GEOTECHNICAL ENGINEERING EXPLORATION

FARRINGTON HIGHWAY IMPROVEMENTS

KAPOLEI GOLF COURSE ROAD TO FORT WEAVER ROAD

EWA, OAHU, HAWAII

W.O. 8135-00 AUGUST 4, 2021

Prepared for

R. M. TOWILL CORPORATION

GEOLABS, INC.

Geotechnical Engineering and Drilling Services

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ROBIN M. LIM
LICENSED PROFESSIONAL ENGINEER
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HAWAII, U.S.A.

THIS WORK WAS PREPARED BY
ME OR UNDER MY SUPERVISION.

SIGNATURE

4-30-22
EXPIRATION DATE
OF THE LICENSE

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GEOLABS, INC.

Geotechnical Engineering and Drilling Services

August 4, 2021
W.O. 8135-00

Mr. Craig W.L. Luke, P.E.
R. M. Towill Corporation
2024 North King Street, Suite 200
Honolulu, HI 96819

Dear **Mr. Luke:**

Geolabs, Inc. is pleased to submit our report entitled "Geotechnical Engineering Exploration, Farrington Highway Improvements, Kapolei Golf Course Road to Fort Weaver Road, Ewa, Oahu, Hawaii" prepared in support of the design of the roadway improvements project.

Our work was performed in general accordance with the scope of services outlined in our fee proposals dated January 3, 2018 and the Professional Services Agreement entered into on May 13, 2020.

Please note that the soil and rock core samples recovered during our field exploration (remaining after testing) will be stored for a period of two months from the date of this report. The samples will be discarded after that date unless arrangements are made for a longer sample storage period. Please contact our office for alternative sample storage requirements, if appropriate.

Detailed discussion and specific design recommendations are contained in the body of the report. If there is any point that is not clear, please contact our office.

Very truly yours,

GEOLABS, INC.

Robin M. Lim, P.E.
President

RML:TK:rl

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SUMMARY OF FINDINGS AND RECOMMENDATIONS

Based on our literature research, site reconnaissance, and field explorations performed for the proposed highway improvements project, we anticipate the proposed highway widening alignment will traverse near-surface fill materials, alluvial deposits, and residual soil deposits at relatively shallow depths. Saprolites, clinkers, and basalt formation were encountered at greater depths in the borings drilled for the replacement bridges at Kaloi Gulch and Honouliuli Stream.

In general, we anticipate the scour potential at the new bridge structure locations and the relatively heavy structural load demands will require supporting the bridges on a deep foundation system, such as cast-in-place concrete drilled shafts. The drilled shaft foundations would derive support principally from adhesion between the drilled shaft and the stiff alluvial and residual soils, saprolites, and/or the medium hard to very hard basalt formation encountered. Based on the structural load demands provided for our engineering analyses, a drilled shaft diameter of 4 feet and an embedment length of 80 feet (Abutment #1) and 75 feet (Abutment #2) may be used for design of the new replacement bridge at Kaloi Gulch. A drilled shaft diameter of 4 feet and an embedment length of 86 feet (Abutment #1) and 82 feet (Abutment #2) may be used for design of the new replacement bridge at Honouliuli Stream.

In general, the box culvert and pipe culvert structures planned for the highway improvements project may be supported on a shallow mat foundation bearing on the relatively stiff soils at the crossing locations. In the event that soft soils are encountered at the design invert elevations of the box and pipe culvert locations, the exposed soft soils within the limits of these drainage structures should be removed and replaced with compacted fills.

Based on the subsurface conditions encountered along the proposed highway widening alignment, we believe slope inclinations of 2H:1V may be used for the design of the planned cut and fill slopes. Further study should be conducted to provide site-specific recommendations pertaining to cut and fill slopes with slope inclinations steeper than the recommended slope inclinations.

In general, we believe the excavated materials may be re-used as a source of fill materials for embankment construction. Because the project site is situated in an area with extended dry weather conditions throughout the year, moisture conditioning of the on-site soils and fill materials would be a critical item during the earthwork construction.

Based on the proposed depths of the utilities crossing Honouliuli Stream, we envision installation of these underground utilities likely will be by microtunneling and/or horizontal directional drilling (HDD) methods. Based on the subsurface conditions encountered, the microtunneling and/or HDD alignments likely will run into and out of the stiff alluvial deposits and/or residual soil deposits, and possibly hard basalt formation in localized areas. Due to the difference in the consistency and/or hardness of the soil deposits and rock formation, there may be a potential for deviation of the microtunneling machine and/or HDD drilling tools from the planned lines and grades. Therefore, special attention should be given to and adjustments should be made continuously during the microtunneling and/or HDD methods to keep the cutting tools advancing the holes to be on course.

The text of this report should be referred to for detailed discussion and specific design recommendations.

END OF SUMMARY OF FINDINGS AND RECOMMENDATIONS

SECTION 1. GENERAL

This report presents the results of our geotechnical engineering exploration and engineering analyses performed in support of the design of the proposed *Farrington Highway Improvements, Kapolei Golf Course Road to Fort Weaver Road* project in the Ewa area on the Island of Oahu, Hawaii. The project location and general vicinity are shown on the Project Location Map, Plate 1.

This report summarizes the findings and presents our geotechnical recommendations based on our field explorations, laboratory testing, and engineering analyses. The recommendations presented herein are intended for the design of foundations, retaining structures, drainage structures, earthwork, pavements, and underground utility lines only. The findings and recommendations presented herein are subject to the limitations noted at the end of this report.

1.1 Project Considerations

The proposed highway improvements project is along a portion of Farrington Highway (between Kapolei Golf Course Road and Fort Weaver Road) for a total distance of about 17,000 linear feet. Geolabs conducted a preliminary geotechnical engineering exploration in the Year 1999 for the conceptual study of widening the existing two-lane road to a four-lane highway. We understand the current design calls for widening the existing two-lane road to a four-lane highway with provisions for up to six lanes in the future with a total Right-of-Way of up to 140 feet wide to accommodate the regional growth in traffic and to improve local circulation and safety.

The widened highway will consist of a divided paved roadway with four lanes (with provisions for six lanes in the future), 20-foot wide median, 10-foot wide planter shoulder, 10-foot wide concrete sidewalks, and bicycle lanes. The proposed highway improvements also will include intersection improvements, traffic signals, overhead signs, storage lanes, turning lanes, and acceleration and deceleration lanes. We also envision utility line improvements, such as construction, relocation, and/or realignment of water, irrigation, electrical, telephone, and cable telephone facilities, will be necessary for the proposed highway widening project.

Based on the information provided, the widening project generally will follow the existing Farrington Highway alignment. In order to reduce the potential impacts from the existing terrain and utilities, the widening project generally will be on the makai side of the highway from Kapolei Golf Course Road to just past the electrical substation/Board of Water Supply (BWS) sites. Thereafter, the highway widening will switch over to the mauka side of the highway to the Fort Weaver Road Interchange.

The proposed highway widening alignment will traverse two stream crossings, which will require replacement of the existing bridge structures to accommodate a wider roadway. The two bridge structures include the Kaloi Gulch Bridge at about Sta. 64+00 and the Honouliuli Stream Bridge at about Sta. 149+50. In addition to these bridge structures, the proposed highway widening project also will involve extending, realigning, or removing and replacing a number of box culverts and pipe culvert structures of different sizes at the other drainage crossings for drainage improvements. In addition, we envision some of the existing culverts may need to be removed and replaced with larger sized culverts to improve the hydraulic capacities. As part of the project construction, we envision the existing traffic signal at the Kualakai Parkway intersection with Farrington Highway will need to be relocated to accommodate the roadway improvements project.

Based on the information provided, we understand new water, gas, and fuel lines will need to be installed beneath Honouliuli Stream using microtunneling and/or horizontal directional drilling (HDD) methods. The design invert elevations of these utility lines will extend down to about +55 feet Mean Sea Level (MSL). The new 30-inch and 36-inch water mains (both to be installed within a 60-inch diameter steel casing) will be installed using microtunneling methods and the new 8-inch and 10-inch fuel lines and 16-inch gas line likely will be installed using HDD methods.

Based on the relatively flat site topography along the general roadway alignment, we anticipate the majority of the cuts and fills will be on the order of less than about 5 feet deep or thick. However, cuts on the order of about 15 feet deep and embankment fills of up to about 15 feet thick may be required in localized areas to achieve the design finished grades. As part of the project construction, we envision new retaining walls may be required for grade separation along some of the proposed cut and fill areas, especially around the Honouliuli Stream Bridge and toward Fort Weaver Road.

As part of the field exploration program, percolation tests were performed at selected locations to evaluate the infiltration characteristics of the subsurface materials along the highway widening alignment in support of the design of storm water runoff disposal system.

1.2 Purpose and Scope

The purpose of our field exploration was to obtain an overview of the surface and subsurface conditions to develop a generalized subsurface data set to formulate geotechnical recommendations for design of bridge foundations, retaining structures, drainage structures, earthwork, pavements, and underground utility lines only. The scope of work for this exploration included the following tasks and work efforts:

1. Research and review of the available plans and in-house soil and geologic information related to the project area, including the following reports:

   "Preliminary Geotechnical Engineering Report, Farrington Highway Widening, Kapolei Golf Course Road to Fort Weaver Road, Ewa, Oahu, Hawaii" dated March 29, 2000 by Geolabs, Inc.

   "Pavement Justification Report, Farrington Highway Widening, Kapolei Golf Course Road to Fort Weaver Road, Ewa, Oahu, Hawaii" dated August 21, 2002 by Geolabs, Inc.

2. Staking out of boring locations and coordination of underground utility line clearance.

3. Procurement of the necessary excavation permits as required by the State of Hawaii, Department of Transportation and the City and County of Honolulu, Department of Planning and Permitting.

4. Provision of traffic control at the proposed boring locations during our field exploration program.

5. Mobilization and demobilization of a bulldozer with operator for mechanized trail clearing to the proposed boring locations.

6. Mobilization and demobilization of truck-mounted drill rigs, water trucks, and operators to the project site and back.

7. Drilling and sampling of 50 borings extending to depths ranging from about 4 to 121 feet below the existing ground and/or pavement surface for a total of approximately 1,247 linear feet of exploration.

8. Performance of seismic shear wave velocity profiling to depths of about 100.6 and 118.3 feet below the ground surface within two of the drilled borings.

9. Coordination of the field exploration and logging of the borings by our geologists.

10. Performance of four field infiltration tests to evaluate the hydraulic characteristics of the subsurface materials to provide information in support of the design of the storm water runoff disposal system.

11. Laboratory testing of selected soil and core samples obtained during the field exploration as an aid in classifying the materials and evaluating their engineering properties.

12. Analyses of the field and laboratory test data to formulate geotechnical recommendations for the design of bridge foundations, retaining structures, drainage structures, earthwork, pavements, and underground utility lines for the proposed project.

13. Preparation of this report summarizing our work and presenting our findings and recommendations.

14. Coordination of our overall work on the project by our senior engineer.

15. Quality assurance and client/design team consultation by our principal engineer.

16. Miscellaneous work efforts such as drafting, word processing, clerical support, and reproductions.

Detailed descriptions of our field exploration methodology and the Logs of Borings are presented in Appendix A. Results of the seismic shear wave velocity profiling is presented in Appendix B. The laboratory test results of selected soil and core samples obtained from our field exploration are presented in Appendix C. Results of the infiltration tests performed at selected locations are presented in Appendix D.

Photographs of the asphaltic concrete cores are presented in Appendix E, and photographs of the core samples are presented in Appendix F. Logs of Borings of the field exploration from the Year 1999 is provided in Appendix G for information purposes and for ease of reference.

END OF GENERAL

SECTION 2. SITE CHARACTERIZATION

Of interest to our geotechnical analysis for foundation design of the new bridge structures and the geotechnical aspects of the highway improvements project are the subsurface materials encountered at the project site, the engineering properties of the materials encountered, and the variability of the subsurface conditions across the project site. Therefore, the following subsections provide a description of the geologic setting of the project site, the surface and subsurface conditions encountered at the site, and a discussion on the items needed for seismic design, such as soil liquefaction, soil profile for the elastic response spectrum, etc.

2.1 Regional Geology

The Island of Oahu was built by the extrusion of basalt and basaltic lavas from the Waianae and Koolau Shield Volcanoes. The older Waianae Volcano is estimated to be middle to late Pliocene in age and forms the bulk of the western one-third of the island. The younger Koolau Volcano is estimated to be late Pliocene to early Pleistocene (Ice Age) in age and forms the majority of the eastern two-thirds of the island. As volcanic activity in Waianae Volcano ceased, lava flows from Koolau Volcano banked against its eroded eastern slope forming a broad plateau, known as Schofield Plateau.

Following the extrusion of lavas in the early Pleistocene Epoch, the island underwent a long cycle of erosion and weathering forming the prominent ridgelines and summits as we know today. During the erosion period, the Island of Oahu began to slowly subside by more than 1,200 feet in elevation, resulting in the drowning and sedimentation of the valleys and the formation of the steep Koolau Pali. Coral reefs continued to grow in the surrounding shallow waters of the island.

From the mid to late Pleistocene Epoch, the sea level rose and fell repeatedly in response to global glaciation and the availability of surface waters to sustain the oceans. The various sea level elevations and their representative deposits are known as “stands” and include from oldest to youngest: (1) the Kahuku; (2) Kahipa; (3) Kaena; (4) Laie; (5) Waialae; (6) Waipio; and (7) Waimanalo stands. Geologic deposits associated with the various sea level stands, including marine sediments and coral reefs, were deposited and subsequently altered or removed by later sea level fluctuation. Therefore, depositional records reflecting the changes in sea level and the occurrence of emerged coral reef deposits are often incomplete.

The project site is situated on the Ewa Plain to the southeast of the Waianae Mountains. The Ewa Plain is a gently sloping alluvial plain formed by the deposition of alluvial clays and silts derived from the weathering of basalt rock further upslope. The alluvial deposits accumulated and the materials interbedded with marine sediments and coral/algal reef formations to form a sedimentary wedge. The thickness of the sedimentary wedge ranges from zero in the area of the Interstate Route H-1 Highway to over 1,000 feet at Ewa Beach. This wedge forms the Ewa Plain and serves as the confining formation, or “caprock,” over the artesian basal aquifers of Southern Oahu. Basalt rock formation resides below the alluvial and marine deposits.

The project is situated on a broad alluvial apron that flanks the southern margin of the Schofield Plateau. Agricultural development within the last 100 years along with more recent land developments have brought the Kapolei/Ewa area to its present form.

2.2 <u>Site Description</u>

The proposed Farrington Highway Improvements alignment generally runs parallel and to the south of the Interstate Route H-1 Highway in the District of Ewa on the Island of Oahu, Hawaii. The proposed highway widening project begins at about the intersection with Kapolei Golf Course Road and extends eastward to the intersection with Fort Weaver Road for a stretch of approximately 17,000 linear feet (3.2 miles) as shown on the General Site Plan (Plate 2). The existing road to be improved is presently a two-lane highway with asphaltic concrete pavement.

In general, the existing highway is bounded by open lands to the north and south, except along the mauka side near Kapolei Golf Course Road, which is occupied by the Grace Pacific Quarry. An electrical substation and the BWS site are located on the mauka and makai sides of Farrington Highway at about Sta. 113+00. The majority of the undeveloped land along Farrington Highway is used for agricultural purposes. Sugar cane is still being cultivated at some of these locations. The sugar canes are typically up to about 6 feet in height and moderate to heavy in density. Native grasses of up to about 4 feet in height also were observed in areas not actively cultivated. The terrain in most of the agricultural areas is generally level to slightly sloping. An earth berm was observed on the mauka side of Farrington Highway for drainage control.

The existing Farrington Highway traverses two major flowing streams and many smaller gullies and drainageways. In these areas with more severe terrain, sugar canes and other crops typically are not cultivated and the land remains unused. Therefore, the vegetation around these locations is generally thick with shrubs and trees. The existing grades can be as steep as one horizontal to one vertical (1H:1V) based on visual observations.

As mentioned above, the proposed highway improvements alignment will involve two major bridge structures, which will require replacement of the existing structures. The two major bridge structures are at the following locations:

Structure Name	**Approximate Location**
Kaloi Gulch Bridge	Sta. 64+00
Honouliuli Stream Bridge	Sta. 149+50

The existing Kaloi Gulch Bridge is a single span concrete bridge of approximately 22 feet long by 27 feet wide constructed back in 1941. At the time of our site reconnaissance, Kaloi Gulch was flowing slightly to moderately. The stream bed materials generally consisted of brown sandy silts. Cobbles and boulders also were observed along the stream channel. The surrounding areas and stream banks generally were obscured by dense vines and vegetation.

We understand the existing Kaloi Gulch Bridge will be replaced with a new 96 feet wide by 105 feet long concrete bridge. In addition, we understand a detention basin will be constructed immediately upstream of the Farrington Highway crossing and a lined channel will be installed through the highway bridge structure. As a result of the planned detention basin and lined channel, we understand installation of the new replacement bridge should not be affected by scour.

The existing Honouliuli Stream Bridge is a single span concrete bridge of approximately 54 feet long and 32 feet wide and constructed back in 1939. At the time of our site reconnaissance, Honouliuli Stream was flowing slightly to moderately. The stream bed materials generally consisted of brown silty sands. Cobbles and boulders also were observed along the stream channel. The surrounding areas and stream banks generally were obscured by dense vines and vegetation.

We understand the existing Honouliuli Stream Bridge will be replaced with a new 93 feet wide by 110 feet long concrete bridge. Based on the information provided, the new replacement bridge will have a maximum scour potential of approximately 27 feet along the east abutment and 37 feet along the west abutment.

Based on our observations during the field exploration, the majority of the existing pavements appeared to be in fair to relatively good condition with the exception of some areas where some minor cracks were noted at the surface. The terrain along the majority of the highway alignment generally is flat, except toward Fort Weaver Road, which become undulating. Overhead and underground utilities were noted along the sides of the existing highway on the eastbound and westbound lanes. Based on the available plans, the existing ground elevations of Farrington Highway within the project limits generally range from about +90 to +180 feet MSL.

2.3 Subsurface Conditions

Our field exploration consisted of drilling and sampling 46 borings, designated as Boring Nos. 301 through 346, extending to depths of about 4 to 50.5 feet below the existing ground and/or pavement surface along the roadway alignment. In addition, four deep borings (two at each bridge structure), designated as Boring Nos. 104 and 105 at the Kaloi Gulch Bridge and Boring Nos. 204 and 205 at the Honouliuli Stream Bridge locations, were drilled to depths ranging from about 101 to 121 feet below the existing ground surface.

Twenty-five bulk samples, designated as Bulk Sample Nos. 104, 105, 204, 205, and 302 through 345, of the near-surface soils were obtained at selected locations along the highway alignment. The approximate locations of the borings drilled and the near-surface bulk samples taken are shown on the General Site Plan (Plate 2). Detailed locations of the drilled borings and near-surface bulk samples are shown on the Site Plans, Plates 3.1 through 3.6.

Based on our field exploration and laboratory testing program, the existing pavement structure and underlying subgrade materials encountered along the proposed highway widening project are summarized below:

SUMMARY OF PAVEMENT STRUCTURE AND SUBSURFACE SOIL PROFILE				
Field Designation	Existing Pavement (inches)			Pavement Subgrade Materials
	AC	Base Course	Total Thickness	
B-301	4	5	9	CLAYEY SILT
B-302	6	10	16	SILTY SAND
B-303	8	8	16	CLAYEY SILT/SANDY CLAY
B-306	7	14	21	CLAYEY SILT
B-308	6.5	12.5	19	CLAYEY SILT
B-311	7.5	11.5	19	SILTY CLAY/SANDY CLAY
B-312	8	7	15	SILTY CLAY
B-315	7.5	3.5	11	SILTY CLAY/SANDY CLAY
B-317	8	2	10	SILTY CLAY/SANDY CLAY
B-318	5	5	10	SILTY GRAVEL
B-320	5	5	10	SILTY SAND
B-321	7	4	11	SILTY CLAY
B-322	7.5	4	11.5	CLAYEY SILT
B-324	9	18	27	SILTY GRAVEL/SANDY CLAY
B-325	8	14	22	SANDY CLAY
B-327	7.5	13.5	21	SILTY SAND/SILTY CLAY

SUMMARY OF PAVEMENT STRUCTURE AND SUBSURFACE SOIL PROFILE				
Field Designation	Existing Pavement (inches)			Pavement Subgrade Materials
	AC	Base Course	Total Thickness	
B-328	8	11	19	SILTY SAND/SANDY CLAY
B-330	7.5	15.5	23	CLAYEY SILT
B-331	7.5	14	21.5	SANDY CLAY
B-333	8	12	20	SANDY CLAY
B-335	8	-	8	SILTY CLAY/ GRAVELLY COBBLES
B-337	4.5	2.5	7	SANDY CLAY
B-339	3.5 AC	7.5 PCC	11	CLAYEY SILT
B-341	7.25	2.75	10	SANDY CLAY
B-342	7.25	4	11.25	SILTY CLAY/SANDY CLAY
B-344	7	23	30	SILTY CLAY
B-346	10	-	10	SILTY SAND

The base course materials encountered generally consisted of dense silty and/or sandy gravel. The subgrade materials encountered below the pavement section and the surrounding areas generally consisted of near-surface fills consisting of very stiff to hard silty clay/clayey silt/sandy clay with occasional silty sands and gravel extending to a depth of approximately 5 feet below the existing pavement/ground surface. Below the surface fills, alluvial and/or residual soils, consisting of very stiff to hard sandy clays, generally were encountered and extended to depths of up to about 120 feet below the existing ground surface in the deep borings drilled for the bridge structures.

The two borings (Boring Nos. 104 and 105) drilled for the new bridge structure at Kaloi Gulch generally encountered near-surface fill materials overlying alluvial soils, consisting of very stiff to hard sandy silts and sandy clays, extending to depths of about 90 feet below the existing ground surface. Alluvial soils and saprolitic materials consisting of medium dense to dense silty sands overlying medium hard to very hard basalt formation were then encountered to the maximum depth explored of about 121 feet below the existing ground surface.

For the new bridge structure at Honouliuli Stream, our field exploration (Boring Nos. 204 and 205) generally encountered near-surface fills overlying alluvial deposits, residual soils, and saprolites, consisting of very stiff to hard sandy clays, extending to depths of about 28 to 53 feet below the existing ground surface. Medium hard to very hard basalt formation interbedded with clinker layers were then encountered and extended to the maximum depth explored of approximately 101.5 feet below the existing ground surface.

Groundwater level was encountered in Boring Nos. 204 and 205 (drilled for Honouliuli Stream Bridge) at depths of about 75.5 and 56.2 feet below the existing ground surface at the time of our field exploration. The groundwater levels measured correspond to about Elevations +14.5 and +17.4 feet MSL. Considering that the bridge is located adjacent to a stream, the groundwater level likely will vary in response to the water level in the stream. Water levels along the project limits also may be influenced by seasonal precipitation, storm surge conditions, and other factors.

Detailed descriptions of the field exploration methodology are presented in Appendix A of this report. Descriptions and graphic representations of the materials encountered in the drilled borings are provided on the Logs of Borings, Plates A-1 through A-50. Laboratory tests were performed on selected soil and rock core samples, and the test results are presented in Appendix C. Photographs of the AC cores are presented in Appendix E, and photographs of the core samples are presented in Appendix F.

2.4 Seismic Design Considerations

Based on the AASHTO LRFD Bridge Design Specifications, the project site may be subject to seismic activity, and seismic design considerations will need to be addressed. The following subsections provide discussions on the seismicity, the potential for liquefaction at the project site, and the soil profile for seismic design.

2.4.1 Earthquakes and Seismicity

In general, earthquakes that occur throughout the world are caused solely by shifts in the tectonic plates. In contrast, earthquake activity in Hawaii is linked primarily to volcanic activity. Therefore, earthquake activity in Hawaii generally occurs before or during volcanic eruptions. In addition, earthquakes may result from the underground movement of magma that comes close to the surface but does not erupt. The Island of Hawaii experiences thousands of earthquakes each year, but most of the earthquakes are so small that they can only be detected by sensitive instruments. However, some of the earthquakes are strong enough to be felt, and a few cause minor to moderate damage.

In general, earthquakes (associated with volcanic activity) are most common on the Island of Hawaii. Earthquakes that are directly associated with the movement of magma are concentrated beneath the active Kilauea and Mauna Loa Volcanoes on the Island of Hawaii. Because the majority of the earthquakes in Hawaii (over 90 percent of earthquakes) are related to volcanic activity, the risk of high seismic activity and degree of ground shaking diminishes with increased distance from the Island of Hawaii. The Island of Hawaii has experienced numerous earthquakes greater than Magnitude 5 (M5+); however, earthquakes are not confined only to the Island of Hawaii.

To a lesser degree, the Island of Maui has experienced numerous earthquakes greater than Magnitude 5. Therefore, moderate to strong earthquakes have occurred in the County of Maui. The effects of earthquakes occurring on the Islands of Hawaii and Maui may be felt on the Island of Oahu. For example, several small landslides occurred on the Island of Oahu as a result of the Maui Earthquake of 1938 (M6.8). In addition, some houses on the Island of Oahu were reportedly damaged as a result of the Lanai Earthquake of 1871 (M7+).

Due to the relatively short period of documented earthquake monitoring in the State of Hawaii, information pertaining to earthquakes that were felt on the Island of Oahu may not be complete. In general, over the last 150 years of recorded history, we are not aware of reported earthquakes greater than Magnitude 6 occurring on the Island of Oahu. Based on available information, we understand that an earthquake of about Magnitude 5.6 occurred on June 28, 1948 in the vicinity of the Island of Oahu, possibly along the hypothesized and controversial Diamond Head Fault feature.

The Diamond Head Fault feature is believed to extend northeasterly away from the southeastern tip of the Island of Oahu. The Diamond Head Fault feature may be related to the widely documented Molokai Fracture Zone located on the sea floor in the vicinity of the Hawaiian Islands. Despite only the moderate tremor intensity, the resulting damage was reportedly widespread and included broken windows, ruptured masonry building walls, and a broken underground water main. In addition, some areas on the Island of Oahu, including the Tantalus, Iwilei, and Tripler areas, reported more intense ground shaking, severe enough to have cracked reinforced concrete.

2.4.2 Liquefaction Potential

Soil liquefaction is a condition where saturated cohesionless soils located near the ground surface undergo a substantial loss of strength due to the build-up of excess pore water pressures resulting from cyclic stress applications induced by earthquakes. In this process, when the loose saturated sand deposit is subjected to vibration (such as during an earthquake), the soil tends to densify and decrease in volume causing an increase in pore water pressure. If drainage is unable to occur rapidly enough to dissipate the build-up of pore water pressure, the effective stress (internal strength) of the soil is reduced. Under sustained vibrations, the pore water pressure build-up could equal the overburden pressure, essentially reducing the soil shear strength to zero and causing it to behave as a viscous fluid. During liquefaction, the soil acquires sufficient mobility to permit both horizontal and vertical movements, and if not confined, will result in significant deformations.

Soils most susceptible to liquefaction are loose, uniformly graded, fine-grained sands and loose silts with little cohesion. The major factors affecting the liquefaction characteristics of a soil deposit are as follows:

FACTORS	LIQUEFACTION SUSCEPTIBILITY
Grain Size Distribution	Fine and uniform sands and silts are more susceptible to liquefaction than coarse or well-graded sands.
Initial Relative Density	Loose sands and silts are most susceptible to liquefaction. Liquefaction potential is inversely proportional to relative density.
Magnitude and Duration of Vibration	Liquefaction potential is directly proportional to the magnitude and duration of the earthquake.

Based on the subsurface conditions encountered, the phenomenon of soil liquefaction is not a design consideration for this project site. The risk for potential liquefaction is non-existent at this project site based on the subsurface conditions encountered (very stiff to hard clayey soils overlying medium hard to very hard basalt formation).

2.4.3 Soil Profile

As mentioned above, we understand the existing Kaloi Gulch Bridge and Honouliuli Stream Bridge will need to be replaced for the Farrington Highway Improvements project. These bridge structures will need to be designed in accordance with AASHTO 2020 LRFD Bridge Design Specifications (9^{th} Edition) and HDOT "Design Criteria for Bridges and Structures" dated August 8, 2014.

Our field exploration for the new bridge structure at Kaloi Gulch generally encountered near-surface fill materials overlying alluvial soils, consisting of very stiff to hard sandy silts and sandy clays, extending to depths of about 90 feet below the existing ground surface. Alluvial soils and saprolitic materials consisting of medium dense to dense silty sands overlying medium hard to very hard basalt formation were then encountered to the maximum depth explored of about 121 feet below the existing ground surface.

For the new bridge structure at Honouliuli Stream, our field exploration (Boring Nos. 204 and 205) generally encountered near-surface fills overlying alluvial and residual soils, and saprolites, consisting of very stiff to hard sandy clays, extending to depths of about 28 to 53 feet below the existing ground surface.

Medium hard to very hard basalt formation interbedded with clinker layers were then encountered to the maximum depth explored of approximately 101.5 feet below the existing ground surface.

Based on the subsurface conditions encountered, we believe the Kaloi Gulch Bridge site may be classified from a seismic analysis standpoint as being a "Very Dense Soil and Soft Rock Profile" site corresponding to a Site Class C soil profile type based on AASHTO 2020 LRFD Bridge Design Specifications, 9th Edition. Similarly, we believe the Honouliuli Stream Bridge site also may be classified as a "Very Dense Soil and Soft Rock Profile" site corresponding to a Site Class C soil profile type.

Based on the AASHTO 2020 LRFD Bridge Design Specifications, the two bridge structures will need to be designed based on an earthquake return period of 1,000 years. Based on a 1,000-year return period and the anticipated Site Class, the following seismic design parameters were estimated and may be used for the seismic analysis of the bridge structures planned for the project.

SEISMIC DESIGN PARAMETERS KALOI GULCH BRIDGE AASHTO 2020 LRFD BRIDGE DESIGN SPECIFICATIONS 1,000-YEAR RETURN PERIOD (~7% PROBABILITY OF EXCEEDANCE IN 75 YEARS)	
Parameter	**Value**
Peak Bedrock Acceleration, PBA (Site Class B)	0.164g
Spectral Response Acceleration (Site Class B), S_S	0.375g
Spectral Response Acceleration (Site Class B), S_1	0.103g
Site Class	"C"
Site Coefficient, F_{pga}	1.20
Site Coefficient, F_a	1.20
Site Coefficient, F_v	1.70
Design Peak Ground Acceleration, PGA (Site Class C) or A_s	0.197g
Design Spectral Response Acceleration, S_{DS}	0.450g
Design Spectral Response Acceleration, S_{D1}	0.174g
Seismic Design Category	"B"

SEISMIC DESIGN PARAMETERS HONOULIULI STREAM BRIDGE AASHTO 2020 LRFD BRIDGE DESIGN SPECIFICATIONS 1,000-YEAR RETURN PERIOD (~7% PROBABILITY OF EXCEEDANCE IN 75 YEARS)	
Parameter	**Value**
Peak Bedrock Acceleration, PBA (Site Class B)	0.166g
Spectral Response Acceleration (Site Class B), S_S	0.378g
Spectral Response Acceleration (Site Class B), S_1	0.104g
Site Class	“C”
Site Coefficient, F_{pga}	1.20
Site Coefficient, F_a	1.20
Site Coefficient, F_v	1.70
Design Peak Ground Acceleration, PGA (Site Class C) or A_s	0.199g
Design Spectral Response Acceleration, S_{DS}	0.453g
Design Spectral Response Acceleration, S_{D1}	0.176g
Seismic Design Category	“B”

END OF SITE CHARACTERIZATION

SECTION 3. DISCUSSION AND RECOMMENDATIONS

Based on our literature research, site reconnaissance, and field explorations performed for the proposed highway improvements project, we anticipate the proposed highway widening alignment will traverse near-surface fill materials, alluvial deposits, and residual soil deposits at relatively shallow depths. Saprolites, clinkers, and basalt formation were encountered at greater depths in the borings drilled for the replacement bridges at Kaloi Gulch and Honouliuli Stream.

Generally, we anticipate the scour potential at the new bridge structures and the relatively heavy structural load demands will require supporting the new bridges on a deep foundation system, such as cast-in-place concrete drilled shafts. The drilled shaft foundations would derive support principally from adhesion between the drilled shaft and the stiff alluvial deposits, residual soils, saprolites, and/or the medium hard to very hard basalt formation. Based on the structural load demands provided for our engineering analyses, a drilled shaft diameter of 4 feet and embedment lengths of 80 feet (Abutment #1) and 75 feet (Abutment #2) may be used for design of the new replacement bridge foundations at Kaloi Gulch. A drilled shaft diameter of 4 feet and an embedment length of 86 feet (Abutment #1) and 82 feet (Abutment #2) may be used for design of the new replacement bridge at Honouliuli Stream.

In general, the box culvert and pipe culvert structures may be supported on a shallow mat foundation bearing on the relatively stiff soils at the drainage crossing locations. In the event that soft soils are encountered at the design invert elevations of the box culvert and pipe culvert locations, the exposed soft soils within the limits of these drainage structures should be removed and replaced with compacted fills.

Based on the subsurface conditions anticipated along the proposed highway widening alignment, we believe slope inclinations of 2H:1V may be used for the design of the planned cut and fill slopes. Further study should be conducted to provide site-specific recommendations pertaining to cut and fill slopes with slope inclinations steeper than the recommended slope inclinations.

In general, we believe the excavated materials may be re-used as a source of fill materials for embankment construction. Because the project site is located in an area with prolonged dry weather throughout the year, moisture conditioning of the on-site soils and fill materials would be a critical item during the earthwork construction.

Based on the proposed depths of the utilities crossing Honouliuli Stream, we envision installation of these underground utilities likely will be by microtunneling and/or horizontal directional drilling (HDD) methods. Based on the subsurface conditions encountered, the microtunneling and/or HDD alignments likely will run into and out of the stiff alluvial deposits and/or residual soil deposits, and possibly hard basalt formation in localized areas. Due to the difference in the consistency and/or hardness of the soil deposits and rock formation, there may be a potential for deviation of the microtunneling machine and/or HDD drilling tools from the planned lines and grades. Therefore, special attention should be given to and adjustments should be made continuously during the microtunneling and/or HDD work to keep the cutting tools advancing the holes to be on course.

Detailed discussions and recommendations for design of foundations, retaining structures, drainage structures, earthwork, pavements, underground utility lines, and other geotechnical aspects of the project are presented in the following sections.

3.1 Structure Foundations

We envision various types of new structures, such as new bridges, retaining structures, box culverts, pipe culverts, etc., will be required for the proposed highway improvements project. Generally, we anticipate both shallow and deep foundation systems will be utilized for support of the planned structures for the project. Where competent subsurface conditions are encountered, the new structures would be supported on shallow foundations, such as spread and/or continuous strip footings and mat foundations. Deep foundations such as drilled shafts may be required for support of the planned structures underlain by poor subsoil conditions or areas subjected to deep scour potential. In areas where marginal subsoil conditions are encountered, consideration may be given to improving the bearing capacity of the subsoil with the use of structural geogrids and other ground improvement applications.

In general, we believe the two new bridge structures will need to be supported on a deep foundation system consisting of concrete drilled shafts. We anticipate the scour potential at the new bridge structure locations and the relatively heavy structural load demands dictate supporting the bridges on a drilled shaft foundation system. Based on the subsurface conditions encountered, we believe drilled shaft foundations with a nominal diameter of 4 feet may be used to support the abutments of the two replacement bridges at Kaloi Gulch and Honouliuli Stream. The drilled shaft foundations of the replacement bridge at Kaloi Gulch would derive support principally from adhesion between the drilled shaft and the stiff alluvial and/or residual soils encountered in our borings. For the replacement bridge at Honouliuli Stream, the drilled shaft foundations would derive support principally from adhesion between the drilled shaft and the stiff alluvial and residual soils, saprolites, and the medium hard to very hard basalt formation encountered in the borings.

In general, the box culvert and pipe culvert structures may be supported on a shallow mat foundation bearing on the relatively stiff soils at the crossing locations. In the event that soft soils are encountered at the box and pipe culvert locations, the exposed soft soils within the limits of these drainage structures should be removed and replaced with compacted fills. Detailed geotechnical recommendations pertaining to the design of the planned structures are presented in the following subsections of this report.

3.2 <u>Drilled Shaft Foundations</u>

As mentioned above, we anticipate the scour potential at the new bridge structure locations and the relatively heavy structural load demands dictate supporting the bridges on a drilled shaft foundation system. Based on the information provided by the project structural engineer, each of the drilled shafts at the abutments for the Kaloi Gulch Bridge will be subjected to a Strength I Limit State load demand of 1,250 kips. The drilled shafts at the abutments of Honouliuli Stream Bridge will be subjected to a Strength I Limit State load demands up to 2,900 kips.

Based on the subsurface conditions encountered at the project site and the anticipated structural loads, we recommend supporting the new bridge structures on drilled shafts having a diameter of 48 inches for both the Kaloi Gulch Bridge and Honouliuli Stream Bridge. Our recommendations pertaining to the drilled shaft foundation support system are presented in the following table.

KALOI GULCH BRIDGE				
	Abutment #1		**Abutment #2**	
Existing Ground Surface	+161	feet MSL	+163	feet MSL
Drilled Shaft Cutoff Elevation	+153	feet MSL	+153.0	feet MSL
Scour Elevation	N/A	feet MSL	N/A	feet MSL
Drilled Shaft Length	80	feet	75	feet
Drilled Shaft Tip Elevation	+73	feet MSL	+78.0	feet MSL
Drilled Shaft Capacity (Resistance)				
Strength Limit State	1,500	kips	1,500	kips
Extreme Event Limit State	2,200	kips	2,200	kips
Nominal Single Shaft Capacity	3,400	kips	3,400	kips

HONOULIULI STREAM BRIDGE				
	Abutment #1		**Abutment #2**	
Existing Ground Surface	+74	feet MSL	+90	feet MSL
Drilled Shaft Cutoff Elevation	+65	feet MSL	+67	feet MSL
Scour Elevation	+48	feet MSL	+60	feet MSL
Drilled Shaft Length	86	feet	82	feet
Drilled Shaft Tip Elevation	-21.0	feet MSL	-15	feet MSL
Drilled Shaft Capacity (Resistance)				
Strength Limit State	2,900	kips	2,900	kips
Extreme Event Limit State	4,200	kips	4,200	kips
Nominal Single Shaft Capacity	6,000	kips	6,000	kips

In general, drilled shafts in groups should be spaced a minimum of three times the drilled shaft diameter center-to-center to avoid reduction in vertical load capacity due to group action and to facilitate drilling of the shaft holes.

The load bearing capacities of the drilled shafts will depend largely on the consistency and relative density of the soils and the quality of the basalt formation within the bearing strata. Because local variations in the subsurface materials likely will occur at the site, it is imperative that a Geolabs representative be present during the shaft drilling operations to confirm the subsurface conditions encountered during the drilled shaft construction and to observe the installation of the drilled shafts. In addition, contract documents should include provisions (unit prices) for additional drilling and extension of the drilled shaft during construction to account for unforeseen subsurface conditions.

Based on our evaluation of the subsurface conditions and the foundation design parameters, we anticipate the drilled shaft installation will require an experienced drilled shaft subcontractor to install the drilled shaft foundations. Therefore, consideration should be given to requiring pre-qualification of the drilled shaft subcontractor. The succeeding subsections address the design and construction of the drilled shaft foundations:

1. Lateral Load Resistance
2. Foundation Settlements
3. Drilled Shaft Construction Considerations
4. Trial Shaft Program
5. Bi-Directional Load Tests

3.2.1 Lateral Load Resistance

In general, lateral load resistance of the drilled shafts is a function of the stiffness of the surrounding soil, the stiffness of the shaft, allowable deflection at the top of the shaft, and induced moment in the shaft. In general, we recommend spacing the drilled shafts at a minimum of three times the diameter of the shaft from center-to-center. The lateral load analyses were performed using the program LPILE-plus for Windows, which is a microcomputer adaptation of a finite difference, laterally loaded pile program originally developed at the University of Texas at Austin.

The lateral loads acting at the top of the shaft, the maximum induced moments, the depths at which the maximum moments occur, and the flexural length of the drilled shaft may be calculated using the computer program. The input parameters for the lateral load resistance was provided to the project Structural Engineer for their use. The effect of group action will need to be considered in the lateral load analysis for drilled shaft foundations based on a center-to-center spacing of at least three times the drilled shaft diameter.

The contribution to lateral load resistance from the passive earth pressure and sliding resistance should be neglected due to uncertainties in soil contact due to potential scour.

3.2.2 Foundation Settlements

Settlement of the drilled shaft foundation will result from elastic compression of the shaft and subgrade response of the foundation embedded in the alluvial deposits, residual soils, and basalt formation (weathered and moderately weathered). Total settlements of the 60 to 90-foot deep drilled shafts are estimated to be less than 0.5 inches. Therefore, differential settlements between the drilled shafts may be about 0.25 inches or less. We believe a significant portion of the settlement is elastic and should occur as the loads are applied.

3.2.3 Drilled Shaft Construction Considerations

In general, the performance of drilled shafts depends significantly upon the contractor's method of installation and construction procedures. The following conditions would have a significant effect on the effectiveness and cost of the drilled shaft foundations.

The load bearing capacities of drilled shafts depend, to a significant extent, on the friction between the shaft and the alluvial deposits/residual soils and/or basalt formation. Therefore, proper construction techniques especially during the drilling operations are important. The contractor should exercise care in drilling the shaft holes and in placing concrete into the drilled holes.

As mentioned above, we encountered hard basalt formation at greater depths within the borings drilled for the replacement bridge structures. Therefore, some difficult drilling conditions likely will be encountered and should be expected. The drilled shaft subcontractor will need to have the appropriate equipment and tools to drill through these types of natural obstructions, where encountered. The drilled shaft subcontractor will need to demonstrate that the proposed drilling equipment (and coring tools, where appropriate) will be capable of installing the drilled shafts to the recommended depths and dimensions.

Drilling by methods utilizing drilling fluids may have a significant effect on the supporting capacity of the drilled shaft; therefore, use of drilling fluids would require prior evaluation and acceptance by Geolabs. If drilling fluids are proposed by the drilled shaft subcontractor, the same type and quantity of drilling fluids should be used to construct the dedicated load test shaft for load testing purposes to evaluate the effect of the drilling fluid on the capacity of the drilled shaft.

We recommend concrete placement by tremie methods during drilled shaft construction due to the depth of the drilled shafts and the potential for presence of groundwater. The concrete should be placed in a suitable manner in an upward fashion from the bottom of the drilled hole. A low-shrink concrete mix with high slump (7 to 9-inch slump range) should be used to provide close contact between the drilled shafts and the surrounding soils. The concrete should be placed in a suitable manner to reduce the potential for segregation of the aggregates from the concrete mix.

In addition, the concrete should be placed promptly after drilling (within 24 hours after drilling of the holes) to reduce the potential for softening of the sides of the drilled holes. Furthermore, drilling adjacent to a recently constructed shaft (within five shaft diameters of the recently constructed drilled shaft) should not commence until the concrete for the recently constructed drilled shaft has cured for a minimum of 24 hours.

It should be noted that some cavities and voids may be encountered in the basalt formation in the project vicinity. Therefore, the actual volume of concrete required to fill the drilled shaft foundation may be appreciably more than the theoretical concrete volume.

It is imperative for a Geolabs representative to be present during construction to observe the drilling and installation of drilled shafts. Although the drilled shaft designs are primarily based on skin friction, the bottom of the drilled hole should be relatively free of loose materials prior to placement of concrete. Therefore, Geolabs observation of the drilled shaft installation operations is necessary to confirm the assumed subsurface conditions and should be designated a “Special Inspection” item.

3.2.4 Bi-Directional Load Tests

As part of the pre-construction activities, we recommend conducting one static load test for each of the replacement bridge structure. The load test should be conducted on a 48-inch diameter dedicated drilled shaft extending to a depth of about 75 feet and 95 feet below the existing ground surface for the Kaloi Gulch Bridge and Honouliuli Stream Bridge, respectively. The results of the load tests will be used to confirm or modify the estimated tip elevations of the production drilled shafts. The load test shafts should be structurally reinforced and instrumented with embedment strain gauges for load testing purposes. As a minimum, two embedment strain gauges should be placed at each level, starting near the load cell location at an elevation of about 5 feet above and below the load cell and subsequently at about 10-foot intervals, as shown on the Drilled Shaft Load Test Detail (Plates 4 and 5).

Due to the high capacities recommended for the drilled shafts, a conventional load test would not be practical and would be costly to conduct. Therefore, we recommend conducting bi-directional axial load test using an expandable load cell (Osterberg Load Cell). The bi-directional load test separately tests the shear resistance and end-bearing components of the drilled shaft by loading the shaft in two directions (upward for shear resistance, and downward for end-bearing and shear resistance).

The expandable load cell should be capable of applying a load of at least 2,500 and 3,600 kips in each direction for the load test shafts at Kaloi Gulch Bridge and Honouliuli Stream Bridge, respectively. The expandable load cell will need to be attached to the reinforcing steel cage prior to lowering the cage into the drilled hole.

The drilled shaft load test should be performed in general accordance with the Quick Load Test Method of ASTM D1143. The load test shaft should be loaded to failure to evaluate the ultimate side shear resistance and end-bearing components of the shaft. Installation of the expandable load cells, installation of the embedment strain gauges, performance of the bi-directional axial load tests, and presentation of the load test data should be performed by a professional experienced in these types of load testing procedures. The load test shaft should be loaded at increments of about 200 kips and should be held for a minimum of 4 hours (each hold) at the 1,500-kip, 2,000-kip, and 2,500-kip load intervals for the Kaloi Gulch Bridge test shaft to evaluate the potential for creep effects. The load test shaft should be loaded at increments of about 200 kips and should be held for a minimum of 4 hours (each hold) at the 2,000-kip, 3,000-kip, and 3,500-kip load intervals for the Honouliuli Stream Bridge test shaft to evaluate the potential for creep effects

A Geolabs representative should observe the installation and performance of the instrumented load test on the drilled shaft. It should be noted that the drilled shaft design was developed from our analysis using the field exploration data. Therefore, Geolabs observation of the drilled shaft installation operations is a vital part of the foundation design to confirm the design assumptions.

3.3 <u>Shallow Foundations</u>

In general, we believe shallow spread and/or continuous strip footings may be used to support minor structures planned at the project site, such as site retaining walls and wing walls for box culverts.

Based on our field exploration results, we believe that the following values may be used to evaluate the bearing support, sliding resistance, and passive pressure resistance of the planned structure based on Load and Resistance Factor Design (LRFD) methods.

SHALLOW FOUNDATIONS			
Description	**Extreme Event Limit State**	**Strength Limit State**	**Service Limit State**
Bearing Pressure (psf)	12,000	5,400	4,000
Coefficient of Sliding Friction	0.46	0.39	N/A
Passive Pressure (pcf)	360	180	N/A

The passive pressure values assume the soils around the foundations are well compacted. Unless covered by pavements or slabs, the passive pressure resistance in the upper 24 inches below the finished grade should be neglected.

In general, the bottom of foundations should be embedded a minimum of 24 inches below the lowest adjacent finished grade. Footings constructed near tops of slopes or on sloping ground should be embedded deep enough to provide a minimum horizontal setback distance of 6 feet measured from the outside edge of the footings to the face of the slope.

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 to a depth 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.

If soft and/or loose materials are encountered at the bottom of footing excavations, the soft and/or loose materials should be over-excavated until dense and/or stiff materials are exposed in the footing excavations. The over-excavation should be backfilled with select granular fill materials placed in level lifts not exceeding

8 inches in loose thickness, moisture-conditioned to at least 2 percent above the optimum moisture content, and compacted to a minimum of 90 percent relative compaction. Alternatively, the bottom of footing may be extended down to bear directly on the underlying competent materials.

If the foundations for the new structures are designed and constructed in strict accordance with our recommendations, total settlement of foundations is estimated to be on the order of 1 inch with differential settlements on the order of about 0.5 inches.

3.4 Retaining Structures

Based on the information provided, we understand retaining structures, such as the site retaining walls and wing walls for box culverts, will be required for the project. Therefore, the following guidelines are provided and may be used for design of retaining structures at the project site.

3.4.1 Retaining Structure Foundations

For site retaining walls and wing walls for box culverts, the retaining structure foundations may be designed in accordance with the "Shallow Foundations" section herein. Wall footings should have a minimum width of 18 inches. In addition, the bottom of wall footings on relatively flat areas should be embedded a minimum depth of 24 inches below the lowest adjacent finished grade. 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.

3.4.2 Static Lateral Earth Pressures

In general, retaining structures should be designed to resist the lateral earth pressures due to 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 below.

LATERAL EARTH PRESSURES FOR DESIGN OF RETAINING STRUCTURES			
Backfill Condition	**Earth Pressure Component**	**Active** (pcf)	**At-Rest** (pcf)
Level Backfill	Above Groundwater	40	60
	Below Groundwater	80	90
Maximum 2H:1V Sloping Backfill (Above Groundwater)	Horizontal	65	80
	Vertical	32	40

Backfill behind retaining structures may consist of the compacted on-site soils or select granular material. We recommend compacting the backfill behind retaining structures to between 90 and 95 percent relative compaction. Over-compaction of the retaining structure backfill should be avoided. The backfill materials should be moisture-conditioned to above the optimum moisture content prior to being utilized as backfill materials.

In general, the active condition should be used only for gravity retaining walls and retaining structures that are free to deflect by as much as 0.5 percent of the wall height. The at-rest condition should be used for retaining structures where the top of the structure is restrained from movement prior to backfilling of the wall or where an active condition could not be achieved.

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 retaining structure, a rectangular distribution with a uniform pressure equal to 33 percent of the vertical surcharge pressure acting on the entire height of the structure that are free to deflect (cantilever), which is restrained, may be used in the design. For retaining structures that restrained from movement, a rectangular distribution equal to 50 percent of the vertical surcharge pressure acting over the entire height of the structure may be used for the design.

3.4.3 Dynamic Lateral Earth Pressure

Forces due to dynamic lateral earth pressures may need to be considered in the design of retaining structures. For design in accordance with AASHTO LRFD Bridge Design Specifications, the force due to dynamic lateral earth pressures associated with seismic loading (A_s = 0.2g) may be estimated using the forces indicated in the table below.

DYNAMIC LATERAL EARTH PRESSURES FOR DESIGN OF RETAINING STRUCTURES AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS 2010	
Wall Movement (Level Backfill Condition)	**Design Force** (**P_E**) (pounds/linear foot of wall)
3 inches (Active Condition)	$4.0H^2$
At-Rest Condition	$7.4H^2$
Note: H is the vertical distance between the finished grade above the edge of the retaining wall heel and the bottom of the footing (in feet)	

The forces due to dynamic lateral earth pressures generally would act at the mid-height of the wall (i.e., 0.5H). It should be noted that the dynamic lateral earth forces provided for the active condition assume that the wall will be allowed to move laterally by about 1 to 2 inches in the event of an earthquake. If this amount of lateral movement is not acceptable, the retaining wall should be designed for the at-rest condition utilizing higher dynamic lateral forces for less lateral movement (0.5 inches or less).

It should be noted that the force due to dynamic lateral earth pressures presented above is in addition to the static lateral earth pressures. An appropriately reduced factor of safety may be used when dynamic lateral earth pressures are accounted for in the design of the retaining structure.

3.4.4 Drainage

Retaining walls 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 open-graded gravel (ASTM C33, No. 67 gradation), placed directly around a perforated pipe (perforations facing down) at the base of the wall discharging to an appropriate outlet or weep holes. As an alternative, a prefabricated drainage product, such as MiraDrain or EnkaDrain, may be used instead of the drainage material. The prefabricated drainage product also should be connected hydraulically to a perforated pipe at the base of the wall.

A typical drainage system for site retaining walls would consist of 1 cubic foot of permeable material, such as open-graded gravel (ASTM C33, No. 67 gradation), wrapped with non-woven filter fabric placed at each of the weep hole locations. The weep holes should be spaced no more than 10 feet apart.

The backfill from the bottom of the wall to the bottom of the weep hole or drainage layer should consist of relatively impervious material to reduce the potential for significant water infiltration into the subsurface. In addition, the upper 12 inches of the retaining wall backfill should consist of relatively impervious material to reduce the potential for significant water infiltration behind the retaining structure unless covered by concrete slabs at the surface.

3.5 Drainage Structures

We understand new box culverts and/or pipe culverts are planned at the drainageways along the highway alignment. As mentioned above, the box and pipe culvert structures may be supported on a shallow mat foundation bearing on the relatively stiff soils at the drainage crossing locations. In the event that soft soils are encountered at the box and/or pipe culvert locations, the exposed soft soils within the limits of these drainage structures should be removed and replaced with compacted fills.

3.5.1 Box Culverts

Box culverts will be used along the proposed alignment for conveying storm water runoff. We understand many of the existing box culverts will be extended, realigned, or removed and replaced for the proposed widening of Farrington Highway.

Where the existing and new box culverts are located in the stream crossings and drainageways with potential soft ground conditions, there exists the potential for some soft ground settlements under the new fill loads.

3.5.2 Pipe Culverts

In addition to box culverts, pipe culverts also are planned along the proposed widened highway. In general, we recommend providing a granular bedding consisting of 6 inches of open-graded gravel (ASTM C33, No. 67 gradation) below pipe culverts. Free-draining granular materials, such as open-graded gravel, also should be used for the initial trench backfill up to about 12 inches above the culverts to provide adequate support around the pipes and to reduce the compaction effort of the backfill, thus reducing the potential for damaging the pipes.

It is critical that free-draining materials be used around the pipes to reduce the potential for formation of voids below the haunches of pipes. The free-draining materials also would provide adequate support for the sides of the pipes, which could result in settlement of the backfill and damage to the pipes. The use of sand or S4C as backfill materials around the pipes should be prohibited due to the potential for migration or loss of fines during heavy rains, which may result in potential ground settlement and pavement distress.

The upper portion of the trench backfill from the level 12 inches above the pipes to the top of the subgrade or finished grade may consist of on-site materials generally less than 3 inches in maximum particle size. The backfill material should be moisture-conditioned to above the optimum moisture, placed in maximum 8-inch level loose lifts, and mechanically compacted to not less than 90 percent relative compaction. Where trenches are below pavement areas, the upper 3 feet of the trench backfill below the pavement grade should be compacted to at least 95 percent relative compaction.

3.6 Stream Bed Material for Scour Analyses

The foundation design of the bridge abutments and piers will need to take into consideration the potential for stream scour. Scour is the result of erosive action of flowing water, excavating and carrying away material from the bed and banks of streams. The rates of scour depend on a number of factors such as the shape and dimensions of a pier or abutment, depth of flow, velocity of approach flow, size and gradation of stream bed material, and bed configuration. Total scour over a period of time generally consists of three components:

- Aggregation and Degradation;
- Contraction Scour; and,
- Local Scour.

One of the factors affecting the scour depth is the grain size characteristics of the stream bed material. The median diameter of the stream bed material (D_{50}), in conjunction with the depth of flow and flow velocity, is used to calculate fall velocity of stream bed materials in scour depth analysis. In order to evaluate the size and gradation of the stream bed materials for scour depth analysis at the bridge locations, soil samples from bulk samples of the stream bed were retrieved during the 1999 field exploration for our laboratory tests.

The stream bed materials generally consist of sandy silts and silty sands at the bridge locations. Sieve analyses with hydrometer tests were performed on the retrieved soil samples to provide grain size distribution of the materials. Based on the results of our laboratory tests, the median diameter of the stream bed material (D_{50}) at the two planned bridge structures were determined and presented in the following table.

Location	Elevation (feet MSL)	D_{50} (mm)
Kaloi Gulch	+155	0.012
Honouliuli Stream	+69	0.55

3.7 Earthwork

Based on the plan and profile plans provided and the topography along the project limits, we envision earthwork for the proposed highway widening construction generally will involve excavations and embankment fills of less than about 5 feet deep or thick. However, excavations on the order of up to about 15 feet deep and embankment fills of up to about 15 feet thick may be required in localized areas, especially beyond Sta. 145+00, to achieve the design finished grades. We anticipate the majority of the embankment fill materials will be generated from the planned excavations along the proposed alignment. Items of earthwork that are addressed in the subsequent subsections include the following:

1. Cut Slope Design;
2. Fill Slope Design;
3. Subdrainage;
4. Site Preparation;
5. Fills and Backfills;
6. Fill Placement and Compaction Requirements;
7. Excavation; and
8. Boulder Disposal.

A Geolabs representative should monitor the grading operations to observe whether undesirable materials are encountered during the excavation and scarification process, and to confirm whether the exposed soil conditions are similar to those encountered in our field exploration.

3.7.1 Cut Slope Design

Based on the subsurface conditions encountered along the proposed alignment, we believe the planned cut slopes likely will expose the upper fill materials and underlying residual soils. In general, we believe a cut slope inclination of 2H:1V or flatter may be used for the design of the planned cut slopes along the proposed alignment. A steeper cut slope inclination of 1.5H:1V may be feasible in some areas where very stiff to hard residual soils are exposed at the cut slope face. Where a cut slope inclination steeper than 2H:1V is desired, Geolabs should be consulted for site-specific cut slope recommendations.

In the event that minor over-cutting of a slope occurs or the cut slope is slightly damaged by erosion, consideration should be given to leaving the slope as is rather than attempting to backfill the slope to the design grade with sliver fills. Sliver fills typically are highly susceptible to erosion and may cause raveling of the slope. If backfilling of an over-cut slope is necessary, the cut slope should be completely over-cut and buttressed with a fill slope constructed of select granular fills by keying and benching the fill materials into the over-cut slope.

Excessive surface water runoff over the slope face may cause erosion of the exposed soils, thus jeopardizing the long-term stability and performance of the cut slopes. Therefore, cut slopes should be protected by appropriate slope planting or by other means, such as placement of geotextile fabrics on the slope face, as soon as practical after the slope is excavated to reduce the potential for erosion of the exposed soils. In addition, V-ditches may be considered at the top and bottom of the cut slopes to provide proper drainage of surface water runoff.

3.7.2 Fill Slope Design

In general, permanent embankments constructed of the compacted on-site soils over competent ground should be designed with a slope inclination of 2H:1V or flatter. It is also possible to steepen the fill slopes to as steep as 1H:1V provided that adequate geotextile reinforcements are incorporated into the fill slope materials. Further studies should be conducted to provide site-specific recommendations pertaining to fill slopes with slope inclinations steeper than 2H:1V as recommended above. Where soft and/or loose foundation soils are encountered, a flatter fill slope ratio may be required for construction of embankments (depending on embankment heights) to reduce the potential for fill slope failures.

Fills to be placed on existing slopes with inclinations steeper than 5H:1V should be keyed and benched into the existing slope to provide stability of the new fill against sliding. The filling operations should start at the lowest point and continue up in level horizontal compacted layers in accordance with the fill placement recommendations in the "Fill Placement and Compaction Requirements" subsection of this technical memorandum. Fill slopes should be constructed by overfilling and cutting back to the design slope ratio to obtain a well-compacted slope face. For fill slopes with a vertical height greater than 10 feet, we recommend that a key be provided at the toe of the fill slope to provide stability of the new embankment fill against sliding. The key should be embedded at least 2 feet below the lowest adjacent grade and should have a minimum base width of 10 feet.

Water should be diverted away from the tops of slopes, and slope planting should be provided as soon as the fill slope is completed to reduce the potential for appreciable erosion of the finished slopes. Construction of earth berms, V-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 planned fill slopes.

3.7.3 Subdrainage

Seepage conditions may be present at localized areas along the proposed highway alignment, especially near the gulches and stream crossings. Therefore, we recommend provisions be incorporated into the construction documents to provide for subdrains in the following areas:

1. at all springs and seepage areas;
2. where fill abuts natural uphill slopes;
3. at the bottom of all canyon fills;
4. on the uphill side of keyways; and
5. in other areas of the site where seepage is observed during and after grading or as recommended by the Engineer during construction.

In general, subdrains should consist of perforated pipes with perforations placed facing down and should be at least 4 inches in diameter (6 inches or larger is preferred). All subdrains should be surrounded and underlain by at least 4 inches of permeable drainage material, such as open-graded gravel (ASTM C33, No. 67 gradation) or equivalent. A non-woven filter fabric, such as Mirafi 180N or equivalent, should wrap around the drainage material. The non-woven filter fabric should conform to the requirements for Permeable Separator, Paragraph 716.02 of the Hawaii Standard Specifications for Road and Public Works Construction, 2005 (HSS). In general, subdrain trenches should be at least 15 inches wide, at least 2 feet deep, and should be capped with compacted fill. Subdrains should be positioned along the upside of all keyway excavations and should discharge into storm drain structures, where possible, or other outlet structures.

3.7.4 Fills and Backfills

At the on-set of earthwork, areas within the contract grading limits should be thoroughly cleared and grubbed. It should be noted that portions of the existing terrain are heavily vegetated. Vegetation, debris, rubbish, and other unsuitable materials, should be removed and disposed of properly off-site to reduce the potential for contamination of the excavated materials. Due to concerns with organically laden soils at the existing ground surface, we recommend stripping the upper 12 inches of the soils below the existing ground as part of the clearing and grubbing operations. The resulting cleared and grubbed spoils should be disposed of properly offsite at an appropriate disposal facility.

Soft and yielding areas encountered during clearing and grubbing below areas designated to receive fill should be over-excavated to expose firm natural material, and the resulting excavation should be backfilled with well-compacted fill. The excavated soft soils should be properly disposed of off-site.

In general, the over-excavated subgrades and areas designated to receive fills exposing generally stiff materials should be scarified to a minimum depth of 8 inches, moisture-conditioned to at least 4 percent above the optimum moisture content, and compacted to a minimum of 90 percent relative compaction. Relative compaction refers to the in-place dry density of soil expressed as a percentage of the maximum dry density of the same soil determined in accordance with AASHTO T-180 (or ASTM D1557). Optimum moisture is the water content (percentage by dry weight) corresponding to the maximum dry density.

Where shrinkage cracks are noted after compaction of the subgrade, we recommend that the soil be prepared again as recommended above. Saturation and subsequent yielding of the exposed subgrade due to inclement weather and poor drainage may require over-excavation of the softened areas and replacement with well-compacted fill.

Because moisture conditioning and compaction of the clayey subgrade soils are critical elements of earthwork, observations and soil density tests should be performed by Geolabs during site grading to assist the contractor in obtaining the required degree of compaction and the proper moisture content on each fill lift. Where compaction is less than required, additional compactive effort should be applied with adjustment of moisture content as necessary, to obtain the specified compaction. It should be noted that the moisture requirement of the on-site fills and subgrades (at least 4 percent above the optimum moisture) is an important requirement considering the relatively dry weather in the Ewa area and the moderately to highly expansive nature of the on-site clayey soils.

3.7.5 Fills and Backfills

In general, we believe the excavated materials may be used as a source of fill materials for embankment construction provided that the materials are properly processed and placed in accordance with the recommendations presented in the "Fill Placement and Compaction Requirements" subsection herein. Soft and/or loose materials generated from excavations should not be used in fill areas and should be properly disposed of off-site.

Fill and backfill materials within the upper 3 feet from the finished grades should consist of materials less than 3 inches in largest dimension. If excavations encounter basalt rock formation at greater depths, these excavated materials may be re-used as a source of fill and backfill materials below an elevation of 3 feet below the finished grades. Fill materials to be placed at an elevation of at least 3 feet below the finished grade may consist of materials with a maximum particle size of 12 inches in largest dimension.

Over-sized rock fragments, if encountered, may be disposed of off-site, used in deep fills, or broken down to smaller-sized materials and incorporated into the fill material. If the excavated materials do not contain sufficient fines to produce a well-graded material, off-site borrow or on-site rock crushing of large-sized rock fragments or boulders should be considered to provide the required gradation and particle size to develop a well-graded material. In general, placement of boulders in fills should be in accordance with the procedures recommended in the "Boulder Disposal" subsection of this geotechnical engineering report.

3.7.6 Fill Placement and Compaction Requirements

In general, fills and backfills up to 3 feet below the finished grade should be moisture-conditioned to at least 4 percent above the optimum moisture content, placed in level lifts not exceeding 8 inches in loose thickness, and compacted to at least 90 percent relative compaction. Fills and backfills within 3 feet of the finished pavement elevation should be moisture-conditioned to above the optimum moisture content, compacted to a minimum of 95 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 AASHTO T-180 (or ASTM D1557). Optimum moisture is the water content (percentage by dry weight) corresponding to the maximum dry density. Compaction should be accomplished by sheepsfoot rollers, vibratory rollers, or other types of acceptable compaction equipment. Water tamping, jetting, or ponding should not be allowed to compact the on-site clayey soils.

3.7.7 Excavation

Our site reconnaissance and field exploration program disclosed that surface fill materials and stiff to very stiff residual soils underlie the majority of the proposed highway widening alignment. In general, it is our opinion that conventional heavy excavation equipment, such as a large bulldozer, excavator, or similar heavy construction equipment, may achieve the excavations into these materials. Basalt formation and boulders may be encountered in deeper excavations and in localized areas along the proposed alignment. It is anticipated that the weathered basalt formation or boulders may be excavated with normal heavy excavation equipment, such as ripping with large bulldozers, where the rocks are closely fractured or highly weathered. However, excavations into the harder areas may require the use of hoerams, chipping, or blasting.

The method and equipment to be used for excavation should be determined by the contractor, subject to practical limits and safety considerations. The excavations should comply with all applicable local safety requirements. The above discussions regarding the rippability of the surface materials are based on field data obtained from our field reconnaissance and the borings performed at the subject site. Contractors proposing to work on this project should be encouraged to examine the site conditions and soil/rock data to make their own interpretation.

3.7.8 Boulder Disposal

Over-sized materials, such as cobbles (greater than 3 inches in largest dimension) and boulders (rock fragments larger than 12 inches in maximum size), may be encountered from deep cuts into the basalt formation. Boulders also may be encountered embedded in the alluvial soils, particularly near the gulches and stream crossings. The over-sized materials may be used in general fills provided that the following recommendations are followed:

1. Boulders less than 3 feet in largest dimension may be utilized as general fills provided that the top of the boulder is placed at least 3 feet below the finished grades. Boulders or portions of boulders should not encroach within 3 feet of the finished grades. Boulders larger than 3 feet in maximum dimension should not be used as general fill unless reduced in size.

2. Boulders should be spread out at the bottom of deeper fills and must not be nested together. They should be placed such that compaction equipment will be able to compact between and around them.

3. Care must be exercised to avoid placement of boulders in the proposed utility alignment and within the depths of the proposed utility lines to reduce the potential for encountering the boulders during excavation for the utility trenches.

3.8 Traffic Signal Pole Foundations

Based on the information provided, we understand that existing traffic signal pole at the Kualakai Parkway intersection will need to be relocated to accommodate the roadway improvements project. In addition, new traffic signal poles also are planned at various locations for the highway improvements project. Based on the loading demands provided by the project structural engineer and the anticipated subsurface soil conditions, we recommend supporting the new traffic signal pole on single cast-in-place drilled shaft foundations. Based on our engineering analyses, our drilled shaft foundation recommendations for the traffic signal poles for various mast arm lengths are presented in the following table.

FOUNDATION ANALYSES FOR TRAFFIC SIGNAL POLES							
Mast Arm Length (feet)	Drilled Shaft Diameter (inches)	Drilled Shaft Length (feet)	Pile Head Deflection (inches)	Maximum Shear (kips)	Max. Induced Moment (kip-feet)	Depth to Max. Moment (feet)	FS Against Torsion
25	30	8	0.26	14.4	57.6	0.8	5.2
35	36	9	0.24	18.1	80.9	1.0	3.1
45	36	9	0.51	2.2	98.2	0.9	2.5
50	36	10	0.48	24.7	121.0	1.1	2.0

3.9 Light Pole Foundations

Based on the information provided, we understand that new light poles are planned along the median areas for the highway widening project. Based on the typical loading demands and anticipated subsurface soil conditions, we recommend supporting the new light poles on single cast-in-place drilled shaft foundations.

In order to develop the required bearing and lateral load resistances, the proposed new light pole structures may be supported by a foundation system consisting of cast-in-place concrete drilled shafts. Based on the subsurface conditions encountered in our field exploration, we believe the Standard Plan TE-47, Highway Light Standard by the State of Hawaii – Department of Transportation, Highways Division, may be used for the design of the proposed drilled shaft foundations to support the new light poles planned.

The cast-in-place concrete drilled shafts would derive vertical support principally from skin friction between the shafts and the surrounding soils. A net allowable compressive load capacity of up to 30 kips per shaft may be used for dead-plus-live loads and may be increased by one-third (1/3) for transient loads, such as wind or seismic forces.

Settlement of the drilled shaft foundation will result from elastic compression of the shaft and subgrade response of the foundation embedded in the soils encountered at the site. We anticipate that the total settlements of the drilled shafts are estimated to be less than 0.5 inch. We believe that a significant portion of the settlement will be elastic and should occur as the loads are applied.

Drilled shafts are desirable for the light pole foundations because of the significant increase in lateral and uplift load capacities when compared to shallow foundations. However, the performance of the drilled shafts will depend significantly upon the contractor's method of construction and construction procedures.

The load bearing capacities of drilled shafts depend, to a large extent, on the contact between the drilled shafts and the surrounding soils. Therefore, proper construction techniques are important. The contractor should exercise care in drilling the shaft holes and in placing concrete into the holes.

Drilling by methods utilizing drilling fluids is not recommended. Placement of concrete using a tremie pipe will be required due to the depth of the drilled shaft holes. The concrete should be placed in a suitable manner by starting at the bottom and continue in an upward fashion to the top of the shaft.

A low-shrink concrete mix with high slump (6 to 9-inch range) should be used for the concreting operation. The concrete should be placed in a suitable manner to reduce the potential for segregation of the aggregates from the concrete mix. If pre-cast concrete pole bases are used, the gap between the pole base and the surrounding soils should be backfilled with concrete or lean concrete.

3.10 <u>Pavement Design</u>

Based on the information provided by the State of Hawaii, Department of Transportation, Highways Division, Materials Testing and Research Branch, we understand the highway improvements project will consist of rigid pavements with the following pavement design section:

Rigid Pavements for Travel Lane

10.0 Inches Portland Cement Concrete
18.0 Inches Aggregate Base (AB)
28.0 Inches Total Pavement Thickness over Biaxial Geogrid and Non-Woven Geotextile Fabric on Recompacted Existing Base/Subbase/Subgrade

In addition, we understand the following provisions and guidelines are recommended for the rigid pavement construction:

1. Due to the potential for lateral movement due to collapsible soils, the travel lane PCC should be tied to the curb/gutter.

2. Due to the potential for lateral movement and faulting due to collapsible and expansive soils, the sidewalks should be reinforced with No. 4 reinforcing bars spaced at 18 inches on-center.

3. The biaxial geogrid below the pavement structural section should extend to below the concrete sidewalk and the supporting base course to the outside edge of the concrete sidewalk slab. The biaxial geogrid should consist of Tensar BX-1200 or equivalent geogrid.

4. The non-woven geotextile fabric should conform to the requirements under HDOT Standard Specifications, Subsection 716.02.

5. No permeable base should be used.

6. Dowels at transverse joints and tie bars at longitudinal joints should be provided.

7. The subgrade under sidewalks and pavements should be maintained at optimum moisture to 3 percent wet of optimum until the aggregate base course and the final surface course are placed. Should shrinkage cracks or erosion piping holes appear or should the subgrade dry below the optimum moisture content, scarification and re-moisturizing should be required.

8. Use of longitudinal edge drains should be considered due to the collapsible/expansive soils provided that the edge drains could be properly daylighted.

9. To avoid erosion piping holes in the surface soils within the drainage swale (to avoid the sinkholes adjacent to North South Road and within the

medians), use non-woven geotextile fabric (Subsection 716.02) with 12 inches of on-site soils over it, with an erosion matting at the top ground surface, with the hydromulch grassing done prior to placement of the erosion matting.

Experience suggests that tree roots and irrigation water could cause heaving and lateral movement of the concrete sidewalk, curb, and gutter. Therefore, we recommend implementing the following measures and guidelines for the project:

- Soil in tree well excavations that are filled with topsoil shall be presoaked / saturated 2 days prior to pouring the adjacent sidewalk.
- Sidewalk should have a 2-foot deep thickened edge next to or within 10 feet laterally from trees.
- Root barrier to be used adjacent to the thickened edge.

3.11 Underground Detention/Infiltration System

Our field exploration indicated that the roadway alignment generally is underlain by clayey silts and silty clays at shallow depths. Based on Table 2 "Typical Soil Infiltration Rates" of the Storm Water BMP Guide by the City and County of Honolulu, Department of Planning and Permitting, the in-situ soils may be considered as Hydrologic Soil Group of C (silt loam, sandy clay loam) and/or Hydrologic Soil Group D (clay loam, silty clay loam, clay) with infiltration rates ranging from about 0.25 inches per hour to less than 0.05 inches per hour. Based on our experience, these infiltration rates are consistent with the infiltration test results obtained for the shallow clayey soils at the nearby Hoopili Development adjacent to Farrington Highway.

In accordance with the City's current storm water requirements, infiltration tests and test pits/borings are required to support the on-site disposal design. To provide information for the design of the detention/filtration system, we advanced four boreholes to a depth of about 5 feet below the existing ground surface and installing temporary casing in the boreholes. The infiltration tests were conducted through the bottom of the cased boreholes in general accordance with the procedures described in the Maryland Storm Water Management manual.

Each boring was pre-soaked with water for approximately 2 hours prior to testing. Water was introduced into the boring to a depth of about 2 feet above the bottom of the boring, and the drop of the water level in the boring was measured with respect to time for a falling head test consisting of four individual one hour trials per test. The water level was refilled, as necessary, for each trial.

The tests were carried out in several increments until achieving a steady-state with a relatively constant water infiltration rate. Results of the final infiltration rates are presented in the following table. Detailed testing data and results are presented on Plates D-1 through D-4.

SUMMARY OF BOREHOLE INFITRATION TESTING		
Boring No.	**Depth** (feet)	**Final Infiltration Rate** (inches/hour)
I-1	5	6.7
I-2	5	0.63
I-3	5	1.38
I-4	5	6.8

The infiltration test results indicated that the infiltration rates at the site may vary from 0.63 to 6.8 inches per hour. It should be noted that each infiltration test was conducted through a 4-inch borehole, which may not represent the actual infiltration condition within a typical infiltration chamber footprint or an open basin. Further, it should be noted that these tests were conducted on a preliminary basis and their locations were selected on accessibility rather that the final locations of storm water management systems.

3.12 Microtunneling/Horizontal Directional Drilling

As mentioned above, we understand that new water, gas, and fuel lines will need to be installed beneath Honouliuli Stream using microtunneling and/or horizontal directional drilling (HDD) methods. The design invert elevations of these utility lines will extend down to about +55 feet MSL. The new 30 and 36-inch waterlines (both installed within a 60-inch diameter steel casing) will be installed using microtunneling methods, and the new 8 and 10-inch fuel and 16-inch gas lines will be installed using horizontal directional drilling methods.

Site exploration in evaluating the subsurface conditions are important in assessing the feasibility of microtunneling/HDD techniques and in determining appropriate construction methods. For the design and cost estimation pertaining to microtunneling/HDD, special attention should be given to the characteristics of the soils and rock likely to be encountered together with details of the water table, such as its rate of inflow and any tidal fluctuation or seasonal changes. There are several important factors relating to the soil and/or rock conditions that may significantly influence project feasibility, construction planning, and associated construction costs. These generally include face or heading stability, settlement potential and magnitudes, friction along the pipeline, allowable passive pressures for providing thrust block resistance, groundwater control, muck characteristics and any special disposal requirements.

Based on the anticipated subsurface conditions and the proposed depths of the utility alignments, it is anticipated that the microtunneling and/or HDD alignments will run into and out of the stiff older alluvial deposits and/or residual soils, and possibly hard basalt formation, in localized areas. Due to the difference in the consistency/hardness of the soil deposits and rock formation, there may be a potential for deviation of the microtunneling machine and/or HDD drilling tools from the planned lines and grades. Therefore, special attention should be given to and adjustments should be made continuously during the microtunneling and/or HDD methods to keep the cutting tools advancing the holes to be on course.

Based on the subsurface conditions encountered in Boring No. 203 from the Year 1999 exploration, it appears that there is a potential for encountering hard basalt rock formation along the microtunneling/HDD alignments. Therefore, the microtunneling/HDD equipment should be capable of excavating into these rock formations, where encountered.

Another important consideration for pipe jacking is the amount of friction generated when the pipe is pushed into the ground. This friction contributes to the jacking resistance and is a major factor in determining the required capacity of the main thrust jacks. The magnitude of the pipe friction depends on the pipe material, type of soil, its moisture content and the depth of cover, as well as the details of the construction equipment and actual construction procedures employed. Factors such as the amount of overcutting by the shield, misalignment of the pipes, excavation methods, duration of work stoppages, and whether or not a bentonite injection system is used also will affect the amount of friction developed along the pipes.

3.13 Underground Utility Lines

We envision new underground utilities, such as sewer, drainage, water, and electrical lines, will be required for the project. In general, we recommend providing granular bedding consisting of 6 inches of free-draining materials, such as open-graded gravel (ASTM C33, No. 67 gradation), below the pipes for uniform support.

Free-draining granular materials, such as bedding sand or open-graded gravel (ASTM C33, No. 67 gradation), also should be used for the initial trench backfill (pipe cover) up to about 12 inches above the crown of the pipes to provide adequate support around the pipes and to reduce the need for substantial effort in compacting the backfill, thus reducing the potential for damage to the pipes.

The trench backfills above the pipe to the finished subgrade or finished grade may consist of the excavated on-site soils. The backfill should be moisture conditioned to at least 2 percent above the optimum moisture content, placed in maximum 8-inch level loose lifts, and mechanically compacted to not less than 90 percent relative compaction to reduce the potential for appreciable future ground subsidence. Where trenches are located in the pavement areas, the upper 3 feet of the trench backfill below the pavement grade should be compacted to at least 95 percent relative compaction.

3.14 Design Review

Final drawings and specifications for the proposed construction should be forwarded to Geolabs for review and written comments prior to bid solicitation and/or construction. This review is necessary to evaluate 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 assume responsibility for misinterpretation of the recommendations presented herein.

3.15 Post-Design Services/Services During Construction

It is highly recommended to retain Geolabs for geotechnical engineering support and continued services during construction. The following are critical items of construction monitoring that require "Special Inspection."

1. Review of drilled shaft foundation and trenchless pipe installation submittals
2. Observation of the trial shaft and load test shaft installation
3. Observation of the drilled shaft load testing
4. Observation of the production drilled shaft installation
5. Observation of shallow foundation excavations
6. Observation of the subgrade soil preparation
7. Observation of fill placement and compaction
8. Observation of the microtunneling and HDD operations

A Geolabs representative should monitor the other aspects of the earthwork construction. This is to observe compliance with the intent of 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 subsurface conditions encountered during construction are different from those assumed or considered in this report, then appropriate modifications to the design should be made.

END OF DISCUSSION AND RECOMMENDATIONS

SECTION 4. LIMITATIONS

The analyses and recommendations submitted herein are based in part upon information obtained from the field borings and bulk samples. Variations of the subsurface conditions between and beyond the field data points 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 presented herein.

The field boring locations indicated in this report are approximate, having been staked out in the field using a hand-held Global Positioning System (GPS) unit. Elevations of the borings were interpolated based on the contour lines shown on the Topographic Survey Map downloaded from the R. M. Towill Corporation ftp site on June 23, 2020. The locations and elevations of the field borings should be considered accurate only to the degree implied by the methods used.

The stratification breaks shown on the graphic representations of the borings depict the approximate boundaries between soil and/or rock types and, as such, may denote a gradual transition. Water level data from the borings were measured at the times shown on the graphic representations and/or presented in the text of this report. These data have been reviewed and interpretations made in the formulation of this report. However, it must be noted that fluctuation may occur due to variation in tides, rainfall, perched groundwater conditions, groundwater withdrawal, and other factors.

This report has been prepared for the exclusive use of R. M. Towill Corporation, and their client, D.R. Horton Hawaii LLC, and their project consultants for specific application to the *Farrington Highway Improvements, Kapolei Golf Course Road to Fort Weaver Road* project as described herein 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 design engineers in the preparation of the design documents for the highway improvements project. Therefore, this report may not contain sufficient data, or the proper information, for use to form the basis for preparation of construction cost estimates or contract bidding. A contractor wishing to bid on this project should retain a competent geotechnical engineer to assist in the interpretation of this report and/or performance of 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 engineering exploration conducted at the project site was not intended to investigate the potential for presence of hazardous materials existing at the project site. It should be noted that the equipment, techniques, and personnel used to conduct a geo-environmental exploration differ substantially from those applied in geotechnical engineering.

END OF LIMITATIONS

CLOSURE

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

-ΩΩΩΩΩΩΩΩΩ-

Respectfully submitted,

GEOLABS, INC.

By ______________________

Robin M. Lim, P.E.
President

RML:TK:rl

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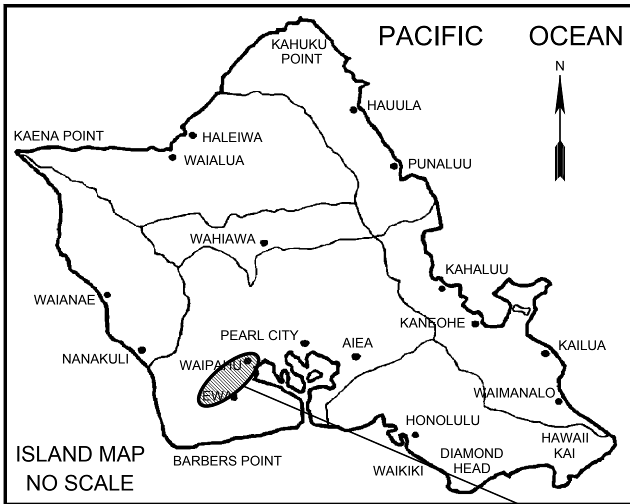
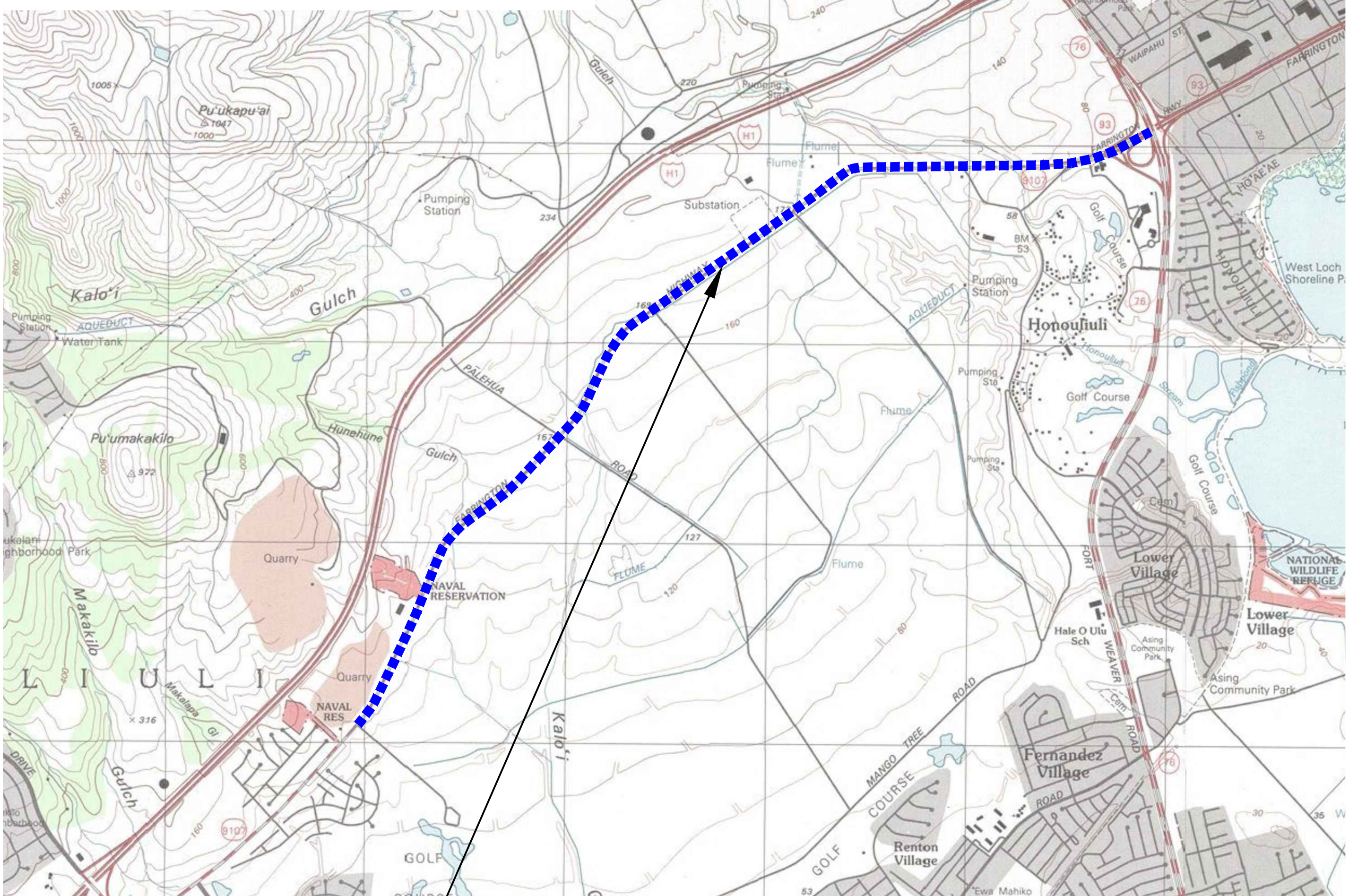
PLATES



GENERAL PROJECT LOCATION »



PROJECT LOCATION »

3000 1500 0 3000 FT.

GRAPHIC SCALE

N

REFERENCE: MAP CREATED WITH TOPO!® ©2010 NATIONAL GEOGRAPHIC; ©2007 TELE ATLAS, REL. 1/2007.

PROJECT LOCATION PLAN

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

GEOLABS, INC.

Geotechnical Engineering

DATE	DRAWN BY	PLATE
SEPTEMBER 2020	HYC	
SCALE	W.O.	
1" = 3,000'	8135-00	1

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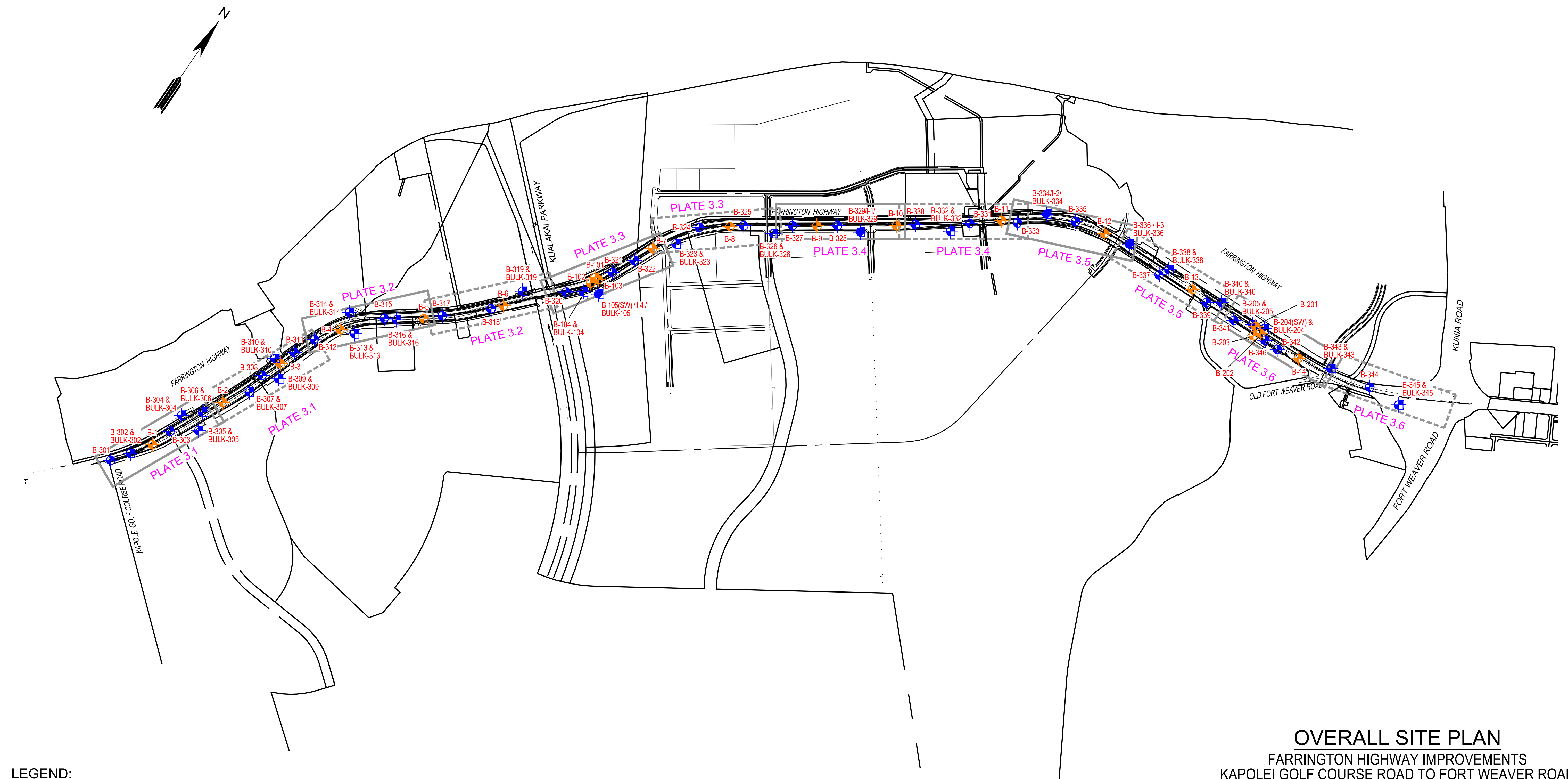

LEGEND:

- APPROXIMATE BORING LOCATION
- APPROXIMATE INFILTRATION TEST LOCATION
- APPROXIMATE BULK SAMPLE LOCATION
- SW SEISMIC SHEAR WAVE VELOCITY TESTING
- APPROXIMATE BORING LOCATION (FROM REPORT BY GEOLABS, INC., W.O. 4190-00(B), DATED MARCH 29, 2000)

REFERENCE: TOPOGRAPHIC SURVEY MAP DOWNLOADED FROM R. M. TOWILL CORPORATION WEBSITE ON JUNE 23, 2020.

0 600 1200 1800 2400 FT.
GRAPHIC SCALE

OVERALL SITE PLAN

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

GEOLABS, INC.
Geotechnical Engineering

DATE	DRAWN BY	PLATE
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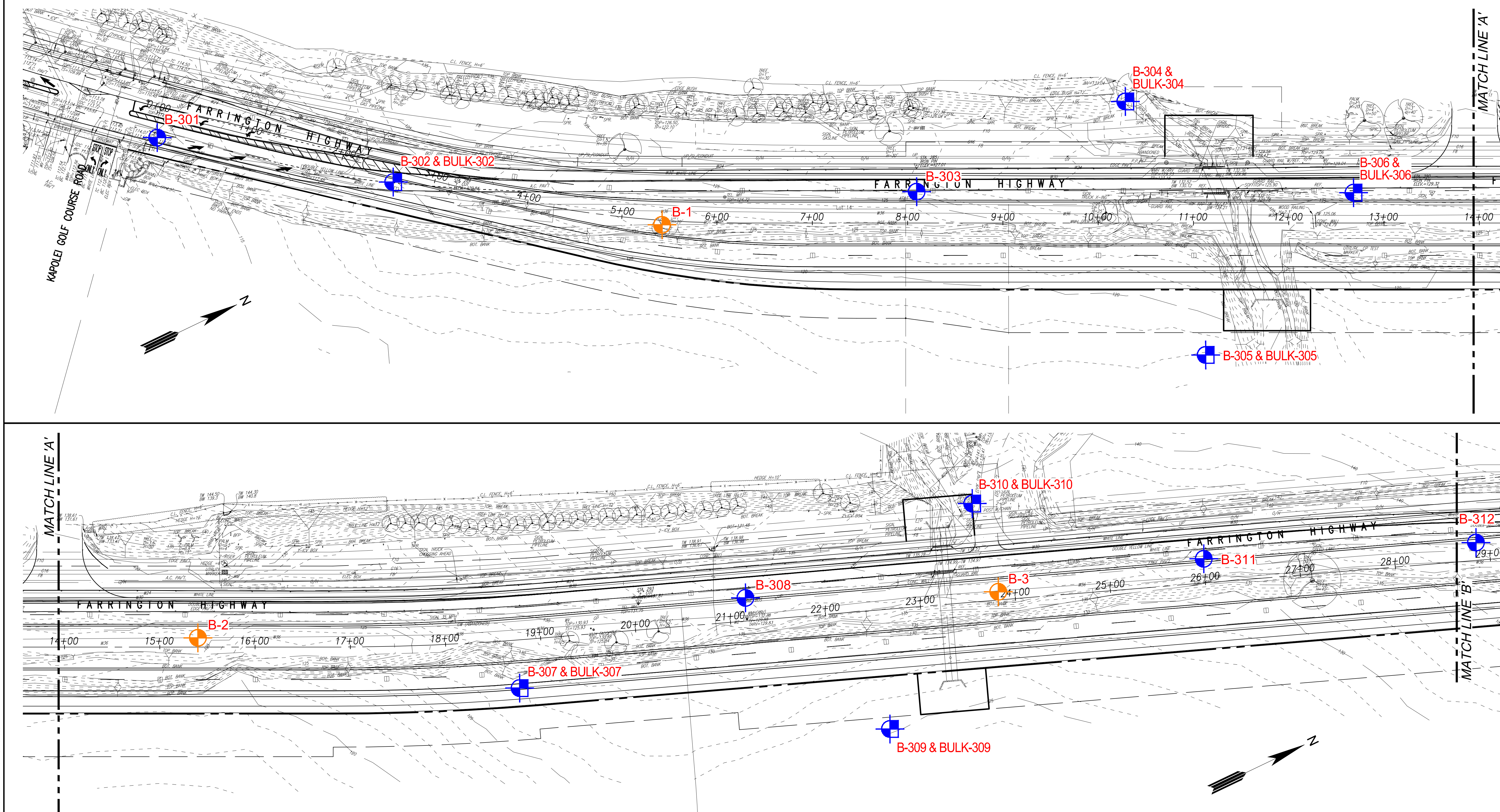

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REFERENCE: TOPOGRAPHIC SURVEY MAP DOWNLOADED FROM R. M. TOWILL CORPORATION WEBSITE ON JUNE 23, 2020.

0 50 100 200 300 FT.

GRAPHIC SCALE

SITE PLAN

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

GEOLABS, INC.
Geotechnical Engineering

DATE	DRAWN BY	PLATE
SEPTEMBER 2020	HYC	
SCALE	W.O.	
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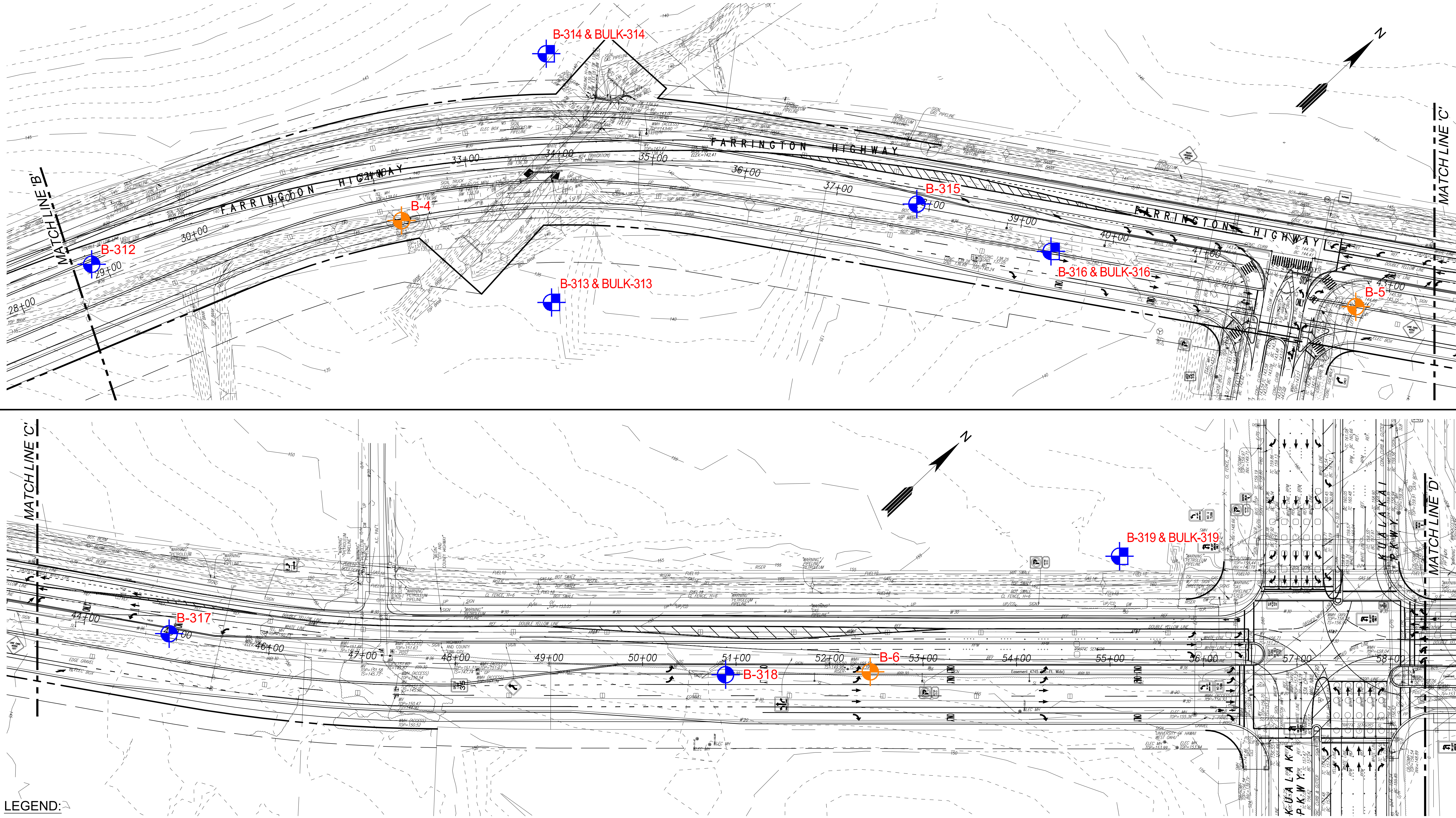

LEGEND:

- APPROXIMATE BORING LOCATION
- APPROXIMATE INFILTRATION TEST LOCATION
- APPROXIMATE BULK SAMPLE LOCATION
- SW SEISMIC SHEAR WAVE VELOCITY TESTING
- APPROXIMATE BORING LOCATION (FROM REPORT BY GEOLABS, INC., W.O. 4190-00(B), DATED MARCH 29, 2000)

REFERENCE: TOPOGRAPHIC SURVEY MAP DOWNLOADED FROM R. M. TOWILL CORPORATION WEBSITE ON JUNE 23, 2020.

0 50 100 200 300 FT.

GRAPHIC SCALE

SITE PLAN

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

GEOLABS, INC.
Geotechnical Engineering

DATE	DRAWN BY	PLATE
SEPTEMBER 2020	HYC	
SCALE	W.O.	3.2
1" =100'	8135-00	

CAD User: HENRY File Last Updated: November 20, 2020 3:10:33pm Plot Date: November 20, 2020 - 3:13:46pm
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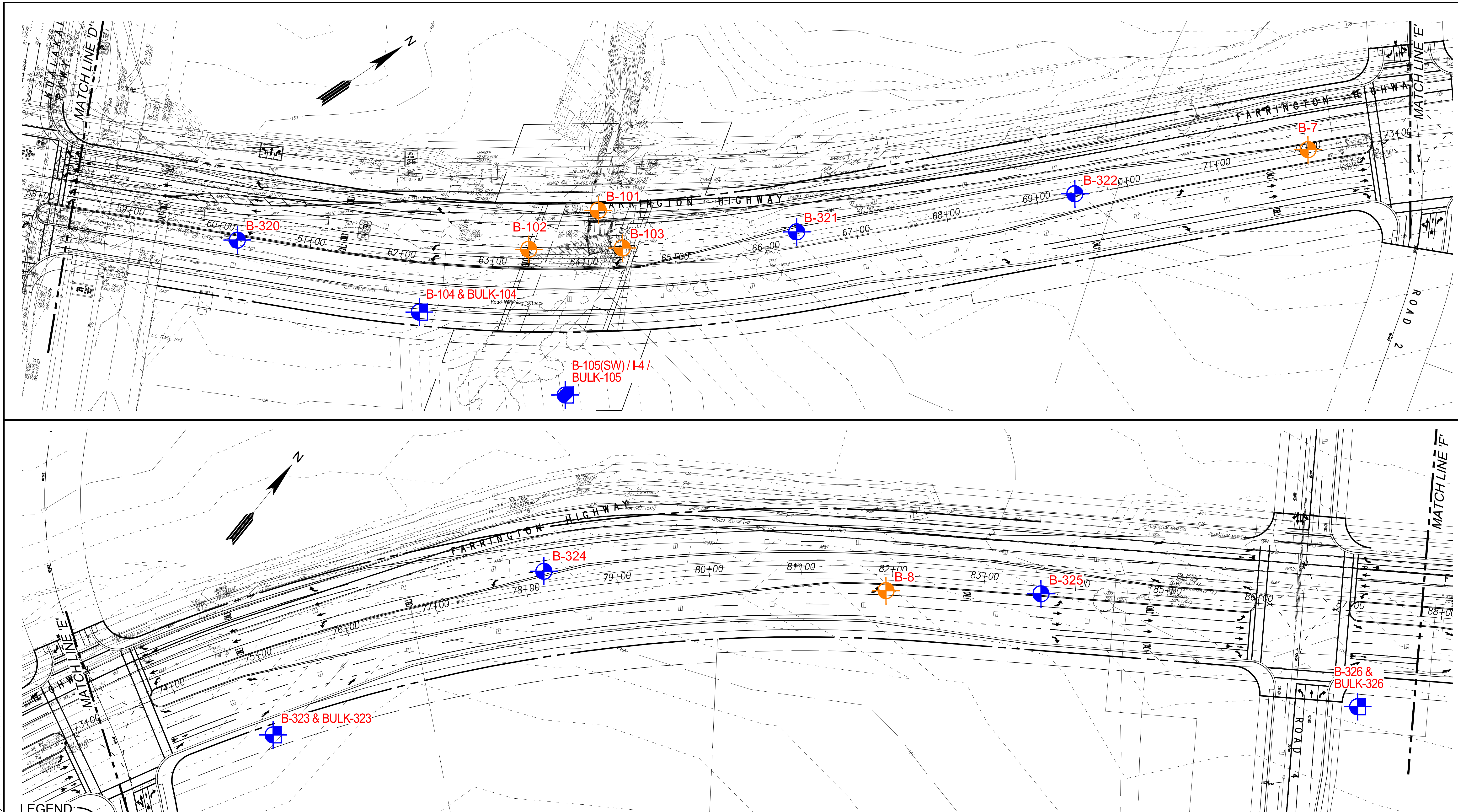

LEGEND:

- APPROXIMATE BORING LOCATION
- APPROXIMATE INFILTRATION TEST LOCATION
- APPROXIMATE BULK SAMPLE LOCATION
- SW SEISMIC SHEAR WAVE VELOCITY TESTING
- APPROXIMATE BORING LOCATION (FROM REPORT BY GEOLABS, INC., W.O. 4190-00(B), DATED MARCH 29, 2000)

REFERENCE: TOPOGRAPHIC SURVEY MAP DOWNLOADED FROM R. M. TOWILL CORPORATION WEBSITE ON JUNE 23, 2020.

0 50 100 200 300 FT.
GRAPHIC SCALE

SITE PLAN

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

GEOLABS, INC.
Geotechnical Engineering

DATE	DRAWN BY	PLATE
SEPTEMBER 2020	HYC	
SCALE	W.O.	3.3
1" =100'	8135-00	

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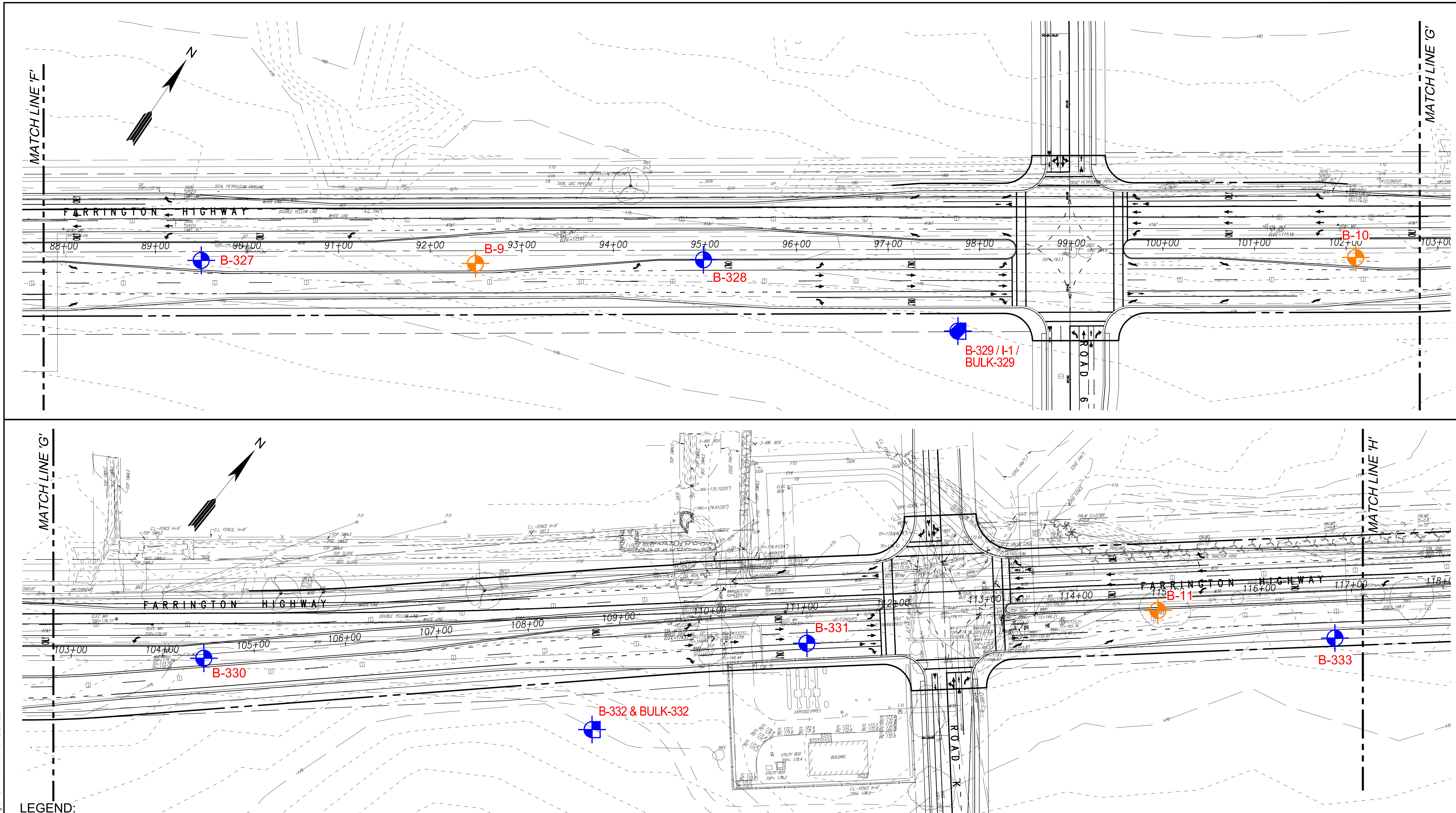


LEGEND:

- APPROXIMATE BORING LOCATION
- APPROXIMATE INFILTRATION TEST LOCATION
- APPROXIMATE BULK SAMPLE LOCATION
- SW SEISMIC SHEAR WAVE VELOCITY TESTING
- APPROXIMATE BORING LOCATION (FROM REPORT BY GEOLABS, INC., W.O. 4190-00(B), DATED MARCH 29, 2000)

REFERENCE: TOPOGRAPHIC SURVEY MAP DOWNLOADED FROM R. M. TOWILL CORPORATION WEBSITE ON JUNE 23, 2020.

0 50 100 200 300 FT.

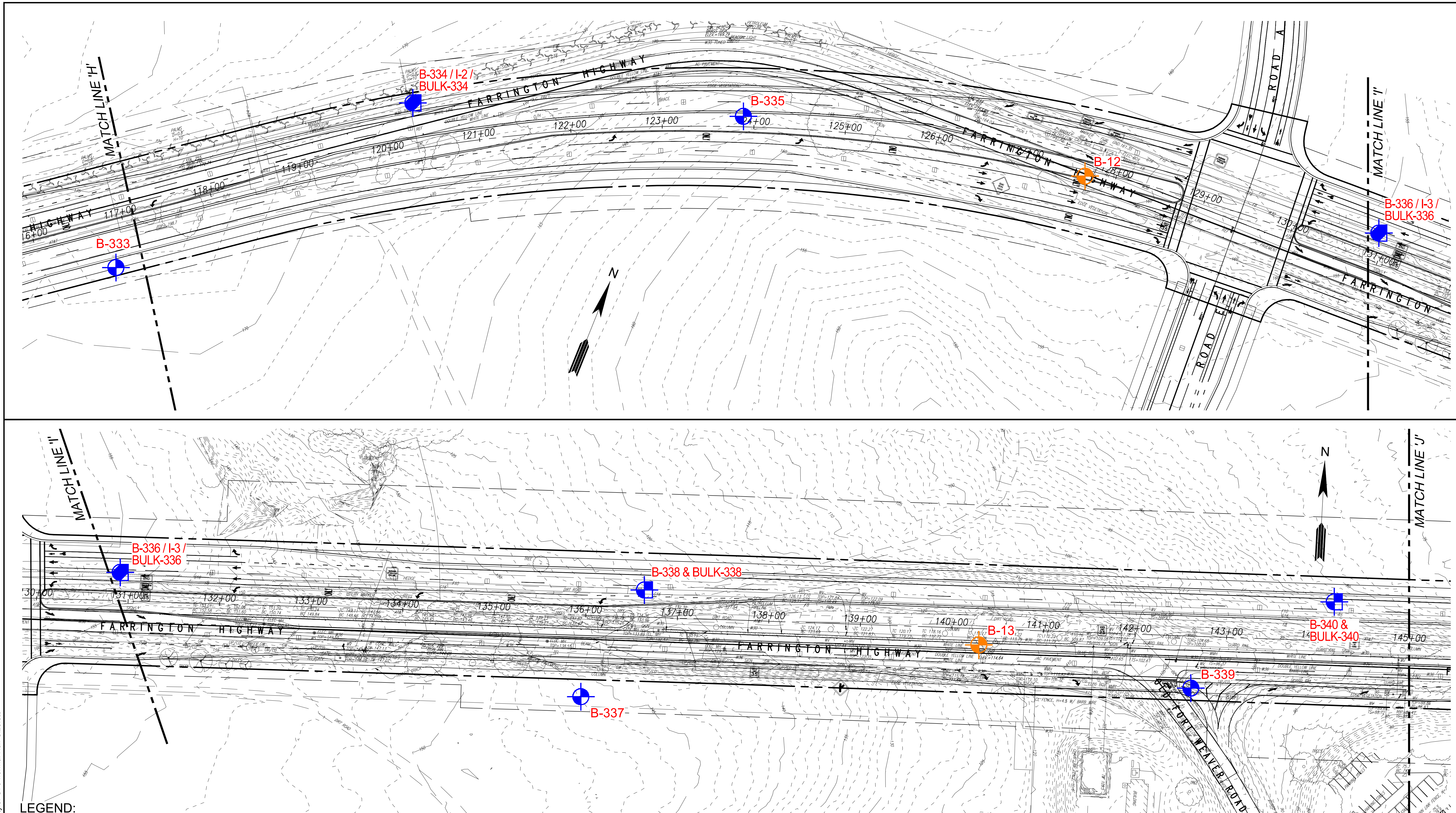
GRAPHIC SCALE

SITE PLAN

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

GEOLABS, INC.
Geotechnical Engineering

DATE	DRAWN BY	PLATE
SEPTEMBER 2020	HYC	
SCALE	**W.O.**	
1" =100'	8135-00	3.4



LEGEND:

- APPROXIMATE BORING LOCATION
- APPROXIMATE INFILTRATION TEST LOCATION
- APPROXIMATE BULK SAMPLE LOCATION
- SW SEISMIC SHEAR WAVE VELOCITY TESTING
- APPROXIMATE BORING LOCATION (FROM REPORT BY GEOLABS, INC., W.O. 4190-00(B), DATED MARCH 29, 2000)

REFERENCE: TOPOGRAPHIC SURVEY MAP DOWNLOADED FROM R. M. TOWILL CORPORATION WEBSITE ON JUNE 23, 2020.

0 50 100 200 300 FT.

GRAPHIC SCALE

SITE PLAN

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

GEOLABS, INC.
Geotechnical Engineering

DATE	DRAWN BY	PLATE
SEPTEMBER 2020	HYC	
SCALE	W.O.	
1" =100'	8135-00	3.5

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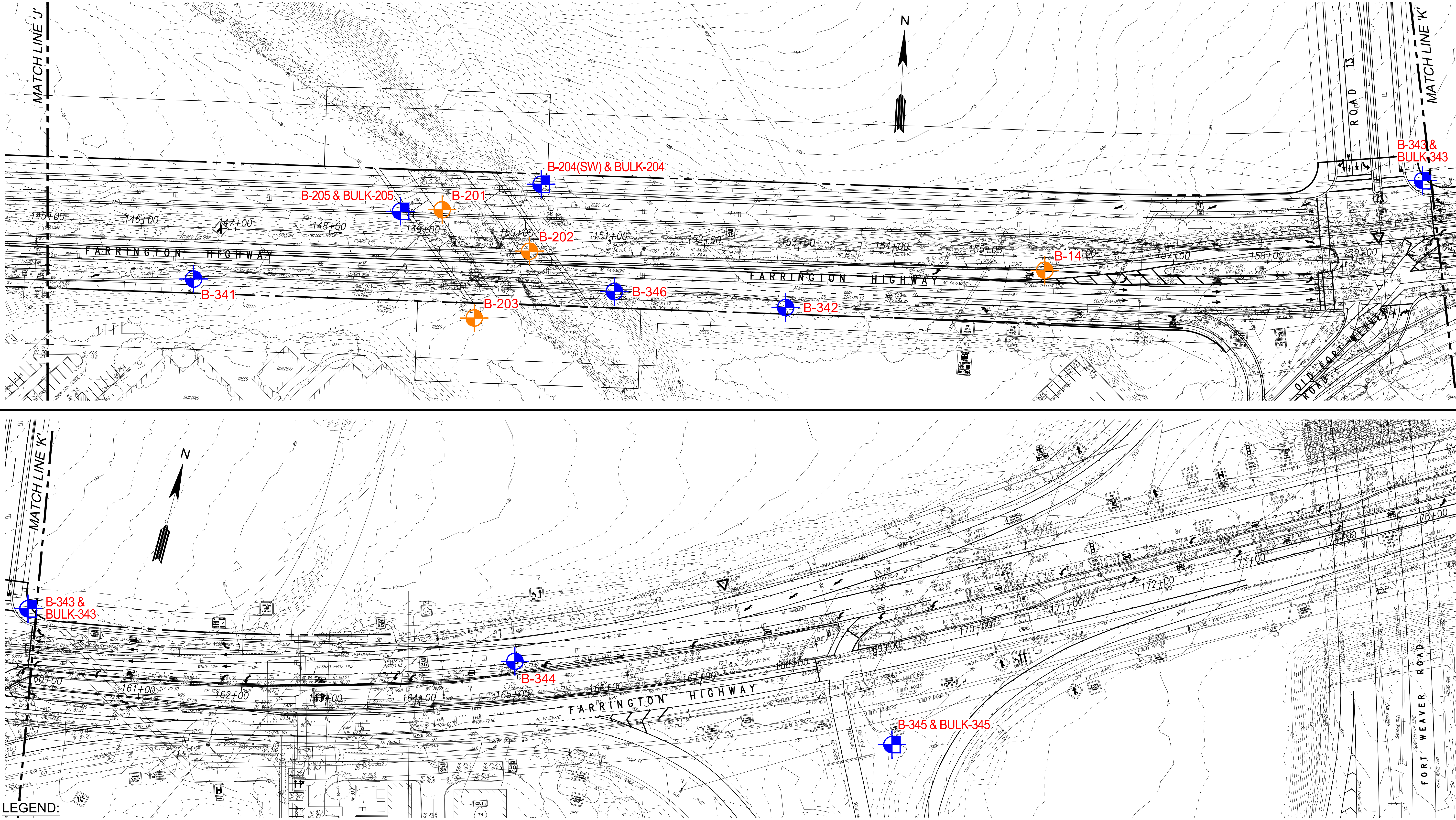

LEGEND:

APPROXIMATE BORING LOCATION

APPROXIMATE INFILTRATION TEST LOCATION

APPROXIMATE BULK SAMPLE LOCATION

SW SEISMIC SHEAR WAVE VELOCITY TESTING

APPROXIMATE BORING LOCATION (FROM REPORT BY GEOLABS, INC., W.O. 4190-00(B), DATED MARCH 29, 2000)

REFERENCE: TOPOGRAPHIC SURVEY MAP DOWNLOADED FROM R. M. TOWILL CORPORATION WEBSITE ON JUNE 23, 2020.

0 50 100 200 300 FT.

GRAPHIC SCALE

SITE PLAN

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

GEOLABS, INC.
Geotechnical Engineering

DATE	DRAWN BY	PLATE
SEPTEMBER 2020	HYC	
SCALE	W.O.	3.6
1" =100'	8135-00	

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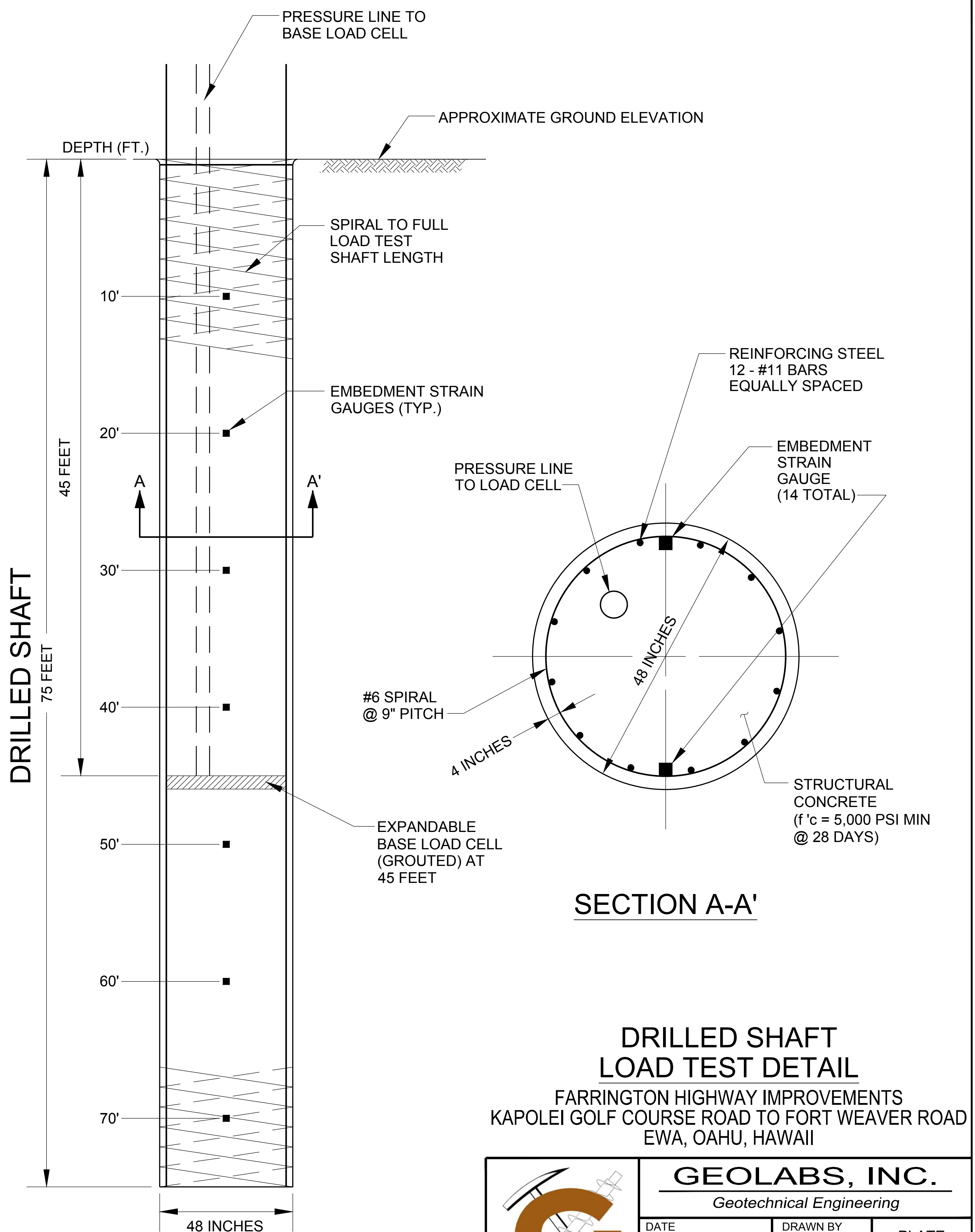
KALOI GULCH BRIDGE



SECTION A-A'

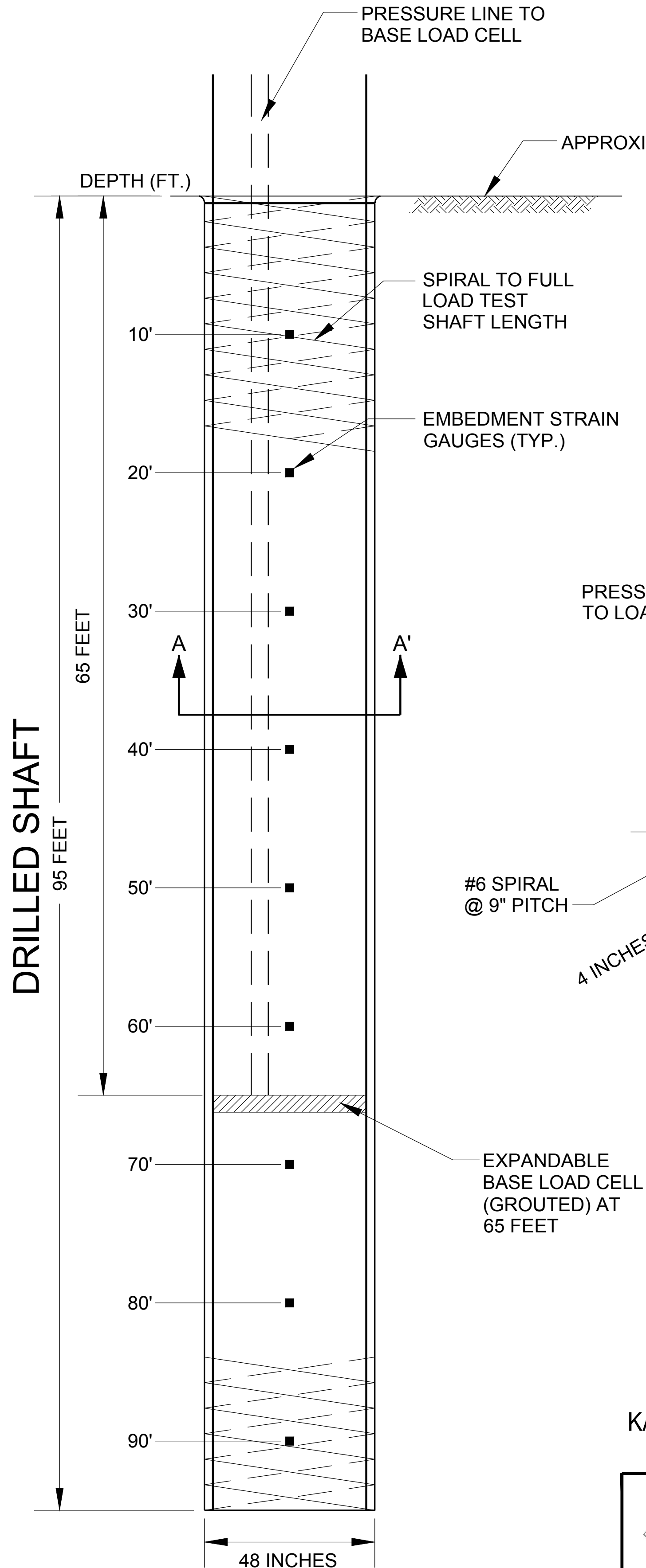
DRILLED SHAFT LOAD TEST DETAIL

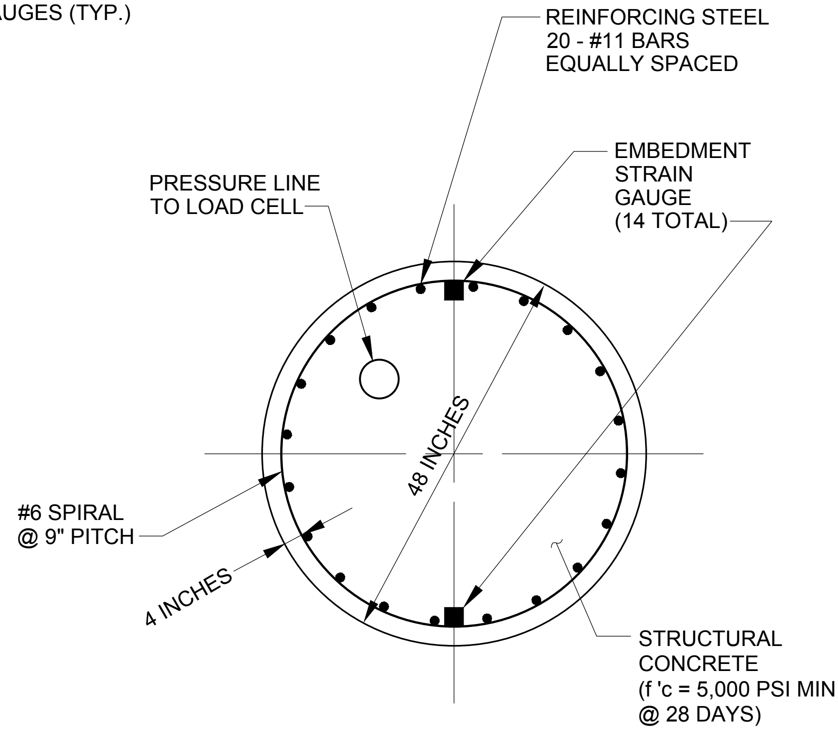
FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

GEOLABS, INC.
Geotechnical Engineering

DATE	DRAWN BY	PLATE
NOVEMBER 2020	KHN	
SCALE	W.O.	4
NOT TO SCALE	8135-00	

HONOULIULI STREAM BRIDGE





SECTION A-A'

DRILLED SHAFT LOAD TEST DETAIL

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

GEOLABS, INC.
Geotechnical Engineering

DATE	DRAWN BY	PLATE
AUGUST 2021	KHN	
SCALE	W.O.	5
NOT TO SCALE	8135-00	

APPENDIX A

APPENDIX A

Field Exploration

We explored the subsurface conditions along the highway improvements alignment by drilling and sampling forty-six borings, designated as Boring Nos. 301 through 346, extending to depths of about 4 to 50.5 feet below the existing ground/pavement surface. In addition, four deep borings (two at each bridge structure), designated as Boring Nos. 104 and 105 at for the Kaloi Gulch Bridge and Boring Nos. 204 and 205 at the Honouliuli Stream Bridge locations, were drilled to depths ranging from about 101 to 121 feet below the existing ground surface. Twenty-five bulk samples, designated as Bulk Sample Nos. 104, 105, 204, 205, and 302 through 345, of the near-surface soils were obtained at selected locations along the highway alignment. The approximate boring and bulk sample locations are shown on the General Site Plan, Plate 2 and Site Plans, Plates 3.1 through 3.6. The borings were drilled using truck-mounted drill rigs equipped with continuous flight augers and coring tools.

Our geologists classified the materials encountered in the borings by visual and textural examination in the field in general accordance with ASTM D2488, Standard Practice for Description and Identification of Soils, and monitored the drilling operations on a near-continuous (full-time) basis. These classifications were further reviewed visually and by testing in the laboratory. Soils were classified in general accordance with ASTM D2487, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System), as shown on the Soil Log Legend, Plate A-0.1. Deviations made to the soil classification in accordance with ASTM D2487 are described in the Soil Classification Log Key, Plate A-0.2. Graphic representations of the materials encountered are presented on the Logs of Borings, Plates A-1 through A-50.

Relatively “undisturbed” soil samples were obtained from the borings drilled in general accordance with ASTM D3550, 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 borings drilled in general accordance with ASTM D1586, 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. The penetration resistance shown on the Logs of Borings indicates the number of blows required for the specific sampler type used. The blow counts may need to be factored to obtain the Standard Penetration Test (SPT) blow counts.

Pocket penetrometer tests were performed on selected cohesive soil samples in the field. The pocket penetrometer test provides an indication of the unconfined compressive strength of the sample. Results of the pocket penetrometer tests are summarized on the Logs of Borings at the appropriate sample depths.

Core samples of the rock materials encountered at the project site were obtained by using diamond core drilling techniques in general accordance with ASTM D2113, Diamond Core Drilling for Site Investigation. Core drilling is a rotary drilling method that uses a hollow bit to cut into the rock formation. The rock material left in the hollow core of the bit is mechanically recovered for examination and description. Rock cores were described in general accordance with the Rock Description System, as shown on the Rock Log Legend, Plate A-0.3. The Rock Description System is based on the publication “Suggested Methods for the Quantitative Description of Discontinuities in Rock Masses” by the International Society for Rock Mechanics (March 1977).

Recovery (REC) may be used as a subjective guide to the interpretation of the relative quality of rock masses, where appropriate. Recovery is defined as the actual length of material recovered from a coring attempt versus the length of the core attempt. For example, if 3.7 feet of material is recovered from a 5.0-foot core run, the recovery would be 74 percent and would be shown on the Logs of Borings as REC = 74%.

The Rock Quality Designation (RQD) is also a subjective guide to the relative quality of rock masses. RQD is defined as the percentage of the core run in rock that is sound material in excess of 4 inches in length without any discontinuities, discounting any drilling, mechanical, and handling induced fractures or breaks. If 2.5 feet of sound material is recovered from a 5.0-foot core run in rock, the RQD would be 50 percent and would be shown on the Logs of Borings as RQD = 50%. Generally, the following is used to describe the relative quality of the rock based on the "Practical Handbook of Physical Properties of Rocks and Minerals” by Robert S. Carmichael (1989).

Rock Quality	**RQD** (%)
Very Poor	0 – 25
Poor	25 – 50
Fair	50 – 75
Good	75 – 90
Excellent	90 – 100

The excavation characteristic of a rock mass is a function of the relative hardness of the rock, its relative quality, brittleness, and fissile characteristics. A dense rock formation with a high RQD value would be very difficult to excavate and probably would require more arduous methods of excavation.

GEOLABS, INC.

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Soil Log Legend

UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)

MAJOR DIVISIONS			USCS	TYPICAL DESCRIPTIONS
COARSE-GRAINED SOILS MORE THAN 50% OF MATERIAL RETAINED ON NO. 200 SIEVE	GRAVELS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS LESS THAN 5% FINES	GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
			GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES MORE THAN 12% FINES	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SANDS 50% OR MORE OF COARSE FRACTION PASSING THROUGH NO. 4 SIEVE	CLEAN SANDS LESS THAN 5% FINES	SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
			SP	POORLY-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
		SANDS WITH FINES MORE THAN 12% FINES	SM	SILTY SANDS, SAND-SILT MIXTURES
			SC	CLAYEY SANDS, SAND-CLAY MIXTURES
FINE-GRAINED SOILS 50% OR MORE OF MATERIAL PASSING THROUGH NO. 200 SIEVE	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
			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
- WATER LEVEL OBSERVED IN BORING AT TIME OF DRILLING
- WATER LEVEL OBSERVED IN BORING AFTER DRILLING
- WATER LEVEL OBSERVED IN BORING OVERNIGHT

LL	LIQUID LIMIT (NP=NON-PLASTIC)
PI	PLASTICITY INDEX (NP=NON-PLASTIC)
TV	TORVANE SHEAR (tsf)
UC	UNCONFINED COMPRESSION OR UNIAXIAL COMPRESSIVE STRENGTH
TXUU	UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION (ksf)

Plate

A-0.1

LOG LEGEND FOR SOIL 8135-00.GPJ GEOLABS.GDT 10/19/20

GEOLABS, INC.

Geotechnical Engineering

Soil Classification Log Key

(with deviations from ASTM D2488)

GEOLABS, INC. CLASSIFICATION*

GRANULAR SOIL (- #200 <50%)	COHESIVE SOIL (- #200 ≥50%)
• **PRIMARY** constituents are composed of the largest percent of the soil mass. Primary constituents are capitalized and bold (i.e., **GRAVEL, SAND**) • **SECONDARY** constituents are composed of a percentage less than the primary constituent. If the soil mass consists of 12 percent or more fines content, a cohesive constituent is used (**SILTY** or **CLAYEY**); otherwise, a granular constituent is used (**GRAVELLY** or **SANDY**) provided that the secondary constituent consists of 20 percent or more of the soil mass. Secondary constituents are capitalized and bold (i.e., **SANDY** GRAVEL, **CLAYEY** SAND) and precede the primary constituent. • **accessory descriptions** compose of the following: with some: >12% with a little: 5 - 12% with traces of: <5% accessory descriptions are lower cased and follow the Primary and Secondary Constituents (i.e., SILTY GRAVEL **with a little sand**)	• **PRIMARY** constituents are based on plasticity. Primary constituents are capitalized and bold (i.e., **CLAY, SILT**) • **SECONDARY** constituents are composed of a percentage less than the primary constituent, but more than 20 percent of the soil mass. Secondary constituents are capitalized and bold (i.e., **SANDY** CLAY, **SILTY** CLAY, **CLAYEY** SILT) and precede the primary constituent. • **accessory descriptions** compose of the following: with some: >12% with a little: 5 - 12% with traces of: <5% accessory descriptions are lower cased and follow the Primary and Secondary Constituents (i.e., SILTY CLAY **with some sand**)

EXAMPLE: Soil Containing 60% Gravel, 25% Sand, 15% Fines. Described as: **SILTY GRAVEL** with some sand

RELATIVE DENSITY / CONSISTENCY

Granular Soils			Cohesive Soils			
N-Value (Blows/Foot)		Relative Density	N-Value (Blows/Foot)		PP Readings (tsf)	Consistency
SPT	MCS		SPT	MCS		
0 - 4	0 - 7	Very Loose	0 - 2	0 - 4		Very Soft
4 - 10	7 - 18	Loose	2 - 4	4 - 7	< 0.5	Soft
10 - 30	18 - 55	Medium Dense	4 - 8	7 - 15	0.5 - 1.0	Medium Stiff
30 - 50	55 - 91	Dense	8 - 15	15 - 27	1.0 - 2.0	Stiff
> 50	> 91	Very Dense	15 - 30	27 - 55	2.0 - 4.0	Very Stiff
			> 30	> 55	> 4.0	Hard

MOISTURE CONTENT DEFINITIONS

Dry: Absence of moisture, dry to the touch

Moist: Damp but no visible water

Wet: Visible free water

ABBREVIATIONS

WOH: Weight of Hammer

WOR: Weight of Drill Rods

SPT: Standard Penetration Test Split-Spoon Sampler

MCS: Modified California Sampler

PP: Pocket Penetrometer

GRAIN SIZE DEFINITION

Description	Sieve Number and / or Size
Boulders	> 12 inches (305-mm)
Cobbles	3 to 12 inches (75-mm to 305-mm)
Gravel	3-inch to #4 (75-mm to 4.75-mm)
Coarse Gravel	3-inch to 3/4-inch (75-mm to 19-mm)
Fine Gravel	3/4-inch to #4 (19-mm to 4.75-mm)
Sand	#4 to #200 (4.75-mm to 0.075-mm)
Coarse Sand	#4 to #10 (4.75-mm to 2-mm)
Medium Sand	#10 to #40 (2-mm to 0.425-mm)
Fine Sand	#40 to #200 (0.425-mm to 0.075-mm)

**Soil descriptions are based on ASTM D2488-09a, Visual-Manual Procedure, with the above modifications by Geolabs, Inc. to the Unified Soil Classification System (USCS).*

Plate

A-0.2

GEOLABS, INC.

Geotechnical Engineering

Rock Log Legend

ROCK DESCRIPTIONS

BASALT	**CONGLOMERATE**
BOULDERS	**LIMESTONE**
BRECCIA	**SANDSTONE**
CLINKER	**SILTSTONE**
COBBLES	**TUFF**
CORAL	**VOID/CAVITY**

ROCK DESCRIPTION SYSTEM

ROCK FRACTURE CHARACTERISTICS

The following terms describe general fracture spacing of a rock:

Massive: Greater than 24 inches apart

Slightly Fractured: 12 to 24 inches apart

Moderately Fractured: 6 to 12 inches apart

Closely Fractured: 3 to 6 inches apart

Severely Fractured: Less than 3 inches apart

DEGREE OF WEATHERING

The following terms describe the chemical weathering of a rock:

Unweathered: Rock shows no sign of discoloration or loss of strength.

Slightly Weathered: Slight discoloration inwards from open fractures.

Moderately Weathered: Discoloration throughout and noticeably weakened though not able to break by hand.

Highly Weathered: Most minerals decomposed with some corestones present in residual soil mass. Can be broken by hand.

Extremely Weathered: Saprolite. Mineral residue completely decomposed to soil but fabric and structure preserved.

HARDNESS

The following terms describe the resistance of a rock to indentation or scratching:

Very Hard: Specimen breaks with difficulty after several "pinging" hammer blows.
Example: Dense, fine grain volcanic rock

Hard: Specimen breaks with some difficulty after several hammer blows.
Example: Vesicular, vugular, coarse-grained rock

Medium Hard: Specimen can be broked by one hammer blow. Cannot be scraped by knife. SPT may penetrate by ~25 blows per inch with bounce.
Example: Porous rock such as clinker, cinder, and coral reef

Soft: Can be indented by one hammer blow. Can be scraped or peeled by knife. SPT can penetrate by ~100 blows per foot.
Example: Weathered rock, chalk-like coral reef

Very Soft: Crumbles under hammer blow. Can be peeled and carved by knife. Can be indented by finger pressure.
Example: Saprolite

GEOLABS, INC. Geotechnical Engineering	FARRINGTON HIGHWAY IMPROVEMENTS KAPOLEI GOLF COURSE ROAD TO FORT WEAVER ROAD EWA, OAHU, HAWAII	Log of Boring 104

Approximate Ground Surface Elevation (feet): 156 *

Other Tests (Laboratory)	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%) (Field)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
								MH	Brown **CLAYEY SILT** with some sand and traces of gravel (coralline), very stiff to hard, moist (fill)
	17	93			43				
	18				35			ML	Brown **SANDY SILT**, hard, moist (older alluvium)
	17	99			80		5		
									grades with black mottling
Sieve - #200 = 52.3%	17				93		10		
									grades with some boulders
	16	99			25/3"		15		
								CL	Reddish brown **SANDY CLAY**, hard, moist (older alluvium)
	16				10/1"		20		
	20	109			50/4"	>4.5	25		
			0						
									grades to very stiff
	31				18		30		
			0						
	20	109					35		

Date Started:	September 14, 2020	Water Level:	Not Encountered	Plate
Date Completed:	September 16, 2020			
Logged By:	B. Aiu	Drill Rig:	CME-75DG2 *(Energy Transfer Ratio = 91.5%)*	A - 1.1
Total Depth:	121.08 feet	Drilling Method:	4" Solid-Stem Auger & PQ Coring	
Work Order:	8135-00	Driving Energy:	140 lb. wt., 30 in. drop	

GEOLABS, INC.

Geotechnical Engineering

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Log of Boring 104

(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
					73	>4.5		CL	
			0						
LL=36 PI=16	25				17		40		
			0						
TXUU S_u=11.8 ksf	29	100			63	>4.5	45		
			13						
							50		
	28				32				
			14						
							55		
TXUU S_u=9.3 ksf	24	105			62	>4.5			grades with a little fine gravel
			24						
							60		
	31				21				
			19						
							65		
TXUU S_u=2.1 ksf	30	93			32	>4.5			
			14						
							70		

Date Started:	September 14, 2020	Water Level:	Not Encountered
Date Completed:	September 16, 2020		
Logged By:	B. Aiu	Drill Rig:	CME-75DG2 *(Energy Transfer Ratio = 91.5%)*
Total Depth:	121.08 feet	Drilling Method:	4" Solid-Stem Auger & PQ Coring
Work Order:	8135-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate A - 1.2

GEOLABS, INC.

Geotechnical Engineering

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Log of Boring **104**

(Continued from previous plate)

Laboratory: Other Tests	Laboratory: Moisture Content (%)	Laboratory: Dry Density (pcf)	Field: Core Recovery (%)	Field: RQD (%)	Field: Penetration Resistance (blows/foot)	Field: Pocket Pen. (tsf)	Depth (feet)	USCS	Description
								CL	
	34				10				grades with a little sand
			12 12						
							75		
TXUU S_u=7.6 ksf	24	104			81	3.8		CL	Brown **SANDY CLAY**, very stiff, moist (older alluvium)
			29						
							80		
LL=40 PI=20	24				86				
			24						
							85		
	22	115			56/6" +25/1"	>4.5			
			21						
								SM	Brown **SILTY SAND (BASALTIC)** with some rounded gravel, dense, moist (older alluvium)
							90		
Sieve - #200 = 37.1%	25				31				
			0						
							95	SW-SM	Brown **GRAVELLY SAND (BASALTIC)** with a little silt, dense, moist (older alluvium)
Sieve - #200 = 10.4%	13	134			24/6" +75/5"				
			23						
							100		grades with some cobbles
	20				53				
			48						
							105		

Date Started:	September 14, 2020	Water Level:	Not Encountered
Date Completed:	September 16, 2020		
Logged By:	B. Aiu	Drill Rig:	CME-75DG2 *(Energy Transfer Ratio = 91.5%)*
Total Depth:	121.08 feet	Drilling Method:	4" Solid-Stem Auger & PQ Coring
Work Order:	8135-00	Driving Energy:	140 lb. wt., 30 in. drop

GEOLABS, INC.

Geotechnical Engineering

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Log of Boring **104**

(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
	27				55			SW-SM	grades with small boulders
			0						
							110		
	36	84	85	100	35/2"				Gray **BASALT**, slightly fractured, slightly weathered, hard (basalt formation)
							115	SM	Gray with multi-color mottling **SILTY SAND (BASALTIC)**, dense, moist (saprolite)
	41				39				
			100	71					Gray **BASALT**, slightly fractured, slightly weathered, hard (basalt formation)
							120		
					25/1"				Boring terminated at 121.08 feet
									* Elevations estimated from Topographic Survey Map downloaded from R. M. Towill Corporation website on June 23, 2020.
							125		
							130		
							135		
							140		

Date Started:	September 14, 2020	Water Level:	Not Encountered
Date Completed:	September 16, 2020		
Logged By:	B. Aiu	Drill Rig:	CME-75DG2 *(Energy Transfer Ratio = 91.5%)*
Total Depth:	121.08 feet	Drilling Method:	4" Solid-Stem Auger & PQ Coring
Work Order:	8135-00	Driving Energy:	140 lb. wt., 30 in. drop

GEOLABS, INC. Geotechnical Engineering	FARRINGTON HIGHWAY IMPROVEMENTS KAPOLEI GOLF COURSE ROAD TO FORT WEAVER ROAD EWA, OAHU, HAWAII	Log of Boring 105

Approximate Ground Surface Elevation (feet): 150 *

Laboratory: Other Tests	Laboratory: Moisture Content (%)	Laboratory: Dry Density (pcf)	Field: Core Recovery (%)	Field: RQD (%)	Field: Penetration Resistance (blows/foot)	Field: Pocket Pen. (tsf)	Depth (feet)	USCS	Description
							0	CH	Brown **SILTY CLAY** with a little cobbles (basaltic), very stiff to hard, moist (older alluvium)
	28	85			49	4.5			
								CL	Brown **SANDY CLAY** with traces of gravel (basaltic), very stiff, moist (older alluvium)
LL=35 PI=25	26				21				
Sieve - #200 = 44.1%	26	88			15	4.0	5		grades to silty sand
Sieve - #200 = 83.5%	29				45		10	CL	Reddish brown **SANDY CLAY**, hard, moist (older alluvium)
	38	87			20/1"	4.5	15		
LL=35 PI=12	22				47/6" +50/4"		20		
	19	98			25/1"	4.5	25		
	20				52		30		
			0						
							35		

Date Started:	September 8, 2020	Water Level:	Not Encountered
Date Completed:	September 10, 2020		
Logged By:	S. Latronic	Drill Rig:	CME-75DR *(Energy Transfer Ratio = 77.3%)*
Total Depth:	120 feet	Drilling Method:	4" Solid-Stem Auger & PQ Coring
Work Order:	8135-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate A - 2.1

GEOLABS, INC.

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FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Log of Boring **105**

(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
	29	95	21		55/3"			CL	grades with cemented siltstone gravel locally
	23				75		40		
			60						
TXUU S_u=6.1 ksf	26	102			26	4.3	45		
			79						
	26				78		50		
			24						
									grades with clay pockets locally
								CL	Brown **SANDY CLAY** with traces of rounded gravel (basaltic), stiff, moist (older alluvium)
TXUU S_u=1.9 ksf	35	87			11	1.0	55		
			33						
									grades with clayey silt
LL=34 PI=18	32				15		60		
									grades to very stiff
			29						
TXUU S_u=2.0 ksf	30	91			14	2.5	65		
			38						
							70		

Date Started:	September 8, 2020	Water Level: ▼	Not Encountered
Date Completed:	September 10, 2020		
Logged By:	S. Latronic	Drill Rig:	CME-75DR *(Energy Transfer Ratio = 77.3%)*
Total Depth:	120 feet	Drilling Method:	4" Solid-Stem Auger & PQ Coring
Work Order:	8135-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate A - 2.2

GEOLABS, INC.

Geotechnical Engineering

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Log of Boring

105

(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
	27		36		35			CL	Reddish brown **SANDY CLAY**, hard, moist (older alluvium)
	24	110	0		51/6" +50/5"	4.5	75		grades with clayey silt pockets locally
LL=40 PI=25	26		57		67		80		
TXUU S_u=7.6 ksf	23	108	63		40/6" +50/4"	4.5	85		
	38		43		14		90	SM	Brown **SILTY SAND (BASALTIC)** with a little gravel, medium dense, moist (older alluvium)
									grades with cobbles (basaltic)
								ML	Brown **SANDY SILT** with a little rounded gravel (basaltic) and traces of clay, very stiff to hard (older alluvium)
	22	115	0		50/5"	4.5	95	SM	Brown **SILTY SAND (BASALTIC)** with some decomposed gravel, medium dense to dense, moist (saprolite)
	17		56	0	50/3"		100		Gray vesicular **BASALT**, closely fractured, slightly to moderately weathered, medium hard to hard (pahoehoe basalt)
								MH	Reddish brown to brown **CLAYEY SILT** with some sand and a little gravel (basaltic), very stiff, moist (weathered clinker)
							105		

Date Started:	September 8, 2020	Water Level:	Not Encountered
Date Completed:	September 10, 2020		
Logged By:	S. Latronic	Drill Rig:	CME-75DR *(Energy Transfer Ratio = 77.3%)*
Total Depth:	120 feet	Drilling Method:	4" Solid-Stem Auger & PQ Coring
Work Order:	8135-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 2.3

GEOLABS, INC.

Geotechnical Engineering

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Log of Boring

105

(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
			23					MH	
	36	88			27		110		
			81	81					Gray and brown cemented **BASALT**, moderately fractured, slightly to moderately weathered, medium hard to hard (welded clinker)
			97	70			115		Gray vugular **BASALT**, moderately fractured, unweathered to slightly weathered, hard to very hard (a'a basalt)
							120		Boring terminated at 120 feet
							125		
							130		
							135		
							140		

Date Started:	September 8, 2020	Water Level: ▼	Not Encountered
Date Completed:	September 10, 2020		
Logged By:	S. Latronic	Drill Rig:	CME-75DR *(Energy Transfer Ratio = 77.3%)*
Total Depth:	120 feet	Drilling Method:	4" Solid-Stem Auger & PQ Coring
Work Order:	8135-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 2.4

GEOLABS, INC.

Geotechnical Engineering

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Log of Boring

204

Approximate Ground Surface Elevation (feet): 87 *

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
							0	CH	Dark brown **SILTY CLAY** with some cobbles (basaltic), very stiff, moist (fill)
								CH	Brown **SILTY CLAY**, very stiff to hard, moist (older alluvium)
	15				33				
	6	118			49		5		
								SM	Gray subrounded **SILTY SAND (BASALTIC)** with some gravel and cobbles, medium dense to dense, dry to moist (river channel deposit)
Sieve - #200 = 21.2%	4				40		10		
								CL	Brown **SANDY CLAY**, hard, moist (older alluvium)
	16	94			50/4"	4.5	15		
	23				50/3"		20		grades with sandy silt locally
	21	101			50/2"	4.5	25		
									grades to very stiff to hard
Sieve - #200 = 78.8%	21		22		70		30		
							35		grades to reddish brown

Date Started:	August 31, 2020	Water Level: ▽	75.1 ft. 09/01/2020 0850 HRS
Date Completed:	September 1, 2020	▼	75.5 ft. 09/01/2020 1110 HRS
Logged By:	S. Latronic	Drill Rig:	CME-75DG1 *(Energy Transfer Ratio = 80.3%)*
Total Depth:	101.5 feet	Drilling Method:	4" Solid-Stem Auger
Work Order:	8135-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 3.1

BORING_LOG 8135-00.GPJ GEOLABS.GDT 11/22/20

GEOLABS, INC.

Geotechnical Engineering

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Log of Boring

204

Laboratory			Field							
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	(Continued from previous plate) Description
										CL	
TXUU S_u=4.4 ksf Sieve - #200 = 76.1%	29	95			42	4.3					
			43								
										CL	Reddish brown **SANDY CLAY**, very stiff to hard, moist (residual soil)
							40				
LL=39 PI=15	32				36						
			67								
							45				
TXUU S_u=5.3 ksf	39	78			22						grades with remnant vesicular structure locally
			60								
							50				
										SM	Gray and brown **SILTY SAND (BASALTIC)** with some gravel, very dense, moist (weathered basalt)
	29				66						
			90	28							
											Gray vesicular **BASALT**, moderately fractured, slightly weathered, medium hard to hard (pahoehoe basalt)
							55				
UC= 6910 psi			88	70		3.5					
							60				
UC= 5240 psi			85	50							grades to highly weathered locally
							65				
			8							GP	Gray **GRAVEL (BASALTIC)** with some cobbles and traces of sand and silt, medium dense to dense, moist (clinker)
							70				

Date Started:	August 31, 2020	Water Level:	75.1 ft. 09/01/2020 0850 HRS
Date Completed:	September 1, 2020		75.5 ft. 09/01/2020 1110 HRS
Logged By:	S. Latronic	Drill Rig:	CME-75DG1 *(Energy Transfer Ratio = 80.3%)*
Total Depth:	101.5 feet	Drilling Method:	4" Solid-Stem Auger
Work Order:	8135-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 3.2

GEOLABS, INC.

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FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Log of Boring

204

(Continued from previous plate)

Other Tests (Laboratory)	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%) (Field)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
	15				29/6" +50/4"			GP	
Sieve - #200 = 0.4%			36				75		
			97	40					Gray vugular **BASALT**, slightly to moderately fractured, unweathered to slightly weathered, very hard (a'a basalt)
							80		
UC= 6080 psi			100	95					
							85		
UC= 10180 psi			100	90					
							90		
UC= 10030 psi			100	80					
							95		
			85	72					
							100		
									Boring terminated at 101.5 feet
							105		

Date Started:	August 31, 2020
Date Completed:	September 1, 2020
Logged By:	S. Latronic
Total Depth:	101.5 feet
Work Order:	8135-00

Water Level:	75.1 ft. 09/01/2020 0850 HRS
	75.5 ft. 09/01/2020 1110 HRS
Drill Rig:	CME-75DG1 *(Energy Transfer Ratio = 80.3%)*
Drilling Method:	4" Solid-Stem Auger
Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 3.3

GEOLABS, INC. Geotechnical Engineering	FARRINGTON HIGHWAY IMPROVEMENTS KAPOLEI GOLF COURSE ROAD TO FORT WEAVER ROAD EWA, OAHU, HAWAII	Log of Boring 205

Approximate Ground Surface Elevation (feet): 70 *

Laboratory			Field						
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
								MH	Brown **CLAYEY SILT** with some gravel (basaltic), very stiff to very stiff, moist (fill)
	13				50/5"				
									Gray **BOULDERS (BASALTIC)**, very dense, dry (fill)
								CL	Brown **SANDY CLAY**, stiff, moist (older alluvium)
	17				8		5		
								SM	Brown **SILTY SAND (BASALTIC)** with traces of gravel, medium dense, moist (older alluvium)
Direct Shear Sieve - #200 = 18.8%	7	117			45		10		
								SC	Brown **CLAYEY SAND** with a little gravel, very stiff to hard, moist (residual soil)
Sieve - #200 = 25.0%	24				35		15		
								SM	Brownish gray **SILTY SAND** with some gravel (basaltic), hard, moist (residual soil)
	28	93			50/2"	4.5	20		
Sieve - #200 = 18.6%	29				45		25		
								MH	Grayish brown **CLAYEY SILT** with some decomposed gravel and remnant vesicular structure, hard, moist (saprolite)
LL=55 PI=22 TXUU S_u=6.3 ksf	34	71			44	4.5	30		
									grades to highly weathered basalt
							35		

Date Started:	August 25, 2020	Water Level:	52.2 ft. 08/26/2020 1210 HRS 52.6 ft. 08/26/2020 1300 HRS	Plate
Date Completed:	August 26, 2020			
Logged By:	S. Latronic	Drill Rig:	CME-75DG1 *(Energy Transfer Ratio = 80.3%)*	A - 4.1
Total Depth:	101 feet	Drilling Method:	4" Solid-Stem Auger & PQ Coring	
Work Order:	8135-00	Driving Energy:	140 lb. wt., 30 in. drop	

GEOLABS, INC. Geotechnical Engineering	FARRINGTON HIGHWAY IMPROVEMENTS KAPOLEI GOLF COURSE ROAD TO FORT WEAVER ROAD EWA, OAHU, HAWAII	Log of Boring 205

(Continued from previous plate)

Other Tests (Laboratory)	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%) (Field)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
	35				32				
UC= 4200 psi			100	54					Brownish gray to gray vesicular **BASALT**, moderately fractured, slightly to moderately weathered, medium hard to hard (pahoehoe basalt)
							40		
			50	0				GW	Gray subangular **SANDY GRAVEL (BASALTIC)** with some cobbles, medium dense to dense, moist (clinker)
							45		
UC= 10280 psi			97	52					
									Gray vugular **BASALT**, slightly to moderately fractured, unweathered to slightly weathered, hard to very hard (a'a basalt)
							50		
UC= 12270 psi			100	85					
							55		
UC= 8250 psi			100	52					
							60		
			100	87					
							65		
UC= 14950 psi			100	93					
							70		

Date Started:	August 25, 2020	Water Level: ▼ 52.2 ft. 08/26/2020 1210 HRS; ▼ 52.6 ft. 08/26/2020 1300 HRS	Plate
Date Completed:	August 26, 2020		
Logged By:	S. Latronic	Drill Rig: CME-75DG1 *(Energy Transfer Ratio = 80.3%)*	A - 4.2
Total Depth:	101 feet	Drilling Method: 4" Solid-Stem Auger & PQ Coring	
Work Order:	8135-00	Driving Energy: 140 lb. wt., 30 in. drop	

GEOLABS, INC.

Geotechnical Engineering

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Log of Boring **205**

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
											(Continued from previous plate)
			98	92							
							75				
UC= 1490 psi			95	67							
							80			GW	Brownish gray **SANDY GRAVEL (BASALTIC)**, medium dense, wet (clinker)
			100	70							Brownish gray to gray vesicular **BASALT**, moderately fractured, slightly to moderately weathered, medium hard to hard (pahoehoe basalt)
							85				
			100	45							
							90				
			100	53							grades to dense and very hard locally
							95				
			100	27							
							100				
											Boring terminated at 101 feet
							105				

Date Started:	August 25, 2020
Date Completed:	August 26, 2020
Logged By:	S. Latronic
Total Depth:	101 feet
Work Order:	8135-00

Water Level:	52.2 ft. 08/26/2020 1210 HRS
	52.6 ft. 08/26/2020 1300 HRS
Drill Rig:	CME-75DG1 *(Energy Transfer Ratio = 80.3%)*
Drilling Method:	4" Solid-Stem Auger & PQ Coring
Driving Energy:	140 lb. wt., 30 in. drop

GEOLABS, INC.

Geotechnical Engineering

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Log of Boring

301

Approximate Ground Surface Elevation (feet): 114 *

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
							0	GM	4-inch **ASPHALTIC CONCRETE**
	9	112			22/6" +25/1"	3.0		GM	Brownish gray **SILTY GRAVEL (BASALTIC)**, dense, moist (base course)
								MH	Brown **CLAYEY SILT** with some sand (coralline) and a little gravel (basaltic), with a little gravel (basaltic) very stiff, moist (fill)
	16	116			50/5"	4.5	5	MH	grades with construction debris grades with construction debris
								MH	Brown **CLAYEY SILT**, hard, moist (older alluvium)
								GM	Gray and brown subrounded **SILTY GRAVEL (BASALTIC)**, dense, moist (river channel deposit)
	14				32/6" +50/3"		10	MH	Brown **CLAYEY SILT**, hard, moist (older alluvium)
									grades with some gravel (basaltic)
									grades with cobbles (basaltic)
TXUU S_u=3.3 ksf	30	90			61/6" +50/3"	4.5	15		
									grades with some gravel (basaltic)
	16				50/5"		20		
								CL	Reddish brown **SANDY CLAY**, hard, moist (older alluvium)
LL=43 PI=20	20	105			50/3"	4.5	25		
	46				30/6" +50/5"		30		
									Boring terminated at 31.4 feet
							35		

Date Started:	September 14, 2020	Water Level:	Not Encountered
Date Completed:	September 14, 2020		
Logged By:	S. Latronic	Drill Rig:	CME-75DR *(Energy Transfer Ratio = 77.3%)*
Total Depth:	31.4 feet	Drilling Method:	4" Solid-Stem Auger
Work Order:	8135-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate

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GEOLABS, INC. Geotechnical Engineering	FARRINGTON HIGHWAY IMPROVEMENTS KAPOLEI GOLF COURSE ROAD TO FORT WEAVER ROAD EWA, OAHU, HAWAII	Log of Boring 302

Approximate Ground Surface Elevation (feet): 120 *

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)	Sample	Graphic	USCS	Description
											6-inch **ASPHALTIC CONCRETE**
	7	111			33					GM	Gray **SILTY GRAVEL (BASALTIC)** with a little sand, dense, moist (base course)
										SM	Tan **SILTY SAND (CORALLINE)** with some gravel, medium dense, moist (fill)
	20				38					CL	Reddish brown **SANDY CLAY** with traces of gravel (basaltic), hard, moist (older alluvium)
							5				Boring terminated at 5 feet
							10				
							15				
							20				
							25				
							30				
							35				

Date Started:	September 14, 2020	Water Level: ▼	Not Encountered	Plate
Date Completed:	September 14, 2020			
Logged By:	S. Latronic	Drill Rig:	CME-75DR *(Energy Transfer Ratio = 77.3%)*	A - 6
Total Depth:	5 feet	Drilling Method:	4" Solid-Stem Auger	
Work Order:	8135-00	Driving Energy:	140 lb. wt., 30 in. drop	

GEOLABS, INC.

Geotechnical Engineering

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Log of Boring

303

Approximate Ground Surface Elevation (feet): 126 *

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
							0		8-inch **ASPHALTIC CONCRETE**
								GW	Gray **SANDY GRAVEL (BASALTIC)**, dense, moist (base course)
	24	103			21	4.0		MH	Dark brown **CLAYEY SILT** with some gravel (basaltic), very stiff, moist (fill)
LL=50 PI=30	22				13			CL	Reddish brown **SANDY CLAY**, very stiff to hard, moist (older alluvium)
							5		Boring terminated at 5 feet

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

Date Started:	September 14, 2020	Water Level:	Not Encountered
Date Completed:	September 14, 2020		
Logged By:	S. Latronic	Drill Rig:	CME-75DR *(Energy Transfer Ratio = 77.3%)*
Total Depth:	5 feet	Drilling Method:	4" Solid-Stem Auger
Work Order:	8135-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate

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GEOLABS, INC.

Geotechnical Engineering

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Log of Boring

304

Approximate Ground Surface Elevation (feet): 134 *

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
							0	SM	Grayish brown **SILTY SAND** with some gravel (basaltic), medium dense, moist (fill)
	12	97			19				
	16				13			CL	Reddish brown **SANDY CLAY** with a little gravel, medium stiff, moist (older alluvium)
	16	72			29/6" +25/1"		5		
									Gray with brown subrounded **COBBLES (BASALTIC)** with some sand and silt, dense, moist (older alluvium)
			80						
							10		
			21		25/1"				
							15		
	35	94	57	50	25/1"				
							20		Gray **BASALT**, closely to moderately fractured, slightly weathered, hard (basalt formation)
			97	12	10/0" Ref.				
							25		
			95	13					
							30		
									Boring terminated at 31 feet
							35		

Date Started:	September 18, 2020	Water Level: ▼	Not Encountered
Date Completed:	September 18, 2020		
Logged By:	B. Aiu	Drill Rig:	CME-75DG2 *(Energy Transfer Ratio = 91.5%)*
Total Depth:	31 feet	Drilling Method:	4" Solid-Stem Auger & PQ Coring
Work Order:	8135-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate

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GEOLABS, INC.

Geotechnical Engineering

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Log of Boring

305

Laboratory			Field								
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Approximate Ground Surface Elevation (feet): 118 * Description
										CH	Reddish brown **SILTY CLAY** with some sand, gravel, and traces of organic matter, very stiff, dry (cultivation zone)
	12	87			29	4.5					
										CL	Reddish brown **SANDY CLAY** with traces of gravel, very stiff, dry (older alluvium)
LL=44 PI=27	15				19						
TXUU S_u=2.0 ksf	29	80			46		5				
	18				61		10				grades to very hard
					50/4"		15				
	16				45/6" +40/2"		20				
	17	106			75/6"		25				
	21				70/6"		30			CH	Reddish brown **SILTY CLAY**, very hard, dry (older alluvium)
											Boring terminated at 31 feet
							35				

Date Started:	September 12, 2020	Water Level: ▼	Not Encountered	Plate
Date Completed:	September 12, 2020			
Logged By:	D. Gremminger	Drill Rig:	CME-75DG1 *(Energy Transfer Ratio = 80.3%)*	A - 9
Total Depth:	31 feet	Drilling Method:	4" Solid-Stem Auger	
Work Order:	8135-00	Driving Energy:	140 lb. wt., 30 in. drop	

GEOLABS, INC.

Geotechnical Engineering

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Log of Boring

306

Approximate Ground Surface Elevation (feet): 129 *

Laboratory: Other Tests	Laboratory: Moisture Content (%)	Laboratory: Dry Density (pcf)	Field: Core Recovery (%)	Field: RQD (%)	Field: Penetration Resistance (blows/foot)	Field: Pocket Pen. (tsf)	Depth (feet)	USCS	Description
							0		7-inch **ASPHALTIC CONCRETE**
								GP	Gray coarse **GRAVEL (BASALTIC)** with traces of silt, moist (base course)
	20	105			32	4.5		MH	Reddish brown **CLAYEY SILT** with traces of fine gravel, very stiff to hard, moist (fill)
	21				8				
	22	105			20	4.5	5	CL	Reddish brown **SANDY CLAY**, very stiff to hard, moist (older alluvium)
									Boring terminated at 6.5 feet
							10		
							15		
							20		
							25		
							30		
							35		

Date Started:	September 15, 2020
Date Completed:	September 15, 2020
Logged By:	S. Latronic
Total Depth:	6.5 feet
Work Order:	8135-00

Water Level: ▼	Not Encountered
Drill Rig:	CME-75DR *(Energy Transfer Ratio = 77.3%)*
Drilling Method:	4" Solid-Stem Auger
Driving Energy:	140 lb. wt., 30 in. drop

Plate

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GEOLABS, INC.

Geotechnical Engineering

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Log of Boring

307

Approximate Ground Surface Elevation (feet): 127 *

Other Tests (Laboratory)	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%) (Field)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
							0	MH	Reddish brown **CLAYEY SILT** with a little sand and traces of organic matter, very stiff, dry (cultivation zone)
	16	79			35	4.5			
LL=40 PI=29	15				15			CL	Reddish brown **SANDY CLAY**, medium stiff to stiff, dry (older alluvium)
TXUU S_u=1.5 ksf	29	74			15	2.5	5		
	17				43		10		grades to very stiff to hard
LL=41 PI=26	18	102			65/4"	4.5	15		grades to very hard
	17				25/1"		20		
	17	93			25/1"	4.5	25		
	13				100		30		grades with a little sand and gravel (basaltic)
							31.5		Boring terminated at 31.5 feet
							35		

Date Started:	September 12, 2020
Date Completed:	September 12, 2020
Logged By:	D. Gremminger
Total Depth:	31.5 feet
Work Order:	8135-00

Water Level: ▼	Not Encountered
Drill Rig:	CME-75DG1 *(Energy Transfer Ratio = 80.3%)*
Drilling Method:	4" Solid-Stem Auger
Driving Energy:	140 lb. wt., 30 in. drop

GEOLABS, INC. Geotechnical Engineering	FARRINGTON HIGHWAY IMPROVEMENTS KAPOLEI GOLF COURSE ROAD TO FORT WEAVER ROAD EWA, OAHU, HAWAII	Log of Boring 308

Laboratory			Field								
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Approximate Ground Surface Elevation (feet): 133 * Description
											6.5-inch **ASPHALTIC CONCRETE**
	19	98			59	4.5				GP	Gray medium to coarse **GRAVEL (BASALTIC)**, dense to very dense, moist (base course)
	11				21					MH	Reddish brown **CLAYEY SILT** with some gravel (basaltic), very stiff to hard, moist (fill) grades with more gravel
							5				Boring terminated at 5 feet
							10				
							15				
							20				
							25				
							30				
							35				

Date Started:	September 15, 2020	Water Level:	Not Encountered	Plate A - 12
Date Completed:	September 15, 2020			
Logged By:	S. Latronic	Drill Rig:	CME-75DR *(Energy Transfer Ratio = 77.3%)*	
Total Depth:	5 feet	Drilling Method:	4" Solid-Stem Auger	
Work Order:	8135-00	Driving Energy:	140 lb. wt., 30 in. drop	

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Geotechnical Engineering

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Log of Boring

309

Approximate Ground Surface Elevation (feet): 125 *

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** with some agricultural debris, stiff to very stiff, moist (fill)
	16	88			27	4.0				CH	Reddish brown **SILTY CLAY**, very stiff to hard, moist (older alluvium)
	17				45						
TXUU S_u=9.7 ksf	23	97			82	4.5	5			CL	Reddish brown **SANDY CLAY**, very stiff to hard, moist (older alluvium)
LL=41 PI=23	18				49/6" +50/3"		10				
											grades to brown
					50/1"		15				
	18				50/5"						
LL=36 PI=18	21	77			50/6" +10/0" Ref.	4.5	20				
	20				85		25				
	21	88			50/6"	4.5	30				
											Boring terminated at 31 feet
							35				

Date Started:	September 11, 2020	Water Level: ▼	Not Encountered
Date Completed:	September 11, 2020		
Logged By:	J.cline	Drill Rig:	CME-75DG1 *(Energy Transfer Ratio = 80.3%)*
Total Depth:	31 feet	Drilling Method:	4" Solid-Stem Auger
Work Order:	8135-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate

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BORING_LOG 8135-00.GPJ GEOLABS.GDT 11/22/20

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FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Log of Boring

310

Approximate Ground Surface Elevation (feet): 138 *

Laboratory			Field						
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
	8	101			75/4"			GP	Brown and gray **SANDY GRAVEL (BASALTIC)**, very dense, moist (fill)
LL=56 PI=39	15				22			CH	Brown **SILTY CLAY** with some sand (basaltic), stiff, moist (alluvium)
TXUU S_u=7.9 ksf	23	103			35	>4.5	5		
								ML	Gray with brown mottling **SANDY SILT**, very stiff, moist (saprolite)
	19				36/6" +50/5"		10		
			100	23	75/3"		15		Gray **BASALT**, closely fractured, slightly weathered, hard (basalt formation)
			70	44			20		
								SP	Grayish brown **GRAVELLY SAND (BASALTIC)**, medium dense, moist (clinker)
			61	0	50/3"		25		Brownish gray **BASALT**, severely to closely fractured, highly weathered, medium hard to hard (basalt formation)
								GP	Reddish brown **SANDY GRAVEL (BASALTIC)**, medium dense, moist (clinker)
	13				40		30		
									Boring terminated at 31.5 feet
							35		

Date Started:	September 17, 2020	Water Level: ▼	Not Encountered
Date Completed:	September 17, 2020		
Logged By:	B. Aiu	Drill Rig:	CME-75DG2 *(Energy Transfer Ratio = 91.5%)*
Total Depth:	31.5 feet	Drilling Method:	4" Solid-Stem Auger & PQ Coring
Work Order:	8135-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate

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GEOLABS, INC. Geotechnical Engineering	FARRINGTON HIGHWAY IMPROVEMENTS KAPOLEI GOLF COURSE ROAD TO FORT WEAVER ROAD EWA, OAHU, HAWAII	Log of Boring 311

Approximate Ground Surface Elevation (feet): 135 *

Other Tests (Laboratory)	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%) (Field)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Description
											7.5-inch **ASPHALTIC CONCRETE**
										GP	Gray medium to coarse **GRAVEL (BASALTIC)**, dense, moist (base course)
	23	118			48	4.5				CH	Reddish brown **SILTY CLAY** with traces of gravel (basaltic), very stiff to hard, moist (fill)
	21				29					CL	Reddish brown **SANDY CLAY** with traces of gravel (basaltic), very stiff to hard, moist (older alluvium)
							5				Boring terminated at 5 feet
							10				
							15				
							20				
							25				
							30				
							35				

Date Started:	September 15, 2020	Water Level: ▼	Not Encountered	Plate
Date Completed:	September 15, 2020			
Logged By:	S. Latronic	Drill Rig:	CME-75DR *(Energy Transfer Ratio = 77.3%)*	
Total Depth:	5 feet	Drilling Method:	4" Solid-Stem Auger	A - 15
Work Order:	8135-00	Driving Energy:	140 lb. wt., 30 in. drop	

GEOLABS, INC.

Geotechnical Engineering

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Log of Boring

312

Approximate Ground Surface Elevation (feet): 139 *

Other Tests (Laboratory)	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%) (Field)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Description
							0				8-inch **ASPHALTIC CONCRETE**
										GP	Gray coarse **GRAVEL (BASALTIC)** with traces of sand (coralline), dense, moist (base course)
LL=55 PI=39	21	106			79	4.5				CH	Reddish brown **SILTY CLAY** with some gravel (basaltic), very stiff, moist (fill)
	23				19						
										CL	Brown **SANDY CLAY**, very stiff to hard, moist (older alluvium)
							5				Boring terminated at 5 feet

Date Started:	September 15, 2020	Water Level:	Not Encountered
Date Completed:	September 15, 2020		
Logged By:	S. Latronic	Drill Rig:	CME-75DR *(Energy Transfer Ratio = 77.3%)*
Total Depth:	5 feet	Drilling Method:	4" Solid-Stem Auger
Work Order:	8135-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate

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GEOLABS, INC.

Geotechnical Engineering

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Log of Boring

313

Approximate Ground Surface Elevation (feet): 135 *

Laboratory: Other Tests	Laboratory: Moisture Content (%)	Laboratory: Dry Density (pcf)	Field: Core Recovery (%)	Field: RQD (%)	Field: Penetration Resistance (blows/foot)	Field: Pocket Pen. (tsf)	Depth (feet)	USCS	Description
							0	CL	Reddish brown **SANDY CLAY**, very stiff to hard, moist (older alluvium)
	15	85			24	4.0			
	9				28				grades with gravel (basaltic) locally
	15	98			37	4.5	5		
	17				15/6" +50/5"		10		
	18	67			50/3"	4.5	15		
LL=37 PI=19	21				87		20		
TXUU S_u=8.6 ksf	19	106				4.5	25		
	20				50/6" +10/0" Ref.		30		
							31		Boring terminated at 31 feet
							35		

Date Started:	September 11, 2020	Water Level: ▼	Not Encountered
Date Completed:	September 11, 2020		
Logged By:	J.cline	Drill Rig:	CME-75DG1 *(Energy Transfer Ratio = 80.3%)*
Total Depth:	31 feet	Drilling Method:	4" Solid-Stem Auger
Work Order:	8135-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate

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GEOLABS, INC.

Geotechnical Engineering

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Log of Boring

314

Approximate Ground Surface Elevation (feet): 142 *

Laboratory			Field						
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
								CH	Reddish brown **SILTY CLAY**, very stiff, moist (fill)
	19	87			29	4.5			
								CL	Reddish brown **SANDY CLAY**, very stiff to hard, moist (older alluvium)
LL=45 PI=26	22				17				
TXUU S_u=3.0 ksf	21	105			42	3.0	5		
									grades with clayey silt pockets locally
	19				24		10		
	19	98			25/1"	4.5	15		
	21				54/6" +25/2"		20		
	20	-109			50/3"	4.5	25		
								MH	Reddish brown **CLAYEY SILT**, hard, moist (residual soil)
	19				37/6" +50/5"		30		
									Boring terminated at 31.4 feet
							35		

Date Started:	August 27, 2020	Water Level: ▼	Not Encountered
Date Completed:	August 27, 2020		
Logged By:	S. Latronic	Drill Rig:	CME-75DG1 *(Energy Transfer Ratio = 80.3%)*
Total Depth:	31.4 feet	Drilling Method:	4" Solid-Stem Auger
Work Order:	8135-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate

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GEOLABS, INC.

Geotechnical Engineering

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Log of Boring

315

Approximate Ground Surface Elevation (feet): 141 *

Other Tests (Laboratory)	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%) (Field)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Description
							0				7.5-inch **ASPHALTIC CONCRETE**
										GP	Gray **GRAVEL (BASALTIC)**, dense, moist (base course)
	24	98			20	3.0				CH	Reddish brown **SILTY CLAY** with traces of gravel (basaltic), stiff to very stiff, moist (fill)
										CH	Brown **SILTY CLAY**, very stiff, moist (older alluvium)
	26				6					CL	Brown **SANDY CLAY**, medium stiff to stiff, moist (older alluvium)
							5				Boring terminated at 5 feet
							10				
							15				
							20				
							25				
							30				
							35				

Date Started:	September 15, 2020	Water Level:	Not Encountered
Date Completed:	September 15, 2020		
Logged By:	S. Latronic	Drill Rig:	CME-75DR *(Energy Transfer Ratio = 77.3%)*
Total Depth:	5 feet	Drilling Method:	4" Solid-Stem Auger
Work Order:	8135-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate

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BORING_LOG 8135-00.GPJ GEOLABS.GDT 11/22/20

GEOLABS, INC.

Geotechnical Engineering

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Log of Boring

316

Approximate Ground Surface Elevation (feet): 141 *

Laboratory			Field						
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
								CH	Brown **SILTY CLAY** with a little gravel (basaltic), very stiff to hard, moist (fill)
	15	99			53	4.5			
								CH	Brown **SILTY CLAY** with traces of gravel (basaltic), very stiff to hard, moist (older alluvium)
	16				34				
	23	89			46	4.5	5		
								CL	Brown **SANDY CLAY**, hard, moist (older alluvium)
	21				62		10		
	21	106			50/5"	4.5	15		
LL=34 PI=13	22				34/6" +50/5"		20		
	19	107			50/3"	4.5	25		
	23				54		30		
									Boring terminated at 31.5 feet
							35		

Date Started:	September 22, 2020
Date Completed:	September 22, 2020
Logged By:	S. Latronic
Total Depth:	31.5 feet
Work Order:	8135-00

Water Level:	Not Encountered
Drill Rig:	CME-45C TRUCK *(Energy Transfer Ratio = 78%)*
Drilling Method:	4" Solid-Stem Auger
Driving Energy:	140 lb. wt., 30 in. drop

Plate

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GEOLABS, INC.

Geotechnical Engineering

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Log of Boring

317

Approximate Ground Surface Elevation (feet): 148 *

Laboratory: Other Tests	Laboratory: Moisture Content (%)	Laboratory: Dry Density (pcf)	Field: Core Recovery (%)	Field: RQD (%)	Field: Penetration Resistance (blows/foot)	Field: Pocket Pen. (tsf)	Depth (feet)	USCS	Description
									8-inch **ASPHALTIC CONCRETE**
	24	90			40	3.0		GW	Gray **SANDY GRAVEL (BASALTIC)**, dense, moist (base course)
	23				12			CH	Brown **SILTY CLAY** with some gravel (basaltic), very stiff, moist (fill)
							5	CL	Brown **SANDY CLAY**, very stiff, moist (older alluvium)
									Boring terminated at 5 feet

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

Date Started:	September 16, 2020	Water Level: ▼	Not Encountered
Date Completed:	September 16, 2020		
Logged By:	S. Latronic	Drill Rig:	CME-75DR *(Energy Transfer Ratio = 77.3%)*
Total Depth:	5 feet	Drilling Method:	4" Solid-Stem Auger
Work Order:	8135-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate

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GEOLABS, INC.

Geotechnical Engineering

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Log of Boring

318

Approximate Ground Surface Elevation (feet): 155 *

Laboratory: Other Tests	Laboratory: Moisture Content (%)	Laboratory: Dry Density (pcf)	Field: Core Recovery (%)	Field: RQD (%)	Field: Penetration Resistance (blows/foot)	Field: Pocket Pen. (tsf)	Depth (feet)	USCS	Description
							0		5-inch **ASPHALTIC CONCRETE**
Sieve - #200 = 25.8%	9	119			54			GW	Gray **SANDY GRAVEL (BASALTIC)**, dense, moist (base course)
								GM	Tan **SILTY GRAVEL (CORALLINE)** with some sand, medium dense to dense, moist (fill)
	24				13			CL	Brown **SANDY CLAY**, very stiff, moist (older alluvium)
							5		Boring terminated at 5 feet

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

Date Started:	September 16, 2020
Date Completed:	September 16, 2020
Logged By:	S. Latronic
Total Depth:	5 feet
Work Order:	8135-00

Water Level:	Not Encountered
Drill Rig:	CME-75DR *(Energy Transfer Ratio = 77.3%)*
Drilling Method:	4" Solid-Stem Auger
Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 22

GEOLABS, INC. Geotechnical Engineering	FARRINGTON HIGHWAY IMPROVEMENTS KAPOLEI GOLF COURSE ROAD TO FORT WEAVER ROAD EWA, OAHU, HAWAII	Log of Boring 319

Approximate Ground Surface Elevation (feet): 157 *

Laboratory: Other Tests	Laboratory: Moisture Content (%)	Laboratory: Dry Density (pcf)	Field: Core Recovery (%)	Field: RQD (%)	Field: Penetration Resistance (blows/foot)	Field: Pocket Pen. (tsf)	Depth (feet)	USCS	Description
								CH	Brown **SILTY CLAY**, very stiff to hard, moist (older alluvium)
	17	103			46	4.5			
	13				35				
	8				51		5		grades with some gravel (basaltic)
								MH	Brown **CLAYEY SILT**, very stiff to hard, moist (older alluvium)
LL=57 PI=24 TXUU S_u=8.5 ksf	22	102			44/6" +50/5"	4.0	10		
									grades with silty sand
	19				41		15		
								SM	Brown **SILTY SAND (BASALTIC)** with a little gravel, dense, moist (older alluvium)
									Gray subrounded **GRAVELLY COBBLES (BASALT)**, very dense, dry (river channel deposit)
	4				25/1"		20		
			20						
								ML	Reddish brown **SANDY SILT** with some siltstone cobbles, hard, moist (older alluvium)
							25		
LL=NP PI=NP	27				50/5"				
			61						
							30		
	24				36/6" +50/2"				
									Boring terminated at 32.2 feet
							35		

Date Started:	August 27, 2020	Water Level: ▼	Not Encountered	Plate
Date Completed:	August 27, 2020			
Logged By:	S. Latronic	Drill Rig:	CME-75DG1 *(Energy Transfer Ratio = 80.3%)*	A - 23
Total Depth:	32.2 feet	Drilling Method:	4" Solid-Stem Auger & PQ Coring	
Work Order:	8135-00	Driving Energy:	140 lb. wt., 30 in. drop	

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Geotechnical Engineering

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Log of Boring

320

Approximate Ground Surface Elevation (feet): 160 *

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
							0				5-inch **ASPHALTIC CONCRETE**
	9				31					GW SM	Gray **SANDY GRAVEL (BASALTIC)**, dense, moist (base course)
	21				18					CL	Brownish tan **SILTY SAND (CORALLINE)** with some gravel, medium dense to dense, moist (fill)
											Brown **SANDY CLAY**, very stiff, moist (older alluvium)
							5				Boring terminated at 5 feet
							10				
							15				
							20				
							25				
							30				
							35				

Date Started:	September 16, 2020	Water Level:	Not Encountered	Plate
Date Completed:	September 16, 2020			
Logged By:	S. Latronic	Drill Rig:	CME-75DR *(Energy Transfer Ratio = 77.3%)*	A - 24
Total Depth:	5 feet	Drilling Method:	4" Solid-Stem Auger	
Work Order:	8135-00	Driving Energy:	140 lb. wt., 30 in. drop	

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TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Log of Boring

321

Approximate Ground Surface Elevation (feet): 162.5 *

Laboratory: Other Tests	Laboratory: Moisture Content (%)	Laboratory: Dry Density (pcf)	Field: Core Recovery (%)	Field: RQD (%)	Field: Penetration Resistance (blows/foot)	Field: Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Description
											7-inch **ASPHALTIC CONCRETE**
	23	86			47	4.5				GW	Gray **SANDY GRAVEL (BASALTIC)**, dense, moist (base course)
LL=67 PI=47	22				15					CH	Reddish brown **SILTY CLAY** with traces of sand (basaltic), very stiff to hard, moist (fill)
							5				grades with some gravel (basaltic)
											Boring terminated at 5 feet
							10				
							15				
							20				
							25				
							30				
							35				

Date Started:	September 16, 2020
Date Completed:	September 16, 2020
Logged By:	S. Latronic
Total Depth:	5 feet
Work Order:	8135-00

Water Level: ▼	Not Encountered
Drill Rig:	CME-75DR *(Energy Transfer Ratio = 77.3%)*
Drilling Method:	4" Solid-Stem Auger
Driving Energy:	140 lb. wt., 30 in. drop

Plate

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FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Log of Boring

322

Approximate Ground Surface Elevation (feet): 165 *

Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Description
											7.5-inch **ASPHALTIC CONCRETE**
	24	92			60/4"					GW	Gray **SANDY GRAVEL (BASALTIC)**, dense, moist (base course)
										MH	Brown **CLAYEY SILT** with a little gravel (basaltic), hard, moist (fill)
	17				15						Gray **GRAVELLY COBBLES (BASALTIC)**, very dense, dry (fill)
										MH	Dark brown **CLAYEY SILT**, very stiff, moist (older alluvium)
							5				Boring terminated at 4.5 feet
							10				
							15				
							20				
							25				
							30				
							35				

Date Started:	September 16, 2020	Water Level:	Not Encountered
Date Completed:	September 16, 2020		
Logged By:	S. Latronic	Drill Rig:	CME-75DR *(Energy Transfer Ratio = 77.3%)*
Total Depth:	4.5 feet	Drilling Method:	4" Solid-Stem Auger
Work Order:	8135-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate

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GEOLABS, INC. Geotechnical Engineering	FARRINGTON HIGHWAY IMPROVEMENTS KAPOLEI GOLF COURSE ROAD TO FORT WEAVER ROAD EWA, OAHU, HAWAII	Log of Boring 323

Approximate Ground Surface Elevation (feet): 165 *

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	Brown **CLAYEY SILT**, very stiff to hard, moist (fill)
	17	93			50	4.5			
	16				34				
							5	CL	Brown **SANDY CLAY**, very stiff to hard, moist (older alluvium)
TXUU S_u=7.7 ksf	17	97			85	4.5			
	18				69		10		
								GM	Brownish gray subrounded **SILTY GRAVEL (BASALTIC)** with some sand and cobbles, dense to very dense, moist (river channel deposit)
Sieve - #200 = 18.9%	13	101			97	4.5	15		
LL=34 PI=14	21				61		20	CL	Brown **SANDY CLAY** with traces of gravel (basaltic), hard, moist (older alluvium)
	23	92			50/6" +10/0" Ref.	4.5	25		grades with silty clay pockets locally
	19				10/0"		30		
									Boring terminated at 30.5 feet
							35		

Date Started:	September 4, 2020	Water Level: ▼	Not Encountered
Date Completed:	September 4, 2020		
Logged By:	J.cline	Drill Rig:	CME-75DG1 *(Energy Transfer Ratio = 80.3%)*
Total Depth:	30.5 feet	Drilling Method:	4" Solid-Stem Auger
Work Order:	8135-00	Driving Energy:	140 lb. wt., 30 in. drop

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FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Log of Boring

324

Approximate Ground Surface Elevation (feet): 166 *

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)	Sample	Graphic	USCS	Description
											9-inch **ASPHALTIC CONCRETE**
	10	92			58					GW	Gray medium to coarse **SANDY GRAVEL (BASALTIC)**, very dense, moist (base course)
	14				16					GM	Brownish gray **SILTY GRAVEL (BASALTIC)**, medium dense to dense, moist (fill)
							5			CL	Brown **SANDY CLAY** with traces of gravel (basaltic), stiff to very stiff, moist (older alluvium)
											Boring terminated at 4.75 feet
							10				
							15				
							20				
							25				
							30				
							35				

Date Started:	September 17, 2020	Water Level:	Not Encountered
Date Completed:	September 17, 2020		
Logged By:	S. Latronic	Drill Rig:	CME-75DR *(Energy Transfer Ratio = 77.3%)*
Total Depth:	4.75 feet	Drilling Method:	4" Solid-Stem Auger
Work Order:	8135-00	Driving Energy:	140 lb. wt., 30 in. drop

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GEOLABS, INC.

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FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Log of Boring

325

Approximate Ground Surface Elevation (feet): 169 *

Other Tests (Laboratory)	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
							0		8-inch **ASPHALTIC CONCRETE**
								GW	Gray coarse **SANDY GRAVEL (BASALTIC)**, very dense, moist (base course)
								CL	Brown **SANDY CLAY**, very stiff to hard, moist (older alluvium)
	22	99			22	4.5			
	22				10		5		
							6		Boring terminated at 6 feet

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

Date Started:	September 17, 2020
Date Completed:	September 17, 2020
Logged By:	S. Latronic
Total Depth:	6 feet
Work Order:	8135-00

Water Level:	Not Encountered
Drill Rig:	CME-75DR *(Energy Transfer Ratio = 77.3%)*
Drilling Method:	4" Solid-Stem Auger
Driving Energy:	140 lb. wt., 30 in. drop

Plate

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GEOLABS, INC. Geotechnical Engineering	FARRINGTON HIGHWAY IMPROVEMENTS KAPOLEI GOLF COURSE ROAD TO FORT WEAVER ROAD EWA, OAHU, HAWAII	Log of Boring 326

Approximate Ground Surface Elevation (feet): 168.5 *

Laboratory			Field							
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	USCS	Description
							0		MH	Brown **CLAYEY SILT**, very stiff to hard, moist (fill)
	25	94			17	4.5				
	25				12					
									CL	Brown **SANDY CLAY**, very stiff to hard, moist (older alluvium)
	26	97			27	4.5	5			
										grades with clayey silt pockets locally
LL=39 PI=19	22				57		10			
TXUU S_u=3.2 ksf	26	87			69	4.5	15			
										grades to hard
	20				45/6" +50/5"		20			
	21	81			50/6" +10/0" Ref.	4.5	25			
	17				10/0"		30			
										Boring terminated at 30.5 feet
							35			

Date Started:	September 4, 2020	Water Level: ▼	Not Encountered	Plate
Date Completed:	September 4, 2020			
Logged By:	J.cline	Drill Rig:	CME-75DG1 *(Energy Transfer Ratio = 80.3%)*	A - 30
Total Depth:	30.5 feet	Drilling Method:	4" Solid-Stem Auger	
Work Order:	8135-00	Driving Energy:	140 lb. wt., 30 in. drop	

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FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Log of Boring

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Approximate Ground Surface Elevation (feet): 171 *

Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
									7.5-inch **ASPHALTIC CONCRETE**
								GW	Gray coarse **SANDY GRAVEL (BASALTIC)**, very dense, moist (base course)
	20	90			34	3.5		SM	Brownish gray **SILTY SAND (BASALTIC)**, medium dense, moist (fill)
	43				13			CH	Brown **SILTY CLAY**, very stiff, moist (older alluvium)
							5	CL	Brown **SANDY CLAY**, very stiff, moist (older alluvium)
									Boring terminated at 5.5 feet
							10		
							15		
							20		
							25		
							30		
							35		

Date Started:	September 17, 2020	Water Level: ▼	Not Encountered
Date Completed:	September 17, 2020		
Logged By:	S. Latronic	Drill Rig:	CME-75DR *(Energy Transfer Ratio = 77.3%)*
Total Depth:	5.5 feet	Drilling Method:	4" Solid-Stem Auger
Work Order:	8135-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate

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Geotechnical Engineering

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Log of Boring

328

Laboratory: Other Tests	Laboratory: Moisture Content (%)	Laboratory: Dry Density (pcf)	Field: Core Recovery (%)	Field: RQD (%)	Field: Penetration Resistance (blows/foot)	Field: Pocket Pen. (tsf)	Depth (feet)	USCS	Description
									Approximate Ground Surface Elevation (feet): 174.5 *
									8-inch **ASPHALTIC CONCRETE**
								GW	Gray medium to coarse **SANDY GRAVEL (BASALTIC)**, very dense, moist (base course)
								SM	Brownish gray **SILTY SAND (BASALTIC)**, medium dense, moist (fill)
	19	101			68	4.5		CL	Brown **SANDY CLAY**, hard, moist (older alluvium)
	19				36		5		
									Boring terminated at 6 feet

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

Date Started:	September 17, 2020	Water Level:	Not Encountered
Date Completed:	September 17, 2020		
Logged By:	S. Latronic	Drill Rig:	CME-75DR *(Energy Transfer Ratio = 77.3%)*
Total Depth:	6 feet	Drilling Method:	4" Solid-Stem Auger
Work Order:	8135-00	Driving Energy:	140 lb. wt., 30 in. drop

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GEOLABS, INC.

Geotechnical Engineering

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Log of Boring

329

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 (Approximate Ground Surface Elevation (feet): 173 *)
							0	CH	Brown **SILTY CLAY**, stiff to stiff, moist (fill)
	18	87			38	4.5		CH	Brown **SILTY CLAY**, very stiff to hard, moist (older alluvium)
	22				23				
	29	93			35	4.5	5		
									grades with cobbles (basaltic)
	9				10/0"		10	GM	Gray with brown subrounded **SILTY GRAVEL (BASALTIC)**, dense to very dense, dry to moist (river channel deposit)
								CL	Brown **SANDY CLAY**, very stiff to hard, moist (older alluvium)
TXUU S_u=5.5 ksf	23	102			73	4.5	15		
LL=36 PI=17	20				87		20		
	20	90			50/6" +20/0" Ref.	4.5	25		
									grades to sandy silt
	18				50/5"	4.5	30		
									Boring terminated at 30.9 feet
							35		

Date Started:	September 3, 2020	Water Level: ▼	Not Encountered
Date Completed:	September 3, 2020		
Logged By:	J.cline	Drill Rig:	CME-75DG1 *(Energy Transfer Ratio = 80.3%)*
Total Depth:	30.9 feet	Drilling Method:	4" Solid-Stem Auger
Work Order:	8135-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate

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BORING_LOG 8135-00.GPJ GEOLABS.GDT 11/22/20

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FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Log of Boring

330

Approximate Ground Surface Elevation (feet): 174.5 *

Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
									7.5-inch **ASPHALTIC CONCRETE**
								GW	Gray medium to coarse angular **SANDY GRAVEL (BASALTIC)**, very dense, moist (base course)
								SM	Brownish gray **SILTY SAND (BASALTIC)**, medium dense, moist (fill)
	19	83			73	4.5		MH	Brown **CLAYEY SILT**, hard, moist (older alluvium)
	20				21		5		grades with multi-color mottling and some decomposed gravel, very stiff
									Boring terminated at 6 feet
							10		
							15		
							20		
							25		
							30		
							35		

Date Started:	September 17, 2020	Water Level: ▼	Not Encountered
Date Completed:	September 17, 2020		
Logged By:	S. Latronic	Drill Rig:	CME-75DR *(Energy Transfer Ratio = 77.3%)*
Total Depth:	6 feet	Drilling Method:	4" Solid-Stem Auger
Work Order:	8135-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate

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GEOLABS, INC.

Geotechnical Engineering

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Log of Boring **331**

Approximate Ground Surface Elevation (feet): 174 *

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
									7.5-inch **ASPHALTIC CONCRETE**
								GW	Gray **SANDY GRAVEL (BASALTIC)** with some cobbles, very dense, moist (base course)
	21	93			55	4.5		CL	Brown **SANDY CLAY**, hard, moist (older alluvium)
	24				32				
							5		Boring terminated at 5 feet

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

Date Started:	September 21, 2020	Water Level: ▼	Not Encountered
Date Completed:	September 21, 2020		
Logged By:	S. Latronic	Drill Rig:	CME-45C TRUCK *(Energy Transfer Ratio = 78%)*
Total Depth:	5 feet	Drilling Method:	4" Solid-Stem Auger
Work Order:	8135-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate

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GEOLABS, INC. Geotechnical Engineering	FARRINGTON HIGHWAY IMPROVEMENTS KAPOLEI GOLF COURSE ROAD TO FORT WEAVER ROAD EWA, OAHU, HAWAII	Log of Boring 332

Approximate Ground Surface Elevation (feet): 170 *

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
							0	MH	Brown **CLAYEY SILT** with some gravel (basaltic), very stiff, moist (fill)
	19	106			49	4.5			
								CL	Dark brown **SANDY CLAY**, hard, moist (older alluvium)
LL=46 PI=30	17				35				
TXUU S_u=9.9 ksf	17	100			50/3"	4.5	5		
									grades to brown
	16				50/5"		10		
									grades to clayey silt locally
	18	82			65/5"		15		
	18				89		20		
									grades with cemented siltstone gravel locally
	17	87			50/4"	4.5	25		
									grades with more sand
	17				103		30		
									Boring terminated at 31.5 feet
							35		

Date Started:	August 28, 2020	Water Level: ▼	Not Encountered
Date Completed:	August 28, 2020		
Logged By:	J.cline	Drill Rig:	CME-75DG1 *(Energy Transfer Ratio = 80.3%)*
Total Depth:	31.5 feet	Drilling Method:	4" Solid-Stem Auger
Work Order:	8135-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate A - 36

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KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Log of Boring

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Approximate Ground Surface Elevation (feet): 172.5 *

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)	Sample	Graphic	USCS	Description
											8-inch **ASPHALTIC CONCRETE**
										GW	Gray medium to coarse **SANDY GRAVEL (BASALTIC)**, very dense, moist (base course)
	24	98			16	3.0				CL	Brown **SANDY CLAY**, very stiff, moist (older alluvium)
LL=127 PI=101	29				6		5				
											grades with some gravel (basaltic)
											Boring terminated at 6 feet

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

Date Started:	September 21, 2020	Water Level:	Not Encountered
Date Completed:	September 21, 2020		
Logged By:	S. Latronic	Drill Rig:	CME-45C TRUCK *(Energy Transfer Ratio = 78%)*
Total Depth:	6 feet	Drilling Method:	4" Solid-Stem Auger
Work Order:	8135-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate

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KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Log of Boring

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Approximate Ground Surface Elevation (feet): 173.5 *

Other Tests (Laboratory)	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
							0	MH	Brown **CLAYEY SILT** with traces of organic matter, very stiff, moist (fill)
	24	98			15	4.0		CH	Brown **SILTY CLAY**, very stiff, moist (fill)
	25				8				
LL=65 PI=47 TXUU S_u=2.4 ksf	26	100			20	2.5	5	CH	Brown **SILTY CLAY**, very stiff, moist (older alluvium)
	22				19/6" +50/4"		10	CL	Brown **SANDY CLAY** with a little fine gravel, hard, moist (older alluvium)
	18	91			20/0"	4.5	15		
LL=29 PI=8	18				50/2"		20		
									grades with more sand locally
	16	92			50/3"	4.5	25		
									grades with very dense silty sand pockets locally
	8				85		30	MH	Brown **CLAYEY SILT**, hard, moist (older alluvium)
									Boring terminated at 31.5 feet
							35		

Date Started:	August 24, 2020
Date Completed:	August 24, 2020
Logged By:	S. Latronic
Total Depth:	31.5 feet
Work Order:	8135-00
Water Level:	Not Encountered
Drill Rig:	CME-45C TRUCK *(Energy Transfer Ratio = 78%)*
Drilling Method:	4" Solid-Stem Auger
Driving Energy:	140 lb. wt., 30 in. drop

Plate

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GEOLABS, INC. Geotechnical Engineering	FARRINGTON HIGHWAY IMPROVEMENTS KAPOLEI GOLF COURSE ROAD TO FORT WEAVER ROAD EWA, OAHU, HAWAII	Log of Boring 335

Approximate Ground Surface Elevation (feet): 163.5 *

Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
							0		8-inch **ASPHALTIC CONCRETE**
								CH	Brown **SILTY CLAY** with some gravel (basaltic), very stiff, moist (fill)
	17	147			50/2"				Gray **GRAVELLY COBBLES (BASALTIC)**, dense to very dense, moist (fill)
							4		Boring terminated at 4 feet

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

Date Started:	September 21, 2020	Water Level:	Not Encountered
Date Completed:	September 21, 2020		
Logged By:	S. Latronic	Drill Rig:	CME-45C TRUCK *(Energy Transfer Ratio = 78%)*
Total Depth:	4 feet	Drilling Method:	4" Solid-Stem Auger
Work Order:	8135-00	Driving Energy:	140 lb. wt., 30 in. drop

GEOLABS, INC. Geotechnical Engineering	FARRINGTON HIGHWAY IMPROVEMENTS KAPOLEI GOLF COURSE ROAD TO FORT WEAVER ROAD EWA, OAHU, HAWAII	Log of Boring 336

Laboratory			Field								Approximate Ground Surface Elevation (feet): 155.5 *
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Description
										CL	Brown **SANDY CLAY**, very stiff to hard, moist (older alluvium)
	17	98			49	4.5					
	16				29						
LL=38 PI=18 TXUU S_u=12.9 ksf	21	106			47	4.5	5				
										ML	Brown **SANDY SILT**, hard, moist (older alluvium)
	18				50/3"		10				
											grades with clayey silt
	19	94			50/2"	4.5	15				
										SM	Brown **SILTY SAND (BASALTIC)** with some gravel, very dense, moist (older alluvium)
Sieve - #200 = 14.8%	15				72		20				
										CL	Brown **SANDY CLAY**, hard, moist (older alluvium)
	16				60/3"		25				
	17				50/5"		30				
											Boring terminated at 30.4 feet
							35				

Date Started:	August 24, 2020	Water Level: ▼	Not Encountered	Plate A - 40
Date Completed:	August 24, 2020			
Logged By:	S. Latronic	Drill Rig:	CME-45C TRUCK *(Energy Transfer Ratio = 78%)*	
Total Depth:	30.4 feet	Drilling Method:	4" Solid-Stem Auger	
Work Order:	8135-00	Driving Energy:	140 lb. wt., 30 in. drop	

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FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Log of Boring

337

Approximate Ground Surface Elevation (feet): 146 *

Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
									4.5-inch **ASPHALTIC CONCRETE**
	18	110			114	4.5		GW	Gray **SANDY GRAVEL (BASALTIC)**, medium dense, moist (base course)
	19				67			CL	Brown **SANDY CLAY**, hard, moist (older alluvium)
							5		Boring terminated at 4.25 feet
							10		
							15		
							20		
							25		
							30		
							35		

Date Started:	September 21, 2020
Date Completed:	September 21, 2020
Logged By:	S. Latronic
Total Depth:	4.25 feet
Work Order:	8135-00

Water Level:	Not Encountered
Drill Rig:	CME-45C TRUCK *(Energy Transfer Ratio = 78%)*
Drilling Method:	4" Solid-Stem Auger
Driving Energy:	140 lb. wt., 30 in. drop

Plate

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GEOLABS, INC. Geotechnical Engineering	FARRINGTON HIGHWAY IMPROVEMENTS KAPOLEI GOLF COURSE ROAD TO FORT WEAVER ROAD EWA, OAHU, HAWAII	Log of Boring 338

Approximate Ground Surface Elevation (feet): 124 *

Laboratory			Field							
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	USCS	Description
									MH	Brown **CLAYEY SILT**, stiff to very stiff, moist (fill)
	15	97			23/6" +50/3"					
										Gray **COBBLES (BASALTIC)**, dense, dry (fill)
	17				44				CH	Brown **SILTY CLAY**, hard, moist (older alluvium)
	16	102			50/5"	4.5	5			
							10			Gray **COBBLES (BASALTIC)**, dense, dry (river channel deposit)
	22				22				GW-GM	Brown **SANDY GRAVEL (BASALTIC)** with a little silt and some cobbles (basaltic), medium dense to dense, moist (river channel deposit)
	12	115			50/3"		15			
Sieve - #200 = 9.1%	8				35		20			
										grades with more silt locally
	9	106			50/3"		25			
									CL	Reddish brown to brown **SANDY CLAY**, very stiff, moist (older alluvium)
	25				44		30			
										Boring terminated at 31.5 feet
							35			

Date Started:	August 28, 2020	Water Level: ▼	Not Encountered	Plate
Date Completed:	August 28, 2020			
Logged By:	J.cline	Drill Rig:	CME-75DG1 *(Energy Transfer Ratio = 80.3%)*	A - 42
Total Depth:	31.5 feet	Drilling Method:	4" Solid-Stem Auger	
Work Order:	8135-00	Driving Energy:	140 lb. wt., 30 in. drop	

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FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Log of Boring

339

Approximate Ground Surface Elevation (feet): 103.5 *

Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
							0		3.5-inch **ASPHALTIC CONCRETE**
									7-inch **CONCRETE**
	18	109			37	4.5		MH	Brown **CLAYEY SILT** with a little fine gravel, very stiff to hard, moist (fill)
	20				19			MH	Brown **CLAYEY SILT**, very stiff to hard, moist (older alluvium)
							4.75		Boring terminated at 4.75 feet

Date Started:	September 21, 2020	Water Level:	Not Encountered
Date Completed:	September 21, 2020		
Logged By:	S. Latronic	Drill Rig:	CME-45C TRUCK *(Energy Transfer Ratio = 78%)*
Total Depth:	4.75 feet	Drilling Method:	4" Solid-Stem Auger
Work Order:	8135-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate

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GEOLABS, INC.

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FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Log of Boring

340

Approximate Ground Surface Elevation (feet): 84 *

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
							0	CH	Brown **SILTY CLAY** with traces of gravel (basaltic), very stiff, moist (fill)
	13	101			36	4.0			
	14				35			CH	Brown **SILTY CLAY**, hard, moist (older alluvium)
								GP-GM	Gray subrounded **GRAVEL (BASALTIC)** with some sand and a little silt, dense to very dense, dry (river channel deposit)
Sieve - #200 = 5.3%	4	114			50/2"		5		
							10		Gray **COBBLY BOULDERS (BASALTIC)**, very dense, dry (river channel deposit)
Sieve - #200 = 10.2%	7				56			GP-GM	Gray **SANDY GRAVEL (BASALTIC)** with some cobbles and a little silt, dense to very dense, dry to moist (older alluvium)
	14				50/1"		15		
								CH	Dark brown **SILTY CLAY**, very stiff to hard, moist (older alluvium)
	22	90			50/1"	3.5	20		
								CL	Reddish brown **SANDY CLAY**, very stiff to hard, moist (older alluvium)
LL=37 PI=17	22				50		25		
TXUU S_u=7.3 ksf	27	101			96	4.5	30		
									Boring terminated at 31.5 feet
							35		

Date Started:	August 28, 2020
Date Completed:	August 28, 2020
Logged By:	J.cline
Total Depth:	31.5 feet
Work Order:	8135-00

Water Level: ▼	Not Encountered
Drill Rig:	CME-75DG1 *(Energy Transfer Ratio = 80.3%)*
Drilling Method:	4" Solid-Stem Auger
Driving Energy:	140 lb. wt., 30 in. drop

Plate

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GEOLABS, INC.

Geotechnical Engineering

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Log of Boring
341

Approximate Ground Surface Elevation (feet): 81 *

Other Tests (Laboratory)	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%) (Field)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Description
											7.25-inch **ASPHALTIC CONCRETE**
	12	106			82	4.5				GW	Light tannish white **SANDY GRAVEL (CORALLINE)**, medium dense to dense, moist (fill)
	16				22					CL	Brown **SANDY CLAY** with a little gravel (basaltic), hard, moist (fill)
							5				Boring terminated at 4.5 feet
							10				
							15				
							20				
							25				
							30				
							35				

Date Started:	September 21, 2020	Water Level:	Not Encountered
Date Completed:	September 21, 2020		
Logged By:	S. Latronic	Drill Rig:	CME-45C TRUCK *(Energy Transfer Ratio = 78%)*
Total Depth:	4.5 feet	Drilling Method:	4" Solid-Stem Auger
Work Order:	8135-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate

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GEOLABS, INC.

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FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Log of Boring

342

Approximate Ground Surface Elevation (feet): 90 *

Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Description
											7-25-inch **ASPHALTIC CONCRETE**
										GW	White **SANDY GRAVEL (CORALLINE)**, dense, moist (base course)
	21	89			53	4.5				CH	Brown **SILTY CLAY** with a little gravel (basaltic), very stiff to hard, moist (fill)
	20				42					CL	Brown **SANDY CLAY**, hard, moist (older alluvium)
							5				Boring terminated at 5 feet
							10				
							15				
							20				
							25				
							30				
							35				

Date Started:	September 18, 2020	Water Level:	Not Encountered
Date Completed:	September 18, 2020		
Logged By:	M. Hassani	Drill Rig:	CME-75DR *(Energy Transfer Ratio = 77.3%)*
Total Depth:	5 feet	Drilling Method:	4" Solid-Stem Auger
Work Order:	8135-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 46

GEOLABS, INC. Geotechnical Engineering	FARRINGTON HIGHWAY IMPROVEMENTS KAPOLEI GOLF COURSE ROAD TO FORT WEAVER ROAD EWA, OAHU, HAWAII	Log of Boring 343

Approximate Ground Surface Elevation (feet): 90 *

Laboratory: Other Tests	Laboratory: Moisture Content (%)	Laboratory: Dry Density (pcf)	Field: Core Recovery (%)	Field: RQD (%)	Field: Penetration Resistance (blows/foot)	Field: Pocket Pen. (tsf)	Depth (feet)	USCS	Description
								CH	Brown **SILTY CLAY**, very stiff to hard, moist (older alluvium)
	18	95			37	4.5			
	20				18				
							5		
TXUU S_u=8.0 ksf	22	106			61	4.5			
							10		
	18				24/6" +50/4"			MH	Brown **CLAYEY SILT** with a little gravel (basaltic), very stiff to hard, moist (older alluvium)
								ML	Brown **SANDY SILT**, hard, moist (older alluvium)
							15		
	17	109			50/4"	4.5			
								CL	Dark brown **SANDY CLAY**, hard, moist (older alluvium)
							20		
LL=40 PI=20	22				60				
							25		
TXUU S_u=5.1 ksf	21	103			49/6" +50/4"	4.5			
									grades to very stiff
							30		
	20				24				
									Boring terminated at 31.5 feet
							35		

Date Started:	August 24, 2020	Water Level:	Not Encountered
Date Completed:	August 24, 2020		
Logged By:	S. Latronic	Drill Rig:	CME-45C TRUCK *(Energy Transfer Ratio = 78%)*
Total Depth:	31.5 feet	Drilling Method:	4" Solid-Stem Auger
Work Order:	8135-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate

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GEOLABS, INC.

Geotechnical Engineering

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Log of Boring

344

Approximate Ground Surface Elevation (feet): 78.5 *

Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
							0		7-inch **ASPHALTIC CONCRETE**
	13	111			30	3.0		GW	Dark gray subangular **SANDY GRAVEL (BASALTIC)** with traces of silt, medium dense, moist (base course)
	24				12			CH	Brown **SILTY CLAY**, very stiff, moist (older alluvium)
							5		Boring terminated at 5 feet

Date Started:	September 18, 2020	Water Level:	Not Encountered
Date Completed:	September 18, 2020		
Logged By:	M. Hassani	Drill Rig:	CME-75DR *(Energy Transfer Ratio = 77.3%)*
Total Depth:	5 feet	Drilling Method:	4" Solid-Stem Auger
Work Order:	8135-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate

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GEOLABS, INC.

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FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Log of Boring **345**

Approximate Ground Surface Elevation (feet): 75 *

Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
							0	MH	Brown **CLAYEY SILT**, stiff to very stiff, dry to moist (fill)
	16	96			41	4.5		MH	Brown **CLAYEY SILT**, hard, moist (older alluvium)
	16				34				
	16	104			71	4.5	5	CH	Brown **SILTY CLAY** with a little gravel (basaltic), hard, moist (older alluvium)
Sieve - #200 = 16.7%	15				68/5"		10	SM	Brown **SILTY SAND (BASALTIC)** with some gravel, very dense, moist (older alluvium)
					75/3"		15		
LL=44 PI=24	19				109		20	CL	Dark brown **SANDY CLAY**, hard, moist (older alluvium)
TXUU S_u=4.8 ksf	33	75			22	4.5	25		grades with more sand locally
	23				23		30		grades to clayey silt
							35		Boring terminated at 31.5 feet

Date Started:	September 18, 2020	Water Level:	Not Encountered
Date Completed:	September 18, 2020		
Logged By:	M. Hassani	Drill Rig:	CME-75DR *(Energy Transfer Ratio = 77.3%)*
Total Depth:	31.5 feet	Drilling Method:	4" Solid-Stem Auger
Work Order:	8135-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate A - 49

GEOLABS, INC.

Geotechnical Engineering

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Log of Boring **346**

Approximate Ground Surface Elevation (feet): 50.5 *

Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
							0		10-inch **ASPHALTIC CONCRETE**
								ML	Brown **SANDY SILT** (fill)
Sieve - #200 = 40.5%	12				90			SM	Brown **SILTY SAND** with traces of gravel, dense, moist (older alluvium)
	8	86			75/5"	4.5			
	6				75/6"		5		
	7				75/5"		10		
								ML	Brown **SANDY SILT** with organic matter, very stiff to hard, moist (older alluvium)
TXUU S_u=7.1 ksf	22	82			60/6" +60/0" Ref.	4.5	15		
LL=NP PI=NP	20				60/6"		20		
	20	86			75/6"	4.5	25		
	23				82		30		
								MH	Reddish brown with black mottling **SANDY SILT**, very stiff to hard, moist (older alluvium)
							35		

Date Started:	September 29, 2020	Water Level: ∇	Not Encountered
Date Completed:	September 29, 2020		
Logged By:	J.cline	Drill Rig:	CME-45C2
Total Depth:	50.5 feet	Drilling Method:	4" Solid-Stem Auger
Work Order:	8135-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 50.1

GEOLABS, INC. Geotechnical Engineering	FARRINGTON HIGHWAY IMPROVEMENTS KAPOLEI GOLF COURSE ROAD TO FORT WEAVER ROAD EWA, OAHU, HAWAII	Log of Boring 346

(Continued from previous plate)

Other Tests (Laboratory)	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
TXUU S_u=7.3 ksf	24	80			75/5"	4.5		MH	
LL=38 PI=12	32				39		40		
	27	82			75/6"		45		
						4.5			
	13				60/0"		50		
							50.5		Boring terminated at 50.5 feet
							55		
							60		
							65		
							70		

Date Started:	September 29, 2020	Water Level: ⊻	Not Encountered	Plate
Date Completed:	September 29, 2020			
Logged By:	J.cline	Drill Rig:	CME-45C2	A - 50.2
Total Depth:	50.5 feet	Drilling Method:	4" Solid-Stem Auger	
Work Order:	8135-00	Driving Energy:	140 lb. wt., 30 in. drop	

APPENDIX B

APPENDIX B

Seismic Shear Wave Velocity Test

Seismic shear wave velocity profiling of the subsurface materials at the two replacement bridge sites was performed using Seismic Cone Penetration Testing (SCPT) equipment. The purpose of the seismic shear wave velocity profiling of the subsurface materials was to analyze the seismic design considerations for the project more closely. Shear wave velocity testing using seismic cone penetration test equipment was performed at two selected boring locations, designated as B-105(SW) and B-204(SW), as shown on the Site Plans (Plates 3.3 and 3.6). The seismic shear wave velocity profiling was performed at various depths extending to a depth of about 118.3 and 100.6 feet below the existing ground surface at the Kaloi Gulch Bridge and Honouliuli Stream Bridge locations, respectively.

In order to conduct the seismic shear wave velocity test in the boring, the test boring was advanced utilizing rotary coring methods to the maximum depth of the boring. Log of the materials encountered in the boring are presented on the Logs of Borings in Appendices A and B. After the boring was advanced to the maximum depth of the borehole, the bored hole was backfilled with 0.25-inch diameter coated bentonite pellets. The temporary casing from the coring operations was used as a tremie pipe to place the bentonite pellets starting from the bottom and advancing upward. When the bentonite pellets are in contact with the groundwater in the borehole, the pellets start to hydrate slowly. As the bentonite pellets hydrate, they swell and soften. The probe was then pushed through the softened bentonite extending to depths of about 118.3 and 100.6 feet below the existing ground surface using seismic cone penetration testing equipment (SCPT).

The seismic shear wave velocity test consists of hydraulically pushing a 10-ton steel electronic subtraction cone with an apex angle of 60 degrees and a projected surface area of 1.55 square inches (10 square centimeters) into the bored hole. The cone carries a uniaxial horizontal accelerator geophone to detect the arrival of a shear wave generated and propagated from the ground surface. The seismic measurements were made when the SCPT had stopped and a shear wave was sent into the subsurface. A shear wave was generated at the surface by striking a loaded plank with a switched hammer. The propagation time of the wave from the hammer blow to the cone was measured at each discrete depth interval. The vector difference of these depths divided by the time difference for the shear wave to arrive at the various depths provided the average shear wave velocity over the depth interval.

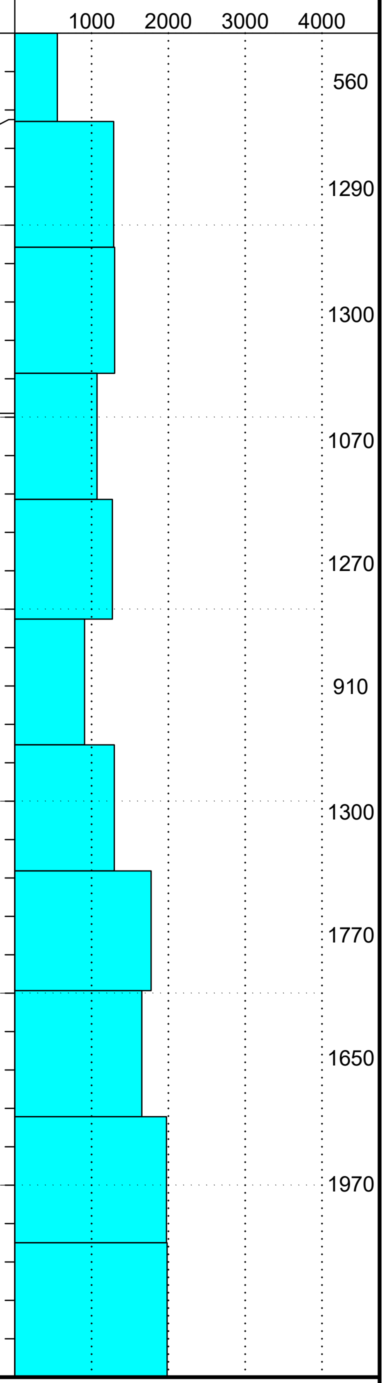
The seismic shear wave velocities measured and the weighted average seismic shear wave velocity calculated for the top 100 feet of the soil profile at the boring location are presented on Plates B-1.1 through B-2.4 in Appendix B. The weighted average shear wave velocity was calculated based on the average shear wave velocity method described in the AASHTO 2020 LRFD Bridge Design Specifications (9th Edition).

GEOLABS, INC. Geotechnical Engineering	FARRINGTON HIGHWAY IMPROVEMENTS KAPOLEI GOLF COURSE ROAD TO FORT WEAVER ROAD EWA, OAHU, HAWAII	Data Plot of Boring 105

Approximate Ground Surface Elevation (feet): 150 *

Core Recovery (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
			0	CH	Brown **SILTY CLAY** with a little cobbles (basaltic), very stiff to hard, moist (older alluvium)
	49	4.5			
	21			CL	Brown **SANDY CLAY** with traces of gravel (basaltic), very stiff, moist (older alluvium)
	15	4.0	5		grades to silty sand
	45		10	CL	Reddish brown **SANDY CLAY**, hard, moist (older alluvium)
	20/1"	4.5	15		
	47/6" +50/4"		20		
	25/1"	4.5	25		
	52		30		
0					
			35		

SHEAR WAVE VELOCITY (feet/sec)



Date Started:	September 8, 2020	Water Level:	Not Encountered
Date Completed:	September 10, 2020		
Logged By:	S. Latronic	Drill Rig:	CME-75DR
Total Depth:	120 feet	Drilling Method:	4" Solid-Stem Auger & PQ Coring
Work Order:	8135-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate B - 1.1

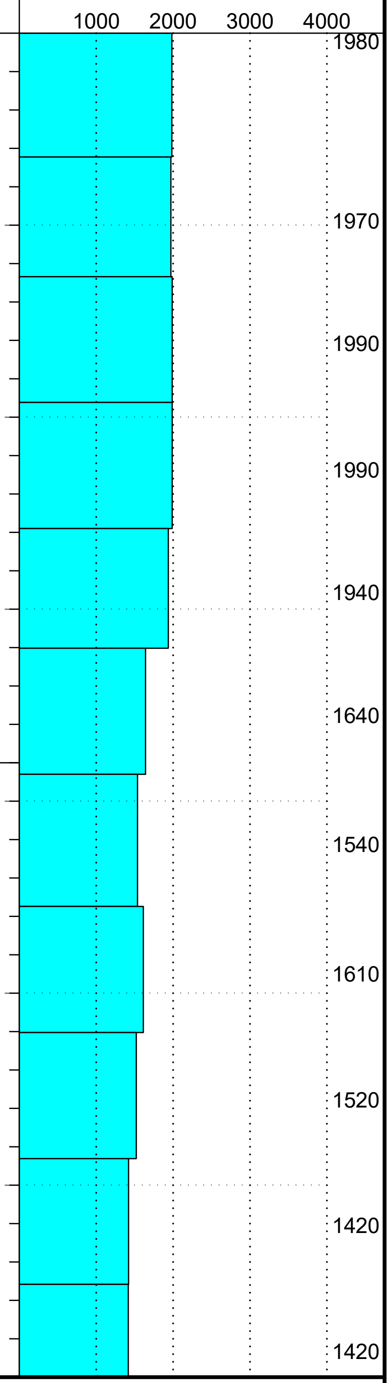
SHEAR_WAVE_PLOT 8135-00.GPJ GEOLABS.GDT 11/22/20

GEOLABS, INC. Geotechnical Engineering	FARRINGTON HIGHWAY IMPROVEMENTS KAPOLEI GOLF COURSE ROAD TO FORT WEAVER ROAD EWA, OAHU, HAWAII	**Data Plot of Boring**	**105**

(Continued from previous plate)

Core Recovery (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
21	55/3"			CL	grades with cemented siltstone gravel locally
			40		
	75				
60					
			45		
	26	4.3			
79					
			50		
	78				
24					
					grades with clay pockets locally
				CL	Brown **SANDY CLAY** with traces of rounded gravel (basaltic), stiff, moist (older alluvium)
			55		
	11	1.0			
33					
					grades with clayey silt
			60		
	15				
					grades to very stiff
29					
			65		
	14	2.5			
38					
			70		

SHEAR WAVE VELOCITY (feet/sec)



Date Started:	September 8, 2020	Water Level:	Not Encountered
Date Completed:	September 10, 2020		
Logged By:	S. Latronic	Drill Rig:	CME-75DR
Total Depth:	120 feet	Drilling Method:	4" Solid-Stem Auger & PQ Coring
Work Order:	8135-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate

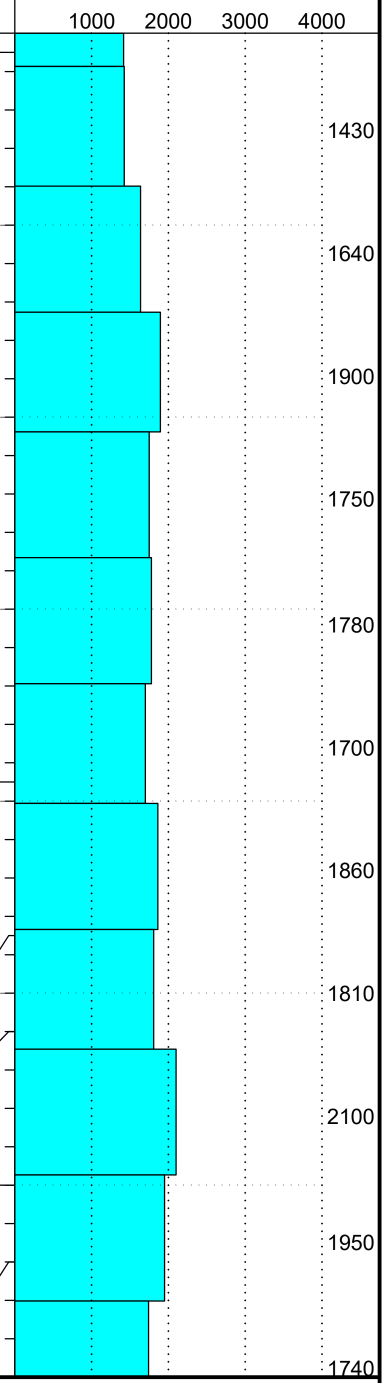
B - 1.2

GEOLABS, INC. Geotechnical Engineering	FARRINGTON HIGHWAY IMPROVEMENTS KAPOLEI GOLF COURSE ROAD TO FORT WEAVER ROAD EWA, OAHU, HAWAII	Data Plot of Boring 105

(Continued from previous plate)

Core Recovery (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
36	35			CL	Reddish brown **SANDY CLAY**, hard, moist (older alluvium)
0	51/6" +50/5"	4.5	75		grades with clayey silt pockets locally
57	67		80		
63	40/6" +50/4"	4.5	85		
43	14		90	SM	Brown **SILTY SAND (BASALTIC)** with a little gravel, medium dense, moist (older alluvium)
					grades with cobbles (basaltic)
				ML	Brown **SANDY SILT** with a little rounded gravel (basaltic) and traces of clay, very stiff to hard (older alluvium)
0	50/5"	4.5	95	SM	Brown **SILTY SAND (BASALTIC)** with some decomposed gravel, medium dense to dense, moist (saprolite)
56	50/3"		100		Gray vesicular **BASALT**, closely fractured, slightly to moderately weathered, medium hard to hard (pahoehoe basalt)
				MH	Reddish brown to brown **CLAYEY SILT** with some sand and a little gravel (basaltic), very stiff, moist (weathered clinker)
			105		

SHEAR WAVE VELOCITY (feet/sec)



Date Started:	September 8, 2020	Water Level:	Not Encountered	Plate B - 1.3
Date Completed:	September 10, 2020			
Logged By:	S. Latronic	Drill Rig:	CME-75DR	
Total Depth:	120 feet	Drilling Method:	4" Solid-Stem Auger & PQ Coring	
Work Order:	8135-00	Driving Energy:	140 lb. wt., 30 in. drop	

GEOLABS, INC.

Geotechnical Engineering

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

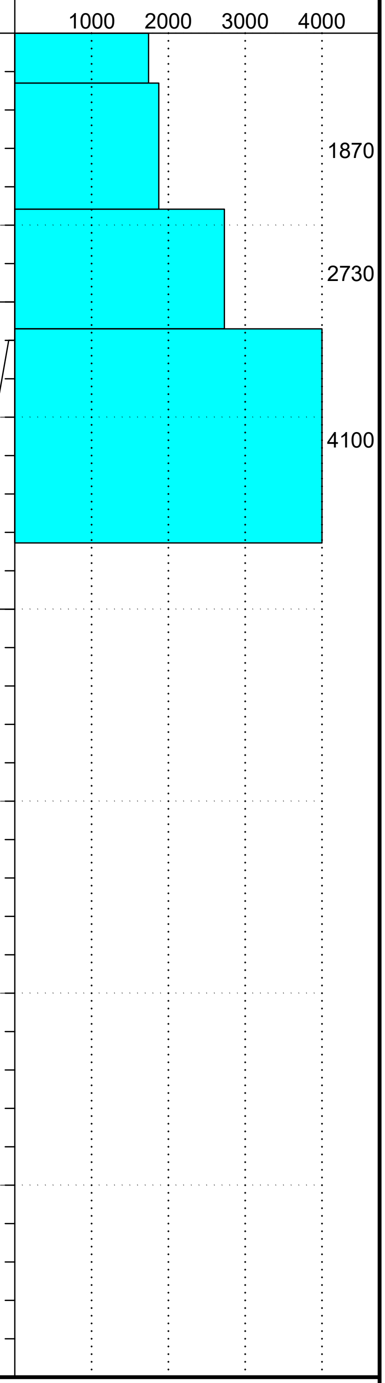
Data Plot of Boring

105

(Continued from previous plate)

Core Recovery (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
23				MH	
	27		110		
81					Gray and brown cemented **BASALT**, moderately fractured, slightly to moderately weathered, medium hard to hard (welded clinker)
97			115		Gray vugular **BASALT**, moderately fractured, unweathered to slightly weathered, hard to very hard (a'a basalt)
			120		Boring terminated at 120 feet
			125		
			130		
			135		
			140		

SHEAR WAVE VELOCITY (feet/sec)



Date Started:	September 8, 2020	Water Level:	Not Encountered
Date Completed:	September 10, 2020		
Logged By:	S. Latronic	Drill Rig:	CME-75DR
Total Depth:	120 feet	Drilling Method:	4" Solid-Stem Auger & PQ Coring
Work Order:	8135-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate

B - 1.4

SHEAR WAVE VELOCITY TEST RESULTS

Farrington Highway Improvements
Kapolei Golf Course Road to Fort Weaver Road
Ewa, Oahu, Hawaii

B-105 (SW)				
Depth (From)	Depth (To)	Layer Thickness (d_i)	Estimated Shear Wave Velocity (V_{si})	Average Travel Time (d_i/V_{si})
(feet)	(feet)	(feet)	(feet/second)	(milliseconds)
0.0	2.3	2.3	556	4.13
2.3	5.6	3.3	1,287	2.55
5.6	8.9	3.3	1,302	2.52
8.9	12.1	3.3	1,070	3.07
12.1	15.3	3.1	1,269	2.46
15.3	18.5	3.3	907	3.62
18.5	21.8	3.3	1,295	2.53
21.8	24.9	3.1	1,773	1.76
24.9	28.2	3.3	1,654	1.98
28.2	31.5	3.3	1,974	1.66
31.5	38.2	6.7	1,982	3.39
38.2	41.3	3.1	1,970	1.58
41.3	44.6	3.3	1,988	1.65
44.6	47.9	3.3	1,989	1.65
47.9	51.0	3.1	1,938	1.61
51.0	54.3	3.3	1,641	2.00
54.3	57.7	3.4	1,539	2.24
57.7	61.0	3.3	1,611	2.04
61.0	64.3	3.3	1,521	2.16
64.3	67.6	3.3	1,422	2.31
67.6	70.9	3.3	1,417	2.32
70.9	74.0	3.1	1,426	2.19
74.0	77.3	3.3	1,637	2.00
77.3	80.4	3.1	1,897	1.64
80.4	83.7	3.3	1,751	1.87
83.7	86.9	3.3	1,780	1.84
86.9	90.1	3.1	1,701	1.83
90.1	93.3	3.3	1,861	1.76
93.3	96.5	3.1	1,810	1.72
96.5	99.7	3.3	2,100	1.56
99.7	103.0	3.3	1,951	1.68
103.0	106.3	3.3	1,743	1.88
106.3	109.6	3.3	1,873	1.75
109.6	112.7	3.1	2,731	1.14
112.7	118.3	5.6	4,097	1.36
TOTAL		118.3		60.60
Standard Weighted Average			1,424	feet/second
Computed $V_{s100'}$ Using IBC Formula			1,530	feet/second

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Geotechnical Engineering

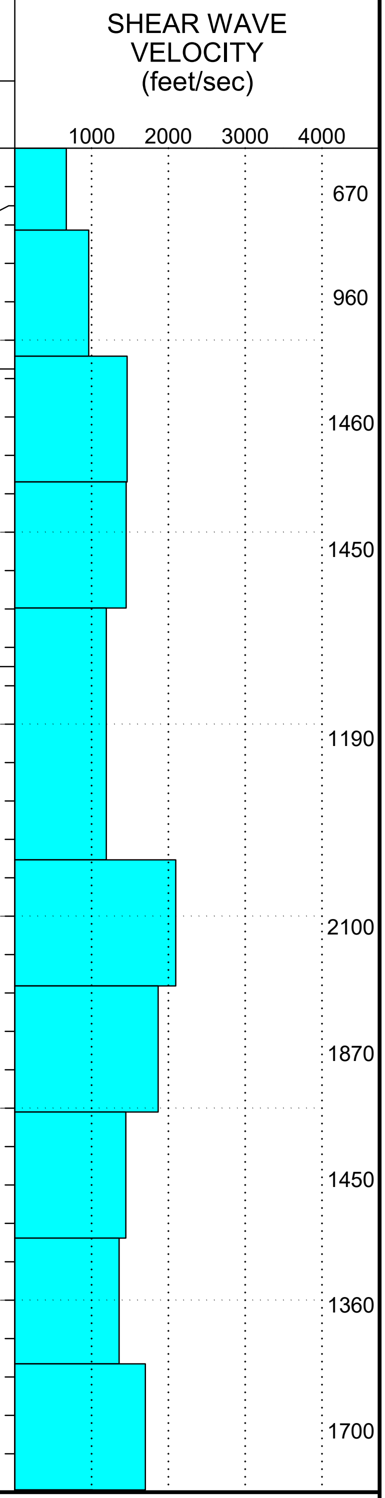
FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Data Plot of Boring

204

Approximate Ground Surface Elevation (feet): 87 *

Core Recovery (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
				CH	Dark brown **SILTY CLAY** with some cobbles (basaltic), very stiff, moist (fill)
				CH	Brown **SILTY CLAY**, very stiff to hard, moist (older alluvium)
	33				
	49		5		
				SM	Gray subrounded **SILTY SAND (BASALTIC)** with some gravel and cobbles, medium dense to dense, dry to moist (river channel deposit)
	40		10		
				CL	Brown **SANDY CLAY**, hard, moist (older alluvium)
	50/4"	4.5	15		
	50/3"		20		grades with sandy silt locally
	50/2"	4.5	25		
					grades to very stiff to hard
	70		30		
22					
			35		grades to reddish brown



Date Started:	August 31, 2020	Water Level:	75.1 ft. 09/01/2020 0850 HRS
Date Completed:	September 1, 2020		75.5 ft. 09/01/2020 1110 HRS
Logged By:	S. Latronic	Drill Rig:	CME-75DG1
Total Depth:	101.5 feet	Drilling Method:	4" Solid-Stem Auger
Work Order:	8135-00	Driving Energy:	140 lb. wt., 30 in. drop

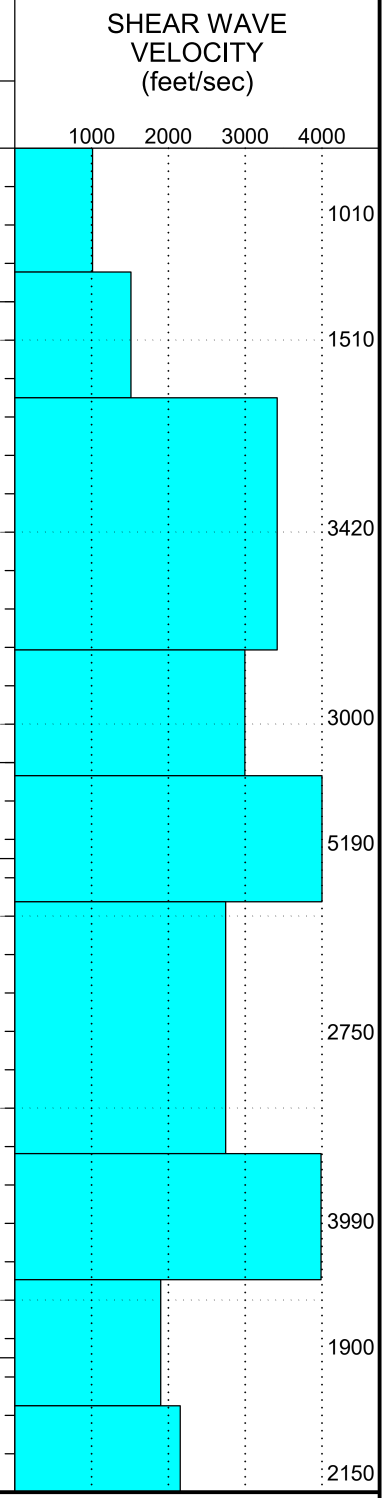
Plate

B - 2.1

GEOLABS, INC. Geotechnical Engineering	FARRINGTON HIGHWAY IMPROVEMENTS KAPOLEI GOLF COURSE ROAD TO FORT WEAVER ROAD EWA, OAHU, HAWAII	Data Plot of Boring 204

(Continued from previous plate)

Core Recovery (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
				CL	
	42	4.3			
43					
				CL	Reddish brown **SANDY CLAY**, very stiff to hard, moist (residual soil)
			40		
	36				
67					
			45		
	22				grades with remnant vesicular structure locally
60					
			50		
				SM	Gray and brown **SILTY SAND (BASALTIC)** with some gravel, very dense, moist (weathered basalt)
	66				
90					Gray vesicular **BASALT**, moderately fractured, slightly weathered, medium hard to hard (pahoehoe basalt)
			55		
88		3.5			
			60		
85					grades to highly weathered locally
			65		
8				GP	Gray **GRAVEL (BASALTIC)** with some cobbles and traces of sand and silt, medium dense to dense, moist (clinker)
			70		



Date Started:	August 31, 2020	Water Level:	75.1 ft. 09/01/2020 0850 HRS
Date Completed:	September 1, 2020		75.5 ft. 09/01/2020 1110 HRS
Logged By:	S. Latronic	Drill Rig:	CME-75DG1
Total Depth:	101.5 feet	Drilling Method:	4" Solid-Stem Auger
Work Order:	8135-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate

B - 2.2

GEOLABS, INC.

Geotechnical Engineering

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

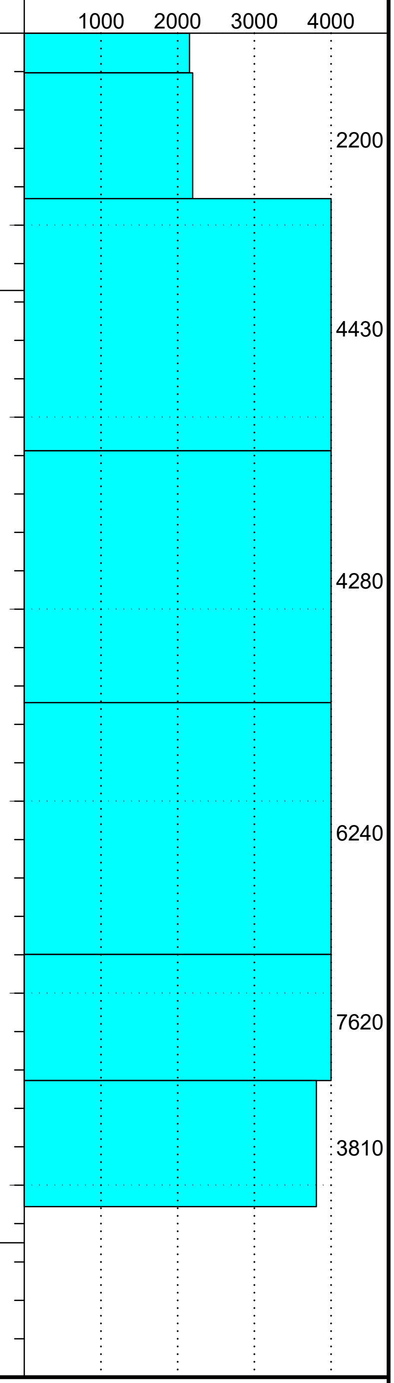
Data Plot of Boring

204

(Continued from previous plate)

Core Recovery (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Description
						GP	
36	29/6" +50/4"						
			75				
97							Gray vugular **BASALT**, slightly to moderately fractured, unweathered to slightly weathered, very hard (a'a basalt)
			80				
100							
			85				
100							
			90				
100							
			95				
85							
			100				
							Boring terminated at 101.5 feet
			105				

SHEAR WAVE VELOCITY (feet/sec)



Date Started:	August 31, 2020
Date Completed:	September 1, 2020
Logged By:	S. Latronic
Total Depth:	101.5 feet
Work Order:	8135-00

Water Level:	75.1 ft. 09/01/2020 0850 HRS
	75.5 ft. 09/01/2020 1110 HRS
Drill Rig:	CME-75DG1
Drilling Method:	4" Solid-Stem Auger
Driving Energy:	140 lb. wt., 30 in. drop

Plate

B - 2.3

SHEAR WAVE VELOCITY TEST RESULTS

Farrington Highway Improvements
Kapolei Golf Course Road to Fort Weaver Road
Ewa, Oahu, Hawaii

B-204 (SW)				
Depth (From)	Depth (To)	Layer Thickness (d_i)	Estimated Shear Wave Velocity (V_{si})	Average Travel Time (d_i/V_{si})
(feet)	(feet)	(feet)	(feet/second)	(milliseconds)
0.0	2.1	2.1	670	3.18
2.1	5.4	3.3	962	3.41
5.4	8.7	3.3	1,461	2.25
8.7	12.0	3.3	1,449	2.26
12.0	18.5	6.6	1,192	5.50
18.5	21.8	3.3	2,097	1.56
21.8	25.1	3.3	1,867	1.76
25.1	28.4	3.3	1,447	2.27
28.4	31.7	3.3	1,360	2.41
31.7	34.9	3.3	1,699	1.93
34.9	38.2	3.3	1,013	3.24
38.2	41.5	3.3	1,514	2.17
41.5	48.1	6.6	3,415	1.92
48.1	51.3	3.3	2,995	1.10
51.3	54.6	3.3	5,185	0.63
54.6	61.2	6.6	2,747	2.39
61.2	64.5	3.3	3,989	0.82
64.5	67.7	3.3	1,902	1.72
67.7	71.0	3.3	2,153	1.52
71.0	74.3	3.3	2,197	1.49
74.3	80.9	6.6	4,425	1.48
80.9	87.4	6.6	4,281	1.53
87.4	94.0	6.6	6,240	1.05
94.0	97.3	3.3	7,620	0.43
97.3	100.6	3.3	3,810	0.86
TOTAL		100.6		48.91
Standard Weighted Average			2,928	feet/second
Computed $V_{s100'}$ Using IBC Formula			2,056	feet/second

APPENDIX C

APPENDIX C

Laboratory Tests

Moisture Content (ASTM D2216) and Unit Weight (ASTM D2937) determinations were performed on selected soil samples as an aid in the classification and evaluation of soil properties. The test results are presented on the Logs of Borings at the appropriate sample depths.

Thirty-six Atterberg Limits tests (ASTM D4318) were performed on selected soil samples to evaluate the liquid and plastic limits to aid in soil classifications. The test results are summarized on the Logs of Borings at the appropriate sample depths. Graphic presentations of the test results are provided on Plates C-1 through C-4.

Twenty Sieve Analysis tests (ASTM D6913), including nine hydrometer tests (ASTM D7928), were performed on selected soil samples to evaluate the gradation characteristics of the soils and to aid in soil classification. Graphic presentations of the grain size distributions are provided on Plates C-5 through C-8.

Eleven Uniaxial Compression tests (ASTM D7012, Method C) were performed on selected core runs to evaluate the unconfined compressive strength of the basalt formation encountered. Test results are presented on Plate C-9.

Thirty-one Unconsolidated Undrained Triaxial Compression tests (ASTM D2850) were performed on selected soil samples to evaluate the undrained shear strength of the in-situ soils. The approximate in-situ effective overburden pressure was used as the applied confining pressure for the relatively “undisturbed” soil sample. The test results and the stress-strain curves are presented on Plates C-10 through C-40.

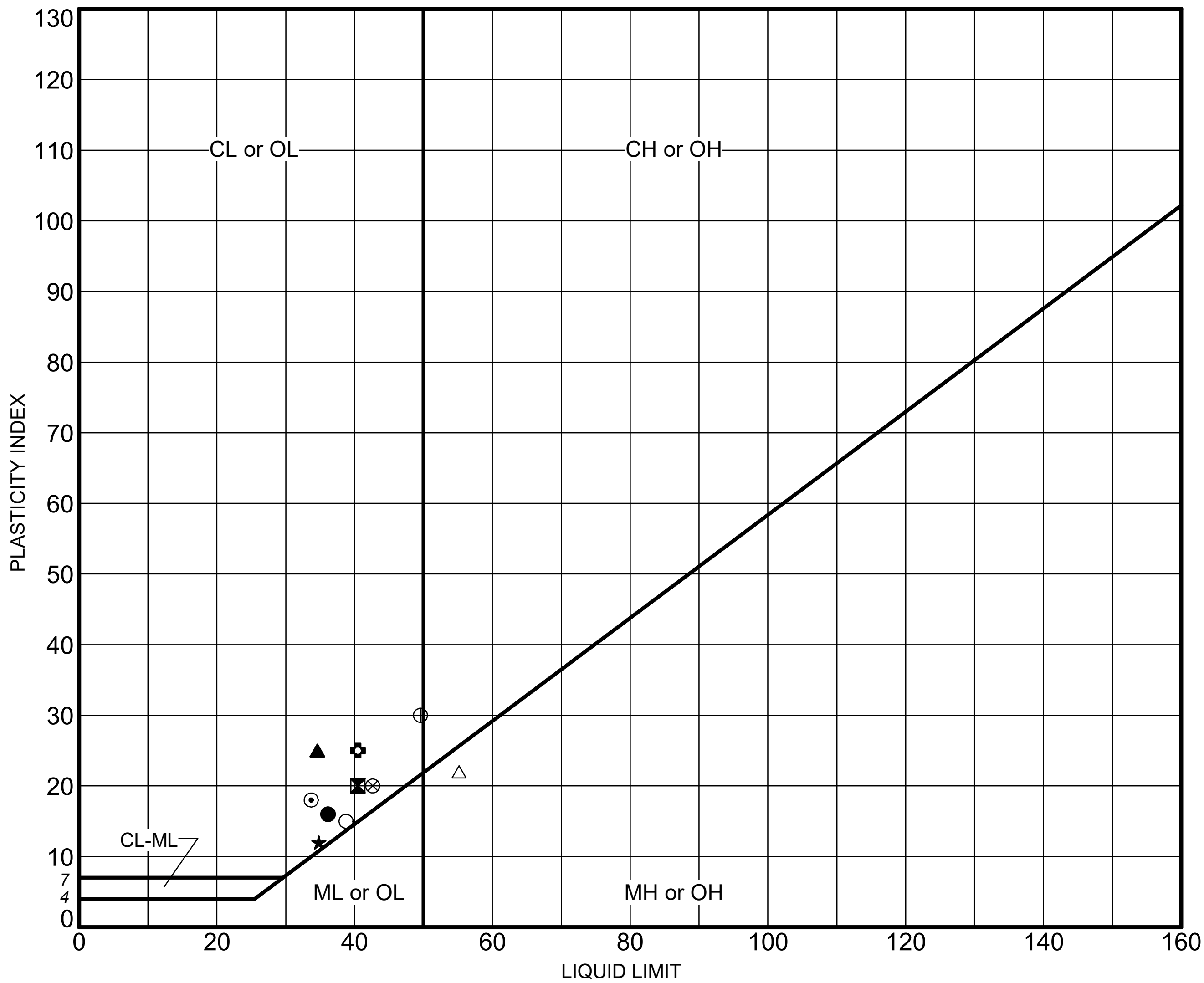
One Direct Shear test (ASTM D3080) was performed on a selected sample to evaluate the shear strength characteristics of the material tested. The test results are presented on Plate C-41.

Twenty-five laboratory California Bearing Ratio tests (ASTM D1883) were performed on bulk samples of the near-surface soils to evaluate the pavement support characteristics of the soils. The test results are presented on Plates C-42 through C-66.

Ten laboratory Resistance (R) Value tests (ASTM D2844) were performed on bulk samples of the near-surface soils to evaluate the pavement support characteristics of the soils. The test results are presented on Plates C-67 through C-76.

Eleven Modified Proctor compaction tests (ASTM D1557) were performed on bulk samples obtained to evaluate the relationship between the moisture content and the dry density of the near-surface soils. The test results are presented on Plates C-77 through C-87.

Corrosivity tests, including seven sets of pH (ASTM G51), Minimum Resistivity (ASTM G57), Chloride Content (EPA 300.0), and Sulfate Content (EPA 300.0) tests, were performed by Geolabs and Eurofins TestAmerica on selected soil samples obtained from our field exploration. The test results are summarized on Plate C-88.



Symbol	Sample	Depth (ft)	LL	PL	PI	Description
●	B-104	39.5-41.0	36	20	16	Reddish brown sandy clay (CL)
⧗	B-104	81.0-82.5	40	20	20	Brown sandy clay (CL)
▲	B-105	3.0-4.5	35	10	25	Brown sandy clay (CL) with traces of gravel
★	B-105	20.0-21.3	35	23	12	Reddish brown sandy clay (CL)
⊙	B-105	60.0-61.5	34	16	18	Brown sandy clay (CL) with traces of gravel
✿	B-105	80.0-81.5	40	15	25	Reddish brown sandy clay (CL)
○	B-204	41.5-43.0	39	24	15	Reddish brown sandy clay (CL)
△	B-205	30.0-31.5	55	33	22	Grayish brown clayey silt (MH) with some decomposed gravel
⊗	B-301	25.0-25.8	43	23	20	Reddish brown sandy clay (CL)
⊕	B-303	3.0-5.0	50	20	30	Reddish brown sandy clay (CL)

NP = NON-PLASTIC

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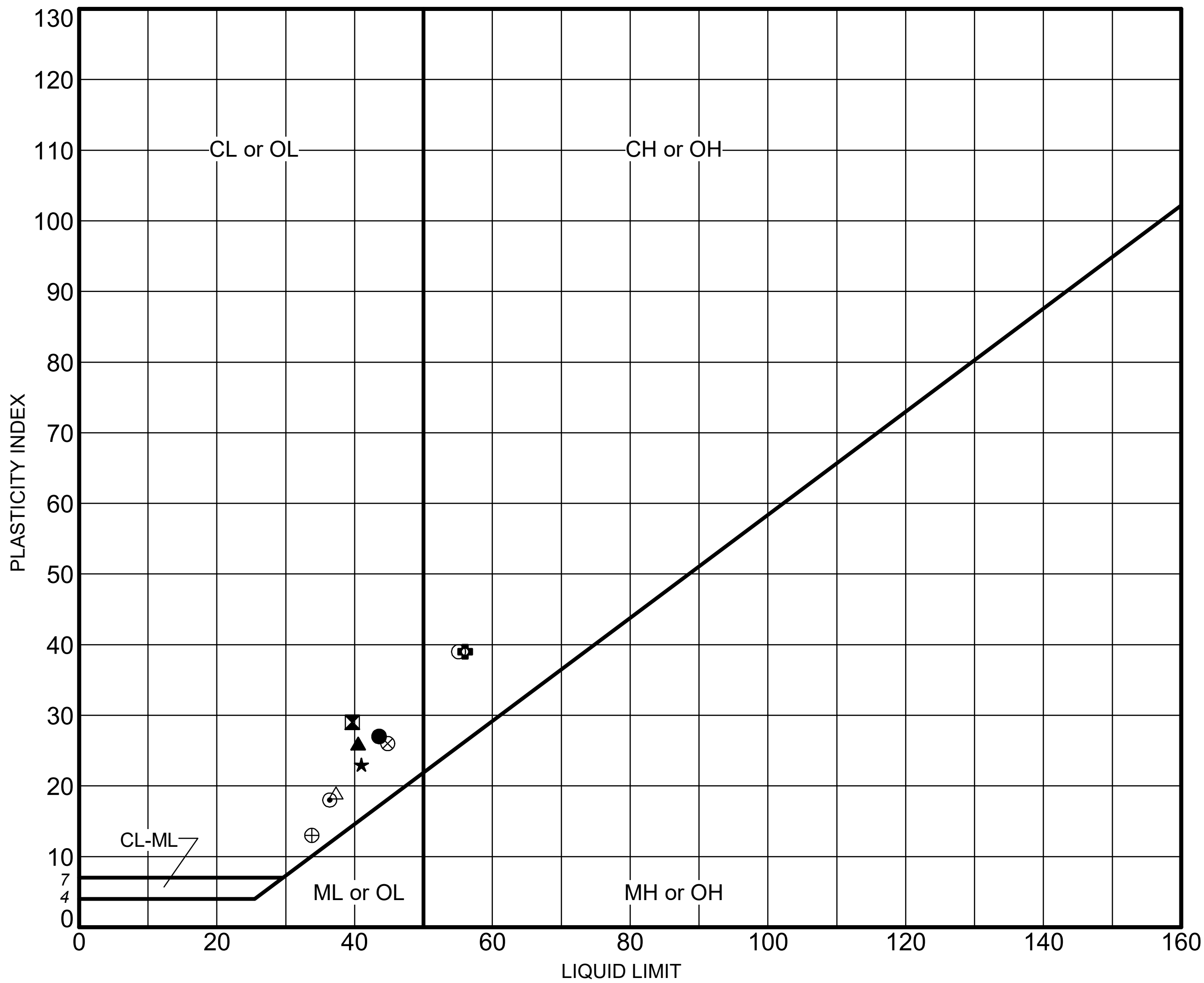
W.O. 8135-00

ATTERBERG LIMITS TEST RESULTS - ASTM D4318

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 1



	Sample	Depth (ft)	LL	PL	PI	Description
●	B-305	2.5-4.0	44	17	27	Reddish brown sandy clay (CL) with traces of gravel
⧗	B-307	2.5-4.0	40	11	29	Reddish brown sandy clay (CL)
▲	B-307	15.0-15.8	41	15	26	Reddish brown sandy clay (CL)
★	B-309	10.0-11.3	41	18	23	Reddish brown sandy clay (CL)
⊙	B-309	20.0-21.0	36	18	18	Brown sandy clay (CL)
✿	B-310	2.5-4.0	56	17	39	Brown silty clay (CH) with some sand
○	B-312	1.5-3.0	55	16	39	Reddish brown silty clay (CH) with some gravel
△	B-313	20.0-21.5	37	18	19	Reddish brown sandy clay (CL)
⊗	B-314	3.0-4.5	45	19	26	Reddish brown sandy clay (CL)
⊕	B-316	20.0-21.4	34	21	13	Brown sandy clay (CL)

NP = NON-PLASTIC

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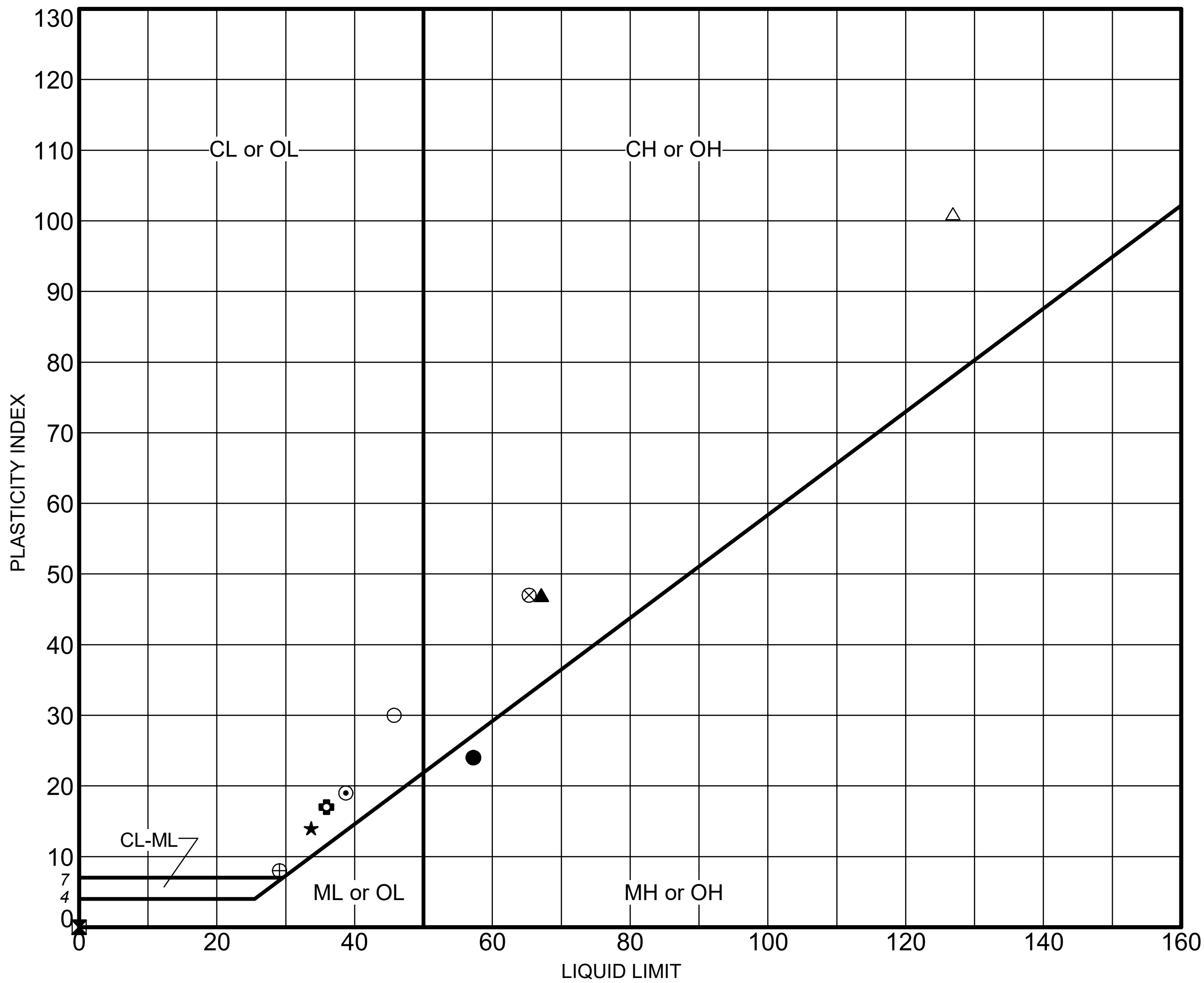
ATTERBERG LIMITS TEST RESULTS - ASTM D4318

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 2



	Sample	Depth (ft)	LL	PL	PI	Description
●	B-319	10.0-11.4	57	33	24	Brown clayey silt (MH)
⊠	B-319	26.0-26.9	NP	NP	NP	Reddish brown sandy silt (NP)
▲	B-321	3.0-5.0	67	20	47	Reddish brown silty clay (CH) with traces of sand
★	B-323	20.0-21.5	34	20	14	Brown sandy clay (CL) with traces of gravel
⊙	B-326	10.0-11.5	39	20	19	Brown sandy clay (CL)
✿	B-329	20.0-21.5	36	19	17	Brown sandy clay (CL)
○	B-332	3.0-4.5	46	16	30	Dark brown sandy clay (CL)
△	B-333	4.0-6.0	127	26	101	Brown sandy clay (CL)
⊗	B-334	5.0-6.5	65	18	47	Brown silty clay (CH)
⊕	B-334	20.0-20.7	29	21	8	Brown sandy clay (CL) with a little fine gravel

NP = NON-PLASTIC

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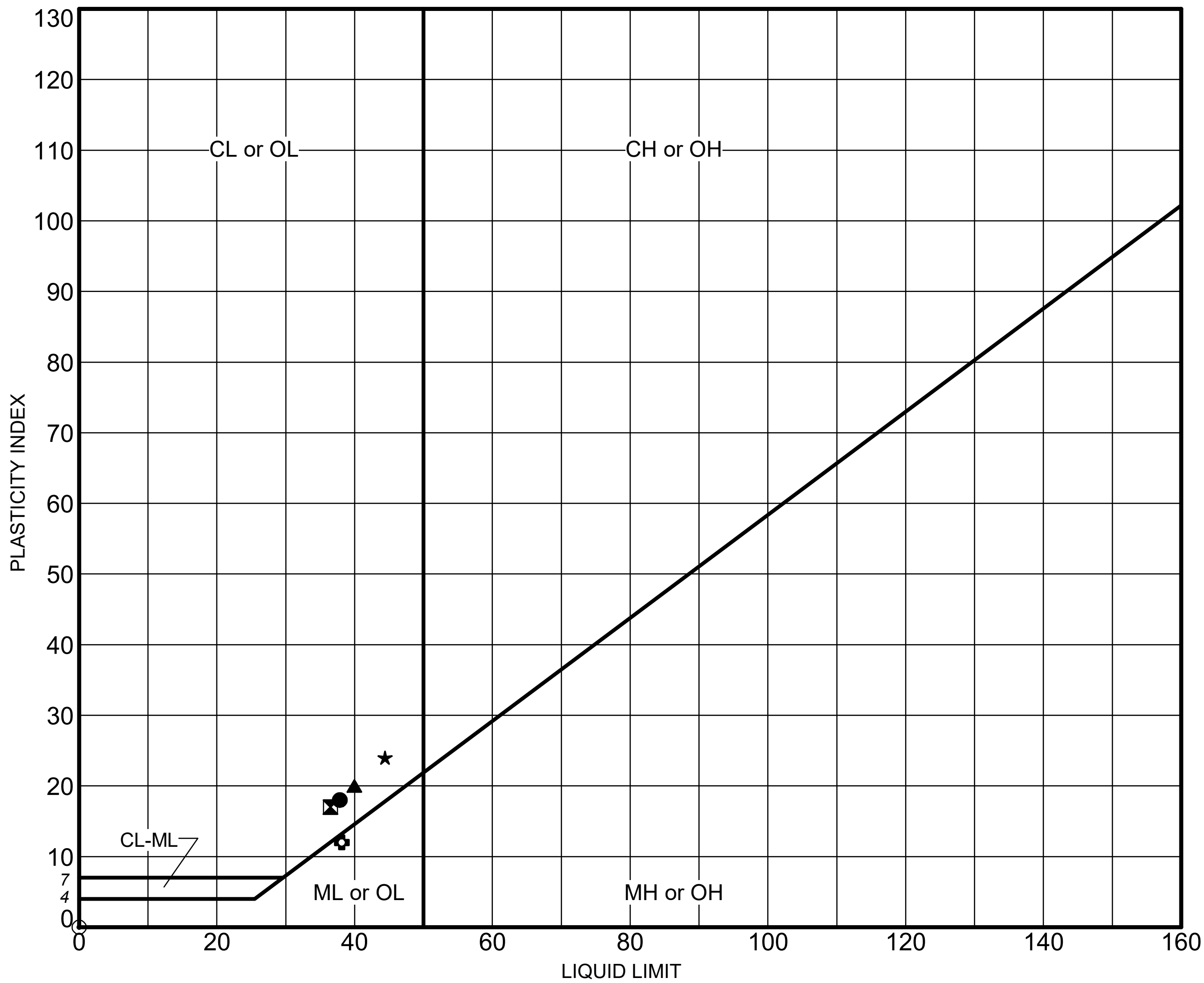
ATTERBERG LIMITS TEST RESULTS - ASTM D4318

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 3



	Sample	Depth (ft)	LL	PL	PI	Description
●	B-336	5.0-6.5	38	20	18	Brown sandy clay (CL)
⊠	B-340	25.0-26.5	37	20	17	Reddish brown sandy clay (CL)
▲	B-343	20.0-21.5	40	20	20	Dark brown sandy clay (CL)
★	B-345	20.0-21.5	44	20	24	Dark brown sandy clay (CL)
⊙	B-346	20.0-21.0	NP	NP	NP	Brown sandy silt (NP)
✿	B-346	40.0-41.5	38	26	12	Reddish brown with black mottling sandy silt (ML)

NP = NON-PLASTIC

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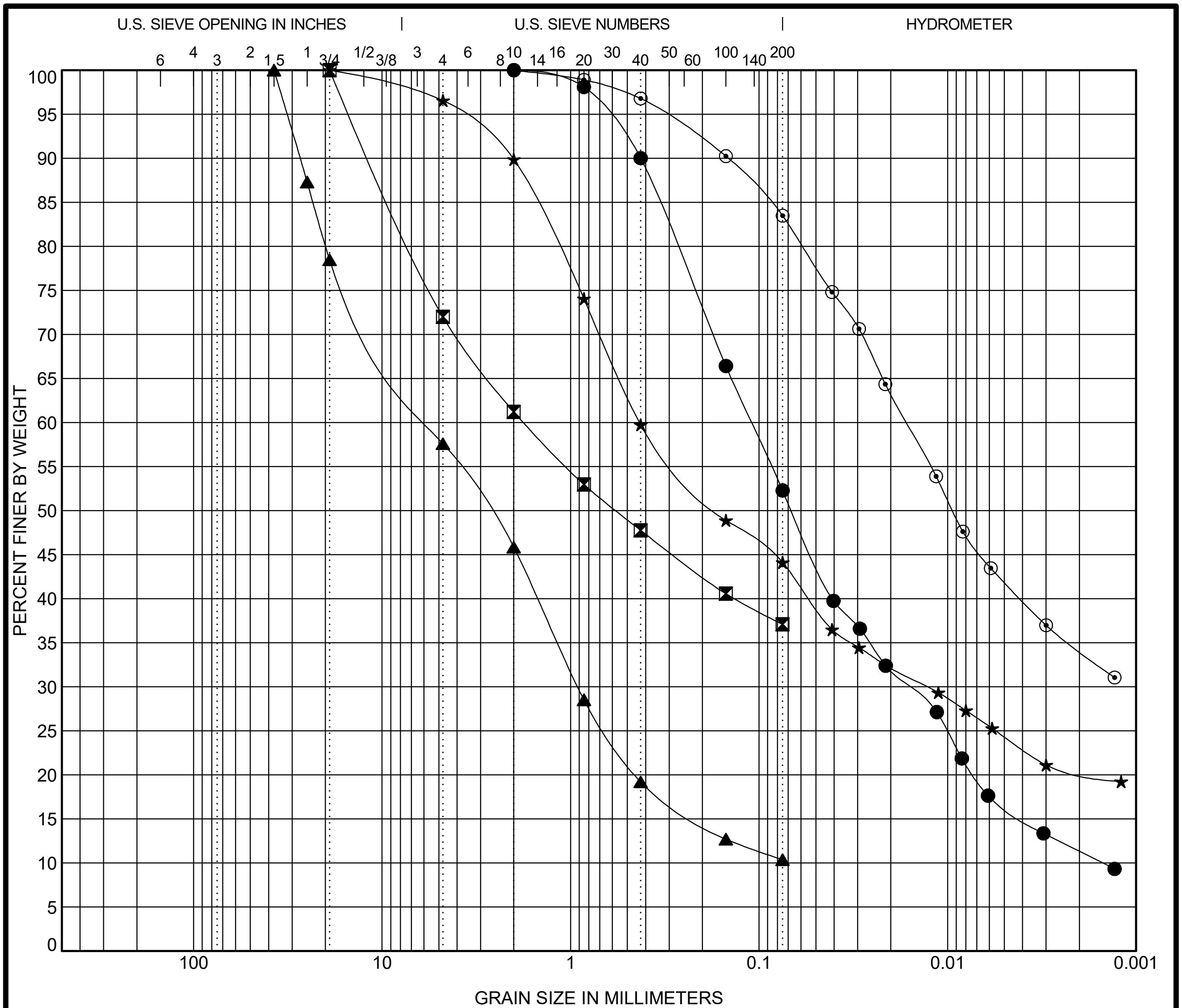
W.O. 8135-00

ATTERBERG LIMITS TEST RESULTS - ASTM D4318

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 4

G ATTERBERG PI-130 LL-160 8135-00.GPJ GEOLABS.GDT 11/22/20



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Sample	Depth (ft)	Description	LL	PL	PI	Cc	Cu
●	B-104	10.0-11.5	Brown sandy silt (ML)				1.6	72.7
⊠	B-104	91.0-92.5	Brown silty sand (SM) with some gravel					
▲	B-104	96.0-97.4	Brown gravelly sand (SW-SM) with a little silt				2.2	82.6
★	B-105	5.0-6.5	Brown silty sand (SM)					
⊙	B-105	10.0-11.5	Reddish brown sandy clay (CL)					

	Sample	Depth (ft)	D100 (mm)	D60 (mm)	D30 (mm)	D10 (mm)	%Gravel	%Sand	%Fine
●	B-104	10.0-11.5	2	0.11	0.016	0.002	0.0	47.7	52.3
⊠	B-104	91.0-92.5	19	1.766			28.0	34.9	37.1
▲	B-104	96.0-97.4	37.5	5.576	0.915		42.4	47.2	10.4
★	B-105	5.0-6.5	19	0.43	0.013		3.5	52.4	44.1
⊙	B-105	10.0-11.5	2	0.017			0.0	16.5	83.5

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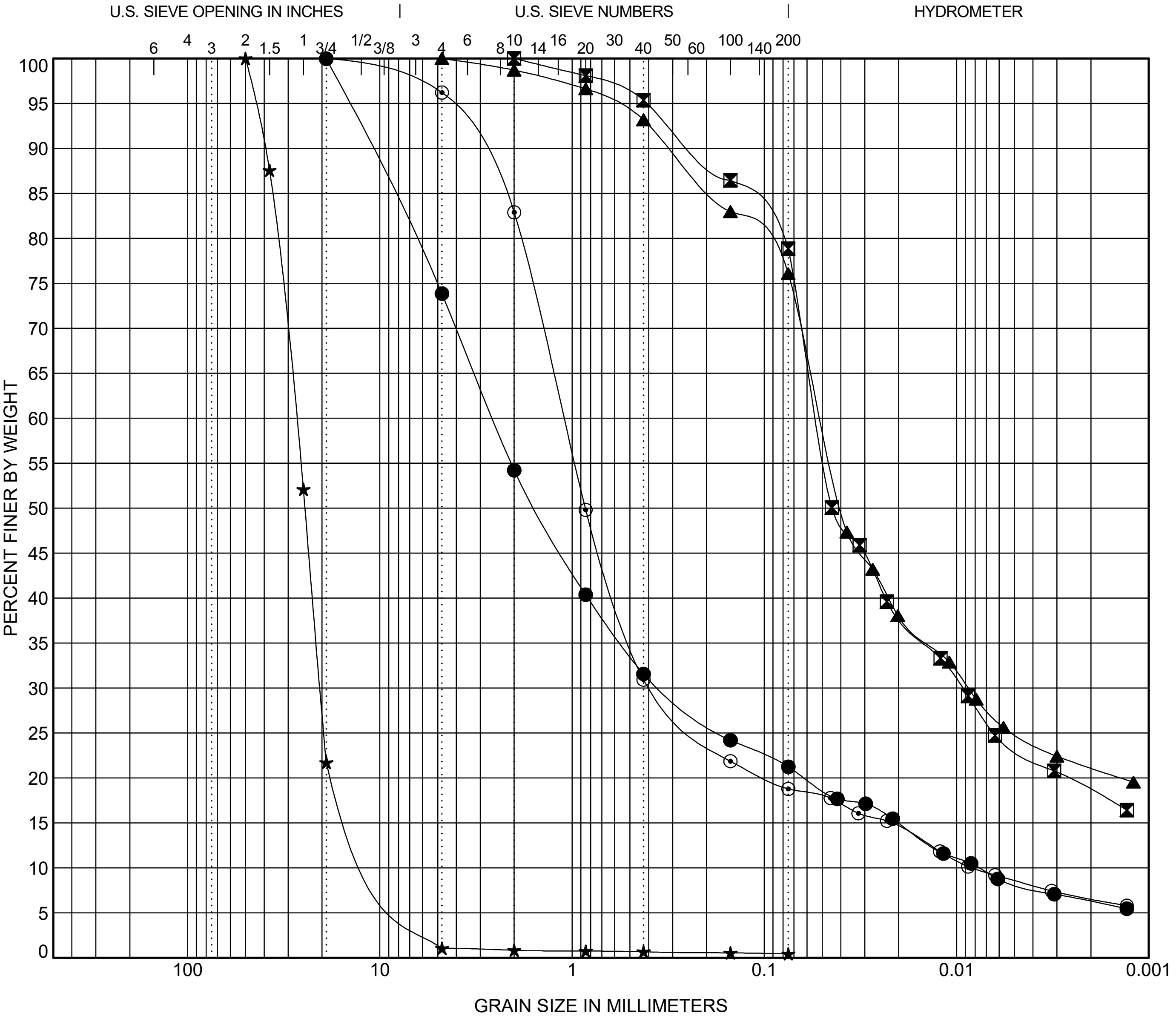
GRAIN SIZE DISTRIBUTION - ASTM D6913 & D7928

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 5



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Sample	Depth (ft)	Description	LL	PL	PI	Cc	Cu
●	B-204	10.0-11.5	Gray silty sand (SM) with some gravel				5.9	336.4
⧗	B-204	30.0-31.5	Brown sandy clay (CL)					
▲	B-204	36.5-38.0	Reddish brown sandy clay (CL)					
★	B-204	72.8-76.5	Gray gravel (GP) with traces of sand and silt				1.8	3.2
⊙	B-205	10.0-11.5	Brown silty sand (SM) with traces of gravel				16.0	133.4

	Sample	Depth (ft)	D100 (mm)	D60 (mm)	D30 (mm)	D10 (mm)	%Gravel	%Sand	%Fine
●	B-204	10.0-11.5	19	2.581	0.341	0.008	26.1	52.6	21.2
⧗	B-204	30.0-31.5	2	0.053	0.009		0.0	21.2	78.8
▲	B-204	36.5-38.0	4.75	0.051	0.009		0.0	23.9	76.1
★	B-204	72.8-76.5	50	27.366	20.478	8.66	98.9	0.6	0.4
⊙	B-205	10.0-11.5	19	1.107	0.383	0.008	3.8	77.4	18.8

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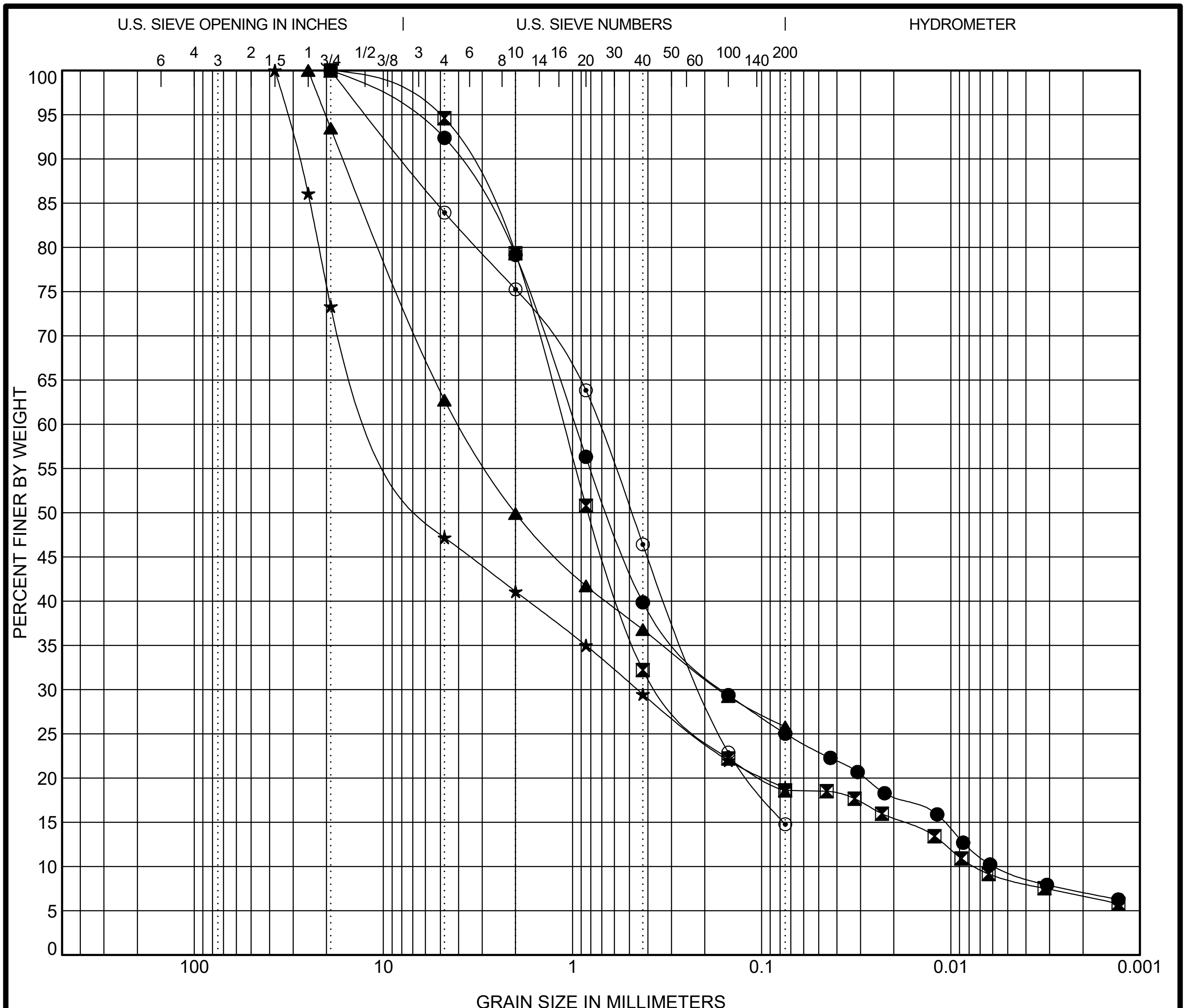
W.O. 8135-00

GRAIN SIZE DISTRIBUTION - ASTM D6913 & D7928

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 6

G_GRAIN_SIZE_MOD 8135-00.GPJ GEOLABS.GDT 11/22/20



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Sample	Depth (ft)	Description	LL	PL	PI	Cc	Cu
●	B-205	15.0-16.5	Brown clayey sand (SC) with a little gravel				4.5	168.4
⧗	B-205	25.0-26.5	Brownish gray silty sand (SM) with some gravel				13.7	151.1
▲	B-318	1.0-2.5	Tan silty gravel (GM) with some sand					
★	B-323	15.0-16.5	Brownish gray silty gravel (GM) with some sand					
⊙	B-336	20.0-21.5	Brown silty sand (SM) with some gravel					

	Sample	Depth (ft)	D100 (mm)	D60 (mm)	D30 (mm)	D10 (mm)	%Gravel	%Sand	%Fine
●	B-205	15.0-16.5	19	0.976	0.16	0.006	7.6	67.4	25.0
⧗	B-205	25.0-26.5	19	1.121	0.338	0.007	5.4	76.0	18.6
▲	B-318	1.0-2.5	25	3.952	0.167		37.3	36.9	25.8
★	B-323	15.0-16.5	37.5	9.377	0.454		52.8	28.3	18.9
⊙	B-336	20.0-21.5	19	0.73	0.206		16.1	69.2	14.8

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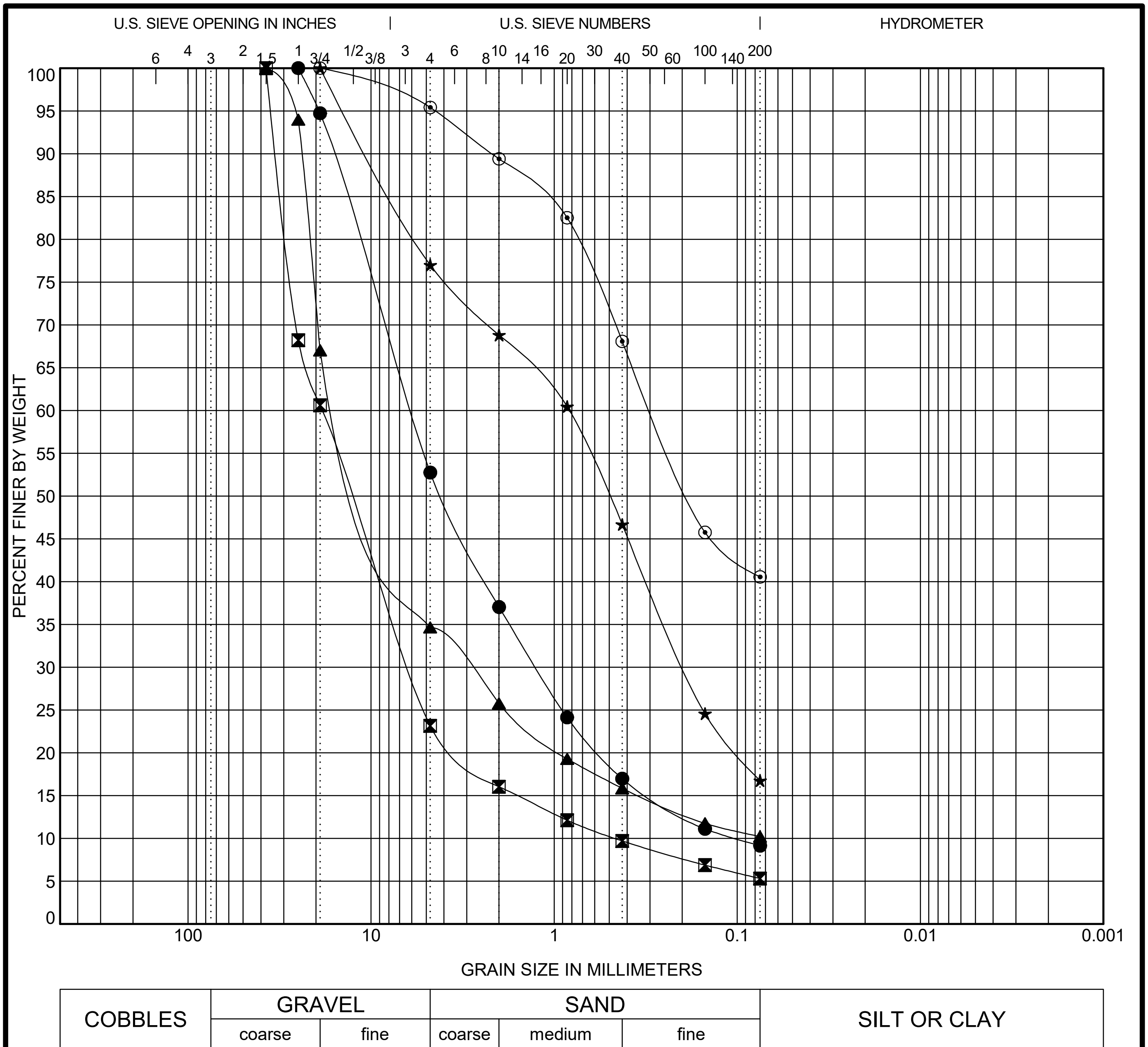
GRAIN SIZE DISTRIBUTION - ASTM D6913 & D7928

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 7

G_GRAIN_SIZE_MOD 8135-00.GPJ GEOLABS.GDT 11/22/20



	Sample	Depth (ft)	Description	LL	PL	PI	Cc	Cu
●	B-338	20.0-21.5	Brown sandy gravel (GW-GM) with a little silt				2.6	59.4
⧗	B-340	5.0-5.7	Gray gravel (GP-GM) with some sand and a little silt				4.3	40.0
▲	B-340	13.0-14.5	Gray sandy gravel (GP-GM) with a little silt				9.5	205.9
★	B-345	10.0-10.9	Brown silty sand (SM) with some gravel					
⊙	B-346	1.5-3.0	Brown silty sand (SM) with traces of gravel					

	Sample	Depth (ft)	D100 (mm)	D60 (mm)	D30 (mm)	D10 (mm)	%Gravel	%Sand	%Fine
●	B-338	20.0-21.5	25	6.036	1.255	0.102	47.3	43.6	9.1
⧗	B-340	5.0-5.7	37.5	18.58	6.121	0.464	76.9	17.8	5.3
▲	B-340	13.0-14.5	37.5	14.062	3.02		65.3	24.4	10.2
★	B-345	10.0-10.9	19	0.831	0.194		23.0	60.3	16.7
⊙	B-346	1.5-3.0	19	0.292			4.6	54.9	40.5

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KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 8

Location	Depth	Length	Diameter	Length/ Diameter Ratio	Density	Load	Compressive Strength
	(feet)	(inches)	(inches)		(pcf)	(lbs)	(psi)
B-204	56.5 - 61.5	6.663	3.263	2.04	133.6	57,790	6,910
B-204	61.5 - 66.5	6.656	3.261	2.04	124.2	43,750	5,240
B-204	81.5 - 86.5	6.688	3.260	2.05	163.9	50,710	6,080
B-204	86.5 - 91.5	6.700	3.256	2.06	166.1	84,750	10,180
B-204	91.5 - 96.5	6.646	3.250	2.05	170.4	83,180	10,030
B-205	36.5 - 41	6.644	3.261	2.04	126.1	35,040	4,200
B-205	46 - 51	6.723	3.255	2.07	163.7	85,540	10,280
B-205	51 - 56	6.663	3.244	2.05	163.7	101,360	12,270
B-205	56 - 61	6.641	3.260	2.04	163.5	68,830	8,250
B-205	66 - 71	6.739	3.248	2.07	171.1	123,890	14,950
B-205	76 - 81	6.572	3.262	2.01	114.1	12,430	1,490

ASTM D7012 (METHOD C)

Note: Samples were not prepared in accordance with ASTM D4543. Therefore, results reported may differ from results obtained from a test speciment that meets the requirements of Practice D4543

G_ROCK_UC_TEST_PORTRAIT 8135-00.GPJ GEOLABS.GDT 11/22/20

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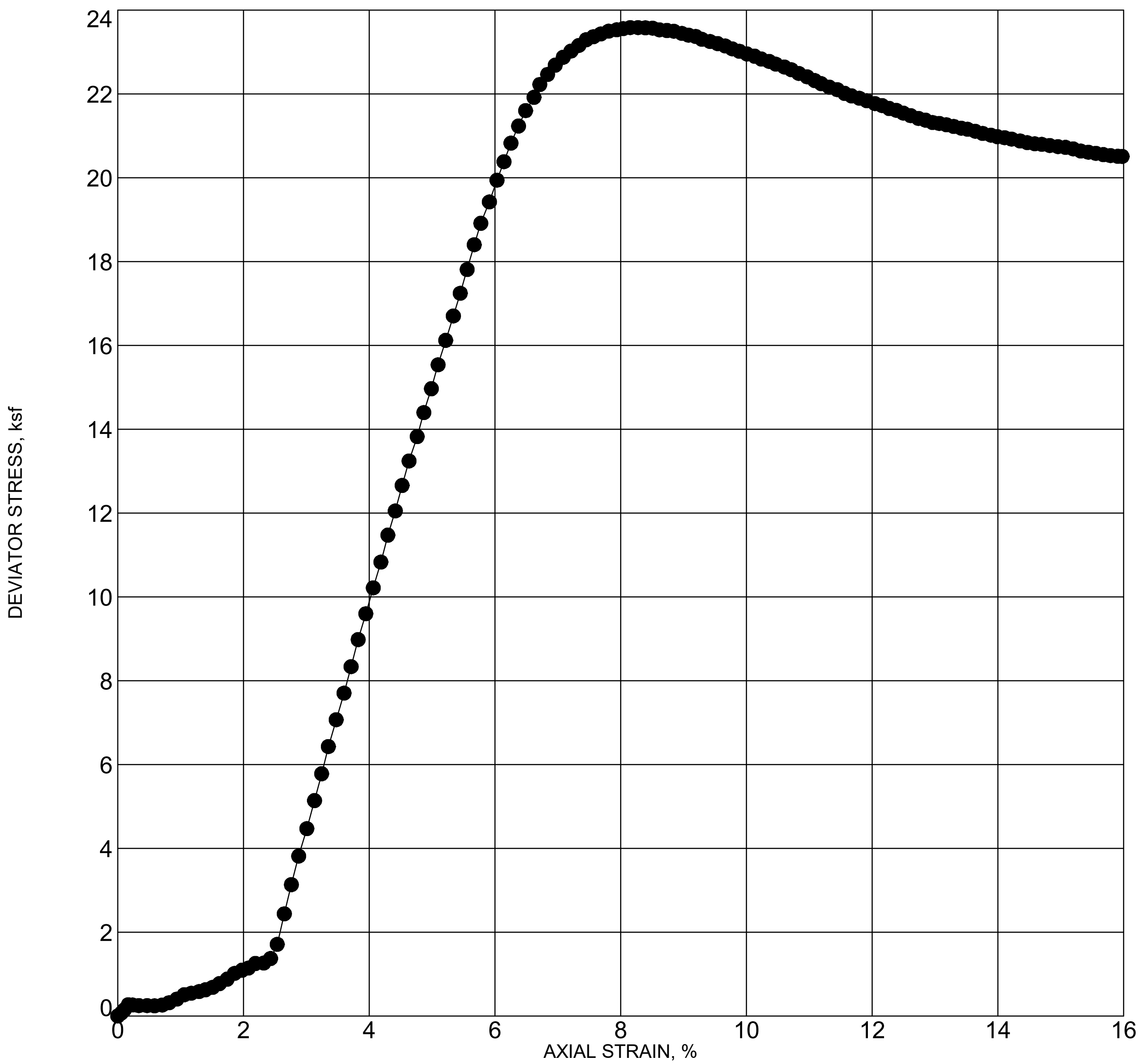
UNIAXIAL COMPRESSIVE STRENGTH TEST

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 9



Max. Deviator Stress (ksf):	23.6
Confining Stress (ksf):	4.5

Location: B-104
Depth: 44.5 - 46.0 feet
Description: Reddish brown sandy clay
Test Date: 9/25/2020

Dry Density (pcf)	100.4	Sample Diameter (inches)	2.413
Moisture (%)	28.7	Sample Height (inches)	5.133
Axial Strain at Failure (%)	8.4	Strain Rate (% / minute)	0.70

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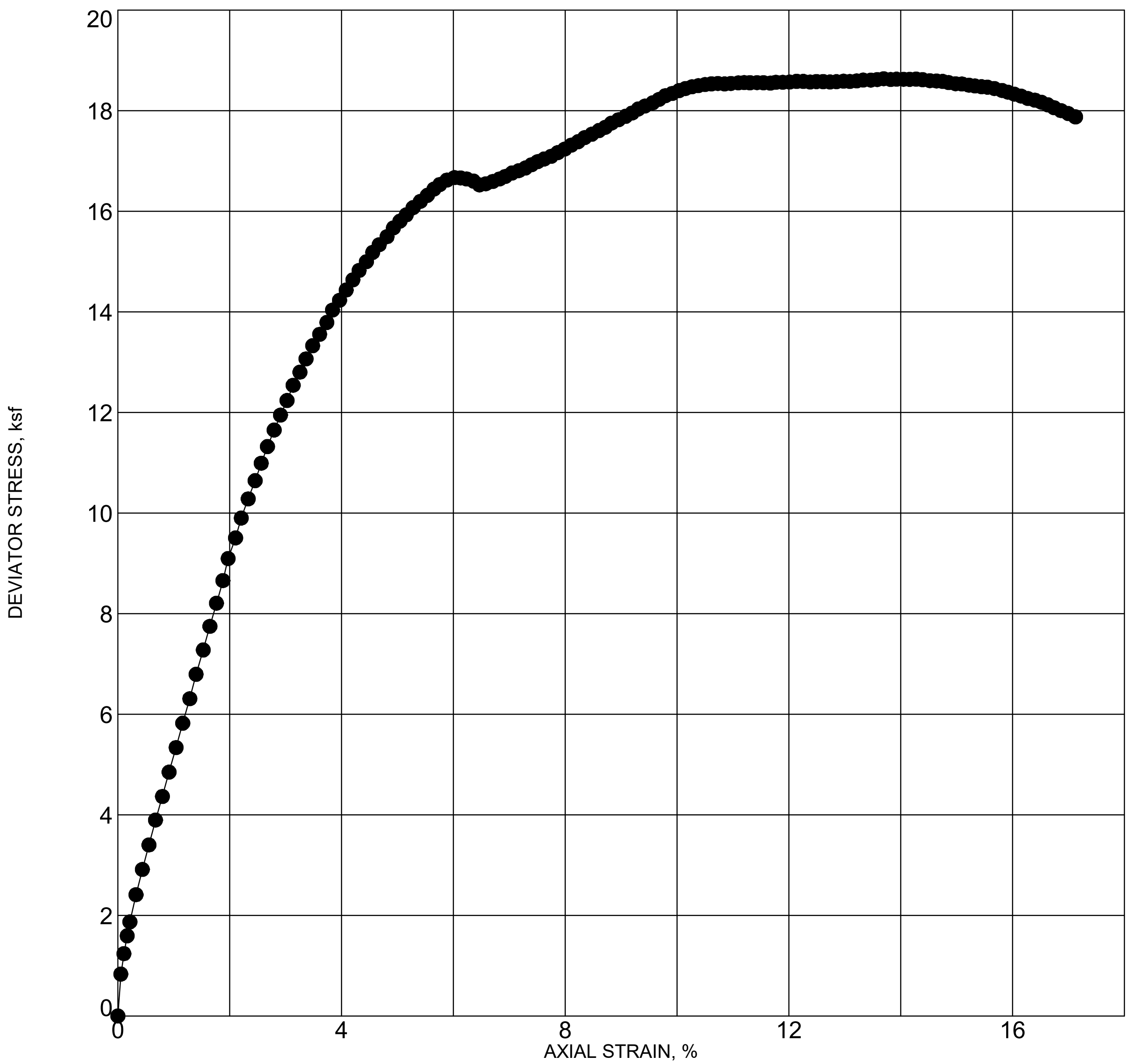
TRIAXIAL UU COMPRESSION TEST - ASTM D2850

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 10

G_TXUU 8135-00.GPJ GEOLABS.GDT 11/22/20



Max. Deviator Stress (ksf):	18.5
Confining Stress (ksf):	5.5

Location: B-104
Depth: 56.0 - 57.5 feet
Description: Reddish brown sandy clay with a little fine gravel
Test Date: 9/25/2020

Dry Density (pcf)	104.6	Sample Diameter (inches)	2.413
Moisture (%)	24.4	Sample Height (inches)	5.133
Axial Strain at Failure (%)	15.0	Strain Rate (% / minute)	0.71

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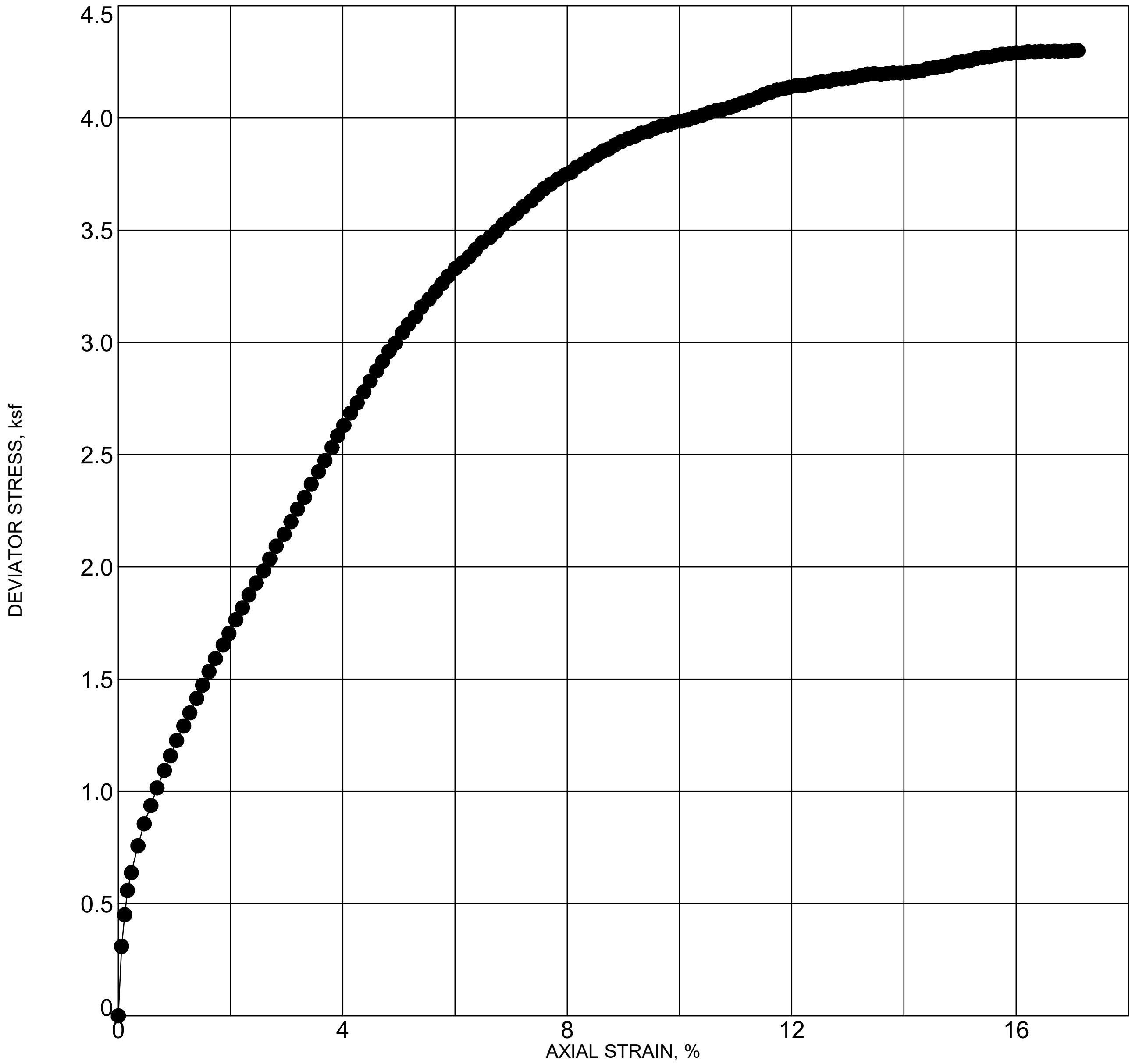
FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 11

G_TXUU 8135-00.GPJ GEOLABS.GDT 11/22/20



Max. Deviator Stress (ksf):	4.2
Confining Stress (ksf):	6.5

Location: B-104
Depth: 66.0 - 67.5 feet
Description: Reddish brown sandy clay
Test Date: 9/28/2020

Dry Density (pcf)	92.5	Sample Diameter (inches)	2.413
Moisture (%)	29.6	Sample Height (inches)	5.067
Axial Strain at Failure (%)	15.0	Strain Rate (% / minute)	0.70

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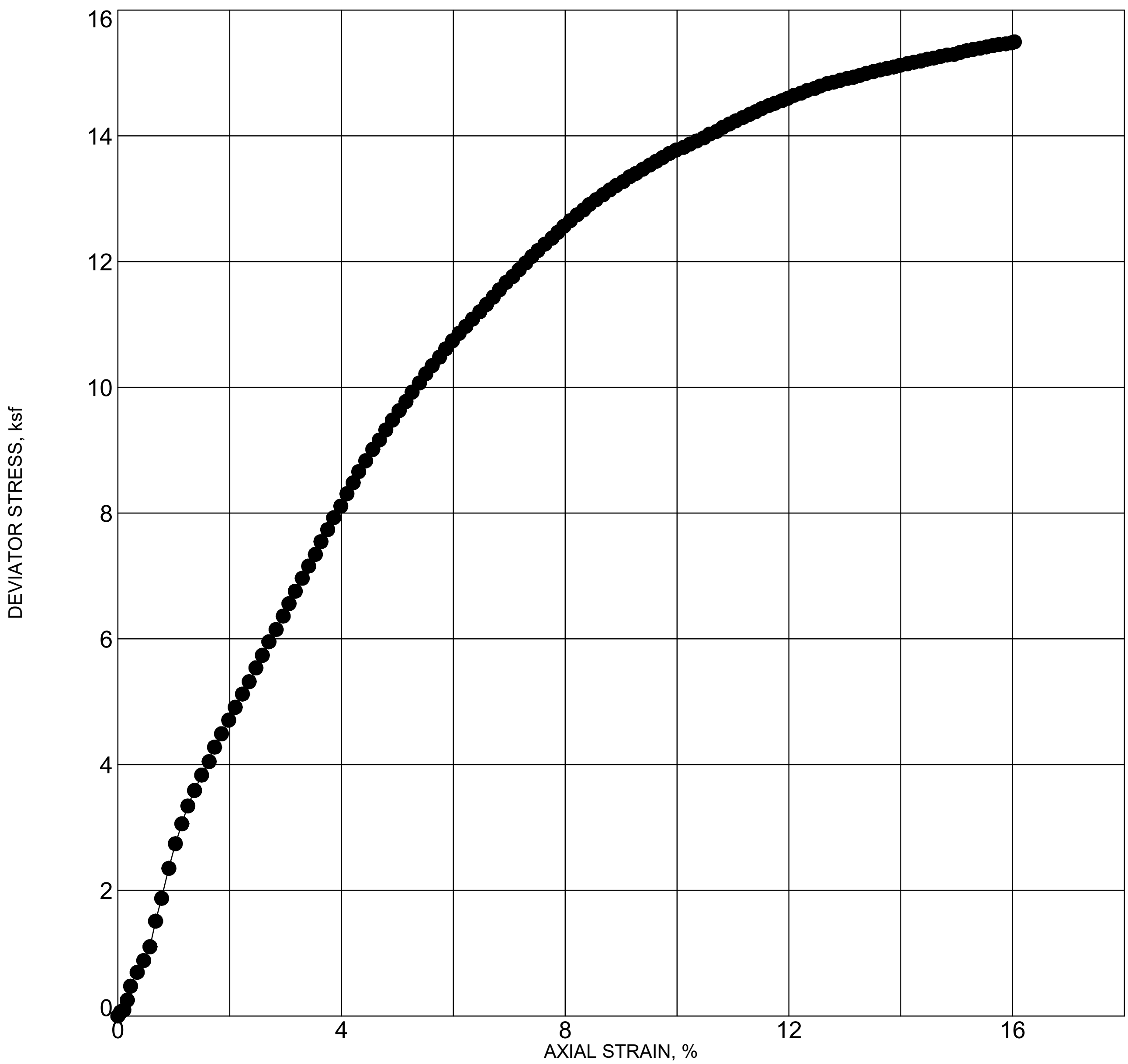
TRIAXIAL UU COMPRESSION TEST - ASTM D2850

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 12



Max. Deviator Stress (ksf):	15.3
Confining Stress (ksf):	7.5

Location: B-104
Depth: 76.0 - 77.5 feet
Description: Brown sandy clay
Test Date: 9/28/2020

Dry Density (pcf)	104.4	Sample Diameter (inches)	2.413
Moisture (%)	23.9	Sample Height (inches)	5.133
Axial Strain at Failure (%)	15.0	Strain Rate (% / minute)	0.71

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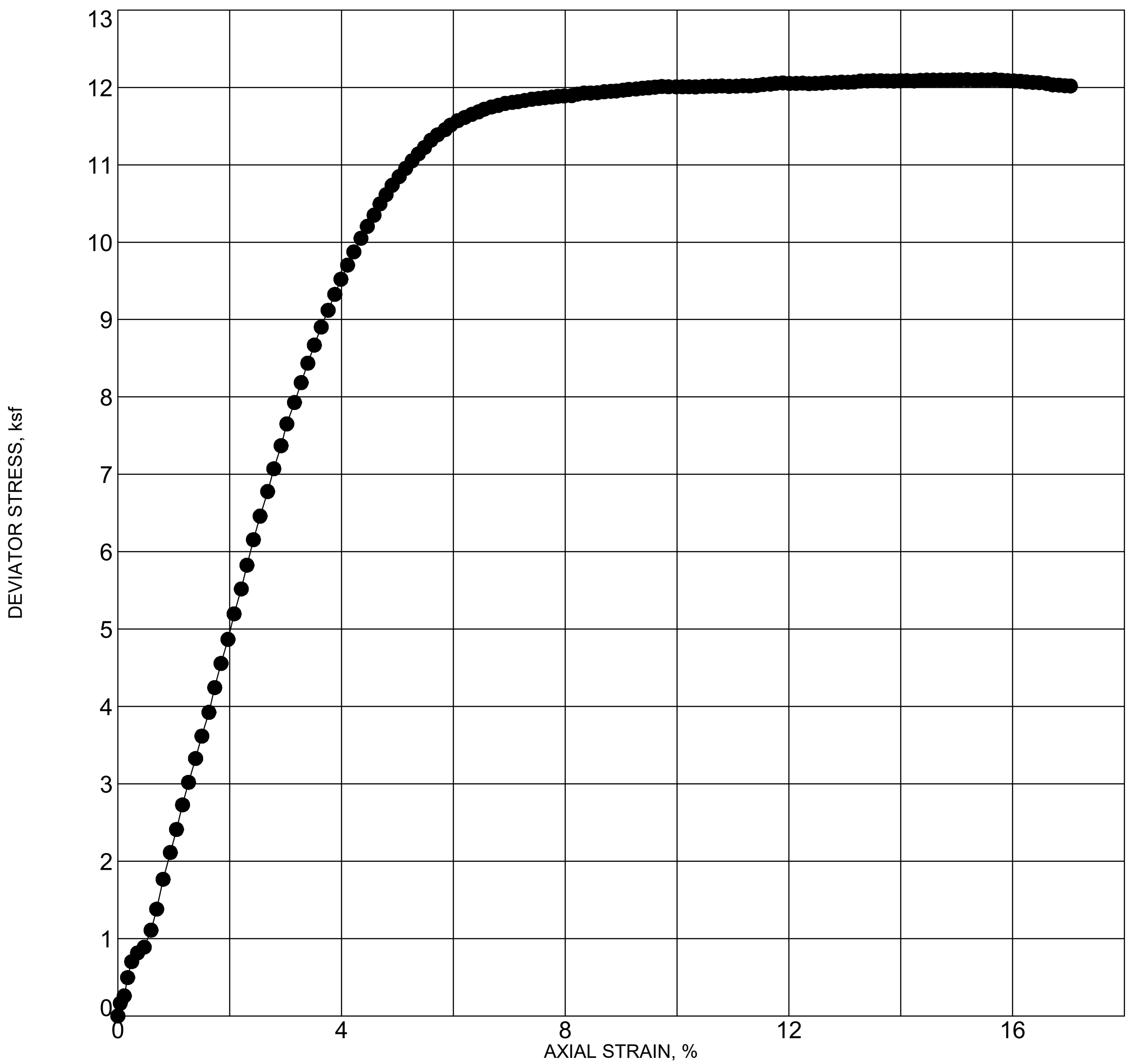
TRIAXIAL UU COMPRESSION TEST - ASTM D2850

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 13



Max. Deviator Stress (ksf):	12.1
Confining Stress (ksf):	4.5

Location: B-105
Depth: 45.0 - 46.5 feet
Description: Reddish brown sandy clay
Test Date: 9/28/2020

Dry Density (pcf)	101.5	Sample Diameter (inches)	2.413
Moisture (%)	25.7	Sample Height (inches)	5.133
Axial Strain at Failure (%)	14.9	Strain Rate (% / minute)	0.71

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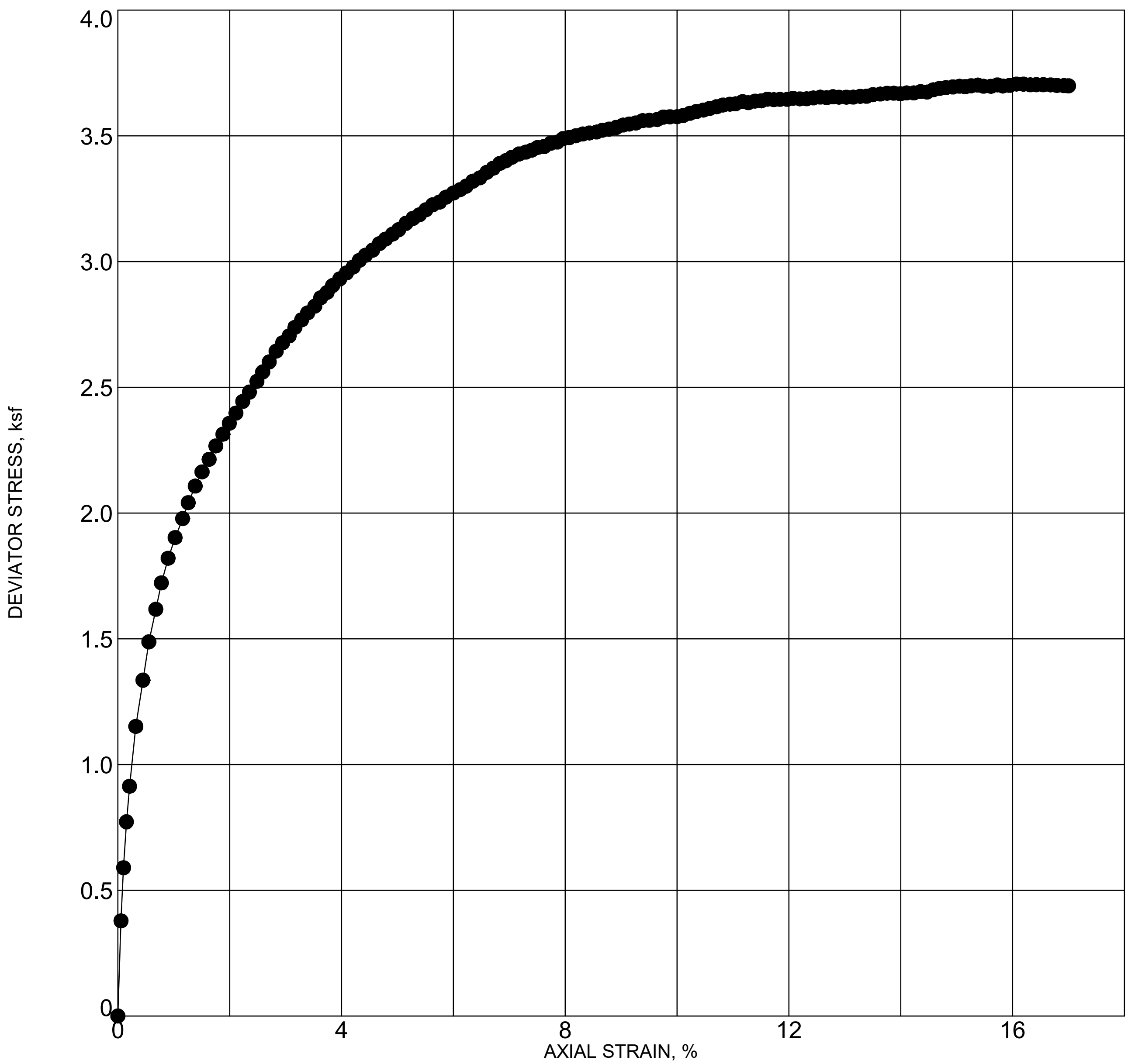
TRIAXIAL UU COMPRESSION TEST - ASTM D2850

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 14



Max. Deviator Stress (ksf):	3.7
Confining Stress (ksf):	5.5

Location: B-105
Depth: 55.0 - 56.5 feet
Description: Brown sandy clay with traces of gravel
Test Date: 9/28/2020

Dry Density (pcf)	87.3	Sample Diameter (inches)	2.413
Moisture (%)	34.6	Sample Height (inches)	5.067
Axial Strain at Failure (%)	15.0	Strain Rate (% / minute)	0.71

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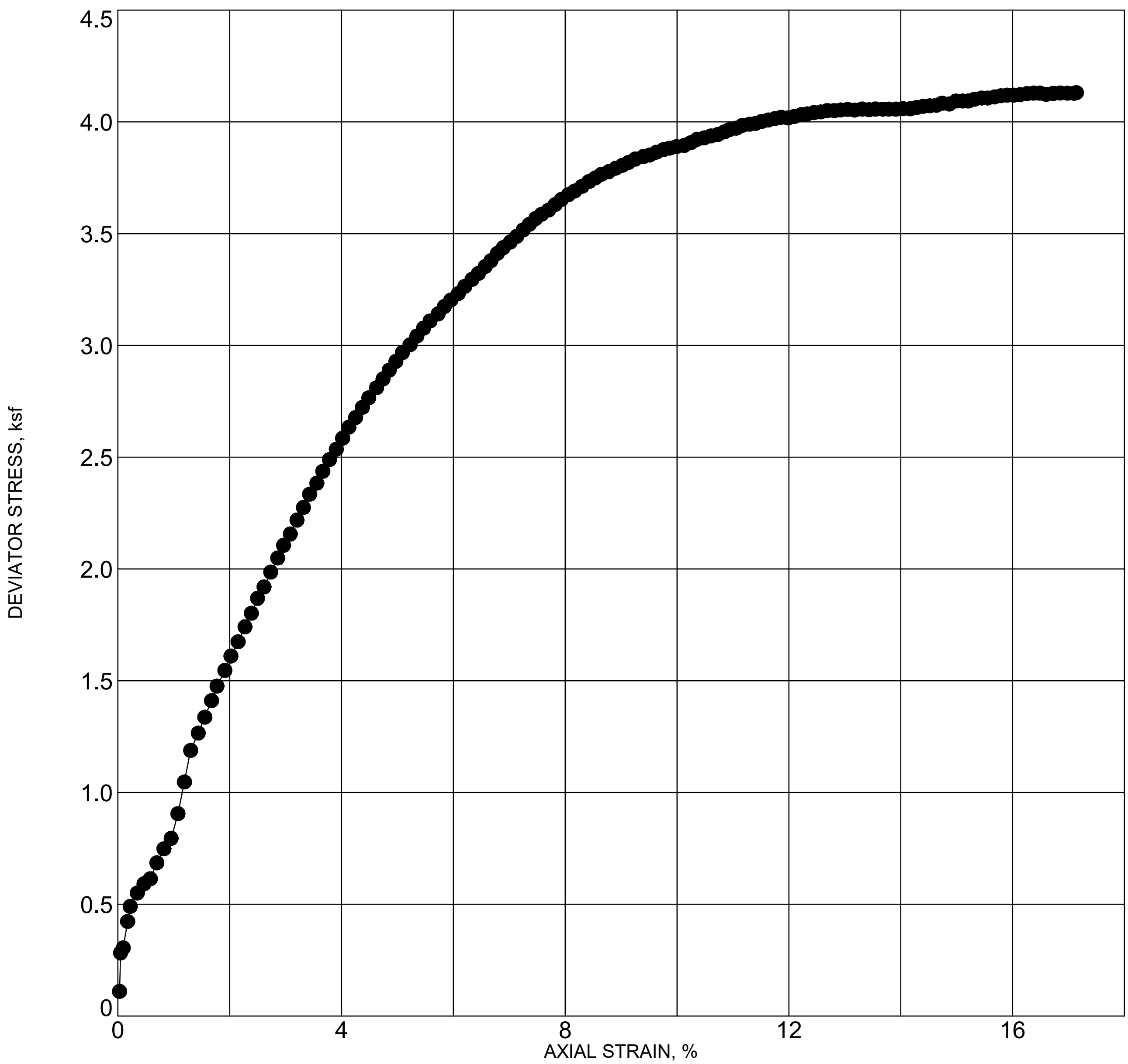
TRIAXIAL UU COMPRESSION TEST - ASTM D2850

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 15



Max. Deviator Stress (ksf):	4.1
Confining Stress (ksf):	6.5

Location: B-105
Depth: 65.0 - 66.5 feet
Description: Brown sandy clay with traces of gravel
Test Date: 9/29/2020

Dry Density (pcf)	91.0	Sample Diameter (inches)	2.413
Moisture (%)	30.0	Sample Height (inches)	5.133
Axial Strain at Failure (%)	15.0	Strain Rate (% / minute)	0.71

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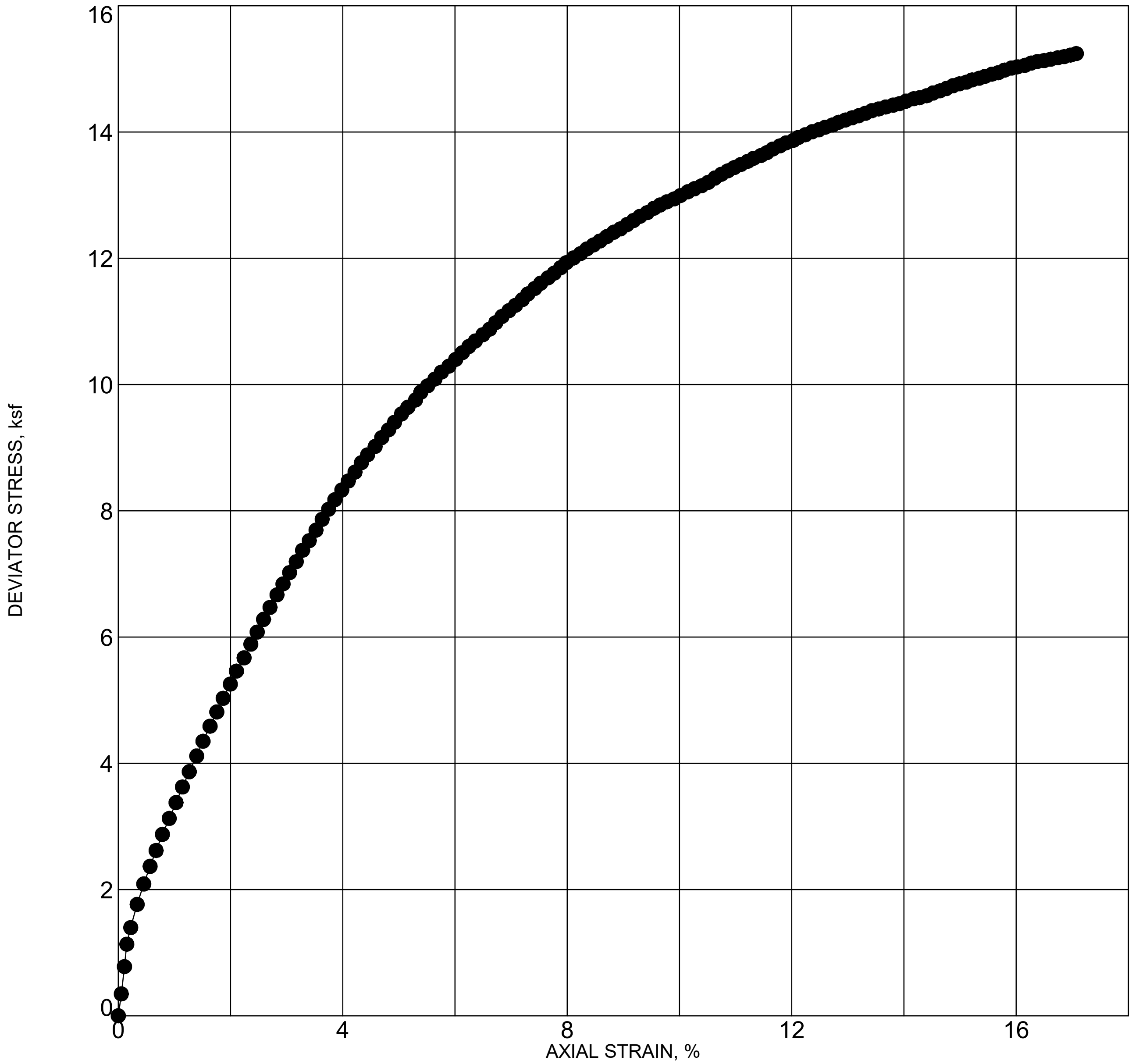
TRIAXIAL UU COMPRESSION TEST - ASTM D2850

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 16

G_TXUU 8135-00.GPJ GEOLABS.GDT 11/22/20



Max. Deviator Stress (ksf):	15.2
Confining Stress (ksf):	8.5

Location: B-105
Depth: 85.0 - 86.3 feet
Description: Reddish brown sandy clay
Test Date: 9/29/2020

Dry Density (pcf)	108.2	Sample Diameter (inches)	2.413
Moisture (%)	23.0	Sample Height (inches)	5.167
Axial Strain at Failure (%)	15.0	Strain Rate (% / minute)	0.71

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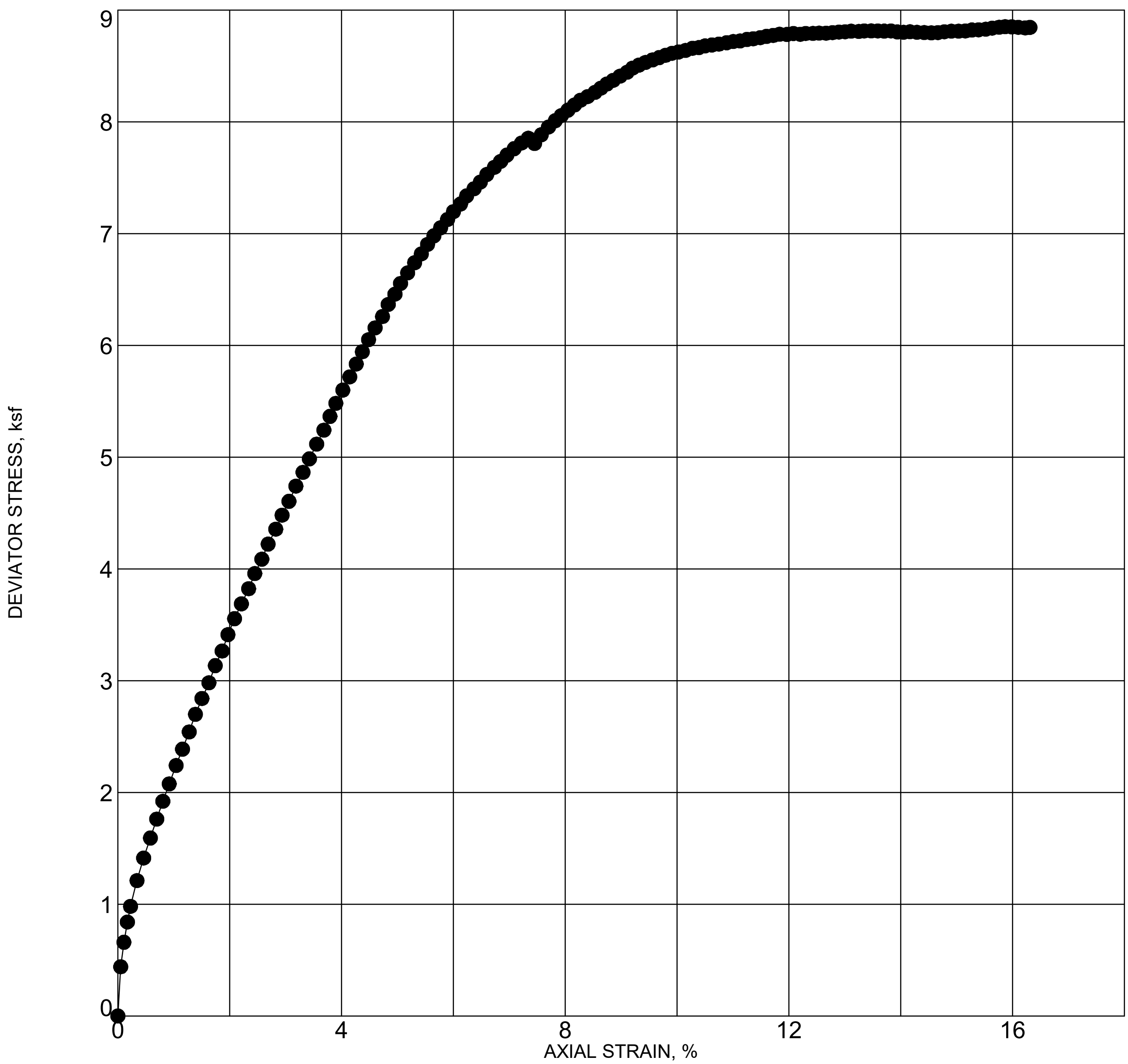
TRIAXIAL UU COMPRESSION TEST - ASTM D2850

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 17



Max. Deviator Stress (ksf):	8.9
Confining Stress (ksf):	3.7

Location: B-204
Depth: 36.5 - 38.0 feet
Description: Reddish brown sandy clay (CL)
Test Date: 9/15/2020

Dry Density (pcf)	94.5	Sample Diameter (inches)	2.413
Moisture (%)	29.4	Sample Height (inches)	5.167
Axial Strain at Failure (%)	15.0	Strain Rate (% / minute)	0.70

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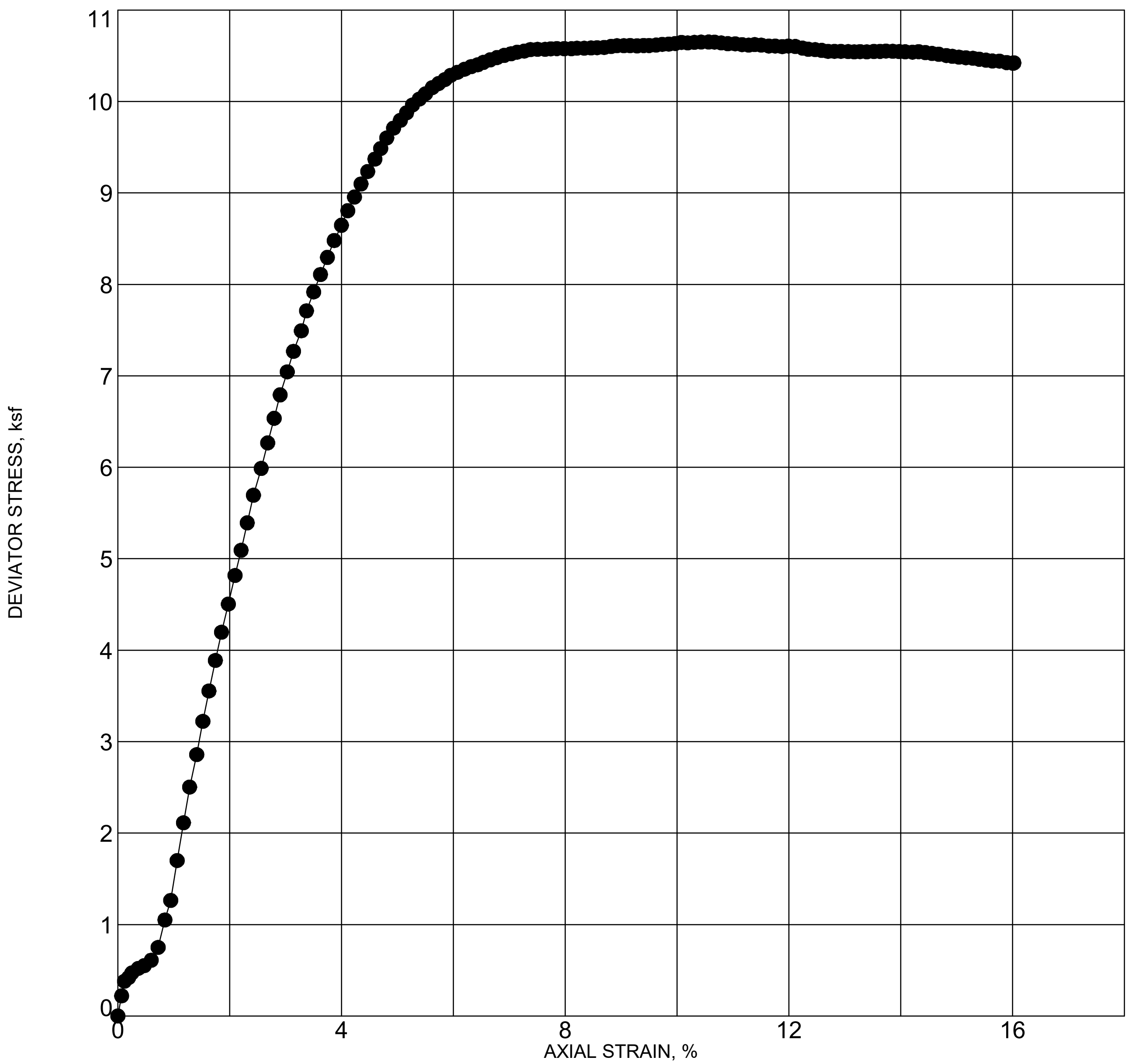
TRIAXIAL UU COMPRESSION TEST - ASTM D2850

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 18

G_TXUU 8135-00.GPJ GEOLABS.GDT 11/22/20



Max. Deviator Stress (ksf):	10.7
Confining Stress (ksf):	4.7

Location: B-204
Depth: 46.5 - 48.0 feet
Description: Reddish brown sandy clay
Test Date: 9/15/2020

Dry Density (pcf)	78.4	Sample Diameter (inches)	2.413
Moisture (%)	38.6	Sample Height (inches)	5.133
Axial Strain at Failure (%)	10.7	Strain Rate (% / minute)	0.70

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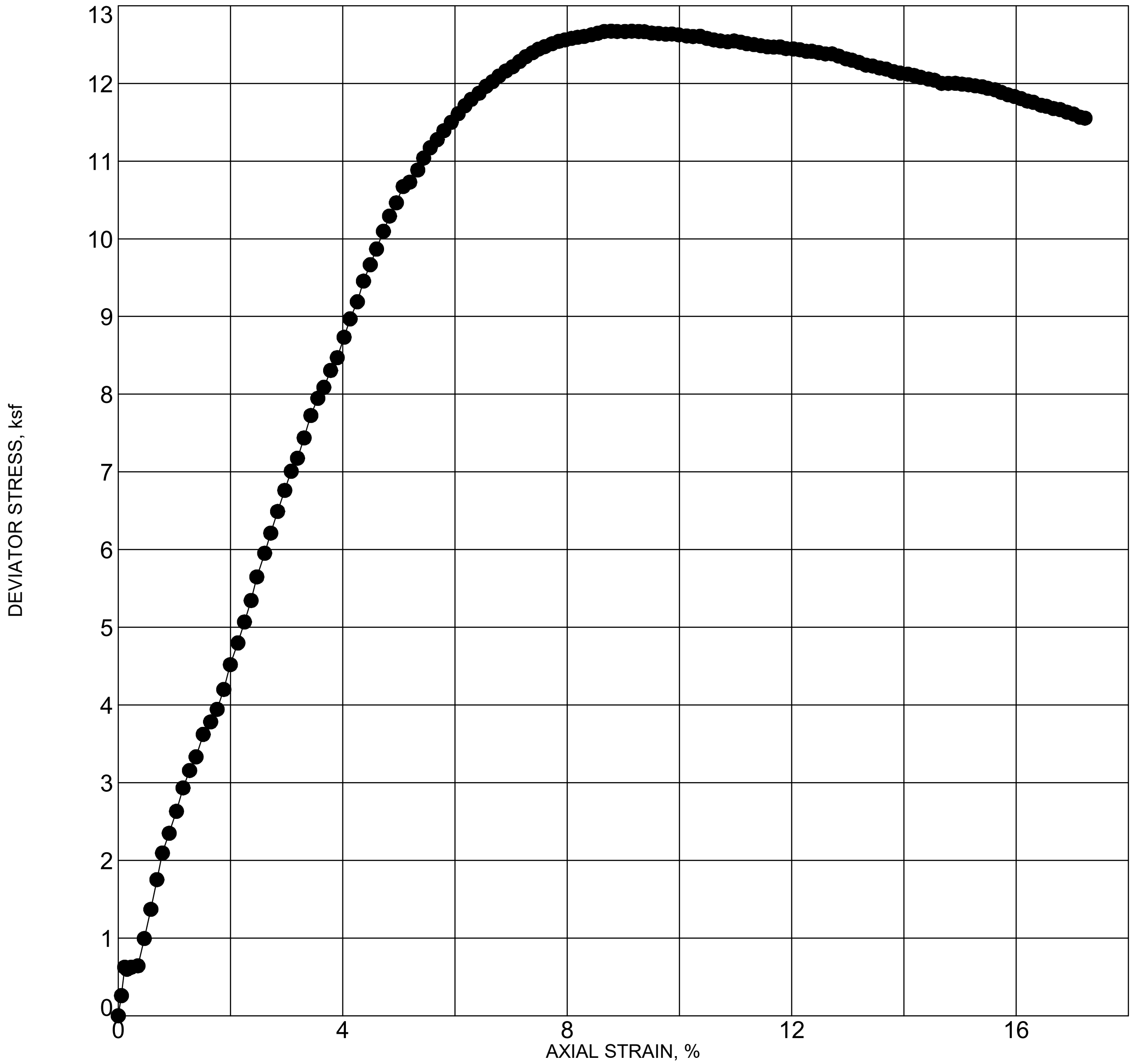
TRIAXIAL UU COMPRESSION TEST - ASTM D2850

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 19



Max. Deviator Stress (ksf):	12.7
Confining Stress (ksf):	3.0

Location: B-205
Depth: 30.0 - 31.5 feet
Description: Grayish brown clayey silt (MH) with some decomposed gravel
Test Date: 9/16/2020

Dry Density (pcf)	70.8	Sample Diameter (inches)	2.413
Moisture (%)	33.8	Sample Height (inches)	5.133
Axial Strain at Failure (%)	9.4	Strain Rate (% / minute)	0.70

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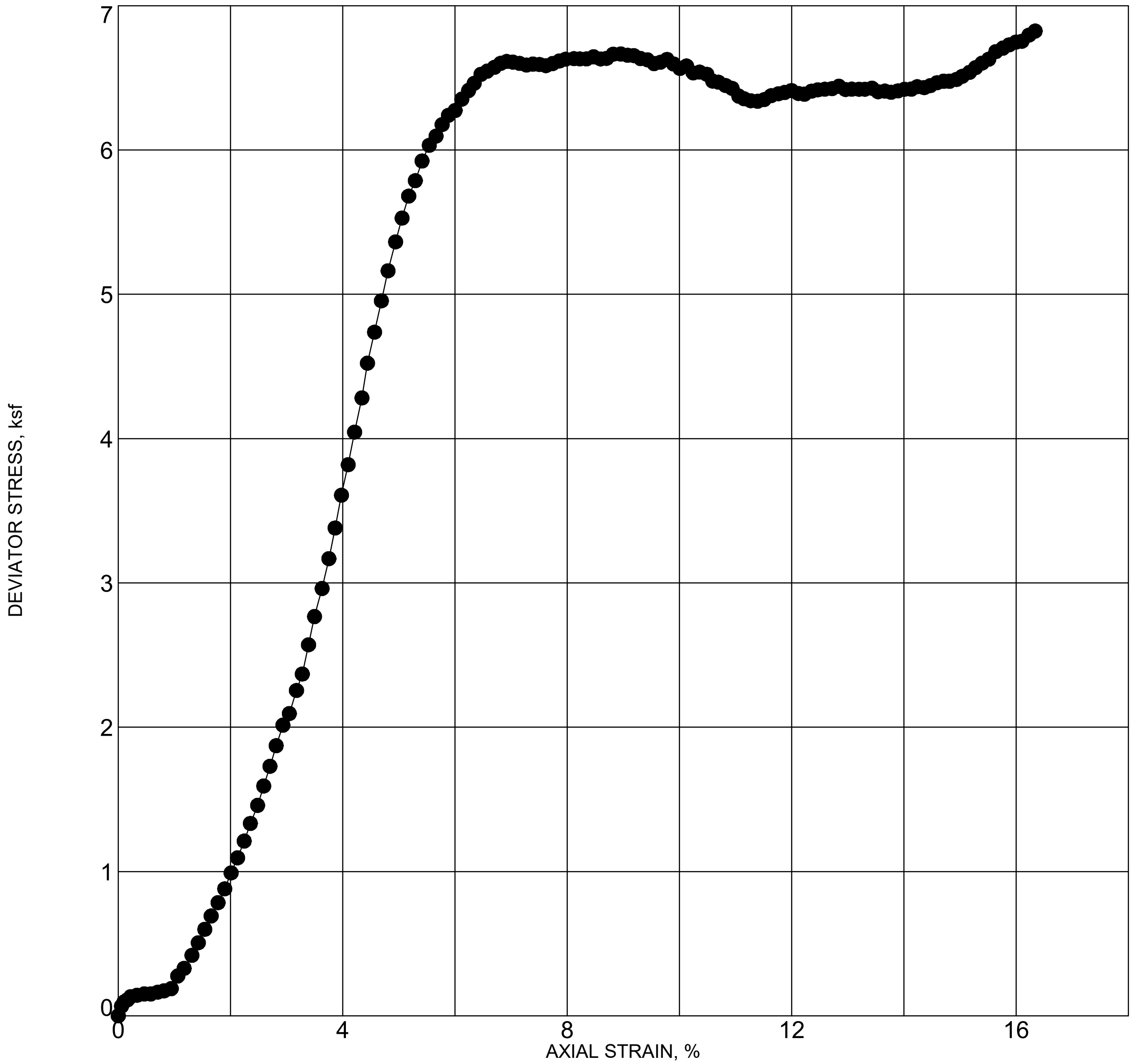
TRIAXIAL UU COMPRESSION TEST - ASTM D2850

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 20

G_TXUU 8135-00.GPJ GEOLABS.GDT 11/22/20



Max. Deviator Stress (ksf):	6.7
Confining Stress (ksf):	1.6

Location: B-301
Depth: 15.0 - 16.3 feet
Description: Brown clayey silt
Test Date: 9/23/2020

Dry Density (pcf)	90.2	Sample Diameter (inches)	2.413
Moisture (%)	29.8	Sample Height (inches)	5.167
Axial Strain at Failure (%)	9.0	Strain Rate (% / minute)	0.71

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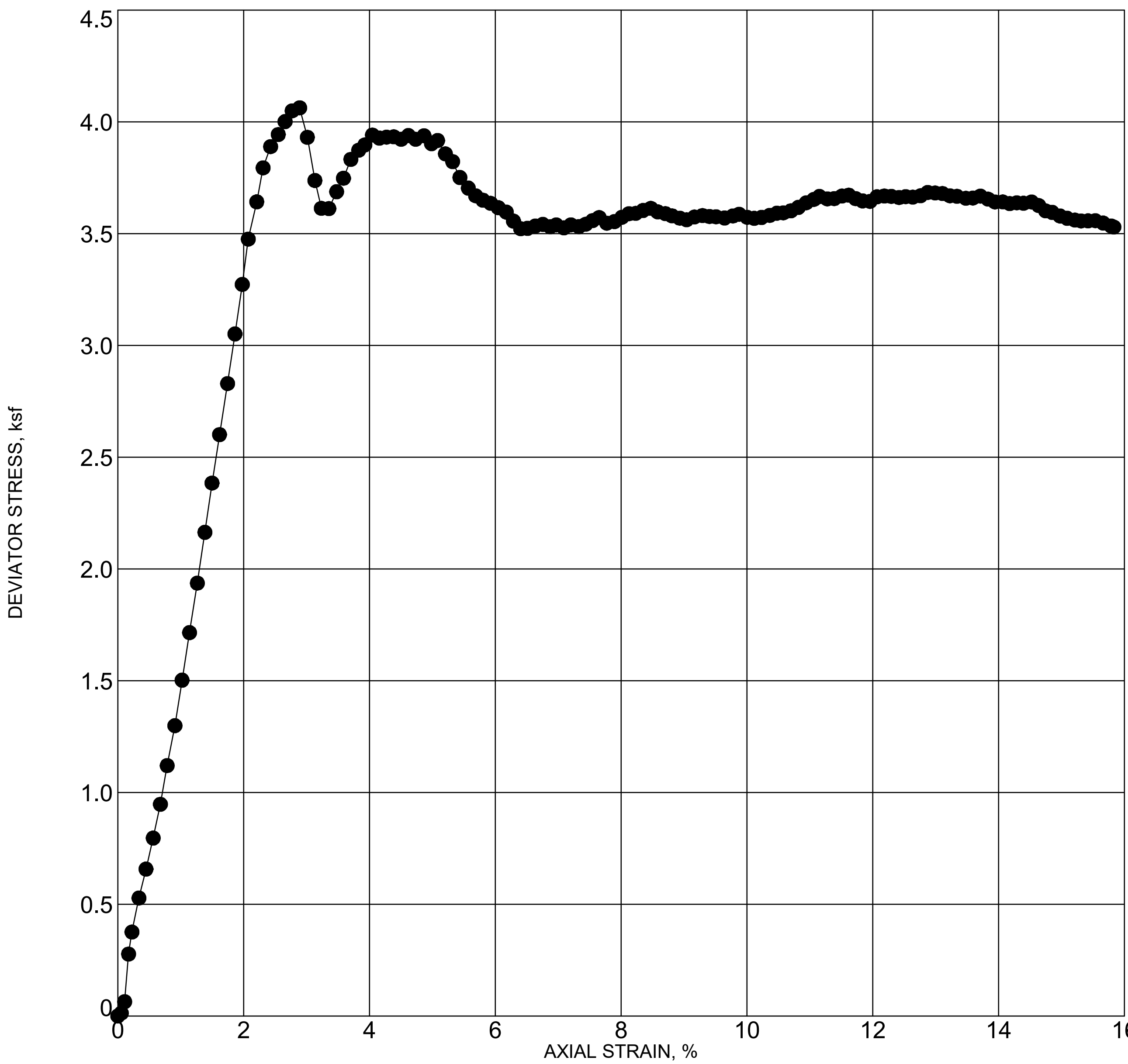
TRIAXIAL UU COMPRESSION TEST - ASTM D2850

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 21



Max. Deviator Stress (ksf):	4.1
Confining Stress (ksf):	0.5

Location: B-305
Depth: 5.0 - 6.5 feet
Description: Reddish brown sandy clay with traces of gravel
Test Date: 9/23/2020

Dry Density (pcf)	79.9	Sample Diameter (inches)	2.413
Moisture (%)	28.5	Sample Height (inches)	5.133
Axial Strain at Failure (%)	2.9	Strain Rate (% / minute)	0.70

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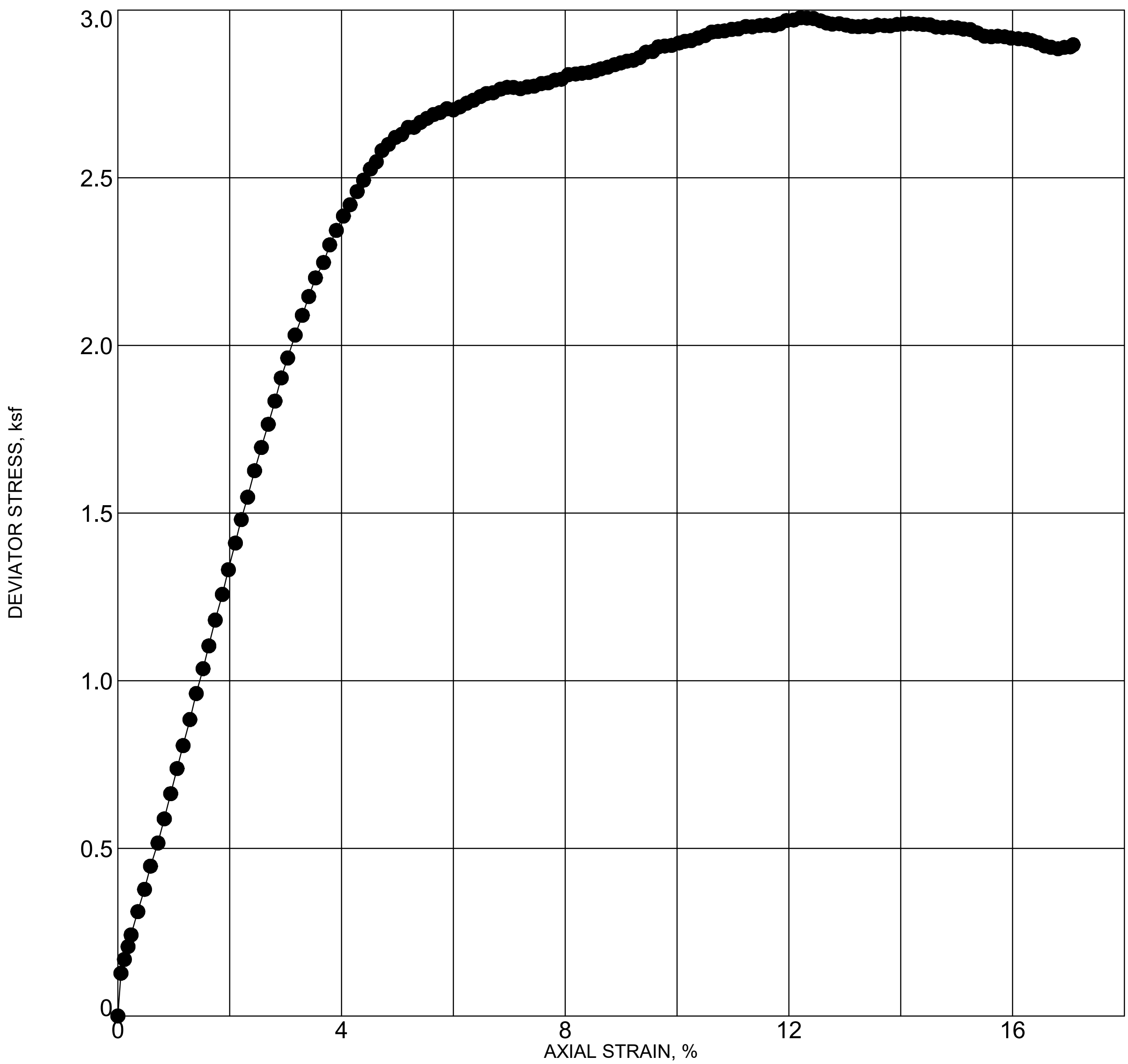
TRIAXIAL UU COMPRESSION TEST - ASTM D2850

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 22

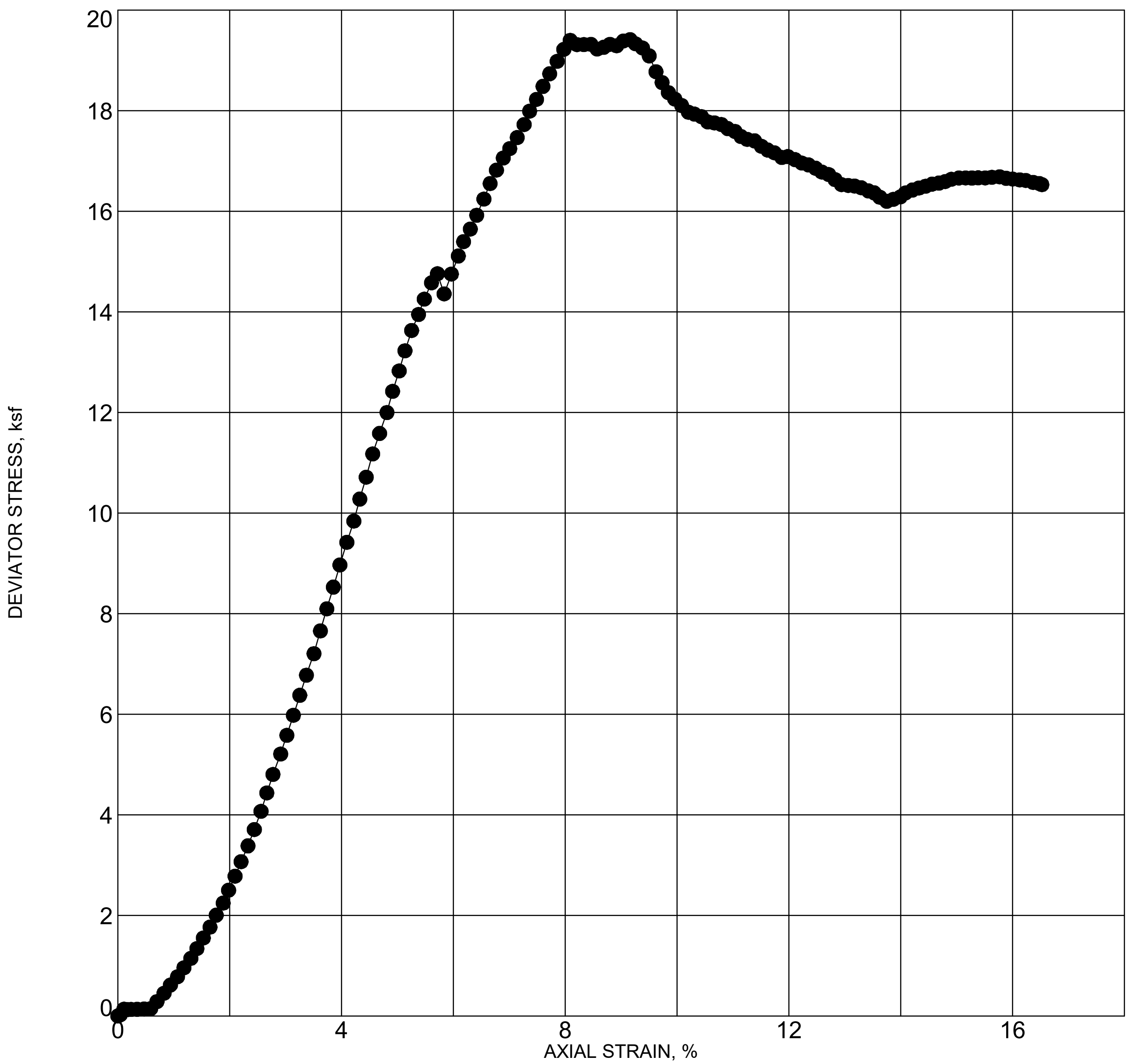
G_TXUU 8135-00.GPJ GEOLABS.GDT 11/22/20



Max. Deviator Stress (ksf):	2.9
Confining Stress (ksf):	0.5

Location: B-307
Depth: 5.0 - 6.5 feet
Description: Reddish brown sandy clay
Test Date: 9/24/2020

Dry Density (pcf)	74.3	Sample Diameter (inches)	2.413
Moisture (%)	28.5	Sample Height (inches)	5.067
Axial Strain at Failure (%)	15.0	Strain Rate (% / minute)	0.70



Max. Deviator Stress (ksf):	19.4
Confining Stress (ksf):	0.5

Location: B-309
Depth: 5.0 - 6.5 feet
Description: Reddish brown sandy clay
Test Date: 9/24/2020

Dry Density (pcf)	97.0	Sample Diameter (inches)	2.413
Moisture (%)	23.0	Sample Height (inches)	5.133
Axial Strain at Failure (%)	9.2	Strain Rate (% / minute)	0.71

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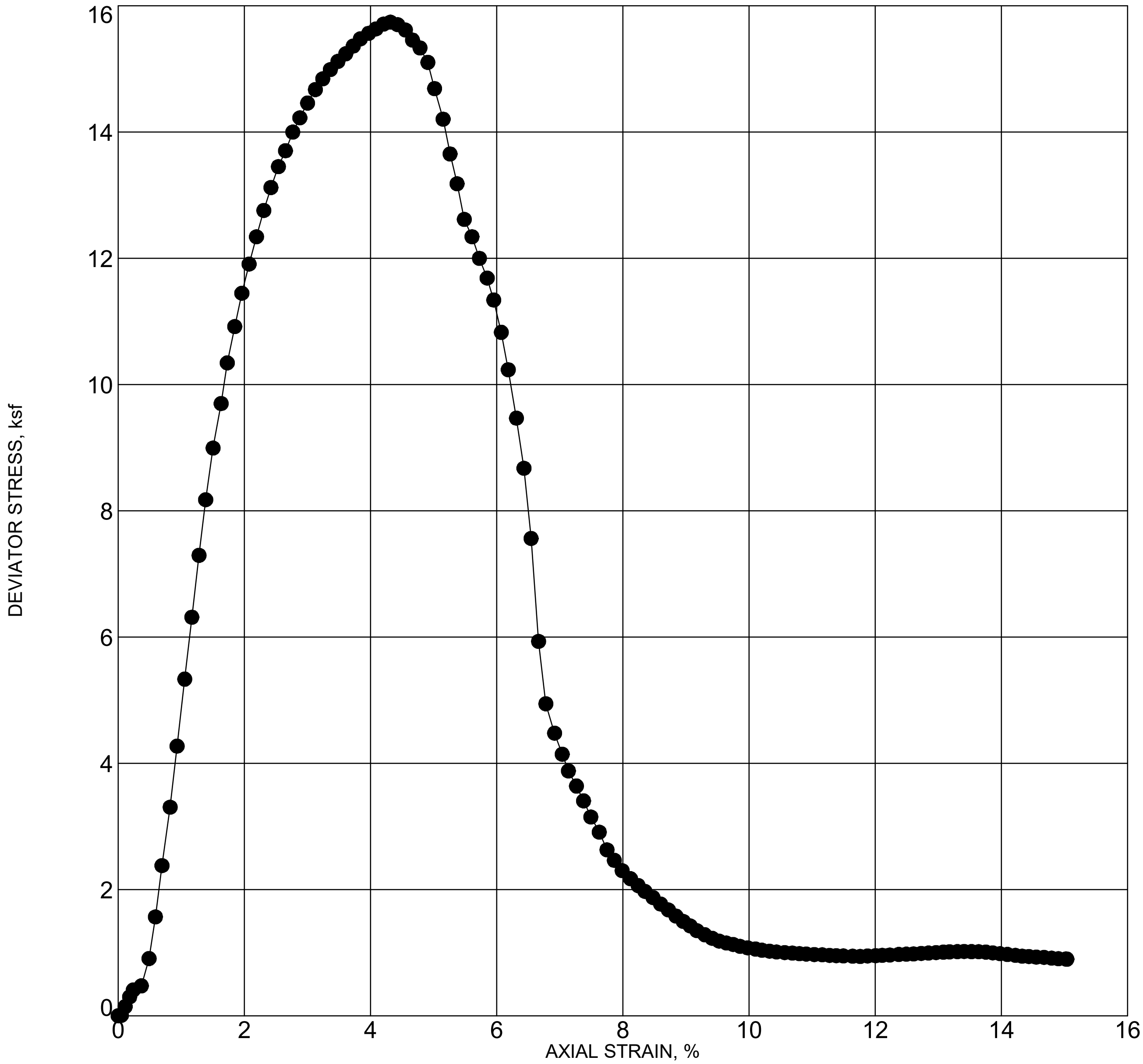
TRIAXIAL UU COMPRESSION TEST - ASTM D2850

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 24



Max. Deviator Stress (ksf):	15.7
Confining Stress (ksf):	0.5

Location: B-310
Depth: 5.0 - 6.5 feet
Description: Brown silty clay with some sand
Test Date: 9/25/2020

Dry Density (pcf)	103.3	Sample Diameter (inches)	2.413
Moisture (%)	22.8	Sample Height (inches)	5.167
Axial Strain at Failure (%)	4.3	Strain Rate (% / minute)	0.70

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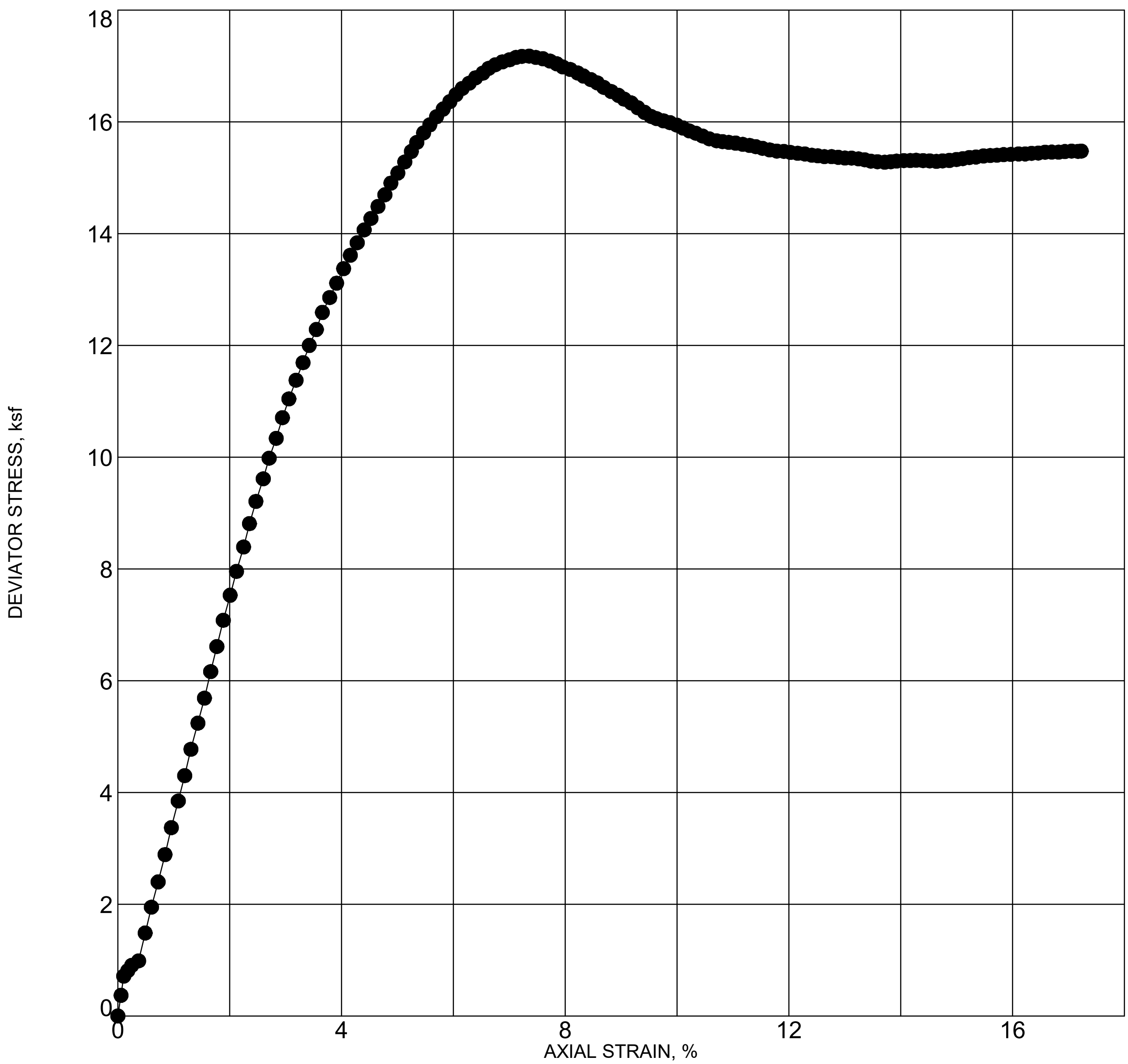
TRIAXIAL UU COMPRESSION TEST - ASTM D2850

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 25



Max. Deviator Stress (ksf):	17.2
Confining Stress (ksf):	2.5

Location: B-313
Depth: 25.0 - 26.5 feet
Description: Reddish brown sandy clay
Test Date: 9/24/2020

Dry Density (pcf)	105.5	Sample Diameter (inches)	2.413
Moisture (%)	18.8	Sample Height (inches)	5.067
Axial Strain at Failure (%)	7.4	Strain Rate (% / minute)	0.70

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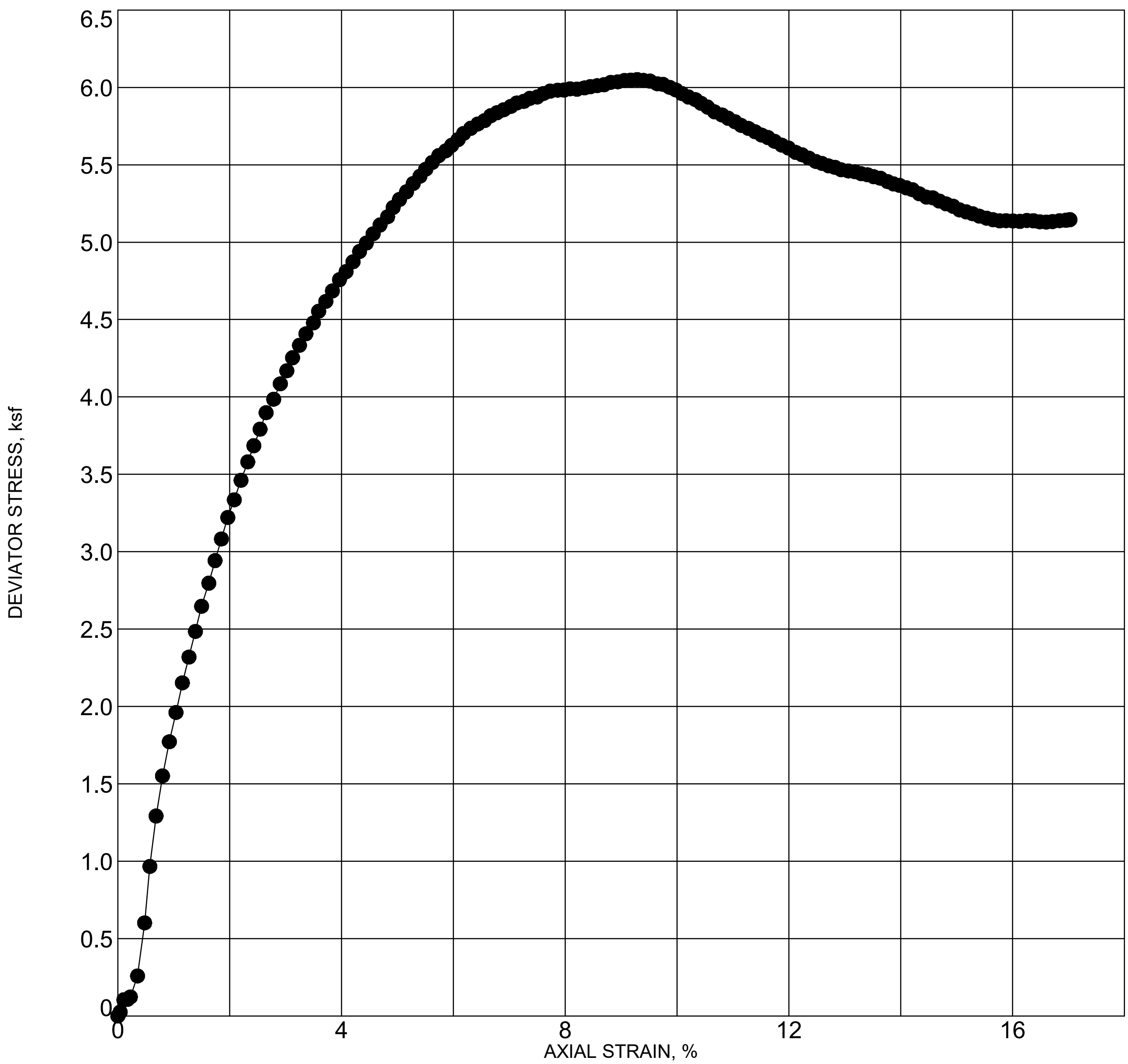
TRIAXIAL UU COMPRESSION TEST - ASTM D2850

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 26

G_TXUU 8135-00.GPJ GEOLABS.GDT 11/22/20



Max. Deviator Stress (ksf):	6.1
Confining Stress (ksf):	0.5

Location: B-314
Depth: 5.0 - 6.5 feet
Description: Reddish brown sandy clay
Test Date: 9/15/2020

Dry Density (pcf)	104.8	Sample Diameter (inches)	2.413
Moisture (%)	20.9	Sample Height (inches)	5.133
Axial Strain at Failure (%)	9.4	Strain Rate (% / minute)	0.71

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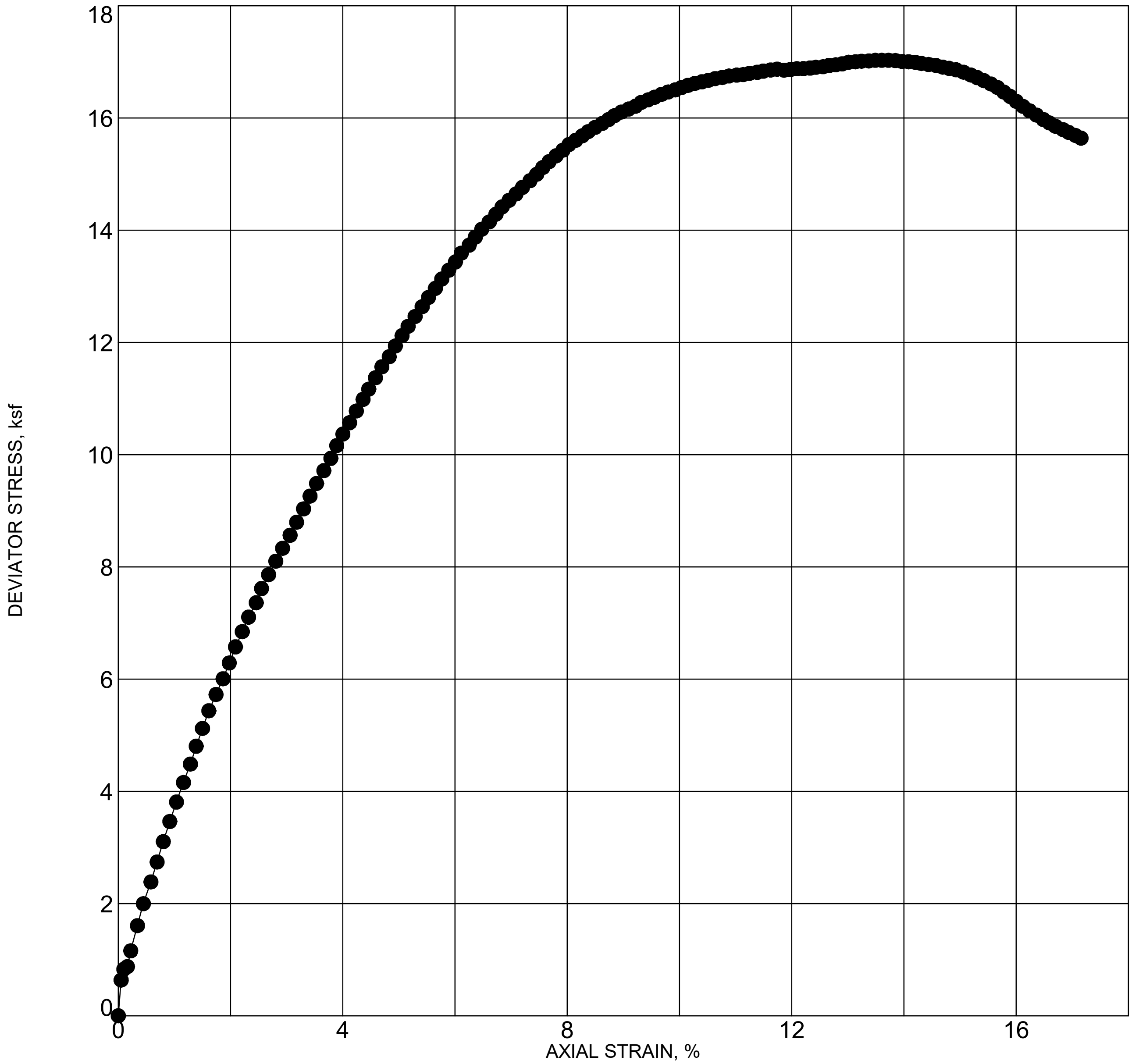
TRIAXIAL UU COMPRESSION TEST - ASTM D2850

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 27



Max. Deviator Stress (ksf):	17.0
Confining Stress (ksf):	1.0

Location: B-319
Depth: 10.0 - 11.4 feet
Description: Brown clayey silt (MH)
Test Date: 9/17/2020

Dry Density (pcf)	101.7	Sample Diameter (inches)	2.413
Moisture (%)	22.3	Sample Height (inches)	5.167
Axial Strain at Failure (%)	13.7	Strain Rate (% / minute)	0.70

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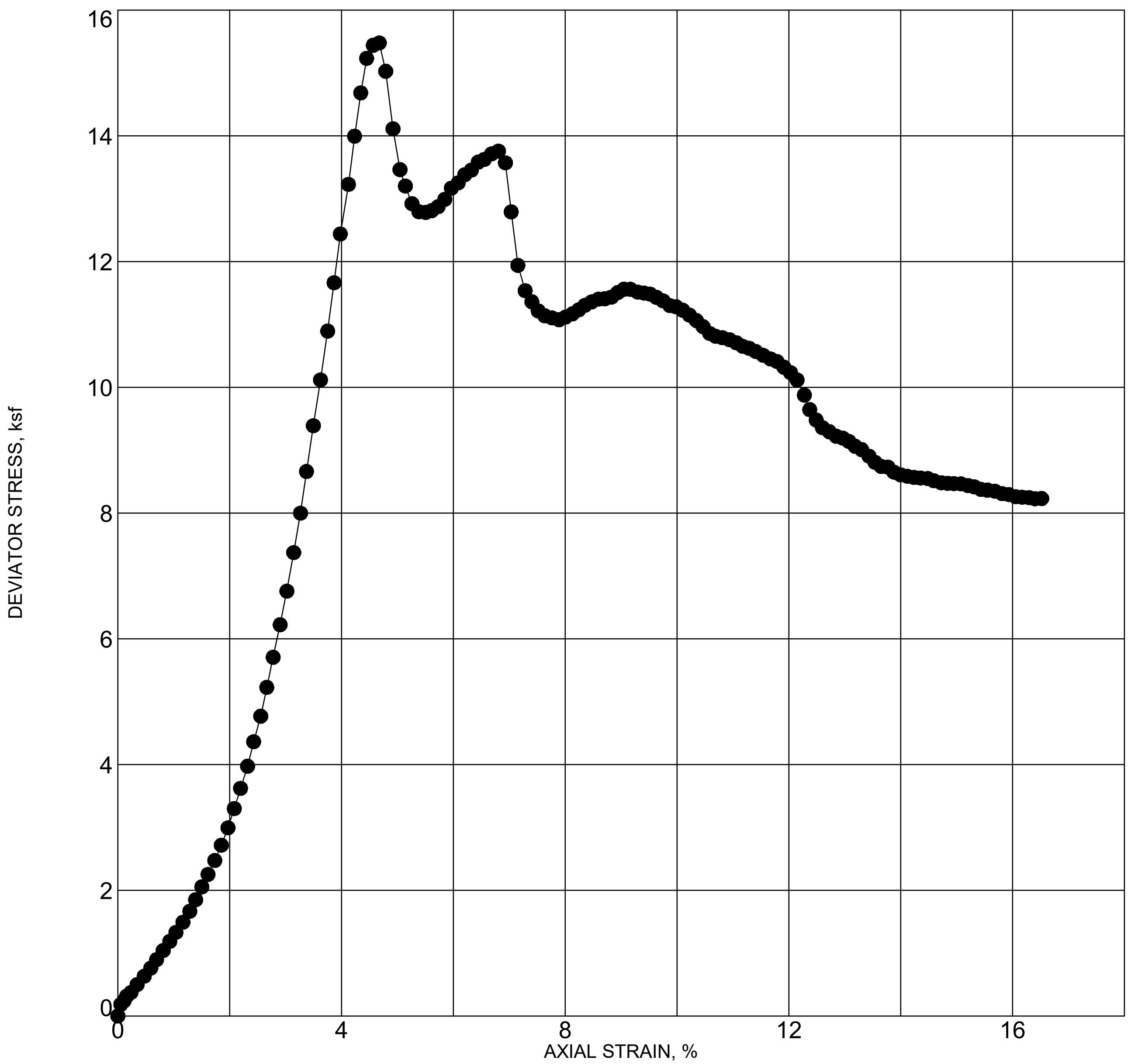
TRIAXIAL UU COMPRESSION TEST - ASTM D2850

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 28

G_TXUU 8135-00.GPJ GEOLABS.GDT 11/22/20



Max. Deviator Stress (ksf):	15.5
Confining Stress (ksf):	0.5

Location: B-323
Depth: 5.0 - 6.5 feet
Description: Brown sandy clay
Test Date: 9/14/2020

Dry Density (pcf)	96.7	Sample Diameter (inches)	2.413
Moisture (%)	17.1	Sample Height (inches)	5.067
Axial Strain at Failure (%)	4.7	Strain Rate (% / minute)	0.70

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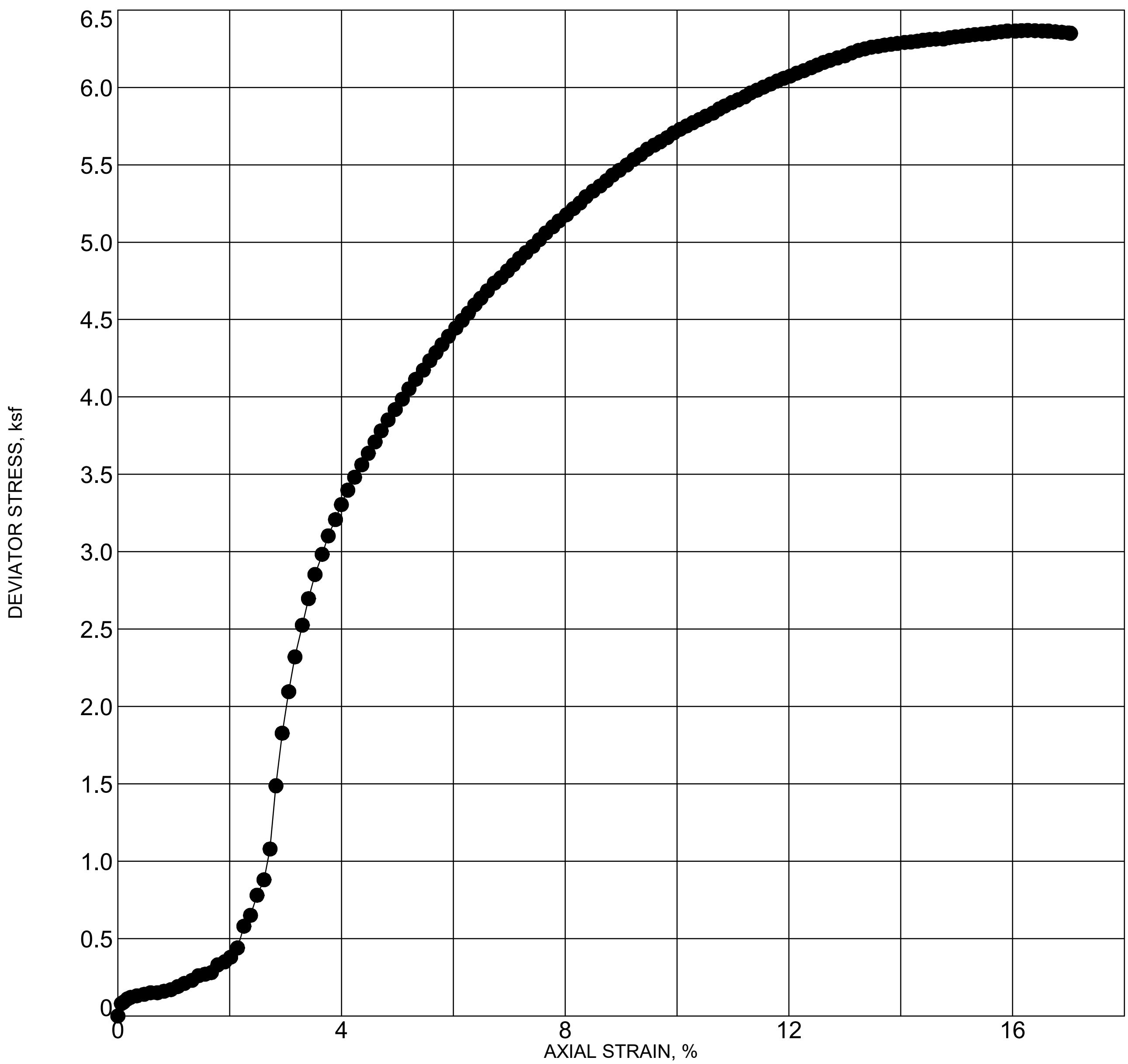
TRIAXIAL UU COMPRESSION TEST - ASTM D2850

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 29

G_TXUU 8135-00.GPJ GEOLABS.GDT 11/22/20



Max. Deviator Stress (ksf):	6.3
Confining Stress (ksf):	1.5

Location: B-326
Depth: 15.0 - 16.5 feet
Description: Brown sandy clay
Test Date: 9/14/2020

Dry Density (pcf)	87.4	Sample Diameter (inches)	2.413
Moisture (%)	26.1	Sample Height (inches)	5.067
Axial Strain at Failure (%)	15.0	Strain Rate (% / minute)	0.70

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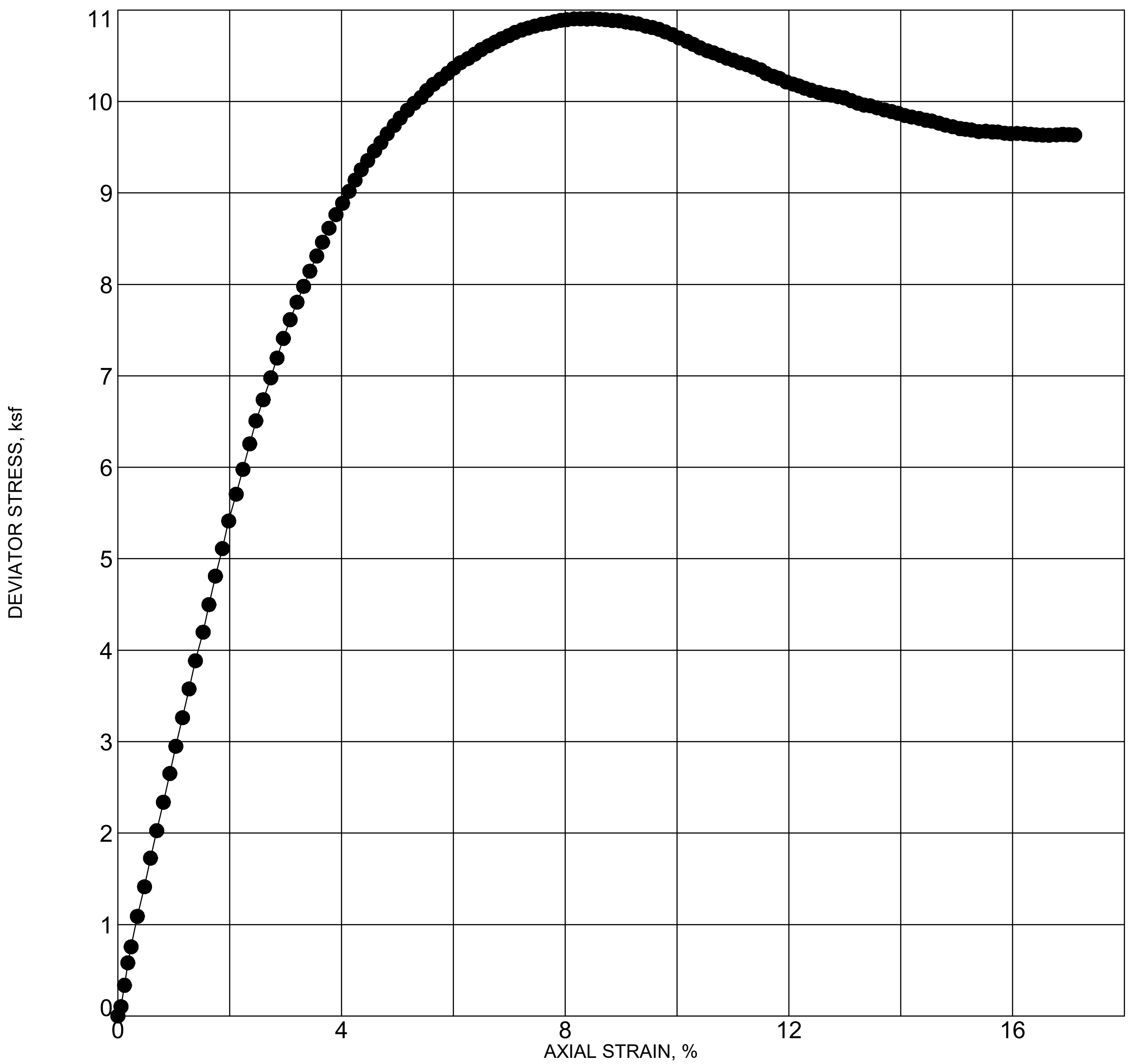
TRIAXIAL UU COMPRESSION TEST - ASTM D2850

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 30

G_TXUU 8135-00.GPJ GEOLABS.GDT 11/22/20



Max. Deviator Stress (ksf):	10.9
Confining Stress (ksf):	1.5

Location: B-329
Depth: 15.0 - 16.5 feet
Description: Brown sandy clay
Test Date: 9/14/2020

Dry Density (pcf)	102.0	Sample Diameter (inches)	2.413
Moisture (%)	23.1	Sample Height (inches)	5.133
Axial Strain at Failure (%)	8.5	Strain Rate (% / minute)	0.70

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TRIAXIAL UU COMPRESSION TEST - ASTM D2850

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
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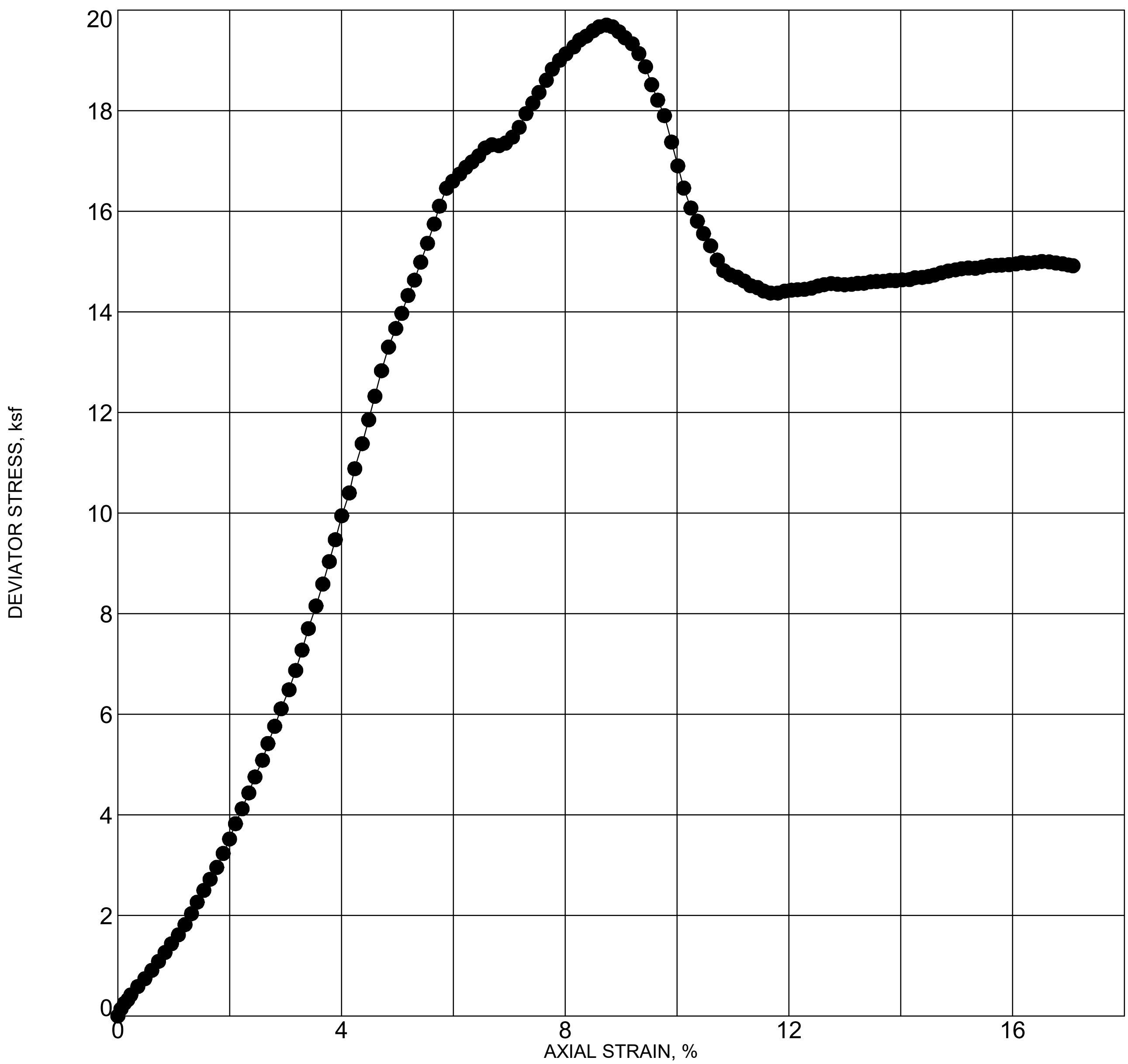

Max. Deviator Stress (ksf):	19.7
Confining Stress (ksf):	0.5

Location: B-332
Depth: 5.0 - 5.8 feet
Description: Dark brown sandy clay
Test Date: 9/16/2020

Dry Density (pcf)	99.5	Sample Diameter (inches)	2.403
Moisture (%)	16.5	Sample Height (inches)	5.033
Axial Strain at Failure (%)	8.7	Strain Rate (% / minute)	0.71

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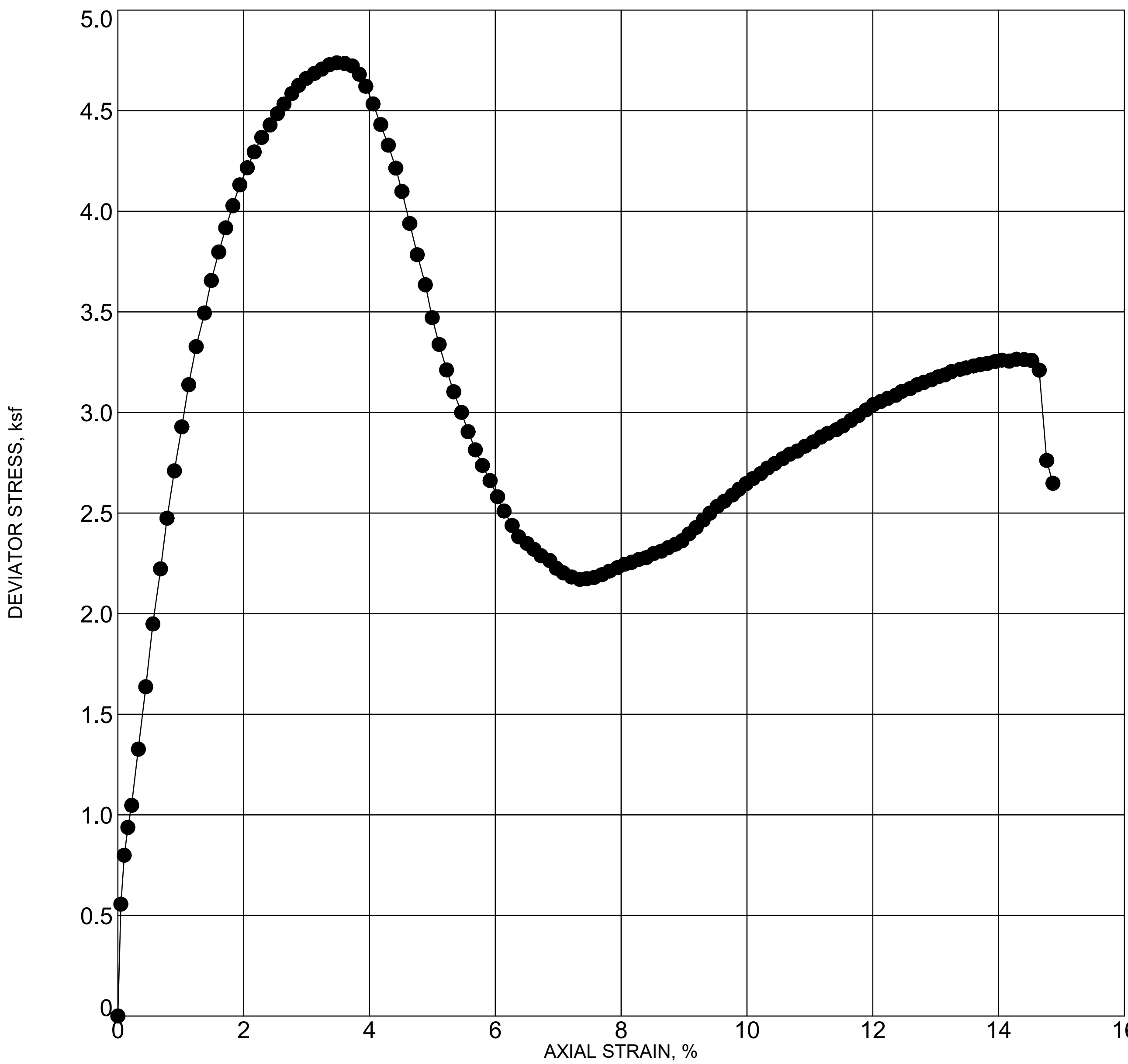
TRIAXIAL UU COMPRESSION TEST - ASTM D2850

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 32



Max. Deviator Stress (ksf):	4.7
Confining Stress (ksf):	0.5

Location: B-334
Depth: 5.0 - 6.5 feet
Description: Brown silty clay (CH)
Test Date: 9/16/2020

Dry Density (pcf)	100.3	Sample Diameter (inches)	2.413
Moisture (%)	26.3	Sample Height (inches)	5.133
Axial Strain at Failure (%)	3.5	Strain Rate (% / minute)	0.70

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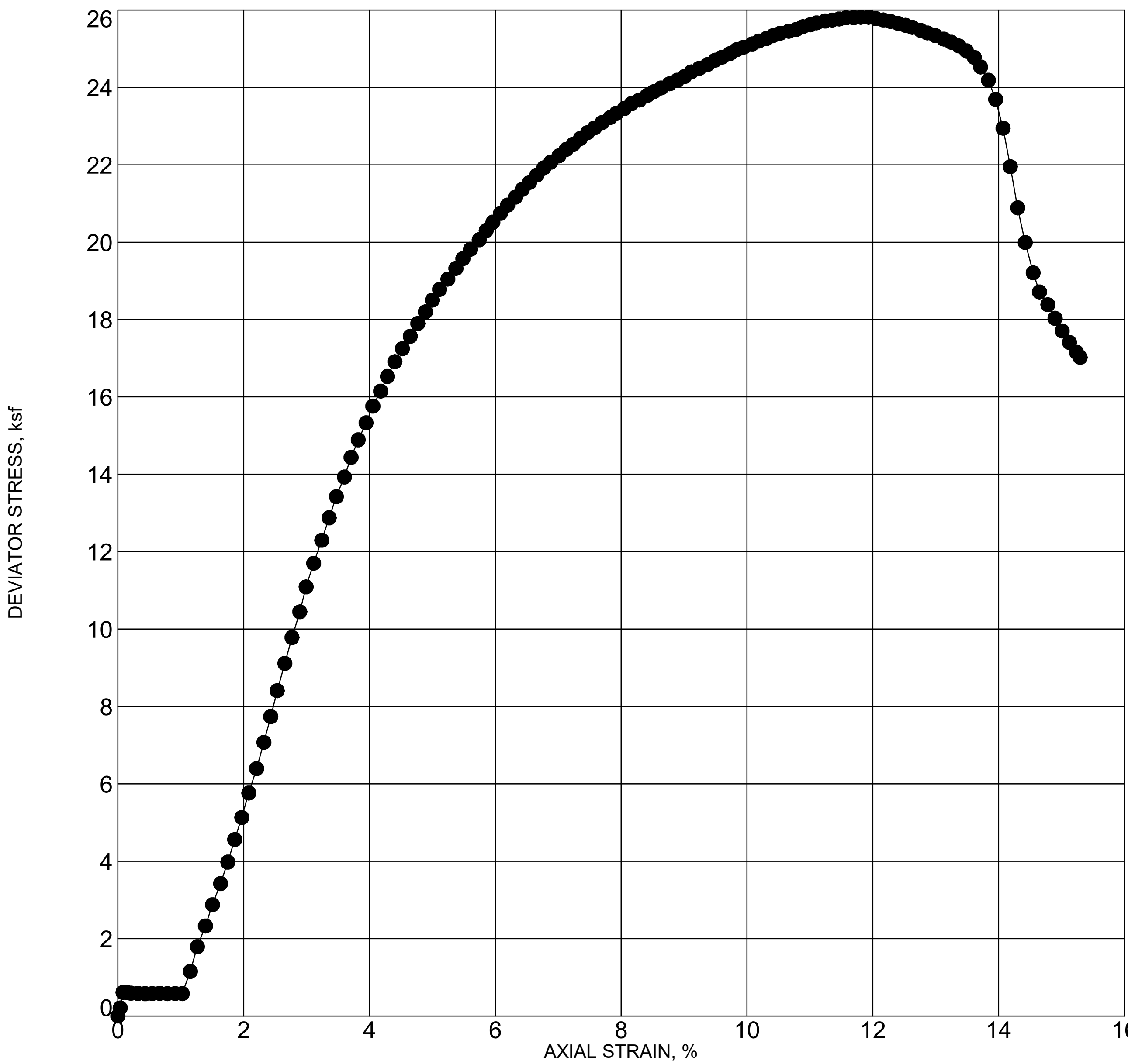
TRIAXIAL UU COMPRESSION TEST - ASTM D2850

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 33

G_TXUU 8135-00.GPJ GEOLABS.GDT 11/22/20



Max. Deviator Stress (ksf):	25.8
Confining Stress (ksf):	0.5

Location: B-336
Depth: 5.0 - 6.5 feet
Description: Brown sandy clay (CL)
Test Date: 9/17/2020

Dry Density (pcf)	106.1	Sample Diameter (inches)	2.413
Moisture (%)	21.0	Sample Height (inches)	5.067
Axial Strain at Failure (%)	11.9	Strain Rate (% / minute)	0.70

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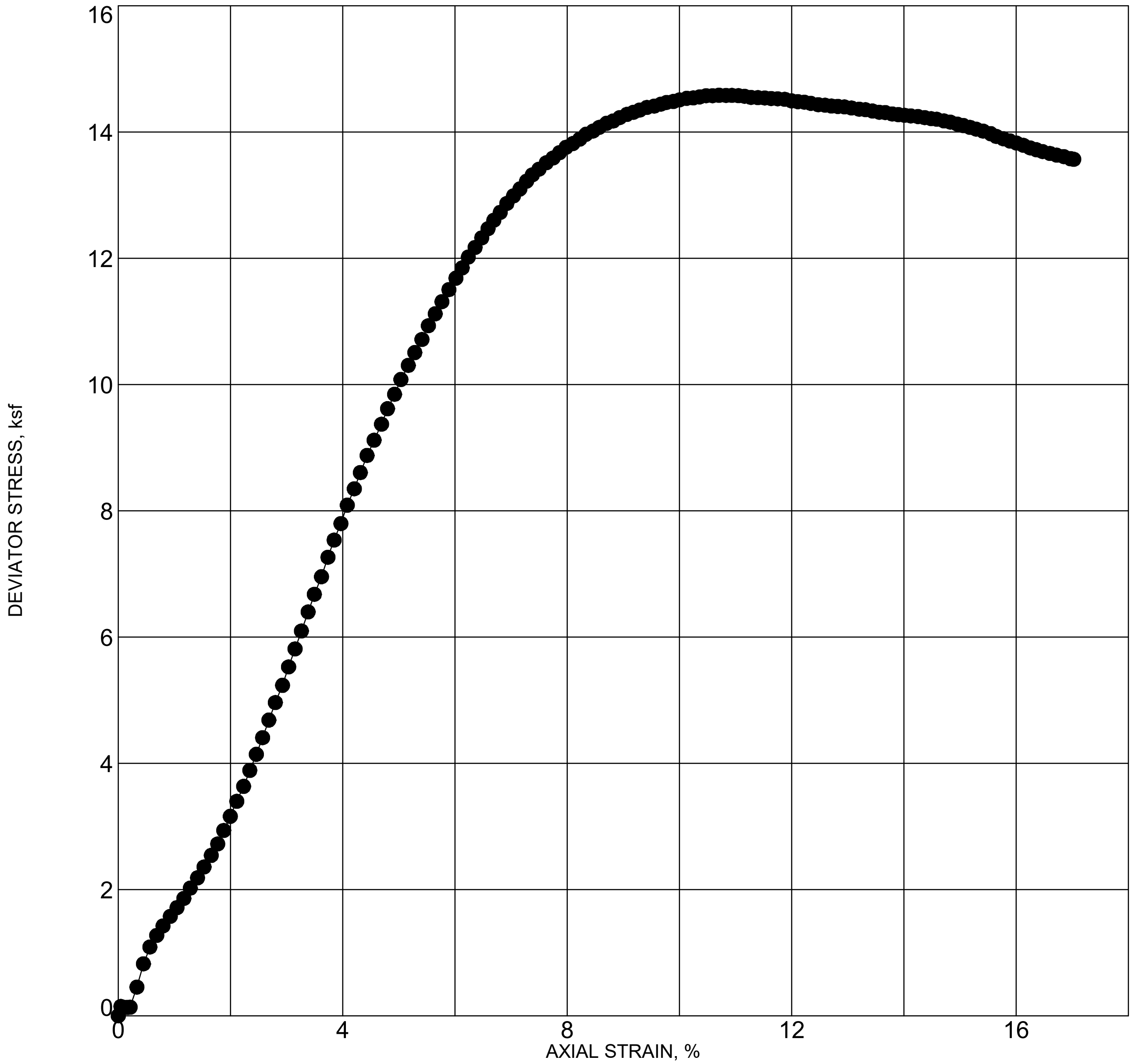
TRIAXIAL UU COMPRESSION TEST - ASTM D2850

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 34

G_TXUU 8135-00.GPJ GEOLABS.GDT 11/22/20



Max. Deviator Stress (ksf):	14.6
Confining Stress (ksf):	3.0

Location: B-340
Depth: 30.0 - 31.5 feet
Description: Reddish brown sandy clay
Test Date: 9/17/2020

Dry Density (pcf)	101.3	Sample Diameter (inches)	2.413
Moisture (%)	27.5	Sample Height (inches)	5.167
Axial Strain at Failure (%)	11.1	Strain Rate (% / minute)	0.70

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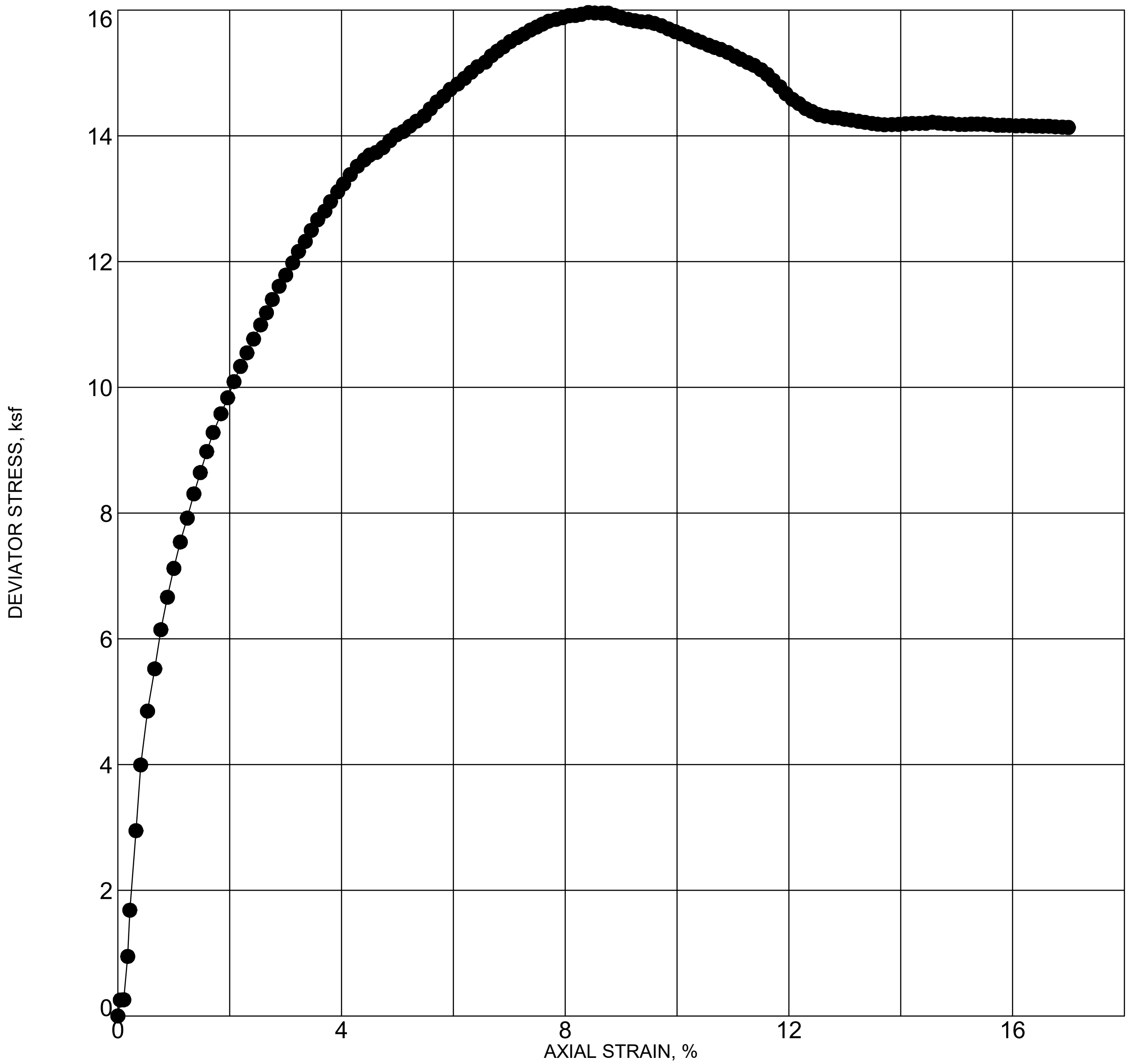
TRIAXIAL UU COMPRESSION TEST - ASTM D2850

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 35

G_TXUU 8135-00.GPJ GEOLABS.GDT 11/22/20



Max. Deviator Stress (ksf):	16.0
Confining Stress (ksf):	0.5

Location: B-343
Depth: 5.5 - 7.0 feet
Description: Brown silty clay
Test Date: 9/17/2020

Dry Density (pcf)	106.3	Sample Diameter (inches)	2.413
Moisture (%)	21.7	Sample Height (inches)	5.167
Axial Strain at Failure (%)	8.4	Strain Rate (% / minute)	0.70

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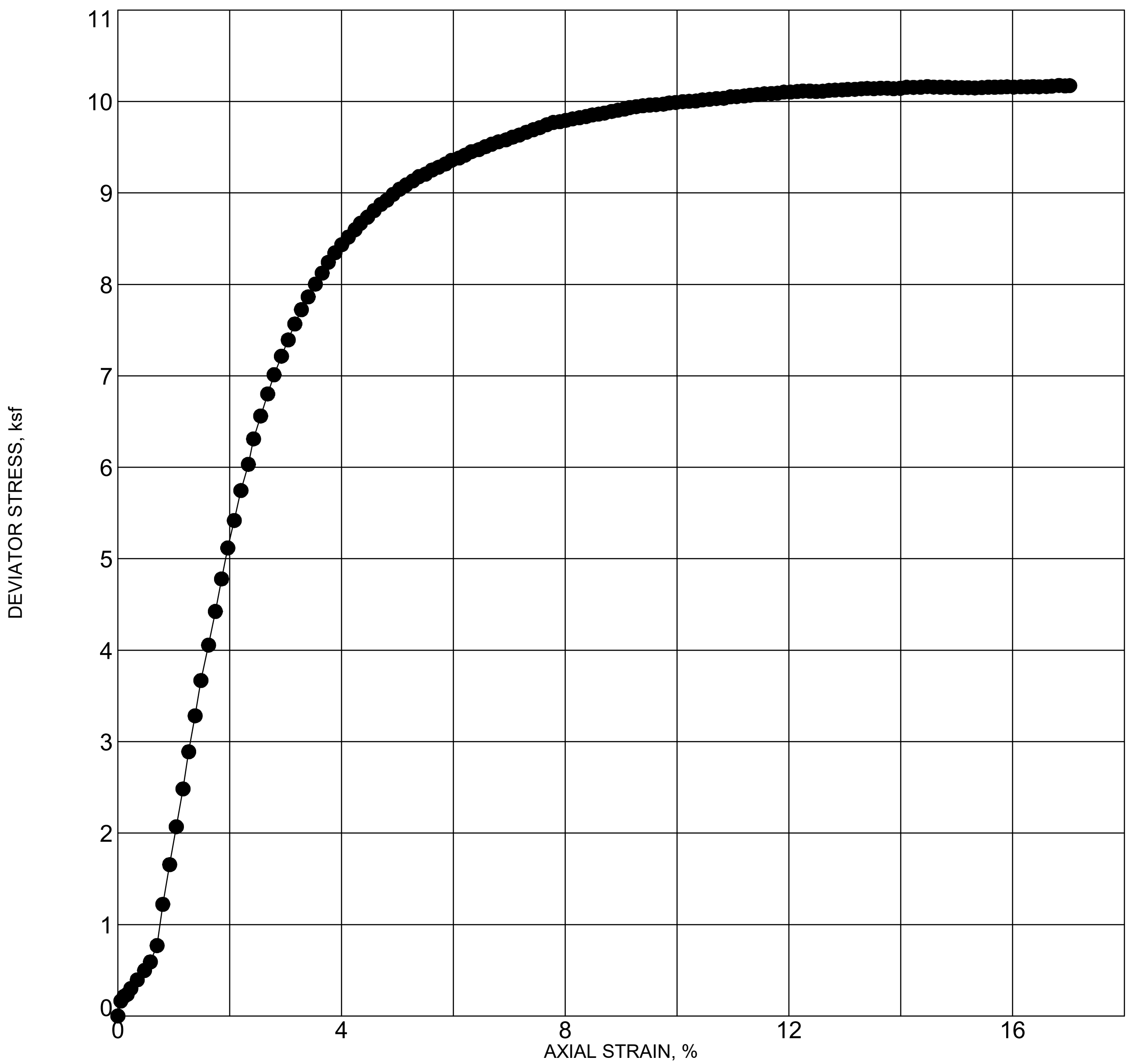
TRIAXIAL UU COMPRESSION TEST - ASTM D2850

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 36



Max. Deviator Stress (ksf):	10.2
Confining Stress (ksf):	2.5

Location: B-343
Depth: 25.0 - 26.3 feet
Description: Dark brown sandy clay
Test Date: 9/18/2020

Dry Density (pcf)	103.2	Sample Diameter (inches)	2.413
Moisture (%)	21.1	Sample Height (inches)	5.167
Axial Strain at Failure (%)	15.0	Strain Rate (% / minute)	0.71

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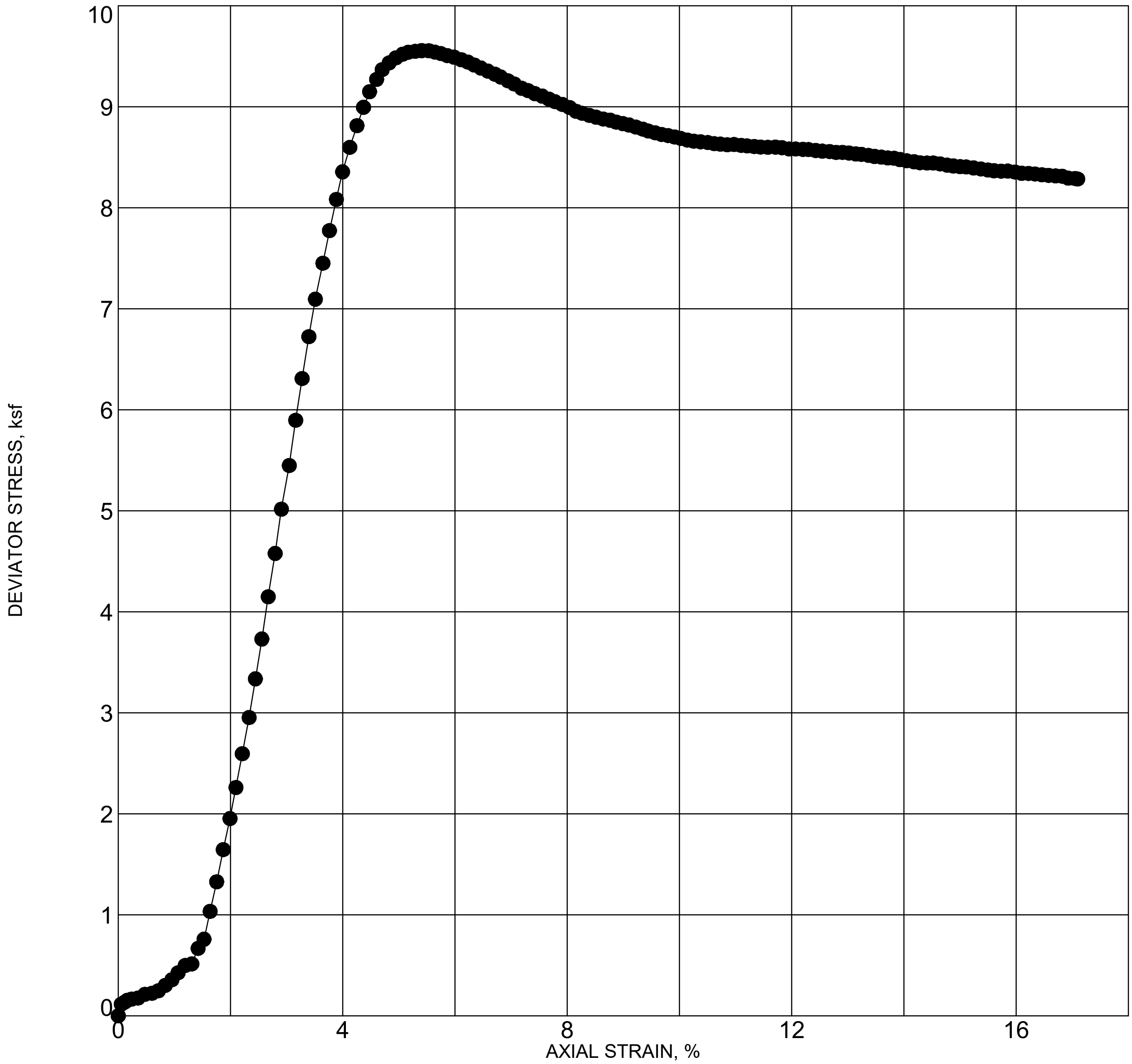
TRIAXIAL UU COMPRESSION TEST - ASTM D2850

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 37



Max. Deviator Stress (ksf):	9.6
Confining Stress (ksf):	2.5

Location: B-345
Depth: 25.0 - 26.5 feet
Description: Dark brown sandy clay
Test Date: 9/25/2020

Dry Density (pcf)	75.0	Sample Diameter (inches)	2.407
Moisture (%)	33.2	Sample Height (inches)	5.033
Axial Strain at Failure (%)	5.4	Strain Rate (% / minute)	0.70

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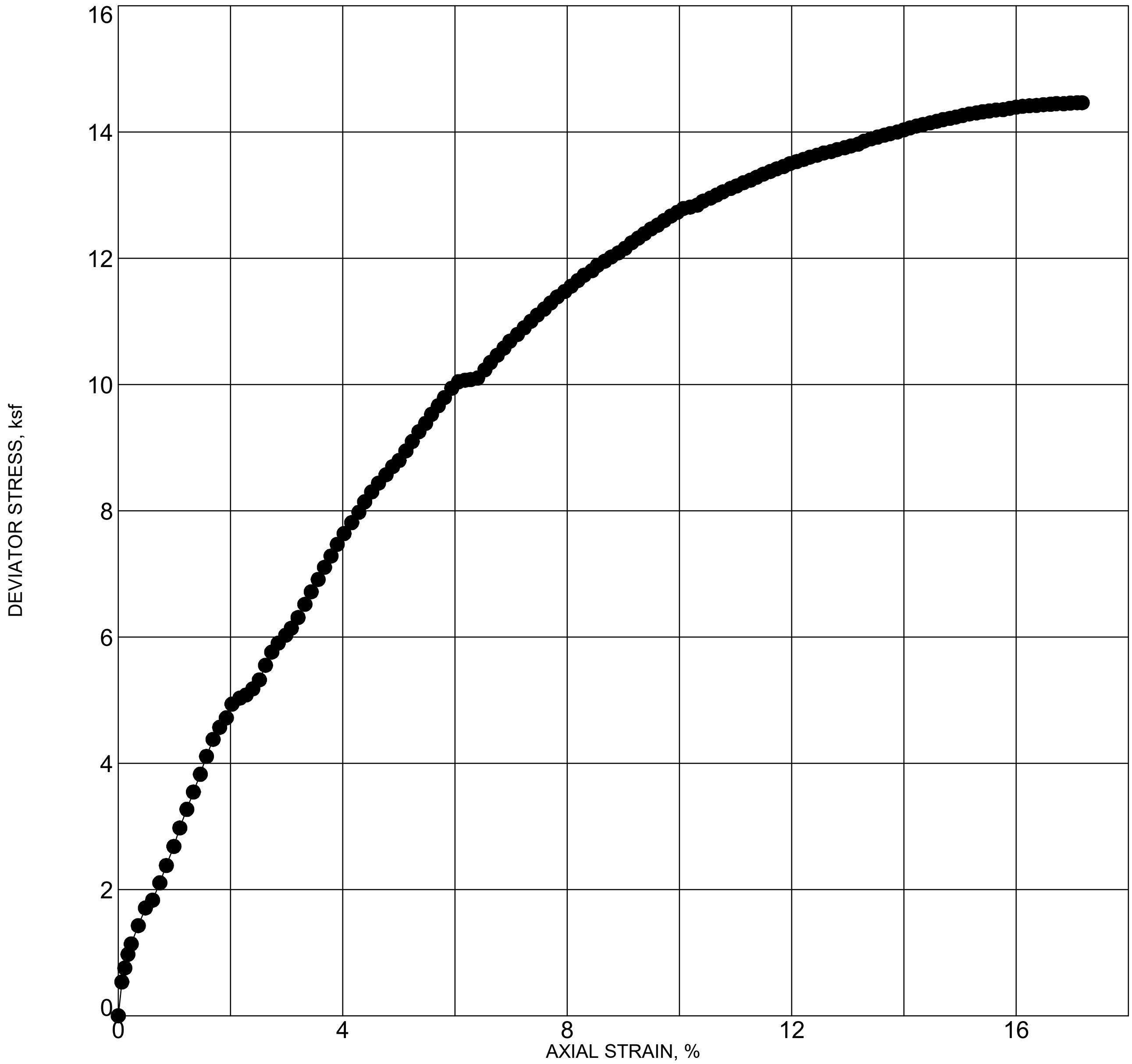
TRIAXIAL UU COMPRESSION TEST - ASTM D2850

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 38



Max. Deviator Stress (ksf):	14.3
Confining Stress (ksf):	1.5

Location: B-346
Depth: 15.0 - 15.4 feet
Description: Brown sandy silt
Test Date: 10/14/2020

Dry Density (pcf)	81.9	Sample Diameter (inches)	2.403
Moisture (%)	22.2	Sample Height (inches)	5.067
Axial Strain at Failure (%)	15.0	Strain Rate (% / minute)	0.72

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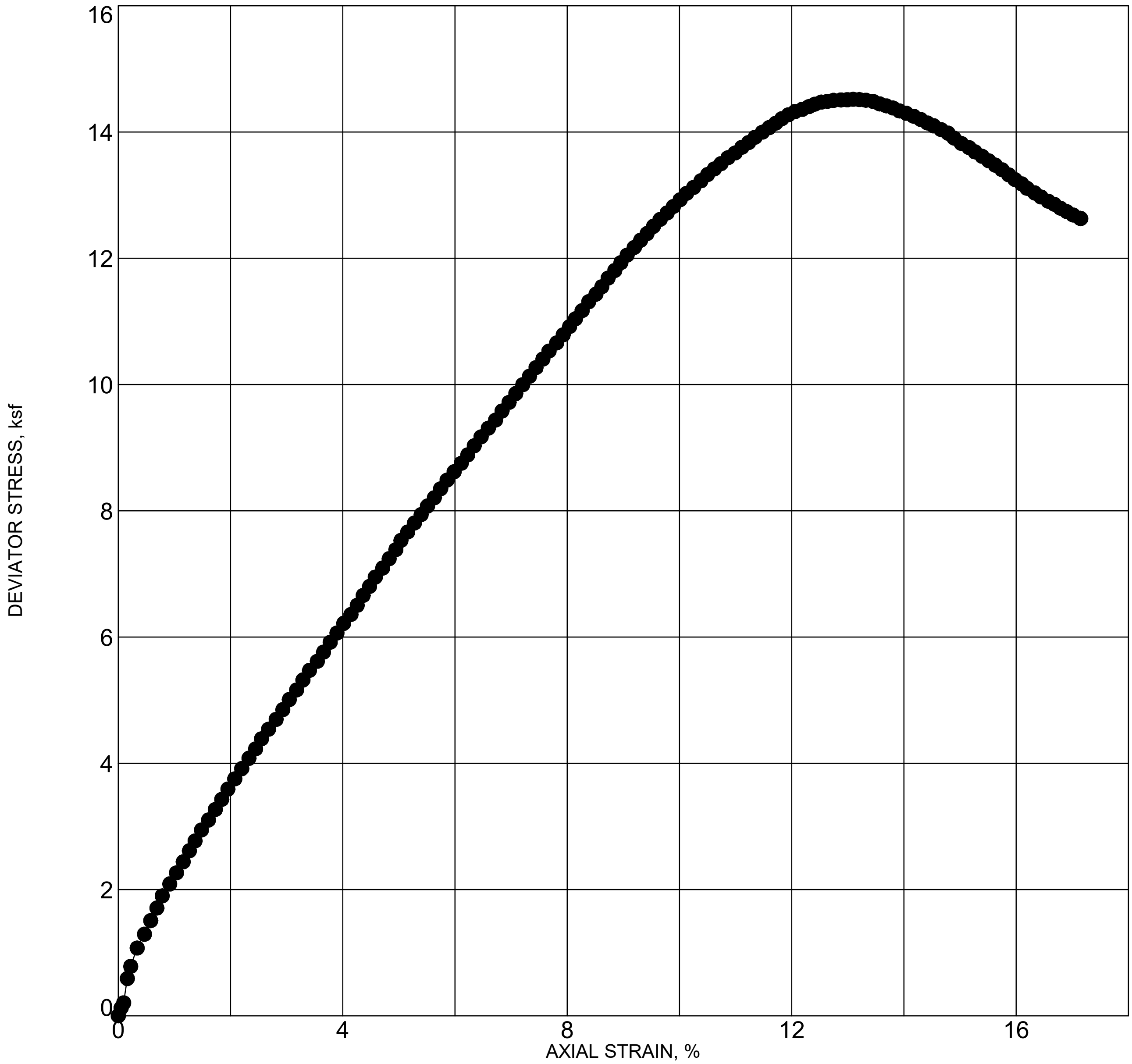
TRIAXIAL UU COMPRESSION TEST - ASTM D2850

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 39

G_TXUU 8135-00.GPJ GEOLABS.GDT 11/22/20



Max. Deviator Stress (ksf):	14.5
Confining Stress (ksf):	3.6

Location: B-346
Depth: 35.0 - 36.0 feet
Description: Reddish brown with black mottling sandy silt
Test Date: 10/14/2020

Dry Density (pcf)	79.7	Sample Diameter (inches)	2.407
Moisture (%)	23.5	Sample Height (inches)	5.067
Axial Strain at Failure (%)	13.1	Strain Rate (% / minute)	0.70

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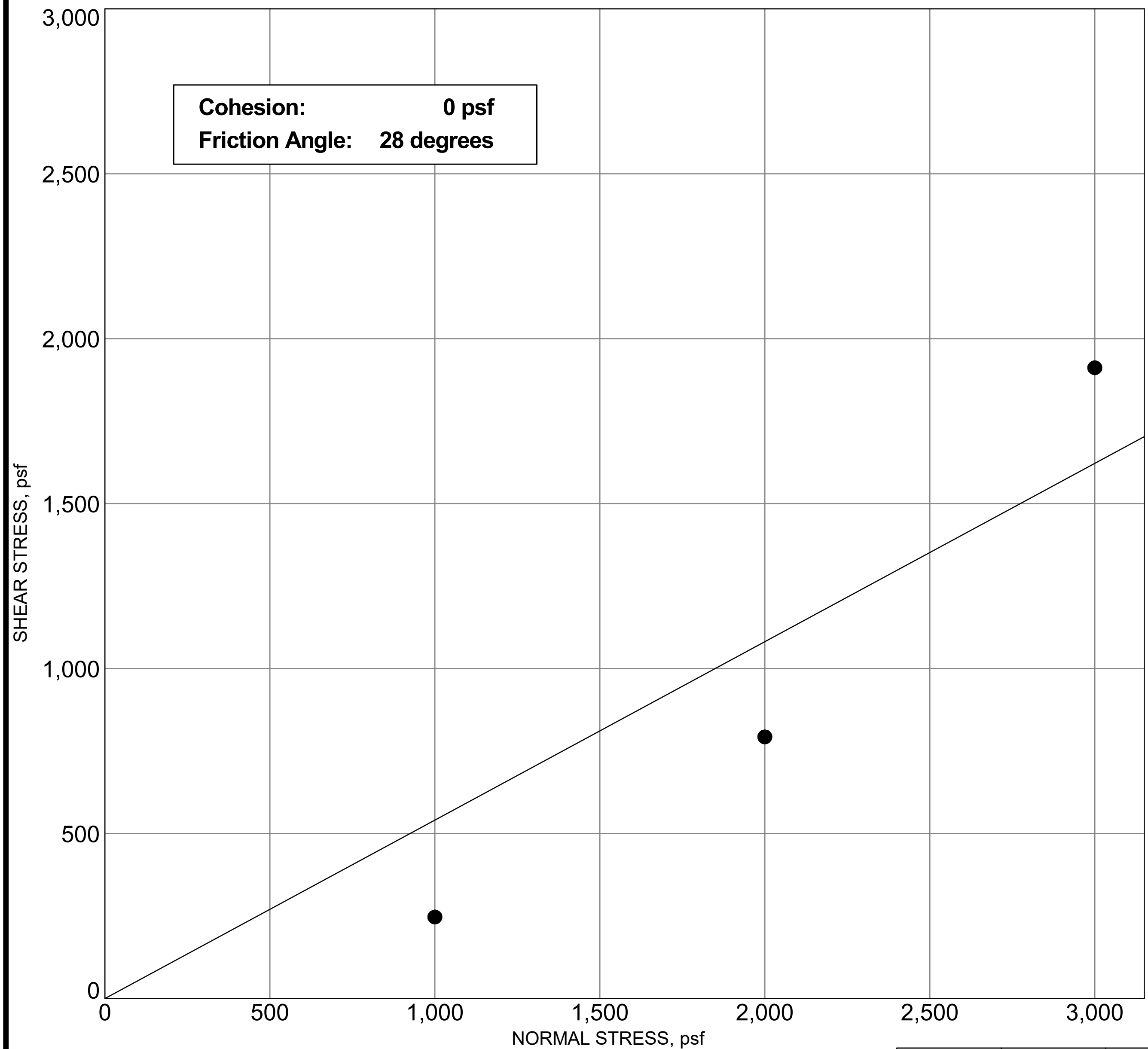
TRIAXIAL UU COMPRESSION TEST - ASTM D2850

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 40

G_TXUU 8135-00.GPJ GEOLABS.GDT 11/22/20



		Sample #1	Sample #2	Sample #3
INITIAL	Moisture Content, %	6.4	7.8	4.9
	Dry Density, pcf	74.8	79.3	81.5
	Height, inches	1.00	1.00	1.00
FINAL	Moisture Content, %	22.6	21.2	21.2
	Dry Density, pcf	74.7	79.7	81.8
	Height, inches	1.001	0.995	0.996
	Diameter, inches	2.42	2.42	2.42
	Deformation Rate, inch/minute	0.0024	0.0025	0.0025
	Normal Stress, psf	**1000**	**2000**	**3000**
	Peak Shear Stress, psf	**247**	**793**	**1912**
	Shear Displacement, inches	0.43	0.43	0.42

Sample: B-205
Depth: 10.0 - 11.5 feet
Description: Brown silty sand (SM) with traces of gravel

G_DIRECT_SHEAR 8135-00.GPJ GEOLABS.GDT 11/22/20

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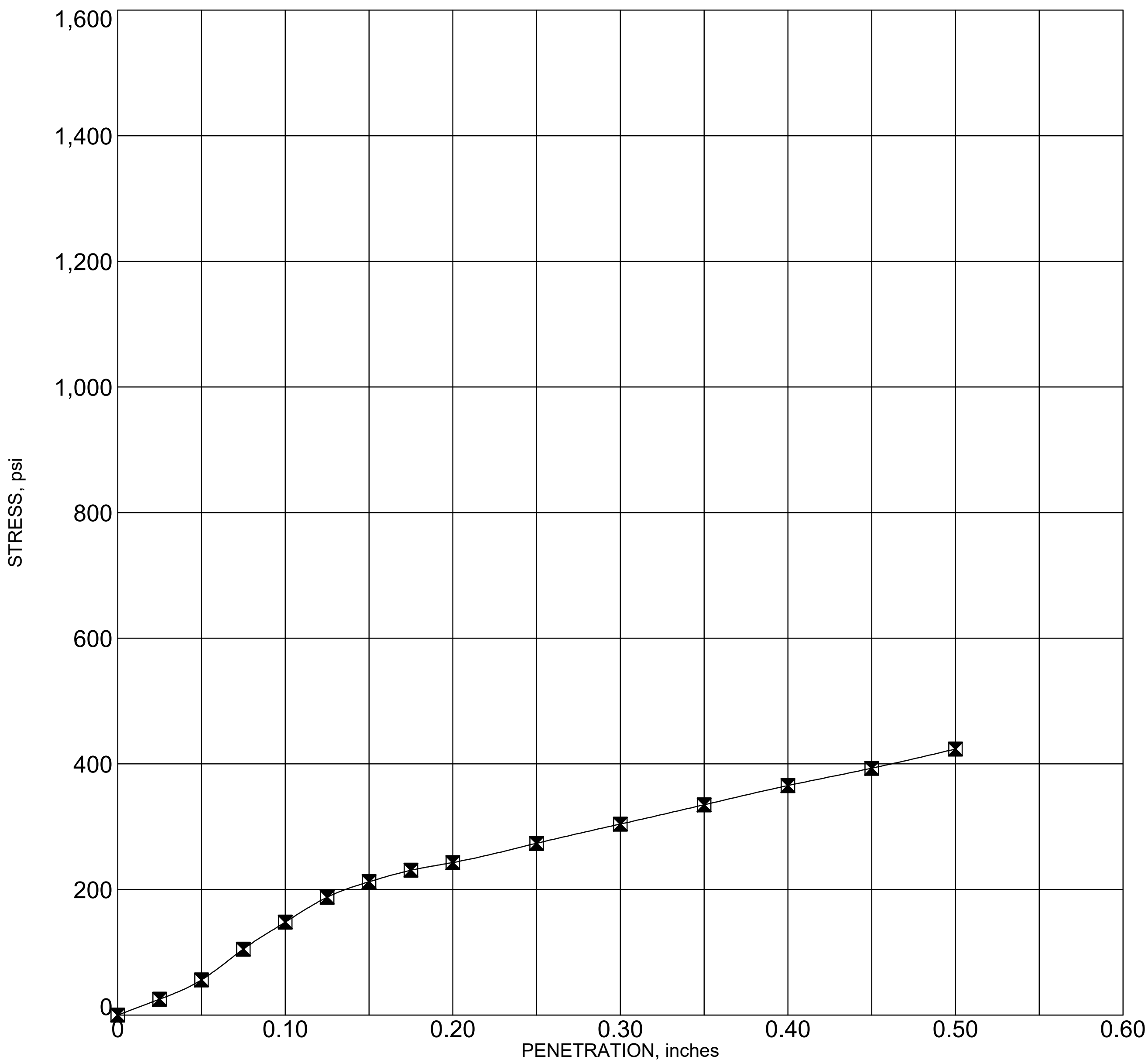
DIRECT SHEAR TEST - ASTM D3080

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 41



Corr. CBR @ 0.1"	18.2
Corr. CBR @ 0.2"	17.1
Swell (%)	2.07

Sample: BULK-104
Depth: 0.0 - 2.5 feet
Description: Brown clayey silt

Molding Dry Density (pcf)	102.2	Hammer Wt. (lbs)	10
Molding Moisture (%)	20.9	Hammer Drop (inches)	18
Days Soaked	5	No. of Blows	56
Aggregate	3/4 inch minus	No. of Layers	5

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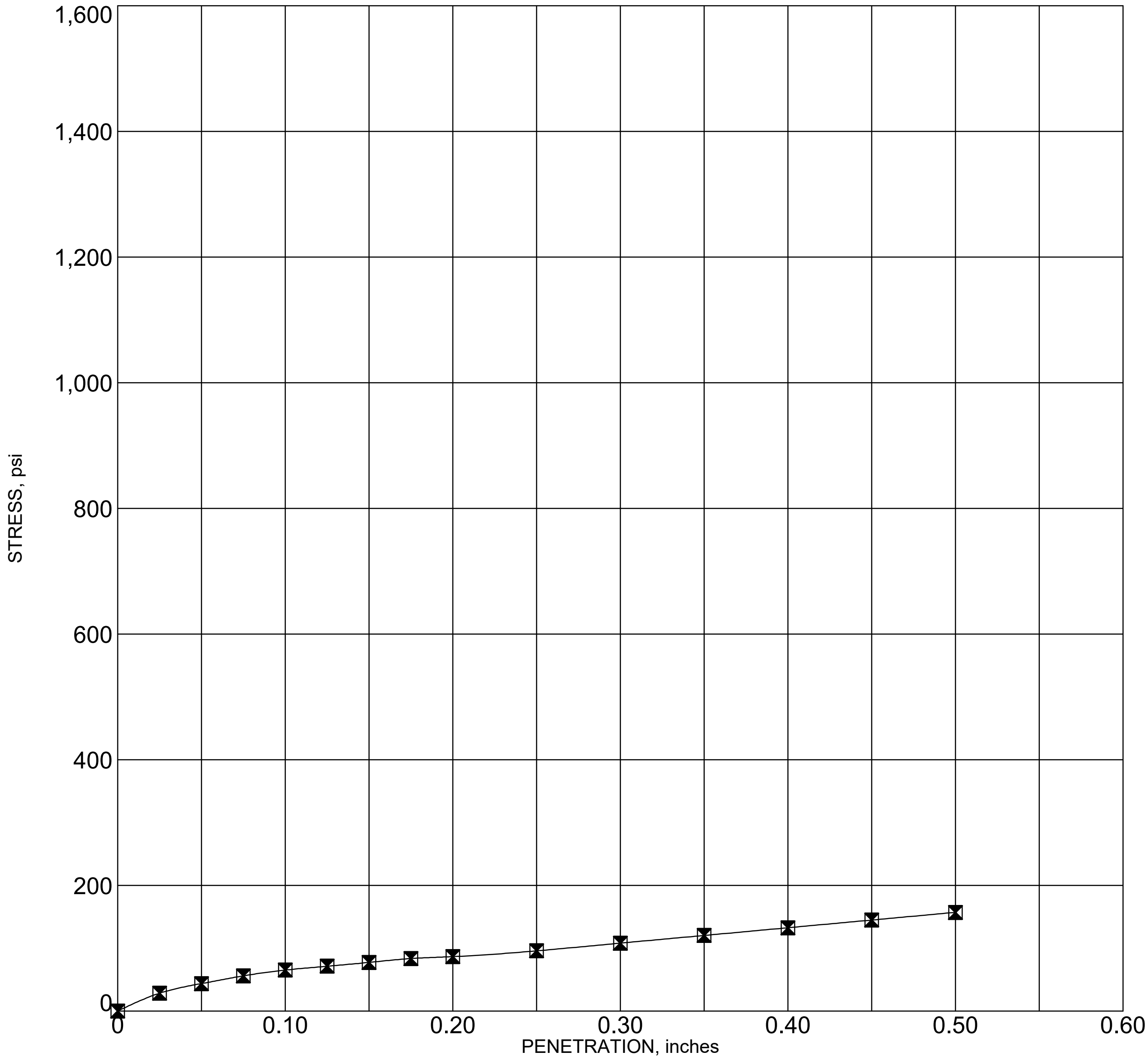
CALIFORNIA BEARING RATIO - ASTM D1883

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 42

G_CBR 8135-00.GPJ GEOLABS.GDT 11/22/20



Corr. CBR @ 0.1"	6.5
Corr. CBR @ 0.2"	5.8
Swell (%)	3.60

Sample: BULK-105
Depth: 0.0 - 2.0 feet
Description: Brown silty clay

Molding Dry Density (pcf)	111.7	Hammer Wt. (lbs)	10
Molding Moisture (%)	18.5	Hammer Drop (inches)	18
Days Soaked	5	No. of Blows	56
Aggregate	3/4 inch minus	No. of Layers	5

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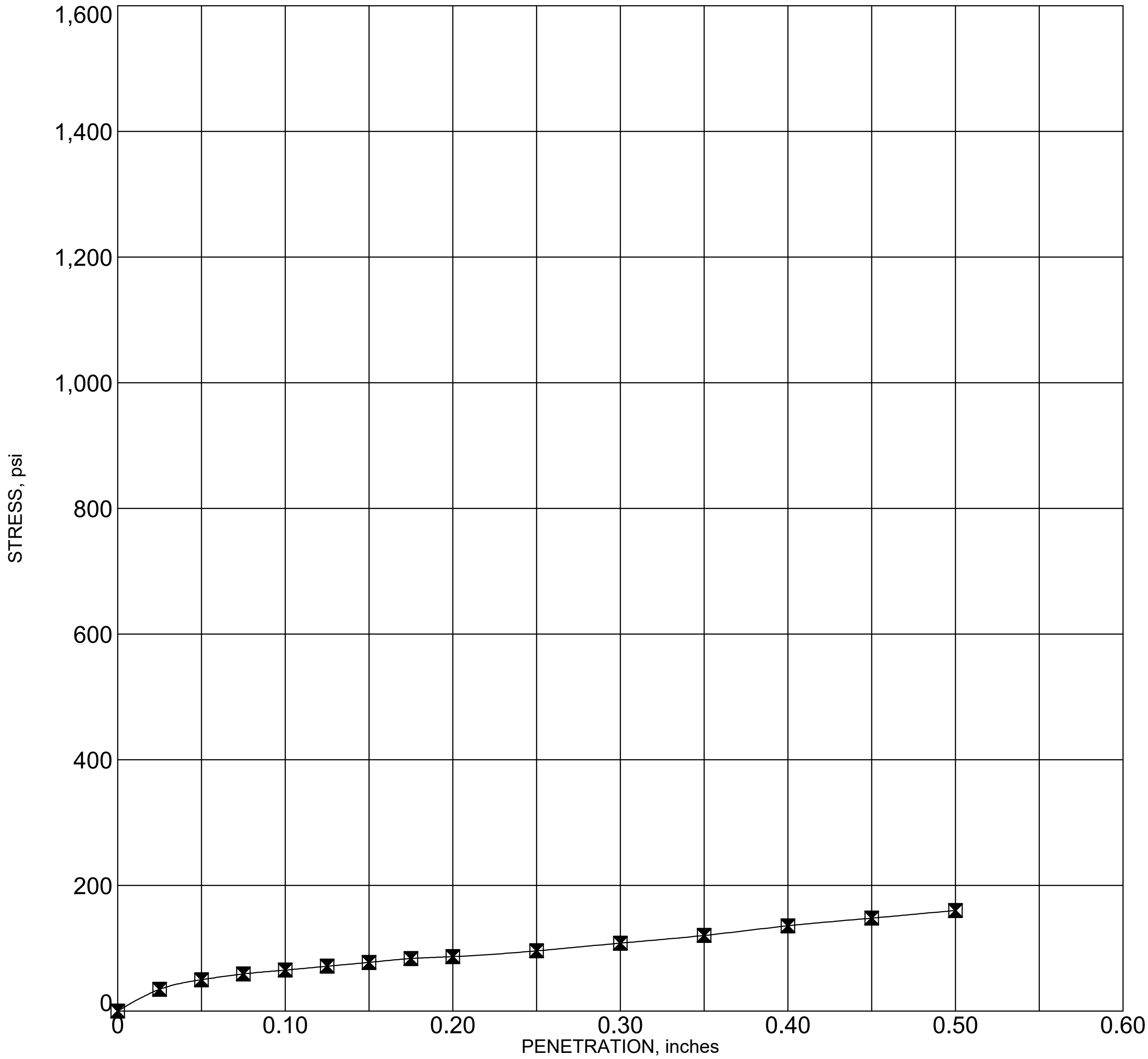
CALIFORNIA BEARING RATIO - ASTM D1883

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 43

G_CBR 8135-00.GPJ GEOLABS.GDT 11/22/20



Corr. CBR @ 0.1"	6.5
Corr. CBR @ 0.2"	5.8
Swell (%)	2.75

Sample: BULK-204
Depth: 0.0 - 2.0 feet
Description: Dark brown silty clay

Molding Dry Density (pcf)	111.7	Hammer Wt. (lbs)	10
Molding Moisture (%)	19.4	Hammer Drop (inches)	18
Days Soaked	5	No. of Blows	56
Aggregate	3/4 inch minus	No. of Layers	5

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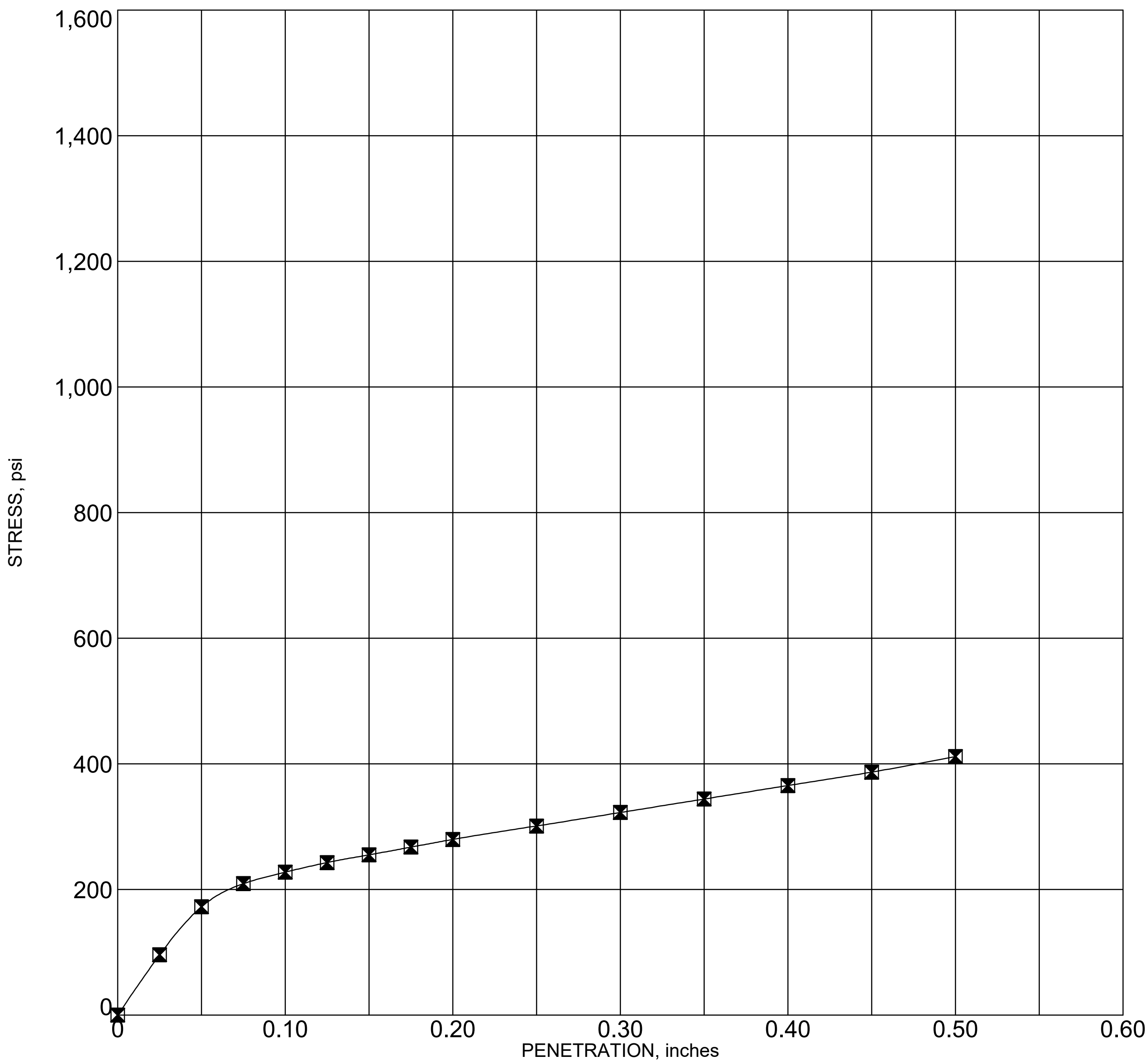
CALIFORNIA BEARING RATIO - ASTM D1883

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 44

G CBR 8135-00.GPJ GEOLABS.GDT 11/22/20



Corr. CBR @ 0.1"	22.7
Corr. CBR @ 0.2"	18.6
Swell (%)	0.72

Sample: BULK-205
Depth: 0.0 - 2.0 feet
Description: Brown clayey silt with some gravel

Molding Dry Density (pcf)	114.1	Hammer Wt. (lbs)	10
Molding Moisture (%)	16.7	Hammer Drop (inches)	18
Days Soaked	5	No. of Blows	56
Aggregate	3/4 inch minus	No. of Layers	5

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CALIFORNIA BEARING RATIO - ASTM D1883

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
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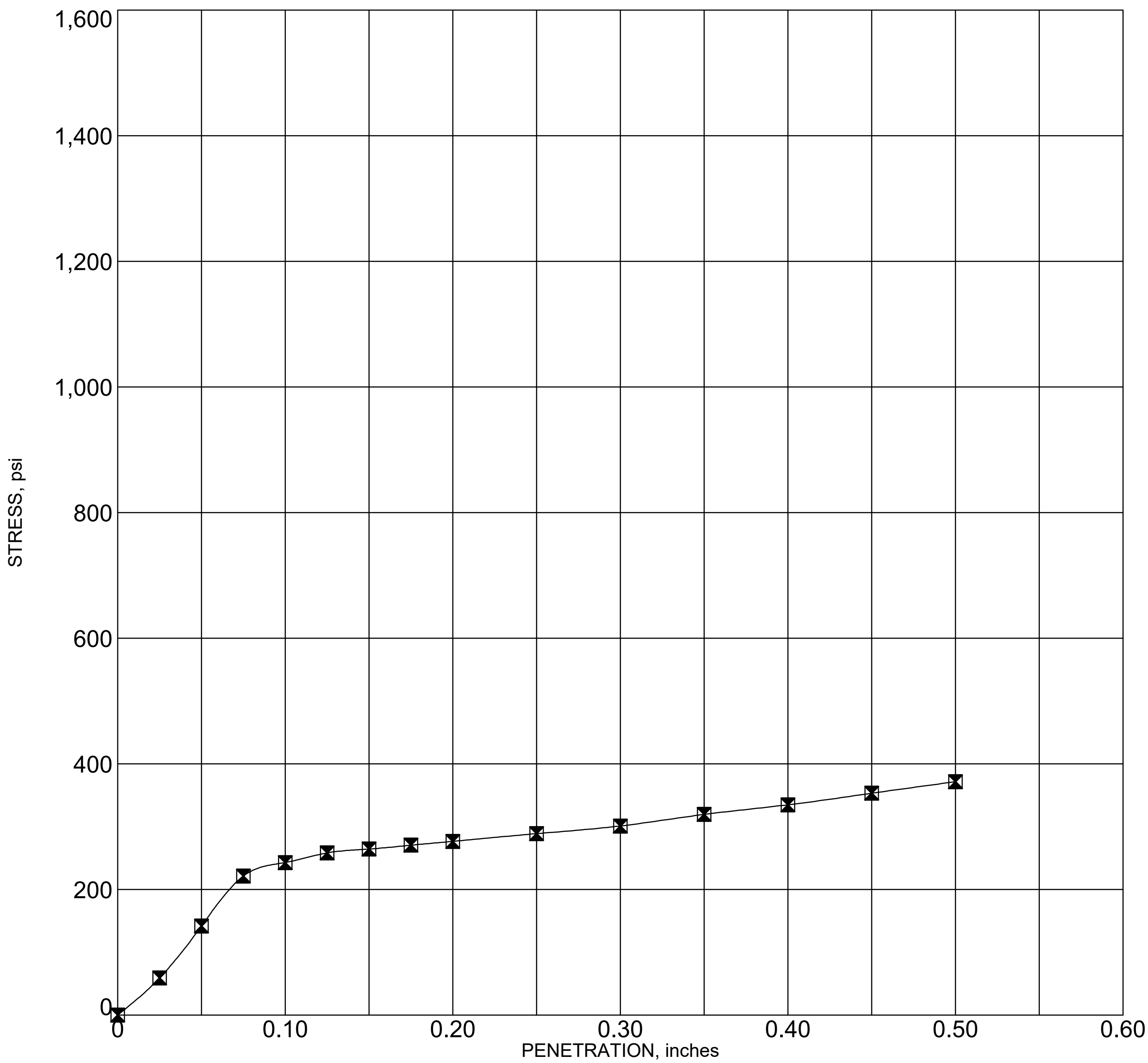

Corr. CBR @ 0.1"	24.7
Corr. CBR @ 0.2"	18.5
Swell (%)	1.24

Sample: BULK-302
Depth: 0.0 - 5.0 feet
Description: Brown clayey sand with some gravel

Molding Dry Density (pcf)	122.6	Hammer Wt. (lbs)	10
Molding Moisture (%)	14.6	Hammer Drop (inches)	18
Days Soaked	5	No. of Blows	56
Aggregate	3/4 inch minus	No. of Layers	5

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CALIFORNIA BEARING RATIO - ASTM D1883

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
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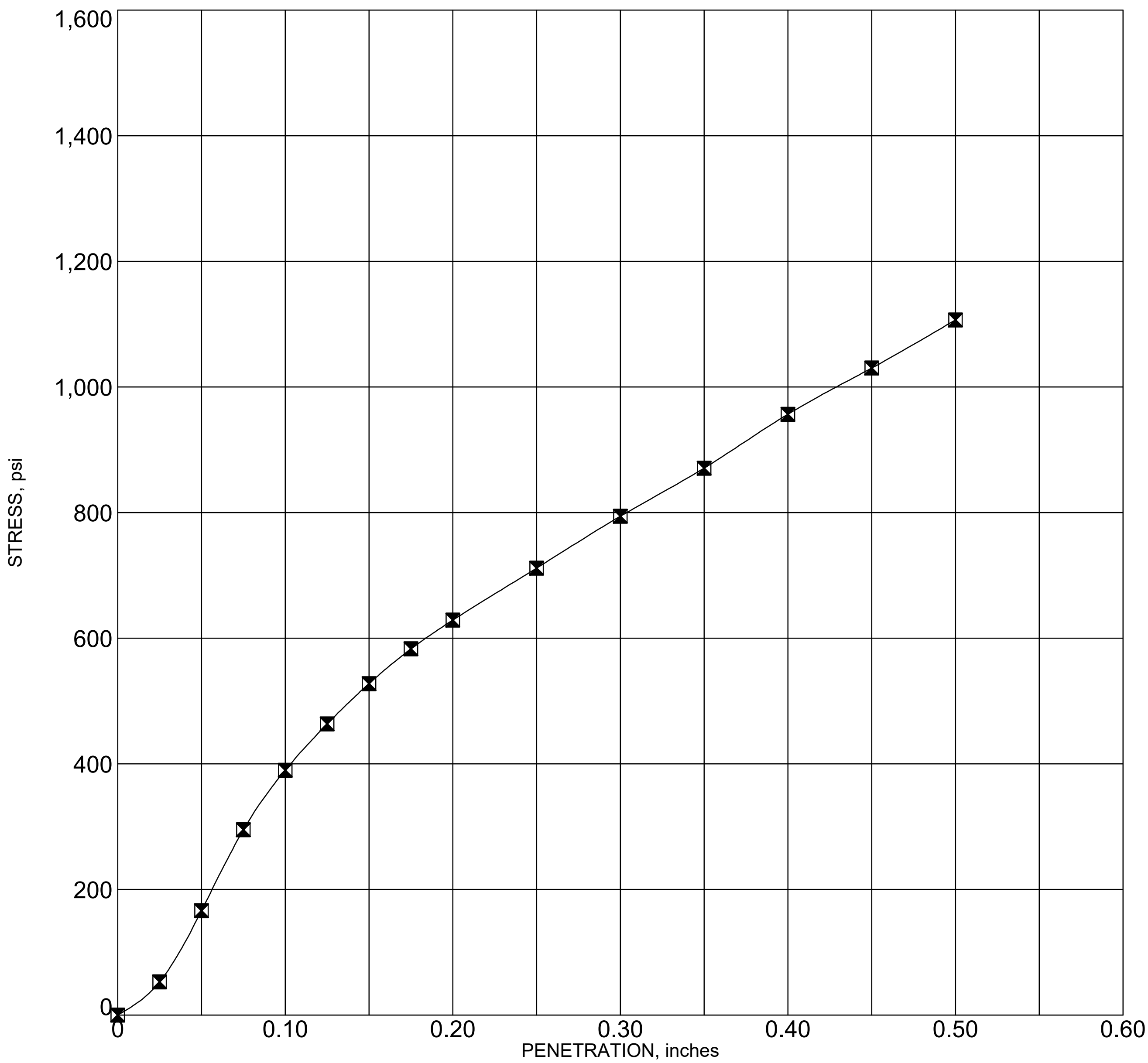
G_CBR 8135-00.GPJ GEOLABS.GDT 11/22/20



Corr. CBR @ 0.1"	42.9
Corr. CBR @ 0.2"	43.4
Swell (%)	1.24

Sample: BULK-304
Depth: 0.0 - 2.0 feet
Description: Grayish brown silty sand with some gravel

Molding Dry Density (pcf)	131.1	Hammer Wt. (lbs)	10
Molding Moisture (%)	10.3	Hammer Drop (inches)	18
Days Soaked	4	No. of Blows	56
Aggregate	3/4 inch minus	No. of Layers	5

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CALIFORNIA BEARING RATIO - ASTM D1883

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
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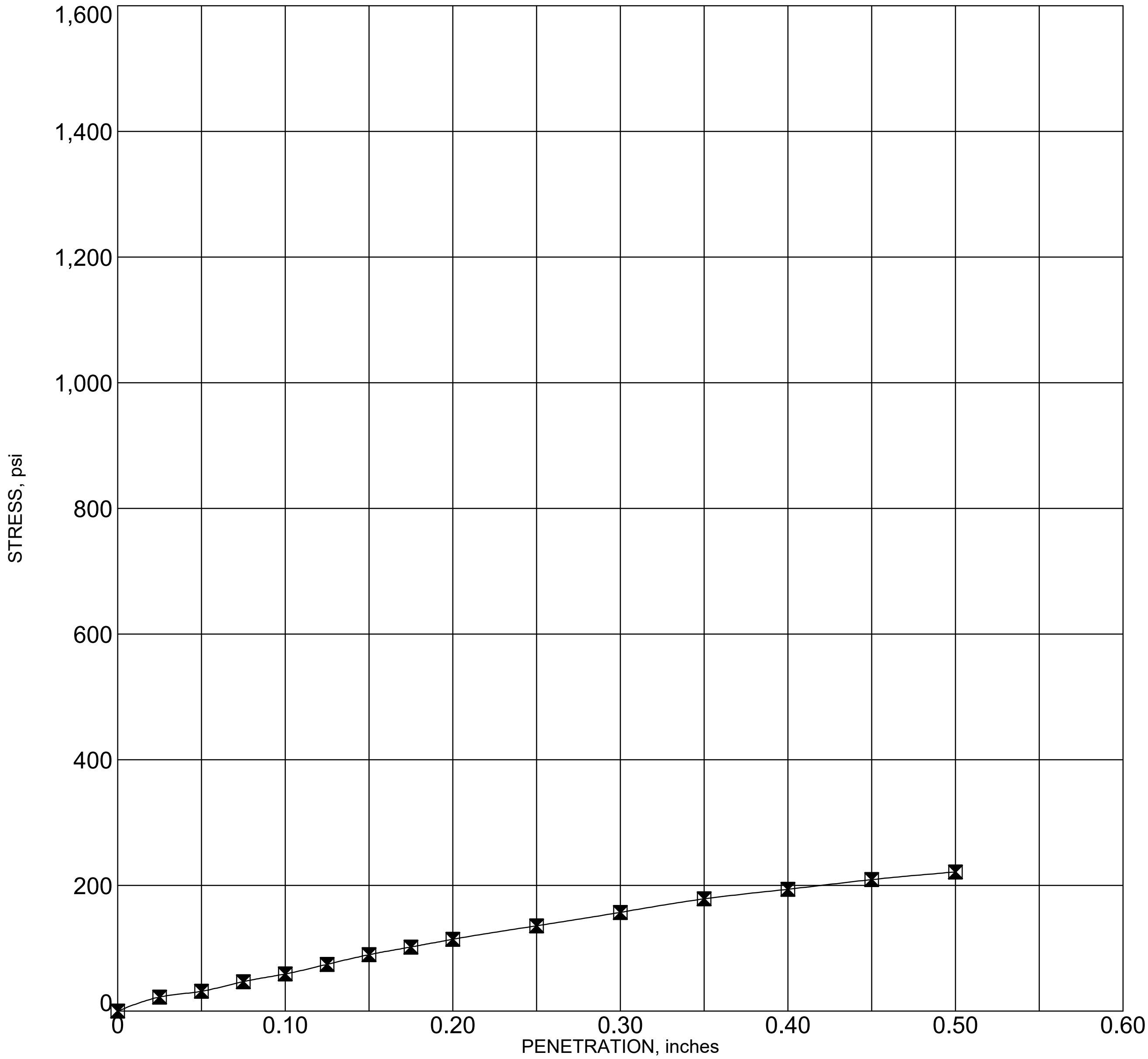
G_CBR 8135-00.GPJ GEOLABS.GDT 11/22/20



Corr. CBR @ 0.1"	5.9
Corr. CBR @ 0.2"	7.6
Swell (%)	3.18

Sample: BULK-305
Depth: 0.0 - 2.0 feet
Description: Brown silty clay

Molding Dry Density (pcf)	110.1	Hammer Wt. (lbs)	10
Molding Moisture (%)	19.4	Hammer Drop (inches)	18
Days Soaked	4	No. of Blows	56
Aggregate	3/4 inch minus	No. of Layers	5

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CALIFORNIA BEARING RATIO - ASTM D1883

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
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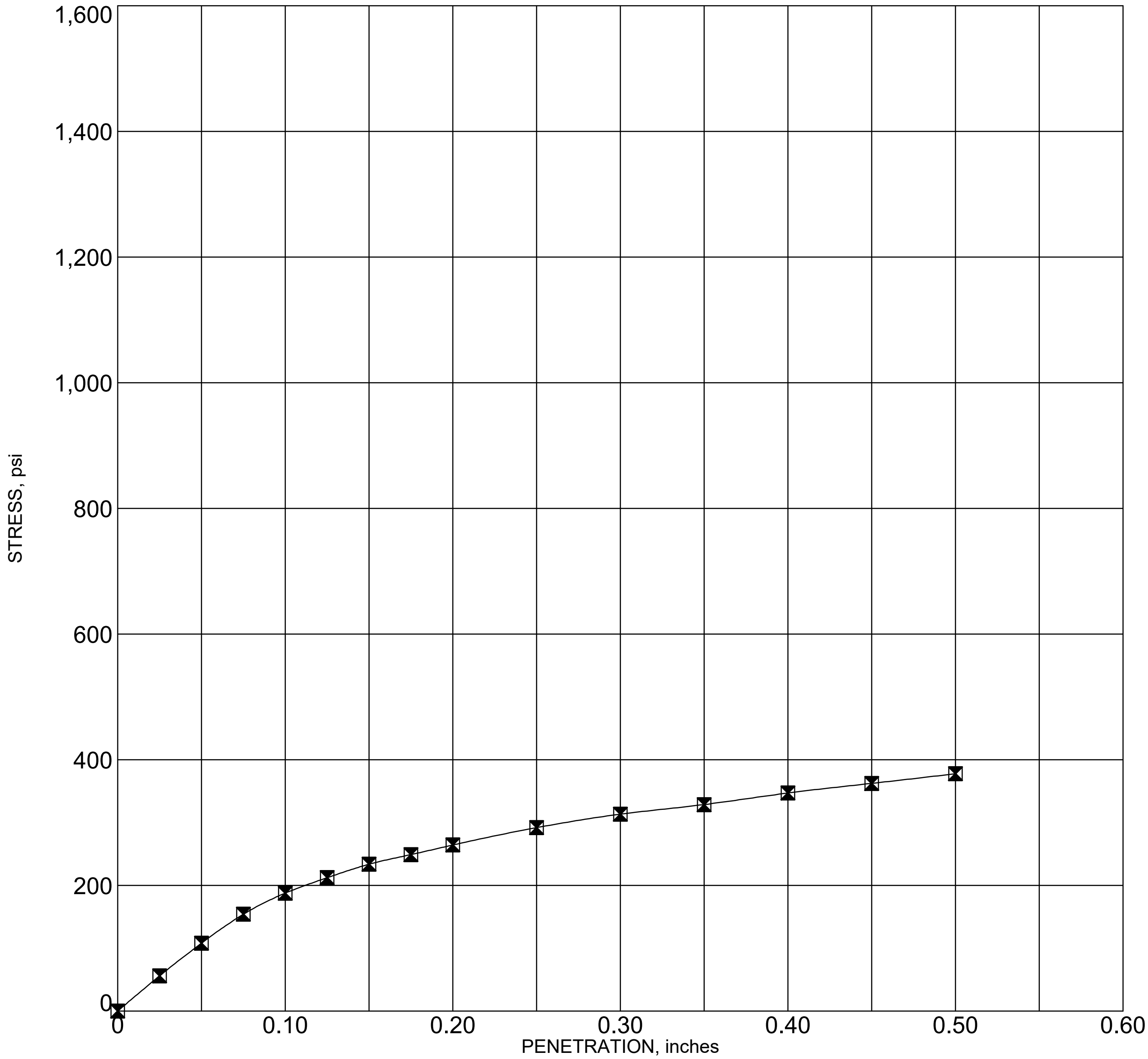
G_CBR 8135-00.GPJ GEOLABS.GDT 11/22/20



Corr. CBR @ 0.1"	18.8
Corr. CBR @ 0.2"	17.6
Swell (%)	0.02

Sample: BULK-306
Depth: 0.0 - 5.0 feet
Description: Reddish brown clayey silt

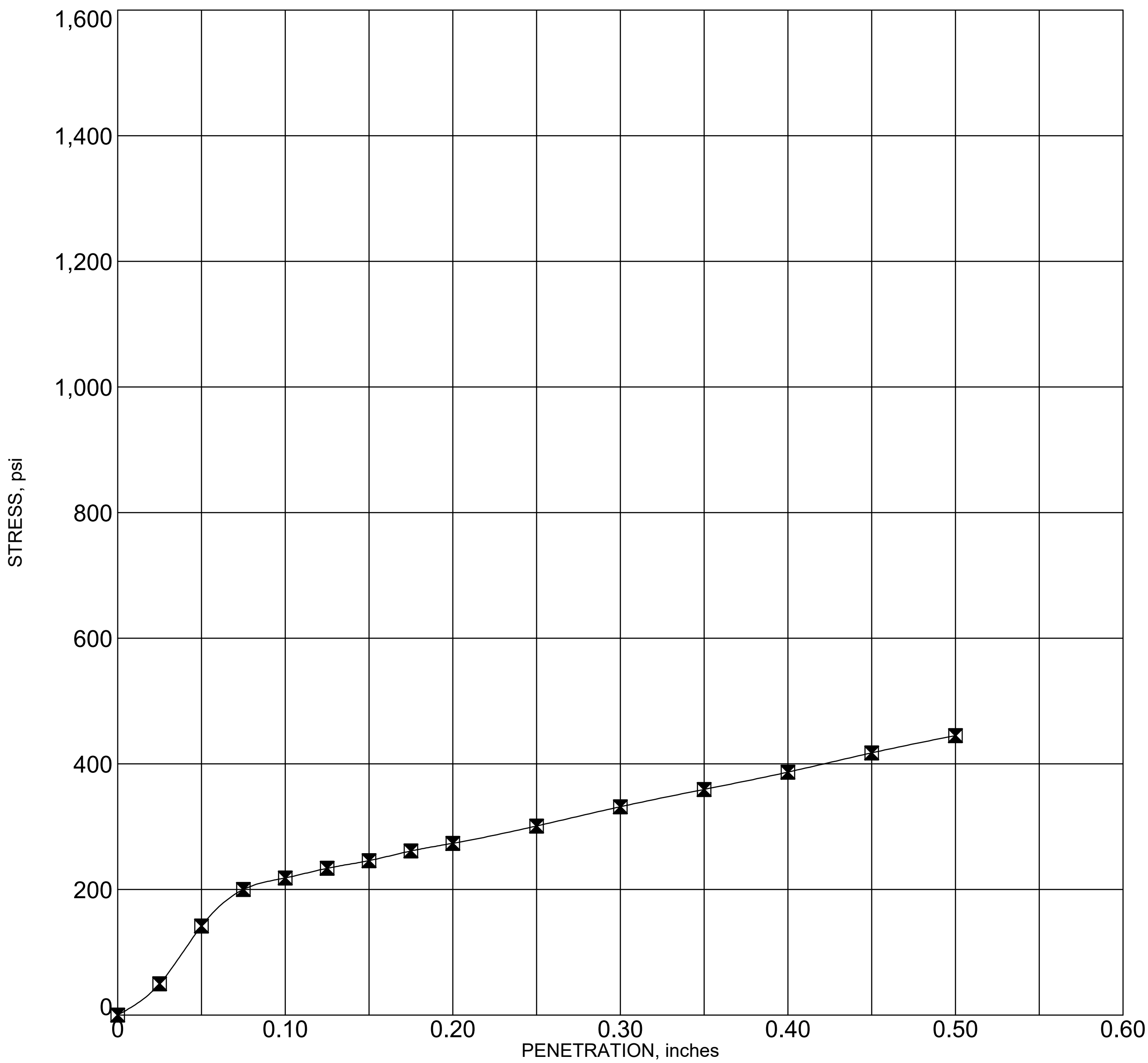
Molding Dry Density (pcf)	125.0	Hammer Wt. (lbs)	10
Molding Moisture (%)	15.3	Hammer Drop (inches)	18
Days Soaked	5	No. of Blows	56
Aggregate	3/4 inch minus	No. of Layers	5

GEOLABS, INC.
GEOTECHNICAL ENGINEERING
W.O. 8135-00

CALIFORNIA BEARING RATIO - ASTM D1883

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 49



Corr. CBR @ 0.1"	22.5
Corr. CBR @ 0.2"	18.6
Swell (%)	1.29

Sample: BULK-307
Depth: 0.0 - 1.5 feet
Description: Reddish brown clayey silt with a little sand

Molding Dry Density (pcf)	109.5	Hammer Wt. (lbs)	10
Molding Moisture (%)	19.7	Hammer Drop (inches)	18
Days Soaked	6	No. of Blows	56
Aggregate	3/4 inch minus	No. of Layers	5

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GEOTECHNICAL ENGINEERING

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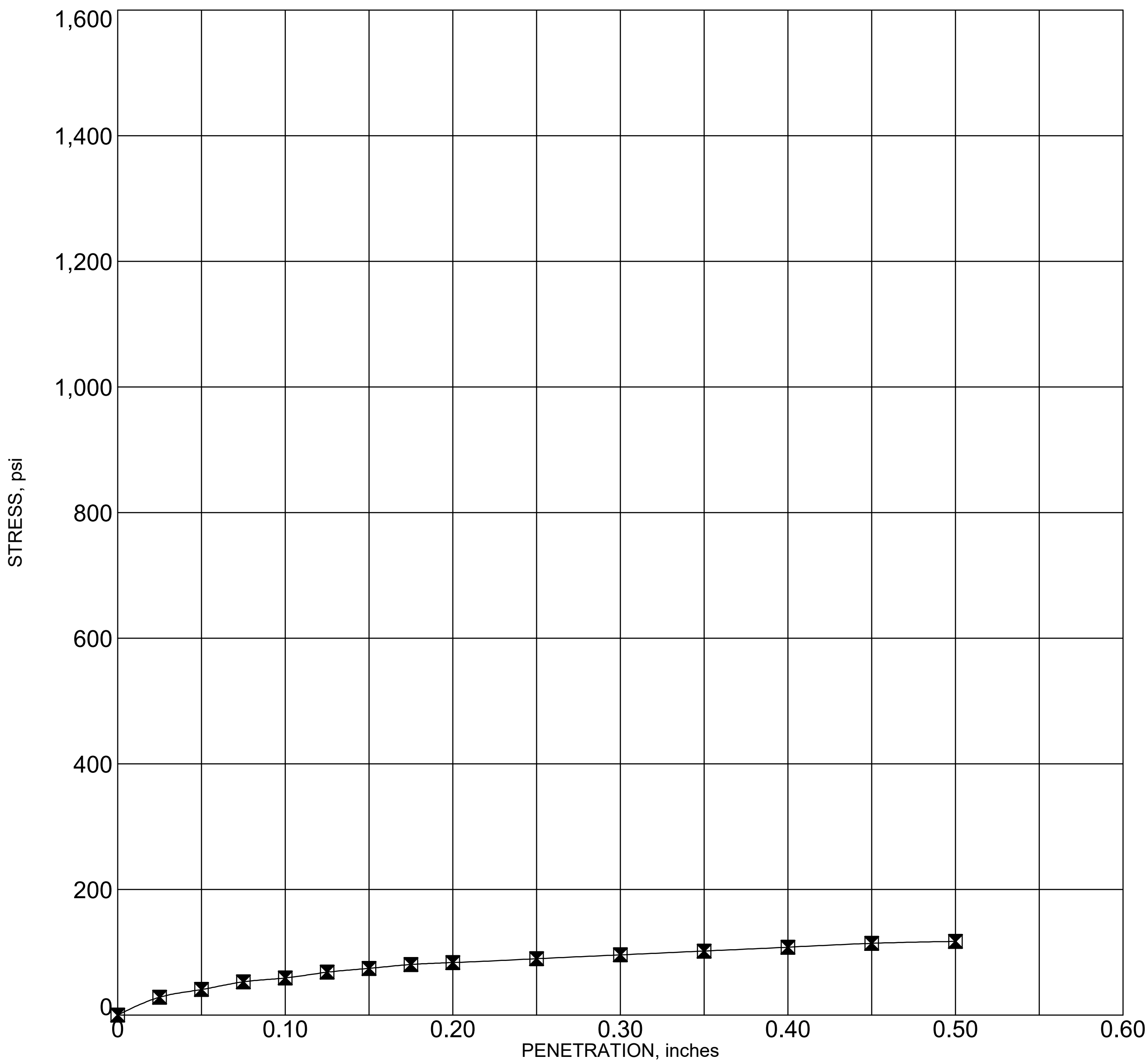
CALIFORNIA BEARING RATIO - ASTM D1883

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 50

G_CBR 8135-00.GPJ GEOLABS.GDT 11/22/20



Corr. CBR @ 0.1"	5.9
Corr. CBR @ 0.2"	5.6
Swell (%)	3.51

Sample: BULK-309
Depth: 0.0 - 3.0 feet
Description: Reddish brown silty clay

Molding Dry Density (pcf)	105.0	Hammer Wt. (lbs)	10
Molding Moisture (%)	18.1	Hammer Drop (inches)	18
Days Soaked	5	No. of Blows	56
Aggregate	3/4 inch minus	No. of Layers	5

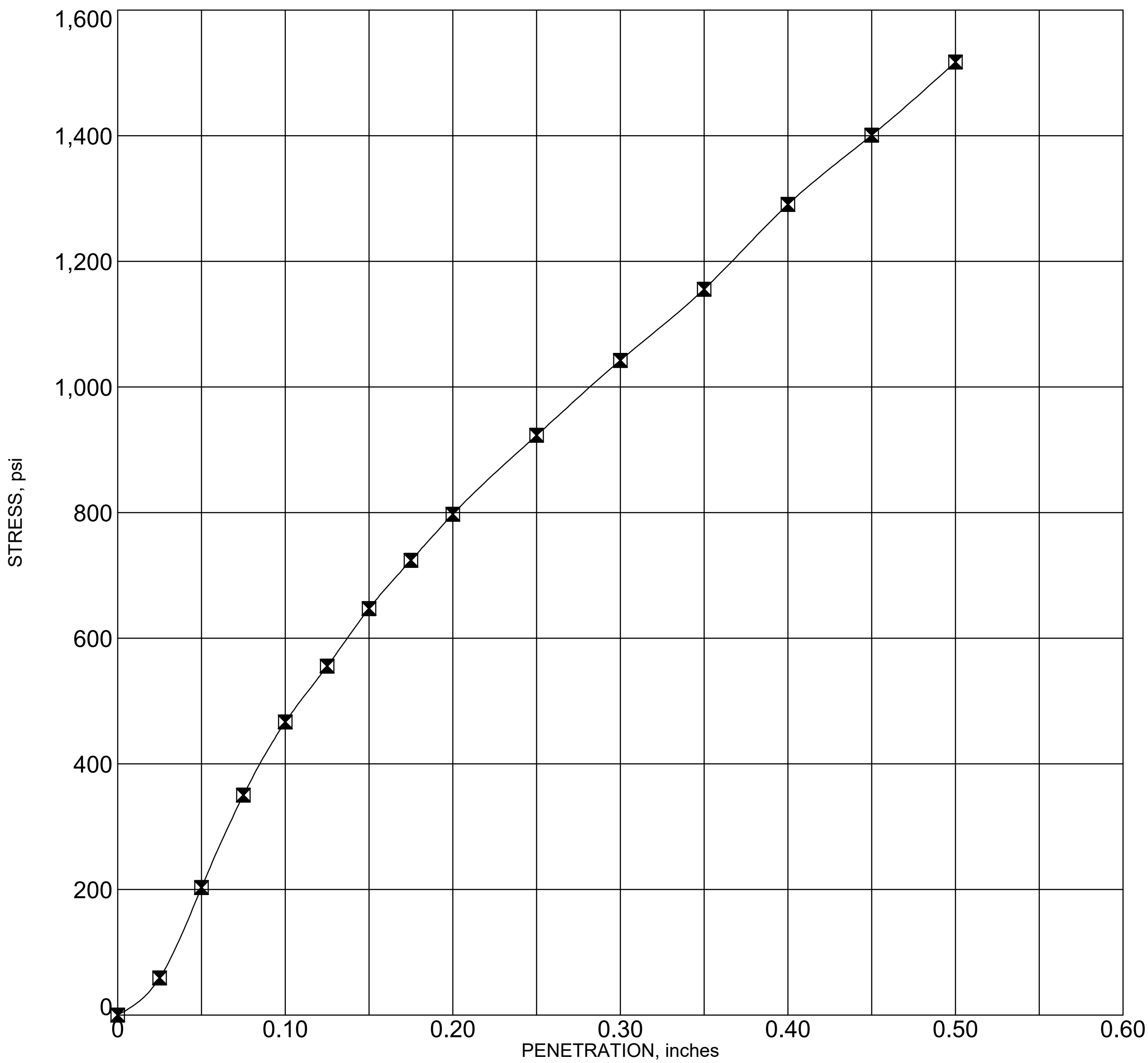
G CBR 8135-00.GPJ GEOLABS.GDT 11/22/20

GEOLABS, INC.
GEOTECHNICAL ENGINEERING
W.O. 8135-00

CALIFORNIA BEARING RATIO - ASTM D1883

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 51



Corr. CBR @ 0.1"	51.9
Corr. CBR @ 0.2"	55.6
Swell (%)	1.05

Sample: BULK-310
Depth: 0.0 - 2.0 feet
Description: Brown sandy gravel with some clay

Molding Dry Density (pcf)	134.7	Hammer Wt. (lbs)	10
Molding Moisture (%)	9.7	Hammer Drop (inches)	18
Days Soaked	5	No. of Blows	56
Aggregate	3/4 inch minus	No. of Layers	5

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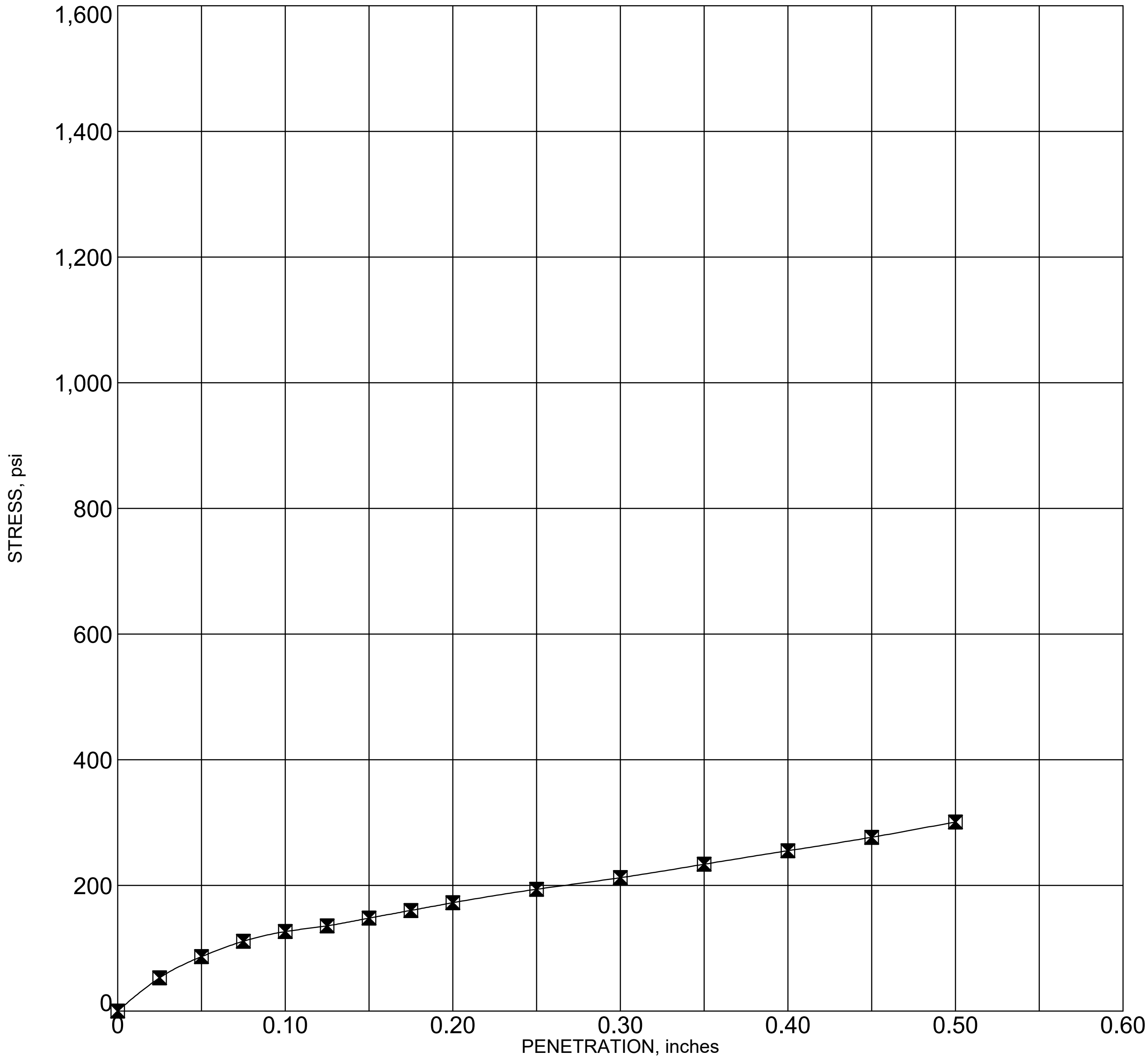
CALIFORNIA BEARING RATIO - ASTM D1883

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 52

G_CBR 8135-00.GPJ GEOLABS.GDT 11/22/20



Corr. CBR @ 0.1"	12.6
Corr. CBR @ 0.2"	11.5
Swell (%)	1.94

Sample: BULK-313
Depth: 0.0 - 3.0 feet
Description: Reddish brown sandy clay

Molding Dry Density (pcf)	112.4	Hammer Wt. (lbs)	10
Molding Moisture (%)	19.4	Hammer Drop (inches)	18
Days Soaked	4	No. of Blows	56
Aggregate	3/4 inch minus	No. of Layers	5

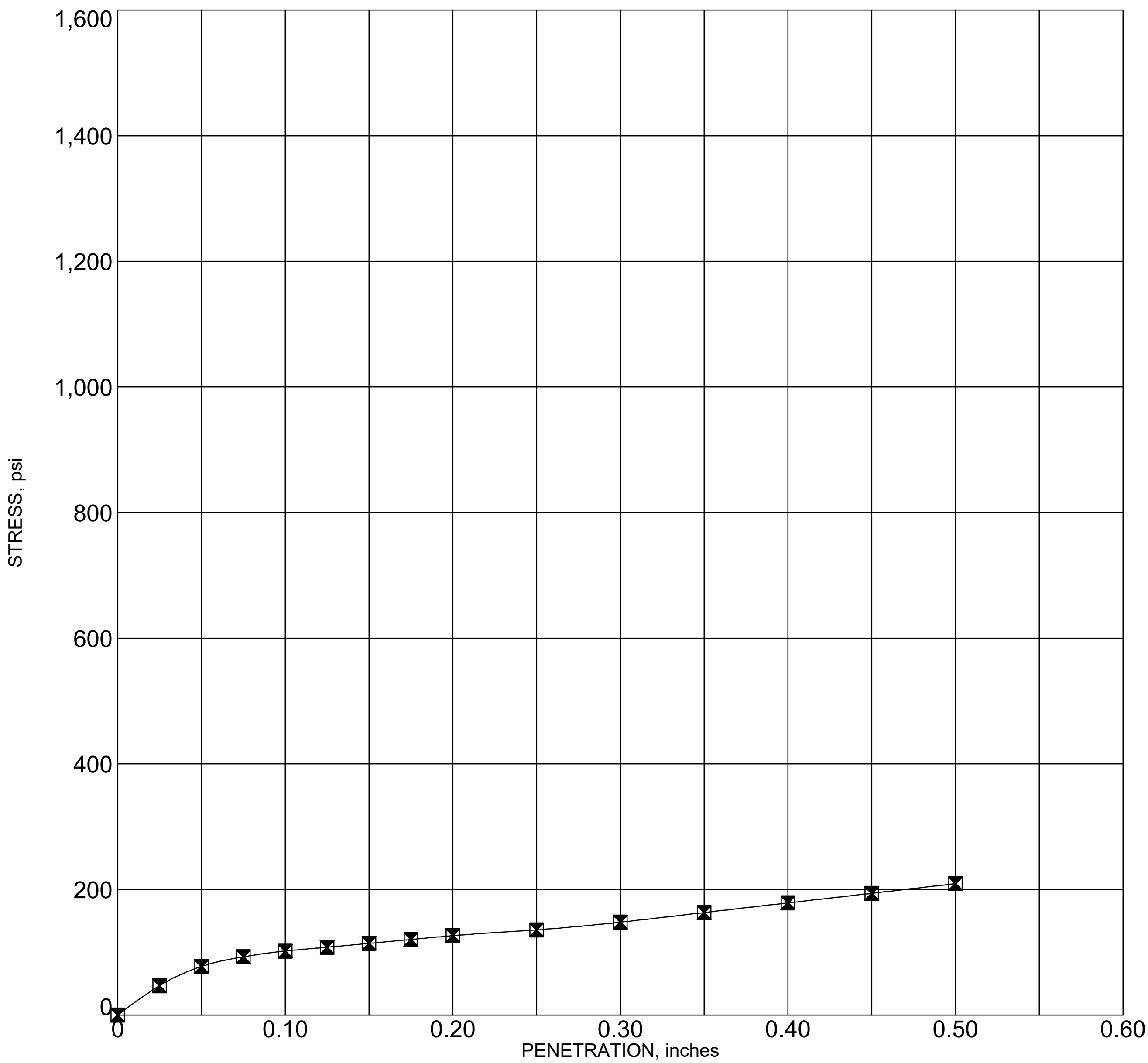
GEOLABS, INC.
GEOTECHNICAL ENGINEERING
W.O. 8135-00

CALIFORNIA BEARING RATIO - ASTM D1883

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 53

G_CBR 8135-00.GPJ GEOLABS.GDT 11/22/20



Corr. CBR @ 0.1"	10.2
Corr. CBR @ 0.2"	8.4
Swell (%)	1.99

Sample: BULK-314
Depth: 0.0 - 2.0 feet
Description: Reddish brown silty clay

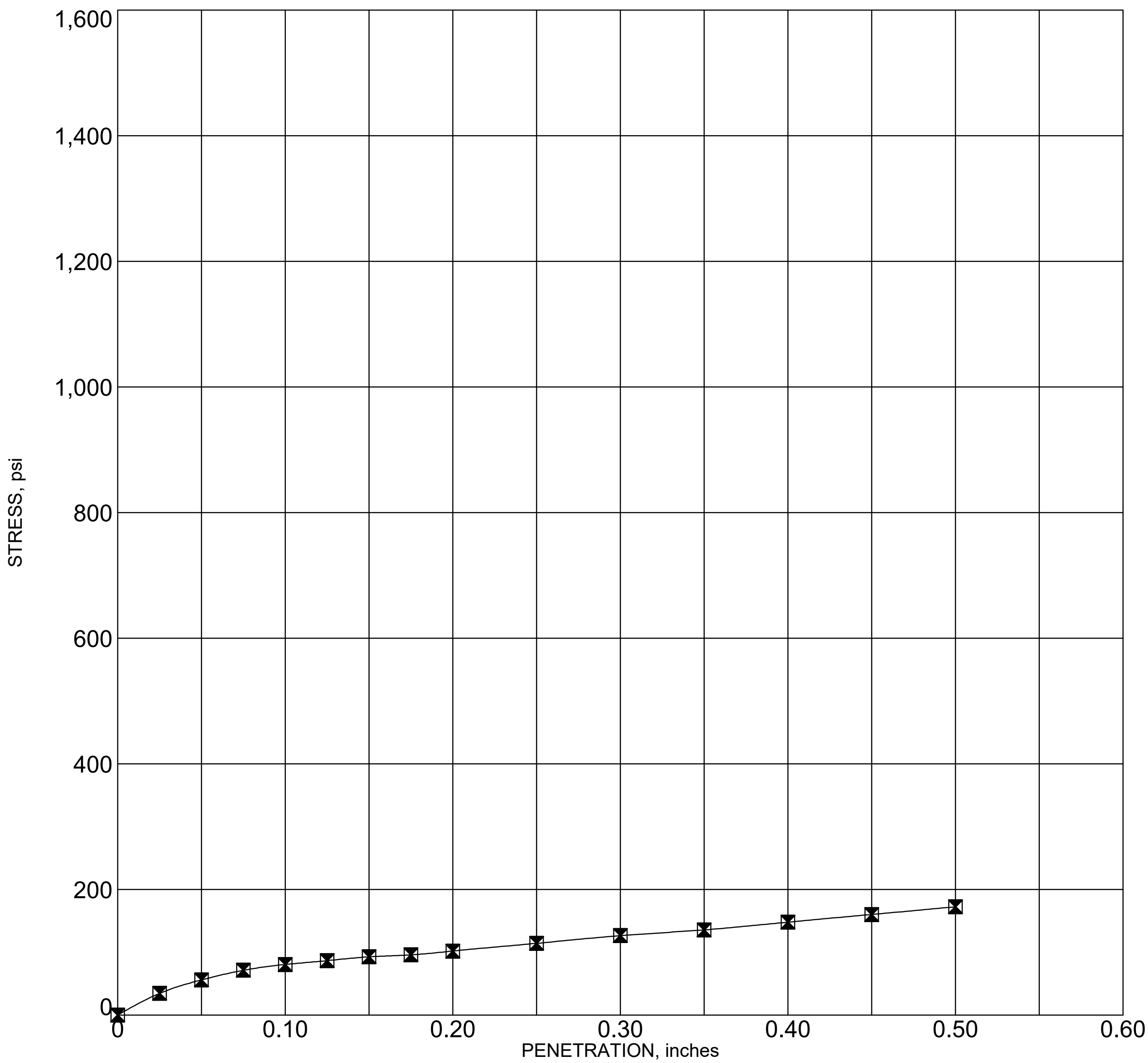
Molding Dry Density (pcf)	111.3	Hammer Wt. (lbs)	10
Molding Moisture (%)	19.7	Hammer Drop (inches)	18
Days Soaked	5	No. of Blows	56
Aggregate	3/4 inch minus	No. of Layers	5

GEOLABS, INC.
GEOTECHNICAL ENGINEERING
W.O. 8135-00

CALIFORNIA BEARING RATIO - ASTM D1883

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 54



Corr. CBR @ 0.1"	8.0
Corr. CBR @ 0.2"	6.8
Swell (%)	2.51

Sample: BULK-316
Depth: 0.0 - 2.5 feet
Description: Brown silty clay

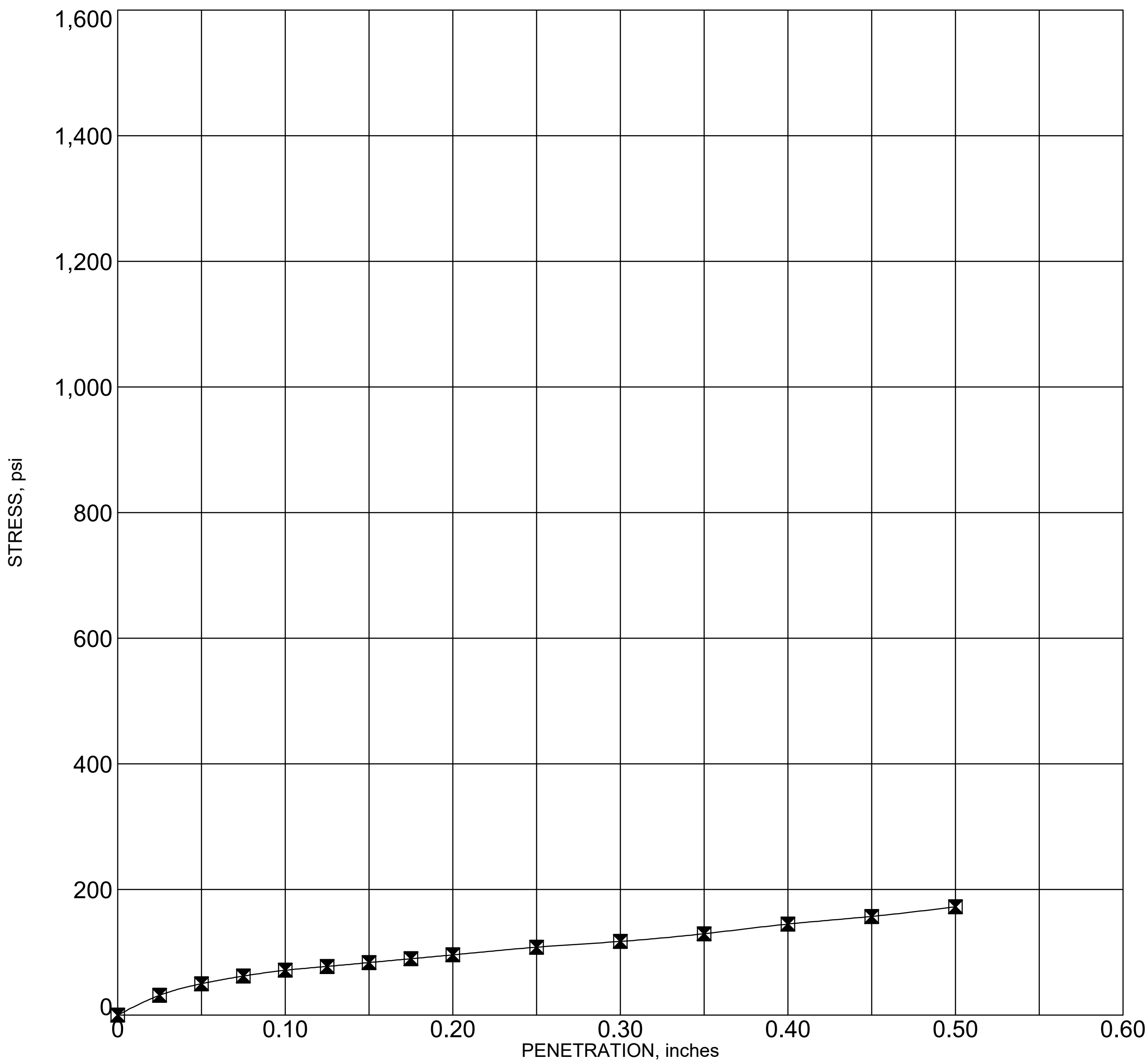
Molding Dry Density (pcf)	114.2	Hammer Wt. (lbs)	10
Molding Moisture (%)	18.9	Hammer Drop (inches)	18
Days Soaked	4	No. of Blows	56
Aggregate	3/4 inch minus	No. of Layers	5

GEOLABS, INC.
GEOTECHNICAL ENGINEERING
W.O. 8135-00

CALIFORNIA BEARING RATIO - ASTM D1883

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 55



Corr. CBR @ 0.1"	7.1
Corr. CBR @ 0.2"	6.4
Swell (%)	3.05

Sample: BULK-319
Depth: 0.0 - 2.0 feet
Description: Brown silty clay

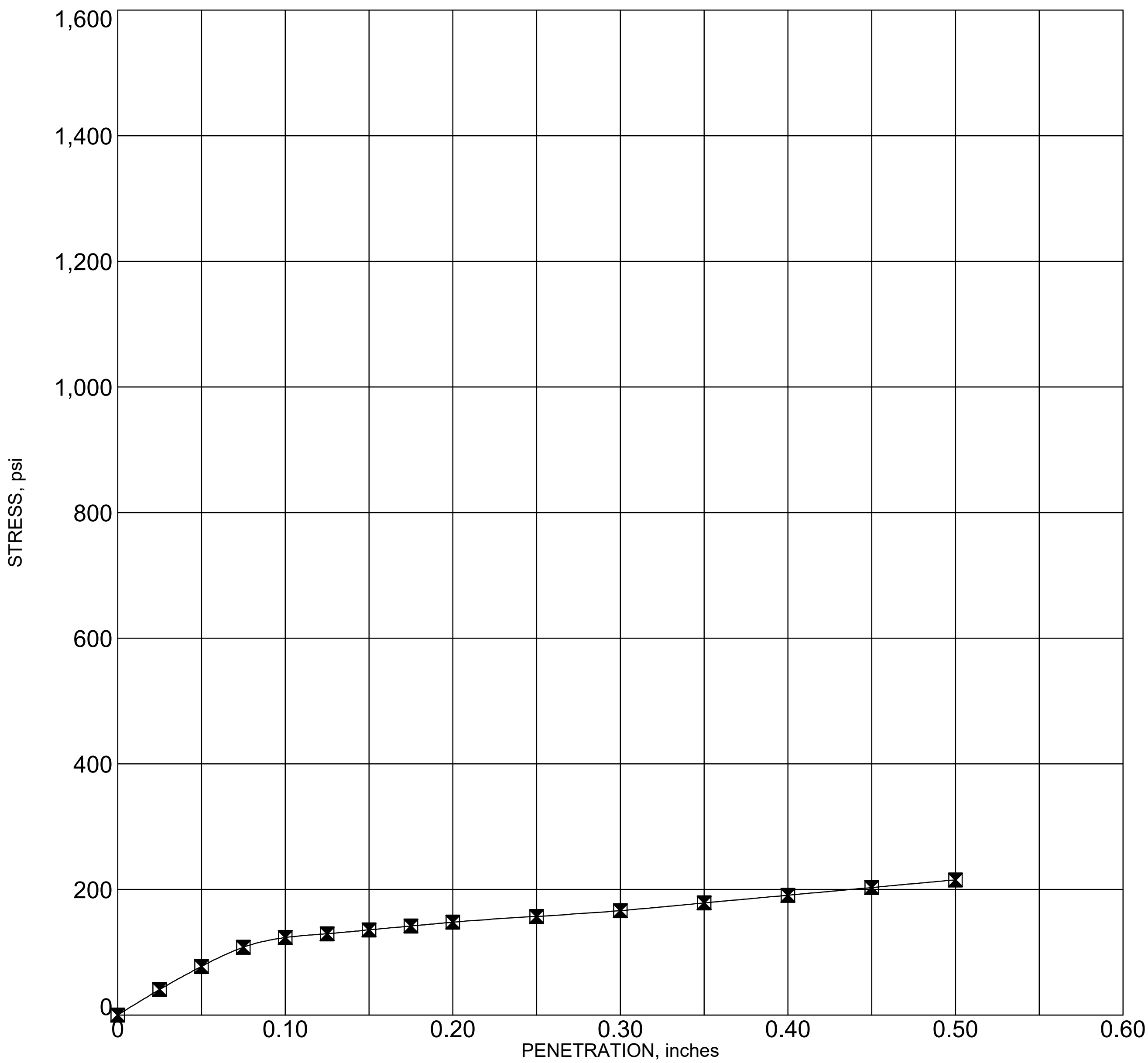
Molding Dry Density (pcf)	113.6	Hammer Wt. (lbs)	10
Molding Moisture (%)	18.3	Hammer Drop (inches)	18
Days Soaked	5	No. of Blows	56
Aggregate	3/4 inch minus	No. of Layers	5

GEOLABS, INC.
GEOTECHNICAL ENGINEERING
W.O. 8135-00

CALIFORNIA BEARING RATIO - ASTM D1883

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 56



Corr. CBR @ 0.1"	12.3
Corr. CBR @ 0.2"	9.9
Swell (%)	2.20

Sample: BULK-323
Depth: 0.0 - 2.0 feet
Description: Brown clayey silt

Molding Dry Density (pcf)	107.8	Hammer Wt. (lbs)	10
Molding Moisture (%)	20.4	Hammer Drop (inches)	18
Days Soaked	5	No. of Blows	56
Aggregate	3/4 inch minus	No. of Layers	5

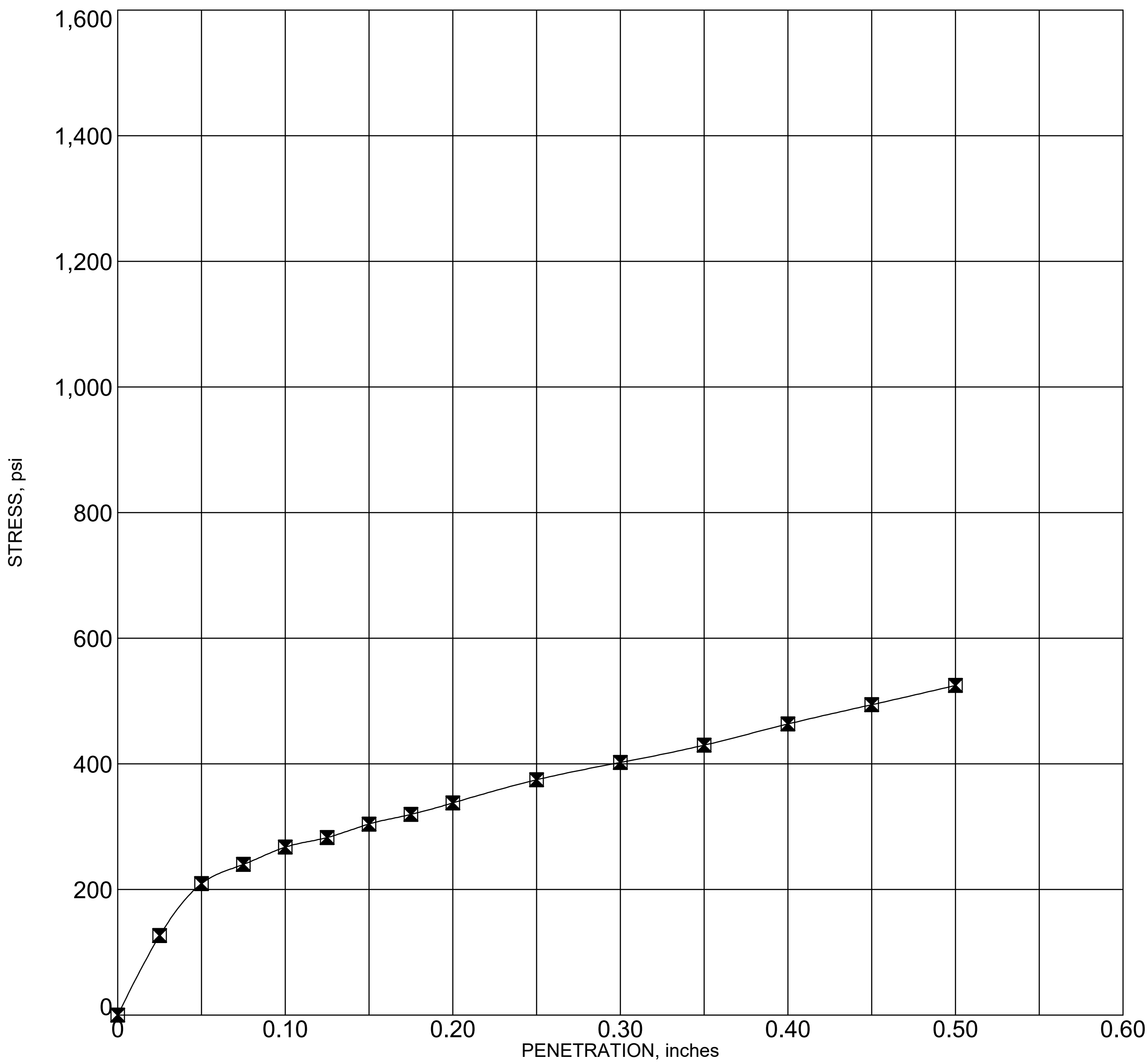
GEOLABS, INC.
GEOTECHNICAL ENGINEERING
W.O. 8135-00

CALIFORNIA BEARING RATIO - ASTM D1883

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 57

G_CBR 8135-00.GPJ GEOLABS.GDT 11/22/20



Corr. CBR @ 0.1"	26.7
Corr. CBR @ 0.2"	22.5
Swell (%)	0.72

Sample: BULK-326
Depth: 0.0 - 4.0 feet
Description: Brown clayey silt

Molding Dry Density (pcf)	110.5	Hammer Wt. (lbs)	10
Molding Moisture (%)	21.2	Hammer Drop (inches)	18
Days Soaked	4	No. of Blows	56
Aggregate	3/4 inch minus	No. of Layers	5

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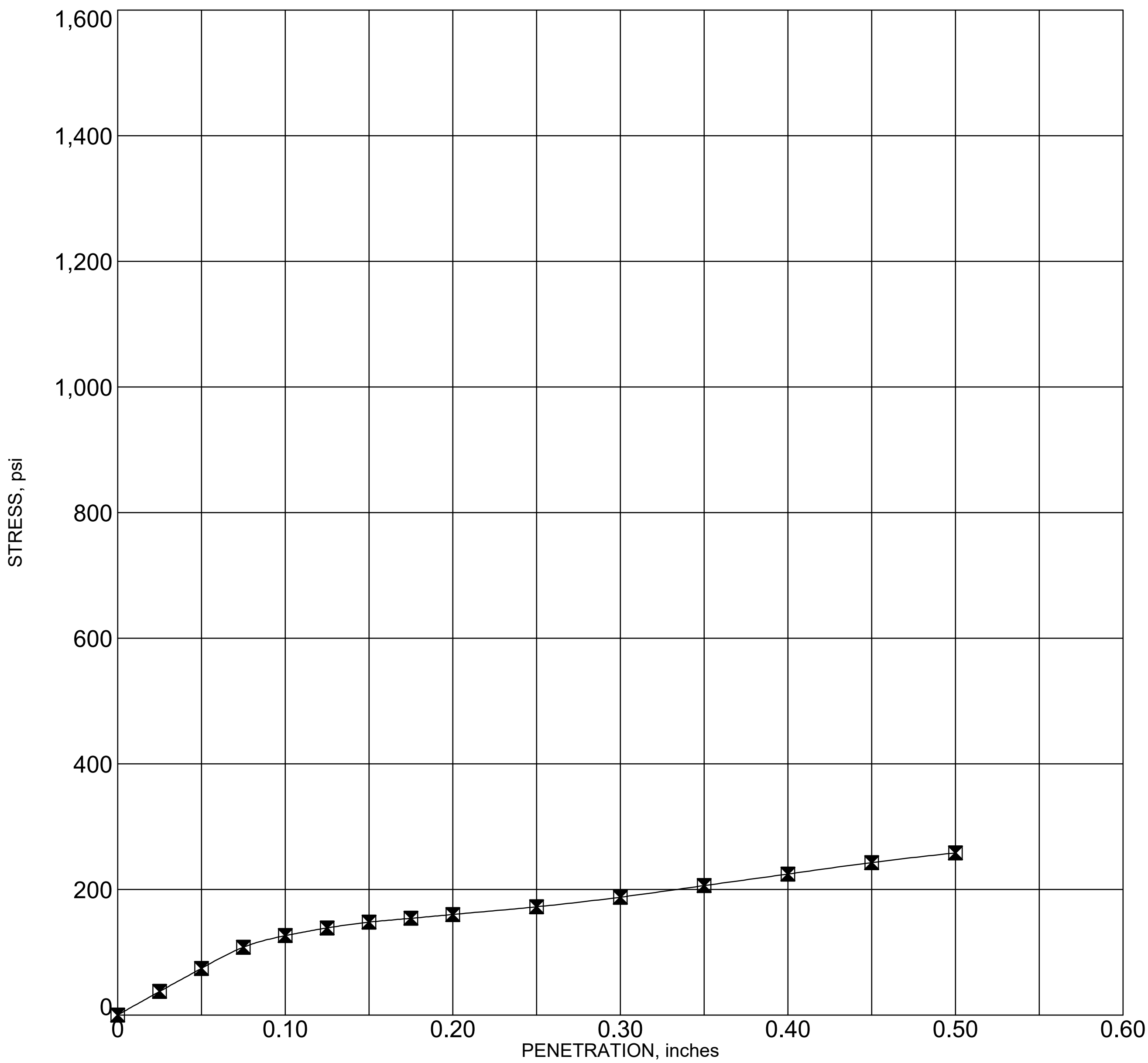
CALIFORNIA BEARING RATIO - ASTM D1883

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 58

G_CBR 8135-00.GPJ GEOLABS.GDT 11/22/20



Corr. CBR @ 0.1"	12.6
Corr. CBR @ 0.2"	10.7
Swell (%)	2.05

Sample: BULK-329
Depth: 0.0 - 2.0 feet
Description: Brown silty clay

Molding Dry Density (pcf)	108.2	Hammer Wt. (lbs)	10
Molding Moisture (%)	20.6	Hammer Drop (inches)	18
Days Soaked	5	No. of Blows	56
Aggregate	3/4 inch minus	No. of Layers	5

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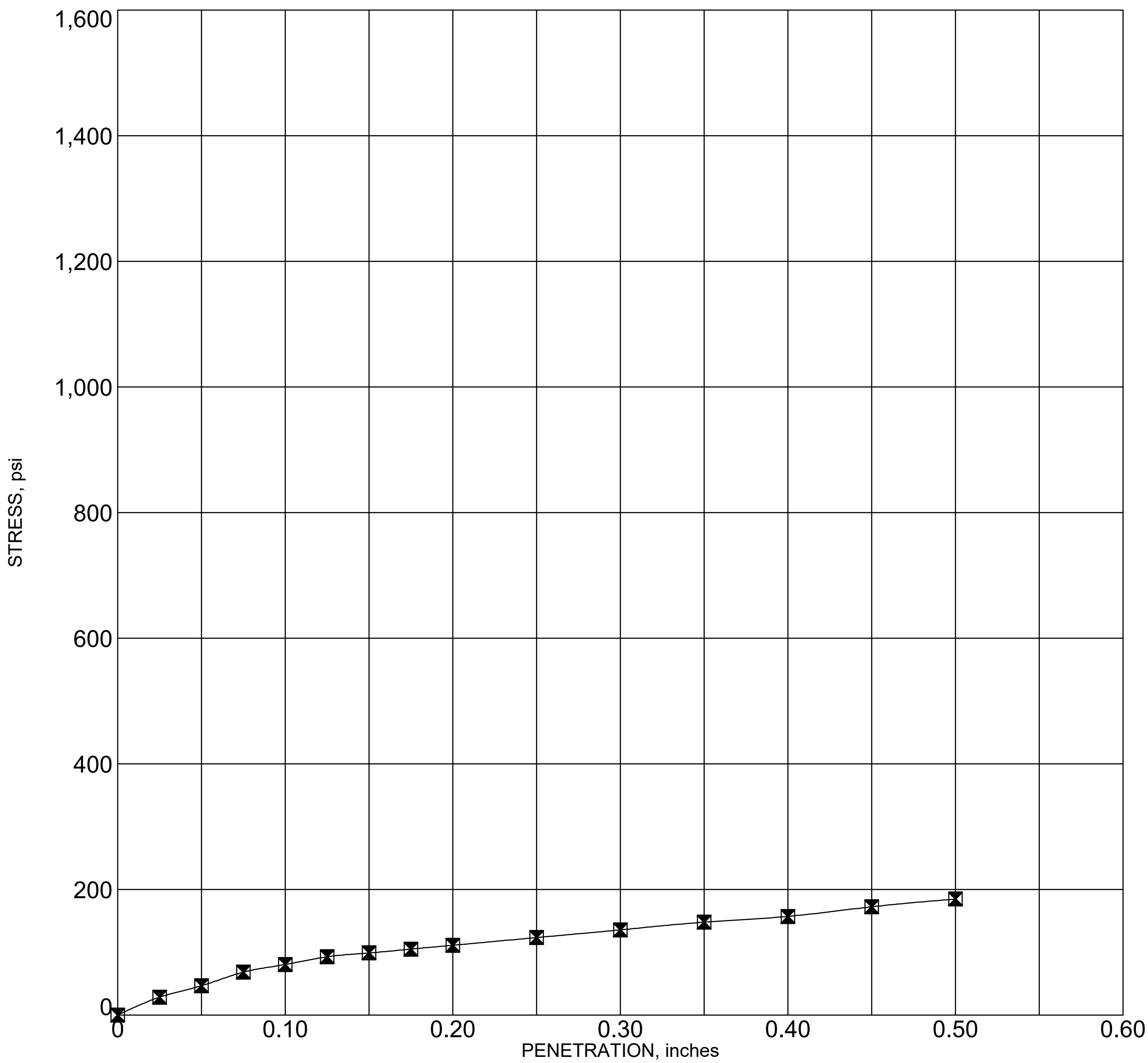
CALIFORNIA BEARING RATIO - ASTM D1883

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 59

G_CBR 8135-00.GPJ GEOLABS.GDT 11/22/20



Corr. CBR @ 0.1"	8.0
Corr. CBR @ 0.2"	7.4
Swell (%)	2.38

Sample: BULK-332
Depth: 0.0 - 2.0 feet
Description: Brown silty clay

Molding Dry Density (pcf)	110.3	Hammer Wt. (lbs)	10
Molding Moisture (%)	19.8	Hammer Drop (inches)	18
Days Soaked	5	No. of Blows	56
Aggregate	3/4 inch minus	No. of Layers	5

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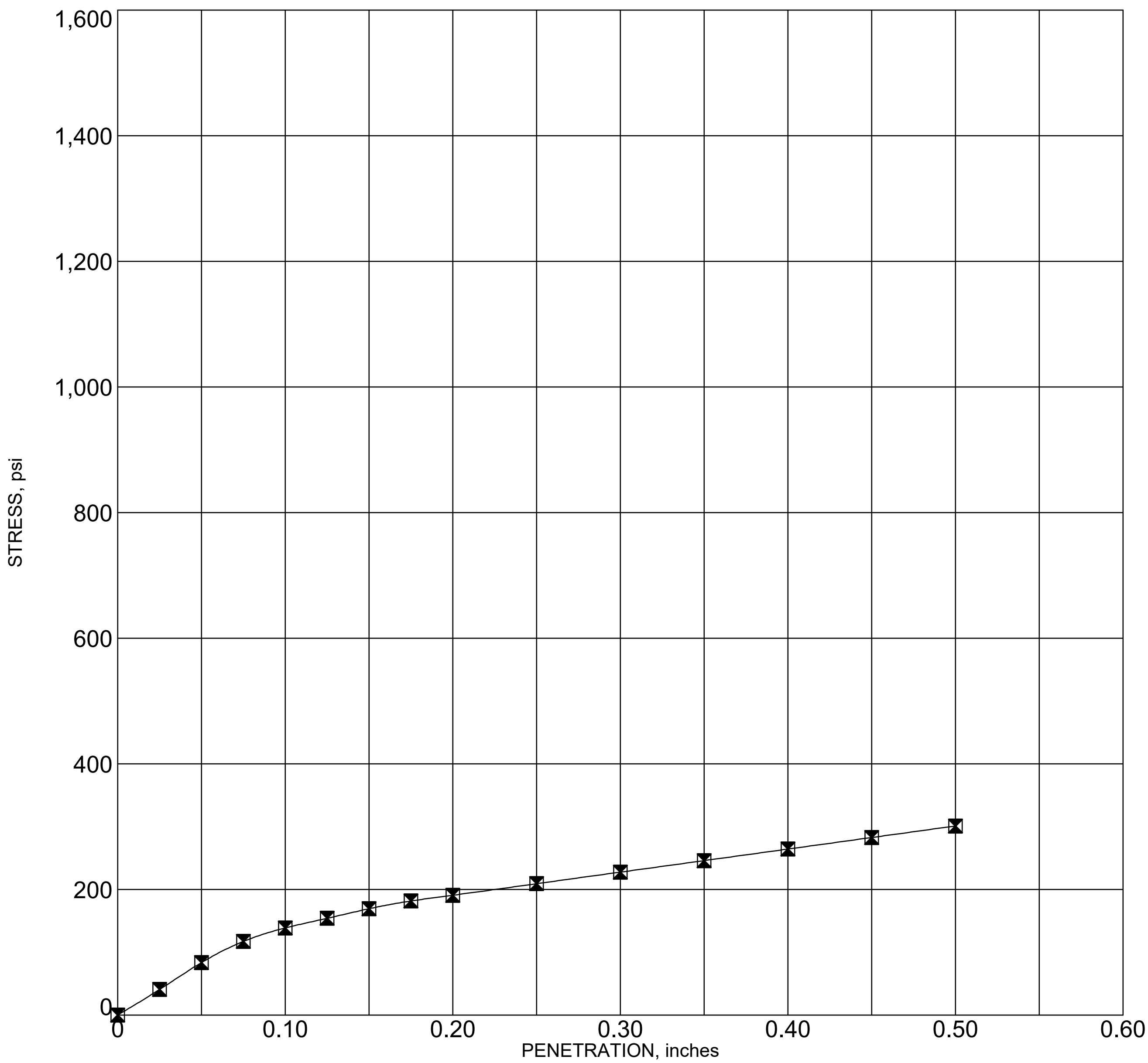
CALIFORNIA BEARING RATIO - ASTM D1883

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 60



Corr. CBR @ 0.1"	13.9
Corr. CBR @ 0.2"	12.7
Swell (%)	1.70

Sample: BULK-334
Depth: 0.0 - 5.0 feet
Description: Brown silty clay

Molding Dry Density (pcf)	107.3	Hammer Wt. (lbs)	10
Molding Moisture (%)	21.7	Hammer Drop (inches)	18
Days Soaked	4	No. of Blows	56
Aggregate	3/4 inch minus	No. of Layers	5

G_CBR 8135-00.GPJ GEOLABS.GDT 11/22/20

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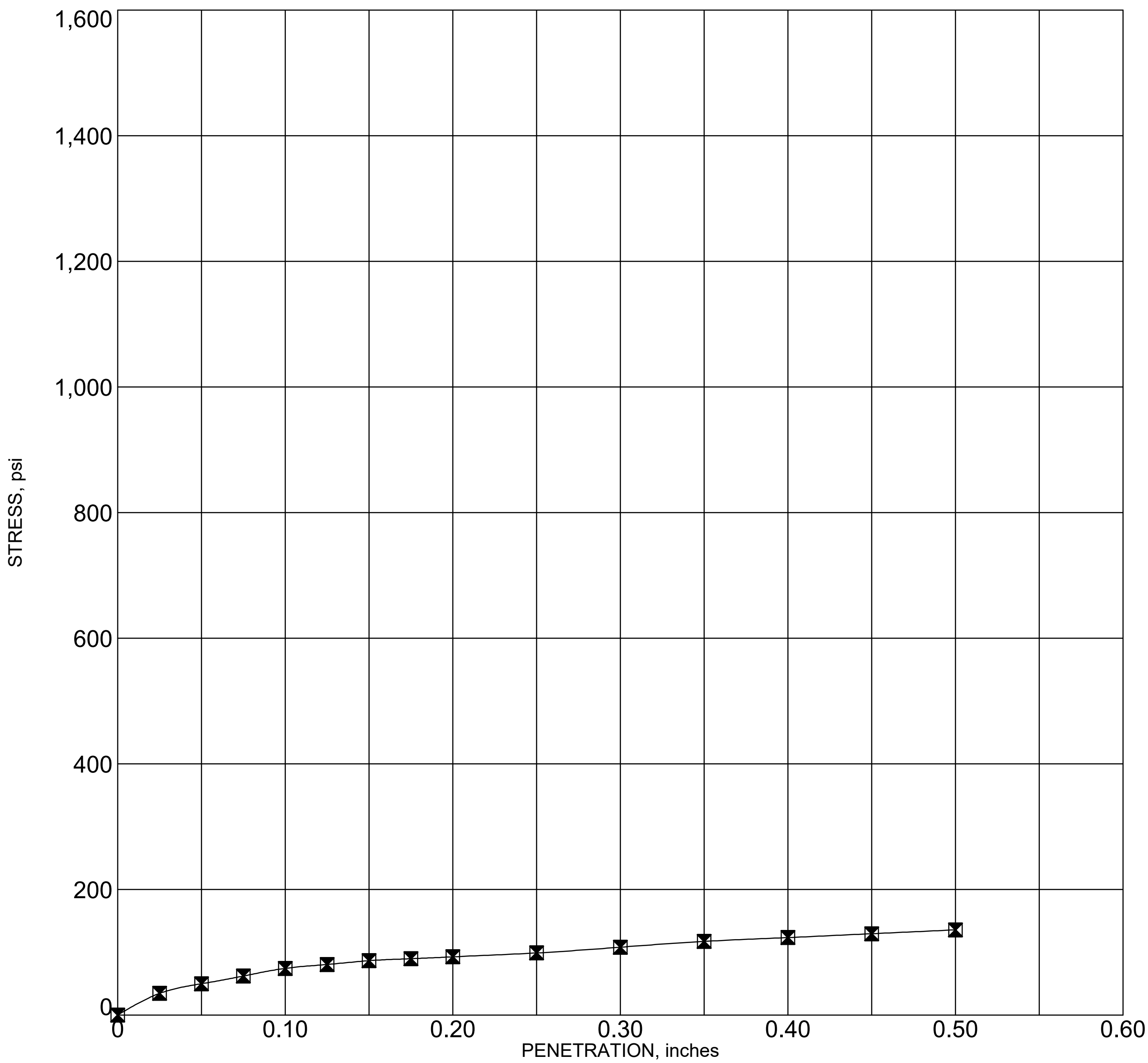
CALIFORNIA BEARING RATIO - ASTM D1883

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 61



Corr. CBR @ 0.1"	7.4
Corr. CBR @ 0.2"	6.2
Swell (%)	3.45

Sample: BULK-336
Depth: 0.0 - 3.0 feet
Description: Brown sandy clay

Molding Dry Density (pcf)	105.8	Hammer Wt. (lbs)	10
Molding Moisture (%)	19.0	Hammer Drop (inches)	18
Days Soaked	5	No. of Blows	56
Aggregate	3/4 inch minus	No. of Layers	5

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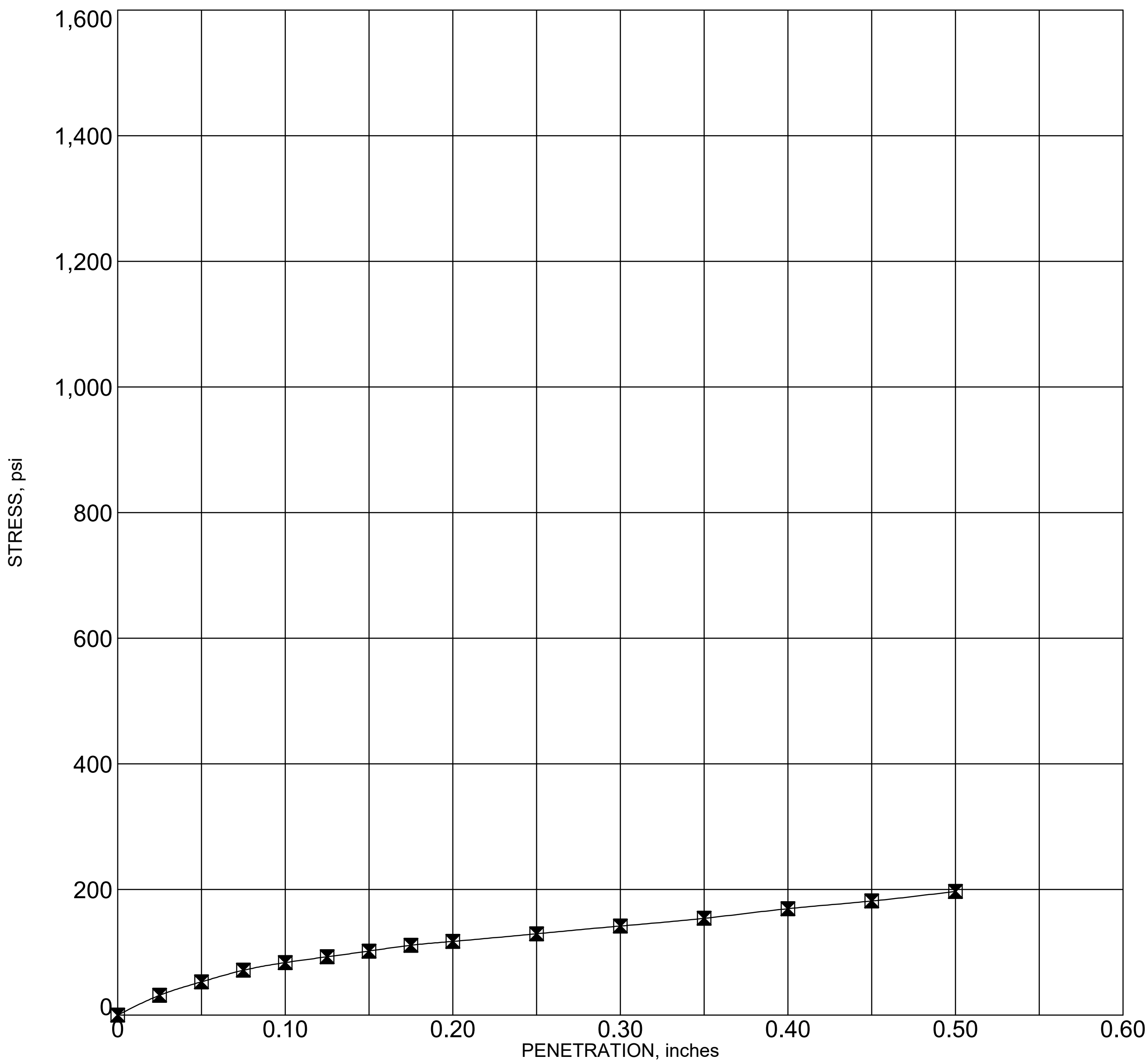
CALIFORNIA BEARING RATIO - ASTM D1883

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 62

G CBR 8135-00.GPJ GEOLABS.GDT 11/22/20



Corr. CBR @ 0.1"	8.4
Corr. CBR @ 0.2"	7.8
Swell (%)	2.86

Sample: BULK-338
Depth: 0.0 - 2.0 feet
Description: Brown clayey silt

Molding Dry Density (pcf)	109.8	Hammer Wt. (lbs)	10
Molding Moisture (%)	20.0	Hammer Drop (inches)	18
Days Soaked	5	No. of Blows	56
Aggregate	3/4 inch minus	No. of Layers	5

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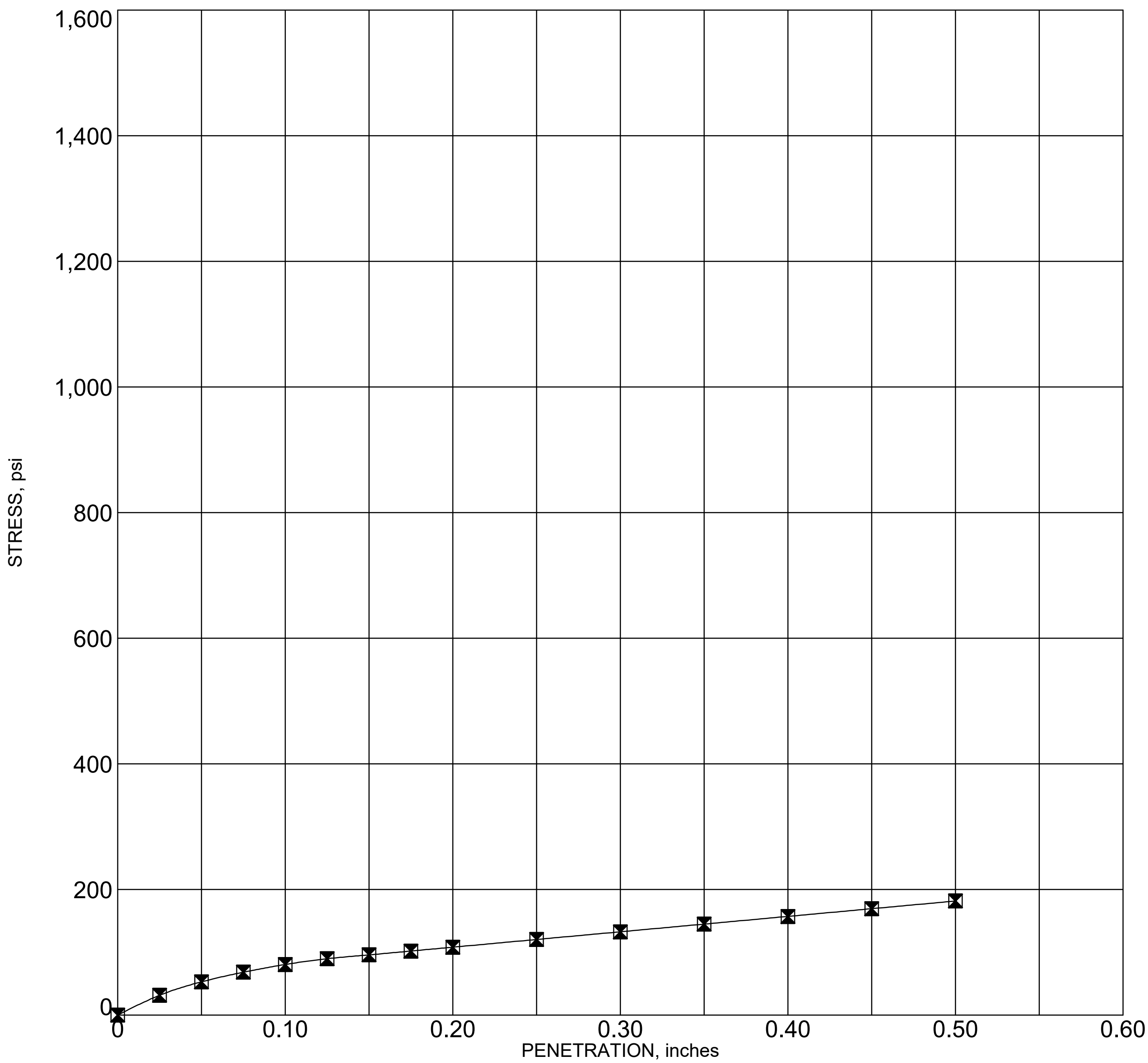
CALIFORNIA BEARING RATIO - ASTM D1883

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 63



Corr. CBR @ 0.1"	8.0
Corr. CBR @ 0.2"	7.2
Swell (%)	2.92

Sample: BULK-340
Depth: 0.0 - 2.0 feet
Description: Brown silty clay

Molding Dry Density (pcf)	109.6	Hammer Wt. (lbs)	10
Molding Moisture (%)	19.9	Hammer Drop (inches)	18
Days Soaked	5	No. of Blows	56
Aggregate	3/4 inch minus	No. of Layers	5

GEOLABS, INC.
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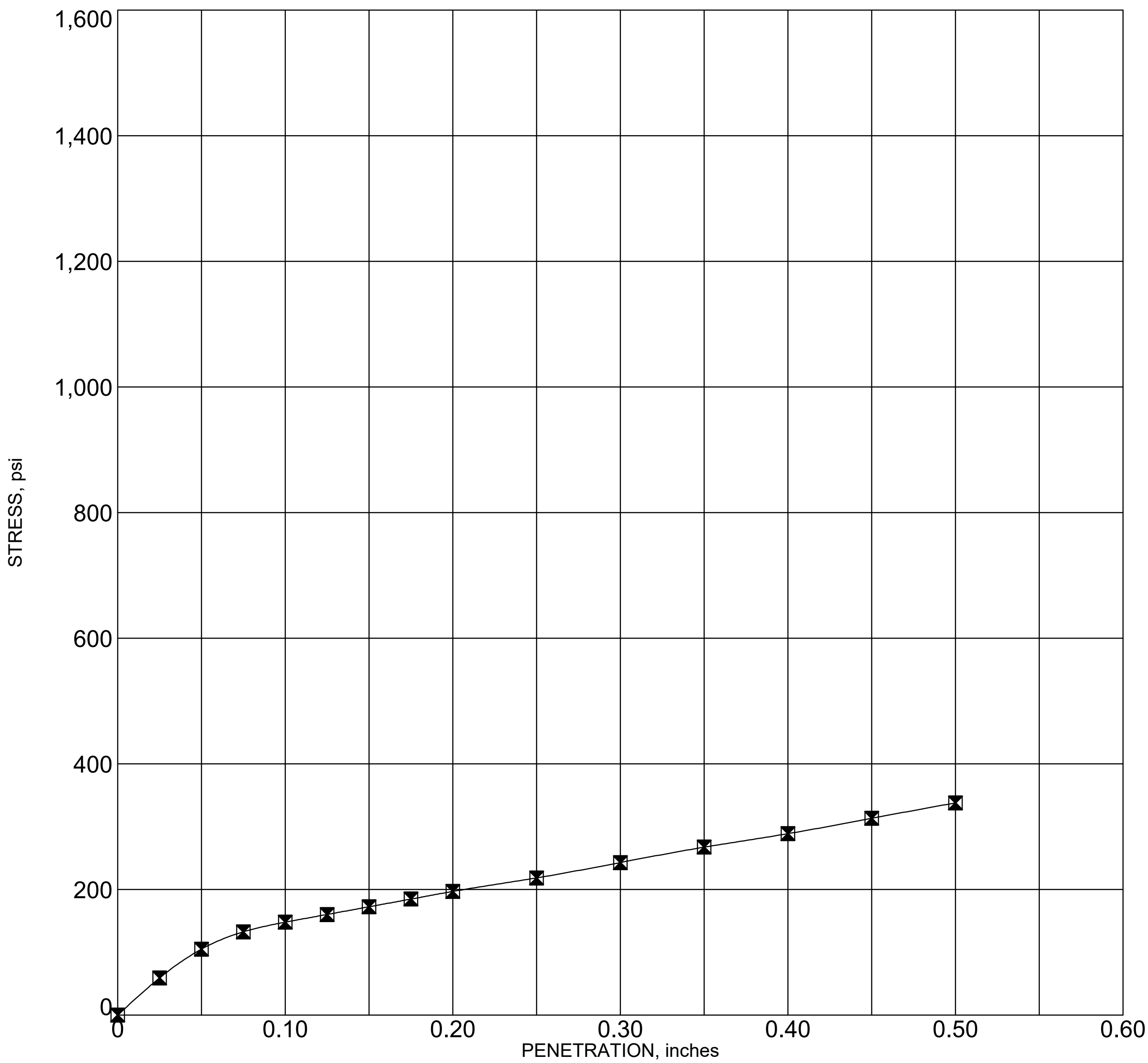
W.O. 8135-00

CALIFORNIA BEARING RATIO - ASTM D1883

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 64

G_CBR 8135-00.GPJ GEOLABS.GDT 11/22/20



Corr. CBR @ 0.1"	14.8
Corr. CBR @ 0.2"	13.1
Swell (%)	1.31

Sample: BULK-343
Depth: 0.0 - 5.0 feet
Description: Brown silty clay

Molding Dry Density (pcf)	109.1	Hammer Wt. (lbs)	10
Molding Moisture (%)	21.3	Hammer Drop (inches)	18
Days Soaked	5	No. of Blows	56
Aggregate	3/4 inch minus	No. of Layers	5

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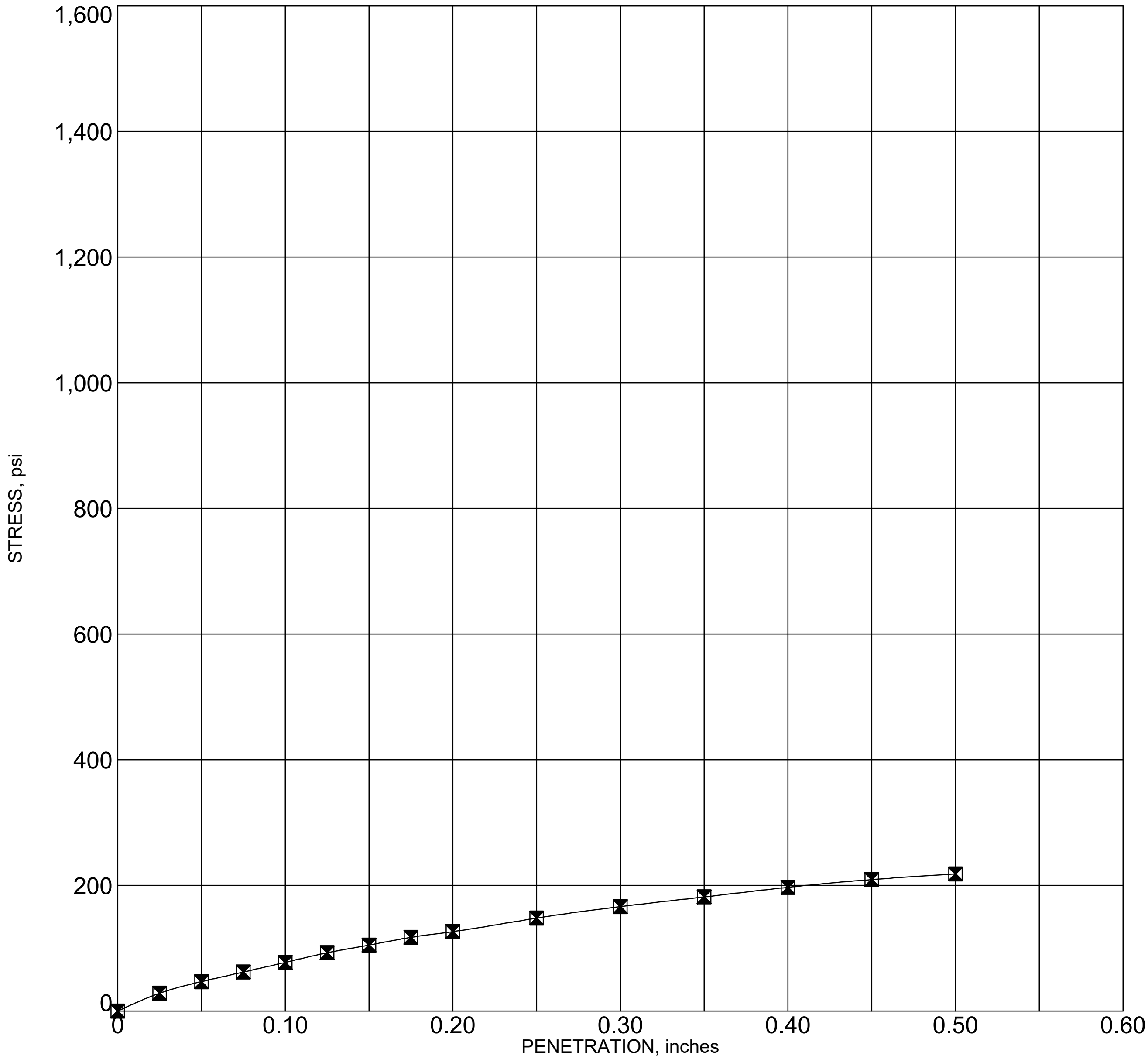
W.O. 8135-00

CALIFORNIA BEARING RATIO - ASTM D1883

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 65

G_CBR 8135-00.GPJ GEOLABS.GDT 11/22/20



Corr. CBR @ 0.1"	7.7
Corr. CBR @ 0.2"	8.4
Swell (%)	1.20

Sample: BULK-345
Depth: 0.0 - 4.0 feet
Description: Brown clayey silt

Molding Dry Density (pcf)	105.9	Hammer Wt. (lbs)	10
Molding Moisture (%)	20.0	Hammer Drop (inches)	18
Days Soaked	5	No. of Blows	56
Aggregate	3/4 inch minus	No. of Layers	5

GEOLABS, INC.
GEOTECHNICAL ENGINEERING
W.O. 8135-00

CALIFORNIA BEARING RATIO - ASTM D1883

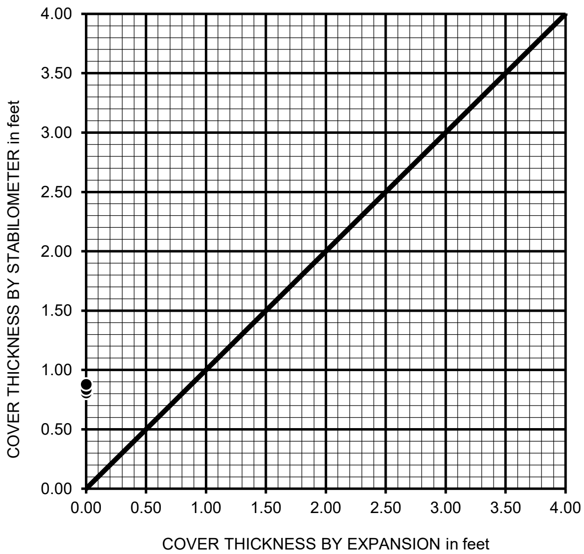
FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 66

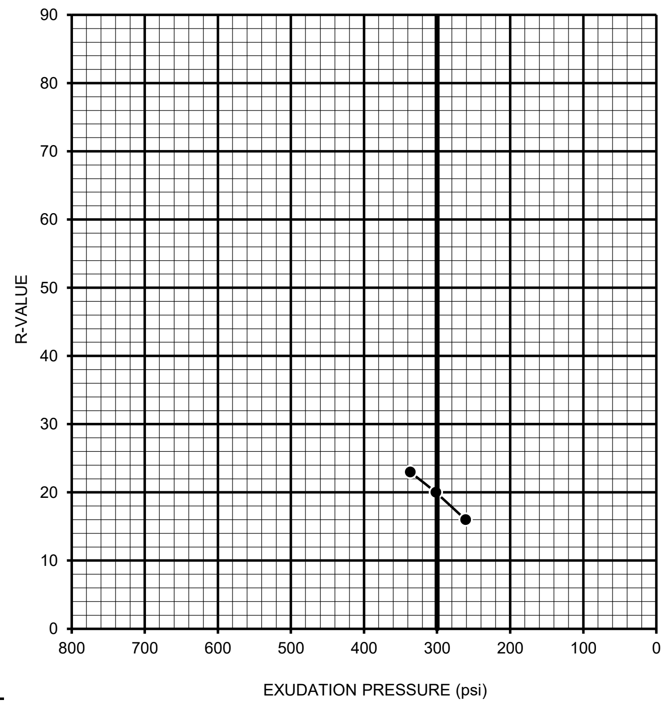
TEST SPECIMEN	a	b	c
MOISTURE AT COMPACTION, %	23.9	24.4	25.0
HEIGHT OF SAMPLE, inches	2.55	2.49	2.56
DRY DENSITY, pcf	107.5	105.5	104.8
COMPACTOR AIR PRESSURE, psi	50	50	50
EXUDATION PRESSURE, psi	337	302	261
EXPANSION, inches x 10exp-4	0	0	0
STABILITY Ph 2,000 lbs (160 psi)	99	105	113
TURNS DISPLACEMENT	5.26	5.32	5.33
R-VALUE UNCORRECTED	23	20	16
R-VALUE CORRECTED	23	20	16

DESIGN CALCULATION DATA	a	b	c
GRAVEL EQUIVALENT NEEDED, ft.	1.23	1.28	1.34
TRAFFIC INDEX		5.0	
STABILOMETER THICKNESS, ft.	0.80	0.84	0.88
EXPANSION PRESSURE THICKNESS, ft.	0.00	0.00	0.00

EXPANSION PRESSURE CHART



EXUDATION PRESSURE CHART



R-VALUE BY EXPANSION: NOT APPLICABLE
R-VALUE BY EXUDATION: 20

Sample Location	Job No.	Description	Equilibrium R-Value
BULK-305	8135-00	CLAY	20

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 2844/CT 301

122385

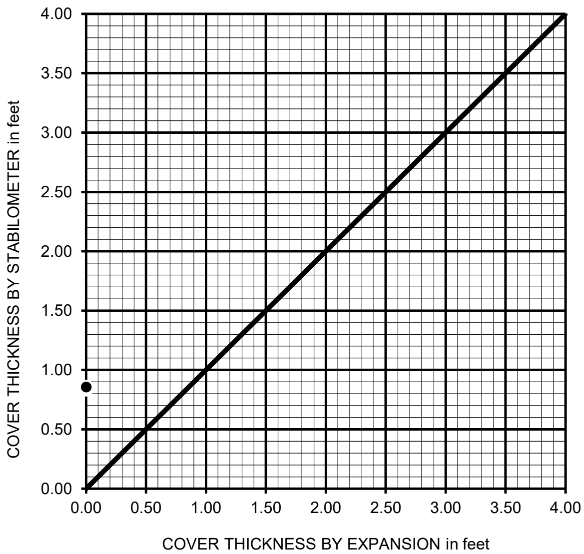
R-VALUE TEST RESULTS
GEOLABS INC.
FARRINGTON HIGHWAY
108026001 10/20

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

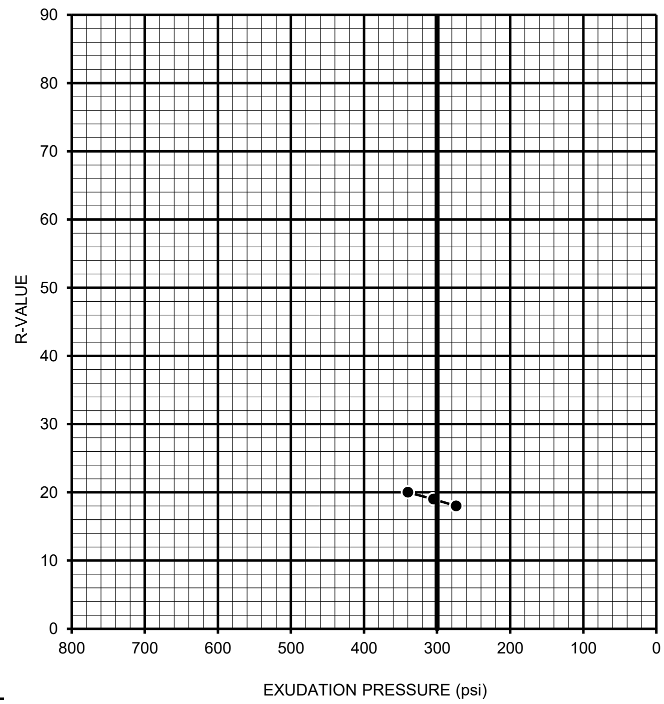
TEST SPECIMEN	a	b	c
MOISTURE AT COMPACTION, %	24.3	24.8	25.3
HEIGHT OF SAMPLE, inches	2.51	2.53	2.51
DRY DENSITY, pcf	106.0	104.9	108.9
COMPACTOR AIR PRESSURE, psi	50	50	50
EXUDATION PRESSURE, psi	340	305	274
EXPANSION, inches x 10exp-4	0	0	0
STABILITY Ph 2,000 lbs (160 psi)	105	107	110
TURNS DISPLACEMENT	5.16	5.19	5.24
R-VALUE UNCORRECTED	20	19	18
R-VALUE CORRECTED	20	19	18

DESIGN CALCULATION DATA	a	b	c
GRAVEL EQUIVALENT NEEDED, ft.	1.28	1.30	1.31
TRAFFIC INDEX		5.0	
STABILOMETER THICKNESS, ft.	0.84	0.85	0.86
EXPANSION PRESSURE THICKNESS, ft.	0.00	0.00	0.00

EXPANSION PRESSURE CHART



EXUDATION PRESSURE CHART



R-VALUE BY EXPANSION: NOT APPLICABLE
R-VALUE BY EXUDATION: 19

Sample Location	Job No.	Description	Equilibrium R-Value
BULK-309	8135	CLAY	19

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 2844/CT 301

122386

R-VALUE TEST RESULTS

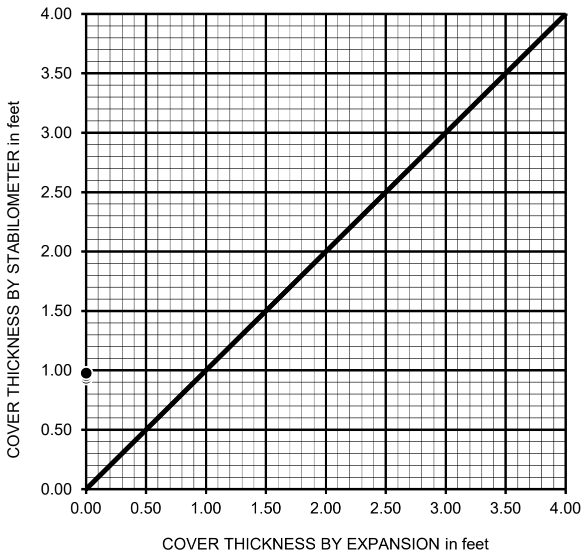
GEOLABS INC.
FARRINGTON HIGHWAY
108026001 10/20

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

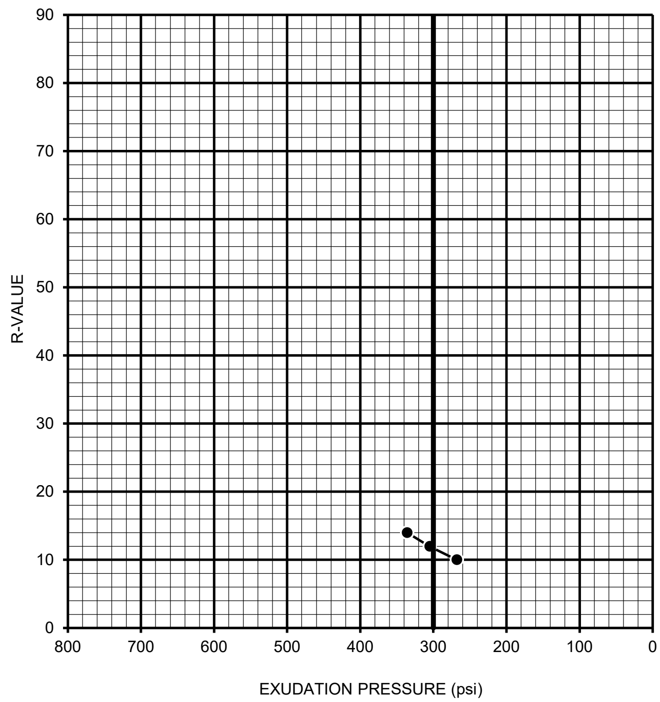
TEST SPECIMEN	a	b	c
MOISTURE AT COMPACTION, %	24.9	25.4	25.9
HEIGHT OF SAMPLE, inches	2.56	2.45	2.46
DRY DENSITY, pcf	102.9	100.3	96.8
COMPACTOR AIR PRESSURE, psi	50	50	50
EXUDATION PRESSURE, psi	336	305	268
EXPANSION, inches x 10exp-4	0	0	0
STABILITY Ph 2,000 lbs (160 psi)	119	124	128
TURNS DISPLACEMENT	5.27	5.31	5.39
R-VALUE UNCORRECTED	14	12	10
R-VALUE CORRECTED	14	12	10

DESIGN CALCULATION DATA	a	b	c
GRAVEL EQUIVALENT NEEDED, ft.	1.38	1.41	1.44
TRAFFIC INDEX		5.0	
STABILOMETER THICKNESS, ft.	0.93	0.95	0.98
EXPANSION PRESSURE THICKNESS, ft.	0.00	0.00	0.00

EXPANSION PRESSURE CHART



EXUDATION PRESSURE CHART



R-VALUE BY EXPANSION: NOT APPLICABLE
R-VALUE BY EXUDATION: 12

Sample Location	Job No	Description	Equilibrium R-Value
BULK-314	8135-00	CLAY	12

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 2844/CT 301

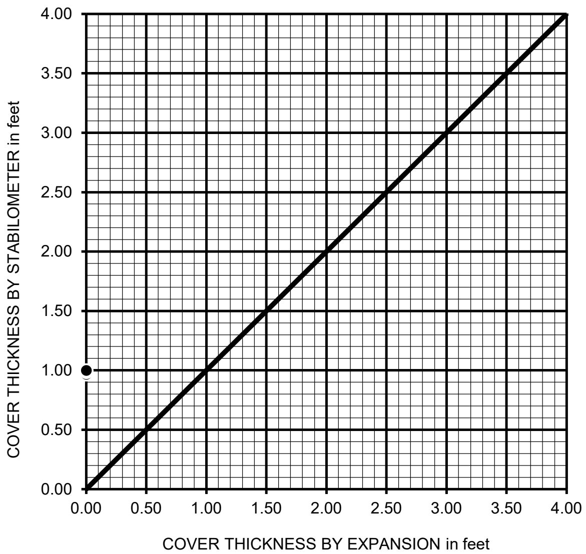
Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

R-VALUE TEST RESULTS
GEOLABS INC.
FARRINGTON HIGHWAY
108062001 10/20

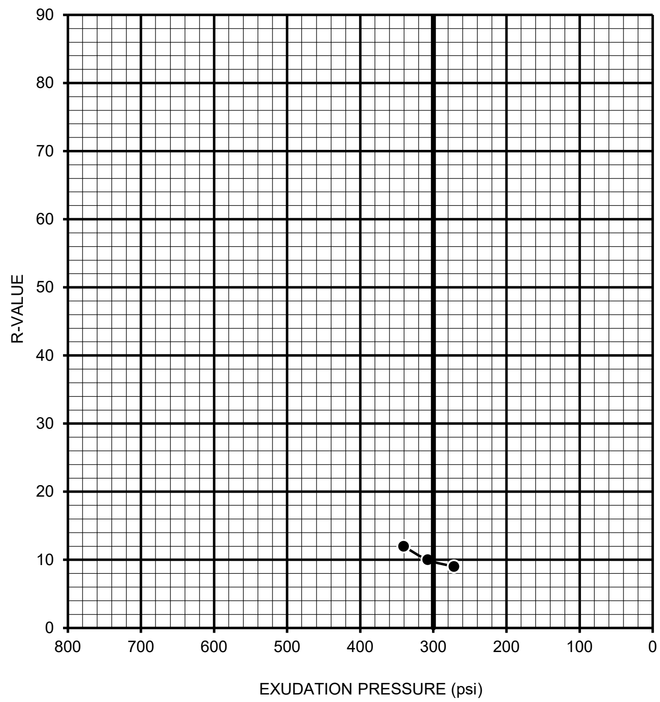
TEST SPECIMEN	a	b	c
MOISTURE AT COMPACTION, %	26.1	26.6	27.0
HEIGHT OF SAMPLE, inches	2.46	2.52	2.56
DRY DENSITY, pcf	93.6	94.2	91.3
COMPACTOR AIR PRESSURE, psi	50	50	50
EXUDATION PRESSURE, psi	341	308	272
EXPANSION, inches x 10exp-4	0	0	0
STABILITY Ph 2,000 lbs (160 psi)	125	129	132
TURNS DISPLACEMENT	5.34	5.37	5.44
R-VALUE UNCORRECTED	12	10	9
R-VALUE CORRECTED	12	10	9

DESIGN CALCULATION DATA	a	b	c
GRAVEL EQUIVALENT NEEDED, ft.	1.41	1.44	1.46
TRAFFIC INDEX		5.0	
STABILOMETER THICKNESS, ft.	0.96	0.99	1.00
EXPANSION PRESSURE THICKNESS, ft.	0.00	0.00	0.00

EXPANSION PRESSURE CHART



EXUDATION PRESSURE CHART



R-VALUE BY EXPANSION: NOT APPLICABLE

R-VALUE BY EXUDATION: 10

Sample Location	Job No.	Description	Equilibrium R-Value
BULK-319	8135-00	CLAY	10

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 2844/CT 301

122375

R-VALUE TEST RESULTS

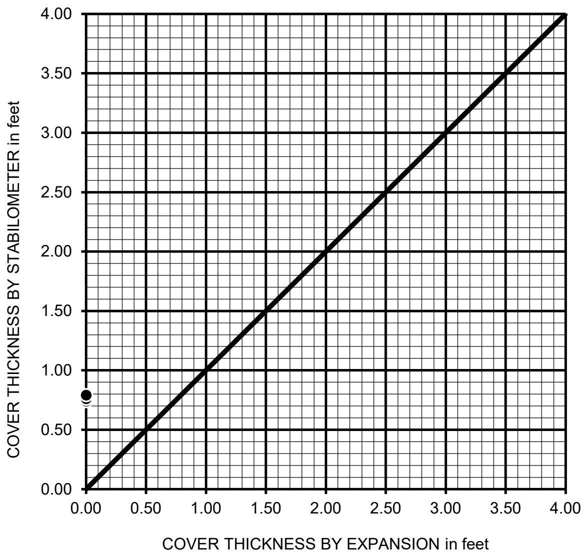
GEOLABS INC.
FARRINGTON HIGHWAY
108062001 10/20

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

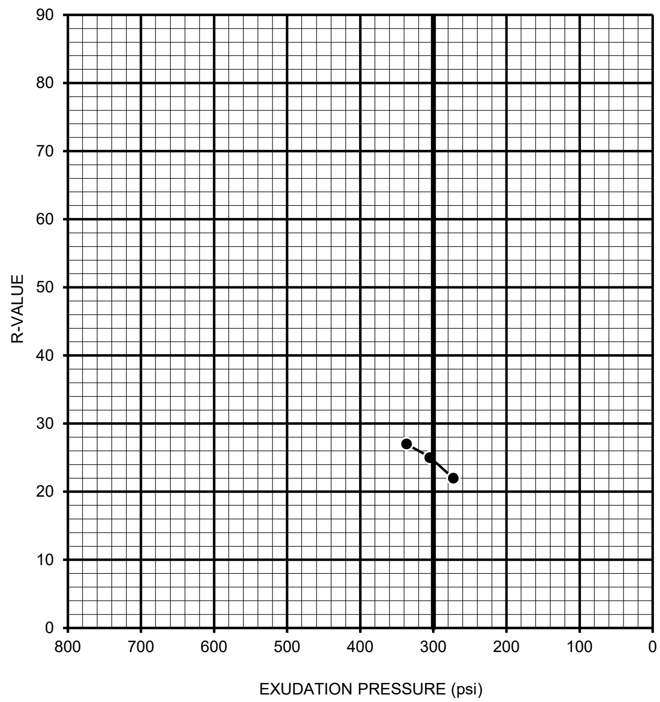
TEST SPECIMEN	a	b	c
MOISTURE AT COMPACTION, %	24.6	25.1	25.6
HEIGHT OF SAMPLE, inches	2.45	2.54	2.55
DRY DENSITY, pcf	98.4	97.5	96.5
COMPACTOR AIR PRESSURE, psi	50	50	50
EXUDATION PRESSURE, psi	337	305	273
EXPANSION, inches x 10exp-4	0	0	0
STABILITY Ph 2,000 lbs (160 psi)	92	95	102
TURNS DISPLACEMENT	5.09	5.14	5.19
R-VALUE UNCORRECTED	27	25	22
R-VALUE CORRECTED	27	25	22

DESIGN CALCULATION DATA	a	b	c
GRAVEL EQUIVALENT NEEDED, ft.	1.17	1.20	1.25
TRAFFIC INDEX		5.0	
STABILOMETER THICKNESS, ft.	0.74	0.76	0.79
EXPANSION PRESSURE THICKNESS, ft.	0.00	0.00	0.00

EXPANSION PRESSURE CHART



EXUDATION PRESSURE CHART



R-VALUE BY EXPANSION: NOT APPLICABLE
R-VALUE BY EXUDATION: 25

Sample Location	Job No.	Description	Equilibrium R-Value
BULK-323	8135-00	Sandy SILT	25

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 2844/CT 301

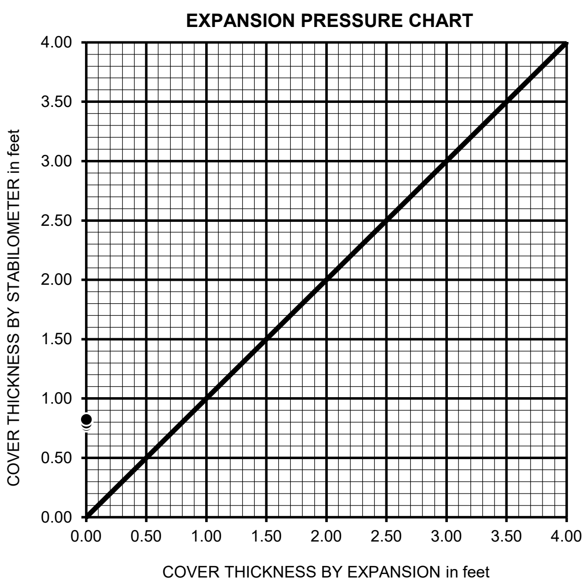
122062

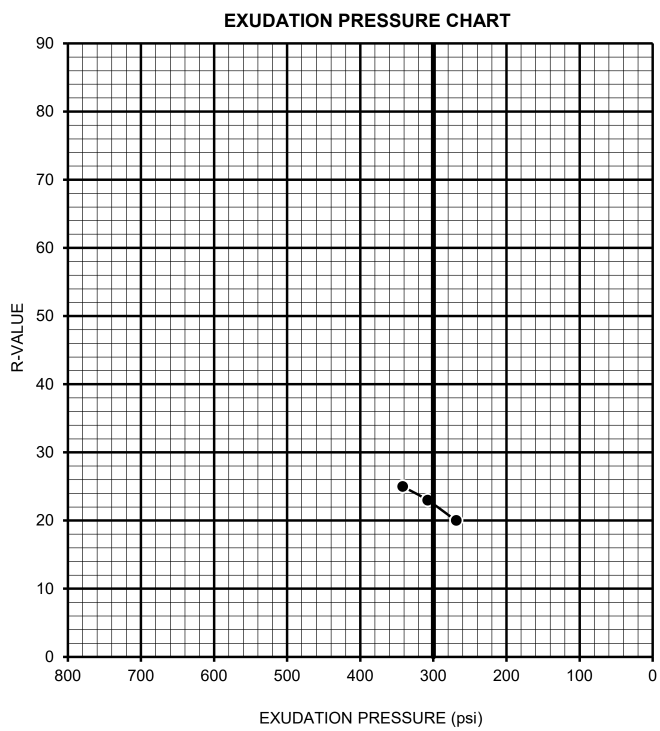
Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

R-VALUE TEST RESULTS
GEOLABS INC.
FARRINGTON HIGHWAY
108026001 9/20

TEST SPECIMEN	a	b	c
MOISTURE AT COMPACTION, %	24.9	25.4	25.9
HEIGHT OF SAMPLE, inches	2.44	2.54	2.54
DRY DENSITY, pcf	98.4	97.9	101.0
COMPACTOR AIR PRESSURE, psi	50	50	50
EXUDATION PRESSURE, psi	342	308	269
EXPANSION, inches x 10exp-4	0	0	0
STABILITY Ph 2,000 lbs (160 psi)	95	99	105
TURNS DISPLACEMENT	5.13	5.19	5.22
R-VALUE UNCORRECTED	25	23	20
R-VALUE CORRECTED	25	23	20

DESIGN CALCULATION DATA	a	b	c
GRAVEL EQUIVALENT NEEDED, ft.	1.20	1.23	1.28
TRAFFIC INDEX		5.0	
STABILOMETER THICKNESS, ft.	0.77	0.79	0.82
EXPANSION PRESSURE THICKNESS, ft.	0.00	0.00	0.00





R-VALUE BY EXPANSION: NOT APPLICABLE
R-VALUE BY EXUDATION: 22

Sample Location	Job No.	Description	Equilibrium R-Value
BULK-329	8135	Sandy SILT	22

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 2844/CT 301

122063

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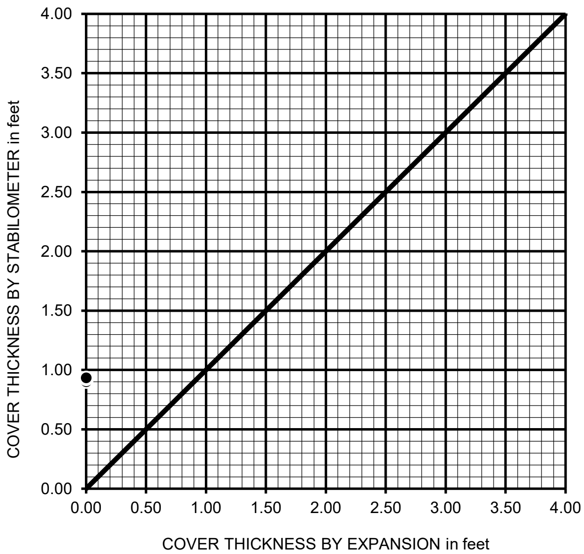
Geotechnical & Environmental Sciences Consultants

R-VALUE TEST RESULTS
GEOLABS INC
FARRINGTON HIGHWAY
108026001 9/20

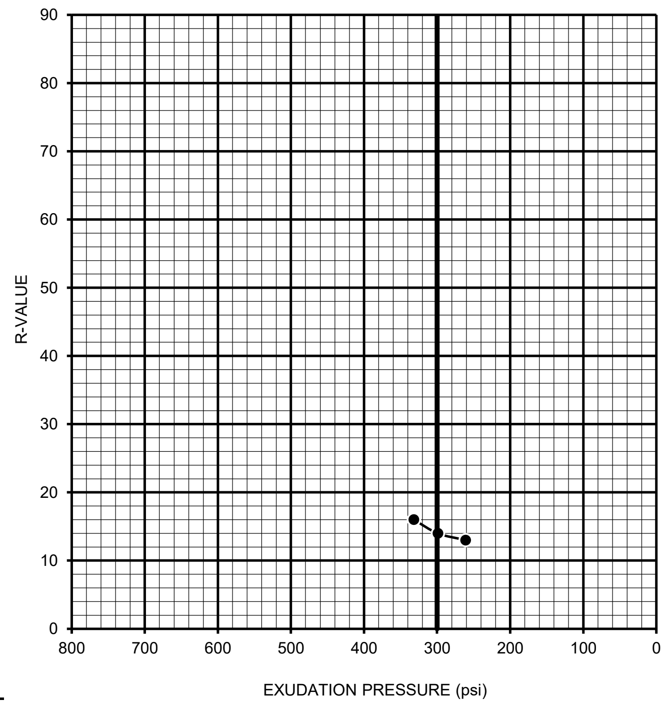
TEST SPECIMEN	a	b	c
MOISTURE AT COMPACTION, %	24.3	24.8	25.3
HEIGHT OF SAMPLE, inches	2.49	2.54	2.51
DRY DENSITY, pcf	100.3	98.8	97.6
COMPACTOR AIR PRESSURE, psi	50	50	50
EXUDATION PRESSURE, psi	332	299	261
EXPANSION, inches x 10exp-4	0	0	0
STABILITY Ph 2,000 lbs (160 psi)	116	120	123
TURNS DISPLACEMENT	5.05	5.06	5.12
R-VALUE UNCORRECTED	16	14	13
R-VALUE CORRECTED	16	14	13

DESIGN CALCULATION DATA	a	b	c
GRAVEL EQUIVALENT NEEDED, ft.	1.34	1.38	1.39
TRAFFIC INDEX		5.0	
STABILOMETER THICKNESS, ft.	0.90	0.92	0.93
EXPANSION PRESSURE THICKNESS, ft.	0.00	0.00	0.00

EXPANSION PRESSURE CHART



EXUDATION PRESSURE CHART



R-VALUE BY EXPANSION: NOT APPLICABLE
R-VALUE BY EXUDATION: 14

Sample Location	Job No.	Description	Equilibrium R-Value
BULK-332	8135-00	CLAY	14

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 2844/CT 301

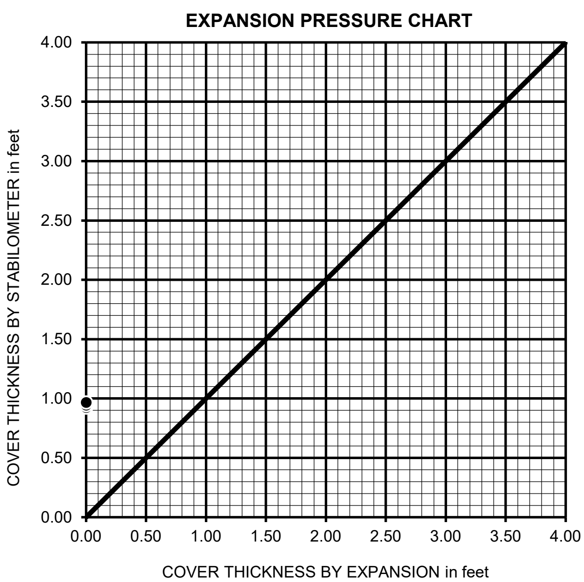
122376

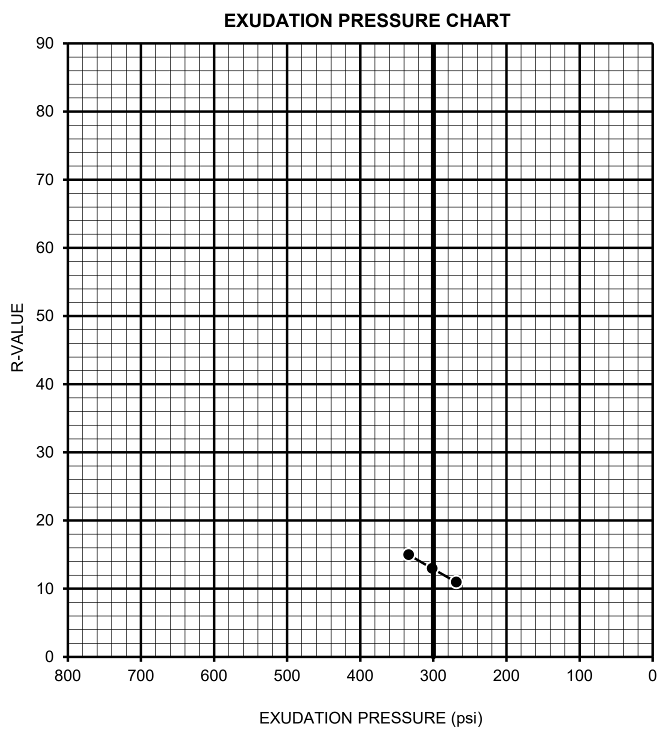
R-VALUE TEST RESULTS
GEOLABS INC.
FARRINGTON HIGHWAY
108026001 10/20

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

TEST SPECIMEN	a	b	c
MOISTURE AT COMPACTION, %	24.6	25.1	25.6
HEIGHT OF SAMPLE, inches	2.53	2.49	2.52
DRY DENSITY, pcf	103.3	99.1	97.1
COMPACTOR AIR PRESSURE, psi	50	50	50
EXUDATION PRESSURE, psi	334	302	269
EXPANSION, inches x 10exp-4	0	0	0
STABILITY Ph 2,000 lbs (160 psi)	117	123	128
TURNS DISPLACEMENT	5.19	5.21	5.28
R-VALUE UNCORRECTED	15	13	11
R-VALUE CORRECTED	15	13	11

DESIGN CALCULATION DATA	a	b	c
GRAVEL EQUIVALENT NEEDED, ft.	1.36	1.39	1.42
TRAFFIC INDEX		5.0	
STABILOMETER THICKNESS, ft.	0.92	0.94	0.97
EXPANSION PRESSURE THICKNESS, ft.	0.00	0.00	0.00





R-VALUE BY EXPANSION: NOT APPLICABLE
R-VALUE BY EXUDATION: 13

Sample Location	Job No.	Description	Equilibrium R-Value
BULK-336	8135-00	CLAY	13

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 2844/CT 301

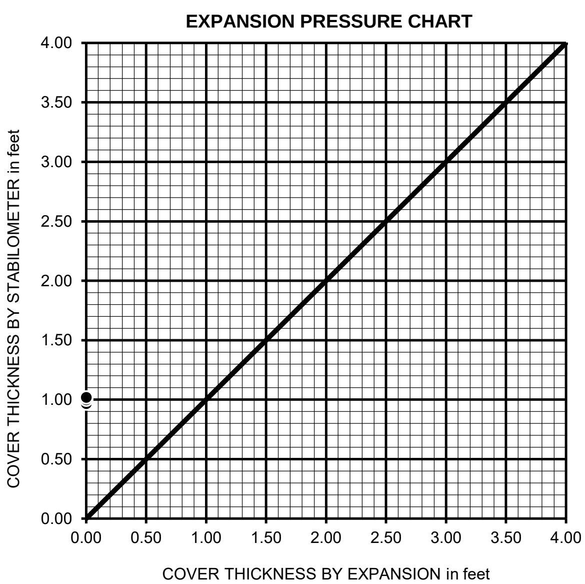
122378

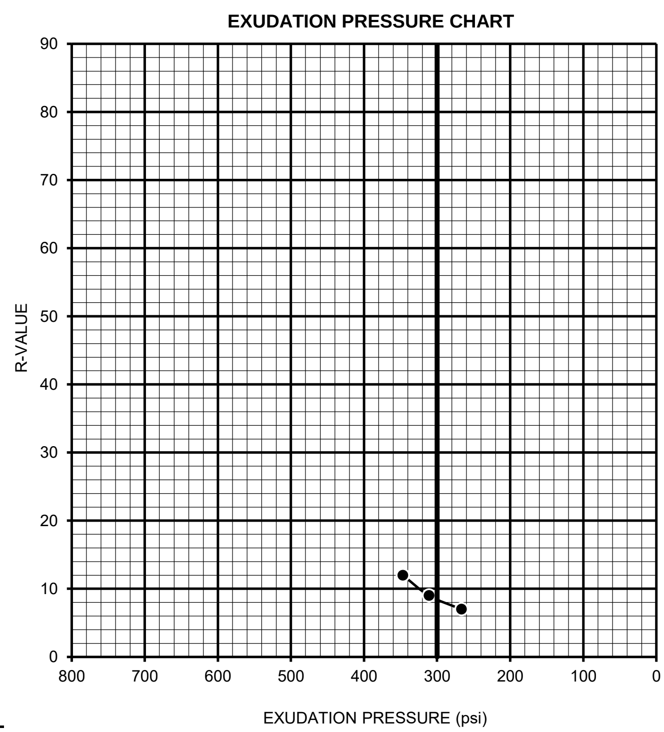
R-VALUE TEST RESULTS
GEOLABS INC.
FARRINGTON HIGHWAY
108026001 10/20

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

TEST SPECIMEN	a	b	c
MOISTURE AT COMPACTION, %	27.8	28.3	28.8
HEIGHT OF SAMPLE, inches	2.54	2.55	2.49
DRY DENSITY, pcf	102.2	100.7	93.2
COMPACTOR AIR PRESSURE, psi	50	50	50
EXUDATION PRESSURE, psi	347	311	267
EXPANSION, inches x 10exp-4	0	0	0
STABILITY Ph 2,000 lbs (160 psi)	126	132	138
TURNS DISPLACEMENT	5.13	5.16	5.17
R-VALUE UNCORRECTED	12	9	7
R-VALUE CORRECTED	12	9	7

DESIGN CALCULATION DATA	a	b	c
GRAVEL EQUIVALENT NEEDED, ft.	1.41	1.46	1.49
TRAFFIC INDEX		5.0	
STABILOMETER THICKNESS, ft.	0.96	1.00	1.02
EXPANSION PRESSURE THICKNESS, ft.	0.00	0.00	0.00





R-VALUE BY EXPANSION: NOT APPLICABLE
R-VALUE BY EXUDATION: 8

Sample Location	Job No.	Description	Equilibrium R-Value
BULK-340	8135-00	CLAY	8

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 2844/CT 301

122377

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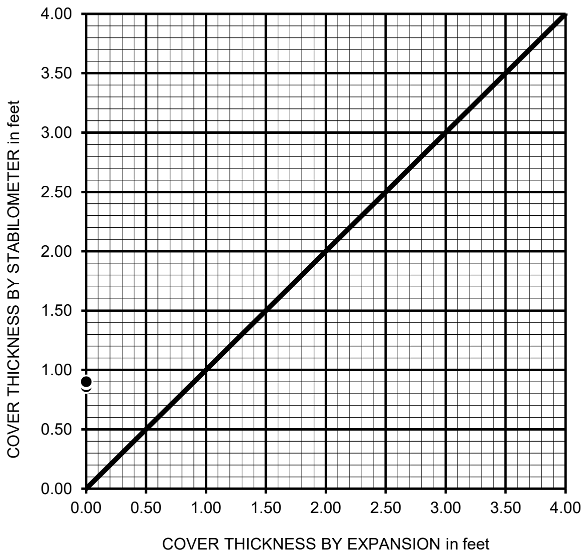
Geotechnical & Environmental Sciences Consultants

R-VALUE TEST RESULTS
GEOLABS INC.
FARRINGTON HIGHWAY
108026001

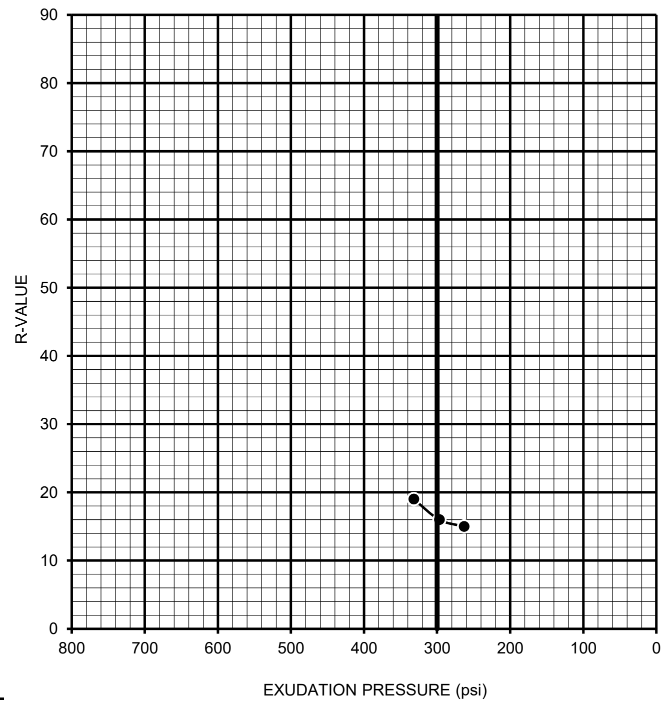
TEST SPECIMEN	a	b	c
MOISTURE AT COMPACTION, %	22.8	23.3	23.8
HEIGHT OF SAMPLE, inches	2.46	2.55	2.56
DRY DENSITY, pcf	103.6	102.4	105.5
COMPACTOR AIR PRESSURE, psi	50	50	50
EXUDATION PRESSURE, psi	332	297	263
EXPANSION, inches x 10exp-4	0	0	0
STABILITY Ph 2,000 lbs (160 psi)	109	115	117
TURNS DISPLACEMENT	5.04	5.21	5.21
R-VALUE UNCORRECTED	19	16	15
R-VALUE CORRECTED	19	16	15

DESIGN CALCULATION DATA	a	b	c
GRAVEL EQUIVALENT NEEDED, ft.	1.30	1.34	1.36
TRAFFIC INDEX		5.0	
STABILOMETER THICKNESS, ft.	0.86	0.89	0.90
EXPANSION PRESSURE THICKNESS, ft.	0.00	0.00	0.00

EXPANSION PRESSURE CHART



EXUDATION PRESSURE CHART



R-VALUE BY EXPANSION: NOT APPLICABLE

R-VALUE BY EXUDATION: 16

Sample Location	Job No.	Description	Equilibrium R-Value
BULK-345	8135-00	CLAY	16

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 2844/CT 301

122388

R-VALUE TEST RESULTS

GEOLABS INC.
FARRINGTON HIGHWAY
108026001 10/20

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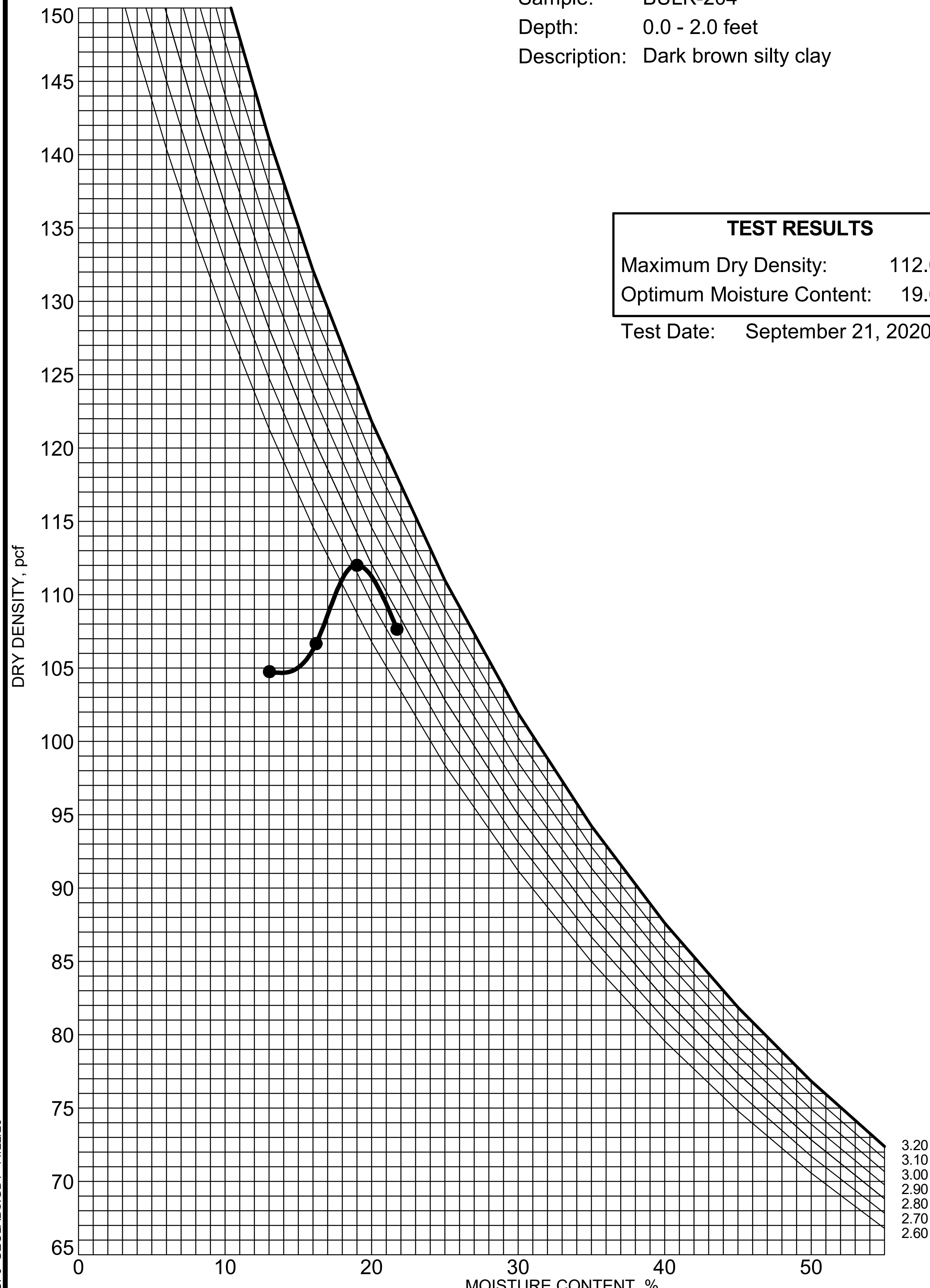
Sample: BULK-204
Depth: 0.0 - 2.0 feet
Description: Dark brown silty clay



TEST RESULTS	
Maximum Dry Density:	112.0 pcf
Optimum Moisture Content:	19.0 %

Test Date: September 21, 2020

G_COMPACTION65 8135-00.GPJ GEOLABS.GDT 11/22/20

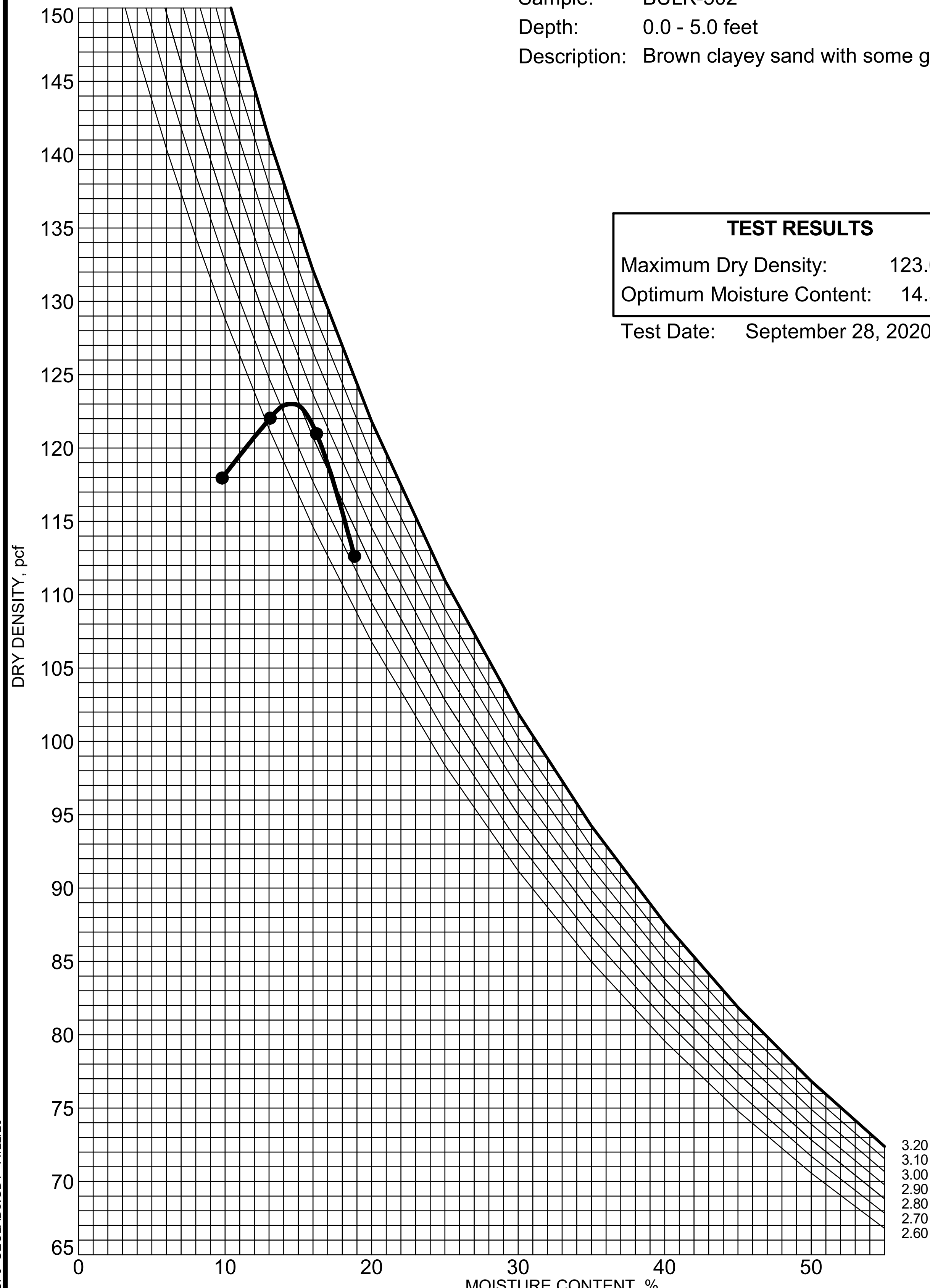
GEOLABS, INC.
GEOTECHNICAL ENGINEERING
W.O. 8135-00

MOISTURE-DENSITY RELATIONSHIP - ASTM D1557 A

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 77

Sample: BULK-302
Depth: 0.0 - 5.0 feet
Description: Brown clayey sand with some gravel



TEST RESULTS	
Maximum Dry Density:	123.0 pcf
Optimum Moisture Content:	14.5 %

Test Date: September 28, 2020

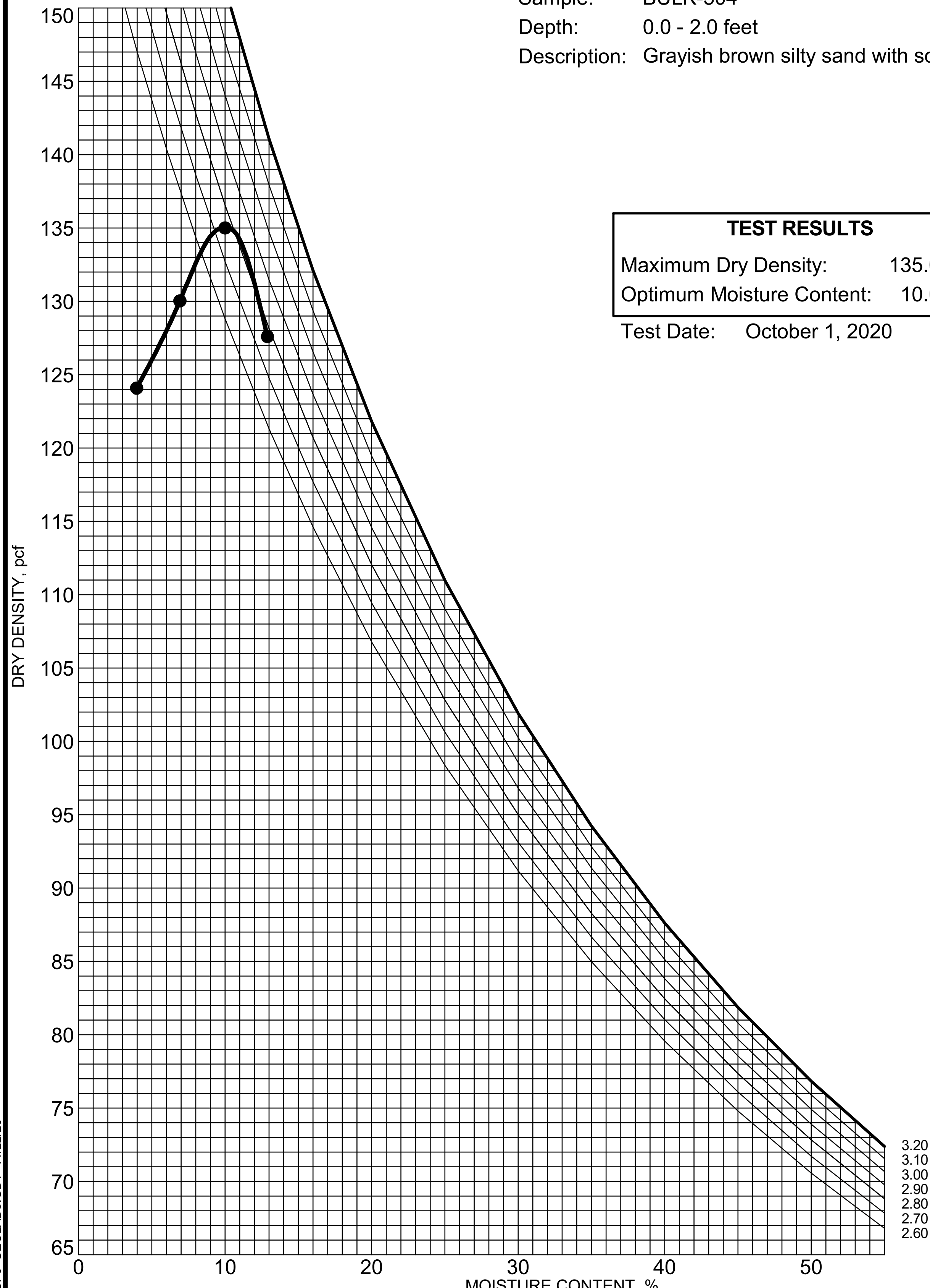
G_COMPACTION65 8135-00.GPJ GEOLABS.GDT 11/22/20

GEOLABS, INC.
GEOTECHNICAL ENGINEERING
W.O. 8135-00

MOISTURE-DENSITY RELATIONSHIP - ASTM D1557 B

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 78



Sample: BULK-304

Depth: 0.0 - 2.0 feet

Description: Grayish brown silty sand with some gravel

TEST RESULTS	
Maximum Dry Density:	135.0 pcf
Optimum Moisture Content:	10.0 %

Test Date: October 1, 2020

G_COMPACTION65 8135-00.GPJ GEOLABS.GDT 11/22/20

GEOLABS, INC.

GEOTECHNICAL ENGINEERING

W.O. 8135-00

MOISTURE-DENSITY RELATIONSHIP - ASTM D1557 B

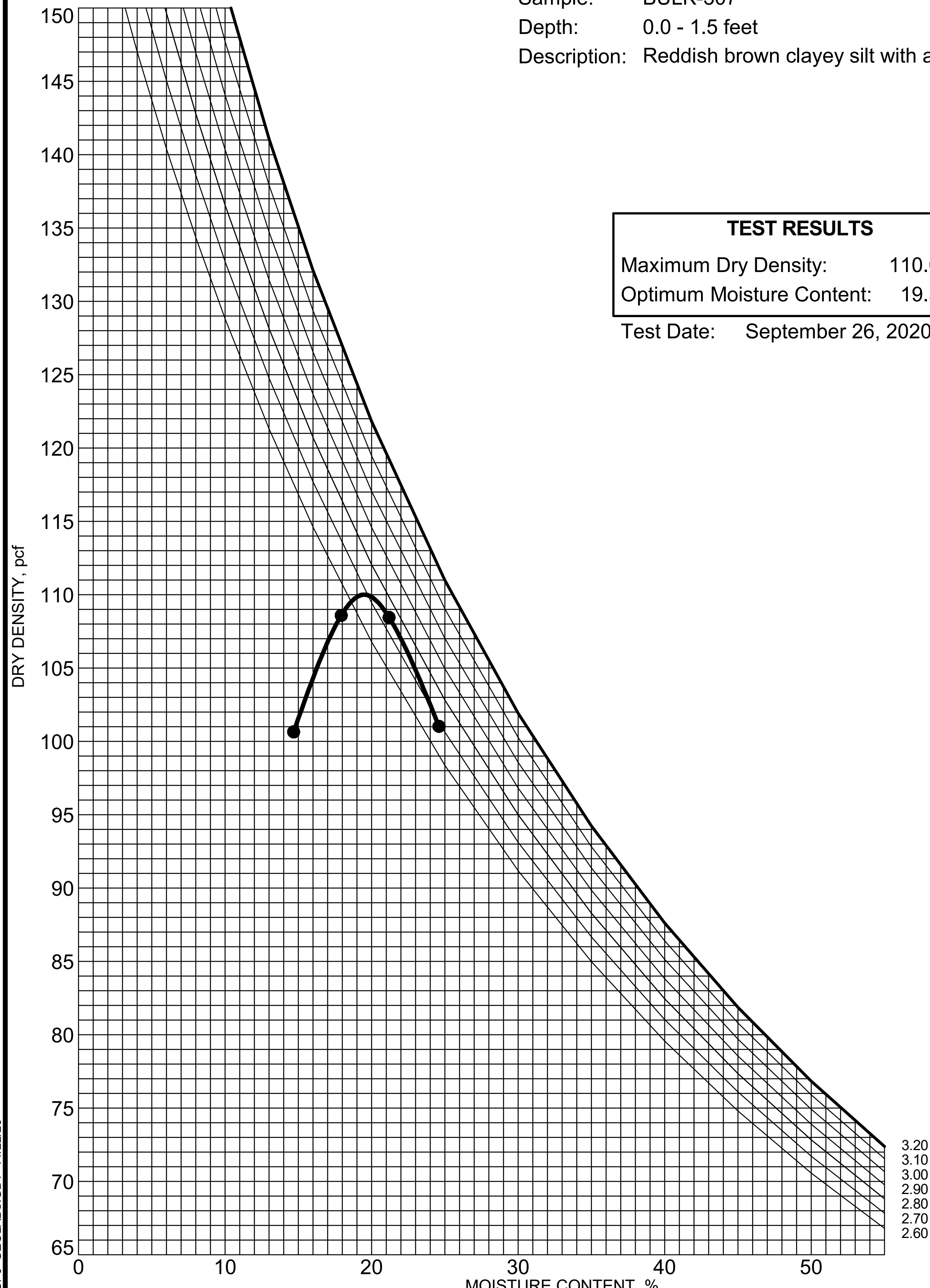
FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 79

Sample: BULK-307
Depth: 0.0 - 1.5 feet
Description: Reddish brown clayey silt with a little sand

TEST RESULTS	
Maximum Dry Density:	110.0 pcf
Optimum Moisture Content:	19.5 %

Test Date: September 26, 2020



G_COMPACTION65 8135-00.GPJ GEOLABS.GDT 11/22/20

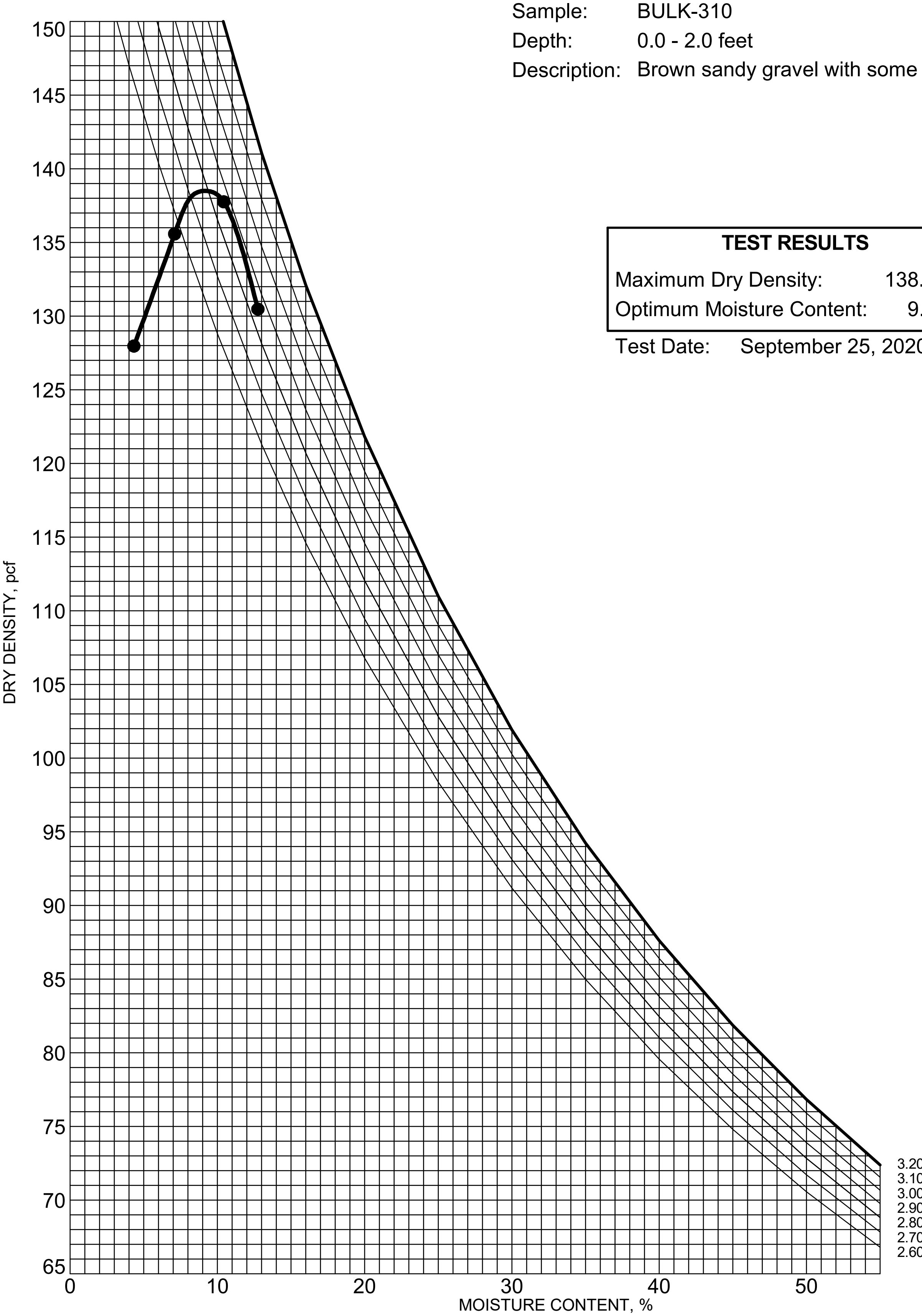
GEOLABS, INC.
GEOTECHNICAL ENGINEERING
W.O. 8135-00

MOISTURE-DENSITY RELATIONSHIP - ASTM D1557 A

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 80

Sample: BULK-310
Depth: 0.0 - 2.0 feet
Description: Brown sandy gravel with some clay



TEST RESULTS	
Maximum Dry Density:	138.5 pcf
Optimum Moisture Content:	9.0 %

Test Date: September 25, 2020

GEOLABS, INC.
GEOTECHNICAL ENGINEERING
W.O. 8135-00

MOISTURE-DENSITY RELATIONSHIP - ASTM D1557 B

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

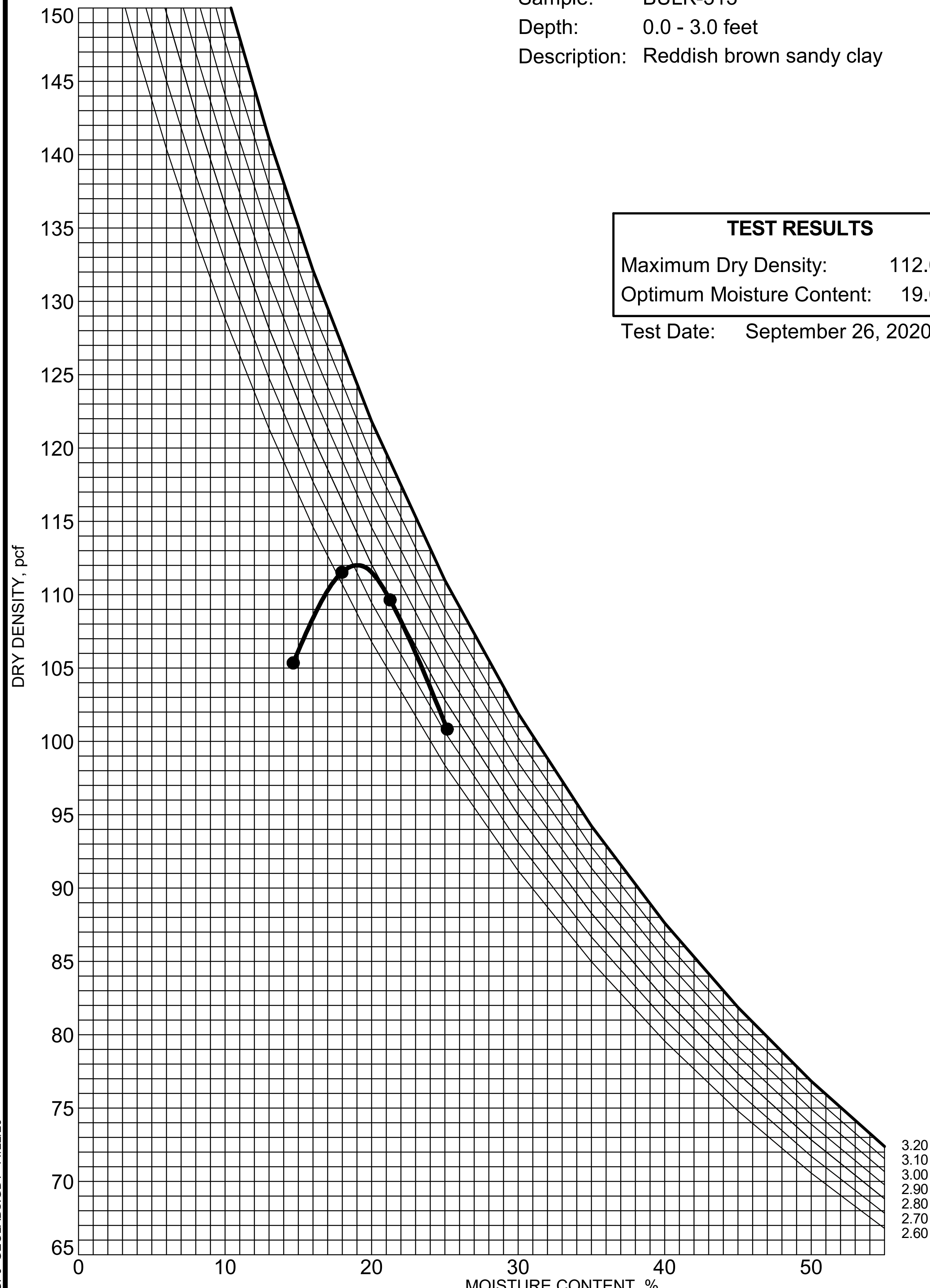
Plate
C - 81

Sample: BULK-313
Depth: 0.0 - 3.0 feet
Description: Reddish brown sandy clay

TEST RESULTS

Maximum Dry Density:	112.0 pcf
Optimum Moisture Content:	19.0 %

Test Date: September 26, 2020



GEOLABS, INC.
GEOTECHNICAL ENGINEERING

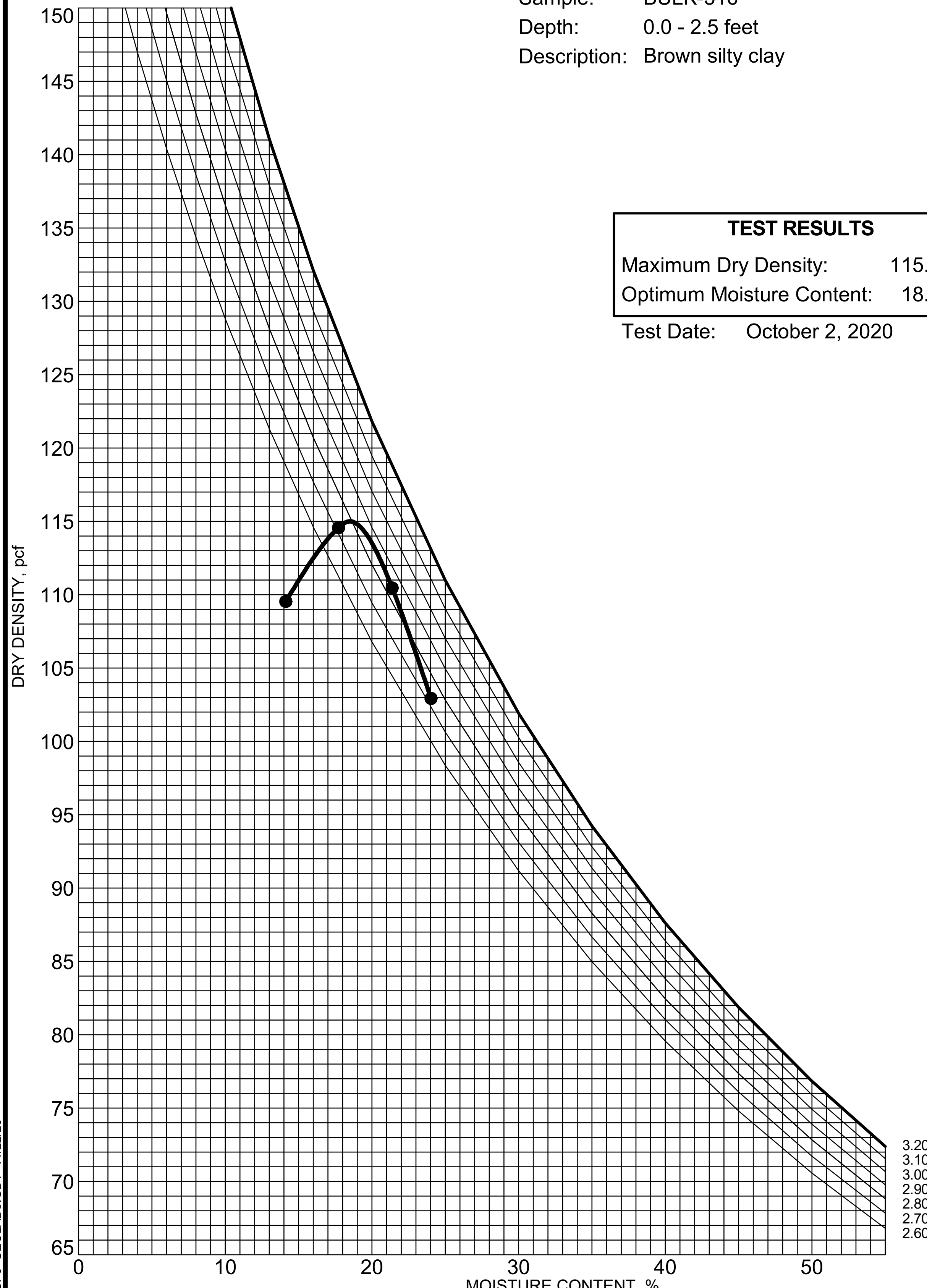
W.O. 8135-00

MOISTURE-DENSITY RELATIONSHIP - ASTM D1557 A

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 82

Sample: BULK-316
Depth: 0.0 - 2.5 feet
Description: Brown silty clay



TEST RESULTS	
Maximum Dry Density:	115.0 pcf
Optimum Moisture Content:	18.5 %

Test Date: October 2, 2020

G_COMPACTION65 8135-00.GPJ GEOLABS.GDT 11/22/20

GEOLABS, INC.
GEOTECHNICAL ENGINEERING

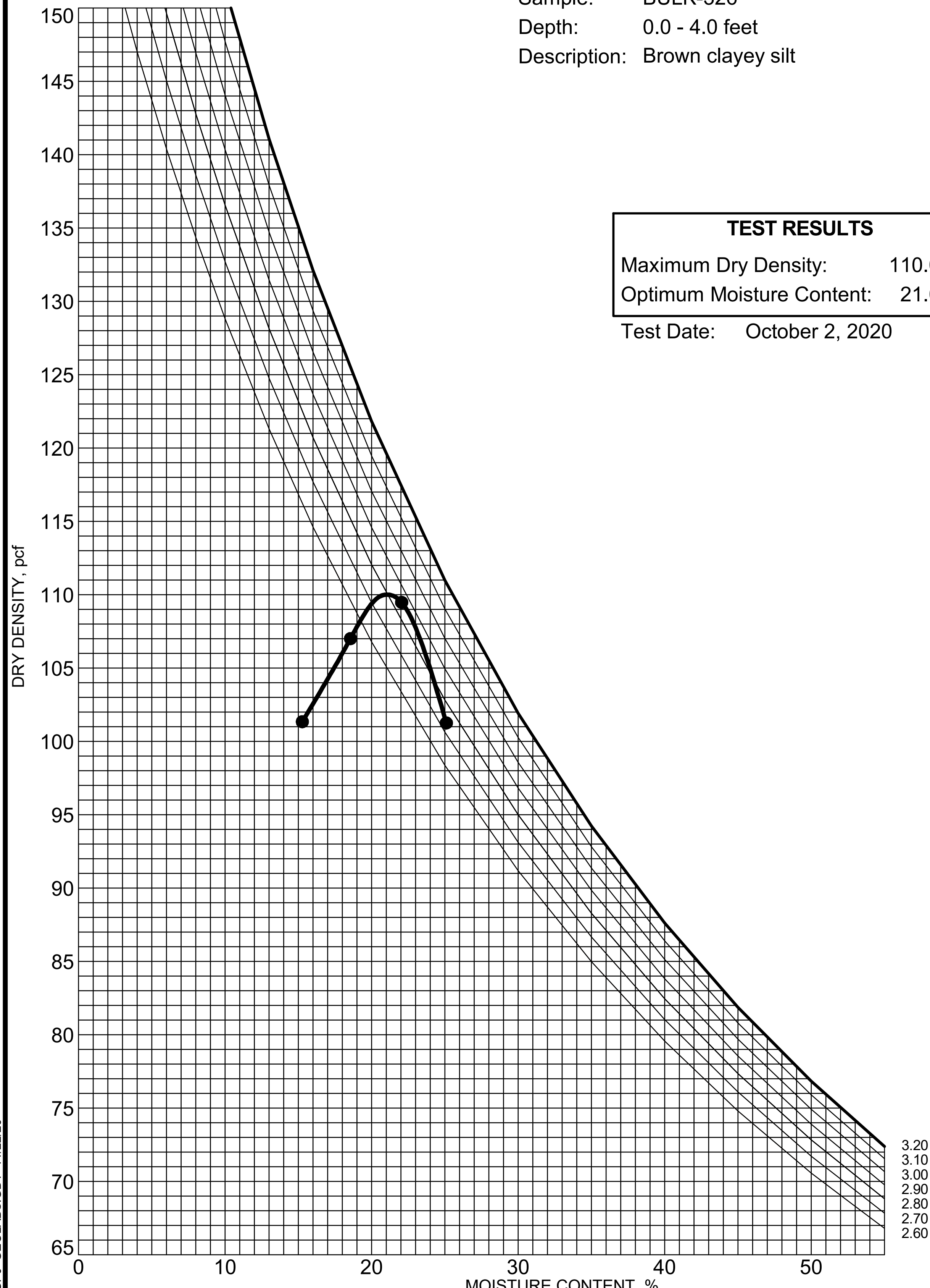
W.O. 8135-00

MOISTURE-DENSITY RELATIONSHIP - ASTM D1557 A

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 83

Sample: BULK-326
Depth: 0.0 - 4.0 feet
Description: Brown clayey silt



TEST RESULTS

Maximum Dry Density:	110.0 pcf
Optimum Moisture Content:	21.0 %

Test Date: October 2, 2020

G COMPACTION65 8135-00.GPJ GEOLABS.GDT 11/22/20

GEOLABS, INC.
GEOTECHNICAL ENGINEERING
W.O. 8135-00

MOISTURE-DENSITY RELATIONSHIP - ASTM D1557 A

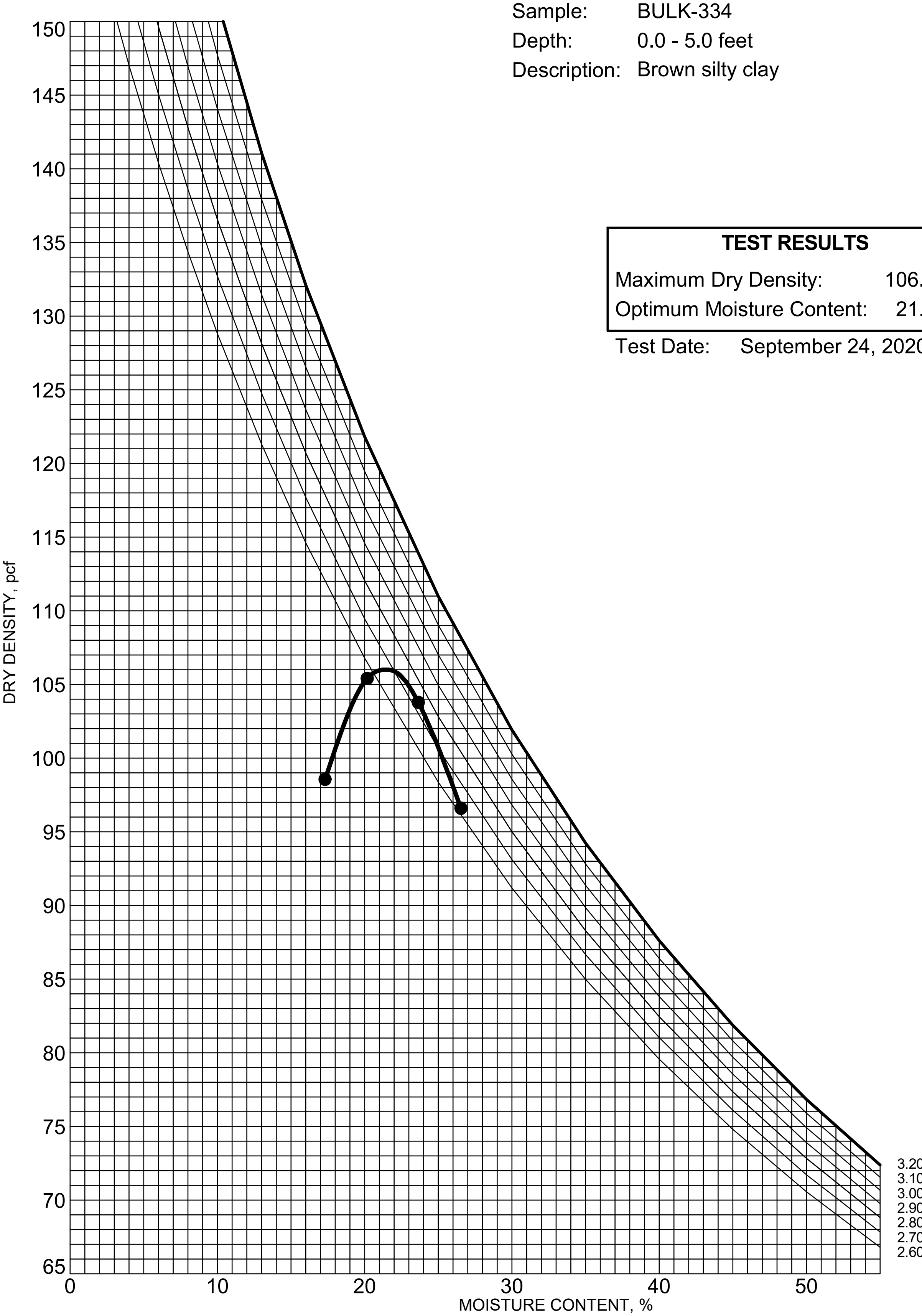
FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 84

Sample: BULK-334
Depth: 0.0 - 5.0 feet
Description: Brown silty clay

TEST RESULTS	
Maximum Dry Density:	106.0 pcf
Optimum Moisture Content:	21.5 %

Test Date: September 24, 2020



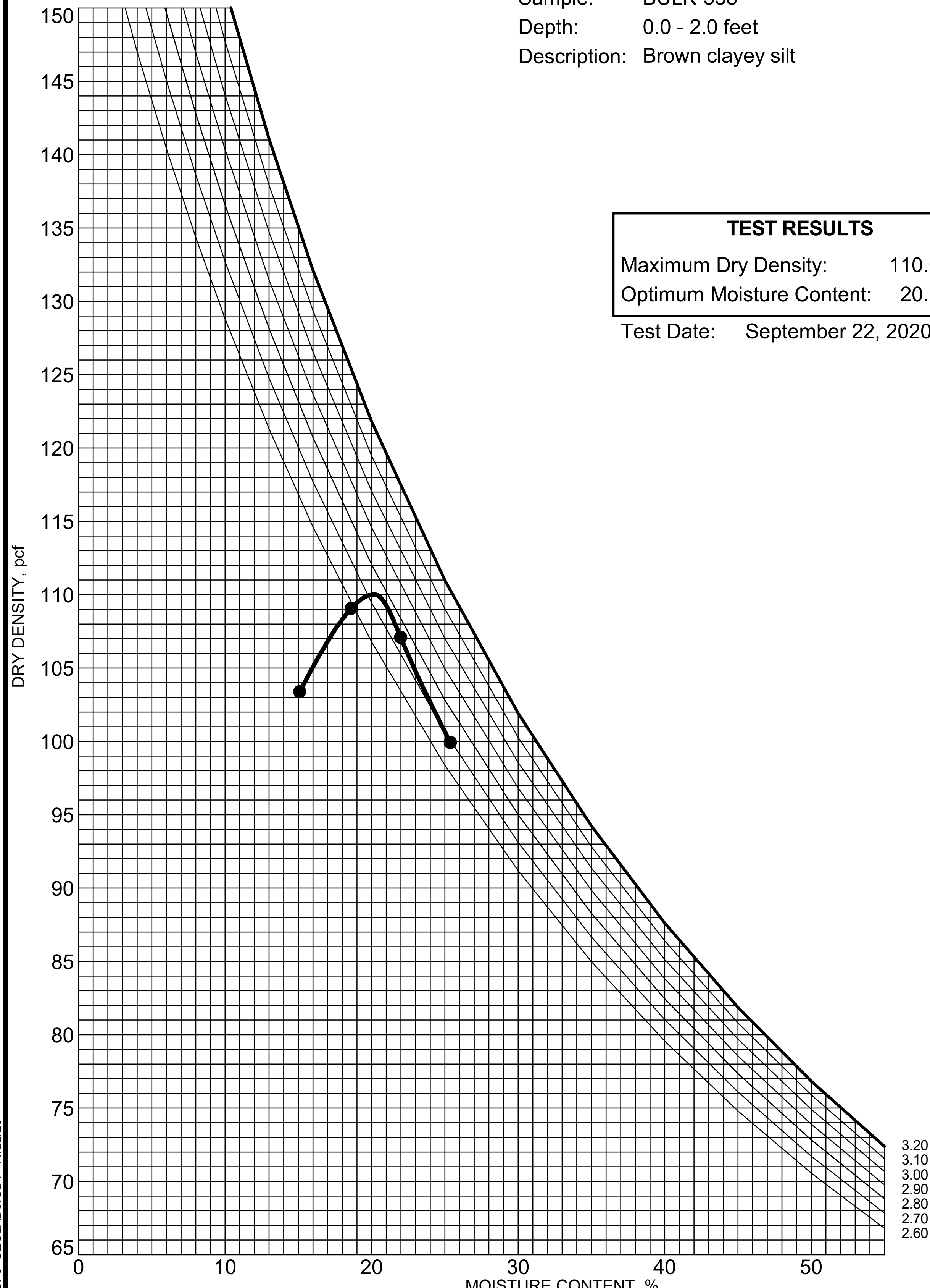
G_COMPACTION65 8135-00.GPJ GEOLABS.GDT 11/22/20

GEOLABS, INC.
GEOTECHNICAL ENGINEERING
W.O. 8135-00

MOISTURE-DENSITY RELATIONSHIP - ASTM D1557 A

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 85



Sample: BULK-338
Depth: 0.0 - 2.0 feet
Description: Brown clayey silt

TEST RESULTS	
Maximum Dry Density:	110.0 pcf
Optimum Moisture Content:	20.0 %

Test Date: September 22, 2020

G_COMPACTION65 8135-00.GPJ GEOLABS.GDT 11/22/20

GEOLABS, INC.
GEOTECHNICAL ENGINEERING
W.O. 8135-00

MOISTURE-DENSITY RELATIONSHIP - ASTM D1557 A

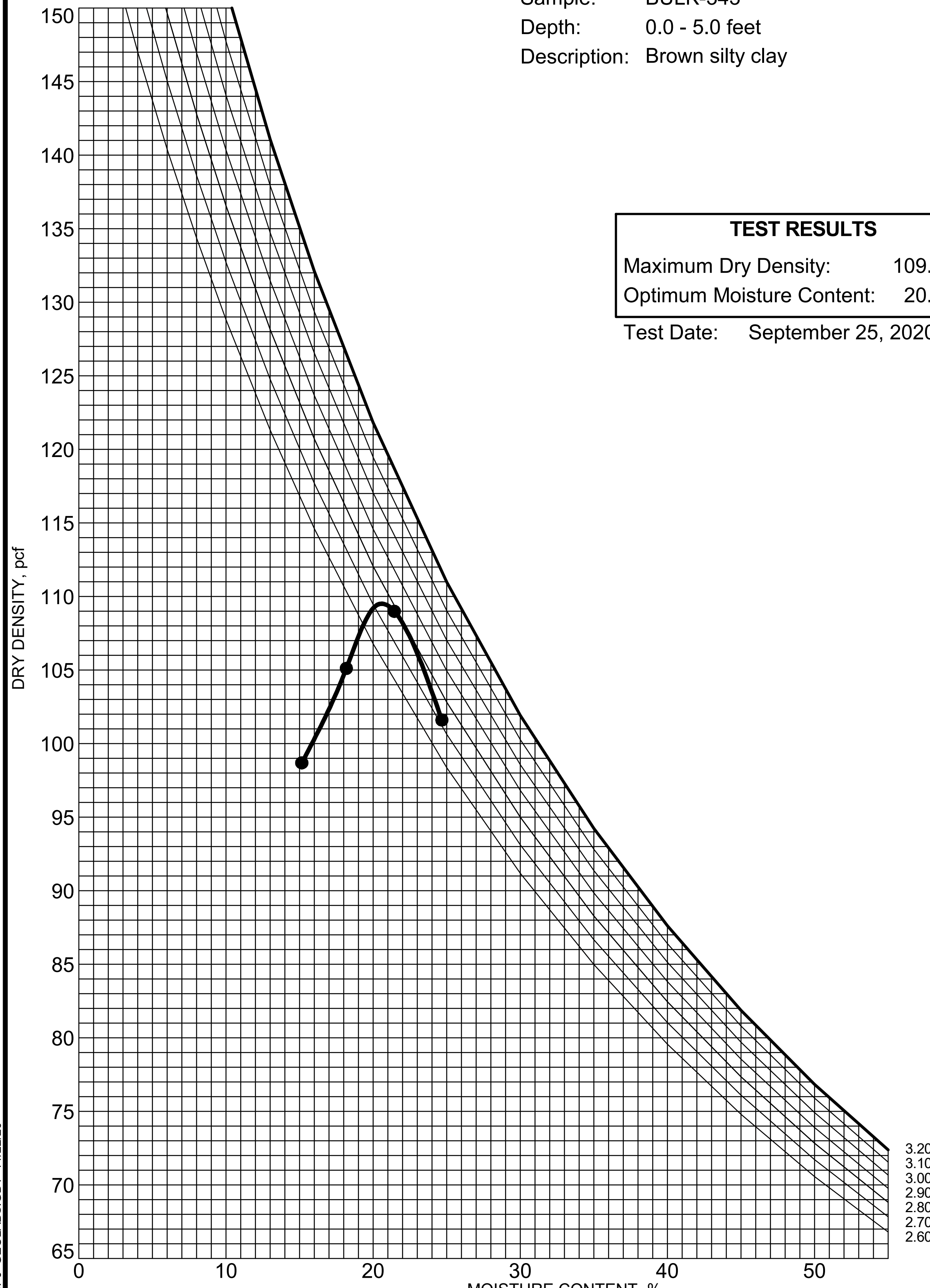
FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 86

Sample: BULK-343
Depth: 0.0 - 5.0 feet
Description: Brown silty clay

TEST RESULTS	
Maximum Dry Density:	109.5 pcf
Optimum Moisture Content:	20.5 %

Test Date: September 25, 2020



G_COMPACTION65 8135-00.GPJ GEOLABS.GDT 11/22/20

GEOLABS, INC. GEOTECHNICAL ENGINEERING	MOISTURE-DENSITY RELATIONSHIP - ASTM D1557 A	
W.O. 8135-00	FARRINGTON HIGHWAY IMPROVEMENTS KAPOLEI GOLF COURSE ROAD TO FORT WEAVER ROAD EWA, OAHU, HAWAII	Plate C - 87

Location	Depth (feet)	pH Value	Minimum Resistivity (ohm-cm)	Chloride Content (mg/kg)	Sulfate Content (mg/kg)
B-305	10.0 - 11.5	8.69*	2000*	ND	ND
B-309	2.5 - 4.0	8.69*	1600*	90	61
B-314	10.0 - 11.5	7.91*	2500*	ND	56
B-323	10.0 - 11.5	8.08*	1000*	140	43
B-329	3.0 - 4.5	7.93*	1500*	110	76
B-336	3.0 - 4.5	7.45*	1300*	41	140
B-343	3.0 - 4.5	7.64*	1500*	63	73

TEST METHODS (by TestAmerica Laboratories, Inc.)

pH Value	Method 9045C
Minimum Resistivity	SM 2510B
Chloride Content	EPA 300.0
Sulfate Content	EPA 300.0

TEST METHODS (by Geolabs, Inc.)*

pH Value	ASTM G51
Minimum Resistivity	ASTM G57
Chloride Content	N/A
Sulfate Content	N/A

ND: Not Detected Within Reporting Limits

GEOLABS, INC.
GEOTECHNICAL ENGINEERING

W.O. 8135-00

SUMMARY OF CORROSIVITY TESTS

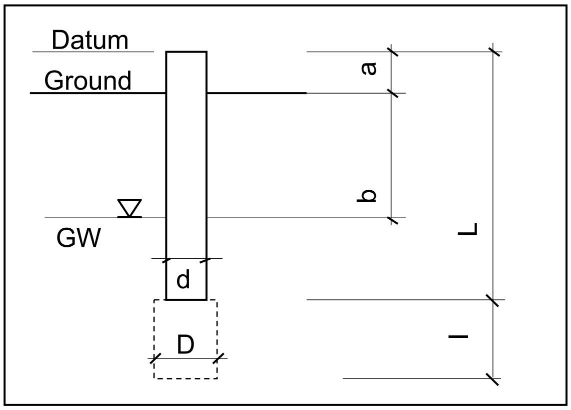
FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD
TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

Plate
C - 88

G_SUMMARY_OF_CORROSIVITY_TESTS 8135-00.GPJ GEOLABS.GDT 11/23/20

APPENDIX D

INFILTRATION TEST RECORD

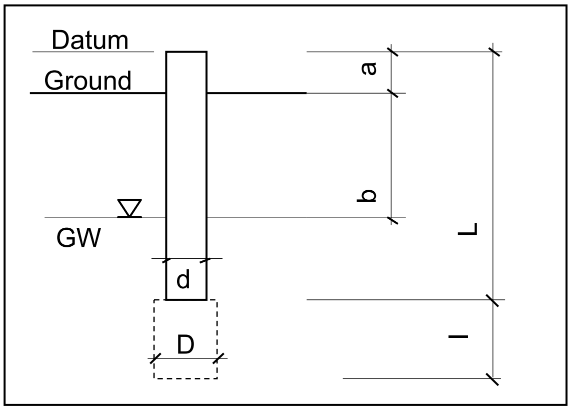


Project:	Farrington Highway Improvements	
W.O.:	8135-00	
Boring No.:	**I-1**	
Date of Testing:	9/23/2020	
Method of Testing:	LID	
Source of Water:	5 Gallon bucket	
Existing Ground Surface Elev.	+175	feet, MSL
GW level, b (from ground):	N/A	feet
Datum, a (above ground):	0.2	feet
Depth of Boring: (from ground)	5.0	feet
Length, L (from datum):	5.2	feet
Open Hole Length, l:	0.0	feet
Casing Depth Elevation:	+170	feet, MSL
Diameter of Open Hole, D:	N/A	inches
Diameter of Casing, d (I.D.):	4	inches

Depth (feet)	Generalized Soil/Rock Description
0 - 2	Brown silty clay, very stiff (fill)
2 - 5	Grayish brown silty clay w/ gravel, very stiff (older alluvium)

Trial	Elapsed Time (min)	Pumping Rate (gpm)	Depth to Water (measured from datum) (inches)	Infiltration Rate (inches per hour)
Trial 1				
	0	N/A	37.75	
	15		38.95	
	30		40.85	
	45		42.25	
	60		43.5	5.75
Trial 2				
	0	N/A	38.3	
	15		39.9	
	30		41.3	
	45		42.6	
	60		43.8	5.5
Trial 3				
	0	N/A	37.2	
	15		39	
	30		40.6	
	45		42.2	
	60		43.6	6.4
Trial 4				
	0	N/A	38.3	
	15		40.21	
	30		41.9	
	45		43.5	
	60		45	6.7

INFILTRATION TEST RECORD



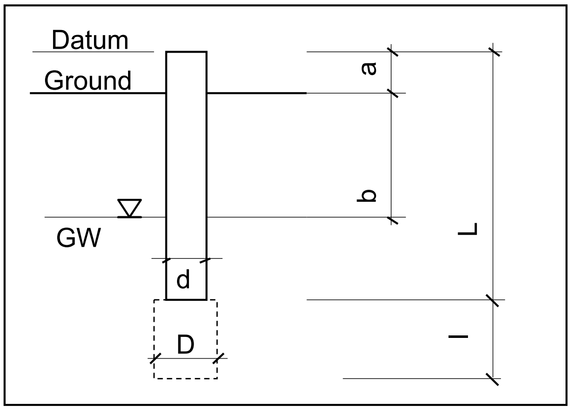
Project:	Farrington Highway Improvements
W.O.:	8135-00
Boring No.:	**I-2**
Date of Testing:	9/23/2020
Method of Testing:	LID
Source of Water:	5 Gallon bucket

Existing Ground Surface Elev.	+170	feet, MSL
GW level, b (from ground):	N/A	feet
Datum, a (above ground):	0.2	feet
Depth of Boring: (from ground)	5.0	feet
Length, L (from datum):	5.2	feet
Open Hole Length, l:	0.0	feet
Casing Depth Elevation:	+165	feet, MSL
Diameter of Open Hole, D:	N/A	inches
Diameter of Casing, d (I.D.):	4	inches

Depth (feet)	Generalized Soil/Rock Description
0 - 2	Brown clayey silt w/ organic matter
2 - 4	Brown silty clay, very stiff (fill)
4 - 5	Brown silty clay, very stiff (older alluvium)

Trial	Elapsed Time (min)	Pumping Rate (gpm)	Depth to Water (measured from datum) (inches)	Infiltration Rate (inches per hour)
Trial 1				
	0	N/A	38.5	
	15		38.6	
	30		38.75	
	45		39	
	60		39.2	0.7
Trial 2				
	0	N/A	37.91	
	15		38.2	
	30		38.375	
	45		38.5	
	60		38.625	0.72
Trial 3				
	0	N/A	37.25	
	15		37.375	
	30		37.5	
	45		37.625	
	60		37.875	0.63
Trial 4				
	0	N/A	37.375	
	15		37.5	
	30		37.75	
	45		37.875	
	60		38	0.63

INFILTRATION TEST RECORD



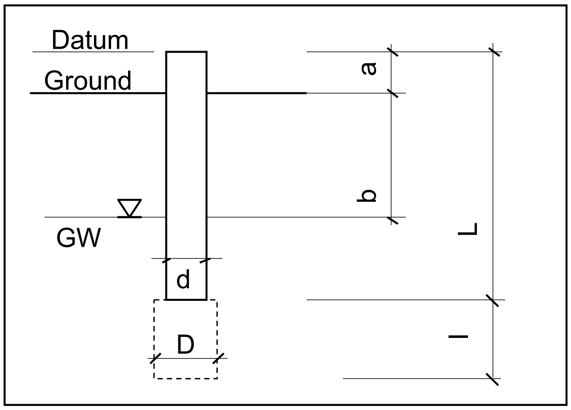
Project:	Farrington Highway Improvements
W.O.:	8135-00
Boring No.:	**I-3**
Date of Testing:	9/23/2020
Method of Testing:	LID
Source of Water:	5 Gallon bucket

Existing Ground Surface Elev.	+158	feet, MSL
GW level, b (from ground):	N/A	feet
Datum, a (above ground):	0.2	feet
Depth of Boring: (from ground)	5.0	feet
Length, L (from datum):	5.2	feet
Open Hole Length, l:	0.0	feet
Casing Depth Elevation:	+153	feet, MSL
Diameter of Open Hole, D:	N/A	inches
Diameter of Casing, d (I.D.):	4	inches

Depth (feet)	Generalized Soil/Rock Description
0 - 5	Brown sandy clay, very stiff (older alluvium)

Trial	Elapsed Time (min)	Pumping Rate (gpm)	Depth to Water (measured from datum) (inches)	Infiltration Rate (inches per hour)
Trial 1				
	0	N/A	38.25	
	15		38.5	
	30		38.9	
	45		39.2	
	60		39.6	1.35
Trial 2				
	0	N/A	38.2	
	15		38.375	
	30		38.625	
	45		39	
	60		39.25	1.05
Trial 3				
	0	N/A	37.9	
	15		38.375	
	30		38.625	
	45		38.875	
	60		39	1.10
Trial 4				
	0	N/A	38.25	
	15		38.625	
	30		38.875	
	45		39.25	
	60		39.625	1.38

INFILTRATION TEST RECORD



Project:	Farrington Highway Improvements		
W.O.:	8135-00		
Boring No.:	**I-4**		
Date of Testing:	9/23/2020		
Method of Testing:	LID		
Source of Water:	5 Gallon bucket		
Existing Ground Surface Elev.		+153	feet, MSL
GW level, b (from ground):		N/A	feet
Datum, a (above ground):		0.2	feet
Depth of Boring: (from ground)		5.0	feet
Length, L (from datum):		5.2	feet
Open Hole Length, l:		0.0	feet
Casing Depth Elevation:		+148	feet, MSL
Diameter of Open Hole, D:		N/A	inches
Diameter of Casing, d (I.D.):		4	inches

Depth (feet)	Generalized Soil/Rock Description
0 - 2.25	Brown silty clay, very stiff (older alluvium)
2.25 - 5	Brown sandy clay w/ gravel very stiff (older alluvium)

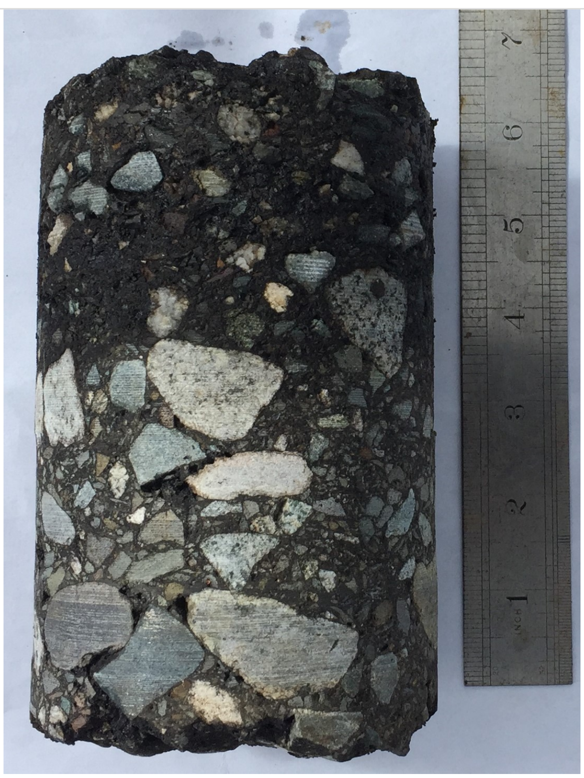
Trial	Elapsed Time (min)	Pumping Rate (gpm)	Depth to Water (measured from datum) (inches)	Infiltration Rate (inches per hour)
Trial 1				
	0	N/A	38.7	
	15		42.4	
	30		44.9	
	45		47.75	
	60		50.5	11.80
Trial 2				
	0	N/A	38.25	
	15		40.25	
	30		42.15	
	45		43.85	
	60		45.4	7.15
Trial 3				
	0	N/A	37.6	
	15		39.6	
	30		41.5	
	45		43.2	
	60		44.8	7.20
Trial 4				
	0	N/A	37.5	
	15		39.4	
	30		41.2	
	45		42.25	
	60		44.3	6.80

APPENDIX E

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

	B-302 0” TO 6.0”
	B-303 0” TO 8.0”

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

	B-306 0” TO 7.0”
	B-308 0” TO 6.5”

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

	B-311 0” TO 7.5”
	B-312 0” TO 8.0”

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

	B-315 0” TO 7.5”
	B-317 0” TO 8.0”

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

	B-318 0” TO 5.0”
	B-320 0” TO 5.0”

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

	B-321 0” TO 7.5”
	B-322 0” TO 7.5”

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

	B-324 0" TO 9.0"
	B-325 0" TO 8.0"

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

	B-327 0" TO 7.5"
	B-328 0" TO 8.0"

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

	B-330 0” TO 7.5”
	B-331 0” TO 7.5”

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

	B-333 0” TO 8.0”
	B-335 0” TO 8.0”

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

	B-337 0" TO 4.5"
	B-339 0" TO 11.0"

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

B-341
0” TO 7.25”

B-342
0” TO 7.25”

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

B-344
0” TO 7.0”

APPENDIX F

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

B-104 46.0' TO 121.0'

46.0' **77.5'** **111.7'** **117.5'**

76.0' **106.0'** **116.0'** **121.0'**

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

B-105 35.25' TO 90.0'

35.25' **47.5'** **61.5'** **81.5'**

47.5' **60.0'** **75.0'** **90.0'**

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

B-105 91.5' TO 120.0'

91.5' **105.0'** **115.25'**

105.0' **115.25'** **120.0'**

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

B-204 31.5' TO 76.5'

31.5' **45.5'** **54.5'** **59.0'** **64.0'**

45.5' **54.5'** **59.0'** **64.0'** **76.5'**

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

B-204 76.5' TO 101.5'

76.5' 81.0' 85.0' 89 .0' 94.0' 98.5'

81.0' 85.0' 89.0' 94.0' 98.5' 101.5'

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

B-205 36.5' TO 61.0'

36.5' **41.0'** **48.5'** **52.5'** **56.75'**

41.0' **48.5'** **52.5'** **56.75'** **61.0'**

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

B-205 61.0' TO 83.5'

61.0' 65.25' 69.5' 74.0' 78.5'

65.25' 69.5' 74.0' 78.5' 83.5'

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

B-205 83.5' TO 101.0'

83.5' **88.0'** **92.5'** **97.0'**

88.0' **92.5'** **97.0'** **101.0'**

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

B-304 8.0' TO 31.0'

8.0' **21.0'** **26.0'**

21.0' **26.0'** **31.0'**

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

B-310 15.0' TO 30.0'

15.0' 20.0' 25.25'

20.0' 25.0' 30.0'

FARRINGTON HIGHWAY IMPROVEMENTS
KAPOLEI GOLF COURSE ROAD TO FORT WEAVER ROAD
EWA, OAHU, HAWAII

B-319 21.0' TO 31.0'

21.0'

31.0'

APPENDIX G

Date Started: 8/20/99
Date Completed: 8/20/99
Logged By: N. Mitchell
Total Depth: 15.8 feet

Drill Rig: Mobile B-80
Drilling Method: 4" Auger
Driving Energy: 140 lb. wt., 30 in. drop

Depth, ft	Sample (FIELD)	Penetra. Resist. Blows/ft (FIELD)	Dry Density pcf (LABORATORY)	Moisture Content % (LABORATORY)	Compress. Strength ksf (LABORATORY)	Other Data	Pen, tsf	DESCRIPTION
								Approximate Surface Elevation (ft): 123.5*
		49	67	32				Reddish brown CLAYEY SILT (MH) with sand, hard, dry to damp (fill)
		67		15				grades with gravel
5		50/.3' Ref.	75	19				grades with traces of basalt fragments BOULDER
10		50/.3' Ref.		15				Reddish brown SILTY CLAY (CL) with gravel, hard, damp (residual)
15		50/.3' Ref.		18				
								Boring terminated at 15.8 feet Groundwater not encountered *Elevations estimated from Preliminary Site Plan provided by Belt Collins Hawaii in July 1999.
20								
25								
30								
35								

tk O\F

GEOLABS, INC.
Geotechnical Engineering

WORK ORDER NO. 4190-00(B) KHN Nov 99

LOG OF BORING 1

FARRINGTON HWY. WIDE., KAPOLEI
GOLF COURSE RD. TO FORT WEAVER RD.
EWA, OAHU, HAWAII

PLATE A-1

Date Started: 8/30/99
Date Completed: 8/30/99
Logged By: N. Mitchell
Total Depth: 15.4 feet

Drill Rig: CME-75
Drilling Method: 4" Auger
Driving Energy: 140 lb. wt., 30 in. drop

Depth, ft	FIELD: Sample	FIELD: Penetra. Resist. Blows/ft	LABORATORY: Dry Density pcf	LABORATORY: Moisture Content %	LABORATORY: Compress. Strength ksf	Other Data	Pen, tsf	DESCRIPTION (Approximate Surface Elevation (ft): 128*)
		12	79	13				Reddish brown CLAYEY SILT (MH) with some sand and gravel and traces of roots, medium stiff to stiff, damp (fill)
		15		8				grades with gravel
5		35/.5' Ref.	95	17				Brown SILTY CLAY (CL) with gravel, stiff, damp (residual)
10		50/.0' Ref.						Gray SANDY GRAVEL (GW) with some sand, very dense, damp
15		50/.4' Ref.		4				Boring terminated at 15.4 feet Groundwater not encountered
20								
25								
30								
35								

tk D\F

GEOLABS, INC.
Geotechnical Engineering

WORK ORDER NO. 4190-00(B) KHN Nov 99

LOG OF BORING 2

FARRINGTON HWY. WIDE., KAPOLEI
GOLF COURSE RD. TO FORT WEAVER RD.
EWA, OAHU, HAWAII

PLATE A-2

Date Started: 8/30/99
Date Completed: 8/30/99
Logged By: N. Mitchell
Total Depth: 16.1 feet

Drill Rig: CME-75
Drilling Method: 4" Auger
Driving Energy: 140 lb. wt., 30 in. drop

Depth, ft	FIELD: Sample	FIELD: Penetra. Resist. Blows/ft	LABORATORY: Dry Density pcf	LABORATORY: Moisture Content %	LABORATORY: Compress. Strength ksf	Other Data	Pen, tsf	DESCRIPTION (Approximate Surface Elevation (ft): 132*)
		25	79	11			1.0	Reddish brown CLAYEY SILT (MH) with sand and gravel, stiff, dry (fill)
		47		8				grades to very stiff to hard
5		39	96	8			>4.5	Reddish brown SILTY CLAY (CL) with sand and gravel, very stiff, damp (residual)
10		28		21				grades with gravel and traces of sand
15		11/.5' +40/.1' Ref.		18			>4.5	grades to hard
								Boring terminated at 16.1 feet
								Groundwater not encountered
20								
25								
30								
35								

tk D\F

GEOLABS, INC.
Geotechnical Engineering

WORK ORDER NO. 4190-00(B) KHN Nov 99

LOG OF BORING 3

FARRINGTON HWY. WIDE., KAPOLEI
GOLF COURSE RD. TO FORT WEAVER RD.
EWA, OAHU, HAWAII

PLATE A-3

Date Started: 8/30/99
Date Completed: 8/30/99
Logged By: N. Mitchell
Total Depth: 16.1 feet

Drill Rig: CME-75
Drilling Method: 4" Auger
Driving Energy: 140 lb. wt., 30 in. drop

Depth, ft	FIELD: Sample	FIELD: Penetra. Resist. Blows/ft	LABORATORY: Dry Density pcf	LABORATORY: Moisture Content %	LABORATORY: Compress. Strength ksf	Other Data	Pen, tsf	DESCRIPTION (Approximate Surface Elevation (ft): 138.7*)
0–5		47	90	16			>4.5	Reddish brown SILTY CLAY (CH) with traces of sand, very stiff to hard, damp (fill)
		42		15				
5		76	90	16			>4.5	Reddish brown SILTY CLAY (CL) with traces of sand, hard, damp (residual)
10		57		17				
15		25/.5' +30/.1' Ref.	91	17				
16.1								Boring terminated at 16.1 feet Groundwater not encountered
20								
25								
30								
35								

tk D\F

GEOLABS, INC.
Geotechnical Engineering

WORK ORDER NO. 4190-00(B) KHN Nov 99

LOG OF BORING 4

FARRINGTON HWY. WIDE., KAPOLEI
GOLF COURSE RD. TO FORT WEAVER RD.
EWA, OAHU, HAWAII

PLATE A-4

Date Started: 8/30/99
Date Completed: 8/30/99
Logged By: N. Mitchell
Total Depth: 16.5 feet

Drill Rig: CME-75
Drilling Method: 4" Auger
Driving Energy: 140 lb. wt., 30 in. drop

Depth, ft	Sample (FIELD)	Penetra. Resist. Blows/ft (FIELD)	Dry Density pcf (LABORATORY)	Moisture Content % (LABORATORY)	Compress. Strength ksf (LABORATORY)	Other Data	Pen, tsf	DESCRIPTION — Approximate Surface Elevation (ft): 144*
		27	79	14			3.8	Reddish brown SILTY CLAY (CL) with sand, very stiff, damp (fill)
		31		16		LL=47 PI=29		
5		65	109	16			>4.5	grades to hard
								Reddish brown SILTY CLAY (CL) with fine sand, hard, damp (residual)
10		50/.3' Ref.		18				
15		53	94	22		LL=33 PI=11	>4.5	grades to very stiff to hard
								Boring terminated at 16.5 feet
								Groundwater not encountered
20								
25								
30								
35								

tk D\F

GEOLABS, INC.
Geotechnical Engineering

WORK ORDER NO. 4190-00(B) KHN Nov 99

LOG OF BORING 5
FARRINGTON HWY. WIDE., KAPOLEI
GOLF COURSE RD. TO FORT WEAVER RD.
EWA, OAHU, HAWAII

PLATE A-5

Date Started: 8/30/99
Date Completed: 8/30/99
Logged By: N. Mitchell
Total Depth: 15.8 feet

Drill Rig: CME-75
Drilling Method: 4" Auger
Driving Energy: 140 lb. wt., 30 in. drop

Depth, ft	FIELD Sample	FIELD Penetra. Resist. Blows/ft	LABORATORY Dry Density pcf	LABORATORY Moisture Content %	LABORATORY Compress. Strength ksf	Other Data	Pen, tsf	DESCRIPTION
								Approximate Surface Elevation (ft): 155.5*
		45/.3' Ref.	83	14			>4.5	Brown SILTY CLAY (CL) with sand and roots, hard, damp (fill)
		22		18				grades to stiff to very stiff
5		53	107	16			>4.5	Brown SILTY CLAY (CL) with traces of gravel, hard, damp (residual)
10		46		19				grades with sand, very stiff to hard, slightly moist
								Brown SANDY SILT (ML) with gravel, hard, damp (residual)
15		50/.3' Ref.	96	11			>4.5	
								Boring terminated at 15.8 feet
								Groundwater not encountered
20								
25								
30								
35								

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GEOLABS, INC.
Geotechnical Engineering

WORK ORDER NO. 4190-00(B) KHN Nov 99

LOG OF BORING 6
FARRINGTON HWY. WIDE., KAPOLEI
GOLF COURSE RD. TO FORT WEAVER RD.
EWA, OAHU, HAWAII

PLATE
A-6

Date Started: 9/3/99
Date Completed: 9/3/99
Logged By: N. Mitchell
Total Depth: 15.2 feet

Drill Rig: CME-75
Drilling Method: 4" Auger
Driving Energy: 140 lb. wt., 30 in. drop

Depth, ft	FIELD: Sample	FIELD: Penetra. Resist. Blows/ft	LABORATORY: Dry Density pcf	LABORATORY: Moisture Content %	LABORATORY: Compress. Strength ksf	Other Data	Pen, tsf	DESCRIPTION — Approximate Surface Elevation (ft): 166.5*
		17	126	15				Brown SILTY CLAY (CL) with sand and gravel, stiff, damp (fill)
		5		14				Brown SANDY CLAY (CL) with traces of gravel, soft, damp (fill)
5		68	100	15			>4.5	Brown SILTY CLAY (CH) with traces of sand, hard, damp (residual)
10								BOULDER
15		50/.2' Ref						Boring terminated at 15.2 feet Groundwater not encountered
20								
25								
30								
35								

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Geotechnical Engineering

WORK ORDER NO. 4190-00(B) KHN Nov 99

LOG OF BORING 7
FARRINGTON HWY. WIDE., KAPOLEI
GOLF COURSE RD. TO FORT WEAVER RD.
EWA, OAHU, HAWAII

PLATE
A-7

Date Started: 9/3/99
Date Completed: 9/3/99
Logged By: N. Mitchell
Total Depth: 16.3 feet

Drill Rig: CME-75
Drilling Method: 4" Auger
Driving Energy: 140 lb. wt., 30 in. drop

Depth, ft	FIELD Sample	FIELD Penetra. Resist. Blows/ft	LABORATORY Dry Density pcf	LABORATORY Moisture Content %	LABORATORY Compress. Strength ksf	Other Data	Pen, tsf	DESCRIPTION (Approximate Surface Elevation (ft): 168*)
		37	85	16			>4.5	Reddish brown SILTY CLAY (CL) with sand, very stiff, damp (fill)
		24		16				Reddish brown CLAYEY SILT (MH) with sand, stiff, damp (residual)
5		44	94	16				grades to very stiff
10		50/.2' Ref.		15				Brown SILTY SAND (SM) with gravel, very dense, slightly moist to moist (residual)
15		43/.5' +50/.3' Ref.		16				
								Boring terminated at 16.3 feet Groundwater not encountered
20								
25								
30								
35								

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Geotechnical Engineering

WORK ORDER NO. 4190-00(B) KHN Nov 99

LOG OF BORING 8
FARRINGTON HWY. WIDE., KAPOLEI
GOLF COURSE RD. TO FORT WEAVER RD.
EWA, OAHU, HAWAII

PLATE **A-8**

Date Started: 9/3/99
Date Completed: 9/3/99
Logged By: N. Mitchell
Total Depth: 16.5 feet

Drill Rig: CME-75
Drilling Method: 4" Auger
Driving Energy: 140 lb. wt., 30 in. drop

Depth, ft	FIELD: Sample	FIELD: Penetra. Resist. Blows/ft	LABORATORY: Dry Density pcf	LABORATORY: Moisture Content %	LABORATORY: Compress. Strength ksf	Other Data	Pen, tsf	DESCRIPTION
								Approximate Surface Elevation (ft): 170*
		16	78	14		LL=38 PI=18	3.8	Reddish brown SANDY CLAY (CL) with silt, medium stiff to stiff, damp (fill)
		14		8				grades with traces of gravel
5		29	81	16				Yellowish brown CLAYEY SILT (MH) with sand, stiff to very stiff, damp (residual)
10		62		13				Brown SILTY CLAY (CL) with traces of sand and gravel, hard, damp (residual)
15		14		7				Brown SILTY SAND (SM) with gravel, medium dense, damp (residual)
								Boring terminated at 16.5 feet
								Groundwater not encountered
20								
25								
30								
35								

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Geotechnical Engineering

WORK ORDER NO. 4190-00(B) KHN Nov 99

LOG OF BORING 9

FARRINGTON HWY. WIDE., KAPOLEI
GOLF COURSE RD. TO FORT WEAVER RD.
EWA, OAHU, HAWAII

PLATE A-9

Date Started:	9/3/99	**Drill Rig:**	CME-75
Date Completed:	9/3/99	**Drilling Method:**	4" Auger
Logged By:	N. Mitchell	**Driving Energy:**	140 lb. wt., 30 in. drop
Total Depth:	15.8 feet		

Depth, ft	FIELD: Penetra. Resist. Blows/ft	LABORATORY: Dry Density pcf	LABORATORY: Moisture Content %	LABORATORY: Compress. Strength ksf	Other Data	Pen, tsf	DESCRIPTION (Approximate Surface Elevation (ft): 176*)
	27	79	15			>4.5	Brown CLAYEY SILT (ML) with sand, stiff, damp (fill)
	28		15				
5	48	88	17			>4.5	Reddish brown SILTY CLAY (CL) with sand, very stiff, damp (residual)
10	32		22				grades to slightly moist
15	40/.3' Ref.	89	20				Brown SILTY SAND (SM) with gravel, dense to very dense, damp (residual)
							Boring terminated at 15.8 feet
							Groundwater not encountered
20							
25							
30							
35							

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Geotechnical Engineering

WORK ORDER NO. 4190-00(B) KHN Nov 99

LOG OF BORING 10

FARRINGTON HWY. WIDE., KAPOLEI

GOLF COURSE RD. TO FORT WEAVER RD.

EWA, OAHU, HAWAII

PLATE A-10

Date Started:	8/25/99	**Drill Rig:**	Mobile B-80
Date Completed:	8/25/99	**Drilling Method:**	4" Auger
Logged By:	N. Mitchell	**Driving Energy:**	140 lb. wt., 30 in. drop
Total Depth:	15.9 feet		

Depth, ft	FIELD: Sample	FIELD: Penetra. Resist. Blows/ft	LABORATORY: Dry Density pcf	LABORATORY: Moisture Content %	LABORATORY: Compress. Strength ksf	Other Data	Pen, tsf	DESCRIPTION (Approximate Surface Elevation (ft): 173.5*)
								4-inch ASPHALT CONCRETE
		50/.3' Ref.		1				Gray SANDY GRAVEL (GW), very dense, dry (fill)
		54	85	18			>4.5	Brown CLAYEY SILT (ML) with sand, very stiff to hard, damp (residual)
5		35		18				grades to hard
10		40/.3' Ref.		11				Brown SILTY SAND (SM), very dense, damp (residual)
15		50/.4' Ref.		20				grades to moist
								Boring terminated at 15.9 feet
								Groundwater not encountered
20								
25								
30								
35								

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Geotechnical Engineering

WORK ORDER NO. 4190-00(B) KHN Nov 99

LOG OF BORING 11
FARRINGTON HWY. WIDE., KAPOLEI
GOLF COURSE RD. TO FORT WEAVER RD.
EWA, OAHU, HAWAII

PLATE **A-11**

Date Started: 8/25/99
Date Completed: 8/25/99
Logged By: N. Mitchell
Total Depth: 15.8 feet

Drill Rig: Mobile B-80
Drilling Method: 4" Auger
Driving Energy: 140 lb. wt., 30 in. drop

Depth, ft	Sample (Field)	Penetra. Resist. Blows/ft (Field)	Dry Density pcf (Laboratory)	Moisture Content % (Laboratory)	Compress. Strength ksf (Laboratory)	Other Data	Pen, tsf	DESCRIPTION
								Approximate Surface Elevation (ft): 162.5*
		58	79	17		LL=44 PI=23	>4.5	Brown SILTY CLAY (CL) with sand, hard, damp (fill)
		28		17				Reddish brown CLAYEY SILT (ML) with sand, very stiff, damp (fill)
5		37	98	20			>4.5	Brown SILTY CLAY (CL), very stiff, slightly moist (residual)
10		50/.0' Ref.						
15		50/.3' Ref.		19				grades with sand, hard
								Boring terminated at 15.8 feet
								Groundwater not encountered
20								
25								
30								
35								

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Geotechnical Engineering

WORK ORDER NO. 4190-00(B) KHN Nov 99

LOG OF BORING 12
FARRINGTON HWY. WIDE., KAPOLEI
GOLF COURSE RD. TO FORT WEAVER RD.
EWA, OAHU, HAWAII

PLATE
A-12

Date Started: 8/25/99
Date Completed: 8/25/99
Logged By: N. Mitchell
Total Depth: 16.3 feet

Drill Rig: Mobile B-80
Drilling Method: 4" Auger
Driving Energy: 140 lb. wt., 30 in. drop

Depth, ft	FIELD: Sample	FIELD: Penetra. Resist. Blows/ft	LABORATORY: Dry Density pcf	LABORATORY: Moisture Content %	LABORATORY: Compress. Strength ksf	Other Data	Pen, tsf	DESCRIPTION (Approximate Surface Elevation (ft): 119*)
								6-inch ASPHALT CONCRETE
		50/.4' Ref.		11				Brown SILTY SAND (SM) with coral and basalt gravel, very dense, damp (fill)
		50/.3' Ref.	58	11				Brown SILTY SAND (SM), very dense, damp (residual)
5		50/.3' Ref.		14				grades with gravel
10		50/.4' Ref.		17				
15		37/.5' +50/.3' Ref.		20				
								Boring terminated at 16.3 feet
								Groundwater not encountered
20								
25								
30								
35								

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WORK ORDER NO. 4190-00(B) KHN Nov 99

LOG OF BORING 13

FARRINGTON HWY. WIDE., KAPOLEI
GOLF COURSE RD. TO FORT WEAVER RD.
EWA, OAHU, HAWAII

PLATE
A-13

Date Started: 8/25/99
Date Completed: 8/25/99
Logged By: N. Mitchell
Total Depth: 16.5 feet

Drill Rig: Mobile B-80
Drilling Method: 4" Auger
Driving Energy: 140 lb. wt., 30 in. drop

Depth, ft	FIELD: Sample	FIELD: Penetra. Resist. Blows/ft	LABORATORY: Dry Density pcf	LABORATORY: Moisture Content %	LABORATORY: Compress. Strength ksf	Other Data	Pen, tsf	DESCRIPTION (Approximate Surface Elevation (ft): 95*)
								5-inch ASPHALT CONCRETE
		50/.4' Ref.	89	14				Brownish gray SANDY GRAVEL (GP) with silt, damp (base material)
		50/.4' Ref.		21				Grayish brown SILTY SAND (SM) with traces of gravel, very dense, damp (fill)
5		50/.4' Ref.		20				Brown SILTY SAND (SM), very dense, moist (residual) grades with traces of gravel at 5 feet
								Brown CLAYEY SILT (ML) with sand, hard, slightly moist (residual)
10		50/.3' Ref.	92	20			>4.5	
15		38		41				Grayish brown SILTY SAND (SM), dense, slightly moist (residual)
								Boring terminated at 16.5 feet
								Groundwater not encountered
20								
25								
30								
35								

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GEOLABS, INC.
Geotechnical Engineering

WORK ORDER NO. 4190-00(B) KHN Nov 99

LOG OF BORING 14
FARRINGTON HWY. WIDE., KAPOLEI
GOLF COURSE RD. TO FORT WEAVER RD.
EWA, OAHU, HAWAII

PLATE
A-14

Date Started: 8/23/99
Date Completed: 8/24/99
Logged By: N. Mitchell
Total Depth: 101.5 feet

Drill Rig: Mobile B-80
Drilling Method: 4" Auger
Driving Energy: 140 lb. wt., 30 in. drop

Depth, ft	FIELD: Sample	FIELD: Penetra. Resist. Blows/ft	LABORATORY: Dry Density pcf	LABORATORY: Moisture Content %	LABORATORY: Compress. Strength ksf	Other Data	Pen, tsf	DESCRIPTION
								Approximate Surface Elevation (ft): 163*
								6-inch ASPHALT CONCRETE
		45	96	21			>4.5	Brownish gray SANDY GRAVEL (GW) with silt, medium dense to dense, damp
		37		20				Reddish brown CLAYEY SILT (MH) with sand, very stiff, slightly moist (fill) grades to hard at 3 feet
5		61	92	25			>4.5	Reddish brown SILTY CLAY (CL) with sand, hard, slightly moist (residual)
								Reddish brown CLAYEY SILT (MH) with sand, hard, slightly moist (residual)
10		32		18				
15		38	85	17			>4.5	grades with gravel, very stiff
								Brown SILTY GRAVEL (GM) with sand, very dense, slightly moist (residual)
20		36/.5' +50/.3' Ref.		9				
								Reddish brown CLAYEY SILT (MH) with some sand, hard, slightly moist (residual)
25		30/.3' Ref.	89	16			>4.5	
30		50/.4' Ref.		21				grades with traces of sand
35								

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Geotechnical Engineering

WORK ORDER NO. 4190-00(B) KHN Nov 99

LOG OF BORING 101
FARRINGTON HWY. WIDE., KAPOLEI
GOLF COURSE RD. TO FORT WEAVER RD.
EWA, OAHU, HAWAII

PLATE
A-15.1

Depth, ft	FIELD: Sample	FIELD: Penetra. Resist. Blows/ft	LABORATORY: Dry Density pcf	LABORATORY: Moisture Content %	LABORATORY: Compress. Strength ksf	Other Data	Pen, tsf	DESCRIPTION
								(Continued from previous plate)
		50/.3' Ref.	97	22			>4.5	Reddish brown CLAYEY SILT (MH) with traces of sand, hard, slightly moist (residual)
40		37		23				
45		50/.3' Ref.	95	20				Reddish brown SANDY SILT (ML) with gravel, hard, slightly moist (residual)
								Reddish brown CLAYEY SILT (MH) with some sand, hard, slightly moist (residual)
50		45/.5' +50/.3' Ref.		21				
55		50/.3' Ref.	100	21				grades with traces of sand
60		48/.5' +50/.3' Ref.		22			4.3	Reddish brown SILTY CLAY (CH) with traces of sand, hard, slightly moist (residual)
65		40/.5' +50/.4' Ref.	104	27			>4.5	
70		28		30				grades to very stiff, moist
								Reddish brown CLAYEY SILT (MH) with some sand, hard, moist (residual)
75								

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WORK ORDER NO. 4190-00(B) KHN Nov 99

LOG OF BORING 101

FARRINGTON HWY. WIDE., KAPOLEI

GOLF COURSE RD. TO FORT WEAVER RD.

EWA, OAHU, HAWAII

PLATE

A-15.2

Depth, ft	FIELD: Sample	FIELD: Penetra. Resist. Blows/ft	LABORATORY: Dry Density pcf	LABORATORY: Moisture Content %	LABORATORY: Compress. Strength ksf	Other Data	Pen, tsf	DESCRIPTION (Continued from previous plate)
		20/.5' +30/.3' Ref.	95	30			>4.5	Reddish brown CLAYEY SILT (MH) with some sand, hard, moist (residual)
80		39/.5' +50/.4' Ref.		24				Reddish brown SILTY CLAY (CH) with traces of sand, hard, slightly moist (residual)
85		50/.4' Ref.	97	23			>4.5	
90		37/.5' +50/.3' Ref.		24				grades with more sand
95		50/.4' Ref.	97	22			>4.5	
100		72		32				Reddish brown CLAYEY SILT (MH) with some sand, hard, moist (residual)
								Boring terminated at 101.5 feet Groundwater not encountered
105								
110								
115								

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Geotechnical Engineering

WORK ORDER NO. 4190-00(B) KHN Nov 99

LOG OF BORING 101

FARRINGTON HWY. WIDE., KAPOLEI

GOLF COURSE RD. TO FORT WEAVER RD.

EWA, OAHU, HAWAII

PLATE

A-15.3

Date Started:	9/1/99	**Drill Rig:**	CME-75
Date Completed:	9/2/99	**Drilling Method:**	H.S. Auger (6.25")
Logged By:	N. Mitchell	**Driving Energy:**	140 lb. wt., 30 in. drop
Total Depth:	101.5 feet		

Depth, ft	FIELD: Sample	FIELD: Penetra. Resist. Blows/ft	LABORATORY: Dry Density pcf	LABORATORY: Moisture Content %	LABORATORY: Compress. Strength ksf	Other Data	Pen, tsf	DESCRIPTION (Approximate Surface Elevation (ft): 161*)
0								Reddish brown SANDY SILT (ML) with gravel and cobbles, soft to medium stiff, dry
								Brownish gray COBBLES with gravelly sand, medium dense to dense, damp (fill)
5		29	75	14		LL=43 PI=25	>4.5	Brown SILTY CLAY (CL) with sand and gravel, very stiff, damp (fill)
10		6		17				Reddish brown CLAYEY SILT (ML) with sand, soft to medium stiff, damp (fill)
15		95	112	7				Reddish brown mottled with gray SILTY GRAVEL (GM) with sand and cobbles, very dense, damp (fill)
20		30/.3' Ref.						
25		15/.0' Ref.	98	17				Reddish brown SANDY SILT (ML), hard, damp (residual)
30		59/.5'		18				Reddish brown mottled with black SILTY CLAY (CH) with traces of sand, hard, damp (residual)
35								

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GEOLABS, INC. *Geotechnical Engineering*	**LOG OF BORING 102** FARRINGTON HWY. WIDE., KAPOLEI GOLF COURSE RD. TO FORT WEAVER RD. EWA, OAHU, HAWAII	**PLATE** A-16.1
WORK ORDER NO. 4190-00(B) KHN Nov 99		

Depth, ft	FIELD: Sample	FIELD: Penetra. Resist. Blows/ft	LABORATORY: Dry Density pcf	LABORATORY: Moisture Content %	LABORATORY: Compress. Strength ksf	Other Data	Pen, tsf	DESCRIPTION (Continued from previous plate)
		61/.5' Ref.		19				Reddish brown mottled with black SILTY CLAY (CH) with traces of sand, hard, damp (residual)
40		39		20				Reddish brown CLAYEY SILT (MH) with sand, hard, damp (residual)
45		71/.5' +10/.0' Ref.	100	18			>4.5	
50		41		22				Reddish brown SILTY CLAY (CH) with gravel and traces of sand, hard, slightly moist (residual)
55		60/.5' +50/.3' Ref.	104	20			>4.5	
60		50		24				grades with white mottled seams with traces of sand
65		76	95	24			>4.5	Reddish brown CLAYEY SILT (MH) with sand and gravel, hard, slightly moist (residual)
70		26		27				grades to very stiff, moist
								Reddish brown SILTY CLAY (CH) with sand, hard, slightly moist (residual)
75								

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Geotechnical Engineering

WORK ORDER NO. 4190-00(B) KHN Nov 99

LOG OF BORING 102

FARRINGTON HWY. WIDE., KAPOLEI

GOLF COURSE RD. TO FORT WEAVER RD.

EWA, OAHU, HAWAII

PLATE **A-16.2**

Depth, ft	FIELD: Sample	FIELD: Penetra. Resist. Blows/ft	LABORATORY: Dry Density pcf	LABORATORY: Moisture Content %	LABORATORY: Compress. Strength ksf	Other Data	Pen, tsf	DESCRIPTION
								(Continued from previous plate)
		32		23				Reddish brown SILTY CLAY (CH) with sand, hard, slightly moist (residual)
80		42		24				
85		41		24				
90		56		23				
95		45		22				
100		34		29				grades to yellow mottled, moist
								Boring terminated at 101.5 feet
								Groundwater not encountered
105								
110								
115								

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Geotechnical Engineering

WORK ORDER NO. 4190-00(B) KHN Nov 99

LOG OF BORING 102
FARRINGTON HWY. WIDE., KAPOLEI
GOLF COURSE RD. TO FORT WEAVER RD.
EWA, OAHU, HAWAII

PLATE **A-16.3**

Date Started: 8/31/99
Date Completed: 9/1/99
Logged By: Mitchell & Shinsato
Total Depth: 101.5 feet

Drill Rig: CME-75
Drilling Method: H.S. Auger (6.25")
Driving Energy: 140 lb. wt., 30 in. drop

Depth, ft	FIELD: Sample	FIELD: Penetra. Resist. Blows/ft	LABORATORY: Dry Density pcf	LABORATORY: Moisture Content %	LABORATORY: Compress. Strength ksf	Other Data	Pen, tsf	DESCRIPTION (Approximate Surface Elevation (ft): 160*)
		40/.2' Ref.	103	8			>4.5	Reddish brown SILTY CLAY (CL) with sand and gravel, hard, dry (fill)
		16		14				grades to stiff, damp
5		9/.5' +35/.3' Ref.	82	17			1.0	
10		66	98	15			>4.5	Reddish brown SILTY CLAY (CL) with sand, hard, damp (residual)
15		18		16				grades with traces of gravel, stiff
20		40/.3' Ref. 50/.3' Ref.		5				Gray GRAVEL (GP) with sand, very dense, damp (boulder)
								Reddish brown SILTY CLAY (CL) with sand and traces of gravel, hard, damp
25		30/.0' Ref.	84	16			>4.5	
30		41/.5' +50/.3' Ref.		18				grades with traces of sand and no gravel
35								

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Geotechnical Engineering

WORK ORDER NO. 4190-00(B) KHN Nov 99

LOG OF BORING 103
FARRINGTON HWY. WIDE., KAPOLEI
GOLF COURSE RD. TO FORT WEAVER RD.
EWA, OAHU, HAWAII

PLATE
A-17.1

Depth, ft	FIELD: Sample	FIELD: Penetra. Resist. Blows/ft	LABORATORY: Dry Density pcf	LABORATORY: Moisture Content %	LABORATORY: Compress. Strength ksf	Other Data	Pen, tsf	DESCRIPTION
								(Continued from previous plate)
		50/.5' Ref.		8				Gray BASALT GRAVEL (GP) with sand and traces of silt, very dense, damp (boulder)
40		50/.0' Ref.						
45		50/.4' Ref.		18				Reddish brown SILTY SAND (SM) with gravel, very dense, slightly moist (residual)
50		58		19				Reddish brown SILTY CLAY (CH) with sand and traces of gravel, hard, slightly moist (residual)
55		44		22				grades with sand
60		43		24				grades with traces of sand
65		33		24				
70		28		25				grades with sand, very stiff
75								

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Geotechnical Engineering

WORK ORDER NO. 4190-00(B) KHN Nov 99

LOG OF BORING 103

FARRINGTON HWY. WIDE., KAPOLEI

GOLF COURSE RD. TO FORT WEAVER RD.

EWA, OAHU, HAWAII

PLATE A-17.2

Depth, ft	FIELD Sample	FIELD Penetra. Resist. Blows/ft	LABORATORY Dry Density pcf	LABORATORY Moisture Content %	LABORATORY Compress. Strength ksf	Other Data	Pen, tsf	DESCRIPTION
								(Continued from previous plate)
		18		28				Reddish brown SILTY CLAY (CH) with traces of sand, stiff, moist
80		78	105	22			>4.5	grades to hard, slightly moist
85		90		21				grades to brown
90		16		26				Reddish brown SANDY SILT (ML) with traces of gravel, stiff, moist (residual)
95		93		21				Reddish brown SILTY CLAY (CH) with traces of sand and gravel, hard, slightly moist (residual)
100		30		24			>4.5	Reddish brown CLAYEY SILT (MH) with sand, very stiff, damp (residual)
								Boring terminated at 101.5 feet
								Groundwater not encountered
105								
110								
115								

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Geotechnical Engineering

WORK ORDER NO. 4190-00(B) KHN Nov 99

LOG OF BORING 103

FARRINGTON HWY. WIDE., KAPOLEI

GOLF COURSE RD. TO FORT WEAVER RD.

EWA, OAHU, HAWAII

PLATE A-17.3

Date Started:	9/29/99	**Drill Rig:**	CME-75
Date Completed:	10/1/99	**Drilling Method:**	4" Auger, HQ Coring
Logged By:	E. Shinsato	**Driving Energy:**	140 lb. wt., 30 in. drop
Total Depth:	125.5 feet		

Approximate Surface Elevation (ft): 74*

Depth, ft	FIELD: Penetra. Resist. Blows/ft	LABORATORY: Dry Density pcf	LABORATORY: Moisture Content %	LABORATORY: Compress. Strength ksf	Other Data	Pen, tsf	DESCRIPTION
	34	93	10				Brown CLAYEY SILT (MH) with sand, gravel and roots, medium stiff, dry grades to stiff at 1 foot
	24		12				grades to very stiff, damp
5	30/.3' Ref.	88	10				
10	28		6				Grayish brown SILTY SAND (SM) with basalt gravel, medium dense, damp grades with cobbles
15	56	111	18			>4.5	Reddish brown SILTY CLAY (CL) with sand, very stiff, damp (saprolite)
20	41		26				grades to mottled with black, without sand, hard, moist
25	84						grades with sand and traces of gravel
							Grayish brown CLAYEY GRAVEL (GC) with sand, very dense, moist (saprolite)
30	35		32				Grayish brown CLAYEY SILT (MH) with sand, hard, moist (saprolite)
35							

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Geotechnical Engineering

WORK ORDER NO. 4190-00(B) KHN Nov 99

LOG OF BORING 201

FARRINGTON HWY. WIDE., KAPOLEI

GOLF COURSE RD. TO FORT WEAVER RD.

EWA, OAHU, HAWAII

PLATE A-18.1

Depth, ft	FIELD: Sample	FIELD: Penetra. Resist. Blows/ft	LABORATORY: Dry Density pcf	LABORATORY: Moisture Content %	LABORATORY: Compress. Strength ksf	Other Data	Pen, tsf	DESCRIPTION
								(Continued from previous plate)
		50	77	39				Grayish brown CLAYEY GRAVEL (GC) with sand, dense, wet (saprolite)
40		10/.0' Ref.						grades to very dense
								Dark brown SILTY GRAVEL (GM) with sand and clay seams, dense, wet (saprolite)
45		40	75	42				
50		21		35				grades to medium dense
55		15/.0' Ref.				RUN 1 REC=100% RQD=100%		Gray BASALT, moderately fractured, moderately weathered, hard
60						RUN 2 REC=100% RQD=100%		
65						RUN 3 REC=100% RQD=100%		grades to slightly fractured, slightly weathered
70						RUN 4 REC=100% RQD=100%		grades to massive
75								

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WORK ORDER NO. 4190-00(B) KHN Nov 99

LOG OF BORING 201

FARRINGTON HWY. WIDE., KAPOLEI

GOLF COURSE RD. TO FORT WEAVER RD.

EWA, OAHU, HAWAII

PLATE

A-18.2

Depth, ft	FIELD: Sample	FIELD: Penetra. Resist. Blows/ft	LABORATORY: Dry Density pcf	LABORATORY: Moisture Content %	LABORATORY: Compress. Strength ksf	Other Data	Pen, tsf	DESCRIPTION (Continued from previous plate)
						RUN 5 REC=92% RQD=92%		Gray BASALT, massive, slightly weathered, hard
80						RUN 6 REC=92% RQD=87%		Gray vesicular BASALT, moderately fractured, highly weathered, medium hard
85						RUN 7 REC=100% RQD=100%		
90						RUN 8 REC=100% RQD=100%		grades to slightly fractured, moderately weathered, hard
95						RUN 9 REC=100% RQD=100%		grades to massive, slightly weathered
100						RUN 10 REC=100% RQD=95%		Gray vesicular BASALT, moderately fractured, highly weathered, medium hard
105						RUN 11 REC=100% RQD=95%		
110						RUN 12 REC=100% RQD=100%		Gray vugular BASALT, slightly fractured, slightly weathered, hard
115								

GEOLABS, INC. Geotechnical Engineering	LOG OF BORING 201	PLATE
WORK ORDER NO. 4190-00(B) KHN Nov 99	FARRINGTON HWY. WIDE., KAPOLEI GOLF COURSE RD. TO FORT WEAVER RD. EWA, OAHU, HAWAII	A-18.3

Depth, ft	FIELD: Sample	FIELD: Penetra. Resist. Blows/ft	LABORATORY: Dry Density pcf	LABORATORY: Moisture Content %	LABORATORY: Compress. Strength ksf	Other Data	Pen, tsf	DESCRIPTION
								(Continued from previous plate)
						RUN 13 REC=100% RQD=100%		Gray vugular BASALT, massive, slightly weathered, hard
120						RUN 14 REC=100% RQD=100%		Gray vesicular BASALT, moderately fractured, moderately weathered, medium hard
125								Boring terminated at 125.5 feet Groundwater not encountered
130								
135								
140								
145								
150								
155								

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WORK ORDER NO. 4190-00(B) KHN Nov 99

LOG OF BORING 201

FARRINGTON HWY. WIDE., KAPOLEI

GOLF COURSE RD. TO FORT WEAVER RD.

EWA, OAHU, HAWAII

PLATE

A-18.4

Date Started: 8/26/99
Date Completed: 8/27/99
Logged By: N. Mitchell
Total Depth: 88.8 feet

Drill Rig: CME-75
Drilling Method: 4" Auger, HQ Coring
Driving Energy: 140 lb. wt., 30 in. drop

Depth, ft	Sample (Field)	Penetra. Resist. Blows/ft (Field)	Dry Density pcf (Laboratory)	Moisture Content % (Laboratory)	Compress. Strength ksf (Laboratory)	Other Data	Pen, tsf	DESCRIPTION — Approximate Surface Elevation (ft): 90*
								8-inch ASPHALT CONCRETE
		26		11				Brown SILTY SAND (SM) with gravel, medium dense, damp (fill)
		26	89	14				
5		16		12				
10		31	90	11				
15		23		11				
								Brown SILTY CLAY (CL) with sand and gravel, stiff, slightly moist (residual)
20		13		22				
								grades to hard, damp
25		40/.4' Ref.	97	14			>4.5	
30		50/.3' Ref.		20				grades to slightly moist
								Reddish brown SILTY CLAY (CH) with traces of sand, hard, slightly moist (residual)
35								

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Geotechnical Engineering

WORK ORDER NO. 4190-00(B) KHN Nov 99

LOG OF BORING 202

FARRINGTON HWY. WIDE., KAPOLEI
GOLF COURSE RD. TO FORT WEAVER RD.
EWA, OAHU, HAWAII

PLATE
A-19.1

Depth, ft	Sample	FIELD Penetra. Resist. Blows/ft	LABORATORY Dry Density pcf	LABORATORY Moisture Content %	LABORATORY Compress. Strength ksf	Other Data	Pen, tsf	DESCRIPTION
								(Continued from previous plate)
		40/.1' Ref.	101	20			>4.5	Reddish brown SILTY CLAY (CH) with traces of sand, hard, slightly moist (residual)
								Reddish brown SILTY SAND (SM), medium dense, wet (residual)
40		28		26				
								Reddish brown mottled with gray SANDY GRAVEL (GW) with silt, medium dense, wet (decomposed rock/saprolite)
45		70						
50		51		32				grades to dense
								Grayish brown mottled with orange SILTY SAND (SM) with gravel, very dense, wet (saprolite)
55		50/.3' Ref.	83	37			>4.5	
60		21		21				Reddish brown SILTY GRAVEL (GM) with sand, medium dense, moist (saprolite)
								Dark gray SILTY SAND (SM) with gravel, dense, wet (saprolite)
65		33		43				
								Gray BASALT GRAVEL with sand and some silt, very dense (saprolite/rock formation)
70		50/.3' Ref.		27		RUN 1 REC=100% RQD=98%		Gray vesicular BASALT, slightly fractured, slightly to moderately weathered, hard
75								

GEOLABS, INC.
Geotechnical Engineering

WORK ORDER NO. 4190-00(B) KHN Nov 99

LOG OF BORING 202
FARRINGTON HWY. WIDE., KAPOLEI
GOLF COURSE RD. TO FORT WEAVER RD.
EWA, OAHU, HAWAII

PLATE **A-19.2**

Depth, ft	FIELD: Sample	FIELD: Penetra. Resist. Blows/ft	LABORATORY: Dry Density pcf	LABORATORY: Moisture Content %	LABORATORY: Compress. Strength ksf	Other Data	Pen, tsf	DESCRIPTION (Continued from previous plate)
						RUN 2 REC=97% RQD=83%		Gray vesicular BASALT, slightly fractured, slightly to moderately weathered, hard
80						RUN 3 REC=100% RQD=99%		
85						RUN 4 REC=100% RQD=100%		grades to massive, slightly weathered
90								Boring terminated at 88.8 feet Groundwater level at: Depth 68.5 ft. — Hours 1645 — Date 8/27/99
95								
100								
105								
110								
115								

GEOLABS, INC.
Geotechnical Engineering

WORK ORDER NO. 4190-00(B) KHN Nov 99

LOG OF BORING 202
FARRINGTON HWY. WIDE., KAPOLEI
GOLF COURSE RD. TO FORT WEAVER RD.
EWA, OAHU, HAWAII

PLATE **A-19.3**

Date Started: 8/18/99
Date Completed: 8/20/99
Logged By: N. Mitchell
Total Depth: 75.0 feet

Drill Rig: Mobile B-80
Drilling Method: 4" Auger, HQ Coring
Driving Energy: 140 lb. wt., 30 in. drop

Depth, ft	Sample	FIELD: Penetra. Resist. Blows/ft	LABORATORY: Dry Density pcf	LABORATORY: Moisture Content %	LABORATORY: Compress. Strength ksf	Other Data	Pen, tsf	DESCRIPTION (Approximate Surface Elevation (ft): 74.5*)
		39	96	25				Brown SILTY SAND (SM) with traces of clay, medium dense, moist (fill)
		9		25				grades to loose to medium dense
5		41					3.8	grades to grayish brown with gravel, medium dense, slightly moist
								Gray vesicular BASALT, moderately fractured, slightly weathered, hard
10								
						RUN 1 REC=79% RQD=62%		
15		40/.2' Ref.						Reddish brown CLAYEY SILT (ML) with some sand, very stiff, wet (saprolite)
20		46		28			>4.5	
						RUN 2 REC=5%		Reddish brown mottled with light gray SILTY SAND (SM) with gravel, very dense, wet
25		20/.5' +50/.3' Ref.		39				
						RUN 3 REC=10%		
30		31/.5' +50/.3' Ref.		32				grades to grayish brown mottled with red
						RUN 4 REC=78% RQD=38%		Gray vesicular BASALT with pockets of sandy silt, moderately to closely fractured, moderately to highly weathered, medium hard to soft
35								

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Geotechnical Engineering

WORK ORDER NO. 4190-00(B) KHN Nov 99

LOG OF BORING 203

FARRINGTON HWY. WIDE., KAPOLEI
GOLF COURSE RD. TO FORT WEAVER RD.
EWA, OAHU, HAWAII

PLATE
A-20.1

Depth, ft	FIELD Sample	FIELD Penetra. Resist. Blows/ft	LABORATORY Dry Density pcf	LABORATORY Moisture Content %	LABORATORY Compress. Strength ksf	Other Data	Pen, tsf	DESCRIPTION
								(Continued from previous plate)
		50/.4' Ref.		20		RUN 5 REC=80% RQD=35%		Gray vesicular BASALT with pockets of sandy silt, moderately to highly fractured, moderately to highly weathered, medium hard to soft
40		22		40		RUN 6 REC=33% RQD=0%		grades with pockets of sand, highly fractured, highly weathered, soft
45		50/.3' Ref.		33		RUN 7 REC=24% RQD=0%		
50		50/.2' Ref.		10		RUN 8 REC=97% RQD=34%		grades to moderately fractured, moderately to highly weathered, hard
55						RUN 9 REC=95% RQD=58%		grades to highly fractured
60						RUN 10 REC=100% RQD=95%		grades to slightly fractured, slightly to moderately weathered
65						RUN 11 REC=100% RQD=75%		grades to slightly to moderately fractured, moderately weathered
70						RUN 12 REC=100% RQD=95%		grades to slightly fractured, slightly to moderately weathered
75								

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WORK ORDER NO. 4190-00(B) KHN Nov 99

LOG OF BORING 203

FARRINGTON HWY. WIDE., KAPOLEI

GOLF COURSE RD. TO FORT WEAVER RD.

EWA, OAHU, HAWAII

PLATE

A-20.2

Depth, ft	FIELD: Sample	FIELD: Penetra. Resist. Blows/ft	LABORATORY: Dry Density pcf	LABORATORY: Moisture Content %	LABORATORY: Compress. Strength ksf	Other Data	Pen, tsf	DESCRIPTION
								(Continued from previous plate)
								Boring terminated at 75 feet
								Groundwater not encountered
80								
85								
90								
95								
100								
105								
110								
115								

GEOLABS, INC. *Geotechnical Engineering*	**LOG OF BORING 203** **FARRINGTON HWY. WIDE., KAPOLEI** **GOLF COURSE RD. TO FORT WEAVER RD.** **EWA, OAHU, HAWAII**	**PLATE** **A-20.3**
WORK ORDER NO. 4190-00(B) KHN Nov 99		