PRELIMINARY GEOTECHNICAL EXPLORATION REPORT
KEOKEA-WAIOHULI DEVELOPMENT PROJECT
KULA, KEOKEA, MAUI, HAWAII

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March 31, 2005 PSC Job No. 24304.10

SUMMARY OF FINDINGS AND RECOMMENDATIONS

The project site is located on the western slopes of Mount Haleakala. It is underlain mainly by volcanic flows of basaltic andesite, andesitic basalt, and picritic basalt geologically termed as the Kula volcanic series. Sections of the road passing over the Kula Volcanic series will encounter volcanic ash generally intermixed with vitric tuffaceous gravels, cobbles and boulders of varying proportions (vitric) on top of the andesitic basalts. The surface soils range in thickness from 0 to more than 8 feet in one location. The Kula volcanic ash by itself is not suitable for engineered fills due to its low density and strength, high natural moisture content, and characteristically difficult to compact. The surface soils are generally classified as silt (MH) based on the Unified Soil Classification System. This soil acts like silt when dry and is prone to wind and water erosion. Some of these surface soil materials can be replaced or capped with borrow fill to provide adequate support for the proposed road network development. Laboratory tests show that the near surface, silt/volcanic ash derived soils generally have relatively low dry densities and high insitu moisture contents. Special attention should therefore be given to the preparation of subgrade and design of pavement for this road network project.

To achieve a relatively uniform support under the proposed roadway pavement structure, it is recommended that the soft or loose ash soil be removed down to at least 2 feet below the design/finish sub grade or until stiff to very stiff silt or gravelly materials are exposed, up to 2 feet below the design/finish subgrade. It should then be replaced with non-expansive, select borrow fill material (or an approved mixture of the insitu silts/volcanic ash with at least 60 percent of crusher-run basaltic aggregates), which may be obtained from the proposed project/borrow sites or other sources. Where fresh to slightly weathered basalt rocks are encountered, the basaltic base course may be placed directly over this after grading. If the grading works for the road involve extensive cutting through fresh or slightly weathered basalt, the use of embankment fill may be considered. For the Keokea site, volcanic ash materials generally range in thickness from 3/4 feet to 7.5 feet, except where the rocks are exposed at the surface. We recommend the removal of the near-surface soft volcanic ash materials in this area until stiff to very stiff soils are exposed and replacing them with select borrow material, except in the area bounded by TP-6 to TP-10 in Road A, TP-11 to TP-13 in future road and TP-14 in Road C. For the Waiohuli site, volcanic ash covered most of the road network, (except in the area bound by TP-24 through TP-27, in Road J, TP-29 through TP-30 in Road H, TP-31 through TP-32 in Road F, TP-36 in Road M, and TP-35 in Road A.) In this area, volcanic ash materials range from about 2.5 feet to 7.5 feet. We recommend the removal of the soft or loose near-surface ash materials encountered in this area, as described, and replacing them with select borrow material (or a mixture of ash and crusher-run basaltic aggregates).



Basaltic rock formations were observed at the proposed bridge and reservoir sites. It is our opinion, from a geotechnical standpoint, that it is feasible to build these structures at these selected sites.

Community Planning and Engineering, Inc. (CP&E) proposes to source borrow material from a parcel at the lower northwestern end of the proposed subdivision (Plate No. 2-A). Based on our field exploration in this area, the borrow site will have adequate borrow material consisting of basaltic/andesitic gravels, as shown in Boring Nos. B-1 to B-10. Some of the topsoils found in the borrow area, particularly in the vicinity of boring B-3, which consists of sandy, clayey silt, may be used as subbase fill material. Preliminary laboratory tests indicate that reconstituting the native volcanic ash silts with crusher run basaltic gravels also found at the site, with properly mixed portions, would considerably improve the soil strength characteristics.

We believe that a grading scheme to strip about 2 feet of the soft or loose volcanic ash soils (or until stiff to very stiff or dense materials are encountered), where these are encountered below the design/finish subgrade elevation along the road right-of-way, and replacing with select borrow material will provide long-term stability. The text of this report should be referred to for detailed and special design recommendations.

INTRODUCTION

This report presents the results of our preliminary geotechnical exploration for the proposed road network of the Keokea-Waiohuli Agricultural Lots project located at Keokea and Waiohuli, Maui, Hawaii. The study also includes the proposed water reservoir and bridge crossing on the Waiohuli side of the subdivision per our proposal of March 2005. The general location and vicinity of the project site is shown on the Project Location Map, Plate No. 1.

Our work on the project was performed generally in accordance with our proposal dated March 2, 2004, except where modified by CP&E and PSC as to the exploration method based on actual site conditions for the borrow and other site areas. This report summarizes our findings and recommendations.

PROJECT CONSIDERATIONS

The proposed Keokea-Waiohuli Agricultural Lots subdivision is located along the western slopes of Mount Haleakala west of Kula Highway Route 37 opposite Keokea Park. The terrain is steep to moderate and rough with boulders, cinder flows and rock outcrops. The majority of the study area, particularly the southern half of the site, is covered with vegetation consisting of groves of trees, Giant Cacti, and grass. The northern half contains less of the trees found at the southern

portion. The site generally slopes downward in a westerly direction from Kula Highway. The proposed subdivision road network will provide access to the proposed 400-Lot Keokea-Waiohuli Subdivision of the Department of Hawaiian Homelands (DHHL). The proposed alignment of the road network, bridge and reservoir sites, are shown in the Site Plan, Plate No. 2.

Geotechnical studies and field explorations were also conducted in the general area of the project site in 1995 by Ernest Hirata & Associates and by Dames & Moore in 1998. The studies revealed that the surface soil in the areas studied consisted of light brown to brown clayey silt with gravel and cobbles. Both studies also revealed that the surface soils are derived from volcanic ash. It was also found that this particular type of soil has high insitu moisture content and low dry density. In the dry and uncompacted state the soil exhibits little or no cohesion and becomes highly susceptible to erosion from both wind and water. Similarly, the dense and weathered basalt formation was reportedly encountered under the surface soils.

The volcanic ash derived soil in its pure form, is not recommended for structural fill, or for road embankment unless it is reconstituted with granular material. Based on these, a proposed grading scheme will consist of removing 2 feet of the soft or loose surface (volcanic ash) soil material below the design subgrade where these are encountered (or until stiff to very stiff or dense materials are encountered) and replacing these with borrow fill of non-expansive granular capping material which will support the pavement structure of the proposed subdivision road network project.

To define the extent of the fill and to obtain samples for index property tests, 50 test pits were excavated at approximately 500-foot intervals along the proposed road system by PSC Consultants, LLC, for this current study.

A borrow area is proposed at the northwestern lower end of the property (Plate No. 2-A). It is being contemplated as a source of fill material and may also serve as disposal area for the unsuitable soils and other debris that will be removed from the roadway construction site. Ten (10) borings (Boring Nos. B-1 through B-10) were excavated, with a Hoeram, by PSC from 10 to 20 feet deep at the proposed borrow area (Plate 2-B) to delineate the depths of the topsoil and to determine the engineering properties of the underlying soil/rock formation intended for borrow material.

We anticipate that asphaltic concrete pavements and or concrete pavements will be required for the roadways in the subdivision and while specific traffic loading has not been specified, we anticipate a medium vehicle loading for the project consisting primarily of passenger vehicles and delivery trucks.

The structural information for the reservoir and bridge sites were provided by Tanimura and Associates, Inc., Consulting Structural Engineers.

PURPOSE AND SCOPE

The purpose of our geotechnical exploration is to gather information on the nature, distribution, and characteristics of the subsurface earth materials encountered on the proposed project site and borrow area, and to provide specific recommendations pertinent to the proposed road network development. The scope of our exploration consisted of the following tasks and work efforts:

1. Review of the existing available data from published and unpublished sources pertaining to the geology and soil conditions at the site and its vicinity and conducting a reconnaissance survey of the project site;
2. Scheduling the field exploration and coordinating with CP&E and Land Surveyors for the test pit/boring locations and site access;
3. Scheduling the field walkover survey and coordinating with CP&E and Site Archeologist for the reservoir and bridge site locations in the Waiohuli area and site access;
4. Mobilization and demobilization of drilling/excavating equipment and operators;
5. Coordination of the field exploration, and logging of the borings and test pits by a field engineer from our firm;
6. Excavating 50 test pits, 1 to 8 feet deep, each, with the use of a Backhoe or Hoe Ram equipment, approximately 500 feet apart along the pre-surveyed road network alignment, and collecting surface bulk samples for classification and CBR testing for pavement design. The depth of the underlying rock limited the depths of the test pits.
7. Excavating 10 borings to depths of about 15 to 20 feet below the existing ground surface at the proposed borrow area;
8. Laboratory testing of selected soil samples obtained from the field exploration to classify the materials encountered and to evaluate their engineering properties relative to their intended use. In addition, mixed design of ash and granular materials and CBR tests were performed to determine their suitability for pavement support.
9. Analyzing the field and laboratory data for the formulation of preliminary geotechnical engineering recommendations pertinent to the road and pavement design, the reservoir, and the bridge at the Wiaohuli site, including but not limited to foundations, engineered fills, and site grading for the proposed subdivision road development;

10. Coordinating with and providing preliminary geotechnical recommendations to the structural designers for the reservoir and bridge sites at Waiohuli area; and

11. Preparation of this report summarizing our work on the project and presenting our findings and recommendations.

Detailed descriptions of our field exploration and laboratory testing are presented in the plates of this report.

SITE DESCRIPTION

The project site is located in the western slopes of Mount Haleakala, along the Kula Highway Route 37 opposite Keokea Park in Keokea, on the island of Maui, Hawaii. The terrain in the general area of the project site slopes downward to the west with grades ranging from moderate to steep. Occasional basaltic rock outcrops and boulders were also observed. Vegetation consisting of grass, groves of trees, and giant Cacti abounds at the site, particularly on the southern half of the property.

The proposed subdivision road network will have an estimated total length of approximately 36,000 feet or about 6.82 miles, providing access to some 400 agricultural lots. At the writing of this report, only the road profiles and cross sections for Roads A, B, D, and Bridge Abutments and a topographic map of the proposed subdivision and Reservoir site are available. The proposed road profiles and sections of the other roads of the subdivision road network were not provided.

SUBSURFACE CONDITIONS

Project Site Geology

The project site is underlain mainly by volcanic flows of basaltic andesite, andesitic basalt and picritic basalt, geologically termed as the Kula volcanic series as shown in the Geologic Map of the Project Site and Vicinity (Plate No. 1-A). These volcanic flows are covered with a surface layer of volcanic ash derived silt sometimes intermixed with tuffaceous gravels, cobbles, and boulders (weathered tuff) in the majority of the study area. These surface soils range in thickness from about 1 foot to more than 8 feet in one location. The ash material is generally not suitable for pavement and foundation support or embankment fill.

Subsurface Exploration

Road Network

Subsurface conditions along the proposed subdivision road network were explored by excavating and sampling 50 test pits spaced at approximately 500 feet on centers. The depth of excavation ranged between 4 to 8 feet except in places where the basaltic/andesitic volcanic rock occur very close to the ground surface. The approximate locations of the test pits are shown on Site Plan, Plate No. 2.

Borrow Area

The proposed borrow area was explored by digging with a hoe ram and sampling 10 borings to depths ranging between 15 to 18 feet below the existing ground surface. The approximate locations of the borings and test pits are shown in the Site Plan of the Proposed Borrow Area, Plate No. 2B.

Subdivision Road Alignment

The proposed road network will generally traverse over volcanic ash derived silt materials (silt), with varying amounts of gravels, cobbles, and boulders. The thickness of the surface soil layer ranges in the order of 1 foot to about 8 feet.

Road "A"

This proposed road alignment runs along the middle central portion of the subdivision from the southern most lots to its northern limits. Eighteen (18) test pits were excavated along this road alignment as shown in the Site Plan, Plate No. 2. The depth to the basaltic rock from the surface ranges from 2 feet in Test Pit TP-6 to about 7.5 feet in Test Pit TP-46. Silt materials were encountered in Test Pits, TP-4, TP-5, TP-34, TP-45, and TP-46. The silt materials encountered in the rest of the test pits contained varying amounts of tuffaceous gravels, cobbles and boulders.

Road "B"

Proposed Road "B", approximately 1,500 feet in length, is the main access road to the subdivision connecting Kula Highway to Road "A". Test Pits TP-1 through TP-4 are located along this proposed road alignment. The thickness of the overburden soils range from 4-feet in Test Pit TP-4 to about 8 feet in Test Pit TP-3. With the exception of Test Pit TP-4 (at the Road "A" and Road "B" junction), where the materials encountered are predominantly silt, the soils encountered in Test Pits TP-1 to TP-3 are either silty gravels or gravelly silts with tuffaceous cobbles and boulders.

Road "C"

Road "C" is a road extension that will run perpendicular to Road "B" (Plate No.2). It is about 1500 feet in length and is aligned in a west-southwest direction. Test Pit TP-14 was excavated approximately near the central portion of this road, which revealed overburden soils consisting of about 4 feet thick of silty gravel underlain with Basaltic rocks. Additional exploration should be performed in other portions of the road alignment to confirm the subsurface soil information.

Road "D"

Road "D" is a lateral road in the mid-western section of the subdivision connecting to Roads "F" and J. Three (3) test pits (TP-21 to TP-23) were excavated along this road. The depth to volcanic rock from the surface is about 5 feet in Test Pit TP-21 to about 1-foot in Test Pit TP-23, near its intersection with Road "J". The overburden soils encountered in Test Pits TP-21 are predominantly silt (MH). The same types of soils are also present in Test Pit TP-22 but contains considerable amount of gravel. A thin layer (about 1-foot) of stones and boulders in a silt matrix were encountered in Test Pit TP-23.

Road "G"

Proposed Road "G" makes a loop originating from and terminating in Road A at the northwestern side of the subdivision. It has an approximate length of about 3,225 feet. Auxilliary roads, G1 and G2 parallel to each other traverse the area bounded by the loop formed by Road G in a north-northeast orientation. Five (5) test pits, namely; TP-40 to TP-44, are located in the vicinity of Road G. The thickness of the overburden soils range from about 4-feet in Test Pits TP-42 and 43 to about 8 feet in Test Pit TP-44. The overburden materials encountered in these Test Pits are predominantly silts and gravelly silts. Additional test pits may be made to confirm the subsurface soil information in other parts of Road G.

Road "H"

Road "H" is a lateral road in the mid-western section of the subdivision connecting Roads F and E. Three test pits TP-28 through TP-30, were excavated along this road. The depth to volcanic rock from the surface is about 1 foot in Test Pit TP-30 to about 4.5 feet in Test Pit TP-28. The overburden soils encountered are predominantly silty gravels and gravelly silts.

Road "K"

Road "K" is a service road that runs perpendicular to both Roads A and E at the northeastern section of the subdivision. It is about 3,225 feet long. Test pits TP-39, 48, 49, and 50 were excavated in the general vicinity of this road. The overburden soil in this road alignment consists of silty gravels and gravelly silts ranging in thickness from 3 to 4.5 feet.

Road "F"

Road "F" is aligned parallel to Road "A" to the west of Road "A". It stretches about 2,400 feet from Road "D" in its southern end and connects with Road E to the north. Test Pits TP-31 through TP-33 were excavated along the general vicinity of this road. The depth to volcanic rock from the surface ranges from about 5 feet in Test Pit TP-32 to about 1.5 and 2.5 feet in Test Pits TP-31 and TP-33, respectively. A thin layer (about 1 foot) of cobbles and boulders in a silt matrix were encountered in Test Pit TP-31. Overburden materials encountered in Test Pit, TP-32 and TP-33 consisted of silty gravel (GM-GW).

Road "M"

Road "M" connects with Road "A" at its southern end and terminates to the north at its intersection with Road "E". It runs parallel to the east side of Road "A" and is about 1,900 feet in length. Test Pits TP-36 and TP-37 are located within this road alignment. The near-surface soils consisted of silt (MH) occurring to a depth of about 4 feet and 2 feet in Test Pits TP-36 and TP-37, respectively. Silty gravel (GM) was also encountered under the surface silt layer in TP-37, occurring down to about 7.5 feet, where it interfaces with the underlying basalt rock.

Roads "L and L-1"

Roads "L and L-1" provide access to the lots bounded by Roads A and K on the northeast side of the subdivision. Road L is approximately 1,125 feet and Road L-1, which branches perpendicular to Road L is about 375 feet. Test Pit TP-47 was excavated in the vicinity of this road. The depth to rock from the surface is about 6 feet in Test Pit TP-47. The overburden materials encountered in this test pit consisted of gravelly silt. Additional test pits can be made in the areas which are more than 500 feet apart, to confirm the subsurface soil conditions.

Road "E"

Road "E" is a header road that traverses across the northern half of the subdivision from east to west with a length of about 2,900 feet. It connects the northern ends of Roads "J", "H", "F", "A", "M" and the southern end of Road "K". Test Pits TP-26, TP-29, TP-33, TP-35, and TP-39 are approximately aligned within the path of this road. The depth to volcanic rock from the surface ranges from 1 foot in the westernmost end at Test Pit TP-26 and appear to thicken to 5 feet toward the other end at Test Pit TP-39. The overburden materials encountered along this road alignment, at the test pit locations, consisted of silty gravel. These near surface soils are generally underlain with basaltic rock of the Kula Volcanic Series.

Additional field exploration may be performed in the eastern end of Road "E" to confirm the subsurface soil information.

Proposed Borrow Site

The designated borrow site is located in a property adjacent to the northwestern side of the subdivision (Plate No. 2-A). Ten (10) borings (B-1 to B-10) were excavated, using a Hoeram, within the proposed borrow area (Plate No. 2-B), to explore the type of materials available at this site and to determine their relevant engineering properties. The borings encountered a surface soil of predominantly silt materials ranging in thickness from 0 (Boring B-5) to about 5.5 feet in Boring B-1. The surface soils are underlain with volcanic flows of basaltic/andesitic rocks with intermediate layers/lenses of tuffaceous gravels (clinker), cobbles, and boulders. A void of about 4.5 feet in vertical dimension, probably originating from a lava tube, was encountered in Boring B-2 between depths of 8 to 12.5 feet. Groundwater was not encountered in any of the borings during the time of our exploration. All borings/test pits were properly backfilled after completion of our field exploration work.

DISCUSSION AND RECOMMENDATIONS

Our field exploration indicated that volcanic ash derived silt soil with varying amounts of gravel, cobbles and boulders generally cover the project site with occasional basaltic rock outcrops. The thickness of the surface soil ranges from about 1 foot to more than 8 feet (Test Pit TP-44). These silt soils contain relatively high amounts of moisture. In the dry state it losses cohesive strength and becomes prone to wind and water erosion. Our field exploration also showed that a large part of the soil overburden within the study area contained considerable amounts of coarse materials such as tuffaceous/basaltic gravels, cobbles and boulders. In some areas the coarse materials exceeded that of the fines, as reflected in the logs of borings. These overburden materials are underlain with fresh to moderately weathered andesitic, basaltic flows also known as the Kula volcanic series.

Keokea Site

The field exploration along Roads A, B, and D, within the Keokea side of the subdivision, indicated overburden soils generally comprising of silty gravels and gravelly silts with varying amounts of cobbles and boulders. Embankment fills may be laid directly over these materials (after clearing, grubbing and scarifying) without over-excavation. Undercutting below subgrade will not be necessary when these gravelly silt and silty gravels with cobbles and boulders are encountered. In this area, volcanic ash materials generally range in thickness from 3/4 feet to 7.5 feet, except where the rocks are exposed at the surface. .If road grading encounters loose volcanic ash below finish subgrade level, we recommend the removal of the upper 2 feet, or more if necessary, until stiff to very stiff or dense materials are encountered or until gravelly silt material is exposed, except in the area bounded by TP-6 to TP-10 in Road A, TP-11 to TP-13 in future road and TP-14 in Road C. We further recommend replacing these with select borrow compacted to 95 percent of relative compaction, to improve the stability of the proposed subdivision road. The removed surface silt/volcanic ash soils may be buried in the borrow pits and covered with 1 foot of the excavated borrow material to limit erosion potential, particularly if future developments are planned.

It should be noted that actual ground conditions or materials within the approximately 500-foot spacing between test pits may vary and should be verified during actual grading operations. In Road A, for instance, a berm-like natural feature rising to about 8 feet from the proposed road cut stands between TP-5 and TP-6, particularly between stations 80+00 through 82+00 in profile of Road A, Plate No. 86 (Sheet 3 of 5 of the provided road profiles). This may be rock, soil, or a combination thereof and therefore the grading method in between the test pits will be dictated, in part, by what is actually encountered in the unexplored portions of the road development.

Waiohuli Site

In this area, volcanic ash materials generally range in thickness from 2.5 feet to 7.5 feet, except where the rocks are exposed at the surface, such as at the proposed bridge crossing. We also recommend the removal of the near-surface soft volcanic ash materials in this area until stiff to very stiff soils are exposed and replacing them with select borrow material, except in the area bounded by TP-24 through TP-27, in Road J, TP-29 and TP-30 in Road H, TP-31 and TP-32 in Road F, TP-36 in Road M and TP-35 in Road A.

At the proposed borrow area, the thickness of the overburden soil is on the order of 2 to 17 feet. The overburden materials encountered in this area are mostly gravelly silts and silty gravels with cobbles and buried boulders. Detailed descriptions of the materials encountered in this site can be referred to the Logs of Borings (Plate No. 53 through 62), Boring Nos. B-1 to B-10.

Bridge Site at Waiohuli

Site Description

The approximate location of the bridge, site contains gray, basaltic rock outcrops on both the left and right abutments. The rock surfaces at the central part of the dry stream channel appear smoother, as compared to the rocks exposed higher up the banks, indicating an intermittent stream flow. Pools of water trapped in small depressions in the rock were also observed along the central portion of the channel. At the approximate location of the bridge site, the upstream channel (eastern portion of the site) is relatively shallower than the western section, where a sudden drop occurs to an estimated depth of about 10 feet, forming a narrow channel at the downstream side of the crossing about 5 wide. Visibility range at the site is limited due to the dense growth of secondary forest cover consisting of native trees and brush. Access to the site is also hampered by the abundance of dead tree debris.

The approximate site of the abutments generally consists of hard, strong, slightly weathered, fractured, basaltic rock exposures.

From our preliminary survey of the project site, it is our opinion that the project is feasible for construction from a geotechnical engineering standpoint, with the following design parameters:

Foundation Design

The proposed single span, 60-foot long bridge abutments may be supported on spread footing foundations initially designed for an allowable bearing pressure of 6000 psf (287 kPa). This allowable bearing capacity may be increased or decreased depending on the geotechnical conditions at the exact bridge locations, which will be determined from an additional field exploration prior to final design. Other geotechnical design parameters are as follows:

Seismic Data

- Shear wave velocity 2,500 fps
- Peak Rock Acceleration 0.2 g (From UBC)

Lateral Soil Forces

Seismic Soil Pressure	33 percent increase over active and passive cases
Active Case: Design Value	36 pcf equivalent fluid pressure for pre-approved backfill material
At Rest Case: Design Value	55 pcf equivalent fluid pressure for pre-approved backfill material
Passive Resistance: Design Value	400 pcf equivalent fluid pressure for pre-approved backfill material. Maximum value 4000 psf.

The above foundation recommendations and design parameters are based on surface site observations only for use in the preliminary design of the structure. These design parameters will be subject to change if the engineering properties of the underlying materials are different from what we have anticipated and should be verified by actual field exploration.

Reservoir Site

Site Description

The general location of the proposed reservoir is undulating ground containing low-lying ridges and valleys. The proposed water storage structure will be set on the ridge about 300 feet northwest of the intersection of Roads K and E. The

ridge area is generally covered with grass and contains gray, basaltic rock outcrops. The exposed rocks were observed to be hard, strong, and massive. The rock surfaces are sharp and rough.

From our preliminary survey of the project site, it is our opinion that the project is feasible for construction from a geotechnical engineering standpoint. The following recommendations may be used for preliminary design of the reservoir

Based on our preliminary field observations, the proposed reservoir tank may bear on the underlying hard basaltic rock formation or properly compacted pre-approved fill material, with the following design parameters:.

Foundation Design

For preliminary design purposes, an allowable bearing pressure of 3000 psf (145 kPa) may be used for the onsite materials or on properly compacted, pre-approved select borrow. The minimum footing embedment depth shall be 18 inches (1.5 feet) below the lowest adjacent finished grade. An allowable bearing pressure of 6,000 (287kPa) may be used, tentatively, for footings bearing on the basaltic rock. These allowable bearing capacities may be increased or decreased depending on the actual geotechnical conditions at the exact reservoir locations which will be determined from future exploration data.

The bearing values are for dead plus live loads and may be increased by 1/3 for transient loads due to wind or seismic forces.

For footings adjacent to slopes, the footing must be deepened such that there is a minimum distance of 6 feet from the edge of the footing to the slope face.

Conditions where the footing will rest partially on rock and partially on fill should be avoided. Foundation fills over cut rock should be more or less uniform in thickness to limit differential settlement. Other geotechnical design parameters are as follows.

Lateral Resistance

For resistance of lateral loads, such as wind or seismic forces, an allowable passive earth resistance equivalent to that exerted by fluid weighing 300 pcf may be used for footings, provided that the vertical surface is in direct contact with undisturbed soil, or properly compacted fill.

Frictional resistance between footings or slabs and the underlying soil may be assumed as 0.3 times the dead load for properly compacted, pre-approved structural fill or 0.5 times the dead load for footings resting on basaltic rock.

Slab on Grade

For the preliminary design of concrete slab on grade, a modulus of subgrade reaction of 300 pci maybe used for the structural fill of select granular borrow materials.

Slopes

Permanent fill or cut slopes of soil type materials shall not exceed 2H:1V (horizontal to vertical). Exposed soil slopes must be covered immediately after construction to limit erosion. Cut slopes into the basaltic rock formation may be made at 1H:1V.

The above recommendations and design parameters are based on surface site observations only for use in the preliminary design of the structure. These design parameters will be subject to change if the engineering properties of the underlying materials are different from what we have anticipated and should be verified by actual field exploration.

Earthwork and Grading

The following sections present guidelines for the design and construction of the earthwork and grading for the subject subdivision road development and appurtenant structures.

Our field exploration indicates that under the silt (volcanic ash) surface soils, the site is generally underlain with competent basaltic/andesitic rocks and deposits of tuffaceous gravels (clinker), cobbles, and boulders. These underlying materials have good strength characteristics and, if excavated and properly processed, could meet the requirements for select borrow for subbase course, as stipulated in Section 16 of the Standard Specifications for Public Works Construction.

Therefore, the recommended grading concept would involve utilization of the suitable overburden soils and the weathered basaltic/andesitic gravels and rocks in the designated borrow site as replacement fill and select material. These materials could be quarried, processed, and classified according to aggregate sizes and stockpiled for use as capping, subbase, basecourse, and paving material. After sufficient quantities of borrow material is excavated, processed, and stockpiled, the soft or loose unsuitable silt (volcanic ash) soils that are encountered within the subdivision road right-of-way will be stripped to a depth of at least 2 feet below the finish subgrade where applicable, or until stiff to very stiff or gravelly materials are encountered. The unsuitable materials should be disposed of, properly, off-site or in the borrow area excavation and capped with 1-foot of the excavated borrow granular material to limit erosion and downhill siltation. Where the design subgrade encounters silty gravel, gravelly silt with cobbles, and boulders or weathered basalt, over excavation and replacement with borrow or embankment fill will not be necessary. After grading, scarification, and proof rolling, the subbase course may be placed directly on top of these gravelly insitu materials. Where fresh basalt rocks are encountered, the basaltic base course may be placed directly over this, after grading. If the grading works for the road involve extensive cutting through slightly weathered to fresh basalt, the use of embankment fill may be considered. In this case, benching is required for slopes that are steeper than 5H:1V, where daylight sections are encountered. Additional recommendations should be provided for areas where ash and granular/basaltic materials are involved. This usually involves the over-excavation of up to 2 feet for an area of several feet to create the same material within the daylight section for uniform support.

Borrow Pit Operation

To generate sufficient select fill materials for the required road grading, a borrow pit operation may be considered as a supplementary or main source of fill and paving materials. Based on field observations, it is our opinion that the weathered subsurface basaltic/andesitic rock formations at the borrow site can be quarried using controlled blasting, if permitted. After blasting, these may be further reduced with rock-breakers (Hoe Ram), and excavated with bucket type excavators. The resulting excavation area could be utilized as a disposal site to contain the stripped unsuitable silt/volcanic ash soils to limit downstream siltation. Any silt soils placed in the borrow pits should be laid in controlled lifts and properly compacted and capped with non-expansive material, if future developments are planned.

As discussed above, the basaltic andesite from the borrow site may be considered comparable to select fill material when properly processed and are suitable for road embankment and capping fill within the upper 1.5 feet below the proposed finished subgrade of the subdivision road.

Site Grading

Currently, numerous boulders and rock outcrops and groves of trees are present at the site and along the proposed road right-of-way and bridge site. The boulders encountered may be processed for aggregates or select fill material, if they can meet the grading specifications and requirements contained in this report. Otherwise, these can be stockpiled for future use such as rip rapping, landscaping, and other purposes, or disposed of in the borrow pits. This can be determined during the construction and grading operations.

Fill embankments and cuts are anticipated in the subdivision road network development. Therefore, proper site preparation and compaction of the new fills and bonding of the new fills to the existing ground surface will be required to provide a stable fill mass. As discussed above, 2 feet of the soft or loose surface silt (volcanic ash derived soils) should be stripped below the design subgrade of the road development where these are encountered. These ash soils should be disposed of off-site or be placed in the borrow pits. However, if the insitu soils contain considerable amounts of gravels, boulders, and cobbles, as encountered in many of the test pits, stripping and replacement of the soft or loose ash soils with select borrow will not be necessary, provided that the volcanic ash soils are properly blended with granular/oversize materials to form a uniform matrix. The basaltic/andesitic materials such as those found at the proposed borrow area, if properly processed, are considered suitable as replacement fill for the stripped ash soils and for road embankment fill.

We recommend that the road grading operations be observed by a representative of PSC Consultants, LLC. It is important that a representative from our office observe the road grading to evaluate whether any undesirable materials are encountered during the excavation and scarification process and whether the exposed soil/rock conditions are similar to those anticipated in our engineering analysis.

Site Preparation

At the onset of earthwork, the area within the contract grading limits of the road right-of-way should be cleared of trees, vegetation, debris, rubbish, boulders, and other deleterious materials. These materials should be removed and properly disposed of off-site.

In areas to receive fill, such as the silt layers that are over excavated down to 2 feet or the insitu silty gravels and gravelly silts, should be scarified to a depth of 6 inches, moisture-conditioned to at least 2 percent above the optimum moisture content, and compacted to a minimum of 90 percent relative compaction. Relative compaction refers to the in-place dry density of soil expressed as percentage of the maximum dry density of the same soil established in accordance with ASTM Test designation D 1557-91. The optimum moisture content is the moisture content corresponding to the maximum compacted dry density. Soft or yielding areas encountered during site preparation should be over-excavated to expose firm soil surface and stabilized by backfilling with select material placed in 8-inch thick, loose, lifts and compacted to 90 percent relative compaction or 95 percent for fills 2 feet below the proposed road subgrade.

Over-Excavation

Some of the existing upper clayey silt (volcanic ash) that do not contain or have very little percentage of coarse material may not be suitable for support of the proposed pavement. These are porous (susceptible to collapse/settlement with increased water content), have a relatively low dry density, and are prone to erosion and should be over excavated and replaced with select onsite/borrow fill. These materials are generally from 0.75 to 8 feet in depth and their limits within the project site were mentioned in the Summary Section and Discussion and Recommendation Section of this report. If these upper clayey silt (volcanic ash) materials are also encountered in areas between test pits or areas outside the aforementioned limits during the grading of the proposed road right-of-way, they should be over-excavated down to at least 2 feet or until stiff to very stiff or dense gravelly materials are encountered and replaced with select granular materials. A minimum of 2 feet of select granular materials should be provided underneath the pavement section along the road right-of-way and compacted to 95 percent relative compaction under the section headed, "Pavements". It is important that a PSC representative be present during the site grading work to determine which areas need to be over excavated or retained. A separating geotextile should be used between the remaining in-place porous volcanic ash materials and select granular fill materials. Adequate sub-drains should also be installed in the areas of deeper porous deposits to prevent surface runoff entering into the porous volcanic ash layer.

The excavated volcanic ash/silt materials can be mixed with onsite granular/basaltic materials for reuse as select/engineering fill, when properly mixed and processed. Some laboratory tests (CBR and compaction tests) were performed on trial mixtures of onsite samples to determine the engineering properties and appropriate proportions of components for possible select fill.

Fill Materials and Placement

Borrow Pit Backfill and Compaction

It is anticipated that the soft or loose silt/volcanic ash soils that will be removed from the subdivision road right-of-way and placed in the borrow pits will be prone to erosion due to its relative lightness and very low to zero cohesive strength when dried. In order to reduce the erosion potential of this soil, the disposed soft or loose silt (ash) backfill material should be moisture conditioned to at least 3 percent above the optimum moisture content and compacted to 85 to 90 percent relative compaction. The final layer of backfill should be placed at a minimum of 12 inches below the finished subgrade in the borrow pits to allow the placement of at least 12 inches of capping material composed of granular select borrow.

Onsite Fills/Backfills and Compaction

Road Embankment and Replacement Fills

Materials used for road embankment filling and the replacement fills placed within the top 2 feet of finished subgrade within the road right-of-way area should be non-expansive, select material, generally less than 3 inches in maximum dimension, should have a plasticity index not exceeding 15, as determined in accordance with ASTM Test Method D 4318-84, and should have a maximum of 40 percent of particles passing the No. 200 sieve. The onsite tuffaceous, basaltic/andesitic materials, if properly processed after excavation, are suitable for this purpose.

Trial Mix of Fill Materials

Preliminary California Bearing Ratio (CBR) tests conducted indicate that the volcanic ash when mixed with 50 percent (by volume) of the onsite basaltic gravel passing Sieve No. 4 would result in a General Rating of Fair to Good. This mixture may be suitable for subbase or base material. Similarly, on site silts mixed with approximately 50 percent (by volume) of the basaltic gravels retained

in sieve No. 4 indicated a General Rating of Fair to Good, which is likewise suitable for use as subbase or base material. Another test was conducted using a mixture of about 25 percent (by volume) of the basalt gravel passing the No. 4 sieve with approximately 75 percent of the onsite silt resulting in a general rating of Poor to Fair.

This type of mixture may only be used as subgrade. On the other hand, CBR tests conducted on purely volcanic ash silt, such as samples from Test Pits TP-4, 18, and 28, resulted in a General Classification Rating of Very Poor (CBR No.<3). The tests indicate that the soil strength characteristics can be improved with the addition of coarse gravelly materials. Based on the above tests, we recommend gravel content of at least 60 percent (by volume) or greater for the replacement and road embankment fills; that is, if a mix-design is to be adopted. Further tests should be conducted during actual construction to insure the consistency of the mix design is satisfied.

Compaction

Fill material should be placed in level lifts with maximum loose thickness of 8 inches; moisture conditioned to least 2 percent above optimum, and properly compacted to a minimum of 90 percent relative compaction. In roadway areas, the minimum degree of compaction within the upper 2 feet of the finished pavement subgrade level should be 95 percent. Each layer should be spread uniformly and blade-mixed to attain uniformity of the material and even distribution of water content. Additional fill material should not be placed on any fill layer that has not been properly compacted.

If additional offsite borrow material is required, it should be tested by PSC Consultants, LLC to evaluate its suitability for use as select fill prior to its delivery to the project site.

Slopes

In cases where sloping fills are required, such as at the edge of fill embankments consisting of select material, these may be designed at 2H:1V or flatter. Fill slopes should be constructed by overfilling 2 to 3 feet, then cutting back to the design slope to expose a well-compacted face.

Water should be diverted away from the slopes by diversion ditches at their tops and surface drains on slope surface and subdrains may be used to provide adequate drainage. Slope planting should be utilized to limit erosion.

Pavements

We anticipate that asphaltic concrete pavements will be required for the roadways in the subdivision. While traffic loading has not been specified, we anticipate a medium vehicle loading for the project consisting primarily of passenger vehicles and delivery trucks. We have made our preliminary pavement design assuming the pavement subgrade soil will consist of compacted tuffaceous, basaltic/andesitic fill materials with a minimum CBR value of 25. The fill material within 2 feet below the pavement subgrade should be compacted to 95 percent relative compaction. Based on the above assumptions, we recommend the following flexible and rigid pavement sections be used for preliminary design purposes:

Flexible Pavement Section

2-Inches	Asphaltic Concrete
6-Inches	Aggregate Base Course
6-Inches	Aggregate Subbase Course
14-Inches	Total Pavement thickness on a minimum of 2 feet of properly compacted select borrow material or insitu basaltic/andesitic rock formation.

Rigid Pavement Section

6-Inches	Concrete
6-Inches	Aggregate Subbase Course
12-Inches	Total Thickness

The recommended section considers medium subdivision traffic. In areas with heavier traffic, such as at main collector roads like Road "A" and Road "B", the section should be thickened with an additional 1/2-inch asphaltic concrete to provide adequate support for the anticipated increased traffic loading.

The base course should be compacted to 95 percent of its maximum dry density, as determined in accordance with ASTM Test Method D 1557-91.

CBR and density test and/or field observations should be performed on the actual subgrade used for the road construction to confirm the adequacy of the above pavement sections. The recommended section assumes that adequate drainage will be provided.

Road Drainage

Subdrains should be provided where there is a possibility that runoff from rainfall or irrigation could saturate the subsurface soils. Exposed surface soils should be protected from erosive runoff by providing surface drains, diversion berms, and other flood control devices. The access of water into the roadbed soil under the pavement should be minimized in order to stabilize the moisture content as by incorporating water inhibiting membrane into the design, as described in Item 1.21.1-d of the DOT Pavement Design Manual (Rev. March 2002).

Utility Trenches

We envision that utility lines will be required for the proposed subdivision road project. A granular bedding consisting of 6 inches of No. 3B Fine gravel is recommended under the pipes. Free draining granular materials, such as No. 3B Fine gravel (ASTM C 33, No. 67 gradation), should also be used for the trench backfill, up to about 12 inches above the pipes to provide adequate support around the pipes and to reduce compaction of the backfill, thus reducing the potential for damaging the pipes.

The upper portion of the trench backfill from 1 foot above the pipes to the top of the subgrade or finished grade should consist of select granular material. The backfill should be moisture conditioned, placed in maximum 8-inch, level, loose lifts and mechanically compacted to not less than 90 percent relative compaction to reduce the potential for future ground subsidence. Where trenches are below pavement areas, the upper 2 feet of the trench backfill below the pavement subgrade should be compacted to 95 percent relative compaction.

Design Review

Drawings and specifications for the proposed construction should be submitted to PSC Consultants, LLC, as geotechnical consultant, for review and written comments prior to construction. This review is needed to evaluate adherence of the plans to the recommendations provided herein. If this review is not made, PSC cannot assume responsibility for the interpretations made by others, or errors resulting there from.

Construction Observation and Testing

The recommendations provided in this report are based on subsurface conditions disclosed by widely spaced exploratory borings and excavations. The geotechnical consultant should check the interpolated subsurface conditions during construction. The geotechnical consultant should attend the pre-construction meeting between the contractors and owners/designers.

During grading, the geotechnical consultant should:

- Observe excavation, placement, and compaction of engineered fill for the road pavement structures;
- Observe preparation and compaction of aggregate base for asphalt/concrete pavement and flatwork subgrade;
- Check and test any imported materials prior to their use as fill;
- Perform field tests to evaluate fill compaction;
- Observe subgrade conditions at the bottom of pipeline trenches;
- Observe fill placement and compaction around the pipes in the utility trenches;
- Observe the fine-grading and exterior drainage improvements constructed around the finished structures; and
- Perform and check the foundation excavations for the Bridge and Reservoir sites.

The recommendations provided in this report assume that PSC will be retained as the geotechnical consultant during the construction phase of the project. If another geotechnical consultant is selected, we request that the selected consultant provide a letter to the architect/designer and owner/client (with a copy to PSC and Maui County) indicating that they fully understand our recommendations and that they are in full agreement with the recommendations contained in this report and will take over as the Geotechnical Consultant of Record for this project. If deviations from soil conditions and recommendations presented in this report occur, they should provide amended recommendations as new geotechnical consultants of record for the project.

LIMITATIONS

The analyses and recommendations submitted in this report are based, in part, upon information obtained from field borings and visual observations. Variations of subsoil conditions between the borings may occur, and the nature and extent of these variations may not become evident until construction is underway. If variations then appear evident, it will be necessary to reevaluate the recommendations provided in this report.

The test pits and boring locations in this report were selected by PSC Consultants LLC, based on the previous boring information done by others and our scope of work. The field locations for the borings and test pits were located by the client's surveyor and modified based on actual site conditions during field exploration work. The physical locations and elevations of the borings should be considered accurate only to the degree implied by the methods used.

The stratification lines shown on graphic representations of the borings depict the approximate boundaries between soil/rock types and, as such, may denote a gradual transition.

This report has been prepared for the exclusive use of Community Planning and Engineering, Inc., their client, and their consultants for specific application to the proposed Keokea-Waiohuli development in accordance with generally accepted geotechnical engineering principles and practices. No warranty is expressed or implied.

This report has been prepared solely for the purpose of assisting the architect/engineer in the design evaluation of the proposed project. Therefore, it may not contain sufficient data, or proper information to serve as the basis for preparation of construction cost estimates. A contractor wishing to bid on this project is urged to retain a competent geotechnical engineer to assist in the interpretation of this report and/or in the performance of additional site-specific exploration for bid estimating purposes.

The owner/client should be aware that unanticipated soil/rock conditions are commonly encountered. Unforeseen soil/rock conditions, such as perched ground water, soft deposits, hard layers, or cavities, may occur in localized areas and may require probing or corrections in the field (which may result in construction delays) to attain a properly constructed project. Therefore, a sufficient contingency fund is recommended to accommodate these extra costs.

The findings in this report are valid as of the present date. However, changes in the soil conditions can occur with the passage of time, whether they be due to natural processes, or to the works of man, on this or adjacent properties. In addition, changes in applicable or appropriate standards occur, whether they result from legislation, or from the broadening of knowledge. Accordingly, the findings in this report might be invalidated, wholly or partially, by changes outside of our control. Therefore, this report is subject to review by the controlling agencies and is valid for a period of 2 years.

Respectfully submitted,

PSC CONSULTANTS, LLC

Melchor Nolasco
Office Engineer



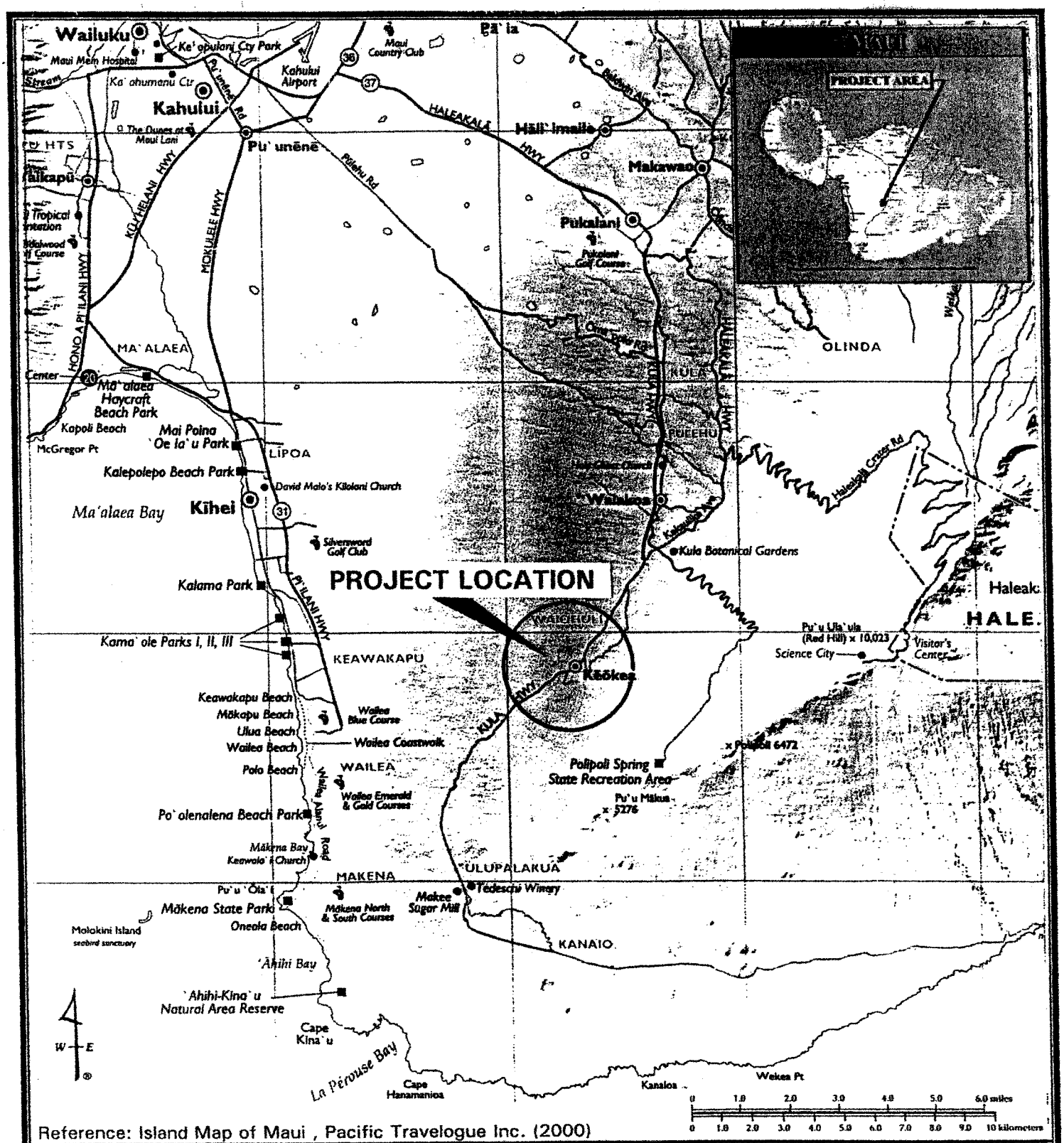
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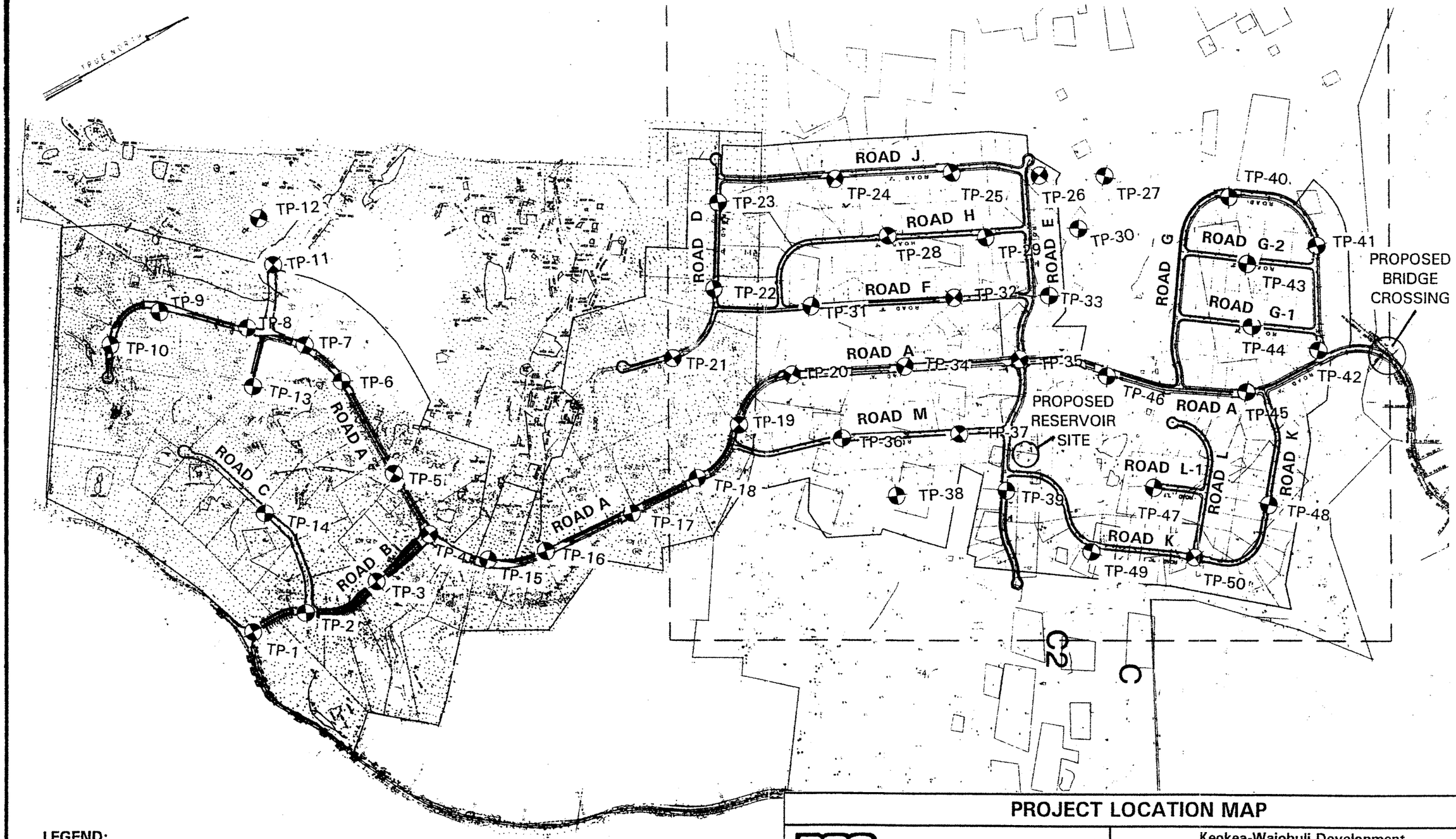
Alex W. Wong, P.E.
Senior Engineer

MGN/ASW/PSC:ch

Enc.:

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Plate No. 1-A	Geologic Map of Project Site
Plate No. 2	Site Plan
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Plate No. 2-B	Site Plan of Proposed Borrow Area
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Plate Nos. 80 through 82	Laboratory Compaction Curves (Borrow Site)
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Plate No. 86	Segment of Road "A" Profile


PROJECT AREA
PROJECT LOCATION
Wailuku
Kahului
Pu`unēnē
Pā`ia
Hāli`imaile
Makawao
Pukalani
Ma`alaea
Kihei
Ma`alaea Bay
Kalama Park
Kama`ole Parks I, II, III
Keawakapu Beach
Mākapu Beach
Ulua Beach
Wailea Beach
Palo Beach
Po`olenalena Beach Park
Mākena Bay
Mākena State Park
Oneola Beach
Molokini Island
seabird sanctuary
`Āhihi Bay
`Ahihi-Kina`u Natural Area Reserve
Cape Kina`u
La Pérouse Bay
Cape Hanamanioa
Wekea Pt
Kanaio
KEAWAKAPU
WAILEA
MAKENA
KANAIO
ULUPALAKUA
PUUNENE
KULA
OLINDA
HALE.
Kēōkea
WAIOHULI
Kula Botanical Gardens
Science City
Visitor's Center
Pu`u Ula`ula (Red Hill) x 10,023
Polipoli Spring State Recreation Area
Pu`u Mākua x 5276
Tedeschi Winery
Makee Sugar Mill
Mākena North & South Courses
Wailea Blue Course
Wailea Coastwalk
Wailea Emerald & Gold Courses
Kihei
Maui Country Club
Kahului Airport
Maui Memorial Hospital
Ke`opulani Cty Park
Ka`ahumanu Ctr
The Dunes at Maui Lani
Waikapū
Tropical Plantation
Waldwood Golf Course
Kapoli Beach
McGregor Pt
Ma`alaea Haycraft Beach Park
Mai Poina `Oe Ia`u Park
Kalepolepo Beach Park
David Malo's Kiloiani Church
Silversword Golf Club
Pukalani Golf Course
Waiakoa
Haleakalā Crater Rd
Kekaulike Hwy
Kula Hwy
Pi`ilani Hwy
Honoapi`ilani Hwy
Mokulele Hwy
Kuihelani Hwy
Haleakalā Hwy
Pulehu Rd
Waipoli Rd
Kahekili Hwy
Waiale Rd
Waiko Rd
Piilani Rd
Waipuilani Rd
Waiakoa Rd
Waiakoa Gulch
Waiakoa Stream
Waiakoa Ditch
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LEGEND:

Approximate Test Pit Location

APPROXIMATE MAP SCALE: 1" = 600'

PROJECT LOCATION MAP

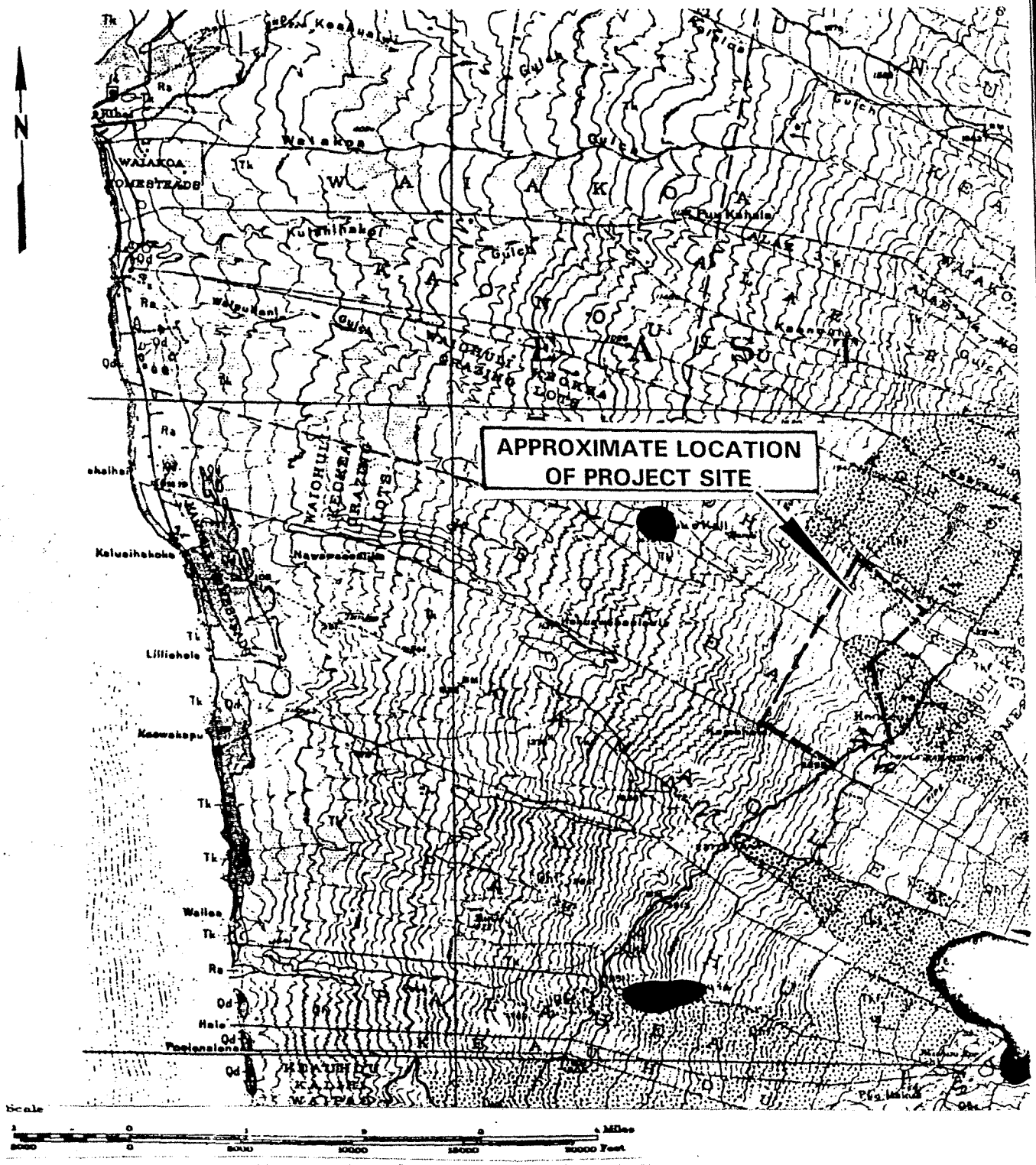
PSC CONSULTANTS, LLC
SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

Keokea-Waiohuli Development
Subdivision Road Network, Bridge, and Water Reservoir Project
Keokea, Kula, Makawao, Maui, Hawaii

DATE: March 2005 | PROJECT NO. 24304.10

Reference: CPE Subdivision Road Map, March 2005

PLATE NO. 2



Reference: GEOLOGIC & TOPOGRAPHIC MAP, ISLAND OF MAUI (USGS 1942)

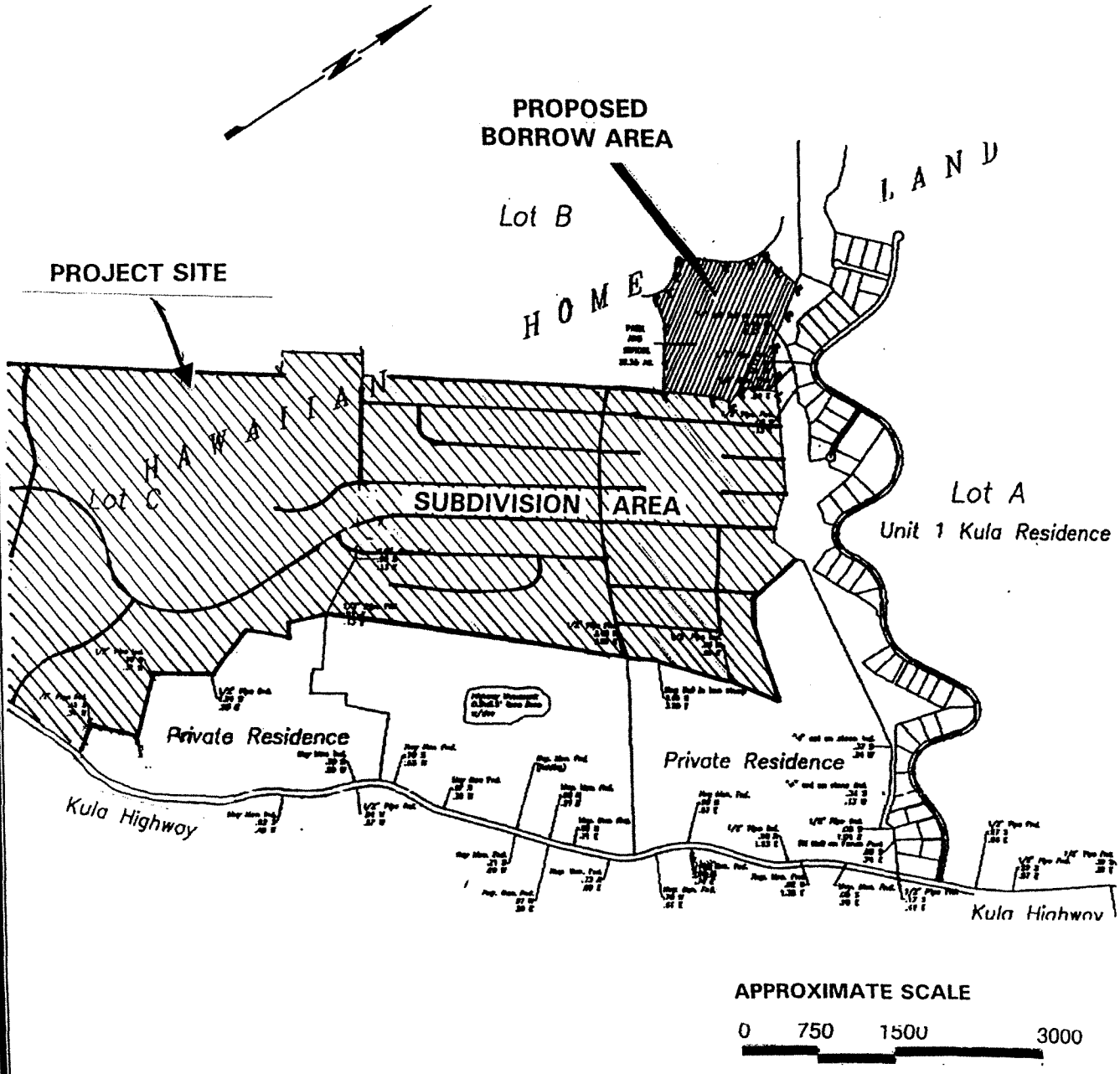
GEOLOGIC MAP OF PROJECT SITE

PSC CONSULTANTS, LLC
SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

Keokea-Waiohuli Development
Proposed DHHL Agricultural Subdivision Road Network
Kula, Makawao, Maui, Hawaii

DATE: March 2005 | PROJECT NO. 24304.10

PLATE NO. 1-A



Reference: Location Map of Proposed Borrow Site (ACE LAND SURVEYING. Dated 07/22/04)

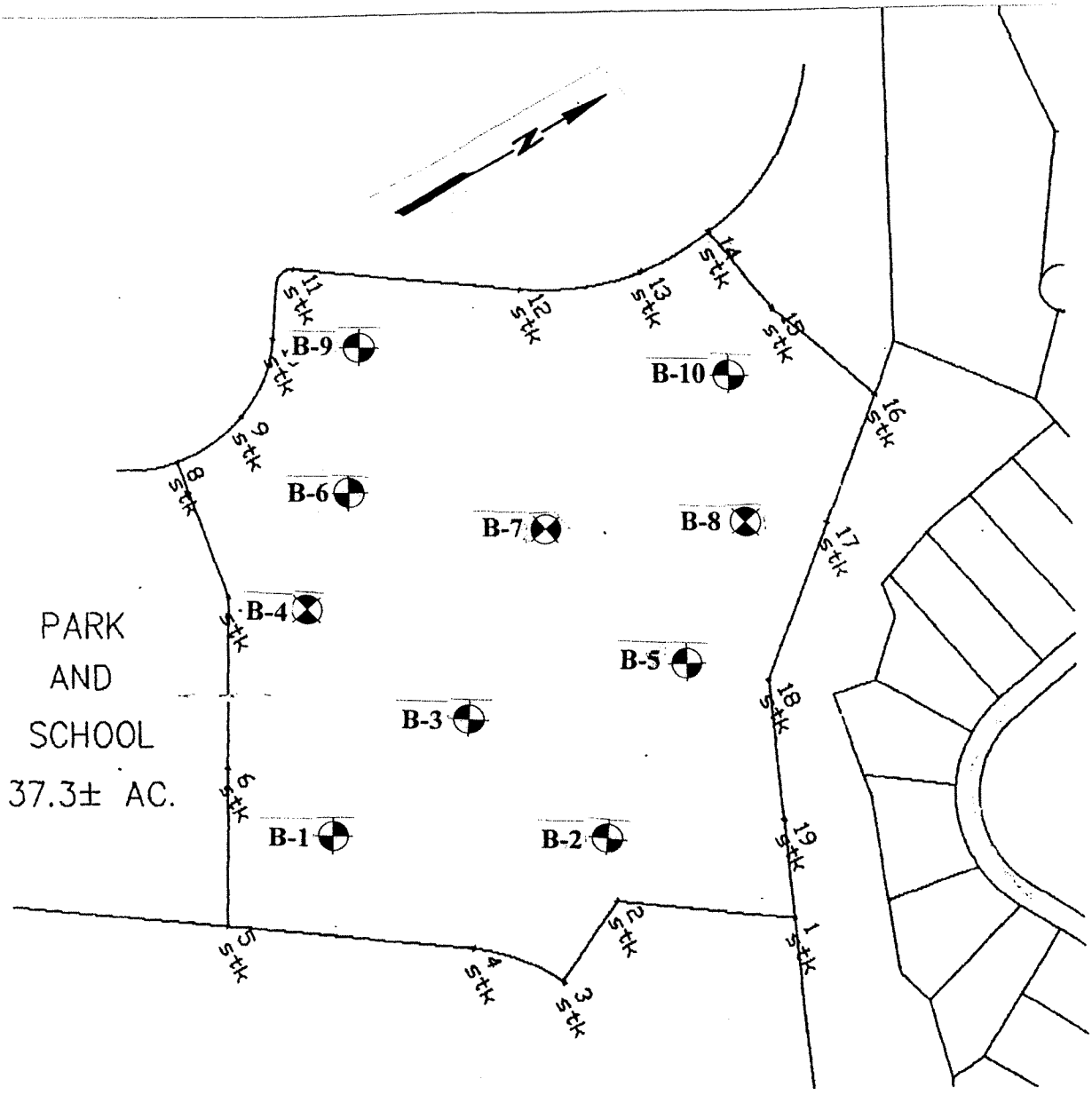
LOCATION MAP OF PROPOSED BORROW AREA

PSC CONSULTANTS, LLC
SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

Keokea-Waiohuli Development
Proposed DHHL Agricultural Subdivision Road Network
Kula, Makawao, Maui, Hawaii

DATE: March 2005 | PROJECT NO. 24304.10

PLATE NO. 2-A



LEGEND:

Approximate Boring/Test Pit Location

APPROXIMATE SCALE

0 125 250 500

Reference: Site Plan of Borrow Site (ACE LAND SURVEYING. Dated 07/28/04)

SITE PLAN OF PROPOSED BORROW AREA

PSC CONSULTANTS, LLC
SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

Keokea-Waiohuli Development
Proposed DHHL Agricultural Subdivision Road Network
Kula, Makawao, Maui, Hawaii

DATE: March 2005 | PROJECT NO. 24304.10

PLATE NO. 2-B

BORING LOCATION: See Site Plan	DRILLER: PSC	**BORING NO. TP-1**
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 6/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
MDD=88 pcf						BS-1	0			**Gravelly SILT/Silty GRAVEL**, dark brown, medium stiff to stiff, with sub-angular tuffaceous cobbles and boulders, traces of sand, clay, and rootlets. Moist.
							1			
		19.7					2		MH GM	
							3			
							4			
							5			**BASALT**, dark gray, moderately weathered to fresh, strong
							6			Test pit terminated at about 5.5 ft. Groundwater was not encountered

SAMPLE TYPE

MC - Modified California SPT - Standard Penetration
CB - Core Barrel SH - Shelby Tube
AUG - Auger Cuttings D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density UC - Unconfined Compression
CON - Consolidation Test SG - Specific Gravity
PI - Atterberg Limits SA - Sieve Analysis

LOG OF BORING

PSC *Geotechnical & Environmental Consultants Construction Management, Testing & Inspection*

Keokea/Waiohuli Development
Kula, Makawao, Maui, Hawaii

DATE: March 2005 PROJECT NO.: 24304.10

BORING KEOKEA.GPJ BORING.GDT 9/7/04

PLATE NO. 3

BORING LOCATION: See Site Plan	DRILLER: PSC	**BORING NO. TP-2**
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 6/04	TYPE RIG: Backhoe excavator	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-2	0			**Silty GRAVEL**, gray tuffaceous subangular gravel, cobbles and boulders in a brown, moist, silt (volcanic ash) matrix with traces of rootlets.
							1			
							2			
							3			
							4		GM	
							5			
							6			
							7			
							8			**BASALT**, gray, moderately weathered to fresh, vessicated, strong
							9			Test pit terminated at about 8.0 ft. Groundwater was not encountered

SAMPLE TYPE

MC - Modified California
SPT - Standard Penetration
CB - Core Barrel
SH - Shelby Tube
AUG - Auger Cuttings
D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density
UC - Unconfined Compression
CON - Consolidation Test
SG - Specific Gravity
PI - Atterberg Limits
SA - Sieve Analysis

LOG OF BORING

PSC *Geotechnical & Environmental Consultants Construction Management, Testing & Inspection*

Keokea/Waiohuli Development
Kula, Makawao, Maui, Hawaii

DATE: March 2005

PROJECT NO.: 24304.10

PLATE NO. 4

BORING KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	**BORING NO. TP-3**
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-3	0			**Gravelly SILT**, with sub-angular basaltic cobbles and boulders, trace clay and rootlets, dark brown, moist
		43.9					1			
							2			
							3			
							4		MH	
							5			
							6			
							7			
							8			**BASALT**, dark gray, moderately weathered, strong
							9			Test pit terminated at about 9 ft. Groundwater was not encountered
							10			

SAMPLE TYPE

MC - Modified California
SPT - Standard Penetration
CB - Core Barrel
SH - Shelby Tube
AUG - Auger Cuttings
D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density
CON - Consolidation Test
PI - Atterberg Limits
UC - Unconfined Compression
SG - Specific Gravity
SA - Sieve Analysis

LOG OF BORING

Geotechnical & Environmental Consultants
Construction Management, Testing & Inspection

Keokea/Waiohuli Development
Kula, Makawao, Maui, Hawaii

DATE: March 2005

PROJECT NO.: 24304.10

PLATE NO. 5

BORING KEOKEA.GPJ BORING.GDT 11/2/04

BORING LOCATION: See Site Plan	DRILLER: PSC	**BORING NO. TP-4**
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 6/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
PI=12						BS-4	1			**SILT** with angular basalt cobbles and boulders, dark brown, moist
CBR=0.80										
		35.5					2		MH	
							3			
							4			**BASALT**, dark gray, very hard, massive, strong
							5			
							6			Test pit terminated at about 5.5 ft. Groundwater was not encountered

SAMPLE TYPE

MC - Modified California
SPT - Standard Penetration
CB - Core Barrel
SH - Shelby Tube
AUG - Auger Cuttings
D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density
CON - Consolidation Test
PI - Atterberg Limits
UC - Unconfined Compression
SG - Specific Gravity
SA - Sieve Analysis

LOG OF BORING

PSC *Geotechnical & Environmental Consultants Construction Management, Testing & Inspection*

Keokea/Waiohuli Development
Kula, Makawao, Maui, Hawaii

DATE: March 2005

PROJECT NO.: 24304.10

BORING KEOKEA.GPJ BORING.GDT 9/7/04

PLATE NO. 6

BORING LOCATION: See Site Plan	DRILLER: PSC	**BORING NO. TP-5**
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-5	0			**SILT**with tuffaceous gravel, cobbles and boulders, trace clay and rootlets, brown, moist
							1			
							2		MH	
							3			
							4			
							5			**BASALT**, gray, moderately weathered to fresh, strong
							6			Test pit excavation terminated at about 5.5 ft. Groundwater was not encountered
							7			

SAMPLE TYPE

MC - Modified California SPT - Standard Penetration
CB - Core Barrel SH - Shelby Tube
AUG - Auger Cuttings D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density UC - Unconfined Compression
CON - Consolidation Test SG - Specific Gravity
PI - Atterberg Limits SA - Sieve Analysis

LOG OF BORING

PSC *Geotechnical & Environmental Consultants Construction Management, Testing & Inspection*

Keokea/Waiohuli Development
Kula, Makawao, Maui, Hawaii

DATE: March 2005 PROJECT NO.: 24304.10

PLATE NO. 7

BORING KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	**BORING NO. TP-6**
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-6				**Gravelly SILT/Silty GRAVEL** with basaltic cobbles and boulders, trace of clay and rootlets, brown, moist
		32.5					1		GM MH	
							2			**BASALT**, gray, fresh to moderately weathered, vessicated, strong
										Test pit terminated at about 2.5 ft. Groundwater was not encountered
							3			

SAMPLE TYPE

MC - Modified California SPT - Standard Penetration
CB - Core Barrel SH - Shelby Tube
AUG - Auger Cuttings D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density UC - Unconfined Compression
CON - Consolidation Test SG - Specific Gravity
PI - Atterberg Limits SA - Sieve Analysis

LOG OF BORING

PSC *Geotechnical & Environmental Consultants Construction Management, Testing & Inspection*

Keokea/Waiohuli Development
Kula, Makawao, Maui, Hawaii

DATE: March 2005 PROJECT NO.: 24304.10

BORING KEOKEA.GPJ BORING.GDT 9/7/04

PLATE NO. 8

BORING LOCATION: See Site Plan	DRILLER: PSC	**BORING NO. TP-7**
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-7	0			**Silty GRAVEL**, gray subangular basaltic gravel with cobbles and boulders with silt matrix, trace rootlets, brown, moist
							1			
							2		GM	
							3			
							4			**BASALT**, dark gray, moderately weathered, strong
							5			Test pit terminated at about 4 ft. Groundwater was not encountered
							6			

SAMPLE TYPE

MC - Modified California SPT - Standard Penetration
CB - Core Barrel SH - Shelby Tube
AUG - Auger Cuttings D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density UC - Unconfined Compression
CON - Consolidation Test SG - Specific Gravity
PI - Atterberg Limits SA - Sieve Analysis

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PLATE NO. 9

BORING KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	**BORING NO. TP-8**
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-8	0			**Silty GRAVEL**, gray, subangular basaltic gravel, cobbles, and boulders with silt matrix, trace rootlets, brown, moist
							1			
							2		GM	
							3			
							4			**BASALT**, gray, moderately weathered, strong
							5			
							6			Test pit terminated at about 5.5 ft. Groundwater was not encountered.

SAMPLE TYPE

MC - Modified California
SPT - Standard Penetration
CB - Core Barrel
SH - Shelby Tube
AUG - Auger Cuttings
D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density
UC - Unconfined Compression
CON - Consolidation Test
SG - Specific Gravity
PI - Atterberg Limits
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BORING KEOKEA.GPJ BORING.GDT 9/7/04

PLATE NO. 10

BORING LOCATION: See Site Plan	DRILLER: PSC	**BORING NO. TP-9**
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-9	0			**Silty GRAVEL**vessicated, subangular, tuffaceous gravels, cobbles and boulders with silt matrix, trace rootlets, dark gray to black, moist
							1		GM	
							2			
							3			**BASALT**, dark gray, moderately weathered, strong.
							4			Test pit terminated at about 3.75 ft. Groundwater was not encountered
							5			

SAMPLE TYPE

MC - Modified California
SPT - Standard Penetration
CB - Core Barrel
SH - Shelby Tube
AUG - Auger Cuttings
D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density
UC - Unconfined Compression
CON - Consolidation Test
SG - Specific Gravity
PI - Atterberg Limits
SA - Sieve Analysis

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PLATE NO. 11

BORING KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	**BORING NO. TP-10**
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-10				**Silty GRAVEL**, gray, tuffaceous, subangular gravels, cobbles and boulders in a brown, moist, silt matrix with trace rootlets.
							1		GM	
		49.2					2			
										BASALT, gray, moderately weathered to fresh, strong.
							3			Test pit terminated at about 2.5 ft. Groundwater was not encountered.
							4			

SAMPLE TYPE

MC - Modified California
SPT - Standard Penetration
CB - Core Barrel
SH - Shelby Tube
AUG - Auger Cuttings
D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density
UC - Unconfined Compression
CON - Consolidation Test
SG - Specific Gravity
PI - Atterberg Limits
SA - Sieve Analysis

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PLATE NO. 12

BORING KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	**BORING NO. TP-11**
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-11			GM	**Silty GRAVEL**, gray, subangular, vessicated basaltic gravels, cobbles and boulders in a brown, medium stiff, moist silt matrix with trace rootlets.
							1			**BASALT**, dark gray, moderately weathered, strong
										Test pit terminated at about 1.75 ft. Groundwater was not encountered.
							2			

SAMPLE TYPE

MC - Modified California
SPT - Standard Penetration
CB - Core Barrel
SH - Shelby Tube
AUG - Auger Cuttings
D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density
UC - Unconfined Compression
CON - Consolidation Test
SG - Specific Gravity
PI - Atterberg Limits
SA - Sieve Analysis

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PLATE NO. 13

BORING KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	**BORING NO. TP-12**
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
		30.9				BS-12	0		GM	**Silty GRAVEL**, dark gray, moderately weathered, dense, subangular, vessicated, tuffaceous gravels, cobbles and boulders, in a brown, fine grained, medium stiff, moist, silt (volcanic ash) matrix. Trace rootlets.
							1			**BASALT**, dark gray basaltic rock, slightly to moderately weathered, vessicated, strong.
							2			
							3			*Test pit terminated at about 2.5 ft.* Groundwater was not encountered

SAMPLE TYPE

MC - Modified California
SPT - Standard Penetration
CB - Core Barrel
SH - Shelby Tube
AUG - Auger Cuttings
D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density
UC - Unconfined Compression
CON - Consolidation Test
SG - Specific Gravity
PI - Atterberg Limits
SA - Sieve Analysis

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PLATE NO. 14

BORING KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	**BORING NO. TP-13**
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-13	0			**Silty GRAVEL**, gray, subangular, vessicated, medium dense to dense, basaltic gravels, cobbles and boulders in a brown, medium stiff, moist silt (volcanic ash) matrix with trace rootlets.
							1			
							2		GM	
							3			
							4			**BASALT**, gray, moderately weathered to fresh, strong, basaltic rock
							5			Test pit terminated at about 5.0 ft. Groundwater was not encountered.
							6			

SAMPLE TYPE

MC - Modified California
SPT - Standard Penetration
CB - Core Barrel
SH - Shelby Tube
AUG - Auger Cuttings
D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density
CON - Consolidation Test
PI - Atterberg Limits
UC - Unconfined Compression
SG - Specific Gravity
SA - Sieve Analysis

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PLATE NO. 15

BORING KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	**BORING NO. TP-14**
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-14	0			**Silty GRAVEL**, dark gray, subangular, vessicated, dense, basaltic gravels, cobbles and boulders in a brown to dark brown, medium stiff, fine grained, moist silt (volcanic ash) matrix with trace rootlets. T
							1			
		30.5					2		GM	
							3			
							4			**BASALT**dark gray basaltic rock, moderately weathered, strong
							5			Test pit terminated at about 5 ft. Groundwater was not encountered
							6			

SAMPLE TYPE

MC - Modified California
SPT - Standard Penetration
CB - Core Barrel
SH - Shelby Tube
AUG - Auger Cuttings
D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density
UC - Unconfined Compression
CON - Consolidation Test
SG - Specific Gravity
PI - Atterberg Limits
SA - Sieve Analysis

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BORING KEOKEA.GPJ BORING.GDT 9/7/04

PLATE NO. 16

BORING LOCATION: See Site Plan	DRILLER: PSC	**BORING NO. TP-15**
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 6/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-15	0			**Silty GRAVEL**, gray, subangular, dense, basaltic gravels, cobbles and boulders in a brown, medium stiff, moist silt matrix with trace rootlets.
		44.7					2		GM	
							5			**BOULDERS**, gray, subangular, lava boulders, moderately weathered, dense, strong
							8			**BASALT** gray, slightly to moderately weathered, strong, massive.
							8.5			Test pit terminated at about 8.5 ft. Groundwater was not encountered.

SAMPLE TYPE

MC - Modified California
SPT - Standard Penetration
CB - Core Barrel
SH - Shelby Tube
AUG - Auger Cuttings
D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density
CON - Consolidation Test
PI - Atterberg Limits
UC - Unconfined Compression
SG - Specific Gravity
SA - Sieve Analysis

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PLATE NO. 17

BORING KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	**BORING NO. TP-16**
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 6/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-16				**Gravelly SILT**,brown, medium stiff, moist, with gray, subangular, tuffaceous gravels, cobbles and boulders. With trace rootlets.
							1			
		41.5					2		MH	
							3			
							4			
							5			**BASALT**, gray basaltic rock, moderately weathered, strong, massive
							6			Boring terminated at about 5.5 ft. Groundwater was not encountered

SAMPLE TYPE

MC - Modified California SPT - Standard Penetration
CB - Core Barrel SH - Shelby Tube
AUG - Auger Cuttings D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density UC - Unconfined Compression
CON - Consolidation Test SG - Specific Gravity
PI - Atterberg Limits SA - Sieve Analysis

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BORING KEOKEA.GPJ BORING.GDT 9/7/04

PLATE NO. 18

BORING LOCATION: See Site Plan	DRILLER: PSC	**BORING NO. TP-17**
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 6/04	TYPE RIG: Backhoe Excavator	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-17	0			**Gravelly SILT**, brown, medium stiff, moist, with loose clinker, cobbles and boulders.
							1			
		26.7					2		MH	
							3			
							4			**BASALT**, gray, moderately weathered, strong
										Test pit terminated at about 4.5 ft. Groundwater was not encountered
							5			
							6			

SAMPLE TYPE

MC - Modified California
SPT - Standard Penetration
CB - Core Barrel
SH - Shelby Tube
AUG - Auger Cuttings
D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density
CON - Consolidation Test
PI - Atterberg Limits
UC - Unconfined Compression
SG - Specific Gravity
SA - Sieve Analysis

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PLATE NO. 19

BORING KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	**BORING NO. TP-18**
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 6/04	TYPE RIG: Backhoe Excavator	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-18	0			**Gravelly SILT**, dark brown, medium stiff, moist (volcanic ash), with lava cobbles and boulders, trace rootlets.
PI=7.5							1			
CBR=0.35										
		28.8					2			
									MH	
							3			
							4			
							5			
										BASALT, gray, moderately weathered, strong
							6			Test pit terminated at about 6.0 ft. Groundwater was not encountered
							7			
							8			

SAMPLE TYPE

MC - Modified California
SPT - Standard Penetration
CB - Core Barrel
SH - Shelby Tube
AUG - Auger Cuttings
D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density
UC - Unconfined Compression
CON - Consolidation Test
SG - Specific Gravity
PI - Atterberg Limits
SA - Sieve Analysis

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PLATE NO. 20

BORING KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	**BORING NO. TP-19**
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 6/04	TYPE RIG:	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-19	0			**Gravelly SILT**, brown, medium stiff, with basalt cobbles, and boulders, trace clay and rootlets, moist (volcanic ash).
		24.8					2		MH	
							5			**BASALT**, gray, moderately weathered, strong
							7			Test pit terminated at about 7.0 ft Groundwater was not encountered

SAMPLE TYPE

MC - Modified California
SPT - Standard Penetration
CB - Core Barrel
SH - Shelby Tube
AUG - Auger Cuttings
D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density
CON - Consolidation Test
PI - Atterberg Limits
UC - Unconfined Compression
SG - Specific Gravity
SA - Sieve Analysis

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PLATE NO. 21

BORING KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	
BORING ELEVATION:	LOGGED BY: JGN	**BORING NO. TP-20**
DATE (S) DRILLED: 6/04	TYPE RIG: Backhoe Excavator	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
MDD=83.25		0.3				BS-20	0			**Silty GRAVEL**,gray, basaltic gravels, cobbles, and boulders in a brown, medium stiff, moist silt matrix with trace rootlets.
		22.0					1		GM	
							2			
							3			
							4			
							5			**BASALT**, gray, moderately weathered, fractured, vessicated strong.
							6			Test pit terminated at about 5.5 ft. Groundwater was not encountered.

SAMPLE TYPE

MC - Modified California SPT - Standard Penetration
CB - Core Barrel SH - Shelby Tube
AUG - Auger Cuttings D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density UC - Unconfined Compression
CON - Consolidation Test SG - Specific Gravity
PI - Atterberg Limits SA - Sieve Analysis

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BORING KEOKEA.GPJ BORING.GDT 9/7/04

PLATE NO. 22

BORING LOCATION: See Site Plan	DRILLER: PSC	**BORING NO. TP-21**
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 6/04	TYPE RIG: Backhoe Excavator	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-21	0			**SILT**, brown, medium stiff, with some gray, subangular basaltic gravels and cobbles, traces of clay and rootlets. Moist (volcanic ash).
		49.7					2		MH	
							5			**BASALT**, gray, fractured, slightly to moderately weathered, strong
							5.25			Test pit terminated at about 5.25 ft. Groundwater was not encountered
							7			

SAMPLE TYPE

MC - Modified California
SPT - Standard Penetration
CB - Core Barrel
SH - Shelby Tube
AUG - Auger Cuttings
D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density
UC - Unconfined Compression
CON - Consolidation Test
SG - Specific Gravity
PI - Atterberg Limits
SA - Sieve Analysis

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PLATE NO. 23

BORING KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	**BORING NO. TP-22**
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 6/04	TYPE RIG: Backhoe Excavator	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-22	1			**Gravelly SILT**, brown, medium stiff, with basalt boulders, traces of clay and rootlets, moist (volcanic ash).
							2			
							3			
							4			**BASALT**, moderately weathered, fractured, strong
							5			Test pit terminated at about 5 ft. Groundwater was not encountered.
							6			

SAMPLE TYPE

MC - Modified California
SPT - Standard Penetration
CB - Core Barrel
SH - Shelby Tube
AUG - Auger Cuttings
D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density
CON - Consolidation Test
PI - Atterberg Limits
UC - Unconfined Compression
SG - Specific Gravity
SA - Sieve Analysis

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BORING KEOKEA.GPJ BORING.GDT 9/7/04

PLATE NO. 24

BORING LOCATION: See Site Plan	DRILLER: PSC	**BORING NO. TP-23**
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 6/04	TYPE RIG: Backhoe Excavator	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
		39.4				BS-23	0		GW GM	**BASALT**, boulders with silt matrix, traces of clay and rootlets, brown, moist
							1			**BASALT** gray, slightly to moderately weathered, fractured with vessicles, stong
							2			
							3			Test pit terminated at about 2.75 ft. Groundwater was not encountered.

SAMPLE TYPE

MC - Modified California SPT - Standard Penetration
CB - Core Barrel SH - Shelby Tube
AUG - Auger Cuttings D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density UC - Unconfined Compression
CON - Consolidation Test SG - Specific Gravity
PI - Atterberg Limits SA - Sieve Analysis

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PLATE NO. 25

BORING KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	**BORING NO. TP-24**
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 6/04	TYPE RIG: Backhoe Excavator	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-24				**Silty GRAVEL** basaltic gravels, cobbles, and boulders with silt matrix, trace rootlets, brown, moist
		33.1					1		GW GM	
										BASALT gray, slightly to moderately weathered, strong,fractured
										Test pit terminated at about 1.75 ft. Groundwater was not encountered.
							2			

SAMPLE TYPE

MC - Modified California SPT - Standard Penetration
CB - Core Barrel SH - Shelby Tube
AUG - Auger Cuttings D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density UC - Unconfined Compression
CON - Consolidation Test SG - Specific Gravity
PI - Atterberg Limits SA - Sieve Analysis

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PLATE NO. 26

BORING KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	**BORING NO. TP-25**
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-25	0			**Silty GRAVEL**, gray tuffaceous gravel (clinker), cobbles and boulders with silt (volcanic ash), trace rootlets, brown, moist
									GW GM	
							1			**BASALT**, dark gray, slightly to moderately weathered, strong
										Test pit terminated at about 1.75 ft. Groundwater was not encountered
							2			
							3			

SAMPLE TYPE

MC - Modified California
SPT - Standard Penetration
CB - Core Barrel
SH - Shelby Tube
AUG - Auger Cuttings
D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density
CON - Consolidation Test
PI - Atterberg Limits
UC - Unconfined Compression
SG - Specific Gravity
SA - Sieve Analysis

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PLATE NO. 27

BORING KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	**BORING NO. TP-26**
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
		10.4				BS-26			GM	**Silty GRAVEL**, gray vitric tuff/lava gravels (clinker), cobbles and boulders with silt, trace rootlets, brown, moist
							1			**BASALT**dark gray, moderately weathered, strong to very strong
							2			Test pit terminated at about 1.75 ft. Groundwater was not encountered.

SAMPLE TYPE

MC - Modified California
SPT - Standard Penetration
CB - Core Barrel
SH - Shelby Tube
AUG - Auger Cuttings
D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density
UC - Unconfined Compression
CON - Consolidation Test
SG - Specific Gravity
PI - Atterberg Limits
SA - Sieve Analysis

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PLATE NO. 28

BORING KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	**BORING NO. TP-27**
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-27	0			**Silty GRAVEL**, gray, sub-angular vitric tuff/lava gravels cobbles and boulders with silt matrix, with trace clay and rootlets, brown, moist
									GM	
							1			**BASALT**, gray, moderaterly weathered to fresh, fractured, strong to very strong
							2			
										Test pit terminated at about 2.5 ft. Groundwater was not encountered.
							3			

SAMPLE TYPE

MC - Modified California
SPT - Standard Penetration
CB - Core Barrel
SH - Shelby Tube
AUG - Auger Cuttings
D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density
UC - Unconfined Compression
CON - Consolidation Test
SG - Specific Gravity
PI - Atterberg Limits
SA - Sieve Analysis

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BORING KEOKEA.GPJ BORING.GDT 9/7/04

PLATE NO. 29

BORING LOCATION: See Site Plan	DRILLER: PSC	**BORING NO. TP-28**
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 6/04	TYPE RIG: Backhoe Excavator	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-28				**SILT**, brown, medium stiff, moist with traces of gravel and rootlets.
PI=2							1		MH	
CBR=1.9										
		27.9					2			**Gravelly SILT** with basaltic cobbles and boulders, traces of clay and rootlets, dark brown, moist
							3		MH	
							4			
							5			**BASALT**,dark gray, fresh to moderately weathered, strong, fractured
							6			Test pit terminated at about 5.25 ft. Groundwater was not encountered.

SAMPLE TYPE

MC - Modified California
SPT - Standard Penetration
CB - Core Barrel
SH - Shelby Tube
AUG - Auger Cuttings
D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density
CON - Consolidation Test
PI - Atterberg Limits
UC - Unconfined Compression
SG - Specific Gravity
SA - Sieve Analysis

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BORING KEOKEA.GPJ BORING.GDT 9/7/04

PLATE NO. 30

BORING LOCATION: See Site Plan	DRILLER: PSC	**BORING NO. TP-29**
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-29	0			**Silty GRAVEL**, gray tuffaceous gravels, cobbles and boulders with a clayey silt matrix, trace rootlets, brown, moist
							1		GW GM	
							2			**BASALT** dark gray, slightly to moderately weathered, strong to very strong.
							3			Test pit terminated at about 3.5 ft. Groundwater was not encountered
							4			

SAMPLE TYPE

MC - Modified California
SPT - Standard Penetration
CB - Core Barrel
SH - Shelby Tube
AUG - Auger Cuttings
D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density
CON - Consolidation Test
PI - Atterberg Limits
UC - Unconfined Compression
SG - Specific Gravity
SA - Sieve Analysis

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BORING KEOKEA.GPJ BORING.GDT 9/7/04

PLATE NO. 31

BORING LOCATION: See Site Plan	DRILLER: PSC	**BORING NO. TP-30**
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 6/24/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-30			GW GM	**Silty GRAVEL**, gray sub-angular to angular tuffaceous gravels, cobbles and boulders, with clayey silt matrix with trace rootlets, brown, moist
							1			**BASALT**, dark gray, moderately weathered, strong
										Test pit terminated at about 1.75 ft. Groundwater was not encountered.
							2			

SAMPLE TYPE

MC - Modified California
SPT - Standard Penetration
CB - Core Barrel
SH - Shelby Tube
AUG - Auger Cuttings
D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density
UC - Unconfined Compression
CON - Consolidation Test
SG - Specific Gravity
PI - Atterberg Limits
SA - Sieve Analysis

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BORING KEOKEA.GPJ BORING.GDT 9/7/04

PLATE NO. 32

BORING LOCATION: See Site Plan	DRILLER: PSC	**BORING NO. TP-31**
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 6/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-31	0			**Basaltic BOULDERS**, gray, moderately weathered, vessicated,with silt (volcanic ash) matrix, brown, moist
							1			**BASALT**, gray, moderately weathered to fresh, strong
		28.2					2			Test pit terminated at about 1.75 ft. Groundwater was not encountered.
							3			

SAMPLE TYPE

MC - Modified California SPT - Standard Penetration
CB - Core Barrel SH - Shelby Tube
AUG - Auger Cuttings D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density UC - Unconfined Compression
CON - Consolidation Test SG - Specific Gravity
PI - Atterberg Limits SA - Sieve Analysis

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BORING KEOKEA.GPJ BORING.GDT 9/7/04

PLATE NO. 33

BORING LOCATION: See Site Plan	DRILLER: PSC	**BORING NO. TP-32**
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 6/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-32	0			**Silty GRAVEL**, gray, subangular basaltic gravels, cobbles, and boulders with silt matrix, trace rootlets, brown, moist
							1			
							2		GW GM	
							3			
							4			
							5			**BASALT**, dark gray, moderately weathered to fresh, strong
							6			Test pit terminated at about 5 ft. Groundwater was not encountered.

SAMPLE TYPE

MC - Modified California
SPT - Standard Penetration
CB - Core Barrel
SH - Shelby Tube
AUG - Auger Cuttings
D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density
CON - Consolidation Test
PI - Atterberg Limits
UC - Unconfined Compression
SG - Specific Gravity
SA - Sieve Analysis

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PLATE NO. 34

BORING KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	**BORING NO. TP-33**
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-33	0			**Silty GRAVEL**, gray tuffaceous gravels, cobbles and boulders with silt (volcanic ash) matrix, trace rootlets, brown, moist
							1		GM GW	
							2			**BASALT**, dark gray, moderately weathered to fresh, strong.
							3			Test pit terminated at about 3.0 ft. Groundwater was not encountered.
							4			

SAMPLE TYPE

MC - Modified California SPT - Standard Penetration
CB - Core Barrel SH - Shelby Tube
AUG - Auger Cuttings D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density UC - Unconfined Compression
CON - Consolidation Test SG - Specific Gravity
PI - Atterberg Limits SA - Sieve Analysis

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PLATE NO. 35

BORING KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	**BORING NO. TP-34**
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-34	0			**SILT**, with basalt boulders, traces of clay and rootlets, brown, moist (volcanic ash)
							1			
							2			grades with more basaltic boulders
							3			
							4			**BASALT**, dark gray, moderately weathered to fresh, strong
							5			Test pit excavation terminated at about 5.0 ft. Groundwater was not encountered.
							6			

SAMPLE TYPE

MC - Modified California SPT - Standard Penetration
CB - Core Barrel SH - Shelby Tube
AUG - Auger Cuttings D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density UC - Unconfined Compression
CON - Consolidation Test SG - Specific Gravity
PI - Atterberg Limits SA - Sieve Analysis

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BORING KEOKEA.GPJ BORING.GDT 9/7/04

PLATE NO. 36

BORING LOCATION: See Site Plan	DRILLER: PSC	**BORING NO. TP-35**
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/2/04	TYPE RIG:	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-35	0			**Silty GRAVEL**, gray tuffaceous gravels, cobbles and boulders with silt matrix, trace rootlets, brown, moist
							1		GM	
							2			
							3			**BASALT**, dark gray, slightly to moderately weathered, strong.
										Test pit terminated at about 3.5 Groundwater was not encountered
							4			

SAMPLE TYPE

MC - Modified California
SPT - Standard Penetration
CB - Core Barrel
SH - Shelby Tube
AUG - Auger Cuttings
D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density
CON - Consolidation Test
PI - Atterberg Limits
UC - Unconfined Compression
SG - Specific Gravity
SA - Sieve Analysis

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PLATE NO. 37

BORING KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	**BORING NO. TP-36**
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-36				**SILT**, with some basaltic gravel and cobbles, trace of clay and rootlets, brown to dark brown, moist
							1			
		38.1					2		MH	
							3			
							4			**BASALT**, dark gray, with coarse sand to pea-sized vesicles, slightly to moderately weathered, strong
							5			
							6			Test pit terminated at about 5.25 ft. Groundwater was not encountered

SAMPLE TYPE

MC - Modified California SPT - Standard Penetration
CB - Core Barrel SH - Shelby Tube
AUG - Auger Cuttings D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density UC - Unconfined Compression
CON - Consolidation Test SG - Specific Gravity
PI - Atterberg Limits SA - Sieve Analysis

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BORING KEOKEA.GPJ BORING.GDT 9/7/04

PLATE NO. 38

BORING LOCATION: See Site Plan	DRILLER: PSC	**BORING NO. TP-37**
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-37	0			**SILT** with some lava cobbles and boulders, trace of clay and rootlets, brown, moist
							1		MH	
							2			
							3			**Silty GRAVEL**, gray lava gravels, cobbles, and boulders with silt matrix, trace rootlets, brown, moist
							4			
							5		GM	
							6			
							7			
							8			**BASALT**, dark gray, moderately weathered, vessicated, strong
							9			Test pit excavation terminated at about 8.0 ft. Groundwater was not encountered.
							10			

SAMPLE TYPE

MC - Modified California
SPT - Standard Penetration
CB - Core Barrel
SH - Shelby Tube
AUG - Auger Cuttings
D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density
CON - Consolidation Test
PI - Atterberg Limits
UC - Unconfined Compression
SG - Specific Gravity
SA - Sieve Analysis

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PLATE NO. 39

BORING KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	**BORING NO. TP-38**
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-38	0			**SILT** with traces of gravel and rootlets, brown, moist (volcanic ash).
							1		MH	
							2			
							3			**Gravelly SILT** with some basaltic cobbles, brown, moist
							4		MH	
							5			**BASALT**, gray to dark gray, moderately weathered, strong
							6			Test pit terminated at about 6.25 ft. Groundwater was not encountered
							7			

SAMPLE TYPE

MC - Modified California
SPT - Standard Penetration
CB - Core Barrel
SH - Shelby Tube
AUG - Auger Cuttings
D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density
CON - Consolidation Test
PI - Atterberg Limits
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PLATE NO. 40

BORING KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	**BORING NO. TP-39**
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/2/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-39	0			**Silty GRAVEL**, gray lava gravels, cobbles and boulders with silt matrix, trace rootlets, brown, moist
							1			
							2		GM	
							3			
							4			
							5			**BASALT**, dark gray, slightly to moderately weathered, strong to very strong
							6			Test pit terminated at about 5.5 ft. Groundwater was not encountered

SAMPLE TYPE

MC - Modified California
SPT - Standard Penetration
CB - Core Barrel
SH - Shelby Tube
AUG - Auger Cuttings
D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density
CON - Consolidation Test
PI - Atterberg Limits
UC - Unconfined Compression
SG - Specific Gravity
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PLATE NO. 41

BORING KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	**BORING NO. TP-40**
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-40	0			**SILT** with some basaltic gravel and cobbles, trace of clay and rootlets, brown to dark brown moist. (volcanic ash)
							1		MH	
							2			
							3			**Gravelly SILT** with basaltic gravels, cobbles and boulders, brown, moist
							4		MH	
							5			**BASALT**, dark gray, slightly to moderately weathered, strong, elongated pea to course sand-sized vesicles
							6			Test pit terminated at about 5.5 ft. Groundwater was not encountered

SAMPLE TYPE

MC - Modified California
SPT - Standard Penetration
CB - Core Barrel
SH - Shelby Tube
AUG - Auger Cuttings
D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density
CON - Consolidation Test
PI - Atterberg Limits
UC - Unconfined Compression
SG - Specific Gravity
SA - Sieve Analysis

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PLATE NO. 42

BORING KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	**BORING NO. TP-41**
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-41				**SILT** with vesicated basaltic boulders and cobbles, trace of clay and rootlets, brown to dark brown, moist (volcanic ash)
MDD=84.5 pcf		0.3					1			
OMC=36%										
		30.1					2			
									MH	
							3			
							4			
							5			**BASALT**, dark gray, moderately weathered, strong.
										Test pit terminated at about 5.5 ft. Groundwater was not encountered.
							6			

SAMPLE TYPE

MC - Modified California
SPT - Standard Penetration
CB - Core Barrel
SH - Shelby Tube
AUG - Auger Cuttings
D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density
UC - Unconfined Compression
CON - Consolidation Test
SG - Specific Gravity
PI - Atterberg Limits
SA - Sieve Analysis

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BORING KEOKEA.GPJ BORING.GDT 9/7/04

PLATE NO. 43

BORING LOCATION: See Site Plan	DRILLER: PSC	**BORING NO. TP-42**
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-42	0			**Gravelly Silt** with basaltic gravels, cobbles and boulders, trace of clay and rootlets, dark brown to brown, moist (volcanic ash)
							1			
							2			
							3			
							4			**BASALT**, dark gray, slightly to moderately weathered, strong
							5			Test pit terminated at about 4.75 ft. Groundwater was not encountered.
							6			

SAMPLE TYPE

MC - Modified California
SPT - Standard Penetration
CB - Core Barrel
SH - Shelby Tube
AUG - Auger Cuttings
D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density
CON - Consolidation Test
PI - Atterberg Limits
UC - Unconfined Compression
SG - Specific Gravity
SA - Sieve Analysis

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PLATE NO. 44

BORING KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	**BORING NO. TP-43**
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-43	0			**SILT** with basaltic gravel, cobbles and boulders, brown, moist
		37.9					1			
							2			
							3		MH	
							4			
							5			
							6			
							7			**BASALT**, dark gray, moderately weathered, strong
							8			
							9			Test pit terminated at about 8 ft. Groundwater was not encountered
							10			

SAMPLE TYPE

MC - Modified California
SPT - Standard Penetration
CB - Core Barrel
SH - Shelby Tube
AUG - Auger Cuttings
D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density
UC - Unconfined Compression
CON - Consolidation Test
SG - Specific Gravity
PI - Atterberg Limits
SA - Sieve Analysis

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BORING KEOKEA.GPJ BORING.GDT 11/2/04

PLATE NO. 45

BORING LOCATION: See Site Plan	DRILLER: PSC	**BORING NO. TP-44**
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-44	0			**SILT** with traces of gravel, brown to dark brown, moist (volcanic ash)
		37.7					1			
							2			
							3			
							4		MH	
							5			
							6			
							7			
							8			Test pit terminated at about 8 feet Groundwater was not encountered
							9			
							10			

SAMPLE TYPE

MC - Modified California
SPT - Standard Penetration
CB - Core Barrel
SH - Shelby Tube
AUG - Auger Cuttings
D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density
UC - Unconfined Compression
CON - Consolidation Test
SG - Specific Gravity
PI - Atterberg Limits
SA - Sieve Analysis

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PLATE NO. 46

BORING KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Suite Plan	DRILLER: PSC	**BORING NO. TP-45**
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/07	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-45	0			**Clayey SILT**with trace gravel, sand and rootlets, dark brown, moist
							1			
							2			
							3		MH	
							4			
							5			
							6			**Gravelly SILT** with angular to sub-angular basaltic boulders, trace of clay and rootlets, brown to dark brown, moist (volcanic ash)
							7		MH	
							8			**BASALT**, dark gray, moderately weathered, strong
							9			Test pit terminated at about 8.5 ft. Groundwater was not encountered
							10			

SAMPLE TYPE

MC - Modified California
SPT - Standard Penetration
CB - Core Barrel
SH - Shelby Tube
AUG - Auger Cuttings
D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density
UC - Unconfined Compression
CON - Consolidation Test
SG - Specific Gravity
PI - Atterberg Limits
SA - Sieve Analysis

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BORING KEOKEA.GPJ BORING.GDT 9/7/04

PLATE NO. 47

BORING LOCATION: See Site Plan	DRILLER: PSC	**BORING NO. TP-46**
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/07	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-46	0			**SILT** with some gravels, cobbles and boulders, trace rootlets, brown, moist
							1			
							2			
							3			
							4		MH	
							5			
							6			
							7			
							8			**BASALT**, dark gray, moderately weathered, strong
							9			Test pit terminated at about 8.0 ft. Groundwater was not encountered.

SAMPLE TYPE

MC - Modified California
SPT - Standard Penetration
CB - Core Barrel
SH - Shelby Tube
AUG - Auger Cuttings
D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density
UC - Unconfined Compression
CON - Consolidation Test
SG - Specific Gravity
PI - Atterberg Limits
SA - Sieve Analysis

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BORING KEOKEA.GPJ BORING.GDT 9/7/04

PLATE NO. 48

BORING LOCATION: See Site Plan	DRILLER: PSC	**BORING NO. TP-47**
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-47	0			**SILT** with sub-rounded to basaltic cobbles, trace rootlets and clay, amber brown, moist (volcanic ash)
		36.7					1			
							2			
							3		MH	
							4			
							5			
							6			**BASALT**, dark gray, slightly to moderately weathered, fractured, strong.
							7			Test pit excavation terminated at about 6.5 ft. Groundwater was not encountered
							8			

SAMPLE TYPE

MC - Modified California
SPT - Standard Penetration
CB - Core Barrel
SH - Shelby Tube
AUG - Auger Cuttings
D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density
CON - Consolidation Test
PI - Atterberg Limits
UC - Unconfined Compression
SG - Specific Gravity
SA - Sieve Analysis

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PLATE NO. 49

BORING KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	**BORING NO. TP-48**
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-48	0			**Gravelly SILT** with basaltic cobbles and boulders, trace of clay and rootlets, brown, moist (volcanic ash)
							1			
							2		MH	
							3			
							4			**BASALT**, Dark gray, moderately weathered to fresh, strong
							5			Test pit excavation terminated at about 5.5 ft. Groundwater was not encountered
							6			

SAMPLE TYPE

MC - Modified California SPT - Standard Penetration
CB - Core Barrel SH - Shelby Tube
AUG - Auger Cuttings D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density UC - Unconfined Compression
CON - Consolidation Test SG - Specific Gravity
PI - Atterberg Limits SA - Sieve Analysis

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PLATE NO. 50

BORING KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	**BORING NO. TP-49**
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-49	0			**Gravelly SILT**with sub-angular basaltic gravel and cobbles, trace of clay and rootlets, brown to dark brown, moist (volcanic ash)
							1			
							2		MH	
							3			
							4			**BASALT** gray, slightly to moderately weathered, strong
							5			Test pit excavation terminated at about 4.75 ft Groundwater was not encountered
							6			

SAMPLE TYPE

MC - Modified California SPT - Standard Penetration
CB - Core Barrel SH - Shelby Tube
AUG - Auger Cuttings D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density UC - Unconfined Compression
CON - Consolidation Test SG - Specific Gravity
PI - Atterberg Limits SA - Sieve Analysis

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PLATE NO. 51

BORING KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	**BORING NO. TP-50**
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-50	0			**SILT** with some cobbles and boulders, trace of clay and rootlets, brown, moist (volcanic ash)
							1		MH	
		37.4					2			
							3			**BASALT**, dark gray, slightly to moderately weathered, strong
							4			Test pit excavation terminated at about 3.75 ft. ~~Groundwater was not encountered.~~

SAMPLE TYPE

MC - Modified California
SPT - Standard Penetration
CB - Core Barrel
SH - Shelby Tube
AUG - Auger Cuttings
D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density
CON - Consolidation Test
PI - Atterberg Limits
UC - Unconfined Compression
SG - Specific Gravity
SA - Sieve Analysis

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PLATE NO. 52

BORING KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	**BORING NO. B-1**
BORING ELEVATION:	LOGGED BY: JAGN	
DATE (S) DRILLED: 7/26	TYPE RIG: Hoe Ram	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-B1	1–5		MH	**SILT**, brown, medium stiff, moist with some basaltic gravel, trace rootlets
							6–9			**BASALT**, blue-black, slightly weathered, very strong, massive
							10–14		GM	**GRAVEL**, gray vitric tuff gravels, cobbles and boulders intersticed with brown, moist, clayey silt.
							15–18			**BASALT**, gray, slightly weatered, very strong, massive
							19–20			Boring terminated at about 18 feet Groundwater was not encountered

SAMPLE TYPE

MC - Modified California
SPT - Standard Penetration
CB - Core Barrel
SH - Shelby Tube
AUG - Auger Cuttings
D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density
UC - Unconfined Compression
CON - Consolidation Test
SG - Specific Gravity
PI - Atterberg Limits
SA - Sieve Analysis

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PLATE NO. 53

BORING KEOBS.GPJ BORING.GDT 8/10/04

BORING LOCATION: See Site Plan	DRILLER: PSC	**BORING NO. B-2**
BORING ELEVATION:	LOGGED BY: JAGN	
DATE (S) DRILLED: 7/27	TYPE RIG: Hoe Ram	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-B2	1		MH	**SILT**, brown, medium stiff, moist with basaltic gravels, cobbles and boulders, trace rootlets
		31.2					2			
							3			**Basaltic BOULDERS**, bluish brown, slightly to moderately weathered, very strong
							4			
							5			
							6			
							7			
							8			
							9			*Cavity, (possibly lava tube)*
							10			
							11			
							12			
							13			**BASALT**, gray, slightly to moderately weathered, vessicated, strong
							14			
							15			
							16			
							17			Boring terminated at about 16.5 feet Groundwater was not encountered
							18			

SAMPLE TYPE

MC - Modified California
SPT - Standard Penetration
CB - Core Barrel
SH - Shelby Tube
AUG - Auger Cuttings
D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density
UC - Unconfined Compression
CON - Consolidation Test
SG - Specific Gravity
PI - Atterberg Limits
SA - Sieve Analysis

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PLATE NO. 54

BORING KEOBS.GPJ BORING.GDT 8/11/04

BORING LOCATION: See Site Plan	DRILLER: PSC	**BORING NO. B-3**
BORING ELEVATION:	LOGGED BY: JAGN	
DATE (S) DRILLED: 7/28	TYPE RIG: Hoe Ram	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
MDD=105 PCF		16.6				BS-B3	1–18		MH	**Clayey SILT** dark brown to gray, medium stiff to stiff with basaltic gravels, cobbles and boulders, trace sand, rootlets. Moist.
										Tuffaceous cobbles and boulders in a clayey silt matrix
										BASALT, bluish gray, slightly weathered, very strong
										Brown tuffaceous cobbles with clayey silt and some boulders
										Basalt Boulder,gray, slightly weathered, vessicated, strong
										Tuffaceous Cobbles and Gravels, brown, subangular basaltic, (clinker) gravel, dense to very dense
										Boring terminated at about 17 feet Groundwater was not encountered

SAMPLE TYPE

MC - Modified California
SPT - Standard Penetration
CB - Core Barrel
SH - Shelby Tube
AUG - Auger Cuttings
D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density
UC - Unconfined Compression
CON - Consolidation Test
SG - Specific Gravity
PI - Atterberg Limits
SA - Sieve Analysis

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PLATE NO. 55

BORING KEOBS.GPJ BORING.GDT 8/10/04

BORING LOCATION: See Site Plan	DRILLER: PSC	**BORING NO. B-4**
BORING ELEVATION:	LOGGED BY: JAGN	
DATE (S) DRILLED: 7/28	TYPE RIG: Hoe Ram	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-B4	1			**SILT**, brown, medium stiff, moist, with tuffaceous gravels and cobbles, trace rootlets. Moist
							2		MH	
							3			
							4			**BASALT**, bluish gray, fresh, massive, very strong
							5			
							6			
							7			
							8			
							9			
							10			
							11			Tuffaceous cobbles and boulders in a brown clayey silt matrix
							12			
							13			
							14			**BASALT**, gray, slightly to moderately weathered, vessicated, strong
							15			
							16			Boring terminated at about 16 feet Groundwater was not encountered
							17			
							18			

SAMPLE TYPE

MC - Modified California
SPT - Standard Penetration
CB - Core Barrel
SH - Shelby Tube
AUG - Auger Cuttings
D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density
UC - Unconfined Compression
CON - Consolidation Test
SG - Specific Gravity
PI - Atterberg Limits
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PLATE NO. 56

BORING KEOBS.GPJ BORING.GDT 8/11/04

BORING LOCATION: See Site Plan	DRILLER: PSC	**BORING NO. B-5**
BORING ELEVATION:	LOGGED BY: JAGN	
DATE (S) DRILLED: 7/29	TYPE RIG: Hoe Ram	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-B5	1			**Tuffaceous boulders, gravel and cobbles**, gray, vessicated, sub-angular, dense, conglomeratic rocks in a clayey silt matrix
							2			
							3			
							4			
							5			**BASALT**, gray, fresh to slightly weathered, very strong
							6			
							7			
							8			**Boulders & Cobbles**, vitric, tuffaceous rocks in a brown silty soil (volcanic ash) matrix
							9			
							10			
							11			**BASALT**, blue gray, fresh, very strong, massive
							12			
							13			
							14			
							15			
							16			Boring terminated at about 15.5 feet Groundwater was not encountered
							17			
							18			

SAMPLE TYPE

MC - Modified California
SPT - Standard Penetration
CB - Core Barrel
SH - Shelby Tube
AUG - Auger Cuttings
D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density
UC - Unconfined Compression
CON - Consolidation Test
SG - Specific Gravity
PI - Atterberg Limits
SA - Sieve Analysis

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PLATE NO. 57

BORING KEOBS.GPJ BORING.GDT 8/11/04

BORING LOCATION: See Site Plan	DRILLER: PSC	**BORING NO. B-6**
BORING ELEVATION:	LOGGED BY: JAGN	
DATE (S) DRILLED: 7/29	TYPE RIG: Hoe Ram	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
MDD=88.13 pcf						BS-B6	1–18		MH	**Gravelly SILT**, brown, medium stiff, moist with subangular tuffaceous gravels and boulders, trace rootlets.
										BASALT, bluish gray, slightly weathered, very strong
										Basaltic GRAVEL (clinker), dark gray, dense to very dense, dry
										BASALT, gray, slightly to moderately weathered, strong
										Basaltic GRAVEL (clinker), dark gray, subangular, dense to very dense
										Boring terminated at about 16 feet Groundwater was not encountered

SAMPLE TYPE

MC - Modified California
SPT - Standard Penetration
CB - Core Barrel
SH - Shelby Tube
AUG - Auger Cuttings
D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density
UC - Unconfined Compression
CON - Consolidation Test
SG - Specific Gravity
PI - Atterberg Limits
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BORING KEOBS.GPJ BORING.GDT 8/11/04

PLATE NO. 58

BORING LOCATION: See Site Plan	DRILLER: PSC	**BORING NO. B-7**
BORING ELEVATION:	LOGGED BY: JAGN	
DATE (S) DRILLED: 7/30	TYPE RIG: Hoe Ram	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
							1		MH	**SILT**, brown, medium stiff, moist, with tuffaceous gravels, cobbles and boulders, trace rootlets
							2			
							3			
							4			**Basalt BOULDERS**, grayish black, slightly to moderately weathered, very strong
							5			
							6			
							7			**Tuffaceous ROCKS**, gray, tuffaceous cobbles and boulders in a silty, volcanic ash matrix
							8			
							9			
							10			**Basalt BOULDERS**, gray, slightly weathered, very strong
							11			
							12			
							13			
							14			
							15			Boring terminated at about 15 feet Groundwater was not encountered
							16			
							17			
							18			

SAMPLE TYPE

MC - Modified California
SPT - Standard Penetration
CB - Core Barrel
SH - Shelby Tube
AUG - Auger Cuttings
D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density
UC - Unconfined Compression
CON - Consolidation Test
SG - Specific Gravity
PI - Atterberg Limits
SA - Sieve Analysis

LOG OF BORING

PSC *Geotechnical & Environmental Consultants Construction Management, Testing & Inspection*

Keokea Waiohuli Development
Proposed Borrow Site
Waiohuli, Maui, Hawaii

DATE: March 2005

PROJECT NO.: 24304.11

BORING KEOBS.GPJ BORING.GDT 8/11/04

PLATE NO. 59

BORING LOCATION: See Site Plan	DRILLER: PSC	**BORING NO. B-8**
BORING ELEVATION:	LOGGED BY: JAGN	
DATE (S) DRILLED: 7/30	TYPE RIG: Hoe Ram	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-B8	1		MH	**Clayey SILT**, brown, with subangular tuffaceous gravel, cobbles and boulders, trace rootlets. Moist
MDD=86.2 pcf		27.7					2			**BASALT**, gray to black, slightly weathered, very strong
							3			
							4			
							5			
							6			
							7			
							8			
							9			
							10			
							11			**Vitric TUFF**, black to gray subangular tuffaceous gravel (clinker) and cobbles, dense to very dense
							12			
							13			
							14			**BASALT**, gray, slightly to moderately weathered, strong
							15			
							16			Boring terminated at about 16 feet Groundwater was not encountered
							17			
							18			

SAMPLE TYPE

MC - Modified California
SPT - Standard Penetration
CB - Core Barrel
SH - Shelby Tube
AUG - Auger Cuttings
D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density
UC - Unconfined Compression
CON - Consolidation Test
SG - Specific Gravity
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SA - Sieve Analysis

LOG OF BORING

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Keokea Waiohuli Development
Proposed Borrow Site
Waiohuli, Maui, Hawaii

DATE: March 2005

PROJECT NO.: 24304.11

PLATE NO. 60

BORING KEOBS.GPJ BORING.GDT 8/11/04

BORING LOCATION: See Site Plan	DRILLER: PSC	**BORING NO. B-9**
BORING ELEVATION:	LOGGED BY: JAGN	
DATE (S) DRILLED: 7/31	TYPE RIG: Hoe Ram	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
		21.3				BS-B9	1 2 3 4		MH	**Gravelly SILT**, brown, medium stiff, moist with tuffaceous gravel, cobbles and boulders, trace rootlets
							5 6 7 8			**Basalt ROCK**, bluish gray, slightly weathered, very strong
							9 10 11			**GRAVEL**, gray tuffaceous gravels (clinker) with cobbles and boulders
							12 13 14			Boring terminated at about 12 feet Groundwater was not encountered

SAMPLE TYPE

MC - Modified California
SPT - Standard Penetration
CB - Core Barrel
SH - Shelby Tube
AUG - Auger Cuttings
D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density
UC - Unconfined Compression
CON - Consolidation Test
SG - Specific Gravity
PI - Atterberg Limits
SA - Sieve Analysis

LOG OF BORING

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Proposed Borrow Site
Waiohuli, Maui, Hawaii

DATE: March 2005 | PROJECT NO.: 24304.11

PLATE NO. 61

BORING KEOBS.GPJ BORING.GDT 8/11/04

BORING LOCATION: See Site Plan	DRILLER: PSC	**BORING NO. B-10**
BORING ELEVATION:	LOGGED BY: JAGN	
DATE (S) DRILLED: 7/31	TYPE RIG: Hoe Ram	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
		21.8				BS-B10	1–18		MH	**Gravelly SILT**, brown, medium stiff, moist, with tuffaceous subangular cobbles and boulders, trace rootlets
										BASALT, bluish gray, slightly to moderately weathered, very strong
										Vitric TUFF, gray tuffaceous gravels (clinker), cobbles and boulders. Dense to very dense
										BASALT, bluish gray, slightly to moderately weathered, strong.
										Boring terminated at about 16 feet Groundwater was not encountered

SAMPLE TYPE

MC - Modified California
SPT - Standard Penetration
CB - Core Barrel
SH - Shelby Tube
AUG - Auger Cuttings
D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density
CON - Consolidation Test
PI - Atterberg Limits
UC - Unconfined Compression
SG - Specific Gravity
SA - Sieve Analysis

LOG OF BORING

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Waiohuli, Maui, Hawaii

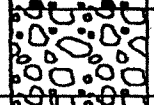
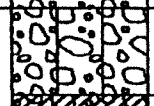
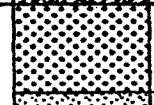
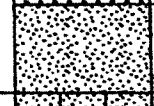
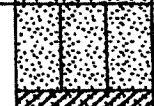
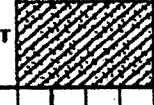
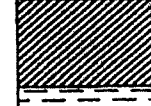
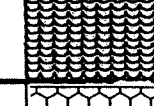
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PROJECT NO.: 24304.11

PLATE NO. 62

BORING KEOBS.GPJ BORING.GDT 8/11/04

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS: GRAPH	SYMBOLS: LETTER	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS — MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS — MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS — 50% OR MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS — 50 % OR MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS — LIQUID LIMIT LESS THAN 50			ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS — LIQUID LIMIT GREATER THAN OR EQUAL TO 50			MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
ROCKS					VOLCANIC BASALT / ANDESITE

UNIFIED SOIL CLASSIFICATION SYSTEM

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Proposed DHHL Agricultural Subdivision Road Network
Kula, Makawao, Maui, Hawaii

DATE: March 2005 | PROJECT NO. 24304.10

PLATE NO. 63

I **CONSOLIDATION OF SEDIMENTARY ROCKS; usually determined from unweathered samples. Largely dependent on cementation.**

U = unconsolidated
P = poorly consolidated
M = moderately consolidated
W = well consolidated

II **BEDDING OF SEDIMENTARY ROCKS**

Splitting Property	Thickness	Stratification
Massive	Greater than 4.0 ft.	very thick bedded
Blocky	2.0 to 4.0 ft.	thick-bedded
Slabby	0.2 to 2.0 ft.	thin-bedded
Flaggy	0.05 to 0.2 ft.	very thin-bedded
Shaly or platy	0.01 to 0.05 ft.	laminated
Papery	less than 0.01 ft.	thinly laminated

III **FRACTURING**

Intensity	Size of Pieces in Feet
Very little fractured	Greater than 4.0
Occasionally fractured	1.0 to 4.0
Moderately fractured	0.5 to 1.0
Closely fractured	0.1 to 0.5
Intensely fractured	0.05 to 0.1
Crushed	Less than 0.05

IV **HARDNESS**

1. Soft – reserved for plastic material alone.
2. Low hardness – can be gouged deeply or carved easily with a knife blade.
3. Moderately hard – can be readily scratched by a knife blade; scratch leaves a heavy trace of dust and is readily visible after the powder has been blown away.
4. Hard – can be scratched with difficulty; scratch produces little powder and is often faintly visible.
5. Very hard – cannot be scratched with a knife blade; leaves a metallic streak.

V **STRENGTH**

1. Plastic or very low strength.
2. Friable - Crumbles easily by rubbing with fingers.
3. Weak – An unfractured specimen of such material will crumble under light hammer blows.
4. Moderately strong – Specimen will withstand a few heavy hammer blows before breaking.
5. Strong – Specimen will withstand a few heavy ringing hammer blows and will yield with difficulty only dust and small flying fragments.
6. Very strong – Specimen will resist heavy ringing hammer blows and will yield with difficulty only dust and small flying fragments.

VI **WEATHERING** – The physical and chemical disintegration and decomposition of rocks and minerals by natural processes such as oxidation, reduction, hydration, solution, carbonation and freezing and thawing.

D. Deep – Moderate to complete mineral decompostion; extensive disintegration; deep and thorough discoloration; many fractures, all extensively coated or filled with oxides, carbonates and/or clay or silt.

M. Moderate – Slight change or partial decomposition of minerals; little disintegration; cementation little to unaffected. Moderate to occasionally intense discoloration. Moderately coated fractures.

L. Little - No megascopic decomposition of minerals; little or no affect on normal cementation. Slight and intermittent, or localized discoloration. Few stains on fracture surfaces.

F. Fresh – Unaffected by weathering agents. No disintegration or discoloration. Fractures usually less numerous than joints.

ROCK CLASSIFICATION SYSTEM

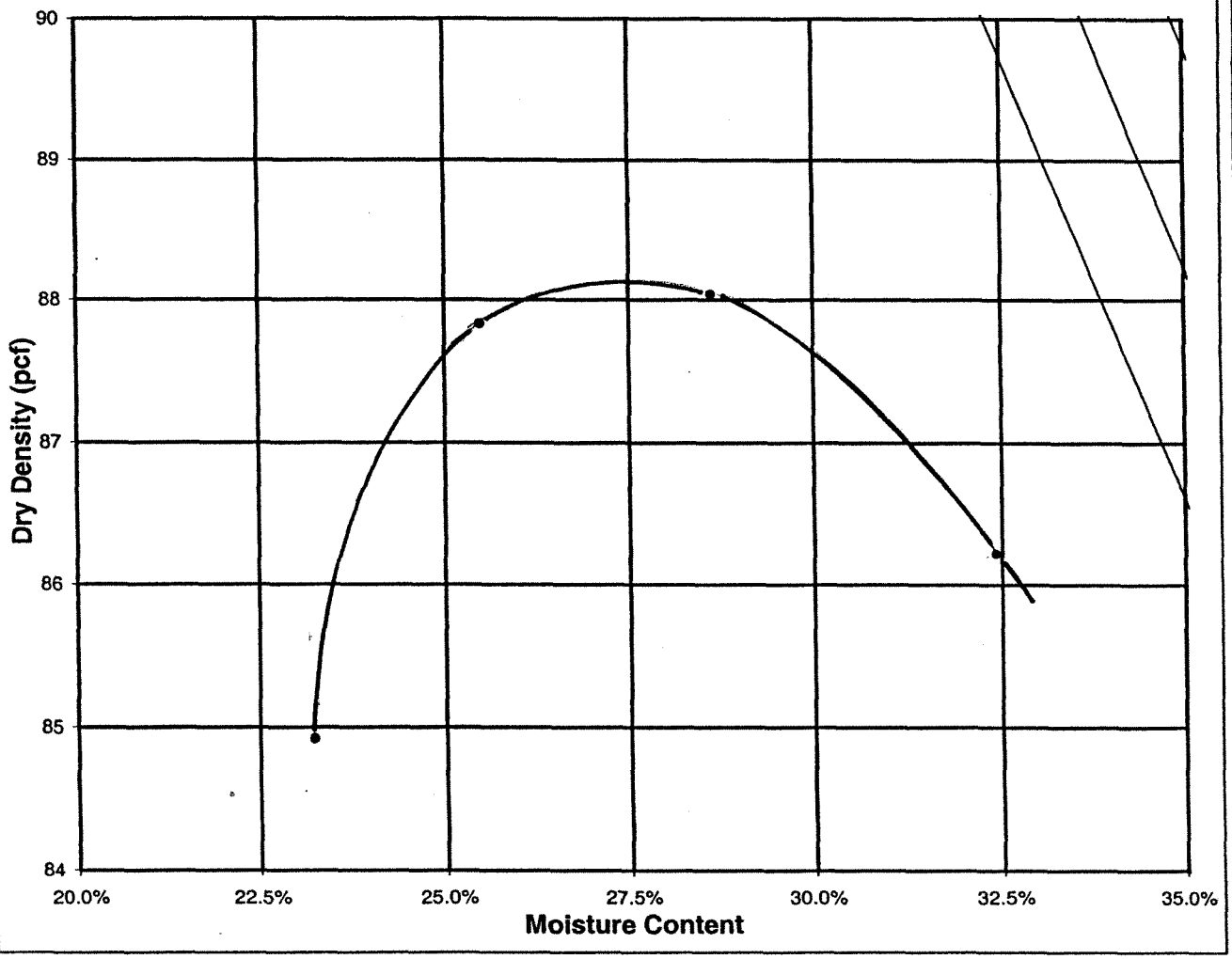
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Kula, Makawao, Maui, Hawaii

DATE: March 2005 | PROJECT NO. 24304.10

PLATE NO. 64

MOISTURE-DENSITY RELATIONSHIP



Sample Source: TP-1 Road Alignment Description: Dark Brown Clayey SILT

	Test Point 1	Test Point 2	Test Point 3	Test Point 4
Wet Density (pcf)	104.65	110.2	113.24	114.17
Moisture Content	23.23%	25.48%	28.63%	32.42%
Dry Density (pcf)	84.92	87.83	88.04	86.22

Maximum Dry Density (pcf): 88.0
Optimum Moisture Content (%) : 28.6
Test Method: ASTM D-1557

Atterberg Limits

LL	PL	PI

COMPACTION TEST RESULTS
ASTM D-1557

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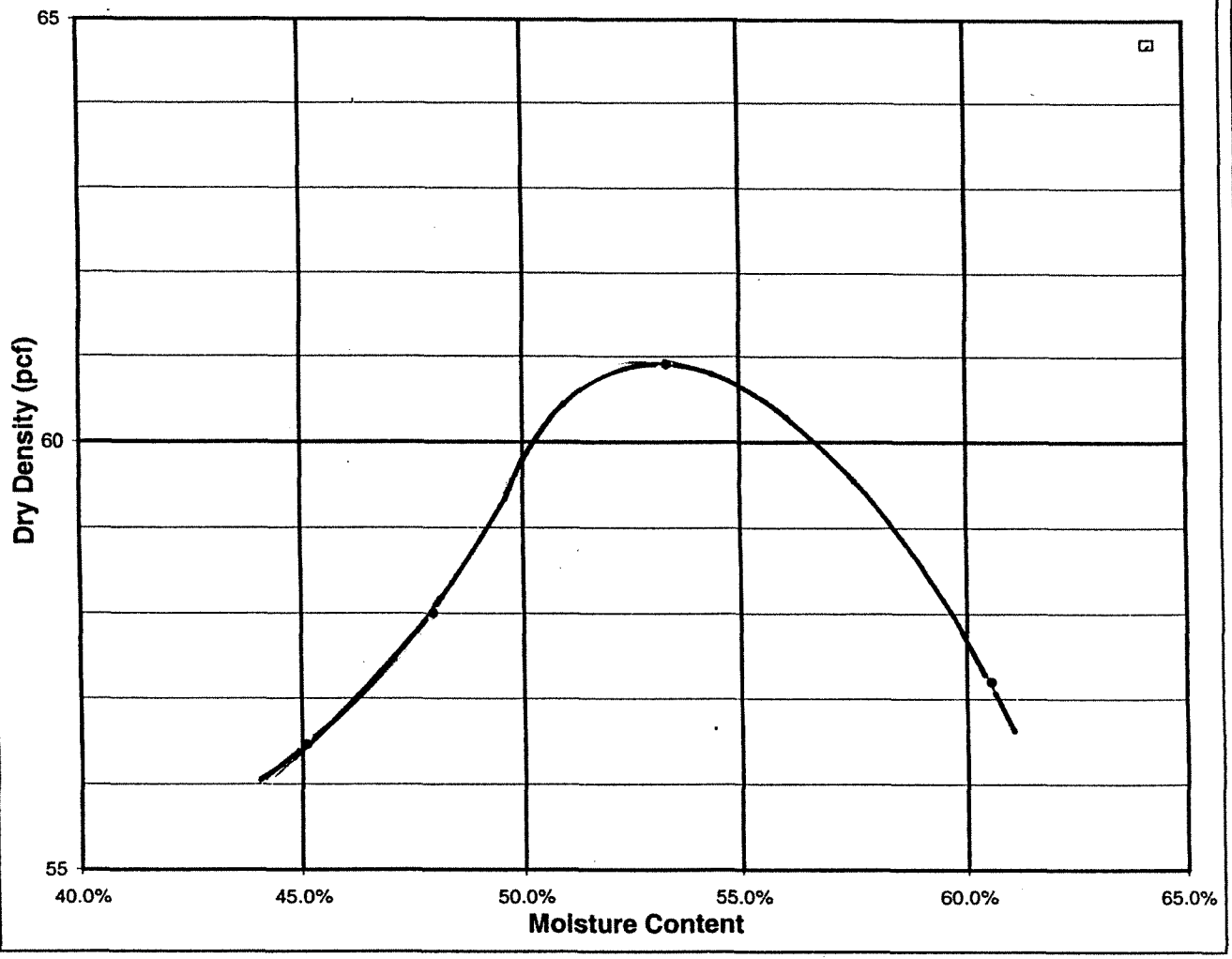
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Proposed Agricultural Subdivision Road Network
Kula, Makawao, Maui, Hawaii

Date: March 2005 | PROJECT NO. 24304.10

PLATE NO. 65

A:\Labshts\Compaction BS-1 Keokea\Points Only

MOISTURE-DENSITY RELATIONSHIP



Sample Source: TP-4 Road Alignment Description: Dark Brown Volcanic Ash

	Test Point 1	Test Point 2	Test Point 3	Test Point 4
Wet Density (pcf)	81.98	85.78	93.42	91.86
Moisture Content	45.1%	47.9%	53.4%	60.6%
Dry Density (pcf)	56.5	58.0	60.9	57.2

Maximum Dry Density (pcf): 60.9
Optimum Moisture Content (%) : 53.4
Test Method: ASTM D-1557-91C

Atterberg Limits		
LL	PL	PI
82	70	12

COMPACTION TEST RESULTS
ASTM D-1557

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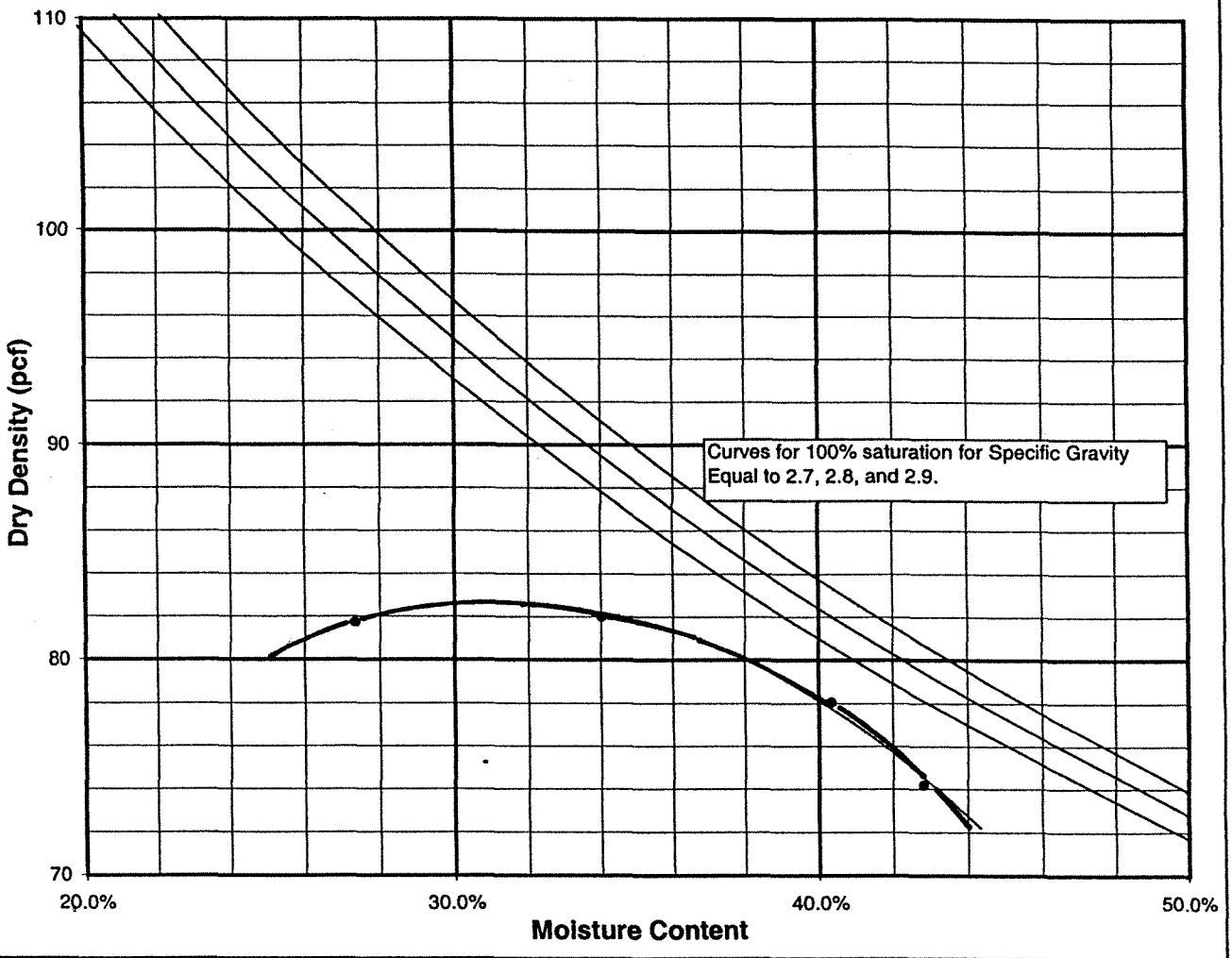
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PLATE NO. 66

A:\Labshts\Compaction BS-4 Keokea\Points Only

MOISTURE-DENSITY RELATIONSHIP



Sample Source: TP-18 Prop.Rd. Alignment Description: Brown Volcanic Ash

	Test Point 1	Test Point 2	Test Point 3	Test Point 4
Wet Density (pcf)	104	109.88	109.65	105.95
Moisture Content	27.3%	34.0%	40.4%	42.8%
Dry Density (pcf)	81.7	82.0	78.1	74.2

Maximum Dry Density (pcf): 82.0
Optimum Moisture Content (%) : 34
Test Method: ASTM D-1557-91C

Atterberg Limits		
LL	PL	PI
69	68	1

COMPACTION TEST RESULTS
ASTM D-1557

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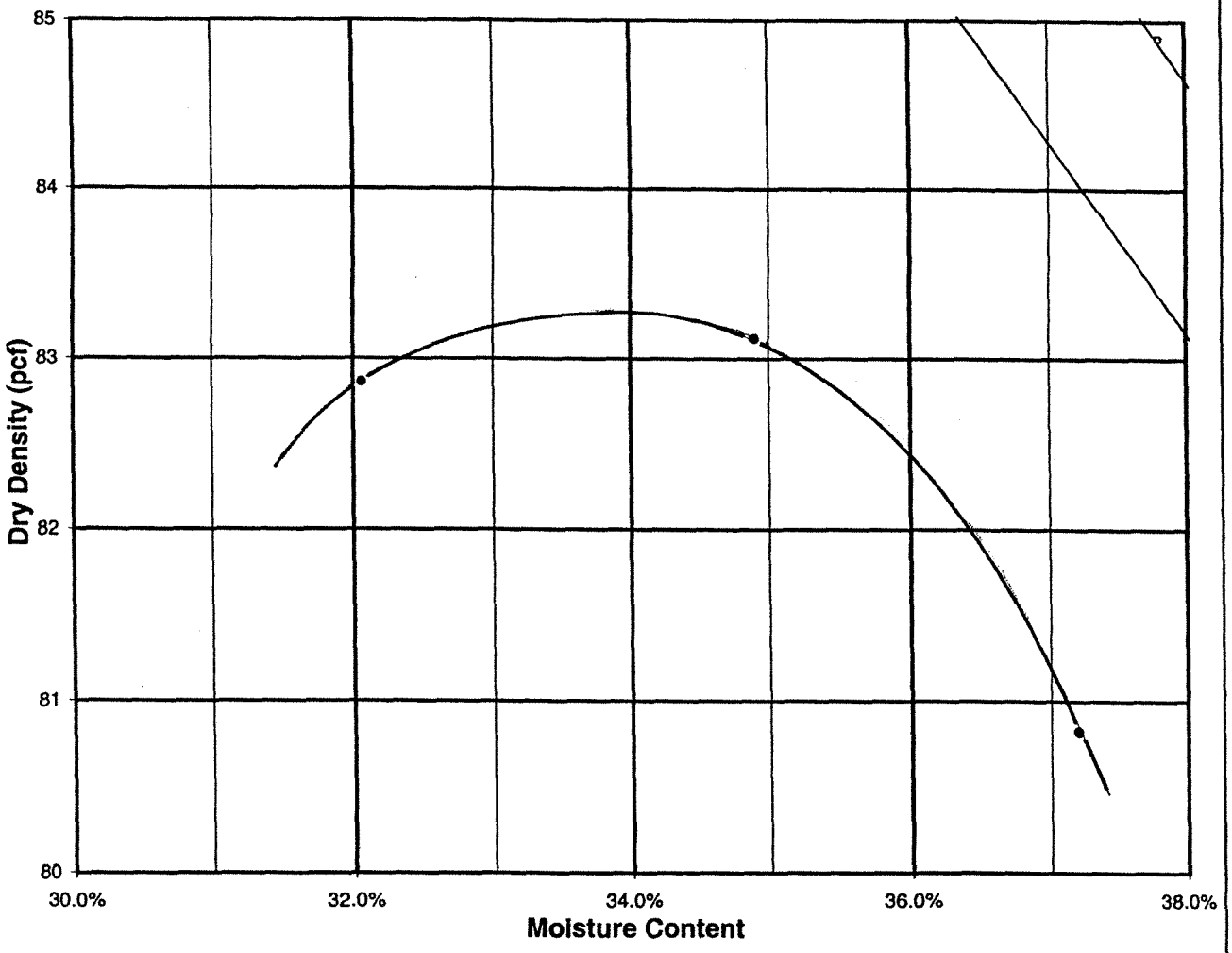
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PLATE NO: 67

A:\Labshts\Compaction BS-18 Keokea\Points Only

MOISTURE-DENSITY RELATIONSHIP



Sample Source: TP-20 Road Alignment Description: Brown SILT

	Test Point 1	Test Point 2	Test Point 3	Test Point 4
Wet Density (pcf)	109.42	112.12	110.88	
Moisture Content	32.06%	34.90%	37.20%	
Dry Density (pcf)	82.86	83.12	80.82	

Maximum Dry Density (pcf): 83.25
Optimum Moisture Content (%) : 34
Test Method: ASTM D-1557

Atterberg Limits

LL	PL	PI

COMPACTION TEST RESULTS
ASTM D-1557

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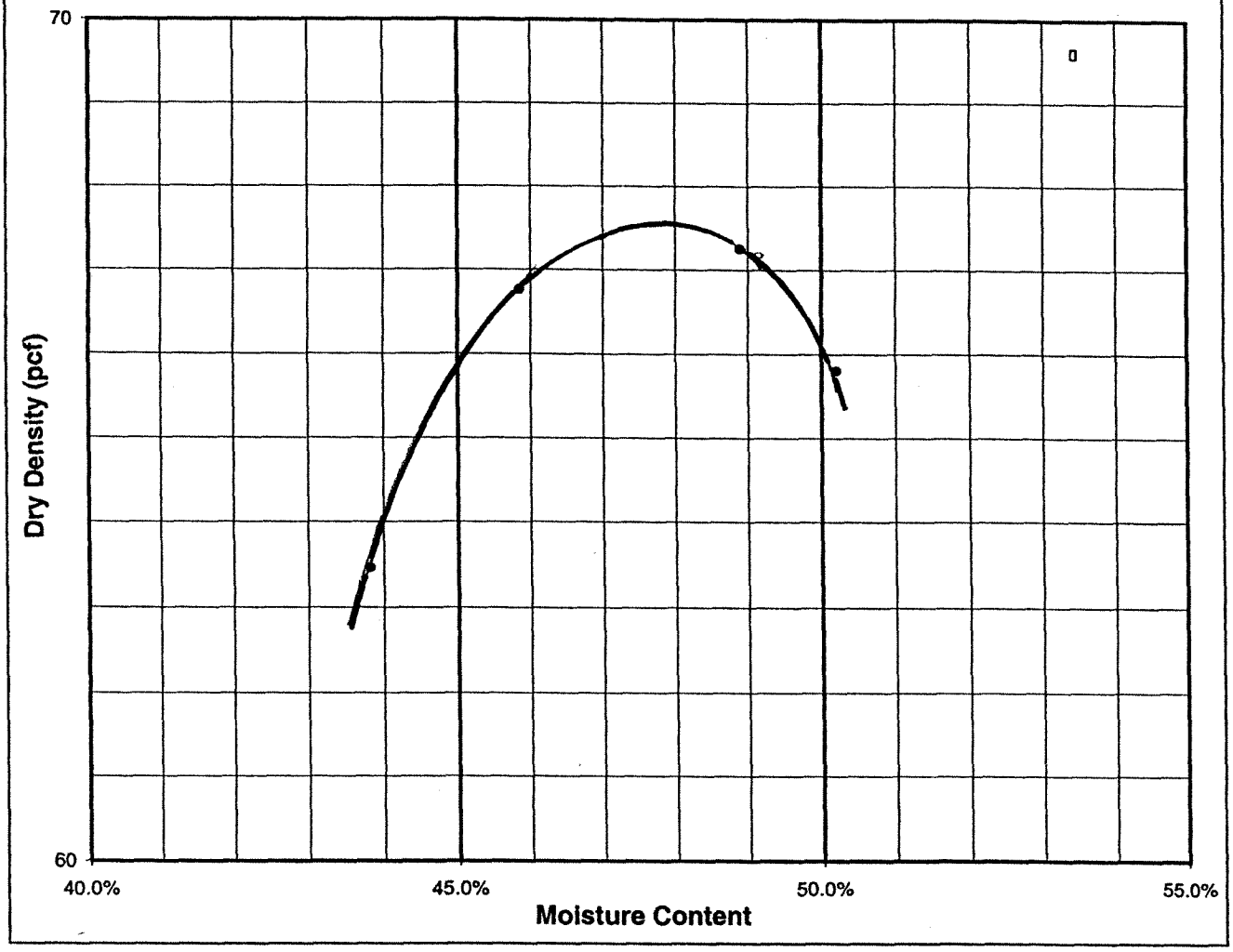
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PLATE NO. 68

A:\Labshts\Compaction BS-20 Keokea\Points Only

MOISTURE-DENSITY RELATIONSHIP



Sample Source: TP-28 Prop.Rd. Alignment Description: Brown Volcanic Ash

	Test Point 1	Test Point 2	Test Point 3	Test Point 4
Wet Density (pcf)	91.31	97.46	100.2	98.83
Moisture Content	43.8%	45.9%	48.9%	50.2%
Dry Density (pcf)	63.5	66.8	67.3	65.8

Maximum Dry Density (pcf): 67.3
Optimum Moisture Content (%) : 48.9
Test Method: ASTM D-1557-91C

Atterberg Limits		
LL	PL	PI
62	60	2

COMPACTION TEST RESULTS
ASTM D-1557

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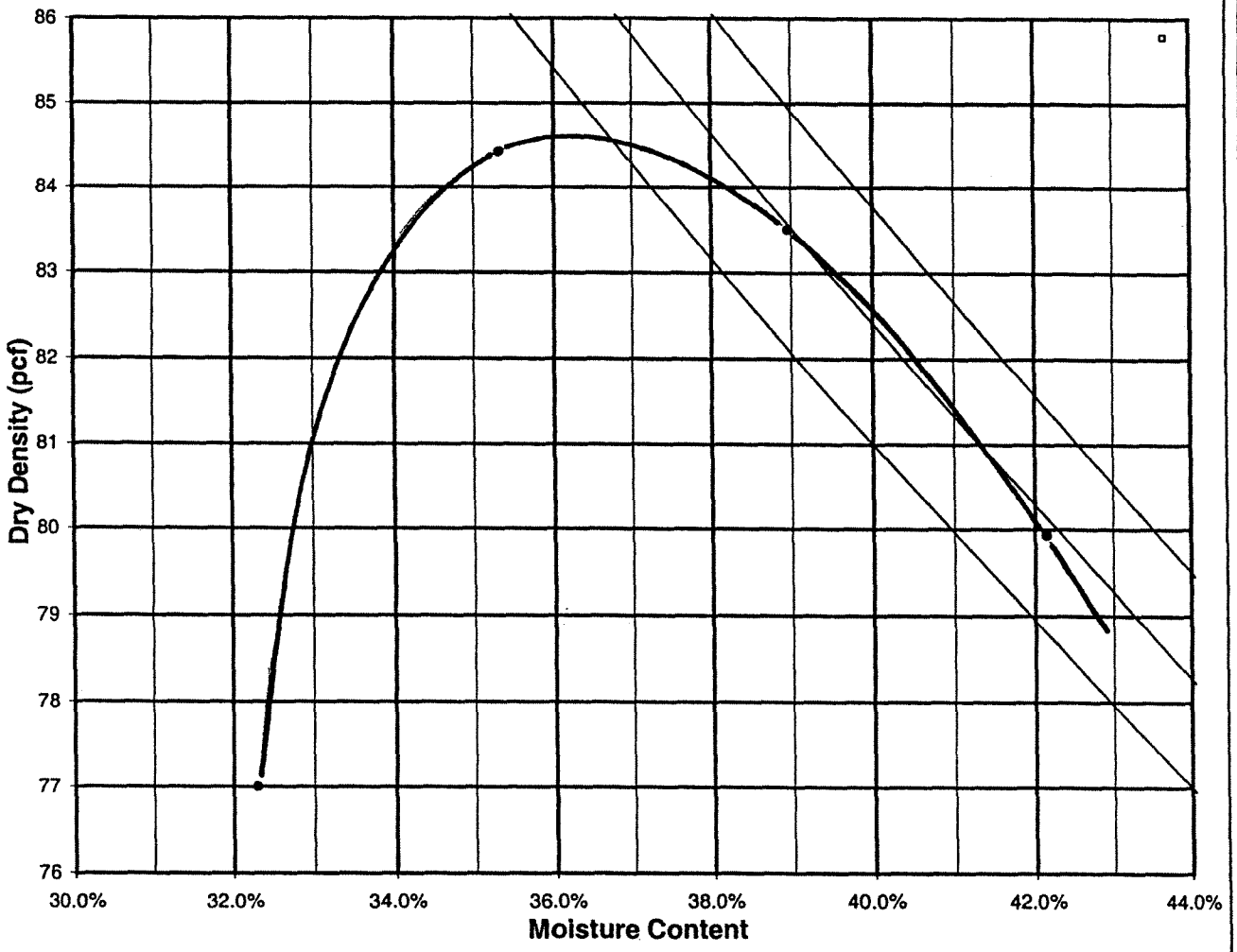
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Proposed Agricultural Subdivision Road Network
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Date: March 2005 PROJECT NO. 24304.10

PLATE NO. 69

A:\Labshts\Compaction BS-28 Keokea\Points Only

MOISTURE-DENSITY RELATIONSHIP



Sample Source: TP-41 Road Alignment Description: Brown SILT (ML) trace of gravel and clay

	Test Point 1	Test Point 2	Test Point 3	Test Point 4
Wet Density (pcf)	101.87	114.24	116.03	113.62
Moisture Content	32.30%	35.32%	38.96%	42.15%
Dry Density (pcf)	77.00	84.42	83.50	79.93

Maximum Dry Density (pcf): 84.50
Optimum Moisture Content (%) : 36
Test Method: ASTM D-1557

Atterberg Limits

LL	PL	PI

COMPACTION TEST RESULTS
ASTM D-1557

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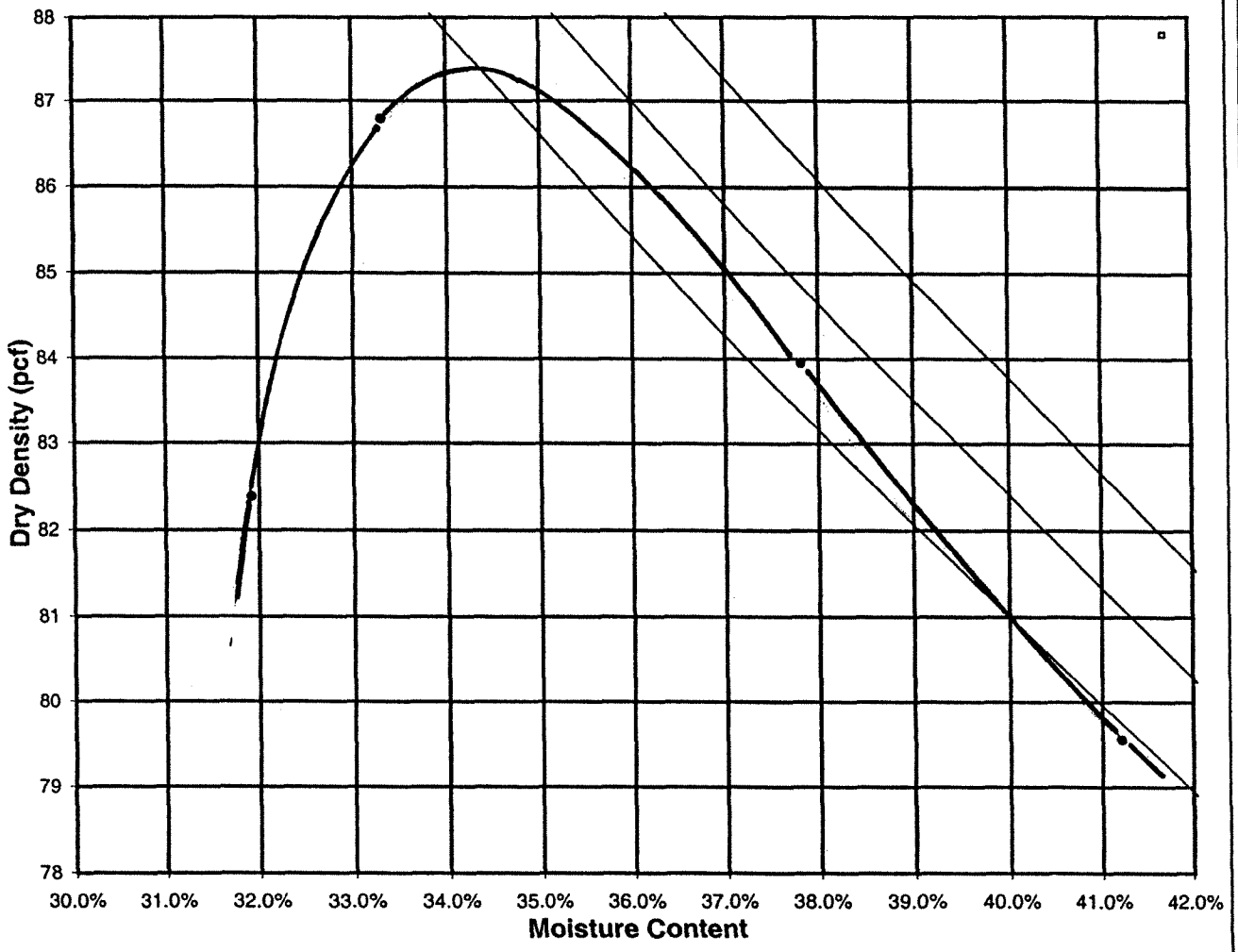
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PLATE NO. 70

A:\Labshts\Compaction BS-41 Keokea\Points Only

MOISTURE-DENSITY RELATIONSHIP



Sample Source: TP-45 Road Alignment Description: Dark Brown Clayey SILT

	Test Point 1	Test Point 2	Test Point 3	Test Point 4
Wet Density (pcf)	108.68	115.7	115.69	112.33
Moisture Content	31.92%	33.31%	37.82%	41.21%
Dry Density (pcf)	82.38	86.79	83.95	79.55

Maximum Dry Density (pcf): about 87.3
Optimum Moisture Content (%) : about 34.5
Test Method: ASTM D-1557

Atterberg Limits

LL	PL	PI

COMPACTION TEST RESULTS
ASTM D-1557

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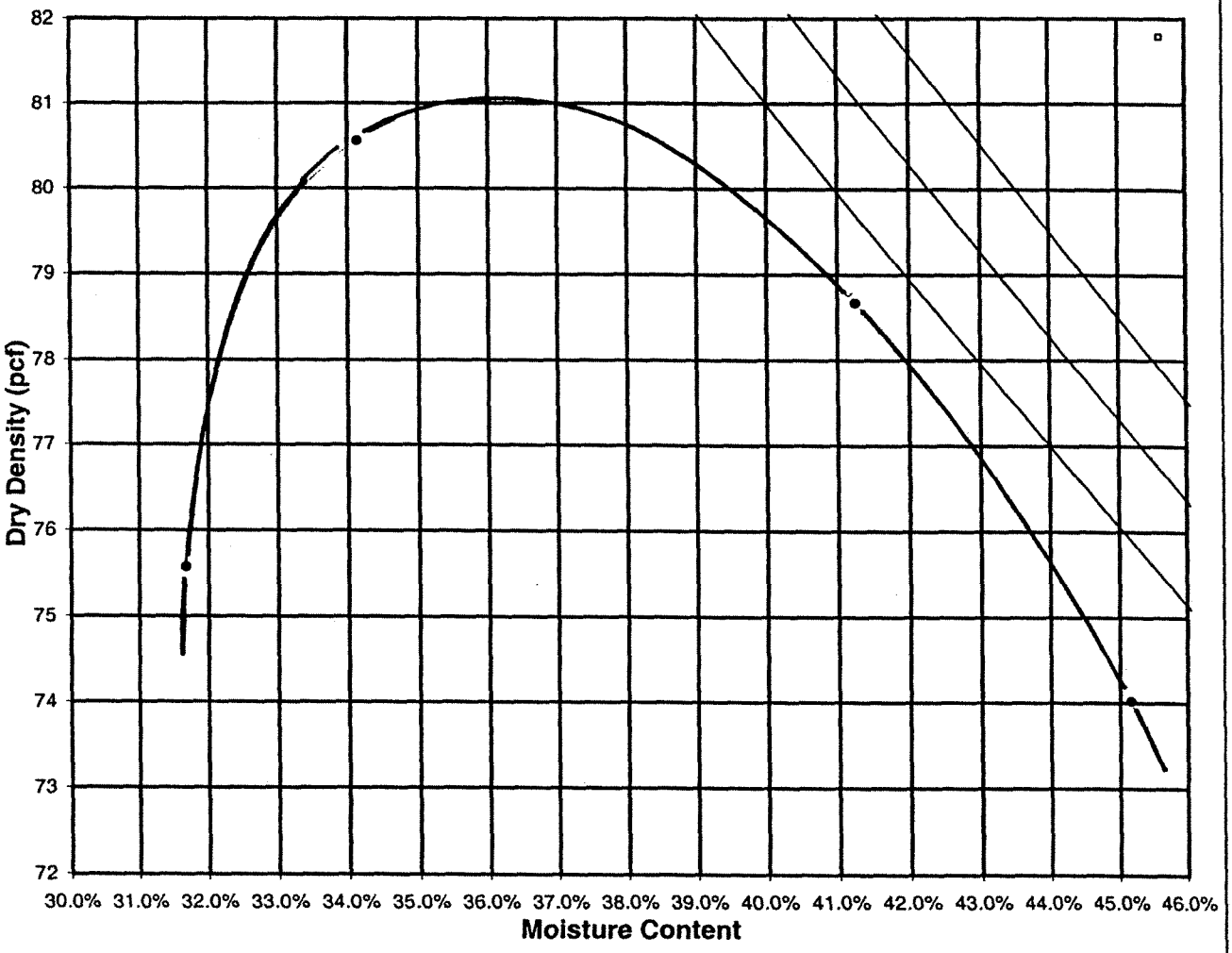
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PLATE NO. 71

A:\Labshts\Compaction BS-45 Keokea\Points Only

MOISTURE-DENSITY RELATIONSHIP



Sample Source: TP-47 Road Alignment Description: Amber Brown Clayey SILT

	Test Point 1	Test Point 2	Test Point 3	Test Point 4
Wet Density (pcf)	99.51	108.06	111.12	107.44
Moisture Content	31.68%	34.14%	41.25%	45.16%
Dry Density (pcf)	75.57	80.56	78.67	74.02

Maximum Dry Density (pcf): 81
Optimum Moisture Content (%) : 36
Test Method: ASTM D-1557

Atterberg Limits

LL	PL	PI

COMPACTION TEST RESULTS
ASTM D-1557

PSC Consultants, LLC
SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

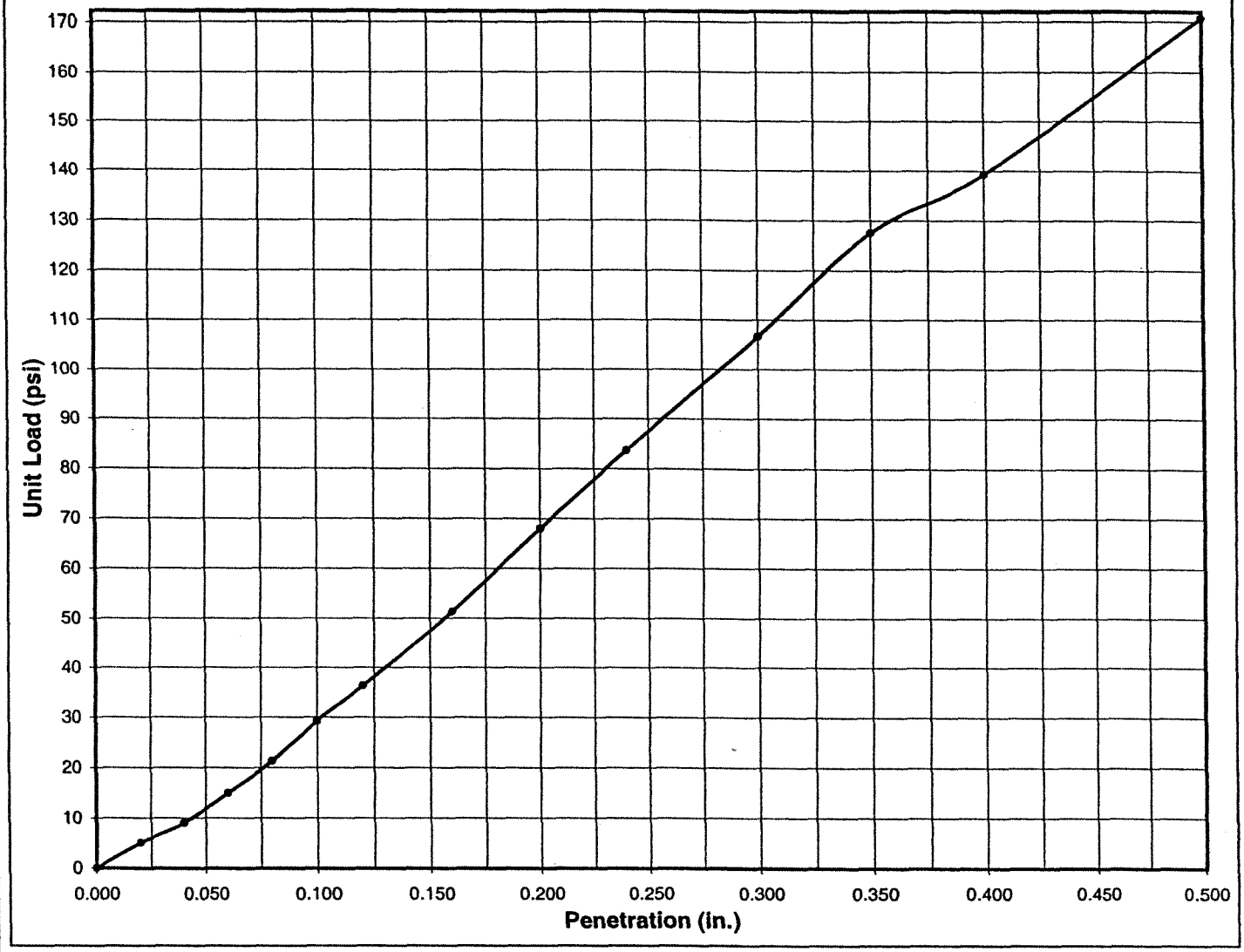
Keokea/Waiohuli Development
Proposed Agricultural Subdivision Road Network
Kula, Makawao, Maui, Hawaii

Date: March 2005 PROJECT NO. 24304.10

PLATE NO. 72

A:\Labshts\Compaction BS-47 Keokea\Points Only

CBR CURVE



Sample Source: TP-1 **Depth:** 0-5 **Description:** Brown Clayey Silt (MH)

	Before Expansion	After Expansion
Relative Compaction (%):	90.93%	90.20%
Moisture Content (%):	37.66%	38.66%
Dry Density (pcf):	80.00	79.41
Percent Swell or Expansion Value (%):	0.80%	
Compaction Test Method:	ASTM D-1557 A	
CBR Value @ 0.1" Corrected:	3	
CBR Value @ 0.2" Corrected:	4.5	

Atterberg Limits

LL	PL	PI

CALIFORNIA BEARING RATIO
ASTM D-1883-94

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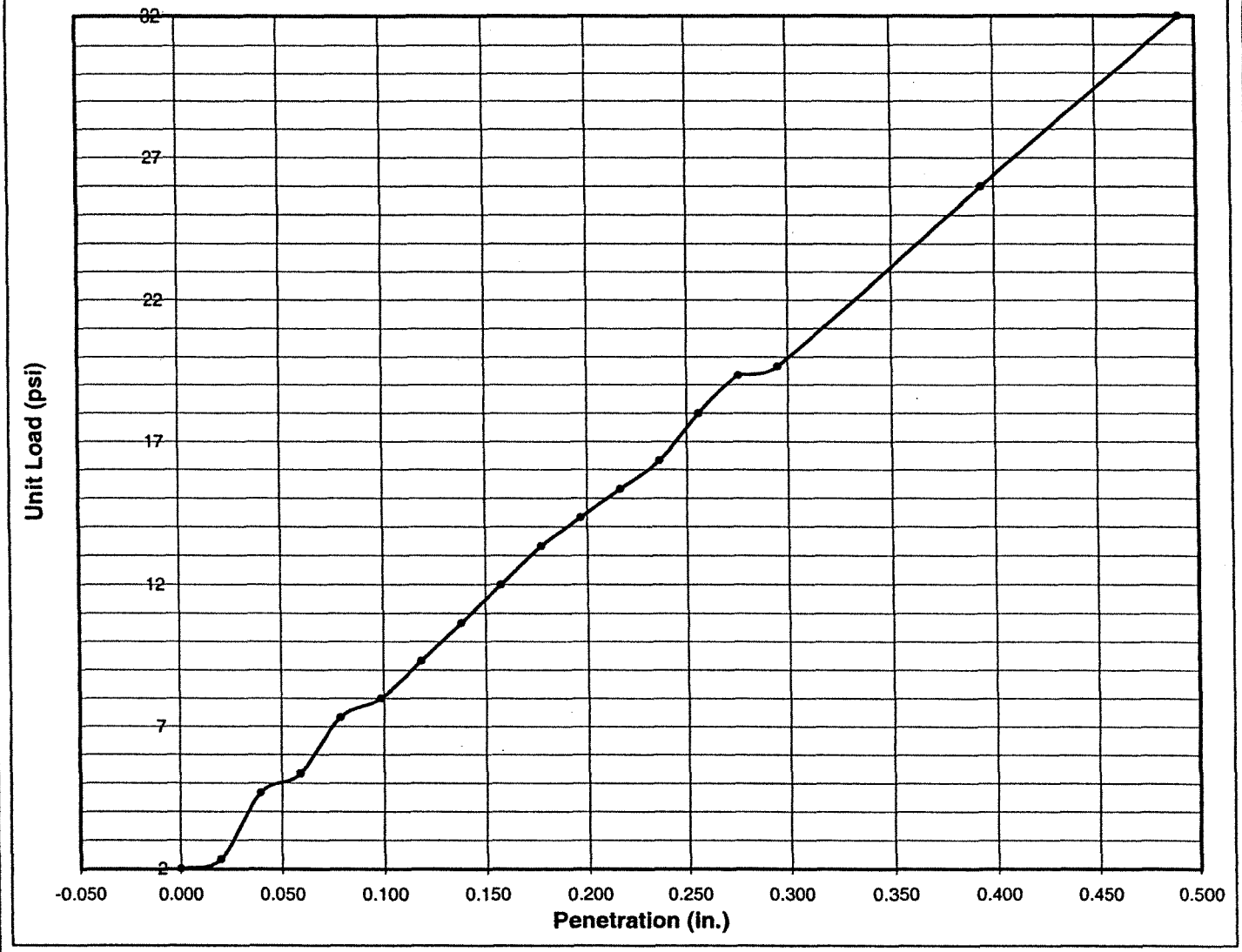
Keokea-Waiohuli Development
DHHL Agricultural Subdivision Road System
Keokea, Maui, Hawaii

Date March 2005 | PROJECT NO. 24304.12

PLATE NO. 73

A:\Labshts\24304.10CBRTP-1tKeokea\CBR Curve

CBR CURVE



Sample Source: TP-4 **Depth:** 0-2 ft **Description:** Brown Silt (MH) volcanic ash

	Before Expansion	After Expansion
Relative Compaction (%):	94.55%	94.48%
Moisture Content (%):	60.35%	61.74%
Dry Density (pcf):	57.63	57.54
Percent Swell or Expansion Value (%):	1.65%	
Compaction Test Method:	ASTM D-1557 A	
CBR Value @ 0.1" Corrected:	0.8	
CBR Value @ 0.2" Corrected:	0.95	

Atterberg Limits

LL	PL	PI
82.00	70	12

CALIFORNIA BEARING RATIO
ASTM D-1883-94

PSC Consultants, LLC
SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

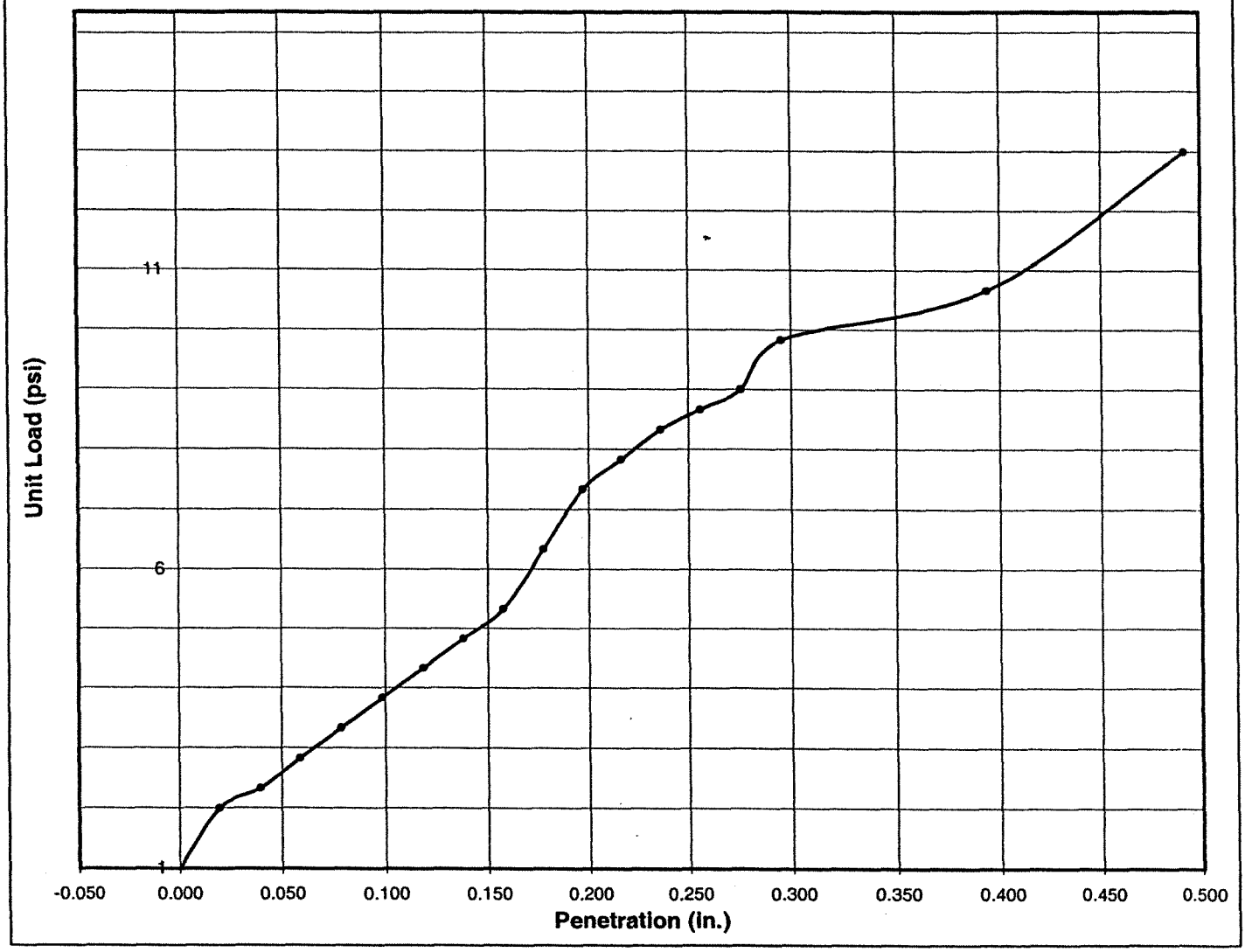
Keokea Waiohuli Development
DHHL Agricultural Lots Subdivision Road Project
Keokea, Kula, Makawao, Maui, Hawaii

Date: July 2004 | PROJECT NO. 24304.10

PLATE NO. 74

A:\Labshts\24304.10 Keokea BS-4 CBR\CBR Curve

CBR CURVE



Sample Source: TP-18 **Depth:** 0-2 **Description:** Brown Silt (MH) volcanic ash

	Before Expansion	After Expansion
Relative Compaction (%):	85.00%	85.09%
Moisture Content (%):	47.88%	49.03%
Dry Density (pcf):	69.73	69.77
Percent Swell or Expansion Value (%):	-0.06%	
Compaction Test Method:	ASTM D-1557 A	
CBR Value @ 0.1" Corrected:	0.35	
CBR Value @ 0.2" Corrected:	0.46	

Atterberg Limits

LL	PL	PI
51.50	44	7.5

CALIFORNIA BEARING RATIO
ASTM D-1883-94

PSC Consultants, LLC
SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

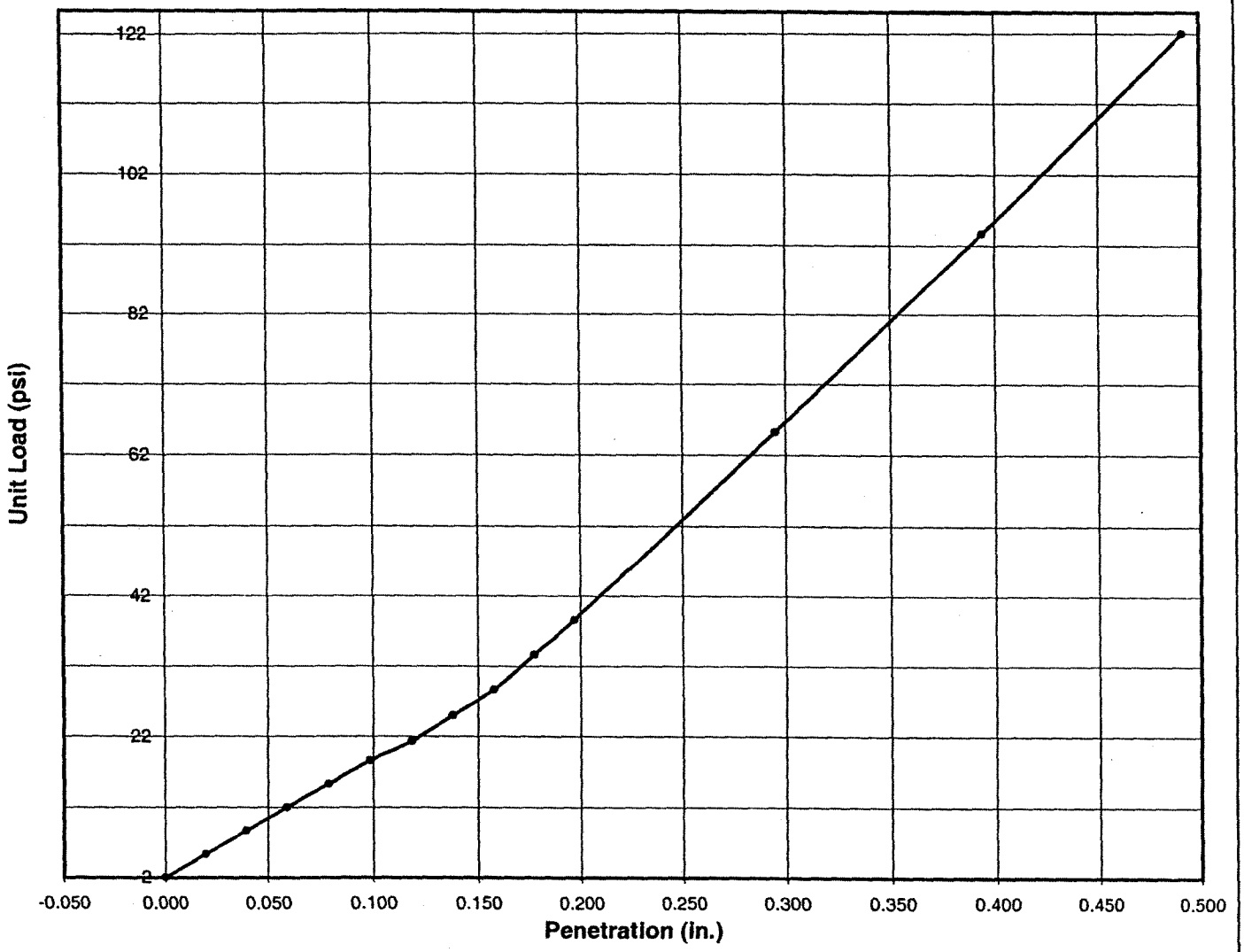
Keokea Waiohuli Development
DHHL Agricultural Lots Subdivision Road Project
Keokea, Kula, Makawao, Maui, Hawaii

Date: March 2005 | PROJECT NO. 24304.10

PLATE NO. 75

A:\Labshts\24304.10 Keokea BS-18 CBR\CBR Curve

CBR CURVE



Sample Source: TP-28 **Depth:** 0-2 **Description:** Brown Silt (MH) volcanic ash

	Before Expansion	After Expansion
Relative Compaction (%):	94.60%	93.00%
Moisture Content (%):	52.72%	56.92%
Dry Density (pcf):	63.61	62.61
Percent Swell or Expansion Value (%):	1.69%	
Compaction Test Method:	ASTM D-1557 A	
CBR Value @ 0.1" Corrected:	1.9	
CBR Value @ 0.2" Corrected:	2.6	

Atterberg Limits

LL	PL	PI
62.00	60	2

CALIFORNIA BEARING RATIO
ASTM D-1883-94

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SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

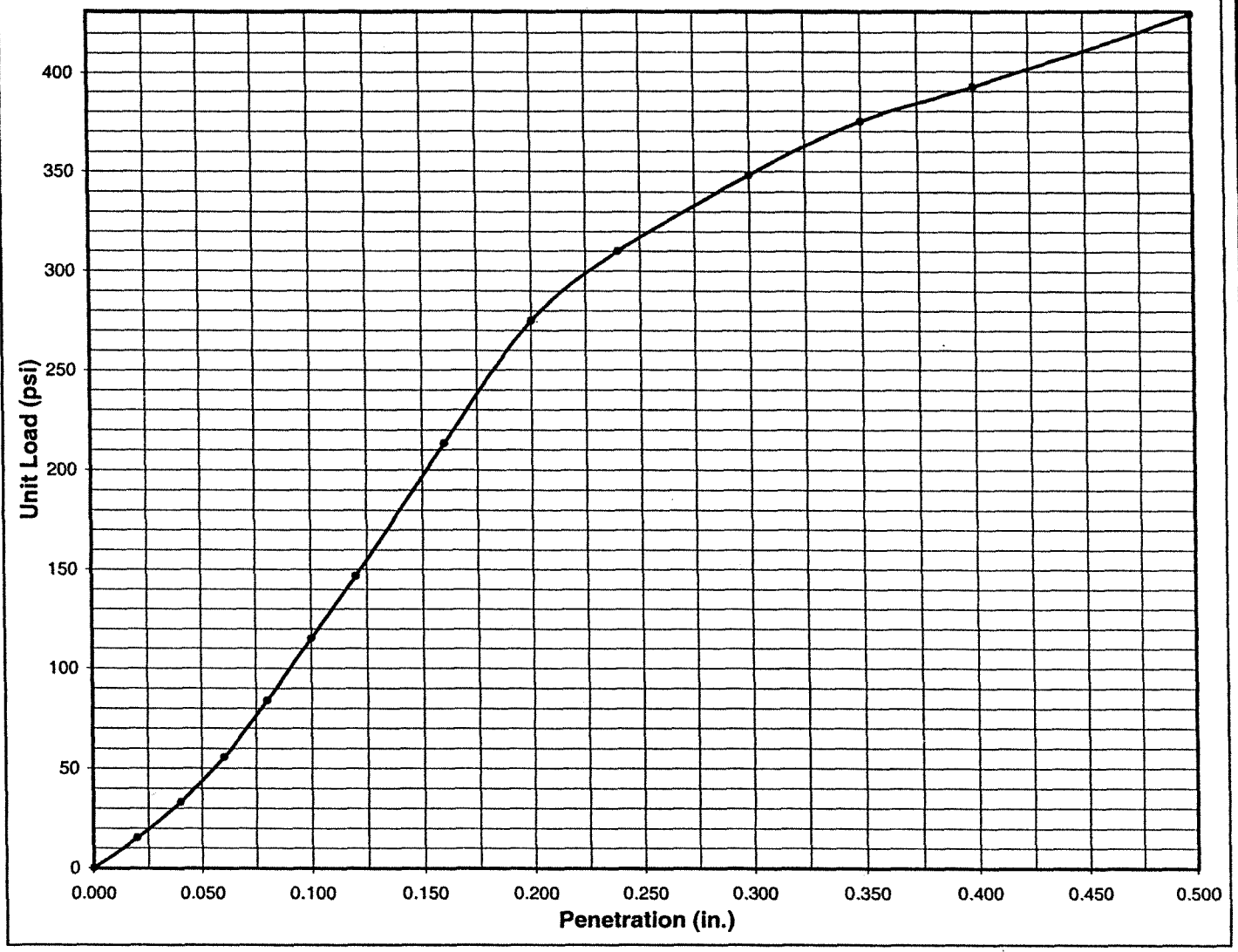
Keokea Waiohuli Development
DHHL Agricultural Lots Subdivision Road Project
Keokea, Kula, Makawao, Maui, Hawaii

Date: March 2005 | PROJECT NO. 24304.10

PLATE NO.76

A:\Labshts\24304.10 Keokea BS-28 CBR\CBR Curve

CBR CURVE



Sample Source: TP-45 **Depth:** 0-5 **Description:** Brown Clayey Silt (MH) with gravel, trace sand

	Before Expansion	After Expansion
Relative Compaction (%):	92.48%	92.34%
Moisture Content (%):	42.26%	43.42%
Dry Density (pcf):	80.27	80.14
Percent Swell or Expansion Value (%):	0.17%	
Compaction Test Method:	ASTM D-1557 A	
CBR Value @ 0.1" Corrected:	11.53	
CBR Value @ 0.2" Corrected:	18.33	

Atterberg Limits

LL	PL	PI

CALIFORNIA BEARING RATIO
ASTM D-1883-94

PSC Consultants, LLC
SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

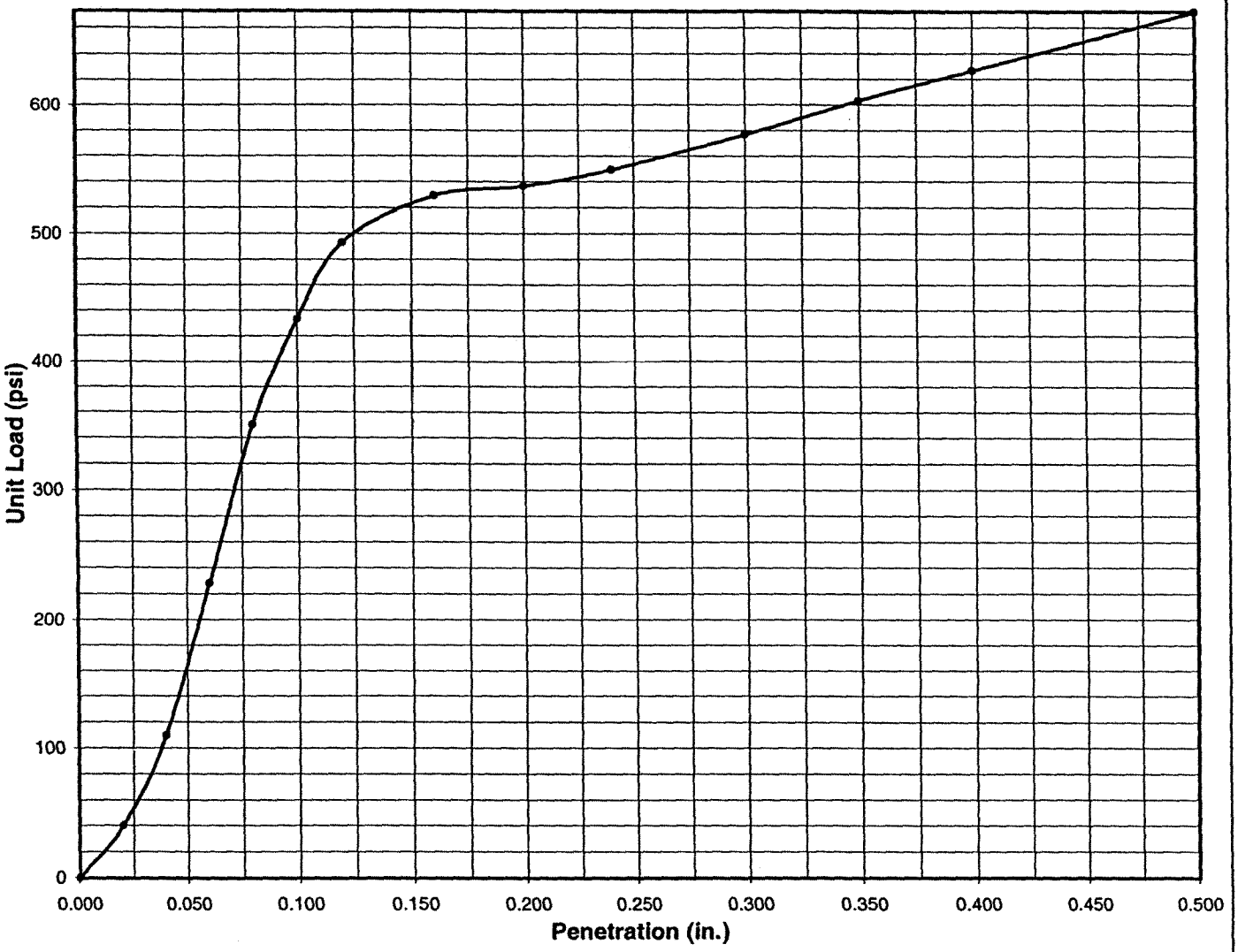
Keokea-Waiohuli Development
DHHL Agricultural Subdivision Road System
Keokea, Maui, Hawaii

Date: March 2005 | PROJECT NO. 24304.10

PLATE NO.77

A:\Labshts\24304.10CBRTP-45Keokea\CBR Curve

CBR CURVE



Sample Source: TP-47 **Depth:** 0-6 **Description:** Amber brown Silty Clay (CL-ML), with cobbles

	Before Expansion	After Expansion
Relative Compaction (%):	97.85%	97.44%
Moisture Content (%):	42.00%	43.69%
Dry Density (pcf):	78.83	78.50
Percent Swell or Expansion Value (%):	0.48%	
Compaction Test Method:	ASTM D-1557 A	
CBR Value @ 0.1" Corrected:	43.3	
CBR Value @ 0.2" Corrected:	35.77	

Atterberg Limits

LL	PL	PI

CALIFORNIA BEARING RATIO
ASTM D-1883-94

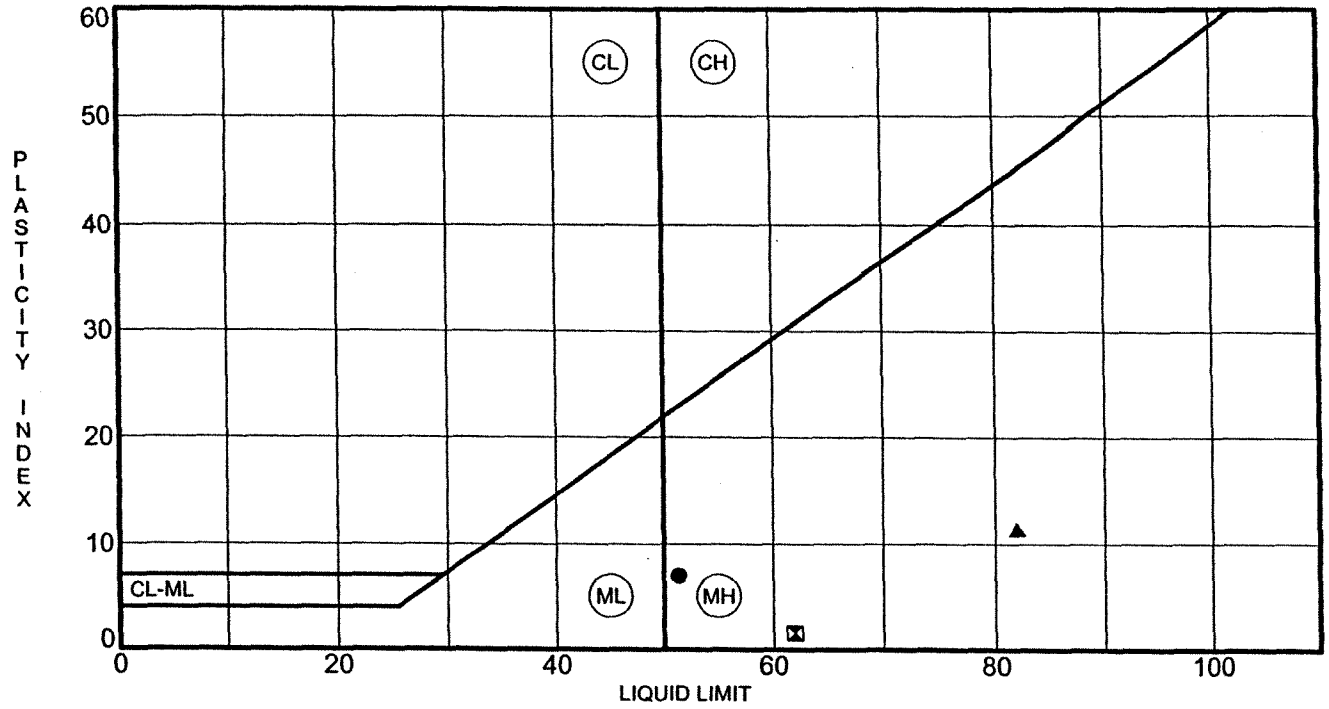
PSC Consultants, LLC
SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

Keokea-Waiohuli Development
DHHL Agricultural Subdivision Road System
Keokea, Maui, Hawaii

Date: March 2005 | PROJECT NO. 24304.10

PLATE NO.78

A:\Labshts\24304.10CBRTP-47Keokea\CBR Curve



	Specimen Identification		LL	PL	PI	Fines	Classification
●	TP-18	2.0	51	44	7		Brown Silt (Volcanic Ash)
⊠	TP-28	2.0	62	60	2		Brown Silt (Volcanic Ash)
▲	TP-4	2.0	82	70	12		Brown Silt (Volcanic Ash)

ATTERBERG LIMITS DATA

PSC CONSULTANTS, LLC

SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

Keokea/Waiohuli Development
Kula, Makawao, Maui, Hawaii

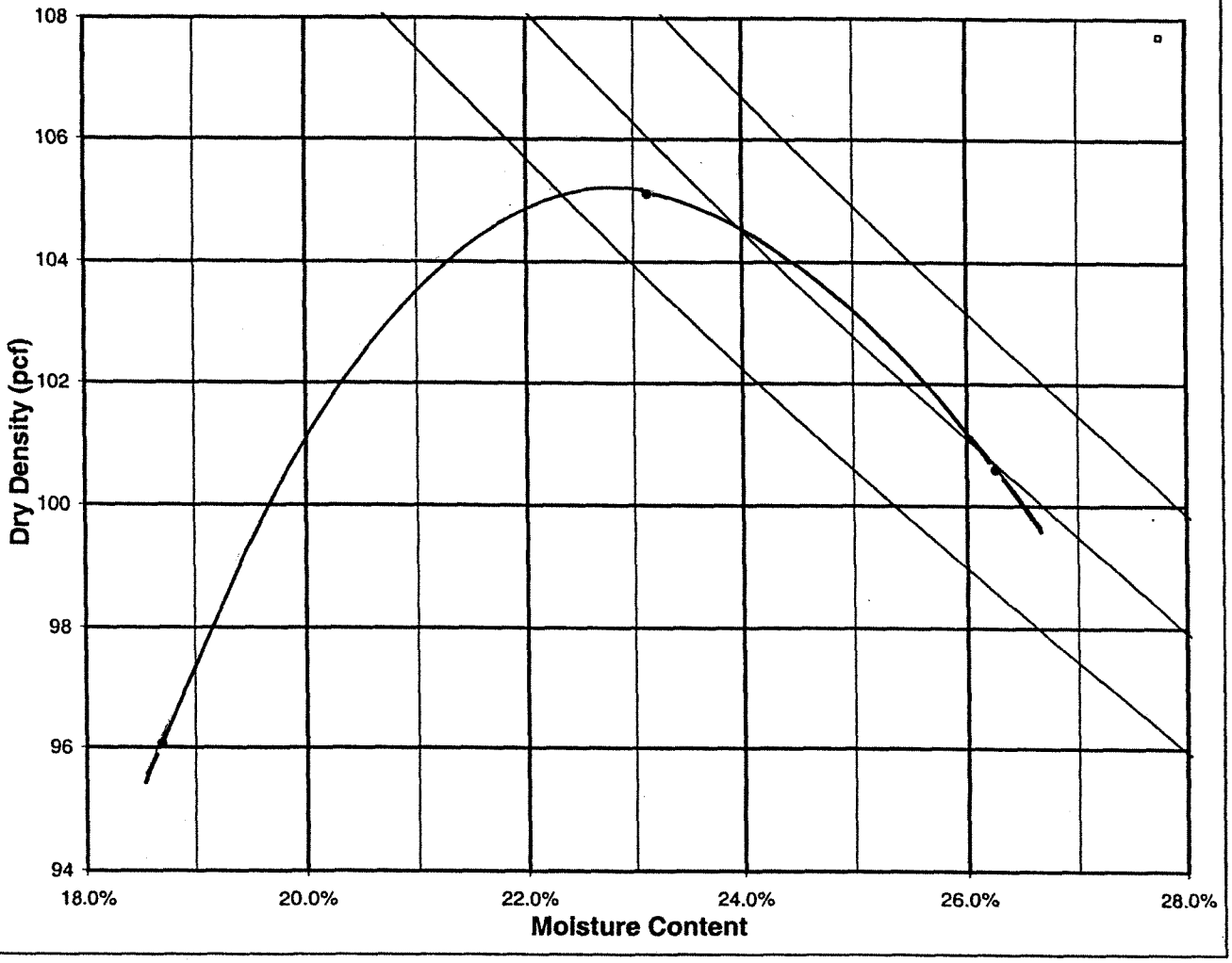
Date: March 2005

Project No.: 24304.10

PLATE NO. 79

US ATTERBERG LIMITS KEOKEA.GPJ BORING.GDT 7/9/04

MOISTURE-DENSITY RELATIONSHIP



Sample Source: TP-3 Borrow Area

Description: Dark brown to gray clayey SILT with tuffaceous gravel, cobbles, trace sand

	Test Point 1	Test Point 2	Test Point 3	Test Point 4
Wet Density (pcf)	114.01	129.4	127	
Moisture Content	18.69%	23.13%	26.26%	
Dry Density (pcf)	96.06	105.10	100.59	

Maximum Dry Density (pcf): 105.1

Optimum Moisture Content (%) : 23

Test Method: ASTM D-1557

Atterberg Limits

LL PL PI

COMPACTION TEST RESULTS

ASTM D-1557

PSC Consultants, LLC

SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

Keokea/Waiohuli Development

Proposed Agricultural Subdivision Borrow Site

Kula, Makawao, Maui, Hawaii

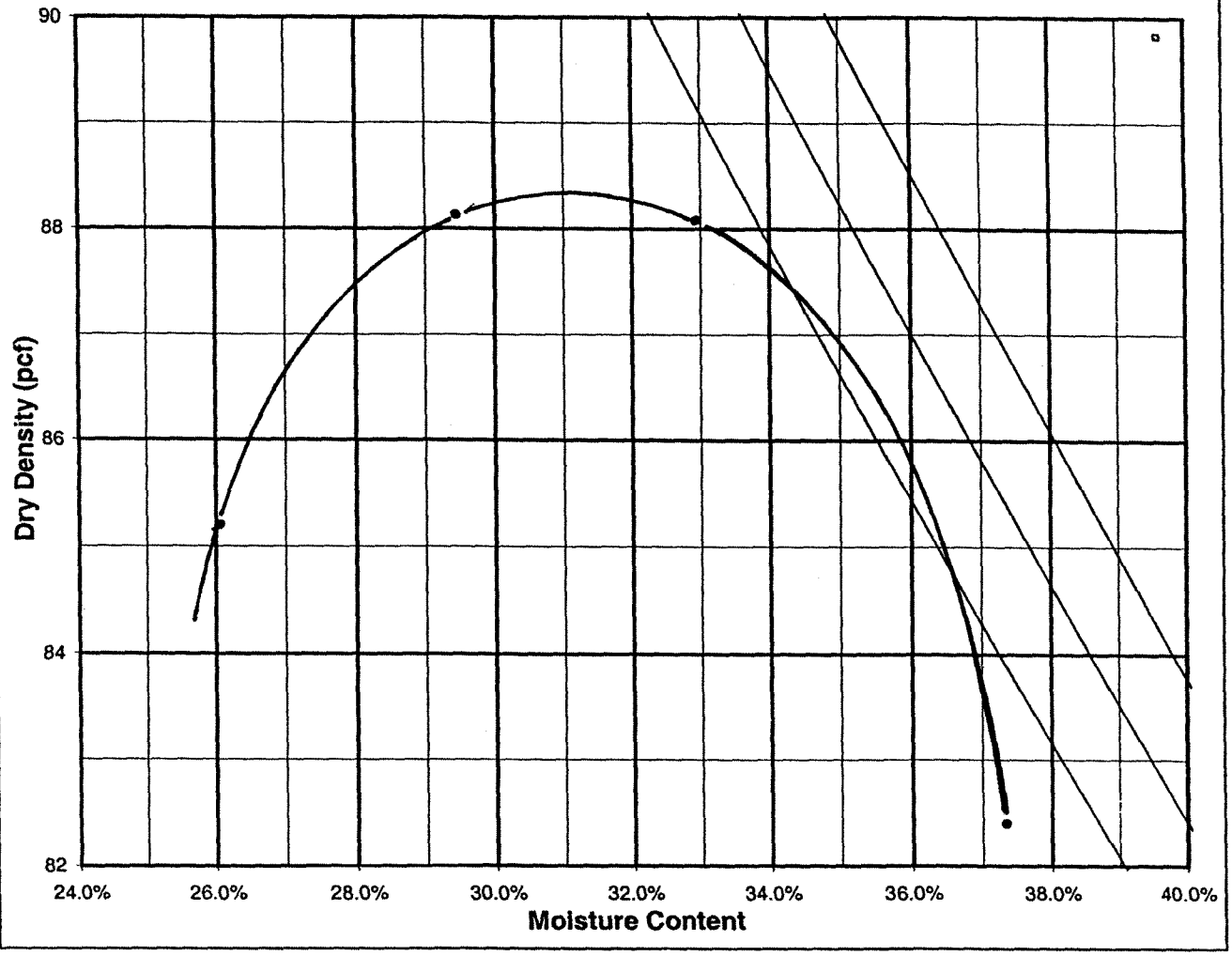
Date: March 2005

PROJECT NO. 24304.11

PLATE NO. 80

A:\Labshts\Compaction BS-3 Keokea Borrow Site\Points Only

MOISTURE-DENSITY RELATIONSHIP



Sample Source: TP-6 Borrow Area Description: Brown clayey SILT with cobbles

	Test Point 1	Test Point 2	Test Point 3	Test Point 4
Wet Density (pcf)	107.4	114.07	117.08	113.16
Moisture Content	26.06%	29.44%	32.93%	37.34%
Dry Density (pcf)	85.20	88.13	88.08	82.40

Maximum Dry Density (pcf): 88.1
Optimum Moisture Content (%) : 29.44
Test Method: ASTM D-1557

Atterberg Limits

LL	PL	PI

COMPACTION TEST RESULTS
ASTM D-1557

PSC Consultants, LLC
SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

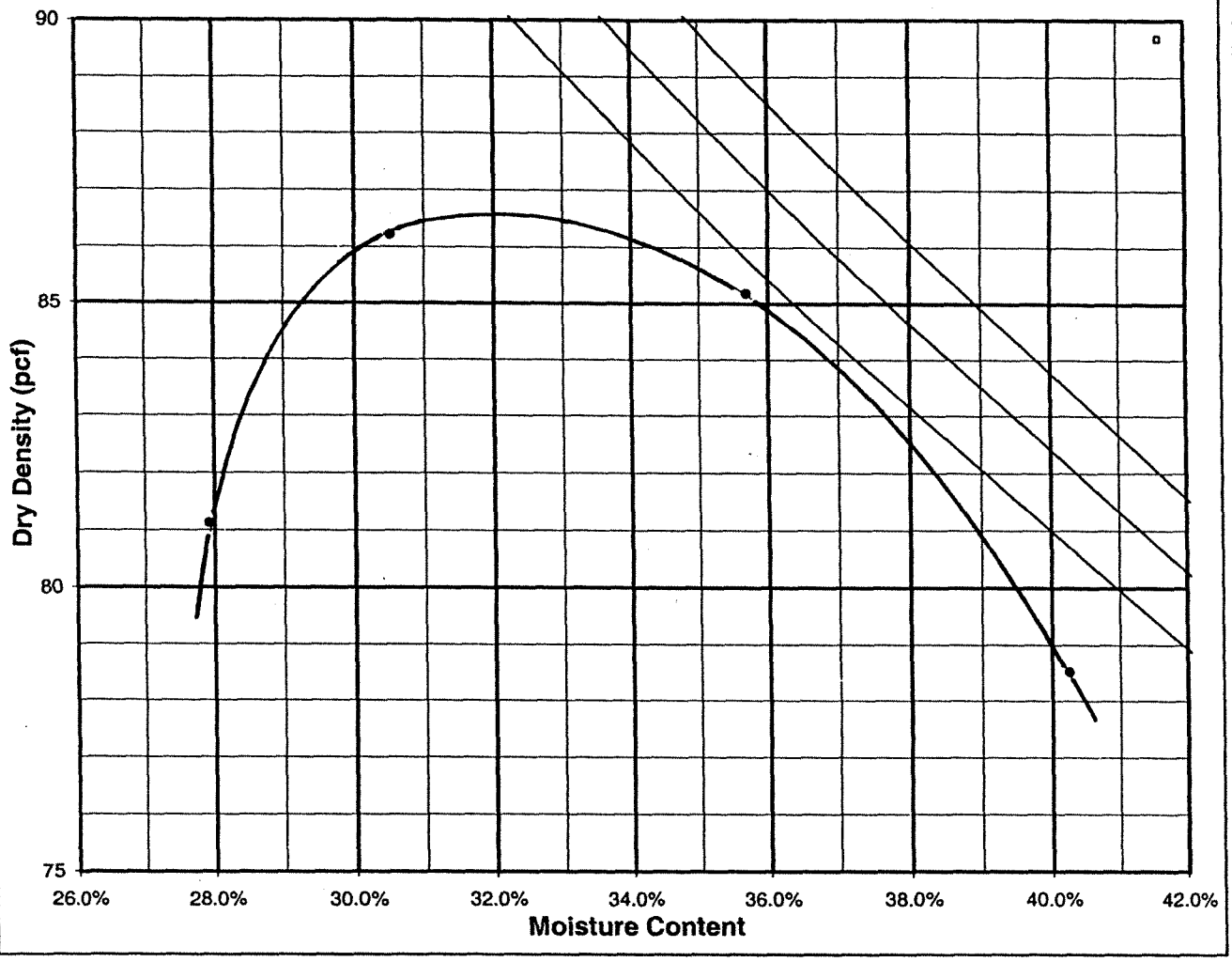
Keokea/Waiohuli Development
Proposed Agricultural Subdivision Bor. Site
Kula, Makawao, Maui, Hawaii

Date: March 2005 | PROJECT NO. 24304.11

PLATE NO. 81

A:\Labshts\Compaction BS-6 Keokea Borrow Site\Points Only

MOISTURE-DENSITY RELATIONSHIP



Sample Source: TP-8 Borrow Area

Description: Brown clayey SILT with basaltic gravel and cobbles

	Test Point 1	Test Point 2	Test Point 3	Test Point 4
Wet Density (pcf)	103.78	112.51	115.58	110.12
Moisture Content	27.92%	30.51%	35.69%	40.25%
Dry Density (pcf)	81.13	86.21	85.18	78.52

Maximum Dry Density (pcf): 86.2

Optimum Moisture Content (%) : 30.5

Test Method: ASTM D-1557

Atterberg Limits

LL PL PI

COMPACTION TEST RESULTS

ASTM D-1557

PSC Consultants, LLC

SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

Keokea/Waiohuli Development

Proposed Agricultural Subdivision Borrow Site

Kula, Makawao, Maui, Hawaii

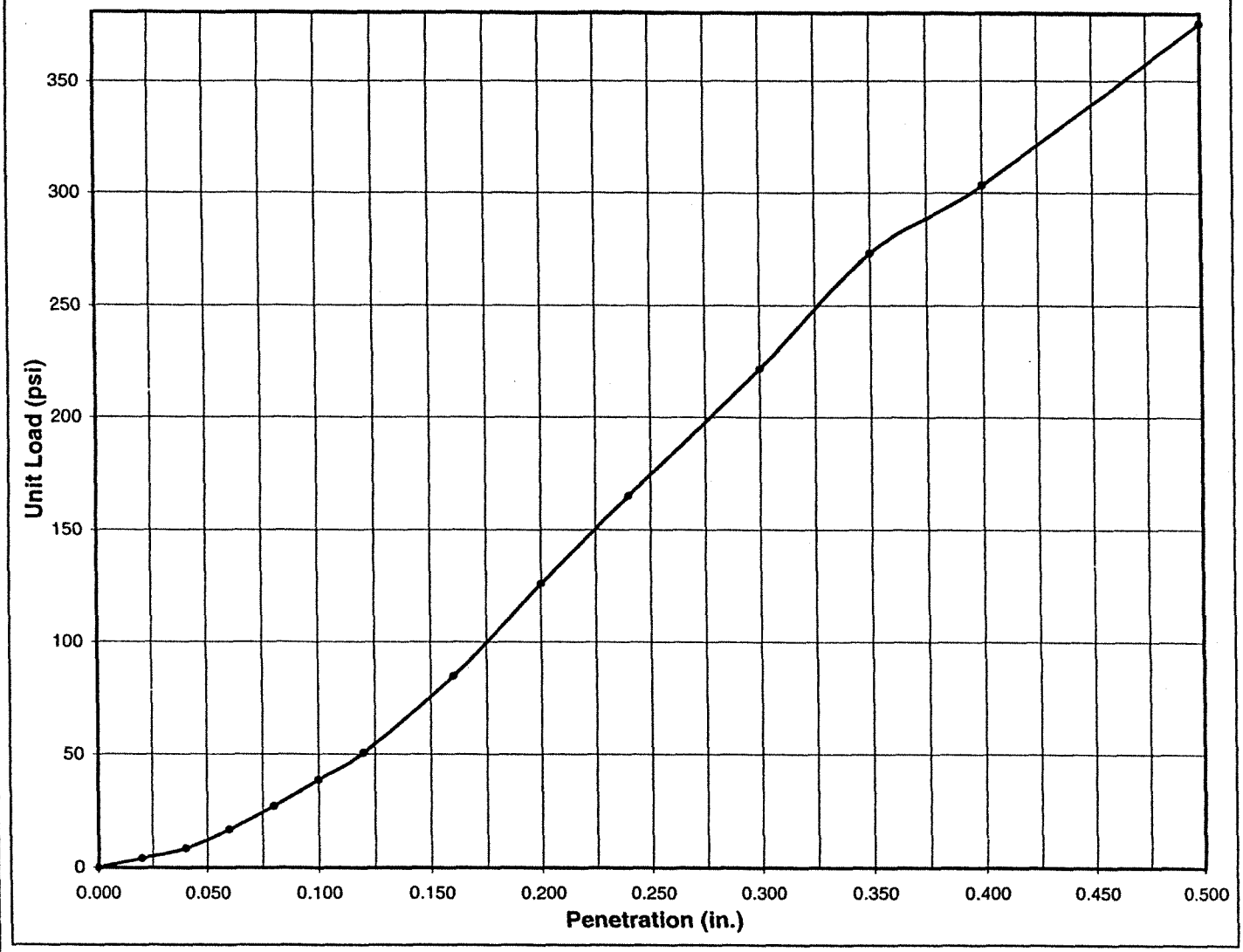
Date: March 2005

PROJECT NO. 24304.11

PLATE NO. 82

A:\Labshts\Compaction BS-8 Keokea Borrow Site\Points Only

CBR CURVE



Sample Source: Borrow Area **Depth:** 0-6 **Description:** Brown silt with approx. 25% sandy gravel

	Before Expansion	After Expansion
Relative Compaction (%):		
Moisture Content (%):	28.21%	29.21%
Dry Density (pcf):	92.35	90.64
Percent Swell or Expansion Value (%):	0.76%	
Compaction Test Method:	ASTM D-1557 A	
CBR Value @ 0.1" Corrected:	3.867	
CBR Value @ 0.2" Corrected:	8.4	

Atterberg Limits

LL	PL	PI

CALIFORNIA BEARING RATIO
ASTM D-1883-94

PSC Consultants, LLC
SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

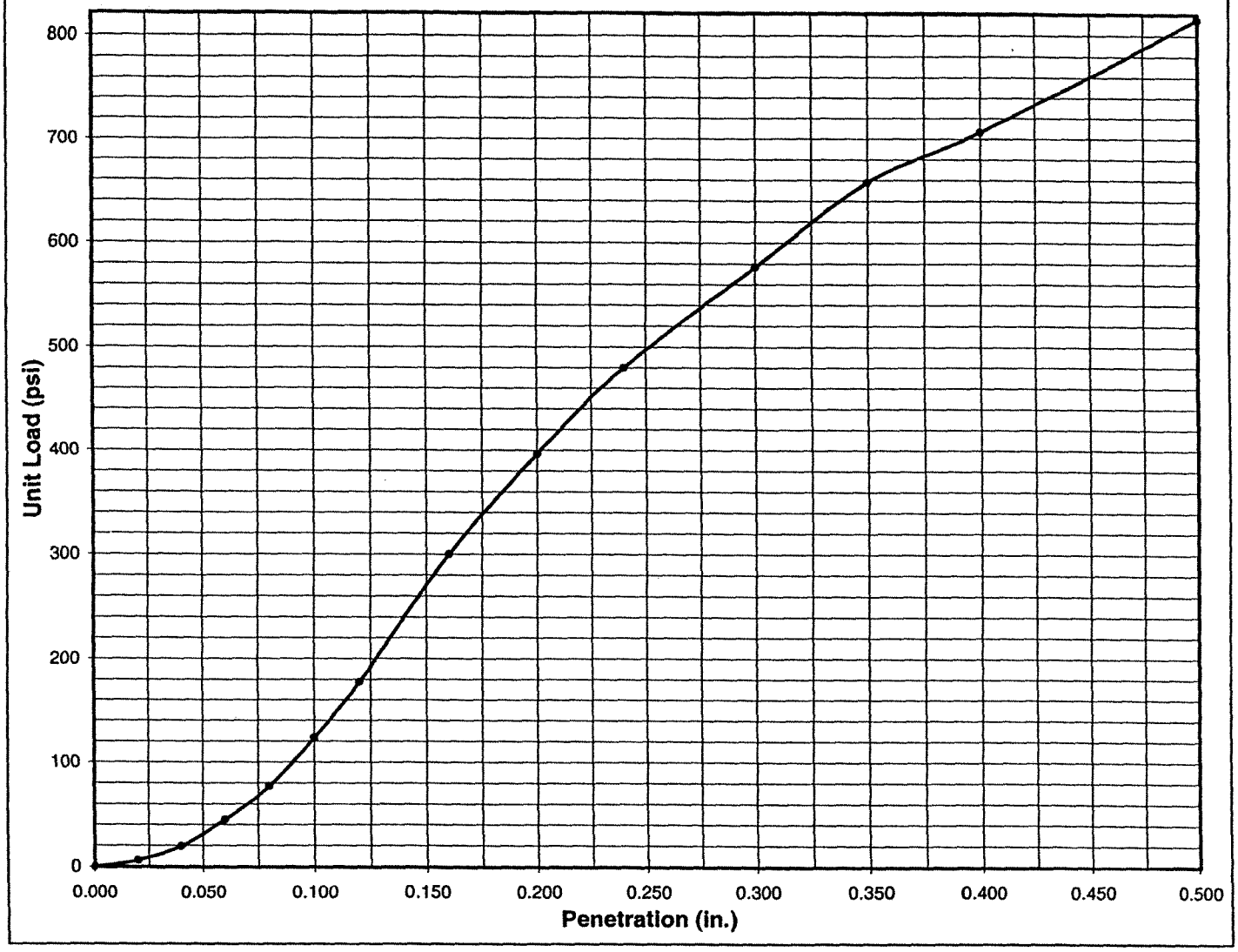
Keokea-Waiohuli Development
DHHL Agricultural Subdivision Road System
Keokea, Maui, Hawaii

Date: March 2005 | PROJECT NO. 24304.10

PLATE NO. 83

A:\Labshts\24304.10CBR-75-25Keokea\CBR Curve

CBR CURVE



Sample Source: Borrow Area **Depth:** 0-6

Description: Brown silt with approx. 50% gravel and sand (ML-GW)

	Before Expansion	After Expansion
Relative Compaction (%):		
Moisture Content (%):	17.38%	22.85%
Dry Density (pcf):	105.03	104.15
Percent Swell or Expansion Value (%):	0.91%	
Compaction Test Method:	ASTM D-1557 A	
CBR Value @ 0.1" Corrected:	12.33	
CBR Value @ 0.2" Corrected:	26.44	

Atterberg Limits

LL	PL	PI

CALIFORNIA BEARING RATIO

ASTM D-1883-94

PSC Consultants, LLC

SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

Keokea-Waiohuli Development

DHHL Agricultural Subdivision Road System

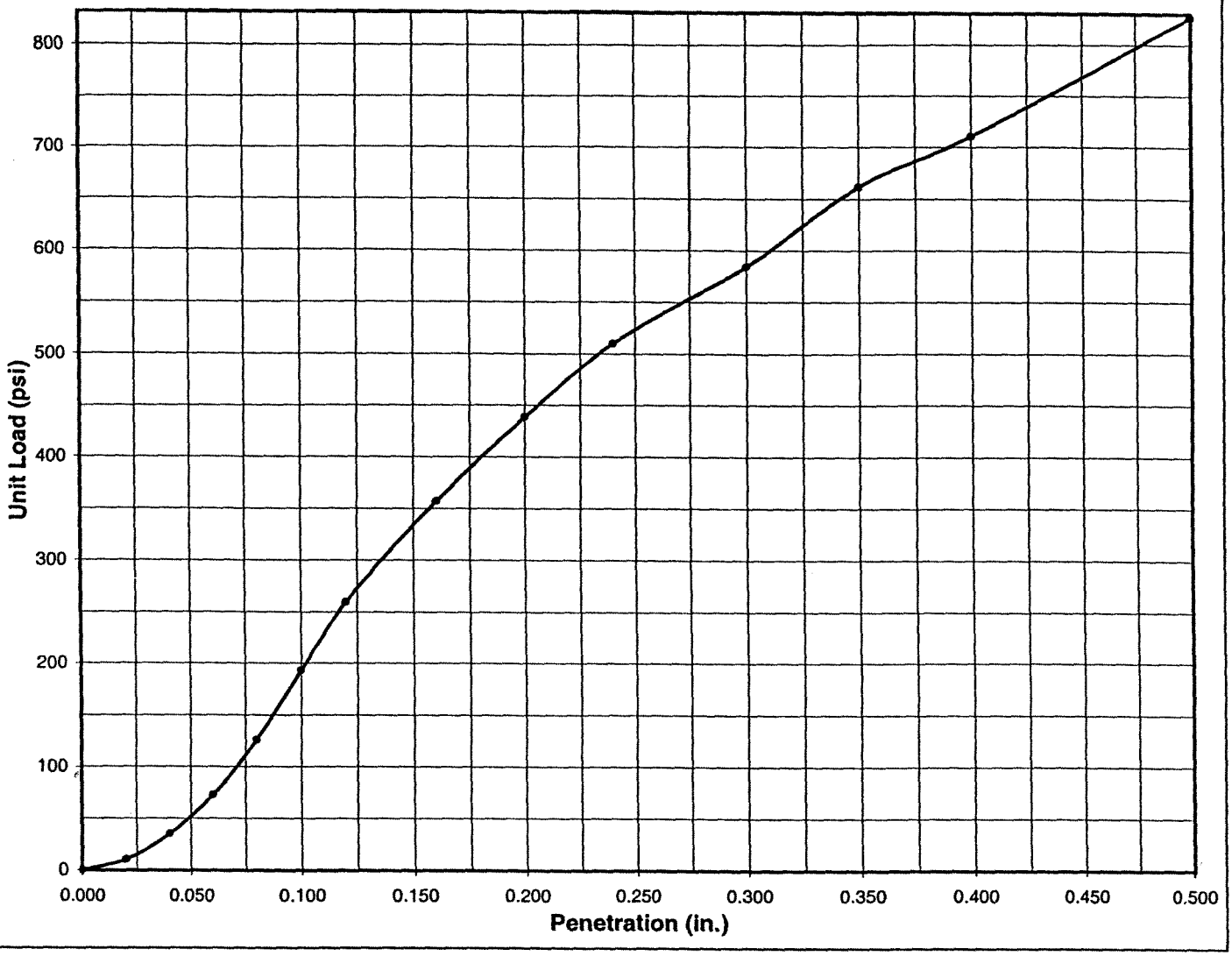
Keokea, Maui, Hawaii

Date: March 2005 | PROJECT NO. 24304.10

PLATE NO. 84

A:\Labshts\24304.10CBR-50-50Keokea\CBR Curve

CBR CURVE



Sample Source: Borrow Area **Depth:** 0-6

Description: 50% Silt with approx. 50% gravel (ML-GP) Gravel>#4 and less than 3/4"

	Before Expansion	After Expansion
Relative Compaction (%):		
Moisture Content (%):	18.02%	23.52%
Dry Density (pcf):	102.20	101.44
Percent Swell or Expansion Value (%):	0.74%	
Compaction Test Method:	ASTM D-1557 A	
CBR Value @ 0.1" Corrected:	19.33	
CBR Value @ 0.2" Corrected:	29.22	

Atterberg Limits

LL	PL	PI

CALIFORNIA BEARING RATIO
ASTM D-1883-94

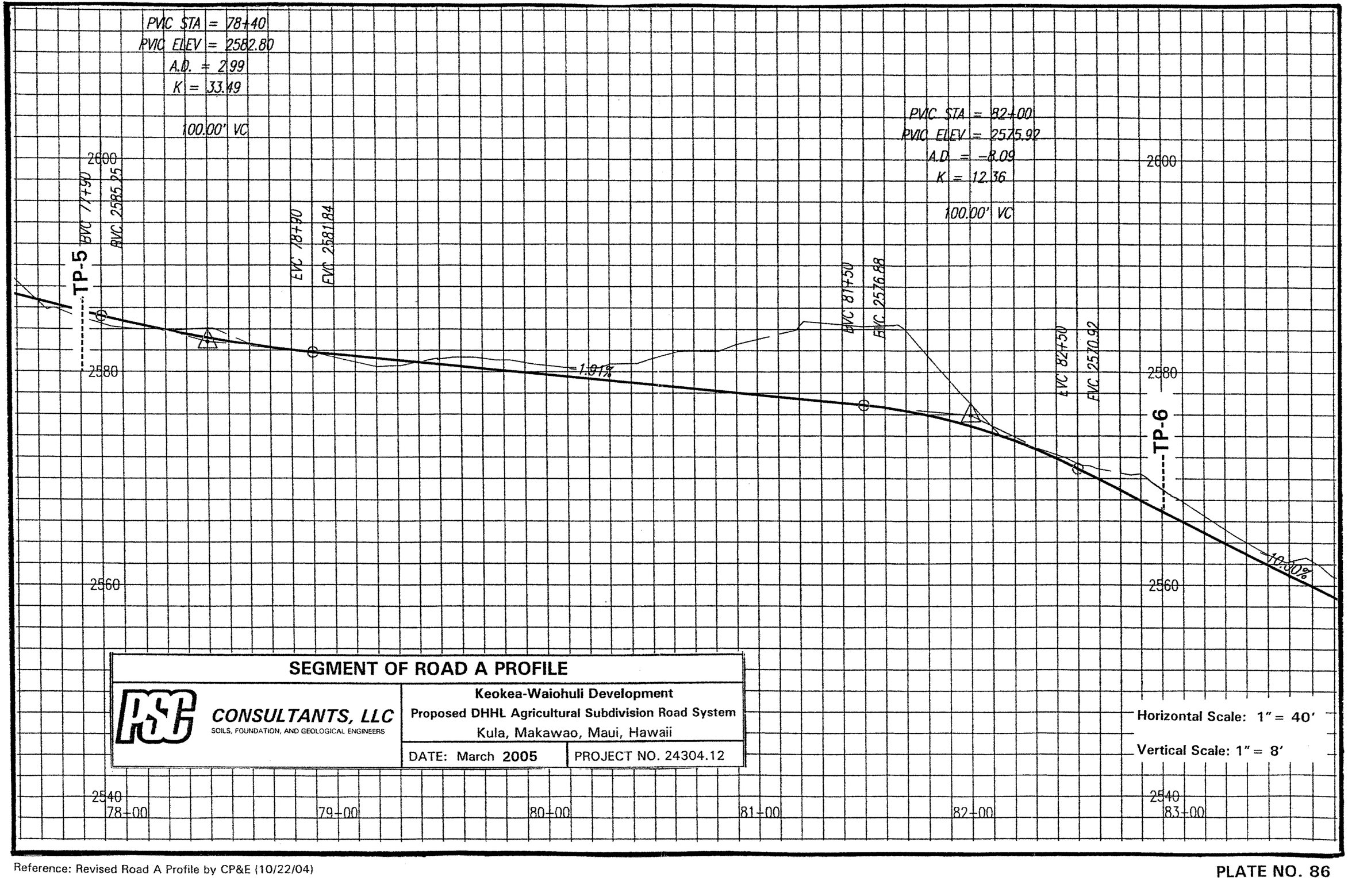
PSC Consultants, LLC
SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

Keokea-Waiohuli Development
DHHL Agricultural Subdivision Road System
Keokea, Maui, Hawaii

Date: March 2005 | PROJECT NO. 24304.10

PLATE NO. 85

A:\Labshts\24304.10CBR-50Fine-50CoarseKeokea\CBR Curve



SEGMENT OF ROAD A PROFILE

PSC CONSULTANTS, LLC
SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

Keokea-Waiohuli Development
Proposed DHHL Agricultural Subdivision Road System
Kula, Makawao, Maui, Hawaii

DATE: March **2005** | PROJECT NO. 24304.12

Horizontal Scale: 1" = 40'

Vertical Scale: 1" = 8'

Reference: Revised Road A Profile by CP&E (10/22/04)

PLATE NO. 86

PRELIMINARY GEOTECHNICAL EXPLORATION REPORT
KEOKEA-WAIOHULI SUBDIVISION PHASES 1, 2, and 4A
KULA, MAKAWAO, MAUI, HAWAII
TMK: (2) 2-2-002:14, 55 AND 71

For:

Community Planning and Engineering, Inc.
1286 Queen Emma Street
Honolulu, Hawaii 96813

By:

Geotechnical • Environmental • Construction Management
Testing • Inspection • Drilling & Sampling

CORPORATE HEADQUARTERS
94-547 Ukee Street, Suite No. 210
Waipahu, Hawaii 96797

Tel: (808) 676-6677 - Fax: (808) 676-7733 - Email: pscwahi@pscconsultants.com
www.pscconsultants.com

April 2013

PSC Job No. 212302.20

PRELIMINARY GEOTECHNICAL EXPLORATION REPORT
KEOKEA-WAIOHULI SUBDIVISION PHASES 1, 2 AND 4A
KULA, MAKAWAO, MAUI, HAWAII
TMK: (2) 2-2-002:14, 55 and 71

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PRELIMINARY GEOTECHNICAL EXPLORATION REPORT
KEOKEA-WAIOHULI SUBDIVISION PHASES 1, 2 and 4A
KULA, MAKAWAO, MAUI, HAWAII
TMK: (2) 2-2-002:14, 55 and 71

April 05, 2013 PSC Job No. 212302.20

SUMMARY OF FINDINGS AND RECOMMENDATIONS

The project site includes the future construction at Phases 1, 2 and 4A within the Keokea-Waiohuli Development on the western slopes of Mount Haleakala. Phase 1 has been constructed and the future construction will cover grading work for drainage and lot boundary shifts at some lots. Phase 2 covers construction at Roads H, J and extension of Road E, and includes about 70 lots. Phase 4A covers Road M and includes about 25 lots.

The area is underlain by volcanic flows of basaltic andesite, andesitic basalt and picritic basalt geologically termed as the Kula volcanic series. Sections of the subdivision within the Kula Volcanic series will encounter volcanic ash generally intermixed with vitric tuffaceous gravels, cobbles and boulders of varying proportions (vitric) on top of the andesitic basalts. The surface soils range in thickness from 0 to more than 8 feet in some locations. The Kula volcanic ash by itself is not suitable for engineered fills due to its low density, weak strength and high natural moisture content. The surface soils are generally classified as silt (MH) based on the Unified Soil Classification System, and when dry are prone to wind and water erosion. Laboratory tests from the previous preliminary geotechnical exploration for roadways show that these silts near ground surface, a silt/volcanic ash soil, generally have relatively low dry densities and do not provide adequate support for the proposed road.

To achieve a relatively uniform support under the roadway and culvert foundations, it is recommended that the soft or loose silt/ash soils be excavated down to 2 feet below the design/finish subgrade or until stiff to very stiff silt or gravelly materials are exposed. The silt/ash soils should then be replaced with non-expansive, select fill material.

This report supplements the Geotechnical Exploration Report of Typical Foundations on Certain Lots at Keokea-Waiohuli Development dated April 30, 2007, and Preliminary Geotechnical Exploration Report for the Keokea-Waiohuli Development dated March 31, 2005 by PSC Consultants, LLC.

INTRODUCTION

This report presents the results of our geotechnical exploration and survey to develop typical roadway, general grading and drainage recommendations for the proposed Keokea-Waiohuli Development for Phases 1, 2 and 4A located at Keokea and Waiohuli, Maui, Hawaii. The general location and vicinity of the project site is shown on the Project Location Map, Plate 1.

PSC
CONSULTANTS, LLC

Our work on the project was performed in general accordance with our proposal and scope of work dated May 4, 2012. This report summarizes our findings and recommendations.

PROJECT CONSIDERATIONS

The project site is within the partially completed Keokea-Waiohuli Development located along the western slopes of Mount Haleakala west of Kula Highway Route 37 opposite Keokea Park. The terrain within the undeveloped area is steep to moderate and rough with boulders, cinder flows and rock outcrops. The majority of the study area, particularly the southern half of the site, is covered with vegetation consisting of groves of haole koa trees, giant cacti and grass. The northern half of the site contains fewer trees and was previously used as pasture or graze land. The site generally slopes downward in a western direction from Kula Highway. The proposed new construction includes approximately 95 lots and Roads H, J and M, and extension of Road E. Roads A, D and most of Road E were completed by a previous construction contract. This area is shown in Plate 3, Site Plan - Roads.

The previous reports by PSC Consultants revealed that the surface soil in the areas studied consisted of light brown to brown clayey silt with gravel and cobbles. This soil has high insitu moisture content and low dry density, and in the dry and uncompacted state, exhibits little or no cohesion and becomes highly susceptible to erosion from both wind and water. A dense and weathered basalt formation is present as occasional outcroppings and under the surface soils. Volcanic ash pockets are present, and this ash is characterized by poor workability, and in its dry state, becomes very loose.

The volcanic ash derived soil, in its pure form, is not recommended for engineered fill or for road embankment unless it is reconstituted with granular material. A recommended grading scheme consists of removing 2 feet of the surface volcanic ash soil material below the design subgrade where ash is encountered and replacing these with borrow fill of non-expansive granular capping material to support the roadway pavement structure.

A borrow area designated as a stockpile site is located at the northwestern lower end of the construction site. This area was a former borrow site (Plate 2) and will be used as a source of general fill material and as disposal area for the unsuitable soils that will be removed from the roadway construction site.

The excavation and embankment quantities for the new construction were not available but is expected to balance. We anticipate that asphaltic concrete pavements and or concrete pavements will be required for Roads H, J and M, and Road E extension. While specific traffic loading has not been specified, we anticipate a medium vehicle loading for the project consisting primarily of passenger vehicles and delivery trucks.

PURPOSE AND SCOPE

The purpose of our geotechnical exploration and survey is to gather information on the nature, distribution and characteristics of the near surface soils encountered for the new roads and to provide grading and pavement recommendations for the proposed roads. The scope of our exploration consisted of the following tasks and work efforts:

1. Review of the existing available data from published and unpublished sources pertaining to the geology and soil conditions at the site and conduct a reconnaissance survey of the project site;
2. Schedule the field exploration and coordinate with Community Planning and Engineering, Inc. (CPE) for the test pit locations and site access;
3. Coordinate field exploration and logging of the test pits by a field engineer;
4. Excavate 9 test pits, 1 to 5 feet deep, with use of backhoe, approximately 400 feet apart (including test pits and borings under the March 2005 report) along Roads H, J and M, Road E extension and at the stockpile site, and collect surface bulk samples for classification and CBR tests for pavement design;
5. Classify the materials encountered and to evaluate their engineering properties relative to their intended use by laboratory testing of select soil samples obtained from the field. Also conduct CBR tests to determine their suitability for pavement support;
6. Mobilization and demobilization of drilling/excavating equipment and operators; and
7. Preparation of this report summarizing our work on the project and presenting our findings and recommendations.

SUBSURFACE CONDITIONS

Project Site Geology

The project site is underlain mainly by volcanic flows of basaltic andesite, andesitic basalt and picritic basalt, geologically termed as the Kula volcanic series. These volcanic flows are covered with a surface layer of volcanic ash derived silt sometimes intermixed with tuffaceous gravels, cobbles and boulders (weathered tuff) generally described as Kula Loam in the majority of the study area. These surface soils range in thickness from surface outcroppings of basaltic rock to more than 4 feet in some locations. The ash material is generally not suitable for pavement and foundation support, and for embankment fill.

Subdivision Road Alignment

The proposed road network will generally traverse over volcanic-ash derived silt materials with varying amounts of gravels, cobbles and boulders. The thickness of the surface soil layer ranges from 1- to about 8-feet deep.

Plate 3 shows location of existing roads adjoining the proposed roads.

Road H
Road "H" is about 2,000 feet in length and connects Road E extension to existing Road F. Two test pits, TP-4 and TP-9 (Plates 8 and 13), were excavated along this road and encountered a basalt layer at about 4 feet and 2 feet below ground elevation, respectively.

Road J
Road J runs parallel to existing Road F and is located at the west side of subdivision, about 1900 feet in length, connecting Road E extension with existing Road D. Test pits 5 and 6 (Plates 9 and 10) encountered a basalt layer at about 2 feet and 4 feet below ground level, respectively.

Road M
Road M is located at the east side of subdivision about 2500 feet in length, connects to Road E at the north side of Road M and connects to Road A at the south side. Test pits 1 and 2 (Plates 5 and 6), both encountering basalt layers at about 4 feet below ground level.

Road E Extension
Road E extension is located at the west side of the subdivision and extends west from existing Road E approximately 600 feet. Test pit 3 (Plate 7) at intersection of Road E and H shows a basalt layer at 2 feet below ground level.

Borrow/Stockpile Site
The designated borrow/stockpile site is located in an area about 1600 feet north of proposed Road J. This site was a former borrow area covered in PSC report dated March 2005 with ten borings and was used as a borrow area for engineered fill material during the construction of Keokea-Waiohuli Development in 2006-2008. Test pits 7 and 8 (Plates 11 and 12) were excavated in the stockpile area.

Currently, this area is a stockpile area about 10 feet high. Test Pits 7 and 8 were excavated to observe the type of material within the stockpile area. Test Pit 7 was dug at the southern corner below Waiohuli Detention Basin No. 1 and encountered 6.5 feet of gravelly silt over basalt. Test Pit 8 was dug on the northern corner of the Borrow/Stockpile site and encountered about 7 feet of silty gravel underlain by basalt. Based on the materials encountered at the test pits, the materials at the stockpile area are suitable for use as general fill. Any unsuitable materials, if encountered, should not be used as general fill.

DISCUSSION AND RECOMMENDATIONS

General
Our field exploration and visual mapping indicated that volcanic ash derived silt soil, also known as Kula Loam, generally cover the project site, occasionally with varying amounts of gravel, cobbles and boulders. Occasional basaltic rock outcrops are also common. The thickness of surface soil ranges from approximately a few inches to more than 8 feet in some locations

throughout the project site. These silt soils contain relatively high amounts of moisture. In a dry state, it loses cohesive strength and becomes prone to wind and water erosion. Our field exploration also showed that a large part of the soil overburden within the study area contained considerable amounts of coarse materials such as tuffaceous/basaltic gravels, cobbles and boulders. In some areas the coarse materials exceeded the fines. These overburden materials are underlain with fresh to moderately weathered andesitic basaltic flows known as Kula volcanic series.

Site Preparation

At the onset of earthwork, the area within the contract grading limits should be cleared of trees, vegetation, debris, rubbish, boulders and other deleterious materials. These materials should be removed and properly disposed of off-site.

Areas to receive fill (such as at silt, silty gravels and gravelly silt areas) are to be over-excavated down 2 feet, and scarified to a depth of 6 inches. The subgrade should then be moisture conditioned to about 2 percent above optimum moisture content and recompacted to a minimum of 90 percent of its maximum dry density as determined in accordance with ASTM Test Method D1557-78. Soft or yielding areas should be over-excavated to expose firm soil surface and stabilized by backfilling with select material placed in 8-inch thick loose lifts and compacted to 90 percent of its maximum dry density.

Site Grading

General

Currently, numerous boulders, rock outcrops and groves of haole koa trees abound at the site. The boulders may be stockpiled for future use, such as for rip rap, gravity walls, landscaping and other such purposes.

Materials used for fills placed within the upper 2 feet of the embankments should be select non-expansive material less than 3 inches in maximum dimension. If additional off site borrow soil is required, it should be tested and approved by a geotechnical engineer prior to its delivery to the project site.

Earthwork and Grading

Soft or loose unsuitable silt/volcanic ash soils encountered within the roadways should be stripped to a depth of at least 2 feet below grade or until stiff to very stiff or gravelly materials are encountered, and replaced with select granular material. Where the design subgrade encounters silty gravel, gravelly silt with cobbles, and boulders or weathered basalt, over excavation will not be necessary. After grading, scarification and proof rolling, the subbase and base course may be placed directly on top of these gravelly insitu materials. If the clinker gravel is covered in volcanic ash matrix, the use of a geofabric, such as Mirafi 140, is recommended to prevent contamination of the select borrow fill or subbase. Where fresh basalt rocks are encountered, the subbase course may be placed directly over the basalt rocks after grading.

Over Excavation

Some of the existing upper silt/volcanic ash soils do not contain, or have very little percentage of coarse material and are not suitable for support of roadways, house pads and driveways. These soils are porous (susceptible to collapse/settle with increased water content), have a relatively low dry density, are prone to erosion, and should be over-excavated and replaced with select onsite granular soils or borrow. The silt/volcanic ash should be over excavated down to at least 2 feet or until stiff to very stiff or dense gravelly materials are encountered, and replaced with select granular materials.

Fill Placement and Compaction

The fill should be placed in level lifts with a maximum loose thickness of 8-inches and compacted to a minimum of 90 percent at house pads and 95 percent at driveways. Each layer should be spread uniformly and processed to attain uniformity of the material and water content. Additional fill material should not be placed on any fill layer which has not been properly compacted and tested.

Lava tubes, if encountered, should be filled with select granular material.

Boulder Fills

Many surface boulders were noted around the site. In addition, a large quantity of boulders will be generated from excavation operations. Boulders at the surface and in the excavations may be used in the deeper fills, provided that the following recommendations are followed:

1. Boulders must not be nested together and should be placed so that compaction equipment is able to suitably compact the soil around them. Boulder placement and compaction should be reviewed and monitored by a geotechnical engineer;
2. Boulders, 6'' plus size rocks, can be used below 5 feet from finish grade or below utility lines whichever is at the greater depth; and
3. Care must be exercised to avoid placement of boulders in proposed utility alignments to prevent difficulty in later excavations of utility trenches.

Slopes

Cut and fill slopes of 2H:1V (horizontal to vertical) may be used. This is based on the assumption that cut slopes have a high percentage of gravels and cobbles and the fill slopes will be constructed of select material.

Steeper cut slope ratios up to 1H:1V may be used in weathered basalt formations.

Fill slopes should be constructed by overfilling 2 to 3 feet, then cutting back to the design slope to obtain a well-compacted slope face.

Where the existing ground is steeper than five horizontal to one vertical (5H:1V), keying and benching are required to properly bond the new fill to the slope. The filling

operations should start at the lowest point and continue up in level compacted layers, as recommended above.

Water should be diverted away from the tops of slopes and slope planting should be implemented to minimize surface erosion.

Pavements

We anticipate that asphaltic concrete pavements will be required for the roadways in the subdivision and while specific traffic loading has not been specified, we anticipate a medium vehicle loading for the project consisting primarily of passenger vehicles and delivery trucks. We have made our preliminary pavement design assuming the pavement subgrade soil will consist of compacted tuffaceous, basaltic/andesitic fill materials with a minimum CBR value of 25. The fill material within 2 feet below the pavement subgrade should be compacted to 95 percent relative compaction. Based on the above assumptions, we recommend the following flexible and rigid pavement sections be used for preliminary design purposes:

Flexible Pavement Section

2-Inches	Asphaltic Concrete
6-Inches	Aggregate Base Course
6-Inches	Aggregate Subbase Course
14-Inches	Total Pavement thickness on a minimum of 2 feet of properly compacted select borrow material or insitu basaltic/andesitic rock formation.

Rigid Pavement Section

6-Inches	Concrete
6-Inches	Aggregate Subbase Course
12-Inches	Total Thickness

The base course should be compacted to 95 percent of its maximum dry density as determined in accordance with ASTM Test Method D 1557-91.

CBR and density test and/or field observations should be performed on the actual subgrade used for the road construction to confirm the adequacy of the above pavement sections. The recommended pavement sections assume that adequate drainage will be provided.

Service Roads

Surface topping will be 3" minus select material. Where dense rocks and cobbles are present, the select material will be placed on the rock/cobble surface. If silt is present on dense rocks and cobbles, the silt should be cleaned from the rocks and cobbles. At silt areas, roadway should be cleared to 12" below service road finish grade and select material placed to 12" thickness. Select material should be rolled to provide a compacted smooth surface.

Road Drainage
Subdrains should be provided where there is a possibility that runoff from rainfall or irrigation could saturate the subsurface soils. Exposed surface soils should be protected from erosive runoff by providing surface drains, diversion berms and other flood control devices. The access of water into the roadbed soil under the pavement should be minimized in order to stabilize the moisture content as by incorporating water inhibiting membrane into the design as described in Item 1.21.1-d of the DOT Pavement Design Manual (Rev. March 2002).

Utility Trenches
We envision that utility lines will be required for the proposed subdivision road project. A granular bedding consisting of 6 inches of No. 3B Fine gravel is recommended under the pipes. Free draining granular materials, such as No. 3B Fine gravel (ASTM C 33, No. 67 gradation), should also be used for the trench backfill, up to about 12 inches above the pipes to provide adequate support around the pipes and compaction of the No. 3B fine gravel should be lowered to reduce potential for damage to the pipes.

The upper portion of the trench backfill from 1-foot above the pipes to the top of the subgrade or finished grade should consist of select granular material. The backfill should be moisture conditioned, placed in maximum 8-inch, level, loose lifts and mechanically compacted to not less than 90 percent relative compaction to reduce the potential for future ground subsidence. Where trenches are below pavement areas, the upper 2 feet of the trench backfill below the pavement finish grade should be compacted to 95 percent relative compaction.

Design Review
Drawings and specifications for the proposed construction should be submitted to PSC Consultants, LLC, as geotechnical consultant, for review and written comments prior to construction. This review is needed to evaluate adherence of the plans to the recommendations provided herein. If this review is not made, PSC cannot assume responsibility for the interpretations made by others or errors resulting there from.

Construction Observation and Testing
The recommendations provided in this report are based on subsurface conditions disclosed by widely spaced exploratory borings and excavations. The geotechnical consultant should check the interpolated subsurface conditions during construction. The geotechnical consultant should attend the pre-construction meeting between the contractors and owners/designers.

During grading, the geotechnical consultant should;

- ❖ Observe excavation, placement and compaction of engineered fill for the road pavement structures;
- ❖ Observe preparation and compaction of aggregate base for asphalt/concrete pavement and flatwork subgrade;
- ❖ Check and test any imported materials prior to their use as fill;

- Perform field tests to evaluate fill compaction;
- Observe subgrade conditions at the bottom of pipeline trenches;
- Observe fill placement and compaction around the pipes in the utility trenches; and
- Observe the fine-grading and exterior drainage improvements constructed around the finished structures.

The recommendations provided in this report assume that PSC will be retained as the geotechnical consultant during the construction phase of the project. If another geotechnical consultant is selected, we request that the selected consultant provide a letter to the architect/designer and owner/client (with a copy to PSC) indicating that they fully understand our recommendations and that they are in full agreement with the recommendations contained in this report. If deviations from soil conditions and recommendations presented in this report occur, they should provide amended recommendations as new geotechnical consultants of record for the project.

LIMITATIONS

The analyses and recommendations submitted in this report are based, in part, upon information obtained from field test pits and visual observations. Variations of subsoil conditions between the test pits may occur, and the nature and extent of these variations may not become evident until construction is underway. If variations then appear evident, it will be necessary to reevaluate the recommendations provided in this report.

The test pit locations were selected by PSC Consultants LLC, by taping existing features and structures shown on the plans available. The physical locations and elevations should be considered accurate only to the degree implied by the method used.
This report has been prepared for the exclusive use of Community Planning and Engineering, Inc., their client and their consultants for specific application to the proposed Keokea-Waiohuli Development Phases 1, 2 and 4A in accordance with generally accepted geotechnical engineering principles and practices. No warranty is expressed or implied.

This report has been prepared solely for the purpose of assisting Community Planning and Engineering, Inc. in the design evaluation of the proposed project. Therefore, it may not contain sufficient data or proper information to serve as the basis for preparation of construction documents and cost estimates for a roadway or lot construction. A contractor wishing to bid on this project is urged to retain a competent geotechnical engineer to assist in the interpretation of this report and/or in the performance of additional site-specific exploration for bid estimating purposes.

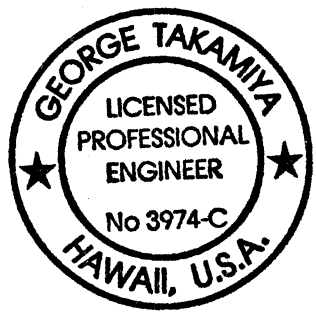


The owner/client should be aware that unanticipated soil/rock conditions are commonly encountered. Unforeseen soil/rock conditions, such as soft deposits, hard layers or cavities, may occur in localized areas and may require probing or corrections in the field (which may result in construction delays) to attain a properly constructed project. Therefore, a sufficient contingency fund is recommended to accommodate these extra costs.

The findings in this report are valid as of the present date. However, changes in the soil conditions can occur with the passage of time whether they are due to natural processes or to the works of man on this or adjacent properties. In addition, changes in applicable or appropriate standards occur, whether they result from legislation, or from the broadening of knowledge. Accordingly, the findings in this report might be invalidated, wholly or partially, by changes outside of our control. Therefore, this report is subject to review by the controlling agencies and is valid for a period of 2 years.

Respectfully submitted,
PSC CONSULTANTS, LLC

Derrick Chan
Project Engineer



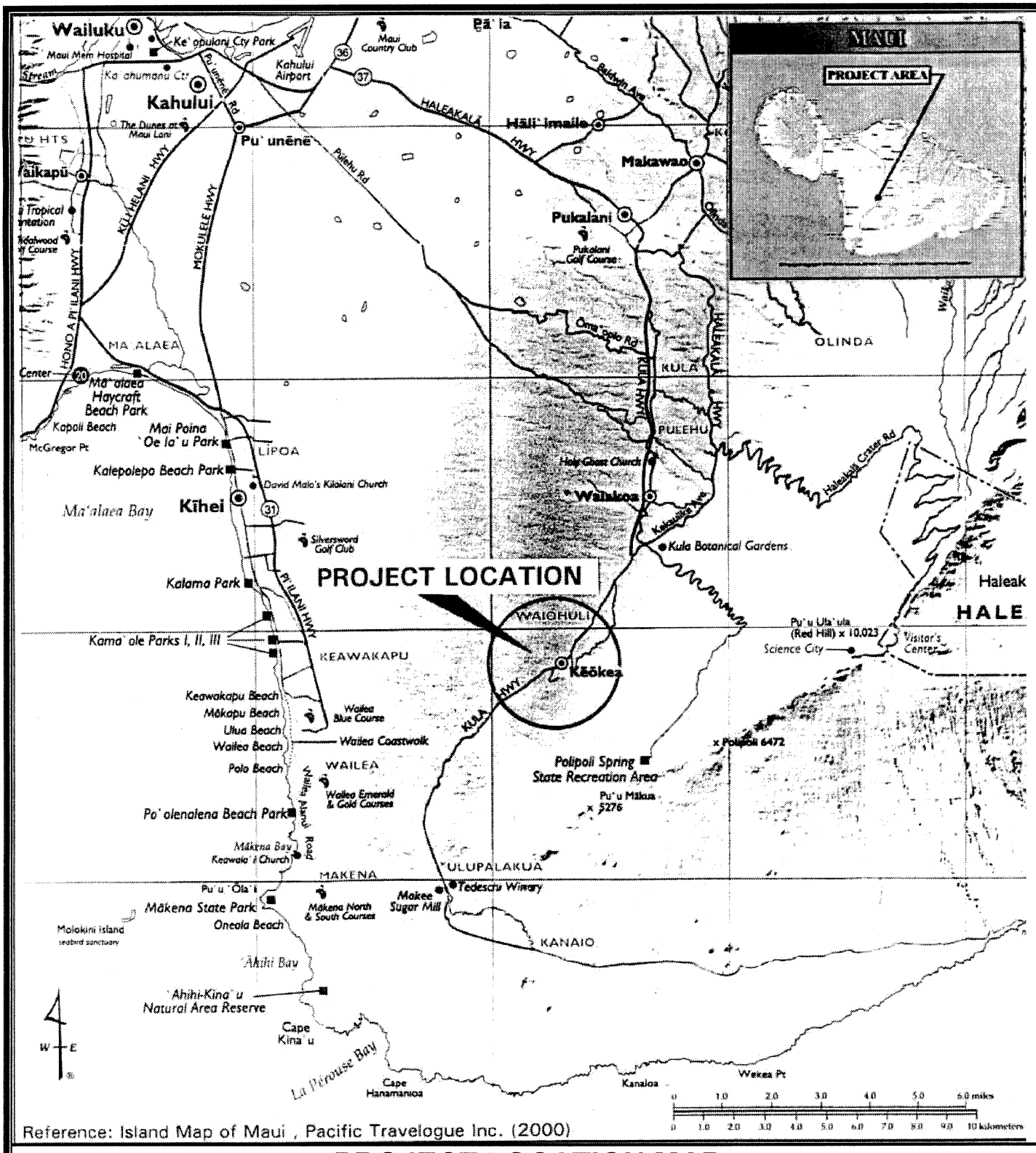
This work was prepared by
me or under my supervision
(License Expires April 2014)

George Takamiya, PE
Senior Engineer

DC/GT/PSC:lk

Enclosures:	Plate 1	Project Location Map
	Plate 2	Site Plan
	Plate 3	Site Plan - Roads
	Plate 4	Site Plan - Borrow/Stockpile Site
	Plates 5 through 13	Log of Boring (TP1 through TP9)
	Plate 14	Unified Soil Classification System
	Plate 15	Rock Classification System
	Plates16 through 19	Compaction Test Results – ASTM D1557
	Plate 20	California Bearing Ratio – ASTMD1883
	Plates 20A through 20C	California Bearing Ratio – ASTMD1883-94
	Plate 21	Grain Size Distribution
	Plates 22 through 25	Sieve Analysis – ASTMD422-63
	Plate 26	Atterberg Limits Data

PSC CONSULTANTS, LLC



Reference: Island Map of Maui , Pacific Travelogue Inc. (2000)

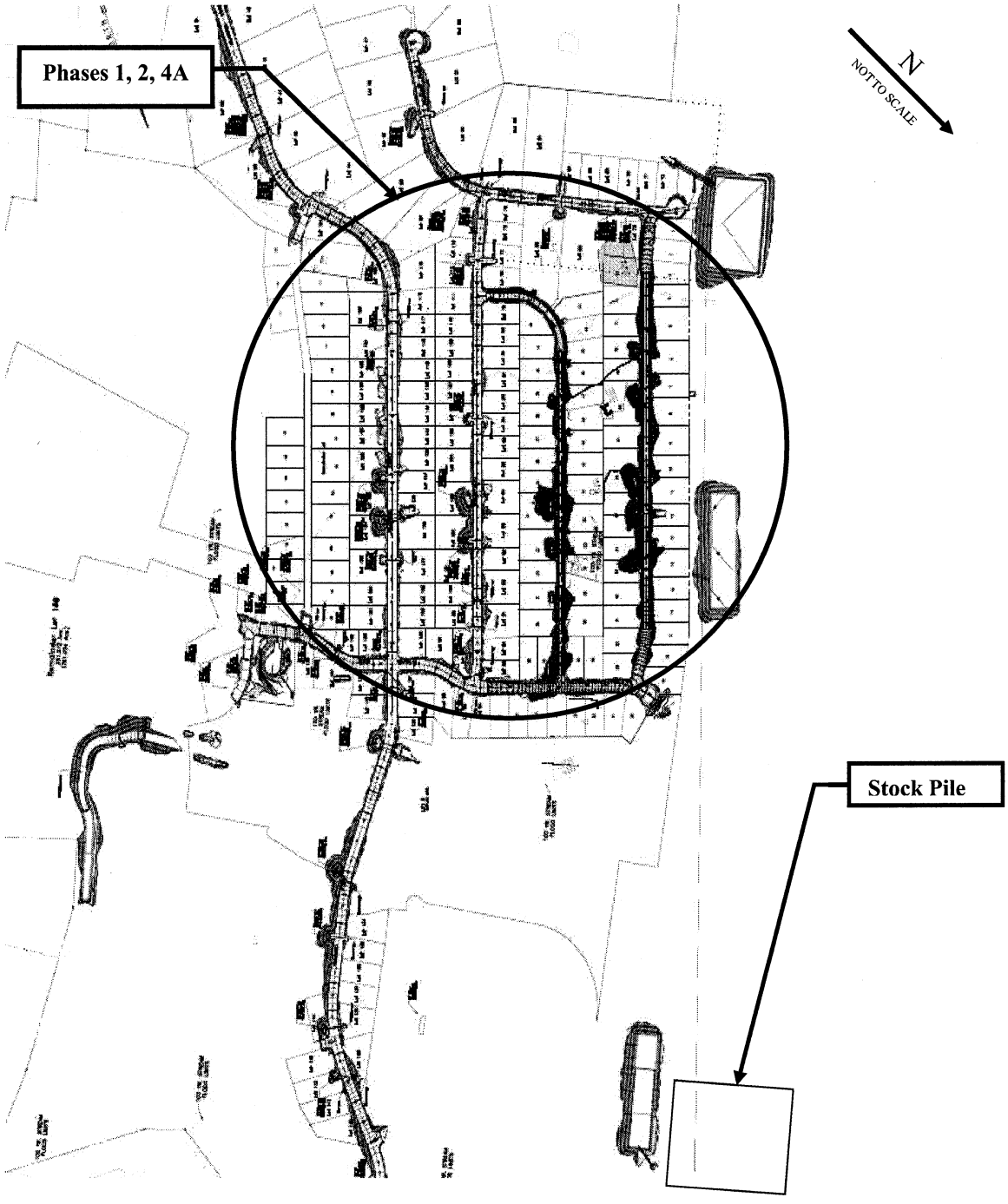
PROJECT LOCATION MAP

CONSULTANTS, LLC
SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

Keokea-Waiohuli Subdivision Phases 1, 2 and 4A
Kula, Makawao, Maui, Hawaii

DATE: April 2013 | PROJECT NO. 212302.20

PLATE 1



Reference: CPE Site plan of Phases 1, 2, 4A

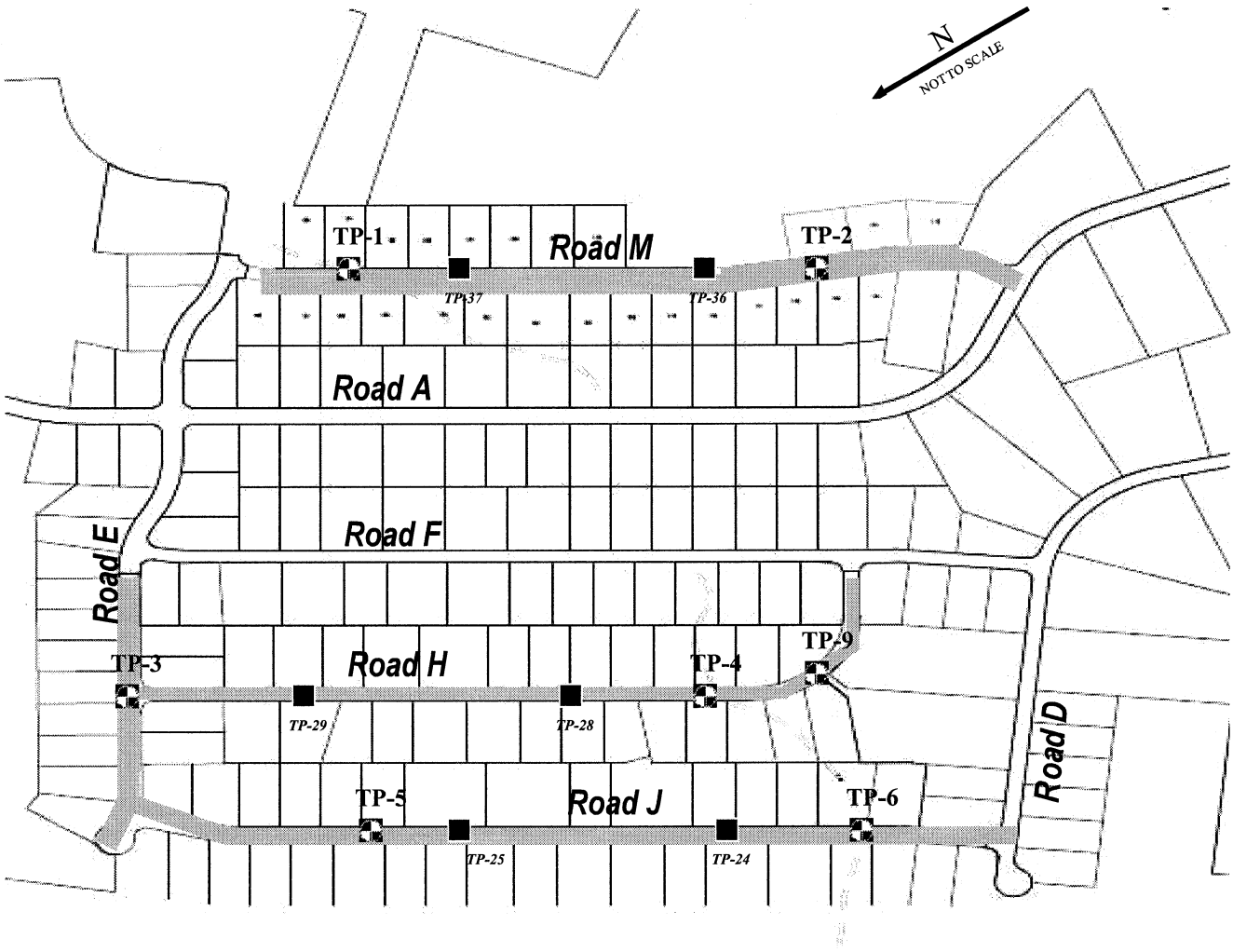
SITE PLAN

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Keokea-Waiohuli Subdivision Phases 1, 2 and 4A
Kula, Makawao, Maui, Hawaii

DATE: April 2013 | PROJECT NO. 212302.20

PLATE 2



LEGEND

- Test Pit Location
- Boring and Test Pit Location from Keokea-Waiohuli Soil Investigation, 2005
- Proposed New Roadways

Reference: CPE Site plan of Phases 1, 2, 4A

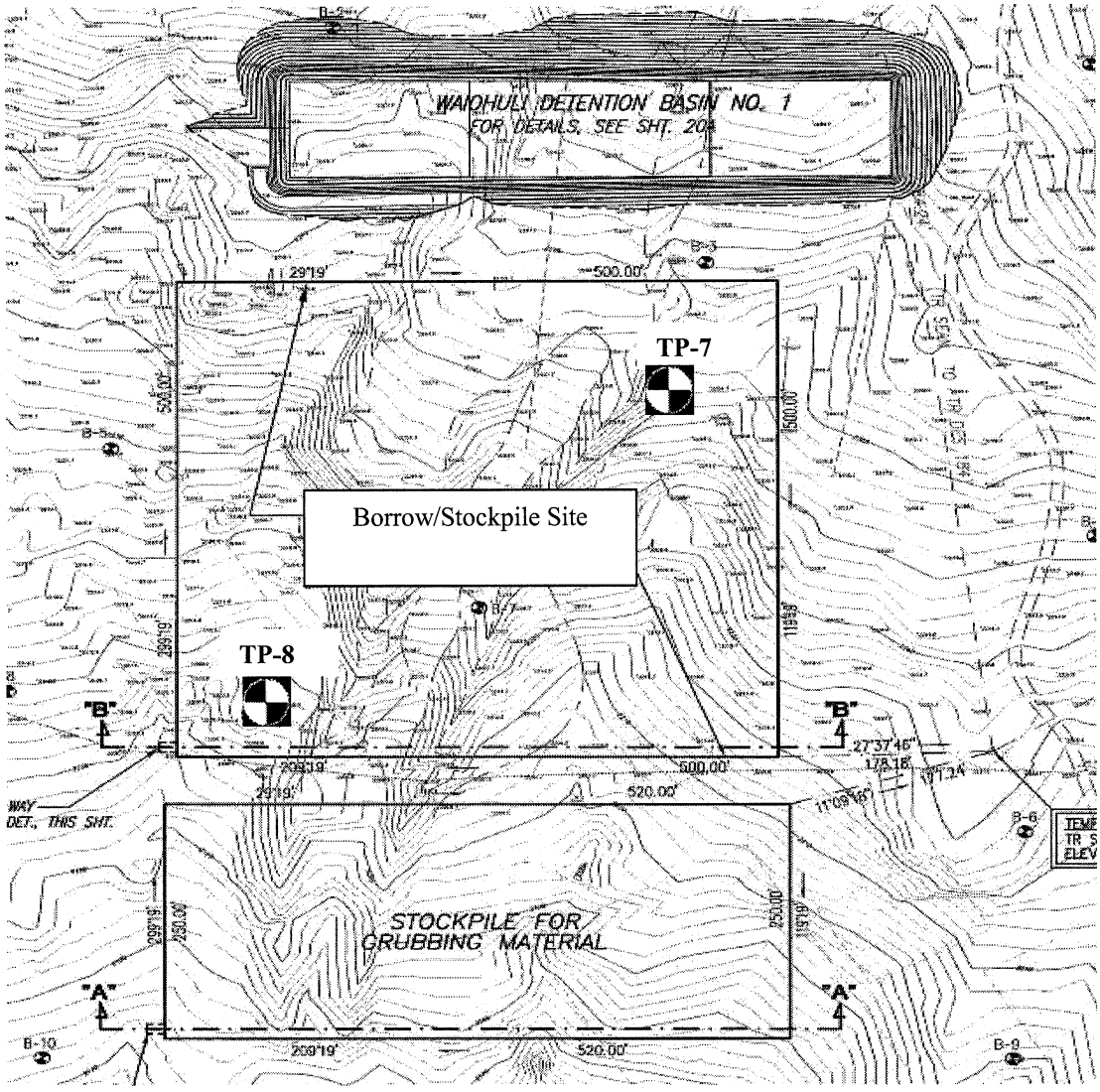
SITE PLAN - ROADS

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Kula, Makawao, Maui, Hawaii

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PLATE 3



LEGEND

Test Pit Location

Reference: Construction Plans for Keokea-Waiohuli Development Phase 1

SITE PLAN - BORROW/STOCKPILE SITE

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Keokea-Waiohuli Subdivision Phases 1, 2 and 4A
Kula, Makawao, Maui, Hawaii

DATE: April 2013 | PROJECT NO. 212302.20

PLATE 4

BORING LOCATION: See Plate 3	DRILLER: Ed Gaynor	**BORING TP-1**
BORING ELEVATION (ft):	LOGGED BY: DSC	
DATE (S) DRILLED: 03/08/13	TYPE RIG: Bobcat 325	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLER TYPE	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
										Dry Vegetation, tall grass
MD/CBR	83	32.7				Grab 1-1	1		MH	SILT, dark brown, trace of clay, rootlets, basaltic gravel and cobbles, moist
							2			
							3			
							4			BASALT, dark gray, moderately weathered, strong
							5			Test pit terminated at about 4.5 ft (Refusal). Ground water was not enountered.
							6			
							7			
							8			

SAMPLE TYPE

D&M - Dames & Moore	SPT - Standard Penetration	MD - Moisture/Density	UC - Unconfined Compression
CB - Core Barrel	SH - Shelby Tube	CON - Consolidation Test	SG - Specific Gravity
AUG - Auger Cuttings	NR - No Recovery	PI - Atterberg Limits	SA - Sieve Analysis

OTHER LABORATORY TESTS

LOG OF BORING

CONSULTANTS, LLC
SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

Keokea-Waiohuli Subdivision Phases 1, 2 and 4A
Kula, Makawao, Maui, Hawaii

DATE: April 2013 | PROJECT NO.: 212302.20

PLATE 5

210301 MAMALAOHOA RD W/ROD A 212302.20 CPE KEOKEA-WAIOHULI PH. 1, 2,4A.GPJ TEST PIT.GDT 4/4/13

BORING LOCATION: See Plate 3	DRILLER: Ed Gaynor	**BORING TP-2**
BORING ELEVATION (ft):	LOGGED BY: DSC	
DATE (S) DRILLED: 03/07/13	TYPE RIG: Bobcat 325	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLER TYPE	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
										Dry Vegetation, Tall Grass
SA/PI		7.4				GRAB 2-1	1		GP GM	Poorly Graded GRAVEL with SILT and SAND, gray lava gravel, cobbles and boulders with silt matrix, trace roots, dark brown, moist
							2			
							3			BASALT, dark gray, strong, weathered
										Test pit terminated at about 3.5 ft (Refusal). Ground water was not enountered.
							4			
							5			
							6			
							7			
							8			

SAMPLE TYPE

D&M - Dames & Moore	SPT - Standard Penetration		
CB - Core Barrel	SH - Shelby Tube		
AUG - Auger Cuttings	NR - No Recovery		

OTHER LABORATORY TESTS

MD - Moisture/Density	UC - Unconfined Compression
CON - Consolidation Test	SG - Specific Gravity
PI - Atterberg Limits	SA - Sieve Analysis

LOG OF BORING

CONSULTANTS, LLC
SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

Keokea-Waiohuli Subdivision Phases 1, 2 and 4A
Kula, Makawao, Maui, Hawaii

DATE: April 2013 | PROJECT NO.: 212302.20

PLATE 6

210301 MAMALAOHOA RD W/ROD A 212302.20 CPE KEOKEA-WAIOHULI PH. 1, 2,4A.GPJ TEST PIT.GDT 4/4/13

BORING LOCATION: See Plate 3	DRILLER: Ed Gaynor	**BORING TP-3**
BORING ELEVATION (ft):	LOGGED BY: DSC	
DATE (S) DRILLED: 03/07/13	TYPE RIG: Bobcat 325	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLER TYPE	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
										Heavy Vegetation
MD/CBR	96	14.8				GRAB 3-1	1		GM	Silty GRAVEL, dark brown, very stiff, 1"-3" subangular vessicate gray basalt, boulders, moist
							2			BASALT
										Test pit terminated at about 2 ft (Refusal). Ground water was not enountered.
							3			
							4			
							5			
							6			
							7			
							8			

SAMPLE TYPE

D&M - Dames & Moore	SPT - Standard Penetration	MD - Moisture/Density	UC - Unconfined Compression
CB - Core Barrel	SH - Shelby Tube	CON - Consolidation Test	SG - Specific Gravity
AUG - Auger Cuttings	NR - No Recovery	PI - Atterberg Limits	SA - Sieve Analysis

OTHER LABORATORY TESTS

LOG OF BORING

CONSULTANTS, LLC
SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

Keokea-Waiohuli Subdivision Phases 1, 2 and 4A
Kula, Makawao, Maui, Hawaii

DATE: April 2013 | PROJECT NO.: 212302.20

PLATE 7

210301 MAMALAOHOA RD W/ROD A 212302.20 CPE KEOKEA-WAIOHULI PH. 1, 2,4A.GPJ TEST PIT.GDT 4/4/13

BORING LOCATION: See Plate 3	DRILLER: Ed Gaynor	**BORING TP-4**
BORING ELEVATION (ft):	LOGGED BY: DSC	
DATE (S) DRILLED: 03/08/13	TYPE RIG: Bobcat 325	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLER TYPE	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
										Light Brush, bushes
SA/PI		3.2				GRAB 4-1	1		GW GM	Well-Graded GRAVEL with SILT and SAND, brown, boulders, cobbles, gray, strong, trace rootlets, trace red clay, dry
										BASALT
							2			Test pit terminated at about 1.75 ft (Refusal). Ground water was not enountered.
							3			
							4			
							5			
							6			
							7			
							8			

SAMPLE TYPE

D&M - Dames & Moore	SPT - Standard Penetration	MD - Moisture/Density	UC - Unconfined Compression
CB - Core Barrel	SH - Shelby Tube	CON - Consolidation Test	SG - Specific Gravity
AUG - Auger Cuttings	NR - No Recovery	PI - Atterberg Limits	SA - Sieve Analysis

OTHER LABORATORY TESTS

LOG OF BORING

CONSULTANTS, LLC
SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

Keokea-Waiohuli Subdivision Phases 1, 2 and 4A
Kula, Makawao, Maui, Hawaii

DATE: April 2013 | PROJECT NO.: 212302.20

PLATE 8

210301 MAMALAOHOA RD W/RQD A 212302.20 CPE KEOKEA-WAIOHULI PH. 1, 2,4A.GPJ TEST PIT.GDT 4/4/13

BORING LOCATION: See Plate 3	DRILLER: Ed Gaynor	**BORING TP-5**
BORING ELEVATION (ft):	LOGGED BY: DSC	
DATE (S) DRILLED: 03/08/13	TYPE RIG: Bobcat 325	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLER TYPE	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
										DRY GRASS VEGETATION
							1			Sandy SILT, brown, soft, with gravel cobbles and boulders, dry
							2		ML SM	
SA/PI		15.9				GRAB 5-1	3			
							4			BASALT, vessicate, strong, gray
							5			Test pit terminated at about 4.5 ft (Refusal). Ground water was not enountered.
							6			
							7			
							8			

SAMPLE TYPE

D&M - Dames & Moore
CB - Core Barrel
AUG - Auger Cuttings
SPT - Standard Penetration
SH - Shelby Tube
NR - No Recovery

OTHER LABORATORY TESTS

MD - Moisture/Density
CON - Consolidation Test
PI - Atterberg Limits
UC - Unconfined Compression
SG - Specific Gravity
SA - Sieve Analysis

LOG OF BORING

CONSULTANTS, LLC
SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

Keokea-Waiohuli Subdivision Phases 1, 2 and 4A
Kula, Makawao, Maui, Hawaii

DATE: April 2013 | PROJECT NO.: 212302.20

PLATE 9

210301 MAMALAOHOA RD W/RQD A 212302.20 CPE KEOKEA-WAIOHULI PH. 1, 2 4A.GPJ TEST PIT.GDT 4/4/13

BORING LOCATION: See Plate 3	DRILLER: Ed Gaynor	**BORING TP-6**
BORING ELEVATION (ft):	LOGGED BY: DSC	
DATE (S) DRILLED: 03/08/13	TYPE RIG: Bobcat 325	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLER TYPE	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
							0			DRY VEGETATION GRASS
										SILT, brown, stiff, trace rootlets and clay, with basalt cobbles and boulders, dry
MD/CBR	73	37.0				GRAB 6-1	1		MH	
							2			
							3			
							4			BASALT, strong, weathered, gray, dry
										Test pit terminated at about 4 ft (Refusal). Ground water was not enountered.
							5			
							6			
							7			
							8			

SAMPLE TYPE

D&M - Dames & Moore	SPT - Standard Penetration		
CB - Core Barrel	SH - Shelby Tube		
AUG - Auger Cuttings	NR - No Recovery		

OTHER LABORATORY TESTS

MD - Moisture/Density	UC - Unconfined Compression
CON - Consolidation Test	SG - Specific Gravity
PI - Atterberg Limits	SA - Sieve Analysis

LOG OF BORING

CONSULTANTS, LLC
SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

Keokea-Waiohuli Subdivision Phases 1, 2 and 4A
Kula, Makawao, Maui, Hawaii

DATE: April 2013 | PROJECT NO.: 212302.20

PLATE 10

210301 MAMALAOHOA RD W/ROD A 212302.20 CPE KEOKEA-WAIOHULI PH. 1, 2,4A.GPJ TEST PIT.GDT 4/4/13

BORING LOCATION: See Plate 4	DRILLER: Ed Gaynor	**BORING TP-7**
BORING ELEVATION (ft):	LOGGED BY: DSC	
DATE (S) DRILLED: 03/07/13	TYPE RIG: Bobcat 325	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLER TYPE	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
										OVERGROWN VEGETATION
										Gravelly SILT, brown, medium stiff, with basalt, boulders, trace of clay and rootlets, dry (volcanic ash)
MD/CBR	99	21.2				GRAB 7-1	1			
							2			
							3		ML	
							4			
							5			
							6			
							7			Test pit terminated at about 6.5 ft (Refusal). Ground water was not enountered.
							8			

SAMPLE TYPE

D&M - Dames & Moore	SPT - Standard Penetration	MD - Moisture/Density	UC - Unconfined Compression
CB - Core Barrel	SH - Shelby Tube	CON - Consolidation Test	SG - Specific Gravity
AUG - Auger Cuttings	NR - No Recovery	PI - Atterberg Limits	SA - Sieve Analysis

OTHER LABORATORY TESTS

LOG OF BORING

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Keokea-Waiohuli Subdivision Phases 1, 2 and 4A
Kula, Makawao, Maui, Hawaii

DATE: April 2013 | PROJECT NO.: 212302.20

PLATE 11

210301 MAMALAOHOA RD W/RGD A 212302.20 CPE KEOKEA-WAIOHULI PH. 1, 2,4A.GPJ TEST PIT.GDT 4/4/13

BORING LOCATION: See Plate 4	DRILLER: Ed Gaynor	**BORING TP-8**
BORING ELEVATION (ft):	LOGGED BY: DSC	
DATE (S) DRILLED: 03/07/13	TYPE RIG: Bobcat 325	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLER TYPE	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
							0			GRASSY BRUSH
										Silty GRAVEL with SAND, dark brown silt, stiff, gray subangular basalt, moist
SA/PI		7.4				GRAB 8-1	3		GM	
							7			BASALT
										Test pit terminated at about 7 ft (Refusal). Ground water was not enountered.

SAMPLE TYPE

D&M - Dames & Moore	SPT - Standard Penetration	MD - Moisture/Density	UC - Unconfined Compression
CB - Core Barrel	SH - Shelby Tube	CON - Consolidation Test	SG - Specific Gravity
AUG - Auger Cuttings	NR - No Recovery	PI - Atterberg Limits	SA - Sieve Analysis

OTHER LABORATORY TESTS

LOG OF BORING

CONSULTANTS, LLC
SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

Keokea-Waiohuli Subdivision Phases 1, 2 and 4A
Kula, Makawao, Maui, Hawaii

DATE: April 2013 | PROJECT NO.: 212302.20

PLATE 12

210301 MAMALAOHOA RD W/RQD A 212302.20 CPE KEOKEA-WAIOHULI PH. 1, 2,4A.GPJ TEST PIT.GDT 4/4/13

BORING LOCATION: See Plate 3	DRILLER: Ed Gaynor	**BORING TP-9**
BORING ELEVATION (ft):	LOGGED BY: DSC	
DATE (S) DRILLED: 03/08/13	TYPE RIG: Bobcat 325	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLER TYPE	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
							0			DRY VEGETATION GRASS
						GRAB 9-1	1		MH	Clayey SILT, brown, soft/stiff, trace rootlets, moist
							2		GP	BASALT
										Test pit terminated at about 2 ft (Refusal). Ground water was not enountered.
							3			
							4			
							5			
							6			
							7			
							8			

SAMPLE TYPE

D&M - Dames & Moore	SPT - Standard Penetration
CB - Core Barrel	SH - Shelby Tube
AUG - Auger Cuttings	NR - No Recovery

OTHER LABORATORY TESTS

MD - Moisture/Density	UC - Unconfined Compression
CON - Consolidation Test	SG - Specific Gravity
PI - Atterberg Limits	SA - Sieve Analysis

LOG OF BORING

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Keokea-Waiohuli Subdivision Phases 1, 2 and 4A
Kula, Makawao, Maui, Hawaii

DATE: April 2013 | PROJECT NO.: 212302.20

PLATE 13

210301 MAMALAOHOA RD W/RQD A 212302.20 CPE KEOKEA-WAIOHULI PH. 1, 2,4A.GPJ TEST PIT.GDT 4/4/13

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS: GRAPH	SYMBOLS: LETTER	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS — MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS — MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS — 50% OR MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS — 50 % OR MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN OR EQUAL TO 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

UNIFIED SOIL CLASSIFICATION SYSTEM

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Keokea-Waiohuli Subdivision Phases 1, 2 and 4A
Kula, Makawao, Maui, Hawaii

DATE: April 2013 | PROJECT NO. 212302.20

PLATE 14

I. CONSOLIDATION OF SEDIMENTARY ROCKS; usually determined from unweathered samples. Largely dependent on cementation.

U = unconsolidated

P = poorly consolidated

M = moderately consolidated

W = well consolidated

II. BEDDING OF SEDIMENTARY ROCKS

Splitting Property	Thickness	Stratification
Massive	Greater than 4.0 ft.	Very Thick-Bedded
Blocky	2.0 to 4.0 ft.	Thick-Bedded
Slabby	0.2 to 2.0 ft.	Thin-Bedded
Flaggy	0.05 to 0.2 ft.	Very Thin-Bedded
Shaly or Platy	0.01 to 0.05 ft.	Laminated
Papery	Less than 0.01 ft.	Thinly Laminated

III. FRACTURING

Intensity	Size of Pieces in Feet
Very Little Fractured	Greater than 4.0
Occasionally Fractured	1.0 to 4.0
Moderately Fractured	0.5 to 1.0
Closely Fractured	0.1 to 0.5
Intensely Fractured	0.05 to 0.1
Crushed	Less than 0.05

IV. HARDNESS

1. Soft – reserved for plastic material alone.
2. Low Hardness – can be gouged deeply r carved easily with a knife blade.
3. Moderately Hard – can be readily scratched by a knife blade; scratch leaves a heavy trace of dust and is readily visible after the powder has been blown away.
4. Hard – can be scratched with difficulty; scratch produces little powder and is often faintly visible.
5. Very Hard – cannot be scratched with a knife blade; leaves a metallic streak.

V. STRENGTH

1. Plastic or very low strength.
2. Friable – crumbles easily by rubbing with fingers.
3. Weak – an unfractured specimen of such material will crumble under light hammer blows.
4. Moderately Strong – specimen will withstand a few heavy hammer blows before breading.
5. Strong – specimen will withstand a few heavy ringing hammer blows and will yield with difficulty only dust and small flying fragments.
6. Very Strong – specimen will resist heavy ringing hammer blows and will yield with difficulty only dust and small flying fragments.

VI. WEATHERING – The physical and chemical disintegration and decomposition of rocks and minerals by natural processes such as oxidation, reduction, hydration, solution, carbonation and freezing and thawing.

D. Deep – moderate to complete mineral decomposition; extensive disintegration; deep and thorough discoloration; many fractures, all extensively coated or filled with oxides, carbonates and/or clay or silt.

M. Moderate – slight change or partial decomposition of minerals; little disintegration; cementation little to unaffected; moderate to occasionally intense discoloration; moderately coated fractures.

L. Little – no megascopic decomposition of minerals; little or no affect on normal cementation; slight and intermittent, or localized discoloration; few stains on fracture surfaces.

F. Fresh – unaffected by weathering agents; no disintegration or discoloration; fractures usually less numerous than joints.

ROCK CLASSIFICATION SYSTEM

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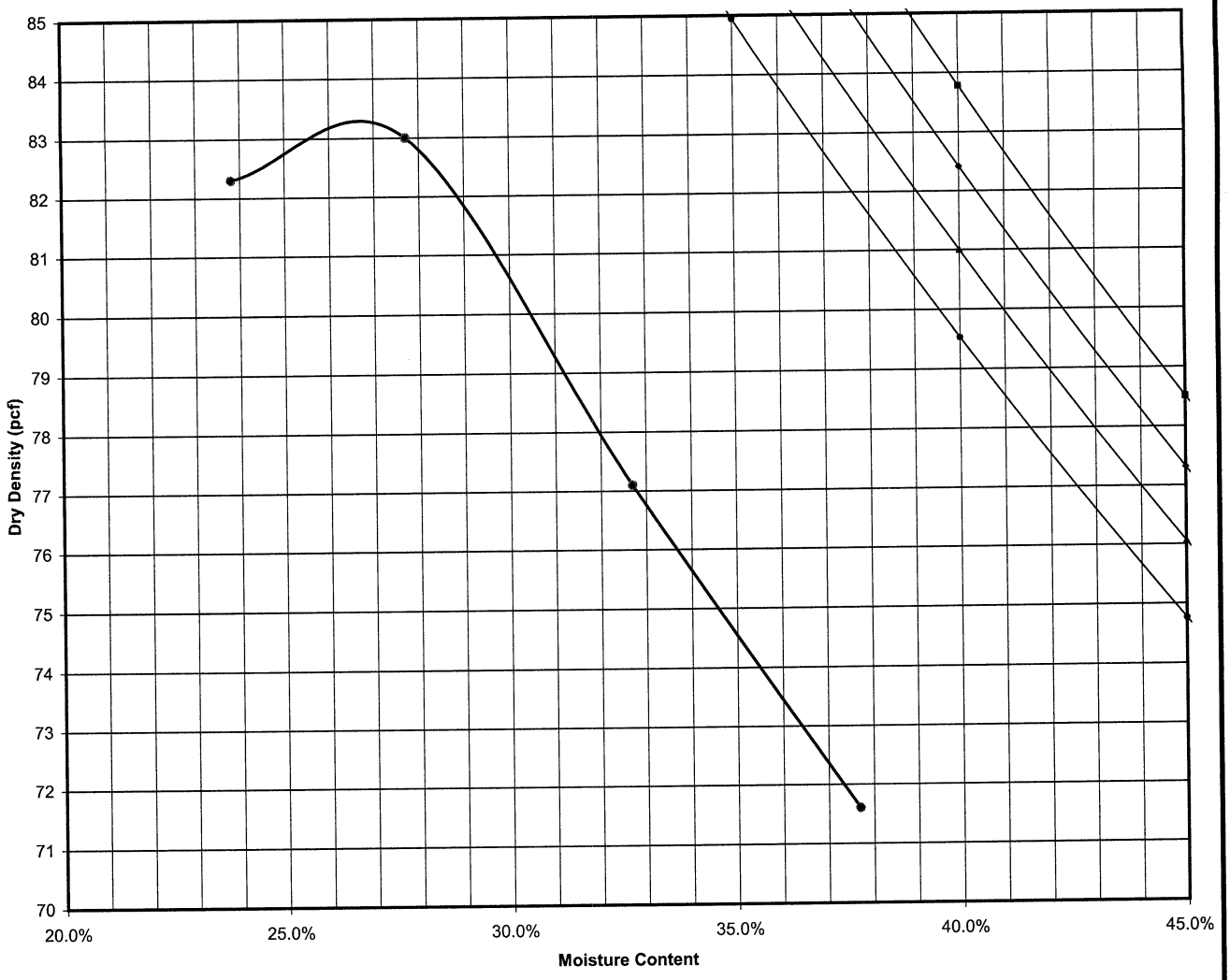
Keokea-Waiohuli Subdivision Phases 1, 2 and 4A
Kula, Makawao, Maui, Hawaii

DATE: April 2013 | PROJECT NO. 212302.20

PLATE 15

Curves for 100% saturation

MOISTURE-DENSITY RELATIONSHIP



Sample Source: 1-1(TP-1)/Road M

Desecription: Dark Brown (MH) Silt w/ Basaltic Gravel

	Test Point 1	Test Point 2	Test Point 3	Test Point 4
Wet Density (pcf)	101.86	105.99	102.4	98.54
Moisture Content	23.80%	27.70%	32.70%	37.70%
Dry Density (pcf)	82.30	83.00	77.10	71.60

Maximum Dry Density (pcf): 83.4

Optimum Moisture Content (%) : 27

Test Method: ASTM D-1557

Atterberg Limits

LL PL PI

COMPACTION TEST RESULTS

ASTM D-1557

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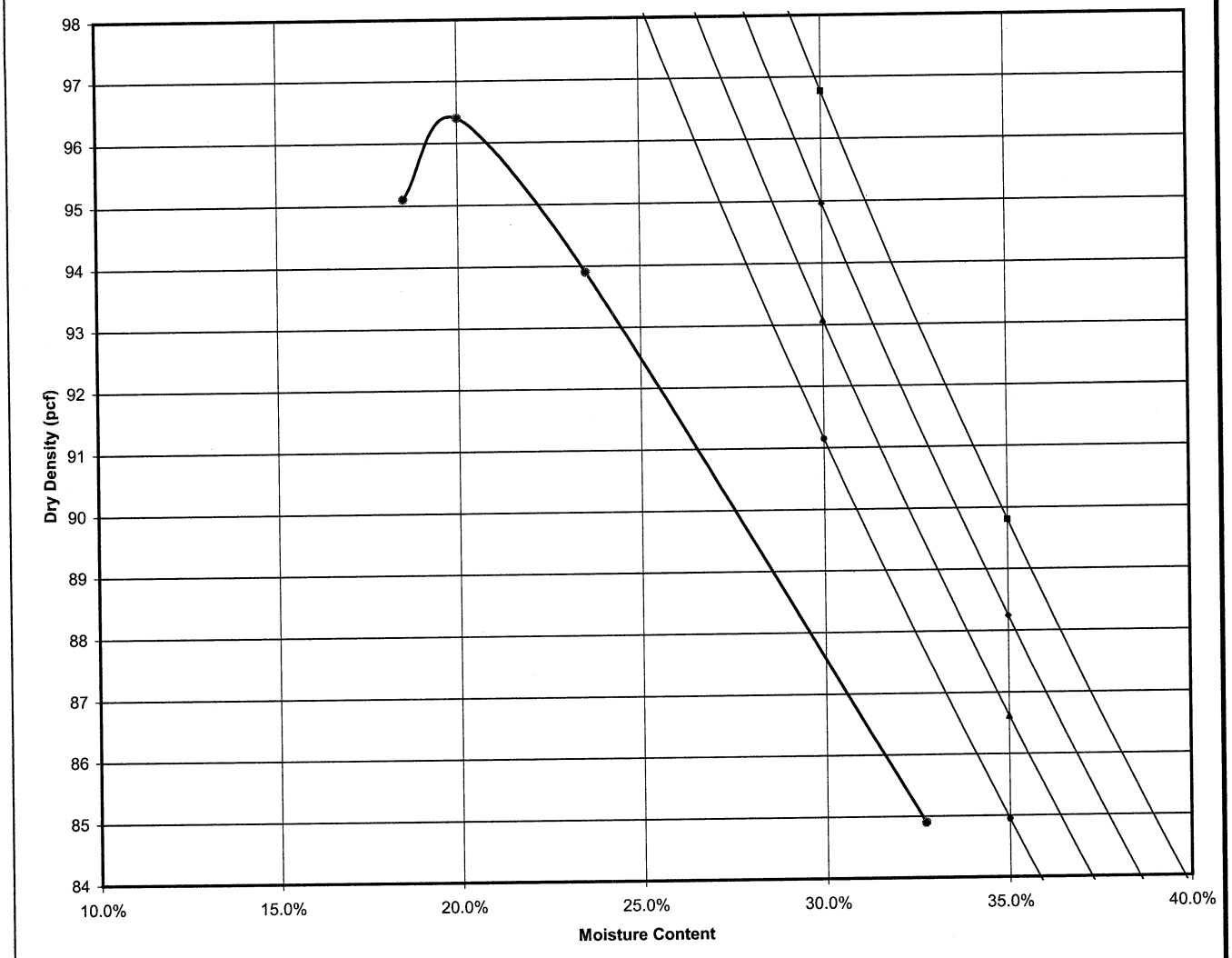
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PLATE 16

A:\Labshts\Proctor 1-1\Curve Plot

MOISTURE-DENSITY RELATIONSHIP



Sample Source: 3-1 (TP-3)/Road E/RoadH

Desecription: Dark Brown (GM) Silty GRAVEL

	Test Point 1	Test Point 2	Test Point 3	Test Point 4
Wet Density (pcf)	112.65	115.71	115.98	112.65
Moisture Content	18.50%	20.00%	23.50%	32.70%
Dry Density (pcf)	95.10	96.40	93.90	84.90

Maximum Dry Density (pcf): 96.4

Optimum Moisture Content (%) : 20

Test Method: ASTM D-1557

Atterberg Limits

LL PL PI

COMPACTION TEST RESULTS

ASTM D-1557

PSC Consultants, LLC

SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

Keokea-Waiohuli Subdivision Phases 1, 2 and 4A

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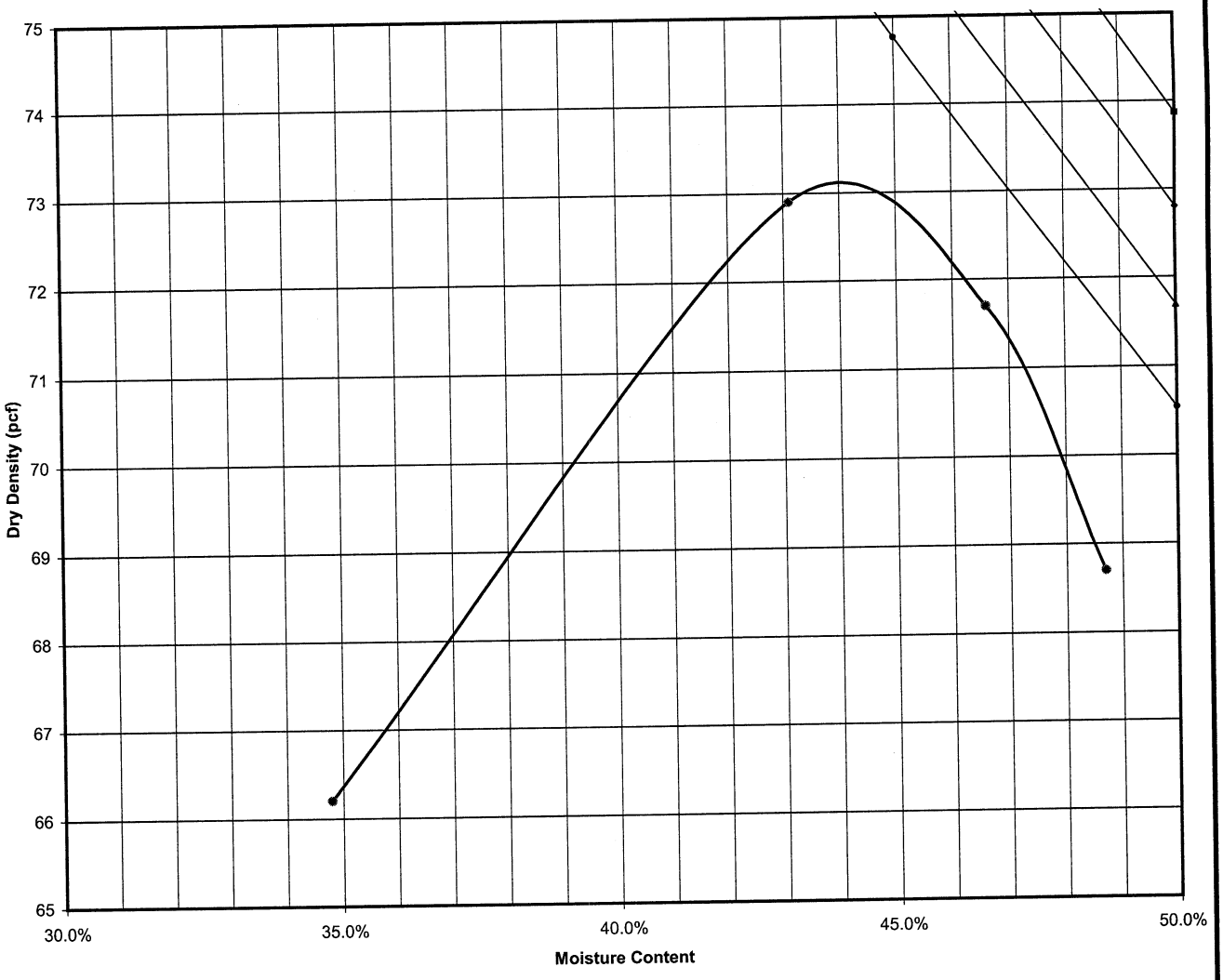
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PLATE 17

A:\Labshts\Proctor 3-1\Curve Plot

MOISTURE-DENSITY RELATIONSHIP

Curves for 100% saturation



Sample Source: 6-1 (TP-6)/Road J

Desecription: Brown (MH) SILT w/ Basalt Cobbles

	Test Point 1	Test Point 2	Test Point 3	Test Point 4
Wet Density (pcf)	89.23	104.39	105.05	102.13
Moisture Content	34.80%	43.10%	46.60%	48.70%
Dry Density (pcf)	66.20	72.90	71.70	68.70

Maximum Dry Density (pcf): 73

Optimum Moisture Content (%) : 44

Test Method: ASTM D-1557

Atterberg Limits

LL PL PI

COMPACTION TEST RESULTS

ASTM D-1557

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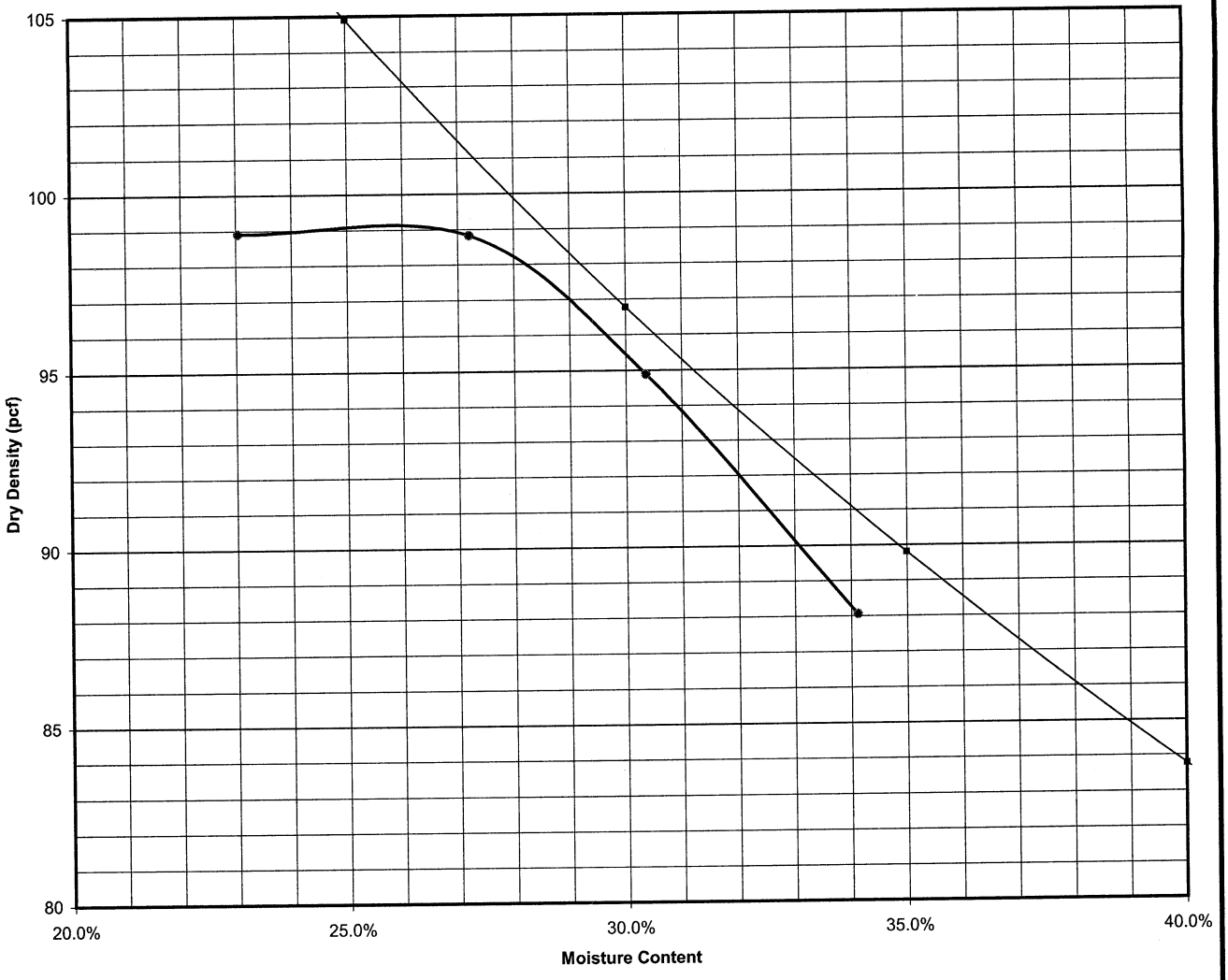
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PLATE 18

A:\Labshts\Proctor 6-1\Curve Plot

Curves for 100% saturation

MOISTURE-DENSITY RELATIONSHIP



Sample Source: 7-1 (TP-7)/Stock Pile

Desecription: Brown (MH) Gravelly SILT

	Test Point 1	Test Point 2	Test Point 3	Test Point 4
Wet Density (pcf)	121.7	125.7	123.7	118.1
Moisture Content	23.04%	27.20%	30.36%	34.12%
Dry Density (pcf)	98.91	98.82	94.89	88.06

Maximum Dry Density (pcf): 99

Optimum Moisture Content (%) : 23

Test Method: ASTM D-1557

Atterberg Limits

LL PL PI

COMPACTION TEST RESULTS

ASTM D-1557

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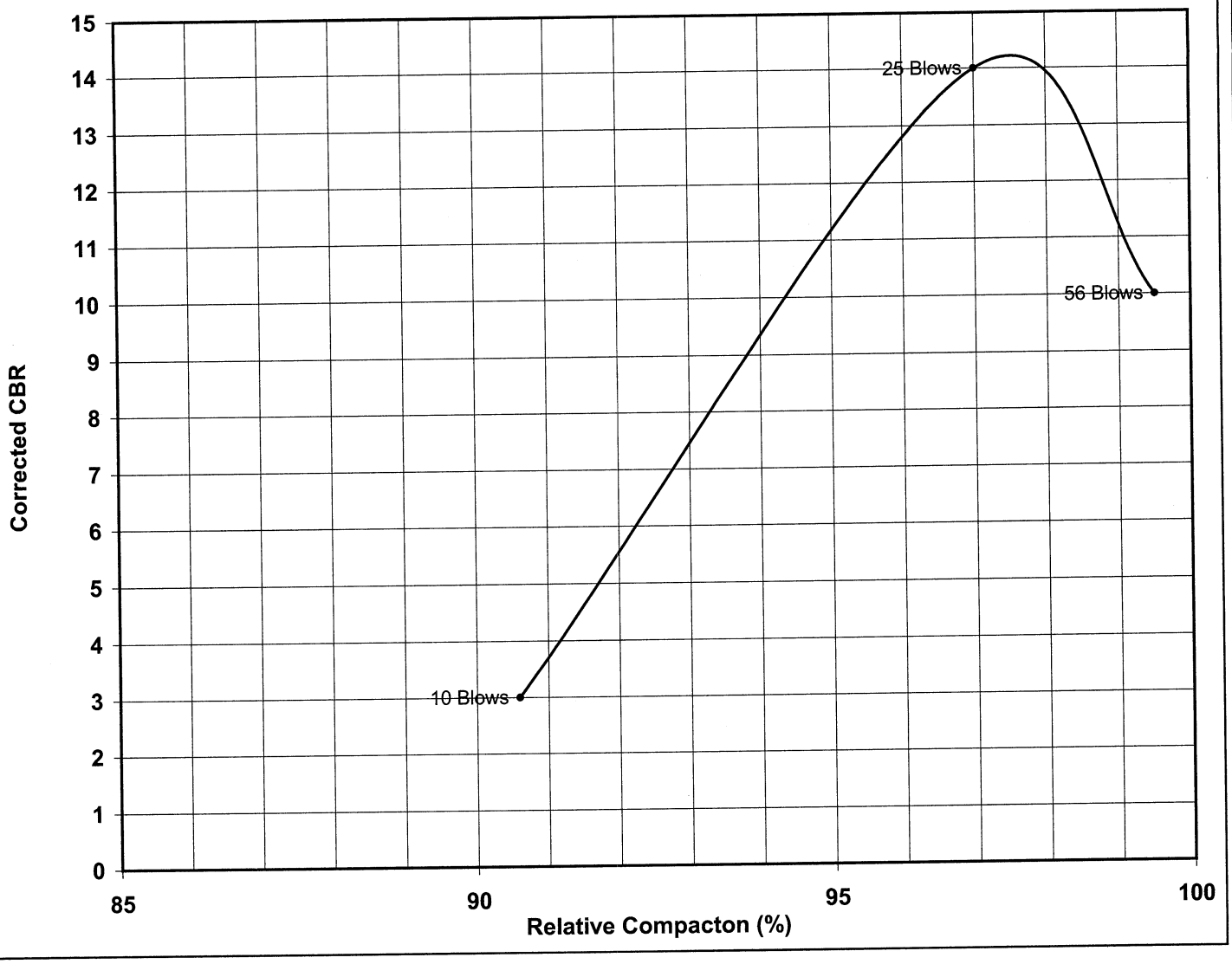
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Project No. 212302.20

PLATE 19

A:\Labshts\Proctor 7-1\Curve Plot

Dry Density vs. CBR



Sample Source: 6-1(TP-6)/Road J **Depth:** Grab **Description:** Brown Silt w/ Basalt Gravel

Blows/Lift	Dry Density (pcf)	CBR	Relative comp. %
10	66.1	3	91
25	70.9	14	97
56	72.5	10	99.5

CBR for at 95% Relative Compaction :	11

CALIFORNIA BEARING RATIO
ASTM D-1883

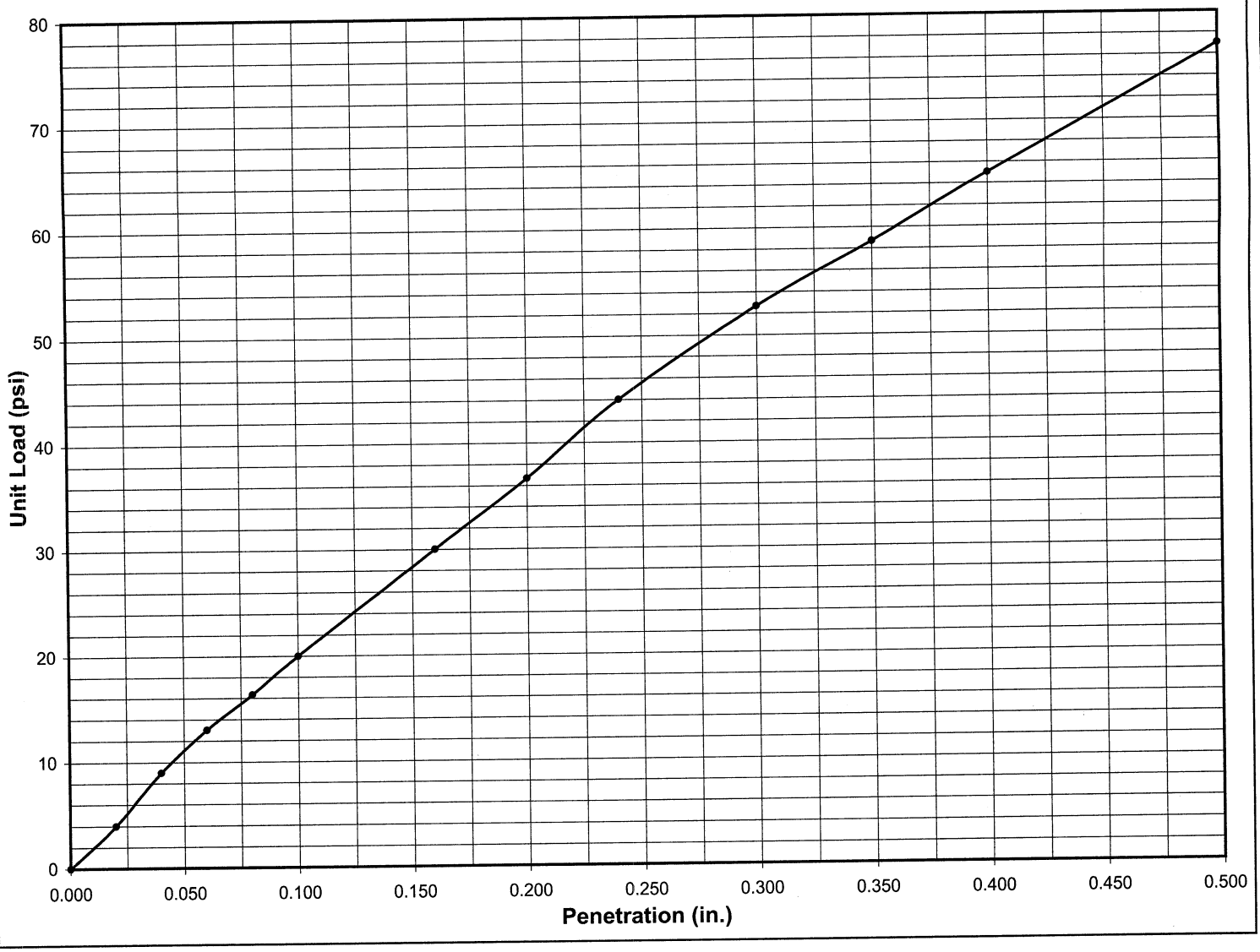
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Plate 20

CBR CURVE



Sample Source: 6-1(TP-6)/Road J **Depth:** Grab **Description:** Brown Silt w/ Basalt Gravel

Blows/lift: 10

	Before Expansion	After Expansion
Relative Compaction (%):	93.70%	90.59%
Moisture Content (%):	43.40%	48.23%
Dry Density (pcf):	68.40	66.13
Percent Swell or Expansion Value (%):	1.27%	
Compaction Test Method:	ASTM D-1557	
Corr. CBR Value @ 0.1" :	3	
Corr. CBR Value @ 0.2" :	2	

Atterberg Limits

LL	PL	PI

CALIFORNIA BEARING RATIO

ASTM D-1883-94

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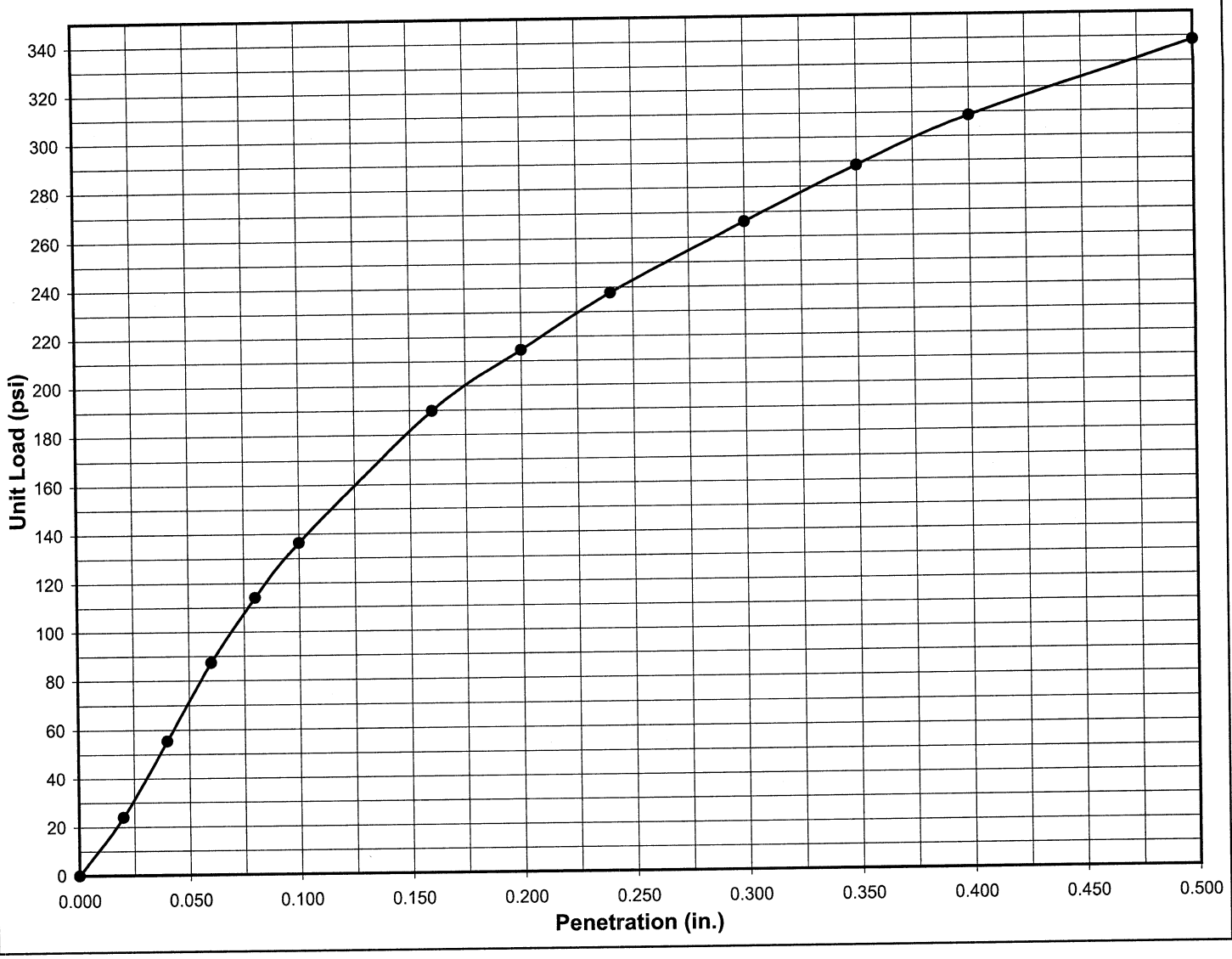
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Date: April 2013 | Project No. 212302.20

Plate 20A

CBR CURVE



Sample Source: 6-1(TP-6)/Road J **Depth:** Grab **Description:** Brown Silt w/ Basalt Gravel

Blows/lift: 25

	Before Expansion	After Expansion
Relative Compaction (%):	99.59%	97.12%
Moisture Content (%):	41.10%	44.70%
Dry Density (pcf):	72.70	70.90
Percent Swell or Expansion Value (%):	0.98%	
Compaction Test Method:	ASTM D-1557	
Corr. CBR Value @ 0.1" :	17	
Corr. CBR Value @ 0.2" :	14	

Atterberg Limits

LL	PL	PI

CALIFORNIA BEARING RATIO

ASTM D-1883-94

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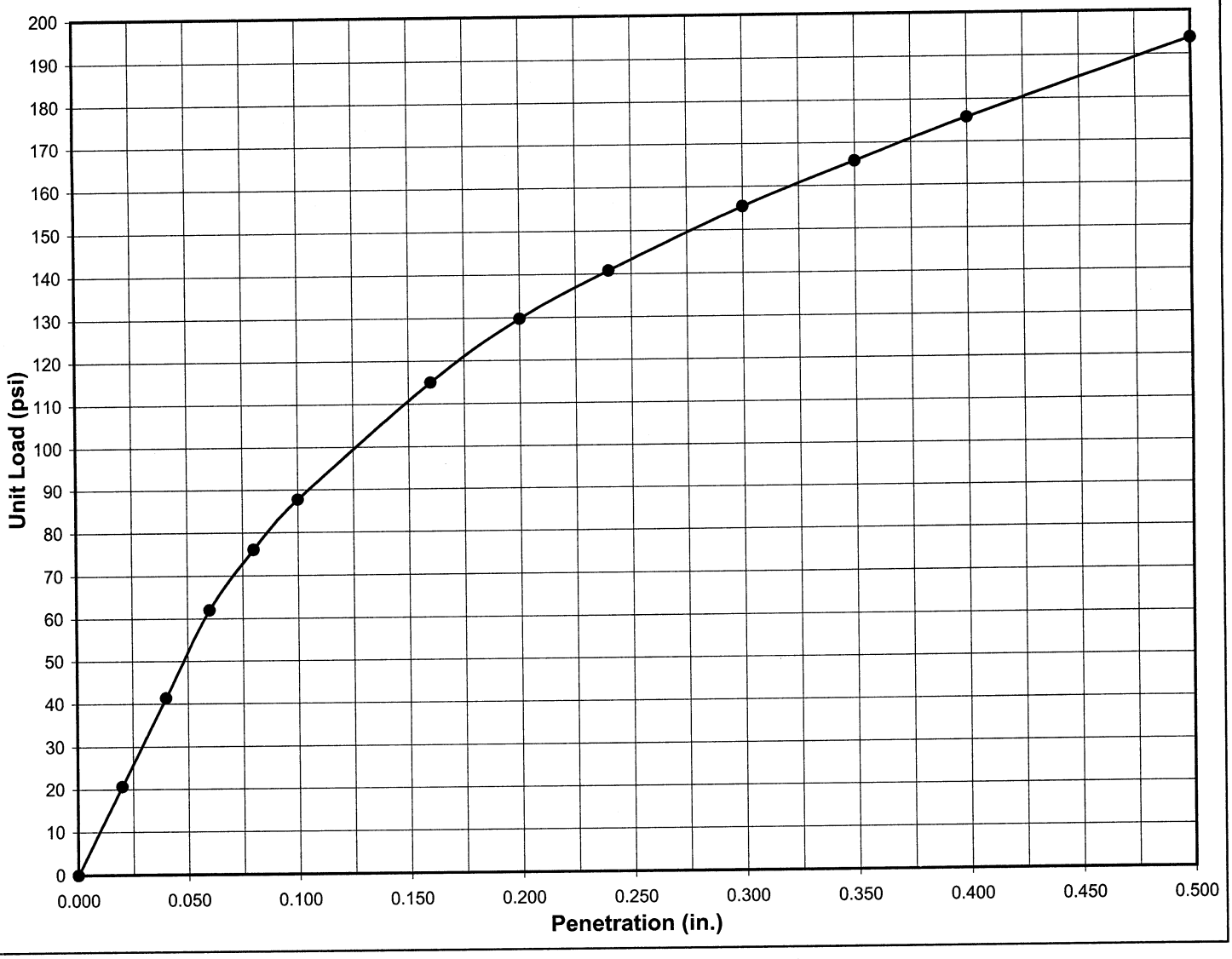
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Plate 20B

CBR CURVE



Sample Source: 6-1(TP-6)/Road J **Depth:** Grab **Description:** Brown Silt w/ Basalt Gravel

Blows/lift: 56

	Before Expansion	After Expansion
Relative Compaction (%):	100.00%	99.45%
Moisture Content (%):	43.80%	44.70%
Dry Density (pcf):	73.00	72.60
Percent Swell or Expansion Value (%):	0.47%	
Compaction Test Method:	ASTM D-1557	
Corr. CBR Value @ 0.1" :	10	
Corr. CBR Value @ 0.2" :	9	

Atterberg Limits

LL	PL	PI

CALIFORNIA BEARING RATIO

ASTM D-1883-94

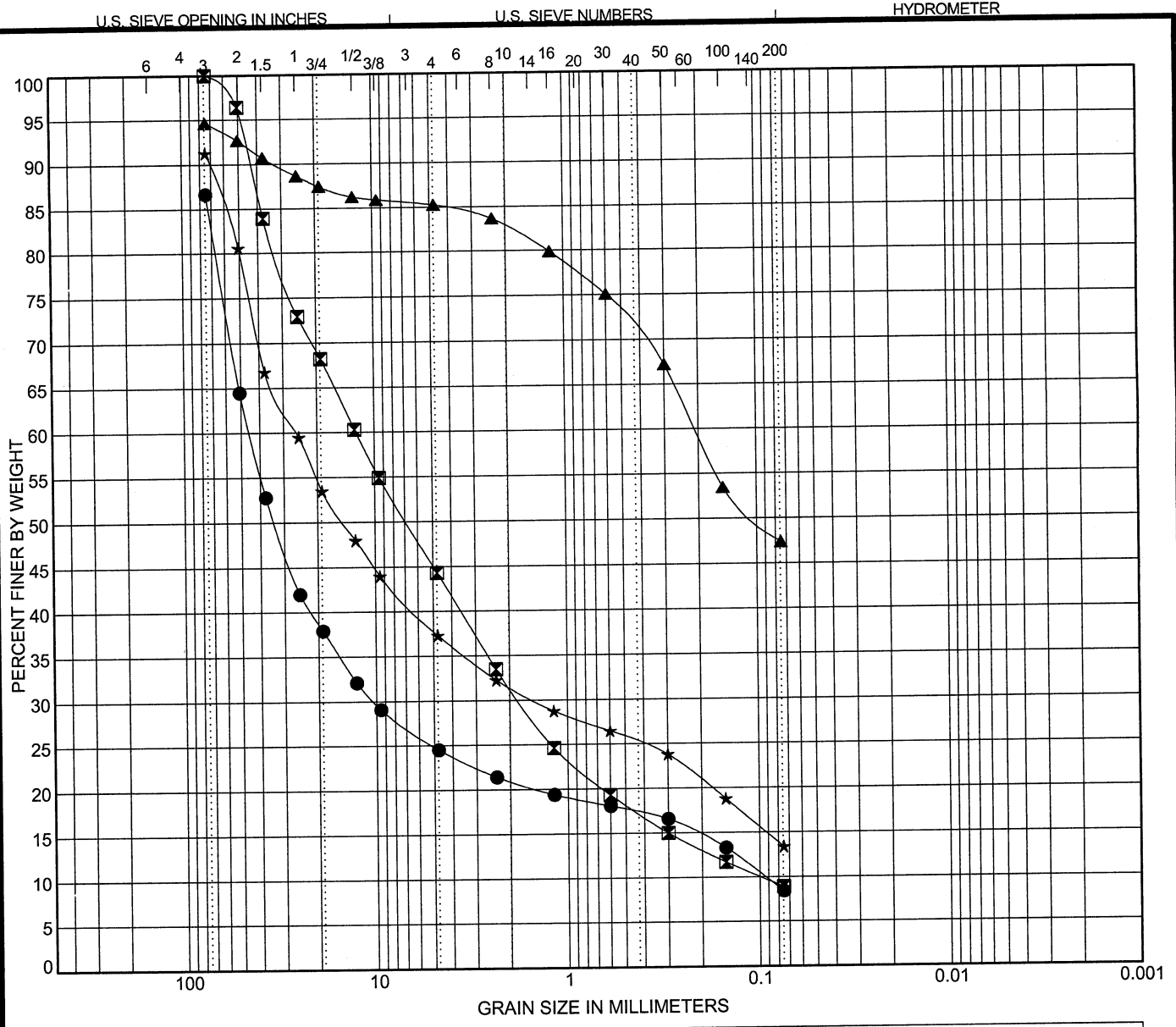
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Keokea-Waiohuli Subdivision Phases 1, 2 and 4A
Kula, Makawao, Maui, Hawaii

Date: April 2013 | Project No. 212302.20

Plate 20C



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	TP-2 @ DEPTH 1ft.	POORLY GRADED GRAVEL with SILT and SAND GP-GM	NP	NP	NP	25.27	480.62
⊠	TP-4 @ DEPTH 1ft.	WELL-GRADED GRAVEL with SILT and SAND GW-GM	NP	NP	NP	2.62	126.90
▲	TP-5 @ DEPTH 3ft.	SANDY SILT ML-SM	NP	NP	NP		
★	TP-8 @ DEPTH 3ft.	SILTY GRAVEL with SAND GM	NP	NP	NP		

Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	TP-2 @ DEPTH 1ft.	75	45.202	10.364	0.094	62.2	16.1	8.4	
⊠	TP-4 @ DEPTH 1ft.	75	12.497	1.797	0.098	55.7	35.4	8.9	
▲	TP-5 @ DEPTH 3ft.	75	0.208			9.4	37.9	47.4	
★	TP-8 @ DEPTH 3ft.	75	25.704	1.497		54.0	23.9	13.4	

GRAIN SIZE DISTRIBUTION

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Kula, Makawao, Maui, Hawaii

Date: April 2013 | Project No.: 212302.20

PLATE 21

210301 SIEVE - MAMALAHOA 212302.20 CPE KEOKEA-WAIOHULI PH. 1, 2 4A.GPJ TEST PIT.GDT 4/4/13

SIEVE ANALYSIS (ASTM D422-63 Re- Approved 2002)

Project	Keokea-Waiohuli Subdivision Phases 1, 2 and 4A	Job No.	212302.20
Sample Source	Test Pit 2 (Road M)	Purpose	Classification
Soil Description	POORLY GRADED GRAVEL with SILT and SAND (GP-GM)	Sample No.	2-1
Tested by	DP	Test Date(s)	3/12/2013

Wt of wet sample & tare (g)	15150.2	**-200 Wash**	
Wt of dry sample and tare (g)	14165.9	**Before Wash**	
Moisture (g)	984.3	Wt of dry sample and tare (g)	14165.9
Wt of tare (g)	926.5	**After Wash**	
Wt of dry sample (g)	13239.4	Wt of dry sample and tare (g)	13236.0
Moisture content	7.4%	Wt. Passing -200 (g)	929.9
		% Passing -200	7.0%

Sieve no.	Diameter (mm)	Cumulative Weight Retained (gm)	% Retained	% Passing
3"	75	1763.00	13.32%	86.68%
2"	50.8	4699.90	35.50%	64.50%
1-1/2"	37.5	6254.60	47.24%	52.76%
1"	25	7685.20	58.05%	41.95%
3/4"	19	8221.50	62.10%	37.90%
1/2"	12.7	8995.60	67.95%	32.05%
3/8"	9.5	9382.20	70.87%	29.13%
#4	4.75	9995.50	75.50%	24.50%
#8	2.36	10403.20	78.58%	21.42%
#16	1.18	10669.90	80.59%	19.41%
#30	0.6	10837.60	81.86%	18.14%
#50	0.3	11035.40	83.35%	16.65%
#100	0.15	11479.60	86.71%	13.29%
#200	0.075	12133.40	91.65%	8.35%
Pan				

SIEVE ANALYSIS (ASTM D422-63 Re- Approved 2002)

Project	Keokea-Waiohuli Subdivision Phases 1, 2 and 4A	Job No.	212302.20
Sample Source	Test Pit 4 (Road H)	Purpose	Classification
Soil Description	WELL-GRADED GRAVEL w/ SILT and SAND (GW-GM)	Sample No.	4-1
Tested by	DP	Test Date(s)	3/12/2013

Wt of wet sample & tare (g)	12151.9	**-200 Wash**	
Wt of dry sample and tare (g)	11807.2	**Before Wash**	
Moisture (g)	344.7	Wt of dry sample and tare (g)	11807.2
Wt of tare (g)	928.5	**After Wash**	
Wt of dry sample (g)	10878.7	Wt of dry sample and tare (g)	10859.2
Moisture content	3.2%	Wt. Passing -200 (g)	948.0
		% Passing -200	8.7%

Sieve no.	Diameter (mm)	Cumulative Weight Retained (gm)	% Retained	% Passing
3"	75	0.00	0.00%	100.00%
2"	50.8	394.00	3.62%	96.38%
1-1/2"	37.5	1750.80	16.09%	83.91%
1"	25	2952.50	27.14%	72.86%
3/4"	19	3458.80	31.79%	68.21%
1/2"	12.7	4318.10	39.69%	60.31%
3/8"	9.5	4904.80	45.09%	54.91%
#4	4.75	6061.70	55.72%	44.28%
#8	2.36	7232.20	66.48%	33.52%
#16	1.18	8199.20	75.37%	24.63%
#30	0.6	8782.40	80.73%	19.27%
#50	0.3	9251.40	85.04%	14.96%
#100	0.15	9600.70	88.25%	11.75%
#200	0.075	9907.70	91.07%	8.93%
Pan				

SIEVE ANALYSIS (ASTM D422-63 Re- Approved 2002)

Project	Keokea-Waiohuli Subdivision Phases 1, 2 and 4A	Job No.	212302.20
Sample Source	Test Pit 5 (Road J)	Purpose	Classification
Soil Description	Orange-Brown Sandy SILT (ML-SM)	Sample No.	5-1
Tested by	DP	Test Date(s)	3/11/2013

Wt of wet sample & tare (g)	10568.9	**-200 Wash**	
Wt of dry sample and tare (g)	9248.9	**Before Wash**	
Moisture (g)	1320.0	Wt of dry sample and tare (g)	9248.9
Wt of tare (g)	929.5	**After Wash**	
Wt of dry sample (g)	8319.4	Wt of dry sample and tare (g)	5347.9
Moisture content	15.9%	Wt. Passing -200 (g)	3901.0
		% Passing -200	46.9%

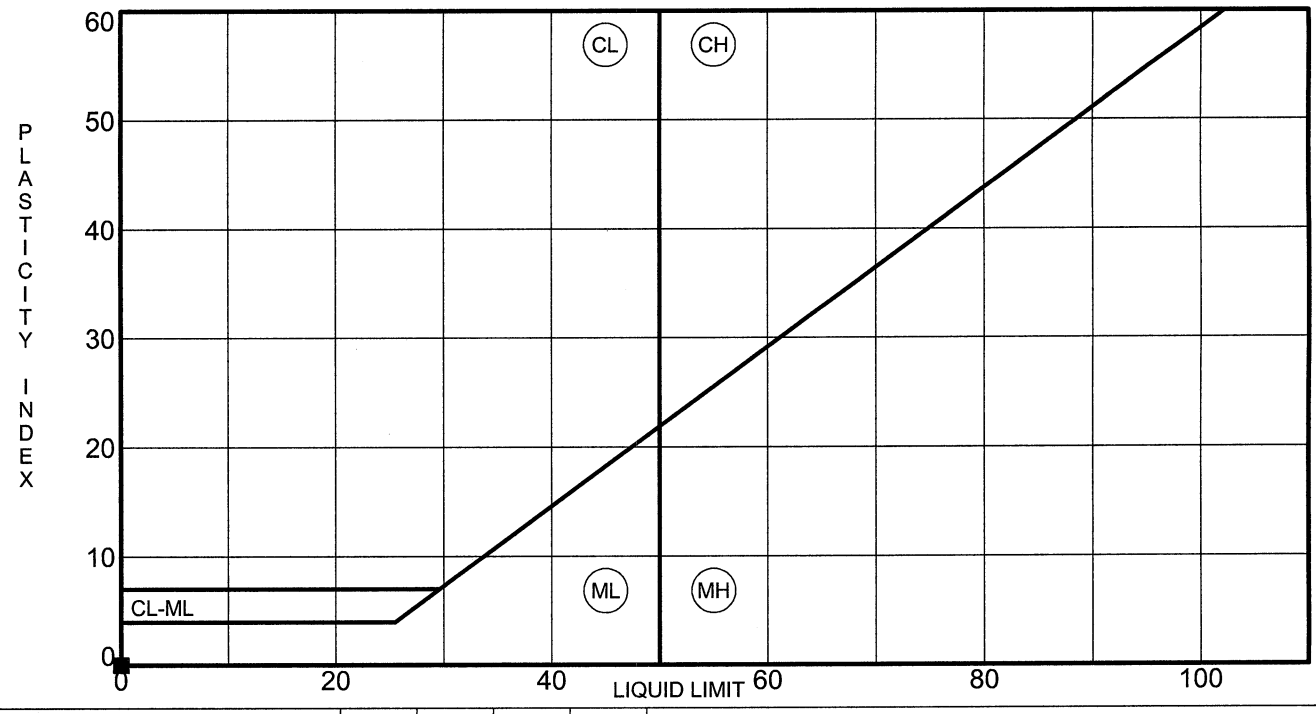
Sieve no.	Diameter (mm)	Cumulative Weight Retained (gm)	% Retained	% Passing
3"	75	446.80	5.37%	94.63%
2"	50.8	608.80	7.32%	92.68%
1-1/2"	37.5	772.20	9.28%	90.72%
1"	25	942.30	11.33%	88.67%
3/4"	19	1042.80	12.53%	87.47%
1/2"	12.7	1142.00	13.73%	86.27%
3/8"	9.5	1173.30	14.10%	85.90%
#4	4.75	1224.70	14.72%	85.28%
#8	2.36	1359.00	16.34%	83.66%
#16	1.18	1673.50	20.12%	79.88%
#30	0.6	2074.20	24.93%	75.07%
#50	0.3	2727.00	32.78%	67.22%
#100	0.15	3870.80	46.53%	53.47%
#200	0.075	4375.80	52.60%	47.40%
Pan				

SIEVE ANALYSIS (ASTM D422-63 Re- Approved 2002)

Project	**Keokea-Waiohuli Subdivision Phases 1, 2 and 4A**	Job No.	212302.20
Sample Source	**Test Pit 8 (Borrow/Stockpile Site)**	Purpose	Classification
Soil Description	**Brown Silty GRAVEL with SAND (GM)**	Sample No.	8-1
Tested by	**DP**	Test Date(s)	3/11/2013

Wt of wet sample & tare (g)	**10714.0**	**-200 Wash**	
Wt of dry sample and tare (g)	**10042.7**	**Before Wash**	
Moisture (g)	**671.3**	Wt of dry sample and tare (g)	10042.7
Wt of tare (g)	**923.6**	**After Wash**	
Wt of dry sample (g)	**9119.1**	Wt of dry sample and tare (g)	9031.2
Moisture content	**7.4%**	Wt. Passing -200 (g)	1011.5
		% Passing -200	11.1%

Sieve no.	Diameter (mm)	Cumulative Weight Retained (gm)	% Retained	% Passing
3"	75	793.30	8.70%	91.30%
2"	50.8	1768.80	19.40%	80.60%
1-1/2"	37.5	3023.40	33.15%	66.85%
1"	25	3690.40	40.47%	59.53%
3/4"	19	4243.50	46.53%	53.47%
1/2"	12.7	4738.40	51.96%	48.04%
3/8"	9.5	5105.80	55.99%	44.01%
#4	4.75	5720.20	62.73%	37.27%
#8	2.36	6174.80	67.71%	32.29%
#16	1.18	6496.60	71.24%	28.76%
#30	0.6	6703.40	73.51%	26.49%
#50	0.3	6948.10	76.19%	23.81%
#100	0.15	7400.30	81.15%	18.85%
#200	0.075	7901.40	86.65%	13.35%
Pan				



Specimen Identification		LL	PL	PI	Fines	Classification
●	TP-2 @ DEPTH 1ft.	NP	NP	NP	8	POORLY GRADED GRAVEL with SILT and SAND GP-GM
⊠	TP-4 @ DEPTH 1ft.	NP	NP	NP	9	WELL-GRADED GRAVEL with SILT and SAND GW-GM
▲	TP-5 @ DEPTH 3ft.	NP	NP	NP	47	SANDY SILT ML-SM
★	TP-8 @ DEPTH 3ft.	NP	NP	NP	13	SILTY GRAVEL with SAND GM

ATTERBERG LIMITS DATA

PSC CONSULTANTS, LLC
SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

Keokea-Waiohuli Subdivision Phases 1, 2 and 4A
Kula, Makawao, Maui, Hawaii

Date: April 2013 | Project No.: 212302.20

PLATE 26

210301 ATTERBERG LIMITS - MAMALAHOA 212302.20 CPE KEOKEA-WAIOHULI PH. 1, 2,4A.GPJ TEST PIT.GDT 4/4/13

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www:pscconsultants.com

LETTER OF TRANSMITTAL

TO: Community Planning & Engineering, Inc.
1286 Queen Emma Street
Honolulu, Hawaii 96813

ATTENTION: Mr. Richard Santo, P.E.

DATE: May 29, 2013
PSC JOB NO.: 212302.20
SUBJECT: Report Addendum
Keokea-Waiohuli Subdivision Phases 1, 2 and 4A
Kula, Makawao, Maui, Hawaii

We ARE SENDING YOU ☒ **Attached** ☐ Under separate cover via USPS the following items:

☐ Invoice ☐ Samples ☐ Prints ☐ Plans ☐ Other: _____

☒ **Letter** ☐ Proposal ☐ Report ☐ Specifications

COPIES	DATE	DESCRIPTION
1 Original	May 28, 2013	Supplementary Recommendations Preliminary Geotechnical Exploration Report Keokea-Waiohuli Subdivision Phases 1, 2 and 4A Kula, Makawao, Maui, Hawaii TMK: (2) 2-2-002:14, 55 and 71

☐ For approval ☒ **For information** ☐ Submit ___ copies for distribution ☒ **For your use** ☐ For review & comment

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Remarks:

cc: _____

SIGNED: _____
Lucy Kaneshiro, Secretary

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CONSULTANTS, LLC (808) 676-6677 - Fax: (808) 676-7733 - Email: pscwahi@pscconsultants.com

Mr. Richard Santo
Community Planning and Engineering, Inc.
1286 Queen Emma Street
Honolulu, Hawaii 96813

May 28, 2013
PSC Job No. 212303.20

Subject: Addendum to Preliminary Geotechnical Exploration Report
Keokea-Waiohuli Subdivision Phases 1, 2 and 4A
Kula, Makawao, Maui, Hawaii

Reference: Preliminary Geotechnical Exploration Report, Proposed Keokea-Waiohuli Subdivision Phases 1, 2 and 4A Kula, Makawao, Maui, Hawaii dated April 5, 2013 prepared by PSC Consultants, LLC

Dear Mr. Santo:

We are pleased to provide our supplementary recommendations to the above-referenced report to address Service Roads:

The following is our revised paragraph on "Service Roads" (pg 7, last paragraph);

1.) "Service Roads"

Surface topping will be 2" asphalt concrete with 2" minimum base thickness of 3" minus select material. Where dense rocks and cobbles are present, the select material will be placed on the rock/cobble surface. If silt is present on dense rocks and cobbles, the silt should be cleaned from the rocks and cobbles. At silt areas, roadway should be cleared to 12" below service road finish grade or till silt pockets are removed, and select material placed where silt was removed. Select material should be rolled to 95 percent compaction and to a smooth surface for the AC topping."

2.) For concern on word "subdrain" at report paragraph on "Road Drainage" (pg 8, first paragraph), we would like to change "Subdrains" to "Drains and culverts" at first line of paragraph.

Standard of Care

The above recommendations are provided in accordance with currently accepted standards of geotechnical engineering principles and practices. No warranty, expressed or implied, or merchantability or fitness is made or intended in connection with our work by furnishing of oral or written reports or findings.

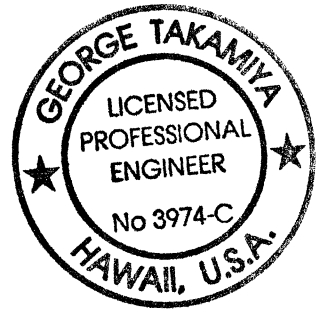
We appreciate this opportunity to be of continued service to you. Should you have any questions, please give us a call.

Respectfully submitted,

PSC CONSULTANTS, LLC

Derrick Chan
Project Engineer

DSC/GT/PSC: lk



This work was prepared by
me or under my supervision
(License Expires April 30, 2014)

George Takamiya, P.E.
Senior Engineer