

BROOK MINING CO., LLC.
BROOK MINE
VOLUME 4 OF 12
TFN 6 2/025

BROOK MINING CO., LLC.
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VOLUME 4 OF 12
TFN 6 2/025

Brook Mine Permit Application Volume IV

Appendix D5

DEQ Exhibit 5



VOLUME IV

Appendix D5

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APPENDIX D5 TEXT

RAMACO

Brook Mine

**TOPOGRAPHY, GEOLOGY
AND
OVERBURDEN ASSESSMENT**

Appendix D5

Prepared by:
WWC Engineering

July 2015

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DEQ 5-008

D5 GEOLOGY, OVERBURDEN, INTERBURDEN, AND MINERAL ASSESSMENT

D5.1 Introduction

Geology, Overburden, Interburden, 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

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.

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



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

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

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

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

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.

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 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 Interburden

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

The interburden 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 interburden 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 interburden thicknesses that these samples will not represent all conditions encountered by the continuous miner. 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.

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 of

the 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 interburden 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 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.

D5.3.3.4 Underburden

The underburden below the Masters coal seam is largely characterized as a thick claystone containing thin coal stringers with interbedded siltstone. From the bottom of the Masters coal seam to the top of the Wall coal seam, underburden thicknesses range from 550-600 feet. The claystone and siltstone are dry and incapable of producing groundwater flows greater than 0.5 gpm. Addendum D5-2 contains the geophysical log and electric log for drill hole R13-026 that describes the underburden.

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.

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

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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 western-side 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 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 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/interburden analyte exceedences will not pose a significant problem to meet WDEQ/LQD reclamation standards. Postmine monitoring procedures may be found in the Reclamation Plan.

D5.5 References

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APPENDIX D5 TABLES

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)
	Tulloch Member	
Lance Formation		
Fox Hills Sandstone		

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Table D5.3-2. Coal Quality Characteristics

Seam	Btu/lb¹	Ash¹	Water Content²	Total Sulfur¹
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.

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

Parameter	Suitable	Surface (potential root zone) and Topsoil		Aquifer Restoration
		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 CaCO3 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.

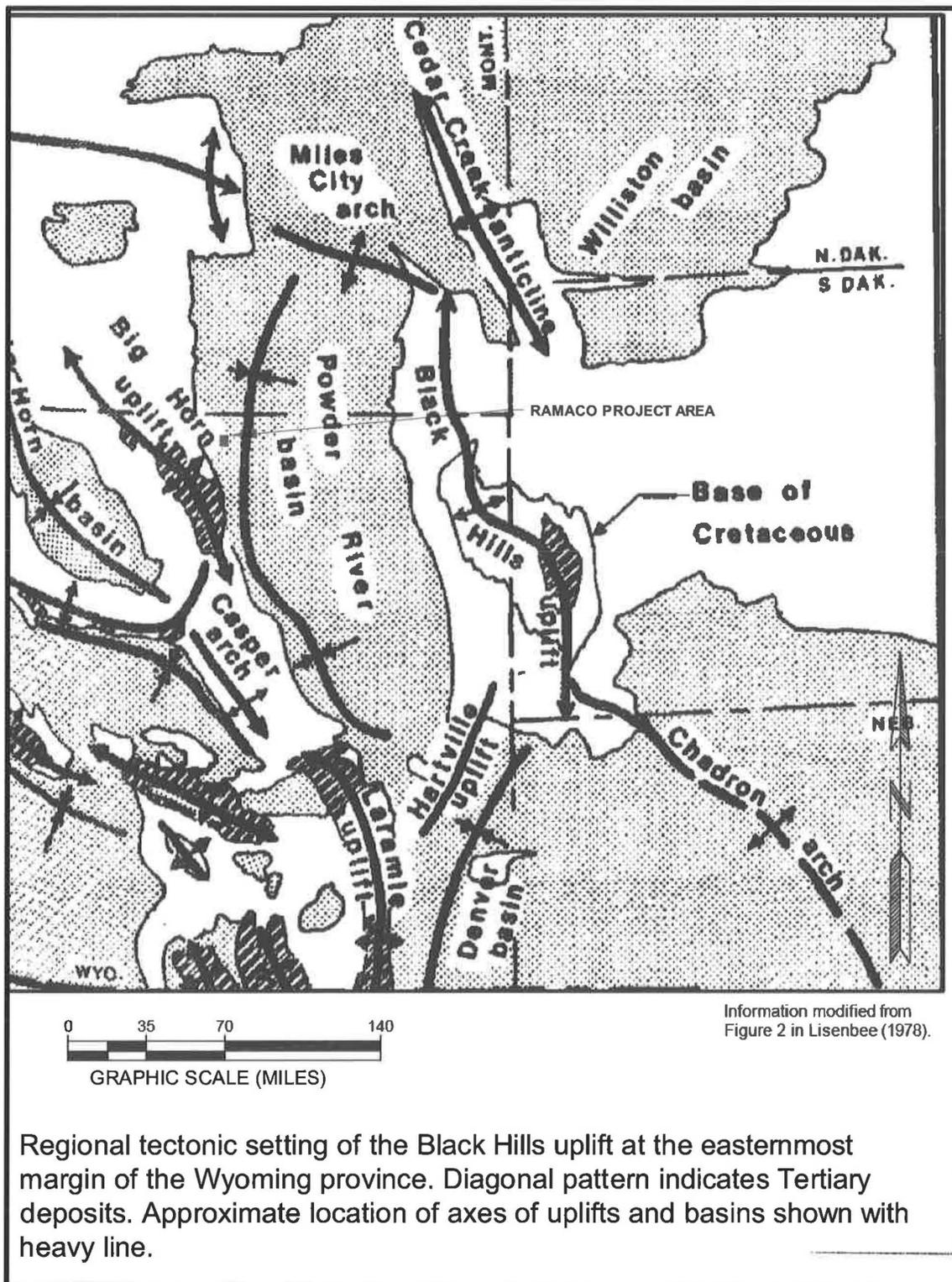
Table D5.4-2. WDEQ/LQD Guideline No. 1 Overburden Reclamation/Restoration Analyte Exceedance Summary

Hole No.	Sample Range (ft)		n	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 (%)		
	from	to		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 CaCO₃ 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)

TFN 6 2/025
 RECD OCT 23, 2015



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

TFN 6 2/025
 RECD NOV 14, 2014

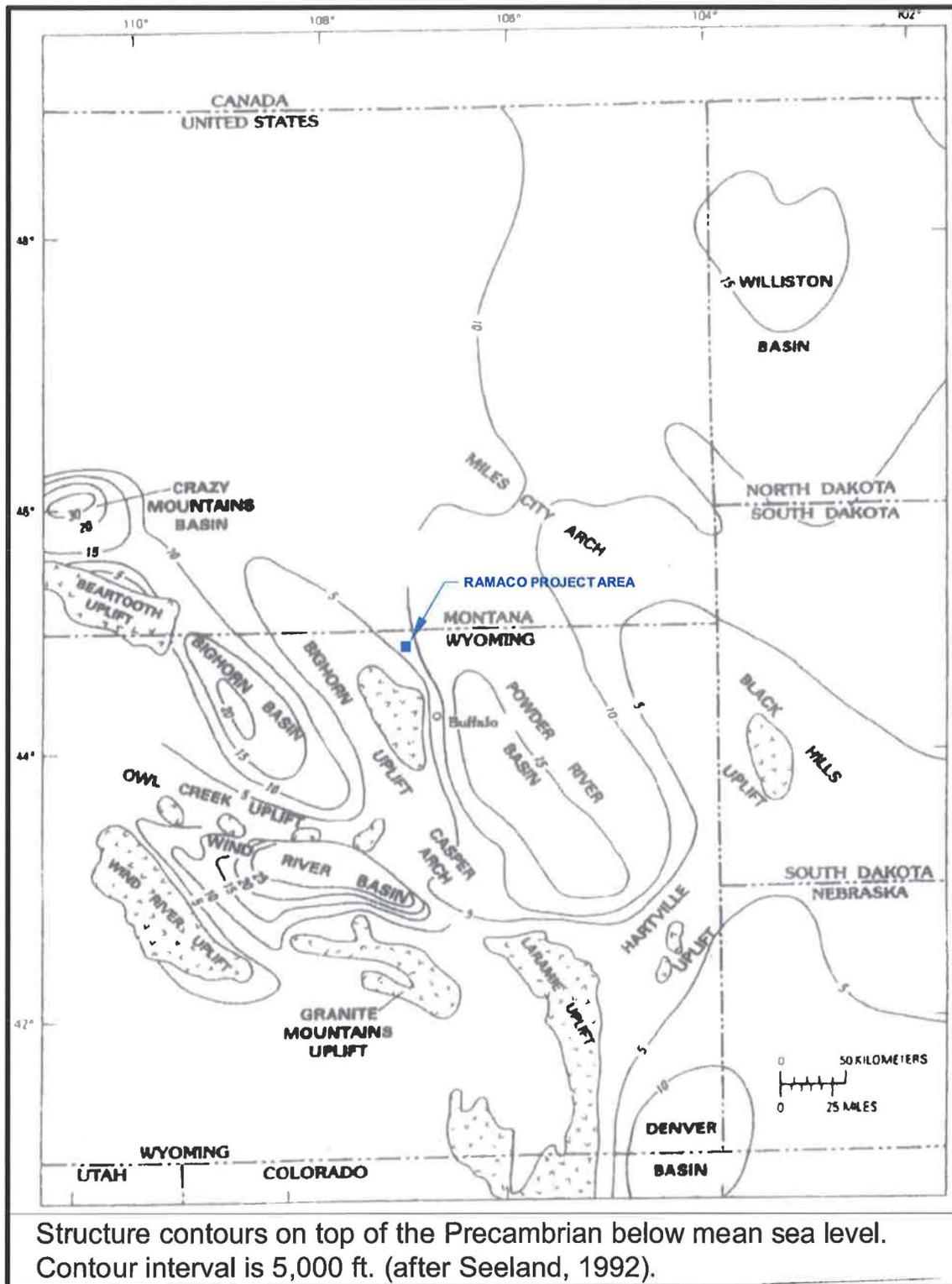
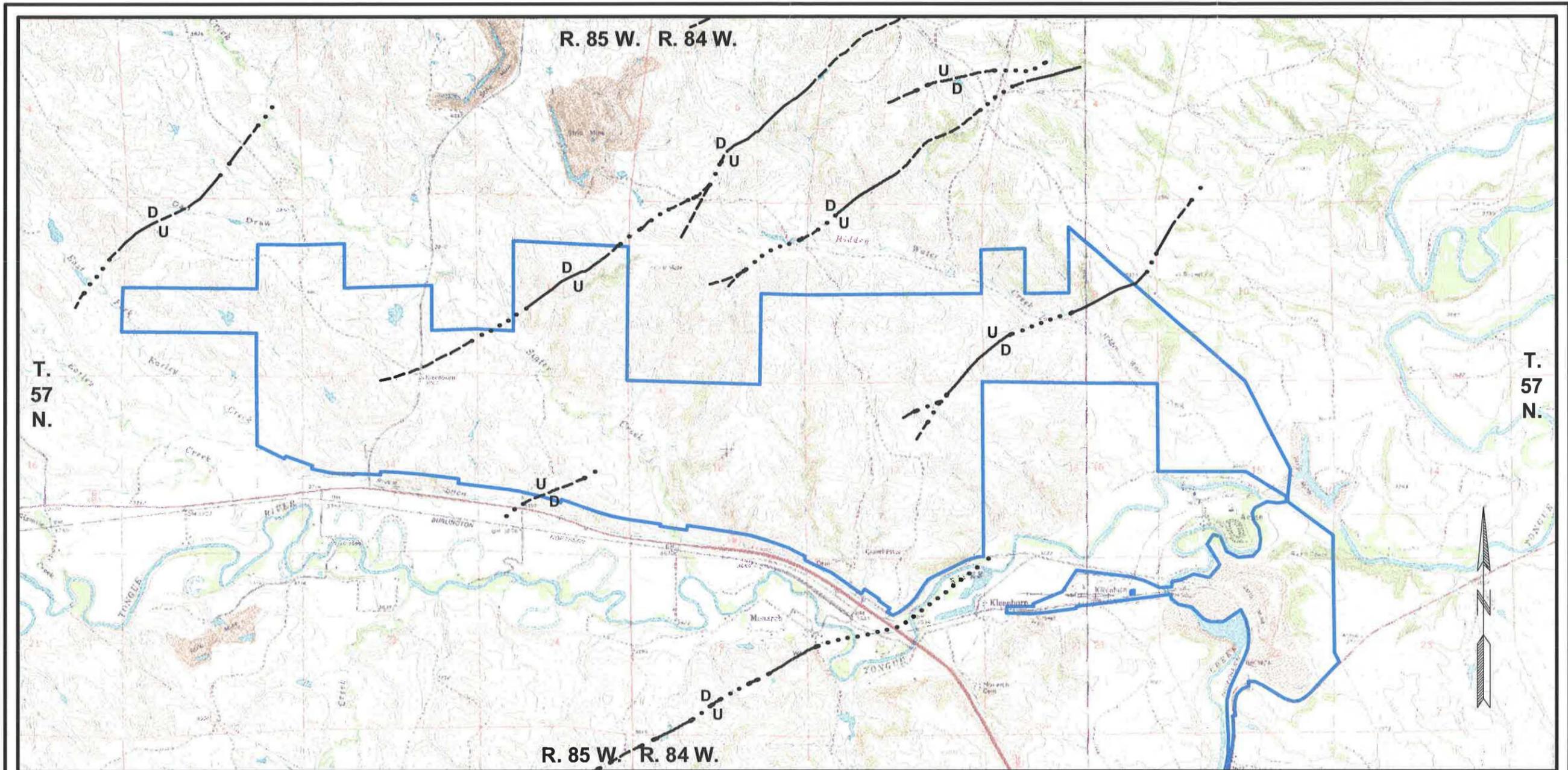


Figure D5.2-2. Generalized Geologic Structures in and near the Powder River Basin

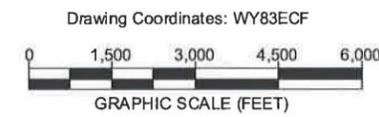
TFN 6 2/025
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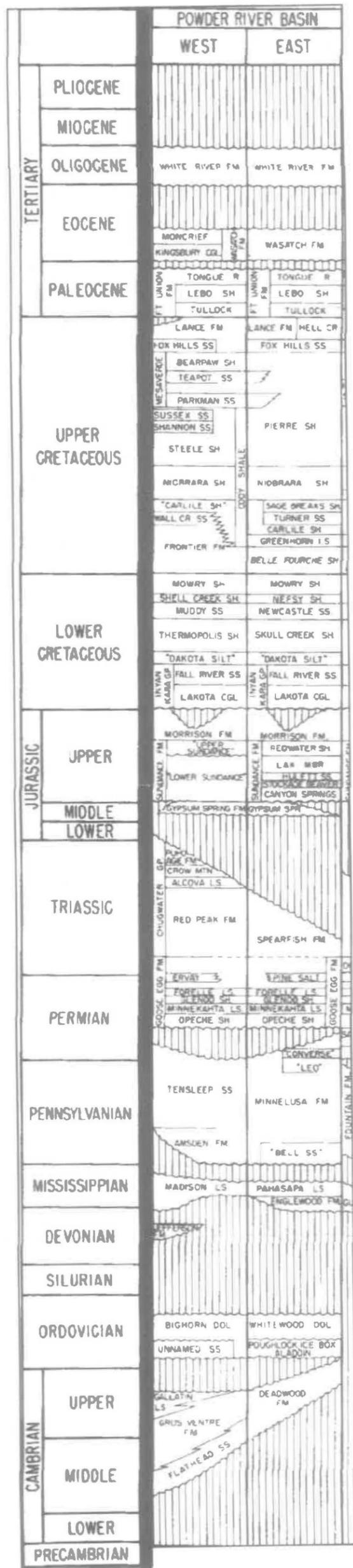
LEGEND

- 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)

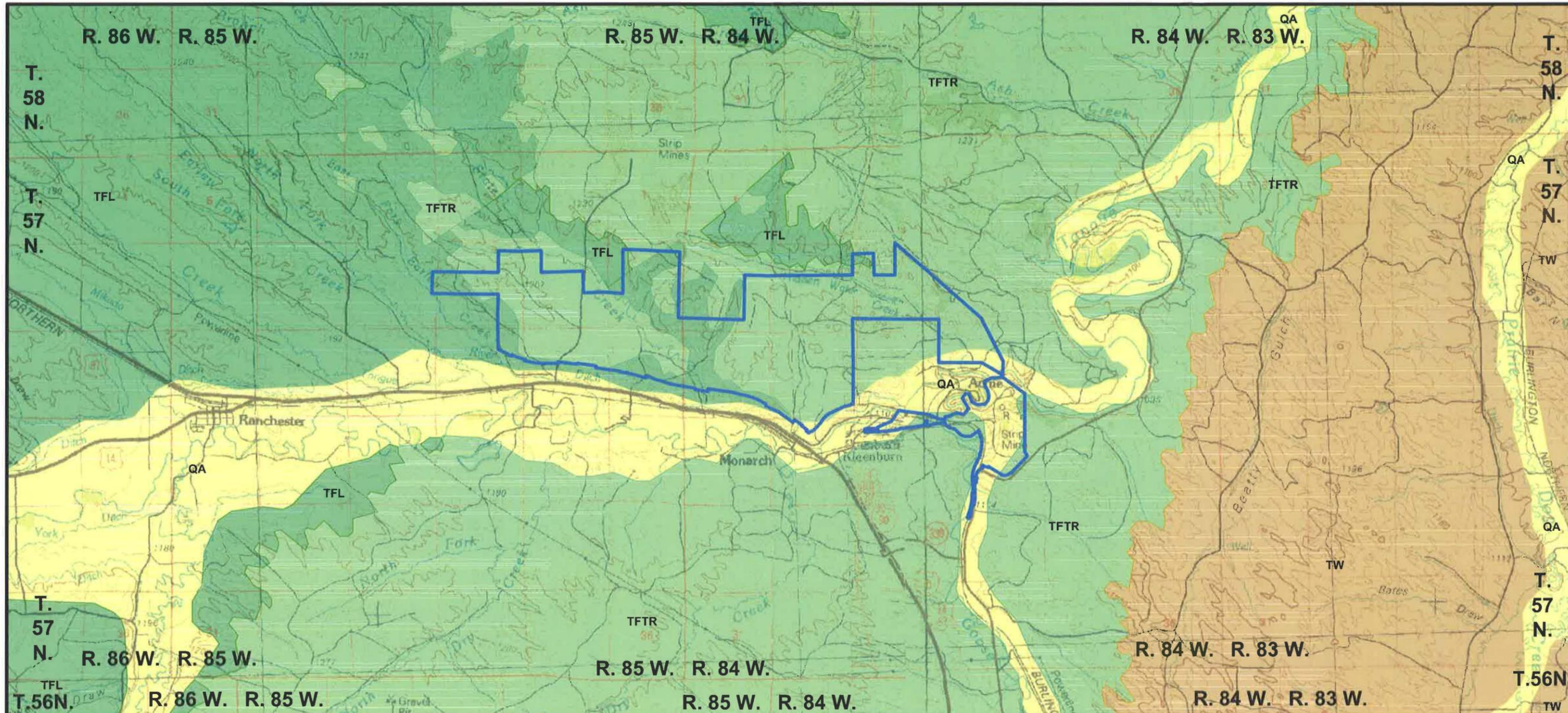


		BROOK MINE SHERIDAN COUNTY, WY 1101 SUGARVIEW DRIVE, STE. 201 SHERIDAN, WY 82801																			
		REVISIONS <table border="1"> <thead> <tr> <th>Date</th> <th>Description</th> </tr> </thead> <tbody> <tr><td> </td><td> </td></tr> </tbody> </table>		Date	Description																
Date	Description																				
FIGURE D5.2.3		FAULTS TFN 6 2 / 025 RECD NOV 14, 2014																			
Drawn By: MBM Checked By: SMR Date: 10/08/14																					

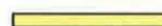
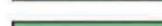
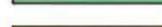


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REC'D NOV 14, 2014

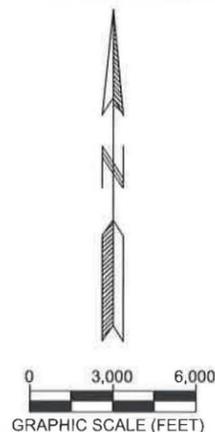
Figure D5.2-4. Regional Stratigraphic Column Modified from WGA Guidebook for 28th Annual Field Conference (1976)



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)

SOURCE: WYGISC AT UNIVERSITY OF WYOMING



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

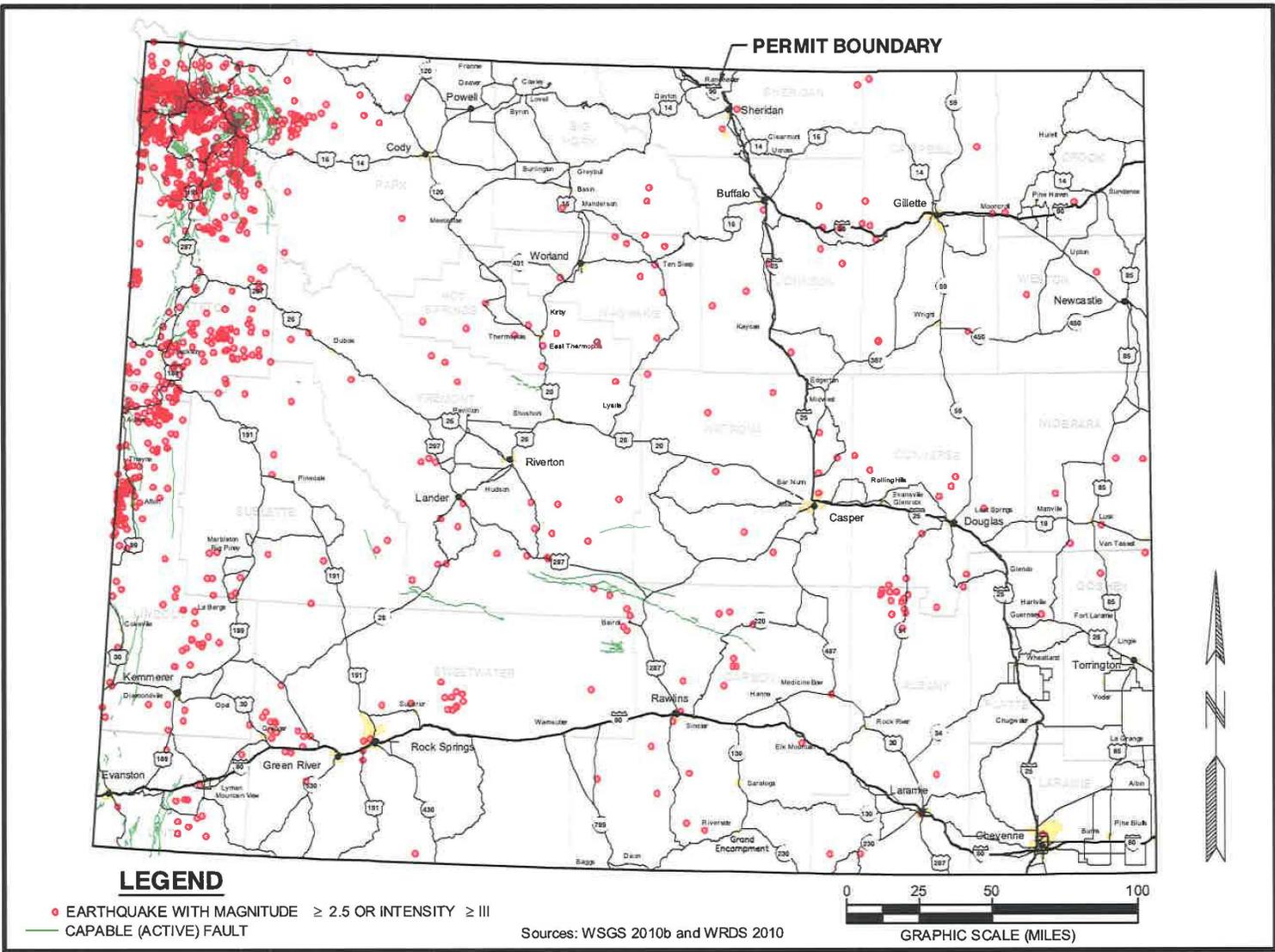


Figure D5.3-1. Historic Earthquakes in Wyoming

October 2014

TFN 6/2/025
RECD NOV 14, 2014

D5-F6

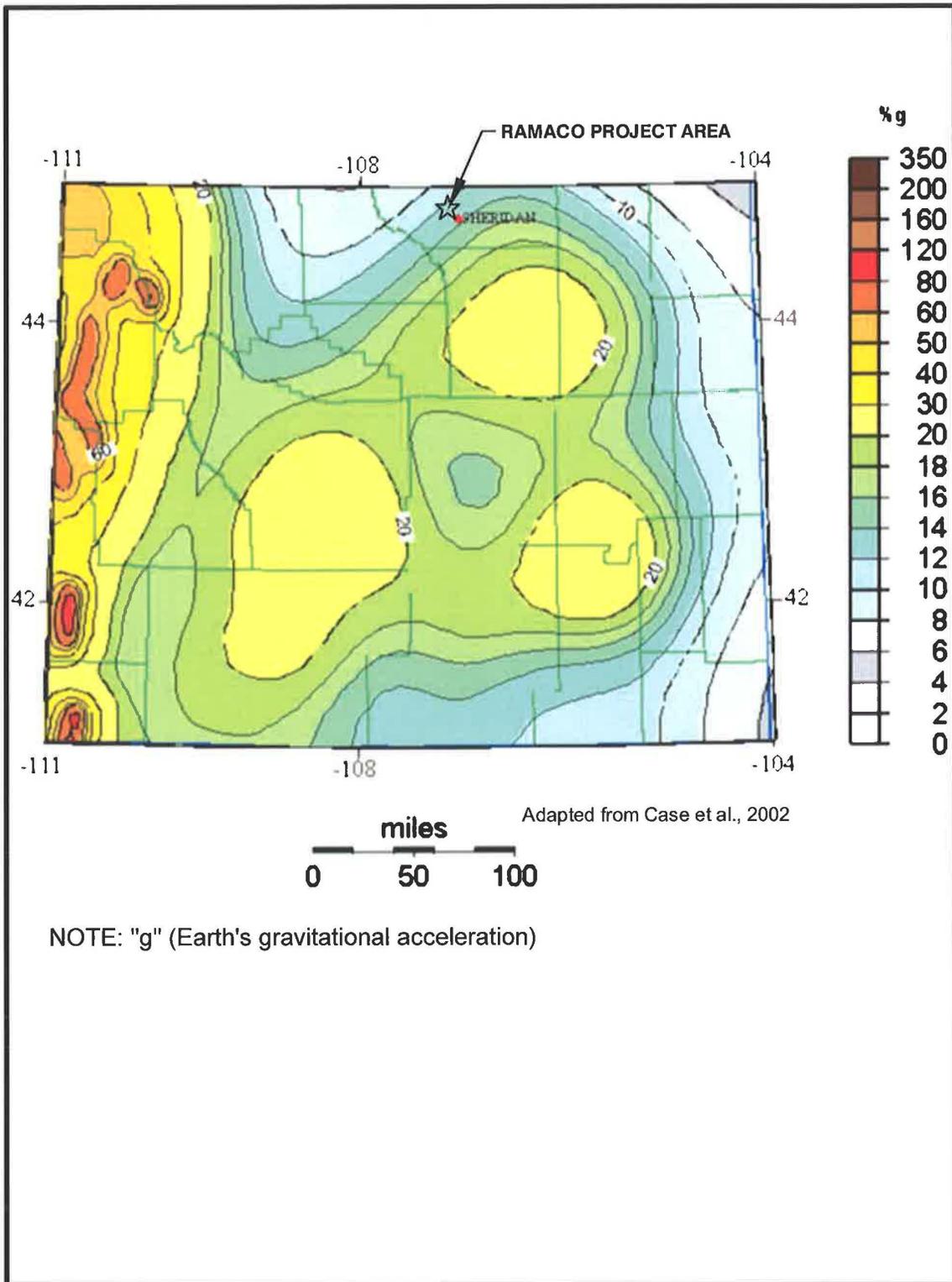
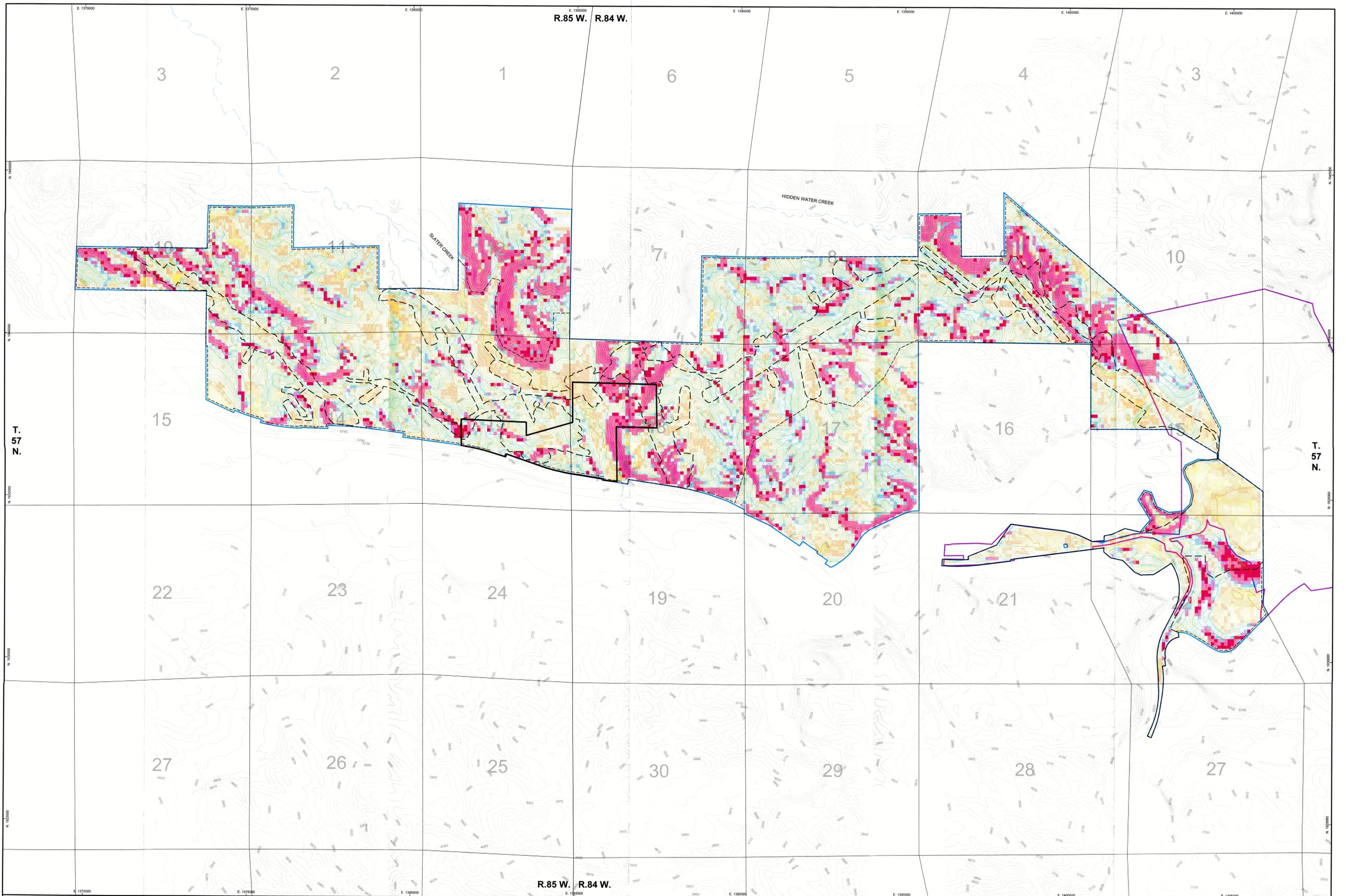


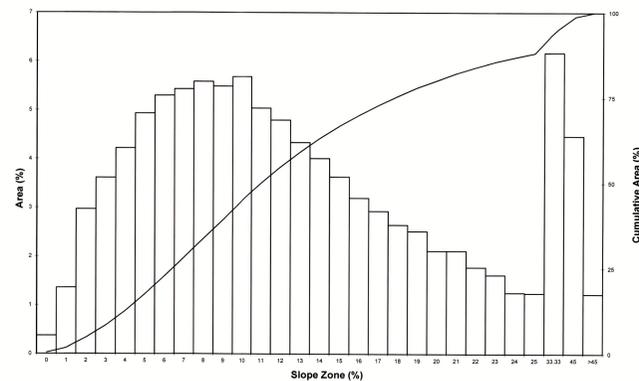
Figure D5.3-2. Expected Ground Acceleration of 2,500 Year Earthquake Event.



Slope Zone (percent)	Area (acres)	Percent of Total (percent)	Accumulated Percent (percent)
0	16.30	0.37	0.37
1	58.45	1.36	1.73
2	130.25	2.97	4.69
3	158.40	3.61	8.30
4	184.62	4.22	12.52
5	216.25	4.89	17.41
6	252.32	5.50	22.79
7	238.25	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	220.86	5.04	50.97
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	140.24	3.19	69.92
17	128.44	2.93	72.85
18	118.06	2.65	75.50
19	110.31	2.52	78.02
20	92.83	2.11	80.13
21	92.83	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	34.54	0.79	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

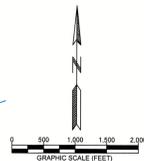
- BROOK MINE PERMIT BOUNDARY
- BIG HORN COAL PERMIT BOUNDARY (PERMIT NO. 215-17)
- TAYLOR QUARRY PERMIT BOUNDARY (PERMIT NO. SP-757)
- AFFECTED AREA BOUNDARY
- DISTURBANCE BOUNDARY

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.



TFW 6 2/025
 RECD NOV 14, 2014

		BROOK MINE SHERIDAN COUNTY, WY 1101 SUGARVIEW DR, STE. 201 SHERIDAN, WY 82801	
		PREMINE SLOPE ANALYSIS	
REVISIONS Date Description		EXHIBIT D5-1-1	
Drawn By: DCJ Checked By: JGB Date: 10/08/14			

FILE: D5_1-1_PRE_SLOPE.dwg

RAMACO

Brook Mine

ADDENDUM D5-1

**Drill Hole Tabulations
(State Plane Coordinates)**

**TFN 6 2/025
RECD JUL 30, 2015**

July 2015

Addendum D5-1-1

DEQ 5-043

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-12009	1382421.6	1937452.1	3806.1
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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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
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
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

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Type	ID	Easting	Northing	Elevation
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
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

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Type	ID	Easting	Northing	Elevation
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
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

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Type	ID	Easting	Northing	Elevation
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
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

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Type	ID	Easting	Northing	Elevation
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
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

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Type	ID	Easting	Northing	Elevation
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
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

Drill Hole Tabulations

Type	ID	Easting	Northing	Elevation
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
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

October 2014

TFN 6 2/025
RECD NOV 14, 2014

Addendum D5-1-9

DEQ 5-051

Drill Hole Tabulations

Type	ID	Easting	Northing	Elevation
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

ADDENDUM D5-2

RAMACO

Brook Mine

ADDENDUM D5-2

Lithologic and Geophysical Logs

**TFN 6 2/025
RECD JUL 30, 2015**

July 2015

Addendum D5-2-1

DEQ 5-054

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.



TFN 6 2/025
RECD JUL 30, 2015

Hole/Well No.: R12-001	Recorded By: M. Wolf WYPG #614	Drilling Co.: A-3 Services; Shawn Ankney Depth: 0 To 121
Company: RAMACO	Geophysical Log Type: Coal suite	CORED: 15-30'; See Page 2 50-80'
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		DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
From	To					
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

TFN 6 2/025
RECD JUL 30, 2015

SWL – Static Water Level
ZP – Ziplock Bag Sample

DEPTH		DESCRIPTION OF MATERIALS (ASTM D2488)
From	To	
		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	Claystone, 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'
ABBREVIATIONS		
BGL – Below Ground Level		GS – Geochemical Sample
DBS – Disturbed Bulk Sample		LA – Laboratory Analysis
GPM – Gallon Per Minute		SWL – Static Water Level
		ZP – Ziplock Bag Sample

TFN 6 2/025
 RECD JUL 30, 2015

Hole/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		DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
From	To					
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				

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

Hole/Well No.: R12-003	Recorded By: M. Wolf WYPG #614	Drilling Co.: A-3 Services; Shawn Ankney Depth: 0 To 142
Company: RAMACO	Geophysical Log Type:	CORED: 55-77 and 105-115
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		DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
From	To					
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

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

GS – Geochemical Sample
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SWL – Static Water Level
ZP – Ziplock Bag Sample

TFN 6 2/025
RECD JUL 30, 2015

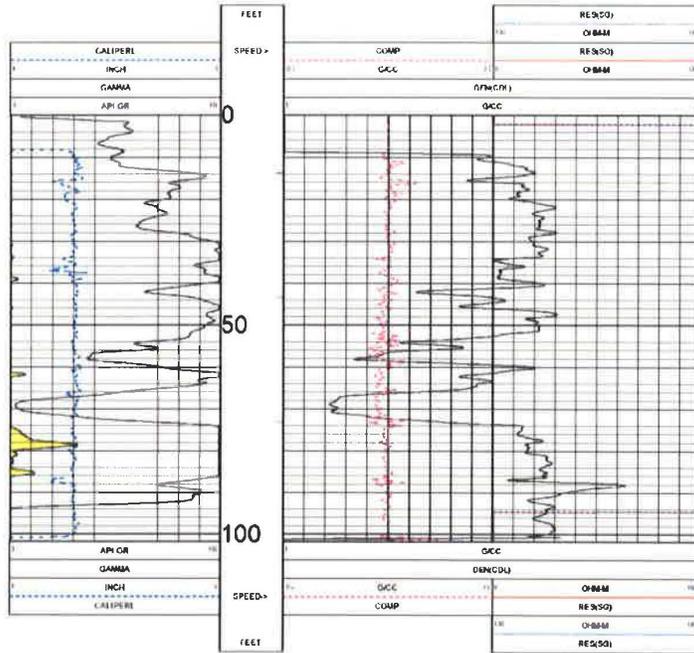
		GAMMA-RES-DENSITY R-12003	
COMPANY	RAMACO, LLC	WELL	R-12003
FIELD	NEBE	COUNTY	SPEERMAN
STATE	WV	LOCATION	SPEERMAN COAL FIELD
SECTION	15	TOWNSHIP	67N
RANGE	65W	APPRO	NA
UNIQUE WELL ID	NA	LOG NUMBER	1227172
LOG NUMBER PREFIX	NA	ELEVATION OF NA	NA
DR. VERSION FROM LOG	NA	ELEVATION OF NA	NA
DATE	12/27/12	LOG NUMBER	AJ SERVICES
DEPTH ORIFER	122	LOGGER TP	LOG
BIT SIZE	5.625	ARRIVAL TIME	1230
LOG TOP	0.90	DEPARTURE TIME	1333
LOG BOTTOM	101.90	CIRC STOPPED	NA
CASING OD	NA		
CASING BOTTOM	NA		
CASING TYPE	NA		
BOND-OUTLET	WATER		
PLATE SPACATURE	NA		
LOG WEIGHT	NA		
WIPESSED BY	K. WOLF		
RECORDED BY	J. CAMPBELL		
REMARKS 1	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 COL 5 inch 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 COL 5 inch 5 31 12 0 11/28/2012 VERSION = 3.64KF

TOOL CALIBRATION R-12003 12/07/12 13 25
 TOOL: 8238C1 TM VERSION 2025
 SERIAL NUMBER: 2748

DATE	TIME	SENSOR	STANDARD	RESPONSE
3	3pm06 12 07 34 00	GAMMA	0.000	API GR 1.000
3	3pm06 12 07 36 00	GAMMA	340.000	SAPOR 227.000
3	3pm04 12 08 20 34	VOLTAGE	0.000	RAV 10623.000
3	3pm04 12 08 20 34	VOLTAGE	2023.000	RAV 292630.000
3	Feb08 12 07 57 24	CALLIPER	6.000	INCH 268608.000
3	Feb08 12 07 52 24	CALLIPER	6.000	INCH 358967.000
3	Nov28 12 10 50 31	DEN(LS)	1.800	EGCC 5346.000
3	Nov28 12 10 50 31	DEN(LS)	2.612	EGCC 758.000
3	Nov28 12 15 47 08	DEN(SS)	1.800	EGCC 19328.000
3	Nov28 12 15 47 08	DEN(SS)	2.600	EGCC 6811.000
3	Nov28 12 11 08 37	CALLIPER	6.000	INCH 266712.094
3	Nov28 12 11 08 37	CALLIPER	11.200	INCH 454202.888
3	3pm04 12 08 21 19	CURRENT	0.000	RA 5183.000
3	3pm04 12 08 21 19	CURRENT	298.000	RA 29827.000
3	Jan25 12 14 32 18	P	Default	CPB
3	Jan25 12 14 32 18	X	Default	CPB

TFN 6 2/025
 RECD JUL 30, 2015

Hole/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		DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
From	To					
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 ₂ O 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'-106'=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

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July 2015

TFN 6 2/025
RECD JUL 30, 2015
Addendum D5-2-12

DEPTH		DESCRIPTION OF MATERIALS (ASTM D2488)
From	To	
		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
101.4	102.2	Coal; dull, clay rich
102.2	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'
ABBREVIATIONS		
BGL – Below Ground Level	GS – Geochemical Sample	SWL – Static Water Level
DBS – Disturbed Bulk Sample	LA – Laboratory Analysis	ZP – Ziplock Bag Sample
GPM – Gallon Per Minute		

July 2015

TFN 6 2/025
 RECD JUL 30, 2015
 Addendum D5-2-13

DEQ 5-066

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		DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
From	To					
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

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 OCT 23, 2015

Hole/Well No.: R12-006	Recorded By: M. Wolf WYPG #614	Drilling Co. : A-2 Services; Shawn Ankney Depth: 0 To 300
Company: RAMACO	Geophysical Log Type: Coal Suite	CORED:136.4- See Core Description 161 and 176-191
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		DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
From	To					
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 ₂ O < ½ GPM
144	145	Claystone	1.0	CL	Parting	
145	154.5	Coal; black, hard	9.5	CØ	L Carney	H ₂ O < 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

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

July 2015

TFN 6 2/025
 RECD JUL 30, 2015
 Addendum D5-2-18

DEQ 5-071

RAMACO

Brook Mine

Century
 GEOTECHNICAL
 century-geotech.com

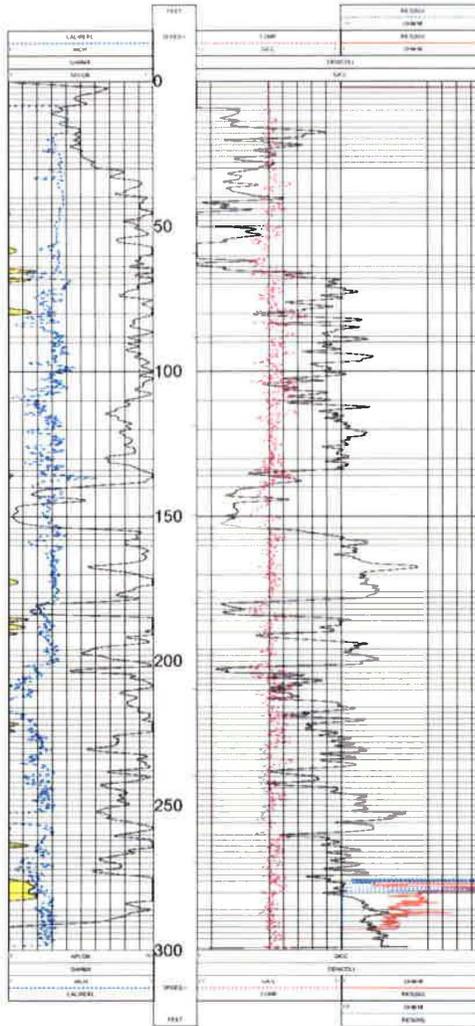
GAMMA-RAY DENSITY
 R-12006

LOG NUMBER: R-12006
 LOG DATE: 01/07/13
 LOG TIME: 09:00
 LOG LOCATION: 3029 Ramapo Blvd, Suite 132, York, PA 17403
 LOG OPERATOR: JDB
 LOG REVIEWER: JDB
 LOG APPROVED: JDB
 LOG SCALE: 1:1
 LOG UNIT: INCHES
 LOG CORRECTION: NONE
 LOG COMMENTS: NONE

5 INCH LOG, DENSITY R-12006 01/07/13

LOG PARAMETERS

MATRIX DENSITY: 2.65 NEUTRON/MATRIX: SANDSTONE MATRIX DELTA T: 54
 MAGNETIC SUSC: 10 ELECT. CORRECT: 0000 DT GRC: 0.124
 PRESENTATION NAME GATE: 3029 Ramapo Blvd, Suite 132, York, PA 17403 VERSION: 1.0



5 INCH LOG, DENSITY R-12006 01/07/13

LOG PARAMETERS

MATRIX DENSITY: 2.65 NEUTRON/MATRIX: SANDSTONE MATRIX DELTA T: 54
 MAGNETIC SUSC: 10 ELECT. CORRECT: 0000 DT GRC: 0.124
 PRESENTATION NAME GATE: 3029 Ramapo Blvd, Suite 132, York, PA 17403 VERSION: 1.0

TICK CALIBRATION 5 INCH LOG, DENSITY R-12006 01/07/13

DATE	TIME	DEPTH	DENSITY	NEUTRON	DT GRC	RESPONSE
01/07/13	09:00	0	2.65	0.00	0.124	0.00
01/07/13	09:00	50	2.65	0.00	0.124	0.00
01/07/13	09:00	100	2.65	0.00	0.124	0.00
01/07/13	09:00	150	2.65	0.00	0.124	0.00
01/07/13	09:00	200	2.65	0.00	0.124	0.00
01/07/13	09:00	250	2.65	0.00	0.124	0.00
01/07/13	09:00	300	2.65	0.00	0.124	0.00

TFN 6 2/025
 RECD JUL 30, 2015
 Addendum D5-2-20

July 2015

DEQ 5-073

WWC Engineering
DRILLING LOG

K:\Sheridan\RAMACO\13139\ID-5\Work\Drilling Logs\R12-007.docx

Hole/Well No.: R12-007	Recorded By: M. Wolf WYPG #614	Drilling Co.: A-3 Services; Shawn Ankney Depth: 0 To 39
Company: RAMACO	Geophysical Log Type: Coal suite	CORED: See page 2 60-68.5, 95-110 and 130-140
Project: Brook Mine	Hole Type: Pilot & Twin for coal core	Date Drilled: 11-29-12
County: Sheridan WY	5 3/4"	
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		DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
From	To					
0	24	Burn-scoria; very hard, losing circulation, injected H ₂ O and soap, change to drag bit – hand change to 8 3/4 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 ₂ O 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	
57	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

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

GS – Geochemical Sample
LA – Laboratory Analysis

SWL – Static Water Level
Block Bag Sample

TFN 6 27025

RECD JUL 30, 2015

Addendum D5-2-21

July 2015

DEPTH		DESCRIPTION OF MATERIALS (ASTM D2488)
From	To	
		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	GS – Geochemical Sample	SWL – Static Water Level
DBS – Disturbed Bulk Sample	LA – Laboratory Analysis	ZP – Ziplock Bag Sample
GPM – Gallon Per Minute		

TFN 6 2/025

RECD JUL 30, 2015

Addendum D5-2-22

July 2015

Hole/Well No.: R12-008		Recorded By: M. Wolf WYPG #614		Drilling Co: A-3 Services; Shawn Ankney Depth: 0 To 201		
Company: RAMACO		Geophysical Log Type: Coal Suite		Cored: 35-60 and 81-91		
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		DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
From	To					
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						
BGL – Below Ground Level		GS – Geochemical Sample		SWL – Static Water Level		
DBS – Disturbed Bulk Sample		LA – Laboratory Analysis		ZP – Ziplock Bag Sample		
GPM – Gallon Per Minute						

TFN 6 2/025
RECD JUL 30, 2015

Hole/Well No.: AMBRE-03		Recorded By: M. Wolf WY PG #614		Drilling Co.: A-3 Services		
Company: RAMACO		Geophysical Log Type: Coal Suite		Depth: 0' To 96'		
Project: Brook Mine		Hole Type: core coal intervals indicated in plan		CORED: 51-96'		
County: Sheridan WY		Water:		Date Drilled: 01-10-13		
Township: 57N Range: 84W						
Location: NWSW Section: 9						
N:1,941,775.3 E:1,398,109.2						
Elevation: 3726.8						
DEPTH		DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
From	To					
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 1/2'				
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		GS – Geochemical Sample		SWL – Static Water Level		
DBS – Disturbed Bulk Sample		LA – Laboratory Analysis		ZP – Ziplock Bag Sample		
GPM – Gallon Per Minute						

TFN 6 2/025
RECD OCT 23, 2015

Hole/Well No.: R12-010	Recorded By: M. Wolf WYPG #614	Drilling Co.: A-3 Services; Shawn Ankney Depth: 0 To 120
Company: RAMACO	Geophysical Log Type:	CORED: No Core
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		DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
From	To					
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 91'-92'=1.0' Local 98'-99'=1.0' Local Thin Beds Below Carney/Masters				
		Note: Beds of insufficient thickness to justify coal core "No Coal Core"				
		P&A: Pilot Hole 24 sacks				

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

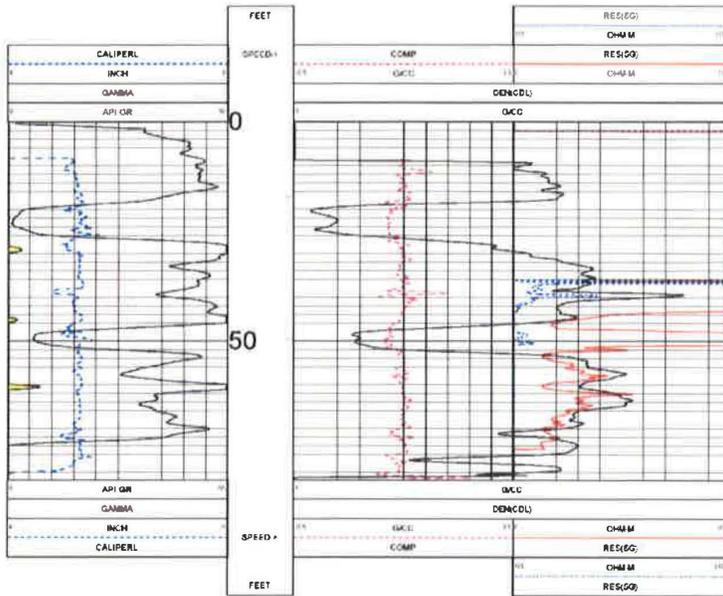
RECD JUL 30, 2015

Addendum D5-2-29

July 2015

		GAMMA-RES-DENSITY R-12011	
COMPANY: RAMACO, LLC WELL: R-12011 FIELD: NEW COUNTY: SHERIDAN STATE: WY	LOCATION: SHERIDAN COAL FIELD SECTION: 13 TOWNSHIP: 57N RANGE: 86W API NO: NA UNIQUE WELL ID: NA	PERMANENT LOG: Q LOG MEASURED FROM: GL DRI MEASURED FROM: GL DATE:	ELEVATION: NA ELEVATION OF: NA ELEVATION GL: NA LOG NUMBER: NA LOG SUFFIX:
Casing Type: NA Borehole Fluid: WATER Mud Res: NA Mud Weight: NA Recognized by: JC-MARBLE Remarks 1: NA Remarks 2: NA	Casing Bottom: NA Casing Type: NA Borehole Fluid: WATER Mud Res: NA Mud Weight: NA Recognized by: JC-MARBLE Remarks 1: NA Remarks 2: NA	Depth Driller: RZ Bit Size: 5.875 Log Top: 6.92 Log Bottom: 81.50 Casing OD: NA Casing ID: NA Casing Type: NA Borehole Fluid: WATER Mud Res: NA Mud Weight: NA Recognized by: JC-MARBLE Remarks 1: NA Remarks 2: NA	Other Services: NA NA NA

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 00000	BIT SIZE 5.875	
PRESENTATION NAME/DATE = 9230 Ramaco Std CDL 5inch 12-1-12-0 11/28/2012 VERSION = 3.84KF			



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 00000	BIT SIZE 5.875	
PRESENTATION NAME/DATE = 9230 Ramaco Std CDL 5inch 12-1-12-0 11/28/2012 VERSION = 3.84KF			

DATE	TIME	SENSOR	STANDARD	RESPONSE
1	Sep05.12 07:38:00	GAMMA	0.080	1.000 (CP)
2	1	GAMMA	340.000	327.000 (CP)
3	1	VOLTAGE	0.000	10823.000 (CP)
4	1	VOLTAGE	2023.000	282830.000 (CP)
5	1	CALIPER	4.000	288409.000 (CP)
6	1	CALIPER	8.000	308867.000 (CP)
7	1	DENLS	1.820	5245.000 (CP)
8	1	DENLS	2.412	736.000 (CP)
9	1	DENLS	1.500	18339.000 (CP)
10	1	DENRES	2.580	8811.000 (CP)
11	1	CALIPER	5.000	29712.000 (CP)
12	1	CALIPERL	11.260	43402.666 (CP)
13	1	CURRENT	0.000	5183.000 (CP)
14	1	CURRENT	289.860	30622.000 (CP)
15	1	F	Default	(CP)
16	1	X	Default	(CP)

TFN 6 2/025
 RECD JUL 30, 2015

Hole/Well No.: R12-013	Recorded By: M. Wolf WYPG #614	Drilling Co. : A-3 Services; Shawn Ankney Depth: 0 To 300
Company: RAMACO	Geophysical Log Type: Coal Suite	CORED: No Core Collected
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		DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
From	To					
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
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

RAMACO

Brook Mine

Century
MINING SERVICES

GAMMA-RS-DENSITY
R-12013

WELL: R-12013
DATE: 12/26/12
LOG TYPE: 5 INCH LOG
LOG NUMBER: 12/26/12
LOG TITLE: 5 INCH LOG, DENSITY

LOG PARAMETERS:
MATRIX DENSITY: 2.65
MAGNETIC DECL: NA
PRESENTATION NAME/GATE: R-12013 Ramaco BM CCL South 12 1 12 0

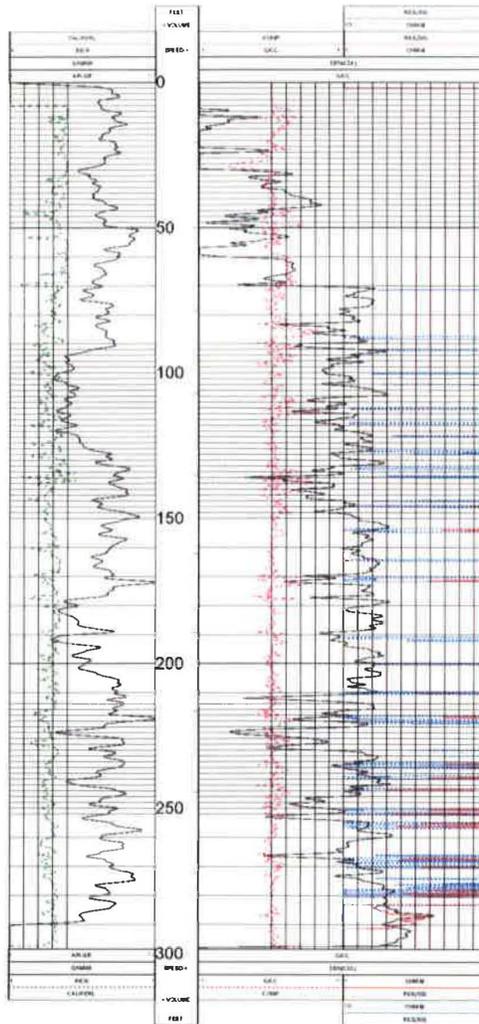
LOG PARAMETERS:
NEUTRON MATRIX: SANDSTONE
ELECT CUT/OFF: 00000
MATRIX DELTA T: 74
BIT SIZE: 5.625

VERSION: 3.846F

5 INCH LOG, DENSITY R-12013 12/26/12

LOG PARAMETERS

MATRIX DENSITY: 2.65 NEUTRON MATRIX: SANDSTONE MATRIX DELTA T: 74
MAGNETIC DECL: NA ELECT CUT/OFF: 00000 BIT SIZE: 5.625
PRESENTATION NAME/GATE: R-12013 Ramaco BM CCL South 12 1 12 0 VERSION: 3.846F



5 INCH LOG, DENSITY R-12013 12/26/12

LOG PARAMETERS

MATRIX DENSITY: 2.65 NEUTRON MATRIX: SANDSTONE MATRIX DELTA T: 74
MAGNETIC DECL: NA ELECT CUT/OFF: 00000 BIT SIZE: 5.625
PRESENTATION NAME/GATE: R-12013 Ramaco BM CCL South 12 1 12 0 VERSION: 3.846F

TOOL CALIBRATION R-12013 (CONT.) IN IN

DATE	TIME	DEPTH	TOOL	LOG	LOG	LOG	LOG	LOG	LOG
12/26/12	14:00:00	0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12/26/12	14:00:00	10	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12/26/12	14:00:00	20	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12/26/12	14:00:00	30	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12/26/12	14:00:00	40	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12/26/12	14:00:00	50	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12/26/12	14:00:00	60	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12/26/12	14:00:00	70	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12/26/12	14:00:00	80	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12/26/12	14:00:00	90	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12/26/12	14:00:00	100	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12/26/12	14:00:00	110	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12/26/12	14:00:00	120	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12/26/12	14:00:00	130	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12/26/12	14:00:00	140	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12/26/12	14:00:00	150	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12/26/12	14:00:00	160	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12/26/12	14:00:00	170	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12/26/12	14:00:00	180	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12/26/12	14:00:00	190	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12/26/12	14:00:00	200	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12/26/12	14:00:00	210	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12/26/12	14:00:00	220	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12/26/12	14:00:00	230	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12/26/12	14:00:00	240	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12/26/12	14:00:00	250	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12/26/12	14:00:00	260	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12/26/12	14:00:00	270	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12/26/12	14:00:00	280	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12/26/12	14:00:00	290	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12/26/12	14:00:00	300	0.000	0.000	0.000	0.000	0.000	0.000	0.000

TFN 6 2/025
RECD JUL 30, 2015

July 2015

Addendum D5-2-38

Hole/Well No.: R12-014		Recorded By: M. Wolf WYPG #614		Drilling Co. : A-3 Services; Shawn Ankney		
Company: RAMACO		Geophysical Log Type: Coal Suite		Depth: 0 To 220		
Project: Brook Mine		Hole Type: pilot, e-log, & twin for coal core		CORED: NO CORE		
County: Sheridan WY		NAD 1983, East Central Zone		Date Drilled: 12-19-12		
Township: 57N Range: 85W						
Location: NESE Section: 12						
N: 1,942,438.4 E: 1,383,971.4						
Elevation: 3953.5						
DEPTH		DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
From	To					
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						
BGL – Below Ground Level		GS – Geochemical Sample		SWL – Static Water Level		
DBS – Disturbed Bulk Sample		LA – Laboratory Analysis		ZP – Ziplock Bag Sample		
GPM – Gallon Per Minute						

TFN 6 2/025

RECD JUL 30, 2015

Hole/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		DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GMP
From	To					
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	

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

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		DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
From	To					
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

GS – Geochemical Sample
LA – Laboratory Analysis

SWL – Static Water Level
ZP – Ziplock Bag Sample

TFN 6 2/025
RECD JUL 30, 2015

Hole/Well No.: R12-019D	Recorded By: M. Wolf WYPG #614	Drilling Co.: A-3 Services; Shawn Ankney Depth: 0 To 140
Company: RAMACO	Geophysical Log Type: Coal suite	CORED: 45 To 96
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		DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
From	To					
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	See Core Log
56	59	Coal; harder	3.0	CØ	U Mon	
59	60	Claystone	1.0	CL		
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
 DBS – Disturbed Bulk Sample
 GPM – Gallon Per Minute

GS – Geochemical Sample
 LA – Laboratory Analysis

SWL – Static Water Level
 ZP – Ziplock Bag Sample

TEN 6 2/025

RECD JUL 30, 2015

DEPTH		DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
From	To					
		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				
ABBREVIATIONS						
BGL – Below Ground Level		GS – Geochemical Sample		SWL – Static Water Level		
DBS – Disturbed Bulk Sample		LA – Laboratory Analysis		ZP – Ziplock Bag Sample		
GPM – Gallon Per Minute						

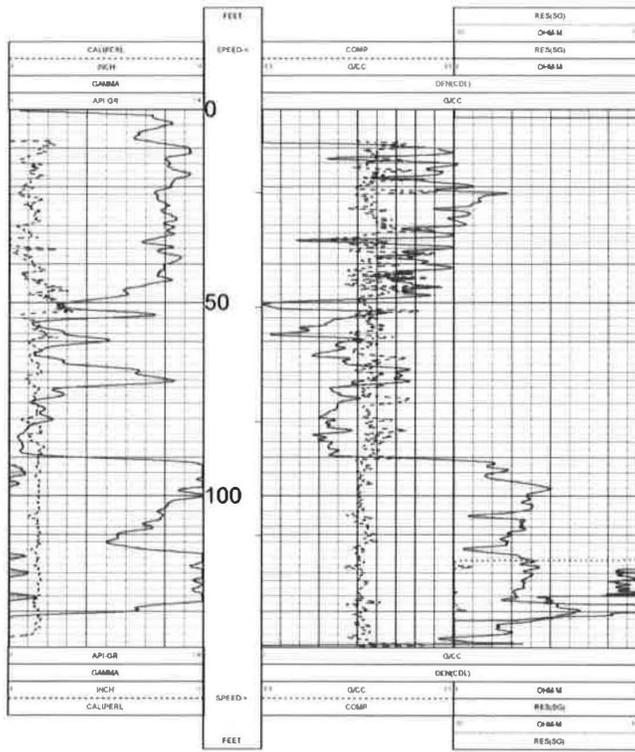
TFN 6 2/025
 RECD JUL 30, 2015

RAMACO

Brook Mine

		GAMMA-RES-DENSITY R-12019D	
COMPANY: RAMACO LLC WELL: 4-12019D FIELD: NA COUNTY: SPENDING STATE: WV	OTHER SERVICES: NA NA NA	LOCATION: SHENANDOAH CO., W. VA. SECTION: 13 TOWNSHIP: 5N RANGE: 8W API NO: NA UNCLUSE WELL ID: NA	
PERFORMANCE DATA: NA LOG HEADLINE: NA DEL. HEADLINE FROM LOG: NA	ELEVATION: NA ELEVATION OF: NA DEL. ELEVATION: NA	DATE: 11/27/12 DEPTH START: 140 DEPTH END: 140 LOG TOP: 5.25 LOG BOTTOM: 136.20 CASING ID: NA CASING BOTTOM: NA CASING TYPE: NA BENCHM. POINT: WATER BENCHM. ELEV.: NA MTD RES: NA MTD WGTCH: NA WGTCHES BY: J. CAMPBELL RECORDED BY: NA REVISION: NA	

5 INCH LOG, DENSITY R-12019D 11/27/12			
LOG PARAMETERS			
MATRIX DENSITY	2.65	NEUTRON MATRIX	SANDSTONE
MAGNETIC DECL.	10	ELECT. CUTOFF	99999
PRESENTATION NAME/DATE = 0230 Ramaco Sld CDL 5inch 5-31-12 0		VERSION = 3.64KF	



5 INCH LOG, DENSITY R-12019D 11/27/12			
LOG PARAMETERS			
MATRIX DENSITY	2.65	NEUTRON MATRIX	SANDSTONE
MAGNETIC DECL.	10	ELECT. CUTOFF	99999
PRESENTATION NAME/DATE = 0230 Ramaco Sld CDL 5inch 5-31-12 0		VERSION = 3.64KF	

DATE	TIME	SENSOR	STANDARD	RESPONSE
Sep08.12	07:36:00	GAMMA	0.000	[NPSIG] 1.000
Sep08.12	07:38:00	GAMMA	540.800	[API GR] 327.000
Sep08.12	08:20:34	VOLTAJE	0.000	[API GR] 16923.000
Fab08.12	08:20:34	VOLTAJE	2022.000	[API GR] 76230.000
Fab08.12	07:37:24	CALIBER	4.000	[API GR] 29890.000
Fab08.12	07:37:24	CALIBER	8.000	[API GR] 34887.000
Oct08.12	11:30:18	DBP(LS)	1.880	[API GR] 530.000
Oct08.12	11:30:18	DBP(LS)	2.813	[API GR] 740.000
Oct08.12	11:30:43	DBP(LS)	1.880	[API GR] 1728.000
Oct08.12	11:30:43	DBP(LS)	2.880	[API GR] 6887.000
Oct08.12	11:42:29	CALIBER	8.000	[API GR] 28748.795
Oct08.12	11:42:29	CALIBER	11.360	[API GR] 43308.188
Sep08.12	08:21:18	CURRENT	0.000	[API GR] 8183.000
Sep08.12	08:21:18	CURRENT	288.800	[API GR] 8183.000
Apr08.12	14:37:15	F	0.000	[API GR] 3862.000
Apr08.12	14:37:15	F	0.000	[API GR] 3862.000

TFN 6 2/025
 RECD JUL 30, 2015

July 2015

Addendum D5-2-50

Hole/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		DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
From	To					
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'				

ABBREVIATIONS

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

GS – Geochemical Sample
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ZP – Ziplock Bag Sample

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DEPTH		DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
From	To					
		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	
96.0	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

GL – Below Ground Level
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 GPM – Gallon Per Minute

GS – Geochemical Sample
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 ZP – Ziplock Bag Sample

TFN 6 2/025

RECD JUL 30, 2015

RAMACO

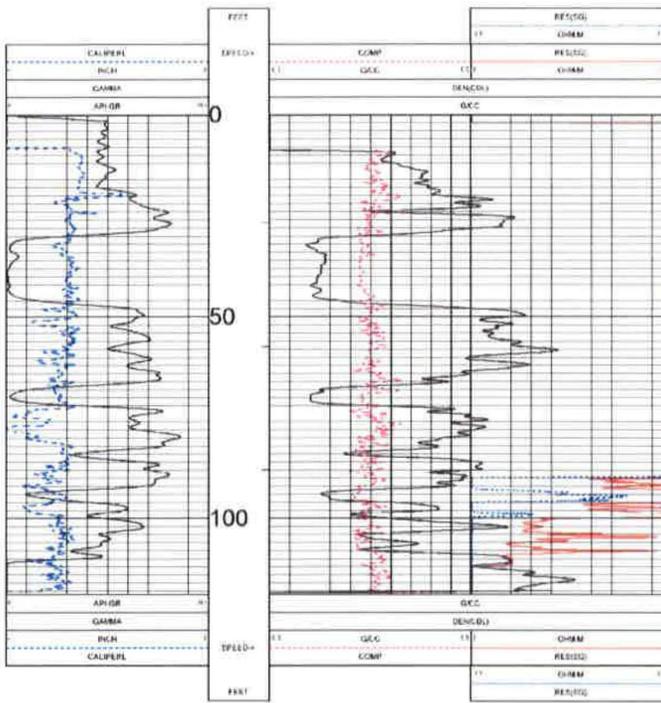
Brook Mine

		GAMMA-RES-DENSITY AMBRE-02	
COMPANY	RAMACO LLC	STATE	WV
WELL	AMBRE-02	COUNTY	SHENANDOAH
FIELD	WV/SH	OTHER SERVICES	NA
LOCATION	SHENANDOAH COAL FIELD	NA	NA
SECTION	9	NA	NA
TOWNSHIP	5TH	NA	NA
RANGE	5TH	NA	NA
PT. NO.	NA	NA	NA
UNIQUE WELL ID	NA	NA	NA
REPORTING DATE	01/09/2013	ELECT. ON	NA
LOG REVISIONS FROM 01		ELEVATION 2'	NA
DATE REVISION FROM 01		ELEVATION 3'	NA
DATE		ELEVATION 4'	NA
DATE		ELEVATION 5'	NA
DATE		ELEVATION 6'	NA
DATE		ELEVATION 7'	NA
DATE		ELEVATION 8'	NA
DATE		ELEVATION 9'	NA
DATE		ELEVATION 10'	NA
DATE		ELEVATION 11'	NA
DATE		ELEVATION 12'	NA
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DATE		ELEVATION 14'	NA
DATE		ELEVATION 15'	NA
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DATE		ELEVATION 91'	NA
DATE		ELEVATION 92'	NA
DATE		ELEVATION 93'	NA
DATE		ELEVATION 94'	NA
DATE		ELEVATION 95'	NA
DATE		ELEVATION 96'	NA
DATE		ELEVATION 97'	NA
DATE		ELEVATION 98'	NA
DATE		ELEVATION 99'	NA
DATE		ELEVATION 100'	NA

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

LOG PARAMETERS

MATRIX DENSITY 2.85 NEUTRON MATRIX SANDSTONE MATRIX DELTA T 64
 MAGNETIC DECL 10 ELECT. CUTOFF 99999 BIT SIZE 5.125
 PRESENTATION NAME/DATE = 9230 Ramaco Std C/DL 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 2.85 NEUTRON MATRIX SANDSTONE MATRIX DELTA T 64
 MAGNETIC DECL 10 ELECT. CUTOFF 99999 BIT SIZE 5.125
 PRESENTATION NAME/DATE = 9230 Ramaco Std C/DL 5inch 12.1-12.0 01/09/2013 VERSION = 3.64KF

TOOL CALIBRATION AMBRE-02 01/09/13 19:57
 LOCAL IP: 192.168.1.100
 SERIAL NUMBER: 2740

ID#	TIME	SENSOR	SERIAL#	RESPONSE
1	07:38:00	GAMMA	0.000	1.000
1	07:38:00	GAMMA	340.000	377.000
2	08:20:34	VOLTAGE	0.000	10829.000
2	08:20:34	VOLTAGE	2023.000	26239.000
3	07:37:24	CALPERL	4.000	70868.000
3	07:37:24	CALPERL	6.000	30867.000
4	10:50:31	DENGR	1.428	6246.000
4	10:50:31	DENGR	2.852	738.000
5	16:47:28	DENGR	1.480	10228.000
5	16:47:28	DENGR	2.880	8811.000
6	11:08:27	CALPERL	6.000	26871.084
6	11:08:27	CALPERL	11.250	44292.888
7	08:31:16	CURRENT	0.000	8150.000
7	08:31:16	CURRENT	388.800	28222.000
8	14:32:16	Y	0.000	0.000
8	14:32:16	Y	0.000	0.000

TFN 6 2/025
 RECD JUL 30, 2015

July 2015

Addendum D5-2-57

Hole/Well No.: AMBRE-03		Recorded By: M. Wolf WY PG #614		Drilling Co.: A-3 Services		
Company: RAMACO		Geophysical Log Type: Coal Suite		Depth: 0' To 96'		
Project: Brook Mine		Hole Type: core coal intervals indicated in plan		CORED: 51-96'		
County: Sheridan WY		Water:		Date Drilled: 01-10-13		
Township: 57N Range: 84W						
Location: NWSW Section: 9						
N:1,941,775.3 E:1,398,109.2						
Elevation: 3726.8						
DEPTH		DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
From	To					
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		GS – Geochemical Sample		SWL – Static Water Level		
DBS – Disturbed Bulk Sample		LA – Laboratory Analysis		ZP – Ziplock Bag Sample		
GPM – Gallon Per Minute						

TFN 6 2/025
RECD JUL 30, 2015

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

DEPTH		DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
From	To					
0	5	Sandy Silt; buff, few small, inject H ₂ O 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 ₂ O
90	97	Claystone; grey	7.0	CL		
97	101.9	Coal; black, hard	4.9	CØ	MASTERS	H ₂ O
101.9	105.5	Claystone; grey, firm, fissile	3.6	CL		
105.5	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			CARNEY	
		97'-101.9'=4.9' Masters			MASTERS	

ABBREVIATIONS

BGL – Below Ground Level
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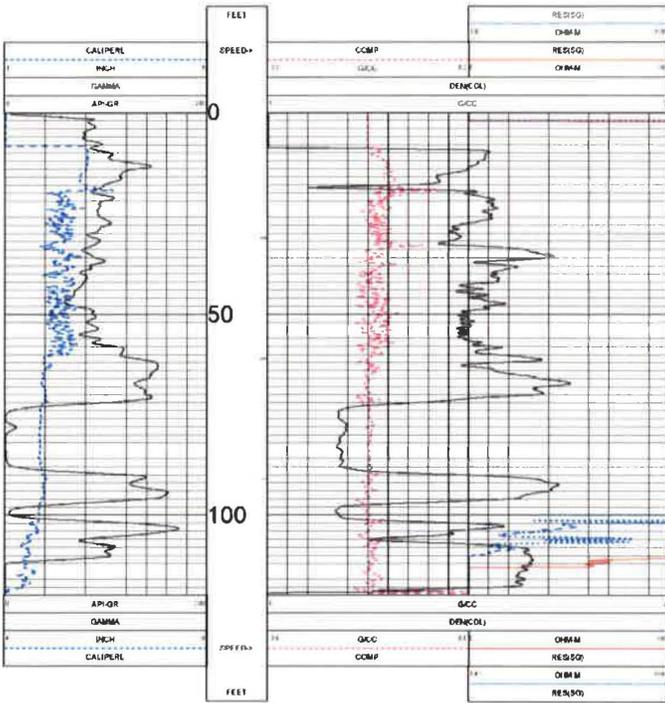
TFN 6 2/025
RECD OCT 23, 2015

		GAMMA-RES-DENSITY AMBRE-04	
COMPANY: RAMACO LLC WELL: AMBRE04 FIELD: SWEE COUNTY: SHERIDAN STATE: WY	OPERATOR: CENTURY LOCATION: SHERIDAN COAL FIELD SECTION: 9 TOWNSHIP: 57N RANGE: 64W APNO: NA UTM/Easting ID: NA	ELEVATION NG: NA ELEVATION BR: NA ELEVATION RL: NA NO. ROUSERS: NA LOG NUMBER: 198 B2 APPROVAL TIME: 1145 DEPARTURE TIME: 1210 CINC STOPPED: NA	UTILITY SERVICES NA NA NA
LOG TOP: 5225 LOG BOTTOM: 1918K CASING OD: 4 CASING ID: 20 CASING TYPE: PVC BOREHOLE FLUID: WATER PAI TEMPERATURE: NA PAI WEL: NA WIND WEIGHT: 0% WOLF WITNESSED BY: CAMPBELL RECORDED BY: NA REVISIONS: NA REVISION 2: NA	LOG TOP: 5225 LOG BOTTOM: 1918K CASING OD: 4 CASING ID: 20 CASING TYPE: PVC BOREHOLE FLUID: WATER PAI TEMPERATURE: NA PAI WEL: NA WIND WEIGHT: 0% WOLF WITNESSED BY: CAMPBELL RECORDED BY: NA REVISIONS: NA REVISION 2: NA	ALL SERVICES WERE PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS	

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 = 9230 Ramaco Std CCL 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 = 9230 Ramaco Std CCL 5inch 12-1-12 0 01/09/2013 VERSION = 3.64KF

TOOL CALIBRATION AMBRE-04 01/15/13 11:45
 TOOL ID: 87061 TR VERSION: 2005
 SERIAL NUMBER: 2140

DATE	TIME	SENSOR	STANDARD	RESPONSE
Sept08,12	07:36:00	GAMMA	0.000	1.000 [CPG]
Sept08,12	07:38:00	GAMMA	340.000	377.000 [CPG]
Sept08,12	08:30:30	VOLTAGE	0.000	1000.000 [CPG]
Sept08,12	08:30:34	VOLTAGE	2029.000	28290.000 [CPG]
Feb09,12	07:57:34	CALPERL	4.000	26800.000 [CPG]
Feb09,12	07:57:54	CALPERL	0.000	26800.000 [CPG]
Jan10,13	12:38:36	DENCL	1.620	8390.000 [CPG]
Jan10,13	12:39:06	DENCL	2.613	734.000 [CPG]
Jan10,13	12:38:49	DENBR	1.000	17151.000 [CPG]
Jan10,13	12:38:48	DENBR	2.000	8824.000 [CPG]
Jan10,13	12:38:40	CALPERL	0.000	26803.000 [CPG]
Jan10,13	12:38:40	CALPERL	11.780	44897.000 [CPG]
Sept08,12	08:21:19	CURRENT	0.000	5163.000 [CPG]
Sept08,12	08:21:19	CURRENT	289.000	28923.000 [CPG]
Jan03,12	14:37:16	F	Defeat	CPG
Jan03,12	14:37:16	X	Defeat	CPG

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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		FLUID: Mud & Polymer	TOTAL DEPTH: 385'	
COORDINATES: N: 1,930,125.6 E: 1,403,477.8		LOG BY: Mike Wolf WYPG #614	HOLE DIAMETER: 5½"	
SURVEYED: Yes				

DEPTH		DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
From	To					
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		
71	176	Claystone; grey, soft, incompetent	5.0	CL		
176	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
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 GPM – Gallon Per Minute

GS – Geochemical Sample
 LA – Laboratory Analysis

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 RECD JUL 30, 2015

SWL – Static Water Level
 ZP – Ziplock Bag Sample

DEPTH		DESCRIPTION OF MATERIALS (ASTM D2488)	ASTM D2487 SYMBOL	TEST, SAMPLES, OR NOTES
From	To			
		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	Silty 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				
- 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

DEPTH		DESCRIPTION OF MATERIALS (ASTM D2488)	ASTM D2487 SYMBOL	TEST, SAMPLES, OR NOTES
From	To			
		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'		
230	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		

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

RAMACO

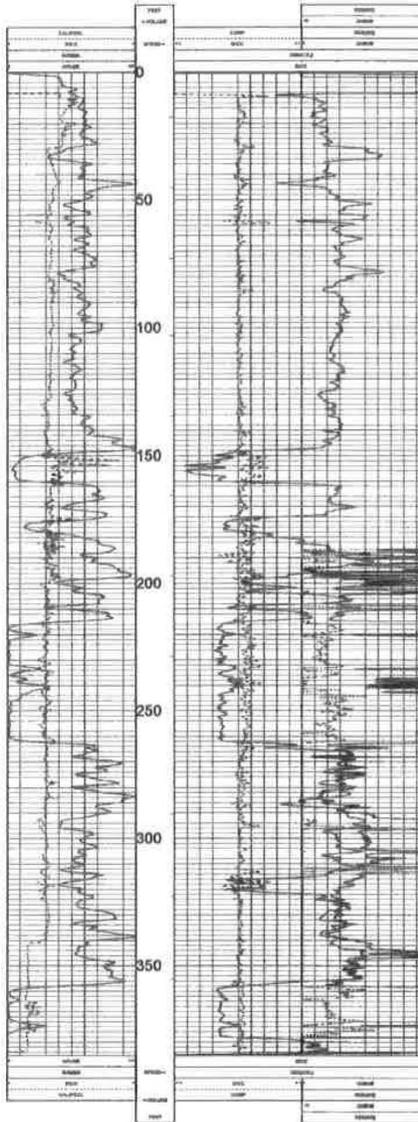
Brook Mine

		GAMMA-RBS-DENSITY AMBRE-05	
WELL NAME LOCATION COUNTY STATE ZONE DEPTH (FEET) DATE LOGGERS SURVEILLANCE COMMENTS	LOG NUMBER LOG DATE LOG TIME LOG TYPE LOG SCALE LOG UNIT LOG CORRECTION LOG STATUS LOG APPROVAL LOG REVIEW LOG SIGNATURE LOG DATE	LOG NUMBER LOG DATE LOG TIME LOG TYPE LOG SCALE LOG UNIT LOG CORRECTION LOG STATUS LOG APPROVAL LOG REVIEW LOG SIGNATURE LOG DATE	LOG NUMBER LOG DATE LOG TIME LOG TYPE LOG SCALE LOG UNIT LOG CORRECTION LOG STATUS LOG APPROVAL LOG REVIEW LOG SIGNATURE LOG DATE

5 INCH LOG, GAMMA-RBS-DENSITY AMBRE-05 01/24/13

LOG PARAMETERS

WATER DENSITY: 6.24 NEUTRON CAPTURE: 0.00000000 WATER DELTA T: 84
 MAGNETIC DECL: 0 SLEW CLIP OFF: 0000 SIF RES: 8.00
 PRESENTATION: HORIZONTAL NEW RECORD: 15.1.12.0 01/24/13 VERSION: 8.000



5 INCH LOG, GAMMA-RBS-DENSITY AMBRE-05 01/24/13

LOG PARAMETERS

WATER DENSITY: 6.28 NEUTRON CAPTURE: 0.00000000 WATER DELTA T: 84
 MAGNETIC DECL: 0 SLEW CLIP OFF: 0000 SIF RES: 8.00
 PRESENTATION: HORIZONTAL NEW RECORD: 15.1.12.0 01/24/13 VERSION: 8.000

DEPTH (FEET)	LOG NUMBER	LOG DATE	LOG TIME	LOG TYPE	LOG SCALE	LOG UNIT	LOG CORRECTION	LOG STATUS	LOG APPROVAL	LOG REVIEW	LOG SIGNATURE	LOG DATE
0	001	01/24/13	08:00	LOG	1.000	FEET	0.000	OK				
10	002	01/24/13	08:05	LOG	1.000	FEET	0.000	OK				
20	003	01/24/13	08:10	LOG	1.000	FEET	0.000	OK				
30	004	01/24/13	08:15	LOG	1.000	FEET	0.000	OK				
40	005	01/24/13	08:20	LOG	1.000	FEET	0.000	OK				
50	006	01/24/13	08:25	LOG	1.000	FEET	0.000	OK				
60	007	01/24/13	08:30	LOG	1.000	FEET	0.000	OK				
70	008	01/24/13	08:35	LOG	1.000	FEET	0.000	OK				
80	009	01/24/13	08:40	LOG	1.000	FEET	0.000	OK				
90	010	01/24/13	08:45	LOG	1.000	FEET	0.000	OK				
100	011	01/24/13	08:50	LOG	1.000	FEET	0.000	OK				
110	012	01/24/13	08:55	LOG	1.000	FEET	0.000	OK				
120	013	01/24/13	09:00	LOG	1.000	FEET	0.000	OK				
130	014	01/24/13	09:05	LOG	1.000	FEET	0.000	OK				
140	015	01/24/13	09:10	LOG	1.000	FEET	0.000	OK				
150	016	01/24/13	09:15	LOG	1.000	FEET	0.000	OK				
160	017	01/24/13	09:20	LOG	1.000	FEET	0.000	OK				
170	018	01/24/13	09:25	LOG	1.000	FEET	0.000	OK				
180	019	01/24/13	09:30	LOG	1.000	FEET	0.000	OK				
190	020	01/24/13	09:35	LOG	1.000	FEET	0.000	OK				
200	021	01/24/13	09:40	LOG	1.000	FEET	0.000	OK				
210	022	01/24/13	09:45	LOG	1.000	FEET	0.000	OK				
220	023	01/24/13	09:50	LOG	1.000	FEET	0.000	OK				
230	024	01/24/13	09:55	LOG	1.000	FEET	0.000	OK				
240	025	01/24/13	10:00	LOG	1.000	FEET	0.000	OK				
250	026	01/24/13	10:05	LOG	1.000	FEET	0.000	OK				
260	027	01/24/13	10:10	LOG	1.000	FEET	0.000	OK				
270	028	01/24/13	10:15	LOG	1.000	FEET	0.000	OK				
280	029	01/24/13	10:20	LOG	1.000	FEET	0.000	OK				
290	030	01/24/13	10:25	LOG	1.000	FEET	0.000	OK				
300	031	01/24/13	10:30	LOG	1.000	FEET	0.000	OK				
310	032	01/24/13	10:35	LOG	1.000	FEET	0.000	OK				
320	033	01/24/13	10:40	LOG	1.000	FEET	0.000	OK				
330	034	01/24/13	10:45	LOG	1.000	FEET	0.000	OK				
340	035	01/24/13	10:50	LOG	1.000	FEET	0.000	OK				
350	036	01/24/13	10:55	LOG	1.000	FEET	0.000	OK				

July 2015

TFN 6 2/025
RECD JUL 30, 2015
Addendum D5-2-68

Hole/Well No.: R13-011		Recorded By: M. Wolf WYPG #614		Drilling Co.: A-3 Services		
Company: RAMACO		Geophysical Log Type: Coal Suite, gamma, density, RES, CAL		Depth: 0' To 222'		
Project: Brook Mine		Hole Type: 5 5/8"		CORED: 122'-147' = 25'		
County: Sheridan WY		Water:		Date Drilled: 08-22-13		
Township: 57N Range: 84W				P&A 8-23-13		
Location: NENE Section: 17						
N: 1,938,441 E: 1,394,131						
Elevation: 3840.5						
DEPTH		DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
From	To					
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 ₂ O
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				
ABBREVIATIONS						
BGL – Below Ground Level		GS – Geochemical Sample		SWL – Static Water Level		
BS – Disturbed Bulk Sample		LA – Laboratory Analysis		ZP – Ziplock Bag Sample		
GPM – Gallon Per Minute						

TFN 6 2/025
 RECD JUL 30, 2015

Addendum D5-2-69

July 2015

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		DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
From	To					
0	18	Fill; clinker and angular rock SET 21. of 6" SDR-17 PVC	18.0	FILL		DRY
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

BGL – Below Ground Level
 BBS – Disturbed Bulk Sample
 GPM – Gallon Per Minute

GS – Geochemical Sample
 LA – Laboratory Analysis

SWL – Static Water Level
 ZP – Ziplock Bag Sample

TFN 62/025
RECD OCT 23, 2015
 Addendum D5-2-72

Hole/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: 5%" 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		DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
From	To					
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						
JGL – Below Ground Level		GS – Geochemical Sample		SWL – Static Water Level		
DBS – Disturbed Bulk Sample		LA – Laboratory Analysis		ZP – Ziplock Bag Sample		
GPM – Gallon Per Minute						

TFN 6 2/025

RECD JUL 30, 2015

Hole/Well No.: R13-018		Recorded By: M. Wolf WY PG #614		Drilling Co.: A-3 Services Depth: 0' To 141'		
Company: RAMACO		Geophysical Log Type: Coal Suite, Gamma, Den Res, caliper		CORED:		
Project: Brook Mine		Hole Type: 8 3/4" to 35'		Date Drilled: 08-30-13		
County: Sheridan WY		5 3/8" button spade to TD				
Township: 57N Range: 84W		Mud and Polymer				
Location: NESE Section: 8						
N: 1,941,802 E: 1,394,423						
Elevation: 3,887.9						
DEPTH		DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
From	To					
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', 91'-93.3', 93.3'-94.5'				
ABBREVIATIONS						
BGL – Below Ground Level		GS – Geochemical Sample		SWL – Static Water Level		
DBS – Disturbed Bulk Sample		LA – Laboratory Analysis		ZP – Ziplock Bag Sample		
GPM – Gallon Per Minute						

TFN 6 2/025
RECD JUL 30, 2015

July 2015

Addendum D5-2-77

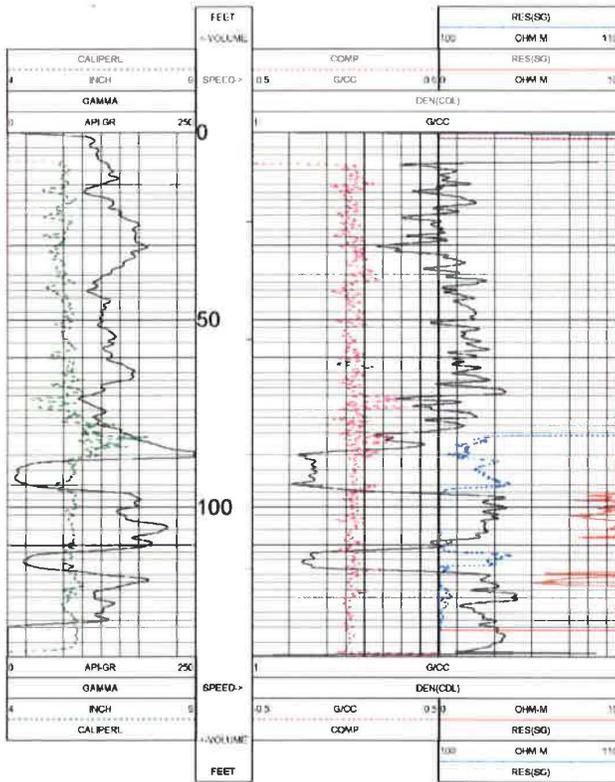
DEQ 5-130

RAMACO

Brook Mine

		GAMMA-RES-DENSITY R13-018	
COMPANY CENTURY WELLBORE SERVICES PROJECT R13-018 COUNTY N. CAROLINA SHEET 000000	SECTION SANDSTONE FORMATION SANDSTONE WELL R13-018 AP NO NA LOG NO NA LOG DATE 08/30/13	OTHER SERVICES NONE NONE NONE	LOG TYPE SANDSTONE LOG DATE 08/30/13 LOG TIME 12:10 LOG BY JAW LOG CHECKED BY NA LOG APPROVED BY NA LOG APPROVED DATE NA LOG APPROVED TIME NA LOG APPROVED SIGNATURE NA LOG APPROVED TITLE NA LOG APPROVED COMPANY NA LOG APPROVED ADDRESS NA LOG APPROVED CITY NA LOG APPROVED STATE NA LOG APPROVED ZIP NA LOG APPROVED PHONE NA LOG APPROVED FAX NA LOG APPROVED EMAIL NA LOG APPROVED WEBSITE NA LOG APPROVED LOGO NA LOG APPROVED NOTES NA LOG APPROVED COMMENTS NA

5 INCH LOG, GAMMA-RES-DENSITY R13-018 08/30/13			
LOG PARAMETERS			
MATRIX DENSITY: 2.65 MAGNETIC DECL: 0 PRESENTATION NAME/DATE: 9239 Ramaco Shd CDL 5inch 12.1.12.0 08/30/2013	NEUTRON MATRIX: SANDSTONE ELECT CUTOFF: 99999 VERSION: 3.64KF	MATRIX DELTA T: 54 BIT SIZE: 5.63	



5 INCH LOG, GAMMA-RES-DENSITY R13-018 08/30/13			
LOG PARAMETERS			
MATRIX DENSITY: 2.65 MAGNETIC DECL: 0 PRESENTATION NAME/DATE: 9239 Ramaco Shd CDL 5inch 12.1.12.0 08/30/2013	NEUTRON MATRIX: SANDSTONE ELECT CUTOFF: 99999 VERSION: 3.64KF	MATRIX DELTA T: 54 BIT SIZE: 5.63	

TOOL CALIBRATION R13-018 08/30/13 08:30 TOOL: 9238C1 TM VERSION 2025 SERIAL NUMBER: 995					
DATE	TIME	SENSOR	STANDARD	RESPONSE	
1	Aug 14 13 13:11:67	GAMMA	1.000 [API-GR]	0.000	[CPS]
2	Aug 14 13 13:11:57	GAMMA	340.000 [API-GR]	324.000	[CPS]
3	Aug 14 13 13:11:51	VOLTAGE	0.000 [MV]	5950.000	[CPS]
4	Aug 14 13 13:11:51	VOLTAGE	2309.000 [MV]	113264.000	[CPS]
5	Jun 11 13 09:58:31	CALPERL	5.000 [INCH]	0.000	[CPS]
6	Jun 11 13 09:58:31	CALPERL	11.250 [INCH]	0.000	[CPS]
7	Aug 14 13 13:29:47	DEN(LS)	1.620 [GACC]	44.54.000	[CPS]
8	Aug 14 13 13:29:47	DEN(LS)	2.612 [GACC]	653.000	[CPS]
9	Aug 14 13 15:13:29	DEN(SS)	1.560 [GACC]	14627.000	[CPS]
10	Aug 14 13 15:13:29	DEN(SS)	2.580 [GACC]	83319.000	[CPS]
11	Aug 14 13 13:12:23	CALPERL	5.000 [INCH]	56920.000	[CPS]
12	Aug 14 13 13:12:23	CALPERL	11.250 [INCH]	62880.000	[CPS]
13	Aug 14 13 13:12:04	CURRENT	0.000 [UA]	4660.000	[CPS]
14	Aug 14 13 13:12:04	CURRENT	330.800 [UA]	58611.000	[CPS]
15	Aug 14 13 13:12:10	F	Default [CPS]		
16	Aug 14 13 13:12:17	X	Default [CPS]		

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 RECD JUL 30, 2015

July 2015

Addendum D5-2-79

DEPTH		DESCRIPTION OF MATERIALS (ASTM D2488)
From	To	
		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
ABBREVIATIONS		
BGL – Below Ground Level	GS – Geochemical Sample	SWL – Static Water Level
DBS – Disturbed Bulk Sample	LA – Laboratory Analysis	ZP – Ziplock Bag Sample
MPM – Gallon Per Minute		

TFN 6 2/025
 RECD JUL 30, 2015

Hole/Well No.: R13-020		Recorded By: M. Wolf WYPG #614		Drilling Co.: A-3 Services		
Company: RAMACO		Geophysical Log Type: GR-RES-CDL		Depth: 0' To 302'		
Project: Brook Mine		Hole Type: Pilot with 5 5/8"		CORED: No Core		
County: Sheridan WY		Water: Saturated in burn ground		Date Drilled: 08-08-13		
Township: 57N Range: 84W		Thin coals below 160				
Location: Section: 18						
NENW						
N: 1,939,535 E: 1, 386,372						
Elevation: 3,952.6						
DEPTH		DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
From	To					
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 ₂ O 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				
ABBREVIATIONS						
BGL – Below Ground Level		GS – Geochemical Sample		SWL – Static Water Level		
DBS – Disturbed Bulk Sample		LA – Laboratory Analysis		ZP – Ziplock Bag Sample		
GPM – Gallon Per Minute						

TFN 6 2/025
RECD JUL 30, 2015

DEPTH		DESCRIPTION OF MATERIALS (ASTM D2488)
From	To	
		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
116.7	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'
ABBREVIATIONS		
BGL – Below Ground Level	GS – Geochemical Sample	SWL – Static Water Level
DBS – Disturbed Bulk Sample	LA – Laboratory Analysis	ZP – Ziplock Bag Sample
GPM – Gallon Per Minute		

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 RECD JUL 30, 2015

July 2015

Addendum D5-2-87

DEQ 5-140

DEPTH		DESCRIPTION OF MATERIALS (ASTM D2488)
From	To	
		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'
ABBREVIATIONS		
BGL – Below Ground Level	GS – Geochemical Sample	SWL – Static Water Level
VBS – Disturbed Bulk Sample	LA – Laboratory Analysis	ZP – Ziplock Bag Sample
GPM – Gallon Per Minute		

TFN 6 2/025
 RECD JUL 30, 2015

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 3/4" Tri-Core to 35'	Date Drilled: 11-12-13			
County: Sheridan WY		5 5/8" button spade to TD				
Township: 57N Range: 85W		Water: Mud & Polymer				
Location: NWSE Section: 11						
N: 1,941,541 E: 1,378,388						
Elevation: 3,885.4						
DEPTH		DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
From	To					
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		
ABBREVIATIONS						
BGL – Below Ground Level		GS – Geochemical Sample		SWL – Static Water Level		
DBS – Disturbed Bulk Sample		LA – Laboratory Analysis		ZP – Ziplock Bag Sample		
GPM – Gallon Per Minute						

TFN 62/025
RECD OCT 23, 2015

DEPTH		DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
From	To					
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		
966	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						
~GL – Below Ground Level		GS – Geochemical Sample		SWL – Static Water Level		
DS – Disturbed Bulk Sample		LA – Laboratory Analysis		ZP – Ziplock Bag Sample		
GPM – Gallon Per Minute						

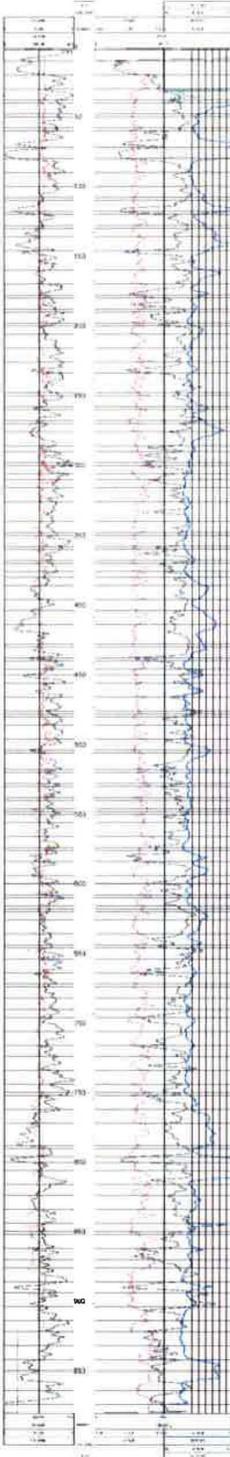
TFN 6 27025
 RECD JUL 30, 2015

RAMACO

Brook Mine

Geology	
1	244.1
2	244.2
3	244.3
4	244.4
5	244.5
6	244.6
7	244.7
8	244.8
9	244.9
10	245.0
11	245.1
12	245.2
13	245.3
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15	245.5
16	245.6
17	245.7
18	245.8
19	245.9
20	246.0
21	246.1
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26	246.6
27	246.7
28	246.8
29	246.9
30	247.0
31	247.1
32	247.2
33	247.3
34	247.4
35	247.5
36	247.6
37	247.7
38	247.8
39	247.9
40	248.0
41	248.1
42	248.2
43	248.3
44	248.4
45	248.5
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47	248.7
48	248.8
49	248.9
50	249.0
51	249.1
52	249.2
53	249.3
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55	249.5
56	249.6
57	249.7
58	249.8
59	249.9
60	250.0
61	250.1
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66	250.6
67	250.7
68	250.8
69	250.9
70	251.0
71	251.1
72	251.2
73	251.3
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77	251.7
78	251.8
79	251.9
80	252.0
81	252.1
82	252.2
83	252.3
84	252.4
85	252.5
86	252.6
87	252.7
88	252.8
89	252.9
90	253.0
91	253.1
92	253.2
93	253.3
94	253.4
95	253.5
96	253.6
97	253.7
98	253.8
99	253.9
100	254.0

EMERGENCY DENSITY: 17.154 17.153



EMERGENCY DENSITY: 17.154 17.153

Geology	
1	244.1
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19	245.9
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27	246.7
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29	246.9
30	247.0
31	247.1
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35	247.5
36	247.6
37	247.7
38	247.8
39	247.9
40	248.0
41	248.1
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67	250.7
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69	250.9
70	251.0
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77	251.7
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88	252.8
89	252.9
90	253.0
91	253.1
92	253.2
93	253.3
94	253.4
95	253.5
96	253.6
97	253.7
98	253.8
99	253.9
100	254.0

July 2015

TFN 6 2/025
RECD JUL 30, 2015

Addendum D5-2-92

Hole/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: 5 7/8" 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		DESCRIPTION OF MATERIALS (ASTM D2488)	THICK	LITH	SEAM	NOTE/GPM
From	To					
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		

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

Addendum D5-2-93

July 2015

RAMACO

Brook Mine

PETER KIEWIT SONS' CO.

EXPLORATION AND DEVELOPMENT
DEPARTMENT

OVERBURDEN & COAL CORE LOG OF PROSPECT BORE HOLE No. 166-76



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.

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 Gjere, Kristiansen, Taylor

Surface Owner _____ (SIGNED) R. A. Gjere
 DATE 2-18-76 (TITLE) Geologist

FORMATION RECORD

DEPTH		Thickness of stratum	Geologic formations; character of rock; oil, gas and water horizons; coal and other mineral occurrences
From— Feet Inches	To— Feet Inches		
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

TFN 6 2/025
RECD JUL 30, 2015

Continued

THE MILLS COMPANY, SHERIDAN

(Attach continuation sheets if necessary)

RAMACO

PETER KIEWIT SONS' CO.
 EXPLORATION AND DEVELOPMENT
 DEPARTMENT

Brook Mine

DATE 2-18-76

AREA Big Horn

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



FORMATION RECORD

DEPTH				Thickness of stratum	Geologic formations; character of rock; oil, gas and water horizons; coal and other mineral occurrences
From—		To—			
Feet	Inches	Feet	Inches	Feet	Inches
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

RECD JUL 30, 2015 Continued

THE HILLS COMPANY, OHIO SH 139508

July 2015

Addendum D5-2-98

DEQ 5-151

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RAMACO

PETER KIEWIT SONS' CO.
 EXPLORATION AND DEVELOPMENT
 DEPARTMENT

Brook Mine

DATE 2-18-76

AREA Big Horn

PAGE No. 3 of HOLE No. C-166-76

FORMATION RECORD

DEPTH				Thickness of stratum	Geologic formations; character of rock; oil, gas and water horizons; coal and other mineral occurrences
From—		To—			
Feet	Inches	Feet	Inches	Feet	Inches
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, wilty
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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RAMACO

PETER KIEWIT SONS' CO.
EXPLORATION AND DEVELOPMENT
DEPARTMENT

Brook Mine

DATE 2-18-76

AREA Big Horn

PAGE No. 4 of HOLE



FORMATION RECORD

DEPTH				Thickness of stratum	Geologic formations; character of rock; oil, gas and water horizons; coal and other mineral occurrences
From—		To—			
Feet	Inches	Feet	Inches	Feet	Inches
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'

RECD JUL 30, 2015

Continued
Addendum D5-2-100

RAMACO

Brook Mine

PETER KIEWIT SONS' CO.
 EXPLORATION AND DEVELOPMENT
 DEPARTMENT

DATE 2-18-76

AREA Big Horn

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FORMATION RECORD

DEPTH				Thickness of stratum	Geologic formations; character of rock; oil, gas and water horizons; coal and other mineral occurrences
From—		To—			
Feet	Inches	Feet	Inches	Feet	Inches
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.
					TFN 6 2/025 RECD JUL 30, 2015
141.0		151.0		10.0	CORE # 14 Cored 10' Recovered 6'
141.0		145.0		4.0	Lost core, believed to be coal

RAMACO

PETER KIEWIT SONS' CO.
EXPLORATION AND DEVELOPMENT
DEPARTMENT

Brook Mine



DATE 2-18-76

AREA Big Horn

PAGE No. 6 of HOLE 310

FORMATION RECORD

DEPTH				Thickness of stratum	Geologic formations; character of rock; oil, gas and water horizons; coal and other mineral occurrences
From—		To—			
Feet	Inches	Feet	Inches	Feet	Inches
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

THE MILLS COMPANY, SHERBORN 139508

July 2015

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RAMACO

PETER KIEWIT SONS' CO.
EXPLORATION AND DEVELOPMENT
DEPARTMENT

Brook Mine



DATE 2-18-76

AREA Big Horn

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FORMATION RECORD

DEPTH				Thickness of stratum	Geologic formations; character of rock; oil, gas and water horizons; coal and other mineral occurrences
From—		To—			
Feet	Inches	Feet	Inches	Feet	Inches
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

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Continued

RAMACO

PETER KIEWIT SONS' CO.
EXPLORATION AND DEVELOPMENT
DEPARTMENT

Brook Mine

DATE 2-18-76AREA Big HornPAGE No. 8 of HOLE No. C-166-76

FORMATION RECORD

DEPTH				Thickness of stratum	Geologic formations; character of rock; oil, gas and water horizons; coal and other mineral occurrences
From—		To—			
Feet	Inches	Feet	Inches	Feet	Inches
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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Continued

THE HILLS COMPANY, AMERICAN 139508

July 2015

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RAMACO

PETER KIEWIT SONS' CO.
EXPLORATION AND DEVELOPMENT
DEPARTMENT

Brook Mine

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FORMATION RECORD

DEPTH				Thickness of stratum	Geologic formations; character of rock; oil, gas and water horizons; coal and other mineral occurrences
From—		To—			
Feet	Inches	Feet	Inches	Feet	Inches
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

THE HILLS COMPANY, SPEARMAN 130308

July 2015

Continued
Addendum D5-2-105

DEQ 5-158

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RAMACO

PETER KIEWIT SONS' CO.
EXPLORATION AND DEVELOPMENT
DEPARTMENT

Brook Mine



DATE 2-18-76

AREA Big Horn

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FORMATION RECORD

DEPTH				Thickness of stratum	Geologic formations; character of rock; oil, gas and water horizons; coal and other mineral occurrences
From—		To—			
Feet	Inches	Feet	Inches	Feet	Inches
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

TFN 6 2/025

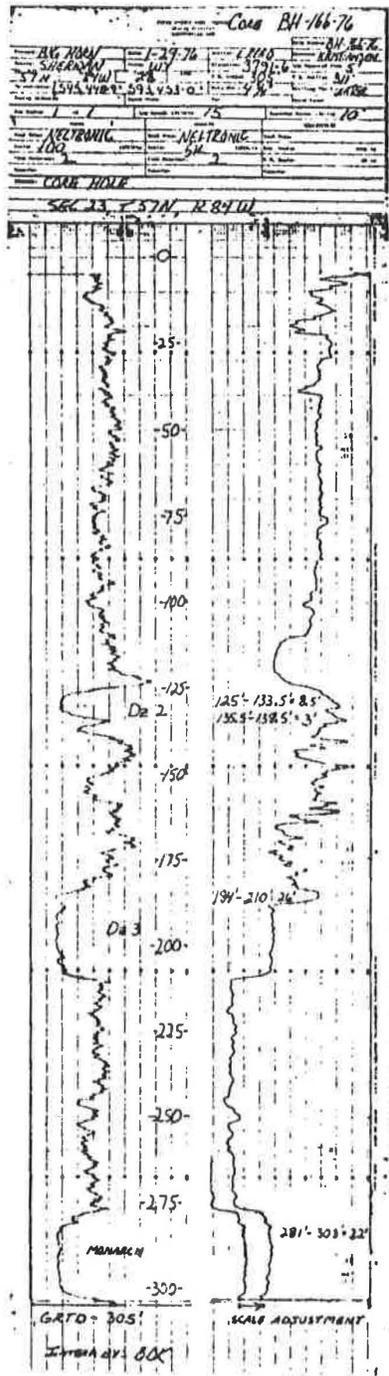
RECD JUL 30, 2015

THE HILL COMPANY, SHERIDAN 138588

July 2015

Continued
Addendum D5-2-106

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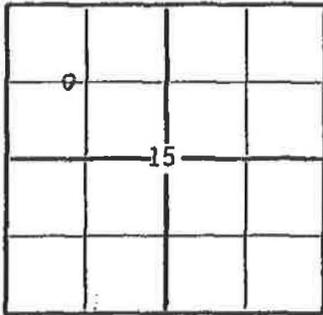


TFN 6 2/025
 RECD JUL 30, 2015

RAMACO

Brook Mine

PETER KIEWIT SONS' CO.
EXPLORATION AND DEVELOPMENT
DEPARTMENT



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.



CORE
LOG OF PROSPECT HOLE

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		Thickness of stratum	Geologic formations; character of rock; oil, gas and water horizons; coal and other mineral occurrences
From-- Feet Tenths	To-- Feet Tenths		
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 H2O 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'
19.0	20.1	1.1	Air drilled 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

THE WILLS COMPANY, SHERIDAN

(Attach continuation sheets if necessary)

TFN 6 2/025

RECD JUL 30, 2015

July 2015

Addendum D5-2-109

DEQ 5-162

RAMACO

PETER KIEWIT SONS' CO.
 EXPLORATION AND DEVELOPMENT
 DEPARTMENT

Brook Mine

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

AREA Big Horn Coal

PAGE No. 2 of HOLE No. C-BH-326-78



FORMATION RECORD

DEPTH				Thickness of stratum	Geologic formations; character of rock; oil, gas and water horizons; coal and other mineral occurrences
From		To			
Feet	Inches	Feet	Inches	Feet	Inches
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

TFN 6 2/025

RECD JUL 30, 2015

Addendum D5-2-110

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ADDENDUM D5-3

RAMACO

Brook Mine

ADDENDUM D5-3
Geologic Cross-Sections

TFN 6 2/025
RECD NOV 14, 2014

October 2014

Addendum D5-3-1

DEQ 5-166

ADDENDUM D5-3
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Addendum D5-3 Exhibit 2 Geologic Cross Section A-A' Segment 2 of 2 Sheet 2 of 12

Addendum D5-3 Exhibit 2 Geologic Cross Section B-B' Segment 1 of 2 Sheet 3 of 12

Addendum D5-3 Exhibit 2 Geologic Cross Section B-B' Segment 2 of 2 Sheet 4 of 12

Addendum D5-3 Exhibit 2 Geologic Cross Section C-C' Segment 1 of 2 Sheet 5 of 12

Addendum D5-3 Exhibit 2 Geologic Cross Section C-C' Segment 2 of 2 Sheet 6 of 12

Addendum D5-3 Exhibit 2 Geologic Cross Sections D-D' & E-E' Sheet 7 of 12

Addendum D5-3 Exhibit 2 Geologic Cross Section F-F' Sheet 8 of 12

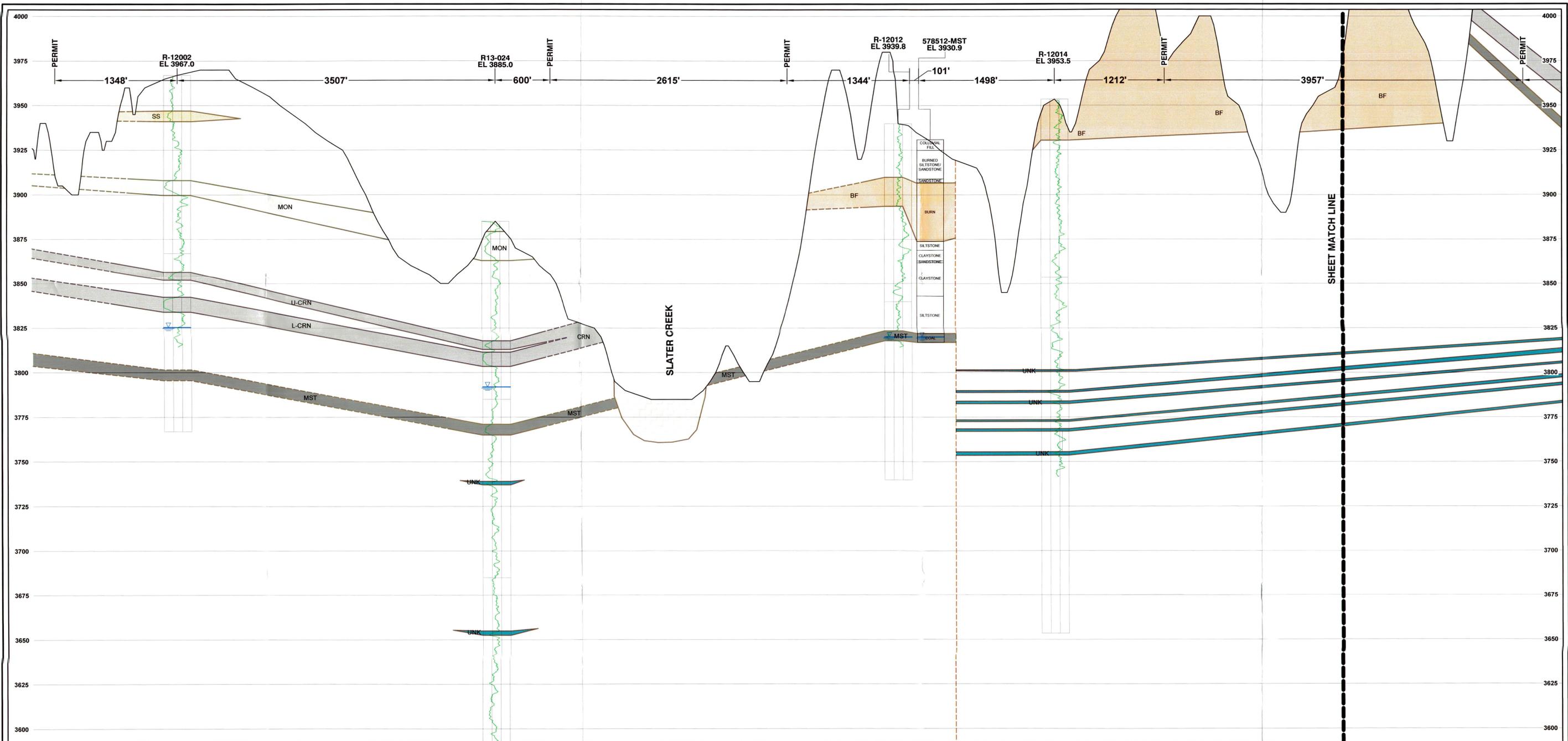
Addendum D5-3 Exhibit 2 Geologic Cross Sections G-G' & H-H' Sheet 9 of 12

Addendum D5-3 Exhibit 2 Geologic Cross Section I-I' Sheet 10 of 12

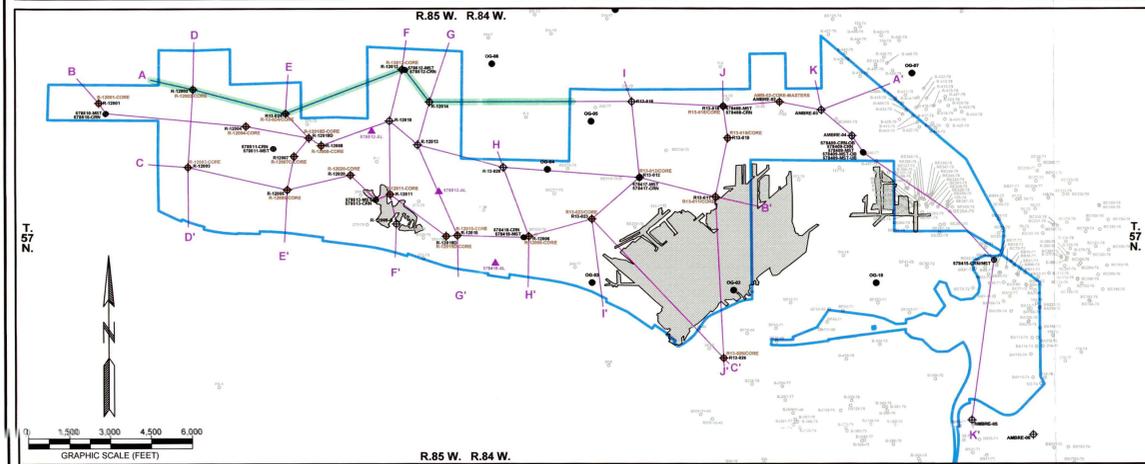
Addendum D5-3 Exhibit 2 Geologic Cross Section J-J' Sheet 11 of 12

Addendum D5-3 Exhibit 2 Geologic Cross Section K-K' Sheet 12 of 12

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RECD NOV 14, 2014



CROSS SECTION A-A' SEGMENT 1
SCALE: HORIZ. 1" = 500', VERT. 1" = 25'

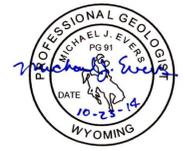


- LEGEND**
- BROOK MINE PERMIT BOUNDARY
 - CROSS SECTION SEGMENT SHOWN ON THIS SHEET
 - POTENTIOMETRIC SURFACE (CARNEY)
 - POTENTIOMETRIC SURFACE (MASTERS)
 - FAULT
 - R12011 ⊕ EXPLORATION BOREHOLE
 - R-12008-CORE ⊕ CORE HOLE
 - 578418-CRN ⊕ MONITOR WELL
 - 88330-71 ⊕ HISTORIC EXPLORATION BOREHOLE
 - 578418-AL ▲ MONITOR WELL - ALLUVIUM
 - 06-11 ● WOGCC OIL OR GAS WELL
 - 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.

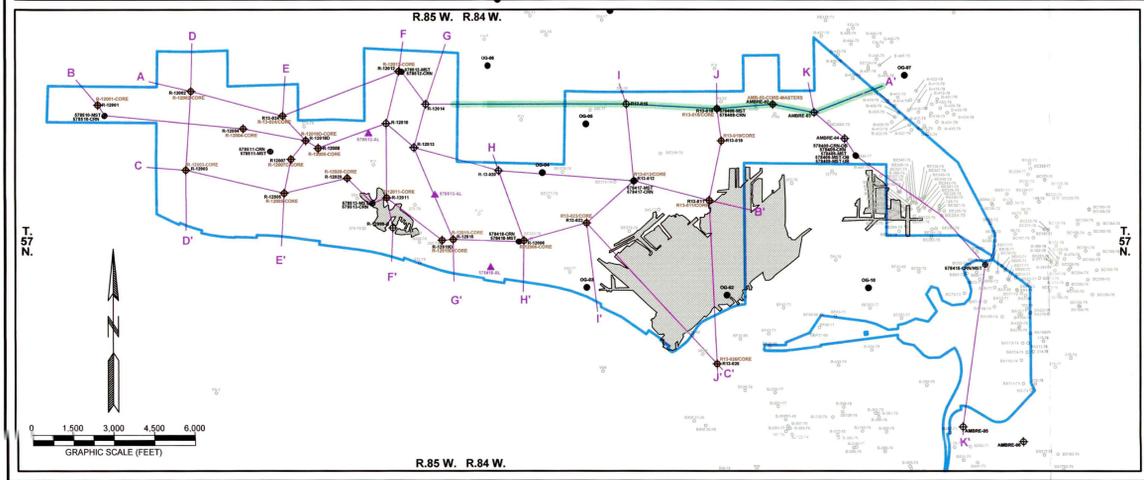
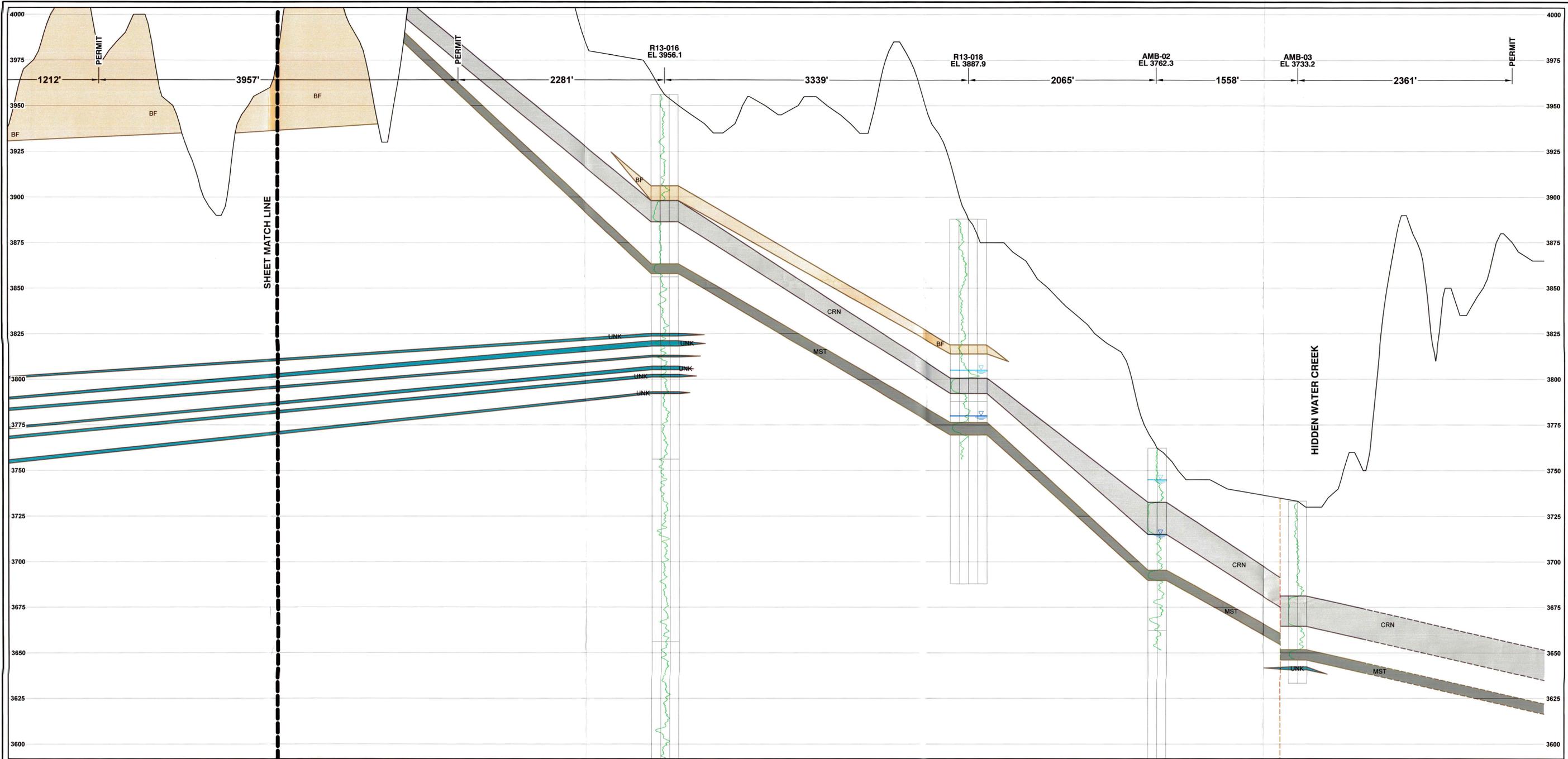
CERTIFICATE OF GEOLOGIST

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.



TFN 6 2 / 025
RECD NOV 14, 2014

RAMACO		BROOK MINE SHERIDAN COUNTY, WY 1101 SUGARVIEW DR, STE. 201 SHERIDAN, WY 82801	
REVISIONS		ADDENDUM D5-3 EXHIBIT 2	
Date	Description	SHEET 1 OF 12	
GEOLOGIC CROSS SECTION A-A' SEGMENT 1 OF 2		DRAWN BY: MBM CHECKED BY: MJE DATE: 10/23/14	
FILE: ADD_D5_3_GEO_CROSS_SECTIONS.dwg		WWC ENGINEERING www.wwcengineering.com	



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
 - R12011 + EXPLORATION BOREHOLE
 - R12008-CORE + CORE HOLE
 - 57418-CRN + MONITOR WELL
 - 8220-75 + HISTORIC EXPLORATION BOREHOLE
 - 57418-AL + MONITOR WELL - ALLUVIUM
 - 06-17 + WOGCC OIL OR GAS WELL
 - CLAYSTONE/SILTSTONE
 - SANDSTONE
 - BAKED/FUSED/CLINKER
 - DIETZ BEDS
 - MONARCH COAL
 - CARNEY COAL
 - HISTORIC MINING
 - MASTERS COAL
 - ALLUVIUM/COLLUVIUM AND/OR COLLUVIUM WITHIN CHANNEL BOTTOMS
 - 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.

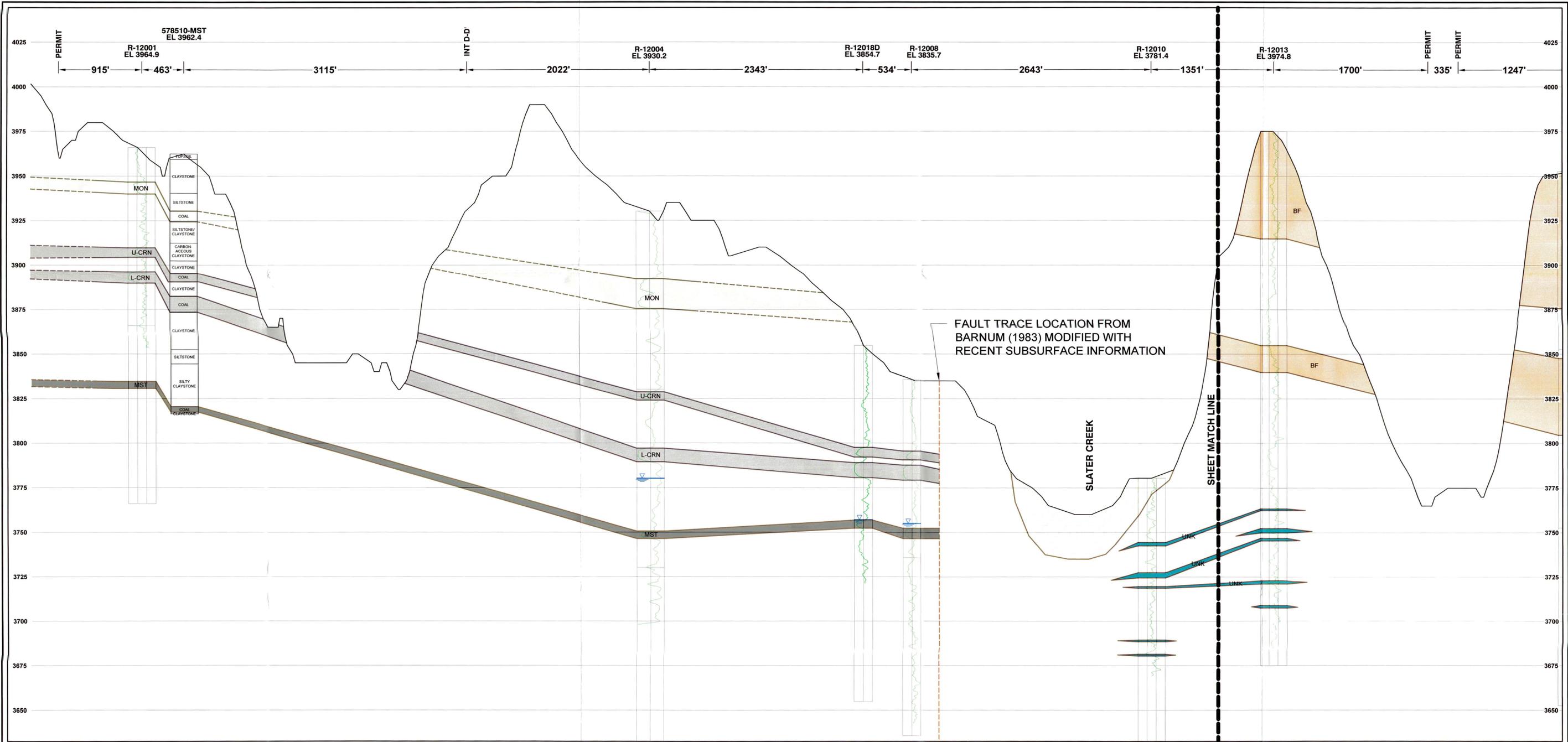
CERTIFICATE OF GEOLOGIST

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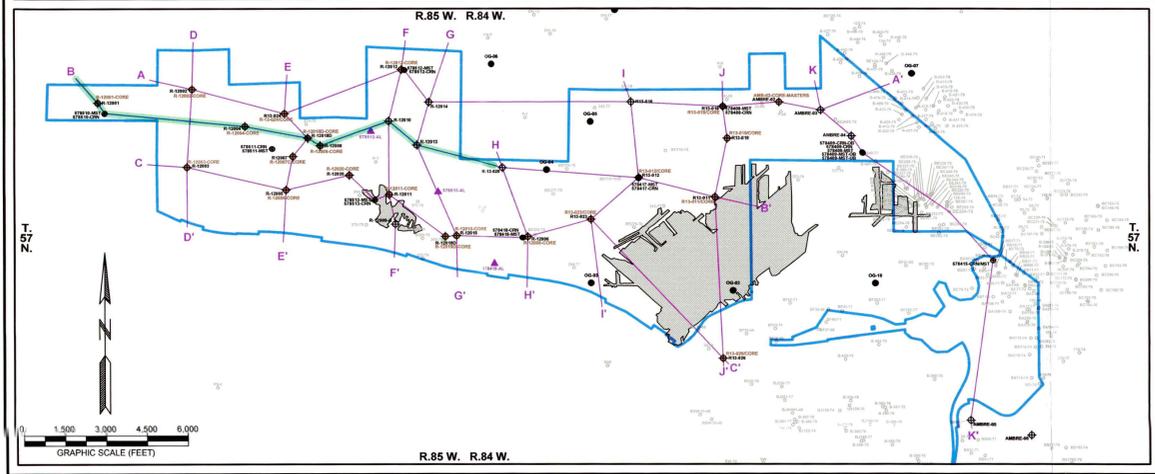


TFN 6 2/025
RECD NOV 14, 2014

RAMACO		BROOK MINE SHERIDAN COUNTY, WY 1101 SUGARVIEW DR, STE. 201 SHERIDAN, WY 82801	
REVISIONS		ADDENDUM D5-3 EXHIBIT 2	
Date	Description	SHEET 2 OF 12	
GEOLOGIC CROSS SECTION A-A' SEGMENT 2 OF 2		 WVC ENGINEERING www.wvcengineering.com	
Drawn By: MBM Checked By: MJE Date: 10/23/14			
FILE: ADD_D5_3_GEO_CROSS_SECTIONS.dwg			



CROSS SECTION B-B' SEGMENT 1
SCALE: HORIZ. 1" = 500', VERT. 1" = 25'

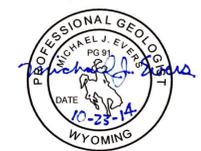


- LEGEND**
- BROOK MINE PERMIT BOUNDARY
 - CROSS SECTION SEGMENT SHOWN ON THIS SHEET
 - POTENTIOMETRIC SURFACE (CARNEY)
 - POTENTIOMETRIC SURFACE (MASTERS)
 - FAULT
 - R12011 + EXPLORATION BOREHOLE
 - R12008-CORE + CORE HOLE
 - 578419-CRN + MONITOR WELL
 - 58329-78 + HISTORIC EXPLORATION BOREHOLE
 - 578418-AL + MONITOR WELL - ALLUVIUM
 - 00-11 + WOGCC OIL OR GAS WELL
 - CLAYSTONE/SILTSTONE
 - SANDSTONE
 - BAKED/FUSED/CLINKER
 - DIETZ BEDS
 - MONARCH COAL
 - CARNEY COAL
 - HISTORIC MINING
 - MASTERS COAL
 - ALLUVIUM/COLLUVIUM AND/OR COLLUVIUM WITHIN CHANNEL BOTTOMS
 - 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.

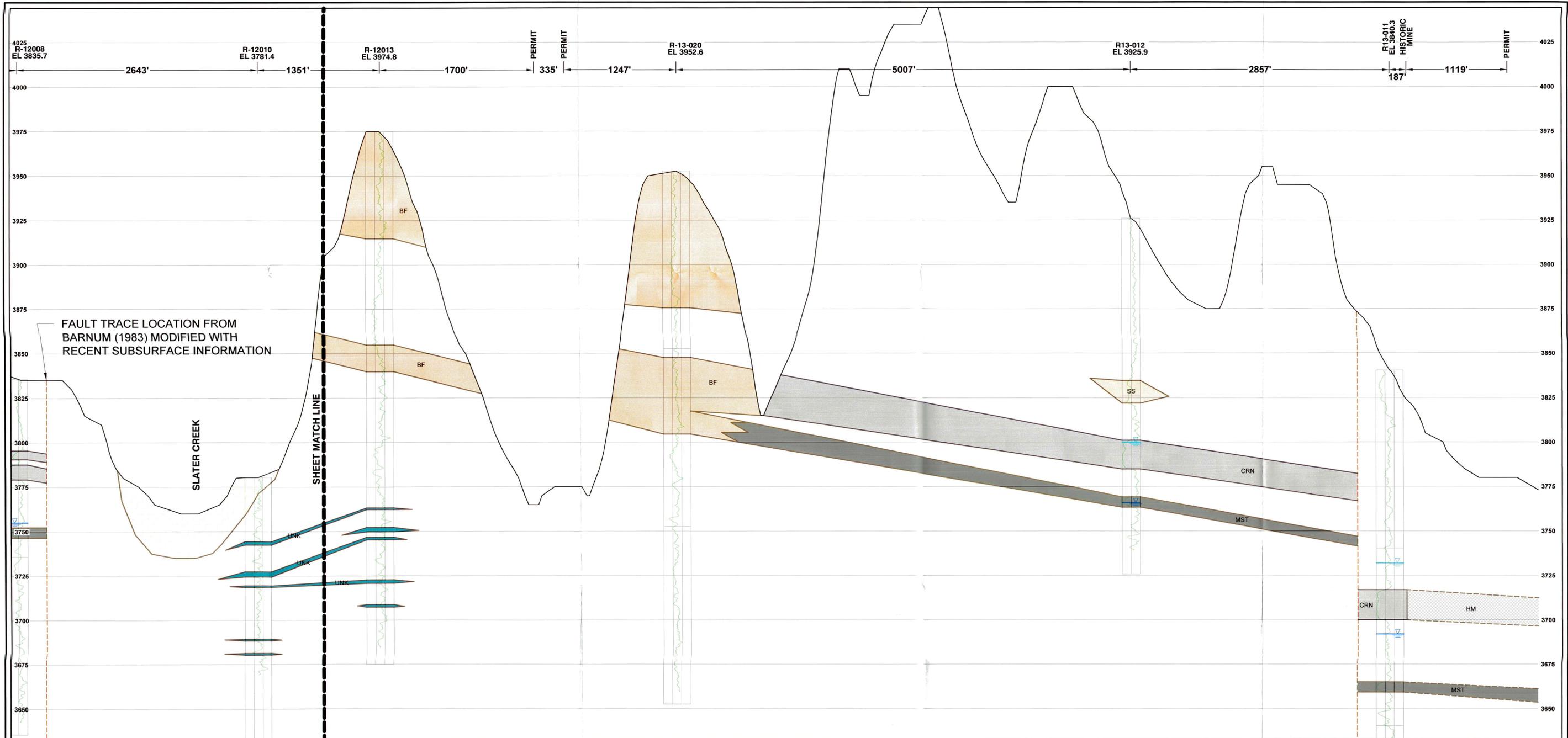
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TFN 6 2/025
RECD NOV 14, 2014

		BROOK MINE SHERIDAN COUNTY, WY 1101 SUGARVIEW DR, STE. 201 SHERIDAN, WY 82801	
		SHEET 3 OF 12	
REVISIONS Date Description		ADDENDUM D5-3 EXHIBIT 2	
Drawn By: MBM Checked By: MJE Date: 10/23/14		GEOLOGIC CROSS SECTION B-B' SEGMENT 1 OF 2	
FILE: ADD_D5_3_GEO_CROSS_SECTIONS.dwg			



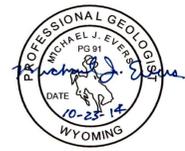
CROSS SECTION B-B' SEGMENT 2

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
 - R12011 EXPLORATION BOREHOLE
 - CORE HOLE
 - 578418-CRN MONITOR WELL
 - 6022019-H HISTORIC EXPLORATION BOREHOLE
 - 578418-A1 MONITOR WELL - ALLUVIUM
 - 06-15 WOGCC OIL OR GAS WELL
 - 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)

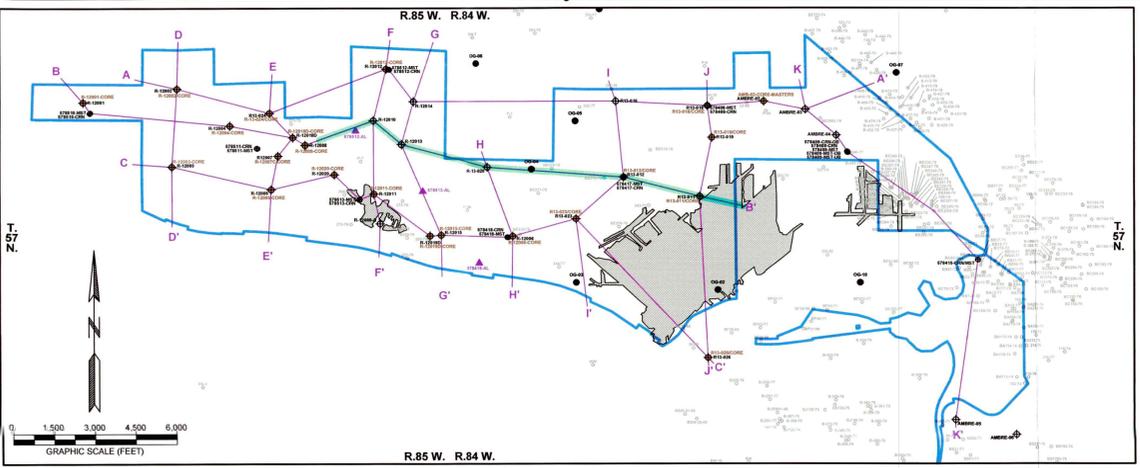
CERTIFICATE OF GEOLOGIST

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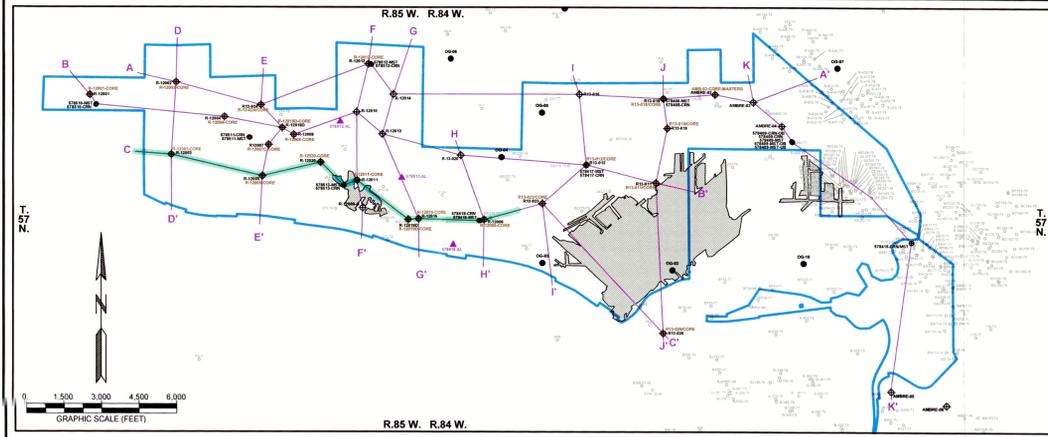
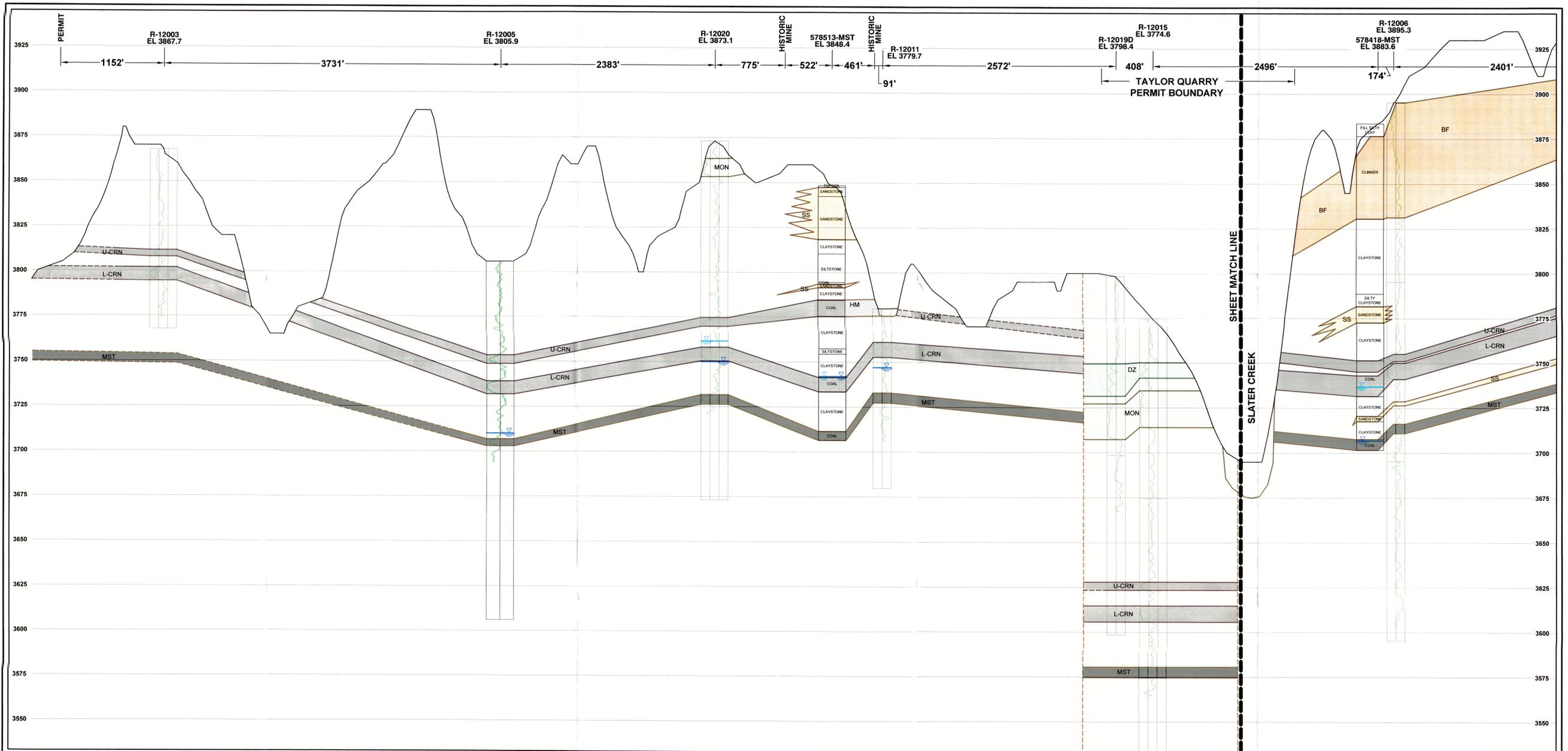


NOTES: 1) REFER TO TABLE D5 3-1 FOR STRATIGRAPHIC NOMENCLATURE.
2) CONTACTS DASHED WHERE INFERRED.
3) COAL SEAM POTENTIOMETRY FROM EXHIBITS D6 2-2 AND D6 2-3.

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REC'D NOV 14, 2014



		BROOK MINE SHERIDAN COUNTY, WY 1101 SUGARVIEW DR, STE. 201 SHERIDAN, WY 82801									
		SHEET 4 OF 12									
ADDENDUM D5-3 EXHIBIT 2		GEOLOGIC CROSS SECTION B-B' SEGMENT 2 OF 2									
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Date	Description										
FILE: ADD_D5_3_GEO_CROSS_SECTIONS.dwg											



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
 - R-12011-1 EXPLORATION BOREHOLE
 - R-12005-CORE CORE HOLE
 - 578418-CRN MONITOR WELL
 - 578418-AL HISTORIC EXPLORATION BOREHOLE
 - 578418-AL MONITOR WELL - ALLUVIUM
 - 00-11 WOGCC OIL OR GAS WELL
 - 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.

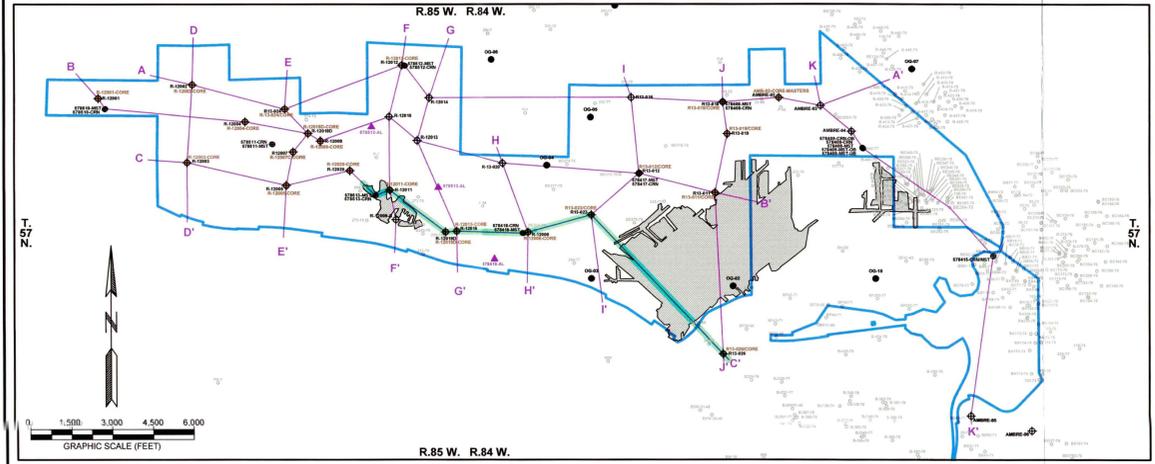
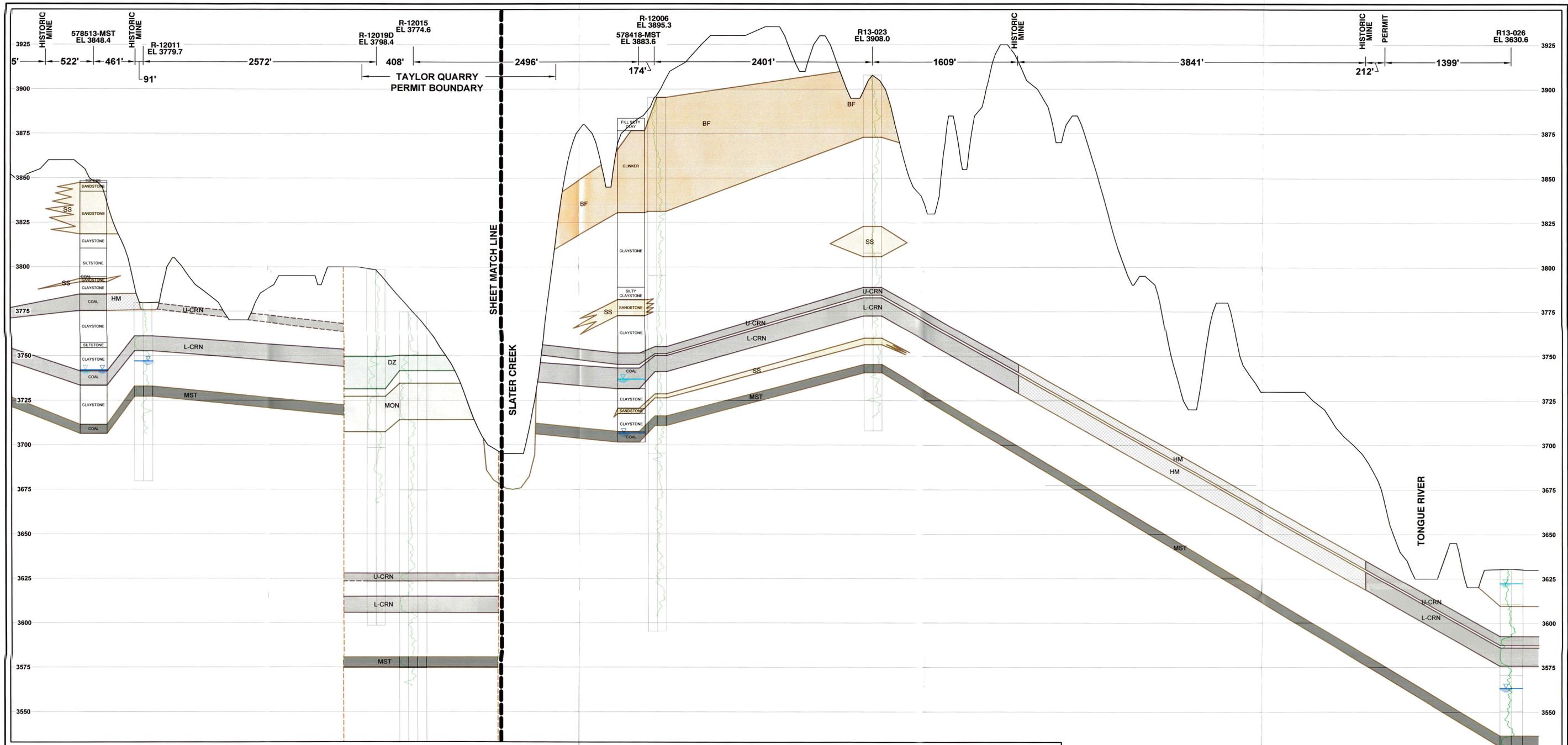
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TFW 6 2/025
 RECD NOV 14, 2014

		BROOK MINE SHERIDAN COUNTY, WY 1101 SUGARVIEW DR, STE. 201 SHERIDAN, WY 82801	
		SHEET 5 OF 12	
REVISIONS Date Description		ADDENDUM D5-3 EXHIBIT 2	
		GEOLOGIC CROSS SECTION C-C' SEGMENT 1 OF 2	
Drawn By: MBM Checked By: MJE Date: 10/23/14			
FILE: ADD_D5_3_GEO_CROSS_SECTIONS.dwg			



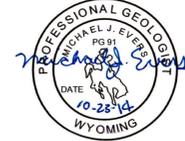
CROSS SECTION C-C' SEGMENT 2
SCALE: HORIZ. 1" = 500', VERT. 1" = 25'

- LEGEND**
- BROOK MINE PERMIT BOUNDARY
 - CROSS SECTION SEGMENT SHOWN ON THIS SHEET
 - POTENTIOMETRIC SURFACE (CARNEY)
 - POTENTIOMETRIC SURFACE (MASTERS)
 - - - FAULT
 - R-12011 ◊ EXPLORATION BOREHOLE
 - R-12006-CORE ◊ CORE HOLE
 - 578418-CRN ◊ MONITOR WELL
 - 578418-AL ◊ HISTORIC EXPLORATION BOREHOLE
 - 578418-AL ◊ MONITOR WELL - ALLUVIUM
 - 06-13 ◊ WOGCC OIL OR GAS WELL
 - 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.

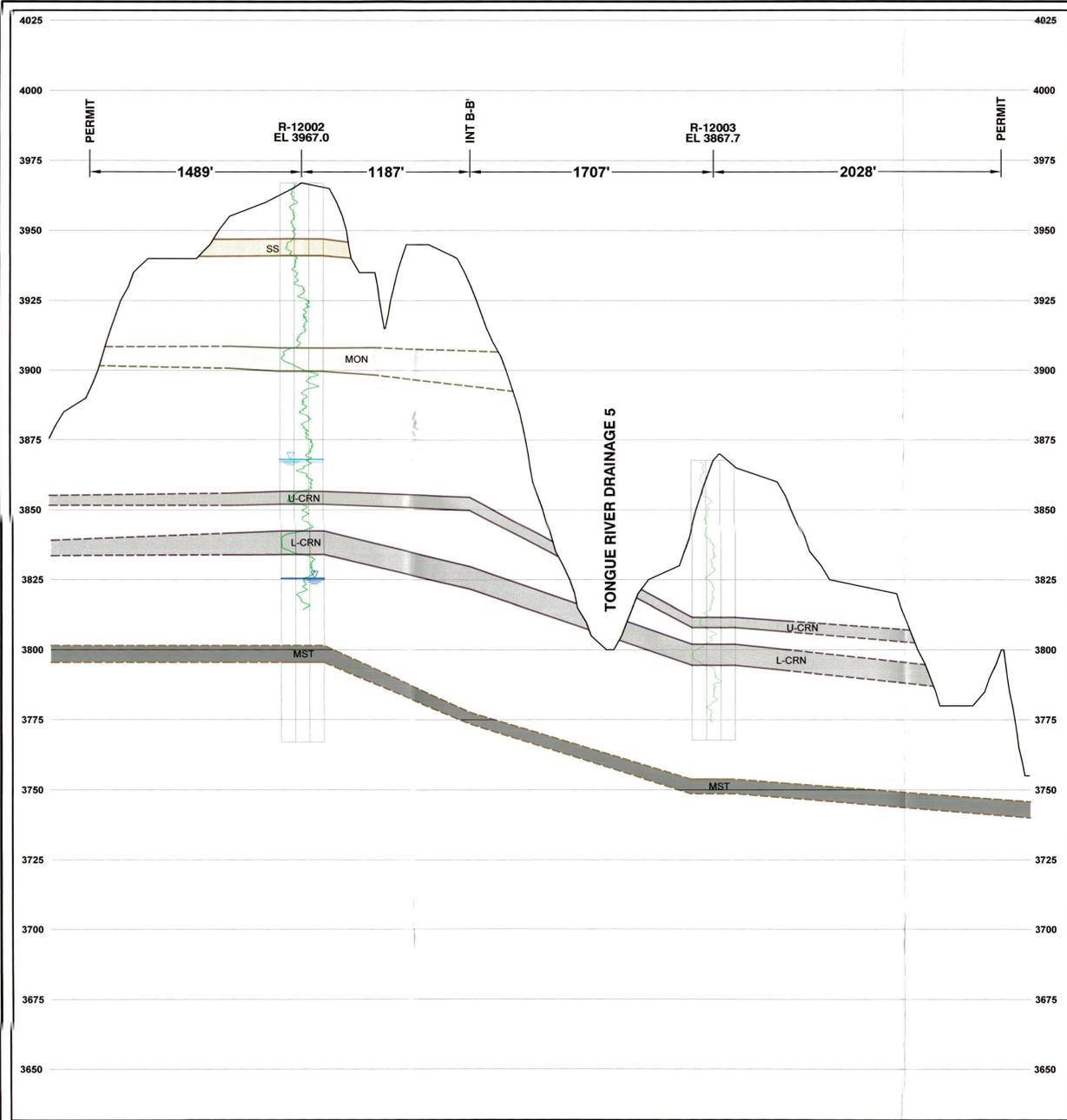
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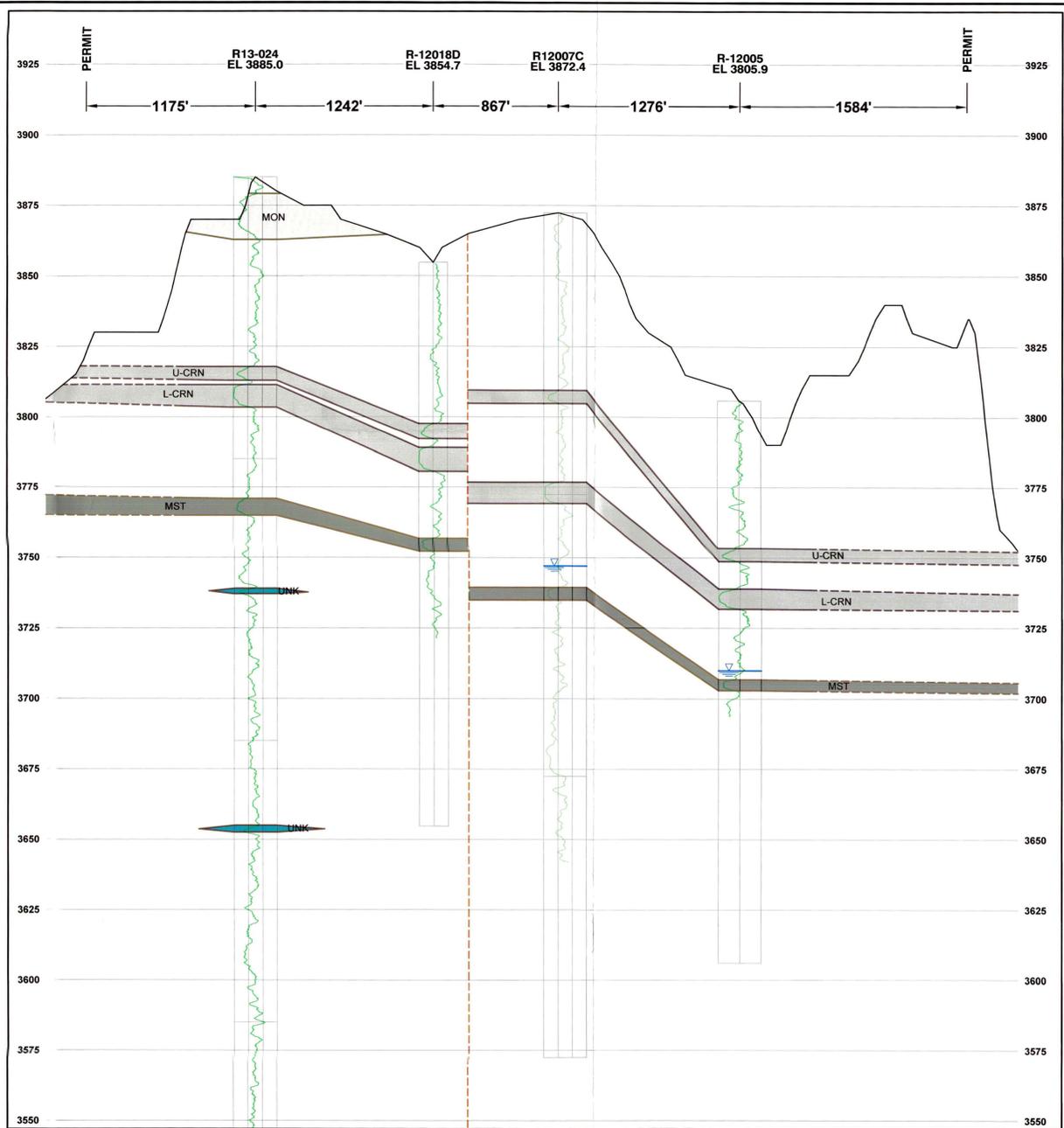


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RECD NOV 14, 2014

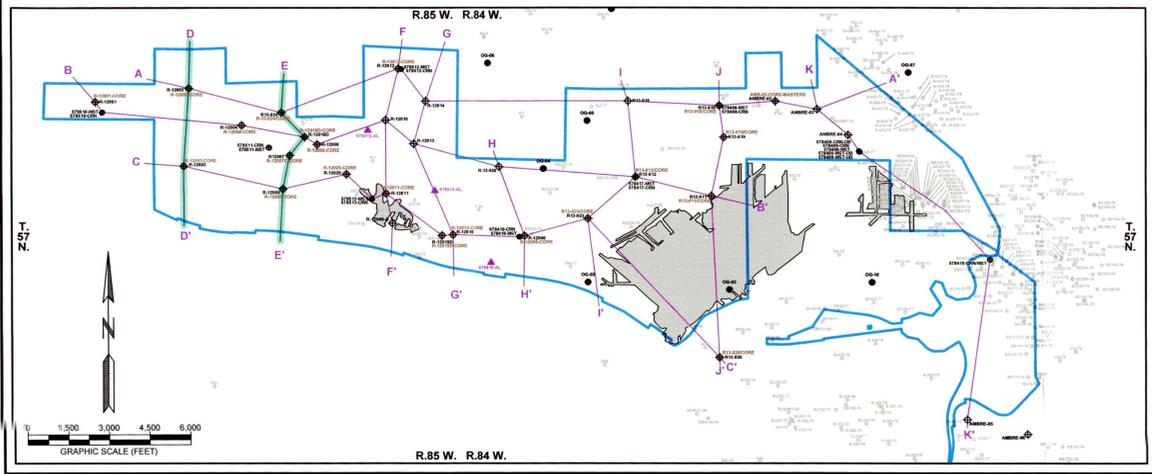
		BROOK MINE SHERIDAN COUNTY, WY 1101 SUGARVIEW DR, STE. 201 SHERIDAN, WY 82801		SHEET 6 OF 12
		ADDENDUM D5-3 EXHIBIT 2		
REVISIONS Date Description		GEOLOGIC CROSS SECTION C-C' SEGMENT 2 OF 2		
Drawn By: MBM Checked By: MJE Date: 10/23/14				
FILE: ADD_D5_3_GEO_CROSS_SECTIONS.dwg				



CROSS SECTION D-D'
SCALE: HORIZ. 1" = 500', VERT. 1" = 25'



CROSS SECTION E-E'
SCALE: HORIZ. 1" = 500', VERT. 1" = 25'



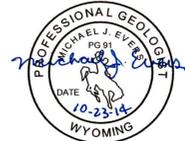
LEGEND

- BROOK MINE PERMIT BOUNDARY
- CROSS SECTION SEGMENT SHOWN ON THIS SHEET
- POTENTIOMETRIC SURFACE (CARNEY)
- POTENTIOMETRIC SURFACE (MASTERS)
- FAULT
- ⊕ R12011 EXPLORATION BOREHOLE
- ⊕ R-12008-CORE CORE HOLE
- ⊕ 578418-CRN MONITOR WELL
- ⊕ 58320-73 HISTORIC EXPLORATION BOREHOLE
- ⊕ 578418-AL MONITOR WELL - ALLUVIUM
- ⊕ 06-11 WOGCC OIL OR GAS WELL
- 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
- UNKN 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.

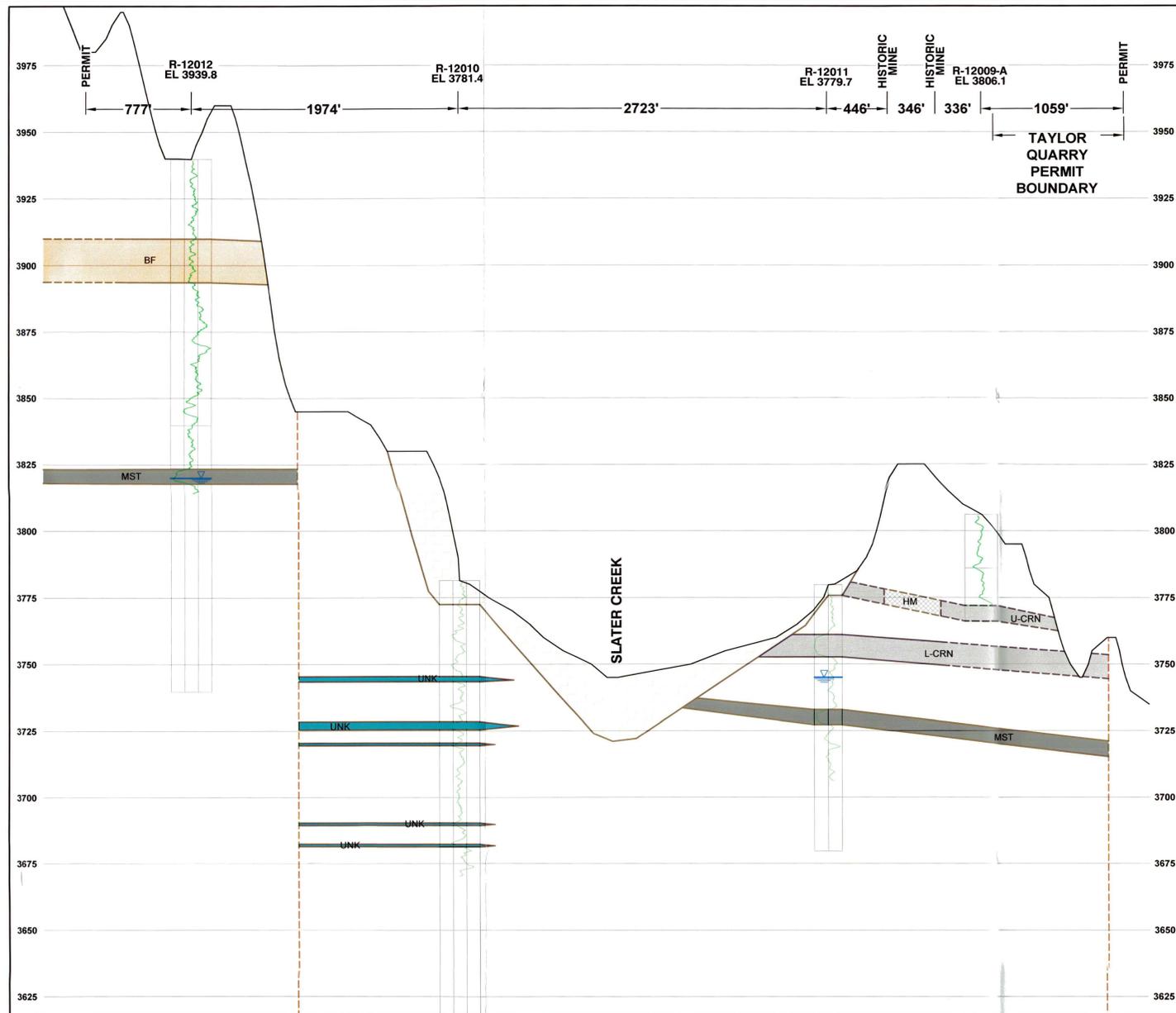
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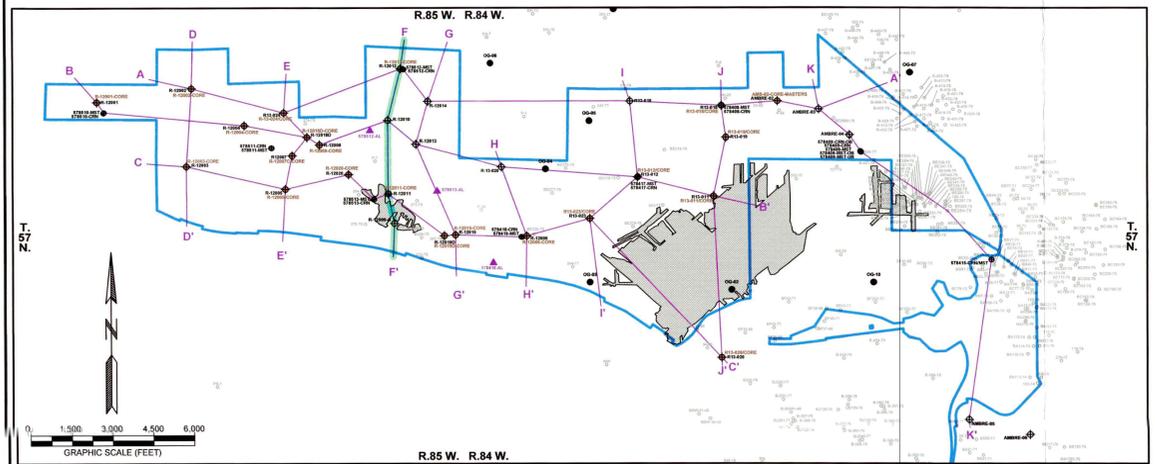


TFN 6 2/025
RECD NOV 14, 2014

		BROOK MINE SHERIDAN COUNTY, WY 1101 SUGARVIEW DR., STE. 201 SHERIDAN, WY 82801	
		SHEET 7 OF 12	ADDENDUM D5-3 EXHIBIT 2
GEOLOGIC CROSS SECTIONS D-D' AND E-E'		Drawn By: MBM Checked By: MJE Date: 10/23/14	
FILE: ADD_D5_3_GEO_CROSS_SECTIONS.dwg			



CROSS SECTION F-F'
SCALE: HORIZ. 1" = 500', VERT. 1" = 25'

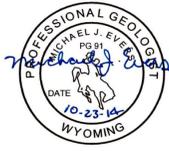


- LEGEND**
- BROOK MINE PERMIT BOUNDARY
 - CROSS SECTION SEGMENT SHOWN ON THIS SHEET
 - POTENTIOMETRIC SURFACE (CARNEY)
 - POTENTIOMETRIC SURFACE (MASTERS)
 - - - FAULT
 - ⊕ R12011 EXPLORATION BOREHOLE
 - ⬮ CORE HOLE
 - ⊙ 578419-CRN MONITOR WELL
 - ⊙ 82330-79 HISTORIC EXPLORATION BOREHOLE
 - ▲ 578419-AL MONITOR WELL - ALLUVIUM
 - 06-15 WOGCC OIL OR GAS WELL
 - 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.

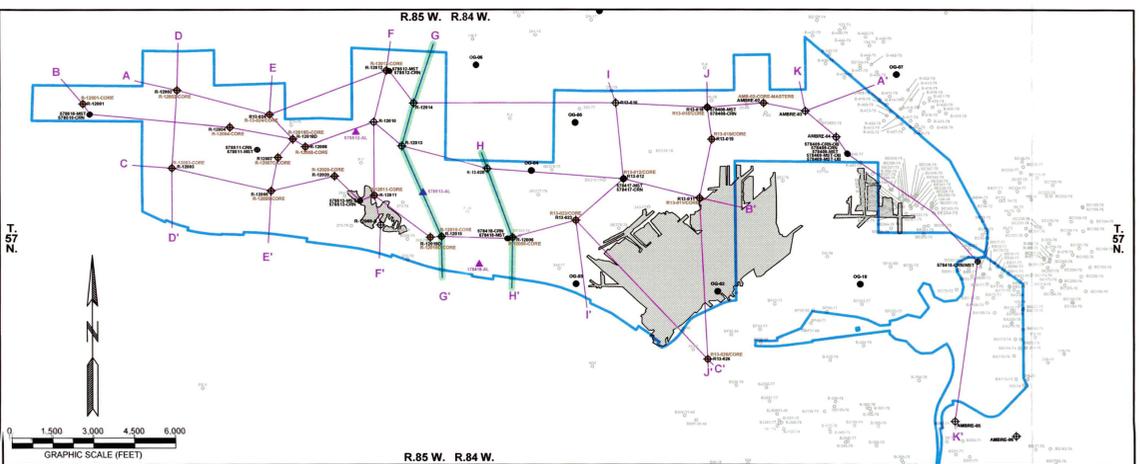
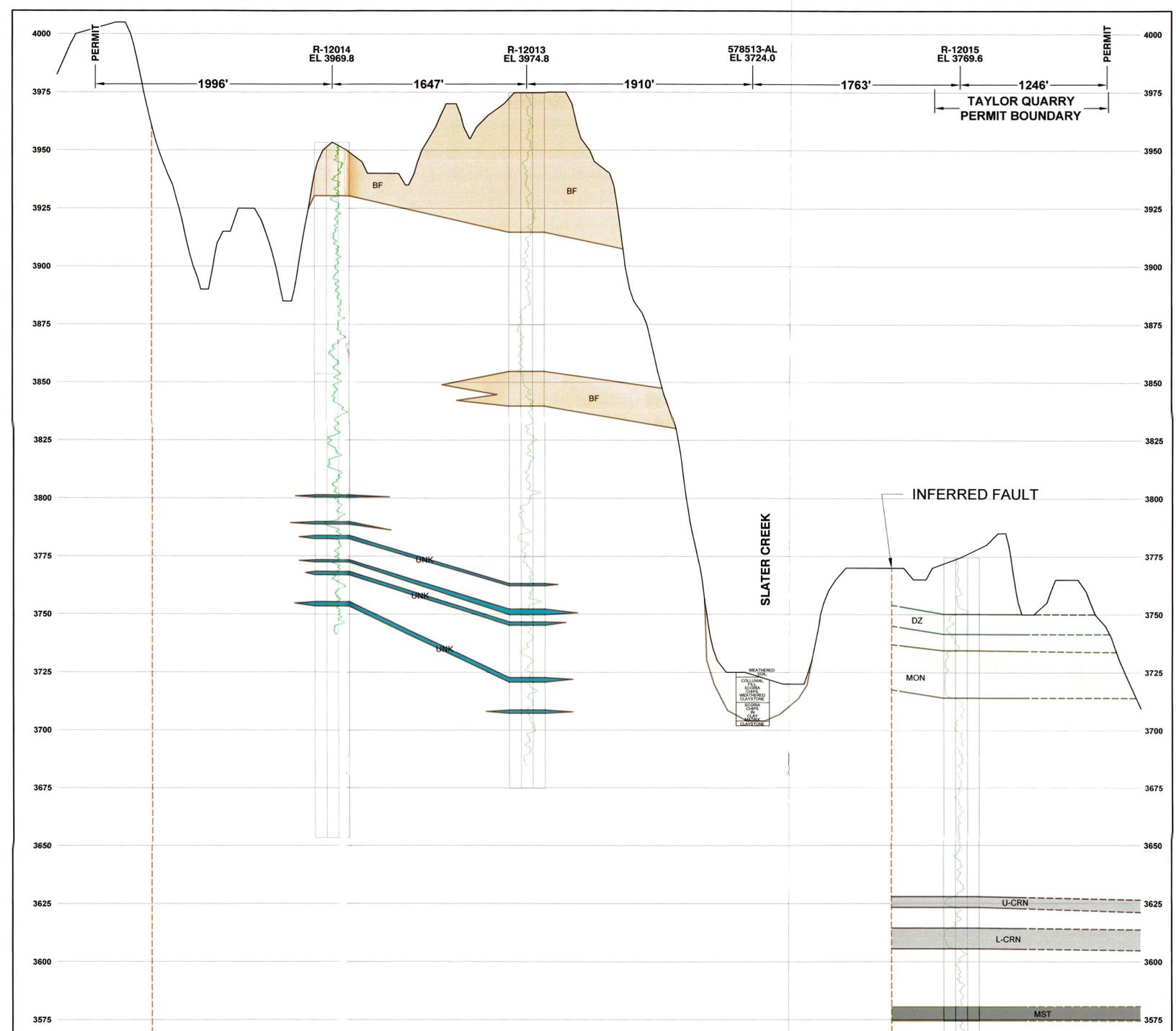
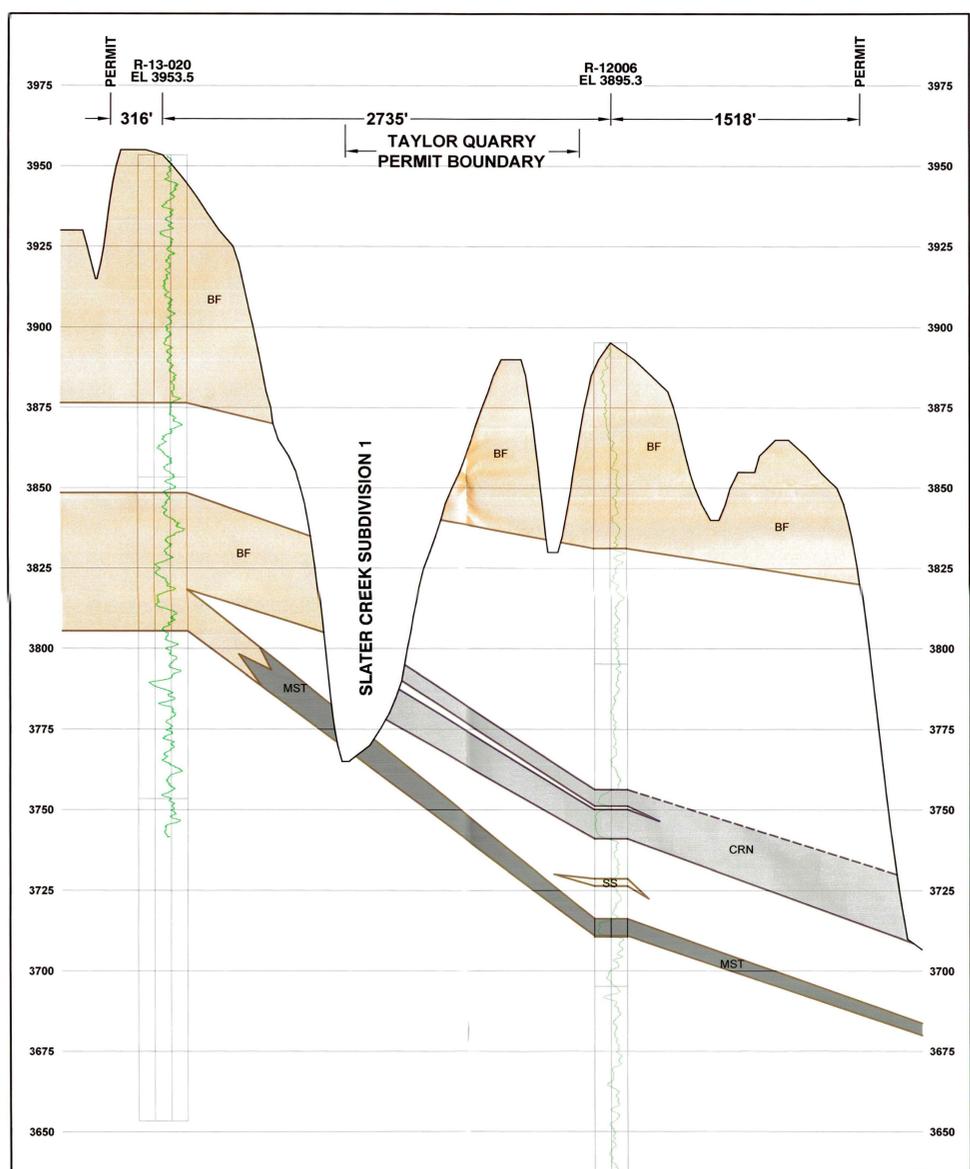
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TFN 6 2/025
RECD NOV 14, 2014

		BROOK MINE SHERIDAN COUNTY, WY 1101 SUGARVIEW DR, STE. 201 SHERIDAN, WY 82801	
		SHEET 8 OF 12	
REVISIONS Date Description		ADDENDUM D5-3 EXHIBIT 2 GEOLOGIC CROSS SECTION F-F'	
Drawn By: MBM Checked By: MJE Date: 10/23/14			



- LEGEND**
- BROOK MINE PERMIT BOUNDARY
 - CROSS SECTION SEGMENT SHOWN ON THIS SHEET
 - POTENTIOMETRIC SURFACE (CARNEY)
 - POTENTIOMETRIC SURFACE (MASTERS)
 - FAULT
 - R12011 EXPLORATION BOREHOLE
 - R12006-CORE CORE HOLE
 - 578418-CRN MONITOR WELL
 - 578217-H HISTORIC EXPLORATION BOREHOLE
 - 578418-AL MONITOR WELL - ALLUVIUM
 - 06-15 WOGCC OIL OR GAS WELL
 - CLAYSTONE/SILTSTONE
 - SANDSTONE
 - 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)

CERTIFICATE OF GEOLOGIST

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PROFESSIONAL GEOLOGIST
MICHAEL J. EVERS
PG 01
DATE 10-23-14
WYOMING

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.

TFN 6 2 / 025
RECD 09/14, 2014

RAMACO

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

ADDENDUM D5-3
EXHIBIT 2

GEOLOGIC CROSS SECTIONS G-G' AND H-H'

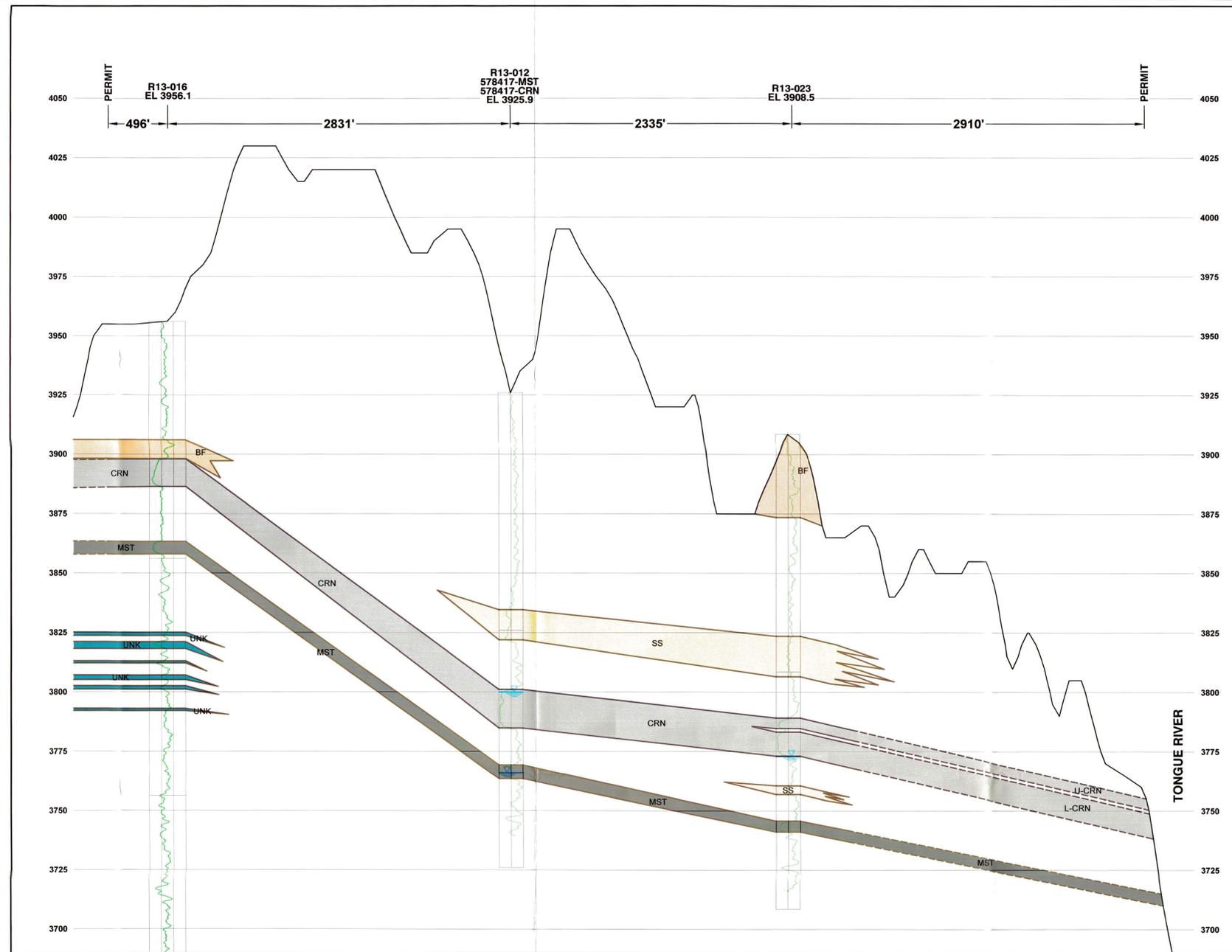
REVISIONS

Date	Description

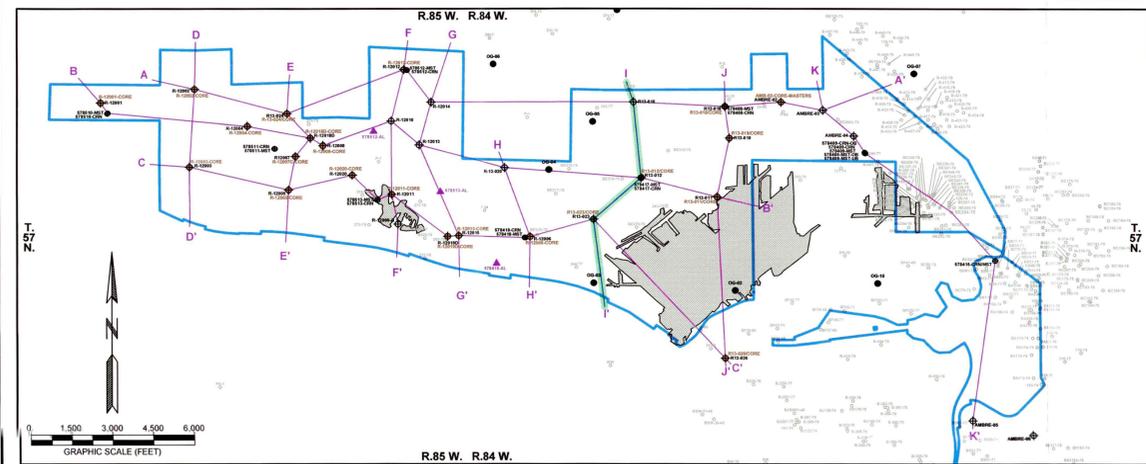
Drawn By: MBM
Checked By: MJE
Date: 10/23/14

FILE: ADD_D5_3_GEO_CROSS_SECTIONS.dwg

WWC ENGINEERING



CROSS SECTION I-I'
SCALE: HORIZ. 1" = 500', VERT. 1" = 25'



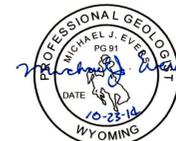
LEGEND

- BROOK MINE PERMIT BOUNDARY
- CROSS SECTION SEGMENT SHOWN ON THIS SHEET
- POTENTIOMETRIC SURFACE (CARNEY)
- POTENTIOMETRIC SURFACE (MASTERS)
- FAULT
- ⊕ R12011 EXPLORATION BOREHOLE
- ⊕ CORE HOLE
- ⊕ 578419-CRN MONITOR WELL
- ⊕ 578419-AL HISTORIC EXPLORATION BOREHOLE
- ⊕ 578419-AL MONITOR WELL - ALLUVIUM
- 06-17 WOGCC OIL OR GAS WELL
- 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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TFN 6/2/025
RECD NOV 14, 2014

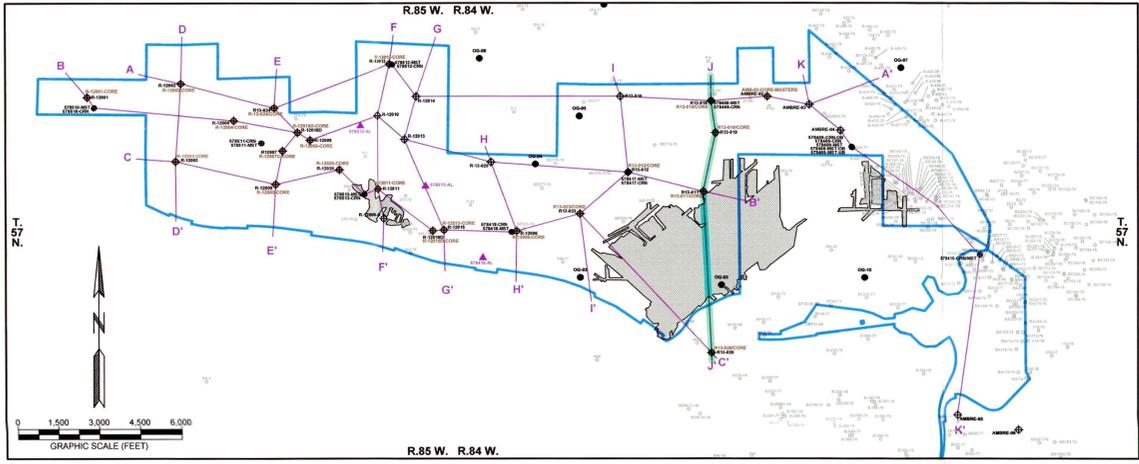
RAMACO BROOK MINE SHERIDAN COUNTY, WY 1101 SUGARVIEW DR, STE. 201 SHERIDAN, WY 82801		SHEET 10 OF 12	
		GEOLOGIC CROSS SECTION I-I'	
REVISIONS Date Description		ADDENDUM D5-3 EXHIBIT 2	
Drawn By: MBM Checked By: MJJE Date: 10/23/14		WWC ENGINEERING www.wwcengineering.com	
FILE: ADD_D5_3_GEO_CROSS_SECTIONS.dwg			



LEGEND

- BROOK MINE PERMIT BOUNDARY
- CROSS SECTION SEGMENT SHOWN ON THIS SHEET
- POTENTIOMETRIC SURFACE (CARNEY)
- POTENTIOMETRIC SURFACE (MASTERS)
- FAULT
- R12011 EXPLORATION BOREHOLE
- R-12006-CORE CORE HOLE
- 578418-CRN MONITOR WELL
- 578418-AL HISTORIC EXPLORATION BOREHOLE
- 578418-AL MONITOR WELL - ALLUVIUM
- 06-43 WOGCC OIL OR GAS WELL
- 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)

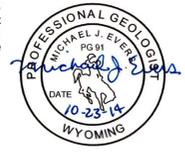
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 2) CONTACTS DASHED WHERE INFERRED.
 3) COAL SEAM POTENTIOMETRY FROM EXHIBITS D6.2-2 AND D6.2-3.



CROSS SECTION J-J'
 SCALE: HORIZ. 1" = 500', VERT. 1" = 25'

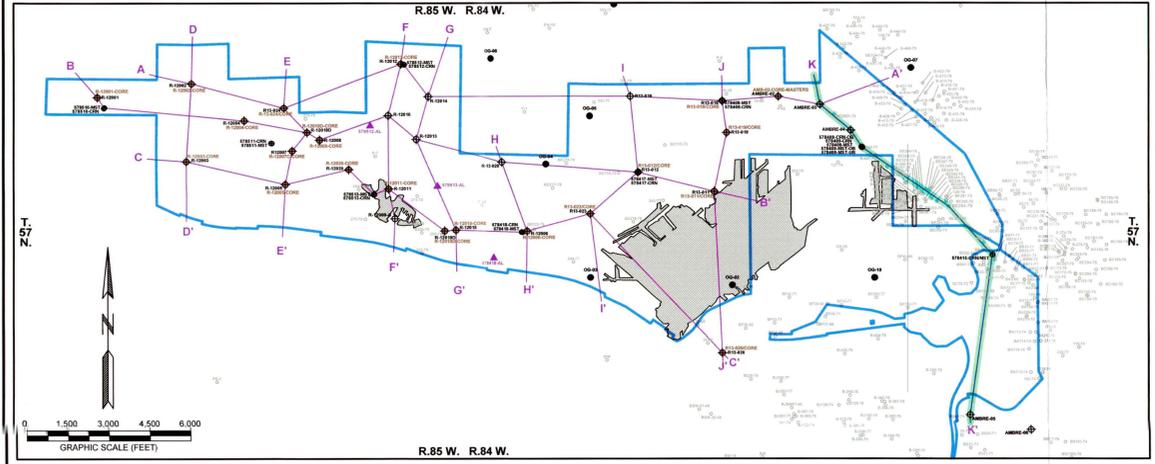
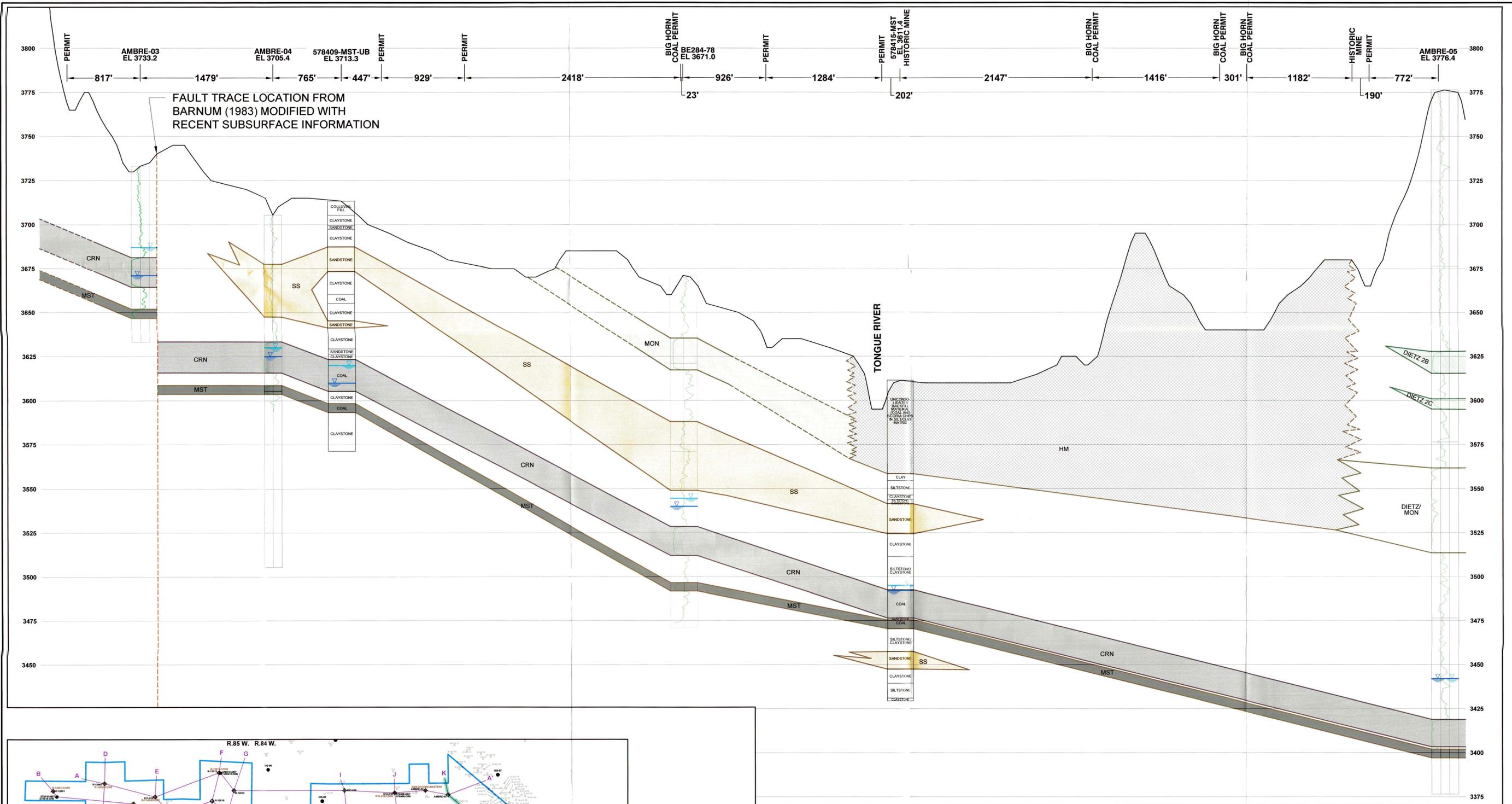
CERTIFICATE OF GEOLOGIST

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.



		BROOK MINE SHERIDAN COUNTY, WY 1101 SUGARVIEW DR., STE. 201 SHERIDAN, WY 82801	
		SHEET 11 OF 12	
REVISIONS Date Description		ADDENDUM D5-3 EXHIBIT 2	
GEOLOGIC CROSS SECTION J-J'		Drawn By: MBM Checked By: MJE Date: 10/23/14	
FILE: ADD_D5_3_GEO_CROSS_SECTIONS.dwg			

TFN 6 2/025
 RECD NOV 14, 2014

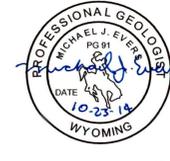


- LEGEND**
- BROOK MINE PERMIT BOUNDARY
 - CROSS SECTION SEGMENT SHOWN ON THIS SHEET
 - POTENTIOMETRIC SURFACE (CARNEY)
 - POTENTIOMETRIC SURFACE (MASTERS)
 - - - FAULT
 - ⊕ R12011 EXPLORATION BOREHOLE
 - ⊕ R-12006-CORE CORE HOLE
 - ⊕ 578418-CRN MONITOR WELL
 - ⊕ 90223-18 HISTORIC EXPLORATION BOREHOLE
 - ⊕ 578418-AL MONITOR WELL - ALLUVIUM
 - ⊕ 06-10 WOGCC OIL OR GAS WELL
 - 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
 - UNKN UNKNOWN COAL SEAM (STRINGER)

CROSS SECTION K-K'
SCALE: HORIZ. 1" = 500', VERT. 1" = 25'

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.



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.

		BROOK MINE SHERIDAN COUNTY, WY 1101 SUGARVIEW DR., STE. 201 SHERIDAN, WY 82801	
		REVISIONS Date Description	ADDENDUM D5-3 EXHIBIT 2 TFN 6 2 / 025 RECD NOV 14, 2014 SHEET 12 OF 12
GEOLOGIC CROSS SECTION K-K'		Drawn By: MBM Checked By: MJE Date: 10/23/14	

ADDENDUM D5-4

RAMACO

Brook Mine

ADDENDUM D5-4

Isopach Maps

July 2015

**TFN 6 2/025
RECD JUL 30, 2015**

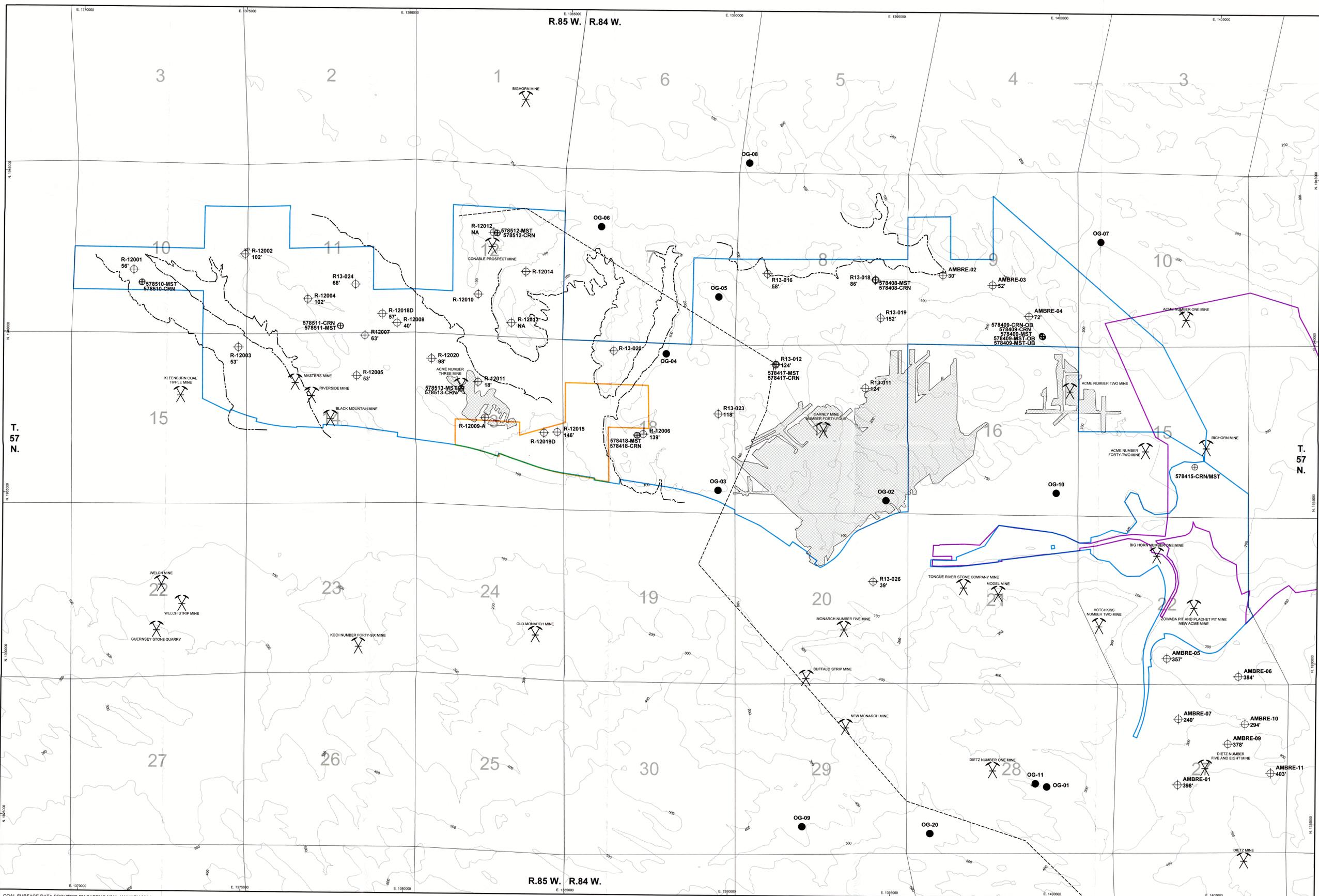
Addendum D5-4-1

DEQ 5-181

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



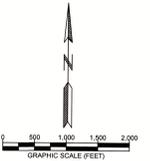
COAL SURFACE DATA PROVIDED BY CARDNO MMA, JANUARY 2014.

- LEGEND**
- BROOK MINE PERMIT BOUNDARY
 - BIG HORN COAL PERMIT BOUNDARY (PERMIT NO. 213-17)
 - TAYLOR QUARRY PERMIT BOUNDARY (PERMIT NO. SP-157)
 - APPROXIMATE LOCATION OF CARNEY SPLIT
 - CARNEY NO. COAL LINE
 - R-12011 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

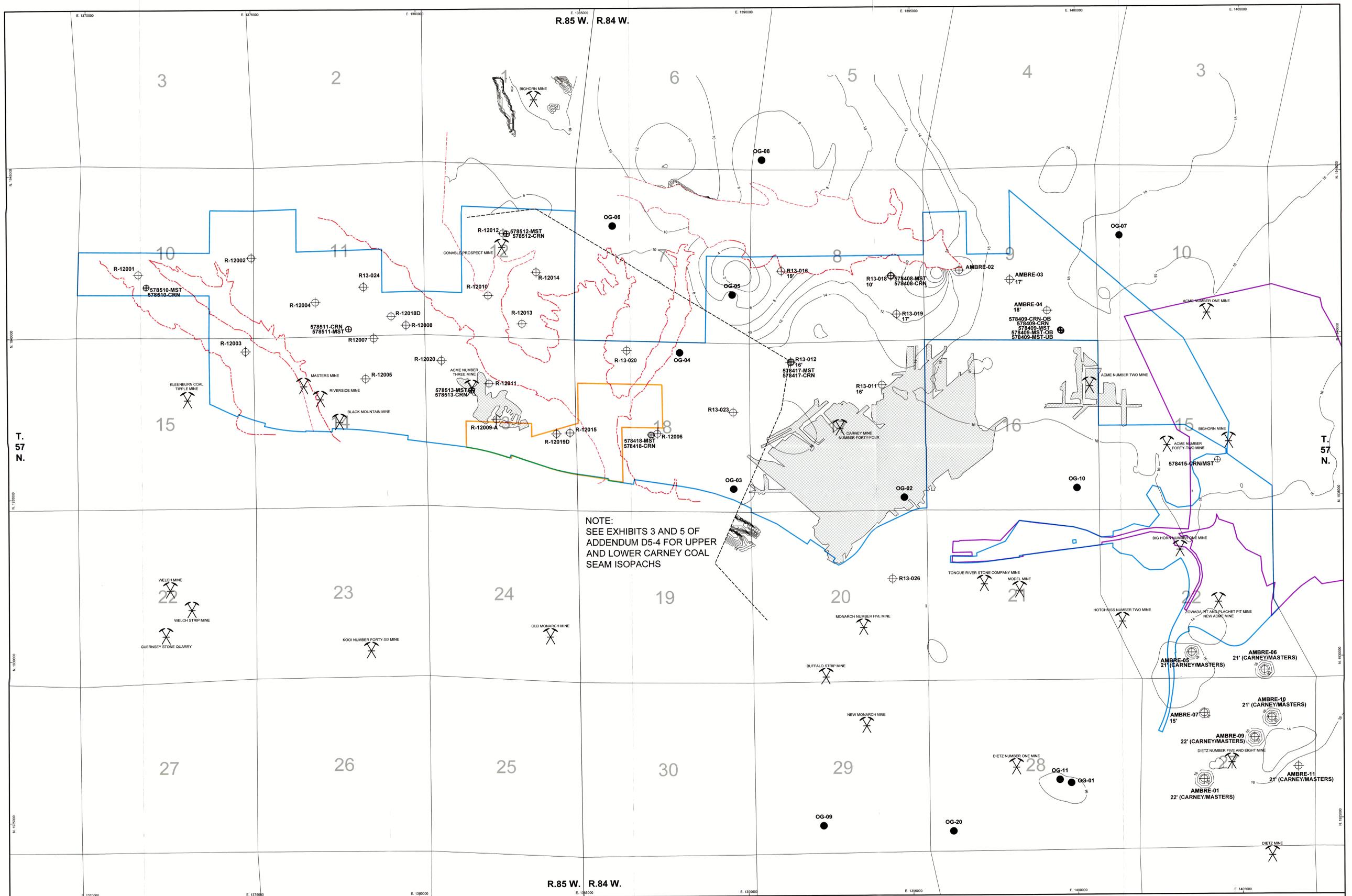
NOTES
 1. SEE ADDENDUM D5-2 FOR SEAM THICKNESS AND NAME.
 2. NA: INDICATES THE PRESENCE OF CARNEY BURN.

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.



		BROOK MINE SHERIDAN COUNTY, WY 1101 SUGARVIEW DR., STE. 201 SHERIDAN, WY 82801	
		TFN 6 2 / 025 RECD DEC 18, 2015	
ADDENDUM D5-4 EXHIBIT 1		OVERBURDEN ISOPACH OVERLYING THE CARNEY COAL SEAM	
REVISIONS 0615 ROUND 1 COMMENTS 1015 ROUND 2 COMMENTS 1215 ROUND 3 COMMENTS	Drawn By: DCJ Checked By: JGB Date: 10/05/14		



NOTE:
SEE EXHIBITS 3 AND 5 OF
ADDENDUM D5-4 FOR UPPER
AND LOWER CARNEY COAL
SEAM ISOPACHS

R.85 W. R.84 W.

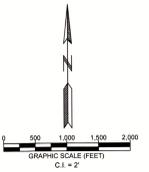
COAL SURFACE DATA PROVIDED BY CARDNO MMA JANUARY 2014.

- LEGEND**
- BROOK MINE PERMIT BOUNDARY
 - BIG HORN COAL PERMIT BOUNDARY (PERMIT NO. 213-77)
 - 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' EXPLORE 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.

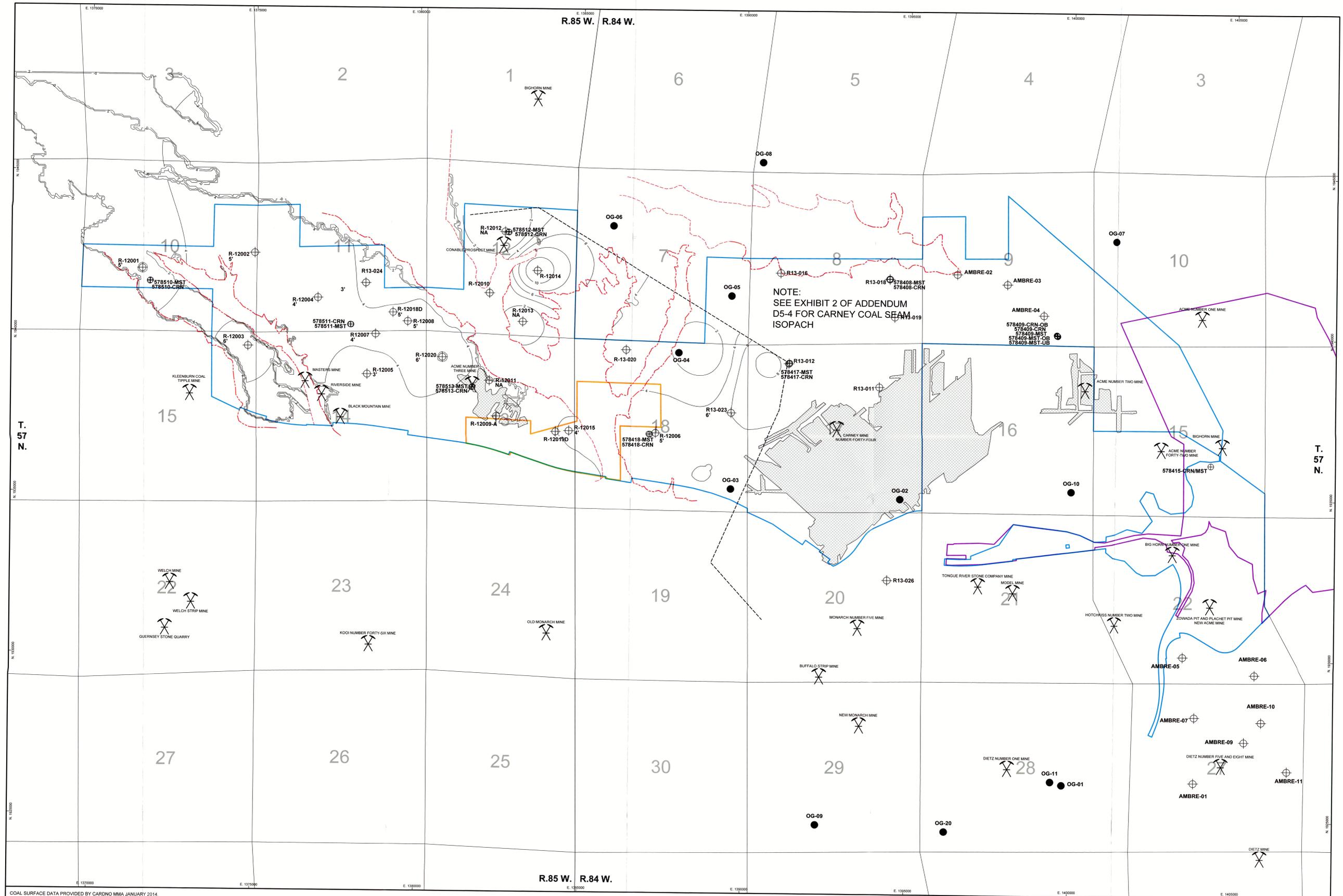
CERTIFICATE OF ENGINEER

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TFN 6 2/025
RECD OCT 23, 2015

		BROOK MINE SHERIDAN COUNTY, WY 1101 SUGARVIEW DR, STE. 201 SHERIDAN, WY 82801	
		ADDENDUM D5-4 EXHIBIT 2 CARNEY COAL SEAM ISOPACH	
REVISIONS Date Description 06/15 ROUND 1 COMMENTS 10/15 ROUND 2 COMMENTS		Drawn By: DCJ Checked By: JGB Date: 10/08/14 FILE: D5-4-CARNEY_ISO_R2.dwg	



COAL SURFACE DATA PROVIDED BY CARDNO MMA, JANUARY 2014.

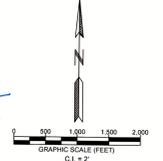
LEGEND

- BROOK MINE PERMIT BOUNDARY
- BIG HORN COAL PERMIT BOUNDARY (PERMIT NO. 213-17)
- TAYLOR QUARRY PERMIT BOUNDARY (PERMIT NO. SP-757)
- APPROXIMATE LOCATION OF CARNEY SPLIT
- CARNEY NO COAL LINE
- CARNEY NO COAL LINE (INFERRED)
- CARNEY SEAM REMOVED BY HISTORIC MINING
- HISTORIC MINE LOCATION
- ⊕ R-12011 EXPLORATION BOREHOLE THICKNESS
- ⊕ 578418-CRN MONITOR WELL
- OG-13 WOGCC OIL OR GAS WELL
- ⊕ DIETZ MINE
- ⊕ HISTORIC MINE LOCATION

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

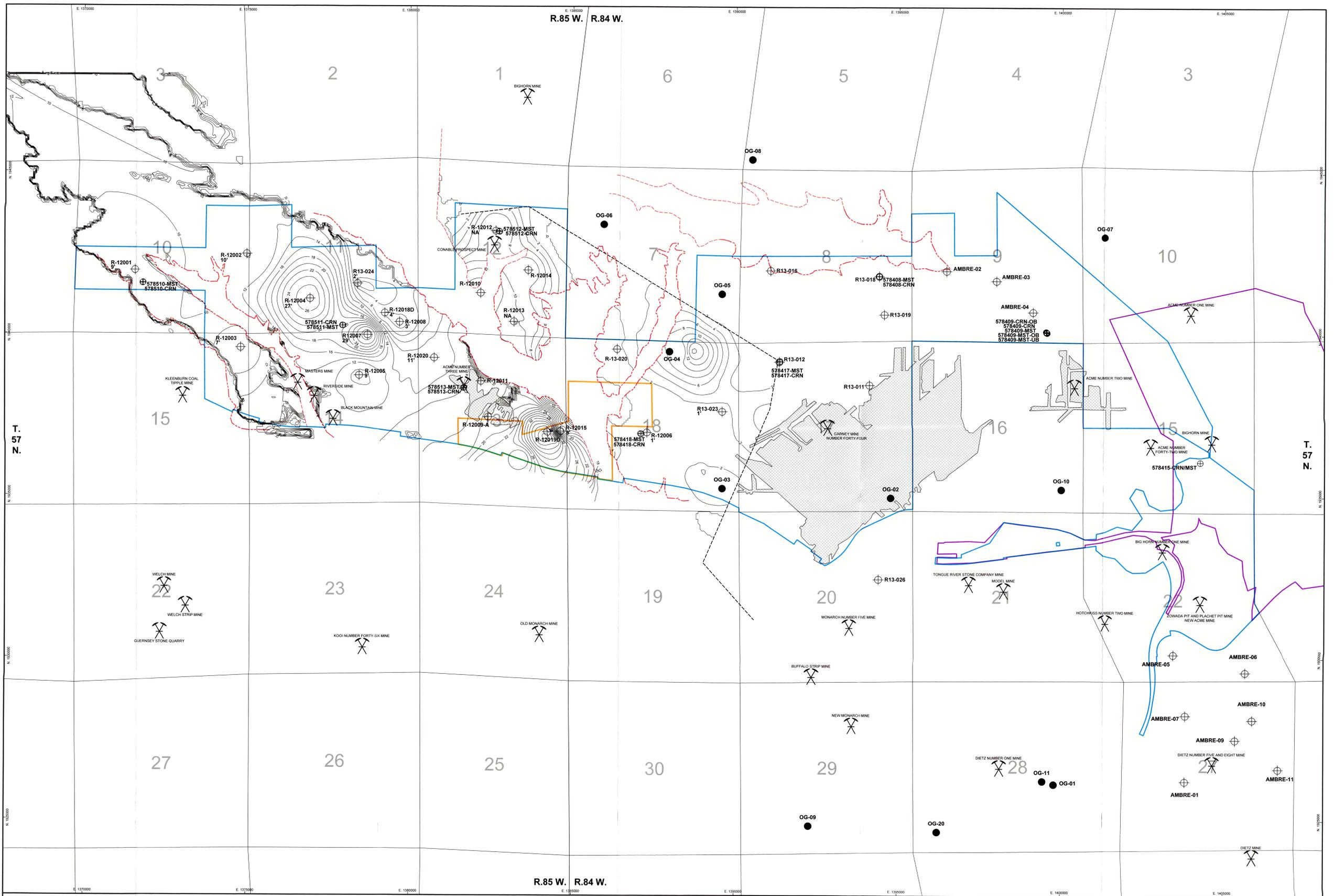
CERTIFICATE OF ENGINEER

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.



TFN 6 2 / 025
 RECD OCT 23, 2015

		BROOK MINE SHERIDAN COUNTY, WY 1101 SUGARVIEW DR., STE. 201 SHERIDAN, WY 82801	
		ADDENDUM D5-4 EXHIBIT 3 UPPER CARNEY COAL SEAM ISOPACH	
REVISIONS Date Description 06/15 ROUND 1 COMMENTS 10/15 ROUND 2 COMMENTS		Drawn By: DCJ Checked By: JGB Date: 10/08/14 FILE: D5-4-CARNEY_ISO_R2.dwg	



COAL SURFACE DATA PROVIDED BY CARDNO MMA, JANUARY 2014.

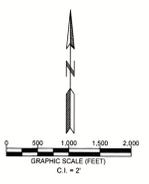
LEGEND

- BROOK MINE PERMIT BOUNDARY
- BIG HORN COAL PERMIT BOUNDARY (PERMIT NO. 213-17)
- 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
- X DIETZ MINE HISTORIC MINE LOCATION

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

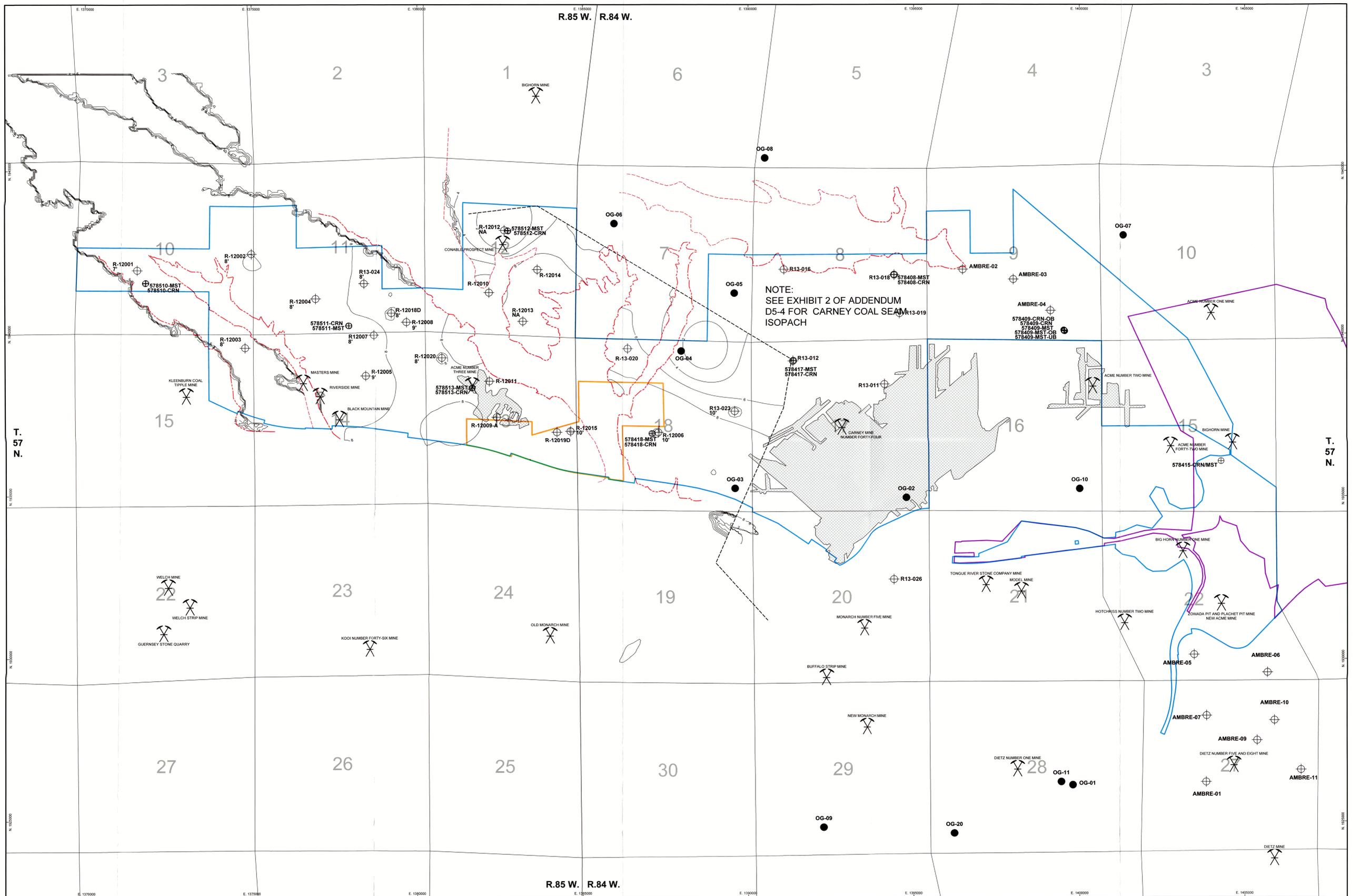
CERTIFICATE OF ENGINEER

I, Jeffrey G. Barton, 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.



TFN 6/2/025
 RECD OCT 23, 2015

		BROOK MINE SHERIDAN COUNTY, WY 1101 SUGARVIEW DR., STE. 201 SHERIDAN, WY 82801	
		ADDENDUM D5-4 EXHIBIT 4 UPPER AND LOWER CARNEY INTERBURDEN ISOPACH	
REVISIONS Date Description 06/15 ROUND 1 COMMENTS 10/15 ROUND 2 COMMENTS		Drawn By: DCJ Checked By: JGB Date: 10/08/14 FILE: D5 4.4_CARNEY_ISO_R2.dwg	



COAL SURFACE DATA PROVIDED BY CARDNO MMA JANUARY 2014.

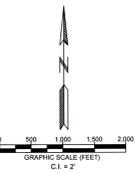
LEGEND

- BROOK MINE PERMIT BOUNDARY
- BIG HORN COAL PERMIT BOUNDARY (PERMIT NO. 213-77)
- TAYLOR QUARRY PERMIT BOUNDARY (PERMIT NO. 39-797)
- APPROXIMATE LOCATION OF CARNEY SPLIT
- CARNEY NO. 4 COAL LINE
- CARNEY NO. 4 COAL LINE (INFERRED)
- R-12011 EXPLORATION BOREHOLE THICKNESS
- 578418-CRN MONITOR WELL
- OG-13 WOODC 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 BURR.

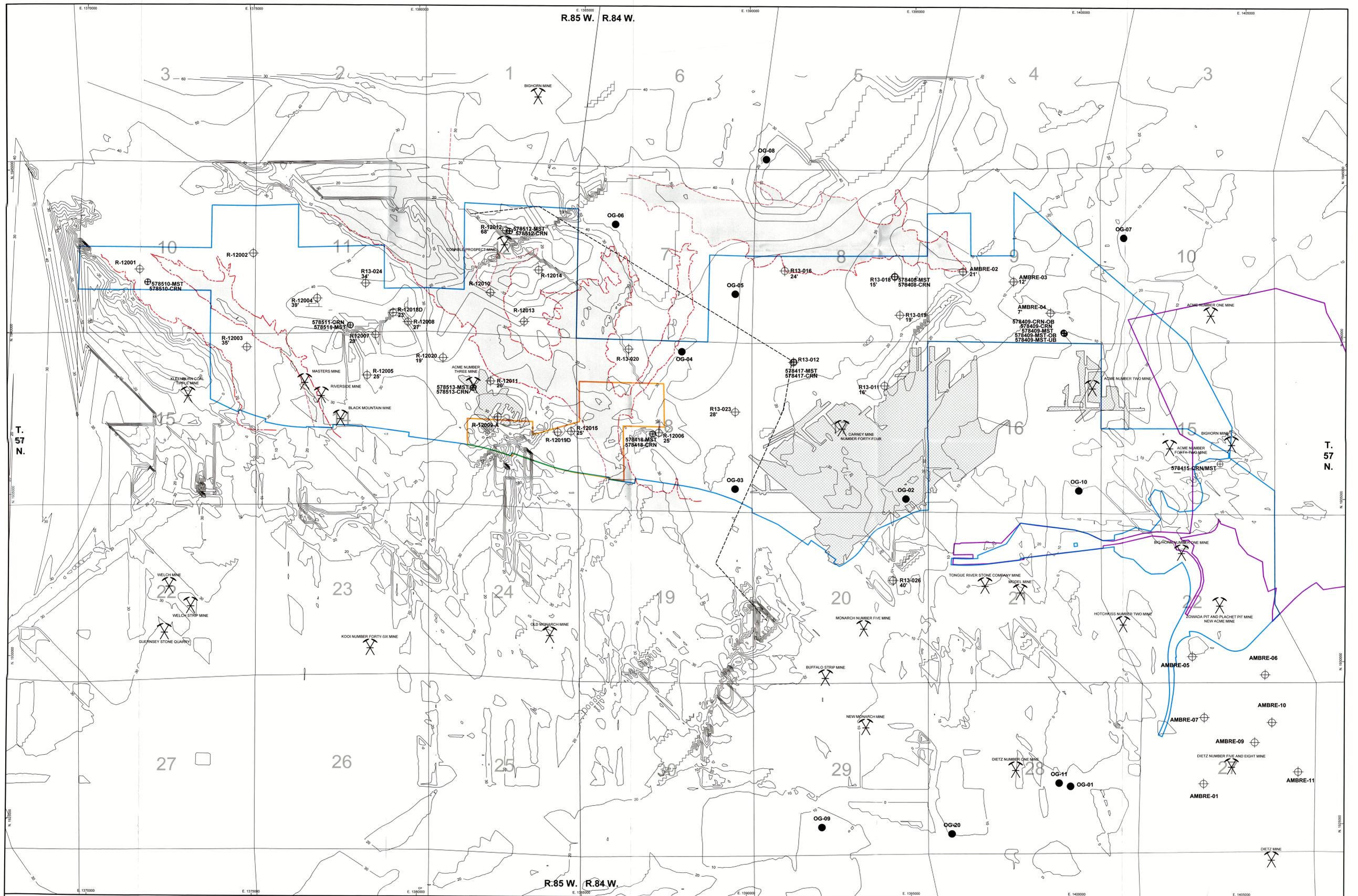
CERTIFICATE OF ENGINEER

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.



TFN 8 2/025
 RECD OCT 23, 2015

		BROOK MINE SHERIDAN COUNTY, WY 1101 SUGARVIEW DR, STE. 201 SHERIDAN, WY 82801	
		ADDENDUM D5-4 EXHIBIT 5	
LOWER CARNEY COAL SEAM ISOPACH			
REVISIONS Date Description 0615 ROUND 1 COMMENTS 1015 ROUND 2 COMMENTS		Drawn By: DCJ Checked By: JGB Date: 10/08/14	
FILE: D5_4-4_CARNEY_ISO_R2.dwg			



COAL SURFACE DATA PROVIDED BY CARDNO MMA JANUARY 2014.

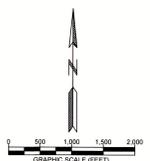
LEGEND

- BROOK MINE PERMIT BOUNDARY
- BIG HORN COAL PERMIT BOUNDARY (PERMIT NO. 213-17)
- TAYLOR QUARRY PERMIT BOUNDARY (PERMIT NO. SP-157)
- APPROXIMATE LOCATION OF CARNEY SPLIT
- CARNEY NO. COAL LINE
- CARNEY NO. COAL LINE (INFERRED)
- ⊕ R-12011 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.

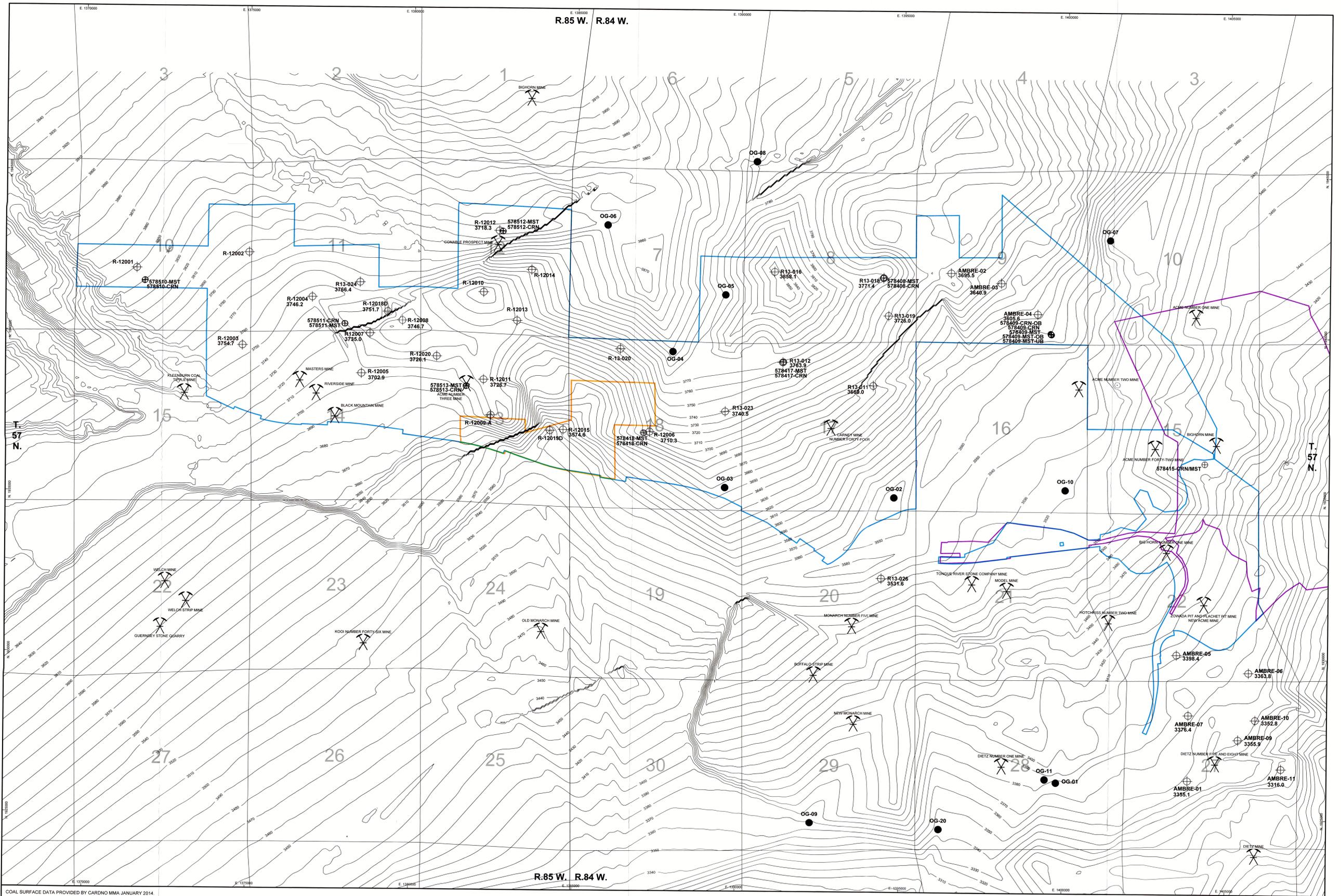
CERTIFICATE OF ENGINEER

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.



TFN 62/025
RECD OCT 23, 2015

		BROOK MINE SHERIDAN COUNTY, WY 1101 SUGARVIEW DR., STE. 201 SHERIDAN, WY 82801	
		ADDENDUM D5-4 EXHIBIT 6 LOWER CARNEY AND MASTERS INTERBURDEN ISOPACH	
REVISIONS Date Description 0515 ROUND 1 COMMENTS 1015 ROUND 2 COMMENTS		Drawn By: DCJ Checked By: JGB Date: 10/06/14	
FILE D5 4.4 CARNEY ISO R2.dwg			



COAL SURFACE DATA PROVIDED BY CARDNO MMA JANUARY 2014

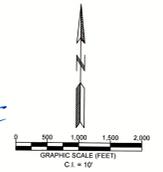
TFN 82/025
REC'D OCT 23, 2015

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

- LEGEND**
- BROOK MINE PERMIT BOUNDARY
 - BIG HORN COAL PERMIT BOUNDARY (PERMIT NO. 213-77)
 - TAYLOR QUARRY PERMIT BOUNDARY (PERMIT NO. SP-757)
 - DIETZ MINE
 - HISTORIC MINE LOCATION
 - EXPLORATION BOREHOLE
 - MASTERS SEAM BOTTOM ELEVATION
 - MONITOR WELL
 - OIL OR GAS WELL

CERTIFICATE OF ENGINEER

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		BROOK MINE SHERIDAN COUNTY, WY 1101 SUGARVIEW DR, STE. 201 SHERIDAN, WY 82801	
		ADDENDUM D5-4 EXHIBIT 8 BOTTOM ELEVATION OF MASTERS COAL SEAM	
REVISIONS Date Description 10/15 ROUND 1 COMMENTS 10/15 ROUND 2 COMMENTS		Drawn By: DCJ Checked By: JGB Date: 10/08/14	
FILE: D5_4-5 MASTERS ISO R2.dwg			

RAMACO

Brook Mine

ADDENDUM D5-5

**Overburden, Roof and
Floor Sample Analysis Tables**

**TFN 6 2/025
RECD NOV 14, 2014**

October 2014

Addendum D5-5-1

DEQ 5-192

TFN 6 2/025
RECD NOV 14, 2014



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

ADVANCED TERRA TESTING
October 2014

Addendum D5-5-2

RAMACO

Brook Mine

SPLITTING TENSILE STRENGTH
By Method of Brazilian Disk
ASTM D 3967

TFN 6 2/025
RECD NOV 14, 2014

October 2014

Addendum D5-5-3

DEQ 5-194

RAMACO

Brook Mine

SPLITTING TENSILE STRENGTH
By Method of Brazilian Disk
ASTM D 3967

CLIENT: Blacktooth Geological

JOB NO: 2892-01

LOCATION: Sheridan County, WY

DATE TESTED: 10/4/13 HN/BL

PROJECT: RAMACO Mine

Page 1 of 1

Specimen ID <small>Boring, Sample No., Depth(ft.)</small>	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

Data Entered By:
Data Checked By:
Filename:

BKL Date: 11/04/2013
HN Date: 11/4/2013
BGBD01AA

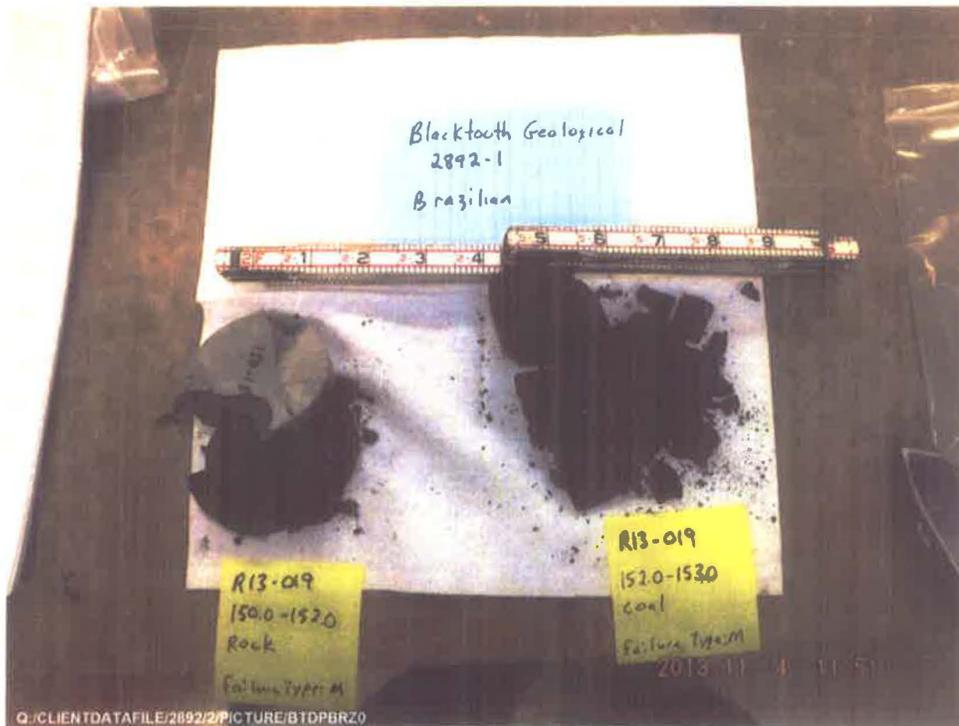


TFN 6 2/025
RECD NOV 14, 2014

October 2014

Addendum D5-5-4

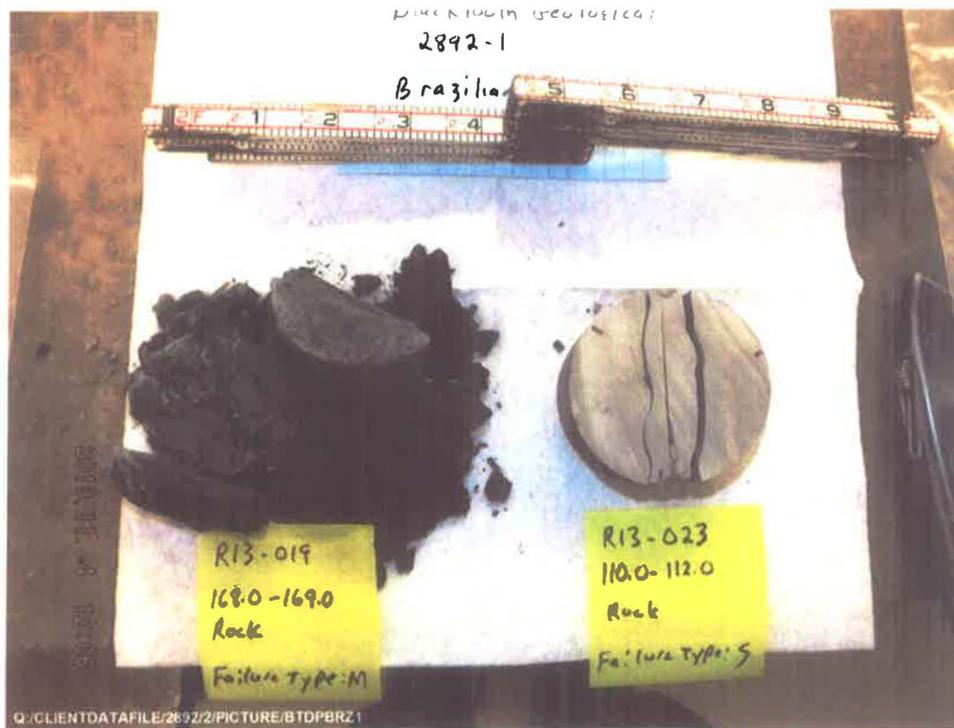
DEQ 5-195



October 2014

TFN 6 2/025
RECD NOV 14, 2014

Addendum D5-5-5



RAMACO

Brook Mine

MOISTURE & DENSITY
ASTM D 2216 & 2937

TFN 6 2/025
RECD NOV 14, 2014

October 2014

Addendum D5-5-7

DEQ 5-198

RAMACO

Brook Mine

Moisture & Density Determinations
ASTM D 2216 & D 2937

CLIENT: Blacktooth Geological
LOCATION: Sheridan County, WY

JOB NO.: 2892-01
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:
Data checked by: HN
FileName:
October 2014

SKL
Date: 11/4/13
BTMDRAMC.WK4

Date: 11/04/2013



Addendum D5-5-8

RAMACO

Brook Mine

**PARIFFIN-COATED DENSITY
ASTM D 4531-B**

**TFN 6 2/025
RECD NOV 14, 2014**

October 2014

Addendum D5-5-9

DEQ 5-200

RAMACO

Brook Mine

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
Data Checked by: HN
FileName: BGCD01AA

Date: 11/01/2013
Date: 11/1/13

TFN 6 2/025
RECD NOV 14, 2014



October 2014

Addendum D5-5-10

DEQ 5-201

RAMACO

Brook Mine

UNCONFINED COMPRESSIVE STRENGTH
ASTM D 7012 Method D

TFN 6 2/025
RECD NOV 14, 2014

October 2014

Addendum D5-5-11

DEQ 5-202

RAMACO

Brook Mine

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

Specimen ID			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
Boring	Depth (ft.)	Rock type									
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, FV Fracture, Bedding/Void Collapse, C: Combination

Data Entered By:
Data Checked By:
Filename:

HN
Date: 11/01/2013
Date: 11/1/13
UCS-SS01



TFN 6 2/025
RECD NOV 14, 2014

October 2014

Addendum D5-5-12

DEQ 5-203

CLIENT: Blacktooth Geological

PROJECT: RAMACO Mine

BORING: R13-019

DEPTH: 152.0-153.0

AREA (in²) = 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 = 0.08×10^6 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)

October 2014

RAMACO

3.9

NOTE: FAILURE DURING STRESS/STRAIN MEASUREMENTS

Failure

GAUGE LENGTH (IN)

350

TFN 8/2/025
RECD NOV 14, 2014

Appendix D5-5-13

Brook Mine

BlackTooth Geological #2892-01
50 kip, UCS/SS
152.0-153.0 Coal
X: 1" = 2500
Y: 1" = 0.0125
6104.65

CLIENT: Blacktooth Geological

UNCONFINED COMPRESSIVE

JOB NO: 2892-01

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

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

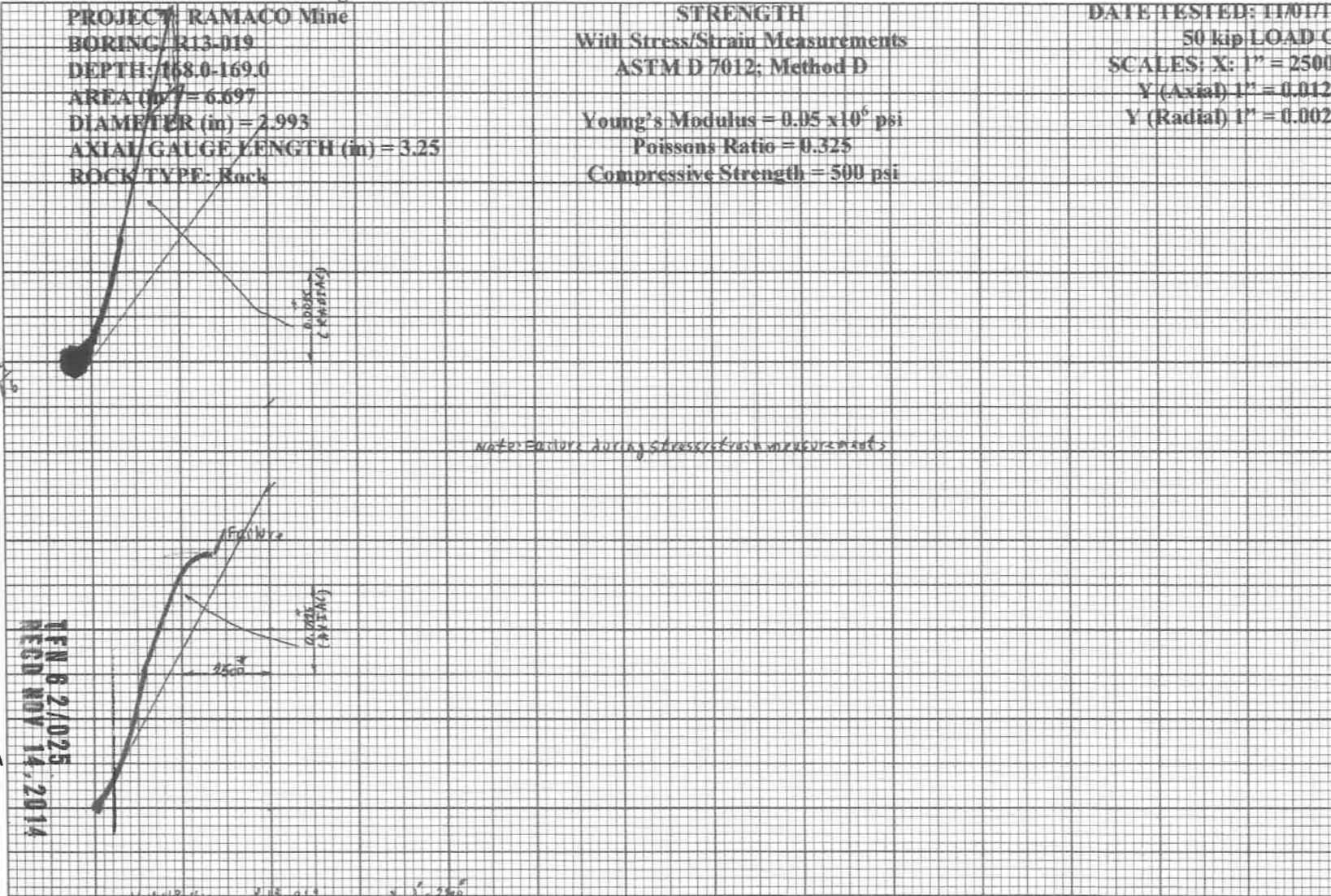
Young's Modulus = 0.95×10^6 psi
Poissons Ratio = 0.325
Compressive Strength = 500 psi

DATE TESTED: 11/07/13
50 kip LOAD CELL
SCALES: X: 1" = 2500 (lbs)
Y (Axial) 1" = 0.0125 (in)
Y (Radial) 1" = 0.0025 (in)

October 2014

2
1
0
1
2

Addendum DS-5-14



FN 8 21/025
NECN NOV 14, 2014

Blacktooth
2892-01
11/11/13
50 kip load cell
168.0-169.0
depth
2.993
dia
3.25
axial gauge length
0.325
nu
0.325
G = 3.25

Brook Mine

CLIENT: Blacktooth Geological

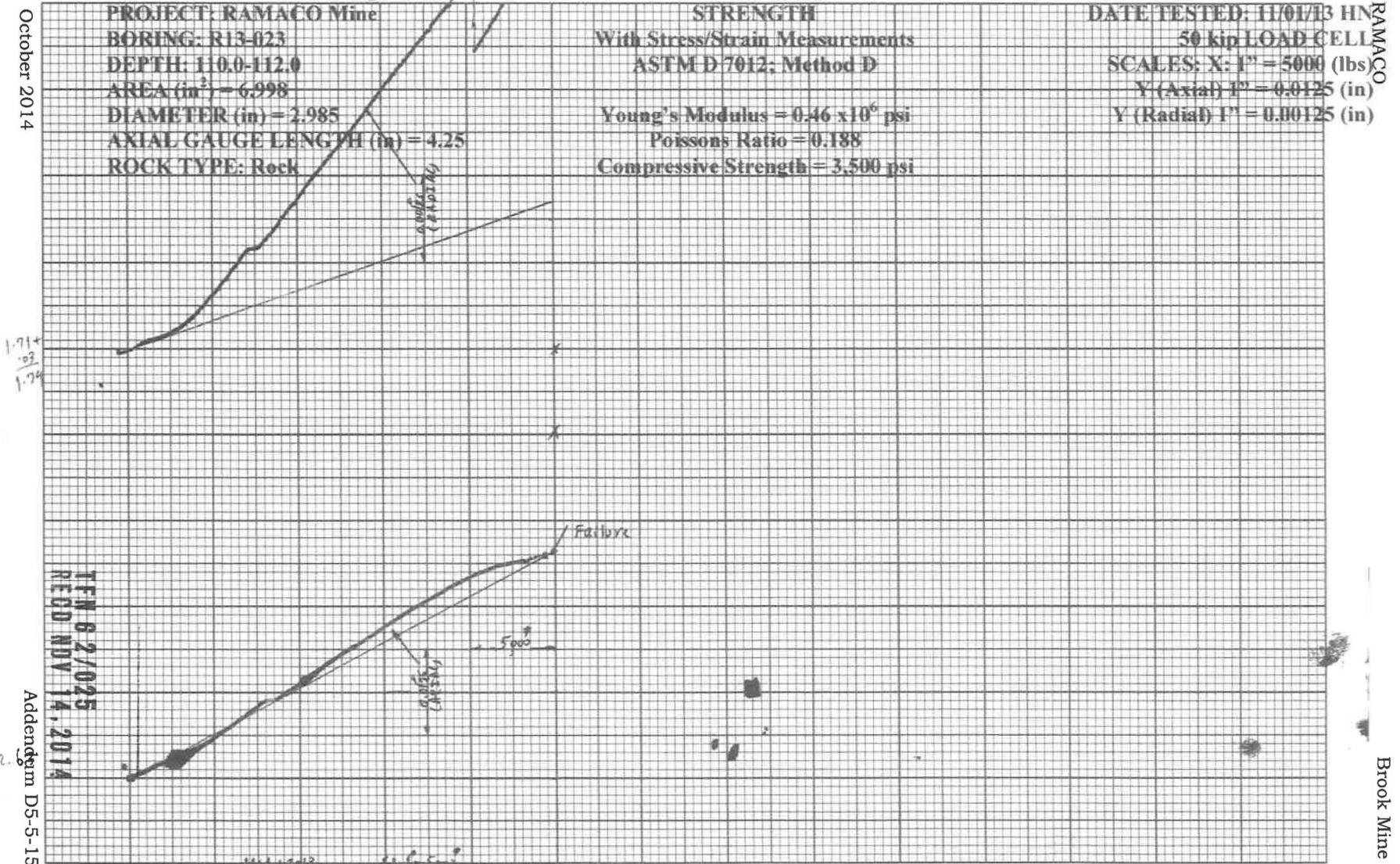
UNCONFINED COMPRESSIVE

JOB NO: 2892-01

PROJECT: RAMACO Mine
BORING: R13-023
DEPTH: 110.0-112.0
AREA (in²) = 6.998
DIAMETER (in) = 2.985
AXIAL GAUGE LENGTH (in) = 4.25
ROCK TYPE: Rock

STRENGTH
With Stress/Strain Measurements
ASTM D 7012; Method D
Young's Modulus = 0.46×10^6 psi
Poissons Ratio = 0.188
Compressive Strength = 3,500 psi

DATE TESTED: 11/01/13
50 kip LOAD CELL
SCALES: X: 1" = 5000 (lbs)
Y (Axial) 1" = 0.0125 (in)
Y (Radial) 1" = 0.00125 (in)



October 2014

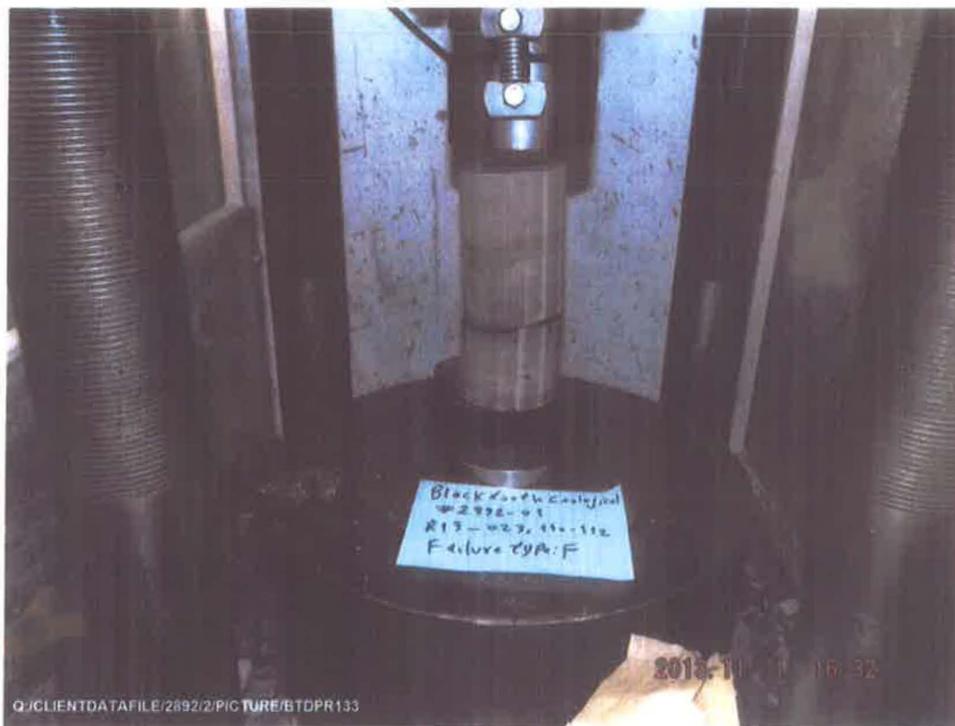
Addendum D5-5-15

RAMACO

Brook Mine

TFM 8/2/025
REGD NOV 14, 2014

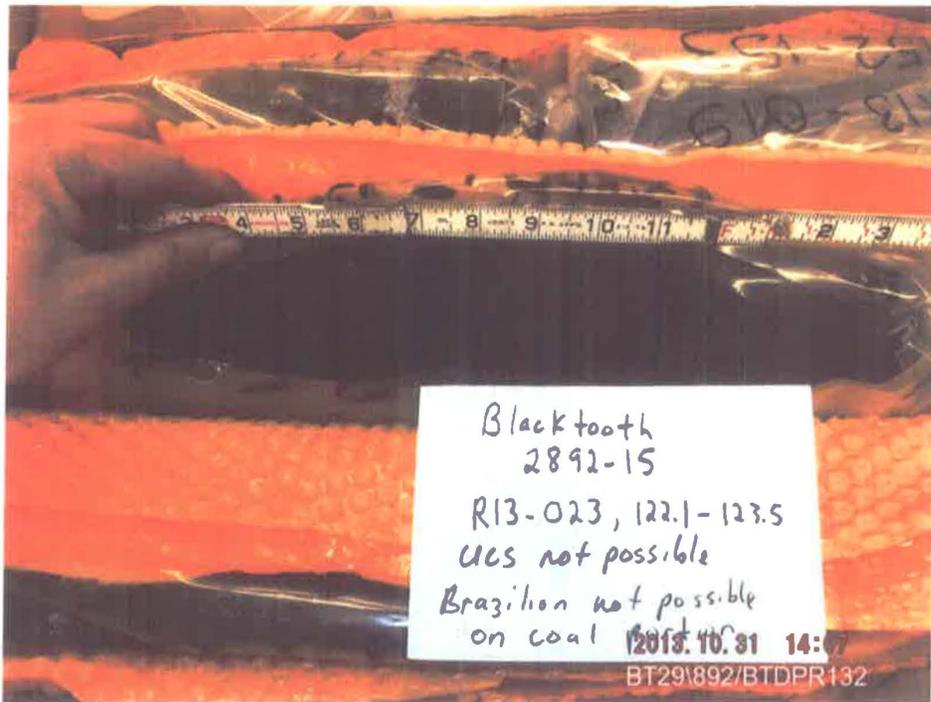
Blacktooth Geological
11/1/2013
R13-023
L₁ = 0.0125
G = 4.25







TFN 6 2/025
RECD NOV 14, 2014



TFN 6 2/025
RECD NOV 14, 2014



TFN 6 2/025
RECD NOV 14, 2014

RAMACO

Brook Mine

ADDENDUM D5-6

**WDEQ/LQD Overburden
Sampling Frequency Waiver**

**TFN 6 2/025
RECD NOV 14, 2014**

October 2014

Addendum D5-6-1

DEQ 5-213

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

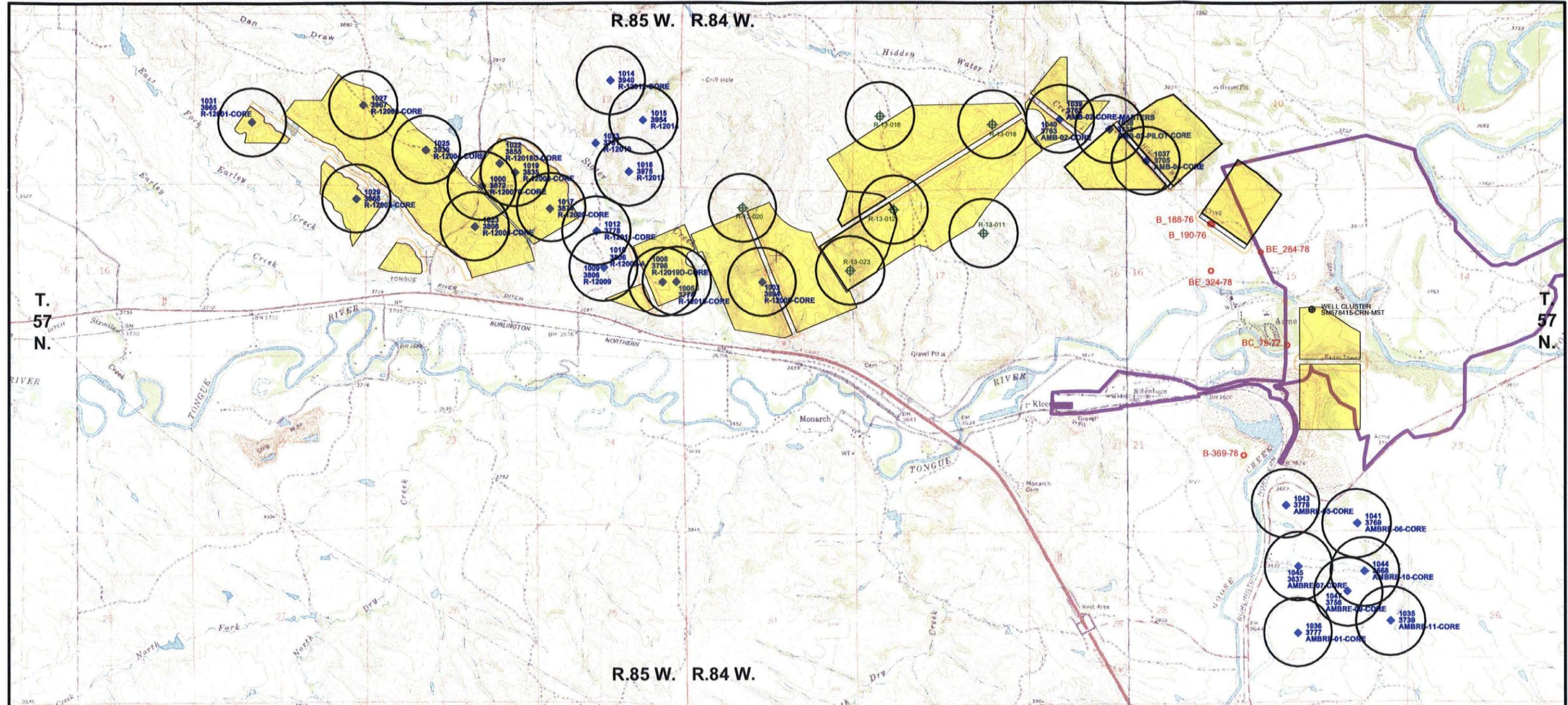
TFN 6 2/025
RECD NOV 14, 2014

/jgb

Enclosure: as noted

K:\RAMACO\13138\10-5\Work\Overburden_analysis\Overburden_Sampling_Plan.docx
October 2014

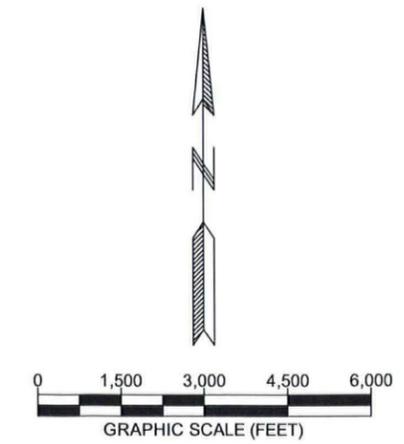
Addendum D5-6-2



LEGEND

- BIG HORN MINE PERMIT BOUNDARY
- 1036
AMBRE-01-CORE
1029
3868
R-12003-CORE
AMBRE ENERGY GEOLOGIC INVESTIGATION COREHOLE
- 1029
3868
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.



		BROOK MINE SHERIDAN COUNTY, WY 1101 SUGARVIEW DR. STE. 201 SHERIDAN, WY 82801	
		TFN 6 2/025 RECD OCT 23, 2015 OVERBURDEN SAMPLING	
REVISIONS		EXHIBIT 1	
Date	Description		
10/15	ROUND 2 COMMENTS		
		Drawn By: DCJ Checked By: JGB Date: 8-26-13	
FILE: ADD_D5-6_WELL_LOC_MINEPLAN_R2.dwg			

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:

"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.



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**

RAMACO

Brook Mine

ADDENDUM D5-7
Soil Analysis Reports

TFN 6 2/025
RECD NOV 14, 2014

October 2014

Addendum D5-7-1

DEQ 5-219



Inter-Mountain Labs

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

Your Environmental Monitoring Partner

October 2014

Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310273001

Date Reported: 12/2/2013

Work Order: S1310273

RAMACO

Project: Overburden
Date Received: 10/17/2013

Lab ID	Sample ID	Depths Feet	pH	Saturation	Electrical Conductivity	PE Calcium	PE Magnesium	PE Sodium	SAR
			s.u.	%	dS/m	meq/L	meq/L	meq/L	
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
REGD NOV 14, 2014

Addendum D5-7-2

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H2Osol= 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

Brook Mine



Inter-Mountain Labs

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

Your Environmental Monitoring Partner

October 2014

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

RAMACO

Brook Mine

Lab ID	Sample ID	Depths Feet	Sand %	Silt %	Clay %	Texture	Arsenic ppm	Boron ppm	Nitrate	Selenium ppm	Molybdenum ppm
									(as N) 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

Addendum D5-7-3

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H2Osol= 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

October 2014

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

RAMACO

Brook Mine

Lab ID	Sample ID	Depths Feet	Total	TOC	Total	T.S.	Neutral.	T.S.
			Carbon	%	Sulfur	AB	Potential	ABP
			%	%	%	†/1000t	†/1000t	†/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
REC'D NOV 14, 2014

Addendum D5-7-4

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H2Osol= 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: 11-27-12

Drillhole ID: R-12019D

SAMPLE INTERVAL DEPTH	INTERVAL ID	COMMENTS
0-5 > 1	1	
5-10 > 2	2	
10-15 > 3	3	
15-20 > 4	4	
20-25 > 3	5	
25-30 > 4	6	
30-35 > 4	7	
35-40 > 4	8	
40-45 > 5	9	
45-50 > 5	10	
50-55	↑ ↓	↑ coal ↓ coal These Sample Intervals Omitted
55-60		
60-65		
65-70		
70-75		
75-80		
80-85		
85-90		
90-95		
95-100		
100-105 > 6	11	
105-110 > 6	12	
110-115 > 7	13	
115-120 > 7	14	
120-125 > 8	15	
125-130 > 8	16	
130-135 > 9	17	
135-140 > 9	18	
140-145 > 10	19	
145-150 > 10	20	

Kane Asco
Rec'd 12/3/12
51212183

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

October 2014

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

RAMACO

Lab ID	Sample ID	Depths Feet	pH	Saturation	Electrical Conductivity	PE Calcium	PE Magnesium	PE Sodium	SAR
			s.u.	%	dS/m	meq/L	meq/L	meq/L	
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 62/025
RECD NOV 14, 2014

Addendum D5-7-6

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H2Osol= 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

Brook Mine



Inter-Mountain Labs

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

Your Environmental Monitoring Partner

October 2014

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

RAMACO

Lab ID	Sample ID	Depths Feet	Sand %	Silt %	Clay %	Texture	Arsenic ppm	Boron ppm	Nitrate	Selenium ppm	Molybdenum ppm
									(as N) 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 62/025
RECD NOV 14, 2014

Addendum D5-7-7

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H2Osol= 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

Brook Mine



Inter-Mountain Labs

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

Your Environmental Monitoring Partner

October 2014

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

RAMACO

Brook Mine

Lab ID	Sample ID	Depths Feet	Total		Total	T.S.	Neutral.	T.S.	Reflux	Pyr+Org	Pyr+Org
			Carbon	TOC	Sulfur	AB	Potential	ABP		AB	ABP
			%	%	%	l/1000t	l/1000t	l/1000t	%	l/1000t	l/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

Addendum D5-7-8

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H2OSol= 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: 12-5-12

Drillhole ID: R-12005

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

S1212189
Rec'd 12/12/12
Kane

TFN 6 2/025
RECD NOV 14, 2014



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October 2014

Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310329001

Date Reported: 12/1/2013

Work Order: S1310329

Project: Overburden
Date Received: 10/22/2013

RAMACO

Lab ID	Sample ID	Depths FEET	pH s.u.	Saturation %	Electrical	PE	PE	PE	SAR
					Conductivity dS/m	Calcium meq/L	Magnesium meq/L	Sodium meq/L	
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

Addendum DS-7-10

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H2Osol= 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

Brook Mine



Inter-Mountain Labs

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Your Environmental Monitoring Partner

October 2014

Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310329001

Date Reported: 12/1/2013

Work Order: S1310329

Project: Overburden
Date Received: 10/22/2013

RAMACO

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
REGD NOV 14, 2014

Addendum DS-7-11

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H2OSol= 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

Brook Mine



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October 2014

Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310329001

Date Reported: 12/1/2013

Work Order: S1310329

Project: Overburden
Date Received: 10/22/2013

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	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

Addendum D5-7-12

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

Brook Mine

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	
5-10	2	
10-15	3	
15-20	4	
20-25	5	
25-30	6	
30-35	7	
35-40	8	
40-50	9	
50-55	10	
55-58	11	core pieces
58-65	coal	coal
65-70	12	core pieces
70-75	13	
75-80	14	
80-85	15	
85-90	16	
90-95	17	
95-100	18	
100-105	19	
105-110	20	
110-115	coal	coal
115-120	21	
120-125	22	
125-133	coal	coal
133-134	-	core pieces
132.7-134	23	↓ ↓

Bottom of core
near 134-140

Rec'd 12/6/12
Kantse
5/2/191

TFN 6 2/025
RECD NOV 14, 2014



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October 2014

Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310331001

Date Reported: 12/1/2013

Work Order: S1310331

Project: Overburden
Date Received: 10/22/2013

RAMACO

Brook Mine

Lab ID	Sample ID	Depths FEET	pH	Saturation	Electrical Conductivity	PE Calcium	PE Magnesium	PE Sodium	SAR
			s.u.	%	dS/m	meq/L	meq/L	meq/L	
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

Addendum D5-7-14

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H2Osol= 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



Inter-Mountain Labs

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October 2014

Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310331001

Date Reported: 12/1/2013

Work Order: S1310331

Project: Overburden
Date Received: 10/22/2013

RAMACO

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

Addendum DS-7-15

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H2Osol= 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

Brook Mine



Inter-Mountain Labs

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Your Environmental Monitoring Partner

October 2014

Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310331001

Date Reported: 12/1/2013

Work Order: S1310331

Project: Overburden
Date Received: 10/22/2013

RAMACO

Brook Mine

Lab ID	Sample ID	Depths FEET	Total	TOC	Total	T.S.	Neutral.	T.S.	Reflux	Pyr+Org	Pyr+Org
			Carbon	%	Sulfur	AB	Potential	ABP		AB	ABP
			%	%	%	†/1000t	†/1000t	†/1000t	%	†/1000t	†/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

Addendum DS-7-16

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H2Osol= 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: 12-7-12

Drillhole ID: R-12003

SAMPLE INTERVAL DEPTH	INTERVAL ID	COMMENTS
-----------------------	-------------	----------

0-5 > 1	1	
5-10 > 1	2	
10-15 > 2	3	
15-20 > 2	4	
20-25 > 3	5	
25-30 > 3	6	
30-35 > 4	7	
35-40 > 4	8	
40-45 > 5	9	
45-50 > 5	10	
50-55 - 6		

55-60 (coal)	11	
--------------	---------------	--

60-65 - 7	11	
-----------	----	--

65-70 (coal)	12	
--------------	---------------	--

75-80 > 8	12	
-----------	----	--

80-85 > 8	13	
-----------	----	--

85-90 > 9	14	
-----------	----	--

90-95 > 9	15	
-----------	----	--

95-100 > 10	16	
-------------	----	--

100-105 > 10	17	
--------------	----	--

105-108 - core piece 11	18	
-------------------------	----	--

108-113 coal	19	
--------------	---------------	--

113-115 core pieces	20	last core slid out bottom
---------------------	---------------	---------------------------

51212192

Rec'd 12/11/12
K. H. Sisco

TFN 6 2/025
RECD NOV 14, 2014



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October 2014

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

RAMACO

Lab ID	Sample ID	Depths FEET	pH s.u.	Saturation %	Electrical	PE	PE	PE	SAR
					Conductivity dS/m	Calcium meq/L	Magnesium meq/L	Sodium meq/L	
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 62/025
REGD NOV 14, 2014

Addendum D5-7-18

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H2Osol= 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

Brook Mine



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October 2014

Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310332001

Date Reported: 12/1/2013

Work Order: S1310332

Project: Overburden
Date Received: 10/22/2013

RAMACO

Brook Mine

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

Addendum DS-7-19

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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October 2014

Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310332001

Date Reported: 12/1/2013

Work Order: S1310332

Project: Overburden
Date Received: 10/22/2013

RAMACO

Brook Mine

Lab ID	Sample ID	Depths FEET	Total	TOC	Total	T.S.	Neutral.	T.S.
			Carbon	%	Sulfur	AB	Potential	ABP
			%	%	%	†/1000t	†/1000t	†/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 62/025
RECD NOV 14, 2014

Addendum DS-7-20

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H2Sol= 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: 12-6-12

Drillhole ID: R-12001

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

rec'd
No
mp

rec'd
No
Samp

512193
rec'd 12/12/12
Kane

TFN 6 2/025
RECD NOV 14, 2014



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October 2014

Soil Analysis Report

RAMACO

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

RAMACO

Brook Mine

Lab ID	Sample ID	Depths FEET	pH	Saturation	Electrical Conductivity	PE Calcium	PE Magnesium	PE Sodium	SAR
			s.u.	%	dS/m	meq/L	meq/L	meq/L	
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 62/025
RECD NOV 14, 2014

Addendum D5-7-22

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H2Osol= 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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October 2014

Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310345001

Date Reported: 12/1/2013

Work Order: S1310345

Project: Overburden
Date Received: 10/23/2013

RAMACO

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 62/025
RECD NOV 14, 2014

Addendum D5-7-23

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H2OSol= 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

Brook Mine



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October 2014

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

RAMACO

Lab ID	Sample ID	Depths FEET	Total	TOC	Total	T.S.	Neutral.	T.S.
			Carbon	%	Sulfur	AB	Potential	ABP
			%	%	%	t/1000t	t/1000t	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 62/025
RECD NOV 14, 2014

Addendum D5-7-24

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H2OSol= 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

Brook Mine

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	13	core pieces
65 - 71	14	core pieces
71 - 89.5	—	coal No samples
89.5 - 96	15	core pieces
96 - 101	coal	No samples
101 - 105	—	lost core - No samples

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

TFN 6 2/025
 RECD NOV 14, 2014

October 2014

Addendum D5-7-25



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October 2014

Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310347001

Project: Overburden

Date Reported: 12/1/2013

Date Received: 10/23/2013

Work Order: S1310347

RAMACO

Lab ID	Sample ID	Depths FEET	pH s.u.	Saturation %	Electrical	PE	PE	PE	SAR
					Conductivity dS/m	Calcium meq/L	Magnesium meq/L	Sodium meq/L	
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
REC'D NOV 14, 2014

Addendum D5-7-26

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H2Osol= 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

Brook Mine



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October 2014

Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310347001

Date Reported: 12/1/2013

Work Order: S1310347

Project: Overburden
Date Received: 10/23/2013

RAMACO

Brook Mine

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

Addendum D5-7-27

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



Inter-Mountain Labs

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October 2014

Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310347001

Project: Overburden
Date Received: 10/23/2013

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

RAMACO

Lab ID	Sample ID	Depths FEET	Total		Total	T.S.	Neutral.	T.S.	Pyr+Org AB	Pyr+Org ABP	
			Carbon %	TOC %	Sulfur %	AB t/1000t	Potential t/1000t	ABP t/1000t			Reflux %
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
ECGD NOV 14, 2014

Addendum D5-7-28

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H2Osol= 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

Brook Mine

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 OBSamples	Coal
68.9 - 75 >	12	core pieces
75 - 78.5 >	13	core pieces
78.5 - 85.9	Coal	No samples
85.9 - 88 >	14	core pieces

Rec'd Jultz
 Kase Seco
 51301173

October 2014

TFN 6 2/025
 RECD NOV 14, 2014

Addendum D5-7-29



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October 2014

Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310350001

Date Reported: 12/1/2013

Work Order: S1310350

Project: Overburden
Date Received: 10/23/2013

Lab ID	Sample ID	Depths FEET	pH s.u.	Saturation %	Electrical	PE	PE	PE	SAR
					Conductivity dS/m	Calcium meq/L	Magnesium meq/L	Sodium meq/L	
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

RAMACO

TFN 62/025
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

Brook Mine

Addendum DS-7-30



Inter-Mountain Labs

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

Your Environmental Monitoring Partner

October 2014

Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310350001

Date Reported: 12/1/2013

Work Order: S1310350

Project: Overburden
Date Received: 10/23/2013

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 62/025
RECD NOV 14, 2014

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H2OSol= 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

Addendum D5-7-31

RAMACO

Brook Mine



Inter-Mountain Labs

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October 2014

Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310350001

Date Reported: 12/1/2013

Work Order: S1310350

Project: Overburden
Date Received: 10/23/2013

Lab ID	Sample ID	Depths FEET	Total	TOC	Total	T.S.	Neutral.	T.S.
			Carbon	%	Sulfur	AB	Potential	ABP
			%	%	%	t/1000t	t/1000t	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 62/025
RECD NOV 14, 2014

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H2OSol= 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

Addendum D5-7-32

RAMACO

Brook Mine

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	
5 - 10	2	
10 - 15	3	
15 - 20	No - sample	later circulation, poor returns cuttings contaminated severely with bentonite clay balls
20 - 25	No - sample	
25 - 30	No - sample	
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	4	
70 - 75	5	
75 - 80	6	
80 - 85	7	
85 - 90	8	
90 - 95	9	
95 - 100	10	
100 - 105	11	
105 - 110	12	
110 - 115	13	
115 - 120	14	
120 - 125	15	
125 - 130	16	received bag w/ no sample
130 - 135	17	
135 - 140	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 Heco
 51301171

Core in Separate Location!

TFN 62/025
 RECD NOV 14, 2014



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October 2014

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

RAMACO

Lab ID	Sample ID	Depths FEET	pH s.u.	Saturation %	Electrical	PE	PE	PE	SAR
					Conductivity dS/m	Calcium meq/L	Magnesium meq/L	Sodium meq/L	
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, H2Osol= 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

Addendum D5-7-34

Brook Mine



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October 2014

Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310351001

Project: Overburden

Date Reported: 12/1/2013

Date Received: 10/23/2013

Work Order: S1310351

RAMACO

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
REGD NOV 14, 2014

Addendum D5-7-35

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

Brook Mine



Inter-Mountain Labs

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October 2014

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

RAMACO

Lab ID	Sample ID	Depths FEET	Total	TOC	Total	T.S.	Neutral.	T.S.	Reflux	Pyr+Org	Pyr+Org
			Carbon	%	Sulfur	AB	ABP	Potential		ABP	AB
			%	%	%	1/1000t	1/1000t	1/1000t	%	1/1000t	1/1000t
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
REGD NOV 14, 2014

Addendum D5-7-36

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H2OSol= 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

Brook Mine

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	
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	13	
65 - 70	14	
70 - 75	15	
75 - 80	16	
80 - 85	17	
85 - 90	18	
90 - 95	19	
95 - 100	20	
100 - 105	21	
105 - 110	22	
110 - 115	23	
115 - 120	24	
120 - 124	25	
124 - 141		coal zone
141 - 146	14	core pieces
146 - 151	15	core pieces
151 - 156.5	15	core pieces
156.5 - 162		coal zone
162 - 163	16	core pieces

Rec'd 8/21/13
Kane Allee

TFN 6 2/025
 RECD NOV 14, 2014
 Addendum D5-7-37



Inter-Mountain Labs

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October 2014

Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310352001

Date Reported: 12/1/2013

Work Order: S1310352

Project: Overburden
Date Received: 10/23/2013

Lab ID	Sample ID	Depths FEET	pH s.u.	Saturation %	Electrical	PE	PE	PE	SAR
					Conductivity dS/m	Calcium meq/L	Magnesium meq/L	Sodium meq/L	
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

RAMACO

TFN 62/025
RECD NOV 14, 2014

Addendum D5-7-38

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H2Osol= 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

Brook Mine



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October 2014

Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310352001

Date Reported: 12/1/2013

Work Order: S1310352

Project: Overburden
Date Received: 10/23/2013

RAMACO

Brook Mine

Lab ID	Sample ID	Depths FEET	Sand %	Silt %	Clay %	Texture	Arsenic ppm	Boron ppm	Nitrate	Selenium ppm	Molybdenum ppm
									(as N) 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 62/025
RECD NOV 14, 2014

Addendum D5-7-39

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H2Osol= 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



Inter-Mountain Labs

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October 2014

Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310352001

Date Reported: 12/1/2013

Work Order: S1310352

RAMACO

Brook Mine

Project: Overburden
Date Received: 10/23/2013

Lab ID	Sample ID	Depths FEET	Total	TOC	Total	T.S.	Neutral.	T.S.
			Carbon	%	Sulfur	AB	Potential	ABP
			%	%	%	1/1000t	1/1000t	1/1000t
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
REGD NOV 14, 2014

Addendum D5-7-40

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: 8-30-13

Drillhole ID: R13-018

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	13	
65 - 70	14	
70 - 75	15	
75 - 80	16	
80 - 85	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	18	chips
125 - 130	19	chips

TFN 6 2/025
RECD NOV 14, 2014

Rec'd 9/3/13
Kandrew
51309033



Inter-Mountain Labs

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

Your Environmental Monitoring Partner

October 2014

Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310353001

Project: Overburden

Date Reported: 12/1/2013

Date Received: 10/23/2013

Work Order: S1310353

RAMACO

Lab ID	Sample ID	Depths FEET	pH	Saturation	Electrical Conductivity	PE Calcium	PE Magnesium	PE Sodium	SAR
			s.u.	%	dS/m	meq/L	meq/L	meq/L	
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, H2OSol= 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

Addendum DS-7-42

Brook Mine



Inter-Mountain Labs

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October 2014

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

RAMACO

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

Addendum D5-7-43

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

Brook Mine



Inter-Mountain Labs

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

Your Environmental Monitoring Partner

October 2014

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

RAMACO

Lab ID	Sample ID	Depths FEET	Total	TOC	Total	T.S.	Neutral.	T.S.
			Carbon	%	Sulfur	AB	Potential	ABP
			%	%	%	1/1000t	1/1000t	1/1000t
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 62/025
RECD NOV 14, 2014

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H2OSol= 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

Addendum D5-7-44

Brook Mine

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	
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	13	
65	70	14	
70	75	15	
75	80	16	
80	85	17	
85	90	18	
90	95	19	
95	100	20	
100	105	21	
105	110	22	
110	115	23	
115	120	24	
120	125	25	
125	130	30	
130	135	31	
135	140	32	
140	145	33	
145	150	34	
150	151.5	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 Analysis Analysis

TFN 62/025
 RECD NOV 14, 2014

Rec'd 9/11/13
 Lane A Seese
 51309040



Inter-Mountain Labs

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

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October 2014

Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310355001

Date Reported: 12/1/2013

Work Order: S1310355

Project: Overburden
Date Received: 10/23/2013

Lab ID	Sample ID	Depths FEET	pH	Saturation	Electrical Conductivity	PE Calcium	PE Magnesium	PE Sodium	SAR
			s.u.	%	dS/m	meq/L	meq/L	meq/L	
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 62/025
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

RAMACO

Brook Mine

Addendum D5-7-46



Inter-Mountain Labs

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October 2014

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

RAMACO

Lab ID	Sample ID	Depths FEET	Sand %	Silt %	Clay %	Texture	Arsenic ppm	Boron ppm	Nitrate	Selenium ppm	Molybdenum ppm
									(as N) 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

Addendum DS-7-47

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H2OSol= 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

Brook Mine



Inter-Mountain Labs

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Your Environmental Monitoring Partner

October 2014

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

RAMACO

Lab ID	Sample ID	Depths FEET	Total	TOC	Total	T.S.	Neutral.	T.S.
			Carbon	%	Sulfur	AB	Potential	ABP
			%	%	%	1/1000t	1/1000t	1/1000t
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
REC'D 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

Addendum D5-7-48

Brook Mine

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 > 1	2	
10 - 15 > 2	3	
15 - 20 > 2	4	
20 - 25 > 3	5	
25 - 30 > 3	6	
30 - 35 > 4	7	
35 - 40 > 4	8	
40 - 45 > 5	9	
45 - 50 > 5	10	
50 - 55 > 6	11	
55 - 60 > 6	12	
60 - 65 > 7	13	
65 - 70 > 7	14	
70 - 75 > 8	15	
75 - 80 > 8	16	
80 - 85 > 9	17	
85 - 90 > 9	18	
90 - 95 > 10	19	
95 - 100 > 10	20	
100 - 105 > 11	21	
105 - 110 > 11	22	
110 - 115 > 12	23	
115 - 120 > 12	24	
120 - 136	—	
120 - 136	—	Coal zone, no samples
136 - 140 > 13	25	
140 - 145 > 13	26	
145 - 150 > 14	27	
150 - 155 > 14	28	
155 - 157 > 15	29	
157 - 168	—	Coal zone, no samples
168 - 170 > 16	30	

TFN 62/025
 RECD NOV 14, 2014

Rec'd 9/16/13
 Kave Sheer
 51309101



Inter-Mountain Labs

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

Your Environmental Monitoring Partner

October 2014

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

RAMACO

Lab ID	Sample ID	Depths Feet	pH	Saturation	Electrical Conductivity	PE Calcium	PE Magnesium	PE Sodium	SAR
			s.u.	%	dS/m	meq/L	meq/L	meq/L	
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, H2OSol= 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

Addendum D5-7-50

Brook Mine



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Your Environmental Monitoring Partner

October 2014

Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310429001

Project: Overburden

Date Reported: 12/1/2013

Date Received: 10/28/2013

Work Order: S1310429

RAMACO

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, H2OSol= 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

Brook Mine

Addendum D5-7-51



Inter-Mountain Labs

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

Your Environmental Monitoring Partner

October 2014

Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310429001

Date Reported: 12/1/2013

Work Order: S1310429

Project: Overburden
Date Received: 10/28/2013

Lab ID	Sample ID	Depths Feet	Total	TOC	Total	T.S.	Neutral.	T.S.	Reflux	Pyr+Org	Pyr+Org
			Carbon	%	Sulfur	AB	ABP	Potential		ABP	AB
			%	%	%	t/1000t	t/1000t	t/1000t	%	t/1000t	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 62/025
RECD NOV 14, 2014

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H2OSol= 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

RAMACO

Brook Mine

Addendum D5-7-52

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	2	
10 - 15 > 2	3	
15 - 20 > 2	4	
20 - 25 > 3	5	
25 - 30 > 3	6	
30 - 35 > 4	7	
35 - 40 > 4	8	
40 - 45 > 5	9	
45 - 50 > 5	10	
50 - 55 > 6	11	
55 - 60 > 6	12	
60 - 65 > 7	13	
65 - 70 > 7	14	
70 - 75 > 8	15	
75 - 80 > 8	16	
80 - 85 No Sample	17	
85 - 90 > 9	18	
90 - 95 > 9	19	
95 - 100 > 10	20	
100 - 105 > 10	21	
105 - 110 > 11	22	
110 - 115 > 11	23	
115 - 120 > 12	24	
120 - 124 > 12	25	
124 - 140		Coal zone "No Sample"
140 - 145 > 13	26	
145 - 150 > 13	27	
150 - 155 > 14	28	
155 - 160 > 14	29	
160 - 165 > 15	30	
165 - 170 > 15	31	
170 - 175 > 16	32	
175 - 181.3		Coal zone "No Sample"
181.3 - 182 > 17	33	

TFN 6 2/025
 RECD NOV 14, 2014

Rec'd 8/23/13
 Kane A Seaman
 51308393



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 Secor, Soil Lab Supervisor

Page 1 of 1

October 2014

Addendum D5-7-54

DEQ 5-272



Inter-Mountain Labs

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Your Environmental Monitoring Partner

October 2014

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

RAMACO

Lab ID	Sample ID	Depths Feet	pH s.u.	Saturation %	Electrical	PE	PE	PE	SAR
					Conductivity dS/m	Calcium meq/L	Magnesium meq/L	Sodium meq/L	
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
REGD NOV 14, 2014

Addendum D5-7-55

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H2Osol= 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

Brook Mine



Inter-Mountain Labs

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

Your Environmental Monitoring Partner

October 2014

Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310274001

Date Reported: 12/5/2013

Work Order: S1310274

Project: Overburden
Date Received: 10/17/2013

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.

Abbreviations for extractants: PE= Saturated Paste Extract, H2OSol= 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

Addendum D5-7-56

RAMACO

Brook Mine



Inter-Mountain Labs

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

Your Environmental Monitoring Partner

October 2014

Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310274001

Date Reported: 12/5/2013

Work Order: S1310274

Project: Overburden
Date Received: 10/17/2013

RAMACO

Brook Mine

Lab ID	Sample ID	Depths Feet	Total		Total	T.S.	Neutral.	T.S.	Reflux	Pyr+Org	Pyr+Org
			Carbon	TOC	Sulfur	AB	Potential	ABP		AB	ABP
			%	%	%	†/1000†	†/1000†	†/1000†	%	†/1000†	†/1000†
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

Addendum DS-7-57

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H2Osol= 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: 11-29-12

Drillhole ID: R-12007 near Kleenburn Survey Pin

SAMPLE INTERVAL DEPTH	INTERVAL ID	COMMENTS
0 - 5 > 1	1	
5 - 10 > 2	2	
10 - 15 > 3	3	
15 - 20 > 2	4	
20 - 25 > 3	5	
25 - 30 > 3	6	
30 - 35 > 4	7	
35 - 40 > 4	8	
40 - 45 > 5	9	
45 - 50 > 5	10	
50 - 55 > 6	11	
55 - 60 > 6	12	
60 - 65 > 7	13	
65 - 70 (Not included)	omit interval	coal; do not analyze
70 - 75 > 8	14	
75 - 80 > 8	15	
80 - 85 > 9	16	
85 - 90 > 9	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 > 11	19	
110 - 115 > 11	20	
115 - 120 > 12	21	
120 - 125 > 12	22	
125 - 130 > 13	23	
130 - 135 (Not included)	omit interval	coal; do not analyze
137.6 - 138.6 (coal) - 14	24	"omit Part 135-140"

Rec'd 12/3/12
Kane Seco

TFN 6 2/025
RECD NOV 14, 2014

51212184



Inter-Mountain Labs

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

Your Environmental Monitoring Partner

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
 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.

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

TFN 6 2/025
 RECD NOV 14, 2014

Page 1 of 1

October 2014

Addendum D5-7-59

DEQ 5-277



Inter-Mountain Labs

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

Your Environmental Monitoring Partner

October 2014

Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310275001

Date Reported: 12/5/2013

Project: Overburden

Date Received: 10/17/2013

Work Order: S1310275

Lab ID	Sample ID	Depths Feet	pH	Saturation	Electrical Conductivity	PE Calcium	PE Magnesium	PE Sodium	SAR
			s.u.	%	dS/m	meq/L	meq/L	meq/L	
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 62/025
RECD NOV 14, 2014

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H2Oso= 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

Addendum D5-7-60

RAMACO

Brook Mine



Inter-Mountain Labs

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

Your Environmental Monitoring Partner

October 2014

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

RAMACO

Lab ID	Sample ID	Depths Feet	Sand %	Silt %	Clay %	Texture	Arsenic ppm	Boron ppm	Nitrate	Selenium ppm	Molybdenum ppm
									(as N) 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 62/025
RECD NOV 14, 2014

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H2OSol= 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

Addendum D5-7-61

Brook Mine



Inter-Mountain Labs

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

Your Environmental Monitoring Partner

October 2014

Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310275001

Date Reported: 12/5/2013

Work Order: S1310275

Project: Overburden
Date Received: 10/17/2013

Lab ID	Sample ID	Depths Feet	Total	TOC	Total	T.S.	Neutral.	T.S.	Reflux	Pyr+Org	Pyr+Org
			Carbon	%	Sulfur	AB	Potential	ABP		AB	ABP
			%	%	%	t/1000t	t/1000t	t/1000t	%	t/1000t	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

Addendum D5-7-62

RAMACO

Brook Mine

OVERBURDEN CORE/CHIP SAMPLE INTERVAL INSTRUCTIONS

Mine Site: Ramaco

Date: 12-3-12

Drillhole ID: R-12004 (con)

SAMPLE INTERVAL DEPTH	INTERVAL ID	COMMENTS
0-5 > 1	1	chips
5-10	2	
10-15 > 2	3	
15-20 > 2	4	
20-25 > 3	5	
25-30 > 3	6	
30-35 > 4	7	
35-39 > 4	8	core pieces
39-55	coal	coal - No samples
55-60 > 5	9	coal pieces
60-65 > 5	10	chips
65-70 > 6	11	
70-75 > 6	12	
75-80 > 7	13	
80-85 > 7	14	
85-90 > 8	15	
90-95 > 8	16	
95-100 > 9	17	core pieces
100-102 > 9	18	" "
102-106	coal	coal - No samples
106-110 > 10	19	core pieces
110-115 > 10	20	chips
115-120 > 11	21	
120-125 > 11	22	
125-130 > 12	23	
130-133 > 12	24	core pieces
133-141 > 13	coal	coal - No samples
141-145 > 13	25	core pieces
145-150 > 14	26	chips
150-155 > 14	27	
155-160 > 15	28	
160-165 > 15	29	
165-170 > 14	30	
170-175 > 14	31	
175-180 > 17	32	core pieces
180-184 > 17		coal - No samples
184-186.5		core stuck out! - No sample below coal

Note:
Samples in
2 - separate
Boxes!

TFN 62/025
RECD NOV 14, 2014

51212186
Rec'd 12/4/12
Kane-Heen



Inter-Mountain Labs

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

Your Environmental Monitoring Partner

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
 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

Page 1 of 1

October 2014

Addendum D5-7-64

DEQ 5-282



Inter-Mountain Labs

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

Your Environmental Monitoring Partner

October 2014

Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310343001

Project: Overburden

Date Reported: 12/5/2013

Date Received: 10/23/2013

Work Order: S1310343

Lab ID	Sample ID	Depths FEET	pH s.u.	Saturation %	Electrical	PE	PE	PE	SAR
					Conductivity dS/m	Calcium meq/L	Magnesium meq/L	Sodium meq/L	
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 62/025
RECD NOV 14, 2014

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H2Osol= 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

RAMACO

Brook Mine

Addendum D5-7-65



Inter-Mountain Labs

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

Your Environmental Monitoring Partner

October 2014

Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310343001

Date Reported: 12/5/2013

Work Order: S1310343

Project: Overburden
Date Received: 10/23/2013

RAMACO

Lab ID	Sample ID	Depths FEET	Sand %	Silt %	Clay %	Texture	Arsenic ppm	Boron ppm	Nitrate	Selenium ppm	Molybdenum ppm
									(as N) 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	3.77	0.6	0.17	0.60
S1310343-014	R-12020	135-142	9.0	33.0	58.0	Silty Clay	0.07	3.33	0.5	0.13	0.34

TFN 6/2/025
REC'D NOV 14, 2014

Addendum D5-7-66

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

Brook Mine



Inter-Mountain Labs

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

Your Environmental Monitoring Partner

October 2014

Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310343001

Date Reported: 12/5/2013

Work Order: S1310343

Project: Overburden
Date Received: 10/23/2013

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	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 62/025
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

RAMACO

Brook Mine

Addendum D5-7-67

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	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	13	
65 - 70	14	
70 - 75	15	
75 - 80	16	
80 - 85	17	
85 - 90	18	
90 - 95	19	
95 - 100	20	
100 - 105	—	coal No samples
105 - 110	21	core pieces
110 - 115	22	core pieces
115 - 123	—	coal NO Samples
123 - 125	—	core pieces core slid out - No samples
125 - 130	23	
130 - 135	24	
135 - 140	25	
140 - 142	26	core pieces
142 - 147	—	coal No samples
147 - 150	—	core pieces core slid out - No samples

TFN 62/025
 RECD NOV 14, 2014

Rec'd 12/17/12
 Karsseker
 51212260



Inter-Mountain Labs

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

Your Environmental Monitoring Partner

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.

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

TFN 6 2/025
 RECD NOV 14, 2014

Page 1 of 1



Inter-Mountain Labs

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

Your Environmental Monitoring Partner

October 2014

Soil Analysis Report
RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310348001

Date Reported: 12/5/2013

Work Order: S1310348

Project: Overburden
Date Received: 10/23/2013

Lab ID	Sample ID	Depths FEET	pH s.u.	Saturation %	Electrical	PE	PE	PE	SAR
					Conductivity dS/m	Calcium meq/L	Magnesium meq/L	Sodium meq/L	
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

RAMACO

TFN 62/025
REC'D NOV 14, 2014

Addendum D5-7-70

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H2Osol= 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

Brook Mine



Inter-Mountain Labs

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

Your Environmental Monitoring Partner

October 2014

Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310348001

Date Reported: 12/5/2013

Work Order: S1310348

Project: Overburden
Date Received: 10/23/2013

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

RAMACO

TFN 6 2/025
REGD NOV 14, 2014

Addendum D5-7-71

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H2OSol= 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

Brook Mine



Inter-Mountain Labs

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

Your Environmental Monitoring Partner

October 2014

Soil Analysis Report

RAMACO

250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1310348001

Project: Overburden

Date Reported: 12/5/2013

Date Received: 10/23/2013

Work Order: S1310348

RAMACO

Lab ID	Sample ID	Depths FEET	Total	TOC	Total	T.S.	Neutral.	T.S.
			Carbon	%	Sulfur	AB	Potential	ABP
			%	%	%	t/1000t	t/1000t	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 62/025
REC'D NOV 14, 2014

Addendum DS-7-72

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H2Osol= 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

Brook Mine

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	5	
25 - 29.8	6	Core pieces Core pieces
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 received 73.7-75

Roof and Floor Core Samples
in separate box - Not included
with OB Samples
m/w

*Local 1/13
Rane*

51301172

October 2014

TEN 62/025
RECD NOV 14, 2014

Addendum D5-7-73

Peter Kiewit Sons' Mining District
 Report of Laboratory Soil Analysis

Lab. No. _____ Date 3/76 Name Big Horn Coal Address _____ City/State _____

July 2015

Contents Overburden Core

Sample No.	Sample Interval	pH		Soluble Salts meq/100g	Sodium meq/l	Calcium meq/l	Magnesium meq/l	SAR	Texture				Boron PPM	N Nitrogen PPM	P Phosphorus PPM	K Potassium PPM	Satur- ation %	Se Selenium PPM
		Paste	1:5 Diln.						very fine sand	% sand	% silt	% clay						
166	0-11	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
	11.5-19.5	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
	19.5-21	8.25	8.56	3.80	13.5	6.14	38.04	2.9		9.8	56.4	33.8	clay loam	0.25			49.2	-.02
	21-23.5	8.15	8.55	2.77	8.4	4.25	27.25	2.1		6.1	55.7	38.2	clay loam	0.48			57.3	-.02
	23.5-27.5	8.38	8.49	1.98	5.6	3.50	15.60	1.8		15.5	52.3	32.2	clay loam	0.43			50.9	-.02
	27.5-31	8.25	8.49	1.60	4.1	3.21	10.71	1.6		16.6	48.0	35.4	clay loam	0.67			56.6	-.02
	31-34.5	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
	34.5-37	8.18	8.55	0.84	2.6	1.80	3.77	1.6		8.9	46.5	44.6	clay loam	0.51			55.1	-.02
	37-39.5	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
	39.5-42	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
D5-48	42-44.5	8.39	8.62	0.80	2.9	1.32	3.85	1.8		33.6	40.4	20.0	loam	0.40			36.8	-.02
	44.5-47	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
	47-49.5	8.52	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
	49.5-52	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
	52-54.5	8.02	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
	54.5-57	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
	57-59.5	8.29	8.60	1.10	4.5	1.23	4.83	2.8		7.9	51.8	40.3	clay loam	0.59			49.6	-.02
	59.5-62	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
	62-64.5	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

RAMACO

Brook Mine

Addendum D5-7-74

TFN 6 2/025
 RECD JUL 30, 2015

Peter Kiewit Sons' Co. Mining District
Report of Laboratory Soil Analysis

Lab No. OB84-2-79 to OB-92-2-79 Date 2/79 Sample ID Big Horn 326-78; 327-78 Comments Pit Four Overburden Samples

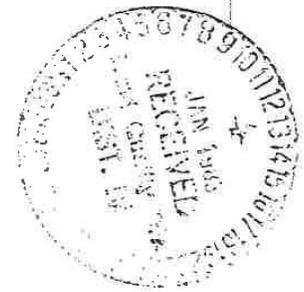
Lab #	Sample Interval	Satura- tion %	pH	Conduc- tivity mmhos/cm	Sodium meq/L	Calcium meq/L	Magnesium meq/L	SAR	V Fine Sand	% Sand	% Silt	% Clay	Texture Class*	Boron PPM	Nitrogen PPM	CEC meq/100 gm	F.S.P.
	326/																
84	0-5	38.4	7.3	4.9	20.0	18.9	34.2	3.9		43.0	36.9	20.1	1	0.82	20.3	13.6	6.9
85	5-10	23.3	6.5	7.4	56.0	16.5	90.4	7.7		64.9	21.2	13.9	s1	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	s1	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	si c1	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	s1	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	53.1	8.0	2.9	9.0	2.3	8.5	3.9		8.5	68.8	22.7	1	0.50	8.2	5.8	3.2
	41-42.7	LOST-----															
	42.7	COAL-----															

*s - sand; si - silt; c - clay; 1 - 1 in



RAMACO

Brook Mine



Peter Hunt Sons' Co. Mining District
 Report of Laboratory Soil Analysis

08 84-2-79 to 08-92-2-79 Date 2/79 Sample ID Big Horn 326-78; 327-78 Comments Pit Four Overburden Samples

Lot #	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-----				

July 2015

D5-68

TFN 6 2/025
 RECD JUL 30, 2015
 Addendum D5-7-77