6. Coordination of the test boring exploration and logging of the borings by our field geologist.
7. Laboratory testing of selected samples obtained during the field exploration as an aid in classifying the materials and evaluating their engineering properties.
8. Analyses of the field and laboratory data to formulate preliminary geotechnical recommendations for slope stability and the design of foundations, retaining structures, site grading, and pavements.
9. Preparation of this report summarizing our work on the project and presenting our findings and recommendations.
10. Coordination of our overall work on the project by our project manager.
11. Quality assurance of our work and client/design team consultation by our principal engineer.
12. Miscellaneous work efforts such as drafting, word processing, and clerical support.

Detailed description of our current test boring exploration and the Logs of Borings (B-101 through B-116) are presented in Appendix A. Detailed description of our previous test boring exploration conducted at the Eastern Plateau and the associated Logs of Borings (B-1 through B-5) are presented in Appendix B. Description and summary information pertaining to our previous test pit field exploration at Landfill Areas I and II are presented in Appendix C. The results of the laboratory tests performed on selected soil samples collected at the project site are presented in Appendix D. And finally, the results of the previous laboratory tests performed on selected soil samples collected at the Eastern Plateau are presented in Appendix E.

END OF GENERAL

SECTION 2.0 - SITE CHARACTERIZATION

2.1 Regional Geology

The Island of Kauai is essentially a dissected basaltic dome that was initially formed by a single large shield volcano, which has subsequently been deeply eroded and partially covered with later (younger) volcanic materials. The Island of Kauai is the oldest of the main Hawaiian Islands and today encompasses approximately 555 square miles with a maximum elevation of about 5,170 feet above Mean Sea Level at Mount Waialeale, near the center of the island. It is believed that during the Tertiary Period (about 5 to 6 million years ago during the Pliocene Epoch), basaltic lavas belonging to the Waimea Canyon Volcanic Series built a roughly circular island volcano from the ocean floor, which is estimated to have been about 20,000 feet deep at the time. Near the end of the Pliocene Epoch, this main shield building volcanic phase came to a halt.

Following a long period of erosion and island mass subsidence, volcanism was renewed during the early Pleistocene Epoch (about 1.5 million years ago) with the eruption of the Koloa Volcanic Series from multiple vents located throughout the island. This post-erosional volcanic activity laid a veneer of fresh lava and interbedded volcanic sediments over the older deposits of the Waimea Canyon Series. Because of the long period of erosion that occurred between the eruption of the Waimea Volcanic Series and the Koloa Volcanic Series, the deposits of the Koloa Volcanic Series typically filled the erosional valleys and depressions, which existed at that time. Consequently, the basaltic rocks of the Koloa Volcanic Series are commonly found to overlie thick residual soil and alluvial deposits.

The dominant geologic processes of weathering, landform erosion, and sediment re-deposition followed during the late Pleistocene and Recent Epochs. Combined with the erosional and depositional effects of the Pleistocene sea-level fluctuations, which occurred in response to the worldwide advance and retreat of the continental ice sheets, the Island of Kauai has evolved to its present form.

The project site encompasses a distinct geographic region that is herein referred to as the upland plateau region. This upland plateau region consists of a broad gently sloping plateau that has been dissected by deep sinuous drainage ravines that have produced steep ravine side slopes. The drainage ravines deepen over relatively short distances beginning as gentle depressions at their headland sources (at the southern portion of the site) and dropping to deep valley floors over 200 feet in depth (at the northern portion of the site).

Based on a review of available geologic information, the project site is generally underlain by a thick sequence of extremely weathered basaltic rock (saprolite) belonging to the Koloa Volcanic Series. The soil materials generally consist of in-situ basalt rock that has been deeply weathered to form silty and clayey saprolitic soils with embedded decomposed rock material. These saprolitic deposits extend for considerable depth below the upland ground surfaces. Due to the high rainfall and runoff experienced at this northern portion of the Island of Kauai, the in-situ saprolitic soils have high moisture contents. In addition, groundwater seepage and high-level perched groundwater are commonly encountered in the subsurface saprolitic materials. These groundwater conditions contribute to the formation of spring discharge at lower elevations and near-continual stream discharge, which occurs in the larger drainages.

2.2 Site Description

The project site is in the Princeville area in the District of Hanalei on the Island of Kauai, Hawaii as shown on the Project Location Map, Plate 1. The project site is north through northwest of the existing Princeville Airport and encompasses the broad upland region referred to as the Eastern and Central Plateaus. The project site covers approximately 800 acres of mostly vacant land, which was formerly used for crop cultivation and pasture land. The project site is in an area characteristic of very high rainfall and humid climate conditions. As a result, groundwater seepage from slopes and relatively high soil moisture contents are characteristic of the project site.

The interior plateau encompasses multiple bluffs that slope down very gently toward the north before transitioning to steeper northerly facing slopes above the

Anini and Kalihikai coastal areas. Sinuous incised drainage valleys and topographic depressions, which generally drain toward the north between Anini and Kalihikai Beaches, separate the individual bluffs. The bounding valleys, drainage ravines, and depressions are typically densely forested with large trees. The tops of the bluffs generally consist of open grass rangeland interspersed with forested terrain mainly along the margins and within the drainage valleys. The existing bluff tops slope gently toward the north at about a 2 to 4 degree inclination. Side slopes bordering the ravines and depressions typically stand at inclinations ranging between approximately one horizontal to one vertical (1H:1V) to 4H:1V, with the steepest slopes bounding the northern perimeter of the project site.

Elevations at the project site generally range between about +340 and +200 feet Mean Sea Level (MSL). In general, the existing valley and ravine side slopes appear to stand at inclinations of about 1H:1V or flatter and are mostly covered with surface vegetation and trees. Our visual observations revealed only localized widely scattered exposures of shallow depth earthen slides existing on portions of the upper elevation slopes. We did not observe visible evidence of large-scale slope instability within the project site or visible evidence of surface groundwater seepage; however, groundwater spring discharges may be encountered on the valley side slopes, especially at lower elevations. The approximate limits of the proposed Princeville Grand Estates Subdivision are shown on the Site Plan, Plate 2.

As previously mentioned, the upland plateau region resides as mainly undeveloped pasture and forested land. The exception is a partially developed area at the southeast corner of the project site and westerly of the existing Anini Vista Road. The area contains a concrete batch plant and a stockpile site for soil and gravel materials within Lot Nos. 9A and 10A as shown on the Site Plan, Plate 2.

Two closed landfills, identified as Landfill Areas I and II on the Landfill Area Site Plan, Plate 3, are on the Eastern Plateau approximately ¼ mile northeasterly from the Princeville Airport. The landfills reportedly contain green and construction debris waste products. We conducted a previous test pit exploration in an effort to delineate the approximate limits of the closed landfills. Based on our field exploration, the irregular shaped landfill areas each encompass a footprint of roughly 400 to 600 feet long by about 200 to 300 feet wide. The results of the test pit exploration are plotted on the Landfill Area Site Plan, Plate 3. A table summarizing the results of the landfill test pit exploration is presented in Appendix C. Additional discussion of our findings and recommendations pertaining to the landfills are presented in Section 3 of this report.

Based on our site reconnaissance, we observed rectangular shaped area of stockpiled clayey soils approximately 800 feet easterly from the existing Prince Golf Clubhouse. The stockpile is within Lot 1-0 as approximately shown on the Site Plan, Plate 2. Based on the available information, the documented stockpile may eventually reach a volume of about 60,000 cubic yards and is to be used as general fill for future development projects. The observed soil stockpile presently covers an area measuring approximately 800 feet by 400 feet as approximately shown on the Site Plan, Plate 2. The stockpile soils appear to have been dumped and spread without compaction effort over a period of time.

One of our earlier reports entitled "Soil Engineering Investigation, Proposed Princeville II Golf Course, Hanalei, Kauai, Hawaii" (W.O. 1142-00) dated July 30, 1982, noted the potential presence of an old water development tunnel crossing the site to the north of the existing Prince Golf Course Clubhouse, as approximately shown on the Site Plan Plate 2.

2.3 <u>Subsurface Conditions</u>

For this current geotechnical field exploration, we explored the general subsurface conditions at the project site by drilling and sampling 16 test borings, designated as Boring Nos. 101 through 116, extending to depths of about 21.5 to 81.5 feet below the existing ground surface. The Logs of Borings for Boring Nos. B-101 through B-116 are presented in Appendix A. In addition, our previous field exploration (conducted in 2004 at the Eastern Plateau) included drilling and sampling of five test borings, designated as Boring Nos. 1 through 5, extending to depths of about 21.5 to 91.5 feet below the existing ground surface. The Logs of Borings for Boring Nos. B-1

through B-5 are presented in Appendix B. The approximate test boring locations are shown on the Site Plan, Plate 2.

In addition, during our previous exploration at the Eastern Plateau, the shallow subsurface conditions and surface limits of existing Landfill Areas I and II were explored by the excavation and backfilling of test pits. We excavated a total of 58 test pits, identified as Test Pit Nos. 1 through 58, at Landfill Areas I and II as shown on the Landfill Area Site Plan, Plate 3. Summary information pertaining to the test pit exploration is presented in Appendix C.

The borings drilled and sampled for both the previous and current explorations indicate that the upland plateau region of the project site is generally underlain by stiff to very stiff residual and saprolitic soils consisting of very moist clayey silts with fine sand extending to the maximum depth explored of about 91.5 feet below the existing ground surface. In general, our explorations encountered a surface layer of topsoil, consisting of brown clayey silts with much organic matter, ranging in thickness from about 0.5 to 1.0 feet below the existing ground surface. We encountered near-surface silty and clayey residual soils in the upper 3 to 10 feet of the borings and some scattered zones of friable, extremely weathered basalt rock throughout the test boring depths. In addition, the soils were observed to be frequently wet indicating groundwater seepage and potential perched groundwater conditions. We did not encounter static groundwater levels in the borings drilled at the project site.

As part of our previous exploration at the site, Test Pit Nos. 1 through 58 were excavated and backfilled at the existing Landfill Areas I and II located on the upland plateau region to evaluate the surface limits of the landfills. The test pit locations were surveyed by a licensed surveyor and plotted on the project base map. In general, stiff to very stiff silty and clayey capping soils were observed overlying buried construction material waste and greenwaste. The capping soil cover was observed to range between about 2 and 7 feet thick depending on location. The depth of soil cover and a tabulation of the materials encountered by the test pits are presented in Appendix C.

We did not encounter groundwater in the test borings or test pits at the time of our field exploration. However, it was noted that seams of very wet soils were frequently observed indicating possible groundwater seepage and potential perched groundwater conditions. It should be noted that groundwater conditions vary with seasonal rainfall, time of the year, and other factors. Therefore, transient seepage or perched groundwater may occur at the site.

In an older exploration, "Soil Engineering Investigation, Proposed Princeville II Golf Course, Hanalei, Kauai, Hawaii" (W.O. 1142-00) dated July 30, 1982, springs were observed at the bases of several slopes below the site. These springs indicate that perched groundwater may be present under the site. This older exploration also noted the possible presence of an old water development tunnel crossing the site to the north of the existing Golf Course Clubhouse as approximately shown on the Site Plan, Plate 2.

Detailed description of our current test boring exploration and the Logs of Borings (B-101 through B-116) are presented in Appendix A. Detailed description of our previous test boring exploration conducted at the Eastern Plateau and the associated Logs of Borings (B-1 through B-5) are presented in Appendix B. Description and summary information pertaining to our previous test pit field exploration at Landfill Areas I and II are presented in Appendix C. The results of the laboratory tests performed on selected soil samples collected at the project site are presented in Appendix D. And finally, the results of the previous laboratory tests performed on selected soil samples collected at the Eastern Plateau are presented in Appendix E.

END OF SITE CHARACTERIZATION

SECTION 3.0 - DISCUSSION AND RECOMMENDATIONS

Based on our field exploration conducted for the project, the upland plateau region of the project site is generally underlain by a thin surface layer of organically rich topsoil which grades to very moist residual and saprolitic soils consisting of medium stiff to very stiff clays and silts with fine sand extending to the maximum depth explored of about 91.5 feet below the ground surface. Our borings encountered varying amounts of decomposed basalt rock generally consisting of friable sandy and gravelly materials at various depths. We did not encounter static groundwater levels in the borings at the time of our field exploration; however, we did encounter frequent wet zones, which indicate the potential presence of subsurface seepage or perched groundwater conditions. It should be noted that groundwater levels and seepage vary with seasonal rainfall, time of the year, and other factors.

Based on the generally competent subsurface conditions encountered at the upland plateau region of the project site, we anticipate that shallow spread and/or continuous footings may be used to support future house structures that are located away from the tops of the bluffs at the project site. Residential structures near the tops of the bluffs may require deep thickened-edge slab footings or drilled piers to provide adequate support and resistance to sliding.

Some important geotechnical engineering considerations pertaining to the development of the upland plateau region consist of the following:

- General guideline for building setback from the top edge of the bluffs
- Landfill slope stability and building setback from landfill limits
- Existing area of soil stockpile
- Possible old water tunnel alignment
- Proposed narrow ridgeline roadway
- General recommendations for residential structure foundations

Detailed discussion of these items and our geotechnical recommendations for design input are presented in the following sections herein.

We understand that the residential lots will be marketed on an "as-is" basis with the individual purchaser being responsible for site improvements such as lot grading and the design of foundations, and assessments for potential geologic hazards such as rockfall and slope stability issues. In view of this, the individual purchasers should retain the service of a geotechnical engineer to provide individual consultation and site-specific geotechnical exploration to develop the necessary construction guidelines and foundation recommendations.

3.1 Building Set-Back on Bluffs

Based on the conceptual development plan provided, we anticipate that some residential structures may be constructed along the top edge of the bluffs above relatively steep slopes generally composed of extremely weathered basalt rock and saprolitic soils. Although our slope stability analysis indicates that the hillsides may be generally stable against deep-seated massive type landslide failure, the slopes may experience recurring shallow-seated failures or thin-skin tears involving the upper few feet of the near-surface materials, especially on the upper steeper portions of the slopes. As a result, our opinion is that a minimum building setback guideline of 40 feet away from the tops of the slopes is necessary to maintain an adequate factor of safety for future residential structures utilizing shallow foundation systems. "Tops of the slopes" may be defined as the top part of any slope with an inclination steeper than about 2H:1V. We recommend conducting additional site-specific geotechnical engineering exploration to address site-specific building setbacks and various alternative foundation systems based on the type of structure and loading proposed.

3.2 Existing Landfills

Based on the conceptual development plan provided, it appears that some future home sites may be planned adjacent to the existing Landfill Areas I and II located on the eastern upland plateau. We conducted a field investigation consisting of surface mapping and test pit exploration to evaluate the surface limits of the landfills. The actual mapped limits generally resemble the suspected landfill limits obtained through evaluation of aerial photographs with some detail refinement. The actual limits reflect the mapped extent to which buried green waste and construction debris were

encountered at the site. The approximate location of the actual landfill limits based on the results of the field exploration is shown on the Landfill Area Site Plan, Plate 3.

The landfill sites are not considered suitable for the construction of structures and home sites due to the limited soil cap cover and the potential for substantial ground settlement. Assuming a valley fill condition, we believe that a minimum 25-foot setback from the landfill limits may be used as a general guideline for the location of future buildings. In addition, consideration should be given to the placement of additional fills at Landfill Area II to meet the required thickness of cover needed for the landfill closure.

Based on our field exploration, we believe that the landfill areas will continue to experience additional ground settlement induced by the decomposition and settling of the buried wastes. It has been reported that the buried wastes may extend to depths greater than about 40 feet in some areas, mainly near the central and northern portions of the landfill sites. In addition, the buried waste in Landfill Area II appears to have only limited soil cover with exposed waste observed in some areas at the ground surface. The capping soil cover encountered on most of this landfill was only a thin veneer of soil over the waste materials. Because the landfills were constructed at the heads of pre-existing natural gulch features, the ground settlement should not adversely impact the stability of the adjacent slopes composed of in-situ saprolitic soils.

However, the landfill perimeter fill slopes generally located upslope of the existing landfill siltation basins may contain some buried wastes and soft overcast fill materials that could be problematic for future slope stability. Based on the test pit exploration, the northwesterly facing fill slope of Landfill Area I was observed to consist of soft, compressible clayey soils mixed with landfill wastes. Therefore, the existing northwesterly facing fill slope at Landfill Area I is considered only marginally stable and may be susceptible to future erosion and slope failure especially since the existing landfill surface drainage appears to discharge onto a portion of the slope surface.

Based on the field exploration conducted at Landfill Area II, we did not observe buried waste at the ground surface of the northerly facing fill slope located above the existing siltation basin. Furthermore, due to the steep and wet surface condition of the slope surfaces, we did not excavate test pits on the fill slope at Landfill Area II. Additional subsurface exploration may be necessary to evaluate the stability of the fill slope at Landfill Areas I and II.

3.3 Existing Soil Stockpile

Based on our review of a recent aerial photograph and confirmation by our site reconnaissance, a broad area of surface soil stockpile is centered approximately 800 feet easterly from the existing Prince Golf Clubhouse. The soils consist of light reddish brown silts and clays. The stockpile soils appear to be spread in level lifts with minimal compaction effort and are reportedly uncontaminated. The thickness of the stockpile could not be estimated due to poor surface exposure and vegetation growth. At the time of our field exploration, the stockpile area was estimated to encompass an area of about 600 feet long (north to south direction) by about 400 feet wide (east to west direction) as approximately shown on the Site Plan, Plate 2.

Based on the information provided, we understand the existing soil stockpile may be used for general fill on future development projects. We recommend the complete removal of the stockpile to expose the in-situ residual and saprolitic soils prior to proceeding with road construction and home site development in the affected area.

3.4 Possible Old Water Tunnel

Based on our review of previous in-house soils reports pertaining to the project site and vicinity, a possible old irrigation water tunnel was previously identified at the project site. The approximate location is north of the existing Prince Golf Course Clubhouse as shown on the Site Plan, Plate 2. The actual presence of the water tunnel should be verified by a review of available records or by field exploration such as test pit excavation before proceeding with site development in the vicinity. If the tunnel is found to exist, additional geotechnical engineering consultation is recommended and exploration is required to explore the existing conditions and provide recommendations for tunnel closure or incorporation into the planned development scheme.

3.5 Proposed Ridgeline Roadway

Based on the available conceptual development plan, we understand that a new subdivision roadway is planned along and crossing the top of a relatively narrow bluff ridgeline. A portion of the proposed new roadway is between the proposed Lot Nos. 1-0 and 4-0 skirts and traverses a narrow ridgeline with steep side slopes on both sides of the ridge. We drilled Boring No. 2 of our previous exploration at this narrow ridgeline location as shown on the Site Plan, Plate 2. We anticipate that the existing side slope topography may pose significant constraints for the construction of a traditional concrete retaining wall system to support the roadway. Therefore, we envision that site grading consisting of earth cuts may be performed to increase the width of the ridgeline, or to develop a stable bench, for the construction of the roadway prism. If the desired ridge or bench width cannot be achieved by site grading alone, we believe that a retaining wall system consisting of Mechanical Stabilized Earth (MSE) walls may be utilized.

3.6 Foundations

Based on the subsurface conditions encountered at the project site, we anticipate that shallow spread and/or continuous footings may be used to support the new structures located away from the tops of bluffs at the project site. Residential structures planned near the tops of the bluffs may require special foundations such as deep thickened-edge slab footings or drilled piers. As a general guide, an allowable bearing pressure of up to 2,000 pounds per square foot (psf) may be used for the design of footings bearing on the compacted fill or stiff on-site clayey silt and/or silty clay materials. This bearing value is for dead-plus-live loads and may be increased by one-third (1/3) for transient loads, such as those caused by wind or seismic forces.

In general, footings should be embedded a minimum of 18 inches below the lowest adjacent exterior grade.

Foundations next to other foundations, utility trenches, or easements should be embedded below a 45-degree imaginary plane extending upward from the bottom edge of the utility trench, or the footings should extend as deep as the inverts of the utility lines. This requirement is necessary to avoid surcharging adjacent below-grade structures with additional structural loads and to reduce the potential for appreciable foundation settlement.

In general, the subgrade soils at the bottom of footing excavations should be moisture-conditioned to above the optimum moisture and recompacted to a minimum of 90 percent relative compaction prior to the placement of reinforcing steel or concrete. Relative compaction refers to the in-place dry density of soil expressed as a percentage of the maximum dry density of the same soil established in accordance with ASTM D 1557. Optimum moisture is the water content (percentage by dry weight) corresponding to the maximum dry density.

Soft and/or loose materials encountered at the bottom of footing excavations should be over-excavated until dense and/or stiff materials are exposed in the footing excavation. The over-excavation should be backfilled with select granular fill materials moisture-conditioned to above the optimum moisture content and compacted to a minimum of 90 percent relative compaction. Alternatively, the bottom of the footing may extend down to bear directly on the underlying competent material.

Lateral loads acting on the structure may be resisted by friction developed between the bottom of the foundation and the bearing soil and by passive earth pressure acting against the near-vertical faces of the foundation system. A coefficient of friction of 0.35 may be used for footings bearing on the stiff on-site clayey silt and/or silty clay materials. Resistance due to passive earth pressure may be estimated using an equivalent fluid pressure of 300 pounds per square foot per foot of depth (pcf) assuming that the soils around the footings are well compacted. The passive resistance in the upper 12 inches of the soil should be neglected unless covered by pavements or slabs.

3.7 Slabs-On-Grade

We anticipate that concrete slabs-on-grade will be used. The near-surface soils encountered in our borings generally consist of silty clays, which exhibit a slight expansion potential when subjected to moisture fluctuations. Therefore, to reduce the

potential for structural distress to the lightly loaded slabs, we recommend providing a minimum of 6 inches of non-expansive select granular fill material below the concrete slab.

The subgrades for concrete slabs-on-grades should be scarified to a depth of at least 8 inches, moisture-conditioned to at least 2 percent above the optimum moisture, and compacted to no less than 90 percent relative compaction. Relative compaction refers to the in-place dry density of soil expressed as a percentage of the maximum dry density of the same soil determined in accordance with ASTM D 1557. Optimum moisture is the water content (percentage by dry weight) corresponding to the maximum dry density.

The non-expansive select granular fill recommended below the floor slabs should consist of imported granular material such as crushed coral, basaltic gravel or cinder sand. The material should be well graded from coarse to fine with no particles larger than 3 inches in largest dimension. The material should have a laboratory California Bearing Ratio (CBR) value of 20 or higher, and a swell potential of 1 percent or less when tested in accordance with ASTM D 1883. The material also should contain between 10 and 30 percent particles passing the No. 200 sieve. The select granular fill materials should be moisture-conditioned to above the optimum moisture content and compacted to at least 90 percent relative compaction. The slab subgrade should be kept moist until covered by the select granular fill.

For the interior building slabs (which will not be subject to vehicular traffic), we recommend providing a minimum 4-inch thick layer of cushion fill over the 6-inch select granular fill materials for uniform support. The cushion fill should consist of open-graded gravel (ASTM C 33, No. 67 gradation) and would also serve as a capillary moisture break.

To reduce the potential for excessive moisture infiltration and subsequent damage to floor coverings, an impervious moisture barrier is recommended on top of the gravel cushion layer. Flexible floor coverings should be considered above the floor slab since they can better mask minor slab cracking.

In addition, we envision that exterior concrete walkways and exterior flatwork will likely be required. In general, we recommend providing a minimum 4-inch thick cushion layer of base course below the exterior concrete slab. To reduce the potential for substantial shrinkage cracks in the slabs, crack control joints should be provided at intervals equal to the width of the walkways (or slabs) with expansion joints at right-angle intersections.

3.8 Retaining Structures

Some retaining structures, such as walls for roadway support and drainage structure headwalls, may be required for construction. Therefore, the following general guidelines are provided and may be used for the design of low retaining structures.

3.8.1 Retaining Structure Foundations

In general, we believe that retaining structure foundations may be designed in accordance with the recommendations and parameters presented in the "Foundations" section herein. However, the retaining structure footings should have a minimum width of 18 inches. In addition, wall foundations located on relatively flat areas should be embedded a minimum depth of 24 inches below the lowest adjacent finished grade for retaining structures of 5 feet high or greater. Footing embedment depth of 18 inches may be used for low retaining structures of less than 5 feet high.

For sloping ground conditions, the footing should extend deeper to obtain a minimum 6-foot setback distance measured horizontally from the outside edge of the footing to the face of the slope. Wall footings oriented parallel to the direction of the slope should be constructed in stepped footings.

3.8.2 Static Lateral Earth Pressures

In general, retaining structures should be designed to resist the lateral earth pressures due to the adjacent soils and surcharge effects. The recommended

lateral earth pressures for design of retaining structures, expressed in equivalent fluid pressures of pounds per square foot per foot of depth (pcf), are presented in the following table. These lateral earth pressures do not include hydrostatic pressures that might be caused by groundwater trapped behind the structures.

LATERAL EARTH PRESSURES FOR DESIGN OF RETAINING STRUCTURES

Backfill Condition	**Earth Pressure Component**	**Active** (pcf)	**At-Rest** (pcf)
Level Backfill	Horizontal	40	60
	Vertical	None	None
Maximum 2H:1V Sloping Backfill	Horizontal	58	76
	Vertical	30	38

The values provided above assume that granular soils less than 3 inches in maximum dimension will be used to backfill directly behind the retaining structures. The zone of granular soils with a maximum particle size of 3 inches should extend a minimum of 3 feet laterally behind the retaining walls. Backfill beyond this 3-foot zone may consist of compacted on-site soils.

We assume that the backfill behind retaining structures will be compacted to between 90 and 95 percent relative compaction. Over-compaction of the retaining structure backfill should be avoided. In general, an active condition may be used for gravity retaining walls and retaining structures that are free to deflect laterally by as much as 0.5 percent of the wall height. If the tops of the structures are not free to deflect beyond this degree, or are restrained, the retaining structures should be designed for the at-rest condition.

Surcharge stresses due to areal surcharges, line loads, and point loads within a horizontal distance equal to the depth of the retaining structures should be considered in the design. For uniform surcharge stresses imposed on the loaded side of the structure, a rectangular distribution with uniform pressure equal to 33 percent of the vertical surcharge pressure acting on the entire height of the structure, which is free to deflect (cantilever), may be used in design. For retaining structures that are restrained, a rectangular distribution equal to 50 percent of the vertical surcharge pressure acting over the entire height of the structure may be used for design. Additional analyses during design may be needed to evaluate the surcharge effects of point loads and line loads.

3.8.3 Retaining Structure Drainage

In general, retaining structures should be well drained to reduce the build-up of hydrostatic pressures. A typical drainage system would consist of a 12-inch wide zone of permeable material, such as No. 3B Fine gravel (ASTM C 33, No. 67 gradation), placed directly around a perforated pipe (perforations down) at the base of the retaining wall. The perforated pipe should discharge to an appropriate outlet or weepholes.

As an alternative, a prefabricated drainage product, such as MiraDrain or EnkaDrain, may be used instead of the permeable drainage material. The prefabricated drainage product should also be hydraulically connected to a perforated pipe at the base of the retaining wall. Unless covered by concrete or asphaltic concrete, the upper 12 inches of backfill should consist of relatively impervious materials, such as the on-site clayey soils, to reduce the potential for significant water infiltration behind the walls.

3.9 Site Grading

In general, we anticipate that cuts and fills of about 10 to 20 feet or less relative to the existing ground surface may be required in order to achieve the finished grades for the proposed project. The following grading items are addressed in the succeeding subsections:

1. Site Preparation
2. Fills and Backfills
3. Fill Placement and Compaction Requirements
4. Cut and Fill Slopes
5. Excavation

Site grading operations should be observed by a Geolabs representative to evaluate whether undesirable materials are encountered during the excavation process and to confirm whether the exposed soil/rock conditions are similar to those encountered in our field exploration.

3.9.1 Site Preparation

At the on-set of earthwork, areas within the contract grading limits should be cleared and grubbed thoroughly. Vegetation, debris, deleterious material, and other unsuitable materials should be removed and disposed of properly off-site to reduce the potential for contamination of the excavated materials.

After clearing and grubbing, finished subgrades in cut areas and areas designated to receive fills should be scarified to a minimum depth of 8 inches, moisture-conditioned to above the optimum moisture content, and compacted to a minimum of 85 percent relative compaction. Relative compaction refers to the in-place dry density of soil expressed as a percentage of the maximum dry density of the same soil established in accordance with AASHTO T-180 (ASTM D 1557). Optimum moisture is the water content (percentage by dry weight) corresponding to the maximum dry density.

Yielding areas and soft/loose areas disclosed during clearing and scarification operations should be over-excavated and backfilled with well-compacted fill materials.

3.9.2 Fills and Backfills

In general, the excavated on-site materials may be re-used as a source of general fill material provided that the materials are free of vegetation, deleterious materials, and clay lumps and rock fragments greater than 3 inches in maximum dimension.

Imported fill materials, if required, should consist of non-expansive select granular material, such as crushed coralline or basaltic materials. The materials should be well graded from coarse to fine with no particles larger than 3 inches in largest dimension and should contain between 10 and 30 percent particles passing the No. 200 sieve. The materials should have a laboratory CBR value of 20 or more and should have a maximum swell of 1 percent or less. Imported fill materials should be tested for conformance with these recommendations prior to delivery to the project site for the intended use.

3.9.3 Fill Placement and Compaction Requirements

Fill materials should be placed in level lifts not exceeding 8 inches in loose thickness, moisture-conditioned to above the optimum moisture, and compacted to at least 85 percent relative compaction. The compaction requirement should be increased to 90 percent relative compaction for fills placed within 3 feet under the pavements. Relative compaction refers to the in-place dry density of soil expressed as a percentage of the maximum dry density of the same soil established in accordance with AASHTO T-180 (ASTM D 1557). Optimum moisture is the water content (percentage by dry weight) corresponding to the maximum dry density. Compaction should be accomplished using sheepsfoot rollers, vibratory rollers, or other types of acceptable compaction equipment.

The filling operations should start at the lowest point and continue up in level horizontal compacted layers in accordance with the above fill placement recommendations. Fill slopes should be constructed by overfilling and cutting back to the design slope ratio to obtain a well-compacted slope face. Surface water should be diverted away from the tops of slopes, and slope planting should be provided as soon as possible to reduce the potential for significant erosion of the finished slopes.

It should be noted that the project site is in an area with significant rainfall throughout the year. Therefore, earthwork operations in these high rainfall areas may be difficult and will result in slower than normal earthwork operations.

3.9.4 Cut and Fill Slopes

We envision that cut slopes at the site will generally expose the stiff to very stiff silty clays and clayey silts encountered in our borings. In general, cut slopes and permanent fill slopes may be designed with a slope inclination of 2H:1V or flatter. Fills placed on slopes steeper than 5H:1V should be keyed and benched into the existing slope to provide stability of the new fill against sliding.

Construction of earth berms, interceptor ditches, and the use of geotextile fabrics over the fill slope face should be considered to reduce the potential for significant erosion, thus enhancing the long-term stability of the fill slopes. Appropriate slope planting or other erosion control measures to reduce the potential for significant erosion of the exposed slopes (including a permanent irrigation system) should be implemented as soon as possible after the finished slope faces are completed.

3.9.5 Excavation

Based on our field exploration, the project site is generally underlain by medium stiff to very stiff silty clay and clayey silt materials. We anticipate that the near-surface materials may be excavated with normal heavy excavation equipment, such as excavating with a backhoe excavator. However, it should be noted that occasional weathered and decomposed rock materials were locally encountered in our borings. Therefore, it should be noted that the contractors may encounter some difficult excavation conditions in localized areas.

The above discussions regarding the excavation of the materials are based on our visual observation of the existing site conditions and field data from the borings drilled at the site. Contractors proposing to bid on this project should be encouraged to examine the site conditions and the boring data to make their own interpretation.

3.10 Pavement Design

We understand that flexible pavements may be used for the subdivision roadways planned. In general, we anticipate that the vehicle loading for the proposed subdivision roadways would primarily consist of passenger vehicles with some light trucks only. However, consideration may be given to the anticipated heavy construction traffic that may be experienced as the home sites are developed over a period of time. Therefore, we have assumed generally light to medium traffic loading conditions for pavement design purposes.

We have assumed that the pavement subgrade soils will be similar to the silty clay and clayey silt soils encountered during our field exploration with a CBR value of about 10. On this basis, we recommend using the following preliminary pavement designs for this project.

Flexible Pavement Section

2.0-Inch Asphaltic Concrete
6.0-Inch Aggregate Base Course (95 Percent Relative Compaction)
6.0-Inch Aggregate Subbase Course (95 Percent Relative Compaction)
14.0-Inch Total Pavement Thickness on Moist Compacted Subgrade

The subgrade soils under the pavement areas should be scarified to a minimum depth of 8 inches, moisture-conditioned to above the optimum moisture, and compacted to at least 95 percent relative compaction. CBR tests and/or field observations should be performed on the actual subgrade soils during construction to confirm that the above design section is adequate. The aggregate base and subbase courses should consist of crushed basaltic aggregate compacted to a minimum of 95 percent relative compaction.

In general, paved areas should be sloped, and drainage gradients should be maintained to carry surface water off the pavements. Surface water ponding should not be allowed on-site during or after construction. Where concrete curbs are used to isolate landscaping in or adjacent to the pavement areas, we recommend extending the curbs a minimum of 2 inches into the subgrade soil to reduce the potential for migration of excessive landscape water into the pavement section.

Due to the extremely humid conditions in the Princeville area, our opinion is that there is a potential for accumulation of water in pavement subgrades, even with the implementation of the recommendations presented above. Such accumulation of water

in the subgrades can result in pumping of the pavement prism and lead to decreased service life for the pavements. Therefore, we recommend giving consideration to the installation of subdrains at the bottom of the base course in the pavement section. Prefabricated drainage materials, such as MiraDrain™, could be placed along the sides of the road prism, providing an easily installed subdrain system. The subdrains should be designed and installed to allow for drainage outside of the road prism by either discharging to catch basins or to daylight outside of the prism area.

3.11 Underground Utility Lines

We envision that new underground utility lines will be required for development. We anticipate that most of the trenches for utilities will be excavated in the on-site silty and clayey soils.

In general, granular bedding consisting of 6 inches of No. 3B Fine gravel (ASTM C 33, No. 67 gradation) is recommended for support below the pipes. Free-draining granular materials, such as No. 3B Fine gravel (ASTM C 33, No. 67 gradation), should also be used for the initial trench backfill up to about 12 inches above the pipes. It is critical to use this free-draining material to reduce the potential for formation of voids below the haunches of the pipes and to provide adequate support for the sides of the pipes. Improper backfill material around the pipes and improper placement of the backfill could result in backfill settlement and pipe damage.

The upper portion of the trench backfill from a level of 12 inches above the pipes to the top of the subgrade or finished grade should consist of granular materials generally less than 6 inches in maximum particle size. The backfill material should be moisture-conditioned to above the optimum moisture content, placed in maximum 8-inch level loose lifts, and mechanically compacted to at least 90 percent relative compaction. Where trenches will be in paved areas, the upper 3 feet of the trench backfill below the pavement grade should be compacted to no less than 95 percent relative compaction.

3.12 Drainage

The finished grades outside the houses and other structures should be sloped to shed water away from the foundations and slabs and to reduce the potential for ponding. It is also advised to install gutter systems around the buildings and to divert the discharge away from the foundation and slab areas. Excessive landscape watering near the foundations and slabs should also be avoided. Planters next to foundations (within 3 feet) should be avoided or have concrete bottoms and drains to reduce the potential for excessive water infiltration into the subsurface.

The foundation excavations should be properly backfilled against the walls or slab edges immediately after setting of the concrete to reduce potential for excessive water infiltration into the subsurface. In addition, drainage swales should be provided as soon as possible and should be maintained to drain surface water runoff away from the foundations and slabs.

Previous experience in the Princeville area indicates that, due to the very humid climate, there is a potential for seepage to occur through interior building retaining walls for basements and half basements. Therefore, careful attention should be given to the design and installation of waterproofing and subdrains for interior retaining walls. Subdrains should be installed at depths lower than the interior floor slabs and as close to the outside edge of the wall footings as possible without undermining the footing.

3.13 Design Review

Preliminary and final drawings and specifications for the proposed project should be forwarded to Geolabs for review and written comments prior to bid advertisement. This review is necessary to evaluate general conformance of the plans and specifications with the intent of the foundation and earthwork recommendations provided herein. If this review is not made, Geolabs cannot be responsible for misinterpretation of our recommendations.

3.14 Construction Monitoring

Geolabs should be retained to provide geotechnical engineering services during construction of the proposed project. The critical items of construction monitoring that require "Special Inspection" include observation of the subgrade preparation, fill placement and compaction, and foundation construction. This is to observe compliance with the design concepts, specifications, or recommendations and to expedite suggestions for design changes that may be required in the event that subsurface conditions differ from those anticipated at the time this report was prepared. The recommendations provided herein are contingent upon such observations.

If the actual exposed subsurface conditions encountered during construction are different from those assumed or considered in this report, then appropriate design modifications should be made.

END OF DISCUSSION AND RECOMMENDATIONS

SECTION 4.0 - LIMITATIONS

The analyses and recommendations submitted herein are based, in part, upon information obtained from literature research and field exploration consisting of site reconnaissance, drilled borings, and test pit excavations. Variations of subsurface conditions between and beyond the observations and test locations may occur, and the nature and extent of these variations may not become evident until construction is underway. If variations then appear evident, it will be necessary to re-evaluate the recommendations provided in this report.

The field boring locations indicated herein are approximate, having been taped from field reference stakes and existing features shown on the aerial topographic survey maps transmitted by Esaki Surveying and Mapping Inc. on January 20, 2004 and October 27, 2006. Boring elevations were estimated based on interpolation between the topographic contour lines shown on the same plan. The physical locations and elevations of the borings should be considered accurate only to the degree implied by the methods used. Esaki Surveying and Mapping Inc. surveyed the locations of the test pits excavated at the existing Landfill Areas I and II and the test pit locations were included on the aerial topographic base map transmitted to our office by same party on January 20, 2004.

The stratification lines shown on the graphic representations of the borings depict the approximate boundaries between soil/rock types and, as such, may denote a gradual transition. Water level data from the borings and test pits were measured at the times shown on the graphic representations and/or presented in the text herein. We encountered groundwater in some of the borings and test pits at the time of our field exploration. These data have been reviewed and interpretations made to formulate this report. However, it must be noted that significant fluctuation may occur due to variation in rainfall, temperature, tides, storm surges, and other factors.

This report has been prepared for the exclusive use of Princeville Prince Golf Course, LLC for specific application to the design of the proposed *Princeville Grand*

Estates Subdivision project in accordance with generally accepted geotechnical engineering principles and practices. No warranty is expressed or implied.

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

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

This geotechnical exploration conducted at the project site was not intended to investigate the potential presence of hazardous materials existing at the site. The equipment, techniques, and personnel used to conduct a geo-environmental exploration differ substantially from those applied in geotechnical engineering.

END OF LIMITATIONS

DRAFT

CLOSURE

The following plates and appendices are attached and complete this report:

Plate 1	-	Project Location Map
Plate 2	-	Site Plan
Plate 3	-	Landfill Area Site Plan
Appendix A	-	Field Exploration
Plate A	-	Boring Log Legend
Plates A-1 thru A-16	-	Logs of Borings
Appendix B	-	Previous Field Exploration
Plate B	-	Log Legend
Plates B-1 thru B-5	-	Logs of Borings
Appendix C	-	Previous Test Pit Exploration
Plates C-1 thru C-3	-	Summary of Test Pit Information
Appendix D	-	Laboratory Testing
Plates D-1 thru D-24	-	Laboratory Test Data
Appendix E	-	Previous Laboratory Testing
Plates E-1 thru E-9	-	Laboratory Test Data

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Respectfully submitted,

GEOLABS, INC.

DRAFT

By ____________________

Clayton S. Mimura, P.E.
President

CSM:DEF/SC:mj

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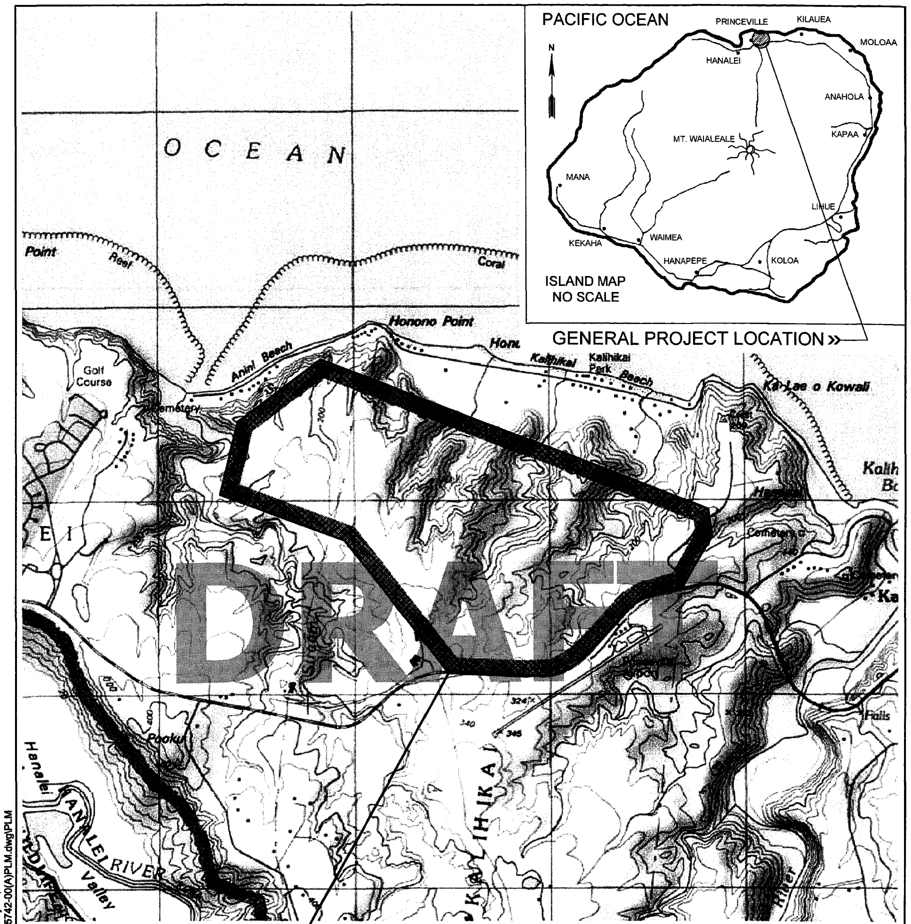
PLATES



PROJECT LOCATION

PROJECT LOCATION MAP

PRINCEVILLE GRAND ESTATES SUBDIVISION
TMK: 5-3-06: 14
PRINCEVILLE, KAUAI, HAWAII

2000 1000 0 2000 FT.
GRAPHIC SCALE

REFERENCE: MAP CREATED WITH TOPO!® ©2001 NATIONAL GEOGRAPHIC (WWW.NATIONALGEOGRAPHIC.COM/TOPO).

GEOLABS, INC. Geotechnical Engineering		
DATE: JANUARY 2007	DRAWN BY: JRP	PLATE
SCALE: 1" = 2,000'	W.O. 5742-00(A)	1

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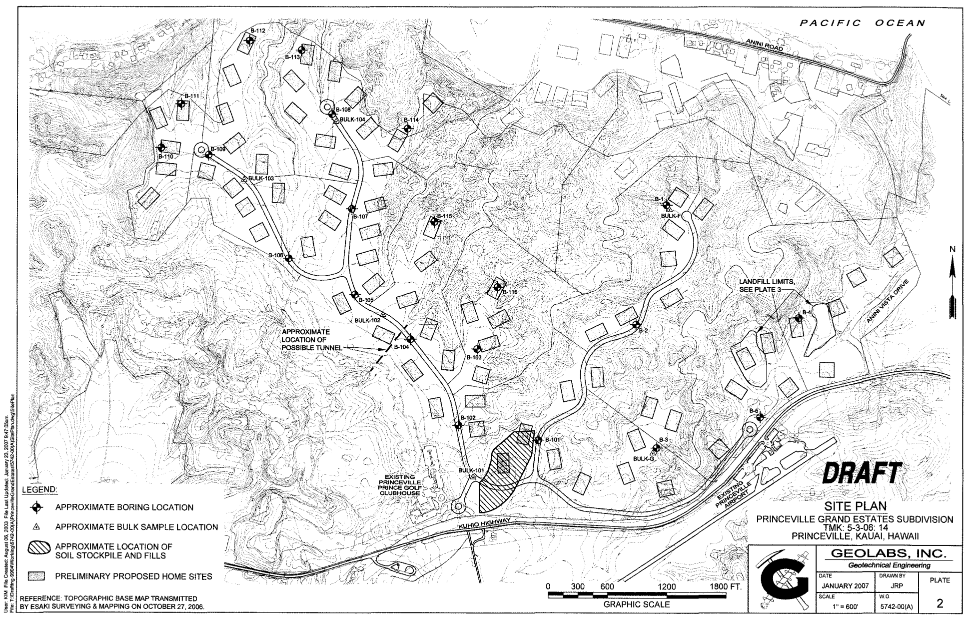

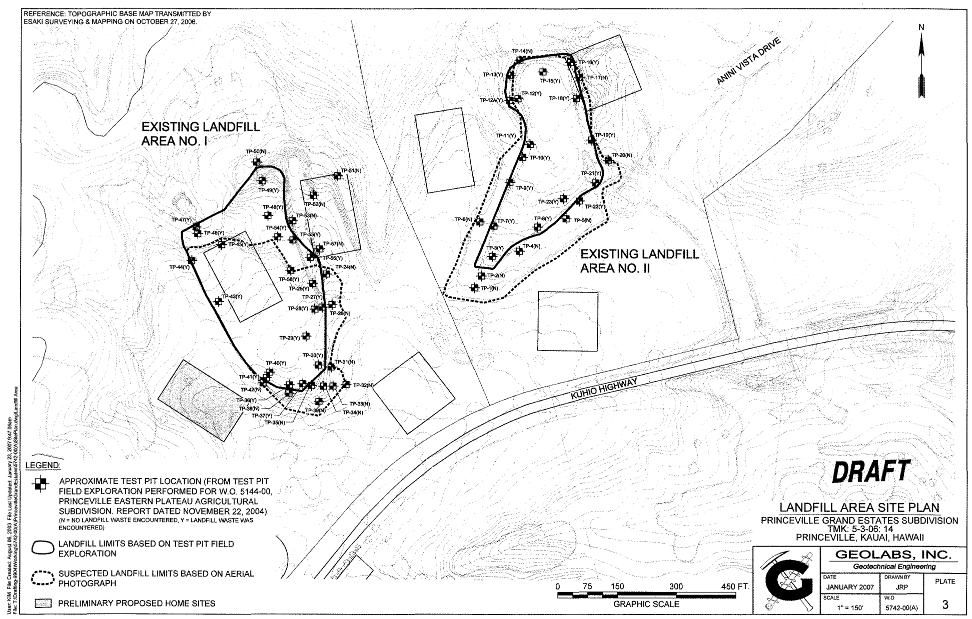

APPENDIX A

Field Exploration

APPENDIX A

Field Exploration

We explored the subsurface conditions at the project by drilling and sampling sixteen borings designated as Boring Nos. B-101 through B-116. The borings were advanced to depths ranging from approximately 21.5 to 81.5 feet below the existing ground surface. The borings were drilled using a truck-mounted drill rig equipped with continuous-flight and hollow-stem auger tools. The approximate boring locations are shown on the Site Plan, Plate 2.

The materials encountered in the borings were classified by visual and textural examination in the field by our geologist, who monitored the drilling operations on a near-continuous basis. Soils were classified in general conformance with the Unified Soil Classification System, as shown on Plate A. Graphic representations of the materials encountered are presented on the Logs of Borings, Plates A-1 through A-16.

Relatively "undisturbed" soil samples were obtained from the borings in general accordance with ASTM D 3550, Ring-Lined Barrel Sampling of Soils, by driving a 3-inch OD Modified California sampler with a 140-pound hammer falling 30 inches. In addition, some samples were obtained from the drilled borings in general accordance with ASTM D 1586, Penetration Test and Split-Barrel Sampling of Soils, by driving a 2-inch OD standard penetration sampler using the same hammer and drop. The blow counts needed to drive the sampler the second and third 6 inches of an 18-inch drive are shown as the "Penetration Resistance" on the Logs of Borings at the appropriate sample depths.

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Log Legend

UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)

MAJOR DIVISIONS			USCS	TYPICAL DESCRIPTIONS
COARSE-GRAINED SOILS	GRAVELS	CLEAN GRAVELS	GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
		LESS THAN 5% FINES	GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	GRAVELS WITH FINES	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
		MORE THAN 12% FINES	GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SANDS	CLEAN SANDS	SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
MORE THAN 50% OF MATERIAL RETAINED ON NO. 200 SIEVE		LESS THAN 5% FINES	SP	POORLY-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
	50% OR MORE OF COARSE FRACTION PASSING THROUGH NO. 4 SIEVE	SANDS WITH FINES	SM	SILTY SANDS, SAND-SILT MIXTURES
		MORE THAN 12% FINES	SC	CLAYEY SANDS, SAND-CLAY MIXTURES
FINE-GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50	ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT 50 OR MORE	MH	INORGANIC SILT, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
50% OR MORE OF MATERIAL PASSING THROUGH NO. 200 SIEVE			CH	INORGANIC CLAYS OF HIGH PLASTICITY
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

LEGEND

(2-INCH) O.D. STANDARD PENETRATION TEST

(3-INCH) O.D. MODIFIED CALIFORNIA SAMPLE

SHELBY TUBE SAMPLE

GRAB SAMPLE

CORE SAMPLE

LL	LIQUID LIMIT
PI	PLASTICITY INDEX
TV	TORVANE SHEAR (tsf)
PEN	POCKET PENETROMETER (tsf)
UC	UNCONFINED COMPRESSION (psi)
⊻	WATER LEVEL OBSERVED IN BORING

Plate A

LOG LEGEND 5742-00(A).GPJ GEOLABS.GDT 11/27/06

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PRINCEVILLE GRAND ESTATES SUBDIVISION
TMK: 5-3-06: 14
PRINCEVILLE, KAUAI, HAWAII

Log of Boring **101**

Approximate Ground Surface Elevation (feet MSL): 295 *

Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
								MH	Orangish brown **CLAYEY SILT**, very stiff, moist (fill)
	36	85			32	>4.5			
	36				7	1.5		MH	Orangish brown **CLAYEY SILT**, medium stiff, moist (residual soil)
	47	76			14	2.0	5		grades to stiff
								MH	Orangish brown with black mottling **CLAYEY SILT** with traces of moderately to highly weathered gravel (basaltic), medium stiff to stiff, moist (saprolite)
	44				8	1.0	10		
	53	69			16	3.0	15		
	61				7	1.0	20		
									Boring terminated at 21.5 feet
									* Elevations estimated from Topographic Map provided by Esaki Surverying & Mapping on October 27, 2006.
							25		
							30		
							35		

Date Started:	November 3, 2006	Water Level: ∇	Not Encountered
Date Completed:	November 3, 2006		
Logged By:	D. Sjolund	Drill Rig:	CME-55
Total Depth:	21.5 feet	Drilling Method:	4" Solid-Stem Auger
Work Order:	5742-00(A)	Driving Energy:	140 lb. wt., 30 in. drop

Plate A - 1

BORING_LOG 5742-00(A).GPJ GEOLABS.GDT 1/15/07

GEOLABS, INC.
Geotechnical Engineering

PRINCEVILLE GRAND ESTATES SUBDIVISION
TMK: 5-3-06: 14
PRINCEVILLE, KAUAI, HAWAII

Log of Boring **102**

Approximate Ground Surface Elevation (feet MSL): 325 *

Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
								MH	Orangish brown **CLAYEY SILT**, very stiff, moist (residual soil)
	42	77			18	3.8			
	41				8	2.0			grades to stiff
	41	83			15	1.8	5		
								MH	Brown with orangish brown and black mottling **CLAYEY SILT** with traces of weathered gravel (basaltic), medium stiff, very moist (saprolite)
	33				4	1.0	10		
	71	62			4	1.5	15		
								MH	Orangish brown with black mottling **CLAYEY SILT**, stiff, moist (saprolite)
	50				11	1.0	20		
	45	77			26	>4.5	25		
	54				15	1.5	30		
									Boring terminated at 31.5 feet
							35		

Date Started:	November 3, 2006	Water Level: ∇	Not Encountered
Date Completed:	November 3, 2006		
Logged By:	D. Sjolund	Drill Rig:	CME-55
Total Depth:	31.5 feet	Drilling Method:	4" Solid-Stem Auger
Work Order:	5742-00(A)	Driving Energy:	140 lb. wt., 30 in. drop

Plate A - 2

BORING_LOG 5742-00(A).GPJ GEOLABS.GDT 1/15/07

GEOLABS, INC.
Geotechnical Engineering

PRINCEVILLE GRAND ESTATES SUBDIVISION
TMK: 5-3-06: 14
PRINCEVILLE, KAUAI, HAWAII

Log of Boring
103

Approximate Ground Surface Elevation (feet MSL): 317 *

Laboratory			Field								
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Description
										MH	Brown **CLAYEY SILT**, stiff, moist (residual soil)
	39	83			14	2.5					
	35				9	1.3					
	34	88			16	1.8	5				
										MH	Brown with orangish brown and black mottling **CLAYEY SILT** with traces of highly weathered gravel (basaltic), stiff, moist (saprolite)
	39				7	1.3	10				
LL=63 PI=26	45	74			17	3.0	15				
	43				17		20				
	52	68			25	3.5	25				
	52				18	1.5	30				
											Boring terminated at 31.5 feet
							35				

Date Started:	November 1, 2006	Water Level: ∇	Not Encountered
Date Completed:	November 1, 2006		
Logged By:	D. Sjolund	Drill Rig:	CME-55
Total Depth:	31.5 feet	Drilling Method:	4" Solid-Stem Auger
Work Order:	5742-00(A)	Driving Energy:	140 lb. wt., 30 in. drop

Plate
A - 3

GEOLABS, INC.
Geotechnical Engineering

PRINCEVILLE GRAND ESTATES SUBDIVISION
TMK: 5-3-06: 14
PRINCEVILLE, KAUAI, HAWAII

Log of Boring
104

Approximate Ground Surface Elevation (feet MSL): 310 *

Laboratory			Field								
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Description
										MH	Brown **CLAYEY SILT**, stiff, moist (residual soil)
	40	76			11	1.5					
	43				7	1.0					
	45	76			15	1.8	5				
										MH	Orangish brown with reddish brown mottling **CLAYEY SILT** with traces of weathered gravel (basaltic), stiff, moist (saprolite)
	56				9	1.0	10				
	48	74			16	1.5	15				
	53				9	0.8	20				
	54	70			24	>4.5	25				
	57				6	0.5	30				
											Boring terminated at 31.5 feet
							35				

Date Started:	November 2, 2006	Water Level: ∇	Not Encountered
Date Completed:	November 2, 2006		
Logged By:	D. Sjolund	Drill Rig:	CME-55
Total Depth:	31.5 feet	Drilling Method:	4" Solid-Stem Auger
Work Order:	5742-00(A)	Driving Energy:	140 lb. wt., 30 in. drop

Plate
A - 4

GEOLABS, INC.

Geotechnical Engineering

PRINCEVILLE GRAND ESTATES SUBDIVISION
TMK: 5-3-06: 14
PRINCEVILLE, KAUAI, HAWAII

Log of Boring **105**

Approximate Ground Surface Elevation (feet MSL): 297 *

Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	USCS	Description
							MH	Orangish brown **CLAYEY SILT**, stiff, moist (residual soil)
	37	62			16	2.0		
	36				13	2.5		
	36	78			16	>4.5		
							MH	Tan **CLAYEY SILT** with traces of weathered gravel (basaltic), medium stiff, moist (saprolite)
	37				5	0.5		
	37	70			5	0.5		
							MH	Brown with black mottling **CLAYEY SILT**, stiff, moist (saprolite)
	55				10	1.3		
	50	73			43	3.0		
	48				18	2.0		
								Boring terminated at 31.5 feet

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

Date Started:	October 30, 2006	Water Level: ∇	Not Encountered
Date Completed:	October 30, 2006		
Logged By:	D. Sjolund	Drill Rig:	CME-55
Total Depth:	31.5 feet	Drilling Method:	4" Solid-Stem Auger
Work Order:	5742-00(A)	Driving Energy:	140 lb. wt., 30 in. drop

Plate A - 5

GEOLABS, INC.

Geotechnical Engineering

PRINCEVILLE GRAND ESTATES SUBDIVISION
TMK: 5-3-06: 14
PRINCEVILLE, KAUAI, HAWAII

Log of Boring **106**

Approximate Ground Surface Elevation (feet MSL): 254 *

Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	USCS	Description
							MH	Orangish brown **CLAYEY SILT** with traces of weathered gravel (basaltic), stiff, moist (residual soil)
	37	75			17	4.0		
	50				8	1.0		
	50	66			17	>4.5		grades with reddish brown
							MH	Purplish brown with gray and black mottling **CLAYEY SILT**, very stiff, moist (saprolite)
	47				18	2.8		
	56	67			19	1.5		
	48				18	2.0		
								Boring terminated at 21.5 feet

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

DRAFT

Date Started:	November 2, 2006	Water Level: ∇	Not Encountered
Date Completed:	November 2, 2006		
Logged By:	D. Sjolund	Drill Rig:	CME-55
Total Depth:	21.5 feet	Drilling Method:	4" Solid-Stem Auger
Work Order:	5742-00(A)	Driving Energy:	140 lb. wt., 30 in. drop

Plate A - 6

BORING_LOG 5742-00(A).GPJ GEOLABS.GDT 1/15/07

GEOLABS, INC.

Geotechnical Engineering

PRINCEVILLE GRAND ESTATES SUBDIVISION
TMK: 5-3-06: 14
PRINCEVILLE, KAUAI, HAWAII

Log of Boring **107**

Approximate Ground Surface Elevation (feet MSL): 278 *

Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	USCS	Description
							MH	Brown **CLAYEY SILT**, very stiff, moist (residual soil)
	40	74			18	3.3		
	32				13	2.0		
	36	80			15	3.0		
							MH	Brown and black **CLAYEY SILT** with traces of weathered gravel (basaltic), medium stiff to stiff, moist (saprolite)
	43				6	0.5		
	61	63			5	2.0		
	36				4	1.5		grades to orangish brown with red mottling
	43	70			7	2.3		
	52				7	1.0		grades to multi-colored
								Boring terminated at 31.5 feet

Date Started:	October 30, 2006	Water Level: ⊻	Not Encountered
Date Completed:	October 30, 2006		
Logged By:	D. Sjolund	Drill Rig:	CME-55
Total Depth:	31.5 feet	Drilling Method:	4" Solid-Stem Auger
Work Order:	5742-00(A)	Driving Energy:	140 lb. wt., 30 in. drop

Plate A - 7

GEOLABS, INC.

Geotechnical Engineering

PRINCEVILLE GRAND ESTATES SUBDIVISION
TMK: 5-3-06: 14
PRINCEVILLE, KAUAI, HAWAII

Log of Boring **108**

Approximate Ground Surface Elevation (feet MSL): 244 *

Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	USCS	Description
							MH	Brown **CLAYEY SILT**, stiff to very stiff, moist (residual soil)
	38	81			21	3.0		
	54				10	1.8		
							MH	Brown with red mottling **CLAYEY SILT** with traces of weathered gravel (basaltic), stiff, moist (saprolite)
	36	90			16	3.0		
	47				13	1.5		
							MH	Tan with black mottling **CLAYEY SILT**, very stiff to hard, moist (saprolite)
	40	83			83	>4.5		
							MH	Purplish brown with black mottling **CLAYEY SILT**, medium stiff to stiff, moist
	53				7	0.5		
	55	63			20	1.5		
	52				19	0.5		
								Boring terminated at 31.5 feet

Date Started:	October 30, 2006	Water Level: ⊻	Not Encountered
Date Completed:	October 30, 2006		
Logged By:	D. Sjolund	Drill Rig:	CME-55
Total Depth:	31.5 feet	Drilling Method:	4" Solid-Stem Auger
Work Order:	5742-00(A)	Driving Energy:	140 lb. wt., 30 in. drop

Plate A - 8

GEOLABS, INC. Geotechnical Engineering	PRINCEVILLE GRAND ESTATES SUBDIVISION TMK: 5-3-06: 14 PRINCEVILLE, KAUAI, HAWAII	Log of Boring 109

Approximate Ground Surface Elevation (feet MSL): 242 *

Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
								MH	Orangish and reddish brown **CLAYEY SILT**, stiff, moist (residual soil)
	46	74			11	2.0			
	37				9	1.8			
	35	91			17	4.0	5		
								MH	Brown with orangish brown mottling **CLAYEY SILT** with traces of weathered gravel (basaltic), stiff to very stiff, moist (saprolite)
	44				16	2.0	10		
	45	71			14	3.0	15		
	52				13	1.0	20		
	55	70			25	1.8	25		
	53				11	2.5	30		
									Boring terminated at 31.5 feet
							35		

Date Started:	November 2, 2006	Water Level: ⊻	Not Encountered	Plate
Date Completed:	November 2, 2006			
Logged By:	D. Sjolund	Drill Rig:	CME-55	A - 9
Total Depth:	31.5 feet	Drilling Method:	4" Solid-Stem Auger	
Work Order:	5742-00(A)	Driving Energy:	140 lb. wt., 30 in. drop	

GEOLABS, INC. Geotechnical Engineering	PRINCEVILLE GRAND ESTATES SUBDIVISION TMK: 5-3-06: 14 PRINCEVILLE, KAUAI, HAWAII	Log of Boring 110

Approximate Ground Surface Elevation (feet MSL): 237 *

Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
								MH	Orangish brown **CLAYEY SILT**, stiff to very stiff, moist (residual soil)
	41	85			24	4.0			
	33				18	2.5			
	36	80			20	2.3	5		
	38				13	2.0	10		
								MH	Orangish brown **CLAYEY SILT**, medium stiff, moist (saprolite)
	32				7	0.8	15		
								MH	Purplish and orangish brown **CLAYEY SILT**, stiff, moist (saprolite)
	45	75			19	3.5	20		
	54				10	1.3	25		grades with black mottling
	52				9	2.0	30		
							35		

Date Started:	November 13, 2006	Water Level: ⊻	Not Encountered	Plate
Date Completed:	November 13, 2006			
Logged By:	D. Sjolund	Drill Rig:	CME-55	A - 10.1
Total Depth:	81.5 feet	Drilling Method:	6" Hollow-Stem Auger	
Work Order:	5742-00(A)	Driving Energy:	140 lb. wt., 30 in. drop	

GEOLABS, INC.
Geotechnical Engineering

PRINCEVILLE GRAND ESTATES SUBDIVISION
TMK: 5-3-06: 14
PRINCEVILLE, KAUAI, HAWAII

Log of Boring **110**

(Continued from previous plate)

Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
	47	72			21	1.8		MH	
	52				9	1.5	40		
	52				12	2.3	45		
	55	71			22	1.5	50		
	56				11	1.3	55		
								MH	Purplish brown with multi-color mottling **CLAYEY SILT**, stiff to very stiff, moist (saprolite)
	62				14	1.5	60		
	54	69			22	1.3	65		
							70		

Date Started:	November 13, 2006	Water Level: ⊻	Not Encountered
Date Completed:	November 13, 2006		
Logged By:	D. Sjolund	Drill Rig:	CME-55
Total Depth:	81.5 feet	Drilling Method:	6" Hollow-Stem Auger
Work Order:	5742-00(A)	Driving Energy:	140 lb. wt., 30 in. drop

Plate A - 10.2

GEOLABS, INC.
Geotechnical Engineering

PRINCEVILLE GRAND ESTATES SUBDIVISION
TMK: 5-3-06: 14
PRINCEVILLE, KAUAI, HAWAII

Log of Boring **110**

(Continued from previous plate)

Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
	50				17	3.3		MH	
	55				15	2.5	75		
	63	65			18	2.0	80		
									Boring terminated at 81.5 feet
							85		
							90		
							95		
							100		
							105		

Date Started:	November 13, 2006	Water Level: ⊻	Not Encountered
Date Completed:	November 13, 2006		
Logged By:	D. Sjolund	Drill Rig:	CME-55
Total Depth:	81.5 feet	Drilling Method:	6" Hollow-Stem Auger
Work Order:	5742-00(A)	Driving Energy:	140 lb. wt., 30 in. drop

Plate A - 10.3

GEOLABS, INC.

Geotechnical Engineering

PRINCEVILLE GRAND ESTATES SUBDIVISION
TMK: 5-3-06: 14
PRINCEVILLE, KAUAI, HAWAII

Log of Boring **111**

Approximate Ground Surface Elevation (feet MSL): 224 *

Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
	35	78			51	>4.5		MH	Brown **CLAYEY SILT** with traces of moderately weathered gravel (basaltic), very stiff to hard, moist (saprolite)
	37				28	2.5			
	38	83			59	>4.5	5		
								MH	Tan with multi-color mottling **CLAYEY SILT**, stiff, moist (saprolite)
	40				13	1.3	10		
LL=65 PI=26	47				10	1.0	15		
								MH	Purplish brown **CLAYEY SILT**, stiff to very stiff, moist (saprolite)
	44	73			38	2.5	20		
	50				13	1.5	25		grades with black mottling
								MH-SM	Purplish brown with black mottling **CLAYEY SILT** with traces of weathered gravel (basaltic) and fine sand, very stiff, moist (saprolite)
	48				36	2.3	30		
							35		

Date Started:	November 13, 2006	Water Level: ⊻	54.8 ft. 11/13/06 1135 HRS
Date Completed:	November 14, 2006		
Logged By:	D. Sjolund	Drill Rig:	CME-55
Total Depth:	60.1 feet	Drilling Method:	6" Hollow-Stem Auger
Work Order:	5742-00(A)	Driving Energy:	140 lb. wt., 30 in. drop

Plate A - 11.1

GEOLABS, INC.

Geotechnical Engineering

PRINCEVILLE GRAND ESTATES SUBDIVISION
TMK: 5-3-06: 14
PRINCEVILLE, KAUAI, HAWAII

Log of Boring **111**

(Continued from previous plate)

Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
	53	74			22	3.3		MH-SM	
								MH-SM	Orangish brown **CLAYEY SILT** with some fine sand, soft, very moist (saprolite)
	67				4	0.5	40		
	58				7	0.8	45		
								MH-SM	Brown with gray and black mottling **CLAYEY SILT** with traces of weathered gravel (basaltic) and fine sand, very stiff, very moist (saprolite)
	52	74			27	3.0	50		
	2				18/.3' Ref.		55		Gray vesicular **BASALT**, medium hard to hard (basalt formation)
					15/.1' Ref.		60		Boring terminated at 60.1 feet
							65		
							70		

Date Started:	November 13, 2006	Water Level: ⊻	54.8 ft. 11/13/06 1135 HRS
Date Completed:	November 14, 2006		
Logged By:	D. Sjolund	Drill Rig:	CME-55
Total Depth:	60.1 feet	Drilling Method:	6" Hollow-Stem Auger
Work Order:	5742-00(A)	Driving Energy:	140 lb. wt., 30 in. drop

Plate A - 11.2

GEOLABS, INC.

Geotechnical Engineering

PRINCEVILLE GRAND ESTATES SUBDIVISION
TMK: 5-3-06: 14
PRINCEVILLE, KAUAI, HAWAII

Log of Boring **112**

Approximate Ground Surface Elevation (feet MSL): 218 *

Other Tests (Laboratory)	Moisture Content (%) (Laboratory)	Dry Density (pcf) (Laboratory)	Core Recovery (%) (Field)	RQD (%) (Field)	Penetration Resistance (blows/foot) (Field)	Pocket Pen. (tsf) (Field)	Depth (feet)	USCS	Description
								MH	Orangish brown **CLAYEY SILT**, very stiff, moist (residual soil)
	27	103			32	>4.5			
	30				16	2.5			
	29	89			23	>4.5	5		
								MH	Purplish brown **CLAYEY SILT** with traces of weathered gravel (basaltic), stiff, moist (saprolite)
	47				9	1.3	10		
	45				12	1.5	15		grades with black mottling
								MH	Orangish brown **CLAYEY SILT** with traces of fine sand, stiff, moist (saprolite)
	39	90			16	4.5	20		
								MH	Reddish brown with tan and black mottling **CLAYEY SILT** with traces of fine sand, soft, moist (saprolite)
	57				4	0.8	25		
	56				8	1.0	30		grades to medium stiff to stiff
							35		

Date Started:	November 14, 2006	Water Level: ∇	Not Encountered
Date Completed:	November 14, 2006		
Logged By:	D. Sjolund	Drill Rig:	CME-55
Total Depth:	81.5 feet	Drilling Method:	6" Hollow-Stem Auger
Work Order:	5742-00(A)	Driving Energy:	140 lb. wt., 30 in. drop

Plate A - 12.1

GEOLABS, INC.

Geotechnical Engineering

PRINCEVILLE GRAND ESTATES SUBDIVISION
TMK: 5-3-06: 14
PRINCEVILLE, KAUAI, HAWAII

Log of Boring **112**

(Continued from previous plate)

Other Tests (Laboratory)	Moisture Content (%) (Laboratory)	Dry Density (pcf) (Laboratory)	Core Recovery (%) (Field)	RQD (%) (Field)	Penetration Resistance (blows/foot) (Field)	Pocket Pen. (tsf) (Field)	Depth (feet)	USCS	Description
	53	71			25	2.5		MH-SM	Purplish brown with black mottling **CLAYEY SILT** with traces of weathered gravel (basaltic) and fine sand, stiff to very stiff, moist (saprolite)
	51				13	1.5	40		
	46				22	2.0	45		grades with grayish brown
	57	69			17	1.8	50		grades to purplish brown with black mottling
	54				11	2.3	55		
LL=61 PI=24					16	2.0	60		
	55	65			11	1.5	65		
							70		

Date Started:	November 14, 2006	Water Level: ∇	Not Encountered
Date Completed:	November 14, 2006		
Logged By:	D. Sjolund	Drill Rig:	CME-55
Total Depth:	81.5 feet	Drilling Method:	6" Hollow-Stem Auger
Work Order:	5742-00(A)	Driving Energy:	140 lb. wt., 30 in. drop

Plate A - 12.2

GEOLABS, INC.
Geotechnical Engineering

PRINCEVILLE GRAND ESTATES SUBDIVISION
TMK: 5-3-06: 14
PRINCEVILLE, KAUAI, HAWAII

Log of Boring **112**

(Continued from previous plate)

Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
	65				9	1.0		MH-SM	grades to very moist
	61				17	2.0	75		
	61	68			25	2.5	80		
									Boring terminated at 81.5 feet
							85		
							90		
							95		
							100		
							105		

DRAFT

Date Started:	November 14, 2006	Water Level: ∇	Not Encountered
Date Completed:	November 14, 2006		
Logged By:	D. Sjolund	Drill Rig:	CME-55
Total Depth:	81.5 feet	Drilling Method:	6" Hollow-Stem Auger
Work Order:	5742-00(A)	Driving Energy:	140 lb. wt., 30 in. drop

Plate A - 12.3

BORING_LOG 5742-00(A).GPJ GEOLABS.GDT 1/15/07

GEOLABS, INC.
Geotechnical Engineering

PRINCEVILLE GRAND ESTATES SUBDIVISION
TMK: 5-3-06: 14
PRINCEVILLE, KAUAI, HAWAII

Log of Boring **113**

Approximate Ground Surface Elevation (feet MSL): 220 *

Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
								MH	Orangish brown **CLAYEY SILT**, very stiff to hard, moist (residual soil)
	37	85			69	>4.5			
	37				39	4.3			
	39	79			40	>4.5	5		
								MH	Reddish and purplish brown **CLAYEY SILT** with traces of fine sand, stiff to very stiff, moist (saprolite)
	41				13	3.3	10		
LL=56 PI=20	38				14	2.5	15		
	42	76			21	>4.5	20		
	43				23	2.0	25		
	43				17	1.8	30		grades with black and tan mottling
							35		

DRAFT

Date Started:	November 15, 2006	Water Level: ∇	Not Encountered
Date Completed:	November 15, 2006		
Logged By:	D. Sjolund	Drill Rig:	CME-55
Total Depth:	81.5 feet	Drilling Method:	6" Hollow-Stem Auger
Work Order:	5742-00(A)	Driving Energy:	140 lb. wt., 30 in. drop

Plate A - 13.1

BORING_LOG 5742-00(A).GPJ GEOLABS.GDT 1/15/07

GEOLABS, INC.
Geotechnical Engineering

PRINCEVILLE GRAND ESTATES SUBDIVISION
TMK: 5-3-06: 14
PRINCEVILLE, KAUAI, HAWAII

Log of Boring **113**

(Continued from previous plate)

Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
	35	83			28	>4.5		MH	grades with traces of weathered gravel (basaltic)
	42				10	1.0	40		
								CH-MH	Red with black mottling **SILTY CLAY**, soft, moist (saprolite/completely weathered clinker)
	59				5	0.8	45		
								MH	Purplish brown with red and black mottling **CLAYEY SILT** with traces of fine sand, stiff to very stiff, moist (saprolite)
	52	70			18	2.5	50		
	48				7	1.0	55		
	56				13	1.5	60		
	44	78			32	2.5	65		
							70		

Date Started:	November 15, 2006	Water Level: ⊻	Not Encountered
Date Completed:	November 15, 2006		
Logged By:	D. Sjolund	Drill Rig:	CME-55
Total Depth:	81.5 feet	Drilling Method:	6" Hollow-Stem Auger
Work Order:	5742-00(A)	Driving Energy:	140 lb. wt., 30 in. drop

Plate A - 13.2

GEOLABS, INC.
Geotechnical Engineering

PRINCEVILLE GRAND ESTATES SUBDIVISION
TMK: 5-3-06: 14
PRINCEVILLE, KAUAI, HAWAII

Log of Boring **113**

(Continued from previous plate)

Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
	55				9	1.5		MH	
								MH	Brown with black and gray mottling **CLAYEY SILT** with traces of fine sand, very stiff, moist (saprolite)
	47				28	>4.5	75		
	42	81			42	2.0	80		
									Boring terminated at 81.5 feet
							85		
							90		
							95		
							100		
							105		

Date Started:	November 15, 2006	Water Level: ⊻	Not Encountered
Date Completed:	November 15, 2006		
Logged By:	D. Sjolund	Drill Rig:	CME-55
Total Depth:	81.5 feet	Drilling Method:	6" Hollow-Stem Auger
Work Order:	5742-00(A)	Driving Energy:	140 lb. wt., 30 in. drop

Plate A - 13.3

GEOLABS, INC.
Geotechnical Engineering

PRINCEVILLE GRAND ESTATES SUBDIVISION
TMK: 5-3-06: 14
PRINCEVILLE, KAUAI, HAWAII

Log of Boring **114**

Approximate Ground Surface Elevation (feet MSL): 245 *

Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
								CL	Orangish brown **SILTY CLAY**, stiff to very stiff, moist (residual soil)
	34	75			16	>4.5			
LL=50 PI=24	35				21	2.5			
	31	82			48	>4.5	5		grades with traces of highly weathered gravel (basaltic)
								MH	Orangish and grayish brown **CLAYEY SILT** with traces of weathered gravel (basaltic), very stiff, moist (saprolite)
	33				25	3.3	10		
	44	72			36	>4.5	15		
	45				12	2.0	20		
	44				29	1.0	25		grades with black mottling
	42	74			30	3.0	30		
								MH-SM	
							35		

Date Started:	October 31, 2006	Water Level: ∇	Not Encountered
Date Completed:	October 31, 2006		
Logged By:	D. Sjolund	Drill Rig:	CME-55
Total Depth:	81.5 feet	Drilling Method:	4" Solid-Stem Auger
Work Order:	5742-00(A)	Driving Energy:	140 lb. wt., 30 in. drop

Plate A - 14.1

BORING_LOG 5742-00(A).GPJ GEOLABS.GDT 1/23/07

GEOLABS, INC.
Geotechnical Engineering

PRINCEVILLE GRAND ESTATES SUBDIVISION
TMK: 5-3-06: 14
PRINCEVILLE, KAUAI, HAWAII

Log of Boring **114**

(Continued from previous plate)

Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
	44				11	1.0		MH-SM	Tan and purple with black mottling **CLAYEY SILT** with some fine sand, stiff to very stiff, moist (saprolite)
	49				12	1.3	40		
	58	67			36	3.0	45		
	51				15	1.5	50		
	49								
	55				17	2.0	55		
	56	65			32	3.8	60		
	58				17	2.0	65		
								MH-SM	Brown with multi-color mottling **CLAYEY SILT** with some fine sand, very stiff, moist (saprolite)
							70		

Date Started:	October 31, 2006	Water Level: ∇	Not Encountered
Date Completed:	October 31, 2006		
Logged By:	D. Sjolund	Drill Rig:	CME-55
Total Depth:	81.5 feet	Drilling Method:	4" Solid-Stem Auger
Work Order:	5742-00(A)	Driving Energy:	140 lb. wt., 30 in. drop

Plate A - 14.2

BORING_LOG 5742-00(A).GPJ GEOLABS.GDT 1/23/07

GEOLABS, INC. Geotechnical Engineering	PRINCEVILLE GRAND ESTATES SUBDIVISION TMK: 5-3-06: 14 PRINCEVILLE, KAUAI, HAWAII	Log of Boring 114

(Continued from previous plate)

Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	USCS	Description
	56				30		MH-SM	
	52	68			49	>4.5		
	55				25	1.8		
								Boring terminated at 81.5 feet

Depth (feet): 75, 80, 85, 90, 95, 100, 105

Date Started:	October 31, 2006	Water Level: ⊻	Not Encountered	Plate
Date Completed:	October 31, 2006			
Logged By:	D. Sjolund	Drill Rig:	CME-55	
Total Depth:	81.5 feet	Drilling Method:	4" Solid-Stem Auger	A - 14.3
Work Order:	5742-00(A)	Driving Energy:	140 lb. wt., 30 in. drop	

GEOLABS, INC. Geotechnical Engineering	PRINCEVILLE GRAND ESTATES SUBDIVISION TMK: 5-3-06: 14 PRINCEVILLE, KAUAI, HAWAII	Log of Boring 115

Approximate Ground Surface Elevation (feet MSL): 262 *

Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	USCS	Description
							MH	Orangish brown **CLAYEY SILT**, stiff to very stiff, moist (residual soil)
	43	80			16	4.5		
	37				16	2.5		
	34	85			29	>4.5		
							MH	Brown with multi-color mottling **CLAYEY SILT** with traces of weathered gravel (basaltic) and fine sand, stiff, moist (saprolite)
LL=67 PI=34	42				9	2.0		
	53				6	1.3		
	49	68			14	4.0		
							MH	Purplish brown with black mottling **CLAYEY SILT** with some fine sand, stiff to very stiff, moist (saprolite)
	49				19	2.5		
	47				12	1.3		
							MH-SM	

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

DRAFT

Date Started:	November 15, 2006	Water Level: ⊻	Not Encountered	Plate
Date Completed:	November 16, 2006			
Logged By:	D. Sjolund	Drill Rig:	CME-55	
Total Depth:	81.5 feet	Drilling Method:	6" Hollow-Stem Auger	A - 15.1
Work Order:	5742-00(A)	Driving Energy:	140 lb. wt., 30 in. drop	

GEOLABS, INC.
Geotechnical Engineering

PRINCEVILLE GRAND ESTATES SUBDIVISION
TMK: 5-3-06: 14
PRINCEVILLE, KAUAI, HAWAII

Log of Boring **115**

(Continued from previous plate)

Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
	44	84			38	>4.5		MH-SM	Purplish brown with black and gray mottling **CLAYEY SILT** with traces of weathered gravel (basaltic) and fine sand, very stiff, moist (saprolite)
	45				19	1.3	40		
	46				22	2.3	45		
	45	80			36	2.5	50		
	50				14	0.8	55		
	52				15	2.3	60		
	48	77			84	>4.5	65		
							70	MH-SM	

Date Started:	November 15, 2006	Water Level: ⊻	Not Encountered
Date Completed:	November 16, 2006		
Logged By:	D. Sjolund	Drill Rig:	CME-55
Total Depth:	81.5 feet	Drilling Method:	6" Hollow-Stem Auger
Work Order:	5742-00(A)	Driving Energy:	140 lb. wt., 30 in. drop

Plate A - 15.2

GEOLABS, INC.
Geotechnical Engineering

PRINCEVILLE GRAND ESTATES SUBDIVISION
TMK: 5-3-06: 14
PRINCEVILLE, KAUAI, HAWAII

Log of Boring **115**

(Continued from previous plate)

Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
	52				28	2.5		MH-SM	Gray with orangish brown mottling **CLAYEY SILT** with traces of fine sand, very stiff to hard, moist (saprolite)
	56				42	3.0	75		
	46	78			41	>4.5	80		
									Boring terminated at 81.5 feet
							85		
							90		
							95		
							100		
							105		

Date Started:	November 15, 2006	Water Level: ⊻	Not Encountered
Date Completed:	November 16, 2006		
Logged By:	D. Sjolund	Drill Rig:	CME-55
Total Depth:	81.5 feet	Drilling Method:	6" Hollow-Stem Auger
Work Order:	5742-00(A)	Driving Energy:	140 lb. wt., 30 in. drop

Plate A - 15.3