Revegetation Plan
Permanente Quarry

SANTA CLARA COUNTY
CALIFORNIA

Prepared For:

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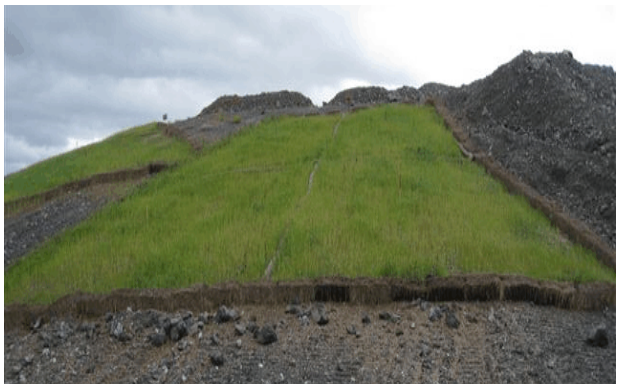

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Executive Summary

This Revegetation Plan (Plan) describes the revegetation program for the Permanente Quarry's proposed Reclamation Plan Amendment. This Plan provides specific guidance on soil composition and depth, species planting palette, and revegetation success criteria. The Plan is based on site specific analysis and testing, augmented by the results of on-going test plot monitoring, and current and future revegetation results, to optimize revegetation success. This Plan provides for the following revegetation strategies:

- Oak plantings totaling 6.5 acres and over 1,700 trees
- Grey Pine woodland plantings totaling 21.7 acres and over 8,600 trees
- Native shrub and grassland hydroseed mix applied over approximately 637 acres
- Riparian plantings in various areas
- Revegetation using seed collected from onsite
- Use of interim erosion control native seed mixes
- Revegetation with a blend of topsoil material and other native materials available on-site
- Information derived from results of 16 test plots established in two distinct areas in Fall 2008
- Performance standards for revegetation
- Monitoring, maintenance and invasive weed controls

Utilizing these strategies, the Plan is designed to reclaim disturbed lands to native habitats similar to surrounding natural areas. South- and west-facing slopes which are warmer and drier are designed to be scrub and chaparral habitats, while north- and east-facing slopes which are cooler and moister are designed to support woodlands. The different planting areas were determined using a solar radiation analysis of reclaimed slope contours. Sloped areas and south-facing benches will be hydroseeded with native shrub and herb seeds and will grow into scrub and chaparral habitat. Flat areas with less intense solar radiation will be planted with container shrubs and trees and will grow into woodlands. North-facing benches will be planted with an oak-woodland species assemblage. East facing benches will be planted with 25% oak woodland species and 75% native grey pine, which can tolerate the harsher solar exposures for such areas and create microhabitats that will allow more successful establishment of oak woodland over time. Eventually these areas will develop into mixed oak woodland habitat that will blend in with the surrounding environment and provide habitat for a variety of wildlife species. The majority of seed used for the revegetation effort has been collected onsite and contract grown in commercial gardens to generate large amounts seed and plant stock that have adapted to local conditions.

These strategies are supported by a soil development plan and a detailed test plot program. The ongoing test plot program is generating useful data every year and will continue to provide useful information regarding the optimal species blends and planting methods. Additionally, the soil development plan and test plot program are designed to develop blends of natural topsoil

with overburden and other materials available onsite that will enhance the amount of growth media available for revegetation purposes, as necessary to ultimately achieve revegetative success. A test plot program is underway that tests the various soil blends, four hydroseed mixes, and container shrub and tree plantings. The first two years of monitoring data were used to adjust species selection and soil treatments and are reported herein. Test plot monitoring will continue for a total of five years and the results will be applied to the revegetation effort.

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1.0 INTRODUCTION

This Revegetation Plan has been prepared at the request of Lehigh Southwest Cement Company (Lehigh) for the Permanente Quarry (Quarry). This plan provides recommendations for revegetation of 637 acres of an approximately 1,238-acre Reclamation Plan Area (RPA). The RPA and boundaries of the larger 3,510-acre Quarry property are shown in Figure 1. The recommendations in this Plan are intended to comply with the requirements of the California Surface Mining and Reclamation Act (SMARA), Public Resources Code section 2710 et seq., and SMARA's reclamation standards at Code of Regulations, Title 14, section 3705 et seq. (Reclamation Standards).

Reclamation of the RPA will occur within the disturbed areas shown in Figure 1. The RPA is divided into distinct Project Area units that include the West Materials Storage Area (WMSA), East Material Storage Area (EMSA), North Quarry, Rock Plant, Surge Pile, and an area that houses crusher equipment and Quarry offices. Engineered swales will be created on the interior edges of benches to collect and direct stormwater. Reclamation of the RPA will include revegetation of disturbed ground, except for active roads and adjacent drainage swales, with native species following the guidance set forth in the Reclamation Standards. Reclamation will occur in phases with progressive revegetation of areas as the planned landforms are graded to final contour.

Revegetation is also proposed for the Permanente Creek Reclamation Area (PCRA) to further stabilize hillside soils against long-term erosion by expanding and enhancing plant communities. The types of vegetation proposed in the PCRA have been selected for their erosion control characteristics, and because they are either already present in the PCRA (indicating that they are well suited to the climate and soil conditions in these locations) or have been demonstrated as suitable through the test plot program. Revegetation will, as in other areas, emphasize plant materials capable of self-regeneration without continued dependence on irrigation, soil amendments or fertilizer.

This Plan also extends to the reclamation of areas disturbed by mineral exploration activities in locations to the south of Permanente Creek, known as the Exploration Area. Revegetation has already commenced in the majority of this area. The remaining areas have been winterized and will undergo revegetation during Phase 1 of the reclamation. This document discusses the revegetation techniques used there and the success criteria for those areas.

This Revegetation Plan includes a description of the following:

- Goals of the revegetation program;
- Site characteristics that influence revegetation;
- Test plot program (constructed in 2008) and preliminary results;
- Proposed soil development and planting methods; and
- Performance standards.

Appendix A provides representative photographs of previous successful revegetation sites at the Quarry and of the test plot construction. Appendix B lists potential suitable native plant species for revegetation of the RPA. Appendix C includes soil test reports from Soil and Plant Lab, Inc. Appendix D includes Figures 1-8 as referenced in this Revegetation Plan. Appendix E provides erosion control installation schematics and willow planting details. And Appendix F includes a conceptual approach and design for restoring two reaches of Permanente Creek based on the URS (2011) creek restoration.

1.1 Revegetation Goals and Objectives

The ultimate goal for revegetation efforts in the RPA is restoration of native vegetation types to blend into the surrounding landscape. This refers to the reclamation of disturbed lands to a self-sustaining community of native species as described in the Reclamation Standards. Revegetation will be sufficient to stabilize the surface against the effects of long-term erosion and is designed to meet the post-extractive land use goals of the RPA. Interim erosion control planting may be used to provide temporary protection for disturbed areas until such time that they may be reclaimed to the approved end use.

The planned end use for the RPA is open space. As a result, revegetation should visually integrate with the surrounding open space areas and provide for permanent soil protection. The surrounding areas include north-facing slopes with scrub and woodland communities and scattered high meadows, and dry south-facing slopes vegetated with chaparral and scrub species.

The objective of RPA revegetation for north-facing slopes is to establish shrub and herbaceous species present in adjacent undisturbed communities, with “islands” of shrub and tree plantings on the benches that eventually will contribute to the regeneration of scrub, woodland, and forest. Shrub cover on north-facing slopes should provide shade and appropriate successional growing conditions for natural recruitment of tree species in the future. Since oak tree establishment is difficult and oak trees are slow growing, native grey pine will be planted in some more visible bench areas with greater solar radiation exposure; these visible bench areas also favor grey pine as a hardier and faster-growing species due to solar exposure that is not optimal for oak tree establishment outside of a mature canopy. Over time, the grey pine will provide shade and protection that will improve oak tree establishment and create a more successful oak woodland habitat.

For south-facing RPA slopes, the objective of revegetation is to mimic the scrub communities present on south-facing slopes in the adjacent open space areas by seeding with native shrubs and grasses that will eventually contribute to the establishment of scrub communities. Small portions of the RPA will include constructing channels that connect ephemeral drainages with receiving waters. These areas may be reclaimed using native riparian species where channel hydrology can support these species.

The results from the ongoing test plot program will be used to improve the phased reclamation of the quarry. Results of annual monitoring of the test plots will provide useful information on species survivorship, natural recruitment success, and soil blend and depth preferences. Additional revegetation components such as benefits of mulch around container plants and the need for herbivory control will also be assessed. These results will be analyzed and used to further refine the planting plan such that the most successful plant species and soil blends are used preferentially to facilitate revegetation of the site as quickly as possible.

1.2 Summary of Revegetation Tasks

Tasks described in this Plan will provide native vegetative cover for final contours, thus controlling erosion and stabilizing slopes in the Project Area, PCRA, and the Exploration Area. Revegetation efforts will utilize plant materials capable of self-regeneration without continued dependence on irrigation, soil amendments, or fertilizer in accordance with the Reclamation Standards.

1.2.1 Project Area Revegetation Summary

Hydroseeding of the finished slopes with a mixture of native grasses, herbaceous plants, and shrubs will provide surface cover and erosion control for the new slopes. Tree and shrub planting areas will be located on contoured benches and riparian drainages to encourage the long-term development of an oak savannah or forest on north- and east-facing slopes, native scrub on south-facing slopes, and a suitable riparian canopy in drainages. This Plan describes a test plot program, soil treatment and plant installation, maintenance and adaptive management guidelines, and verifiable monitoring standards to achieve the goals and objectives listed above.

1.2.2 Permanente Creek Reclamation Area Revegetation Summary

Revegetation and erosion control is proposed for the Permanente Creek Reclamation Area (PCRA) to further stabilize hillside soils against long-term erosion by expanding and enhancing plant communities. The types of vegetation proposed in the PCRA have been selected for their erosion control characteristics, and because they are either already present in the PCRA (indicating that they are well suited to the climate and soil conditions in these locations) or have been demonstrated as suitable through the test plot program. Revegetation will, as in other areas covered in the Amendment, emphasize plant materials capable of self-regeneration without continued dependence on irrigation, soil amendments or fertilizer. A number of the PCRA subareas include portions of Permanente Creek that will also be restored. A more detailed explanation of the approach of the creek restoration is provided in Appendix F.

There are seven separate areas included in the PCRA (Subareas 1 through 7, Figure 5). Many of the areas receive unique treatments related to revegetation and erosion control, which are summarized in Table 1. These treatments are discussed in more detail below. Additional information, details and cross-sections regarding sedimentation basins and other erosion control measures for the PCRA are contained in Chang Consultants' engineering maps and the Amendment.

Table 1. PCRA Revegetation and Erosion Control Treatments by Subarea

Area	Treatment
Subarea 1	Hydroseed disturbed areas (totaling 8.68 acres) with seed mix listed below, install riparian vegetation along bottom of slopes in locations with adequate hydrology, fiber rolls installed along disturbed slopes at 10-15 foot intervals.
Subarea 2	Roll slopes with sheepsfoot, hydroseed disturbed areas (totaling 21.81 acres) with seed mix listed below, install riparian vegetation along bottom of slopes in locations with adequate hydrology, fiber rolls installed along disturbed slopes at 10-15 foot intervals, install silt fence to protect creek during equipment work to improve catchbasins.
Subarea 3	Roll slopes with sheepsfoot, hydroseed disturbed areas (totaling 4.25 5acres) with seed mix listed below, install riparian vegetation along bottom of slopes in locations with adequate hydrology, fiber rolls installed along disturbed slopes at 10-15 foot intervals, install silt fence at toe of slope to protect creek during equipment work to improve catchbasins.
Subarea 4	Hydroseed and plant disturbed areas (totaling 2.93 acres) on north side of creek slope, cover north slope with erosion control blanket, seed areas of

	historic disturbance on the south side of creek slope by hand or using a broadcast-seeder, install riparian vegetation along bottom of slopes in locations with adequate hydrology, fiber rolls installed along disturbed slopes at 10-15 foot intervals. Permanente Creek will also be restored in this area by removing overburden and creating a new channel per Appendix F.
Subarea 5	Hydroseed and plant disturbed areas (totaling 3.37 acres) on north side of creek, seed areas of historic disturbance on the south side of creek slope by hand or using a broadcast-seeder, install riparian vegetation along bottom of slopes in locations with adequate hydrology, fiber rolls installed along disturbed slopes at 10-15 foot intervals, install silt fence to protect creek during equipment work. Permanente Creek will also be restored in this area by removing overburden and creating a new channel per Appendix F.
Subarea 6	Hydroseed disturbed areas (totaling 0.90 acres) with seed mix listed below, install riparian vegetation along bottom of slopes in locations with adequate hydrology, fiber rolls installed along disturbed slopes at 10-15 foot intervals.
Subarea 7	Hydroseed and plant disturbed areas (totaling 4.06 acres) with seed mix listed below, install riparian vegetation along bottom of slopes in locations with adequate hydrology, fiber rolls installed along disturbed slopes at 10-15 foot intervals. Silt fence will be installed at the toe of fill pile slopes. Permanente Creek will also be restored in this area by removing the Pond 13 dam, ½ culvert, and creating a new channel per Appendix F.

1.2.3 Exploration Area Revegetation Summary

Upon the completion of drilling activities, greenfield roads and pads were reclaimed and revegetated. Roads and pads were recontoured as necessary to native slopes, and exposed soils were broadcast seeded with native grasses and wildflowers. Hay was spread over exposed soil surfaces to control erosion. In some cases, brush that was cleared for road and drill pad construction was spread back over the disturbed area creating microclimate variation for revegetation.

2.0 EXISTING CONDITIONS

2.1 Native Soil Types

The USDA *Soil Survey of Santa Clara Area, California* (USDA 1958) indicates that the RPA has seven native soil types (map units) and depicts excavated Quarry areas as a “Pit” map unit. These map units are described in detail below. According to the soil survey, the native soils of the RPA were subject to erosion and gullying, were generally quite shallow, and hosted a plant community almost wholly dominated by scrub. Although historical Quarry activities have disturbed the native soils, previous successful restoration plantings at the Quarry have shown that plant communities and soil characteristics may be restored.

Pit (Ec) - This map unit consists of areas large enough to map where excavations have been made and where the original soil has been removed. Excavations in this area have been principally for limestone and aggregate production.

Azule silty clay, 20-30 percent slopes (At) - Azule silty clay surface soil consists of brown or pale-brown silty clay that normally varies from 8 to 15 inches in depth. The surface soil overlies a brown or pale-brown slightly compact subsoil of silty clay texture. The underlying material occurs at depths of 20 to 45 inches and is light-brown or light yellowish brown unconsolidated material of clay loam or silty clay loam texture. In a few places a small amount of gravel occurs in the profile. The native vegetation is mostly brush, but there are some areas of this soil type in grassland and woodland.

Los Gatos clay loam, 20-35 percent slopes (La) - The Los Gatos surface soils are brown and become nearly reddish brown when moist. They grade into brown or reddish brown subsoil of clay loam texture. In most places some rock fragments occur in the subsoils. The number and size of fragments increase with depth. The soils are underlain by hard but generally broken or shattered metamorphosed sedimentary rock at depths of 26 to 38 inches.

Los Gatos clay loam, moderately eroded, 20-35 percent slopes (Lb) - This soil differs from the non-eroded Los Gatos clay loam described above mainly in degree of erosion, except that the exposed soil is redder in color, somewhat shallower, and contains a few gullies.

Los Gatos - Maymen stony soils, undifferentiated, 50+ percent slopes (Lf) – This map unit consists of very steep and stony areas of Los Gatos and Maymen soils. Slopes are steep, and in most places rock outcrops are numerous. The vegetation is a dense growth of brush. The Los Gatos soils predominate, but in some places fairly large areas of Maymen soils occur. The Los Gatos surface soils are brown and become nearly reddish brown when moist. They grade into brown or reddish brown slightly compact subsoils of finer texture than the surface soils. In most places some rock fragments occur in the subsoils. The number and size of fragments increase with depth. The soils are underlain by hard but generally broken or shattered shale or sandstone that has undergone varying degrees of metamorphosis. Maymen surface soils are light brown or pale brown. They overlie light brown or light reddish brown medium textured subsoils. In most places rock fragments occur in the subsoils and in the surface soils. The subsoils grade irregularly at shallow depths into hard sandstone or conglomerate bedrock.

Permanente stony soils, undifferentiated, 50+ percent slopes (Pa) - These very steep areas of Permanente soils are very shallow and stony. The surface soils are brown (becoming nearly reddish brown when moist), medium textured, stony, and generally non-calcareous. In most places fragments of bedrock are mixed with the surface soils, which grade irregularly at very shallow depths into light-gray or white hard limestone bedrock. The natural vegetation is almost entirely brush.

Soper gravelly loam, 20-35 percent slopes (Sm) - The surface soil is a brown or light-brown, slightly or medium acid gravelly loam to depths of 8 to 13 inches. The surface soil grades into a slightly more reddish-brown, moderately compact, weakly blocky subsoil of gravelly clay loam texture. The subsoil retards drainage somewhat and causes waterlogging of the surface soil during heavy rains. At depths of 23 to 32 inches the subsoil grades into a noncalcareous moderately or weakly consolidated conglomerate bedrock that is somewhat more permeable than the subsoil.

Soper gravelly loam, 35-50 percent slopes (So) - This soil is normally somewhat shallower than that on less steep slopes. The natural vegetation is a thick growth of brush. The typical slopes

of Soper soils usually range from 20 to 35 percent, but steep slopes are more common in this area. The surface soils are brown or light brown, medium textured, and generally gravelly. The surface soils grade into slightly more reddish-brown, moderately compact, weakly blocky subsoils of gravelly clay loam texture. The subsoils in most places are dense enough to retard drainage to a moderate degree. The subsoils grade into brown or yellowish-brown noncalcereous, moderately or weakly consolidated conglomerate bedrock.

2.2 Climate

The RPA lies within a semi-arid Mediterranean climate zone characterized by warm summer and mild winter temperatures with a substantial slope effect contributing to vegetative community differences on north- and south-facing slopes. Rainfall occurs mainly from November through April. Average annual rainfall is about 22 inches; however, precipitation can range widely from year to year. On north-facing slopes, conditions are moister and less warm than on south-facing slopes as evidenced by the dramatic differences in vegetative communities. The RPA will have both north-facing and south-facing slopes.

WRA conducted an analysis of the average solar radiation of the reclaimed slopes in order to determine the best types of plants to use for revegetation in different areas. Figure 2 depicts the variation in solar radiation at the ground surface within different areas of the RPA based on proposed final reclaimed slope and aspect. Classes of “low”, “medium”, and “high” solar radiation were determined based on average conditions in surrounding intact vegetation communities. The upper limit of the low range was defined by the mean plus one-half of the standard deviation of the solar radiation value of the existing tree-dominated communities (oak and bay woodland). The upper end of the medium range extends the mean plus one standard deviation of the existing tree-dominated communities. And the high range includes all solar radiation values higher than the low and medium. The unvegetated slopes of the RPA may experience higher summer temperatures than would be expected for this region because sparse vegetative cover will be less effective in reflecting and absorbing sunlight until a denser cover of vegetation is established.

2.3 Vegetation

Vegetation in the RPA is described in the *Biological Resources Assessment* prepared by WRA (2011). Portions of the RPA have been historically disturbed by Quarry operations and other industrial activities dating to the early 1900’s. According to the *Biological Resources Assessment*, a Northern Mixed Chaparral / Scrub Oak Chaparral / Coast Live Oak Woodland community is presumably the natural community that once dominated the majority of the RPA. Most of the hillslopes surrounding the RPA are described as one of these community types. These biological communities are a mosaic of south-facing dry rocky slopes with thin soils dominated by chaparral species and north-facing slopes and shaded ravines dominated by a mature tree and shrub dominated canopy. These north facing slopes support oak woodland and bay forest in the canyons and scrub oak chaparral on the ridges.

Shrub species typical of the chaparral community on south-facing slopes include mainly native species: California sagebrush (*Artemisia californica*), chamise (*Adenostoma fasciculatum*), coyote brush (*Baccharis pilularis*), scrub oak (*Quercus berberidifolia*), buckbrush (*Ceanothus cuneatus*), toyon (*Heteromeles arbutifolia*), and poison oak (*Toxicodendron diversilobum*). On north-facing slopes, typical overstory species include coast live oak (*Quercus agrifolia*), California bay (*Umbellularia californica*), scrub oak, toyon, and California buckeye (*Aesculus californica*) with scattered valley oak (*Quercus lobata*), and blue oak (*Quercus douglasii*). Scrub species in the understory on north-facing slopes are typically coyote brush and poison oak.

Within the 3,510-acre Quarry property, Permanente Creek supports riparian tree species including willow (*Salix* spp.), alder (*Alnus rhombifolia*), maple (*Acer macrophyllum*), and sycamore (*Platanus racemosa*). The ephemeral tributaries to this creek do not typically support riparian-specific vegetation, such as willows, except near where they are in closer proximity of the water table as they approach Permanente Creek.

2.4 Previous Revegetation Sites

Previous natural and focused revegetation efforts at the Quarry have occurred successfully. In the EMSA, a cut slope above the present day "boneyard" is covered with a dense shrub community dominated by purple sage (*Salvia leucophylla*; see Appendix A). The slope below the boneyard is adjacent to the Quarry entrance and is vegetated with a variety of native and ornamental tree species, including olive (*Olea europaea*), Monterey pine (*Pinus radiata*), Deodar cedar (*Cedrus deodara*), and coast live oak. These slopes were graded during the construction of the previous administration building locations in 1941. Historic aerial photos from 1948 show young plantings in some of these areas that are currently covered with a dense layer of trees and shrubs.

Previous material storage areas were successfully revegetated per the 1985 Reclamation Plan (known as Area C in that plan). Native shrub species such as coyote brush and California buckwheat (*Eriogonum fasciculatum*) were used in that revegetation effort and currently dominate the area today (Appendix A).

Recent revegetation efforts typically consisted of grading slopes to a final contour, hydroseeding with native grass species, and planting at a low to moderate density with native shrubs and trees including coyote brush, chamise, and oaks from locally collected cuttings and acorns. The growing substrate was typically crushed overburden rock with little reclaimed topsoil. The most successful sites were primarily south-facing slopes which are now dominated by 70 to 100 percent cover of native shrubs including California buckwheat, coyote brush, buckbrush, and California sagebrush.

Irrigation was utilized in some revegetated areas to encourage the establishment of planted trees and shrubs, and protective cages were installed around most plantings to reduce damage from deer browsing. Generally, these areas are now dominated by an herbaceous layer of non-native and native grass species including wild oats (*Avena* spp.), brome grasses (*Bromus* spp.), three weeks fescue (*Vulpia microstachys*), and Italian rye-grass (*Lolium multiflorum*).

3.0 SOIL DEVELOPMENT

Areas to be revegetated in the RPA will initially consist of an overburden rock surface or cut and fill slopes. Overburden is low-grade ore that must be mined in order to reach the high-grade limestone situated at deeper elevations. Slopes scheduled to undergo revegetation will be graded to a final contour no steeper than 2:1, with most being flatter. A blend of topsoil material with overburden and fine greenstone has been shown to be an effective medium. The soil development plan is designed to produce recommendations for additional materials that may be added, if necessary, to improve the substrate's texture, structure, and nutrient availability, and to promote faster soil development.

To provide information on soil conditions for the RPA soil development program, several soil samples were collected. The soil samples included a representative sample of the overburden rock which will be the underlying substrate throughout the RPA, as well as samples from twenty-

five undisturbed reference sites, three existing revegetation sites, and five potential supplemental material sources.

The Soil and Plant Laboratory, Inc. in Santa Clara, California performed an analysis of the soil samples, including an assessment of the following characteristics:

- pH
- Total Exchangeable Cations
- Salinity
- Sodium
- Sulfate
- Sodium Adsorption Ratio (SAR) Value
- Boron
- Macronutrients (Nitrogen, Phosphate, Potassium, Calcium, Magnesium, Sulfur)
- Micronutrients (Iron, Manganese, Copper, Zinc)
- United States Department of Agriculture (USDA) Soil Textural Classification
- Organic Matter Content (Percent Dry Weight)

Detailed reports on the soil sample analyses are provided in Appendix C. Two additional samples included in Appendix C, the "Basin Clean Out" and "Pit #2", are not discussed below due to poor sample quality. Figure 3 shows the location of soil samples described below. Table 1 outlines the primary characteristics of the soil samples.

3.1 Reference Sites

Soil conditions at the 25 undisturbed reference sites supporting native plant communities served as a reference for determining the requirements to achieve a suitable growth medium for native plants in the RPA. Existing revegetation sites also provide information for targeting suitable soil conditions since these sites are underlain by a substrate similar to that which will be used in the RPA. Three revegetation sites were sampled in the WMSA and North Quarry, and they vary in age of installation and revegetation techniques and plant materials used.

<u>Undisturbed Topsoil Sites</u>

The "EMSA Native" and "WMSA Native" topsoil samples (referred to as "East Dump Native" and "West Dump Native" in soil laboratory reports [Appendix C]) were collected and analyzed in May 2008 while the other 23 undisturbed topsoil samples were collected and analyzed in February and March 2009. Samples were taken from existing road cut banks and vegetated portions of the RPA and adjacent areas on the Quarry property, within oak woodland, chaparral, and grassland vegetation communities. The samples varied in soil texture, organic matter content, and other characteristics (Appendix C). Soil structure and organic matter also varied within each vegetation community type, although grassland samples had low organic matter content and woodland and forest samples generally had higher organic matter content. The organic matter content of the reference soil samples varies between 0.7 and 9.7 percent with an average content of 4.8 percent. A minimum organic matter content of approximately 3.0 percent is typically desired for native plant establishment.

<u>East Quarry Revegetation Site</u>

The "East Quarry Revegetation" soil sample (referred to as "Reveg East Pit" in soil laboratory data) was obtained from a revegetation area in the northeast portion of the North Quarry (Figure 3). This area was planted in the 1980s, and the primarily south-facing slopes of the site are now

dominated by grass and native brush species, including California buckwheat, coyote brush, buckbrush, and California sagebrush. Soil analyses indicate that soil at the East Quarry Revegetation site has the highest organic matter content (4.8 percent) of the three revegetation

Table 2. Description and characteristics of soil samples (additional details in Appendix C).

SAMPLE MATERIAL	DOMINANT PLANT COMMUNITY	USDA map unit (1958)	Organic matter (% dry weight)	USDA SOIL CLASSIFICATION
Undisturbed Reference Topsoil (potential topsoil sources)				
South of Quarry - B1	bay forest	Pa	7.8	Very Gravelly Sandy Loam
South of Quarry - B2	bay forest	Lf	9.7	Very Gravelly Sandy Loam
South of Rock Plant - B3	bay forest	Lf	4.7	Loam
EMSA - C5	chaparral	La	2.4	Clay Loam
EMSA - C6	chaparral	Lf	2.5	Very Gravelly Sandy Loam
EMSA - C7	chaparral	Sm	3.5	Sandy Clay Loam
EMSA - C8	chaparral	La	2.5	Clay Loam
EMSA Native	chaparral	Sm	7.4	Sandy Loam
WMSA Native	chaparral	Lf	2.5	Clay Loam
South of Quarry - C1	chaparral	Pa	6.9	Gravelly Sandy Loam
South of Quarry - C2	chaparral	Lf	8.8	Sandy Clay Loam
South of Rock Plant - C3	chaparral	Pa	6.7	Loam
South of Rock Plant - C4	chaparral	So	7.6	Gravelly Sandy Loam
EMSA - G3	grassland	La	0.7	Gravelly Sandy Clay Loam
EMSA - G4	grassland	La	2.2	Gravelly Clay Loam
South of Quarry - G1	grassland	La	2.6	Sandy Clay Loam
South of Rock Plant - G2	grassland	At	0.7	Sandy Clay Loam
EMSA - O5	oak woodland	Sm	7.1	Clay Loam
EMSA - O6	oak woodland	Lf	5.5	Gravelly Sandy Loam
EMSA - O7	oak woodland	Ec	2.6	Sandy Loam
EMSA - O9	oak woodland	La	2.8	Clay Loam
South of Quarry - O1	oak woodland	Pa	5.7	Gravelly Sandy Loam
South of Quarry - O2	oak woodland	Lf	5.1	Very Gravelly Sandy Loam
South of Rock Plant - O3	oak woodland	Pa	6.4	Gravelly Loam
South of Rock Plant - O4	oak woodland	Pa	6.1	Gravelly Sandy Clay Loam
Revegetation Site Samples				
East Quarry Revegetation	native shrubs (70%) [Cal. buckwheat, coyote brush]	Lf	4.8	Very Gravelly Sandy Loam
West Quarry Revegetation	non-native grass (90%), w/ scattered plantings	Pa	3.7	Very Gravelly Loam Sand
WMSA Revegetation	native & non-native grass (70%), w/ shrub/tree plantings	Lb	0.8	Very Gravelly Sandy Loam
Supplemental Materials				
Overburden rock	N/A	Lf	1.2	Gravelly Sandy Loam
North Quarry fine greenstone	N/A	Ec	0.7	Very Gravelly Loamy Sand
Rock Plant fines	N/A	At	1.4	Clay Loam
West Main topsoil	N/A	Lf	0.5	Very Gravelly Sand
North Quarry topsoil	N/A	Pa	1.2	Very Gravelly Sandy Loam

sites, an amount sufficient to support native vegetation (Appendix C). The soil texture has a high amount of gravel fractions as well as coarse sands. A soil pit showed a relatively thick "O" horizon, or organic horizon, compared to the other two revegetation sites. Of the three revegetation sites where soil samples were taken, the East Quarry Revegetation site also supports the highest cover of native vegetation, dominated by native shrubs. The other two revegetation sites were dominated by non-native grasses. Given the relatively high organic matter content of the soil and the well-established native vegetation at the East Quarry Revegetation site, the soils at this site provide an appropriate target for RPA soil characteristics.

West Quarry Revegetation Site

The "West Quarry Revegetation" soil sample (referred to as "Reveg West Pit" in soil laboratory data) was obtained from a revegetation area in the northwest portion of the North Quarry (Figure 3). The West Quarry Revegetation site was developed in the 1970s. Currently the non-native grass wild oats (*Avena barbata*) dominates the site with broadly scattered plantings consisting of such species as Monterey cypress (*Cupressus macrocarpa*), ornamental pine (*Pinus* sp.), and blue elderberry (*Sambucus mexicana*). The soil conditions at the West Quarry Revegetation site show a slightly lower amount of organic matter (3.7 percent) than the East Quarry Revegetation site and a similarly high amount of gravel fractions and coarse sands.

WMSA Revegetation Site

The "WMSA Revegetation" soil sample (referred to as "Reveg Slope West Dump" in soil laboratory data) was obtained from a revegetation area at the north end of the WMSA (Figure 3). Installed between 2002 and 2006, the WMSA Revegetation site is less mature than the other two revegetation sites and correspondingly, the vegetation cover at this site is less dense. Hydroseeded grasses and shrub and tree plantings dominate these north-facing slopes. The soil has a relatively low amount of organic matter (0.8 percent) compared to the other two revegetation sites. A hydroseed slurry, including some compost, biosol fertilizer, mycorrhizal inoculant, and hydrostraw, was applied directly to the overburden rock in this revegetation effort.

3.2 Target Soil Characteristics

Based on the assessment of the undisturbed reference and revegetation sites, some recommendations can be made on the soil characteristics for the RPA which would likely support native plant communities. Critical factors to consider include soil texture and organic matter content in addition to soil chemistry and nutrient levels. The soil characteristics of the East Quarry Revegetation site provide an appropriate target because it is a revegetation site with the most well-established vegetation and utilized a loamy topsoil medium similar to that which will be available under the project. The soil conditions of the undisturbed reference sites provide better conditions as plant growth media; however, these conditions will be more difficult and less realistic to achieve than those at the revegetation sites since the RPA will be more similar to the previous revegetation sites.

Targeting a loamy topsoil texture would be desirable for the RPA to achieve adequate infiltration rates and an appropriate plant growth medium. Loamy soils with high amounts of gravel and coarse sand were observed to support native shrub species, and so may be an acceptable and desirable soil characteristic in revegetation areas. The East Quarry Revegetation site soil is classified as a Very Gravelly Sandy Loam, and while this soil may include large, gravel-size particles which are not ideal for facilitating plant growth, it has enough smaller material and organic matter to support a chaparral community. A minimum organic matter content of approximately 3.0 percent is typically desired for native plant establishment. The organic matter

content of the East Quarry Revegetation site is 4.8 percent, and this content is recommended as an approximate final target for RPA soil development.

Due to the steep slopes of the PCRA and desire to avoid the use of heavy equipment, no topsoil blend is proposed for these areas. Instead, fiber mulch will be added to the hydroseed mix and sprayed on the unvegetated areas. This material retains moisture and promotes seed germination and plant growth and will enhance revegetation success in the rocky slopes that characterize portions of this area.

3.3 Available Materials

Existing stockpiles of topsoil, in addition to new topsoil generated during quarry operational and reclamation practices, will be incorporated with the top layer of overburden rock when present to improve soil conditions in the RPA. Topsoil from the RPA will be harvested and stockpiled for reclamation purposes. In cases where woody plant material must be removed from within the RPA to achieve the appropriate grade, the material will be chipped and blended with the topsoil to increase the organic matter. The overburden rock substrate and potential soil materials are described below in more detail.

Overburden Rock

The results of the soil analysis for the representative overburden rock sample (referred to as "West Waste Rock" in soil laboratory data) indicate that the overburden rock alone is not an ideal substrate for the desired native plant communities in the RPA. The particle size analysis shows that the USDA classification is a Gravelly Sandy Loam with a diverse distribution of particle sizes. With this varied distribution of particle sizes, the susceptibility to consolidation is high. Over time, particles of various sizes could lock into a consolidated state which could slow down water infiltration rates to an undesirable degree and could cause the soil to be impervious in places. The organic content (1.2 percent) of the overburden rock is low for supporting a native plant community. The pH level indicates slightly alkaline conditions and the natural lime content is relatively high. The content of salinity, sodium, and boron is safely low and the Sodium Adsorption Ratio (SAR) value is acceptable. Available nitrogen and potassium are low, phosphorus is fair, and calcium, magnesium, and sulfate are well supplied. Iron, copper, manganese, and zinc occur at low levels (Appendix C).

Given its rocky texture and low organic content, the overburden rock would benefit from the addition of topsoil and/or organic amendments. Blending stockpiled overburden rock with harvested topsoil and other materials available within the RPA is a consideration for improving texture and nutrient content, and potential blends are described below.

Undisturbed Topsoil

The 25 undisturbed topsoil samples described above represent native soil conditions found within the footprint of the RPA. Prior to removing the topsoil, existing trees and shrubs may be cut and chipped in place. This woody debris will be incorporated into the topsoil to increase the level of organic matter in the soil.

The soil texture, organic matter content, and other characteristics of the topsoil samples varied in quality, with 15 of the 25 samples having generally adequate amounts of organic matter for native plant establishment. Samples classified as "gravelly" or "very gravelly" were identified by the Soil & Plant Lab as less suitable for revegetation as they are more susceptible to consolidation. Several samples were identified by the Lab that would benefit from organic matter and/or potassium supplementation. However, the samples generally exhibited favorable

soil chemical composition and they clearly can support native communities as evidenced in the reference sites examined. Available topsoil is a priority material for use in RPA revegetation, as it will potentially also contain native seeds and microorganisms that can improve revegetation success.

Disturbed Topsoil

Both the West Main and North Quarry topsoils are samples of salvaged, disturbed soils. These samples contained highly excessive gravel content and excessive coarse sands with a broad distribution of particle sizes. The susceptibility to consolidation is very high for these materials. The organic matter content is relatively low at 0.5 percent and 1.2 percent, respectively. Somewhat similar to the North Quarry fine greenstone material, incorporating the West Main and North Quarry topsoil materials with the overburden rock may improve soil texture conditions but would add little value as a source of nutrients and organic matter and would do little to improve soil structure.

North Quarry Fine Greenstone

The North Quarry (referred to as Pit 1 in soil laboratory data) fine greenstone material may be harvested from a slope failure occurring in the North Quarry pit. This material contains coarse sands with high gravel content, and similar to the overburden rock material, the susceptibility to consolidation of this material is high. The infiltration rates are estimated at a slow 0.10 inches per hour and could be even slower when consolidated. Organic matter content is relatively low (0.7 percent). North Quarry fine greenstone material may improve soil texture conditions of the overburden rock but based on the low organic matter content, would provide little added value in nutrient availability or soil structural development to the overburden rock substrate.

Rock Plant Fines

The Rock Plant fines material is a byproduct of the rock processing activities at the Quarry. It has a clay loam texture and contains a substantially greater amount of silt and clay compared to the overburden rock. The Rock Plant fines material has relatively low organic matter content (1.4 percent). Blending the Rock Plant fines material with the overburden rock may improve soil texture conditions. However, based on efforts to create soil blends by the Soil & Plant Laboratory, achieving a homogeneous blend with this material may be difficult to achieve on the broad scale required. The Rock Plant fines material has high moisture content and would have to be dried before it is incorporated with the other soil materials. Only non-limestone fines would be used for revegetation purposes, to address water-quality considerations.

3.4 Soil Blends

Based on the soil analysis results, a suitable plant growth medium can be created in the RPA by placing supplemental materials on top of and/or incorporating them directly with overburden rock, when present, and adding organic amendments if necessary (Section 3.5.4). When revegetation occurs on areas without overburden then topsoil will be blended with other materials available onsite. Nine different soil combinations were tested at the Soil & Plant Laboratory to gain information on the soil composition resulting from various blends of soil materials, overburden rock, and compost. In formulating the blends, the lab targeted 4.8 percent organic matter, the amount of organic matter found in the East Quarry Revegetation soil sample. A summary of the soil blend results is listed in Table 3.

Nutrient values show improvement in overall fertility for all of the blends compared to the overburden rock alone, most often as a result of the nutrient rich compost addition. The target

organic matter content of 4.8 percent was surpassed for all of the test blends except one, which still had an adequate amount of organic matter for native plants. In general, adding about 25 percent compost on a volume basis, as a substitute for pure topsoil in the test plots, provided an appropriate amount of organic matter for establishment of native plants.

Lab results indicated that excess sodium occurring in the compost used in the test blends contributed to elevated salinity and Sodium Adsorption Ratio (SAR) values present in the test blend results which was not present in the soil samples tested alone. Evaluating the intended compost product prior to use is recommended to assure that salts are safely low. Elevated salinity in the soil could hinder seed germination and be toxic to seedlings. Compost is not currently proposed for use in reclamation of the RPA (see Section 4.0).

Table 3. Summary of soil blend test results

SOIL BLEND	ORGANIC MATTER (% DRY WEIGHT)	USDA SOIL CLASSIFICATION
1. Overburden rock (73%); compost (27%)	7.0	Very Gravelly Sandy Loam
2. North Quarry fine greenstone (40%); overburden rock (20%); Rock Plant fines (20%); compost (20%)	4.0	Very Gravelly Sandy Clay Loam
3. Rock Plant fines (41%); North Quarry fine greenstone (35%); compost (24%)	5.6	Very Gravelly Loam
4. North Quarry fine greenstone (81%); compost (19%)	5.1	Very Gravelly Sandy Loam
5. North Quarry fine greenstone (43%); overburden rock (36%); compost (21%)	8.5	Very Gravelly Sandy Loam
6. EMSA Native topsoil (68%); overburden rock (32%)	5.1	Very Gravelly Sandy Loam
7. EMSA Native topsoil (75%); North Quarry fine greenstone (25%)	10.1	Very Gravelly Sandy Loam
8. Rock Plant fines (50%); West Main topsoil (28%); compost (22%)	6.3	Very Gravelly Loam
9. Rock Plant fines (46%); compost (22%); North Quarry fine greenstone (16%); West Main topsoil (16%)	6.8	Very Gravelly Loam

The most favorable soil blend candidates were those with predominantly EMSA Native topsoil material [blends 6 and 7]. Blending the overburden rock or North Quarry fine greenstone material with the EMSA Native topsoil results in soils with excellent fertility and organic content and creates the most promising plant growth media of the blends tested. The soil blends which include the EMSA Native topsoil do not need compost to achieve the target organic matter content level since they are well-supplied with organic matter. However, incorporating compost with the EMSA Native topsoil could enhance nutrient supply and improve soil infiltration if necessary.

The second best soil blends contain the Rock Plant fines material [blends 3, 8, and 9]. While the Rock Plant fines material favorably increases silt and clay content of the coarser overburden rock, North Quarry fine greenstone, and West Main and North Quarry disturbed topsoil materials, producing homogeneous soil blends with these materials may prove to be logistically difficult. The Rock Plant fines material has a high moisture content and would have to be dried before it is incorporated with the other soil materials. In field conditions, the drying and

consequent incorporation of this material may be time-consuming and its effectiveness unpredictable. It is recommended that results from test plots using the Rock Plant fines material be obtained before application on a large scale.

The tested soil blends utilizing compost with the overburden rock or North Quarry fine greenstone and no topsoil provide adequate conditions for native plant establishment although the soil texture may be coarser than desired [blends 1, 4, and 5]. Native topsoil will be the highest priority material for use in reclamation. However, other materials discussed above will be available to create soil treatment blends in future revegetation efforts or if topsoil harvest does not meet the quantities needed for ultimate revegetation.

3.5 Soil Preparation

The objective of this Plan is to meet revegetation objectives using the entirety of available topsoil. To the extent that topsoil blending is necessary to enhance the amount of growth media available to achieve growth targets, certain soil preparation strategies have been developed. Soil preparation in the majority of the RPA will involve preparing the overburden rock as well as incorporating soil and topsoil materials and soil amendments as needed to provide suitable plant growth media for revegetation activities. Different soil treatments may be used for the various portions of the RPA, depending on the target plant community and general aspect and substrate of each area. For the purposes of the reclamation plan, it is understood that the soil blending materials discussed below will be non-limestone materials.

3.5.1 Material Quantities

WRA has investigated portions of the EMSA, Rock Plant, and areas south of the active Quarry with undisturbed topsoil and native vegetation and described available topsoil depths and general condition. Soil depths (including the A and B horizons) in undisturbed portions of the RPA average from 8 to 11 inches in chaparral, 13 inches in grasslands, 17 to 22 inches in oak woodland, and 35 inches in bay forest.

The target soil preparation depth for areas targeted for scrub in the RPA is a minimum of six inches, a depth being tested in the test plots and considered suitable to support most shrub and grass species to be seeded. This target will include 50 percent ripped overburden rock mixed with 50 percent topsoil blend. Preliminarily, this would include 3 inches of pure topsoil as shown in Table 4 which will be blended with other materials to achieve the 6 inch planting medium. The exact percentages of the blend may be altered based on future test plot results or if extra topsoil is available.

The tree and shrub benches require a deeper planting substrate of at least 12 inches to support root establishment of the planted trees. Similar to the reclaimed slopes, the planting substrate will consist of 50 percent overburden rock blended with 50 percent topsoil blend. Preliminarily, this would include 6 inches of pure topsoil as shown in Table 4, to be blended with other materials to achieve the 12 inch planting medium. The exact percentages of the blend may be adjusted in future reclamation efforts based on test plot results and material availability. These topsoil quantities were chosen based on the results of test plot monitoring. Test plots with thicker soils (up to 24 inches) were consistently overrun by non-native annual grasses that outcompeted the target native species.

As the revegetation efforts continue through the phases of the reclamation project, if it is determined that extra topsoil is available the percentage of topsoil used in revegetation will be increased such that at the end of reclamation, all available topsoil will be utilized. Currently proposed soil treatment volumes and depths for slopes and benches are listed in Table 4.

Table 4. Proposed topsoil blend application depths and volumes*.						
LOCATION	Hydroseed Only			Oak and Pine Tree Planting Areas		
	AREA (acres)	DEPTH OF TOPSOIL TO BE BLENDED (inches)	VOLUME (cubic yd)	AREA (acres)	DEPTH OF TOPSOIL TO BE BLENDED (inches)	VOLUME (cubic yd)
North Quarry	261.8	3	105,166	0.6	6	479.16
WMSA	172.4	3	69,254	0.2	6	159.72
EMSA	56.4	3	22,656	16.9	6	13496.34
Rock Plant	13.6	3	5,463	5.5	6	4392.3
Surge Pile	8.8	3	3,535	0	--	0
Crusher/Support	48.4	3	19,442	5	6	3,993
Total	**561.4**	-	**225,516**	**28.2**	**-**	**22,521**

*Note: For purposes of computing topsoil volumes, non-planimetric areas were calculated for the various project areas. This takes into account the slope of the land which can increase the surface area of plantable space and significantly affect the volume of planting medium needed. Therefore the acreage listed for each project area may not match the acreage in other portions of this document.

3.5.2 Overburden Rock Placement

Overburden rock is the subgrade material at the RPA. Inter-bench slopes scheduled to undergo restoration planting that are covered by overburden rock will be graded to a final contour no steeper than 2:1. There are a few steep highwalls in the upper North Quarry that are stable and be left in their current state. These will be subject to revegetation treatments but will not receive applications of overburden or growth medium due to the steepness of the slopes at approximately 70 degrees. The total area of slopes and benches available for revegetation within the RPA Project Areas will be approximately 589 acres. This does not include drainage channels that will be constructed on the interior edges of benches. These will not be actively revegetated as they are intended to manage stormwater flow. Prior to the incorporation of topsoil or other soil-building materials, the upper layer of the overburden rock substrate, when present, should be ripped, disced, or otherwise broken up to loosen the material to facilitate topsoil blending and seed and plant establishment.

3.5.3 Topsoil Preparation

This section provides guidelines for topsoil preparation within the RPA, with the exception that guidelines for the PCRA and Exploration Area are contained in sections 3.5.6 through 3.5.8 below.

Topsoil will be harvested from appropriate areas within the RPA. Prior to topsoil harvest, the RPA will be cleared of woody vegetation and root balls using chainsaws and a portable excavator. Plant debris will be chipped in place and spread on the topsoil, so that this organic matter is blended with the topsoil during harvest.

Topsoil Stripping and Salvaging

Salvaging topsoil for reclamation helps assure productivity of reclaimed lands. Identifying topsoil locations and depth is important to securing appropriate topsoil in optimal locations. Topsoil depth can vary; for example, deep topsoil usually occurs in draws and valley floors and ridge tops have generally very shallow topsoil. Topsoil can be identified by color. Often topsoil has a brownish or dark earthtone color consistent with the color of the soil near the surface. When bright colored earth tones or distinct color change occurs, it usually means topsoil has ended. The topsoil resources in the RPA vary in composition, nutrient content, and depth. WRA has investigated portions of the EMSA, Rock Plant, and vegetated areas south of the active Quarry with suitable topsoil and described available depths and general condition. Available soil depths (including the A and B horizons) in undisturbed portions of RPA average from 8 to 11 inches in chaparral, 13 inches in grasslands, 17 to 22 inches in oak woodland, and 35 inches in bay forest. When grading and contouring of slopes in undisturbed areas is necessary to achieve the necessary grade, the topsoil will be salvaged and stockpiled onsite. Topsoil salvage will be avoided in historically disturbed areas, reclaimed areas, or active Quarry areas containing poor topsoil.

Topsoil Stockpiling and Placement

After topsoil is stripped, it will be hauled and stored within the RPA if it cannot be used at that time for concurrent reclamation activities. In order to facilitate plant root growth, the topsoil should be compacted as little as possible. When soil materials are to be harvested, moved, stored, or worked during the construction or mining phase, it is important that these activities occur when the soil materials are dry. Wet or damp soils are easily compacted and will be much less able to grow plants than if they were handled when dry. Beneficial bacteria, fungal spores, and plant seeds are also in a resistant stage of their life cycle if the soil is dry and are more likely to survive the disturbance of the moving process.

Topsoil stockpile areas will be identified and well-marked to avoid any unnecessary disturbance to the topsoil. In addition, relocation of topsoil after it is stockpiled will be minimized. If topsoil is stored during the winter rainy season, erosion control measures may be necessary to protect the stockpile. If compacting of a portion of the stockpiles is necessary for stability, compacting will occur to minimum extent necessary.

A small bulldozer or similar equipment will be used to rip and blend the soil materials as necessary. Topsoil will be track walked to stabilize the topsoil material, and then the surface will be scarified to allow for proper seed germination. Topsoil compaction will not be such that its ability to perform as a planting medium will be compromised. To the extent feasible, rocks and plant material in excess of four inches in greatest dimension should be removed from the topsoil.

3.5.4 Organic Amendments and Mulches

Organic amendments such as compost and mulch provide a ready source of carbon and nitrogen to facilitate the presence of microorganisms in the soil, contributing to the essential soil nutrient cycling that facilitates plant growth. Bacteria, fungi, and other microorganisms involved in decomposing organic material increase dramatically when materials such as compost are added to soils. Microorganisms break down the organic matter and in turn provide a supply of nutrients for higher plants.

As described above, existing plant material on topsoil harvest areas can be grubbed, chipped, and incorporated into the topsoil to be stockpiled. Additional potential organic amendments are

described below. These materials may be added as necessary to promote establishment and growth of native vegetation.

Compost

Compost is derived from the biological decomposition of organic material, including such materials as grass and lawn clippings, food overburden, municipal solid overburden, and sewage sludge. Compost is known to enhance macronutrient fertility, improve soil structure, increase infiltration and moisture retention, and improve nutrient exchange capabilities of the soil. When topsoil is not available for use, compost is especially useful as an amendment to enhance soil structure and nutrient composition of the soil substrate. To ensure adequate quality of the compost, if used, it should be certified with the Seal of Testing Assurance by the U.S. Composting Council. Compost is not currently recommended for RPA revegetation.

Mycorrhizal Inoculants

Mycorrhizal fungi grow in beneficial association with plant roots in the soil and form unique structures known as mycorrhizae. The mycorrhizae play an important role in facilitating nutrient transfer from the soil to the plant roots. Mycorrhizal inoculants can be added to the soil to help provide the benefits of mycorrhizae; however, the effectiveness of such inoculants is not well established. To achieve the potential benefits of mycorrhizae, it is recommended that mycorrhizal inoculants or duff collected from vegetative litter at an adjacent site be installed in planting sites. Alternatively, the inoculants can be added to a hydroseed mix.

Slow-release Fertilizers

Fertilizers should be used sparingly on soils which support native plants. Since native plants are accustomed to drought conditions and low levels of nutrients in the soil, the use of fertilizers can promote the presence of exotic weeds which can outcompete native plants. The use of slow-release fertilizers can be suitable for native plants. Slow-release fertilizers release nutrients over a three-month to two-year period of time, providing the appropriate amount of nutrients for native plants. Installing slow-release fertilizer tablets in planting pits is recommended in some reclaimed soil conditions to provide a supplemental nutrient source for container plants. However, when included in broadcasted hydroslurry or mulch treatments, slow-release fertilizers can promote the establishment of grasses which may outcompete trees or shrubs. While this may be desirable in some areas, it could prevent establishment of woodland or shrubland vegetation types in other areas. Therefore slow-release fertilizers should be used sparingly or only in planting pits during revegetation efforts.

Mulch

Mulches include many different materials and can be applied on the soil surface or incorporated into the soil. Surface applications protect a site from erosion but do not have as much effect on soil composition as when they are incorporated into the soil. When incorporated, mulches can act as organic amendments, increasing organic matter content, moisture infiltration, and nutrient cycling. Materials such as straw and wood residues (wood chips, bark, and sawdust) are commonly used as mulch. Straw mulches can be blown on to the surface of the soil and secured with a tackifying agent following hydroseed application.

While wood residues such as chips, bark, and sawdust can provide cheap organic matter for soils, they may not stay in place adequately on steep slopes. A layer of two to three inches of wood and bark mulch is recommended for application around individual tree and large shrub plantings to help exclude weeds, improve moisture retention, and add organic matter to the soil.

The effect of direct mulching around plantings is being tested in test plots, as described in Section 5.0. This treatment would be recommended if it proves to be a cost-effective measure to substantially improve plant survival and establishment.

Bonded Fiber Mulches

The addition of various types of bonded fiber mulches is an available option for blending with hydroseed mixes that could contribute to both plant growth and soil stabilization. The mulches contain wood fibers and other inert materials that retain moisture while maintaining air circulation which promotes seed germination and plant growth. They also add organic material to the growing surface which contributes carbon and other nutrients. Soil-bonding agents are also added to the fiber mulches which provide excellent erosion control. The combined aspects of these materials make them an ideal option suited to the steep and inaccessible slopes in the PCRA. While these products are not currently proposed for use in revegetation, they may be a suitable alternative to fiber rolls on steeper, less accessible slopes.

3.5.5 Timing Restrictions and Recommendations

Topsoil earthwork activities, including soil development work, should occur during the dry season. Topsoil should not be moved or handled when wet. Organic amendments should be applied shortly before seeding and planting, if possible, to ensure optimal microbial activity.

3.5.6 Permanente Creek Reclamation Area Soil Preparation

Because soils in the PCRA have generally had several decades to stabilize since they were disturbed by surface mining operations, and to avoid damage and destabilization to slopes adjacent to the creek from the use of heavy equipment, the application of topsoil blends is not proposed in contrast to other areas that have been more recently disturbed by quarrying operations. These areas will receive hydroseeding that incorporates mulch to increase organic matter.

The mulch retains moisture which promotes seed germination and plant growth. It also contributes organic materials to the growing surface which raise levels of carbon and other nutrients. Bonding agents will also added to the hydroseed mix which helps the seed and mulch mix adhere to the slope surface and promotes erosion control.

Where roads exist in the PCRA, they will be ripped or disced as needed to promote establishment of an appropriate root zone prior to revegetation activities.

3.5.7 Permanente Creek Reclamation Area Erosion Control

In addition to the use of the hydroseeded mulch which will promote erosion control, other standard BMP/erosion control measures are proposed for the PCRA. These erosion control measures include the installation of fiber rolls and erosion control blankets as noted in Table 1, above. Fiber rolls will be installed at 10-15 foot intervals according to the engineering plans. Erosion control blankets will be utilized in Subarea 4 and where appropriate. Silt fencing will also be used temporarily during ground-disturbing activities in Subareas 2, 3 and 5 of the PCRA to ensure that any incidental fallback does not enter the creek. Technical diagrams for the installation of these erosion control measures are included below in Appendix E.

3.5.8 Exploration Area Soil Preparation

Greenfield roads and drill pads were regraded to original contours before native seed was spread over reclamation areas. Hay was spread over exposed soils after seeding to help

prevent erosion and provide microclimates for germination. For roads and pads that have yet to be revegetated, these areas will be regraded to their original contour. This work will be done using soils that were sidecast during road and pad construction.

4.0 REVEGETATION

This section describes plant installation planned for the RPA, with a future revegetation area of approximately 637 acres. Revegetation will focus on returning the RPA to a native plant-dominated habitat similar to surrounding natural areas. Revegetation efforts will be implemented in stages following completion of each stage of overburden placement and soil preparation. Planting and maintenance will be conducted using an adaptive management approach, based on revegetation test plots that were initiated in 2008. A preliminary erosion control stage may be incorporated prior to the revegetation tasks listed below, to allow for specific site revegetation plans to be developed based on the most current test plot results. The native seed mix shown in Table 5 includes species that have proven successful in other revegetation efforts on the Quarry property and is recommended to provide erosion control and initial establishment of native grasses and herbaceous species as needed in temporarily disturbed areas.

Table 5. Proposed erosion control seed mix.

SCIENTIFIC NAME	COMMON NAME	PURE LIVE SEED (lb / acre)
Bromus carinatus	California brome	16.00
Elymus glaucus	blue wildrye	10.00
Lupinus nanus	sky lupine	5.00
Nassella pulchra	purple needlegrass	8.00
Plantago erecta	California plantain	3.00
Trifolium willdenovii	tomcat clover	3.00
Vulpia microstachys	three weeks fescue	8.00
	TOTAL	**53.00**

Appendix B provides an extensive list of native species observed in undisturbed portions of the Quarry property, which may be or have previously been used in revegetation planting or seeding at the Quarry. Propagule availability, lead time needed for nursery production, and results of test plots will help to refine this list. The majority of seed and container plants used in the test plots and in the reclamation revegetation effort will come from on-site sources. To date seed has been collected on-site, contract grown by local seed growing facilities, and the resulting seeds used for revegetation efforts. When onsite seed or plants are not available, local sources are used with an attempt to obtain the most local stock possible. Onsite and local stock is adapted to the specific microclimates of the RPA and reduces genetic mixing with nearby natural vegetation. The general plan for revegetation is to establish grasses, forbs, and shrubs on slopes with tree and shrub container plantings installed in deeper soils on the benches (Figure 4). The cooler north and east facing benches will support the most diverse tree plantings while some of the south facing benches will contain grey pine which can tolerate more extreme conditions.

4.1 Seeding

4.1.1 Project Area Hydroseeding

In the main portions of the RPA (seeding for the PCRA and Exploration Area is described below), contoured surfaces will be covered with native grass, herb, and shrub species via hydroseeding a homogenous slurry of mulch, fertilizer, seed, and a binding agent over the areas to be revegetated. Drainage ditches and access roads will be left bare until the completion of the contouring and slope hydroseeding, at which time roads will be ripped and revegetated. The small area of steep benches in the upper North Quarry will not be recontoured, but they will be hydroseeded. Local seed suppliers have developed appropriate native seed mixes for reclamation and are testing several mixes in the test plots (see Section 5.0). A preliminary hydroseed mix of shrubs and grasses is shown in Table 6, which includes species known to thrive in undisturbed adjacent habitats or observed to perform well in previous revegetation areas and preliminary test plot results. These species should be used, pending availability, for the earliest stages of the proposed reclamation project. Test plot results will be used to further refine and expand the species selection. The hydroseed mix will be applied as necessary over the entire revegetation area, which is approximately 589 acres.

Table 6. Preliminary species for RPA general hydroseeding.

SCIENTIFIC NAME	COMMON NAME	PURE LIVE SEED (lb / acre)	BULK SEED (lb/acre)
SHRUBS			
Artemisia californica	California sagebrush	1.4	16
Baccharis pilularis	coyote brush	0.2	20
Eriogonum fasciculatum	California buckwheat	1.0	20
Salvia leucophylla	purple sage	0.7	2
Salvia mellifera	black sage	1.1	3
GRASSES AND HERBS			
Achillea millefolium	yarrow	1.7	2
Artemisia douglasiana	mugwort	0.1	1
Bromus carinatus	California brome	4.6	6
Elymus glaucus	blue wildrye	4.6	6
Eschscholzia californica	California poppy	1.2	2
Heterotheca grandiflora	telegraph weed	0.2	1
Lotus purshianus	Spanish clover	0.7	1
Lotus scoparius	deerweed	1.5	2
Lupinus nanus	sky lupine	0.8	1
Melica californica	California melic	1.3	2
Nassella pulchra	purple needlegrass	2.9	4
Poa secunda	one-sided bluegrass	1.3	2
Trifolium willdenovii	tomcat clover	1.4	2
Total		**26.7**	**93**

4.1.2 Permanente Creek Reclamation Area Hydroseeding

Hydroseeding will be the primary revegetation method for the majority of the PCRA. Slopes in Subareas 2 and 3 will be track-walked using a sheep's foot attached to a winch. This will help stabilize the slopes and create a planting surface with variable relief and microhabitats to promote seed germination and growth. Hydroseeding will cover slopes with a homogenous slurry of mulch, seed and other growth agents as applicable.

The preliminary hydroseed mix for the PCRA is shown in Table 7. These species have been demonstrated to be suitable for the PCRA as they are currently growing on the pre-SMARA hillsides or were observed to perform well in test plots with similar growth substrates. The hydroseed mix will be applied to disturbed areas in the PCRA identified in Figure 5 where the natural vegetative cover does not provide sufficient protection against erosion control. Areas of existing dense vegetation and rock outcrops or boulders will be excluded from treatment.

Hydroseeding and other reclamation activities in Subareas 3 - 7 will commence following approval of the Amendment in Phase 1, and at the end of Phase 2 in Subareas 1 and 2 after the excavation of the WMSA. The total area of the PCRA that will potentially receive hydroseed is approximately 23 acres. Hydroseeding will be performed between September 1 and December 1 to take advantage of warm soil temperatures and winter rains for successful germination and establishment, and to aid in erosion prevention.

Table 7. Preliminary species for Permanente Creek Reclamation Area general hydroseeding

SCIENTIFIC NAME	COMMON NAME	PURE LIVE SEED (lb / acre)	BULK SEED (lb / acre)
SHRUBS			
Artemisia californica	California sagebrush	1	10
Baccharis pilularis	Coyote brush	.1	6
Eriogonum fasciculatum	California buckwheat	1.5	16
Lotus scoparius	Deerweed	1.5	2
Salvia mellifera	black sage	1.5	4.3
GRASSES AND HERBS			
Achillea millefolium	Yarrow	.75	2
Artemisia douglasiana	Mugwort	.15	1.9
Bromus carinatus	California brome	8	10
Clarkia purpurea ssp. quadrivulnera	winecup clarkia	1	1
Elymus glaucus	blue wildrye	4.6	6
Heterotheca grandiflora	telegraph weed	0.2	1
Lotus purshianus	Spanish clover	3	3.6
Plantago erecta	dotseed plantain	2.5	3
Sisyrinchium bellum	western blue-eyed grass	1	1.4
Vulpia microstachys	small fescue	8	10
Total		34.8	78.2

4.1.3 Exploration Area Reclamation Seeding

The majority of the exploratory drilling pads and roads were reclaimed upon completion of the drilling project in 2008. Drill pads were regraded to original contour and seeded with a native seed mix. Roads were ripped and seeded with native seed. The seed mix and application rates used for the revegetation of the exploratory drill area is shown in Table 8. The exploratory drill areas were assessed in late summer of 2011 and were well vegetated and generally dominated by native vegetation. Portions of the drilling project area that were not reclaimed in 2008 were predominantly historic roads. These areas were winterized upon completion of the drilling project to prevent erosion. The remainder of the drilling project will be revegetation using the same techniques previously described for the main RPA during Phase 1 of the reclamation.

Table 8. Exploration Area Reclamation Seed Mix

SCIENTIFIC NAME	COMMON NAME	PURE LIVE SEED (lb / acre)	BULK SEED (lb / acre)
GRASSES AND HERBS			
Bromus carinatus	California brome	16	21
Elymus glaucus	blue wildrye	10	13
Eschscholzia californica	California poppy	2.5	4.5
Festuca rubra	red fescue	8	11
Lupinus nanus	sky lupine	5	6.5
Trifolium wildenovii	tomcat clover	3	4
Plantago erecta	dotseed plantain	3	4
Vulpia microstachys	small fescue	8	11
Total		55.5	75

4.2 Tree and Shrub Plantings

Trees and shrubs will be planted as container plants or seeds in the revegetation areas. Tree and shrub container plantings will occur on the benches where a deeper layer of topsoil and/or soil-building materials is applied to ensure adequate space for root development. To the extent feasible, trees and shrubs to be planted will be obtained from seeds collected from the Quarry property or from local sources. Approximately 50 acres of the total RPA will be planted as tree and/or shrub container planting areas (Figure 4). Shrubs will be planted at approximately 4.5-foot spacing and trees at 9-foot spacing in the designated planting areas. The remaining slopes and benches will be covered with shallower topsoil and/or soil-building materials and hydroseeded with a grass/herb/shrub seed mix, without containerized tree and shrub plantings.

The north-facing benches can support a wider variety of tree and shrub species since they have less solar radiation and higher soil moisture (Figure 2). These north-facing benches will be revegetated with approximately 6.5 acres of oak-dominated plantings along with hydroseed. A target quantity of approximately 1,745 oak trees is scheduled to be planted in these areas, in addition to other native tree species. The oaks will be a mixture of acorn and container plantings. East-facing benches normally support some oak woodland habitat but given the existing conditions with no shade and intense solar radiation, planted oaks would likely have high mortality in these areas. Therefore approximately 21.7 acres of more visible east-facing benches will be planted with 75 percent (approximately 8,660) grey pine (*Pinus sabiniana*), a native tree species that is tolerant of drier conditions, along with 25 percent other native tree and shrub plantings common to oak woodland habitats. The grey pines will establish more

readily than oak seedlings in the sunnier and harsher conditions on the south-facing benches. As the pines develop they will provide a protected microclimate that will support oak woodland establishment and development that should occur over time through natural recruitment. This successional approach will facilitate more rapid woodland revegetation in more highly visible areas while allowing eventual oak woodland establishment.

The need for herbivory protection for specific species will be evaluated based on the results of test plots and early stages of the proposed reclamation project. Weed mats or several inches of mulch may be placed around planted trees and shrubs to reduce competition and retain moisture. The benefit of mulch applications are currently being tested in the test plot program.

This plan is designed to provide appropriate conditions for native species so that they are not dependent upon irrigation. The need for irrigation during initial establishment will be assessed during the test plot monitoring and adaptive management reclamation efforts. DriWater gel pac irrigation systems are currently being tested in the test plots. DriWater is a biodegradable silica-based product that is buried next to the plants and slowly releases stored water into the soil. By planting a large number of acorns without irrigation, a more drought-tolerant stand of oaks may be established, increasing the chances of their survival. However, if monitoring during the first five years of the early revegetation stages and test plots indicate significant losses of plant material that threatens achievement of performance standards, the need for irrigation will be re-evaluated.

As with hydroseeding, adaptive management will be used to determine which tree and shrub species will be planted, the most effective spacing and location, and species to use in replacement plantings if necessary. A preliminary list of trees and shrubs to be planted on benches of the RPA is provided in Table 9. Species selection and numbers will depend on propagule collection and availability, as well as on test plot results.

Sudden Oak Death (SOD) has been observed within the Permanente Quarry property, and many oak trees in the RPA are foliar hosts of *Phytophthora ramorum*, the pathogen that causes SOD syndrome, including coast live oak and canyon live oak. Foliar hosts are thought to be an important component in spreading SOD as the pathogen can fruit (sporulate) within one to three days on infected foliage. Known or suspected hosts of *P. ramorum* are listed by the California Oak Mortality Task Force (COMTF 2008). Species not known to be susceptible to *P. ramorum* (such as Valley oak, blue oak, and grey pine) will be more heavily represented in revegetation plantings than might be present in the RPA to reduce the susceptibility of the revegetation program. Mitigation measures for the RPA will include measures to prevent spread of SOD outside of the Permanente Quarry property.

4.3 Riparian Revegetation

4.3.1 Project Area Riparian Vegetation

The RPA reclamation design includes created drainage channels and detention ponds to carry and temporarily store stormwater runoff. Some of these features may have sufficient hydrology to support wetland or riparian vegetation. Those areas will be revegetated primarily with willows (as poles or container stock). The narrow riparian corridors along the drainages will also support many of the same species utilized in tree and shrub plantings, particularly the oaks, toyon, and coffeeberry, in addition to California buckeye. As the drainages approach Permanente Creek, there may be opportunities to plant flatter wetland benches as well. Table 10 lists species that may be appropriate for planting or seeding along the drainages.

Table 9. Preliminary trees and shrubs for planting on RPA benches.	
SCIENTIFIC NAME	COMMON NAME
TREES (may use acorns instead of container planting for some oaks)	
Arbutus menziesii	Pacific madrone
Pinus sabiniana	grey pine
Quercus agrifolia	coast live oak
Quercus chrysolepis	Canyon live oak
Quercus douglasii	blue oak
Quercus lobata	Valley oak
Quercus wislizenii	Interior live oak
SHRUBS*	
Cercocarpus betuloides	mountain mahogany
Heteromeles arbutifolia	Toyon
Quercus berberidifolia	scrub oak
Rhamnus californica	California coffeeberry
Rhamnus crocea	Redberry
Ribes californicum	Hillside gooseberry
Ribes malvaceum	chaparral currant

* Shrub species selection may change based on the success of seeded shrubs in test plots. If seed germination and establishment success of some shrub species is poor in the test plots, these shrub species may be tested as container plants.

The riparian areas with sufficient hydrology to support riparian habitat will most likely be along the reclaimed North Quarry floor. The total area that may support riparian species is dependent on the hydrology of the reclaimed areas which will be determined once final contours have been constructed.

4.3.2 Permanente Creek Reclamation Area Riparian Vegetation

Riparian vegetation will also be planted in appropriate areas in the PCRA. The PCRA contain ephemeral channels that drain to Permanente Creek, and some of the PCRA lead down to the edge of Permanente Creek. Due to the ephemeral nature of these channels, the upper areas tend to not support riparian-specific vegetation. However, the lower reaches of a few of the drainages may have sufficient flow to support some riparian vegetation such as willows. These will primarily be below sediment basin outfalls where larger quantities of water will accumulate and be discharged. Willows will be planted as poles and will add long term structural support to the drainages (see Appendix E for planting details). Other species of riparian trees or shrubs may also be added as appropriate for specific areas as seeds or container stock. Several of the PCRA Subareas contain portions of Permanente Creek that will be restored under this revegetation plan. These reaches will be recontoured, a new channel will be graded as necessary, anthropomorphic structures and fill will be removed, and the new channel will be planted with wetland and riparian species to create restored habitats similar to other portions of the creek. Appendix F has a more detailed explanation of the conceptual approach of the creek restoration. Table 11 below lists species that may be appropriate for planting or seeding along the drainages.

Table 10. Preliminary species for planting along Project Area ephemeral drainages and detention basins.	
SCIENTIFIC NAME	COMMON NAME
TREES	
Aesculus californica	California buckeye
Quercus agrifolia	coast live oak
Quercus chrysolepis	canyon live oak
Quercus lobata	Valley oak
Quercus wislizenii	interior live oak
Salix laevigata	red willow
Salix lasiolepis	arroyo willow
SHRUBS	
Heteromeles arbutifolia	Toyon
Rhamnus californica	California coffeeberry
Rosa californica	California rose
Sambucus mexicana	blue elderberry
GRASSES AND HERBS	
Artemisia douglasiana	mugwort
Carex barbarae	valley sedge
Carex praegracilis	field sedge
Cyperus eragrostis	tall flatsedge
Hordeum brachyantherum	meadow barley
Juncus effusus	bog rush
Juncus patens	common rush
Leymus triticoides	creeping wildrye

Table 11. Preliminary species for planting along Permanente Creek reclamation area ephemeral drainages and detention basins.	
SCIENTIFIC NAME	COMMON NAME
TREES	
Aesculus californica	California buckeye
Salix laevigata	red willow
Salix lasiolepis	arroyo willow
Acer macrophyllum	big leaf maple
SHRUBS	
Heteromeles arbutifolia	Toyon
Rhamnus californica	California coffeeberry
Rosa californica	California rose
Sambucus mexicana	blue elderberry

4.4 Timing

All hydroseeding should be performed and completed between September 1 and December 1 to take advantage of warm soil temperatures and winter rains for successful germination and establishment. Container planting should be performed during the winter season and completed by approximately the end of January to improve plant establishment.

5.0 TEST PLOT PROGRAM

The California Code of Regulations Section 3705 (b) requires that test plots be implemented if a proposed revegetation plan has not been demonstrated to work in similar situations elsewhere. A test plot program has been established in the RPA to determine appropriate materials and techniques to improve revegetation success throughout areas to be reclaimed. The specific objectives of the test plots are to assess the response of native seed mixes and container tree and shrub plantings to various soil blends and depths, using the available materials evaluated as described in Section 3.0.

Sixteen test plots were constructed on top of bare graded overburden rock at two locations within the RPA in the fall of 2008. Plots 1-12 and 16 were constructed at the relatively flat "Yeager Yard" site, and plots 13-15 were constructed at a sloped location within the EMSA (Figure 6). To test the response of the seed mixes and plantings to various soil treatments, the test plots each differ by soil composition and depth of soil. The soil treatments consisted of a combination of materials, including overburden rock, North Quarry fine greenstone material, rock plant fines, and imported compost. Each test plot was divided into four equal quadrants upon which four different native seed mixes were applied, followed by straw mulch and a hydroslurry of fertilizers and a tackifier. In addition, container plantings were installed in the 24-inch depth test plots (11, 12, and 16) in November 2009.

A summary of the test plot program is provided below. Additional details on design, construction, maintenance, and monitoring can be found in the *Revegetation Test Plot Program*

As-built Report (WRA 2010). A five year monitoring program will evaluate the performance of each soil blend and planting palette, to inform future revegetation efforts.

5.1 Test Plot Design and Soil Treatments

The basic test plot design is similar at both the Yeager Yard and EMSA sites. The border of each test plot was outlined by certified weed-free straw bales. At Yeager Yard, plots 1-12 are each 50-foot (ft.) by 50-ft. squares, and plot 16 is a 25-ft. by 25-ft. square. At the EMSA, plots 13 and 14 are 100-ft. by 100-ft. squares, and plot 15 is a slightly reduced size due to site constraints (100 ft. x 100 ft. x 100 ft. x 40 ft.). The soil materials specific to each plot treatment were laid down and mixed on site as described below.

Test plot soil blends are comprised of various combinations of overburden rock, North Quarry fine greenstone, and Rock Plant fines originating from Quarry operations, as well as compost delivered from offsite. The soil treatments for all plots are listed in Table 12. Plots 1-6 and 10 are six inches in depth, plots 7-9 are 12 inches in depth, and plots 11, 12, and 16 are 24 inches in depth. At the EMSA site, plots 13, 14, and 15 are all six inches in depth.

The materials were blended together with construction equipment within each test plot to achieve a relatively uniform consistency. For the plots with multiple materials blended together, each material was added separately and then ripped or blended with the other material in sequence. The rock plant fines material included some consolidated chunks which required pulverizing before blending. Rocks over six inches in diameter were removed from the plots to the extent possible. The plots were compacted to approximately 90% and were finish graded to a smooth surface.

Following application of the soil blends, each plot was divided into four quadrants of equal area using six-inch certified weed-free straw wattles. Plots were numbered with a sign at the center of each plot. A stake was placed in the center of each quadrant and painted green, red, yellow, or blue to indicate the native seed mix applied to that quadrant. The test plot layouts at the Yeager Yard site and the EMSA are shown in Figures 7 and 8, respectively.

Table 12. Test plot soil treatments.

PLOT NUMBER	PLOT SIZE	SOIL TREATMENT DEPTH	MATERIAL COMPONENTS	COMPONENT PROPORTIONS	COMPONENT DEPTH (BEFORE BLENDING)
YEAGER YARD (flat)					
1	50' x 50'	6”	overburden rock	100%	6"
2	50' x 50'	6”	overburden rock compost	75% 25%	4.5" 1.5"
3	50' x 50'	6”	overburden rock compost	50% 50%	3" 3"
4	50' x 50'	6”	overburden rock Rock Plant fines Compost	35% 40% 25%	2" 2.5" 1.5"
5	50' x 50'	6”	fine greenstone compost	75% 25%	4.5" 1.5"
6	50' x 50'	6”	overburden rock Rock Plant fines fine greenstone compost	33% 17% 25% 25%	2" 1" 1.5" 1.5
7	50' x 50'	12”	overburden rock compost	75% 25%	9" 3"
8	50' x 50'	12”	overburden rock fine greenstone compost	37.5% 37.5% 25%	4.5" 4.5" 3"
9	50' x 50'	12”	overburden rock Rock Plant fines fine greenstone compost	25% 25% 25% 25%	3" 3" 3" 3"
10	50' x 50'	24”	overburden rock compost	75% 25%	18" 6"
11	50' x 50'	24”	fine greenstone compost	75% 25%	18" 6"
12	50' x 50'	24”	overburden rock Rock Plant fines fine greenstone compost	25% 25% 25% 25%	6" 6" 6" 6"
16	25' x 25'	24”	overburden rock fine greenstone compost	37.5% 37.5% 25%	9" 9" 6"
EMSA (sloped)					
13	100’ x 100’	6”	overburden rock compost	75% 25%	4.5" 1.5"
14	100’ x 100’	6”	overburden rock Rock Plant fines Compost	35% 40% 20%	2" 2.5" 1.5"
15	100’ x 100’ x 100’ x 40’	6”	fine greenstone compost	75% 25%	4.5" 1.5"

5.2 Seed and Amendment Application

A native shrub mix was applied manually with a belly grinder to all of the plots; the components of this mix are listed in Table 13. Four different native grass and herbaceous seed mixes were then applied manually with a belly grinder within the allocated quadrants of each plot. Components of these seed mixes are provided in Table 14. Following seeding at the test plots, straw mulch and a hydroslurry consisting of fertilizers and a tackifier was applied to all of the plots. At the EMSA site only, a mycchorhizal inoculant was included in the hydroslurry. The application rates of the straw and hydroslurry components are listed in Table 15.

Table 13. Native shrub seed mix applied to all test plots.

SCIENTIFIC NAME	COMMON NAME	PURE LIVE SEED (lb / acre)
Adenostoma fasciculatum	Chamise	1.50
Artemisia californica	California sagebrush	1.00
Artemisia douglasiana	Mugwort	0.10
Baccharis pilularis	coyote brush	0.10
Ceanothus cuneatus	Buckbrush	2.00
Eriodictyon californicum	yerba santa	0.50
Eriogonum fasciculatum	California buckwheat	1.50
Heteromeles arbutifolia	Toyon	3.00
Mimulus aurantiacus	sticky monkeyflower	0.10
Salvia mellifera	black sage	1.00
	TOTAL	**10.80**

Table 14. Grass and herbaceous seed mixes applied to test plot quadrants.

SCIENTIFIC NAME	COMMON NAME	PURE LIVE SEED (lb / acre)
Native Seed Mix #1 (green quadrant)		
Achillea millefolium	white yarrow	0.75
Bromus carinatus	California brome	8.00
Clarkia purpurea ssp. *quadrivulnera*	Clarkia	0.75
Elymus glaucus	blue wildrye	6.50
Heterotheca grandiflora	telegraph weed	0.15
Lotus purshianus	Spanish clover	2.50
Lotus scoparius	Deerweed	4.00
Lupinus nanus	sky lupine	1.50
Nassella pulchra	purple needlegrass	3.00
Oenothera hookeri	evening primrose	1.25
Plantago erecta	California plantain	2.50
Vulpia microstachys	three weeks fescue	4.00
	TOTAL	**34.90**

Native Seed Mix #2 (red quadrant)		
Bromus carinatus	California brome	20.00
Elymus glaucus	blue wildrye	8.00
Vulpia microstachys	three weeks fescue	6.00
Trifolium willdenovii	tomcat clover	4.00
	TOTAL	**38.00**
Native Seed Mix #3 (yellow quadrant)		
Achillea millefolium	white yarrow	1.00
Bromus carinatus	California brome	10.00
Clarkia purpurea ssp. *quadrivulnera*	Clarkia	0.76
Elymus glaucus	blue wildrye	10.00
Lotus purshianus	Spanish clover	3.00
Lotus scoparius	Deerweed	6.00
Lupinus nanus	sky lupine	3.00
Oenothera hookeri	evening primrose	2.00
Vulpia microstachys	three weeks fescue	4.00
	TOTAL	**39.76**
Native Seed Mix #4 (blue quadrant)		
Achillea millefolium	Yarrow	1.00
Bromus carinatus	California brome	9.00
Elymus glaucus	blue wildrye	8.00
Eriogonum nudum	naked buckwheat	0.25
Eriophyllum confertiflorum	golden yarrow	0.05
Festuca occidentalis	western fescue	6.00
Leymus triticoides	creeping wildrye	2.00
Lotus purshianus	Spanish clover	3.00
Melica californica	California melic	3.00
Plantago erecta	California plantain	3.00
Poa secunda	one-sided bluegrass	3.00
Scrophularia californica	Beeplant	0.25
Sisyrinchium bellum	blue eyed grass	1.00
Vulpia microstachys	three weeks fescue	8.00
	TOTAL	**47.55**

Table 15. Mulch and hydroslurry application rates used in test plots.	
TREATMENT	APPLICATION RATE (lb / acre)
Weed-free sterile wheat straw mulch	4000
“Fiber Wood” organic mulch	2000
Plantago-based M-binder (tackifier)	200
42-0-0 Sulphur-coated urea	175
0-0-50 Sulfate “potash”	175
mychorrhizal inoculant (EMSA site only)	120

5.3 Test Plot Plantings

Plants were installed in the test plots by a landscape contractor in November 2009. Plants were installed in the 24 inch-deep soil treatment plots 11, 12, and 16. The planting design was arranged to ensure that two of each species was tested within each soil and plant care treatment combination. Planting space was very limited in the smaller-sized Plot 16, so a simplified planting and treatment scheme was devised for this plot. A plant list for the completed plant installation is provided in Table 16.

Table 16. Trees and shrubs installed in test plots in November 2009.

SCIENTIFIC NAME	COMMON NAME	SIZE*	PLOT 11	PLOT 12	PLOT 16	TOTAL NUMBER
Arbutus menziesii	Pacific madrone	DP	8	8	3	19
Pinus sabiniana	grey pine	TB	8	8	3	19
Quercus agrifolia	coast live oak	TP	8	8	3	19
Quercus douglasii	blue oak	LT6 (two LT4)	8	8	3	19
Cercocarpus betuloides	mountain mahogany	TB	8	8	3	19
Heteromeles arbutifolia	toyon	1G	8	8	3	19
Quercus berberidifolia	scrub oak	TB	8	8	3	19
Rhamnus californica	coffeeberry	TB	8	8	3	19
Ribes californicum	hillside gooseberry	TB	8	8	3	19
		TOTAL	72	72	27	171

*DP = 10” tall DeePot; TB = 5.5” tall treeband; TP = 14” tall 1 gallon Treepot; LT6(4) = 6(4)” deep leach tube; 1G = one gallon pot

General planting guidelines for RPA revegetation specify planting trees on a minimum of 9-foot centers, with shrubs interspersed among the trees at 4.5-foot centers. The test plots are not likely to be maintained for more than 5 to 10 years, so the test plot design did not need to account for the expected full-grown size of these specimens. Therefore, plants were installed in a grid pattern with spacing between plants ranging from 3.5 to 5 feet. The plantings were concentrated in the center of each plot to prevent competition with seed treatments on a portion of each plot quadrant. Small container sizes with high depth to width ratios were selected, as availability allowed, to improve survival and mimic likely large-scale planting conditions.

In addition to planting, two types of plant care treatments were installed in various combinations in each plot. These treatments include applying mulch and using DriWater gel pacs, a biodegradable silica-based product that is buried next to the plants and slowly releases stored water into the soil. The straw wattles delimiting the four seed treatment quadrants in each plot were used to designate plant care treatment combinations. Each plot includes four different treatment combinations: mulch only (yellow quadrant), DriWater only (green quadrant), mulch and DriWater (blue quadrant), and no treatment (red quadrant). Due to the small size of Plot 16, planting was limited to one individual of each species per treatment, and a combined mulch and DriWater treatment was not installed in the blue quadrant.

Weed control in areas surrounding the test plots will be conducted to prevent invasion from species that will also be targeted in future revegetation efforts. Weeding conducted within plots will be conducted in all plots for uniformity.

5.4 Preliminary Test Plot Results

Trends observed in the first two years of test plot monitoring indicate that all soil materials added to overburden rock help to increase total plant cover and grass cover in particular. While shrub cover was low after the first two years, shrub density was fairly high with many small individuals observed. A higher cover of grasses appears to suppress shrub establishment, which is particularly true in plots with higher percentages of compost. Deeper and richer compost-laden plots mimic grassland soils more so than typical scrub soils which promotes grass growth. Test plots with larger amounts of overburden rock supported lower cover, fewer grasses, and a greater number of shrub seedlings, although they are small and develop slowly. The preliminary results were used to refine the recommended hydroseed mixes listed in Section 4.0. In particular, species that were seeded but never observed were omitted from the proposed plant palette while species that performed well were retained. The quantity of some native annual grass seed was reduced to prevent overcompetition with shrubs, a target natural community.

6.0 MONITORING

6.1 Installation Monitoring

To ensure adherence to the guidelines of this revegetation plan, all implementation activities will be monitored by a qualified individual. Records will be kept of soil-building treatments applied, addition of soil amendments as determined to be necessary, and all plant and seed installation. Hydroseed records will include identification of the date of application and a description and map of the location where various seed mixes are applied. Additionally, installation of tree and shrub plantings will be documented to identify the location and approximate area planted, and the number of trees or shrubs planted or seeded.

6.2 Vegetation Monitoring

6.2.1 Project Area Vegetation Monitoring

Monitoring must be performed to document revegetation success. Following installation, each revegetation area will be monitored at least three times during the following five year period. Contouring and revegetation will be conducted in stages; therefore, monitoring of each stage will be stratified, commencing in a particular revegetation area upon completion of installation. Each stage will be monitored at least three times during the following five year period after installation, and until the area meets performance standards for two consecutive years without

intervention. Revegetation sites shall be identified on a map and monitored to assure that standards are adequately achieved to within a minimum 80 percent confidence level as required by Reclamation Standards.

Tree and Shrub Planting Areas – Randomly selected plots will be monitored in planting areas, with the number of plots sampled suitable to attain 80 percent confidence in data results. In addition, both north- and south-facing areas should be represented in sampling. All container planting areas will be sampled using a nested approach as utilized in reference site data collection; other sampling methods may be used but will require appropriate conversion of native species richness standards. The nested approach means that once a plot center is randomly selected, trees are assessed within a ten meter radius, shrubs within a five meter radius, and herbs within a one meter radius from the plot center. Monitors will identify and count all trees and shrubs surviving in their respective plots. Cover of all tree, shrub, and herb species within each layer will be estimated within each respective plot, and all species will be identified to the extent possible.

Hydroseed areas - Sampling plots will be selected randomly throughout the areas hydroseeded with grasses, herbs, and shrubs to determine native species richness and percent cover of each species. As with the planting areas, sampling will occur in nested plots, with shrubs assessed within five meter radius and herbs within a one meter radius from the plot center. The number of plots for each installation stage will be selected in order to achieve an 80 percent confidence level in the performance results. Stratification of sampling areas may be necessary if the mix of shrubs and herbs varies greatly in different areas either due to variation in hydroseed applications or soil or other site conditions. For example, areas strongly dominated by herbs and grasses may instead be monitored using smaller sampling plots appropriate to grasslands.

Revegetated areas will be monitored in late spring or early summer to ensure that most plants will be identifiable to the species level. Monitoring will be conducted by a qualified biologist with experience in plant identification. After monitoring data has been collected, a report summarizing the success of revegetation efforts, comparison of data to Year 5 performance standards, any observed obstacles to achieving performance standards, and any remedial actions recommended will be prepared and submitted to Lehigh by October 15 of that year. This will allow for proper timing of remedial plantings and/or seeding if determined to be necessary.

6.2.2 Permanente Creek Reclamation Area Vegetation Monitoring

Monitoring in the PCRA relies on the same methods applied to the RPA as a whole. Information regarding the initial PCRA hydroseeding and riparian restoration will be recorded for future reference and to track the success of vegetation against the performance standards. Planting records will include the date of the application and a description and map showing where seed mixes and plantings were applied. Monitoring will occur at least three times in the five year period following initial hydroseeding. Monitoring will be conducted by a qualified biologist in late spring or early summer to ensure that plants are identifiable.

The success of hydroseeding will be tracked using randomly-selected sampling plots to determine native species richness and percent cover of each species. Sampling will occur in nested plots, with shrubs assessed within five meter radius and herbs within a one meter radius from the plot center. Success in the restored riparian portions of Permanente Creek will also be assessed with random plots as discussed in the tree and shrub planting description of Section 6.2.1 above. The number of plots for each installation stage will be selected in order to achieve an 80 percent confidence level in the performance results.

Monitoring data collected during monitoring activities will be contained in a report to the operator. The report will summarize the success of revegetation efforts, including a comparison of data to "Year 5" performance standards and any observed obstacles to achieving performance standards with corrective recommendations. The report will be submitted by October 15 of that year to allow for any remedial seeding.

Monitoring will cease when revegetated areas in the PCRA meet the performance standards listed below for two consecutive years without intervention. Maintenance will consist of reseeding areas that do not meet performance standards within five years after initial seeding. Underperforming areas will be reevaluated to determine the measures necessary to improve performance, and reseeded or replanted as needed.

6.2.3 Exploration Area Revegetation Monitoring

Preliminary monitoring of the drill project revegetation areas occurred in October 2011. Although sampling plots were not conducted to measure average cover and species assemblage, field observations indicated a very successful revegetation effort to date. Reclaimed areas supported significant plant cover and native species composition. Formal monitoring will commence upon completion of revegetation of the drilling project area, concurrent with monitoring of other portions of the Phase 1 reclamation. The same methodology described in Section 6.2.1 above for the hydroseeded areas will be used here.

6.3 Performance Standards

6.3.1 Project Area Performance Standards

Performance standards describe the minimum targets for species richness and percent cover for hydroseed and planting areas. Performance standards represent anticipated conditions five years after installation, based on a study of reference sites in the vicinity conducted by WRA and preliminary test plot results. SMARA requirements state that performance standards must be met for two consecutive years without significant human intervention prior to release of financial assurances. Revegetation of approximately 589 acres in the RPA is intended to create approximately 40 percent coverage of native tree and shrub habitat interspersed among grasses within five years of installation. Planting areas on south-facing benches of the RPA would be dominated by shrubs while planting areas on north- and east-facing benches will eventually be dominated by trees and shrubs.

Reference site data were used to create a science-based and achievable set of performance standards (Table 17). Native species richness targets have been chosen to reflect data collected from the reference sites and preliminary test plot results. These densities and percent cover values reflect the expected growth of trees and shrubs in the first five years of the revegetation areas.

Reference data values for percent cover and density of trees and shrubs describe mature woody communities that have not seen significant disturbance in decades. While the target plant communities of the revegetation areas should eventually blend with these mature communities, they cannot be expected to achieve similar characteristics over only five years of growth. Instead, shrub and tree planting areas are designed to mimic pioneering plant communities that will continue to develop and dominate the benches and slopes over several decades through tree growth and natural regeneration.

Table 17. Proposed five-year performance standards for RPA Project Area revegetation								
	Oak Woodland (north- and northeast-facing benches)		Pine Woodland (east-facing benches)		Hydroseed Areas shrub/grassland mix		Riparian Areas	
	Woody Plants	Herbs	Woody Plants	Herbs	Woody Plants	Herbs	Woody Plants	Herbs
Richness *(avg. native species per plot)***	5	3	4	3	3*	3*	4	3
Density *(avg. native individuals per acre)*	470	-	345	-	-	-	470	-
Canopy Cover	40%		40%		40%*		40%	

* Performance standards for hydroseed areas may need to be adjusted to reflect feasible five-year results of the species mix ultimately selected based on test plot results and early revegetation efforts during the reclamation period. In particular, the balance between shrub and herbaceous species cover may vary.
** Richness standards are based on plot sizes used in reference data collection and described in this Plan: 10m-radius plots for trees, 5m-radius plots for shrubs, and 1m-radius plots for herbs/grasses.

6.3.2 Permanente Creek Reclamation Area Performance Standards

Specific performance standards have been developed for the PCRA (Table 18). These standards describe the minimum targets for species richness and percent cover for hydroseeded areas. Performance standards represent anticipated conditions five years after installation. The standards selected for species, cover and density represent what is reasonably achievable in the PCRA in light of the past disturbance, current vegetation conditions, and avoidance of significant earth-moving work.

Table 18. Proposed five-year performance standards for RPA Permanente Creek Reclamation Area revegetation			
	Hydroseed Areas		Riparian Area
	Shrub	Herb	Trees/Shrubs
Richness (avg. species per plot)	2	2	2
Canopy Cover	45%	45%	45%
Density (avg. individuals per acre)	200	NA	200
Percent Survival of planted individuals	NA	NA	60%

6.3.3 Exploration Area Revegetation Performance Standards

Specific performance standards have also been developed for the drill project revegetation efforts. Since the drill project impacted small areas in a native-dominated community situated on cooler, north-facing slopes, revegetation of this area is anticipated to occur more rapidly than in other areas of the RPA. Therefore vegetation cover performance standards (Table 19) are

slightly higher than the other areas covered in the Reclamation Plan. Since the seed mix used in the exploratory drilling project was a hand-broadcast native herb and seed mix, not stem density performance criterion is included. However natural recruitment of native shrubs in the reclaimed roads and pads is already evident.

Table 19. Proposed five-year performance standards for RPA Exploration Area revegetation	
	Broadcase Seeded Areas
	Herb
Richness (avg. species per plot)	2
Canopy Cover	60%
Density (avg. individuals per acre)	NA

6.4 Performance Standards for Weed Control

In addition to vegetation monitoring to assess the success of revegetation efforts, the density of weeds (non-native invasive plants) will be assessed as part of vegetation sampling described in Section 6.2.

Reference plots were surveyed by WRA in undisturbed natural grassland habitat in and adjacent to the Quarry property to assess native and non-native species richness and cover. The reference plots contained 28 species, 13 of which were non-native, and an additional 8 are listed as invasive species in the California Invasive Plant Council's (Cal-IPC) Inventory (Cal-IPC 2006). Although two of the seven native species recorded had the highest cover, the next ten species with the highest cover were non-native or invasive species. Non-native and invasive species accounted for over 50 percent of the vegetative cover. Therefore performance standards were developed that took this information into account.

6.4.1 Project Area Weed Control Performance Standards

For the purposes of RPA maintenance and monitoring, non-native non-graminoid plants listed in the Cal-IPC Inventory (2006) as highly invasive will be considered invasive weeds subject to control and performance standards. If invasive weeds are found to exceed a combined 10 percent relative cover over all sampled quadrats in the RPA Project Areas, weed abatement activities will commence. The following species in particular have been identified as invasive species present on the quarry property and should be included as subject to this performance standard: yellow star thistle (*Centaurea solstitialis*, annual), black mustard (*Brassica nigra*, annual), stinkwort (*Dittrichia graveolens*, annual), pampas grass (*Cortaderia* spp., perennial), and fennel (*Foeniculum vulgare*, perennial). Although some of these species are only listed as moderately invasive by Cal-IPC, they should be managed promptly because they are currently present in large numbers in the RPA and could impede establishment of native cover.

6.4.2 Permanente Creek Reclamation Area Weed Control Performance Standards

The PCRA is partially vegetated and partially bare ground. The vegetated areas are comprised of native grasses and shrubs, in addition to yellow star thistle on several of the slopes. Given the steepness of the slopes and their rocky nature, access by personnel for weed control is not

recommended. Many of these slopes and the associated vegetation will be removed during reclamation as the areas are returned to their original grade. While the remaining slopes may support invasive species, these plants contribute valuable carbon and other nutrients to the rocky soils which is needed for plant growth and development. The hydroseed mix will add additional plant growth amendments and native seed mixes to the areas as well. As the native seeded shrubs begin to grow and mature, they will start to shade out and outcompete the smaller yellow star thistle which needs ample sunlight for growth. Therefore, as native plants thrive on the slopes, invasive species will diminish in their amount of cover naturally.

The areas adjacent to Permanente Creek are more accessible and should be assessed for invasive species and controlled as needed. Therefore, during the periodic monitoring visits, the riparian areas within the PCRA should be checked for weeds. If weeds (defined as non-native non-graminoid plants listed in the Cal-IPC Inventory (2006) as “highly invasive” exceed 10% total cover throughout the riparian portion of the PCRA, weed abatement activities should commence. These are discussed in the maintenance section, below.

6.4.3 Exploration Area Weed Control Performance Standards

For the purposes of Exploration Area maintenance and monitoring, non-native non-graminoid plants listed in the Cal-IPC Inventory (2006) as highly invasive will be considered invasive weeds subject to control and performance standards. If invasive weeds are found to exceed a combined 10 percent relative cover over all sampled quadrats in the Exploration Area, weed abatement activities will commence. The same species listed in the Project Area Weed Control Performance Standards (6.4.1) above should be included as subject to this performance standard and should be managed promptly because they are currently present in large numbers on the quarry property and could impede establishment of native cover.

6.5 Adaptive Management

The operators responsible for revegetation efforts to date in the RPA have experienced success with adaptive strategies. The strategy described above may prove to be less efficient than other strategies developed at a later date. Therefore, if a different planting strategy is implemented in the RPA in which the above performance standards and monitoring guidelines cannot be followed, a revision to this revegetation plan will be submitted as a substitute for this document or portions thereof.

7.0 MAINTENANCE

Maintenance of revegetation areas across the site will take place as necessary based on post-revegetation monitoring and the evaluation of meeting performance standards.

7.1 General Maintenance

Maintenance of revegetation areas shall consist of reseeding or replanting unsuccessful revegetation efforts, weed control to limit the extent of noxious weeds, and repair of erosion damage. If any significant rills or gullies are identified in the RPA, remedial actions will include reseeding of the area with an approved erosion control seed mix, and if necessary, slope stabilization measures will be undertaken.

If revegetation efforts are not successful with regard to the performance standards outlined in Section 6.3 of this report within five years following initial seeding, the under-performing areas will be reevaluated to determine the measures necessary to improve performance. If

necessary, these areas will be reseeded and/or replanted with methods modified as needed. This may include the use of container stock and irrigation or simply additional seeding during a wet winter season. Prior to reseeding, the operator shall evaluate previous revegetation practices to identify cultural methods to benefit the overall revegetation effort. If, after a site is reseeded, revegetation efforts still do not yield satisfactory results, additional reseeding or other intervention methods may be required.

Weed control is necessary to reduce the occurrence of undesirable non-native species of plants that may invade the RPA where disturbance has removed the native plant cover and where active and natural revegetation is taking place. Weeds (non-native, and usually invasive, species) can compete with native plant species for available moisture and nutrients and consequently interfere with revegetation efforts. However, many weeds are common in both the surrounding active Quarry and adjacent natural open space lands.

As described in Section 6.4, species listed by Cal-IPC (2006) as highly invasive will be considered problematic and will be targeted during maintenance of this revegetation effort if they exceed the designated threshold of ten percent cover. Invasive plant species typically found in the RPA and in surrounding lands include yellow star thistle (*Centaurea solstitialis*, annual), black mustard (*Brassica nigra*, annual), stinkwort (*Dittrichia graveolens*, annual), pampas grass (*Cortaderia* spp., perennial), and fennel (*Foeniculum vulgare*, perennial).

Weed control methods may include chemical and mechanical removal techniques depending on the species and number of individuals encountered. Priorities in weed abatement should focus on those species listed as highly invasive, in addition to other weeds that directly threaten the successful establishment and survival of native species. The percent cover of weeds, abatement measures recommended and undertaken, and other observations on weed control will be included in vegetation monitoring reports. Weed abatement responsibilities may cease once performance standards have been met for each phase of revegetation efforts, unless invasive species in completed revegetation areas are deemed a threat to nearby efforts still in progress.

7.2 Permanente Creek Reclamation Area Maintenance

The PCRA slopes are anticipated to receive limited general maintenance due to steep slopes in the area. Annual monitoring to ensure erosion control is performing adequately is recommended. If any major erosion is evident, reapplication of hydroseed slurry is recommended. Biannual observation of fiber rolls adjacent to Permanente Creek during the rainy season will ensure that sediments do not enter receiving waters. Replacement of fiber rolls as needed should be conducted to maintain erosion and sediment control. The planted riparian vegetation should be replaced as needed to meet PRCA performance standards. When weeds exceed 10% cover in the riparian areas of the PRCA, weed abatement activities should commence. Weed abatement can be achieved best by early detection and removal to reduce the potential for additional seed set. Removal of weeds should be done by hand or mechanically in the riparian area. If seed heads are present on the plants the material should be bagged and disposed of off site.

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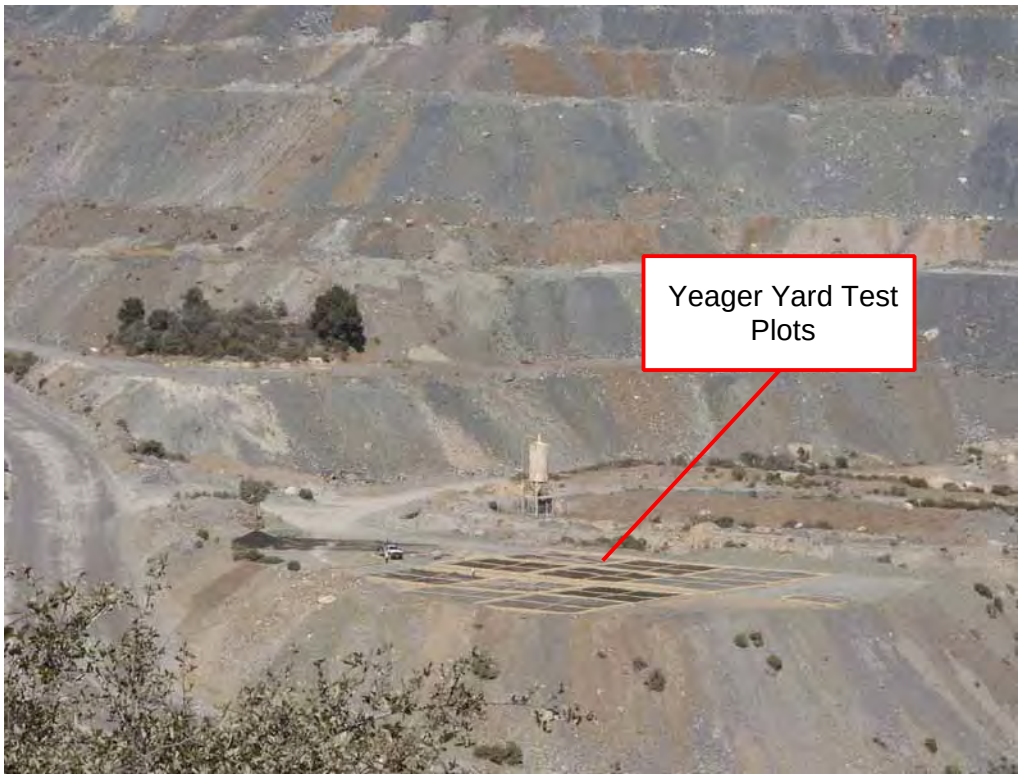
APPENDIX A

PHOTOGRAPHS OF TEST PLOTS

AND PREVIOUS REVEGETATION SITES



Appendix A - Revegetation and Test Plot Photographs

Top: Yeager Yard Test Plots (October 21, 2008)

Bottom: EMSA Test Plots (October 21, 2008)

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Top: Test plot construction at Yeager Yard: Blending soil materials (October 17, 2008)

Bottom: Early spring growth of hydroseed in the EMSA test plots (February 2, 2009)

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Previous successful revegetation areas supporting dense cover of native shrubs.

Top: East Quarry Revegetation area (photo May 27, 2008).

Bottom: Revegetation site above the “boneyard” in the EMSA (photo February 12, 2009).

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APPENDIX B

PLANT LIST FOR PERMANENTE QUARRY REVEGETATION

Appendix B. Potential native plant palette for Lehigh Permanente Quarry upland revegetation. Species in bold were successfully established in previous revegetation efforts, or have colonized revegetation sites effectively, and should be included in seed mixes or planting palettes.

FAMILY	SCIENTIFIC NAME	COMMON NAME
NATIVE GRASSES		
Poaceae	*Bromus carinatus*	California brome
Poaceae	***Elymus glaucus***	**blue wildrye**
Poaceae	*Elymus multisetus*	big squirreltail grass
Poaceae	*Festuca occidentalis*	western fescue
Poaceae	*Festuca rubra*	red fescue
Poaceae	*Leymus triticoides*	creeping wild rye
Poaceae	*Melica californica*	California melic grass
Poaceae	***Nassella pulchra***	**purple needle grass**
Poaceae	*Vulpia microstachys*	three-weeks fescue
Poaceae	*Poa secunda*	one-sided bluegrass
NATIVE HERBS		
Asteraceae	*Achillea millefolium*	common yarrow
Asteraceae	*Achyrachaena mollis*	blow wives
Asteraceae	*Eriophyllum confertiflorum*	golden yarrow
Asteraceae	***Heterotheca grandiflora***	**telegraphweed**
Asteraceae	*Wyethia glabra*	smooth mule ears
Brassicaceae	*Streptanthus glandulosus* ssp. *glandulosus*	bristly jewelflower
Caryophyllaceae	*Silene californica*	California windmill pink
Fabaceae	*Lotus purshianus* var. *purshianus*	Spanish clover
Fabaceae	***Lotus scoparius***	**deerweed**
Fabaceae	*Lupinus bicolor*	miniature lupine
Fabaceae	*Lupinus microcarpus* var. *densiflorus*	chick lupine
Fabaceae	*Lupinus nanus*	sky lupine
Fabaceae	*Lupinus succulentus*	succulent lupine
Fabaceae	*Trifolium willdenovii*	tomcat clover
Hydrophyllaceae	*Nemophila menziesii*	baby blue eyes
Hydrophyllaceae	*Phacelia campanularia*	desert bells
Iridaceae	*Sisyrinchium bellum*	blue-eyed grass
Lamiaceae	*Salvia columbariae*	Chia
Liliaceae	*Chlorogalum pomeridianum*	soap plant
Linaceae	*Linum grandiflorum*	flowering flax
Nyctaginaceae	*Mirabilis californica*	California four o'clock
Onagraceae	*Camissonia ovata*	sun cup

FAMILY	SCIENTIFIC NAME	COMMON NAME
Onagraceae	*Clarkia purpurea* ssp. *Quadrivulnera*	winecup clarkia
Onagraceae	*Epilobium canum*	California fuchsia
Onagraceae	*Oenothera elata* var. *hookeri*	evening primrose
Papaveraceae	***Eschscholzia californica***	**California poppy**
Papaveraceae	*Stylomecon heterophylla*	wind poppy
Plantaginaceae	*Plantago erecta*	California plantain
Polemoniaceae	*Navarretia squarrosa*	skunkweed
Polygonaceae	*Eriogonum nudum*	naked buckwheat
Portulacaceae	*Calandrinia ciliata*	red maids
Rosaceae	*Fragaria vesca*	woodland strawberry
Scrophulariaceae	*Antirrhinum kelloggii*	Kellogg's snapdragon
Scrophulariaceae	*Castilleja exserta*	purple owl's clover
Scrophulariaceae	*Scrophularia californica*	bee plant
NATIVE SHRUBS		
Asteraceae	***Artemisia californica***	**California sagebrush**
Asteraceae	*Artemisia douglasiana*	California mugwort
Asteraceae	***Baccharis pilularis***	**coyote brush**
Caprifoliaceae	*Sambucus mexicana*	blue elderberry
Ericaceae	*Arctostaphylos glauca*	big berry manzanita
Ericaceae	*Arctostaphylos viscida*	white-leaf manzanita
Fabaceae	*Lupinus albifrons var. albifrons*	silver bush lupine
Grossulariaceae	*Ribes californicum*	hillside gooseberry
Grossulariaceae	*Ribes malvaceum*	chaparral currant
Lamiaceae	***Salvia leucophylla***	**purple sage**
Lamiaceae	***Salvia mellifera***	**black sage**
Malvaceae	*Malacothamnus fasciculatus*	chaparral bushmallow
Malvaceae	*Malacothamnus fremontii*	Fremont's bushmallow
Polygonaceae	***Eriogonum fasciculatum***	**California buckwheat**
Rhamnaceae	*Ceanothus cuneatus*	buckbrush
Rhamnaceae	*Ceanothus integerrimus*	deer brush
Rhamnaceae	*Ceanothus leucodermis*	chaparral whitethorn
Rhamnaceae	*Rhamnus californicus*	coffeeberry
Rhamnaceae	*Rhamnus crocea*	redberry
Rosaceae	***Adenostoma fasciculatum***	**chamise**
Rosaceae	*Cercocarpus betuloides*	birch-leaf mountain mahogany
Rosaceae	*Heteromeles arbutifolia*	toyon
Rosaceae	*Holodiscus discolor*	ocean spray

FAMILY	SCIENTIFIC NAME	COMMON NAME
Rosaceae	*Prunus ilicifolius*	holly-leaf cherry
Rosaceae	*Rosa californica*	wild rose
Scrophulariaceae	*Mimulus aurantiacus*	bush monkey flower
Sterculiaceae	*Fremontodendron californica*	flannel-bush
NATIVE TREES		
Aceraceae	*Acer macrophyllum*	Big leaf maple
Ericaceae	*Arbutus menziesii*	Pacific madrone
Fagaceae	*Quercus agrifolia*	coast live oak
Fagaceae	*Quercus chrysolepis*	canyon live oak
Fagaceae	*Quercus douglasii*	blue oak
Fagaceae	*Quercus wislizenii*	interior live oak
Hippocastanaceae	*Aesculus californica*	California buckeye
Pinaceae	***Pinus sabiniana***	**grey pine**
Pinaceae	*Pseudotsuga menziesii*	Douglas-fir
Taxodiaceae	*Sequoia sempervirens*	Redwood

APPENDIX C

SOIL LABORATORY REPORTS

Soil & Plant Laboratory, Inc
Leaders in Soil & Plant Testing Since 1946
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Locations:

352 Mathew St.
Santa Clara, CA 95050
(408) 727-0330

1594 North Main St.
Orange, CA 92867
(714) 282-8777

SANTA CLARA OFFICE
June 11, 2008
Report 08-162-0042
Analyses under Report 08-143-9035

WRA ENVIRONMENTAL
2169-G E. Francisco Blvd.
San Rafael, CA 94901

Attn: Ingrid Morken

RE: HANSON PERMANENTE QUARRY – CUPERTINO, JOB NO. 16143

Background

The 10 samples analyzed under Report #08-143-0035 represent soils in need of evaluation to determine their suitability to support native plant growth. Analytical results are discussed in a manner to help categorize desirable soil candidates to those less and undesirable for use.

Analytical Results

Best Soil Candidates

Samples represented by Pit #2 and East Dump Natives show favorable soil composition. Particle size data show a loam for Pit #2 and sandy loam for East Dump Native by USDA standards. Organic content at 6.6% and 7.4% in Pit #2 and East Dump native, respectively, is ample for natives. The pH values are moderately alkaline and with natural lime content high this indicates a strong buffering capacity to remain in this alkaline range. The pH is a bit higher than desired by most plants though some natives may be more alkaline tolerant. Dissipating the high lime may be of interest to prevent it from interfering with nutrient availability. Salinity, sodium and boron are very safely low in both and the SAR values show a proper balance. Nutritional data is comparable between the two and shows nitrogen, potassium, magnesium and sulfate deficient. Phosphorus and calcium are well supplied.

Secondary Soil Candidates

West Dump Native and Rock Plant Fines contain significantly greater silt and clay which indicates dense soil types that will hold water tightly and drain slowly. Both soils fall into the clay loam USDA classification. Silt plus clay at 65-75% indicates high moisture retention and slow drainage. Organic content is fair for natives in the West Dump Native while a bit low in the Rock Plant Fines. Organic content near 3.0% on a dry weight basis is in the range typically desired. Infiltration rates are estimated at 0.22 inch per hour.

Secondary Soil Candidates - continued

The pH in West Dump Native is slightly acidic and in the range preferred by most plants with natural lime favorably absent. The reaction level in Rock Plant Fines is at the upper end of the slightly alkaline range preferred by most plants and high lime content indicates pH is strongly buffered to remain in this range. This alkaline pH is likely suitable for most natives though dissipating high lime would be desirable to prevent antagonism of nutrient availability. Sodium and boron are safely low in both and the SAR values show a proper balance. Salinity is very slightly elevated in Rock Plant Fines and safely the reflection of abundant soluble calcium with salinity safely low in West Dump Native.

Nutritional data show nitrogen, phosphorus, and potassium low in both. Sulfate is additionally low in West Dump Native and well supplied in Rock Plant Fines. In West Dump Native, calcium is only fair relative to high magnesium. In Rock Plant Fines, magnesium is just fair relative to ample calcium.

Least Desirable Soil Candidate

The Basin Clean Out contains 50% clay and a combination of silt and clay at 85% which suggests very high moisture retention characteristics and very slow drainage. The USDA soil classification is clay and the infiltration rate is estimated at a slow 0.14 inch per hour. Organic content at 3.4% is sufficient for natives though greater organic matter would be desired to improve structure of this dense soil type. Salinity is very slightly elevated but safely the reflection of abundant soluble calcium. Sodium and boron are safely low and SAR value shows a proper balance. Nutritional data show nitrogen, phosphorus and potassium low. Calcium, magnesium and sulfate are well supplied. The pH is slightly alkaline and in the range preferred by most plants, though high lime is less than desirable.

Poor Soil Candidates

West Waste Rock, Pit #1 Topsoil and Crusher Site contain highly excessive gravel content and excessive coarse sands that in combination with a broad distribution between medium to fine sands, silt and clay *the susceptibility to consolidation is high*. The intermingling of these various particle sizes over time could result in a consolidated state impervious to air and water. Particle size data for West Waste Rock and Pit #1 Topsoil show sandy loam classifications by USDA standards and highly excessive gravel qualify these as “gravelly” and “very gravelly”, respectively. Greater clay content in the Crusher Site places this into the sandy clay loam textural class and excess gravel qualifies this as “gravelly”. Infiltration rates are estimated at 0.19 inch per hour and could be slower in a consolidated state. Organic content is low in all three for natives. The reaction level in West Waste Rock is at the upper end of the slightly alkaline range with unfavorable high lime content. The pH values in Pit#1 Topsoil and Crusher Site are moderately alkaline and higher than preferred by most plants with unfavorable high lime that will buffer pH to remain in this alkaline range. Salinity, sodium and boron are safely low throughout with SAR values showing a proper balance.

Poor Soil Candidates - continued

Nutrient levels show nitrogen and potassium low throughout with phosphorus fair in West Waste Rock and Pit #1 Topsoil. Sulfate is fair in the Crusher Site and otherwise well supplied. Calcium and magnesium are sufficient in all three.

The Pit 1 Fine Greenstone and West Main Topsoil contain significantly greater coarse sands with similar excessive gravel contents and the coarser particle make-up makes the *susceptibility to consolidation very high*. Particle size data indicate a loamy sand for Pit 1 Fine Greenstone and a sand for West Main Topsoil. Highly excessive gravel fractions qualify both as "very gravelly". Infiltration rates are estimated at a significantly slow 0.10 inch per hour and could be even slower when consolidated. Organic content is low in both. The pH levels fall in the moderately alkaline range with medium to high lime content which will buffer pH to remain in this range that may be a bit high for natives. Salinity is safely low in both as is boron. Sodium is slightly elevated in Pit 1 Fine Greenstone and the elevated SAR value indicates calcium and magnesium do not properly balance soluble sodium which can adversely impact soil permeability. Sodium is safely low in the West Main Topsoil and the SAR value shows a proper balance. Nitrogen and potassium are low in both. Magnesium is fair relative to ample calcium in the Pit 1 Fine Greenstone. Remaining major nutrients are otherwise sufficient.

Heidi Fisher

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Project : Hanson Permainente Quarry, Cupertino

COMPREHENSIVE SOIL ANALYSIS

Report No : **08-143-9035**
Purchase Order : Job 16143
Date Recd : 05/22/2008
Date Printed : 04/14/2009

Sample Description - Sample ID	Half Sat % / TEC	pH / Qual Lime	ECe dS/m	NO_3-N ppm	NH_4-N ppm	PO_4-P ppm	K ppm	Ca ppm	Mg ppm	Cu ppm	Zn ppm	Mn ppm	Fe ppm	Organic % dry wt.	Lab No.
				Sufficiency Factors											
Rock Plant Fines	29	7.6	3.8	20	7	14	64	2901	189					1.4	27561
	145	High		0.5		0.4	0.3	1.2	0.6						
West Main Topsoil	14	8.2	0.6	2	4	15	40	4491	1159					0.5	27562
	319	High		0.2		0.9	0.2	1.5	2.8						
Pit #1 Topsoil	17	7.8	2.6	3	5	17	42	2602	328					1.2	27563
	147	High		0.2		0.9	0.3	1.3	1.2						
Crusher Site	21	8.0	0.5	3	6	29	17	4811	738					1.0	27564
	299	High		0.2		1.2	0.1	1.3	1.5						

Saturation Extract Values						SAR	Gravel %		Percent of Sample Passing 2 mm Screen					USDA Soil Classification	Lab No.
									Sand						
Ca meq/L	Mg meq/L	Na meq/L	K meq/L	B ppm	SO_4 meq/L		Coarse 5 - 12	Fine 2 - 5	Very Coarse 1 - 2	Coarse 0.5 - 1	Med. to Very Fine 0.05 - 0.5	Silt .002-.05	Clay 0-.002		
27.9	8.3	10.2	0.9	0.12	31.6	2.4	0	0.3	0	0.6	24.2	42.6	32.6	Clay Loam	27561
3.0	2.5	0.7	0.1	0.02	2.3	0.4	23.4	36.0	44.6	21.4	22.8	8.0	3.2	Very Gravelly Sand	27562
21.7	11.6	2.8	0.3	0.09	33.1	0.7	20.6	21.8	12.2	12.4	33.2	25.6	16.6	Very Gravelly Sandy Loam	27563
2.7	1.7	0.7	0.1	0.03	2.0	0.5	12.1	19.2	15.4	12.2	24.2	23.0	25.2	Gravelly Sandy Clay Loam	27564

Sufficiency factor (1.0=sufficient for average crop) below each nutrient value. N factor based on 200 ppm constant feed. SAR = Sodium adsorption ratio. Half Saturation %=approx field moisture capacity. Nitrogen(N), Potassium(K), Calcium(Ca) and Magnesium(Mg) by sodium chloride extraction. Phosphorus(P) by sodium bicarbonate extraction. Copper(Cu), Zinc(Zn), Manganese(Mn) & Iron(Fe) by DTPA extraction. Sat. ext. method for salinity (ECe as dS/m),Boron (B), Sulfate(SO_4), Sodium(Na). Gravel fraction expressed as percent by weight of oven-dried sample passing a 12mm(1/2 inch) sieve. Particle sizes in millimeters. Organic percentage determined by Walkley-Black or Loss on Ignition.

* LOW , SUFFICIENT , HIGH

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Project : Hanson Permainente Quarry, Cupertino

COMPREHENSIVE SOIL ANALYSIS

Report No : **08-143-9035**
Purchase Order : Job 16143
Date Recd : 05/22/2008
Date Printed : 04/14/2009

Sample Description - Sample ID	Half Sat % / TEC	pH / Qual Lime	ECe dS/m	NO_3-N ppm	NH_4-N ppm	PO_4-P ppm	K ppm	Ca ppm	Mg ppm	Cu ppm	Zn ppm	Mn ppm	Fe ppm	Organic % dry wt.	Lab No.
				Sufficiency Factors											
Pit #2	30	7.8	1.1	2	12	37	208	5883	265					6.7	27555
	312	High		0.2		1.0	0.5	1.2	0.4						
West Waste Rock	15	7.6	3.1	1	6	14	63	2672	232					1.2	27556
	146	High		0.2		0.8	0.5	1.5	1.0						
West Dump Native	28	6.9	0.6	1	5	13	37	5205	2866					2.5	27557
	494	None		0.1		0.4	0.1	0.8	3.5						
Pit 1 Fine Greenstone	11	7.8	2.7	1	4	15	40	1935	114					0.7	27558
	127	Medium		0.2		1.1	0.3	1.3	0.6						
East Dump Native	34	7.8	0.9	2	6	60	181	4063	93					7.4	27559
	207	High		0.1		1.5	0.7	1.2	0.2						
Basin Clean Out	36	7.5	4.1	1	7	15	46	3841	556					3.4	27560
	211	High		0.1		0.3	0.2	1.1	1.2						

Saturation Extract Values						SAR	Gravel %		Percent of Sample Passing 2 mm Screen					USDA Soil Classification	Lab No.
									Sand						
Ca meq/L	Mg meq/L	Na meq/L	K meq/L	B ppm	SO_4 meq/L		Coarse 5 - 12	Fine 2 - 5	Very Coarse 1 - 2	Coarse 0.5 - 1	Med. to Very Fine 0.05 - 0.5	Silt .002-.05	Clay 0-.002		
10.7	2.2	0.6	0.3	0.05	0.7	0.2	5.4	8.2	8.8	9.4	28.2	32.0	21.6	Loam	27555
24.6	9.1	6.2	0.3	0.15	34.5	1.5	16.1	18.7	19.8	15.2	29.2	20.5	15.3	Gravelly Sandy Loam	27556
2.5	3.4	0.8	0.1	0.04	0.5	0.5	4.6	6.3	6.4	7.4	20.6	27.0	38.6	Clay Loam	27557
3.6	1.4	21.8	0.2	0.98	21.0	13.9	7.3	29.5	27.5	23.8	35.1	9.8	3.8	Very Gravelly Loamy Sand	27558
8.7	1.0	0.4	0.4	0.09	0.5	0.2	6.5	7.3	8.1	12.8	48.5	21.8	8.8	Sandy Loam	27559
27.6	17.1	9.0	0.3	0.21	40.2	1.9	5.3	3.7	2.8	3.0	11	33.6	49.6	Clay	27560

Sufficiency factor (1.0=sufficient for average crop) below each nutrient value. N factor based on 200 ppm constant feed. SAR = Sodium adsorption ratio. Half Saturation %=approx field moisture capacity. Nitrogen(N), Potassium(K), Calcium(Ca) and Magnesium(Mg) by sodium chloride extraction. Phosphorus(P) by sodium bicarbonate extraction. Copper(Cu), Zinc(Zn), Manganese(Mn) & Iron(Fe) by DTPA extraction. Sat. ext. method for salinity (ECe as dS/m),Boron (B), Sulfate(SO_4), Sodium(Na). Gravel fraction expressed as percent by weight of oven-dried sample passing a 12mm(1/2 inch) sieve. Particle sizes in millimeters. Organic percentage determined by Walkley-Black or Loss on Ignition.

* LOW , SUFFICIENT , HIGH

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SANTA CLARA OFFICE
June 9, 2008
Report 08-149-0043

WRA ENVIRONMENTAL
2169-G E. Francisco Blvd.
San Rafael, CA 94901

Attn: Ingrid Morken

RE: HANSON PERMANENTE QUARRY – CUPERTINO, JOB NO. 16143
RE-VEGETATED SITES FOR COMPARISON

Background

The five samples received 5/28 were described as representing soils from sites that have been re-vegetated. Chemistry and particle size evaluation was requested to determine the discrepancies between areas and corresponding plant communities.

Summary/ Results

The pH values for East Dump Topsoil Source 1 & 2 and Reveg Slope West Dump show moderate alkalinity higher than preferred most plants, though likely suitable for some natives. East Dump Topsoil Source 2 and Reveg Slope West Dump do not contain any qualitative lime while East Dump Topsoil Source 1 contains medium natural lime. Reaction levels for Reveg East and West Pits are slightly alkaline and in the desired range with medium lime at Reveg West Pit and high natural lime at Reveg East Pit. Salinity, sodium and boron are comparable throughout and safely low throughout. The favorably low SAR values in all indicate calcium and magnesium properly balance soluble sodium.

Nutritional data show nitrogen low throughout with the exception of fair nitrogen at Reveg West Pit. At East Dump Topsoil Source 1 & 2, phosphorus and potassium are sufficient with magnesium low. Magnesium is also low at Reveg East Pit. Phosphorus and potassium are otherwise low and magnesium otherwise sufficient. Calcium is well supplied throughout with sulfate low to fair.

Organic content is low at Reveg Slope West Dump. Organic content is ample at Reveg East Pit and otherwise sufficient. Particle size analyses reveal sandy loam soils in all but Reveg West Pit which contains just slightly less clay qualifying this as a loamy sand. All contain highly excessive gravel fractions as well as very high coarse sands and range from very gravelly to gravelly qualifications. Infiltration rates are estimated on average of 0.22 inch per hour, but could be substantially slower in a consolidated state.

Heidi Fisher

HEIDI FISHER Email only 3 pages.

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San Rafael, CA 94901

COMPREHENSIVE SOIL ANALYSIS
(AO5-1, AO5-2 or AO5-3)

Samples Rec'd: 5/28/08

Santa Clara Office
Lab No. 08-149-0043
Hanson Permanente Quarry Cupertino
P.O. No. Job 16143

Sample #	Half Sat%/ TEC	pH/ Qual Lime	ECe	Parts Per Million Parts Dry Soil: NO_3 N	NH_4 N	PO_4 P	K	Ca	Mg	Cu	Zn	Mn	Fe	Organic % dry wt.	Sample Description & Log Number
27712	15	7.8	0.6	10	1	8	67	5685	907					0.8	Reveg Slope West Dump
	360	None		0.4		0.5	0.2	1.6	2.0						0.608-G5800 SC-40

Sample #	Saturation Extract Values: Ca me/l	Mg me/l	Na me/l	K me/l	B ppm	SO_4 me/l	SAR	Gravel: Coarse 5-12	Gravel: Fine 2-5	Percent of Sample Passing 2 mm Screen: Sand: Very Coarse 1-2	Sand: Coarse 0.5-1	Sand: Med. to V. Fine 0.05-.5	Silt .002-.05	Clay 0-.002	USDA Soil Classification
27712	3.7	2.5	0.6	0.1	0.01	1.3	0.3	30.0	23.7	24.3	12.2	32.0	18.1	13.4	Very Gravelly Sandy Loam

6/ 9/08

Sufficiency factor (1.0=sufficient for average crop) below each nutrient value. N factor based on 200 ppm constant feed. SAR = Sodium adsorption ratio. Half Saturation %=approx field moisture capacity. Nitrogen(N), Potassium(K), Calcium(Ca) and Magnesium(Mg) by sodium chloride extraction. Phosphorus(P) by sodium bicarbonate extraction. Copper(Cu), Zinc(Zn), Manganese(Mn) & Iron(Fe) by DTPA extraction. Sat. ext. method for salinity (ECe as dS/m), Boron(B), Sulfate(SO_4), Sodium(Na) and SAR. TEC(listed below Half Sat) = Est.Total Exchangeable Cations(meq/kg). Gravel fraction expressed as percent by weight of oven-dried sample passing a 12mm(1/2 inch) sieve. Particle sizes in millimeters.

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COMPREHENSIVE SOIL ANALYSIS
(AO5-1, AO5-2 or AO5-3)

Samples Rec'd: 5/28/08

Santa Clara Office
Lab No. 08-149-0043
Hanson Permanente Quarry Cupertino
P.O. No. Job 16143

Sample #	Half Sat%/ TEC	pH/ Qual Lime	ECe	Parts Per Million Parts Dry Soil: NO_3 N	NH_4 N	PO_4 P	K	Ca	Mg	Cu	Zn	Mn	Fe	Organic % dry wt.	Sample Description & Log Number
27708	22	7.5	1.0	11	2	10	150	7553	330					4.8	Reveg East Pit
	404	High		0.3		0.4	0.4	1.6	0.5						0.7308-G5796 SC-40
27709	19	7.4	0.6	23	4	9	118	7216	1086					3.7	Reveg West Pit
	452	Med		0.7		0.4	0.3	1.5	1.7						0.6608-G5797 SC-40
27710	17	8.0	0.7	11	1	17	124	2723	78					3.0	East Dump Topsoil Source 1
	143	Med		0.4		0.8	0.7	1.3	0.3						0.8708-G5798 SC-40
27711	22	7.9	0.8	11	4	24	214	3304	161					3.8	East Dump Topsoil Source 2
	181	None		0.3		0.9	0.8	1.1	0.4						1.0108-G5799 SC-40

Sample #	Saturation Extract Values: Ca me/l	Mg me/l	Na me/l	K me/l	B ppm	SO_4 me/l	SAR	Percent of Sample Passing 2 mm Screen: Gravel: Coarse 5-12	Gravel: Fine 2-5	Sand: Very Coarse 1-2	Sand: Coarse 0.5-1	Sand: Med. to V. Fine 0.05-.5	Silt .002-.05	Clay 0-.002	USDA Soil Classification
27708	5.9	1.0	0.3	0.1	0.05	1.0	0.2	22.4	26.8	24.8	14.8	26.8	18.8	14.8	Very Gravelly Sandy Loam
27709	3.4	2.6	0.4	0.1	0.04	0.7	0.2	15.6	31.9	28.9	15.6	36.0	14.1	5.4	Very Gravelly Loamy Sand
27710	6.1	0.8	0.5	0.2	0.01	1.8	0.3	14.8	17.7	18.9	11.0	43.7	17.0	9.4	Gravelly Sandy Loam
27711	12.3	2.3	1.1	0.4	0.01	2.4	0.4	27.0	11.4	10.1	9.6	46.9	19.0	14.4	Very Gravelly Sandy Loam

6/ 9/08

Sufficiency factor (1.0=sufficient for average crop) below each nutrient value. N factor based on 200 ppm constant feed. SAR = Sodium adsorption ratio. Half Saturation %=approx field moisture capacity. Nitrogen(N), Potassium(K), Calcium(Ca) and Magnesium(Mg) by sodium chloride extraction. Phosphorus(P) by sodium bicarbonate extraction. Copper(Cu), Zinc(Zn), Manganese(Mn) & Iron(Fe) by DTPA extraction. Sat. ext. method for salinity (ECe as dS/m), Boron(B), Sulfate(SO_4), Sodium(Na) and SAR. TEC(listed below Half Sat) = Est.Total Exchangeable Cations(meq/kg). Gravel fraction expressed as percent by weight of oven-dried sample passing a 12mm(1/2 inch) sieve. Particle sizes in millimeters.

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SOIL FERTILITY AND MICRONUTRIENT ANALYSIS

Project : Hanson Permanente - Cupertino

Report No : **08-179-0041**
Purchase Order :
Date Printed : 07/01/2008
Date Recd : 06/27/2008

Sample Description - Sample Id - Plant Name	HalfSat %	pH s.u.	NO_3-N ppm	NH_4-N ppm	PO_4-P ppm	K ppm	Ca ppm	Mg ppm	Cu ppm	Zn ppm	Mn ppm	Fe ppm	Saturation Extract B ppm	SO_4 meq/L	Na meq/L	K meq/L	Ca meq/L	Cl meq/L	ECe dS/m	OM %	Lab No
	TEC	Qual. Lime	Sufficiency Factor										Sufficiency Factor		(SAR)		Mg meq/L				
West Waste Rock									0.9	0.5	5	16									28512
East Dump Native									1.5	6.4	6	28									28513
Green Stone Slide									0.8	0.8	4	13									28514
Rock Plant Fines									2.2	3.6	9	25									28515
West Main Topsoil									0.8	0.8	6	33									28516
Pit #1 Topsoil									1.3	1.3	4	19									28517
East Dump Topsoil Site 4									1.3	2.5	4	21									28518
East Dump Topsoil Site 5									2.5	2.4	8	72									28519

Sufficiency factor (1.0=sufficient for average crop) below each nutrient value. N factor based on 200 ppm constant feed. The value below sodium (Na) result is the SAR = Sodium adsorption ratio. Half Saturation %=approx field moisture capacity. Major elements, Nitrogen(N),Potassium(K), Calcium(Ca) and Magnesium(Mg) by sodium chloride extraction. Phosphorus(P) by sodium bicarbonate extraction. Copper(Cu), Zinc(Zn), Manganese(Mn) & Iron(Fe) by DTPA extraction. TEC(listed below Half Sat.) = Est.Total Exchangeable Cations (meq/kg).

* LOW , SUFFICIENT, HIGH

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SANTA CLARA OFFICE
July 24, 2008
Report 08-196-0046

WRA ENVIRONMENTAL
2169-G E. Francisco Blvd.
San Rafael, CA 94901

Attn: Ingrid Morken

RE: HANSON PERMANENTE QUARRY – CUPERTINO, JOB NO. 16143
SOIL DEVELOPMENT

Background

The 9 soil blends created in the laboratory on 7/14 represent the percentages of mineral topsoils and compost as requested. The blends were submitted to the laboratory for chemistry, fertility and particle size evaluation with regards to their feasibility for use in revegetation of areas with California natives.

Analytical Results

Particle size data for the Blend 2 (20% Waste Rock, 20% Pit 1 Fine Greenstone, 40% Plant Fines, 20% Compost) shows a sandy clay loam classification by USDA standards. The soils infiltration rate is estimated at a slow 0.18 inch per hour. Blend 3 (35% Pit 1 Fine Greenstone, 41% Plant Fines, 24% Compost) Blend 8 (28% West Main, 50% Plant Fines, 22% Compost) and Blend 9 (16% Pit 1 Fine Greenstone, 16% West Main, 46% Plant Fines, 22% Compost) all contain slightly higher silt content as a reflection of the Plant Fines which places these into the loam textural class. Infiltration rates are estimated on average of a slow 0.14 inch per hour. The remaining blends contain less silt and clay which qualifies these as sandy loam textural classes. Infiltration rates are estimated on average of a slow 0.11 inch per hour. All 9 of the soil blends are qualified as “very gravelly” and this qualifier is applied for greater than 35% combined gravel. The greater the diversity of gravel combined with coarse sands increases the susceptibility to consolidation of these various particle sizes and the tendency is highest in Blend 4 (81% Pit 1 Fine Greenstone, 19% Compost) Blend 5 (36% Waste Rock, 43% Pit 1 Fine Greenstone, 21% Compost) and Blend 9 (16% Pit 1 Fine Greenstone, 16% West Main, 46% Plant Fines, 22% Compost). Blend 1 (73% Waste Rock, 27% Compost) also shows a significant degree of susceptibility to consolidation with the remaining blends high to moderate.

Organic content at 4.0% in Blend 2 (20% Waste Rock, 20% Pit 1 Fine Greenstone, 40% Plant Fines, 20% Compost) is well supplied for natives. The 5.1% organic matter in Blend 4 (81% Pit 1 Fine Greenstone, 19% Compost) and Blend 6 (32% Waste Rock, 68% East Dump) is also well supplied for natives. The 5.6% in Blend 3 (35% Pit 1 Fine Greenstone, 41% Plant Fines, 24% Compost) and 6.3% in Blend 8 (28% West Main,

50% Plant Fines, 22% Compost) is ample. The 6.8% organic matter in Blend 9 (16% Pit 1 Fine Greenstone, 16% West Main, 46% Plant Fines, 22% Compost) as well as the 7.0% in Blend 1 (73% Waste Rock, 27% Compost) are abundant for natives. The 8.5% organic matter in Blend 5 (36% Waste Rock, 43% Pit 1 Fine Greenstone, 21% Compost) and the 10.1% organic matter in Blend 7 (25% Pit 1 Fine Greenstone, 75% East Dump) are ample as well.

The pH is moderately alkaline for Blend 6 (32% Waste Rock, 68% East Dump) and Blend 7 (25% Pit 1 Fine Greenstone, 75% East Dump) with natural lime medium. These values are a bit higher than preferred by most plants but likely suitable for natives. The remaining pH values are slightly alkaline and suitable for natives. Natural lime is absent in Blend 4 (81% Pit 1 Fine Greenstone, 19% Compost) and medium in Blend 5 (36% Waste Rock, 43% Pit 1 Fine Greenstone, 21% Compost) and is favorable. Natural lime content is otherwise high and indicates pH will be strongly buffered to remain in the alkaline range.

Salinity is safely low in Blend 6 (32% Waste Rock, 68% East Dump) and Blend 7 (25% Pit 1 Fine Greenstone, 75% East Dump) with sodium levels correspondingly safely low as well. The remaining samples, which contained the compost addition, show elevated salinity as a result of elevated sodium. The baseline soil results from Report #'s 08-143-0035 & 08-149-0043 did not reveal any significant concern relative to sodium. The South Valley Organics Compost would appear to be the source of the excess sodium. The elevated SAR values are a reflection of the sodium excess which would not be an issue when using compost safely low in sodium. Boron remains safely low throughout.

Nutritional data show iron continuing at low levels in all the blends. For Blend 6 (32% Waste Rock, 68% East Dump) and Blend 7 (25% Pit 1 Fine Greenstone, 75% East Dump) magnesium is low relative to ample calcium. Calcium is quite ample throughout. Zinc and manganese are low in these blends as well with copper additionally low in Blend 7 (25% Pit 1 Fine Greenstone, 75% East Dump). Zinc is low in Blend 4 (81% Pit 1 Fine Greenstone, 19% Compost) as well as Blend 5 (36% Waste Rock, 43% Pit 1 Fine Greenstone, 21% Compost). Remaining major and minor nutrients are sufficient to well supplied.

Comments

Nutritive values show a favorable improvement in overall fertility of the blends, as a result of the nutrient rich compost addition. The Waste Rock and Pit 1 Fine Greenstone blended with the East Dump still show excellent fertility and organic content, even with magnesium potentially low. The excess sodium of the South Valley Organics Compost is contributing to elevated salinity and SAR values. Evaluating the intended compost product prior to use is suggested to assure all troublesome salts are safely low. Elevated salinity could impair seed germination and be toxic to tender seedlings.

The compost addition was based on a target of 4.8% organic matter. This was achieved and even

surpassed with the compost rates, with the exception of Blend 2 which was slightly lower though still well supplied for natives. The compost addition is felt to be within appropriate ranges and to simplify, incorporating 25% Compost on a volume basis would provide ample organic matter for healthy establishment of the natives. The only soil blends that do not apply are the Waste Rock and Pit 1 Fine Greenstone amended only with the East Dump which in itself provides ample organic matter.

Particle size distribution is quite similar between the Waste Rock and Pit 1 Fine Greenstone though the Waste Rock generally contains greater larger gravel. Blend 4, Pit 1 Fine Greenstone with Compost, and Blend 5 being Waste Rock, Pit 1 Fine Greenstone and Compost display nearly comparable particle size results. There is no significant improvement from blending the Waste Rock with the Pit 1 Fine Greenstone and consideration might be given to the energy expenditure of blending these two similar sources.

The logistics behind using the Plant Fines might be hindered by the issue of obtaining a homogenous soil blend with the other gravelly sources. The very high moisture content of the plant fines would need to be reduced for incorporation, however we found that drying of this material resulted in a dense, hard soil comparable to adobe brick that had to be pulverized for use in the blends. The addition of the Plant Fines does increase silt and clay content of the final blends thus decreasing gravel and coarse sands which is advantageous, but again the feasibility of achieving a homogenous blend may prove to be very difficult.

The best soil candidates are limited to Blend 6 & 7 which are predominantly the East Dump material. The second best candidates are those that contain 40% and 50% Plant Fines i.e. Blend 2, 3 & 8. Blends 2 & 3 are so similar and again the Pit 1 Fine Greenstone and Waste Rock are so similar that these are interchangeable. The 40% Plant Fines is the minimum amount of this material suggested for the blends in order to make some beneficial impact on soil texture. The next best candidate would be Blend 9. The Waste Rock or Pit 1 Fine Greenstone with just the Compost addition, Blends 1 & 4, provides the attributes of ample organic matter and abundant fertility for native plant establishment, though the coarse, diverse soil composition is less than desired. A blend of 75% Waste Rock or Pit 1 Fine Greenstone with 25% Compost would be a suitable blend to achieve adequate organic matter. The 75% Waste Rock or Pit 1 Fine Greenstone could be divided at any percentage if this of interest.

Heidi Fisher

HEIDI FISHER
Email only 5 pages. /dlb

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Project : Hanson Permanente - Soil Development

COMPREHENSIVE SOIL ANALYSIS

Report No : **08-196-9046**
Purchase Order :
Date Recd : 07/14/2008
Date Printed : 04/14/2009

Sample Description - Sample ID	Half Sat % / TEC	pH / Qual Lime	ECe dS/m	NO_3-N ppm	NH_4-N ppm	PO_4-P ppm	K ppm	Ca ppm	Mg ppm	Cu ppm	Zn ppm	Mn ppm	Fe ppm	Organic % dry wt.	Lab No.
				Sufficiency Factors											
1)73% Waste Rock & 27% Compost	16	7.3	5.2	9	27	58	511	2549	417	1.5	4.3	13	13	7.0	28846
	164	High		1.1		3.1	3.2	1.2	1.5	0.9	0.7	1.0	0.2		
2)20% Waste, 20% Pit 1 Fine Greenstone, 40% Fines, 20% Compost	17	7.4	6.4	12	24	45	427	2282	255	1.9	5.3	12	14	4.0	28847
	141	High		1.1		2.2	2.7	1.1	1.0	1.2	0.8	0.8	0.2		
3)35% Pit 1 Fine Greenstone, 41% Plant Fines, 24% Compost	16	7.3	7.3	11	23	31	376	2174	253	1.7	4.3	11	13	5.6	28848
	137	High		1.1		1.6	2.7	1.2	1.0	1.2	0.8	0.9	0.2		
4)81% Pit 1 Fine Greenstone & 19% Compost	11	7.6	3.5	11	18	31	273	2138	214	1.1	1.2	8	9	5.1	28849
	153	None		1.4		2.5	2.1	1.2	0.9	0.8	0.2	0.7	0.2		
5)36% Waste, 43% Pit 1 Fine Greenstone, 21% Compost	13	7.4	5.3	10	26	32	378	2263	285	1.1	3.0	9	11	8.5	28850
	155	Medium		1.4		2.1	2.7	1.3	1.2	0.8	0.5	0.8	0.2		
6)32% Waste, 68% East Dump	22	7.7	1.9	118	46	24	167	3282	141	1.2	2.7	3	9	5.1	28851
	174	Medium		3.8		0.9	0.8	1.2	0.4	0.5	0.3	0.1	0.1		

Saturation Extract Values						SAR	Gravel %		Percent of Sample Passing 2 mm Screen					USDA Soil Classification	Lab No.
									Sand						
Ca meq/L	Mg meq/L	Na meq/L	K meq/L	B ppm	SO_4 meq/L		Coarse 5 - 12	Fine 2 - 5	Very Coarse 1 - 2	Coarse 0.5 - 1	Med. to Very Fine 0.05 - 0.5	Silt .002-.05	Clay 0-.002		
29.0	17.4	10.9	8.1	0.46	23.5	2.3	58.9	12.9	22.6	14.0	29.1	17.4	16.8	Very Gravelly Sandy Loam	28846
29.5	15.5	28.1	7.9	0.47	26.2	5.9	32.4	9.3	11.1	8.5	31	26.5	22.9	Very Gravelly Sandy Clay Loam	28847
30.0	15.3	34.0	9.8	0.51	26.2	7.1	47.6	8.1	13.6	9.7	25.4	29.5	21.8	Very Gravelly Loam	28848
7.1	2.9	26.5	2.5	0.65	15.1	11.8	28.8	27.8	28.4	23.1	32.2	9.4	6.9	Very Gravelly Sandy Loam	28849
19.9	10.0	29.2	5.3	0.54	22.2	7.6	34.5	28.7	30.6	17.3	28.7	12.4	10.9	Very Gravelly Sandy Loam	28850
17.1	3.0	2.2	0.5	0.08	16.6	0.7	39.0	9.1	11.5	12.5	39.6	20.5	15.9	Very Gravelly Sandy Loam	28851

Sufficiency factor (1.0=sufficient for average crop) below each nutrient value. N factor based on 200 ppm constant feed. SAR = Sodium adsorption ratio. Half Saturation %=approx field moisture capacity. Nitrogen(N), Potassium(K), Calcium(Ca) and Magnesium(Mg) by sodium chloride extraction. Phosphorus(P) by sodium bicarbonate extraction. Copper(Cu), Zinc(Zn), Manganese(Mn) & Iron(Fe) by DTPA extraction. Sat. ext. method for salinity (ECe as dS/m),Boron (B), Sulfate(SO_4), Sodium(Na). Gravel fraction expressed as percent by weight of oven-dried sample passing a 12mm(1/2 inch) sieve. Particle sizes in millimeters. Organic percentage determined by Walkley-Black or Loss on Ignition.

* LOW , SUFFICIENT , HIGH

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www.soilandplantlaboratory.com

Project : Hanson Permanente - Soil Development

COMPREHENSIVE SOIL ANALYSIS

Report No : **08-196-9046**
Purchase Order :
Date Recd : 07/14/2008
Date Printed : 04/14/2009

Sample Description - Sample ID	Half Sat %	pH	ECe dS/m	NO_3-N ppm	NH_4-N ppm	PO_4-P ppm	K ppm	Ca ppm	Mg ppm	Cu ppm	Zn ppm	Mn ppm	Fe ppm	Organic % dry wt.	Lab No.
	TEC	Qual Lime		Sufficiency Factors											
7)25% Pit 1 Fine Greenstone, 75% East Dump	22	8.2	1.0	103	40	29	177	2986	84	1.0	2.9	2	9	10.1	28852
	170	Medium		3.2		1.1	0.8	1.1	0.2	0.5	0.3	0.1	0.1		
8)28% West Main, 50% Plant Fines, 22% Compost	21	7.2	5.9	13	27	47	616	3025	450	1.9	5.7	16	16	6.3	28853
	183	High		1.0		1.9	2.8	1.1	1.2	0.8	0.6	0.8	0.2		
9)16% Pit 1 Fine Greenstone, 16% West Main, 46% Fines, 22% Compost	18	7.3	6.7	12	25	50	469	2739	405	1.7	4.8	12	15	6.8	28854
	172	High		1.0		2.3	2.6	1.1	1.3	0.9	0.7	0.8	0.2		

Saturation Extract Values						SAR	Gravel %		Percent of Sample Passing 2 mm Screen					USDA Soil Classification	Lab No.
									Sand						
Ca meq/L	Mg meq/L	Na meq/L	K meq/L	B ppm	SO_4 meq/L		Coarse 5 - 12	Fine 2 - 5	Very Coarse 1 - 2	Coarse 0.5 - 1	Med. to Very Fine 0.05 - 0.5	Silt .002-.05	Clay 0-.002		
4.1	0.5	7.0	0.4	0.07	4.5	4.6	39.3	13.2	17.1	13.8	37.7	18.4	13.0	Very Gravelly Sandy Loam	28852
34.0	25.1	11.1	4.6	0.40	25.3	2.0	44.6	9.5	10.7	4.8	21	36.5	27.0	Very Gravelly Loam	28853
32.9	22.6	23.2	6.3	0.44	25.8	4.4	31.1	26.8	13.4	8.9	23.4	30.4	23.9	Very Gravelly Loam	28854

Sufficiency factor (1.0=sufficient for average crop) below each nutrient value. N factor based on 200 ppm constant feed. SAR = Sodium adsorption ratio. Half Saturation %=approx field moisture capacity. Nitrogen(N), Potassium(K), Calcium(Ca) and Magnesium(Mg) by sodium chloride extraction. Phosphorus(P) by sodium bicarbonate extraction. Copper(Cu), Zinc(Zn), Manganese(Mn) & Iron(Fe) by DTPA extraction. Sat. ext. method for salinity (ECe as dS/m),Boron (B), Sulfate(SO_4), Sodium(Na). Gravel fraction expressed as percent by weight of oven-dried sample passing a 12mm(1/2 inch) sieve. Particle sizes in millimeters. Organic percentage determined by Walkley-Black or Loss on Ignition.

* LOW , SUFFICIENT , HIGH

Locations:

352 Mathew St.
Santa Clara, CA 95050
(408) 727-0330

1594 North Main St.
Orange, CA 92867
(714) 282-8777

SANTA CLARA OFFICE
February 27, 2009
Report 09-054-0030

WRA ENVIRONMENTAL
2169-G E. Francisco Blvd.
San Rafael, CA 94901

Attn: Geoff Smick

RE: PERMANENTE QUARRY – CUPERTINO, JOB NO. 16143

Background

The 10 samples received 2/23 represent native topsoil that will be striped and stockpiled and later spread in areas for re-vegetation with California natives. The sample descriptions provided are referenced on the attached data sheets.

Analytical Results

Particle size data for Samples 09, G4, C8, 05 and C5-wetter show clay loam classifications by USDA standards. The abundance of silt and clay at about 60% indicates characteristics of high moisture retention and slow drainage. Slightly higher sand fractions for C7 and G3 place these into the sandy clay loam textural class. Even greater sand content and less silt and clay in Samples 07, 06 and C5-dryer place these into the sandy loam classification.

Gravel fractions are only slightly elevated in Sample G4 qualifying this as “gravelly” and only slightly increases the susceptibility to consolidation. Gravel content is moderate in Samples 06 and G3 qualifying these as “gravelly”, and combined with elevated coarse sands the susceptibility to consolidation is moderate. Highly excessive gravel content in Sample C5-drier qualifies this as “very gravelly” which significantly increases the susceptibility to consolidation.

The infiltration rates are an estimation based upon soil texture and the clay loam classifications are estimated to have an infiltration rate of 0.22 inch per hour. The sandy clay loam for C7 is estimated at 0.27 inch per hour while high gravel content in G3 makes this slightly slower at 0.21 inch per hour. The sandy loam of Samples 07 is estimated at 0.36 inch per hour while higher gravel content in Sample 06 makes this slower at 0.28 inch per hour. Even higher gravel content in Sample C5-drier decreases the infiltration rate to 0.22 inch per hour.

Organic content for Sample G3 is low for natives while Samples 05 and 06 are ample in organic matter. Organic content is sufficient for natives in Samples C7 and 07. All other areas are a bit low given their corresponding fine textures and greater clay. Modest supplementation would be of benefit to improve soil structure.

The reaction levels for Samples G4, C8, G3 and C5-wetter fall into the slightly alkaline range preferred by most plants, including natives. All other areas are moderately alkaline and a bit higher than preferred by natives. Natural lime is favorably low in Samples 06 and C5-drier and otherwise absent. This will allow for some beneficial pH adjustment where desired. Potentially troublesome salinity, sodium and boron are very safely low throughout and the SAR values indicate calcium and magnesium properly balance soluble sodium.

Available nutrient levels show nitrogen, manganese, sulfate and boron low throughout with the exception of sufficient nitrogen in Sample 07 and sufficient sulfate in 09. Boron deficiency is extremely rare. Zinc is also low in all but C7 and C5-drier. Phosphorus is fair in Sample 09 and otherwise sufficient to well supplied. Potassium is low in Samples 09, G4, C8, G3 and C5-wetter. Calcium is particularly ample in Samples 07, G4, 06 and C5-wetter & drier. Magnesium is low in Samples 07, 06 and C5-drier in comparison to the ample calcium levels. Magnesium is ample in Sample C8 and C5-wetter, though adequately balanced with sufficient calcium. In Sample G3, magnesium is excessive with calcium just equal in the saturation extract. Copper is low in Samples 05, 06, G3 and C5-wetter. Iron is low in Samples G4, G3 and C5-wetter while iron is ample in C7 and 07. All other major and minor elements are otherwise sufficient.

Comments

Samples C7 and 07 are the most favorable topsoil candidates given their desirable soil compositions with adequate organic matter. The elevated alkalinity will readily adjust into the slightly alkaline range given the adequate inclusion of soil sulfur as suggested below. No other supplementation would be required.

Sample 05 is also quite favorable given the ample organic content and suitable soil texture. A modest rate of soil sulfur would slightly adjust the alkalinity and no other amendments would be required.

Samples 09, G4, C8 and C5-wetter contain greater clay content and therefore higher moisture retention characteristics. However overall texture is quite suitable and increasing organic content very modestly would help improve soil structure for the long term. Utilizing green waste compost abundant in nutrients and particularly potassium at the modest rate suggested below would address the potassium deficits and sufficiently boost organic content to improve soil structure. A modest rate of soil sulfur is also suggested for Sample 09 for some beneficial pH adjustment.

Organic content in Sample 06 is quite ample and favorable however excessive gravel and coarse sand fractions moderately increase the susceptibility for soil particles to consolidate over time and the result would be decreased porosity and drainage capacity. The ample organic matter would be of benefit to offset the gravel fractions, in the short term at least. Sample 06 is a marginal topsoil candidate based on the texture limitations and if you choose to utilize this soil then the recommendation for adjusting pH with soil sulfur is the only requirement.

Sample G3 is not a desirable topsoil candidate given the combination of poor soil structure and serpentine like characteristics where magnesium is excessive and potassium deficient. Calcium is insufficient relative to the magnesium excess, which can impair plant development. An abundant addition of agricultural gypsum as well as organic matter would be required to begin to correct the shortcomings and plant survivability given the serpentine character may still be questionable.

Sample C5-drier is an unsuitable topsoil candidate given the very poor soil structure and high tendency to lock up and provide inadequate aeration and drainage. Increasing organic content could help offset the gravel fractions in the short term though long term suitability would be marginal at best. This soil is not suggested for use.

Recommendations

The soil sulfur treatment could be broadcast along the surface prior to stripping and stockpiling the soils and should get mixed sufficiently during the stockpiling process. This would provide a jump start on pH adjustment. The organic amendment could also be handled in the same manner.

The following rates of soil sulfur and amendment should be applied to the following areas as indicated. The following rates are to treat a soil depth of 6-inches.

	Amount / 1000 square feet	
Samples C7 & 07:	8 pounds	Soil Sulfur
Samples G4, C8 & C5-wetter:	2-1/2 cubic yards	Green waste Compost
Sample 09:	2-1/2 cubic yards	Green waste Compost
	8 pounds	Soil Sulfur
Sample 05:	8 pounds	Soil Sulfur
Sample 06:	12 pounds	Soil Sulfur
*Sample G3:	4 cubic yards	Green waste Compost
	130 pounds	Agricultural Gypsum

* Using the G3 soil is not suggested however.

The Green waste compost will adequately supplement potassium nutrition while the soil sulfur will adjust pH closer to 7.3.

Nitrogen fertilization may be left to your discretion and could rely upon a very modest rate of an organic fertilizer such as Blood Meal or Alfalfa Meal used at 1/3 of the suggested rate.

HEIDI FISHER
Email 6 pages.

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Project : Permanente - Cupertino - 16143

COMPREHENSIVE SOIL ANALYSIS

Report No : **09-054-0030**
Purchase Order :
Date Recd : 02/23/2009
Date Printed : 02/26/2009

Sample Description - Sample ID	Half Sat % / TEC	pH / Qual Lime	ECe dS/m	NO_3-N ppm	NH_4-N ppm	PO_4-P ppm	K ppm	Ca ppm	Mg ppm	Cu ppm	Zn ppm	Mn ppm	Fe ppm	Organic % dry wt.	Lab No.
				Sufficiency Factors											
Soil Sample 1 - C7 1/27/09	17	7.9	0.7	15	4	27	151	1950	200	2.0	8.6	6	224	3.5	32855
	116	None		0.6		1.4	1.1	1.1	0.8	1.4	1.6	0.5	4.2		
Soil Sample 2 - 07 1/27/09	11	8.0	0.5	14	5	25	155	2399	63	1.0	2.8	5	161	2.6	32856
	128	None		0.9		1.9	1.3	1.6	0.3	0.8	0.6	0.5	3.5		
Soil Sample 4 - 09 1/27/09	22	7.9	0.6	10	4	15	105	2847	833	2.0	2.1	9	145	2.8	32857
	211	None		0.3		0.6	0.4	0.9	2.0	0.8	0.2	0.4	1.5		
Soil Sample 5 - G4 1/27/09	21	7.6	0.4	11	4	19	67	5712	865	2.4	1.3	6	42	2.2	32858
	356	None		0.4		0.7	0.2	1.4	1.6	0.7	0.1	0.2	0.3		
Soil Sample 6 - C8 1/27/09	19	7.6	0.5	10	4	20	52	2843	1374	1.9	1.1	8	85	2.5	32859
	255	None		0.4		0.9	0.2	0.9	3.3	0.7	0.1	0.4	0.9		
05 - 02/12/09	22	7.8	0.5	10	15	27	221	4607	947	1.8	5.0	8	129	7.1	32860
	312	None		0.6		1.0	0.7	1.1	1.8	0.5	0.4	0.3	1.1		

Saturation Extract Values						SAR	Gravel %		Percent of Sample Passing 2 mm Screen					USDA Soil Classification	Lab No.
									Sand						
Ca meq/L	Mg meq/L	Na meq/L	K meq/L	B ppm	SO_4 meq/L		Coarse 5 - 12	Fine 2 - 5	Very Coarse 1 - 2	Coarse 0.5 - 1	Med. to Very Fine 0.05 - 0.5	Silt .002-.05	Clay 0-.002		
4.3	1.3	1.0	0.3	0.05	0.9	0.6	5.0	9.0	5.6	8.0	38.2	26.6	21.6	Sandy Clay Loam	32855
2.9	0.8	0.6	0.4	0.09	0.7	0.5	8.0	4.6	3.0	8.0	47.6	23.8	17.6	Sandy Loam	32856
4.0	2.3	0.8	0.1	0.05	2.2	0.5	9.8	4.6	9.0	6.2	22.9	22.3	39.6	Clay Loam	32857
2.0	1.2	0.5	0.1	0.04	0.6	0.4	9.2	6.4	7.0	9.4	27.8	18.3	37.4	Gravelly Clay Loam	32858
2.4	1.5	0.6	0.1	0.05	0.7	0.5	5.8	8.4	5.6	6.6	31.9	20.4	35.5	Clay Loam	32859
3.0	1.6	0.7	0.2	0.08	0.8	0.5	4.6	9.0	7.4	7.6	28.9	28.4	27.7	Clay Loam	32860

Sufficiency factor (1.0=sufficient for average crop) below each nutrient value. N factor based on 200 ppm constant feed. SAR = Sodium adsorption ratio. Half Saturation %=approx field moisture capacity. Nitrogen(N), Potassium(K), Calcium(Ca) and Magnesium(Mg) by sodium chloride extraction. Phosphorus(P) by sodium bicarbonate extraction. Copper(Cu), Zinc(Zn), Manganese(Mn) & Iron(Fe) by DTPA extraction. Sat. ext. method for salinity (ECe as dS/m),Boron (B), Sulfate(SO_4), Sodium(Na). Gravel fraction expressed as percent by weight of oven-dried sample passing a 12mm(1/2 inch) sieve. Particle sizes in millimeters. Organic percentage determined by Walkley-Black or Loss on Ignition.

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www.soilandplantlaboratory.com

Project : Permanente - Cupertino - 16143

COMPREHENSIVE SOIL ANALYSIS

Report No : **09-054-0030**
Purchase Order :
Date Recd : 02/23/2009
Date Printed : 02/26/2009

Sample Description - Sample ID	Half Sat %	pH	ECe dS/m	NO_3-N ppm	NH_4-N ppm	PO_4-P ppm	K ppm	Ca ppm	Mg ppm	Cu ppm	Zn ppm	Mn ppm	Fe ppm	Organic % dry wt.	Lab No.
	TEC	Qual Lime		Sufficiency Factors											
06 - 02/12/09	26	8.1	0.7	10	6	41	289	4904	123	1.3	5.1	9	124	5.5	32861
	258	Low		0.3		1.3	0.9	1.2	0.2	0.4	0.4	0.3	1.0		
G3 - 02/12/09	18	7.2	0.5	9	3	19	48	3975	2773	1.5	1.2	12	64	0.7	32862
	429	None		0.3		0.9	0.1	0.9	4.7	0.4	0.1	0.4	0.5		
C5 - 02/12/09 (wetter)	18	7.3	0.5	10	4	25	43	4287	1482	1.8	1.1	8	45	2.4	32863
	337	None		0.4		1.2	0.2	1.2	3.1	0.6	0.1	0.3	0.4		
C5 - 02/12/09 (drier)	21	8.0	0.8	14	5	54	281	2726	45	2.3	5.7	5	60	2.5	32864
	144	Low		0.5		2.2	1.6	1.2	0.1	1.2	0.8	0.3	0.9		

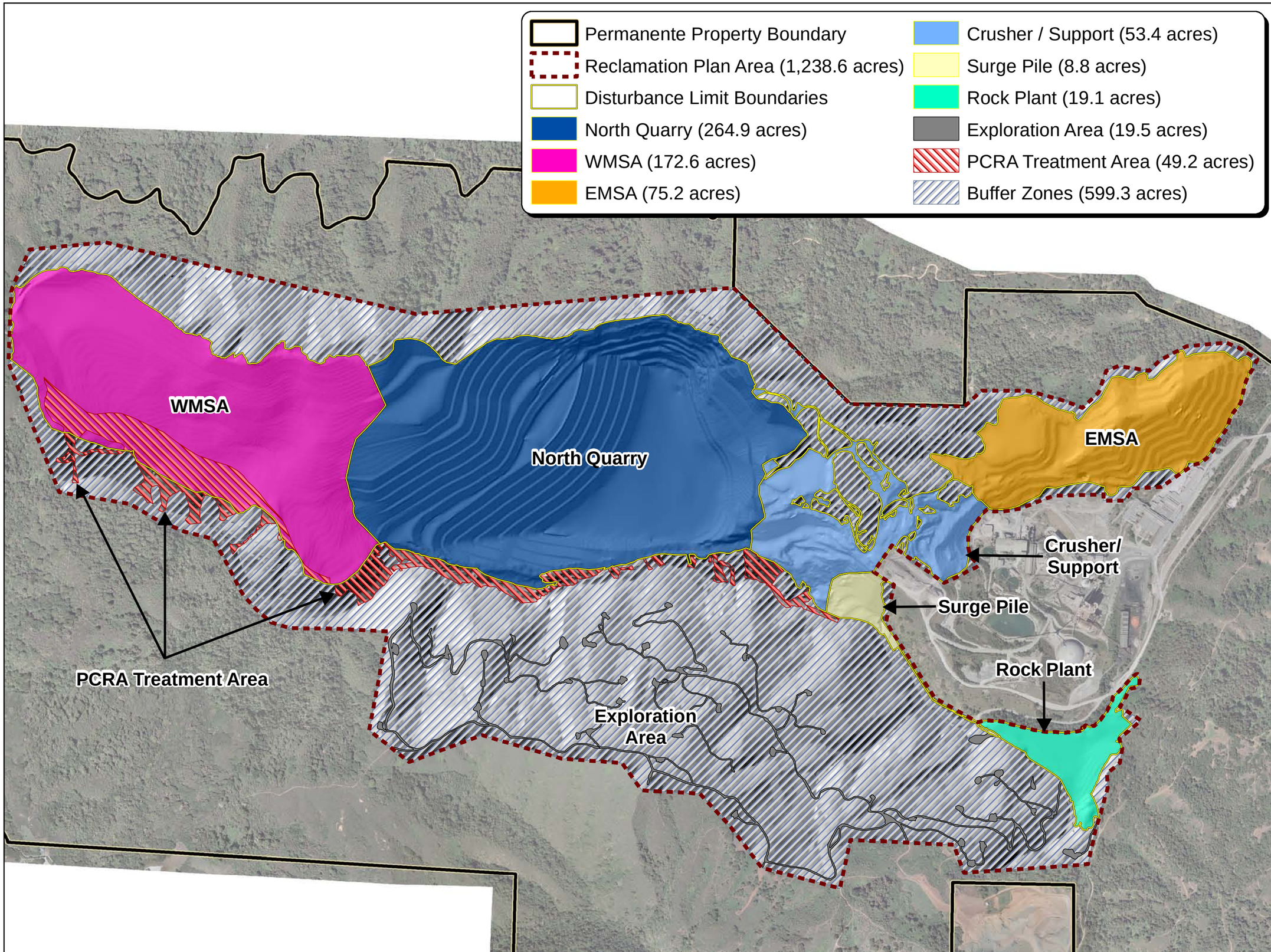
Saturation Extract Values						SAR	Gravel %		Percent of Sample Passing 2 mm Screen					USDA Soil Classification	Lab No.
									Sand						
Ca meq/L	Mg meq/L	Na meq/L	K meq/L	B ppm	SO_4 meq/L		Coarse 5 - 12	Fine 2 - 5	Very Coarse 1 - 2	Coarse 0.5 - 1	Med. to Very Fine 0.05 - 0.5	Silt .002-.05	Clay 0-.002		
4.5	0.7	0.6	0.7	0.11	1.1	0.3	14.2	13.2	10.8	9.0	41.1	24.3	14.8	Gravelly Sandy Loam	32861
1.6	1.6	0.9	0.1	0.05	0.5	0.7	13.0	14.0	12.2	12.0	30.6	16.0	29.2	Gravelly Sandy Clay Loam	32862
1.6	1.3	0.8	0.1	0.04	0.6	0.7	2.8	8.2	5.2	8.6	29.1	23.9	33.2	Clay Loam	32863
5.9	0.6	0.5	0.4	0.04	1.5	0.3	25.2	15.6	11.0	12.4	45.5	21.9	9.2	Very Gravelly Sandy Loam	32864

Sufficiency factor (1.0=sufficient for average crop) below each nutrient value. N factor based on 200 ppm constant feed. SAR = Sodium adsorption ratio. Half Saturation %=approx field moisture capacity. Nitrogen(N), Potassium(K), Calcium(Ca) and Magnesium(Mg) by sodium chloride extraction. Phosphorus(P) by sodium bicarbonate extraction. Copper(Cu), Zinc(Zn), Manganese(Mn) & Iron(Fe) by DTPA extraction. Sat. ext. method for salinity (ECe as dS/m),Boron (B), Sulfate(SO_4), Sodium(Na). Gravel fraction expressed as percent by weight of oven-dried sample passing a 12mm(1/2 inch) sieve. Particle sizes in millimeters. Organic percentage determined by Walkley-Black or Loss on Ignition.

* LOW , SUFFICIENT , HIGH

APPENDIX D

REVEGETATION PLAN FIGURES



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Lehigh Permanente Quarry
Santa Clara County, CA

Figure 1.

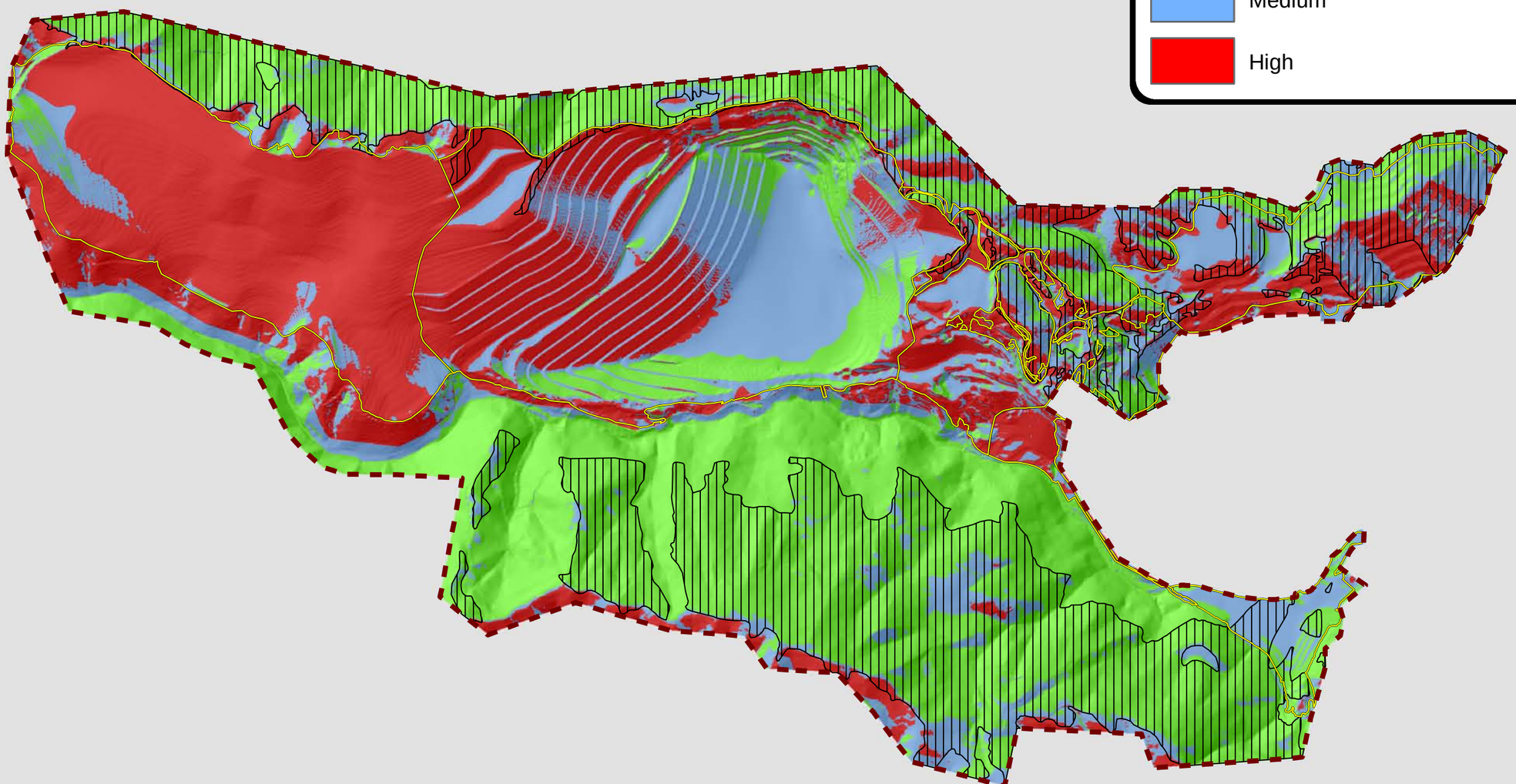
Reclamation Plan Area

N
W E
S

0 500 1,000 2,000
Feet

Date: November 2011
Map By: Michael Rochelle
Image: April 2007

Path: L:\Acad 2000 Files\16000\16143\gis\arcmap\2011 Round 4\Revegetation\Proposed_Project.mxd



Viewshed and Solar Radiation Analysis was performed using ArcGIS Spatial Analyst Surface Tools.

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ENVIRONMENTAL CONSULTANTS

Lehigh Permanente Quarry,
Santa Clara County,
California

Figure 2.

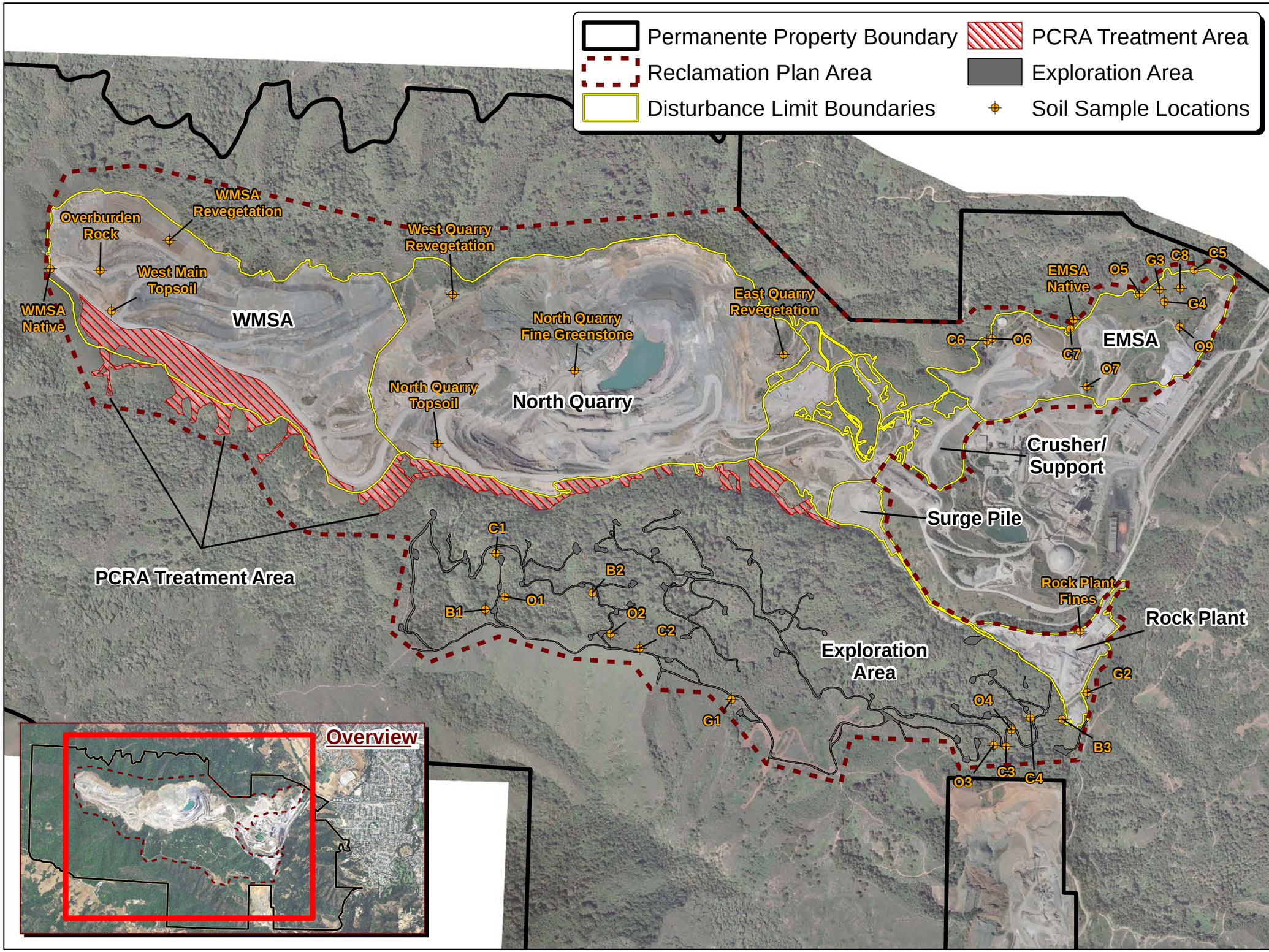
Visibility and
Solar Radiation
Analysis

N
W E
S

0 500 1,000 2,000
Feet

Date: November 2011
Map By: Michael Rochelle

Path: L:\Acad 2000 Files\16000\16143\gis\arcmap\2011 Round 4\Revegetation\Visibility_SolarRadiation.mxd



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Lehigh Permanente Quarry,
Santa Clara County,
California

Figure 3:

Soil Sample Locations

N
W E
S

0 500 1,000 2,000
Feet

Date: November 2011
Map by: Michael Rochelle
Aerial Date: April 2007

Path: L:\Acad 2000 Files\16000\16143\gis\arcmap\2011 Round 4\Revegetation\SoilSamples.mxd

Acres of revegetation per project area*							
	North Quarry	**WMSA**	**EMSA**	**Rock Plant**	**Surge Pile**	**Crusher/Support**	**Total**
Oak Woodland (acres)	0.0	0.0	4.5	1.8	0.0	0.2	6.5
Pine Woodland (acres)	0.6	0.2	12.4	3.7	0.0	4.8	21.7
Native Scrub (acres)	260.7	172.4	56.4	13.6	8.8	48.4	560.3
Total Planting Area	**261.3**	**172.6**	**73.3**	**19.1**	**8.8**	**53.4**	**588.5**

* Note: The inner 10-20 feet of engineered benches are left unvegetated to facilitate unobstructed stormwater flow. Therefore the revegetation acreages reported in this table may not match other references to acres for each of the project areas.

Reclamation Plan Area

Disturbance Limit Boundaries

Exploration Area

Undisturbed Existing Vegetation

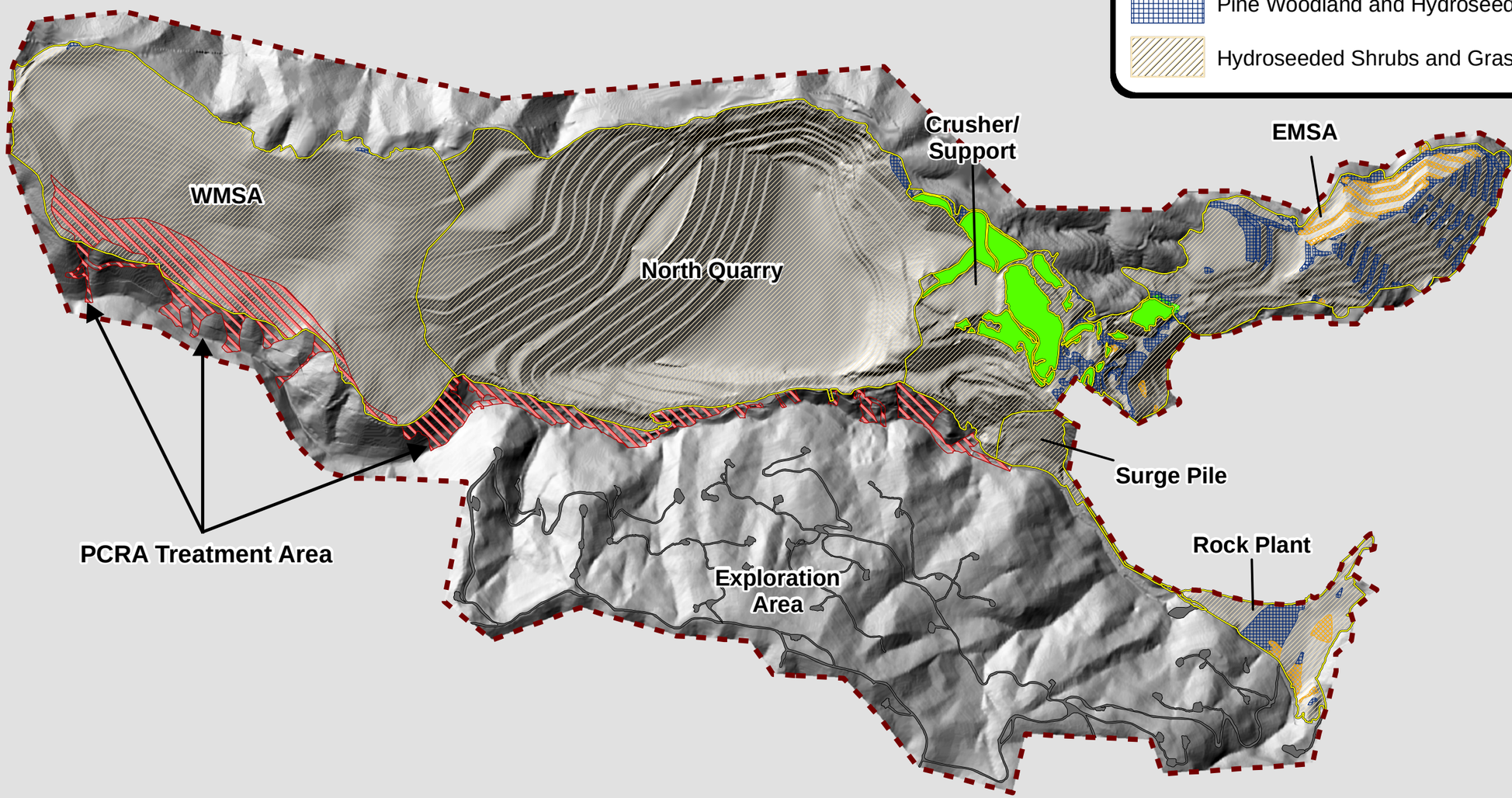
PCRA Treatment Area (49.2 acres)

Proposed Revegetation Plan

Oak Woodland and Hydroseed

Pine Woodland and Hydroseed

Hydroseeded Shrubs and Grasses



wra
ENVIRONMENTAL CONSULTANTS

Lehigh Permanente Quarry,
Santa Clara County,
California

Figure 4.

Proposed Revegetation Plan

N
W E
S

0 500 1,000 2,000
Feet

Date: November 2011
Map By: Michael Rochelle

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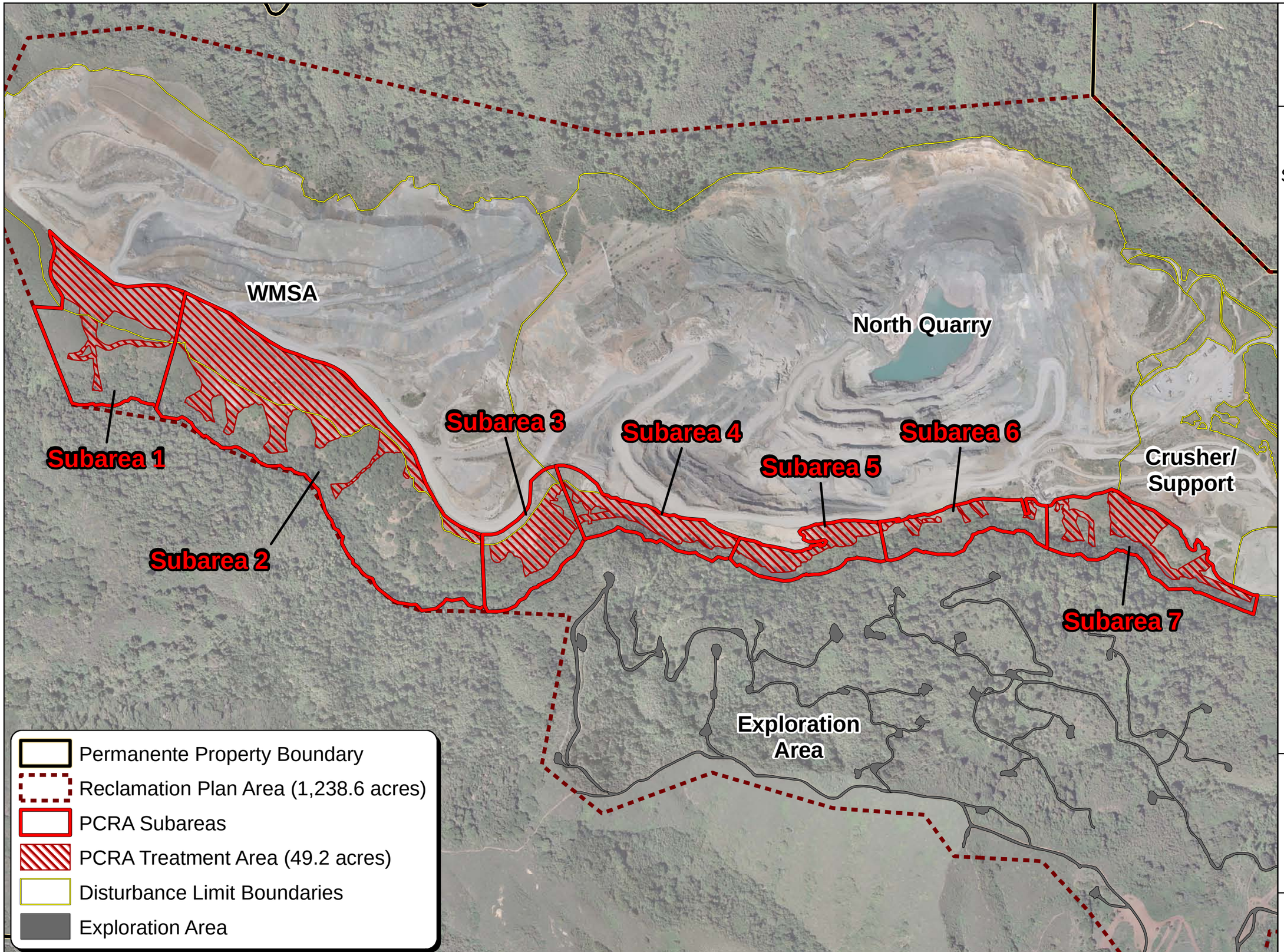

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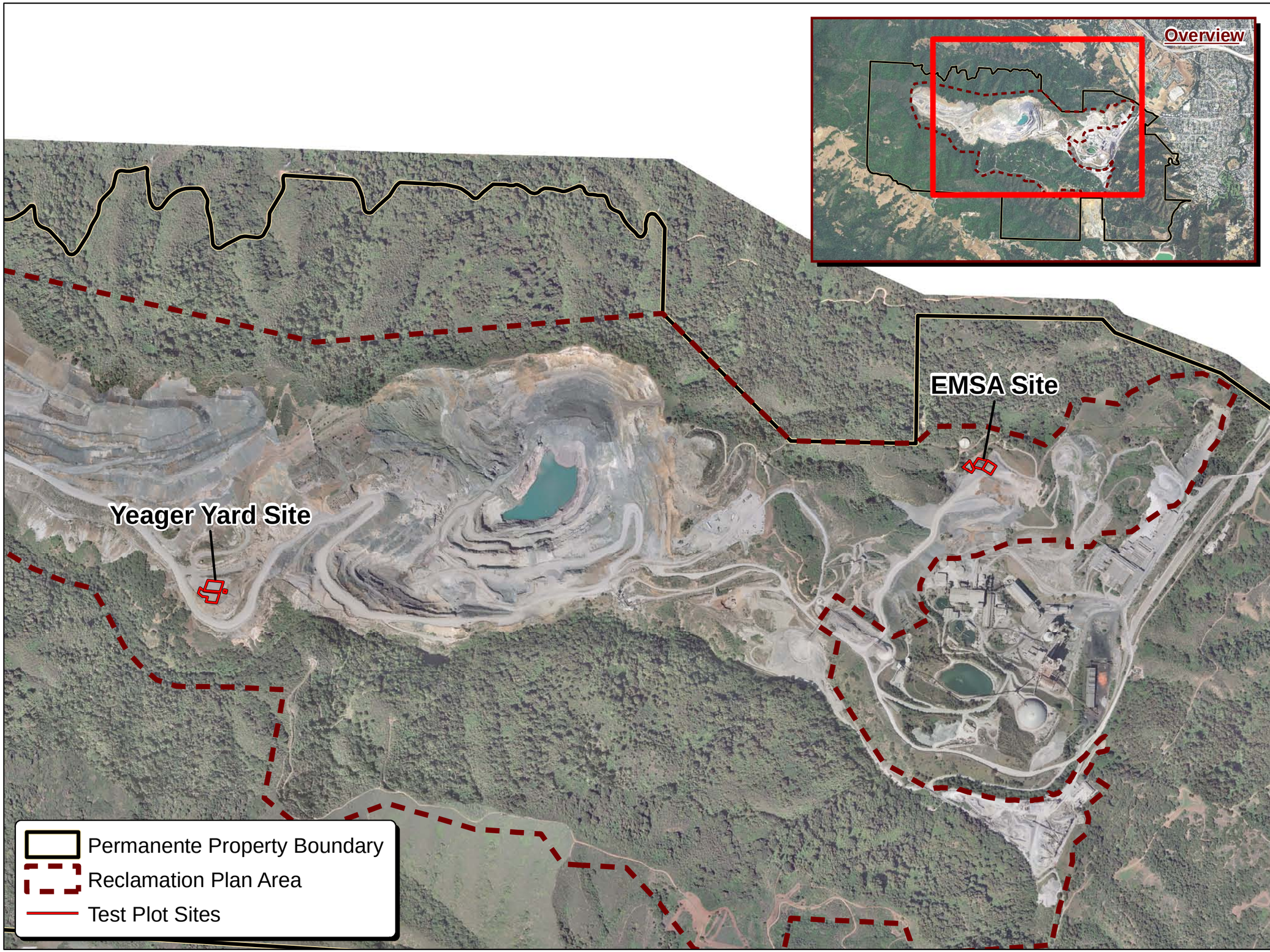
Lehigh Permanente
Quarry
Santa Clara County, CA

Figure 5.

Permanente Creek
Reclamation Area

Date: November 2011
Map By: Michael Rochelle
Image: April 2007

Path: L:\Acad 2000 Files\16000\16143\gis\arcmap\2011 Round 4\Revegetation\Permanente Creek Reclamation Areas.mxd



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Lehigh Permanente Quarry,
Santa Clara County,
California

Figure 6.

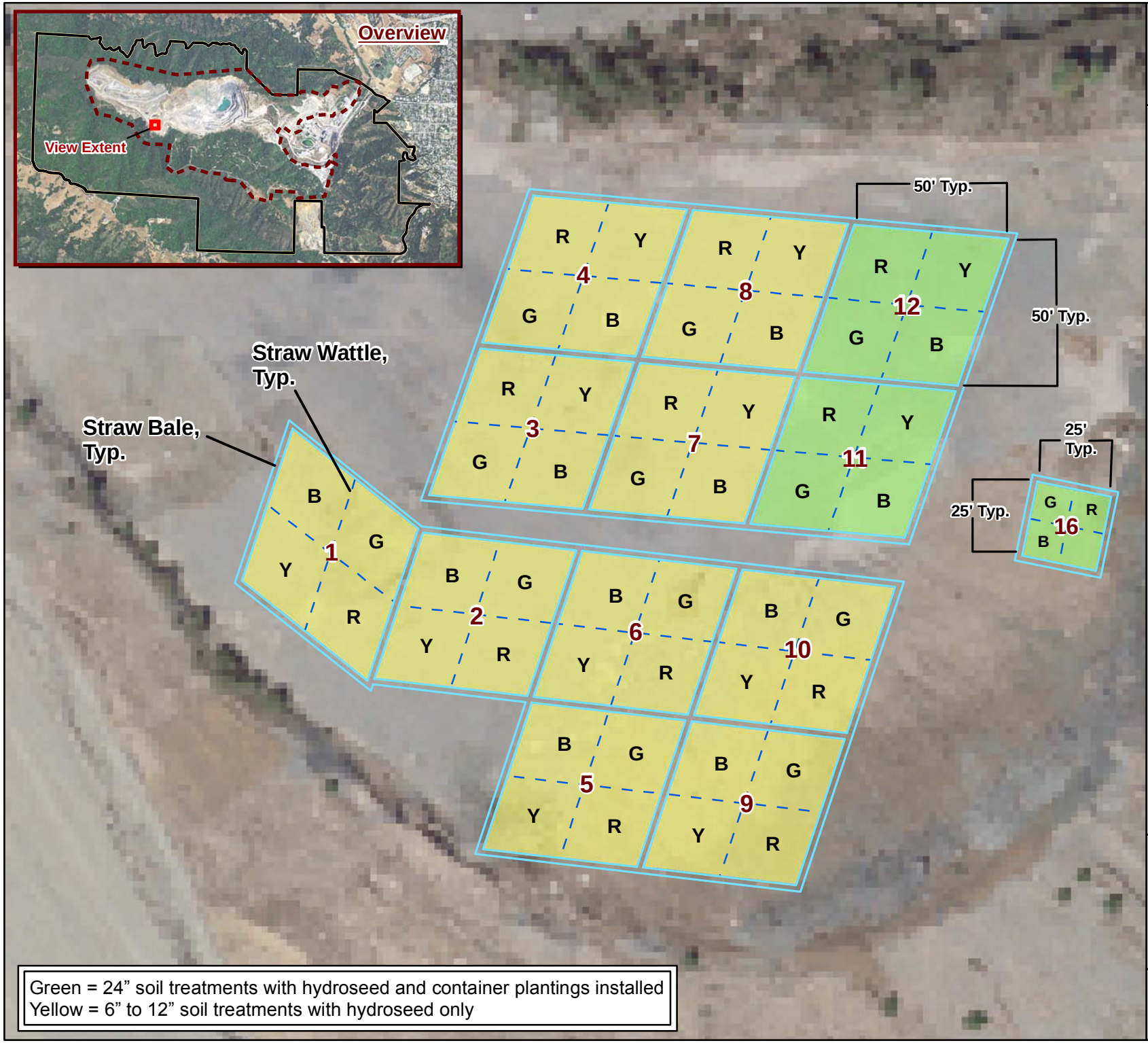
Test Plot
Location Map

N
W E
S

0 500 1,000 2,000
Feet

Date: November 2011
Map by: Michael Rochelle
Image Date: April 2007

Path: L:\Acad 2000 Files\16000\16143\gis\arcmap\2011 Round 4\Revegetation\Test Plot Location.mxd



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Lehigh Permanente Quarry,
Santa Clara County,
California

Figure 7.

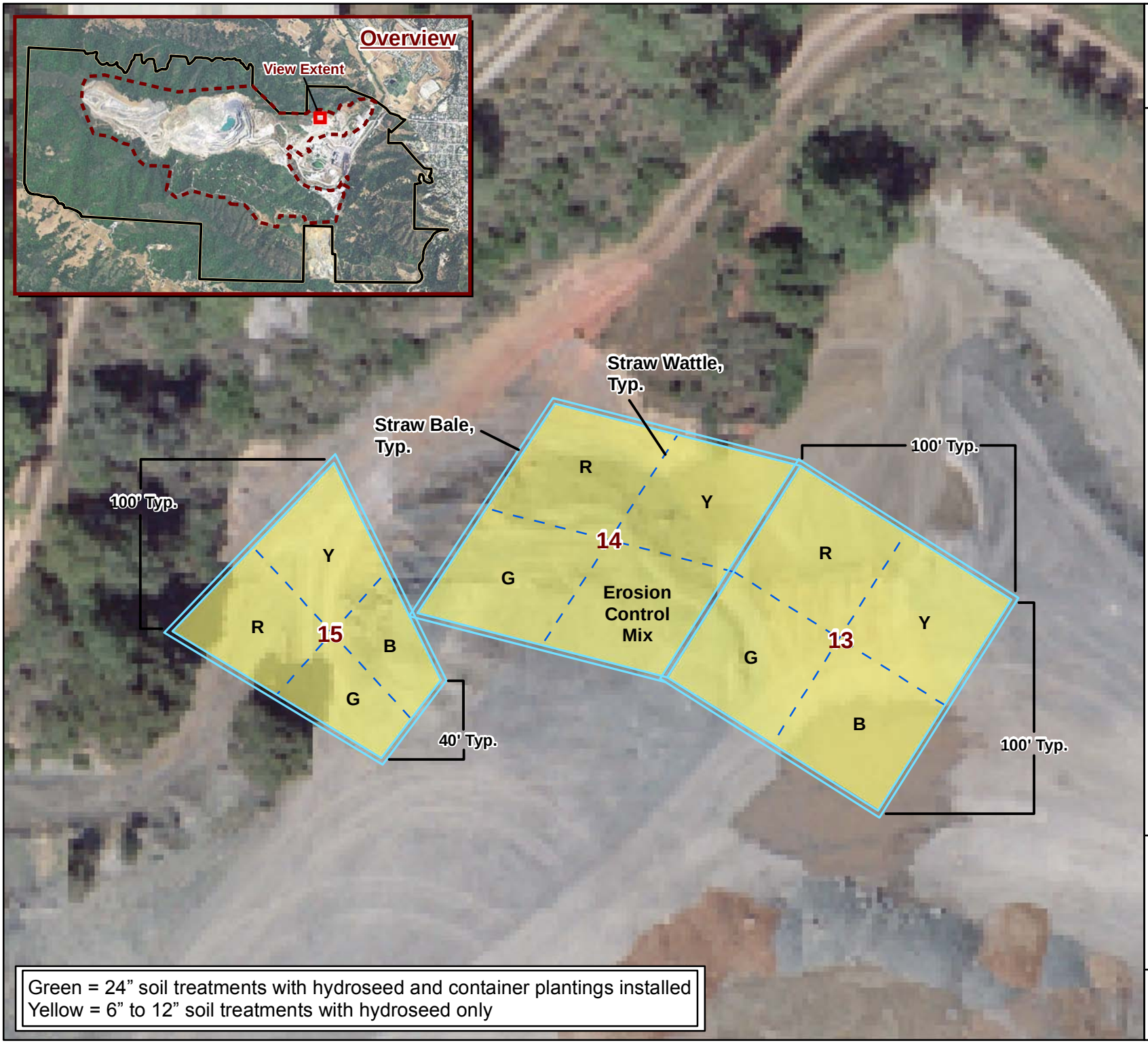
Test Plot Layout
at Yeager Yard Site

N
W E
S

0 25 50
Feet

Date: November 2011
Map by: Michael Rochelle
Image Date: April 2007

Path: L:\Acad 2000 Files\16000\16143\gis\arcmap\2011 Round 4\Revegetation\Yeager_Site.mxd



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Santa Clara County,
California

Figure 8.

Test Plot Layout at EMSA Site

N
W E
S

0 15 30 60
Feet

Date: November 2011
Map by: Michael Rochelle
Image Date: April 2007

Path: L:\Acad 2000 Files\16000\16143\gis\arcmap\2011 Round 4\Revegetation\EMSA_Site.mxd

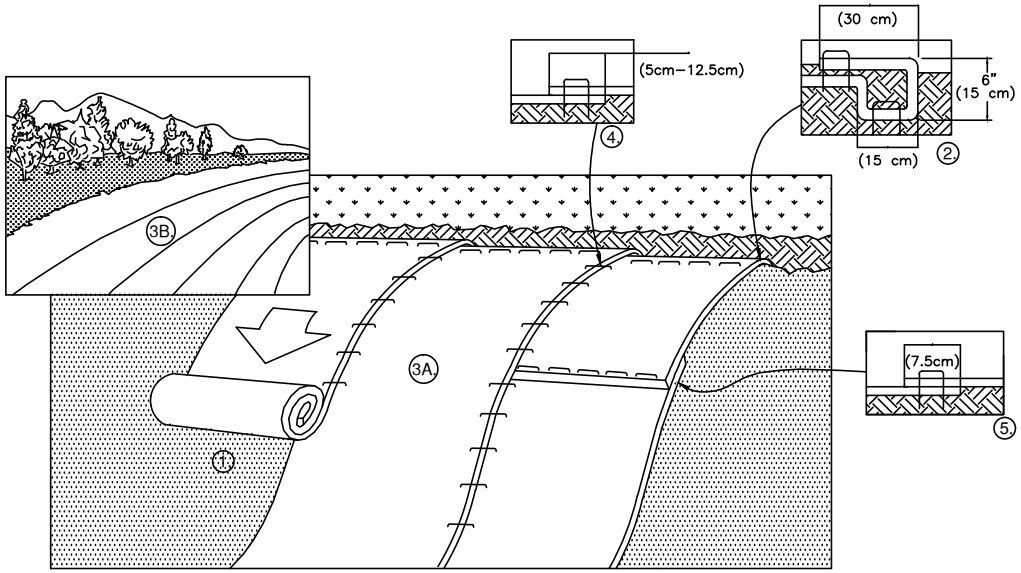
APPENDIX E

EROSION CONTROL INSTALLATION SCHEMATICS AND WILLOW PLANTING DETAILS

NORTH AMERICAN GREEN

EROSION CONTROL *Products*
Guaranteed SOLUTIONS

OR APPROVED EQUIVALENT



1. PREPARE SOIL BEFORE INSTALLING ROLLED EROSION CONTROL PRODUCTS (RECP's), INCLUDING ANY NECESSARY APPLICATION OF LIME, FERTILIZER, AND SEED.
   NOTE: WHEN USING CELL–O–SEED DO NOT SEED PREPARED AREA. CELL–O–SEED MUST BE INSTALLED WITH PAPER SIDE DOWN.
2. BEGIN AT THE TOP OF THE SLOPE BY ANCHORING THE RECP's IN A 6" (15 CM) DEEP X 6" (15 CM) WIDE TRENCH WITH APPROXIMATELY 12" (30cm) OF RECP's EXTENDED BEYOND THE UP–SLOPE PORTION OF THE TRENCH. ANCHOR THE RECP's WITH A ROW OF STAPLES/STAKES APPROXIMATELY 12" (30 CM) APART IN THE BOTTOM OF THE TRENCH. BACKFILL AND COMPACT THE TRENCH AFTER STAPLING. APPLY SEED TO COMPACTED SOIL AND FOLD REMAINING 12" (30 CM) PORTION OF RECP's BACK OVER SEED AND COMPACTED SOIL. SECURE RECP's OVER COMPACTED SOIL WITH A ROW OF STAPLES/STAKES SPACED APPROXIMATELY 12" (30 CM) APART ACROSS THE WIDTH OF THE RECP's.
3. ROLL THE RECP's (A.) DOWN OR (B.) HORIZONTALLY ACROSS THE SLOPE. RECP's WILL UNROLL WITH APPROPRIATE SIDE AGAINST THE SOIL SURFACE. ALL RECP's MUST BE SECURELY FASTENED TO SOIL SURFACE BY PLACING STAPLES/STAKES IN APPROPRIATE LOCATIONS AS SHOWN IN THE STAPLE PATTERN GUIDE. WHEN USING THE DOT SYSTEM™ , STAPLES/STAKES SHOULD BE PLACED THROUGH EACH OF THE COLORED DOTS CORRESPONDING TO THE APPROPRIATE STAPLE PATTERN.
4. THE EDGES OF PARALLEL RECP's MUST BE STAPLED WITH APPROXIMATELY 2" – 5" (5 CM – 12.5 CM) OVERLAP DEPENDING ON RECP's TYPE.
5. CONSECUTIVE RECP's SPLICED DOWN THE SLOPE MUST BE PLACED END OVER END (SHINGLE STYLE) WITH AN APPROXIMATE 3" (7.5 CM) OVERLAP. STAPLE THROUGH OVERLAPPED AREA, APPROXIMATELY 12" (30 CM) APART ACROSS ENTIRE RECP's WIDTH.
   NOTE:
   *IN LOOSE SOIL CONDITIONS, THE USE OF STAPLE OR STAKE LENGTHS GREATER THAN 6" (15 CM) MAY BE NECESSARY TO PROPERLY SECURE THE RECP's.

EROSION CONTROL BLANKET - SLOPE INSTALLATION

NOT TO SCALE

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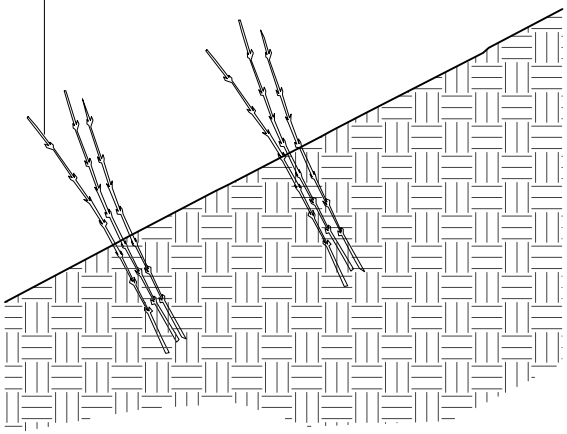
ENVIRONMENTAL CONSULTANTS
2169-G East Francisco Blvd.
San Rafael, CA 94901
(415) 454-8868 Phone
(415) 454-0129 Fax

Permanente Creek Reclamation Area:
Standard Erosion Control Blanket Detail

Appendix E

WILLOW POLE CUTTINGS - SEE PLANTING SPECIFICATIONS. PLANT WILLOWS SUCH THAT BASE OF CUTTING EXTENDS A MINIMUM OF 24" BELOW THE FINISH GRADE.



SECTION

WILLOW POLE PLANTING

NOT TO SCALE

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(415) 454-8868 Phone
(415) 454-0129 Fax

Permanente Creek Reclamation Area:
Standard Willow Pole Detail

Appendix E

Appendix F – Permanente Creek Restoration Conceptual Approach and Design

Appendix F

Permanente Creek Conceptual Restoration Plan

This appendix provides a conceptual plan for certain restoration processes and activities in Permanente Creek. The restoration activities are designed to reclaim the effects of historic mining operations in portions of the creek channel, enhance riparian habitat along the creek corridor, and improve hydrologic functioning.

These designs still retain a conceptual nature due to the fact that these reclamation activities will take place concurrent with and in a manner consistent with the Restoration Plan under the jurisdiction of the RWQCB. This reclamation plan treatment will also be refined during any necessary permitting processes of all jurisdictional agencies including the RWQCB, the U.S Army Corps of Engineers and the California Department of Fish and Game. In no event shall the treatments be less stringent than those required under SMARA. To the extent that future changes or refinements to these plans occur as a result of future regulatory review, and such changes involve potentially significant new environmental impacts, subsequent environmental review would be expected to occur.

Permanente Creek is divided into various reaches as outlined in the Permanente Creek Long-Term Restoration Plan (URS 2011). The restoration activities proposed here are planned in a lower segment consisting of Reaches 12 and 13, and an upper segment consisting of Reaches 17 and 18 (see Chang 2011). Generally, the restoration of the creek will decrease each individual run of the creek to a target of less than 2% grade by the realignment of the creek to include channel lengthening meanders and the addition of rock stepped pool complexes. The creek main channel will incorporate a modified trapezoidal cross-section regraded to incorporate floodplain benches on one or both sides of the creek which will accommodate a two-year flood event. Beyond the 2-year floodplain bench a 3:1 bank will continue up to the top of bank which will be designed to accommodate a 100-year flood (Figure 1). Any fill generated from the creek restoration grading will be deposited in the North Quarry.

Each segment and reach is described and restoration activities are recommended below, followed by a synopsis of the regulatory permits that may be required to construct the project.

<u>Downstream Segment</u>

The lower segment containing Reaches 12 and 13 currently extends a distance of approximately 1,100 feet from station 81+00 to 92+00 in the URS report. The downstream portion of this reach contains a half culvert which acts as a potential fish passage barrier and limits availability of habitat. The half culvert also potentially acts to increase water temperatures in this section. A dirt road exists parallel to the half culvert which provides access to quarry operational areas. Pond 13 exists at the upstream head of the half culvert and extends from approximately marker 89+00 to 85+00. The pond is formed by an in-stream dam.

Proposed restoration measures include the removal of the concrete half culvert, removal of artificial fills adjacent to the half culvert, removal of Pond 13, construction of a realigned creek and floodplain, and revegetation of the riparian corridor.

A new creek channel will be created with a thalweg located slightly north of the existing thalweg. Pond 13 will be abandoned along with any associated infrastructure to match historic upstream

and downstream valley topography. The new creek bed will meander throughout its alignment allowing for a longer path when compared to the existing condition. While the overall longitudinal profile of the creek segment will remain the same, each run within the creek will meet a target slope of less than 2% grade by incorporating channel lengthening meanders and stepped pool and grade control complexes. Areas of the creek with step pools will be steeper and have shallower flows. Floodplain benches will be omitted from these areas, however willow poles will be planted in the joints of the rocks to increase channel stability (Figure 2).

A generalized cross section plan for the creek and floodplain are shown in Figure 1. The newly constructed channel will have a modified trapezoidal cross-section with a main channel bed width of 10 feet. Floodplain benches will be constructed 2.5 feet above the main channel bed at the two-year flood elevation. The floodplain bench will be 2 feet wide and will be revegetated with a wetland grass and herb plant palette as detailed in Table 1. Outside of the floodplain bench, the creek banks will be graded at a 3:1 ratio to the top of bank where the topography and bedrock allows. The floodplain banks will be revegetated with a riparian tree and shrub plant palate as detailed in Table 2. The channel will be designed to accommodate 100-year storm flows.

Table 1. Preliminary grass and herb species for planting along riparian floodplain benches.

SCIENTIFIC NAME	COMMON NAME
Artemisia douglasiana	mugwort
Carex barbarae	valley sedge
Carex praegracilis	field sedge
Cyperus eragrostis	tall flatsedge
Hordeum brachyantherum	meadow barley
Juncus effusus	bog rush
Juncus patens	common rush
Leymus triticoides	creeping wildrye

Table 2. Preliminary tree and shrub species for planting along riparian floodplain banks.

SCIENTIFIC NAME	COMMON NAME
TREES	
Aesculus californica	California buckeye
Quercus agrifolia	coast live oak
Quercus chrysolepis	canyon live oak
Quercus lobata	Valley oak
Quercus wislizenii	interior live oak
Salix laevigata	red willow
Salix lasiolepis	arroyo willow

SHRUBS	
Heteromeles arbutifolia	Toyon
Rhamnus californica	California coffeeberry
Rosa californica	California rose
Sambucus mexicana	blue elderberry

Upstream Segment

The upstream segment consists of portions of Reaches 17 and 18 and currently extends a distance of approximately 1,400 feet from stations 120+00 to 136+00. The profile of the existing creek corridor is affected by historic overburden fills on the side slopes and creek bottom. The existing channel profile also may be controlled by bedrock, particularly where a profile change occurs at the upstream end of the Reach 17 into Reach 18. Proposed restoration measures include the removal of the remnants of relic concrete structures, removal of overburden materials in the creek, reestablishment of a bankfull bench and floodplain, and revegetation of riparian areas and stabilization of slopes.

The existing creek will be regraded in its current alignment to remove overburden fill. The basic creek design will generally be the same as described above for the downstream segment (see Figure 1). The creek bed will meander throughout its alignment allowing for a longer path when compared to the existing condition and meet the target slope of less than 2% grade for each run within the reach. The creek channel will have a modified trapezoidal cross-section with a main channel bed width of 10 feet and have banks with slopes to accommodate a two-year flood. A stable profile of the creek will be established by installing step pools where necessary between runs. Notably, a geotechnical and groundwater investigation may be warranted to identify bedrock controls by mapping the valley topography beneath the overburden material. Similar to the lower reach, areas of the creek with step pools will not have 2-year floodplain benches, but willow poles will be planted in the joints of the rocks to increase channel stability (Figure 2).

Floodplain benches will be constructed at the 2-year flood elevation (approximately 2.5 feet above the main channel bed). The floodplain will be created on either side of the newly aligned creek channel as feasible by removal of artificial valley fill material and regrading. The floodplain base will be 14 feet wide (2 feet on each side of the 10 foot channel bed) and its banks will be graded at a 3:1 ratio to the top of bank where possible. The restored creek will be designed to accommodate a 100-year storm flow. The floodplain bench will be revegetated with a wetland grass/herb plant palate as described in Table 1, and the floodplain banks will be revegetated with a riparian tree/shrub plant palate as described in Table 2.

Potential Permits and Mitigation Required

To perform restoration work for both the upstream and downstream segments, the following permits will likely be required from federal, state, and regional regulatory agencies:

Section 404 (Corps of Engineers)

Because the project proposes discharge and/or dredging of fill material into the waters of the United States, including special aquatic sites such as wetlands, a Section 404 permit must be obtained. The U.S. Army Corps of Engineers (Corps) authorizes activities by a standard

individual permit, nationwide permit, or regional permit. The Corps will make the determination on what type of permit is needed for the proposed work.

CWA 401 Certification (RWQCB)

Applicants receiving a Section 404 permit from the Corps are required to obtain a Section 401 water quality certification from the Regional Water Quality Control Board (RWQCB). The Federal Clean Water Act, in Section 401, specifies that states must certify that any activity subject to a permit issued by a federal agency, such as the Corps, meets all state water quality standards. In California, the State Board and the regional boards are responsible for taking certification actions for activities subject to any permit issued by the Corps pursuant to Section 404. Regional boards or their executive officers may issue 401 certifications.

1602 Stream Alteration Agreement (CDFG)

The Fish and Game Code (Section 1602) requires an entity to notify the California Department of Fish and Game (CDFG) of any proposed activity that may substantially modify a river, stream, or lake. The notification requirement applies to any work undertaken in or near a river, stream, or lake that flows at least intermittently through a bed or channel. This includes ephemeral streams, desert washes, and watercourses with a subsurface flow. It may also apply to work undertaken within the flood plain of a body of water. If DFG determines that the activity may substantially adversely affect fish and wildlife resources, a Lake or Streambed Alteration Agreement will be prepared. The Agreement includes reasonable conditions necessary to protect those resources and must comply with the California Environmental Quality Act (CEQA).

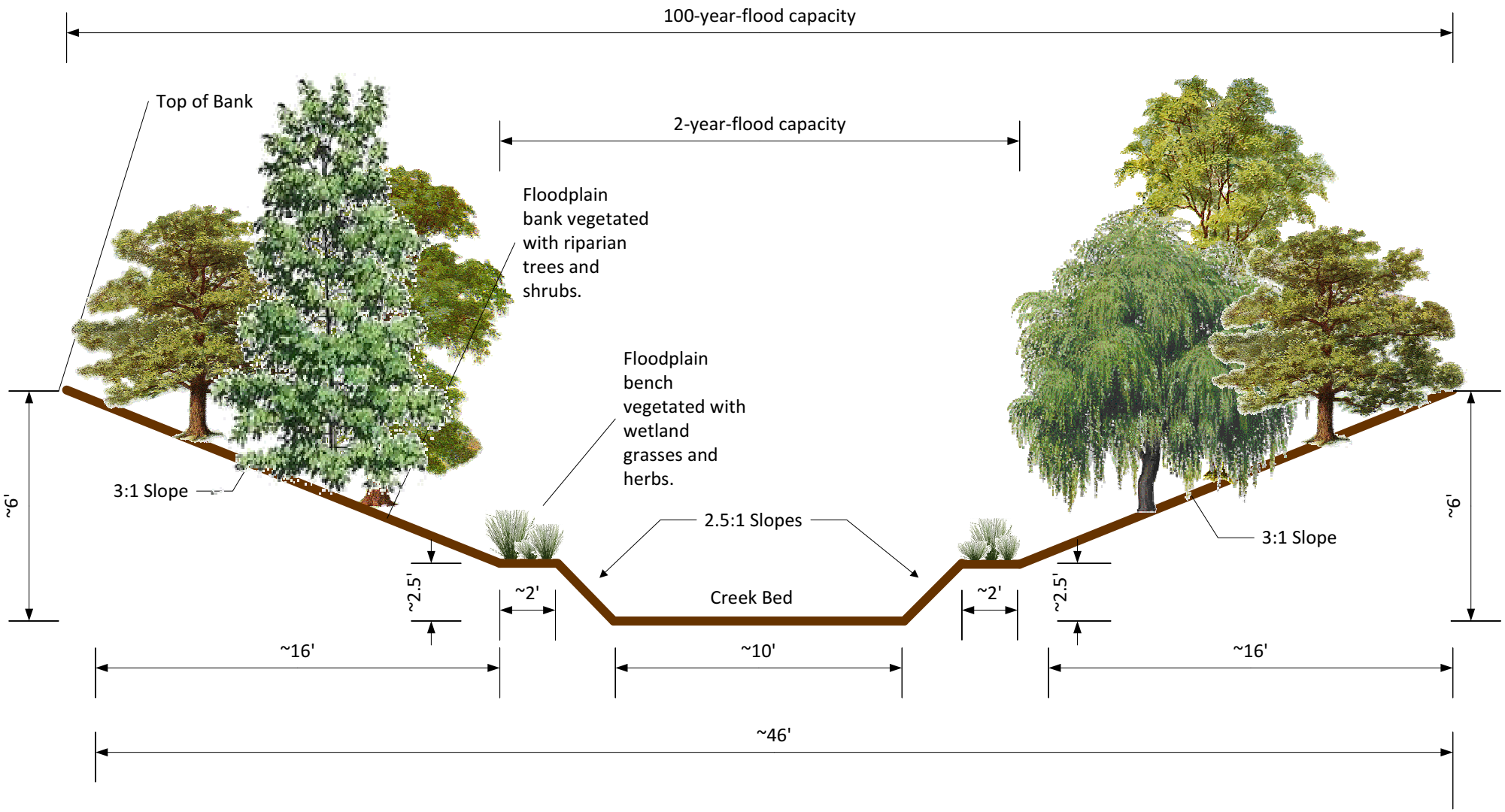
Section 7 ESA Consultation (USFWS)

Because California red-legged frog occurrences are documented downstream from the project site, the project may need to consult with the United States Fish and Wildlife Service (USFWS) through the Section 7 Endangered Species Act (ESA) process. Section 7 of the ESA requires federal agencies to consult with the USFWS if they are proposing (e.g. permitting) an "action" that may affect listed species or their designated habitat. Each federal agency is to insure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of a listed species or result in the destruction or adverse modification of designated critical habitat. This is done through the consultation process. If the USFWS determines that the project has potential to affect listed species or habitat, a Section 7 Biological Assessment (BA) is prepared to analyze the potential effects of the project. The USFWS uses this to establish and justify an "effect determination" and typically issues a biological opinion which acts as take coverage for listed species.

Mitigation

Grading and restoration of the creek channel may result in limited impacts to riparian and wetland habitats. Impacts to these habitats will be avoided or minimized to the greatest extent possible, although it should be noted that those portions of the creek subject to restoration are impacted by historical mining activities in their present condition, and the long-term effects of restoration will be entirely beneficial. Potential impacts will be quantified during the permitting process as the conceptual design is refined. Any necessary mitigation for these impacts will be accomplished through wetland and riparian habitat creation during the creek restoration.

Figure 1. Generalized cross section view of proposed restoration for Permanente Creek channel and floodplain.



* All dimensions are approximate based on conceptual analyses.

Figure 2. General schematic design of step pools.