FREEPORT-MCMORAN

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VIA EMAIL AND U.S. MAIL

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RE: Addendum No. 9 to the Interim Action Workplan for the Former Satralloy Site – Proposed Geotechnical Slag Investigation

On behalf of Cyprus Amax Minerals Company (Cyprus), this submittal constitutes Addendum No. 9 to the Interim Action Workplan for the Former Satralloy Site (IA Workplan) approved by the Ohio Environmental Protection Agency (OEPA). This Addendum has been prepared in response to Comment No. 4 in the email sent by Mr. Kevin O'Hara of OEPA to Ms. Barbara Nielsen on July 20, 2022, requesting additional strength testing of the slag.

<u>Objective</u>

The interim action currently being proposed for the site includes consolidating the existing slag materials into a single consolidation area with side slope grades as steep as 3H:1V (horizontal:vertical; 18.43°), with 25-foot-wide drainage benches at maximum vertical intervals of no more than 50 feet. Previous experience using slag for fill on-site and general observations of slag pile stability indicate that the slag should have sufficient strength to support 3H:1V slopes with acceptable factors of safety (Golder 2022). The objective of the investigation described in this workplan is to directly measure the strength of slag materials at the site to either confirm this assumption or provide data for revising the stability analysis.

<u>Previous Slag Characterization</u>

Slag was previously characterized in 2008 to determine the mineralogy and chemical characteristics (Golder 2016).

A slag classification system was also developed based on the texture of the slag. The vast majority of the slag, apart from the surfacing of access roads, was classified as bedded slag, which is described as generally lightweight slag often deposited or weathered into beds and layers. Bedded slag was divided into gravelly slag, containing 20% to 50% gravel-sized material; boulder slag, a slightly coarser material of limited occurrence; and powdery slag, a fine-grained material. Powdery slag was further subdivided into siliceous slag, which breaks into chips with conchoidal fractures, and chalky slag, a low-strength material.

A slag sampling task was completed during the Remedial Investigation in 2014 and involved drilling six boreholes at the locations shown on Figure 1. The types of slag encountered in the boreholes are summarized in Table 1.

Table 1. 2014 Slag Characterization Borehole Data

Location ID	Depth Top	Depth Base	Classification
SLG-BH01	0	16	Gravelly bedded
SLG-BH01	16	17	Powdery bedded siliceous
SLG-BH01	17	29	Powdery bedded chalky
SLG-BH02	0	5	Boulder bedded chalky
SLG-BH02	5	9.5	Boulder bedded chalky
SLG-BH03	0	10	Gravelly bedded
SLG-BH03	10	16.5	Gravelly bedded
SLG-BH04	0	4	Gravelly bedded
SLG-BH04	4	10	Powdery to gravelly bedded
SLG-BH04	10	11	Powdery to gravelly bedded
SLG-BH04	11	15	Powdery to gravelly bedded
SLG-BH04	15	20	Gravelly to powdery bedded
SLG-BH04	20	25	Powdery bedded
SLG-BH04	25	30	Gravelly to powdery bedded
SLG-BH04	30	31	Powdery bedded
SLG-BH04	31	35	Gravelly to powdery bedded
SLG-BH04	35	50	Powdery bedded
SLG-BH05	NA	NA	Road surfacing and native subgrade
SLG-BH06	NA	NA	Road surfacing and native subgrade

Based on the results of this previous investigation, there appear to be two predominant types of slag material: gravelly and powdery. At a minimum, the strength of these two types of material will need to be characterized as part of the proposed investigation.

Additional discussion of the previous slag investigation is provided in the Draft Remedial Investigation (RI) Report (Golder 2016).

Field Program

Slag samples will be obtained from four boreholes to be drilled at the locations shown on Figure 1. The boreholes will be drilled with a sonic drill rig capable of obtaining continuous 4-inch diameter cores.

This drilling will be performed in conjunction with the mill floor soil sampling activities, currently scheduled for early October 2022.

The boreholes will be drilled through the slag and a few feet into the underlying native materials. This will provide data on the total slag thickness at the borehole location as well as the maximum core length for sampling. The core will be laid out, logged, and photographed in the field by a Golder Associates USA Inc. (Golder) geologist, engineer, or other qualified individual. Samples of each major slag type will then be selected and placed in 5-gallon buckets; a moisture content sample of each material will also be collected in a glass jar.

Laboratory Testing

The slag samples will be sent to Golder's Denver, Colorado laboratory for geotechnical testing. The initial round of testing will consist of particle size analyses (ASTM D6913) and moisture content determination (ASTM D2216) for each sample. On the basis of the particle size results, the samples will be classified into one of the slag types described above or other slag type, depending on the variability of the material encountered. To the extent possible, samples with similar particle size curves will be composited into larger samples to provide adequate volumes of material for the second phase of testing.

For the second phase of testing, moisture-density tests (ASTM D1557) will be performed on each slag type; these results will be used to prepare the samples for triaxial strength testing. Triaxial strength test specimens will be 2.5 inches in diameter and compacted to nominally 92% of the maximum dry density at a moisture content of optimum ±2%. Samples will be tested in accordance with ASTM D4767, including pore pressure measurements. If the sample texture does not allow reliable preparation of cylindrical specimens, then a direct shear test method such as ASTM D3080 will be utilized instead. For each sample, tests will be performed at normal loads of 10, 20, and 40 pounds per square inch (psi) to determine the strength envelope under the full range of expected slag thicknesses [i.e., up to 50 feet of slag with a unit weight of 120 pounds per cubic foot (pcf)].

Use of Results

Friction angle and cohesion will be calculated from the test results. These parameters will be compared to values assumed for the preliminary design of the slag consolidation area side slopes.

References

ASTM International, 2022:

D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3))

D2216 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass

D3080 Standard Test Method for Direct Shear Test of Soils Under Consolidated Drained Conditions

D4767 Standard Test Method for Consolidated Undrained Triaxial Compression Test for Cohesive Soils

D6913 Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

Golder Associates USA Inc. 2016. *Draft Remedial Investigation / Feasibility Study Report for the Former Satralloy Site, Jefferson County, Ohio*. December 28.

Golder Associates USA Inc. 2022. *Satralloy Slag Consolidation IA Design Basis*. Technical Memorandum from Frank Shuri (Golder) to Barbara Nielsen (FMI) and Jordan Sisson (FMI). Project No. 21480300. June 9.