APPENDIX Q

Soil Investigation Reports

FEWELL
GEOTECHNICAL
ENGINEERING, LTD.

Oahu Office
96-1416 Waihona Place
Pearl City, Hawaii 96782-1973
(808) 455-6569
FAX (808) 456-7062
E-mail: fge@fgeltd.com

Maui Office
360 Papa Place, Suite 103
Kahului, Hawaii 96732-2464
(808) 873-0110
FAX (808) 873-0906

SUBSURFACE INVESTIGATION REPORT

MASS GRADING FOR LOT 2A
PIILANI PROMENADE NORTH SHOPPING CENTER

KIHEI, MAUI, HAWAII

for

PIILANI PROMENADE NORTH, LLC

by

FEWELL GEOTECHNICAL ENGINEERING, LTD.

ALAN J. SHIMAMOTO
LICENSED PROFESSIONAL ENGINEER
No. 4393-C
HAWAII, U.S.A.

This report was prepared by
me or under my supervision.

By Alan J. Shimamoto, P.E.

August 15, 2011

Important Information about Your

Geotechnical Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you —* should apply the report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations" many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

Rely, on Your ASFE-Member Geotechncial Engineer for Additional Assistance

Membership in ASFE/The Best People on Earth exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with your ASFE-member geotechnical engineer for more information.

ASFE THE GEOPROFESSIONAL BUSINESS ASSOCIATION

8811 Colesville Road/Suite G106, Silver Spring, MD 20910
Telephone: 301/565-2733 Facsimile: 301/589-2017
e-mail: info@asfe.org www.asfe.org

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Piilani Promenade North Shopping Center
Kihei, Maui, Hawaii

INTRODUCTION

We have completed a subsurface investigation for Lot 2A to assist Piilani Promenade North, LLC with the geotechnical aspects of its mass grading. Lot 2A will be the site of the Piilani Promenade North Shopping Center in Kihei, Maui, Hawaii. This report presents our findings and conclusions. This work was completed in general accordance with our March 3, 2011 Proposal and your authorization to proceed dated April 6, 2011.

Two related shopping center complexes are planned by affiliated developers, Piilani Promenade North, LLC (PPN) and Piilani Promenade South, LLC (PPS), for the parcels designated as Lots 2A, 2C and 2D in Kihei, Maui, Hawaii. Lot 2A will be developed for the proposed Piilani Promenade North Shopping Center, while the adjoining Lots 2C and 2D will be developed to support the Piilani Promenade South Shopping Center.

Lot 2A is separated from Lots 2C and 2D by the future Kaonoulu Street Extension, which together with an additional street extension and an off-site water tank, is part of the off-site infrastructure improvements for the shopping center. The geotechnical aspects of the design and construction of the off-site infrastructure improvements, including the future Kaonoulu Street Extension, have been previously addressed by others and are not part of this investigation.

Both shopping centers will house a number of retail shops of varying sizes, including large national retailers. Although the proposed footprints of the new buildings are shown on the mass grading plans, the tenants have not been finalized at this time. Additionally, national retailers often perform their own geotechnical engineering for their stores.

Due to the uncertainty with regard to the actual tenants and their geotechnical engineering requirements, the scope of the investigations has been limited to addressing the mass grading of the lots in support of the new shopping centers. We understand that additional geotechnical investigations for the actual building construction will be performed as necessary once the users or tenants of the shopping centers have been determined.

PURPOSE AND SCOPE

At the request of both PPN and PPS, subsurface investigations were undertaken by Fewell Geotechnical Engineering, Ltd. (FGE) for the above three parcels to assist PPN and PPS, and their consultants, with the geotechnical aspects of the mass grading of the parcels to support the shopping centers. Although the field work for both shopping center parcels were performed concurrently, separate subsurface investigation reports have been developed for each site. This report presents the findings and conclusions for the investigation of the parcel designated as Lot 2A, which will support the Piilani Promenade North Shopping Center. A separate report has been issued addressing Lots 2C and 2D for the Piilani Promenade South Shopping Center.

The scope of work for the investigation of the mass grading for the Piilani Promenade North Shopping Center is detailed in the above-referenced proposal and agreement with PPN, but in general, included the exploration of the subsurface of Lot 2A with 11 test borings and 14 test pits. Samples were obtained for laboratory testing. The results of the field exploration and laboratory tests were reviewed in conjunction with the planned mass grading construction to evaluate the ramifications of the general subsurface conditions on the mass grading. The results of our evaluation are presented in this report.

The results of the subsurface exploration, including a Boring Location Plan and the logs of the borings and test pits, are presented in Appendix A. The laboratory test results are included in Appendix B. The limitations of this investigation and report are presented in Appendix C.

PROJECT CONSIDERATIONS

Lots 2A, 2C and 2D are immediately south of Piilani Business Plaza and on the eastern side of Piilani Highway and its intersection with Kaonoulu Street in Kihei. Lot 2A is separated from Lots 2C and 2D by the future Kaonoulu Street Extension and is on the northern side of the future extension. The section of Piilani Highway fronting the lots is aligned in a general north-south direction. The general area of Lot 2A for the Piilani Promenade North Shopping Center is shown on the Project Location Map, Figure 1, in Appendix A.

Lots 2A, 2C and 2D total about 68 acres and are secured with cattle fencing and a locked gate along Piilani Highway. All 3 lots are undeveloped and are covered with scattered shrubs and small trees. Cobbles and small boulders litter the ground surface and occasional shallow swales cut through the lots in the northeast to southwest direction. An existing easement for a 36-inch diameter water line passes through the southeastern corner of Lot 2A and diagonally through Lot 2D in a general northeast to southwest direction. Topography in all 3 lots slopes down gradually toward the southwest at an overall gradient of between about 3 and 5 percent, with localized areas as steep as about 30 percent.

Lot 2A covers about 30 acres and is between the future Kaonoulu Street Extension and Piilani Business Plaza. The lot is trapezoidal in shape and averages about 1,450 feet by 1,400 feet in plan dimensions. The site will include a new substation in its northeastern corner and a 50-foot wide electrical easement just inside its northern property line. The remainder of the site will be developed as part of the shopping center.

Except along portions of its northern property line, the ground surface in Lot 2A generally slopes down gradually toward the south and west. Ground surface elevations vary from approximately Elev. 111 in its northeastern corner, down to about Elev. 50 at its southwestern corner, near the intersection of the Piilani Highway and the future Kaonoulu Street Extension.

Much of the northern property line of Lot 2A abuts the existing Piilani Business Plaza, which is elevated up to about 8 feet above the natural ground surface of Lot 2A. The area appears to have been previously filled, likely from the grading of the existing Piilani Business Plaza. The level area next to the business plaza extends about 50 feet into Lot 2A. The existing slope supporting the fill is visually estimated at an inclination of about 2 Horizontal to 1 Vertical (2H:1V). The exposed slope appears loose and uncompacted, with occasional boulders exposed in the slope.

The preliminary November 19, 2010 Mass Grading Plan for Lot 2A indicates that significant grading will be required to support the new shopping center. In general, the retail stores in Lot 2A are planned mainly in the northeastern half of the site with 2 smaller restaurants at its southwestern corner, overlooking a drainage basin. The remainder of Lot 2A would be developed for shopping center parking.

The area of the retail shops in the northeastern half of the site will be constructed in 2 levels with a grade difference of about 15 feet in height. The northeastern-most section will be graded at about Elev. 95, while the area immediately to the southwest of this upper section will be graded to about Elev. 80. The parking area between the lower level shops and the restaurants in the southwestern corner of the site will be graded such that it gradually slopes down toward the restaurants at a gradient of about 2 percent.

The area of the 2 restaurants in the southwestern corner of Lot 2A will be filled to about Elev. 70. A retention basin will be excavated down to about Elev. 40 in the southwestern corner of Lot 2A, near the intersection of Piilani Highway and the future Kaonoulu Street Extension. The 2 restaurants would overlook the area of the basin in the southwestern direction. A graded 2H:1V slope, of about 26 feet in total height, would support the grade difference between the level of the restaurants and bottom of the basin.

Due to the sloping terrain and the planned finished grade levels, significant site grading will be necessary for the development of Lot 2A. Cuts of 5 to 26 feet in depth will be necessary to establish the finished grades within the area of the new shops in the northeastern half of the site. Fills of up to 12 feet in thickness are anticipated in the area of the 2 restaurants in the southwestern corner of the site, although fill thickness are significantly less for the remainder of the site. Cut slopes of up to 27 feet in height are planned along the eastern edge of the lot, and up to 18 feet on the northern property line. Combined cuts and fills will result in total slope heights of up to about 25 feet for the basin side slopes.

Graded 2H:1V slopes are currently planned to support the grade differences generated along the perimeter of the lot, and the grade changes within the lot. However, we understand that steeper slopes are being considered to maximize the useable area within the lot.

Building information for the new shopping center structures is not available at this time, except for a typical elevation view of the shopping center and the approximate footprint of the new buildings. The elevation view of the shopping center suggests that the structures will be 1- and 2-story buildings, or 1-story buildings with higher than normal ceilings.

Most of the retail shops of the shopping center will be clustered within 2 rows or sections, one on an upper level and another cluster along a lower level. The structure housing the upper level shops is about 85 feet in width by about 530 feet long. The lower level shops are clustered in a number of groups and wings in a curved strip about 1000 feet long by up to 265 feet wide. The types of structures, and their column and wall loads, are not known at this time, although it is assumed that concrete slab-on-grade ground floors are preferred.

SUBSURFACE INVESTIGATION

A total of 13 test borings were drilled and 9 test pits were excavated during the period of May 4, 2011 through June 3, 2011 at the approximate locations shown on the Boring Location Plan, Figure 2 in Appendix A. Although the scope of our services only included 11 borings, 2 borings, Borings 2A and 9A were added during the field work due to unanticipated conditions found at the site. Boring 2A was drilled adjacent to Boring 2, and Boring 9A was drilled adjacent to Boring 9. In addition, 5 borings drilled for an adjacent project along the northern property line of Lot 2A were reviewed in the evaluation of the site conditions.

The borings were drilled to depths of 10 to 40 feet below the existing ground surface with a Mobile B-53 truck-mounted drilling rig advancing 4-inch diameter continuous flight augers, wash-boring and coring tools. Relatively undisturbed samples of the subsurface soils were obtained at selected depths for laboratory testing. The samplers were advanced with either a 3.0-inch O.D. split-spoon sampler or a 2.0-inch O.D. Standard Penetration Test (SPT) sampler, both driven by a 140-pound hammer falling 30 inches.

The number of blow required to advance the samplers the final 12 inches was recorded and is shown on the Boring Logs, Figures 3 through 15 in Appendix A, together with the materials encountered. The blow counts shown on the logs are the actual blow counts obtained in the field during sampling; the estimated corresponding equivalent SPT blow counts for the 3-inch sampler are shown in parentheses below the actual blow counts.

The test pits were excavated to depths of 2 to 9½ feet below the existing ground surface with a Komatsu track-mounted backhoe provided by PPN. The test pits were terminated once impenetrable intact basalt was encountered. Disturbed bag samples were obtained from the test pits for laboratory testing. The materials found in the test pits are shown on the Test Pit Logs, Figures 16 through 24 in Appendix A.

In addition to the 13 borings for the exploration of Lot 2A, 5 previously drilled FGE borings for a separate project were reviewed in the evaluation of the site. These borings were drilled just within the northern property line of Lot 2A, and their locations are also shown on Figure 2. The materials found in the borings are shown on their Boring Logs, Figures 25 through 29 in Appendix A. A Boring Log Legend is included as Figure 30 for reference.

Where intact basalt was encountered in the test borings, the borings were advanced with an NX or HQ Double Tube Core Barrel with an industrial diamond cutting bit. Core samples of the basalt were recovered from the borings for laboratory testing. The degree of Recovery (REC) and the Rock Quality Designation (RQD) for each core run in the basalt are shown on the boring logs. Photographs of the core samples recovered from the borings are shown as Figures 31 through 42 at the end of Appendix A.

LABORATORY TESTING

Selected samples of the subsurface soils were tested in our laboratory to determine their pertinent general engineering characteristics, including in-situ moisture content, density, shear strength, consolidation, and swell under their in-situ moisture conditions. In addition to the tests on the soil materials, unconfined compression tests were performed on selected rock core samples to obtain a general indication of the rock strengths and their dry densities.

Three of the bulk samples from the test pits were tested in general accordance with Laboratory California Bearing Ratio (CBR) test ASTM D1883 to determine their pavement support characteristics and swell when compacted as fill. Atterberg Limits and Gradation tests were performed on visually representative soil samples to aid in the classifications of the soils.

The results of the laboratory tests are shown on the boring and test pit logs, where appropriate. The results of the Consolidation, CBR, Gradation and Atterberg Limits tests are graphically exhibited as Figures 43 through 57 in Appendix B. Table I presents a summary of the results of the tests performed on the undisturbed soil samples, while Table II summarizes the results on the samples obtained from the test pits. Table III at the end of Appendix B presents a summary of the unconfined compressive test results on the basalt cores.

GENERAL SUBSURFACE CONDITIONS

The borings and test pits have revealed that the natural materials beneath Lot 2A for the Piilani Promenade North Shopping Center generally consists of a layer of "soil materials" or "soils" over an initial basalt formation consisting of relatively intact, hard basalt with occasional interbedded layers of cobble- and gravel-sized volcanic rock fragments, generally referred to as Aa Clinker. Portions of the northern property line are underlain by up to 8 feet of previously placed fill.

Except for Borings 1, 5 and 7, the upper basalt formation is generally underlain by a second layer of soil which varies from 3 to 13 feet in thickness. The deeper soils are followed by a second intact basalt formation which extends to the bottom of the deeper borings at depths of 16½ to 40 feet below the existing ground surface. The deeper soils were not found in the areas of Borings 1, 5 and 7 where the basalt formations extend to the bottom of the borings at depths of 10 to 30½ feet below the ground surface.

The surface fills were found along the western end of the northern property line of Lot 2A and are underlain by similar natural materials as the borings within the interior of the site. The natural near-surface soils are generally comprised of residual soils and saprolites (soils weathered in-place from parent rock and exhibiting remnant rock structure).

The combined layering of the near-surface natural soil materials varies significantly in thickness, ranging from as thin as 1 foot to as thick as 8 feet in thickness at the boring and test pit locations.

The upper basalt is generally relatively massive and extends down to depths ranging from 12 to 17½ feet before encountering the deeper residual soils. Table A below presents a summary of the general layering found within the borings and test pits.

Table A – Subsurface Condition Summary

Boring/ Test Pit No.	Ground Elev.	Prop. Finish Grade Elev.	Depth in feet to Bottom of: Surface Residual	Saprolites	Upper Basalt Form.	Deeper Residual	Elev. At Top of Deeper Basalt
1	Elev. 51±	Elev. 40±	3'±	6'±	>10'±		Terminated @ 10'
2	Elev. 91±	Elev. 80±	2'±	3'±	15'±	23'±	Elev. 68±
2A	Elev. 91±	Elev. 80±	2'±	3'±	15'±	24'±	Elev. 76±
3	Elev. 89±	Elev. 80±	3½'±'	5½'±	12'±	19'±	Elev. 70±
4	Elev. 90±	Elev. 80±	1'±	None	15'±	18'±	Elev. 72±
5	Elev. 90±	Elev. 80±	1'±	3'±	>20'±		Terminated @ 20'
6	Elev. 111±	Elev. 80±	1'±	None	13½'±	18'±	Elev. 93±
7	Elev. 100±	Elev. 80±	<1'±	None	>30½'±		Terminated @ 30½'
8	Elev. 100±	Elev. 80±	1'±	3±	18'±	23'±	Elev. 76½±
9	Elev. 98±	Elev. 80±	2½'±	6'±	17'±	30½ ±	Elev. 67½±
9A	Elev. 98±	Elev. 80±	2½'±	6'±	18½'±	30'±	Elev. 68±
10	Elev. 98±	Elev. 95±	<1'±	3'±	14½'±	>16½'±	Terminated @ 16½'
11	Elev. 106±	Elev. 95±	1'±	3½'±	13½'±	18½'±	Elev. 87½±
TP1	Elev. 90±	Elev. 84±	3'±	None		Terminated on Basalt @ 3'	
TP2	Elev. 72±	Elev. 74±	4'±	None		Terminated on Basalt @ 4'	
TP3	Elev. 79±	Elev. 80±	5'±	6'±		Terminated on Basalt @ 6'	
TP4	Elev. 60±	Elev. 70±	5½'±	7½'±		Terminated on Basalt @ 7½'	
TP5	Elev. 71±	Elev. 74±	2'±	None		Terminated on Basalt @ 2'	
TP6	Elev. 90±	Elev. 78±	1½'±	2½'±		Terminated on Basalt @ 2½'	
TP7	Elev. 59±	Elev. 70±	1'±	None	>2½'±	Terminated on Basalt @ 2½'	
TP8	Elev. 68±	Elev. 74±	3'±	None	>2½'±	Terminated on Basalt @ 2½'	
TP9	Elev. 80±	Elev. 81±	>2½'±	5½'±	>9 ½'±	Terminated on Basalt @ 9½'	
2[2]	Elev. 84±	Elev.81±	3'±(Fill)	6'±	22'±	25½'±	Elev. 58½±
3[2]	Elev. 98±	Elev. 80±	8'±(Fill)	11½'±	20'±	27'±	Elev. 71±
4[2]	Elev. 100±	Elev. 97±	1'±	3'±	12½'±	21'±	Elev. 79±
5[2]	Elev. 106±	Elev. 96±	1'±	None	14½'±	21'±	Elev. 85±
6[2]	Elev. 106±	Elev. 100±	1'±	None	13½'±	>19½'±	Terminated @ 19½'

Notes: [1] Elevations estimated from Topographic Plan provided by PPN [2] In-house FGE boring for others

In general, the thickness of the near-surface soils appear thinner toward the eastern end of the site and along the higher knolls of the site, and thicker toward the southwestern side of the site and within the depressed areas of the site. Each of the main types of subsurface materials is described in more detail below.

Surface Residual Soils – The surface layer of residual soils was found in nearly all of the boring and test pit location and its thickness varies from as thin as less than 1 foot, to as thick as 5½ feet below the existing ground surface. Root mats for the above-ground vegetation extend down to depths of 2 to 5 inches below the existing ground surface in the surface residual soils.

In nearly all of the borings, the thickness of the residual soils was found to be less than a foot, notable exceptions being in the areas of Borings 2, 3 and 9, where the thickness of the surface residual soils extends down to depths of 2½ to 3½ feet. The areas of the thinner residual soils generally appear to occur in the northeastern half of Lot 2A, to the northeast of an imaginary diagonal line extending from its southeastern corner down to its northwestern corner. These are the areas of the stores and shops where significant cuts are planned.

The thicker residual soils appear to occur to the southwest of this imaginary lines where many of the test pits were excavated, and where significant fills are planned for the parking lot and 2 restaurants overlooking the retention basin. The residual soils found in the test pits in this section generally extend to depths of 3 feet to 5½ feet below the existing ground surface.

The surface residual soils generally consist of reddish brown, light brown and brown silts and sandy silts with occasional gravel- and cobble-sized rock fragments. They appear to be of volcanic ash origin. The weathered gravel-sized and cobble-sized rock fragments are likely the core stones remaining from Aa Clinker deposited with the volcanic ash.

The residual soils are classified as ML, ML-CL, and ML-MH under the Unified Soil Classification (USC) system, and generally exhibit a hard consistency and relatively high shear strengths. Laboratory tests performed on samples of the residual soils generally showed friction angles of 34 to 37 degrees with cohesion values of 390 to 900 pounds per square foot (psf).

Swell tests on the residual soils showed swells of 0.2 to 1.4 percent under their in-situ moisture contents, and CBR swells of 0.4 to 1.6 percent when compacted near their optimum moisture contents and saturated for a 96-hour period. The CBR tests showed that the residual soils exhibit relatively good pavement support characteristics with CBR's of 26.5 to 43.8 when compacted. The test results suggest that the residual soils generally exhibit low shrink-swell characteristics.

Although the residual soils exhibit relatively good in-situ strength characteristics, they exhibit poor consolidation characteristics. The laboratory tests performed on the residual soils showed that they possess relatively low in-situ densities, low to moderate moisture contents, and moderate but significant consolidation under light to moderate loads. In addition, sudden compression, or "collapse" of 3 to 6 percent occurs with the introduction of water.

These results indicate that although significant loads can be applied to the soils under dry conditions, the soils would consolidate significantly, and suddenly, if water is introduced into the soils, either naturally or through landscaping. We believe that this is likely due to the dissolution of the vestiges of the original structure of the residual soils by the water.

Saprolites – Saprolites consist of residual soils with remnant rock structure. Although they consist of gray/brown and gray low plasticity silts, sandy silts, and clays, they still exhibit the appearance of the rock from which they originated. Sections and seams of highly weathered basalt and some core stones, which are likely weathered clinker, are also included within the saprolite layers. The saprolites are classified as ML and CL under the USC.

The saprolites extend down to depths ranging from as shallow as 3 feet to as deep as 8 feet below the existing ground surface in the boring and test pits within the main part of Lot 2A. A 3-foot thick layer of saprolite extends down to a depth of 11 feet in one of FGE's previous borings along the northern property line due to 8 feet of fill placed over the original ground in this area. Variations in the thickness of the saprolite appear to occur randomly throughout the site.

The saprolites exhibit relatively high penetration resistances to the sampling (high blow counts) and a hard to very hard consistency. Although they exhibit low to moderate densities, they possess high shear strengths. Shear tests performed on samples of saprolites from this investigation and the investigation of the adjacent Lots 2C and 2D showed friction angles of 28 to 45 degrees and cohesion of 335 to 1,000 psf. Swells of 0.2 to 0.8 percent were obtained for the saprolites under their in-situ moisture contents, indicating low shrink-swell characteristics.

No sudden compression was observed during consolidation tests for the saprolite samples. The consolidation tests for the saprolites suggest that they possess relatively high preconsolidation pressures of 6,800 psf or more, a virgin compression index of 15 percent, and a compression index during reloading of less than 1 percent. The tests suggest that relatively minor compression or consolidation of the saprolites should occur under light to moderate loads.

Upper Basalt Formation - The upper basalt formations generally consist of gray, brown/gray and gray/blue intact basalt with occasional interbedded layers of unbonded cobble- and gravel-sized rock fragments, or Aa Clinker. In general the upper basalts are a fine-grained rock with few vesicles or vugs. The Aa Clinker materials interbedded between the layers of intact basalt consist of relatively thin seams of gravel-sized rock fragments, which possess little or no bonding, but are dense to very dense. No voids or cavities were encountered in the upper basalt, although small voids of 6 to 12 inches in vertical dimension, were found within the basalt formation in 3 of the borings drilled in the adjacent Lots 2C and 2D.

The upper intact basalt is mostly slightly weathered with occasional seams of moderately weathered basalt and some fresh basalt. The intact basalt is hard to very hard, and massive in many areas. Laboratory unconfined compression tests on the samples of the basalt cores of the upper basalts show dry densities of 154 to 166 pounds per cubic foot (pcf) and unconfined compressive strengths of 7,025 to 22,315 pounds per square inch. Most of the cores of the upper basalt showed strengths in the range of 11,000 to 15,000 psi.

Deeper Residual Soils – A second layer of residual soils was found below the upper basalt formation in Borings 2, 3, 4, 6, 8, 9, 10, and 11 and in the previous FGE Borings 2 through 6 which were drilled just inside the northern property line of Lot 2A. The deeper residual soils were not found in Borings 1, 5 and 7, where a second deeper basalt formation was found immediately below the upper basalt formation.

Where encountered, the deeper residual soils were found below the upper basalt formation at depths ranging from 12 feet to 22 feet below the existing ground surface, which corresponds to between about Elev. 62 and Elev. 99. In general, the level of the top of the deeper residual soils appears to between Elev. 75 and Elev. 81 in the main area of the shopping center buildings, but is as shallow as Elev. 91 to 99 along the eastern edge of Lot 2A and its northeastern corner, and as deep as Elev. 62 in the northwestern corner of the lot.

The thickness of the deeper residual soil layer varies from as thin as 3 feet to as thick as 14 feet, extending to depths of 18 to 31 feet below the existing ground surface. These depths correspond to between about Elev. 58 and Elev. 92. For the majority of the main building areas within the northeastern half of the site, the deeper residual soils extend to between Elev. 67 and Elev. 79.

The deeper residual soils generally consist of a reddish brown and red silt and clayey silt which are classified as ML and MH under the USC and a reddish brown silty sand which is classified as an SM soil. They appear to be of volcanic ash origin and include occasional seams of weathered sand- and gravel-sized volcanic rock fragments which are likely remnant core stones of Aa Clinker deposited with the volcanic ash.

The deeper residual soils possess moderate to high moisture contents and many samples exhibit low densities of 42 to 55 pcf, which are characteristic of volcanic ash deposits. However, they exhibit high penetration resistance during sampling and hard to very hard consistencies. Direct shear tests on samples of the deeper residual silts show relatively high strengths with friction angles of 35 to 41 degrees and cohesion of 600 to 900 psf.

Consolidation tests on the deeper residual silts show relatively low compression indices of 6 to 9 percent with pre-consolidation pressures in the range of 4,500 to 5,500 psf, or about 2,500 to 3,000 psf above their existing overburden pressure. The tests suggest that these soils should not consolidate significantly under light to moderate loads.

Second Basalt Formation – A second, deeper basalt formation was found below the deeper residual soils at depths of 18 to 31 feet below the existing ground surface, or between about Elev. 58 and Elev. 92 at the boring locations. The deeper basalt formation extends to the bottom of the deeper test borings at depths of up to 40 feet below the existing ground surface.

The second basalt formation generally consists of gray and gray/brown vesicular intact basalt with interbedded thin layers of dense Aa Clinker, or gravel-sized rock fragments. The intact basalt appears "porous," or vesicular, and exhibits numerous vesicles and vugs. It is generally broken to very broken and exhibits moderate strengths. A 12-inch thick void was encountered within the deeper basalt in one of the test borings at a depth of 29 feet below the existing ground surface. Unconfined compressive strength test performed on cores of the second basalt layer showed dry densities of 140 to 149 pcf and unconfined compressive strengths of 5,690 to 6,195 psi.

Groundwater – Groundwater or subsurface seepage was not observed in any of the borings or test pits of this investigation, even after a period of at least 24 hours had elapsed after the completion of the borings. It should be realized, however, that fluctuations in the level of groundwater may occur due to variations in natural subsurface seepage, rainfall, and other factors not present at the time the measurements were made.

DISCUSSION AND CONCLUSIONS

The subsurface investigation has revealed that except for the surface layer of residual soils, Lot 2A is generally underlain by relatively competent saprolites, deeper residual soils and basalt formations. These materials should provide adequate support for the planned mass grading of the Piilani Promenade North Shopping Center, provided the recommendations of this report are followed. Groundwater or seepage was not observed in any of the borings or test pits of this investigation and is not anticipated to have a major impact on the planned construction.

The most significant geotechnical concerns with regard to the mass grading of the site are the compressibility of the surface layer of residual soils, or volcanic ash, and the hard intact basalt found at depths as shallow as 1 foot below the existing ground surface. The deeper residual soils should provide adequate support for the mass grading but will likely require some special considerations in the design and construction of the buildings bearing partially on the intact basalt and partially on the deeper residual soils. This consideration may require further evaluation of the building layout in view of the subsurface conditions found during this investigation.

The near-surface residual soils appear to be a derivative of volcanic ash and exhibit properties which are not uncommon for volcanic ash in Hawaii. These characteristics can result in long-term, post-grading concerns which would be dependent on if, and when, the soils become wet, which is not predictable. Although double-handling of the materials would add costs to the mass grading, we believe that it would be prudent to remove at least some of the residual soils from the parking areas, and all of the residual soils from the building areas, and compact them prior to additional construction or fill placement over these soils.

Our analysis indicates that unpredictable settlements of up to 1 inch can occur under the weight of the new fill over a 2½- to 3-foot thickness of the residual volcanic ash soils in their current condition, if water is introduced into these soils either through natural or man-made causes. Although 1 inch of settlement should not significantly affect the parking areas over the fills, it would be significant for the new buildings constructed on the fill, particularly since the settlements cannot be accurately predicted and may be abrupt differential movements depending on where and when water is introduced to these soils.

Based on the planned mass grading indicated in the preliminary grading plans, most of the northeastern half of the site will be excavated well into the underlying upper basalt formations, while the southwestern half of the site will be filled. Most of the site excavations are in the part of the site northeast of an imaginary diagonal line from the southeastern corner of the site down to its northwestern corner, with the fills to the southwest of the diagonal line.

The proposed site excavations will likely remove most of the surface residual soils from the main building areas on the northeastern side of the site, such that they do not impact the future buildings. However, they would likely underlay the fills areas on the southwestern side of the site where the thickness of the residual soils generally extend down to depths of 3½ to 5½ feet below the existing ground surface.

We believe that it would be prudent to remove the surface layer of the residual soils in their entirety where they underlay the proposed building areas plus a 10-foot perimeter. Provided no future buildings are planned in the parking areas, the removal of the residual soils may be terminated at a maximum depth of 3 feet below the existing ground surface. Should buildings be later proposed in the parking areas in the future, it should be realized that the then-planned buildings would have to be investigated and designed to accommodate the characteristics of the residual soils left beneath the fills in these areas.

The removal of the surface residual soils should extend throughout the areas of the buildings, plus a 10-foot perimeter and their supportive fill embankments. It should extend down to the saprolite below the residual soils. Most of the residual soil, if not all, will likely be removed in the cut areas due to the site excavations. Any remaining residual soils at the finished grade levels should be similarly removed and replaced with compacted fills. Beneath the fills placed for the parking areas, we believe that the removal of the surface residual soils may be terminated at a maximum depth of 3 feet below the existing ground surface.

The actual depth of the removal of the surface residual soils must be determined in the field during the construction. The boring and test pit information in the proposed fill areas suggest that depths of 1 to 5½ feet should be anticipated, with most of the removal likely extending down to an average depth of about 3 feet.

The excavated surface residual soils can be re-used as fill provided they are placed, moisture-conditioned, and compacted in accordance with the recommendations of this report. Once the residual soils have been removed and replaced with properly compacted engineered fill, the remainder of the construction can proceed using relatively typical construction methods and techniques.

The borings indicate that some of the areas to be excavated are generally underlain by as little as 1 foot of soil cover over intact massive basalt, with the soil extending down to depths of 1 to 3 feet from the ground surface at most of the boring locations. This is especially true in the northeastern half of the site where most of the site excavations will occur.

The saprolites found above the intact basalt formations were easily penetrated with augers and we believe that they can be excavated with heavy earth-excavating equipment, but the upper basalt formation is hard to very hard and massive in some areas. Excavation of the intact basalt will require the use of heavy rock-excavating equipment such as single-ripper D-9, or larger, dozers and hoe-rams. Blasting will facilitate and expedite the site excavations provided it can be safely performed in accordance with the governmental regulations for blasting.

The intact basalt should be relatively stable even with steep cut slopes, but significant consideration must be given to the interbedded layers of Aa clinker consisting of the gravel- and cobble-sized rock fragments, and in the building areas, the deeper residual soils which will form the lower portions of the cut slopes. The intact basalt should be able to stand satisfactorily at near-vertical slopes, but the Aa clinker layers and deeper residual soils will tend to ravel over time and approach a more stable slope of between about 1H:1V and 1½H:1V.

We believe that the intact basalt can be cut at slopes as steep as ½H:1V, and up to 15 feet high without benches, provided any encountered clinker layers, or other defects in the basalt, are stabilized by grouting and guniting such that future raveling and sloughing of the clinker materials is prevented. In addition, a drop zone of at least 8 feet in width, and sloped back toward the toe of the cut slope, should be provided at the base of the slope to minimize the lateral movement of any rocks falling from the steep slope.

Flatter slopes are necessary should the cut slopes include the deeper residual soils, which is anticipated for many of the cuts for the 15-foot grade difference in the main building areas on the northeastern half of the site. Where this occurs, the overall cut slopes in the basalt formation, clinker and deeper residuals soils should be cut at a flatter slope of no steeper than 1H:1V for vertical heights of up to 15 feet without benches to accommodate the weaker clinker layers and residual soils. In addition the clinker seams and residual soils should be gunited to protect them from future raveling and subsequent undermining of the intact basalt above these layers.

Cut slopes in the existing fills, surface residual soils and saprolites, should be cut at slopes of 2H:1V or flatter for heights of up to 15 feet without benches. For the above slopes, an 8-foot wide bench should be provided at their approximate mid-heights where the slopes exceed 15 feet.

Slopes steeper than 1½H:1V are relatively steep and can be dangerous. A fence should be constructed at the top of the slopes steeper than 1½H:1V as a safety precaution to prevent access to the top of the steeper slopes.

Excavations into the basalt will likely result in boulder- and cobble-sized rock fragments which would require significant crushing and processing for use as a typical granular fill material. An on-site crusher would have to be used to process the large basalt fragments generated from the site excavations. Although the boulders and cobbles can be used without significant processing as a coarse rock fill (also referred to as a boulder fill), some limitations must be considered. These limitations generally favor the use of a more typical crushed rock fill rather than coarse rock fills for this project.

Future excavations into the coarse rock or boulder fill, will be significantly costly and potentially not feasible without jeopardizing the integrity of the boulder fill. Such excavations typically disturb not only the boulders being excavated, but also the adjacent boulders which are to remain in place. Attempts to stabilize the adjacent boulder fills typically result in nearly complete removal and reconstruction of the fill due to the inability to contain the disturbed fill areas. Injection grouting of the adjacent boulder fill areas with a low-strength material such as CLSM would likely be necessary for excavations into the boulder fills. Hence, coarse rock fills, or boulder fills, should be considered permanent fills which will not be disturbed in any way in the future.

Additionally, subsurface investigations for building foundations would be severely limited by a boulder fill, and obtaining adequate information for the geotechnical aspects of the foundation design would be difficult, if not impossible, within the fills. Hence, depending on the designer's familiarity with boulder fills, the foundation designs for the buildings can be significantly impacted by the presence of the rock fills beneath the structures. This is normally not a concern if the same geotechnical engineer is retained throughout the project, but can be significant for this project since it is anticipated that the larger retailers will probably want to undertake their own foundation investigations for the design and construction of their buildings.

If coarse rock fills or boulder fills are used on this project we recommend that they be constructed in the parking areas at least 10 feet away from the future building areas and existing or future slopes, at least 5 feet below the future finished subgrades, and in areas where future utilities and site excavations are not planned. The above limitations severely limit the use of a boulder fill on this project since except for the building area in the southwestern corner of the site, most of the site grading will result in fill thicknesses of no more than about 6 feet.

It is anticipated that the use of a portable on-site rock crusher would be more cost-effective to generate the vast majority of the fill materials from the basalt formations, rather than using a boulder fill. The crusher should be capable of crushing the basalt, which exhibited unconfined compressive strengths of up to 22,000 psi, to materials to a maximum size of 6 inches in dimension, typically referred to as minus 6-inch materials, which will likely be simpler and more expedient in grading the site.

Fill slopes constructed of the minus 6-inch crushed rock materials, or fill materials comprised of the surface residual soils and saprolites, may be inclined at slopes of 2H:1V for heights of up to 15 feet without benches. Where the fills slopes have been constructed entirely of the minus 6-inch crushed rock fill, they maybe sloped as steep as 1½H:1V for vertical heights of up to 15 feet without benches. Slopes exceeding this height should be provided with an 8-foot wide bench at their approximate mid-heights or at vertical intervals of no more than 15 feet.

Our analyses indicates that the above-recommended slope inclinations and heights should provide an acceptable factor of safety of at least 1.5 against slope failure under static conditions and a safety factor of at least 1.1 under the seismic conditions recommended under the 2006 International Building Code (IBC) for this area of Maui. These are the typically accepted minimum factors of safety for this type of geotechnical stability evaluation.

The remainder of this report presents recommendations addressing the mass grading of the site, but does not include recommendations for the design and construction of the buildings and their foundations. Separate foundation investigations, with additional borings and/or test pits should be undertaken by the future retailers or builders for the buildings of the shopping center to specifically address the new shopping center buildings.

Additional subsurface information should be obtained for the transition of the shopping center between the upper and lower levels in the northeastern half of the site where the deeper residual soils were found between the upper and lower basalt formation. Although these layers would individually provide competent bearing for moderate column loads anticipated for the new structures, they possess significantly different compressibility characteristics.

Based on the currently planned mass grading and building layout, it is anticipated the 15-foot grade differential in the transition between the upper- and lower-level buildings of the shopping center will result in the buildings bearing partially on the upper basalt formation, partially on the deeper residual soils, and partly on the lower basalt formation. Negligible settlements, if any, are anticipated for foundations bearing on the intact basalt layers, while some minor settlements will likely occur to the same type of foundations bearing on residual soils.

Although minor, these settlements would manifest themselves as abrupt differential settlements between the foundations bearing on the different materials: 1) between the upper-level foundations on intact basalt and the adjacent lower-level foundations the deeper residual soils, and 2) between the lower-level foundations bearing on the residual soil and the adjacent lower-level foundations bearing on the lower basalt formation.

The abrupt differential movements can have an adverse impact on the structures unless they are designed to accommodate the movements, either structurally or though the grading for the building construction. Such limitations may warrant a review of the building layout to avoid or reduce the potential for this situation.

For preliminary planning and cost-estimating purposes, we believe that the natural saprolites and the fills processed, placed and compacted in accordance with the recommendations of this report should be capable of providing allowable bearing capacities of between 3,000 and 4,000 pounds per square foot (psf). The foundations should be embedded at least 12 to 18 inches below the lowest compacted subgrade adjacent to the footings, and set-back at least 7 feet from the top of the graded slopes. Increased embedment would be necessary for foundations bearing on a slope, or within 7 feet of the compacted slope face.

Where foundations are embedded at least 6 inches into intact basalt, the allowable bearing capacity can likely be increased to at least 5,000 psf and probably much higher. Voids, cavities, loose clinker seams or other defects in the intact basalt should be cleaned out and filled with concrete. Spread footings should bear entirely on similar materials, i.e. either completely on intact basalt, on saprolites and/or deeper residual soil, or completely on compacted fill.

Due to the possibility of clinker layers and the occasional presence of voids, the drilling of foundations probes may be warranted, depending on the findings of the investigations for the buildings. Foundation probes in the rock are typically drilled at each spread footing and at about 10-foot intervals along the lengths of the continuous footings.

The above comments and preliminary geotechnical guidelines for the building construction are given for preliminary planning purposes. Each of the buildings should be evaluated in more detail once their detailed design has been finalized and additional subsurface investigations have been completed for the buildings.

RECOMMENDATIONS

General

1. We believe that Lot 2A can be adequately developed to satisfactorily support the mass grading for the Piilani Promenade North Shopping Center, provided the recommendations of this report are followed. The presence of the surface layer of volcanic ash residual soils with poor supportive characteristics and the relatively shallow depth to intact basalt present some concerns to be addressed, which will likely result in higher costs than those incurred on sites with more favorable conditions.

2. The most significant geotechnical concerns with the development of the site to support the planned mass grading is the moderate, but sudden, compression which can occur with the near-surface residual soils, and the shallow depth to hard intact basalt. We believe however, that these concerns can be reduced by the removal and replacement of the near-surface residual sols within the building areas with compacted fill, and anticipating the use of heavy rock-excavating equipment and blasting in excavating the intact basalt.

3. Groundwater or seepage was not found in any of the borings or test pits during this investigation and is not anticipated to be a major factor in the planned mass grading.

Site Preparation

4. Prior to the start of actual site grading, the site should be cleared and grubbed in accordance with Section 201 of the Standard Specifications for Road, Bridge and Public Works Construction of the County of Maui (Standard Specifications).

   a. The clearing and grubbing operations should extend throughout the area of the planned construction and at least 5 feet beyond the toes of the planned fill slopes and other new construction.

   b. The actual depth of the clearing and grubbing should be determined in the field during construction, but based on our observations of the borings and test pits, it is likely that 2 to 4 inches will suffice.

   c. All vegetation, trash, rubble, and other deleterious materials should be removed and wasted off-site.

5. Existing utilities or similar items which interfere with the planned construction, should be removed and re-routed. The depressions or trenches resulting from their removal should be backfilled in accordance with the Grading and Utility recommendations of this report.

Grading

6. Once the site has been cleared and grubbed, mass grading can commence to generate the designed grades. The graded, level pads for the shopping center buildings and structures should extend at least 7 feet beyond the exterior edge of the new structures, their foundations and their related attachments. Deeper than normal foundation embedment will be required for the future buildings where this criteria cannot be met.

7. Excavations for the site grading should provide a relatively level area such that protruding high-points in the underlying basalt are minimized for the future shopping center buildings and their slabs. The removal of the basalt in the cut areas should extend at least 6 inches below the bottom of the concrete slabs to allow for the installation of their slab cushions or base materials.

8. The use of heavy rock excavating equipment, such as single-ripper D-9 dozers, or larger, and hoe-rams should be anticipated for the site excavations into the basalt formations and for the construction of any below-grade structures penetrating the basalt. Blasting will facilitate and expedite the removal of the basalt provided it can be performed safely in accordance with applicable governmental regulations for blasting in this area.

9. The surface layer of volcanic ash residual soils should be removed throughout the areas of the new construction and stockpiled for future use as fill.

   a. Within the area of the future buildings, plus a 10-foot perimeter, the removal of the volcanic ash residual soils should extend down to the underlying layers of hard saprolites or the intact basalt formation. The actual depth of their removal must be determined in the field during the construction, but based on the boring and test pit operation, it is anticipated that it will average about 3 feet.

   b. In the parking lot areas, where future buildings are not planned, the depth of the removal of the surface volcanic ash residual soils may be terminated at a maximum depth of 3 feet below the existing ground surface.

   c. Where the then exposed ground surface slopes down in excess of 5H:1V, it should be benched with a series of horizontal terraces prior to fill placement. The benches should extend through any loose slope materials into hard natural ground.

10. The then exposed subgrade should be proof-rolled to detect any remaining soft spots or loose zones prior to fill placement or additional construction. The proof-rolling should consist of at least 5 passes of a heavy compactor such as a Cat 825, or its equivalent, weighing at least 40,000 pounds.

11. Areas to receive fill or new construction should be scarified for a depth of 8 inches, moisture-conditioned to within 3 percent of its optimum moisture content, and uniformly compacted to at least 90 percent relative compaction as determined by Laboratory Compaction Test ASTM D1557. Where the ground is within 2 feet of the bottom of future pavement sections, it should be compacted to at least 95 percent relative compaction.

12. The excavated on-site soil materials, consisting of the residual soils and saprolites may be used for fill for the mass grading and to backfill the over-excavated areas resulting from the removal of the surface residual soils. Little or no processing is anticipated for these materials for their use as fill.

13. Excavated rock materials should be segregated from the soils, and crushed and processed to generate a granular crushed rock material.

a. The excavated rock should be crushed to generate a well-graded material with a maximum dimension of no larger than 6 inches (minus 6-inch crushed rock) with no more than 15 percent passing the No. 200 US Sieve.

b. The use of an on-site crusher should be anticipated to crush and process the basalt to generate the above-recommended fill materials.

14. Fill materials, whether imported or generated on-site, should be free of organics, rubbish, debris, soil clods, and other deleterious materials. Additionally, imported materials should be a low-expansion soil, which is as good as, or similar to, the on-site materials.

a. Imported fill should have a maximum size of no more than 3 inches, no more than 15 percent passing the No. 200 US Sieve and exhibit a Plasticity Index of no more than 15.

b. When tested in accordance with Laboratory CBR Test ASTM D1883, imported fill should exhibit a CBR of at least 15 and no more than 1 percent CBR swell.

15. Fill and backfill should be placed in relatively uniform lifts of no more than 8 inches in loose thickness, moisture-conditioned to within 3 percent of their optimum moisture content and uniformly compacted to at least 90 percent relative compaction as determined by Laboratory Compaction Test ASTM D1557. Fill placed within 2 feet of the bottom of pavements should be compacted to at least 95 percent relative compaction.

16. Field density testing of the minus 6-inch crushed rock fill is not practical due to the over-sized materials comprising the fill. The fill should be compacted to a tight, unyielding layer, and should be continuously observed during the construction to determine whether it appears adequately compacted.

17. Where the on-site soils (consisting of the residual soils and saprolites) are used at the top of the graded building pads, they should be kept moist as much as is practical during the intervening period between the grading of the pad and the construction of the concrete slabs for the buildings. This is to avoid excessive drying and shrinking which can result in future expansion after the construction of the buildings. Should shrinkage cracks in excess of 1/8 inch in width occur, the upper 8 inches of the pads should be scarified and recompacted as indicated above prior to the construction of the concrete slabs-on-grades for the buildings.

18. Cut slopes in the residual soils, saprolites and existing compacted fills should be cut at no steeper than 2H:1V for heights of up to a maximum of 15 feet without benches. Cut slopes in the basalt formation below the soil materials can be cut relatively steeply but should include fences or other safety considerations at the top of the slope to prevent falling off the top of the slopes.

a. Cut slopes in the basalt formation which will expose the deeper residual soils at the base of the formation should be excavated at no steeper than 1H:1V for vertical heights of up to 15 feet without benches, <u>and</u> the deeper residual soils, clinker, or defects in the rock should be gunited to reduce the potential for future raveling, and subsequent undermining of the rock above.

b. Slopes cut into the intact basalt formation which will not expose the deeper residual soils may be sloped as steep as ½H:1V for heights of up to 15 feet without benches, <u>provided</u> any clinker layers and defects found in the rock are grouted and gunited to prevent future raveling and sloughing of the clinker materials.

   i. Loose rocks, boulders or cobbles on the slope should be removed, and a drop zone, at least 8 feet in width, should be provided at the toe of the slope to reduce the potential or future loosened rocks traveling horizontally away from the slope. The drop zone should be sloped toward the cut slopes.

   ii. Maintenance should be provided periodically to observe the condition of the slope and to remove rocks and boulders which accumulate within the drop zone.

c. An 8-foot wide bench should be provided at the approximate mid-height of the slopes where the cut slopes exceed 15 feet, or at about 15 feet intervals up to a maximum height of 30 feet.

19. Fill slopes using the above recommended minus 6-inch well-graded crushed rock fills or the on-site soil materials consisting of residual soils and/or saprolites should be constructed such that the toes of the fill slopes are set-back at least 8 feet from the top of any steep slopes at the site.

a. Fill slopes comprised of any, or all, of the above materials may be constructed as steep as 2H:1V for vertical heights of up to 20 feet without benches.

b. Fills slopes constructed entirely of the minus 6-inch well-graded crushed rock fill materials may be constructed as steep as 1½H:1V for vertical heights of up to 15 feet without benches.

c. Where the fills slopes exceed 20 feet for the 2H:1V slopes, or 15 feet for the 1½H:1V slopes, 8-foot wide benches should be provided at their approximate mid-heights, or at intervals not exceeding 20 feet and 15 feet, respectively, for vertical total heights of up to 20 feet. Fill slopes exceeding this height are not anticipated on this project and should be individually evaluated where they occur.

d. The fill slopes should be over-constructed during the rough grading and subsequently cut back to their desired lines and grades such that the finished slope face is a tight, well-compacted surface.

20. For slopes consisting partially of fill and partially of cut slopes, an 8-foot wide bench should be provided at the approximate mid-height of the total slope, but at intervals of no more than 15 feet up to a height of approximately 30 feet.

21. Where multiple slope inclinations are planned due to the characteristics of the different materials (i.e. 2H:1V in soil cuts over 1H:1V in rock cuts), 8-foot wide benches should be provided at the approximate mid-height of the overall slope and at no more than 15-foot vertical increments up to a height of 30 feet.

22. Slopes exceeding the above-referenced maximum total heights are not anticipated on this project and should be individually evaluated by FGE should they occur.

23. Drainage provisions should be included in the design of the mass grading to direct water away from the slopes and to preclude the ponding of water adjacent to or beneath the slopes.

24. The soil cut slopes and the fill slopes should exhibit adequate overall stability but are susceptible to raveling and rilling due to erosion. The slopes should be protected from erosion by

planting, seeding or mulching as soon as practical after they are graded to minimize the potential for these occurrences.

Utilities & Site Improvements

25. Utilities and site improvements should be installed and backfilled in accordance with Section 206 of the Standard Specifications and the Grading recommendations of this report using the appropriate mechanical compactors above and around the pipes. Jetting, flooding, or ponding techniques should not be allowed as a method of compacting the backfill.

26. Hard intact basalt should be anticipated as shallow as 1 foot below the existing ground surface. The use of heavy rock excavating equipment such as hoe-rams should be anticipated for the utility trench excavations and other site excavations into the basalt.

27. Where rock is found at the invert of the utilities at the bottom of the trench, at least 6 inches of pipe cushion or bed course should be placed over the rock to minimize the potential for point loads on the pipes. The actual thickness of the cushion or bed course should be in accordance with the applicable sections of the Standard Specifications for each type of utility, but should not be less than 6 inches.

28. The well-graded minus 6-inch crushed rock fills will have little or no binder and will be susceptible to raveling and caving. Shielding, shoring, and bracing should be provided by the contractor for the work on the utilities and other deep site excavations in accordance with HIOSH to protect the workers in the excavations. The design and installation of the shoring system should be the responsibility of the contractor.

29. Site improvements such as manholes and drainage inlets can be supported on shallow foundation systems such as mat foundations, individual spread foundations, continuous line foundations, or a combination of these types provided the Grading recommendations have been followed. This will assure that the residual soils have been removed in accordance with the Grading recommendations and replaced with fill that has been compacted to at least 90 percent relative compaction prior to the construction of the improvements and their foundations.

30. Shallow foundations should be founded at least 12 inches below the lowest adjacent compacted subgrade on level ground. The embedment may be reduced to 6 inches into intact

basalt where the foundations bear on rock. Foundations on slopes or within 7 feet of the top of slopes should be embedded such that there is at least 7 feet of horizontal setback from the lower outside edge of the footing to the compacted slope face.

31. Continuous footings should have a minimum base width of 12 inches, while individual spread foundations should have a base width of at least 18 inches. Foundations may be founded on the fill compacted in accordance with the recommendations herein, saprolite, the deeper residual soils or the natural basalt formations. However, individual spread footings and mat foundations should be founded entirely on the same material throughout their contact area.

32. Any soft spots encountered in the foundation excavations should be removed down to compacted fill, or hard natural materials, and the resulting depression backfilled in accordance with the Grading recommendations. Soil-filled holes found in the intact basalt should be cleaned out and backfilled with low-cost concrete.

33. Footings may be founded on the compacted fill, saprolites or deeper residual soils, where an allowable bearing capacity of 3,000 psf may be used for the design of the footings. Mat foundations should be dimensioned such that the contact pressure of the mat does not exceed 2,000 psf. Foundations embedded at least 6 inches into the intact basalt may be designed for an allowable bearing capacity of 5,000 psf. These values may be increased by one-third for short-term wind or seismic loads.

34. The bottom of the foundations excavations in the fill or native soil materials should be compacted to at least 90 percent relative compaction as determined by Laboratory Compaction Test ASTM D1557. Loose materials within the foundation trenches should be removed prior to the placement of the reinforcing steel and concrete.

35. The walls of the below-grade improvements such as drainage inlets and manholes may be designed for an at-rest lateral earth pressure of 60 p.c.f. equivalent fluid pressure assuming the level backfill behind the walls consists of the recommended fill materials indicated in the Grading recommendations. <u>This pressure does not include foundation, surcharge, or hydrostatic pressure, which must be added where appropriate</u>.

36. Weepholes should be provided in the walls of the drainage inlets or catch basins to minimize the accumulation of water within the base course layers of the adjacent pavements. Filter material, approximately 1 cubic foot in volume, and consisting of a free-draining granular material such as ASTM C33 No. 67 aggregate, wrapped in a non-woven geotextile filter fabric, should be provided in front of each weephole. Care must be taken in the construction of the filter materials in front of the weephole to maintain the hydraulic conductivity between the base course for the pavements and the weepholes.

37. Backfill around the improvements should be placed and compacted in accordance with the Grading recommendations of this report using small light equipment to minimize the lateral earth pressures against the improvement walls.

38. Steel reinforcement of the improvements and their foundations should be provided as recommended by the Project Structural Engineer. Total and differential settlements of the foundations for the improvements exceeding ¼ inch are not anticipated under the light loading conditions typical of site improvements.

39. Assuming the soil and rock conditions found in the borings extend to a depth of at least 100 feet below the existing ground surface, we believe that Lot 2A is likely designated as Site Class B, "Rock," due to the predominance of the basalt formations underlying the area.

Pavements

40. It is anticipated that once the shopping center grading has been completed, the subgrade soils beneath the planned pavement areas should consist of either the natural basalt formations, saprolite or fill meeting the requirements of the Grading recommendations of this report.

a. Based on these results, we believe that a minimal pavement section of 2 inches of Asphalt Concrete Paving (ACP), over 6 inches of Aggregate Base Course, placed on the compacted subgrade should be sufficient for the anticipated light passenger car traffic and utility trucks.

b. The thickness of the ACP course should be increased to 3 inches in heavy traffic areas, or where heavy truck traffic is anticipated.

41. The composition of the Aggregate Base Course should conform to Section 703.06 of the Standard Specifications. The subgrade should be shaped to drain and be compacted to at least 95 percent relative compaction for a minimum depth of 6 inches prior to the placement of the base course.

42. The above pavement section is provided for preliminary design and cost-estimating purposes. The actual pavement will depend on the materials encountered at the pavement subgrade levels. The final pavement section should be based on the results of CBR tests obtained on samples of the subgrade soils during construction.

Quality Control

43. The site preparation, grading and backfilling operations, including the removal of the surface residual soils and the proof-rolling operations, should be observed by FGE to determine whether the anticipated conditions are encountered.

44. Intermittent, random field density tests should be taken to determine whether the specified levels of compaction are being consistently obtained in the finer grained fills, backfills, and the existing ground to receive fill. Field density testing is not appropriate to evaluate the compaction of the minus 6-inch fill materials; compaction of the minus 6-inch fills must be visually observed on a full-time basis.

45. Samples of proposed fill materials should be submitted to FGE no less than 7 working days prior to its intended jobsite delivery to allow adequate time for testing, evaluation, and approval.

46. Excavations for the site improvements should be observed by FGE to determine whether the anticipated bearing materials are being encountered. The recommendations given herein are contingent on adequate monitoring of the geotechnical phases of the construction by FGE.

Limitations

51. This report has been prepared for the exclusive use of **Piilani Promenade North, LLC** for the proposed **Mass Grading of Lot 2A** of the **Piilani Promenade North Shopping Center** in Kihei, Maui, Hawaii. In the performance of this investigation and the preparation of this report, FGE has strived to perform our work in general accordance with accepted geotechnical engineering practices and principles in Hawaii. No other warranty, expressed or implied is made. The limitations of the investigation and this report are detailed in Appendix C.

/ajs:tjc:fse

APPENDIX A

Subsurface Investigation Summary

Project Designation: Piilani Promenade North Shopping Center **File:** 3050.01

Location: Kihei, Maui, Hawaii

Project Location Map: Figure 1

Boring Location Plan: Figure 2

Drilling Contractor: Hawaii Test Borings, Inc.

Drilling Equipment: Mobile B-53

Drilling Method: /x/ 4-inch Auger /x/ Wash
/x/ NX Core /x/ HQ Core

Boring Summary:

Boring	Depth	Number of Samples	NX/HQ Core	Depth to Water Table[1]	Water Table Elevation[2]	Boring Log Figure No.
1	10.0'	3	4.0'	N.E.	N.A.	3
2	24.0'	6	18.0'	N.E.	N.A.	4
2A	34.0'	9	10.0	N.E.	N.A.	5
3	22.0'	7	11.0'	N.E.	N.A.	6
4	22.5'	5	20.0'	N.E.	N.A.	7
5	20.0'	2	17.0'	N.E.	N.A.	8
6	40.0'	7	31.7'	N.E.	N.A.	9
7	30.5'	3	28.0'	N.E.	N.A.	10
8	30.0'	4	23.0'	N.E.	N.A.	11
9	38.0'	9	21.0'	N.E.	N.A.	12
9A	30.2'	9	0.0'	N.E.	N.A.	13
10	16.5'	2	11.5'	N.E.	N.A.	14
11	22.5'	5	15.0'	N.E.	N.A.	15
Totals	340.2'	71	210.2'			

Date Started: 5-23-11 **Date Completed:** 6-3-11

Test Pit Summary:

Test Pit	Depth	Number of Samples	Depth to Water Table	Test Pit Log Figure No.
TP1	3.0'	1	N.E.	16
TP2	4.0'	1	N.E.	17
TP3	6.0'	2	N.E.	18
TP4	8.5'	2	N.E.	19
TP5	2.0'	1	N.E.	20
TP6	2.5'	2	N.E.	21
TP7	2.5'	1	N.E.	22
TP8	3.5'	1	N.E.	23
TP9	9.5'	3	N.E.	24
Totals	41.5'	14		

Date Started: 5-4-11 **Date Completed:** 5-5-11

[1] N.E.=None Encountered [2] N.A.=Not Applicable

APPENDIX A (Continued)

Subsurface Investigation Summary

Project Designation: Piilani Promenade North Shopping Center **File:** 3050.01

Location: Kihei, Maui, Hawaii

Existing Adjacent FGE Borings:

Boring	Depth	Number of Samples	NX Core	Depth to Water Table[1]	Water Table Elevation[2]	Boring Log Figure No.
2	36.8'	7	26.2'	N.E.	N.A.	25
3	39.0'	8	21.6'	N.E.	N.A.	26
4	30.0'	5	19.0'	N.E.	N.A.	27
5	25.0'	7	14.0'	N.E.	N.A.	28
6	19.5'	5	12.5'	N.E.	N.A.	29
Totals	150.3'	32	93.3'			

Boring Log Legend: Figure 30

Rock Core Photographs:

Boring 1	Figure 31
Boring 2	Figure 32
Boring 2a	Figure 33
Boring 3	Figure 34
Boring 4	Figure 35
Boring 5	Figure 36
Boring 6	Figure 37
Boring 7	Figure 38
Boring 8	Figure 39
Boring 9	Figure 41
Boring 10	Figure 41
Boring 11	Figure 42

[1] N.E.=None Encountered [2] N.A.=Not Applicable

LEGEND:

PROJECT LOCATION

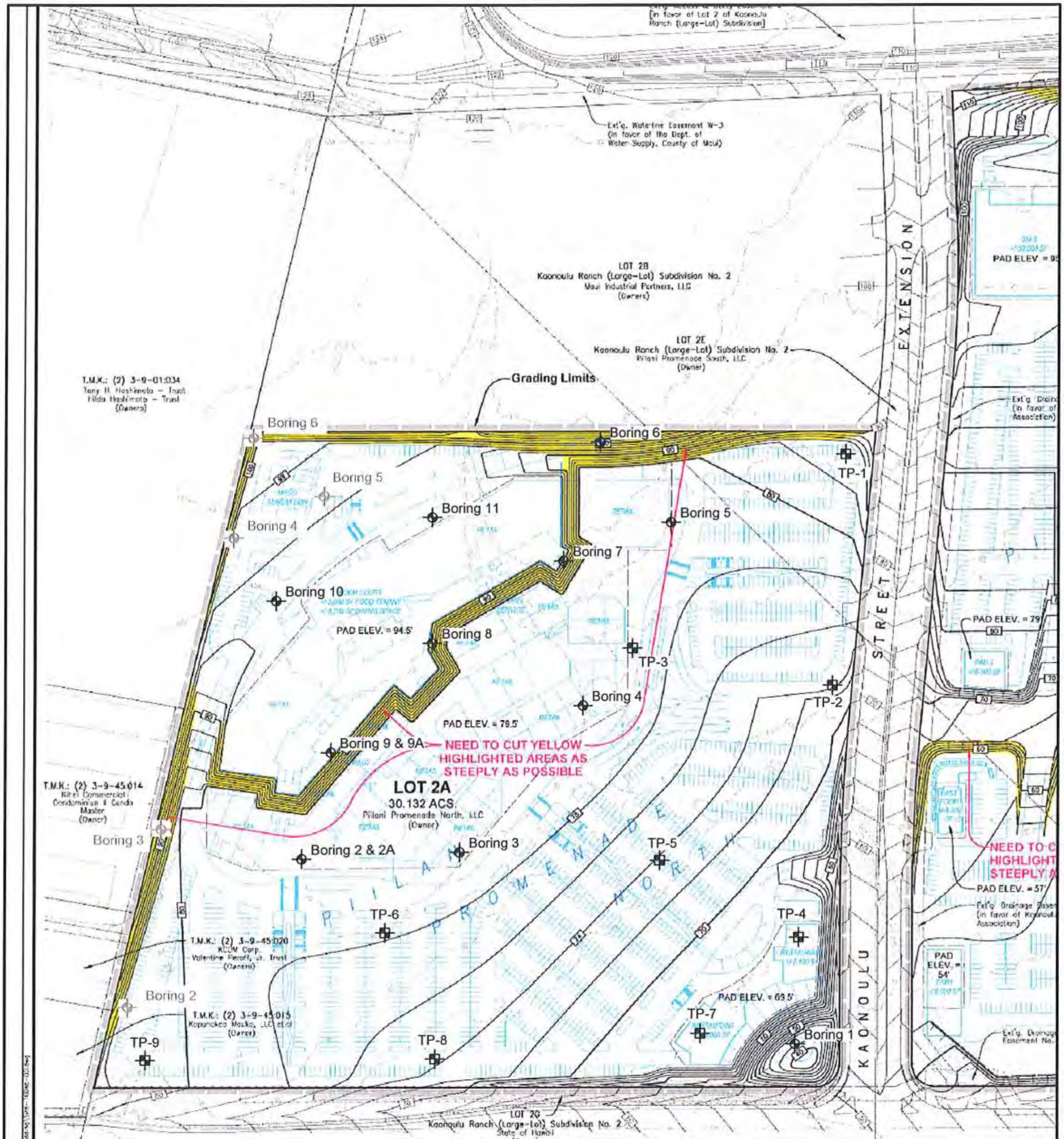
SCALE: 1:24000

GENERAL AREA:
KIHEI, MAUI, HAWAII

REFERENCE:
PUU O KALI QUADRANGLE
U.S.G.S. TOPOGRAPHIC MAP

F.G.E.	**PROJECT LOCATION MAP** Piilani Promenade North Shopping Center Kihei, Maui, Hawaii	File: 3050.01 August 2011

Figure 1



LEGEND

APPROXIMATE SCALE IN FEET

60 120 240

PLAN NORTH

- APPROXIMATE FGE BORING LOCATION
- APPROXIMATE FGE TEST PIT LOCATION
- APPROXIMATE EXISTING FGE BORING LOCATION

PLAN PROVIDED BY ECLIPSE DEVELOPMENT GROUP, FEBRUARY 2011

96-1416 Waihona Place Pearl City Hawaii 96782-

FEWELL GEOTECHNICAL ENGINEERING, LTD.

BORING LOCATION PLAN

Piilani Promenade North Shopping Center
Kihei, Maui, Hawaii

File: 3050.01 | August 2011

Figure 2

F.G.E. Ltd.

Boring: 1
Project: Piilani Promenade North Shopping Center
Location: Kihei, Maui, Hawaii
Surface Elevation: 51'±
Depth to Water: None Encountered (5/29/11, 12:30pm)
Date Completed: 5-26-11

File: 3050.01
Project Engineer: AS
Field Engineer: TRN
Drafted by: KSL
Date of Drawing: August 2011

LAB TEST RESULTS	MOIST CONT. %	DRY DEN. PCF	BLOWS PER FT. *(x) See Legend	SAMPLE	DEPTH	CLASSIFICATION
	17	73	36 (26)	1	0–4	Reddish Brown SILT (ML) with roots to 4", hard, dry **(RESIDUAL)**
Direct Shear: C= 335psf Ø= 45° Swell= 0.5% S.I.= 0.02	26	68	70/9" (47/9")	2	5	Light Brown/Gray SILT (ML) with some remnant rock structure, hard, damp **(SAPROLITE)**
			R	3		Gray Slightly Weathered BASALT (WS), hard, massive
U.C.= 11,145psi		160	REC=100% RQD=90%	HQ Core		
			REC=100% RQD=77%	HQ Core		Brown Silty GRAVEL-sized Volcanic Rock Fragments (GM), dense, damp **(WEATHERED Aa CLINKER)**
					10	Brown/Gray Slightly Weathered Vesicular BASALT (F), hard, massive
						BOH @ 10.0'

Depth scale: 5, 10, 15, 20, 25, 30, 35

F.G.E. Ltd.

Boring: 2
Project: Piilani Promenade North Shopping Center
Location: Kihei, Maui, Hawaii
Surface Elevation: 91'±
Depth to Water: None Encountered (6/4/11, 9:30am)
Date Completed: 6-1-11

File: 3050.01
Project Engineer: AS
Field Engineer: TRN
Drafted by: KSL
Date of Drawing: August 2011

LAB TEST RESULTS	MOIST CONT. %	DRY DEN. PCF	BLOWS PER FT. *(x) See Legend	SAMPLE	DEPTH	CLASSIFICATION
	19	66	28 (21)	1	0–1	Reddish Brown SILT (ML) with roots to 5", hard, dry
					2	Gray/Brown Sandy SILT (ML) with remnant rock structure, hard, dry to damp **(SAPROLITE)**
			REC=35% RQD=13%	HQ Core	3–5	Brown/Gray Slightly to Moderately Weathered BASALT (WS-WM) with occasional seams of Brown Silty Sand- and Gravel-sized Volcanic Rock Fragments, medium hard to hard, broken to very broken
			R REC=53% RQD=15%	2 HQ Core	8	
			R REC=56% RQD=15%	3 HQ Core	11	
			R REC=19% RQD=17%	4 HQ Core	14	
					15	Reddish Brown SILT (MH), hard, damp
	65		60	5	17	
	28		58/9"	6	19–20	At 19.0', grades with occasional seams of Sand
			REC=100% RQD=100%	HQ Core	23–24	Gray Fresh BASALT (F), hard, massive
					24	**BOH @ 24.0'**

Depth scale: 5, 10, 15, 20, 25, 30, 35

Figure 4

F.G.E. Ltd.

Boring: 2A
Project: Piilani Promenade North Shopping Center
Location: Kihei, Maui, Hawaii
Surface Elevation: 91'±
Depth to Water: None Encountered (6/15/11, 6:10am)
Date Completed: 6-14-11

File: 3050.01
Project Engineer: AS
Field Engineer: TRN
Drafted by: KSL
Date of Drawing: August 2011

LAB TEST RESULTS	MOIST CONT. %	DRY DEN. PCF	BLOWS PER FT. *(x) See Legend	SAMPLE	DEPTH	CLASSIFICATION
					0	Reddish Brown SILT (ML) with roots to 5", hard, dry
						Gray/Brown Sandy SILT (ML) with remnant rock structure, hard, dry to damp **(SAPROLITE)**
					5	Brown/Gray Slightly to Moderately Weathered BASALT (WS-WM) with occasional seams of Brown Silty Sand- and Gravel-sized Volcanic rock fragments, medium hard to hard, broken to very broken
					10	
Direct Shear: C= 900psf Ø= 35° Swell= 0.5% S.I.= 0.1	45	41	87 (59)	1	15	Reddish Brown SILT (MH), hard, damp
LL= 70, PI= 0 Torv.= 1,750psf	47	51	108/10" (71/10")	2		
Direct Shear: C= 675psf Ø= 38° Swell= 0.5% S.I.= 0.01 Torv.= 1,250psf	42	55	132/10" (88/10")	3		
			172 (115)	4	20	
Torv.= 2,250psf	27	87	105/10" (70/10")	5		
			100/5" (67/5")	6		**(RESIDUAL)**
			R REC=81% RQD=64%	7 NX Core	25	Gray Fresh Vesicular BASALT (F), hard, occasionally broken At 26.0', grades with seams of dense Brown/Gray Gravel-sized Volcanic Rock Fragments
			REC=52% RQD=49%	NX Core	30	
			32/3" R	8		Gray Silty GRAVEL-sized Volcanic Rock Fragments (GM), dense, moist
			R	9		
					35	**BOH @ 34.0'**

F.G.E. Ltd.

Boring: 3
Project: Piilani Promenade North Shopping Center
Location: Kihei, Maui, Hawaii
Surface Elevation: 89'±
Depth to Water: None Encountered (5/29/11, 6:30am)
Date Completed: 5-26-11

File: 3050.01
Project Engineer: AS
Field Engineer: TRN
Drafted by: KSL
Date of Drawing: August 2011

LAB TEST RESULTS	MOIST CONT. %	DRY DEN. PCF	BLOWS PER FT. *(x) See Legend	SAMPLE	DEPTH	CLASSIFICATION
					0	Reddish Brown SILT (ML) with roots to 4", hard, damp **(RESIDUAL)**
Direct Shear: C= 390psf Ø= 37° Swell= 0.2%	24	77	41 (29)	1		
S.I.= 0.01	21	90	39 (28)	2		Gray Brown SILT (ML) with remnant rock structure, hard, dry to damp **(SAPROLITE)**
			27 (21)	3	5	Brown/Gray GRAVEL-sized Volcanic Rock Fragments (GP), trace roots, medium dense, damp **(Aa Clinker)**
			REC=69% RQD=0%	HQ Core		
			R	4		Brown/Gray Moderately Weathered BASALT (WM) with seams of Silty Sand- and Gravel-sized Volcanic Rock Fragments, medium hard, very broken
			REC=31% RQD=0%	HQ Core	10	
			R	5		Red SILT (MH), trace Weathered Gravel-sized Rock Fragments, very hard, damp **(RESIDUAL)**
	70		48	6	15	
	77		67	7		At 17.5', grades with occasional seams of Sand
			50/6"	8		
					20	Brown/Gray Moderately Weathered Vesicular BASALT (WM), medium hard, broken
			REC=78% RQD=71%	HQ Core		Gray Slightly Weathered Vesicular BASALT (F), hard, massive
						BOH @ 22.0'
					25	
					30	
					35	

F.G.E. Ltd.

Boring: 4
Project: Piilani Promenade North Shopping Center
Location: Kihei, Maui, Hawaii
Surface Elevation: 90'±
Depth to Water: None Encountered (6/4/11, 9:00am)
Date Completed: 6-3-11

File: 3050.01
Project Engineer: AS
Field Engineer: TRN
Drafted by: KSL
Date of Drawing: August 2011

LAB TEST RESULTS	MOIST CONT. %	DRY DEN. PCF	BLOWS PER FT. *(x) See Legend	SAMPLE	DEPTH	CLASSIFICATION
			R	1	0	Reddish Brown SILT (ML) with roots to 4", hard, damp **(RESIDUAL)**
			R REC=91% RQD=89%	2 HQ Core		Gray Fresh BASALT (F), hard, massive
					5	
U.C.= 22,315psi		164	R REC=100% RQD=98%	3 HQ Core		At 5.5' to 6.0', seam of Silt with Gravel-sized Rock Fragments
						At 8.0', grades with occasional fractures and trace Silt in fractures
					10	
			REC=56% RQD=53%	HQ Core		
					15	
			R REC=17% RQD=0%	4 HQ Core		Reddish Brown SILT (MH) with occasional seams of Sand, hard, damp **(REDSIDUAL)**
	62		96	5		
			REC=95% RQD=94%	HQ Core		Gray Fresh Vesicular BASALT (F), hard, massive
					20	
						Gray Slightly to Moderately Weathered Vesicular BASALT (WS-WM), hard, broken
						BOH @ 22.5'
					25	
					30	
					35	

F.G.E. Ltd.

Boring: 5
Project: Piilani Promenade North Shopping Center
Location: Kihei, Maui, Hawaii
Surface Elevation: 90'±
Depth to Water: None Encountered (6/4/11, 8:45am)
Date Completed: 5-31-11

File: 3050.01
Project Engineer: AS
Field Engineer: TRN
Drafted by: KSL
Date of Drawing: August 2011

LAB TEST RESULTS	MOIST CONT. %	DRY DEN. PCF	BLOWS PER FT. *(x) See Legend	SAMPLE	DEPTH	CLASSIFICATION
					0	Light Brown SILT (ML) with roots to 3", hard, damp **(RESIDUAL)**
	15	67	95/9" (64/9")	1		Light Brown SILT (ML) with remnant rock structure, hard, damp **(SAPROLITE)**
			R REC=100% RQD=100%	2 HQ Core		Gray Slightly Weathered BASALT (WS), hard, massive
					5	
			REC=81% RQD=81%	HQ Core		At 8.0' to 8.3', seam Welded Clinker
			REC=81% RQD=91%	HQ Core	10	At 10.5', grades Moderately Weathered, broken
			REC=100% RQD=90%	HQ Core	15	At 16.0' to 16.5' seam of dense Gravel-sized Volcanic Rock Fragments
			REC=67% RQD=67%	HQ Core	20	**BOH @ 20.0'**
					25	
					30	
					35	

F.G.E. Ltd.

Boring: 6
Project: Piilani Promenade North Shopping Center
Location: Kihei, Maui, Hawaii
Surface Elevation: 111'±
Depth to Water: None Encountered (6/4/11, 9:00am)
Date Completed: 5-28-11

File: 3050.01
Project Engineer: AS
Field Engineer: TRN
Drafted by: KSL
Date of Drawing: August 2011

LAB TEST RESULTS	MOIST CONT. %	DRY DEN. PCF	BLOWS PER FT. *(x) See Legend	SAMPLE	DEPTH	CLASSIFICATION
					0	Light Brown SILT (ML) with roots to 4", hard, damp **(RESIDUAL)**
			R REC=65% RQD=48%	1 HQ Core		Gray Slightly Weathered BASALT (WS) with Silt in fractures, hard, occasionally broken
			REC=27% RQD=0%	HQ Core		
			55/9"	2	5	
U.C.= 13,700psi		154	REC=100% RQD=87%	HQ Core		
			REC=50% RQD=0%	HQ Core	10	
			R REC=75% RQD=27%	3 HQ Core		
			REC=100% RQD=67%	HQ Core		Gray Slightly Weathered BASALT (WS), hard, occasionally broken
			47/6"	4	15	Reddish/Brown SILT (MH), very hard, damp
	42		50/6"	5		**(RESIDUAL)**
			REC=100% RQD=100%	HQ Core	20	Gray Slightly Weathered Vesicular BASALT (WS), hard, massive
U.C.= 6,195psi		149	REC=100% RQD=100%	HQ Core	25	
			REC=75% RQD=64%	HQ Core		At 27.0', grades Moderately Weathered, occasionally broken
					30	VOID
			R REC=75% RQD=33%	6 HQ Core		Brown/Gray Silty GRAVEL-sized Volcanic Rock Fragments, very dense, hard
			REC=100% RQD=37%	HQ Core	35	Gray Fresh BASALT (F) with occasional seams of Weathered Clinker, medium hard to hard, occasionally broken to very broken

Figure 9 a

F.G.E. Ltd.

Boring: 6
Project: Piilani Promenade North Shopping Center
Location: Kihei, Maui, Hawaii
Surface Elevation: 111'±
Depth to Water: None Encountered (6/4/11, 9:00am)
Date Completed: 5-28-11

File: 3050.01
Project Engineer: AS
Field Engineer: TRN
Drafted by: KSL
Date of Drawing: August 2011

LAB TEST RESULTS	MOIST CONT. %	DRY DEN. PCF	BLOWS PER FT. *(x) See Legend	SAMPLE	DEPTH	CLASSIFICATION
			REC=100% RQD=48%	HQ Core		Gray Fresh BASALT (F) with occasional seams of Weathered Clinker, medium hard to hard, occasionally broken to very broken
			50/6"	7		
			REC=81% RQD=72%	HQ Core	40	
						BOH @ 40.0'
					45	
					50	
					55	
					60	
					65	
					70	

Figure 9 b

F.G.E. Ltd.

Boring: 7
Project: Piilani Promenade North Shopping Center
Location: Kihei, Maui, Hawaii
Surface Elevation: 100'±
Depth to Water: None Encountered (6/4/11, 8:15am)
Date Completed: 5-31-11

File: 3050.01
Project Engineer: AS
Field Engineer: TRN
Drafted by: KSL
Date of Drawing: August 2011

LAB TEST RESULTS	MOIST CONT. %	DRY DEN. PCF	BLOWS PER FT. *(x) See Legend	SAMPLE	DEPTH	CLASSIFICATION
					0	Brown SILT (ML), hard, damp
U.C.= 14,570psi		160	REC=90% RQD=75%	HQ Core		Gray Slightly Weathered BASALT (WS) with Silt in fractures, hard, broken
			20/3"	1		
U.C.= 12,895psi		166	REC=96% RQD=87%	HQ Core	5	Gray Slightly Weathered BASALT (WS), hard, massive
			REC=42% RQD=20%	HQ Core	10	
						Gray/Brown Moderately Weathered BASALT (WM) with seams of dense Gravel-sized Rock Fragments, soft to medium hard, broken to very broken
			R REC=42% RQD=35%	2 HQ Core	15	
			20/6"	3		
U.C.= 5,690psi		140	REC=82% RQD=71%	HQ Core		Gray Slightly Weathered Vesicular BASALT (WS) with occasional seams of Silty Gravel-sized Rock Fragments, hard, massive
					20	
			REC=86% RQD=78%	HQ Core		At 23.0', grades to occasionally broken to massive
					25	
			REC=100% RQD=100%	HQ Core		
					30	
						BOH @ 30.5'
					35	

F.G.E. Ltd.

Boring: 8
Project: Piilani Promenade North Shopping Center
Location: Kihei, Maui, Hawaii
Surface Elevation: 100'±
Depth to Water: None Encountered (6/4/11, 9:45am)
Date Completed: 6-2-11

File: 3050.01
Project Engineer: AS
Field Engineer: TRN
Drafted by: KSL
Date of Drawing: August 2011

LAB TEST RESULTS	MOIST CONT. %	DRY DEN. PCF	BLOWS PER FT. *(x) See Legend	SAMPLE	DEPTH	CLASSIFICATION
						Light Brown SILT (ML) with roots to 5", hard, damp **(RESIDUAL)**
	13	72	54/6" (37/6")	1		Gray/Brown SILT (ML), with remnant rock structure, hard, damp **(SAPROLITE)**
			REC=100% RQD=100%	HQ Core		Gray Slightly Weathered BASALT (WS), hard, massive
					5	
U.C.= 14,655psi		162	REC=100% RQD=100%	HQ Core		
					10	
						At 13.5', grades occasionally broken
			REC=60% RQD=35%	HQ Core		
					15	Brown/Gray Moderately Weathered BASALT (WM) with seams of Gravel-sized Rock Fragments, medium hard, broken to very broken
			R REC=0% RQD=48%	2 HQ Core		Reddish Brown Clayey SILT (MH), very hard, damp
	65		39	3	20	
LL= 64, PI= 0			12	4		At 22.0', grades with seams of Sand
			REC=89% RQD=52%	HQ Core	25	Gray Fresh Vesicular BASALT (F), hard, occasionally broken to broken
						Brown/Gray Moderately Weathered BASALT (WM), hard, broken to very broken
			REC=100% RQD=100%	HQ Core		Gray Fresh Vesicular BASALT (F), hard, massive
					30	**BOH @ 30.0'**
					35	

F.G.E. Ltd.

Boring: 9
Project: Piilani Promenade North Shopping Center
Location: Kihei, Maui, Hawaii
Surface Elevation: 98'±
Depth to Water: None Encountered (6/4/11, 9:50am)
Date Completed: 6-1-11

File: 3050.01
Project Engineer: AS
Field Engineer: TRN
Drafted by: KSL
Date of Drawing: August 2011

LAB TEST RESULTS	MOIST CONT. %	DRY DEN. PCF	BLOWS PER FT. *(x) See Legend	SAMPLE	DEPTH	CLASSIFICATION
Direct Shear: C= 900psf Ø= 34° Swell= 1.4% S.I.= 0.04	19	75	65 (44)	1		Light Brown SILT (ML) with trace roots, hard, damp
			70/9" (47/9")	2	5	Light Brown/Gray SILT (ML) with remnant rock structure, roots, hard, damp **(SAPROLITE)**
			R	3		
			REC=100% RQD=0%	HQ Core		Gray Slightly Weathered BASALT (WS), hard, broken
			REC=100% RQD=100%	HQ Core	10	At 8.0', grades massive
U.C.= 7,025psi		166	REC=100% RQD=100%	HQ Core	15	
			REC=25% RQD=12%	HQ Core		Reddish Brown Clayey SILT (MH), hard, damp
			44	4	20	
	62		32	5		At 20.5', with occasional Sand seams
	46		22	6		
	68		5	7	25	
	69		18	8		
			43/4"	9	30	
			REC=87% RQD=40%	HQ Core		Gray Slightly Weathered Vesicular BASALT (WS) with Silt in fractures, hard, occasionally broken to massive
			REC=100% RQD=77%	HQ Core	35	

Figure 12 a

F.G.E. Ltd.

Boring: 9
Project: Piilani Promenade North Shopping Center
Location: Kihei, Maui, Hawaii
Surface Elevation: 98'±
Depth to Water: None Encountered (6/4/11, 9:50am)
Date Completed: 6-1-11

File: 3050.01
Project Engineer: AS
Field Engineer: TRN
Drafted by: KSL
Date of Drawing: August 2011

LAB TEST RESULTS	MOIST CONT. %	DRY DEN. PCF	BLOWS PER FT. *(x) See Legend	SAMPLE	DEPTH	CLASSIFICATION
						At 35.0', grades broken
						Gray Fresh BASALT (F), hard, massive
						BOH @ 38.0'
					40	
					45	
					50	
					55	
					60	
					65	
					70	

Figure 12 b

F.G.E. Ltd.

Boring: 9A
Project: Piilani Promenade North Shopping Center
Location: Kihei, Maui, Hawaii
Surface Elevation: 98'±
Depth to Water: None Encountered (6/15/11, 5:30am)
Date Completed: 6-13-11

File: 3050.01
Project Engineer: AS
Field Engineer: TRN
Drafted by: KSL
Date of Drawing: August 2011

LAB TEST RESULTS	MOIST CONT. %	DRY DEN. PCF	BLOWS PER FT. *(x) See Legend	SAMPLE	DEPTH	CLASSIFICATION
					0–2	Light Brown SILT (ML) with roots, hard, damp
					2–6	Light Brown/Gray SILT (ML) with remnant rock structure, roots, hard, damp **(SAPROLITE)**
					6–16.5	Gray Slightly Weathered BASALT (WS), hard, broken
			84/10" (45/10")	1	16.5–18.5	Brown/Gray GRAVEL-sized Volcanic Rock Fragments (GP), very dense, damp
Gradation: Gravel= 4% Sand= 66% Silt/Clay= 30% Torv.= 435psf	28	90	102 (59)	2	18.5–22.5	Reddish Brown Silty SAND (SM), very dense, moist **(RESIDUAL)**
Direct Shear: C= 600psf Ø= 41° Swell= 0.0% S.I.= 0.0	30	88	96/9" (56/9")	3		
Direct Shear: C= 600psf Ø= 39° Swell= 0.7%	59	49	44 (30)	4	22.5–30.2	Reddish Brown SILT (MH), hard, damp **(RESIDUAL)**
			46 (31)	5		
S.I.= 0.02 Torv.= 800psf LL= 115, PI= 41	72	60	37 (27)	6		
Torv.= 1,670psf Direct Shear: C= 700psf Ø= 39° Swell= 0.7% S.I.= 0.04	96	42	37 (27)	7		
			76/8" R (51/8")	8		
Torv.= 1,665psf Torv.= 2,165psf	58	54	50/3" R (34/3") R	9		
					30.2	**BOH @ 30.2'**

F.G.E. Ltd.

Boring: 10
Project: Piilani Promenade North Shopping Center
Location: Kihei, Maui, Hawaii
Surface Elevation: 100'±
Depth to Water: None Encountered (6/4/11, 10:00am)
Date Completed: 6-3-11

File: 3050.01
Project Engineer: AS
Field Engineer: TRN
Drafted by: KSL
Date of Drawing: August 2011

LAB TEST RESULTS	MOIST CONT. %	DRY DEN. PCF	BLOWS PER FT. *(x) See Legend	SAMPLE	DEPTH	CLASSIFICATION
	19	79	80 (54)	1	0–1.5	Light Brown SILT (ML) with roots to 4", hard, damp **(RESIDUAL)**
					1.5–3	Gray/Brown SILT (ML) with remnant rock structure, hard, damp **(SAPROLITE)**
			REC=84% RQD=56%	HQ Core	3	Gray Slightly Weathered BASALT (WS) with Silt in fractures, hard, occasionally broken to massive
					5	
U.C.= 15,080psi		165	REC=92% RQD=58%	HQ Core	8	
					10	
			REC=80% RQD=47%	HQ Core	12	Gray/Brown Moderately Weathered BASALT (WM) with seams of dense Gravel-sized Volcanic Rock Fragments, soft to medium hard
			36	2	15	Red SILT (MH), hard, moist **(RESIDUAL)**
					16.5	**BOH @ 16.5'**
					20	
					25	
					30	
					35	

F.G.E. Ltd.

Boring: 11
Project: Piilani Promenade North Shopping Center
Location: Kihei, Maui, Hawaii
Surface Elevation: 106'±
Depth to Water: None Encountered (6/4/11, 10:30am)
Date Completed: 6-2-11

File: 3050.01
Project Engineer: AS
Field Engineer: TRN
Drafted by: KSL
Date of Drawing: August 2011

LAB TEST RESULTS	MOIST CONT. %	DRY DEN. PCF	BLOWS PER FT. *(x) See Legend	SAMPLE	DEPTH	CLASSIFICATION
					0	Brown SILT (ML) with roots to 4", hard, damp **(RESIDUAL)**
	15	77	85 (57)	1		
						Brown/Gray SILT (ML) with remnant rock structure, hard, damp **(SAPROLITE)**
	11	69	R	2		
			REC=78% RQD=64%	HQ Core		Gray Slightly Weathered BASALT (WS), hard, massive
					5	
			REC=100% RQD=69%	HQ Core		
					10	
						Brown GRAVEL-sized Volcanic Rock Fragments (SM-GM), very dense **(WEATHERED Aa CLINKER)**
			28/5"	3		
			REC=100% RQD=28%	HQ Core		
						Reddish Brown SILT (MH), very hard, damp
	59		58/9"	4		
					15	
	70		77	5		
			REC=82% RQD=73%	HQ Core		**(RESIDUAL)**
						Gray Slightly Weathered Vesicular BASALT (WS), hard, massive
					20	
						BOH @ 22.5'
					25	
					30	
					35	

F.G.E. Ltd.

Boring: TP1
Project: Piilani Promenade North Shopping Center
Location: Kihei, Maui, Hawaii
Surface Elevation: 90'±
Depth to Water: None Encountered (5/5/11)
Date Completed: 5-5-11

File: 3050.01
Project Engineer: AS
Field Engineer: TRN
Drafted by: KSL
Date of Drawing: August 2011

LAB TEST RESULTS	MOIST CONT. %	DRY DEN. PCF	BLOWS PER FT.	SAMPLE	DEPTH	CLASSIFICATION
						Brown Silt with roots to 3", loose, dry
CBR= 26.5 Swell= 1.6% LL= 39, PI= 12 Gradation: Gravel= 5% Sand= 24% Silt/Clay= 71%	21	104		1		Light Brown Sandy SILT (ML) with trace Gravel, very stiff to hard, damp **(RESIDUAL)**
					5	**BOH on Basalt @ 3.0'**
					10	
					15	
					20	
					25	
					30	
					35	

F.G.E. Ltd.

Boring: TP2
Project: Piilani Promenade North Shopping Center
Location: Kihei, Maui, Hawaii
Surface Elevation: 72'±
Depth to Water: None Encountered (5/5/11)
Date Completed: 5-5-11

File: 3050.01
Project Engineer: AS
Field Engineer: TRN
Drafted by: KSL
Date of Drawing: August 2011

LAB TEST RESULTS	MOIST CONT. %	DRY DEN. PCF	BLOWS PER FT.	SAMPLE	DEPTH	CLASSIFICATION
						Boulders and Cobbles in Brown Silt matrix, dense, damp
Gradation: Gravel= 0% Sand= 30% Silt/Clay= 70%	22			1		Light Brown Sandy SILT (ML), very stiff to hard **(RESIDUAL)**
					5	**BOH on Basalt @ 4.0'**
					10	
					15	
					20	
					25	
					30	
					35	

F.G.E. Ltd.

Boring: TP3
Project: Piilani Promenade North Shopping Center
Location: Kihei, Maui, Hawaii
Surface Elevation: 79'±
Depth to Water: None Encountered (5/5/11)
Date Completed: 5-5-11

File: 3050.01
Project Engineer: AS
Field Engineer: TRN
Drafted by: KSL
Date of Drawing: August 2011

LAB TEST RESULTS	MOIST CONT. %	DRY DEN. PCF	BLOWS PER FT.	SAMPLE	DEPTH	CLASSIFICATION
	18			1	0–1	COBBLES and BOULDERS in Brown Silt matrix, and roots to 2", dense, damp
	13			2	1–5	Light Brown SILT (ML), very stiff to hard, damp **(RESIDUAL)**
					5–6	Light Brown Sandy SILT (ML) with Remnant Rock Structure, hard, damp **(SAPROLITE)**
						BOH on Basalt @ 6.0'

Depth scale: 5, 10, 15, 20, 25, 30, 35

F.G.E. Ltd.

Boring: TP4
Project: Piilani Promenade North Shopping Center
Location: Kihei, Maui, Hawaii
Surface Elevation: 60'±
Depth to Water: None Encountered (5/4/11)
Date Completed: 5-5-11

File: 3050.01
Project Engineer: AS
Field Engineer: TRN
Drafted by: KSL
Date of Drawing: August 2011

LAB TEST RESULTS	MOIST CONT. %	DRY DEN. PCF	BLOWS PER FT.	SAMPLE	DEPTH	CLASSIFICATION
						BOULDERS and COBBLES in a Brown Silt matrix, loose, dry
CBR= 43.8 Swell= 0.4% LL= 50, PI= 15 Gradation: Gravel= 1% Sand= 41% Silt/Clay= 58%	30	92		1		Light Brown Sandy SILT (ML-MH) with some Cobbles and Boulders, medium dense, dry to damp **(RESIDUAL)**
					5	
				2		Gray/Brown Sandy SILT (ML) with Remnant Rock Structure, hard, damp **(SAPROLITE)**
						Gray Slightly Weathered BASALT (F), hard, occasionally broken
					10	**BOH @ 8.5'**
					15	
					20	
					25	
					30	
					35	

F.G.E. Ltd.

Boring: TP5
Project: Piilani Promenade North Shopping Center
Location: Kihei, Maui, Hawaii
Surface Elevation: 71'±
Depth to Water: None Encountered (5/4/11)
Date Completed: 5-4-11

File: 3050.01
Project Engineer: AS
Field Engineer: TRN
Drafted by: KSL
Date of Drawing: August 2011

LAB TEST RESULTS	MOIST CONT. %	DRY DEN. PCF	BLOWS PER FT.	SAMPLE	DEPTH	CLASSIFICATION
	14			1		Light Brown SILT (ML) with Cobbles and roots to 3", loose, dry to damp **(RESIDUAL)**
						BOH on Basalt @ 2.0'
					5	
					10	
					15	
					20	
					25	
					30	
					35	

F.G.E. Ltd.

Boring: TP6
Project: Piilani Promenade North Shopping Center
Location: Kihei, Maui, Hawaii
Surface Elevation: 90'±
Depth to Water: None Encountered (5/4/11)
Date Completed: 5-4-11

File: 3050.01
Project Engineer: AS
Field Engineer: TRN
Drafted by: KSL
Date of Drawing: August 2011

LAB TEST RESULTS	MOIST CONT. %	DRY DEN. PCF	BLOWS PER FT.	SAMPLE	DEPTH	CLASSIFICATION
CBR= 30.0 Swell= 1.4% LL= 48, PI= 17	24	98		1		Light Brown Sandy SILT (ML), loose, dry
				2		Brown/Gray Sandy SILT (ML) with Remnant Rock Structure, very stiff, damp to moist **(SAPROLITE)**
					5	**BOH on Basalt @ 2.5'**
					10	
					15	
					20	
					25	
					30	
					35	

F.G.E. Ltd.

Boring: TP7
Project: Piilani Promenade North Shopping Center
Location: Kihei, Maui, Hawaii
Surface Elevation: 59'±
Depth to Water: None Encountered (5/4/11)
Date Completed: 5-4-11

File: 3050.01
Project Engineer: AS
Field Engineer: TRN
Drafted by: KSL
Date of Drawing: August 2011

LAB TEST RESULTS	MOIST CONT. %	DRY DEN. PCF	BLOWS PER FT.	SAMPLE	DEPTH	CLASSIFICATION
	17			1		Brown Sandy SILT (ML), loose, damp **(RESIDUAL)**
						Gray Slightly Weathered BASALT (WS), hard, occasionally broken
						BOH @ 2.5'
					5	
					10	
					15	
					20	
					25	
					30	
					35	

F.G.E. Ltd.

Boring: TP8
Project: Piilani Promenade North Shopping Center
Location: Kihei, Maui, Hawaii
Surface Elevation: 68'±
Depth to Water: None Encountered (5/4/11)
Date Completed: 5-4-11

File: 3050.01
Project Engineer: AS
Field Engineer: TRN
Drafted by: KSL
Date of Drawing: August 2011

LAB TEST RESULTS	MOIST CONT. %	DRY DEN. PCF	BLOWS PER FT.	SAMPLE	DEPTH	CLASSIFICATION
	16			1	0–2.8	Light Brown Sandy SILT (ML) with Cobbles and roots to 2", hard, dry to damp **(RESIDUAL)**
					2.8–3.5	Gray Slightly Weathered BASALT (WS), hard, occasionally broken
					3.5	**BOH on Basalt @ 3.5'**

Depth scale: 5, 10, 15, 20, 25, 30, 35

F.G.E. Ltd.

Boring: TP9
Project: Piilani Promenade North Shopping Center
Location: Kihei, Maui, Hawaii
Surface Elevation: 80'±
Depth to Water: None Encountered (5/4/11)
Date Completed: 5-4-11

File: 3050.01
Project Engineer: AS
Field Engineer: TRN
Drafted by: KSL
Date of Drawing: August 2011

LAB TEST RESULTS	MOIST CONT. %	DRY DEN. PCF	BLOWS PER FT.	SAMPLE	DEPTH	CLASSIFICATION
				1		Gray GRAVEL (GP) with Sand and Silt, loose, dry **(FILL)**
LL= 38, PI= 13	20			2		Light Brown Sandy SILT (ML-CL) with some Cobbles, hard, damp **(RESIDUAL)**
				3	5	Light Brown/Gray SILT (ML) with remnant rock structure, very stiff to hard, moist **(SAPROLITE)**
						Gray Moderately Weathered BASALT (WM), medium hard, broken to occasionally broken
					10	Gray Slightly Weathered BASALT (WS), hard, occasionally broken to massive
						BOH @ 9.5'
					15	
					20	
					25	
					30	
					35	

Boring: 2

Project: Kaonoulu Substation and Support Poles

Location: Kihei, Maui, Hawaii

Surface Elevation: 84'±

Depth to Water: None Encountered (6/9/11 @ 6:15am)

Date Completed: 6-9-11

File: 2930.21

Project Engineer: AS

Field Engineer: TRN

Drafted by: KSL

Date of Drawing: July 2011

F.G.E. Ltd.

LAB TEST RESULTS	MOIST CONT. %	DRY DEN. PCF	BLOWS PER FT. *(x) See Legend	SAMPLE	DEPTH	CLASSIFICATION
			28/8" (21/8")*	1		Light Gray Silty SAND and GRAVEL (SM-GM), dense, dry **(FILL)**
Direct Shear: C= 450psf Ø= 37° Swell= 0.3% S.I.= 0.0	20	86	25/2" (13/2")	2		Brown Silty SAND (SM) with trace Gravel, dense, damp **(FILL)**
LL= 37, PI= 15	20	88	25/3" (13/3")	3	5	Brown/Gray Sandy CLAY (CL) with Weathered Rock Fragments and remnant rock structure, trace roots, hard, damp **(SAPROLITE)**
			REC= 93% RQD= 87%	HQ Core		Gray Slightly Weathered BASALT (WS), hard, massive
U.C.= 11,600psi		165	REC= 89% RQD= 89%	HQ Core	10	
						At 11.0', grades Fresh
			REC= 100% RQD= 100%	HQ Core	15	
			REC= 100% RQD= 83%	HQ Core	20	At 20.5', grades Slightly to Moderately Weathered
			58/10"	4		Red SILT (ML), hard, damp
	51		30/2"	5	25	**(RESIDUAL)**
			REC= 100% RQD= 100%	HQ Core		Gray Slightly to Moderately Weathered Vesicular BASALT (WS-WM), hard, massive
			REC= 64% RQD= 47%	HQ Core	30	At 27.0', grades occasionally broken to broken
			R	6		
			REC= 92% RQD= 87%	HQ Core	35	

F.G.E. Ltd.

Boring: 2
Project: Kaonoulu Substation and Support Poles
Location: Kihei, Maui, Hawaii
Surface Elevation: 84'±
Depth to Water: None Encountered (6/9/11 @ 6:15am)
Date Completed: 6-9-11

File: 2930.21
Project Engineer: AS
Field Engineer: TRN
Drafted by: KSL
Date of Drawing: July 2011

LAB TEST RESULTS	MOIST CONT. %	DRY DEN. PCF	BLOWS PER FT. *(x) See Legend	SAMPLE	DEPTH	CLASSIFICATION
			30/4"	7		Brown/Gray GRAVEL-sized Volcanic Rock Fragments (GP), very dense, damp
						BOH @ 36.8'
					40	
					45	
					50	
					55	
					60	
					65	
					70	

F.G.E. Ltd.

Boring: 3
File: 2930.21
Project: Kaonoulu Substation and Support Poles
Location: Kihei, Maui, Hawaii
Project Engineer: AS
Surface Elevation: 94'±
Field Engineer: TRN
Depth to Water: None Encountered (6/11/11 @ 6:40am)
Drafted by: KSL
Date Completed: 6-10-11
Date of Drawing: July 2011

LAB TEST RESULTS	MOIST CONT. %	DRY DEN. PCF	BLOWS PER FT. *(x) See Legend	SAMPLE	DEPTH
	13		56 (31)*	1	
Gradation: Gravel= 48% Sand= 25% Silt/Clay= 27%	8		20/4" (10/4")	2	
			57 (31)	3	5
			REC= 39% RQD= 38%	HQ Core	
	34		67/7"	4	
	41		38/4"	5	10
			REC= 92% RQD= 60%	HQ Core	
			REC= 100% RQD= 28%	HQ Core	15
U.C.= 12,150psi		164	REC= 100% RQD= 92%	HQ Core	
	74		68	6	20
	45		50	7	
	88		75	8	25
U.C.= 2,450psi		135	REC= 92% RQD= 53%	HQ Core	
			REC= 67% RQD= 18%	HQ Core	30
			REC= 100% RQD= 92%	HQ Core	
			REC= 100%	HQ	35

CLASSIFICATION

Depth (approx.)	Classification
0–0.3'	Brown Silty SAND (SM) with Gravel and roots to 4", loose, damp
to ~8'	Light Brown Silty SAND and GRAVEL (SM-GM) with some Cobbles and occasional seams of Silt, dense, damp **(FILL)**
~8'–11.5'	Light Brown/Gray Sandy SILT (ML) with remnant rock structure, hard, moist **(SAPROLITE)**
~11.5'–20'	Gray Moderately Weathered BASALT (WS), medium hard, broken to occasionally broken. At 17.5', grades Slightly Weathered, hard, occasionally broken to massive
20'–27.5'	Red SILT (ML) with occasional seams of Silty Sand, hard, damp **(RESIDUAL)**
27.5'–31'	Gray Slightly Weathered BASALT (WS), medium hard, occasionally broken. At 28.5', grades to Moderately Weathered, broken
31'–35'+	Gray Slightly Weathered Vesicular BASALT (WS), hard, occasionally broken to massive. At 34.0', grades with occasional seams of Moderately Weathered Basalt

F.G.E. Ltd.

Boring: 3
Project: Kaonoulu Substation and Support Poles
Location: Kihei, Maui, Hawaii
Surface Elevation: 94'±
Depth to Water: None Encountered (6/11/11 @ 6:40am)
Date Completed: 6-10-11

File: 2930.21
Project Engineer: AS
Field Engineer: TRN
Drafted by: KSL
Date of Drawing: July 2011

LAB TEST RESULTS	MOIST CONT. %	DRY DEN. PCF	BLOWS PER FT. *(x) See Legend	SAMPLE	DEPTH	CLASSIFICATION
			RQD= 83%	Core		Gray Slightly Weathered BASALT (WS) with occasional seams of Moderately Weathered Basalt, hard, occasionally broken to massive At 38.5', grades Fresh
					40	**BOH @ 39.0'**
					45	
					50	
					55	
					60	
					65	
					70	

F.G.E. Ltd.

Boring: 4 **File:** 2930.21
Project: Kaonoulu Substation and Support Poles
Location: Kihei, Maui, Hawaii **Project Engineer:** AS
Surface Elevation: 100'± **Field Engineer:** TRN
Depth to Water: None Encountered (6/8/11 @ 7:30pm) **Drafted by:** KSL
Date Completed: 6-7-11 **Date of Drawing:** July 2011

LAB TEST RESULTS	MOIST CONT. %	DRY DEN. PCF	BLOWS PER FT. *(x) See Legend	SAMPLE	DEPTH	CLASSIFICATION
					0	Brown SILT (ML) with roots to 4", hard, damp **(RESIDUAL)**
Direct Shear: C= 2,700psf Ø= 33° Swell= 0.02% S.I.= 0.0 LL= 38, PI= 0	14	89	72 (49)*	1		Brown/Gray SILT (ML) with remnant rock structure, trace roots, hard, damp **(SAPROLITE)**
					5	Gray Fresh BASALT (F) with occasional seams of Silt in fractures, hard, massive At 4.0', grades broken At 4.5', grades massive
U.C.= 13,500psi		167	REC= 87% RQD= 76%	HQ Core		
U.C.= 15,900psi		164	REC = 65% RQD= 76%	HQ Core		
					10	Brown/Gray Moderately Weathered Vesicular BASALT (WM), hard, broken
	59		73	2		Red SILT (ML) with occasional Silty Sand- and Gravel-sized Rock Fragments, hard, damp
	59		56	3	15	
			63/9"	4		
	92		50/6"	5	20	**(RESIDUAL)**
			REC= 100% RQD= 58%	HQ Core		Gray Slightly Weathered Vesicular BASALT (WS) with Silt in fractures, hard, broken to occasionally broken At 22.0', grades Fresh, massive
			REC= 96% RQD= 89%	HQ Core		
			REC= 100% RQD= 100%	HQ Core	25	
					30	**BOH @ 30.0'**
					35	

F.G.E. Ltd.

Boring: 5
Project: Kaonoulu Substation and Support Poles
Location: Kihei, Maui, Hawaii
Surface Elevation: 106'±
Depth to Water: None Encountered (6/8/11 @ 7:15pm)
Date Completed: 6-7-11

File: 2930.21
Project Engineer: AS
Field Engineer: TRN
Drafted by: KSL
Date of Drawing: July 2011

LAB TEST RESULTS	MOIST CONT. %	DRY DEN. PCF	BLOWS PER FT. *(x) See Legend	SAMPLE	DEPTH	CLASSIFICATION
						Brown SILT (ML) with roots to 3", hard, damp **(RESIDUAL)**
U.C.= 14,000psi		160	50/4" REC= 78% RQD= 63%	1 HQ Core		Gray Moderately Weathered BASALT (WM), with occasional seams of Gravel-sized rock fragments, hard, broken to very broken
			REC= 86% RQD= 22%	2 HQ Core	5	
						Void
Gradation: Gravel= 54% Sand= 37% Silt/Clay= 9%	16		30	3		Gray COBBLE-and GRAVEL-sized Volcanic Rock Fragments (GM) , dense, moist
			REC= 29% RQD= 0%	HQ Core	10	
			46	4		
			REC= 36% RQD= 0%	HQ Core	15	
						Red Sandy SILT (ML), very stiff to hard, damp
	64		65	5		At 17.0', grades Reddish Brown
	57		52	6	20	
						(RESIDUAL)
			30/3"	7		Gray Slightly Weathered Vesicular BASALT (WS), hard, massive
			REC= 100% RQD= 100%	HQ Core		
			REC= 100% RQD= 100%	HQ Core	25	
						BOH @ 25.0'
					30	
					35	

F.G.E. Ltd.

Boring: 6
Project: Kaonoulu Substation and Support Poles
Location: Kihei, Maui, Hawaii
Surface Elevation: 106'±
Depth to Water: None Encountered (6/8/11 @ 6:40pm)
Date Completed: 6-6-11

File: 2930.21
Project Engineer: AS
Field Engineer: TRN
Drafted by: KSL
Date of Drawing: July 2011

LAB TEST RESULTS	MOIST CONT. %	DRY DEN. PCF	BLOWS PER FT. *(x) See Legend	SAMPLE	DEPTH	CLASSIFICATION
			R	1	0	Brown SILT (ML) with roots to 5", trace Cobbles, hard, damp **(RESIDUAL)**
			REC= 88% RQD= 55%	HQ Core	5	Gray Slightly to Moderately Weathered BASALT (WS-WM) with occasional seams of SAND- and GRAVEL-sized Rock Fragments, hard, occasionally broken to very broken
U.C.= 11,050psi		164	50/3" REC= 48% RQD= 23%	2 HQ Core	10	
			52/6"	3		
			REC= 17% RQD= 0%	HQ Core	15	Red Sandy SILT (ML), hard, damp
	88		54	4		
	50		49	5		**(RESIDUAL)**
					20	**BOH @ 19.5'**
					25	
					30	
					35	

MAJOR SOIL TYPES

Symbol	Description
ML	Inorganic silts and very fine sands, rock flour, silty or clayey silts with slight plasticity
MH	Inorganic silts, micaceous or diatomaceous fine sand or silty soils
CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
CH	Inorganic clays of high plasticity
OL	Organic silts and organic silty clays of low plasticity
OH	Organic clays of medium to high plasticity, organic silts
PT	Peat, humus, swamp soils with high organic contents
GW	Well-graded gravels, gravel-sand mixtures, little or no fines
GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines
GM	Silty gravels, gravel-sand-silt mixtures
GC	Clayey gravels, gravel-sand-clay mixtures
SW	Well-graded sands, gravelly sand, little or no fines
SP	Poorly-graded sands, gravelly sand, little or no fines
SM	Silty sands, sand-silt mixtures
SC	Clayey sands, sand-clay mixtures

MAJOR ROCK TYPES

BASALT

TUFF

DECOMPOSED ROCK

CORAL

Sampling Symbols

3" O.D. Relatively Undisturbed Sample

2" O.D. Standard Penetration Sample

3" O.D. Disturbed Sample

Shelby Tube

No Recovery

Core

Water Level

*(x) Equivalent Estimated SPT Blow Count

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BORING LOG LEGEND

Piilani Promenade North Shopping Center
Kihei, Maui, Hawaii

File: 3050.01

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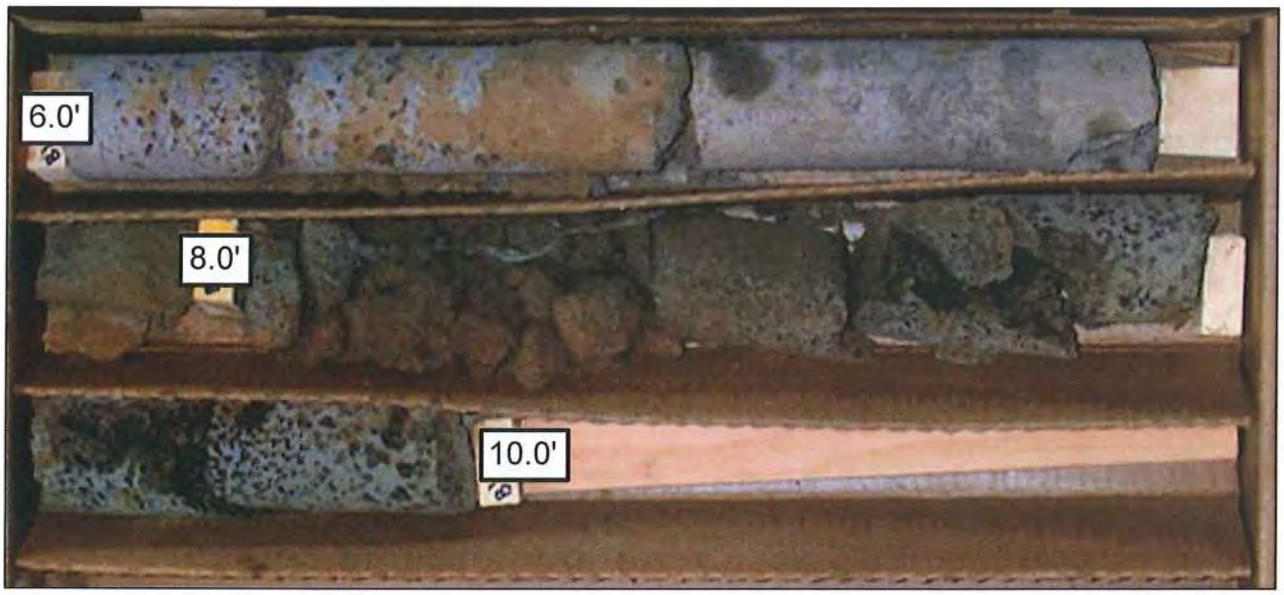
Figure 30

Boring 1: 6.0'-10.0'



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ROCK CORE PHOTOGRAPH

Piilani Promenade North Shopping Center
Kihei, Maui, Hawaii

File: 3050.01

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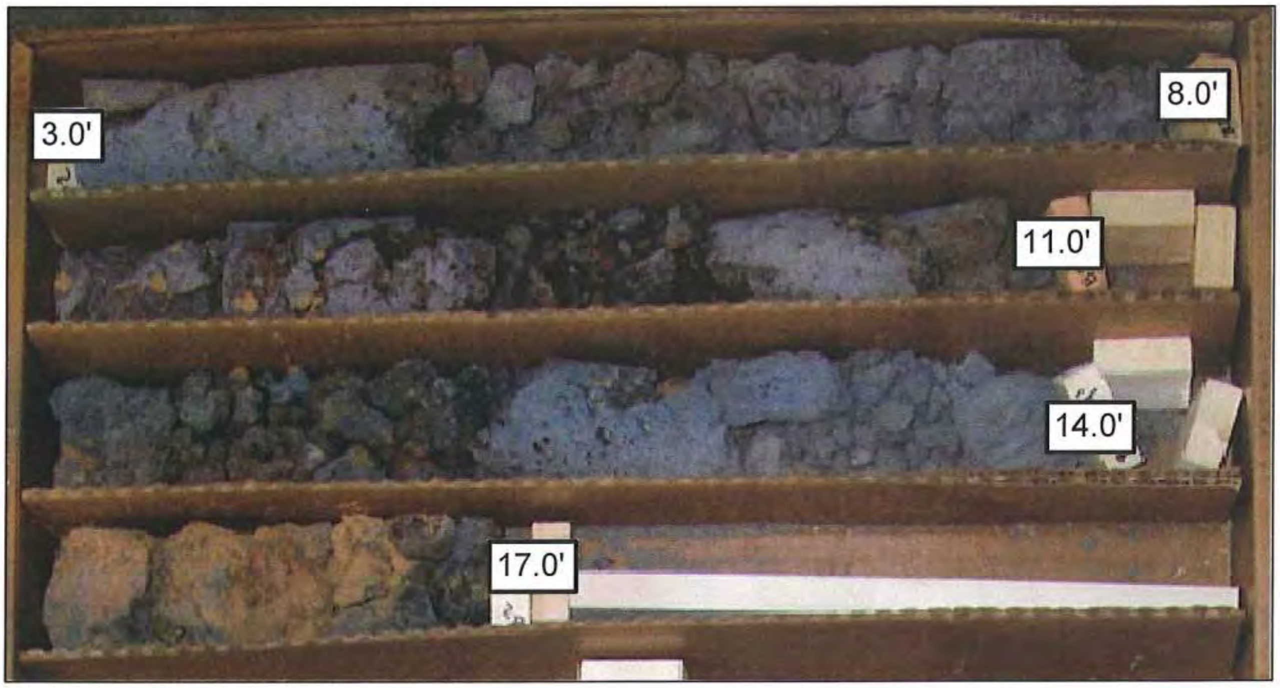
Figure 31

Boring 2: 3.0'-17.0'



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Piilani Promenade North Shopping Center
Kihei, Maui, Hawaii

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Figure 32

Boring 2a: 24.0'-32.5'

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Piilani Promenade North Shopping Center
Kihei, Maui, Hawaii

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Figure 33

Boring 3: 7.0'-22.0'

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Kihei, Maui, Hawaii

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Figure 34

Boring 4: 1.0'-10.5'

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Piilani Promenade North Shopping Center
Kihei, Maui, Hawaii

File: 3050.01

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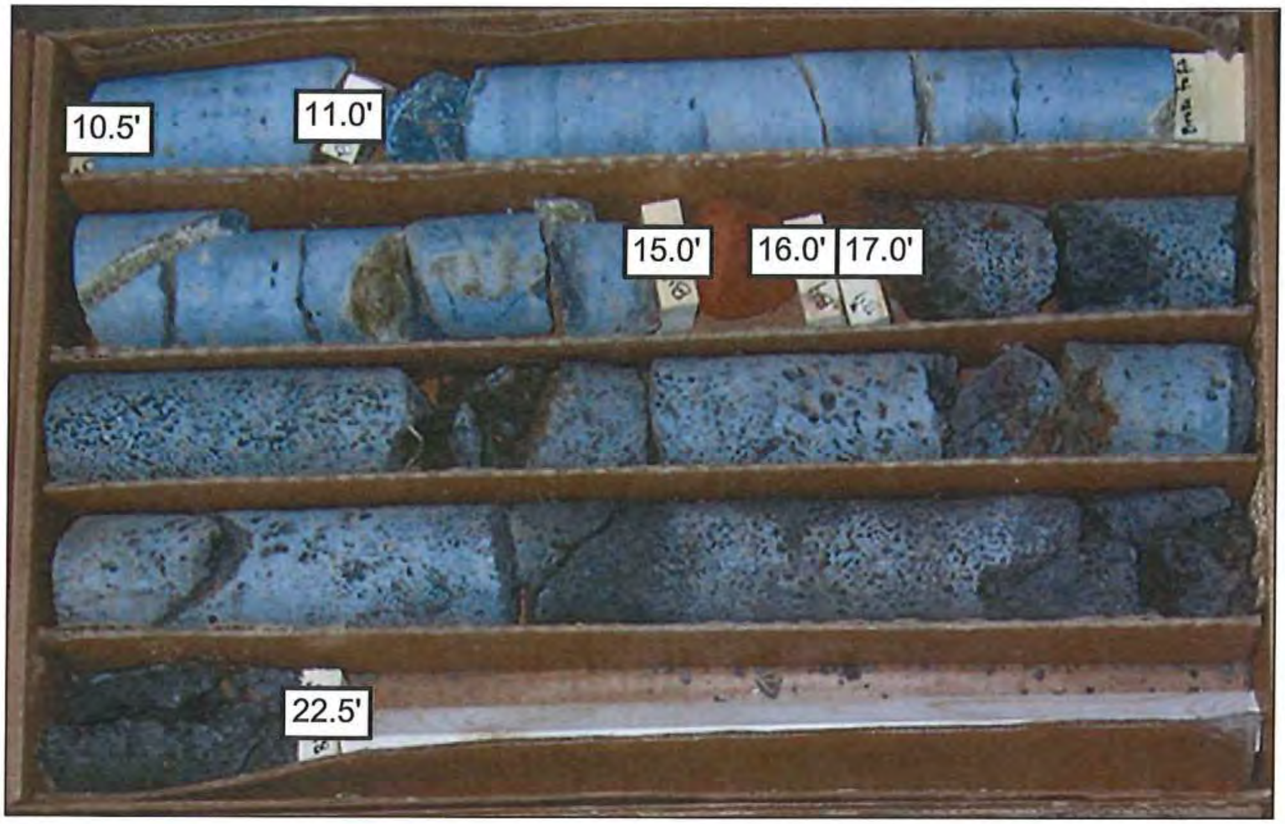
Figure 35a

Boring 4: 10.5'-22.5'



ROCK CORE PHOTOGRAPH

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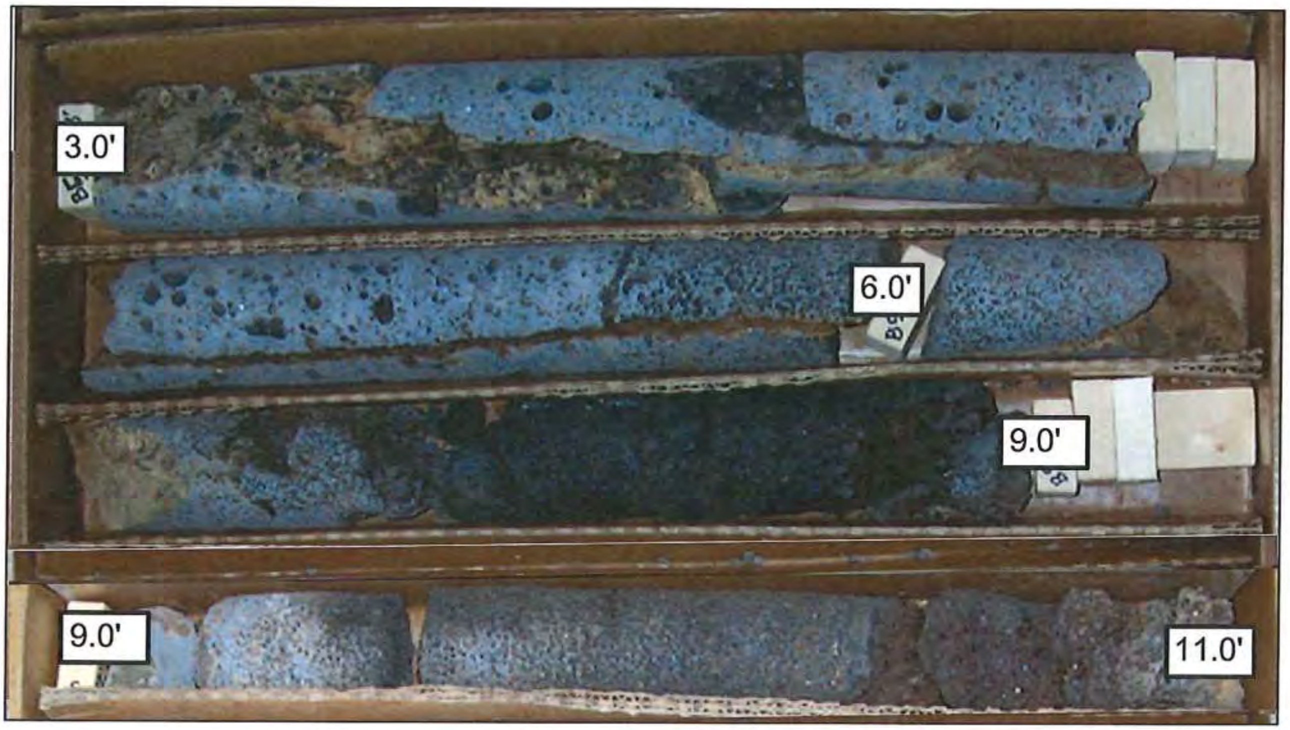
Figure 35b

Boring 5: 3.0'-11.0'



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ROCK CORE PHOTOGRAPH

Piilani Promenade North Shopping Center
Kihei, Maui, Hawaii

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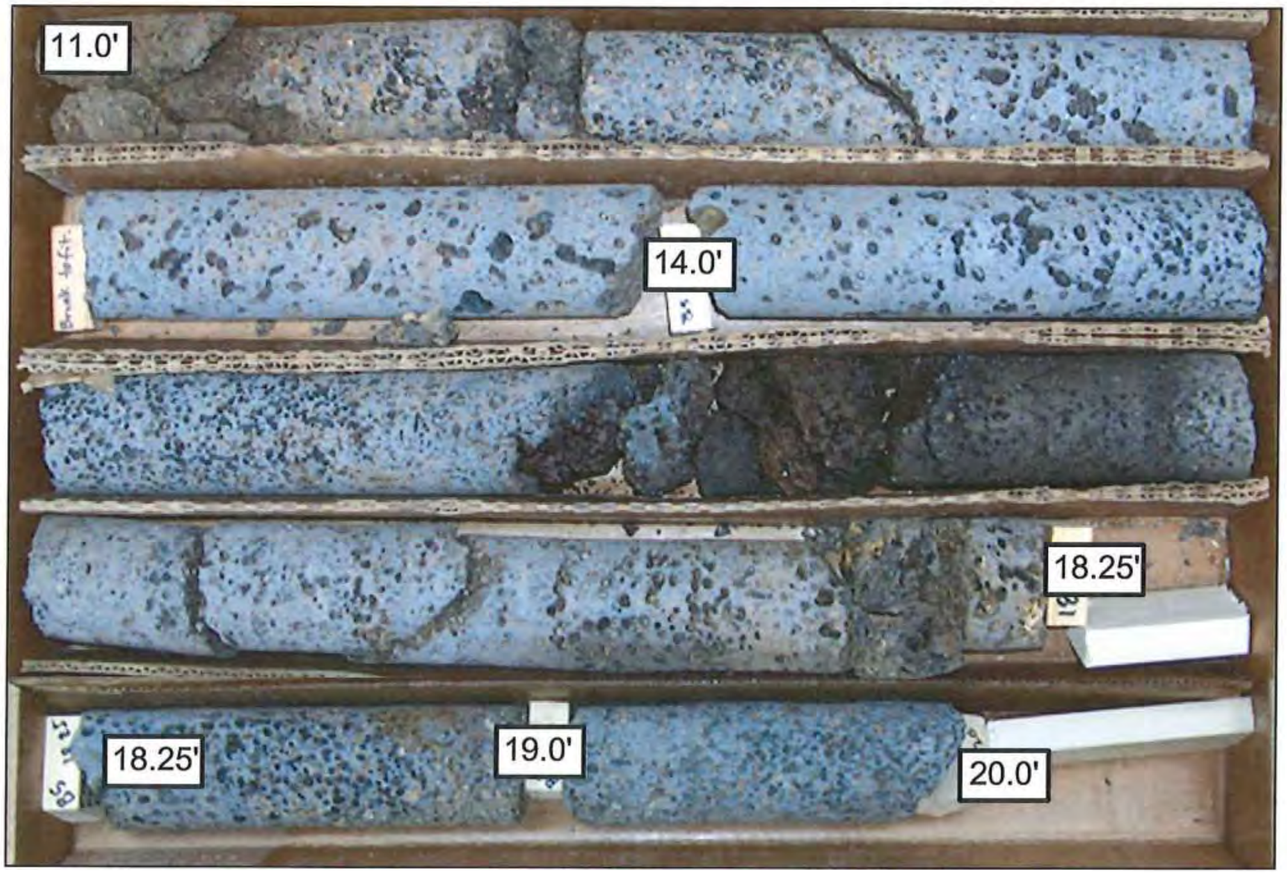
Figure 36a

Boring 5: 11.0'-20.0'



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ROCK CORE PHOTOGRAPH

Piilani Promenade North Shopping Center
Kihei, Maui, Hawaii

File: 3050.01

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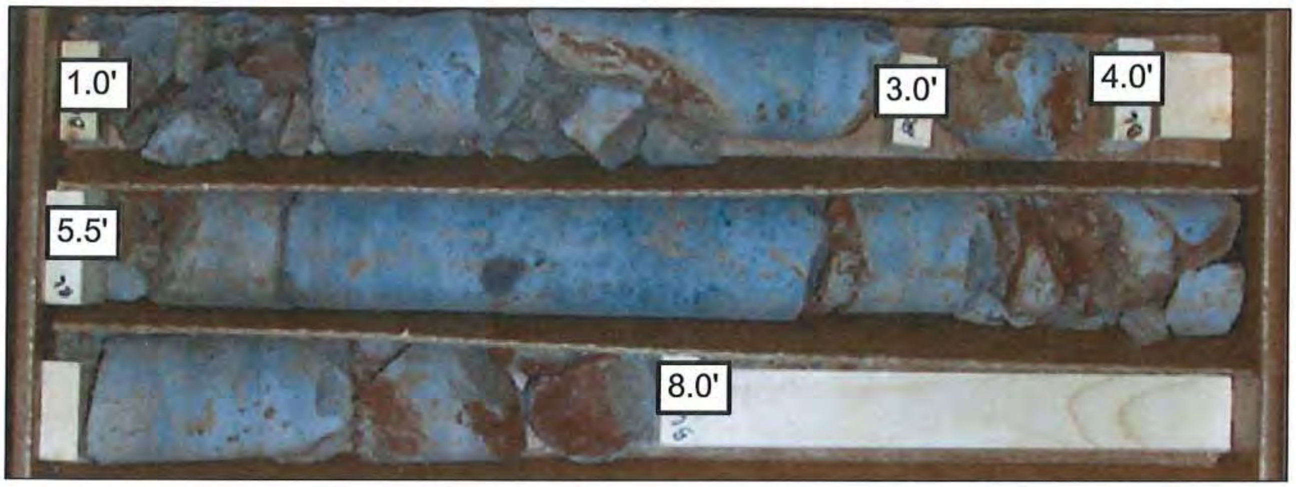
Figure 36b

Boring 6: 1.0'-8.0'



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ROCK CORE PHOTOGRAPH

Piilani Promenade North Shopping Center
Kihei, Maui, Hawaii

File: 3050.01

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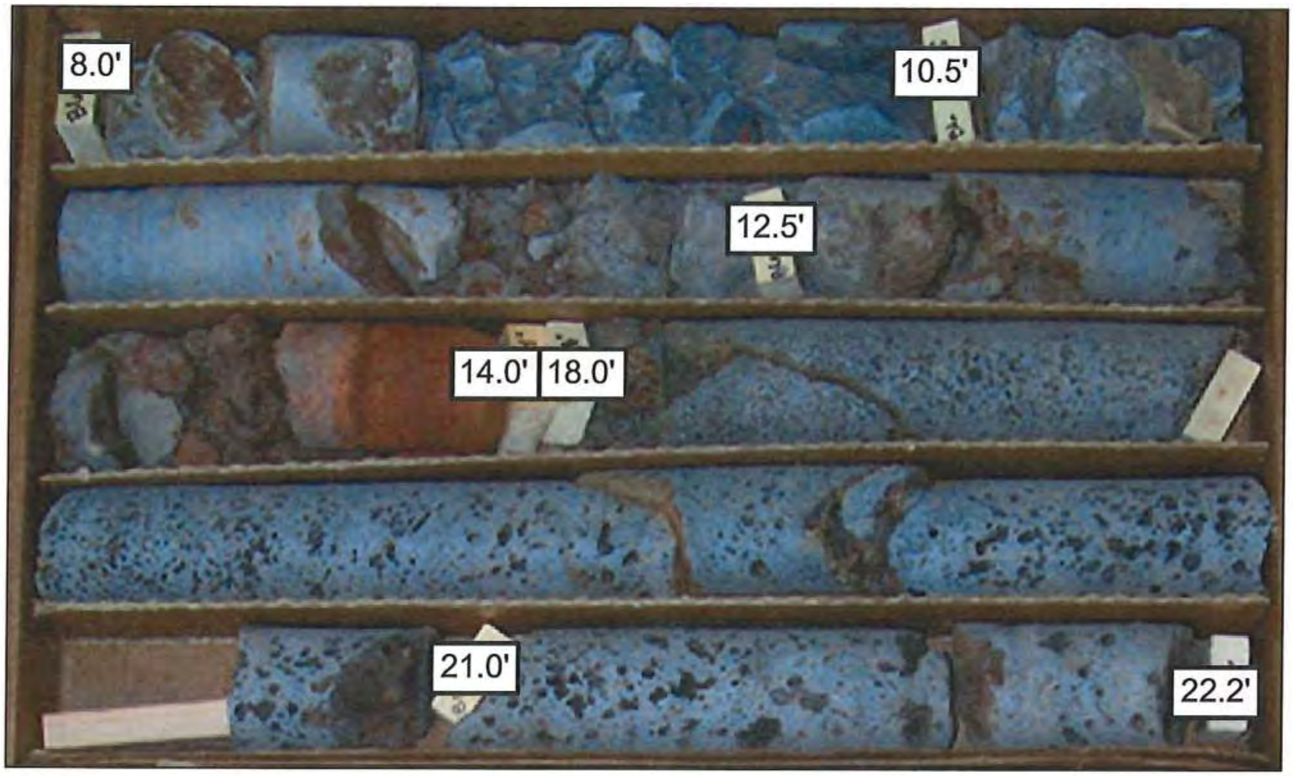
Figure 37a

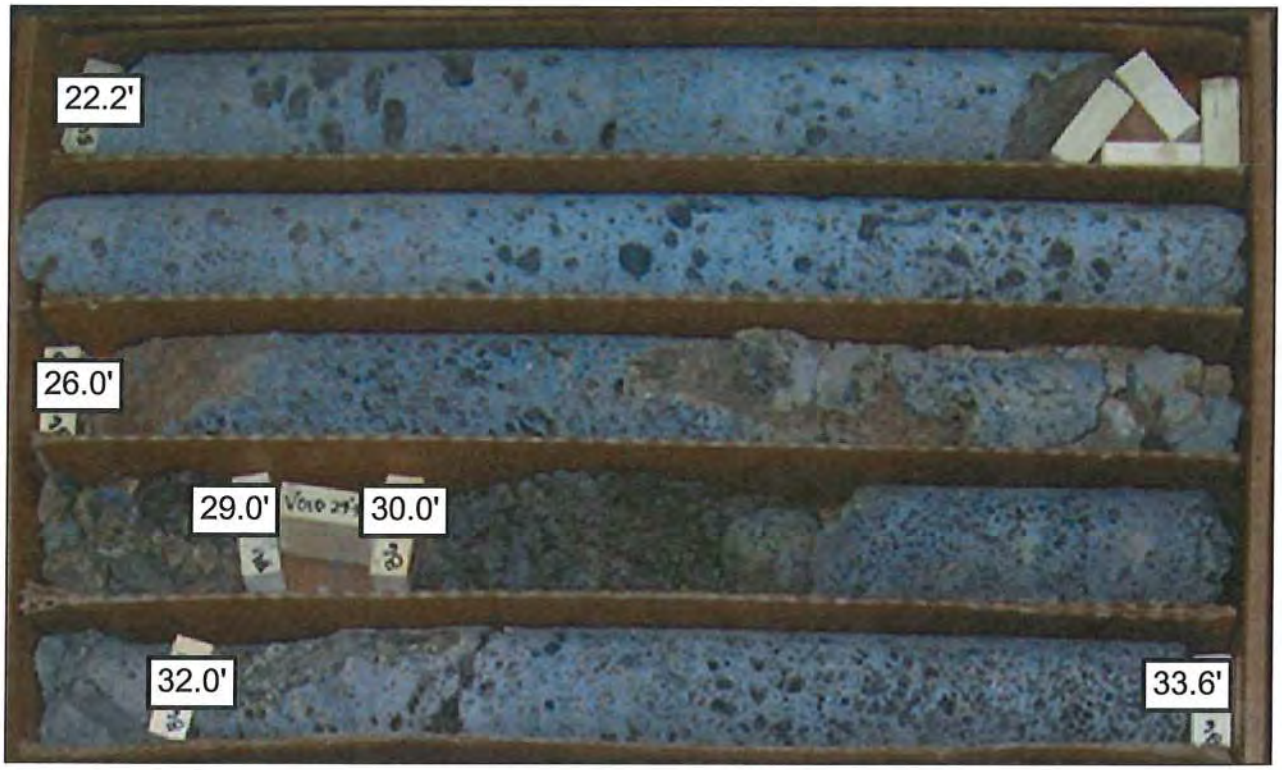
Boring 6: 8.0'-22.2'



F.G.E.	**ROCK CORE PHOTOGRAPH** Piilani Promenade North Shopping Center Kihei, Maui, Hawaii	File: 3050.01 August 2011

Figure 37b

Boring 6: 22.2'-33.6'



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ROCK CORE PHOTOGRAPH

Piilani Promenade North Shopping Center
Kihei, Maui, Hawaii

File: 3050.01

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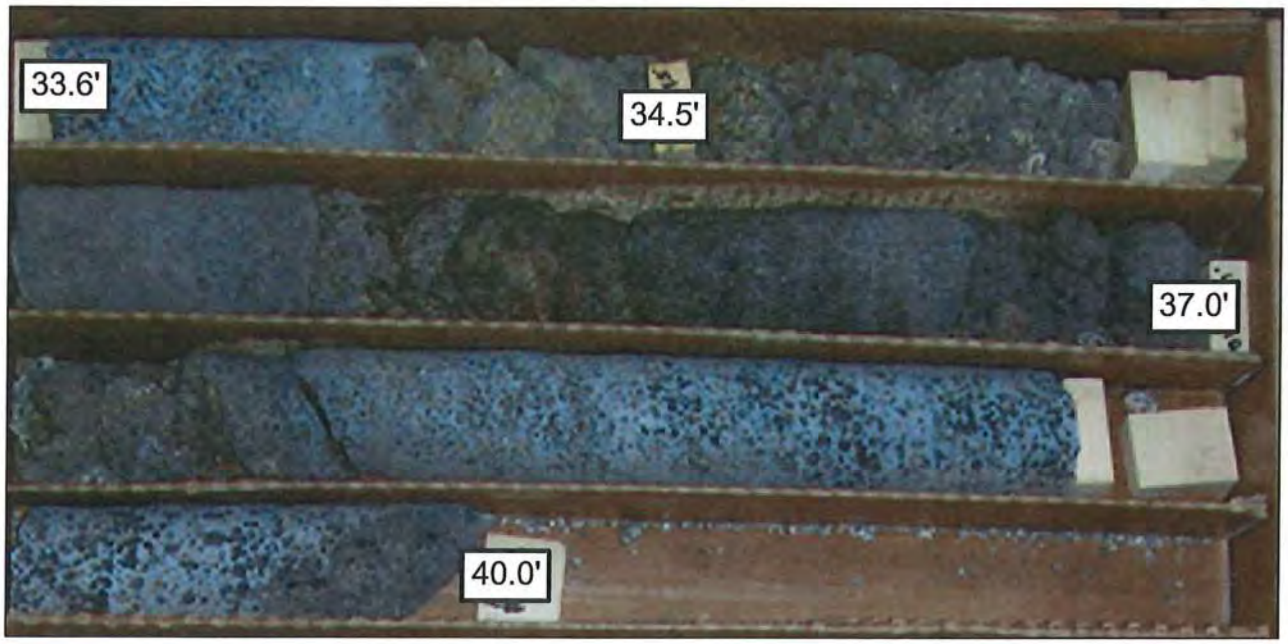
Figure 37c

Boring 6: 33.6'-40.0'



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ROCK CORE PHOTOGRAPH

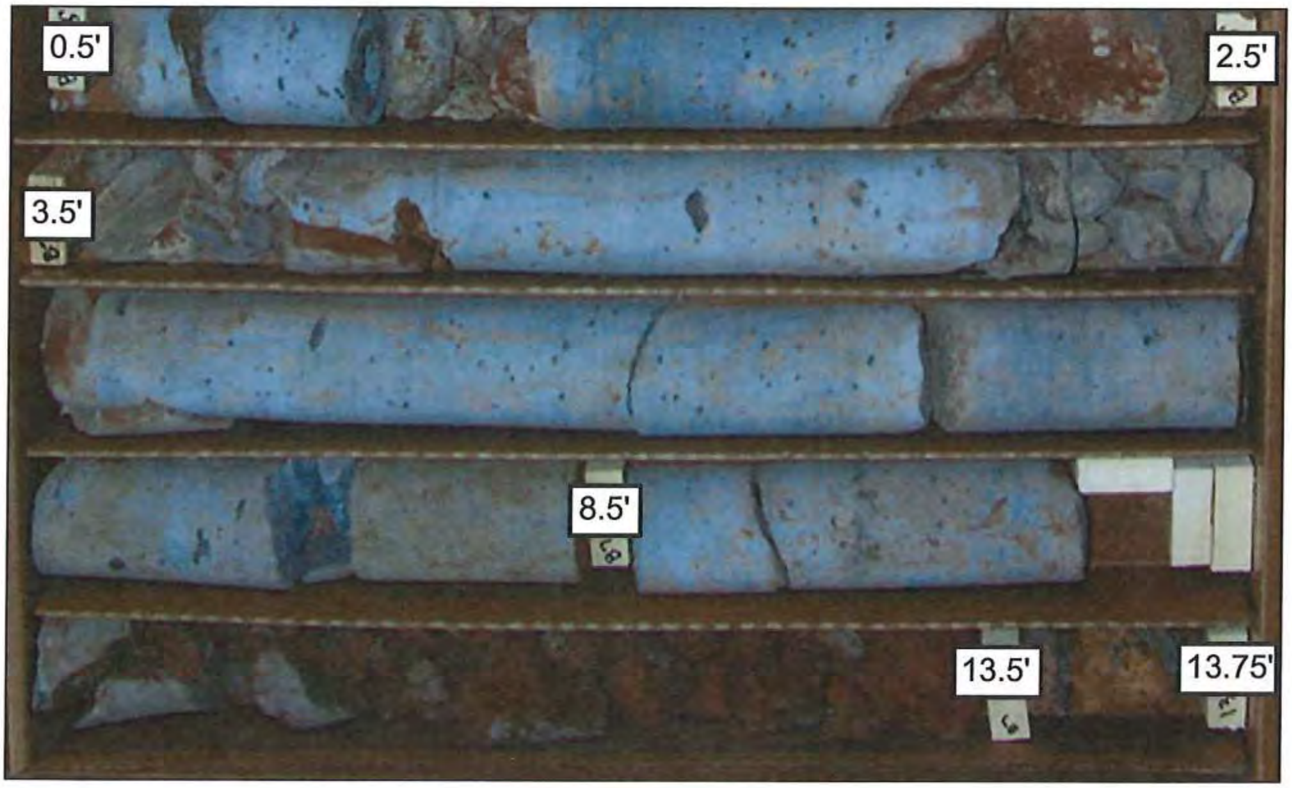
Piilani Promenade North Shopping Center
Kihei, Maui, Hawaii

File: 3050.01

August 2011

Figure 37d

Boring 7: 0.5'-13.75'



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ROCK CORE PHOTOGRAPH

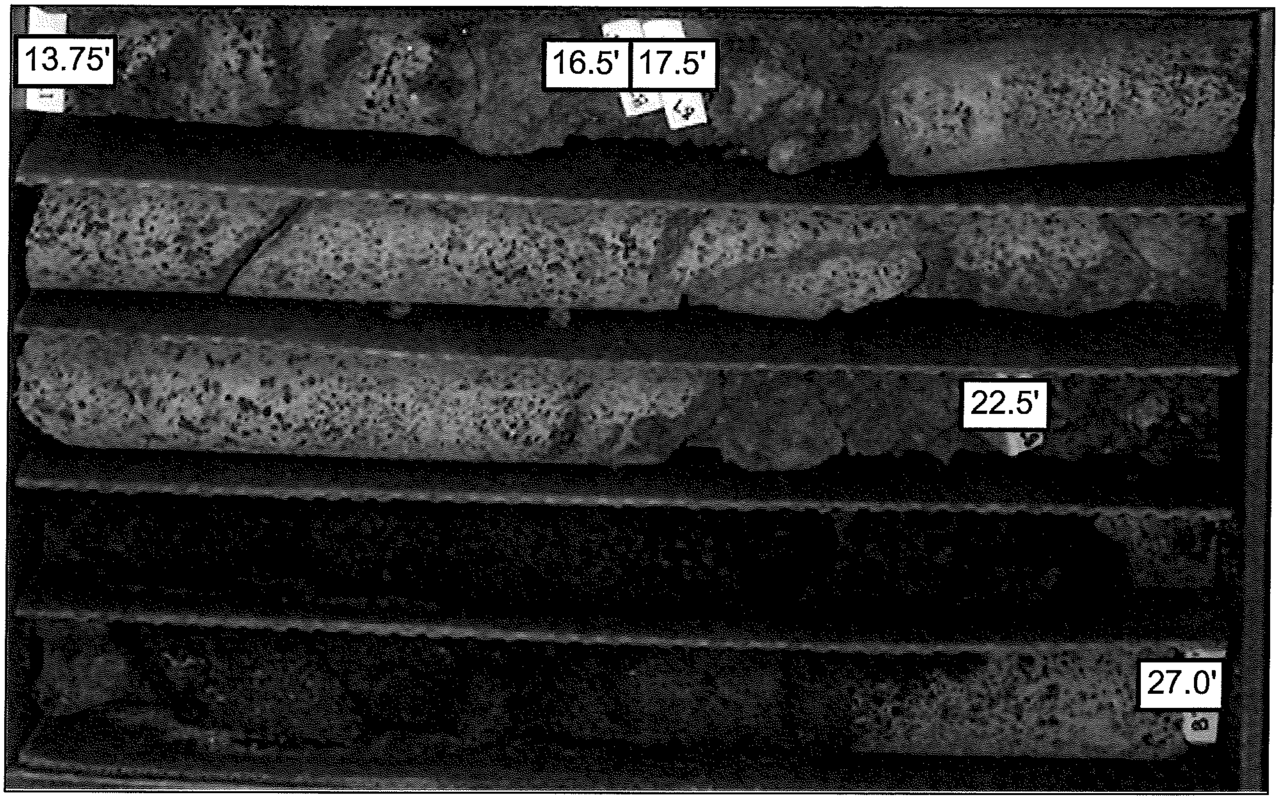
Piilani Promenade North Shopping Center
Kihei, Maui, Hawaii

File: 3050.01

August 2011

Figure 38a

Boring 7: 13.75'-27.0'



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ROCK CORE PHOTOGRAPH

Piilani Promenade North Shopping Center
Kihei, Maui, Hawaii

File: 3050.01

August 2011

Figure 38b

Boring 7: 27.0'-30.5'

F.G.E.	**ROCK CORE PHOTOGRAPH** Piilani Promenade North Shopping Center Kihei, Maui, Hawaii	File: 3050.01 August 2011

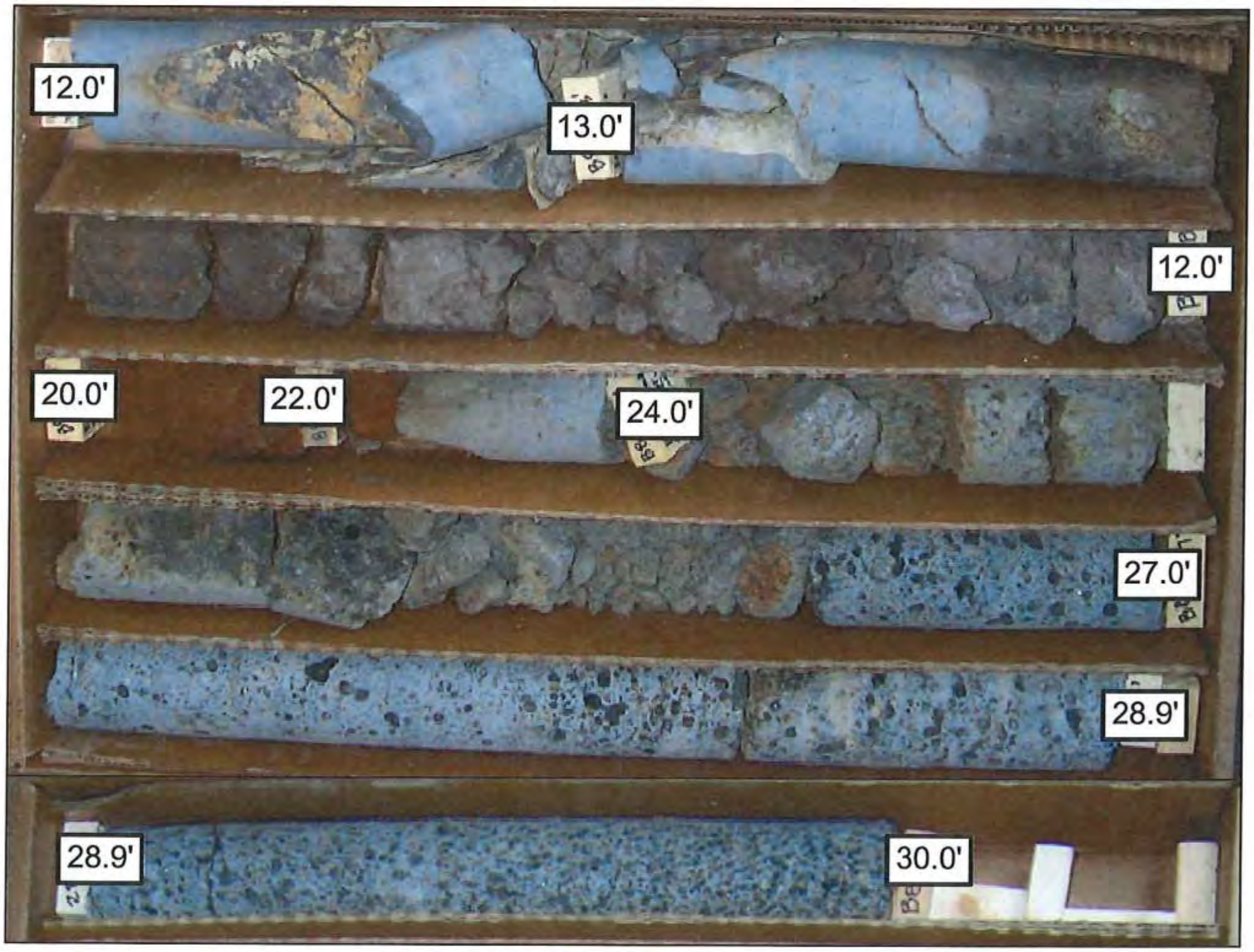
Figure 38c

Boring 8: 3.0'-12.0'

F.G.E.	**ROCK CORE PHOTOGRAPH** Piilani Promenade North Shopping Center Kihei, Maui, Hawaii	File: 3050.01 August 2011

Figure 39a

Boring 8: 12.0'-30.0'



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ROCK CORE PHOTOGRAPH

Piilani Promenade North Shopping Center
Kihei, Maui, Hawaii

File: 3050.01

August 2011

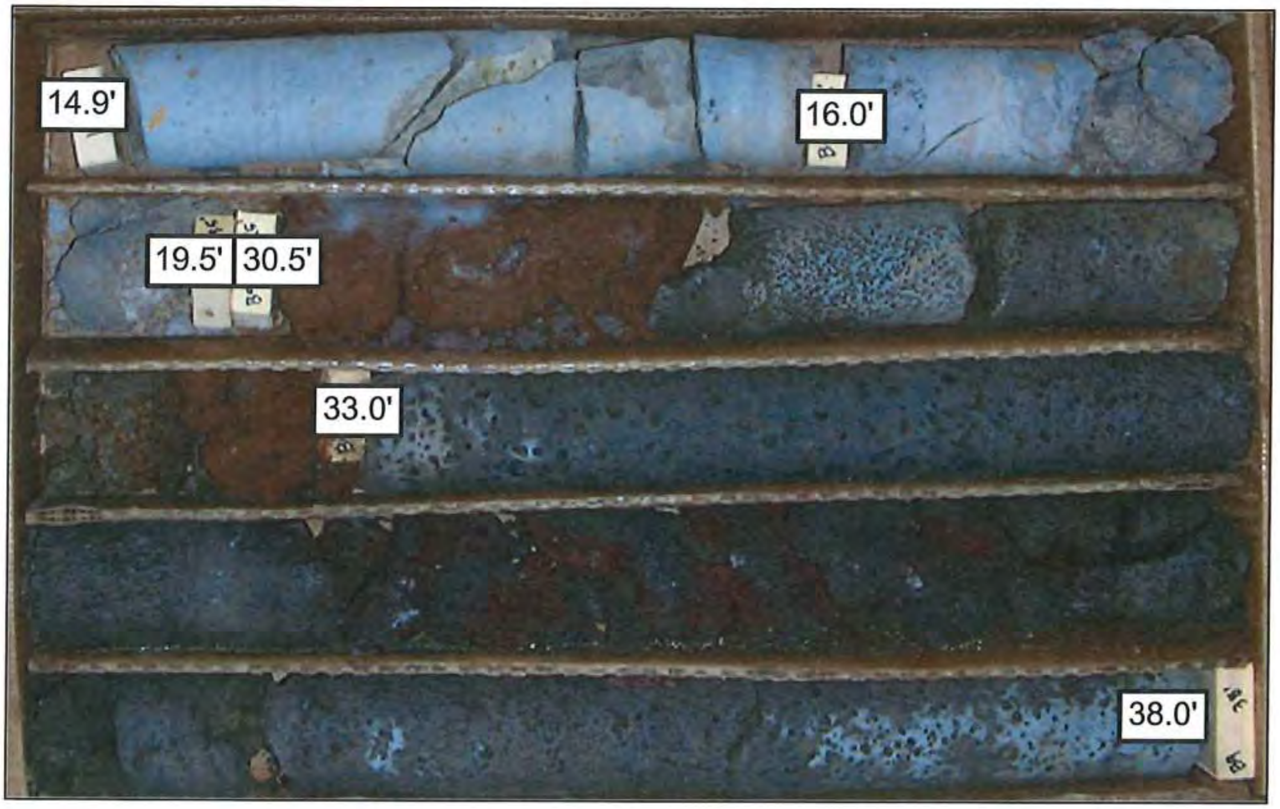
Figure 39b

Boring 9: 6.0'-14.9'

F.G.E.	**ROCK CORE PHOTOGRAPH** Piilani Promenade North Shopping Center Kihei, Maui, Hawaii	File: 3050.01 August 2011

Figure 40a

Boring 9: 14.9'-38.0'



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ROCK CORE PHOTOGRAPH

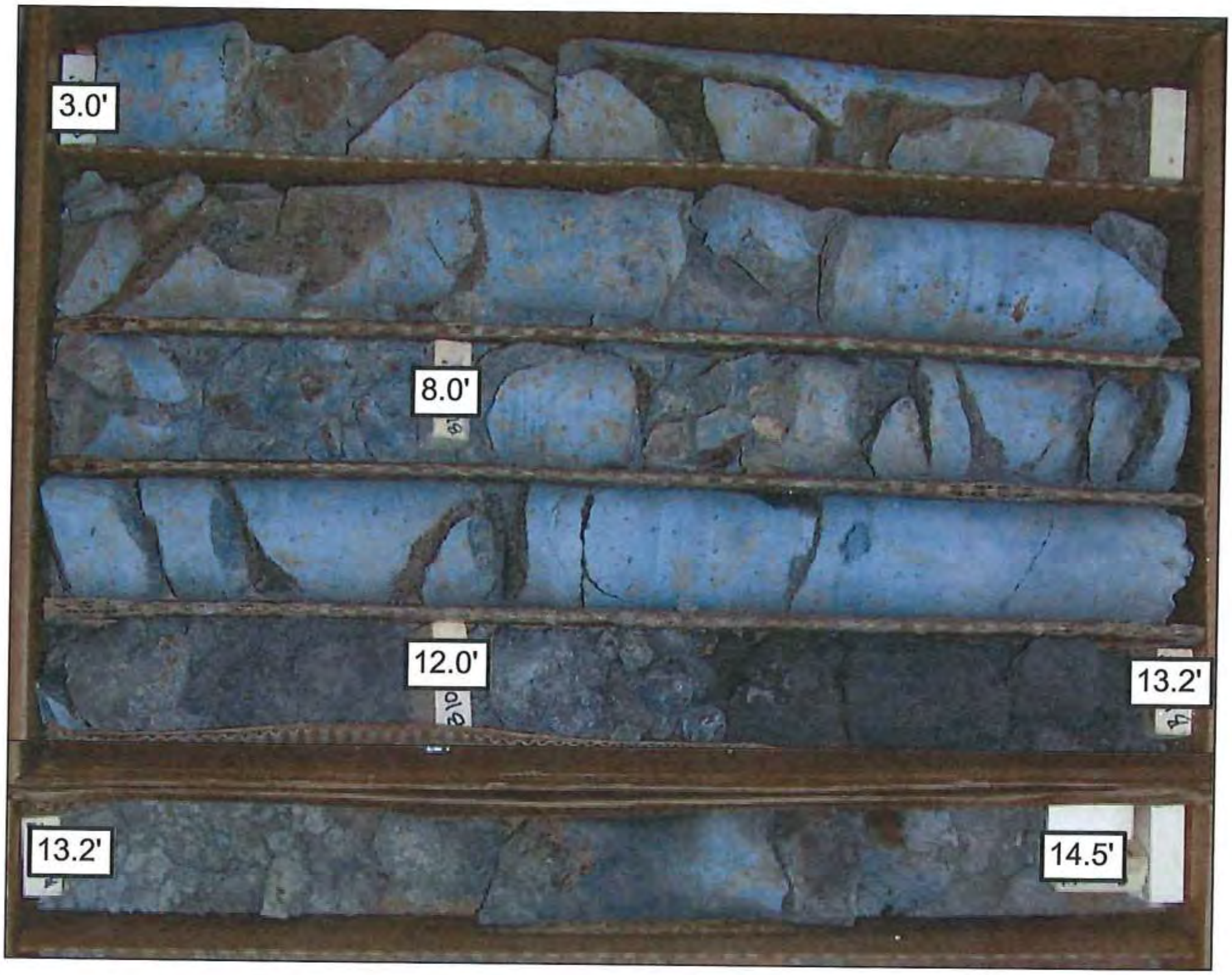
Piilani Promenade North Shopping Center
Kihei, Maui, Hawaii

File: 3050.01

August 2011

Figure 40b

Boring 10: 3.0'-14.5'



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ROCK CORE PHOTOGRAPH

Piilani Promenade North Shopping Center
Kihei, Maui, Hawaii

File: 3050.01

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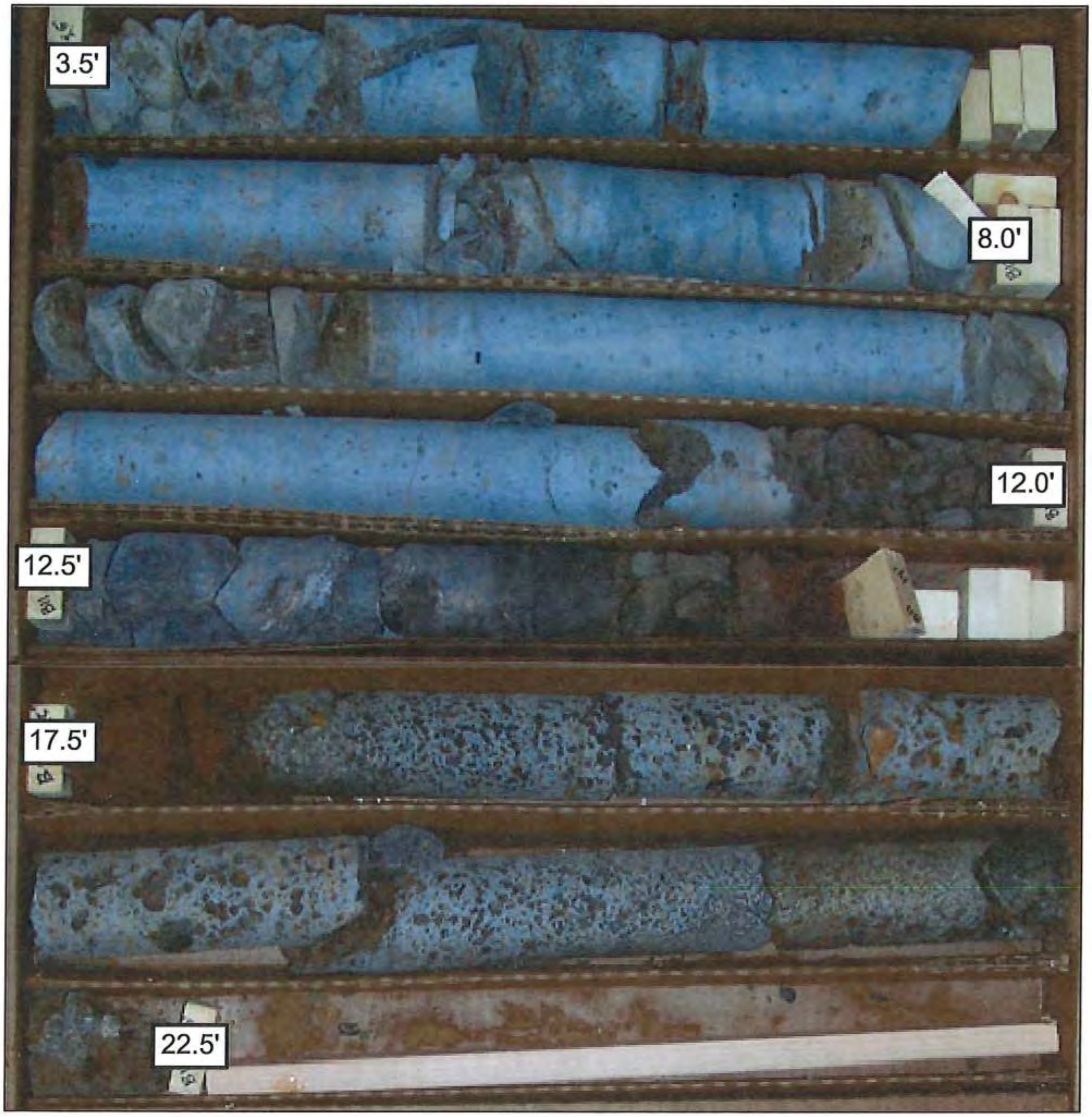
Figure 41

Boring 11: 3.5'-22.5'



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ROCK CORE PHOTOGRAPH

Piilani Promenade North Shopping Center
Kihei, Maui, Hawaii

File: 3050.01

August 2011

Figure 42

APPENDIX B

Laboratory Testing Summary

Project Designation: Piilani Promenade North Shopping Center **File:** 3050.01

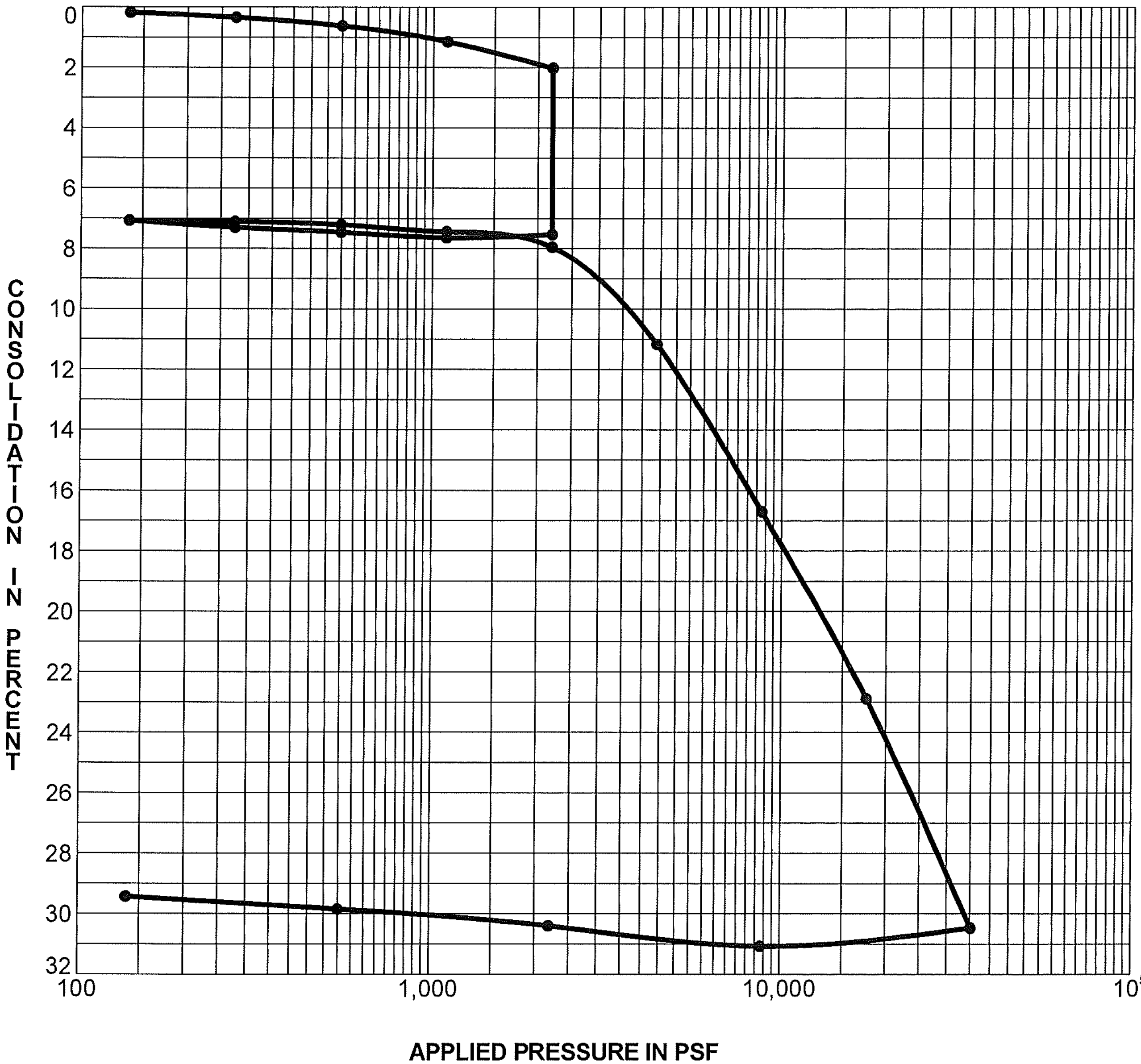
Location: Kihei, Maui, Hawaii

	Sample No.	Figure Designation
Consolidation Curves:	1-1	43
	2A-5	44
	8-1	45
	9-1	46
	9A-6	47
	11-1	48
California Bearing Ratio Curves:	TP1-1	49
	TP4-1	50
	TP6-1	51
Gradation Charts:	9A-2	52
	TP1-1	53
	TP2-1	54
	TP4-1	55
Plasticity Chart:		
	8-4	56
	2A-2	56
	9A-6	56
	TP1-1	57
	TP4-1	57
	TP6-1	57
	TP9-2	57

Summary of Boring Samples Laboratory Test Results: Table I

Summary of Test Pit Samples Laboratory Test Results: Table II

Summary of Basalt Rock Unconfined Compressive Tests: Table III



Sample Identification	Depth (feet)	Classification	LL	PI
1 - 1	1.0	Reddish Brown SILT (ML)		

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CONSOLIDATION CURVE

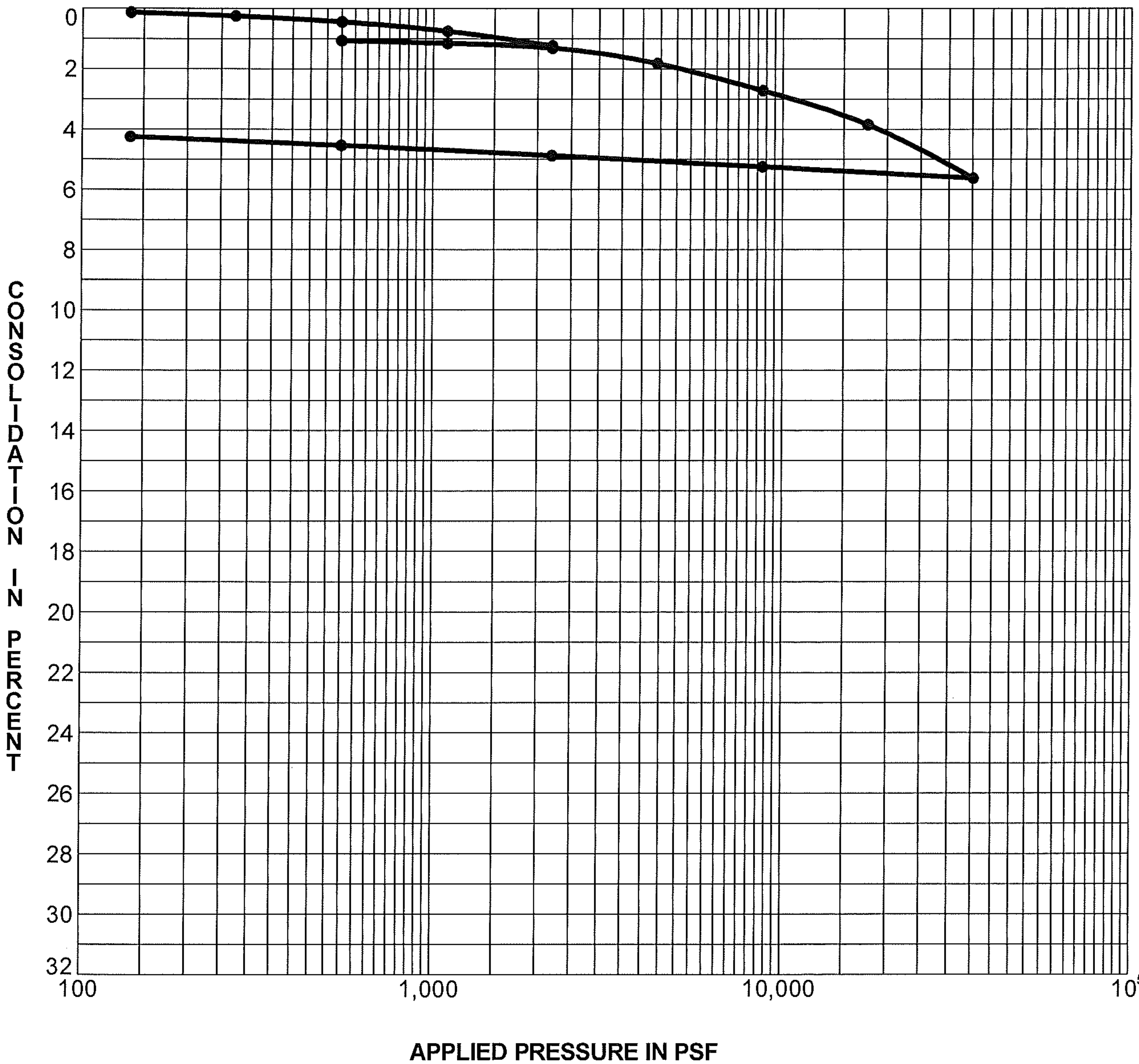
Piilani Promenade North Shopping Center

Kihei, Maui, Hawaii

File: 3050.01

August 2011

Figure 43



Sample Identification	Depth (feet)	Classification	LL	PI
2A - 5	21.0	Reddish Brown SILT (MH)		

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CONSOLIDATION CURVE

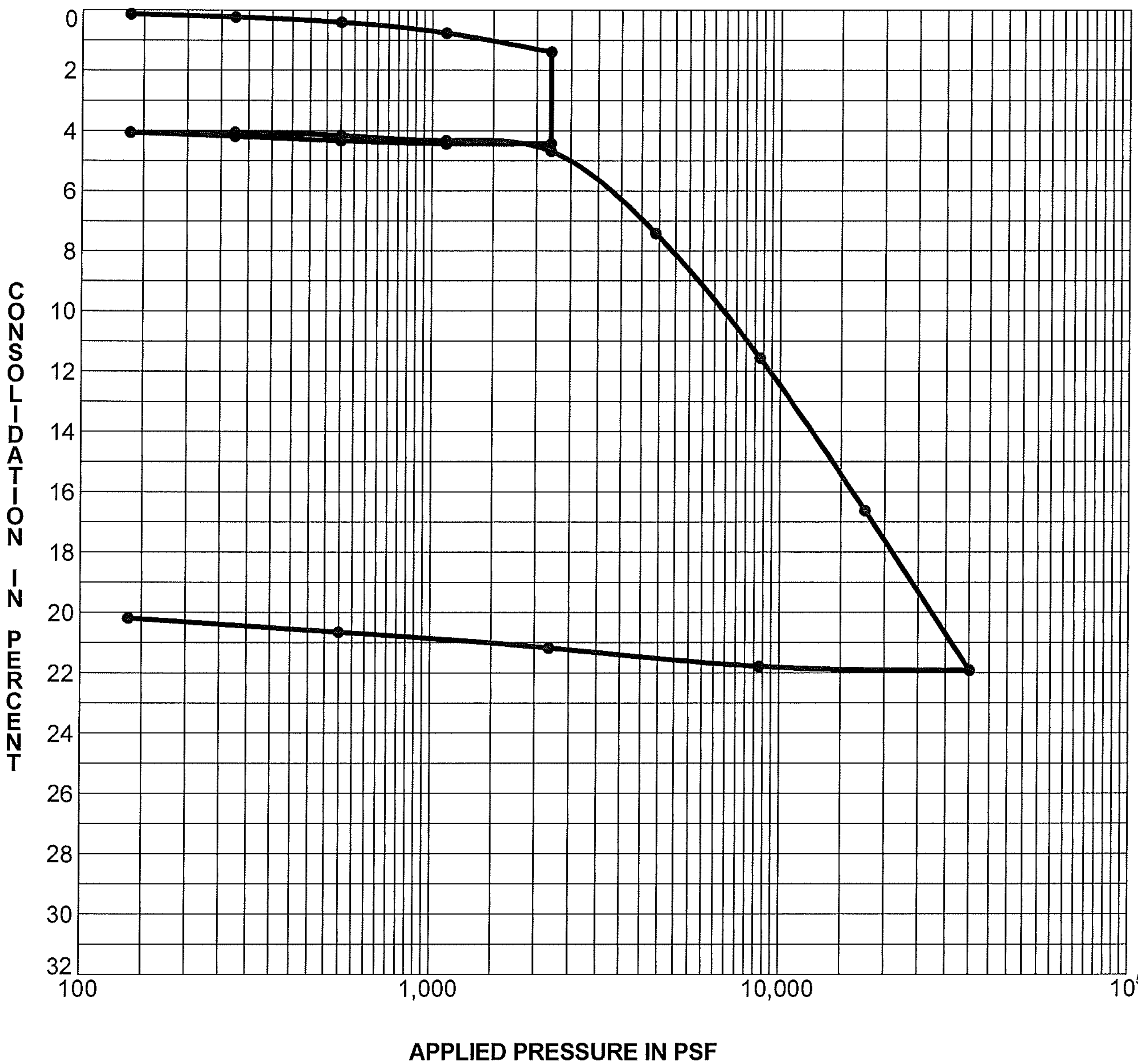
Piilani Promenade North Shopping Center

Kihei, Maui, Hawaii

File: 3050.01

August 2011

Figure 44



Sample Identification	Depth (feet)	Classification	LL	PI
8 - 1	1.0	Light Brown SILT (ML)		

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CONSOLIDATION CURVE

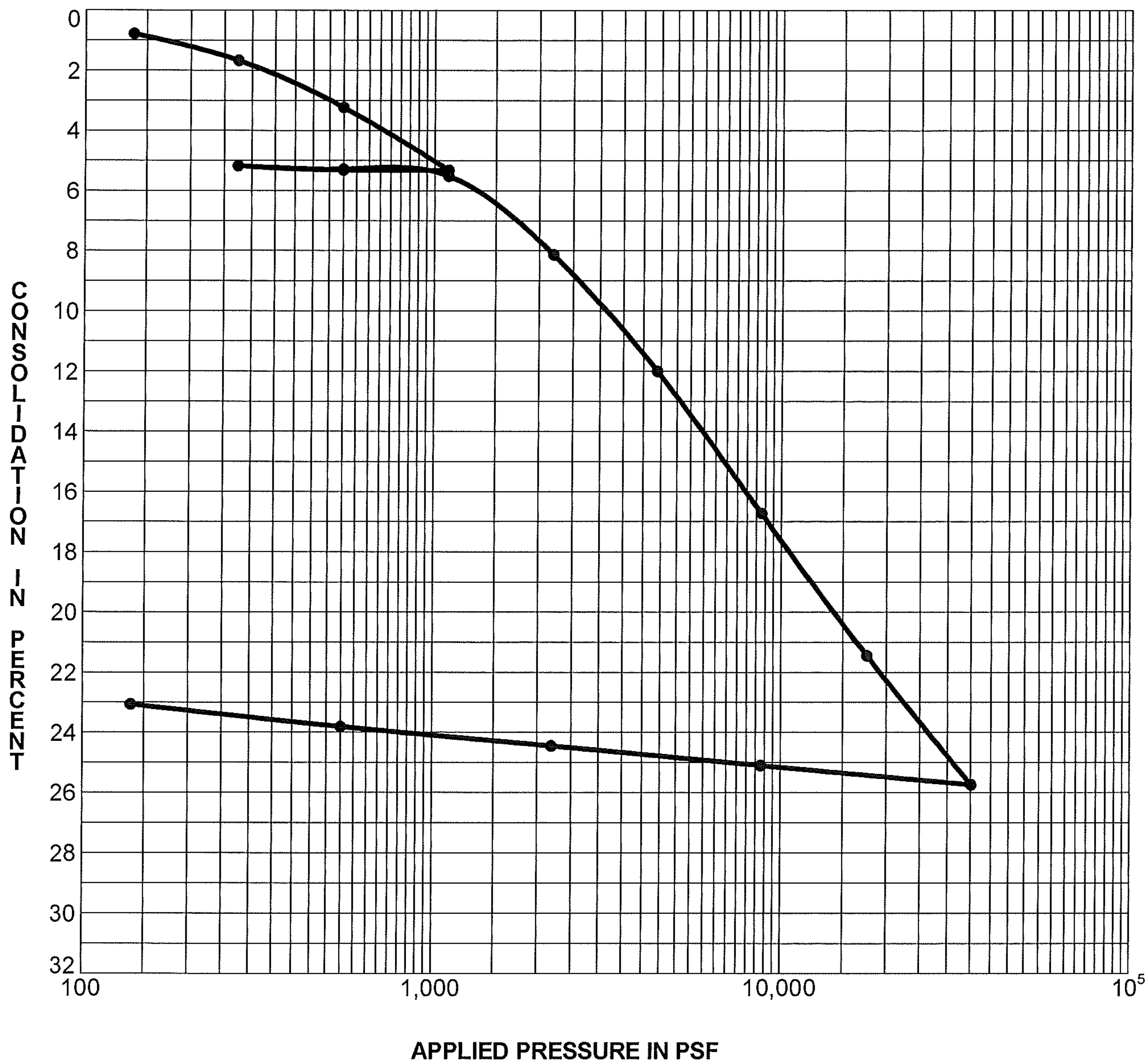
Piilani Promenade North Shopping Center

Kihei, Maui, Hawaii

File: 3050.01

August 2011

Figure 45



Sample Identification	Depth (feet)	Classification	LL	PI
9 - 1	1.0	Light Brown SILT (ML)		

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CONSOLIDATION CURVE

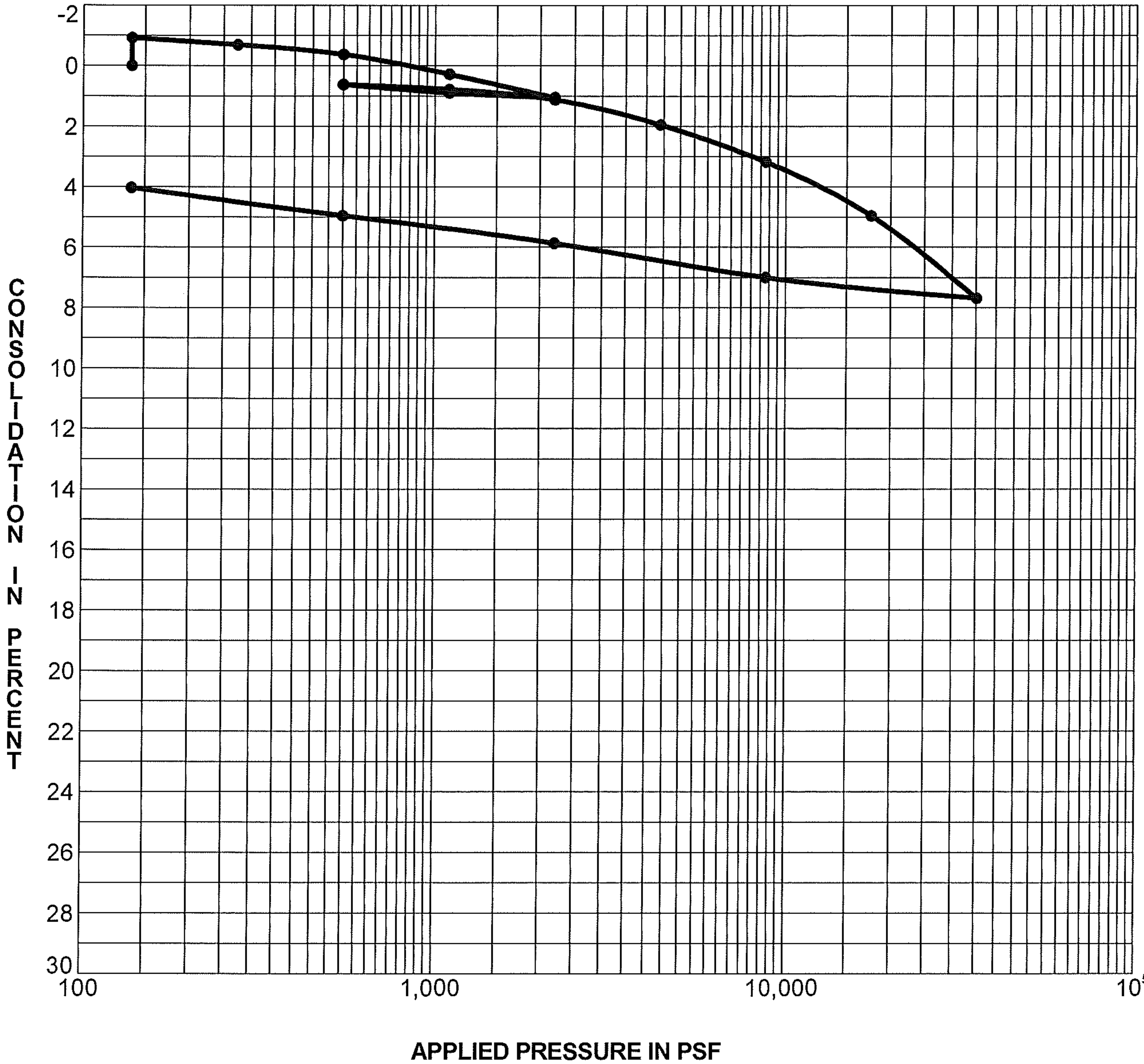
Piilani Promenade North Shopping Center

Kihei, Maui, Hawaii

File: 3050.01

August 2011

Figure 46



Sample Identification	Depth (feet)	Classification	LL	PI
9A - 6	25.0	Reddish Brown SILT (MH)	115	41

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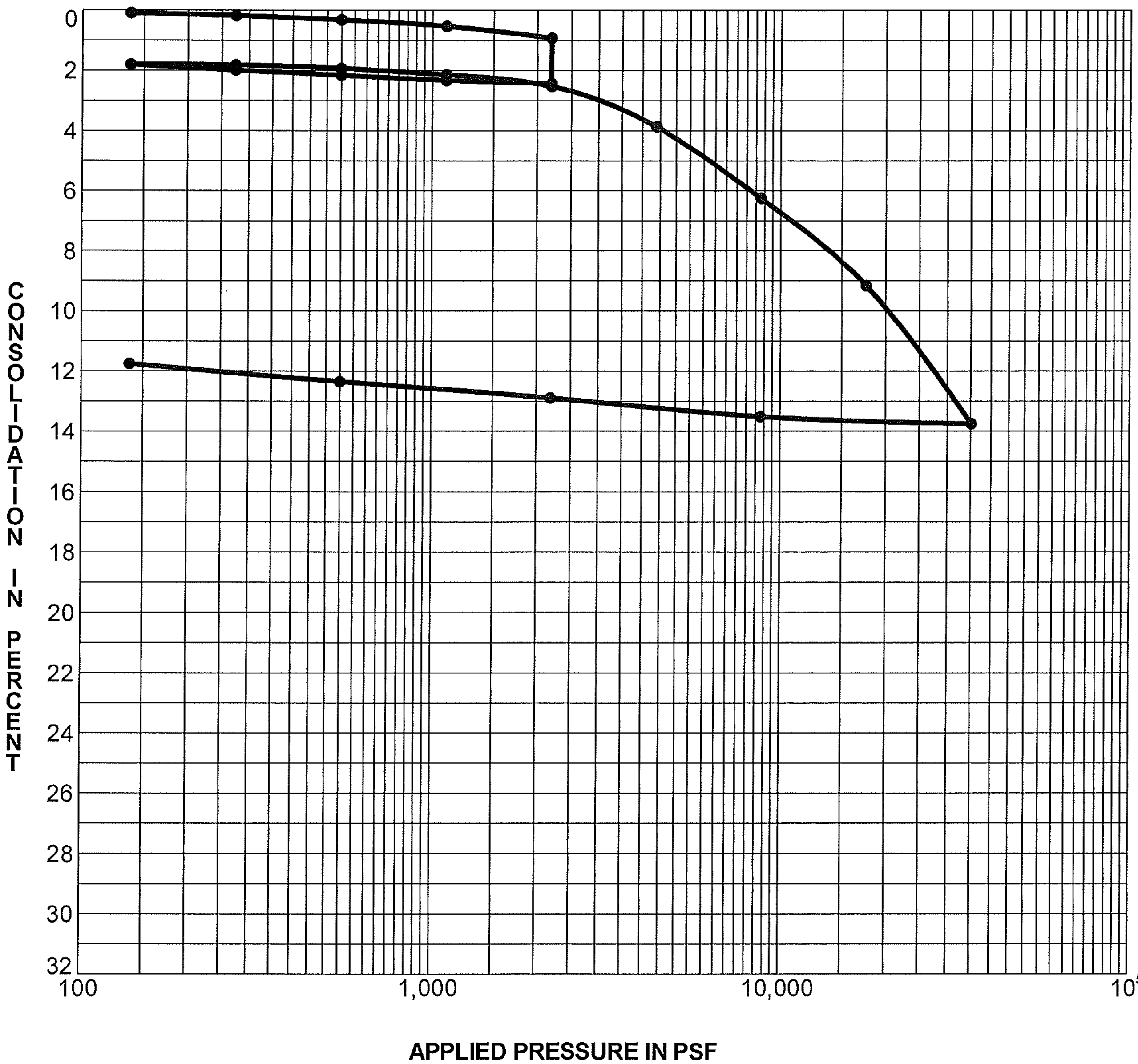
CONSOLIDATION CURVE

Piilani Promenade North Shopping Center

Kihei, Maui, Hawaii

File: 3050.01

August 2011



Sample Identification	Depth (feet)	Classification	LL	PI
11 - 1	1.0	Light Brown/Gray SILT (ML)		

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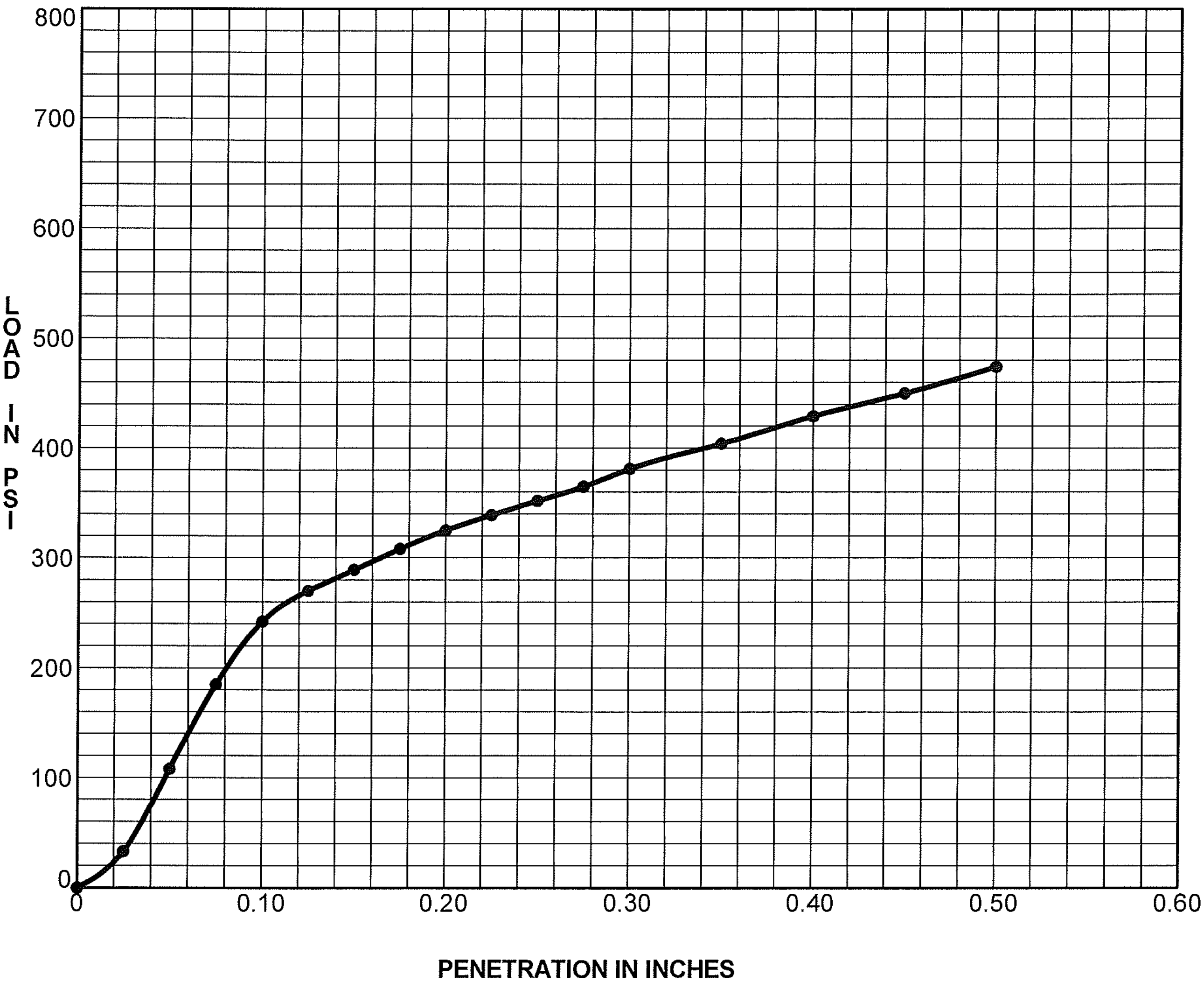
CONSOLIDATION CURVE

Piilani Promenade North Shopping Center

Kihei, Maui, Hawaii

File: 3050.01

August 2011



	Sample Identification	Classification	CBR	% Comp	Max Den	Opt. % MC	% Swell	LL	PI
●	TP1 - 1	Light Brown SILT (ML)	26.5	97	104.0	21.0	1.6	39	12

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CALIFORNIA BEARING RATIO

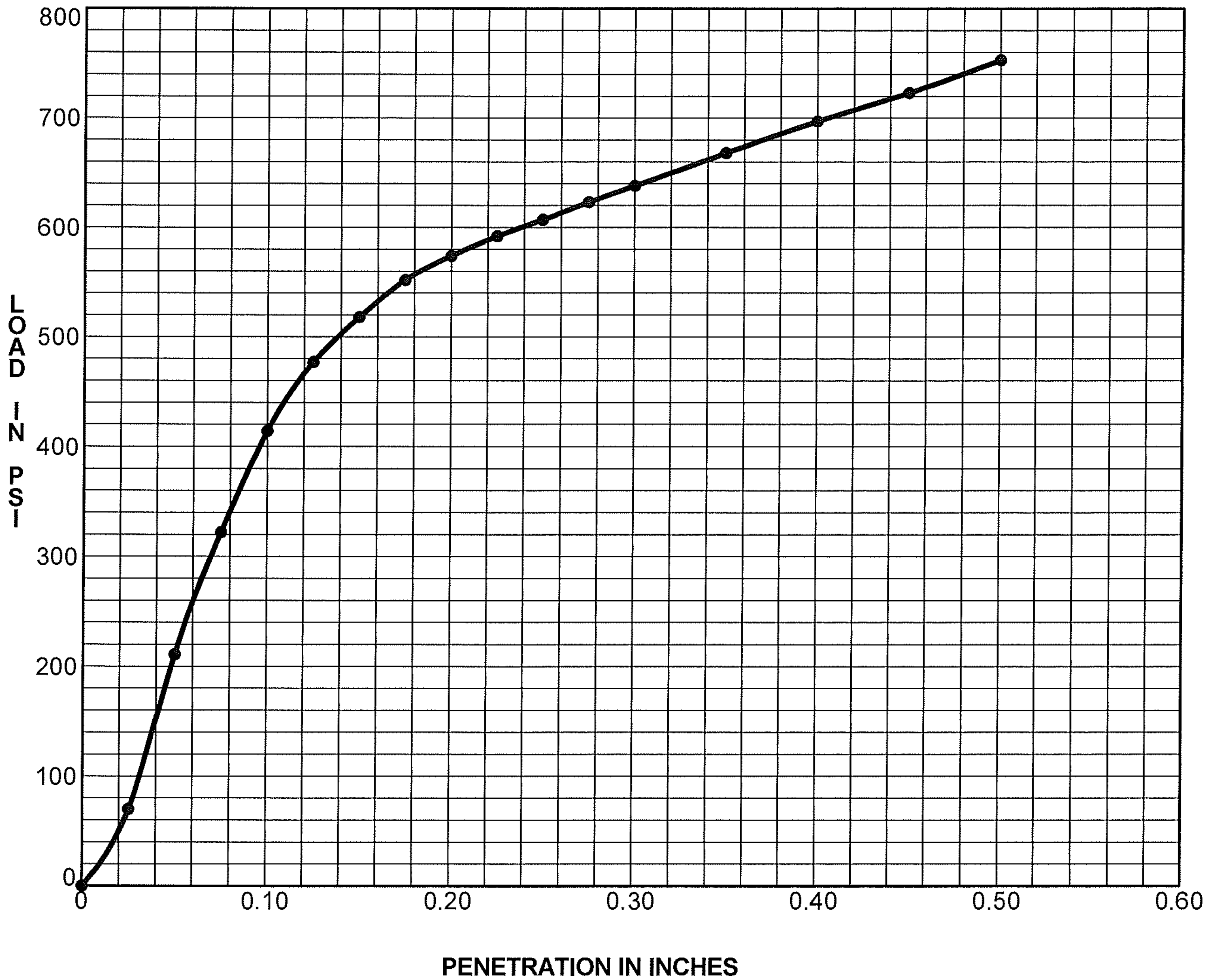
Piilani Promenade North Shopping Center

Kihei, Maui, Hawaii

File: 3050.01

August 2011

Figure 49



	Sample Identification	Classification	CBR	% Comp	Max Den	Opt. % MC	% Swell	LL	PI
●	TP4 - 1	Light Brown Sandy SILT (ML-MH)	43.8	98	92.0	30.0	0.4	50	15

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CALIFORNIA BEARING RATIO

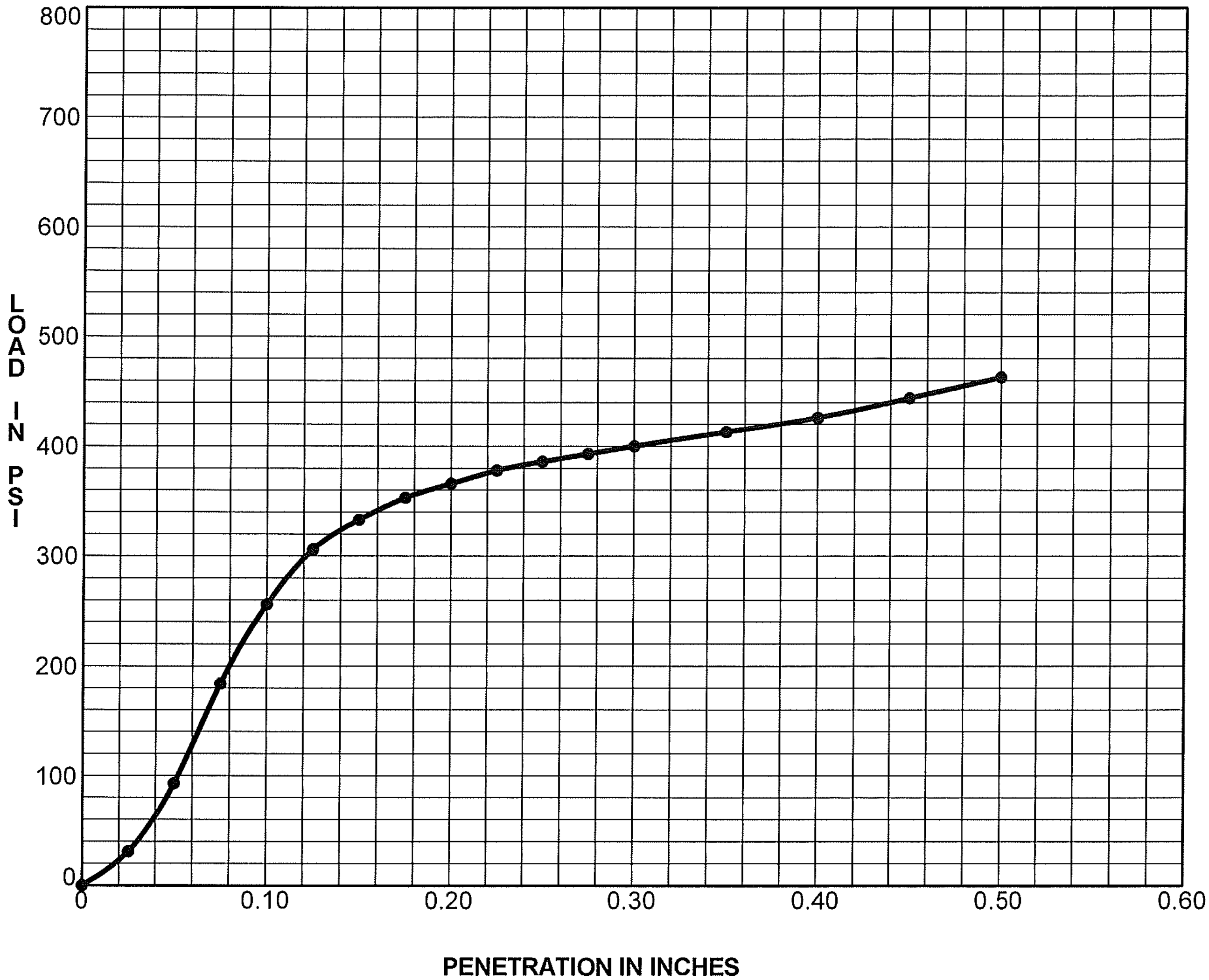
Piilani Promenade North Shopping Center

Kihei, Maui, Hawaii

File: 3050.01

August 2011

Figure 50



	Sample Identification	Classification	CBR	% Comp	Max Den	Opt. % MC	% Swell	LL	PI
●	TP6 - 1	Light Brown SILT (ML)	30.0	95	97.0	25.0	1.4	48	17

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CALIFORNIA BEARING RATIO

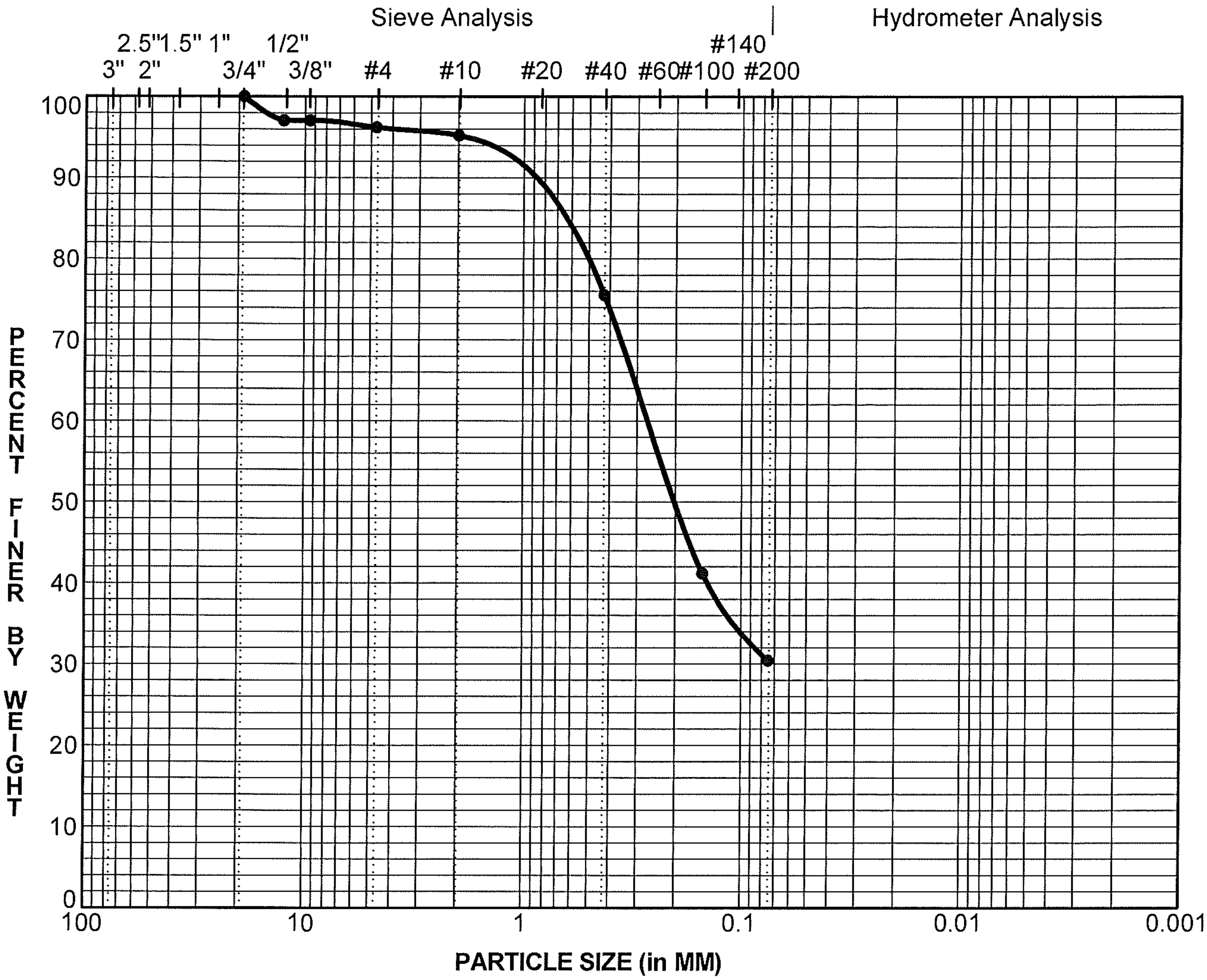
Piilani Promenade North Shopping Center

Kihei, Maui, Hawaii

File: 3050.01

August 2011

Figure 51



Gravel		Sand			Silt and Clay
coarse	fine	coarse	medium	fine	

	Sample ID	Depth	Classification	MC%	LL	PL	PI	Cc	Cu
●	9A - 2	19.0	Reddish Brown Silty SAND (SM)	28					

	Sample ID	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt & Clay
●	9A - 2	19.0	19.0	0.3			4	66	30

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GRAIN SIZE DISTRIBUTION

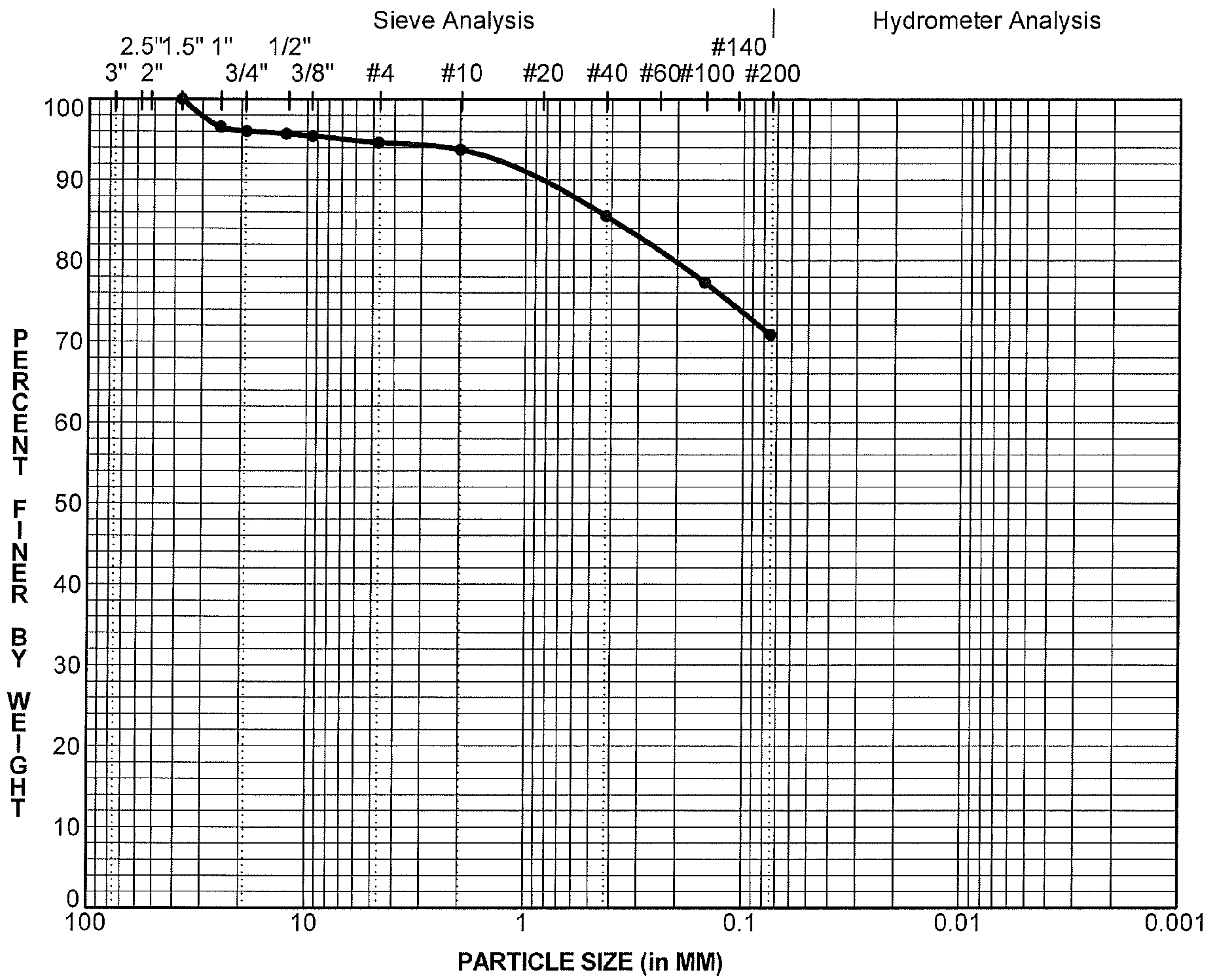
Piilani Promenade North Shopping Center

Kihei, Maui, Hawaii

File: 3050.01

August 2011

Figure 52



Gravel		Sand			Silt and Clay
coarse	fine	coarse	medium	fine	

	Sample ID	Depth	Classification	MC%	LL	PL	PI	Cc	Cu
●	TP1 - 1	1.0	Light Brown SILT (ML)	21	39	27	12		

	Sample ID	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt & Clay
●	TP1 - 1	1.0	37.5				5	24	71

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GRAIN SIZE DISTRIBUTION

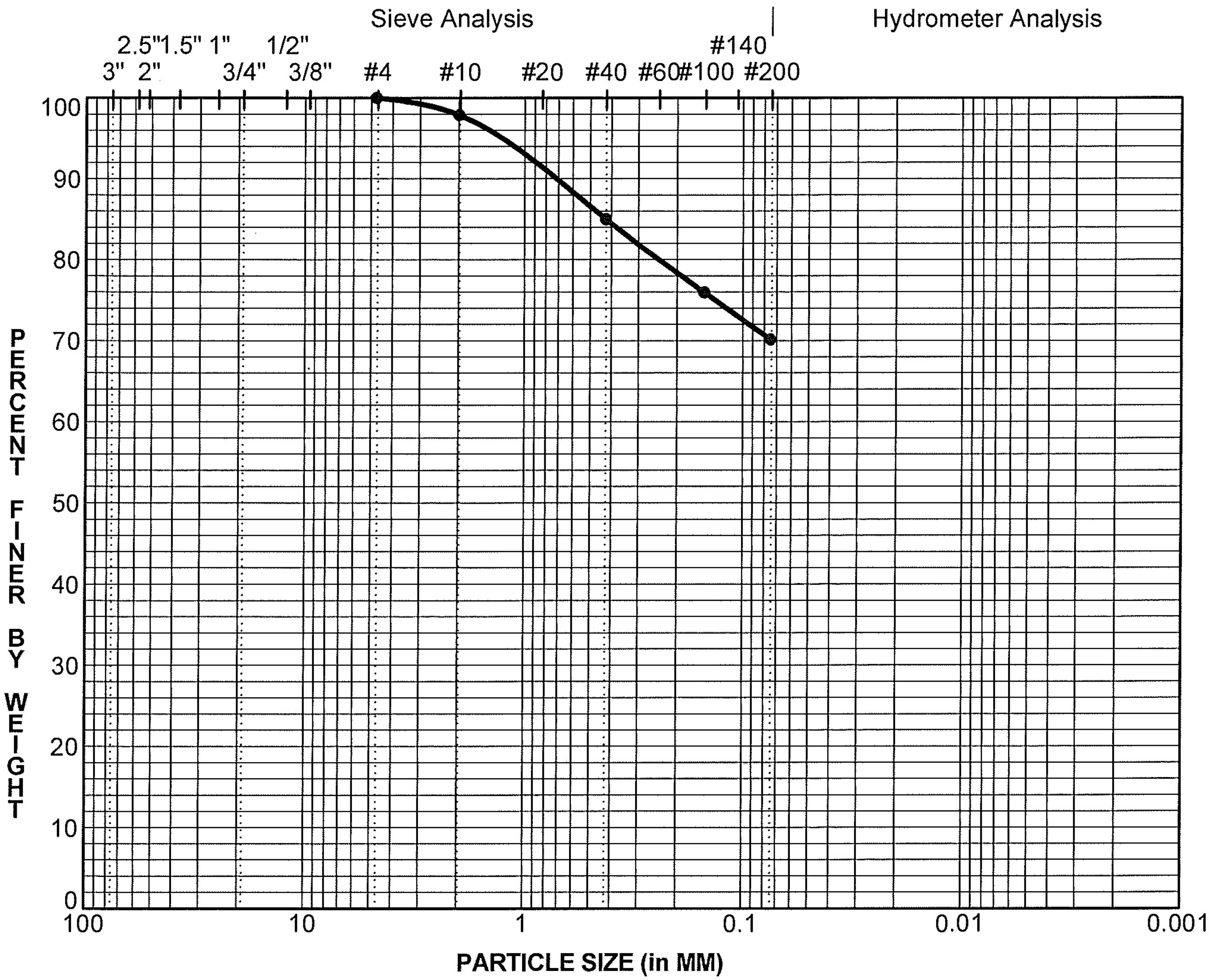
Piilani Promenade North Shopping Center

Kihei, Maui, Hawaii

File: 3050.01

August 2011

Figure 53



Gravel		Sand			Silt and Clay
coarse	fine	coarse	medium	fine	

	Sample ID	Depth	Classification	MC%	LL	PL	PI	Cc	Cu
●	TP2 - 1	1.5	Light Brown Clayey SILT (ML)	22					

	Sample ID	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt & Clay
●	TP2 - 1	1.5	4.8				0	30	70

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GRAIN SIZE DISTRIBUTION

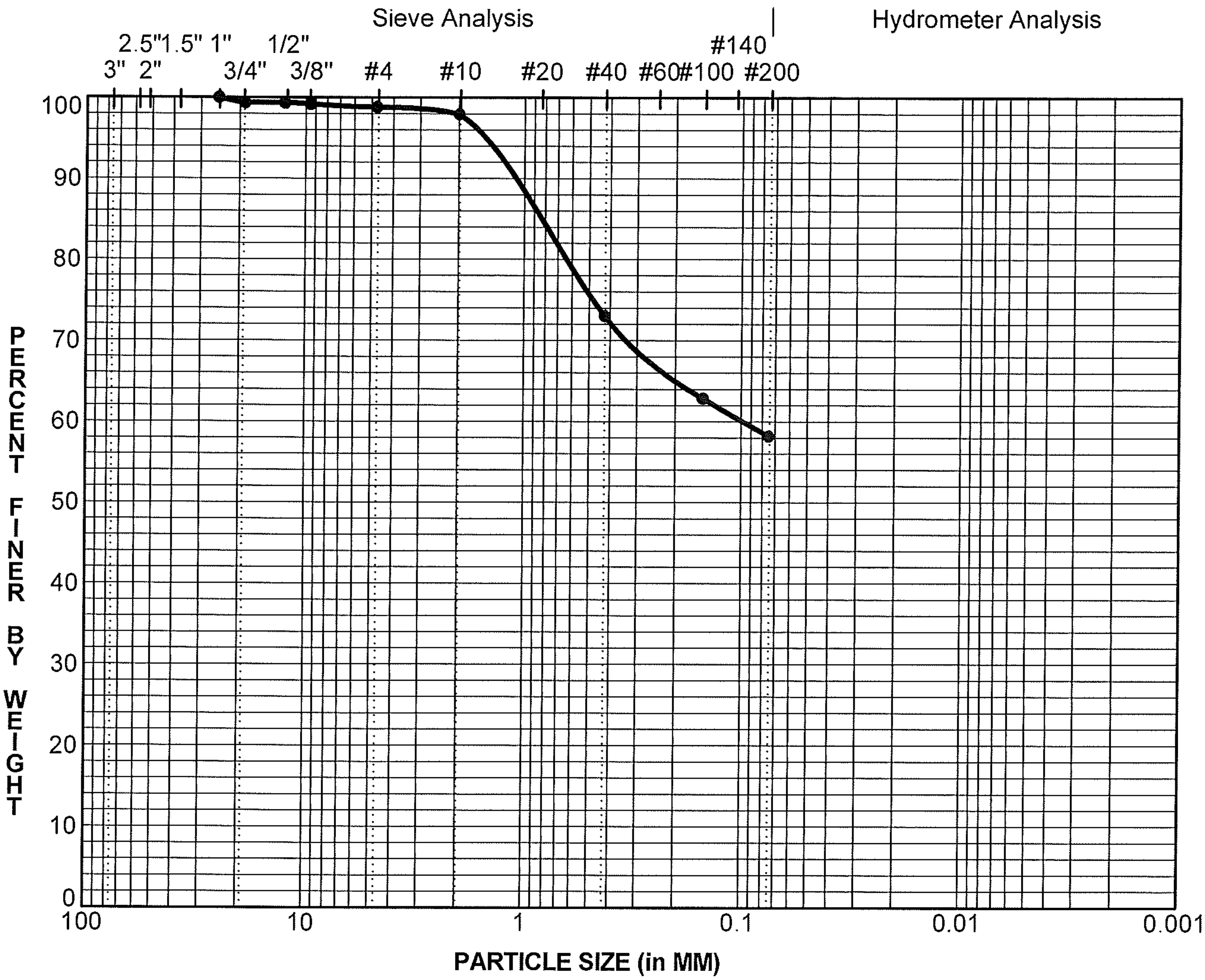
Piilani Promenade North Shopping Center

Kihei, Maui, Hawaii

File: 3050.01

August 2011

Figure 54



Gravel		Sand			Silt and Clay
coarse	fine	coarse	medium	fine	

	Sample ID	Depth	Classification	MC%	LL	PL	PI	Cc	Cu
●	TP4 - 1	2.5	Light Brown Sandy SILT (ML-MH)	30	50	35	15		

	Sample ID	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt & Clay
●	TP4 - 1	2.5	25.0	0.1			1	41	58

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GRAIN SIZE DISTRIBUTION

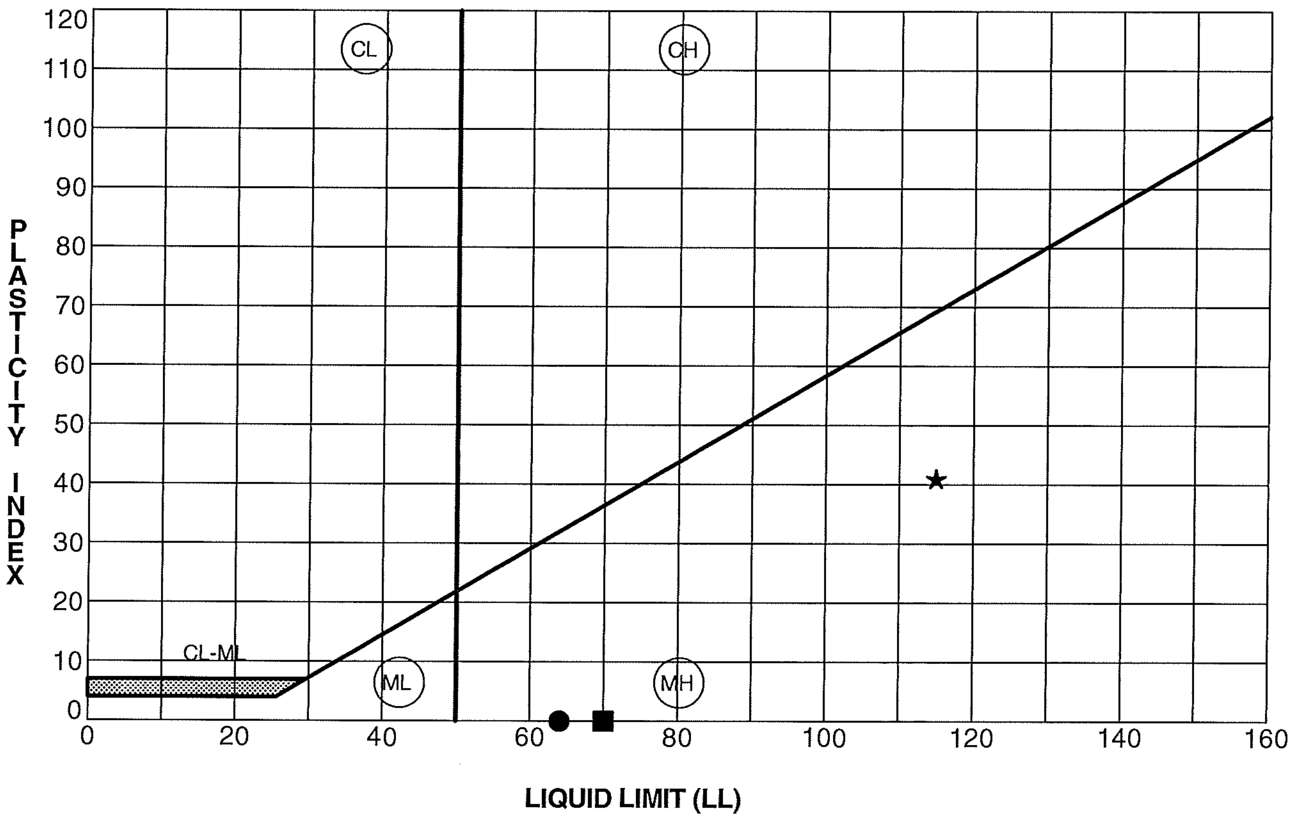
Piilani Promenade North Shopping Center

Kihei, Maui, Hawaii

File: 3050.01

August 2011

Figure 55



	Sample ID	Depth (ft)	LL	PL	PI	Classification
●	8 - 4	22.0	64	64	NP	Red Clayey SILT (MH)
■	2A - 2	16.5	70	70	NP	Reddish Brown SILT (MH)
★	9A - 6	25.0	115	74	41	Reddish Brown SILT (MH)

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PLASTICITY INDEX CHART

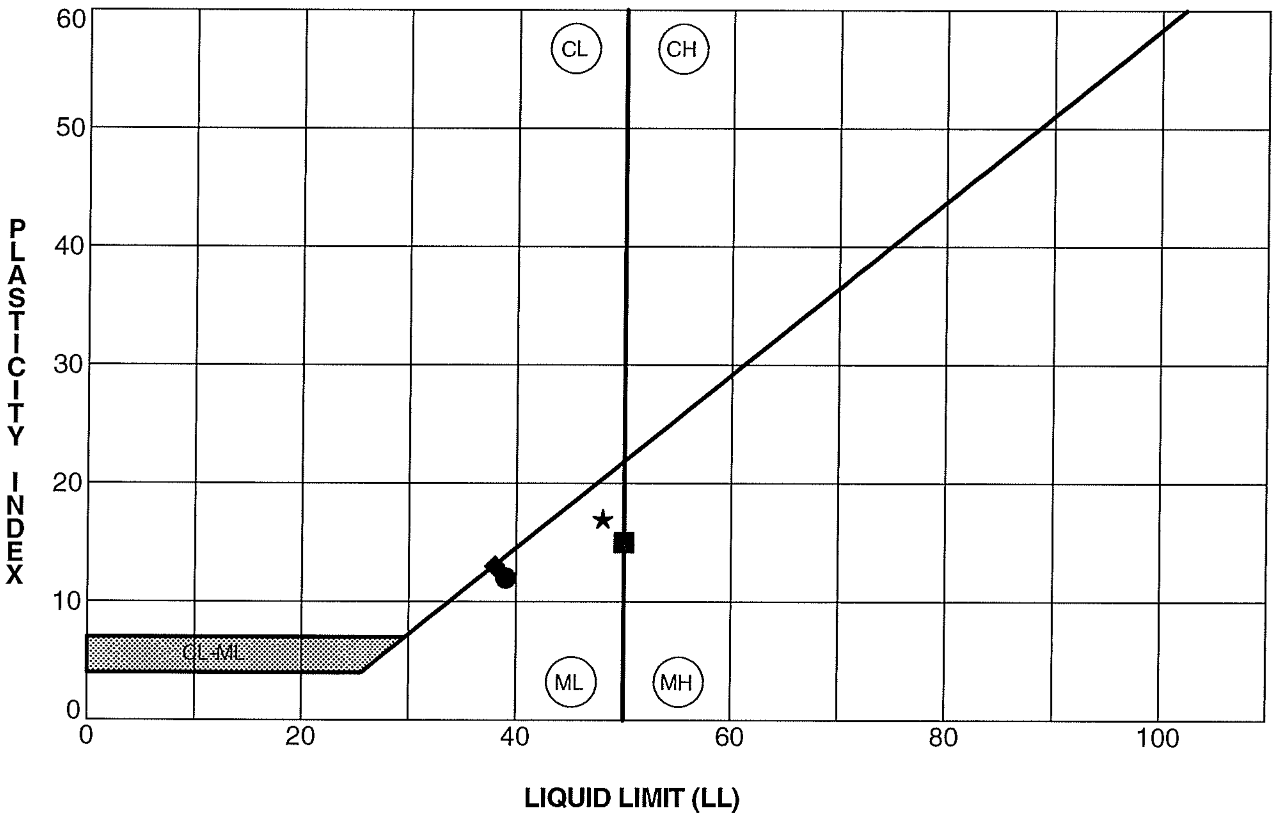
Piilani Promenade North Shopping Center

Kihei, Maui, Hawaii

File: 3050.01

August 2011

Figure 56



	Sample ID	Depth (ft)	LL	PL	PI	Classification
●	TP1 - 1	1.0	39	27	12	Light Brown SILT (ML)
■	TP4 - 1	2.5	50	35	15	Light Brown Sandy SILT (ML-MH)
★	TP6 - 1	0.5	48	31	17	Light Brown SILT (ML)
◆	TP9 - 2	1.0	38	25	13	Light Brown Sandy SILT (ML-CL)

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PLASTICITY INDEX CHART

Piilani Promenade North Shopping Center
Kihei, Maui, Hawaii

File: 3050.01

August 2011

TABLE I

Summary of Boring Samples Laboratory Test Results

Sample No.	Depth (ft)	Moisture Content (%)	Dry Density (pcf)	Direct Shear C (psf)	Direct Shear Ø (Degrees)	Torvane (psf)	Liquid Limit	Plasticity Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	USC	Swell (%)	Swell Index
1-1	1.0	17	73											
1-2	3.0	26	68	335	45°								0.5	0.02
2-1	1.0	19	66											
2-5	16.5	65	---											
2-6	19.0	28	---											
2A-1	15.0	45	41	900	35°								0.5	0.01
2A-2	16.5	47	51			1,750	70	0				MH		
2A-3	18.0	42	55	675	38°	1,250							0.5	0.01
2A-5	21.0	27	87			2,250								
3-1	1.0	24	77	390	37°								0.2	0.01
3-2	3.0	21	90											
3-6	15.0	70	---											
3-7	17.0	77	---											
4-5	16.0	62	---											
5-1	1.0	15	67											
6-5	17.0	42	---											
8-1	1.0	13	72											
8-3	20.0	65	---											
8-4	22.0						64	0				MH		
9-1	1.0	19	75	900	34°								1.4	0.04
9-5	21.0	62	---				Non-Plastic							
9-6	23.0	46	---											
9-7	25.0	68	---											
9-8	27.0	69	---											

TABLE I (Continued)

Summary of Boring Samples Laboratory Test Results

Sample No.	Depth (ft)	Moisture Content (%)	Dry Density (pcf)	Direct Shear C (psf)	Direct Shear Ø (Degrees)	Torvane (psf)	Liquid Limit	Plasticity Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	USC	Swell (%)	Swell Index
9A-2	19.0	28	90			435			4	66	30	SM		
9A-3	20.5	30	88	600	41°								0	0
9A-4	22.0	59	49	600	39°	800							0.7	0.02
9A-6	25.0	72	60			1,665	115	41				MH		
9A-7	26.5	96	42	700	39°	1,665							0.7	0.04
9A-9	29.5	58	54			2,165								
10-1	1.0	19	79											
11-1	1.0	15	77											
11-2	3.0	11	69											
11-4	14.0	59	---											
11-5	16.0	70	---											

TABLE II

Summary of Test Pit Samples Laboratory Test Results

Sample No.	Depth in feet	In-Situ Moisture Cont.(%)	Max. Dry Density (pcf)	Opt. Moist. Cont.(%)	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Liquid Limit (%)	Plasticity Index (%)	USC	Rel. Comp. (%)	Comp. Moist. (%)	CBR	CBR Swell (%)
TP1-1	1.0'	15	104.0	21	5	24	71	39	12	ML	97	21	26.5	1.6
TP2-1	1.5'	22			0	30	70							
TP3-1	0.0	18												
TP3-2	2.0	13												
TP4-1	2.5'	23	91.5	30	1	41	58	50	15	ML-MH	98	30	43.8	0.4
TP5-1	0.5	14												
TP6-1	0.5	24	97.0	25				48	17	ML	95	25	30.0	1.4
TP7-1	0.5	17												
TP8-1	0.0	16												
TP9-2	1.0	20						38	13	ML-CL				

TABLE III

Summary of Basalt Rock Unconfined Compressive Tests

Boring	Depth (feet)	Core Type	Material Description	Dry Density (p.c.f.)	Unconf. Compr. Strength (p.s.i)
Boring 1	6.0-7.0'	HQ	Gray Basalt (WS)	160	11,145
Boring 4	6.0-7.0'	HQ	Gray Basalt (F)	164	22,315
Boring 6	6.0-7.0'	HQ	Gray Basalt (WS)	154	13,700
Boring 6	21.0-22.0'	HQ	Gray Vesicular Basalt (WS)	149	6,195
Boring 7	1.0-2.0'	HQ	Gray Basalt (WS)	160	14,570
Boring 7	6.0-7.0'	HQ	Gray Basalt (WS)	166	12,895
Boring 7	18.0-19.0'	HQ	Gray Vesicular Basalt (WS)	140	5,690
Boring 8	7.0-8.0'	HQ	Gray Basalt (WS)	162	14,655
Boring 9	13.0-14.0'	HQ	Gray Basalt (WS)	166	7,025
Boring 10	6.0-7.0'	HQ	Gray Basalt (WS)	165	15,080

APPENDIX C

Limitations

This report has been prepared for the exclusive use of **Piilani Promenade North, LLC** for site of the **Piilani Promenade North Shopping Center,** in Kihei, Maui, Hawaii. In the completion of the investigation and the preparation of this report, we have strived to perform our services in a manner consistent with that level of care and skill ordinarily exercised by members of the geotechnical profession practicing under similar conditions in Hawaii. No other warranty, either expressed or implied, is made.

The analysis, conclusions and recommendations submitted in this report are based in part upon the data obtained in the test borings and test pits, and upon the assumption that the soil conditions do not deviate from those observed. If any variations or undesirable conditions are encountered during construction, or if the proposed construction will differ from that planned at the present time, FGE should be notified so that supplemental recommendations can be given. The conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and the conclusions of this report modified or verified in writing.

Unanticipated soil conditions are commonly encountered and cannot be fully determined by soil samples, test borings, or test pits. Such unexpected conditions frequently require that additional expenditures be made to attain a properly constructed project. Some contingency funds are recommended to accommodate such potential extra costs.

The site investigation for this report may not have disclosed the presence of underground structures, such as cesspools, drywells, storage tanks, etc. that may be present at the site. Should these items be encountered during construction, FGE should be notified to provide recommendations for their disposition.

The scope of work for this investigation was limited to conventional geotechnical services and did not include environmental, botanical, or archeological assessments or evaluations. Silence in the report regarding any environmental, botanical, or archeological aspects of the site does not indicate the absence of potential environmental, botanical or archeological concerns.

The boring and test pit locations were staked out in the field and their ground surface elevations were determined by Piilani Promenade North, LLC's Project Surveyors. Where occasional borings or test pits were re-located by FGE in the field, the ground surface elevations at the borings were estimated by a hand level using the staked out boring elevation. The previously drilled borings along the northern side of the site were located in the field by FGE from the visible references, and their ground surface elevations were estimated from the topographic plans. The locations and elevations of the borings should be considered accurate only to the degree implied by the methods used.

Groundwater was not observed in any of the test borings or test pits during the field investigation. It should be realized, however, that fluctuations in the level of the groundwater, or seepage may occur due to variations in natural subsurface seepage, rainfall, tides and other factors not present at the time the measurements were made.

FGE should be provided the opportunity for general review of the final design drawings and specification to verify that the earthwork and foundation recommendations have been properly interpreted and implemented in the design and specification. If FGE is not accorded the privilege of making this recommended review, it can assume no responsibility for misinterpretations of the recommendations.

FGE should also be retained to provide periodic soil engineering services during construction. This is to observe compliance of the design concepts, specifications and recommendations and to allow design changes in the event the subsurface conditions differ from that anticipated prior to construction. <u>The recommendations contained herein are contingent upon adequate construction observation and testing of the geotechnical phases of the construction by FGE</u>.

FEWELL
GEOTECHNICAL
ENGINEERING, LTD.

Oahu Office
96-1416 Waihona Place
Pearl City, Hawaii 96782-1973
(808) 455-6569
FAX (808) 456-7062
E-mail: fge@fgeltd.com

Maui Office
360 Papa Place, Suite 103
Kahului, Hawaii 96732-2464
(808) 873-0110
FAX (808) 873-0906

SUBSURFACE INVESTIGATION REPORT

MASS GRADING FOR LOTS 2C & 2D
PIILANI PROMENADE SOUTH SHOPPING CENTER

KIHEI, MAUI, HAWAII

for

PIILANI PROMENADE SOUTH, LLC

by

FEWELL GEOTECHNICAL ENGINEERING, LTD.

ALAN J. SHIMAMOTO
LICENSED PROFESSIONAL ENGINEER
No. 4393-C
HAWAII, U.S.A.

This report was prepared by
me or under my supervision.

By Alan J. Shimamoto, P.E.

August 3, 2011

Important Information about Your

Geotechnical Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you* — should apply the report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations" many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

Rely, on Your ASFE-Member Geotechncial Engineer for Additional Assistance

Membership in ASFE/The Best People on Earth exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with your ASFE-member geotechnical engineer for more information.

ASFE THE GEOPROFESSIONAL BUSINESS ASSOCIATION

8811 Colesville Road/Suite G106, Silver Spring, MD 20910
Telephone: 301/565-2733 Facsimile: 301/589-2017
e-mail: info@asfe.org www.asfe.org

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Mass Grading for Lots 2C & 2D
Piilani Promenade South Shopping Center
Kihei, Maui, Hawaii

INTRODUCTION

A subsurface investigation has been completed to assist Piilani Promenade South, LLC, with the Mass Grading of Lots 2C & 2D. Lots 2C and 2D will be the site of the Piilani Promenade South Shopping Center in Kihei, Maui, Hawaii. This report summarizes our findings and conclusions. This work has been completed in general accordance with our March 3, 2011 Proposal and our Agreement with Piilani Promenade South, LLC, dated April 6, 2011.

Two related shopping center complexes are planned by affiliated developers, Piilani Promenade North, LLC (PPN) and Piilani Promenade South, LLC (PPS), for the parcels designated as Lots 2A, 2C and 2D in Kihei, Maui, Hawaii. Lot 2A will be developed for the proposed Piilani Promenade North Shopping Center, while the adjoining Lots 2C and 2D will be developed to support the Piilani Promenade South Shopping Center.

Lots 2C and 2D are separated from Lot 2A by the future Kaonoulu Street Extension, which together with an additional street extension and an off-site water tank, is part of the off-site infrastructure improvements for the shopping center. The geotechnical aspects of the design and construction of the off-site infrastructure improvements, including the future Kaonoulu Street Extension, have been previously addressed by others and are not part of this investigation.

The shopping centers will house a number of retail shops of varying sizes, including large national retailers. Although the proposed footprints of the new buildings are shown on the grading plans, the tenants have not been finalized at this time. Additionally, national retailers often perform their own geotechnical engineering for their stores.

Due to the uncertainty with regard to the actual tenants and their geotechnical engineering requirements, the scope of the investigations has been limited to addressing the mass grading of the lots in support of the new shopping centers. We understand that additional geotechnical investigations for the actual building construction will be performed as necessary once the users or tenants of the shopping centers have been determined.

PURPOSE AND SCOPE

At the request of both PPN and PPS, subsurface investigations were undertaken for the above three parcels to assist PPN and PPS, and their consultants, with the geotechnical aspects of the mass grading of the parcels to support the shopping centers. Although the field work for both shopping center parcels were performed concurrently, separate subsurface investigation reports have been developed for each site.

This report presents the findings and conclusions for the investigation of the parcels designated as Lots 2C and 2D, which will support the Piilani Promenade South Shopping Center. A report addressing Lot 2A, which will support the Piilani Promenade North Shopping Center, is being issued separately.

The scope of work for the investigation of the Piilani Promenade South Shopping Center is detailed in the above-referenced proposal and agreement with PPS, but in general, included the exploration of the subsurface of Lots 2C and 2D with 14 test borings and 11 test pits. Samples were obtained for laboratory testing. The results of the field exploration and laboratory tests were reviewed in conjunction with the planned mass grading construction to evaluate the ramifications of the general subsurface conditions on the mass grading. The results of our evaluation are presented in this report.

The results of the subsurface exploration, including a Boring Location Plan and the logs of the borings and test pits, are presented in Appendix A. The laboratory test results are included in Appendix B. The limitations of this investigation and report are presented in Appendix C.

PROJECT CONSIDERATIONS

Lots 2A, 2C and 2D will be developed to support the Piilani Promenade North and South Shopping Centers. The parcels are immediately south of the existing Piilani Business Park, and on the eastern side of Piilani Highway and its intersection with Kaonoulu Street in Kihei. The section of Piilani Highway fronting the lots is aligned in a general north-south direction in this area. The general area of the Piilani South Shopping Center is shown on the Project Location Map, Figure 1, in Appendix A.

Lots 2A, 2C and 2D total about 68 acres of open, undeveloped pasture land, and are secured with cattle fencing and a locked gate along Piilani Highway. All 3 lots appear to be covered with scattered shrubs and small trees. Cobbles and small boulders litter the ground surface and occasional shallow swales cut through the lots in the northeast to southwest direction. An existing easement for a 36-inch diameter water line passes through the southeastern corner of Lot 2A and diagonally through Lot 2D in a general northeast to southwest direction. Overall topography in this area slopes down gradually toward the south and west.

Lots 2C and 2D are contiguous lots on the southern side of the future Kaonoulu Street Extension and immediately north of Kulanihakoi Gulch. Together, the 2 lots form the general shape of a rectangle of about 1,200 feet in width by 2,150 feet in length. The longitudinal axis of the combined lots is in a general east-west direction. Lot 2D is immediately adjacent to Piilani Highway and covers about 19½ acres. Lot 2C covers about 18½ acres and is on the eastern, or upslope, side of Lot 2D.

Except for the side slopes of the gulch, the topography at the site generally slopes down towards the south and west at an overall gradient of between about 3 and 5 percent, with localized areas as steep as about 30 percent. The ground surface in Lots 2C and 2D range from Elev. 110 in the northeastern corner of Lot 2C, down to Elev. 30 at the southwestern corner of Lot 2D, where Kulanihakoi Gulch passes beneath Piilani Highway.

Both Lots 2C and 2D are immediately adjacent to Kulanihakoi Gulch which is aligned in a general east-west direction along the southern edges of the lots. The preliminary topographic plans indicates that the gulch is up to about 200 feet wide where it is adjacent to the lots and varies from about 12 to 30 feet deep. The inclination of the side-slopes of the gulch is estimated at generally between 1½ Horizontal to 1 Vertical (1½H:1V) and 4H:1V from the preliminary topographic plans, with localized slopes of as steep as about 1H:1V.

The preliminary November 19, 2010 Mass Grading Plan for Lots 2C and 2D indicates that Lot 2C will be developed for retail shops on the eastern half of the lot and parking on its western half. The retailers will include a large retail store occupying the southeastern quadrant of the lot and 2 medium-sized buildings for stores in the northeastern corner of the lot. The pads for the area of the stores will be graded to between about Elev. 93 and Elev. 95. The parking lot west of the stores will be graded to about Elev. 92 just west of the stores, and will gradually slope down to Elev. 80 on the western side of the lot where it connects to Lot 2D.

Lot 2D will be developed to support another large retailer along the southern half of the lot adjacent to Kulanihakoi Gulch, with smaller stores and a fast food restaurant along its northern edge, adjacent to the future Kaonoulu Street Extension. Two additional smaller buildings are planned on a terrace just above, and to the east of the main entry into the lot. The remainder of the area is designated for parking. The area of the large store is planned for about Elev. 52, while the smaller stores and fast food restaurant along the northern edge of the lot will be graded to between about Elev. 54 and Elev. 57. The two smaller stores above the main entry road are planned at about Elev. 79.

The preliminary grading plans indicate that both Lots 2C and 2D will be cut on their eastern sides and filled on their western sides, thereby creating a relatively level terrace for each lot. In general, the area of Lot 2C will be graded to between Elev. 80 and Elev. 95, while the main part of Lot 2D will be graded to between about Elev. 52 and Elev. 57. The area of the parking lots of Lot 2D, which transitions to Lot 2C will be graded between about Elev. 58 and Elev. 80.

Cuts of 15 to 20 feet in depth are estimated along eastern side of Lot 2C, while 6- to 8-foot deep cuts are anticipated for the eastern side of Lot 2D. Fills of 8 to 10 feet in thickness are estimated on the western end of Lot 2C, with fills of 12 to 18 feet in thickness on the western end of Lot 2D, adjacent to Piilani Highway and Kulanihakoi Gulch. Combined with the existing natural slopes of the gulch, the total overall slope heights along the site boundary next to the gulch are anticipated to be in the range of 30 to 40 feet.

Graded 2H:1V slopes are currently planned to support the grade differences between Lots 2C and 2D, the grade differences generated along the perimeter of the lots, and the grade changes within the lots. However, steeper slopes are being considered to maximize the useable areas for each of the lots.

Building information for the new shopping center structures is not available at this time, except for a typical elevation view of the shopping center and the approximate footprint of the new buildings. The elevation view of the shopping center within Lots 2C and 2D suggests that the structures will be 1- and 2-story buildings, or 1-story buildings with higher than normal ceilings.

The building for the large retailer in Lot 2C is about 400 feet by 585 feet in plan dimensions, while the building for the medium-sized stores in Lot 2C are 150 feet to 200 feet wide by 215 feet to 235 feet long. The building for the large retailer on Lot 2D is about 290 feet by 530 feet in dimensions. The remainder of the buildings in Lots 2C and 2D are generally no larger than 75 feet in width by 85 to 180 feet in length. The types of structures, and their column and wall loads, are not known at this time, although it is assumed that concrete slab-on-grade ground floors are preferred.

SUBSURFACE INVESTIGATION

A total of 14 test borings and 11 test pits were drilled and excavated during the period of May 4, through May 26, 2011 at the approximate locations shown on the Boring Location Plan, Figure 2 in Appendix A. The borings and test pits have been arbitrarily labeled consecutively from the borings and test pits of the adjacent Lot 2A to avoid confusion, and hence are designated as Borings 12 through 25 and Test Pits 10 through 20.

The test borings were mainly drilled in the areas of the site where excavations are planned, in the areas of the future buildings, and along the edges of the gulch where large fills are proposed. The test pits were generally excavated in the relatively level areas of the site planned for parking lots, and/or where fills are planned beneath the smaller retail structures.

The test borings were drilled to depths of 10 to 30½ feet below the existing ground surface with a Mobile B-53 truck-mounted drilling rig advancing 4-inch diameter continuous-flight augers. Where hard rock was encountered which could not be penetrated by the augers, the borings were advanced with 4-inch diameter casing, NX coring equipment and wash-boring tools.

Relatively undisturbed samples of the subsurface soils were obtained at selected depths with either a 3.0-inch O.D. split-spoon sampler or a 2.0-inch O.D. Standard Penetration Test (SPT) sampler, both driven by a 140-pound hammer falling 30 inches. The number of blows required to advance the samplers the final 12 inches into the soil was recorded as the "blow counts" and are shown on the Boring Logs, Figures 3 through 16 in Appendix A, together with the materials encountered. The blow counts shown on the boring logs are the actual blow counts obtained in the field during the sampling. The estimated corresponding SPT blow counts for the 3-inch O.D. sampler are shown in parentheses below the blow counts obtained in the field.

Where rock was encountered, the borings were advanced, and samples were obtained, with a double-tube NX core barrel and an industrial diamond cutting bit. The degree of Recovery (REC) and the Rock Quality Designation (RQD) for each core run is also shown on the Boring Logs.

Test pits were excavated to depths ranging from 1 foot to 8½ feet below the existing ground surface with a Komatsu track-mounted excavator provided by PPS. The test pits were terminated once impenetrable materials were encountered. Bag samples of the soils found in the test pits were obtained for laboratory testing.

The materials found in the borings and test pits are shown on the Boring Logs and Test Pit Logs, Figures 3 through 27 in Appendix A. A Boring Log Legend is included as Figure 28 for reference. Photographs of the rock cores obtained in the test borings are shown in Figures 29 through 41 at the end of Appendix A.

LABORATORY TESTING

Selected samples of the subsurface soils obtained in the borings and test pits were tested in our laboratory to determine their pertinent general engineering characteristics, including in-situ moisture content and density, compression/consolidation under load, shear strength and swell under their in-situ moisture conditions. In addition, selected cores of the intact basalt obtained from the test borings were tested to determine their unconfined compressive strengths.

Bulk samples of the predominant near-surface soils were tested in general accordance with Laboratory California Bearing Ratio (CBR) Test ASTM D1883 to determine their pavement support characteristics and swell when compacted at their optimum moisture contents as determined by ASTM D1557. Gradation and Atterberg Limits tests were performed on visually representative samples from the borings and test pits to aid in the classifications of the soils.

The results of most of the laboratory tests are shown on the boring and test pit logs where appropriate. The results of the Consolidation, CBR, Gradation, and Atterberg Limits tests are graphically illustrated as Figures 42 through 50 in Appendix B. The results of the laboratory tests for the relatively undisturbed samples obtained from the borings are summarized in Table I at the end of Appendix B, while the results of the tests for the samples from the test pits are summarized in Table II. Table III presents a summary of the unconfined compressive strength tests performed on the rock cores.

GENERAL SUBSURFACE CONDITIONS

The borings and test pits have revealed that the site of Lots 2C and 2D for the Piiilani Promenade South Shopping Center is generally underlain by a layer of "soil materials" or "soils" over a basalt formation consisting of relatively intact basalt with interbedded layers of cobble- and gravel-sized volcanic rock fragments, generally referred to as Aa Clinker. The basalt formations generally extend to the bottom of the deeper borings at depths of 15 to 30½ feet below the existing ground surface. Basalt was not found within Boring 12, which was terminated at a depth of 10 feet.

The near-surface soils are generally comprised of residual soils (soils weathered in-place from parent rock), saprolites (residual soils with remnant rock structure) and decomposed rock (highly to completely weathered rock which exhibits soil-like properties). The saprolite and decomposed rock are similar and both still exhibit remnant rock structure, but the saprolites exhibit more advanced weathering than the decomposed rock.

The combined layering of the soil materials varies significantly in thickness, ranging from as thin as 1 foot to over 10 feet in thickness at the boring locations. The attached Table A below presents a summary of the general layering found within the borings and test pits.

Table A – Subsurface Condition Summary

Boring/ Test Pit No.	Ground Elev.	Prop. Finish Grade Elev.	Approx. Depth to Bottom of: Residual Soil	Approx. Depth to Bottom of: Saprolite/Decomposed Rock	Elev. At Top Basalt Formation
12	Elev. 46±	Elev. 54±	1'±	10'±	None Encountered
13	Elev. 37±	Elev. 52±	3'±	10'±	Elev. 27±
14	Elev. 63±	Elev. 57±	1'±	6'±	Elev. 57±
15	Elev. 61±	Elev. 52±	2'±	6'±	Elev. 55±
16	Elev. 68±	Elev. 84±	2'±	9'±	Elev. 47±
17	Elev. 68±	Elev. 84±	0'±	None	Elev. 68±
18	Elev. 98±	Elev. 94±	None	9'±	Elev. 89±
19	Elev. 94±	Elev. 93±	None	4'±	Elev. 90±
20	Elev. 79±	Elev. 93±	2'±	4'±	Elev. 75±
21	Elev. 92±	Elev. 93±	2'±	6'±	Elev. 86±
22	Elev. 108±	Elev. 93±	1'±	6'±	Elev. 102±
23	Elev. 110±	Elev. 95±	1'±	3'±	Elev. 107±
24	Elev. 112±	Elev. 92±	3'±	None	Elev. 109±
25	Elev. 107±	Elev. 92±	4'±	None	Elev. 103±
TP10	Elev. 94±	Elev. 93±	None	2'±	Elev. 92±
TP11	Elev. 87±	Elev. 90±	2'±	5'±	Elev. 82±
TP12	Elev. 81±	Elev. 90±	3'±	None	Elev. 78±
TP13	Elev. 83±	Elev. 86±	None	3'±	Elev. 80±
TP14	Elev. 77±	Elev. 86±	1'±	2'±	Elev. 75±
TP15	Elev. 74±	Elev. 79±	2'±	None	Elev. 72±
TP16	Elev. 67±	Elev, 79±	<1'±	7'±	Elev. 60±
TP17	Elev. 50±	Elev. 52±	<1'±	None	Elev. 49±
TP18	Elev. 48±	Elev. 52±	3'±	6'±	Elev. 42±
TP19	Elev. 42±	Elev. 52±	<1'±	1'±	Elev. 41±
TP20	Elev.38±	Elev.52±	2'±	5'±	Elev. 33±

Note: Elevations estimated from Topographic Plan provided by PPS

In general the thickness of the soils appear thinner toward the eastern end of the site and along the higher knolls of the site, and thicker toward the western side of the site and within the depressed areas of the site. Each of the main types of subsurface materials is described in more detail below.

Residual Soils – Where encountered, the surface layer of residual soils varies from as thin as less than 1 foot, to as thick as 4 feet, and in most of the borings and test pits, extend down to depths of about 1 to 3 feet below the existing ground surface. Residual soils were not found in Borings 18 and 19 and in Test Pits 10 and 13, where either saprolites or decomposed rock was found at the ground surface. Root mats for the above-ground vegetation extend down to depths of 2 to 5 inches below the existing ground surface in the surface soils.

The residual soils generally consist of reddish brown, light brown and brown silts, sandy silts, clayey silts and silty clays. They appear to be of volcanic ash origin and include weathered gravel-sized and cobble-sized rock fragments which are likely the core stones remaining from Aa Clinker deposited with the ash.

The residual soils are classified as ML, MH and CL under the Unified Soil Classification (USC) system, and generally exhibit a hard consistency and relatively high shear strengths. Laboratory tests performed on samples of the residual soils generally showed friction angles of 28 to 45 degrees with cohesion values of 600 to 930 pounds per square foot (psf).

Swell tests on the residual soils showed swells of 0.2 to 1.3 percent under their in-situ moisture contents, and CBR swells of 0.7 to 1.1 percent when compacted near their optimum moisture contents and saturated for a 96-hour period. The CBR tests showed that the residual soils exhibit relatively good pavement support characteristics with CBR's of 12.8 and 41.8 when compacted. The test results suggest that the residual soils generally exhibit low shrink-swell characteristics.

Although the residual soils exhibit relatively good in-situ strength characteristics, they exhibit poor consolidation characteristics. The laboratory tests performed on the residual soils showed that they possess relatively low in-situ densities, low to moderate moisture contents, and moderate but significant consolidation under light to moderate loads. In addition, sudden compression, or "collapse" of 4 to 5 percent occurs with the introduction of water.

These results indicate that although significant loads can be applied to the soils under dry conditions, the soils would consolidate significantly, and suddenly, if water is introduced into the soils, either naturally or through landscaping. We believe that this is likely due to the dissolution of the vestiges of the original rock structure of the residual soils by the water.

Saprolites and Decomposed Rock – Saprolites consist of residual soils with remnant rock structure. Although they consist of gray/brown and gray low plasticity silts, sandy silts and silty sands, which are classified as ML and SM, they still exhibit the appearance of the rock from which they originated. Sections and seams of highly weathered basalt and some core stones, which are likely weathered clinker, are also included within the saprolite layers.

Decomposed rock is similar to the saprolites but generally consist of gray/brown or gray highly to completely weathered rock. Hence, although the saprolites and decomposed rock appear similar, the saprolites are more like a soil. The decomposed rock appears more like a soft rock which is the equivalent of a very hard soil. The decomposed rock could be easily drilled with the augers and can be broken down to silts and sands, but require significant remolding pressure.

Together, the saprolites and decomposed rock layers extend down to depths ranging from as shallow as 1 foot to as deep as 10 feet below the existing ground surface. Although variations in their thickness occurs randomly throughout the area, the saprolites and decomposed rock layers generally extend to depths of 6 to 10 feet on the western side of the site (in the area of Lot 2D), and to depths of 2 to 6 feet in the eastern portion of the site (general area of Lot 2C).

Both the saprolites and decomposed rock exhibit relatively high penetration resistances to the sampling (high blow counts) and a hard to very hard consistency. Although they exhibit low to moderate densities, they possess high shear strengths with friction angles of 23 to 45 degrees and cohesion of 680 to 1,000 psf. Swells of 0.2 to 0.8 percent were obtained for the saprolites under their in-situ moisture contents, indicating low shrink-swell characteristics.

No sudden compression was observed during consolidation tests for the saprolite samples. The consolidation tests for the saprolites suggest that they possess relatively high preconsolidation pressures of 6,800 psf or more, a virgin compression index of 15 percent, and a compression index during reloading of less than 1 percent. The tests suggest that relatively minor compression or consolidation of the saprolites should occur under light to moderate loads.

Basalt Formation - The basalt formations generally consist of gray intact basalt with interbedded layers of unbonded cobble- and gravel-sized rock fragments, or Aa Clinker. Occasional small voids or cavities, of 6 to 12 inches in vertical dimension, were found within the basalt formation in Borings 15, 18 and 22.

In Lot 2D, the borings indicate that the vast majority of the formation consist of intact basalt with dense clinker seams of no more than about 12 inches in thickness. Where found in the borings within Lot 2C, the clinker layers are thicker and generally range from 4½ to 8 feet in thickness sandwiched between sections of intact basalt.

The Aa Clinker materials interbedded between the layers of intact basalt consist of cobble- and gravel-sized rock fragments, which possess little or no bonding. The clinker materials are generally dense to very dense, with occasional medium dense sections, although a loose to medium dense, 8-foot thick layer was found in Boring 20.

The intact basalt is mostly slightly weathered with occasional seams of moderately weathered basalt and some fresh basalt. The intact basalt is medium hard to hard, and massive in many areas. Laboratory unconfined compression tests on the samples of the basalt cores show dry densities of 126 to 167 pounds per cubic foot (pcf) and unconfined compressive strengths of 2,110 to 10,970 pounds per square inch. The denser and higher strength rock appears to occur near the existing ground surface. Similar results have been obtained for the cores of the adjacent Lot 2A, but much higher strengths in the range of 11,145 to 22,315 psi were obtained for the near-surface basalts.

Groundwater – Groundwater or seepage was not observed in any of the borings and test pits of this investigation, even after a period of at least 24 hours had elapsed after the completion of the borings. It should be realized, however, that fluctuations in the level of groundwater may occur due to variations in natural subsurface seepage, rainfall, and other factors not present at the time the measurements were made.

DISCUSSION AND CONCLUSIONS

The subsurface investigation has revealed that except for the surface layer of residual soils, Lots 2C and 2D are generally underlain by relatively competent saprolites, decomposed rock and basalt formations. These materials should provide adequate support for the planned mass grading of the Piilani Promenade South Shopping Center, provided the recommendations of this report are followed. Groundwater or seepage was not observed in any of the borings or test pits of this investigation and is not anticipated to have a major impact on the planned construction.

The most significant geotechnical concerns with regard to the mass grading of the site are the compressibility of the surface layer of residual soils, or volcanic ash, and the hard intact basalt found at depths as shallow as 1 foot below the existing ground surface. Based on the planned mass grading, most of the site excavation will be performed on the eastern portions of both Lots 2C and 2D, where the boring information indicates the basalt is at shallower depths. The basalt formation appears deeper on the western portions of each of the lots, but these are the lower areas of the lots where fills are anticipated.

The near-surface residual soils appear to be a derivative of volcanic ash and exhibit properties which are not uncommon for volcanic ash in Hawaii. These characteristics can result in long-term, post-grading concerns which would be dependent on if, and when, the soils become wet, which is not predictable. Although double-handling of the materials would add costs to the mass grading, we believe that it would be prudent to remove the residual soils and compact them prior to additional construction or fill placement over these soils.

The removal of the residual soils should extend throughout the area of the fill placement and new construction plus a 5-foot perimeter. It should extend down to the saprolite or decomposed rock below the residual soils. The actual depth of their removal must be determined in the field during the construction. The boring and test pit information in the proposed fill areas suggest that depths of 1 to 4 feet should be anticipated, with most of the removal likely extending down to depths of about 2 feet.

It is anticipated that the residual soils will generally be removed from the cut areas due to the site excavations. Any remaining residual soils at the finished grade levels should be similarly removed and replaced with compacted fills. The excavated materials can be re-used as fill provided they are placed, moisture-conditioned, and compacted in accordance with the recommendations of this report. Once the residual soils have been removed and replaced with properly compacted engineered fill, the remainder of the construction can proceed using relatively typical construction methods and techniques.

The test boring and test pits indicate that the site excavations will encounter a basalt formation at depths ranging from as shallow as 1 foot to as deep as 10 feet below the existing ground surface. In most of the borings and test pits, intact hard basalt was found in the range of 3 to 6 feet below the existing ground surface, particularly within the planned cut areas of the site. The saprolites and decomposed rock found above the intact basalt formations were easily penetrated with augers and we believe that they can be excavated with heavy earth-excavating equipment.

The basalt formation generally consists of slightly weathered, medium hard to hard intact basalt with interbedded layers of clinker, most of which is medium dense to dense. Excavation of the intact basalt will require the use of heavy rock-excavating equipment such as single-ripper D-9, or larger, dozers and hoe-rams. Blasting would facilitate and expedite the site excavations provided it can be safely performed in accordance with the governmental regulations for blasting.

The intact basalt should be relatively stable even with steep cut slopes, but some consideration must be given to the thicker interbedded layers of Aa clinker consisting of the gravel- and cobble-sized rock fragments and other possible defects or loose zones in the formation. The intact basalt should be able to stand satisfactorily at near-vertical slopes, but the Aa clinker layers which are sometimes found within the basalt consist of the unbonded rock fragments. The clinker layers will tend to ravel over time and approach a more stable slope of about 1H:1V to 1½H:1V.

We believe that the intact basalt can be cut at slopes as steep as ½H:1V, and up to 15 feet high without benches, provided any encountered clinker layers, or other defects in the basalt, are stabilized by grouting and guniting such that future raveling and sloughing of the clinker materials is prevented. In addition, a drop zone of at least 8 feet in width, and sloped back toward the toe of the cut slope, should be provided at the base of the slope to minimize the lateral movement of any rocks falling from the steep slope.

Alternatively, the overall cut slopes in the basalt formations may be cut at a flatter slope of 1H:1V for vertical heights of up to 20 feet without benches to accommodate the potential for clinker layers found within the basalt. Some surface guniting of the clinker seams should still be anticipated where loose clinker zones are encountered.

For both of the above slopes, an 8-foot wide bench should be provided at their approximate mid-heights where the ½H:1V cut slopes exceed 15 feet, and where the 1H:1V slopes exceed 20 feet. Both of the above slopes are relatively steep and can be dangerous. A fence should be constructed at the top of slope as a safety precaution to prevent access to the top of the slopes.

Excavations into the basalt will likely result in boulder- and cobble-sized rock fragments which would require significant crushing and processing for use as a typical granular fill material. An on-site crusher would have to be used to process the large basalt fragments generated from the site excavations. Although the boulders and cobbles can be used without significant processing as a coarse rock fill (also referred to as a boulder fill), some limitations must be considered.

These limitations generally favor the use of a more typical crushed rock fill rather than coarse rock fills for this project.

Future excavations into the coarse rock or boulder fill, will be significantly costly and potentially not feasible without jeopardizing the integrity of the boulder fill. Such excavations typically disturb not only the boulders being excavated, but also the adjacent boulders which are to remain in place. Attempts to stabilize the adjacent boulder fills typically result in nearly complete removal and reconstruction of the fill due to the inability to contain the disturbed fill areas. Injection grouting of the adjacent boulder fill areas with a low-strength material such as CLSM would likely be necessary for excavations into the boulder fills. Hence, coarse rock fills, or boulder fills, should be considered permanent fills which will not be disturbed in any way in the future.

Additionally, subsurface investigations for building foundations would be severely limited by a boulder fill, and obtaining adequate information for the geotechnical aspects of the foundation design would be difficult, if not impossible, within the fills. Hence, depending on the designer's familiarity with boulder fills, the foundation designs for the buildings can be significantly impacted by the presence of the rock fills beneath the structures. This is normally not a concern if the same geotechnical engineer is retained throughout the project, but can be significant for this project since it is anticipated that the larger retailers will probably want to undertake their own foundation investigations for the design and construction of their buildings.

If coarse rock fills or boulder fills are used on this project we recommend that they be constructed in the parking areas at least 10 feet away from the future building areas and existing or future slopes, at least 5 feet below the future finished subgrades, and in areas where future utilities and site excavations are not planned. The use of a portable on-site rock crusher should be anticipated to generate the vast majority of the fill materials from the basalt formations, which will be simpler, more expedient and likely more cost-effective in grading the site. The crusher should be capable of crushing the basalt to materials to a maximum size of 6 inches in dimension, typically referred to as minus 6-inch materials.

Fill slopes constructed of the minus 6-inch crushed rock materials, the residual soils, saprolites, or decomposed rock materials may be inclined at slopes of 2H:1V for heights of up to 20 feet without benches provided the toes of the slopes are set-back at least 8 feet from the top of the existing gully slopes or other similar steep slopes. Where the fills slopes have been constructed entirely of the minus 6-inch crushed rock fill, they maybe sloped as steep as 1½H:1V for vertical heights of up to 15 feet without benches. Slopes exceeding these heights should be provided with an 8-foot wide bench at their approximate mid-heights or at vertical intervals of no more than 20 feet and 15 feet, respectively.

Our analyses indicates that the above-recommended slope inclinations and heights should provide an acceptable factor of safety of at least 1.5 against slope failure under static conditions and a safety factor of at least 1.1 under the seismic conditions recommended under the 2006 International Building Code (IBC) for this area of Maui. These are the typically accepted minimum factors of safety for this type of geotechnical stability evaluation.

The remainder of this report presents recommendations addressing the mass grading of the site, but does not include recommendations for the design and construction of the buildings and their foundations. Separate foundation investigation, with additional borings and/or test pits should be undertaken by the future retailers or builders for the buildings of the shopping center to specifically address the new shopping center buildings.

For preliminary planning and cost-estimating purposes, we believe that the natural saprolites, decomposed rock, and the fills processed, placed and compacted in accordance with the recommendations of this report should be capable of providing allowable bearing capacities of between 3,000 and 4,000 pounds per square foot (psf). The foundations should be embedded at least 12 to 18 inches below the lowest compacted subgrade adjacent to the footings, and set-back at least 7 feet from the top of the graded slopes. Increased embedment would be necessary for foundations bearing on a slope, or within 7 feet of the compacted slope face.

Where foundations are embedded at least 6 inches into intact basalt, the allowable bearing capacity can likely be increased to at least 5,000 psf and probably much higher. Voids, cavities, loose clinker seams or other defects in the intact basalt should be cleaned out and filled with concrete. Spread footings should bear entirely on similar materials, i.e. either completely on intact basalt, on saprolites and decomposed rock, or completely on compacted fill.

Due to the possibility of clinker layers and the occasional presence of voids, the drilling of foundations probes may be warranted, depending on the findings of the investigations for the buildings. Foundation probes in the rock are typically drilled at each spread footing and at about 10-foot intervals along the lengths of the continuous footings.

The above preliminary geotechnical guidelines for the building construction are given for preliminary planning purposes. Each of the buildings should be evaluated in more detail once their detailed design has been finalized and additional subsurface investigations have been completed for the buildings.

RECOMMENDATIONS

General

1. We believe that Lots 2C and 2D can be adequately developed to satisfactorily support the mass grading for the Piilani Promenade South Shopping Center, provided the recommendations of this report are followed. The presence of the volcanic ash residual soils with poor supportive characteristics and the relatively shallow depth to intact basalt present some concerns to be addressed, which will likely result in higher costs than those incurred on site with more favorable conditions.

2. The most significant geotechnical concerns with the development of the site to support the planned mass grading is the moderate, but sudden, compression which can occur with the near-surface residual soils and the shallow depth to hard intact basalt. We believe however, that these concerns can be reduced by the removal and replacement of the near-surface residual sols with compacted fill, and anticipating the use of heavy rock-excavating equipment in excavating the intact basalt.

3. Groundwater was not encountered in any of the borings or test pits during this investigation and is not anticipated to be a major factor in the planned mass grading.

Site Preparation

4. Prior to the start of actual site grading, the site should be cleared and grubbed in accordance with Section 201 of the Standard Specifications for Road, Bridge and Public Works Construction of the County of Maui (Standard Specifications).

   a. The clearing and grubbing operations should extend throughout the area of the planned construction and at least 5 feet beyond the toes of the planned fill slopes and other new construction.

   b. The actual depth of the clearing and grubbing should be determined in the field during construction, but based on our observations of the borings and test pits, it is likely that 2 to 4 inches will suffice.

   c. All vegetation, trash, rubble, and other deleterious materials should be removed and wasted off-site.

5. Existing utilities or similar items which interfere with the planned construction, should be removed and re-routed. The depressions or trenches resulting from their removal should be backfilled in accordance with the Grading and Utility recommendations of this report.

Grading

6. Once the site has been cleared and grubbed, mass grading can commenced to generate the designed grades. The graded, level pads for the shopping center buildings and structures should extend at least 7 feet beyond the exterior edge of the new structures and their foundations. Deeper than normal foundation embedment will be required where this criteria cannot be met.

7. Excavations for the site grading should provide a relatively level area such that protruding high-points in the underlying basalt are minimized for the shopping center buildings and their slabs. The removal of the basalt in the cut areas should extend at least 6 inches below the bottom of the concrete slabs to allow for the installation of their slab cushions or base materials.

8. The use of heavy rock excavating equipment, such as single-ripper D-9 dozers, or larger, and hoe-rams should be anticipated for the site excavations into the near-surface basalt formations and for the construction of any below-grade structures penetrating the basalt. Blasting can facilitate and expedite the removal of the basalt provided it can be performed safely in accordance with applicable governmental regulations for blasting in this area.

9. The near-surface layer of volcanic ash residual soils should be removed throughout the area of the new construction, plus a 5-foot perimeter, and stockpiled for future use as fill.

   a. The removal of the volcanic ash residual soils should extend down the underlying layers of hard saprolites, decomposed rock or the intact basalt formation.

   b. The actual depth of their removal must be determined in the field during the construction, but based on the boring and test pit operation, it is anticipated that it will average about 2 feet.

   c. Where the then exposed ground surface slopes down in excess of 5H:1V, it should be benched with a series of horizontal terraces prior to fill placement. The benches should extend through any loose slope materials into hard natural ground.

10. The then exposed subgrade should be proof-rolled to detect any remaining soft spots or loose zones prior to fill placement or additional construction. The proof-rolling should consist of at least 5 passes of a heavy compactor such as a Cat 825, or its equivalent, weighing at least 40,000 pounds.

11. Areas to receive fill or new construction should be scarified for a depth of 8 inches, moisture-conditioned to within 3 percent of its optimum moisture content, and uniformly compacted to at least 90 percent relative compaction as determined by Laboratory Compaction Test ASTM D1557. Where the ground is within 2 feet of the bottom of future pavement sections, it should be compacted to at least 95 percent relative compaction.

12. The excavated on-site soil materials, consisting of the residual soils, saprolites and decomposed rock may be used for fill for the mass grading. Little or no processing is anticipated for these materials for their use as fill.

13. Excavated rock materials should be segregated from the soils, and crushed and processed to generate a granular crushed rock material.

a. The excavated rock should be crushed to generate a well-graded material with a maximum dimension of no larger than 6 inches (minus 6-inch crushed rock) with no more than 15 percent passing the No. 200 US Sieve.

b. The use of an on-site crusher should be anticipated to crush and process the basalt to generate the above-recommended fill materials.

14. Fill materials, whether imported or generated on-site, should be free of organics, rubbish, debris, free of soil clods, and other deleterious materials. Additionally, imported materials should be a low-expansion soil, which is as good as, or similar to, the on-site materials.

a. It should have a maximum size of no more than 3 inches, no more than 15 percent passing the No. 200 US Sieve and exhibit a Plasticity Index of no more than 15.

b. When tested in accordance with Laboratory CBR Test ASTM D1883, it should exhibit a CBR of at least 15 and no more than 1 percent CBR swell.

15. Fill should be placed in relatively uniform lifts of no more than 8 inches in loose thickness, moisture-conditioned to within 3 percent of their optimum moisture content and uniformly compacted to at least 90 percent relative compaction as determined by Laboratory Compaction Test ASTM D1557. Fill placed within 2 feet of the bottom of pavements should be compacted to at least 95 percent relative compaction.

16. Field density testing of the minus 6-inch crushed rock fill is not practical due to the over-sized materials comprising the fill. The fill should be compacted to a tight, unyielding layer, and

should be continuously observed during the construction to determine whether it appears adequately compacted.

17. Where the on-site soils (consisting of the residual soils, saprolites and/or decomposed rock) are used at the top of the graded building pads, they should be kept moist as much as is practical during the intervening period between the grading of the pad and the construction of the concrete slabs for the buildings. This is to avoid excessive drying and shrinking which can result in future expansion after the construction of the buildings. Should shrinkage cracks in excess of 1/8 inch in width occur, the upper 8 inches of the pads should be scarified and recompacted as indicated above prior to the construction of the concrete slabs-on-grades for the buildings.

18. Cut slopes in the residual soils, saprolites and decomposed rock should be cut at no steeper than 2H:1V for heights of up to a maximum of 15 feet without benches. Cut slopes in the basalt formation below the soil materials can be cut relatively steep but should include fences or other safety considerations at the top of the slope to prevent falling off the top of the slopes.

a. Slopes cut into the intact basalt formation may be sloped as steep as ½H:1V for heights of up to 15 feet without benches, provided any clinker layers and defects found in the rock are grouted and gunited to prevent future raveling and sloughing of the clinker materials.

    i. Loose rocks, boulders or cobbles on the slope should be removed, and a drop zone, at least 8 feet in width, should be provided at the toe of the slope to reduce the potential or future loosened rocks traveling horizontally away from the slope. The drop zone should be sloped toward the cut slopes.

    ii. Maintenance should be provided periodically to observe the condition of the slope and to remove rocks and boulders which accumulate within the drop zone.

b. Alternatively the cut slopes in the basalt formation may be excavated as steep as 1H:1V for vertical heights of up to 20 feet without benches. Should loose clinker, or defects in the rock be encountered, they should be gunited to reduce the potential for future raveling, and subsequent undermining of the rock above.

c. An 8-foot wide bench should be provided at the approximate mid-height of the slopes where the ½H:1V cut slopes exceed 15 feet, or at about 15 feet intervals up to a maximum height of 25 feet. A similar 8-foot wide bench is recommended at the approximate mid-height of the 1H:1V cut slopes in the basalt where the slopes exceed 20 feet in height, or at about 20 feet intervals for slopes of up to 25 feet in height.

d. Cut slopes exceeding the above-recommended maximum heights are not anticipated on this project and should be individually evaluated should they occur.

19. Fill slopes using the above recommended minus 6-inch well-graded crushed rock fills or the on-site soil materials consisting of residual soils, saprolites or decomposed rock should be constructed such that the toes of the fill slopes are set-back at least 8 feet from the top of the existing gulch slopes or other similar steep slopes at the site.

a. Fill slopes comprised of any, or all, of the above materials may be constructed as steep as 2H:1V for vertical heights of up to 20 feet without benches.

b. Fills slopes constructed entirely of the minus 6-inch well-graded crushed rock fills or a combination of minus 6-inch and minus 2-inch well-graded crushed rock materials may be constructed as steep as 1½H:1V for vertical heights of up to 15 feet without benches.

c. Where the fills slopes exceed 20 feet for the 2H:1V slopes, or 15 feet for the 1½H:1V slopes, 8-foot wide benches should be provided at their approximate mid-heights, or at intervals not exceeding 20 feet and 15 feet, respectively, for vertical total heights of up to 25 feet. Fill slopes exceeding this height are not anticipated on this project and should be individually evaluated where they occur.

d. The fill slopes should be over-constructed during the rough grading and subsequently cut back to their desired lines and grades such that the finished slope face is a tight, well-compacted surface.

20. Drainage provisions should be included in the design of the mass grading to direct water away from the slopes and to preclude the ponding of water adjacent to or beneath the slopes.

21. The soil cut slopes and the fill slopes should exhibit adequate overall stability but are susceptible to raveling and rilling due to erosion. The slopes should be protected from erosion by planting, seeding or mulching as soon as practical after they are graded to minimize the potential for these occurrences.

Coarse Rock or Boulder Fills

22. Coarse rock fill or boulder fill may be used provided it is judiciously placed, segregated, processed and compacted in accordance with the recommendations of this report. Coarse rock fills or boulder fills should be restricted to areas where no future excavations are planned and where they can be a permanent fill which will not be disturbed in the future.

23. Coarse rock fills should not be used in: 1) the future building areas, plus a 10-foot perimeter, 2) within 10 feet laterally of the top of the compacted finished fill slopes, 3) above a

depth of 5 feet of the planned finished grades for the mass grading (as measured from the top of the last choke layer), and 4) within 1 foot vertically of the bottom of the future utilities (as measured from the anticipated bottom of the utility trench and the top of the final choke layer.

24. The coarse rock materials should be segregated such that they are free of soil materials and only consist of crushed rock materials. The crushed rock should be segregated such that they consist of minus 6-inch materials, cobbles between 4 inches and 12 inches in maximum dimension, and boulders which are 12 to 24 inches in maximum dimension.

25. At least a 12-inch thick layer of minus 6-inch well-graded crushed rock fill should be placed and compacted on the existing ground to receive fill prior to the construction of the coarse rock fill.

26. The initial deeper layers of the coarse rock fill should consist of 1-foot to 2-foot sized boulders placed in lifts or no more than 2 feet in thickness and tracked into a tight, unyielding layer with a D-8, or larger, dozer. Once compacted, additional layers of coarse rock fill, or boulder fill may be added. Fines should not be allowed into the open voids of the rock fill until it has been adequately compacted as they can interfere with the boulder-to-boulder contact of the coarse rock fills.

27. Choke layers consisting of successively finer sized crushed rock materials should be provided at the top of the coarse rock fill or boulder fill prior to the placement of fined grained soil fills to prevent future migration of the fines into the coarse rock fill, and before attaining the minimum vertical clearances recommended above for the placement of the coarse rock fills.

a. The initial choke layer over the coarse rocks and boulder should consist of a 12-inch thick layer of well-graded cobble-sized material of 4 inches to 12 inches in size. It should be tracked into place with a D-8, or larger, dozer until it forms a dense, unyielding layer.

b. The second and final layer of choke material should consist of at least a 6-inch layer of minus 6-inch well graded crushed rock materials placed and compacted with a heavy vibratory compactor such as a Raygo 400, or its equivalent, imparting at least 27,000 foot-pounds of dynamic force to the underlying choke layer.

28. Once the final choke layer has been placed and compacted, at least 5 feet of the finer grained minus 6-inch well-graded crushed rock fill (or more where deep utilities are anticipated) should be placed over the final choke layer of the coarse rock fill to complete the site grading.

Utilities & Site Improvements

29. Utilities and site improvements should be installed and backfilled in accordance with Section 206 of the Standard Specifications and the Grading recommendations of this report using the appropriate mechanical compactor above and around the pipes. Jetting, flooding, or ponding techniques should not be allowed as a method of compacting the backfill.

30. Hard intact basalt should be anticipated as shallow as 1 foot below the existing ground surface. The use of heavy rock excavating equipment such as hoe-rams should be anticipated for the utility trench excavations and other site excavations into the basalt.

31. Where rock is found at the invert of the utilities at the bottom of the trench, at least 6 inches of pipe cushion or bed course should be placed over the rock to minimize the potential for point loads on the pipes. The actual thickness of the cushion or bed course should be in accordance with the applicable sections of the Standard Specifications for each type of utility, but should not be less than 6 inches.

32. The well-graded minus 6-inch crushed rock fills will have little or no binder and will be susceptible to raveling and caving. Shielding, shoring, and bracing should be provided by the contractor for the work on the utilities and other deep site excavations in accordance with HIOSH to protect the workers in the excavations. The design and installation of the shoring system should be the responsibility of the contractor.

33. Site improvements such as manholes and drainage inlets can be supported on shallow foundation systems such as mat foundations, individual spread foundations, continuous line foundations, or a combination of these types provided the Grading recommendations have been followed. This will assure that the residual soils have been removed and replaced with compacted fill and that the fill has been compacted to at least 90 percent relative compaction prior to the construction of the improvements and their foundations.

34. Shallow foundations should be founded at least 12 inches below the lowest adjacent compacted subgrade on level ground. The embedment may be reduced to 6 inches into intact basalt where the foundations bear on rock. Foundations on slopes or within 7 feet of the top of

slopes should be embedded such that there is at least 7 feet of horizontal setback from the lower outside edge of the footing to the compacted slope face.

35. Continuous footings should have a minimum base width of 12 inches, while individual spread foundations should have a base width of at least 18 inches. Foundations may be founded on the fill compacted in accordance with the recommendations herein, saprolite, decomposed rock or the natural basalt formations. However, individual spread footings and mat foundations should be founded on the same materials throughout their contact area.

36. Any soft spots encountered in the foundation excavations should be removed down to compacted fill, or hard natural materials, and the resulting depression backfilled in accordance with the Grading recommendations. Soil-filled holes found in the intact basalt should be cleaned out and backfilled with low-cost concrete.

37. Footings may be founded on the compacted fill, saprolite or decomposed rock, where an allowable bearing capacity of 3,000 psf may be used for the design of the footings. Mat foundations should be dimensioned such that the contact pressure of the mat does not exceed 2,000 psf. Foundations embedded at least 6 inches into the intact basalt may be designed for an allowable bearing capacity of 5,000 psf. These values may be increased by one-third for short-term wind or seismic loads.

38. The bottom of the foundations excavations in fill, saprolite or decomposed rock should be compacted to at least 90 percent relative compaction as determined by Laboratory Compaction Test ASTM D1557. Loose materials within the foundation trenches should be removed prior to the placement of the reinforcing steel and concrete.

39. The walls of the below-grade improvements such as drainage inlets and manholes may be designed for an at-rest lateral earth pressure of 60 p.c.f. equivalent fluid pressure assuming the backfill behind the walls consists of the recommended fill materials indicated in the Grading Recommendations. This pressure does not include foundation, surcharge, or hydrostatic pressure, which must be added where appropriate.

40. Weepholes should be provided in the walls of the drainage inlets or catch basins to minimize the accumulation of water within the base course layers of the adjacent pavements.

Filter material, approximately 1 cubic foot in volume, and consisting of a free-draining granular material such as ASTM C33 No. 67 aggregate, wrapped in a non-woven geotextile filter fabric, should be provided in front of each weephole. Care must be taken in the construction of the filter materials in front of the weephole to maintain the hydraulic conductivity between the base course for the pavements and the weepholes.

41. Backfill around the improvements should be placed and compacted in accordance with the Grading recommendations of this report using small light equipment to minimize the lateral earth pressures against the improvement walls.

42. Steel reinforcement of the improvements and their foundations should be provided as recommended by the Project Structural Engineer. Total and differential settlements of the foundations for the improvements exceeding ¼ inch are not anticipated under the light loading conditions typical of site improvements.

43. Assuming the soil and rock conditions found in the borings extend to a depth of at least 100 feet below the existing ground surface, we believe the site of the substation and the alignment of the poles is likely designated as Site Class B, "Rock," due to the predominance of the basalt formations underlying the area.

Pavements

44. It is anticipated that once the shopping center grading has been completed, the subgrade soils beneath the planned pavements should consist of either the natural basalt formations, saprolite, decomposed rock or fill meeting the requirements of the Grading recommendations of this report.

a. Based on these results, we believe that a minimal pavement section of 2 inches of Asphalt Concrete Paving (ACP), over 6 inches of Aggregate Base Course, placed on the compacted subgrade should be sufficient for the anticipated light passenger car traffic and utility trucks.

b. The thickness of the ACP course should be increased to 3 inches in heavy traffic areas, or where heavy truck traffic is anticipated.

45. The composition of the Aggregate Base Course should conform to Section 703.06 of the Standard Specifications. The subgrade should be shaped to drain and be compacted to at least

95 percent relative compaction for a minimum depth of 6 inches prior to the placement of the base course.

46. The above pavement section is provided for preliminary design and cost-estimating purposes. The actual pavement will depend on the materials encountered at the pavement subgrade levels. The final pavement section should be based on the results of CBR tests obtained on samples of the subgrade soils during construction.

Quality Control

47. The site preparation, grading and backfilling operations, including the proof-rolling operations, should be observed by FGE to determine whether the anticipated conditions are encountered.

48. Intermittent, random field density tests should be taken to determine whether the specified levels of compaction are being consistently obtained in the finer grained fills, backfills, and the existing ground to receive fill. Field density testing is not appropriate to evaluate the compaction of the minus 6-inch fill materials; compaction of the minus 6-inch fills must be visually observed on a full-time basis.

49. Samples of proposed fill materials should be submitted to FGE no less than 7 working days prior to its intended jobsite delivery to allow adequate time for testing, evaluation, and approval.

50. Excavations for the site improvements should be observed by FGE to determine whether the anticipated bearing materials are being encountered. The recommendations given herein are contingent on adequate monitoring of the geotechnical phases of the construction by FGE.

Limitations

51. This report has been prepared for the exclusive use of **Piilani Promenade South, LLC** for the proposed **Mass Grading of Lots 2C and 2D** of the **Piilani Promenade South Shopping Center** in Kihei, Maui, Hawaii. In the performance of this investigation and the preparation of this report, FGE has strived to perform our work in general accordance with accepted geotechnical engineering practices and principles in Hawaii. No other warranty, expressed or implied is made. The limitations of the investigation and this report are detailed in Appendix C.

/ajs:tjc:fse

APPENDIX A

Subsurface Investigation Summary

Project Designation: Piilani Promenade South Shopping Center **File:** 3051.01

Location: Kihei, Maui, Hawaii

Project Location Map: Figure 1

Boring Location Plan: Figure 2

Drilling Contractor: Hawaii Test Borings, Inc.

Drilling Equipment: Mobile B-53

Drilling Method: /x/ 4-inch Auger /x/ Wash
/x/ NX Core / / HQ Core

Boring Summary:

Boring	Depth	Number of Samples	NX Core	Depth to Water Table[1]	Water Table Elevation[2]	Boring Log Figure No.
12	10.0'	4	0.0'	N.E.	N.A.	3
13	21.0'	5	11.0'	N.E.	N.A.	4
14	17.0'	4	11.5'	N.E.	N.A.	5
15	22.5'	4	14.7'	N.E.	N.A.	6
16	30.0'	4	21.0'	N.E.	N.A.	7
17	20.0'	2	18.5'	N.E.	N.A.	8
18	16.5'	6	8.0'	N.E.	N.A.	9
19	15.0'	2	11.0'	N.E.	N.A.	10
20	30.0'	4	23.0'	N.E.	N.A.	11
21	19.5'	5	12.5'	N.E.	N.A.	12
22	30.5'	7	21.0'	N.E.	N.A.	13
23	25.5'	4	18.0'	N.E.	N.A.	14
24	25.0'	2	21.5'	N.E.	N.A.	15
25	25.0'	2	21.0'	N.E.	N.A.	16
Totals	307.5'	55	212.7			

Date Started: 5-9-11 **Date Completed:** 5-26-11

Test Pit Summary:

Test Pit	Depth	Number of Samples	Depth to Water Table	Test Pit Log Figure No.
TP10	5.0'	1	N.E.	17
TP11	7.0'	3	N.E.	18
TP12	4.0'	1	N.E.	19
TP13	4.5'	1	N.E.	20
TP14	3.5'	1	N.E.	21
TP15	7.0'	2	N.E.	22
TP16	8.5'	2	N.E.	23
TP17	6.5'	1	N.E.	24
TP18	6.5'	2	N.E.	25

APPENDIX A (Continued)

Subsurface Investigation Summary

Project Designation: Piilani Promenade South Shopping Center **File:** 3051.01

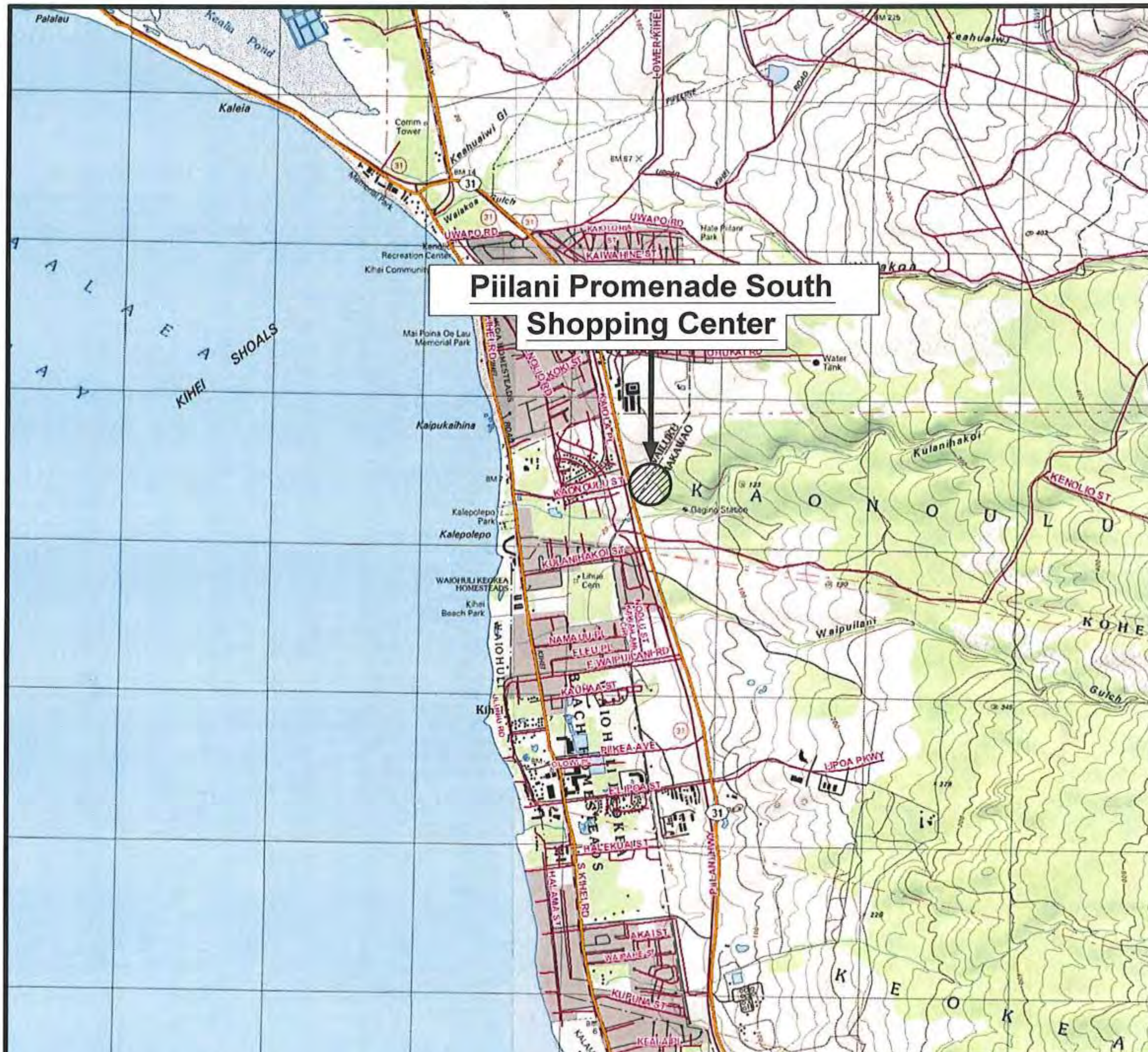
Location: Kihei, Maui, Hawaii

Test Pit Summary (Continued):

Test Pit	Depth	Number of Samples	Depth to Water Table	Test Pit Log Figure No.
TP19	1.0'	1	N.E.	26
TP20	7.5'	2	N.E.	27
Totals	61.0'	17		

Date Started: 5-4-11 **Date Completed:** 5-5-11

Boring Log Legend:	Figure 28
Rock Core Photographs:	
Boring 13	Figure 29
Boring 14	Figure 30
Boring 15	Figure 31
Boring 16	Figure 32
Boring 17	Figure 33
Boring 18	Figure 34
Boring 19	Figure 35
Boring 20	Figure 36
Boring 21	Figure 37
Boring 22	Figure 38
Boring 23	Figure 39
Boring 24	Figure 40
Boring 25	Figure 41



LEGEND:

PROJECT LOCATION

SCALE: 1:24000

GENERAL AREA:
KIHEI, MAUI, HAWAII

REFERENCE:
PUU O KALI QUADRANGLE
U.S.G.S. TOPOGRAPHIC MAP

F.G.E.

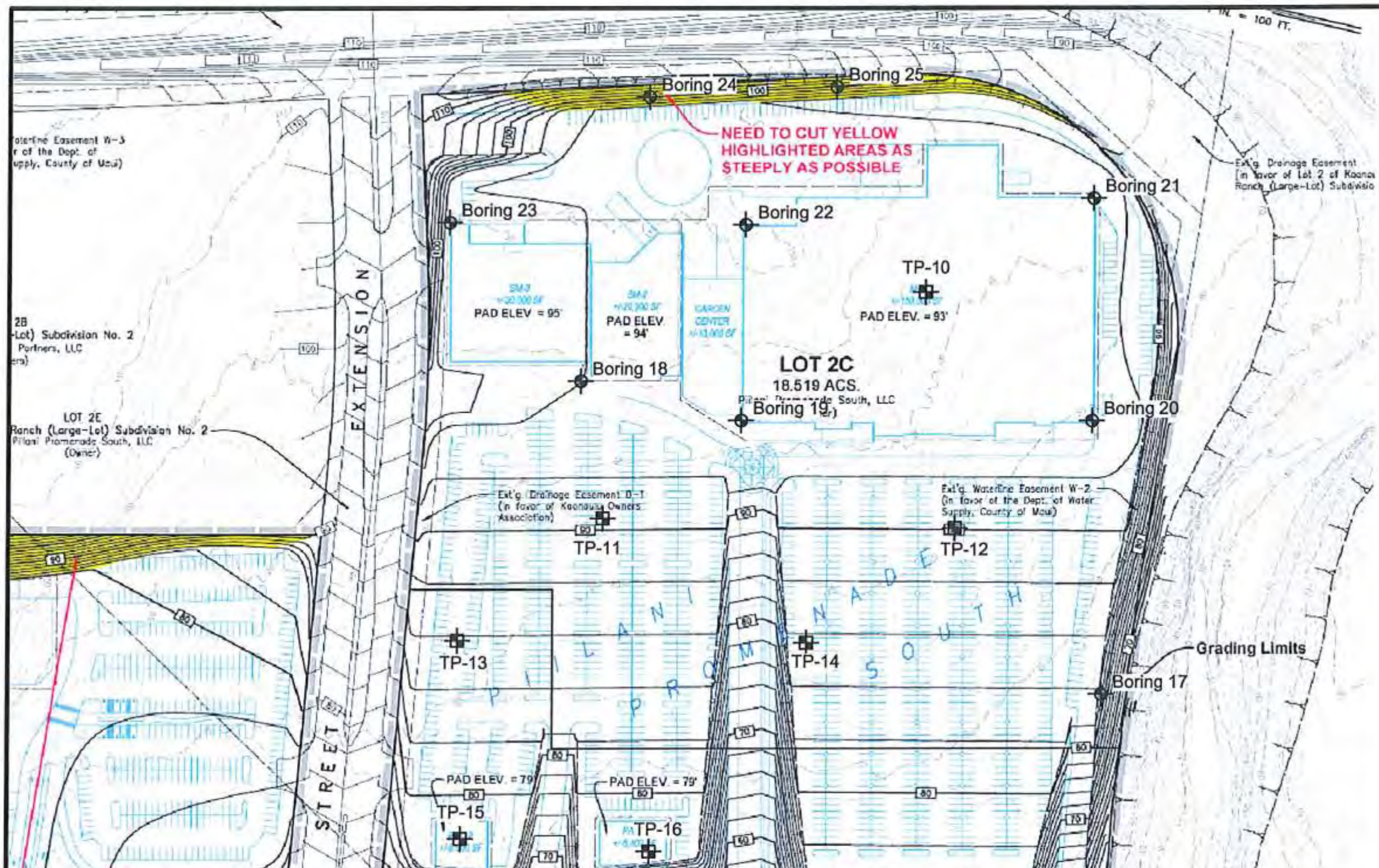
PROJECT LOCATION MAP

Piilani Promenade South Shopping Center
Kihei, Maui, Hawaii

File: 3051.01

August 2011

Figure 1



LEGEND

N

APPROXIMATE SCALE IN FEET

60 120 240

PLAN NORTH

APPROXIMATE FGE BORING LOCATION

APPROXIMATE FGE TEST PIT LOCATION

PLAN PROVIDED BY ECLIPSE DEVELOPMENT GROUP, FEBRUARY 2011

FEWELL GEOTECHNICAL ENGINEERING, LTD.

BORING LOCATION PLAN

Piilani Promenade South Shopping Center
Kihei, Maui, Hawaii

96-1416 Waihona Place Pearl City Hawaii 96782-

File: 3051.01

August 2011

Figure 2

F.G.E. Ltd.

Boring: 12
Project: Piilani Promenade South Shopping Center
Location: Kihei, Maui, Hawaii
Surface Elevation: 46'±
Depth to Water: None Encountered (5/21/11, 3:18pm)
Date Completed: 5-17-11

File: 3051.01
Project Engineer: AS
Field Engineer: TRN
Drafted by: KSL
Date of Drawing: August 2011

LAB TEST RESULTS	MOIST CONT. %	DRY DEN. PCF	BLOWS PER FT. *See Legend	SAMPLE	DEPTH	CLASSIFICATION
					0	Brown SILT (ML) with roots to 4", loose, dry
	12	81	40/3" R (28)	1		Gray Sandy SILT (ML) with remnant rock structure, hard, moist
Swell= 0.0% LL= 11, PI= 37	14	72	70 (47)	2		
					5	
			25 (19)	3		
			50 (34)	4		
					10	**(SAPROLITE)**
						BOH @ 10.0'
					15	
					20	
					25	
					30	
					35	

Figure 3

F.G.E. Ltd.

Boring: 13
Project: Piilani Promenade South Shopping Center
Location: Kihei, Maui, Hawaii
Surface Elevation: 37'±
Depth to Water: None Encountered (5/21/11, 2:10pm)
Date Completed: 5-9-11

File: 3051.01
Project Engineer: AS
Field Engineer: TRN
Drafted by: KSL
Date of Drawing: August 2011

LAB TEST RESULTS	MOIST CONT. %	DRY DEN. PCF	BLOWS PER FT. *See Legend	SAMPLE	DEPTH	CLASSIFICATION
					0	Brown SILT (ML) with roots to 2", hard, dry
LL= 37, PI= 14			26 (20)	1		
					2.5	Gray/Brown Sandy SILT (ML) with remnant rock structure, hard, moist
Direct Shear: C= 1,000psf Ø= 39°	23	72	74/5" (50/5")	2		
Swell= 0.8% S.I.= 0.03 LL= 37, PI= 14	23	63	59 (40)	3	5	
	23	72	71 (48)	4		
						(SAPROLITE)
			R REC=88% RQD=75%	5 NX Core	10	Gray Slightly Weathered BASALT (WS), hard, occasional broken to massive
			REC=73% RQD=71%	NX Core	15	
			REC=100% RQD=98%	NX Core	20	
					21	**BOH @ 21.0'**
					25	
					30	
					35	

Figure 4

F.G.E. Ltd.

Boring: 14
Project: Piilani Promenade South Shopping Center
Location: Kihei, Maui, Hawaii
Surface Elevation: 63'±
Depth to Water: None Encountered (5/21/11, 2:35pm)
Date Completed: 5-18-11

File: 3051.01
Project Engineer: AS
Field Engineer: TRN
Drafted by: KSL
Date of Drawing: August 2011

LAB TEST RESULTS	MOIST CONT. %	DRY DEN. PCF	BLOWS PER FT. *See Legend	SAMPLE	DEPTH	CLASSIFICATION
	24	62	29 (22)	1		Brown SILT (ML) with roots to 4" and trace Weathered Rock Fragments, hard, dry to damp
			24 (19)	2		Brown/Gray SILT (ML) with remnant rock structure and occasional seams of Highly Weathered Basalt, hard, damp **(SAPROLITE)**
					5	
			R REC=95% RQD=75%	3 NX Core		Gray Slightly Weathered BASALT (WS), hard, occasionally broken At 6.3' to 7.0', layer of Moderately to Highly Weathered Basalt, broken
U.C.= 4,440psi		145				
			REC=88% RQD=74%	NX Core	10	At 10.0', grades to occasionally broken to massive
			REC=74% RQD=64%	NX Core	15	
			R	4		Brown/Gray Silty COBBLE- and GRAVEL-sized Volcanic Rock Fragments (GM), dense, moist **(WEATHERED Aa CLINKER)**
						BOH @ 17.0'
					20	
					25	
					30	
					35	

Figure 5

F.G.E. Ltd.

Boring: 15
Project: Piilani Promenade South Shopping Center
Location: Kihei, Maui, Hawaii
Surface Elevation: 61'±
Depth to Water: None Encountered (5/21/11, 9:05am)
Date Completed: 5-13-11

File: 3051.01
Project Engineer: AS
Field Engineer: TRN
Drafted by: KSL
Date of Drawing: August 2011

LAB TEST RESULTS	MOIST CONT. %	DRY DEN. PCF	BLOWS PER FT. (*See Legend)	SAMPLE	DEPTH	CLASSIFICATION
					0	Brown SILT (ML) with roots to 4", dry to damp
LL= 49, PI= 4	30	48	25 (19)	1		Gray/Brown SILT (ML) with remnant rock structure and occasional Highly Weathered Basalt sections, hard, damp
	20	79	50/3" (34/3")	2		
					5	**(SAPROLITE)**
	25	100	50/2" (34/2")	3		Gray Highly Weathered BASALT (WH-WM), soft to medium hard, very broken
			REC=53% RQD=50%	NX Core		
					10	Gray Slightly Weathered BASALT (WS), medium hard, massive
			REC=100% RQD=99%	NX Core		
U.C.= 2,710psi		126				
			42/6" R	4		Red/Gray GRAVEL-sized Volcanic Rock Fragments (GP), dense **(Aa CLINKER)**
			REC=90% RQD=88%	NX Core	15	
						VOID
						Gray Fresh BASALT (F), hard, massive
			REC=100% RQD=100%	NX Core	20	
						BOH @ 22.5'
					25	
					30	
					35	

F.G.E. Ltd.

Boring: 16
Project: Piilani Promenade South Shopping Center
Location: Kihei, Maui, Hawaii
Surface Elevation: 56'±
Depth to Water: None Encountered (5/21/11, 8:40am)
Date Completed: 5-16-11

File: 3051.01
Project Engineer: AS
Field Engineer: TRN
Drafted by: KSL
Date of Drawing: August 2011

LAB TEST RESULTS	MOIST CONT. %	DRY DEN. PCF	BLOWS PER FT. *See Legend	SAMPLE	DEPTH	CLASSIFICATION
Direct Shear: C= 600psf Ø= 45° Swell= 1.3% S.I.= 0.06	31	69	45 (31)	1		Light Brown SILT (ML) with roots to 4" and trace Weathered Rock Fragments, hard, dry to damp
LL= 43, PI= 3 Direct Shear: C= 800psf Ø= 45° Swell= 0.2% S.I.= 0.01	20	76	60 (41)	2	5	Gray SILT (ML) with remnant rock structure, hard, damp
	12		60/9" (41/9")	3		**(SAPORLITE)**
						Gray Highly Weathered BASALT (WH), soft, broken
			50/2" REC=100% RQD=88%	4 NX Core	10	Gray Slightly Weathered BASALT (WS), hard, occasionally broken to massive At 11.0', grades massive
U.C.= 10,970psi		167				
			REC=100% RQD=100%	NX Core	15	
			REC=100% RQD=100%	NX Core	20	At 19.0', grades occasionally broken to broken
					25	**BOH @ 24.0'**
					30	
					35	

F.G.E. Ltd.

Boring: 17
Project: Piilani Promenade South Shopping Center
Location: Kihei, Maui, Hawaii
Surface Elevation: 68'±
Depth to Water: None Encountered (5/29/11, 7:20am)
Date Completed: 5-26-11

File: 3051.01
Project Engineer: AS
Field Engineer: TRN
Drafted by: KSL
Date of Drawing: August 2011

LAB TEST RESULTS	MOIST CONT. %	DRY DEN. PCF	BLOWS PER FT. *See Legend	SAMPLE	DEPTH	CLASSIFICATION
			REC=100% RQD=0%	NX Core	0	Brown SILT (ML) with roots to 4", hard, damp
			REC=69% RQD=51%	NX Core		Gray Moderately Weathered BASALT (WM) with Silt in fractures, medium hard, broken to very broken
					5	Gray Slightly Weathered BASALT (WS), hard, massive
			R REC=0% RQD=0% 20/3"	1 HQ Core 2		Gray Moderately to Highly Weathered BASALT (WM-WH) with seams of Silty Gravel- and Cobble-sized Basalt Fragments, medium hard, broken
			REC=100% RQD=73%	HQ Core	10	Gray Slightly Weathered BASALT (WS), hard, broken to massive
			REC=78% RQD=73%	HQ Core		
					15	
			REC=100% RQD=98%	HQ Core		At 17.0', grades Vesicular
					20	**BOH @ 20.0'**
					25	
					30	
					35	

Figure 8

F.G.E. Ltd.

Boring: 18
Project: Piilani Promenade South Shopping Center
Location: Kihei, Maui, Hawaii
Surface Elevation: 98'±
Depth to Water: None Encountered (5/21/11, 6:00am)
Date Completed: 5-19-11

File: 3051.01
Project Engineer: AS
Field Engineer: TRN
Drafted by: KSL
Date of Drawing: August 2011

LAB TEST RESULTS	MOIST CONT. %	DRY DEN. PCF	BLOWS PER FT. *See Legend	SAMPLE	DEPTH	CLASSIFICATION
LL= 60, PI= 18 Direct Shear: C= 930psf Ø= 28° Swell= 1.0% S.I.= 0.04	30	72	30 (28)	1		Light Gray and Brown Clayey SILT (MH) with roots to 3" and remnant rock structure, hard damp **(SAPROLITE)**
			52 (35)	2		Light Gray Sandy SILT (ML) with some remnant rock structure, hard, damp
					5	
	26	64	44 (30)	3		
	26	64	R	4		**(SAPROLITE)**
			REC=83% RQD=72%	NX Core	10	Gray Slightly Weathered Vesicular BASALT (WS) with occasional seams of Gravel-sized Rock Fragments (Aa Clinker), medium hard, massive
						VOID
			R REC=69% RQD=56%	5 NX Core		Gray Slightly Weathered Vesicular BASALT (WS), hard, massive
					15	
			R	6		Red/Gray GRAVEL-sized Basalt Fragments (GP), very dense
						BOH @ 16.5'
					20	
					25	
					30	
					35	

F.G.E. Ltd.

Boring: 19
Project: Piilani Promenade South Shopping Center
Location: Kihei, Maui, Hawaii
Surface Elevation: 94'±
Depth to Water: None Encountered (5/21/11, 5:50am)
Date Completed: 5-20-11

File: 3051.01
Project Engineer: AS
Field Engineer: TRN
Drafted by: KSL
Date of Drawing: August 2011

LAB TEST RESULTS	MOIST CONT. %	DRY DEN. PCF	BLOWS PER FT. *See Legend	SAMPLE	DEPTH	CLASSIFICATION
Direct Shear: C= 680 psf Ø= 23° Swell= 0.6% S.I.= 0.02 LL= 53, PI= 16	22	68	51 (35)	1		Light Gray/Brown Clayey SILT (MH) with remnant rock structure, roots to 4" and Weathered Rock Fragments, hard, damp **(SAPROLITE)**
	16	77	R	2		Gray Highly Weathered BASALT (WH), soft, very broken
			REC=100% RQD=65%	NX Core	5	Gray Slightly to Moderately Weathered BASALT (WS-WM), medium hard, occassionally broken
			REC=46% RQD=0%	NX Core	10	Brown Silty GRAVEL-sized Volcanic Rock Fragments (GM), dense, damp **(WEATHERED Aa CLINKER)**
			REC=78% RQD=78%	NX Core	15	Gray Slightly Weathered Vesicular BASALT (WS), hard, occasionally broken to massive
						BOH @ 15.0'
					20	
					25	
					30	
					35	

F.G.E. Ltd.

Boring: 20
Project: Piilani Promenade South Shopping Center
Location: Kihei, Maui, Hawaii
Surface Elevation: 79'±
Depth to Water: None Encountered (5/21/11, 8:15am)
Date Completed: 5-16-11

File: 3051.01
Project Engineer: AS
Field Engineer: TRN
Drafted by: KSL
Date of Drawing: August 2011

LAB TEST RESULTS	MOIST CONT. %	DRY DEN. PCF	BLOWS PER FT. *See Legend	SAMPLE	DEPTH	CLASSIFICATION
	17	75	78/10" (52/10")	1	0	Brown SILT (ML) with roots to 3", hard, damp **(RESIDUAL)**
			R	2		Gray and Brown Highly Weathered BASALT (WH), soft, very broken
			REC=93% RQD=93%	NX Core	5	Gray Slightly Weathered BASALT (WS), hard, massive
			REC=53% RQD=42%	NX Core	10	
			7	3	15	Gray and Brown GRAVEL-sized Basalt Fragments (GP), loose to medium dense, damp
			REC=25% RQD=0%	NX Core		
			27 (21)	4	20	**(Aa CLINKER)**
			REC=64% RQD=55%	NX Core		Gray Slightly Weathered Vesicular BASALT (WS), hard, occasional broken to massive
			REC=100% RQD=100%	NX Core	25	
					30	**BOH @ 30.0'**
					35	

F.G.E. Ltd.

Boring: 21
Project: Piilani Promenade South Shopping Center
Location: Kihei, Maui, Hawaii
Surface Elevation: 92'±
Depth to Water: None Encountered (5/21/11, 7:39am)
Date Completed: 5-17-11

File: 3051.01
Project Engineer: AS
Field Engineer: TRN
Drafted by: KSL
Date of Drawing: August 2011

LAB TEST RESULTS	MOIST CONT. %	DRY DEN. PCF	BLOWS PER FT. *See Legend	SAMPLE	DEPTH	CLASSIFICATION
	18	70	43 (30)	1		Brown SILT (ML) with roots to 4", hard, damp **(RESIDUAL)**
	18	84	R	2		Gray/Brown Highly Weathered BASALT (WH) with occasional Moderately Weathered seams, soft, very broken
					5	
			R REC=33% RQD=22%	3 NX Core		Gray Slightly Weathered BASALT (WS), hard, occasionally broken
			R R REC=0% RQD=0%	4 5 NX Core		Gray/Brown Silty COBBLE- and GRAVEL-sized Volcanic Rock Fragments (GM), very dense, damp **(WEATHERED Aa CLINKER)**
					10	
			REC=88% RQD=79% REC=100% RQD=92%	NX Core NX Core		Gray Slight Weathered BASALT (WS), hard, occasional broken At 11.5' grades massive
					15	
			REC=100% RQD=100% REC=99% RQD=78%	NX Core NX Core		
						At 18.0', grades Vesicular
					20	**BOH @ 19.5'**
					25	
					30	
					35	

Boring: 22
Project: Piilani Promenade South Shopping Center
Location: Kihei, Maui, Hawaii
Surface Elevation: 108'±
Depth to Water: None Encountered (5/21/11, 7:10am)
Date Completed: 5-19-11

File: 3051.01
Project Engineer: AS
Field Engineer: TRN
Drafted by: KSL
Date of Drawing: August 2011

F.G.E. Ltd.

LAB TEST RESULTS	MOIST CONT. %	DRY DEN. PCF	BLOWS PER FT. *See Legend	SAMPLE	DEPTH	CLASSIFICATION
	23	71	40/4" (28/4")	1		Brown SILT (ML) with roots to 3", hard, damp **(RESIDUAL)**
	13		45/4" (31/4")	2	5	Gray/Brown Silty SAND (SM) with remnant rock structure and occasional Highly Weathered Basalt seams, very dense, damp **(SAPROLITE)**
			R REC=82% RQD=76%	3 NX Core		Gray Slightly Weathered BASALT (WS), hard, occasionally broken to massive
			REC=96% RQD=88%	NX Core	10	At 8.5', seam of Aa Clinker At 9.0' grades to massive
U.C.= 7,820psi		166				
					15	VOID
			R REC=81% RQD=22%	4 NX Core		Brown/Gray Moderately Weathered Vesicular BASALT (WM), with occasional seams of Fresh Basalt, hard, broken
			7	5		
			REC=37% RQD=23%	NX Core	20	Gray Slightly to Moderately Weathered Vesicular BASALT (WS-WM) with occasional layers of dense Aa Clinker, hard, broken to occasionally broken
			R REC=37% RQD=23%	6 NX Core		
			45	7	25	
U.C.= 2,110psi		134	REC=100% RQD=54%	NX Core		
			REC=100% RQD=47%	NX Core		
			REC=100% RQD=46%	NX Core	30	
						BOH @ 30.5'
					35	

F.G.E. Ltd.

Boring: 23
Project: Piilani Promenade South Shopping Center
Location: Kihei, Maui, Hawaii
Surface Elevation: 110'±
Depth to Water: None Encountered (5/21/11, 6:20am)
Date Completed: 5-20-11

File: 3051.01
Project Engineer: AS
Field Engineer: TRN
Drafted by: KSL
Date of Drawing: August 2011

LAB TEST RESULTS	MOIST CONT. %	DRY DEN. PCF	BLOWS PER FT. *See Legend	SAMPLE	DEPTH	CLASSIFICATION
				1		Brown SILT (ML) with roots to 3", hard, dry
			70/4" (47/4")	2		Gray Sandy SILT (ML) with remnant rock structure and occassional Gravel-sized Volcanic Rock Fragments, hard, damp **(SAPROLITE)**
			REC=40% RQD=25%	NX Core	5	Gray Slightly Weathered BASALT (WS), hard, massive to occassionally broken
	22					
Gradation: Gravel= 25% Sand= 63% Silt/Clay= 12%			20	3		Brown Silty SAND and GRAVEL-sized Volcanic Rock Fragments (SM-GM), medium dense
			21	4	10	**(Aa CLINKER)**
U.C.= 9,320psi		176	REC=100% RQD=95%	NX Core		Gray Slightly Weathered Vesicular BASALT (WS), hard, massive
U.C.= 3,730psi		145			15	
			REC=100% RQD=100%	NX Core	20	
			REC=95% RQD=73%	NX Core		Brown/Gray Slightly Weathered BASALT (WS), hard, very broken to broken
					25	Gray Fresh BASALT (F), hard, massive
						BOH @ 25.5'
					30	
					35	

F.G.E. Ltd.

Boring: 24
Project: Piilani Promenade South Shopping Center
Location: Kihei, Maui, Hawaii
Surface Elevation: 112'±
Depth to Water: None Encountered (5/21/11, 6:47am)
Date Completed: 5-20-11

File: 3051.01
Project Engineer: AS
Field Engineer: TRN
Drafted by: KSL
Date of Drawing: August 2011

LAB TEST RESULTS	MOIST CONT. %	DRY DEN. PCF	BLOWS PER FT. *See Legend	SAMPLE	DEPTH	CLASSIFICATION
LL= 48, PI= 11	18	66	28 (21)	1		Reddish Brown SILT (ML) with roots to 3" and some Sand, hard, damp **(RESIDUAL)**
			R REC=100% RQD=99%	2 NX Core	5	Gray Slightly Weathered BASALT (WS), hard, massive
U.C.= 4,370psi		146				
			REC=97% RQD=97%	NX Core	10	
			REC=100% RQD=98%	NX Core	15	
			REC=100% RQD=98%	NX Core	20	
			REC=100% RQD=100%	NX Core		At 21.0', 4" layer of Aa Clinker
U.C.= 3,170psi		138			25	
						BOH @ 25.0'
					30	
					35	

F.G.E. Ltd.

Boring: 25
Project: Piilani Promenade South Shopping Center
Location: Kihei, Maui, Hawaii
Surface Elevation: 107'±
Depth to Water: None Encountered (5/29/11 8:35am)
Date Completed: 5-23-11

File: 3051.01
Project Engineer: AS
Field Engineer: TRN
Drafted by: KSL
Date of Drawing: August 2011

LAB TEST RESULTS	MOIST CONT. %	DRY DEN. PCF	BLOWS PER FT. *See Legend	SAMPLE	DEPTH	CLASSIFICATION
LL= 42, PI= 15	25	83	59 (40)	1		Brown SILT (ML) with roots to 4", hard, damp (RESIDUAL)
	28	84	R	2		
			REC=92% RQD=56%	NX Core	5	Gray Slightly Weathered BASALT (WS) with occasional seams of Silty Sand- and Gravel-sized Rock Fragments, trace roots, hard, broken to occasionally broken
			REC=100% RQD=94%	NX Core	10	Gray Fresh BASALT (F), hard, massive
			REC=27% RQD=0%	NX Core	15	Reddish Gray GRAVEL-sized Volcanic Rock Fragments (GP), dense **(Aa CLINKER)**
			R REC=20% RQD=0%	3 NX Core		Brown Silty SAND- and GRAVEL-sized Volcanic Rock Fragments (SM-GM), dense **(WEATHERED Aa CLINKER)**
			R REC=100% RQD=94%	4 NX Core	20	Gray Slightly Weathered BASALT (WS), hard, massive At 18.5', grades Fresh
			REC=100% RQD=98%	NX Core		
					25	**BOH @ 25.0'**
					30	
					35	

F.G.E. Ltd.
96-1416 Waihona Place
Pearl City, Hawaii

Test Pit: TP10
Project: Piilani Promenade South Shopping Center
Location: Kihei, Maui, Hawaii
Surface Elevation: 94±'
Depth to Water: None Encountered (5/5/11)
Date Completed: 5-5-11

File: 3051.01
Project Engineer: AS
Field Engineer: TRN
Drafted by: KSL
Date of Drawing: August 2011

LAB TEST RESULTS	MOIST CONT. %	DRY DENS. PCF	BLOWS PER FT.	SAMPLE	DEPTH	CLASSIFICATION
				1		Highly Weathered BASALT (WH) with some Silt pockets, soft, broken
						Gray Highly Weathered to Moderately Weathered BASALT (WH-WM), soft to medium hard, broken to occasionally broken
					5	Gray Moderately Weathered BASALT (WM), occasionally broken, hard
						BOH @ 5.0'
					10	
					15	
					20	
					25	
					30	
					35	

F.G.E. Ltd.
96-1416 Waihona Place
Pearl City, Hawaii

Test Pit:	TP11	**File:**	3051.01
Project:	Piilani Promenade South Shopping Center		
Location:	Kihei, Maui, Hawaii	**Project Engineer:**	AS
Surface Elevation:	87±'	**Field Engineer:**	TRN
Depth to Water:	None Encountered (5/5/11)	**Drafted by:**	KSL
Date Completed:	5-5-11	**Date of Drawing:**	August 2011

LAB TEST RESULTS	MOIST CONT. %	DRY DENS. PCF	BLOWS PER FT.	SAMPLE	DEPTH	CLASSIFICATION
CBR= 12.8 LL= 45, PI= 14 Swell= 0.7%	27	93		1		Reddish Brown SILT (ML), very stiff, damp **(RESIDUAL)**
				2		Reddish Brown Highly Weathered BASALT (WH), soft, broken
				3	5	
						Moderately Weathered BASALT (WM), medium hard, broken to occasionally broken
						BOH @ 7.0'
					10	
					15	
					20	
					25	
					30	
					35	

F.G.E. Ltd.
96-1416 Waihona Place
Pearl City, Hawaii

Test Pit: TP12
Project: Piilani Promenade South Shopping Center
Location: Kihei, Maui, Hawaii
Surface Elevation: 81±'
Depth to Water: None Encountered (5/5/11)
Date Completed: 5-5-11

File: 3051.01
Project Engineer: AS
Field Engineer: TRN
Drafted by: KSL
Date of Drawing: August 2011

LAB TEST RESULTS	MOIST CONT. %	DRY DENS. PCF	BLOWS PER FT.	SAMPLE	DEPTH	CLASSIFICATION
				1	0–2.5	Brown SILT (ML) with Gravel and Cobbles and roots to 4", hard, dry to damp **(RESIDUAL)**
					3–4	Brown/Gray Moderately Weathered BASALT (WM), medium hard, occasionally broken
						BOH @ 4.0'

Depth scale: 5, 10, 15, 20, 25, 30, 35

Figure 19

F.G.E. Ltd.
96-1416 Waihona Place
Pearl City, Hawaii

Test Pit:	TP13	**File:**	3051.01
Project:	Piilani Promenade South Shopping Center		
Location:	Kihei, Maui, Hawaii	**Project Engineer:**	AS
Surface Elevation:	83±'	**Field Engineer:**	TRN
Depth to Water:	None Encountered (5/5/11)	**Drafted by:**	KSL
Date Completed:	5-5-11	**Date of Drawing:**	August 2011

LAB TEST RESULTS	MOIST CONT. %	DRY DENS. PCF	BLOWS PER FT.	SAMPLE	DEPTH	CLASSIFICATION
	15			1	0–2.5	Gray/Tan Highly Weathered BASALT (WH), soft to medium hard, broken
					2.5–4.5	Gray Moderately Weathered Highly Vesicular BASALT (WM), hard, occasionally broken
						BOH @ 4.5'

Depth scale: 5, 10, 15, 20, 25, 30, 35

Figure 20

F.G.E. Ltd.
96-1416 Waihona Place
Pearl City, Hawaii

Test Pit:	TP14	**File:**	3051.01
Project:	Piilani Promenade South Shopping Center		
Location:	Kihei, Maui, Hawaii	**Project Engineer:**	AS
Surface Elevation:	77±'	**Field Engineer:**	TRN
Depth to Water:	None Encountered (5/5/11)	**Drafted by:**	KSL
Date Completed:	5-5-11	**Date of Drawing:**	August 2011

LAB TEST RESULTS	MOIST CONT. %	DRY DENS. PCF	BLOWS PER FT.	SAMPLE	DEPTH	CLASSIFICATION
				1		Brown SILT (ML) with roots to 4", stiff, damp
						Brown Highly Weathered BASALT (WH), soft, broken
					5	Gray Highly to Moderately Weathered Highly Vesicular BASALT (WH-WM), soft to medium hard, broken to occasionally broken
						BOH @ 3.5'
					10	
					15	
					20	
					25	
					30	
					35	

F.G.E. Ltd.
96-1416 Waihona Place
Pearl City, Hawaii

Test Pit: TP15
Project: Piilani Promenade South Shopping Center
Location: Kihei, Maui, Hawaii
Surface Elevation: 74±'
Depth to Water: None Encountered (5/4/11)
Date Completed: 5-4-11

File: 3051.01
Project Engineer: AS
Field Engineer: TRN
Drafted by: KSL
Date of Drawing: August 2011

LAB TEST RESULTS	MOIST CONT. %	DRY DENS. PCF	BLOWS PER FT.	SAMPLE	DEPTH	CLASSIFICATION
				1	0	Reddish Brown SILT (ML) with roots to 4", loose, dry
						Gray Moderately Weathered BASALT (WM) with some Highly Weathered pockets, medium hard, occasionally broken
				2	5	Reddish Brown Highly Weathered BASALT (WH), soft, broken
						BOH on Basalt @ 7.0'
					10	
					15	
					20	
					25	
					30	
					35	

F.G.E. Ltd.
96-1416 Waihona Place
Pearl City, Hawaii

Test Pit: TP16
Project: Piilani Promenade South Shopping Center
Location: Kihei, Maui, Hawaii
Surface Elevation: 67±'
Depth to Water: None Encountered (5/5/11)
Date Completed: 5-5-11

File: 3051.01
Project Engineer: AS
Field Engineer: TRN
Drafted by: KSL
Date of Drawing: August 2011

LAB TEST RESULTS	MOIST CONT. %	DRY DENS. PCF	BLOWS PER FT.	SAMPLE	DEPTH	CLASSIFICATION
					0	Brown SILT (ML) with roots, to 4", loose, dry
				1		Highly Weathered BASALT (WH), soft, broken to occasionally broken
					5	
				2		
						Gray Moderately Weathered BASALT (WM), hard, occasionally broken to massive
						BOH @ 8.5'
					10	
					15	
					20	
					25	
					30	
					35	

Figure 23

F.G.E. Ltd.
96-1416 Waihona Place
Pearl City, Hawaii

Test Pit:	TP17	**File:**	3051.01
Project:	Piilani Promenade South Shopping Center		
Location:	Kihei, Maui, Hawaii	**Project Engineer:**	AS
Surface Elevation:	50±'	**Field Engineer:**	TRN
Depth to Water:	None Encountered (5/4/11)	**Drafted by:**	KSL
Date Completed:	5-4-11	**Date of Drawing:**	August 2011

LAB TEST RESULTS	MOIST CONT. %	DRY DENS. PCF	BLOWS PER FT.	SAMPLE	DEPTH	CLASSIFICATION
					0	Brown SILT (ML) with roots to 5", loose, dry
					0–6.5	Gray Slightly Weathered BASALT (WS), medium hard, occasionally broken with vertical fractures
					6.5	**BOH @ 6.5'**

Depth scale: 5, 10, 15, 20, 25, 30, 35

F.G.E. Ltd.
96-1416 Waihona Place
Pearl City, Hawaii

Test Pit: TP18
Project: Piilani Promenade South Shopping Center
Location: Kihei, Maui, Hawaii
Surface Elevation: 48±'
Depth to Water: None Encountered (5/5/11)
Date Completed: 5-5-11

File: 3051.01
Project Engineer: AS
Field Engineer: TRN
Drafted by: KSL
Date of Drawing: August 2011

LAB TEST RESULTS	MOIST CONT. %	DRY DENS. PCF	BLOWS PER FT.	SAMPLE	DEPTH	CLASSIFICATION
				1		Reddish Brown SILT (ML) with roots to 5", trace Cobbles, very stiff, dry to damp **(RESIDUAL)**
				2		Gray Highly Weathered BASALT (WH), soft, broken
					5	Gray Moderately Weathered BASALT (WM), hard, occasionally broken to massive
						BOH @ 6.5'
					10	
					15	
					20	
					25	
					30	
					35	

F.G.E. Ltd.
96-1416 Waihona Place
Pearl City, Hawaii

Test Pit: TP19
Project: Piilani Promenade South Shopping Center
Location: Kihei, Maui, Hawaii
Surface Elevation: 42±'
Depth to Water: None Encountered (5/4/11)
Date Completed: 5-4-11

File: 3051.01
Project Engineer: AS
Field Engineer: TRN
Drafted by: KSL
Date of Drawing: August 2011

LAB TEST RESULTS	MOIST CONT. %	DRY DENS. PCF	BLOWS PER FT.	SAMPLE	DEPTH	CLASSIFICATION
				1		Brown SILT (ML) with roots to 4", loose, dry
						Dark Brown Highly Weathered BASALT (WH), soft, broken
						BOH on Basalt @ 1.0'

Depth scale (ft): 5, 10, 15, 20, 25, 30, 35

F.G.E. Ltd.
96-1416 Waihona Place
Pearl City, Hawaii

Test Pit: TP20
Project: Piilani Promenade South Shopping Center
Location: Kihei, Maui, Hawaii
Surface Elevation: 38±'
Depth to Water: None Encountered (5/5/11)
Date Completed: 5-5-11

File: 3051.01
Project Engineer: AS
Field Engineer: TRN
Drafted by: KSL
Date of Drawing: August 2011

LAB TEST RESULTS	MOIST CONT. %	DRY DENS. PCF	BLOWS PER FT.	SAMPLE	DEPTH	CLASSIFICATION
CBR= 41.8 Swell= 1.1% LL= 48,PI= 12		93		1 2	0–2	Reddish Brown SILT (ML), trace Weathered Rock Fragments, hard, damp **(RESIDUAL)**
					2–5	Gray Highly Weathered BASALT (WH), soft, broken
					5–7.5	Gray Moderately Weathered BASALT (WM), hard, occasionally broken to massive
						BOH @ 7.5'

Depth scale: 5, 10, 15, 20, 25, 30, 35

MAJOR SOIL TYPES

Symbol	Description	Symbol	Description
ML	Inorganic silts and very fine sands, rock flour, silty or clayey silts with slight plasticity	GW	Well-graded gravels, gravel-sand mixtures, little or no fines
MH	Inorganic silts, micaceous or diatomaceous fine sand or silty soils	GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines
CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	GM	Silty gravels, gravel-sand-silt mixtures
CH	Inorganic clays of high plasticity	GC	Clayey gravels, gravel-sand-clay mixtures
OL	Organic silts and organic silty clays of low plasticity	SW	Well-graded sands, gravelly sand, little or no fines
OH	Organic clays of medium to high plasticity, organic silts	SP	Poorly-graded sands, gravelly sand, little or no fines
PT	Peat, humus, swamp soils with high organic contents	SM	Silty sands, sand-silt mixtures
		SC	Clayey sands, sand-clay mixtures

MAJOR ROCK TYPES

BASALT

TUFF

DECOMPOSED ROCK

CORAL

Sampling Symbols

3" O.D. Relatively Undisturbed Sample

2" O.D. Standard Penetration Sample

3" O.D. Disturbed Sample

Shelby Tube

No Recovery

Core

Water Level

*(x) Equivalent Estimated SPT Blow Count

F.G.E.

BORING LOG LEGEND

Piilani Promenade South Shopping Center
Kihei, Maui, Hawaii

File: 3051.01

August 2011

Figure 28

Boring 13: 10.0'-21.0'

ROCK CORE PHOTOGRAPH

Piilani Promenade South Shopping Center
Kihei, Maui, Hawaii

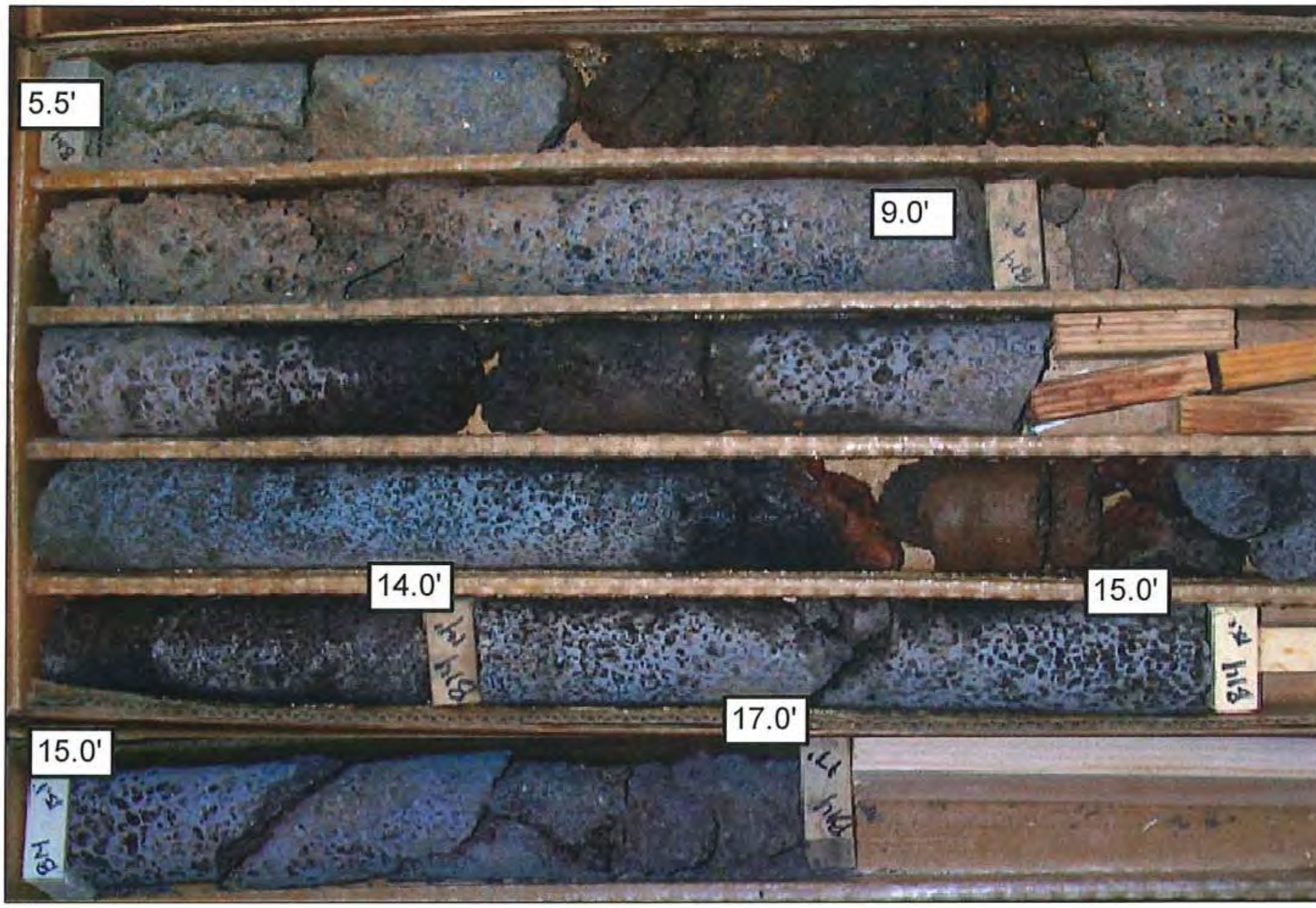
F.G.E.

File: 3051.01

August 2011

Figure 29

Boring 14: 5.5'-17.0'



F.G.E.

ROCK CORE PHOTOGRAPH

Piilani Promenade South Shopping Center
Kihei, Maui, Hawaii

File: 3051.01

August 2011

Figure 30

Boring 15: 7.7'-18.4'

ROCK CORE PHOTOGRAPH

Piilani Promenade South Shopping Center
Kihei, Maui, Hawaii

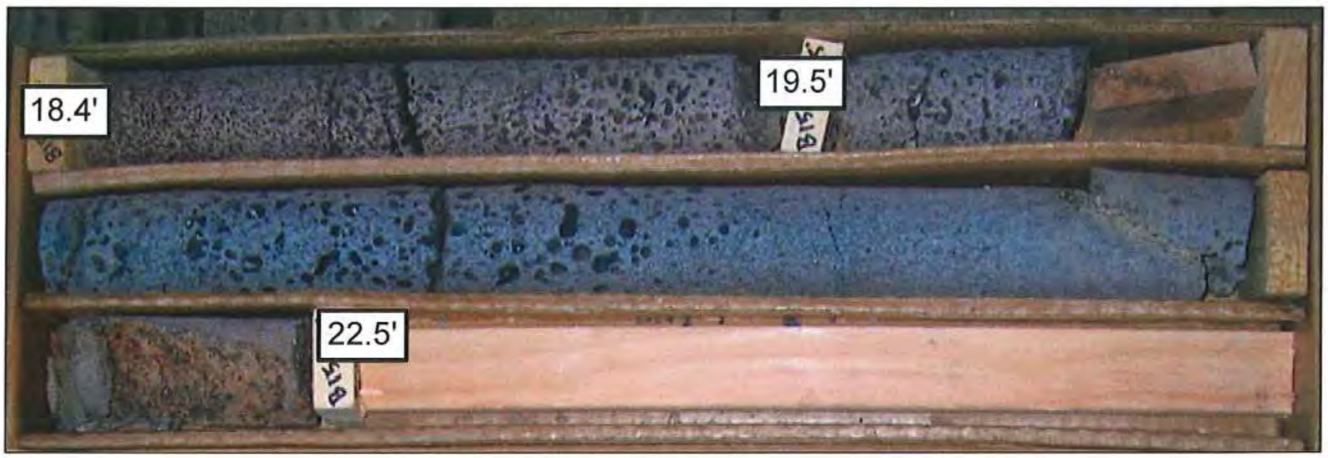
F.G.E.

File: 3051.01

August 2011

Figure 31a

Boring 15: 18.4'-22.5'



F.G.E.

ROCK CORE PHOTOGRAPH

Piilani Promenade South Shopping Center
Kihei, Maui, Hawaii

File: 3051.01

August 2011

Figure 31b

Boring 16: 9.0'-18.0'

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ROCK CORE PHOTOGRAPH

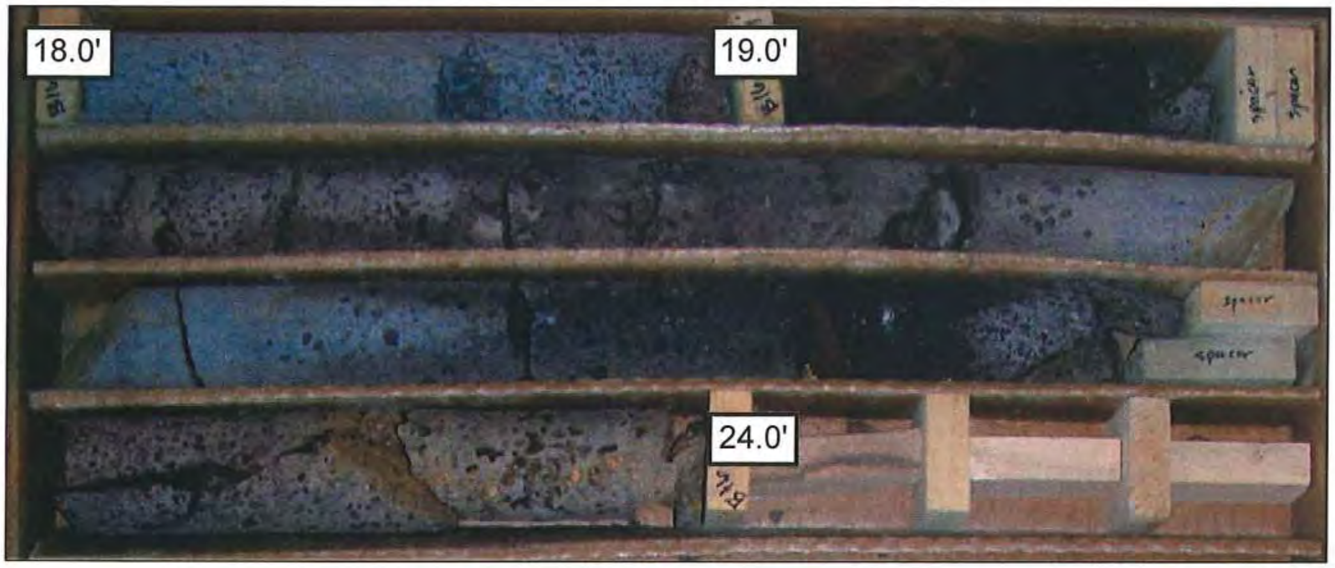
Piilani Promenade South Shopping Center
Kihei, Maui, Hawaii

File: 3051.01

August 2011

Figure 32a

Boring 16: 18.0'-24.0'



ROCK CORE PHOTOGRAPH

Piilani Promenade South Shopping Center
Kihei, Maui, Hawaii

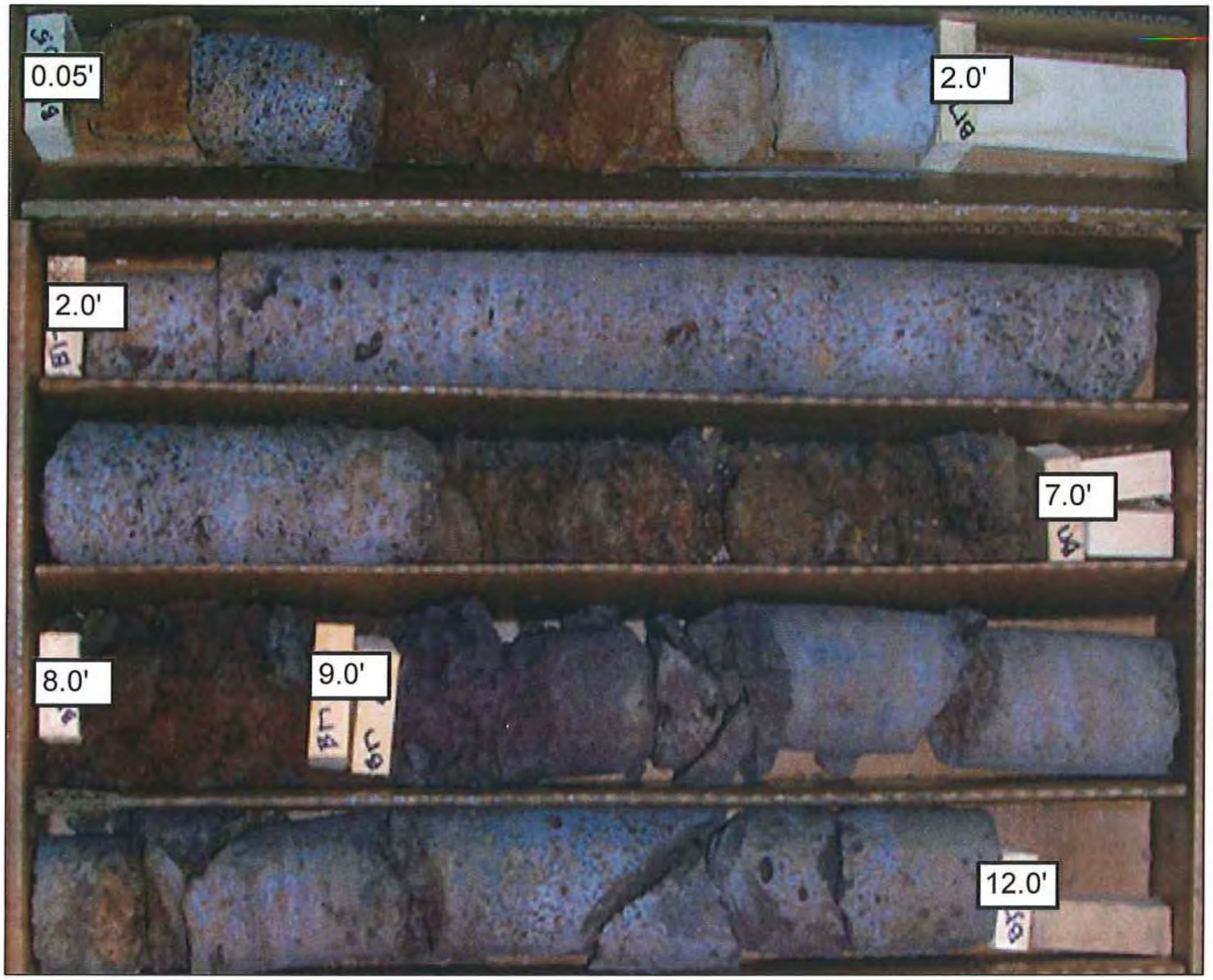
F.G.E.

File: 3051.01

August 2011

Figure 32b

Boring 17: 0.05'-12.0'



ROCK CORE PHOTOGRAPH

Piilani Promenade South Shopping Center
Kihei, Maui, Hawaii

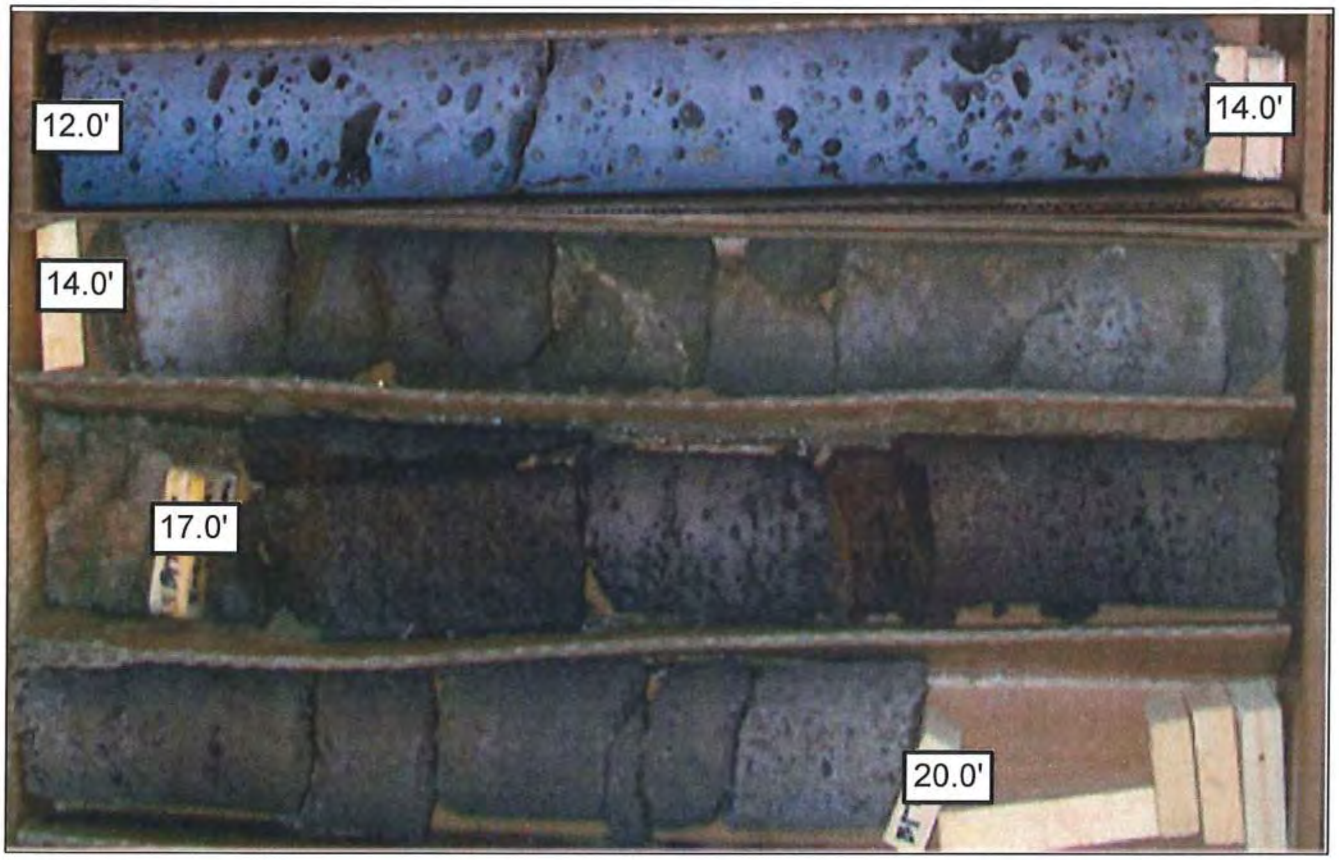
F.G.E.

File: 3051.01

August 2011

Figure 33a

Boring 17: 12.0'-20.0'



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ROCK CORE PHOTOGRAPH

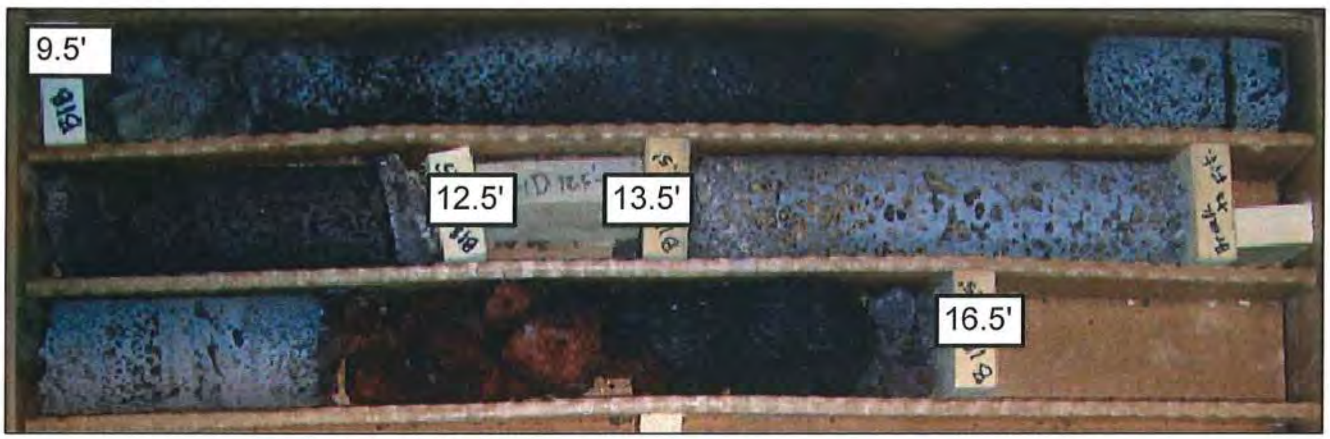
Piilani Promenade South Shopping Center
Kihei, Maui, Hawaii

File: 3051.01

August 2011

Figure 33b

Boring 18: 9.5'-16.5'



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ROCK CORE PHOTOGRAPH

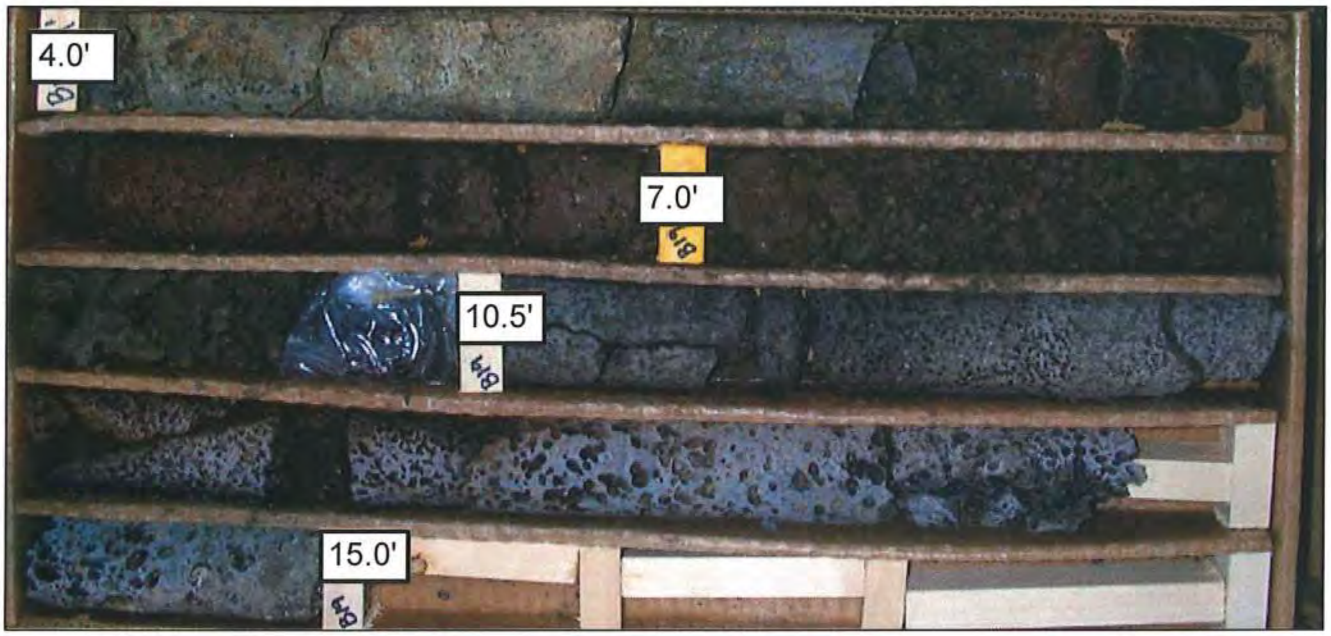
Piilani Promenade South Shopping Center
Kihei, Maui, Hawaii

File: 3051.01

August 2011

Figure 34

Boring 19: 4.0'-15.0'



ROCK CORE PHOTOGRAPH

Piilani Promenade South Shopping Center
Kihei, Maui, Hawaii

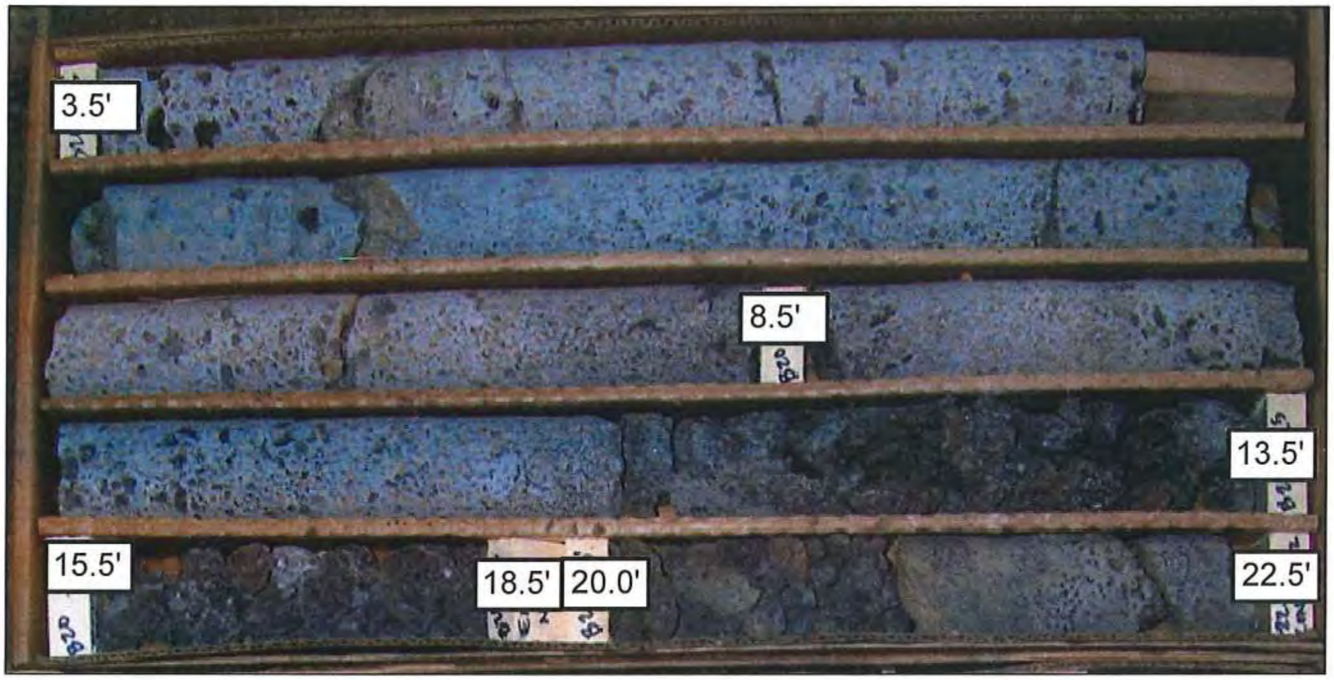
File: 3051.01

August 2011

F.G.E.

Figure 35

Boring 20: 3.5'-22.5'



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ROCK CORE PHOTOGRAPH

Piilani Promenade South Shopping Center
Kihei, Maui, Hawaii

File: 3051.01

August 2011

Figure 36a

Boring 20: 22.5'-30.0'

ROCK CORE PHOTOGRAPH

Piilani Promenade South Shopping Center
Kihei, Maui, Hawaii

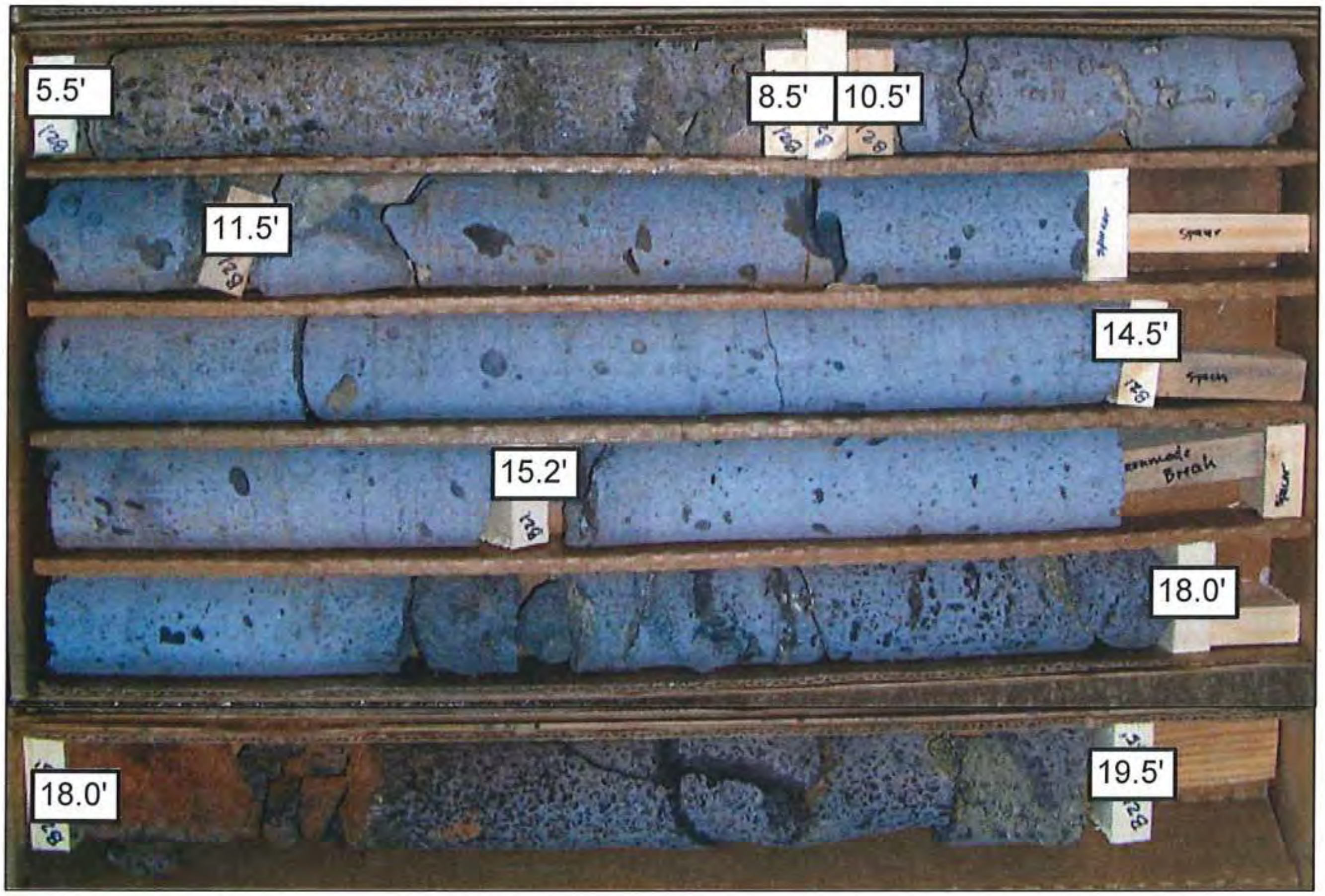
F.G.E.

File: 3051.01

August 2011

Figure 36b

Boring 21: 5.5'-19.5'



ROCK CORE PHOTOGRAPH

Piilani Promenade South Shopping Center
Kihei, Maui, Hawaii

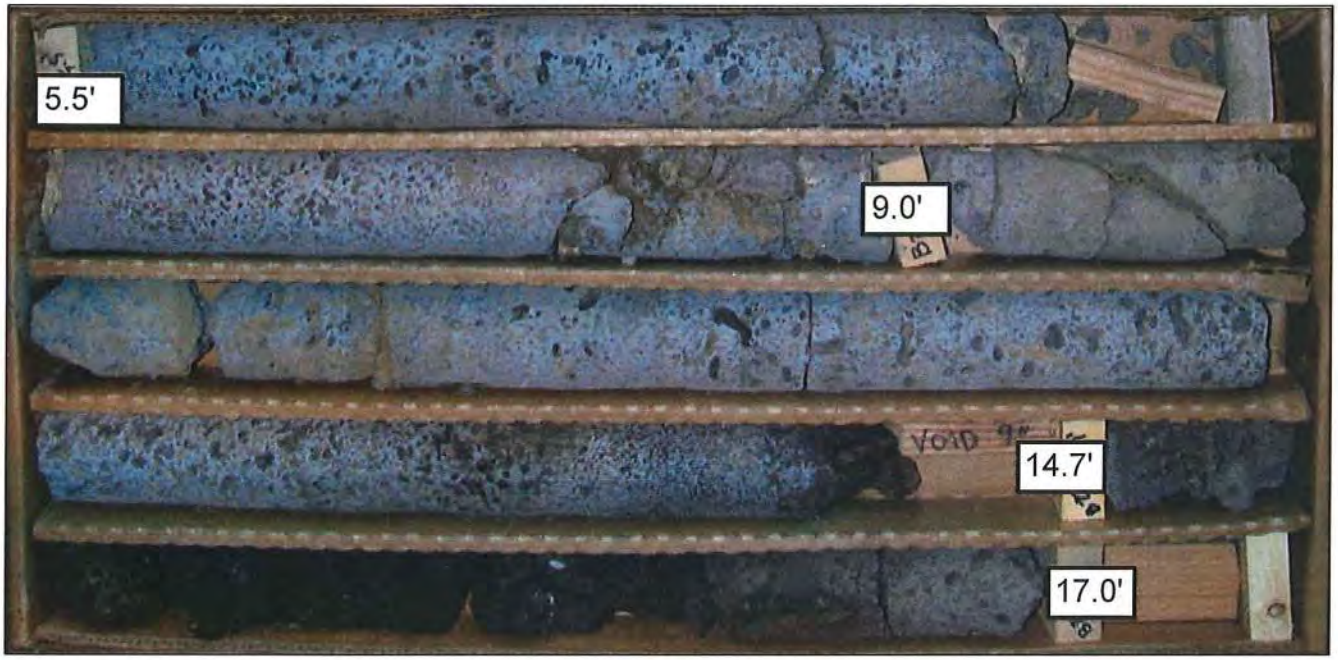
F.G.E.

File: 3051.01

August 2011

Figure 37

Boring 22: 5.5'-17.0'



ROCK CORE PHOTOGRAPH

Piilani Promenade South Shopping Center
Kihei, Maui, Hawaii

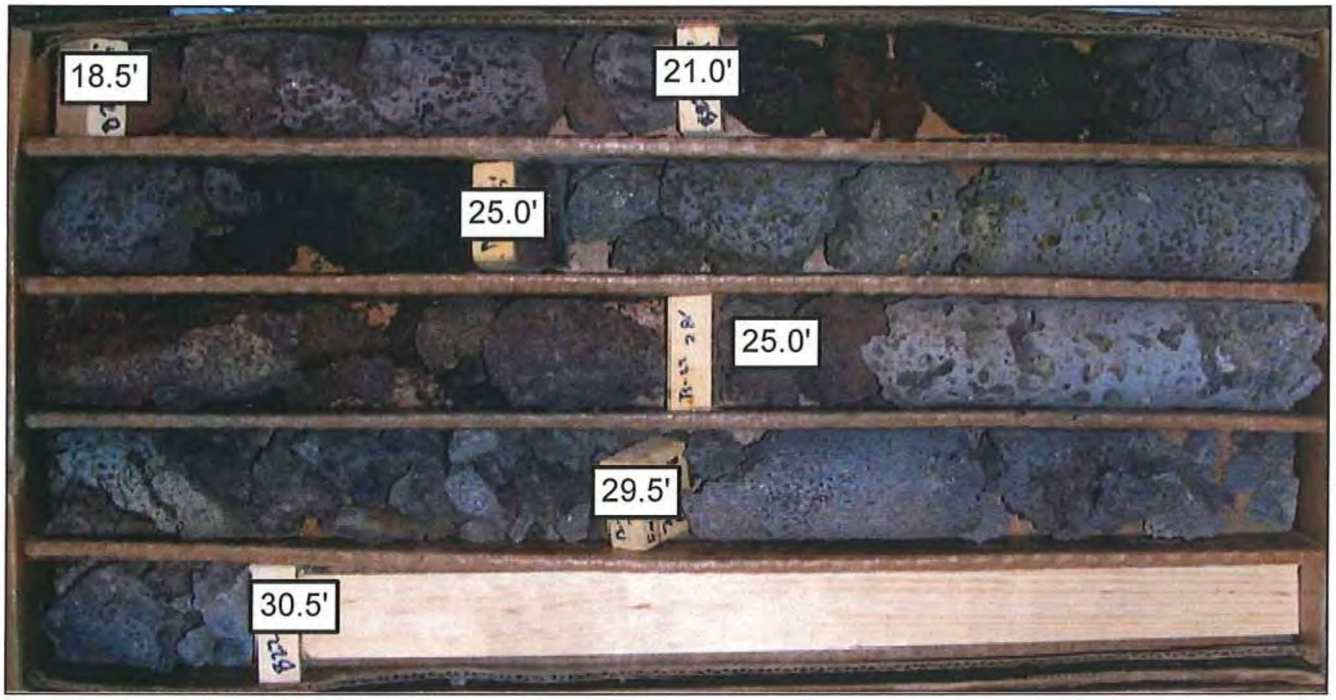
F.G.E.

File: 3051.01

August 2011

Figure 38a

Boring 22: 18.5'-30.5'



F.G.E.

ROCK CORE PHOTOGRAPH

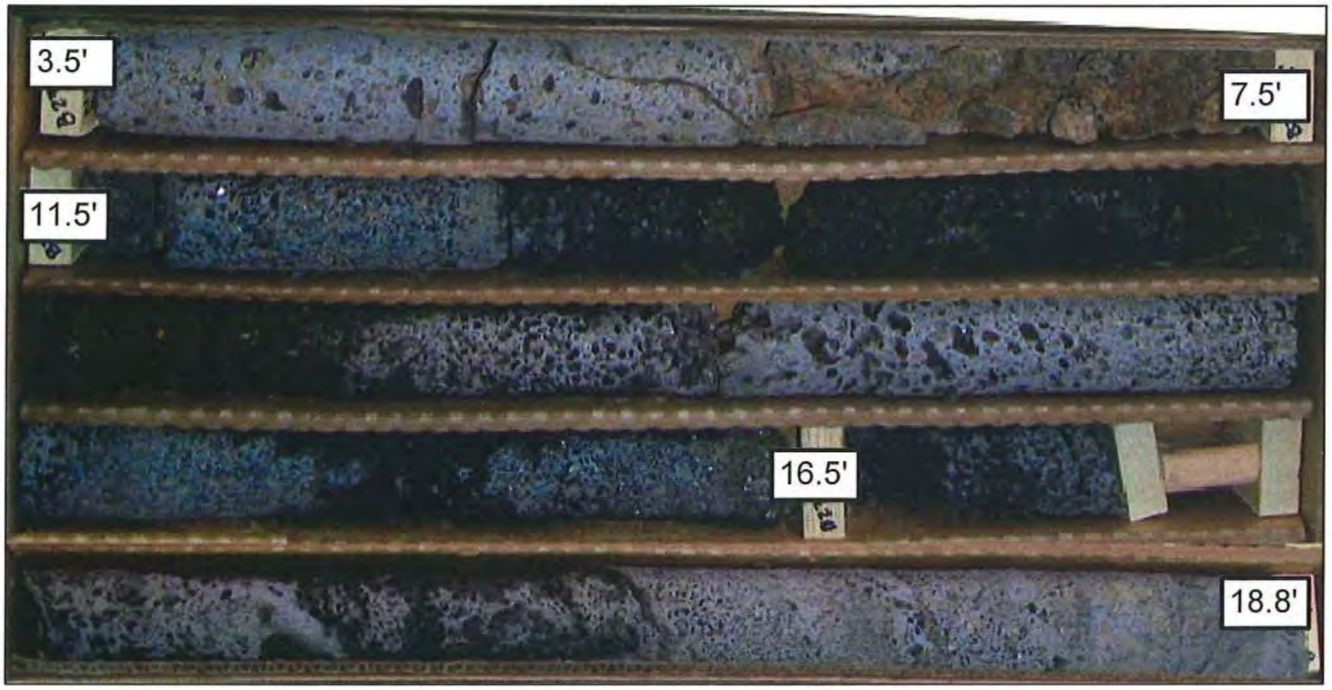
Piilani Promenade South Shopping Center
Kihei, Maui, Hawaii

File: 3051.01

August 2011

Figure 38b

Boring 23: 3.5'-18.8'



F.G.E.

ROCK CORE PHOTOGRAPH

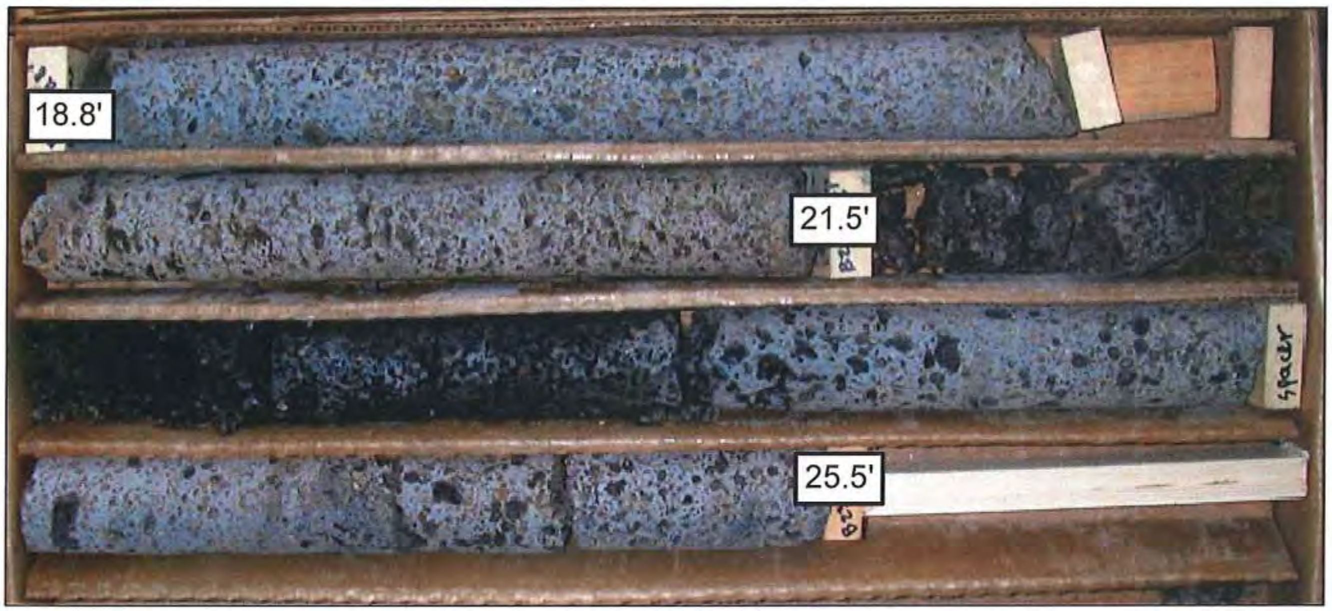
Piilani Promenade South Shopping Center
Kihei, Maui, Hawaii

File: 3051.01

August 2011

Figure 39a

Boring 23: 18.8'-25.5'



ROCK CORE PHOTOGRAPH

Piilani Promenade South Shopping Center
Kihei, Maui, Hawaii

F.G.E.

File: 3051.01

August 2011

Figure 39b

Boring 24: 3.5'-13.0'

ROCK CORE PHOTOGRAPH

Piilani Promenade South Shopping Center
Kihei, Maui, Hawaii

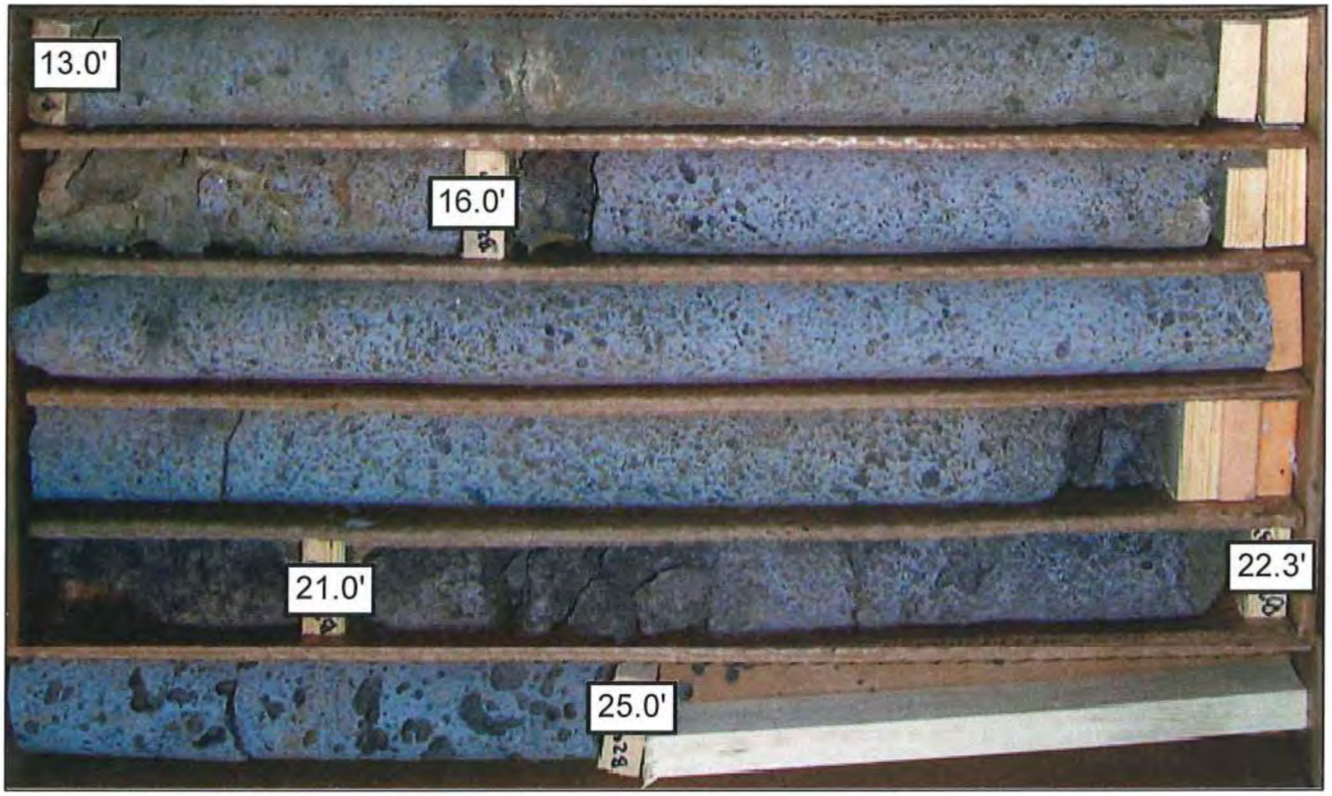
F.G.E.

File: 3051.01

August 2011

Figure 40a

Boring 24: 13.0'-25.0'



ROCK CORE PHOTOGRAPH

Piilani Promenade South Shopping Center
Kihei, Maui, Hawaii

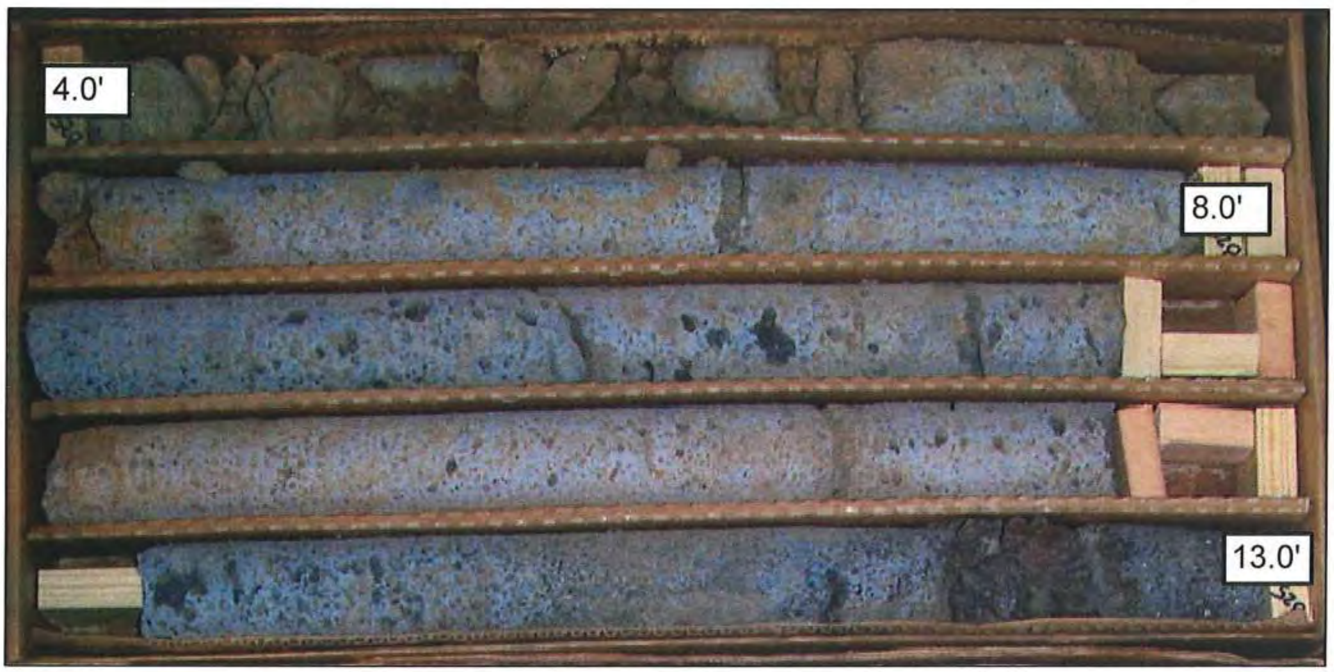
F.G.E.

File: 3051.01

August 2011

Figure 40b

Boring 25: 4.0'-13.0'



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ROCK CORE PHOTOGRAPH

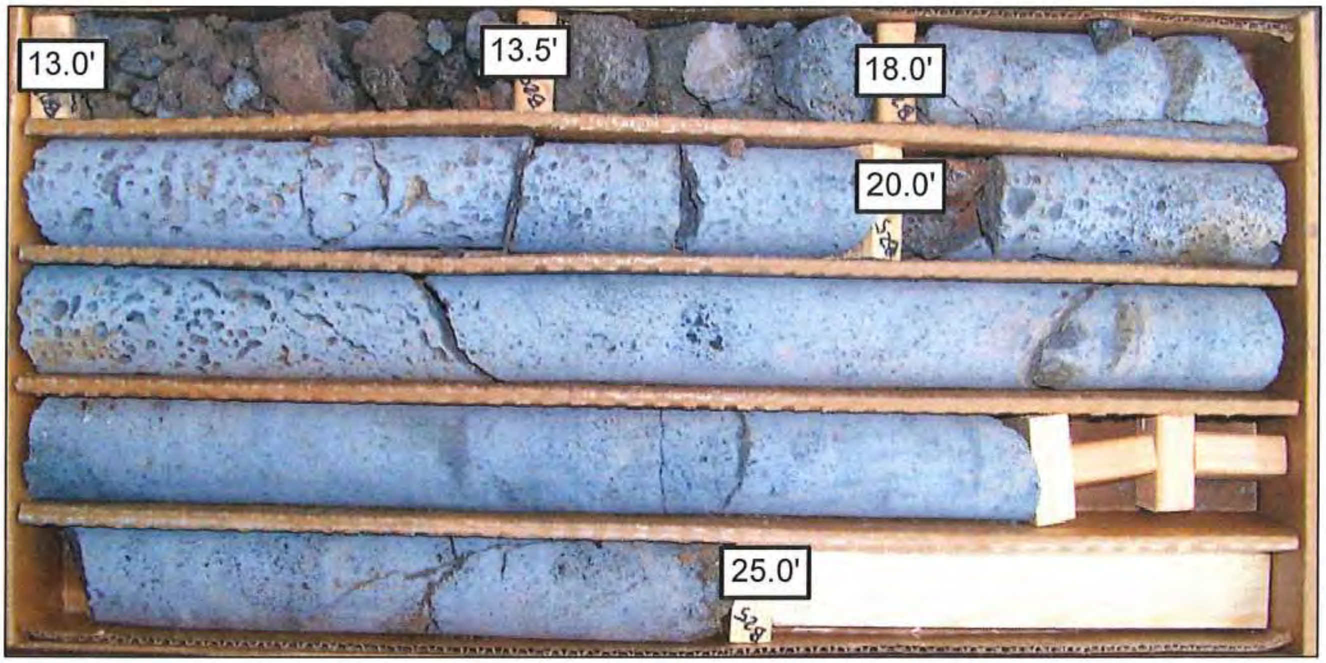
Piilani Promenade South Shopping Center
Kihei, Maui, Hawaii

File: 3051.01

August 2011

Figure 41a

Boring 25: 13.0'-25.0'



F.G.E.

ROCK CORE PHOTOGRAPH

Piilani Promenade South Shopping Center
Kihei, Maui, Hawaii

File: 3051.01

August 2011

Figure 41b

APPENDIX B

Laboratory Testing Summary

Project Designation: Piilani Promenade South Shopping Center **File:** 3051.01

Location: Kihei, Maui, Hawaii

	Sample No.	Figure Designation
Consolidation Curves:	14-1	42
	18-3	43
	19-1	44
	24-1	45
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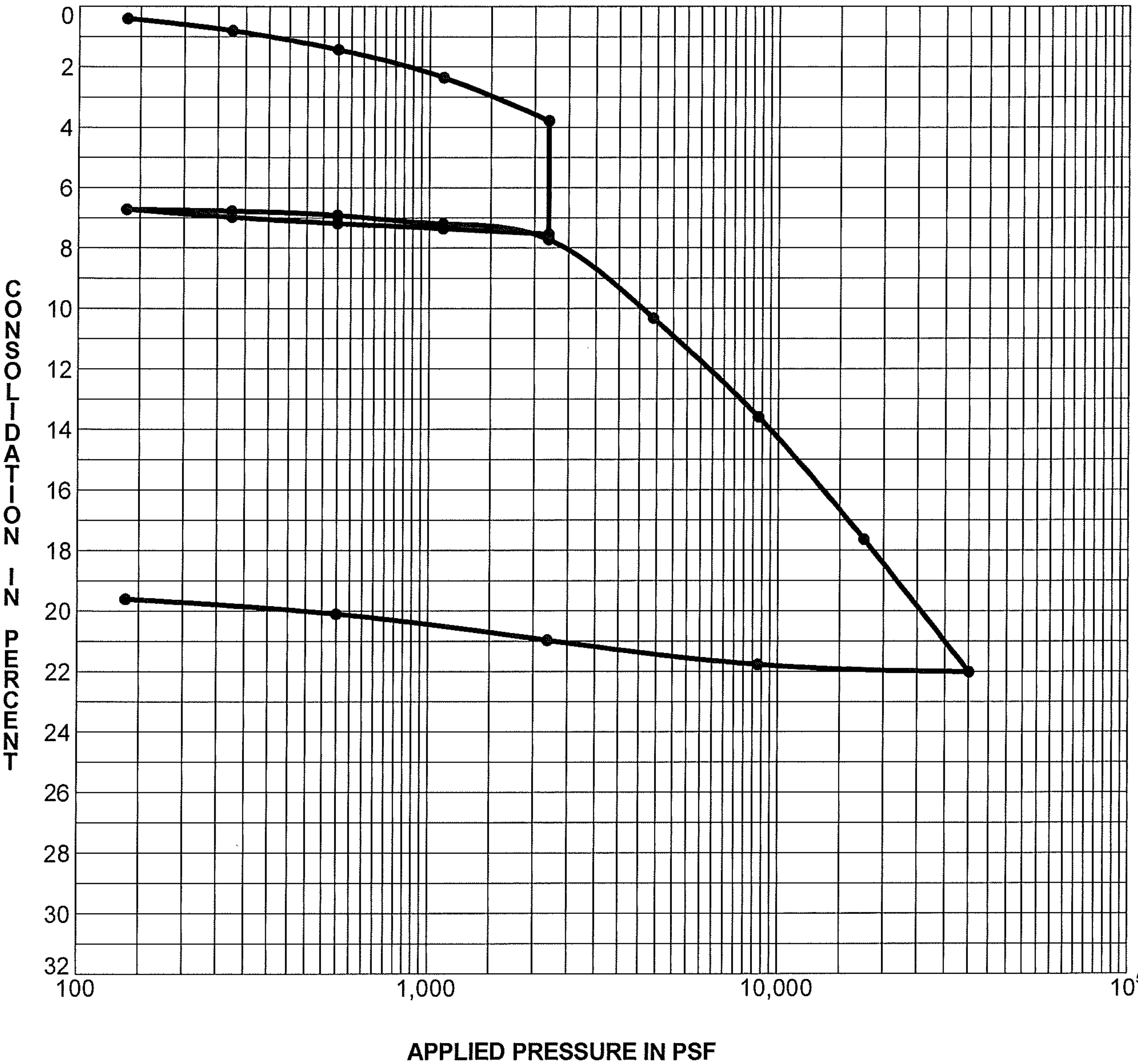
Plasticity Chart:	12-2	49
	13-1	49
	15-1	49
	16-2	49
	18-1	49
	19-1	49
	20-1	49
	TP11-1	50
	TP20-1	50
Summary of Laboratory Test Results:		Table I
Summary of Laboratory CBR Test Results:		Table II
Summary of Basalt Rock Unconfined Compressive Tests:		Table III



Sample Identification	Depth (feet)	Classification	LL	PI
14 - 1	1.0	Brown SILT (ML)		

F.G.E. Ltd.

CONSOLIDATION CURVE

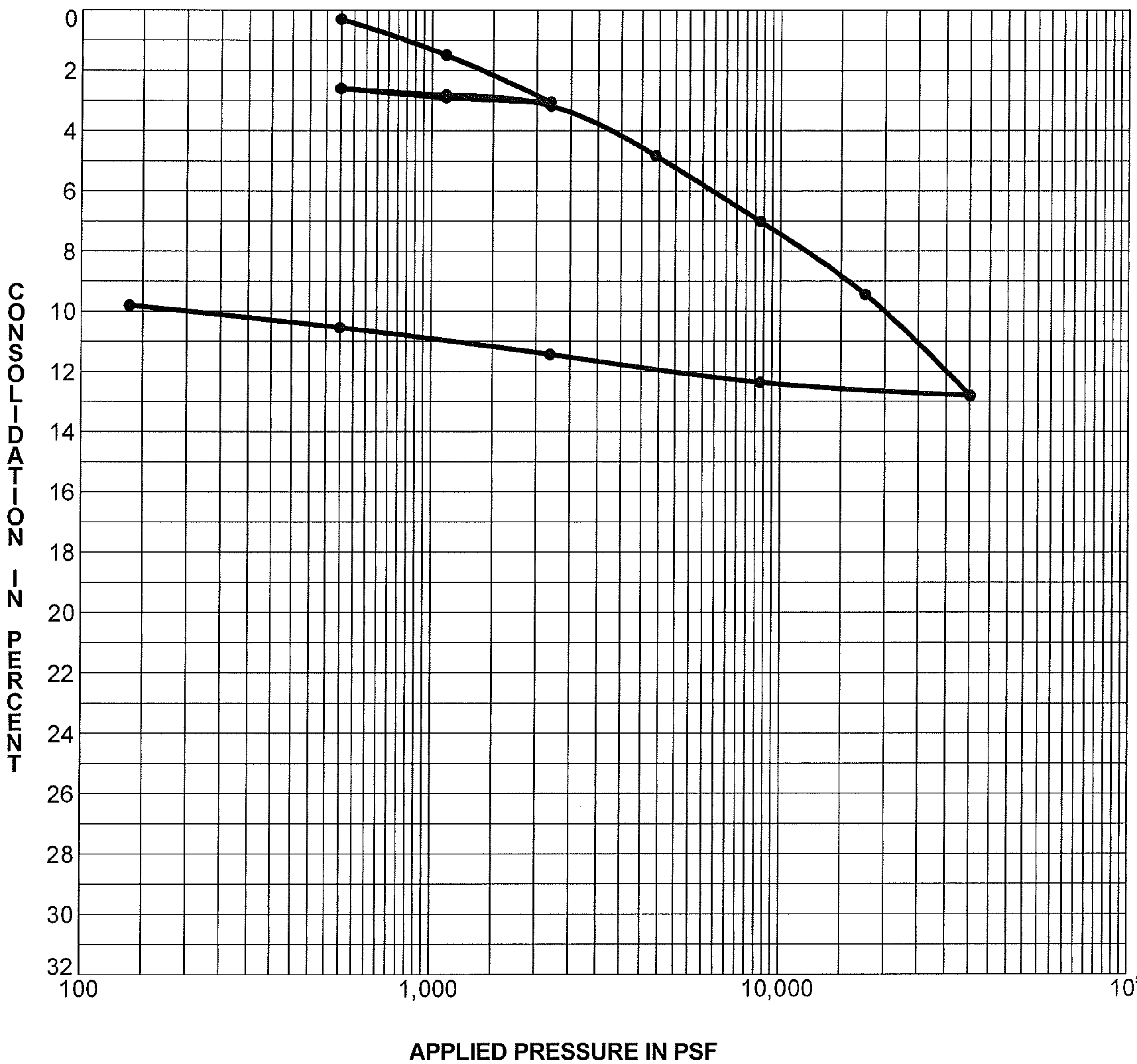
Piilani Promenade South Shopping Center

Kihei, Maui, Hawaii

File: 3051.01

August 2011

Figure 42



Sample Identification	Depth (feet)	Classification	LL	PI
18 - 3	5.5	Light Gray Sandy SILT (ML)		

F.G.E. Ltd.

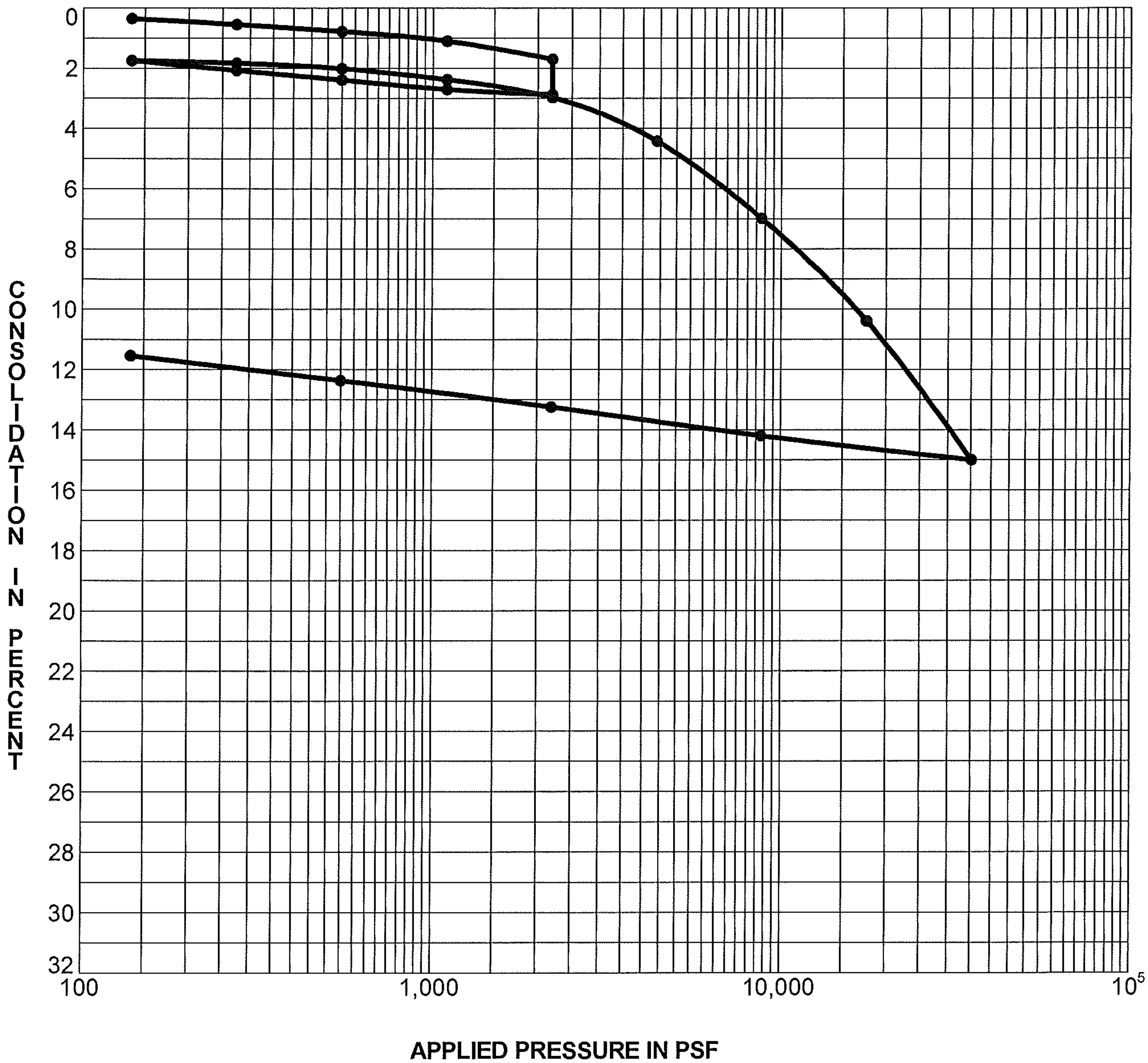
CONSOLIDATION CURVE

Piilani Promenade South Shopping Center

Kihei, Maui, Hawaii

File: 3051.01

August 2011



Sample Identification	Depth (feet)	Classification	LL	PI
19 - 1	0.5	Light Brown Clayey SILT (MH)	53	16

F.G.E. Ltd.

CONSOLIDATION CURVE

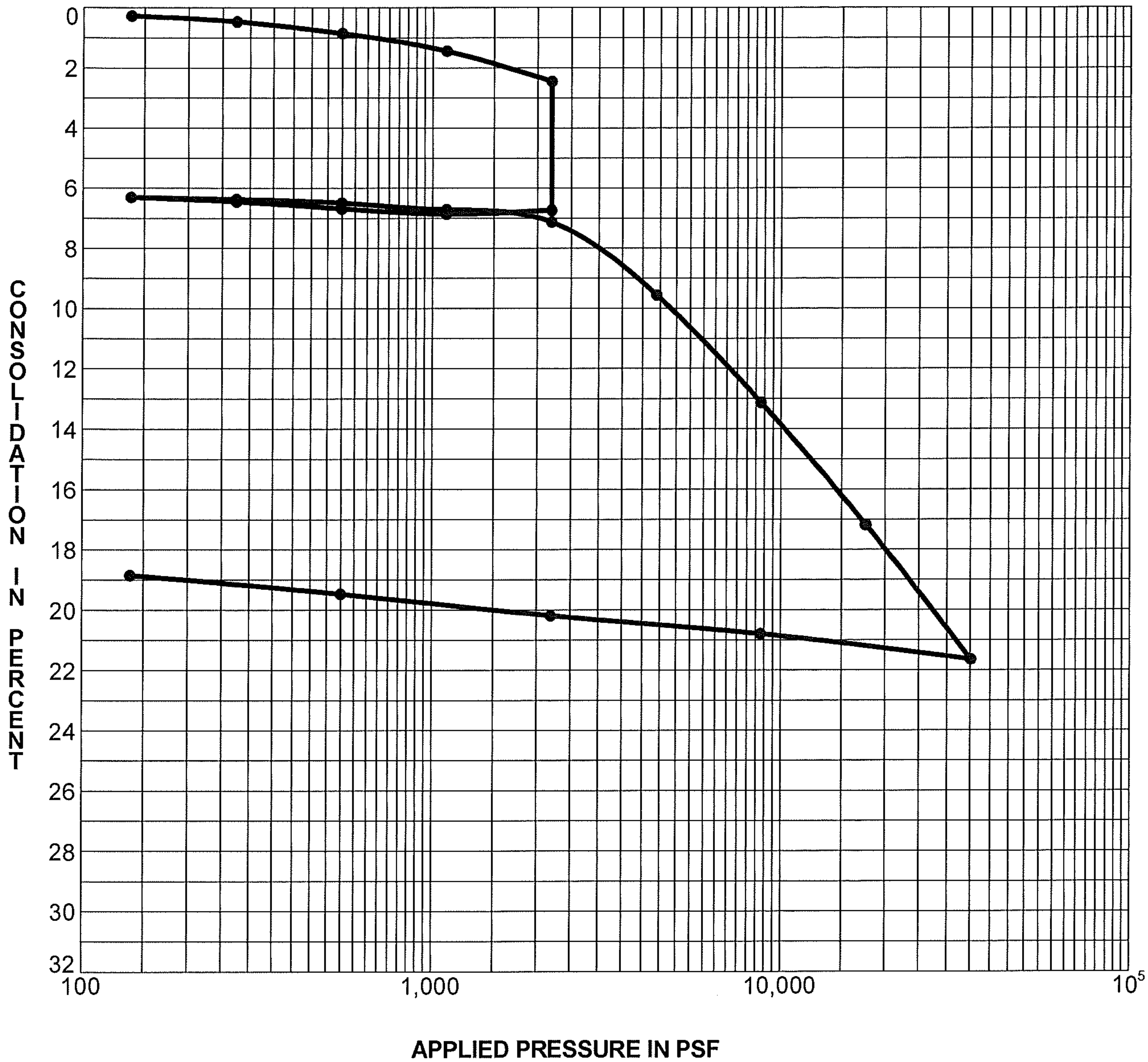
Piilani Promenade South Shopping Center

Kihei, Maui, Hawaii

File: 3051.01

August 2011

Figure 44



Sample Identification	Depth (feet)	Classification	LL	PI
24 - 1	1.0	Reddish Brown SILT (ML)		

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CONSOLIDATION CURVE

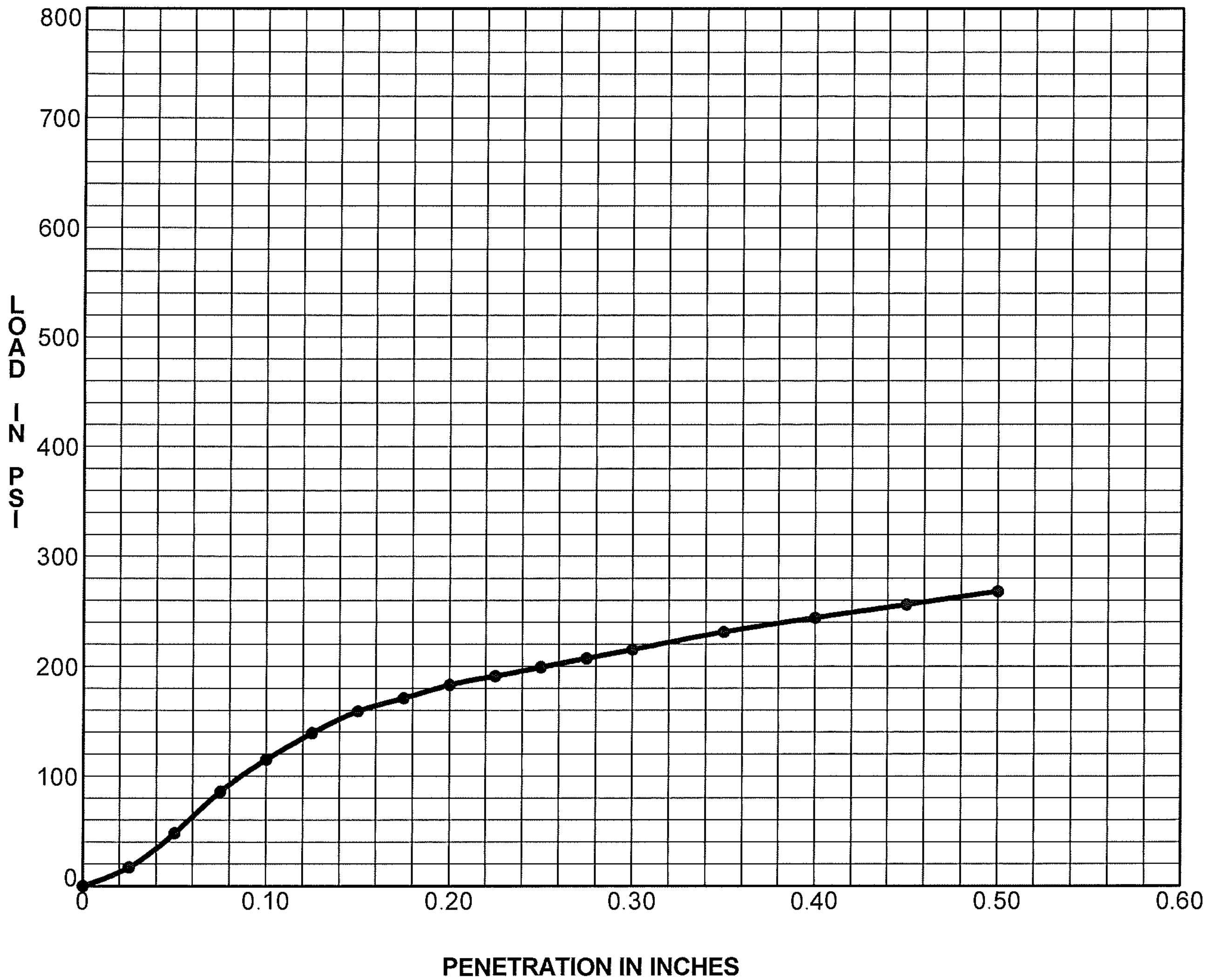
Piilani Promenade South Shopping Center

Kihei, Maui, Hawaii

File: 3051.01

August 2011

Figure 45



	Sample Identification	Classification	CBR	% Comp	Max Den	Opt. % MC	% Swell	LL	PI
●	TP11 - 1	Reddish Brown SILT (ML)	12.8	96	93.0	26.5	0.7	45	14

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CALIFORNIA BEARING RATIO

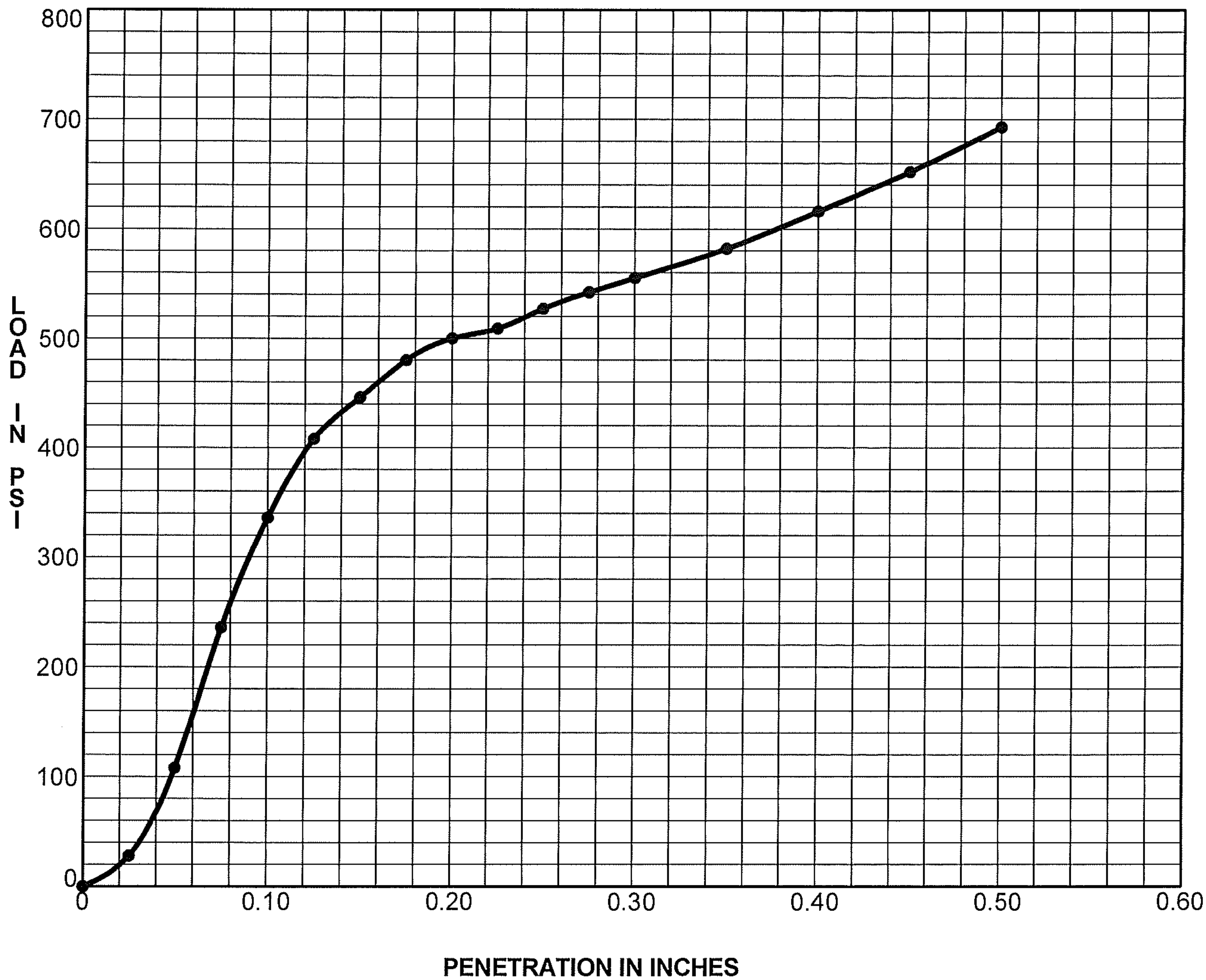
Piilani Promenade South Shopping Center

Kihei, Maui, Hawaii

File: 3051.01

August 2011

Figure 46



	Sample Identification	Classification	CBR	% Comp	Max Den.	Opt. % MC	% Swell	LL	PI
●	TP20 - 1	Reddish Brown SILT (ML)	41.8		92.5		1.1	48	12

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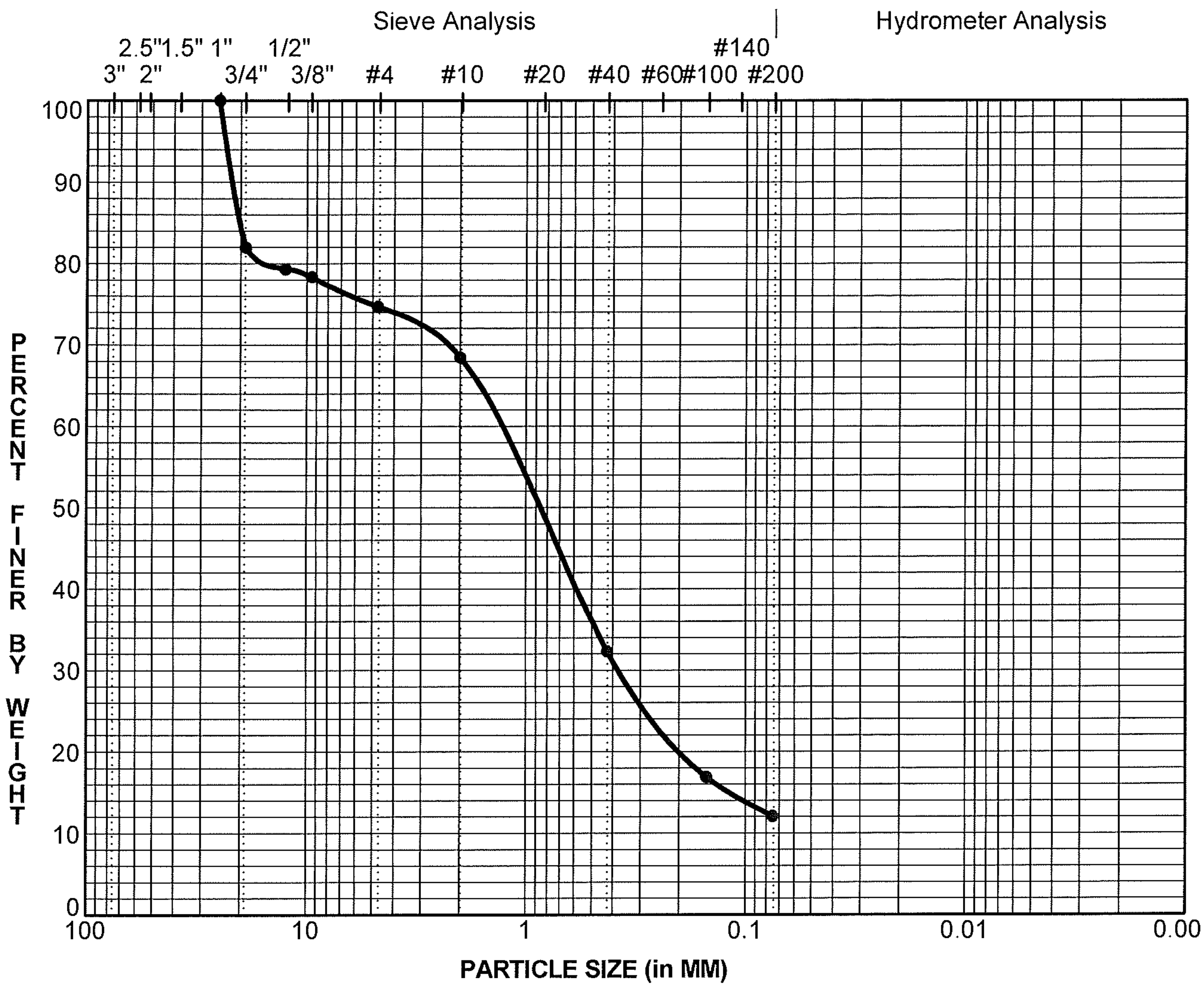
CALIFORNIA BEARING RATIO

Piilani Promenade South Shopping Center

Kihei, Maui, Hawaii

File: 3051.01

August 2011



Gravel		Sand			Silt and Clay
coarse	fine	coarse	medium	fine	

	Sample ID	Depth	Classification	MC%	LL	PL	PI	Cc	Cu
●	23 - 3	6.5	Brown Silty SAND (SM)					2	25

	Sample ID	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt & Clay
●	23 - 3	6.5	25.0	1.4	0.36		25	63	12

F.G.E. Ltd.

GRAIN SIZE DISTRIBUTION

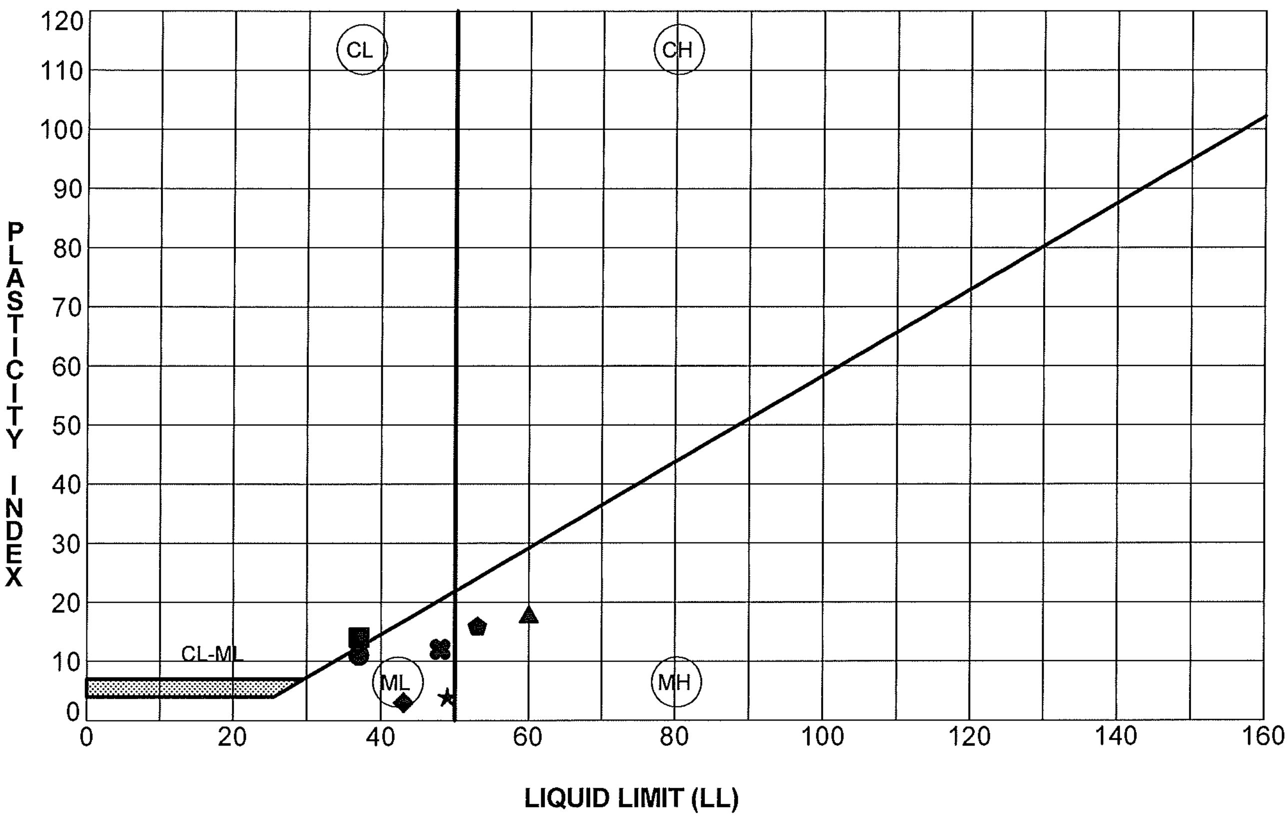
Piilani Promenade South Shopping Center

Kihei, Maui, Hawaii

File: 3051.01

August 2011

Figure 48



	Sample ID	Depth (ft)	LL	PL	PI	Classification
●	12 - 2	3.0	37	26	11	Brown SILT (ML)
■	13 - 1	1.0	37	23	14	Brown Silty CLAY (CL)
★	15 - 1	1.0	49	45	4	Gray/Brown SILT (ML)
◆	16 - 2	3.0	43	40	3	Gray SILT (ML)
▲	18 - 1	1.0	60	42	18	Light Brown Clayey SILT (MH)
⬟	19 - 1	0.5	53	37	16	Light Brown Clayey SILT (MH)
✖	20 - 1	1.0	48	36	12	Brown SILT (ML)

F.G.E. Ltd.

PLASTICITY INDEX CHART

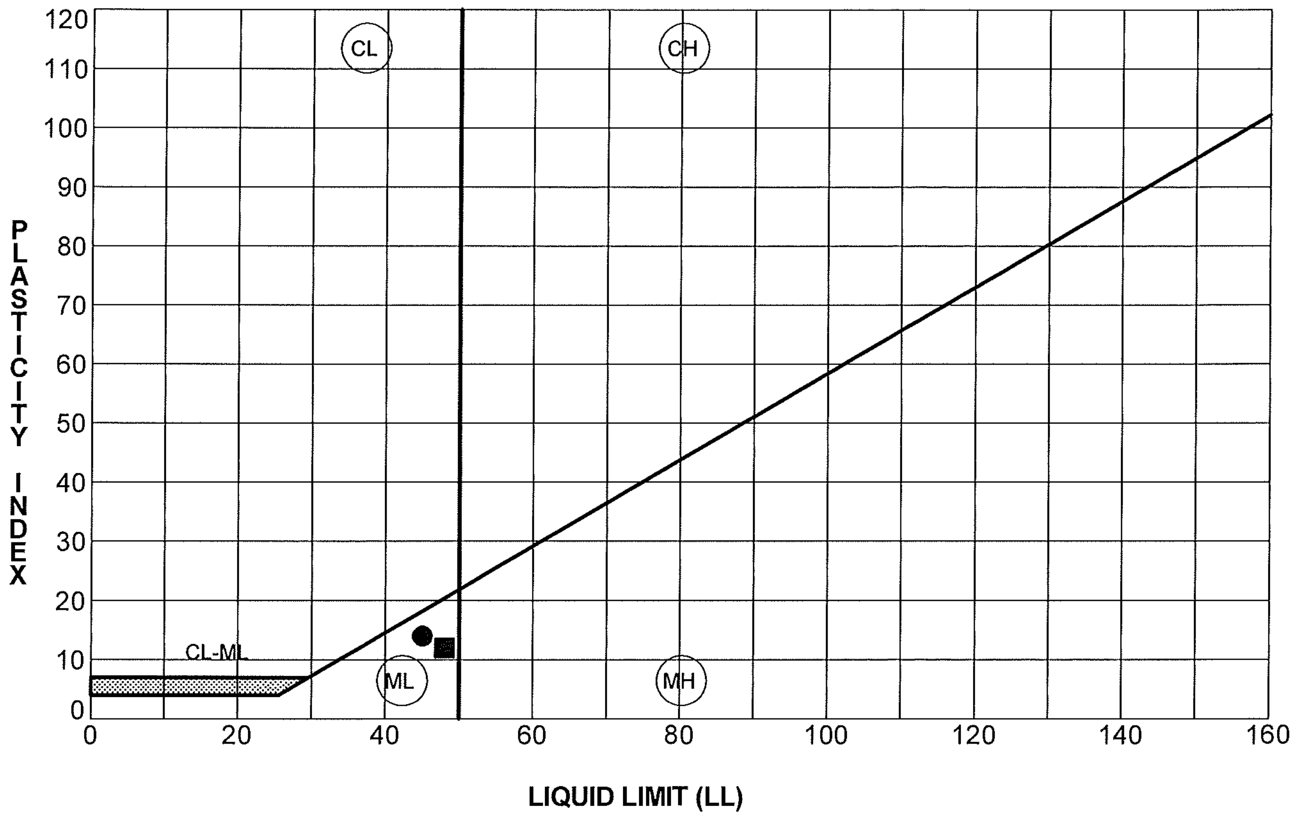
Piilani Promenade South Shopping Center

Kihei, Maui, Hawaii

File: 3051.01

August 2011

Figure 49



	Sample ID	Depth (ft)	LL	PL	PI	Classification
●	TP11 - 1	0.5	45	31	14	Reddish Brown SILT (ML)
■	TP20 - 1	0.5	48	36	12	Reddish Brown SILT (ML)

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PLASTICITY INDEX CHART

Piilani Promenade South Shopping Center

Kihei, Maui, Hawaii

File: 3051.01

August 2011

TABLE I

Summary of Laboratory Test Results

Sample No.	Depth (ft)	Moisture Content (%)	Dry Density (pcf)	Direct Shear C (psf)	Direct Shear Ø (Degrees)	Torvane (psf)	Liquid Limit	Plasticity Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	USC	Swell (%)	Swell Index
12-1	1.0	12	81											
12-2	3.0	14	72				37	11				ML	-2.8	
12-3	5.5													
12-4	8.5													
13-1	1.0						37	14				CL		
13-2	3.0	23	72	1,000	39°								0.8	0.03
13-3	5.0	23	63				50	9				ML		
13-4	7.0	23	72											
14-1	1.0	24	62											
15-1	1.0						49	4				ML		
15-2	3.0													
15-3	6.0													
16-1	1.0	31	69	600	45°								1.3	0.06
16-2	3.0	20	76	800	45°		43	3				MH	0.2	0.01
16-3	5.5	12												
18-1	1.0	30	72	930	28°		60	18				MH	1.0	0.04
18-3	5.5	26	64											
18-4	8.5	26	64											
19-1	1.0	22	68	680	23°		53	16				MH	0.6	0.02
19-2	3.0	16	77											
20-1	1.0	17	75											
21-1	1.0	18	70											
21-2	3.0	18	84											

TABLE I (Continued)

Summary of Laboratory Test Results

Sample No.	Depth (ft)	Moisture Content (%)	Dry Density (pcf)	Direct Shear C (psf)	Direct Shear Ø (Degrees)	Torvane (psf)	Liquid Limit	Plasticity Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	USC	Swell (%)	Swell Index
22-1	1.0	23	71											
22-2	3.0	13												
23-3	5.5	22							25	63	12	SM		
24-1	1.0	18	66											
25-1	1.0	25	83				42	15				ML		
25-2	3.0	28	84											

TABLE II

Summary of Laboratory CBR Test Results

Sample No.	Depth in feet	In-Situ Moisture Cont.(%)	Max. Dry Density (pcf)	Opt. Moist. Cont.(%)	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Liquid Limit (%)	Plasticity Index (%)	USC	Rel. Comp. (%)	Comp. Moist. (%)	CBR	CBR Swell (%)
TP11-1	0.5'	29	97	27				45	14	ML	97	26	12.8	0.7
TP13-1	0.5'	15												
TP20-1	2.0'	17	93	30				48	12	ML	98	29	41.8	1.1

TABLE III

Summary of Basalt Rock Unconfined Compressive Tests

Boring	Depth (feet)	Core Type	Material Description	Dry Density (p.c.f.)	Unconf. Compr. Strength (p.s.i)
Boring 14	5.5-9.0'	NX	Gray Basalt (WS)	145	4,440
Boring 15	11.0-12.0'	NX	Gray Basalt (WS)	126	2,710
Boring 16	13.0-14.0'	NX	Gray Basalt (WS)	167	10,970
Boring 22	11.0-12.0'	NX	Gray Basalt (WS)	166	7,820
Boring 22	26.0-27.0'	NX	Gray Vesicular Basalt (WS-WM)	134	2,110
Boring 23	12.0-13.0'	NX	Gray Vesicular Basalt (WS)	176	9,320
Boring 23	14.0-15.0'	NX	Gray Vesicular Basalt (WS)	145	3,730
Boring 24	7.0-8.0'	NX	Gray Basalt (WS)	146	4,370
Boring 24	23.0-24.0'	NX	Gray Basalt (WS)	138	3.170

APPENDIX C

Limitations

This report has been prepared for the exclusive use of **Piilani Promenade South, LLC** for site of the **Piilani Promenade South Shopping Center,** in Kihei, Maui, Hawaii. In the completion of the investigation and the preparation of this report, we have strived to perform our services in a manner consistent with that level of care and skill ordinarily exercised by members of the geotechnical profession practicing under similar conditions in Hawaii. No other warranty, either expressed or implied, is made.

The analysis, conclusions and recommendations submitted in this report are based in part upon the data obtained in the test borings and test pits, and upon the assumption that the soil conditions do not deviate from those observed. If any variations or undesirable conditions are encountered during construction, or if the proposed construction will differ from that planned at the present time, FGE should be notified so that supplemental recommendations can be given. The conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and the conclusions of this report modified or verified in writing.

Unanticipated soil conditions are commonly encountered and cannot be fully determined by soil samples, test borings, or test pits. Such unexpected conditions frequently require that additional expenditures be made to attain a properly constructed project. Some contingency funds are recommended to accommodate such potential extra costs.

The site investigation for this report may not have disclosed the presence of underground structures, such as cesspools, drywells, storage tanks, etc. that may be present at the site. Should these items be encountered during construction, FGE should be notified to provide recommendations for their disposition.

The scope of work for this investigation was limited to conventional geotechnical services and did not include environmental, botanical, or archeological assessments or evaluations. Silence in the report regarding any environmental, botanical, or archeological aspects of the site does not indicate the absence of potential environmental, botanical or archeological concerns.

The boring and test pit locations were staked out in the field and their ground surface elevations were determined by Piilani Promenade South, LLC's Project Surveyors. Where occasional borings or test pits were re-located by FGE in the field, the ground surface elevations at the borings were estimated by a hand level using the staked out boring elevation. The locations and elevations of the borings should be considered accurate only to the degree implied by the methods used.

Groundwater was not observed in any of the test borings or test pits during the field investigation. It should be realized, however, that fluctuations in the level of the groundwater, or seepage may occur due to variations in natural subsurface seepage, rainfall, tides and other factors not present at the time the measurements were made.

FGE should be provided the opportunity for general review of the final design drawings and specification to verify that the earthwork and foundation recommendations have been properly interpreted and implemented in the design and specification. If FGE is not accorded the privilege of making this recommended review, it can assume no responsibility for misinterpretations of the recommendations.

FGE should also be retained to provide periodic soil engineering services during construction. This is to observe compliance of the design concepts, specifications and recommendations and to allow design changes in the event the subsurface conditions differ from that anticipated prior to construction. The recommendations contained herein are contingent upon adequate construction observation and testing of the geotechnical phases of the construction by FGE.