Hanson Aggregates Pennsylvania LLC
7660 Imperial Way
Allentown, PA 18195-1040
Tel 610-366-4600
Fax 610-871-5994

Sent via e-mail & FedEx

January 15, 2021

Richard Tallman, P.E.
Pottsville District Mining Office
Pennsylvania Department of Environmental Protection
5 West Laurel Boulevard
Pottsville, PA 17901

Re: Response to Comments – November 18, 2020 Department Letter
Rock Hill Quarry
Hanson Aggregates Pennsylvania LLC
SMP # 7974SM1
East Rockhill Twp., Bucks Co., PA

Mr. Tallman:

Hanson Aggregates Pennsylvania LLC (Hanson) is providing this response to address the items in the Department's November 18, 2020 letter. Hanson also confirms that R.E. Pierson Materials, Co. (Pierson) terminated its lease for the Rock Hill Quarry in early 2020.

Prior to addressing the specific comments in the Department's letter, it is important to provide context of Hanson's near-term intended operations at the Rock Hill Quarry. As indicated in our May 29, 2020 letter, in the near term, Hanson intends only limited site activities once the Department lifts the cessation order. Those activities are: 1) removal of the requisite 500 tons annually from the site to maintain Large Noncoal Surface Mine Permit active status; 2) monthly collection of NPDES water discharge samples; 3) routine site inspection and security detail; 4) non-scheduled site maintenance; and 5) potential background air monitoring events. At some point in the future when Hanson desires to resume production of crushed aggregate at the Rock Hill Quarry, a minor amendment application will be submitted to the Department that details methods and type of mining, engineering techniques, major equipment to be used and anticipated sequencing. Currently, it is premature to attempt to describe in detail the future mining practices at the site.

Response to Department's November 18, 2020 Letter

The Department's November 18, 2020 comments are repeated below in *italics*, followed by comment responses in **bold**.

1. *Module 3: Ownership/Compliance Information*
   a. *Please update Module 3.2: Contractor §77.162 (a)(1)(iii)*

Hanson Response: **A revised Module 3 is included at the end of this letter as Attachment 1(a). All references to contractors have been removed.**

2. *Module 9: Operations Map*
   a. *Please provide an updated Operations Map showing the aerial extent of affected lands on the Rock Hill Permit, the length(s) of affected pre-act highwalls and newly created highwalls. §77.454*

Hanson Response: **A revised Exhibit 9 – Operations Map is included in Attachment 2(a). The topography has been updated with an aerial drone survey, completed on December 7, 2020, to identify the affected pre-act highwalls and newly created highwalls.**

   b. *Please delineate or identify the areas that would be affected and the way (active, reclaimed, revegetated) they would be affected through current and intended operations. §77.454, §77.452*

Hanson Response: **An Existing Site Plan has been included in Attachment 2(b) that includes the recent December 7, 2020 aerial image. The plan delineates areas within the surface mine permit area that have been affected by support activity and mining activity. For the immediate future Hanson intends to conduct only limited site activities. Those activities include: 1) removal of the requisite 500 tons annually from the site to maintain the Large Noncoal Surface Mine Permit active status; 2) monthly collection of NPDES water discharge sample; 3) routine site inspection and security detail; 4) non-scheduled site maintenance; and 5) potential background air monitoring events. The annual 500 tons would be removed from the four (4) aggregate product stockpiles as delineated on the Existing Site Plan in the northwest corner of the permit area. Hanson, or its subcontractors, may need to access other areas within the support and mining portions of the SMP for the activities listed above.**

3. *Module 10: Operational Information*
   a. *Please updated Module 10.1: Equipment and Operation Plan to reflect current and intended operations at the Rock Hill Quarry. §77.452 (2)(iii)*

Hanson Response: **See Attachment 3(a). Module 10.1 has been revised to reflect current and intended operations activities at the site. Reference to R.E. Pierson's planned aggregate processing operation and hot-mix asphalt (HMA) plant have been removed.**

   b. *Please update Module 10.8: Special Handling of Toxic Material*
      i. *Please present a comprehensive and detailed plan to safely handle Naturally Occurring Asbestos wherever it may be encountered in the diabase host rock,*

in the produced aggregate, or in the overburden at the Rock Hill Quarry. §77.130 (1)

Hanson Response: **Plans to safely handle diabase aggregate at the site are included in the revised Module 10.1 and associated documents.**

c. *Please update Module 10.15: Bonding Calculations*
   i. *Please provide a detailed plan to accomplish reclamation of the current reclamation obligations at the Rock Hill Quarry. Specifically, describe the selected method(s) that would be used to reclaim affected pre-act or newly created highwalls. §77.456*

Hanson Response: **Currently, a significant portion of the existing highwalls at the site have been delineated as Pre-Act (see existing SMP Exhibits) and therefore, per Department regulations reclamation of those highwalls are not required. A limited portion of the Pre-Act highwall was affected by recent mining activities conducted by R.E. Pierson in 2017-2018. Please see Attachment 3(c)(i) for a conceptual reclamation plan of the newly created highwall area. This concept was prepared as requested by the Department; however, a significant amount of aggregate reserves remain beneath this conceptual reclamation area. Reclamation will occur only after aggregate reserves are mined and removed as per Exhibit 9 – Operations Map.**

   ii. *Please provide an addendum to the bonding calculations reflecting the current reclamation obligations at the Rock Hill Quarry. §77.202, §77.456 (2)*

Hanson Response: **The Conceptual Reclamation calculations and Conceptual Bonding Map are provided in Attachment 3(c)(ii).**

4. *Module 17: Air Pollution and Noise Control Plan*
   a. *Please update Module 17 to reflect current and intended operations at the Rock Hill Quarry. Specifically, describe in detail measures that will be taken to prevent dust and Naturally Occurring Asbestos from crossing the permit boundary. §77.455 (1)*

Hanson Response: **See Attachment 4(a). Module 17 has been revised to reflect current and intended operations activities at the site.**

   b. *Please provide a comprehensive Naturally Occurring Asbestos Monitoring and Mitigation Plan covering all present and potential operations at the Rock Hill Quarry. §77.455 (1), §77.575 (2)*

Hanson Response: **See the revised Module 10.1 included in Attachment 3(a). As stated earlier, at some point in the future when Hanson desires to resume production of crushed aggregate at the Rock Hill Quarry, a minor amendment application will be submitted to the Department including detailed methods and**

type of mining, engineering techniques, major equipment to be used and anticipated sequencing.

i. Please address all concerns expressed by the Pennsylvania Department of Health in its September 16, 2020 letter to the Pennsylvania Department of Environmental Protection. §77.122 (b)

Hanson Response: **The September 16, 2020 letter referenced above is not addressed to Hanson, nor was Hanson included on the distribution by the Pennsylvania Department of Health (PADOH). Hanson is only able to address the specific instances where the Rock Hill Quarry is mentioned in the letter (see below).**

PADOH Letter – Page 2: "As it pertains to the health of citizens who live near the Rockhill Quarry, NOA is best to be avoided and left alone."

Hanson Response: **The PADOH statement fails to acknowledge that the Rock Hill Quarry is a lawfully permitted Large Noncoal Surface Mine. NOA exposure related to citizens who live near the Rock Hill Quarry has not been documented or observed at any time as evidenced by air sample analysis or any other means. Hanson has previously detailed engineering controls and practices that will mitigate exposure of NOA to employees and any off-site receptors.**

PADOH Letter – Page 3: "There are varying levels of agreement between DEP, Rockhill Environmental Preservation Alliance (REPA) and Pierson Materials/Hanson Aggregates concerning the amount or type of respiratory elongated mineral fibers (EMF) present. However, environmental and geological sampling commissioned by the aforementioned entities have agreed that actinolite, a type of asbestos fiber, is present in the rock material at the Rockhill Quarry site. Analytical reports also agree that "non-asbestos" mineral material exceeding 3:1 length to width ratio is also present in the geological materials sampled and analyzed from the site."

Hanson Response: **The November 15, 2019 Qualitative Geologic Survey Report and subsequent submittals acknowledge the presence of actinolite within the limited mineral veining that occurs in the diabase host rock. The PADOH statement fails to acknowledge that actinolite occurs in both non-asbestos and asbestos forms. It is important to also realize that the presence of NOA in host rock does not equate to human exposure.**

PADOH Letter – Page 3: "Both these observations justify pause for further evaluation."

Hanson Response: **Hanson's request for authorization for limited site activity as detailed in this submission allows for further discussion, evaluation, and the establishment of appropriate engineering controls to mitigate potential future exposure associated with future mining activities.**

PADOH Letter – Page 3: "Although the presence of these types of minerals have been associated with illness and injury in medical reports, and environmental investigations, the Department does not currently have sufficient data to support the assessment that communities or children who attend schools in close proximity to Rockhill Quarry are in immediate risk of asbestos or EMF-related illness. There is also a paucity of data available to evaluate whether current or proposed activities on the Rockhill Quarry site are protective of the health of workers on site, adults and children who live near the Rockhill Quarry, and children who attend school near the site. To address these gaps in knowledge, additional environmental sampling should be conducted."

Hanson Response: **Hanson has proposed air sampling, as detailed in this submission, that is appropriate for the proposed site activities.**

PADOH Letter – Page 3: "Comprehensive health-based environmental sampling should at least included air and soil sampling for onsite, source, property/fence line, and offsite locations."

Hanson Response: **Hanson will continue to work with the Department of Environmental Protection regarding any necessary sampling.**

PADOH Letter – Page 4: "Until sufficient data are available to determine the level of onsite and offsite asbestos or hazardous EMF exposure occurs during various activities over more than one season, the risk of asbestos-related illness in the stakeholder population will not be fully understood. As environmental investigations continue at the Rockhill Quarry site, material containing NOA should be addressed with concern."

Hanson Response: **Hanson will continue to work with the Department of Environmental Protection regarding any necessary sampling.**

ii. Please include a detailed air monitoring and dust suppression plan.

Hanson Response: **See attached Draft Air Monitoring Plan in Attachment 4(b)(ii). Also see the revised Module 17 – Air Pollution & Noise Control Plan included in Attachment 4(a) for dust suppression measures.**

5. Module 18: Land Use and Reclamation Map
   a. Please update the Land Use and Reclamation Map to reflect the current status of the Rock Hill Quarry. §77.456

Hanson Response: **A revised Module 18 – Land Use and Reclamation Map is included in Attachment 5(a). Exhibit 18 has been updated with aerial drone topography, completed on December 7, 2020, to identify the affected Pre-Act highwalls and newly created highwalls.**

6. *Module 20: Post-Mining Land Use & Reclamation*
   a. *Please update Module 20.3 to reflect the current status of the Rock Hill Quarry and provide an explanation of how reclamation of affected areas would be accomplished including grading of affected pre-act or newly created highwalls to a maximum 35 slope. §77.462 (2), §77.456 (3)*

Hanson Response: **The language provided in Module 20.3 is sufficient to describe the conditions included in conceptual reclamation. Additional explanation of conceptual reclamation has been provided in Attachment 3(c)(i). The current Module 20.3 indicates the intention of creating final slopes of a maximum 35-degree slopes and an unmanaged water impoundment.**

Please feel free to contact me at (610) 366-4819 should you wish to discuss this submission.

Regards,

Andrew J. Gutshall, P.G.
Area Environmental Manager

encl:

cc: John Stefanko, PADEP (e-mail only)
Daniel Sammarco, P.E., PADEP (e-mail only)
Gary Latsha, PADEP (e-mail only)
Michael P. Kutney, P.G., PADEP (e-mail only)
Randy Shustack, PADEP (e-mail only)
Amiee Bollinger, PADEP (e-mail only)
Thomas Boretski, PADEP (e-mail only)
Patrick Patterson, PADEP (e-mail only)
James Rebarchak, PADEP (e-mail only)
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Jillian Gallagher, PADEP (e-mail only)
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Virginia Cain, PADEP (e-mail only)
Craig Lambeth, Esq., PADEP (e-mail only)
Marianne Morano, East Rockhill Township (e-mail only)
County of Bucks (e-mail only)
Rockhill Environmental Preservation Alliance (e-mail only)
David J. Raphael, Esq., K&L Gates LLP (e-mail only)
Kelly Bailey, CIH, KBC LLC (e-mail only)
Bryan Bandli, RJ Lee Group (e-mail only)
Matthew Weikel, P.G., EARTHRES (e-mail only)
Joe Kim, P.E., EARTHRES (e-mail only)
Kristian Witt, CMI (e-mail only)
Mark E. Kendrick, Hanson (e-mail only)
Catherine Stehlin, Esq., Hanson (e-mail only)
Michael C. Lewis, CHMM, Hanson (e-mail only)
Timothy J. Poppenberg, Hanson (e-mail only)
Environmental File

ATTACHMENT 1(a)

Module 3 – Ownership/Compliance Information
January 15, 2021

Module 3: Ownership/Compliance Information

Instructions: Provide the following information on an 8½ x 11 sheet of paper. Attach the page(s) to this Module and identify as *Exhibit 3: Ownership/Compliance Information.* Use Module number, letter, and heading to identify information.

If applicant is currently a licensed mine operator or has submitted an application for mine operators license to the Department, provide only contractor information requested in Module 3.2, if applicable. The ownership and compliance information will be generated by the Department from information on file with the Department (in eFACTS) for a licensed mine operator or a mine operator that has submitted an application for mine operators license. That information will be made part of this Module.

3.1 Ownership Interest. [§77.162] Identify whether the applicant is a single proprietorship, corporation, partnership, association, or other business entity. For businesses other than single proprietorships provide the following:

a) name and address of every officer, partner, director, or other person performing a function similar to a director of the applicant;

See attachment for information

b) name and address of any person who is a principal shareholder of the applicant; (**Note:** A principal shareholder is any person who is the legal owner of ten percent or more of any class of voting stock) and,

N/A

c) names under which the applicant, partner, or principal shareholder previously operated a mining operation in Pennsylvania and the United States within the five years preceding the date of this application.

N/A

d) the name, address and phone number of the resident agent of the applicant who will accept service of process.

Hanson Aggregates Pennsylvania LLC

c/o Andrew J. Gutshall, P.G.

7660 Imperial Way

Allentown, PA 18195

3.2 Contractor. [§77.162(a)(iii)] If a contractor or contractors will be conducting the operation provide the name, address, and telephone number of the contractor and if the contractor is a business entity other than a single proprietor, provide the names and addresses of the respective principals, officers, and resident agents.

N/A

Hanson Aggregates Pennsylvania LLC

Module 3: Ownership / Compliance Information

3.1(a) Ownership Interest

Heidelberg Cement AG Berliner Str. 6 Heidelberg, Germany 69120	Parent
Lehigh Hanson, Inc. 300 E John Carpenter Freeway Irving, TX 75062	Parent
Hanson Aggregates Pennsylvania LLC 7660 Imperial Way Allentown, PA 18195	Applicant

Hanson Aggregates Pennsylvania LLC

Module 3: Ownership / Compliance Information

3.1(a) Ownership Interest

Organizational Chart

CORPORATE STRUCTURE

/

(Various Holding Companies)

/

Heidelberg Cement AG

/

Lehigh Hanson, Inc. – FEI #59-2503701

/

Hanson Aggregates Pennsylvania LLC – FEI #24-0649400
(formerly Hanson Aggregates Pennsylvania, Inc.)
(formerly Milestone Materials, Inc.)

Hanson Aggregates Pennsylvania LLC

Module 3: Ownership / Compliance Information

3.1(a) Ownership Interest

General Partners, Management Information

Officers:

Name	Office
Christopher J. Ward [1]	Chairman of the Board
Alexander Car [2]	President
Henner Böttcher [1]	Vice President and Chief Financial Officer
Carol Lowry [1]	Vice President and Secretary
Chris D. Hobby [2]	Vice President and General Manager
Mark E. Kendrick [2]	Vice President and General Manager
Ronald T. Kurpiel [3]	Vice President and General Manager
Thomas D. Capelli [2]	Vice President
Francois Perrin [1]	Vice President
Rebecca D. Robbins [1]	Treasurer
Thaddius Haas [1]	Assistant Secretary
Larry S. Lauritzen [2]	Assistant Secretary
Catherine Stehlin [2]	Assistant Secretary
Michael T. Sullivan [2]	Assistant Secretary
James L. Wallmann [1]	Assistant Secretary
Amy C. Yi [1]	Assistant Secretary

Addresses (corresponding to superscript)

[1] Lehigh Hanson
300 East John Carpenter Freeway
Irving, TX 75062

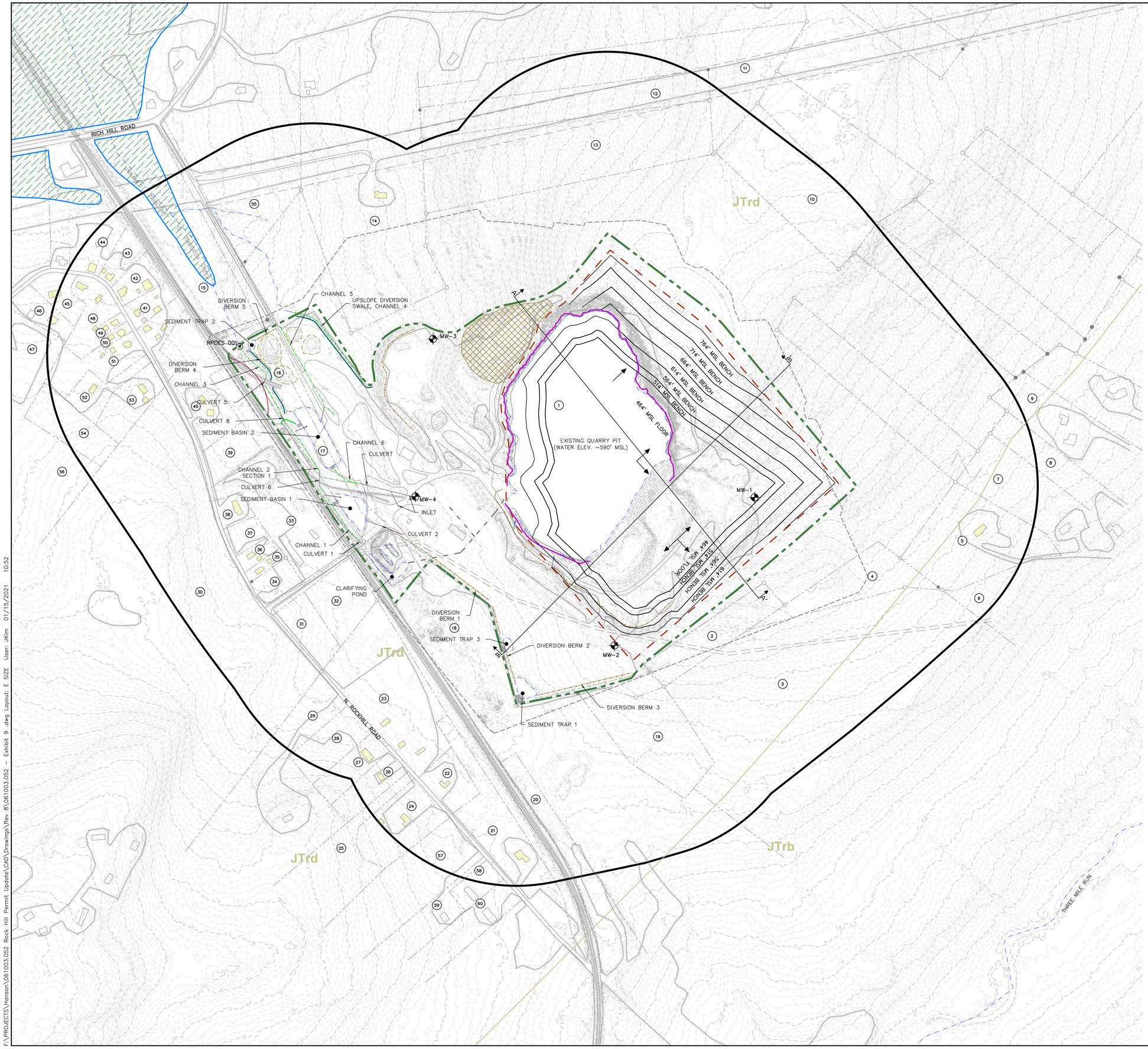
[2] Lehigh Hanson
7660 Imperial Way
Allentown, PA 18195

[3] Hanson Aggregates
2200 Springfield Pike
Connellsville, PA 15425

Last revised January 13, 2021

ATTACHMENT 2(a)

Exhibit 9 – Operations Map
January 15, 2021



NORTH

LEGEND

- EXISTING GRADE CONTOUR (2' INTERVAL)
- EXISTING SMP BOUNDARY
- LIMIT OF MINING
- 1,000' SMP OFFSET
- PRE-ACT HIGHWALL
- PROPOSED BENCHING
- 300' BUILDING SETBACK
- LIMIT OF HANSON DRONE SURVEY
- EXISTING RIGHT OF WAY
- PROPERTY BOUNDARY
- EXISTING QUARRY PIT DEWATERING/INTERCEPTOR PIPE
- EXISTING SURFACE WATER
- EXISTING RAILROAD
- EXISTING TREELINE
- EXISTING GAS PIPELINE
- EXISTING DRAINAGE CHANNEL
- EXISTING DIVERSION BERM
- EXISTING PERIMETER BERM (PRECAST CONCRETE BLOCKS)
- EXISTING FILTER BERM
- TEMPORARY COMPOST FILTER SOCK
- AGGREGATE PILES FOR REMOVAL
- EXISTING BUILDING – RESIDENTIAL
- NPDES 001 NPDES DISCHARGE POINT
- OVERBURDEN/TOPSOIL STORAGE
- NWI WETLANDS
- DIRECTION OF MINING
- 21 PROPERTY ID
- MW-1 MONITORING WELL (TEST HOLE)

GEOLOGIC LEGEND

- GEOLOGIC CONTACT
- JTrb BRUNSWICK FORMATION
- JTrd DIABASE

NOTES:
1. EXISTING GRADE TOPOGRAPHY COMPILED BY PAMAP PROGRAM, PA DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES, BUREAU OF TOPOGRAPHIC AND GEOLOGIC SURVEY, DATED JUNE 2010.
2. TOPOGRAPHY WITHIN HANSON SURVEY AREA WAS SURVEYED BY HANSON PERSONNEL ON DECEMBER 7, 2020.
3. EXISTING PERMIT INFORMATION INCLUDING PERMIT BOUNDARY, MINING LIMIT, DEPTH OF MINING, AND PRE-ACT HIGHWALLS ARE REFERENCED TO THE PERMIT DRAWING "MINING PLAN, SHEET 3 OF 6" PREPARED BY SKELLY AND LOY, DATED MARCH 18, 1980.
4. HANSON PROPERTY BOUNDARY PROVIDED BY VAN CLEEF ENGINEERING ASSOCIATES VIA MAP TITLED "PLAT OF SURVEY OF LANDS OF GENERAL CRUSHED STONE", PREPARED BY ORANGEVILLE SURVEYING CONSULTANTS, INC., DATED MAY 7, 2001.
5. ADJACENT PARCEL BOUNDARIES ARE REFERENCED TO THE BUCKS COUNTY GIS RECORDS.
6. WETLANDS REFLECT THOSE DEPICTED IN THE NATIONAL WETLANDS INVENTORY FWS WETLANDS MAPPER.
7. PROPERTY OWNERSHIP INFORMATION IS REFERENCED TO MODULE 5 OF THE PERMIT APPLICATION.
8. STREAM INFORMATION IS REFERENCED TO THE PA DEP eMAPPA ONLINE RECORDS.
9. REFER TO THE E&S PLAN DRAWINGS FOR LOCATION OF ALL EROSION AND SEDIMENTATION CONTROL STRUCTURES.
10. GEOLOGY OBTAINED FROM PAGEODE, PA GEOLOGIC DATA EXPLORATION, WWW.GIS.DCNR.STATE.PA.US/GEOLOGY/(2018).

GRAPHIC SCALE

200 0 100 200 400 800

(IN FEET)

1 inch = 200 ft.

NO.	DATE	BY	REVISIONS
1	1/15/21	JTK	REVISED PER DEP COMMENTS
2	10/16/18	JTK	REVISED PER DEP COMMENTS
3	07/18/18	JTK	REVISED PER DEP COMMENTS
4	5/21/18	JTK	REVISED PER DEP COMMENTS

COMMONWEALTH OF PENNSYLVANIA — JOHN T. KIM — PROFESSIONAL ENGINEER — LICENSE NO. PE068887

PROJECT SITE:
HANSON AGGREGATES PENNSYLVANIA LLC
SMP NO 7974SM1
EAST ROCKHILL TOWNSHIP, BUCKS COUNTY
PENNSYLVANIA

PREPARED FOR: Hanson HEIDELBERGCEMENT Group

PREPARED BY:
EARTHRES
ENGINEERING FOR SUCCESS™
www.earthres.com
HEADQUARTERS PHILADELPHIA REGION: P.O. Box 468, 691 Gulph Road, Yeadon, PA 19050
APPALACHIAN REGIONAL OFFICE: P.O. Box 794, 8000 Cranberry Road, Morgantown, WV 26505

EXHIBIT 9
OPERATIONS MAP

HANSON AGGREGATES PENNSYLVANIA LLC
ROCKHILL QUARRY

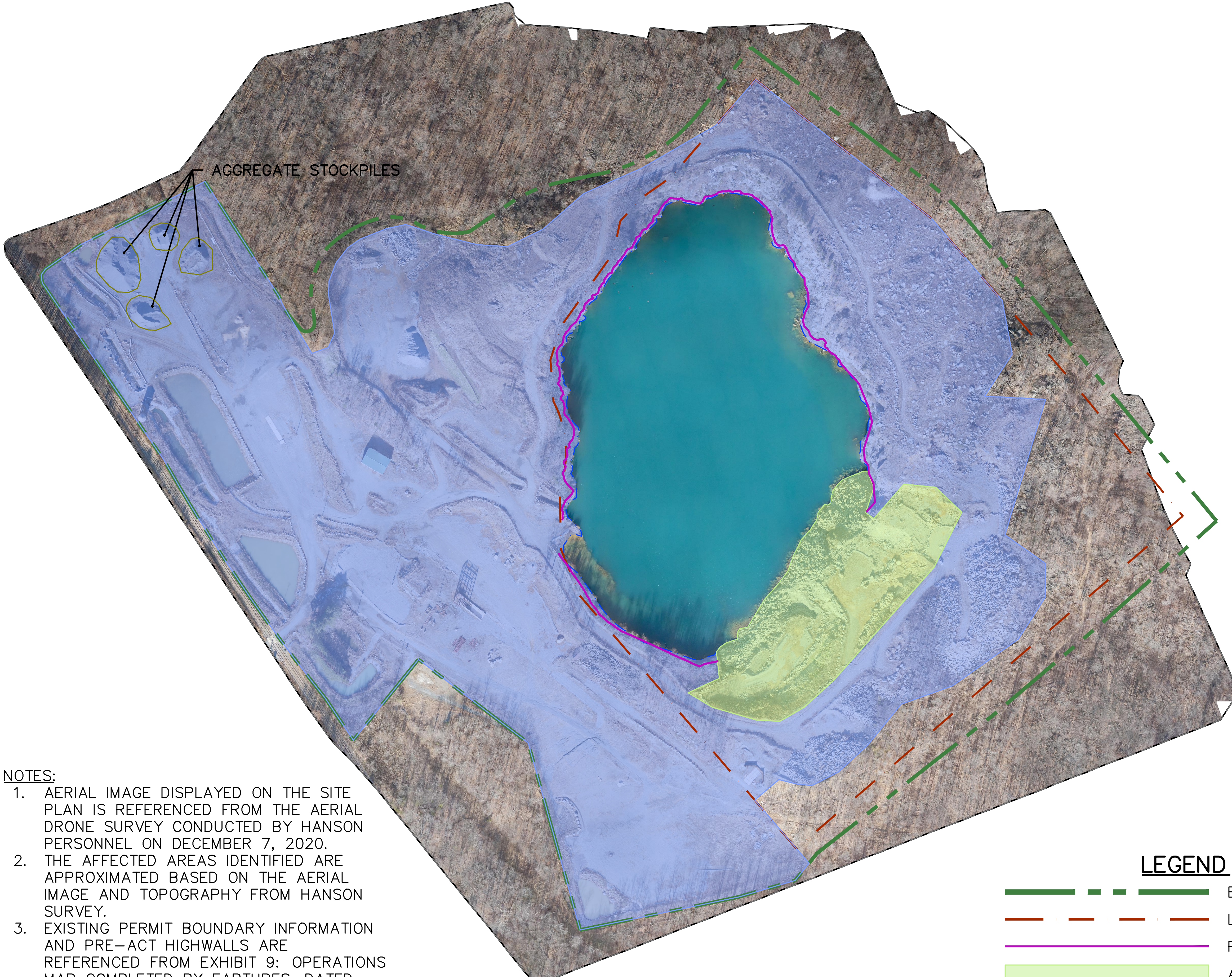
DRAWN BY: JTK
CHECKED BY: MDF
DATE: 02/20/18
PROJECT NO: 061003.052
DRAWING NUMBER: R-003
SHEET 3 OF 6

F:\PROJECTS\Hanson\061003.052 Rock Hill Permit Update\CAD\Drawings\Rev 8\061003.052 – Exhibit 9 .dwg Layout: E SIZE User: JKim 01/15/2021 10:52

ATTACHMENT 2(b)

Existing Site Plan
January 15, 2021

F:\PROJECTS\Hanson\061003.052 Rock Hill Permit Update\CAD\Drawings\Rev 8\Existing Site Plan.dwg Layout: B SIZE PORT User: JKim 01/15/2021 10:56



NOTES:

1. AERIAL IMAGE DISPLAYED ON THE SITE PLAN IS REFERENCED FROM THE AERIAL DRONE SURVEY CONDUCTED BY HANSON PERSONNEL ON DECEMBER 7, 2020.
2. THE AFFECTED AREAS IDENTIFIED ARE APPROXIMATED BASED ON THE AERIAL IMAGE AND TOPOGRAPHY FROM HANSON SURVEY.
3. EXISTING PERMIT BOUNDARY INFORMATION AND PRE–ACT HIGHWALLS ARE REFERENCED FROM EXHIBIT 9: OPERATIONS MAP COMPLETED BY EARTHRES, DATED FEBRUARY 20, 2018.

LEGEND

- EXISTING SMP BOUNDARY
- LIMIT OF MINING
- PRE–ACT HIGHWALL
- AFFECTED MINING AREA
- AFFECTED SUPPORT AREA

EXISTING SITE PLAN

HANSON AGGREGATES PENNSYLVANIA LLC
ROCK HILL QUARRY

DRAWN BY: CBR	CHECKED BY: JTK
DATE: 1/15/21	PROJECT NO: 061003.052
DRAWING SCALE: 1" = 300'	

HEADQUARTERS
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ATTACHMENT 3(a)

Module 10: Operational Information
January 15, 2021

Module 10: Operational Information [§§77.452/77.456/77.563/77.564]

10.1 Equipment and Operation Plan

For each phase of mining, identify the type and method of mining; engineering techniques; major equipment to be used; starting point; and the anticipated sequence in which the phases are to be mined.

For the immediate future Hanson intends only limited site activity. Those activities include: 1) removal of the requisite 500 tons annually from the site to maintain the Large Noncoal Surface Mine Permit active status; 2) monthly collection of NPDES water discharge sample; 3) routine site inspection and security detail; 4) non-scheduled site maintenance; and 5) potential air monitoring events.

Annual Removal of 500 tons

Hanson will conduct removal of a minimum 500 tons of previously crushed aggregate material on an annual basis. The event will likely last one (1) day; however, some equipment (e.g. loader, water truck, etc.) may be transported to the site ahead of the loadout event. Wet dust suppression (e.g. standard water sprinklers) may be used to control fugitive dust emissions during material loading activities if sufficient moisture is not present in the aggregate piles to prevent generation of fugitive dust. Air monitoring as per the Air Monitoring Plan will be conducted. In addition, all vehicle movement at the site will obey the posted speed limit of 15 mph intended to prevent fugitive dust emissions.

Monthly NPDES Water Sample Collection

Hanson personnel or a subcontractor will access the site at least once per month to collect water samples from the NPDES discharge point(s). It is possible that additional trips in a month would be necessary to collect follow-up water samples. Since the site visit duration, typically by only one (1) person, would last less than 30 minutes, Hanson does not propose air monitoring to be conducted during these events. Hanson or its subcontractor will obey the posted speed limit of 15 mph intended to prevent fugitive dust emissions.

Routine Site Inspection and Security Detail

Hanson personnel or a subcontractor will access the site to conduct routine inspections for evidence of trespassing, site vandalism or regular checks on the stormwater management controls. Hanson does not propose air monitoring to be conducted during these events. Hanson or it's subcontractor will obey the posted speed limit of 15 mph intended to prevent fugitive dust emissions.

Non-scheduled Site Maintenance

At any time, Hanson or a subcontractor may access the site to conduct maintenance to stormwater ponds or site roads. Should the nature of the work disturb any dry aggregate or earthen material and last more than four (4) continuous hours, air monitoring will be conducted as detailed in the Air Monitoring Plan. If the maintenance event is to last less than four (4) continuous hours, water sprays will be used to prevent fugitive dust emissions that could be generated by the maintenance activities. Natural precipitation should also be considered sufficient to prevent fugitive dust emissions. Hanson or its subcontractor will also obey posted speed limit of 15 mph intended to prevent additional fugitive dust emissions from moving vehicles.

At such time authorized by the Department, mining of the Rock Hill Quarry will commence in a single phase. Bulldozers or track loaders, excavators, and haul trucks will be used to remove and stockpile topsoil and overburden from the mining area. Overburden will be hauled to and stored in the designated overburden material stockpile. The underlying rock will then be drilled and blasted to facilitate its removal. The shot rock will be excavated by front-end loader, track loader, or excavator.

The excavated material will then be loaded into a haul truck and transported to either a portable processing plant or a stationary processing plant that will be located within the Surface Mine Permit boundary. The processed material will be staged for sale in stockpiles. Support area in the northwest corner of the permitted area will likely be used to stockpile material.

10.2 Pit Configuration

a) Identify the maximum depth of mining and the elevation of the pit floor at the maximum depth of mining for each mining phase.

The maximum depth of mining is approximately 330 feet at a pit floor elevation of 464' MSL.

b) If mining consolidated rock, identify the maximum highwall height and the benching interval to include the distance between the benches measured vertically (i.e. height of the working face of the bench) and the width of the benches.

A maximum highwall height of 50 feet will be maintained, with the exception of the uppermost level, where the maximum highwall height may reach 65 feet to account for variations in the surface topography. A minimum bench width of 25 feet will be maintained between operating levels at all times. A 71.4-foot bench will be utilized in areas where blast to grade reclamation is proposed. The proposed benching and final highwall positions are shown on Exhibit 9: Operations Map.

c) If mining consolidated rock and the reclamation plan is an alternative to approximate original contour involving restoration of the pit floor and final working face, identify the total acreage of pit floor and final graded slopes.

Reclamation of the proposed mining area will be an alternative to approximate original contour, as grades across the site will be lowered by as much as 330 feet. The final configuration will form a water impoundment area, which will be surrounded by unmanaged natural habitat. The final highwalls along the perimeter edge will be reduced by blasting to achieve the maximum 35º final slopes, merging the surrounding rim elevation with the slope. The proposed water impoundment area will be approximately 39.1 acres, and the final graded perimeter slope areas total approximately 22.4 acres.

10.3 Existing Structures

Identify and describe the intended use of all existing structures or facilities to be used in connection with or to facilitate mineral removal activities. (Common existing structures include impoundments, stream crossing facilities, water obstructions and processing waste dams.)

Previous site activities included the installation of multiple structures. Existing structures include processing plant foundations, processing plant settling ponds, stormwater culverts and channels, and sediment ponds. These structures are to be maintained in place and utilized for the current operation. Structures will be rehabbed and/or upgraded as needed.

10.4 Overburden Piles

Provide a narrative plan for reclamation of overburden piles specifying the timing and extent of overburden piles returned to the pit and final grading of the overburden pile areas for blending into existing contours.

Overburden is proposed to be placed in the overburden storage area. Upon completion of mining activities, overburden will be returned to the mining area for use in final reclamation and for the establishment of vegetative cover. Material will be placed to achieve the desired reclamation subgrade elevation and to blend into the sloped highwalls (blast-to-grade) and existing perimeter grades. Site topsoil will then be spread over the overburden to provide a base for revegetation.

As piles and berms are removed, the areas impacted by topsoil/overburden storage will be scarified and prepared for final revegetation. Materials will be spread in advance of revegetation when it is a suitable time for planting as noted in Module 23.

10.5 Final Grade and Drainage

Identify the final grading and drainage pattern, including topographic contours on Exhibit 18 and a description of compaction and stabilization techniques. Provide cross-sections or a contour map showing permit line setback(s), final postmining slopes, postmining watertable and safety benches.

The final reclamation configuration for the Rock Hill Quarry will be a water impoundment, and the post-mining land use will be unmanaged natural habitat. As mining reaches its vertical and horizontal extent, concurrent reclamation will be undertaken. The final perimeter highwalls will be reduced to a maximum 35-degree reclamation configuration by blasting to grade. Overburden materials will be placed over the shot rock. The surface will drain directly to the water-filled-impoundment. The proposed reclamation grading, drainage pattern, and associated stormwater controls are presented on Exhibit 18: Land Use and Reclamation Map.

10.6 Reclamation Timetable

Provide a sequence of operations for the accomplishment of major stages in the reclamation plan demonstrating compliance with the concurrent reclamation requirements in 25 Pa Code 77.595. Include an estimated timetable for reclamation which is tied to the mining phases and the termination of mineral extraction.

Stages of reclamation will include 1) a reduction of perimeter highwalls; 2) spreading and grading of overburden materials on slopes; 3) final grading; 4) revegetation; and 5) filling of the water impoundment. To the extent practical, reclamation will be completed concurrent with mine development, except where access cannot be eliminated. Reclamation will be completed according to the concurrent reclamation requirements set forth in 25 PA Code § 77.595.

10.7 Identification of Toxic Materials

When applicable (e.g., noncoal operation in coal measures) provide a detailed description of the methods used in the identification of potentially acid and toxic forming materials (boney, rooster, blossom or other inferior coal and noncoal strata) which will be encountered and separately handled. Correlate and identify these strata in the test hole data.

N/A

10.8 Special Handling of Toxic Material

When applicable (e.g. noncoal operation in coal measures) provide a detailed description of the methods to be used in the separation and handling of acid and toxic forming materials. Include transportation, storage, treatment and return of the material to the backfill. Identify the amount and source of clean fill to be placed above and below the material and the compaction and other methods to preclude combustion of the material and prevent groundwater contamination. Indicate all disposal areas on Exhibits 9 and 18.

N/A

10.9 Oil and Gas Wells

Where mining activities are proposed to be conducted within 125 feet of any oil or gas well, identify the location on Exhibits 6, 9 and 18 and provide a description of the activity. Provide a demonstration that the well has been sealed; or describe the measures to be taken to insure the integrity of the well, access to the well at all times and the well operator's consent to the proposed activity.

There are no known oil or gas wells within 125 feet of the mining operation.

10.10 Wells, Exploration Holes and Bore Holes

Identify the type and location of wells, exploration holes, bore holes and monitoring wells and provide a description of the manner in which each will be cased, sealed or otherwise managed.

Any well developed at the Site will be sealed at the close of site mining. The well will be grouted from its base to the surface in accordance with State requirements for well closure. A licensed well driller will be contracted to complete the closure.

10.11 Underground Mines

Where proposed surface mining activities will be conducted within 500 feet of any point of either an active or abandoned underground mine (coal or noncoal), provide a description of the nature, timing, and sequence of the operation. Identify the location of each underground mine opening and the manner in which the opening will be sealed or otherwise managed including appropriate cross sections and design specifications for mine seals. Provide a description of the potential hydrologic impacts of the proposed activities, the effects on the existing groundwater system, and the effect the proposed activities will have upon abatement of pollution or the elimination of hazards to the health and safety of the public.

There are no known underground mines within 500 feet of the mining operation.

10.12 Public Highways

Where opening or expansion of pits are proposed within 100 feet of the outside right-of-way of a public highway, or a relocation of a public highway is proposed, identify the name and section of the public highway involved, a description of the activities to be conducted and detailed plans and cross-sections of the proposed activities. Include the written approval of the government agency having jurisdiction over the highway.

(**Note:** If the initial public notice advertisement does not contain a notice of the variance request, attach the proof of publication for advertisement of the variance.)

The proposed mining area is not within the 100-foot right-of-way setback for any public road.

10.13 Public Parks and Historic Places

Where the proposed mining activities may affect any public park or historic place, provide a demonstration of the measures which will be taken to minimize or prevent adverse impacts.

N/A

10.14 Utilities

Where the proposed mining activities may adversely affect services provided by oil, gas, and water wells; oil and gas pipelines; railroads; utility lines; and water and sewage lines, provide a demonstration of the measures which will be taken to minimize or prevent these impacts.

No services are anticipated to be adversely affected by mining activities. Agreements are in place with SEPTA for the site access road crossing of the railroad.

10.15 Bonding Calculations

Attach a completed Bond Calculation Summary-Noncoal for consolidated (5600-FM-BMP0474) or unconsolidated (5600-FM-BMP0473) material (sand, gravel, shale, soil). Complete a Bonding Increment Application and Authorization To Conduct Noncoal Mining Activities (5600-FM-BMP0304).

A Bonding Increment Application, Bonding Calculations, and a Bonding Map have been included as an attachment to this Application.

ATTACHMENT 3(c)(i)

Conceptual Reclamation Plan
January 15, 2021

Attachment 3(c)(i) – Conceptual Reclamation Plan

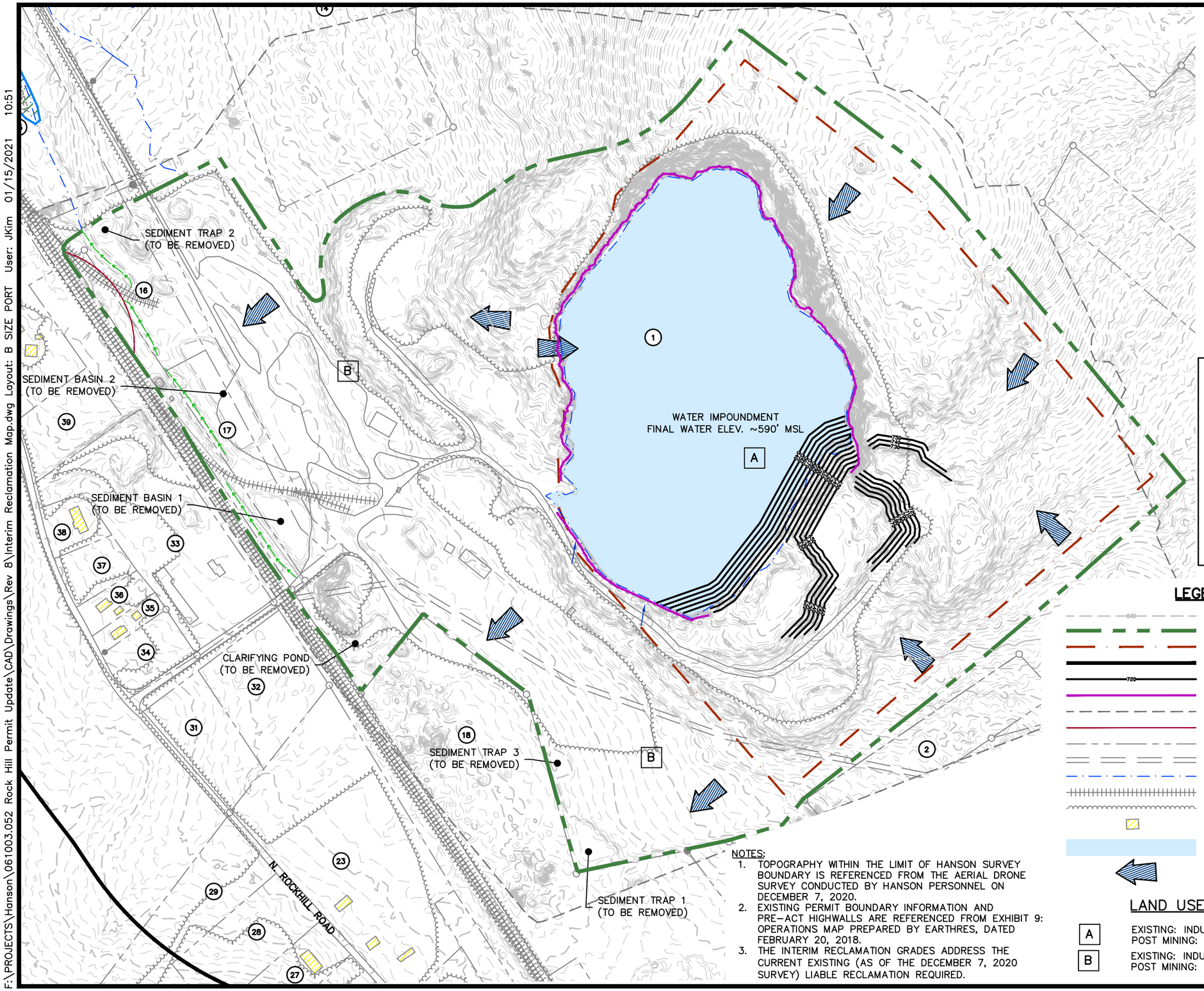
Rock Hill Quarry
SMP No. 7974SM1
January 15, 2021

As depicted on the attached Conceptual Reclamation Map (dated January 15, 2021), the mining area affected by R.E. Pierson mining activities in 2017 and 2018 consists of approximately 5.4 acres. The extent of newly created highwalls and affected Pre-Act highwalls is delineated on the Conceptual Bonding Map.

The conceptual reclamation would consist of the following:

- Identified affected Pre-Act highwalls and newly created highwalls (see Conceptual Reclamation Map and Conceptual Bonding Map) shall be reclaimed by drilling and blasting. Standard air-rotary drilling practices would be utilized as well as standard blasting techniques;
- Approximately 52,000 cubic yards of rock would need to be blasted to achieve the conceptual grading on the Conceptual Reclamation Map;
- Blasting of the newly created highwalls would create slopes of a maximum 35-degrees (from horizontal) that will extend to terraces at elevations 614 feet above mean sea level (AMSL), 654 feet AMSL and 714 feet AMSL;
- Reclaimed areas would likely need additional coverage using existing overburden material staged north of the quarry pit. Approximately 235,000 square feet (5.4 acres) of disturbed area would need to be covered with one (1) foot of material, which equals approximately 8,700 cubic yards of overburden needed for grading;
- Reclaimed areas would be graded to blend with the surrounding area when feasible to achieve a functional post-mining environment; and
- Upon final grading, the slopes and terraces would be vegetated and stabilized at a minimum uniform 70 percent perennial vegetative cover.

F:\PROJECTS\Hanson\061003.052 Rock Hill Permit Update\CAD\Drawings\Rev 8\Interim Reclamation Map.dwg Layout: B SIZE PORT User: JKim 01/15/2021 10:51



NOTES:

1. TOPOGRAPHY WITHIN THE LIMIT OF HANSON SURVEY BOUNDARY IS REFERENCED FROM THE AERIAL DRONE SURVEY CONDUCTED BY HANSON PERSONNEL ON DECEMBER 7, 2020.
2. EXISTING PERMIT BOUNDARY INFORMATION AND PRE-ACT HIGHWALLS ARE REFERENCED FROM EXHIBIT 9: OPERATIONS MAP PREPARED BY EARTHRES, DATED FEBRUARY 20, 2018.
3. THE INTERIM RECLAMATION GRADES ADDRESS THE CURRENT EXISTING (AS OF THE DECEMBER 7, 2020 SURVEY) LIABLE RECLAMATION REQUIRED.

LEGEND

- EXISTING GRADE CONTOUR
- EXISTING SMP BOUNDARY
- LIMIT OF MINING
- 1,000' SMP OFFSET
- INTERIM RECLAMATION CONTOURS
- PRE-ACT HIGHWALL
- LIMIT OF HANSON DRONE SURVEY
- 300' BUILDING SETBACK
- PROPERTY BOUNDARY
- EXISTING RIGHT OF WAY
- EXISTING SURFACE WATER
- EXISTING RAILROAD
- EXISTING TREELINE
- EXISTING BUILDING – RESIDENTIAL
- WATER IMPOUNDMENT
- POST-MINING DRAINAGE DIRECTION

LAND USE LEGEND

A — EXISTING: INDUSTRIAL (MINING)
POST MINING: UNMANAGED WATER IMPOUNDMENT

B — EXISTING: INDUSTRIAL (MINING SUPPORT)
POST MINING: UNMANAGED NATURAL HABITAT

COMMONWEALTH OF PENNSYLVANIA — REGISTERED PROFESSIONAL ENGINEER — JUNG TAEK KIM — PE088887

JUNG TAEK KIM, P.E.
LICENSE NO. PE088887

CONCEPTUAL RECLAMATION MAP

HANSON AGGREGATES PENNSYLVANIA LLC
ROCK HILL QUARRY

DRAWN BY: CBR	CHECKED BY: JTK	DATE: 1/15/21	PROJECT NO: 061003.052
DRAWING SCALE: 1" = 300'			

EARTHRES
ENGINEERING FOR SUCCESS"
www.earthres.com

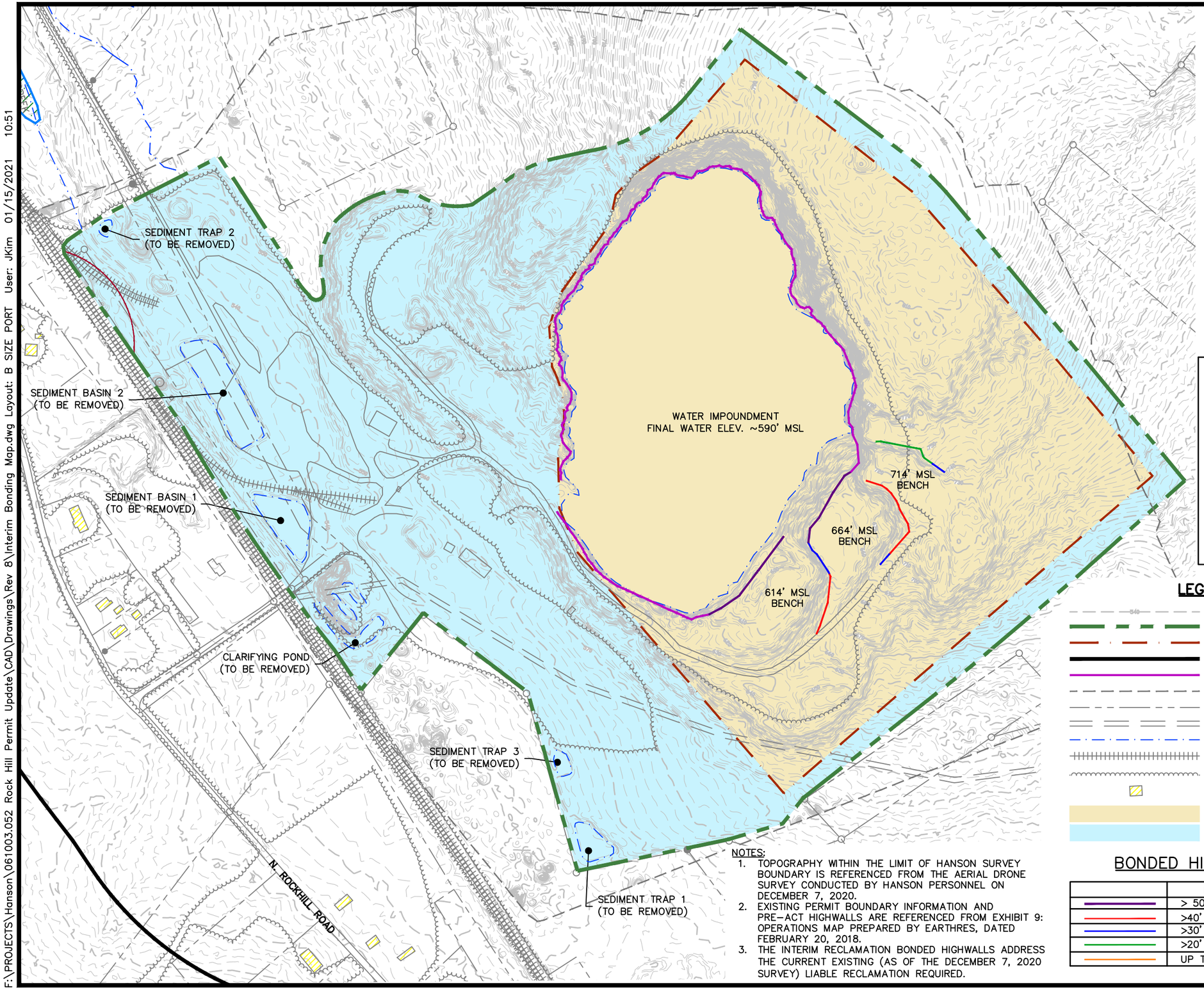
HEADQUARTERS
PHILADELPHIA REGION
P. O. Box 468
6912 Old Easton Road
Pipersville, PA 18947

APPALACHIAN
REGIONAL OFFICE
P. O. Box 794
8000 Coombs Farm Drive
Morgantown, WV 26505

ATTACHMENT 3(c)(ii)

Conceptual Bonding Map &
Conceptual Reclamation Calculations
January 15, 2021

F:\PROJECTS\Hanson\061003.052 Rock Hill Permit Update\CAD\Drawings\Rev 8\Interim Bonding Map.dwg Layout: B SIZE PORT User: JKim 01/15/2021 10:51



NOTES:

1. TOPOGRAPHY WITHIN THE LIMIT OF HANSON SURVEY BOUNDARY IS REFERENCED FROM THE AERIAL DRONE SURVEY CONDUCTED BY HANSON PERSONNEL ON DECEMBER 7, 2020.
2. EXISTING PERMIT BOUNDARY INFORMATION AND PRE-ACT HIGHWALLS ARE REFERENCED FROM EXHIBIT 9: OPERATIONS MAP PREPARED BY EARTHRES, DATED FEBRUARY 20, 2018.
3. THE INTERIM RECLAMATION BONDED HIGHWALLS ADDRESS THE CURRENT EXISTING (AS OF THE DECEMBER 7, 2020 SURVEY) LIABLE RECLAMATION REQUIRED.

LEGEND

- EXISTING GRADE CONTOUR
- EXISTING SMP BOUNDARY
- LIMIT OF MINING
- 1,000' SMP OFFSET
- PRE-ACT HIGHWALL
- LIMIT OF HANSON DRONE SURVEY
- PROPERTY BOUNDARY
- EXISTING RIGHT OF WAY
- EXISTING SURFACE WATER
- EXISTING RAILROAD
- EXISTING TREELINE
- EXISTING BUILDING – RESIDENTIAL
- BONDED FOR MINING (55.0 AC)
- BONDED FOR SUPPORT (54.8 AC)

BONDED HIGHWALL HEIGHTS

	HEIGHT	LENGTH (LINEAR FT)
	> 50'	602
	>40' UP TO 50'	507
	>30' UP TO 40'	209
	>20' UP TO 30'	200
	UP TO 20'	0

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL ENGINEER
JUNG TAEK KIM
PE088887

JUNG TAEK KIM, P.E.
LICENSE NO. PE088887

CONCEPTUAL BONDING MAP

HANSON AGGREGATES PENNSYLVANIA LLC
ROCK HILL QUARRY

DRAWN BY: CBR	CHECKED BY: JTK	DATE: 1/15/21	PROJECT NO: 061003.052
DRAWING SCALE: 1" = 300'			

HEADQUARTERS
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Pipersville, PA 18947

APPALACHIAN
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8000 Coombs Farm Drive
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5600-FM-BMP0474 12/2013

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF MINING PROGRAMS

BOND CALCULATION SUMMARY-NONCOAL CONSOLIDATED

Permittee: **Hanson Aggregates Pennsylvania LLC**		Date: **January 2021**
Permit #: **7974SM1**	Mine Name: **Rock Hill Quarry**	
Municipality: **East Rockhill Township**		County: **Bucks**

Operation (see attached calculations)	Quantity	Units	Rate $/Unit	Bond Amount
Mining Area (i.e. minor grading/vegetation)	55.0	Acres	$3,500	$192,500
Support Area (revegetation)	54.8	Acres	$1,900	$104,120
Spoil Storage/Earthmoving		Cubic yards		
Highwall Blasting				
Up to 20 ft Height	0	Linear foot	$10.00	$0.00
>20 up to 30 Height	200	Linear foot	$20.00	$4,000
>30 up to 40 Height	209	Linear foot	$40.00	$8,360
>40 up to 50 Height	507	Linear foot	$55.00	$27,885
>50 Height	602	Linear foot	$75.00	$45,150
Mine Sealing		Calculation		
Ponds	6	No of Ponds	$3,800	$22,800
Demolition of Structures	Lump Sum	Calculation		
Large Tires		Each		
Other Costs				
Mobilization/Demobilization	Lump Sum	Calculation		$16,192.60
Total Reclamation Cost				$421,007.60 *

* The total reclamation cost is based on interim site conditions from the December 7, 2020 Hanson aerial drone survey.

ATTACHMENT 4(a)

Module 17 – Air Pollution & Noise Control Plan
January 15, 2021

Module 17: Air Pollution and Noise Control Plan

[Chapters 121,123,127,129/NSMCRA 3323(a)(3)/§§ 77.455/77.575]

17.1 Processing Facilities

a) Indicate whether or not there are any processing facilities in the permit area. (Key to Exhibit 9) and specify the mineral(s) to be processed.

Type of Processing Facility	YES	NO	If YES: DRY	WET	Minerals/Product
Crushing	☐	☒	☐	☐	
Screening	☐	☒	☐	☐	
Cleaning	☐	☒	☐	☐	
Stockpiling	☒	☐	☐	☐	Diabase

b) Describe the processing facilities and the amount of minerals to be processed.

No aggregate processing is currently conducted at the site.

c) Provide the date that the DEP Regional Air Quality Office was contacted or, if applicable, provide a copy of the DEP Air Quality Program's determination to grant an exemption from the Air Quality Permit requirements and of any authorizations granted under the Air Quality General Permit for Portable Nonmetallic Mineral Processing Plants (BAQ-GPA/GP-3).

There are no DEP Air Quality authorizations associated with the Rock Hill Quarry site.

Note: All crushing and screening of noncoal minerals other than sand and gravel will require a separate Air Quality Permit from the DEP Regional Office Air Quality Program unless that Program makes a determination to grant an exemption. Crushing and/or screening of sand and gravel will require a separate Air Quality Permit from the DEP Regional Office Air Quality Program except for wet sand and gravel operations (screening only) and wet or dry sand and gravel operations (crushing and/or screening) unconsolidated material with a rated capacity of processing less than 150 tons per hour unless that Program makes a determination to grant an exemption. BAQ-GPA/GP-3 may be used for authorizing the construction, operation, and modification of portable nonmetallic mineral processing plants that will be located at the mine site.

d) Is the processing facility to be operated by the mining permittee? Yes ☐ No ☐ **No processing facility proposed**
If so, will the Air Quality permit be held by the mining permittee or a third party? Permittee ☐ Third Party ☐

17.2 Air Pollution Control Plan

Provide a description of the air pollution control plan including what measures will be taken to reduce dust from the following activities:

Prior to commencing site activities, Hanson will conduct a meeting with all personnel to review site procedures including air emission controls. Hanson proposes to install a windsock at the site to provide a visual indicator of wind direction during site activities.

a) Access roads, haul roads and adjoining portions of the public road

Fugitive dust may be minimized utilizing the following measures:

- As needed, water will be applied to unpaved roads at the facility each operating day through the use of a water truck assigned to the facility unless weather conditions (e.g. rain/snow) prohibit the use of this control measure.
- A facility-wide speed limit of 15 miles per hour (mph) will be posted and enforced to minimize fugitive dust emissions that could potentially be generated by mobile equipment.
- A 450 foot section of paved road exists between North Rockhill Road the unpaved portion of the site and should minimize fugitive dust emissions or track out.
- Any spillage of stone onto public roads will be removed and the roadway cleaned as soon as practical. All materials will be wetted prior to removal. A street sweeper will be utilized as needed for public roads.
- In addition to water, other dust suppressants approved by the Department may be used to control fugitive dust. Currently, the Department has approved calcium chloride; Ultra Bond 2000 (manufactured by JMG Enterprises - www.jmgemulsions.com); Pennzsuppress D (manufactured by PennzSuppress - www.pennzsuppress.com); Coherex and

Dustbond (manufactured by Weavertown Oil (distributed by D&D Emulsions). Operator reserves the right to use any additional dust suppressants approved by the Department in the future. See Attachment 17.2(a) for documentation provided by the Department.

b) Truck traffic (including fugitive particulate material from truck loads).

All trucks carrying products from the site are required to tarp their loads prior to exiting the site. A sign will be posted at the entrance/exit gate to the facility reminding drivers of the tarping requirements.

During 500-ton removal activities, all trucks will tarp their loads prior to moving from the loading area at the aggregate stockpile.

c) Drilling operation.

Drilling activities are not anticipated in the current or intended operations at the site until such time in the future Hanson requests and the Department approves aggregate processing activities.

d) Overburden removal and mineral extraction

Overburden removal and mineral extraction activities are not anticipated in the current or intended operations at the site until such time in the future Hanson requests and the Department approves these activities.

e) Stockpiles (overburden, topsoil, product).

Overburden materials have been stockpiled and stabilized with vegetation to minimize erosion by wind or water.

Existing product stockpiles should contain sufficient moisture to minimize fugitive dust emissions.

During 500-ton removal activities, if sufficient moisture is not present in the aggregate piles to minimize fugitive dust generation during material loading activities, wet dust suppression (e.g. standard water sprinklers) will be used to minimize fugitive dust emissions.

During 500-ton removal activities, the loader operator will minimize the drop height from the bucket into the dump truck in an effort to minimize fugitive dust emissions.

During 500-ton removal activities, the aggregate will be loaded from the downwind side of the existing aggregate stockpiles in an effort to minimize fugitive dust emissions.

Hanson will attempt to schedule the 500-ton removal activities during wet weather or during calm (wind) weather days in an effort to minimize fugitive dust emissions.

f) Loading and unloading areas.

Sufficient moisture should exist in the stockpiled aggregate products to control fugitive dust emissions during loadout. As needed, water will also be applied to the unpaved surfaces in the loading and unloading areas; stockpiles; and any other area where stone is being handled to minimize fugitive dust.

g) Crushing and other processing equipment.

At this time, no aggregate processing at the site is proposed.

h) Conveyors.

N/A

Activities under 17.2 a) through h) which are addressed and regulated as part of a separate Air Quality Permit do not need to be included in this module. Indicate which activities (or specific aspects of an activity) are addressed under a separate Air Quality Permit.

N/A

17.3 Noise Control

Describe the measures that will be taken to prevent noise from becoming a public nuisance.

The area between the quarry permit area and all surrounding residences is wooded, consisting of mostly deciduous vegetation. The trees and other vegetation assist in defusing sound during any site work.

Aggregate product stockpiles and berms provide additional noise attenuation.

Hanson will comply with the East Rockhill Township Noise Ordinance.

ATTACHMENT 17.2(a)

Dust Suppressant Documentation
January 15, 2021

From: Menghini, Michael
Sent: Friday, July 18, 2008 9:05:33 AM
To: Bollinger, Amiee; Stutzman, Colleen
Subject: FW: Update on Dust Suppressants

-----Original Message-----
From: Hoyle, Susan
Sent: Friday, April 12, 2002 9:23 AM
To: Menghini, Michael; Bish, David; Bonga, David; Bubbenmoyer, David; Disabella, Peter; Foster, Susan; Gee, Karen; Gratzmiller, Keith; Gray, Ronald; Gustafson, Staci; Heagy, Frederick; Mclemore, Kevin; Mordosky, Ronald; Murray, Richard; Orr, James; Rebarchak, James; Roller, Richard; Stroble, William; Archambault, John; Higgins, Francis; Krueger, John; Mendicino, Michael; Ruhl, Richard; Zvirblis, Anthony
Cc: Kepner, Scott; Colbert, Woodrow; Pounds, William; Sloan, Samuel; Shipman, Rick; Hayes, Joe; Socash, Stephen; Michael Silsbee (E-mail)
Subject: Update on Dust Suppressants

I received an update yesterday from Dr. Silsbee of the PSU Dirt and Gravel Road Program about some new dust suppressants that are expected to be added soon to the list of approved chemicals.

The two new products are Coherex and Dustbond. The parent company is Weaverton Oil and the local distributor appears to be D & D Emulsions.

These will be in addition to the Ultrabond, which is currently on the list of approved chemicals.

Peregrine Falcons Start New Family!
Live video/sound from the nest!
http://www.dep.state.pa.us/dep/falcon

From: Menghini, Michael
Sent: Wednesday, June 15, 2016 9:31:52 AM
To: Bollinger, Amiee
Cc: Latsha, Gary
Subject: Dust Suppressant Info

Per your request

Michael J. Menghini | District Mining Manager
Department of Environmental Protection
Pottsville District Mining Office
5 West Laurel Boulevard | Pottsville, PA 17901
Phone: 570.621.3118 | Fax: 570.621.3110
http://secure-web.cisco.com/11sekQix0B19MWA7M1kljdwALBqPFE3KfqkiPdBFgSE8I73pKJBU9Z10lc4_ILHtCdmVcaBjfRz5TViXu575hypSOztzulIxFYJ0bkQ1JEQV_Iax1GFqECF027_U1Lw0v3xhgqkJK6h2fmqEOG8ZSN486oQnbyqQT95jwou_jUF-bnQFoeR_m46LA-cWQSd06S4ZnAKOzUYQm5jYVk2dfV731tccHHRUQXcC_ohqxhwgH21J4Choj6EPji2hjBkJBHSS5W2l50ApnkEOP3jA4I1djcMFBMkwHd1sprPXnAA-vFvCOTJA1uWMsdG3sAP52vFV2XIaTsSdbUBKQVi6_wA/http%3A%2F%2Fwww.dep.pa.gov

GE Betz, Inc.
4636 Somerton Road
Trevose, PA 19053
Business telephone: (215) 355-3300

Material Safety Data Sheet

Issue Date: 29-MAR-2002

EMERGENCY TELEPHONE (Health/Accident): (800) 877-1940

1 PRODUCT IDENTIFICATION

PRODUCT NAME:

DUSTREAT DC9112

PRODUCT APPLICATION AREA:

DUST CONTROL AGENT.

2 COMPOSITION / INFORMATION ON INGREDIENTS

Information for specific product ingredients as required by the U.S. OSHA HAZARD COMMUNICATION STANDARD is listed. Refer to additional sections of this MSDS for our assessment of the potential hazards of this formulation.

HAZARDOUS INGREDIENTS:

This product is not hazardous as defined by OSHA regulations.

No component is considered to be a carcinogen by the National Toxicology Program, the International Agency for Research on Cancer, or the Occupational Safety and Health Administration at OSHA thresholds for carcinogens.

3 HAZARDS IDENTIFICATION

****

EMERGENCY OVERVIEW

CAUTION

May cause slight irritation to the skin. May cause moderate irritation to the eyes. Mists/aerosols may cause irritation to upper respiratory tract.

DOT hazard is not applicable
Emergency Response Guide is not applicable
Odor: Sweet; Appearance: Dark Brown, Liquid

Menghini, Michael

From: Menghini, Michael
Sent: Tuesday, February 26, 2002 8:41 AM
To: 'druhlin@bellatlantic.net'
Subject: Approved Dust Suppressants

Doug,
Here is the contact info I have on the two dust suppressants I discussed at the PACA mtg.:

Ultra Bond 2000
JMG Enterprises website: http://www.jmgemulsions.com/mainpage.html
Tech rep: John George 1-800-446-6785

Pennzsuppress D
websites: http://www.pennzsuppress.com/index.htm and http://www.pennzsuppress.com/html/ingredients.htm

Please let me know if you need any further info

Drought Information Center
Now Open! Save Water Now!
http://www.dep.state.pa.us (directLINK "drought")

Menghini, Michael

From:	Hoyle, Susan
Sent:	Friday, April 12, 2002 9:23 AM
To:	Menghini, Michael; Bish, David; Bonga, David; Bubbenmoyer, David; Disabella, Peter; Foster, Susan; Gee, Karen; Gratzmiller, Keith; Gray, Ronald; Gustafson, Staci; Heagy, Frederick; Mclemore, Kevin; Mordosky, Ronald; Murray, Richard; Orr, James; Rebarchak, James; Roller, Richard; Stroble, William; Archambault, John; Higgins, Francis; Krueger, John; Mendicino, Michael; Ruhl, Richard; Zvirblis, Anthony
Cc:	Kepner, Scott; Colbert, Woodrow; Pounds, William; Sloan, Samuel; Shipman, Rick; Hayes, Joe; Socash, Stephen; Michael Silsbee (E-mail)
Subject:	Update on Dust Suppressants

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Peregrine Falcons Start New Family!
Live video/sound from the nest!
http://www.dep.state.pa.us/dep/falcon

Ultra Bond 2000
JMG Enterprises website: http://www.jmgemulsions.com/mainpage.html
Tech rep; John George 1-800-446-6785

Pennzsuppress D
websites: http://www.pennzsuppress.com/index.htm and http://www.pennzsuppress.com/html/ingredients.htm

Please let me know if you need any further info

Drought Information Center
Now Open! Save Water Now!
http://www.dep.state.pa.us (directLINK "drought")

Christina:

Here are the websites for the 2 approved dust suppressants. Please call me if you have any questions.

Michael
(570) 621-3118

D.O.7	Check condition of remote fax.	8215972109

P.1 Mar 11 2002 14:35

** Transmit Conf. Report **

DEP DMO-POTTSVILLE OFC Fax:570-621-3110

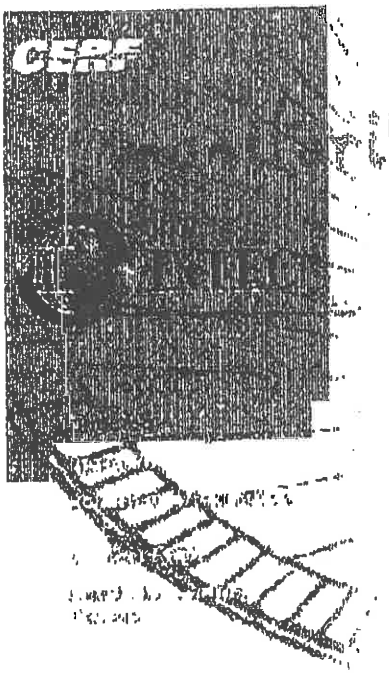
Menghini, Michael

From: Hoyle, Susan
Sent: Tuesday, April 16, 2002 11:46 AM
To: Menghini, Michael; Bish, David; Bonga, David; Bubbenmoyer, David; Disabella, Peter; Foster, Susan; Gee, Karen; Gratzmiller, Keith; Gray, Ronald; Gustafson, Staci; Heagy, Frederick; Mclemore, Kevin; Mordosky, Ronald; Murray, Richard; Orr, James; Rebarchak, James; Roller, Richard; Stroble, William; Archambault, John; Higgins, Francis; Krueger, John; Mendicino, Michael; Ruhl, Richard; Zvirblis, Anthony
Cc: Kepner, Scott
Subject: Contact Information for D&D Emulsions and Weavertown Group

The contact information for the Dustbond and Coherex dust suppressants is as follows:

D&D Emulsions Inc.
Attention: Dave Scott
270 Park Avenue East
PO Box 1706
Mansfield, OH 44901
419-522-9440

Weavertown Group
Donald Fuch, President & CEO
201 South Johnson Road
Houston, PA 15342
724-746-4850 ext. 1111

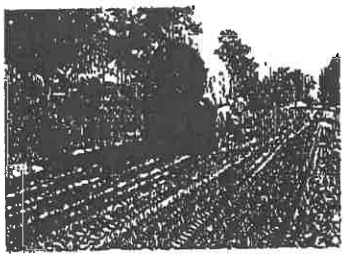


Evaluations

Dust Control/Road Stabilization Agents

last updated 04/01

Project Description



CERF is seeking vendors to participate in a group evaluation of various dust suppression and roadway stabilization products to assess both performance and potential environmental impacts of their use. HITEC will be evaluating the performance aspect of the products, while EvTEC will oversee the evaluation of environmental impacts. As part of the evaluation, in-service demonstrations will be conducted throughout the country in order to gather a broad range of data on how these products perform in different regions, climates, and soil types.

Evaluation Status

To date, four companies have signed on for the evaluation, with a total of five different dust suppression/stabilization products to be evaluated. Vendors who are interested in participating in this effort are encouraged to contact EvTEC for more details. The Final Evaluation Plan is complete and the project is moving into the testing phase for this verification. A total of six demonstration sites from across the country have been identified.

Product Description

Calcium Chloride from General Chemical Calcium Chloride has long been used in cost-effective road maintenance programs. General Chemical's calcium chloride is provided as a 35% liquid solution, packaged both in bulk and flake form. Calcium chloride absorbs moisture from the air, forming a clear liquid that is extremely resistant to evaporation.

Terra Bond® from Fluid Sciences, LLC TerraBond Poly Seal is a liquid soil-stabilizing chemical formulated to effectively seal surfaces, providing strength to virtually all

soil types. TerraBond Poly Seal is blended using combination of organic polymers.

Soil Sement® from Midwest Industrial Supply Soil Sement is a polymer emulsion that produces effective control of dust and erosion and soil stabilization. Soil Sement generates its effectiveness from the length and strength of its polymer molecules and their ability to bond with surface materials.

Enviro Kleen® from Midwest Industrial Supply EnviroKleen is a formulated synthetic organic dust control product that is said to be nontoxic, clean, oil-sheen-free, colorless, odorless, and safe for human, animal, and plant life.

Perma-Zyme 11X from RMI/International Enzymes Inc. Perma-Zyme 11X is an organic, non-toxic multi-enzyme formlutation designed to maximize compaction (increasing soil densities). It acts as a catalyst to greatly accelerate cohesive bonding of soil particles, creating a tight, permanent stratum.

Report Plans

The initial panel meeting was held June 2 and 3, 1999, in Washington, DC, with 15 panelists and four vendors present. The evaluation plan was completed in September 2000. The final evaluation report is tentatively scheduled for publication in early 2002 .

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For further information on EvTEC or this group evaluation, contact Jenise Dunn at 202.785.6454.

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ATTACHMENT 4(b)(ii)

Draft Air Monitoring Plan
January 15, 2021

Draft Air Monitoring Plan

Rock Hill Quarry
SMP No. 7974SM1
January 15, 2021

As requested by the Department, Hanson has prepared the following Draft Air Monitoring Plan (hereafter referred to as Plan) that incorporates monitoring for potential airborne asbestos fibers during periods of limited activity at the quarry as well as during inactivity. The scope of this Plan includes those activities Hanson, or its subcontractors, perform at the site. The limited activities are described below along with task-based air sampling protocols.

During the proposed limited activity period at the Rock Hill Quarry, the following site tasks must be conducted:

Monthly NPDES water sample collection

Hanson personnel or a subcontractor will access the site at least once per month to collect water samples from the NPDES discharge point(s). It is possible that additional trips in a month would be necessary to collect follow-up water samples. Since the site visit duration, typically by only one (1) person, would last less than 30 minutes, Hanson does not propose air monitoring to be conducted during these events. Hanson or its subcontractor will obey the posted speed limit of 15 miles per hour (mph) intended to minimize fugitive dust emissions that could potentially be generated by the passenger vehicle driving to the sample points.

Routine site inspection conducted via drive through;

At any time, Hanson or a subcontractor may access the site to conduct routine inspections for evidence of trespassing, site vandalism or regular checks on the stormwater management controls. Since the site visit duration would typically last less than 30 minutes, Hanson does not propose air monitoring to be conducted during these events. Hanson or its subcontractor will obey the posted speed limit of 15 mph intended to minimize fugitive dust emissions that could potentially be generated by the passenger vehicle.

Annual removal of 500 tons of crushed aggregate from existing stockpiles; and

As required by the Department, Hanson will conduct removal of a minimum 500 tons of previously crushed aggregate material on an annual basis. The event will likely last one (1) day; however, some equipment (e.g., loader, etc.) may be transported to the site ahead of the loadout event. During 500-ton removal activities, if sufficient moisture is not present in the aggregate piles to minimize fugitive dust generation during material loading activities, wet dust suppression (e.g. standard water sprinklers) will be used to minimize fugitive dust emissions. All vehicle movement at the site will obey the posted speed limit of 15 mph intended to minimize fugitive dust emissions. A maximum of 25 truckloads should be needed to remove the 500 tons. Additional details are provided in the Module 17 – Air Pollution and Noise Control Plan (revised January 15, 2021).

Prior to commencing site activities, Hanson will conduct a meeting with all personnel to review site procedures including air emission controls. During the day of the 500-ton loadout event, Hanson will conduct air monitoring to assess airborne particulate for the potential presence of naturally occurring asbestos (NOA). The air monitoring will be conducted at two (2) upwind and three (3) downwind locations relative to the aggregate loading operation and be located at or near the perimeter of the disturbed area of the Surface Mine Permit boundary (or as close as possible). The sample collection will follow the attached draft protocol titled Naturally Occurring Asbestos (NOA) Perimeter Monitoring Practices (to be finalized upon approval from the Department).

A letter report will be prepared and submitted to the Department no later than 30 days after the receipt of the analytical data from the laboratory. The report will include a description of the sample methodology, weather conditions, pump serial numbers, initial/final flow rates, sample numbers, sample locations, sample start/end times, laboratory analysis results, and recommendations (if necessary).

Non-scheduled site maintenance (e.g., ponds, roads, etc.)

At any time, Hanson or a subcontractor may access the site to conduct maintenance to stormwater ponds, berms, site roads, etc. Should the nature of the work disturb any dry aggregate or earthen material and last more than four (4) hours, the air monitoring methodology presented above will be utilized to monitor the site activity. If the maintenance event is to last less than four (4) hours, water sprays will be used to minimize fugitive dust emissions that could be generated by the maintenance activities. Natural precipitation will be used to minimize fugitive dust emissions when weather conditions allow. Hanson or its subcontractor will also obey posted speed limit of 15 mph intended to minimize additional fugitive dust emissions from moving vehicles.

Idle Site Background Conditions Monitoring

To address the Department's concerns regarding potential exposure to airborne NOA at the site, Hanson proposes to conduct a one-time background air monitoring event. This air monitoring event will last a total of two (2) days and consist of five (5) samples per day with two (2) upwind and three (3) downwind locations relative to the site permit boundary. Hanson will plan this background sampling event during dry weather conditions. The sample collection will follow the attached draft protocol titled Naturally Occurring Asbestos (NOA) Perimeter Monitoring Practices (to be finalized upon approval from the Department). Upon receipt of DEP-approval, the background sampling will be completed prior to the next 500-ton loadout event.

Effective Date XX/XX/XXXX	Rev XX

Naturally Occurring Asbestos (NOA)
Perimeter Monitoring Practices
ROCK HILL QUARRY

Approver			xx/xx/xxxx
	Name	**Signature**	**Date**

AMENDMENT HISTORY

Rev No	Date	Description of Amendments	Approver	Sections
00	xx/xx/xxxx	Initial Document		N/A

1. Purpose

The purpose of this document is to outline practices for periodically assessing potential naturally occurring asbestos (NOA) fibers in air at the perimeter of the Rock Hill Quarry permit boundary, in East Rockhill Township, Bucks County, Pennsylvania. This document defines air sampling and analysis techniques to be implemented through certified and licensed third-party specialists.

2. Scope

The scope of this document is limited to the permitted boundary of the Rock Hill Quarry operations. It is not applicable to assessments conducted beyond the facility's perimeter. The focus of this assessment is to establish a plan for assessing the potential presence of NOA fibers in air at the perimeter of the Rock Hill Quarry.

3. Definitions

Asbestos – A generic term for several asbestiform hydrated silicates. The term asbestos is limited to the following mineral fibers: chrysotile, amosite, crocidolite, anthophyllite asbestos, tremolite asbestos, and actinolite asbestos.

Asbestos Fiber – A fiber, longer than 5 micrometers (µm) with a length-to-width ratio of at least 3:1 and comprised of the asbestiform minerals listed in the above definition of asbestos.

Phase Contrast Microscopy (PCM) – Counts fibers that are present on filters to give a time-weighted average of the concentration of those fibers for the volume of air sampled. PCM results are fiber concentrations and do not distinguish between asbestos and non-asbestos fibers.

Transmission Electron Microscopy (TEM) - Identifies specific asbestos fibers in air (and bulk) samples. TEM is capable of analyzing samples at high magnification (20,000X and higher) and identifies asbestos fibers by morphology, crystalline structure and elemental analysis.

4. Naturally Occurring Asbestos (NOA) Air Sampling Practices

4.1. Number and Locations for Air Sampling

For each sampling event, a minimum of five (5) samples will be collected:

- Two (2) upwind; and
- Three (3) downwind.

General air sampling locations will be selected based upon:

- Site-specific activities ongoing during the sampling period;
- Historic prevailing wind direction; and
- Wind direction and site-specific weather conditions at the time of sampling.

Wind direction and wind speed will be monitored during each sampling event. If wind direction changes materially during a sampling event in any one sampling phase, the time and change in direction will be documented to reflect the change and provide data for analysis and comparison. In addition, if wind direction change is considered extreme during any sampling

event, the sampling location may be adjusted to reflect the change based on judgement of the field sampling technician.

- Wind direction and speed will be measured using a hand-held anemometer and recorded on field sampling data sheets.

In all cases, based upon professional judgment and knowledge of potential offsite receptors, sampling areas may also be adjusted to provide more representative data and consideration of special conditions. Any change in location will be properly documented to reflect the location, time, and change in wind direction.

4.2. Air Sample Collection

Sampling will be in accordance with the National Institute for Occupational Safety and Health (NIOSH) Manual for Analytical Methods (Method 7400 or Method 7402 for Asbestos and other Fibers). Air samples will be collected from fixed sampling locations with low-flow pumps. Each sampling apparatus shall include a cassette that contains a 25-millimeter (mm) diameter Mixed Cellulose Ester (MCE) filter with a pore size of 0.8 or 0.45 micrometers (um). Sample pumps shall be:

- Set to operate at approximately three (3) to four (4) liters per minute (lpm);
- Placed approximately five (5) feet above the ground surface (e.g. designed to approximate the breathing area of a worker or passerby to assess potential exposure);
- Calibrated prior to and following each sampling event using a cassette reserved for calibration (from the same lot of sample cassettes to be used for sample collection); and
- Sampled for durations lengthy enough to assure an adequate sample volume to achieve the desired laboratory reporting limits.

(Note: the site is a remote location where power for high volume sampling pumps is not available.)

Attachment A includes the field sampling data sheet and log sheet forms that will be used to document sampling activities.

4.3. Air Sample Analyses

Laboratory analyses of the collected samples will be conducted via a certified and licensed third-party. The analyses will be in accordance with the NIOSH Manual for Analytical Methods (Method 7400 and Method 7402 for Asbestos and other Fibers).

- Method 7400 Phase Contrast Microscopy (PCM): PCM will be used to analyze all samples. (See Attachment B – Method 7400.)
- Method 7402 Transmission Electron Microscopy (TEM): TEM will be used to further identify asbestos fibers of all widths longer than 5 micrometers (µm) with a length-to-width ratio of greater than or equal to 3:1. (See Attachment C – Method 7402.)

4.4. Third-Party Requirements

Third-party personnel collecting samples will be both certified for asbestos work and licensed and/or certified according to applicable State of Pennsylvania requirements, as applicable.

Third party laboratories conducting analysis shall be accredited through both recognized accreditation bodies, the American Industrial Hygiene Association (AIHA) and the National Voluntary Laboratory Accreditation Program (NVLAP).

4.5. Reports and Records

Air monitoring results will be formally documented within a summary report. Reports are to be maintained for a period of no less than five (5) years past the sampling date.

5. Responsibilities

Quarry Management

Quarry Management is responsible for the implementation of the sampling through:

- Providing for the contractual use of third parties conducting the air monitoring; and
- Maintaining result summary documentations.

Environment & Sustainability

Environment & Sustainability (E&S) representatives are responsible for supporting management during sampling implementation, coordinating for any necessary Occupational Health support with Corporate, and assisting in result communication.

6. References

1. National Institute of Occupational Health and Safety (NIOSH) Manual for Analytical Methods:
   1.1. Method 7400
   1.2. Method 7402

ATTACHMENTS

PROJECT AIR SAMPLE LOG

Facility:	Date:	Page ____ of ____

Sample Number	Date of Sample	Sample Area/Description	Time On	Time Off	Sampling Media Identification No.	Sampling Equipment Identification No.	Pre Cal Flow	Post Cal Flow	Flowrate Final (lpm)	Volume (liters)

	AIR SAMPLING RECORD **Field Sampling Data**	**Lehigh Hanson** HEIDELBERGCEMENT Group

Date: _____

Facility: _____

Temp: _____ **Humidity:** _____

Conditions (include wind direction/speed): _____

Sample Area and Description: _____

Activities being performed: _____

_____

_____

SAMPLING DATA

Time Start: _____ **Time End:** _____ **Total Time (min):** _____

Flowrate: _____ **Volume:** _____

Chemicals Monitored: _____

Pump: _____ **Pump ID:** _____

Media: _____ **Media ID:** _____

Secondary Calibrator / ID: _____

Comments / Unusual or Upset Conditions / Task or Work Activity Considerations:

Performed by: _____ **Signature:** _____

ASBESTOS and OTHER FIBERS by PCM 7400

FORMULA: Various MW: Various CAS: see Synonyms RTECS: Various

METHOD: 7400, Issue 2 **EVALUATION: FULL** **Issue 1: Rev. 3 on 15 May 1989**
Issue 2: 15 August 1994

OSHA: 0.1 asbestos fiber (> 5 µm long)/cc; 1 f/cc, 30 min excursion; carcinogen
MSHA: 2 asbestos fibers/cc
NIOSH: 0.1 f/cc (fibers > 5 µm long), 400 L; carcinogen
ACGIH: 0.2 f/cc crocidolite; 0.5 f/cc amosite; 2 f/cc chrysotile and other asbestos; carcinogen

PROPERTIES: solid, fibrous, crystalline, anisotropic

SYNONYMS [CAS #]: actinolite [77536-66-4] or ferroactinolite [15669-07-5]; amosite [12172-73-5]; anthophyllite [77536-67-5]; chrysotile [12001-29-5]; serpentine [18786-24-8]; crocidolite [12001-28-4]; tremolite [77536-68-6]; amphibole asbestos [1332-21-4]; refractory ceramic fibers [142844-00-6]; fibrous glass

SAMPLING

SAMPLER: FILTER (0.45- to 1.2-µm cellulose ester membrane, 25-mm; conductive cowl on cassette)

FLOW RATE*: 0.5 to 16 L/min

VOL-MIN*: 400 L @ 0.1 fiber/cc
-MAX*: (step 4, sampling)

*Adjust to give 100 to 1300 fiber/mm^2

SHIPMENT: routine (pack to reduce shock)

SAMPLE STABILITY: stable

BLANKS: 2 to 10 field blanks per set

ACCURACY

RANGE STUDIED: 80 to 100 fibers counted

BIAS: see EVALUATION OF METHOD

OVERALL PRECISION ($\hat{S}_{rT}$): 0.115 to 0.13 [1]

ACCURACY: see EVALUATION OF METHOD

MEASUREMENT

TECHNIQUE: LIGHT MICROSCOPY, PHASE CONTRAST

ANALYTE: fibers (manual count)

SAMPLE PREPARATION: acetone - collapse/triacetin - immersion method [2]

COUNTING RULES: described in previous version of this method as "A" rules [1,3]

EQUIPMENT:
1. positive phase-contrast microscope
2. Walton-Beckett graticule (100-µm field of view) Type G-22
3. phase-shift test slide (HSE/NPL)

CALIBRATION: HSE/NPL test slide

RANGE: 100 to 1300 fibers/mm^2 filter area

ESTIMATED LOD: 7 fibers/mm^2 filter area

PRECISION ($\bar{S}_r$): 0.10 to 0.12 [1]; see EVALUATION OF METHOD

APPLICABILITY: The quantitative working range is 0.04 to 0.5 fiber/cc for a 1000-L air sample. The LOD depends on sample volume and quantity of interfering dust, and is <0.01 fiber/cc for atmospheres free of interferences. The method gives an index of airborne fibers. It is primarily used for estimating asbestos concentrations, though PCM does not differentiate between asbestos and other fibers. Use this method in conjunction with electron microscopy (e.g., Method 7402) for assistance in identification of fibers. Fibers < ca. 0.25 µm diameter will not be detected by this method [4]. This method may be used for other materials such as fibrous glass by using alternate counting rules (see Appendix C).

INTERFERENCES: If the method is used to detect a specific type of fiber, any other airborne fiber may interfere since all particles meeting the counting criteria are counted. Chain-like particles may appear fibrous. High levels of non-fibrous dust particles may obscure fibers in the field of view and increase the detection limit.

OTHER METHODS: This revision replaces Method 7400, Revision #3 (dated 5/15/89).

REAGENTS:

1. Acetone,* reagent grade.
2. Triacetin (glycerol triacetate), reagent grade.

*See SPECIAL PRECAUTIONS.

EQUIPMENT:

1. Sampler: field monitor, 25-mm, three-piece cassette with ca. 50-mm electrically conductive extension cowl and cellulose ester filter, 0.45- to 1.2-µm pore size, and backup pad.
   NOTE 1: Analyze representative filters for fiber background before use to check for clarity and background. Discard the filter lot if mean is ≥ 5 fibers per 100 graticule fields. These are defined as laboratory blanks. Manufacturer-provided quality assurance checks on filter blanks are normally adequate as long as field blanks are analyzed as described below.
   NOTE 2: The electrically conductive extension cowl reduces electrostatic effects. Ground the cowl when possible during sampling.
   NOTE 3: Use 0.8-µm pore size filters for personal sampling. The 0.45-µm filters are recommended for sampling when performing TEM analysis on the same samples. However, their higher pressure drop precludes their use with personal sampling pumps.
   NOTE 4: Other cassettes have been proposed that exhibit improved uniformity of fiber deposit on the filter surface, e.g., bellmouthed sampler (Envirometrics, Charleston, SC). These may be used if shown to give measured concentrations equivalent to sampler indicated above for the application.
2. Personal sampling pump, battery or line-powered vacuum, of sufficient capacity to meet flow-rate requirements (see step 4 for flow rate), with flexible connecting tubing.
3. Wire, multi-stranded, 22-gauge; 1″ hose clamp to attach wire to cassette.
4. Tape, shrink- or adhesive-.
5. Slides, glass, frosted-end, pre-cleaned, 25- × 75-mm.
6. Cover slips, 22- × 22-mm, No. 1½, unless otherwise specified by microscope manufacturer.
7. Lacquer or nail polish.
8. Knife, #10 surgical steel, curved blade.
9. Tweezers.

EQUIPMENT (continued):

10. Acetone flash vaporization system for clearing filters on glass slides (see ref. [5] for specifications or see manufacturer's instructions for equivalent devices).
11. Micropipets or syringes, 5-µL and 100- to 500-µL.
12. Microscope, positive phase (dark) contrast, with green or blue filter, adjustable field iris, 8 to 10× eyepiece, and 40 to 45× phase objective (total magnification ca. 400×); numerical aperture = 0.65 to 0.75.
13. Graticule, Walton-Beckett type with 100-µm diameter circular field (area = 0.00785 mm^2) at the specimen plane (Type G-22). Available from Optometrics USA, P.O. Box 699, Ayer, MA 01432 [phone (508)-772-1700], and McCrone Accessories and Components, 850 Pasquinelli Drive, Westmont, IL 60559 [phone (312) 887-7100].
    NOTE: The graticule is custom-made for each microscope. (see APPENDIX A for the custom-ordering procedure).
14. HSE/NPL phase contrast test slide, Mark II. Available from Optometrics USA (address above).
15. Telescope, ocular phase-ring centering.
16. Stage micrometer (0.01-mm divisions).

SPECIAL PRECAUTIONS: Acetone is extremely flammable. Take precautions not to ignite it. Heating of acetone in volumes greater than 1 mL must be done in a ventilated laboratory fume hood using a flameless, spark-free heat source.

SAMPLING:

1. Calibrate each personal sampling pump with a representative sampler in line.
2. To reduce contamination and to hold the cassette tightly together, seal the crease between the cassette base and the cowl with a shrink band or light colored adhesive tape. For personal sampling, fasten the (uncapped) open-face cassette to the worker's lapel. The open face should be oriented downward.
    NOTE: The cowl should be electrically grounded during area sampling, especially under conditions of low relative humidity. Use a hose clamp to secure one end of the wire (Equipment, Item 3) to the monitor's cowl. Connect the other end to an earth ground (i.e., cold water pipe).
3. Submit at least two field blanks (or 10% of the total samples, whichever is greater) for each set of samples. Handle field blanks in a manner representative of actual handling of associated samples in the set. Open field blank cassettes at the same time as other cassettes just prior to sampling. Store top covers and cassettes in a clean area (e.g., a closed bag or box) with the top covers from the sampling cassettes during the sampling period.
4. Sample at 0.5 L/min or greater [6]. Adjust sampling flow rate, Q (L/min), and time, t (min), to produce a fiber density, E, of 100 to 1300 fibers/mm^2 (3.85×10^4 to 5×10^5 fibers per 25-mm filter with effective

collection area A_c = 385 mm^2) for optimum accuracy. These variables are related to the action level (one-half the current standard), L (fibers/cc), of the fibrous aerosol being sampled by:

$$t = \frac{A_c \times E}{Q \times L \times 10^3}.$$

NOTE 1: The purpose of adjusting sampling times is to obtain optimum fiber loading on the filter. The collection efficiency does not appear to be a function of flow rate in the range of 0.5 to 16 L/min for asbestos fibers [7]. Relatively large diameter fibers (>3 µm) may exhibit significant aspiration loss and inlet deposition. A sampling rate of 1 to 4 L/min for 8 h is appropriate in atmospheres containing ca. 0.1 fiber/cc in the absence of significant amounts of non-asbestos dust. Dusty atmospheres require smaller sample volumes (≤400 L) to obtain countable samples. In such cases take short, consecutive samples and average the results over the total collection time. For documenting episodic exposures, use high flow rates (7 to 16 L/min) over shorter sampling times. In relatively clean atmospheres, where targeted fiber concentrations are much less than 0.1 fiber/cc, use larger sample volumes (3000 to 10000 L) to achieve quantifiable loadings. Take care, however, not to overload the filter with background dust. If ≥50% of the filter surface is covered with particles, the filter may be too overloaded to count and will bias the measured fiber concentration.

NOTE 2: OSHA regulations specify a minimum sampling volume of 48 L for an excursion measurement, and a maximum sampling rate of 2.5 L/min [3].

5. At the end of sampling, replace top cover and end plugs.
6. Ship samples with conductive cowl attached in a rigid container with packing material to prevent jostling or damage.
   NOTE: Do not use untreated polystyrene foam in shipping container because electrostatic forces may cause fiber loss from sample filter.

SAMPLE PREPARATION:

NOTE 1: The object is to produce samples with a smooth (non-grainy) background in a medium with refractive index ≤ 1.46. This method collapses the filter for easier focusing and produces permanent (1–10 years) mounts which are useful for quality control and interlaboratory comparison. The aluminum "hot block" or similar flash vaporization techniques may be used outside the laboratory [2]. Other mounting techniques meeting the above criteria may also be used (e.g., the laboratory fume hood procedure for generating acetone vapor as described in Method 7400—revision of 5/15/85, or the non-permanent field mounting technique used in P&CAM 239 [3,7–9]). Unless the effective filtration area is known, determine the area and record the information referenced against the sample ID number [1,9–11].

NOTE 2: Excessive water in the acetone may slow the clearing of the filter, causing material to be washed off the surface of the filter. Also, filters that have been exposed to high humidities prior to clearing may have a grainy background.

7. Ensure that the glass slides and cover slips are free of dust and fibers.
8. Adjust the rheostat to heat the "hot block" to ca. 70 °C [2].
   NOTE: If the "hot block" is not used in a fume hood, it must rest on a ceramic plate and be isolated from any surface susceptible to heat damage.
9. Mount a wedge cut from the sample filter on a clean glass slide.
   a. Cut wedges of ca. 25% of the filter area with a curved-blade surgical steel knife using a rocking motion to prevent tearing. Place wedge, dust side up, on slide.
      NOTE: Static electricity will usually keep the wedge on the slide.
   b. Insert slide with wedge into the receiving slot at base of "hot block". Immediately place tip of a micropipet containing ca. 250 µL acetone (use the minimum volume needed to consistently clear the filter sections) into the inlet port of the PTFE cap on top of the "hot block" and inject the

acetone into the vaporization chamber with a slow, steady pressure on the plunger button while holding pipet firmly in place. After waiting 3 to 5 s for the filter to clear, remove pipet and slide from their ports.

CAUTION: Although the volume of acetone used is small, use safety precautions. Work in a well-ventilated area (e.g., laboratory fume hood). Take care not to ignite the acetone. Continuous use of this device in an unventilated space may produce explosive acetone vapor concentrations.

c. Using the 5-µL micropipet, immediately place 3.0 to 3.5 µL triacetin on the wedge. Gently lower a clean cover slip onto the wedge at a slight angle to reduce bubble formation. Avoid excess pressure and movement of the cover glass.

NOTE: If too many bubbles form or the amount of triacetin is insufficient, the cover slip may become detached within a few hours. If excessive triacetin remains at the edge of the filter under the cover slip, fiber migration may occur.

d. Mark the outline of the filter segment with a glass marking pen to aid in microscopic evaluation.

e. Glue the edges of the cover slip to the slide using lacquer or nail polish [12]. Counting may proceed immediately after clearing and mounting are completed.

NOTE: If clearing is slow, warm the slide on a hotplate (surface temperature 50 °C) for up to 15 min to hasten clearing. Heat carefully to prevent gas bubble formation.

CALIBRATION AND QUALITY CONTROL:

10. Microscope adjustments. Follow the manufacturer's instructions. At least once daily use the telescope ocular (or Bertrand lens, for some microscopes) supplied by the manufacturer to ensure that the phase rings (annular diaphragm and phase-shifting elements) are concentric. With each microscope, keep a logbook in which to record the dates of microscope cleanings and major servicing.
    a. Each time a sample is examined, do the following:
        (1) Adjust the light source for even illumination across the field of view at the condenser iris. Use Kohler illumination, if available. With some microscopes, the illumination may have to be set up with bright field optics rather than phase contract optics.
        (2) Focus on the particulate material to be examined.
        (3) Make sure that the field iris is in focus, centered on the sample, and open only enough to fully illuminate the field of view.
    b. Check the phase-shift detection limit of the microscope periodically for each analyst/microscope combination:
        (1) Center the HSE/NPL phase-contrast test slide under the phase objective.
        (2) Bring the blocks of grooved lines into focus in the graticule area.

        NOTE: The slide contains seven blocks of grooves (ca. 20 grooves per block) in descending order of visibility. For asbestos counting, the microscope optics must completely resolve the grooved lines in block 3 although they may appear somewhat faint, and the grooved lines in blocks 6 and 7 must be invisible when centered in the graticule area. Blocks 4 and 5 must be at least partially visible but may vary slightly in visibility between microscopes. A microscope which fails to meet these requirements has resolution either too low or too high for fiber counting.

        (3) If image quality deteriorates, clean the microscope optics. If the problem persists, consult the microscope manufacturer.
11. Document the laboratory's precision for each counter for replicate fiber counts.
    a. Maintain as part of the laboratory quality assurance program a set of reference slides to be used on a daily basis [13]. These slides should consist of filter preparations including a range of loadings and background dust levels from a variety of sources including both field and reference samples (e.g., PAT, AAR, commercial samples). The Quality Assurance Officer should maintain custody of the reference slides and should supply each counter with a minimum of one reference

slide per workday. Change the labels on the reference slides periodically so that the counter does not become familiar with the samples.

b. From blind repeat counts on reference slides, estimate the laboratory intra- and intercounter precision. Obtain separate values of relative standard deviation (S_r) for each sample matrix analyzed in each of the following ranges: 5 to 20 fibers in 100 graticule fields, >20 to 50 fibers in 100 graticule fields, and >50 to 100 fibers in 100 graticule fields. Maintain control charts for each of these data files.

NOTE: Certain sample matrices (e.g., asbestos cement) have been shown to give poor precision [9].

12. Prepare and count field blanks along with the field samples. Report counts on each field blank.

NOTE 1: The identity of blank filters should be unknown to the counter until all counts have been completed.

NOTE 2: If a field blank yields greater than 7 fibers per 100 graticule fields, report possible contamination of the samples.

13. Perform blind recounts by the same counter on 10% of filters counted (slides relabeled by a person other than the counter). Use the following test to determine whether a pair of counts by the same counter on the same filter should be rejected because of possible bias: Discard the sample if the absolute value of the difference between the square roots of the two counts (in fiber/mm^2) exceeds $2.77XS_r'$ where X = average of the square roots of the two fiber counts (in fiber/mm^2) and $S_r' = S_r / 2$ where S_r is the intracounter relative standard deviation for the appropriate count range (in fibers) determined in step 11. For more complete discussions see reference [13].

NOTE 1: Since fiber counting is the measurement of randomly placed fibers which may be described by a Poisson distribution, a square root transformation of the fiber count data will result in approximately normally distributed data [13].

NOTE 2: If a pair of counts is rejected by this test, recount the remaining samples in the set and test the new counts against the first counts. Discard all rejected paired counts. It is not necessary to use this statistic on blank counts.

14. The analyst is a critical part of this analytical procedure. Care must be taken to provide a non-stressful and comfortable environment for fiber counting. An ergonomically designed chair should be used, with the microscope eyepiece situated at a comfortable height for viewing. External lighting should be set at a level similar to the illumination level in the microscope to reduce eye fatigue. In addition, counters should take 10- to 20-minute breaks from the microscope every one or two hours to limit fatigue [14]. During these breaks, both eye and upper back/neck exercises should be performed to relieve strain.
15. All laboratories engaged in asbestos counting should participate in a proficiency testing program such as the AIHA-NIOSH Proficiency Analytical Testing (PAT) Program for asbestos and routinely exchange field samples with other laboratories to compare performance of counters.

MEASUREMENT:

16. Center the slide on the stage of the calibrated microscope under the objective lens. Focus the microscope on the plane of the filter.
17. Adjust the microscope (Step 10).

NOTE: Calibration with the HSE/NPL test slide determines the minimum detectable fiber diameter (ca. 0.25 µm) [4].

18. Counting rules: (same as P&CAM 239 rules [1,10,11]: see examples in APPENDIX B).

a. Count any fiber longer than 5 µm which lies entirely within the graticule area.
   (1) Count only fibers longer than 5 µm. Measure length of curved fibers along the curve.
   (2) Count only fibers with a length-to-width ratio equal to or greater than 3:1.

b. For fibers which cross the boundary of the graticule field:
   (1) Count as ½ fiber any fiber with only one end lying within the graticule area, provided that the fiber meets the criteria of rule a above.

(2) Do not count any fiber which crosses the graticule boundary more than once.
(3) Reject and do not count all other fibers.

c. Count bundles of fibers as one fiber unless individual fibers can be identified by observing both ends of a fiber.
d. Count enough graticule fields to yield 100 fibers. Count a minimum of 20 fields. Stop at 100 graticule fields regardless of count.

19. Start counting from the tip of the filter wedge and progress along a radial line to the outer edge. Shift up or down on the filter, and continue in the reverse direction. Select graticule fields randomly by looking away from the eyepiece briefly while advancing the mechanical stage. Ensure that, as a minimum, each analysis covers one radial line from the filter center to the outer edge of the filter. When an agglomerate or bubble covers ca. 1/6 or more of the graticule field, reject the graticule field and select another. Do not report rejected graticule fields in the total number counted.

NOTE 1: When counting a graticule field, continuously scan a range of focal planes by moving the fine focus knob to detect very fine fibers which have become embedded in the filter. The small-diameter fibers will be very faint but are an important contribution to the total count. A minimum counting time of 15 s per field is appropriate for accurate counting.

NOTE 2: This method does not allow for differentiation of fibers based on morphology. Although some experienced counters are capable of selectively counting only fibers which appear to be asbestiform, there is presently no accepted method for ensuring uniformity of judgment between laboratories. It is, therefore, incumbent upon all laboratories using this method to report total fiber counts. If serious contamination from non-asbestos fibers occurs in samples, other techniques such as transmission electron microscopy must be used to identify the asbestos fiber fraction present in the sample (see NIOSH Method 7402). In some cases (i.e., for fibers with diameters >1 µm), polarized light microscopy (as in NIOSH Method 7403) may be used to identify and eliminate interfering non-crystalline fibers [15].

NOTE 3: Do not count at edges where filter was cut. Move in at least 1 mm from the edge.

NOTE 4: Under certain conditions, electrostatic charge may affect the sampling of fibers. These electrostatic effects are most likely to occur when the relative humidity is low (below 20%), and when sampling is performed near the source of aerosol. The result is that deposition of fibers on the filter is reduced, especially near the edge of the filter. If such a pattern is noted during fiber counting, choose fields as close to the center of the filter as possible [5].

NOTE 5: Counts are to be recorded on a data sheet that provides, as a minimum, spaces on which to record the counts for each field, filter identification number, analyst's name, date, total fibers counted, total fields counted, average count, fiber density, and commentary. Average count is calculated by dividing the total fiber count by the number of fields observed. Fiber density (fibers/mm^2) is defined as the average count (fibers/field) divided by the field (graticule) area (mm^2/field).

CALCULATIONS AND REPORTING OF RESULTS

20. Calculate and report fiber density on the filter, E (fibers/mm^2), by dividing the average fiber count per graticule field, F / n_f, minus the mean field blank count per graticule field, B / n_b, by the graticule field area, A_f (approx. 0.00785 mm^2):

$$E = \frac{(F/n_f - B/n_b)}{A_f}, \text{ fibers/mm}^2.$$

NOTE: Fiber counts above 1300 fibers/mm^2 and fiber counts from samples with >50% of filter area covered with particulate should be reported as "uncountable" or "probably biased." Other fiber counts outside the 100–1300 fiber/mm^2 range should be reported as having "greater than optimal variability" and as being "probably biased."

21. Calculate and report the concentration, C (fibers/cc), of fibers in the air volume sampled, V (L), using the effective collection area of the filter, A_c (approx. 385 mm^2 for a 25-mm filter):

$$C = \frac{EA_c}{V \times 10^3}.$$

NOTE: Periodically check and adjust the value of A_c, if necessary.

22. Report intralaboratory and interlaboratory relative standard deviations (from Step 11) with each set of results.
    NOTE: Precision depends on the total number of fibers counted [1,16]. Relative standard deviation is documented in references [1,15–17] for fiber counts up to 100 fibers in 100 graticule fields. Comparability of interlaboratory results is discussed below. As a first approximation, use 213% above and 49% below the count as the upper and lower confidence limits for fiber counts greater than 20 (Figure 1).

EVALUATION OF METHOD:

Method Revisions:

This method is a revision of P&CAM 239 [10]. A summary of the revisions is as follows:

1. Sampling:
   The change from a 37-mm to a 25-mm filter improves sensitivity for similar air volumes. The change in flow rates allows for 2-m^3 full-shift samples to be taken, providing that the filter is not overloaded with non-fibrous particulates. The collection efficiency of the sampler is not a function of flow rate in the range 0.5 to 16 L/min [10].
2. Sample preparation technique:
   The acetone vapor-triacetin preparation technique is a faster, more permanent mounting technique than the dimethyl phthalate/diethyl oxalate method of P&CAM 239 [2,4,10]. The aluminum "hot block" technique minimizes the amount of acetone needed to prepare each sample.
3. Measurement:
   a. The Walton-Beckett graticule standardizes the area observed [14,18,19].
   b. The HSE/NPL test slide standardizes microscope optics for sensitivity to fiber diameter [4,14].
   c. Because of past inaccuracies associated with low fiber counts, the minimum recommended loading has been increased to 100 fibers/mm^2 filter area (a total of 78.5 fibers counted in 100 fields, each with field area = 0.00785 mm^2.) Lower levels generally result in an overestimate of the fiber count when compared to results in the recommended analytical range [20]. The recommended loadings should yield intracounter S_r in the range of 0.10 to 0.17 [21–23].

Interlaboratory Comparability:

An international collaborative study involved 16 laboratories using prepared slides from the asbestos cement, milling, mining, textile, and friction material industries [9]. The relative standard deviations (S_r) varied with sample type and laboratory. The ranges were:

Rules	Intralaboratory S_r	Interlaboratory S_r	Overall S_r
AIA (NIOSH A Rules)*	0.12 to 0.40	0.27 to 0.85	0.46
Modified CRS (NIOSH B Rules)†	0.11 to 0.29	0.20 to 0.35	0.25

*Under AIA rules, only fibers having a diameter less than 3 µm are counted and fibers attached to particles larger than 3 µm are not counted. NIOSH A Rules are otherwise similar to the AIA rules.
†See Appendix C.

A NIOSH study conducted using field samples of asbestos gave intralaboratory S_r in the range 0.17 to 0.25 and an interlaboratory S_r of 0.45 [21]. This agrees well with other recent studies [9,14,16].

At this time, there is no independent means for assessing the overall accuracy of this method. One measure of reliability is to estimate how well the count for a single sample agrees with the mean count from a large number of laboratories. The following discussion indicates how this estimation can be carried out based on measurements of the interlaboratory variability, as well as showing how the results of this method relate to the theoretically attainable counting precision and to measured intra- and interlaboratory S_r. (NOTE: The following discussion does not include bias estimates and should not be taken to indicate that lightly loaded samples are as accurate as properly loaded ones).

Theoretically, the process of counting randomly (Poisson) distributed fibers on a filter surface will give an S_r that depends on the number, N, of fibers counted:

$$S_r = 1/N^{1/2}.$$

Thus S_r is 0.1 for 100 fibers and 0.32 for 10 fibers counted. The actual S_r found in a number of studies is greater than these theoretical numbers [17,19–21].

An additional component of variability comes primarily from subjective interlaboratory differences. In a study of ten counters in a continuing sample exchange program, Ogden [15] found this subjective component of intralaboratory S_r to be approximately 0.2 and estimated the overall S_r by the term:

$$\frac{[N + (0.2 \times N)^2]^{1/2}}{N}.$$

Ogden found that the 90% confidence interval of the individual intralaboratory counts in relation to the means were +2 S_r and −1.5 S_r. In this program, one sample out of ten was a quality control sample. For laboratories not engaged in an intensive quality assurance program, the subjective component of variability can be higher.

In a study of field sample results in 46 laboratories, the Asbestos Information Association also found that the variability had both a constant component and one that depended on the fiber count [14]. These results gave a subjective interlaboratory component of S_r (on the same basis as Ogden's) for field samples of ca. 0.45. A similar value was obtained for 12 laboratories analyzing a set of 24 field samples [21]. This value falls slightly above the range of S_r (0.25 to 0.42 for 1984–85) found for 80 reference laboratories in the NIOSH PAT program for laboratory-generated samples [17].

A number of factors influence S_r for a given laboratory, such as that laboratory's actual counting performance and the type of samples being analyzed. In the absence of other information, such as from an interlaboratory quality assurance program using field samples, the value for the subjective component of variability is chosen as 0.45. It is hoped that the laboratories will carry out the recommended interlaboratory quality assurance programs to improve their performance and thus reduce the S_r.

The above relative standard deviations apply when the population mean has been determined. It is more useful, however, for laboratories to estimate the 90% confidence interval on the mean count from a single sample fiber count (Figure 1). These curves assume similar shapes of the count distribution for interlaboratory and intralaboratory results [16].

For example, if a sample yields a count of 24 fibers, Figure 1 indicates that the mean interlaboratory count will fall within the range of 227% above and 52% below that value 90% of the time. We can apply these percentages directly to the air concentrations as well. If, for instance, this sample (24 fibers counted) represented a 500-L volume, then the measured concentration is 0.02 fibers/mL (assuming 100 fields counted, 25-mm filter, 0.00785 mm^2 counting field area). If this same sample were counted by

a group of laboratories, there is a 90% probability that the mean would fall between 0.01 and 0.08 fiber/mL. These limits should be reported in any comparison of results between laboratories.

Note that the S_r of 0.45 used to derive Figure 1 is used as an estimate for a random group of laboratories. If several laboratories belonging to a quality assurance group can show that their interlaboratory S_r is smaller, then it is more correct to use that smaller S_r. However, the estimated S_r of 0.45 is to be used in the absence of such information. Note also that it has been found that S_r can be higher for certain types of samples, such as asbestos cement [9].

Quite often the estimated airborne concentration from an asbestos analysis is used to compare to a regulatory standard. For instance, if one is trying to show compliance with an 0.5 fiber/mL standard using a single sample on which 100 fibers have been counted, then Figure 1 indicates that the 0.5 fiber/mL standard must be 213% higher than the measured air concentration. This indicates that if one measures a fiber concentration of 0.16 fiber/mL (100 fibers counted), then the mean fiber count by a group of laboratories (of which the compliance laboratory might be one) has a 95% chance of being less than 0.5 fibers/mL; i.e., $0.16 + 2.13 \times 0.16 = 0.5$.

It can be seen from Figure 1 that the Poisson component of the variability is not very important unless the number of fibers counted is small. Therefore, a further approximation is to simply use +213% and −49% as the upper and lower confidence values of the mean for a 100-fiber count.

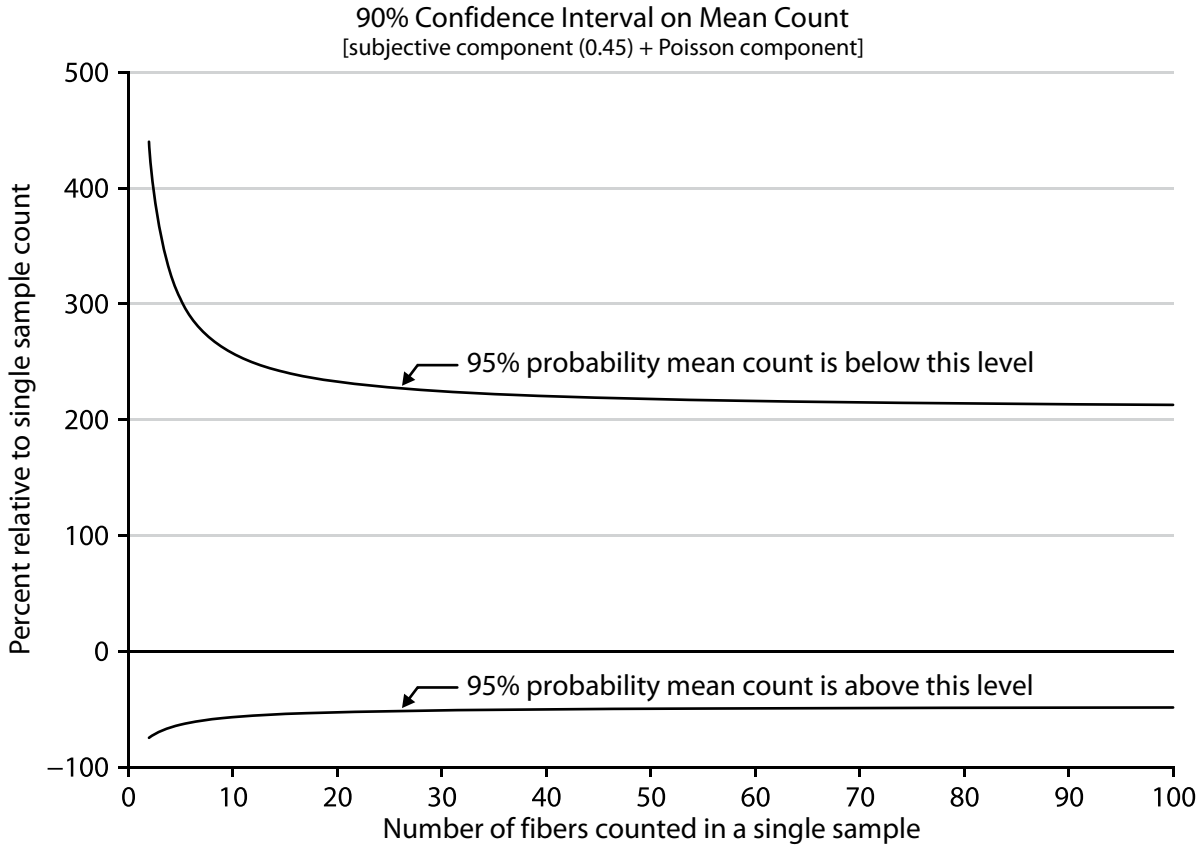

Figure 1. Interlaboratory precision of fiber counts.

The curves in Figure 1 are defined by the following equations:

$$U_{CL} = \frac{2X + 2.25 + [(2.25 + 2X)^2 - 4(1 - 2.25S_r^2)X^2]^{½}}{2(1 - 2.25S_r^2)} \text{ and}$$

$$L_{CL} = \frac{2X + 4 - [(4 + 2X)^2 - 4(1 - 4S_r^2)X^2]^{½}}{2(1 - 4S_r^2)},$$

where S_r = subjective interlaboratory relative standard deviation, which is close to the total interlaboratory S_r when approximately 100 fibers are counted,
X = total fibers counted on sample,
L_{CL} = lower 95% confidence limit, and
U_{CL} = upper 95% confidence limit.

Note that the range between these two limits represents 90% of the total range.

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APPENDIX A. CALIBRATION OF THE WALTON-BECKETT GRATICULE

Before ordering the Walton-Beckett graticule, the following calibration must be done to obtain a counting area (*D*) 100 µm in diameter at the image plane. The diameter, d_c (mm), of the circular counting area and the disc diameter must be specified when ordering the graticule.

1. Insert any available graticule into the eyepiece and focus so that the graticule lines are sharp and clear.
2. Set the appropriate interpupillary distance and, if applicable, reset the binocular head adjustment so that the magnification remains constant.
3. Install the 40 to 45× phase objective.
4. Place a stage micrometer on the microscope object stage and focus the microscope on the graduated lines.
5. Measure the magnified grid length of the graticule, L_o (µm), using the stage micrometer.
6. Remove the graticule from the microscope and measure its actual grid length, L_a (mm). This can best be accomplished by using a stage fitted with verniers.
7. Calculate the circle diameter, d_c (mm), for the Walton-Beckett graticule:

$$d_c = \frac{L_a}{L_o} \times D.$$

   Example: If L_o = 112 µm, L_a = 4.5 mm, and D = 100 µm, then d_c = 4.02 mm.
8. Check the field diameter, *D* (acceptable range 100 µm ± 2 µm) with a stage micrometer upon receipt of the graticule from the manufacturer. Determine field area (acceptable range 0.00754 mm^2 to 0.00817 mm^2).

APPENDIX B. COMPARISON OF COUNTING RULES

Figure 2 shows a Walton-Beckett graticule as seen through the microscope. The rules will be discussed as they apply to the labeled objects in the figure.

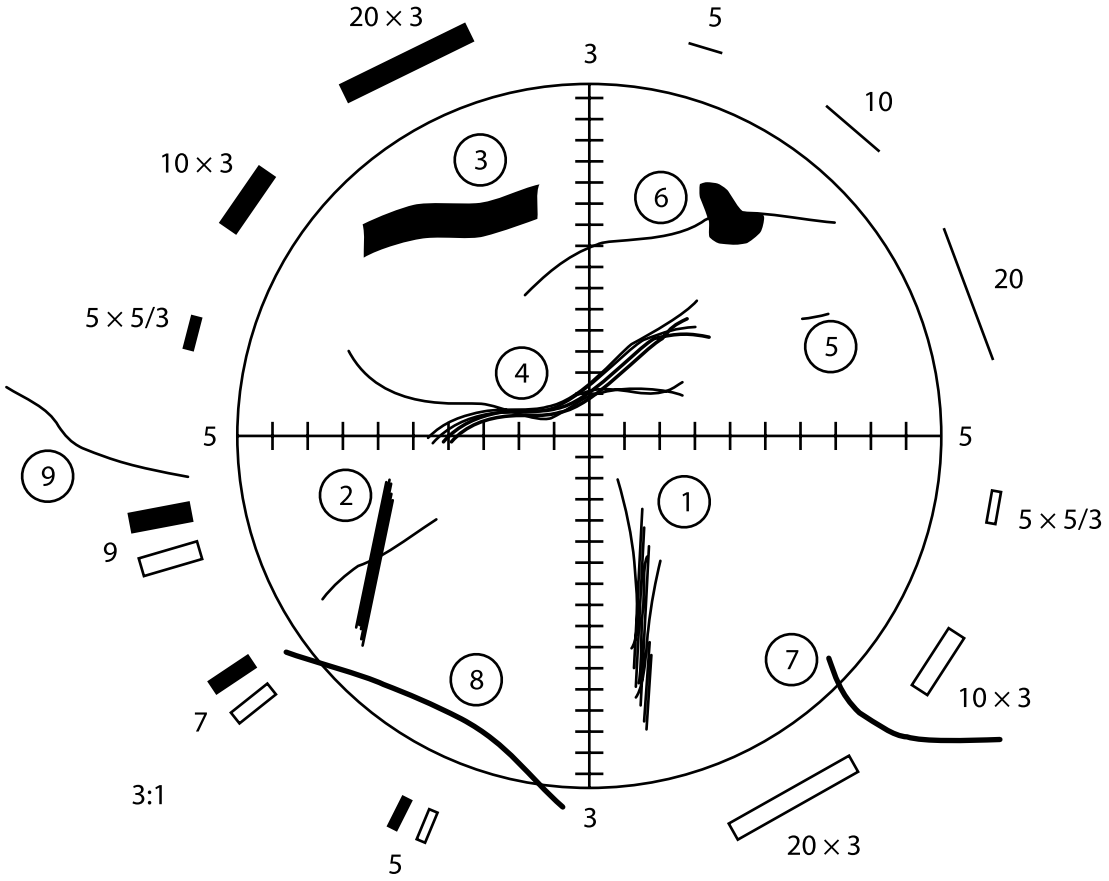


Figure 2. Walton-Beckett graticule with fibers.

These rules are sometimes referred to as the "A" rules:

Object	Count	Discussion
1	1 fiber	Optically observable asbestos fibers are actually bundles of fine fibrils. If the fibrils seem to be from the same bundle, the object is counted as a single fiber. Note, however, that all objects meeting length and aspect ratio criteria are counted whether or not they appear to be asbestos.
2	2 fibers	If fibers meeting the length and aspect ratio criteria (length >5 µm and length-to-width ratio > 3 to 1) overlap, but do not seem to be part of the same bundle, they are counted as separate fibers.
3	1 fiber	Although the object has a relatively large diameter (>3 µm), it is counted as fiber under the rules. There is no upper limit on the fiber diameter in the counting rules. Note that fiber width is measured at the widest compact section of the object.
4	1 fiber	Although long fine fibrils may extend from the body of a fiber, these fibrils are considered part of the fiber if they seem to have originally been part of the bundle.
5	Do not count	If the object is ≤ 5 µm long, it is not counted.
6	1 fiber	A fiber partially obscured by a particle is counted as one fiber. If the fiber ends emanating from a particle do not seem to be from the same fiber and each end meets the length and aspect ratio criteria, they are counted as separate fibers.
7	½ fiber	A fiber which crosses into the graticule area one time is counted as ½ fiber.
8	Do not count	Ignore fibers that cross the graticulate boundary more than once.
9	Do not count	Ignore fibers that lie outside the graticule boundary.

APPENDIX C. ALTERNATE COUNTING RULES FOR NON-ASBESTOS FIBERS

Other counting rules may be more appropriate for measurement of specific non-asbestos fiber types, such as fibrous glass. These include the "B" rules given below (from NIOSH Method 7400, Revision #2, dated 8/15/87), the World Health Organization reference method for man-made mineral fiber [24], and the NIOSH fibrous glass criteria document method [25]. The upper diameter limit in these methods prevents measurements of non-thoracic fibers. It is important to note that the aspect ratio limits included in these methods vary. NIOSH recommends the use of the 3:1 aspect ratio in counting fibers.

It is emphasized that hybridization of different sets of counting rules is not permitted. Report specifically which set of counting rules are used with the analytical results.

"B" Counting Rules

1. Count only *ends* of fibers. Each fiber must be longer than 5 µm and less than 3 µm diameter.
2. Count only ends of fibers with a length-to-width ratio equal to or greater than 5:1.
3. Count each fiber end which falls within the graticule area as one end, provided that the fiber meets rules 1 and 2 above. Add split ends to the count as appropriate if the split fiber segment also meets the criteria of rules 1 and 2 above.
4. Count visibly free ends which meet rules 1 and 2 above when the fiber appears to be attached to another particle, regardless of the size of the other particle. Count the end of a fiber obscured by another particle if the particle covering the fiber end is less than 3 µm in diameter.

5. Count free ends of fibers emanating from large clumps and bundles up to a maximum of 10 ends (5 fibers), provided that each segment meets rules 1 and 2 above.
6. Count enough graticule fields to yield 200 ends. Count a minimum of 20 graticule fields. Stop at 100 graticule fields, regardless of count.
7. Divide total end count by 2 to yield fiber count.

APPENDIX D. EQUIVALENT LIMITS OF DETECTION AND QUANTITATION

	Fiber density on filter*		Fiber concentration in air, f/cc	
	Fibers per 100 fields	Fibers/mm^2	400-L air sample	1000-L air sample
	200	255	0.25	0.10
	100	127	0.125	0.05
LOQ	80.0	102	0.10	0.04
	50	64	0.0625	0.025
	25	32	0.03	0.0125
	20	25	0.025	0.010
	10	12.7	0.0125	0.005
	8	10.2	0.010	0.004
LOD	5.5	7	0.00675	0.0027

*Assumes 385 mm^2 effective filter collection area, and field area = 0.00785 mm^2, for relatively "clean" (little particulate aside from fibers) filters.

ASBESTOS by TEM 7402

FORMULA: Various MW: Various CAS: Various RTECS: Various

METHOD: 7402 **EVALUATION: PARTIAL** **Issue 1: 15 May 1989**
Issue 2: 15 August 1994

OSHA : 0.1 asbestos fibers (>5 µm long)/cc; 1 f/cc/30 min excursion; carcinogen
MSHA: 2 asbestos fibers/cc
NIOSH: 0.1 f/cc (fibers > 5 µm long)/400 L; carcinogen
ACGIH: 0.2 crocidolite; 0.5 amosite; 2 chrysotile and other asbestos, fibers/cc; carcinogen

PROPERTIES: solid, fibrous, crystalline, anistropic

SYNONYMS [CAS#]: actinolite [77536-66-4] or ferroactinolite [15669-07-5]; amosite [12172-73-5]; anthophyllite [77536-67-5]; chrysotile [12001-29-5]; serpentine [18786-24-8]; crocidolite [12001-28-4]; tremolite [77536-68-6]; amphibole asbestos [1332-21-4].

SAMPLING

SAMPLER: FILTER (0.45- to 1.2-µm cellulose ester membrane, 25-mm diameter; conductive cassette)

FLOW RATE: 0.5 to 16 L/min

VOL-MIN*: 400 L @ 0.1 fiber/cc
-MAX*: (step 4, sampling)
*Adjust for 100 to 1300 fibers/mm^2

SHIPMENT: routine (pack to reduce shock)

SAMPLE STABILITY: stable

BLANKS: 2 to 10 field blanks per set

ACCURACY

RANGE STUDIED: 80 to 100 fibers counted

BIAS: not determined

OVERALL PRECISION ($\hat{S}_{rT}$): see EVALUATION OF METHOD

ACCURACY: not determined

MEASUREMENT

TECHNIQUE: MICROSCOPY, TRANSMISSION ELECTRON (TEM)

ANALYTE: asbestos fibers

SAMPLE PREPARATION: modified Jaffe wick

EQUIPMENT: transmission electron microscope; energy dispersive X-ray system (EDX) analyzer

CALIBRATION: qualitative electron diffraction; calibration of TEM magnification and EDX system

RANGE: 100 to 1300 fibers/mm^2 filter area [1]

ESTIMATED LOD: 1 confirmed asbestos fiber above 95% of expected mean blank value

PRECISION ($\hat{S}_r$): 0.28 when 65% of fibers are asbestos; 0.20 when adjusted fiber count is applied to PCM count [2].

APPLICABILITY: The quantitative working range is 0.04 to 0.5 fiber/cc for a 1000-L air sample. The LOD depends on sample volume and quantity of interfering dust, and is <0.01 fiber/cc for atmospheres free of interferences. This method is use d to determine asbestos fibers in the optically visible range and is intended to complement the results obtained by phase con trast microscopy (Method 7400).

INTERFERENCES: Other amphibole particles that have aspect ratios greater than 3:1 and elemental compositions similar to the asbestos minerals may interfere in the TEM analysis. Some non-amphibole minerals may give electron diffraction patterns similar to amphiboles. High concentrations of background dust interfere with fiber identification. Some non-asbestos amphibole m inerals may give electron diffraction patterns similar to asbestos amphiboles.

OTHER METHODS: This method is designed for use with Method 7400 (phase contrast microscopy).

REAGENTS:

1. Acetone. (See SPECIAL PRECAUTIONS.)

EQUIPMENT:

1. Sampler: field monitor, 25-mm, three-piece cassette with ca. 50-mm electrically-conductive extension cowl, cellulose ester membrane filter, 0.45- to 1.2-µm pore size, and backup pad.
   NOTE 1: Analyze representative filters for fiber background before use. Discard the filter lot if mean count is >5 fibers/100 fields. These are defined as laboratory blanks.
   NOTE 2: Use an electrically-conductive extension cowl to reduce electrostatic effects on fiber sampling and during sample shipment. Ground the cowl when possible during sampling.
   NOTE 3: 0.8-µm pore size filters are recommended for personal sampling. 0.45-µm filters are recommended for sampling when performing TEM analysis on the samples because the particles deposit closer to the filter surface. However, the higher pressure drop through these filters normally preclude their use with personal sampling pumps.
2. Personal sampling pump, 0.5 to 16 L/min, with flexible connecting tubing.
3. Microscope, transmission electron, operated at ca. 100 kV, with electron diffraction and energy-dispersive X-ray capabilities, and having a fluorescent screen with inscribed or overlaid calibrated scale (Step 15).
   NOTE: The scale is most efficient if it consists of a series of lines inscribed on the screen or partial circles every 2 cm distant from the center.
4. Diffraction grating replica with known number of lines/mm.
5. Slides, glass, pre-cleaned, 25- x 75-mm.
6. Knife, surgical steel, curved-blade.
7. Tweezers.
8. Grids, 200-mesh TEM copper, (optional: carbon-coated).
9. Petri dishes, 15-mm depth. The top and bottom of the petri dish must fit snugly together. To assure a tight fit, grind the top and bottom pieces together with an abrasive such as carborundum to produce a ground-glass contact surface.
10. Foam, clean polyurethane, spongy, 12-mm thick.
11. Filters, Whatman No. 1 qualitative paper or equivalent, or lens paper.
12. Vacuum evaporator.
13. Cork borer, (about 8-mm).
14. Pen, waterproof, marking.
15. Reinforcement, page, gummed.
16. Asbestos standard bulk materials for reference; e.g. SRM #1866, available from the National Institute of Standards and Technology.
17. Carbon rods, sharpened to 1 mm x 8 mm.
18. Microscope, light, phase contrast (PCM), with Walton-Beckett graticule (see method 7400).
19. Grounding wire, 22-gauge, multi-strand.
20. Tape, shrink- or adhesive-.

SPECIAL PRECAUTIONS: Acetone is extremely flammable (flash point = 0 °F). Take precautions not to ignite it. Heating of acetone must be done in a fume hood using a flameless, spark-free heat source. Asbestos is a confirmed human carcinogen. Handle only in a well-ventilated fume hood.

SAMPLING:

1. Calibrate each personal sampling pump with a representative sampler in line.
2. For personal sampling, fasten sampler to worker's lapel near worker's mouth. Remove the top cover from cowl extension ("open-face") and orient sampler face down. Wrap joint between extender and monitor body with tape to help hold the cassette together and provide a marking surface to identify the cassette. Where possible, especially at low %RH, attach sampler to electrical ground to reduce electrostatic effects during sampling.
3. Submit at least two field blanks (or 10% of the total samples, whichever is greater) for each set of samples. Remove top covers from the field blank cassettes and store top covers and cassettes in a clean area (e.g., closed bag or box) during sampling. Replace top covers when sampling is completed.
4. Sample at 0.5 to 16 L/min [3]. Adjust sampling rate, Q (L/min), and time, t (min), to produce fiber density, E, of 100 to 1300 fibers/mm ^{2} [$3.85 \cdot 10^4$ to $5 \cdot 10^5$ fibers per 25-mm filter with effective collection area (A_c = 385 mm^2)] for optimum accuracy. Do not exceed ca. 0.5 mg total dust loading on the filter. These variables are related to the action level (one-half the current standard), L (fibers/cc), of the fibrous aerosol being sampled by:

$$t = \frac{A_c \cdot E}{Q \cdot L \cdot 10^3}, \text{ min.}$$

   NOTE: The purpose of adjusting sampling times is to obtain optimum fiber loading on the filter. A sampling rate of 1 to 4 L/min for 8 h (700 to 2800 L) is appropriate in atmospheres containing ca. 0.1 fiber/cc in the absence of significant amounts of non-asbestos dust. Dusty atmospheres require smaller sample volumes (≤400 L) to obtain countable samples. In such cases take short, consecutive samples and average the results over the total collection time. For documenting episodic exposures, use high rates (7 to 16 L/min) over shorter sampling times. In relatively clean atmospheres, where targeted fiber concentrations are much less than 0.1 fiber/cc, use larger sample volumes (3000 to 10000 L) to achieve quantifiable loadings. Take care, however, not to overload the filter with background dust [3].
5. At the end of sampling, replace top cover and small end caps.
6. Ship samples upright with conductive cowl attached in a rigid container with packing material to prevent jostling or damage.
   NOTE: Do not use untreated polystyrene foam in the shipping container because electrostatic forces may cause fiber loss from sample filter.

SAMPLE PREPARATION:

7. Remove circular sections from any of three quadrants of each sample and blank filter using a cork borer [4]. The use of three grid preparations reduces the effect of local variations in dust deposit on the filter.
8. Affix the circular filter sections to a clean glass slide with a gummed page reinforcement. Label the slide with a waterproof marking pen.
   NOTE: Up to eight filter sections may be attached to the same slide.
9. Place the slide in a petri dish which contains several paper filters soaked with 2 to 3 mL acetone. Cover the dish. Wait 2 to 4 min for the sample filter(s) to fuse and clear.
   NOTE: The "hot block" clearing technique [5] of Method 7400 or the DMF clearing technique [6] may be used instead of steps 8 and 9.
10. Transfer the slide to a rotating stage inside the bell jar of a vacuum evaporator. Evaporate a 1-by 5-mm section of a graphite rod onto the cleared filter(s). Remove the slide to a clean, dry, covered petri dish [4].
11. Prepare a second petri dish as a Jaffe wick washer with the wicking substrate prepared from filter or lens paper placed on top of a 12-mm thick disk of clean, spongy polyurethane foam [7].

Cut a V-notch on the edge of the foam and filter paper. Use the V-notch as a reservoir for adding solvent.

NOTE: The wicking substrate should be thin enough to fit into the petri dish without touching the lid.

12. Place the TEM grid on the filter or lens paper. Label the grids by marking with a pencil on the filter paper or by putting registration marks on the petri dish halves and marking with a waterproof marker on the dish lid. In a fume hood, fill the dish with acetone until the wicking substrate is saturated.

NOTE: The level of acetone should be just high enough to saturate the filter paper without creating puddles.

13. Remove about a quarter section of the carbon-coated filter from the glass slide using a surgical knife and tweezers. Carefully place the excised filter, carbon side down, on the appropriately-labeled grid in the acetone-saturated petri dish. When all filter sections have been transferred, slowly add more solvent to the wedge-shaped trough to raise the acetone level as high as possible without disturbing the sample preparations. Cover the petri dish. Elevate one side of the petri dish by placing a slide under it (allowing drops of condensed acetone to form near the edge rather than in the center where they would drip onto the grid preparation).

CALIBRATION AND QUALITY CONTROL:

14. Determine the TEM magnification on the fluorescent screen:
    a. Define a field of view on the fluorescent screen either by markings or physical boundaries.
       NOTE: The field of view must be measurable or previously inscribed with a scale or concentric circles (all scales should be metric) [7].
    b. Insert a diffraction grating replica into the specimen holder and place into the microscope. Orient the replica so that the grating lines fall perpendicular to the scale on the TEM fluorescent screen. Ensure that goniometer stage tilt is zero.
    c. Adjust microscope magnification to 10,000X. Measure the distance (mm) between the same relative positions (e.g., between left edges) of two widely-separated lines on the grating replica. Count the number of spaces between the lines.
       NOTE: On most microscopes the magnification is substantially constant only within the central 8- to 10-cm diameter region of the fluorescent screen.
    d. Calculate the true magnification (M) on the fluorescent screen:

$$m = \frac{X \cdot G}{Y}$$

       where: X = total distance (mm) between the two grating lines;
              G = calibration constant of the grating replica (lines/mm);
              Y = number of grating replica spaces counted
    e. After calibration, note the apparent sizes of 0.25 and 5.0 µm on the fluorescent screen. (These dimensions are the boundary limits for counting asbestos fibers by phase contrast microscopy.)
15. Measure 20 grid openings at random on a 200-mesh copper grid by placing a grid on a glass slide and examining it under the PCM. Use the Walton-Beckett graticule to measure the grid opening dimensions. Calculate an average graticule field dimension from the data and use this number to calculate the graticule field area for an average grid opening.
    NOTE: A grid opening is considered as one graticule field.
16. Obtain reference selected area electron diffraction (SAED) or microdiffraction patterns from standard asbestos materials prepared for TEM analysis.
    NOTE: This is a visual reference technique. No quantitative SAED analysis is required [7]. Microdiffraction may produce clearer patterns on very small fibers or fibers partially obscured by other material.
    a. Set the specimen holder at zero tilt.

b. Center a fiber, focus, and center the smallest field-limiting aperture on the fiber. Obtain a diffraction pattern. Photograph each distinctive pattern and keep the photo for comparison to unknowns.

NOTE: Not all fibers will present diffraction patterns. The objective lens current may need adjustment to give optimum pattern visibility. There are many more amphiboles which give diffraction patterns similar to the analytes named on p. 7402-1. Some, but not all, of these can be eliminated by chemical separations. Also, some non-amphiboles (e.g., pyroxenes, some talc fibers) may interfere.

17. Acquire energy-dispersive X-ray (EDX) spectra on approximately 5 fibers having diameters between 0.25 and 0.5 µm of each asbestos variety obtained from standard reference materials [7].

NOTE: The sample may require tilting to obtain adequate signal. Use same tilt angle for all spectra.

a. Prepare TEM grids of all asbestos varieties.

b. Use acquisition times (at least 100 sec) sufficient to show a silicon peak at least 75% of the monitor screen height at a vertical scale of ≥500 counts per channel.

c. Estimate the elemental peak heights visually as follows:

(1) Normalize all peaks to silicon (assigned an arbitrary value of 10).

(2) Visually interpret all other peaks present and assign values relative to the silicon peak.

(3) Determine an elemental profile for the fiber using the elements Na, Mg, Si, Ca, and Fe. Example: 0-4-10-3-<1 [7].

NOTE: In fibers other than asbestos, determination of Al, K, Ti, S, P, and F may also be required for fiber characterization.

(4) Determine a typical range of profiles for each asbestos variety and record the profiles for comparison to unknowns.

MEASUREMENT:

18. Perform a diffraction pattern inspection on all sample fibers counted under the TEM, using the procedures given in step 17. Assign the diffraction pattern to one of the following structures:

a. chrysotile;

b. amphibole;

c. ambiguous;

d. none.

NOTE: There are some crystalline substances which exhibit diffraction patterns similar to those of asbestos fibers. Many of these, (brucite, halloysite, etc.) can be eliminated from consideration by chemistry. There are, however, several minerals (e.g., pyroxenes, massive amphiboles, and talc fibers) which are chemically similar to asbestos and can be considered interferences. The presence of these substances may warrant the use of more powerful diffraction pattern analysis before positive identification can be made. If interferences are suspected, morphology can play an important role in making positive identification.

19. Obtain EDX spectra in either the TEM or STEM modes from fibers on field samples using the procedure of step 18. Using the diffraction pattern and EDX spectrum, classify the fiber:

a. For a chrysotile structure, obtain EDX spectra on the first five fibers and one out of ten thereafter. Label the range profiles from 0-5-10-0-0 to 0-10-10-0-0 as "chrysotile."

b. For an amphibole structure, obtain EDX spectra on the first 10 fibers and one out of ten thereafter. Label profiles ca. 0-2-10-0-7 as "possible amosite"; profiles ca. 1-1-10-0-6 as "possible crocidolite"; profiles ca. 0-4-10-3-<1 as "possible tremolite"; and profiles ca. 0-3-10-0-1 as "possible anthophyllite."

NOTE: The range of profiles for the amphiboles will vary up to ± 1 unit for each of the elements present according to the relative detector efficiency of the spectrometer.

c. For an ambiguous structure, obtain EDX spectra on all fibers. Label profiles similar to the chrysotile profile as "possible chrysotile." Label profiles similar to the various amphiboles as "possible amphiboles." Label all others as "unknown" or "non-asbestos."

20. Counting and Sizing:
    a. Insert the sample grid into the specimen grid holder and scan the grid at zero tilt at low magnification (ca. 300 to 500X). Ensure that the carbon film is intact and unbroken over ca. 75% of the grid openings.
    b. In order to determine how the grids should be sampled, estimate the number of fibers per grid opening during a low-magnification scan (500 to 1000X). This will allow the analyst to cover most of the area of the grids during the fiber count and analysis. Use the following rules when picking grid openings to count [7,8]:
        (1) Light loading (<5 fibers per grid opening): count total of 40 grid openings.
        (2) Moderate loading (5 to 25 fibers per grid opening): count minimum of 40 grid openings or 100 fibers.
        (3) Heavy loading (>25 fibers per opening): count a minimum of 100 fibers and at least 6 grid openings.

        Note that these grid openings should be selected approximately equally among the three grid preparations and as randomly as possible from each grid.
    c. Count only grid openings that have the carbon film intact. At 500 to 1000X magnification, begin counting at one end of the grid and systematically traverse the grid by rows, reversing direction at row ends. Select the number of fields per traverse based on the loading indicated in the initial scan. Count at least 2 field blanks per sample set to document possible contamination of the samples. Count fibers using the following rules:
        (1) Count all particles with diameter greater than 0.25 µm that meet the definition of a fiber (aspect ratio ≥3:1, longer than 5 µm). Use the guideline of counting all fibers that would have been counted under phase contrast light microscopy (Method 7400). Use higher magnification (10000X) to determine fiber dimensions and countability under the acceptance criteria. Analyze a minimum of 10% of the fibers, and at least 3 asbestos fibers, by EDX and SAED to confirm the presence of asbestos. Fibers of similar morphology under high magnification can be identified as asbestos without SAED. Particles which are of questionable morphology should be analyzed by SAED and EDX to aid in identification.
        (2) Count fibers which are partially obscured by the grid as half fibers.
            NOTE: If a fiber is partially obscured by the grid bar at the edge of the field of view, count it as a half fiber only if more than 2.5 µm of fiber is visible.
        (3) Size each fiber as it is counted and record the diameter and length:
            (a) Move the fiber to the center of the screen. Read the length of the fiber directly from the scale on the screen.
                NOTE 1: Data can be recorded directly off the screen in µm and later converted to µm by computer.
                NOTE 2: For fibers which extend beyond the field of view, the fiber must be moved and superimposed upon the scale until its entire length has been measured.
            (b) When a fiber has been sized, return to the lower magnification and continue the traverse of the grid area to the next fiber.
    d. Record the following fiber counts:
        (1) f_s, f_b = number of asbestos fibers in the grid openings analyzed on the sample filter and corresponding field blank, respectively.
        (2) F_s, F_b = number of fibers, regardless of identification, in the grid openings analyzed on the sample filter and corresponding field blank, respectively.

CALCULATIONS:

21. Calculate and report the fraction of optically visible asbestos fibers on the filter, $(f_s - f_b)/(F_s - F_b)$. Apply this fraction to fiber counts obtained by PCM on the same filter or on other filters for which the TEM sample is representative. The final result is an asbestos fiber count. The type of asbestos present should also be reported.
22. As an integral part of the report, give the model and manufacturer of the TEM as well as the model and manufacturer of the EDX system.

EVALUATION OF METHOD:

The TEM method, using the direct count of asbestos fibers, has been shown to have a precision of 0.275 (s_r) in an evaluation of mixed amosite and wollastonite fibers. The estimate of the asbestos fraction, however, had a precision of 0.11 (s_r). When this fraction was applied to the PCM count, the overall precision of the combined analysis was 0.20 [2].

REFERENCES:

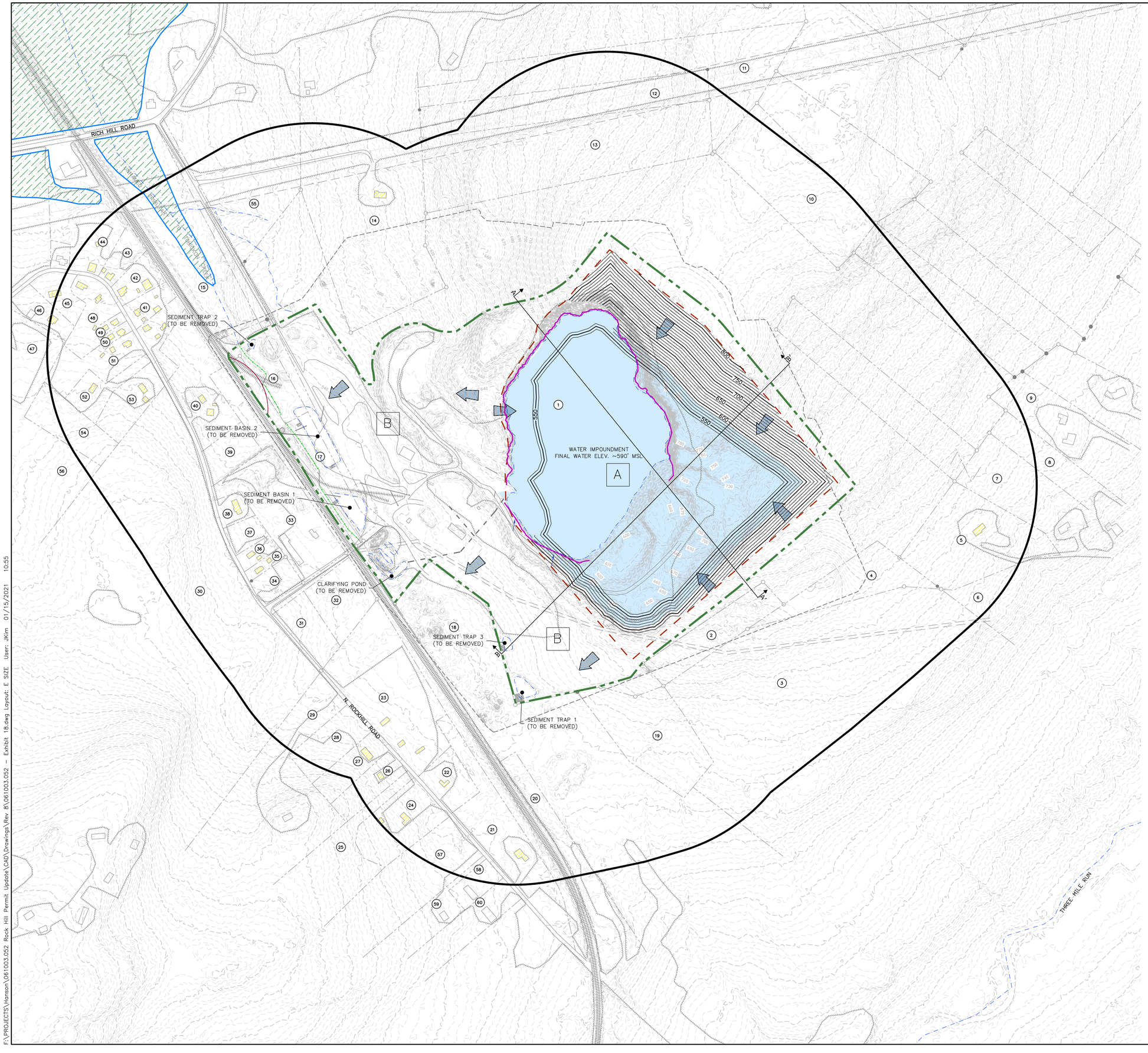
[1] Walton, W. H. "The Nature, Hazards, and Assessment of Occupational Exposure to Airborne Asbestos Dust: A Review," Ann. Occup. Hyg., 25, 115-247 (1982).
[2] Taylor, D. G., P. A. Baron, S. A. Shulman and J. W. Carter. "Identification and Counting of Asbestos Fibers," Am. Ind. Hyg. Assoc. J. 45(2), 84-88 (1984).
[3] Johnston, A. M., A. D. Jones, and J. H. Vincent. "The Influence of External Aerodynamic Factors on the Measurement of the Airborne Concentration of Asbestos Fibers by the Membrane Filter Method," Ann. Occup. Hyg., 25, 309-316 (1982).
[4] Zumwalde, R. D. and J. M. Dement. Review and Evaluation of Analytical Methods for Environmental Studies of Fibrous Particulate Exposures, NIOSH Technical Information Bulletin #77-204 (1977).
[5] Baron, P. A. and G. C. Pickford. "An Asbestos Sample Filter Clearing Procedure," Appl. Ind. Hyg., 1:169-171,199 (1986).
[6] LeGuen, J. M. and S. Galvin "Clearing and Mounting Techniques for the Evaluation of Asbestos Fibers by the Membrane Filter Method" Ann. Occup. Hyg. 24, 273-280 (1981).
[7] Yamate, G., S. A. Agarwal, and R. D. Gibbons. "Methodology for the Measurement of Airborne Asbestos by Electron Microscopy," EPA Contract No. 68-02-3266 (in press).
[8] Steel, E. B. and J. A. Small. "Accuracy of Transmission Electron Microcopy for the Analysis of Asbestos in Ambient Environments," Anal. Chem., 57, 209-213 (1985).

METHOD REVISED BY:

Paul A. Baron, Ph.D.; NIOSH/DPSE.

ATTACHMENT 5(a)

Exhibit 18 – Land Use & Reclamation Map
January 15, 2021



NORTH

LEGEND

- EXISTING GRADE CONTOUR (2' INTERVAL)
- EXISTING SMP BOUNDARY
- LIMIT OF MINING
- 1,000' SMP OFFSET
- RECLAMATION CONTOURS (10' INTERVAL)
- PRE-ACT HIGHWALL
- LIMIT OF HANSON DRONE SURVEY
- 300' BUILDING SETBACK
- PROPERTY BOUNDARY
- EXISTING RIGHT OF WAY
- EXISTING SURFACE WATER
- EXISTING RAILROAD
- EXISTING TREELINE
- EXISTING GAS PIPELINE
- EXISTING DRAINAGE CHANNEL (TO REMAIN)
- EXISTING BUILDING – RESIDENTIAL
- NWI WETLANDS
- WATER IMPOUNDMENT
- POST-MINING DRAINAGE DIRECTION
- PROPERTY ID

LAND USE LEGEND

A — EXISTING: INDUSTRIAL (MINING)
POST MINING: UNMANAGED WATER IMPOUNDMENT

B — EXISTING: INDUSTRIAL (MINING SUPPORT)
POST MINING: UNMANAGED NATURAL HABITAT

NOTES:
1. EXISTING GRADE TOPOGRAPHY COMPILED BY PAMAP PROGRAM, PA DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES, BUREAU OF TOPOGRAPHIC AND GEOLOGIC SURVEY, DATED JUNE 2010.
2. TOPOGRAPHY WITHIN HANSON SURVEY AREA IS REFERENCED FROM THE DRONE SURVEY COMPLETED BY HANSON PERSONNEL ON DECEMBER 7, 2020.
3. EXISTING PERMIT INFORMATION INCLUDING PERMIT BOUNDARY, MINING LIMIT, DEPTH OF MINING, AND PRE-ACT HIGHWALLS ARE REFERENCED TO THE PERMIT DRAWING "MINING PLAN, SHEET 3 OF 6" PREPARED BY SKELLY AND LOY, DATED MARCH 18, 1980.
4. HANSON PROPERTY BOUNDARY PROVIDED BY VAN CLEEF ENGINEERING ASSOCIATES VIA MAP TITLED "PLAT OF SURVEY OF LANDS OF GENERAL CRUSHED STONE", PREPARED BY ORANGEVILLE SURVEYING CONSULTANTS, INC., DATED MAY 7, 2001.
5. ADJACENT PARCEL BOUNDARIES ARE REFERENCED TO THE BUCKS COUNTY GIS RECORDS.
6. WETLANDS REFLECT THOSE DEPICTED IN THE NATIONAL WETLANDS INVENTORY FWS WETLANDS MAPPER.
7. PROPERTY OWNERSHIP INFORMATION IS REFERENCED TO MODULE 5 OF THE PERMIT APPLICATION.
8. STREAM INFORMATION IS REFERENCED TO THE PA DEP eMAPPA ONLINE RECORDS.
9. REFER TO THE E&S PLAN DRAWINGS FOR LOCATION OF ALL EROSION AND SEDIMENTATION CONTROL STRUCTURES.
10. GEOLOGY OBTAINED FROM PAGEODE, PA GEOLOGIC DATA EXPLORATION, WWW.GIS.DCNR.STATE.PA.US/GEOLOGY/(2018).

GRAPHIC SCALE

200 0 100 200 400 800

(IN FEET)
1 inch = 200 ft.

NO.	DATE	BY	REVISIONS
1	1/15/21	JTK	REVISED PER DEP COMMENTS

COMMONWEALTH OF PENNSYLVANIA — JOHN T. KIM — PROFESSIONAL ENGINEER — JOHN T. KIM — LICENSE NO. PE088887

PROJECT SITE:
HANSON AGGREGATES PENNSYLVANIA LLC
SMP NO 7974SM1
EAST ROCKHILL TOWNSHIP, BUCKS COUNTY
PENNSYLVANIA

PREPARED FOR:
Hanson
HEIDELBERGCEMENT Group

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EXHIBIT 18
LAND USE AND RECLAMATION MAP

HANSON AGGREGATES PENNSYLVANIA LLC
ROCKHILL QUARRY

DRAWN BY: JTK
CHECKED BY: MEP
DATE: 02/20/18
PROJECT NO: 061003.052
DRAWING NUMBER: R-004
SHEET 4 OF 6

F:\PROJECTS\Hanson\061003.052 Rock Hill Permit Update\CAD\Drawings\Rev 8\061003.052 – Exhibit 18.dwg Layout: E SIZE User: JKim 01/15/2021 10:55