Preliminary Soil Salvage Management Plan

Rosemont Copper Company

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Rosemont Copper Project

Barrel Alternative

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List of Acronyms

ABA  acid base accounting
ADEQ  Arizona Department of Environmental Quality
amsl  above mean sea level
AZPDES  Arizona Pollutant Discharge Elimination System
C  clay
CL  clay loam
cm  centimeter
CMs  control measures
COS  coarse sand
DEIS  Draft Environmental Impact Statement
EC  electrical conductivity
EPA  U.S. Environmental Protection Agency
FS  fine sand
in  inch
L  loam
LCOS  loamy coarse sand
LFS  loamy fine sand
LS  loamy sand
LVFS  loamy very fine sand
Mcy  Million cubic yards
meq/L  milliequivalents per liter
mg/kg  milligram per kilogram
MPO  Mine Plan of Operations
mmhos/cm  millimhos per centimeter
NPDES  National Pollutant Discharge Elimination System
OM  organic matter
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Section 1
Introduction

Tetra Tech completed a soil resource assessment within the vicinity of the proposed Rosemont Copper Project (Project) in Pima County, Arizona for the Rosemont Copper Company (Rosemont). The soil assessment was conducted to assist in identifying soil map units based on soil characteristics for evaluation of soil suitability for reclamation and appropriate salvage depths for the soil.

This Preliminary Soil Salvage Management Plan (Plan) is intended to summarize the soil resource assessment and provide greater detail in the management of salvaged soil from removal, through storage, to final placement, with the goal of providing sufficient cover on all disturbed areas to be reclaimed. This Plan describes aspects specific to the management of the salvaged soil and the reuse of suitable available soil within the disturbed areas. For further details on the contouring, grading and re-vegetation of the disturbed areas refer to the Preliminary Reclamation and Closure Plan for the Barrel Alternative.

1.1 Background

Rosemont proposes to mine and process ores from the Project located 30 miles southeast of Tucson, Arizona. Figure 1 shows the layout of the Project site at the completion of active mining operations. Overall, the Project will entail an open pit mine with ore processing by milling and tailings storage using the dry stack tailings storage method.

The proposed Project facilities will be constrained to Barrel Canyon, located upgradient of Davidson Canyon in the Cinema Creek basin.

As a component of Rosemont’s overall environmental stewardship vision for the Project, a Preliminary Reclamation, and Closure Plan has been designed to meet regulatory requirements through a concurrent reclamation and closure approach. This approach also provides a template for operational measures that will be employed during the life of the facility. A previous Reclamation and Closure Plan was submitted as part of the Mine Plan of Operations (MPO) in 2007. In response to the United States Forest Service (USFS) selection of the Barrel Alternative, a Preliminary Reclamation and Closure Plan was prepared along with a Preliminary Soil Salvage Management Plan.

1.2 Scope and Objectives

This Preliminary Soil Salvage Management Plan builds on Tetra Tech’s Survey of Salvage Topsoil Resources for the Rosemont Mining Area prepared in 2007 and also on their 2010 Survey of Salvage Topsoil Resources for the Rosemont Mining Area – Revision 1. The 2010 revision included all alternative areas under consideration by the USFS during development of the Draft Environmental Impact Statement (DEIS), which included the Barrel Alternative.

The objectives of this Plan are outlined below:

- Summarize the location and volumes of potential suitable soil for salvage within the Project area, and the characteristics that define these locations.
Section 1 • Introduction

- Locate suitable storage areas for soil stockpiles. Locations should consider long-term management, as needed.
- Describe the duration and phasing of soil stockpiles.
- Provide guidelines for soil stockpiles to manage air, water, and soil quality concerns.
- Explain the final placement of salvaged soils and provide procedures for final placement.

Excluding references, this Plan is organized into four (4) sections:

- Introduction
- Soil Salvage
- Soil Stockpiles
- Soil Placement
Section 2

Soil Salvage

Soil management begins with soil salvage. This section describes the soil types within the Project vicinity, suitable soil salvage locations, and soil salvaging procedures. Soil salvage is anticipated to be conducted over the entirety of the defined Project area, with the depth of salvage dependent on the suitability of the soil for reclamation efforts. Figure 2 shows the results of soil survey work for the area of the Project.

On Figure 2, three (3) operational areas are shown. These are the Open Pit Area, Plant Site Area and Storage Area. Throughout the Plan, the quantities and types of salvageable soil, reclamation cover volumes and sequencing of the development of the mine are presented for these areas. The Storage Area contains Phase 1 and 2 of the Dry Stack Tailings Facility and the Waste Rock Storage Area. The Soil Stockpiles #1 and #2 are also contained within the Storage Area.

2.1 Soil Salvage Goals

Salvage of soil in the Project area prior to the development of the operation of the mine, allows Rosemont to reuse the valuable growth media in reclamation efforts during the Project. However, not all of the topsoil within the Project area is suitable for salvage and reuse. Salvage requires that the volume of available desirable topsoil is balanced with the volume of topsoil needed during reclamation efforts. The goals of salvage include:

- Identify the soil classifications, and the soil characteristics for each classification.
- Stockpile suitable soils that meet the physical and chemical characteristics needed for reclamation efforts.
- Manage salvage quantities so there is optimal operational efficiency and protection of the soils and surrounding environment during handling and storage.
- Provide suitable cover for the area identified in the Preliminary Reclamation and Closure Plan for the Barrel Alternative.

Rosemont has identified soil classifications and potential soil salvage locations within the Project area. The results of this effort are summarized within this section.

2.2 Soil Classifications

Soil classification is a necessary component of a soil salvage effort. To ensure that soils will be useful in the long-term for reclamation purposes, physical characteristics and soil chemistry for the different soil classes were evaluated. In conjunction with this evaluation, it is also useful to consider if the soils can be improved with amendments such as lime or biological enhancements.

Through evaluation of the soil survey information, it was clear that a substantial amount of the soils classified were suitable for salvage soil during reclamation efforts. The classifications suggest the availability of good quality soils that need little to no alteration.
In March 2007, a soil resources assessment at the Rosemont site was performed with the objective of describing the soil profiles, or pedons. The assessment included documenting soil characteristics and any limiting characteristics, sampling and analyzing the physical and chemical properties of representative pedons, preparing a description of the mapping units and components, evaluating the soil suitability for reclamation, and proposing suitable salvage depths (Tetra Tech 2007). This assessment was revised in 2010 based on additional potential areas of disturbance for the proposed alternatives, including the Barrel Alternative. The total area surveyed by Tetra Tech for potential topsoil borrow included approximately 7,550 acres.

Six (6) soil pedon units and eight (8) borrow depths were identified within the Project Area, as a result of the study. These six (6) soil pedon units are further delineated into eight (8) different borrow depths as shown on Figure 2.

**Northern Aspect**

Northern aspect soils located in the southern portion of the survey area are formed from colluvium and slope wash-alluvium. The geologic parent material of this area is the Gila Conglomerate, which consists of quartz sandstone, carbonates, argillite, hornfels, granitic rock and quartz–feldspar. The average depth of suitable borrow soil is approximately twelve (12) inches. The soils available for salvage are sandy loams with 15 to 20% gravel, 0 to 5% cobbles and between 45 and 65% surface coarse fragments. Slopes range from 20 to 45 degrees. These soils generally have moderate vegetative cover including trees, shrubs, and grasses.

**Southern Aspect**

Southern aspect soils located in the southern portion of the survey area are formed from colluvium and slope wash-alluvium. The geologic parent material of this area, as with the northern aspect soils, is the Gila Conglomerate. These soils have approximately six (6) inches of suitable soil for salvage with occasional deeper deposits in concave physiographic positions. The texture of these soils is sandy loam to coarse sandy loam with coarse fragment content on the surface ranging from 50 to 75% and coarse fragment content ranging from 20 to 40% gravel and 0 to 5% cobbles. Slopes occurring in these areas range from 20 to 40 degrees. Vegetation cover is primarily forbs, cacti, and grasses.

**Alluvial Wash/Fans**

Alluvial washes are located in drainage bottoms throughout the Project area. These soils are deep with borrow depths ranging from 18 to 36 inches and with textures of loamy sand to sandy loams. Coarse fragment content, consisting primarily of small gravels ranges from 15 to 45%. The active flood plain portions of the wash generally have insufficient fines within the profile to support vegetation. Vegetation cover varies widely depending on the orientation/position of the soil survey location.

The alluvial fans were limited in extent and were included with the alluvial wash map unit. These fans are located at the mouths of side drainages and have the deepest soil salvage potential. Vegetative cover in the fans also varies greatly depending on slope aspect and grazing pressure but is generally good.

**Alluvial Terraces**

Alluvial terraces are fairly limited and located in the western portion of the survey area. These soils are derived from Late Pleistocene alluvial terrace material at the toe of the upper slopes of the Santa Rita Mountains. They are deep gravelly to very gravelly loams over weakly cemented, very reactive, extremely gravelly alluvium. The salvageable borrow ranges from 12 to 18 inches with gravel and
cobble generally being the restrictive feature. Vegetation cover is good and is primarily comprised of grasses.

**Residual Benches**

Residual benches are located in the northwestern portion of the Project area. The soils are derived from very weathered residuum of the Willow Canyon Formation. These soils are moderately deep; however, borrow depths are generally limited to one foot due to coarse fragment content and heavy clay soils. Surface coarse fragment content ranges from 30 to 50%. Near surface texture are generally clay loams grading to clays with slopes varying greatly from 5 to 40% dependent on position. Vegetative cover varies from moderate to good.

**Opportunistic Topsoil Salvage**

This map unit comprises the majority of the survey area and is located primarily throughout the northern extent of the soil assessment area, within the Project Area. While this area is generally considered not to have potential borrow capability, opportunistic topsoil salvage is available but is difficult to quantify due to the scale of the soil survey. The geology of this area consists of shale and laminated mudstone with interbeds of micritic limestone. Soil depths range from very shallow to five (5) inches on slopes and 24 inches in drainages. The soils in this area range from coarse sandy loams to clay loams. Coarse fragments within the soil are between 25 and 45% gravels and surface fragments of 40 to 60% and higher. Some additional isolated pockets of borrow soil may be available on site specific basis. The limiting factor for suitable borrow soil in this area is the bedrock outcrops and shallow depth to bedrock throughout the majority of these areas. These soils generally have a high percentage (80%) of surface coarse fragment cover with limited vegetative cover.

**2.2.1 Physical Soil Characteristics**

Physical characteristics of potential salvageable soils are important factors used to identify soils suitable for reclamation. Characteristics such as type, texture, and soil structure allow the soil to be used as a basis for good vegetative growth as described below. The available soils within the Project Area that are identified for salvage are considered of good physical quality. The following characteristics were considered in evaluating the quality of the available soils:

- **Soil Type** – characterizes the type of soil with respect to genesis and development. Soils demonstrate various characteristics that result from the nature of parent material, the length of time of exposure to the elements, the amount of organic material present, position in the drainage (i.e., geomorphology), and the degree to which the elements (primarily water infiltration) have distributed nutrients within the soil profile. Differences in types related to these factors are reflected in the soil mapping units that are described in Section 2.3.1.1.

- **Soil Texture** – describes soil composition in terms of percent of sand, silt, clay. Evaluation of soil texture can allow for differentiation of viable soils for growth within the region. Generally speaking, predominantly sandy soils have poorer moisture retention capability and higher infiltration, while soils containing excessive clay can be tighter (will hold more moisture but less plant-available) and more erosive. An optimal blend of sand, silt, and clay will yield soils with favorable moisture retention capabilities for revegetation.

- **Soil Structure** – reflects the interaction of factors such as type, texture, organic content, and development. Well-developed structure, particularly in more clayey soils, enhances permeability and moisture retention capabilities and overall suitability for revegetation.
Handling of these well-developed soils can disrupt favorable soils structure if conducted without a proper level of care.

- In addition to the above, consideration must also be given to the question of whether or not the salvaged soil will integrate well with the underlying material. Large differences in characteristics, such as vegetation root depth, compaction, water movement, biological material present or chemical incompatibility may result in a situation that can lead to failure of seeding attempts, erosion and possible loss of viable habitat.

As described in the Survey of Salvage Topsoil Resources for the Rosemont Mining Area– Revision 1 (Tetra Tech 2010), soil textures in the Project survey area are predominately sandy loam with some sandy clay loams. Of the forty four (44) soil samples collected, the clay content ranged from between 6 and 46%, with an average of 20%. Most of the identified borrow soils are gravelly to extremely gravelly. These soils have potential use in reclamation due to their low clay content. However, the sandy soils have low water-holding capacity, which limits some re-growth potential. While this high percentage of coarse fragments may negatively affect the water-holding capacity, it does assist in reducing the water and wind erosion potential.

### 2.2.2 Soil Chemistry

Soil chemistry is another major factor used in determining what soils are suitable for salvage operations. Without the proper soil nutrients and chemical characteristics, vegetation cannot be expected to survive. The chemistry, consistent with classification of the soils, lends itself to characterization for vegetative growth potential. The following points outline considerations during the soil chemistry investigation:

- **pH** – suitable soil requires an acceptable level of pH. Soil cannot be considered relatively basic or acidic. The optimal pH range for most soil uses as growth media ranges between 4.5 to 9, but the ideal range is between 6 to 8.

- **Salinity** – a major factor in vegetation seeding and long-term growth. As soils develop higher salinity values, they undergo salinization, which leads to erosion and the displacement of viable water for vegetation. Salinity can also impact soil structure and result in lower soil moisture retention capability. Vegetation can be tailored for salinity values, with some plants more robust and capable of handling extreme conditions. This can be characterized using a sodium adsorption ratio (SAR).

- **Organic Matter (OM)** – a measure of available nutrients for growth. The necessary amount of OM depends greatly on the intended vegetation type.

- **Contaminants** – excessive concentrations of other constituents, such as metals, is an important concern in revegetation potential. High concentrations of metals can result in plant toxicity, which can then result in loss of cover and/or animal life. This can be determined through investigations such as total metals analysis or metal leaching potential.

Soil chemical properties evaluated in the Survey of Salvage Topsoil Resources for the Rosemont Mining Area – Revision 1 (Tetra Tech 2010) include acidity and alkalinity (pH), electrical conductivity (EC), cations and cation exchange capacity, SAR, nutrient content, and acid base accounting (ABA).
Soil Acidity and Alkalinity

The acidity and alkalinity of soils in the survey area are closely tied to the parent materials, topographic position, and moisture regime. The pH of all samples tested ranged from between 5.6 to 8.0 and averaged 7.2 (neutral pH = 7). Measured pH levels were primarily between 6.7 and 8.0 due to the mostly calcic parent materials.

EC

A soil’s EC, recorded in millimhos per centimeter (mmhos/cm), is an indirect indicator of the salt content of the soil and is directly related to osmotic potential and soil water availability. Soils with an EC less than 8.0 mmhos/cm are generally considered not to inhibit revegetation. Since the highest EC measurement taken was 3.20 mmhos/cm, EC is not likely to be a limiting factor.

SAR

The SAR of the soil is an indicator of soil sodicity, which degrades soil structure and inhibits plant growth at levels above a pH of 8.0. SAR levels above 8.0 may cause surface crusting and reduce plant growth. Levels above 12.0 are further limiting and may require amendment treatments in order to revegetate. The SAR of most soils sampled within the survey area was less than 2.0. None of the soils sampled contained SAR levels above 8.0. Therefore, SAR does not appear to be a limiting factor for soils within the Project Area.

Nutrient Content

The nutrient content of native soils in this location is generally low, and therefore, there are no strict guidelines for determining limitations. However, nutrient data from the various profiles across the survey area provided reference for comparison purposes. Soil OM is a critical source of nutrients in native soils and often accounts for free nutrient levels. Soil OM levels for the soils within the survey area ranged from 0.38 to 4.1% with an average of 1%. Ridges and south-facing slopes exhibited the lowest OM content, while north-facing slopes and alluvial fans had the highest content, as would be expected. Overall OM content was low throughout the survey area with the upper 12 inches generally having the highest OM content and the alluvial washes generally containing moderately high levels of OM.

Nitrate levels in the soil samples ranged from 20 milligram per kilogram (mg/kg) to below the laboratory detection limit of 0.5 mg/kg. Nitrate levels mimicked the OM levels, as expected. Available phosphorus content ranged from 226 to 619 milliequivalents per liter (meq/L) and averaged 449 meq/L. The soils with the lowest phosphorus levels were located in the southwest portion of the survey area while the highest phosphorus levels were found in the central portion of the survey area. Potassium levels ranged from 1,170 to 2,890 meq/L with an average of 1,702 meq/L. The highest potassium levels were located in alluvial fans near washes and the lowest potassium levels occurred on ridges. The phosphorus laboratory analyses conducted for the 2010 assessment were reported as total phosphorus and were generally below the laboratory detection limit of 1.0 mg/kg. Similar to OM content, phosphorus, nitrate, and potassium concentrations were generally low but adequate and should not be limiting factors to re-growth potential.

ABA

Nineteen soil samples were submitted for ABA tests. Of these nineteen (19) samples, only two (4-11 inches) were shown to have low pH, which may hamper plant growth, based on the U.S. Department of the Interior and U.S. Environmental Protection Agency (USEPA) guidelines as presented in Table 2.1 below. The two soil samples are likely localized and may not equate to potentially acid generating rock
material. The soil underlying these two samples was tested and the ABA results indicate that the underlying soils were not acid generating. Two (2) soil profile locations sampled during the 2010 survey exhibited lower pH and the potential to produce acid rock drainage. However, neither of these profiles was located within areas proposed for topsoil salvage due to the predominance of underlying carbonate bedrock. ABA test results indicate that 17 of 19 shallow soil samples collected from the survey area were found to have either a low or no potential for being acid generating material. Hence, the acidity of the available suitable soils for salvage are not considered a limitation to plant growth.

2.2.3 Soil Amendments

Soil amendments may be used to modify a soil's physical and/or chemical properties to make it more suitable for vegetation. Amendments can be broken down into two (2) main groups; chemical and physical.

- Physical Amendments – consist of organic and aggregate materials. Organic, or biological, amendments include wood products, biosolids, peat, compost, straw, and manure that can help to stabilize and bind soils but have the added capability to supplement nutrients through biological interaction. Aggregate as amendments include brick, crushed pottery, fly ash, or rock, which improves the physical nature of the soil with respect to permeability, water retention, and cohesiveness. Fly ash also has the potential to add nutrients to soils as well.

- Chemical Amendments – are intended to enhance nutrient content, either directly or indirectly, or improve soil structure through chemical-biological reactions. Such measures include soil amendments of nutrients or trace substances, or chemicals that enhance soil cohesion and structure (floculants, binding agents, etc.).

The amendments evaluated for reclamation at the Project included tackified straw and tackified straw combined with slow-release fertilizer. Tackified straw, (straw that has been glued or fastened onto a field site), is a popular amendment for regional reclamation efforts. The second amendment, slow-release fertilizer, will provide a temporary source of nutrients in the surface soil where the plants will be established.

2.3 Salvage from Operable Areas

Based on the soil classifications and characteristics discussed in Section 2.2, soil suitability, depths of salvage, locations for soil salvage and salvage quantities can be defined for the Project area.

2.3.1 Soil Suitability

Soil salvage suitability can be determined based on soil type and soil characteristics. The review of soil types and characteristics indicates that a majority of soils are suitable for salvage on this site.

2.3.1.1 Soil Types

Soil type descriptions were compiled by the University of Arizona School of Natural Resources. Included in the descriptions are approximate locations of these soil types, as generated by Tetra Tech and illustrated in Figure 2. Types of soil characterized within the Project area are as follows:

- Bernadino-Hathway Association –See Bernadino and Hawthaway (described below). This soil type currently covers approximately 39 acres of the 955 acres designated for the Open Pit Area. Of the combined disturbance area for the Waste Rock Storage Area and Dry Stack Tailings
This soil type association covers approximately 680 acres or 29%. This association consists of the following soil series:

- **Bernadino** - fine, mixed, thermic (Reddish Brown). Bernardino soils are deep and well drained. They typically have a dark brown loam surface layer about five centimeters (cm) (2 inch) thick and a dark reddish brown, gravelly clay loam upper subsoil and clay lower subsoil that grades at about 38 cm (15 inch) to lime mottled pinkish gray, gravelly sandy clay loam to more than 150 cm (60 inch). Bernardino soils are on rolling fan terraces with slopes that are dominantly 5 to 15% but may range up to 25%. These soils are located predominately in the area of the Phase 2 dry stack tailing area. These soils have moderate available water capacity and slow permeability. They are moderately alkaline and are usually calcareous throughout with zones of high lime at less than 50 cm (20 inch). Run-off is slow to medium and the hazard of erosion is slight to moderate.

- **Casta** – loamy-skeletal, mixed, mesic (Reddish Chestnut). Casto soils are deep and well drained. Typically, they have a grayish brown, very gravelly, sandy loam surface layer about 3 cm (1 inch) thick. The subsoil is reddish brown and reddish gray, very gravelly, heavy, sandy clay loam 69 cm (27 inch) thick. The underlying material is pinkish-white, very gravelly, sandy loam to a depth of 150 cm (60 inch) or more. Casto soils occur on the sides and tops of narrow fan terraces and steep sides of broad fan terraces with slopes ranging from 8 to 40%. These soils have moderate available water capacity and slow permeability. They are moderately acidic in the upper layers and become moderately alkaline and calcareous below depths of about 61 cm (24 inches). Run-off is medium to rapid and the hazard of erosion is slight. The Open Pit Area has 88 salvageable acres, the Plant Site has 57 salvageable acres and the Waste Rock Storage Area and Dry Stack Tailings Facility have less than two acres of salvageable Casto soil series.

- **Chiricahua** – clayey, mixed, thermic, shallow (Reddish Brown). Chiricahua soils are shallow and well drained. Typically, they have a brown, very cobbly loam surface layer about five (5) cm (2 inches) thick. The upper five (5) cm (2 inches) of subsoil is reddish brown, very gravelly clay loam. The lower 30 cm (12 inches) of subsoil is reddish brown, gravelly clay. Below this is pink and reddish yellow, strongly weathered granite. The Open Pit Area has 180 acres while the Plant Site has 34 acres of salvageable Chiricahua soils.

- **Comoro** - coarse-loamy, mixed (calcareous), thermic (alluvial). Comoro soils are deep and well drained. Typically, they have a grayish brown, sandy loam surface layer about 35 cm (14 inches) thick. The underlying material to a depth of 150 cm (60 inches) is grayish brown, sandy loam and gravelly sandy loam. Comoro soils occur on floodplains and alluvial fans with slopes of 0 to 3%. They have moderate available water capacity and moderately rapid permeability. They are moderately alkaline and calcareous throughout the profile. Runoff is slow to medium and the hazard of erosion is moderate. The Waste Rock Storage Area and Dry Stack Tailings Facility have a combined total of 11 acres of Comoro soil series.

- **Faraway** – loamy-skeletal, mixed, mesic (Lithosols). Faraway soils are shallow or very shallow and well drained. Typically, the soil profile is a grayish brown, very cobbly loam about 20 cm (8 in) thick over light gray rhyolite bedrock having widely spaced fractures. Faraway soils occur on hill slopes with slopes ranging from 10 to 80%. They have very low available water capacity and moderate permeability above the bedrock. They are moderately acidic to mildly alkaline.
and noncalcareous throughout the profile. Runoff is rapid and hazard of erosion is slight. The Open Pit Area has 66 acres of Faraway soil series.

- **Hathaway - loamy-skeletal, mixed, thermic (Calcisols).** Hathaway soils are deep and well drained. Typically, they have a dark grayish brown very gravelly loam surface layer about 20 cm (8 inches) thick underlain by pale brown and pinkish gray, calcareous, very gravelly sandy loam and loamy sand to more than 150 cm (60 inches). Hathaway soils occur on long, narrow fan terraces with slopes ranging from 10 to 60%. These soils have low available water capacity and moderately rapid permeability. They are moderately alkaline and calcareous throughout with zones of high lime below 18 to 40 cm (7 to 16 inches). They have medium runoff and the hazard of erosion is medium.

- **Lampshire-Graham – see Lampshire and Graham.** The Waste Rock Storage Area and the Dry Stack Tailings Facility have a total of 44 acres of Lampshire-Graham soil series.
  - **Lampshire - loamy-skeletal, mixed, thermic (Lithosols).** Lampshire soils are very shallow and well drained. Typically, they have a grayish brown, very cobbly loam profile about 20 cm (8 inches) deep over pinkish gray, widely fractured dacite bedrock. Depth to bedrock ranges from 10 to 50 cm (4 to 20 inches). Lampshire soils occur on hillslopes with slopes ranging from 50 to 90%. These soils have low available water capacity and moderate permeability. They are slightly acidic to moderately alkaline and are non-calcareous throughout the profile. The hazard of erosion is slight and runoff is medium to rapid.
  - **Graham - clayey, montmorillonitic, thermic (Reddish Chestnut).** Graham soils are shallow and well drained. Typically, they have a reddish brown, cobbly clay loam surface layer about 2.5 cm (1 inch) thick. The subsoil is dark reddish brown, gravelly clay loam and clay about 33 cm (13 inches) thick. This is underlain by basalt bedrock that has a few fractures. Graham soils occur on hill slopes with slopes ranging from 5 to 50%. These soils have low available water capacity and slow permeability. They are slightly acidic to moderately alkaline and may be slightly calcareous in the lower part. Runoff is medium and the hazard of erosion is slight. These soils areas are located along the lower northern reaches of the Lower Barrel Canyon Basin. The soils in this area have been identified to be less than six (6) inches in depth.

- **Mabray-Chiricahua – See Mabray and Chiricahua.** The Waste Rock Storage Area and Dry Stack Tailings Facility, Plant Site, and Open Pit Area have 577, 190 and 40 acres of Mabray-Chiricahua soil series, respectively.
- **Mabray - loamy-skeletal, carbonatic, thermic (Lithosols).** Mabray soils are shallow and very shallow and well drained. Typically, they have dark grayish brown, very gravelly or very cobbly loam profiles overlying extremely hard, widely fractured, limestone bedrock at about 30 cm (12 inches). Depth to bedrock ranges from 10 to 50 cm (4 to 20 inches). Mabray soils occur on steep hill slopes of limestone or marble with slopes ranging from 15 to 70%. These soils have very low available water capacity and moderate permeability. They are moderately alkaline and contain more than 40% calcium carbonate. Runoff is medium to rapid and the hazard of erosion is slight.
• Rock outcrop-Lithic Haplustolls – see rock outcrop and lithic haplustolls. The Waste Rock Storage Area and Dry Stack Tailings Facility have 36 acres of this soil series.

• Rock outcrop - Rock outcrop occurs mainly as steep or very steep peaks, ledges and escarpments. In some areas it occurs as low ridges or boulder piles or on pediment surfaces with less than 15% slope. Rock outcrop is barren of vegetation and has rapid runoff. The rock type is highly variable and may be granite, gneiss, andesite, rhyolite, tuff, basalt, limestone, sandstone, shale or conglomerate. These areas are located at the southern slopes of the Wasp Canyon at the northern reaches of the Barrel Alternative boundary.

• Tortugas – rock outcrop – see Rock Outcrop (above) and Tortugas (below). The Open Pit Area has 119 acres of this soil type.

• Tortugas - loamy-skeletal, carbonatic, mesic (Lithosols). Tortugas soils are shallow and very shallow and well drained. Typically, they have grayish brown, very cobbly loam profiles about 30 cm (12 inches) thick over gray limestone with widely spaced fractures. Depth to bedrock ranges from 15 to 50 cm (6 to 20 inches). Tortugas soils occur on gently rolling to very steep hillslopes with slopes of 5 to 70%. Available water capacity is very low and permeability is moderate. These soils are moderately alkaline and calcareous. Runoff is medium to high and erosion hazard is slight to moderate. These soils are located in the upper reaches of the Wasp Canyon Basin.

• White house - fine, mixed, thermic (Reddish Chestnut). White House soils are deep and well drained. They typically have a surface layer of brown gravelly loam, about eight (8) cm (3 inches) thick over reddish brown and dark red clay upper subsoil that grades at about 65 cm (26 inches) to yellowish red, lime mottled, gravelly sandy clay loam to more than 150 cm (60 inches). White House soils occur on fan terraces with slopes of 0 to 35%. These soils have high available water capacity and slow permeability. They are medium acid to neutral in the upper layers and moderately alkaline and calcareous below about 50 cm (20 inches). Runoff is slow to medium and the hazard of erosion is moderate. The Open Pit area has 194 acres and the Waste Rock Storage Area and the Dry Stack Tailings Facility have 13 acres of White house soil series.

• Soil salvage quantities for the Open Pit, Plant Site and Waste Rock Storage Area and Dry Stack Tailings Facility areas were calculated to provide an estimated acreage of salvageable soils suitable for stockpile and placement for reclamation. The types of soils present are suitable for salvage and later placement as reclamation topsoil. The acreage of soils suitable for salvage by soil type is shown in Table 2-1 below.

### Table 2-1. Soil Type Salvage Areas by Location

<table>
<thead>
<tr>
<th>Soil Type</th>
<th>Salvage Area in Pit Area (acres)</th>
<th>Salvage Area in Plant Site (acres)</th>
<th>Salvage Area in Waste Rock and Dry Tailings Storage Area (acres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bernadino-Hathaway</td>
<td>39</td>
<td>0</td>
<td>724</td>
</tr>
<tr>
<td>Casto</td>
<td>88</td>
<td>57</td>
<td>2</td>
</tr>
<tr>
<td>Chiricahua</td>
<td>181</td>
<td>34</td>
<td>0</td>
</tr>
<tr>
<td>Comoro</td>
<td>0</td>
<td>0</td>
<td>12</td>
</tr>
<tr>
<td>Faraway</td>
<td>66</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Hathaway</td>
<td>3</td>
<td>0</td>
<td>890</td>
</tr>
<tr>
<td>Hathaway (previously eroded)</td>
<td>0</td>
<td>0</td>
<td>219</td>
</tr>
</tbody>
</table>
Table 2-1. Soil Type Salvage Areas by Location

<table>
<thead>
<tr>
<th>Soil Type</th>
<th>Salvage Area in Pit Area (acres)</th>
<th>Salvage Area in Plant Site (acres)</th>
<th>Salvage Area in Waste Rock and Dry Tailings Storage Area (acres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lampshire-Graham</td>
<td>0</td>
<td>0</td>
<td>59</td>
</tr>
<tr>
<td>Mabray-Chiricahua</td>
<td>38</td>
<td>190</td>
<td>609</td>
</tr>
<tr>
<td>Rock Outcrop</td>
<td>0</td>
<td>0</td>
<td>35</td>
</tr>
<tr>
<td>Tortugas-Rock</td>
<td>119</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>White House</td>
<td>194</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>Total Salvage Area</td>
<td>728</td>
<td>281</td>
<td>2570</td>
</tr>
</tbody>
</table>

2.3.1.2 Soil Salvage Criteria

A combination of field observations and laboratory tests are used to evaluate suitability of soil for reuse as a plant growth medium and to assess potential salvage depths for each soil type in the vicinity of the Project. Site specific soil suitability criteria were also defined to identify suitable, marginally suitable, and unsuitable soils. These are included in Table 2-2 below.

Table 2-2. Soil Suitability Guidelines

<table>
<thead>
<tr>
<th>Property</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
<th>Unsuitable</th>
</tr>
</thead>
<tbody>
<tr>
<td>USDA Texture (thickset layer 0-40 in.)</td>
<td>L</td>
<td>LCOS, LS, LFS, LVFS, SCL, CL, SICL</td>
<td>COS, S, FS, VFS, SIC, C, SC</td>
<td>&gt;60% Clay content</td>
</tr>
<tr>
<td>USDA Texture (thickset layer 0-40 in. and &lt;35% clay)</td>
<td>SCL, CL, SICL</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Rock Fragments Volume % (0-40 in.)</td>
<td>&lt;15</td>
<td>15 to 25</td>
<td>25 to 55</td>
<td>&gt;55</td>
</tr>
<tr>
<td>Depth to High Water Table (feet)</td>
<td>--</td>
<td>--</td>
<td>&lt;1</td>
<td>Perennial wetness</td>
</tr>
<tr>
<td>Soil Acidity (pH 0-40 in.)</td>
<td>6 to 8</td>
<td>5 to 6</td>
<td>4.5 to 5</td>
<td>&lt;4.5</td>
</tr>
<tr>
<td></td>
<td>8 to 8.5</td>
<td>8.5 to 9.0</td>
<td>&gt;9.0</td>
<td></td>
</tr>
<tr>
<td>Slope %</td>
<td>&lt;8</td>
<td>8 to 25</td>
<td>25 to 50</td>
<td>&gt;50</td>
</tr>
</tbody>
</table>

For the six soil classification units in the Project area discussed in Section 2.2, Table 2-3 identifies the suitable soil salvage depths for the Project. These soil units were delineated on Figure 2 as soil borrow depths.

Table 2-3. Salvage Depths by Soil Classification

<table>
<thead>
<tr>
<th>Soil Classification</th>
<th>Depth of Salvage (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northern Aspect</td>
<td>12</td>
</tr>
<tr>
<td>Southern Aspect</td>
<td>6 – 12</td>
</tr>
<tr>
<td>Alluvial Wash/Fans</td>
<td>18 – 36</td>
</tr>
<tr>
<td>Alluvial Terraces</td>
<td>18</td>
</tr>
</tbody>
</table>
### Table 2-3. Salvage Depths by Soil Classification

<table>
<thead>
<tr>
<th>Soil Classification</th>
<th>Depth of Salvage (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residual Benches</td>
<td>6 – 12</td>
</tr>
<tr>
<td>Opportunistic Topsoil</td>
<td>&lt; 6</td>
</tr>
</tbody>
</table>

#### 2.3.2 Complete Salvage

Complete salvage is considered to be the removal of soil within a specific area to a specified depth. The depth of salvage has been defined based on the soil classification, as determined in Tetra Tech’s 2007 Survey of Salvage Topsoil Resources for the Rosemont Mining Area and 2010 Survey of Salvage Topsoil Resources for the Rosemont Mining Area – Revision 1. Complete salvage will be used in areas where a significant quantity of soil beneficial for reuse has been identified.

##### 2.3.2.1 Volume

The volume of soil available for complete salvage is presented in Table 2-4 based on the anticipated soil salvage depths discussed in this section. The total soil salvage volume is approximately 2.8 million cubic yards (MCY). The 2.8 MCY does not take into account the salvage area identified as areas of opportunistic salvage (< 6 inches). The area identified as opportunistic salvage is estimated to encompass approximately 1,772 acres. The 1,772 acres represents approximately 49% of the total salvage areas described above in Table 2-1. These volumes represent a bank (in place) cubic yard quantity.

#### Table 2-4. Salvage Volumes by Location

<table>
<thead>
<tr>
<th>Location</th>
<th>Soil Salvage Volume (CY)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open Pit Area</td>
<td>248,340</td>
</tr>
<tr>
<td>Plant Area</td>
<td>11,322</td>
</tr>
<tr>
<td>Waste Rock and Dry Stack Tailings Area</td>
<td>2,572,279</td>
</tr>
<tr>
<td>Total Areas</td>
<td>2,831,941</td>
</tr>
</tbody>
</table>

##### 2.3.2.2 Locations

Salvage will occur throughout the Project area at variable depths based on pre-determined suitability. Locations determined not suitable for complete salvage (> 6 inches) will be opportunistically salvaged. Salvage locations based on soil classification are indicated in Figure 2 with estimated salvage depths.

#### 2.3.3 Opportunistic Salvage

Opportunistic salvage may occur in areas identified as unsuitable. Salvage is considered to be opportunistic when the quantity of soil that meets salvage requirements has not been identified or was identified in thickness less than six inches. These locations are indicated on Figure 2. In general, locations for opportunistic salvage have the characteristics described below:

- The geology of the opportunistic salvage area consists of shale and laminated mudstone with interbeds of micritic limestone.
- Soil depths range from very shallow to five inches on slopes, and 24 inches in drainages.
- The soils in this area range from coarse sandy loams to clay loams.
Coarse fragments within the soil are between 25 and 45% gravels and surface fragments of 40 to 60% and higher.

Some isolated pockets of borrow soil may be available on a site-specific basis. The limiting factor for suitable borrow soil in this area is the bedrock outcrops and shallow depth to bedrock. These soils generally have a high percentage (80%) of surface coarse fragment cover with limited vegetative cover. Final cover for certain pre-determined areas have been identified in the Preliminary Reclamation and Closure Plan for the Barrel Alternative as having a mix (50%) of salvage soil and rock. These areas may be good candidates for soil salvaged from these opportunistic soil areas identified by shallow soil thicknesses.

Additional potential borrow material includes unconsolidated and weathered bedrock observed throughout the survey area. Geophysics performed in the west central portion of the soil survey confirms the material depth extends to between 4 and 10 feet. This material is the initial pedogenesis zone and is generally not considered as a topsoil salvage map unit. However, the shallow nature of many of the map units throughout the area would indicate the unconsolidated and weathered bedrock is actively serving as a growth media.

In general, there is limited soil salvage identified in the Plant Site. There is however, established vegetation in the Plant Site indicating that it is likely good growth media, and there may be opportunities for salvage identified during development of the Plant Site. If the soil is determined to be suitable for salvage, it will be reused on the side slopes of the building pad during operation. This material then would be available for use during final closure and reclamation of the Plant Site.

The total opportunistic salvage area roughly equals the same acreage as the total salvage area comprising the 2.8 MCY of suitable salvage. Approximately 83% of the Plant Site and Pit Area are identified as opportunistic salvage. Approximately 35% of the Storage Area is identified as opportunistic salvage. There is strong potential for additional salvaged soil to be obtained through opportunistic salvage within the Project Area. Assuming an average salvage thickness of 6 inches over the 1,772 acres equates to an approximate volume of an additional 1.4 MCY. This would be expected to include some of the underlying rock, but for certain reclamation cover areas this may be determined to be suitable.

2.3.4 No Salvage

Certain soils have been deemed unsuitable for salvage, either due to physical or chemical characteristics, which make the soil unsuitable for growth.

Invasive species found in the soil stockpiles will be addressed according to the Invasive Species Management Plan.

2.3.5 Modified Salvage Option

There may be unexpected variances in the volume of soil available for salvage during the life of the Project. In this event, or at the discretion of Rosemont, two additional reclamation methods may be used in lieu of placement of salvaged topsoil:

- Additional alluvial materials beneath the discussed salvage depth may be excavated and amended as needed to provide suitable growth medium and used as cover.
Locations on the west side of the Dry Stack Tailings Facility and the Waste Rock Storage Area may be stabilized using rock rather than topsoil and vegetation. The use of rock cover in these areas is a contingency in the event that suitable soil is limited. This minimizes erosion potential of these locations, and reduces the volume of topsoil required for successful reclamation of the Project area.

2.4 Soil Access

2.4.1 Soil Removal

Soil salvage operations will be overseen by a soil scientist or reclamation specialist to conform to this Plan. Soil to be salvaged will be removed prior to other construction/mining activities in the Project Area. The following measures will be taken during soil salvage:

- Pits will be dug by hand or using equipment to verify the removal depth of the soil to be salvaged.
- Erosion and sediment controls will be implemented upslope and downslope of the soil removal areas to comply with the Rosemont Storm Water Pollution Prevention Plan (SWPPP). These controls will remain in place until the appropriate control measures are implemented for the anticipated mining activity at the disturbance location.
- Soil will be transported to the stockpile location or Rosemont Landform. Efforts will be made to move the soil directly from the removal location to the longer-term stockpile location rather than storing salvaged material at an intermediate location. Where possible, soil will be taken directly from the removal site to a reclamation location for immediate use and final placement.
- Dust controls will be implemented at the removal site as needed. Dust controls may include, but are not limited to: application of water, use of silt fence as wind breaks, or stopping work in the case of extreme wind conditions.

2.4.2 Soil Transportation

Soil will be transported from the removal location to the stockpile location using haul trucks or other appropriate haulage equipment, such as scrapers. The soil will be loaded using front end loaders or similar equipment and placed in the haul truck in such a manner as to limit compaction to the extent possible. The haul trucks will transport the material to the stockpile location or final placement location. Routes for soil transportation will be on planned haul roads to the extent possible.
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Section 3

Soil Stockpiles

3.1 Soil Storage and Retention

Once soil has been salvaged from its original location, soil that is not directly placed onto the Landform will need to be stored until it will be used in the reclamation efforts. Goals of soil storage include:

- Minimize the handling of stockpiled soil.
- Minimize the duration of time soil is needed to be stockpiled.
- To the extent possible, locate soil stockpiles within the Project boundaries but outside of the mining disturbance area and away from waterways in locations in close proximity to their final placement location.
- To preserve the original characteristics (i.e., fertility, microbes).
- To protect from erosion due to incidental rainfall and run-on.

3.1.1 Stockpile Locations

Stockpiles are proposed to be located close to final placement locations and away from areas that would require relocation of the stockpile during the Project. Salvaged soils may be used during initial facility development, concurrent reclamation, or during post-mining closure reclamation.

Stockpile locations should also consider the anticipated soil needs during reclamation. Table 3-1 below summarizes anticipated reclamation needs during the life of the Project. This considers reclamation requirements in Table 13-3 of the Preliminary Reclamation and Closure Plan for the Barrel Alternative.

**Table 3-1. Reclamation Needs**

<table>
<thead>
<tr>
<th>Location</th>
<th>Salvage Soil Placement Depth (inches)</th>
<th>Location Size (acres)</th>
<th>Volume of Soil Needed (CY)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open Pit Area</td>
<td>12</td>
<td>50</td>
<td>80,667</td>
</tr>
<tr>
<td>Perimeter Berm</td>
<td>12</td>
<td>802</td>
<td>1,293,893</td>
</tr>
<tr>
<td>Plant Site Area</td>
<td>12</td>
<td>163</td>
<td>262,973</td>
</tr>
<tr>
<td>Waste Rock Storage Area</td>
<td>12</td>
<td>495</td>
<td>798,600</td>
</tr>
<tr>
<td>Tailings Waste Rock Buttress Area (mixed with 6 inches of rock)</td>
<td>6</td>
<td>829</td>
<td>668,727</td>
</tr>
<tr>
<td>Surface of Dry Stack Tailings Facility</td>
<td>12</td>
<td>354</td>
<td>571,120</td>
</tr>
<tr>
<td>PWTS Pond and Primary Settling Basin (side slopes)</td>
<td>12</td>
<td>8</td>
<td>12,907</td>
</tr>
<tr>
<td>Total of All Areas</td>
<td></td>
<td>2,701</td>
<td>3,688,887</td>
</tr>
</tbody>
</table>
Other considerations for stockpile siting include:

- **Soil Type.** Soils with different classifications should be stored separately to simplify placement during reclamation.

- **Stockpile Size.** Compaction of soils has been demonstrated to lead to decreased soil quality due to collapsed pore networks. These collapsed pore networks may contribute to poor air and water infiltration and root penetration during reclamation efforts. To the extent possible and where conditions allow, wide, shallow stockpiles not more than nine (9) feet deep should be used.

- **Side Slopes.** Slopes on soil stockpiles will generally be shallower than 3:1 (H:V) to decrease the potential for erosion.

- **Drainage.** Stockpiles should be placed in upland locations away from identified streams, creeks, or dry washes. Upland flows should be diverted to avoid run-on.

Based on these considerations, Table 3-2 includes soil stockpile locations and volumes. These correspond to the locations identified in Figures 4 through 7.

### 3.1.1.1 Stockpile Staging

The intent of soil staging is to stockpile salvageable soil in four different areas (Soil Stockpiles #1 through #4) over the life of the mine and during closure following mining operations. The four areas will provide stockpile locations adjacent to soil salvage operations and areas being covered with soil during concurrent reclamation activities. The locations are within areas which will eventually have waste rock or tailings placed for final storage. Existing access used for the placement of waste rock and tailings will be utilized to transport the soil for stockpiling. The locations are identified by their operational years in which the stockpiles can be developed and utilized before and after placement of the waste rock and tailings. The four stockpiles are located to provide approximately between 283,000 to 502,000 CY each of stockpile material at each location, encompassing areas approximately 18 to 39 acres in size, at maximum heights of 20 to 45 feet, with 3:1 side slopes.

Soil Stockpile #1 will be used during pre-production through the first eight years of operation. Soil Stockpile #1 is located in an area planned for dry stack tailings storage (Figures 3 and 4). Soil Stockpile #1 will be located east of the haul road bordering the eastern boundary of the Barrel Canyon Basin. Soil Stockpile #1 has approximately 501,000 CY at its maximum capacity with a footprint of 18 Acres.

Soil Stockpile #2 will be used during mining operations between years 8 through 14. Soil Stockpile #2 is located at the south east area of the Barrel Canyon Basin (Figure 5). This area will have waste rock placed to elevation 5300 prior to using for soil stockpiling through year 14. Soil Stockpile #2 has approximately 502,000 CY at its maximum capacity with a footprint of 39 acres.

Soil Stockpile #3 will be used during mining operations between years 14 through 22. Soil Stockpile #3 is located on the top of the south west waste rock storage area (Figure 6). This area will have waste rock placed to its final elevation of 5700 prior to using for soil stockpiling through year 22. Soil Stockpile #3 has approximately 335,000 CY of capacity at its maximum size with a footprint of 22 acres.
Soil Stockpile $4 will be used during mining operations between years 14 through 22 and into the closure period. Soil Stockpile #4 is located on the top of the south central waste rock storage area at the east end of the South Haul Road (Figures 6 and 7). This area will have waste rock placed to its final elevation of 5600 feet prior to using for soil stockpiling through year 22 and into the closure period. Soil Stockpile #4 has approximately 283,000 CY of capacity at its maximum size at a 18 acres.

During the first year of site development (pre-production - Year -1), the salvage material available within the Plant Site will be used as cover on the slopes surrounding the building pads and road areas at the Plant Site. During this same first year, salvage material within the Open Pit Area and Waste Rock Storage Area and the Dry Stack Tailings Facility will be stockpiled in the location of the Topsoil Stockpiles #1. During years 1 through 10, it is anticipated that salvage material from the Open Pit, Waste Rock Storage Area, and Dry Stack Tailings Facility areas will be hauled directly to the areas undergoing the first phases of concurrent reclamation. This approach allows for soil salvaging and reclamation to occur concurrently. Where soil salvaging occurs in the Open Pit, Waste Rock Storage Area, and Dry Stack Tailings Facility areas without any concurrent reclamation, the soil will be stockpiled in Topsoil Stockpile #1 for use in future reclamation during years 1 through 8. During years 8 through 14, salvage material will be hauled to Topsoil Stockpile #2. During years 14 through 22, salvage material will be hauled to Soil Stockpiles #3 and #4. These waste rock storage areas beginning in year 14 will be at their final height and placement of soil stockpiles in these locations will allow these locations to remain throughout the remainder of the mining operations and into closure.

The majority of the available salvage areas will have been removed for stockpiling and concurrent reclamation by year 10, at which time the stockpile storage will be at its full utilization.

<table>
<thead>
<tr>
<th>Location</th>
<th>Operation Years</th>
<th>Maximum Location Size (acres)</th>
<th>Maximum Volume of Stockpile (CY)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil Stockpile #1</td>
<td>1 to 8</td>
<td>18</td>
<td>501,000</td>
</tr>
<tr>
<td>Soil Stockpile #2</td>
<td>8 to 14</td>
<td>39</td>
<td>502,000</td>
</tr>
<tr>
<td>Soil Stockpile #3</td>
<td>14 to 22</td>
<td>22</td>
<td>335,000</td>
</tr>
<tr>
<td>Soil Stockpile #4</td>
<td>14 to closure</td>
<td>18</td>
<td>283,000</td>
</tr>
</tbody>
</table>

Soil salvage volumes discussed in Section 2 are based on bank (in place) cubic yards. As the material is removed and handled, there is an increase in volume due to the losing, which creates an expansion of the material of up to 10 to 20%, resulting in a greater volume of material stored and available for cover. An assumed 15% expansion in soil volume is assumed between the in-place (or bank) soils and that placed in the stockpiles.

**3.1.2 Stockpile Storage Techniques**

**3.1.2.1 Stockpile Storage Duration**

Soil stockpiles have been sequenced to minimize the stockpile duration to the extent possible given the other stockpile considerations.
3.2 Soil Storage Considerations

3.2.1 Air Quality
Maintaining soil quality is an important consideration when stockpiling soil. Stockpiles may become anaerobic over time, decreasing the biological properties of the stockpile. This can contribute to nitrogen loss through denitrification. Nutrients can also be lost by leaching through the soil. Microbes also decrease over time (Alberta Environment 2011, Utah Oil Gas and Mining 2000), as does seed viability within the stockpile.

3.2.2 Water Quality
There is the potential for stockpiled soil to migrate due to wind or water action from the stockpile location to local drainages, degrading water quality through sedimentation.

3.2.3 Soil Quality
Maintaining soil quality is an important consideration when stockpiling soil. Stockpiles may become anaerobic over time, decreasing the biological properties of the stockpile. This can also contribute to nitrogen loss through denitrification. Nutrients can also be lost by leaching through the soil. Microbes also decrease over time (Alberta Environment 2011, Utah Oil Gas and Mining 2000), as does seed viability within the stockpile.

Stockpiling may also result in increased compaction in the soil, resulting in higher bulk density and decreased pore space (Alberta Environment 2011, Utah Oil Gas and Mining 2000). Compaction discourages water retention and air circulation within the soil and root growth. Compaction can also increase the chances of run-off and soil loss by erosion.

3.3 Control Measures

3.3.1 Erosion Control
Steps can be taken to mitigate soil storage losses and potential environmental consequences. These steps, or control measures (CMs), can serve multiple functions in reducing potential impacts, as summarized in Table 3-3 below.

<table>
<thead>
<tr>
<th>BMP</th>
<th>Air Quality</th>
<th>Water Quality</th>
<th>Soil Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stockpile Siting</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Stockpile Design</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Vegetative Cover</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Run-On Controls</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Run-Off Controls</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Weed Control</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Temporary Cover</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

Considerations for stockpile siting and stockpile design have been incorporated into every stockpile location.
Stockpile Siting. One of the most significant CMs is stockpile siting, as discussed in Section 3.1. By locating soil stockpiles in upland locations away from drainages, the potential for sediment from the stockpiles to be transported from the site is greatly decreased.

Stockpile Design. Design features, such as slope steepness and stockpile height, contribute to well-managed stockpiles by reducing the potential for compaction within the stockpile, encouraging air circulation within the stockpile, and encouraging water drainage without erosion. Details of stockpile design features are discussed in more detail in Section 3.1. Stockpile side slopes will be no greater than 3:1. See Figure 8 for cross sections of stockpiles.

Additional CMs are discussed in more detail in the sections below.

3.3.1.1. Vegetative Cover
Vegetative cover will be used on stockpiles anticipated to be in existence for at least one year. Cover will be established through the seeding on the surface soil. Potential seed types for the mix are included in Table 3-4 below and may be refined based on testing and observed performance on the stockpile.

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mexican gold poppy</td>
<td><em>Eschscholzia californica ssp. mexicana</em></td>
</tr>
<tr>
<td>Bottlebrush squirrel</td>
<td><em>Elymus elymoides</em></td>
</tr>
<tr>
<td>Desert marigold</td>
<td><em>Baileya multiradiata</em></td>
</tr>
<tr>
<td>False mesquite</td>
<td><em>Calliandra eriophylla</em></td>
</tr>
<tr>
<td>Red threeawn</td>
<td><em>Aristida purpurea var. longiseta</em></td>
</tr>
<tr>
<td>Plains Lovegrass</td>
<td><em>Eragrostis intermedia</em></td>
</tr>
<tr>
<td>Sideoats grama</td>
<td><em>Bouteloua curtipendula</em></td>
</tr>
<tr>
<td>Blue grama</td>
<td><em>Bouteloua gracilis</em></td>
</tr>
<tr>
<td>Arizona cottontop</td>
<td><em>Digitaria californica</em></td>
</tr>
<tr>
<td>Curly mesquite</td>
<td><em>Hilaria belangeri</em></td>
</tr>
<tr>
<td>Green sprangletop</td>
<td><em>Leptochloa dubia</em></td>
</tr>
</tbody>
</table>

Seed will be broadcast seeded onto the stockpile once the stockpile has been completed. A stabilizer in the form of blown straw mulch with tackifier may be used to provide temporary cover while the seed mix is establishing itself. Temporary CMs in the form of berms, wattles, straw bale barriers, or similar barrier devices will be used to provide erosion and sediment control until the seed is established, and will be inspected and maintained until they are no longer required.

3.3.1.2 Open Cover with CMs
Stockpiles that will be in place for less than a year will be managed with no vegetative cover (open cover) on the pile. Stockpiles that are actively being developed will also be managed as open cover, until the stockpiling activities are complete. CMs that will be used while open cover is used are discussed in more detail below.

Run-On Controls. Berms and run-on diversion ditches will be installed on the upslope side of the stockpile to minimize the potential for stormwater run-on to the stockpile location (Figure 8). Reducing run-on will reduce the potential for stormwater to convey sediment from the stockpiles to a waterway, and will also assist in maintaining the quality of the stockpiled soil. Exposure to excessive...
moisture has been shown in studies to contribute to anaerobic conditions, which reduce the nitrogen content in soils, leads to the production of organic acids, and potentially the production of substances toxic to plants. Run-on control design will be consistent with the CMs described in detail in the Project’s SWPPP, as required by the Arizona Department of Environmental Quality's (ADEQ’s) Arizona Pollutant Discharge Elimination System (AZPDES) multi sector general permit for stormwater permit.

**Run Off Controls.** Run-off diversion ditches will also be installed downslope of the soil stockpiles to minimize the potential for soil to be washed from the stockpile to a waterway or otherwise outside of the temporary placement location (Figure 8). Examples of CMs that may be used include, but are not limited to: gravel or earthen berms and weed-free straw bale or wattle barriers. CMs will be selected based on the length of time the stockpile is anticipated to be at the site. CMs will be inspected on a weekly basis until the soil stockpile has been stabilized by vegetation or has otherwise achieved stabilization. Run off control CMs will be consistent in design with the CMs discussed in the Project’s SWPPP.

**Weed Control.** Invasive weeds will be managed in the soil stockpiles prior to placement as reclamation cover, in accordance with the Preliminary Reclamation and Closure Plan for the Barrel Alternative, to minimize the potential for these species to be spread to the reclamation locations.

**Temporary Cover.** It may be necessary to seed stockpiles that will be in place for less than one year with a temporary cover seed mix. The seed mix will vary from that presented in Table 3-2, with an emphasis on fast-growing grasses. A cover crop may be used in place of the native seed mix to stabilize soil and promote microbe growth. Seeding density will be increased as needed to ensure quick and dense vegetation.
Section 4
Soil Placement

Final placement of salvaged soil demands many components necessary for a successful, sustainable remediation effort. The following sections outline key procedures and considerations for a final placement of growth media.

4.1 Soil Placement Phasing
Placement of salvaged soils on the final reclamation site is typically done in a phased approach consisting of three stepwise events. Where possible soil salvage and phased reclamation will occur concurrently until around year 10, at which point all of the suitable soils will have been salvaged.

4.1.1 Initial Facility Development (Year -1)
During mine development activities in Year -1, a portion of the Project site will be available for immediate cover. These locations are primarily within the Plant Site, on slopes surrounding building and infrastructure facilities.

4.1.2 Concurrent Reclamation (Years 1 through 22)
Concurrent reclamation occurs as storage area berm and buttress slopes reach their final inner bench elevations. The primary consideration for concurrent reclamation is to reduce visual impact of the mine and reclaim disturbed areas as soon as possible to minimize erosion and dust. Reclamation schedule and anticipated reclamation areas are shown below in Table 4-1, while reclamation areas are indicated on Figures 4 through 7. The volume provided in Table 4-1 assumes a 12 inch thick cover over all disturbed areas. Table 3-1 above provided the actual estimated soil cover needed based on identified areas of cover for reclamation.

<table>
<thead>
<tr>
<th>Phase/Year</th>
<th>Concurrent Reclamation Surface Area (acres)</th>
<th>Concurrent Reclamation Volume (1) (CY)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Operation(-1)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>114</td>
<td>183,920</td>
</tr>
<tr>
<td>2</td>
<td>169</td>
<td>272,653</td>
</tr>
<tr>
<td>3</td>
<td>259</td>
<td>471,853</td>
</tr>
<tr>
<td>4</td>
<td>75</td>
<td>121,000</td>
</tr>
<tr>
<td>5</td>
<td>93</td>
<td>150,040</td>
</tr>
<tr>
<td>6-10</td>
<td>390</td>
<td>629,200</td>
</tr>
<tr>
<td>11-15</td>
<td>383</td>
<td>617,906</td>
</tr>
<tr>
<td>16-22 (Post Operation)</td>
<td>1990</td>
<td>3,210,533</td>
</tr>
</tbody>
</table>

*Based on a uniform cover thickness of 12 inches throughout the entire reclamation area.*
Table 4.2 below provides a breakout of acreage by year between the various land ownership areas.

### Table 4-2. Reclamation Plan

<table>
<thead>
<tr>
<th>Operational Year</th>
<th>Total Acres Reclaimed</th>
<th>Federal Lands (approx. acres)</th>
<th>State Lands (approx. acres)</th>
<th>Private Lands (approx. acres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Production</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Year 1</td>
<td>114</td>
<td>104</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>Year 2</td>
<td>169</td>
<td>125</td>
<td>10</td>
<td>34</td>
</tr>
<tr>
<td>Year 3</td>
<td>259</td>
<td>224</td>
<td>10</td>
<td>25</td>
</tr>
<tr>
<td>Year 4</td>
<td>75</td>
<td>51</td>
<td>7</td>
<td>17</td>
</tr>
<tr>
<td>Year 5</td>
<td>93</td>
<td>77</td>
<td>5</td>
<td>11</td>
</tr>
<tr>
<td>Years 6-10</td>
<td>390</td>
<td>374</td>
<td>5</td>
<td>11</td>
</tr>
<tr>
<td>Years 11-15</td>
<td>383</td>
<td>374</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>Years 16-22 (closure)</td>
<td>1990</td>
<td>1801</td>
<td>5</td>
<td>184</td>
</tr>
<tr>
<td>Total Area</td>
<td>3473</td>
<td>3130</td>
<td>44</td>
<td>299</td>
</tr>
</tbody>
</table>

To the extent possible, direct placement of salvaged soils on reclaimed areas will be used. In instances where this is not possible, the stockpiled soils will be used, with the most recently salvaged soils used as the top-most layer to maximize soil quality.

Stored stockpiles are moved to reclaimed areas that are in need of salvaged soil in order to enhance vegetative efforts. A phased approach decreases the time and effort involved in a final closure of the mine at cessation of operations.

### 4.1.3 Post-Mine Closure Reclamation

Post-mine closure reclamation is the last step before Rosemont can transition from active operations to a state of monitoring. Areas of development must be able to show increasing or stable vegetative cover working to return the land to a productive state. Intended uses according to the reclamation plan include recreation, ranching, and wildlife habitats.

Areas of the mine that are anticipated to be reclaimed following mining activities (i.e., in year 22) are summarized in Table 4-3.

### Table 4-3. Post-Mining Reclamation Locations (Year 22)

<table>
<thead>
<tr>
<th>Location</th>
<th>Surface Area (acres)</th>
<th>Salvaged Soil Placement Depth (feet)</th>
<th>Salvaged Soil Volume (CY)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perimeter Berm</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Waste Rock Regrade</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Waste Rock Storage - Top and Inside (includes haul roads)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Leach Pad</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Tailings (Buttress)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Tailings Top</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Tailings - Top and Inside</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Process Ponds</td>
<td>27</td>
<td>1</td>
<td>43,560</td>
</tr>
</tbody>
</table>
4.2 Soil Placement Practices

Salvaged soil placement should be conducted in accordance with the practices discussed below, as well as in agreement with the Preliminary Reclamation and Closure Plan for the Barrel Alternative (CDM Smith 2012). This Plan focuses on salvaged soil movement and site preparation needed for successful placement of the salvaged soils. The placement of soil for reclamation cover, including the revegetation procedures, are discussed in the Preliminary Reclamation and Closure Plan in greater detail.

4.2.1 Timing

Salvaged soil will be placed after contouring and grading has been performed at the reclamation site, when the salvaged topsoil can be revegetated in accordance with the Preliminary Reclamation and Closure Plan (CDM Smith 2012) soon after placement.

4.2.2 Seedbed Preparation

Proper stability and seedbed preparation techniques will be implemented to promote vegetative growth. General management techniques provide for cover such as rocks and debris, incorporates pockets, minimizes compaction and limits erosion. Techniques helpful in achieving such goals include:

- **Roughening** – creates microbasins, or safe sites, by using a trackhoe shovel to dig, poke, or push basins to a minimum soil depth. The most common method utilizes the trackhoe to drop soil mounds in randomly overlapping patterns from dugout holes. This not only provides for spreading of vegetation, but provides for water management and erosion control by preventing water from running directly down the hill.

- **Ripping** – used to break up compacted dry soils and contours the area. This technique increase water drainage to the soils and helps moderate erosion. Ripping also creates a rough surface for seed germination and establishment. Ripping along the contour will assist in directing infiltration. This method was evaluated in the Rosemont reclamation test plots.

- **Discing, Cultipacking, Harrowing** – Not recommended for arid climates, as these procedures leave soils ripe for erosion from wind and water.

- **Contour Furrowing** – contour furrows need to be at a grade of less than or equal to 10% but creates a visual scar that may take some time to return to a natural state. Terracing manages erosion in a much more efficient manner and helps in water handling. The terracing concept reduces the steepness of the slope creating sections capable of intercepting run-off with an opportunity for infiltration.

- The Preliminary Reclamation and Closure Plan includes discussion of waste rock reclamation and rock placement on slopes, which would be used in conjunction with the salvaged soil cover techniques.
Section 5

References


SSURGO Soil Data
Map Unit ID Description

BhD  Bernardino-Hathaway association, rolling
CmE  Casto very gravelly sandy loam, 10 to 40 percent slopes
CoE  Chiricahua cobby sandy loam, 10 to 45 percent slopes
CtB  Comoro Soils, 0 to 5 percent slopes
FrF  Faraway-rock outcrop complex, 30 to 60 percent slopes
HaF  Hathaway gravelly sandy loam, 20 to 50 percent slopes
HhE2 Hathaway soils, 1 to 40 percent slopes, eroded
LgF  Lampshire-Graham-Rock outcrop association, steep
McF  Mabray-Chiricahua-Rock outcrop association, steep
Rn  Rock outcrop-Lithic Haplustolls association
TrF  Tortugas-Rock outcrop complex, 25 to 60 percent slopes
WgE  White House gravelly loam, 10 to 35 percent slopes

Topsoil Unit Delineation Depth

< 6" Opportunistic Topsoil
6" Residual Benches
6-12" Southern Aspect
12" Northern Aspect
18" Alluvial Terraces
18-24" Alluvial Wash/Fans
24" Alluvial Wash/Fans
36" Alluvial Wash/Fans

General Site Boundaries (2010)
- Open Pit
- Plant Site
- Storage Area
- 2007 Soil Survey
- 2010 Soil Survey
- SSURGO Soil Data

Rosemont Soil Survey
Preliminary Soil Salvage Management Plan

Figure 2
Pima County, Arizona