GEOTECHNICAL INVESTIGATION
NORTH KOHALA
WATER SYSTEM IMPROVEMENTS
UPOLU WELL SITE PUMP BUILDING
AND 0.5 MG WATER TANK
HAWI, NORTH KOHALA, HAWAII

for

AKINAKA & ASSOCIATES, LTD.

HIRATA & ASSOCIATES, INC.
W.O. 21-6633
August 30, 2022

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August 30, 2022
W.O. 21-6633

Mr. Scott Kunioka
Akinaka & Associates, Ltd.
1100 Alakea Street, Suite 1800
Honolulu, Hawaii 96813

Dear Mr. Kunioka:

Our report, "Geotechnical Investigation, North Kohala Water System Improvements, Upolu Well Site Pump Building and 0.5 MG Water Tank, Hawi, North Kohala, Hawaii," dated August 30, 2022, our Work Order 21-6633 is enclosed. This investigation was conducted in general conformance with the scope of services presented in our revised proposal dated December 1, 2021.

Our borings encountered surface soil classified as brown clayey silt with gravel. The clayey silt was in a stiff condition and extended to depths ranging from about 3.5 to 5.5 feet. Underlying the clayey silt was mottled brown completely to highly weathered basalt. The weathered basalt was in a medium dense to dense condition and extended to the maximum depths drilled. Neither groundwater nor seepage water was encountered in our borings.

Conventional shallow foundations bearing directly on the stiff clayey silt may be used for support of the proposed pump building. We understand that three options are being considered for the location of the proposed water tank and grading for each site will include cuts ranging between 6 and 8 feet. To provide more uniform support, foundations for the proposed water tank may be founded on a minimum of 12 inches of imported granular structural fill. The following is a summary of our geotechnical recommendations. This summary is not intended to be a substitute for our report which includes a detailed explanations of our recommendations, as well as additional requirements.

- Allowable bearing value = 2,500 psf
- Coefficient of friction = 0.4
- Passive earth pressure = 250 psf

We appreciate this opportunity to be of service. Should you have any questions concerning this report, please feel free to call on us.

Very truly yours,

HIRATA & ASSOCIATES, INC.

Rick I.K. Yoshida, P.E. Vice President

RIKY:JC

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NORTH KOHALA
WATER SYSTEM IMPROVEMENTS
UPOLU WELL PUMP BUILDING AND
0.5 MG WATER TANK
HAWI, NORTH KOHALA, HAWAII

INTRODUCTION

This report presents the results of our geotechnical investigation performed for the proposed pump building and 0.5 MG water tank in Hawi, North Kohala, Hawaii. Our scope of services for this study included the following:

- A visual reconnaissance of the site and its vicinity to observe existing conditions which may affect the project. The general location of the project site is shown on the enclosed Location Map, Plate A2.1.

- A review of available in-house soils information pertinent to the site and the proposed project.

- Drilling and sampling two borings to depths of about 30.5 feet for the proposed water tank and two borings to depths of about 14 and 14.5 feet for the proposed pump building. A description of our field investigation is summarized on Plates A1.1 and A1.2. The approximate exploratory boring locations are shown on the enclosed Boring Location Plan, Plate A2.2, and the soils encountered in the borings are described on the Boring Logs, Plates A4.1 through A4.4.

- Laboratory testing of selected soil samples. Testing procedures are presented in the Description of Laboratory Testing, Plates B1.1 and B1.2. Test results are presented on the Boring Logs (Plates A4.1 through A4.4), Consolidation Test reports (Plates B2.1 and B2.2), Direct Shear Test reports (Plates B3.1 and B3.2), Modified Proctor Test report (Plate B4.1), and CBR Test Report (Plate B5.1).

- Engineering analyses of the field and laboratory data.

- Preparation of this report presenting the results of our exploratory fieldwork and laboratory testing, and geotechnical recommendations for the design of foundations, including seismic considerations, resistance to lateral pressures, concrete slabs-on-grade, flexible pavement, and site grading.

PROJECT CONSIDERATIONS

In lieu of improvements at an existing DLNR water tank site along Kynnersley Road as previously proposed, we understand that the proposed project will consist of improvements at the existing Upolu Well site near the intersection of Upolu Airport Road and Akoni Pule Highway. The proposed improvements will consist of a new non-potable production well and well pad, a pump building in the northwestern portion of the site, and a 0.5 MG water tank with a diameter on the order of 75 feet in the southeastern portion of the site. At the time of this report, the water tank is proposed to utilize masonry construction, however, steel is also being considered. We assume that the proposed pump building will have plan dimensions similar to the previously proposed building at the Kynnersley Road site, about 20 by 63 feet. Asphaltic concrete (AC) paved driveways are proposed extending from Upolo Airport Road to the proposed pump building and water tank.

Subsequent to our fieldwork, we understand that two additional options are being considered for the location of the proposed water tank. Option 2 is located approximately 170 feet to the north of the initially proposed location (Option 1) and Option 3 is located about 270 feet to the northwest. Based on information provided by your office, site grading will generally consist of shallow fills on the north sides of the proposed tanks and cuts of about 7 and 6 feet on the south sides for Options 1 and 2, respectively, and about 8 feet on the southwest side for Option 3. We assume that cut slopes will accommodate grade changes at the water tank site.

Site grading for the proposed well and pump building site will consist of shallow cuts and fills.

SITE CONDITIONS

The Upolu Well site is located on the north side of Akoni Pule Highway, east of its intersection with Upolo Airport Road, in Hawi, North Kohala, Hawaii. The site is vacant of structures and generally consists of pasture land with a light to moderate growth of vegetation. Numerous cobbles and boulders were observed on the surface. The existing well is located in the northwestern area of the site.

Based on the topographic survey provided by your office, the site slopes downward in a northerly direction with ground elevations ranging from about +600 in the southern portion of the site to about +567 in the northern portion.

SOIL CONDITIONS

Our borings encountered near surface soil classified as brown clayey silt with gravel. The clayey silt was in a stiff condition and extended to depths ranging from about 3.5 to 5.5 feet. Underlying the clayey silt was mottled brown completely to highly weathered basalt. The weathered basalt was in a medium dense to dense condition and extended to the maximum depths drilled.

Neither groundwater nor seepage water was encountered in our borings.

CONCLUSIONS AND RECOMMENDATIONS

Based on our exploratory fieldwork and laboratory testing, we believe that from a geotechnical viewpoint the site can generally be developed as planned.

Foundations

Conventional shallow foundations, such as spread footings or thickened slab foundations, bearing directly on the stiff clayey silt may be used for support of the proposed pump building.

Based on the results of our borings and the proposed finish elevations for the water tanks, footing excavations are expected to encounter the surface clayey silt and underlying completely to highly weathered basalt. Conventional shallow foundations may be used to support the proposed tank. However, the standard of practice is for all foundations for a particular structure to bear on the same material. As a result, to provide more uniform support, we recommend that all foundations be underlain by a minimum of 12 inches of imported granular structural fill.

The granular structural fill should also extend a minimum 12 inches beyond the edge of footings. Overexcavation of the insitu clayey silt may be required for placement of the granular structural fill. Based on the results of our exploratory borings, the depth to the completely to highly weathered basalt is about 3.5 feet below existing grade.

Foundations may be designed for an allowable bearing value of 2,500 pounds per square foot. The recommended allowable bearing value is for the total of dead and frequently applied live loads and may be increased by one-third for short duration loading which includes the effects of wind and seismic forces.

Spread footings should be a minimum 16 inches in width and embedded at least 12 inches below finish adjacent grade. Foundations supporting the proposed water

tank should also be embedded at least 6 inches into the weathered basalt stratum. The bottom of footing excavations should be thoroughly tamped and cleaned of loose material prior to placement of reinforcing steel and concrete. If cobbles or boulders are exposed at the bottom of structural excavations, they should be removed and replaced with compacted granular structural fill.

In areas where granular structural fill is placed outside building areas, and is open to the environment, the granular structural fill should be capped with a minimum 12 inches of low permeability soil such as the onsite clayey silt. The intent of this recommendation is to reduce intrusion of surface runoff into granular fill below footings. This low permeability capping layer should be placed as soon as practical and should be compacted in lifts to a minimum 90 percent compaction as determined by ASTM D 1557. In addition, we recommend that areas adjacent to the structure be graded to allow surface water to drain away from the proposed water tank.

Seismic Design

Based on the borings drilled as part of this study and our knowledge of the deep soil conditions in the area, the subsurface soils can be characterized as a stiff soil profile. Therefore, based on the 2012 International Building Code, Site Class D is recommended for this site.

Lateral Design

Resistance to lateral loading may be provided by friction acting at the base of foundations, and by passive earth pressure acting on the buried portions of foundations.

A coefficient of friction of 0.4 may be used with the dead load forces. Passive earth pressure may be computed as an equivalent fluid having a density of 250 pounds per cubic foot with a maximum earth pressure 2,500 pounds per square foot. Unless

covered by pavement or concrete slabs, the upper 12 inches of soil should not be considered in computing lateral resistance.

Foundation Settlement

Structural loads were not available at the time of this report. However, neither excessive total nor differential settlement is expected for footings bearing on compacted granular structural fill or the stiff clayey silt.

Slabs-on-Grade

The pump building and tank slab should be underlain by a minimum 6 inches of aggregate base course. The base course should be compacted to a minimum 95 percent compaction as determined by ASTM D 1557.

Prior to placement of the base course, the exposed subgrade should be scarified to a minimum depth of 6 inches, moisture conditioned to about 2 percent above optimum moisture content, and recompacted to a minimum 90 percent compaction as determined by ASTM D 1557.

Flexible Pavement

We assume that the pavement areas will generally be limited to passenger vehicles and light trucks. Based on the results of our laboratory testing, flexible pavement may be designed on the following sections.

2.0”	Asphalt Concrete
6.0”	Base Course (CBR = 85 minimum)
8.0”	Total Thickness

Prior to placement of the base course, the exposed subgrade should be sacrificed to a minimum depth of 6 inches, moisture conditioned to about 2 percent above optimum moisture content, and compacted to a minimum 95 percent compaction as determined by ASTM D 1557. The base course should also be compacted to a minimum 95 percent compaction as determined as ASTM D 1557.

Site Grading

Site Preparation - The project site should be cleared of all vegetation, including large roots and other deleterious material. In areas requiring fill placement, the exposed subgrade should be scarified to a minimum depth of 6 inches, moisture conditioned to about 2 percent above the optimum moisture content and compacted to a minimum 90 percent compaction as determined by ASTM D 1557.

Slope Gradients - Fill and cut slopes exposing the onsite clayey silt or weathered basalt may be designed for slope gradients of 2H:1V or flatter. All slopes should be planted as soon as practical to reduce the effects of erosion and weathering.

Structural Excavations - Based on our exploratory borings, we believe that excavations into the surface and near surface soils can generally be accomplished using conventional excavating equipment. Temporary cuts into the clayey silt and underlying weathered basalt should be stable at slope gradients of 1H:1V or flatter. Excavations where cobbles and boulders are encountered may require hydraulic hoe ramming equipment. It should be the Contractor's responsibility to conform to all OSHA safety standards for excavations.

Onsite Fill Material – The onsite clayey silt and weathered basalt will be acceptable for reuse in compacted fills and backfills except in the granular structural fill section recommended beneath footings.

All rock fragments larger than 3 inches in maximum dimension should be removed prior to reuse. Excavated cobbles and boulders may be reused in structural fills and backfills provided the material is crushed to a well-graded consistency with a maximum particle size of 3 inches.

Imported Fill Material - Imported structural fill should be well-graded, non-expansive granular material. Specifications for imported granular structural fill

should indicate a maximum particle size of 3 inches, and state that between 8 and 20 percent of soil by weight shall pass the #200 sieve. In addition, the plasticity index (P.I.) of that portion of the soil passing the #40 sieve shall not be greater than 10. Imported structural fill should have a CBR expansion value no greater than 1.0 percent and a minimum CBR value of 15 percent, when tested in accordance with ASTM D 1883.

Compaction – Cohesive soils, such as the onsite clayey silt, should be placed in horizontal lifts restricted to eight inches in loose thickness and compacted to a minimum 90 percent compaction as determined by ASTM D 1557.

Granular fill, such as imported granular structural fill, should be placed in horizontal lifts restricted to eight inches in loose thickness and compacted to a minimum 95 percent compaction as determined by ASTM D 1557. Fill placed in areas which slope steeper than 5H:1V should be continually benched as the fill is brought up in lifts.

ADDITIONAL SERVICES

We recommend that we perform a general review of the final design plans and specifications. This will allow us to verify that the foundation design and earthwork recommendations have been properly interpreted and implemented in the design plans and construction specifications.

For continuity, we recommend that we be retained during construction to (1) check footing excavations prior to placement of imported granular structural fill, reinforcing steel and concrete, (2) review and/or perform laboratory testing on import borrow to determine its acceptability for use in compacted fills, (3) observe structural fill placement and perform compaction testing, and (4) provide geotechnical consultation as required.

Our services during construction will allow us to verify that our recommendations are properly interpreted and included in construction, and if necessary, to make modifications to those recommendations, thereby reducing construction delays in the event subsurface conditions differ from those anticipated.

LIMITATIONS

The boring logs indicate the approximate subsurface soil conditions encountered only at those times and locations where our borings were made and may not represent conditions at other times and locations.

This report was prepared specifically for Akinaka & Associates, Ltd. and their sub-consultants for design of the proposed water system improvements at the Upolu Well site in Hawi, North Kohala, Hawaii. The boring logs, laboratory test results, and recommendations presented in this report are for design purposes only and are not intended for use in developing cost estimates by the contractor.

During construction, should subsurface conditions differ from those encountered in our borings, we should be advised immediately in order to re-evaluate our recommendations, and to revise or verify them in writing before proceeding with construction.

Our recommendations and conclusions are based upon the site materials observed, the preliminary design information made available, the data obtained from our site exploration, our engineering analyses, and our experience and engineering judgment. The conclusions and recommendations in this report are professional opinions which we have strived to develop in a manner consistent with that level of care, skill, and competence ordinarily exercised by members of the profession in good standing, currently practicing under similar conditions in the same locality. We will be responsible for those recommendations and conclusions, but will not be

responsible for the interpretation by others of the information developed. No warranty is made regarding the services performed, either expressed or implied.

Respectfully submitted,

HIRATA & ASSOCIATES, INC.

Juanito Cajimat, Project Engineer

Rick Yoshida, P.E., Project Manager

This work was prepared by me or under my supervision.
Expiration Date of License:
April 30, 2024

APPENDIX A

FIELD INVESTIGATION

DESCRIPTION OF FIELD INVESTIGATION

GENERAL

The site was explored on June 8, 2022, by performing a visual reconnaissance of the site and drilling two exploratory borings to depths of about 30.5 feet for the proposed water tank and two borings to depths of about 14 and 14.5 feet for the proposed pump building with a CME 55 truck-mounted drill rig.

During drilling operations, the soils were continuously logged by our field engineer and classified by visual examination in accordance with the Unified Soil Classification System. The boring logs indicate the depths at which the soils or their characteristics change, although the change could actually be gradual. If the change occurred between sample locations, the depth was interpreted based on field observations. Classifications and sampling intervals are shown on the boring logs. A Boring Log Legend is presented on Plate A3.1, while the Unified Soil Classification and Rock Weathering Classification Systems are shown on Plate A3.2 and A3.3, respectively. The soils encountered are logged on Plates A4.1 through A4.4.

Borings were located in the field by measuring/taping offsets from existing site features shown on the plans. Surface elevations at boring locations were estimated based on the Topographic Survey Map provided by Akinaka & Associates, Ltd. on April 13, 2022. The accuracy of the boring locations shown on Plate A2.2 and the boring elevations shown on Plates A4.1 through A4.4 are therefore approximate, in accordance with the field methods used.

SOIL SAMPLING

Representative and bulk soil samples were recovered from the borings for selected laboratory testing and analyses. Representative samples were recovered by driving a 3-inch O.D. split tube sampler a total of 18 inches with a 140-pound hammer dropped from a height of 30 inches. The number of blows required to drive the

sampler the final 12 inches are recorded at the appropriate depths on the boring logs, unless noted otherwise. A bulk soil sample was recovered from boring B4 between depths of about 0.5 and 2 feet.

APPENDIX B

LABORATORY TESTING

Reference: Topographic Quadrangle Map prepared by the United States Department of the Interior Geologic Survey
Hawi and Hawi OE N Quadrangle
Hawaii-Hawaii Co., Hawaii. 2017

North Kohala Water System Improvements - Upolu Well Pump Building and 0.5 MG Water Tank

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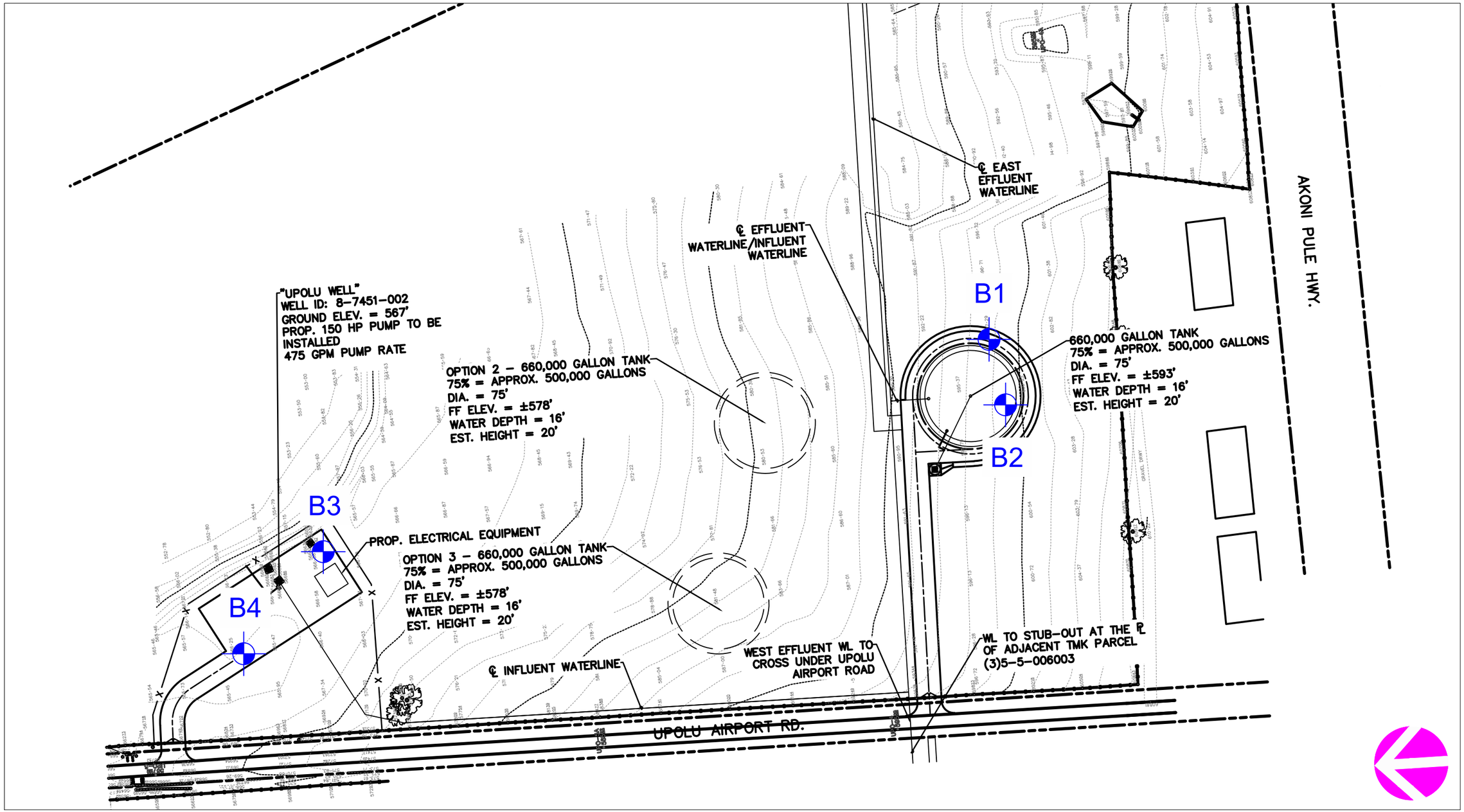
LOCATION MAP

Plate A2.1



LEGEND:

Approximate location of borings

Reference: Site Plan provided by Akinaka & Associates, Ltd. on August 29, 2022.

GRAPHIC SCALE:

0 40 80 160FT.

1" = 80'

North Kohala Water System Improvements - Upolu Well Pump Building and 0.5 Water Tank

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BORING LOCATION PLAN

Plate A2.2

MAJOR DIVISIONS			GROUP DIVISIONS		TYPICAL NAMES
COARSE GRAINED SOILS (More than 50% of the material is LARGER than No. 200 sieve size.)	GRAVELS (More than 50% of coarse fraction is LARGER than the No. 4 sieve size.)	CLEAN GRAVELS (Little or no fines.)		GW	Well graded gravels, gravel-sand mixtures, little or no fines.
				GP	Poorly graded gravels or gravel-sand mixtures, little or no fines.
		GRAVELS WITH FINES (Appreciable amt. of fines.)		GM	Silty gravels, gravel-sand-silt mixtures.
				GC	Clayey gravels, gravel-sand-clay mixtures.
	SANDS (More than 50% of coarse fraction is SMALLER than the No. 4 sieve size.)	CLEAN SANDS (Little or no fines.)		SW	Well graded sands, gravelly sands, little or no fines.
				SP	Poorly graded sands or gravelly sands, little or no fines.
		SANDS WITH FINES (Appreciable amt. of fines.)		SM	Silty sands, sand-silt mixtures.
				SC	Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS (More than 50% of the material is SMALLER than No. 200 sieve size.)	SILTS AND CLAYS (Liquid limit LESS than 50.)			ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
				CL	Inorganic clays of high plasticity, lean clays.
				OL	Organic silts and organic silty clays of low plasticity.
	SILTS AND CLAYS (Liquid limit GREATER than 50.)			MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
				CH	Inorganic clays of high plasticity, fat clays.
				OH	Organic clays of medium to high plasticity, organic silts.
HIGHLY ORGANIC SOILS				PT	Peat and other highly organic silts.
FORMATIONS					FRESH TO MODERATELY WEATHERED BASALT
					VOLCANIC TUFF / HIGHLY TO COMPLETELY WEATHERED BASALT
					CORAL

SAMPLE DEFINITION

2" O.D. Standard Split Spoon Sampler	Shelby Tube	RQD: Rock Quality Designation
3" O.D. Split Tube Sampler	Core Sample	Water Table

North Kohala Water System Improvements - Upolu Well Pump Building and 0.5 MG Water Tank

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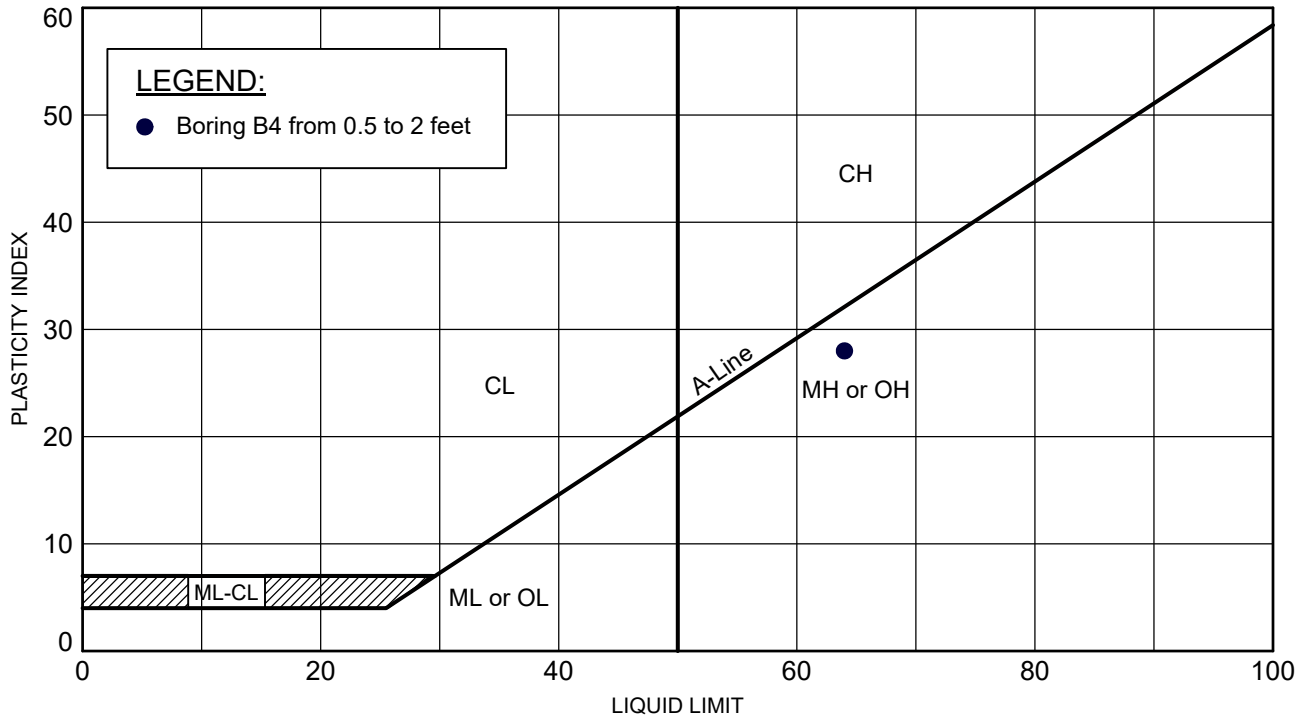
BORING LOG LEGEND

Plate A3.1

PLASTICITY CHART



GRADATION CHART

COMPONENT DEFINITIONS BY GRADATION	
COMPONENT	SIZE RANGE
Boulders	Above 12 in.
Cobbles	3 in. to 12 in.
Gravel	3 in. to No. 4 (4.76 mm)
Coarse	3 in. to 3/4 in.
Fine Gravel	3/4 in. to No. 4 (4.76 mm)
Sand	No. 4 (4.76 mm) to No. 200 (0.074mm)
Coarse Sand	No. 4 (4.76 mm) to No. 10 (2.0 mm)
Medium Sand	No. 10 (2.0 mm) to No. 40 (0.42 mm)
Fine Sand	No. 40 (0.42 mm) to No. 200 (0.074 mm)
Silt and Clay	Smaller than No. 200 (0.074 mm)

North Kohala Water System Improvements - Upolu Well Pump Building and 0.5 MG Water Tank

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UNIFIED SOIL CLASSIFICATION SYSTEM

Plate
A3.2

Grade	Symbol	Description
Fresh	F	No visible signs of decomposition or discoloration. Rings under hammer impact.
Slightly Weathered	WS	Slight discoloration inwards from open fractures, otherwise similar to F.
Moderately Weathered	WM	Discoloration throughout. Weaker minerals such as feldspar decomposed. Strength somewhat less than fresh rock but cores cannot be broken by hand or scraped by knife. Texture preserved.
Highly Weathered	WH	Most minerals somewhat decomposed. Specimens can be broken by hand with effort or shaved with knife. Core stones present in rock mass. Texture becoming indistinct but fabric preserved.
Completely Weathered	WC	Minerals decomposed to soil but fabric and structure preserved (Saprolite). Specimens easily crumbled or penetrated.
Residual Soil	RS	Advance state of decomposition resulting in plastic soils. Rock fabric and structure completely destroyed. Large volume change.

Reference: Soil Mechanics, NAVFAC DM-7.1, Department of the Navy, Naval Facilities Engineering Command, September, 1986.

Hirata & Associates, Inc.
GEOTECHNICAL ENGINEERING

Boring No.
B1

BORING LOG

PROJECT NAME North Kohala Water System Improvements - Upolu Well Pump Building and 0.5 MG Water Tank
WORK ORDER NO. 21-6633 DRIVING WT. 140 lb. START DATE 6/8/22
SURFACE ELEV. 597.0 ±* DROP 30 in. END DATE 6/8/22

REMARKS/ SAMPLE NO.	CORE RECOVERY (%)	RQD (%)	BLOWS PER FOOT	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	DEPTH (ft)	GRAPHIC LOG	SAMPLE	MATERIAL DESCRIPTION
						0			Clayey SILT (MH) - Brown, moist, stiff. Cobble at 0.5 feet.
			24	79	39	5			COMPLETELY TO HIGHLY WEATHERED BASALT (WC-WH) - Mottled brown, moist, medium dense to dense.
			34	60	48	10			
			14	64	61	15			
			20	69	51	20			Neither groundwater nor seepage water encountered.
						25			*Elevations based on Topographic Survey Map provided by Akinaka & Associates, Ltd. on April 13, 2022.
			36	65	55	30			
									End boring at 30.5 feet.
						35			

Plate A4.1

Hirata & Associates, Inc.
GEOTECHNICAL ENGINEERING

Boring No. B2

BORING LOG

PROJECT NAME North Kohala Water System Improvements - Upolu Well Pump Building and 0.5 MG Water Tank
WORK ORDER NO. 21-6633 DRIVING WT. 140 lb. START DATE 6/8/22
SURFACE ELEV. 600.0 ± * DROP 30 in. END DATE 6/8/22

REMARKS/ SAMPLE NO.	CORE RECOVERY (%)	RQD (%)	BLOWS PER FOOT	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	DEPTH (ft)	GRAPHIC LOG	SAMPLE	MATERIAL DESCRIPTION
NP: No Penetration			47	82	35				Clayey SILT (MH) - Brown, moist, stiff, with gravel.
			14/6"	93	19				
			27	76	45				COMPLETELY TO HIGHLY WEATHERED BASALT (WC-WH) - Mottled brown, moist, medium dense to dense.
			24	76	43	5			
			21	76	45	10			
			11	68	43	15			
			15	74	42	20			
						25			
			78/11"	84	28	30			
			10/NP						End boring at 30.5 feet.
									Neither groundwater nor seepage water encountered.
						35			

Plate A4.2

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GEOTECHNICAL ENGINEERING

Boring No.
B3

BORING LOG

PROJECT NAME North Kohala Water System Improvements - Upolu Well Pump Building and 0.5 MG Water Tank
WORK ORDER NO. 21-6633 DRIVING WT. 140 lb. START DATE 6/8/22
SURFACE ELEV. 566.5 ± * DROP 30 in. END DATE 6/8/22

REMARKS/ SAMPLE NO.	CORE RECOVERY (%)	RQD (%)	BLOWS PER FOOT	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	DEPTH (ft)	GRAPHIC LOG	SAMPLE	MATERIAL DESCRIPTION
NP: No Penetration Lost Recovery			40						Clayey SILT (MH) - Brown, moist, stiff, with gravel.
			48	80	28				
			81/8" 10/NP	77	43	5			COMPLETELY TO HIGHLY WEATHERED BASALT (WC-WH) - Mottled brown, moist, medium dense to dense.
			46	80	37	10			
			10/NP			15			End boring at 14.0 feet.
									Neither groundwater nor seepage water encountered.
						20			
						25			
						30			
						35			

Plate A4.3

Hirata & Associates, Inc.
GEOTECHNICAL ENGINEERING

Boring No.
B4

BORING LOG

PROJECT NAME North Kohala Water System Improvements - Upolu Well Pump Building and 0.5 MG Water Tank
WORK ORDER NO. 21-6633 DRIVING WT. 140 lb. START DATE 6/8/22
SURFACE ELEV. 566.5 ± * DROP 30 in. END DATE 6/8/22

REMARKS/ SAMPLE NO.	CORE RECOVERY (%)	RQD (%)	BLOWS PER FOOT	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	DEPTH (ft)	GRAPHIC LOG	SAMPLE	MATERIAL DESCRIPTION
			36	77	29				Clayey SILT (MH) - Brown, moist, stiff, with gravel.
			57	83	32	5			
			27	62	47				COMPLETELY TO HIGHLY WEATHERED BASALT (WC-WH) - Mottled brown to orangish brown, moist, dense to medium dense.
			24	61	46	10			
						15			End boring at 14.5 feet.
									Neither groundwater nor seepage water encountered.
						20			
						25			
						30			
						35			

Plate A4.4

APPENDIX B

LABORATORY TESTING

DESCRIPTION OF LABORATORY TESTING

CLASSIFICATION

Field classification was verified in the laboratory in accordance with the Unified Soil Classification System. Laboratory classification was determined by both visual examination and Atterberg Limit tests performed in general accordance with ASTM D 4318. Results of Atterberg Limit tests are plotted on Plate A3.2. The final classifications are shown at the appropriate locations on the Boring Logs, Plates A4.1 through A4.4.

MOISTURE-DENSITY

Representative samples were tested for field moisture content and dry unit weight. The dry unit weight was determined in pounds per cubic foot while the moisture content was determined as a percentage of dry weight. Samples were obtained using a 3-inch O.D. split tube sampler. Test results are shown at the appropriate depths on the Boring Logs, Plates A4.1 through A4.4.

CONSOLIDATION

Selected representative samples were tested for its consolidation characteristics. The test samples were 2.42 inches in diameter and 1 inch high. Porous stones were placed in contact with the top and bottom of the test sample to permit addition and release of pore fluid. Loads were then applied in several increments in a geometric progression, and the resulting deformations recorded at selected time intervals. Test results are plotted on the Consolidation Test reports, Plates B2.1 and B2.2.

SHEAR TESTS

Shear tests were performed in the Direct Shear Machine which is of the strain control type. Each sample was sheared under varying confining loads in order to determine the Coulomb shear strength parameters, cohesion, and angle of internal friction. Test results are presented on Plates B3.1 and B3.2.

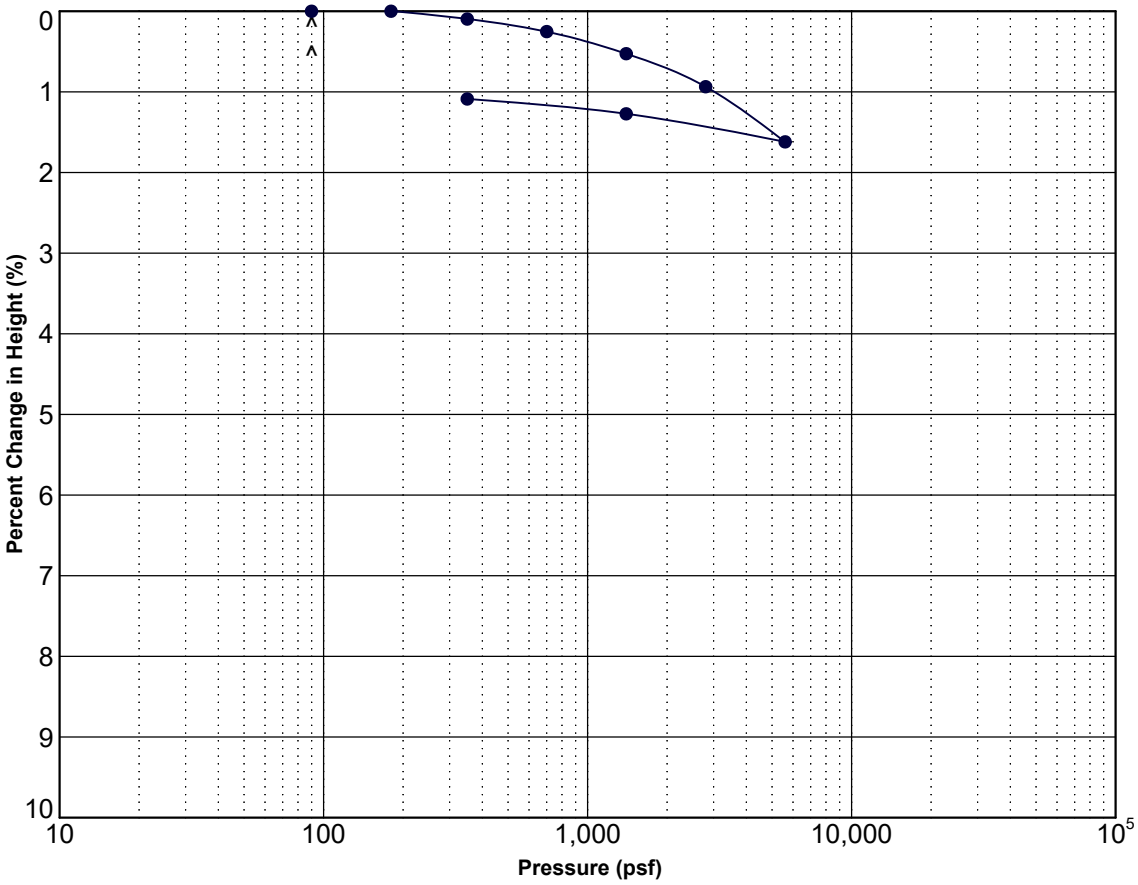
MODIFIED PROCTOR TEST

A Modified Proctor test was performed in general accordance with ASTM D 1557 on a bulk sample obtained from boring B4 at depths from about 0.5 to 2 feet. The test is used to determine the optimum moisture content at which the soil compacts to 100 percent density. Results are shown on Plates B4.1.

CALIFORNIA BEARING RATIO TEST

A CBR test was performed on a bulk sample obtained from boring B4 at depths from about 0.5 to 2 feet. The test sample was prepared in general accordance with ASTM D 1883. The test is used to evaluate the relative quality of subgrade soils to be used in the design of flexible pavement. Results are shown on Plate B5.1.

Consolidation Test Results



Sample Description

Boring No.: B2 Depth (ft): 9

Soil Description: Mottled brown completely weathered basalt

	Moisture Content (%)	Dry Density (pcf)
Initial	44.9	76.1
Final	42.9	77.0

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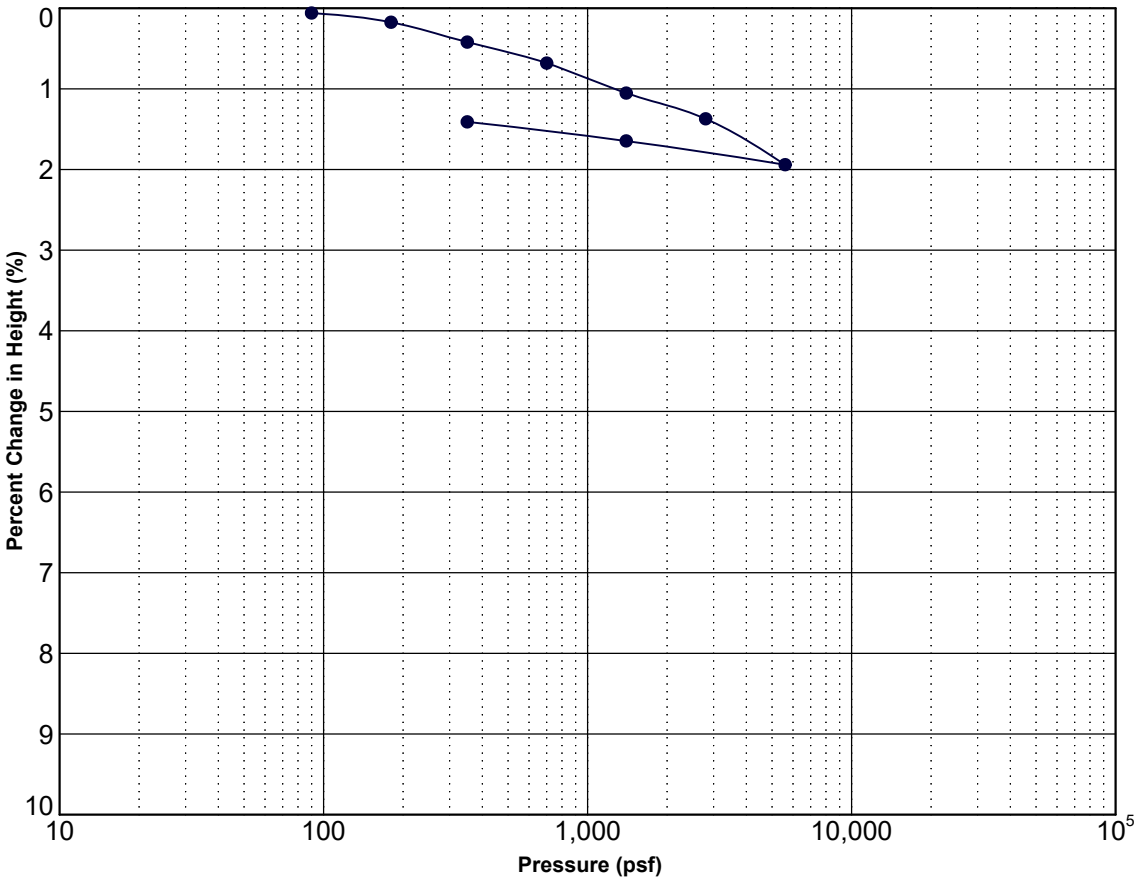
CONSOLIDATION TEST

ASTM D2435 / D2435M - 11

Plate B2.1

Consolidation Test Results



Sample Description

Boring No.: B4 Depth (ft): 4

Soil Description: Brown clayey silt

	Moisture Content (%)	Dry Density (pcf)
Initial	31.9	83.2
Final	30.7	84.4

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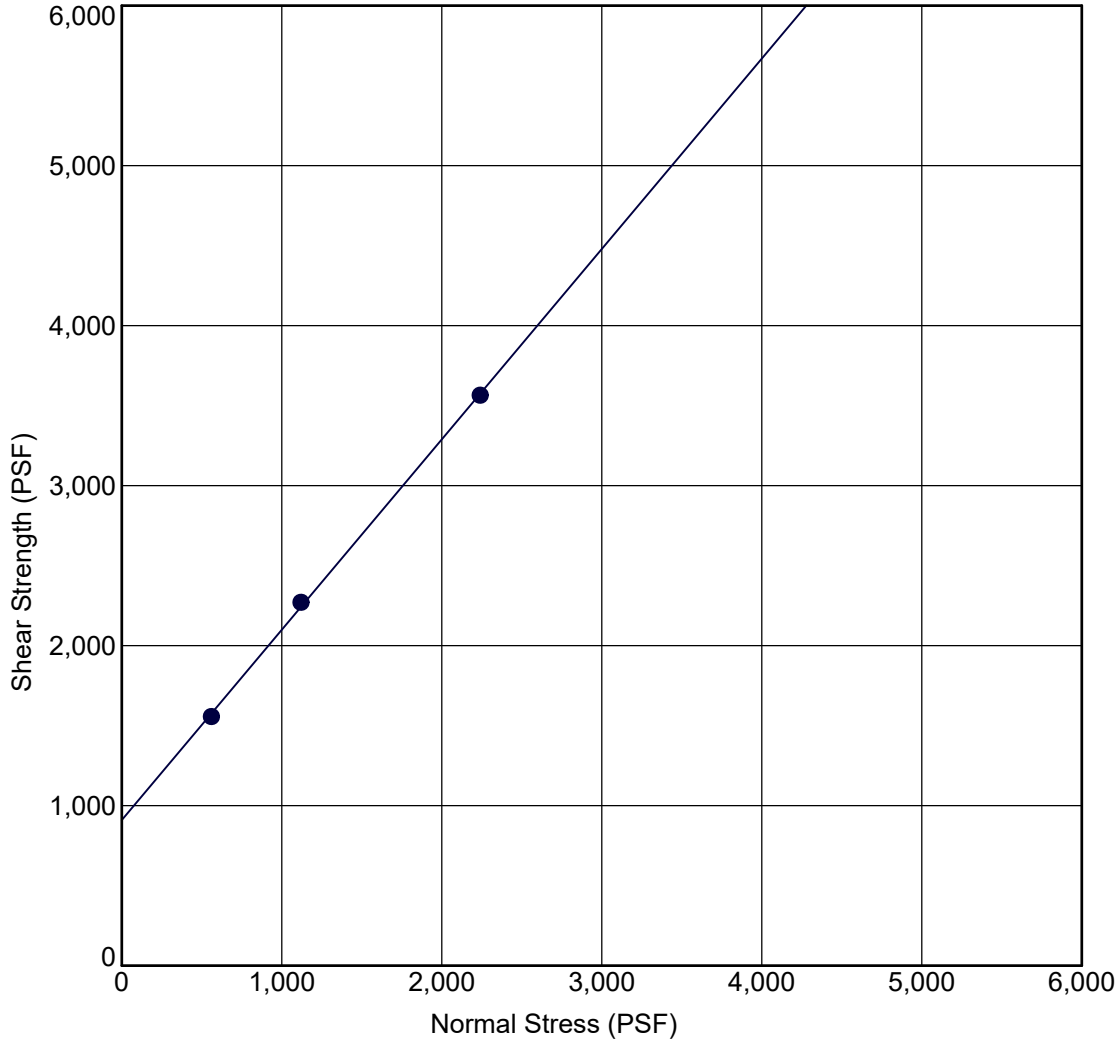
CONSOLIDATION TEST

ASTM D2435 / D2435M - 11

Plate B2.2

Direct Shear Test Results



Soil Data

Boring No.: B1 Depth (ft): 5

Soil Description: Mottled brown completely to highly weathered rock

Test Results

Strength Intercept (c): 909.6 PSF (Peak Strength)

Friction Angle (phi): 50.0 DEG (Peak Strength)

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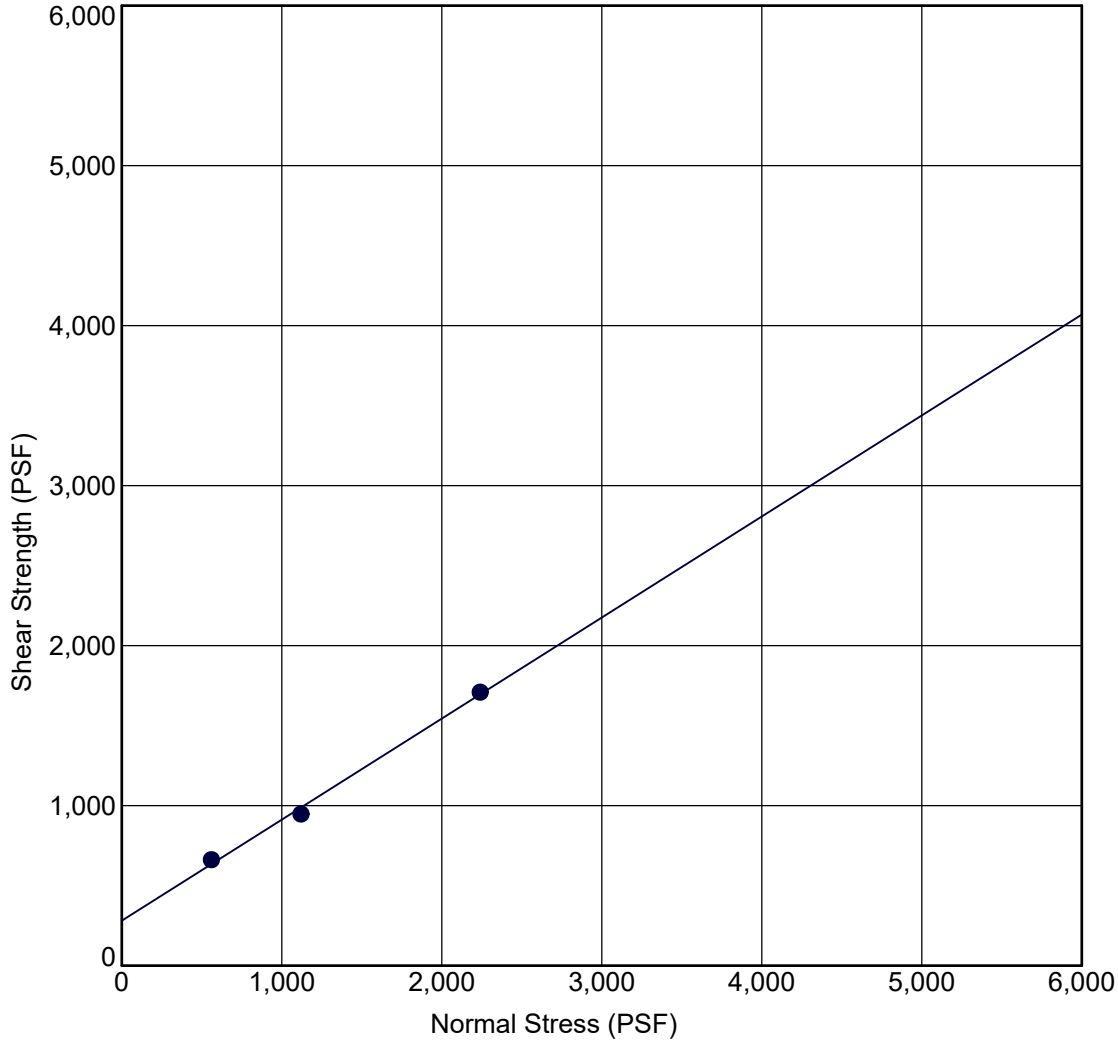
DIRECT SHEAR TEST

ASTM D3080

Plate B3.1

Direct Shear Test Results



Soil Data

Boring No.: B3 Depth (ft): 1
Soil Description: Brown clayey silt with gravel

Test Results

Strength Intercept (c): 281.4 PSF (Peak Strength)
Friction Angle (phi): 32.3 DEG (Peak Strength)

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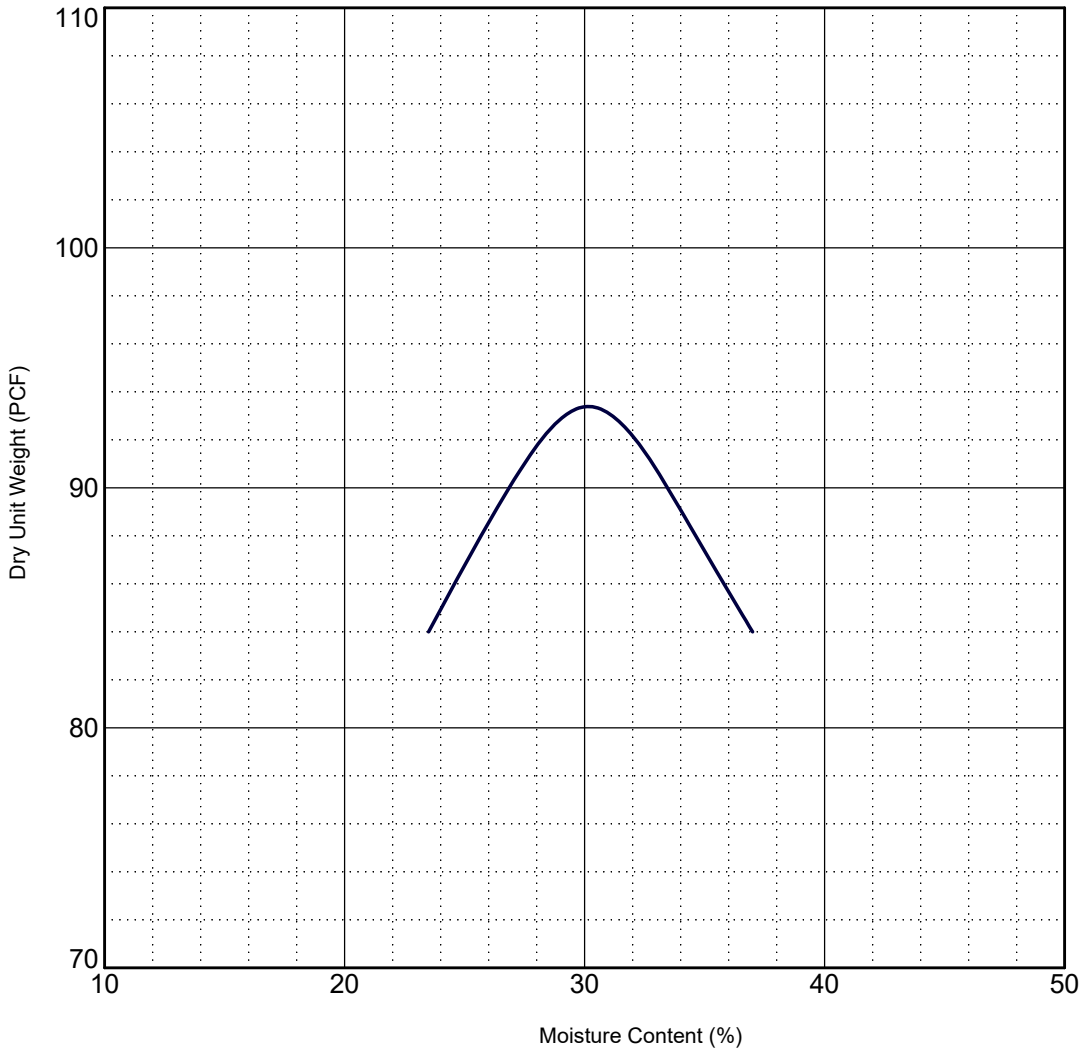
DIRECT SHEAR TEST

ASTM D3080

Plate
B3.2



Soil Data

Location: Boring B4 from 0.5 to 2 feet

Description: Brown clayey silt with gravel

Test Results

Maximum Dry Density: 93.4 PCF

Optimum Moisture Content: 30.1 %

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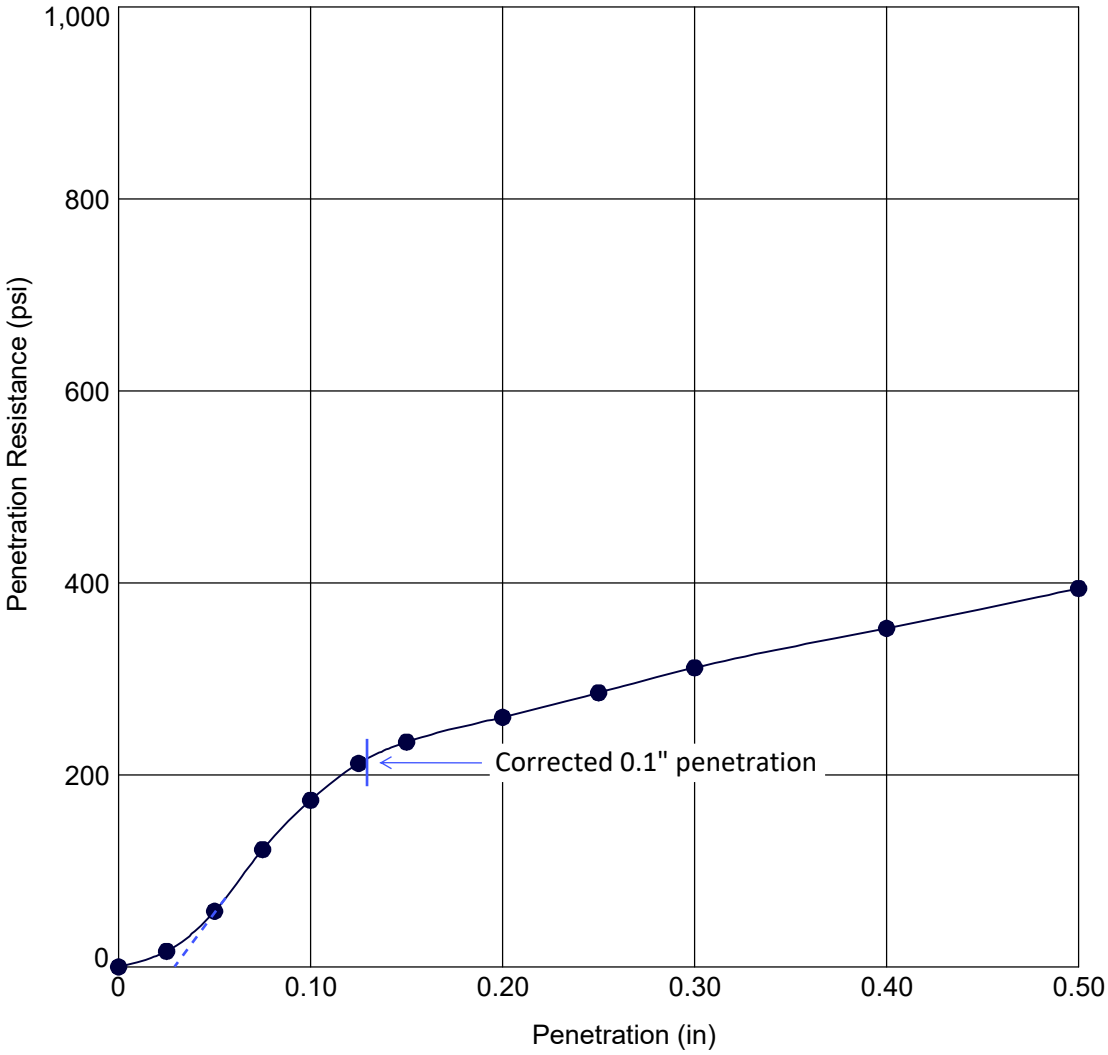
MODIFIED PROCTOR CURVE

ASTM D1557

Plate B4.1



Soil Data

Location:	Boring B4 from 0.5 to 2 feet
Description:	Brown clayey silt with gravel
Sample Dry Density	92.6 pcf
Sample Moisture Content	30.3 %

Test Results

CBR Value:	21.1 %
Expansion:	0.0 %

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CBR STRESS PENETRATION CURVE

ASTM D1883

Plate B5.1