WEST VIRGINIA ENVIRONMENTAL QUALITY BOARD
CHARLESTON, WEST VIRGINIA

JEFFERSON COUNTY FOUNDATION, INC., et al.,

Appellants,

v. **Appeal No. 20-13-EQB**

KATHY EMERY, DIRECTOR
DIVISSION OF WATER AND WASTE MANAGEMENT,
WEST VIRGINIA DEPARTMENT OF ENVIRONMENTAL PROTECTION,

Appellee,

and

ROXUL USA, Inc., d/b/a ROCKWOOL,

Intervenor-Appellee.

APPELLANTS' MOTION FOR STAY

The Jefferson County Foundation, Inc. and Christine Wimer, ("Appellants") by and through counsel, Christopher P. Stroech, Esq. and the law firm of Arnold and Bailey, PLLC, hereby request a Stay (of Operations) authorized under the Multi-Sector General Permit (MSGP) registration, issued to Intervenor Rockwool. The stay is being requested because the Appellants will suffer undue hardship if Operations commence causing harm to the environment as a result of the inadequate design of the stormwater system. Such harm is both imminent and irreparable should 1) industrial stormwater be present, and 2) there is a rain event that causes ponding at the Rockwool site outside the design parameters of the current system.

According to representations made to the Charles Town Utility Board (CTUB), operations are set to begin June 22, 2021. (Rockwool has already begun testing in preparations for full operations at their Ranson facility.)[1]

I. Jurisdiction:

Pursuant to W.Va. Code 46 CSR 4-5.5 and W. Va. Code § 22B-1-7(d), this Board may grant a stay of certain terms and conditions of an appealed permit if Appellant can demonstrate that "an unjust hardship to the appellant will result from the executed or implementation of a . . . permit . . . pending determination of the appeal." *Id.* While the code provides that Appellants "may" request a stay contemporaneous with the filing of the appeal; in this case the irreparable harm of industrial waste water penetrating the ground, and flowing unobstructed through karst to the ground water, does not ripen until operations begin, which Appellant's believe is on or about June 22, 2021.

II. Legal Standard:

If the Appellant can demonstrate that it will suffer an "unjust hardship" if a stay is not granted, then a stay should issue. "Undue hardship" is not specifically defined by the statute; however, this Board has adopted the four-part standard from the Supreme Court of Appeals of West Virginia's decision in *Camden Clark Memorial Hospital v. Turner*, 212 W.Va. 752 (2002), 575 S.E.2d 362, which is derived from the United States Court of Appeals for the Fourth

[1] During the April 28, 2021 Charles Town Utility Board (CTUB) meeting Duke Pierson, Ranson Mayor and CTUB Board member, stated, "They [Rockwool] will be in full testing Mode the 17th of May.... and they will be in full production the 22 of June." Video recording of the CTUB special board meeting on April 28, 2021 at 1 hour 21 minutes. Video available at https://ctubwv.granicus.com/MediaPlayer.php?view_id=1&clip_id=87 , last accessed on June 14, 2021.

Circuit's analysis in *Merrill Lynch, Perce, Fenner & Smith, Inc v. Bradley*, 756 F.2d.1048, 1054 (4th Cir. 1985) (*See, also, Crab Orchard-MacArthur Public Service District v. Director, Division of Water and Waste Management, West Virginia Department of Environmental Protection*, Order Granting Motion To Stay, Appeal No. 14-14 EQB (Aug.6, 2014) In *Turner,* the Court stated:

> In making this "balancing" inquiry, we have followed the lead of the Fourth Circuit Court of Appeals: Under the balance of hardship test the [lower] court must consider , in "flexible interplay," the following four factors in determining whether to issue a preliminary injunction: (1) the likelihood of irreparable harm to the plaintiff without the injunction; (2) the likelihood of harm to the defendants with an injunction; (3) the plaintiff's likelihood of success on the merits; and, (4) the public interest.

Id. (citing Turner, 575 S.E.2d, at 366*)* (quoting *Jefferson County Bd., of Educ. V. Jefferson County Public Educ. Ass'n,* 183 W.Va. 15, 24, 393 S.E.2d 653,662 (1990) *(citations omitted)*

Under this standard, a party seeking a stay must show a flexible combination of the four elements listed above, the most important of which in this case is whether the Appellant will suffer irreparable harm if the stay is denied.

III. Appellants' Request Meets the Standards for Granting A Stay:

A. The Likelihood of Irreparable Harm to the Plaintiff Without the Injunction:

As set forth by Appellant's experts, Ryan Linthicum, P.E., LEED AP, and Dr. Chris Groves, the Appellants, the citizens of Jefferson County and any users of the ground water impacted by contamination, will suffer irreparable harm if the stay is not granted. As stated below, and set out in full in the full report of Mr. Linthicum:

> "On April 20th 2021, I prepared and issued a summary of my opinions as they relate to the design, permitting, and operations of the Roxul RAN-5 facility. Amongst the numerous opinions in my report, I identified and expressed serious concern regarding the design and operation of the site's stormwater conveyance system. Specifically, I noted in my Opinion 3A that 'inlets are clearly undersized and are shown to pond during simulated rainfall events. In some cases, the extent of the ponding will spread laterally more than 50 feet from an inlet location

creating a widespread flooding condition on the site resulting in uncontrolled transport of polluted waters to unintended site areas.'" ....

"As stated in my report 'if not corrected immediately, the RAN-5 Facility will not drain effectively or as portrayed in Figure 3 of The SWPPP resulting in a flawed pollution prevention analysis subjecting the surrounding surface and groundwater to risk of contamination.

"Simply put, the designed, approved, and constructed drainage system will not properly manage site runoff leading to uncontrolled ponding that will then overtop curbs and convey industrial stormwater in a manner that by-passes the engineering best management practices designed to treat or capture impacted water. Therefore, should the facility be allowed to operate and store industrial waste, a 2 year, 10 year, or greater rainfall event would result in industrial runoff leaving the developed site limits entering one of the many known downstream karst features via direct discharge or infiltration. Left uncontrolled and untreated, industrial water entering the groundwater that flows through the below grade karst matrix in this area would then result in irreparable harm to the groundwater and surrounding environment. (emphasis added) ...

"In closing, neither the Stormwater Pollution Prevention Plan (SWPPP) nor the Groundwater Protection Plan (GPP) address this concern and are thus deficient. To protect the health and safety of the public, I strongly urge that the Roxul RAN-5 facility not be allowed to operate, create, or store industrial waste until this and other concerning matters are adequately addressed."

See, June 17, 2021, Notarized Statement of Ryan Linthicum, Exhibit 1; and the April 20, 2021 Expert Report of Mr. Linthicum., Exhibit 2.

The issues regarding the increased risk "associated with the RAN 5 project shows that the facility is located on a well-developed karst landscape and aquifer and is subject to the environmental risks expected in such a hydrogeologic setting." Exhibit 3, Report of April 20, 2021 report of Dr. Chris Groves, at 3. As he stated in his report, these risks include:

"...the potential both for sinkhole development and groundwater contamination. These are related in the sense that loss of structural support that can occur with sinkhole development could compromise the function of stormwater and/or chemical containment structures. In the case of a release groundwater impacts could be catastrophic in ecological terms, and potentially creating human disruptions by polluting groundwater, springs, and the surface waters to which these springs flow."

These opinions, in combination, establish that once Rockwool commences operations, and uses and generates industrial waste in connection with their manufacturing process, i.e., begins the movement and storage of raw and in process materials across the site, any significant stormwater event (as small as a 2-year rain event), could – and likely would – result in uncontrolled ponding because the Stormwater system is undersized and inadequate. In addition, as opined by Dr. Groves, the subsequent infiltration of uncontrolled stormwater will further undermine the karst hydrogeology of the site.

These facts support the existence of irreparable harm from Rockwools' operations and the issuance of a stay.

B. The Likelihood of Harm to the Intervenor with an Injunction:

While one of the factors for consideration, Appellants anticipate that the Intervenor will assert harm to its business operations if the Board issues a Stay in this case, describing some combination of economic losses, impact on employment, and the consequences of any delay in operations. Appellants do not know exactly what assertions the Intervenor will argue, or what supporting evidence it will present. However, the economic issues arising from delay in operations, while the Board considers the merits of the technical issues, they pale in comparison to the impacts contaminated groundwater can have on a community.

C. The Likelihood of Success on the Merits:

The issue to be considered in support of this element of the stay request is the design and operation of the site's stormwater conveyance system. In considering this issue, Mr. Linthicum has already opined on the accuracy of Rockwool's response to address the identified concerns. As he stated:

> "In response to my opinion, James Hemme, Roxul's engineer, dismissed my concern stating that the 'spread associated with the inlet entrances are associated with significant design storms and large rainfall depths that are infrequent and have relatively short durations of peak flow.' Unfortunately, Mr. Hemme is incorrect and he did not properly evaluate the concern in the best interest of the public and the environment. Had Mr. Hemme actually evaluated the design of the conveyance system, he would have realized that ponding occurs at numerous storms drain inlets during various storm events including the more common 2 and 10 year events and that the ponding is not limited to or a result of 'large rainfall depths, but an insufficient design."

See, Exhibit 1, at 1.

Appellants believe that the expert opinion and assessment of the weaknesses in the design and operation of the site's stormwater conveyance system support a finding on the merits of this important technical aspect of the appeal. Appellant's assert that the information currently available is that the Stormwater System design was not adequately evaluated by the DEP, and that the information to be presented by Rockwool has already been reviewed by Appellant's expert, and responded to by Rockwool's expert. Thus, there is likely no other information that will demonstrate any different information exists. As this Board held in the matter of *Crab Orchard-MacArthur Public Service District v. Director, Division of Water and Waste Management, West Virginia Department of Environmental Protection*, Order Granting Motion for Stay, Appeal No. 14-14 EQB, August 6, 2014. "The Board declines to rule on the likeliness to prevail on the merits of the appeal given that there is no record developed in the case and it would be improper to make a judgment on the likelihood of success at this time." Id, at 4.

D. That the public interest will be served by granting the stay:

As set forth in Chapter 22 article 11 of the West Virginia code that it is the "public policy of the State of West Virginia to maintain reasonable standards of purity and quality of water of the state consistent with: (1) Public health and public enjoyment thereof; (2) the propagation and

protection of animal, bird, fish, aquatic and plant life…".[2] Similarly Chapter 22 Article 12 of the West Virginia code finds that WV has relatively clean pure ground water, a majority of the population relies on this ground water, rural lifestyle depends on groundwater and rural lifestyle is valuable and worth protecting, the ground water is geologically complex in WV, contamination of ground water is difficult and expensive to clean up, ground and surface water are highly interconnected and groundwater effects surface water, and maintenance of the ground water provide economic, social and environmental benefits for the citizens of West Virginia.[3] In Jefferson County a majority of house holds depend on groundwater for all uses. The agriculture, equine, and tourism industries in Jefferson county depend heavily on groundwater, and these synergistic industries are critical to Jefferson County's economy.

Contamination of the groundwater as a result of the undersized and inadequate design of the stormwater conveyance system at the Rockwool site would cause irreparable harm to the groundwater in Jefferson County. Thus, taking all reasonable action to prevent such contamination is undeniably in the public interest, and cannot be responsibly outweighed by any short-term economic impact a stay may have on the delay of operations at Rockwool.

IV. Conclusion:

As stated above, in this case the Appellants, and the citizens of Jefferson County, will suffer an undue hardship if Rockwool's stormwater handling system, as predicted and identified by Appellant's experts, cannot appropriately handle the stormwater at the Rockwool site.[4] The

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[2] Chapter 22 Article 11 Water Pollution Control Act, 2 (a) and (b).

[3] Chapter 22 Article 12 Ground water Protection Act, 2(a)(1)-(11).

[4] The Board has generally granted a stay in EQB appeals in cases in which the parties have asserted a monetary impact from the action complained of, or the parties have agreed that a

consequences of this hardship will be the uncontrolled contamination of stormwater; and, because of the karst hydrogeology of the site, almost immediate and irreparable contamination of the groundwater.

The Board will hear the merits of the Appellant's case in less than a month. The key issue under consideration in the appeal is whether the Appellee/WVDEP actually evaluated the risks to the surface and groundwater that exist as a result of the stormwater design identified by Rockwool, and the numerous weaknesses, inadequacies, and non-existent protections to the stormwater system that Rockwool has constructed.

For all these reasons, the Appellants seek a Stay of operations until the issues are fully addressed.

APPELLANTS
By Counsel

/s/Christopher P. Stroech
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procedural stay of a permit will benefit the applicant for a permit, and/or that the parties have jointly agreed to make a change to a condition of the permit that will require time to accomplish, or similar issues. In this case, there is no agreement between the parties regarding the necessity of a stay, and the issues are not primarily economic or administrative in nature.

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Appellee,

and

ROXUL USA, Inc., d/b/a ROCKWOOL,

Intervenor-Appellee.

CERTIFICATE OF SERVICE

I, Christopher P. Stroech, Esq., counsel for Appellants, do hereby certify that I have served a true copy of the foregoing APPELLANTS' MOTION FOR STAY upon the following parties via email this 17th day of June, 2021:

Jackie Shultz, Clerk
Environmental Quality Board
601 57th Street, SE
Charleston, WV 25304
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/s/Christopher P. Stroech
Christopher P. Stroech, Esq.

LANGAN

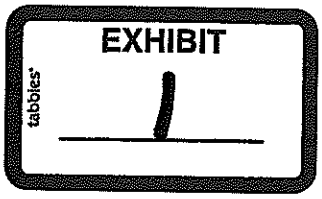
Technical Excellence
Practical Experience
Client Responsiveness

17 June 2021

Via Email: cstroech@arnoldandbailey.com

Christopher P. Stroech, Esq.
Arnold & Bailey, PLLC
208 N. George Street
Charles Town, WV 25414

Re: Professional Engineering Concern
Roxul RAN-5 Facility
WV/NPDES Multi-Sector Stormwater General Permit
Ranson, Jefferson County, West Virginia
Langan Project Number: 270112301



Dear Mr. Stroech:

As you are aware, I was asked to review, and if appropriate, opine on the above referenced matter. On April 20th 2021, I prepared and issued a summary of my opinions as they relate to the design, permitting, and operations of the Roxul RAN-5 facility. Amongst the numerous opinions in my report, I identified and expressed serious concern regarding the design and operation of the site's stormwater conveyance system. Specifically, I noted in my Opinion 3A that "inlets are clearly undersized and are shown to pond during simulated rainfall events. In some cases, the extent of the ponding will spread laterally more than 50 feet from an inlet location creating a widespread flooding condition on the site resulting in uncontrolled transport of polluted waters to unintended site areas."

In response to my opinion, Mr. James Hemme, Roxul's engineer, dismissed my concern stating that the "spread associated with the inlet entrances are associated with significant design storms and large rainfall depths that are infrequent and have relatively short durations of peak flow." Unfortunately, Mr. Hemme is incorrect and he did not properly evaluate the concern in the best interest of the public and the environment. Had Mr. Hemme actually evaluated the design of the conveyance system, he would have realized that ponding occurs at numerous storm drain inlets during various storm events including the more common 2 and 10 year events and that the ponding is not limited to or a result of "large rainfall depths"; but an insufficient design.

As stated in my report, "If not corrected immediately, the RAN-5 Facility will not drain effectively or as portrayed in Figure 3 of The SWPPP resulting in a flawed pollution prevention analysis subjecting the surrounding surface and groundwater to risk of contamination."

Simply put, the designed, approved, and constructed drainage system will not properly manage site runoff leading to uncontrolled ponding that will then overtop curbs and convey industrial stormwater in a manner that by-passes the engineering best management practices designed to treat or capture impacted water. Therefore, should the facility be allowed to operate and store

industrial waste, a 2 year, 10 year, or greater rainfall event would result in industrial runoff leaving the developed site limits entering one of the many known downstream karst features via direct discharge or infiltration. Left uncontrolled and untreated, industrial water entering the groundwater that flows through the below grade karst matrix in this area would then result in irreparable harm to the groundwater and surrounding environment.

In closing, neither the Stormwater Pollution Prevention Plan (SWPPP) nor the Groundwater Protection Plan (GPP) address this concern and are thus deficient. To protect the health and safety of the public, I strongly urge that the Roxul RAN-5 facility not be allowed to operate, create, or store industrial waste until this and other concerning matters are adequately addressed.

Very truly yours,

Langan Engineering and Environmental Services, Inc.

Ryan C. Linthicum, P.E., LEED AP
Senior Principal / Senior Vice President

State of Virginia
County of Arlington

On this 6/17/2021 (enter date) before me Katie Murphy (enter notary's name), Notary Public, personally appeared Ryan Linthicum (insert name of person signing) who proved to me on the basis of satisfactory evidence to be the person whose name is subscribed to the within instrument and acknowledged to me that he executed the same in his authorized capacity, and that by his signature on the instrument the person, or entity upon behalf of which the person acted, executed the instrument

I certify under penalty of perjury under the laws of the State of Virginia that the foregoing paragraph is true and correct.
Witness my hand an official seal:

Signature: K Murphy
My commission expires 01/31/2022

KATIE ROCK MURPHY
NOTARY PUBLIC
REG. #7797639
COMMONWEALTH OF VIRGINIA

20 April 2021

Via Email: cstroech@arnoldandbailey.com

Christopher P. Stroech, Esq.
Arnold & Bailey, PLLC
208 N. George Street
Charles Town, WV 25414

Re: Professional Engineering Opinions
Roxul RAN-5 Facility
WV/NPDES Multi-Sector Stormwater General Permit
Ranson, Jefferson County, West Virginia
Langan Project Number: 270112301

Dear Mr. Stroech:

As requested, I have reviewed and evaluated available information concerning the above referenced matter. A list of pertinent documents, plans, and reports that I reviewed and relied upon are given in Attachment A.

As you are aware, I have been retained as an expert in the field of civil engineering on a time and materials basis at the rate of $315/hour and $175/hour for staff assistance. A summary of my relevant experience, a brief background of the events related to this matter, and my professional opinions and conclusions are given herein.

RELEVANT PROFESSIONAL EXPERIENCE

I hold a Bachelor and a Master of Science degree in civil engineering from Lehigh University and have worked as a civil and geotechnical engineer for approximately 24 years at Langan Engineering and Environmental Services, Inc. I have extensive experience in civil site design and geotechnical investigations throughout the Northeast, Mid-Atlantic, and internationally. My experience includes site layout design, site grading and drainage, hydrologic studies, utility layout, retaining wall design, slope stability analyses, design and oversight of shallow and deep foundation systems, and temporary sheeting or shoring design. In addition, I have been accepted as an expert civil engineer on several legal matters and also by numerous townships, cities, and counties throughout the northeast United States to testify on matters including but not limited to site design, grading and drainage plans, retaining wall designs, ground improvement processes, foundation options, and soils reports.

A partial resume is attached for reference; See Attachment B.

BACKGROUND

ROXUL Inc., part of the ROCKWOOL Group, (Roxul) is a large, global manufacturer of stone wool insulation. In September of 2017, Roxul acquired an approximately 130-acre former apple orchard from Jefferson Orchards, Inc. in the City of Ranson in Jefferson County, West Virginia. Shortly after, Roxul proposed to construct an approximate 460,000-square-foot mineral wool manufacturing facility, identified as the RAN-5 Facility.

The major companies and/or firms involved with the RAN-5 Facility development of design, plans, and permitting are referenced throughout this report and are as follows:

- ROXUL Inc./ROCKWOOL Group (Roxul) – Industrial Developer/Owner
- The Thrasher Group, Inc. (Thrasher) – Project Civil Engineer
- Environmental Resources Management, Inc. (ERM) – Environmental Consultant
- Specialized Engineering – Project Geotechnical Engineer
- West Virginia Department of Environmental Protection (WV DEP) – State Permitting and Review Agency for the Multi-Sector Stormwater General Permit

The development for the RAN-5 Facility is proposed to disturb 98.8 acres of the 130 acres of property. The property is bounded by a MARC rail line and US Route 9 to the west and south and farmland and forested areas to the north, west, and east.

The RAN-5 facility is proposed to manufacture mineral wool insulation to support building construction. The facility will include office space, manufacturing space, and parking and internal roadways. In addition, several ancillary buildings including designated loading and unloading, bulk storage, above ground storage tanks (ASTs), and water treatment processes are also proposed to support the facility.

To build and operate their facility, Roxul was required to obtain multiple permits. For the purpose of this report, the two permits of primary concern include:

- The West Virginia National Pollutant Discharge Elimination System (WV/NPDES) Water Pollution Control Permit No. WV0115924 filed under the application registration WVR108876, which is hereby referred to as the "Construction Permit"
- The West Virginia National Pollutant Discharge Elimination System (WV/NPDES) Multi-Sector Stormwater General Permit (MSGP) No. WV0111457 filed under the application registration WVG611896, which is hereby referred to as the "Industrial Permit"

The Construction Permit is required for operators of construction sites to obtain authorization to discharge stormwater during construction activities while the Industrial Permit is required for operators of industrial facilities to obtain authorization to discharge stormwater from their facility to a municipal separate storm sewer system (MS4) or directly to waters of the State of West Virginia. Alternatively, an industrial facility could apply for and obtain an individual NPDES permit.

The management and discharge of stormwater for the RAN-5 facility during construction and for final operations is of particular concern because of the high potential for pollutants to enter storm

systems, waterways, and the surrounding environment. This is even more of a concern for a facility located in a karst topography and near multiple groundwater wells and protection areas because of the potential for significant connection to groundwater via sinkholes, fissures, and fractures. Karst topography is defined as *"a type of landform developed in a region of easily soluble limestone. It is characterized by vast numbers of depressions of all sizes sometimes by great outcrops of limestone ledges, sinks, and other solution passages..." (Robert W. Day - Geotechnical Engineer's Portable Handbook – 2000).*

The Industrial Permit has many constraints and requirements associated with the application and review process including:

- Public Notice in local newspaper with largest distribution area where facility is located
- Prohibition on non-stormwater discharges
- Releases in excess of Reportable Quantities
- Benchmark Monitoring
- Effluent Limit Monitoring
- Visual Examination of Stormwater Quality
- Water Quality Standards
- Total Maximum Daily Load (TMDL) and Federal Water Pollution Control Act (CWA) Impaired Waters Requirements
- Endangered and Threatened Species Requirements
- Other Statutes or Regulations
- Stormwater Pollution Prevention Plan (SWPPP)
- Groundwater Protection Plan (GPP)

The SWPPP and GPP are required to be developed and maintained as separate stand-alone documents.

In general, the SWPPP is intended to identify potential sources of pollution that might affect the quality of stormwater discharge associated with the RAN-5 facility industrial activities. The SWPPP shall also describe implemented practices to reduce pollutants in stormwater discharges and assure compliance with the terms and conditions of the Industrial Permit.

In general, the GPP is intended to identify sources that might contaminate or affect the quality of groundwater resources and the practices selected to protect groundwater resources from the potential contaminants.

The RAN-5 Facility implemented three primary Best Management Practices (BMPs) that are referenced throughout the 13 October 2020 Groundwater Protection Plan and the 13 October 2020 Stormwater Pollution Prevention Plan both prepared by ERM for Roxul. These BMPs are referenced as the Stormwater Management Pond, the Rainwater Re-use Pond, and the Bioretention Area. Each BMP is intended to manage stormwater pollution and runoff from the RAN-5 Facility. Based on our understanding, the installation of these BMPs has already commenced.

The WV DEP has expressed concern of the quality of surface and ground waters throughout West Virginia and acknowledged that "groundwater in many areas of the state is critical to economic growth and the well-being of its citizens".

OVERVIEW

This report focuses on a review of the stormwater design and permitting processes associated with Roxul's RAN-5 mineral wool manufacturing facility in Ranson, West Virginia. Additionally, this report also provides my professional opinions regarding the adequacy of Roxul's permit application materials and the WV DEP's review processes.

Based on my review of available information including stormwater pollution prevention plans, groundwater protection plans, design drawings, calculations, and various correspondences, the following outlines some of the major dates associated with the project, the stormwater permitting procedures, and the general design of the facility.

1-Jan-2017	-	Negotiations begin for a manufacturing facility in Ranson, WV under code name "Project Shuttle."
12-Apr-2017	-	City of Ranson holds pre-application meeting.
31-Jul-2017	-	Roxul submits Construction Permit Application to WV DEP.
17 Aug 2017	-	Thrasher submits site plan application.
Oct-2017	-	Site Plan approved by the City of Ranson after the public hearing.
19-Oct-2017	-	Construction Permit is approved.
27-Oct-2017	-	Roxul submits Site Development Building Permit Application.
30-Oct-2017	-	Site Development Building Permit Application issued.
Nov-2017	-	Site Works Permit – Approved/issued, which allowed for the current phase of clearing and preparing the land for construction.
Nov-2017	-	Initial clearing and grubbing, temporary BMP installation, and initial grading commences.
20-Nov-2017	-	Roxul submits Prevention of Significant Determination (PSD) Application for Permit to Construct to WV DEP Division of Air Quality.
1-Jan-2018	-	Roxul rebrands as Rockwool North America.
30-Apr-2018	-	Division of Air Quality Final Determination and Permit to Construct Issued.
22-Jul-2019	-	Rockwool submits Industrial Permit Application (WVG611896).
24-Jul-2019	-	Rockwool's application (WVG611896) is deemed administratively complete by the WV DEP.

18-Sep-2019 - Rockwool's draft permit registration is approved by the WV DEP; and the WV DEP issues the Public Notice letter regarding the issuance of the draft permit.

11-Oct-2019 - The NPDES MSGP (WV0111457) is appealed to the EQB by the Builders Supply Association of WV.

12-Oct-2019 - NPDES MSGP (WV0111457) that was issued on September 12, 2019 becomes effective, replacing the 2014 permit.

23-Oct-2019 - A public hearing about Rockwool's draft registration is held in Shepherdstown.

2-Nov-2019 - The extended public comment period ends. The Appellants all submit public comments.

26-Jan-2020 - Jefferson County Foundation, Inc. submits a petition to the Secretary requesting that Rockwool be required to obtain an individual NPDES permit, as opposed to a Registration under the general NPDES permit.

30-Jan-2020 - The EQB proposes an Order resolving the appeal of the NPDES MSGP accepting the settlement between the WV DEP and the Builder's Supply Association of WV.

25-Feb-2020 - The Construction Permit and WV/NPDES General Water Pollution Control Permit No. WV0115924 are re-approved

18-Sep-2020 - The revised draft NPDES MSGP is released to the public for public comment. On October 23, 2020, the public comment period closes for the revised draft NPDES MSGP.

5-Nov-2020 - Rockwool's Industrial Permit is approved.

These dates represent a general background of events regarding the design, layout, and permit approval process of the facility and is not intended to provide a comprehensive account of the site's design and development.

PROFESSIONAL OPINIONS

Based on a review of available information and my experience with similar development projects, I have rendered several opinions regarding the application review process and ultimate approval of the Industrial Permit for the Rockwool RAN-5 facility located in Ranson, West Virginia. My opinions are based on a reasonable degree of professional engineering and include aspects of the stormwater design, groundwater and surface water protection strategies, and special considerations for development in karst topography.

Although my opinions address three main issues, my overall opinion is that a lack of care, quality control, and a failure of the WV DEP to meet their own guidelines, laws, and regulations resulted in the application approval of a substandard design, that if left unaddressed, may cause harm to the surface and groundwater in this region and to the users/receivers of these resources.

A summary and basis for my opinions are given herein.

<u>Opinion 1</u> – The WV DEP disregarded their own policies, regulations, and best practices as they relate to the management and treatment of stormwater runoff from the RAN-5 Facility.

I have reviewed Roxul's Industrial Permit and supporting documents including the 13 October 2020 Groundwater Protection Plan and the 13 October 2020 Stormwater Pollution Prevention Plan both prepared by ERM for Roxul, hereafter referred to as The GPP and The SWPPP respectively. Based on my review, there are numerous instances where basic WV DEP guidance and/or regulatory direction were disregarded. A summary of these instances are as follows:

A. <u>GPP Approval vs. Start of Construction</u> - According to the West Virginia Code of State Rules, which is also referenced in the Industrial Permit, "For new facilities, the GPP shall be completed ***prior to construction*** (emphasis added)" (47 CSR 58 Section 4.12.2).

   However, according to *Section 3 – Facility Description* of The GPP "The RAN-5 Facility ***is currently under construction*** (emphasis added)". This is a clear violation of the State Rules where the GPP had to be approved **prior to construction** and not during or after. Further, the GPP report does not address construction activities despite the requirement in the State Rules (47 CSR 58 Section 4.11). The WV DEP and other governing agencies should not have allowed construction activities to begin until after approval of the GPP especially, considering the vulnerability of groundwater within a karst region such as the RAN-5 facility.

B. <u>GPP Grouting of Borings</u> - According to the West Virginia Code of State Rules, "Subsurface borings (e.g., water wells, injection wells, soil boring, production wells, extraction wells, exploratory wells and groundwater monitoring wells) shall be constructed, operated and closed in a manner that protects groundwater" (47 CSR 58 Section 4.4.2). Additional guidance is also provided in Section J of the WV DEP's publically available *Format for the Groundwater Protection Plan* where their Design Requirements Item 5 states that "For any subsurface investigations requiring boreholes, such as air track drilling or rock coring, the boreholes must be grouted upon completion."

   The July 11, 2017 Geotechnical Investigation performed by Specialized Engineering to support the development of this facility included 31 borings and 50 air track probes. The borings were backfilled with auger cuttings (soil) upon completion, and grouting of the air track probes is not discussed. The performance of subsurface borings and their abandonment are not addressed in The GPP. It is concerning that the WV DEP did not comment on this given that the improper abandonment of the borings/air track probes provide for 81 potential access pathways from the surface to groundwater. These

exploratory holes must be grouted (with approved material) by a West Virginia licensed driller immediately to comply with code and protect the environment.

C. SWPPP Site Radius – According to Section B – Item 17.A.1.a.3 of the Industrial Permit, a topographic map (or other map if a topographic map is unavailable), extending one mile beyond the property boundaries of the facility..." must be included as part of the facility's SWPPP.

However, according to Figure 1 of The SWPPP, the site radius map provided was limited to a one-mile radius from "Site Center" and not the "property boundaries of the facility" as was required. This requirement was disregarded or overlooked by the WV DEP and if drawn correctly, would have placed the USDA Appalachian Fruit Research Source Water Protection within the RAN-5 Facility's one-mile radius and would have also required additional extents to be shown around the area.

D. GPP and Utilities in Proximity to Karst Formations – According to the *Format for the Groundwater Protection Plan* Section J Design Requirement 6, for "underground utilities located within one-hundred feet (100') of a karst feature, then a dike of clay or other suitable material shall be placed across the trench at twenty-foot (20') intervals or less along the entire length which pass through the one hundred foot (100') radius, or as directed by a G or PE". In summary, utility trenches excavated within one-hundred feet of a karst feature should include impermeable measures every twenty feet to contain and isolate potential contaminants from infiltrating the highly-permeable karst features.

According to the 10/12/2020 Sinkhole Locations Overall Site Plan View prepared by The Thrasher Group, nearly all of the major site utility trenches would be impacted by this guidance requiring a more protective utility trench design against possible subsurface contaminant leaks or flow from associated utilities. However, in The GPP there is no discussion about utilities within 100 feet of karst features or protection measures for such cases. These measures are also not incorporated into Thrasher's June 2019 Site Package, and only typical Charles Town Utility Board or basic sewer trench details consisting of granular materials are referenced (Sheets 000-0047 and 000-048).

E. SWPPP Bioretention Basin Design Guidelines – Section 3.3 of The SWPPP discusses the site topography and drainage - a critical component to any SWPPP. An overview of the various site drainage areas, discharge points, and stormwater BMP's are outlined that include Level 2 Water Quality Swales; Level 1 Bioretention Areas; Oil/Water Separators; and Flexstorm Pure Filter Bags. Reference is directed to a separate attachment listed as "Stormwater Calculations by Thrasher Engineering" for more details.

According to The SWPPP's referenced drainage design and maps, a bioretention basin is located in the northwest portion of the facility and is designed to receive stormwater runoff from approximately 14.9 acres of mainly grassed areas. Based on my experience

and many states in the mid-Atlantic region (including West Virginia), this contributing drainage area is excessive for a bioretention basin design.

According to the West Virginia Stormwater Management and Design Guidance Manual (SWMDGM), Section 4.2.3 Section BR-3, "Typical drainage area size for traditional Bioretention areas can range from 0.1 to 2.5 acres" or about one sixth the size of the RAN-5 Facility's Bioretention basin designed by Thrasher. Furthermore, in Section 4.2.3 Section BR-6.1 Karst Terrain, The WV DEP states that "Bioretention basins with contributing drainage areas not exceeding one-half acre are preferred (compared to Bioretention basins with larger drainage areas) in order to prevent possible sinkhole formation".

Lastly, Chapter 5 of the West Virginia DEP's 2006 Stormwater Management Structure Guidance Document states that Bioretention Areas are able to manage a maximum runoff of only five acres..." which is one third the size of Thrasher's design.

According to these three State guidelines, a bioretention basin is not intended to be used for such large drainage areas as is proposed at the RAN-5 Facility. Standard stormwater management practice for a drainage area of this size is to design and construct multiple bioretention basins to limit the drainage area for each basin to 2.5 acres or less.

Irrespective of their own published guidelines, the WV DEP made no comments to the effectiveness and design of the site's atypical Bioretention Basin.

F. SWPPP PVC vs. HDPE Liners – According to the Appendix B - Pond Liner System Detail referenced in The SWPPP, the Bioretention Basin, the Rainwater Re-use Pond, and the Stormwater Management Pond are to be lined with a 60-mil HDPE liner.

However, according to Section 4.2.3 BR-4.15 of the West Virginia SWMDGM, "designers should use a thirty mil (minimum) ***PVC*** (emphasis added) geomembrane liner covered by 8 to 12 oz/sq. yd. non-woven geotextile".

PVC is more flexible and more expensive than HDPE, it can be factory assembled, and is less prone to puncturing. This makes PVC a more ideal liner selection for karst regions because of the resistance to sudden catastrophic rupture or tears.

In spite of these advantages and their own clear guidance, the WV DEP never commented on the liner selection resulting in a less expensive and less forgiving design, which results in unnecessary risk to the environment.

G. SWPPP Cold Climate Considerations – The SWPPP's discussion on stormwater BMPs (basins, ponds, and swales) does not discuss or consider cold climate impacts to their viability, function, and effectiveness.

Section 4.2.8 of the West Virginia SWMDGM - Rainwater Harvesting subsection RH-6.3 states that rainwater harvesting (aka the Rainwater Re-use Pond) "can be used throughout the year if they are located underground or indoors to prevent problems

associated with freezing, ice formation and subsequent system damage. Alternately, an outdoor system can be used seasonally or year round ***if special measures and design considerations are incorporated*** (emphasis added).

The Rainwater Re-use Pond is not located below grade or indoors and The SWPPP and design do not include special measures or design considerations to protect against cold climate impacts. Cold temperatures can lead to freezing water in the rainwater reuse pumps and lines causing broken or bursting pipes. The Rainwater Re-use Pond receives industrial impacted water from the manufacturing and wash area of equipment and vehicles with no emergency overflow. Therefore, should a pipe burst or equipment failure occur, a catastrophic event to the groundwater and surrounding areas could take place if not immediately rectified.

Cold Climate as it relates to bioretention is less critical but also an impactful issue if not properly designed for. Section 4.2.3 Subsection BR-6.3 of the West Virginia SWMDGM states that salt-tolerant non-woody plant species should be used in the bioretention areas so that they function as designed. However, the large bioretention basin on Sheet 000-019A of Thrasher's June 2019 Site Package merely show a typical bioretention section that calls for unspecified native grass and shrubs without regard for density. Also, the SWMDGM recommends considering frost depth when designing the underdrain pipe to reduce freezing potential. According to the Bioretention Basin design, the underdrain pipe is located approximately 24 inches below grade, whereas the frost depth is 24 to 30 inches as reported in the July 11, 2017 Geotechnical Investigation by Specialized Engineering.

The published guidance on these issues by the WV DEP was ignored or overlooked, which could in turn result in a dysfunctional site stormwater management system. Improvements to these areas should be made as soon as possible to protect against cold weather conditions.

H. SWPPP Stormwater BMP Maintenance – Based on the descriptions, site layout, and drainage area maps provided in The SWPPP, there is very little to no stormwater maintenance incorporated into the design.

For instance, the atypically large 10,000-square-foot Bioretention Basin has no accessibility for maintenance or emergency vehicles. In addition, only light, rubber-tired vehicles should maintain these facilities from the basin edge to avoid compaction of the organic media and damage to the underdrain pipes and liners. Given the atypical size of the Bioretention Basin, maintenance or emergency vehicles will not be able to access a majority of the basin.

Clogging of the Bioretention Basin due to sediment build-up and a lack of maintenance will cause excessive impounding of water, death of vegetation, and possible overtopping and breach of the basin releasing an unmanaged discharge of water, organic media, and accumulated solids into downstream areas. Likewise, maintenance of the Rainwater

Re-use Pond, the Stormwater Management Pond, and conveyance networks (pipes and swales) were not addressed and will degrade.

Despite the WV DEP's strict maintenance and monitoring guidelines found in the SWMDGM and the 2006 Stormwater Management Structure Guidance Document, no comments were made on stormwater maintenance, and The SWPPP and The GPP were approved.

l. SWPPP and GPP Rainwater Re-use Pond Treatment and Secondary Outlet – The Rainwater Re-use Pond located at the north end of the facility receives waters that come into contact with the manufacturing, storage, washing, and processing operations of the facility (industrial water). There are reportedly two oil/water separators that are part of the drainage system and are stated in Section 3.3.2 of The SWPPP to be included on Figure 2A of The SWPPP. These oil water separators could not be located on Figure 2A nor could details be found that describe their capacity, maintenance, type, and efficiency.

The intent of the Rainwater Re-use Pond is to provide a water source (after filtering and treatment) for the manufacturing processes of the plant. According to The SWPPP, water is not intended to be discharged off site; however, there is a potential for an uncontrolled release from a major storm event, which could impact the groundwater. According to the WV DEP, the Rainwater Re-use Pond would be classified as a "wet detention basin" and based on their 2006 Stormwater Management Structure Guidance Document, "an overflow ***must*** (emphasis added) be incorporated into the design of the wet detention basin to safely discharge the excess runoff in the event of a major storm event."

Despite this requirement, no overflow was incorporated into the design of this pond. The pond designer should have included a secondary riser with a below grade pump station that could discharge excess water to the sanitary sewer system. This design would have required additional analysis of the pond waters to understand treatment requirements prior to discharging to the sanitary sewer and eventually the Charles Town Waste Water Treatment Plant. A second design option would be to include the overflow via a spillway or riser/pipe and stabilized discharge. This too would require further analyses of the pond water, but it is doubtful that this discharge would be able to meet water quality requirements.

As currently designed (no overflow), the Rainwater Re-use Pond could be subject to overtopping in which the untreated industrial water would discharge around the pond perimeter and directly onto grade where topography would then carry the water north, infiltrate, or discharge to a nearby karst feature, polluting surface and groundwater resources.

J. SWPPP and GPP Basic Requirements – According to Section B – Items A and B of the Industrial Permit, any and all parties seeking coverage are required to discuss, identify, or report on numerous items and operations at their facility. These permit requirements are critical as they provide the reviewers, users, and the general public with information on the facility, how the facility operates, materials that are handled on site, and possible risks associated with pollution impacts to stormwater and groundwater. More specifically, some of the basic requirements to be included in a SWPPP or a GPP include:

- Description of the nature of the industrial activities and potential pollutant sources
- Loading or unloading of dry bulk materials or liquids
- Outdoor storage of raw materials, intermediary products, or final products
- Outdoor process activities
- Dust or particulate generating processes
- Waste disposal practices
- Risk identification and assessment/material inventory
- Preventative maintenance

In reviewing both The SWPPP and The GPP, many of these items were not fully addressed or simply not addressed at all. Some examples of these shortcomings include:

- The description of industrial activities is not adequate to provide an understanding of the processes, sequences, raw materials, products, by-products, and the general daily operations at the facility. Without this understanding, the potential pollution sources, paths, and exposure ability cannot be determined and therefore a plan written to protect against these cannot be adequately reviewed let alone approved.

- The identification and evaluation of outdoor storage of raw materials intermediary products or final products is deficient in that the Melt for Re-Use area is not adequately discussed. The location is merely labeled on Figure 2B; however the Melt for Re-Use stockpile area does not appear in the facility's inventory, is not quantified, and the storage and management practices are not discussed. Furthermore, as shown on Figure 2A, there are not adequate perimeter controls to prevent stormwater runoff from leaving this area and discharging north into the Bioretention Basin and surrounding grade.

- Dust or Particulate generating processes are not discussed in The SWPPP or the The GPP and how these processes could impact areas inside and outside of the Rainwater Re-Use drainage area limits.

- Preventative measures are not detailed and do not even mention the Rainwater Re-use Pond – the main containment of industrial runoff water from the site. A detailed discussion on inspecting and testing the rainwater reuse pond, the

containment dikes, the liner system, the pumps, and the settling forebay are non-existent in The SWPPP and The GPP.

Despite Roxul's inability to meet these basic requirements in The SWPPP and The GPP, the WV DEP still approved coverage under their Industrial Permit. These deficient items (among others) should be addressed immediately and in detail to demonstrate compliance with the permit and to adequately protect the environment and the surrounding community.

Opinion 2 – The WV DEP reviewed and approved the RAN-5 Facility's SWPPP and GPP without adequate supporting information to conclude that the measures of these plans protect the environment.

Based on my review of the RAN-5 Facility's SWPPP and GPP, the WV DEP's action to approve these plans as they were presented in October 2020 is concerning given the ambiguity, lack of detail, and misrepresentations made throughout the documents. Examples of these issues are as follows:

A. Conflicting SWPPP Figures – In The SWPPP, three specific figures are included and referenced to locate the site features, stormwater best management practices, and grading at the site. These figures are referenced as:

- Figure 2A – Site Layout, Location of Site BMP's, and Grading;
- Figure 2B – Site Layout and Site Features; and
- Figure 3 – Drainage Area Map

These figures are meant to provide a comprehensive understanding of the site's stormwater infrastructure, drainage patterns, and site features that may impact stormwater runoff quantity and quality. In reviewing these figures, conflicting and concerning information is apparent and raises questions about the site's layout, drainage, and possible pollutant paths.

For example, in Figure 2A and Figure 3, at the southeast corner intersection where the main entrance drive meets the internal site access road, a stormwater drainage swale and inlet with a piped connection that discharges runoff to the site's stormwater management pond is shown. However, in Figure 2B, a designated solid waste area is shown in this location directly over the inlet and the swale; see Exhibit 2A-1. Either the solid waste area needs to be moved to a location where it is not obstructing any stormwater systems, or the swale and inlet needs to be relocated. Regardless, all figures should be updated to consistently reflect the current and intended design.

Another example of conflicting information is the diesel above ground storage tank (AST) shown northwest of the utility building and inbound of the site access road on Figure 2B. According to Figure 3, this tank is also located on top of drainage inlet #33; see Exhibit 2A-2. Further information on this AST could not be located in The SWPPP according to its "Diesel-1 1,200 gallon" identification. Either the AST needs to be moved to a location

where it is not obstructing any stormwater systems or the inlet needs to be relocated. Again, all figures should be updated to consistently reflect the current and intended design.

These two conflicts are not minor and raise serious questions about how the facility will be storing waste and fuel and how drainage will actually occur. Given these unknowns, it is not clear how the WV DEP could make a decision to approve The SWPPP as submitted in October 2020. A more thorough review should have been performed and additional information, corrections, or clarifications should have been requested and provided before the WV DEP could have determined that the pollution prevention measures being provided were adequate.

B. Conflicting SWPPP Grading and Layout – The proposed grading, drainage, and site layout associated with a SWPPP is important as this information is used to determine where runoff will flow to as a result of a precipitation event, and if adequate prevention measures have been put in place to protect these areas from potential pollution sources.

When reviewing Figure 2A and Figure 3 compared to Figure 2B, a clear difference in the grading design and parking lot layout at the southwest area of the site is evident between figures raising questions on the drainage intent of this area; see Exhibit 2-B. This discrepancy should have been inquired about and The SWPPP should not have been approved given the lack of clarity on site runoff patterns. The correct site layout should be shown on all figures as well as a consistent grading design.

C. SWPPP Outfall Omission – When developing or reviewing a SWPPP, a focus on the stormwater outfalls is important as these are locations where concentrated stormwater is discharged from a given drainage area. Proper identification of the outfalls is a basic SWPPP requirement and each outfall should be given a unique identifier to easily locate and assess the outfall as needed.

Section 3.3.1 of The SWPPP states that "stormwater discharges within DA-A, shown on Figure 3, are conveyed through roof drains, surface drains and underground stormwater lines before flowing to an outfall labeled Outfall1." Section 3.3.3 states that "Water collected from the Bioretention Drainage Area, shown on Figure 3"... "discharges to a concrete level spreader to maintain sheet flow and non-erosive velocities at the NPDES outfall (Outfall 2)." However, no outfalls are labeled or shown on Figures 2A, 2B, or 3.

Without a clear understanding of the outfall locations, approving a SWPPP missing this information is irresponsible because the outfalls are the most critical point for assessing (via sampling) the current and future efficiency of a SWPPP. Furthermore, the omission of outfall labels and locations does not meet the minimum requirements of the Industrial Permit.

D. SWPPP and GPP Contingent on Future Development – A future West Virginia Division of Highways (WVDOH) road is referenced throughout The GPP and The SWPP's stormwater and drainage figures along the east side of the development. This "future road" is relied

Additional Comments Concerning Karst Hydrogeology and Potential for Associated Environmental Risks at the RAN 5 Site, Jefferson County, West Virginia

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by

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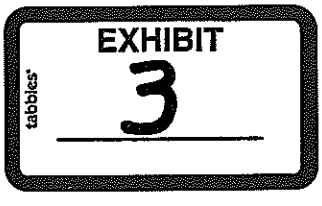
April 20, 2021



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1. Introduction

Jefferson County, West Virginia has well-developed karst landscapes and groundwater flow systems developed on especially soluble bedrock such as limestone and dolomite. Features such as caves, sinkholes, underground rivers, and large springs are common. Karst landscapes present serious challenges for urban development. with potential for soil subsidence and/or bedrock collapse into subsurface voids. Water falling as rain quickly sinks into the ground into these areas of highly permeable "Swiss Cheese" bedrock and flows underground in fractures and conduits—caves being those large enough for humans to explore—rather than across the surface as in most landscapes. Perhaps the most widespread environmental problem in karst regions is that when water quickly and easily infiltrates the ground it can carry contaminants from industrial, agricultural, urban, and other land use. As a result, karst groundwater, including that in Jefferson County, is highly vulnerable to contamination.

2. Previous analysis of karst hydrogeology of Jefferson County and the RAN 5 Site

I have evaluated the karst hydrogeology of Jefferson County, and in particular conditions in the vicinity of the Roxul USA, Inc. RAN 5 Project near Kearneysville (Figure 1, Appendix 1), a facility for the manufacture of stone wool insulation (Groves, 2020). This analysis was based on a wealth of existing data as the landscape and hydrology of Jefferson County have been particularly well-studied (e.g. Beiber 1961; Davies 1965; Cardwell et al. 1968; Hobba et al. 1971; Hatfield and Warner 1973; Trainer and Watkins, 1975; Hobba 1981; Jones and Deike 1981; McColloch, 1986; Dean et al. 1990; Kozar et al. 1991; Jones 1991, 1997; Kozar et al. 2008; Evaldi et al. 2009; Doctor and Doctor, 2012; Maloy and Carter, 2012). A series of evaluation and planning projects had also been made for the site which pay varying attention to the impact of local karst hydrogeology on the potential environmental risks of site construction and operation of the RAN 5 Project (e.g. Specialized Engineering 2017; The Thrasher Group, Inc. 2017; 2019; Environmental Resources Management, Inc. 2019a, 2019b; 2020).

As well documented in my 2020 report, an evaluation of risks associated with the RAN 5 project shows that the facility is located on a well-developed karst landscape and aquifer and is subject to the environmental risks expected in such a hydrogeologic setting. These include the potential both for sinkhole development and groundwater contamination. These are related in the sense that loss of structural support that can occur with sinkhole development could compromise the function of stormwater and/or chemical containment structures. In the case of a release groundwater impacts could be catastrophic in ecological terms (a complex ecosystem that includes the federally threatened Madison Cave isopod lives within the karst aquifer of Jefferson County) and potentially creating human disruptions by polluting groundwater, springs, and the surface waters to which these springs flow.

Perhaps the most important conclusion of the report is that with the current state of understanding *it is not clear to which spring, or potentially wells, such contamination would flow, or put another way, what the receiving stream(s) for the facility even are.* Although there has been considerable progress in understanding ground water flow through dye tracing in northern Jefferson County, tracer tests from the facility itself would be required to identify the particular spring(s) and stream(s) that would be impacted by a release of contamination.

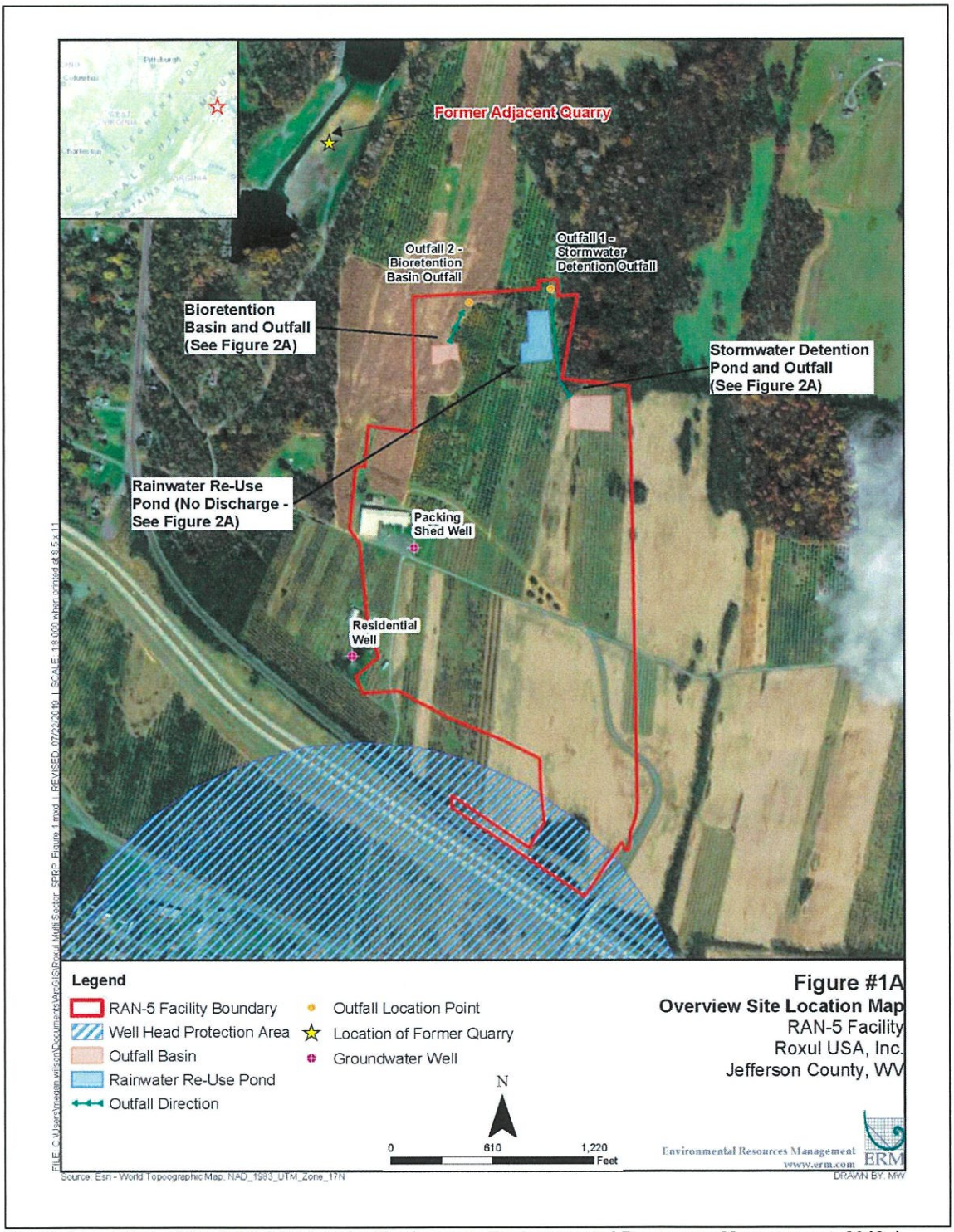

Figure 1 Location of the RAN 5 Project facility (source: Environmental Resources Management, 2019a). Stormwater Outfalls 1 and 2 are shown at the northern end of the facility.

I concluded that this is a well-studied groundwater system at the county scale (see details in Groves 2020), but critical detail is lacking for groundwater flow at the RAN 5 Project and the relation of that flow to the surrounding area of Jefferson County. The facility overlies the northern part of an area of radial flow, which might be characterized by thinking of the center of a wagon wheel with flow radiating outward in different directions like the spokes of the wheel. Released contaminants could potentially flow northward towards the Potomac River, or westward toward springs at the US Geological Leetown Science Center or elsewhere along Opequon Creek. Though apparently less likely, flow towards springs reaching the Shenandoah River is also a possibility (Figure 2).

I encouraged those responsible for project planning and implementation not only to take the strongest possible measures to prevent this from occurring in the first place, but because the site lies close to a groundwater divide between the Potomac River and Opequon Creek, and possibly to the Shenandoah River, that groundwater dye tracing should be undertaken from several points at the facility to identify the spring(s) and stream(s) that would be impacted by any releases of contamination.

Since I wrote this report, I have become aware that Rockwool has retained the services of an experienced karst scientist, Dr. Tim Bechtel. I know and have collaborated with Dr. Bechtel and am broadly familiar with his qualifications in this area. In a letter dated September 20, 2020 (Bechtel 2020) Dr. Bechtel stated that "The geology and hydrogeology of the site are comprehensively reviewed in the report of Professor Chris Groves, dated August 4, 2020," and when asked during his February 25, 2021 deposition (Bechtel 2021) whether he took any issues with the report, he testified that he did not.

3. Purpose of the current report

The purpose of the current report is to evaluate risks associated with facility operation within the karst area impacted by the RAN 5 Project, based on my previous work (Groves 2020) in combination with additional data that I have reviewed since that time. It is limited to technical (hydrogeology) considerations, as I make no claim to have expertise in either legal matters, nor detailed familiarity with West Virginia's environmental regulations. Although an evaluation of these risks certainly informs consideration of the need and importance of measures designed to prevent hazards related to karst risk, an evaluation of the efficacy of particular designs for such measures is also beyond the scope of this report.

4. Professional qualifications

I serve as University Distinguished Professor of Hydrogeology at Western Kentucky University where I direct the Crawford Hydrology Lab, a nationally leading laboratory for the study of karst groundwater flow. I received a PhD in Environmental Sciences at the University of Virginia and have since developed an active international research program in karst hydrogeology, geochemistry and water resources, with fieldwork in 25 countries.

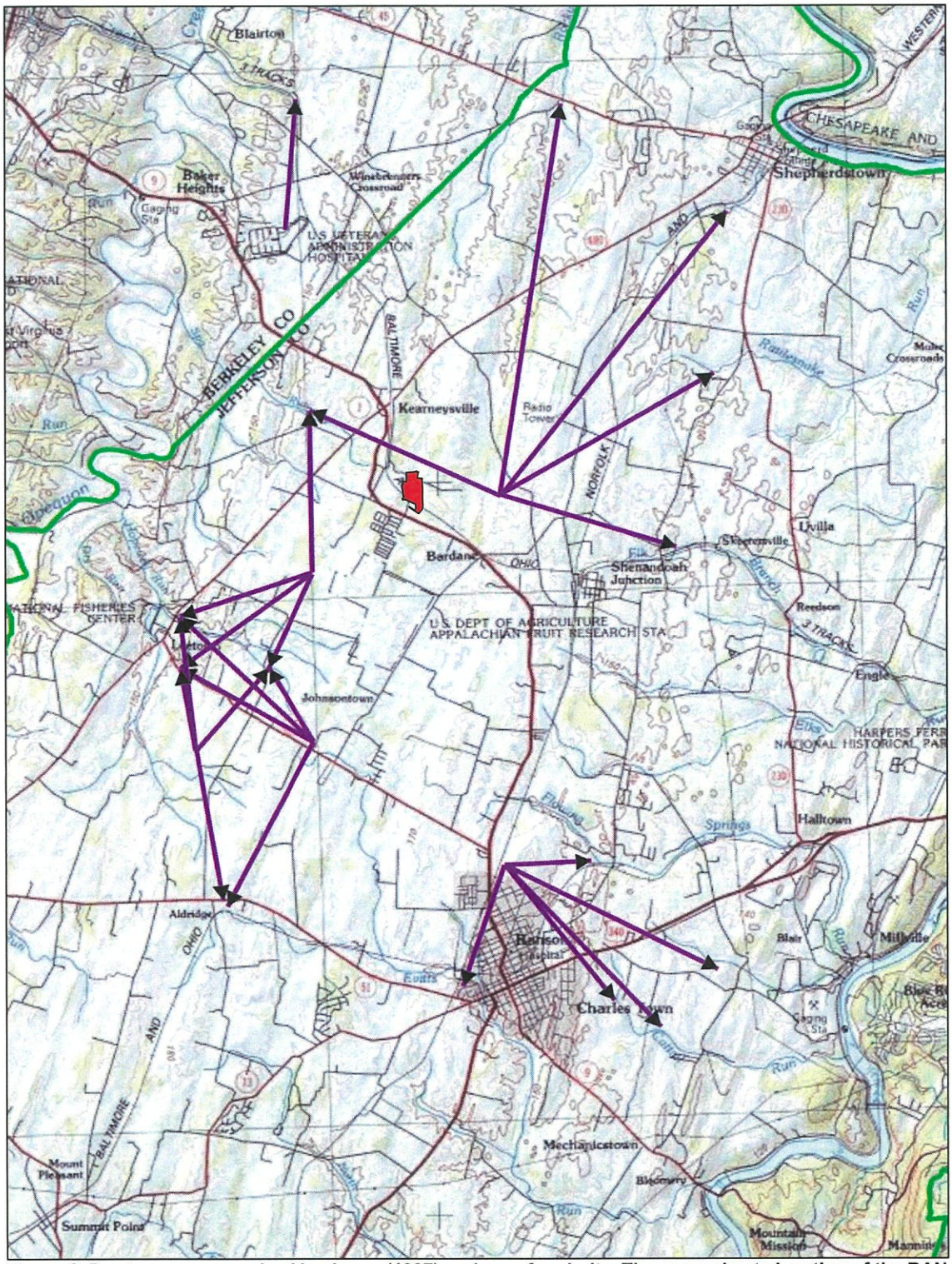

Figure 2. Dye traces summarized by Jones (1997), redrawn for clarity. The approximate location of the RAN 5 facility is shown in red. The dashed red line near RAN 5 is explained below in section 5.3.

I have served as a member or leader of several karst-related United Nations scientific programs, including the current project International Geoscience Program IGCP 661 "The Critical Zone in Karst Systems" through 2021. I have served as an Associate Editor for *Journal of Hydrology* and *Hydrogeology Journal* and have published in the field's leading journals including *Groundwater, Water Resources Research, Journal of Hydrology,* and *Geomorphology.* I am a member of the Karst Commission of the International Association of Hydrogeologists and of the Governing Board of the International Research Center on Karst Under the Auspices of UNESCO in Guilin, China. In 2017 I received the *International Cooperation in Science and Technology Award of the People's Republic of China* from President Xi Jinping, China's highest award for foreign scientists, for "great contributions to China's hydrogeology and karst geology fields."

Closer to home, my first exploration of a West Virginia cave was in Pendleton County in 1973, and in Jefferson County the following year.

Although I have been hired by the Jefferson County Foundation, Inc. to undertake this evaluation, my task as an expert in this case is to objectively describe the risks as a result of hydrogeologic conditions at the RAN 5 Project site and the potential for associated environmental impacts. I have not manipulated or cherry-picked information to have it reflect any pre-determined outcome, and my contributions to this process, and all of my professional activities, reflect that philosophy. My comments are accurate and truthful to the best of my experience and abilities.

5. Additional data have increased my previous concerns

My concern about the suitability of site under the proposed circumstances has grown.

5.1 Visualization of bedrock voids beneath the site

Further review of the Thrasher (2017) geotechnical investigation is a game changer in making clear the remarkable quantity of void space present in bedrock beneath the site. During this investigation 53[1] air track holes were drilled into the bedrock beneath the facility (Figure 3) and 12 of them, more than 20%, had voids at least one foot in height. Seven, more than 10%, had total void height of ten feet or more. Four, more than 7%, had total void height of 20 feet or more, and well 4—beneath the Reuse Pond and less that 200 feet laterally from Outfall A—*has a total void space equal to the height of a four-story building.*

Two related observations critical to understanding the subsurface at the site (Figure 3) are that every line of drillholes encountered bedrock voids, and for the most part, the areas of the map in which no voids are shown are areas without drill holes. For a first approximation of subsurface conditions at the site it doesn't take much imagination to mentally project sets of lines with similar void densities across the site—there is no evidence to suggest that the random positions of the drilling lines encountered a higher density of voids than to be expected in other areas.

[1]While the Thrasher (2017) report text describes 50 air track holes, data for 53 are shown in Appendices A and B.

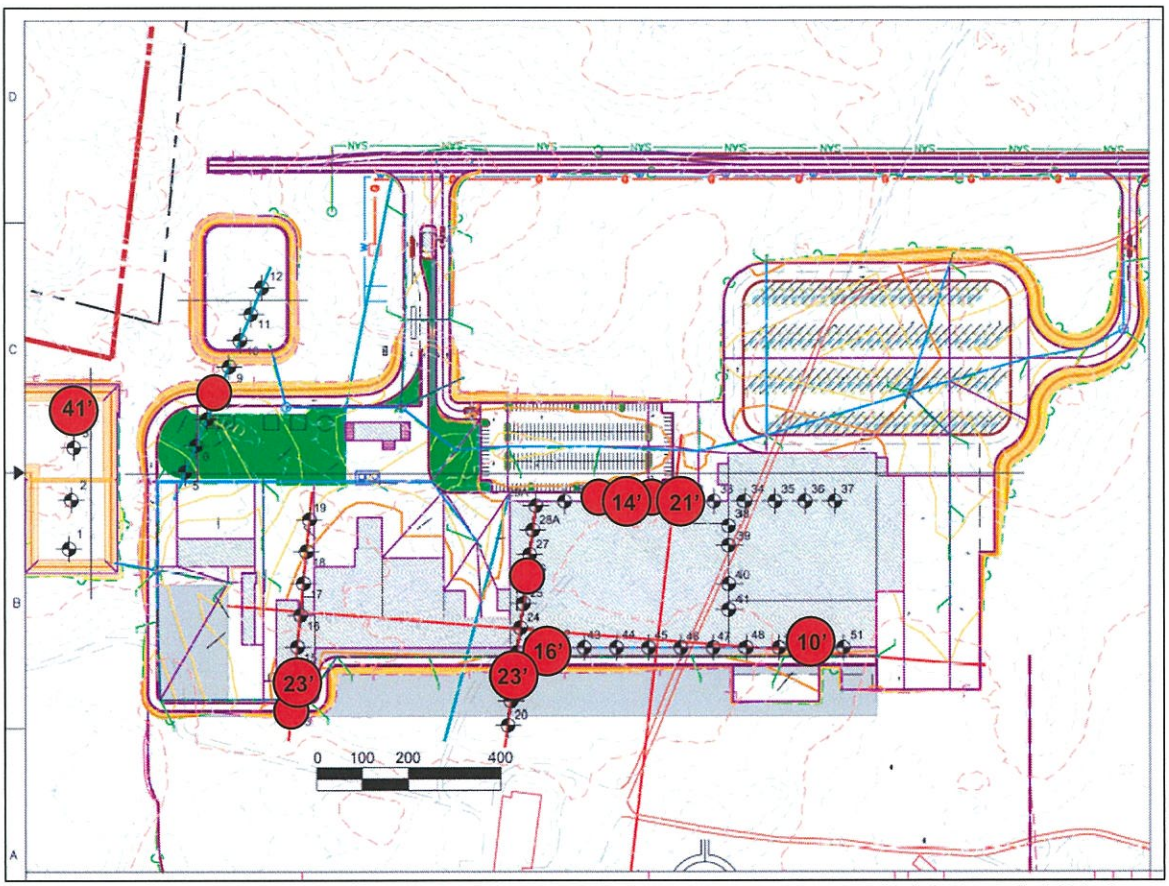

Figure 3. Map of the facility showing results from air track drilling the showing the 12 (of 53 total) drill holes that have voids of at least 1 foot in height. Small red circles show holes with 1'-9' of total void height, and large circles are 10' or greater, with the total void space shown (Thrasher 2017, Appendix A (base map) and Appendix B (void data).

The extensive bedrock void network that has thus been shown to exist beneath the site make clear 1) why this an area of prolific sinkhole development (Figure 4) (WVDEP 2018a; 2018b; 2018c; 2018d, 2019, 2020a, 2020b, 2020c; Connelly, 2018), 2) why water that might be expected in such an environment to move so easily through the subsurface should be highly vulnerable to contamination, and 3) why there should be high concern for potential lack of structural support across the site. Combined with the fact that hazardous chemicals will be used and stored at the site (Roxul 2020) it is imperative that the highest level of engineering considerations be made to ensure the structural integrity of containment structures in this unstable geologic setting, and that regardless of the structural interventions that are employed to prevent contaminant releases in the first place, an effective groundwater monitoring strategy be implemented.

Evaluation of the appropriateness and expected effectiveness of engineering applications at the site is beyond the scope of this report, but in my opinion Rockwool's current groundwater monitoring strategy at the RAN 5 site (Rockwool 2020) is inadequate, both in the lack of an appropriate level of consideration of the well-established understanding of the hydrogeologic setting and in its specific design.

5.2 The groundwater monitoring design

While Rockwool (Rockwool 2020) explains that the four-well groundwater monitoring network they have employed exceeds the regulatory requirements of the West Virginia Department of Environmental Protection, it is likely to have limited effectiveness, at best, based on its basic conceptual design for this hydrogeologic setting, the fact that it largely ignores (and indeed misinterprets) details of the well-studied county-scale hydrogeology (Groves 2020 and sources therein), and lacks data necessary for the required, more local scale understanding of groundwater flow.

Rockwool's strategy of using one upgradient and three downgradient monitoring wells is a common and often effectively employed design in many hydrologic settings but may well not be effective here.

A little technical background is appropriate to understand the situation. In this well strategy the upgradient well is "upstream" from the facility with regard to the direction of groundwater flow, and thus the quality of groundwater coming from that direction will presumably not have been impacted by activities at the site. The upgradient well thus serves as a control and after the water passes beneath the site the three (in this case) downgradient wells are designed to identify any contamination that may have been released at the facility.

Here I will necessarily define two important terms that describe the behavior of groundwater flow related to the geometry of the spaces in the otherwise solid bedrock through which the water flows. These are **homogeneity** (or heterogeneity, the lack thereof) and **isotropy** (as opposed to anisotropy) (Freeze and Cherry 1979). Homogeneity refers to how uniform the geometry and properties of those spaces are in space. If one considers water in a bucket of saturated sand, for example, in which the sand grains are of uniform size and shape, it is clear that the properties of the interconnect spaces between the various grains are similar throughout the saturated material. Limestone karst aquifers are typically very different—often highly heterogeneous where the available spaces for water to exist and flow are highly variable in size and orientation. The rock beneath the RAN 5 site shows an *extreme* level of heterogeneity that could well serve as an example in a hydrogeology textbook. Well 4 (Figure 3) has 41 feet of void space and well 3, less than 100 feet away, has none.

Similarly, the uniform saturated sand could be expected to be highly isotropic, where isotropy describes how the ease with water is transmitted through the material depends on the direction that it is flowing. In the isotropic sand example, the flow properties are more or less the same regardless of what direction the water would flow. In contrast, well-developed karst aquifers like that beneath the RAN 5 site can have *extreme* anisotropy: water flowing along a solutionally enlarged fracture or conduit can flow very easily, yet in a perpendicular direction not at all.

So, a fundamental problem at the site with the four-well strategy is that it works very well in homogenous, isotropic aquifers, but the effectiveness breaks down in aquifers, also along a continuum, where this is not the case. Most aquifers are somewhere in the middle with regard both properties, but the aquifer beneath RAN 5 is somewhere near the extreme end of these continua, as is common on karst aquifers, and as Figure 3 makes clear.

Figures 4 and 5 (Groves 2018) illustrate this point. Figure 4 shows how such a monitoring scheme can work in a relatively homogenous, isotropic aquifer where contaminants tend to travel in blob-like masses that are easy to hit with monitoring wells.

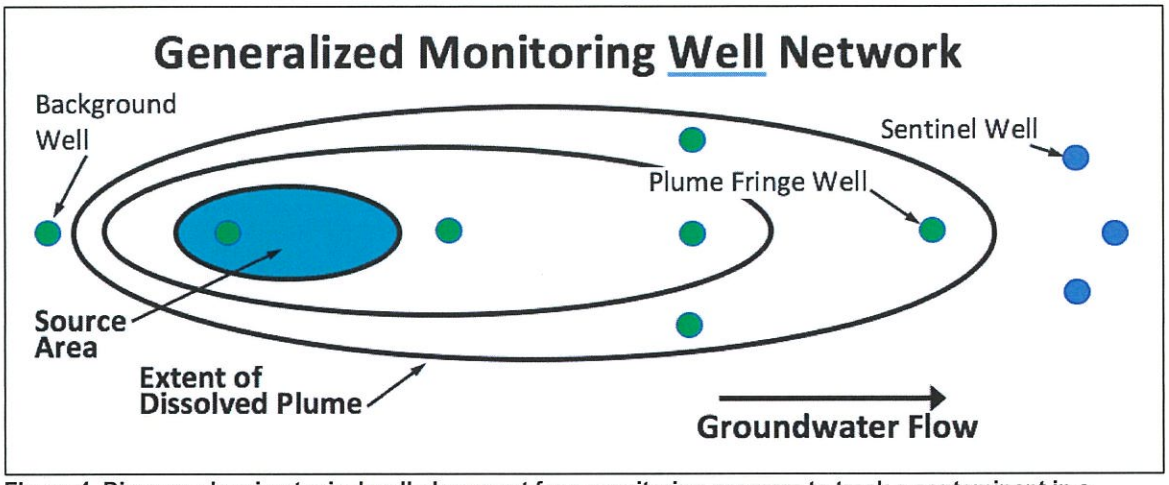

Figure 4. Diagram showing typical well placement for a monitoring program to track a contaminant in a homogeneous, isotropic aquifer where contaminants often travel in large, blob-like plumes that are relatively easy to hit with monitoring wells (Groves, 2018; original from New Jersey Department of Environmental Protection, 2012).

Figure 5 (Groves 2018) is more like the situation in northern Jefferson County. Indeed, describing the same concept of well monitoring in well-developed karst aquifers, Quinlan and Ewers (1986) wrote that the "probability of a randomly located monitoring well intercepting the trunk conduit which drains a groundwater basin, or the tributary conduit which drains a site, is similar to the probability of a dart thrown at a wall map of the United States hitting the Mississippi River or a specific tributary." By "randomly located" they meant a well that is drilled without knowing the location of the conduit in advance—the case at RAN 5.

One can also easily see that a dye trace from the generic facility in Figure 5 would easily identify the spring to which any contaminants would flow, and that is where effective monitoring would take place.

5.3 Where would groundwater contamination from RAN 5 go?

As I had indicated in my previous analysis (Groves 2020), dye tracing shows the RAN 5 Project overlies the northern part of an area of radial flow (Figure 2). Contaminants released at the site could potentially flow northward towards the Potomac River, or westward toward springs at the US Geological Leetown Science Center or elsewhere along Opequon Creek. Though less likely, flow towards springs reaching the Shenandoah River is also a possibility.

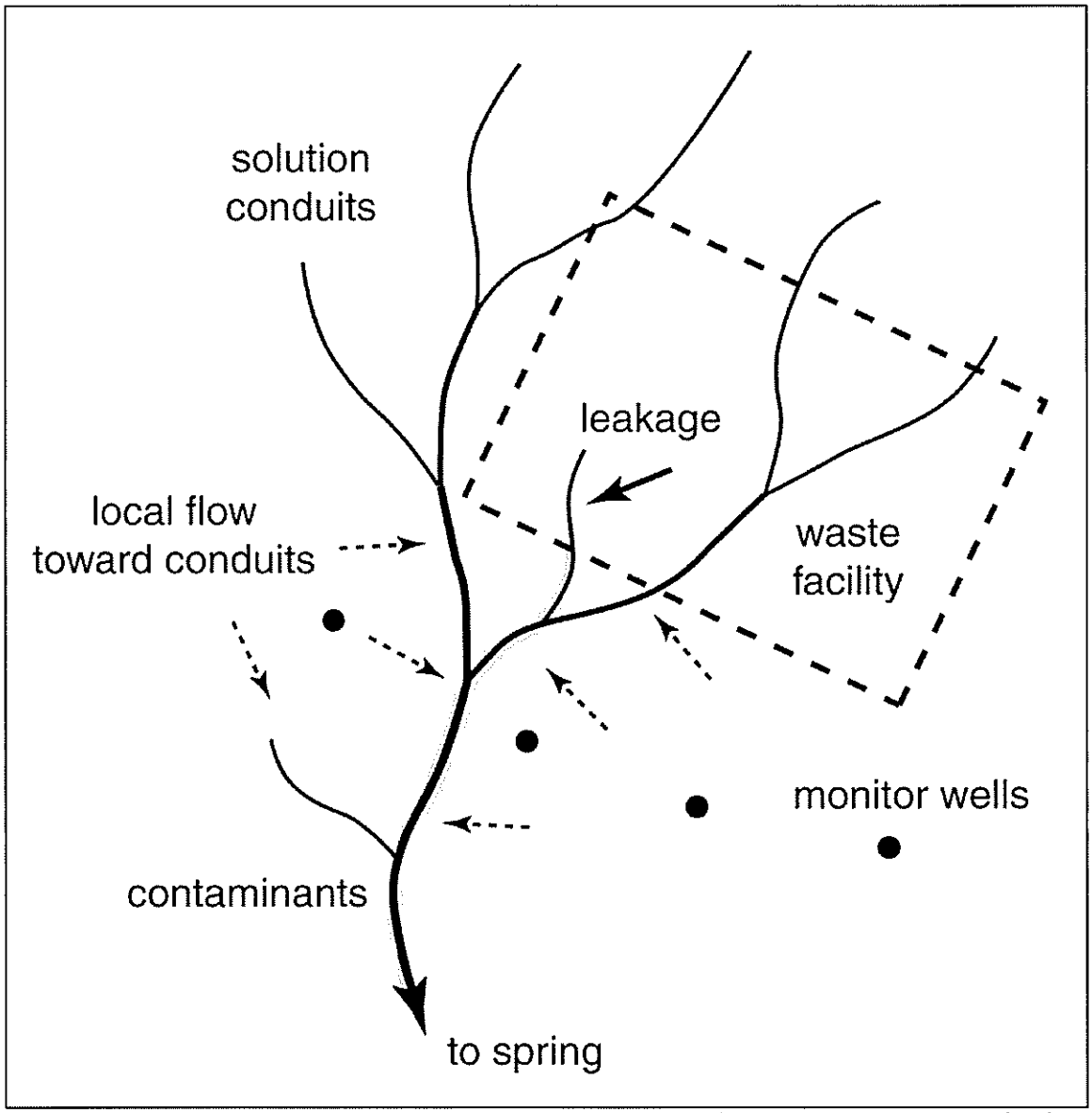

Figure 5. Map showing how conduits within a well-developed karst aquifer may pass between even closely spaced monitoring wells. Note that the flow (shown by dotted arrows) is towards the conduits throughout the aquifer (Groves 2018, original from Palmer, 2007).

Beyond my broad concerns of the current well-based monitoring plan for the reasons described above, I have very specific concerns that revolve around how Rockwool has evaluated the direction of groundwater flow at the site. I will (in a simplified but still useful way) define two additional terms in order to discuss these issues: the top of groundwater over some area can be defined as a **potentiometric surface**. This is let's say a kind of groundwater analogue to the land

surface above, in the sense that in the same way we can predict which way a bowling ball will roll on the landscape—from higher areas to lower—groundwater similarly can be predicted to flow from high to low areas of the potentiometric surface, in the absence of complicating factors. Maps of this surface can be made from drilling, and measuring water levels in, water wells. Similar to how we could call the slope of the landscape in an area a landscape gradient, the slopes on a potentiometric surface map define **hydraulic gradients.** Where a bowling ball placed somewhere on the landscape would roll lower based on the direction of the *landscape* gradient, which in this case is another way to say downhill, groundwater moves from higher to lower points along a *hydraulic* gradient. The terms *upgradient* and *downgradient* direction refer to the directions from which, and towards which, groundwater is expected to flow.

Even setting aside whether such wells, even if correctly placed with respect to the appropriate gradient, would be useful, my concerns about how Rockwool is managing groundwater issues were heightened when I read in Dr. Bechtel's report (Bechtel 2020, p. 3) that

> A final level of protection for the karst aquifer will be provided by four groundwater monitoring wells that are scheduled[xxi] to be installed by the end of September 2020. These will be located with one on the apparent upgradient side of the facility, and three on the downgradient side (based on interpretation of dye-tracing studies by others as reviewed by Professor Groves[xxii]).

The dye tracing studies in my opinion did not indicate that water under the site has a hydraulic gradient to the north, and, though Dr. Bechtel had indicated that he had "no issues" with the conclusions of my 2020 report (Bechtel 2021) this ignores one of its central conclusions that I repeat here (Groves 2020, p. 29)

> This is a well-studied groundwater system, and dye tracing shows the RAN 5 Project overlies the northern part of an area of radial flow. Contaminants introduced along the route could potentially flow northward towards the Potomac River, or westward toward springs at the US Geological Leetown Science Center or elsewhere along Opequon Creek. Though less likely, flow towards springs reaching the Shenandoah River is also a possibility.

When I commented on this during my testimony in the March 19, 2021 hearing during which I offered rebuttal to Dr. Bechtel's report (Environmental Quality Board 2021, p. 65) Rockwool's lawyer Mr. Walls (Environmental Quality Board 2021, p. 81) asked whether I knew that Rockwool had done a potentiometric study before the wells were provided. I was taken aback for a moment—because it's the wells themselves that provide the necessary data at the scale of such a facility—but Mr. Walls moved on to another line of questions before we could discuss it any further.

Neither Dr. Bechtel (Bechtel 2020) nor the monitoring well plan (Rockwool 2020) made any mention of using existing potentiometric data to choose the locations of the monitoring wells, and both technical explanations of the process that say that dye tracing data from Jones (1997, though cited as Karst Waters Institute in some places as the organization that published the

work) was used to site the wells. This seems to be further supported by a September 22 email from Rick D. Adams to Yogesh Patel and others that said

> The following items in the Monitoring Well Network Development Plan should be addressed: (maybe can be addressed after conditional approval)
>
> - *Groundwater flow patterns are estimated based on Karst Water Institute study from 1997.* They will not know site specific until the monitoring wells are installed. Once this is complete they can determine if additional wells are needed and appropriate well location.

[Italics added].

There are indeed potentiometric data for Jefferson County that I described earlier (Groves 2020, Figure 14, originally from Kozar, 1991), but these are far too coarse to be useful at the scale that would be used to site groundwater monitoring wells, particularly where Rockwool happens to be located.

Beyond this, I disagree whether an interpretation of Jones' (1997) data indicating a hydraulic gradient to the north is correct, for two reasons. Jones' data do not show northward flow, but as the monitoring plan (Rockwool 2020, p. 3) describes, "a half-radial pattern oriented toward the north." (this report, Figure 2). While the "half radial" (which I could describe as a "half wagon wheel") pattern is generally oriented to the north, the flow direction indicated by the dye tracing can be to the west, north, northeast, or east. In fact, the dye trace line closest to the site—not that this necessarily determines the hydraulic gradient at the site—is to the west!

Most importantly, this interpretation ignores that fact that other dye traces nearby go in different directions in other patterns. Groundwater from RAN 5 may go to the north at the site, and even if that that turns out to be the case beneath the site, for this well-developed karst flow system in my opinion information from more detailed dye tracing from the site itself would be necessary to design an effective groundwater contaminant monitoring system.

6. Drainage from stormwater outfalls

A large amount of stormwater will be discharged at the northern end of the facility (Figure 1). Outfall 1 will have an average of 86,330 gallons/day, with 10,207 gallons/day at Outfall 2. On some days there will be much larger flows. As Dr. Bechtel has observed (Bechtel 2020 p. 2), "Sinkholes are induced by increased infiltration that washes soils down in pre-existing bedrock dissolution cavities" and this is exacerbated by concentrated inputs. Sinkholes have been documented in the area receiving these flows, and it seems reasonable to expect a significant increase in the rate of sinkhole development there. This carries the risk of increased contamination of the groundwater by the resulting sediment loads into the karst aquifer below. Collapses triggered by concentrated stormwater inputs can also occur some distance laterally from the inputs, and having a well with 41 feet of rock void space a short distance away from the Outfall 1, and beneath the Reuse Pond, might well also deserve concern about structural issues related to these flows.

7. Conclusions

An evaluation of risks associated with facility operation within the karst area impacted by the RAN 5 Project, based on a combination of my previous work (Groves 2020) in combination with additional data that I have reviewed since that time, has not reduced my concerns about the environmental risks that the facility may pose, particularly to the highly vulnerable karst groundwater resources of Jefferson County. This is in large part based on Rockwool's relative lack of appropriate hydrogeologic analysis at the site, in particular as it has informed the current groundwater monitoring strategy at the facility.

I offer these conclusions with a reasonable degree of scientific certainty.

April 20, 2020

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on in the facility's drainage plans as a drainage divide and assumes that no off-site stormwater flows onto the RAN-5 Facility despite existing contours suggesting otherwise. As a result, the stormwater pond located in the northwest corner of the facility is actually undersized and does not properly account for the conditions present during the design of the basin (i.e. no WVDOH Road). The WV DEP should have questioned this design or at the very least, required that the WVDOH road and proposed infrastructure be shown on Figure 3 of The SWPPP and Figure 4 of The GPP (drainage area maps) and installed prior to approving The SWPPP and The GPP.

E. SWPPP Pre and Post Development Peak Flows – The proposed drainage area map (Figure 3) provided in The SWPPP attempts to delineate the drainage areas associated with each proposed inlet and stormwater best management practices on the site. In addition to the delineated drainage areas, the figure also provides pre and post development peak flows associated with the proposed drainage areas. A peak flow is the maximum volume of water discharged over a period of time from a drainage area during a storm event. This information is the basis of design for stormwater structures and conveyance systems. The provision of pre-development peak flows as they relate to the boundaries of the proposed drainage areas is fundamentally wrong and only creates confusion for those reviewing the plans.

   Predevelopment flows should not have been included. A request to eliminate this erroneous information from the proposed drainage area map should have been made by the WV DEP to provide for a clear understanding of the proposed drainage areas and peak flows to each inlet. However, the WV DEP approved The SWPPP without seeking clarity or asking for the errors to be removed.

F. SWPPP Bioretention Level Spreader – The outflow associated with the large Bioretention Basin is discharged via an outflow control structure. This water is then conveyed northeast out of the basin via an underground pipe and swale system to a level spreader just west of the Rainwater Re-use Pond. The level spreader works as an erosion control device that converts high-velocity stormwater runoff to low-velocity sheet flow.

   According to the figures and the stormwater calculations referenced in The SWPPP, there is no way to determine the adequacy of this design, the stability of the ultimate discharge, and the flow path of the discharge. In fact, when reviewing the limited topography in this area, a portion of the flow from the level spreader appears to be directed into the Rainwater Re-use Pond. Without additional details in this area, the adequacy of the level spreader and the amount of water possibly flowing into the Rainwater Re-use Pond cannot be quantified. Additional topographic information should be collected and analyzed

to determine flow paths in this area and the validity of the sizing of Rainwater Re-use Pond.

During the WV DEP's review of the outfalls, this should have been raised as a concern, and additional information should have been sought. Instead, The SWPPP was approved without clarification or adjustment to these areas.

G. SWPPP and GPP Slope Stability – The northernmost side/berm of the Rainwater Re-use Pond is designed with fill material meaning that the contractor needs to add soil to this area of the site to reach the proposed grade. The fill portion of the northern berm is higher than five feet, and may be required to restrain a large amount of water. A catastrophic failure of this berm would release polluted waters directly into the downstream environment. Basin slope stability analyses were not included or discussed in The SWPPP, The GPP, or referenced documents. A slope stability analysis is an engineering study that assesses a slope's ability to resist movement or collapse based on soil and water properties.

Although not classified as a regulated dam, according to the WV DEP, the Rainwater Re-use Pond still meets the legal definition of a dam and a discussion, detailed design, and supporting calculations addressing the stability or instability of the Rainwater Re-use Pond's berm should have been considered a standard industry practice. The WV DEP did not question or ask for details on the berm's construction or stability and instead approved The GPP and The SWPPP with no regard for downstream safety.

Opinion 3 – The WV DEP reviewed and approved the RAN-5 Facility's SWPPP and GPP despite numerous design and methodology errors.

During my review of The SWPPP, The GPP, and associated or referenced documents, I noted numerous errors or omissions in the stormwater methodology and design, which The SWPPP and The GPP rely on. The acceptance of these errors is concerning and should have been identified for correction by the WV DEP. Notable concerns are as follows:

A. SWPPP GPP Inlet Capacity – A stormwater collection and conveyance system was designed by Thrasher to drain the facility during precipitation events. The system includes a series of stormwater inlets, underground piping, and swales. The networks were modeled using the computer modeling software Hydraflow Storm Sewers. This software simulates a specified rainfall event and reports inlet and pipe efficiency.

In Thrasher's computer generated output, a majority of the inlets are clearly undersized and are shown to pond during simulated rainfall events. In some cases, the extent of the ponding will spread laterally more than 50 feet from an inlet location creating a widespread flooding condition on the site resulting in uncontrolled transport of polluted waters to unintended site areas.

Standard industry practice for the design of collection and conveyance systems is to rectify simulated inlet flooding by introducing additional inlets to break up the drainage

areas or by adding larger inlets with increased capacity. This is an iterative design process and not one that that occurs during construction or post permitting. If not corrected immediately, the RAN-5 Facility will not drain effectively or as portrayed in Figure 3 of The SWPPP resulting in a flawed pollution prevention analysis subjecting the surrounding surface and groundwater to risk of contamination.

B. SWPPP and GPP Incorrect Drainage Area Delineations – The stormwater management design for any facility is based on an analysis of the existing and proposed topography of the site as well as drainage features, pipes, and structures. Collectively this information is used to generate drainage area maps that clearly show where stormwater runoff will flow to. Based on my review of Thrasher's drainage area maps used to analyze and prepare The SWPPP and The GPP (Figures 3 and 4 respectively), several errors were observed which impact the design of the stormwater management structures. A summary of these errors include:

   - Post Development Drainage Bioretention Basin Area – The delineated drainage area associated with the atypical Bioretention Basin is shown on Figure 3 of The SWPPP and Figure 4 of The GPP. The drainage area characteristics are reported as having an overall size of 14.9 acres that includes 1.12 acres of impervious cover and 13.78 acres of grassed area. Upon review of this drainage area, the 1.12 acres of impervious cover that is located adjacent to the west side of the building, is collected via inlets and conveyed to the Rainwater Re-use Pond and not the Bioretention Basin; see Exhibit 3-B1. In addition, the delineation of the western limits of this drainage area are unsupported and in my opinion, additional area further to the west should be included into the drainage area limits, thus increasing Bioretention Basin's overall contributing drainage area.

   - Post Development Drainage Area A Stormwater Basin - The delineated drainage area associated with the Stormwater Management Pond is shown on Figure 3 of The SWPPP and Figure 4 of The GPP. The drainage area characteristics are reported as having an overall size of 40.5 acres that includes 17.0 acres of impervious cover and 23.5 acres of grassed area. However, upon review of this drainage area, the southern and eastern limits are not properly delineated.

     The southern border, which includes drainage inlet (DI) number 15, is not shown correctly. The contours in this area clearly show a minimum of 0.5 acres of additional contributing runoff that was not included to subdrainage area DI#15; see Exhibit 3-B2.

     Along the eastern border, Swale #1 subdrainage area is not shown correctly. The drainage map indicates that runoff from a majority of the area between the midpoint of the stockpile and the "future WVDOH" defies gravity by flowing uphill towards Swale #1; see Exhibit 3-B2. A new subdrainage area flowing to Swale #4 should be introduced, and Swale #1's drainage should be correctly delineated.

There are also major differences in the alignment of Swale #4, the parking lot layout, and the grading in this area among The SWPPP and The GPP figures.

These errors should all be fixed and the Rainwater Re-use Pond, the Bioretention Basin, the Stormwater Management Pond, and Swale #1 and #4 should be reanalyzed and reviewed by the WV DEP for issues that may impact The SWPPP and The GPP.

C. Post Development Drainage Area B Settling/Reuse Basin - The delineated drainage area associated with the Settling/Reuse Basin (Drainage Area B) is shown on Figure 3 of the SWPPP and Figure 4 of the GPP. The drainage area characteristics are reported as having an overall size of 14.7 acres that includes 13.5 acres of impervious cover and 3.7 acres of grassed area. Upon review, there was not enough information to accurately draw the northern boundary of the drainage area and additional topographic information needs to be added to the drawings so that a proper hydrologic assessment can be made.

In addition to this concern, none of the building and roof leader systems were properly assessed. Roofs should be modeled as separate drainage areas that discharge into roof leader systems connecting to specified inlets.

For example, when reviewing subdrainage area DI #32, the roof of the wool waste recycling building is actually collected and conveyed to subdrainage area DI #31 via an underground pipe. However, Thrasher's drainage area map ignores their own design and assumes that the wool waste recycling building's roof runoff somehow discharges to subdrainage area DI #32; see Exhibit 3-C. Misappropriation of flows will result in undersized pipe designs, inlet capacity issues, and potential transport of industrial water to areas other than the Rainwater Re-use Pond.

This type of error occurs in multiple locations throughout Drainage Area B. Each of the subdrainage areas, pipe conveyance calculations, and the Rainwater Re-use Pond sizing should be revised and a new drainage area map, calculations, and performance characteristics of the Rainwater Re-use Pond should be reanalyzed as part of a revised SWPPP and GPP for the site.

D. SWPPP and GPP Underreported Flow Rates and Volumes – The drainage area maps provided with The SWPPP and Thrasher's Stormwater Calculations provide drainage area and subdrainage area limits, characteristics, and peak flow rates. Thrasher used the United States Soil Conservation (SCS) methodology published in Technical Bulletin Number 55 (TR-55) and the software Hydraflow Hydrogrpahs to generate hydrographs for each drainage and subdrainage area under different rainfall return periods.

Although Thrasher's reports produced peak flows and volumes for each subdrainage and drainage area, their hydrographs were established by selecting a time interval of 3-minutes. However, a 3-minute time interval will skip over the peak flow and **underestimates** the actual peak flow by approximately 4 to 5 cfs (1,800 to 2,200 gallons per minute) per subdrainage area. Therefore, to avoid ponding and possible overflowing of inlets, pipes, and basins in an uncontrolled manner, the errors should be corrected and

new hydrographs should be replotted using a standard 1-minute time interval. The updated flow rates and corresponding volumes should then be used to reanalyze and redesign the site stormwater inlets, pipes, basins, ponds, and outfalls. The new designs should be used to update The SWPPP and The GPP for the facility and resubmitted to the WV DEP for review.

E. SWPPP Parking Lot Bioretention Area – To help control stormwater runoff quality and quantity from the proposed development, a bioretention basin in the east parking lot was designed and is depicted in Figure 3 of The SWPPP and The GPP. The bioretention basin is rectangular shaped and is bisected with two pedestrian crossings according to Thrasher's June 2019 Site Package (Sheet 000-009). In this same package, there is a dedicated Bioretention (Parking Area) Detail (Sheet 000-026). The layout and design of the Bioretention Basin on this sheet does not resemble the rectangular version shown on The SWPPP's or The GPP's figures. Given this major inconsistency, I am surprised that the WV DEP reviewed and approved this as a component of The SWPPP and The GPP design. Thrasher should correct the site package to indicate a consistent and detailed bioretention basin design that satisfies the requirements of the West Virginia SWMDGM and is coordinated with the The SWPPP and The GPP.

F. SWPPP and GPP Stormwater Management Pond Outfall / Underground Injection Control – The Stormwater Management Pond is located in the northeast corner of the facility. This basin accepts flow from Drainage Area A and discharges detained water via a riser and an underground pipe that conveys flows north. Eventually, the pipe daylights into a proposed swale cut into existing grade as is shown in Figures 2A, 2B, and 3 of The SWPPP. During construction, this basin was designated as a sediment basin, which utilizes the same outfall riser, pipe, and swale labeled as Ditch D-8.

In accordance with Chapter 3.17 – Outlet Protection of the West Virginia Erosion & Sediment Control BMP Manual, this outfall (pipe daylight) must be stabilized to prevent critical erosion. Thrasher designed outlet protection, detailed the dimensions, and provided rip-rap sizing on their 2019 Site Package (Sheet 000-027). However, Thrasher did not transpose this detail to their grading and drainage plan and instead designed the pipe to discharge directly into Ditch D-8. The detail requirements to construct the outfall protection (Sheet 000-027) is nearly double the proposed width of Ditch D-8. Why this was not shown on their grading and drainage plan and not constructed is concerning. Without proper outlet protection, this discharge will cause severe erosion at this location. I understand that this location has already been issued a notice of violation for erosion.

In addition, Ditch D-8, also referred to as a dry swale or a stormwater structure by the WV DEP, requires cutting or excavating approximately 5 to 8 feet into existing grade to form the swale bottom and sides. According to the July 11, 2017 Geotechnical Investigation by Specialized Engineering, the closest investigation boring to this area was air track probe #4. This probe encountered rock as shallow as 4 feet below grade suggesting that parts or all of Ditch D-8 would be excavated into rock. Because of shallow rock, and the requirements in WV DEP's 2006 Stormwater Management Structure Guidance Document, "structures excavated to bedrock in karst or fractured limestone

areas that do not employ a liner system are required to obtain an Underground Injection Control (UIC) permit from the Division of Water and Waste Management prior to construction and operations."

Therefore, Ditch D-8 should never have been permitted or constructed without a liner or a UIC permit. Use of this outfall and the Stormwater Management Pond should be stopped immediately until this issue is rectified and the environment is better protected.

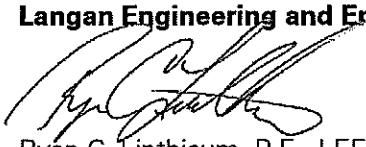
CONCLUSION

The approval of the RAN-5 Facility's application for inclusion into West Virginia's Multi-Sector Stormwater General Permit should have been denied based on my review of the available information submitted to the WV DEP. There are numerous disregards of standards and state guidance, ambiguities throughout the information presented, and numerous errors in the engineering and design of the facility. Accepting the application with these issues at hand shows a clear disregard for public safety and the health of the surrounding environment.

The opinions provided are based on a reasonable degree of engineering certainty and are subject to amendment based on the discovery of additional information including depositions of the associated parties as made available.

Very truly yours,

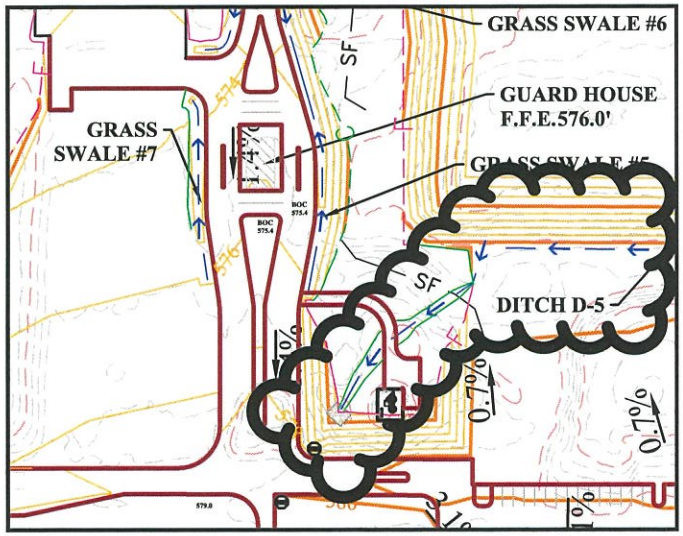
Langan Engineering and Environmental Services, Inc.



Ryan C. Linthicum, P.E., LEED AP
Senior Principal / Senior Vice President

\\langan.com\data\ARL\other\Proposals & Opportunities_2021\Jefferson County\DRAFT report.docx

EXHIBITS



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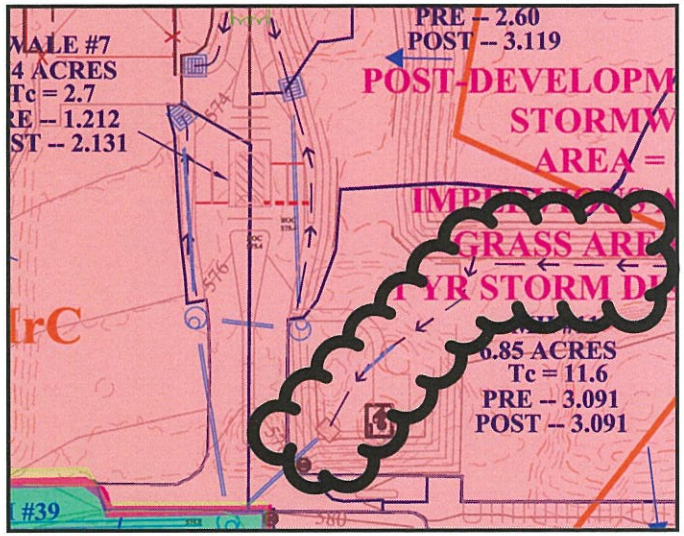

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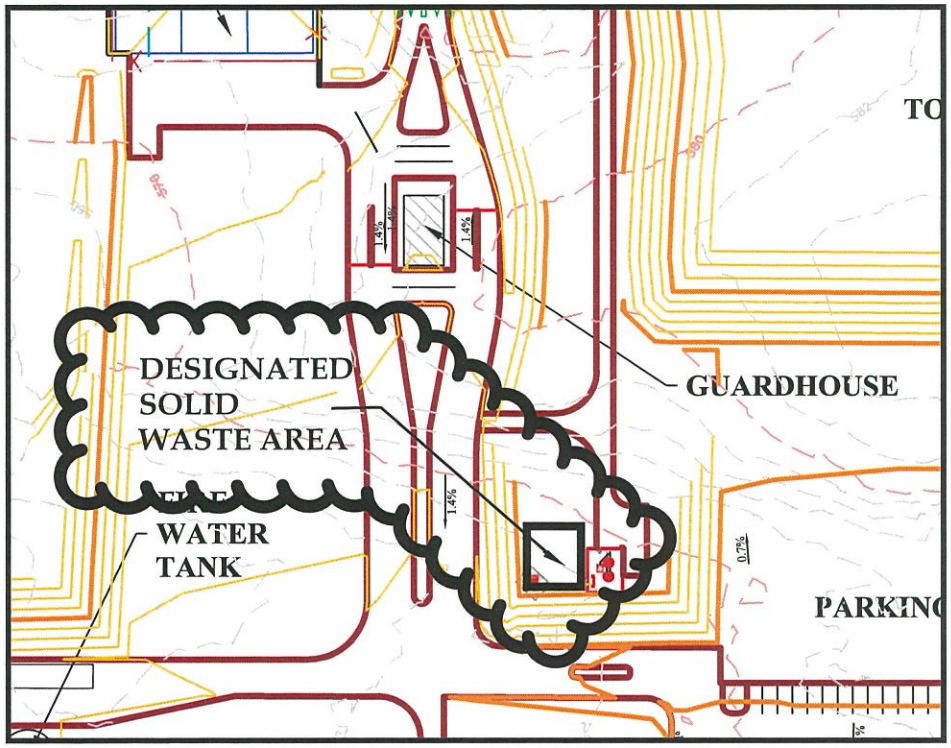
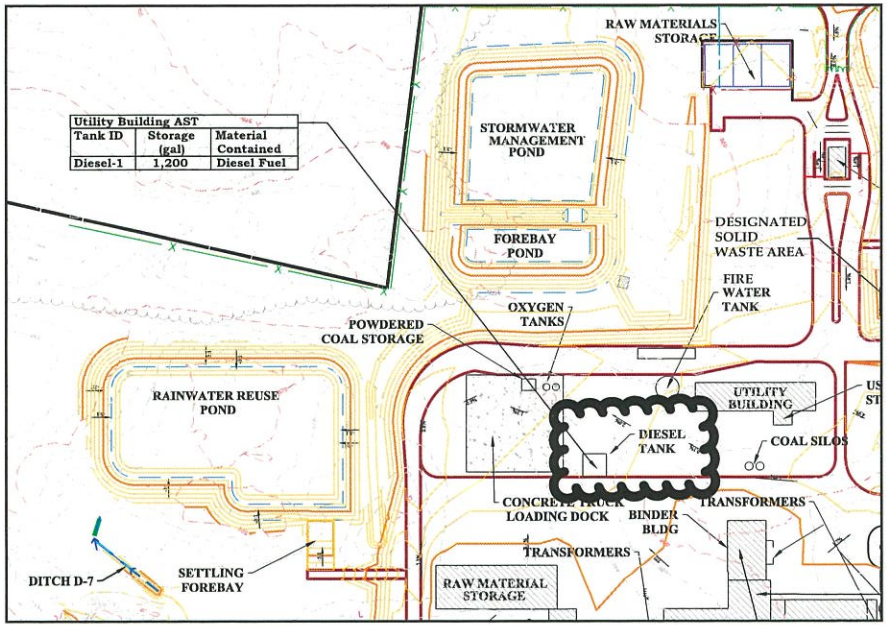


Inset from The SWPPP Figure 2B

EXHIBIT 2A-1



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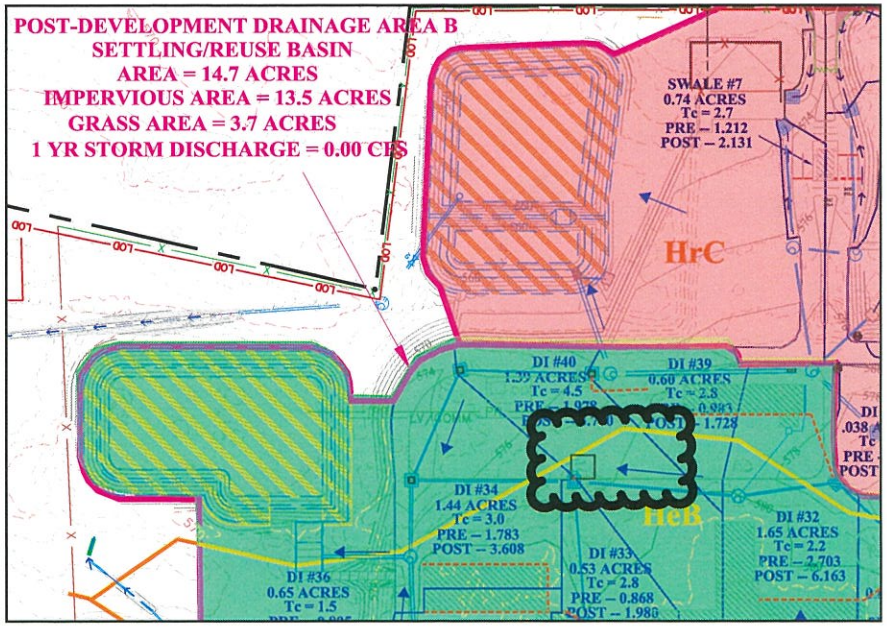

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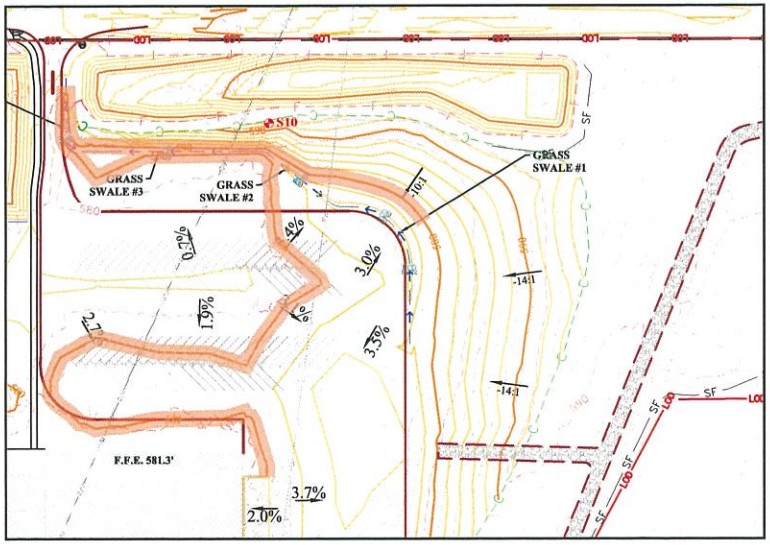

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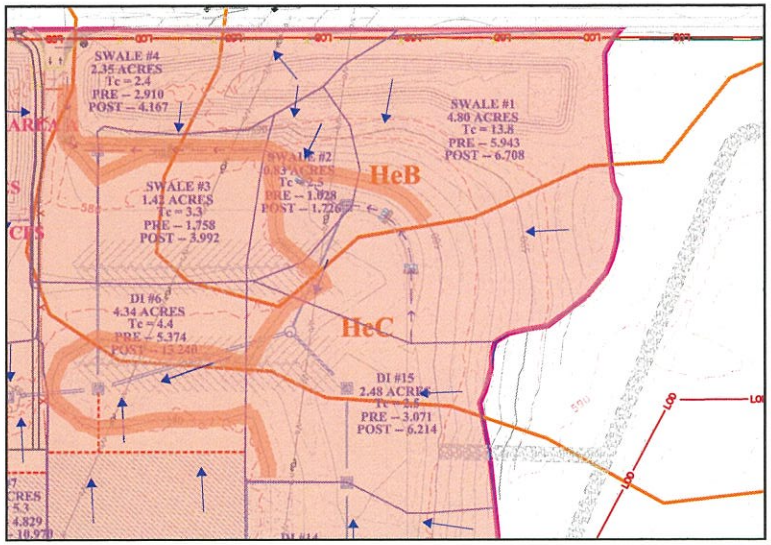

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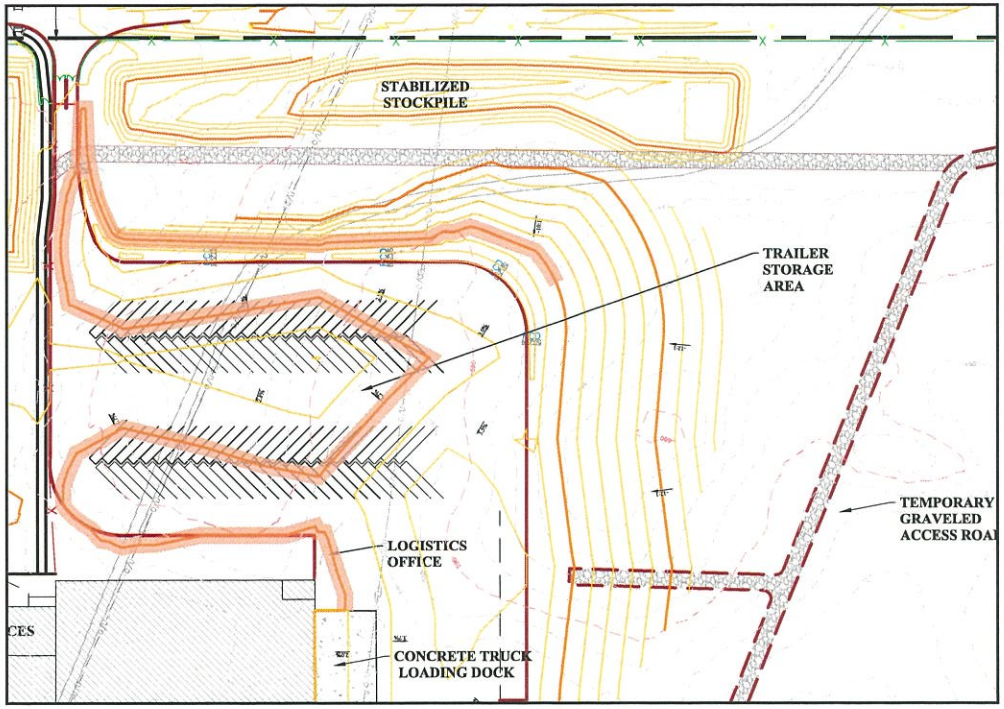

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Note:

Proposed major contour highlighted on all insets for clarity.

EXHIBIT 2B

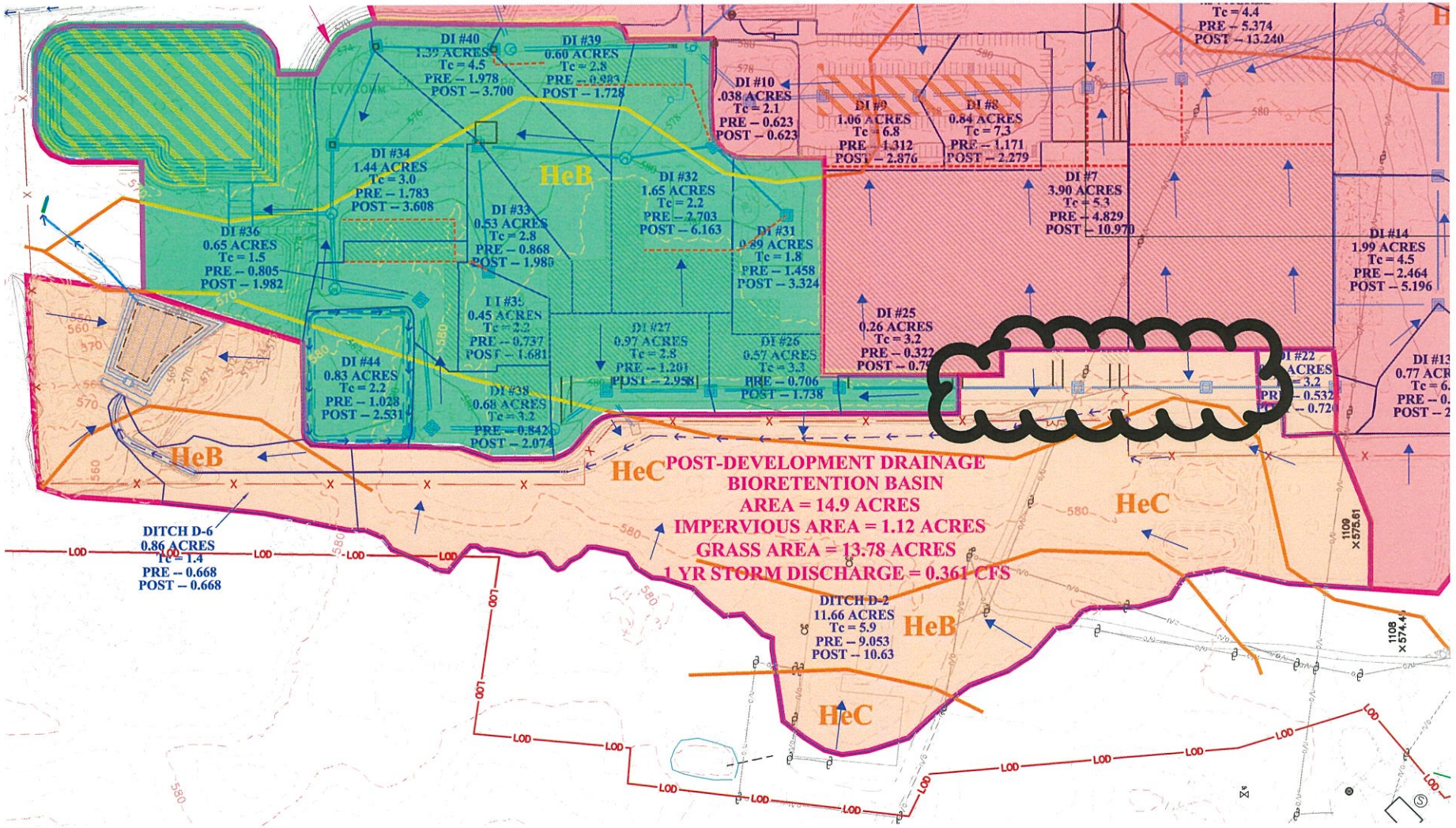

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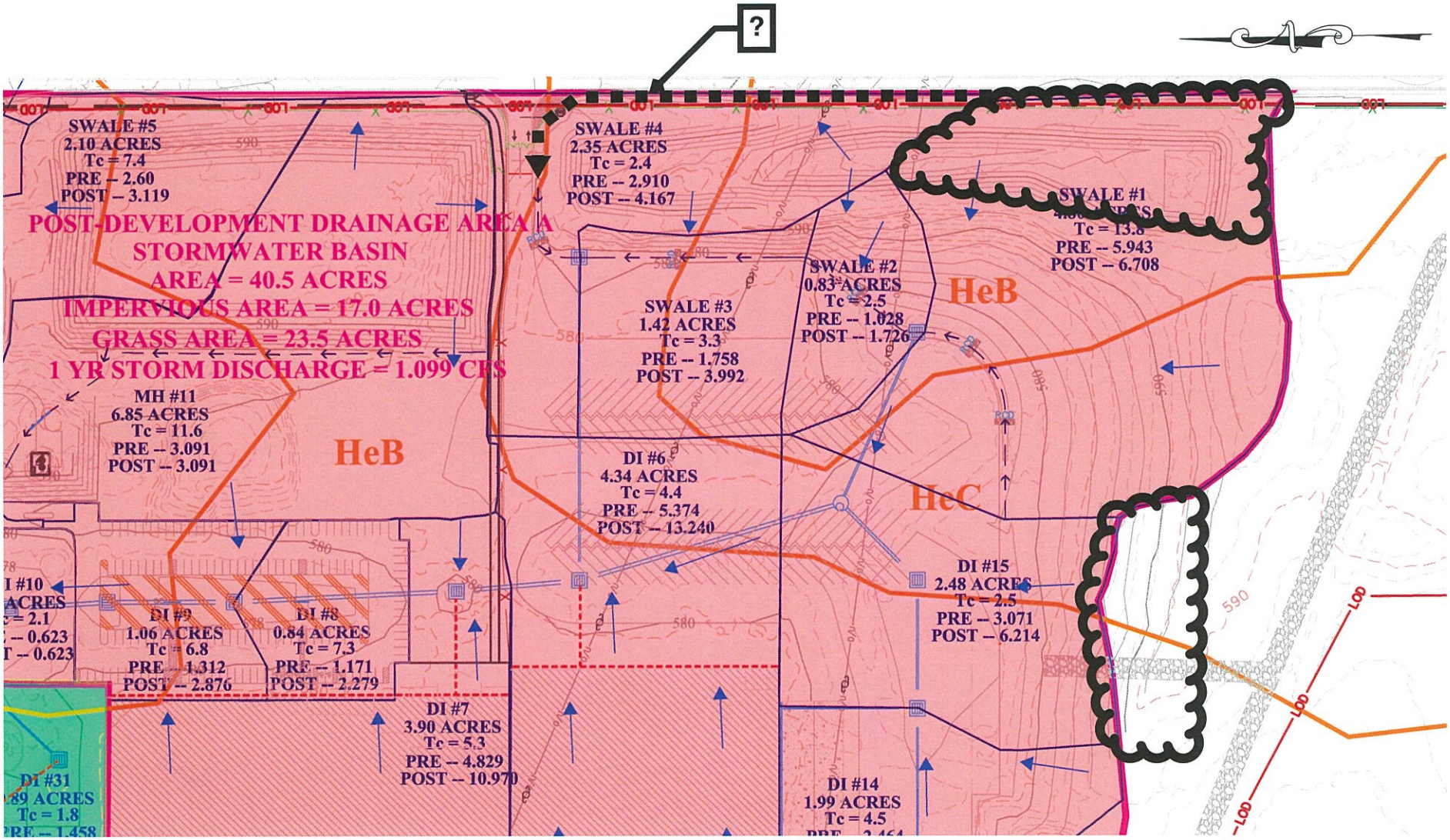
EXHIBIT 3B-1



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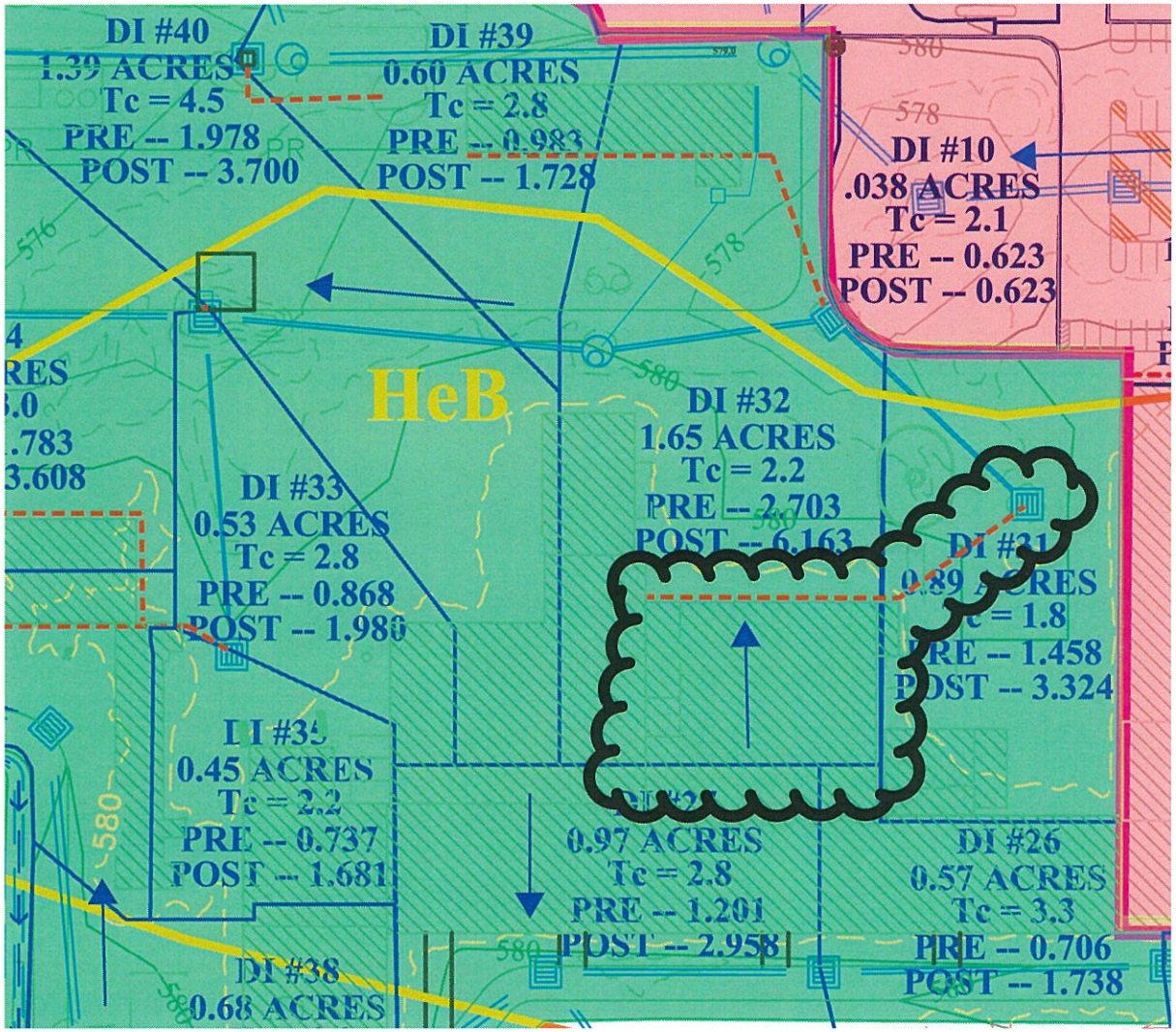

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EXHIBIT 3-C

ATTACHMENT A
Reviewed Documents List

Attachment A
Documents Reviewed for Professional Engineering Opinions
Roxul RAN-5 Facility
WV/NPDES Multi-Sector Stormwater General Permit
Ranson, Jefferson County, West Virginia

Document Number	Date	Author	Title
#1	2000	Robert W. Day	Geotechnical Engineer's Portable Handbook
#2	May 1, 1994	State of West Virginia Legislature	West Virginia Code of State Regulations - Title 47 Legislative Rules Division of Environmental Protection Department of Commerce, Labor and Environmental Resources, Series 58, Groundwater Protection Regulations
#3	May 13, 1994	WV Secretary of State	Notice of Final Filing and Adoption of a Legislative Rule
#4	August 8, 2005	WVDEP	Sinkhole Mitigation Guidance
#5	September 2006	WVDEP	Stormwater Management Structure Guidance Document: Groundwater/UIC Program
#6	November 2012	Center for Watershed Protection, Inc. / WVDEP	West Virginia Stormwater Management and Design Guidance Manual (SMDGM)
#7	June 2017	ERM	Application to Participate in Voluntary Remediation Program, Jefferson Orchards, Inc.
#8	July 2017	Roxul USA, Inc.	Ran 5 Project Storm Water Pollution Prevention Plan
#9	July 11, 2017	Specialized Engineering	Report of Geotechnical Investigation - Project Shuttle - New Industrial Site at the former Jefferson Orchard Kearneysville, Jefferson County, West Virginia Project No, 177164
#10	July 14, 2017	Thrasher Group, Inc.	Figure 1: Site Location, Proposed Development Parcel - Granny Smith Lane, Jefferson, West Virginia, Sheet No. USGS
#11	July 28, 2017	USDA Natural Resources Conservation Service	Web Soil Survey, National Cooperative Soil Survey - Jefferson County, West Virginia (ROXUL LOD)
#12	July 31, 2017	Roxul USA, Inc.	WV Construction Stormwater Permit Application Addendum for Chesapeake Bay Counties Ran 5 Project
#13	July 31, 2017	Roxul USA, Inc.	WVDEP Electronic Submission - New NPDES/State Storm Water Construction - New Permit
#14	July 31, 2017	Roxul USA, Inc.	WV Construction Stormwater Permit Application Addendum for Chesapeake Bay Counties Ran 5 Project - Bioretention Area for Western Grass Area Diversion
#15	August 8, 2017	Thrasher Group, Inc. Group Inc.	Grading Plan, Roxul USA Inc., City of Ranson Site Plan Application, RAN 5 Project, Jefferson County, Ranson, WV - Sheet 000-013
#16	August 8, 2017	Thrasher Group, Inc. Group Inc.	Grading Plan - Roxul USA Inc. City of Ranson Site Plan Application RAN 5 Project Jefferson County, West Virginia Grading Plan
#17	August 8, 2017	Thrasher Group, Inc.	Grading Plan - Roxul USA Inc. City of Ranson Site Plan Application RAN 5 Project Jefferson County, West Virginia Sheet No. 000-013
#18	August 8, 2017	Thrasher Group, Inc.	Pre-Development Watershed Map - ROXUL USA, Inc., City of Ranson Site Plan Application RAN 5 Project, Jefferson County, West Virginia Sheet No. 1
#19	August 8, 2017	Thrasher Group, Inc.	Phase I Construction - ROXUL USA, Inc., City of Ranson Site Plan Application RAN 5 Project, Jefferson County, West Virginia Sheet No. 000-014 & 000-014A

Document Number	Date	Author	Title
#20	August 8, 2017	Thrasher Group, Inc.	Post Development Watershed Map - Roxul USA Inc. - City of Ranson Site Plan Application - RAN 5 Project Jefferson County, West Virginia Sheet No. 2
#21	September 2017	ERM	Site Characterization Report VRP Parcel Jefferson Orchards Site
#22	September 2017	Thrasher Group, Inc.	Hydrology Report - RAN 5 Project, Jefferson County, West Virginia
#23	October 19, 2017	WVDEP	Construction Permit Registration - WV/NPDES Water Pollution Control Permit Registration No. WVR108876
#24	October 19, 2017	WVDEP - Scott G. Mandirola	Approval for WVR 108876, RAN 5 Project, Jefferson County, Acres (98.8) Attachments: WVR108876 Approval Letter.pdf (email)
#25	November 20, 2017	Roxul USA, Inc.	New Source Review, Prevention of Significant Determination Application for Permit to Construct, Mineral Wool Production Facility - Ranson, West Virginia
#26	December 18, 2017	Roxul USA, Inc.	Roxul USA, Inc. Prevention of Significant Deterioration Application - Appendix C Air Quality Assessment, Jefferson County, West Virginia
#27	January 31, 2018	Roxul USA, Inc.	WVDEP Voluntary Remediation Program Application Amendment
#28	February 5, 2018	Roxul USA, Inc.	Prevention of Significant Deterioration (PDS) Application for the Construction of a Mineral Wool Manufacturing Facility, Roxul USA, Inc., Jefferson County, West Virginia
#29	March 2, 2018	WVDEP DAQ - Jon McClung	Air Quality Impact Analysis Review - Roxul USA, Inc., PSD Application R14-0037 - Facility ID# 037-00108
#30	March 8, 2018	WVDEP	Preliminary Determination / Fact Sheet for the Construction of ROXUL USA, Inc.'s RAN Facility, Ranson, Jefferson County, WV Permit: R14-0037 Facility ID 037-00108
#31	March 28, 2018	WVDEP	IPR File Index - Roxul USA, Inc., RAN Facility, Plant ID No. 037-00108, Permit No. R14-0037
#32	March 28, 2018	Spirit of Jefferson Advocate	Air Quality Permit Notice - R14-0037
#33	April 25, 2018	USEPA	Draft Permit to Construct for ROXUL USA, Inc., RAN Facility, Ranson, Jefferson County, Permit Number R14-0037-00108 - Comments
#34	April 27, 2018	WVDEP	Response to Comments ROXUL USA, Inc. RAN Facility Permit No. R14-0037 Plant ID 037-00108
#35	April 30, 2018	WVDEP	Final Determination for the Construction of ROXUL USA, Inc.'s RAN Facility - Permit Number: R14-0037, Facility ID: 037-00108
#36	April 30, 2018	WVDEP	Permit Issuance, ROXUL USA, Inc. RAN Facility Permit No. R14-0037, Plant ID No. 037-00108
#37	June 22, 2018	WVDEP	Review Application Comments/Notes Applicant: Roxul USA Inc. Reissue NPDES/State Storm Water Construction #1 Permit: WVR108876
#38	June 22, 2018	WVDEP	Section Activities - Roxul USA Inc. Reissue NPDES/State Storm Water Construction #1 Permit: WVR108876
#39	September 2018	ERM	Ran 5 Project Storm Water Pollution Prevention Plan
#40	September 10, 2018	Thrasher Group, Inc.	Watershed and Soils Map - Roxul USA Inc. City of Ranson Site Plan Application RAN 5 Project Jefferson County ,WV Sheet No. 000-024

Document Number	Date	Author	Title
#41	September 27, 2018	Roxul USA, Inc.	Statement for Billing Permit Application No. WVR108876
#42	September 28, 2018	Roxul USA, Inc.	WVDEP Electronic Submission Signature Page - Reissue NPDES/State Storm Water Construction Permit ID: WVR108876
#43	October 2018	Thrasher Group, Inc.	Roxul USA Inc. - RAN 5 Project - Site Package - Ranson, WV
#44	October 5, 2018		Rockwool RAN 5 Project - Permanent Pond Liner Cross Section Description
#45	October 16, 2018		Rockwool RAN-5 Project: Supplemental Sinkhole Repair Procedure
#46	October 19, 2018	Thrasher Group, Inc.	Progress Update Map - Roxul USA Inc. - City of Ranson Site Plan Application - RAN 5 Project Jefferson County, West Virginia Sheet No. 2
#47	October 31, 2018	Rockwool USA, Inc.	Application Withdrawal (Letter to WVDEP)
#48	January 10, 2019	WVDEP	Construction Permit - WV/NPDES Water Pollution Control Permit (WV0115924)
#49	February 2019	Thrasher Group, Inc.	City of Ranson Construction Plans for the Northport Avenue Extension State Project No. X319-9/68-0.30
#50	June 2019	Thrasher Group, Inc.	Site Package - Roxul USA Inc. RAN 5 Project Site Package Ranson, WV
#51	June 20, 2019	Thrasher Group, Inc.	Bioretention Basin - Roxul USA Inc. City of Ranson Site Plan Application RAN 5 Project Jefferson County ,WV Sheet No. 000-019A
#52	June 20, 2019	Thrasher Group, Inc.	Final Site Plan - Roxul USA Inc. City of Ranson Site Plan Application RAN 5 Project Jefferson County ,WV Sheet No. 000-006
#53	July 2019	ERM	Integrated Environmental Plan: Storm Water Pollution Prevention Plan and Groundwater Protection Plan - RAN 5 Facility
#54	July 22, 2019	ERM	Spill Prevention, Control, and Countermeasure Plan (SPCCP) Prepared for Roxul (Updated October 13, 2020)
#55	July 22, 2019	WVDEP	Review Application Comments/Notes Applicant: Roxul USA Inc. WVG611896
#56	July 22, 2019	WVDEP	Section Activities - Roxul USA Inc. New NPDES Industrial Permit #1 WVG611896
#57	July 22, 2019	Roxul USA, Inc.	DEP Electronic Submission System Statement for Billing for Roxul USA, Inc. New NPDES Industrial Permit
#58	July 22, 2019	Roxul USA, Inc.	DEP Review Section Attachments - Rockwool USA, Inc. New NPDES Industrial Permit #1 - WVG611896
#59	July 22, 2019	Roxul USA, Inc.	DEP Review Application Comments - Rockwool USA, Inc. New NPDES Industrial Permit #1 - WVG611896
#60	July 22, 2019	ERM	Spill Prevention and Response Plan RAN-5 Manufacturing Facility
#61	July 24, 2019	ERM	USGS 7.5" Quadrangle Topo Map RAN-5 Facility Location

Document Number	Date	Author	Title
#62	September 13, 2019	Rockwool USA, Inc.	Rockwool Response to Multi-Sector Application Comments Dated September 12, 2019. Permit Application WVG611896
#63	November 4, 2019	Jefferson County Foundation, Inc.	Public Hearing/Notice No. SM-108-2019. Application Nos. WVR108876 reissue #2 and WVG611896 - Public Comments
#64	January 27, 2020	ERM	RAN 5 Project Groundwater Protection Plan
#65	January 27, 2020	Thrasher Group, Inc.	Pre-Construction Watershed - Roxul USA Inc. City of Ranson Site Plan Application RAN 5 Project Jefferson County ,WV Sheet No. 000-024-A
#66	January 27, 2020	ERM	Response to WVDEP Comments on Renewal Application for Coverage Under the West Virginia General Storm Water Permit (WV0115924)
#67	February 6, 2020	ERM	Ran 5 Project Storm Water Pollution Prevention Plan
#68	February 6, 2020	Thrasher Group, Inc.	Watershed and Soils Map - Roxul USA Inc. City of Ranson Site Plan Application RAN 5 Project Jefferson County ,WV Sheet No. 000-024
#69	February 6, 2020	ERM	Rain Gauge and NPDES Sign Location RAN - 5 Facility
#70	February 25, 2020	WVDEP	General Permit Registration No. WVR108876, Jefferson Co. Roxul USA Acres (98.5) Authorization
#71	February 25, 2020	WVDEP	WV Permit No. WV0115924 Roxul USA, Inc., Registration Application No. WVR108876 Response to Public Comments
#72	May 24, 2020	Thrasher Group, Inc.	Progress Update Map - Roxul USA Inc. - City of Ranson Site Plan Application - RAN 5 Project Jefferson County, West Virginia
#73	June 2, 2020	ERM	Response to WVDEP Comments on Renewal Application for Coverage Under the West Virginia General Storm Water Permit (WV0115924)
#74	June 4, 2020	ERM	Response to WVDEP Comments on Construction Storm Water Permit Renewal Application, Registration #WVR108876 RAN 5 Project (Letter)
#75	August 4, 2020	Chris Groves, PhD, PG	Karst Hydrogeology and the Potential for Associated Environmental Risks Resulting From the RAN 5 Project, Jefferson County, West Virginia
#76	August 19, 2020	Roxul USA, Inc.	WVDEP Electronic Submission - Reissue NPDES/State Storm Water Construction #1 - Permit ID: WVR108876
#77	September 13, 2020	Roxul USA, Inc.	WVDEP Electronic Submission System - Reissue NPDES/State Storm Water Construction #2 - Permit ID: WVR108876
#78	October 2020	ERM	Spill Prevention and Response Plan RAN-5 Manufacturing Facility
#79	October 12, 2020	Thrasher Group, Inc.	Sinkhole Locations Overall Site Plan View Jefferson County, Ranson, WV Sheet 1
#80	October 13, 2020	ERM	Storm Water Pollution Prevention Plan (SWPPP) Prepared for Rockwool USA, Inc.
#81	October 13, 2020	ERM	Ground Water Protection Plan (GPP) Prepared for Rockwool USA, Inc.
#82	October 13, 2020	ERM	Response to WVDEP Comments Dated 10/07/2020 on New NPDES Industrial Permit Application, Registration #WVG611896

Document Number	Date	Author	Title
#83	October 13, 2020	Roxul USA, Inc.	DEP Electronic Submission System Application for Roxul USA, Inc. New NPDES Industrial Permit #1 WVG611896
#84	November 2, 2020	Rockwool USA, Inc.	Monitoring Well Network Development Plan - Revision 1.0
#85	November 2, 2020	ERM	RAN-5 Facility and Surrounding Area Source Water Protection Area Data
#86	November 3, 2020	ERM	Response to WVDEP Comments Dated 10/30/2020 on New NPDES Industrial Permit Application, Registration #WVG611896
#87	November 9, 2020	WVDEP	Application Milestones - Roxul USA Inc. New NPDES Industrial Permit #1 WVG611896
#88	December 4, 2020	Arnold and Bailey	Notice of Appeal Jefferson County Foundation, Inc. v. WVDEP
#89	January 26, 2021	WVDEP	Industrial Permit - West Virginia NPDES Multi-Sector General Water Pollution Control Permit (WV0111457)
#90		WVDEP	West Virginia Generic Groundwater Protection Plan https://dep.wv.gov/WWE/Programs/stormwater/csw/Documents/WV GENERIC GROUNDWATER PROTECTION PLAN.docx
#91		WVDEP	Draft Permit to Construct R14-0037 Issued to: ROXUL USA, Inc., RAN Facility 037-00108

APPENDIX B
Resume

RYAN C. LINTHICUM, PE, LEED AP

SENIOR PRINCIPAL / SENIOR VICE PRESIDENT

SITE/CIVIL AND GEOTECHNICAL ENGINEERING

Mr. Linthicum is an experienced engineer in site/civil, geotechnical, and dam safety engineering. With over 23 years of experience, Ryan currently heads Langan's Arlington, Virginia office and is a Senior Principal in the firm. He has served both public and private sector clients in land development and redevelopment throughout the District of Columbia, Maryland, Virginia, New Jersey, and New York; in addition to an impressive portfolio internationally. His experience includes site engineering, hydrologic modeling, landfill redevelopment, infiltration basin studies, roadway design, sanitary design and permitting, erosion and sediment-control plans, subsurface geotechnical investigations, establishment and monitoring of geotechnical instrumentation, design and inspection of shallow and deep foundation systems; slope stability analyses; landslide failure restraint and remediation, temporary and permanent earth retaining structures, preparation of geotechnical engineering reports; and coordination and supervision of construction inspection services.

SELECTED PROJECTS

Crystal Creek Estates Expert Witness, Howell, NJ – Provided expert witness services for a litigation case involving the influence of stormwater, groundwater, earthwork, and construction sequencing/processes on several single-family residential units in Howell Township, NJ. Expert findings and conclusions were submitted in a technical report and were also defined during depositional proceedings.

Mansfield Farms Expert Witness, Mansfield Township, NJ – Provided expert witness services involving the design, documentation, contractual agreements, construction, and functioning of wastewater infiltration basins located in Mansfield Township, NJ. The basins were intended to receive secondary wastewater from a residential development and infiltrate the receiving wastewater below grade into the groundwater regime. Expert findings and conclusions were submitted in a technical report and were also defined during depositional proceedings.

Watchung Square Expert Witness, Watchung, NJ – Provided geotechnical and site/civil expert services for litigation proceedings regarding a 2,000 LF slope failure in New Jersey. The slope failure resulted in large project delays and added significant costs to the overall project. Investigations into the cause of the failure with respect to subsurface conditions as well as construction means and methods were completed and expert findings and conclusions were submitted in a technical report and were also defined during depositional proceedings and in trial.

Residential Development Expert Witness, City of Manassas Park, VA – Provided site/civil expert services in support of a lengthy arbitration process regarding the permitting, design, stake-out, and construction of several site retaining walls. The walls were allegedly not designed, permitted, and constructed according to previous agreements and approvals. Expert findings and conclusions were submitted in a technical report and the case was settled.

EDUCATION

M.Sc., Civil Engineering
Lehigh University

B.Sc., Civil Engineering
Lehigh University

PROFESSIONAL REGISTRATIONS

Professional Engineer (PE) in WV, VA, DC, MD, NY, NJ, PA, NC, GA, AL, SC, MT, WA, TN, ME, IN, CO, KY, MI, ND, AZ

LEED Accredited Professional (LEED AP)

USCEIP International Registry, Division of NCEES

AFFILIATIONS

District of Columbia Building Industry Association

Urban Land Institute

American Society of Civil Engineers

Design-Build Institute of America

LANGAN

Retaining Wall Collapse Expert Witness, Woodbridge, VA – Provided expert witness services in support of an arbitration process regarding the design and construction of a 40-foot tall site retaining wall faced with precast concrete façade panels. The panels were part of a mechanically stabilized earth retaining wall system constructed to transition grades at the site. Expert findings and conclusions were submitted in a technical report and were also defined during arbitration proceedings.

Confidential Assignment, Dam Safety Expert Witness, NJ – Provided civil, geotechnical, and dam safety expert witness services for an embankment failure in southern New Jersey. Expert findings and conclusions were submitted in a technical letter and were also defined during depositional proceedings. The dispute was settled via arbitration hearings.

Warehouse Collapse Expert Support, Capitol Heights, MD – Provided geotechnical forensic support services in a warehouse collapse investigation in Maryland. Support tasks involved subsurface investigations and site documentation. Factual data was given to the involved parties to facilitate expert findings.

USGS Leetown Science Center, Kearneysville, WV – Performed subsurface borings, a geophysical survey, and hydraulic and hydrologic studies to assess the extents of the existing eroded dam. Drawings and reports were required to confirm that no detrimental impacts would occur as a result of the required repair work to the USGS's Leetown Science Center earthen dam located in Jefferson County, West Virginia. A dam stability analysis and structural improvements were designed, which required the installation of a metal sheet pile wall into the existing berm.

Target Store, Barboursville, WV – Provided civil and geotechnical consulting services associated with movement and settlement of a 60-ft high embankment. The embankment was previously stabilized by others with anchored thrust blocks, a toe berm, and surficial geosynthetics. Despite these efforts, the slope continued to experience movements and thus remedial construction drawings to facilitate a 70-ft high hillside stabilization program consisting of a two-tiered anchored sheet pile wall system. Once completed, the slope was stabilized and the structures upslope structures were repaired and opened for business.

Norfolk Southern Autoramp Facility, Hagerstown, MD – Provided site/civil and permitting services associated with a proposed auto ramp facility in Hagerstown, Maryland. The facility included the addition of two new railroad tracks, a site access roadway with guardhouse, and a vehicle storage parking lot. Numerous site constraints and project design parameters were considered to successfully design the 35-acre± facility within four months. Major design challenges included the presence of karst bedrock, construction, extensive proposed grade changes of 20 to 30 feet across the site, and detailed construction/permitting sequencing. Important design parameters included grading the site to direct runoff away from both the existing and proposed railroad tracks, minimizing the amount of earthwork required for construction, and designing the stormwater management system to consider karst bedrock and to incorporate non-structural measures.

United States Embassy, Rabat, Morocco – Provided site/civil, environmental, and geotechnical engineering services for the New Embassy Compound (NEC) in the south east portion of the City of Rabat. The proposed site is a former orange orchard surrounded by residential properties. Site constraints include sloping terrain, shallow karst rock, zoning restrictions, and coordination with the City's Master Plan. Stormwater detention areas were located away from building foundations and lined with an impermeable liner to

avoid interaction with the underlying karst bedrock. The detention systems also retained a portion of condensate water for re-use as irrigation supply on site. Deliverables included the development of a Design-Build RFP package containing drawings, specifications, calculations, earthwork quantities, and construction staging/sequencing drawings.

Sinking Spring Shopping Center, Berks County, PA – Provided site/civil design services for the Sinking Shopping Center on a 25-acre site. The site is located in a geological region of Pennsylvania that has high incidences of sinkholes. Geotechnical engineering practices were implemented, including proof drilling and grouting, and sinkhole remediation. Sinkhole monitoring was required through the construction period as the site was cleared.

Drainage Basin Slope Failure, Greenbrook Township, NJ – Performed field inspection and engineering analysis of a slope failure that had occurred within a detention basin constructed within clayey soils. Performed several back analyses to determine a range of soil parameters for the on site materials and checked against available design soil test data. Provided recommendations for long-term slope stabilization, consisting of re-grading portions of the slope, applying TECCO® over portions of the slope, and stabilizing the surficial material with a crown vetch mix.

Charlotte Hall Multi-Sport Athletic Fields, Saint Mary's County, MD – Provided site/civil, permitting, surveying, natural resources, forest conservation, and geotechnical services for three proposed multi-purpose athletic fields located in Saint Mary's County, Maryland. The proposed design requires approximately 7-acres of forest clearing, significant earthwork (6 to 10 foot changes in grade), and close coordination with riparian buffers associated with a nearby intermittent stream. Design approval was obtained in 2010 and construction was completed in 2013.

Infiltration Investigation and Remediation, Neptune, NJ – Performed a site wide investigation to determine the reason for the poor performance of four stormwater infiltration basins. The investigation consisted of a series of groundwater wells, geotechnical test pits, and percolation testing. The study indicated that the improper construction of the basins, which included the discovery of thick layers of topsoil and debris lining the basins, had a direct impact on the infiltration capacity of the basins. The basins were remediated and the intended infiltration capacity of the basins was restored.

Montoursville Dam/Levee, Fairfield, PA – Performed a geotechnical and hydraulic analysis of the proposed Montoursville dam/levee required to compensate for the construction of a retail development partially located within the floodplain limits of the Loyalsock Creek. The proposed dam/levee ranges in height from 1 foot to 12 feet and will have a top width ranging from 30 feet to over several hundred feet. The purpose of the earthen dam/levee is to separate the Loyalsock Creek from a large proposed flood storage area adjacent to the new development. The geotechnical and hydraulic evaluations included evaluating the dam/levee for scour potential, piping failure, overbank erosion, and overall stability under flood and ice flow events.

Pennsylvania Avenue Groundwater Investigation, Washington, DC – Provided geotechnical and environmental services associated with groundwater infiltration through the walls and lowest floor slab of a below-grade parking garage along Pennsylvania Avenue in Washington DC's northwest quadrant. The proposed investigation consisted of installing groundwater monitoring wells to document the confined and unconfined groundwater levels surrounding the garage. The results of the monitoring well data and subsurface geotechnical information collected during the well installation was used to present remedial solutions to the property owner.

United States Embassy Redevelopment, Brasilia, Brazil – Provided site/civil and geotechnical engineering services to support the planning, design, and construction of a new embassy campus on the same site as the existing embassy. Site challenges included complex phasing, deep foundations, and subgrade improvements to address collapsible soils in areas of stormwater retention areas and utility corridors.

Silver Lake Dam, Gibbsboro, NJ – Provided annual regular inspections of the Silver Lake Dam and associated appurtenances. The dam is located on an EPA site with extensive subsurface contamination. Performed sinkhole repair, masonry repair, boardwalk repair and trash-rack design work. Designed a new stormwater conveyance network downstream of the dam to avoid infiltration and exfiltration of the discharge line..

Rock Slope Analysis for Residential Development, Jersey City, NJ – Geotechnical engineering and consulting related to development at the toe of an 80 feet high by 500 feet long section of the Palisades cliff. Assisted in the inspection and evaluation of rockfall hazards and developed recommendations for stabilizing the cliff and protecting against rock fall of an adjacent existing building. Rock stabilization bid documents were also prepared.

SELECTED PUBLICATIONS, REPORTS, AND PRESENTATIONS

Langan, B, Linthicum, R, Tonning, R, "Holding Back the Watchung Mountains", Earth Retention Systems 2003, A Joint Conference presented by ASCE Metropolitan Section Geotechnical Group, The Deep Foundations Institute, and the International Association of Foundation Drilling May 6 and7 2003.

Linthicum, Ryan C.; Various American Institute of Architects seminars associated with Land Development Engineering, Geothermal Systems, and Geotechnical Engineering, 2007-ongoing