ROCKWOOL'S STORMWATER POND DESIGN, CONSTRUCTION DEFICIENCIES AND GROUNDWATER CONTAMINATION

G. A. Perry, Architect, LEED AP - gavarch@gmail.com – January 7, 2020.

Sinkhole in Rockwool's Basin #1 – October, 2018

CONTENTS

INTRODUCTION

My name is Gavin Perry; I am an architect, LEED AP and live with my family approximately half a mile from the Rockwool factory. Like 80% of the County residents, businesses and farms, our only water source comes from our private well.

The Rockwool factory will include a number of above ground ponds, including Stormwater and Process Water ponds. The ponds will hold stormwater runoff and waste materials from the mineral wool manufacturing process.

Of great concern to the residents of Jefferson County is that sinkholes will open up under the ponds, rupturing the lining and seams and allowing waste materials from the factory to drain into and contaminate the groundwater.

Jefferson County geology consists primarily of karst (limestone) and includes large numbers of sinkholes. Karst is very susceptible to sinkhole formation and the sinkholes have direct connections to the groundwater.

For ten years I volunteered for the Land Trust of the Eastern Panhandle of WV and annually visited over 40 farms and saw the direct impact of sinkholes on water sources; from large farm ponds running dry because they had "sprung a leak", sinkhole; to Rattlesnake Run disappearing into a sink hole and resurfacing a couple of hundred yards downstream; to the Run disappearing totally as it drained in a sinkhole on its bank.

I am currently on the Board and Treasurer of the Jefferson County Farmland Protection Board, **but views expressed here are my own.**

SUMMARY

West Virginia DEP must not issue the Rockwool Stormwater Permit until the indentified design and construction deficiencies are corrected. Rockwool's stormwater pond design is **INADEQUATE AND INAPPROPRIATE for karst terrain, located as it is, at the highest concentration of sinkholes in Jefferson County and at the headwaters of numerous local streams.**

ALL STORMWATER POND LINERS LEAK, BECAUSE OF HOLES, CRACKS AND RIPS IN THE MATERIAL AND SEAMS OR THROUGH A COMPLETE FAILURE CAUSED BY SINKHOLES OPENING UP UNDER THE LINER.

A LINER SYSTEM MUST BE INSTALLED WHICH WILL MINIMIZE THE LEAKAGE. THE QUESTIONS THEN BECOME:

HOW MUCH WILL LEAK?

WHAT IS CONTAINED IN THE PONDS THAT LEAK?

WHAT DAMAGE WILL THE LEAK CAUSE TO THE GROUND AND WATER BELOW?.

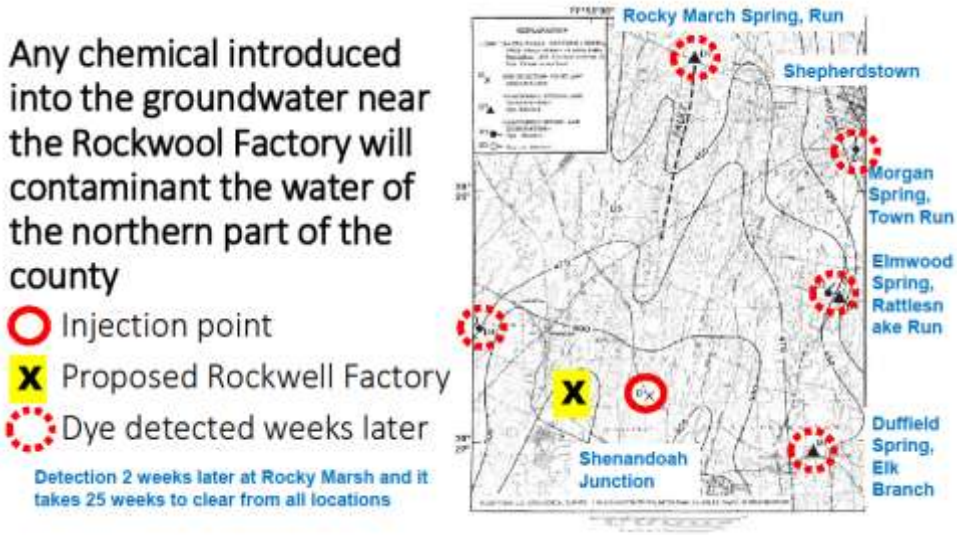
The design and construction deficiencies identified in the report are based on the recommendations contained in the **Chesapeake Stormwater Network, Technical Bulletin No. 1, Stormwater Design Guideless for Karst Terrain in the Chesapeake Bay Watershed,** and **recommendations of L. Everett & Associates** a leading national environmental consulting firm.

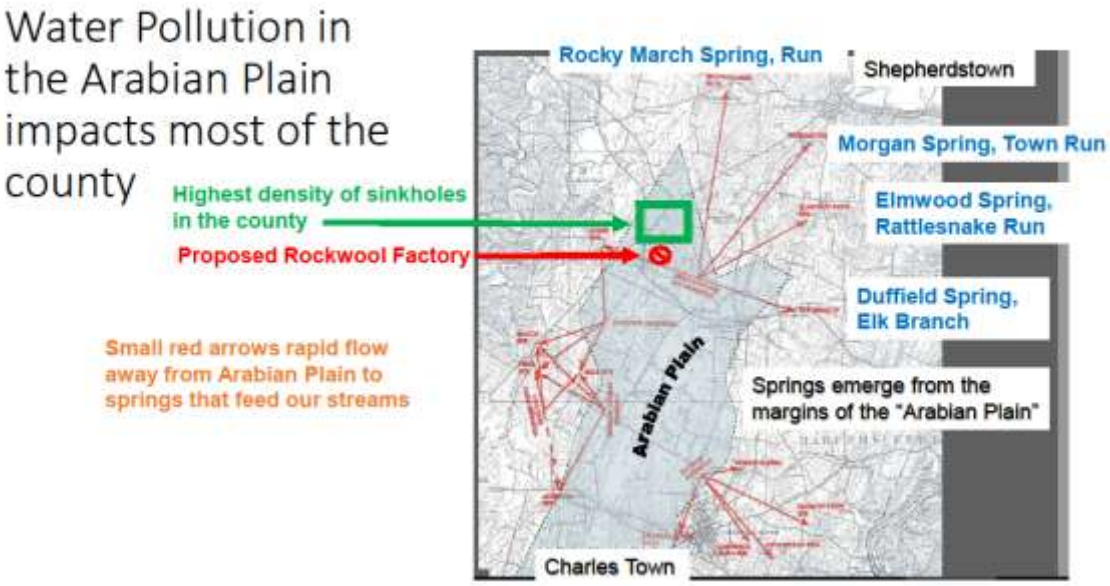
The danger to the underground water supply is from SINKHOLES WHICH HAVE NOT YET FORMED. It is certain that sinkholes will form under the lagoons and the pond liners will be damaged and the seams opened up. A dye test done in the 1990s showed that dye injected into the groundwater near the Rockwool site found its way to the **Morgan Spring, which feeds the Shepherdstown's Town Run, Elmwood Spring, which feeds Rattlesnake Run and the Duffield Spring- Elk Branch.**

EXISTING SITE CONDITIONS

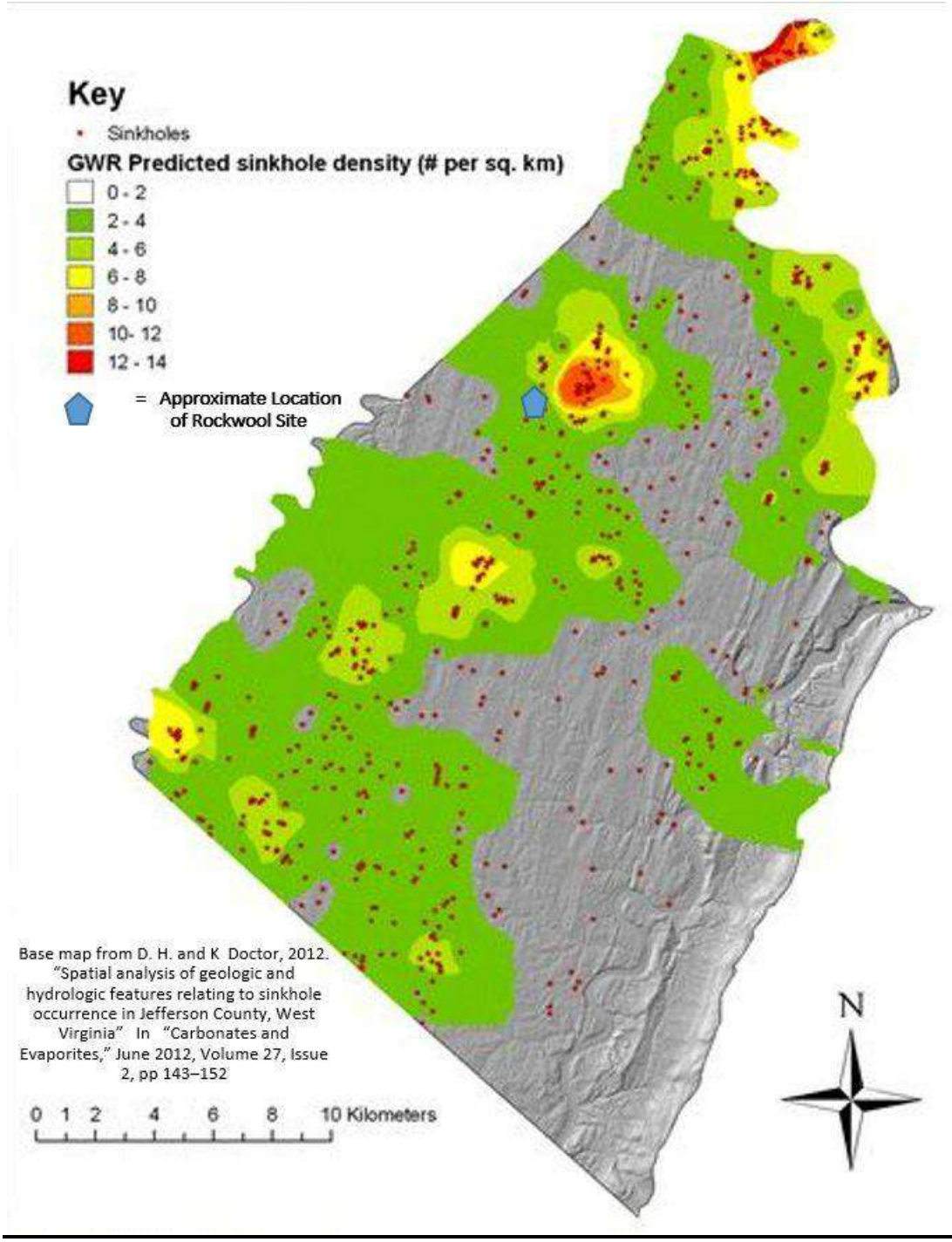
LOCAL HYDROLOGY AT ROCKWOOL SITE

The local hydrology of Jefferson County consists of three Hydrogeologic Units, two of which meet at the location of the site of the Rockwool factory; creating ground faults, fractures and sinkholes through which pollutants can enter the groundwater and contaminate local wells and springs. **A spill, leaking sewer line or rupture of the stormwater ponds liners would result in water contamination and health and safety issues as the contaminated material will move rapidly underground. It will be very difficult to track and very expensive to clean up.**





PONDS LOCATED AT THE HIGHEST CONCENRATION OF SINKHLES



ROCKWOOL'S GEOTECHNICAL RREPORT

Project Shuttle -New Industrial Site at the former Jefferson Orchard Kearneysville, Jefferson County, West Virginia Specialized Engineering Project No. 177164

Prepared for: Thrasher 600 White Oaks Blvd Bridgeport, WV 26330.

Prepared by: Specialized Engineering 4845 International Blvd, Suite 104 Frederick, MD 21703, July 11, 2017

1.0 EXECUTIVE SUMMARY

The greatest difficultly in developing this site is expected to arise from dealing with the Karst terrain. Karst will likely have several effects on the project, which include the following:

• Dropouts may form during (and after) construction, and must be repaired;

• Constructed ponds should include a synthetic liner to reduce the potential for infiltration from the ponds to the subsurface.

3.2 Area Geology

Limestone and dolomite are a bedrock type susceptible to solution by water. This solution creates voids in the bedrock, creates a highly irregular bedrock surface, and has the potential for sinkhole formation. Areas underlain by limestone/dolomite are known as karst terrain for the distinctive landform (i.e., sinkholes) found at the surface.

The Project Site Is Located In An Area With The Potential For Sinkhole Formation.

a) Sinkholes are formed in karst by either slow, downward solutioning or rapid collapse of the land surface. Sinkholes can occur naturally or can be induced by activities of man.

b) The stability of the residual soils that overlie limestone is a concern for long term stability and maintenance of structures located in karst terrain. **Voids or domes often form in the residual soil above rock cavities, and unless the thickness of the residual soil is sufficient to carry the imposed loads and for development of arching, the soil may collapse and sinkholes may form.**

c) Some sinkholes failures can be induced by construction activities and are of significance because the sinkholes can directly affect the site being developed, either immediately or some years later. Construction activities that can trigger sinkholes include 1) diversion or impoundment of drainage or dewatering activities, 2) removal of overburden cover, 3) shock vibrations, such as blasting, and 4) increased loading.

d) Prediction of sinkhole location or occurrence is difficult, if not impossible, and there is always a significant degree of uncertainty associated with the occurrence of future sinkholes. Structures built within the area of influence of a sinkhole can also be affected by sinkhole collapse or subsidence.

By virtue of the underlying geologic formation, the Owner must acknowledge there is an inherent risk of potential ground subsidence or collapse associated with construction of structures in karst terrain. All sites in karst terrain have the potential for sinkhole formation. Specialized Engineering can provide no warranties or guarantees regarding future sinkhole or subsidence conditions.

ROCKWOOL HAS DONE NONTHING TO MITIGATE THE DANGERS CAUSED BY THE ACTUAL AND OF FUTURE SINKHOLE OPENING UP UNDER THE STORMWATER PONDS

STORMWATER POND DESIGN GUIDELINES AND RECOMMENDATIONS

STORMWATER POND DESIGN GUIDELINES

CSN TECHNICAL BULLETIN No. 1

STORMWATER DESIGN GUIDELINES FOR KARST TERRAIN IN THE CHESAPEAKE BAY WATERSHED, VERSION 2.0

(Sinkhole at the abandoned Tackley Mills subdivision at the intersection of Old 9 and Wiltshire Bld. The sinkhole grew large enough to threaten Old 9)

The stormwater design supplement has been prepared for engineers, plan reviewers, and public works officials to guide better stormwater decisions when land is developed in karst regions of the Chesapeake Bay watershed. Until now, available local and state guidance on this topic has been uneven, sometimes conflicting and certainly not comprehensive. An informal working group has spent the last year developing this guide.

It is intended that the Technical Bulletin can be incorporated directly or by reference into local and state land development codes, ordinances, regulations, permits and engineering manuals in the Bay watershed that govern how stormwater is managed in karst terrain.

Several important caveats apply to this edition. **First, the effect of land development on karst terrain is complex and hard to predict, and requires professional analysis to reduce the risk of geological hazards, damage to infrastructure and groundwater contamination**. Second, the bulletin has been produced to respond to the recent growth pressures in many small communities in the Great Valley, Eastern Panhandle and South Central Pennsylvania. **The working group acknowledges that past approaches to stormwater and land development in karst terrain have been inadequate to safeguard the public and the environment.**

It Is Recommended That Stormwater Ponds Not Be Located In Karst Terrain. Rockwool Built Their Ponds In Karst Terrain.

ROCKWOOL HAS BUILT ITS STORMWATER AND PROCESS WATER PONDS IN KARST TERRAIN

"…while communities that incorporate this guidance into their development review process can reduce the incidence of infrastructure damage and groundwater contamination, there is always some inherent risk when development occurs on this sensitive terrain. **Consequently, the best local approach is to craft stronger comprehensive land use plans that direct new growth away from karst areas to more appropriate locations**…"

KARST FEATURE PLAN

"Detailed site investigations are required in the design of all building, roads, stormwater conveyance and centralized stormwater facilities proposed within karst areas. The purpose of the investigation is to develop a **KARST FEATURE PLAN** that identifies the location and elevation of subsurface voids, cavities, fractures and discontinuities. **Presence of any of these features could pose a danger to groundwater quality, a construction hazard or an increased risk of sinkhole creation at a proposed centralized stormwater facility.**

Pertinent site data to collect includes:

- Bedrock characteristics (e.g., type, geologic contacts, faults, geologic structure).
- Soil characteristics (type, thickness, spatial variability, mapped unit, geologic parent/history, infiltration rate, depth to seasonally high water table)
- Identification/verification of geological contacts if present, especially between karst and non-karst formations
- Photo-geologic fracture trace map
- Bedrock outcrop areas
- Sinkholes, closed depressions, grikes and solution-enlarged voids
- Cave Openings
- Springs
- Perennial, intermittent and ephemeral streams and their flow behavior and surface or subsurface discharge points (e.g., losing or gaining streams), channels and surface drainage network
- Site-scale watershed boundaries based on large scale site topography (i.e., one foot or less contour intervals)

- Layout of proposed buildings, roads, and stormwater structures (and estimated site impervious and turf cover)
- Existing stormwater flow pattern

Stormwater designers should retain the services of a qualified consultant experienced in working in karst landscapes. There are many different techniques to reveal the nature of subsurface conditions in karst terrain, including:

- Electric resistivity tomography
- Seismic refraction
- Gravity surveys
- Electromagnetic (EM) inductance/conductivity surveys

Electric resistivity tomography has proven to be a particularly useful technique to identify subsurface anomalies at a scale that impacts stormwater design. These surveys provide a qualitative evaluation of the site area and may identify "suspect areas" to be further evaluated by borings. The use of these surveys may reduce the total number of soil borings by narrowing down the locations of suspect areas at the site".

ROCKWOOL DID NOT DEVELOP A KARST FEATURE PLAN.

STORMWATER DESIGN PRINCIPLES FOR KARST TERRAIN

Treat runoff as sheet flow in a series of small runoff reduction practices before it becomes concentrated. **Practices should be designed to disperse flows over the broadest area possible to avoid ponding, concentration or soil saturation.**

- **Small-scale low impact design (LID) practices work well in karst areas, although they should be shallow and sometimes use perforated under drains to prevent groundwater interaction**. For example, micro-bioretention and infiltration practices are a key part of the treatment train.
- **Distributed treatment is recommended over centralized stormwater facilities,** which are defined as any practice that treats runoff from a contributing drainage area greater than 20,000 square feet IC, and/or has a surface ponding depth greater than three feet. Examples include wet ponds, dry extended detention (ED) ponds, and infiltration basins.
- **The use of centralized stormwater practices with large drainage areas is strongly discouraged even when liners are used.** Centralized treatment practices require more costly geotechnical investigations and design features than smaller, shallower distributed LID practices. In addition, distributed LID practices generally eliminate the need to obtain an underground injection permit
- **Designers should refer to the list of preferred and acceptable stormwater practices as outlined in Table 3.**
- **Designers must address both the flooding and water quality aspects of post development stormwater runoff.** In most localities, the sequence of stormwater practices should have the capacity to safely handle or bypass the 2- and 10- year design storm, following the methods outlined in Section 5.4.
- **Designers should maintain both the quality and quantity of runoff to predevelopment levels and minimize rerouting of stormwater from existing drainage.**

ROCKWOO DID NOT FOLLOW THE DESIGN PRINCIPLES WHEN IT DESIGNED ITS STORMWATER PONDS

L. EVERETT & ASSOCIATES
ENVIRONMENTAL CONSULTANTS

L. Everett & Associates is an environmental consulting firm, advising clients in the area of soil and groundwater remediation, vapor intrusion, water quality and environmental regulatory compliance. We are hydrogeologists, engineers and geologists who design and manage subsurface site characterization projects and soil and groundwater remediation programs. We also provide services to law firm clients, advising on technical aspects of environmental lawsuits and serving as expert witnesses.

James T. Wells, PhD, PG is an environmental geologist with 20 years of experience in hydrogeology and geochemistry and is a Professional Geologist, registered by the State of California. Dr. Wells is the Chief Operating Officer of L. Everett & Associates. He earned a BA in Earth Sciences from Dartmouth College and MS and PhD degrees in Geological Sciences from the University of Washington. He serves on the editorial board of the academic journal, Environmental Forensics. **His area of expertise includes groundwater hydrology, environmental forensics and fate and transport of contamination in soil and groundwater.**

Below are the recommendations from Dr. Wells detailing the best way to protect groundwater from contamination caused by leaks and the failure of the stormwater ponds.

"Mr. Perry, We reviewed your write-up about the planned stormwater and waste lagoons at the proposed Rockwool plant in Ranson, WV. My colleague, Dr. Lorne Everett has done a lot of work over the years designing vapor zone and ***groundwater monitoring systems*** *for all sorts of waste facilities like landfills and land treatment units. We recognize that one of the challenges at this site will be that it's probably not feasible to design a groundwater monitoring network since the karst geology makes it very difficult to understand where releases into the aquifer would go.* ***We are also not aware of any way to specifically monitor for sinkholes under the lagoons, once they are constructed.***

One level of protection that is employed at hazardous waste sites and other types of landfills is:

- **INSTALLATION OF A DOUBLE COMPOSITE LINER SYSTEM WITH TWO LAYERS OF LINERS WITH A LIQUID DETECTION SYSTEM BETWEEN THE LINERS. This might consist of a sand layer with perforated pipe (like a French drain) all leading to a centralized sump.**
- **INSTALLING MONITORING WELLS AND REGULARLY TESTING THE GROUNDWATER FOR CONTAMINATION.**
- **DETERMINING THE ACTIONS TO BE TAKEN BY ROCKWOOL WHEN GROUNDWATER CONTAMINATION IS DETECTED.**
    - **Will Rockwool Stop Production?**
    - Remove liquids from the pond(s);
    - Store or transport the liquids from the site;
    - Find the leak(s) in the pond residue;
    - Drive crane, trucks and equipment into pond to remove the damaged liner system;
    - Drive dump trucks an backhoe into the pond to repair the sinkhole(s);
    - Repair the damaged liner system using trucks, crane and welding equipment
    - Restart the production line,

    - **Or Continue To Operate And Continue To Contaminate The Groundwater?**

GEOMEMBRANE LINER INFORMATION

(From the Fabricated Geomembrane Institute Webinar: Pre-Fabrication, Installation and Testing of Geomembranes. T.D. Start, December 10, 2019)

GEOMEMBRANE LINER TERMINOLOGY AND TYPES

CSPE - Chlorosulphonated Polyethylene – (Can Be Pre-Fabricated)

EIA - Ethylene Interpolymer Alloy – (Can Be Pre-Fabricated)

EPDM - Ethylene Propylene Diene (EPDM) - (Can Be Pre-Fabricated)

EVOH - Ethylene Vinyl Alcohol – (Can Be Pre-Fabricated)

fPP - Flexible polypropylene – (Can Be Pre-Fabricated)

fPP-R - Reinforced flexible polypropylene – (Can Be Pre-Fabricated)

HDPE - High density polyethylene – (Can Not Be Pre-Fabricated) – Used to build Rockwool's Ponds.

LLDPE - Liner low density polyethylene – (Can Be Pre-Fabricated)

Polyurethane - Polyurethane – (Can Be Pre-Fabricated)

PVC - Polyvinyl chloride – (Can Be Pre-Fabricated)

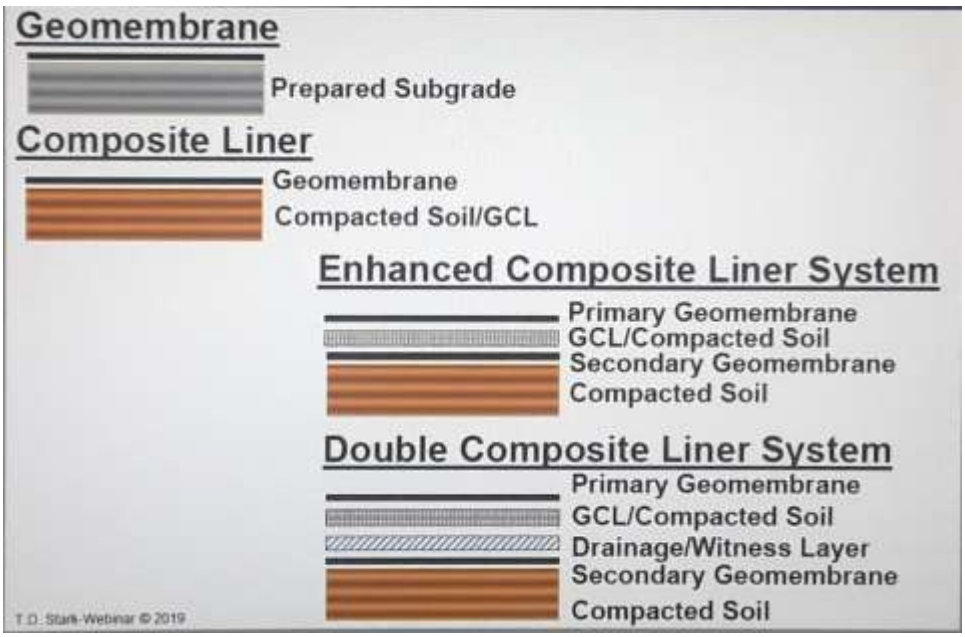
WCPE - Woven coated polyethylene – (Can Be Pre-Fabricated)

Scrim/reinforcement - Reinforcing fabric – (Can Be Pre-Fabricated)

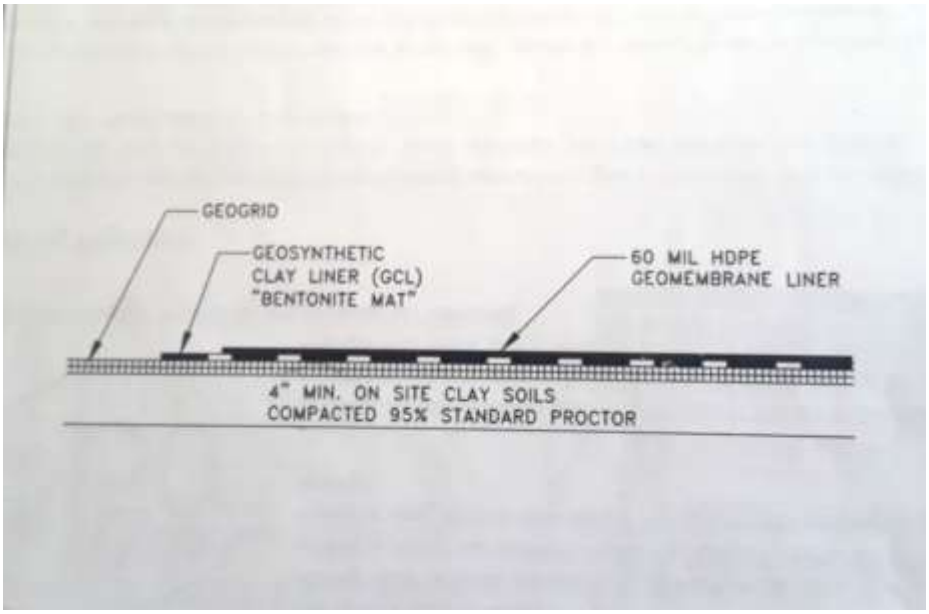
CHEMICAL RESISTANCE

	AIE	PVC	HDPE	LLDPE	WCPE	fPP
Acids/Bases (General)	A	A	**A**	A	A	A
Naphtha	A	B	**C**	C	C	B
Kerosene/Gasoline	A	C	**B**	B	B	B
Jet Fuels	A	C	**A**	A	A	B
Sulfuric Acid (30%)	A	A	**A**	A	A	A
Nitric Acid (10%)	B	B	**A**	A	A	B
Oils	A	B	**B**	B	B	B

Recommend for use: A – Prolonged Contact. B – Occasional Contact. C – Inappropriate Use.



A DOUBLE COMPOSITE LINER SYSTEM IS REQUIRED TO MININIZE THE RISK OF CONTAMINATION OF THE GROUDWATER AND WATER WELLS

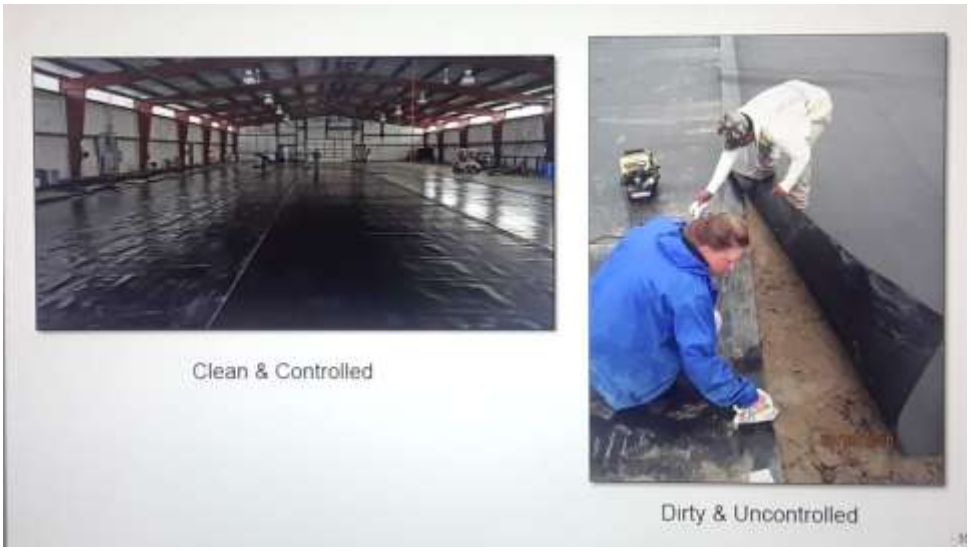


ROCKWOOL HAS BUILT THE STORMWATER AND PROCESS PONDS USING A FIELD FABRICATED HDPE GEOMEMBRANE LINER SYSTEM

In order to select the **correct liner system** for Stormwater Ponds, information on the materials and quantities of the materials to be **DISCHARGED INTO THE PONDS** must be known. **ROCKWOOL HAS NOT PROVIDED THIS INFORMATION.**

From the Chemical Resistance chart above it appears that LLDPE and WCPE provide equal chemical resistance than HPDE and have the added advantage of being able to be Pre-Fabricated in the clean and controlled environment of a factory, while HDPE can only be Field Fabricated

PRE-FABRICATED Vs FIELD FABRICATED



PRE-FABRICATED FIELD FABRICATED

PRE-FABRICATED

(INSTALLATION METHOD FOR ALL GEOMEMBRANE, EXCEPT HDPE)

- Clean, Controlled environment
- Large panels
- Up to 80% less field seams
- Consistent seam welds done in factory
- Non destructive seams tested in factory
- Able to be installed in a single piece
- Few and smaller wrinkles
- Allows leak detection systems
- Only limiting factor is the shipping weight

FIELD FABRICATED

(INSTALLATION METHOD FOR HDPE GEOMEMBRANE)

- Dirty, Uncontrolled environment
- Small panels
- Seams welded in field
- Three times more seams required
- Destructive seam testing done in the field
- More and larger wrinkles
    - Causes localized stresses and stains
    - Interferes with drainage
    - Stress cracks form along wrinkles
    - Increased potential for construction damage
    - Clay migration if GCL used
    - Leak detection systems more difficult to install

ROCKWOOL'S INSTALLED HDPE STORMWATER POND LINER SYSTEM WAS FIELD FABRCIATED.

LINER INTEGRITY MONITORING SYSTEM

THE LEAK LOCATION LINER SYSTEM has proven to be the most effective method for locating and quickly repairing leaks before a facility is put into operation. **But once installation is complete, how will you demonstrate to regulators and others that the system is performing in order to minimize liability?**

THE NEXT LEVEL OF ASSURANCE

The Liner Integrity Monitoring System is the newest advance in a long history of innovative products. It provides the next level of quality assurance and risk management: continuous, long-term monitoring of a Geomembrane system for early detection of leaks.

LONG-TERM RELIABILITY

Consisting of Leak Location Liner, engineered sensors embedded in the liner, and a Central Monitoring Unit, the system works by measuring the electrical fields above and below the Geomembrane. If the liner is damaged, the system detects a change in the electrical field and signals a leak. This process is repeated in cycles to continuously monitor the site and provide real-time information to the operator.

WHEN YOU NEED TO BE SURE

The Liner Integrity Monitoring System will add another layer of protection to any application where you can't afford a leak. From mitigating environmental risks to helping prevent product or fresh water loss, if there is a critical need to guard against leaks, the Liner Integrity Monitoring System can do the job.

ROCKWOOL DID NOT FOLLOW THE LINER MANUFCATURES RECOMMENDATION TO INSTALL A LEAK DETECTION SYSTEM

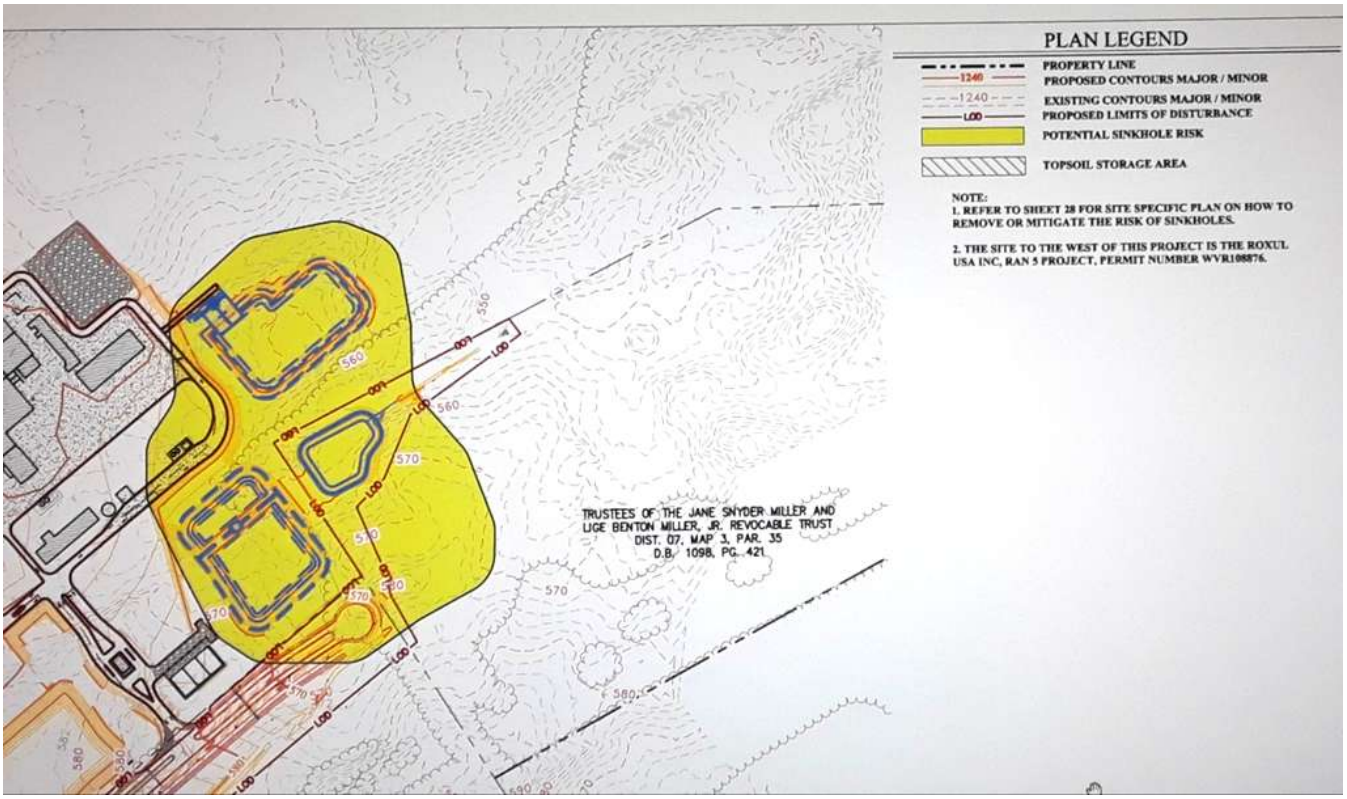
STORMWATER POND DESIGN AND CONTRUCTION DEFICIENCIES

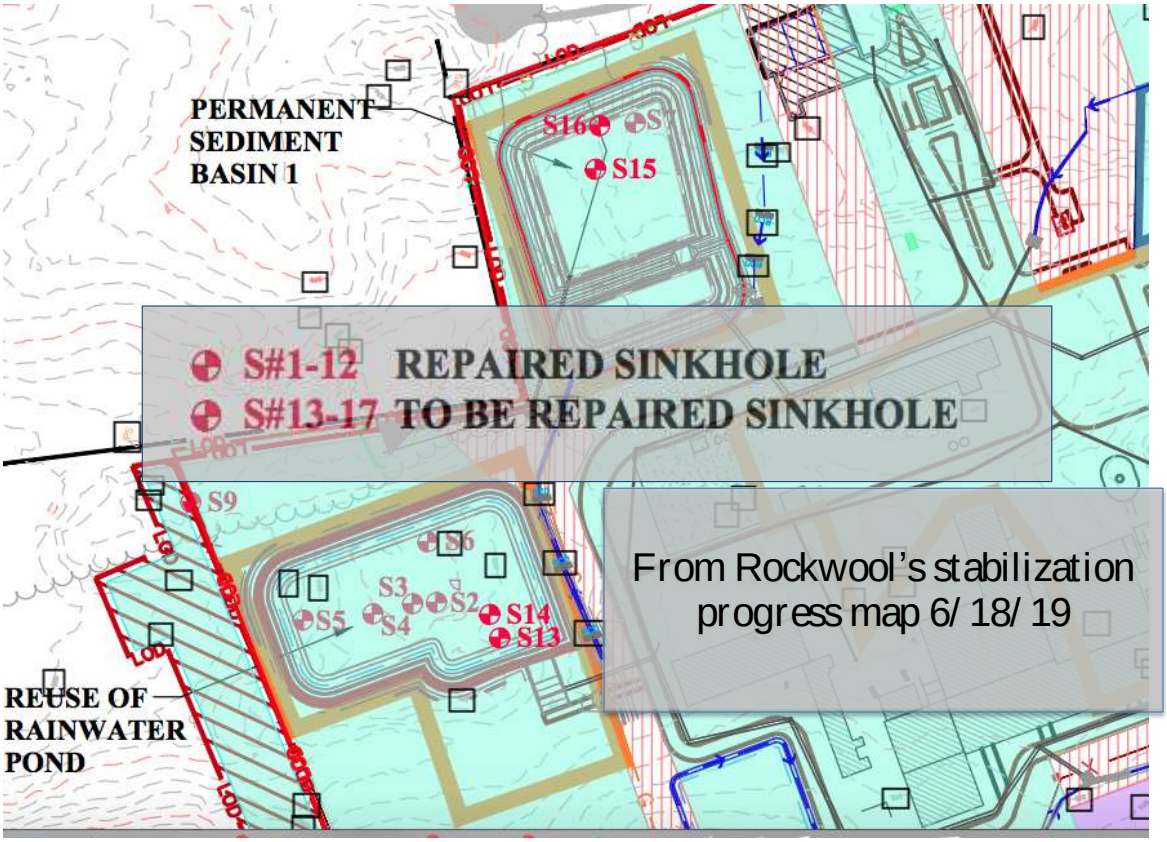
ROCKWOOL'S "POTENTAIL SINKHOLE RISK" MAP

The Rockwool drawing below is titled Potential Sinkhole Risk Map and shows the location of the ponds. The drawing notes that the ponds are located in a **"POTENTIAL SINKHOLE RISK"** area.

- According to Rockwool's stabilization map dated 6/18/19, there are a total of **17 reported sinkholes within the site, including 7 in the Rainwater Reuse Pond.** Some of the sinkholes are many feet in diameter..
- The increase of **impervious surface** area due to roads, parking lots and buildings will produce a much greater rate and volume of runoff.
- **More runoff greatly increases the risk of new sinkhole formation.**
- It is **certain that more sinkholes will be formed,** caused by the excavation, blasting and pile driving required to construct the foundations of the smokestacks and the heavy equipment required to build the smokestacks.

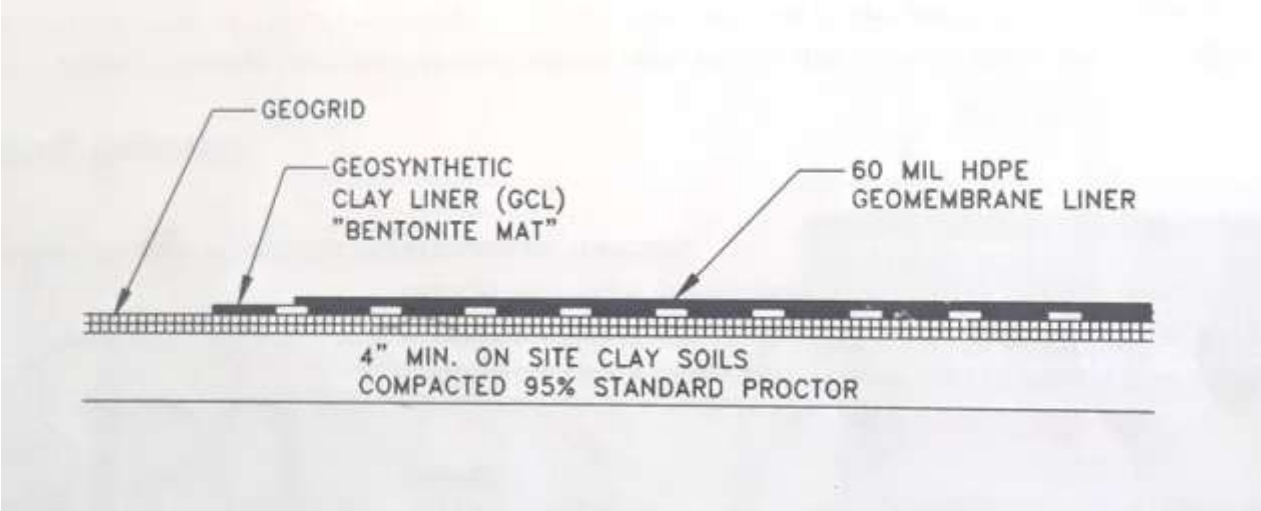
ROCKWOOL DID NOT MITIGATE THE RISKS OF SINKHOLES UNDER THE STORMWATER PONDS.




PERMANENT SEDIMENT BASIN 1
S16
S15
S#1-12 REPAIRED SINKHOLE
S#13-17 TO BE REPAIRED SINKHOLE
S9
S6
S3
S2
S5
S4
S14
S13
REUSE OF RAINWATER POND
From Rockwool's stabilization progress map 6/ 18/ 19

DESIGN COMMENTS ON ROCKWOOL'S POND LINER SYSTEM

The following design comments are based the Stormwater Pond's cross section below and ERM's Ran5, Pond Liner System, Rockwool USA, Inc's drawing and notes..



- **Rockwool installed one layer of Field Fabricated HDPE (High Density Polyethylene) liner membrane in the ponds.**
  - **A Double Composite Liner System is needed, with two layers of liner membrane and leak detection and a drainage system installed between the two layers of liner membrane.**
  - The plans do not show the **liner joint layou**t. It is estimated for a 72,000 square foot stormwater pond using 12 foot wide rolls and field fabricated there will be **over 7,000 linear feet of on-site welded seams. The welded seams are the weakest part of liners and the most likely to fail.**

- **Rockwool installed one layer of Geogrid liner.**
  - Geogrid is an open plastic mesh material, like heavy duty deer netting**. It is designed to allow liquids to easily pass through it.**

- **Rockwool installed one layer of Geosynthetic Clay Liner (GCL).**
  - **GCL has woven geotextile fabric at the top and bottom and in between the fabric layers it is filled with a one quarter of an inch of sodium bentonite clay between the fabric layers. The 7,000 linear feet of un-welded seams will allow liquids to pass through..**

- Notes 2-5, shows a Compacted Clay Layer of 4 inches thick. **Table 6 from the CSN Technical Bulletin recommends 24 inches of soil or clay, depending on the depth to bedrock.**

- **Note 2 indicate soil oil requirements and properties which vary from the information in Table 6.**

- Note 3 states **"making several passes on vibratory mode"**. **The compaction of the soil under the liners can lead to formation of new sinkholes.**

- The Notes states that the contractor or material installer shall be responsible for the installation. **Because of the critical nature of the pond liners in preventing groundwater contamination, it is necessary that an independent Quality Assurance Program** be implemented to ensure the lagoons are constructed as designed in the construction documents.

- The Stormwater Design Guideline notes that **60 mil is the minimum** thickness for liners. Because of the critical role liners play in preventing groundwater contamination, **the minimum should not be the standard that is used.**

- Rockwool did not install a **LEAK DETECTION SYSTEM** under the pond liner. It is critically important that leaks in the liner be detected as soon as possible so that remediation action can be taken as quickly as possible.
    - **HDPE IS AVAILABLE IN A LEAK LOCATION LINER SYSTEM. The leak location system will demonstrate to the community and regulators that the system is performing in order to minimize groundwater contamination and liability**. Sensors are embedded in the liner and a central monitoring unit. **The system works by measuring the electrical fields above and below the HDPE liner. If the liner is damaged, the system detects a change in the electrical field and signals a leak.** This process is repeated in cycles to continuously monitor the site and provide real-time information in order to detect leaks into the groundwater.

Table 6. Required Groundwater Protection Liners for Ponds in Karst Terrain (WVDEP, 2006 and VA DCR, 1999)	
Pond Excavated at least Three Feet Above Bedrock	**24 inches of soil** with maximum hydraulic conductivity of 1 x 10^{-5} cm/sec
Pond Excavated within Three Feet of Bedrock	**24 inches of clay**[1] with maximum hydraulic conductivity of 1 x 10^{-6} cm/sec
Pond Excavated Near Bedrock within wellhead protection area, in recharge area for domestic well or spring, or in area with high fracture density or significant geophysical anomalies.	Synthetic liner with a **minimum thickness of 60 ml.**
[1] **Clay properties as follows:** Plasticity Index of Clay: Not less than 15% (ASTM D-423/424) Liquid Limit of Clay: Not less than 30% (ASTM D-2216) Clay Particles Passing: Not less than 30% (ASTM D-422) Clay Compaction: 95% of standard proctor density (ASTM D-2216)	

MONITORING WELLS AND GROUNDWATER CONTAMINATION

- Page 69 of the WVDEP stormwater management guidance document states: **"Monitoring wells and groundwater sampling may be required by the Director for the assessment of the potential for or existence of groundwater contamination…"**
- 47 CSR 58 4.9C; states; "**new facilities shall monitor groundwater upon order of the director if the director reasonably believes that an industrial establishment or activity has the potential to contaminate groundwater"**
- **The existing authority of the Director should be used to require Rockwool to install groundwater monitoring wells** along its property boundaries, especially northeast and northwest from the two Stormwater Outlets, as these are the directions towards existing surface water receptors at The Compound, Historic Nature Preserve Park (recharged by groundwater,) and the drinking water wells at residences along Warm Springs Road, Granny Smith Lane, Good Folks Road, Stubbs Road, Americana Lane and Vista Lane.

ROCKWOOL HAS NOT INSTALLED MONITOIRNG DETECTION WELLS TO IDENTIFY CONTAMINATION OF THE GROUNDWATER

RECOMMENDATIONS

Because of the critical role Rockwool's stormwater ponds will play in protecting the safety of the groundwater from contamination, it is necessary that;

- **Rockwool provide WVDEP with a complete list of the ponds and the materials and quantities of the materials which will be discharged into the ponds.**
- **Rockwool provide WVDEP with As Built Plumbing Drawings in order to determine which plumbing fixtures, floor drains, traps and other plumbing equipment discharge into the stormwater ponds.**
- **WV DEP require Rockwool to install a Double Composite Liner System and engage a third party independent engineering firm, experts in designing stormwater ponds in Karst terrain, to design and supervise the construction of the Stormwater Ponds.**

FINAL QUESTIONS

- **Will Rockwool set aside dedicated funds to respond to and remediate the groundwater and private wells which have been contaminated by its operations?**
- **Will Rockwool set aside dedicated funds to clean up the site contaminated by its operations at the end of the life of the factory?**
- **Who will be legally responsible and financially liable** when the groundwater and drinking wells are contaminated because of the **design deficiencies of Rockwool's stormwater ponds**; Rockwool, Thrasher engineering, ERM, the construction contractor, **or Jefferson County and the State of West Virginia?**