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6 Topsoil Survey and Sampling

6.1 Background and General Description of Topsoil

A successful reclamation program is dependent, in part, upon the quantity and quality of soil available for use during the reclamation process. New Mexico Copper Corporation (NMCC) assessed the quantity and suitability of topsoil present at the Copper Flat Mine Permit Area (Site) in two ways. First, NMCC reviewed current literature concerning soil characteristics, and second, NMCC determined site-specific soil characteristics. The findings are summarized in this section of the SAP. In addition, baseline soil surveys were completed on the project area as recently as the late 1990s, and are briefly summarized and referenced in the PFEIS (BLM, 1999).

The term “topsoil” refers to the A master soil horizon (Soil Survey Staff, 1999), which is the uppermost mineral horizon that contains organic matter and can be salvaged from the areas to be disturbed and is capable of supporting vegetation, or other soil material capable of supporting vegetation. This material is often referred to as “suitable top dressing.” NMCC has reviewed previous literature describing the results of soil surveys completed at the Site (BLM, 1999) and is aware that the presence of an A master soil horizon across the Site is limited. The purpose of the soil survey and sampling proposed in this section of the SAP is to evaluate the presence of suitable top dressing. However, in the interest of conforming to the requirements of the Mine Act regulations, the term “topsoil” will be used throughout this section to refer to suitable top dressing.

General information about the soils present at the Site was obtained from a Soil Conservation Service (SCS) survey completed by Neher (1984). The SCS (now the Natural Resources Conservation Service) mapped two major soil types that occur in the Copper Flat area:

1. The Luzena-Rock Outcrop association
2. The Scholle-Ildelfonso association

Figure 6-1 shows the boundary of the two soil types found in the proposed mine area along with the proposed operational areas within the proposed mine permit boundary. All but the easternmost portion of the proposed Site is mapped as Luzena-Rock Outcrop association, which is typically present on the steeper slopes of hills and mountains. These soils are typically shallow, very gravelly and cobbly loams and clay loams. The Scholle-Ildelfonso association occurs on more gentle slopes of the piedmonts and mountain toes and is deep, well-drained, and formed in mixed alluvium. The resulting soil texture in these areas is primarily gravely loams and gravelly clay loams (SRK, 1996).

The soils are thin and of low productive capacity. The soil textures are primarily gravelly loams and gravelly clay loams and are subject to continuing wind and water erosion. Along with the natural erosion, much of the Copper Flat landscape has been severely disturbed by historical placer mining and the 1982 mining operation. Over 63 percent of the areas targeted by the proposed operation were disturbed during the 1982 operation. Soils were replaced in the north cell of the tailings impoundment and over a portion of the plant site during 1986. Much of the remaining 1982 operational area remains disturbed and unvegetated (SRK, 1996).

6.2 Sampling Objectives

The objectives of soil sampling plan are:

- To determine the suitability of in-place soils in areas of proposed disturbance for use as a topsoil material during reclamation. Suitability parameters will be defined. Two key parameters for a topsoil source are soil texture and coarse fragment content because these are the most difficult parameters to amend. Also critical, particularly for soils in the southwestern United States, are soil salinity and sodicity.

Salt and sodium concentrations in soils affect plant growth and soil infiltration characteristics, and are also difficult to amend. Other soil characteristics that are important in reclamation, but which can more easily be amended, are organic matter content, macronutrient concentrations, and micronutrient concentrations.

- To determine the volume of suitable material present and calculate the amount of topsoil that must be obtained from a borrow source to complete Site reclamation.

6.3 Sampling Frequency

In accordance with 19.10.6.602 of the New Mexico Administrative Code (NMAC), there will be one sampling event for topsoil characterization during the 12-month baseline data collection period.

6.4 List of Data to Be Collected

Table 6-1 shows the four data requirements identified for topsoil and the plans for addressing these requirements. NMCC proposes to satisfy the data requirements by characterizing soils in areas that will be disturbed by proposed mining operations and that may be used as topsoil borrow sources. Figure 6-1 shows the proposed mining disturbance areas.

6.5 Methods of Collection

First order (order 1) pedestrian soil surveys will be conducted by a qualified soils scientist within each of the disturbed areas shown on Figure 6-1 to delineate topsoil. First order soil surveys have delineations of 1 hectare (2.5 acres) or less, depending on scale; typically show phases of soil series and miscellaneous areas as components of map units; and typically display results at a scale of 1:15,840 or larger (Soil Survey Division Staff, 1993). Surveys will be conducted by walking along parallel transects defined within the boundary of each disturbed area. The total number of transects per disturbed area will be randomly selected using the random point generation function within Hawth's Analysis Tools ArcGIS plug-in. During this process, the required number of random transects will be placed in each disturbed area. The resulting geographic coordinates will be transferred to a Global Positioning System (GPS) receiver with a horizontal accuracy≤3m for field navigation to the target locations. If field conditions do not match the stratum intended, the transect will be moved to a nearby location within the disturbed area. While walking along each transect, the soils scientist will delineate the boundaries for topsoil by making visual observations of surface soils and confirming those observations with hand-auger holes. Topography, vegetative cover, slope and aspect will all be used to guide the decisions. Boundaries recorded in the GPS receiver will later be downloaded and imported into an ESRI geographic information system (GIS) as a shapefile.

Soil samples will be collected from topsoil within the disturbed areas using a hand auger, shovel, mechanized geoprobe (if permitted), or other means necessary to retrieve samples until bedrock or a hardened surface is reached. A total of six samples will be taken: three from the tailings impoundment and one each from the North, West, and East Waste Rock disposal areas (Figure 6-1). It is anticipated that at each sample location, a soil subsample will be collected at three different depth intervals in the topsoil. The subsamples from each location will be collected and mixed to form a composite sample. Typically, the soil scientist will estimate soil texture visually at 6-inch intervals within the top 2 feet (ft). Below 2 ft, texture will be estimated at 1-ft intervals. Soil features, such as color, presence of calcium carbonates, salt accumulation, volume of coarse fragments, and depth to bedrock or rocky layer, will also be noted. For mapping purposes, the location of the subsample will be documented with a GPS receiver.

Soil samples will be air-dried before submission to the laboratory. Sample handling and chain-of-custody procedures will be followed for the preparation of soil samples for shipment to the off-site analytical laboratory.

6.5.1 Sampling Methods

The sampling methods described below may be used for obtaining the necessary soil samples. The surface soil sample collection procedures discussed in 6.5.1.1 may be used if the soil sampling location is not below a water surface. The procedures discussed in 6.5.1.2 may be used if the soil sampling location is below a water surface.

The following equipment will be assembled before surface-soil sampling begins:

- Coolers
- Sample containers and laboratory-supplied preservatives (if needed)
- Sample labels
- Personal protective equipment
- Custody seals
- Waterproof pens
- Appropriate sampling equipment
- Acetate sleeves (if needed)
- Personnel/equipment decontamination supplies
- Field logbook
- Sample control logs
- Chain-of-custody forms

All sampling equipment will be cleaned before use.

6.5.1.1 Surface Soil Sample Collection Procedure (Dry)

The following procedure will be used for collecting surface soil samples for chemical analysis.

1. If necessary, use a shovel to remove vegetation from the sampling point.
2. Use any of the following three methods to obtain representative samples from the intervals of interest:
    a. Soil samples may be collected using a hydraulic soil sampler or a hand-driven soil sampler, both with acetate sleeves. These samples will be extruded from the acetate sleeve or else the sleeve will be cut to segregate the sample interval of interest.

       Cap the acetate sleeves as quickly as possible and send them intact to the laboratory so that the interval of interest can be tested with a minimum loss of volatile components.

    b. A pit may be excavated with a clean shovel to expose a soil profile, which is a vertical cut in the soils that exposes the genetic layers or horizons. Because the soil samples will be analyzed for metals, samples will not be collected from the surface that was in contact with the shovel. Instead, the surface will be scraped with a clean, non-metal trowel before collection. Soil samples may be collected using a clean, stainless-steel trowel or an appropriate disposable trowel to remove equal portions of the soil from the surface or near the surface to the base of the interval of interest.

    c. Soil samples may be collected using a clean, stainless-steel hand auger. Note the sampling depth. Use a non-metal trowel, spatula, or knife to assist in removing the sample for placement in the sample container.
3. Remove obvious rock material from each sample.

4. Place each sample in a clean, labeled sample container and cap securely as quickly as possible. Ensure that neither the sample nor its container comes into contact with any contaminated surfaces.
5. Provide complete information when filling out the sample label. Labels must include the following information:
   - Project name and/or number
   - Field sample number
   - Depth interval (if applicable)
   - Initials of collector
   - Date and time of collection
   - Sample type and preservative (if any)
6. Immediately place the sealed and labeled sample container in a cooler containing double-bagged ice or frozen ice packs. Store at <4°C, if required. (The use of protective packaging will be dictated by the mode of transport.)
7. Record the sampling data on the sample control log and in the field logbook, as appropriate.
8. Decontaminate the sampling equipment before collecting the next sample. If possible, have a sufficient quantity of clean, decontaminated equipment available so that each sample can be taken with separate equipment and all sampling tools can be decontaminated periodically or at the end of the sampling effort rather than between each sampling event.
9. Complete a chain-of-custody form for laboratory shipment.
10. Place custody seals across the shipping container lids so that the shipping containers cannot be opened without breaking the custody seals. Custody seals must contain the following information:
    - Collector's signature or initials
    - Date of shipping
11. Ship sample containers to the laboratory for analysis within 24 hours of sample collection, carefully observing all minimum holding time requirements for degradable constituents.

The chain-of-custody form, sample control logs, and field logbook must be completed in accordance with the procedures set forth in the Quality Assurance Project Plan (Attachment 1).

6.5.1.2 Sampling Beneath a Water Surface

The following sampling methods may be used if the soil sampling location is below a water surface.

6.5.1.2.1 Sampling with a Trowel

Sediment samples can be collected using a stainless steel or disposable trowel provided the water depth is very shallow (e.g., a few centimeters). A stainless steel trowel or scoop is recommended because of its inert nature. Single grab samples may be collected or, if the area in question is large, a grid can be used and multiple samples can be collected and composited. The sample collection procedure is as follows:

1. Label all bottles. Fill out all information except the sampler's name/initials and the actual date and time. Sort bottles according to the sampling locations.
2. Note the sampling location in the logbook, measuring distances and direction from stationary landmarks. If possible, photograph the location.

3. Record the date, time, and sampler's name/initials on all sample containers and on the sample control log. Cover all container labels with wide transparent waterproof tape to ensure label integrity.
4. Insert the trowel into the sediment and begin to remove material. Avoid collecting large rocks or plant roots as much as possible.
5. Decontaminate the sampling equipment before collecting the next sample by cleaning the equipment with warm water and Liquinox, then rinsing again with warm water. If possible, have a sufficient quantity of clean, decontaminated trowels available so that each of the sediment samples can be taken with a separate trowel and decontamination can be performed on all the trowels at the end of the sampling effort rather than between each sampling event.
6. Store and transport at <4°C, if required, and place custody seals on the cooler lid so that the cooler cannot be opened without breaking the seals.

6.5.1.2.2 Sampling with a Hand Corer

A hand corer is essentially the same type of thin-wall sampler that is used for collecting surface soil samples. It has a handle to facilitate driving the corer into the sediment and a check valve on the top to prevent sample washout during retrieval through an overlying water layer.

Hand corers can be used for the same situations and with the same materials as trowels (see previous section). The advantage of a hand corer is the ability to collect an undisturbed sample that can profile any stratification in the sample as a result of changes in the deposition. Some hand corers can be fitted with extension handles that allow collection of sediment samples in water of moderate depth (6 ft). Most corers can be fitted with liners of brass, polycarbonate plastic, or Teflon. The appropriate liner can be chosen to match the type of contamination expected in the sample and the intended analytical procedures.

The sample collection procedure using a hand corer is as follows:

1. Label all bottles. Fill out all information except the sampler's name/initials and the actual date and time. Sort bottles into sets: one per sampling location, with additional sets as needed for blanks and duplicates.
2. Note the location of the sample in the logbook, measuring distances and direction from stationary landmarks. If possible, photograph the location.
3. Record the date, time, and sampler's name/initials on all sample containers and on the sample control log. Cover all container labels with wide transparent waterproof tape to ensure label integrity.
4. Force the corer into the sediment with a smooth, continuous motion.
5. Twist the corer and withdraw in a single smooth motion.
6. Decontaminate the sampling equipment before collecting the next sample.
7. Store and transport at <4°C, if required, and place custody seals on the cooler lid so that the cooler cannot be opened without breaking the seals.

6.6 Parameters to Be Analyzed

Soil samples will be collected and analyzed at a soil testing laboratory accredited by the National Environmental Laboratory Accreditation Program (NELAP) and the New Mexico Environment Department (NMED) for the soil characteristics summarized in Table 6-2. While performing the field sampling, the New Mexico Copper

Corporation (NMCC) representative will measure pH and electrical conductivity as necessary in order to "field-calibrate" for these parameters. Rock fragments will be removed from samples in the field and will be estimated by percentage by the soils scientist. In addition to the analyses outlined in Table 6-2, measurements of electrical conductivity, saturation percentage, and salinity will be collected following USDA guidelines (U.S. Salinity Laboratory Staff, 1954). Sodium adsorption ratio, a measure of the sodicity of the soil, will be calculated from the parameters of paste calcium, magnesium, and sodium in units of milliequivalents per liter.

6.7 Maps Showing Proposed Sampling Locations

A total of six samples will be taken: three from the tailings impoundment and one each from the North, West, and East Waste Rock disposal areas. Figure 6-1 shows the general boundaries of these locations at the Site.

6.8 Laboratory and Field Quality Assurance Plans

Sampling will be conducted in accordance with the sampling procedures described above. Soil sampling will be conducted by a qualified NMCC representative, who will document the sample location on a map, take a GPS reading, and record observations in a logbook. Sample handling and chain-of-custody procedures will be followed to prepare soil samples for shipment to the off-site analytical laboratory. Laboratory analyses will be conducted in accordance with methods described in *Methods of Soil Analysis, Parts 1 and 2* (Klute, 1986, and Weaver, 1994, respectively). NMCC will select a laboratory that operates under a quality program and has expertise and experience with the approved soil analytical methods.

6.9 Discussion in Support of Proposal

The proposed data collection will allow the characterization and establishment of baseline topsoil conditions across the Site in advance of mining and will supplement existing topsoil data. A deficit in volume of topsoil for Site reclamation is expected. The topsoil required to compensate for the deficit is expected to be obtained from within the tailings impoundment area (SRK, 1996).

6.10 References

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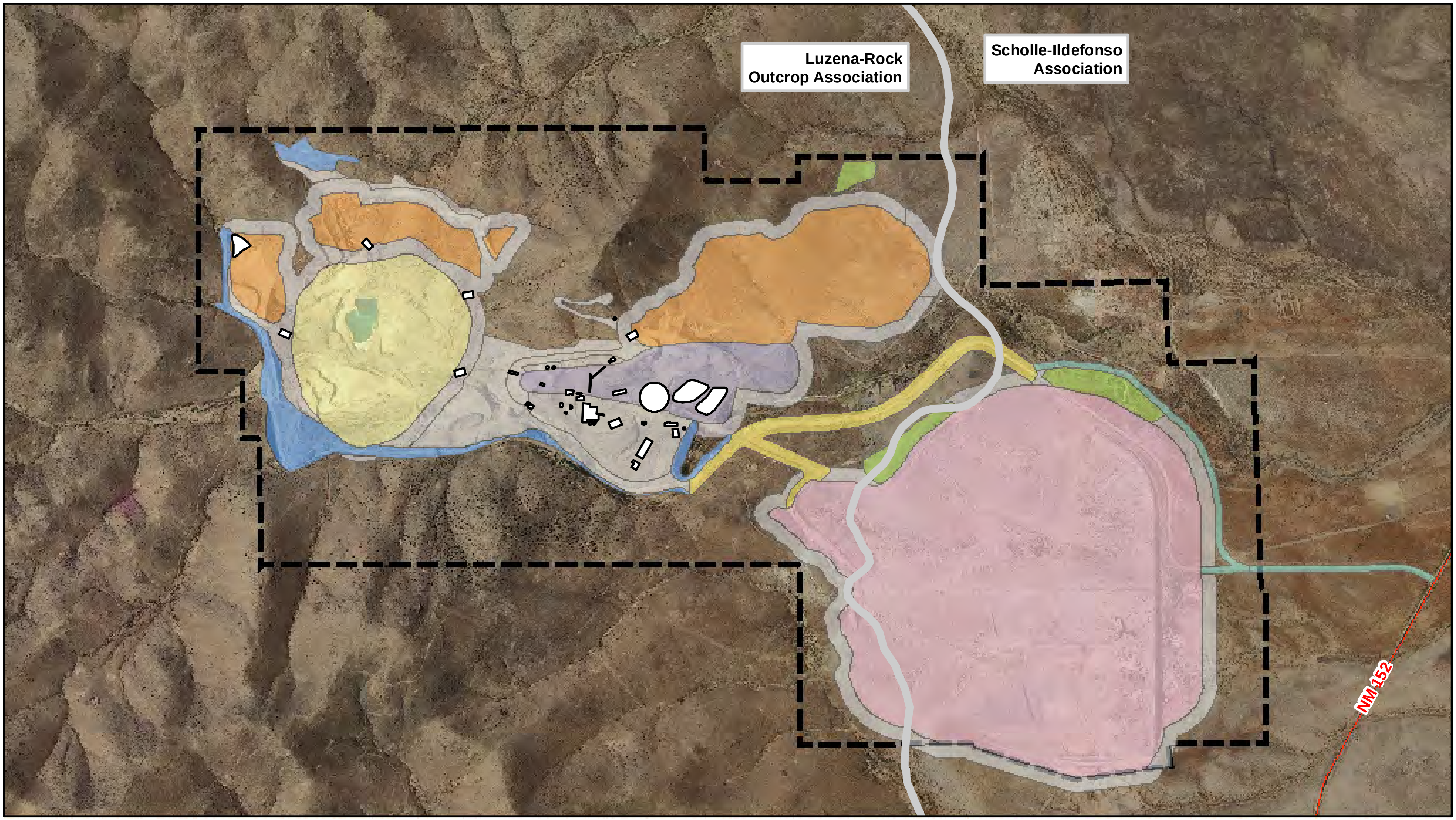
Figure



N
W E
S

0 1,000 2,000 4,000 6,000
Feet

Mine Boundary:
Tom Reynolds
Disturbed areas/mine facilities: SRK, 2010
Imagery Information:
-USGS 7.5-Minutes County DOQQ
mosaic Sierra County, 2009
Projection Information:
-New Mexico State Plane West, NAD 1927

Legend

- Proposed Mine Permit Boundary
- Proposed Mine Facility
- Scholle-Ildefonso/Lusena-Rock soil boundary
- Waste Rock
- Topsoil Stockpile
- Tailings
- Stockpile
- Pit
- Haul Road
- Diversion
- Ancillary
- Access Road

Figure 6-1
Topsoil Sampling Locations

New Mexico Copper Corporation

Tables

Table 6-1

Topsoil Data Needs

Data Need	Plan to Address Data Need
Determine accurate soil depths in areas to be disturbed to ensure proper topsoil volume calculation.	Measure soil depths in areas where planned disturbances will take place (locations will be entered into a GPS unit).
Determine suitability of stripped material for use as topsoil during reclamation.	Send soil samples to a laboratory for analysis to determine characteristics and suitability as topsoil.
Determine need for additional topsoil.	Estimate the available topsoil based on the results of the soil survey and calculate topsoil deficit by subtracting the available topsoil from the topsoil needed. Any topsoil deficit will be addressed identifying additional on-site borrow areas or other potential borrow sources in the immediate vicinity of the mine.
Sample and characterize any material needed from borrow pits to complete reclamation efforts.	Conduct soil characterization and analysis on soils that may be used as a borrow source.

Table 6-2

Soil Characteristics and Methods Used

(Sampling requires 125 ml/4 oz wide mouth glass jar.)

Analytical Parameter	Analysis Method	Lab Detection Limit for Sediments (mg/kg unless noted)
Nitrate-nitrite	EPA Method 353.2	0.05
Phosphorous	EPA Method 365.2	2.5
Arsenic	EPA Method 200.7	1.0
Boron	EPA Method 200.7	2.0
Cadmium	EPA Method 200.7	0.1
Calcium	EPA Method 200.7	5.0
Copper	EPA Method 200.7	0.2
Iron	EPA Method 200.7	1.0
Lead	EPA Method 200.8	0.25
Magnesium	EPA Method 200.7	5.0
Manganese	EPA Method 200.7	0.1
Mercury	M7471A CVAA	0.03
Molybdenum	EPA Method 200.7	0.4
Nickel	EPA Method 200.7	0.5
Potassium	M6010C ICP	10
Selenium	EPA Method 200.7	1.0
Sodium	EPA Method 200.7	5.0
Zinc	EPA Method 200.7	0.25
pH	EPA Method 150.1	NA
Grain size	Plumb, 1981	NA