3.3 Soils and Watershed

The study area for direct and indirect impacts to soils and watershed includes the proposed POO expansion areas. The CESA for soils and watershed is defined as the Buffalo Valley Hydrographic Basin (**Figure 3.3-1**).

3.3.1 Affected Environment

Baseline soil data for the study area are based on information provided in the Phoenix Project Final EIS (BLM 2002a). The Soil Survey Geographic National Resources Conservation Service [NRCS] 2006) (formally U.S. Soil Conservation Service) database review and analyses also were used to characterize the soils in the study area.

3.3.1.1 Soils

The study area lies within the Great Basin Section of the Basin and Range Province of the Intermountain Plateaus (NRCS 2006). Soils within the study area were developed on lower mountain slopes and hills, including alluvial fans, pediments, terraces, and basin floors. The dominant soil orders in this area are Aridisols, Inceptisols, and Entisols.

The soils in the study area are highly varied and range in depth from shallow (i.e., less than 20 inches) to very deep (i.e., greater than 60 inches). The shallow soils lie to the north of the study area with soils becoming deeper to the south and in drainages. Soil variability within the study area results from residual and transported parent materials subsequently influenced by topography, climate, vegetation, and weathering rates.

The occurrence of soil types within the study area previously was described in the Phoenix Project Final EIS (BLM 2002a) and are shown in **Figure 3.3-2**. Selected soil characteristics that affect the suitability of the dominant soils for use as growth media for reclamation are presented in **Table 3.3-1**.

Table 3.3-1 Soil Characteristics

Map Unit Symbol	Map Unit Name (allow 15 to 20% inclusions)	Reaction (pH)	Available Water Capacity (inches)	Depth to Bedrock or Hardpan (inches)	Water Erosion Hazard	Wind Erosion Hazard	Slope %
Soil Types Associated with Newly Proposed Disturbance Areas							
413	Golconda-Blownout land complex	8.2	0-0.2	20-40	Slight	Moderate	2-25
835	Reese-Ocala association	9.0-9.2	0.15- 0.21	>60	Slight-moderate	Moderate	0-2
1144	Wendane-Batan-Broyles association	8.6-9.6	0.09-0.21	>60	Moderate	Moderate	0-2
Soil Types Associated with Currently Permitted Disturbance Areas							
1342[1]	Doowak-Cobbly Doowak-Veta association	6.6-8.4	0.03-0.13	>60	Slight	Moderate	0-2

[1] Occurs on approximately 1 acre within the proposed areas of disturbance.

Sources: BLM 2002a; NRCS 2006.

Soils in the study area were evaluated for reclamation suitability on the basis of chemical and physical soil properties, as determined by the NRCS. Threshold values for assessing the suitability of material for plant growth media were based on the following physical and chemical parameters (the criterion limitations are described in parentheses following this criterion):

- Sodium adsorption ratio greater than 13 (excess sodium);
- Electrical conductivity greater than 4 millimhos per centimeter (excess salt);
- pH greater than 8.5 (too basic) or less than 6.0 (too acidic);
- Soil texture: clay, silty clay, sandy clay (too clayey); or sand, fine sand, very fine sand (too sandy);
- Coarse fragments (rock fragments greater than 2 mm in size) greater than 50 percent by weight, depending on size (excess small stones, large stones);
- Depth to rock or hardpan less than 20 inches (shallow depth to rock, cemented pan); and
- Erosion hazard for water or wind: severe (erosion hazard).

Table 3.3-2 identifies depths of potentially salvageable growth media, as well as limitations to reclamation for each soil unit. The majority of the soils have excess salts and sodium either at the surface or subsurface. Map Unit 1342 has excess rock fragments and is droughty.

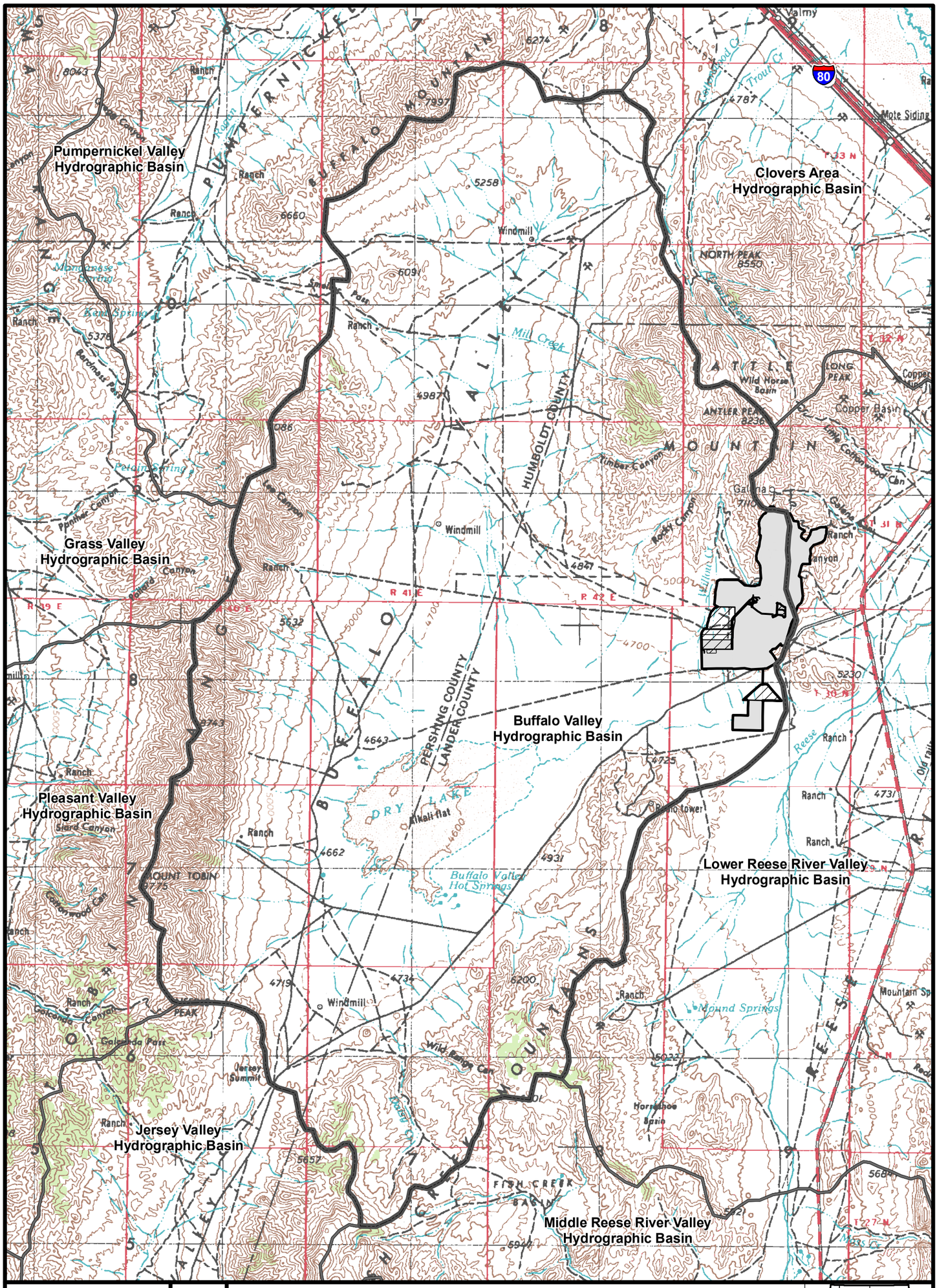
Soils at higher elevations in the northern and central mountainous portion of the Phoenix Mine were described in the previous analysis for the Phoenix Project Final EIS (BLM 2002a).

Map Unit 413 occurs on fan piedmonts and piedmont slopes in relative proximity to the base of the mountains. The soils are forming in alluvium from mixed rock sources on slopes typically ranging from 2 to 8 percent. They are typically deep and well drained to somewhat excessively drained, and the soil materials vary widely in their ability to hold water available for plant growth. Map units 413, 1042, and 1283 are indurated or have a cemented hardpan at depths starting at approximately 18 inches, which restricts plant growth. Soil textures are highly variable in these units, ranging from clay to extremely gravelly, sandy loams, and sands. Coarse fragment contents typically range from 0 to 30 percent.

Soils overlying fan landforms, such as Map Unit 1144, typically occur on fan piedmonts, skirts, and slopes, as well as associated alluvial flats at slopes less than 8 percent. These soils are all 60 or more inches deep, although indurate hardpans may occur within this depth increment. Parent materials consist primarily of alluvium and mixed rock sources overlain or influenced by loess. Revegetation limitations include excess salt, sodium, and rooting depth. The hazards for both wind and water are rated as slight for all dominant soil series.

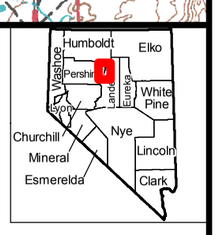
Floodplains associated with the Reese River and an unnamed tributary to Willow Creek in the southern portion of the CESA are overlain by Map Unit 835. Parent material consists of alluvium from volcanic rocks, which is influenced by volcanic ash away from active riparian channels. These soils are typically deep, strongly alkaline, and moderately to strongly saline and sodic and occur on level to nearly level landforms. Both soils are typified by silt loam surface textures and silt loam to silty clay loam subsurface textures.

The main limitations to revegetation of floodplain soils are high pH, salinity, and sodicity. The Reese soil is subject to occasional flooding. The hazards for wind and water are rated as slight for both of these soils.



Legend

- Soils and Watershed CESA
- Proposed POO Boundary
- Proposed Action
- Proposed Action Linear Feature
- Permitted Disturbance
- Hydrographic Basin Boundary



N

0 2.5 5 Miles

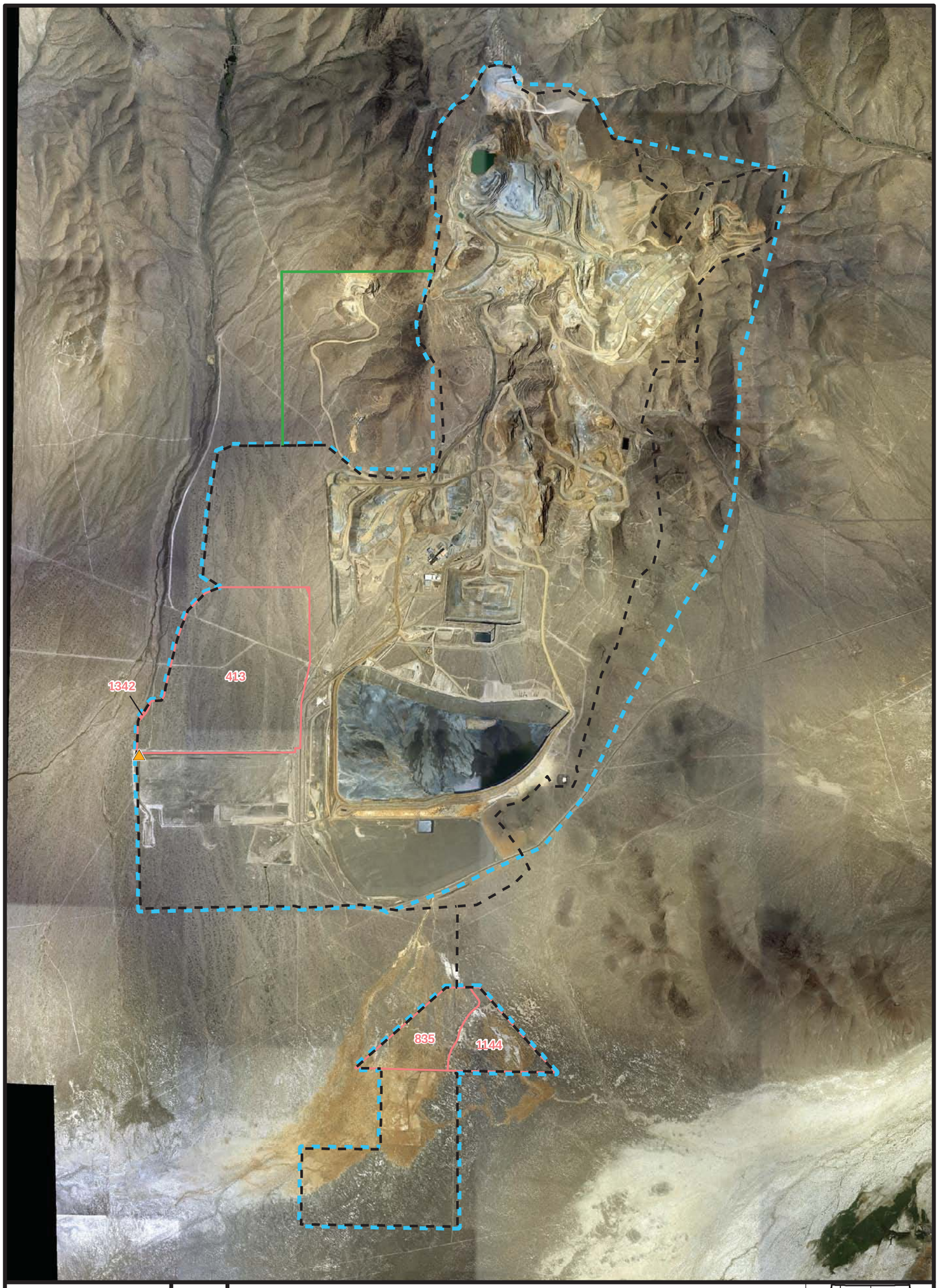
Note: In addition to the Buffalo Valley Hydrographic Basin, the Soils and Watershed CESA also encompasses the currently authorized Phoenix Mine POO boundary in its entirety.

Source: BLM 2008e.

Figure 3.3-1
Soils and Watershed CESA

Phoenix Copper Leach Project

06/29/2011

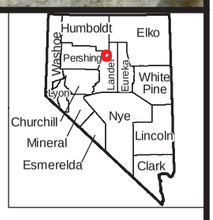


Legend

- Proposed POO Boundary
- Reona POO Fenceline
- NRCS Soil Map Units
- Proposed Production Well

NRCS Map Units

413 - Golconda-Blownout Land Complex
835 - Reese-Ocala Association
1144 - Wendane-Batan-Broyles Association
1342 - Doowak-Cobbly Doowak Veta Association



N

0 0.5 1 Miles

Source: NRCS 2006.

Phoenix Copper Leach Project

Figure 3.3-2
NRCS Soils Map Units in the Project Area

08/23/2011

Table 3.3-2 Salvageable Soil Characteristics – Reconnaissance-level Mapping Units

Mapping Unit	Soil Component	% of Unit	Potential Salvage Depth (inches)[1]	Suitability Limitations within Potential Salvage Depth	Limits to Deeper Salvage on Overall Unit
Soil Types Associated with the Proposed Expansion Area					
413	Golconda	60	8	Small stones	Excess salt, excess sodium, cemented pan
	Blownout land	25	0	---	
	Inclusions	15	6	---	
835	Reese	45	0	---	Excess salt, excess sodium
	Ocala	40	0	---	
	Inclusions	15	0	---	
Mapping Unit	**Soil Component**	**Percent of Unit**	**Potential Salvage Depth (inches)[1]**	**Suitability Limitations within Potential Salvage Depth**	**Limits to Deeper Salvage on Overall Unit**
1144	Wendane	30	0	---	Excess salt, excess sodium
	Batan	30	0	---	
	Broyles	25	0	---	
	Inclusions	15	0	---	
Soil Types Associated with Currently Permitted Disturbance Areas					
1342[2]	Doowak	30	0	---	Excess rock fragments, too sandy
	Cobbly-Doowak	30	0	---	
	Veta	30	0	---	

[1] Inclusions were given a nominal 6-inch salvage depth potential if they appeared to be salvageable based on the brief descriptions in the NRCS soil survey. Further information to refine this is not available.

[2] Occurs on approximately 1 acre within the proposed areas of disturbance.

Sources: BLM 2002a; NRCS 2006.

3.3.1.2 Watershed

Buffalo Valley Hydrographic Basin is an enclosed administrative basin (Hydrographic Area 131) within Hydrographic Basin 10, Nevada's Central Region (NDWR 2008). This basin encompasses approximately 504 square miles of terrain, ranging from mountains and hillslopes to alluvial fans and playas. The existence of perennial or intermittent channels in the basin is limited to higher elevation mountain areas. Surface flows typically are lost to infiltration or ET as they approach the valley. Buffalo Valley is a closed evaporite basin, where evaporation characteristically exceeds inflow, creating a saline/alkaline environment.

3.3.2 Environmental Consequences

Primary issues associated with soil resources include the: 1) loss of soil productivity or productive post-mining land uses; and 2) physical and chemical stability of the reclaimed landscape and project components.

Environmental impacts to soil resources would be significant if the Proposed Action or alternatives to the Proposed Action result in any of the following:

- Accelerated erosion in excess of soil loss tolerances on HLFs or other sloping surfaces;
- Compromised public safety through mass instabilities on slopes or fills, or inadequate draindown and closure procedures;
- Loss of growth media during stockpiling or reclamation that would limit revegetation success;
- Substantial decrease in the amount of overall site productivity from pre-mining to post-mining land uses; or
- Lack of concurrent reclamation that promotes unnecessary resource degradation during the active processing period or fosters delays in determining appropriate post-mining reclamation approaches.

3.3.2.1 Proposed Action

Soils and Reclamation

Implementation of the Proposed Action would result in the disturbance and loss of native soil profiles and related productivity on approximately 902 acres of proposed new surface disturbance, including 200 acres for the Phoenix Copper HLF, 398 acres for the proposed Section 5 OUA, 254 acres for the proposed Section 15/16 Borrow Area, and 50 acres for the proposed haul road and utility corridor.

Most of the soils within the study area are coarse-textured and rocky, and several are affected by saline and alkaline conditions as discussed in Section 3.3.1. Native soil materials would be salvaged, to the extent possible, and used in site reclamation when their characteristics are suitable for adapted plant growth and where they could be safely salvaged. Replacement of growth media is proposed for major disturbances associated with the Proposed Action. The recommended salvage depth for native soil material is presented in **Table 3.3-2**.

The Phoenix Copper HLF, Section 5 OUA, and haul roads and utility corridor is proposed where the Golconda-Blownout land complex occurs. According to the NRCS soil survey data, the Golconda series is moderately deep to a cemented hardpan. Test pits investigated by AMEC for Newmont (AMEC 2010) suggest that a cemented layer occurs at approximately 30 inches in depth at 2 sites in the southern portion of the Section 5, T30N, R43E, and may not be present consistently across the site. Where the cemented hardpan does occur, soils would be expected to be strongly saline and sodic in the horizon directly above the cemented layer. Soils below the cemented layer would typically be too gravelly and dry for use as growth media.

Much of the disturbance acreage associated with the proposed Section 15/16 Borrow Area would occur where the Reese-Ocala association and Wendane-Batan-Broyles association occur. These soils are very deep and occur on flat to gentle slopes. All of these soils have saline-sodic properties and clayey subsoils.

Soils subject to water erosion include steeply sloping land with shallow soils. Highly wind-erodible soils are associated with sandy and silty textured, sparsely vegetated soils. Although accelerated erosion due to project-related soil disturbance could occur at any stage of the project, the maximum potential for erosion within the study area would be expected when soils are salvaged and while soils are loose, with no established cover. Erosion also would be of concern after reclamation work has occurred but before a vegetative cover has been re-established. As discussed in Section 2.4, Reclamation, Newmont would implement concurrent reclamation to the extent possible, and install surface water and erosion controls, where needed, to minimize soil loss and erosion. As a result, significant impacts related to soil loss and erosion are not anticipated.

Soil contamination could result from material spills during project activities. If a large spill occurs, it could result in the removal and disposal of large amounts of soil. Saturated soils may have the potential to diffuse contaminants. To minimize potential spill-related effects to soils, Newmont would implement its Phoenix Mine Emergency Response Plan as discussed in Section 2.3.10.9, Spill Prevention and Emergency Response.

Compaction from vehicular traffic would occur within the utility and road corridors, decreasing soil quality in those areas. Soil that is excessively compacted is limited in its ability to function. Compaction damages soil structure and reduces pore space, which impedes the movement of air and water to plant roots and can result in lower growth rates and hinder revegetation. Compaction reduces infiltration and results in excessive surface runoff, erosion, nutrient loss, and potential water-quality effects. To minimize soil compaction-related effects on reclamation success, roadways and other compacted areas would be ripped prior to reclamation for effective establishment of vegetation as discussed in Section 2.4, Reclamation.

Overall site productivity is primarily a vegetation measure. Productivity varies by vegetation community, but more importantly, with land management objectives as they relate to desirable or productive vegetation types. In contrast, soil quality is an inherent soil resource characteristic involving aeration, permeability, texture, salinity and alkalinity, microbial populations, fertility, and other physical and chemical characteristics that are accepted as beneficial to overall plant growth and establishment. Based on this concept, there would be impacts to the existing quality of native soils from project-related disturbance. Growth media excavation, transport and storage, and redistribution would modify existing soil structure, generating adverse impacts relative to aeration, permeability, and microbial action.

Saline-sodic soils occur commonly throughout the study area. Physical and chemical properties such as high sodium content, high alkalinity, low organic matter, high salinity, rock fragments, high carbonates, and high sand or clay content have a negative effect on soil productivity. It is likely that some mixing of textural zones would occur, as well as mixing of saline and alkaline materials with relatively salt-free materials. This may create adverse chemical impacts to soil quality for seedbeds. Whatever microbial populations currently exist likely would decrease during growth media stockpiling and storage. Due to these probable effects, the initial soil quality of reconstructed seedbeds and root zones would be less than that of the existing soil resources.

Over time, these impacts would be reduced based on Newmont's commitment to reclaim project components and successfully restore productive post-mining land uses (see Section 2.4, Reclamation). These objectives would be attained through the use of BMPs, as well as the use of site-adapted plant species for reseeding. Newmont has committed to seeding with a saline and sodium tolerant seed mixture for reclamation of project disturbances. The proposed seed mixture provides native species well adapted to the soils and are anticipated to successfully stabilize the disturbance area and provide a self-sustaining and diverse native plant community. In addition, state and federal reclamation requirements require revegetation monitoring in comparison with established quantitative standards for the locale. A period of overall reclamation monitoring (and maintenance as necessary) also is required by the BLM and State of Nevada. Based on these requirements, it is likely that decreases in soil quality would not limit the attainment of overall post-mining land use objectives. Over time, soil quality on reclaimed and revegetated sites would resemble pre-mining conditions. Significant effects on the desired post-mining site productivity from soil quality impacts are not anticipated. Implementation of the project's Reclamation Plan would mitigate the loss of native soils and create productive post-mining land uses, primarily grazing and wildlife habitat.

Newmont would rely on alluvium obtained from the proposed Section 5 OUA and existing South OUA for reclamation growth media. As described in the Reclamation Plan, the OUAs are capable of providing up to 9,476,692 cubic yards of alluvium for reclamation capping purposes. The successful use of the alluvial material in the reclamation program would be dependent on its ability to support the establishment and long-term productivity of desirable revegetated plant species.

The proposed Section 5 OUA would be located on the Golconda-Blownout land complex. The Golconda series can be moderately deep to a cemented hardpan at approximately 23 inches. Exchangeable sodium percent is high, from 10 to 23 inches. Based on the NRCS (2006) soil survey information, these materials are not considered suitable for growth media due to the high levels of sodium and salts; however, the reclamation seed mix consists of native plant species that are well suited to the soil characteristics found in the project area.

Newmont has successfully closed its Copper Basin facility that is located approximately 7 miles north of the proposed project. Similar revegetation practices that were successful at Copper Basin and facilities at the Phoenix Project would be implemented for the closure of the proposed facilities.

Watershed

Proposed Operations

The proposed disturbance area would occur on a system of coalescing alluvial fans occurring within Buffalo Valley, an enclosed administrative basin (Hydrographic Area 131) within Hydrographic Basin 10 of Nevada's Central Region (NDWR 2008). Examination of the proposed project configuration indicates that little or no obstruction of existing alluvial fan drainages would occur from the placement of proposed facilities. Project-related disturbance activities would affect approximately 0.3 percent of this watershed.

Storm water runoff from the proposed project site and components would be controlled in accordance with state and federal regulations pertaining to storm water management and pollution prevention. The project would be operated as a zero-discharge facility, as defined through the WPCP review and approval process by the NDEP.

Post-mining Conditions

Post-mining recontouring, reclamation, enhancement of drainage features, and long-term access restrictions would facilitate stabilization of the mine site. After proposed operations cease, reclamation and closure plans would be implemented, in accordance with permit requirements. The reclaimed configuration of the project area is discussed in Section 2.4, Reclamation. Many features of the reclamation plan and the associated regulatory program address potential long-term watershed issues. With respect to watershed considerations, the reclamation plan developed by Newmont addresses recontouring and slope stability, restoration of surface drainage, growth media restoration and revegetation, reclamation of road features and ponds, and measures to minimize sediment contributions to surface waters. Heap leach components would be stabilized, and then recontoured and revegetated.

After the cessation of operations, the successful implementation of the proposed reclamation plan would mitigate watershed impacts over the long term. No significant impacts to existing watershed conditions would be anticipated.

3.3.2.2 Reona Copper Heap Leach Facility Elimination Alternative

The Reona Copper HLF Elimination Alternative would be similar to the Proposed Action, except that the proposed Reona Copper HLF and associated infrastructure (i.e., solution pipelines) would not be developed. The Reona HLF (Gold) would continue to operate under the current permitted authorizations. All other direct and indirect impacts associated with this alternative would be the same as the Proposed Action.

3.3.2.3 No Action Alternative

Under the No Action Alternative, the proposed project would not be developed and associated impacts to soil and watershed resources would not occur. The existing Phoenix Project would continue to operate under existing authorizations. Potential impacts to soils and watershed resources previously were discussed and analyzed in the Phoenix Project Final EIS (BLM 2002a).

3.3.3 Cumulative Impacts

The CESA for soils and watershed resources is shown in **Figure 3.3-1**. Past and present actions and RFFAs are identified in **Table 2.8-1**; their locations are shown in **Figure 2.8-1**.

Past and present actions and RFFAs within the CESA have resulted, or would result, in approximately 21,974 acres of soil disturbance, of which approximately 11,354 acres have been related to mining activities, approximately 490 acres have been related to exploratory projects, and 10,130 acres have been related to utilities/community actions (e.g., transmission lines, interstate highways, secondary roads, landfills). The Proposed Action incrementally would increase soil disturbance by an additional 902 acres, resulting in a total cumulative disturbance to soils of approximately 22,876 acres. It is assumed that portions of past disturbances have been reclaimed, and ongoing reclamation at existing operations would continue to reduce impacts to soils. The incremental addition of soil impacts as a result of the Proposed Action would be short-term in nature, pending completion of successful reclamation of all the proposed disturbance. Based on permitting requirements relative to reclamation, it is assumed that the majority of the soil disturbance and associated impacts as a result of future operations also would be reclaimed and, therefore, short-term.

The Buffalo Valley (Nevada Hydrographic Area 131) is characterized by mountain ranges running north to south with extensive alluvial fan sediments and valley floor deposits. Buffalo Valley is a closed evaporite basin, where evaporation characteristically exceeds inflow. The Battle Mountain Complex (Phoenix Mine) is located such that the surface water and sediments drain to Buffalo Valley. Surface runoff is typically lost to seepage and ET on the extensive downgradient alluvial fan system. The proposed project would be operated as a zero discharge facility and although considerable mining disturbances have occurred in Buffalo Valley, the additional disturbance from the Proposed Action is not expected to contribute to adverse cumulative impacts related to watershed yield, erosion, and sedimentation.

3.3.4 Monitoring and Mitigation Measures

Issue: Soils in the proposed disturbance and borrow areas are high in salts and sodium. Newmont proposes to utilize seedbed amendments for reclamation of the heap leach pads where pH, nitrogen, phosphorous, or potassium levels are low. Amendments such as inorganic fertilizers and livestock waste are often high in salts. Livestock waste also may have weed seed.

Monitoring and Mitigation Measure SW1: Prior to reclamation and reseeding, Newmont would perform soil testing for the above identified parameters. Where pH, nitrogen, phosphorous, or potassium levels are low compared to the soil survey, soil amendments would be applied in consultation with the BLM.

Where soil nutrient levels are low, any amendments utilized also must be low in salt. Livestock waste will not be used due to high levels of salt and possible weed seed introduction.

Effectiveness: Where nutrient levels are poor, the use of fertilizers low in salt would promote reclamation efforts. In addition, the avoidance of livestock waste would reduce the spread of noxious weed species and the introduction of additional salts to already saline soils.

3.3.5 Residual Adverse Effects

No residual adverse effects to soil resources are anticipated as a result of the Proposed Action with implementation of the reclamation plan and the recommended mitigation measure.