HANSON AGGREGATES PA, LLC

MINERAL IDENTIFICATION AND MANAGEMENT GUIDE FOR THE ROCK HILL QUARRY

A. Purpose

This Mineral Identification and Management Guide (hereinafter "Guide") memorializes protocols and procedures implemented by Hanson Aggregates PA, LLC (Hanson) to assess whether "protocol minerals" as defined below are present on a quarry site and to minimize the processing of such materials in a manner that may release undesirable mineral fibers.

Some igneous and metamorphic rock materials have the potential to contain, as minor constituents, asbestiform minerals. Six of these asbestiform minerals are currently regulated as asbestos by USEPA, MSHA, and OSHA. The mineralogical properties of asbestos fiber and regulated mineral fibers covered by this Guide are hereinafter referred to as "protocol minerals". Materials suspected of containing protocol minerals are referred to as "suspect material."

This document is solely a guide and is not intended and shall not give rise to new legal obligations or standards. The procedures established in this guide may be varied in light of operational demands or restrictions. This guide shall not alter any applicable environmental, health or safety standards. All such standards shall be followed.

B. Scope

This guide is applicable to and outlines responsibilities of operations at the Rock Hill Quarry. This supplements other mineral identification guides that may be applicable to other quarries operated by Hanson.

C. Protocol Mineral Fibers

1. Asbestos PMFs. "Asbestos" is a commercial term that includes six silicate minerals that belong to the serpentine and amphibole mineral groups—but are "asbestos" only when those minerals *crystallized in nature as asbestiform fibers* (i.e., crystallized with the mineralogical habit of "asbestos").

Table 1 provides information about these six minerals. Note again that the minerals are (a) classified as "asbestos" only when they formed in nature with the asbestiform mineral habit; and (b) not classified as "asbestos" when they formed in nature with the nonasbestiform mineral habit.

Table 1. Asbestos and Nonasbestos Forms of Six Minerals.

Mineral (and crystalline habit)	Commercial or Common Name	CAS No.
Asbestiform serpentine	**Chrysotile Asbestos**	**12001-29-5**
Asbestiform riebeckite	**Crocidolite Asbestos**	**12001-28-4**
Asbestiform cummingtonite-grunerite	**Amosite Asbestos**	**12172-73-5**
Asbestiform anthophyllite	**Anthophyllite Asbestos**	**77536-67-5**
Asbestiform tremolite	**Tremolite Asbestos**	**77536-68-6**
Asbestiform actinolite	**Actinolite Asbestos**	**77536-66-4**
Nonasbestiform serpentine	**Antigorite (see note 4 below)**	**12135-86-3**
Nonasbestiform riebeckite	**Riebeckite**	**17787-87-0**
Nonasbestiform cummingtonite-grunerite	**Cummingtonite-grunerite**	**14567-61-4**
Nonasbestiform anthophyllite	**Anthophyllite**	**17068-78-9**
Nonasbestiform tremolite	**Tremolite**	**14567-73-8**
Nonasbestiform actinolite	**Actinolite**	**13768-00-8**

Notes:

1. "Asbestos" is regulated in the U.S. by numerous state and federal agencies, including EPA, OSHA, and MSHA. A full reference to all regulations is beyond the scope of this Guide. The User is encouraged to become familiar with all mineral fiber regulations for the jurisdictions in which they operate.
2. The term "asbestiform" means the mineralogical habit or form of a mineral in which ultra-fine single crystal fibers (fibrils) occur in bundles that can be separated into increasingly finer fiber bundles that typically display curvature.[1]
3. "Asbestos" possesses (certain) properties such as long fiber length and high tensile strength. Under the light microscope, samples exhibit the asbestiform habit as defined by several of the following characteristics: (a) mean aspect ratios ranging from 20:1 to 100:1 or higher for fibers longer than 5 μm, (b) very thin fibrils, usually less than 0.5 μm in width,

[1] See, for example, EPA, 1993. "Method for the Determination of Asbestos in Bulk Building Materials" (EPA/600/R-93/116).

(c) parallel fibers occurring in bundles, (d) fiber bundles displaying splayed ends, (e) fibers in the form of thin needles, (f) matted masses of individual fibers, and (g) fibers showing curvature.[2]
4. Lizardite (CAS No. 12161-84-1) is another nonasbestiform serpentine mineral. Rarely, asbestiform antigorite may be discovered; for the purposes of this Guide it is considered a PMF

2. Other PMFs (Not Asbestos). It is important to emphasize that Hanson's Guide goes beyond "asbestos" and includes certain asbestiform minerals that Hanson has elected to treat as a potentially equivalent hazard as "asbestos." [3]

These "Other PMFs" include a variety of (a) amphiboles that formed in nature with the asbestiform habit but are not classified as "asbestos" (e.g., asbestiform winchite, asbestiform richterite, asbestiform fluoro-edenite, etc.); and (b) naturally occurring "durable asbestiform zeolites" (e.g., erionite). "Other PMFs" are not "asbestos" and they are not currently regulated by most U.S. authorities in the same manner as "asbestos."

All PMFs exist more commonly in a prismatic crystal growth habit or form (i.e., a nonasbestiform habit or form). These nonasbestiform minerals tend not to grow with parallel alignment, but instead form multi-directional growth patterns. When enough pressure is applied, the crystals fracture easily, fragmenting into prismatic particles called cleavage fragments. While some cleavage fragments are acicular or needle shaped as a result of the tendency to cleave along two dimensions but not along a third, they do not possess the characteristics described above for asbestiform minerals. Furthermore, these cleavage fragments are not associated with asbestos-related diseases, as documented in the published, peer-reviewed scientific literature.

It is not possible to create asbestos from common rock or cleavage fragments by crushing or processing them. Likewise, cleavage fragments cannot be created from "asbestos." When a PMF occurs in nature, the corresponding nonasbestiform habit of that mineral will also always be present. However, the converse is not always true due to the unique set of geologic conditions necessary for minerals to crystallize in the asbestiform habit.

D. Mine Planning

Initial Field Mapping and Description of Primary Structural/alteration features, prior mapping and geologic surveys have established the presence of suspect material. These activities include, but are not limited to:

[2] (a) National Institute of Standards and Technology (NIST), Certificate of Analysis, Standard Reference Material® 1867a, Uncommon Commercial Asbestos; (b) EPA, 1993.
[3] This Guide includes the "Other PMFs" out of an abundance of caution, based on reports that excess exposures to certain asbestiform fibers (that are not classified as "asbestos") may nonetheless have asbestos-like health effects. However, exposure and health effects data are absent or incomplete for some asbestiform mineral fibers; thus, the inclusion of "Other PMFs" in this Guide does not necessarily mean that they represent an equivalent hazard compared with "asbestos."

1. Qualitative Geologic Survey;
2. Laboratory analysis of aggregate, water, and core samples;
3. Literature review.

The information from the above activities will be used to develop a mine plan to delineate areas where there is a higher probability of suspect material being present.

E. Routine & Periodic Inspection Plan

- Inspection of the quarry should occur annually or at such periods related to mining activity established by the geologist and other professional staff.

- The geologist should visually inspect all active faces on operating levels of the quarry, walls, floors and benches that are safely accessible to determine if PMFs are or may be concentrated. (After the initial field evaluation, future periodic inspections may focus only on the active walls, floors and benches.)

- Shot rock and muck piles will also be visually inspected by knowledgeable site personnel as those materials are produced in the mining process.

- Settled dust samples may be collected and analyzed as a means to monitor fine particulate resulting from the mining process.

- In some cases, PMF identification may be obvious in the field. In other cases, indications for the potential presence of PMFs may include the type of rock mass or, e.g., the relationship to joints, faults/shear zones, or intrusions.

- Training will occur to provide detail on what employees should be aware of in order to readily identify suspect material. Employees working in the quarry will also be informed of the geologic survey results to indicate where suspect material has previously been identified. Employees will receive annual training to visually recognize suspect area where PMFs might be found.

- Hanson further expects all employees who work at production sites to immediately report to the site management the potential discovery of any PMFs, so that an appropriate investigation may ensue.

- Method to identify/confirm suspect material:

    1. If designated site personnel identify suspect material, they will follow the reporting protocol and with the involvement of the geologist, determine by visual inspection and/or laboratory testing that the material does or does not contain protocol mineral fibers.
    2. Suspect material will be identified based on criteria defined by the geologist, including the following: any minerals identified in the rock that appear to be

present in bundles of long, thin, flexible fibers. These minerals may appear in several different forms in the quarry, including bundles of parallel fibers, radiating fibers, matted masses of fibers, or in needle-like formations.

- Action protocol:
    1. If suspect material is found to contain protocol fibers, appropriate personnel will be informed, and additional sampling and testing may be initiated to determine if protocol mineral fibers are present or not.
    2. Based on these results, actions will be undertaken to isolate and dispose of material if the amount is determined to be unacceptable.

- Active mining within a delineated affected area where suspect material has been identified must cease and cannot resume until appropriate personnel have reviewed inspection results and verify that PMF concentration is acceptably low (e.g., <0.1-0.25%) in the area, or appropriate actions have been taken to dispose of suspect material (see below).

- Recording and Reporting:
    1. Location(s) of suspect material identified will be recorded and include coordinates (Northing and easting) and elevation within the quarry.
    2. Results of suspect material inspections, photographs of collected materials, narrative descriptions of suspect materials and laboratory reports will be documented and reported to appropriate knowledgeable mine personnel. Documentation of the results will also be appended to the mine plan.
    3. Reports will also be produced and distributed as described in the Asbestos Monitoring and Mitigation Plan.

- Disposal protocol:
    1. Material identified as suspect material will be delineated by the site geologist.
    2. The material will be wetted prior to any movement or disturbance.
    3. Any personnel involved in the disposal will wear appropriate protective equipment.
    4. Material to be disposed of will be moved using appropriate equipment to a location designated by the geologist within the requirements of the permits. Suspect material will be disposed of within permanently inactive areas within the quarry and covered with non-PMF material overburden.
    5. Locations of any suspect material will be provided to the appropriate personnel for inclusion in the mine plan.
    6. Locations of disposed suspect material areas within the quarry will be provided to the appropriate personnel for inclusion in the mine plan.

F: Additional Steps

Based on the foregoing analysis, on information derived from other sources not included in the Guide, and on the professional judgement of the geologist and other professionals,

Hanson may elect to take additional steps with the goal of avoiding or minimizing PMF contact.

Any additional steps are likely to be site specific and depend on a host of variables that may change from time to time. Accordingly, specific recommendations for any additional steps are beyond the scope of this Guide. However, strictly as suggestions for consideration, additional steps might include but are not limited to:

- Modifying the mining plan
- Modifying the areas of the property where mining and processing occurs
- Implementing personal or area air sampling (i.e. activity based sampling)
- Surface sampling in enclosed spaces (mobile equipment, control booths, etc.)
- Product sampling (stockpiles, conveyors, etc.)
- Creating a visual identification plan
- Special cleaning methods and schedules
- Implementing NSSGA's Occupational Health Program

Many of these additional steps should be directed by the geologist and a competent industrial hygienist who has experience with aggregate production and PMFs.

RESERVATION OF RIGHTS:

Hanson reserves the right to modify, revoke, suspend, terminate or change this guide in whole or in part, at any time, without notice.

Appendix
Identification of Protocol Mineral Fibers

Material to be analyzed for PMFs and/or PPFs will be analyzed by a qualified laboratory. In this Guide, "qualified laboratory" means a laboratory accredited by the American Industrial Hygiene Association and/or the NIST National Voluntary Laboratory Accreditation Program for asbestos analysis. The qualified laboratory must have mineralogical expertise and have the ability and experience to detect PMFs in the natural environment (e.g., rocks, soils, etc.) in accordance with the EPA analytical method and the NIST definition (see the Glossary)..

The analysis should include gross visual examination of the samples provided to inspect for the presence of suspect fibrous mineralization prior to any crushing, grinding, or pulverization of the received material.

Upon receipt, samples should be dried and pulverized using a plate grinder (aka Braun mill) as described in CARB method 435[4]. This should be done with care to avoid over-pulverization of the sample while still producing a sample that is finer than 200 Tyler mesh. Details of the preparation steps are provided in the CARB Method 435 Field Sampling and Laboratory Practices, 2017 document.[5]

Polarized light microscopy (PLM) will be performed following USEPA method 600/R-93/116, with quantification performed by a 1000-point count analysis. All PMFs and PPFs will be reported when observed.

Transmission electron microscopy (TEM) will also be performed if the PLM result is negative for PMF. Samples will be prepared from pulverized sample following USEPA method 600/R-93/116 and fibers counted using ISO 10312 as modified by USEPA OSWER directive #9200.0-68 for PMF and PPF as described above.

Transmission electron microscopy will also be performed on water samples collected from the site. Samples will be prepared and analyzed following USEPA method 100.1.

[4] California Environmental Protection Agency Air Resources Board, "Method 435--Determination of Asbestos Content of Serpentine Aggregate", pages 1-23, June 6, 1991.

[5] California Environmental Protection Agency Air Resources Board, "Implementation Guidance Document Air Resources Board Test Method 435--Determination of Asbestos Content of Serpentine Aggregate: Field Sampling and Laboratory Practices", pages 1-34, April 2017