Attachment B

Revegetation Plan

Revegetation Plan
Permanente Quarry

SANTA CLARA COUNTY
CALIFORNIA

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Executive Summary

This Revegetation Plan (Plan) describes the revegetation program for the Permanente Quarry's proposed Reclamation Plan Amendment (RPA). 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 39 acres and over 10,000 trees
- Oak tree replacement ratio of 7.5 to 1 for new extraction areas
- Grey Pine woodland plantings totaling 39 acres and over 15,000 trees
- Native shrub species planted over 78 acres
- Native hydroseed mix (including shrubs) applied over approximately 627 acres
- Riparian plantings in various areas totaling up to one acre
- Revegetation using seed collected from on-site
- Use of interim erosion control native seed mixes
- Revegetation with 75 percent native topsoil, with additional blends available
- Conservation areas set aside to provide for mitigation of potential impacts
- Results from 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. South 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 these areas will develop into mixed oak woodland habitat that will blend in with the surrounding environment and provide wilfdlife habitat. The majority of seed used for the revegetation effort has been collected on-site and contract grown in commercial gardens to generate large amounts of local 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 and will continue to develop 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 on site materials that will enhance the amount of growth media available for revegetation purposes, as necessary to ultimately achieve revegetative success. The result of these efforts has thus far targeted a recommended blend of natural topsoil, overburden and various other materials available on site. A test plot program is underway that tests the various soil blends, four hydroseed mixes, and container shrub and tree plantings. The first year and a half of monitoring data was 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.

TABLE OF CONTENTS

APPENDICES

Appendix A – Photographs of Test Plots and Previous Revegetation Sites

Appendix B – List of Potential Native Plant Species for Permanente Quarry Revegetation

Appendix C – Technical Memorandum: Year 1 Test Plot Monitoring Results

Appendix D – Soil Laboratory Reports

Appendix E – Revegetation Plan Figures

Figure 1. Proposed Project Area
Figure 2. Visibility and Solar Radiation Analysis
Figure 3. Soil Sample Locations
Figure 4. Proposed Revegetation Plan
Figure 5. Test Plot Location Map
Figure 6. Yeager Yard Test Plot Layout
Figure 7. EMSA Test Plot Layout

LIST OF TABLES

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 705 acres of an approximately 1,105-acre Reclamation Plan Amendment area (Project Area). The Project Area 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 Project Area will occur within the disturbed areas shown in Figure 1. The Project Area is divided into nine units: the West Materials Storage Area (WMSA), Central Materials Storage Area (CMSA), East Material Storage Area (EMSA), North Quarry, South Quarry, Rock Plant, Surge Pile, Topsoil Storage Area, 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 Project Area will include revegetation of disturbed ground as identified in the RPA, except for active roads and swales, with native species following the guidance set forth in the Reclamation Standards. Reclamation will occur in phases as areas are brought to final contours with progressive revegetation of slopes and benches as the planned landforms are completed.

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 Project Area. Appendix C provides a technical memo summarizing preliminary results of revegetation test plots. Appendix D includes soil test reports from Soil and Plant Lab, Inc. Appendix E includes Figures 1-7 as referenced in this Revegetation Plan.

1.1 Revegetation Goals and Objectives

The ultimate goal for revegetation efforts in the Project Area is restoration of native vegetation types. 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 Project Area. 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 Project Area 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 Project Area 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 very slow growing, native grey pine will be planted in some more visible bench areas; 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. 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 Project Area 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 Project Area 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. 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. 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-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.

2.0 EXISTING CONDITIONS

2.1 Native Soil Types

The USDA *Soil Survey of Santa Clara Area, California* (USDA 1958) indicates that the Project Area has nine 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 Project Area 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, slightly eroded, 20-35 percent slopes (Lc) - This soil differs from the non-eroded Los Gatos clay loam described above mainly in degree of erosion. In a number of places, the exposed soil is somewhat redder and somewhat finer textured than typical, because of partial or complete removal of the surface soil and mixture with subsoils.

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.

Maymen loam, slightly eroded, 20-35 percent slopes (Md) - The typical uneroded soil profile for Maymen loam soils are light-brown or pale-brown loams to depths of 6 to 10 inches. In most places some rock fragments are present. Ths surface soil grades into a light-brown or light reddish-brown loam subsoil that contains numerous rock fragments. At depths of 11 to 16 inches, the subsoil grades into hard sandstone or conglomerate bedrock. Slightly eroded Maymen loams are associated with other Maymen soils and with soils of the Los Gatos series, mainly on Monte Bello Ridge.

Maymen loam, moderately eroded, 20-35 percent slopes (Mc) - This soil differs from the non-eroded Maymen loam soils described above mainly in degree of erosion. Moderately eroded Maymen loams are associated with other Maymen soils and with soils of the Los Gatos series, mainly on Monte Bello Ridge.

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 Project Area 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 Project Area 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 Project Area based on proposed final reclaimed slope and aspect. The initially unvegetated slopes of the Project Area may experience relatively 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 Project Area is described in the *Biological Resources Assessment* prepared by WRA (2010a). Portions of the Project Area 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 Project Area. Most of the hillslopes surrounding the Project Area are described as this community type. This biological community is 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 Project Area 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. Native topsoil is the preferred growth substrate, and will be applied to the surface to provide for vegetative growth. 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. The soil development plant also is designed to identify blends of topsoil with overburden and other on site materials to increase the amount of substrate available for revegetation if additional substrate proves necessary to meet revegetation objectives.

Where continuing Quarry operations disturb native soils, topsoil will be harvested and moved directly to an area of active revegetation whenever possible. If the harvested soils must be stored for some time prior to use in revegetation, those soils will be stockpiled and clearly labeled. While the margins of stockpiled soil may need to be compacted for stabilization, in general harvested topsoil will be compacted as little as possible and will only be moved or worked when it is dry. Stockpiles of topsoil or other growth medium intended for use in revegetation efforts will be protected from erosion and weed establishment through the use of hydroseeding with a native erosion control mix and tackifiers, mulches, erosion control blankets, wattles, silt fences, or other soil protection measures.

Where mining activities have resulted in compaction of the soil, ripping, discing, or other means will be used in revegetation areas to establish a suitable rooting zone in preparation for planting. Where access roads, haul roads, or other traffic routes are to be revegetated, all roadbase materials shall be stripped from the road, the substrate shall be ripped or disced as needed to promote establishment of an appropriate root zone, a soil mix containing topsoil or compost will be spread to promote plant growth, and the area will be revegetated.

To provide information on soil conditions for the Project Area 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 Project Area, 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 D. Two additional samples included in Appendix D, 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 Project Area. 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 Project Area. 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.

Undisturbed Topsoil Sites

The "EMSA Native" and "WMSA Native" topsoil samples (referred to as "East Dump Native" and "West Dump Native" in soil laboratory reports [Appendix D]) 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 Project Area, within oak woodland, chaparral, and grassland vegetation communities. The samples varied in soil texture, organic matter content, and other characteristics (Appendix D). 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.

East Quarry Revegetation Site

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 revegetation site has the highest organic matter content (4.8 percent) of the three revegetation sites, an amount sufficient to support native vegetation (Appendix D). 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 Project Area soil characteristics.

Table 1. Description and characteristics of soil samples (additional details in Appendix D).

SAMPLE MATERIAL	DOMINANT PLANT COMMUNITY	USDA map unit (1958)	Organic matter (% dry weight)	USDA SOIL CLASSIFICATION
Undisturbed Reference Topsoil (potential topsoil sources)				
South Quarry - B1	bay forest	Pa	7.8	Very Gravelly Sandy Loam
South Quarry - B2	bay forest	Lf	9.7	Very Gravelly Sandy Loam
Topsoil Storage Area - 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 Quarry - C1	chaparral	Pa	6.9	Gravelly Sandy Loam
South Quarry - C2	chaparral	Lf	8.8	Sandy Clay Loam
Topsoil Storage Area - C3	chaparral	Pa	6.7	Loam
Topsoil Storage Area - 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 Quarry - G1	grassland	La	2.6	Sandy Clay Loam
Topsoil Storage Area - 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 Quarry - O1	oak woodland	Pa	5.7	Gravelly Sandy Loam
South Quarry - O2	oak woodland	Lf	5.1	Very Gravelly Sandy Loam
Topsoil Storage Area - O3	oak woodland	Pa	6.4	Gravelly Loam
Topsoil Storage Area - 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

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 Project Area 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 Project Area will be more similar to the previous revegetation sites.

Targeting a loamy topsoil texture would be desirable for the Project Area 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 Project Area soil development.

3.3 Available Materials

Stockpiled topsoil will be incorporated with the top layer of overburden rock when present to improve soil conditions in the Project Area. Topsoil from the Project Area will be harvested and stockpiled for reclamation purposes. Woody plant material removed within the Project Area will be chipped and blended with the topsoil to increase the organic matter. Although there should be sufficient topsoil harvested and stockpiled on-site for the revegetation efforts, additional materials may also be added. 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 would not support the desired native plant communities in the Project Area. 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 considered 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 D).

According to the soils analysis, the coarse, diverse soil composition of the overburden rock does not provide an ideal growth medium given the high potential for consolidation to occur over time, resulting in greater imperviousness to air and water. 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 or some of the materials available within the Project Area 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 Project Area. Approximately 625,000 cubic yards of topsoil will be harvested and stockpiled within the Project Area. Prior to removing the topsoil, existing trees and shrubs may be cut and chipped in place. This woody debris can be incorporated into the topsoil to increase the level of organic matter in the soil. The volume of woody debris available within the Project Area to blend with topsoil is estimated to be 40,000 cubic yards.

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 Project Area 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.

3.4 Soil Blends

Based on the soil analysis results, a suitable plant growth medium can be created in the Project Area by placing supplemental materials on top of and/or incorporating them directly with overburden rock, when present, and adding organic amendments (Appendix D). When revegetation occurs on areas without overburden then topsoil will be used solely or as a dominant in combination with one of the materials listed in Table 3. 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 2.

Table 2. 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

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 would provide 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 Project Area (see Section 4.0).

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. This measure may only be necessary if sufficient topsoil quantities are not available.

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 expected quantities.

3.5 Soil Preparation

The objective of this Plan is to meet revegetation objectives using the entirety of available topsoil in as high a percentage as possible. To the extent that topsoil blending is necessary to enhance the amount of growth media available to growth targets, certain soil preparation strategies have been developed. Soil preparation in the Project Area 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 Project Area, depending on the target plant community and general aspect and substrate of each area.

3.5.1 Material Quantities

The volumes of available resources will be a primary factor in determining the feasibility of the soil blends. The soil types and estimated available volumes are listed in Table 3.

WRA has investigated portions of the EMSA, South Quarry, and Rock Plant with undisturbed topsoil and native vegetation and described available depths and general condition. Soil depths (including the A and B horizons) in undisturbed portions of the Project Area 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 reclaimed slopes in the Project Area is 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 a minimum of 75 percent topsoil and chipped vegetation that will be placed on top of and blended with 25 percent ripped overburden rock when present. This blend may be altered based on future test plot results or if extra topsoil is available as described below. The tree and shrub benches require a deeper planting substrate of approximately 18 to 24 inches to support root establishment of the planted trees. This will likely include a planting blend consisting of a minimum of 75 percent salvaged topsoil and chipped vegetation blended with overburden rock when present, but may be adjusted in future reclamation efforts based on test plot results and material availability. As the phased 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 topsoil will be utilized. Planting benches that include a diverse assemblage of native tree species will generally be located on north-facing and east-facing benches, where aspect will be most suitable to support trees. Currently proposed soil treatment volumes and depths for slopes and benches are listed in Table 4.

Table 3. Estimated available volumes of material for soil development	
MATERIAL	VOLUME AVAILABLE (CUBIC YARDS)
Overburden rock	Unlimited
North Quarry fine greenstone	Unlimited
Rock Plant fines	5,000 / year
Topsoil	625,000
Chipped vegetation/woody debris	~40,000
Total Available Topsoil Blend (Approx. 47% topsoil; 3% chipped vegetation; 50% overburden rock and/or other Quarry materials)	**~1,330,000**

Table 4. Proposed topsoil application depths and volumes.

LOCATION	Hydroseed Only			Tree Plantings and Hydroseed		
	AREA (acres)	DEPTH (inches)	VOLUME (cubic yd)	AREA (acres)	DEPTH (inches)	VOLUME (cubic yd)
WMSA	101.9	3	61,649	14.4	18	34,848
CMSA	35.9	3	21,719	15.5	18	37,510
North Quarry	261.1	3	157,965	2.7	18	6,534
South Quarry	161.7	3	97,828	37.4	18	90,508
Rock Plant	13.6	3	8,228	1.9	18	4,598
Topsoil Storage Area	8.0	3	4,840	3.2	18	7,744
Surge Pile	9.0	3	5,445	0.0	18	0
Office/ Crusher	36.1	3	21,840	3.3	18	7,986
Total	**627.3**	**3**	**379,514**	**78.4**	**18**	**189,728**

3.5.2 Overburden Rock Placement

Overburden rock is the subgrade material at the Project Area. 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. The total surface area of slopes and benches available for revegetation within the Project Area will be approximately 705 acres. Drainage channels will be constructed on the interior edges of benches and 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

Topsoil will be harvested from appropriate areas within the Project Area. General guidelines for harvesting and stockpiling topsoil are described below.

Prior to topsoil harvest, the Project Area 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 Project Area vary in composition, nutrient content, and depth. WRA has investigated portions of the EMSA, South Quarry, and Rock Plant with suitable topsoil and described available depths and general condition. Available soil depths (including the A and B horizons) in undisturbed portions of Project Area 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. 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 Project Area 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 are not anticipated to be used at this time, but 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.

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.

3.5.5 Timing Restrictions and Recommendations

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.

4.0 REVEGETATION

This section describes plant installation planned for the Project Area, with a future revegetation area of approximately 705 acres. Revegetation will focus on returning the Project Area 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 on-site seed or plants are not available, local sources are used with an attempt to obtain the most local stock possible. On-site and local stock is adapted to the specific microclimates of the Project Area 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 Hydroseeding

In the Project Area, 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 unneeded roads will be revegetated. 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 705 acres.

Table 6. Preliminary species for 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**

4.2 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 78 acres of the total restoration area 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- and east-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 and east-facing benches will be revegetated with approximately 39 acres of oak-dominated plantings along with hydroseed. A target quantity of approximately 10,000 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. South-facing benches will be hydroseeded and 39 acres of these benches will also be planted with 75 percent (approximately 15,700) grey pine (*Pinus sabiniana*), a native tree species that is tolerant of drier conditions, along with 25 percent other native tree and shrub plantings. 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 development. This successional approach will facilitate more rapid woodland revegetation in viewshed 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 Project Area is provided in Table 7. 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 Project Area are foliar hosts of *Phytophthora ramorum*, the pathogen that causes SOD syndrome, including coast live oak and canyon live oak. Foliar hosts are thought

Table 7. Preliminary trees and shrubs for planting on Project Area 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.

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 Project Area to reduce the susceptibility of the revegetation program. Mitigation measures for the Project Area will include measures to prevent spread of SOD outside of the Permanente Quarry property.

4.3 Riparian Revegetation

The Project Area 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 8 lists species that may be appropriate for planting or seeding along the drainages.

The riparian areas with sufficient hydrology to support riparian habitat will most likely be along the reclaimed North Quarry floor, South Quarry sedimentation basin outfalls, and in reclaimed

Table 8. Preliminary species for planting along 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

Topsoil Storage Area. The total area that may support riparian species is dependent on the hydrology of the reclaimed areas.

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 Project Area 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 Project Area 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 5). 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 2010b). 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 9. 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 6 and 7, respectively.

Table 9. 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 10. 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 11. 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 12.

Table 10. 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 11. 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 12. Mulch and hydroslurry application rates.	
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 13.

Table 13. 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 Project Area 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

Appendix C provides a technical memorandum summarizing test plot results in Year 1, including data collected in May 2009 and January 2010. These preliminary results were used to refine the recommended hydroseed mixes listed in Section 4.0. Trends observed in the early germination and seedling establishment phases indicate that all soil materials added to overburden rock help to increase total plant cover and grass cover in particular. Shrub cover was low in the first year and a half, and a higher cover of grasses appears to suppress shrub establishment. Test plots with larger amounts of overburden rock supported lower cover, fewer grasses, and a greater number of shrub seedlings.

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

Monitoring must be performed to document revegetation success. Following installation, each revegetation area will be monitored up to 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.

<u>Tree and Shrub Planting Areas</u> – 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.

6.3 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 705 acres in the Project Area is intended to create approximately 40 percent coverage of planted tree and shrub areas interspersed among seeded grass and shrub areas within five years of installation. Planting areas on south-facing benches of the Project Area 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 14). 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 14. Proposed five-year performance standards for Project Area revegetation

	Oak Woodland (north- and east-facing benches)			Pine Woodland (south-facing benches)			Hydroseed Areas shrub/grassland mix		
	Tree	Shrub	Herb	Tree	Shrub	Herb	Tree	Shrub	Herb
Richness *(avg. native species per plot)***	2	3	3	1	3	3	0	3*	3*
Canopy Cover	10%	15%	20%	10%	15%	20%	0%	15%*	20%*
Density *(avg. individuals per acre)*	70	400	-	75	270	-	-	-	-

*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.

6.4 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 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.

For the purposes of Project Area maintenance and monitoring, non-native 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, weed abatement activities will commence. The following species 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). Some of these species are only listed as moderately invasive by Cal-IPC, but they should be managed promptly because they are currently present in large numbers in the Project Area and will impede establishment of native cover.

6.5 Adaptive Management

The operators responsible for revegetation efforts to date in the Project Area 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 Project Area 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 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 Project Area, 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 Project Area 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 Project Area 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.

8.0 REFERENCES

Cal-IPC. 2006. California Invasive Plant Inventory. Cal-IPC Publication 2006-02. California Invasive Plant Council: Berkeley, CA. Available: www.cal-ipc.org/inventory

California Association of Nurseries and Garden Centers (CANGC). 2008. *Phytophthora ramorum* Nursery Industry Best Management Practices Manual. September. Available at: http://www.suddenoakdeath.org/html/nursery_best_mgmt_practices.html

California Oak Mortality Task Force (COMTF). 2008. List of *P. ramorum* regulated hosts and associated plants. May. Available at: http://www.suddenoakdeath.org/html/host_plant_lists.html

Kaplow, Dave. 2008. Personal Communication (telephone). President, Pacific Open Space Inc. and North Coast Native Nursery, Petaluma, California. June 25.

Munshower, Frank. 1994. Practical Handbook of Disturbed Land Revegetation. Boca Raton, Florida: CRC Press, Inc.

Newton, Gail, and Vic Claassen. 2003. Rehabilitation of Disturbed Lands in California: A Manual for Decision Making. Special Publication 123. California Geological Survey.

Ruth and Going Inc. 1984. Reclamation Plan Kaiser Cement Permanente Quarry. Prepared for the County of Santa Clara, October 1984.

Science Applications International Corporation (SAIC). 2004. Burton Mesa Mitigation Site Final Project Report, prepared for: Central Coast Water Authority. Buellton, California.

U.S. Department of Agriculture, Soil Conservation Service.1958. Soil Survey of Santa Clara Area, California. In cooperation with the University of California Agricultural Experiment Station.

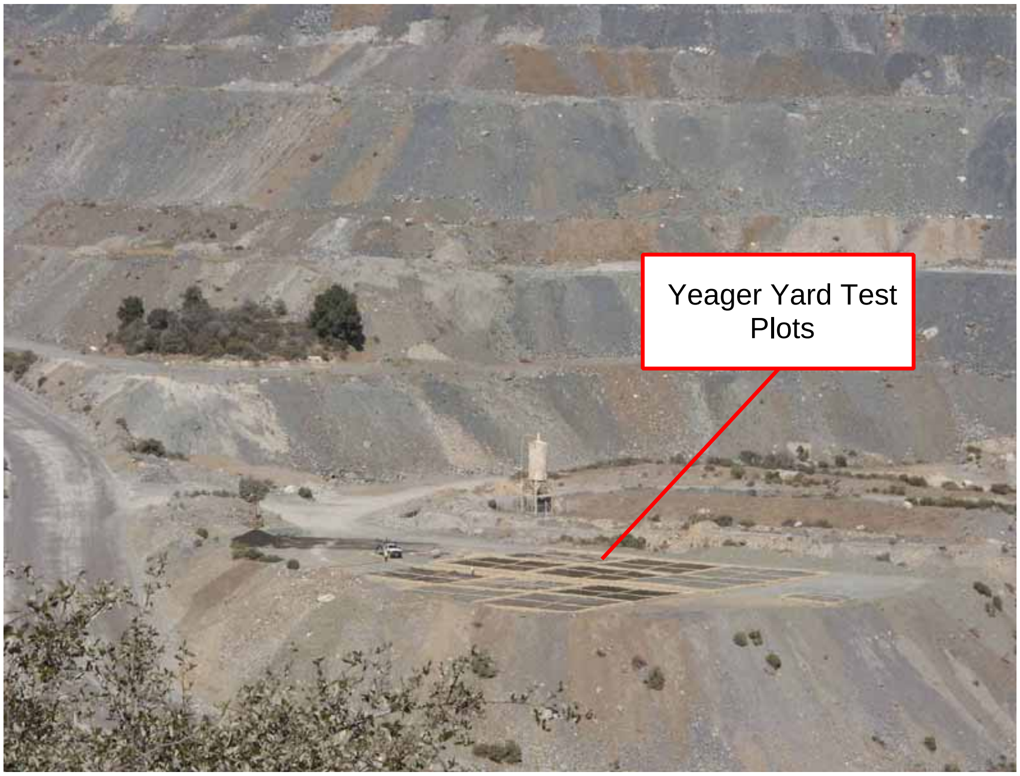
WRA, Inc. 2010a. Biological Resources Assessment for the Permanente Quarry, Cupertino, Santa Clara County, California. March.

WRA, Inc. 2010b. Revegetation Test Plot Program As-built Report for the Permanente Quarry, Cupertino, Santa Clara County, California. March.

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).

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

TECHNICAL MEMORANDUM:

YEAR 1 TEST PLOT MONITORING RESULTS

TECHNICAL MEMORANDUM: YEAR 1 TEST PLOT MONITORING RESULTS
February 24, 2010

On May 21, 2009, WRA conducted vegetation monitoring on the revegetation test plots at Permanente Quarry to complete the first of several years of vegetation monitoring to occur over the next five years. On January 28, 2010, WRA conducted a supplemental monitoring visit to gather additional data on shrub germination and shrub versus herbaceous cover following the first dry season. This data is to be used for initial recommendations for the Permanente Quarry Revegetation Plan, in support of the updated Reclamation Plan. The purpose of this memo is to summarize the monitoring results from Year 1 (2009) and the winter 2010 supplemental visit.

Test plots were installed in the fall of 2008, including 13 plots at a flat site within the Yeager Yard and 3 plots on a slope in the East Materials Storage Area (EMSA). Each plot was demarcated with straw bales and further divided into four quadrants using straw wattles. Installation included application of various combinations of quarry materials and compost on top of bare graded overburden rock, followed by application of various hydroseed mixes and soil amendments to the different quadrants. Containerized native plants were installed in some of the test plots by Central Coast Wilds in November 2009. The *Revegetation Test Plot Program As-Built Report* (WRA 2009) provides additional details on the test plot program design and installation.

This monitoring report only evaluates performance of the seed application, as plant installation occurred too recently to be evaluated. However, it was observed during the January 2010 visit that deer had heavily browsed the toyon (*Heteromeles arbutifolia*) plantings and seeded grasses and shrubs, while generally leaving other plantings alone.

Monitoring data collected within the first two years of construction is useful for evaluating initial germination success. Additional monitoring in future years will help identify species best suited for long-term success in the soil and climate conditions present at this location. Results are therefore summarized in this brief memo, and future monitoring efforts will better elucidate results of the various treatments tested.

Methods

Monitors divided each plot quadrant into nine equal sections; each plot quadrant was numbered consistently from one through nine. A random list of numbers between one and nine was generated prior to the site visit, and this list was utilized to select two of the nine sections for sampling in each consecutive quadrant. One 0.25-m^2 quadrat was randomly dropped in each of the two selected sections to sample vegetation data. As a result, approximately 0.9% of each plot and quadrant was sampled, with a lower sampling intensity in the larger (100'x100') plots, and higher intensity in the 25'x25' plot (plot number 16).

During the Year 1 (2009) monitoring visit, WRA identified all plants present in each sampling quadrat to the species level when possible. Monitoring was conducted at the best time of year to identify the greatest number of species, but some of the perennial grasses and shrubs were still seedlings and are therefore difficult to identify until they are larger and flowering in subsequent monitoring years. In each sampling quadrat, monitors estimated absolute percent cover of each species, and an overall percent cover of vegetation, bare ground, and mulch/litter. Monitors also wandered through each plot quadrant and noted any additional species present that were not observed within the sampling quadrats.

During the January 2010 monitoring visit, WRA sampled the same number of quadrats as in 2009, but collected more general vegetation data because many herbs and grasses were not yet identifiable. This data collection effort focused on presence and cover of shrubs compared to overall cover of herbs and grasses, mulch and litter, and bare ground. In each quadrat, WRA estimated the total cover of shrubs, total cover of herbs and grasses combined, bare ground, and mulch/litter. In addition, the number of individuals of each shrub species was counted in each quadrat. Other shrub species present in the plot quadrant but not observed within the sampling quadrats were also noted.

Results

Vegetation monitoring data collected is summarized in Tables 1 and 2 at the end of this report. Table 1 shows the average performance of the native hydroseed mixes and presence of non-native species in each plot. Table 2 is a summary of germination of individual species in the hydroseed mixes.

In Year 1, the difference in seed performance and cover of native species between soil treatments was generally minimal. Average cover of native species ranged from 6.5% to 17.7%, with the exception of Plot 15. Plot 15, a sloped plot containing a mix of 75% North Quarry Fine Greenstone and 25% compost, supported 32.9% average cover of native species. However, the higher native cover was provided by only one annual grass species, small fescue (*Vulpia microstachys*), a standard component in native erosion control mixes.

In January 2010 (early Year 2 monitoring), shrub cover in all plots remained low, generally between 0% and 1%. Four shrub species were present throughout most plots: California sagebrush (*Artemisia californica*, at an average density of 9,740 individuals per acre), California buckwheat (*Eriogonum fasciculatum*, 5,950 per acre), black sage (*Salvia mellifera*, 3,900 per acre), and mugwort (*Artemisia douglasiana* [actually a large herb, not a shrub], 760 per acre). Coyote brush (*Baccharis pilularis*) was present in very low numbers, and was found almost exclusively in corners of the plots, where straw bales and wattles may provide shade and additional moisture. All shrubs present had grown larger at these edges, and were very small in more exposed portions of the plots.

Although all shrub cover was very low and variation in shrub cover may not yet be statistically significant, a trend was observed that dense grass cover corresponded with little or no presence of shrub seedlings. Similarly, soil treatments dominated by overburden rock tended to support more shrub seedlings and less grass and herbs. An increase in each soil component, with the exception of overburden rock, appears to result in an increase in grass and herb cover. Additional data collection in future monitoring years will be needed to verify these trends, once plants have grown and established.

Discussion

As observed on May 21, 2009 and subsequent site checks, the test plots were in generally good condition: straw bales, signage, and soil treatments remain in place and undamaged, seed mixes germinated in all plots, and weed species were not dominant. Weed cover had increased by January 2010, and invasive black mustard (*Brassica nigra*) was present in high numbers in Plots 9 and 16. Representative photographs are included following this memo. In Year 1, volunteer sterile wheat germinated and was a dominant component in most plots; however, very little weed germination was observed indicating the straw was weed-free. Since the wheat is sterile; however, it should not be present in subsequent years. Future monitoring may help to determine whether the mulch is more of a benefit due to moisture retention or a hindrance due to germination suppression and competition from sprouting sterile wheat.

The results of this preliminary monitoring are a good indication of seed germination success in the given conditions, and future monitoring will help indicate which annual species contribute significant seed in subsequent years and which species survive over time. The January 2010 data gives a preliminary indication of which shrub species were able to survive the dry season. All shrub species were present at approximately the same percent cover except for toyon, which was observed in 2009 but was no longer present in 2010. Other shrubs survived and additional seed may have germinated, although many seedlings were browsed by deer. California sagebrush, California buckwheat, and black sage exhibited the highest densities, while other shrubs were not present or only occurred at protected plot edges near straw wattles and bales.

Species at the bottom of Table 2 were present in very few of the plot quadrants seeded, so this provides a preliminary indication of species that are not likely to provide significant germination or cover in revegetation efforts. However, several of the species that did not appear to germinate are very drought-tolerant shrubs (such as chamise [*Adenostoma fasciculatum*]) that would be expected to perform well under the difficult test plot conditions, and should not yet be removed from potential seed selections. It is possible that additional species will germinate from the seed mixes in subsequent wet seasons.

The primary trend observed at these early stages is that soil treatments with more overburden rock supported slightly more shrub germination and less grass and herbaceous cover. Compost and other soil components all encouraged more grass and herb growth, which resulted in less shrub cover. It is believed that competition from grasses is suppressing the shrubs, although it is also possible, but less likely, that the shrubs don't germinate as well in the soil blends containing less overburden rock.

Recommendations

It is recommended that deer fencing be installed around the entire Yeager Yard test plot site, as heavy deer browse is occurring on many herbs and grasses and some planted shrubs. Very minimal browsing was observed in the EMSA plots, so fencing may not be necessary at that site. While deer will certainly be present in the larger future reclamation areas, the effect will not be as intense as in the small test plot areas. We believe test plot results could be skewed by the deer browsing variable, as they appear to favor the small numbers of shrubs currently present in the test plots.

Stinkwort (*Dittrichia graveolens*), a Cal-IPC-listed moderate and invasive plant, has become established adjacent to the test plots during the summer. These plants were removed prior to flowering and setting seed by scraping with a small front-end loader. Black mustard and bur clover (*Medicago polymorpha*) were also present in large numbers within the plots, and these should be controlled in early spring before setting seed. Future visits should continue to monitor the presence of this species in and around the test plots.

Small fescue, a typical erosion control mix component, was observed in high numbers and cover in many plots. This species may not be appropriate for hydroseeding in areas where shrub cover is desired. Blue wildrye (*Elymus glaucus*) was also observed in high numbers in Plot 14, where the Quarry's standard erosion control mix was used; the erosion control mix was applied at a higher rate of pounds of grass seed per acre than the test plot mixes. Therefore it appears that grass seed application rates should be relatively low in Quarry revegetation areas, to prevent competition with seeded and planted shrubs and trees. The current reclamation goal is to establish a dense shrub and/or tree canopy that will suppress weeds and will best mimic adjacent undisturbed areas.

Table 1. Summary of vegetation cover based on soil treatment (sorted by cover of native species in May 2009).

PLOT #	Soil treatment depth	SOIL TREATMENT COMPONENTS (%)				AVERAGE PERCENT COVER (%)					
						May 2009 (YEAR 1)			January 2010 (preliminary YEAR 2)		
		Overburden Rock	Compost	North Quarry Fine Greenstone	Rock Plant Fines	Hydroseed species	Non-native species*	Mulch & litter	Shrub species	Herbs & grasses	Mulch & litter
15	6"		25	75		32.9	5.3	58	0.13	78.1	20.0
8	12"	37.5	25	37.5		17.7	4.3	70	0.25	81.3	10.0
14	6"	35	25		40	17.1	10.1	61	0.25	78.1	15.8
12	24"	25	25	25	25	13.4	4.3	81	0.00	84.4	13.8
16	24"	37.5	25	37.5		12.6	12.0	59	2.50	65.6	25.6
5	6"		25	75		11.5	2.6	75	0.88	73.4	23.1
10	6"		100			11.1	4.3	53	0.13	78.1	10.0
13	6"	75	25			11.0	7.0	77	0.13	65.9	38.1
7	12"	75	25			10.8	6.9	73	0.00	65.6	27.5
11	24"		25	75		10.1	1.9	72	0.25	81.3	14.4
2	6"	75	25			9.1	3.1	72	0.88	38.8	23.8
9	12"	25	25	25	25	8.5	5.4	45	0.25	87.5	8.5
6	6"	33	25	25	17	8.1	2.3	36	0.00	56.3	10.1
1	6"	100				7.8	1.9	61	0.88	2.8	48.8
4	6"	35	25		40	7.0	2.6	69	0.75	62.5	14.4
3	6"	50	50			6.5	6.8	73	0.75	55.1	12.5

* Non-native species cover was predominantly sprouted sterile wheat from the initial mulch application. This species is not expected to be present in significant numbers in subsequent monitoring years.

Table 2. Hydroseed species present in test plots (sorted by presence in May 2009).
Seed mixes: #1 green (G); #2 red (R); #3 yellow (Y); #4 blue (B); shrub (S) [applied to all plots]; erosion (E) [in place of blue mix in plot 14]

SPECIES	May 2009 (YEAR 1)			Jan. 2010
	Seed mixes containing species	Average cover where seeded (%)	Presence where seeded (% of quadrants)	Shrub presence (% of quadrants)
SHRUB HYDROSEED MIX				
Artemisia californica (California sagebrush)	S	1.0	87	94
Eriogonum fasciculatum (California buckwheat)	S	0.7	76	83
Salvia mellifera (black sage)	S	0.4	71	60
Heteromeles arbutifolia (toyon)	S	0.6	65	0
Artemisia douglasiana (mugwort) [large herb]	S	0.1	59	63
Baccharis pilularis (coyote bush)	S	0.1	46	46
Mimulus aurantiacus (sticky monkeyflower)	S	0.0	10	2
Eriodictyon californicum (yerba santa)	S	0.0	3	0
Adenostoma fasciculatum (chamise)	S	0.0	0	0
Ceanothus cuneatus (buckbrush)	S	0.0	0	0
Eriophyllum confertiflorum (golden yarrow)	B	0.0	0	5
HERBACEOUS HYDROSEED MIX (and mulch)				
Triticum sp. (sterile wheat)	[mulch]	6.7	98	-
Clarkia purpurea ssp. *quadrivulnera* (clarkia)	GY	1.6	97	-
Vulpia microstachys (small fescue)	GRYBE	14.2	97	-
Achillea millefolium (yarrow)	GYB	1.9	94	-
Bromus carinatus (California brome)	GRYBE	1.8	94	-
Lotus purshianus (Spanish lotus)	GYB	1.7	94	-
Plantago erecta (Foothill plantain)	GBE	1.4	91	-
Trifolium willdenovii (tomcat clover)	RE	0.5	71	-
Elymus glaucus (blue wildrye = “unknown grass”?)	GRYBE	0.4	69	-
Lupinus nanus (sky lupine)	GYE	0.1	52	-
Oenothera hookeri (evening primrose)	GY	0.2	50	-
Poa secunda (one-sided bluegrass = “unknown grass”?)	B	0.8	47	-
Heterotheca grandiflora (telegraph weed)	G	0.1	44	-
unknown grass – potentially native	[GRYBE]	0.4	34	-
Nassella pulchra (purple needlegrass = “unknown grass”?)	G	0.3	25	-
Eriogonum nudum (naked buckwheat)	B	0.0	7	-
Sisyrinchium bellum (blue-eyed grass)	B	0.0	7	-
Lotus scoparius (deerweed)	GY	0.0	6	-
Festuca occidentalis (western fescue = “unknown grass”?)	B	0.2	0	-
Festuca rubra (red fescue)	E	0.0	0	-
Leymus triticoides (creeping wild rye)	B	0.0	0	-
Melica californica (California melic grass = “unknown grass”?)	B	0.0	0	-
Scrophularia californica (beeplant)	B	0.1	0	-

Representative Photographs – May 2009
Top: Plot 15, green seed mix. The overall plot had the highest average native species cover (33%, mostly *Vulpia microstachys*). This quadrant had an average cover of 31% natives and 9% non-natives (mostly sterile wheat).

Bottom: Plot 1, with a soil treatment consisting of only overburden rock, exhibited the lowest total percent cover of vegetation (less than 10%).

wra
ENVIRONMENTAL CONSULTANTS

APPENDIX D

SOIL LABORATORY REPORTS

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.

Page-3
WRA ENVIRONMENTAL
Report 08-162-0042

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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Email only 5 pages. /dlb

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Project : Hanson Permainente Quarry, Cupertino

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

COMPREHENSIVE SOIL ANALYSIS

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

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

COMPREHENSIVE SOIL ANALYSIS

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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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	NO_3 N	NH_4 N	PO_4 P	K	Ca	Mg	Cu	Zn	Mn	Fe	Organic % dry wt.	Sample Description & Log Number
				Parts Per Million Parts Dry Soil											
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 #	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	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
	Saturation Extract Values							Percent of Sample Passing 2 mm Screen							
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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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	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

Parts Per Million Parts Dry Soil: NO_3 N through Fe.

Sample #	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	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

Ca through SO_4: Saturation Extract Values. Gravel through Clay: Percent of Sample Passing 2 mm Screen.

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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Project : Hanson Permanente - Cupertino

SOIL FERTILITY AND MICRONUTRIENT ANALYSIS

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

Sample Description - Sample Id - Plant Name	HalfSat % / TEC	pH s.u. / Qual. Lime	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	B ppm	SO_4 meq/L	Na meq/L (SAR)	K meq/L	Ca meq/L / Mg meq/L	Cl meq/L	ECe dS/m	OM %	Lab No
			Sufficiency Factor										Sufficiency Factor								
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

Saturation Extract: B through ECe columns.

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
Attorney Work Product - Privileged and Confidential

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

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Email only 5 pages. /dlb

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Project : Hanson Permanente - Soil Development

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

COMPREHENSIVE SOIL ANALYSIS

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

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

COMPREHENSIVE SOIL ANALYSIS

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											
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

HEIDI FISHER
Email 6 pages.

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www.soilandplantlaboratory.com

Project : Permanente - Cupertino - 16143

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

COMPREHENSIVE SOIL ANALYSIS

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.

* LOW , SUFFICIENT , HIGH

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www.soilandplantlaboratory.com

Project : Permanente - Cupertino - 16143

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

COMPREHENSIVE SOIL ANALYSIS

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											
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.

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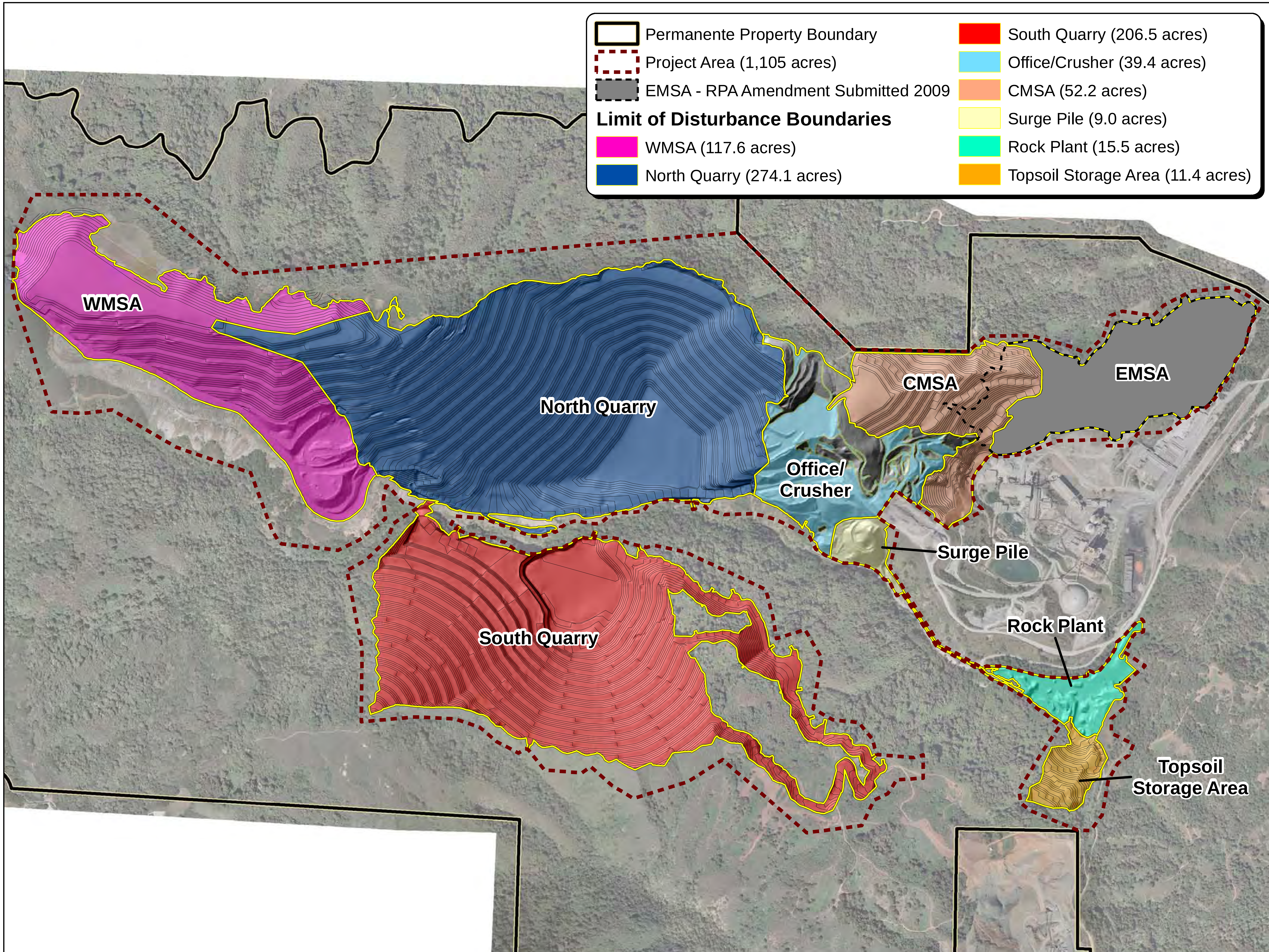
APPENDIX E

REVEGETATION PLAN FIGURES



WRA ENVIRONMENTAL CONSULTANTS

Lehigh Permanente Quarry
Santa Clara County, CA

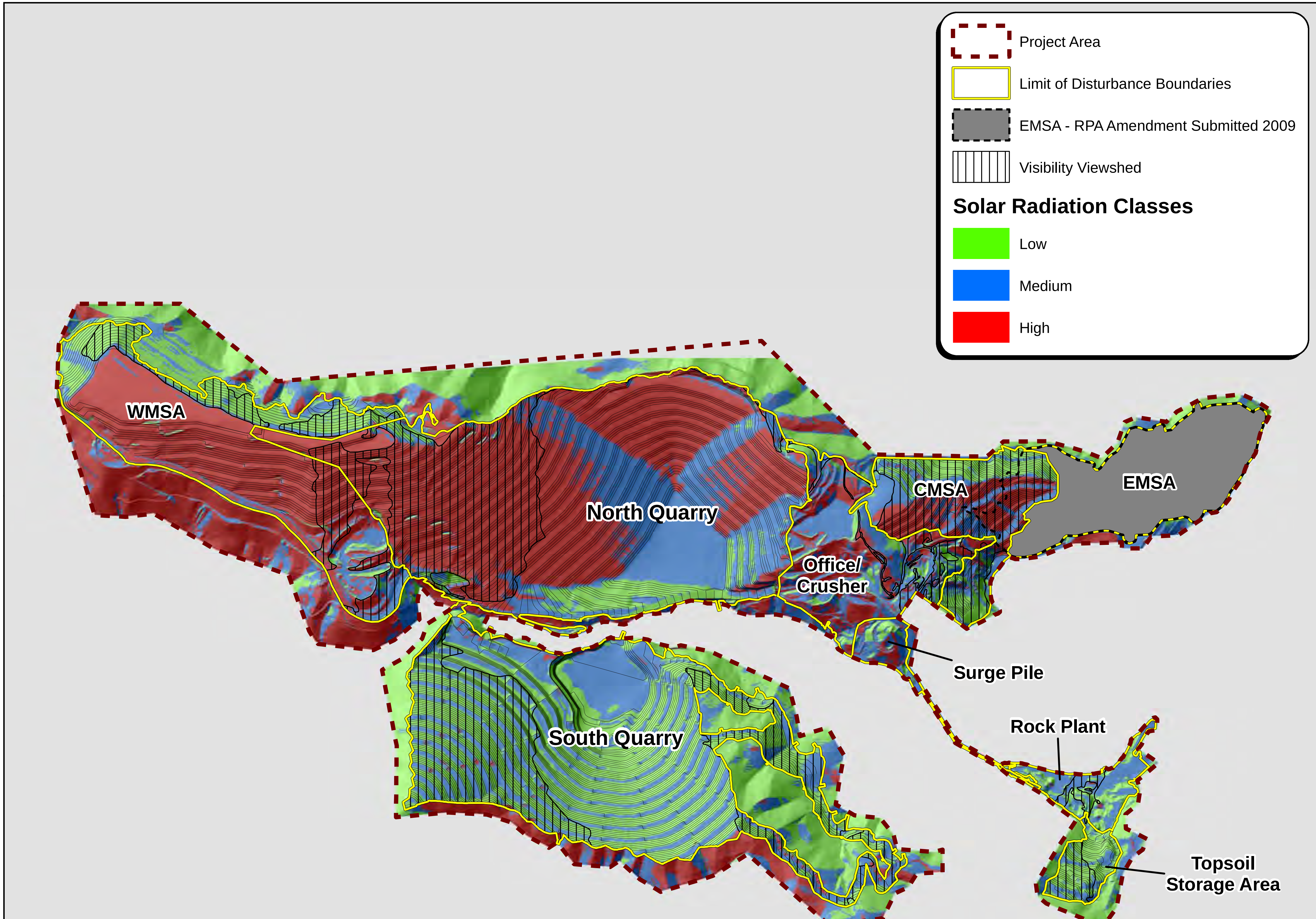
Figure 1.

Project Area Plan

N W E S

0 500 1,000 2,000
Feet

Date: May 2010
Map By: Michael Rochelle
Image: 2005 NAIP
Filepath: I:\Acad2000\16000\16143\gis\Arcmap\2010 Figures\Reveg\Proposed_Project.mxd



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

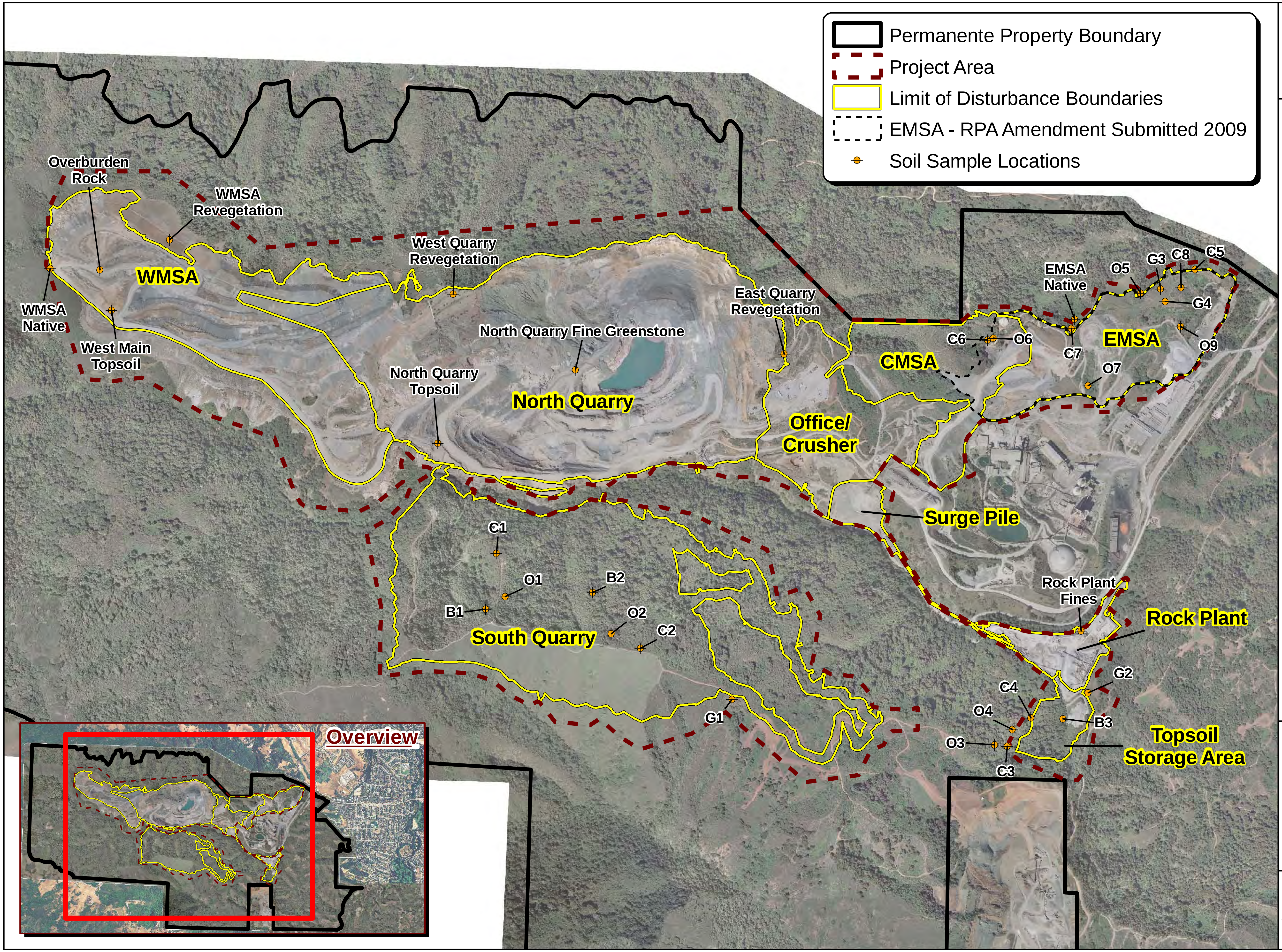
wra ENVIRONMENTAL CONSULTANTS

Lehigh Permanente Quarry, Santa Clara County, California

Figure 2.

Visibility and Solar Radiation Analysis

Date: May 2010
Map By: Michael Rochelle
File Path: L:Acad2000\16000\16143\Arcmap\
2010 Report\Revegetation Plan\Visibility_SolarRadiation.mxd



ENVIRONMENTAL CONSULTANTS

Lehigh Permanente Quarry,
Santa Clara County,
California

Figure 3:

Soil Sample Locations

0 500 1,000 2,000 Feet

Date: May 2010
Map by: Michael Rochelle
Aerial Date: April 2007
File path; I:\Acad2000\16000\16143\gis\arcmap\2010 Report\RevegSoilSamples.mxd

	North Quarry	WMSA	CMSA	Rock Plant	Topsoil	South Quarry	Surge Pile	Office/Crusher	TOTAL
Oak Plantings + hydroseed (acres; 12" topsoil) [1]	0.0	7.5	7.0	0.0	0.0	24.8	0.0	0.0	**39.3**
Pine Plantings + hydroseed (acres; 12" topsoil) [2,3]	2.7	6.9	8.5	1.9	3.2	12.6	0.0	3.3	**39.1**
Hydroseed only (acres; 3" topsoil)	261.1	101.9	35.9	13.6	8.0	161.7	9.0	36.1	**627.3**
Total Revegetation Area (acres; minus 'drainage')	**263.8**	**116.3**	**51.4**	**15.5**	**11.2**	**199.1**	**9.0**	**39.4**	**705.7**
Minimum Topsoil Volume (cubic yards) [4]	164,499	96,497	59,229	12,826	12,584	188,336	5,445	29,826	**569,244**
Impacted Oak Woodland (acres)	0.7	0	2.4	0	5.7	27.7	0	0	**36.5**
Impacted Oak Woodland (trees, estimated)	35	0	120	0	286	1,383	0	0	**1,824**
# oak trees planted	0	2010	1876	0	0	6646	0	0	**10,532**
# pine trees planted	1085	2774	3417	764	1286	5065	0	1327	**15,718**
Total Number of Trees (including others [1 2])	1450	7725	8317	1020	1718	20059	0	1772	**42,062**

note: Tree spacing is 9 feet on center = 537 trees/acre.

[1] Oak planting areas are planted with 50% oaks, 50% other tree/shrub species.

[2] Pine planting areas are planted with 75% pine, 25% other tree/shrub species.

[3] Pine planting area calculations includes the two proposed riparian planting areas

[4] Total Topsoil Available = ~625,000 cubic yards.

Project Area

Limit of Disturbance Boundaries

EMSA - RPA Amendment Submitted 2009

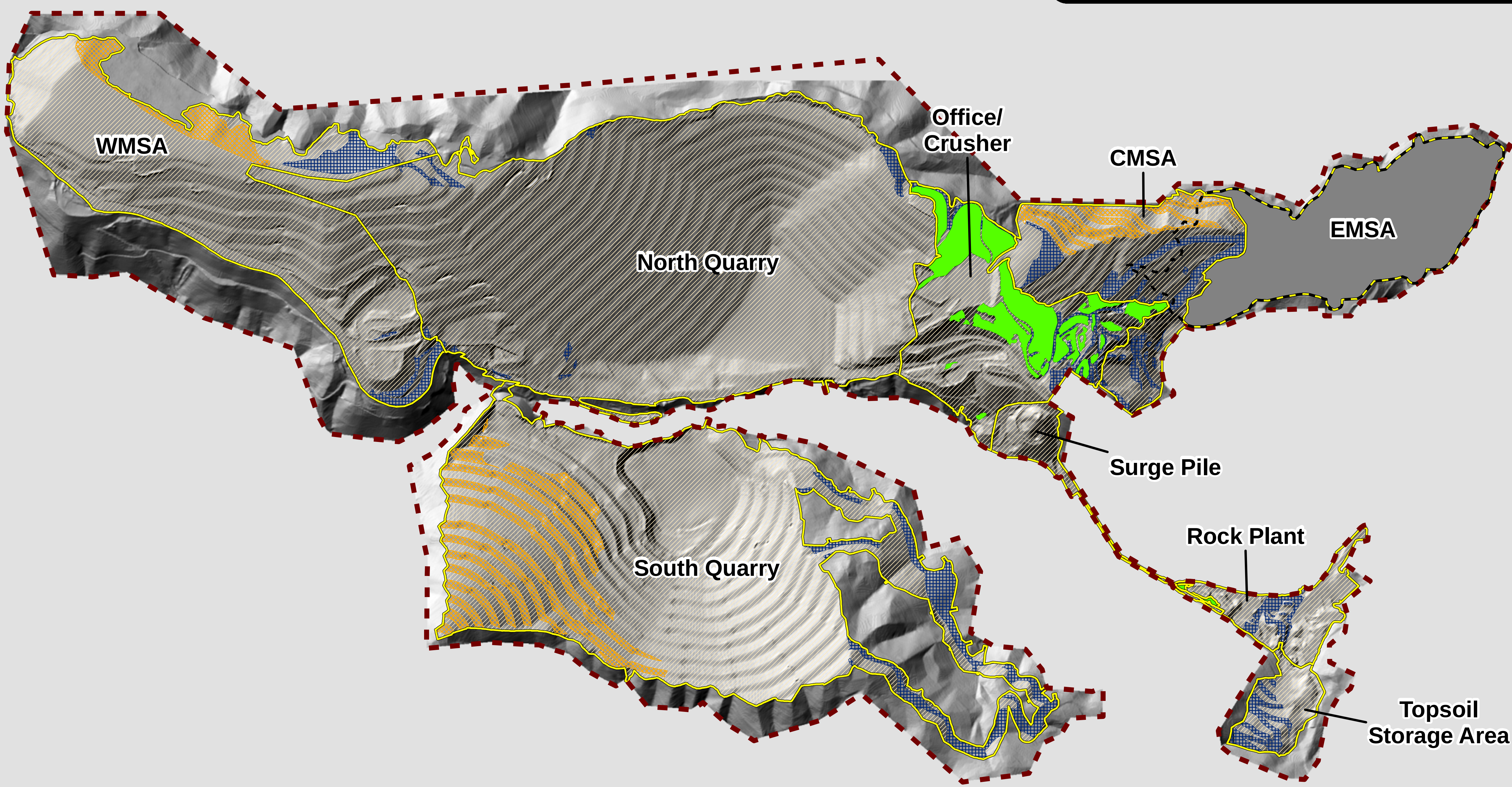
Undisturbed Existing Vegetation

Proposed Revegetation Plan

Oak Woodland and Hydroseed (39.3 acres)

Pine Woodland and Hydroseed (39.1)

Hydroseeded Shrubs and Grasses (627.3 acres)



wra
ENVIRONMENTAL CONSULTANTS

Lehigh Permanente Quarry, Santa Clara County, California

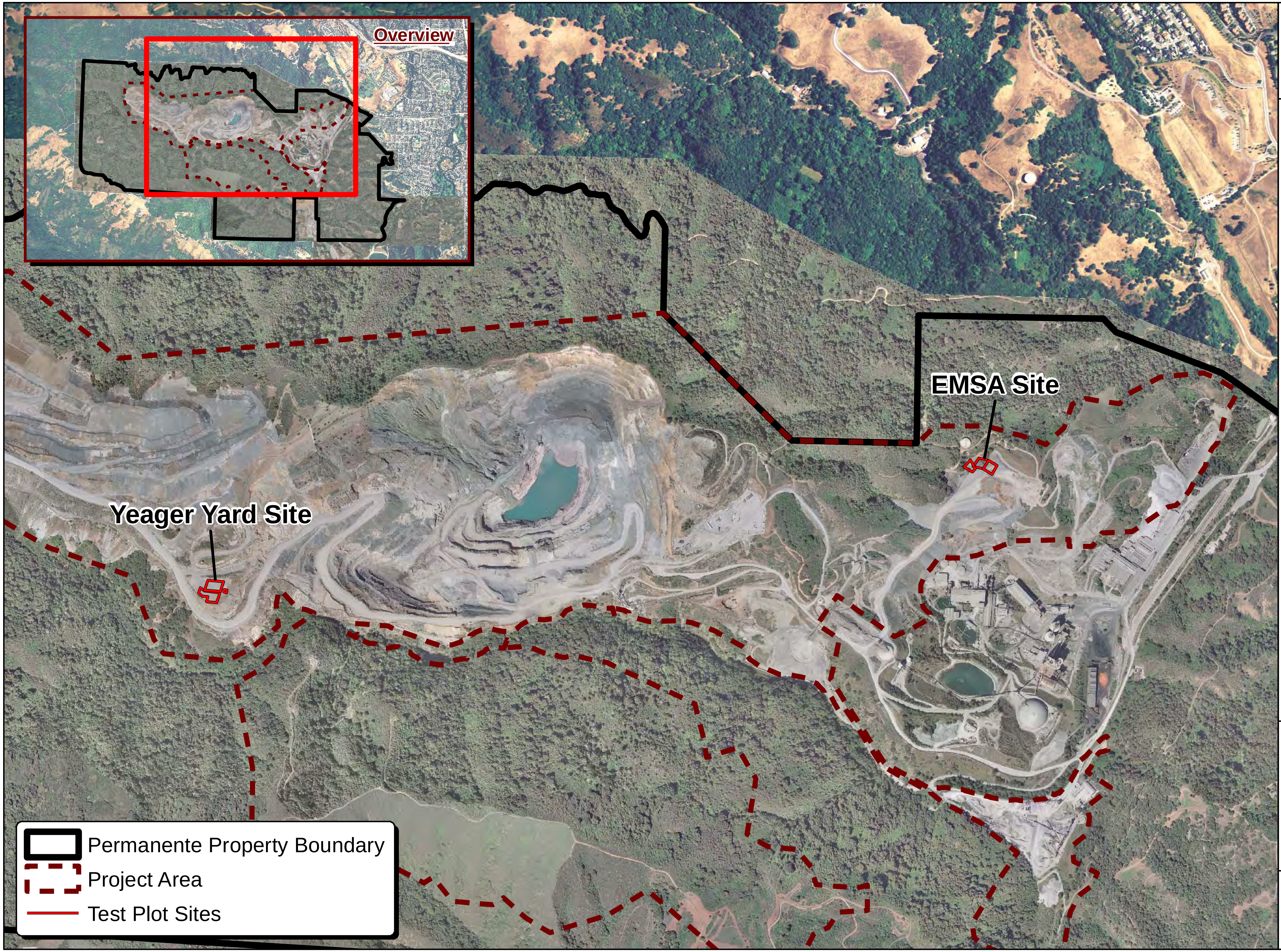
Figure 4.

Proposed Revegetation Plan

N
W E
S

0 500 1,000 2,000
Feet

Date: May 2010
Map By: Michael Rochelle
File Path: L:Acad2000\16000\16143\Arcmap\
2010 Report\Revegetation Plan\Proposed Reveg.mxd



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Lehigh Permanente Quarry, Santa Clara County, California

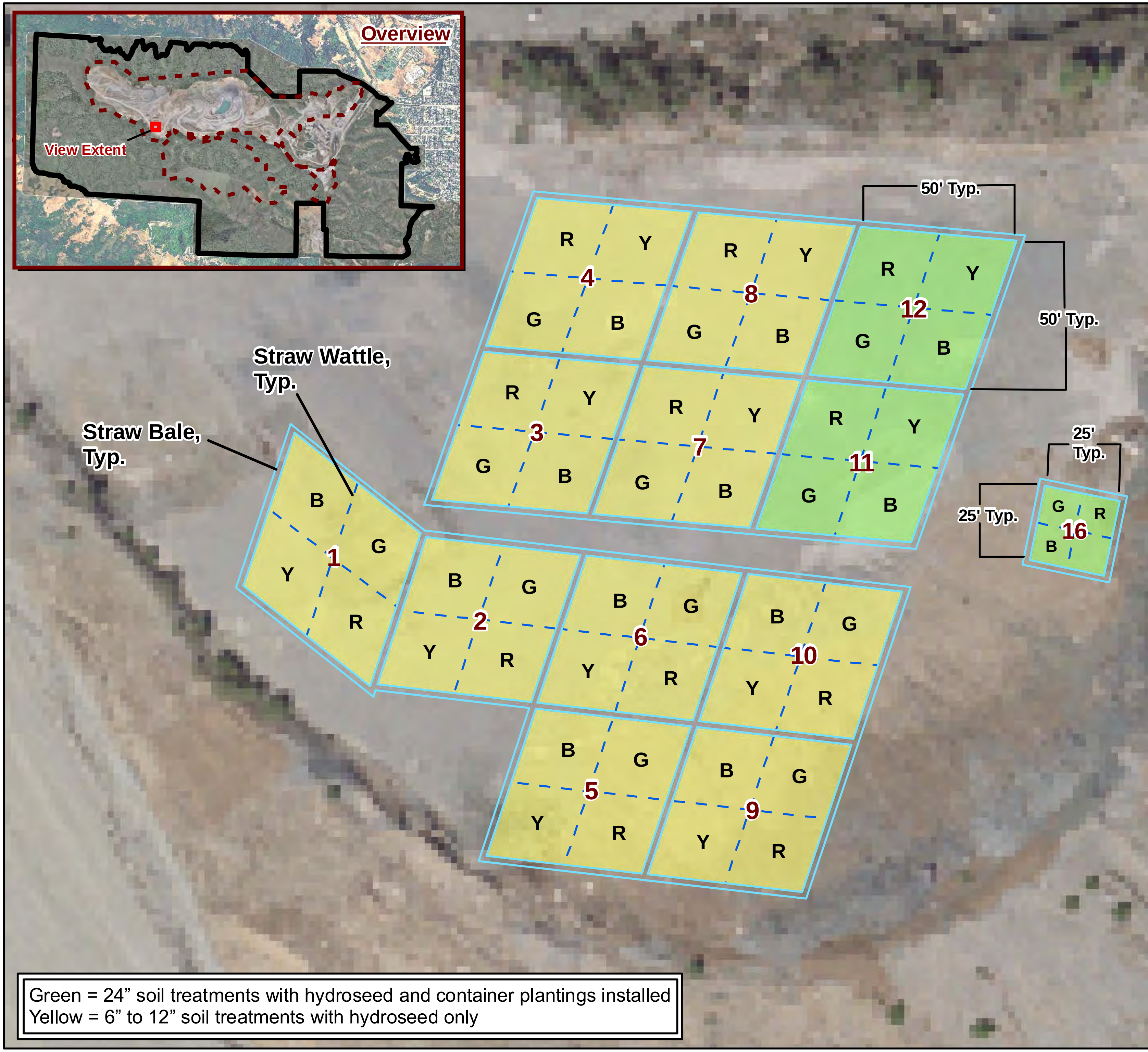
Figure 5.

Test Plot Location Map

N
W E
S

0 500 1,000 2,000
Feet

Date: May 2010
Map by: Michael Rochelle
Image Date: April 2007
File path; I:\Acad2000\16000\16143\gis\arcmap\2010 Reports\Revegetation\Test Plot Location.mxd



WRA ENVIRONMENTAL CONSULTANTS

Lehigh Permanente Quarry,
Santa Clara County,
California

Figure 6.

Test Plot Layout
at Yeager Yard Site

0 25 50
Feet

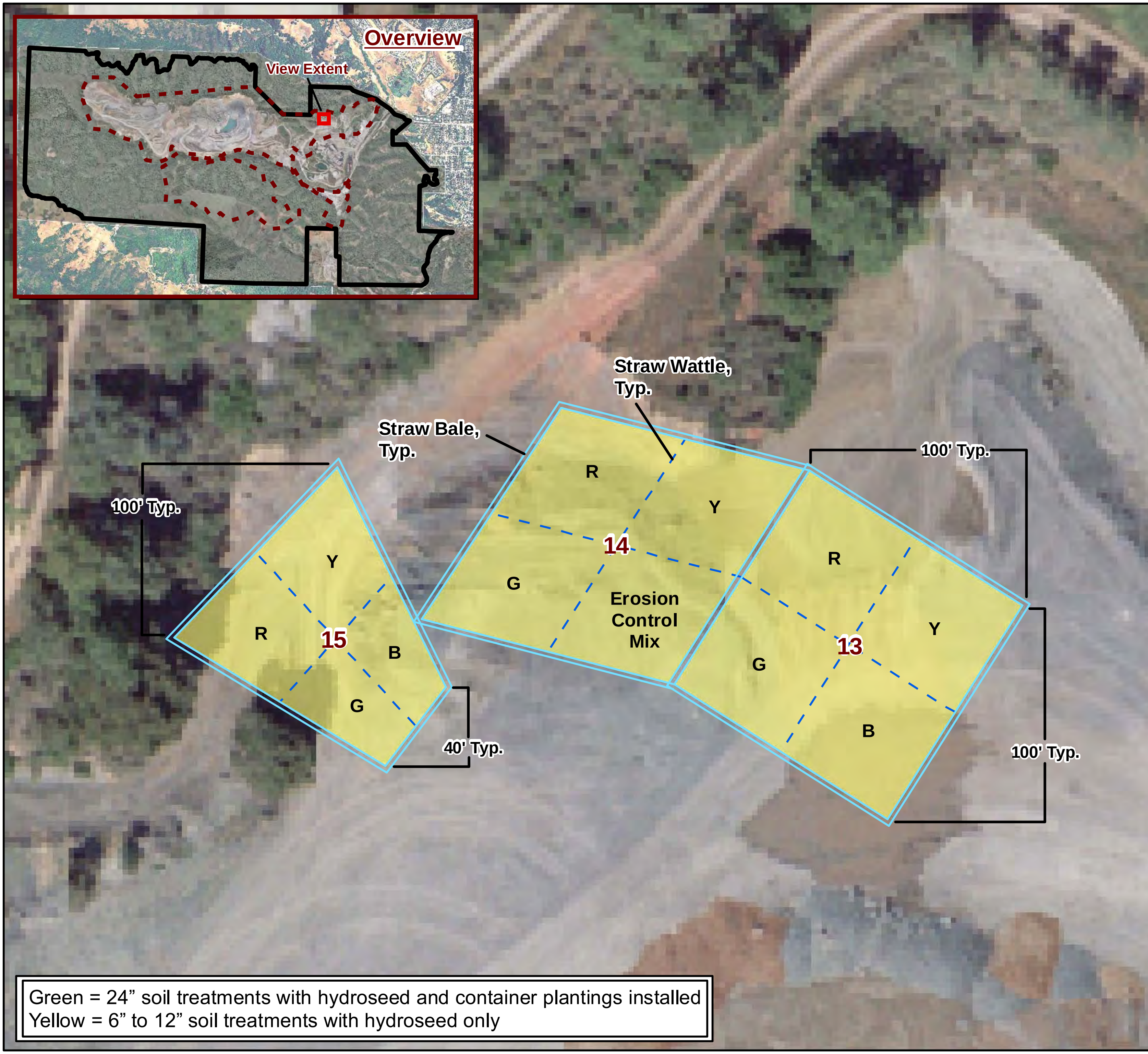
Date: May 2010
Map by: Michael Rochelle
Image Date: April 2007
File path; I:\Acad2000\16000\16143\gis\arcmap\
2010 Figures\Reveg Plan\Yeager_Site.mxd

wra
ENVIRONMENTAL CONSULTANTS

Lehigh Permanente Quarry,
Santa Clara County,
California

Figure 7.

Test Plot Layout
at EMSA Site



0 15 30 60
Feet

Date: May 2010
Map by: Michael Rochelle
Image Date: April 2007
File path: I:\Acad2000\16000\16143\gis\arcmap\2010 Report\Reveg Plan\EMSA_Site.mxd