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BEFORE THE ENVIRONMENTAL QUALITY COUNCIL
STATE OF WYOMING

In re Brook Mining Co., LLC coal mine permit – PT0841	)	EQC Docket No._____

PETITION FOR HEARING FOR ENVIRONMENTAL QUALITY COUNCIL REVIEW OF THE DEPARTMENT OF ENVIRONMENTAL QUALITY DIRECTOR'S APPROVAL OF THE COAL MINE PERMIT APPLICATION SUBMITTED BY BROOK MINING CO., LLC (PT0841)

INTRODUCTION

1. The Powder River Basin Resource Council ("Resource Council" or "PRBRC") [1] respectfully submits this administrative appeal of the approval of coal mine permit PT0841 for the Brook Mine to Brook Mining Co., LLC. ("Brook")

2. The Resource Council petitions the Environmental Quality Council ("EQC" or "Council") to hold a hearing on the appeal.

STATEMENT OF JURISDICTION

3. This petition for hearing is pursuant to Ch. 1 § 8 of the Department of Environmental Quality ("DEQ") Rules of Practice and Procedure, which provide for an appeal to

[1] The Resource Council's address is 934 N. Main St., Sheridan, WY 82801. All correspondence should be addressed to the organization's undersigned counsel, Shannon Anderson, via the office address or email: sanderson@powderriverbasin.org.

the EQC of a decision rendered by the DEQ Director following an informal conference held on a coal mining permit application. *See also* revised W.S. § 35-11-406(p) (effective July 1, 2020).[2]

4. This petition for hearing is timely filed within thirty (30) days of the DEQ decision released electronically and via the DEQ website on July 7, 2020. (*See* http://deq.wyoming.gov/lqd/news/deq-approves-brook-mine-company-coal-permit).

STATEMENT OF INTEREST

5. The Resource Council and its members timely filed objections to Brook's coal mine permit application and participated in the informal conference held on May 13, 2020. Resource Council members John Buyok, Gillian Malone, Anton Bocek, Joan Tellez, Joanne Westbrook, and William Bensel all filed objections and participated in the informal conference.

6. The objections and concerns of the Resource Council members demonstrate that the Resource Council, through representation of its members, is an "interested person" within the meaning of the Wyoming Environmental Quality Act ("WEQA" or "Act") section 406(p) and a "person with an interest which is or may be adversely affected" within the meaning of Ch.1 § 17(b) of DEQ's Rules of Practice and Procedure. The Resource Council's objections are attached as Appendix A to this petition for hearing and the comments of individual Resource Council members are available on the DEQ's website.

[2] It should be noted that until the DEQ's Rules of Practice and Procedure are updated following the passage of Senate File 44 this past legislative session, there may be inconsistencies between the rules and the statute. In all cases of inconsistency, the statute must govern.

ISSUES OF LAW TO BE REVIEWED BY THE EQC[3]

ISSUE FOR HEARING 1: THE MINE PERMIT IS PATENTLY DEFICIENT BECAUSE IT DOES NOT CONTAIN A SUBSIDENCE CONTROL PLAN THAT COVERS THE ENTIRE AREA OF THE PERMIT THAT WILL HAVE HIGHWALL MINING

7. According to the WEQA, "No mining operation may be commenced or conducted on land for which there is not in effect a valid mining permit to which the operator possesses the rights." W.S. § 35-11-405(a).

8. Requirements for coal mine permit applications as well as grounds for approval and denial are governed by Section 406 of the Wyoming Environmental Quality Act, along with the Land Quality Division's Rule and Regulations implementing the Environmental Quality Act.

9. "The applicant for a surface coal mining permit has the burden of establishing that his application is in compliance with this act and all applicable state laws." *Id.* at § 406(n).

10. An important aspect of this compliance demonstration for underground mining is a Subsidence Control Plan that is a core component of the mine plan. Under DEQ's rules, a company that carries out underground mining has an obligation to prevent subsidence and corresponding damage to surface resources. DEQ Land Quality Regulations require a coal mining permit application with underground components, such as this permit application, to include "[e]xcept for areas where planned subsidence is projected to be used, measures to be taken in the mine to prevent or minimize subsidence, including backfilling of voids and leaving areas in which no coal is removed." Ch. 7 § 1(a)(v)(C). Additionally, "[u]nderground mining

[3] The issues presented are appropriate for resolution through summary judgment. The Resource Council looks forward to a scheduling order for this proceeding that will promptly accommodate a motion for summary judgment to limit the burden on the parties and the EQC.

activities shall be planned and conducted so as to prevent subsidence from causing material damage to structure, the land surface, and groundwater resources." Ch. 2 § 2(b)(iii).

11. After an initial period of five years of surface mining, Brook proposes to conduct highwall mining operations for thirty-four additional years in an area covering 1,960 acres. This means almost all of the proposed permit area is highwall mining.

12. In spite of the extent of highwall mining proposed, the Subsidence Control Plan contained within the mine plan *does not* have any geotechnical analysis or information related to subsidence risk or prevention for any highwall mining after the TR-1 area.

13. Additionally, even for the TR-1 area, the information and analysis contained within the Subsidence Control Plan is deficient.

14. The above-described facts are not in dispute. DEQ's own expert consultant that reviewed the subsidence control aspects of the permit application, Dan Overton of Engineering Analytics, determined that (1) the permit application was limited to the TR-1 area; and (2) additional geotechnical analysis is needed to adequately determine subsidence risk and prevention even for the TR-1 area. The Overton memo to DEQ dated June 9, 2020 is attached as Appendix B.

15. For instance, the Overton memo determined that "In our opinion, the single core hole (2017-4) does not adequately characterize the stratigraphy or the geotechnical properties of the rock in the immediate area of the proposed TR-1 highway mining area." *Id.*

16. The Overton memo further determined that "It must be noted that the Agapito Report (AAI, 2020), included in the Subsidence Control Plan as Attachment MP-6-A, evaluated highwall mining in the area of TR-1 only, where the single Carney seam is proposed to be mined. It does not include any analyses of highwall mining outside the TR-1 area, or areas where

multiple seams will be mined, or 'pillar stacking.' Therefore, it simply does not apply to proposed mining areas other than TR-1." *Id.*

17. Furthermore, the Overton memo concluded that "In our opinion, the Subsidence Control Plan should be revised to apply only to the open pit and TR-1 area that is being permitted at this time." *Id.*

18. However, Overton was incorrect in his assumption that only the open pit and TR-1 area is being permitted at this time. In contrast to what DEQ's own expert recommended, the agency permitted the *entire* permit area – while knowing that the analyses and information contained within the subsidence control plan did not justify such an action.

19. For these reasons, the permit application is patently deficient and the permit applicant has not met its burden to justify approval of any highwall mining areas. Therefore, any aspects of the permit application that occur beyond the initial surface mining period must be denied, and Brook's permit boundary should be revised to include only the initial surface mining area.

ISSUE FOR HEARING 2: THE DEQ CANNOT REMEDY THE FOREGOING DEFICIENCIES THROUGH A PERMIT CONDITION REQUIRING A REVISION TO THE SUBSIDENCE CONTROL PLAN AND MINE PLAN, PRE-DETERMINED TO BE "NON-SIGNIFICANT"

20. Having received the Overton memo and having reviewed Dr. Jerry Marino's public comments on the permit application, the DEQ staff recognized they could not approve the permit application as is.

21. In an attempt to remedy the known and patently evident permit deficiencies, the DEQ imposed several key conditions to the permit. Permit PT0841, Form 1, attached as Appendix C.

22. Form 1, Condition 9 requires geotechnical analysis "Before commencing mining in the TR-1 area or any subsequent highwall mining panel . . ."

23. However, Form 2, Condition 10 provides that "Brook Mine shall submit all data and analysis from the geotechnical testing required in Condition No. 9 to WDEQ/LQD in the form of non-significant revisions to the Mine Plan and Subsidence Control Plan."

24. While it is important that DEQ conditioned the ability to commence highwall mining on the "written approval of the corresponding non-significant revision," in (1) allowing Brook to fix a permit deficiency through submission of post-permit information and by (2) pre-determining that any such submission would be "non-significant" DEQ violated the WEQA in several key ways.

25. First, there is nothing in the permit application that is being revised. Instead, the new information is required to fix an omission, rather than revise information already contained within the permit application. Therefore, a permit revision is not appropriate here and instead DEQ should have determined that the permit application was deficient.

26. Under the WEQA, a deficiency is an error or omission in a permit application "serious enough to preclude correction or compliance by stipulation in the approved permit to be issued by the director." Wyo. Stat. § 35-11-103(e)(xxiv).

27. Given the centrality of the Subsidence Control Plan, without it, DEQ is unable to approve the highwall mining portions of the permit. There is perhaps nothing more "serious" than the Subsidence Control Plan to prevent environmental damage from highwall mining.

28. Since the Subsidence Control Plan did not contain *any* information to evaluate the risk or prevention of subsidence in any highwall mining panel, such information is unable to be "correct[ed]" and "compliance by stipulation" is not appropriate.

29. Therefore, the absence of the necessary information in the Subsidence Control Plan is a "deficiency" as that term is defined in the WEQA.

30. Second, "non-significant" permit revisions *do not* require public notice and comment opportunities. DEQ Coal Rules & Regulations Ch. 13 § 2. Therefore, they should be used sparingly and only with strict application to the limited situations for which they were designed. This is not such a situation.

31. By allowing Brook to submit any new information as a "non-significant" revision, the rights of the Resource Council and any other interested person to participate in the public comment and hearing processes normally afforded for permit revisions will be thwarted in violation of the WEQA's public participation mandates and those under federal law.

32. As discussed above, the permit should be limited to the areas proposed to be surface mined. The company should be required to come back and submit a significant amendment to add in the additional acreage for highwall mining when the information in the Subsidence Control Plan supports it. This will allow for the legally required public notice and comment opportunities necessary for permit approval.

33. Such a process would be naturally timed well for the Brook mine since the initial period of mining of five years is limited to surface mining. This means that the permit at this time should be limited to the surface mining area, and at the time of its permit renewal application, Brook could submit an amendment to add in additional acreage for the highwall mining panels for the next five-year period. Permit renewals require public notice and comment opportunities. Brook could easily proceed this way through the life of the mine.[4]

[4] While not directly at issue here, such an approach would also help ensure recreation areas will remain open to public access until needed for mining operations, which was a main area of public comment on the permit application.

34. Finally, DEQ cannot pre-determine that the permit revision is "non-significant." DEQ rules provide "Within 90 days after submission of the application for permit revision the Administrator shall notify the operator of whether or not the application is complete and whether notice and opportunity for public hearing is required." *Id.* At the very least, the permit conditions should be amended to remove the "non-significant" determination, as that determination must be made only after the permit revision has been submitted.

ISSUE FOR HEARING 3: THE PERMIT APPLICATION IS DEFICIENT BECAUSE THE MINE PLAN DOES NOT INCLUDE ALL FACILITIES AND HAUL ROADS INCIDENT TO MINING AND DOES NOT INCLUDE A TRAFFIC PLAN FOR THESE HAUL ROADS

35. For the purposes of delineating a permit boundary, the WEQA defines "Surface coal mining operation" to mean surface lands where surface coal mining activities take place and/or surface lands "incident" to underground coal mining activities. The operation shall also "include any adjacent land the use of which is incidental to any of these activities, all lands affected by the construction of new roads or the improvement *or use of existing roads to gain access to the site of these activities and for haulage* . . . processing areas, shipping areas and other areas upon which are sited structures, *facilities or other property or materials on the surface, resulting from or incident to these activities*." W.S. § 35-11-103(e)(xx) (emphasis added).

36. The permit application fails to include associated facilities necessary to get coal to a point of sale, including necessary roads and facilities.

37. The permit application also fails to include the coal "processing areas" and "facilities" associated with the proposed carbon research facilities, industrial park, and manufacturing facilities, which are incidental to the mine. The company's only stated source of coal for the proposed research facility (iCam) and manufacturing center (iPark) is the Brook

Mine. Meaning, but for the Brook Mine, these facilities would not exist. *See* DEQ Coal Rules and Regulations Ch. 1 (defining "Mine facilities" as "those structures and areas incidental to the operation of the mine, including mine offices, processing facilities, mineral stockpiles, storage facilities, shipping, loadout and repair facilities, and utility corridors.").[5] A copy of the company's description of these facilities is attached as Appendix D.

38. These requirements have been interpreted by various courts, and judicial opinions provide instruction for including the facilities here. For instance, in 1992, the Alaska Supreme Court found that an eleven-mile access/haul road and adjacent conveyor from the mine site to a port, port facilities, a solid waste disposal facility, gravel pits, and a housing facility with an air strip and access road should have been considered as "incident" to coal mining activities. *Trustees for Alaska, Alaska Center for Environment v. Gorsuch*, 835 P.2d 1239 (1992).

39. Closer to home, the Spring Creek Mine permit was recently amended to include a nine-mile long haul road between the Youngs Creek Mine and the Spring Creek Mine designed to facilitate moving coal from the Youngs Creek Mine to the Spring Creek Mine loadout facilities. *See* Montana DEQ, *Notice of Release, public comment period, and public meeting for the Draft Environmental Impact Statement for the Proposed Spring Creek Coal Amendment* https://deq.mt.gov/Portals/112/Public/EIS/Documents/Spring%20Creek/Draft%20SCM%20EIS_June%202018_WEBversion.pdf.

[5] The issue of not including all mine facilities in the permit application is not unique to the mine permit. DEQ also recently approved the Air Quality Permit for the Brook Mine, which left out permitting of coal crushing/screening and preparation equipment necessary for the coal mining operations at the Brook Mine. DEQ imposed a permit condition that requires the coal crushing/screening and preparation plant at the Brook Mine to receive a separate air permit prior to installation. *See* Air Quality Permit P0025939, Ramaco Wyoming Coal Co. LLC.

40. Brook's permit is no different. If there are roads or facilities being used for mining operations and/or part of the process to get the coal from the mine to a point of use, those roads and facilities are "incident" to coal mining activities and require a coal mining permit. The permit application is incomplete by not including these facilities.

41. Specific to the haul roads, it was confirmed at the mine site tour prior to the informal conference that the state highway, Wyoming Highway 345, will be used as a haul road between the surface mining location and the iCam research facility. However, the permit application does not disclose the use of the highway as a haul road. *See* Exhibit MP.3-1 (Transportation Network Map).

42. Since the state highway is a primary haul road for the mine to haul the coal between the surface pit and the iCam facility, it must be included within the boundary of the coal mine permit. *See* DEQ Coal Rules and Regulations Ch. 1 (defining "roads" as "a surface corridor of affected land associated with travel by land vehicles used in surface coal mining and reclamation operations or coal exploration . . . [t]he term includes access and haulroads constructed, used, reconstructed, improved, or maintained for use in surface coal mining and reclamation operations or coal exploration, including use by coal hauling vehicles to and from transfer, processing, or storage areas.").

43. The same is true for any county road proposed to be used as a haul road, such as South Ash Creek Road and Slater Creek Road.

44. The use of these state and county roads must also be disclosed to estimate and mitigate impacts from coal mine traffic. The Mine Plan is deficient because it does not estimate truck traffic, disclose any impacts to public or private roads used by the public, and does not

include a traffic plan or any agreements with Sheridan County and/or the Wyoming Department of Transportation on road use, repair, and compensation.

45. Additionally, the mine will directly cross or impact public roads through highwall mining. The mine plan does not provide the required buffer around these roads or alternatively it does not provide a plan, approved by the Sheridan County Board of County Commissioners, to move the roads.

ISSUE FOR HEARING 4: THE PERMIT APPLICATION IS DEFICIENT BECAUSE IT DOES NOT ACCURATELY ESTIMATE THE AMOUNT OF COAL THAT WILL BE MINED

46. As discussed above, DEQ regulations require information in a permit application to be "current" . . . "accurate and complete." DEQ Land Quality Division Rules and Regulations, Ch. 2 § 1. The mine plan must include "[a] complete operations plan proposed to be conducted during the life of the mine" with an accurate estimate of "the number of acres that will be affected annually" and the "anticipated annual and total production by tonnage." Id. at § 5(a)(i).

47. In the case of the Brook Mine, the mine plan is based on a plan that will never occur. The mine plan estimates annual production at a level that is in direct conflict with statements of the company's representatives explaining the company's plans for the area.

48. Early statements by the company estimated 6-8 million tons a year of production over 20 years. Originally aimed at export markets, Ramaco then shifted its proposal to selling its coal locally for stoves or marketing it as "thermal coal" for power plants (arguing that private reserves and corresponding lack of federal royalties, along with "low cost" highwall mining, would make their coal marketable even in a down market). In 2014, Ramaco stated "Negotiations are currently underway with domestic utilities to purchase the majority of the of Brook Mine production."

49. But now, the company has shifted to using the coal solely for its proposed research and industrial facilities. Company representatives have represented that only very small amounts of coal would be needed for the research and processing facilities at the iPark and iCam. This very small amount is confirmed by similar facilities such as Atlas Carbon in Gillette, which produces carbon products for air and water treatment systems from coal and currently uses around 30,000 tons of coal per year.[6]

50. Accurately estimating the amount of coal to be mined is a critical component of any mine plan as it establishes the time period of the permit and the level of anticipated impacts, provides transparency to the public, and allows for enforcement by DEQ once a permit is issued.

51. Consistent with the issues identified above related to the inability to approve the portion of the permit with highwall mining operations until the subsidence control plan is greatly improved, the permit application should be amended to limit mining to the first five years of surface mining. Even that portion of coal production as estimated in the mine plan is speculative, but it is less speculative than the remaining years for which Ramaco has not shown any proposed buyers or opportunities to use the coal.

ISSUE FOR HEARING 5: THE PERMIT APPLICATION IS DEFICIENT BECAUSE IT DOES NOT IDENTIFY THE COAL MINE OPERATOR

52. As early as March 2015, the Resource Council wrote to DEQ to express concern that the mine permit application did not contain "complete identification" of "[t]he names, addresses and telephone numbers of any operators, if different from the applicant" as required by the DEQ's rules. Land Quality Rules & Regulations (hereafter "LQRR") Ch. 2 § 2(a)(i).

53. However, throughout the entire time the permit application was under review by DEQ, DEQ did not require Brook to remedy this deficiency. Brook has still not identified who

[6] See http://www.energycapitaled.com/wp-content/uploads/2016/10/Presentation-6-Atlas-Carbon-Jim-Dye.pdf

the operator of the coal mine will be. The permit application refers to contractors or consultants but these parties are left unnamed.

54. While Brook has a local "office," the company does not actually have staff that would be able to carry out mining activities should the company receive a permit. If any party other than Brook will be operating the mine, that party must be identified in the permit application. Until such identification occurs, the permit application is deficient.

CONCLUSION AND REQUEST FOR RELIEF

55. Paragraphs 1-53 are hereby incorporated.

56. The Resource Council reserves the right to supplement its objections and grounds for hearing based on discovery provided by DEQ and Brook as part of this hearing process.

57. The Resource Council also reserves the right to provide additional evidence and support for its objections.

58. Given the deficiencies in the permit application described above, the permit applicant has not met its burden to demonstrate that the application "is in compliance with this act and all applicable state laws" pursuant to Section 406(n).

59. As a result, the EQC must find that the permit application should be denied as its "decision on the application" following any hearing.

Respectfully submitted this 4th day of August, 2020.

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CERTIFICATE OF SERVICE

The undersigned hereby certifies that on this 4th day of August, 2020, the foregoing PETITION was served on the following parties via USPS registered mail, return receipt requested.

Wyoming EQC
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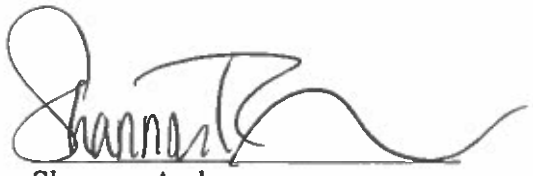

Shannon Anderson

APPENDIX A

ENCOURAGING RESPONSIBLE DEVELOPMENT TODAY ~ FOR TOMORROW

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POWDER RIVER BASIN
Resource Council

April 23, 2020

Alan Edwards, Deputy Director
Wyoming Department of Environmental Quality
200 W. 17th St.
Cheyenne, WY 82002
Submitted online via: http://lq.wyomingdeq.commentinput.com

Re: Objections to Brook Mining Co., LLC Coal Mining Permit Application & Comments on the Department of Environmental Quality Draft Cumulative Hydrologic Impact Assessment

Dear Mr. Edwards,

On behalf of the members of the Powder River Basin Resource Council ("Resource Council"), our organization hereby submits these objections to the proposed coal mining permit for Brook Mining Co., LLC ("Brook" "company" or "applicant") in Sheridan County. We also submit the following comments on the Department of Environmental Quality's ("DEQ") draft Cumulative Hydrologic Impact Assessment ("CHIA").

Pursuant to W.S. § 35-11-406(k), the Resource Council requests an informal conference with the Director to discuss our objections and comments. We request that such an informal conference be held in Sheridan, the location of the proposed mining operation. Given the complexity of the issues presented, and the current difficulties in scheduling such a public hearing during the COVID-19 pandemic, we will stipulate to hold the informal conference at a period beyond the 20 days provided for under subsection 406(k) of the Environmental Quality Act. In fact, as discussed below, if DEQ holds the informal conference during the pandemic, public participation rights will be violated.

Organizational Interest in the Coal Mining Permit

The Resource Council is a grassroots, member-based organization that has worked to address the impacts of coal mining on people and the environment since our inception in 1973.

Many of our members work, live, and recreate in Sheridan County adjacent to and on the site of the proposed Brook Mine permit. We have members who live next to the proposed Brook Mine permit boundary that will experience aesthetic impacts, impacts to their property, and impacts to their livelihoods as a result of the mine's proposed operations. We also have members that regularly travel the public roads within the mine permit boundary and members that frequently occupy public access and recreational areas within and in close proximity to the mine permit boundary. We are therefore an "interested person" within the meaning of W.S. § 35-11-406(k).

Given their proximity to the mine's proposed location, some of our members received personal notice of the opportunity to submit objections and will be submitting their own

objections. Other members with recreational and aesthetic interests in the area will also be submitting objections. Our organizational objections are intended to supplement, not supplant, the individual objections of our members. However, their own stated objections and interests further support our organizational interest in the proceeding.

Objections and Concerns

1. Public Participation Violations During the COVID-19 Pandemic

At the outset, it is important for us to comment on the time we find ourselves in as we submit these comments. Wyoming, and most of the world, is grappling with the consequences of a global public health pandemic. Governor Gordon has issued orders to limit public access to government buildings, prohibit meetings of greater than ten people, and has otherwise encouraged and directed Wyomingites to stay home and refrain from unnecessary travel to limit infection to themselves and others.

a. Need to extend public comment period

We wrote to DEQ on March 23, 2020 requesting the agency to extend the comment deadline because locations where the permit application must be made available for review by the public (Sheridan County's courthouse and the Sheridan DEQ offices) were closed to regular public access. DEQ replied that a comment period extension was not needed because the permit application is available for download on the agency's website, and that the offices with hard copies remained accessible by appointment. While we appreciate the agency putting the application online, the size of the file has prevented easy downloading by some members of the public. Additionally, we remain concerned that there is a possible violation of federal and state laws and regulations that require public access to the permit application during all times of the comment period at the County Clerk's Office in the county in which the mine is located. *See* Wyo. Stat. § 35-11-406(d); 30 C.F.R. § 773.6(a)(2). We renew our request for DEQ to extend the public comment deadline until such a time as Wyoming, and Sheridan County, are not under any public health restrictions.

b. Requests for an informal conference & mine site visit must be placed on hold

We do not believe DEQ can lawfully hold an informal conference or other public hearing on the permit application so long as the public health orders are in place. DEQ regulations require an informal conference to "be held in the locality of the operation or at the state capitol, at the option of the requester." DEQ Rules of Practice and Procedure Ch. 3 § 3(a). Additionally, DEQ (and federal) rules provide that an objecting party may also request access to the proposed permit area through a site visit tour. Such a tour is open to any objecting party, and of course representatives of the agency and the permit applicant, who must be present if private lands must be accessed.

While the Resource Council hereby requests an informal conference in Sheridan County and a visit to the proposed permit area, we request that DEQ hold off on scheduling such public participation activities until the public health orders have been lifted. We do not believe there

will be a way to meet the Environmental Quality Act's and SMCRA's mandates for public participation while public health restrictions are in place.[1]

If DEQ wishes to risk non-compliance and proceed with scheduling an informal conference and site visit, we welcome the opportunity to discuss the logistics surrounding the public participation opportunities, but our discussion or negotiations should in no way be viewed as waiving any objections we may have to the process itself.

2. DEQ violated the Environmental Quality Act by Not Requiring Brook to "Resubmit" its Permit Application Under Section 406(f)

Section 406(p) of the Environmental Quality Act dictates that once a hearing is held and the EQC issues its order, the mining permit should be issued or denied fifteen days after the order. Following, the EQC's decision the original Brook Mine permit application was denied. The EQC's Order and DEQ's denial of the application was not a "deficiency notice" under subsection 406(h) – it was a denial under subsection 406(p).

The Environmental Quality Act speaks directly to the case at hand in subsection 406(f) when a company "resubmits" an application. This is exactly what the EQC Order told the company to do – "revise" and "resubmit." Therefore, DEQ should have followed the process under subsection 406(f), which requires a sixty-day completeness review period of the resubmitted application, similar to subsection 406(e) for new permits. After the completeness review, the process is the same as new applications, with the requirements of subsections 406(g)-(p).

DEQ did not follow this process. Instead, it treated the EQC Order as "Round 7" of technical review under subsection 406(h).

Unfortunately, this led to real negative consequences for DEQ's ability to fully and fairly review the substantial changes to the company's permit application that were submitted in October 2018. Under the DEQ's process, staff members had a mere thirty days to review the new information submitted by the company under subsection 406(h) versus the time for completeness review under subsection 406(f) and the 150-day review period under subsection 406(h) for resubmitted applications. Given the public controversy and attention and important natural resources in the Tongue River Valley, it is not harmless error for DEQ to illegally restrict the time afforded to them under the Environmental Quality Act to fully review the resubmitted application.

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[1] For instance, please see the recent letter sent by Sweetwater County Commissioners to the BLM. We echo their concerns and comments: "Open public dialog cannot be replaced by Zoom and computerized meeting formats. Sweetwater County has participated in these types of meetings and have found them to be ineffective leaving many participants feeling frustrated and wondering if their comments were understood or would even be addressed." https://www.sweetwaternow.com/sweetwater-county-commissioners-request-rock-springs-rmp-be-postponed/

Additionally, because of this error, DEQ's process circumvented the public notice required in Section 406(g) for a resubmitted application.

We put DEQ on notice of these process violations by letter in February 2018, giving the agency ample opportunity to correct any violations before the October 2018 revised permit application submission. Unfortunately, DEQ proceeded with a process that is outside the scope of the Environmental Quality Act, therefore rendering any subsequent permit decisions illegal. To remedy this, DEQ must start over – by requiring Brook to resubmit a revised permit application under subsection 406(f), and subsequently following the process in subsections 406(g)-(p) for review of the resubmitted permit application.

3. Failure to Disclose Coal Mine Operators

As early as March 2015, our organization wrote to DEQ to express concern that the mine permit application did not contain "complete identification" of "[t]he names, addresses and telephone numbers of any operators, if different from the applicant" as required by the DEQ's rules. Land Quality Rules & Regulations (hereafter "LQRR") Ch. 2 § 2(a)(i). Upon our review of the application, Brook has not identified who the operator of the coal mine will be. The permit application refers to contractors or consultants but these parties are left unnamed. Additionally, it is our understanding that while Brook has a local "office," the company does not actually have staff that would be able to carry out mining activities should the company receive a permit. If any party other than Brook will be operating the mine, that party must be identified in the permit application. As you know, such identification is necessary for a complete applicant violator system ("AVS") check, but it is also required as part of the permit application for public notice and review.

4. The Permit Application Is Not Complete Because It Fails to Include All Coal Hauling, Processing, and Upgrading Facilities

For the purposes of delineating a permit boundary, the Environmental Quality Act defines "Surface coal mining operation" to mean surface lands where surface coal mining activities take place and/or surface lands "incident" to underground coal mining activities. The operation shall also "include any adjacent land the use of which is incidental to any of these activities, all lands affected by the construction of new roads or the improvement or use of existing roads to gain access to the site of these activities and for haulage . . . processing areas, shipping areas and other areas upon which are sited structures, facilities or other property or materials on the surface, resulting from or incident to these activities." W.S. § 35-11-103(e)(xx).

Here, the permit application fails to include associated facilities necessary to get coal to a point of sale, including necessary roads and facilities, and does not include the coal "processing areas" associated with the proposed industrial park and manufacturing facilities, which are incidental to the mine. The company's only stated source of coal for the proposed research park (iCam) and manufacturing center (iPark) is the Brook Mine.[2] Meaning, but for the Brook Mine, these facilities would not exist.

[2] See https://ramacocarbon.com/facilities/

These SMCRA requirements have been interpreted by various courts, and judicial opinions provide instruction for including the facilities here. For instance, in 1992, the Alaska Supreme Court found that an eleven-mile access/haul road and adjacent conveyor from the mine site to a port, port facilities, a solid waste disposal facility, gravel pits, and a housing facility with an air strip and access road should have been considered as "incident" to coal mining activities. *Trustees for Alaska, Alaska Center for Environment v. Gorsuch*, 835 P.2d 1239 (1992).

Brook's permit is no different. If there are roads or facilities being used for mining operations and/or part of the process to get the coal from the mine to a point of use, those roads and facilities are "incident" to coal mining activities and require a SMCRA permit. The permit application is incomplete by not including these facilities.

5. The Permit Application is Not Complete and Accurate – It Is Too Vague and Unrealistic

The core of any coal mine permit is the mine plan. The mine plan establishes how much coal will be mined in what time period, and it describes the impacts to land, air, and water resources. It establishes the basis for the DEQ or impacted members of the public to enforce the terms of the permit, and the associated reclamation plan as the timing and measures needed in the reclamation plan are based on the mine plan, and if the mine plan is too vague or unrealistic, enforcement will prove problematic in the future.

DEQ regulations require information in a permit application to be "current" . . . "accurate and complete." DEQ Land Quality Division Rules and Regulations, Ch. 2 § 1. The mine plan must include "[a] complete operations plan proposed to be conducted during the life of the mine" with an accurate estimate of "the number of acres that will be affected annually" and the "anticipated annual and total production by tonnage." *Id.* at § 5(a)(i).

In the case of the Brook Mine, the mine plan is based on a plan that will never occur. The mine plan estimates annual production at a level that is in direct conflict with statements of the company's representatives explaining the company's plans for the area. And in fact, the company's own statements have contradicted each other.

Early statements by the company estimated 6-8 million tons a year of production over 20 years. Originally aimed at export markets, Ramaco then shifted its proposal to selling its coal locally for stoves or marketing it as "thermal coal" for power plants (arguing that private reserves and corresponding lack of federal royalties, along with "low cost" highwall mining, would make their coal marketable even in a down market). In 2014, Ramaco stated "Negotiations are currently underway with domestic utilities to purchase the majority of the of Brook Mine production."

But now, the company has shifted to using the coal for its proposed research and industrial facilities – a demand of which also contradicts the mine plan and show that its estimated production overestimates the amount of production. Ramaco executives are now stating that production will be on a "very limited basis" with "no more than a couple hundred

thousand tons a year just to get started" and employment of "under 20 people."[3] Finally, company representatives have further represented that only *very* small amounts of coal would be needed for the research and processing facilities at the iPark and iCam. Atlas Carbon in Gillette, which produces carbon products for air and water treatment systems from coal currently uses around 30,000 tons of coal per year.[4]

Additionally, Ramaco's facilities are highly dependent on government funding, technology breakthroughs, and other unknowns that make them speculative. The company has not provided any justification for its thirty-nine year proposed mine life and/or the amount of coal it proposes to mine.

It is clear that the company's plans are in flux and the permit application is merely a placeholder for things yet to come. Our coal mining regulations require more; they require accurate, complete, and current information detailing anticipated production levels and an accurate, complete, and current estimate of the life of the mine. At the very least, the permit application should have fully disclosed that the company's plans are not finalized and the permit application should have presented a range of anticipated production, a range of operating years, or even production level alternatives based on different options of company investment, to allow DEQ to assess the completeness and technical adequacy of the permit application, along with any impacts to land, air, and water resources.

Consistent with Dr. Marino's recommendation discussed below, at the very least the permit application should be amended to limit mining to the first five years of surface mining. Even that portion of the mine is speculative, but it is less speculative than the remaining years for which Ramaco has not shown any proposed buyers or opportunities to use the coal.

6. The Permit Application Remains Deficient Regarding Baseline Water Testing and Hydrology Analysis

As the attached report from our hydrogeology expert Mike Wireman explains, the mining and reclamation plan does not include "a plan to minimize the disturbances to the prevailing hydrologic balance at the minesite and in associated offsite areas and to the quality and quantity of water in surface and ground water systems both during and after mining operations and during reclamation" as required by the Environmental Quality Act and corresponding DEQ regulations. W.S. § 35-11-406(b)(xvii). DEQ must deny the permit application *unless* it is sufficiently demonstrated that the proposed operations will not materially damage the hydrologic balance outside the permit area and will minimize disturbances to the prevailing hydrologic balance at the minesite.

Also as explained in the attached report, the permit application fails to protect the numerous AVFs in the permit area and adjacent areas as required by the Environmental Quality Act, SMCRA, and corresponding state and federal regulations.

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[3] *See* http://trib.com/business/energy/energy-journal-q-a-randall-atkins-ramaco/article_7834a593-c06d-5785-aeea-8f3b5637a337.html

[4] See http://www.energycapitaled.com/wp-content/uploads/2016/10/Presentation-6-Atlas-Carbon-Jim-Dye.pdf

7. The Permit Application Remains Deficient Regarding Subsidence Prevention

As discussed in the attached expert report from Dr. Jerry Marino, the subsidence control plan does not achieve its required objective: to control and prevent subsidence at the mine site. The expert report concludes that the subsidence remediation plan is inadequate.

Dr. Marino further concludes:

> As noted above, the permit application only addresses the highwall mining of the 68 acres of Carney Seam. With application approval, this may provide an administrative mechanism for DEQ to approve remaining underground mining of other mineable seam areas without proper public oversight via a non-significant revision to the permit. This would involve the entire 1,960 acres of proposed highwall mining.
>
> At a minimum, it is recommended that any highwall mining be removed from the permit until it is reasonably investigated in order not to setup such a precedent of unacceptable protocols. HWM areas should be applied for increments as Significant Revisions as proper subsidence engineering investigation is accomplished. Moreover, in the first 5 years on operation the Brook Mine intends on only surface mining with no highwall mining. This is also consistent with Ramaco's statement in the application that the permit will be renewed every 5 years (Mine Plan prepared by WWC Engineering dated 12/19). Another reason why the HWM application should be delayed and become a Significant Revision is the statement by Ramaco … "AAI agrees that reevaluation should be considered if the ultimate plan involves a greater cutting width, height, or penetration or a lesser production rate than assumed" (Ramaco Response to Round 8 DEQ Memo of Deficiencies dated January 9, 2018).

The company has an obligation to prevent subsidence. DEQ Land Quality Regulations require a coal mining permit application with underground components, such as this permit application, to include "[e]xcept for areas where planned subsidence is projected to be used, measures to be taken in the mine to prevent or minimize subsidence, including backfilling of voids and leaving areas in which no coal is removed." Ch. 7 § 1(a)(v)(C). Additionally, "[u]nderground mining activities shall be planned and conducted so as to prevent subsidence from causing material damage to structure, the land surface, and groundwater resources." Ch. 2 § 2(b)(iii).

The company is proposing to mine under at least one county road and will be mining in close proximity to numerous home and business structures, including cell towers, agricultural lands and associated structures, water wells, and public rights of way. Subsidence also has implications for whether the "reclamation plan can accomplish reclamation as required." *Id.* at § 406(n)(ii). And it has implications for creating damage to the hydrologic balance both within the permit area and in outside areas. *Id.* at §§ 406(b)(xvii), 406(n)(iii).

For the reasons stated in Dr. Marino's report and for the regulatory requirements discussed above, the permit application should be rejected. At the very least, as Dr. Marino concludes, the permit application should remove all highwall mine portions and limit the permit to the first five years of surface mining.

8. The Permit Application Does Not Adequately Disclose Impacts to Traffic & Road Use and It Does Not Contain the Required Traffic Plan

The mine plan does not estimate truck traffic, disclose any impacts to public or private roads used by the public, and does not include a traffic plan or any agreements with Sheridan County and/or the Wyoming Department of Transportation on road use, repair, and compensation. Additionally, the mine will directly impact Slater Creek Road, a county road that is the only access point for the property of Resource Council member Phil Klebba and his family at the Klebba Ranch. The mine plan does not provide the required buffer around Slater Creek Road or alternatively it does not provide a plan, approved by the Sheridan County Board of County Commissioners, to move the road.

Additionally, as discussed above, any roads used for mining operations or "incident" to mining operations require a SMCRA permit. Even if the company will be using state or county roads that are already in place, the use of those roads must be considered within the scope of the SMCRA permit.

9. The Permit Application Does Not Adequately Disclose Impacts to Conservation Easements and Recreation Access

While the permit application discloses that two walk-in areas for hunting and recreation are within the permit boundary (D1-7), it does not discuss how the use of these areas will be impacted by mining operations nor does it establish a plan to mitigate any impacts.

Additionally, the proposed mine and associated "industrial park" is located within eyesight of the Kleenburn Recreation Area, an area frequently used for recreation activities, including fishing, picnicking, and hiking. Again, the permit application fails to mitigate any impacts to recreation use in the area.

10. The Permit Application Continues to Fail to Include Necessary Controls and Restrictions on Blasting Intensity and Timing

While we appreciate the modifications made to the blasting plan, the plan remains deficient. The plan continues to fail to ensure that the requirements of Chapter 6 of the Land Quality Regulations will be met during mining and that offsite impacts resulting from pollution and seismicity will be prevented. Blasting is of particular concern to members of the public who recreate in the area given pollution and other impacts and to nearby homeowners and landowners whose structures could be impacted from blasting activities.

In particular, we ask that the DEQ restrict blasting operations to the weekdays only given the frequent use of the area for recreation during the weekends.

11. Failure to Include Information on an Important MSHA Requirement

The subsidence control plan references a "ground control plan" that is approved by MSHA and is commonly included for DEQ review in a subsidence control plan. However, no such plan exists. DEQ regulations require "[a] list identifying the Mine Safety and Health Administration identification number for all mine facilities that require MSHA approval and licenses, permits or approvals needed by the application to conduct the proposed operation, whether and when they have been issued, the issuing authority, and the steps to be taken to comply with the requirements" as part of the permit application. Ch. 2 § 2(a)(v). This information is not included in the permit application.

12. Water Rights & Use of the Tongue River

The mine proposes to use surface water rights to provide the majority of the mine's water supply. According to DEQ's analysis in the draft CHIA, any new surface water rights needed for water supply would be subject to approval by the Wyoming State Engineer under evaluation of the Yellowstone River Compact, which will require that bypass or make-up water be made available. However, the permit application is lacking in specific detail about the water rights that will be acquired and how the "bypass or make-up water" will be made available by Ramaco. If the mine is unable to acquire surface water rights, which may be very likely, it will be forced to use more groundwater, putting additional stress on the aquifer systems and potentially impacting nearby water wells.

13. Impacts from Flooding

Given that the area is in the Tongue River Valley with numerous tributaries and small streams, there are a variety of waterways that could be impacted by mining activities. Additionally, the area is prone to flooding, especially in high snowmelt runoff years. We are concerned that the sedimentation and runoff control structures identified in the mine plan will not protect impacts from flooding, especially when adding the water from mine dewatering activities. The analyses presented in the application regarding estimation of flood magnitudes and frequencies and volumes of water that will need to be managed (run-off / run-on) during mining operations did not consider extreme precipitation events. Given the occurrence of extreme events in the Tongue River Valley in recent years, it is important to model extreme events.

14. The Reclamation Bond Does Not Include Monitoring Costs

As discussed in Mr. Wireman's report, the water monitoring plan for the mine is deficient. The amount bonded for monitoring should be increased to reflect a revised and much more robust monitoring plan. Monitoring should include the costs for personnel and analysis, maintaining monitoring locations/sites/equipment, and developing new monitoring sites as appropriate. Any "additional cost to the state of bringing in personnel and equipment" should also be included.

15. The Reclamation Bond Does Not Include Costs to Restore Hydrologic Conditions

The bond fails to include sufficient funds to carry out all operations needed to restore to pre-mine hydrologic conditions within the permit area – and in any offsite areas that are impacted. At a minimum, there must be a thorough analysis of aquifer recharge capacity, what engineering techniques would be used to restore the aquifer to pre-mining capacity and water quality conditions, and what timetable and costs would be involved with such reclamation. The same must be done for surface water, and all associated costs must be included in the reclamation bond.

16. The Land Use Section of the Permit Application Must Be Updated

Ramaco incorrectly states in Appendix D1 that lands within the permit area have been used extensively for industrial purposes and that heavy industrial use is compliant with Sheridan County's land use plan. These incorrect statements must be revised. The proposed mining area is zoned for agricultural use and the only "light" industrial zoned land is where the proposed iCam and iPark facilities are located. These lands are not permitted for heavy industrial uses, and all mining lands must be returned to pre-mining land uses, including agriculture and recreation. An assumption of industrial use minimizes the reclamation expense to the mine operator, and limits the potential land use for future users.

Conclusion

Thank you for your time and consideration of these objections. We look forward to your scheduling of an informal conference to discuss these objections.

Sincerely,

Shannon Anderson
Staff Attorney

MARINO ENGINEERING ASSOCIATES, INC.

April 15, 2020

Ms. Shannon Anderson
Acting Director
Powder River Basin Resource Council
934 N. Main Street
Sheridan, WY 82801

Re: Review of Brook Mine Application – Rounds 8 to 12

Dear Ms. Anderson,

As you have requested, we have reviewed the relevant sections of the mine application and related documents for the proposed Brook Mine as it relates to mine subsidence potential and their effects and geotechnical reclamation issues. These materials include those prepared by Ramaco, WCC Engineering, Agapito Associates, Inc., Wyoming Department of Environmental Quality, and Engineering Analytics, Inc. A list of these documents reviewed for this report are provided in Attachment A.

The report covers Rounds 8 through 12. The 8th round submittal by Ramaco was mainly in response to the Wyoming Environmental Quality Council (EQC) comments who deemed the 7th application as inadequate for a number of issues. Rounds 9 to 12 submitted by Ramaco addressed further comments made by the Wyoming Department of Environmental Quality (DEQ). DEQ has determined the Round 12 mine application to be complete. Despite the Findings of Fact and Conclusions of Law by EQC, and having gone through 12 rounds of review with the Department of Environmental Quality, Ramaco only made a token effort to address the mine subsidence issues of the mine design. Because of the limited additional geotechnical information gathered by Ramaco, Ramaco's consultant Agapito Associates Inc. (AAI) of Colorado provides a Subsidence Control Plan (SCP) for only one seam and only the first area (TR-1) to be highwall mined, and even in this SCP analysis, there is a number of disclaimers/qualifiers to their findings. For example, AAI "DISCLAIMER:" ... states ... **"conclusions expressed herein are based on the facts currently available within the limits of existing data, scope of work, budget, and schedule.** Supporting data and information relied upon during the course of this investigation and used to prepare this report have been obtained from Ramaco Carbon records and files, available published reports and literature, personal communication with Ramaco Carbon staff, and other information sources. **Agapito Associates, Inc. makes no representation or warranty as to the accuracy of the data supplied and used in the development of this report"**(highlights added). This disclaimer is understandable given

that only one additional hole was drilled and sampled with geotechnical testing for only one seam (the non-split Carney Seam). Yet, even with AAI's qualification for the design of only the TR-1 area (68 acres), Ramaco applies for in the application to allow highwall mining of a total of 1,960 acres with all, or the vast majority, of the land with proposed multi-seam mining.

It is acknowledged that Ramaco has hired a mining/geotechnical consultant, AAI, to address subsidence potential issues since the EQC's recent rejection of the Brook Mine application. AAI has provided responsive mine design analyses and associated subsidence potential analyses. These reported analyses, however, do not meet the necessary standard for review or provide sufficient assurances that significant subsidence will not occur from the highwall mining. Consequently, because there has been no substantive change in the Rounds 8 to 12 submittals, the main opinions provided in our report to you on January 23, 2017 have remained unchanged. The January 23, 2017 report is attached for your reference. See Attachment B.

A detailed review of the submitted AAI's report, the mining plan, the Subsidence Control Plan (SCP), and surface reclamation is given below.

PROPOSED MINING

The proposed highwall mining (HWM) methodology has been discussed in MEA, 2017. Since this report, the current application calls for the strip mining of the Monarch seam and no planned mining of the Monarch seam (MP1-2.2, MP.4.4, MP.4.4.1, and MP.4.6). In other words, only the Carney Coal is planned to be underground mined at this time. Another significant change from the Round 7 application is the abandonment of the most eastern highwall mining area, formerly TR-1 (see Figure 4.3, MEA, 2017). As pointed out by MEA during Round 7, HWM in this area was not well thought out. It contains significant mine spoil from previous Big Horn strip mining operations, and consequently, was not practical.

The new proposed HWM TR-1 area consists of only one block (in lieu Blocks 3 and 4 formerly TR-2, see MEA, 2017). The new mine plan is shown in Figure 2. Comparing Figure 4.3 (MEA, 2017) to Figure 2, it appears the changes in the mine plan only pertain to the old TR-1 and TR-2 areas. Consequently, the HWM areas which were Blocks 9 and 16 in Figure 4.3 still abut against old workings with minimum barrier coal of 0 to 70 ft. and consequently result in potentially flooding from the old workings to the south especially considering the likely inaccuracies of the mine map of the old works. Based on historical mapping, the floor depths in the minimum barrier areas are about 87 to 115 ft. in the new TR-4B, 5, and 7 areas. See Figure 2. Based on various empirical relationships on the minimum confirmed barrier thickness, this barrier should be at least about 55 to 110 ft. (Koehler and Tadolini, 1995), and therefore all areas (TR-4B, 5, and 7) would exceed the

minimum confirmed barrier width depending on what criterion was used. Moreover, MSHA requires a minimum coal barrier width of 200 ft. for underground mining next to abandoned workings (30 CFR 75.388).

The general information on the room and pillar dimensions and panel, and coal barrier widths has remained unchanged. Only for new TR-1 area was more specific HWM design criteria proposed for the unsplit Carney Seam. For the maximum recommended extraction with a mined coal height of 14 ft. (Add. MP-6-42) and room width of 11.5 ft. (Add. MP-6-36) AAI determined the following (Add. MP-6-47).

Panel	Design Depth	Web Pillar Width	Panel Extraction	Tributary Pressure
1	266 ft.	14.1 ft.	45%	544 psi
2	279 ft.	14.2 ft.	45%	571 psi
3	333 ft.	17.9 ft.	39%	614 psi
4	338 ft.	18.3 ft.	39%	623 psi

AAI, however, assumed that only the Carney Seam will be mined in TR-1. For the TR-1 area, both the overlying Monarch and underlying Masters coal seams have mineable thicknesses (see Table 4.1, Block 4, MEA, 2017). Even though these seams are not currently planned to be underground mined, no comment was made by AAI on design of multiple seams. It should also be noted that no consideration is made in the design for the pillar loading imposed by the planned stockpiles of mine spoils depicted in the Exhibit MP.1-2. This exhibit shows the stockpiles to be as wide as about 500 ft. and as long as about 1,500 ft. These stockpiles could reach significant heights with no restriction.

GEOTECHNICAL DRILLING AND TESTING

The proposed geotechnical drilling and testing after Round 7 for the proposed future underground mining areas has generally become less stringent and more ambiguous as modifications were made to the permit application by Ramaco. In its final form, Ramaco states "in future highwall mining blocks outside the study (TR-1) area, additional hole(s) covering a similar area are appropriate, with a similar suite of tests" ... in the roof, coal and floor of the Carney Seam as has been performed in the TR-1 panel (Ramaco Responses to Round 8 DEQ Memorandum of Deficiencies dated January 14, 2019). Ramaco further stated in the permit application that "prior to initiation of auger mining activity, samples will be collected and strength testing will be conducted ... in order to satisfy the requirements of the MSHA ground control plan which must be approved prior to mining." These test results and analysis "will be provided to WDEQ/LQD" prior to mining.

In Appendix D5 – Topography, Geology & Overburden Assessment dated 12/19 prepared by WWC Engineering, it states tensile strength results will be used to size web pillars and barrier pillars to achieve SF set by MSHA ground control plan to conduct mining and minimize the risk of subsidence.

Below are the issues related to the above proposed geotechnical drilling and testing in the mine application.

1. The one geotechnical boring which was done in the TR-1 area, which is proposed first area to be highwall mined. This boring indicated the roof and floor contains anomalous rock conditions compared to other borings drilled in the application area. Therefore, applying these rock conditions and associated test data to all of the application areas or, for the matter, all of TR-1 appears inappropriate.

2. The promised number of geotechnical test holes and testing on what strata per HWM area is vague and undefinable as given in the above statements and in the application. Therefore, these geotechnical promises are not enforceable.

3. Specific types of geomechanical testing are given but they will provide a deficient assessment of long-term strength and should include the consolidated drained triaxial tests which were originally promised after Round 7. Also, no Atterberg Limits are stipulated which really assist in rock classification, the potential for softening, and softened strength parameter values.

4. Use of the tensile strength for determining the pillar strength by Ramaco as noted above is not appropriate and should not be allowed.

5. The exploration and testing program proposed in the mine application assumes only the Carney seam will be mined without any geotechnical provisions if multi-seam mining were to occur in the future.

6. DEQ should regulate the number of holes and testing required, not the mining company. Undefinable information supplied by Ramaco where future data and analysis are promised at an undetermined time prior to mining and without noted approval of a SCP by DEQ. Moreover, the data and analyses promised are related to MSHA requirements which are not focused on surface subsidence above HWM areas.

MINE STABILITY ANALYSIS

Ramaco's Approach

In response to EQC's Finding of Facts and Conclusions of Law – Round 7, Ramaco cites "Brook plans to do the necessary engineering work Dr. Marino suggests as part of the ground control plan Transcript – Barron testimony, pp. 1532-1533 (Comment EQC 60 – Round 7)". This was not done. The main concern is the assessment of the long term stability of the mine design analysis to prevent mine subsidence. In an effort to ensure that the "necessary engineering work" was done, long term stability design guidelines were provided and for convenience are provided in Attachment C. Instead, Ramaco ignored significant portions of these guidelines. Ramaco hired and directed AAI to perform design analyses for mining of one seam in one area (TR-1), see Figure 3. AAI utilized in design only one test hole in the TR-1 area with insufficient testing. Using this provisional design, however, Ramaco applied for a permit to mine the whole proposed mining area. The area of HWM of one seam that AAI provisionally designed for was about 68 acres compared to a total of about 1,960 acres of HWM applied for. Since no engineering analysis was performed for the multi-seam HWM condition, the submitted mine plan was absent of any criteria on the allowable thickness of the interburden for the different lithologic and mining conditions.

Because AAI's design report is incomplete in many respects, a complete critical expert review was not possible. This includes:

- No codified rock classification for understanding material types.
- Point data not provided for Carney Coal Thickness with contours of 0.5 ft. (see AAI Figure 3).
- Point data not provided for Carney Coal floor elevations with contours to 1.0 ft. (see AAI Figure 4).
- AAI states: "Unmapped faults may exist that complicate the seam structure" (Add. MP-6-24), but are not addressed in the design.
- Joint (fracture) pattern assumed in UDEC modeling used to check for mine instability not given (Add. MP-6-55).
- Joint slippage properties assumed in UDEC modeling used to check for mine instability not given (Add. MP-6-56).
- No reference for the assumed "western coal" strength.

- No long term strength data for the mine roof or floor.

- No analysis provided on how the floor stability was determined to be adequate (Add. MP-6-38,39).

In the analysis below, the fine-grained rock overburden and floor in the test hole (Boring 2017-4) done for the design of the TR-1 HWM area are classified as mudstone and is assumed as such in AAI stability analysis. It is unreasonable, however, to assume a roof and floor containing mudstone as the worst case condition when there is a significant amount of roof and floor material described as claystone in the other borings submitted in the application, especially without running, at a minimum, Atterberg Limits to verify the rock plasticity. These fine-grained clastic rocks are very difficult to properly identify without this testing (Marino and Osouli, 2012).

Below is the review of limited AAI mine design analyses against mine roof, pillar and floor failure based on the information available in the AAI report. See Figure 3.

Roof Stability Design Analysis

For the TR-1 area, AAI analyzes the mine roof short term stability for highwall mining. Because of the reported weak mudstone beds, AAI recommended leaving 1 ft. of coal in place to avoid short term collapse of the more immediate roof rock, although the more immediate mudstone is likely to collapse in the long term. AAI calculated a roof stand up time of only 77 days (Add. MP-6-38). AAI noted, however, that above the 6 ft. of strata of essentially mudstone sequences is a "18+ ft.-thick sequence of moderately strong sandstone that may be sufficiently competent to bridge across the 11.5 ft. opening width." In view of the reported overburden geology across application area as discussed in MEA, 2017, these sandstone beds are laterally discontinuous and thus, should not be relied upon as being omnipresent. Furthermore, evidence that sandstone is sufficiently present with adequate capacity in the overburden is not borne out by the massive amount of pit subsidence over the adjacent old works which are in the Carney Seam (see MEA, 2017).

Pillar Stability Design Analysis

For HWM in TR-1, AAI offers two designs: one with a stability factor (SF) of 1.6, and another where SF is 1.8 "to reduce the likelihood of pillar failure" (Add. MP-6-39). SF is calculated using the program ARMPS-HWM. This design methodology was developed for bituminous coal fields with web pillar heights of 7 ft. or less. The application conditions, however, fall outside this criteria. The Carney Seam is sub-bituminous coal and is 16-17 ft. thick in the TR-1 area reaching 18+ ft.-thick across the application area (see Table 4.1, MEA, 2017).

As stated by AAI, "Mark and Barton (1997) concluded that laboratory test results (typically from tests on 2-3 in. core) are a poor predictor of in-situ pillar performance, and that a constant in-situ coal strength of 900 psi (when considering 36" or greater cubes of inplace coal) produce better results" (Add. MP-6-40). However, AAI correctly recognized, as noted in MEA, 2017, that bituminous coal would have a higher strength than the Carney sub-bituminous coal. Therefore, AAI assumed in-situ coal strength of 762 psi. Rationale to arrive at 762 psi, however, defies logic. AAI justified the reduction from 900 psi to 762 psi for sub-bituminous coal based on the reduction of an unsubstantiated laboratory compressive strength for "western coal" to that for the Carney Seam (from Test Hole 2017-4). Yet by their own admission, lab tests do not relate to the larger in-situ cube strength. In addition, it is not known if the "western coal" strength was from bituminous or sub-bituminous coal or how it was derived. Moreover, AAI then claims the derived strength of 762 psi is "more conservative" without explanation (Add. MP-6-40).

Roof/Floor Bearing Design Analysis

AAI describes the immediate 6 ft. of the Carney roof as weak carbonaceous mudstone to mudstone which becomes sandy towards the top (Add. MP-6-33, 75-77). The carbonaceous mudstone was found to be non-durable with Slake Durability Index (SDI) of only 11.8% (Add. MP-6-32). As noted above, AAI calculated this roof's "stand up time" to be 77 days. Because of the concern for fallout during mining, however, AAI recommended leaving 1 ft. of sub-bituminous coal in the roof. However, whether or not this coal thickness can be remotely controlled or maintained if the coal thins or undulates, and how long the coal (without bolting with mesh) will remain are suspect. Caving in the long or short term of the weak immediate roof adversely affects the roof's ability to laterally restrain these mudstone strata above the pillar from roof squeeze. Based on the pillar design at SF=1.6, web pillar width to weak roof thickness ratio $(\frac{W_p}{h})$ would range from 2.35 to 3.0 for Test Hole 2017-4, and would be clearly susceptible to roof squeeze. No roof bearing analysis was performed by AAI.

The upper almost 2 ft. of the floor is described as carbonaceous mudstone which AAI states "is not expected to provide adequate floor conditions in a wet environment." This non-durable immediate floor had a reported SDI of only 22.4% with a very high natural moisture content of 18%. This material is underlain with at least 14 ft. of mudstone which is described as "weak, plastic mudstone which would form a very poor floor." This rock tested to be fairly non-durable with SDI's of 59.7% and 71% and with a high natural moisture content of 12.8%

(Add. MP-6-32-33)[1]. At the termination of the test hole, these mudstone sequence was at least about 14 ft. thick.

AAI also recommended leaving 1 ft. of sub-bituminous coal cover as a result of their concern for the floor conditions. This may assist in the immediate short term with HWM trafficability, if it can be done, but provides little benefit over time to restrain floor heaving. Given these floor conditions, $\frac{W_p}{h}$ is no greater than 1.3 for Test Hole 2017-4 and thus clearly more susceptible to pillar punching.

As noted above, AAI recommended the use of 1 ft. of roof and floor coal in their report. However, they later stated in response to a DEQ Deficiency Letter (Ramaco response to DEQ Memorandum dated December 27, 2018 by R. Barney) that the need for this roof and floor coal was not expected to be the normal condition. Consequently, an extraction height of 16 ft. should be considered in lieu of 14 ft. in the TR-1 area. Therefore, AAI analyses which assume an extraction height of 14 ft. are not most representative of what is expected in the TR-1 area.

AAI only performed a bearing capacity analysis on the mine floor. AAI stated "the bearing capacity stability factor of the CMS (carbonaceous mudstone) floor layer was calculated to be greater than 2" (Add. MP-6-39). AAI appears to erroneously ignore any failure through the underlying "weak, plastic mudstone." Moreover, no details of this important analysis are provided for review. However, it is stated that the bearing capacity analysis was done considering the cohesion and internal friction angle values for each layer as given in AAI Table 8. For the floor materials, AAI assumed cohesion and friction values of 243-553 psi and 20.9-29.2° respectively.

From our experience with mudstone floors, the strength values assumed by AAI for the fully softened and unsoftened conditions are too great (Marino and Osouli, 2012). AAI described these mudstones being weak and plastic yet while the friction angle values are reasonable, these assumed cohesion values, which are the dominant factor in determining the AAI calculated bearing capacity are too high. In fact, from a significant amount of testing we have done, the cohesion can drop to essentially zero in the fully softened state leaving only friction to resist bearing failure[2]. In the softened state, the bearing capacity of the non-durable mine floor with initial moisture contents of about 13% (as reported by AAI) can be easily below the design pillar pressures of 544 psi to 623 psi noted above. Moreover, it is unknown how these strength parameter values were specifically extrapolated by AAI since

[1] From our experience, given a reported material moisture content of about 13% these reported SDI appear high.

[2] Although the extraction ratio proposed by AAI is below 50%, significant softening is expected below the web pillars because they only reach widths of about 18 ft. and $\frac{W_p}{h}$ is no greater than 1.3

they were not directly measured from any reported laboratory tests performed yet very specific. And, it is unknown why AAI only considered shearing in the top 1.8 ft. of carbonaceous mudstone (Add. MP-6-39) and ignored deeper seated failure into the "weak, plastic mudstone," which is likely the more critical condition.

In fact, the UDEC modeling used to "check roof and floor for stability, and detect other potential failure mechanisms" considered the mudstone floor to also have a tensile strength ranging from 76 to 89 psi per layer in addition to the unrealistic cohesion, thereby further increasing the floor strength and improving stability. Note, in the unreported bearing capacity analysis, AAI stated no tensile strength was assumed. Use of a tensile strength in unsoftened to softened mudstone floor is completely unrealistic and reduces any indicated instability results.

As can be seen from the above, AAI using unreported bearing capacity methodology, arrived at acceptable floor stability using unrealistic floor strengths even in the unsoftened state. AAI did not consider the much weaker moisture softened condition despite moisture deterioration potential indicated by their only durability tests.

This floor will most likely be exposed to groundwater as a result of a number of factors:

- Even if a 1 ft. coal cover is considered, groundwater will seep through exacerbated by cracking in the coal from any significant floor heave from pillar punching and swell of floor materials from exposure to moisture.

- Groundwater exposure from unmapped faulting or shear zones, roof collapse uncovering beds seeping groundwater, surface runoff through complete chimney collapse events and the HWM opening, and flooding from adjacent old works.

AAI reported "It is expected that aquifers are associated with the coal seam(s) and adjacent sandstones with intervening shales and clays inhibiting vertical movement. Some groundwater inflows can be expected during highwall mining operations" (Add. MP-6-24,25).

AAI also investigated the potential for "cascading pillar failure," or in other words, the potential of an outward progressive failure from localized pillar crushing or compression. This was analyzed using a program called LA Model. This software calculates the transfer of stress to adjacent previously unyielded pillars through bridging (or arching) in the roof overburden. However, the LA Model does not account for roof/floor bearing deformations and therefore this analysis is not valid given the site conditions. Moreover, given the reported mudstone roof and floor, it is not reasonable to consider there is not significant yielding of roof/floor which affects the outward progression of pillar failure especially since the failure is most likely in bearing not in the pillar.

SUBSIDENCE ANALYSIS

Surface subsidence is an expression of an underlying mine collapse. Over room-and-pillar workings subsidence develops in the form of sinkholes (aka pits) and bowl-shaped depressions (aka sags over room-and-pillar mines). Pits and smaller sags are caused by chimney roof failure above a mine opening, whereas larger sags result from yielding of a number of pillars from outright crushing, or roof/floor deformation (see UPDATE 14).

Pit Subsidence

The potential for pit or chimney subsidence was evaluated by AAI for only the TR-1 area for highwall mining of only the Carney seam. AAI concluded "the risk of sinkhole subsidence associated with highwall mining at the Brook Mine is considered low, but cannot be dismissed entirely, particularly in the shallower cover areas near the box cut (or highwall)." This opinion was in part based on a study of pit development in Colorado performed by Matheson, 1990, who developed the following equation to estimate the probability of pit subsidence.

$$P=1{,}516\left(\frac{D}{H}\right)^{-4.0} \quad \left(\text{for } \frac{D}{H} \geq 6.3\right)$$

where: D = depth of floor of opening
H = mining height
P = probability of pit subsidence

This probability model by Matheson was not applied by AAI as the data relied upon for this model excluded the case data AAI used in their analysis for sinkhole development potential above the proposed Brook Mine. Consequently, the above equation is not applicable. AAI used Matheson's excluded Colorado case because it better represented the room-and-pillar conditions proposed at the Brook Mine. From the excluded case data of 82 observed sinkholes, AAI determined the 100% probability was when $\frac{D}{H}$ equaled 2.7. Also, the Matheson probability is somewhat a misnomer as it actually is based on the frequency of subsidence occurrences per unit area.

With the use of the Matheson case data, AAI determined the frequency of observable sinkholes per unit area for different mine depth ranges. AAI added similar results were obtained when examining the observable subsidence over the adjacent Carney, KOOL and Monarch mines to the Brook Mine. With the use of these depth related frequencies, AAI determined that 7 sinkholes may develop using the Matheson Model to a depth of 178 ft. and none should develop beyond this depth. This, however, is only for the TR-1 area where

the extraction height was erroneously assumed at 14 ft. AAI also noted 7 sinkholes was considered a conservative estimate since the HWM entry width of 11.5 ft. of roof span, was less compared to the Matheson studied mined-out area.

In performing a "probability" analysis of estimated number of sinkholes in the TR-1 area, AAI adopts the Matheson $\frac{D}{H}$ model. However, in the Matheson reference used by AAI, the definition for D is mis-stated and thus, inappropriately applied by AAI in their sinkhole analyses. D is the depth to the coal seam or the overburden thickness as indicated to Figure 4 and Table 3 of Matheson, 1990[3]. Also, this definition of D does not intuitively make sense and is not traditionally defined that way. Moreover, given that the "normal condition" for TR-1 is not to leave coal in the roof and floor, H will be 16 ft. not 14 ft. as assumed. Therefore, Table 9 in the AAI report was redone using the appropriate values and is provided in Table 1. This is analysis results in a predicted 16 sinkhole (distinct subsidence) features compared to 7 estimated by AAI. For the remaining HWM application area, these calculations with assumptions by HWM panel are given in Tables 2 to 15. Using this chimney subsidence prediction methodology by AAI, 2,680 sinkholes (1.4 subsidence events/acre) are estimated over the entire proposed HWM area. With this number of events, it is clearly not an unplanned subsidence plan.

Even though the AAI chimney subsidence prediction method appears inappropriate and an excessive over-estimate on the frequency of events, it does not provide any confidence that future chimney subsidence is not problematic. Moreover, the risk of surface subsidence from HWM entry roof collapse should also account for the following factors.

1. The less distinctive chimney features or sags will not be noticeable from the aerial photography used in the AAI analysis count subsidence events. In other words, the subsidence count made by AAI would be only for the more dramatic features which can be seen from high elevation aerial images. It would not include all the smaller pits or smaller to larger sags or troughs. Therefore, the prediction of "probability" of chimney subsidence (pits and smaller sags) underestimates the frequency of subsidence events.

2. In the current application, the Monarch seam is no longer highwall mined. It is only planned to be surface mined throughout the application area (Figure MP-6.1-1). Based on Figures 4.3, 4.1, to 4.24 in the 2017 MEA Report. The Monarch seam is shown present in Mine Blocks 13, 17, and 20. Surface mining in these areas will remove at least up to 35 to 105 ft. of overburden, the vast majority of which is rock and will be replaced with mine spoil. The reduction of the rock overburden in these

[3] D is mis-defined in the text of the paper. Note, if D were taken as floor depth, the overburden thickness to mined height would not be 2.7 at < 25 ft. depth.

areas with clayey mine spoil will clearly increase the risk of surface subsidence from HWM entry collapse from the underground mined Carney.

3. AAI chimney subsidence analysis does not account for the "portal" subsidence at the tapered back highwall. Also, data on how closure of the HWM openings will be addressed is not provided, for example, will the mine spoil be merely dumped in front of these HWM openings, as implied.

4. The method of "probability" used by AAI given above for sinkhole subsidence for HWM of the Carney seam in the TR-1 area is also in conflict with the methodology provided by Ramaco in the Subsidence Control Plan (SCP) for the overall application area. This methodology is discussed in detail in MEA, 2017. The methodology used by Ramaco recognizes the importance of other parameters in prediction of chimney subsidence which is ignored by the "probability" criteria used by AAI. Chimney prediction methodology (e.g., Piggott and Eynon, 1977, Garrad and Taylor, 1988, Whittaker and Reddish, 1989, and Dyne, 1998) typically considers at a minimum the bulking (volume expansion) from the caving of intact roof rock, the extraction height, width of intersecting mine openings and the repose angle or the spread of the caved material into mine openings. This was exemplified by Ramaco in Figure MP-6.2-4 (see Figure 4).

Sag Subsidence

AAI states that "the highwall mining plan (for the Carney seam in the TR-1 area) for the Brook Mine has been developed to minimize the likelihood of trough (sag) subsidence"... (Add. MP-6-62). As noted above, sag subsidence from pillar bearing failures into the "weak" "plastic" mudstone floor (and possibly roof) appears likely. This type of failure would cause sag or trough subsidence in addition to smaller sags from chimney subsidence. From a study performed by the USGS in the project area, Dunrud and Osterwald 1980 illustrated both trough and pit subsidence from the area, which is shown in Figure 5. Note, the USGS illustration depicts pit/sinkhole subsidence inside a larger sag. This indicates at shallower depths where sinkholes occur, massive pillar related failure would also occur. In addition to outright crushing, pillar failure can be induced by excessive deformation in the weak adjacent mudstone. Moreover, AAI notes that pillar failure can cause spontaneous combustion (Add. MP-6-21). Coal fires are not uncommon in the area and can result in additional subsidence and possibly other environmental concerns. Moreover, in review of the mine application, the Wyoming Land Quality Division (LQD) noted in a Memorandum dated December 27, 2018 that "leaving coal in the roof and the floor (as proposed by AAI above) there may be increased chance for spontaneous combustion of coal and coal fires. Coal fires could potentially weaken pillars."

SUBSIDENCE REMEDIATION

In the mine application, Ramaco discussed their remediation plan if chimney (sinkhole) subsidence would result over the proposed HWM area. Ramaco stated that areas highwall mined will be "monitored for at least 6 months after highwall mining of the individual areas are completed. If there is no evidence of subsidence, then the monitoring of the area will be discontinued" ... "Backfill" of the detected subsidence will however only be "performed on a selective/as-needed basis." The select subsidences which will be remediated will be only those which do not exhibit "self-healing" and there is the introduction of oxygen or surface water. Ramaco notes it "will continue to perform remediation on any subsidence, detected during or subsequent to the 6 month monitoring period, until bond release is approved" (MP-6.3 and MP-6.4).

The above remediation plan does not require any monitoring above HWM areas beyond 6 months, and only remediates those which are not "self-healing" in lieu of remediating all sinkholes. Moreover, "self-healing" is not sufficiently defined. If the sinkhole collects water, would that mean it has "self-healed"? In lieu immediately "backfilling" the pit, is there a waiting period to determine if it will "self-heal"? It is also unclear how the pit will be backfilled.

From our experience, at a minimum, backfilling a subsidence event in an open field should include compaction of the subsidence bottom and then compaction of the subsequent lifts of select fill placed in depression. The backfilling should continue to at least meet the natural surrounding surface contour, and as noted in the application, be covered with topsoil that supports the vegetation demand. Although not even considered in the Ramaco SCP, remediation should also apply to trough or sags which have significant depth affecting surface drainage.

It should be noted that the Ramaco subsidence remediation plan falls way short of the reclamation efforts performed by the State on the subsidence features which have resulted above the adjacent abandoned Carney Mine No. 44 (PHC Reclamation, 2006).

Criteria is recommended by AAI for "any surface structures or other facilities" that would require protection from subsidence for HWM. Their report states "AAI considers a 50 ft. offset and an angle of critical deformation of 25° to be appropriate." Under the most likely site conditions, this criteria appears to be acceptable.

SURFACE RECLAMATION

In Section RP.3.3 entitled Post Mine Slope Analysis, the reclaimed land slopes are reported from 0 to greater than 45° and are in fact, noted to 69.5° (Table RP.3-1) without

distinction of which slopes are native or reclaimed. It is not known whether the greater slopes are in native rock or highwall areas, or native or reclaimed soil slopes. Further, there is no discussion of how the reclaimed slope will be constructed to prevent landsliding conditions, or analysis of the stability of such slopes. Given that the majority of the mine spoil will likely consist of rubblized claystone, only gentle slopes should be tolerated.

DEQ OVERSIGHT

In Round 7, DEQ admitted it has only limited expertise in mine subsidence engineering. This explained the blatantly inadequate review of the subsidence engineering aspects of the Brook Mine Application. In lieu of soliciting an expert in mine subsidence, the agency had in effect acted as a "pass through" in determining that the application was technically complete in this respect.

Recognizing that they did not have sufficient expertise to evaluate the subsidence engineering aspects of the Brook Mine application, after Round 7 DEQ contracted with Engineering Analytics, Inc. (EAI). Engineering Analytics scope of work was "to provide an evaluation of a subsidence sampling and analysis plan" of the Brook Mine Submittals and to provide "evaluation of the adequacy of Brook Mine's submittal in addressing each subsidence finding in the EQC order" (EAI Technical Memorandum dated June 19, 2018 and DEQ Memorandum dated October 16, 2018).

Accordingly, Mr. Dan Overton of Engineering Analytics notes in a Technical Memorandum dated June 29, 2018 that the EQC recommended "a commitment by the Brook Mine to do the appropriate studies per Dr. Marino's suggestions to move towards a proper mine subsidence plan (Findings No. 59 and 60)". These suggestions and concerns were spelled out in the 2017 MEA Report (see Attachment B) and the document entitled: Room and Pillar Recommendations Against Surface Subsidence – Proposed Brook Mine, Sheridan, Wyoming (see Attachment C) and in an initial review of items from the Round 8 application provided to DEQ in an email dated December 31, 2018. The MEA report and recommendations documents were in the possession of the DEQ in addition to the EQC prior to their written order. Based on the review of the most recent Brook Mine application documents, which was deemed complete, our concerns provided in these above documents were substantially ignored. Furthermore, there is no evidence, other than possibly MEA 2017, that these documents were even received or considered by Engineering Analytics, despite EQC findings. Note, there is no reference to any of these documents in any of EAI's reports.

From review of their Technical Memorandums on the Brook Mine submittals related subsidence issues, Engineering Analytics performed no independent critical analyses of the mine design and associated subsidence potential as performed herein. The vast majority of

the EAI Technical Memorandums are a regurgitation and explanation of Ramaco's submittals. However, EAI properly identified the use of consolidated drained triaxial tests in one of the earlier reviews (Technical Memorandum dated June 29, 2018). In this earlier memorandum, EAI states the Brook Mine "subsidence sampling plan is not sufficient as presented" and their plan "remains deficient" in all subsidence related phases. Given the subsequent responses by Ramaco, it is unclear how these major issues were resolved.

Moreover, DEQ provides no geotechnical guidelines or requirements for mine subsidence engineering, such as: minimum required drilling and testing requirements, design methodology, minimum safety or stability factor criteria, protection requirements against subsidence for surface infrastructure, and minimum subsidence remediation requirements. In fact, without such constraints, DEQ had accepted Ramaco explanation that the mine design "will be done in due time."

In terms of subsidence remediation and surface reclamation, DEQ accepted vague and minimal subsidence remediation and reclamation standards. These subsidence standards are far below even the State's own standards as evident by the subsidence reclamation efforts by the State conducted above the adjacent abandoned Mine No. 44.

SUMMARY AND CONCLUSIONS

The findings from this investigation are provided below.

1. Ramaco Resources, Inc. has submitted several rounds of application for the Brook Mine (Rounds 8 to 12). Despite the Wyoming Environmental Quality Council (EQC) comments regarding the technical deficiencies in the applications associated with the subsidence issues of the application from Round 7, Ramaco responded with merely a token effort to address EQC's concerns.

2. Through their consultant, Agapito Associates, Inc. (AAI), Ramaco provided in their Round 8 application more specific mine design criteria for a highwall mining (HWM) of about 68 acres for one coal seam while applying for a total of 1,960 acres of HWM mining. Even their consultant, AAI would not extend their provisional design (with disclaimer) beyond the 68 acre area and just for the unsplit Carney seam with only one new test hole done in supposedly the 68 acre area.

3. Because of lack of specificity, it is unclear how extensive the geotechnical exploration and testing will be, but it clearly lacks long-term stability assessment investigation.

Also unidentifiable, are the types of future mine subsidence engineering analyses that will be performed, and when they will be submitted to DEQ for future HWM areas.

4. In the design analysis, AAI treats the anomalous conditions in one test hole to be uniformly applicable across the entire 68 acre HWM design area. These anomalous conditions depicted in the one test hole and relied upon, may be the cause for AAI disclaimer on their recommendations. In this test hole, the most critical roof/floor conditions are described as mudstone compared to all the other drilled holes in the application which report the presence of claystone – which is considered a more unstable material.

5. Ramaco and AAI do not adequately address the long-term instability of the proposed mine workings that could lead to subsidence. Ramaco and AAI do not account for the significant deterioration of at least mudstone roof and floor materials when exposed to moisture despite their own testing indicating such. In places, the design analysis lacked specificity and thus cannot be critically reviewed. For example, a more critical element of mine instability, which could lead to surface subsidence, are roof/floor bearing failures. AAI only reported a safety factor against failure of only the immediate mudstone floor without any calculations. Further, there was no analysis by AAI of roof bearing failure in the weak mudstone.

6. AAI determines for the TR-1 area that 7 distinctive subsidence features (aka sinkholes) may occur of this HWM area. After correction of this calculation this amount is more than double and over 2,000 such events are expected over the entire proposed HWM area using this methodology.

7. The proposed subsidence remediation by Ramaco in the application is ambiguous and allows for the possibility of many resulting subsidence events to remain untreated. This proposed subsidence remediation plan falls way short of the State's own reclamation standards. Moreover, the surface reclamation plan contains no slope stability analysis despite the steep proposed slopes.

8. With insufficient expertise in mine subsidence engineering, the Department of Environmental Quality (DEQ) has acted as a "pass through" agency through Round 12 and has contracted with Engineering Analytics Inc. (EAI) to review these aspects of the mine application after Round 7.

9. Based on the review of correspondence, DEQ did not provide their subsidence consultant EAI, MEA's suggested guidelines for room-and-pillar design against

subsidence for review (see Attachment B) and other MEA material to the application. The consultant subsidence did not include any significant critical analyses of the submitted application materials.

10. As noted above, the permit application only addresses the highwall mining of the 68 acres of Carney Seam. With application approval, this may provide an administrative mechanism for DEQ to approve remaining underground mining of other mineable seam areas without proper public oversight via a non-significant revision to the permit. This would involve the entire 1,960 acres of proposed highwall mining.

    At a minimum, it is recommended that any highwall mining be removed from the permit until it is reasonably investigated in order not to setup such a precedent of unacceptable protocols. HWM areas should be applied for increments as Significant Revisions as proper subsidence engineering investigation is accomplished. Moreover, in the first 5 years on operation the Brook Mine intends on only surface mining with no highwall mining. This is also consistent with Ramaco's statement in the application that the permit will be renewed every 5 years (Mine Plan prepared by WWC Engineering dated 12/19). Another reason why the HWM application should be delayed and become a Significant Revision is the statement by Ramaco ... "AAI agrees that reevaluation should be considered if the ultimate plan involves a greater cutting width, height, or penetration or a lesser production rate than assumed" (Ramaco Response to Round 8 DEQ Memo of Deficiencies dated January 9, 2018).

QUALIFICATIONS

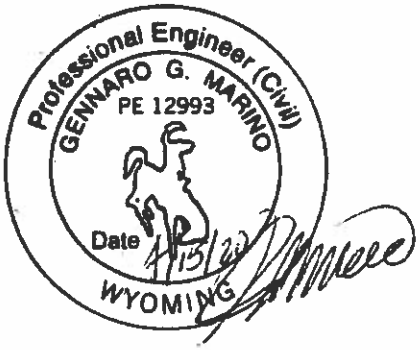
MEA is a leading expert in subsidence engineering from underground mining and from karst. For over 40 years, MEA's staff have provided services across the full scope of subsidence engineering, including significant work in research, site subsidence studies, mine stability design, failure analyses, prediction of subsidence displacement and damage potential, subsidence damage evaluation, foundation design, repair design, and grout stabilization design and monitoring. Being foremost in this field, MEA staff has authored over 100 publications on related topics and have worked in ore fields and karst across the U.S. and Canada. MEA's experience extends to underground mines in limestone, gold, trona, salt, lead/zinc, iron, and coal. Because of our broad reach, MEA is licensed to practice in 27 states.

MEA has also been hired by mining companies and others to provide consulting services on active or new operations for both room-and-pillar and longwall mining in addition to low to high extraction old works. These services are included in those listed above.

Because of the amount of coal mining related work MEA has done, it has designed and developed a cross-hole radar to detect mine voids for cases where mining may exist. Also, from our experience in karst, MEA has researched and developed a TDR system which can be used to detect incipient subsidence beneath a structure.

Having extensively worked on old workings and both low and high extraction active mines, MEA is uniquely qualified and separates itself from other geotechnical and mining engineering companies across the U.S.

If you have any questions about our review of the most recent Brook Mine Application, please contact us.



Sincerely,

Gennaro G. Marino, Ph.D., P.E., D.GE
President

ENCLOSURES:

REFERENCES

FIGURE 1	NEW PROPOSED MINE PLAN OF THE BROOK MINE SHOWING COAL REMOVAL SEQUENCE
FIGURE 2	NEW PROPOSED MINE PLAN OF THE BROOK MINE SHOWING THE ADJACENT OLD WORKS
FIGURE 3	SKETCHES OF THE THREE PRINCIPAL MODES OF FAILURE OF ROOM-AND-PILLAR MINE WORKINGS WHICH CAN RESULT IN SURFACE SUBSIDENCE
FIGURE 4	RAMACO ILLUSTRATION SHOWING THE VARIABLES INVOLVED IN DETERMINING CHIMNEY SUBSIDENCE
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TABLE 1	REVISED AAI TABLE 9 SUBSIDENCE DATA FROM DEVELOPMENT – ONLY MINES – FOR TR1

TABLE 2 CARNEY SEAM TOTAL ACREAGE PER DEPTH INTERVAL, AVERAGE THICKNESS AND MINIMUM THICKNESS

TABLE 3 ESTIMATED NUMBER OF SINKHOLES FOR PANELS 5 AND 6 FOR AVERAGE CARNEY THICKNESS

TABLE 4 ESTIMATED NUMBER OF SINKHOLES FOR PANEL 7 FOR AVERAGE CARNEY THICKNESS

TABLE 5 ESTIMATED NUMBER OF SINKHOLES FOR PANEL 8 FOR AVERAGE CARNEY THICKNESS

TABLE 6 ESTIMATED NUMBER OF SINKHOLES FOR PANEL 9 FOR AVERAGE CARNEY THICKNESS

TABLE 7 ESTIMATED NUMBER OF SINKHOLES FOR PANEL 10 FOR AVERAGE CARNEY THICKNESS

TABLE 8 ESTIMATED NUMBER OF SINKHOLES FOR PANEL 11A FOR AVERAGE CARNEY THICKNESS

TABLE 9 ESTIMATED NUMBER OF SINKHOLES FOR PANEL 11B FOR AVERAGE CARNEY THICKNESS

TABLE 10 ESTIMATED NUMBER OF SINKHOLES FOR PANEL 12 FOR AVERAGE CARNEY THICKNESS

TABLE 11 ESTIMATED NUMBER OF SINKHOLES FOR PANELS 13, 14 AND 15 FOR AVERAGE CARNEY THICKNESS

TABLE 12 ESTIMATED NUMBER OF SINKHOLES FOR PANELS 16 AND 17 FOR AVERAGE CARNEY THICKNESS

TABLE 13 ESTIMATED NUMBER OF SINKHOLES FOR PANEL 18 FOR AVERAGE CARNEY THICKNESS

TABLE 14 ESTIMATED NUMBER OF SINKHOLES FOR PANEL 19 FOR AVERAGE CARNEY THICKNESS

TABLE 15 ESTIMATED NUMBER OF SINKHOLES FOR PANEL 20 FOR AVERAGE CARNEY THICKNESS

ATTACHMENT A – Reviewed Documents

ATTACHMENT B – MEA January 23, 2017 Report

ATTACHMENT C – Room and Pillar Design Recommendations Against Surface Subsidence – Proposed Brook Mine, Sheridan, WY

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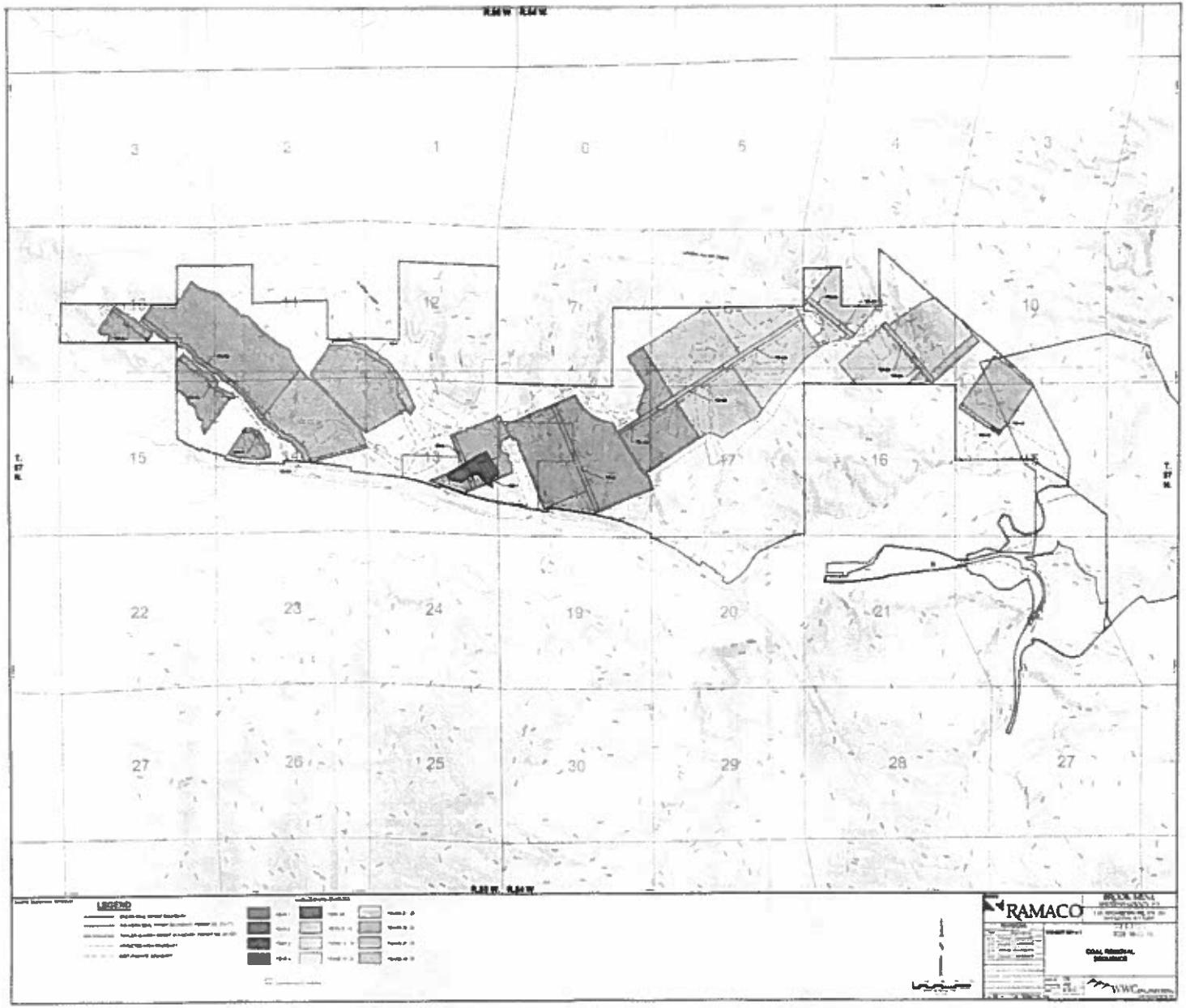


FIGURE 1 NEW PROPOSED MINE PLAN OF THE BROOK MINE SHOWING COAL REMOVAL SEQUENCE

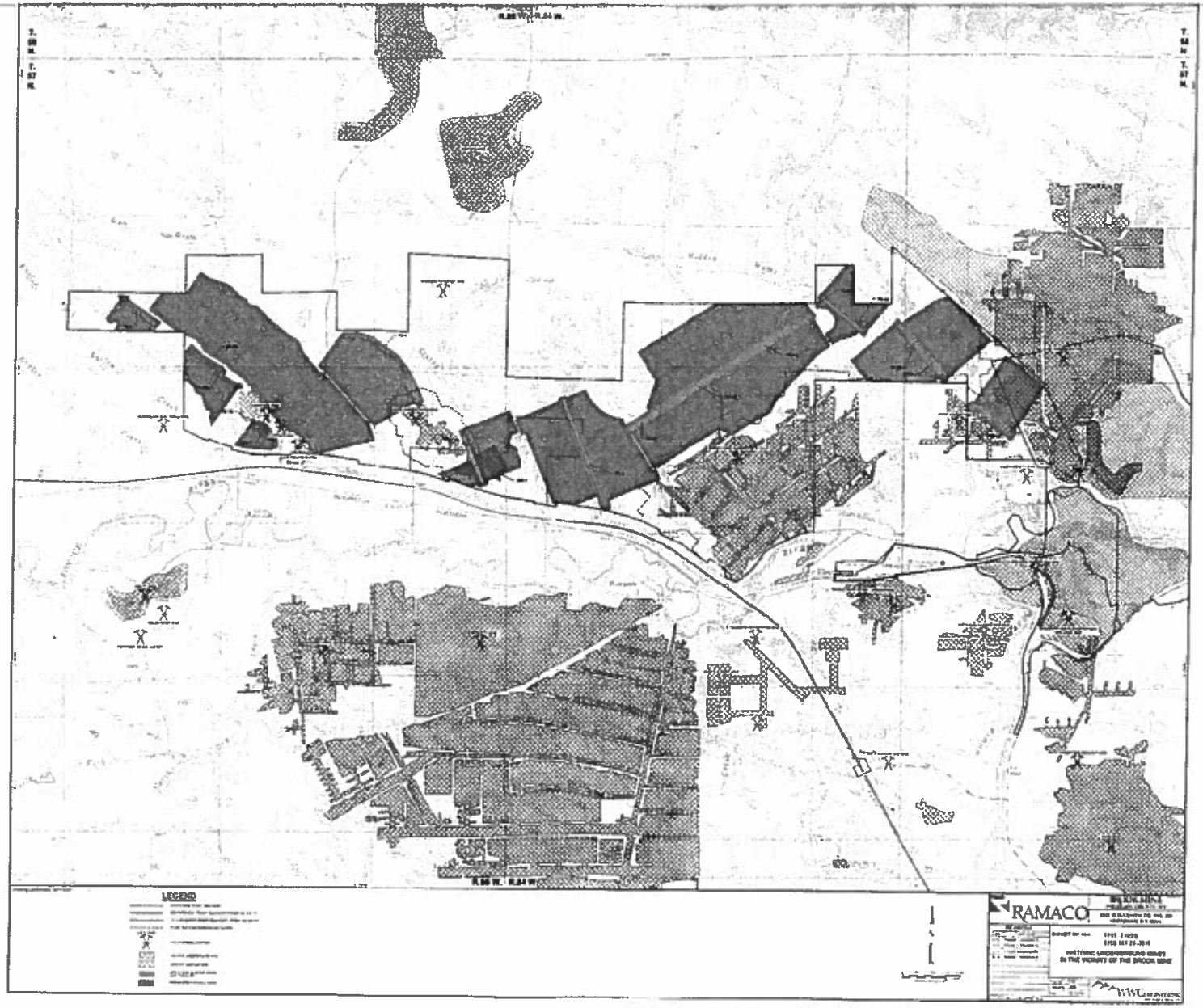
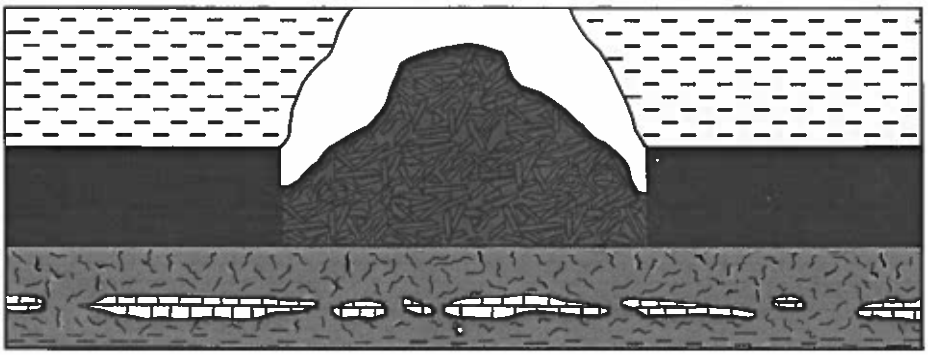
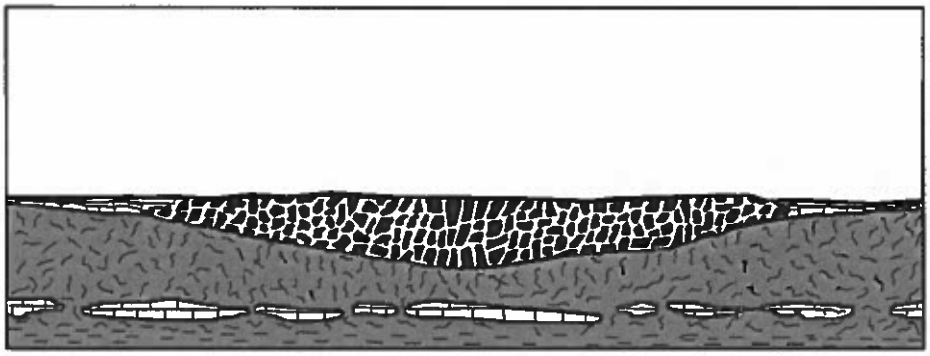


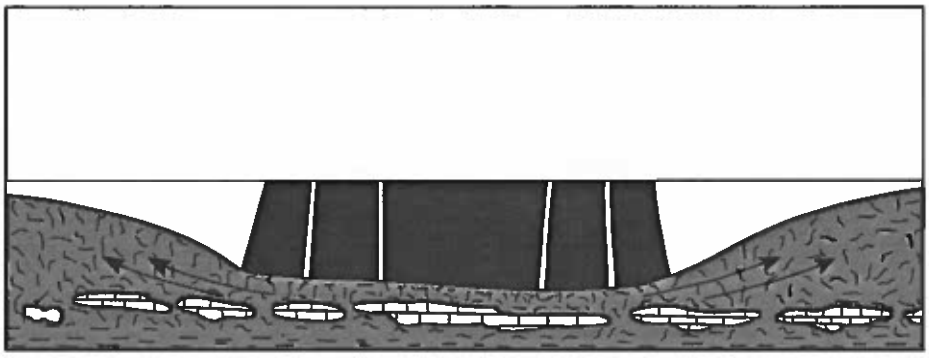
FIGURE 2 NEW PROPOSED MINE PLAN OF THE BROOK MINE SHOWING THE ADJACENT OLD WORKS



ROOF FAILURE ABOVE ROOM



PILLAR CRUSHING



PILLAR PUNCHING

FIGURE 3 SKETCHES OF THE THREE PRINCIPAL MODES OF FAILURE OF ROOM-AND-PILLAR MINE WORKINGS WHICH CAN RESULT IN SURFACE SUBSIDENCE

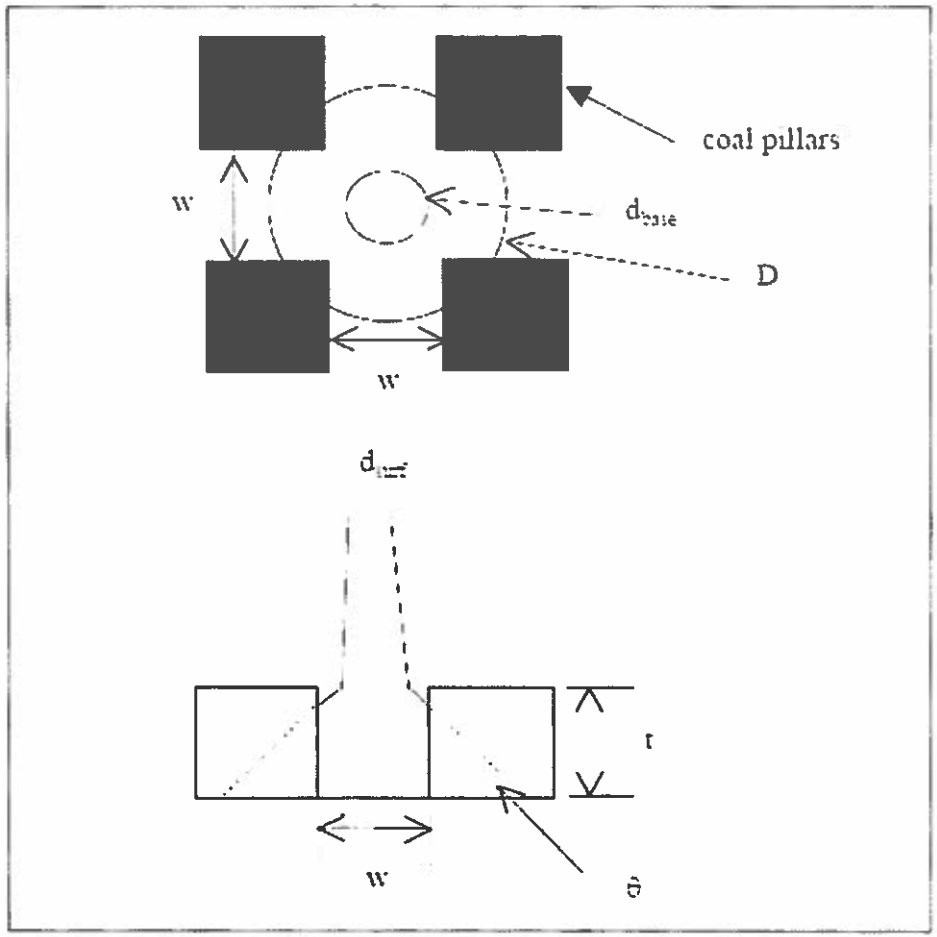


Figure MP-6.2-4 Explanation of Variables in Equation MP-6.2-1 (Dyne, 1998)

FIGURE 4 RAMACO ILLUSTRATION SHOWING THE VARIABLES INVOLVED IN DETERMINING CHIMNEY SUBSIDENCE MEA

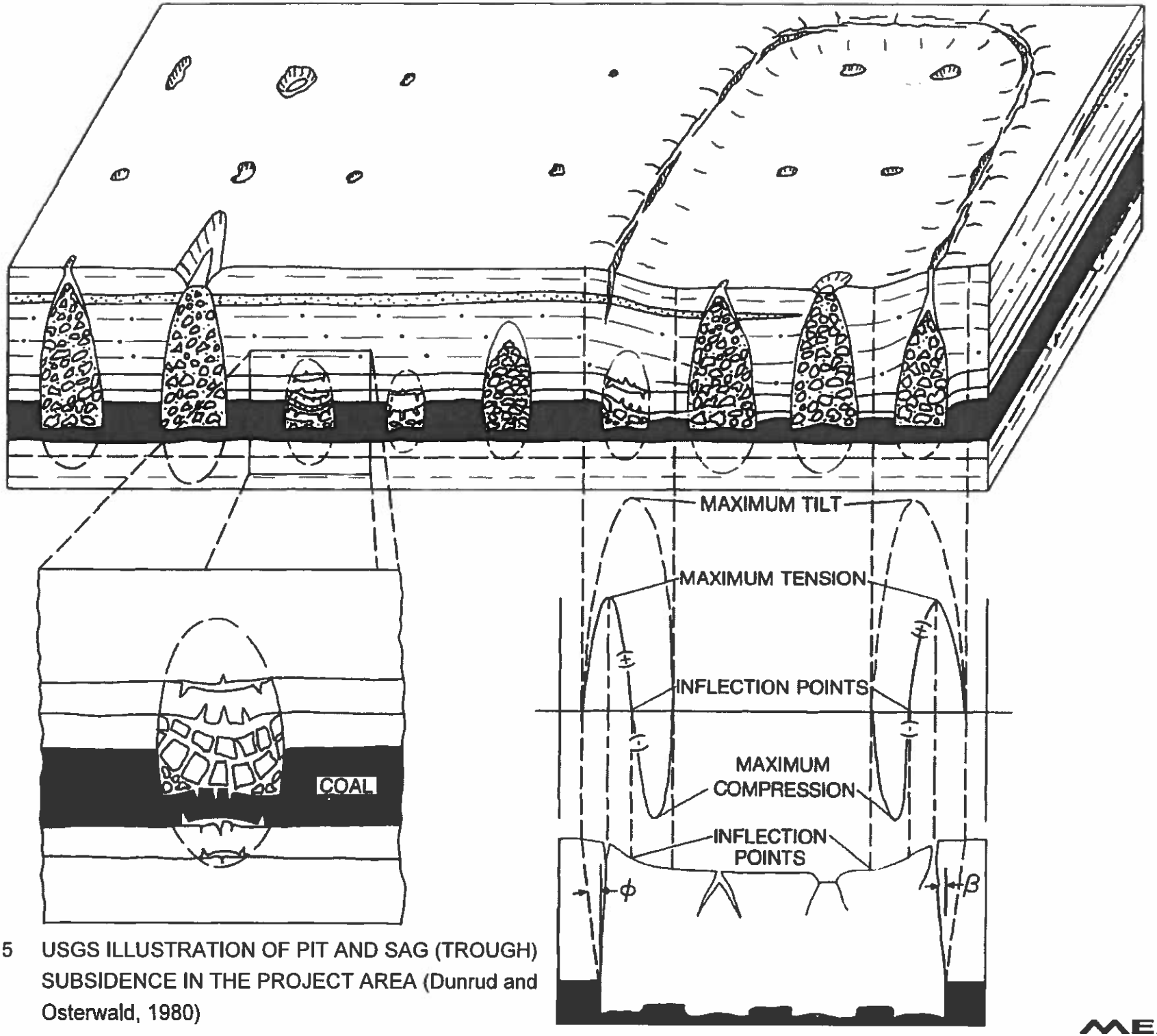


FIGURE 5 USGS ILLUSTRATION OF PIT AND SAG (TROUGH) SUBSIDENCE IN THE PROJECT AREA (Dunrud and Osterwald, 1980)

MEA

TABLE 1 REVISED AAI TABLE 9 SUBSIDENCE DATA FROM DEVELOPMENT- ONLY MINES- FOR TR1

Matheson Depth Range (ft)	Brook Mine Depth Range (ft)	Ratio of Depth to Thickness	Surface Area (Acres)	Density of Subsidence Features (No./Acre)	No. of Subsidence Features
<25	<44	2.7	0.0	17.01	0.0
25-50	44-87	4.1	0.0	8.05	0.0
50-75	87-131	6.9	1.6	5.47	8.7
75-100	131-175	9.6	19.1	0.24	4.6
100-125	175-218	12.4	7.8	0.26	2.0
125-150	218-262	14.6	7.0	0.06	0.4
150-175	262-306	17.9	21.0	0.00	0.0
				Total	16

Notes:
1) TR-1 encompasses Panel 4 based on MEA Figure 4.3
2) Overburden contours used are found on Addendum D5-4 Exhibit 1
3) Assumed Coal Height of 16ft.

TABLE 2 CARNEY SEAM TOTAL ACREAGE PER DEPTH INTERVAL, AVERAGE THICKNESS AND MINIMUM THICKNESS

							Thicknesses				
Trench	Panel	Total Acreage of Panel	0-115ft Deep (Total Acreage)	115-154ft. Deep (Total Acreage)	154-178ft. Deep (Total Acreage)	Shallowest Carney is Present. (FT.)	Average Carney (FT)	Average Upper Carney(FT.)	Average Lower Carney (FT.)	Interburden between Upper and Lower Thickness (ft.)	Add to Overburden Contours
TR-1	4	72	0.8	15.1	4.6	110	16.5	NA	NA	NA	NA
TR-2	5	78	12.8	3.3	1	55	16.5	NA	NA	NA	NA
TR-2	6	103	15.75	10	11.65	50	18	NA	NA	NA	NA
TR-3	7	16	16	NA	NA	30	11.5	NA	NA	NA	NA
TR-3	8	43	25.2	7	4.4	15	15	NA	NA	NA	NA
TR-4	9	261	87.3	56.1	58.7	75	13.5	6	6.5	<2	NA
TR-4	10	210	21.6	36	34.7	60	11	6	4	<2	NA
TR-5	11A 11B	124	9.9	36.2	64.4	50	11.5 6	4.5	6	11A <2, 11B 4	11A NA, 11B 8.5
TR-5	12	123	28.8	13.6	29	35	14	4	9	<2	NA
TR-6	13	34	34	NA	NA	30	9	4	9	20	24
TR-6	14	2	NA	2	NA	140	9	4	9	36	40
TR-6	15	12	0.1	1.1	0.1	100	9	4	9	24	28
TR-7	16	131	131	NA	NA	40	8.5	5	8.5	10	15
TR-8	17	368	322.9	44.7	0.4	15	8.5	3.5	8.5	16	19.5
TR-11	18	19	19	NA	NA	10	4	2	4	11	13
TR-10	19	48	48	NA	NA	10	5	5	5	7	12
TR-9	20	22	22	NA	NA	35	4.5	3.5	4.5	9	12.5

Notes: Panels 1-3 have been eliminated from the mining plan.

Panels 4-8 are Carney seam,Panels 9 and 10 have the Carney and where it splits into Upper and Lower Carney, and Panels 11-20 are Upper and Lower Carney.
Panels 11 and 12 are primarily under 2ft difference, 11B is 4ft. Average difference.
For Panels 13-18 an average thickness of the interburden was used for these to determine the overburden depth.
For Panels 19 and 20 the borehole drilled in that area was used for the interval information.
Where coal seam splits are less than 2ft. both the upper and lower veins are considered mined with a 1ft. Thick split considered between the veins.

TABLE 3 ESTIMATED NUMBER OF SINKHOLES FOR PANELS 5 AND 6 FOR AVERAGE CARNEY THICKNESS

Panel Depth Range (ft)	Ratio of Depth to Thickness	Panel 5 Surface Area (Acres)	Panel 6 Surface Area (Acres)	Total Surface Area (Acres)	Density of Subsidence Features (No./Acre)	No. of Subsidence Features
<44	2.7	0.0	0.0	0.0	17.01	0.0
44-87	4.1	4.7	8.9	13.6	8.05	109.1
87-131	6.9	2.1	10.8	12.9	5.47	70.4
131-175	9.6	31.2	14.4	45.5	0.24	10.9
175-218	12.4	14.6	17.2	31.8	0.26	8.3
218-262	14.6	7.5	25.6	33.0	0.06	2.0
262-306	17.9	0.0	0.0	0.0	0.00	0.0
					Total	201

Notes:
1) TR-2 encompasses Panels 5 and 6 based on MEA Figure 4.3
2) Overburden contours used are found on Addendum D5-4 Exhibit 1
3) Assumed Coal Height of 16ft.

TABLE 4 ESTIMATED NUMBER OF SINKHOLES FOR PANEL 7 FOR AVERAGE CARNEY THICKNESS

Panel Depth Range (ft)	Ratio of Depth to Thickness	Surface Area (Acres)	Density of Subsidence Features (No./Acre)	No. of Subsidence Features
<32	2.7	0.0	17.01	0.0
32-63	4.1	3.7	8.05	29.9
63-95	6.9	7.1	5.47	38.7
95-126	9.6	2.3	0.24	0.6
126-158	12.4	0.0	0.26	0.0
158-190	14.6	0.0	0.06	0.0
190-221	17.9	0.0	0.00	0.0
			Total	70

Notes:
1) TR-3 encompasses Panel 7 based on MEA Figure 4.3
2) Overburden contours used are found on Addendum D5-4 Exhibit 1
3) Assumed Coal Height of 11.5ft.

TABLE 5 ESTIMATED NUMBER OF SINKHOLES FOR PANEL 8 FOR AVERAGE CARNEY THICKNESS

Ratio of Depth to Thickness	Ratio of Depth to Thickness	Surface Area (Acres)	Density of Subsidence Features (No./Acre)	No. of Subsidence Features
<41	2.7	5.7	17.01	96.6
41-82	4.1	8.0	8.05	64.4
82-124	6.9	7.6	5.47	41.4
124-165	9.6	7.2	0.24	1.7
165-206	12.4	5.5	0.26	1.4
206-247	14.6	1.9	0.06	0.1
247-288	17.9	0.0	0.00	0.0
			Total	206

Notes:
1) TR-3 encompasses Panel 8 based on MEA Figure 4.3
2) Overburden contours used are found on Addendum D5-4 Exhibit 1
3) Assumed Coal Height of 15ft.

TABLE 6 ESTIMATED NUMBER OF SINKHOLES FOR PANEL 9 FOR AVERAGE CARNEY THICKNESS

Ratio of Depth to Thickness	Ratio of Depth to Thickness	Surface Area (Acres)	Density of Subsidence Features (No./Acre)	No. of Subsidence Features
<37	2.7	0.0	17.01	0.0
37-74	4.1	0.0	8.05	0.0
74-111	6.9	73.5	5.47	402.0
111-148	9.6	83.7	0.24	20.1
148-185	12.4	74.5	0.26	19.4
185-223	14.6	28.4	0.06	1.7
223-260	17.9	0.0	0.00	0.0
			Total	444

Notes:
1) TR-4 encompasses Panel 9 based on MEA Figure 4.3
2) Overburden contours used are found on Addendum D5-4 Exhibit 1
3) Assumed Coal Height of 13.5ft.

TABLE 7 ESTIMATED NUMBER OF SINKHOLES FOR PANEL 10 FOR AVERAGE CARNEY THICKNESS

Ratio of Depth to Thickness	Ratio of Depth to Thickness	Surface Area (Acres)	Density of Subsidence Features (No./Acre)	No. of Subsidence Features
<30	2.7	0.0	17.01	0.0
30-60	4.1	1.2	8.05	9.4
60-91	6.9	10.8	5.47	59.3
91-121	9.6	12.0	0.24	2.9
121-151	12.4	42.8	0.26	11.1
151-181	14.6	52.5	0.06	3.2
181-212	17.9	41.1	0.00	0.0
			Total	86

Notes:
1) TR-4 encompasses Panel 10 based on MEA Figure 4.3
2) Overburden contours used are found on Addendum D5-4 Exhibit 1
3) Assumed Coal Height of 13.5ft.

TABLE 8 ESTIMATED NUMBER OF SINKHOLES FOR PANEL 11A FOR AVERAGE CARNEY THICKNESS

Ratio of Depth to Thickness	Ratio of Depth to Thickness	Surface Area (Acres)	Density of Subsidence Features (No./Acre)	No. of Subsidence Features
<32	2.7	0.0	17.01	0.0
32-63	4.1	0.0	8.05	0.0
63-95	6.9	2.3	5.47	12.6
95-126	9.6	9.0	0.24	2.1
126-158	12.4	14.2	0.26	3.7
158-190	14.6	38.0	0.06	2.3
190-221	17.9	0.0	0.00	0.0
			Total	21

Notes:
1) TR-5 encompasses Panel 11A based on MEA Figure 4.3
2) Overburden contours used are found on Addendum D5-4 Exhibit 1
3) Assumed Coal Height of 11.5ft.

TABLE 9 ESTIMATED NUMBER OF SINKHOLES FOR PANEL 11B FOR AVERAGE CARNEY THICKNESS

Ratio of Depth to Thickness	Ratio of Depth to Thickness	Surface Area (Acres)	Density of Subsidence Features (No./Acre)	No. of Subsidence Features
<16	2.7	0.0	17.01	0.0
16-33	4.1	0.0	8.05	0.0
33-49	6.9	0.0	5.47	0.0
49-66	9.6	1.4	0.24	0.3
66-82	12.4	0.8	0.26	0.2
82-99	14.6	0.9	0.06	0.1
99-115	17.9	1.1	0.00	0.0
			Total	1

Notes:
1) TR-5 encompasses Panel 11B based on MEA Figure 4.3
2) Overburden contours used are found on Addendum D5-4 Exhibit 1
3) Assumed Coal Height of 6ft.

TABLE 10 ESTIMATED NUMBER OF SINKHOLES FOR PANEL 12 FOR AVERAGE CARNEY THICKNESS

Ratio of Depth to Thickness	Ratio of Depth to Thickness	Surface Area (Acres)	Density of Subsidence Features (No./Acre)	No. of Subsidence Features
<38	2.7	0.0	17.01	0.0
38-77	4.1	6.4	8.05	51.1
77-115	6.9	16.0	5.47	87.8
115-154	9.6	26.0	0.24	6.2
154-192	12.4	18.9	0.26	4.9
192-231	14.6	5.8	0.06	0.3
231-269	17.9	0.0	0.00	0.0
			Total	151

Notes:
1) TR-5 encompasses Panel 12 based on MEA Figure 4.3
2) Overburden contours used are found on Addendum D5-4 Exhibit 1
3) Assumed Coal Height of 14 ft.

TABLE 11 ESTIMATED NUMBER OF SINKHOLES FOR PANELS 13, 14 AND 15 FOR AVERAGE CARNEY THICKNESS

Ratio of Depth to Thickness	Ratio of Depth to Thickness	Panel 13 Surface Area (Acres)	Panel 14 Surface Area (Acres)	Panel 15 Surface Area (Acres)	Total Surface Area (Acres)	Density of Subsidence Features (No./Acre)	No. of Subsidence Features
<25	2.7	0.0	0.0	0.0	0.0	17.01	0.0
25-49	4.1	0.2	0.0	0.0	0.2	8.05	1.8
49-74	6.9	2.0	0.0	0.0	2.0	5.47	11.1
74-99	9.6	6.1	0.0	0.0	6.1	0.24	1.5
99-124	12.4	2.4	0.0	0.0	2.4	0.26	0.6
124-148	14.6	0.7	0.0	4.2	4.8	0.06	0.3
148-173	17.9	0.0	0.1	3.2	3.3	0.00	0.0
						Total	16

Notes:
1) TR-6 encompasses Panels 13, 14 and 15 based on MEA Figure 4.3
2) Overburden contours used are found on Addendum D5-4 Exhibit 1
3) Assumed Coal Height of 9 ft.

TABLE 12 ESTIMATED NUMBER OF SINKHOLES FOR PANELS 16 AND 17 FOR AVERAGE CARNEY THICKNESS

Ratio of Depth to Thickness	Ratio of Depth to Thickness	Panel 16 Surface Area (Acres)	Panel 17 Surface Area (Acres)	Total Surface Area (Acres)	Density of Subsidence Features (No./Acre)	No. of Subsidence Features
<23	2.7	0.0	0.0	0.0	17.01	0.0
23-46	4.1	2.5	58.4	60.9	8.05	489.9
46-70	6.9	79.6	58.4	138.0	5.47	755.0
70-93	9.6	37.4	59.6	97.0	0.24	23.3
93-117	12.4	11.5	79.8	91.2	0.26	23.7
117-140	14.6	0.0	61.9	61.9	0.06	3.7
140-163	17.9	0.0	29.7	29.7	0.00	0.0
					Total	1296

Notes:
1) TR-7 and TR-8 encompass Panels 16 and 17, respectively based on MEA Figure 4.3
2) Overburden contours used are found on Addendum D5-4 Exhibit 1
3) Assumed Coal Height of 8.5 ft.

TABLE 13 ESTIMATED NUMBER OF SINKHOLES FOR PANEL 18 FOR AVERAGE CARNEY THICKNESS

Ratio of Depth to Thickness	Ratio of Depth to Thickness	Surface Area (Acres)	Density of Subsidence Features (No./Acre)	No. of Subsidence Features
<11	2.7	0.0	17.01	0.0
11-22	4.1	0.0	8.05	0.0
22-33	6.9	0.0	5.47	0.0
33-44	9.6	9.7	0.24	2.3
44-55	12.4	9.4	0.26	2.4
55-66	14.6	0.0	0.06	0.0
66-77	17.9	0.0	0.00	0.0
			Total	5

Notes:
1) TR-11 encompasses Panel 18 based on MEA Figure 4.3
2) Overburden contours used are found on Addendum D5-4 Exhibit 1
3) Assumed Coal Height of 4 ft.

TABLE 14 ESTIMATED NUMBER OF SINKHOLES FOR PANEL 19 FOR AVERAGE CARNEY THICKNESS

Ratio of Depth to Thickness	Ratio of Depth to Thickness	Surface Area (Acres)	Density of Subsidence Features (No./Acre)	No. of Subsidence Features
<14	2.7	0.0	17.01	0.0
14-27	4.1	0.0	8.05	0.0
27-41	6.9	23.2	5.47	127.0
41-55	9.6	9.3	0.24	2.2
55-69	12.4	11.8	0.26	3.1
69-82	14.6	3.6	0.06	0.2
82-96	17.9	0.0	0.00	0.0
			Total	133

Notes:
1) TR-10 encompasses Panel 19 based on MEA Figure 4.3
2) Overburden contours used are found on Addendum D5-4 Exhibit 1
3) Assumed Coal Height of 5ft.

TABLE 15 ESTIMATED NUMBER OF SINKHOLES FOR PANEL 20 FOR AVERAGE CARNEY THICKNESS

Ratio of Depth to Thickness	Ratio of Depth to Thickness	Surface Area (Acres)	Density of Subsidence Features (No./Acre)	No. of Subsidence Features
<12	2.7	0.0	17.01	0.0
12-25	4.1	0.0	8.05	0.0
25-37	6.9	5.6	5.47	30.9
37-49	9.6	3.5	0.24	0.8
49-62	12.4	6.6	0.26	1.7
62-74	14.6	3.3	0.06	0.2
74-87	17.9	2.6	0.00	0.0
			Total	34

Notes:
1) TR-9 encompasses Panel 20 based on MEA Figure 4.3
2) Overburden contours used are found on Addendum D5-4 Exhibit 1
3) Assumed Coal Height of 4.5ft.

ATTACHMENT A

Documents Reviewed

MEA

Response to EQC Finding of Facts and Conclusions of Law, WDEQ Comments Round 7 – Brook Mine Permit to Mine Application TFN 6 2/025

Figure 2.3-1 – Carney Seam Pre-mine Potentiometry (Round 7 and Round 9)

Addendum MP-6 – Subsidence Control Plan (Round 7 and Round 9)

Addendum MP-6-11 (Round 8 and Round 9)

Addendum MP-6-12,13,14,15 (Round 7 and Round 9)

Attachment MP-6-A (Round 9)

Mining Plan (Round 8 and Round 9)

Table MP.1-3,4 (Round 7 and Round 9)

Figure MP.1-1,2,3,4,5 (Round 7 and Round 9)(MP.1-5 Removed in Round 9)

Figure MP.4-1,2,3 (Round 7 and Round 9)

Figure MP.2-1,2 (Round 9)

Figure MP.3-1 (Round 9)

Figure MP.9-1 (Round 7 and Round 9)

Mine Plan Exhibits (Round 8 and Round 9)

Index Sheet for Mine Permit Amendments or Revisions (Round 8 and Round 9)

Mining Plan Table of Contents (Round 8 and Round 9)

Exhibit MP.15-1,2 (Round 7 and Round 9)

Brook Mine_New Permit Application_CHIA 39_DRAFT_28Feb2020 (Round 12)

Reclamation Plan (Round 9)

Appendix D5 Topography, Geology and Overburden Assessment (Round 9)

Appendix D6 Hydrology (Round 7 and Round 9)

Addendum MP3 Hydrostatic Units (Round 7 and Round 9)

Brook RD10_Total Submittal_Combined (Round 10)

RAMACO_CARF_2019_GW_Elevations (Round 10)

RAMACO_CARF_2019_GW_Quality_Field (Round 10)

RAMACO_CARF_2019_GW_Quality_Lab (Round 10)

Round 8 Technical Review, DEQ Comments, Brook Mine Coal Mine Permit Application, TFN 6 6/025

Round 8 Technical Review, Ramaco Comments, Brook Mine Coal Mine Permit Application, TFN 6 6/025

Round 9 Technical Review, DEQ Comments, Brook Mine Coal Mine Permit Application, TFN 6 6/025

Round 9 Technical Review, Ramaco Comments, Brook Mine Coal Mine Permit Application, TFN 6 6/025

Round 10 Technical Review, DEQ Comments, Brook Mine Coal Mine Permit Application, TFN 6 6/025

Round 10 Technical Review, Ramaco Comments, Brook Mine Coal Mine Permit Application, TFN 6 6/025

Round 11 Technical Review, DEQ Comments/Cover letter, Brook Mine Coal Mine Permit Application, TFN 6 6/025

Round 12 Technical Review, DEQ Comments, Brook Mine Coal Mine Permit Application, TFN 6 6/025

Round 12 Technical Review, Ramaco Comments, Brook Mine Coal Mine Permit Application, TFN 6 6/025

Round 12 Technical Review, Ramaco Cover Letter, Brook Mine Coal Mine Permit Application, TFN 6 6/025

Round 12 Technical Review, Ramaco Submittal, Brook Mine Coal Mine Permit Application, TFN 6 6/025

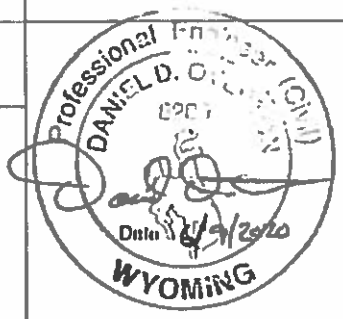
Round 12 Technical Review, Ramaco Comments Change Index, Brook Mine Coal Mine Permit Application, TFN 6 6/025

APPENDIX B

Engineering Analytics, Inc. • 1600 Specht Point Rd. • Suite 209 • Fort Collins, CO 80525 • Ph 970.488.3111 • Fax 970.488.3112

Technical Memorandum

To:	Mr. Bjarne Kristiansen, P.G.	From:	Daniel D. Overton, P.E.
Company:	Wyoming Department of Environmental Quality – Land Quality Division	Date:	June 9, 2020
EA No.:	110875		
Re:	Review Response to Public Comments and Informal Conference, Issues Specific to Subsidence, Brook Mine Permit to Mine Application (TFN 6 2/025)		



1.0 INTRODUCTION

Engineering Analytics, Inc. (EA) was tasked by the Wyoming Department of Environmental Quality (DEQ) Land Quality Division (LQD) to provide an evaluation of subsidence-related public comments to the Brook Mine Permit to Mine Application (Permit Application) (TFN 6 2/025) which were received by the DEQ in April 2020, and subsidence-related oral comments provided during the DEQ Brook Mine Informal Conference conducted on May 13, 2020.

1.1 Documents Reviewed

EA has reviewed previous Permit Application submittals as documented in EA memoranda to the DEQ dated June 29, 2018, January 14, 2019, and March 15, 2019 (see References). In addition to the permit documents we have reviewed previously, we reviewed public comments submitted to the DEQ by the following:

1. Shannon Anderson (April 23, 2020). Includes the following as attachments: an Expert Report written by Marino Engineering Associates, Inc. (MEA) regarding mine subsidence, dated April 15, 2020; a Memorandum from Mike Wireman of Granite Ridge Groundwater dated April 16, 2020.
2. James Aksamit (undated).
3. Christine M. Anderson (April 15, 2020).
4. John and Shelley Barbula (April 17, 2020).
5. Bill Bensel regarding Ramaco Brook Mine, dated April 23, 2020.
6. Big Horn Coal Company (April 23, 2020).
7. Anton Bocek (April 5, 2020).
8. John P. Buyok and Vanessa Buyok (April 23, 2020).
9. Wendy Condrat (undated).
10. Louisa Crosby (undated).
11. Mary Brezik-Fisher and David Fisher (April 23, 2020)

12. Gillian Malone (undated).
13. Pam Marks (undated).
14. Author unknown (undated).
15. Joan Tellez (April 8, 2020).

We also reviewed public comments provided to the DEQ during the Informal Conference conducted on May 13, 2020. We reviewed the recorded video oral comments provided by Dr. Gennaro Merino of Merino Engineering Associates, Inc. (MEA) and Tim Ross of Agapito Associates, Inc. (AAI).

1.2 Scope of Review

Our review was limited to issues related to potential mine subsidence in the highwall mining area. Our review was also limited to the portion of the proposed mining area currently under permit review. It's our understanding that the current permit review entails a 5-year period and includes the surface mine and panel TR-1 only, as shown on Figure 1. Public comments pertaining to mining in areas outside of this area, including mining of the split Carney Seam, are not addressed in this technical memorandum.

2.0 SUBSIDENCE-RELATED REVIEW COMMENTS

Based on our review of the written public comments, recorded video oral comments, and documents provided to us previously, we provide the following comments.

2.1 Additional Core Holes

It appears that Agapito (AAI, 2018) relied upon the geotechnical parameters from a single core hole (2017-4) for their geotechnical analysis, modeling and subsidence prediction. The location of core hole 2017-4 is shown on Figure 1. Reference is made in AAI (2018) to additional holes which were used to develop the stratigraphic model, but the specific holes used are not referenced, nor are the associated logs provided.

In an earlier phase of the permitting process, the drilling of additional core holes and geotechnical testing was proposed by Ramaco. We reviewed the proposed Sampling and Analysis Plan (SAP) in a previous Technical Memorandum (EA, 2018). The additional sampling and analysis proposed by Ramaco in their SAP was not performed.

In our opinion, the single core hole (2017-4) does not adequately characterize the stratigraphy or the geotechnical properties of the rock in the immediate area of the proposed TR-1 highwall mining area. From our review of the maps and geologic cross sections in Appendix D5 (Ramaco, 2019a), we note that most of the existing core holes are located well to the west of the TR-1 area. These core hole locations have been overlaid onto the overall mine plan on our Figure 1. We reviewed Cross-Section K-K' on Sheet 14 of Addendum D5-3 Exhibit 2, and it appears that the closest core holes to 2017-4 are 578409 and 578415 which are located well outside the proposed TR-1 mining area at a distance of approximately 3,100 and 3,300 feet from core hole 2017-4, respectively (see Figure 1). In our opinion, this distance between core holes is excessive and does not allow an adequate characterization of the TR-1 area. We recommend that

additional core holes be drilled within the TR-1 boundary, especially since this area will be the first area to be highwall mined.

Dr. Marino expresses a similar concern regarding the use of the single core hole in his written report (MEA, 2020) and in his oral comments during the Informal Conference. In bullet #1 on page 4 of his report (MEA, 2020) he states the following:

> *"The one geotechnical boring which was done in the TR-1 area, which is [the] proposed first area to be highwall mined. This boring indicated the roof and floor contains anomalous rock conditions compared to other borings drilled in the application area. Therefore, applying these rock conditions and associated test data to all of the application area or, for the matter, all of TR-1 appears inappropriate."*

It appears from our review that there is some uncertainty regarding the stratigraphy in the area of TR-1. In the fourth paragraph in Section 2.1 on page MP-6-24 of AAI (2018), Agapito discusses the contours of depth of cover, coal seam thickness, etc. shown on Figures 2 through 7 of their report. The paragraph includes the following:

> *"The slope variations seen in the plots seem unusually severe and apparently coincide with the drill holes that were used to construct the contours. It is possible that different series of holes were surveyed and interpreted differently, and the data may contain discrepancies that account for the slope variations. Also, unmapped faults may exist that complicate the seam structure."*

The additional core holes recommended herein should provide additional information regarding the overall stratigraphy, the thickness and extent of the various lithologic units, and the presence of faults that should supplement the applicant's current understanding of the conditions in the proposed highwall mining area.

Furthermore, additional core holes will allow the applicant to better evaluate the strength of the stratigraphic units, in particular the carbonaceous mudstone and mudstone layers which will form the immediate floor of the highwall openings. AAI (2018) describes this material as "weak." AAI (2018) states the following in the first paragraph in Section 2.2.2 on page MP-6-33:

> *"The floor is also composed of carbonaceous mudstone underlain by a weak mudstone."*

In discussing floor stability in the first paragraph in Section 3.4 on page MP-6-38, AAI (2018) states:

> *"The proposed highwall panel pillars are underlain by a thin layer (approximately 2 ft thick) of a weak carbonaceous mudstone (CMS). The laboratory tests (Table 1) indicate a moisture content of 18% for the CMS layer, which tends to weaken such shale-related rocks. Weak floor layers can adversely affect pillar and flor stability as well as the efficiency of mining operations through possible mechanisms of floor heave and pillar punching."*

We reviewed the Rock Mechanics Testing report in Appendix B of AAI (2018). A limited amount of geotechnical testing was performed on the carbonaceous mudstone which will comprise the immediate floor of the highwall openings and pillars. For example, only a single Uniaxial Compressive Strength (UCS) test was conducted for the carbonaceous mudstone (Specimen UCS-16/E). The additional core holes recommended herein should provide additional samples for geotechnical testing which will allow Ramaco and AAI to better evaluate the strength of the stratigraphic units in the proposed highwall mining area, especially the weak units which will comprise the floor.

Determining the sufficient number of core holes to adequately characterize a proposed new underground mining area is somewhat subjective and depends upon many factors. Some researchers have found geostatistical analysis to be useful in determining the maximum spacing between boreholes to adequately characterize coal mine units (Ledvina et al., 1994). We recommend that a geostatistical analysis be performed to determine the adequate number of borings, and that the minimum of two additional core holes be drilled and sampled in the proposed TR-1 highwall mining area. We recommend that the location of the core holes and the associated sampling program be determined by Ramaco in consultation with their geotechnical consultant (AAI) to ensure the data collected meet AAI's needs for modeling and subsidence evaluation.

The data provided from the additional core holes will supplement the currently-available data and allow AAI to refine their analyses and subsidence predictions, and allow Ramaco to revise their Subsidence Control Plan for TR-1 if necessary.

2.2 Geotechnical Testing for Subsidence Evaluation

Samples collected from the additional core holes should include the roof, coal, and floor of the proposed highwall mining area, with special attention paid to the "weak" carbonaceous mudstone and mudstone which will underlie the tunnel openings and pillars. The suite of testing should be similar to that performed by AAI for core hole 2017-4 (including tensile strength, uniaxial compressive strength, axial and diametral point load testing) and any other testing deemed necessary by AAI for a thorough analysis. All testing should be performed in accordance with applicable ASTM standards.

The geotechnical testing should also include testing to evaluate the long-term strength of the roof and floor materials. Dr. Marino expressed concern regarding the long-term strength of the floor layers on pages 7 through 9 and bullet #5 on page 16 of his written report (MEA, 2020), and in his oral comments during the Informal Conference. We recommend that the testing include Atterberg Limit testing to evaluate the plasticity of the roof and floor units, as well as consolidated-drained triaxial testing to better evaluate the long-term strength of the roof and floor.

The geotechnical data collected from the additional core holes will allow AAI to refine their analyses and subsidence predictions, including the long-term stability of the overall highwall mining area, and allow Ramaco to revise their Subsidence Control Plan for TR-1 if necessary.

2.3 Abandoned Mine Lands Standards

In his oral comments during the Informal Conference on May 13, 2020, Dr. Marino of Merino Engineering Associates, Inc. (MEA) states (at approximately 3:53 in the recorded video oral comments) that the Abandoned Mine Lands standards don't appear to be being applied in the Brook Mine permitting process. He does not specify which standard is not being applied. We reviewed his report (MEA, 2020), and we cannot find reference to a specific standard that is not being applied.

We have previously reviewed the applicable standards, as documented in our Technical Memorandum dated January 24, 2019 (EA, 2019a). Our conclusion is repeated below:

A review of the Department of Environmental Quality (020) regulations related to Land Quality – Coal (0006) of the Wyoming Administrative Code (WAC) were reviewed in regards to subsidence for underground coal mining. Pertinent sections with citations relevant to subsidence include:

- Chapter 1: Authorities and Definitions for Surface Coal Mining Operations (020.0006.1.08272014)
- Chapter 2: Permit Application Requirements (020.0006.2.08272014)
- Chapter 4: Environmental Protection Performance Standards (020.0006.4.12172012)
- Chapter 7: Underground Coal Mining (020.0006.7.04112011)

In general, the Subsidence Control Plan and the Agapito Report appear to provide information requested by the code related to evaluating for the potential of subsidence for the planned underground coal mine. The documents provide geotechnical analyses based on local core, with standard approaches to design for stability with the intent to minimize subsidence, as well as provide for monitoring and remediation in the event of subsidence.

2.4 Applicability of Subsidence Control Plan

The Subsidence Control Plan in Addendum MP-6 dated March 2019 (Ramaco, 2019b) is written in such a way that Ramaco seems to intend it to apply to all proposed highwall mining areas, even areas outside of TR-1 and areas where multiple seams will be mined. The following is stated in the first paragraph in Section MP-6.1 on page MP-6-3:

> *"The majority of highwall mining will be conducted in the two splits of the Carney seam. West of the Carney Seam's split line shown in Figure MP-6.1-1, the highwall mining activity will be concentrated primarily in the Carney lower split due to its greater thickness. East of the split line the two splits merge allowing full seam thickness extraction within the limits of the highwall mining machine. Figure MP-6.1 also shows the additional highwall mining planned in the lower Master's seam."*

The Subsidence Control Plan also first paragraph on page MP-6-8:

> *"Highwall miner holes will be oriented in the same azimuth as the holes in the Carney Seam located directly above. Its pillar dimensions will be sized based on the thicker Carney Seam so that 'pillar stacking' is achieved."*

It must be noted that the Agapito report (AAI, 2020), included in the Subsidence Control Plan as Attachment MP-6-A, evaluated highwall mining in the area of TR-1 only, where the single Carney seam is proposed to be mined. It does not include any analyses of highwall mining outside of the TR-1 area, or areas where multiple seams will be mined, or "pillar stacking." Therefore, it simply does not apply to proposed mining areas other than TR-1. In our opinion, the Subsidence Control Plan should be revised to apply only to the open pit and TR-1 area that is being permitted at this time.

2.5 Web Pillar Stability

AAI (2018) states the following in the fourth paragraph in Section 4.2 on page MP-6-42:

> *"The design charts shown in Figures 9a through 9c are based on the ARMPS recommended web pillar stability factor of 1.6. An additional set of design curves were prepared using a more*

conservative value of 1.8, to further reduce the potential for pillar failure. The charts are included in Appendix C if Ramaco wishes to use the more conservative design."

EA recommends that the applicant indicate which web pillar stability factor (1.6 or 1.8) will be used during highwall mining.

3.0 REFERENCES

Agapito Associates, Inc. (AAI), 2018. *Geotechnical Design and Operational Considerations for Highwall Mining – Brook Mine.* Prepared for Ramaco Carbon. September 13.

Engineering Analytics, Inc. (EA), 2018. Technical Memorandum regarding Review of Brook Mine Subsidence Sampling and Analysis Plan. Prepared for Wyoming Department of Environmental Quality – Land Quality Division. June 28.

Engineering Analytics, Inc. (EA), 2019a. Technical Memorandum regarding Review of Brook Mine Permit to Mine Application Specific to Subsidence: Response to EQC Finding of Facts and Conclusions of Law, WDEQ Comments Round 7, and supplemental Materials. Prepared for Wyoming Department of Environmental Quality – Land Quality Division. January 24.

Engineering Analytics, Inc. (EA), 2019b. Technical Memorandum regarding Review of Round 8 Technical Review response to Comments Specific to Subsidence, Brook Mine Permit to Mine Application (TFN 6 2/025). Prepared for Wyoming Department of Environmental Quality – Land Quality Division. March 15.

Ledvina, C.T., Dowding, C.H., Fowler, S., Hunt, G. and Nance, R., 1994. *Geostatistical Guidance of Exploration in Roof Control – How many Drill Holes are Enough?* Proceedings of the 5th Conference on Ground Control for Midwest U.S. Coal Mines, Collinsville, Illinois, pp. 14-30.

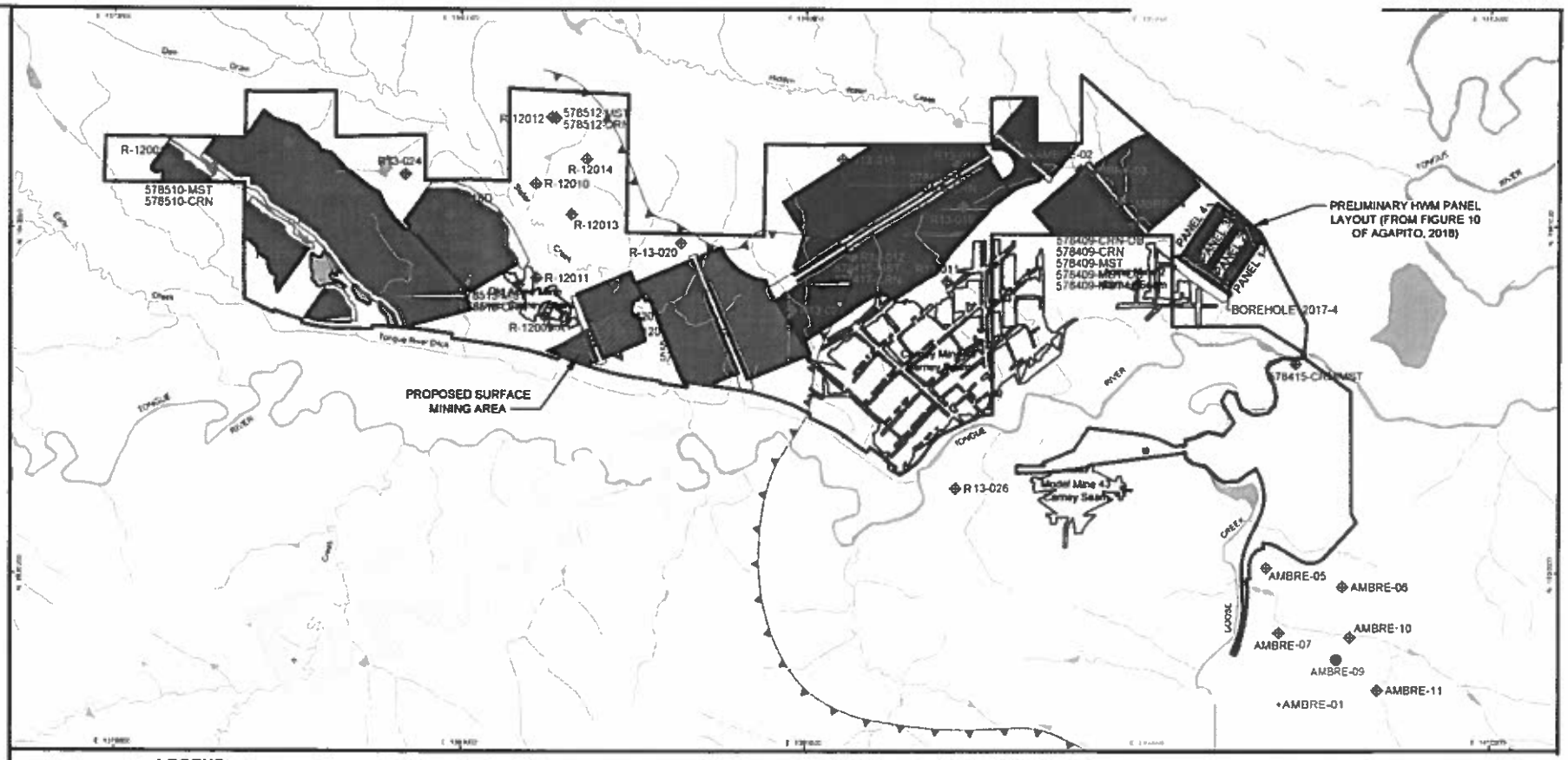
Merino Engineering Associates, Inc. (MEA), 2020. Letter to Ms. Shannon Anderson, Acting Director, Powder River Basin Resource Council regarding Review of Brook Mine Application. April 15.

RAMACO, 2019a. Appendix D5, Topography, Geology and Overburden Assessment, Brook Mine Permit Application TFN 6 2/025. In Volume IV. December.

RAMACO, 2019b. Addendum MP-6, Subsidence Control Plan, Brook Mine Permit Application TFN 6 2/025. In Volume XI, Mine Plan. March.

RAMACO, 2019c. Volume XI, Mine Plan, Brook Mine Permit Application TFN 6 2/025. December.

FIGURE



LEGEND

- BROOK MINE PERMIT BOUNDARY
- LINE OF SEAM SPLITTING
- TRENCH OPENCUT AREAS

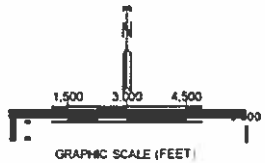
MONARCH SEAM SURFACE ONLY MINING

LOWER CARNEY SEAM HIGHWALL MINING

UPPER CARNEY SEAM HIGHWALL MINING

UPPER & LOWER CARNEY SEAM (MERGED) HIGHWALL MINING

NOTES:
BASE MAP FROM FIGURE MP-6.1-1 OF ADDENDUM MP6-6 (SUBSIDENCE CONTROL PLAN).
BORING LOCATIONS FROM RAMACO ADDENDUM D5-4, EXHIBIT 1 (ROUND 3 COMMENTS, 12/2015).



Project No. 110975

May 2020

Engineering Analytics, Inc.

FIGURE 1
OVERALL PROPOSED MINING AREA WITH CURRENTLY-PROPOSED HIGHWALL MINING AREA
BROOK MINE, SHERIDAN COUNTY, WYOMING

APPENDIX C

NOTE: DO NOT MODIFY THIS FORM. Use typewriter or print neatly in blue ink. Submit two (2) copies one of which must be an original Form 1 as supplied by the Department of Environmental Quality, Land Quality Division.

STATE OF WYOMING
DEPARTMENT OF ENVIRONMENTAL QUALITY
LAND QUALITY DIVISION
APPLICATION
FOR
PERMIT TO MINE
OR
AMENDMENT TO A PERMIT TO MINE
OR
COAL PERMIT RENEWAL

1. (a) Name, telephone number, and mailing address of applicant:
Brook Mining Co., LLC 1101 Sugarview Drive, Suite 201, Sheridan, WY 82801 - (307) 674-8000, FAX (866) 519-5232

(b) If the applicant is a partnership, association or corporation, (circle one) the names and addresses of all managers, partners and executives directly responsible for operations in this State: (Limited Liability Company)

Name: Randall W. Atkins Address: 1101 Sugarview Drive, Suite 201, Sheridan, WY 82801
Title: Manager, Chairman, Chief Executive Officer Phone No. (307) 674-8000

Name: Michael D. Bauersachs Address: 250 West Main Street, Suite 201, Lexington, KY 40507
Title: Manager, President, Secretary Phone No. (859) 244-7455

Name: _____ Address: _____
Title: _____ Phone No. _____

Name: _____ Address: _____
Title: _____ Phone No. _____

2. Name, address, and telephone number of the agent or person to whom any notice under the provisions of Wyoming Environmental Quality Act or Rules and Regulations adopted thereunder may be sent: Randall W. Atkins 1101 Sugarview Drive, Suite 201, Sheridan, WY 82801 (307) 674-8000

3. Attach the following information as part of the specific appendices:

(a) APPENDIX "A"

Names and addresses of surface and mineral owners of record within the proposed permit (amendment) area.

(b) APPENDIX "B"

(i) Names and last known addresses of the owners of record of the surface rights of the lands immediately adjacent to the proposed permit (amendment) area.

(ii) Names and last known addresses of any other persons within one-half (1/2) mile having a valid legal estate of record.

(iii) **For surface coal mining operations**, the names and last known addresses of coal ownership immediately adjacent to the proposed permit (amendment) area.

Appendices "A" and "B" shall each be accompanied by maps showing the ownership locations required by the respective appendices. Mapping of (b)(ii) is not required.

(c) APPENDIX "C"

(i) All lands to be included in the proposed permit (amendment) area shall be tabulated by legal subdivision, section, township, range, county, and municipal corporation, if any, and the number of acres for each subdivision listed.

(ii) Lands which are to be part of the proposed permit (amendment) area, for which no right to mine is claimed shall be identified in item (c)(i) above as such and tabulated separately listing the number of acres for each legal subdivision.

(iii) Lands which are located within other permit areas shall be identified and a copy of the land use agreement with the other permittee shall be attached as part of this application.

(iv) An original United State Geological Survey topographic map, clearly outlining and identifying the lands to be within the proposed permit areas, shall be provided. Photo copies or other similar copies are not acceptable unless prior approval is obtained from the Land Quality Division.

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RECD DEC 13,2019

Initial RWA Date 11/19/19

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(d) APPENDIX "D"

A description of the land which shall include: historic and present land use; vegetative cover; annual rainfall; general directions and average velocities of the winds; indigenous wildlife; present surface water and the immediate drainage areas; valid water rights; nature and depth of the overburden, subsoil, topsoil; including a soils map; mineral seams, or other deposits; subsurface water(s) known to exist above the deepest projected depth of the mining operation.

(e) APPENDIX "E"

A map or maps with the boundary of the proposed permit (amendment) are clearly outlined and identified showing:

(i) The lands to be affected by the mining;

(ii) The drainage area within and surrounding the proposed permit (amendment) area;

(iii) The location and names, where known, of all roads, railroads, public or private rights-of-way and easements, utility lines, lakes, streams, creeks, springs, and other surface water courses, oil wells, gas wells, and water wells;

(iv) An outline of the probable limits of all areas previously disturbed or to be disturbed by underground or subsurface mining, whether active or inactive, on or immediately adjacent to the proposed permit (amendment) area;

(v) The names, last known addresses and boundary lines of the present surface landowners and occupants on the adjacent land to be affected;

(vi) The location, ownership, and uses of all buildings on, or on lands adjacent to, the land to be affected;

(vii) Information presented as part of APPENDIX "D" when necessary for clarification.

4. Mineral(s) to be mined: Coal
Mining method to be used: Strip/Highwall

Estimated dates of commencement and termination of the proposed operation:
Start: 2020 Terminate: 2062

6. The total number of acres in the proposed permit (amendment) area and an estimate of the total number of acres to be affected by the operation:

Permit Acres	Approved Acreage to Affect	Surface Ownership
Original Permit	Original Permit	No. of Federal Acres
Approved Amendments	Approved Amendments	No. of State Acres
This Application 4,548.8	This Application 1,135.1	No. of Private Acres 4,548.8
Total Acres 4,548.8	Total Acres 1,135.1	Total Acres 4,548.8

7. The name, if any, by which the permit (amendment) lands or any part thereof are known:
Brook Mine

8. The nearest town or city: Ranchester, WY

9. A filing fee of $100.00 ($200.00 for amendments) plus $10.00 for each acre in the request permit (amendment) area. For any single permit (amendment) the maximum fee shall not exceed $2,000.00.

10. Plan or plans of the applicant, including maps for the proposed mining operation and the reclamation of all affected lands as required by W.S. §35-11-406(b) and Chapter 2, Sec. 2 of the Land Quality Rules and Regulations.

11. Each application **for coal mining operations** shall also contain:

(a) Additional information as required in Chapter 2, Section 2 of the Land Quality Division Coal Rules and Regulations;

(b) A certification that the applicant has a public liability insurance policy in force for the proposed mining and reclamation, as required by W.S. §35-11-406(a)(xiii) and Land Quality Division Coal Rules and Regulations Chapter 12, Section 2.;

(c) A listing of all notices of violations required by W.S. §35-11-406(a)(xiv).

12. The following obligations are incumbent upon the applicant upon approval of this application:

(a) The provisions of the permit are severable, and if any provision of the permit, or the application of any provision of the permit, to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of the permit, shall not be affected thereby.

(b) The operator shall allow the Director, the Administrator and/or his authorized representatives, at reasonable times and upon presentation of appropriate credentials, to enter upon and have access to any and all lands covered by this permit and amendments thereto and to inspect and copy any records or documents, obtain or monitor any samples or sampling, for any activities associated with the operation and permit.

(c) The following shall also apply **for coal mining operations**:

(i) The operator shall conduct his operation in a manner which prevents violation of any other applicable State or Federal law.

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(ii) The operato ll take all possible steps to nize any adverse impact to the environment ublic health and safety res ; from noncompliance with his approved mi and reclamation plan and c terms and conditions of any permit or license, including monitoring to define the nature of the noncompliance and warning of any potentially dangerous condition.

(iii) The operator shall conduct all operations in accordance with his approved mining and reclamation plan and with any special conditions of the permit or license attached thereto.

(iv) All reclamation fees shall be paid as required by Title IV, P.L. 95-87, for coal produced under the permit for sale, transfer or use.

FINAL SWORN STATEMENT

State of Wyoming)
) ss
County of Sheridan)

I Randall W. Atkins being duly sworn on my oath that I am the applicant (President or Vice President if the applicant is a corporation) for the foregoing permit (amendment); that I have read the said application and fully know the contents thereof; that all statements contained in the permit (amendment) application are true and correct to my best knowledge and belief; by execution of this statement I certify that Brook Mining Co., LLC, applicant or entities controlled by or under common control with the applicant has the right and power by the legal estate owned to mine from the land for which this permit (amendment) is desired; that applicant or entities controlled by or under common control with the applicant has not forfeited, or is not involved in forfeiture proceedings for, a bond posted for reclamation purposes; and if a **surface coal mining application**, that applicant or entities controlled by or under common control with the applicant has paid the reclamation fees for this and all coal mining tions under the jurisdiction of P.L. 95-87 as required by Title IV of that law; and that ant or entities controlled by or under common control with the applicant has not had any Federal or State coal mining permits suspended or revoked in the five years preceding the date of this application.

Dated this 19th day of November, 2019.

Signature Randall W. Atkins

(Corporate Seal)

Name Randall W. Atkins
(Printed or typed)

Title Manager, Chairman, Chief Executive Officer

The foregoing instrument was acknowledged before me by _____
this 19th day of November, 2019.

Witness my hand and official seal.

Carla J. Ash
(Notary Public or Secretary if a Corporation)

Carla J. Ash
(Name printed or typed)

ry Seal)

CARLA J. ASH - NOTARY PUBLIC
COUNTY OF SHERIDAN STATE OF WYOMING
My Commission Expires Dec. 11, 2021

My Commission Expires: 12.11.2021

TFN6 2/025
RECD DEC 13,2019

Initial RWA Date 11/19/19

Permit No. _____
Temporary Filing No. 6.2/025

The State of Wyoming)
) ss
Department of Environmental Quality)

This is to certify that I have examined this foregoing application and do hereby grant the same subject to the following limitations and conditions:

This permit/coal renewal/amendment grants only the right to affect the land described in Appendix "C" of the application.

Acceptance of the approved permit/coal renewal/amendment obligates the operator to abide by the standard conditions specified in Item No. 12 of this application form. Any condition and/or special condition attached to approval of this permit/coal renewal/amendment shall supersede and/or replace any conflicts with the original permit, amendments, coal renewals or any other revision.

Additional special conditions and limitations are as follows:

Form 1, Condition 1: Structures identified in a pre-blast survey to (1) have plaster on lathe construction or (2) to otherwise face a greater risk to damage due to blasting vibrations will be subject to a 0.5 inches per second limit with a scaled distance factor of 85.

Form 1, Condition 2: The blasting schedule will be limited to weekdays, excluding holidays. The blasting schedule will also be limited to times between 8:00 AM and sunset. Blasting may not be conducted at times different from those announced in the blasting schedule except in conditions where operator or public safety requires detonation or for emergency blasting actions. Reasons for detonation outside of the published blasting schedule shall be documented.

Form 1, Condition 3: In July 2019, Brook Mine installed an alluvial monitor well 578415-AL-1, to monitor water levels and water quality of the Tongue River alluvium. Two quarters of data were collected in July 2019 and December 2019. These two quarters of data are included in the permit application. Brook Mine has collected and submitted to WDEQ/LQD the third and fourth quarters of water level and water quality data for this alluvial monitor well. This data along with appropriate revisions to text, figures, and tables in Appendix D6 shall be submitted to WDEQ/LQD as a non-significant revision no later than August 31, 2020. In addition, Brook Mine shall monitor alluvial wells 578524-AL-1, 578420-AL-1, and 578415-AL-1 on a quarterly basis for the entire life of the Brook Mine. The quarterly data collected from these three wells shall be submitted to WDEQ/LQD in the standard Coal Annual Report Format as part of the annual report submittals.

Form 1, Condition No. 4: Within 60 days of approval of the Brook Mine Permit, Brook Mine shall submit a non-significant revision to the permit to include the USFWS approval letter of their MBHFI and Raptor monitoring plan.

Form 1, Condition No. 5: Within 60 days of approval of the Brook Mine Permit, Brook Mine shall submit a non-significant revision to update Appendix D9 with wildlife monitoring data obtained during their spring 2020 surveys. This application shall also include required revisions to the mine and reclamation plans to protect any sensitive species or nest location(s) as recommended by the USFWS.

Form 1, Condition No. 6: Within 60 days of approval of the Brook Mine Permit, Brook Mine shall submit a non-significant revision to update the mine plan to include the commitment to prohibit surface disturbances within a two-mile buffer of any known sage-grouse lek from March 15 through June 30 of each calendar year to prevent impacts to lekking, nesting, and early brood rearing.

Form 1, Condition No. 7: Within 60 days of approval of the Brook Mine Permit, Brook Mine shall submit a non-significant revision to update Appendix D10, the Mine Plan, and Reclamation Plan to incorporate as appropriate the June 19, 2020 wetlands jurisdictional determination from the US Army Corps of Engineers.

Form 1, Condition 8: Within ninety (90) days of each LQD approval revision for Permit No. 213 (Big Horn Coal Mine) which affects the "Dual Permitted Areas" between Permit Nos. 213 and the Brook Mine permit, Brook Mine shall submit a revision to their permit. This revision application shall update and revise all text and maps associated with the "Dual Permitted Area" to bring the Brook Mine Permit into accord with the revised Permit No. 213. The LQD District III Office shall notify Brook Mine of the need to submit any such revisions. Brook Mine shall also notify Big Horn Coal Company of any revision application Brook Mine submits to LQD that affects lands within the DPA. This notification shall occur within 7 days after a Temporary File Number (TFN) has been assigned to the revision by LQD

Form 1, Condition 9: Before commencing mining in the TR-1 area or any subsequent highwall mining panel, Brook Mine shall provide WDEQ/LQD with the results from physical property testing of cores from a minimum of at least three geotechnical core holes for each panel to be mined. For the TR-1 area, this will require drilling and sampling at least two more core holes in addition to the previously tested hole 2017-4 core. The location and number of the core holes to be drilled should be based on a geostatistical algorithm, such as Kriging (Gaussian process regression), to demonstrate the adequacy of the core holes for purposes of characterizing each highwall

mining panel. Samples collected from each core hole should include the roof, coal, and floor of the proposed highwall mining panel. For all future core holes, Atterberg limits and consolidated-drained triaxial testing should be performed in addition to the testing procedures performed on core hole 2017-4.

The results of the core laboratory testing shall be reviewed and analyzed by a Wyoming registered Professional Geologist or Engineer. The Mine Plan and Subsidence Control Plan shall be revised, if necessary, based upon the additional data and analyses.

Form 1, Condition 10: Brook Mine shall submit all data and analysis from the geotechnical testing required in Condition No. 9 to WDEQ/LQD in the form of non-significant revisions to the Mine Plan and Subsidence Control Plan. Brook Mine shall not commence mining in any new highwall mining panel until WDEQ/LQD has provided written approval of the corresponding non-significant revision.

Form 1, Condition 11: Within 60 days of approval of the Brook Mine Permit, Brook Mine shall submit a non-significant revision to correct an inadvertent omission from the third paragraph of Section MP-6.4 of Mine Plan Addendum MP-6. The third paragraph of Section MP-6.4 shall be revised to the following, which existed in the permit application prior to the March 2019 responses to comments:

"Regardless of its right to subside the surface, the operator acknowledges that, if subsidence due to its mining operation causes material damage or reduces the value of the reasonably foreseeable use of the surface lands, the land will, to the extent technologically feasible, be restored to a condition capable of supporting the uses it was capable of supporting prior to subsidence. The operator will continue to perform remediation on any subsidence, detected during or subsequent to the 6-month monitoring period, until bond release is approved."

Form 1, Condition 12: The Brook Mining Company, LLC reclamation bond for PT0841 in the amount of $1,358,637 must be posted and approved prior to commencement of mine related disturbance.

Brook Mining Company, LLC has demonstrated that the Brook Mine surface coal mine permit application substantially complies with Article 4 of the Wyoming Environmental Quality Act and all other applicable State and Federal Laws and regulations.

The Brook Mine permit is issued with the conditions described within this document and the following standard conditions, as required by Wyoming Department of Environmental Quality, Land Quality Division Rules and Regulations Chapter 12, Section 1(a)(xviii):

(A) All operations shall be conducted in accordance with the approved mining and reclamation plan and any conditions of the permit or license.

(B) The rights of entry shall be provided as described by the Act and any regulations promulgated pursuant thereto.

(C) The operation shall be conducted in a manner which prevents violation of any other applicable State or Federal law.

(D) All possible steps shall be taken to minimize any adverse impact to the environment or public health and safety resulting from noncompliance with this approved mining and reclamation plan and other terms and conditions of any permit or license, including monitoring to define the nature of the noncompliance and warning of any potentially dangerous condition; and

(E) All reclamation fees shall be paid as required by Title IV, P.L. 95-87, for coal produced under the permit for sale, transfer, or use.

Approved: Alan Edwards
Acting Administrator
Land Quality Division
Department of Environmental Quality

Approved: _____
Director
Department of Environmental Quality

Effective Date: July 7, 2020

THE STATE OF WYOMING)
) ss
DEPARTMENT OF ENVIRONMENTAL QUALITY)

is to certify that I have examined the foregoing application and do hereby grant the same ct to the following limitations and conditions:

This permit/coal renewal/amendment grants only the right to affect the land described in Appendix "C" of the application.

Acceptance of the approved permit/coal renewal/amendment obligates the operator to abide by the standard conditions specified in Item No. 12. of this application form. Any condition and/or special condition attached to approval of this permit/coal renewal/amendment shall supersede and/or replace any conflicts with the original permit, amendments, coal renewals or any other revision.

Additional special conditions and limitations are as follows:

Approved:_____
Administrator
Land Quality Division
Department of Environmental Quality

Approved:_____
Director
Department of Environmental Quality

TFN6 2/025
RECD DEC 13, 2019

Effective Date:_____

Initial RWSA Date 11/19/19

Permit No._____
Temporary Filing No. 62/025

APPENDIX D

Facilities - Ramaco Carbon

ramacocarbon.com/facilities/

RAMACO CARBON

Home | About Us | The Carbon Valley | 3D Manufacturing | News & Presentations | Contact

iCAM

Research Park

The iCAM (Innovating Carbon Advanced Materials) center will host research professionals from national laboratories, universities, private research groups and manufacturing organizations in both laboratory, pilot-plant and permanent operating facilities.

This facility will foster research that allows strategic manufacturing partners to conduct applied research and development with one goal: To use the carbon found in coal to create advanced manufactured products.

iPARK

Manufacturing Center

The iPark center will be a next generation mine-mouth "coal to products" manufacturing facility, with zero net emissions. Located next to the Brook Mine, operations at the iPark will utilize coal from the mine to create high-value carbon products. These include carbon fiber, graphene, graphite, carbon nano tubes, carbon dots, carbon-based resins, carbon based building products, medical products and activated carbon.

BROOK MINE

Mineral Resources

The Brook Mine comprises over 15,000 acres and contains over one billion tons of thermal coal reserves, and is located on the site of previous coal mines going back to the 19th century. Its coal will serve as feedstock for research and manufacturing efforts at the iCAM and iPark. We have received approval for our application from the Wyoming Department of Environmental Quality, and are committed to responsible stewardship of the region's environment and quality of life.