



ORIGINAL

TRANSMITTAL  
DEPT OF PLANNING  
AND PERMITTING  
CITY & COUNTY OF HONOLULU  
08 FEB -5 AM 1:11  
RECEIVED

TO: Mr. Raymond Young  
Department of Planning and Permitting  
City and County of Honolulu  
650 South King Street, 7th Floor  
Honolulu, Hawaii 96813

FROM: Glen Koyama  
Belt Collins Hawaii Ltd.

SUBJECT: Makakilo Quarry

DATE: February 5, 2008

JOB NUMBER/REFERENCE NUMBER:  
2004-33-8000

VIA:  
 Mail  Courier  Messenger  Will Call

WE ARE SENDING YOU:

- Reports
- Prints
- Tracings
- Shop Drawings
- Samples
- Specifications
- Electronic Files
- Change Order
- Other Letter

COPIES:	DATE:	DESCRIPTION:
1	January 2008	Existing Structures and Parking in Quarry and Processing Site (Site Plan)
1	July 2007	Section 5.8 Excerpt from Application to Modify CUP (Major) 72/CUP-15 and SUP No. SP73-147 Describing Existing and Proposed Building Heights

Honolulu  
Guam  
Hong Kong  
Philippines  
Seattle  
Singapore  
Thailand

THESE ARE TRANSMITTED AS CHECKED BELOW:

- For approval
- No exceptions taken
- Resubmit \_\_\_ copies for approval
- For your use
- Make corrections noted
- Submit \_\_\_ copies for distribution
- As requested
- Revise and resubmit
- Return \_\_\_ corrected prints
- For review and comment
- Rejected
- Other: \_\_\_\_\_

REMARKS:

As per DPP letter of November 9, 2007 and as called for processing of the CUP Application, we submit the above site plan and height description for your review and comment. For your information, the line drawing is to scale and the aerial photo is provided for your convenience as a quick reference to what is on the ground. However, the aerial photo is uncorrected and slightly distorted, so it does not match up precisely with the line drawing. In this review, the line drawing should be used, because it is the accurate plan.

COPY TO: Robert Creps, Grace Pacific Corporation

BELT COLLINS HAWAII LTD.:

*Glen Koyama*  
Glen Koyama

RECEIVED  
SEP 12 2008

Belt Collins Hawaii Ltd.  
2153 North King Street, Suite 200 ■ Honolulu, Hawaii 96819-4554 USA  
T/808 521 5361 ■ F/808 538 7819 ■ honolulu@beltcollins.com ■ www.beltcollins.com

STATE OF HAWAII  
LAND USE COMMISSION

Belt Collins Hawaii is an Equal Opportunity Employer

EXHIBIT 13

## **5.8 Existing and Proposed Building Heights**

### Existing - Parcel 82

The heights of the structures on Parcel 82 are: Primary Crushing Plant, 45 feet; Recycle/B-grade Crushing plant, 27 feet; Employee Lounge, 12 feet; and Scalehouse, 12 feet. The Primary Crushing Plant was constructed under building permit #32769. The Recycle Plant and Truck Scale are construction equipment. The Employee lounge and Scalehouse are portable trailers. See Figure 9 and Photo F-3 for the location of the structures, and Photo F-5 for photos of the structures.

### Proposed - Parcel 82

There will be no changes to the heights of the structures on Parcel 82 under this proposal.

### Existing - Parcel 74

There are no structures on Parcel 74 today.

### Proposed - Parcel 74

There are no structures planned on Parcel 74 under this proposal.

### Existing - Parcel 4

The heights of the structures on Parcel 4 are: Finish Crushing Plant, 57 feet; Wash Plant, 40 feet; Hot Mix Asphalt Plant, 61 feet; Ready-Mix Concrete Batch Plant, 80 feet; Maintenance Shop building, 38 feet; Scalehouse, 18 feet; Administrative Office building, 15 feet; Truck Scalehouse 15 feet, Testing Lab building, 22 feet; and Employee Training building, 15 feet.

The Finish Crushing Plant and Wash Plant were constructed under building permits #33572 and #40934. The Hot Mix Asphalt Plant is a portable plant and considered to be construction equipment. The Ready Mix Concrete plant and the Truck Scalehouse were constructed under pre-1978 PC&R permits. The Maintenance Shop, Administrative Office building, and Testing Lab building were constructed under building permits #117626, 131567/207801, and 227048 respectively. The Employee Training building and several other offices are portable trailers. See Figure 10 and Photo F-4 for the locations of the structures, and Photo F-6 for photos of the structures.

### Proposed - Parcel 4

There will be no changes to the heights of the structures on Parcel 82 under this proposal.

## **5.9 Existing and Proposed Setbacks and Buffering**

### Existing - Parcel 82

See Photo F-3 for the existing setbacks and buffering from adjoining parcels for Parcel 82.



RECEIVED  
 08 JAN 31 A9:59  
 DEPT OF PLANNING AND PERMITTING  
 CITY & COUNTY OF HONOLULU  
 TRANSMITTAL

TO:  
 Mr. Raymond Young  
 Department of Planning and Permitting  
 City and County of Honolulu  
 650 South King Street, 7th Floor  
 Honolulu, Hawaii 96813

FROM:  
 Glen Koyama  
 Belt Collins Hawaii Ltd.

SUBJECT: Makakilo Quarry      DATE: January 30, 2008

JOB NUMBER/REFERENCE NUMBER: 2004-33-8000      VIA:  Mail  Courier  Messenger  Will Call

WE ARE SENDING YOU:  
 Reports       Prints       Tracings       Shop Drawings       Samples  
 Specifications       Electronic Files       Change Order       Other Letter

COPIES:	DATE:	DESCRIPTION:
1	April 2007 (Stamped and Signed)	Makakilo Quarry (Tax Map Key 9-2-3: 82) Conditional Use Permit No. 72/CUP-15 Engineering Report Amendment (with signed stamped cover and revised Page 5)
1	January 10, 2008	BCH Letter to Henry Eng regarding LUC comments

Honolulu  
 Guam  
 Hong Kong  
 Philippines  
 Seattle  
 Singapore  
 Thailand

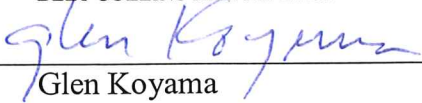
THESE ARE TRANSMITTED AS CHECKED BELOW:

<input type="checkbox"/> For approval	<input type="checkbox"/> No exceptions taken	<input type="checkbox"/> Resubmit ___ copies for approval
<input checked="" type="checkbox"/> For your use	<input type="checkbox"/> Make corrections noted	<input type="checkbox"/> Submit ___ copies for distribution
<input type="checkbox"/> As requested	<input type="checkbox"/> Revise and resubmit	<input type="checkbox"/> Return ___ corrected prints
<input type="checkbox"/> For review and comment	<input type="checkbox"/> Rejected	<input type="checkbox"/> Other: _____

REMARKS:

As requested, we have revised our Engineering Report to include an engineer's signed stamp on the report cover and a correct reference on page 5.

We are also transmitting, as requested, a hard copy of the letter we submitted to Mr. Henry Eng responding to the Land Use Commission's comment of the project.

COPY TO: Robert Creps, Grace Pacific Corporation      BELT COLLINS HAWAII LTD.:  
  
 Glen Koyama

**MAKAKILO QUARRY  
(Tax Map Key 9-2-3: 82)  
CONDITIONAL USE PERMIT NO. 72/CUP-15  
ENGINEERING REPORT AMENDMENT**

Prepared for:

**GRACE PACIFIC CORPORATION**  
P.O. Box 78  
Honolulu, Hawaii 96810

Prepared by:

**BELT COLLINS HAWAII, LTD.**  
2153 North King Street, Suite 200  
Honolulu, Hawaii 96819

April 2007



*Jon M. Young*

\_\_\_\_\_  
This work was prepared by me or under my supervision.

April 30, 2008

Expiration Date of the License

# ENGINEERING REPORT AMENDMENT

## TABLE OF CONTENTS

1.	INTRODUCTION .....	1
1.1	Purpose.....	1
1.2	Site Description.....	1
2.	GRADING PLAN.....	1
2.1	Grading .....	1
2.2	Alternative Floor Reclamation.....	2
2.3	Bench Reclamation .....	3
3.	DRAINAGE PLAN .....	3
3.1	Drainage Plan.....	3
3.1.1	Method .....	3
3.1.2	Existing Drainage.....	3
3.1.3	Quarry Drainage with Relocation of Quarry .....	4
3.1.4	Conclusion .....	4
3.2.	Erosion Control Plan.....	5
3.3.	Water Quality.....	6
4.	2007 REVEGETATION PLAN .....	6
4.1	Purpose of the Plan .....	6
4.2	Goals and Objectives .....	7
4.3	Site Opportunities and Constraints .....	8
4.4	Landscape Development Plan.....	10

## APPENDICES

### Appendix A - Restoration Grading Plan Recommendations

Agra Earth & Environmental (from July 1998 Engineering Report)

### Appendix B - Grading Figures, Plans and Sections

Map of 100 Year Rainfall, Oahu, Hawaii

Figure 1

Existing Drainage

Figure 2

Developed Drainage

Figure 3

Overall Site Plan

Figure 4

Cross Sections FF and GG

Figure 5a

Cross Section HH

Figure 5b

Excavation Phasing Map

Figure 6

### Appendix C - Storm Drainage Calculations

C-1 Existing Runoff and Rainfall Storage Calculations

C-2 Developed Runoff and Rainfall Storage Calculations

C-3 Berm Surface Water Calculations

C-4 Storage-Elevation Tables

### Appendix D - Not Used

### Appendix E - Revised Mitigation/Revegetation Plan

Existing Vegetation

Exhibit 1

Location of View Planes

Exhibit 2-0

Viewplane Exhibits

Exhibits 2-1 - 2-9

Recommended Plant Palette

Exhibit 3

Revegetation Matrix

Exhibit 4

Revegetation Phasing

Exhibit 5

### Appendix F - Not Used

## 1. INTRODUCTION

### 1.1 PURPOSE

This Makakilo Quarry Engineering Report, dated April 2007 (the "April 2007 Report"), is prepared to assist Grace Pacific Corporation in its application for a modification to use permits 72/CUP-15 and 73/SUP-147, to allow the relocation and continuation of quarrying activities at Pu'u Makakilo (the "Application").

The original Makakilo Quarry Engineering Report was approved by the City and County of Honolulu Department of Planning and Permitting on October 19, 1998 (the "1998 Report"). The 1998 Report was prepared to satisfy Condition no. 2 of City Council resolution 95. An amendment was made to the 1998 Report in March of 2004 (the "2004 Report"). The 2004 Report dealt largely with the retention of run-off within the property, visual mitigation and landscaping.

While this report is written to be a free-standing document, a review of the 1998 Report and the 2004 Report is of value in understanding the current operations. These reports are included as Exhibit J of the Application.

### 1.2 SITE DESCRIPTION

The James Campbell Company owns the land under the Makakilo Quarry (Tax Map Key 9-2-3:82), and licenses it to Grace Pacific Corporation for quarry operations. The license agreement expires in the year 2017. Subject to the approval of the Application, Grace Pacific has negotiated with Campbell for an extension of the license to 2032.

The quarry is situated on the slopes of Pu'u Makakilo. The west bound lanes of the H-1 Freeway front the southeast side of the property. The area makai of the H-1 Freeway is used as a processing site for quarry, but its operations are not included in this report.

Pu'u Makakilo Inc., a subsidiary of Grace Pacific Corporation, owns the property surrounding the existing quarry. The land is characterized as dry-range land with poor, scrub-type vegetation on greater than 10 percent slopes.

## 2. GRADING PLAN

### 2.1 GRADING

The attached grading plan (Figure 4, Appendix B) shows the proposed final grades prior to reclamation of the quarry in the year 2032. The plan maximizes the excavation of the known basalt reserve while minimizing visual and environmental impacts to the surrounding community.

The southeast boundary of the quarry, which consists of undisturbed ridges and gullies, parallels the H-1 freeway. This area serves as a buffer and will remain undisturbed,

providing a noise and visual barrier from the freeway. The quarry sides and mauka face will utilize staggered benches and undulating faces to minimize the appearance of a man-made landform. The existing quarry floor will gently slope from the back and sides to the front at approximately a 2% grade. The floor of the proposed mauka quarry area will be steeper, at 15% to 25%, matching the gradients of the existing Pu'u formation.

Restoration grading recommendations prepared by a geotechnical engineer are attached as Appendix A. Several key methods are recommended to provide an adequate foundation for access roads, residential and light loaded commercial development. Excess stockpile material, 1 inch minus, may be used for landscape restoration provided the material contains or is amended with proper portions of organics, sand and silts.

The proposed relocation of the quarry extends up the Pu'u from lower elevations between 500 feet to 550 feet to an upper elevation of 700 feet. An access road running along the 500 excavated contour will be constructed to allow vehicle access from the southwest portion of the 312 acre parcel (TMK 9-2-3-74) to the northeast portion of the parcel, skirting the foot of the Puu.

As part of this proposal, three drainage basins will be constructed within the lower active pit for runoff retention. There is only minimal additional run-on arising from this proposal, representing runoff from the southwestern portion of the berm that is to be constructed on the northeast boundary. Today, approximately one-half of the runoff in the vicinity of the proposed berm finds its way into the Kaloi Gulch watershed.

Two new landforms will be created from the 475 foot to 675 foot elevations in conjunction with the relocation of quarrying activities. On the southwest boundary, the ridgeline of the Puu will be cut and graded by up to 50 feet to reduce the visual impact of the quarrying, as seen from the H-1 freeway on the approach to Kapolei. For the same reason, Grace Pacific will construct a ridge-like berm extending from the northeastern ridge of the Puu. This berm will range in height from 15 feet to 100 feet above the existing ground. The berm will be constructed with a 2:1 horizontal to vertical slope, and with 10 foot wide benches at each interval of 30 feet in height.

The quarry sides and mauka face will utilize vertical cuts and horizontal benches to reach the desired depths of approximately 200 feet to 250 feet below the existing surface. Typical benches will be 25 feet wide and 50 feet tall. The uppermost benches, particularly on the southwest and mauka faces will utilize 1:1, 1:1.5 and 2:1 horizontal to vertical slopes to facilitate revegetation efforts and visual mitigation. See Figures 4, 5a and 5b of Appendix B for a detailed look at the slopes, vertical cuts and benches along the sides and mauka face of the proposed quarry area.

## 2.2 ALTERNATIVE FLOOR RECLAMATION

If post-closure development plans deem it desirable, the quarry can be indirectly reclaimed to increase infiltration. After the quarry has been shaped to match the grading plan, the pit floor can be regraded to produce a rough, irregular surface. This method will increase



water infiltration and slow erosion by keying the replaced soil into the substrate. This can be achieved by either blasting or ripping the pit floor. Since this quarry is hard rock quarry, blasting is the appropriate method to fracture the pit floor so that water can drain slowly and roots can penetrate. A good technique is to blast an extra 10 feet during the last production round and leave some of the fractured material in place.

### 2.3 BENCH RECLAMATION

Typically, the 25 foot wide benches will be sloped toward the high wall to help trap moisture and soil. Topsoil will be placed on the benches and planted. However, since the quarry is located in an arid area, the linear features of the benches will probably not be obscured by significant vegetation. Therefore, other methods may be necessary to break up some of the linear features including performing post-production blasting to form staggered benches. Strategic blasting can create chutes, spurs, and rough vertical cliff faces can be created. The desired effect depends on the rock type, structural geology, and blasting agent from a choice of blast patterns, delays, and stemming depths. The appropriate methods will be chosen only when final quarry grades are achieved and rock faces can be evaluated.

The quarry reclamation will use a combination of vegetative benches along with staggered benches to create a more natural appearance. Appendix E presents the current revegetation plan for screening and restoration of the quarry.

## 3. DRAINAGE PLAN

### 3.1 DRAINAGE PLAN

#### 3.1.1 METHOD

The intent of the Makakilo Quarry drainage plan is to reduce the amount of stormwater run-on and minimize the impacts of run-off on the quarry as well as downstream. Elements of the drainage plan are detailed in Appendix C.

The method used in this report to calculate required storage uses the total rainfall depth from the design storm. This number is multiplied by the drainage area to yield the total required storage. See Appendices C-1 through C-4 for rainfall storage calculations.

The depth of recorded rainfall for a 100-year storm with a 24-hour duration was extracted from the State Hawaii Department of Land and Natural Resources, Division of Water Land Development, "Rainfall Frequency Study for Oahu, Report R-73", 1984. The applicable page from this reference is included in Appendix B, as figure 1.

#### 3.1.2 EXISTING DRAINAGE

The existing upper quarry covers 94 acres of the Makakilo Pu'u. The slopes of Pu'u Makakilo generate approximately 148 acres of rainfall into the existing quarry area. Figure 2 of Appendix B shows the extent of the existing drainage area.

Three existing drainage basins located near the bottom elevation of the quarry create the necessary storage capacity for a design 100-year 24-hour storm. They are DB#1, DB#2, and DB#3. The required storage was calculated to be 151.9 ac-ft. See Appendix C-1 for required storage calculations. The volume capacity of the three drain basins is 175 ac-ft.

### 3.1.3 QUARRY DRAINAGE WITH RELOCATION OF QUARRY

The relocated quarry extends mauka within the northeast and southwest trending ridges of Pu'u Makakilo. See Figure 4 of Appendix B for the proposed relocation of quarrying activities. The total proposed area plus the offsite area contribution totals 170.0 acres. This includes the rainfall from the southwestern face of the new berm. See Figure 3 of Appendix B for the developed drainage arising from the proposed relocation of the quarry. On-site storage capacity of 174.3 ac-ft is needed for the increased runoff surface. Free board at this rainfall capacity will be 2 feet. See Appendix C-2 for calculations.

The limit of grading runs along the outer ridge of the Pu'u on the southwest side of the quarry. Runoff generated outside the limit of grade will fall away naturally from the quarry. On the northeast, a new berm will be constructed. As a result, no measures are necessary to divert offsite runoff from the northeast and southwest limits of the relocated quarry. Subsequently, run-on generated from the northwestern edge of the relocated quarry will be handled by the three drainage basins.

The flow off of the northeastern berm face is 18.33 cfs and will continue to flow along the existing flow patterns.

### 3.1.4 CONCLUSION

The intent of the Makakilo quarry drainage plan is to reduce the amount of storm water entering the site and fully retain all the storm water runoff within the upper quarry.

The three existing basins (DB#1, DB#2, and DB#3) with capacity of 175 ac-ft sufficiently store the 174.3 ac-ft (100-yr storm) of required by the expansion. A 100-yr storm at 174.3 ac-ft of rainfall will reach hydrological water levels of 253 ft. The surrounding berm height at the 96" culvert is at elevation 255 ft. This results in 2' of freeboard. The existing slopes along the southwestern edge of the quarry will convey runoff away along its natural existing flow pattern preventing offsite runoff from entering the site.

The berm on the northeastern edge of the proposed quarry will serve as an offsite runoff diversion. The southwestern face of the berm will produce approximately 18.33 cfs of runoff and will follow existing flow patterns. The existing area (under the site of the proposed berm) generates approximately 18.33 cfs, therefore there is no net increase in runoff generated by the construction of the berm. The direction of flow of this 18.33 cfs of runoff will continue along the same direction as the existing flows.

Overall, no additional flows will be added to outside drainage patterns. Runoff will be contained within the quarry limits. The quarry relocation project will have no adverse impact on adjacent properties or existing downstream drainage systems.

### 3.2. EROSION CONTROL PLAN

Minimizing or eliminating water-quality problems by mechanical or operational means is generally described as a *best management practice* (BMP). BMPs can be classified as either short- or long-term with considerable overlap existing between the two. Also, erosion controls at a site will likely change over time as the configuration of the site changes. The best strategy for stormwater control is to divert stormwater around the quarry and into an existing drainage. However, in the absence of such diversion, once stormwater has entered a quarry, a very effective control technique during ongoing operations is to develop numerous sumps or low areas to disperse stormwater. These low areas collect sediments and allow stormwater to infiltrate into the ground.

The runoff created within the Makakilo quarry expansion will be retained, therefore no soil loss is expected within the quarry expansion.

Proper erosion control measures will be implemented during the construction of the new berm. The northeastern face of the berm measures to be approximately 5.7 acres. Flow generated during a 10-year storm for this area would be 18.33 cfs.

In order to sustain and manage soil loss, a number of measures will be taken. The height of the berm will require it to be constructed with 10' wide benches at 30' height intervals. These benches will serve as a slope stabilization measure as well as an erosion control measure to lower the velocity of runoff flows and retain sediments because of the benches' level surface.

To further control sediment runoff, silt fences will be installed along the toe of the berm slope down stream of drainage pattern flow. Geotextile fabrics will be installed along the berm slopes, in order to stabilize the bare slopes while the grassing is being established. Other methods include mulching, straw bales, silt fences, jute matting, and plastic coverings. Mulching, matting, and plastic covering are good methods to reduce rain drop erosion especially on slopes; while straw bales and silt fences are designed to prevent fully or rill erosion of long overland areas such as swales.

The quarry is exempted from complying with the *City and County of Honolulu, Soil Erosion Standards and Guidelines, November 1975. (Chapter 23. Grading, Soil Erosion and Sediment Control)*, except for the proposed berm along the northeast limit of the Quarry, which is not exempt and would require a grading permit. Grace Pacific, will use the guidelines, as appropriate, in its erosion control activities at the site.

### 3.3. WATER QUALITY

No discharge is expected from the quarry. The site has been designed to fully contain runoff for a 100-year storm event.

The newly constructed berm will produce runoff that will flow towards Kaloi Gulch but the quantity of flow will not be in excess of what was already conveyed in the same area. Industrial activity will not take place within the berm area.

## 4. 2007 REVEGETATION PLAN

### 4.1 PURPOSE OF THE PLAN

The purpose of the Plan is to address the visual mitigation and revegetation of the areas affected by the proposed relocated quarry while operating (2007-2032), and the post-closure revegetation efforts beginning in 2032.

The Plan assumes the final landforms described in the Grading Plan section of this report. See Figures 4, 5a, 5b, and 6 of Appendix B.

The tools of the Plan are landforms and re-naturalization (or "revegetation"). The key elements of the Plan are:

- 1) the use of the existing ridges and man-made berms as effective visual screens of quarry activities and quarry faces;
- 2) for quarried faces not able to be screened, minimizing the man-made appearance of the final contours is preferable from a visual standpoint; and
- 3) the re-naturalization of man-made berms and quarried faces with drought tolerant vegetation, mixed and placed to blend with that existing on the Puu, is the most water-efficient and effective approach to long term landscape management.

The Proposed Use affords an opportunity an opportunity to improve upon several aspects of the 2004 Revegetation Plan. The existing excavation area is completely screened from view from the Kapolei Regional Park towards Ko Olina by a ridge on the southwest boundary. This aspect will be retained. A ridge and berm along the H-1 freeway at the 275 foot elevation screens the close-in views from Farrington Highway in the vicinity of Kapolei Knolls around to Palehua Road. This aspect will also be retained.

The intermediate and distant views from the Villages of Kapolei and Kalaeloa (formerly BPNAS) presently are that of a 2,400 foot wide active quarry face with a visible height of 250 feet (from elevation at 275 feet to 525 feet). The proposed excavation activity will quarry upslope through this quarry face and leave a bowl-shaped landform 700 feet further mauka, complementing the existing bowl of the Puu. The exposed face of the bowl (prior to revegetation) will be 200 feet in height (from elevation at 500 feet to 700 feet). The top of the Pu'u is at an elevation of 980 feet. What is presently the quarry face will become the quarry floor (from elevation at 275 feet to 500 feet), which as a landform, will be readily revegetated.

The intermediate and distant views from Ewa and Waipahu, while not viewing the existing active face head-on, will benefit from the move mauka and the bowl-shaped final landform.

The weak ridge on the northeast boundary of the proposed excavation area will expose the southwest quarry face on the approach to Kapolei on the H-1 Freeway from Kunia Road to the vicinity of the proposed North South Road Interchange. To mitigate this visual impact, Grace Pacific is proposing to lower the southwest ridgeline by approximately 50 feet in elevation and to build a berm on the northeast ridgeline of approximately 75 feet in height. The net effect of these actions will be to leave no more than 100 feet of the southwest face unscreened. Further, it is planned to grade the unscreened face with slopes ranging from 1:1 to 2:1 (horizontal to vertical slope) to facilitate the revegetation effort.

#### 4.2 GOALS AND OBJECTIVES

Minimize or eliminate the visual recognition of the quarry from off-site locations. Through the re-establishment of plant material and careful excavation of exposed rock areas, it is the intent of this Plan to either screen or "visually blend" wherever possible exposed areas of the site. "Visual blending" is based on the use of appropriate plant material and grow-in procedures.

Screen the quarry machinery and equipment from public view. Placing the quarry machinery and equipment on the Quarry floor effectively screens it from the public view. The quarry floor will be at a 245-foot elevation, which will be at least 70 feet below the quarry rim.

Minimize the long-term use of irrigation water. Although all plant materials require water for establishment and to survive, this plan recommends a minimum of water consumption through the use of drought-tolerant species and growth in procedures that are designed to acclimate plants to dry conditions.

Minimize long-term maintenance in the re-naturalized areas. On the same basis in which irrigation water use is being minimized, recommendations are geared towards the long term, low maintenance requirements of the quarry environment. Plant materials will be selected based on ability to survive with minimal maintenance for the two-year establishment period. These plants ultimately will naturalize into the existing vegetation and survive without regular maintenance. See Exhibits 3 of Appendix E for the Recommended Plant Palette. See Exhibits 4 and 5 of Appendix E for the Revegetation Matrix and Revegetation Phasing Plan arising from the Proposed Use.

Avoid an "engineered appearance" to the completed project. In regards to the arrangement and appearance of the plant materials and rock walls, it is the intent of this plan to convey the importance of using irregular forms wherever possible. No straight row plantings will occur anywhere within the site or at the site boundary,

including the benches. Clusters of plant materials and benches of varying shapes, orientation and dimension will be used to create a more natural appearance.

Quickly establish a re-naturalized appearance. Plant materials that are currently surviving on the site without irrigation provide a guide to those plants that will survive in the hot, windy and dry climate of the site and should be considered for use. Plant materials with a fast growth rate and hardy nature will be used so that screening and slope stabilization can occur as quickly and effectively as possible. Plant materials that have strong colors and textures and would not visually blend in with the naturally occurring grasses and lightly textured and colored trees found in neighboring areas will not be used. See Exhibit 3 of Appendix E for recommended Plant Palette.

Activities will not disturb protected areas of the site. All areas, which are not intended for quarry development, will be left undisturbed. These areas will serve as the benchmark and guide for the appearance of the quarry re-naturalized areas when that work is done. See Exhibits 1 of Appendix E for photos of undisturbed lands on the surrounding Puu Makakilo slopes.

Minimize costs associated with the re-naturalization efforts. The plan strives to minimize short and long-term costs associated with the re-naturalization. Seed or seedlings of many of the plant materials recommended can be propagated directly on-site and most are considered easy to grow. Many of the plant materials used will reseed themselves and spread on their own eliminating the potential need for periodic follow-up plantings. Typically smaller container size trees will be planted because they more readily adapt to site conditions and because they are available at a relatively low cost. The irrigation system contemplated for use will require an initial cost and some on-going costs for maintenance but will lower the potential long-term costs of replanting during extremely dry periods. Test plots will be used on-site to test varying seed mixes and maintenance practices to improve the chances of success and to fine tune a cost effective planting and low maintenance approach.

#### 4.3 SITE OPPORTUNITIES AND CONSTRAINTS

Site opportunities and constraints are summarized below:

Natural ridgelines screen views. The ridge on the Makakilo side of the quarry completely screens distant, intermediate and close-up views of the quarry from the Makakilo residential neighborhood (Exhibits 2-1 and 2-2 of Appendix E) to the Kapolei Regional Park; The ridge on the Waipahu side of the quarry screens intermediate and close-up views of the quarry face, as seen from the intersection of Farrington Hwy and the old Palehua Road (Exhibit 2-3 of Appendix E). The western quarry face is visible from the distant view at the H-1/Kunia intersection (Exhibit 2-4 of Appendix E). The lowering of the elevation of the southwest ridge and construction of a berm on the northeast ridge will mitigate the effects of the proposed excavation area on this distant view. See Exhibit 2-0 of Appendix E for a map of screening zones and photograph vantage points.

Berm above H-1 freeway screens views into Upper Quarry. The existing H-1 freeway cut faces and the intervening gullies of Puu Makakilo serve to screen close-up views of the quarry from the H-1 and Farrington Hwy (Exhibit 2-5 of Appendix E). The quarry face is visible from intermediate views such as Kapolei Golf Course (Exhibit 2-6 of Appendix E) and the Villages of Kapolei (Exhibit 2-7 of Appendix E) and from distant views, such as the Ewa Golf Course (Exhibit 2-8 of Appendix E). See Exhibit 2-0 of Appendix E for a map of screening zones and photograph vantage points.

Puu Makakilo screens views from Upper Makakilo. Puu Makakilo completely screens views of the quarry from the residents of upper Makakilo (Exhibit 2-9 of Appendix E).

The variation of colors of the quarry face rock and surrounding natural vegetation. Distant views of the quarry are indistinct due to moving cloud shadows and the mottled appearance of the quarry rock and cinder. Much of the existing quarry face rock and surrounding vegetation has an uneven gray-brown to blue color from a distance. This unevenness helps to break up the line of the quarry faces and benches.

Color/Texture. During the dry season, the surrounding area vegetation is brown to yellow in color. During the rainy season, the plants are grayish-green with occasion splashes of yellow. Textures vary among the vegetation found on site, but generally smaller, finer textured plants appear to predominate visually rather than broad-leaved ones. Brightly colored plants, such as Bougainvillea, should be avoided, as they attract attention, rather than diffuse it.

Types of plants. The plants existing on site have volunteered naturally. These plants include a wide variety of shrubs, groundcovers, and grasses. None of the established plants on site receive any permanent irrigation. Therefore, only the hardiest and drought tolerant plants tend to survive. All proposed plants should be extremely drought-tolerant, and require minimal water after establishment. See Plant Palette, Exhibit 3 of Appendix E.

Volunteer/Natives. Many volunteered or native plants are very drought tolerant and hardy. Many are considered "weeds" in ornamental landscapes, but on this site they cover the ground and minimize erosion. However, there are a few noxious weeds and toxic plants that should be eliminated. An example of this is the Tree Tobacco (*Nicotiana glauca*), which is poisonous to man and to livestock.

Source of irrigation water. Grace Pacific Corporation has a well at its Processing Site with an allocation of 168,000 GPD. Water from this well is pumped to the Upper Quarry and stored in tanks near the primary crusher. Portable water tanks may be located on the upper benches and supplied by water wagons.

The Revegetation Matrix and Revegetation Phasing Plan (Exhibits 4 and 5 of Appendix E) assume the availability of approximately .200 mgd of water for all quarry purposes (Processing Site well plus Board of Water Farrington Hwy meters). Of this amount, the Revegetation Plan targets .050 mgd or less for revegetation purposes. This limitation on supply serves as a constraint on the speed by which quarried land and land graded for visual mitigation purposes may be revegetated.

Climate. Rainfall is historically less than 20 inches per year, and usually occurs between the months of December and February. Prevailing trade winds are from the northeast and can be quite strong. Temperatures are very high, with summer average highs in the mid to high 90's and winter average highs in the lower 80's. The average annual humidity ranges from 65% in the summer to 75% in the winter.

Agricultural soils analysis. Soil tests on quarry benches and the slopes surrounding the quarry suggest that existing site soils are high in sodium and magnesium, and low in calcium, phosphorous, iron and zinc. With proper amendments re-naturalization can occur readily given the soils present on-site. Toxic concentrations of boron and magnesium have been found in certain areas of the site. These areas will require the addition of Gypsum to bind the toxic materials in the soil.

#### 4.4 LANDSCAPE DEVELOPMENT PLAN

Quarry Floor. The quarry floor will encompass an area of approximately 128 acres. This area makes up the lower ground plane or base of the quarry. It is understood that this base area of the quarry may be developed in the future, however until the specific development plan has been determined, the area will be planted with grasses and ground covers to control dust and erosion. The floor of the quarry with elevations below 300 feet will be hidden from view and will have no visual impact from off-site locations.

Upon removal of Grace Pacific's plant and equipment in 2032, the first priority will be to establish a natural appearing grass/ground cover mix. The species already growing on site provide a good indication of species that will tolerate the harsh site conditions occurring in Makakilo. A carefully selected combination of grass/ground cover species that are fast growing, drought tolerant and will reseed or otherwise spread is recommended. Species will be combined to ensure that plants will establish within all of varying microclimates present on-site. The quarry floor soil materials may also need to be amended to provide nutrients and drainage. The ultimate planting plan for the quarry floor will depend upon the final land use determined by the James Campbell Company and Grace Pacific. For this reason no large landscape materials will be introduced within the quarry floor area.

Irrigation will be required to establish grasses and ground covers in the quarry floor area. Rotary impact heads will be used to establish the plantings for a period of approximately two years. Irrigation lines will be buried in shallow 4" trenches to protect them from UV and other damage and lengthen the usable life of the system. The



irrigation system will be turned on periodically in times of drought to minimize potential fire hazards.

Mauka Quarry Faces. The most visible aspect of the quarry at its completion will be the vertical face along the mauka perimeter. To mitigate the appearance of these faces, an undulating landform and a series of random benches of various heights and lengths will be created to render a more natural appearance than straight benches and slopes. A technique termed "restoration blasting" will be used to create gullies and talus slopes on the quarry faces. Although the random benching and restoration blasting of the quarry faces will greatly mitigate the appearance of the quarry faces, landscape re-naturalization of these faces will be necessary for effective visual blending. The upper-most 100 feet of the quarry faces are most visible from off-site locations, and this is where the major planting effort will be made.

Because of the high face walls that will be exposed, it is not the intent of the revegetation plan to screen the entire face with trees but rather to soften the rock face itself with grasses and shrubs. This treatment will create the illusion that these faces are naturally formed and aged. The excavation pattern for the quarry will emphasize the uppermost benches first. It will be very important to complete landscape work as soon as possible after the excavation of each bench to ensure the landscape installation is not hindered due to conflicts with mining procedures. Soil will also be added to the horizontal surfaces of the benches immediately after completion, as it may be difficult to add any soil later. Soils used in the work will come from on-site stockpiles where possible. If imported soils are used, they will be matched with the structure and characteristics of on-site soils and will be inspected to prevent the introduction of noxious weeds and insects.

The plant materials used would be fast growing, drought tolerant and self-spreading varieties. Random placement of tree and shrub groupings will be under the direction of a Landscape Architect to select appropriate variation and density of clusters. Clusters of larger plants such as Kiawe and Opiuma will be planted in specific areas. Large tree or shrub plantings will not be planted along the entire length of benches to avoid reinforcing unnatural horizontal lines.

Irrigation is required to establish plant material on the faces. It will be particularly critical that a sturdy system is in place (even though considered of temporary quality) because of the potential future access problems. A PVC line system is recommended with lower trajectory and narrower coverage area impact heads due to the strong prevailing winds. Where adjacent benches occur within 25' of elevation change of each other, it is possible that one row on the upper bench could irrigate both levels. This would be determined on a case-by-case analysis in the field. Irrigation will be implemented for a two-year grow-in period. Irrigation mainlines will be buried in shallow 4" trenches to protect from UV and lengthen the usable life of the system. The irrigation system will be turned on periodically in times of drought to minimize potential fire hazards. As field stock materials will be used on the benches, no drip irrigation will be required. See Exhibits 4 and 5 of Appendix E for the re-naturalization schedule.

Access Road. From the existing Quarry, the access road skirts the lower edge of the adjacent Puu Makakilo property, and then turns into Old Palehua Road, crossing under the H-1 and terminating at Farrington Highway. The visibility of the access road varies depending on where it is being viewed from and the particular segment of the road being viewed. Wherever possible undulating re-naturalized berms of 6 feet in height planted with grasses, groundcovers, trees and shrubs will be maintained to screen the access road from view. Earth mounds and rock material laid in natural patterns should be used in certain areas where highest visibility exists. A continuous landscape treatment along the road is not desirable (such as a row of trees or a long berm) and would serve to draw more attention to the roadway. A limited number of field stock trees are recommended to soften the most critical areas immediately. The irrigation system provided will consist of a rotor head system, which will remain in place for the duration of the use of the access road use to revitalize plant materials, which are affected, by heavy vehicle use. A temporary drip irrigation system will be used to establish the field stock materials for an approximate 12-month period.

Existing Buffer at H-1, the "Adjacent Area". The portions of the existing Quarry parcel flanking the quarry, but not used for quarrying, are termed the "Adjacent Area" in the license agreement with the James Campbell Company. The Adjacent Area for the most part is untouched and has a natural appearance with kiawe, hauole koa and naturally occurring grasses. It is the intent of this Plan to maintain this area in its entirety as it currently exists and to a substantial degree emulate this "look" as much as possible in the surrounding areas to be naturalized.