11.0 REVEGETATION PLANNING AND SOIL SURVEYS

To facilitate optimal revegetation success, Augusta has begun investigation of appropriate seed mixes and soil types. This initial planning and testing will allow Augusta to determine the suitability and availability of plant materials and growth medium over the life of the Project. It will also allow the assessment of other factors affecting the revegetation plan, such as wildlife habitat requirements. The following sections provide more detail on these studies.

11.1 University of Arizona Testing Program

In April 2007, Augusta Resource signed a contract with the University of Arizona's School of Natural Resources to perform greenhouse plant testing as well as to perform on-site test plots. The target of the Rosemont mine reclamation effort is to prevent soil loss from the site, reclaim its capacity for productive use, and return the site to a higher functioning plant community. The uplands in the prospective site of the Rosemont mine are not currently at their highest potential as a plant community. The most visible evidence of a degraded plant community is the substantial cover of Alligator or One-seed Juniper and Velvet or Honey Mesquite. These trees, while being native species, encroach upon sites that have had a lower than normal fire frequency combined with historical overgrazing by cattle. Once the canopy cover of these species gets above about 25%, soil erosion and soil loss often becomes a serious issue and the overall site becomes unstable. The proposed seed mixes should reclaim the site to a condition more like its ideal plant community.

11.1.1 Prospective Seed Mixes

Twenty-nine species (four overlapping mixes of eleven species each) were chosen for the greenhouse evaluation. All selected species are natives and represent the highest condition native plant communities across the range of conditions expected on the site. The species chosen for testing represent a range of functional types of plants including: warm-season perennial grasses, cool-season perennial grasses, annual grasses, perennial forbs (broadleaved flowering plants), annual forbs, and shrubs. This array of plants maximizes the ability to select a successful mix at the end of the greenhouse testing but also will allow the final mix to have all the components of a resilient and productive system. All species chosen for inclusion are currently available from large-scale commercial seed vendors.

11.1.2 Rainfall Scenarios

Three rainfall scenarios were chosen based on an evaluation of storm-by-storm rainfall data from two rain gauges near the site. The average scenario was an average rainfall year rather than the average daily rainfall over the 31-year period. Having a sufficiently large storm size and appropriate interval between storms is critical for plant germination and establishment. Similarly, the low rainfall scenario is a characteristic low rainfall year from center of the range encompassing the bottom 20% of total rainfall years. The high rainfall scenario is a high rainfall year from center of the range encompassing the top 20% of rainfall years. For this Project, the monsoon was considered to last from the beginning of July to the end of September or a little more than 90 days. Once the monsoon season trial is complete, the plants will not be given water again for at least two months before the start of the winter season growth period. This will mimic the normal dry period between seasons. The winter season was considered to be from the beginning of December to the end of March or a little more than 120 days.

11.1.3 Soil/Surface Amendments

The amendments chosen for evaluation are tackified straw and tackified straw combined with slow-release fertilizer. Tackified straw, straw that has been glued or tackified onto a field site, is

a popular amendment for regional reclamation efforts and ameliorates some of the harsh surface conditions common to the site. The second amendment, slow-release fertilizer, will provide a temporary source of nutrients in the surface soil where the plants will be establishing.

11.1.4 Greenhouse Testing

During June 2007, approximately 5 cubic yards of three different soil types including Gila Conglomerate, Glance Limestone Conglomerate, and Willow Canyon Formation (Arkose) were delivered to the University Greenhouses near Prince and Campbell. In addition, approximately 390 pounds of tailings material derived from metallurgical testing was also delivered. Each soil type, as well as the tailings mixed with the other materials, will be used for the greenhouse pot tests. These material types were chosen to give an understanding of the growth potential for the on-site soils, etc.

11.1.5 Test Plots

In addition to the greenhouse study, on-site test plots are planned to verify the greenhouse findings. Test plots will commence on private property at the Rosemont site. This portion of the work may run concurrently with the greenhouse tests once sufficient information has been derived from the pot studies.

11.2 Soil Survey Results

In March 2007, Tetra Tech completed a soil resources assessment at the Rosemont site with the objectives of describing the soil profiles or pedons, documenting soil characteristics including 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).

11.2.1 Suitable Soil Areas

Six soil pedon units and eight borrow depths were identified as a result of the study. The location of these soil pedon units are shown on maps provided in the soil investigation reports.

Northern Aspect – 12 inches

North aspect soils located in the southern potion of the survey area are formed from colluvium and slope wash-alluvium. The geologic parent material of this area is of 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 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 – 6-12 inches

South aspect soils located in the southern portion of the survey area are formed from colluvium and slope wash-alluvium. The geology of this area is also the Gila Conglomerate. These soils have approximately 6 inches of suitable soil for salvage with occasional deeper deposits in concave physiographic positions. The texture of these soils are sandy loam to coarse sandy loam with coarse fragment content on the surface ranges from 50 to 75% and coarse fragment content in the soil ranges 20 to 40% gravel and 0 to 5% cobbles. Slopes occurring in these areas range from 20 to 40 degrees. Vegetation cover is primarily forbes, cactus, and grasses.

Alluvial Wash/Fans – 24-25 inches

Alluvial washes are located in drainage bottoms throughout the Project area. These soils are deep with borrow depths ranging from 24 to 45 inches and with textures of loamy sand to sandy loams. Coarse fragment content ranges from 15 to 45% consisting primarily of small gravels. 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 site.

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 aspect and grazing pressure but is generally good.

Alluvial Terraces – 18 inches

Alluvial terraces are fairly limited and located in the western portion of the study 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. Vegetative production is good and is primarily comprised of grasses.

Residual Benches – 12 inches

These map units 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.

Shallow to Bedrock – <6 inches

The shallow bedrock unit is located in the center and northern portions of the Project area. The major geologic formations include the Willow Canyon, an arkosic to tuffaceous siltstone, sandstone, and conglomerate; the Apache Canyon, a shale and laminated siltstone; and the Mount Fagan Rhyolite, an ash flow tuff. Soil depths range from very shallow to 5 inches on slopes, to deep 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 throughout the majority of these areas. This material is the initial pedogenesis zone and is generally not considered during soil salvage determinations. However since the current vegetation cover primarily includes forbes, cactus, and grasses, this indicates that the shallow bedrock unit is actively serving as a growth media. Revegetation success has been observed within the proposed pit area where weathered bedrock material has been used for reclamation of exploration sites.

The primary physical properties limiting salvage include high clay content and high coarse fragment content. Soils on the ridge tops, especially derived from the Willow Canyon formation in the northwest Project area, have high concentrations in the subsoil that may warrant special consideration for reclamation planning. High percentages of coarse fragments are generally common throughout the Project area. The primary chemical property limiting salvage is nutrient content. Nutrient content is variable throughout the survey area.

11.2.2 Estimated Soil Salvage Areas and Volumes

The estimated soil salvage areas and volumes in the dry tailings, waste rock storage, and operations areas of the Rosemont Mine are based on the suitable soil pedons identified above. The total estimated volume of salvage soil in the prospective operational areas is approximately 4,583,000 cubic yards.

Underlying the salvageable soil throughout the site, and specifically underlying the above operational areas, is a substantial amount of unconsolidated and weathered bedrock. The volume of these areas was estimated using a minimum depth of 4 feet. The estimated volume of unconsolidated and weathered bedrock is 17,230,000 cubic yards. The University of Arizona studies described in Section 11.1 will be used to determine the suitability of these deeper subgrade materials as growth media.

11.3 Other Revegetation Issues

Biological surveys have identified one or more species of nectar-feeding bats and two species of Forest Service-sensitive butterfly species inhabiting the Project area (see WestLand Resources, Inc. "*Biological Resources and Mitigation Concept"* Prepared for Augusta Resource Corporation, August 2007). The bats and butterflies are dependent on agaves for a food source. To the extent that seeds for agave are available, they will be included in the reclamation plan plant mix. In addition, transplanting agaves will be investigated to determine appropriate techniques and procedures and the feasibility of transplanting.