale, gray, hard
76.1	76.6	0.5	Sandstone, buff, fine grained, very hard, well cemented
76.6	79.8	3.2	Sandstone, buff to tan, fine grained, medium hard, silty
79.8	80.8	1.0	Shale, tan, medium hard
80.8	81.0	0.2	Sandstone, buff, fine grained, soft
81.0	91.0	10.0	CORE # 8 Cored 10' Recovered 10'
81.0	81.25	0.25	Sandstone, buff to tan, very fine grained, shaley, soft, friable
81.25	83.05	1.8	Shale, gray, silty, soft
83.05	84.0	0.95	Sandstone, tan, very fine grained, soft, friable, shaley, carbonaceous laminations
84.0	85.5	1.5	Shale, gray, silty, medium hard

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EXPLORATION AND DEVELOPMENT DEPARTMENT

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AREA Big Horn PAGE No. 4 of HOLE No. C-106-76

FORMATION RECORD

DEPTH From— Feet Inches	DEPTH To— Feet Inches	Thickness of stratum Feet Inches	Geologic formations; character of rock; oil, gas and water horizons; coal and other mineral occurances
85.5	86.7	1.2	Shale, gray to buff, very silty, medium hard
86.7	88.7	2.0	Shale, gray, medium hard, silty, carbonaceous laminations
88.7	89.4	0.7	Shale, buff, very silty, medium hard, carbonaceous laminations
89.4	89.6	0.2	Shale, buff to tan, medium hard, silty
89.6	91.0	1.4	Shale, gray, medium hard, sandy
91.0	101.5	10.5	CORE # 9 Cored 10.5' Recovered 10.5'
91.0	98.3	7.3	Shale, gray, medium hard, silty, a few carbonaceous laminations
98.3	101.5	3.2	Sandstone, gray, very fine grained, very hard, well cemented, well consolidated, carbonaceous material along fractures, fossilized leaf impressions
101.5	111.0	9.5	CORE # 10 Cored 9.5' Recovered 9.5'
101.5	102.6	1.1	Sandstone, gray, fine grained, very hard, well cemented, well consolidated, carbonaceous material along fractures
102.6	103.5	0.9	Shale, dark gray, semi-carbonaceous, clayey, soft
103.5	111.0	7.5	Shale, gray, medium hard, silty lenses alternating with clayey lenses, carbonaceous laminations - a 0.2' layer of high iron oxide staining @ 109.7'

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Continued

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Brook Mine

PETER KIEWIT SONS' CO.

EXPLORATION AND DEVELOPMENT DEPARTMENT

JAN 1983 RECEIVED Land Quality Div. DIST. IV

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AREA Big Horn

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FORMATION RECORD

DEPTH From— Feet Inches	DEPTH To— Feet Inches	Thickness of stratum Feet Inches	Geologic formations; character of rock; oil, gas and water horizons; coal and other mineral occurances
111.0	121.5	10.5	CORE # 11 Cored 10.5' Recovered 10.5'
			Shale, gray, hard, dense, carbonaceous material, bedding, a few thin silty lenses
121.5	131.0	9.5	CORE # 12 Cored 9.5' Recovered 9.5'
121.5	125.5	4.0	Shale, dark gray, medium hard, carbonaceous plant impressions, grades to carbonaceous shale
125.5	126.0	0.5	Shale, black, carbonaceous to coaly, semifissile, hard
126.0	131.0	5.0	Coal, black, medium hard, banded to semibanded, conchoidal fracture, highly pyritized (scale), medium dull luster, evidence of slickensides in random spots
131.0	141.0	10.0	CORE # 13 Cored 10' Recovered 6.6'
131.0	134.4	3.4	Lost
134.4	137.5	3.1	Coal, black, medium hard, brittle, conchoidal fracture, banded, pyrite scale along fracture planes, this segment of core very broken.
137.5	138.6	1.1	Shale, gray, medium hard, coal inclusions, grading to carbonaceous shale.
138.6	141.0	2.4	Coal, black, hard, brittle, conchoidal fracture, banded, some pyrite scale.
141.0	151.0	10.0	CORE # 14 Cored 10' Recovered 6'
141.0	145.0	4.0	Lost [illegible] believed to be coal

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EXPLORATION AND DEVELOPMENT DEPARTMENT

Brook Mine

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FORMATION RECORD

DEPTH From— Feet Inches	DEPTH To— Feet Inches	Thickness of stratum Feet Inches	Geologic formations; character of rock; oil, gas and water horizons; coal and other mineral occurances
145.0	145.25	0.25	Coal, black, brittle, medium hard, banded
145.25	151.0	5.75	Shale, gray, carbonaceous, medium soft, silty horizons, dense
151.0	161.0	10.0	CORE # 15 Cored 10' Recovered 1'
			Lost 9'; 1' recovered was 6" coal and 6" black carbonaceous shale; pieces are rounded showing they've been rolling around in core barrel. This interval was bagged.
			Logged by Gjere
161.0	171.0	10.0	CORE #16 Cored 10' Recovered 3.7'
			Mud, caved in overnight
161.0	164.7	3.7	Shale, gray, moderately hard, some fissility, some carbonized plant remains (this interval was bagged)
164.7	171.0	6.3	Lost, probably washed away
171.0	181.5	10.5	CORE #17 Cored 10.5' Recovered 10.5'
			Shale, dark gray, medium hard, thin silty lenses, carbonized plant impressions along bedding planes
181.5	191.0	9.5	CORE # 18 Cored 9.5' Recovered 8.5'
181.5	182.1	0.6	Shale, dark gray, carbonaceous, coal streaks
182.1	184.6	2.5	Shale, gray, medium hard, some fissility apparent

Continued

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EXPLORATION AND DEVELOPMENT DEPARTMENT

Brook Mine

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AREA Big Horn

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FORMATION RECORD

DEPTH From— Feet Inches	DEPTH To— Feet Inches	Thickness of stratum Feet Inches	Geologic formations; character of rock; oil, gas and water horizons; coal and other mineral occurances
184.6	184.8	0.2	Sandstone, gray, coarse grained, hard
184.8	190.0	5.2	Coal, black, hard, brittle, conchoidal fracture,
			medium luster, little pyrite
190.0	191.0	1.0	Lost
			Logged by Taylor
191.0	201.0	10.0	CORE # 19 Cored 10' Recovered 8.6'
191.0	196.8	5.8	Coal, vitreous, hard, conchoidal fracture, semi-banded
			Black
196.8	198.2	1.4	Coal, missing except for finely ground coal
198.2	201.0	2.8	Coal, vitreous, hard, semi-banded, conchoidal fracture,
			black, pyrite scale
201.0	211.0	10.0	CORE # 20 Cored 10' Recovered 10'
			Coal, hard, semi-banded, vitreous, conchoidal fracture,
			black, trace of pyrite scale
211.0	221.0	10.0	CORE # 21 Cored 10' Recovered 9.5'
211.0	211.5	0.5	Lost Coal?
211.5	220.2	8.7	Shale, hard, light gray
220.2	221.0	0.8	Sandstone, hard, tan, medium grained
			TFN 6 2/025
			RECD JUL 30, 2015

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FORMATION RECORD

DEPTH From— Feet Inches	DEPTH To— Feet Inches	Thickness of stratum Feet Inches	Geologic formations; character of rock; oil, gas and water horizons; coal and other mineral occurances
221.0	231.0	10.0	CORE # 22 Cored 10' Recovered 7.8'
221.0	221.3	0.3	Sandstone, medium grained, tan
221.3	228.8	7.5	Siltstone, light gray, sandy, medium hard, carbonaceous laminations, coal inclusion @ 225'
228.8	231.0	2.2	Lost
			Logged by Gjere
231.0	241.0	10.0	CORE # 23 Cored 10' Recovered 8.7'
231.0	231.6	0.6	Siltstone, gray, medium hard, sandy
231.6	232.9	1.3	Lost
232.9	240.6	7.7	Siltstone, gray, hard, sandy, carbonaceous laminations
240.6	241.0	0.4	Shale, gray, medium hard
241.0	243.5	2.5	CORE # 24 Cored 2.5' Recovered 2.3'
241.0	241.2	0.2	Lost
241.2	242.4	1.2	Sandstone, gray, fine grained, medium hard, thin carbonaceous laminations
242.4	243.5	1.1	Shale, gray, hard, silty
243.5	251.0	7.5	CORE # 25 Cored 7.5 Recovered 6.7
243.5	244.3	0.8	Lost
244.3	245.6	1.3	Shale, gray, hard, silty
245.6	246.3	0.7	Sandstone, gray, fine grained, medium hard, well compacted

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THE RILLE COMPANY, SHERIDAN 139508

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EXPLORATION AND DEVELOPMENT DEPARTMENT

Brook Mine

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AREA Big Horn

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FORMATION RECORD

DEPTH From— Feet Inches	DEPTH To— Feet Inches	Thickness of stratum Feet Inches	Geologic formations; character of rock; oil, gas and water horizons; coal and other mineral occurances
246.3	249.4	3.1	Sandstone, light gray, very fine grained, very hard, well compacted, well cemented
249.4	250.8	1.4	Sandstone, gray, fine grained, medium hard, thin stringers of carbonaceous material
250.8	251.0	0.2	Shale, gray, soft
251.0	261.0	10.0	CORE # 26 Cored 10' Recovered 7.6'
251.0	253.4	2.4	Lost
253.4	257.4	4.0	Sandstone, gray, fine to medium grained, moderately hard, friable in spots
257.4	257.5	0.1	Shale, gray, soft
257.5	261.0	3.5	Sandstone, gray, fine to medium grained, hard, some thin stringers of carbonaceous material and plant impressions in bedding.
261.0	271.0	10.0	CORE # 27 Cored 10' Recovered 2.2'
261.0	263.2	2.2	Sandstone, gray, fine to medium grained, hard, well cemented and compacted, thin stringers of carbonaceous material
263.2	271.0	7.8	Lost
271.0	281.0	10.0	CORE # 28 Cored 10' Recovered 5.7'
			Top of core was plugged with fill-in
271.0	275.3	4.3	Lost

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EXPLORATION AND DEVELOPMENT DEPARTMENT

Brook Mine

JAN 1983 RECEIVED Land Quality Div. DISTRICT

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AREA Big Horn

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FORMATION RECORD

DEPTH From— Feet Inches	DEPTH To— Feet Inches	Thickness of stratum Feet Inches	Geologic formations; character of rock; oil, gas and water horizons; coal and other mineral occurances
275.3	276.3	1.0	Sandstone, gray, fine to medium grained, medium hard
276.3	277.2	0.9	Shale, gray, hard
277.2	277.4	0.2	Shale, brown, carbonaceous
277.4	279.4	2.0	Coal, black, hard, brittle, conchoidal fracture, dull luster
279.4	279.5	0.1	Shale, black, soft, carbonaceous
279.5	281.0	1.5	Coal, black, hard, brittle, conchoidal fracture, medium luster, banded.
281.0	291.0	10.0	CORE # 29 Cored 10' Recovered 5.7'
281.0	286.7	5.7	Coal, black, hard, brittle, some pyrite flakes medium luster, banded, conchoidal fracture
286.7	291.0	4.3	Lost
291.0	301.0	10.0	CORE # 30 Cored 10' Recovered 8.2'
291.0	299.2	8.2	Coal, as above
299.3	301.0	1.8	Lost
301.0	311.0	10.0	CORE #31 Cored 10' Recovered 7.3'
301.0	303.7	2.7	Lost
303.7	305.0	1.3	Coal, black, hard, brittle, conchoidal fracture, some pyrite
305.0	305.3	0.3	Shale, black, soft, carbonaceous
305.3	306.4	1.1	Shale, dark gray, soft

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EXPLORATION AND DEVELOPMENT DEPARTMENT

Brook Mine

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AREA Big Horn

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FORMATION RECORD

DEPTH From— Feet Inches	DEPTH To— Feet Inches	Thickness of stratum Feet Inches	Geologic formations; character of rock; oil, gas and water horizons; coal and other mineral occurances
306.4	308.4	2.0	Shale, black, medium hard, carbonaceous
308.4	311.0	2.6	Shale, gray, soft
	311.0		T. D.
			GAMMA RAY -- 305' T. D.
			Coal: 125.0 - 133.5 = 8.5' Dietz 2
			135.5 - 138.5 = 3.0' Dietz 2
			184.0 - 210.0 = 26.0' Dietz 3
			281.0 - 307.0 = 22.0' Monarch

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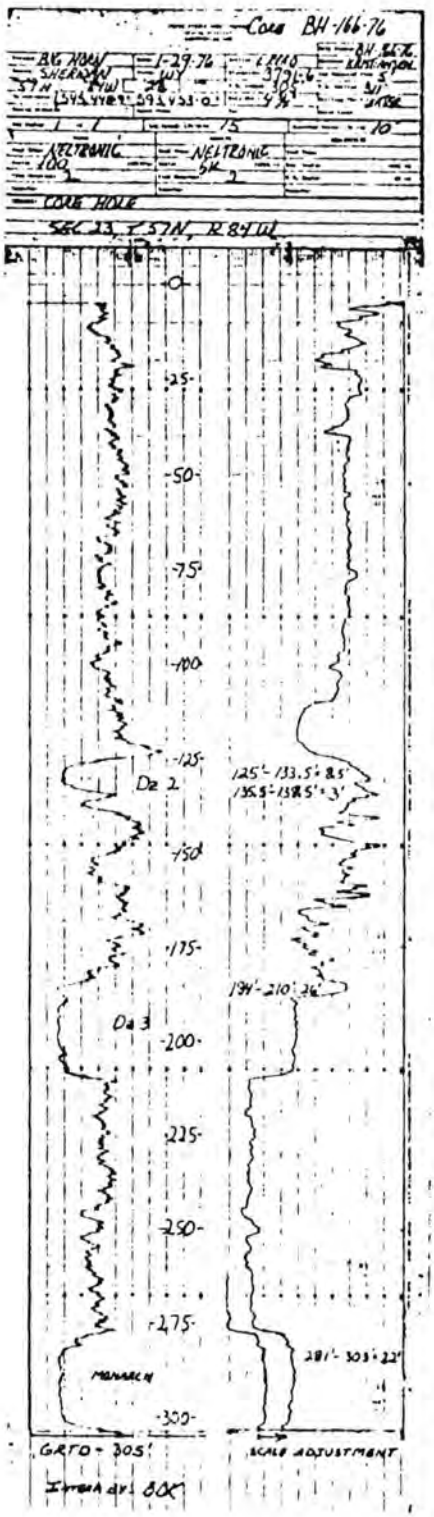

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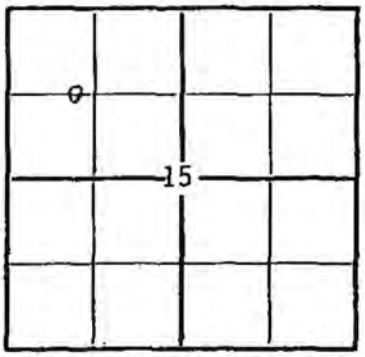
Brook Mine

PETER KIEWIT SONS' CO.

EXPLORATION AND DEVELOPMENT DEPARTMENT

JAN 1983 RECEIVED Land Quality Div. IV



Locate hole correctly, giving distance in feet from N. or S. and E. or W. line of section; when hole is not vertical, give direction and angle.

LOG OF PROSPECT ~~BORE~~ CORE HOLE No. BH-5326-78

Lessee or permittee: P.K.S.

Address: Sheridan, Wyoming

Driller: R. Reed

Commenced drilling: 6-14-78 Finished: 6-14-78

W/Center Sec. 15 T. 57N R. 84W M. State Wyoming

Method of drilling: Air Logged by: JCS

Surface Owner: (SIGNED) Joseph C. Sarnecki

DATE Typed 7-20-78 Page 1 of 2 (TITLE) Geologist

FORMATION RECORD

DEPTH From— Feet Tenths	DEPTH To— Feet Tenths	Thickness of stratum Feet Tenths	Geologic formations; character of rock; oil, gas and water horizons; coal and other mineral occurrences
0.0	5.0	5.0	Gravel & Sand - in orange clay Bag 1
5.0	10.0	5.0	Gravel & Sand - in orange clay Bag 2
10.0	11.0	1.0	Gravel & Sand - in orange clay, Inject H20 at 10'
11.0	15.0	4.0	Gravel on Coal (D3?) Bag 3 (10-15)
15.0	20.0	5.0	Attempt core @ 15' - Cased 0-15'
16.0	19.0	3.0	CORE #1 Cored 3' Recovered 2'
16.0	16.5	0.5	Coal - weathered
16.5	17.25	0.75	Coal - black, weathered
17.25	17.5	0.25	Shale - carbonaceous
17.5	17.75	0.25	Shale - gray
17.75	18.0	0.25	Coal - black, weathered
18.0	19.0	1.0	Lost
19.0	23.0	4.0	CORE #2 Cored 4' Recovered 3'
			Air drilled
19.0	20.1	1.1	Shale - gray to brown
20.1	20.3	0.2	Fe material - orange and yellow
20.3	21.8	1.5	Shale - tan to light brown, clayey (no radiation)
21.8	22.0	0.2	Selenite crystals

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(Attach continuation sheets if necessary)

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PETER KIEWIT SONS' CO.

EXPLORATION AND DEVELOPMENT DEPARTMENT

Brook Mine

DATE Drilled 6/14/78 Typed 7/20/78

AREA Big Horn Coal

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FORMATION RECORD

DEPTH From— Feet Inches	DEPTH To— Feet Inches	Thickness of stratum Feet Inches	Geologic formations; character of rock; oil, gas and water horizons; coal and other mineral occurances
22.0	23.0	1.0	Lost
23.0	28.0	5.0	CORE #3 Cored 5' Recovered 4'
23.0	25.6	2.6	Cored dry Clay - tan, silty with some orange concretions
25.6	26.1	0.5	Clay - tan, silty with some orange concretions
26.1	27.0	0.9	Sandstone - hard, gray, with plant fragments
27.0	28.0	1.0	Lost
			Box 1: 16-18 (1' weathered coal (D3?)
			" 19-22; 23-27
28.0	31.0	3.0	CORE #4 Cored 3' Recovered 3'
28.0	31.0	3.0	Sandstone - hard, gray with leaves
31.0	60.0	29.0	Drilled out Box 2: 25.6 - 27.0 (1' missing 28.0 - 31.0
31.0	34.5	3.5	Sandstone - gray, hard
34.5	40.0	5.5	Siltstone
40.0	50.0	10.0	Siltstone ?
50.0	66.0	16.0	Coal
66.0	80.0	14.0	Sandstone - silty, clayey, gray
	80.0		T.D.
			GAMMA RAY
			10.5 - 18.0 = 7.5' Dietz 3
			48.0 - 66.0 = 18.0' Monarch

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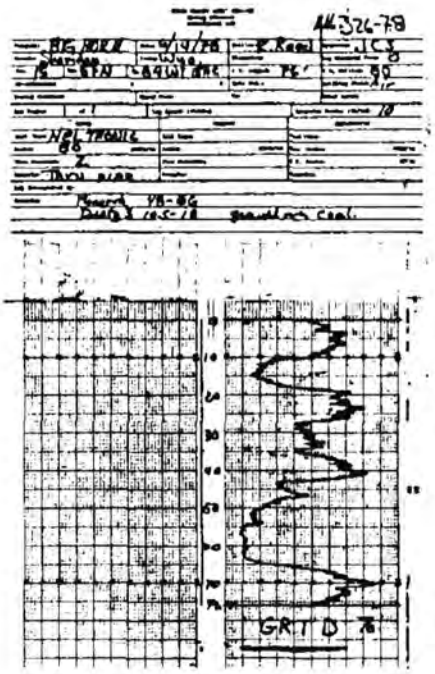
BH 326

BIG HORN COAL



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ADDENDUM D5-3

Geologic Cross-Sections

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ADDENDUM D5-3

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Addendum D5-3 Exhibit 2 Geologic Cross Section B-B' Segment 2 of 2 Sheet 4 of 16

Addendum D5-3 Exhibit 2 Geologic Cross Section C-C' Segment 1 of 2 Sheet 5 of 16

Addendum D5-3 Exhibit 2 Geologic Cross Section C-C' Segment 2 of 2 Sheet 6 of 16

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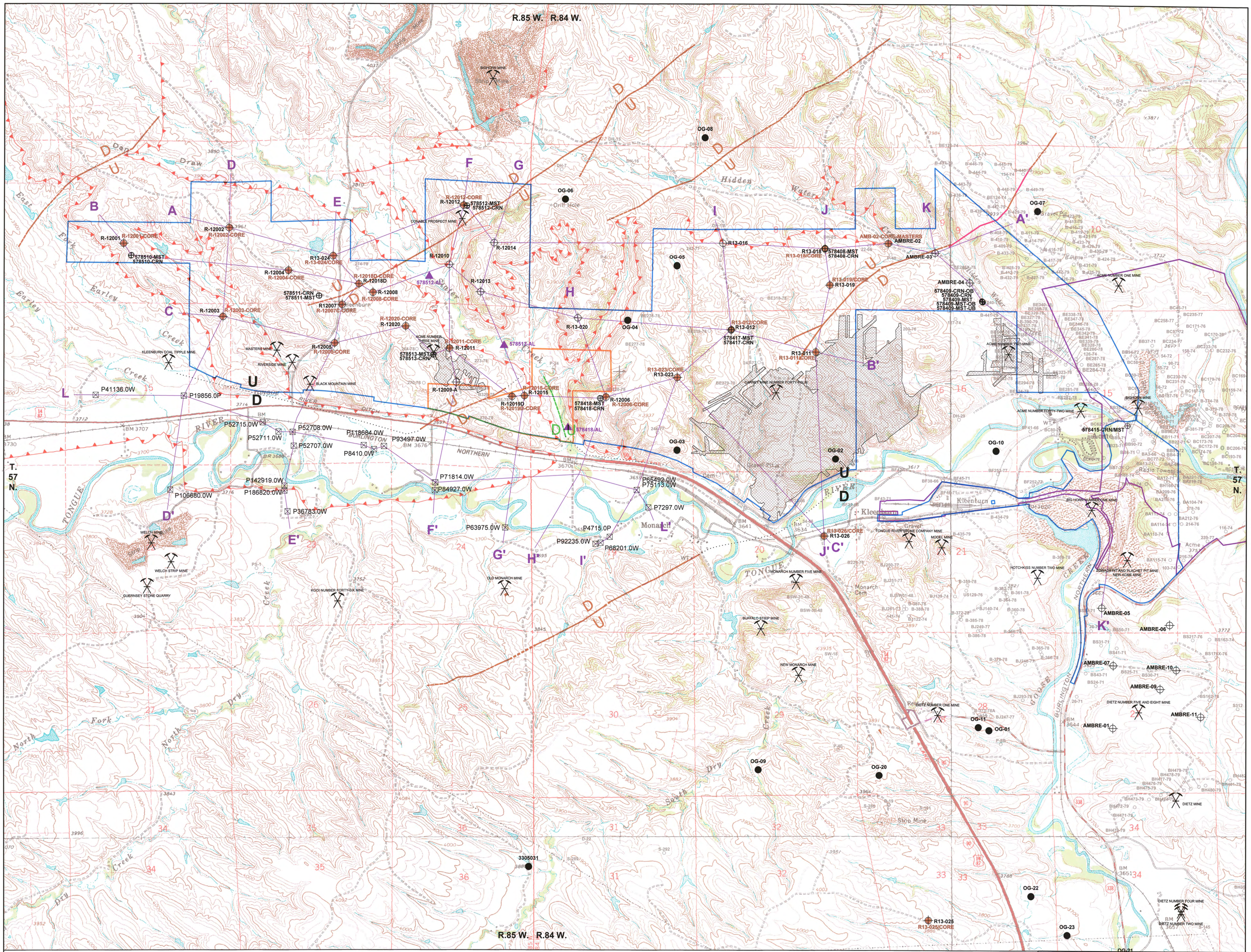
DEQ Ex. 2-249



LEGEND

- BROOK MINE PERMIT BOUNDARY
- BIG HORN COAL PERMIT BOUNDARY (PERMIT NO. 213-T7)
- TAYLOR QUARRY PERMIT BOUNDARY (PERMIT NO. SP-757)
- CARNEY SEAM REMOVED BY HISTORIC MINING
- DIETZ MINE — HISTORIC MINE LOCATION
- R-12011 — EXPLORATION BOREHOLE
- R-12006-CORE — CORE HOLE
- 578418-CRN — MONITOR WELL
- 578418-AL — MONITOR WELL - ALLUVIUM
- OG-13 — WOGCC OIL OR GAS WELL
- BE320-78 — HISTORIC EXPLORATION BOREHOLE
- P7297.0W — SEO PERMITTED WATER WELL
- FAULT (BARNUM)
- FAULT INFERRED (BARNUM)
- FAULT INFERRED (MIKE WOLF, P.G. 614)
- FAULT (KANIZAY)
- FAULT INFERRED (WWC)
- APPROXIMATE CARNEY OUTCROP LINE

Faults Adapted from:
PRELIMINARY GEOLOGIC MAP OF THE SHERIDAN AREA, NORTHWESTERN POWDER RIVER BASIN, WYOMING (S.P. Kanizay, 1978)
GEOLOGIC AND STRUCTURE MAPS OF THE MONARCH QUADRANGLE, SHERIDAN COUNTY, WYOMING, AND BIG HORN COUNTY, MONTANA (B.E. Barnum, 1983)

N

0 500 1,000 1,500 2,000
GRAPHIC SCALE (FEET)
C.I. = 20'

RAMACO

BROOK MINE
SHERIDAN COUNTY, WY

1101 SUGARVIEW DR, STE. 201
SHERIDAN, WY 82801

REVISIONS	
Date	Description
06/15	ROUND 1 COMMENTS
08/18	ROUND 7 COMMENTS
12/19	ROUND 11 COMMENTS
01/2020	ROUND 12 COMMENTS

ADDENDUM D5-3
EXHIBIT 1

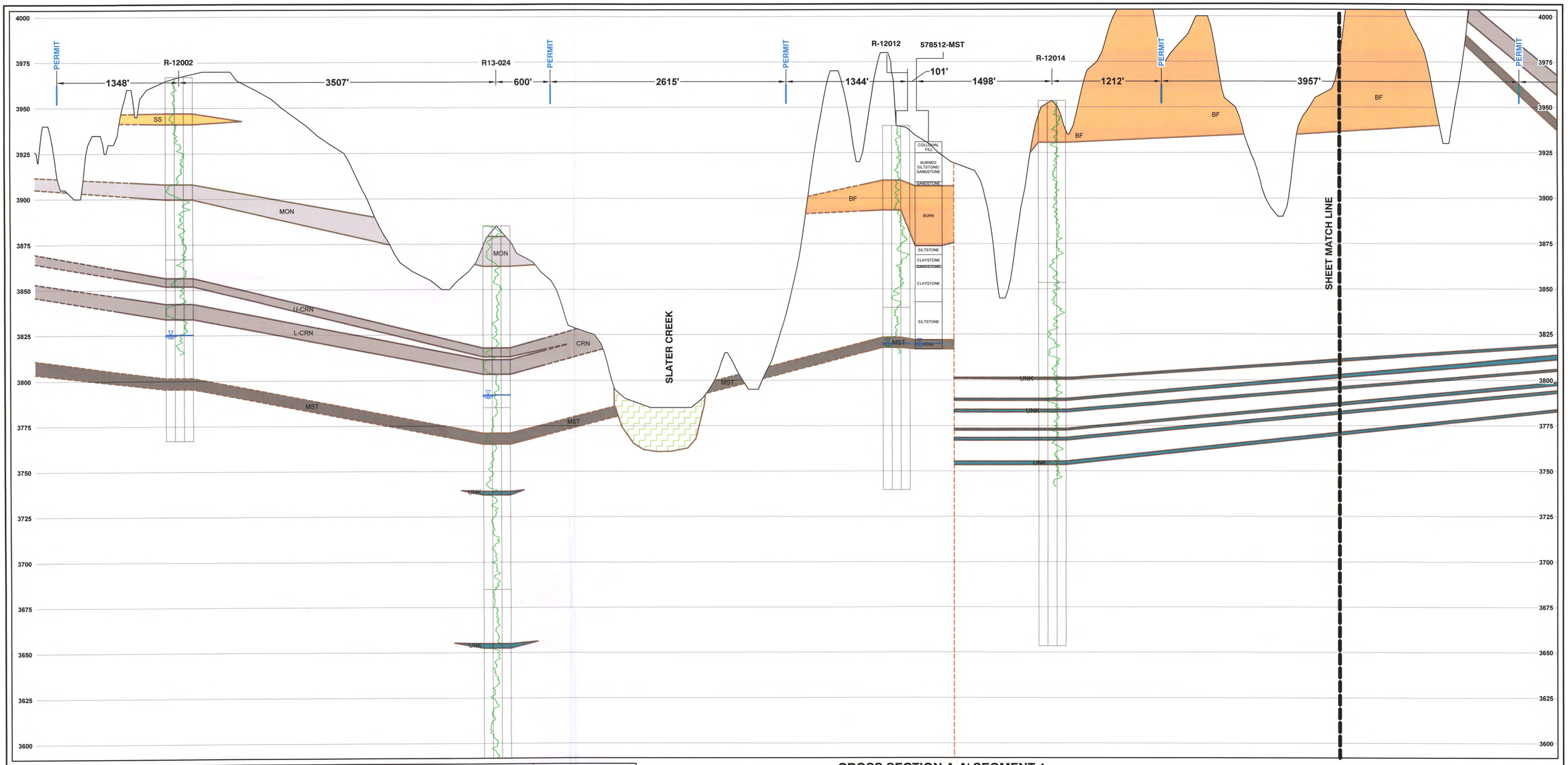
GEOLOGIC CROSS SECTION LOCATION MAP

TFN 6 2/025
RECD JAN 27, 2020

Drawn By: MBM
Checked By: JGB
Date: 10/22/14

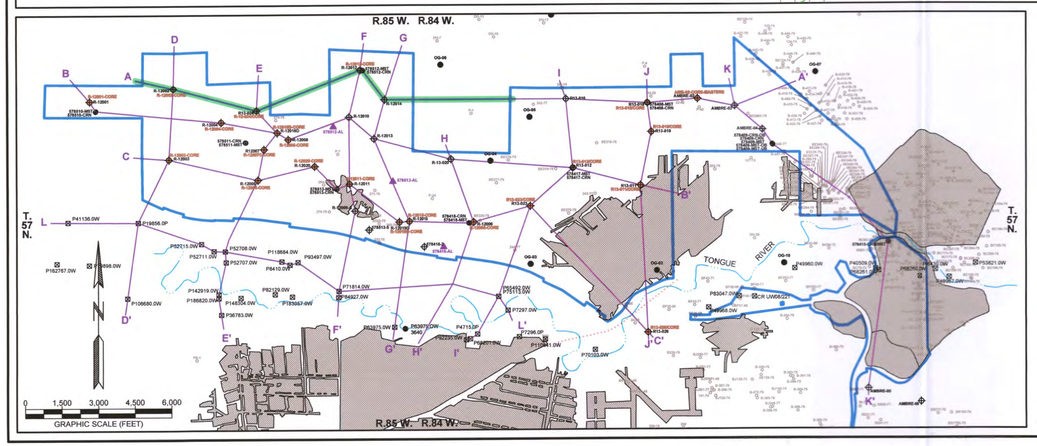
WWC ENGINEERING
www.wwcengineering.com

FILE: ADD_D5_3_GEO_CROSS_SECTION_LOCS.dwg



CROSS SECTION A-A' SEGMENT 1

SCALE: HORIZ. 1" = 500', VERT. 1" = 25'



LEGEND

- BROOK MINE PERMIT BOUNDARY
- CROSS SECTION SEGMENT SHOWN ON THIS SHEET
- POTENTIOMETRIC SURFACE (CARNEY)
- POTENTIOMETRIC SURFACE (MASTERS)
- FAULT
- INFERRED FAULT
- R12011 EXPLORATION BOREHOLE
- P71814.0W STATE ENGINEER'S OFFICE PERMITTED WATER WELL
- 578418-CRN MONITOR WELL
- BE325-78 HISTORIC EXPLORATION BOREHOLE
- 578415-AL MONITOR WELL - ALLUVIUM
- OG-13 WOGCC OIL OR GAS WELL
- R-12006-CORE CORE HOLE
- CLAYSTONE/SILTSTONE
- SS SANDSTONE
- BF BAKED/FUSED/CLINKER
- DZ DIETZ BEDS
- MON MONARCH COAL
- CRN CARNEY COAL
- HM HISTORIC MINING
- MST MASTERS COAL
- ALLUVIUM/COLLUVIUM AND/OR COLLUVIUM WITHIN CHANNEL BOTTOMS
- UNK UNKNOWN COAL SEAM (STRINGER)

NOTES:
1) REFER TO TABLE D5.3-1 FOR STRATIGRAPHIC NOMENCLATURE.
2) CONTACTS DASHED WHERE INFERRED.
3) COAL SEAM POTENTIOMETRY FROM EXHIBITS D6.2-2 AND D6.2-3.

CERTIFICATE OF GEOLOGIST

I, Michael J. Evers, hereby certify that this drawing was prepared by myself or under my direct supervision and that it correctly represents the conditions described in the accompanying application which is provided to meet the requirements of the Wyoming Environmental Quality Act and its regulations.

PROFESSIONAL GEOLOGIST MICHAEL J. EVERS DATE 9-12-18 WYOMING

RAMACO

BROOK MINE
SHERIDAN COUNTY, WY
1101 SUGARVIEW DR. STE. 201
SHERIDAN, WY 82801

REVISIONS	
Date	Description
06/18	ROUND 7 COMMENTS

ADDENDUM D5-3
EXHIBIT 2

SHEET 1 OF 16

GEOLOGIC CROSS SECTION A-A'
SEGMENT 1 OF 2

TFN 6 2/025
RECD 10-25-18

Drawn By: MBM
Checked By: MJE
Date: 5/24/18

WWC ENGINEERING
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FILE: ADD_D5_3_GEO_CROSS_SECTIONS.dwg

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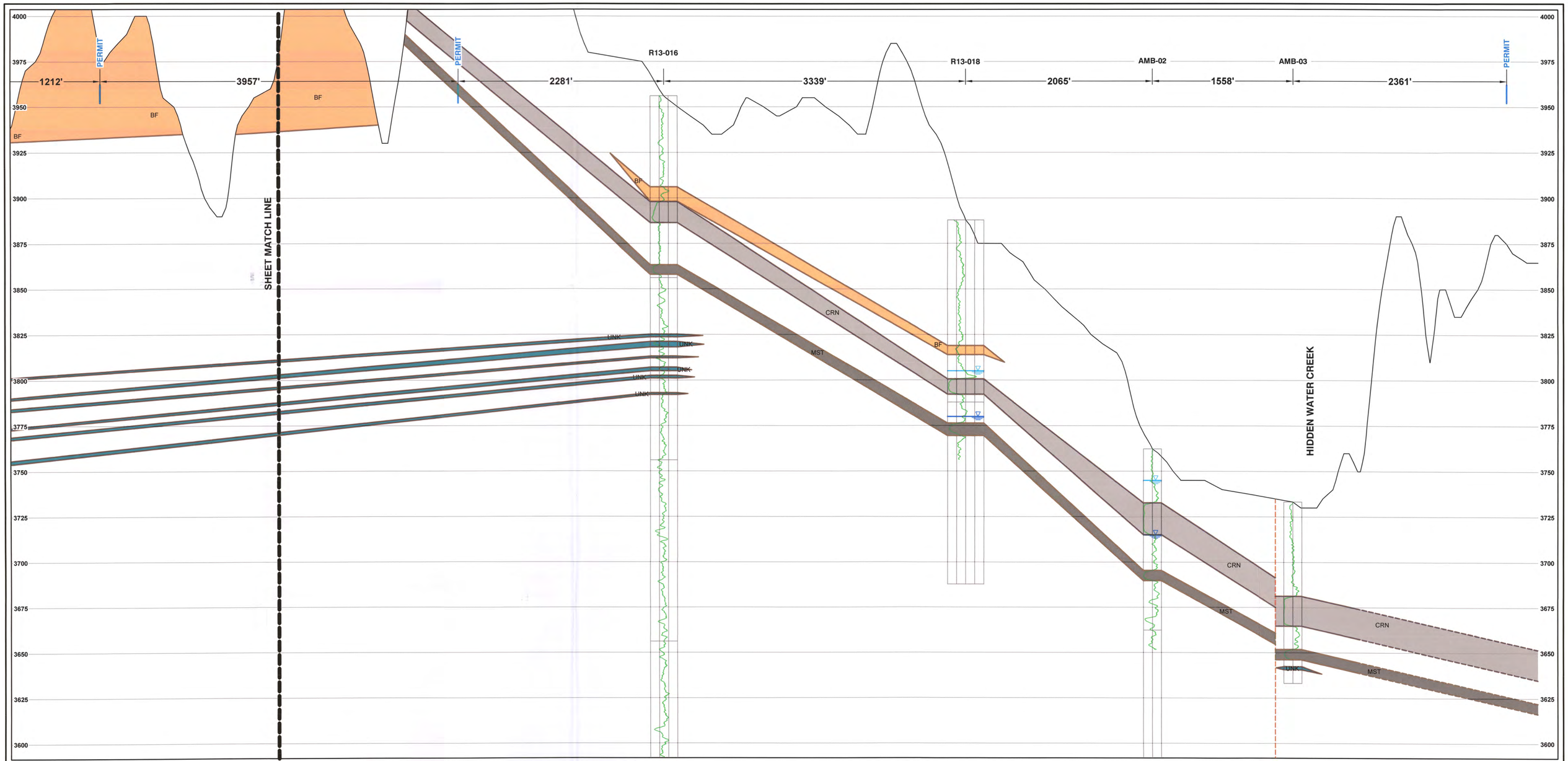

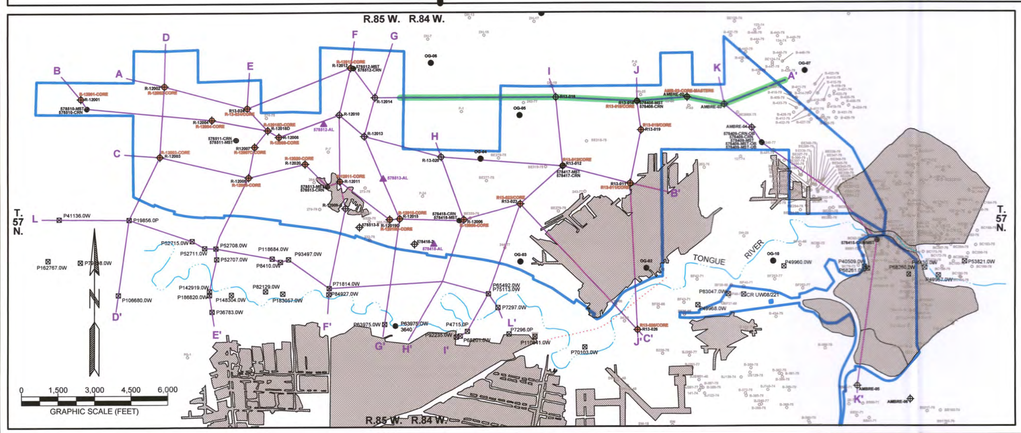

CROSS SECTION A-A' SEGMENT 2

SCALE: HORIZ. 1" = 500', VERT. 1" = 25'

LEGEND

- BROOK MINE PERMIT BOUNDARY
- CROSS SECTION SEGMENT SHOWN ON THIS SHEET
- POTENTIOMETRIC SURFACE (CARNEY)
- POTENTIOMETRIC SURFACE (MASTERS)
- FAULT
- INFERRED FAULT
- R12011 EXPLORATION BOREHOLE
- P71814.0W STATE ENGINEER'S OFFICE PERMITTED WATER WELL
- 578418-CRN MONITOR WELL
- BE320-78 HISTORIC EXPLORATION BOREHOLE
- 578418-AL MONITOR WELL - ALLUVIUM
- OG-13 WOGCC OIL OR GAS WELL
- R-12008-CORE CORE HOLE
- CLAYSTONE/SILTSTONE
- SS SANDSTONE
- BF BAKED/FUSED/CLINKER
- DZ DIETZ BEDS
- MON MONARCH COAL
- CRN CARNEY COAL
- HM HISTORIC MINING
- MST MASTERS COAL
- ALLUVIUM/COLLUVIUM AND/OR COLLUVIUM WITHIN CHANNEL BOTTOMS
- UNK UNKNOWN COAL SEAM (STRINGER)

NOTES:
1) REFER TO TABLE D5.3-1 FOR STRATIGRAPHIC NOMENCLATURE.
2) CONTACTS DASHED WHERE INFERRED.
3) COAL SEAM POTENTIOMETRY FROM EXHIBITS D6.2-2 AND D6.2-3.

CERTIFICATE OF GEOLOGIST

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PROFESSIONAL GEOLOGIST
MICHAEL J. EVERS
PG 91
DATE 9-12-18
WYOMING

RAMACO

BROOK MINE
SHERIDAN COUNTY, WY

1101 SUGARVIEW DR. STE. 201
SHERIDAN, WY 82801

REVISIONS	
Date	Description
06/18	ROUND 7 COMMENTS

ADDENDUM D5-3
EXHIBIT 2

TFN 6 2/025
REC'D 10-25-18

SHEET 2 OF 16

GEOLOGIC CROSS SECTION A-A'
SEGMENT 2 OF 2

Drawn By: MBM
Checked By: MJE
Date: 5/24/18

WWC ENGINEERING
www.wwcengineering.com

FILE: ADD_D5_3_GEO_CROSS_SECTIONS.dwg

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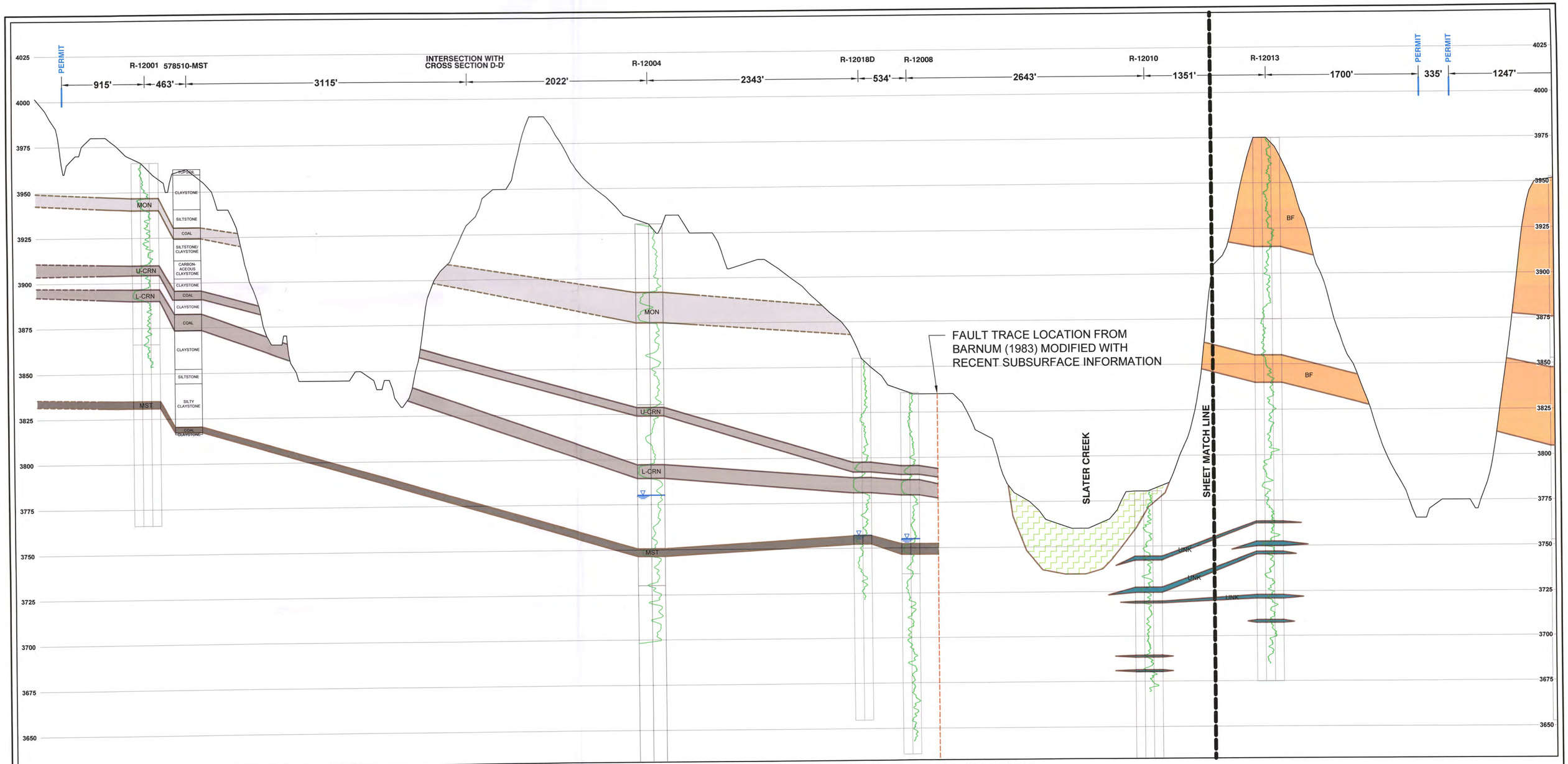
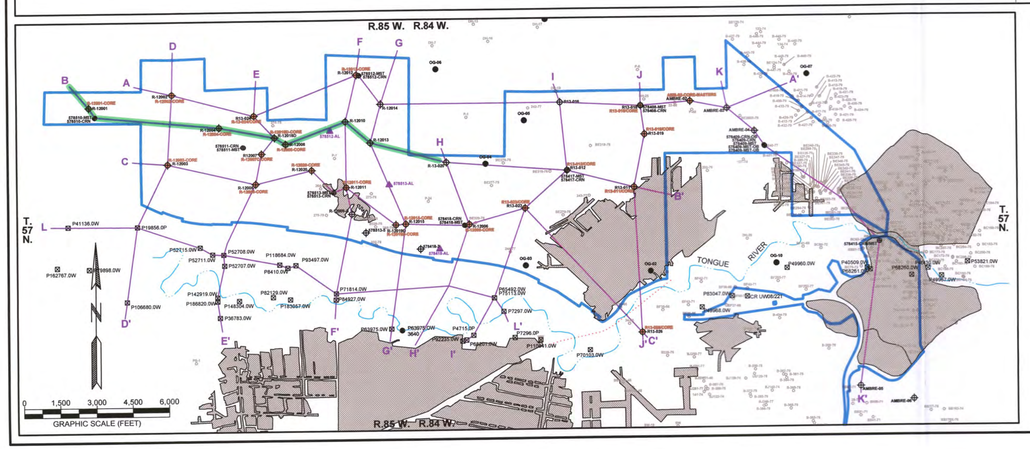


CROSS SECTION B-B' SEGMENT 1

SCALE: HORIZ. 1" = 500', VERT. 1" = 25'



LEGEND

- BROOK MINE PERMIT BOUNDARY
- CROSS SECTION SEGMENT SHOWN ON THIS SHEET
- POTENTIOMETRIC SURFACE (CARNEY)
- POTENTIOMETRIC SURFACE (MASTERS)
- FAULT
- INFERRED FAULT
- R12011 EXPLORATION BOREHOLE
- P71814.0W STATE ENGINEER'S OFFICE PERMITTED WATER WELL
- 578418-CRN MONITOR WELL
- BE320-78 HISTORIC EXPLORATION BOREHOLE
- 578418-AL MONITOR WELL - ALLUVIUM
- OG-13 WOGCC OIL OR GAS WELL
- R-12006-CORE CORE HOLE

- CLAYSTONE/SILTSTONE
- SS SANDSTONE
- BF BAKED/FUSED/CLINKER
- DZ DIETZ BEDS
- MON MONARCH COAL
- CRN CARNEY COAL
- HM HISTORIC MINING
- MST MASTERS COAL
- ALLUVIUM/COLLUVIUM AND/OR COLLUVIUM WITHIN CHANNEL BOTTOMS
- UNK UNKNOWN COAL SEAM (STRINGER)

NOTES:
1) REFER TO TABLE D5.3-1 FOR STRATIGRAPHIC NOMENCLATURE.
2) CONTACTS DASHED WHERE INFERRED.
3) COAL SEAM POTENTIOMETRY FROM EXHIBITS D6.2-2 AND D6.2-3.

CERTIFICATE OF GEOLOGIST

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PROFESSIONAL GEOLOGIST MICHAEL J. EVERS WYOMING
DATE 9.12.18

RAMACO

BROOK MINE
SHERIDAN COUNTY, WY

1101 SUGARVIEW DR. STE. 201
SHERIDAN, WY 82801

REVISIONS	
Date	Description
06/18	ROUND 7 COMMENTS

ADDENDUM D5-3
EXHIBIT 2

TFN 6 2/025
RECD 10-25-18

SHEET 3 OF 16

GEOLOGIC CROSS SECTION B-B'
SEGMENT 1 OF 2

Drawn By: MBM
Checked By: MJE
Date: 5/24/18

WWC ENGINEERING
www.wwcengineering.com

FILE: ADD_D5_3_GEO_CROSS_SECTIONS.dwg

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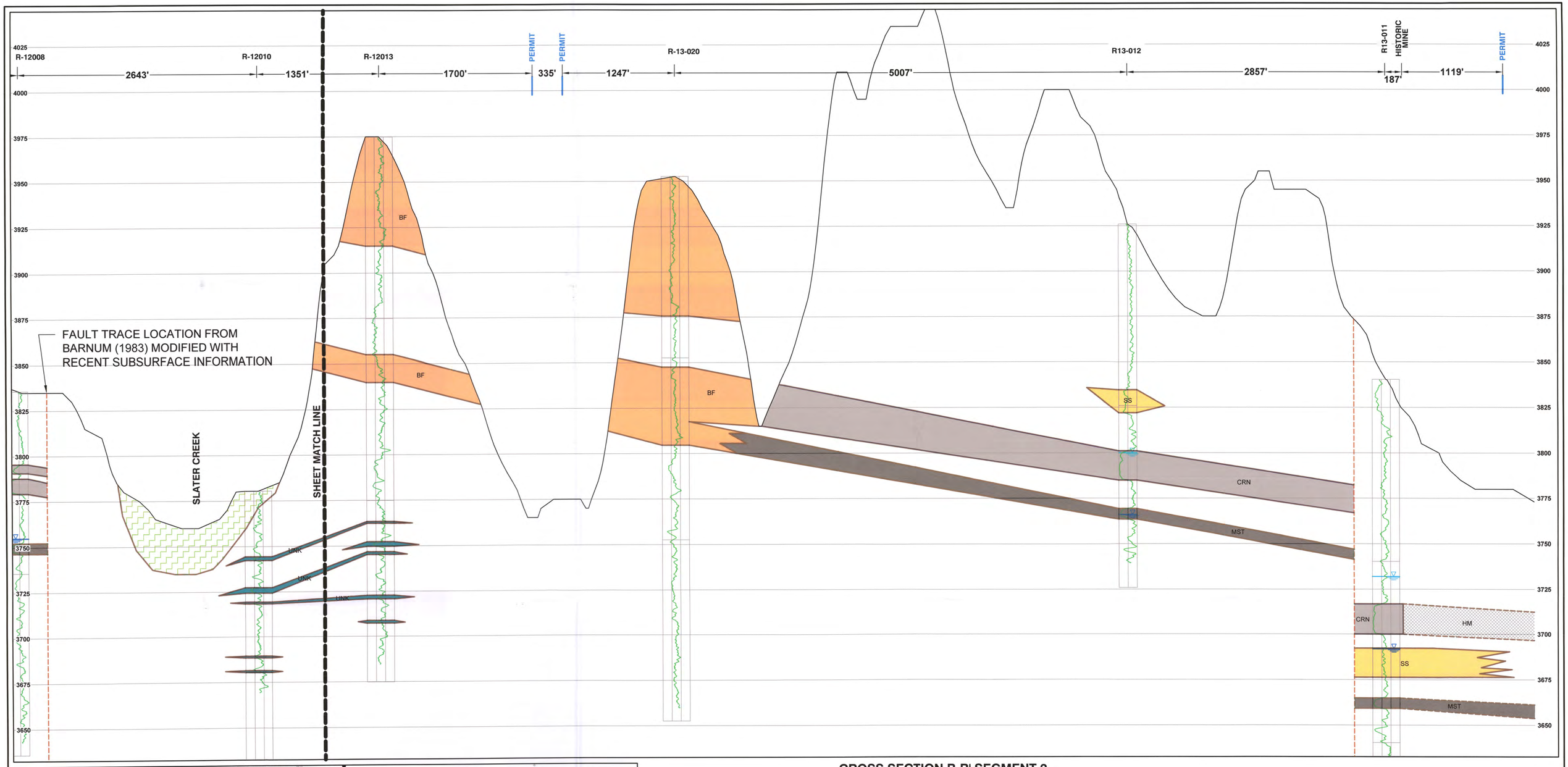
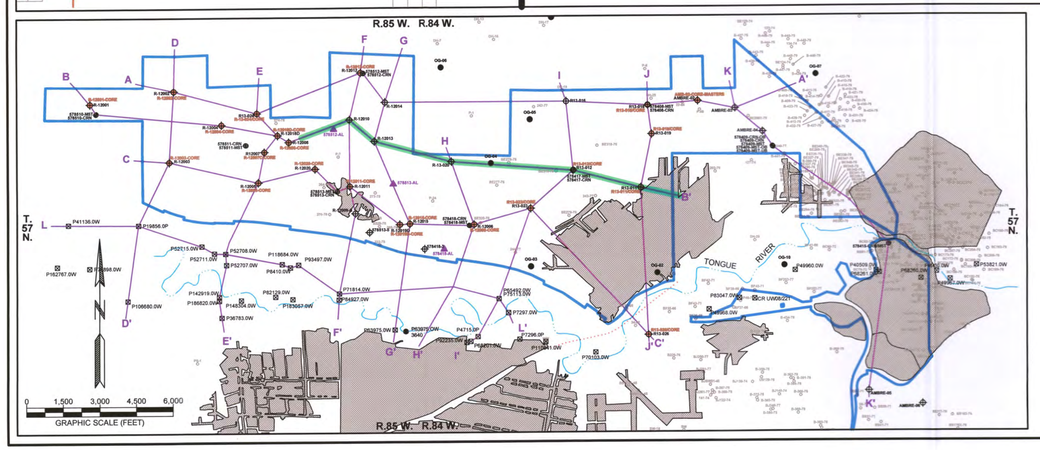


CROSS SECTION B-B' SEGMENT 2

SCALE: HORIZ. 1" = 500', VERT. 1" = 25'



LEGEND

- BROOK MINE PERMIT BOUNDARY
- CROSS SECTION SEGMENT SHOWN ON THIS SHEET
- POTENTIOMETRIC SURFACE (CARNEY)
- POTENTIOMETRIC SURFACE (MASTERS)
- FAULT
- INFERRED FAULT
- R12011 EXPLORATION BOREHOLE
- P71814.0W STATE ENGINEER'S OFFICE PERMITTED WATER WELL
- 578418-CRN MONITOR WELL
- BE320-76 HISTORIC EXPLORATION BOREHOLE
- 578418-AL MONITOR WELL - ALLUVIUM
- OG-13 WOGCC OIL OR GAS WELL
- R-12008-CORE CORE HOLE

- CLAYSTONE/SILTSTONE
- SS SANDSTONE
- BF BAKED/FUSED/CLINKER
- DZ DIETZ BEDS
- MON MONARCH COAL
- CRN CARNEY COAL
- HM HISTORIC MINING
- MST MASTERS COAL
- ALLUVIUM/COLLUVIUM AND/OR COLLUVIUM WITHIN CHANNEL BOTTOMS
- UNK UNKNOWN COAL SEAM (STRINGER)

NOTES:
1) REFER TO TABLE D5.3-1 FOR STRATIGRAPHIC NOMENCLATURE.
2) CONTACTS DASHED WHERE INFERRED.
3) COAL SEAM POTENTIOMETRY FROM EXHIBITS D6.2-2 AND D6.2-3.

CERTIFICATE OF GEOLOGIST

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PROFESSIONAL GEOLOGIST MICHAEL J. EVERS PG-98 WYOMING

Michael J. Evers

DATE 9-12-18

RAMACO

BROOK MINE
SHERIDAN COUNTY, WY

1101 SUGARVIEW DR. STE. 201
SHERIDAN, WY 82801

REVISIONS	
Date	Description
06/18	ROUND 7 COMMENTS

ADDENDUM D5-3
EXHIBIT 2

TFN 6 2/025
RECD 10-25-18

SHEET 4 OF 16

GEOLOGIC CROSS SECTION B-B'
SEGMENT 2 OF 2

Drawn By: MBM
Checked By: MJE
Date: 5/24/18

WWC ENGINEERING
www.wwcengineering.com

FILE: ADD_D5_3_GEO_CROSS_SECTIONS.dwg

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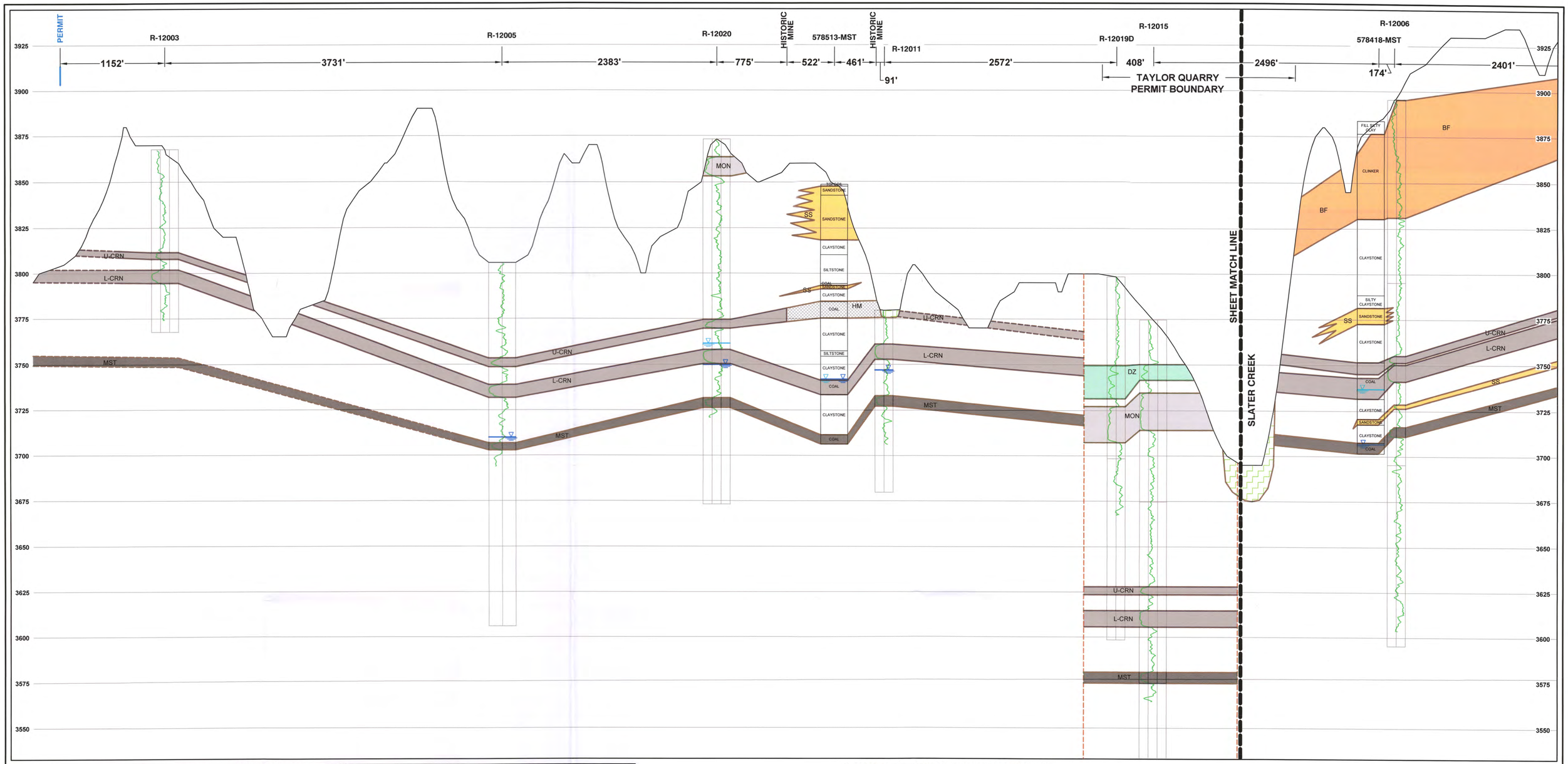
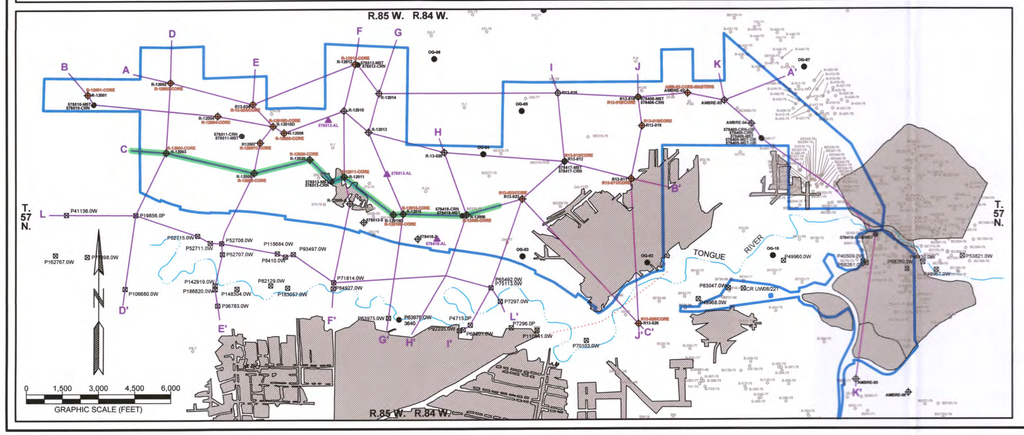


CROSS SECTION C-C' SEGMENT 1

SCALE: HORIZ. 1" = 500', VERT. 1" = 25'



LEGEND

- BROOK MINE PERMIT BOUNDARY
- CROSS SECTION SEGMENT SHOWN ON THIS SHEET
- POTENTIOMETRIC SURFACE (CARNEY)
- POTENTIOMETRIC SURFACE (MASTERS)
- FAULT
- INFERRED FAULT
- R12011 EXPLORATION BOREHOLE
- P71814.0W STATE ENGINEER'S OFFICE PERMITTED WATER WELL
- 578418-CRN MONITOR WELL
- BE320-78 HISTORIC EXPLORATION BOREHOLE
- 578418-AL MONITOR WELL - ALLUVIUM
- OG-13 WOGCC OIL OR GAS WELL
- R-12006-CORE CORE HOLE

- CLAYSTONE/SILTSTONE
- SS SANDSTONE
- BF BAKED/FUSED/CLINKER
- DZ DIETZ BEDS
- MON MONARCH COAL
- CRN CARNEY COAL
- HM HISTORIC MINING
- MST MASTERS COAL
- ALLUVIUM/COLLUVIUM AND/OR COLLUVIUM WITHIN CHANNEL BOTTOMS
- UNK UNKNOWN COAL SEAM (STRINGER)

NOTES:
1) REFER TO TABLE D5.3-1 FOR STRATIGRAPHIC NOMENCLATURE.
2) CONTACTS DASHED WHERE INFERRED.
3) COAL SEAM POTENTIOMETRY FROM EXHIBITS D6.2-2 AND D6.2-3.

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PROFESSIONAL GEOLOGIST
MICHAEL J. EVERS
PG 91
DATE: 9-12-18
WYOMING

RAMACO

BROOK MINE
SHERIDAN COUNTY, WY
1101 SUGARVIEW DR, STE. 201
SHERIDAN, WY 82801

REVISIONS	
Date	Description
06/18	ROUND 7 COMMENTS

ADDENDUM D5-3
EXHIBIT 2

TFN 6 2/025
RECD 10-25-18

SHEET 5 OF 16

GEOLOGIC CROSS SECTION C-C'
SEGMENT 1 OF 2

Drawn By: MBM
Checked By: MJE
Date: 5/24/18

WWC ENGINEERING
www.wwcengineering.com

FILE: ADD_D5_3_GEO_CROSS_SECTIONS.dwg

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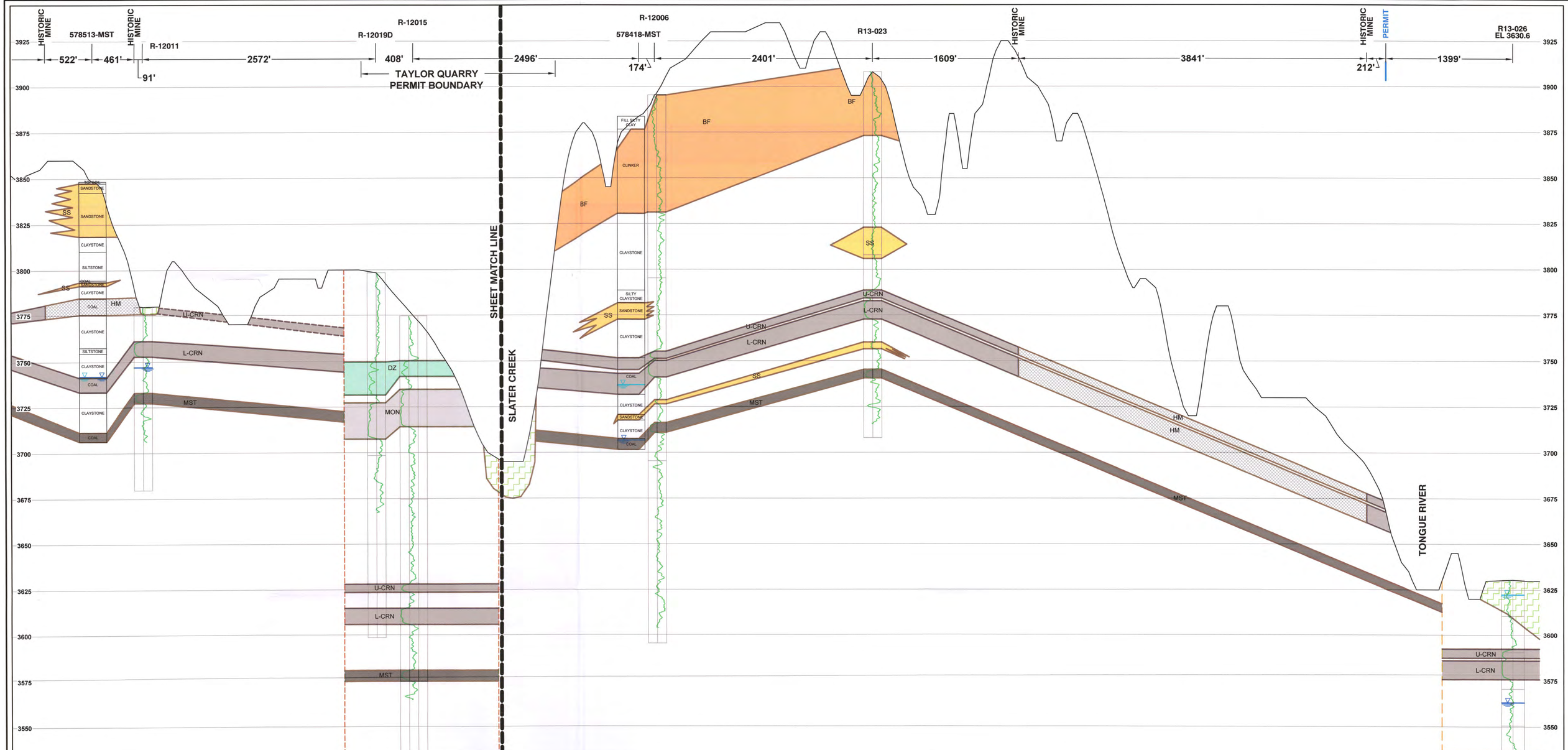

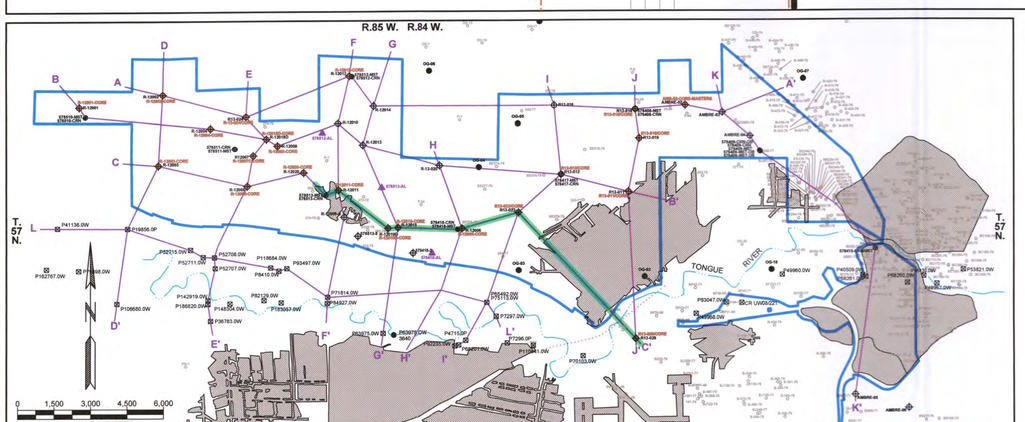

CROSS SECTION C-C' SEGMENT 2

SCALE: HORIZ. 1" = 500', VERT. 1" = 25'

LEGEND

- BROOK MINE PERMIT BOUNDARY
- CROSS SECTION SEGMENT SHOWN ON THIS SHEET
- POTENTIOMETRIC SURFACE (CARNEY)
- POTENTIOMETRIC SURFACE (MASTERS)
- FAULT
- INFERRED FAULT
- R12011 EXPLORATION BOREHOLE
- P71814.0W STATE ENGINEER'S OFFICE PERMITTED WATER WELL
- 578418-CRN MONITOR WELL
- BE320-79 HISTORIC EXPLORATION BOREHOLE
- 578418-AL MONITOR WELL - ALLUVIUM
- OG-13 WOGCC OIL OR GAS WELL
- R-12008-CORE CORE HOLE
- CLAYSTONE/SILTSTONE
- SS SANDSTONE
- BF BAKED/FUSED/CLINKER
- DZ DIETZ BEDS
- MON MONARCH COAL
- CRN CARNEY COAL
- HM HISTORIC MINING
- MST MASTERS COAL
- ALLUVIUM/COLLUVIUM AND/OR COLLUVIUM WITHIN CHANNEL BOTTOMS
- UNK UNKNOWN COAL SEAM (STRINGER)

NOTES:
1) REFER TO TABLE D5.3-1 FOR STRATIGRAPHIC NOMENCLATURE.
2) CONTACTS DASHED WHERE INFERRED.
3) COAL SEAM POTENTIOMETRY FROM EXHIBITS D6.2-2 AND D6.2-3.

CERTIFICATE OF GEOLOGIST

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PROFESSIONAL GEOLOGIST MICHAEL J. EVERS PG-841 DATE 9-12-18 WYOMING

RAMACO

BROOK MINE
SHERIDAN COUNTY, WY
1101 SUGARVIEW DR. STE. 201
SHERIDAN, WY 82801

REVISIONS	
Date	Description
06/18	ROUND 7 COMMENTS

ADDENDUM D5-3
EXHIBIT 2

TFN 6 2/025
RECD 10-25-18

SHEET 6 OF 16

GEOLOGIC CROSS SECTION C-C'
SEGMENT 2 OF 2

Drawn By: MBM
Checked By: MJE
Date: 5/24/18

WWC ENGINEERING
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FILE: ADD_D5_3_GEO_CROSS_SECTIONS.dwg

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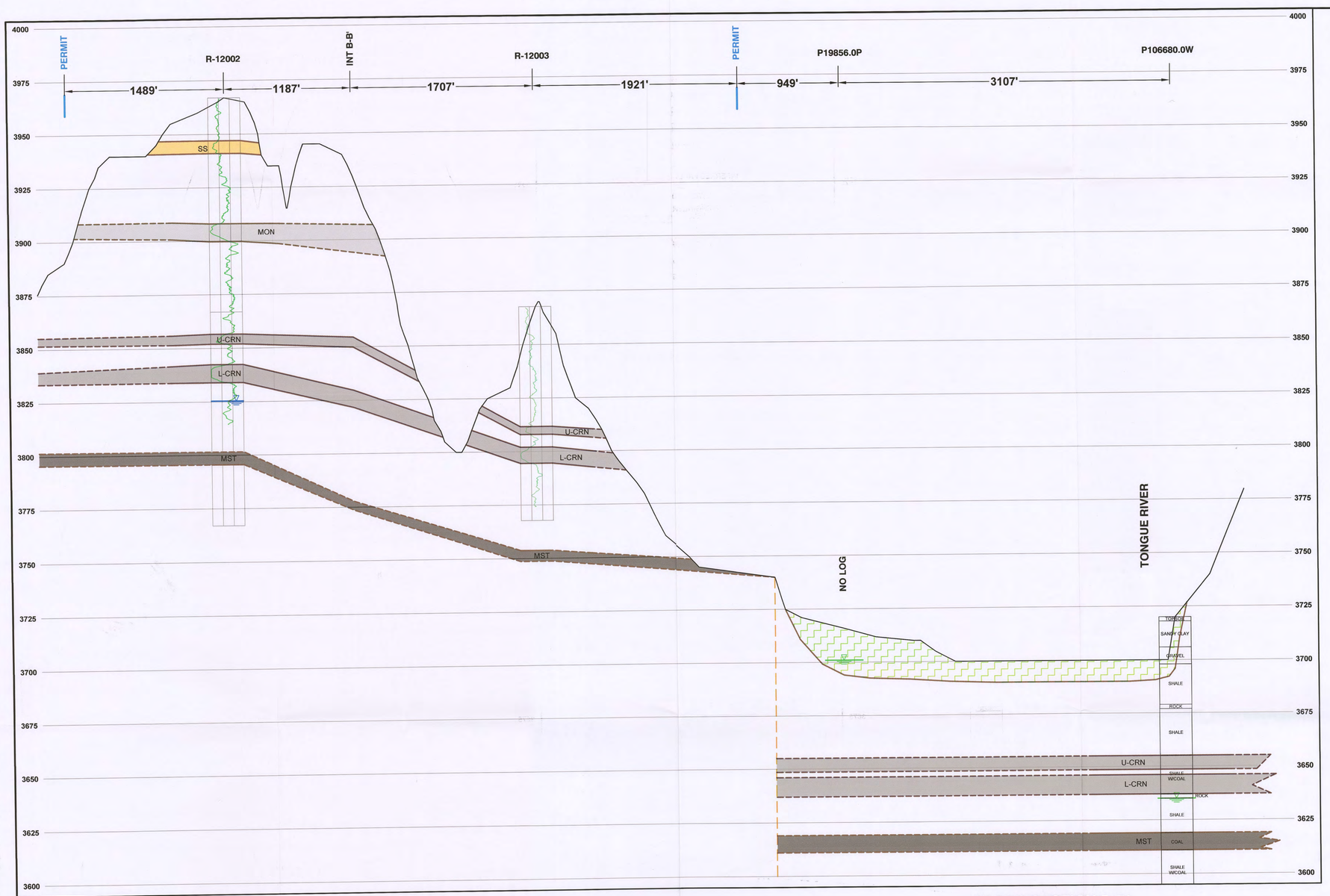

CROSS SECTION D-D'

SCALE: HORIZ. 1" = 500', VERT. 1" = 25'

LEGEND

- BROOK MINE PERMIT BOUNDARY
- CROSS SECTION SEGMENT SHOWN ON THIS SHEET
- POTENTIOMETRIC SURFACE (CARNEY)
- POTENTIOMETRIC SURFACE (MASTERS)
- SEO WATER LEVEL
- FAULT
- INFERRED FAULT
- R12011 EXPLORATION BOREHOLE
- P71814.0W STATE ENGINEER'S OFFICE PERMITTED WATER WELL
- 578418-CRN MONITOR WELL
- BE339-79 HISTORIC EXPLORATION BOREHOLE
- 578418-AL MONITOR WELL - ALLUVIUM
- OG-13 WOGCC OIL OR GAS WELL
- R-12006-CORE CORE HOLE
- CLAYSTONE/SILTSTONE
- SS SANDSTONE
- BF BAKED/FUSED/CLINKER
- DZ DIETZ BEDS
- MON MONARCH COAL
- CRN CARNEY COAL
- HM HISTORIC MINING
- MST MASTERS COAL
- ALLUVIUM/COLLUVIUM AND/OR COLLUVIUM WITHIN CHANNEL BOTTOMS
- UNK UNKNOWN COAL SEAM (STRINGER)

NOTES:
1) REFER TO TABLE D5.3-1 FOR STRATIGRAPHIC NOMENCLATURE.
2) CONTACTS DASHED WHERE INFERRED.
3) COAL SEAM POTENTIOMETRY FROM EXHIBITS D6.2-2 AND D6.2-3.
4) REFER TO ADDENDUM D5-8 FOR SEO LITHOLOGY LOGS.

CERTIFICATE OF GEOLOGIST

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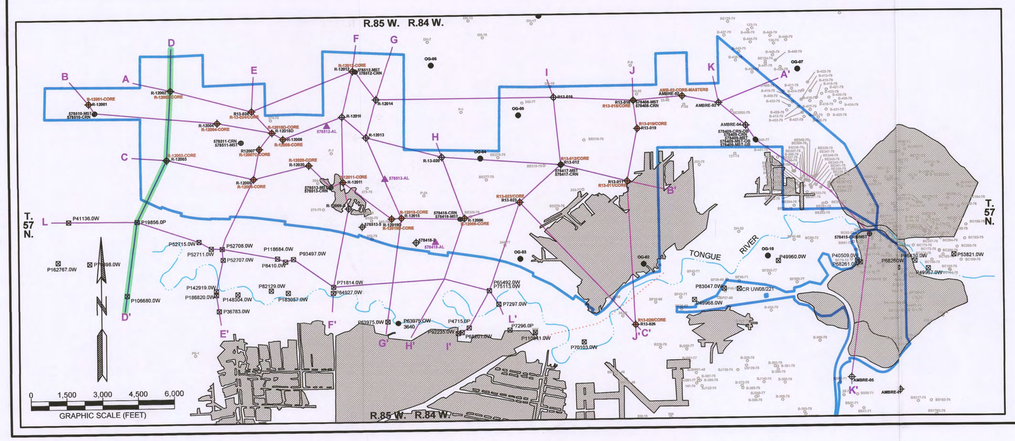
Disclaimer: Well completion data from the SEO database are included in this cross section at agency request. These data have not been verified.

PROFESSIONAL GEOLOGIST
MICHAEL J. EVERS
DATE 12-18-19
WYOMING



RAMACO

BROOK MINE
SHERIDAN COUNTY, WY
1101 SUGARVIEW DR. STE. 201
SHERIDAN, WY 82801

REVISIONS	
Date	Description
06/18	ROUND 7 COMMENTS
02/19	ROUND 8 COMMENTS
12/19	ROUND 11 COMMENTS

ADDENDUM D5-3
EXHIBIT 2

SHEET 7 OF 16

GEOLOGIC CROSS SECTIONS D-D'

TFNG 2/025
RECD DEC 13, 2019

Drawn By: MBM
Checked By: MJE
Date: 5/24/18

WWC ENGINEERING
www.wwcengineering.com

FILE: ADD_D5_3_GEO_CROSS_SECTIONS.dwg

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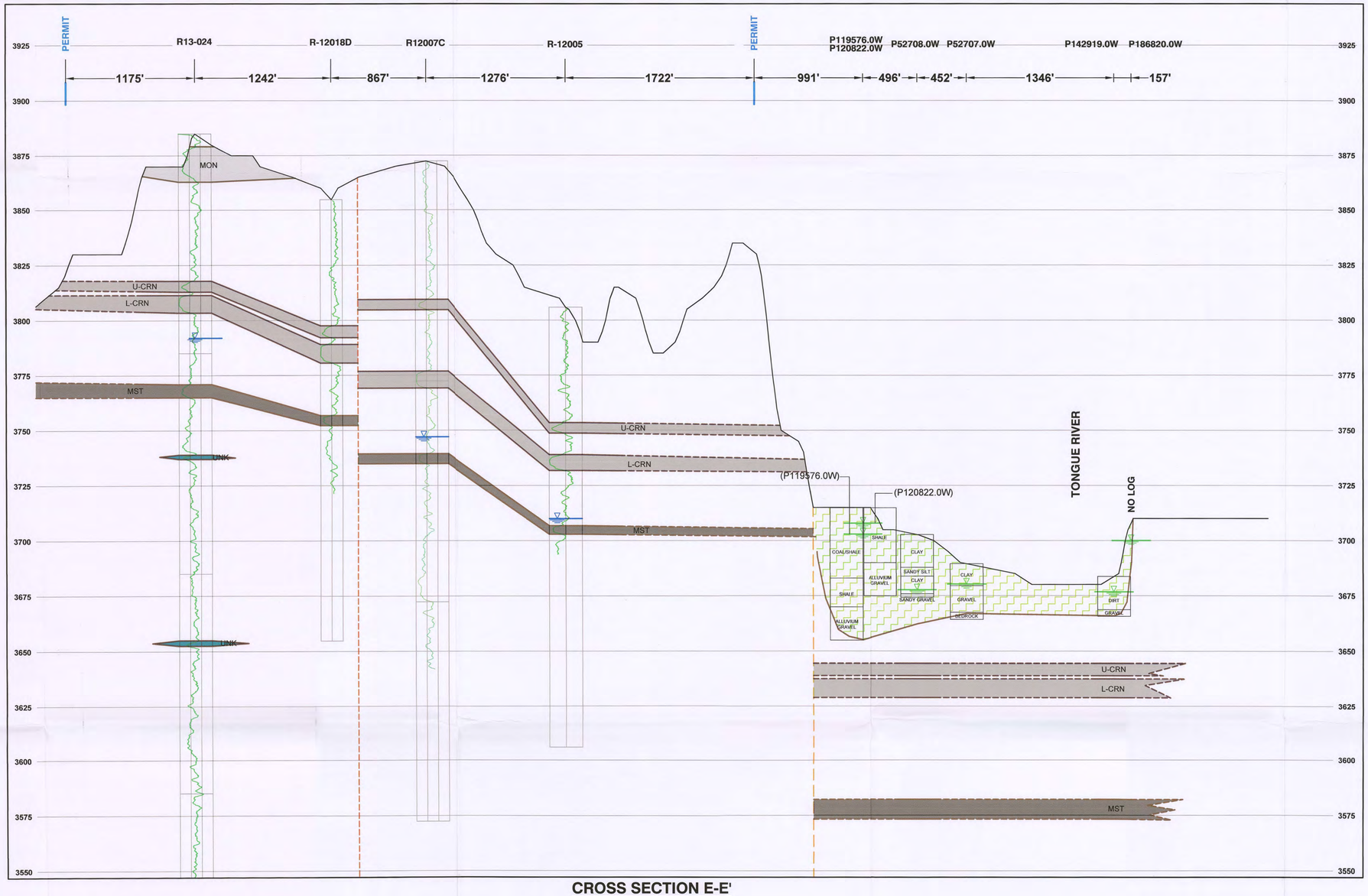
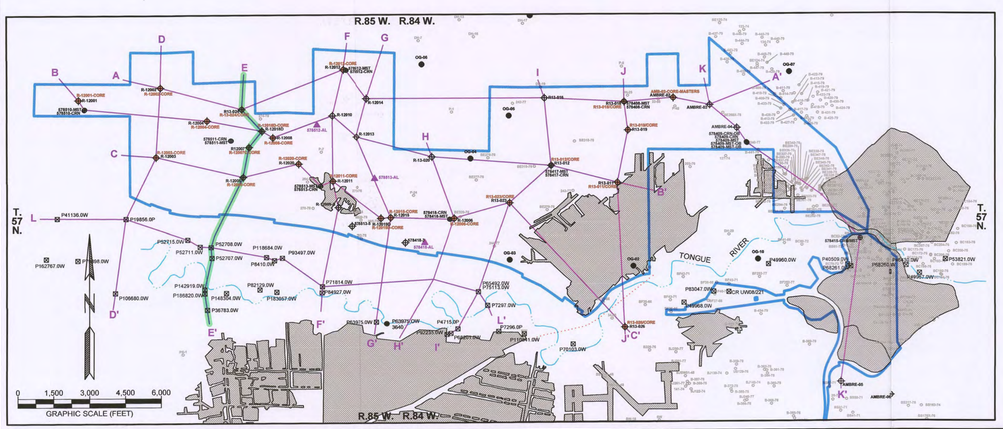


CROSS SECTION E-E'

SCALE: HORIZ. 1" = 500', VERT. 1" = 25'



LEGEND

- BROOK MINE PERMIT BOUNDARY
- CROSS SECTION SEGMENT SHOWN ON THIS SHEET
- POTENTIOMETRIC SURFACE (CARNEY)
- POTENTIOMETRIC SURFACE (MASTERS)
- SEO WATER LEVEL
- FAULT
- INFERRED FAULT
- R12011 EXPLORATION BOREHOLE
- P71814.0W STATE ENGINEER'S OFFICE PERMITTED WATER WELL
- 578418-CRN MONITOR WELL
- BE320-70 HISTORIC EXPLORATION BOREHOLE
- 578418-AL MONITOR WELL - ALLUVIUM
- OG-13 WOGCC OIL OR GAS WELL
- R-12006-CORE CORE HOLE
- CLAYSTONE/SILTSTONE
- SS SANDSTONE
- BF BAKED/FUSED/CLINKER
- DZ DIETZ BEDS
- MON MONARCH COAL
- CRN CARNEY COAL
- HM HISTORIC MINING
- MST MASTERS COAL
- ALLUVIUM/COLLUVIUM AND/OR COLLUVIUM WITHIN CHANNEL BOTTOMS
- UNK UNKNOWN COAL SEAM (STRINGER)

NOTES:
1) REFER TO TABLE D5.3-1 FOR STRATIGRAPHIC NOMENCLATURE.
2) CONTACTS DASHED WHERE INFERRED.
3) COAL SEAM POTENTIOMETRY FROM EXHIBITS D6.2-2 AND D6.2-3.
4) REFER TO ADDENDUM D5-8 FOR SEO LITHOLOGY LOGS.

CERTIFICATE OF GEOLOGIST

I, Michael J. Evers, hereby certify that this drawing was prepared by myself or under my direct supervision and that it correctly represents the conditions described in the accompanying application which is provided to meet the requirements of the Wyoming Environmental Quality Act and its regulations.

Disclaimer: Well completion data from the SEO database are included in this cross section at agency request. These data have not been verified.

PROFESSIONAL GEOLOGIST
MICHAEL J. EVERS
PG-01
DATE 12-18-19
WYOMING

RAMACO

BROOK MINE
SHERIDAN COUNTY, WY

1101 SUGARVIEW DR. STE. 201
SHERIDAN, WY 82801

REVISIONS	
Date	Description
06/18	ROUND 7 COMMENTS
12/19	ROUND 11 COMMENTS

ADDENDUM D5-3
EXHIBIT 2

SHEET 8 OF 16

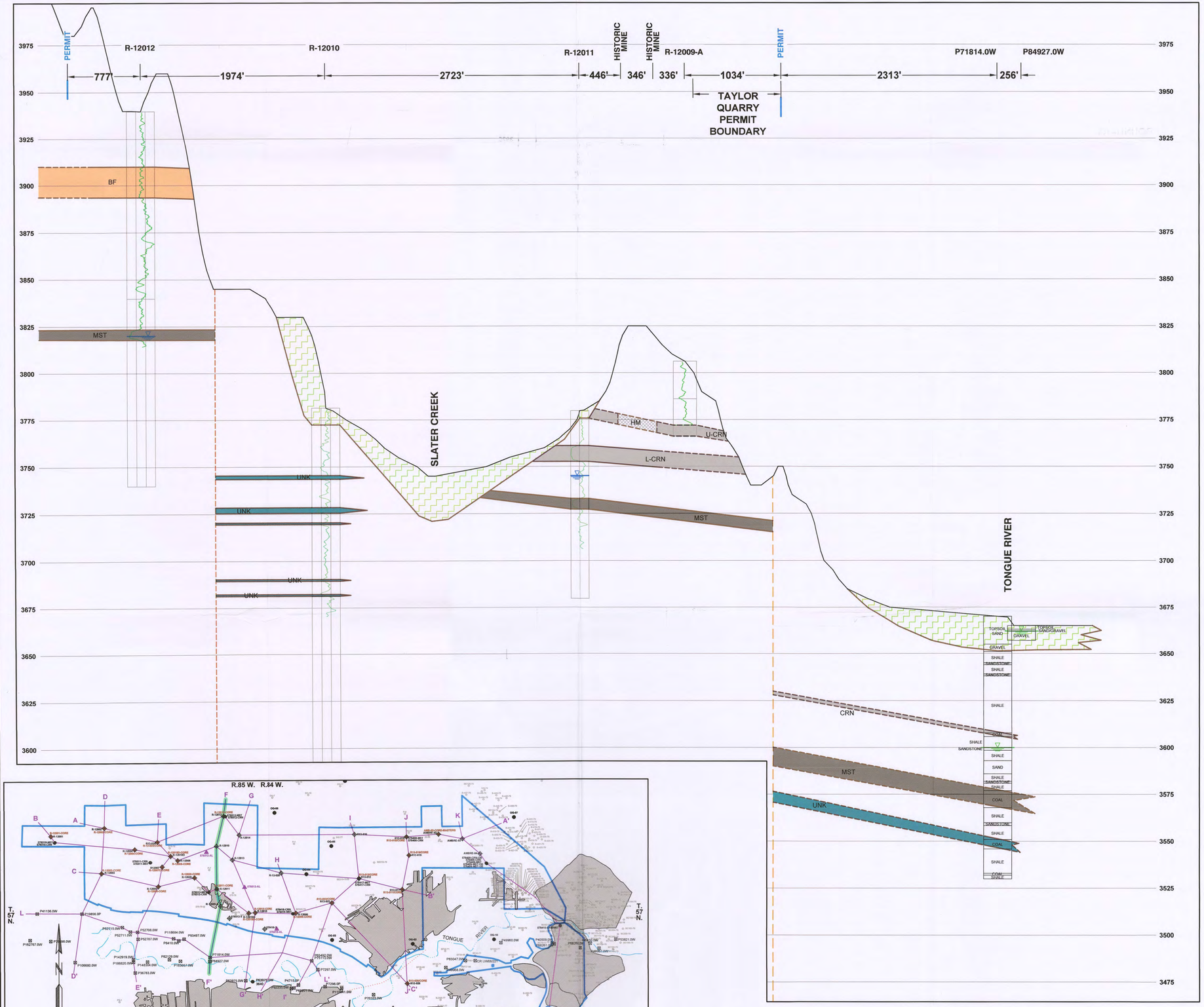
GEOLOGIC CROSS SECTIONS E-E'

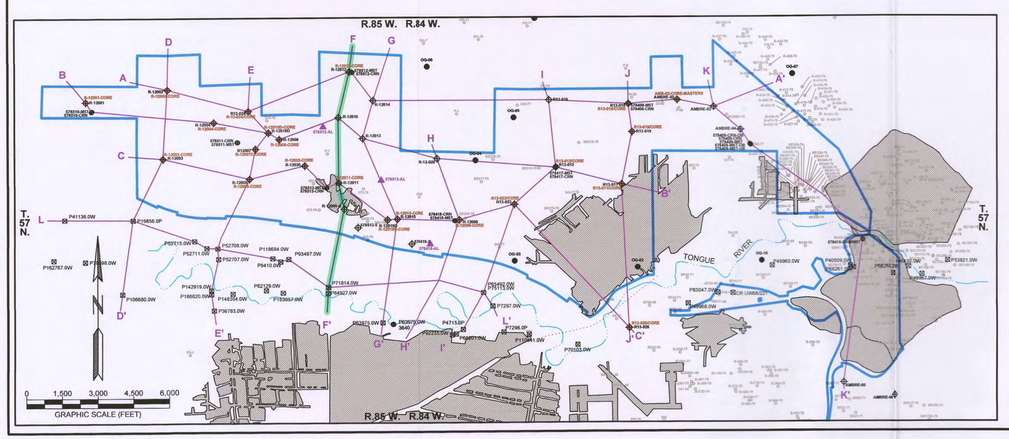
TFN 6 2/025
RECD DEC 13, 2019

Drawn By: MBM
Checked By: MJE
Date: 5/24/18

WWC ENGINEERING
www.wwcengineering.com

FILE: ADD_D5_3_GEO_CROSS_SECTIONS.dwg





CROSS SECTION F-F'

SCALE: HORIZ. 1" = 500', VERT. 1" = 25'

LEGEND

- BROOK MINE PERMIT BOUNDARY
- CROSS SECTION SEGMENT SHOWN ON THIS SHEET
- POTENTIOMETRIC SURFACE (CARNEY)
- POTENTIOMETRIC SURFACE (MASTERS)
- SEO WATER LEVEL
- FAULT
- INFERRED FAULT
- R12011 EXPLORATION BOREHOLE
- P71814.0W STATE ENGINEER'S OFFICE PERMITTED WATER WELL
- 578418-CRN MONITOR WELL
- BE320-78 HISTORIC EXPLORATION BOREHOLE
- 578418-AL MONITOR WELL - ALLUVIUM
- OG-13 WOGCC OIL OR GAS WELL
- R-12006-CORE CORE HOLE
- CLAYSTONE/SILTSTONE
- SS SANDSTONE
- BF BAKED/FUSED/CLINKER
- DZ DIETZ BEDS
- MON MONARCH COAL
- CRN CARNEY COAL
- HM HISTORIC MINING
- MST MASTERS COAL
- ALLUVIUM/COLLUVIUM AND/OR COLLUVIUM WITHIN CHANNEL BOTTOMS
- UNK UNKNOWN COAL SEAM (STRINGER)

NOTES:
1) REFER TO TABLE D5.3-1 FOR STRATIGRAPHIC NOMENCLATURE.
2) CONTACTS DASHED WHERE INFERRED.
3) COAL SEAM POTENTIOMETRY FROM EXHIBITS D6.2-2 AND D6.2-3.
4) REFER TO ADDENDUM D5-8 FOR SEO LITHOLOGY LOGS.

CERTIFICATE OF GEOLOGIST

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PROFESSIONAL GEOLOGIST
MICHAEL J. EVERS
PG-03
DATE 12-18-19
WYOMING

RAMACO

BROOK MINE
SHERIDAN COUNTY, WY
1101 SUGARVIEW DR. STE. 201
SHERIDAN, WY 82801

REVISIONS	
Date	Description
06/18	ROUND 7 COMMENTS
12/19	ROUND 11 COMMENTS

ADDENDUM D5-3
EXHIBIT 2

SHEET 9 OF 16

GEOLOGIC CROSS SECTION F-F'

TFN 6 2/025
RECD DEC 13, 2019

Drawn By: MBM
Checked By: MJE
Date: 5/24/18

WWC ENGINEERING
www.wwcengineering.com

FILE: ADD_D5_3_GEO_CROSS_SECTIONS.dwg

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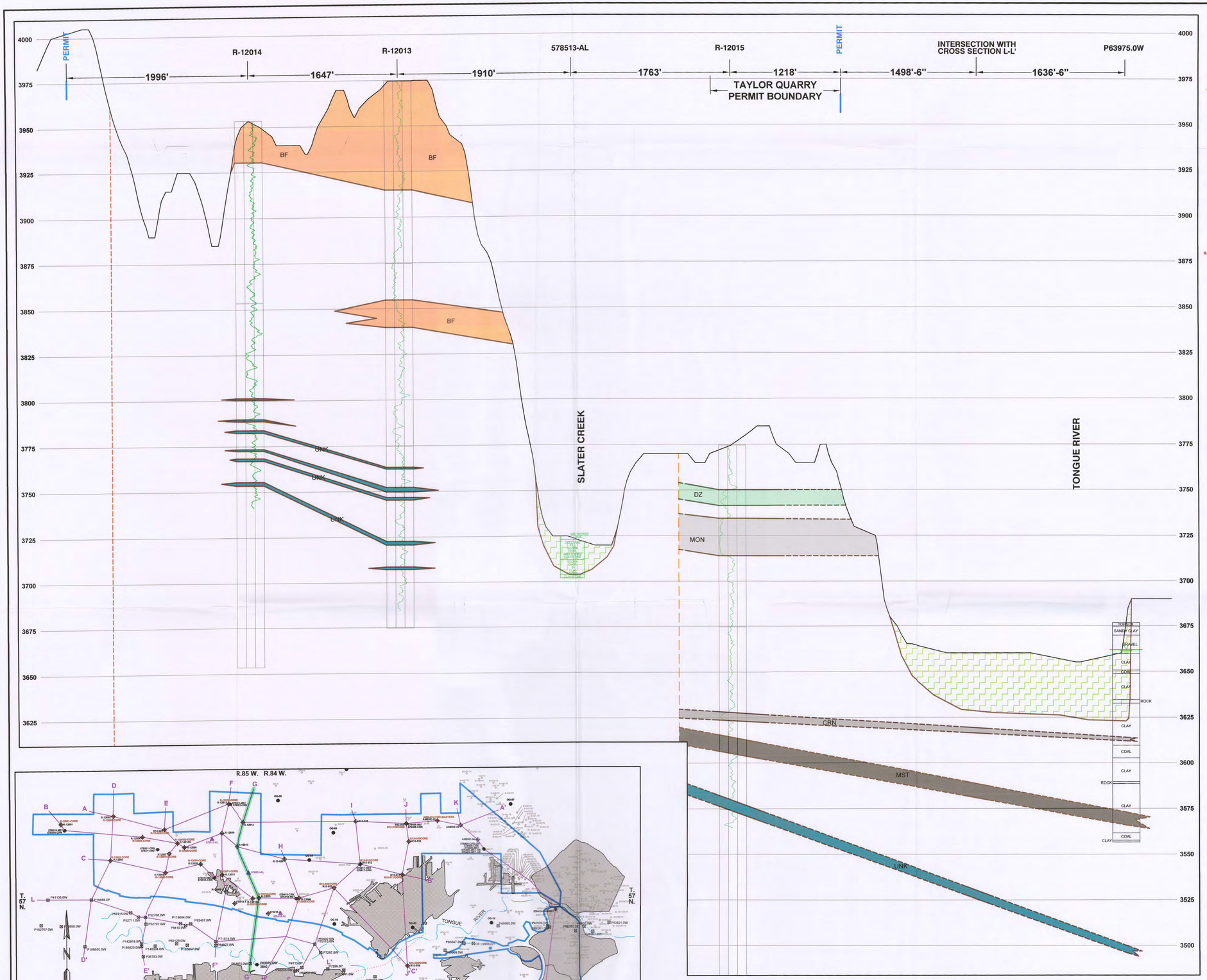

CROSS SECTION G-G'

SCALE: HORIZ. 1" = 500', VERT. 1" = 25'

LEGEND

- BROOK MINE PERMIT BOUNDARY
- CROSS SECTION SEGMENT SHOWN ON THIS SHEET
- POTENTIOMETRIC SURFACE (CARNEY)
- POTENTIOMETRIC SURFACE (MASTERS)
- SEO WATER LEVEL
- FAULT
- INFERRED FAULT
- R12011 EXPLORATION BOREHOLE
- P71814.0W STATE ENGINEER'S OFFICE PERMITTED WATER WELL
- 578418-CRN MONITOR WELL
- BE320-78 HISTORIC EXPLORATION BOREHOLE
- 578418-AL MONITOR WELL - ALLUVIUM
- OG-13 WOGCC OIL OR GAS WELL
- R-12006-CORE CORE HOLE
- CLAYSTONE/SILTSTONE
- SS SANDSTONE
- BF BAKED/FUSED/CLINKER
- DZ DIETZ BEDS
- MON MONARCH COAL
- CRN CARNEY COAL
- HM HISTORIC MINING
- MST MASTERS COAL
- ALLUVIUM/COLLUVIUM AND/OR COLLUVIUM WITHIN CHANNEL BOTTOMS
- UNK UNKNOWN COAL SEAM (STRINGER)

NOTES:
1) REFER TO TABLE D5.3-1 FOR STRATIGRAPHIC NOMENCLATURE.
2) CONTACTS DASHED WHERE INFERRED.
3) COAL SEAM POTENTIOMETRY FROM EXHIBITS D6.2-2 AND D6.2-3.
4) REFER TO ADDENDUM D5-8 FOR SEO LITHOLOGY LOGS.

CERTIFICATE OF GEOLOGIST

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PROFESSIONAL GEOLOGIST
MICHAEL J. EVERS
PG 3000
DATE 12-18-19
WYOMING

RAMACO

BROOK MINE
SHERIDAN COUNTY, WY
1101 SUGARVIEW DR. STE. 201
SHERIDAN, WY 82801

REVISIONS	
Date	Description
06/18	ROUND 7 COMMENTS
12/19	ROUND 11 COMMENTS

ADDENDUM D5-3
EXHIBIT 2

SHEET 10 OF 16

GEOLOGIC CROSS SECTION G-G'

TFNS 2/025
RECD DEC 13, 2019

Drawn By: MBM
Checked By: MJE
Date: 5/24/18

WWC ENGINEERING
www.wwcengineering.com

FILE: ADD_D5_3_GEO_CROSS_SECTIONS.dwg

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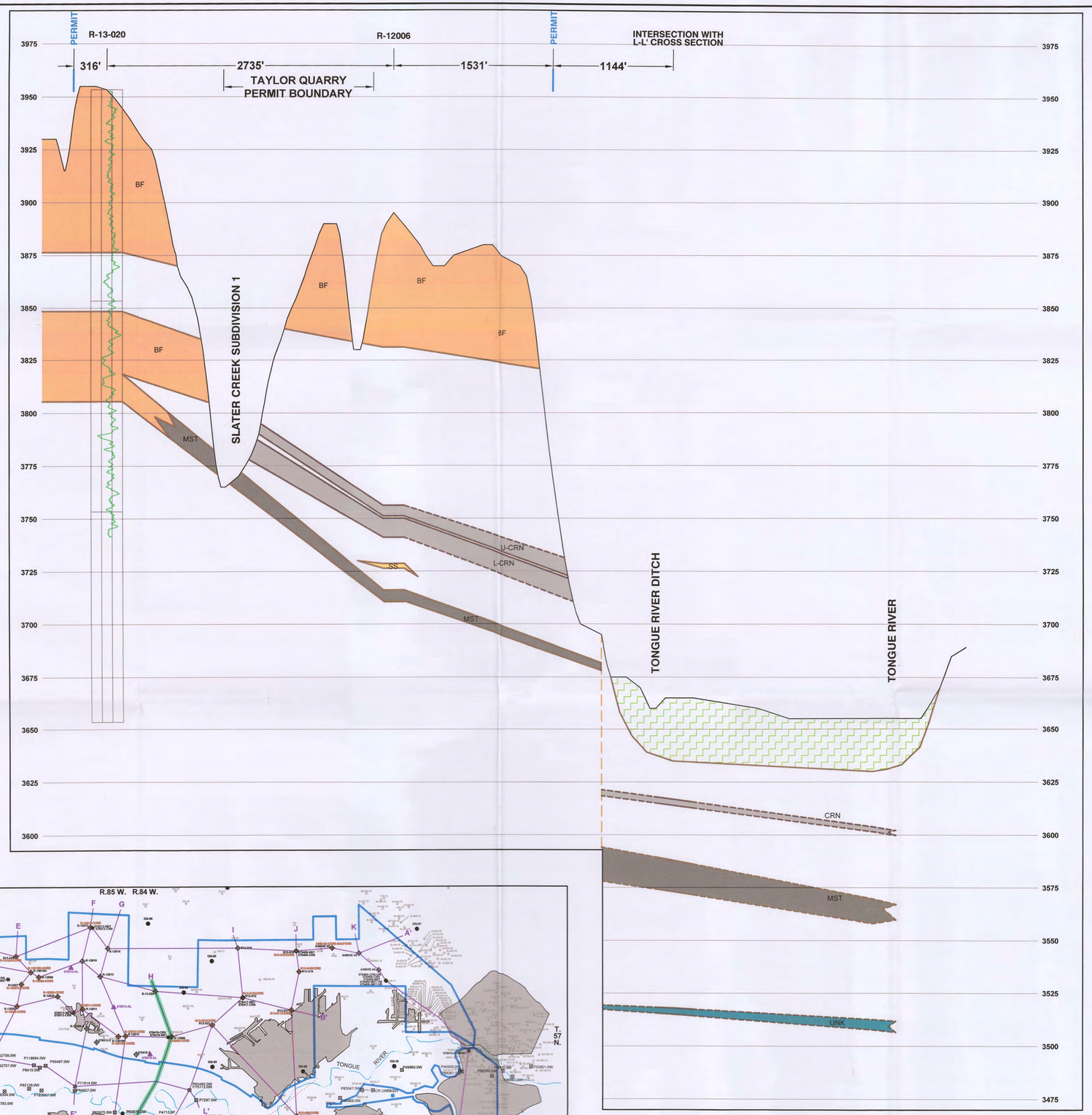
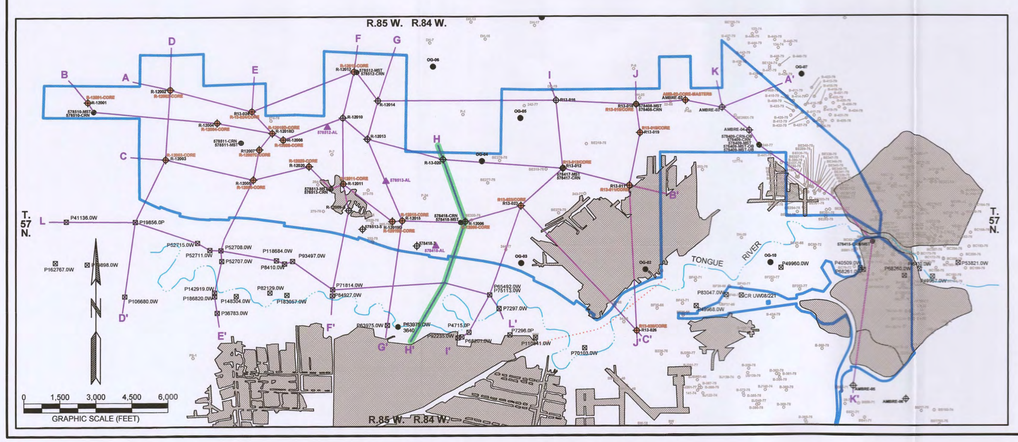


CROSS SECTION H-H'

SCALE: HORIZ. 1" = 500', VERT. 1" = 25'



LEGEND

- BROOK MINE PERMIT BOUNDARY
- CROSS SECTION SEGMENT SHOWN ON THIS SHEET
- POTENTIOMETRIC SURFACE (CARNEY)
- POTENTIOMETRIC SURFACE (MASTERS)
- FAULT
- INFERRED FAULT
- R12011 EXPLORATION BOREHOLE
- P71814.0W STATE ENGINEER'S OFFICE PERMITTED WATER WELL
- 578418-CRN MONITOR WELL
- BE335-79 HISTORIC EXPLORATION BOREHOLE
- 578418-AL MONITOR WELL - ALLUVIUM
- OG-13 WOGCC OIL OR GAS WELL
- R-12006-CORE CORE HOLE

- CLAYSTONE/SILTSTONE
- SS SANDSTONE
- BF BAKED/FUSED/CLINKER
- DZ DIETZ BEDS
- MON MONARCH COAL
- CRN CARNEY COAL
- HM HISTORIC MINING
- MST MASTERS COAL
- ALLUVIUM/COLLUVIUM AND/OR COLLUVIUM WITHIN CHANNEL BOTTOMS
- UNK UNKNOWN COAL SEAM (STRINGER)

NOTES:
1) REFER TO TABLE D5.3-1 FOR STRATIGRAPHIC NOMENCLATURE.
2) CONTACTS DASHED WHERE INFERRED.
3) COAL SEAM POTENTIOMETRY FROM EXHIBITS D6.2-2 AND D6.2-3.

CERTIFICATE OF GEOLOGIST

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PROFESSIONAL GEOLOGIST
MICHAEL J. EVERS
PG
DATE 9-12-18
WYOMING

RAMACO

BROOK MINE
SHERIDAN COUNTY, WY

1101 SUGARVIEW DR. STE. 201
SHERIDAN, WY 82801

REVISIONS	
Date	Description
06/18	ROUND 7 COMMENTS

ADDENDUM D5-3
EXHIBIT 2

TFN 6 2/025
RECD 10-25-18

SHEET 11 OF 16

GEOLOGIC CROSS SECTION H-H'

Drawn By: MBM
Checked By: MJE
Date: 5/24/18

WWC ENGINEERING
www.wwcengineering.com

FILE: ADD_D5_3_GEO_CROSS_SECTIONS.dwg

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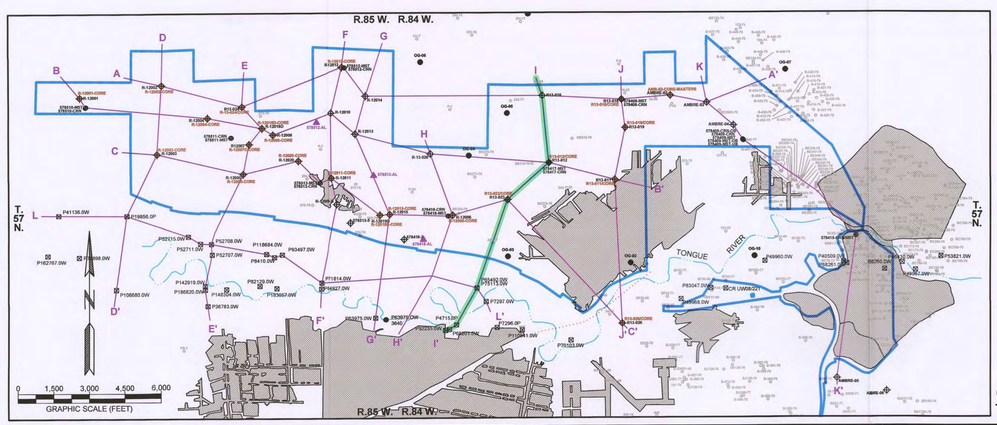

CROSS SECTION I-I'

SCALE: HORIZ. 1" = 500', VERT. 1" = 25'

LEGEND

- BROOK MINE PERMIT BOUNDARY
- CROSS SECTION SEGMENT SHOWN ON THIS SHEET
- POTENTIOMETRIC SURFACE (CARNEY)
- POTENTIOMETRIC SURFACE (MASTERS)
- SEO WATER LEVEL
- FAULT
- INFERRED FAULT
- R12011 EXPLORATION BOREHOLE
- P71814.0W STATE ENGINEER'S OFFICE PERMITTED WATER WELL
- 578418-CRN MONITOR WELL
- BE335-78 HISTORIC EXPLORATION BOREHOLE
- 578418-AL MONITOR WELL - ALLUVIUM
- OG-13 WOGCC OIL OR GAS WELL
- R-12006-CORE CORE HOLE
- CLAYSTONE/SILTSTONE
- SS SANDSTONE
- BF BAKED/FUSED/CLINKER
- DZ DIETZ BEDS
- MON MONARCH COAL
- CRN CARNEY COAL
- HM HISTORIC MINING
- MST MASTERS COAL
- ALLUVIUM/COLLUVIUM AND/OR COLLUVIUM WITHIN CHANNEL BOTTOMS
- UNK UNKNOWN COAL SEAM (STRINGER)

NOTES:
1) REFER TO TABLE D5.3-1 FOR STRATIGRAPHIC NOMENCLATURE.
2) CONTACTS DASHED WHERE INFERRED.
3) COAL SEAM POTENTIOMETRY FROM EXHIBITS D6.2-2 AND D6.2-3.
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PROFESSIONAL GEOLOGIST
MICHAEL J. EVERS
PG-81
DATE 12-10-19
WYOMING

RAMACO

BROOK MINE
SHERIDAN COUNTY, WY
1101 SUGARVIEW DR. STE. 201
SHERIDAN, WY 82801

REVISIONS	
Date	Description
06/18	ROUND 7 COMMENTS
12/19	ROUND 11 COMMENTS

ADDENDUM D5-3
EXHIBIT 2

SHEET 12 OF 16

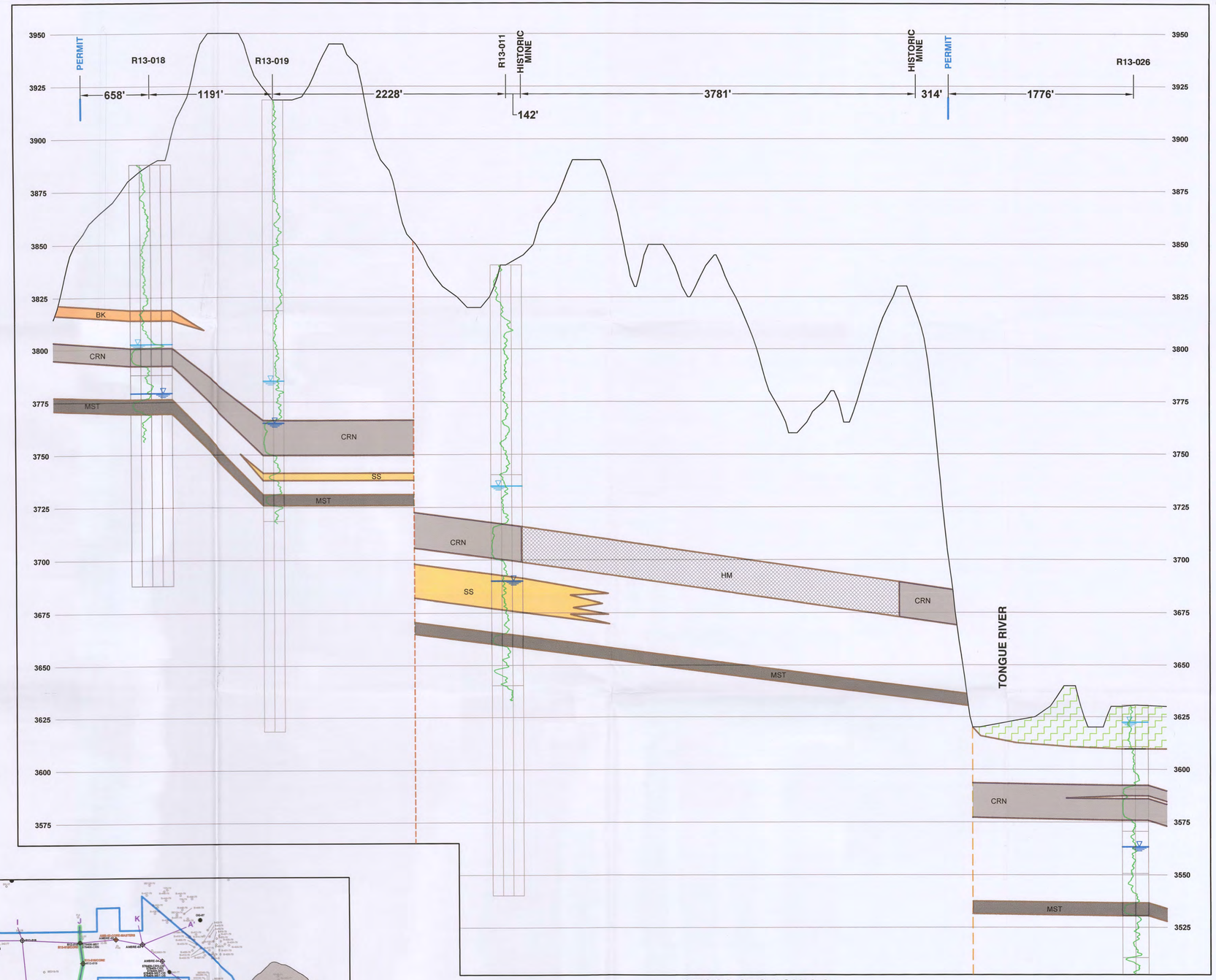
GEOLOGIC CROSS SECTION I-I'

TFN 6 2/025
RECD DEC 13, 2019

Drawn By: MBM
Checked By: MJE
Date: 5/24/18

WWC ENGINEERING
www.wwcengineering.com

FILE: ADD_D5_3_GEO_CROSS_SECTIONS.dwg



CROSS SECTION J-J'

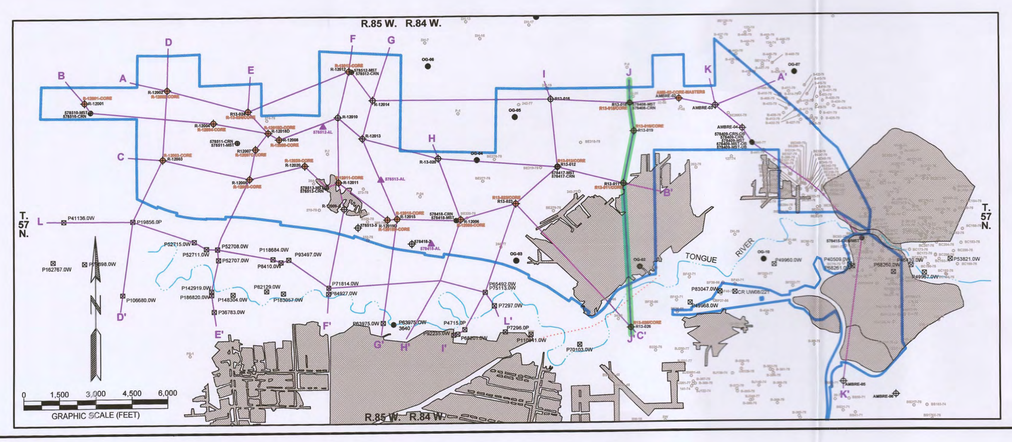
SCALE: HORIZ. 1" = 500', VERT. 1" = 25'

LEGEND

- BROOK MINE PERMIT BOUNDARY
- CROSS SECTION SEGMENT SHOWN ON THIS SHEET
- POTENTIOMETRIC SURFACE (CARNEY)
- POTENTIOMETRIC SURFACE (MASTERS)
- FAULT
- INFERRED FAULT
- R12011 EXPLORATION BOREHOLE
- P71814.0W STATE ENGINEER'S OFFICE PERMITTED WATER WELL
- 578418-CRN MONITOR WELL
- BE320-78 HISTORIC EXPLORATION BOREHOLE
- 578419-AL MONITOR WELL - ALLUVIUM
- OG-13 WOGCC OIL OR GAS WELL
- R-12009-CORE CORE HOLE

- CLAYSTONE/SILTSTONE
- SS SANDSTONE
- BF BAKED/FUSED/CLINKER
- DZ DIETZ BEDS
- MON MONARCH COAL
- CRN CARNEY COAL
- HM HISTORIC MINING
- MST MASTERS COAL
- ALLUVIUM/COLLUVIUM AND/OR COLLUVIUM WITHIN CHANNEL BOTTOMS
- UNK UNKNOWN COAL SEAM (STRINGER)

NOTES:
1) REFER TO TABLE D5.3-1 FOR STRATIGRAPHIC NOMENCLATURE.
2) CONTACTS DASHED WHERE INFERRED.
3) COAL SEAM POTENTIOMETRY FROM EXHIBITS D6.2-2 AND D6.2-3.



CERTIFICATE OF GEOLOGIST

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PROFESSIONAL GEOLOGIST MICHAEL J. EVERS PG 93 DATE 9-12-18 WYOMING

RAMACO

BROOK MINE
SHERIDAN COUNTY, WY
1101 SUGARVIEW DR. STE. 201
SHERIDAN, WY 82801

REVISIONS	
Date	Description
06/18	ROUND 7 COMMENTS

ADDENDUM D5-3
EXHIBIT 2

TFN 6 2/025
RECD 10-25-18

SHEET 13 OF 16

GEOLOGIC CROSS SECTION J-J'

Drawn By: MBM
Checked By: MJE
Date: 5/24/18

WWC ENGINEERING
www.wwcengineering.com

FILE: ADD_D5_3_GEO_CROSS_SECTIONS.dwg

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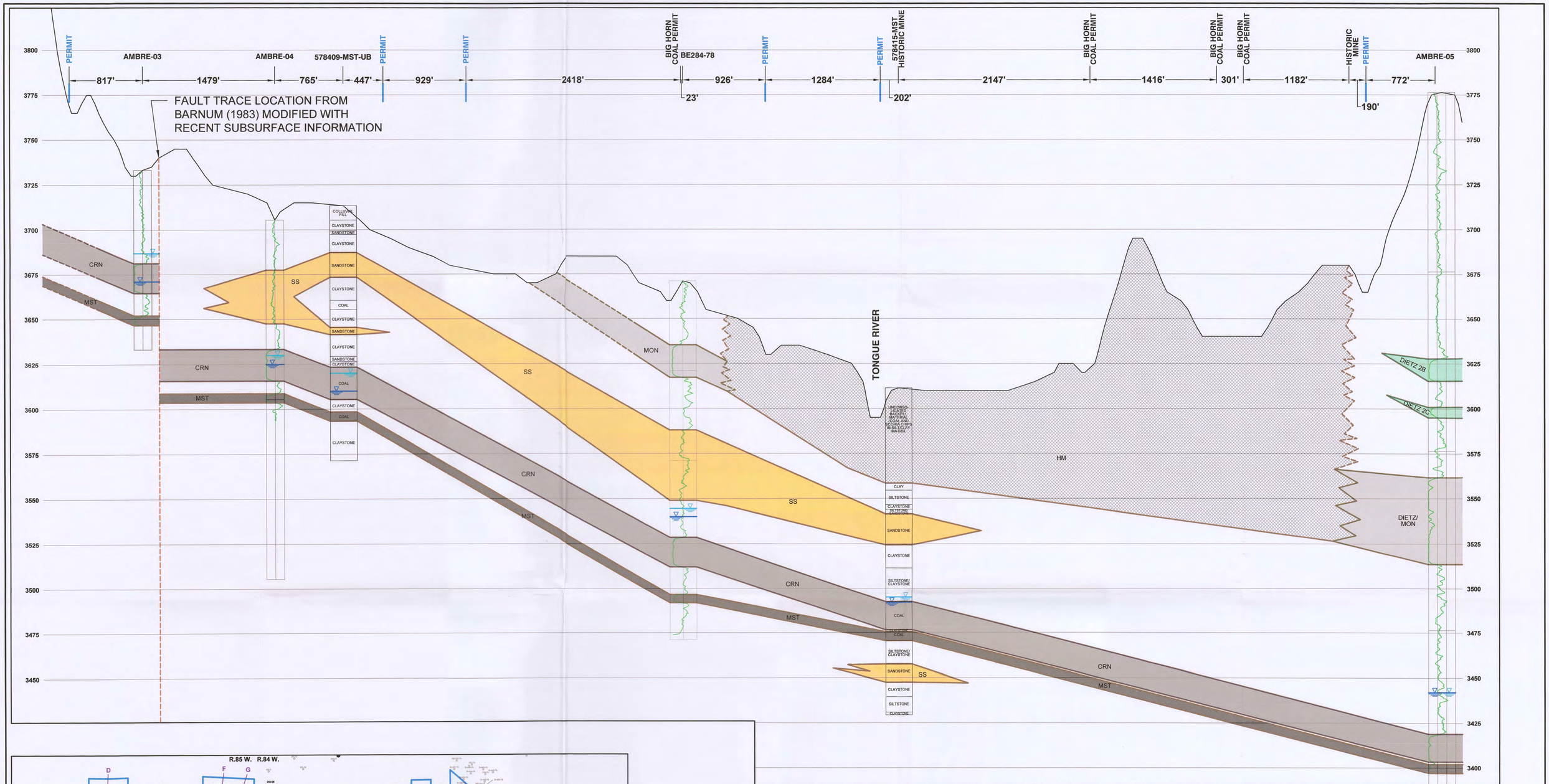
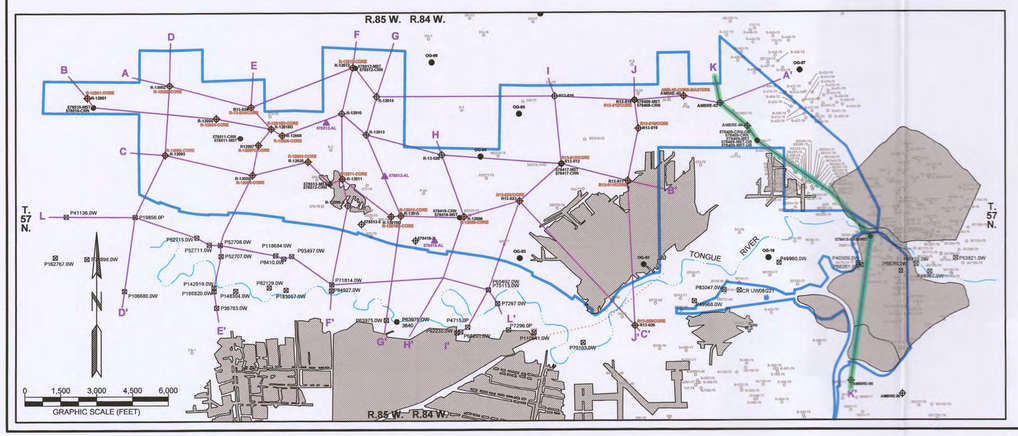


CROSS SECTION K-K'

SCALE: HORIZ. 1" = 500', VERT. 1" = 25'



LEGEND

- BROOK MINE PERMIT BOUNDARY
- CROSS SECTION SEGMENT SHOWN ON THIS SHEET
- POTENTIOMETRIC SURFACE (CARNEY)
- POTENTIOMETRIC SURFACE (MASTERS)
- FAULT
- INFERRED FAULT
- R12011 EXPLORATION BOREHOLE
- P71814.0W STATE ENGINEER'S OFFICE PERMITTED WATER WELL
- 578418-CRN MONITOR WELL
- BE320-78 HISTORIC EXPLORATION BOREHOLE
- 578415-AL MONITOR WELL - ALLUVIUM
- OG-13 WOGCC OIL OR GAS WELL
- R-12005-CORE CORE HOLE

- CLAYSTONE/SILTSTONE
- SS SANDSTONE
- BF BAKED/FUSED/CLINKER
- DZ DIETZ BEDS
- MON MONARCH COAL
- CRN CARNEY COAL
- HM HISTORIC MINING
- MST MASTERS COAL
- ALLUVIUM/COLLUVIUM AND/OR COLLUVIUM WITHIN CHANNEL BOTTOMS
- UNK UNKNOWN COAL SEAM (STRINGER)

NOTES:
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2) CONTACTS DASHED WHERE INFERRED.
3) COAL SEAM POTENTIOMETRY FROM EXHIBITS D6.2-2 AND D6.2-3.

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PROFESSIONAL GEOLOGIST MICHAEL J. EVERS PG 98 WYOMING
DATE 9-12-18

RAMACO

BROOK MINE
SHERIDAN COUNTY, WY
1101 SUGARVIEW DR. STE. 201
SHERIDAN, WY 82801

REVISIONS	
Date	Description
06/18	ROUND 7 COMMENTS

ADDENDUM D5-3
EXHIBIT 2

TFN 6 2/025
RECD 10-25-18

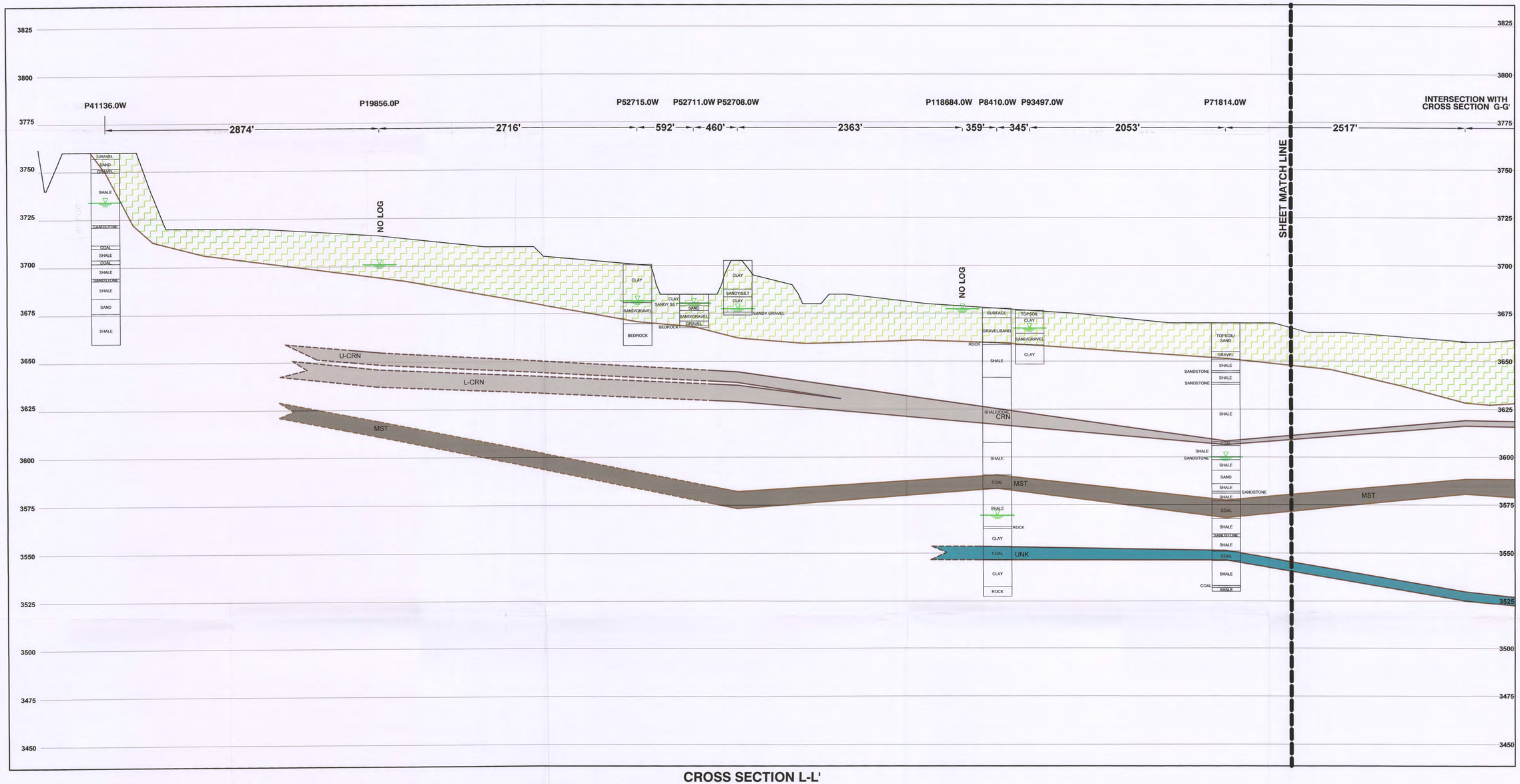
SHEET 14 OF 16

GEOLOGIC CROSS SECTION K-K'

Drawn By: MBM
Checked By: MJE
Date: 5/24/18

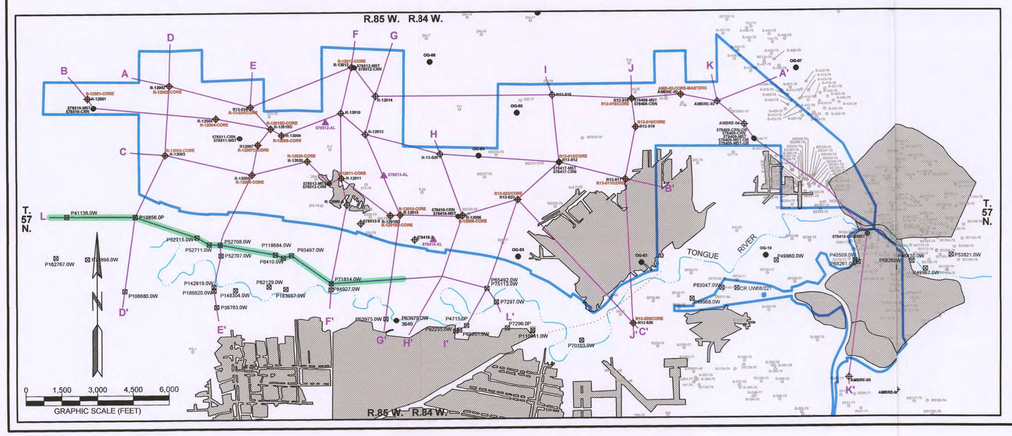
FILE: ADD_D5_3_GEO_CROSS_SECTIONS.dwg

WWC ENGINEERING
www.wwcengineering.com



CROSS SECTION L-L'

SCALE: HORIZ. 1" = 500', VERT. 1" = 25'



LEGEND

- BROOK MINE PERMIT BOUNDARY
- CROSS SECTION SEGMENT SHOWN ON THIS SHEET
- POTENTIOMETRIC SURFACE (CARNEY)
- POTENTIOMETRIC SURFACE (MASTERS)
- SEO WATER LEVEL
- FAULT
- INFERRED FAULT
- R12011 EXPLORATION BOREHOLE
- P71814.0W STATE ENGINEER'S OFFICE PERMITTED WATER WELL
- 578418-CRN MONITOR WELL
- BE320-78 HISTORIC EXPLORATION BOREHOLE
- 578418-AL MONITOR WELL - ALLUVIUM
- OG-13 WOGCC OIL OR GAS WELL
- R-12006-CORE CORE HOLE
- CLAYSTONE/SILTSTONE
- SS SANDSTONE
- BF BAKED/FUSED/CLINKER
- DZ DIETZ BEDS
- MON MONARCH COAL
- CRN CARNEY COAL
- HM HISTORIC MINING
- MST MASTERS COAL
- ALLUVIUM/COLLUVIUM AND/OR COLLUVIUM WITHIN CHANNEL BOTTOMS
- UNK UNKNOWN COAL SEAM (STRINGER)

NOTES:
1) REFER TO TABLE D5.3-1 FOR STRATIGRAPHIC NOMENCLATURE.
2) CONTACTS DASHED WHERE INFERRED.
3) COAL SEAM POTENTIOMETRY FROM EXHIBITS D6.2-2 AND D6.2-3.
4) REFER TO ADDENDUM D5-8 FOR SEO LITHOLOGY LOGS.

CERTIFICATE OF GEOLOGIST

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PROFESSIONAL GEOLOGIST MICHAEL J. EVERS PG 3165 DATE 12-10-19 WYOMING

RAMACO

BROOK MINE
SHERIDAN COUNTY, WY
1101 SUGARVIEW DR. STE. 201
SHERIDAN, WY 82801

REVISIONS	
Date	Description
06/18	ROUND 7 COMMENTS
12/19	ROUND 11 COMMENTS

ADDENDUM D5-3
EXHIBIT 2

SHEET 15 OF 16

GEOLOGIC CROSS SECTION L-L'
SEGMENT 1 OF 2

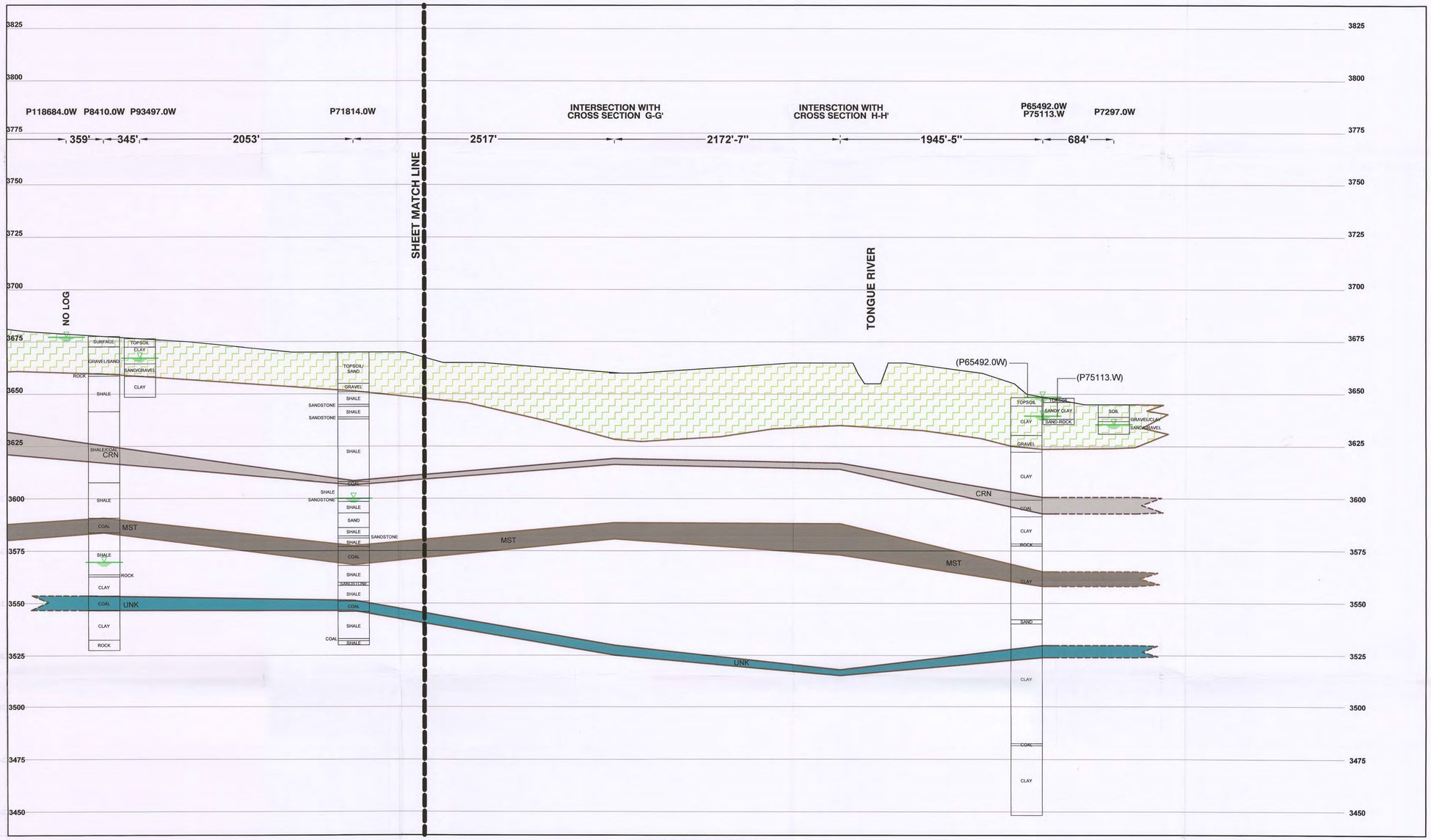
TFNG 2/025
RECD DEC 13, 2019

Drawn By: MBM
Checked By: MJE
Date: 5/24/18

WWC ENGINEERING
www.wwcengineering.com

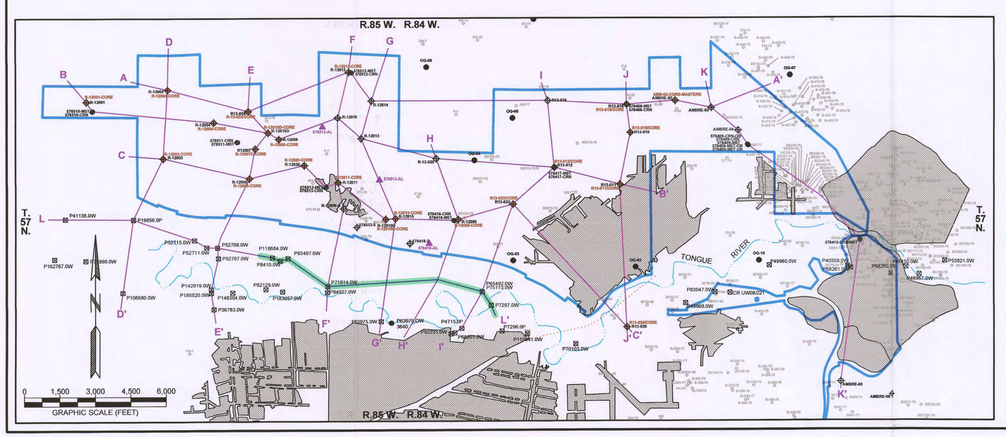
FILE: ADD_D5_3_GEO_CROSS_SECTIONS.dwg

K:\Sheridan\RAMACO\5115\RAWCAD_WYE\SECDWG\GEOWGS_GRROUND_11_COMMENT\ADDDD\MJMADD_D5_3_GEO_CROSS_SECTIONS.dwg 12/5/2019 2:35:45 PM mof wwcEng



CROSS SECTION L-L'

SCALE: HORIZ. 1" = 500', VERT. 1" = 25'



LEGEND

- BROOK MINE PERMIT BOUNDARY
- CROSS SECTION SEGMENT SHOWN ON THIS SHEET
- POTENTIOMETRIC SURFACE (CARNEY)
- POTENTIOMETRIC SURFACE (MASTERS)
- SEO WATER LEVEL
- FAULT
- INFERRED FAULT
- R12011 EXPLORATION BOREHOLE
- P71814.0W STATE ENGINEER'S OFFICE PERMITTED WATER WELL
- 578418-CRN MONITOR WELL
- BE335-78 HISTORIC EXPLORATION BOREHOLE
- 578418-AL MONITOR WELL - ALLUVIUM
- OG-13 WOGCC OIL OR GAS WELL
- R-12006-CORE CORE HOLE

- CLAYSTONE/SILTSTONE
- SS SANDSTONE
- BF BAKED/FUSED/CLINKER
- DZ DIETZ BEDS
- MON MONARCH COAL
- CRN CARNEY COAL
- HM HISTORIC MINING
- MST MASTERS COAL
- ALLUVIUM/COLLUVIUM AND/OR COLLUVIUM WITHIN CHANNEL BOTTOMS
- UNK UNKNOWN COAL SEAM (STRINGER)

NOTES:
1) REFER TO TABLE D5.3-1 FOR STRATIGRAPHIC NOMENCLATURE.
2) CONTACTS DASHED WHERE INFERRED.
3) COAL SEAM POTENTIOMETRY FROM EXHIBITS D6.2-2 AND D6.2-3.
4) REFER TO ADDENDUM D5-8 FOR SEO LITHOLOGY LOGS.

CERTIFICATE OF GEOLOGIST

I, Michael J. Evers, hereby certify that this drawing was prepared by myself or under my direct supervision and that it correctly represents the conditions described in the accompanying application which is provided to meet the requirements of the Wyoming Environmental Quality Act and its regulations.

Disclaimer: Well completion data from the SEO database are included in this cross section at agency request. These data have not been verified.

PROFESSIONAL GEOLOGIST MICHAEL J. EVERS PG. 1 DATE 12-10-19 WYOMING

RAMACO

BROOK MINE
SHERIDAN COUNTY, WY
1101 SUGARVIEW DR. STE. 201
SHERIDAN, WY 82801

REVISIONS	
Date	Description
06/18	ROUND 7 COMMENTS
12/19	ROUND 11 COMMENTS

ADDENDUM D5-3
EXHIBIT 2

SHEET 16 OF 16

GEOLOGIC CROSS SECTION L-L'
SEGMENT 2 OF 2

TFN 8 2/025
RECD DEC 13, 2019

Drawn By: MBM
Checked By: MJE
Date: 5/24/18

WWC ENGINEERING
www.wwcengineering.com

FILE: ADD_D5_3_GEO_CROSS_SECTIONS.dwg

Scanned, 02/28/2020

ADDENDUM D5-4

Isopach Maps

TFN 6 2/025
RECD JUL 30,2015

Scanned, 02/28/2020

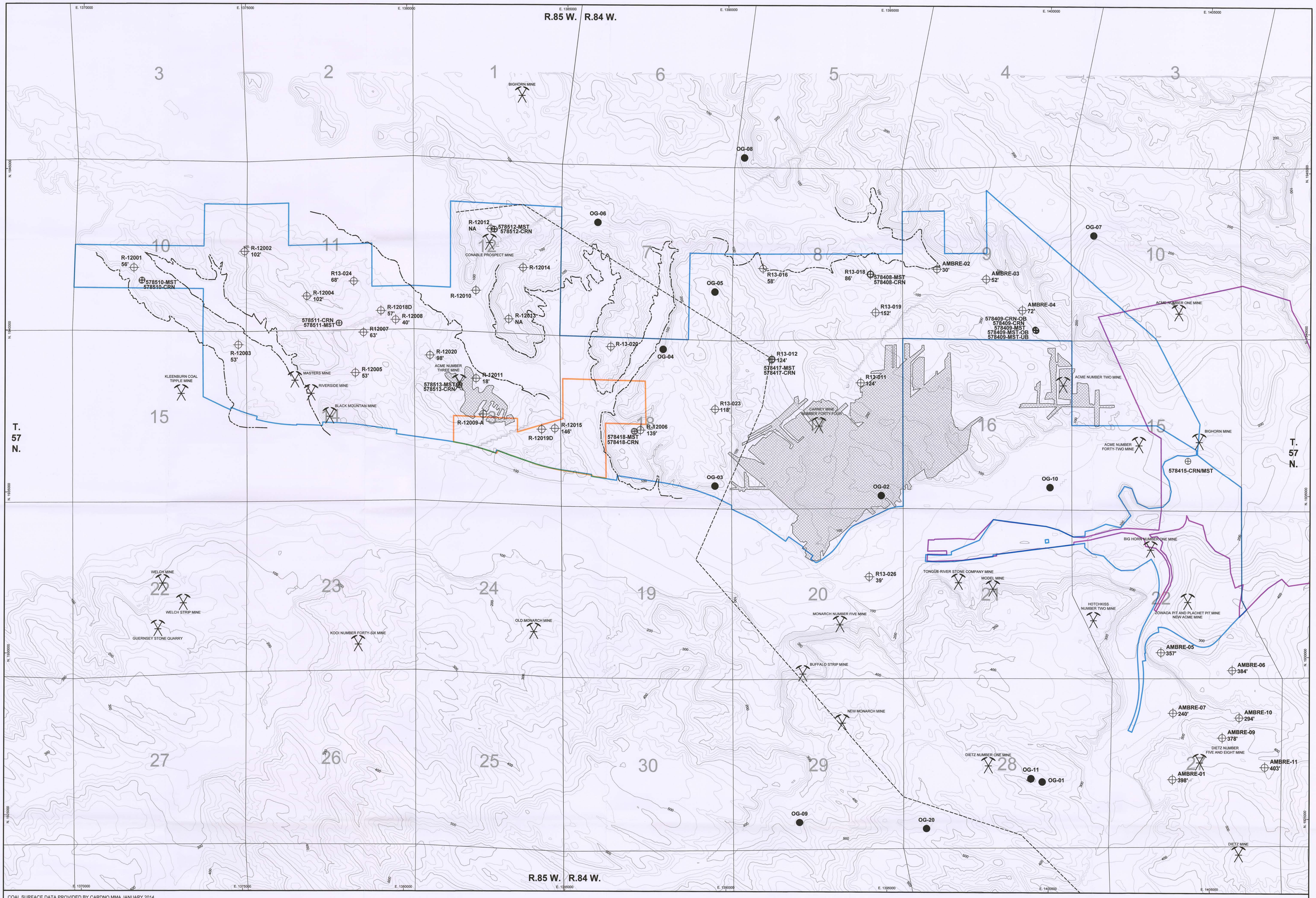
ADDENDUM D5-4

TABLE OF CONTENTS

Addendum D5-4 Exhibit 1	Overburden Isopach Overlying the Carney Coal Seam
Addendum D5-4 Exhibit 2	Carney Coal Seam Isopach
Addendum D5-4 Exhibit 3	Upper Carney Coal Seam Isopach
Addendum D5-4 Exhibit 4	Upper & Lower Carney Interburden Isopach
Addendum D5-4 Exhibit 5	Lower Carney Coal Seam Isopach
Addendum D5-4 Exhibit 6	Lower Carney and Masters Interburden Isopach
Addendum D5-4 Exhibit 7	Masters Coal Seam Isopach
Addendum D5-4 Exhibit 8	Bottom Elevation of Masters Coal Seam

TFN 6 2/025
RECD JUL 30,2015

DEQ Ex. 2-268



COAL SURFACE DATA PROVIDED BY CARDNO MMA JANUARY 2014.

LEGEND

- BROOK MINE PERMIT BOUNDARY
- BIG HORN COAL PERMIT BOUNDARY (PERMIT NO. 213-T7)
- TAYLOR QUARRY PERMIT BOUNDARY (PERMIT NO. SP-757)
- APPROXIMATE LOCATION OF CARNEY SPLIT
- CARNEY NO COAL LINE
- R-12011 138' — EXPLORATION BOREHOLE THICKNESS
- 578418-CRN — MONITOR WELL
- OG-13 — WOGCC OIL OR GAS WELL
- CARNEY SEAM REMOVED BY HISTORIC MINING
- DIETZ MINE — HISTORIC MINE LOCATION

NOTES:
1. SEE ADDENDUM D5-2 FOR SEAM THICKNESS AND NAME.
2. NA: INDICATES THE PRESENCE OF CARNEY BURN.

CERTIFICATE OF ENGINEER

I, Jeffrey G. Barron, hereby certify that this drawing was prepared by myself or by engineers under my direct supervision and that it correctly represents the conditions described in the accompanying application which is designed to meet the requirements of the Wyoming Environmental Quality Act and its accompanying regulations.

Professional Engineer (Civil) Jeffrey G. Barron 13033 WYOMING
Date 12/31/2015

0 500 1,000 1,500 2,000
GRAPHIC SCALE (FEET)
C.I. = 20'

RAMACO

BROOK MINE
SHERIDAN COUNTY, WY

1101 SUGARVIEW DR, STE. 201
SHERIDAN, WY 82801

REVISIONS	
Date	Description
06/15	ROUND 1 COMMENTS
10/15	ROUND 2 COMMENTS
12/15	ROUND 3 COMMENTS

ADDENDUM D5-4
EXHIBIT 1

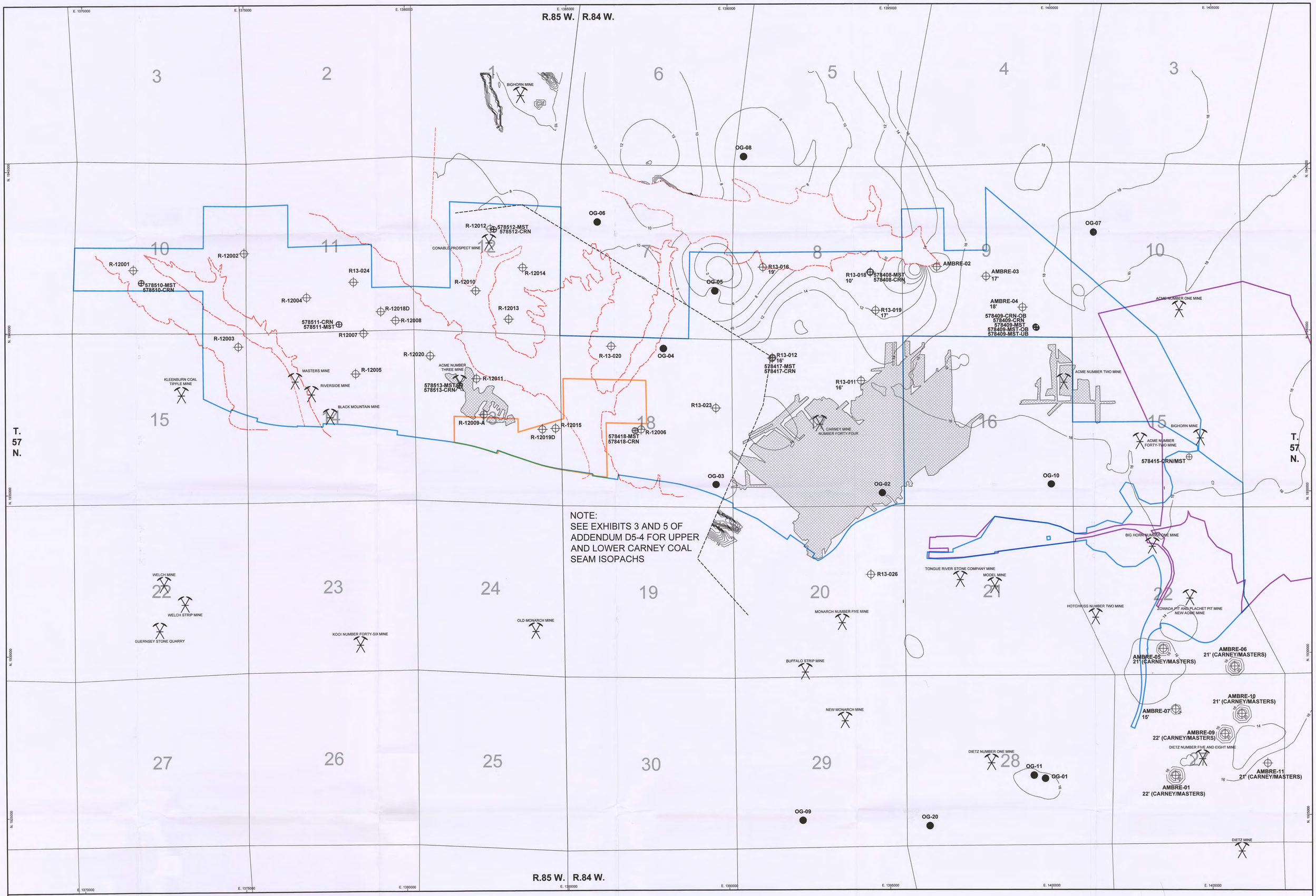
TFN 6 2/025
RECD DEC 18, 2015

OVERBURDEN ISOPACH OVERLYING THE CARNEY COAL SEAM

Drawn By: DCJ
Checked By: JGB
Date: 10/08/14

WWC ENGINEERING
www.wwcengineering.com

FILE: D5_4-1_OVB_ISO_R3.dwg



COAL SURFACE DATA PROVIDED BY CARDNO MMA JANUARY 2014.

TFN 6 2/025
RECD OCT 23, 2015

LEGEND

- BROOK MINE PERMIT BOUNDARY
- BIG HORN COAL PERMIT BOUNDARY (PERMIT NO. 213-T7)
- TAYLOR QUARRY PERMIT BOUNDARY (PERMIT NO. SP-757)
- APPROXIMATE LOCATION OF CARNEY SPLIT
- CARNEY NO COAL LINE
- CARNEY NO COAL LINE (INFERRED)
- R-12011 15' — EXPLORATION BOREHOLE THICKNESS
- 578418-CRN — MONITOR WELL
- OG-13 — WOGCC OIL OR GAS WELL
- CARNEY SEAM REMOVED BY HISTORIC MINING
- DIETZ MINE — HISTORIC MINE LOCATION

NOTE:
SEE ADDENDUM D5-2 FOR SEAM THICKNESS AND NAME.

CERTIFICATE OF ENGINEER

I, Jeffrey G. Barron, hereby certify that this drawing was prepared by myself or by engineers under my direct supervision and that it correctly represents the conditions described in the accompanying application which is designed to meet the requirements of the Wyoming Environmental Quality Act and its accompanying regulations.

Professional Engineer (Civil) JEFFREY G. BARRON 13033 WYOMING

10/12/2015

N

0 500 1,000 1,500 2,000
GRAPHIC SCALE (FEET)
C.I. = 2'

RAMACO

BROOK MINE
SHERIDAN COUNTY, WY
1101 SUGARVIEW DR, STE. 201
SHERIDAN, WY 82801

REVISIONS	
Date	Description
06/15	ROUND 1 COMMENTS
10/15	ROUND 2 COMMENTS

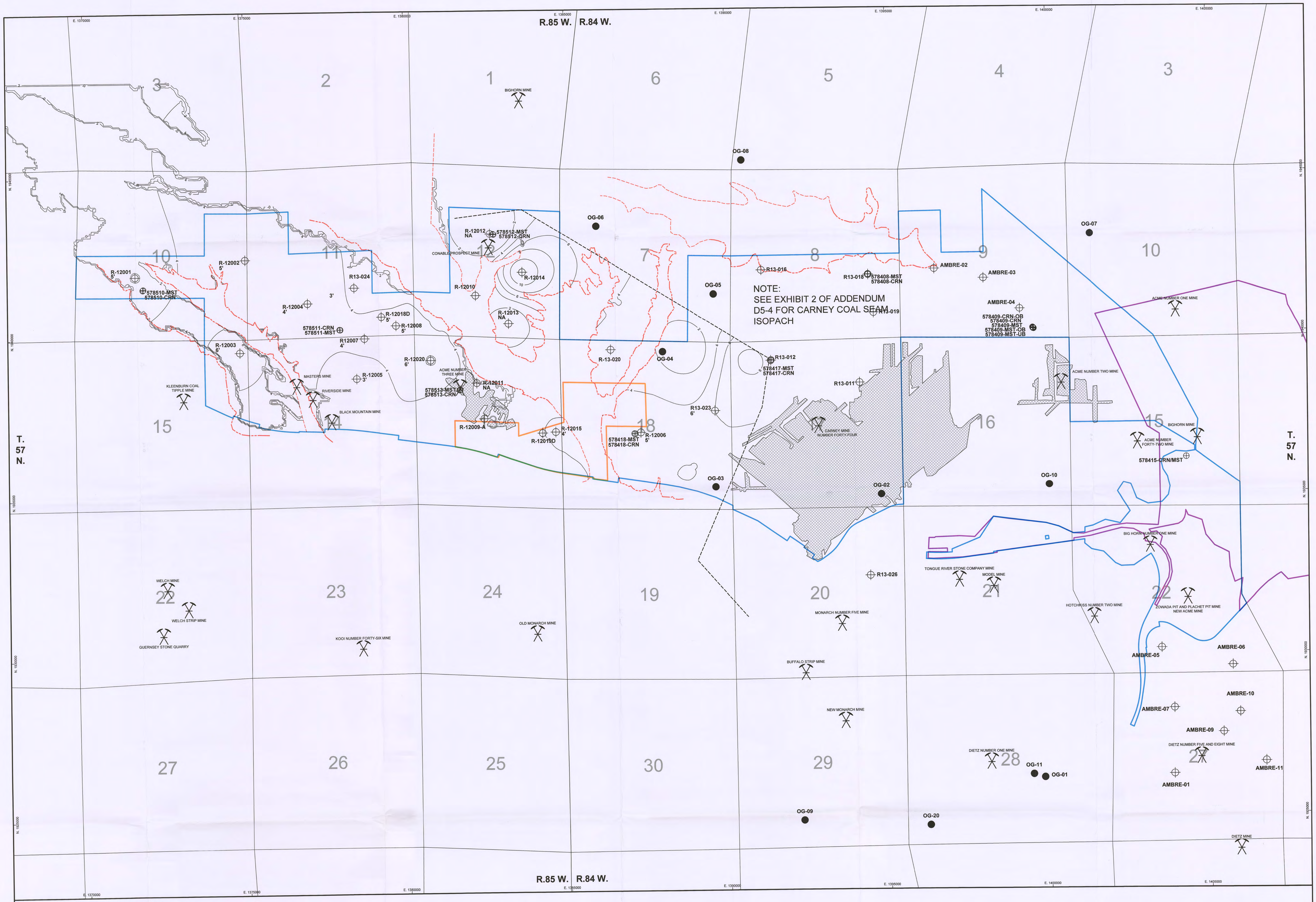
ADDENDUM D5-4
EXHIBIT 2

CARNEY COAL SEAM ISOPACH

Drawn By: DCJ
Checked By: JGB
Date: 10/08/14

WWC ENGINEERING
www.wwcengineering.com

FILE: D5_4-4_CARNEY_ISO_R2.dwg



TFN 6 2/025
RECD OCT 23, 2015

LEGEND

- BROOK MINE PERMIT BOUNDARY
- BIG HORN COAL PERMIT BOUNDARY (PERMIT NO. 213-T7)
- TAYLOR QUARRY PERMIT BOUNDARY (PERMIT NO. SP-757)
- APPROXIMATE LOCATION OF CARNEY SPLIT
- CARNEY NO COAL LINE
- CARNEY NO COAL LINE (INFERRED)
- R-12011 15' — EXPLORATION BOREHOLE THICKNESS
- 578418-CRN — MONITOR WELL
- OG-13 — WOGCC OIL OR GAS WELL
- CARNEY SEAM REMOVED BY HISTORIC MINING
- DIETZ MINE — HISTORIC MINE LOCATION

NOTES:
1. SEE ADDENDUM D5-2 FOR SEAM THICKNESS AND NAME.
2. NA: INDICATES THE PRESENCE OF CARNEY BURN.

CERTIFICATE OF ENGINEER

I, Jeffrey G. Barron, hereby certify that this drawing was prepared by myself or by engineers under my direct supervision and that it correctly represents the conditions described in the accompanying application which is designed to meet the requirements of the Wyoming Environmental Quality Act and its accompanying regulations.

Professional Engineer (Civil) JEFFREY G. BARRON 13033 STATE OF WYOMING
10/12/15

0 500 1,000 1,500 2,000
GRAPHIC SCALE (FEET)
C.I. = 2'

RAMACO

BROOK MINE
SHERIDAN COUNTY, WY
1101 SUGARVIEW DR, STE. 201
SHERIDAN, WY 82801

REVISIONS	
Date	Description
06/15	ROUND 1 COMMENTS
10/15	ROUND 2 COMMENTS

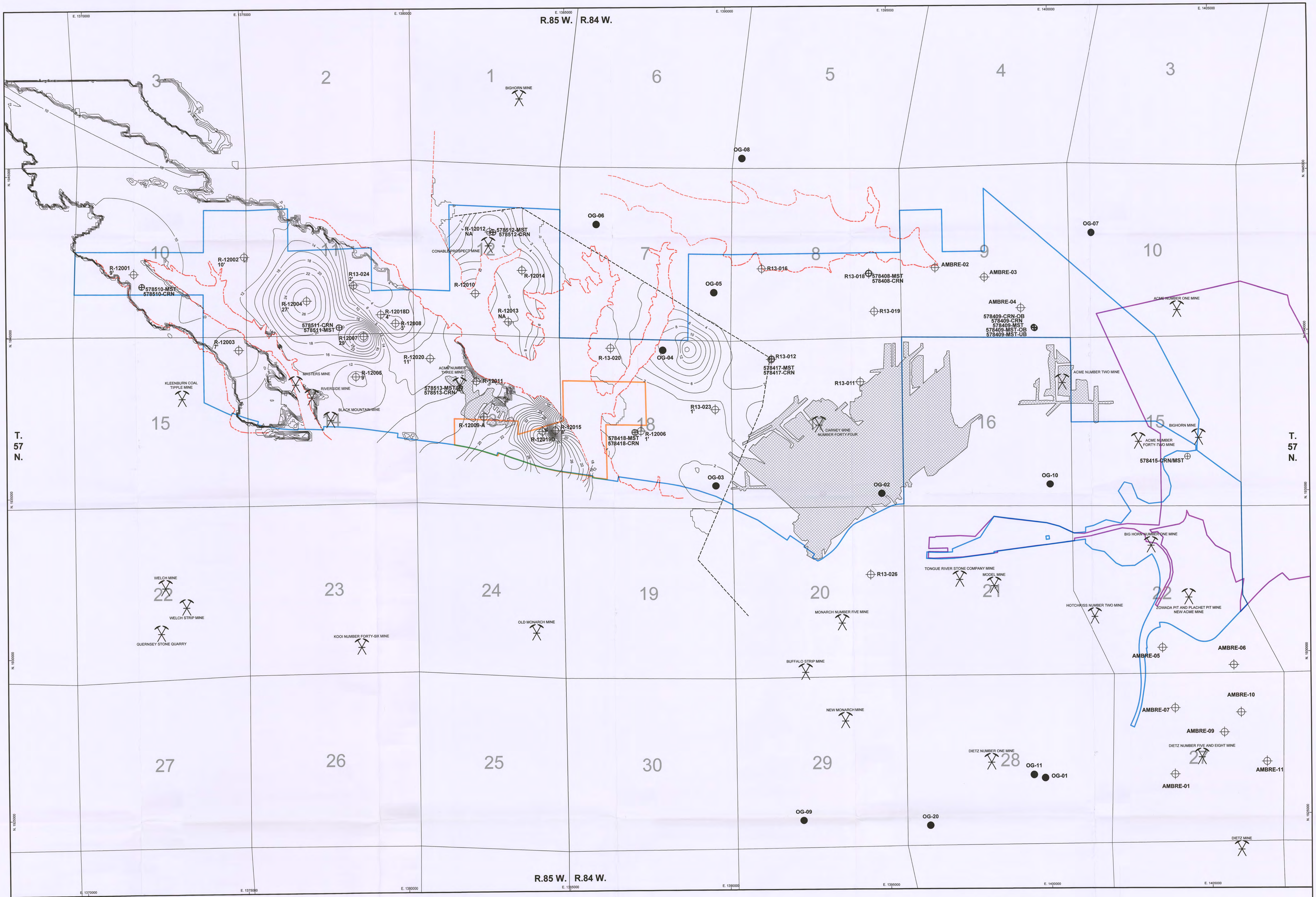
ADDENDUM D5-4
EXHIBIT 3

UPPER CARNEY COAL SEAM ISOPACH

Drawn By: DCJ
Checked By: JGB
Date: 10/08/14

WWC ENGINEERING
www.wwcengineering.com

FILE: D5_4-4_CARNEY_ISO_R2.dwg



COAL SURFACE DATA PROVIDED BY CARDNO MMA JANUARY 2014.

TFN 6 2/025
RECD OCT 23, 2015

LEGEND

- BROOK MINE PERMIT BOUNDARY
- BIG HORN COAL PERMIT BOUNDARY (PERMIT NO. 213-T7)
- TAYLOR QUARRY PERMIT BOUNDARY (PERMIT NO. SP-757)
- APPROXIMATE LOCATION OF CARNEY SPLIT
- CARNEY NO COAL LINE
- CARNEY NO COAL LINE (INFERRED)
- R-12011 15' — EXPLORATION BOREHOLE THICKNESS
- 578418-CRN — MONITOR WELL
- OG-13 — WOGCC OIL OR GAS WELL
- CARNEY SEAM REMOVED BY HISTORIC MINING
- DIETZ MINE — HISTORIC MINE LOCATION

NOTES:
1. SEE ADDENDUM D5-2 FOR SEAM THICKNESS AND NAME.
2. NA: INDICATES THE PRESENCE OF CARNEY BURN.

CERTIFICATE OF ENGINEER

I, Jeffrey G. Barron, hereby certify that this drawing was prepared by myself or by engineers under my direct supervision and that it correctly represents the conditions described in the accompanying application which is designed to meet the requirements of the Wyoming Environmental Quality Act and its accompanying regulations.

Professional Engineer (Civil) JEFFREY G. BARRON 13033 WYOMING
10/12/2015

0 500 1,000 1,500 2,000
GRAPHIC SCALE (FEET)
C.I. = 2'

RAMACO

BROOK MINE
SHERIDAN COUNTY, WY
1101 SUGARVIEW DR. STE. 201
SHERIDAN, WY 82801

REVISIONS	
Date	Description
06/15	ROUND 1 COMMENTS
10/15	ROUND 2 COMMENTS

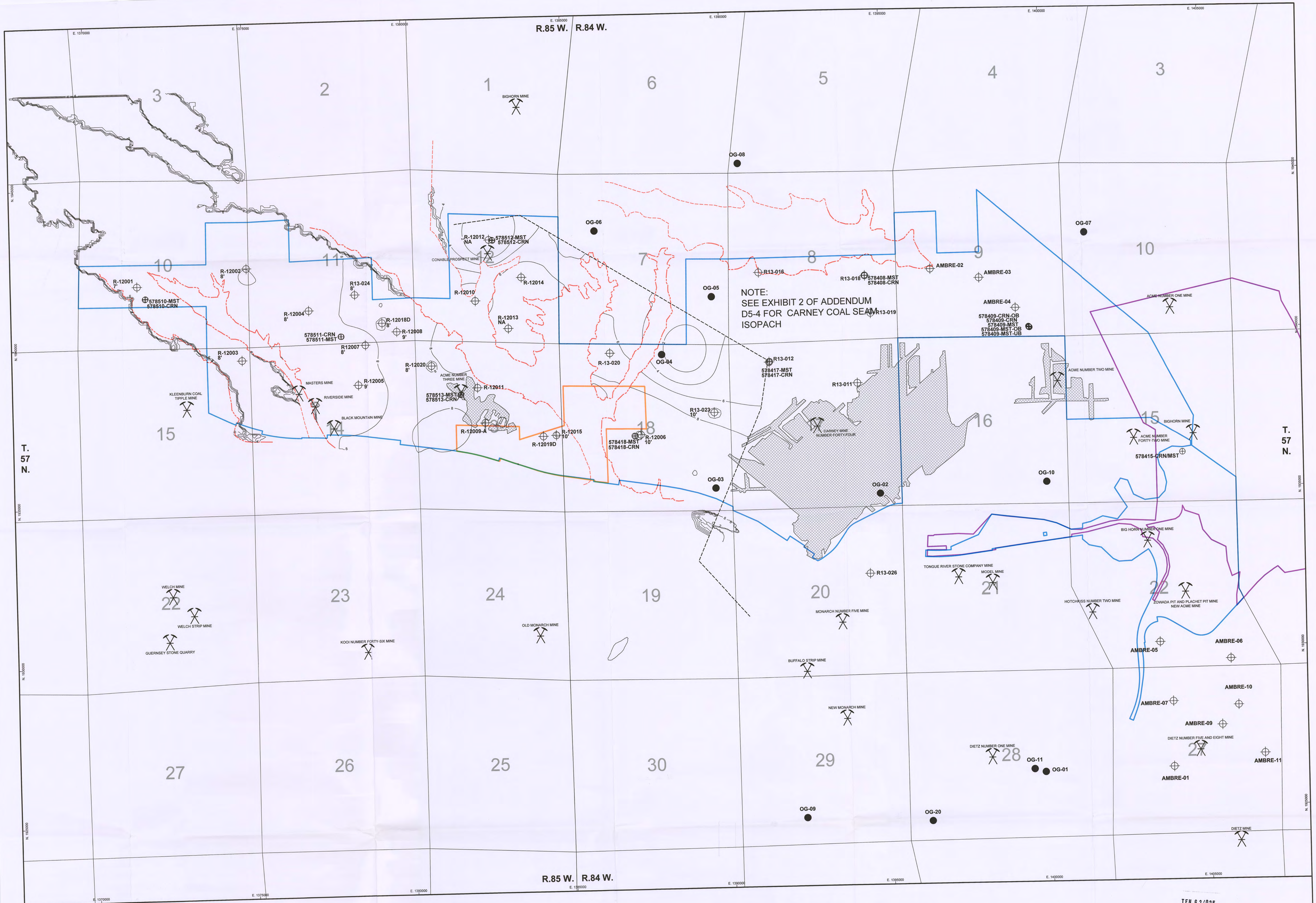
ADDENDUM D5-4
EXHIBIT 4

UPPER AND LOWER CARNEY INTERBURDEN ISOPACH

Drawn By: DCJ
Checked By: JGB
Date: 10/08/14

WWC ENGINEERING
www.wwcengineering.com

FILE: D5_4-4_CARNEY_ISO_R2.dwg



COAL SURFACE DATA PROVIDED BY CARDNO MMA JANUARY 2014.

TFN 6 2/025
RECD OCT 23, 2015

LEGEND

- BROOK MINE PERMIT BOUNDARY
- BIG HORN COAL PERMIT BOUNDARY (PERMIT NO. 213-T7)
- TAYLOR QUARRY PERMIT BOUNDARY (PERMIT NO. SP-757)
- APPROXIMATE LOCATION OF CARNEY SPLIT
- CARNEY NO COAL LINE
- CARNEY NO COAL LINE (INFERRED)
- R-12011 15' — EXPLORATION BOREHOLE THICKNESS
- 578418-CRN — MONITOR WELL
- OG-13 — WOGCC OIL OR GAS WELL
- CARNEY SEAM REMOVED BY HISTORIC MINING
- DIETZ MINE — HISTORIC MINE LOCATION

NOTES:
1. SEE ADDENDUM D5-2 FOR SEAM THICKNESS AND NAME.
2. NA: INDICATES THE PRESENCE OF CARNEY BURN.

CERTIFICATE OF ENGINEER

I, Jeffrey G. Barron, hereby certify that this drawing was prepared by myself or by engineers under my direct supervision and that it correctly represents the conditions described in the accompanying application which is designed to meet the requirements of the Wyoming Environmental Quality Act and its accompanying regulations.

Professional Engineer Civil — JEFFREY G. BARRON — 13033 — DATE 10/12/2015 — WYOMING

N

0 500 1,000 1,500 2,000
GRAPHIC SCALE (FEET)
C.I. = 2'

RAMACO

BROOK MINE
SHERIDAN COUNTY, WY

1101 SUGARVIEW DR, STE. 201
SHERIDAN, WY 82801

REVISIONS	
Date	Description
06/15	ROUND 1 COMMENTS
10/15	ROUND 2 COMMENTS

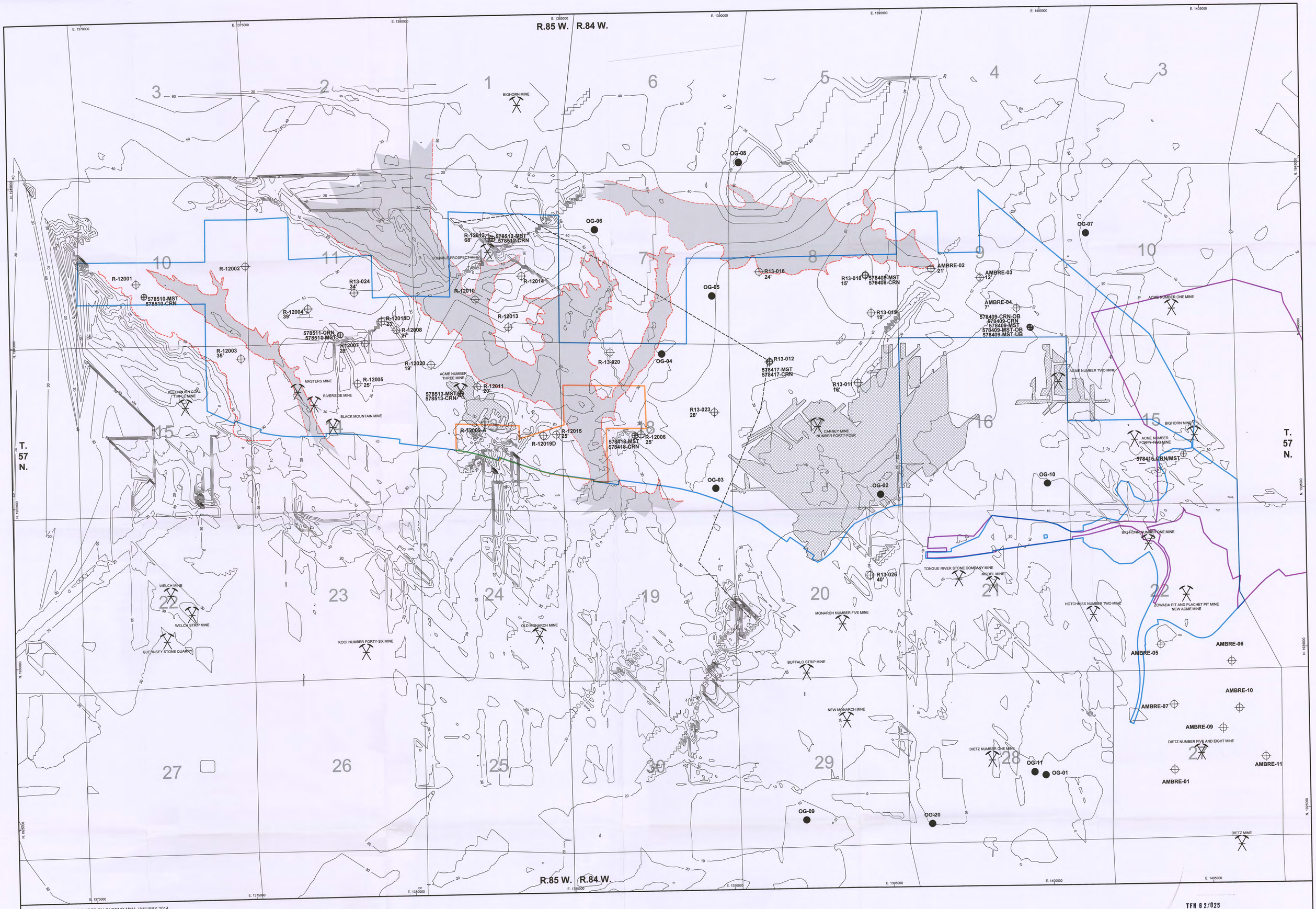
ADDENDUM D5-4
EXHIBIT 5

LOWER CARNEY COAL SEAM ISOPACH

Drawn By: DCJ
Checked By: JGB
Date: 10/08/14

WWC ENGINEERING
www.wwcengineering.com

FILE: D5_4-4_CARNEY_ISO_R2.dwg



COAL SURFACE DATA PROVIDED BY CARDNO MMA JANUARY 2014.

TFN 6 2/025
RECD OCT 23, 2015

LEGEND

- BROOK MINE PERMIT BOUNDARY
- BIG HORN COAL PERMIT BOUNDARY (PERMIT NO. 213-T7)
- TAYLOR QUARRY PERMIT BOUNDARY (PERMIT NO. SP-757)
- APPROXIMATE LOCATION OF CARNEY SPLIT
- CARNEY NO COAL LINE
- CARNEY NO COAL LINE (INFERRED)
- R-12011 15' — EXPLORATION BOREHOLE THICKNESS
- 578418-CRN — MONITOR WELL
- OG-13 — WOGCC OIL OR GAS WELL
- CARNEY SEAM REMOVED BY HISTORIC MINING
- DIETZ MINE — HISTORIC MINE LOCATION
- MASTERS OVERBURDEN

NOTE:
SEE ADDENDUM D5-2 FOR SEAM THICKNESS AND NAME.

CERTIFICATE OF ENGINEER

I, Jeffrey G. Barron, hereby certify that this drawing was prepared by myself or by engineers under my direct supervision and that it correctly represents the conditions described in the accompanying application which is designed to meet the requirements of the Wyoming Environmental Quality Act and its accompanying regulations.

Professional Engineer (Civil) JEFFREY G. BARRON 13033 WYOMING
DATE 10/14/2015

N

0 500 1,000 1,500 2,000
GRAPHIC SCALE (FEET)
C.I. = 2

RAMACO
1101 SUGARVIEW DR, STE. 201
SHERIDAN, WY 82801

BROOK MINE
SHERIDAN COUNTY, WY

REVISIONS	
Date	Description
06/15	ROUND 1 COMMENTS
10/15	ROUND 2 COMMENTS

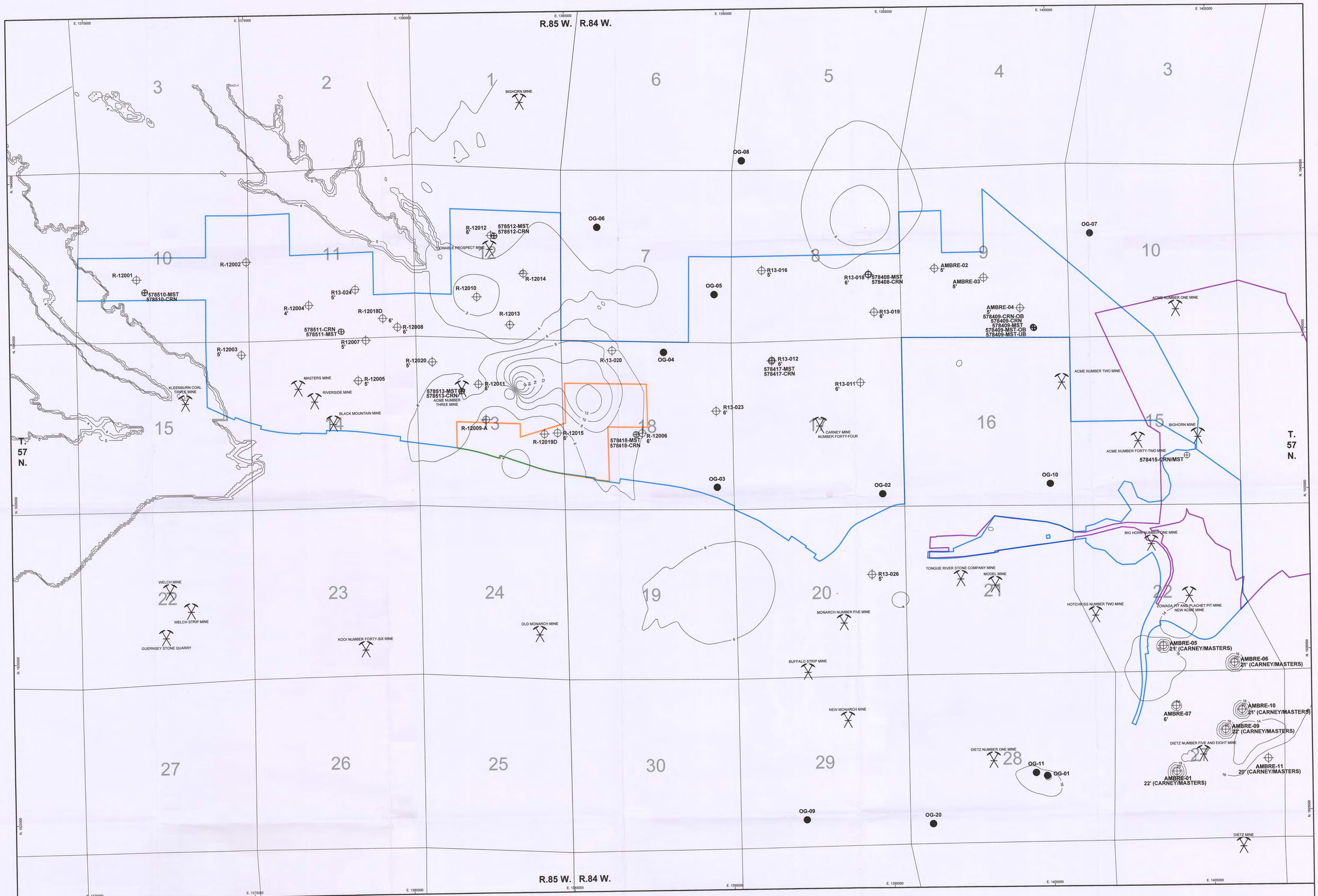
ADDENDUM D5-4
EXHIBIT 6

LOWER CARNEY AND MASTERS INTERBURDEN ISOPACH

Drawn By: DCJ
Checked By: JGB
Date: 10/08/14

WWC ENGINEERING
www.wwcengineering.com

FILE: D5_4-4_CARNEY_ISO_R2.dwg



COAL SURFACE DATA PROVIDED BY CARDNO MMA JANUARY 2014.

TFN 6 2/025
RECD OCT 23, 2015

NOTE:
SEE ADDENDUM D5-2 FOR SEAM THICKNESS AND NAME.

LEGEND

- BROOK MINE PERMIT BOUNDARY
- BIG HORN COAL PERMIT BOUNDARY (PERMIT NO. 213-T7)
- TAYLOR QUARRY PERMIT BOUNDARY (PERMIT NO. SP-757)
- DIETZ MINE — HISTORIC MINE LOCATION
- R-12011 5' — EXPLORATION BOREHOLE THICKNESS
- 578418-CRN — MONITOR WELL
- OG-13 — WOGCC OIL OR GAS WELL

CERTIFICATE OF ENGINEER

I, Jeffrey G. Barron, hereby certify that this drawing was prepared by myself or by engineers under my direct supervision and that it correctly represents the conditions described in the accompanying application which is designed to meet the requirements of the Wyoming Environmental Quality Act and its accompanying regulations.

Professional Engineer (Civil) JEFFREY G. BARRON 13033 WYOMING
DATE SIGNED 10/15/2015

0 500 1,000 1,500 2,000
GRAPHIC SCALE (FEET)
C.I. = 2'

RAMACO

BROOK MINE
SHERIDAN COUNTY, WY

1101 SUGARVIEW DR, STE. 201
SHERIDAN, WY 82801

REVISIONS	
Date	Description
06/15	ROUND 1 COMMENTS
10/15	ROUND 2 COMMENTS

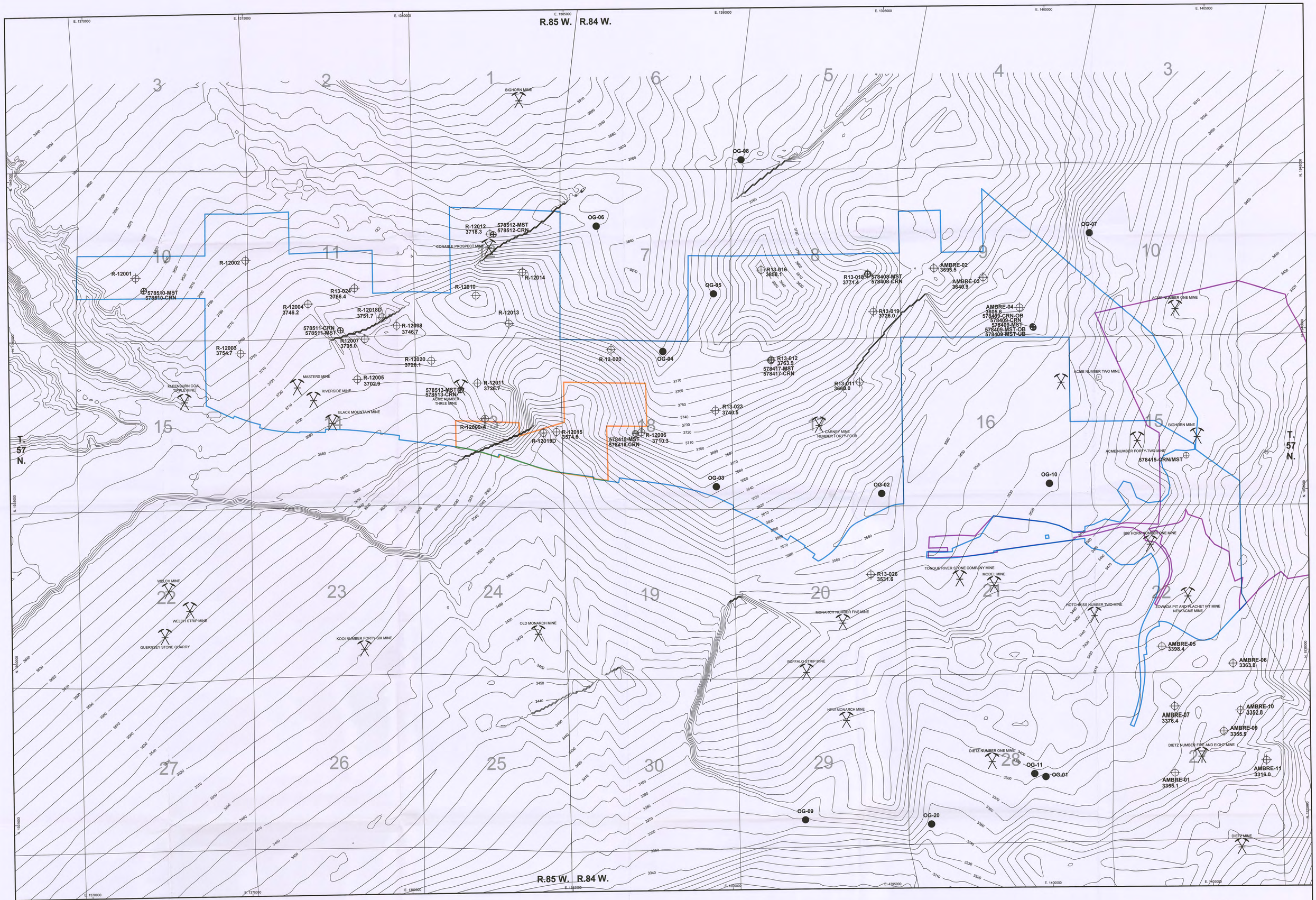
ADDENDUM D5-4
EXHIBIT 7

MASTERS COAL SEAM ISOPACH

Drawn By: DCJ
Checked By: JGB
Date: 10/08/14

WWC ENGINEERING
www.wwcengineering.com

FILE: D5_4-5_MASTERS_ISO_R2.dwg



COAL SURFACE DATA PROVIDED BY CARDNO MMA JANUARY 2014.

TFN 6 2/025
RECD OCT 23, 2015

NOTE:
SEE ADDENDUM D5-2 FOR SEAM THICKNESS AND NAME.

LEGEND

- BROOK MINE PERMIT BOUNDARY
- BIG HORN COAL PERMIT BOUNDARY (PERMIT NO. 213-T7)
- TAYLOR QUARRY PERMIT BOUNDARY (PERMIT NO. SP-757)
- DIETZ MINE — HISTORIC MINE LOCATION
- R-12011 3398.4 — EXPLORATION BOREHOLE MASTERS SEAM BOTTOM ELEVATION
- 578418-CRN — MONITOR WELL
- OG-13 — WOGCC OIL OR GAS WELL

CERTIFICATE OF ENGINEER

I, Jeffrey G. Barron, hereby certify that this drawing was prepared by myself or by engineers under my direct supervision and that it correctly represents the conditions described in the accompanying application which is designed to meet the requirements of the Wyoming Environmental Quality Act and its accompanying regulations.

Professional Engineer (Civil) JEFFREY G. BARRON 13033 STATE OF WYOMING
10/18/2015

N

0 500 1,000 1,500 2,000
GRAPHIC SCALE (FEET)
C.I. = 10'

RAMACO

BROOK MINE
SHERIDAN COUNTY, WY
1101 SUGARVIEW DR, STE. 201
SHERIDAN, WY 82801

REVISIONS	
Date	Description
06/15	ROUND 1 COMMENTS
10/15	ROUND 2 COMMENTS

ADDENDUM D5-4
EXHIBIT 8

BOTTOM ELEVATION OF MASTERS COAL SEAM

Drawn By: DCJ
Checked By: JGB
Date: 10/08/14

WWC ENGINEERING
www.wwcengineering.com

FILE: D5_4-5_MASTERS_ISO_R2.dwg

Scanned, 02/28/2020

ADDENDUM D5-5

Overburden, Roof and Floor Sample Analysis Tables

TFN 6 2/025
RECD NOV 14, 2014

Scanned, 02/28/2020

TFN 6 2/025
RECD NOV 14, 2014

ATT
ADVANCED TERRA TESTING
833 Parfet Street, Unit A • Lakewood, Colorado 80215 • (303) 232-8308 • Fax: (303) 232-1579

Scanned, 02/28/2020

SPLITTING TENSILE STRENGTH
By Method of Brazilian Disk
ASTM D 3967

TFN 6 2/025
RECD NOV 14,2014

Scanned, 02/28/2020

SPLITTING TENSILE STRENGTH
By Method of Brazilian Disk
ASTM D 3967

CLIENT Blacktooth Geological
LOCATION Sheridan County, Wy
PROJECT RAMACO Mine

JOB NO 2892-01
DATE TESTED 10/4/13 HN/BL

Page 1 of 1

Specimen ID Boring, Sample No., Depth(ft.)	Diameter (in.)	Length (in.)	Mass (gms)	Wet Density (pcf)	Failure Load (lb)	Failure Type *	Splitting Tensile Strength (psi)
R13-019, 150.0-152.0, Rock	2.918	1.520	370.93	139.0	1,165	M	170
R13-019, 152.0-153.0, Coal	2.992	1.506	217.76	78.3	653	M	90
R13-019, 168.0-169.0, Rock	2.945	1.982	455.31	128.5	534	M	60
R13-023, 110.0-112.0, Rock	2.980	1.404	402.39	156.5	2,921	S	440

Notes and Comments

Splitting Tensile Strength=2P/piLD
P=Failure Load
pi = 3.1415926....
D = Sample Diameter
L = Sample Length

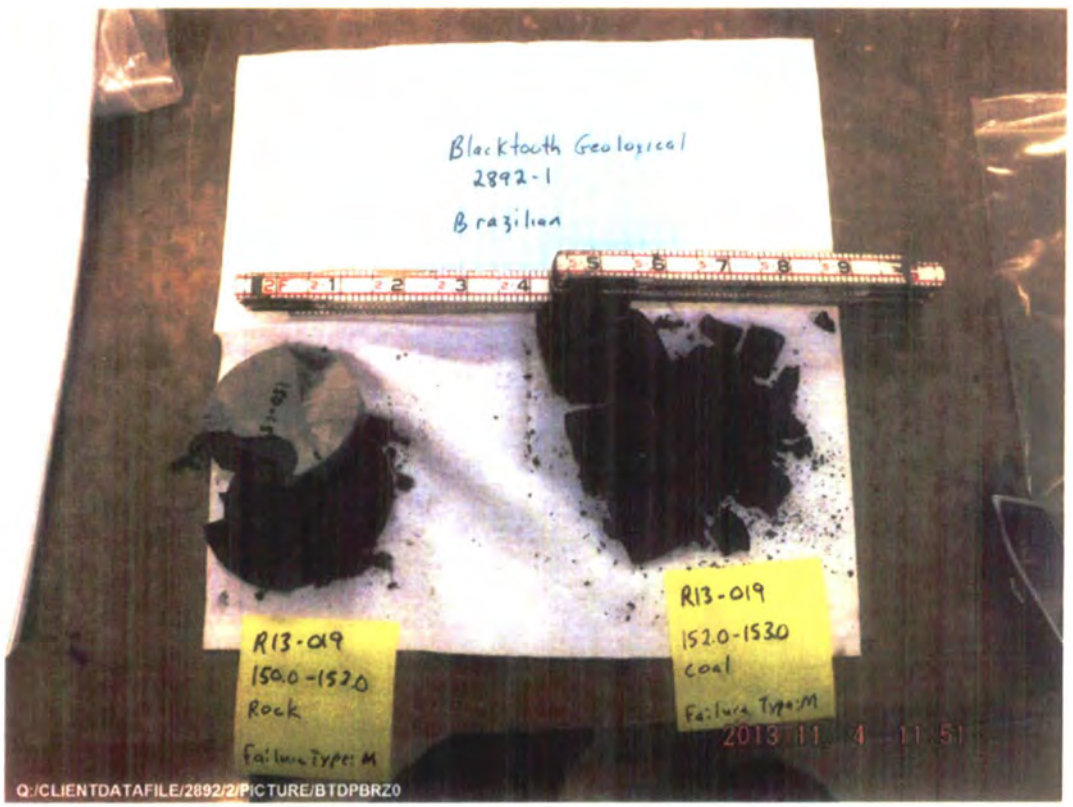
* Failure Type: S: Single Failure Plane, M: Multiple Failure Planes

ata Entered By BKL Date 11/04/2013
ıta Checked By HN Date 11/4/2013
ilename BGBD01AA

ADVANCED TERRA TESTING, INC. ATT

TFN 6 2/025
RECD NOV 14, 2014

Scanned, 02/28/2020



TFN 6 2/025
RECD NOV 14,2014

Scanned, 02/28/2020

TFN 6 2/025
RECD NOV 14, 2014

Scanned, 02/28/2020

MOISTURE & DENSITY

ASTM D 2216 & 2937

TFN 6 2/025
RECD NOV 14, 2014

Scanned, 02/28/2020

Moisture & Density Determinations
ASTM D 2216 & D 2937

CLIENT: Blacktooth Geological JOB NO.: 2892-01
LOCATION: Sheridan County, WY PROJECT NO. RAMACO

BORING	R13-019	R13-019	R13-019	R13-023
SAMPLE DEPTH	150.0-152.0	152.0-153.0	168.0-169.0	110.0-112.0
SAMPLE NO.	-	-	-	-
DATE SAMPLED	-	-	-	-
DATE TESTED	10/31/13 BL	10/31/13 BL	10/31/13 BL	10/31/13 BL
ROCK DESCRIPTION	Rock	Coal	Rock	Rock
DENSITY DETERMINATIONS				
Sample Height (IN)	1.520	6.695	5.662	6.492
Sample Diameter (IN)	2.918	2.993	2.920	2.985
Wt of Wet Rock (GMs)	370.93	1000.20	1440.70	1901.10
Sample Volume (CU Ft)	0.00588	0.02726	0.02194	0.02629
WET DENSITY (PCF)	139.0	80.9	144.8	159.4
DRY DENSITY (PCF)	126.4	64.7	133.0	147.8
MOISTURE DETERMINATIONS				
Wt. of Wet Rock & Dish (gms)	338.74	330.06	323.25	330.96
Wt. of Dry Rock & Dish (gms)	308.78	265.36	297.68	307.45
Net Loss of Moisture (gms)	29.96	64.70	25.57	23.51
Wt. of Dish (gms)	8.21	6.52	8.24	8.36
Wt. of Dry Rock (gms)	300.57	258.84	289.44	299.09
Moisture Content (%)	10.0	25.0	8.8	7.9

TFN 6 2/025
RECD NOV 14, 2014

Data entered by: SKL Date: 11/04/2013
Data checked by: HN Date: 11/4/13
FileName: BTMDRAMC.WK4

Scanned, 02/28/2020

PARIFFIN-COATED DENSITY
ASTM D 4531-B

TFN 6 2/025
RECD NOV 14,2014

Scanned, 02/28/2020

PARAFFIN-COATED DENSITY
ASTM D 4531-B

CLIENT Blacktooth Geological JOB NO 2892-01

SOIL DESCR Coal SAMPLED
LOCATION RAMACO Mine DATE TESTED 11/1/13 BL

Sample Info

Boring/#/Depth	Wsa	Wsa	Wsw	[K]	Sp Wax	Wet Density (pcf)	Moisture Cont (%)	Dry Density (pcf)
R13-023								
110.0-112.0	164.2	182.8	32.4	0.99974	0.89	79.1	20.14	65.9

Data Entered by: BKL Date: 11/01/2013
Data Checked by: HN Date: 11/21/13
FileName: BGCD01AA

TFN 6 2/025
RECD NOV 14, 2014

ADVANCED TERRA TESTING, INC. ATT

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UNCONFINED COMPRESSIVE STRENGTH

ASTM D 7012 Method D

TFN 6 2/025
RECD NOV 14, 2014

Scanned, 02/28/2020

UNCONFINED COMPRESSIVE STRENGTH
With Stress / Strain Measurements
ASTM D 7012, Method D (Previously ASTM D 3148)

CLIENT: Blacktooth Geological
JOB NO.: 2892-01
PROJECT: RAMACO Mine
DATE TESTED: 11/1/13 HN
LOCATION: Sheridan County, WY

Boring	Specimen ID Depth (ft.)	Rock type	Diameter (in.)	Length (in.)	Mass (gms)	Wet Density (pcf)	Failure Load (lb)	Failure Type **	Compressive Strength (psi)	Young's Modulus (X10^6 psi)	Poisson's Ratio
R13-019	152.0-153.0	Coal	2.993	6.695	1000.2	80.9	10,250	F	1,460	0.08	0.182
R13-019	168.0-169.0	Rock	2.920	5.662	1440.7	144.8	3,350	F	*500	0.05	0.325
R13-023	110.0-112.0	Rock	2.985	6.492	1901.1	159.4	24,500	F	3,500	0.46	0.188

Notes and Comments

* Indicates regardless of ASTM D 7012 method D, sample with L/D < 2.0 was tested and correction factor for short sample was applied to the calculation

C=Ca/[0.88+0.24b/h]
Ca = Failure Load / Surface Area
b = Sample Diameter
h = Sample Length

** Failure Type:
S: Shear Failure, M: Matrix Failure, F/V Fracture, Bedding/Void Collapse, C: Combination

Data Entered By: HN Date: 11/01/2013
Data Checked By: Date: 11/1/13
Filename: UCS-SS01

ADVANCED TERRA TESTING, INC. ATT

TFN 6 2/025
RECD NOV 14, 2014

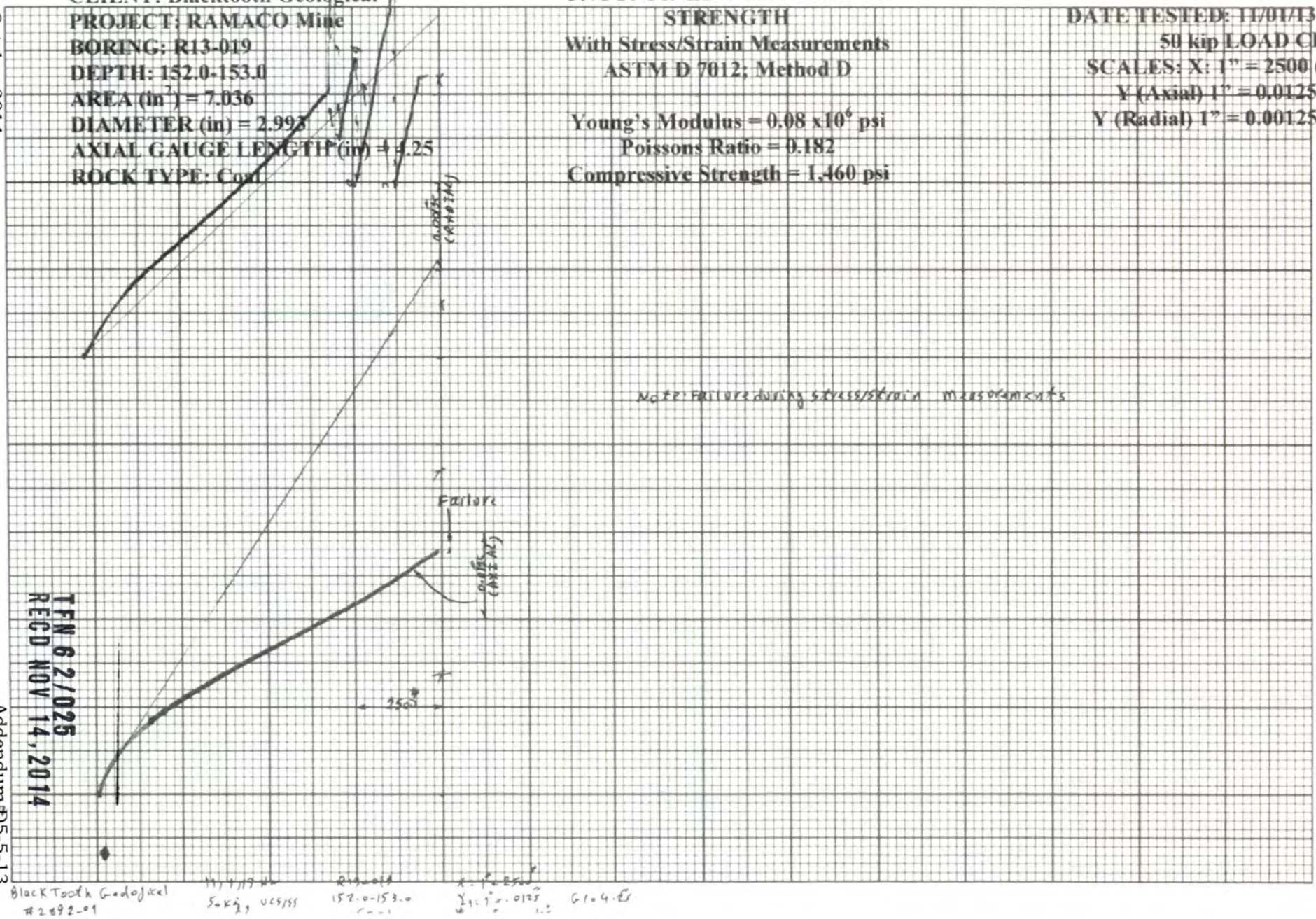
Scanned, 02/28/2020

CLIENT: Blacktooth Geological
PROJECT: RAMACO Mine
BORING: R13-019
DEPTH: 152.0-153.0
AREA (in^2) = 7.036
DIAMETER (in) = 2.993
AXIAL GAUGE LENGTH (in) = 4.25
ROCK TYPE: Coal

UNCONFINED COMPRESSIVE
STRENGTH
With Stress/Strain Measurements
ASTM D 7012; Method D

Young's Modulus = 0.08 x10^6 psi
Poissons Ratio = 0.182
Compressive Strength = 1,460 psi

JOB NO: 2892-01
DATE TESTED: 11/01/13 HN
50 kip LOAD CELL
SCALES: X: 1" = 2500 (lbs)
Y (Axial) 1" = 0.0125 (in)
Y (Radial) 1" = 0.00125 (in)



TFN 6 2/025
RECD NOV 14, 2014

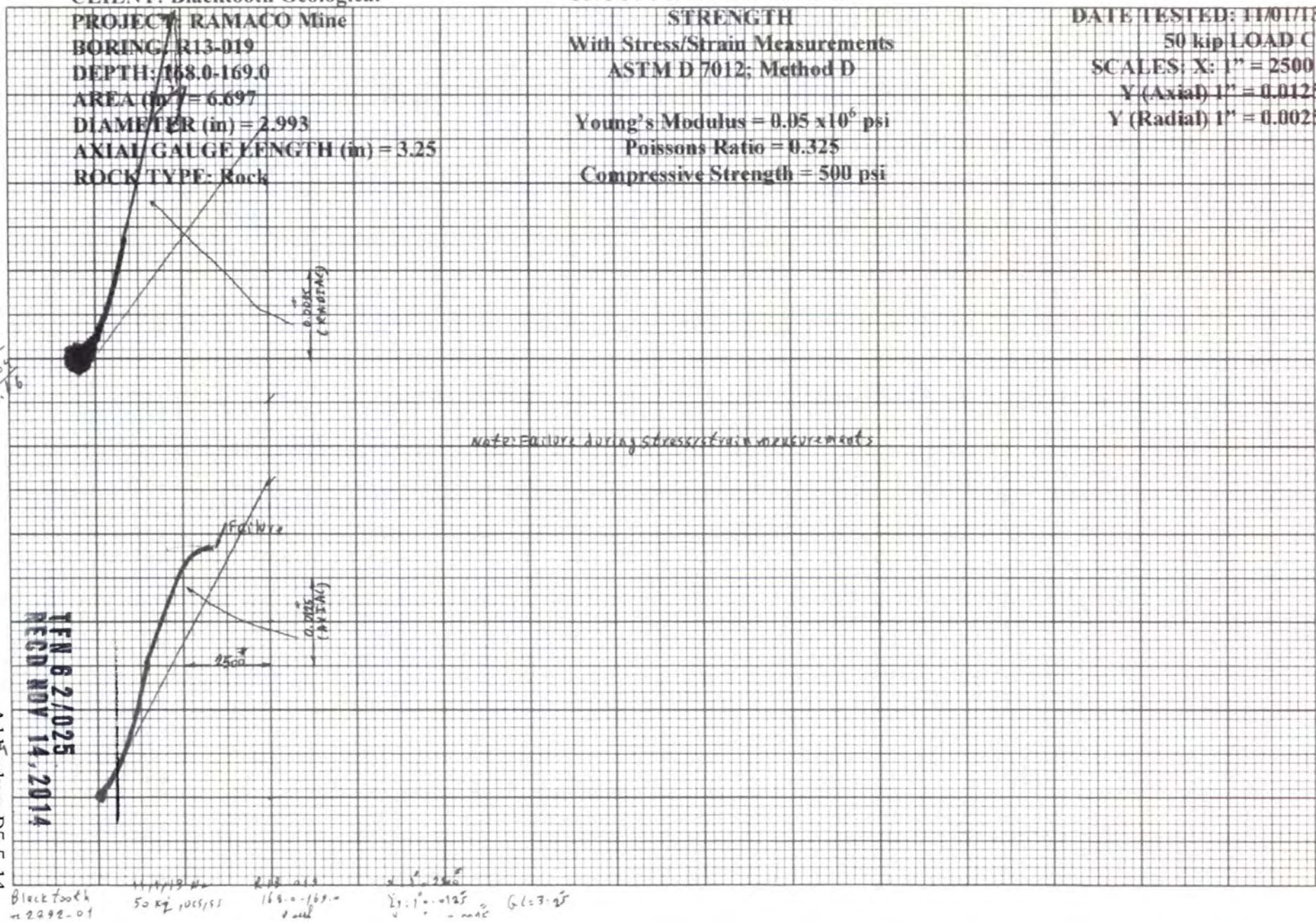
Scanned, 02/28/2020

CLIENT: Blacktooth Geological
PROJECT: RAMACO Mine
BORING: R13-019
DEPTH: 168.0-169.0
AREA (in²) = 6.697
DIAMETER (in) = 2.993
AXIAL GAUGE LENGTH (in) = 3.25
ROCK TYPE: Rock

UNCONFINED COMPRESSIVE
STRENGTH
With Stress/Strain Measurements
ASTM D 7012; Method D

Young's Modulus = 0.05 x10^6 psi
Poissons Ratio = 0.325
Compressive Strength = 500 psi

JOB NO: 2892-01
DATE TESTED: 11/01/13 HN
50 kip LOAD CELL
SCALES: X: 1" = 2500 (lbs)
Y (Axial) 1" = 0.0125 (in)
Y (Radial) 1" = 0.0025 (in)



TFN 6 2/025
RECD NOV 14, 2014

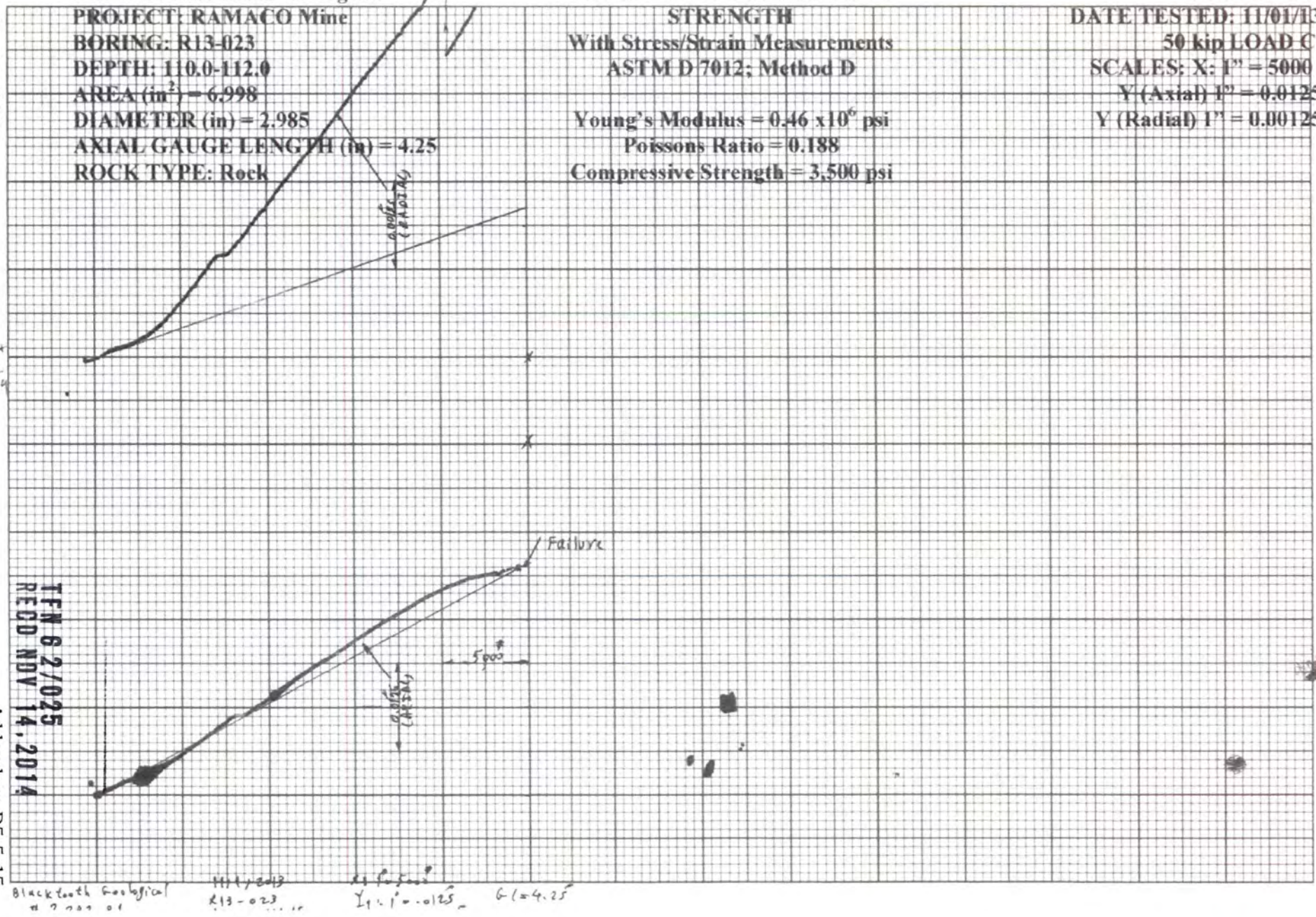
Scanned, 02/28/2020

CLIENT: Blacktooth Geological
PROJECT: RAMACO Mine
BORING: R13-023
DEPTH: 110.0-112.0
AREA (in^2) = 6.998
DIAMETER (in) = 2.985
AXIAL GAUGE LENGTH (in) = 4.25
ROCK TYPE: Rock

UNCONFINED COMPRESSIVE
STRENGTH
With Stress/Strain Measurements
ASTM D 7012; Method D

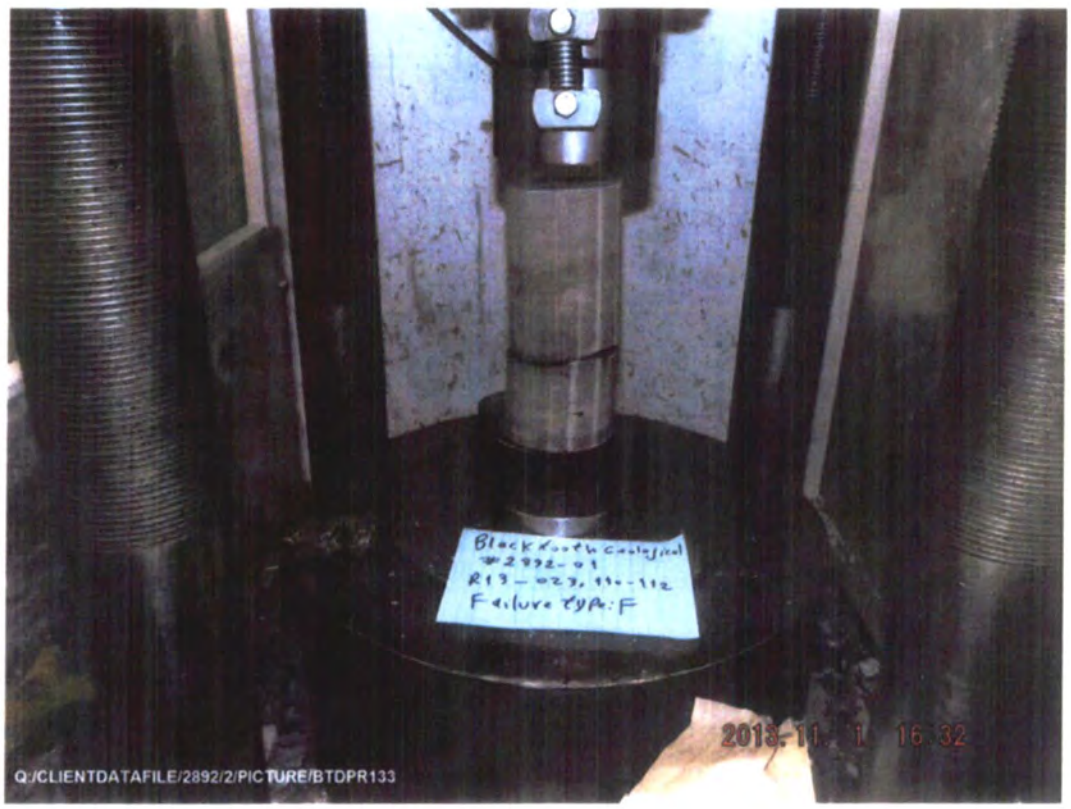
Young's Modulus = 0.46 x10^6 psi
Poissons Ratio = 0.188
Compressive Strength = 3,500 psi

JOB NO: 2892-01
DATE TESTED: 11/01/13 HN
50 kip LOAD CELL
SCALES: X: 1" = 5000 (lbs)
Y (Axial) 1" = 0.0125 (in)
Y (Radial) 1" = 0.00125 (in)



TFN 6 2/025
RECD NOV 14, 2014

Scanned, 02/28/2020



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RECD NOV 14, 2014

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TFN 6 2/025
RECD NOV 14,2014

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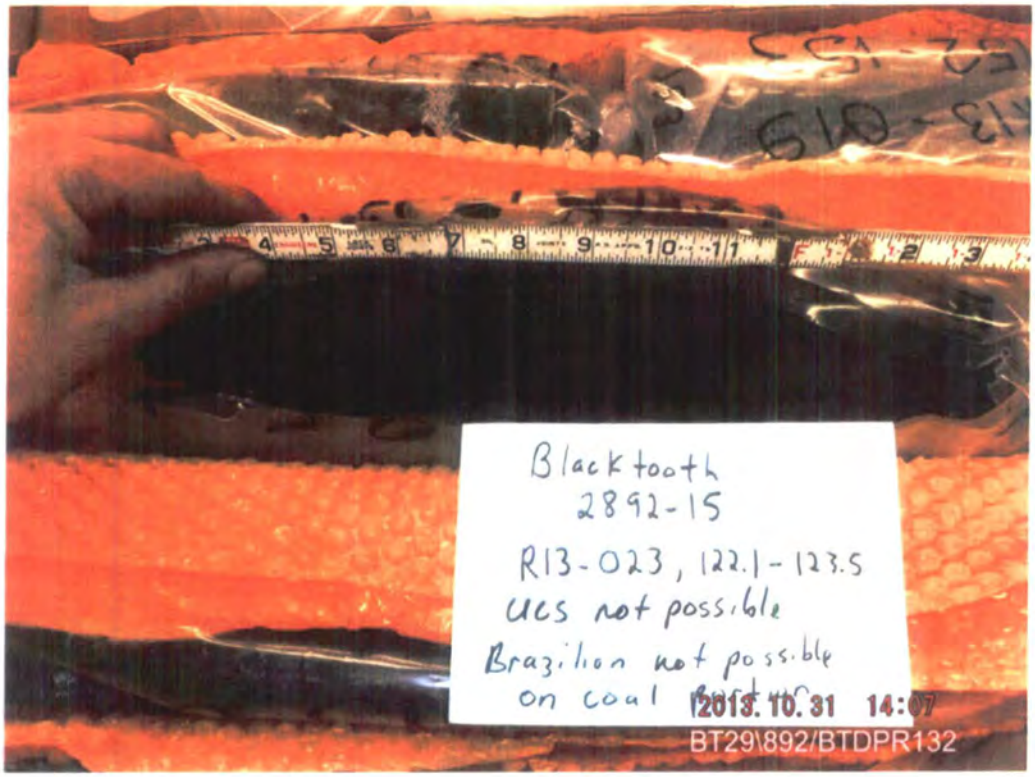
TFN 6 2/025
RECD NOV 14, 2014

Scanned, 02/28/2020



TFN 6 2/025
RECD NOV 14, 2014

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TFN 6 2/025
RECD NOV 14, 2014

Scanned, 02/28/2020

ADDENDUM D5-6

WDEQ/LQD Overburden Sampling Frequency Waiver

TFN 6 2/025
RECD NOV 14, 2014

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RAMACO
WWC ENGINEERING

Brook Mine
1849 Terra Avenue • Sheridan, WY 82801
Phone: 307-672-0761 • Fax: 307-674-4265
www.wwcengineering.com

August 26, 2013

Mr. BJ Kristiansen
WDEQ/LQD
2100 West 5th Street
Sheridan, WY 82801

RE: BASELINE OVERBURDEN QUALITY SAMPLING AND TESTING FOR THE BROOK MINE (TFN 6 2/011)

Dear BJ:

The enclosed map illustrates overburden samples sample sites taken in coordination with coal coring activities (coal notification CN160) for the Brook Mine, Sheridan County, Wyoming. The map illustrates 80 acre areas of interest centered around both existing core holes and proposed core holes to be drilled by the end of 3rd quarter 2013. The yellow shaded areas represent the acres that coal will be removed using auger mining methods. The slot between the yellow areas is where overburden will be removed to accommodate the auger mining. Based on discussions with you on August 20, 2013, Ramaco can reduce the sampling density of one sample per 80 acres (eight per section) so long as samples can reasonably represent the area where the slot/highwall is to be constructed for auger mining access.

Ramaco believes that the reduced baseline sampling frequency is justifiable since the method of mining only disturbs a single slot used for access of the auger mining equipment which removes the adjacent coal without further disturbance to the overburden above or below. Furthermore it is anticipated that overburden removed from the slot will be stockpiled and then likely be placed back into the slot in the reverse manner that it was removed, thus the material will be placed back into the slot at approximately the same elevation that it was removed.

For the baseline sampling, a composite sample will be collected for every ten-foot interval of overburden drilled. The samples have been and will be collected from a combination of drill chips and coring. The baseline samples will be analyzed for the parameters listed in Table I-1 (Appendix I) of Guideline No. 1, using WDEQ recommended procedures.

Please call me with any questions/comments regarding this plan. Ramaco is currently drilling; therefore, a prompt response would be appreciated.

Regards,

Jeff Barron, PE
Project Manager

TFN 6 2/025
RECD NOV 14, 2014

/jgb
Enclosure: as noted

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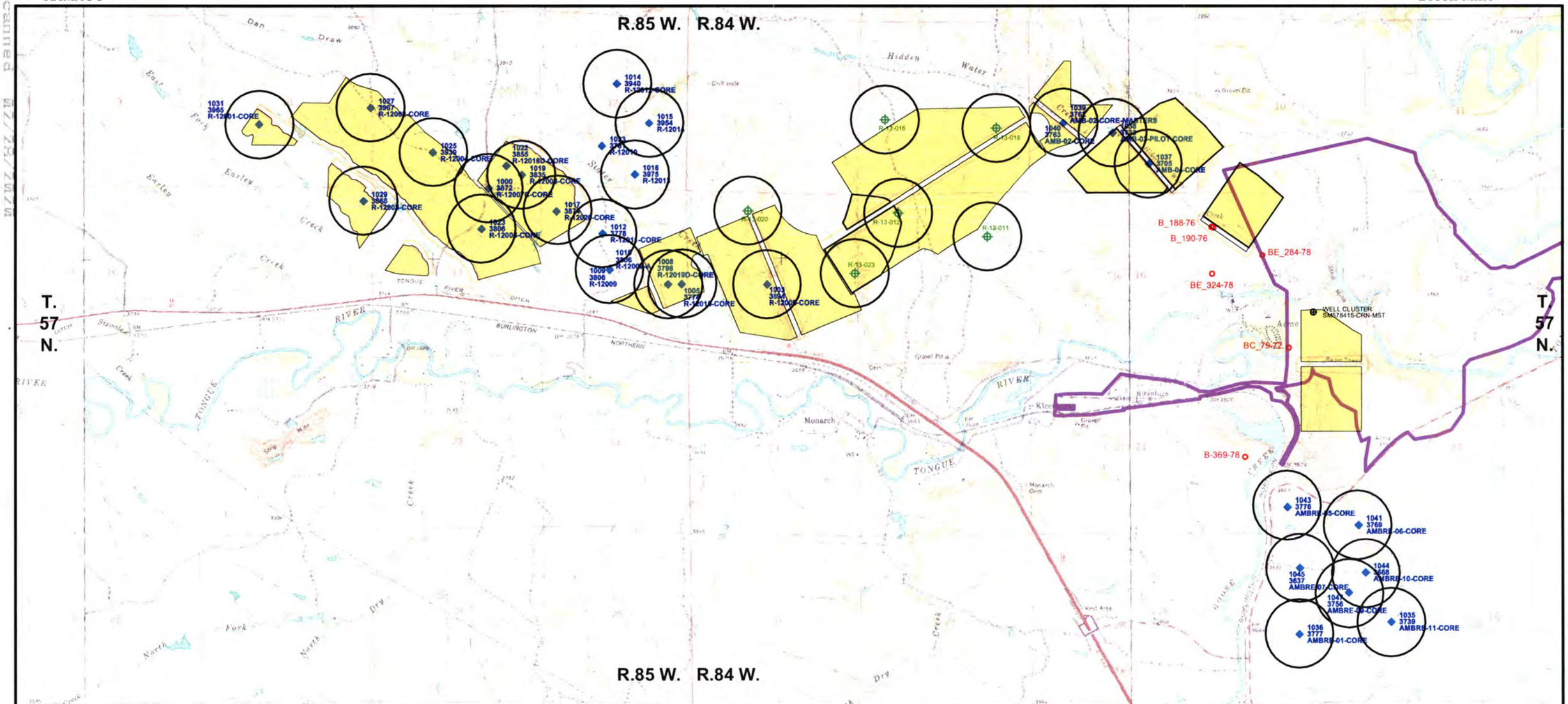

LEGEND

- BIG HORN MINE PERMIT BOUNDARY
- 1036 3777 AMBRE-01-CORE — AMBRE ENERGY GEOLOGIC INVESTIGATION COREHOLE
- 1029 3962 R-12003-CORE — RAMACO GEOLOGIC INVESTIGATION COREHOLE
- R-13-011 — PROPOSED COAL CORE HOLE LOCATION (WILL BE DRILLED)
- BE_324-78 — BIG HORN COAL CORE HOLE LOCATION
- PROPOSED AUGER MINING EXTENT OF SLOT
- PROPOSED AUGER MINING
- 80 ACRE CIRCLE AROUND CORE HOLE

NOTE: REFER TO EXHIBIT C1A OF THE ADJUDICATION FILE FOR THE CORRECT PERMIT BOUNDARY.

0 1,500 3,000 4,500 6,000
GRAPHIC SCALE (FEET)

RAMACO

BROOK MINE
SHERIDAN COUNTY, WY

1101 SUGARVIEW DR. STE. 201
SHERIDAN, WY 82801

REVISIONS

Date	Description
10/15	ROUND 2 COMMENTS

EXHIBIT 1

TFN 6 2/025
RECD OCT 23, 2015

OVERBURDEN SAMPLING

Drawn By: DCJ
Checked By: JGB
Date: 8-26-13

FILE: ADD_D5-6_WELL_LOC_MINEPLAN_R2.dwg

WWC ENGINEERING
www.wwcengineering.com

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Scanned, 02/28/2020

Jeff Barron

From: BJ Kristiansen <bj.kristiansen@wyo.gov>
Sent: Tuesday, April 21, 2015 11:03 AM
To: Jeff Barron
Subject: RE: Overburden Sampling for RAMACO

Jeff,

I remember the conversation we had on the 1st of October, back in 2013. Based on the geology in the area that RAMACO was drilling, I agreed to allow chip samples to be taken on 10 foot intervals to represent the overburden quality. There were several reasons for this as well as a couple of caveats that would change sampling procedures if they were encountered. I summarize our conversation as follows:

1. Historically, overburden sampling at the Big Horn Coal Mine was performed by the Kiewit company on 10 foot intervals when drilling with air only. The geology consisted of interbedded shales and siltstones that were typical of the western Powder River Basin. These units are very similar chemically and vertical variation is generally slight. 10 foot intervals are adequate to represent the chemistry of the overburden when taking chip samples.
2. It was understood during the phone conversation that sampling procedures would change if a significant change in the overburden lithology occurred. The samples would be broken at the intersection point of the two differing lithologies to separate them for analysis. New 10 foot intervals would then be taken to top of coal or another major change in lithology.
3. When damp conditions were encountered to the point that water injection had to be activated, the overburden sampling would be modified again to allow for a distinct break between wet and dry samples.
4. If the hole had to be drilled with bentonite mud then full core samples were to be taken to insure that any possible contamination from the mud was removed prior to bagging the core for shipment to the analytical lab.
5. All overburden and interburden materials were to be sampled. The only intervals that would not be sampled were the coal intervals that were to be mined. All other materials, regardless of lithology, had to have representative samples taken. Coal beds that were not to be mined were also to be sampled as potential acid forming or toxin producing materials, as this is the case in many of the mines in the Sheridan area.
6. LQD reserved the right to make changes in the sampling intervals should circumstances warrant more refined sampling.

Those points, to the best of my recollection, represent the gist of our conversation on October 1st, 2013. If there is anything I forgot, let me know, and we will capture it for the correspondence files.

-Bj Kristiansen, PG
Natural Resources Program Principal
LQD-District III

From: Jeff Barron [mailto:jbarron@wwcengineering.com]
Sent: Monday, April 20, 2015 2:57 PM
To: BJ Kristiansen
Subject: Overburden Sampling for RAMACO

TFN 6 2/025
RECD JUL 30,2015

BJ,

I sent an email to you 10/1/2013 with the subject Overburden Quality Sampling which stated:

DEQ Ex. 2-300

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"As a followup to our phone conversation this morning regarding the overburden sampling and analysis plan (attached), I want to thank the state for allowing RAMACO to sample the proposed sites in the plan on 10ft intervals as proposed in the plan."

Pursuant to Dave Schellinger Comment 2:

"Appendix D5, Section D5.4. – documentation of protocols that differ from those approved by the Administrator in Guideline 1 typically require a signed document by LQD staff, not a request for different procedure signed by the company. This issue has been discussed with other mining companies and it has been determined that documentation of approval by LQD staff will be required if sampling/analytical protocols differ from those required by standing LQD policy. Please provide documentation of LQD staff approval for the 10-ft. overburden sampling interval."

Can you provide the written approval that was verbally stated on 10/1/2013.

WWC ENGINEERING
Jeff Barron, P.E. | Project Manager
1849 Terra Avenue | Sheridan, WY 82801
Tel 307-672-0761 | Cell 307-751-1427
www.wwcengineering.com

E-Mail to and from me, in connection with the transaction of public business, is subject to the Wyoming Public Records Act and may be disclosed to third parties.

TFN 6 2/025
RECD JUL 30,2015

DEQ Ex. 2-301

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ADDENDUM D5-7

Soil Analysis Reports

TFN 6 2/025
RECD NOV 14, 2014

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Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Your Environmental Monit _ Partner

Soil Analysis Report
RAMACO
250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310273001
Date Reported: 12/2/2013
Work Order: S1310273

Project: Overburden
Date Received: 10/17/2013

Lab ID	Sample ID	Depths Feet	pH s.u.	Saturation %	Electrical Conductivity dS/m	PE Calcium meq/L	PE Magnesium meq/L	PE Sodium meq/L	SAR
S1310273-001	R-12019D	0-10	7.6	36.0	2.80	28.4	18.6	7.97	1.65
S1310273-002	R-12019D	10-20	7.9	68.1	3.55	21.3	38.7	21.5	3.93
S1310273-003	R-12019D	20-30	7.9	57.3	3.13	15.6	28.3	18.0	3.85
S1310273-004	R-12019D	30-40	6.0	75.4	3.00	20.0	29.6	14.5	2.91
S1310273-005	R-12019D	40-50	6.3		2.39	19.0	20.4	6.28	1.41
S1310273-006	R-12019D	90-100	5.7	62.9	1.43	7.08	7.52	4.65	1.72
S1310273-008	R-12019D	110-120							
S1310273-009	R-12019D	120-130	8.2	61.5	1.00	2.68	0.79	7.23	5.49
S1310273-010	R-12019D	130-140							

TFN 6 2/025
RECD NOV 14, 201-

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate

Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential

Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Scanned, 02/28/2020

Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Your Environmental Monitoring Partner

Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310273001

Project: Overburden
Date Received: 10/17/2013

Date Reported: 12/2/2013
Work Order: S1310273

Lab ID	Sample ID	Depths Feet	Sand %	Silt %	Clay %	Texture	Arsenic ppm	Boron ppm	Nitrate (as N) ppm	Selenium ppm	Molybdenum ppm
S1310273-001	R-12019D	0-10	54.0	28.0	18.0	Sandy Loam	0.17	0.90	118	<0.02	0.27
S1310273-002	R-12019D	10-20	20.0	44.0	36.0	Clay Loam	<0.05	0.76	66.9	0.02	0.10
S1310273-003	R-12019D	20-30	25.0	43.0	32.0	Clay Loam	<0.05				<0.05
S1310273-004	R-12019D	30-40					0.13				<0.05
S1310273-005	R-12019D	40-50					0.40				0.07
S1310273-006	R-12019D	90-100					0.60				0.28
S1310273-008	R-12019D	110-120									
S1310273-009	R-12019D	120-130									0.43
S1310273-010	R-12019D	130-140									

TFN 6 2/025
RECD NOV 14, 2014

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Scanned, 02/28/2020

Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Your Environmental Monitoring Partner

Soil Analysis Report

RAMACO
250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310273001
Date Reported: 12/2/2013
Work Order: S1310273

Project: Overburden
Date Received: 10/17/2013

Lab ID	Sample ID	Depths Feet	Total Carbon %	TOC %	Total Sulfur %	T.S. AB t/1000t	Neutral. Potential t/1000t	T.S. ABP t/1000t
S1310273-001	R-12019D	0-10	0.6	0.2	0.38	11.8	33.8	21.9
S1310273-002	R-12019D	10-20	0.4	0.2	0.18	5.72	22.8	17.0
S1310273-003	R-12019D	20-30	1.2	0.3	0.26	8.04	69.8	61.8
S1310273-004	R-12019D	30-40	0.5	0.3	0.23	7.19	12.9	5.74
S1310273-005	R-12019D	40-50	1.2	0.8	0.17	5.30	37.0	31.7
S1310273-006	R-12019D	90-100	26.0	25.8	0.32	9.84	14.5	4.67
S1310273-008	R-12019D	110-120	2.1	1.6	0.15	4.79	38.8	34.0
S1310273-009	R-12019D	120-130	2.1	1.5	0.11	3.44	51.3	47.8
S1310273-010	R-12019D	130-140	3.9	1.6	0.08	2.57	193	191

TFN 6 2/025
RECD NOV 14, 2014

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate

Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential

Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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OVERBURDEN CORE/CHIP SAMPLE INTERVAL INSTRUCTIONS

Mine Site: Ramaco

Date: 11-27-12

Drillhole ID: R-12019 D

SAMPLE INTERVAL DEPTH	INTERVAL ID	COMMENTS
[illegible] > 1	[illegible]	
[illegible] > 2	[illegible]	
[illegible] 30 > 3	[illegible]	
[illegible] > 4	[illegible]	
[illegible] > 5	[illegible]	
[illegible]	↕	Coal – Coal: These Sample Intervals Omitted
[illegible] > 6	[illegible]	
[illegible] > 7	[illegible]	
[illegible] > 8	[illegible]	
[illegible] > 9	[illegible]	
130-[illegible] / [illegible]-140 > 10	[illegible]	

Kane A Seco
Rec'd 12/3/12

S1212183

TFN 6 2/025
RECD NOV 14, 2014

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Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945
Your Environmental Monit.....g Partner

Soil Analysis Report

RAMACO
250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310277001
Date Reported: 12/2/2013
Work Order: S1310277

Project: Overburden
Date Received: 10/17/2013

Lab ID	Sample ID	Depths Feet	pH s.u.	Saturation %	Electrical Conductivity dS/m	PE Calcium meq/L	PE Magnesium meq/L	PE Sodium meq/L	SAR
S1310277-001	R-12005	0-10	8.0	40.9	3.01	13.0	25.4	18.2	4.15
S1310277-002	R-12005	10-20	8.1	46.7	1.18	2.06	4.09	5.66	3.23
S1310277-003	R-12005	20-30	7.8	47.9	1.25	2.29	5.38	5.42	2.77
S1310277-004	R-12005	30-40	8.3	33.9	1.12	1.87	3.36	5.78	3.57
S1310277-005	R-12005	40-50	7.1	58.5	1.31	1.87	3.19	10.2	6.41
S1310277-006	R-12005	50-53	6.3	61.5	1.47	1.69	2.69	11.2	7.55
S1310277-007	R-12005	56-66	7.5	70.8	0.61	1.01	1.89	4.39	3.65
S1310277-008	R-12005	74-85	8.1	68.0	0.95	1.19	1.91	8.13	6.53
S1310277-009	R-12005	85-95	8.5	56.0	0.62	1.18	3.70	5.45	3.49
S1310277-010	R-12005	95-105	7.9	61.4	0.92	1.09	3.78	7.75	4.96

TFN 6 2/025
RECD NOV 14, 2014

These results apply only to the samples tested.

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Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential

Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Scanned, 02/28/2020

Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Your Environmental Monitoring Partner

Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310277001

Project: Overburden
Date Received: 10/17/2013

Date Reported: 12/2/2013
Work Order: S1310277

Lab ID	Sample ID	Depths Feet	Sand %	Silt %	Clay %	Texture	Arsenic ppm	Boron ppm	Nitrate (as N) ppm	Selenium ppm	Molybdenum ppm
S1310277-001	R-12005	0-10	34.0	38.0	28.0	Clay Loam	<0.05	0.30	1.1	0.03	0.05
S1310277-002	R-12005	10-20	26.0	44.0	30.0	Clay Loam	0.11	0.14	0.5	0.03	0.25
S1310277-003	R-12005	20-30	22.0	46.0	32.0	Clay Loam	0.27	0.49	0.6	0.09	0.45
S1310277-004	R-12005	30-40	38.0	40.0	22.0	Loam	0.23	0.27	0.5	0.06	0.38
S1310277-005	R-12005	40-50	18.0	34.0	48.0	Clay	0.31	0.89	0.7	0.11	1.04
S1310277-006	R-12005	50-53	34.0	20.0	46.0	Clay	0.76	2.36	0.5	0.06	0.76
S1310277-007	R-12005	56-66	13.0	21.0	66.0	Clay	0.09	0.96	0.5	0.06	0.44
S1310277-008	R-12005	74-85	6.0	37.0	57.0	Silty Clay	0.41				0.47
S1310277-009	R-12005	85-95	8.0	50.0	42.0	Silty Clay	0.11	0.36	0.7	0.11	0.28
S1310277-010	R-12005	95-105	14.0	34.0	52.0	Clay	0.39	0.63	0.6	0.09	0.55

TFN 6 2/025
RECD NOV 14, 2014

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Soil Analysis Report
RAMACO
250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310277001

Project: Overburden
Date Received: 10/17/2013

Date Reported: 12/2/2013
Work Order: S1310277

Lab ID	Sample ID	Depths Feet	Total Carbon %	TOC %	Total Sulfur %	T.S. AB t/1000t	Neutral. Potential t/1000t	T.S. ABP t/1000t	Reflux %	Pyr+Org AB t/1000t	Pyr+Org ABP t/1000t
S1310277-001	R-12005	0-10	1.4	0.5	0.15	4.53	69.4	64.9			
S1310277-002	R-12005	10-20	1.2	0.8	0.08	2.41	33.2	30.8			
S1310277-003	R-12005	20-30	0.8	0.7	0.09	2.79	9.65	6.86			
S1310277-004	R-12005	30-40	2.8	1.2	0.07	2.22	133	131			
S1310277-005	R-12005	40-50	6.4	6.2	0.33	10.2	15.3	5.15			
S1310277-006	R-12005	50-53	23.3	23.1	1.18	36.8	17.8	-19.1	1.12	34.9	-17.1
S1310277-007	R-12005	56-66	5.1	4.9	0.15	4.82	13.5	8.69			
S1310277-008	R-12005	74-85	2.3	2.0	0.20	6.20	24.1	17.9			
S1310277-009	R-12005	85-95	1.4	1.0	0.04	1.10	32.7	31.6			
S1310277-010	R-12005	95-105	4.4	4.3	0.23	7.27	7.96	0.69			

TFN 6 2/025
RECD NOV 14, 2014

These results apply only to the samples tested.

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Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Scanned, 02/28/2020

OVERBURDEN CORE/CHIP SAMPLE INTERVAL INSTRUCTIONS

Mine Site: Ramaco

Date: 12-5-12

Drillhole ID: R-12005

SAMPLE INTERVAL DEPTH		INTERVAL ID	COMMENTS
0 - 5	1	1	
5 - 10		2	
10 - 15	2	3	
15 - 20		4	
20 - 25	3	5	
25 - 30		6	
30 - 35	4	7	
35 - 40		8	
40 - 45	5	9	
45 - 50	core pieces	10	
50 - 53	core pieces	11	
53 - 56	6	Coal	coal - NO sample
56 - 60	core pieces	12	
60 - 65	7	13	
65 - 66		14	
66 - 74		Coal	coal - NO sample
74 - 80	8	15	
80 - 85		16	
85 - 90	9	17	
90 - 95		18	
95 - 98	10	19	
98 - 103		coal	coal - NO sample
103 - 105		20 underburden	

51212189
Rec'd 12/6/12
Kara Allen

TFN 6 2/025
RECD NOV 14, 2014

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Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310329001

Project: Overburden
Date Received: 10/22/2013

Date Reported: 12/1/2013
Work Order: S1310329

Lab ID	Sample ID	Depths FEET	pH s.u.	Saturation %	Electrical Conductivity dS/m	PE Calcium meq/L	PE Magnesium meq/L	PE Sodium meq/L	SAR
S1310329-001	R-12002	0-10	8.0	31.5	3.14	17.9	28.7	15.6	3.24
S1310329-002	R-12002	10-20	7.9	34.0	2.89	14.5	25.1	12.8	2.87
S1310329-003	R-12002	20-30	8.2	32.5	2.42	4.93	14.3	8.40	2.71
S1310329-004	R-12002	30-40	7.6	43.1	3.21	18.0	32.6	13.9	2.76
S1310329-005	R-12002	40-50	7.1	74.0	2.58	5.62	22.3	11.0	2.94
S1310329-006	R-12002	50-59	6.3	57.6	1.81	3.85	12.7	6.04	2.10
S1310329-007	R-12002	65-75	6.1	56.9	1.75	3.77	6.91	8.92	3.86
S1310329-008	R-12002	75-85	7.9	60.9	1.42	2.24	3.55	8.08	4.75
S1310329-009	R-12002	85-95	7.6	61.8	1.09	1.61	2.41	6.69	4.72
S1310329-010	R-12002	95-105	6.8	63.3	1.35	1.90	1.98	8.35	5.99
S1310329-011	R-12002	105-110	6.3	67.4	1.69	2.49	3.98	11.9	6.59
S1310329-012	R-12002	115-125	7.0	59.7	1.68	1.95	2.51	12.9	8.61
S1310329-013	R-12002	132.7-134	4.3	76.5	4.18	14.2	24.5	32.1	7.29

TFN 6 2/025
RECD NOV 14, 2014

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Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Scanned, 02/28/2020

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Your Environmental Monitoring Partner

Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310329001

Project: Overburden
Date Received: 10/22/2013

Date Reported: 12/1/2013
Work Order: S1310329

Lab ID	Sample ID	Depths FEET	Sand %	Silt %	Clay %	Texture	Arsenic ppm	Boron ppm	Nitrate (as N) ppm	Selenium ppm	Molybdenum ppm
S1310329-001	R-12002	0-10	66.0	16.0	18.0	Sandy Loam	0.05	0.89	0.6	0.04	<0.05
S1310329-002	R-12002	10-20	60.0	22.0	18.0	Sandy Loam	<0.05	0.89	0.4	0.03	<0.05
S1310329-003	R-12002	20-30	60.0	23.0	17.0	Sandy Loam	0.08	0.25	0.6	0.02	<0.05
S1310329-004	R-12002	30-40	32.0	40.0	28.0	Clay Loam	<0.05	0.08	0.4	0.03	0.14
S1310329-005	R-12002	40-50	7.0	47.0	46.0	Silty Clay	0.11	0.15	0.3	0.20	0.40
S1310329-006	R-12002	50-59	15.0	43.0	42.0	Silty Clay	0.70	1.21	0.5	0.11	0.21
S1310329-007	R-12002	65-75	12.0	42.0	46.0	Silty Clay	0.76	1.04	1.1	0.12	0.50
S1310329-008	R-12002	75-85	10.0	39.0	51.0	Clay	0.10	0.20	1.8	0.11	0.19
S1310329-009	R-12002	85-95	8.0	39.0	53.0	Clay	0.19	0.31	0.8	0.12	0.44
S1310329-010	R-12002	95-105	16.0	31.0	53.0	Clay	0.17	1.74	0.7	0.09	0.82
S1310329-011	R-12002	105-110	18.0	26.0	56.0	Silty Clay	1.17	2.66	0.8	0.06	1.03
S1310329-012	R-12002	115-125	10.0	38.0	52.0	Clay	0.12	0.71	0.7	0.13	0.27
S1310329-013	R-12002	132.7-134	14.0	16.0	70.0	Clay	3.14	3.59	0.4	0.57	1.11

TFN 6 2/025
RECD NOV 14, 2014

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Karen Secor, Soil Lab Supervisor

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Your Environmental Monitoring Partner

Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310329001

Project: Overburden
Date Received: 10/22/2013

Date Reported: 12/1/2013
Work Order: S1310329

Lab ID	Sample ID	Depths FEET	Total Carbon %	TOC %	Total Sulfur %	T.S. AB t/1000t	Neutral. Potential t/1000t	T.S. ABP t/1000t	Reflux %	Pyr+Org AB t/1000t	Pyr+Org ABP t/1000t
S1310329-001	R-12002	0-10	0.4	0.2	0.19	5.78	17.2	11.5			
S1310329-002	R-12002	10-20	0.4	0.1	0.17	5.40	26.5	21.1			
S1310329-003	R-12002	20-30	0.7	0.2	0.03	1.08	35.3	34.2			
S1310329-004	R-12002	30-40	1.2	0.5	0.22	6.99	61.6	54.6			
S1310329-005	R-12002	40-50	1.5	1.3	0.15	4.61	23.2	18.6			
S1310329-006	R-12002	50-59	7.8	7.6	0.20	6.11	18.7	12.6			
S1310329-007	R-12002	65-75	4.8	4.5	0.17	5.36	28.8	23.4			
S1310329-008	R-12002	75-85	1.8	1.2	0.06	1.97	45.2	43.2			
S1310329-009	R-12002	85-95	2.8	2.7	0.14	4.44	11.9	7.42			
S1310329-010	R-12002	95-105	9.4	9.2	0.25	7.91	15.2	7.25			
S1310329-011	R-12002	105-110	10.2	10.0	0.70	21.8	16.4	-5.34	0.69	21.6	-5.16
S1310329-012	R-12002	115-125	4.4	4.3	0.12	3.77	12.3	8.50			
S1310329-013	R-12002	132.7-134	10.6	10.4	1.20	37.4	9.95	-27.4	0.89	27.9	-17.9

TFN 6 2/025
RECD NOV 14, 2014

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Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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OVERBURDEN CORE/CHIP SAMPLE INTERVAL INSTRUCTIONS

Mine Site: Ramaco

Date: 12-5-12

Drillhole ID: R-12002

SAMPLE INTERVAL DEPTH	INTERVAL ID	COMMENTS
0-5 > 1	1	
5-10	2	
10-15 > 2	3	
15-20	4	
20-25 > 3	5	
25-30	6	
30-35 > 4	7	
35-40	8	
40-50 > 5	9	
50-55	10	
55-58 > 6 core pieces	11	
58-65 coal	coal	
65-70 > 7 core pieces	12	
70-75	13	
75-80 > 8	14	
80-85	15	
85-90	16	
90-95 > 9	17	
95-100 > 10	18	
100-105	19	
105-110 - 11	20	
110-114.2 coal	coal	
115-120 > 12	21	
120-125	22	
125-133 coal	coal	
~~[illegible]~~ core pieces		
132.7-134 -13	23	Bottom slight end no core 134-140

Recd 12/6/12
Kan Ser
5121191

TFN 6 2/025
RECD NOV 14, 2014

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Soil Analysis Report

RAMACO
250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310331001

Project: Overburden
Date Received: 10/22/2013

Date Reported: 12/1/2013
Work Order: S1310331

Lab ID	Sample ID	Depths FEET	pH s.u.	Saturation %	Electrical Conductivity dS/m	PE Calcium meq/L	PE Magnesium meq/L	PE Sodium meq/L	SAR
S1310331-001	R-12003	0-10	8.6	34.0	0.84	1.25	1.96	6.71	5.30
S1310331-002	R-12003	10-20	8.1	58.2	2.72	7.63	26.9	16.5	3.98
S1310331-003	R-12003	20-30	7.7	60.7	2.84	9.58	34.0	14.9	3.18
S1310331-004	R-12003	30-40	5.0	68.8	2.58	6.95	29.4	11.7	2.75
S1310331-005	R-12003	40-50	5.7	75.8	2.72	6.43	31.5	13.3	3.04
S1310331-006	R-12003	50-55	6.7	72.4	1.90	3.71	11.4	9.98	3.63
S1310331-007	R-12003	60-65	6.5	58.7	1.61	3.32	6.51	10.1	4.56
S1310331-008	R-12003	75-85	7.2	76.7	1.38	2.19	3.40	10.2	6.12
S1310331-009	R-12003	85-95	8.7	71.6	0.68	1.84	7.99	6.01	2.71
S1310331-010	R-12003	95-105	8.7	69.8	0.46	0.84	0.75	4.62	5.19
S1310331-011	R-12003	105-108	6.7	56.3	0.54	0.80	0.54	4.10	5.00

TFN 6 2/025
RECD NOV 14, 2014

These results apply only to the samples tested.

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Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
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Report ID: S1310331001

Project: Overburden
Date Received: 10/22/2013

Date Reported: 12/1/2013
Work Order: S1310331

Lab ID	Sample ID	Depths FEET	Sand %	Silt %	Clay %	Texture	Arsenic ppm	Boron ppm	Nitrate (as N) ppm	Selenium ppm	Molybdenum ppm
S1310331-001	R-12003	0-10	49.0	31.0	20.0	Loam	0.13	1.00	0.9	0.02	0.11
S1310331-002	R-12003	10-20	24.0	44.0	32.0	Clay Loam	0.06	0.45	2.6	0.12	<0.05
S1310331-003	R-12003	20-30	22.0	48.0	30.0	Clay Loam	<0.05	0.11	3.8	0.12	<0.05
S1310331-004	R-12003	30-40	9.0	33.0	58.0	Silty Clay	0.38	0.33	1.5	0.08	<0.05
S1310331-005	R-12003	40-50	21.0	26.0	53.0	Clay	1.64	2.02	0.5	0.13	1.18
S1310331-006	R-12003	50-55	10.0	42.0	48.0	Silty Clay	0.16	0.60	0.6	0.19	1.01
S1310331-007	R-12003	60-65	18.0	27.0	55.0	Silty Clay	0.49	1.63	1.0	0.12	0.57
S1310331-008	R-12003	75-85	14.0	34.0	52.0	Clay	0.23	0.94	0.4	0.19	0.29
S1310331-009	R-12003	85-95	10.0	38.0	52.0	Clay	0.30	0.16	0.6	0.27	0.23
S1310331-010	R-12003	95-105	10.0	45.0	45.0	Silty Clay	0.90	0.12	0.5	0.23	0.73
S1310331-011	R-12003	105-108	32.0	40.0	28.0	Clay Loam	0.28	5.54	0.4	0.13	1.32

TFN 6 2/025
RECD NOV 14, 2014

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Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310331001

Project: Overburden
Date Received: 10/22/2013

Date Reported: 12/1/2013
Work Order: S1310331

Lab ID	Sample ID	Depths FEET	Total Carbon %	TOC %	Total Sulfur %	T.S. AB t/1000t	Neutral. Potential t/1000t	T.S. ABP t/1000t	Reflux %	Pyr+Org AB t/1000t	Pyr+Org ABP t/1000t
S1310331-001	R-12003	0-10	0.8	<0.1	0.01	0.38	61.8	61.4			
S1310331-002	R-12003	10-20	0.1	<0.1	0.09	2.71	12.3	9.61			
S1310331-003	R-12003	20-30	<0.1	<0.1	0.09	2.82	11.6	8.80			
S1310331-004	R-12003	30-40	0.5	0.4	0.15	4.70	7.08	2.38			
S1310331-005	R-12003	40-50	11.3	11.1	1.11	34.5	14.9	-19.7	0.89	27.8	-13.0
S1310331-006	R-12003	50-55	4.0	3.4	0.43	13.3	45.9	32.6			
S1310331-007	R-12003	60-65	7.6	7.4	0.46	14.2	14.3	0.03			
S1310331-008	R-12003	75-85	6.3	6.0	0.22	6.81	17.7	10.9			
S1310331-009	R-12003	85-95	0.9	0.4	0.07	2.26	42.9	40.6			
S1310331-010	R-12003	95-105	0.8	0.5	0.07	2.11	28.1	26.0			
S1310331-011	R-12003	105-108	14.7	14.5	0.36	11.4	14.8	3.44			

TFN 6 2/025
RECD NOV 14, 2014

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate

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Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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OVERBURDEN CORE/CHIP SAMPLE INTERVAL INSTRUCTIONS

Mine Site: Ramaco

Date: 12-7-12

Drillhole ID: R-12003

SAMPLE INTERVAL DEPTH	INTERVAL ID	COMMENTS
0-5 > 1	1	
5-10	2	
10-15 > 2	3	
15-20	4	
20-25 > 3	5	
25-30	6	
30-35 > 4	7	
35-40	8	
40-45 > 5	9	
45-50	10	
50-55 - 6		
55-60 (coal)	—	
60-65 - 7	11	
65-75 coal	—	
75-80 > 8	12	
80-85	13	
85-90 > 9	14	
90-95	15	
95-100 > 10	16	
100-105	17	
105-108 - core pieces 11	18	
108-113 coal	—	
~~113-115 core pieces~~	~~19~~	lost core slid out bottom

5/2/2/92

Rec'd 12/11/12

Karen Seco

TFN 6 2/025
RECD NOV 14, 2014

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Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310332001

Project: Overburden
Date Received: 10/22/2013

Date Reported: 12/1/2013
Work Order: S1310332

Lab ID	Sample ID	Depths FEET	pH s.u.	Saturation %	Electrical Conductivity dS/m	PE Calcium meq/L	PE Magnesium meq/L	PE Sodium meq/L	SAR
S1310332-001	R-12001	0-10	8.2	39.1	1.21	1.97	4.50	6.30	3.50
S1310332-002	R-12001	10-20	7.4	51.2	0.86	2.85	5.02	2.59	1.31
S1310332-003	R-12001	24-30	6.2	44.6	2.27	20.0	27.4	5.21	1.07
S1310332-004	R-12001	30-40	6.2	71.5	1.85	10.3	17.9	3.84	1.02
S1310332-005	R-12001	45-55	6.8	68.8	1.30	3.33	6.72	6.64	2.96
S1310332-006	R-12001	60-69	7.2	75.8	0.84	1.29	1.80	6.23	5.01

TFN 6 2/025
RECD NOV 14, 2014

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Lexington, KY 40507

Report ID: S1310332001

Project: Overburden
Date Received: 10/22/2013

Date Reported: 12/1/2013
Work Order: S1310332

Lab ID	Sample ID	Depths FEET	Sand %	Silt %	Clay %	Texture	Arsenic ppm	Boron ppm	Nitrate (as N) ppm	Selenium ppm	Molybdenum ppm
S1310332-001	R-12001	0-10	43.0	26.0	31.0	Clay Loam	<0.05	0.35	1.5	<0.02	0.09
S1310332-002	R-12001	10-20	22.0	45.0	33.0	Clay Loam	<0.05	0.76	8.7	0.03	<0.05
S1310332-003	R-12001	24-30	26.0	41.0	33.0	Clay Loam	0.23	2.75	17.1	0.02	0.09
S1310332-004	R-12001	30-40	5.0	44.0	51.0	Silty Clay	0.66	0.95	0.6	0.10	0.40
S1310332-005	R-12001	45-55	14.0	34.0	52.0	Clay	0.20	1.31	0.9	0.13	0.89
S1310332-006	R-12001	60-69	12.0	26.0	62.0	Clay	<0.05	1.71	0.4	0.10	0.37

TFN 6 2/025
RECD NOV 14, 2014

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Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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250 West Main Street, Suite 210
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Report ID: S1310332001

Project: Overburden
Date Received: 10/22/2013

Date Reported: 12/1/2013
Work Order: S1310332

Lab ID	Sample ID	Depths FEET	Total Carbon %	TOC %	Total Sulfur %	T.S. AB t/1000t	Neutral. Potential t/1000t	T.S. ABP t/1000t
S1310332-001	R-12001	0-10	0.9	<0.1	<0.01	<0.01	81.2	81.2
S1310332-002	R-12001	10-20	0.4	<0.1	0.02	0.69	32.3	31.6
S1310332-003	R-12001	24-30	0.7	0.5	0.65	20.2	19.8	-0.35
S1310332-004	R-12001	30-40	1.9	1.7	0.18	5.53	19.4	13.9
S1310332-005	R-12001	45-55	6.1	5.9	0.33	10.4	21.5	11.2
S1310332-006	R-12001	60-69	5.8	5.6	0.12	3.81	15.5	11.7

TFN 6 2/025
RECD NOV 14, 2014

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Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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OVERBURDEN CORE/CHIP SAMPLE INTERVAL INSTRUCTIONS

Mine Site: Ramaco

Date: 12-6-12

Drillhole ID: R-12001

SAMPLE INTERVAL DEPTH	INTERVAL ID	COMMENTS
0-5 >1	1	
5-10	2	
10-15 >2	3	
15-20	4	
20-24 (coal?)	Coal	No OB Samples
24-30 >3 core pieces	5	
30-35 >4	6	
35-40	7	
40-45 >5	8	
45-50	9	
50-55 >6 core pieces	10	
55-60 (coal)	coal	NO OB Samples
60-65 >7 core piece	11	
65-69 >6 core pieces	12	
69-76 (coal)	Coal	No OB Samples
76-80 >8 core pieces	13	

Rec'd No Samp

Rec'd No Samp

5/2/2/93
Rec'd 12/11/12
[illegible]

TFN 6 2/025
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Soil Analysis Report

RAMACO
250 West Main Street, Suite 210
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Report ID: S1310345001

Project: Overburden
Date Received: 10/23/2013

Date Reported: 12/1/2013
Work Order: S1310345

Lab ID	Sample ID	Depths FEET	pH s.u.	Saturation %	Electrical Conductivity dS/m	PE Calcium meq/L	PE Magnesium meq/L	PE Sodium meq/L	SAR
S1310345-001	AMBRE-04	0-10	8.0	32.4	1.29	6.21	4.84	2.38	1.01
S1310345-002	AMBRE-04	10-20	8.2	40.8	1.10	3.46	4.15	2.28	1.17
S1310345-003	AMBRE-04	20-30	7.5	35.5	1.23	3.76	5.21	2.82	1.33
S1310345-004	AMBRE-04	30-40	8.3	27.6	1.04	3.64	4.46	1.70	0.84
S1310345-005	AMBRE-04	40-50	8.4	28.4	0.94	3.58	3.70	1.48	0.78
S1310345-006	AMBRE-04	50-60	8.1	29.9	1.00	3.65	3.87	1.89	0.97
S1310345-007	AMBRE-04	60-65	6.7	42.3	1.77	6.48	8.98	3.58	1.29
S1310345-008	AMBRE-04	65-71	6.6	48.8	1.24	3.76	4.54	3.91	1.92
S1310345-009	AMBRE-04	89.5-96	8.3	53.5	0.81	1.09	0.74	4.76	4.98

TFN 6 2/025
RECD NOV 14, 2014

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate

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Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Report ID: S1310345001

Project: Overburden
Date Received: 10/23/2013

Date Reported: 12/1/2013
Work Order: S1310345

Lab ID	Sample ID	Depths FEET	Sand %	Silt %	Clay %	Texture	Arsenic ppm	Boron ppm	Nitrate (as N) ppm	Selenium ppm	Molybdenum ppm
S1310345-001	AMBRE-04	0-10	64.0	21.0	15.0	Sandy Loam	<0.05	0.29	0.8	<0.02	0.17
S1310345-002	AMBRE-04	10-20	44.0	35.0	21.0	Loam	<0.05	0.25	0.3	<0.02	0.31
S1310345-003	AMBRE-04	20-30	54.0	31.0	15.0	Sandy Loam	0.11	0.22	0.3	0.02	0.26
S1310345-004	AMBRE-04	30-40	67.0	25.0	8.0	Sandy Loam	0.13	<0.05	0.3	<0.02	0.21
S1310345-005	AMBRE-04	40-50	80.0	15.0	5.0	Loamy Sand	0.21	0.05	0.3	<0.02	0.06
S1310345-006	AMBRE-04	50-60	54.0	33.0	13.0	Sandy Loam	0.37	0.15	0.3	0.03	0.29
S1310345-007	AMBRE-04	60-65	4.0	55.0	41.0	Silty Clay	1.02	0.37	0.4	0.05	0.89
S1310345-008	AMBRE-04	65-71	10.0	51.0	39.0	Silty Clay Loam	0.36	0.89	0.4	0.07	0.88
S1310345-009	AMBRE-04	89.5-96	8.0	33.0	59.0	Silty Clay	0.08	0.20	0.3	0.12	0.75

TFN 6 2/025
RECD NOV 14, 2014

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Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Soil Analysis Report
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250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310345001

Project: Overburden
Date Received: 10/23/2013

Date Reported: 12/1/2013
Work Order: S1310345

Lab ID	Sample ID	Depths FEET	Total Carbon %	TOC %	Total Sulfur %	T.S. AB t/1000t	Neutral. Potential t/1000t	T.S. ABP t/1000t
S1310345-001	AMBRE-04	0-10	1.2	<0.1	0.04	1.14	91.9	90.7
S1310345-002	AMBRE-04	10-20	0.9	<0.1	0.02	0.75	82.3	81.6
S1310345-003	AMBRE-04	20-30	1.6	1.6	0.05	1.68	3.85	2.17
S1310345-004	AMBRE-04	30-40	3.3	0.4	0.02	0.51	238	238
S1310345-005	AMBRE-04	40-50	3.4	0.5	<0.01	<0.01	245	245
S1310345-006	AMBRE-04	50-60	2.3	0.3	0.05	1.52	163	161
S1310345-007	AMBRE-04	60-65	3.0	2.4	0.38	12.0	43.8	31.8
S1310345-008	AMBRE-04	65-71	4.8	4.4	0.33	10.3	34.2	23.8
S1310345-009	AMBRE-04	89.5-96	1.1	0.7	0.11	3.56	35.7	32.2

TFN 6 2/025
RECD NOV 14, 2014

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Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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OVERBURDEN CORE/CHIP SAMPLE INTERVAL INSTRUCTIONS

Mine Site: Ramaco

Date: 1-15-2013

Drillhole ID: AMBRE-04

SAMPLE INTERVAL DEPTH		INTERVAL ID	COMMENTS
0 - 5		1	
5 - 10		2	
10 - 15		3	
15 - 20		4	
20 - 25		5	
25 - 30		6	
30 - 35		7	
35 - 40		8	
40 - 45		9	
45 - 50		10	
50 - 55		11	
55 - 60		12	
60 - 65	core pieces	13	
65 - 71	core pieces	14	
71 - 89.5	coal	—	No samples
89.5 - 96	core pieces	15	
96 - 101		coal	No Samples
101 - 105		—	lost core - No Samples

Rec'd 4/16/13
Kane A Seco
51301220

TFN 6 2/025
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Soil Analysis Report

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Report ID: S1310347001

Project: Overburden
Date Received: 10/23/2013

Date Reported: 12/1/2013
Work Order: S1310347

Lab ID	Sample ID	Depths FEET	pH s.u.	Saturation %	Electrical Conductivity dS/m	PE Calcium meq/L	PE Magnesium meq/L	PE Sodium meq/L	SAR
S1310347-001	AMBRE-03	0-10	8.0	33.6	3.04	10.8	21.8	7.81	1.93
S1310347-002	AMBRE-03	10-20	8.3	25.3	1.45	4.24	6.17	3.74	1.64
S1310347-003	AMBRE-03	20-30	7.9	46.6	1.37	4.40	6.14	2.98	1.30
S1310347-004	AMBRE-03	30-40	7.9	45.6	1.09	3.66	4.49	1.95	0.97
S1310347-005	AMBRE-03	40-50	7.4	38.0	1.60	6.00	8.27	2.92	1.09
S1310347-006	AMBRE-03	50-52	6.4	54.6	1.71	6.54	9.80	2.77	0.97
S1310347-007	AMBRE-03	68.9-78.5	7.6	52.8	1.10	2.28	2.06	5.16	3.51
S1310347-008	AMBRE-03	85.9-88	8.1	78.1	0.82	1.19	0.78	6.18	6.23

TFN 6 2/025
RECD NOV 14, 2014

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

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Report ID: S1310347001

Project: Overburden
Date Received: 10/23/2013

Date Reported: 12/1/2013
Work Order: S1310347

Lab ID	Sample ID	Depths FEET	Sand %	Silt %	Clay %	Texture	Arsenic ppm	Boron ppm	Nitrate (as N) ppm	Selenium ppm	Molybdenum ppm
S1310347-001	AMBRE-03	0-10	65.0	18.0	17.0	Sandy Loam	0.05	0.76	0.7	0.03	0.11
S1310347-002	AMBRE-03	10-20	74.0	17.0	9.0	Sandy Loam	0.05	0.20	0.1	<0.02	0.26
S1310347-003	AMBRE-03	20-30	24.0	51.0	25.0	Silty Loam	0.09	0.24	0.3	0.02	0.62
S1310347-004	AMBRE-03	30-40	20.0	53.8	26.3	Silty Loam	0.17	0.11	0.3	0.05	0.35
S1310347-005	AMBRE-03	40-50	40.0	35.0	25.0	Loam	0.30	0.32	0.4	0.04	0.50
S1310347-006	AMBRE-03	50-52	14.0	38.0	48.0	Clay	2.90	1.61	0.2	0.13	2.12
S1310347-007	AMBRE-03	68.9-78.5	19.0	38.0	43.0	Clay	0.44	0.39	0.5	0.16	0.34
S1310347-008	AMBRE-03	85.9-88	6.0	29.0	65.0	Clay	0.79	0.19	0.2	0.23	0.50

TFN 6 2/025
RECD NOV 14, 2014

These results apply only to the samples tested.

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Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

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Report ID: S1310347001

Project: Overburden
Date Received: 10/23/2013

Date Reported: 12/1/2013
Work Order: S1310347

Lab ID	Sample ID	Depths FEET	Total Carbon %	TOC %	Total Sulfur %	T.S. AB t/1000t	Neutral. Potential t/1000t	T.S. ABP t/1000t	Reflux %	Pyr+Org AB t/1000t	Pyr+Org ABP t/1000t
S1310347-001	AMBRE-03	0-10	1.3	0.2	0.06	1.84	92.4	90.5			
S1310347-002	AMBRE-03	10-20	2.7	0.2	0.03	0.92	206	205			
S1310347-003	AMBRE-03	20-30	1.7	0.5	0.05	1.42	94.1	92.7			
S1310347-004	AMBRE-03	30-40	1.7	0.6	0.06	1.91	87.4	85.5			
S1310347-005	AMBRE-03	40-50	2.6	1.1	0.11	3.51	126	122			
S1310347-006	AMBRE-03	50-52	6.9	6.7	0.97	30.4	16.5	-13.9	0.97	30.3	-13.8
S1310347-007	AMBRE-03	68.9-78.5	2.8	1.3	0.26	8.24	120	112			
S1310347-008	AMBRE-03	85.9-88	1.5	1.4	0.24	7.42	14.2	6.73			

TFN 6 2/025
ECD NOV 14, 2014

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate

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Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Scanned: 02/28/2020

OVERBURDEN CORE/CHIP SAMPLE INTERVAL INSTRUCTIONS

Mine Site: Ramaco

Date: 1-10-13

Drillhole ID: AMBRE - 03

SAMPLE INTERVAL DEPTH		INTERVAL ID	COMMENTS
0 - 5		1	
5 - 10		2	
10 - 15		3	
15 - 20		4	
20 - 25		5	
25 - 30		6	
30 - 35		7	
35 - 40		8	
40 - 45		9	
45 - 50		10	
50 - 52		11	
52 - 68.9		NO OB Samples	Coal
68.9 - 75	core pieces	12	
75 - 78.5	core pieces	13	
78.5 - 85.9		Coal	No samples
85.9 - 88	core pieces	14	

Rec'd 1/11/13
Kane Geo
51301173

TFN 6 2/025
RECD NOV 14, 2014

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Soil Analysis Report
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Report ID: S1310350001

Project: Overburden
Date Received: 10/23/2013

Date Reported: 12/1/2013
Work Order: S1310350

Lab ID	Sample ID	Depths FEET	pH s.u.	Saturation %	Electrical Conductivity dS/m	PE Calcium meq/L	PE Magnesium meq/L	PE Sodium meq/L	SAR
S1310350-001	R-12006	0-10	8.1	39.5	0.27	2.24	1.07	0.34	0.27
S1310350-002	R-12006	10-15	8.3	53.7	0.40	1.54	0.98	1.69	1.51
S1310350-003	R-12006	65-75	7.3	51.0	0.43	1.68	1.35	1.57	1.27
S1310350-004	R-12006	75-85	7.9	64.4	0.59	2.33	1.97	1.45	0.99
S1310350-005	R-12006	85-95	8.0	60.7	0.59	2.56	2.07	1.31	0.86
S1310350-006	R-12006	95-105	7.8	60.1	0.80	3.23	3.42	1.86	1.02
S1310350-007	R-12006	105-115	7.6	62.6	1.03	3.88	4.64	2.30	1.12
S1310350-008	R-12006	115-125	7.6	49.9	1.23	4.31	6.05	2.50	1.10

TFN 6 2/025
RECD NOV 14, 2014

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Scanned, 02/28/2020

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1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310350001

Project: Overburden

Date Received: 10/23/2013

Date Reported: 12/1/2013

Work Order: S1310350

Lab ID	Sample ID	Depths FEET	Sand %	Silt %	Clay %	Texture	Arsenic ppm	Boron ppm	Nitrate (as N) ppm	Selenium ppm	Molybdenum ppm
S1310350-001	R-12006	0-10	88.0	9.0	3.0	Sand	<0.05	0.11	0.2	<0.02	<0.05
S1310350-002	R-12006	10-15					<0.05	<0.05	0.3	0.02	<0.05
S1310350-003	R-12006	65-75	7.0	42.0	51.0	Silty Clay	<0.05	0.49	0.7	0.03	0.20
S1310350-004	R-12006	75-85	7.0	44.0	49.0	Silty Clay	<0.05	0.19	0.9	0.03	0.22
S1310350-005	R-12006	85-95	12.0	47.0	41.0	Silty Clay	<0.05	0.25	0.6	0.07	0.18
S1310350-006	R-12006	95-105	14.0	39.0	47.0	Clay	0.19	0.26	0.7	0.09	0.61
S1310350-007	R-12006	105-115	10.0	48.0	42.0	Silty Clay	0.17	0.26	0.9	0.08	0.50
S1310350-008	R-12006	115-125	18.0	47.4	34.6	Silty Clay Loam	0.09	0.20	0.5	0.06	0.35

TFN 6 2/025
RECD NOV 14, 2014

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate

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Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Scanned, 02/28/2020

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Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310350001

Project: Overburden

Date Received: 10/23/2013

Date Reported: 12/1/2013

Work Order: S1310350

Lab ID	Sample ID	Depths FEET	Total Carbon %	TOC %	Total Sulfur %	T.S. AB t/1000t	Neutral. Potential t/1000t	T.S. ABP t/1000t
S1310350-001	R-12006	0-10	0.2	0.1	<0.01	<0.01	3.03	3.03
S1310350-002	R-12006	10-15	<0.1	<0.1	<0.01	<0.01	5.52	5.52
S1310350-003	R-12006	65-75	0.7	0.6	0.02	0.75	12.4	11.7
S1310350-004	R-12006	75-85	0.7	0.5	0.03	1.07	13.4	12.3
S1310350-005	R-12006	85-95	1.1	0.6	0.05	1.51	41.1	39.6
S1310350-006	R-12006	95-105	1.8	1.1	0.14	4.34	59.9	55.6
S1310350-007	R-12006	105-115	2.3	1.8	0.27	8.42	46.7	38.3
S1310350-008	R-12006	115-125	2.5	1.4	0.29	9.03	89.2	80.1

TFN 6 2/025
RECD NOV 14, 2014

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate

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Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

RAMACO

OVERBURDEN CORE/CHIP SAMPLE INTERVAL INSTRUCTIONS

Mine Site: Ramaco

Date: 1-3-2013

Drillhole ID: R-12006

SAMPLE INTERVAL DEPTH	INTERVAL ID	COMMENTS
0 - 5 > 1	1	
5 - 10	2	
10 - 15 > 2	3	
15 - 20	No - sample	lost circulation, poor return
20 - 25	No - sample	cuttings contaminated
25 - 30	No - sample	severely with bentonite clay balls
30 - 35	No - sample	
35 - 40	No - sample	
40 - 45	No - sample	
45 - 50	No - sample	
50 - 55	No - sample	
55 - 60	No - sample	
60 - 65	No - sample	
65 - 70 > 3	4	
70 - 75	5	
75 - 80 > 4	6	
80 - 85	7	
85 - 90 > 5	8	
90 - 95	9	
95 - 100 > 6	10	
100 - 105	11	
105 - 110 > 7	12	
110 - 115	13	
115 - 120 > 8	14	
120 - 125	15	
125 - 130 received bag	16	
130 - 135 w/ no	17	
135 - 140 sample	18	
137 - 139 >	?	Roof Core for geotech or OB Analysis
139 - 154.8 >	—	Coal - Carney No samples
154.8 - 156.8 >	?	Floor Core for geotech or OB Analysis
177 - 179 >		Roof Core for geotech or OB Analysis
179 - 184.5 >	—	Coal - Masters
184.5 - 186.5 >		Floor Core for geotech or OB Analysis

Rec'd 1/9/13
Kane Adeco
51301171

Core in Seperate Location!

TFN 6 2/025
RECD NOV 14, 2014

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Soil Analysis Report

RAMACO
250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310351001

Project: Overburden
Date Received: 10/23/2013

Date Reported: 12/1/2013
Work Order: S1310351

Lab ID	Sample ID	Depths FEET	pH s.u.	Saturation %	Electrical Conductivity dS/m	PE Calcium meq/L	PE Magnesium meq/L	PE Sodium meq/L	SAR
S1310351-001	R13-012	0-10	7.9	42.1	0.49	3.00	2.30	0.57	0.35
S1310351-002	R13-012	10-20	8.0	33.2	0.43	2.61	1.98	0.63	0.41
S1310351-003	R13-012	20-30	8.1	49.1	0.41	1.95	1.79	0.83	0.61
S1310351-004	R13-012	30-40	8.2	53.3	0.35	1.42	1.42	0.69	0.58
S1310351-005	R13-012	40-50	8.2	45.7	0.35	1.48	1.46	0.81	0.67
S1310351-006	R13-012	50-60	8.2	47.2	0.34	1.62	1.39	0.99	0.80
S1310351-007	R13-012	60-70	8.2	37.2	0.26	1.24	1.47	0.60	0.52
S1310351-008	R13-012	70-80	7.6	36.2	1.26	5.72	8.80	1.28	0.48
S1310351-009	R13-012	80-90	7.8	44.8	1.30	6.02	9.67	0.98	0.35
S1310351-010	R13-012	90-100	8.0	32.0	1.21	5.22	8.25	1.45	0.56
S1310351-011	R13-012	100-110	6.6	36.8	2.78	20.5	31.0	2.19	0.43
S1310351-012	R13-012	110-120	7.3	44.7	1.66	5.97	11.9	3.97	1.33
S1310351-013	R13-012	120-124	7.5	56.1	1.49	5.09	8.93	4.40	1.66
S1310351-014	R13-012	141-151	8.6	65.2	0.59	1.48	3.10	3.49	2.31
S1310351-015	R13-012	151-156.5	7.9	53.8	0.65	1.27	1.36	5.28	4.60
S1310351-016	R13-012	162-163	8.8	77.1	0.57	1.19	1.92	4.84	3.88

TFN 6 2/025
RECD NOV 14, 2014

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310351001

Project: Overburden
Date Received: 10/23/2013

Date Reported: 12/1/2013
Work Order: S1310351

Lab ID	Sample ID	Depths FEET	Sand %	Silt %	Clay %	Texture	Arsenic ppm	Boron ppm	Nitrate (as N) ppm	Selenium ppm	Molybdenum ppm
S1310351-001	R13-012	0-10	26.0	25.0	49.0	Clay	0.17	0.81	2.1	<0.02	0.08
S1310351-002	R13-012	10-20	59.0	24.0	17.0	Sandy Loam	0.08	0.56	0.3	<0.02	<0.05
S1310351-003	R13-012	20-30	9.0	52.0	39.0	Silty Clay Loam	<0.05	0.34	0.4	<0.02	<0.05
S1310351-004	R13-012	30-40	4.0	52.0	44.0	Silty Clay	<0.05	0.39	0.6	<0.02	<0.05
S1310351-005	R13-012	40-50	33.0	26.0	41.0	Clay	<0.05	0.78	0.4	<0.02	0.09
S1310351-006	R13-012	50-60	7.0	55.0	38.0	Silty Clay Loam	<0.05	0.31	0.4	<0.02	<0.05
S1310351-007	R13-012	60-70	30.0	29.0	41.0	Clay	<0.05	0.30	0.4	<0.02	<0.05
S1310351-008	R13-012	70-80	8.0	57.0	35.0	Silty Clay Loam	<0.05	0.35	0.4	0.16	0.26
S1310351-009	R13-012	80-90	32.0	41.0	27.0	Clay Loam	0.08	0.34	0.3	0.14	0.14
S1310351-010	R13-012	90-100	50.0	31.0	19.0	Loam	<0.05	0.33	0.3	0.07	0.18
S1310351-011	R13-012	100-110	45.0	32.0	23.0	Loam	0.25	1.69	0.5	0.08	0.17
S1310351-012	R13-012	110-120	26.0	31.0	43.0	Clay	0.24	1.03	0.3	0.06	1.00
S1310351-013	R13-012	120-124	19.0	32.0	49.0	Clay	0.40	1.79	0.4	0.08	1.28
S1310351-014	R13-012	141-151	4.0	49.0	47.0	Silty Clay	0.10	0.34	0.3	0.08	0.20
S1310351-015	R13-012	151-156.5	8.0	46.0	46.0	Silty Clay	<0.05	1.14	0.4	0.07	1.10
S1310351-016	R13-012	162-163	5.0	32.0	63.0	Clay	<0.05	0.41	0.6	0.10	0.18

TFN 6 2/025
RECD NOV 14, 2014

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Scanned, 02/28/2020

Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

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Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310351001

Project: Overburden
Date Received: 10/23/2013

Date Reported: 12/1/2013
Work Order: S1310351

Lab ID	Sample ID	Depths FEET	Total Carbon %	TOC %	Total Sulfur %	T.S. AB t/1000t	Neutral. Potential t/1000t	T.S. ABP t/1000t	Reflux %	Pyr+Org AB t/1000t	Pyr+Org ABP t/1000t
S1310351-001	R13-012	0-10	0.5	0.2	0.39	12.2	27.5	15.4			
S1310351-002	R13-012	10-20	0.3	<0.1	0.02	0.65	20.9	20.3			
S1310351-003	R13-012	20-30	0.4	0.2	0.02	0.50	14.6	14.1			
S1310351-004	R13-012	30-40	0.3	0.2	0.03	0.92	5.01	4.09			
S1310351-005	R13-012	40-50	0.3	0.1	0.01	0.47	17.1	16.7			
S1310351-006	R13-012	50-60	0.4	0.2	0.01	0.35	17.4	17.0			
S1310351-007	R13-012	60-70	0.6	0.2	<0.01	<0.01	29.8	29.8			
S1310351-008	R13-012	70-80	1.4	0.6	0.09	2.70	69.6	66.9			
S1310351-009	R13-012	80-90	1.1	0.6	0.19	5.80	48.9	43.1			
S1310351-010	R13-012	90-100	2.7	0.7	0.07	2.20	166	164			
S1310351-011	R13-012	100-110	4.0	3.7	0.94	29.5	26.1	-3.42			
S1310351-012	R13-012	110-120	6.8	5.5	0.72	22.5	113	90.6			
S1310351-013	R13-012	120-124	8.0	7.8	0.88	27.4	20.3	-7.13	0.88	27.5	-7.19
S1310351-014	R13-012	141-151	1.4	1.0	0.09	2.81	32.6	29.7			
S1310351-015	R13-012	151-156.5	6.3	6.2	0.14	4.47	10.8	6.37			
S1310351-016	R13-012	162-163	2.2	2.1	0.27	8.31	7.72	-0.59			

TFN 6 2/025
RECD NOV 14, 2014

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate

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Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Scanned, 02/28/2020

OVERBURDEN CORE/CHIP SAMPLE INTERVAL INSTRUCTIONS

Mine Site: Ramaco

Date: 8-8-2013

Drillhole ID: R13-012

SAMPLE INTERVAL DEPTH		INTERVAL ID	COMMENTS
0 – 5	1	1	
5 – 10		2	
10 – 15	2	3	
15 – 20		4	
20 – 25	3	5	
25 – 30		6	
30 – 35	4	7	
35 – 40		8	
40 – 45	5	9	
45 – 50		10	
50 – 55	6	11	
55 – 60		12	
60 – 65	7	13	
65 – 70		14	
70 – 75	8	15	
75 – 80		16	
80 – 85	9	17	
85 – 90		18	
90 – 95	10	19	
95 – 100		20	
100 – 105	11	21	
105 – 110		22	
110 – 115	12	23	
115 – 120		24	
120 – 124	13	25	
124 – 141		—	coal zone
141 – 146	14	core pieces 26	
146 – 151		core pieces 27	
151 – 156.5	15	core pieces 28	
156.5 – 162	—	—	coal zone
162 – 163	16	core pieces 29	

Rec'd 8/21/13
Kane Alecu

TFN 6 2/025
RECD NOV 14, 2014

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Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310352001

Project: Overburden
Date Received: 10/23/2013

Date Reported: 12/1/2013
Work Order: S1310352

Lab ID	Sample ID	Depths FEET	pH s.u.	Saturation %	Electrical Conductivity dS/m	PE Calcium meq/L	PE Magnesium meq/L	PE Sodium meq/L	SAR
S1310352-001	R13-018	0-10	8.0	47.9	4.03	17.8	28.4	25.0	5.21
S1310352-002	R13-018	10-20	8.3	50.3	1.11	2.08	3.23	6.51	4.00
S1310352-003	R13-018	20-30	7.7	75.5	0.44	1.92	2.20	0.92	0.64
S1310352-004	R13-018	30-40	7.9	74.5	0.49	1.78	2.64	0.84	0.56
S1310352-005	R13-018	40-50	8.1	68.4	0.67	2.02	3.77	0.80	0.47
S1310352-006	R13-018	50-60	8.2	63.1	0.87	2.28	7.21	1.08	0.50
S1310352-007	R13-018	60-70	8.2	48.8	0.86	2.13	6.03	1.10	0.54
S1310352-008	R13-018	70-80	8.2	32.5	0.91	3.55	6.03	1.30	0.60
S1310352-009	R13-018	80-85	7.7	48.4	1.08	4.75	7.27	2.00	0.82
S1310352-010	R13-018	120-130	7.3	39.2	1.60	7.77	13.7	3.04	0.93

TFN 6 2/025
RECD NOV 14, 2014

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Scanned, 02/28/2020

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1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Your Environmental Monitoring Partner

Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310352001

Project: Overburden
Date Received: 10/23/2013

Date Reported: 12/1/2013
Work Order: S1310352

Lab ID	Sample ID	Depths FEET	Sand %	Silt %	Clay %	Texture	Arsenic ppm	Boron ppm	Nitrate (as N) ppm	Selenium ppm	Molybdenum ppm
S1310352-001	R13-018	0-10	30.0	41.0	29.0	Clay Loam	<0.05	1.04	0.2	0.09	0.26
S1310352-002	R13-018	10-20	18.0	48.0	34.0	Silty Clay Loam	<0.05	0.35	0.4	<0.02	0.13
S1310352-003	R13-018	20-30	6.0	38.0	56.0	Silty Clay	0.11	0.13	1.7	<0.02	0.13
S1310352-004	R13-018	30-40	4.0	47.0	49.0	Silty Clay	0.21	<0.05	1.3	<0.02	0.09
S1310352-005	R13-018	40-50	15.0	50.0	35.0	Silty Clay Loam	<0.05	<0.05	0.4	<0.02	0.09
S1310352-006	R13-018	50-60	12.0	54.0	34.0	Silty Clay Loam	<0.05	<0.05	0.3	0.06	<0.05
S1310352-007	R13-018	60-70	24.0	45.0	31.0	Clay Loam	<0.05	0.10	0.6	<0.02	<0.05
S1310352-008	R13-018	70-80	36.0	44.0	20.0	Loam	<0.05	0.20	0.6	<0.02	0.07
S1310352-009	R13-018	80-85	17.0	39.0	44.0	Clay	<0.05	0.53	0.5	<0.02	0.14
S1310352-010	R13-018	120-130	40.0	37.0	23.0	Loam	0.17	0.51	0.4	0.06	0.35

TFN 6 2/025
RECD NOV 14, 2014

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Scanned, 02/28/2020

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1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Your Environmental Monitoring Partner

Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310352001

Project: Overburden
Date Received: 10/23/2013

Date Reported: 12/1/2013
Work Order: S1310352

Lab ID	Sample ID	Depths FEET	Total Carbon %	TOC %	Total Sulfur %	T.S. AB t/1000t	Neutral. Potential t/1000t	T.S. ABP t/1000t
S1310352-001	R13-018	0-10	1.1	<0.1	0.13	4.06	96.0	92.0
S1310352-002	R13-018	10-20	1.3	<0.1	0.01	0.45	104	104
S1310352-003	R13-018	20-30	0.4	0.1	0.19	6.05	23.4	17.4
S1310352-004	R13-018	30-40	0.4	0.2	0.07	2.16	16.5	14.3
S1310352-005	R13-018	40-50	1.0	0.4	0.03	0.94	54.6	53.7
S1310352-006	R13-018	50-60	1.0	0.3	0.02	0.76	55.7	54.9
S1310352-007	R13-018	60-70	1.8	<0.1	0.02	0.52	139	139
S1310352-008	R13-018	70-80	2.6	0.2	0.02	0.51	193	193
S1310352-009	R13-018	80-85	1.6	1.1	0.18	5.72	45.3	39.6
S1310352-010	R13-018	120-130	3.2	1.8	0.67	20.9	117	95.7

TFN 6 2/025
RECD NOV 14, 2014

These results apply only to the samples tested.

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Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Scanned, 02/28/2020

OVERBURDEN CORE/CHIP SAMPLE INTERVAL INSTRUCTIONS

Mine Site: Ramaco

Date: 8-30-13

Drillhole ID: R13-018

SAMPLE INTERVAL DEPTH	INTERVAL ID	COMMENTS
0 – 5 > 1	1	
5 – 10	2	
10 – 15 > 2	3	
15 – 20	4	
20 – 25 > 3	5	
25 – 30	6	
30 – 35 > 4	7	
35 – 40	8	
40 – 45 > 5	9	
45 – 50	10	
50 – 55 > 6	11	
55 – 60	12	
60 – 65 > 7	13	
65 – 70	14	
70 – 75 > 8	15	
75 – 80	16	
80 – 85 > 9	17	
85 – 96	—	Coal zone "No Samples"
96 – 111 >		collect core – for Geotech
111 – 116.3	—	coal zone "No Samples"
116.3 – 118.3	—	core Available: not included
120 – 125 > 10	18	chips
125 – 130	19	chips

Rec'd 9/3/13
Kane A Secor
51307033

TFN 6 2/025
RECD NOV 14, 2014

Scanned, 02/28/2020

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Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310353001

Project: Overburden
Date Received: 10/23/2013

Date Reported: 12/1/2013
Work Order: S1310353

Lab ID	Sample ID	Depths FEET	pH s.u.	Saturation %	Electrical Conductivity dS/m	PE Calcium meq/L	PE Magnesium meq/L	PE Sodium meq/L	SAR
S1310353-001	R13-019	0-10	7.7	48.8	2.75	22.0	24.0	14.1	2.95
S1310353-002	R13-019	10-20	7.6	52.9	2.36	21.4	10.6	12.1	3.02
S1310353-003	R13-019	20-30	7.6	51.3	2.40	22.2	8.27	12.2	3.13
S1310353-004	R13-019	30-40	7.7	50.5	1.79	14.2	4.99	9.02	2.91
S1310353-005	R13-019	40-50	8.0	37.9	0.90	5.58	2.10	4.10	2.09
S1310353-006	R13-019	50-60	7.7	48.3	0.97	6.25	3.84	3.22	1.44
S1310353-007	R13-019	60-70	7.8	44.2	0.59	3.14	3.49	1.68	0.92
S1310353-008	R13-019	70-80	8.1	37.2	1.00	5.73	4.91	3.42	1.48
S1310353-009	R13-019	80-90	7.6	44.2	0.95	3.48	3.92	4.02	2.09
S1310353-010	R13-019	90-100	7.2	60.6	1.20	3.76	4.46	6.23	3.07
S1310353-011	R13-019	100-110	8.0	47.2	1.19	3.64	3.99	7.43	3.81
S1310353-012	R13-019	110-120	8.3	35.3	1.35	3.92	4.41	8.29	4.06
S1310353-013	R13-019	120-130	8.0	54.8	1.60	4.44	5.41	9.45	4.26
S1310353-014	R13-019	130-140	7.8	47.8	1.58	4.72	5.99	9.83	4.25
S1310353-015	R13-019	140-150	7.9	43.3	1.19	3.77	4.49	6.97	3.43
S1310353-016	R13-019	150-151.5	7.5	47.2	1.35	4.99	5.67	7.55	3.27

TFN 6 2/025
RECD NOV 14, 2014

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Scanned, 02/28/2020

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Your Environmental Monitoring Partner

Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310353001

Project: Overburden
Date Received: 10/23/2013

Date Reported: 12/1/2013
Work Order: S1310353

Lab ID	Sample ID	Depths FEET	Sand %	Silt %	Clay %	Texture	Arsenic ppm	Boron ppm	Nitrate (as N) ppm	Selenium ppm	Molybdenum ppm
S1310353-001	R13-019	0-10	28.0	46.0	26.0	Loam	0.07	1.45	<0.1	0.05	0.13
S1310353-002	R13-019	10-20	20.0	52.0	28.0	Clay Loam	0.10	0.58	25.2	0.11	0.08
S1310353-003	R13-019	20-30	31.0	42.0	27.0	Clay Loam	0.08	0.50	26.0	0.04	0.13
S1310353-004	R13-019	30-40	22.0	50.0	28.0	Clay Loam	0.10	0.33	10.9	<0.02	0.06
S1310353-005	R13-019	40-50	56.0	29.0	15.0	Sandy Loam	<0.05	0.31	0.8	<0.02	0.08
S1310353-006	R13-019	50-60	36.0	30.0	34.0	Clay Loam	<0.05	0.48	0.4	<0.02	0.21
S1310353-007	R13-019	60-70	9.0	35.0	56.0	Silty Clay	0.09	0.26	0.9	<0.02	0.10
S1310353-008	R13-019	70-80	33.0	44.0	23.0	Loam	0.13	0.27	0.2	0.03	0.29
S1310353-009	R13-019	80-90	18.0	50.0	32.0	Silty Clay Loam	0.15	0.28	0.2	0.03	0.32
S1310353-010	R13-019	90-100	13.0	40.0	47.0	Silty Clay	0.65	0.90	0.5	0.03	1.04
S1310353-011	R13-019	100-110	24.0	47.0	29.0	Clay Loam	0.57	0.29	0.2	0.05	0.59
S1310353-012	R13-019	110-120	40.0	38.0	22.0	Loam	0.14	0.24	0.2	<0.02	0.23
S1310353-013	R13-019	120-130	22.0	45.0	33.0	Clay Loam	0.44	0.28	0.3	0.04	0.31
S1310353-014	R13-019	130-140	20.0	49.0	31.0	Clay Loam	0.49	0.27	0.2	<0.02	0.54
S1310353-015	R13-019	140-150	20.0	51.0	29.0	Clay Loam	0.33	0.36	0.2	0.03	0.64
S1310353-016	R13-019	150-151.5	20.0	46.0	34.0	Clay Loam	0.29	0.60	0.3	0.04	0.61

TFN 6 2/025
RECD NOV 14, 2014

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Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Scanned, 02/28/2020

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Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310353001

Project: Overburden
Date Received: 10/23/2013

Date Reported: 12/1/2013
Work Order: S1310353

Lab ID	Sample ID	Depths FEET	Total Carbon %	TOC %	Total Sulfur %	T.S. AB t/1000t	Neutral. Potential t/1000t	T.S. ABP t/1000t
S1310353-001	R13-019	0-10	1.4	0.3	0.16	4.96	83.5	78.5
S1310353-002	R13-019	10-20	0.9	0.2	0.10	3.14	62.9	59.7
S1310353-003	R13-019	20-30	0.9	0.1	0.08	2.59	68.1	65.5
S1310353-004	R13-019	30-40	0.8	<0.1	0.05	1.51	59.0	57.5
S1310353-005	R13-019	40-50	0.9	<0.1	0.03	0.80	64.9	64.1
S1310353-006	R13-019	50-60	0.6	0.2	0.06	1.84	30.7	28.8
S1310353-007	R13-019	60-70	0.5	0.3	0.04	1.33	12.0	10.7
S1310353-008	R13-019	70-80	3.6	0.6	0.08	2.52	250	248
S1310353-009	R13-019	80-90	3.2	1.7	0.15	4.64	129	125
S1310353-010	R13-019	90-100	6.3	5.8	0.85	26.5	44.0	17.5
S1310353-011	R13-019	100-110	1.7	0.8	0.20	6.18	76.9	70.7
S1310353-012	R13-019	110-120	3.2	0.8	0.05	1.64	204	203
S1310353-013	R13-019	120-130	3.9	2.9	0.19	5.85	86.8	81.0
S1310353-014	R13-019	130-140	1.3	0.3	0.18	5.51	84.3	78.8
S1310353-015	R13-019	140-150	2.1	0.6	0.74	23.2	130	107
S1310353-016	R13-019	150-151.5	3.0	2.0	0.14	4.50	84.3	79.8

TFN 6 2/025
RECD NOV 14, 2014

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Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Scanned, 02/28/2020

OVERBURDEN CORE/CHIP SAMPLE INTERVAL INSTRUCTIONS

Mine Site: Ramaco

Date: 9-3-2013

Drillhole ID: R13-019

SAMPLE INTERVAL DEPTH				INTERVAL ID	COMMENTS
0	–	5	1	1	
5	–	10		2	
10	–	15	2	3	
15	–	20		4	
20	–	25	3	5	
25	–	30		6	
30	–	35	4	7	
35	–	40		8	
40	–	45	5	9	
45	–	50		10	
50	–	55	6	11	
55	–	60		12	
60	–	65	7	13	
65	–	70		14	
70	–	75	8	15	
75	–	80		16	
80	–	85	9	17	
85	–	90		18	
90	–	95	10	19	
95	–	100		20	
100	–	105	11	21	
105	–	110		22	
110	–	115	12	23	
115	–	120		24	
120	–	125	13	25	
125	–	130		30	
130	–	135	14	31	
135	–	140		32	
140	–	145	15	33	
145	–	150		34	
150	–	151.5	16	35	
151.5	–	168		—	Coal Interval - No Samples
168	–	187		—	Core for Geotech Analysis
187	–	192.5		—	Coal Interval - No Samples
192.5	–	205		—	Core for Geotech ~~Purposes~~ Analysis

Rec'd 9/4/13
Kane A Seco
51309040

TFN 6 2/025
RECD NOV 14, 2014

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Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310355001

Project: Overburden

Date Received: 10/23/2013

Date Reported: 12/1/2013

Work Order: S1310355

Lab ID	Sample ID	Depths FEET	pH s.u.	Saturation %	Electrical Conductivity dS/m	PE Calcium meq/L	PE Magnesium meq/L	PE Sodium meq/L	SAR
S1310355-001	R13-023	0-10	8.2	36.0	0.88	4.50	3.85	2.44	1.19
S1310355-002	R13-023	10-20	8.4	38.2	0.43	1.87	1.84	1.34	0.98
S1310355-003	R13-023	20-30	8.1	52.0	0.45	1.73	1.45	1.19	0.95
S1310355-004	R13-023	30-40	8.0	37.9	0.65	2.14	2.57	2.36	1.53
S1310355-005	R13-023	40-50	8.1	81.4	0.52	1.61	1.68	1.95	1.52
S1310355-006	R13-023	50-60	8.2	42.0	0.82	3.56	4.41	2.51	1.26
S1310355-007	R13-023	60-70	7.7	53.5	1.00	2.90	4.52	3.83	1.99
S1310355-008	R13-023	70-80	8.0	49.3	0.90	2.56	3.45	3.68	2.12
S1310355-009	R13-023	80-90	7.8	51.7	1.02	2.65	4.33	4.58	2.45
S1310355-010	R13-023	90-100	7.9	43.4	1.01	2.49	4.11	4.97	2.74
S1310355-011	R13-023	100-110	7.6	56.3	1.33	3.25	5.94	7.35	3.43
S1310355-012	R13-023	110-120	7.3	51.5	1.25	3.20	6.02	6.32	2.95
S1310355-013	R13-023	136-145	7.1	45.2	0.98	1.28	1.18	8.35	7.53
S1310355-014	R13-023	145-155	8.4	36.0	0.79	1.08	1.16	8.72	8.24
S1310355-015	R13-023	155-157	8.3	62.9	0.84	1.20	1.07	9.86	9.25
S1310355-016	R13-023	168-170	8.2	74.6	0.79	0.79	0.63	6.35	7.54

TFN 6 2/025
RECD NOV 14, 2014

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate

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Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor

Karen Secor, Soil Lab Supervisor

Scanned, 02/28/2020

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Your Environmental Monitoring Partner

Soil Analysis Report
RAMACO
250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310355001

Project: Overburden
Date Received: 10/23/2013

Date Reported: 12/1/2013
Work Order: S1310355

Lab ID	Sample ID	Depths FEET	Sand %	Silt %	Clay %	Texture	Arsenic ppm	Boron ppm	Nitrate (as N) ppm	Selenium ppm	Molybdenum ppm
S1310355-001	R13-023	0-10	78.0	18.0	4.0	Loamy Sand	<0.05	0.67	0.1	<0.02	<0.05
S1310355-002	R13-023	10-20	88.0	12.0	<0.1	Sand	<0.05	0.25	<0.1	<0.02	<0.05
S1310355-003	R13-023	20-30	85.0	9.0	6.0	Loamy Sand	<0.05	0.33	<0.1	<0.02	<0.05
S1310355-004	R13-023	30-40	63.0	19.0	18.0	Sandy Loam	<0.05	0.54	0.2	<0.02	0.05
S1310355-005	R13-023	40-50	5.0	43.0	52.0	Silty Clay	0.06	0.30	0.3	0.05	0.17
S1310355-006	R13-023	50-60	32.0	39.0	29.0	Clay Loam	0.66	0.43	0.1	<0.02	0.79
S1310355-007	R13-023	60-70	22.0	50.0	28.0	Clay Loam	0.43	0.27	0.3	0.08	0.44
S1310355-008	R13-023	70-80	24.0	51.0	25.0	Silty Loam	0.19	0.24	0.3	0.06	0.41
S1310355-009	R13-023	80-90	20.0	64.0	16.0	Silty Loam	0.16	0.42	0.3	0.05	0.43
S1310355-010	R13-023	90-100	32.0	48.0	20.0	Loam	0.08	0.28	0.2	0.06	0.31
S1310355-011	R13-023	100-110	16.0	50.0	34.0	Silty Clay Loam	0.38	0.46	0.3	0.07	0.44
S1310355-012	R13-023	110-120	16.0	35.0	49.0	Clay	0.37	0.80	0.3	0.06	1.08
S1310355-013	R13-023	136-145	26.0	45.0	29.0	Clay Loam	0.66	0.99	0.4	0.16	0.39
S1310355-014	R13-023	145-155	35.0	41.0	24.0	Loam	0.41	0.28	0.2	0.15	0.77
S1310355-015	R13-023	155-157	15.0	61.0	24.0	Silty Loam	0.66	0.23	0.2	0.21	0.97
S1310355-016	R13-023	168-170					0.28	1.77	0.6	0.19	0.72

TFN 6 2/025
RECD NOV 14, 2014

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Scanned, 02/28/2020

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Your Environmental Monitoring Partner

Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310355001

Project: Overburden
Date Received: 10/23/2013

Date Reported: 12/1/2013
Work Order: S1310355

Lab ID	Sample ID	Depths FEET	Total Carbon %	TOC %	Total Sulfur %	T.S. AB t/1000t	Neutral. Potential t/1000t	T.S. ABP t/1000t
S1310355-001	R13-023	0-10	0.4	<0.1	0.02	0.58	28.9	28.3
S1310355-002	R13-023	10-20	0.2	<0.1	<0.01	<0.01	8.79	8.79
S1310355-003	R13-023	20-30	0.2	<0.1	0.04	1.11	10.2	9.12
S1310355-004	R13-023	30-40	0.2	0.2	0.02	0.65	7.23	6.58
S1310355-005	R13-023	40-50	0.6	0.5	0.03	1.04	7.64	6.60
S1310355-006	R13-023	50-60	2.7	0.5	0.06	1.75	183	181
S1310355-007	R13-023	60-70	1.6	1.2	0.22	6.95	33.8	26.8
S1310355-008	R13-023	70-80	1.6	0.8	0.08	2.36	60.2	57.9
S1310355-009	R13-023	80-90	2.0	1.3	0.09	2.86	59.4	56.5
S1310355-010	R13-023	90-100	1.7	0.9	0.05	1.59	61.3	59.7
S1310355-011	R13-023	100-110	2.5	1.9	0.34	10.7	48.1	37.3
S1310355-012	R13-023	110-120	5.7	4.7	0.66	20.7	81.0	60.3
S1310355-013	R13-023	136-145	5.4	5.2	0.26	8.25	17.5	9.26
S1310355-014	R13-023	145-155	2.1	1.1	0.13	4.14	82.0	77.8
S1310355-015	R13-023	155-157	2.1	1.7	0.26	8.13	36.4	28.2
S1310355-016	R13-023	168-170	5.3	5.2	0.32	9.83	15.5	5.65

TFN 6 2/025
RECD NOV 14, 2014

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate

Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential

Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Scanned, 02/28/2020

OVERBURDEN CORE/CHIP SAMPLE INTERVAL INSTRUCTIONS

Mine Site: RAMACO

Date: 9-5-2013

Drill Hole ID: R13-023

SAMPLE INTERVAL DEPTH	INTERVAL ID	COMMENTS
0 – 5 >1	1	
5 – 10	2	
10 – 15 >2	3	
15 – 20	4	
20 – 25 >3	5	
25 – 30	6	
30 – 35 >4	7	
35 – 40	8	
40 – 45 >5	9	
45 – 50	10	
50 – 55 >6	11	
55 – 60	12	
60 – 65 >7	13	
65 – 70	14	
70 – 75 >8	15	
75 – 80	16	
80 – 85 >9	17	
85 – 90	18	
90 – 95 >10	19	
95 – 100	20	
100 – 105 >11	21	
105 – 110	22	
110 – 115 >12	23	
115 – 120	24	
[redacted] –		
120 – 136	—	Coal Zone, no samples
136 – 140 >13	25	
140 – 145	26	
145 – 150 >14	27	
150 – 155	28	
155 – 157 >15	29	
157 – 168	—	Coal zone, no samples
168 – 170 >16	30	

Rec'd 9/6/13
Kane Adeco
51309101

TFN 6 2/025
RECD NOV 14, 2014

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1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Your Environmental Monitoring Partner

Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310429001

Project: Overburden
Date Received: 10/28/2013

Date Reported: 12/1/2013
Work Order: S1310429

Lab ID	Sample ID	Depths Feet	pH s.u.	Saturation %	Electrical Conductivity dS/m	PE Calcium meq/L	PE Magnesium meq/L	PE Sodium meq/L	SAR
S1310429-001	R13-011	0-10	8.4	28.9	0.47	1.33	3.35	0.70	0.46
S1310429-002	R13-011	10-20	8.3	29.0	0.56	1.74	2.50	1.90	1.30
S1310429-003	R13-011	20-30	8.1	60.7	0.56	2.00	2.17	1.84	1.28
S1310429-004	R13-011	30-40	7.9	70.4	0.60	3.17	2.02	1.41	0.88
S1310429-005	R13-011	40-50	8.1	56.5	0.54	2.54	1.94	1.48	0.99
S1310429-006	R13-011	50-60	8.2	42.3	0.53	2.54	1.82	1.05	0.71
S1310429-007	R13-011	60-70	8.3	32.1	0.70	2.78	3.07	1.97	1.15
S1310429-008	R13-011	70-80	7.7	42.1	0.93	3.38	5.08	2.33	1.14
S1310429-009	R13-011	85-95	7.8	45.3	1.26	4.26	7.99	3.87	1.56
S1310429-010	R13-011	95-105	7.9	50.5	1.17	3.23	6.55	4.28	1.94
S1310429-011	R13-011	105-115	7.9	41.9	1.00	2.47	4.91	4.33	2.26
S1310429-012	R13-011	115-124	7.4	40.9	1.06	2.56	5.21	4.86	2.47
S1310429-013	R13-011	140-150	7.0	48.4	1.25	1.93	2.24	8.97	6.21
S1310429-014	R13-011	150-160	8.1	37.3	0.88	1.35	1.17	8.11	7.23
S1310429-015	R13-011	160-170	8.6	48.6	1.04	1.01	0.80	9.92	10.4
S1310429-016	R13-011	170-175	8.4	45.7	0.91	0.95	0.71	7.37	8.11
S1310429-017	R13-011	181.3-182	8.7	103	0.50	0.84	0.43	4.25	5.33

TFN 6 2/025
RECD NOV 14, 2014

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310429001

Project: Overburden
Date Received: 10/28/2013

Date Reported: 12/1/2013
Work Order: S1310429

Lab ID	Sample ID	Depths Feet	Sand %	Silt %	Clay %	Texture	Arsenic ppm	Boron ppm	Nitrate (as N) ppm	Selenium ppm	Molybdenum ppm
S1310429-001	R13-011	0-10	82.0	10.0	8.0	Loamy Sand	0.41	0.47	0.4	<0.02	<0.05
S1310429-002	R13-011	10-20	80.0	10.0	10.0	Loamy Sand	0.27	0.56	0.2	<0.02	0.09
S1310429-003	R13-011	20-30	26.0	33.0	41.0	Clay	0.09	1.12	0.6	<0.02	0.12
S1310429-004	R13-011	30-40	13.0	33.0	54.0	Clay	0.07	0.77	0.9	0.02	0.10
S1310429-005	R13-011	40-50	14.0	45.0	41.0	Silty Clay	<0.05	1.35	0.4	<0.02	<0.05
S1310429-006	R13-011	50-60	56.0	18.0	26.0	Sandy Clay Loam	0.07	0.83	0.3	<0.02	<0.05
S1310429-007	R13-011	60-70	32.0	43.0	25.0	Loam	<0.05	0.72	0.4	<0.02	<0.05
S1310429-008	R13-011	70-80	21.0	45.0	34.0	Clay Loam	0.40	1.09	0.3	0.04	0.30
S1310429-009	R13-011	85-95	26.0	40.0	34.0	Clay Loam	0.52	0.81	0.3	0.04	0.61
S1310429-010	R13-011	95-105	52.0	17.0	31.0	Sandy Clay Loam	0.51	0.79	0.6	0.05	0.59
S1310429-011	R13-011	105-115	28.0	26.0	46.0	Clay	0.26	0.60	0.4	0.04	0.42
S1310429-012	R13-011	115-124	58.0	18.0	24.0	Sandy Clay Loam	0.25	0.71	0.3	0.04	0.52
S1310429-013	R13-011	140-150	30.0	40.0	30.0	Clay Loam	0.82	1.33	0.6	0.13	0.86
S1310429-014	R13-011	150-160	30.0	47.0	23.0	Loam	0.53	0.36	0.2	0.09	0.51
S1310429-015	R13-011	160-170	13.0	54.0	33.0	Silty Clay Loam	0.53	0.35	0.4	0.22	0.95
S1310429-016	R13-011	170-175	18.0	50.0	32.0	Silty Clay Loam	0.61	0.40	0.3	0.20	0.74
S1310429-017	R13-011	181.3-182	4.0	22.0	74.0	Clay	<0.05	0.46	0.3	0.27	0.54

TFN 6 2/025
RECD NOV 14, 2014

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Inter-Mountain Labs
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Your Environmental Monitoring Partner

Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310429001

Project: Overburden
Date Received: 10/28/2013

Date Reported: 12/1/2013
Work Order: S1310429

Lab ID	Sample ID	Depths Feet	Total Carbon %	TOC %	Total Sulfur %	T.S. AB t/1000t	Neutral. Potential t/1000t	T.S. ABP t/1000t	Reflux %	Pyr+Org AB t/1000t	Pyr+Org ABP t/1000t
S1310429-001	R13-011	0-10	0.4	0.2	0.04	1.12	17.0	15.9			
S1310429-002	R13-011	10-20	0.1	0.1	0.22	6.92	2.32	-4.60			
S1310429-003	R13-011	20-30	0.2	0.2	0.08	2.62	3.65	1.03			
S1310429-004	R13-011	30-40	0.4	0.3	0.07	2.21	5.55	3.34			
S1310429-005	R13-011	40-50	0.6	0.4	0.02	0.69	15.5	14.8			
S1310429-006	R13-011	50-60	1.7	0.4	<0.01	<0.01	105	105			
S1310429-007	R13-011	60-70	1.9	0.5	0.01	0.35	120	119			
S1310429-008	R13-011	70-80	4.9	4.1	0.43	13.5	67.1	53.6			
S1310429-009	R13-011	85-95	1.6	1.1	0.49	15.3	39.8	24.5			
S1310429-010	R13-011	95-105	1.8	1.1	0.32	9.99	52.0	42.1			
S1310429-011	R13-011	105-115	2.0	1.0	0.16	4.90	83.1	78.2			
S1310429-012	R13-011	115-124	3.8	2.9	0.22	6.93	72.6	65.7			
S1310429-013	R13-011	140-150	8.6	8.4	0.65	20.2	12.9	-7.33	0.64	20.1	-7.21
S1310429-014	R13-011	150-160	1.8	1.2	0.08	2.42	44.6	42.2			
S1310429-015	R13-011	160-170	1.4	1.0	0.09	2.69	31.2	28.5			
S1310429-016	R13-011	170-175	1.5	1.3	0.12	3.67	12.7	9.03			
S1310429-017	R13-011	181.3-182	1.3	1.1	0.05	1.43	12.6	11.1			

TFN 6 2/025
RECD NOV 14, 2014

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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OVERBURDEN CORE/CHIP SAMPLE INTERVAL INSTRUCTIONS

Mine Site: Ramaco

Date: 8-22-2013

Drillhole ID: R13-011

SAMPLE INTERVAL DEPTH		INTERVAL ID	COMMENTS
0 – 5	1	1	
5 – 10		2	
10 – 15	2	3	
15 – 20		4	
20 – 25	3	5	
25 – 30		6	
30 – 35	4	7	
35 – 40		8	
40 – 45	5	9	
45 – 50		10	
50 – 55	6	11	
55 – 60		12	
60 – 65	7	13	
65 – 70		14	
70 – 75	8	15	
75 – 80		16	
80 – 85	No Sample	17	
85 – 90	9	18	
90 – 95		19	
95 – 100	10	20	
100 – 105		21	
105 – 110	11	22	
110 – 115		23	
115 – 120	12	24	
120 – 124		25	
124 – 140	—	—	Coal zone "No sample"
140 – 145	13	26	
145 – 150		27	
150 – 155	14	28	
155 – 160		29	
160 – 165	15	30	
165 – 170		31	
170 – 175	16	32	
175 – 181.3		—	Coal zone "No sample"
181.3 – 182	17	33	

Rec'd 8/23/13
Kane A Seon
S1308393

TFN 6 2/025
RECD NOV 14, 2014

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Inter-Mountain Labs
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1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Date: 12/5/2013

CLIENT: RAMACO
Project: Overburden
Lab Order: S1310274

CASE NARRATIVE

Report ID: S1310274001

Sample R-12007 was received on October 17, 2013.

Samples were analyzed using the methods outlined in the following references:

U.S.E.P.A. 600/2-78-054 "Field and Laboratory Methods Applicable to Overburden and Mining Soils", 1978
American Society of Agronomy, Number 9, Part 2, 1982
USDA Handbook 60 "Diagnosis and Improvement of Saline and Alkali Soils", 1969
Wyoming Department of Environmental Quality, Land Quality Division, Guideline No. 1, 1984
New Mexico Overburden and Soils Inventory and Handling Guideline, March 1987
State of Utah, Division of Oil, Gas, and Mining: Guidelines for Management of Topsoil and Overburden for Underground and Surface Coal Mining, April 1988
Montana Department of State Lands, Reclamation Division: Soil, Overburden, and Regraded Spoil Guidelines, December 1994
State of Nevada Modified Sobek Procedure
Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, 3rd Edition

Quality Control parameters met the acceptance criteria defined by EPA and Inter-Mountain Laboratories except as indicated in this case narrative.

TFN 6 2/025
RECD NOV 14, 2014

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Your Environmental Monitoring Partner

Soil Analysis Report

RAMACO
250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310274001

Project: Overburden
Date Received: 10/17/2013

Date Reported: 12/5/2013
Work Order: S1310274

Lab ID	Sample ID	Depths Feet	pH s.u.	Saturation %	Electrical Conductivity dS/m	PE Calcium meq/L	PE Magnesium meq/L	PE Sodium meq/L	SAR
S1310274-001	R-12007	0-10	8.1	33.6	0.59	5.02	1.32	0.50	0.28
S1310274-002	R-12007	10-20	8.1	33.0	0.37	2.12	0.68	0.76	0.64
S1310274-003	R-12007	20-30	8.0	37.5	1.22	6.49	1.91	5.22	2.55
S1310274-004	R-12007	30-40	7.5	70.4	0.68	3.61	1.79	2.07	1.26
S1310274-005	R-12007	40-50	8.3	58.2	0.59	1.70	2.17	3.82	2.75
S1310274-006	R-12007	50-60	7.5	49.8	0.70	1.71	2.00	3.83	2.81
S1310274-007	R-12007	60-65	6.7	69.1	0.95	1.85	2.85	6.52	4.25
S1310274-008	R-12007	70-80	8.3	56.5	0.66	1.38	2.03	6.33	4.85
S1310274-009	R-12007	80-90	8.7	55.3	0.78	1.23	1.86	7.03	5.66
S1310274-010	R-12007	90-95	8.9	55.9	0.75	0.86	0.52	6.18	7.44
S1310274-011	R-12007	105-115	7.6	68.8	0.62	1.26	0.76	5.05	5.03
S1310274-012	R-12007	115-125	8.4	57.8	0.49	1.10	1.03	3.65	3.54
S1310274-013	R-12007	125-130	8.7	40.3	0.35	1.23	1.42	2.51	2.18
S1310274-014	R-12007	137.6-138.6	7.9	45.7	0.40	0.83	0.66	2.97	3.44

TFN 6 2/025
RECD NOV 14, 2014

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310274001

Project: Overburden
Date Received: 10/17/2013

Date Reported: 12/5/2013
Work Order: S1310274

Lab ID	Sample ID	Depths Feet	Sand %	Silt %	Clay %	Texture	Arsenic ppm	Boron ppm	Nitrate (as N) ppm	Selenium ppm	Molybdenum ppm
S1310274-001	R-12007	0-10	90.0	5.0	5.0	Sand	<0.05	0.22	1.5	<0.02	0.07
S1310274-002	R-12007	10-20	94.0	4.0	2.0	Sand	<0.05	0.11	0.3	<0.02	<0.05
S1310274-003	R-12007	20-30	70.0	7.5	22.5	Sandy Clay Loam	0.17	0.38	0.9	0.02	0.13
S1310274-004	R-12007	30-40	8.0	27.0	65.0	Clay	0.13	0.57	0.8	0.02	0.14
S1310274-005	R-12007	40-50	8.0	42.0	50.0	Silty Clay	0.10	0.37	0.7	<0.02	0.25
S1310274-006	R-12007	50-60	28.0	28.0	44.0	Clay	0.15	0.47	0.5	<0.02	0.54
S1310274-007	R-12007	60-65	27.5	17.5	55.0	Silty Clay	0.48	2.18	2.3	0.05	0.83
S1310274-008	R-12007	70-80	14.0	46.0	40.0	Silty Clay	0.10	0.28	0.5	0.06	0.26
S1310274-009	R-12007	80-90	13.0	53.0	34.0	Silty Clay Loam	0.17	0.24	0.7	0.24	0.38
S1310274-010	R-12007	90-95	14.0	52.0	34.0	Silty Clay Loam	0.11	0.27	0.4	0.12	0.17
S1310274-011	R-12007	105-115	12.0	36.0	52.0	Clay	0.19	0.75	0.8	0.07	0.46
S1310274-012	R-12007	115-125	14.0	41.0	45.0	Silty Clay	0.14	0.31	0.5	0.10	0.36
S1310274-013	R-12007	125-130	20.0	52.0	28.0	Clay Loam	0.12	0.29	0.4	0.05	0.23
S1310274-014	R-12007	137.6-138.6	16.0	44.0	40.0	Silty Clay	0.24	0.47	0.5	0.08	0.18

TFN 6 2/025
RECD NOV 14, 2014

These results apply only to the samples tested.

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Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Your Environmental Monitoring Partner

Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310274001

Project: Overburden
Date Received: 10/17/2013

Date Reported: 12/5/2013
Work Order: S1310274

Lab ID	Sample ID	Depths Feet	Total Carbon %	TOC %	Total Sulfur %	T.S. AB t/1000t	Neutral. Potential t/1000t	T.S. ABP t/1000t	Reflux %	Pyr+Org AB t/1000t	Pyr+Org ABP t/1000t
S1310274-001	R-12007	0-10	0.3	<0.1	<0.01	<0.01	20.9	20.9			
S1310274-002	R-12007	10-20	0.1	<0.1	<0.01	<0.01	9.86	9.86			
S1310274-003	R-12007	20-30	0.3	0.2	0.01	0.45	11.2	10.8			
S1310274-004	R-12007	30-40	0.9	0.8	0.03	1.06	12.9	11.8			
S1310274-005	R-12007	40-50	1.7	1.0	0.07	2.16	51.1	49.0			
S1310274-006	R-12007	50-60	5.0	3.8	0.15	4.70	101	96.6			
S1310274-007	R-12007	60-65	12.9	12.7	0.83	25.8	17.5	-8.37	0.81	25.4	-7.91
S1310274-008	R-12007	70-80	2.3	2.0	0.08	2.56	25.5	23.0			
S1310274-009	R-12007	80-90	1.0	0.7	0.02	0.72	24.8	24.1			
S1310274-010	R-12007	90-95	1.1	0.7	0.02	0.65	27.5	26.9			
S1310274-011	R-12007	105-115	4.9	4.7	0.12	3.82	24.4	20.6			
S1310274-012	R-12007	115-125	1.9	1.4	0.05	1.66	37.0	35.4			
S1310274-013	R-12007	125-130	1.1	0.8	0.02	0.68	29.9	29.2			
S1310274-014	R-12007	137.6-138.6	1.7	1.6	0.09	2.96	10.1	7.11			

TFN 6 2/025
RECD NOV 14, 2014

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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OVERBURDEN CORE/CHIP SAMPLE INTERVAL INSTRUCTIONS

Mine Site: Ramaco

Date: 11-29-12

Drillhole ID: R-12007 Near Kleenburn Survey Pin

SAMPLE INTERVAL DEPTH	INTERVAL ID	COMMENTS
0 – 5 > 1	1	
5 – 10	2	
10 – 15 > 2	3	
15 – 20	4	
20 – 25 > 3	5	
25 – 30	6	
30 – 35 > 4	7	
35 – 40	8	
40 – 45 > 5	9	
45 – 50	10	
50 – 55 > 6	11	
55 – 60	12	
60 – 65 – 7	13	
~~65 – 70~~ (Not included)	omit interval	Coal; do not analyze
70 – 75	14	
75 – 80 > 8	15	
80 – 85 > 9	16	
85 – 90	17	
90 – 95 – 10	18	
~~95 – 100~~ (Not included)	omit interval	Coal; do not analyze
~~100 – 105~~ (Not included)	omit interval	Coal; do not analyze
105 – 110	19	
110 – 115 > 11	20	
115 – 120	21	
120 – 125 > 12	22	
125 – 130 – 13	23	
~~130 – 135~~ (Not included)	omit interval	Coal, do not analyze
132½ – 133.5 > 13 – 14	24	Bone Coal

Rec'd 12/3/12
Kane A Seca

TFN 6 2/025
RECD NOV 14, 2014 5121284

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Inter-Mountain Labs
Your Environmental Monitoring Partner
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Date: 12/5/2013

CLIENT: RAMACO
Project: Overburden
Lab Order: S1310275

CASE NARRATIVE

Report ID: S1310275001

Sample R-12004 was received on October 17, 2013.

Samples were analyzed using the methods outlined in the following references:

U.S.E.P.A. 600/2-78-054 "Field and Laboratory Methods Applicable to Overburden and Mining Soils", 1978
American Society of Agronomy, Number 9, Part 2, 1982
USDA Handbook 60 "Diagnosis and Improvement of Saline and Alkali Soils", 1969
Wyoming Department of Environmental Quality, Land Quality Division, Guideline No. 1, 1984
New Mexico Overburden and Soils Inventory and Handling Guideline, March 1987
State of Utah, Division of Oil, Gas, and Mining: Guidelines for Management of Topsoil and Overburden for Underground and Surface Coal Mining, April 1988
Montana Department of State Lands, Reclamation Division: Soil, Overburden, and Regraded Spoil Guidelines, December 1994
State of Nevada Modified Sobek Procedure
st Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, 3rd Edition

All Quality Control parameters met the acceptance criteria defined by EPA and Inter-Mountain Laboratories except as indicated in this case narrative.

TFN 6 2/025
RECD NOV 14, 2014

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Your Environmental Monitoring Partner

Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310275001

Project: Overburden
Date Received: 10/17/2013

Date Reported: 12/5/2013
Work Order: S1310275

Lab ID	Sample ID	Depths Feet	pH s.u.	Saturation %	Electrical Conductivity dS/m	PE Calcium meq/L	PE Magnesium meq/L	PE Sodium meq/L	SAR
S1310275-001	R-12004	0-10	8.0	63.5	3.01	14.7	36.8	22.3	4.40
S1310275-002	R-12004	10-20	8.0	76.3	2.87	7.65	21.7	17.3	4.51
S1310275-003	R-12004	20-30	7.5	71.2	2.21	11.7	20.8	11.4	2.82
S1310275-004	R-12004	30-39	4.1	53.5	2.51	4.44	18.4	12.2	3.59
S1310275-005	R-12004	55-65	3.8	54.5	3.05	8.35	24.6	16.6	4.09
S1310275-006	R-12004	65-75	6.8	64.9	1.28	1.70	4.72	6.94	3.87
S1310275-007	R-12004	75-85	7.6	46.4	1.34	2.49	4.62	6.98	3.70
S1310275-008	R-12004	85-95	7.6	59.9	1.28	2.03	3.25	8.66	5.33
S1310275-009	R-12004	95-102	6.1	57.0	1.33	1.98	3.00	9.46	5.99
S1310275-010	R-12004	106-115	6.7	61.4	0.73	1.13	1.20	5.23	4.84
S1310275-011	R-12004	115-125	6.7	29.1	0.66	1.31	1.18	4.15	3.72
S1310275-012	R-12004	125-133	7.8	40.2	0.67	0.96	2.35	3.85	2.99
S1310275-013	R-12004	133-145	6.5	80.0	1.41	1.35	1.73	11.3	9.12
S1310275-014	R-12004	145-155	6.9	82.2	0.49	1.10	3.08	4.16	2.88
S1310275-015	R-12004	155-165	8.5	64.3	0.58	1.26	1.69	4.27	3.52
S1310275-016	R-12004	165-175	8.3	60.0	0.52	1.01	1.36	3.78	3.48
S1310275-017	R-12004	175-184	7.9	63.4	0.52	0.90	0.51	3.93	4.69

TFN 6 2/025
RECD NOV 14, 2014

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945
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Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310275001

Project: Overburden
Date Received: 10/17/2013

Date Reported: 12/5/2013
Work Order: S1310275

Lab ID	Sample ID	Depths Feet	Sand %	Silt %	Clay %	Texture	Arsenic ppm	Boron ppm	Nitrate (as N) ppm	Selenium ppm	Molybdenum ppm
S1310275-001	R-12004	0-10	16.0	46.0	38.0	Silty Clay Loam	<0.05	0.91	13.4	0.05	0.07
S1310275-002	R-12004	10-20	8.0	48.0	44.0	Silty Clay	<0.05	0.24	61.4	0.07	<0.05
S1310275-003	R-12004	20-30	11.0	42.0	47.0	Silty Clay	<0.05	0.38	86.0	0.09	<0.05
S1310275-004	R-12004	30-39	14.0	30.0	56.0	Silty Clay	0.13	1.68	115	0.06	0.10
S1310275-005	R-12004	55-65	8.0	36.0	56.0	Silty Clay	0.42	5.26	98.8	0.06	0.34
S1310275-006	R-12004	65-75	14.0	29.0	57.0	Silty Clay	0.12	1.60	25.5	0.04	0.26
S1310275-007	R-12004	75-85	28.0	40.0	32.0	Clay Loam	0.28	0.45	6.6	0.04	0.42
S1310275-008	R-12004	85-95	14.0	38.0	48.0	Clay	0.24	0.59	2.1	0.05	0.48
S1310275-009	R-12004	95-102	24.0	22.0	54.0	Clay	2.88	1.78	5.6	0.08	2.04
S1310275-010	R-12004	106-115	22.0	16.0	62.0	Clay	0.48	2.46	<0.1	0.07	0.92
S1310275-011	R-12004	115-125	56.0	22.0	22.0	Sandy Clay Loam	0.22	0.80	<0.1	<0.02	0.38
S1310275-012	R-12004	125-133	40.0	30.0	30.0	Clay Loam	0.35	0.63	<0.1	0.08	0.44
S1310275-013	R-12004	133-145	20.0	17.0	63.0	Clay	1.80	3.47	<0.1	0.29	2.53
S1310275-014	R-12004	145-155	14.0	24.0	62.0	Clay	0.62	2.38	0.7	0.38	0.74
S1310275-015	R-12004	155-165	12.0	37.0	51.0	Clay	0.37	0.44	0.7	0.29	0.58
S1310275-016	R-12004	165-175	10.0	44.0	46.0	Silty Clay	0.40	0.51	0.7	0.18	0.32
S1310275-017	R-12004	175-184	22.0	24.0	54.0	Clay	0.53	1.36	0.3	0.19	1.53

TFN 6 2/025
RECD NOV 14, 2014

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Your Environmental Monitoring Partner

Soil Analysis Report
RAMACO
250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310275001

Project: Overburden
Date Received: 10/17/2013

Date Reported: 12/5/2013
Work Order: S1310275

Lab ID	Sample ID	Depths Feet	Total Carbon %	TOC %	Total Sulfur %	T.S. AB t/1000t	Neutral. Potential t/1000t	T.S. ABP t/1000t	Reflux %	Pyr+Org AB t/1000t	Pyr+Org ABP t/1000t
S1310275-001	R-12004	0-10	0.7	0.3	0.19	5.84	29.0	23.2			
S1310275-002	R-12004	10-20	0.5	0.3	0.08	2.62	18.7	16.1			
S1310275-003	R-12004	20-30	0.4	0.2	0.19	6.00	16.6	10.6			
S1310275-004	R-12004	30-39	0.9	0.9	0.07	2.15	1.50	-0.65			
S1310275-005	R-12004	55-65	7.0	6.9	0.22	6.90	8.70	1.80			
S1310275-006	R-12004	65-75	2.5	2.0	0.13	4.19	38.0	33.8			
S1310275-007	R-12004	75-85	2.3	0.9	0.57	17.8	116	98.6			
S1310275-008	R-12004	85-95	2.3	1.6	0.14	4.45	58.8	54.3			
S1310275-009	R-12004	95-102	12.1	12.0	1.65	51.6	13.8	-37.9	1.63	51.1	-37.3
S1310275-010	R-12004	106-115	14.4	14.2	0.70	21.9	16.0	-5.87	0.61	18.9	-2.89
S1310275-011	R-12004	115-125	6.0	3.9	0.30	9.27	182	173			
S1310275-012	R-12004	125-133	1.7	1.4	0.16	4.87	23.9	19.1			
S1310275-013	R-12004	133-145	19.2	19.0	1.51	47.3	19.9	-27.4	1.30	40.7	-20.8
S1310275-014	R-12004	145-155	5.8	5.6	0.29	8.93	12.7	3.79			
S1310275-015	R-12004	155-165	1.3	0.9	0.09	2.68	32.3	29.6			
S1310275-016	R-12004	165-175	1.3	1.0	0.07	2.31	27.1	24.7			
S1310275-017	R-12004	175-184	8.3	8.1	0.43	13.5	17.0	3.58			

TFN 6 2/025
RECD NOV 14, 2014

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Scanned, 02/28/2020

OVERBURDEN CORE/CHIP SAMPLE INTERVAL INSTRUCTIONS

Mine Site: Ramaco

Date: 12-3-12

Drillhole ID: R-12004 (core)

SAMPLE INTERVAL DEPTH			INTERVAL ID	COMMENTS
0 - 5	1	chips	1	
5 - 10			2	
10 - 15	2		3	
15 - 20			4	Note:
20 - 25	3		5	
25 - 30			6	Samples in
30 - 35	4		7	2 - Seperate
35 - 39		core pieces	8	Boxes!
39 - 55		coal - No samples	coal	
55 - 60	5	core pieces	9	
60 - 65		chips	10	
65 - 70	6		11	
70 - 75			12	
75 - 80	7		13	
80 - 85			14	
85 - 90	8		15	
90 - 95			16	
95 - 100	9	core pieces	17	
100 - 102		" "	18	
102 - 106		coal - No samples	coal	
106 - 110	10	core pieces	19	
110 - 115		chips	20	
115 - 120	11		21	
120 - 125			22	
125 - 130	12		23	
130 - 133		core pieces	24	
133 - 141	13	coal - No Samples	coal	
141 - 145		core pieces	25	
145 - 150	14	chips	26	
150 - 155			27	
155 - 160	15		28	
160 - 165			29	
165 - 170	16		30	
170 - 175			31	
175 - 180	17	core pieces	32	
180 - 184		coal - No Samples		
184 - 186.5		core slid out! - No Sample below coal		

TFN 6 2/025
RECD NOV 14, 2014

51212186
Rec'd 12/4/12
Kane Steen

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1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Date: 12/5/2013

CLIENT: RAMACO
Project: Overburden
Lab Order: S1310343

CASE NARRATIVE

Report ID: S1310343001

Sample R-12020 was received on October 23, 2013.

Samples were analyzed using the methods outlined in the following references:

U.S.E.P.A. 600/2-78-054 "Field and Laboratory Methods Applicable to Overburden and Mining Soils", 1978
American Society of Agronomy, Number 9, Part 2, 1982
USDA Handbook 60 "Diagnosis and Improvement of Saline and Alkali Soils", 1969
Wyoming Department of Environmental Quality, Land Quality Division, Guideline No. 1, 1984
New Mexico Overburden and Soils Inventory and Handling Guideline, March 1987
State of Utah, Division of Oil, Gas, and Mining: Guidelines for Management of Topsoil and Overburden for Underground and Surface Coal Mining, April 1988
Montana Department of State Lands, Reclamation Division: Soil, Overburden, and Regraded Spoil Guidelines, December 1994
State of Nevada Modified Sobek Procedure
st Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, 3rd Edition

All Quality Control parameters met the acceptance criteria defined by EPA and Inter-Mountain Laboratories except as indicated in this case narrative.

TFN 6 2/025
RECD NOV 14,2014

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Your Environmental Monitoring Partner

Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310343001

Project: Overburden
Date Received: 10/23/2013

Date Reported: 12/5/2013
Work Order: S1310343

Lab ID	Sample ID	Depths FEET	pH s.u.	Saturation %	Electrical Conductivity dS/m	PE Calcium meq/L	PE Magnesium meq/L	PE Sodium meq/L	SAR
S1310343-001	R-12020	0-10	7.1	41.7	2.54	17.9	25.0	12.4	2.69
S1310343-002	R-12020	10-20	3.9	79.0	4.80	17.8	70.7	49.0	7.37
S1310343-003	R-12020	20-30	4.8	70.9	2.47	11.3	23.5	15.4	3.69
S1310343-004	R-12020	30-40	7.5	81.2	0.87	2.37	4.03	3.76	2.10
S1310343-005	R-12020	40-50	8.1	58.9	1.11	2.06	5.20	5.22	2.74
S1310343-006	R-12020	50-60	8.2	47.5	1.19	2.22	5.74	6.55	3.28
S1310343-007	R-12020	60-70	7.8	70.3	1.08	2.64	5.06	5.33	2.71
S1310343-008	R-12020	70-80	7.9	48.7	1.92	3.70	8.05	13.1	5.42
S1310343-009	R-12020	80-90	7.9	57.7	1.40	2.12	3.77	9.27	5.40
S1310343-010	R-12020	90-100	6.4	54.9	1.59	2.51	5.07	11.3	5.83
S1310343-011	R-12020	105-115	6.5	59.0	1.08	1.84	2.99	11.5	7.41
S1310343-013	R-12020	125-135	8.0	63.1	0.55	0.85	0.65	4.22	4.87
S1310343-014	R-12020	135-142	8.2	60.2	0.55	1.43	5.59	4.88	2.60

TFN 6 2/025
RECD NOV 14, 2014

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Your Environmental Monitoring Partner

Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310343001

Project: Overburden
Date Received: 10/23/2013

Date Reported: 12/5/2013
Work Order: S1310343

Lab ID	Sample ID	Depths FEET	Sand %	Silt %	Clay %	Texture	Arsenic ppm	Boron ppm	Nitrate (as N) ppm	Selenium ppm	Molybdenum ppm
S1310343-001	R-12020	0-10	60.0	14.0	26.0	Sandy Clay Loam	<0.05	1.97	2.8	0.03	0.23
S1310343-002	R-12020	10-20	62.0	14.0	24.0	Sandy Clay Loam	0.18	4.17	62.1	0.07	7.22
S1310343-003	R-12020	20-30	16.0	40.0	44.0	Silty Clay	0.34	2.26	10.8	0.04	<0.05
S1310343-004	R-12020	30-40	6.0	45.0	49.0	Silty Clay	<0.05	0.49	6.3	0.03	<0.05
S1310343-005	R-12020	40-50	12.0	52.0	36.0	Silty Clay Loam	0.09	0.12	3.1	0.06	0.17
S1310343-006	R-12020	50-60	28.0	44.0	28.0	Clay Loam	0.08	0.05	2.4	0.03	0.10
S1310343-007	R-12020	60-70	12.0	48.0	40.0	Silty Clay	0.25	0.08	0.8	0.07	0.27
S1310343-008	R-12020	70-80	18.0	53.0	29.0	Silty Clay Loam	0.25	0.15	0.6	0.08	0.34
S1310343-009	R-12020	80-90	10.0	53.0	37.0	Silty Clay Loam	0.21	0.20	0.4	0.12	0.54
S1310343-010	R-12020	90-100	22.0	26.0	52.0	Clay	1.04	2.04	1.2	0.07	0.91
S1310343-011	R-12020	105-115	12.0	43.0	45.0	Silty Clay	0.06	1.62	0.7	0.09	0.41
S1310343-013	R-12020	125-135	35.0	25.0	40.0	Clay	0.42	0.77	0.6	0.17	0.60
S1310343-014	R-12020	135-142	9.0	33.0	58.0	Silty Clay	0.07	0.33	0.5	0.13	0.34

TFN 6 2/025
RECD NOV 14, 2014

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Your Environmental Monitoring Partner

Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310343001

Project: Overburden
Date Received: 10/23/2013

Date Reported: 12/5/2013
Work Order: S1310343

Lab ID	Sample ID	Depths FEET	Total Carbon %	TOC %	Total Sulfur %	T.S. AB t/1000t	Neutral. Potential t/1000t	T.S. ABP t/1000t	Reflux %	Pyr+Org AB t/1000t	Pyr+Org ABP t/1000t
S1310343-001	R-12020	0-10	0.6	<0.1	0.42	13.2	45.8	32.6			
S1310343-002	R-12020	10-20	22.8	22.6	0.42	13.1	17.2	4.02			
S1310343-003	R-12020	20-30	3.2	3.1	0.18	5.71	7.39	1.68			
S1310343-004	R-12020	30-40	0.7	0.5	0.08	2.62	23.2	20.6			
S1310343-005	R-12020	40-50	0.6	<0.1	0.05	1.49	48.4	46.9			
S1310343-006	R-12020	50-60	1.5	0.3	0.03	0.98	96.5	95.5			
S1310343-007	R-12020	60-70	0.4	0.1	0.19	5.79	21.1	15.4			
S1310343-008	R-12020	70-80	0.9	0.4	0.11	3.45	47.0	43.6			
S1310343-009	R-12020	80-90	1.7	0.7	0.12	3.63	77.0	73.3			
S1310343-010	R-12020	90-100	9.6	9.4	0.75	23.5	18.0	-5.50	0.70	21.9	-3.95
S1310343-011	R-12020	105-115	6.3	6.1	0.14	4.22	12.7	8.47			
S1310343-013	R-12020	125-135	4.2	3.0	0.29	8.90	105	95.6			
S1310343-014	R-12020	135-142	1.8	1.4	0.07	2.26	31.8	29.5			

TFN 6 2/025
RECD NOV 14, 2014

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Scanned, 02/28/2020

OVERBURDEN CORE/CHIP SAMPLE INTERVAL INSTRUCTIONS

Mine Site: Ramaco

Date: 12-13-12

Drillhole ID: R-12020

SAMPLE INTERVAL DEPTH		INTERVAL ID	COMMENTS
0 - 5		1	
5 - 10 > 1		2	
10 - 15		3	
15 - 20 > 2		4	
20 - 25		5	
25 - 30 > 3		6	
30 - 35		7	
35 - 40 > 4		8	
40 - 45		9	
45 - 50 > 5		10	
50 - 55		11	
55 - 60 > 6		12	
60 - 65		13	
65 - 70 > 7		14	
70 - 75		15	
75 - 80 > 8		16	
80 - 85		17	
85 - 90 > 9		18	
90 - 95		19	
95 - 100 > 10		20	
100 - 105	coal	—	No samples
105 - 110 > 11	core pieces	21	
110 - 115	core pieces	22	
115 - 123	coal	—	NO Samples
123 - 125 > 12	core pieces	—	core slid out - No samples
125 - 130 > 13		23	
130 - 135		24	
135 - 140		25	
140 - 142 > 14	core pieces	26	
142 - 147	coal	—	NO Samples
~~147 - 150~~	core pieces	—	core slid out - No samples

TFN 6 2/025
RECD NOV 14, 2014

Recd 12/17/12
Kara Alecon
5 12 12 260

Scanned, 02/28/2020

Inter-Mountain Labs
Your Environmental Monitoring Partner
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Date: 12/5/2013

CLIENT: RAMACO
Project: Overburden
Lab Order: S1310348

CASE NARRATIVE

Report ID: S1310348001

Sample AMBRE-02 was received on October 23, 2013.

Samples were analyzed using the methods outlined in the following references:

U.S.E.P.A. 600/2-78-054 "Field and Laboratory Methods Applicable to Overburden and Mining Soils", 1978
American Society of Agronomy, Number 9, Part 2, 1982
USDA Handbook 60 "Diagnosis and Improvement of Saline and Alkali Soils", 1969
Wyoming Department of Environmental Quality, Land Quality Division, Guideline No. 1, 1984
New Mexico Overburden and Soils Inventory and Handling Guideline, March 1987
State of Utah, Division of Oil, Gas, and Mining: Guidelines for Management of Topsoil and Overburden for Underground and Surface Coal Mining, April 1988
Montana Department of State Lands, Reclamation Division: Soil, Overburden, and Regraded Spoil Guidelines, December 1994
State of Nevada Modified Sobek Procedure
Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, 3rd Edition

All Quality Control parameters met the acceptance criteria defined by EPA and Inter-Mountain Laboratories except as indicated in this case narrative.

TFN 6 2/025
RECD NOV 14, 2014

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Your Environmental Monitoring Partner

Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310348001

Project: Overburden
Date Received: 10/23/2013

Date Reported: 12/5/2013
Work Order: S1310348

Lab ID	Sample ID	Depths FEET	pH s.u.	Saturation %	Electrical Conductivity dS/m	PE Calcium meq/L	PE Magnesium meq/L	PE Sodium meq/L	SAR
S1310348-001	AMBRE-02	0-10	8.1	45.2	7.93	21.8	124	41.4	4.85
S1310348-002	AMBRE-02	10-20	8.2	40.5	6.56	20.4	91.1	25.9	3.46
S1310348-003	AMBRE-02	20-29.8	6.7	50.4	1.76	5.98	10.7	1.88	0.65

TFN 6 2/025
RECD NOV 14, 2014

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Your Environmental Monitoring Partner

Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310348001

Project: Overburden
Date Received: 10/23/2013

Date Reported: 12/5/2013
Work Order: S1310348

Lab ID	Sample ID	Depths FEET	Sand %	Silt %	Clay %	Texture	Arsenic ppm	Boron ppm	Nitrate (as N) ppm	Selenium ppm	Molybdenum ppm
S1310348-001	AMBRE-02	0-10	34.0	36.0	30.0	Clay Loam	<0.05	1.06	1.4	0.20	0.13
S1310348-002	AMBRE-02	10-20	45.0	28.8	26.3	Loam	<0.05	1.50	1.2	0.12	0.35
S1310348-003	AMBRE-02	20-29.8	13.0	48.0	39.0	Silty Clay Loam	0.43	0.95	0.3	0.06	1.01

TFN 6 2/025
RECD NOV 14, 2014

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate

Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential

Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Scanned, 02/28/2020

Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Your Environmental Monitoring Partner

Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310348001

Project: Overburden
Date Received: 10/23/2013

Date Reported: 12/5/2013
Work Order: S1310348

Lab ID	Sample ID	Depths FEET	Total Carbon %	TOC %	Total Sulfur %	T.S. AB t/1000t	Neutral. Potential t/1000t	T.S. ABP t/1000t
S1310348-001	AMBRE-02	0-10	0.7	0.1	0.37	11.7	50.7	39.0
S1310348-002	AMBRE-02	10-20	1.5	<0.1	0.35	10.8	122	111
S1310348-003	AMBRE-02	20-29.8	5.9	5.1	0.43	13.4	59.7	46.3

TFN 6 2/025
RECD NOV 14, 2014

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

OVERBURDEN CORE/CHIP SAMPLE INTERVAL INSTRUCTIONS

Mine Site: Ramaco

Date: 1-9-2013

Drillhole ID: AMBRE-02

SAMPLE INTERVAL DEPTH	INTERVAL ID	COMMENTS
0 - 5	1	
5 - 10	2	
10 - 15	3	
15 - 20	4	
20 - 25 core pieces	5	
25 - 29.8 core pieces	6	
27.8 - 29.8	"core"	Roof core for geotech or OB Testing
29.8 - 47.2	—	Coal interval
47.2 - 49.2	"core"	Floor for geotech or OB Testing
50 - 65	—	No Samples - Drilled Up
65 - 66.5	"Core"	Roof for geotech or OB Testing
66.5 - 71.25	—	Coal Interval
71.25 - 73.7	"Core"	Floor for geotech or OB Testing

Also recieved 73.7 - 75

Roof and Floor Core Samples in seperate box - Not Included with OB Samples

MW

Rec'd 1/9/13
Kane Scott
5130172

TEN 6 2/025
RECD NOV 14, 2014

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Pete. Kiewit Sons' .ning District
Report of Laborat. il Analysis

Lab. No's. _____ Date 3/76 Name Big Horn Coal Address _____ City/State _____

Comments: Overburden Core

Sample No.	Sample Interval	pH Paste	pH 1:5 Dilu.	Soluble Salts $\Omega \times 10^{-3}$	Sodium meq/l	Calcium meq/l	Magnesium meq/l	SAR	Texture: Very fine sand	Texture: % sand	Texture: % silt	Texture: % clay	Texture: Class	Boron PPM	N Nitrogen PPM	P Phosphorus PPM	K Potassium PPM	Saturation %	Se Selenium PPM
166	-11	8.38	8.66	3.84	16.3	8.32	33.57	3.6		58.6	22.8	18.6	sandy loam	0.10				30.6	-.02
	11.5-15.[illegible]	8.44	8.67	3.44	12.4	8.74	35.31	2.6		74.3	18.0	7.7	sandy loam	0.14				20.9	-.02
	[illegible]-21	8.25	8.56	3.80	13.5	6.14	38.04	2.9		9.8	56.4	33.8	silty clay loam	0.25				49.2	-.02
	[illegible]	8.15	8.55	2.77	8.4	4.25	27.25	2.1		6.1	55.7	38.2	silty clay loam	0.48				57.3	-.02
	[illegible]-33.[illegible]	8.38	8.49	1.98	5.6	3.50	15.60	1.8		15.5	52.3	32.2	silty clay loam	0.43				50.9	-.02
	[illegible]	8.29	8.49	1.60	4.1	3.21	10.71	1.6		16.6	48.0	35.4	silty clay loam	0.67				56.6	-.02
	[illegible]	8.02	8.71	1.05	2.6	2.57	5.76	1.3		10.3	38.0	51.7	clay	0.62				65.1	-.02
	[illegible]	8.18	8.55	0.84	2.6	1.80	3.77	1.6		8.9	46.5	44.6	silty clay	0.51				55.1	-.02
	[illegible]	8.45	8.58	0.72	2.4	1.23	3.45	1.6		20.3	54.4	25.3	silt loam	0.72				47.5	-.02
	[illegible]-31	8.22	8.54	0.75	2.6	1.36	3.45	1.7		17.5	60.2	22.3	silt loam	0.25				44.2	-.02
	[illegible]	8.33	8.62	0.80	2.9	1.32	3.85	1.8		33.6	40.4	20.0	loam	0.40				36.8	-.02
	[illegible]	8.37	8.62	0.74	2.2	1.02	4.01	1.4		28.4	50.5	21.1	silt loam	0.31				41.2	-.02
	[illegible]	8.32	8.62	0.95	2.8	1.04	5.57	1.5		28.5	51.9	19.6	silt loam	0.24				44.9	-.02
	[illegible]	8.45	8.63	0.87	2.6	0.89	5.03	1.5		19.0	54.7	26.3	silt loam	0.13				39.7	-.02
	[illegible]	8.92	9.13	1.43	5.0	1.98	7.22	2.3		71.4	19.8	8.8	sandy loam	0.23				18.2	-.02
	[illegible]	8.33	8.77	1.52	5.4	1.51	9.15	2.3		20.2	55.6	24.2	silt loam	0.22				40.8	-.02
	[illegible]	8.29	8.60	1.10	4.5	1.23	4.83	2.8		7.9	51.8	40.3	silty clay loam	0.59				49.6	-.02
	[illegible]	8.07	8.60	0.96	4.8	1.51	3.12	3.2		16.0	31.3	52.7	clay	0.47				61.0	-.02
	[illegible]	8.05	8.81	1.17	9.0	1.14	3.87	5.7		9.7	14.9	75.4	clay	0.37				98.3	-.02

July 2015

TFN 6 2/025
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Peter Kiewit Sons' ning District
Report of Laborat il Analysis

Lab. No. _____ Date 3-76 Name Big Horn Coal Address _____ City/State _____

Co: Overburden Core

Sample No.	Sample Interval	pH Paste	pH 1:5 Diln.	Soluble Salts $\times 10^{-3}$	Sodium meq/l	Calcium meq/l	Magnesium meq/l	SAR	Texture: Very fine sand	% sand	% silt	% clay	Class	Boron PPM	N Nitrogen PPM	P Phosphorus PPM	K Potassium PPM	Saturation %	Se Selenium PPM
166	145-151	8.63	9.19	0.88	11.3	0.28	0.29	21.0		9.5	24.5	66.0	clay	0.77				89.9	-.02
	171-1[illegible]5	8.37	9.09	0.93	9.1	0.36	0.08	19.4		12.0	28.0	60.0	clay	1.29				64.0	-.02
	[illegible]	8.40	8.70	0.44	4.9	0.42	0.15	10.5		10.0	12.2	77.8	clay	1.61				78.9	-.02
	211.5-[illegible]	8.10	9.00	1.40	11.6	1.29	0.77	11.4		9.8	58.8	31.4	silty clay loam	0.34				38.8	-.02
	[illegible]	8.31	8.62	1.18	11.4	0.79	0.64	13.5		28.2	52.7	19.1	silt loam	0.21				27.7	-.02
	[illegible]	8.15	8.56	1.42	13.0	1.23	0.77	13.0		25.0	51.9	23.1	silt loam	0.20				30.7	-.02
	[illegible]	7.90	8.18	1.55	13.4	1.70	1.02	11.5		19.6	58.4	22.0	silt loam	0.20				28.9	-.02
	[illegible]	8.94	8.95	1.18	9.9	0.85	0.69	11.3		60.0	27.7	12.3	sandy loam	0.16				18.8	-.02
	[illegible]	9.10	9.14	1.05	8.4	0.72	0.37	11.4		72.6	18.0	9.4	sandy loam	0.08				21.2	-.02
	[illegible]	8.23	8.64	1.55	12.4	1.27	0.42	13.5		42.7	28.8	28.5	clay loam	0.10				21.8	-.02
	305-311	6.94	7.90	2.23	25.4	2.51	2.16	16.6		40.0	23.4	36.6	clay loam	0.66				39.8	-.02

July 2015

RAMACO

Brook Mine

Addendum D5-7-75

TFN 6 2/025
RECD JUL 30, 2015

DEQ Ex. 2-376

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Peter Kiewit Sons' Co. Mining District
Report of Laboratory Soil Analysis

Lab No. 0884-2-79 to 08-92-2-79 Date 2/79 Sample ID Big Horn 326-78; 327-78 Comments Pit Four Overburden Samples

Lab #	Sample Interval	Saturation %	pH	Conductivity mmhos/cm	Sodium meq/L	Calcium meq/L	Magnesium meq/L	SAR	V Fine Sand	% Sand	% Silt	% Clay	Texture Class*	Boron PPM	Nitrogen PPM	CEC meq/100 gm	E.S.P.
	326/																
84	0-5	38.4	7.3	4.9	20.0	18.9	34.2	3.9		43.0	36.9	20.1	l	0.82	20.3	13.6	6.9
85	5-10	23.3	6.5	7.4	56.0	16.5	90.4	7.7		64.9	21.2	13.9	sl	0.50	27.8	10.8	24.0
86	10-15	32.7	5.2	5.7	47.0	13.1	61.9	7.7		67.6	18.1	14.3	sl	0.71	51.2	62.0	7.5
	15-16	LOST															
87	16-18	78.4	3.7	8.8	75.0	13.5	102.5	9.8		6.8	60.4	32.8	sicl	3.05	69.4	86.0	2.4
	18-19	LOST															
88	19-22	51.5	6.0	5.8	27.0	16.4	46.5	4.8		14.5	61.6	23.9	sil	1.86	41.7	7.2	4.3
	22-23	LOST															
89	23-27	51.2	7.2	4.7	21.0	16.6	32.5	4.2		24.0	52.6	23.4	sil	1.33	12.6	5.2	10.1
	27-28	LOST															
90	28-31	19.5	7.9	3.3	8.0	13.9	25.8	1.8		64.5	23.8	11.7	sl	0.20	13.7	4.4	7.1
	327/ 0 -31	DRILLED OUT															
91	31-33	26.6	7.7	4.2	12.0	12.2	27.7	2.7		31.5	56.1	12.4	sil	0.29	18.9	4.6	5.7
92	33-41	54.1	8.0	2.9	9.0	2.1	8.5	3.9		8.5	68.8	22.7	l	0.50	8.2	5.8	3.2
	41-42.7	LOST															
	42.7	COAL															

*S = Sand, Sy = Silt, C = Clay, L = Loam

JAN 1983 RECEIVED Land Quality Div. DIST. IV

TFN 6 2/025
RECD JUL 30, 2015

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Peter Kiewit Sons' Co. Main District
Report of Laboratory Soil Analysis

DB 84-2-79 to DB-92-2-79 Date 2/79 Sample ID Big Horn 326-78; 327-78 Comments Pit Four Overburden Samples

Lab #	Sample Interval	Acid Base Potential	Lime	Lead PPM	Molybdenum PPM	Selenium PPM
	326/					
84	0-5		M	1.3	3.6	-0.02
85	5-10		M	1.0	4.0	-0.02
86	10-15	108.6	S	0.7	4.0	-0.02
	15-16	LOST----------				
87	16-18	71.61	S	0.1	3.6	-0.02
	18-19	LOST----------				
88	19-22	84.63	S	1.0	2.4	-0.02
	22-23	LOST----------				
89	23-27		M	1.4	2.8	-0.02
	27-28	LOST----------				
90	28-31		M	1.2	3.4	-0.02
	327/ 0-31	DRILLED OUT----------				
91	31-33		M	1.4	1.2	-0.02
92	33-41		M	2.1	1.2	-0.02
	41-42.7	LOST----------				
	42.7	COAL----------				

JAN 1980 RECEIVED

TFN 6 2/025
RECD JUL 30, 2015

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ADDENDUM D5-8

State Engineer's Office Water Well Information

TFN 8 27025
RECD 09-20-19

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Drill Hole Tabulations

WELL ID	Easting	Northing
P106680.0W	1933910.6	1373102.1
P118684.0W	1935375.5	1379410.4
P142919.0W	1934044.0	1376826.3
P186820.0W	1933886.5	1376825.5
P19856.0P	1936986.2	1373542.9
P36783.0W	1933208.4	1376928.1
P41136.0W	1937006.8	1370668.7
P4715.0P	1932390.9	1387433.5
P52707.0W	1935355.6	1377126.5
P52708.0W	1935806.6	1377087.5
P52711.0W	1935819.6	1376627.5
P52715.0W	1936116.6	1376115.5
P63975.0W	1932686.6	1384023.7
P65492.0W	1933921.9	1388304.5
P68201.0W	1932198.5	1387139.3
P71814.0W	1934157.7	1381746.5
P7297.0W	1933355.3	1388687.4
P75113.0W	1933921.9	1388304.5
P8410.0W	1935241.2	1379744.2
P84927.0W	1933902.3	1381730.4
P92235.0W	1932160.6	1386972.3
P93497.0W	1935346.6	1380072.2
P119576.0W	1936690.7	1376789.7
P120822.0W	1936690.7	1376789.7

TFNG 2/025
RECD DEC 13,2019

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FORM U.W.6
REV. 5-93

STATE OF WYOMING

OFFICE OF THE STATE ENGINEER
HERSCHLER BUILDING
CHEYENNE, WYOMING 82002
(307) 777-5959

SCANNED

STATEMENT OF COMPLETION AND DESCRIPTION OF WELL OR SPRING

NOTE: Do not fold this form. Use typewriter or print neatly with black ink.

PERMIT NO. U.W. 106680 NAME OF WELL (SPRING) WARNER #1

1. NAME OF OWNER GEORGE K AND F CHRISTINE WARNER

2. ADDRESS 2167 N Main
Please check if address has changed from that shown on permit. ☐
City Sheridan State Wy Zip Code 82801 Phone No. 307-672-3760

3. USE OF WATER: Domestic ☒ Stock Watering ☐ Irrigation ☐ Municipal ☐ Industrial ☐ Miscellaneous ☐
Explain proposed use (Example: One single family dwelling) use of water in single family dwellings or less, noncommercial watering less than 1 acre, 2 horses, etc.

4. LOCATION OF WELL (SPRING): NW ¼ NE ¼ of Section [illegible], T. 57 N., R. 85 W., of the 6th P.M. (or W.R.M.),
Subdivision Name _____ Lot _____ Block _____
If surveyed, bearing, distance and reference point: _____

5. TYPE OF CONSTRUCTION: Drilled ☒ Rotary (Type of Rig) Dug ☐ Driven ☐ Other ☐
Describe: Air/mud

6. CONSTRUCTION: Total Depth of Well/Spring 260 ft. Depth to Static Water Level 85 ft. (Below land surface)
a. Diameter of borehole (Bit size) 6 3/4 inches.

b. Casing Schedule New ☒ Used ☐
4 diameter from 0 ft. to 260 ft. Material PVC Gage S 40
_____ diameter from _____ ft. to _____ ft. Material _____ Gage _____

c. Was casing cemented: Yes ☐ No ☒ Cemented Interval, From _____ feet to _____ feet.

d. Number of sacks of cement used _____ type of cement _____

e. Perforations: Type of perforator used Factory
Size of perforations _____ inches by _____ inches.

Number of perforations and depths where perforated:
_____ perforations from _____ ft. to _____ feet.
_____ perforations from _____ ft. to _____ feet.

f. Was well screen installed? Yes ☒ No ☐
Diameter: 4 slot size: .025 set from 240 feet to 260
Diameter: _____ slot size: _____ set from _____ feet to _____

g. Was well gravel packed? Yes ☐ No ☒ Size of gravel _____

h. Was surface casing used: Yes ☐ No ☒ Was it cemented in place? Yes ☐ No ☐

7. NAME & ADDRESS OF DRILLING COMPANY DAVID Drilling PO Box 353, Big Horn, Wy 82833

8. DATE OF COMPLETION OF WELL (including pump installation) OR SPRING (first used) [illegible]

9. PUMP INFORMATION: Manufacturer Flotec Type Submersible
Source of power Elect. Horsepower 1 Depth of Pump Setting or intake 220
Amount of Water Being Pumped 6 Gallons Per Minute. (For Springs or flowing wells, see item 10.)
Total Volumetric Gallons Used Per Calendar Year. _____

10. FLOWING WELL (Owner is responsible for control of flowing well).
If well yields artesian flow, yield is _____ gal./min. Surface pressure is _____ lb./sq. inch, or _____ feet of water.
The flow is controlled by: valve ☐ cap ☐ plug ☐
Does well leak around casing? Yes ☐ No ☐

Permit No. U.W. 106680 Book No. 817 Page No. 81

TFN 6 2/025

DEQ Ex. 2-381

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11. If spring, how was it constructed? (Some method of artificial diversion, i.e., spring box, cribbing, etc., is necessary to qualify for a water right.) _____

12. PUMP TEST: Was a pump test made? Yes ☒ No ☐
If so, by whom DRILLER Address _____
Yield: 6 gal./min. with 115 foot drawdown after 2 hours.
Yield: 6 gal./min. with 115 foot drawdown after 24 hours.

13. LOG OF WELL: Total depth drilled 260 feet.
Depth of completed well 260 feet. Diameter of well 4 inches.
Depth to first water bearing formation 242 feet.
Depth to principal water bearing formation. Top 242 feet to Bottom 254 feet.

Ground Elevation, if known 3800'

DRILL CUTTINGS DESCRIPTION:

From Feet	To Feet	Material Type, Texture Color	Remarks (Cementing, Shutoff)	Indicate Water Bearing Formation & Name	Indicate Perforated Casing Location
0	2	Top			
2	14	Sandy Clay			
14	22	Gravel		Dry	
22	41	Blue Shale			
41	43	Rock			
43	65	Blue Shale w/coal			
65	83	Blue Shale w/coal			
83	101	Rock			
101	109	Blue Shale			
109	128	COAL			
128	129	Blue Shale w/coal			
129	242	Rock	PARKER		
242	254	Blue Shale			
254	260	Coal		WATER BEARING	
		Blue Shale			

14. QUALITY OF WATER INFORMATION:
Does a chemical and/or bacteriological water quality analysis accompany this form? Yes ☑ No ☐
It is recommended that chemical and bacteriologic water quality analyses be performed and that the report(s) be filed with the records of this well. (Contact Department of Agriculture, Analytical Lab Services, Laramie, 742-2984.)
If not, do you consider the water as: Good ☐ Acceptable ☐ Poor ☐ Unusable ☐

REMARKS: _____

Under penalties of perjury, I declare that I have examined this form and to the best of my knowledge and belief it is true, correct and complete.

Gerald K Waney
Signature of Owner or Authorized Agent

11-16, 1997
Date

UW 106480

FOR STATE ENGINEER'S USE ONLY

Date of Receipt NOV 17 1999, 19 ____

Date of Priority JUL 2 1997, 19 ____

Date of Approval March 29, 2000

Cheryl Duplanek
for State Engineer

TFN 6 2/025
RECD 09-20-19

Scanned, 02/28/2020

FORM U.W.6
Rev. 3.99

STATE OF WYOMING

OFFICE OF THE STATE ENGINEER
HERSCHLER BUILDING
CHEYENNE, WYOMING 82002
(307) 777-5959

SCANNED JAN 1 9 2016

STATEMENT OF COMPLETION AND DESCRIPTION OF WELL OR SPRING

NOTE Do not fold this form. Use typewriter or print neatly with black ink.

PERMIT NO. U.W. 118684 NAME OF WELL (SPRING) JOHNSON NO. 2

1. NAME OF OWNER JOHN L. & GAYLENE JOHNSON

2. ADDRESS P.O. Box 424
Please check if address has changed from that shown on permit. ☐
City Ranchester State Wyoming Zip Code 82839 Phone No. 307-655-2410

3. USE OF WATER: Domestic ☐ Stock Watering ☒ Irrigation ☐ Municipal ☐ Industrial ☐ Miscellaneous ☐
☐ Monitor or Test ☐ Coal Bed Methane Explain proposed use (Example: One single family dwelling)
one stock tank in corral or future barn

4. LOCATION OF WELL (SPRING): SE ¼ SE ¼ of Section 14, T. 57 N., R. 85 W., of the 6th P.M. (or W.R.M.).
Subdivision Name — Lot — Block —
If surveyed, bearing, distance and reference point: —

5. TYPE OF CONSTRUCTION: Drilled ☐ (Type of Rig) Dug ☒ Driven ☐ Other ☐
Describe: Hand dug

6. CONSTRUCTION: Total Depth of Well/Spring 7 ft.
Depth to Static Water Level 6'6" ft. (Below land surface)
a. Diameter of borehole (Bit size) 48 inches.
b. Casing Schedule New ☐ Used ☒
36" diameter from 0 ft. to 7 ft. Material galvanized pipe Gage 16
____ diameter from ____ ft. to ____ ft. Material ____ Gage ____
c. Was casing cemented: Yes ☐ No ☒ Cemented Interval, From ____ feet to ____ feet.
d. Number of sacks of cement used — type of cement —
e. Perforations: Type of perforator used chisel
Size of perforations 3/4 inches by 1½ inches.
Number of perforations and depths where perforated:
50 perforations from 4 ft. to 6 feet.
____ perforations from ____ ft. to ____ feet.
f. Was well screen installed? Yes ☐ No ☒
Diameter: ____ slot size: ____ set from ____ feet to ____
Diameter: ____ slot size: ____ set from ____ feet to ____
g. Was well gravel packed? Yes ☒ No ☐ Size of gravel pea, 1", 2"
h. Was surface casing used: Yes ☒ No ☐ Was it cemented in place? Yes ☐ No ☒

7. NAME & ADDRESS OF DRILLING COMPANY Self, Same

8. DATE OF COMPLETION OF WELL (including pump installation) OR SPRING (first used) 8/29/00

9. PUMP INFORMATION: Manufacturer Sears Type centrifugal
Source of power electricity Horsepower 1 Depth of Pump Setting or intake 6'
Amount of Water Being Pumped 11 Gallons Per Minute. (For Springs or flowing wells, see item 10.)
Total Volumetric Gallons Used Per Calendar Year 100,000 gallons

10. FLOWING WELL (Owner is responsible for control of flowing well).
If well yields artesian flow, yield is ____ gal./min. Surface pressure is ____ lb./sq. inch, or ____ feet of water.
The flow is controlled by: valve ☐ cap ☐ plug ☐
Does well leak around casing? Yes ☐ No ☐

Permit No. U.W. 118684 Book No. 897 Page No. 135

SEE REVERSE SIDE

TFN 8 2/025
RECD 09-20-19

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11. If spring, how was it constructed? (Some method of artificial diversion, i.e., spring box, cribbing, etc., is necessary to qualify for a water right.)

12. PUMP TEST. Was a pump test made? Yes [X] No [ ]
If so, by whom: Same Address: Same
Yield: 11 gal./min. with 5 foot drawdown after 1/2 hours.
Yield: gal./min. with foot drawdown after hours.

13. LOG OF WELL. Total depth drilled 7 feet.
Depth of completed well: 7 feet. Diameter of well: 36 inches.
Depth to first water bearing formation: 6 feet.
Depth to principal water bearing formation: Top 6 feet to Bottom 6 feet.

Ground Elevation, if known: 3650

DRILL CUTTINGS DESCRIPTION:

From Feet	To Feet	Material Type, Texture Color	Remarks (Cementing, Shutoff)	Indicate Water Bearing Formation & Name	Indicate Perforated Casing Location

14. QUALITY OF WATER INFORMATION
Does a chemical and/or bacteriological water quality analysis accompany this form? Yes [ ] No [X]
It is recommended that chemical and bacteriologic water quality analyses be performed and that the report(s) be filed with the records of this well. (Contact Department of Agriculture, Analytical Lab Services, Laramie, 742-2984.)
If not, do you consider the water as: Good [X] Acceptable [ ] Poor [ ] Unusable [ ]

REMARKS: Clear, Smells ok, good for stock
the static H_2O level is at 1' 6"

Under penalties of perjury, I declare that I have examined this form and to the best of my knowledge and belief it is true, correct and complete.

John S. Johnson
Signature of Owner or Authorized Agent

9/25, 2000
Date

UW 118484

FOR STATE ENGINEER'S USE ONLY

Date of Receipt: SEP 2 1 2000, 19

Date of Priority: SEPTEMBER 9, 1999

Date of Approval: December 22, 19 2000

Dawn Parkin
for State Engineer

TFN & 27025
RECD 08-20-19

Scanned, 02/28/2020

FORM U.W.6
Rev. 6/00

STATE OF WYOMING

OFFICE OF THE STATE ENGINEER
HERSCHLER BUILDING
CHEYENNE, WYOMING 82002
(307) 777-6163

MICRO MAR 1 8 2004

STATEMENT OF COMPLETION AND DESCRIPTION OF WELL OR SPRING

NOTE: Do not fold this form. Use typewriter or print neatly with black ink.

PERMIT NO. U.W. 142919 NAME OF WELL (SPRING) BROWN #1

1. NAME OF OWNER R. STANLEY & PATRICIA A. BROWN

2. ADDRESS 89 Kooi Rd
Please check if address has changed from that shown on permit
City RANCHESTER State WYOMING Zip Code 82839 Phone No. 307 655-7460

3. USE OF WATER: Domestic ☒ Stock Watering ☐ Irrigation ☐ Municipal ☐ Industrial ☐ Miscellaneous ☐
Monitor or Test ☐ Coal Bed Methane ☐ Explain proposed use (Example: One single family dwelling)
TWO SINGLE FAMILY DWELLINGS - 78 Kooi Rd & 89 Kooi Rd

4. LOCATION OF WELL (SPRING) NE ¼ NW¼ of Section 23, T. 57 N., R. 85 W., of the 6th P.M. (or W.R.M.),
Subdivision Name _____ Lot _____ Block _____
If surveyed, bearing, distance and reference point _____

5. TYPE OF CONSTRUCTION: Drilled ☐ _____ Dug ☒ Driven ☐ Other ☐
(Type of Rig)
Describe: Dug with BACKHOE

6. CONSTRUCTION: Total Depth of Well/Spring 19 ft.
Depth to Static Water Level 7 ft. (Below land surface)
a. Diameter of borehole (Bit size) 48 inches.
b. Casing Schedule New ☒ Used ☐
48" diameter from 0 ft. to 19 ft. Material GALV CULVERT Gage _____
____ diameter from _____ ft. to _____ ft. Material _____ Gage _____
c. Was casing cemented: Yes ☐ No ☒ Cemented Interval, From _____ feet to _____ feet.
d. Number of sacks of cement used _____ type of cement _____
e. Perforations: Type of perforator used SAWN SLITS
Size of perforations ¼ inches by 6 inches
Number of perforations and depths where perforated:
12 perforations from 15 ft. to 18 feet.
_____ perforations from _____ ft. to _____ feet.
f. Was well screen installed? Yes ☐ No ☒
Diameter: _____ slot size: _____ set from _____ feet to _____
Diameter: _____ slot size: _____ set from _____ feet to _____
g. Was well gravel packed? Yes ☒ No ☐ Size of gravel 1"
h. Was surface casing used: Yes ☐ No ☐ Was it cemented in place? Yes ☐ No ☐

RECEIVED OCT 7 2003 STATE ENGINEER CHEYENNE, WY

7. NAME & ADDRESS OF DRILLING COMPANY OWNER

8. DATE OF COMPLETION OF WELL (including pump installation) OR SPRING (first used) SEPT 24, 2003

9. PUMP INFORMATION: Manufacturer FRANKLIN Type SUBMERSIBLE
Source of power ELECTRIC Horsepower 1 Depth of Pump Setting or intake 18'
Amount of Water Being Pumped 18 Gallons Per Minute. (For Springs or flowing wells, see item 10.)
Total Volumetric Gallons Used Per Calendar Year IAF

10. FLOWING WELL OR SPRING (Owner is responsible for control of flowing well).
If well yields artesian flow or if spring, yield is _____ gal./min. Surface pressure is _____ lb./sq. inch, or _____ feet of water.
The flow is controlled by: valve ☐ cap ☐ plug ☐
Does well leak around casing? Yes ☐ No ☐

Permit No. U.W. 142919 Book No. 1059 Page No. 145

SEE REVERSE SIDE

DEQ Ex. 2-385

RECD 08-20-19

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11. If spring, how was it constructed? (Some method of artificial diversion, i.e., spring box, cribbing, etc., is necessary to qualify for a water right.) _____

12. PUMP TEST: Was a pump test made? Yes ☐ No ☒
If so, by whom _____ Address _____
Yield _____ gal./min. with _____ foot drawdown after _____ hours.
Yield _____ gal./min. with _____ foot drawdown after _____ hours.

13. LOG OF WELL: Total depth drilled 19 feet.
Depth of completed well 19 feet. Diameter of well 48 inches.
Depth to first water bearing formation 15 feet.
Depth to principal water bearing formation. Top 15 feet to Bottom 18 feet.

Ground Elevation, if known _____

DRILL CUTTINGS DESCRIPTION:

From Feet	To Feet	Material Type, Texture Color	Remarks (Cementing, Shutoff)	Indicate Water Bearing Formation & Name	Indicate Perforated Casing Location
0	15	Dirt			
15	18	GRAVEL			15 - 18

14. QUALITY OF WATER INFORMATION:
Does a chemical and/or bacteriological water quality analysis accompany this form? Yes ☐ No ☒
It is recommended that chemical and bacteriologic water quality analyses be performed and that the report(s) be filed with the records of this well. (Contact Department of Agriculture, Analytical Lab Services, Laramie, 742-2984.)
If not, do you consider the water as: Good ☒ Acceptable ☐ Poor ☐ Unusable ☐

REMARKS _____

Under penalties of perjury, I declare that I have examined this form and to the best of my knowledge and belief it is true, correct and complete.

R Shady Sum
Signature of Owner or Authorized Agent

10 - 6, 20 03
Date

FOR STATE ENGINEER'S USE ONLY

Permit No. U.W. 142919

Date of Receipt OCT 07 2003, 20

Date of Priority 2/28/2002, 20

Date of Approval 10/20, 20 03

Cheryl Vieplanck
for State Engineer

TFN E 2/025
RECD 09-20-19

Scanned, 02/28/2020

FORM U.W.6
Rev. 2/07

STATE OF WYOMING

OFFICE OF THE STATE ENGINEER
HERSCHLER BLDG., 4-E
CHEYENNE, WYOMING 82002
(307) 777-6163

STATEMENT OF COMPLETION AND DESCRIPTION OF WELL OR SPRING

NOTE: Do not fold this form. Use typewriter or print neatly with black ink.

PERMIT NO. U.W. **186820** NAME OF WELL/SPRING **JAKE'S WELL**

1. NAME OF OWNER **R. STANLEY & PATRICIA A. BROWN**

2. ADDRESS 73 Kooi Rd
☒ Please check if address has changed from that shown on permit.
City RANCHESTER State WYO Zip Code 82839 Phone No 307-655-7460

3. USE OF WATER ☒ Domestic ☒ Stock Watering ☐ Irrigation ☐ Municipal ☐ Industrial ☐ Miscellaneous
☐ Monitor or Test ☐ Coal Bed Methane Explain proposed use (Example: One single family dwelling) 2 FAMILY dwellings & 2 stock waters

4. LOCATION OF WELL/SPRING NE 1/4 NW 1/4 of Section 23, T. 57 N., R 85 W., of the 6th P.M. (or W.R.M.)
Subdivision Name _____ Lot _____ Block _____
Resurvey Location Tract _____ or Lot _____ Datum ☐ NAD27 ☐ NAD83 _____
Geographic Coordinates: Latitude 44 54.575 N Longitude [redacted] W (degrees, minutes, seconds)
UTM: Zone _____ Northing W 107 04.757 Easting _____ (meters)
State Plane Coordinates: Zone _____ Northing _____ Easting _____ (Feet)
Land surface elevation (ft. above mean sea level) _____ Datum ☐ NAVD29 ☐ NAVD88 GPS correct zone
Source ☐ GPS ☐ Map ☐ Survey ☐ Unknown ☐ Other ☐ Altimeter (for elevation only)

5. TYPE OF CONSTRUCTION ☐ Drilled BACK HOE (type of rig, and fluid used, if any) ☒ Dug ☐ Driven ☐ Other
Describe _____

6. CONSTRUCTION Total depth of well/spring 17'-4" ft.
Depth to static water level 9'2" ft. (below land surface) Casing height 0 ft. above ground
a. Diameter of borehole (bit size) 48" inches
b. Casing schedule ☐ New ☐ Used Joint type ☐ Threaded ☐ Glued ☐ Welded
48" diameter from 2'-2" ft. to 17'4" ft. Material 48" Plastic Culvert Gage _____
_____ diameter from _____ ft. to _____ ft. Material _____ Gage _____
c. Cemented/grouted interval, from 2'-2" ft. to 17'-4" ft.
Amount of grout used 27 yards (example: 10 sacks) type 1"4 washed Rock (example: bentonite pellets)
d. Type of completion ☐ Customized perforations ☐ Open hole ☐ Factory screen
Type of perforator used _____
Size of perforations 1/4" inches by 12 inches
Number of perforations and depths where perforated
6 [redacted]" perforations from 17'4" ft. to 14 ft.
_____ perforations from _____ ft. to _____ ft.
Open hole from _____ ft. to _____ ft.
Well screen details
Diameter _____ slot size _____ set from _____ ft. to _____ ft.
Diameter _____ slot size _____ set from _____ ft. to _____ ft.
e. Well development method _____ How long was well developed? _____
f. Was a filter/gravel pack installed? ☒ Yes ☐ No Size of sand/gravel 1"4 washed Rock
Filter pack/gravel installed from _____ ft. to _____ ft.
g. Was surface casing used? ☐ Yes ☒ No Was it cemented in place? ☐ Yes ☐ No
Surface casing installed from _____ ft. to _____ ft.

RECEIVED JUN - 1 [redacted]

7. NAME AND ADDRESS OF DRILLING COMPANY OWNER 89 Kooi Rd RANCHESTER, WY

8. DATE OF COMPLETION OF WELL (including pump installation) OR SPRING (first used) MAY 4, 09

9. PUMP INFORMATION Manufacturer FLOTEC Type SUBMERSIBLE
Source of power 220 ELECTRIC Horsepower 1 HP Depth of pump setting or intake 16' ft.
Amount of water being pumped 10 gal./min.* (For springs or flowing wells, see item 10)
Total volumetric quantity used per calendar year.* 1 Acre Feet

10. FLOWING WELL OR SPRING (Owner is responsible for control of flowing well)
If well yields artesian flow or if spring, yield is _____ gal./min.* Surface pressure is _____ lb./sq.inch, or _____ feet of water
The flow is controlled by ☐ Valve ☐ Cap ☐ Plug
Does well leak around casing? ☐ Yes ☐ No
*If these amounts exceed permitted amount an enlargement is required.

Permit No. U.W. **186820** Book No. **1351** Page No. **20**

SEE REVERSE SIDE

TFN 6 2/02 9
2019-20-19

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11. IF SPRING, HOW WAS IT CONSTRUCTED? (Some method of artificial diversion, i.e., springbox, cribbing, etc., is necessary to qualify for a water right) _____

12. PUMP TEST Was a pump test conducted? ☒ Yes ☐ No
If so, by whom R Stanley Brown
Yield 10 gal./min. with 6 ft. drawdown after 3 hours
Yield _____ gal./min. with _____ ft. drawdown after _____ hours

13. LOG OF WELL Total depth drilled 17' 4" ft.
Depth of completed well 17' 4" ft. Diameter of well 4.3" inches.
Depth to first water bearing formation 12 ft.
Depth to principal water bearing formation Top 15 ft. to bottom 17' 4" ft.

DRILL CUTTINGS DESCRIPTION:

From Feet	To Feet	Rock Type Or Description	Formation	Water Bearing? (Yes or no)
Surface				

14. DOES A GEOPHYSICAL LOG ACCOMPANY THIS FORM? ☐ Yes ☒ No

15. QUALITY OF WATER INFORMATION
Does a chemical and/or bacteriological water quality analysis accompany this form? ☐ Yes ☒ No
It is recommended that chemical and bacteriologic water quality analyses be performed and that the report(s) be filed with the records of this well. (Contact Department of Agriculture, Analytical Lab Services, Laramie, 742-2984.)
If not, do you consider the quality of water as ☒ Good ☐ Acceptable ☐ Poor ☐ Unusable

REMARKS _____

Under penalties of perjury, I declare that I have examined this form and to the best of my knowledge and belief it is true, correct, and complete.

R Stanley Brown
Signature of Owner or Authorized Agent

5-8-, 2009
Date

FOR STATE ENGINEER'S USE ONLY

Permit No. U.W. 186820

Date of Receipt ~~MAY 11 2009~~ JUN 1 2009

Date of Priority 5/14/2008

Date of Approval 5-2, 2012

for State Engineer

TFN 8 2/025
RECD 09-20-19

Scanned, 02/28/2020

Form U.W. 7

IF WELL IS TO BE ABANDONED, SEE ITEM 20

NOTE: Do not fold this form. Use typewriter or print neatly with black ink.

STATE OF WYOMING

OFFICE OF THE STATE ENGINEER

STATEMENT OF COMPLETION AND DESCRIPTION OF WELL

for Domestic or Stock Watering Use Only

A preferred water right is given to such use when the yield or flow does not exceed .056 cubic feet per second or 25 gallons per minute. Domestic use refers to household use and the watering of lawns and gardens for family use, not to exceed one acre.

Permit No. U.W. 19856

Temporary Filing No. 7-5-171

Water Division No. 2(5)

U.W. District Sheridan Co.

**Completed Prior to May 24, 1969 [X]

NAME OF WELL Scott #1 (N Bar 5)

1. Owner Pacific Power & Light Company
2. Address 920 S.W. 6th Ave., Portland, Oregon
3. Agent to receive correspondence Pacific Power & Light Company
4. Name & address of driller Big Horn Coal Company Sheridan, Wyoming
5. Well is constructed on lands owned by Pacific Power & Light Co. (Obtaining of easement or right of way is the responsibility of the applicant's. Include copy if land is privately owned and owner is not a co-applicant.)
6. Type of construction: Dug [ ] Drilled [X] Rotary (Type of Rig)
   Driven [ ] Jet [ ] Other
7. Use of Water—Domestic [ ] Stock [X]
8. Means of conveyance, distance and direction to point of use Direct into tank
9. Date started approx., 1957
10. Date completed ", 1957 (including pump)
11. Date after completion when water was used ------, 1957
12. WELL DESCRIPTION
    Total Depth 40 Depth to Water Level 15 ft.
13. TEST DATA none available
    Yield ____ How Tested ____
    Drawdown ____ Length of Test ____
14. PUMP DATA
    Type pump jack (Turbine, Centrifugal, etc.) Power Source gas (Elec., Gas, etc.)
    Horsepower 1½ Amount of Water Being Used 3 (Gallons per Minute)
15. CASING RECORD

Plain Casing

Size	Kind	from	ft. to	ft.
4"	steel	0	40	

Perforated Casing

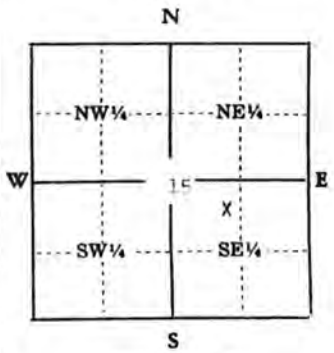
Size	Kind	from	ft. to	ft.

WELL LOCATION

Sheridan County

NW ¼ of SE ¼ of Sec. 15

T. 57 N., R. 85 W.



Scale: 2" = 1 mile

Above diagram represents one full section. Locate well accurately in small square representing 40 ac. or fill in the following:

Lot ____ & Block ____ or Tract ____

of the ____ (Subdivision or Addition)

of ____ (City, Town or County)

Section ____, T. ____ N., R. ____ W.

**For wells constructed after May 24, 1969, Application Form U.W. 5 must be submitted prior to construction.

Permit No. U.W. 19856

Book No. 104 Page No. 94

FR 5 2/025
REC'D 09-20-19

Scanned, 02/28/2020

16. Was surface seal provided? Yes ☐ No ☒ To What Depth _____ Material used: _____
Was well gravel packed? Yes ☐ No ☒

17. FLOWING WELL (Owner is responsible for installing control device on flowing well.)
Does well flow? Yes ☐ No ☒
Flow controlled by: Valve ☐ Cap ☐ Plug ☐ Does well leak around casing? Yes ☐ No ☐ UW 19856

18. LOG OF WELL—Clearly indicate first water bearing material and principal water bearing material.
none available

From Feet	To Feet	Material Type, Texture, Color	REMARKS (Cementing, Shutoff, Packing, etc.)	Indicate Water Bearing Formation	Indicate Perforated Casing Location

19. QUALITY OF WATER INFORMATION
Was a chemical analysis made? Yes ☐ No ☒
If so, please include a copy of the analysis with this form.
If not, do you consider the water as: Good ☐ Acceptable ☒ Poor ☐ Unusable ☐
Was a bacteriological analysis made? Yes ☐ No ☒
If a domestic well, was the well disinfected by the driller? Yes ☐ No ☒

20. IF WELL IS TO BE ABANDONED, complete only Items 1 through 6, Item 10 and Item 18 (Log of Well) and state reason for abandonment below.
It is the responsibility of the owner to properly plug or fill in the well in order to prevent contamination of ground water and to cover or cap the well at ground level.

REMARKS: _____

Under penalties of perjury, I declare that I have examined this form and to the best of my knowledge and belief it is true, correct and complete.

PACIFIC POWER & LIGHT COMPANY
A L Bartholomew
Signature of Owner or Authorized Agent
Senior Vice President

December 21, 1972
Date

Date of Receipt: DEC 27 1972, 19____ Date of Priority: December 31, 1972

Jeannine P. Jarvitt

Date of Approval: March 11, 1973 Richard R. Stahle
for State Engineer

SCANNED FEB 2 3 2017

TFR 6 37025

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RECEIVED JUN 1 1977 STATE ENGINEER

SCANNED MAY 23 2012

MICRO FILMED AUG 3 '77

Form U.W. 6

NOTE: Do not fold this form. Use typewriter or print neatly with black ink.

IF WELL IS TO BE ABANDONED, SEE ITEM 15, PAGE 4

STATE OF WYOMING

OFFICE OF THE STATE ENGINEER

STATEMENT OF COMPLETION AND DESCRIPTION OF WELL

PERMIT NO. U.W. 36783 NAME OF WELL Brown No. 1

1. NAME OF OWNER Stanley Brown
2. ADDRESS Buffalo Star Rte, Box 166, Sheridan, Wyo Zip Code 82801
3. USE OF WATER: Domestic ☑ Stock Watering ☐ Irrigation ☐ Municipal ☐ Industrial ☐ Miscellaneous ☐
4. LOCATION OF WELL: SE ¼ NW ¼ of Section 23, T. 57 N., R. 85 W., of the 6th P.M. (or W.R.M.), Wyoming, being specifically _____ (Bearing and Distance) or _____ ft. North/South and _____ ft. East/West from the _____ corner of Section ____, T. ____ N., R. ____ W. (Strike out words not needed).
5. TYPE OF CONSTRUCTION: Drilled ☑ Rotary Failing 1500 (Type of Rig) Dug ☐ Driven ☐ Jetted ☐
   Other _____
6. CONSTRUCTION: Total Depth 360 ft. Depth to Water Level 40 ft.
   a. Casing Schedule New ☑ Used ☐
   6" diameter from 0 ft. to 17 ft. Material galvanized surface Gage _____
   4" diameter from 0 ft. to 213 ft. Material galvanized Gage 9 16.
   _____ diameter from _____ ft. to _____ ft. Material _____ Gage _____
   b. Perforations: Type of perforator used torch
   Size of perforations ¼ inches by 12 inches.
   Number of perforations and depths where perforated:
   36 perforations from 143 ft. to 155 feet.
   51 perforations from 196 ft. to 213 feet.
   c. Was well screen installed? Yes ☐ No ☑
   Diameter: _____ slot size: _____ set from _____ feet to _____ feet.
   Diameter: _____ slot size: _____ set from _____ feet to _____ feet.
   d. Was well gravel packed? Yes ☑ No ☐ Size of gravel ¼"
   e. Was surface casing used Yes ☑ No ☐ Was it cemented in place? Yes ☑ No ☐
7. NAME & ADDRESS OF DRILLER Stewart Drilling P.O. Box 529 Sheridan Wyo
8. DATE OF COMPLETION OF WELL (including pump installation) June 1, 1977
9. PUMP INFORMATION: Manufacturer Air motor Type submersible
   Source of power electric Horsepower ½ Depth of Pump Setting 180'
   Amount of Water Being Pumped 3 Gallons Per Minute.

Permit No. U.W. 36783 Book No. 190 Page No. 72

TFM 8 3/025

SEP 8 09-20-19

DEQ Ex. 2-391

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UW 36783

10. **PUMP TEST:** Was a pump test made? Yes ☐ No ☑

If so, by whom_____ Address_____

Yield: _____gal./min. with_____foot drawdown after_____hours.

Yield: _____gal./min. with_____foot drawdown after_____hours.

11. **FLOWING WELL** (Owner is responsible for control of flowing well).

If well yields artesian flow, yield is_____gal./min. Surface pressure is_____lb./sq. inch, or_____feet of water.

The flow is controlled by: valve ☐ cap ☐ plug ☐

Does well leak around casing? Yes ☐ No ☐

12. **LOG OF WELL:** Total depth drilled 360 feet.

Depth of completed well 213 feet. Diameter of well 4 inches.

Depth to first water bearing formation 143 feet.

Depth to principal water bearing formation Top 143 feet to Bottom 213 feet.

Ground Elevation, if known_____

From Feet	To Feet	Material Type, Texture, Color	REMARKS (Cementing, Shutoff, Packing, etc.)	Indicate Water Bearing Formation	Indicate Perforated Casing Location
0	3	top soil			
3	6	yellow sand			
6	16	brown shale			
16	18	gray shale			
18	19	super hard sandstone			
19	21½	gray shale			
21½	23	hard sandstone			
23	45	gray shale			
45	47	coal			
47	68	gray shale			
68	72	gray sandy shale			
72	73	gray shale			
73	74	coal			
74	105	gray shale			
105	107	hard sandstone			
107	111	gray shale			
111	112	hard sandstone			
112	123	gray shale			
123	125	coal			
125	152	gray shale	packer 143'		143' - - 155'
152	156	coal			
156	159	gray shale			
159	160	hard sandstone			
160	165	gray shale			
165	168	hard sandstone			
168	174	gray shale			
174	176	hard sandstone			
176	184	gray shale			
184	186	coal			
186	188	hard sandstone			
188	199	gray shale			
199	200	coal	packer 196'		196' - - 213'
200	247	gray shale			
247	250	hard sandstone			
250	254	gray shale			
254	257	gray sand			
257	261	gray shale			
261	262	coal			
262	284	gray shale			
284	289	gray sandy shale			
289	290	hard sandstone			
290	302	gray sand			
302	306	gray shale			
306	307	coal			
307	317	gray shale			
317	318	coal			
318	342	gray shale			
342	355	gray sand			
355	360	gray shale.			

QUALITY OF WATER INFORMATION:

Was a chemical analysis made? Yes ☐ No ☑

If so, please include a copy of the analysis with this form.

If not, do you consider the water as: Good ☑ Acceptable ☐ Poor ☐ Unusable ☐

TFN 6 2/025

REC'D 09-20-19

Scanned, 02/28/2020

U 40 36783

13. TABULATION

a. If for irrigation, the land proposed to be irrigated should be described in the following tabulation. Describe in the "Remarks" section, under Item 14, the means of conveying the water to the lands and the method of irrigation.

(Give irrigable acreage in each legal subdivision. If proposed use is for supplemental supply for lands with a right from another source, indicate in the tabulation the priority or permit number, the source of supply and the name of the ditch or other well.)

b. If not used for irrigation, show the area and point(s) of use and location of well in the tabulation below. Also describe the method of conveyance in the "Remarks" section under Item 14.

Town-ship	Range	Sec.	NE¼				NW¼				SW¼				SE¼				TOTALS
			NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	

TOTAL NUMBER OF ACRES TO BE IRRIGATED_____

Original Supply_____**acres**

Supplemental Supply_____**acres**

14. PLAT

a. If the well is to be used for irrigation, industrial, miscellaneous or municipal use, show the location of the well on the plat below. For such uses, a plat certified by a licensed engineer or land surveyor is required to be submitted at the time the Proof of Appropriation and Beneficial Use of Ground Water is submitted.

b. **For other uses, accurately show the well location, point of use or uses and describe method of conveyance of water to points of use on plat and in "Remarks" section below. Make certain location on plat agrees with written description.**

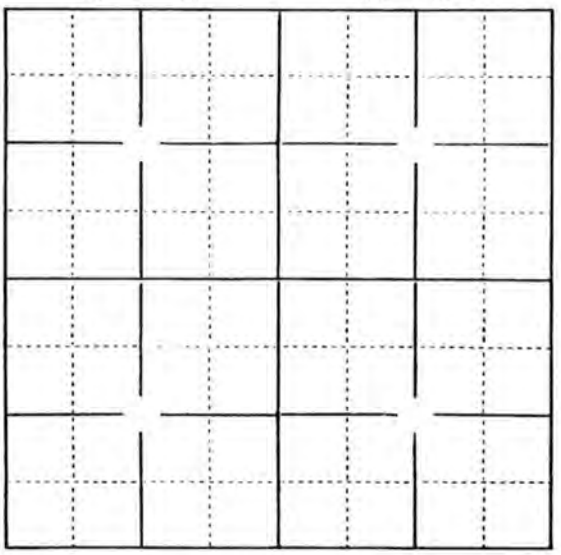
c. **A separate map may be submitted if the information required cannot be shown on this plat.**

R._____W. R._____W.

Scale: 2" = 1 Mile

T._____N.

T._____N.



REMARKS: _____

TFN 8 37025
RECD 09-20-19

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U W 36783

15. **IF WELL IS TO BE ABANDONED,** complete Items 1 through 8, Item 12 (Log of Well) and state reason for abandonment below.

It is the responsibility of the owner to properly plug or fill in the well in order to prevent contamination of ground water and to cover or cap the well at ground level.

Under penalties of perjury, I declare that I have examined this form and to the best of my knowledge and belief it is true, correct and complete.

Carol Stewart DBA Stewart Drilling — June 10, 1977
Signature of Owner or Authorized Agent — Date

JUL 1 1977 SR

Date of Receipt _____, 19____

Date of Priority Mar 28, 1977

Date of Approval July 18, 1977

for State Engineer

TFN 6 2/025
RECD 09-20-19

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RECEIVED JAN 15 1980 STATE ENGINEER Cheyenne, Wyo.

Form U.W. 6

NOTE: Do not fold this form. Use typewriter or print neatly with black ink.

IF WELL IS TO BE ABANDONED, SEE ITEM 15, PAGE 4

STATE OF WYOMING

OFFICE OF THE STATE ENGINEER

MICRO-FILMED APR 23 '80

STATEMENT OF COMPLETION AND DESCRIPTION OF WELL

PERMIT NO. U.W. 41136 NAME OF WELL N-5 #2

1. NAME OF OWNER Flying V Cattle Company
2. ADDRESS Box 65 Manchester, Wyoming Zip Code 82839
3. USE OF WATER: Domestic ☒ Stock Watering ☒ Irrigation ☐ Municipal ☐ Industrial ☐ Miscellaneous ☐
4. LOCATION OF WELL: NW ¼ SW ¼ of Section 15, T. 57 N., R. 85 W., of the 6th P.M. (or W.R.M.), Wyoming, being specifically _____ (Bearing and Distance) or 330 ft. ~~North~~ South and 990 ft. ~~East~~ West from the W 1/4 corner of Section 15, T. 57 N., R. 85 W. (Strike out words not needed).
5. TYPE OF CONSTRUCTION: Drilled ☒ Rotary (Type of Rig) Dug ☐ Driven ☐ Jetted ☐
   Other _____
6. CONSTRUCTION: Total Depth 100 ft. Depth to Water Level ~~75~~ 26' ft. upon completion 25 80 gpm.
   a. Casing Schedule New ☒ Used ☐
   5" diameter from 0 ft. to 100 ft. Material PVC Gage _____
   _____ diameter from _____ ft. to _____ ft. Material _____ Gage _____
   _____ diameter from _____ ft. to _____ ft. Material _____ Gage _____
   b. Perforations: Type of perforator used saw - slotted;
   Size of perforations 1/8 inches by 2 inches.
   Number of perforations and depths where perforated:
   100 perforations from 76 ft. to 84 feet.
   _____ perforations from _____ ft. to _____ feet.
   c. Was well screen installed? Yes ☐ No ☒
   Diameter: _____ slot size: _____ set from _____ feet to _____ feet.
   Diameter: _____ slot size: _____ set from _____ feet to _____ feet.
   d. Was well gravel packed? Yes ☐ No ☒ Size of gravel _____
   e. Was surface casing used Yes ☐ No ☒ Was it cemented in place? Yes ☒ No ☐
7. NAME & ADDRESS OF DRILLER Peter Kiewit Sons' Co.
8. DATE OF COMPLETION OF WELL (including pump installation) November 10th, 1979
9. PUMP INFORMATION: Manufacturer Gould Type Submersible
   Source of power electricity Horsepower 1/2 Depth of Pump Setting 74
   Amount of Water Being Pumped 5 Gallons Per Minute.

Permit No. U.W. 41136 Book No. 219 Page No. 71

TFN 6 2/025

DEQ Ex. 2-395

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UW 41136

10. **PUMP TEST: Was a pump test made? Yes ☒ No ☐**

If so, by whom Flying V Cattle Company **Address** Box 65 Ranchester, Wyoming 82839

Yield: 5 **gal./min. with** 70 **foot drawdown after** 48 **hours.**

Yield: _____ **gal./min. with** _____ **foot drawdown after** _____ **hours.**

11. **FLOWING WELL (Owner is responsible for control of flowing well).**

If well yields artesian flow, yield is _____ **gal./min. Surface pressure is** _____ **lb./sq. inch, or** _____ **feet of water.**

The flow is controlled by: valve ☐ cap ☐ plug ☐

Does well leak around casing? Yes ☐ No ☐

12. **LOG OF WELL: Total depth drilled** 100 **feet.**

Depth of completed well 100 **feet. Diameter of well** 5 **inches.**

Depth to first water bearing formation 76 **feet.**

Depth to principal water bearing formation Top 76 **feet to Bottom** 84 **feet.**

Ground Elevation, if known _____

From Feet	To Feet	Material Type, Texture, Color	REMARKS (Cementing, Shutoff, Packing, etc.)	Indicate Water Bearing Formation	Indicate Perforated Casing Location
0	3	Gravel			
3	8.5	Sand			
8.5	10.5	gravel			
10.5	28	Brown Shale			
28	37.5	Shale - gray			
37.5	39	Sandstone			
48	50	Coal			
50	56	Shale Gray			
56	58	Coal			
58	65.5	Shale - Gray			
65.5	67	Sandstone - hard			
67	76	Sandy Shale - Gray	Packer placed at 74'		
76	84	Sand - soft			
84	100	Shale - Gray			

QUALITY OF WATER INFORMATION:

Was a chemical analysis made? Yes ☒ No ☐

If so, please include a copy of the analysis with this form.

If not, do you consider the water as: Good ☒ Acceptable ☐ Poor ☐ Unusable ☐

TFN 6 3/025
RECD 09-20-19

DEQ Ex. 2-396

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U W. 41136

13. TABULATION

a. If for irrigation, the land proposed to be irrigated should be described in the following tabulation. Describe in the "Remarks" section, under Item 14, the means of conveying the water to the lands and the method of irrigation.

(Give irrigable acreage in each legal subdivision. If proposed use is for supplemental supply for lands with a right from another source, indicate in the tabulation the priority or permit number, the source of supply and the name of the ditch or other well.)

b. If not used for irrigation, show the area and point(s) of use and location of well in the tabulation below. Also describe the method of conveyance in the "Remarks" section under Item 14.

Town-ship	Range	Sec.	NE¼				NW¼				SW¼				SE¼				TOTALS
			NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	

TOTAL NUMBER OF ACRES TO BE IRRIGATED_____

Original Supply_____acres

Supplemental Supply_____acres

14. PLAT

a. If the well is to be used for irrigation, industrial, miscellaneous or municipal use, show the location of the well on the plat below. For such uses, a plat certified by a licensed engineer or land surveyor is required to be submitted at the time the Proof of Appropriation and Beneficial Use of Ground Water is submitted.

b. For other uses, accurately show the well location, point of use or uses and describe method of conveyance of water to points of use on plat and in "Remarks" section below. Make certain location on plat agrees with written description.

c. A separate map may be submitted if the information required cannot be shown on this plat.

R. 33 W. R._____W.

Scale: 2" = 1 Mile

T. 21 N. 15

T._____N.

REMARKS: _____

TFN 8 21025
RECD 09-20-19

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U.W 41136

15. **IF WELL IS TO BE ABANDONED,** complete Items 1 through 8, Item 12 (Log of Well) and state reason for abandonment below.

It is the responsibility of the owner to properly plug or fill in the well in order to prevent contamination of ground water and to cover or cap the well at ground level.

Under penalties of perjury, I declare that I have examined this form and to the best of my knowledge and belief it is true, correct and complete.

FLYING V CATTLE COMPANY

By: [signature]
Signature of Owner or Authorized Agent

November 25, 1979
Date

Cathy Fickell
My Commission Expires Apr. 7, 1981

Date of Receipt ~~JAN 10 1980~~ JAN 15 1980

Date of Priority October 20, 1977

Date of Approval February 29, 1980

[signature]
for State Engineer

TFN 2/025
REC'D 09-20-19

RAMACO

Brook Mine

M

Form U.W. 7
**Completed Prior to May 24, 1969 ☒

NOTE: Do not fold this form. Use typewriter or ball point pen.

STATE OF WYOMING

OFFICE OF THE STATE ENGINEER

STATEMENT OF COMPLETION AND DESCRIPTION OF WELL

for Domestic or Stock Watering Use Only

A preferred water right is given to such use when the yield or flow does not exceed .056 cubic feet per second or 25 gallons per minute. Domestic use refers to household use and the watering of lawns and gardens for family use, not to exceed one acre.

Permit No. U.W. 4715 Temporary Filing No. 3-6-350

Water Division No. 2 (6)

U.W. District Sheridan County

Name of Well Buyck No. 1

IF WELL IS TO BE ABANDONED, SEE ITEM 21

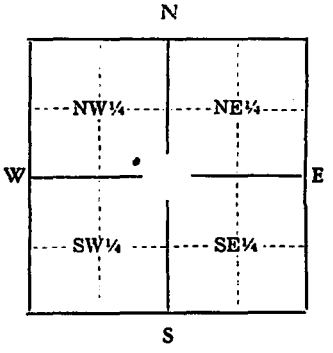
1. Owner Buyck Ranch
2. Address Acme Wyo 82830
3. Agent to receive correspondence Annie Buyck
4. Name & address of driller Carl Ritola (Owner) 929 S Main ST Sheridan Wyo
5. Well is constructed on lands owned by Buyck Ranch
(Obtaining of easement or right of way is the responsibility of the applicant's. Include copy if land is privately owned and owner is not a co-applicant.)
6. Type of construction: Dug ☐ Drilled ☒ _____ Type of Rig
Driven ☐ Jet ☐ Other
7. Use of Water—Domestic ☒ Stock ☐
8. Means of conveyance, distance and direction to point of use
9. Date started Sept, 19 53
10. Date completed Sept 26, 19 53 (including pump)
11. Date after completion when water was used Sept 26, 1953
12. WELL DESCRIPTION
Total Depth 126 ft Depth to Static Water Level
13. TEST DATA
Yield Not available How Tested
Drawdown not available Length of Test not available
14. PUMP DATA
Type Centrifugal (Turbine, Centrifugal, etc.) Power Source Elec. (Elec., Gas, etc.)
Horsepower 1½ Yield 15 (Gallons per Minute)
15. CASING RECORD
Plain Casing
Size 6" Kind STD Black Pipe from 20 ft. to ft.
Size 4" Kind STD Black Casing from ft. to ft.
Size 3" Kind from ft. to ft.
Perforated Casing
Size 3" Kind STD Pipe from ft. to ft.
Size Kind from ft. to ft.
16. CONSTRUCTION Unknown, driller is deceased so or former owner
Was surface seal provided? Yes ☐ No ☐ To What Depth Material used:
Was surface casing used? Yes ☐ No ☐ Was it cemented in place? Yes ☐ No ☐
17. FLOWING WELL (Owner is responsible for installing control device on flowing well.)
Controlled by: Valve ☐ Cap ☐ Plug ☐ Does well leak around casing? Yes ☐ No ☐

WELL LOCATION

Sheridan County

SE ¼ of NW ¼ of Sec. 19

T. 57 N., R. 84 W.



Scale: 2" = 1 mile

Above diagram represents one full section. Locate well accurately in small square representing 40 ac.
or
if the above does not apply fill in the following:

Lot Block

City, Town or Subdivision:

(Include filing or number)

**For wells constructed after May 24, 1969, Application Form U.W. 5 must be submitted prior to construction.

Permit No. U.W. 4715 Book No. 28 Page No. 162

THE MILLS COMPANY, SHERIDAN 124861

TFN 6 2/025

DEQ Ex. 2-399

RAMACO Brook Mine

18. Ground Elevation, if known _____ U.W. 4715

19. LOG OF WELL—Clearly indicate first water bearing material and principal water bearing material.

~~From~~ Feet	To Feet	Material Type, Texture, Color	REMARKS (Cementing, Shutoff, Packing, etc.)	Indicate Water Bearing Formation	Indicate Perforated Casing Location
9	9	yellow Clay			
5	14	Sandy Clay			
5	19	Gravel			
17	36	Blue shale			
3	39	Sandstone			
21	60	Blue shale			
3	63	Coal			
11	74	Blue shale			
1	75	Rock			
10	85	Blue shale			
7	92	Coal with Water bearing			
1	93	Blue shale			
2	100	Rock			
5	105	Blue shale			
7	112	Sand Rock			
2	114	Blue shale			
1	115	Hard rock			
5	120	Blue shale			
1	121	Coal with Water Bearing			

20. QUALITY OF WATER INFORMATION

Was a chemical analysis made? Yes ☐ No ☐ not available

If so, please include a copy of the analysis with this form.

If not, do you consider the water as: Good ☐ Acceptable ☒ Poor ☐ Unusable ☐

Was a bacteriological analysis made? Yes ☐ No ☐ not available

If a domestic well, was the well disinfected by the driller? Yes ☐ No ☐ not available

21. IF WELL IS TO BE ABANDONED, complete Items 1 through 6, Item 10 and Item 19 (Log of Well) and state reason for abandonment below.

It is the responsibility of the owner to properly plug or fill in the well in order to prevent contamination of ground water and to cover or cap the well at ground level.

REMARKS: _____

(Signed) Anna Buyak
(Owner)

THE STATE OF WYOMING
County of Sheridan } ss.

I hereby certify that the foregoing statement was signed in my presence and sworn to before me by Anna Buyak this 13 day of Feb., 1970

My Commission expires April 9, 1970

My Commission Expires _____, 19____ Kenneth W. Wolk
Notary Public

Date of Receipt: Sy Ross February 16, 1970 Date of Priority: September 26, 1953

Date of Approval: 28 February, 1970

Sylvia H. Ross
for State Engineer

SCANNED NOV 04 2011

TFN 6 2/025

RECD 09-20-19

DEQ Ex. 2-400

SCANNED 02/28/2020

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RECEIVED OCT 27 1981 STATE ENGINEER Cheyenne, Wyo.

Form U.W. 6

NOTE: Do not fold this form. Use typewriter or print neatly with black ink.

IF WELL IS TO BE ABANDONED, SEE ITEM 15, PAGE 4

STATE OF WYOMING

OFFICE OF THE STATE ENGINEER

MICRO FILMED SEP 15 '87
MICRO FILMED NOV 25 '81

STATEMENT OF COMPLETION AND DESCRIPTION OF WELL

SCANNED SEP 26 2012

PERMIT NO. U.W. 52707 NAME OF WELL LF-1

1. NAME OF OWNER Sheridan Enterprises Inc.
2. ADDRESS ~~P. O. Box 6025, Sheridan, Wyoming~~ Zip Code 82801
   751 HORIZON COURT, GRAND JUNCTION, CO 81506
3. USE OF WATER: Domestic ☐ Stock Watering ☐ Irrigation ☐ Municipal ☐ Industrial ☐ Miscellaneous ☒
   Ground Water Monitoring
4. LOCATION OF WELL: SE ¼ SW ¼ of Section 14, T. 57 N., R. 85 W., of the 6th P.M. (or W.R.M.),
   Wyoming, being specifically S45°53'35"E 2849.77' (Bearing and Distance)
   ~~N.S.~~ ft. ~~E.W.~~ ft. ~~N.S.~~ ~~E.W.~~ from the W¼ corner of Section 14, T. 57 N., R. 85 W.
   (Strike out words not needed).
5. TYPE OF CONSTRUCTION: Drilled ☒ CME S-5 Auger (Type of Rig) Dug ☐ Driven ☐ Jetted ☐
   Other
6. CONSTRUCTION: Total Depth of Well 25.25 ft. Depth to Static Water Level 9.30 ft.
   a. Casing Schedule New ☒ Used ☐
   3" diameter from 0 ft. to 25.25 ft. Material PVC Gage Sch.40
   diameter from ft. to ft. Material Gage
   diameter from ft. to ft. Material Gage
   b. Perforations: Type of perforator used Saw slots
   Size of perforations .05 inches by 2 inches.
   Number of perforations and depths where perforated:
   122 perforations from 13 ft. to 25.25 feet.
   perforations from ft. to feet.
   c. Was well screen installed? Yes ☐ No ☒
   Diameter: slot size: set from feet to feet.
   Diameter: slot size: set from feet to feet.
   d. Was well gravel packed? Yes ☒ No ☐ Size of gravel Pea gravel
   e. Was surface casing used Yes ☐ No ☒ Was it cemented in place? Yes ☐ No ☐
7. NAME & ADDRESS OF DRILLER Custom Auger Drilling Service, Inc., 5611 W. Bates Denver, Colorado 80227
8. DATE OF COMPLETION OF WELL (including pump installation) July 10, 1980
9. PUMP INFORMATION: Manufacturer N/A Type
   Source of power Horsepower Depth of Pump Setting
   Amount of Water Being Pumped 0 Gallons Per Minute. (For springs or flowing wells, see item 11.)

Permit No. U.W. 52707

TFN 5 2/025 RECD 09-20-19

Book No. 307 Page No. 39

Scanned, 02/28/2020

U.W. 52707

10. **PUMP TEST:** Was a pump test made? Yes ☐ No XX

If so, by whom_____ Address_____

Yield: _____gal./min. with_____ foot drawdown after_____hours.

Yield: _____gal./min. with_____ foot drawdown after_____hours.

11. **FLOWING WELL** (Owner is responsible for control of flowing well). N/A

If well yields artesian flow, yield is_____gal./min. Surface pressure is_____lb./sq. inch, or_____feet of water.

The flow is controlled by: valve ☐ cap ☐ plug ☐

Does well leak around casing? Yes ☐ No ☐

12. **LOG OF WELL:** Total depth drilled_____feet. (see attached log)

Depth of completed well_____feet. Diameter of well_____inches.

Depth to first water bearing formation_____feet.

Depth to principal water bearing formation Top_____feet to Bottom_____feet.

Ground Elevation, if known 3689.20

(see attached boring log)

From Feet	To Feet	Material Type, Texture, Color	REMARKS (Cementing, Shutoff, Packing, etc.)	Indicate Water Bearing Formation	Indicate Perforated Casing Location
(see attached log)					

QUALITY OF WATER INFORMATION:

Was a chemical analysis made? Yes ☒ No ☐ See attached table

If so, please include a copy of the analysis with this form.

If not, do you consider the water as: Good ☐ Acceptable ☐ Poor ☐ Unusable ☐

TFN 6 2/025

REC'D 09-20-19

Sheridan Enterprises Inc. HW MICRO: NOV 25 '81
PROJECT: Coal Loadout Facility 5276 BC LF-1
LOCATION: Sheridan, Wyoming
COORDINATES N. E. ELEV. PAGE 1 OF 1

ELEVATION DEPTH	GRAPHIC LOG	SOIL CLASSIFICATION	SAMPLES	STANDARD PENETRATION RESISTANCE (BLOWS/FT)	WATER CONTENT (%)	DESCRIPTION OF SOILS
		cl				Clay, medium brown, with a trace of fine sand.
5				27		Water content increases.
10		gm		32		Gravel coarse, white to off white, in a yellow to orange fine to medium sandy and silty matrix.
15				19		
20				10		
		Bed-rock				Bedrock, soft, probably weathered.
25						Bedrock becomes more competent. Medium gray shale.
30						Boring completed at 29 ft. on 1-10-80, 25 ft. 3 in. of 3-inch PVC casing installed in boring.

RECEIVED OCT 29 1981 STATE ENGINEER Cheyenne, Wyo.

LOG OF BORING

GEO-HYDRO CONSULTING, INC.

PLATE

Scanned, 02/28/2020

FEB 5 2020 RECD 09-20-19

Scanned, 02/28/2020

U W 52707

13. TABULATION

a. If for irrigation, the land proposed to be irrigated should be described in the following tabulation. Describe in the "Remarks" section, under Item 14, the means of conveying the water to the lands and the method of irrigation.

(Give irrigable acreage in each legal subdivision. If proposed use is for supplemental supply for lands with a right from another source, indicate in the tabulation the priority or permit number, the source of supply and the name of the ditch or other well.)

b. If not used for irrigation, show the area and point(s) of use and location of well in the tabulation below. Also describe the method of conveyance in the "Remarks" section under Item 14.

Township	Range	Sec.	NE¼				NW¼				SW¼				SE¼				TOTALS
			NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	
57N	85W	14												X					1

TOTAL NUMBER OF ACRES TO BE IRRIGATED_____

Original Supply_____**acres**

Supplemental Supply_____**acres**

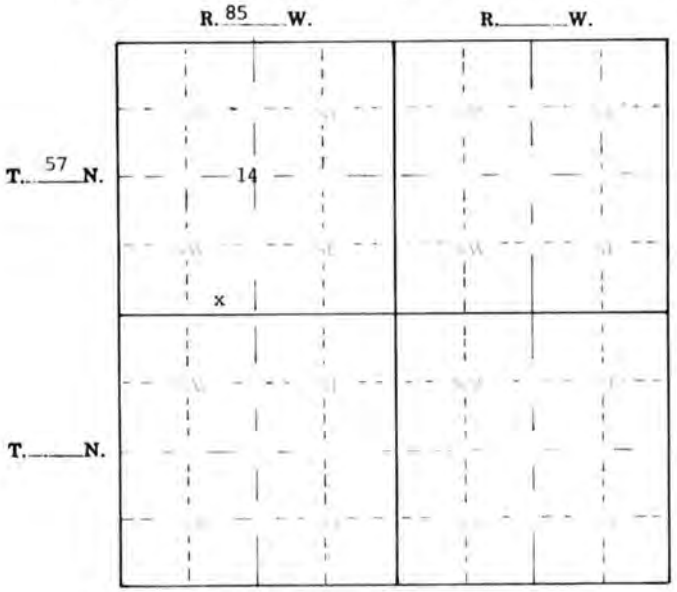
14. PLAT

a. If the well is to be used for irrigation, industrial, miscellaneous or municipal use, show the location of the well on the plat below. For such uses, a plat certified by a licensed engineer or land surveyor is required to be submitted at the time the Proof of Appropriation and Beneficial Use of Ground Water is submitted.

b. For other uses, accurately show the well location, point of use or uses and describe method of conveyance of water to points of use on plat and in "Remarks" section below. Make certain location on plat agrees with written description.

c. A separate map may be submitted if the information required cannot be shown on this plat.

Scale: 2" = 1 Mile



REMARKS:

TFN & 2/025
REC'D 09-20-19

Scanned, 02/28/2020

U.W. 52707

15. **IF WELL IS TO BE ABANDONED,** complete Items 1 through 8, Item 12 (Log of Well) and state reason for abandonment below.

It is the responsibility of the owner to properly plug or fill in the well in order to prevent contamination of ground water and to cover or cap the well at ground level.

Under penalties of perjury, I declare that I have examined this form and to the best of my knowledge and belief it is true, correct and complete.

John L. Wright
Signature of Owner or Authorized Agent

28 October, 19 81
Date

MD.

Date of Receipt OCT 29 1981, 19____

Date of Priority ~~APR 7 1980~~, 19____

Date of Approval November 3, 19 81

for State Engineer

TFN 6 2/025
RECD 09-20-19

Scanned, 02/28/2020

Form U.W. 6

NOTE: Do not fold this form. Use typewriter or print neatly with black ink.

IF WELL IS TO BE ABANDONED, SEE ITEM 15, PAGE 4

STATE OF WYOMING

OFFICE OF THE STATE ENGINEER

FILMED SEP 15 '87

MICRO-FILMED NOV 25 '81

STATEMENT OF COMPLETION AND DESCRIPTION OF WELL

SCANNED SEP 26 2012

PERMIT NO. U.W. 52706 NAME OF WELL LF-2

1. NAME OF OWNER Sheridan Enterprises Inc.
2. ADDRESS P. O. Box 6025, Sheridan, Wyoming Zip Code 82801
   751 HORIZON COURT; GRAND JUNCTION, CO 82506
3. USE OF WATER: Domestic ☐ Stock Watering ☐ Irrigation ☐ Municipal ☐ Industrial ☐ Miscellaneous ☒
   Ground Water Monitoring
4. LOCATION OF WELL: SE ¼ SW ¼ of Section 14, T. 57 N., R. 85 W., of the 6th P.M. (or W.R.M.), Wyoming, being specifically S52°38'24"E 2525.36' (Bearing and Distance)
   ~~¼ ¼ North South and ¼ ¼ East West~~ from the W¼ corner of Section 14, T. 57 N., R. 85 W. (Strike out words not needed).
5. TYPE OF CONSTRUCTION: Drilled ☒ CME S-5 Auger (Type of Rig) Dug ☐ Driven ☐ Jetted ☐
   Other
6. CONSTRUCTION: Total Depth of Well 28.25 ft. Depth to Static Water Level 25.2 ft.
   a. Casing Schedule New ☒ Used ☐
   3" diameter from 0 ft. to 28.25 ft. Material PVC Gage Sch.40
   diameter from ft. to ft. Material Gage
   diameter from ft. to ft. Material Gage
   b. Perforations: Type of perforator used Saw slots
   Size of perforations .05 inches by 2 inches.
   Number of perforations and depths where perforated:
   152 perforations from 13 ft. to 28.25 feet.
   perforations from ft. to feet.
   c. Was well screen installed? Yes ☐ No ☒
   Diameter: slot size: set from feet to feet.
   Diameter: slot size: set from feet to feet.
   d. Was well gravel packed? Yes ☒ No ☐ Size of gravel Pea gravel
   e. Was surface casing used Yes ☐ No ☒ Was it cemented in place? Yes ☐ No ☐
7. NAME & ADDRESS OF DRILLER Custom Auger Drilling Service, Inc., 5611 W. Bates Denver, Colorado 80227
8. DATE OF COMPLETION OF WELL (including pump installation) July 10, 1980
9. PUMP INFORMATION: Manufacturer N/A Type
   Source of power Horsepower Depth of Pump Setting
   Amount of Water Being Pumped 0 Gallons Per Minute. (For springs or flowing wells, see item 11.)

Permit No. U.W. 52706 Book No. 307 Page No. 40

TFN 6 2/025

RECD 09-20-19

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U.W. 52708

10. **PUMP TEST:** Was a pump test made? Yes ☐ No X

If so, by whom_____ Address_____

Yield: _____gal./min. with_____ foot drawdown after_____hours.

Yield: _____gal./min with_____ foot drawdown after_____hours.

11. **FLOWING WELL** (Owner is responsible for control of flowing well). N/A

If well yields artesian flow, yield is_____gal./min. Surface pressure is_____lb./sq. inch, or_____feet of water.

The flow is controlled by: valve ☐ cap ☐ plug ☐

Does well leak around casing? Yes ☐ No ☐

12. **LOG OF WELL:** Total depth drilled_____feet. (see attached log)

Depth of completed well_____feet. Diameter of well_____inches.

Depth to first water bearing formation_____feet.

Depth to principal water bearing formation Top_____feet to Bottom_____feet.

Ground Elevation, if known 3702.10

(see attached boring log)

From Feet	To Feet	Material Type, Texture, Color	REMARKS (Cementing, Shutoff, Packing, etc.)	Indicate Water Bearing Formation	Indicate Perforated Casing Location
(see attached boring log)					

QUALITY OF WATER INFORMATION:

Was a chemical analysis made? Yes XX ☐ No ☐ (see attached Table)

If so, please include a copy of the analysis with this form.

If not, do you consider the water as: Good ☐ Acceptable ☐ Poor ☐ Unusable ☐

TFN 6 2/025
RECD 09-20-19

DEQ Ex. 2-407

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CLIENT: Sheridan Enterprises Inc. GW-52708 MICRO FILMED NOV 25 '81

PROJECT: Coal Loadout Facility BORING: LF-2

LOCATION: Sheridan, Wyoming

COORDINATES N ____ E ____ ELEV. ____ PAGE 1 OF 2

ELEVATION DEPTH	GRAPHIC LOG	SOIL CLASSIFICATION	SAMPLES	STANDARD PENETRATION RESISTANCE (BLOWS/FT)	WATER CONTENT (%)	DESCRIPTION OF SOILS
		CL				Clay, medium brown, with a trace of fine sand, medium stiff.
5					10.5	Grades very stiff and slightly calcareous with minor white stringers. Light brown to grayish.
				33		
10				31		
15		ml				Fine sandy silt. Light brown.
				38		
20		cl		32		Light brown clay. Increase in water content, probably top of water.
25						
		gm				Coarse sandy gravel with some silt. Gravel is whitish with light brown matrix. Dense.
30				33		
35						

RECEIVED

LOG OF BORING

GEO-HYDRO CONSULTING, INC.

PLATE

TFN 6 2/025
RECD 09-20-19

Scanned, 02/28/2020

OWNER: Sheridan Enterprises Inc.

MICRO-FILMED NOV 25 '81

PROJECT: Coal Loadout Facility

BORING NO. LF-2

LOCATION: Sheridan, Wyoming

COORDINATES N ____ E ____ ELEV. ____

PAGE 2 OF 2

ELEVATION	DEPTH	GRAPHIC LOG	SOIL CLASSIFICATION	SAMPLES	STANDARD PENETRATION RESISTANCE (BLOWS/FT)	WATER CONTENT (%)	DESCRIPTION OF SOILS
			Bed-rock				Weathered bedrock.
	45						Competent bedrock. Boring completed at 47 ft. on 1-9-80, 28 ft. 3 in. of 3-inch PVC casing installed in boring.

HW 52708

LOG OF BORING

GEO-HYDRO CONSULTING, INC.

PLATE

TFN 6 2/025
RECD 09-20-19

Scanned, 02/28/2020

U.W. 52708

13. TABULATION

a. If for irrigation, the land proposed to be irrigated should be described in the following tabulation. Describe in the "Remarks" section, under Item 14, the means of conveying the water to the lands and the method of irrigation.

(Give irrigable acreage in each legal subdivision. If proposed use is for supplemental supply for lands with a right from another source, indicate in the tabulation the priority or permit number, the source of supply and the name of the ditch or other well.)

b. If not used for irrigation, show the area and point(s) of use and location of well in the tabulation below. Also describe the method of conveyance in the "Remarks" section under Item 14.

Township	Range	Sec.	NE¼				NW¼				SW¼				SE¼				TOTALS
			NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	
57N	85W	14												X					1

TOTAL NUMBER OF ACRES TO BE IRRIGATED_____

Original Supply_____**acres**

Supplemental Supply_____**acres**

14. PLAT

a. If the well is to be used for irrigation, industrial, miscellaneous or municipal use, show the location of the well on the plat below. For such uses, a plat certified by a licensed engineer or land surveyor is required to be submitted at the time the Proof of Appropriation and Beneficial Use of Ground Water is submitted.

b. For other uses, accurately show the well location, point of use or uses and describe method of conveyance of water to points of use on plat and in "Remarks" section below. Make certain location on plat agrees with written description.

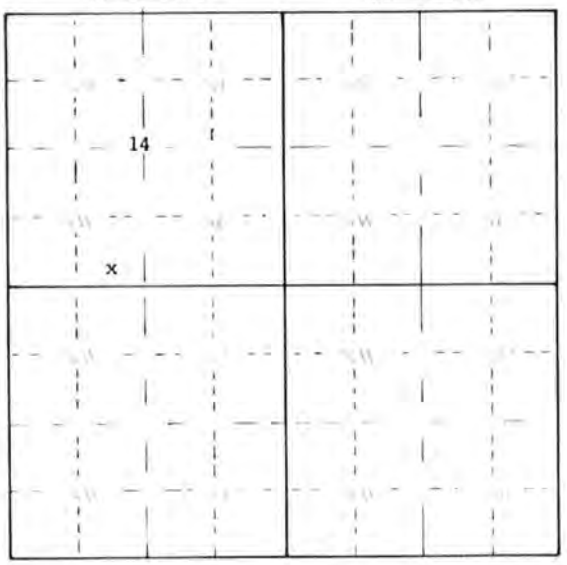
c. A separate map may be submitted if the information required cannot be shown on this plat.

R. 85 **W.** **R.**_____**W.**

Scale: 2" = 1 Mile

T. 57 **N.**

T._____**N.**



TFN 6 2/025
RECD 09-20-19

REMARKS:

DEQ Ex. 2-410

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U.W. 52708

15. **IF WELL IS TO BE ABANDONED**, complete Items 1 through 8, Item 12 (Log of Well) and state reason for abandonment below.

It is the responsibility of the owner to properly plug or fill in the well in order to prevent contamination of ground water and to cover or cap the well at ground level.

Under penalties of perjury, I declare that I have examined this form and to the best of my knowledge and belief it is true, correct and complete.

John L. Wright
Signature of Owner or Authorized Agent

28 October, 19 81
Date

Date of Receipt OCT 2 [illegible] M.D., 19____

Date of Priority [illegible] 1980, 19____

Date of Approval November 3, 19 81

Earl D. Montgomery
for State Engineer

TFN 6 2/025
RECD 09-20-19

Scanned, 02/28/2020

RECEIVED OCT 29 1981
MICRO-FILMED NOV 25 81
SCANNED SEP 26 2012

Form U.W. 6

NOTE: Do not fold this form. Use typewriter or print neatly with black ink.

IF WELL IS TO BE ABANDONED, SEE ITEM 15, PAGE 4

STATE OF WYOMING

OFFICE OF THE STATE ENGINEER

STATEMENT OF COMPLETION AND DESCRIPTION OF WELL

PERMIT NO. U.W. 52711 NAME OF WELL LF-5

1. NAME OF OWNER Sheridan Enterprises Inc.
2. ADDRESS P. O. Box 6025, Sheridan, Wyoming Zip Code 82801
   751 HORIZON COURT; GRAND JUNCTION, CO 81506
3. USE OF WATER: Domestic ☐ Stock Watering ☐ Irrigation ☐ Municipal ☐ Industrial ☐ Miscellaneous ☒
   Ground Water Monitoring
4. LOCATION OF WELL: SE ¼ SW ¼ of Section 14, T. 57 N., R. 85 W., of the 6th P.M. (or W.R.M.),
   Wyoming, being specifically N45°31'10"W 2168.57' (Bearing and Distance)
   or ~~fx NNW NNE SSW SSE NW NE SW SE~~ from the W¼ corner of Section 14, T. 57 N., R. 85 W.
   (Strike out words not needed).
5. TYPE OF CONSTRUCTION: Drilled ☒ CME S-5 Auger (Type of Rig) Dug ☐ Driven ☐ Jetted ☐
   Other
6. CONSTRUCTION: Total Depth of Well 17.5 ft. Depth to Static Water Level 4.75 ft.
   a. Casing Schedule New ☒ Used ☐
   3" diameter from 0 ft. to 17.5 ft. Material PVC Gage Sch.40
   diameter from ft. to ft. Material Gage
   diameter from ft. to ft. Material Gage
   b. Perforations: Type of perforator used Saw slots
   Size of perforations .05 inches by 2 inches.
   Number of perforations and depths where perforated:
   100 perforations from 7.5 ft. to 17.5 feet.
   perforations from ft. to feet.
   c. Was well screen installed? Yes ☐ No ☒
   Diameter: slot size: set from feet to feet.
   Diameter: slot size: set from feet to feet.
   d. Was well gravel packed? Yes ☒ No ☐ Size of gravel Pea gravel
   e. Was surface casing used Yes ☐ No ☒ Was it cemented in place? Yes ☐ No ☐
7. NAME & ADDRESS OF DRILLER Custom Auger Drilling Service, Inc., 5611 W. Bates
   Denver, Colorado 80227
8. DATE OF COMPLETION OF WELL (including pump installation) July 11, 1980
9. PUMP INFORMATION: Manufacturer N/A Type
   Source of power Horsepower Depth of Pump Setting
   Amount of Water Being Pumped 0 Gallons Per Minute. (For springs or flowing wells, see item 11.)

Permit No. U.W 52711 TFN 6 2/025 RECD 09-20-19 Book No. 307 Page No. 13

DEQ Ex. 2-412

Scanned, 02/28/2020

U.W. 52211

10. **PUMP TEST:** Was a pump test made? Yes ☐ No ☒

If so, by whom_____ Address_____

Yield: _____gal./min. with_____ foot drawdown after_____hours.

Yield: _____gal./min. with_____ foot drawdown after_____hours.

11. **FLOWING WELL** (Owner is responsible for control of flowing well). N/A

If well yields artesian flow, yield is_____gal./min. Surface pressure is_____lb./sq. inch, or_____feet of water.

The flow is controlled by: valve ☐ cap ☐ plug ☐

Does well leak around casing? Yes ☐ No ☐

12. **LOG OF WELL:** Total depth drilled_____feet. (see attached log)

Depth of completed well_____feet. Diameter of well_____inches.

Depth to first water bearing formation_____feet.

Depth to principal water bearing formation Top_____feet to Bottom_____feet.

Ground Elevation, if known 3682.4

(See attached log)

From Feet	To Feet	Material Type, Texture, Color	REMARKS (Cementing, Shutoff, Packing, etc.)	Indicate Water Bearing Formation	Indicate Perforated Casing Location
(see attached log)					

QUALITY OF WATER INFORMATION:

Was a chemical analysis made? Yes ☒ No ☐

If so, please include a copy of the analysis with this form.

If not, do you consider the water as: Good ☐ Acceptable ☐ Poor ☐ Unusable ☐

TFN 6 2/025
RECD 09-20-19

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Sheridan Enterprises

MICRO FILMED NOV 25 '8

PROJECT Coal Loadout Facility BORING NO 1B-5

LOCATION Sheridan, Wyoming

COORDINATES N. E. ELEV. PAGE 1 OF 1

UW 52711

ELEVATION DEPTH	GRAPHIC LOG	SOIL CLASSIFICATION	SAMPLES	STANDARD PENETRATION RESISTANCE (BLOWS/FT.)	WATER CONTENT (%)	DESCRIPTION OF SOILS
		cl				Clay with a trace of fine sand, soft.
5					28.7	Fine sandy silt.
		sp				Sand, medium to coarse grained. Medium brown with multi-colored grains, loose becomes gravelly.
		sm				Silty fine sand with some gravel, medium brown, loose.
10				8		
				50		
15		gm				Coarse gravel with some medium brown fine sand and silt.
						Bedrock.
20						
25						
30						
35				43		Siltstone, light to medium gray, soft. Boring completed at 35.5 ft. on 1-8-80, approximately 17 ft. 6 in. of 3-inch PVC casing installed in boring.

RECEIVED OCT 29 1981 STATE ENGINEER Cheyenne, Wyo.

LOG OF BORING

GEO-HYDRO CONSULTING, INC.

PLATE

TFN 6 2/025
RECD 09-20-19

DEQ Ex. 2-414

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U.W. 52711

13. TABULATION

a. If for irrigation, the land proposed to be irrigated should be described in the following tabulation. Describe in the "Remarks" section, under Item 14, the means of conveying the water to the lands and the method of irrigation.

(Give irrigable acreage in each legal subdivision. If proposed use is for supplemental supply for lands with a right from another source, indicate in the tabulation the priority or permit number, the source of supply and the name of the ditch or other well.)

b. If not used for irrigation, show the area and point(s) of use and location of well in the tabulation below. Also describe the method of conveyance in the "Remarks" section under Item 14.

Township	Range	Sec.	NE¼				NW¼				SW¼				SE¼				TOTALS
			NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	
57N	85W	14												X					1

TOTAL NUMBER OF ACRES TO BE IRRIGATED_____

Original Supply_____acres

Supplemental Supply_____acres

14. PLAT

a. If the well is to be used for irrigation, industrial, miscellaneous or municipal use, show the location of the well on the plat below. For such uses, a plat certified by a licensed engineer or land surveyor is required to be submitted at the time the Proof of Appropriation and Beneficial Use of Ground Water is submitted.

b. For other uses, accurately show the well location, point of use or uses and describe method of conveyance of water to points of use on plat and in "Remarks" section below. Make certain location on plat agrees with written description.

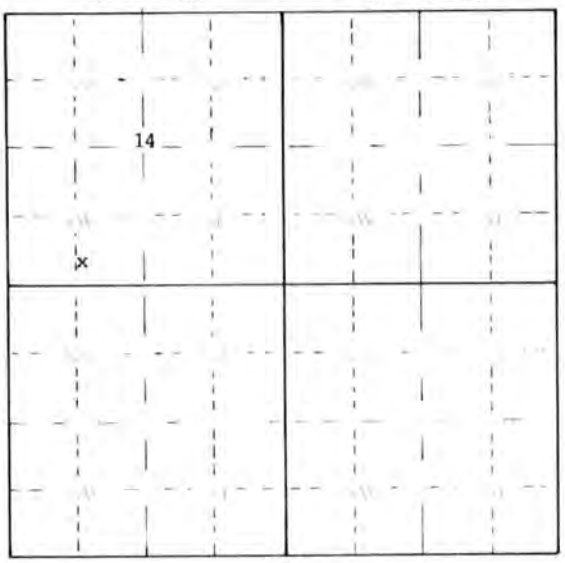
c. A separate map may be submitted if the information required cannot be shown on this plat.

R. 85 W. R.____W.

Scale: 2" = 1 Mile

T. 57 N.

T.____N.



TFM 6 2/025
RECD 09-20-19

REMARKS:

DEQ Ex. 2-415

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U.W. 52711

15. **IF WELL IS TO BE ABANDONED**, complete Items 1 through 8, Item 12 (Log of Well) and state reason for abandonment below.

It is the responsibility of the owner to properly plug or fill in the well in order to prevent contamination of ground water and to cover or cap the well at ground level.

Under penalties of perjury, I declare that I have examined this form and to the best of my knowledge and belief it is true, correct and complete.

John L. Wright
Signature of Owner or Authorized Agent

28 October, 19 81
Date

Date of Receipt OCT 29 1981 TMJ, 19____

Date of Priority APR 1980, 19____

Date of Approval November 3, 19 81

for State Engineer

TFN 6 2/625
RECD 09-20-19

Scanned, 02/28/2020

RAMACO Brook Mine

RECEIVED OCT 29 1981 STATE ENGINEER CHEYENNE, WYO.

V
MICRO FILMED Sep 15 '87
MICRO FILMED NOV 25 '81

Form U.W. 6

NOTE: Do not fold this form. Use typewriter or print neatly with black ink.

SCANNED SEP 26 2012

IF WELL IS TO BE ABANDONED, SEE ITEM 15, PAGE 4

STATE OF WYOMING

OFFICE OF THE STATE ENGINEER

STATEMENT OF COMPLETION AND DESCRIPTION OF WELL

PERMIT NO. U.W. 52712 NAME OF WELL LF-9

1. NAME OF OWNER Sheridan Enterprises
2. ADDRESS P. O. Box 6025, Sheridan, Wyoming Zip Code 82801
   751 HORIZON COURT; GRAND JUNCTION, CO 81506
3. USE OF WATER: Domestic ☐ Stock Watering ☐ Irrigation ☐ Municipal ☐ Industrial ☐ Miscellaneous ☒
   Ground Water Monitoring
4. LOCATION OF WELL: NW ¼ SW ¼ of Section 14, T. 57 N., R. 85 W., of the 6th P.M. (or W.R.M.), Wyoming, being specifically N40°15'37"W 1601.91' (Bearing and Distance)
   of ~~XX ¼ ¼ Northx ¼ ¼ Southx~~ ~~XX ft. ~~East~~ ~~Westx~~ from the W½ corner of Section 14, T. 57 N., R. 85 W.
   (Strike out words not needed).
5. TYPE OF CONSTRUCTION: Drilled ☒ CME S-5 Auger (Type of Rig) Dug ☐ Driven ☐ Jetted ☐
   Other
6. CONSTRUCTION: Total Depth of Well 42.25 ft. Depth to Static Water Level 19.1 ft.
   a. Casing Schedule New ☒ Used ☐
   2" diameter from 0 ft. to 42.25 ft. Material PVC Gage Sch.40
   diameter from ft. to ft. Material Gage
   diameter from ft. to ft. Material Gage
   b. Perforations: Type of perforator used Saw slots
   Size of perforations .05 inches by 2 inches.
   Number of perforations and depths where perforated:
   100 perforations from 22 ft. to 42.25 feet.
   perforations from ft. to feet.
   c. Was well screen installed? Yes ☐ No ☒
   Diameter: slot size: set from feet to feet.
   Diameter: slot size: set from feet to feet.
   d. Was well gravel packed? Yes ☒ No ☐ Size of gravel Pea gravel
   e. Was surface casing used Yes ☐ No ☒ Was it cemented in place? Yes ☐ No ☐
7. NAME & ADDRESS OF DRILLER Custom Auger Drilling Service, Inc., 5611 W. Bates Denver, Colorado 80227
8. DATE OF COMPLETION OF WELL (including pump installation) July 11, 1980
9. PUMP INFORMATION: Manufacturer N/A Type
   Source of power Horsepower Depth of Pump Setting
   Amount of Water Being Pumped Gallons Per Minute. (For springs or flowing wells, see item 11.)

Permit No. U.W. 52712 TFN 8 2/625 Book No. 307 Page No. 47

RECD 08-20-19

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4.W.52215

10. PUMP TEST: Was a pump test made? Yes ☐ No X

If so, by whom_____ Address_____

Yield: _____gal./min. with_____ foot drawdown after_____hours.

Yield: _____gal./min. with_____ foot drawdown after_____hours.

11. FLOWING WELL (Owner is responsible for control of flowing well). N/A

If well yields artesian flow, yield is_____gal./min. Surface pressure is_____lb./sq. inch, or_____feet of water.

The flow is controlled by: valve ☐ cap ☐ plug ☐

Does well leak around casing? Yes ☐ No ☐

12. LOG OF WELL: Total depth drilled_____feet. (see attached log)

Depth of completed well_____feet. Diameter of well_____inches.

Depth to first water bearing formation_____feet.

Depth to principal water bearing formation Top_____feet to Bottom_____feet.

Ground Elevation, if known_____

(See attached log)

From Feet	To Feet	Material Type, Texture, Color	REMARKS (Cementing, Shutoff, Packing, etc.)	Indicate Water Bearing Formation	Indicate Perforated Casing Location
(see attached log)					

QUALITY OF WATER INFORMATION:

Was a chemical analysis made? Yes ☒ No ☐

If so, please include a copy of the analysis with this form.

If not, do you consider the water as: Good ☐ Acceptable ☐ Poor ☐ Unusable ☐

TFN 8 2/025
RECD 09-20-19

DEQ Ex. 2-418

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NOV 25 81

PROJECT: Sheridan Enterprises
Coal Loadout Facility
LOCATION: Sheridan, Wyoming
COORDINATES N. ____ E. ____ ELEV. ____
BORING NO. LF-9
PAGE 1 OF 2

ELEVATION	DEPTH	GRAPHIC LOG	SOIL CLASSIFICATION	SAMPLES	STANDARD PENETRATION RESISTANCE (BLOWS/FT.)	WATER CONTENT (%)	DESCRIPTION OF SOILS
			cl/ch				Clay, medium brown, with trace of fine sand. Soft.
	5				4		
							Grades medium stiff.
	10				9		
			CH				
	15				11		
	20		gm		11		Whitish gravel in medium brown matrix. Gravel and sand are interlayered.
	25						
	30						Bedrock, soft, probably weathered.
	35						Bedrock becomes more competent.

UW 53715

RECEIVED OCT 30 1981 STATE ENGINEER Cheyenne, Wyo.

LOG OF BORING

GEO-HYDRO CONSULTING, INC.

PLATE

TFN 8 2/625
RECD 09-20-19

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Sheridan Enterprises

PROJECT Coal Loadout Facility BORING NO LF-9

LOCATION Sheridan, Wyoming

COORDINATES N ____ E ____ ELEV ____ PAGE 2 OF 2

ELEVATION	DEPTH	GRAPHIC LOG	SOIL CLASSIFICATION	SAMPLES	STANDARD PENETRATION RESISTANCE (BLOWS/FT.)	WATER CONTENT (%)	DESCRIPTION OF SOILS
	45						Boring completed at 43 ft. on 1-10-80, 42 ft. 3 in. of 2-inch PVC casing installed in boring.
	50						
	55						
	60						
	65						
	70						
	75						

LOG OF BORING

GEO-HYDRO CONSULTING, INC.

PLATE

RECEIVED OCT 29 1981 STATE ENGINEER Cheyenne, Wyo.

TFN 6 2/625
RECD 09-20-19

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U.W. 52715

13. TABULATION

a. If for irrigation, the land proposed to be irrigated should be described in the following tabulation. Describe in the "Remarks" section, under Item 14, the means of conveying the water to the lands and the method of irrigation.

(Give irrigable acreage in each legal subdivision. If proposed use is for supplemental supply for lands with a right from another source, indicate in the tabulation the priority or permit number, the source of supply and the name of the ditch or other well.)

b. If not used for irrigation, show the area and point(s) of use and location of well in the tabulation below. Also describe the method of conveyance in the "Remarks" section under Item 14.

Township	Range	Sec.	NE¼				NW¼				SW¼				SE¼				TOTALS
			NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	
57N	85W	14										X							1

TOTAL NUMBER OF ACRES TO BE IRRIGATED_____

Original Supply_____acres

Supplemental Supply_____acres

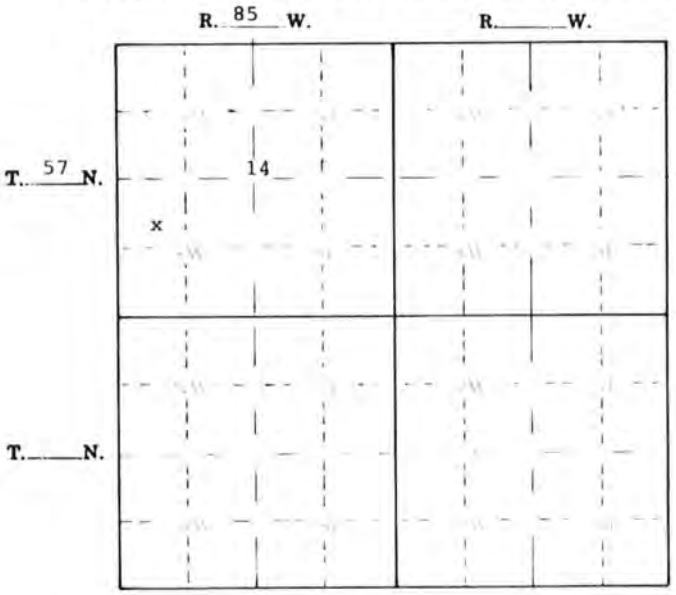
14. PLAT

a. If the well is to be used for irrigation, industrial, miscellaneous or municipal use, show the location of the well on the plat below. For such uses, a plat certified by a licensed engineer or land surveyor is required to be submitted at the time the Proof of Appropriation and Beneficial Use of Ground Water is submitted.

b. For other uses, accurately show the well location, point of use or uses and describe method of conveyance of water to points of use on plat and in "Remarks" section below. Make certain location on plat agrees with written description.

c. A separate map may be submitted if the information required cannot be shown on this plat.

Scale: 2" = 1 Mile



TFN 8 2/625
RECD 08-20-19

REMARKS:

DEQ Ex. 2-421

Scanned, 02/28/2020

U.W. 52715

15. **IF WELL IS TO BE ABANDONED,** complete Items 1 through 8, Item 12 (Log of Well) and state reason for abandonment below.

It is the responsibility of the owner to properly plug or fill in the well in order to prevent contamination of ground water and to cover or cap the well at ground level.

Under penalties of perjury, I declare that I have examined this form and to the best of my knowledge and belief it is true, correct and complete.

John L. Wright
Signature of Owner or Authorized Agent

28 October, 19 81
Date

Date of Receipt OCT 29 1981 YMD, 19____

Date of Priority APR 7 1980, 19____

Date of Approval November 3, 19 81

Robert R. Montgomery
for State Engineer

TFW E 21025
RECD 09-20-19

DEQ Ex. 2-422

Scanned, 02/28/2020

Form U.W. 6
Rev. 2-83

STATE OF WYOMING

OFFICE OF THE STATE ENGINEER

SCANNED FEB - 1 2013
MICRO FILMED JUL 27 '83

IF WELL IS TO BE ABANDONED, SEE ITEM 15, PAGE 4

STATEMENT OF COMPLETION AND DESCRIPTION OF WELL

NOTE: Do not fold this form. Use typewriter or print neatly with black ink.

PERMIT NO. U.W. 63975 NAME OF WELL Addleman #2

1. NAME OF OWNER Lawrence E. Addleman
2. ADDRESS Box 104 Ranchester Wyo. Zip Code 82839
3. USE OF WATER: Domestic X Stock Watering ☐ Irrigation ☐ Municipal ☐ Industrial ☐ Miscellaneous ☐
4. LOCATION OF WELL: S.E. ¼ NE ¼ of Section 24, T. 57 N., R. 85 W., of the 6th P.M. (or W.R.M.), Wyoming, being specifically (Bearing and Distance) or 250 ft. ~~North~~ South and 700 ft. ~~East~~ West from the corner of Section 24, T. 57 N., R. 85 W. (Strike out words not needed)
5. TYPE OF CONSTRUCTION: Drilled ☐ Cable Tool (Type of Rig) Dug ☐ Driven ☒ Jetted ☐
   Other
6. CONSTRUCTION: Total Depth of Well 120 ft. Depth to Static Water Level ~~40~~ 15 ft. Per letter 7/6/83
   a. Casing Schedule New ☒ Used ☐
   4 in. Galvanized diameter from 0 ft. to 110 ft. Material Gage
   diameter from ft. to ft. Material Gage
   diameter from ft. to ft. Material Gage
   b. Perforations: Type of perforator used None
   Size of perforations inches by inches.
   Number of perforations and depths where perforated:
   perforations from ft. to feet.
   perforations from ft. to feet.
   c. Was well screen installed? Yes ☐ No ☒
   Diameter: slot size: set from feet to feet.
   Diameter: slot size: set from feet to feet.
   d. Was well gravel packed? Yes ☒ No ☐ Size of gravel
   e. Was surface casing used? Yes ☒ No ☐ Was it cemented in place? Yes ☐ No ☒
7. NAME & ADDRESS OF DRILLER Leys Water Well Drilling And Service Inc. 2014 Hickory Ave, Sheridan Wyo 82801
8. DATE OF COMPLETION OF WELL (including pump installation) 6/1/1983
9. PUMP INFORMATION: Manufacturer Aermotor Type Submersable
   Source of power 220 volt M.D.U. Horsepower ½ Depth of Pump Setting ~~100' to 102'~~ 107 Per letter 7-6-83
   Amount of Water Being Pumped 10 to 12 gpm Gallons Per Minute. (For springs or flowing wells, see item 11.)

RECEIVED JUN 14 1993 STATE ENGINEER Cheyenne, Wyo.

Permit No. U.W. 63975 Book No. 420 Page No. 6

TFR 5 27025

DECD 08-20-19

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UW63975

10. PUMP TEST: Was a pump test made? Yes X No

If so, by whom Leys Water Well Drilling Address Sheridan Wyo

Yield: _____ gal./min. with _____ foot drawdown after _____ hours.

Yield: _____ gal./min. with _____ foot drawdown after _____ hours.

11. FLOWING WELL (Owner is responsible for control of flowing well).

If well yields artesian flow, yield is _____ gal./min. Surface pressure is _____ lb./sq. inch, or _____ feet of water.

The flow is controlled by: valve ☐ cap ☐ plug ☐

Does well leak around casing? Yes ☐ No ☐

12. LOG OF WELL: Total depth drilled 120 feet.

Depth of completed well 110 feet. Diameter of well 4 in inches.

Depth to first water bearing formation 100 feet.

Depth to principal water bearing formation. Top 100 feet to Bottom 120 feet.

Ground Elevation, if known _____

From Feet	To Feet	Material Type, Texture, Color	REMARKS (Cementing, Shutoff, Packing, etc.)	Indicate Water Bearing Formation	Indicate Perforated Casing Location
0	2	Top Soil			
2	7	Sandy Clay			
7	17	Gravel			
17	26	Dark Clay			
26	28	Coal			
28	42	Blue Clay			
42	44	Rock			
44	67	Blue Clay			
67	74	Coal			
74	76	Blue Clay			
76	87	Sandy Blue Clay			
87	88	Rock			
88	115	Blue Clay			
115	119	Coal			
119	120	Blue Clay			

QUALITY OF WATER INFORMATION:

Was a chemical analysis made? Yes ☐ No ☐

If so, please include a copy of the analysis with this form.

If not, do you consider the water as: Good ☐ Acceptable ☐ Poor ☐ Unusable ☐

TFN S 21625
RECD 09-20-19

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L/W. 63925

13. TABULATION

a. If for irrigation, the land proposed to be irrigated should be described in the following tabulation. Describe in the "Remarks" section, under Item 14, the means of conveying the water to the lands and the method of irrigation.

(Give irrigable acreage in each legal subdivision. If proposed use is for additional supply for lands with a right from another source, indicate in the tabulation the priority or permit number, the source of supply and the name of the ditch or other well.)

b. If not used for irrigation, show the area and point(s) of use and location of well in the tabulation below. Also describe the method of conveyance in the "Remarks" section under Item 14.

Town Ship	Range	Sec	NE¼				NW¼				SW¼				SE¼				TOTALS
			NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	

TOTAL NUMBER OF ACRES TO BE IRRIGATED _____

Original Supply _____ acres

Additional Supply _____ acres

14. PLAT

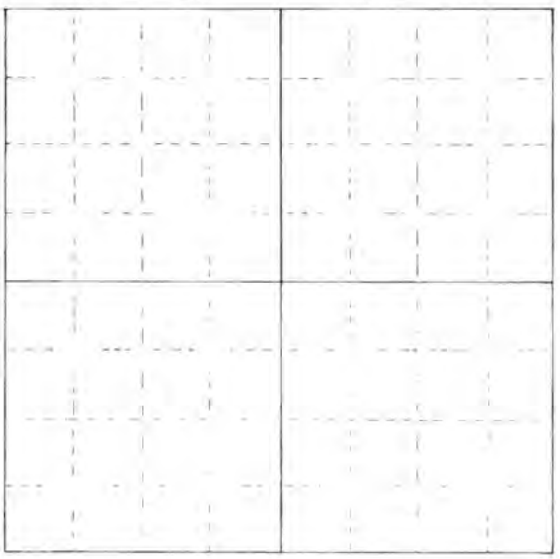
a. If the well is to be used for irrigation, industrial, miscellaneous or municipal use, show the location of the well on the plat below. For such uses, a plat certified by a licensed engineer or land surveyor is required to be submitted at the time the Proof of Appropriation and Beneficial Use of Ground Water is submitted.

b. For other uses, accurately show the well location, point of use or uses and describe method of conveyance of water to points of use on plat and in "Remarks" section below. Make certain location on plat agrees with written description.

c. A separate map may be submitted if the information required cannot be shown on this plat.

R._____W. R._____W.

Scale: 2" = 1 Mile



T._____N.

T._____N.

TFN 6 2/625
RECD 09-20-19

REMARKS: _____

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U.W. 63975

15. IF WELL IS TO BE ABANDONED, complete Items 1 through 8, Item 12 (Log of Well) and state reason for abandonment and details of the plugging below.

It is the responsibility of the owner to properly plug or fill in the well in order to prevent contamination of ground water and to cover or cap the well at ground level.

Under penalties of perjury, I declare that I have examined this form and to the best of my knowledge and belief it is true, correct and complete.

Lawrence E. Pittsinger — June 10, 1983

Signature of Owner or Authorized Agent — Date

AN

Date of Receipt JUN 14 1983, 19

Date of Priority May 9, 19 83

Date of Approval July 15, 19 83

for State Engineer

TFN 8 2/625
RECD 09-20-19

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RAMACO

Brook Mine

SCANNED JAN 07 2011

Form U.W. 6
Rev 2-83

STATE OF WYOMING

OFFICE OF THE STATE ENGINEER

MICRO FILMED FEB 1 '84

IF WELL IS TO BE ABANDONED, SEE ITEM 15, PAGE 4

STATEMENT OF COMPLETION AND DESCRIPTION OF WELL

NOTE: Do not fold this form. Use typewriter or print neatly with black ink.

PERMIT NO. U.W. 65492 NAME OF WELL Bocek No 1

1. NAME OF OWNER Tony Bocek

2. ADDRESS ACME STAR RTE RANCHESTER WYO. Zip Code 82839

3. USE OF WATER: Domestic X Stock Watering ( ) Irrigation ( ) Municipal ( ) Industrial ( ) Miscellaneous ( )

4. LOCATION OF WELL NW ¼ NE ¼ of Section 19, T. 57 N., R. 84 W., of the 6th P.M. (or W.R.M.), Wyoming, being specifically _____ (Bearing and Distance)

or _____ ft. North/South and _____ ft. East/West from the _____ corner of Section _____, T. _____ N., R. _____ W.
(Strike out words not needed)

5. TYPE OF CONSTRUCTION: Drilled ( ) CABLE TOOL (Type of Rig) Dug ( ) Driven X Jetted ( )

Other _____

6. CONSTRUCTION: Total Depth of Well 200 ft. Depth to Static Water Level ARTISAN FLOW ft.

a. Casing Schedule New X Used ( )

6" diameter from 0 ft. to 29 ft. Material Iron Gage ~~Sch 40~~ .280

4" diameter from 0 ft. to 105 ft. Material Iron Gage .250

2½ diameter from 105 ft. to 200 ft. Material Iron Gage .250

b. Perforations: Type of perforator used Torch

Size of perforations ½ inches by 6 inches.

Number of perforations and depths where perforated:

40 perforations from 105 ft. to 125 feet.

40 perforations from 170 ft. to 190 feet.

RECEIVED DEC 21 1983 State Engineer Cheyenne, Wyo.

c. Was well screen installed? Yes ( ) No X

Diameter: _____ slot size: _____ set from _____ feet to _____ feet.

Diameter: _____ slot size: _____ set from _____ feet to _____ feet.

d. Was well gravel packed? Yes ( ) No X Size of gravel _____

e. Was surface casing used? Yes X No ( ) Was it cemented in place? Yes X ~~No~~

7. NAME & ADDRESS OF DRILLER LEV DRILLING 2014 HICKORY AVE SHERIDAN WYO 82801

8. DATE OF COMPLETION OF WELL (including pump installation) 11-28-83

9. PUMP INFORMATION: Manufacturer AER MOTOR PUMP Type 8D-5-33-110V Submersible

Source of power MCDL Elec. Horsepower ½ Depth of Pump Setting 103'

Amount of Water Being Pumped 4 Gallons Per Minute. (For springs or flowing wells, see item 11.)

Permit No. U.W. 65492 Book No. 135 Page No. 23

TFR 5 21625
BFD 08-20-19

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U.W. 65492

10. PUMP TEST: Was a pump test made? Yes ☒ No ☒

If so, by whom Applicant Address

Yield: gal./min. with foot drawdown after hours.

Yield: gal./min. with foot drawdown after hours.

11. FLOWING WELL (Owner is responsible for control of flowing well)

If well yields artesian flow, yield is 4 gal./min. Surface pressure is lb./sq. inch, or feet of water.

The flow is controlled by: valve ☒ cap ☐ plug ☐

Does well leak around casing? Yes No ☒

12. LOG OF WELL: Total depth drilled 200 feet.

Depth of completed well 200 feet. Diameter of well 4 inches.

Depth to first water bearing formation 18 feet.

Depth to principal water bearing formation. Top 105 feet to Bottom 187 feet.

Ground Elevation, if known

From Feet	To Feet	Material Type, Texture, Color	REMARKS (Cementing, Shutoff, Packing, etc.)	Indicate Water Bearing Formation	Indicate Perforated Casing Location
0	4	top soil			
4	18	yellow sandy clay			
18	26	gravel			
26	49	blue clay			
49	57	coal			
57	65	blue clay			
65	69	dark clay			
69	70	blue clay			
70	71	rock			
71	88	sandy blue clay			
88	90	dark clay			
90	106	blue clay			
106	108	sand -		water	
108	111	dark clay			
111	114	blue clay			
114	166	dark clay			
166	167	coal		water	
167	180	blue clay			
180	187	sandy blue clay			
187	200	blue clay			

QUALITY OF WATER INFORMATION:

Was a chemical analysis made? Yes No ☒

If so, please include a copy of the analysis with this form.

If not, do you consider the water as: Good ☒ Acceptable Poor Unusable

TFN 6 2/625
RECD 09-20-19

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U.W. 654/92

13. TABULATION

a. If for irrigation, the land proposed to be irrigated should be described in the following tabulation. Describe in the "Remarks" section, under Item 14, the means of conveying the water to the lands and the method of irrigation.

(Give irrigable acreage in each legal subdivision. If proposed use is for additional supply for lands with a right from another source, indicate in the tabulation the priority or permit number, the source of supply and the name of the ditch or other well.)

b. If not used for irrigation, show the area and point(s) of use and location of well in the tabulation below. Also describe the method of conveyance in the "Remarks" section under Item 14.

Town-Ship	Range	Sec	NE¼				NW¼				SW¼				SE¼				TOTALS
			NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	

TOTAL NUMBER OF ACRES TO BE IRRIGATED 0

Original Supply ____ acres

Additional Supply ____ acres

14. PLAT

a. If the well is to be used for irrigation, industrial, miscellaneous or municipal use, show the location of the well on the plat below. For such uses, a plat certified by a licensed engineer or land surveyor is required to be submitted at the time the Proof of Appropriation and Beneficial Use of Ground Water is submitted.

b. For other uses, accurately show the well location, point of use or uses and describe method of conveyance of water to points of use on plat and in "Remarks" section below. Make certain location on plat agrees with written description.

c. A separate map may be submitted if the information required cannot be shown on this plat.

R. ____ W. R. ____ W.

Scale: 2" = 1 Mile

T. N.

T. N.

REMARKS:

TFN 6 2/025

DEQ 08-30-19

DEQ Ex. 2-429

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U.W. 6542

15. IF WELL IS TO BE ABANDONED, complete Items 1 through 8, Item 12 (Log of Well) and state reason for abandonment and details of the plugging below.

It is the responsibility of the owner to properly plug or fill in the well in order to prevent contamination of ground water and to cover or cap the well at ground level.

Under penalties of perjury, I declare that I have examined this form and to the best of my knowledge and belief it is true, correct and complete.

Tony Brook
Signature of Owner or Authorized Agent

12-14 19 83
Date

Date of Receipt DEC 21 1987 M.H. , 19

Date of Priority Aug 25 , 19 83

Date of Approval January 25 , 19 84

Carla D. Montgomery
for State Engineer

TFN 6 2/625
RECD 09-20-19

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RAMACO Brook Mine

Form U.W. 6
Rev. 2-83

STATE OF WYOMING

OFFICE OF THE STATE ENGINEER

MICRO-FILMED JAN 9 '85

IF WELL IS TO BE ABANDONED, SEE ITEM 15, PAGE 4

STATEMENT OF COMPLETION AND DESCRIPTION OF WELL

NOTE: Do not fold this form. Use typewriter or print neatly with black ink.

PERMIT NO. U.W. 68201 NAME OF WELL Buyok Ranch No 2

1. NAME OF OWNER Buyok Ranch

2. ADDRESS Box 282, Star Rte, Acme, WY Zip Code 82839

3. USE OF WATER: Domestic ☒ Stock Watering ☐ Irrigation ☐ Municipal ☐ Industrial ☐ Miscellaneous ☐

4. LOCATION OF WELL: SE ¼ NW ¼ of Section 19, T. 57 N., R. 84 W., of the 6th P.M. (or W.R.M.), Wyoming, being specifically S 43°45' E and 3307 ft from the NW corner of Section (Bearing and Distance)

or 2388.9 ft. North-South and 2286.8 ft. East-West from the NW corner of Section 19, T. 57 N., R. 84 W. (Strike out words not needed).

5. TYPE OF CONSTRUCTION: Drilled ☒ Rotary (Type of Rig) Dug ☐ Driven ☐ Jetted ☐

Other

6. CONSTRUCTION: Total Depth of Well 70 ft. Depth to Static Water Level 55 ft.

a. Casing Schedule New ☒ Used ☐

6" diameter from 0 ft. to 20 ft. Material Steel Gage N/A

4" diameter from 20 ft. to 70 ft. Material PVC Plastic Gage N/A

_____ diameter from _____ ft. to _____ ft. Material _____ Gage _____

b. Perforations: Type of perforator used Circular Saw

Size of perforations 4 inches by 1/8 inches.

Number of perforations and depths where perforated:

12 perforations from 62 ft. to 70 feet.

_____ perforations from _____ ft. to _____ feet.

RECEIVED OCT 26 1984 STATE ENGINEER Cheyenne, Wyo.

c. Was well screen installed? Yes ☐ No ☒

Diameter: _____ slot size: _____ set from _____ feet to _____ feet.

Diameter: _____ slot size: _____ set from _____ feet to _____ feet.

d. Was well gravel packed? Yes ☒ No ☐ Size of gravel Pea gravel

e. Was surface casing used? Yes ☒ No ☐ Was it cemented in place? Yes ☐ No ☒

7. NAME & ADDRESS OF DRILLER Fleming Well Service, P.O. Box 455 Sheridan, Wyoming

8. DATE OF COMPLETION OF WELL (including pump installation) 9/28/84

9. PUMP INFORMATION: Manufacturer Monitor Type Submersible

Source of power Electric Horsepower 1/3 Depth of Pump Setting 65 ft

Amount of Water Being Pumped 8 Gallons Per Minute. (For springs or flowing wells, see Item 11.)

Permit No. U.W. 68201 Book No. 462 Page No. 32

TFN 6 2/025

10. PUMP TEST: Was a pump test made? Yes ☐ No ☒

If so, by whom _____ Address _____

Yield: _____ gal./min. with _____ foot drawdown after _____ hours.

Yield: _____ gal./min. with _____ foot drawdown after _____ hours.

11. FLOWING WELL (Owner is responsible for control of flowing well).

If well yields artesian flow, yield is _____ gal./min. Surface pressure is _____ lb./sq. inch, or _____ feet of water.

The flow is controlled by: valve ☐ cap ☐ plug ☐

Does well leak around casing? Yes ☐ No ☐

12. LOG OF WELL: Total depth drilled 70 feet.

Depth of completed well 70 feet. Diameter of well 4 inches.

Depth to first water bearing formation 55 feet.

Depth to principal water bearing formation. Top 62 feet to Bottom 70 feet.

Ground Elevation, if known N/A

From Feet	To Feet	Material Type, Texture, Color	REMARKS (Cementing, Shutoff, Packing, etc.)	Indicate Water Bearing Formation	Indicate Perforated Casing Location
0	20	Sandy Clay			
20	25	Shale			
25	26	Sandstone			
26	33	Shale			
33	37	Loose Shale			
37	42	Shale			
42	43	Sandstone			
43	44	Shale			
44	46	Sandstone			
46	47	Shale			
47	49	Sandstone			
49	55	Shale			
55	59	Loose Shale-Coal		X	
59	62	Shale			
62	70	Coal		Main Formation	Perforated casing

QUALITY OF WATER INFORMATION:

Was a chemical analysis made? Yes ☐ No ☒

If so, please include a copy of the analysis with this form.

If not, do you consider the water as: Good ☐ Acceptable ☒ Poor ☐ Unusable ☐

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13. TABULATION

a. If for irrigation, the land proposed to be irrigated should be described in the following tabulation. Describe in the "Remarks" section, under Item 14, the means of conveying the water to the lands and the method of irrigation.

(Give irrigable acreage in each legal subdivision. If proposed use is for additional supply for lands with a right from another source, indicate in the tabulation the priority or permit number, the source of supply and the name of the ditch or other well.)

b. If not used for irrigation, show the area and point(s) of use and location of well in the tabulation below. Also describe the method of conveyance in the "Remarks" section under Item 14.

Town-Ship	Range	Sec.	NE¼				NW¼				SW¼				SE¼				TOTALS
			NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	
57	84	19								X									

TOTAL NUMBER OF ACRES TO BE IRRIGATED 0

Original Supply _____ acres

Additional Supply _____ acres

14. PLAT

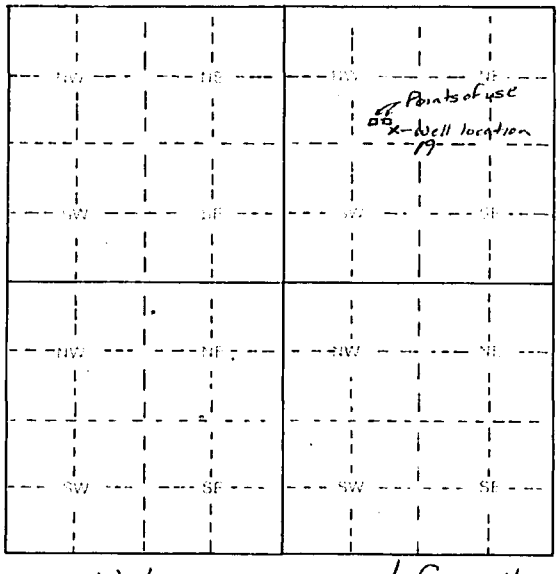
a. If the well is to be used for irrigation, industrial, miscellaneous or municipal use, show the location of the well on the plat below. For such uses, a plat certified by a licensed engineer or land surveyor is required to be submitted at the time the Proof of Appropriation and Beneficial Use of Ground Water is submitted.

b. For other uses, accurately show the well location, point of use or uses and describe method of conveyance of water to points of use on plat and in "Remarks" section below. Make certain location on plat agrees with written description.

c. A separate map may be submitted if the information required cannot be shown on this plat.

R.____W. R. 84 W.

Scale: 2" = 1 Mile



T. 57 N.

T.____N.

REMARKS: Water is conveyed from the well to a house and mobile home located north and west of the well for domestic use.

TFN 8 2/025
REC'D 09-20-19

DEQ Ex. 2-433

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15. IF WELL IS TO BE ABANDONED, complete Items 1 through 8, Item 12 (Log of Well) and state reason for abandonment and details of the plugging below.

It is the responsibility of the owner to properly plug or fill in the well in order to prevent contamination of ground water and to cover or cap the well at ground level.

Under penalties of perjury, I declare that I have examined this form and to the best of my knowledge and belief it is true, correct and complete.

Buyok Ranch Anna Buyok — Signature of Owner or Authorized Agent

10-24, 19 84 — Date

Date of Receipt OCT 26 1984 m.r., 19

Date of Priority Aug 15, 19 84

Date of Approval January 4, 19 85

for State Engineer

YFH 8 2/025
RECD 09-20-19

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Form U.W. 6
Rev. 2-83

STATE OF WYOMING

OFFICE OF THE STATE ENGINEER

IF WELL IS TO BE ABANDONED, SEE ITEM 15, PAGE 4

STATEMENT OF COMPLETION AND DESCRIPTION OF WELL

MICROFILMED JUL 9 '86

NOTE: Do not fold this form. Use typewriter or print neatly with black ink.

PERMIT NO. U.W. 71814 NAME OF WELL Legerski Ranch No 1

1. NAME OF OWNER Legerski Ranch
2. ADDRESS Box 6498 SHERIDAN WYOMING Zip Code 82801
3. USE OF WATER: Domestic X Stock Watering ( ) Irrigation ( ) Municipal ( ) Industrial ( ) Miscellaneous ( )
4. LOCATION OF WELL: NE¼ NW¼ of Section 24, T. 57 N., R. 85 W., of the 6th P.M. (or W.R.M.), Wyoming, being specifically (Bearing and Distance) or ±600 ft. ~~North~~ South and ±1400 ft. ~~West~~ East from the NW corner of Section 24, T. 57 N., R. 85 W. (Strike out words not needed)
5. TYPE OF CONSTRUCTION: Drilled X Rotary Air (Type of Rig) Dug ( ) Driven ( ) Jetted ( )

   Other
6. CONSTRUCTION: Total Depth of Well 140 ft. Depth to Static Water Level 70 ft.

   a. Casing Schedule New X Used ( )

   5" diameter from 0 ft. to 140 ft. Material PVC Gage

   diameter from ft. to ft. Material Gage

   diameter from ft. to ft. Material Gage

   b. Perforations: Type of perforator used DRILLED 1/4" dia

   Size of perforations inches by inches.

   Number of perforations and depths where perforated:

   50 perforations from 90 ft. to 100 feet.

   50 perforations from 115 ft. to 125 feet.

   c. Was well screen installed? Yes ( ) No X

   Diameter: slot size: set from feet to feet.

   Diameter: slot size: set from feet to feet.

   d. Was well gravel packed? Yes ( ) No X Size of gravel

   e. Was surface casing used? Yes X No ( ) Was it cemented in place? Yes ( ) No X
7. NAME & ADDRESS OF DRILLER KIEWIT MINING & ENGR. CO
8. DATE OF COMPLETION OF WELL (including pump installation) 3-26-86
9. PUMP INFORMATION: Manufacturer GOULD Type SUBM.

   Source of power ELECTRIC Horsepower 1/2 Depth of Pump Setting 130

   Amount of Water Being Pumped 15 Gallons Per Minute. (For springs or flowing wells, see item 11.)

RECEIVED APR 1 1986 STATE ENGINEER Cheyenne, Wyo.

Permit No. U.W. 71814 Book No. 498 Page No. 42

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RECD 09-20-19

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10. PUMP TEST: Was a pump test made? Yes X No

If so, by whom WALT PILCH Address BOX 6498 STANLEY

Yield: 15 gal./min. with 20 foot drawdown after 1/2 hours.

Yield: 10 gal./min. with 60 foot drawdown after 1 hours.

11. FLOWING WELL (Owner is responsible for control of flowing well).

If well yields artesian flow, yield is _____ gal./min. Surface pressure is _____ lb./sq. inch, or _____ feet of water

The flow is controlled by: valve [ ] cap [ ] plug [ ]

Does well leak around casing? Yes No [ ]

12. LOG OF WELL: Total depth drilled 140 feet.

Depth of completed well 140 feet. Diameter of well 5" inches.

Depth to first water bearing formation 90 feet.

Depth to principal water bearing formation. Top 90 feet to Bottom 100 feet.

Ground Elevation, if known NO

From Feet	To Feet	Material Type, Texture, Color	REMARKS (Cementing, Shutoff, Packing, etc.)	Indicate Water Bearing Formation	Indicate Perforated Casing Location
		SEE ATTACHED DRILL LOG			

QUALITY OF WATER INFORMATION:

Was a chemical analysis made? Yes X No

If so, please include a copy of the analysis with this form.

If not, do you consider the water as: Good Acceptable X Poor Unusable

TFN 6 27025
RECD 05-20-19

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Grou. 71814

KIEWIT MINING & ENGINEERING CO.

LITHOLOGY LOG

DATE 2-4-86

PROPERTY Legerski Ranch

PAGE No 2 of HOLE No. 1

DEPTH From— Feet Tenths	DEPTH To— Feet Tenths	Thickness of stratum Feet Tenths	Geologic formations; character of rock; oil, gas and water horizons; coal and other mineral occurrences
84.0	88.0	4.0	Shale - gray
88.0	89.0	1.0	Sandstone
89.0	93.0	4.0	Shale - gray
93.0	102.0	9.0	Coal
102.0	110.0	8.0	Shale - gray
110.0	111.5	1.5	Sandstone
111.5	119.0	7.5	Shale - gray
119.0	124.0	5.0	Coal
124.0	137.0	13.0	Shale - gray
137.0	138.0	1.0	Coal
138.0	140.0	2.0	Shale - gray
	140.0		TD
			Drilled 0-40' with 12¼" and set 40 LF of 8" PVC
			surface casing.
			Drilled 40-140' of 7 7/8" and set 140 LF of 5" PVC
			with Habiburton packer set at 65' and perforations
			at 90' to 100' and 115' to 125'.
			Well developing 15 gpm
			cc: Hydrology Department
			Big Horn Coal: L. Skretteberg, W. Pilch
			Static water level 20'

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TFN & 2/025
RECD 08-20-19

DEQ Ex. 2-437

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W.W. 71814

KIEWIT MINING & ENGINEERING CO.

LITHOLOGY LOG

Locate hole correctly, giving distance in feet from N. or S. and E. or W. line of section; when hole is not vertical, give direction and angle.

Property: Legerski Ranch HOLE No: 1

TYPE: Domestic WW

Lessee or permittee: Sean Carroll

Address:

Driller: Dean Fudge

Commenced drilling: 2-8-86 Finished: 2-9-86

Sec. ____ T ____ R ____ M ____ State ____

Method of drilling: Rotary Air Logged by: D. Fudge

Drilling fluid: Air - Water Inject

Surface Owner: Legerski Ranch (SIGNED)

DATE: 2-4-86 Page 1 of 2 (TITLE): Drilling Superintendent

DEPTH From— Feet Tenths	DEPTH To— Feet Tenths	Thickness of stratum Feet Tenths	Geologic formations, character of rock, oil, gas and water horizons; coal and other mineral occurrences
0.0	15.0	15.0	Topsoil and sand
15.0	19.0	4.0	Gravel
19.0	25.0	6.0	Shale - gray and sandy
25.0	26.0	1.0	Sandstone
26.0	31.0	5.0	Shale - blue/gray
31.0	32.0	1.0	Sandstone
32.0	39.0	7.0	Shale
39.0	55.0	16.0	Shale - with carbonaceous shale stringers
55.0	61.0	6.0	Shale - carbonaceous
61.0	62.0	1.0	Shale - gray
62.0	64.0	2.0	Coal
64.0	70.0	6.0	Shale - gray
70.0	71.5	1.5	Sandstone
71.5	77.0	5.5	Shale - dark gray
77.0	84.0	7.0	Sand - clay filled

QUICK PRINTING SHERIDAN (Attach continuation sheets if necessary)

TFN 5 2/025
RECD 09-20-19

DEQ Ex. 2-438

Scanned, 02/28/2020

13. TABULATION

a. If for irrigation, the land proposed to be irrigated should be described in the following tabulation. Describe in the "Remarks" section, under Item 14, the means of conveying the water to the lands and the method of irrigation.

(Give irrigable acreage in each legal subdivision. If proposed use is for additional supply for lands with a right from another source, indicate in the tabulation the priority or permit number, the source of supply and the name of the ditch or other well.)

b. If not used for irrigation, show the area and point(s) of use and location of well in the tabulation below. Also describe the method of conveyance in the "Remarks" section under Item 14.

Town Ship	Range	Sec	NE¼				NW¼				SW¼				SE¼				TOTALS
			NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	
57	85	24					X												

POINT OF USE IS FARM HOUSE ADJACENT TO WELL (±75')

TOTAL NUMBER OF ACRES TO BE IRRIGATED

Original Supply _____ acres

Additional Supply _____ acres

14. PLAT

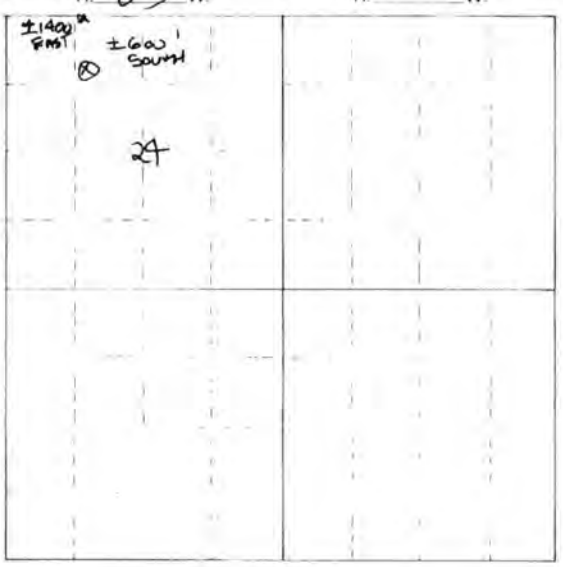
a. If the well is to be used for irrigation, industrial, miscellaneous or municipal use, show the location of the well on the plat below. For such uses, a plat certified by a licensed engineer or land surveyor is required to be submitted at the time the Proof of Appropriation and Beneficial Use of Ground Water is submitted.

b. For other uses, accurately show the well location, point of use or uses and describe method of conveyance of water to points of use on plat and in "Remarks" section below. Make certain location on plat agrees with written description.

c. A separate map may be submitted if the information required cannot be shown on this plat.

R. 85 W. R. _____ W.

Scale: 2" = 1 Mile



T. 57 N.

T. _____ N.

REMARKS:

TFN & 2/025
REC'D 08-20-19

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15. IF WELL IS TO BE ABANDONED, complete Items 1 through 8, Item 12 (Log of Well) and state reason for abandonment and details of the plugging below.

It is the responsibility of the owner to properly plug or fill in the well in order to prevent contamination of ground water and to cover or cap the well at ground level.

Under penalties of perjury, I declare that I have examined this form and to the best of my knowledge and belief it is true, correct and complete.

Signature of Owner or Authorized Agent: Walter J. Bilsh
Managing Partner
Legitimate Owner

Date: 4-1, 19 86

Date of Receipt APR 17 1986, 19

Date of Priority Feb 7, 19 86

Date of Approval June 24, 19 86

Bruce R. Breitman
for State Engineer

TFN 6 2/025
RECD 08-20-19

Scanned, 02/28/2020

SCANNED

Form U.W. 7

IF WELL IS TO BE ABANDONED, SEE ITEM 20

NOTE: Do not fold this form. Use typewriter or print neatly with black ink.

STATE OF WYOMING

OFFICE OF THE STATE ENGINEER

MICRO FILMED JAN

STATEMENT OF COMPLETION AND DESCRIPTION OF WELL

for Domestic or Stock Watering Use Only

A preferred water right is given to such use when the yield or flow does not exceed .056 cubic feet per second or 25 gallons per minute. Domestic use refers to household use and the watering of lawns and gardens for family use, not to exceed one acre.

Permit No. U.W. U.W. 7297 Temporary Filing No. _____

Water Division No. 2

U.W. District Sheridan County

**Completed Prior to May 24, 1969 ☐

NAME OF WELL Wishing No. 1 Well

1. Owner William Long
2. Address P. O. Box 192 Acme, Wyoming 82830
3. Agent to receive correspondence same
4. Name & address of driller Lee Garrett Big Horn, Wyoming 82833
5. Well is constructed on lands owned by William Long (Obtaining of easement or right of way is the responsibility of the applicant's. Include copy if land is privately owned and owner is not a co-applicant.)
6. Type of construction: Dug ☒ Drilled ☐ _____ Type of Rig
   Driven ☐ Jet ☐ Other Backhoe
7. Use of Water—Domestic ☒ Stock ☐
8. Means of conveyance, distance and direction to point of use
   1½" plastic pipeline from well to house
9. Date started Prior to 1 August, 19 71
10. Date completed 30 September, 19 72 (including pump)
11. Date after completion when water was used 30 September, 19 72
12. WELL DESCRIPTION
    Total Depth 14 Depth to Water Level 9½ ft.
13. TEST DATA
    Yield 25 How Tested pump
    Drawdown 3' Length of Test 2 hrs
14. PUMP DATA
    Type Centrifugal (Turbine, Centrifugal, etc.) Power Source Electric (Elec., Gas, etc.)
    Horsepower 1 Amount of Water Being Used 25 (Gallons per Minute)
15. CASING RECORD

Plain Casing

Size	Kind	from	ft. to	ft.
24"	cement	0	12	
22"	Stainless Steel	12	14	

Perforated Casing

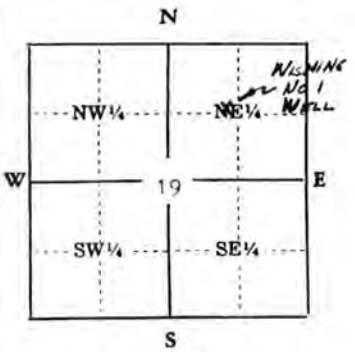
Size	Kind	from	ft. to	ft.
22"	Stainless Steel	12	14	

WELL LOCATION

Sheridan County

NW ¼ of NE ¼ of Sec. 19

T. 57 N., R. 84 W.



Scale: 2" = 1 mile

Above diagram represents one full section. Locate well accurately in small square representing 40 ac. or fill in the following:

Lot _____ & Block _____ or Tract _____

of the _____ (Subdivision or Addition)

of _____ (City, Town or County)

Section _____, T. _____ N., R. _____ W.

**For wells constructed after May 24, 1969, Application Form U.W. 5 must be submitted prior to construction.

Permit No. U.W. 7297 Book No. 41 Page No. 144

TFN 6 2/025
RECD 08-20-19

Scanned, 02/28/2020

U.W. 7297

*16. Was surface seal provided? Yes ☐ No ☒ To What Depth _____ Material used: _____
Was well gravel packed? Yes ☒ No ☐

17. FLOWING WELL (Owner is responsible for installing control device on flowing well.)
Does well flow? Yes ☐ No ☒
Flow controlled by: Valve ☐ Cap ☐ Plug ☐ Does well leak around casing? Yes ☐ No ☐

18. LOG OF WELL—Clearly indicate first water bearing material and principal water bearing material.

From Feet	To Feet	Material Type, Texture, Color	REMARKS (Cementing, Shutoff, Packing, etc.)	Indicate Water Bearing Formation	Indicate Perforated Casing Location
0	6	Soil			
6	8	Gravel and clay			
8	14	Sand and gravel	packed with 5 cu. yd. washed gravel	Water	perforated Stainless Steel ~~section~~ 12-14'
		Top = 9½			
		Bot = 14			
		1st = 9½			

19. QUALITY OF WATER INFORMATION
Was a chemical analysis made? Yes ☐ No ☒
If so, please include a copy of the analysis with this form.
If not, do you consider the water as: Good ☐ Acceptable ☒ Poor ☐ Unusable ☐
Was a bacteriological analysis made? Yes ☐ No ☒
If a domestic well, was the well disinfected by the driller? Yes ☐ No ☐

20. IF WELL IS TO BE ABANDONED, complete only Items 1 through 6, Item 10 and Item 18 (Log of Well) and state reason for abandonment below.
It is the responsibility of the owner to properly plug or fill in the well in order to prevent contamination of ground water and to cover or cap the well at ground level.

REMARKS: 16* PROVIDED EARTH FILL AROUND WELL 2' ABOVE NATURAL GROUND LEVEL FOR BETTER DRAINAGE

Under penalties of perjury, I declare that I have examined this form and to the best of my knowledge and belief it is true, correct and complete.

William Long
Signature of Owner or Authorized Agent

2 OCTOBER, 1972
Date

Date of Receipt: OCT 18 1972, 19____ Date of Priority: December 1, 1970

Norma Bridges

Date of Approval: Jan 3, 1973

Richard H. Stoddale
for State Engineer

TFN 6 2/025
RECD 09-20-19

Scanned, 02/28/2020

Form U.W. 6
Rev. 2-83

STATE OF WYOMING

OFFICE OF THE STATE ENGINEER

IF WELL IS TO BE ABANDONED, SEE ITEM 15, PAGE 4

STATEMENT OF COMPLETION AND DESCRIPTION OF WELL

SCANNED OCT 5 '87

NOTE: Do not fold this form. Use typewriter or print neatly with black ink.

PERMIT NO. U.W. 75113 NAME OF WELL Squires #1

1. NAME OF OWNER Betty L Squires
2. ADDRESS 307 Main St. Ranchester, Wy Zip Code 82839
3. USE OF WATER: Domestic ☑ Stock Watering ☐ Irrigation ☐ Municipal ☐ Industrial ☐ Miscellaneous ☐
4. LOCATION OF WELL: NW ¼ NE ¼ of Section 19, T. 57 N., R. 84 W., of the 6th P.M. (or W.R.M.), Wyoming, being specifically Lot 17, Block 10 of the town of Ranchester (Bearing and Distance)
   or 650 ft. ~~North~~ South and 6550 ft. ~~East~~ West from the NE corner of Section 19, T. 57 N., R. 84 W.
   (Strike out words not needed).
5. TYPE OF CONSTRUCTION: Drilled ☐ (Type of Rig) Dug ☑ Driven ☐ Jetted ☐
   Other Hand Auger
6. CONSTRUCTION: Total Depth of Well 12½ ft. Depth to Static Water Level 9 ft.
   a. Casing Schedule New ☑ Used ☐
   4" diameter from 0 ft. to 12½ ft. Material Plastic Gage ?
   _____ diameter from _____ ft. to _____ ft. Material _____ Gage _____
   _____ diameter from _____ ft. to _____ ft. Material _____ Gage _____
   b. Perforations: Type of perforator used Circular saw
   Size of perforations ¼ inches by 12 inches.
   Number of perforations and depths where perforated:
   24 perforations from 9 ft. to 12 feet.
   _____ perforations from _____ ft. to _____ feet.
   c. Was well screen installed? Yes ☐ No ☑
   Diameter: _____ slot size: _____ set from _____ feet to _____ feet.
   Diameter: _____ slot size: _____ set from _____ feet to _____ feet.
   d. Was well gravel packed? Yes ☐ No ☑ Size of gravel _____
   e. Was surface casing used? Yes ☐ No ☑ Was it cemented in place? Yes ☐ No ☐
7. NAME & ADDRESS OF DRILLER —
8. DATE OF COMPLETION OF WELL (including pump installation) August 10, 1987
9. PUMP INFORMATION: Manufacturer Myers Type Jet
   Source of power Electricity Horsepower ½ Depth of Pump Setting 12 ft
   Amount of Water Being Pumped 12 Gallons Per Minute. (For springs or flowing wells, see item 11.)

STATE ENGINEER Cheyenne, Wyo.

Permit No. U.W. 75113 Book No. 531 Page No. 51

TFN 6 2/625
RECD 09-20-19

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10. PUMP TEST: Was a pump test made? Yes ☐ No ☑

If so, by whom _____ Address _____

Yield: _____ gal./min. with _____ foot drawdown after _____ hours.

Yield: _____ gal./min. with _____ foot drawdown after _____ hours.

11. FLOWING WELL (Owner is responsible for control of flowing well).

If well yields artesian flow, yield is _____ gal./min. Surface pressure is _____ lb./sq. inch, or _____ feet of water.

The flow is controlled by: valve ☐ cap ☐ plug ☐

Does well leak around casing? Yes ☐ No ☐

12. LOG OF WELL: Total depth drilled 12½ feet.

Depth of completed well 12 feet. Diameter of well 8 inches.

Depth to first water bearing formation 10 feet.

Depth to principal water bearing formation. Top 10 feet to Bottom 12½ feet.

Ground Elevation, if known –

From Feet	To Feet	Material Type, Texture, Color	REMARKS (Cementing, Shutoff, Packing, etc.)	Indicate Water Bearing Formation	Indicate Perforated Casing Location
0	2	Top soil	none	none	none
2	10	sand + clay grey	none	none	none
10	12½	sand + small rock	none	yes	9-12 ft

QUALITY OF WATER INFORMATION:

Was a chemical analysis made? Yes ☐ No ☑

If so, please include a copy of the analysis with this form.

If not, do you consider the water as: Good ☐ Acceptable ☑ Poor ☐ Unusable ☐

TFN 6 2/025
RECD 09-20-19

DEQ Ex. 2-444

Scanned, 02/28/2020

13. TABULATION

a. If for irrigation, the land proposed to be irrigated should be described in the following tabulation. Describe in the "Remarks" section, under Item 14, the means of conveying the water to the lands and the method of irrigation.

(Give irrigable acreage in each legal subdivision. If proposed use is for additional supply for lands with a right from another source, indicate in the tabulation the priority or permit number, the source of supply and the name of the ditch or other well.)

b. If not used for irrigation, show the area and point(s) of use and location of well in the tabulation below. Also describe the method of conveyance in the "Remarks" section under Item 14.

Town-Ship	Range	Sec.	NE¼				NW¼				SW¼				SE¼				TOTALS
			NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	
57	84	19		✓															

TOTAL NUMBER OF ACRES TO BE IRRIGATED_____

Original Supply _____ acres

Additional Supply _____ acres

14. PLAT

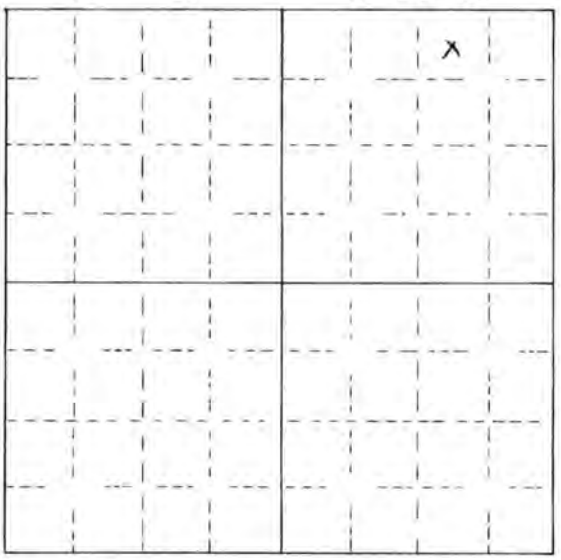
a. If the well is to be used for irrigation, industrial, miscellaneous or municipal use, show the location of the well on the plat below. For such uses, a plat certified by a licensed engineer or land surveyor is required to be submitted at the time the Proof of Appropriation and Beneficial Use of Ground Water is submitted.

b. For other uses, accurately show the well location, point of use or uses and describe method of conveyance of water to points of use on plat and in "Remarks" section below. Make certain location on plat agrees with written description.

c. A separate map may be submitted if the information required cannot be shown on this plat.

R._____W. R. 84 W.

Scale: 2" = 1 Mile



T. 57 N.

T._____N.

REMARKS: Domestic, watering lawn, garden hose

TFN 6 21025
RECD 09-20-19

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15. IF WELL IS TO BE ABANDONED, complete Items 1 through 8, Item 12 (Log of Well) and state reason for abandonment and details of the plugging below.

It is the responsibility of the owner to properly plug or fill in the well in order to prevent contamination of ground water and to cover or cap the well at ground level.

Under penalties of perjury, I declare that I have examined this form and to the best of my knowledge and belief it is true, correct and complete.

Betty Fogelsee
Signature of Owner or Authorized Agent

August 10, 1987
Date

Date of Receipt AUG 1 1987, 19

Date of Priority July 9, 1987

Date of Approval August 14, 1987

Bruce R. Brinkman
for State Engineer

TFN 6 2/025
RECD 09-20-19

DEQ Ex. 2-446

RAMACO

Brook Mine

SCANNED DEC 19 2011

Form U.W. 7

IF WELL IS TO BE ABANDONED, SEE ITEM 20

NOTE: Do not fold this form. Use typewriter or print neatly with black ink.

STATE OF WYOMING

OFFICE OF THE STATE ENGINEER

STATEMENT OF COMPLETION AND DESCRIPTION OF WELL

for Domestic or Stock Watering Use Only

A preferred water right is given to such use when the yield or flow does not exceed .056 cubic feet per second or 25 gallons per minute. Domestic use refers to household use and the watering of lawns and gardens for family use, not to exceed one acre.

Permit No. U.W. 8410

Temporary Filing No.

Water Division No. 2 (5)

U.W. District Sheridan County

**Completed Prior to May 24, 1969 ☐

NAME OF WELL HOME No. 1

1. Owner LAURENT HOME LORETTA HOME - FOR MONTANA
2. Address 300 WEST 4TH
3. Agent to receive correspondence LAURENT HOME 300 WEST 4th SHERIDAN, WYOMING - 82801
4. Name & address of driller MARVIN LEY DOUGLAS ARGETSINGER SHERIDAN, WYOMING - 82801
5. Well is constructed on lands owned by LAURENT HOME - LORETTA HOME (Obtaining of easement or right of way is the responsibility of the applicant's. Include copy if land is privately owned and owner is not a co-applicant.)
6. Type of construction: Dug ☐ Drilled ☒ DRILLING Type of Rig

   Driven ☐ Jet ☐ Other
7. Use of Water—Domestic ☒ Stock ☒
8. Means of conveyance, distance and direction to point of use PUMP - PRESSURE SYSTEM FOR HOUSE - WEST
9. Date started MARCH 7 - 19 71
10. Date completed MARCH 9 19 71 (including pump)
11. Date after completion when water was used MARCH 10 19 71
12. WELL DESCRIPTION

    Total Depth 150 FEET Depth to Water Level 108 ft.
13. TEST DATA

    Yield 5 GPM at BOTTOM How Tested

    Drawdown UNKNOWN Length of Test
14. PUMP DATA

    Type TYSON Pump Jack (Turbine, Centrifugal, etc.) Power Source ELEC. (Elec., Gas, etc.)

    Horsepower 1 1/4 Amount of Water Being Used 3 G.P.M. (Gallons per Minute)
15. CASING RECORD

    Plain Casing

    Size 16" Kind 6" PIPE from SURFACE ft. to 108 ft.

    Size Kind SEAL AT from 108 ft. to ft.

    Size Kind GRAVEL-PACK from 108' ft. to BOTTOM ft.

    Perforated Casing

    Size Kind from ft. to ft.

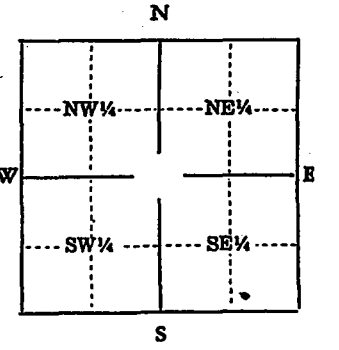
    Size Kind from ft. to ft.

WELL LOCATION

SHERIDAN County

SE ¼ of SE ¼ of Sec. 14

T. N., R. W.



Scale: 2" = 1 mile

Above diagram represents one full section. Locate well accurately in small square representing 40 ac. or fill in the following:

Lot & Block or Tract

of the (Subdivision or Addition)

of (City, Town or County)

Section, T. N., R. W.

**For wells constructed after May 24, 1969, Application Form U.W. 5 must be submitted prior to construction.

Permit No. U.W. 8410

Book No. 47 Page No. 56

THE HILL COMPANY, SHERIDAN 127214

TFN 6 2/025

RECD 09-20-19

September 2019

Addendum D5-8-69

DEQ Ex. 2-447

SCANNED 12/28/2022

RAMACO

Brook Mine

U.W. 8410

16. Was surface seal provided? Yes ☐ No ☐ To What Depth_____ Material used: _____
Was well gravel packed? Yes ☑ No ☐

17. FLOWING WELL (Owner is responsible for installing control device on flowing well.)
Does well flow? Yes ☐ No ☐
Flow controlled by: Valve ☐ Cap ☐ Plug ☐ Does well leak around casing? Yes ☐ No ☐

18. LOG OF WELL—Clearly indicate first water bearing material and principal water bearing material.

From Feet	To Feet	Material Type, Texture, Color	REMARKS (Cementing, Shutoff, Packing, etc.)	Indicate Water Bearing Formation	Indicate Perforated Casing Location
0	5	SURFACE			
5	18	GRAVEL & SAND			
18	19	ROCK			
19	36	LIGHT BLUE SHALE			
36	67	DARK SHALE & COAL			
67	70	SHALE AND STREAKS	OF ROCK		
70	87	LIGHT SHALE			
87	94	COAL WATER & GAS			
94	114	LIGHT SHALE			
114	115	ROCK			
115	124	BLUE CLAY			
124	131	COAL-WATER & GAS			
131	145	BLUE CLAY			
145	150	ROCK			
			THIS WELL IS	CASED	
			TO 18' WITH	6" P.P.'.	
			FROM THE SURFACE	TO 108'	
			IS CASED WITH	4" STANDARD	
			GALV PIPE	THERE IS	A SEAL
			AT 108' — FROM	108' TO	THE BOTTOM
			IS GRAVEL	PACKED.	
			5 GPM AT BOTTOM		
			3 GPM AT 90'	-STATIC LEVEL IS	8'
			WATER IS 5 GRS	HARD	

19. QUALITY OF WATER INFORMATION
Was a chemical analysis made? Yes ☐ No ☒
If so, please include a copy of the analysis with this form.
If not, do you consider the water as: Good ☐ Acceptable ☒ Poor ☐ Unusable ☐
Was a bacteriological analysis made? Yes ☐ No ☒
If a domestic well, was the well disinfected by the driller? Yes ☐ No ☐

20. IF WELL IS TO BE ABANDONED, complete only Items 1 through 6, Item 10 and Item 18 (Log of Well) and state reason for abandonment below.
It is the responsibility of the owner to properly plug or fill in the well in order to prevent contamination of ground water and to cover or cap the well at ground level.

REMARKS: _____

Under penalties of perjury, I declare that I have examined this form and to the best of my knowledge and belief it is true, correct and complete.

Lawrence Horne
Signature of Owner or Authorized Agent

MARCH 16, 1971
Date

Date of Receipt: March 17, 1971

Date of Priority: March 17, 1971

Sylvia H. Ross

Date of Approval: 23 April, 1971

Sylvia H. Ross
for State Engineer

TFN 6 2/025

RECD 09-20-19

Scanned: 02/23/2020

Scanned, 02/28/2020

SCANNED MAY 15 2013
MICRO FILMED

Form U.W. 6
Rev. 2-83

STATE OF WYOMING

OFFICE OF THE STATE ENGINEER

IF WELL IS TO BE ABANDONED, SEE ITEM 15, PAGE 4

STATEMENT OF COMPLETION AND DESCRIPTION OF WELL

NOTE: Do not fold this form. Use typewriter or print neatly with black ink.

PERMIT NO. U.W. 84927 NAME OF WELL Legerski Ranch HDQ No. 1

1. NAME OF OWNER Legerski Ranch

2. ADDRESS C/o WALT PILCH BOX 6498 SHERIDAN, WYO. Zip Code 82801

3. USE OF WATER: Domestic X Stock Watering ( ) Irrigation ( ) Municipal ( ) Industrial ( ) Miscellaneous ( )

4. LOCATION OF WELL: NE ¼ NW ¼ of Section 24, T. 57 N., R. 85 W., of the 6th P.M. (or W.R.M.), Wyoming, being specifically S61°E 1690' (Bearing and Distance)

or ____ ft. North/South and ____ ft. East/West from the NW corner of Section 24, T. 57 N., R. 85 W.
(Strike out words not needed)

5. TYPE OF CONSTRUCTION: Drilled ( ) ____ (Type of Rig) Dug X Driven ( ) Jetted ( )

Other ____

6. CONSTRUCTION: Total Depth of Well 8 ft. Depth to Static Water Level 3 ft.

a. Casing Schedule New X Used ( )

5 Ft. diameter from 0 ft. to 8 ft. Material C.M.P Gage 14

____ diameter from ____ ft. to ____ ft. Material ____ Gage ____

____ diameter from ____ ft. to ____ ft. Material ____ Gage ____

b. Perforations: Type of perforator used NONE

Size of perforations ____ inches by ____ inches

Number of perforations and depths where perforated:

____ perforations from ____ ft. to ____ feet.

____ perforations from ____ ft. to ____ feet.

c. Was well screen installed? Yes ( ) No X

Diameter: slot size: set from ____ feet to ____ feet.

Diameter: ____ slot size: ____ set from ____ feet to ____ feet.

d. Was well gravel packed? Yes X No ( ) Size of gravel 3/4" GRAVEL PLACED BELOW PIPE & FROM 6'-8'

e. Was surface casing used? Yes ( ) No X Was it cemented in place? Yes ( ) No ( )

7. NAME & ADDRESS OF DRILLER DUG (W) BACKHOE BY OWNER

8. DATE OF COMPLETION OF WELL (including pump installation) APRIL 30, 1991

9. PUMP INFORMATION: Manufacturer BURKE Type CENTRIFUGAL

Source of power ELECTRIC Horsepower 1/2 Depth of Pump Setting 8' SEE REMARKS

Amount of Water Being Pumped 20 Gallons Per Minute. (For springs or flowing wells, see item 11.)

Permit No. U.W. 84927 Book No. 630 Page No. 28

TFN 6 2/025

RECD 09-20-19

Scanned, 02/28/2020

10. PUMP TEST: Was a pump test made? Yes ☒ No ☐

If so, by whom OWNER Rep. Address W. Pilch Box 6498 Silverdale

Yield: 20 gal./min. with NO foot drawdown after 1 hours.

Yield: _____ gal./min. with _____ foot drawdown after _____ hours.

11. FLOWING WELL (Owner is responsible for control of flowing well). N/A

If well yields artesian flow, yield is _____ gal./min. Surface pressure is _____ lb./sq. inch, or _____ feet of water.

The flow is controlled by: valve ☐ cap ☐ plug ☐

Does well leak around casing? Yes ☐ No ☐

12. LOG OF WELL: Total depth ~~drilled~~ DUG 8 feet.

Depth of completed well 8 feet. Diameter of well 5 ~~inches~~ FEET

Depth to first water bearing formation 3 feet.

Depth to principal water bearing formation. Top 3 feet to Bottom 8 feet.

Ground Elevation, if known ± 3665

From Feet	To Feet	Material Type, Texture, Color	REMARKS (Cementing, Shutoff, Packing, etc.)	Indicate Water Bearing Formation	Indicate Perforated Casing Location
0	2	TOPSOIL			
2	3	SAND - GRAVEL		H_2O @ 3'	5' dia C.M.P.
3	8	GRAVEL			

QUALITY OF WATER INFORMATION:

Was a chemical analysis made? Yes ☒ No ☐

If so, please include a copy of the analysis with this form.

If not, do you consider the water as: Good ☒ Acceptable ☐ Poor ☐ Unusable ☐

UW 8/19/1

TFN 6 2/025

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UW 54927

13. TABULATION

a. If for irrigation, the land proposed to be irrigated should be described in the following tabulation. Describe in the "Remarks" section, under Item 14, the means of conveying the water to the lands and the method of irrigation.

(Give irrigable acreage in each legal subdivision. If proposed use is for additional supply for lands with a right from another source, indicate in the tabulation the priority or permit number, the source of supply and the name of the ditch or other well.)

b. If not used for irrigation, show the area and point(s) of use and location of well in the tabulation below. Also describe the method of conveyance in the "Remarks" section under Item 14.

Town-Ship	Range	Sec.	NE¼				NW¼				SW¼				SE¼				TOTALS
			NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	
57	85	24					X												
				Domestic Use only															

TOTAL NUMBER OF ACRES TO BE IRRIGATED _____

Original Supply _____ acres

Additional Supply _____ acres

14. PLAT

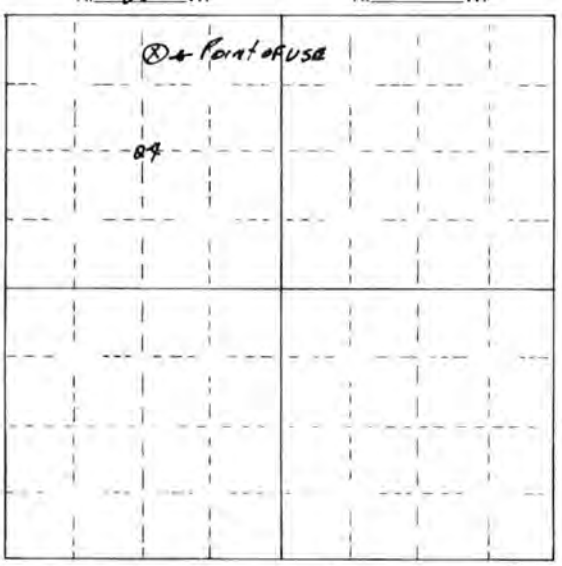
a. If the well is to be used for irrigation, industrial, miscellaneous or municipal use, show the location of the well on the plat below. For such uses, a plat certified by a licensed engineer or land surveyor is required to be submitted at the time the Proof of Appropriation and Beneficial Use of Ground Water is submitted.

b. For other uses, accurately show the well location, point of use or uses and describe method of conveyance of water to points of use on plat and in "Remarks" section below. Make certain location on plat agrees with written description.

c. A separate map may be submitted if the information required cannot be shown on this plat.

R. 85 W. R. _____ W.

Scale: 2" = 1 Mile



T. 57 N.

T. _____ N.

REMARKS: THIS WELL IS A DUG WELL LOCATED NEAR TONGUE RIVER APPROX. 100 FEET FROM RANCH HOUSE, A 5' DIA. C.M.P. IS INSTALLED AND GRAVEL AROUND & AT BOTTOM. A 1¼" P.V.C. PIPE IS INSTALLED FROM WELL TO BASEMENT OF HOUSE WHICH HAS A DIFFENCE OF ELEV. OF ± 5 FEET. A PRESSURE PUMP SUPPLIES HOUSEHOLD USE

TFN 6 27025
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15. IF WELL IS TO BE ABANDONED, complete Items 1 through 8, Item 12 (Log of Well) and state reason for abandonment and details of the plugging below.

It is the responsibility of the owner to properly plug or fill in the well in order to prevent contamination of ground water and to cover or cap the well at ground level.

Under penalties of perjury, I declare that I have examined this form and to the best of my knowledge and belief it is true, correct and complete.

Signature of Owner or Authorized Agent

Date MAY 1 19 91

UW 84971

Date of Receipt MAY 6 1991 , 19

Date of Priority April 22, 1991 , 19

Date of Approval Aug 7 , 19 91

for State Engineer

TFN 6 27025
RECD 09-20-19

Scanned, 02/28/2020

FORM U.W.6
REV 5-93

STATE OF WYOMING

SCANNED JUL 01 2013

OFFICE OF THE STATE ENGINEER
HERSCHLER BUILDING
CHEYENNE, WYOMING 82002
(307) 777-5959

STATEMENT OF COMPLETION AND DESCRIPTION OF WELL OR SPRING

NOTE: Do not fold this form. Use typewriter or print neatly with black ink.

PERMIT NO. U.W. 92235 NAME OF WELL (SPRING) Buyok #4

1. NAME OF OWNER John P & Vanessa A Buyok

2. ADDRESS HC 31/ 36 Monarch Road
Please check if address has changed from that shown on permit [X]
City Ranchester State WY Zip Code 82839 Phone No. (307) 672-0657

3. USE OF WATER: Domestic [X] Stock Watering [X] Irrigation [ ] Municipal [ ] Industrial [ ] Miscellaneous [ ]
Explain proposed use (Example: One single family dwelling) single family dwelling with yard and water for livestock on ranch

4. LOCATION OF WELL (~~SPRING~~): SE ¼ NW ¼ of Section 19, T. 57 N., R. 84 W., of the 6th P.M. (or W.R.M.),
Subdivision Name NA Lot Block
If surveyed, bearing, distance and reference point: NA

5. TYPE OF CONSTRUCTION: Drilled [X] Rotary (Type of Rig) Dug [ ] Driven [ ] Other [ ]
Describe:

6. CONSTRUCTION: Total Depth of Well/~~Spring~~ 90 ft. Depth to Static Water Level 13 ft. (Below land surface)
a. Diameter of borehole (Bit size) 6 inches.

b. Casing Schedule New [X] Used [ ]
6" diameter from 0 ft. to 27 ft. Material Steel Gage S-40
4" diameter from 0 ft. to 90 ft. Material PVC Gage S-40

c. Was casing cemented: Yes [ ] No [X] Cemented Interval, From feet to feet.

d. Number of sacks of cement used type of cement

e. Perforations: Type of perforator used Factory
Size of perforations inches by inches.

Number of perforations and depths where perforated:
Factory perforations from 75 ft. to 85 feet
perforations from ft. to feet

f. Was well screen installed? Yes [X] No [ ]
Diameter: 4" slot size: 30 set from feet to
Diameter: slot size: set from feet to

g. Was well gravel packed? Yes [ ] No [X] Size of gravel

h. Was surface casing used: Yes [X] No [ ] Was it cemented in place? Yes [X] No [ ]

7. NAME & ADDRESS OF DRILLING COMPANY David Drilling, P.O. Box 383, Big Horn, WY 82833

8. DATE OF COMPLETION OF WELL (including pump installation) OR SPRING (first used) 1/25/2001

9. PUMP INFORMATION: Manufacturer Webtrol Type Submersible
Source of power 230V Electric Horsepower 3/4 Depth of Pump Setting or intake 65
Amount of Water Being Pumped 12 Gallons Per Minute (For Springs or flowing wells, see item 10.)
Total Volumetric Gallons Used Per Calendar Year. 110,000

10. FLOWING WELL (Owner is responsible for control of flowing well).
If well yields artesian flow, yield is NA gal./min. Surface pressure is lb./sq. inch, or feet of water.
The flow is controlled by: valve [ ] cap [ ] plug [ ]
Does well leak around casing? Yes [ ] No [ ]

Permit No. U.W. 92235 Book No. 703 Page No. 36

TFN 6 27025
RECD 09-20-19

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11. If spring, how was it constructed? (Some method of artificial diversion, i.e., spring box, cribbing, etc., is necessary to qualify for a water right.) NA

12. PUMP TEST: Was a pump test made? Yes [X] No [ ]
If so, by whom Driller Address
Yield: 20 gal./min. with 12 foot drawdown after 4 hours.
Yield: 20 gal./min. with 12 foot drawdown after 24 hours.

13. LOG OF WELL: Total depth drilled 140 feet.
Depth of completed well 90 feet. Diameter of well 6 inches.
Depth to first water bearing formation 12 feet.
Depth to principal water bearing formation. Top 75 feet to Bottom 83 feet.

Ground Elevation, if known

DRILL CUTTINGS DESCRIPTION:

From Feet	To Feet	Material Type, Texture Color	Remarks (Cementing, Shutoff)	Indicate Water Bearing Formation & Name	Indicate Perforated Casing Location
0	2	Topsoil			
2	12	Sandy Clay			
12	22	Gravel			
22	50	Blue Shale	Surface casing to 27'		
50	57	Blue Shale w Sandstone Streaks			
57	75	Blue Shale	Packer @ 73'		
75	83	Coal		H^2O	Screen 75' to 85'
83	140		Plugged (3/8" Hole Plug Bentonite Chips)		

14. QUALITY OF WATER INFORMATION:
Does a chemical and/or bacteriological water quality analysis accompany this form? Yes [X] No [ ]
It is recommended that chemical and bacteriologic water quality analyses be performed and that the report(s) be filed with the records of this well. (Contact Department of Agriculture, Analytical Lab Services, Laramie, 742-2984.)
If not, do you consider the water as: Good [ ] Acceptable [ ] Poor [X] Unusable [ ]

REMARKS:

Under penalties of perjury, I declare that I have examined this form and to the best of my knowledge and belief it is true, correct and complete.

Signature of Owner or Authorized Agent

Date 1/31 2001

FOR STATE ENGINEER'S USE ONLY

UW 92235

Date of Receipt FEB 02 2001, 19

Date of Priority July 9, 19 93

Date of Approval Feb 8 2001

Cheryl Verplanche
for State Engineer

TFN 8 2/625
RECD 09-20-19

Scanned, 02/28/2020

FORM U.W.R. REV. 5-89

STATE OF WYOMING

OFFICE OF THE STATE ENGINEER
HERSCHLER BUILDING
CHEYENNE, WYOMING 82002
(307) 777-5959

KAI OCT 31 1994
SCANNED AUG 05 2013

STATEMENT OF COMPLETION AND DESCRIPTION OF WELL OR SPRING

NOTE: Do not fold this form. Use typewriter or print neatly with black ink.

PERMIT NO. U.W. 93497 NAME OF WELL (SPRING) Johnson #1

1. NAME OF OWNER John L and Gaylene Johnson

2. ADDRESS 1690 Hwy 87 PO Box 424
Please check if address has changed from that shown on permit. ☐
City Ranchester State Wyo Zip Code 82839 Phone No. 307-655-2410

3. USE OF WATER: Domestic ☒ Stock Watering ☐ Irrigation ☐ Municipal ☐ Industrial ☐ Miscellaneous ☐
Explain proposed use (Example: One single family dwelling)
One Single Family dwelling

4. LOCATION OF WELL (SPRING): SE ¼ SE ¼ of Section 14, T. 57 N., R. 85 W., of the 6th P.M. (or W.R.M.),
Subdivision Name Lot Block
If surveyed, bearing, distance and reference point:

5. TYPE OF CONSTRUCTION: Drilled ☒ Cable Tool (Type of Rig) Dug ☐ Driven ☐ Other ☐
Describe:

6. CONSTRUCTION: Total Depth of Well/Spring 28 ft. Depth to Static Water Level 7 ft. (Below land surface)
a. Diameter of borehole (Bit size) 8 inches.
b. Casing Schedule New ☒ Used ☐
6" diameter from 0 ft. to 28 ft. Material Steel Gage .025
diameter from ft. to ft. Material Gage
c. Was casing cemented: Yes ☐ No ☒ Cemented Interval, From feet to feet.
d. Number of sacks of cement used type of cement
e. Perforations. Type of perforator used slot
Size of perforations 1/8 inches by 6 inches.
Number of perforations and depths where perforated:
40 perforations from 8 ft. to 20 feet.
perforations from ft. to feet.
f. Was well screen installed? Yes ☐ No ☒
Diameter: slot size: set from feet to
Diameter: slot size: set from feet to
g. Was well gravel packed? Yes ☒ No ☐ Size of gravel 3/8"
h. Was surface casing used: Yes ☐ No ☒ Was it cemented in place? Yes ☐ No ☐

RECEIVED JUN 16 1994 STATE ENGINEER CHEYENNE, WY

7. NAME & ADDRESS OF DRILLING COMPANY Ley's Water Well Drilling & Service Inc.
1908 W 17th St. Sheridan Wyoming 82801
8. DATE OF COMPLETION OF WELL (including pump installation) OR SPRING (first used) 5-19-94 - 5-30-94

9. PUMP INFORMATION: Manufacturer Sears Type Submersible
Source of power Electricity Horsepower 3/4 Depth of Pump Setting or intake 20'
Amount of Water Being Pumped 10 Gallons Per Minute. (For Springs or flowing wells, see item 10.)
Total Volumetric Gallons Used Per Calendar Year. 50,000

10. FLOWING WELL (Owner is responsible for control of flowing well).
If well yields artesian flow, yield is gal./min. Surface pressure is lb./sq. inch, or feet of water.
The flow is controlled by: valve ☐ cap ☐ plug ☐
Does well leak around casing? Yes ☐ No ☐

Permit No. U.W. 93497 Book No. 715 Page No. 98

TFN 8 2/02 5
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11. If spring, how was it constructed? (Some method of artificial diversion, i.e., spring box, cribbing, etc., is necessary to qualify for a water right.)

12. PUMP TEST: Was a pump test made? Yes ☐ No ☒
If so, by whom _____ Address _____
Yield: _____ gal./min. with _____ foot drawdown after _____ hours.
Yield: _____ gal./min. with _____ foot drawdown after _____ hours.

13. LOG OF WELL: Total depth drilled 28 feet.
Depth of completed well 28 feet. Diameter of well 6 inches.
Depth to first water bearing formation 12 feet.
Depth to principal water bearing formation. Top 12 feet to Bottom 18 feet.

Ground Elevation, if known _____

DRILL CUTTINGS DESCRIPTION:

From Feet	To Feet	Material Type, Texture Color	Remarks (Cementing, Shutoff)	Indicate Water Bearing Formation & Name	Indicate Perforated Casing Location
0	4	Grey Top Soil			8' to 20'
4	12	Sandy Clay			
12	18	Sand & Gravel			
18	28	Blue Clay			

14. QUALITY OF WATER INFORMATION:
Does a chemical and/or bacteriological water quality analysis accompany this form? Yes ☐ No ☒
It is recommended that chemical and bacteriologic water quality analyses be performed and that the report(s) be filed with the records of this well. (Contact Department of Agriculture, Analytical Lab Services, Laramie, 742-2984.)
If not, do you consider the water as: Good ☒ Acceptable ☐ Poor ☐ Unusable ☐

REMARKS: Water analyses taken to inter mountain Labatory in Sheridan Wyo. Results not back.

Under penalties of perjury, I declare that I have examined this form and to the best of my knowledge and belief it is true, correct and complete.

John L. Johnson
Signature of Owner or Authorized Agent

6-13-, 19 94
Date

UW 93997

FOR STATE ENGINEER'S USE ONLY

Date of Receipt JUN 1 6 1994, 19 ____

Date of Priority November 22, 19 93

Date of Approval Aug 15, 19 94

for State Engineer

TFH 9 2/025
RECD 08-20-19

Scanned, 02/28/2020

RAMACO
FORM U.W.6
Rev. 6/00

Brook Mine

STATE OF WYOMING

OFFICE OF THE STATE ENGINEER
HERSCHLER BUILDING
CHEYENNE, WYOMING 82002
(307) 777-6163

WATER RIGHTS AUG 14 2000

STATEMENT OF COMPLETION AND DESCRIPTION OF WELL OR SPRING

NOTE: Do not fold this form. Use typewriter or print neatly with black ink.

PERMIT NO. U.W. 119576 NAME OF WELL (SPRING) St. Francis # 1

1. NAME OF OWNER St Francis Land Co. William J. Laya, Joyce J. Laya, Thomas C. Laya
2. ADDRESS 91 Kooi Road
   Please check if address has changed from that shown on permit
   City Ranchester State Wy. Zip Code 82839 Phone No. 307-655-9812
3. USE OF WATER: Domestic ☒ Stock Watering ☒ Irrigation ☐ Municipal ☐ Industrial ☐ Miscellaneous ☐
   Monitor or Test ☐ Coal Bed Methane ☐ Explain proposed use (Example: One single family dwelling) _____
4. LOCATION OF WELL (SPRING): NE ¼ ~~SE~~ ¼ of Section 14, T. 54 N., R. 85 W., of the 6th P.M. (or W.R.M.), SW Per Hr rec'd 3-12-01 JT.
   Subdivision Name _____ Lot _____ Block _____
   If surveyed, bearing, distance and reference point: _____
5. TYPE OF CONSTRUCTION: Drilled ☐ Rotary (Type of Rig) Dug ☐ Driven ☐ Other ☒
   Describe: _____
6. CONSTRUCTION: Total Depth of Well/Spring 60 ft.
   Depth to Static Water Level 12 ft. (Below land surface)
   a. Diameter of borehole (Bit size) 7 7/8 inches.
   b. Casing Schedule New ☒ Used ☐
   5 in. diameter from 0 ft. to 60 ft. Material PVC Gage SC H40.
   ____ diameter from ____ ft. to ____ ft. Material ____ Gage ____
   c. Was casing cemented: Yes ☐ No ☒ Cemented Interval, From ____ feet to ____ feet.
   d. Number of sacks of cement used ____ type of cement ____
   e. Perforations: Type of perforator used Factory Screen
   Size of perforations .025 inches by .025 inches
   Number of perforations and depths where perforated:
   3000 perforations from 20 ft. to 60 feet.
   ____ perforations from ____ ft. to ____ feet.
   f. Was well screen installed? Yes ☒ No ☐
   Diameter: 3000 slot size: ____ set from ____ feet to ____.
   Diameter: ____ slot size: ____ set from ____ feet to ____.
   g. Was well gravel packed? Yes ☒ No ☐ Size of gravel 3/8" Pea Gravel
   h. Was surface casing used: Yes ☐ No ☒ Was it cemented in place? Yes ☐ No ☒
7. NAME & ADDRESS OF DRILLING COMPANY Young Drilling, 94 U.S. Highway 16 East, Buffalo, WYL 82834
8. DATE OF COMPLETION OF WELL (including pump installation) OR SPRING (first used) 1-6-2000
9. PUMP INFORMATION: Manufacturer Flint & Walling Type Electric Submersible
   Source of power Electric Horsepower 1/2 Depth of Pump Setting or intake 50 ft
   Amount of Water Being Pumped 25 Gallons Per Minute. (For Springs or flowing wells, see item 10.)
   Total Volumetric Gallons Used Per Calendar Year. 300,000
10. FLOWING WELL OR SPRING (Owner is responsible for control of flowing well).
   If well yields artesian flow or if spring, yield is ____ gal./min. Surface pressure is ____ lb./sq. inch, or ____ feet of water.
   The flow is controlled by: valve ☐ cap ☐ plug ☐
   Does well leak around casing? Yes ☐ No ☐

TFN6 2/025
RECD DEC 13, 2019

Permit No. U.W. 119576 Book No. 903 Page No. 129

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11. If spring, how was it constructed? (Some method of artificial diversion, i.e., spring box, cribbing, etc., is necessary to qualify for a water right.) _____

12. PUMP TEST: Was a pump test made? Yes ☐ No ☒
If so, by whom _____ Address _____
Yield: _____ gal./min. with _____ foot drawdown after _____ hours.
Yield: _____ gal./min. with _____ foot drawdown after _____ hours.

13. LOG OF WELL: Total depth drilled _____ feet.
Depth of completed well 60 feet. Diameter of well 5 inches.
Depth to first water bearing formation _____ feet.
Depth to principal water bearing formation. Top _____ feet to Bottom _____ feet.

Ground Elevation, if known 3700 ft

DRILL CUTTINGS DESCRIPTION:

From Feet	To Feet	Material Type, Texture Color	Remarks (Cementing, Shutoff)	Indicate Water Bearing Formation & Name	Indicate Perforated Casing Location
0	32	Coal Shale			
32	45	Gray Shale			
45	60	Alluvium Gravel			40 - 60 ft

14. QUALITY OF WATER INFORMATION:
Does a chemical and/or bacteriological water quality analysis accompany this form? Yes ☐ No ☒
It is recommended that chemical and bacteriologic water quality analyses be performed and that the report(s) be filed with the records of this well. (Contact Department of Agriculture, Analytical Lab Services, Laramie, 742-2984.)
If not, do you consider the water as: Good ☐ Acceptable ☒ Poor ☐ Unusable ☐

REMARKS: Well noted as 25 gpm - 12 Parts Hardness per million or very hard by driller

Under penalties of perjury, I declare that I have examined this form and to the best of my knowledge and belief it is true, correct and complete.

William J. Laya
Signature of Owner or Authorized Agent

10-10-, 20 00
Date

FOR STATE ENGINEER'S USE ONLY

Date of Receipt OCT 12 2000, 20 ____

Date of Priority OCT 14 1999, 20 ____

U. W. 119576

Date of Approval June 13, 20 01

Dawn Parlin
for State Engineer

TFN6 2/025
RECD DEC 13, 2019

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RAMACO
FORM U.W.6
Rev. 6/00

Brook Mine

STATE OF WYOMING

OFFICE OF THE STATE ENGINEER
HERSCHLER BUILDING
CHEYENNE, WYOMING 82002
(307) 777-6163

SCANNED
WRONG FILMED AUG 14 2001

STATEMENT OF COMPLETION AND DESCRIPTION OF WELL OR SPRING

NOTE: Do not fold this form. Use typewriter or print neatly with black ink.

PERMIT NO. U.W. 120822 NAME OF WELL (SPRING) St. Francis #2

1. NAME OF OWNER St. Francis Land Co., William J. Laya, Joyce J. Laya, Thomas C. Laya
2. ADDRESS 91 Kooi Rd
   Please check if address has changed from that shown on permit
   City Ranchester State Wy. Zip Code 82839 Phone No. 307-655-9812
3. USE OF WATER: Domestic ☒ Stock Watering ☒ Irrigation ☐ Municipal ☐ Industrial ☐ Miscellaneous ☐
   Monitor or Test ☐ Coal Bed Methane ☐ Explain proposed use (Example: One single family dwelling) _____
4. LOCATION OF WELL (SPRING): NE ¼ SE ¼ (SW) of Section 14, T. 57 N., R. 85 W., of the 6th P.M. (or W.R.M.),
   Subdivision Name _____ Lot _____ Block _____
   If surveyed, bearing, distance and reference point: _____
5. TYPE OF CONSTRUCTION: Drilled ☐ Rotary (Type of Rig) Dug ☐ Driven ☐ Other ☒
   Describe: _____
6. CONSTRUCTION: Total Depth of Well/Spring 40 ft.
   Depth to Static Water Level 7 ft. (Below land surface)
   a. Diameter of borehole (Bit size) 7 7/8 inches.
   b. Casing Schedule New ☒ Used ☐
   5 diameter from 0 ft. to 40 ft. Material PVC Gage SCH40
   ____ diameter from ____ ft. to ____ ft. Material ____ Gage ____
   c. Was casing cemented: Yes ☐ No ☒ Cemented Interval, From ____ feet to ____ feet.
   d. Number of sacks of cement used ____ type of cement ____
   e. Perforations: Type of perforator used Factory Screen
   Size of perforations .025 inches by .025 inches.
   Number of perforations and depths where perforated:
   3000 perforations from 20 ft. to 40 feet.
   ____ perforations from ____ ft. to ____ feet.
   f. Was well screen installed? Yes ☒ No ☐
   Diameter: 3000 slot size: ____ set from ____ feet to ____
   Diameter: ____ slot size: ____ set from ____ feet to ____
   g. Was well gravel packed? Yes ☒ No ☐ Size of gravel 3/8" Pea Gravel
   h. Was surface casing used: Yes ☐ No ☒ Was it cemented in place? Yes ☐ No ☒
7. NAME & ADDRESS OF DRILLING COMPANY Young Drilling 94 U.S. Highway 16 East Buffalo, Wy. 82834
8. DATE OF COMPLETION OF WELL (including pump installation) OR SPRING (first used) 1-7-2000
9. PUMP INFORMATION: Manufacturer Flint & Walling Type Electric Submersible
   Source of power Electric Horsepower ½ Depth of Pump Setting or intake 30 ft.
   Amount of Water Being Pumped 15 Gallons Per Minute. (For Springs or flowing wells, see item 10.)
   Total Volumetric Gallons Used Per Calendar Year. 300,000
10. FLOWING WELL OR SPRING (Owner is responsible for control of flowing well).
   If well yields artesian flow or if spring, yield is ____ gal./min. Surface pressure is ____ lb./sq. inch, or ____ feet of water.
   The flow is controlled by: valve ☐ cap ☐ plug ☐
   Does well leak around casing? Yes ☐ No ☐

TFN6 2/025
RECD DEC 13, 2019

Permit No. U.W. 120822 Book No. 912 Page No. 23

SEE REVERSE SIDE

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U.W120822

11. If spring, how was it constructed? (Some method of artificial diversion, i.e., spring box, cribbing, etc., is necessary to qualify for a water right.) _____

12. PUMP TEST: Was a pump test made? Yes ☐ No ☒
If so, by whom _____ Address _____
Yield: _____ gal./min. with _____ foot drawdown after _____ hours.
Yield: _____ gal./min. with _____ foot drawdown after _____ hours.

13. LOG OF WELL: Total depth drilled _____ feet.
Depth of completed well 40 feet. Diameter of well 5 inches.
Depth to first water bearing formation _____ feet.
Depth to principal water bearing formation. Top _____ feet to Bottom _____ feet.

Ground Elevation, if known 3650 ft

DRILL CUTTINGS DESCRIPTION:

From Feet	To Feet	Material Type, Texture Color	Remarks (Cementing, Shutoff)	Indicate Water Bearing Formation & Name	Indicate Perforated Casing Location
0	25	Gray Shale			
25	40	Alluvium gravel			25 - 40

14. QUALITY OF WATER INFORMATION:
Does a chemical and/or bacteriological water quality analysis accompany this form? Yes ☐ No ☒
It is recommended that chemical and bacteriologic water quality analyses be performed and that the report(s) be filed with the records of this well. (Contact Department of Agriculture, Analytical Lab Services, Laramie, 742-2984.)
If not, do you consider the water as: Good ☒ Acceptable ☐ Poor ☐ Unusable ☐

REMARKS: 560 parts Hardness per million (our test) ie by driller

Under penalties of perjury, I declare that I have examined this form and to the best of my knowledge and belief it is true, correct and complete.

William J Laya
Signature of Owner or Authorized Agent

10-10, 2000
Date

FOR STATE ENGINEER'S USE ONLY

Date of Receipt OCT 12 2000, 20 ____
Date of Priority NOV 17 1999, 20 ____

Date of Approval June 13, 2001
Darren Parlin
for State Engineer

TFN6 2/025
RECD DEC 13, 2019