PRELIMINARY GEOTECHNICAL INVESTIGATION
AGRICULTURE ROADWAY AND
BRIDGE #108 REPAIR
KEKAHA AGRICULTURE ASSOCIATION
KEKAHA, HAWAII

for

SSFM INTERNATIONAL

HIRATA & ASSOCIATES, INC.
W.O. 22-6746
October 9, 2023

Hirata & Associates
Geotechnical Engineering
Hirata & Associates, Inc.
99-1433 Koaha Pl
Aiea, HI 96701
tel 808.486.0787
fax 808.486.0870

October 9, 2023
W.O. 22-6746

Ms. Renee Ishisaka
SSFM International
501 Sumner Street, Suite 620
Honolulu, Hawaii 96817

Dear Ms. Ishisaka:

Our report, "Preliminary Geotechnical Investigation, Agriculture Roadway and Bridge #108 Repair, Kekaha Agriculture Association, Kekaha, Hawaii," dated October 9, 2023, our Work Order 22-6746 is enclosed. This investigation was conducted in general conformance with the scope of services presented in our revised proposal dated February 8, 2022, in support of the preparation of Design-Build RFP documents for the above referenced project.

The existing AC pavement was in a severely deteriorated condition. The asphaltic concrete surface layer, probably due to severe oxidation and fatigue cracking, has unraveled to loose gravel in many areas and completely disappeared in other areas, exposing the underlying base course material. Based on the design vehicle data for this project, it is our opinion that repairs to the existing pavement such as sealcoating, mill and resurfacing would not be sufficient. A full-depth pavement reconstruction is recommended.

Conventional spread footings, founded on medium stiff silty clay, may be used to support the proposed bridge structure provided the bridge abutment areas are protected from potential scour.

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.

for Jennifer H. Yamaguchi President

JHY:CCT

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PRELIMINARY GEOTECHNICAL INVESTIGATION AGRICULTURE ROADWAY AND BRIDGE #108 REPAIR KEKAHA AGRICULTURE ASSOCIATION KEKAHA, HAWAII

INTRODUCTION

This report presents the results of our preliminary geotechnical investigation in support of the preparation of Design-Build RFP documents for the proposed roadway and Bridge #108 repairs in Kekaha, Kauai, 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 15 exploratory borings to depths ranging from about 5.5 to 39.5 feet. A description of our field investigation is summarized on Plates A1.1 and A1.2. The approximate exploratory boring locations are shown on Plates A2.2 and A2.3, and the soils encountered in the borings are described on the Boring Logs, Plates A4.1 through A4.17.

- Performing Dynamic Cone Penetrometer (DCP) tests in selected test borings. Test results are presented on Plates A5.1 through A5.12.

- 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 Unified Soil Classification System Sheet (Plate A3.2), Boring Logs (Plates A4.1 through A4.17), Consolidation Test reports (Plates B2.1 through B2.7), Direct Shear Test report (Plate B3.1), Sieve Analysis Test reports (Plates B4.1 and B4.2), and California Bearing Ratio Test reports (Plates B5.1 through B5.7).

- Engineering analyses of the field and laboratory data.

- Preparation of this report presenting our opinions regarding pothole

repairs and pavement reconstruction, as well as preliminary geotechnical recommendations for the design of new flexible pavement and bridge structure foundations, including seismic considerations, resistance to lateral pressures, and site grading.

PROJECT CONSIDERATIONS

Information regarding the proposed project was provided by your office.

The proposed project will consist of pavement repair to the existing Kekaha Agriculture Association (KAA) cane haul road and replacing existing bridge structure #108 along the cane haul road.

The existing cane haul road within the project limits is about 36,000 lineal feet in length and varies from about 20 to 30 feet in width, extending in a northwest-southeast direction. The road is paved with AC pavement except for approximately 1,500 lineal feet of roadway on the northwest end which consists of a coral gravel road. The road is used for farming equipment as well as trucks and passenger vehicles. The farming equipment consists primarily of pneumatic tire vehicles. The AC pavement is presently in poor condition.

Bridge structure #108 is located along the southern portion of the cane haul road, near Field #108 and #110. The existing bridge spans about 44 feet over an irrigation ditch and consists of old railroad ties used for the various elements of the bridge structure. Information regarding the replacement bridge was not available at the time of this report. We assume that the new bridge structure will consist of a single span structure with similar length as the existing bridge.

SITE CONDITIONS

The project site is located to the east of Kekaha Road, in the Kekaha area on the island of Kauai. Entry into the site is provided by Mana Road. The existing cane haul road follows the gently undulating terrain and generally slopes downward

from north to south. Drainage over the area generally flows in southerly and westerly directions. Agricultural fields border the road on the east and west sides.

The existing AC pavement was in a severely deteriorated condition. The asphaltic concrete surface course, probably due to severe oxidation and fatigue cracking, has unraveled to loose gravel in many areas and completely disappeared in other areas, exposing the underlying base course material. Potholes were also observed throughout AC pavement.

The invert of the irrigation ditch at the bridge crossing location is about 10 to 12 feet below bridge structure #108. The ditch banks below the bridge deck stood at about 1/2H:1V slope gradient with a horizontal bench at about 3 feet above the toe of the banks. The slope face exposed brown clayey/sandy silt with little vegetation cover. The slope face below the north abutment was also partially covered by grouted small boulders. The irrigation ditch was dry at the time of our field work.

SOIL CONDITIONS

The existing asphaltic concrete pavement encountered in the test borings consisted of approximately 2 to 3 inches of AC over about 4 to 8 inches of base material. A summary of the pavement sections is presented in the following table.

Boring No.	AC Thickness (in.)	Aggregate Base Thickness (in.)
B1	-	-
B2	2	7
B3	3	8
B4	2.5	6
B5	2.5	6
B6	2	6
B7	2.5	6
B8	2.5	4

B9	2	8
B10	-	-
B11	2	4
B12	3	4
B13	2.5	6
B14	3	4
B15	2.5	6

Underlying the AC pavement was a thin layer of tan to mottled tan silty sand, ranging from about 6 to 16 inches in thickness. The silty sand may be a subbase layer of the AC pavement.

Underlying the tan to mottled tan silty sand was brown to dark reddish brown silty clay with sand. Laboratory Atterberg Limits testing on the silty clay resulted in a Unified Soil Classification of CH, which usually corresponds to a high expansion potential. The silty clay encountered in the borings was generally in a medium stiff to stiff condition and extended to the maximum depths drilled in most of the shallow borings. Petroleum odor was detected in borings B5 and B6 at depths of about 0.5 to 1.5 feet.

Underlying the silty clay at a depth of about 5.5 feet in boring B14 was light gray clayey silt in a soft to medium stiff condition. Underlying the silty clay at a depth of about 6 feet in boring B15 was gray silty sand in a dense condition. The light gray clayey silt and gray silty sand extended down to the maximum depths drilled in borings B14 and B15, respectively.

Borings B9 and B10, drilled adjacent to the bridge structure #108, encountered surface soil consisting of brown silty clay in a stiff condition. The silty clay extended to depths of about 17 and 17.5 feet. A layer of dark reddish brown silty sand was encountered within the silty clay stratum at depths of about 8 feet. The

silty sand was in a medium dense to loose condition and about 3 to 5 feet in thickness.

Underlying the silty clay was mottled tan and gray sand. The sand was in a dense condition extending down to the maximum depths drilled in borings B9 and B10.

Groundwater was encountered at depths of about 18.6, 19.6, and 7.2 feet in borings B9, B10, and B14, respectively. The remainder of the borings were terminated prior to encountering groundwater.

CONCLUSIONS AND RECOMMENDATIONS

The existing AC pavement was in a severely deteriorated condition. The asphaltic concrete surface layer, probably due to severe oxidation and fatigue cracking, has unraveled to loose gravel in many areas and completely disappeared in other areas, exposing the underlying base course material. Based on the design vehicle data for this project, it is our opinion that repairs to the existing pavement such as pothole backfilling, sealcoating, milling and resurfacing would not be sufficient. As a result, a full depth pavement reconstruction is recommended.

Pavement Design

Based on the vehicle data provided by KAA, the heaviest vehicles that will travel daily on the cane haul road consist of Kenworth T800 dump trucks (56,000 lbs. GVWR) and Freightliner water wagons (56,000 lbs. GVWR). The complete list of design vehicle data is included in Appendix C.

Our preliminary pavement design was based on procedures in the 1993 AASHTO Guide for Design of Pavement Structures. A computer program WinPAS 12 by American Concrete Pavement Association (ACPA) was used for the calculations. The design assumes 50 daily passes of a 56-kip dump truck over a design life of 20 years. Based on our laboratory test results, a design CBR value of 3 percent was selected. The following is the recommended flexible pavement section for full depth reconstruction.

5.0"	Asphalt Concrete
8.0"	Aggregate Base Course (CBR = 85 minimum)
12.0"	Aggregate Subbase (CBR = 25 minimum)
25.0"	Total Thickness

The subgrade should be moisture conditioned to about 2 percent above optimum moisture content and compacted to between 90 and 95 percent compaction as

determined by ASTM D 1557. The aggregate base course and subbase should be compacted in lifts to a minimum 95 percent compaction.

The existing base course and the tan to mottled silty sand may be reused as subbase material. Imported cold plane material may also be used as subbase, provided that the cold plane material is processed to a well graded gradation and has a minimum CBR value of 25 percent when tested in accordance with ASTM D 1883.

Bridge Foundations

Conventional spread footings, founded on medium stiff silty clay, may be used to support the proposed bridge structure provided the bridge abutment areas are protected from potential scour.

The foundations may be designed for an allowable bearing value of 3,000 pounds per square foot. This 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 effect of wind and seismic forces.

Spread footings should be a minimum of 24 inches in width and embedded at least 12 inches below finish adjacent grade. In addition, the footings should be embedded such that a minimum horizontal distance of 6 feet is maintained between the bottom edge of footing and slope face.

The bottom of footing excavations should be thoroughly tamped and cleaned of loose material prior to placement of reinforcing steel and concrete. Exposed soft or loose soils should be removed and replaced with compacted granular structural fill.

If it is not feasible to protect spread footings from potential sour, the footing should be embedded at least 2 feet below the potential scour depth.

If the scour depth is too deep, drilled shafts should be used to support the bridge structure. The drilled shafts will derive their load bearing capacity from adhesion between the shafts and surrounding soils below the potential scour depths. We envision that 2 to 3-foot diameter drilled shafts extending below the potential scour depth may be designed to support the bridge structure. The required drilled shaft lengths will depend on the design scour depth and the structural loads imposed on the drilled shaft. The preliminary drilled shaft length recommendation can be provided once the scour depth and structural loads are determined. The drilled shafts should be spaced a minimum 3 shaft diameters on centers.

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 2018 International Building Code, Site Class D is recommended for the bridge structure #108 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 300 pounds per cubic foot with a maximum earth pressure of 3,000 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.

For active earth pressure considerations, equivalent fluid pressures of 40 and 55 pounds per cubic foot may be used for freestanding and restrained or at-rest conditions, respectively. To prevent buildup of hydrostatic pressures, weepholes or subdrains should be included in the design of all retaining structures.

Foundation Settlement

Structural loads were not available at the time of this report.

Bridge Approach Slabs

Approach slabs behind the bridge abutments, if needed, should be underlain by at least 8 inches of aggregate base course. The base course should be compacted to a minimum 95 percent compaction as determined by ASTM D 1557. The subgrade should be compacted to between 90 and 95 percent compaction. A bearing value of 3,000 pounds per square foot at strength limit states may be used to design the footings supporting the slab.

Site Grading

Site Preparation - The project site should be cleared of all vegetation, AC pavement, concrete footings, and other deleterious material. Prior to placement of fill, the exposed subgrade should be scarified to a minimum depth of 6 inches, moisture conditioned to about 2 percent above optimum moisture content, and compacted to between 90 and 95 percent compaction as determined by ASTM D 1557.

Structural Excavations - Based on our exploratory borings, we believe that excavations into the surface soils can generally be accomplished using conventional excavating equipment. Temporary cuts into the surface soils should be stable at slope gradients of 1H:1V or flatter. However, the contractor should be responsible for conforming to OSHA safety standards for all excavations.

Onsite Fill Material - The onsite silty sand and silty clay may be reused in compacted fills and backfills provided all rock fragments larger than 3 inches in maximum dimension are removed prior to reuse. In addition, the moisture content of the silty clay should be maintained at about 2 percent above the optimum moisture content during recompaction.

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 - In general, fill and backfill consisting of cohesive soils, such as the onsite silty clay should be placed in horizontal lifts restricted to 8 inches in loose thickness, and compacted to between 90 and 95 percent compaction as determined by ASTM D 1557. Granular fill, such as the onsite silty sand, imported granular structural fill, aggregate base course and subbase, should also be placed in 8-inch loose lifts, but compacted to at least 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.

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 preliminary geotechnical investigation report was prepared specifically for SSFM International and their sub-consultants in support of the preparation of the Design-Build RFP documentation for the proposed repairs to the agriculture roadway and bridge #108 at Kekaha, Kauai. The boring logs, laboratory test results, and recommendations presented in this report are for preliminary design purposes only, for use in the preparation of design-build RFP documentation, and are not intended for use in the final design or developing cost estimates by the contractor. A final geotechnical investigation for the project, including additional exploratory test borings, laboratory testing, and analyses, should be prepared by the Design-Build Contractor's geotechnical engineer for the final design.

Our preliminary 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.

Con Truong, Project Engineer

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 between August 15 and 19, 2022, by performing a visual reconnaissance of the site and drilling fifteen test borings to depths ranging from about 5.5 to 39.5 feet with a Mobile L22 truck-mounted drill rig. In addition, Dynamic Cone Penetrometer tests were performed in selected test borings.

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 System is shown on Plate A3.2. The soils encountered are logged on Plates A4.1 through A4.17.

Borings were located in the field by using a hand-held GPS device as well as by measuring/taping offsets from existing site features shown on the plans. Surface elevations at the locations of boring B9 and B10 were estimated based on a topographic survey map prepared by Esaki Surveying and Mapping, Inc., dated February 26, 2022. The accuracy of the boring locations shown on Plates A2.2 and A2.3, and the boring elevations shown on the Plates A4.1 through A4.17 are therefore approximate, in accordance with the field methods used.

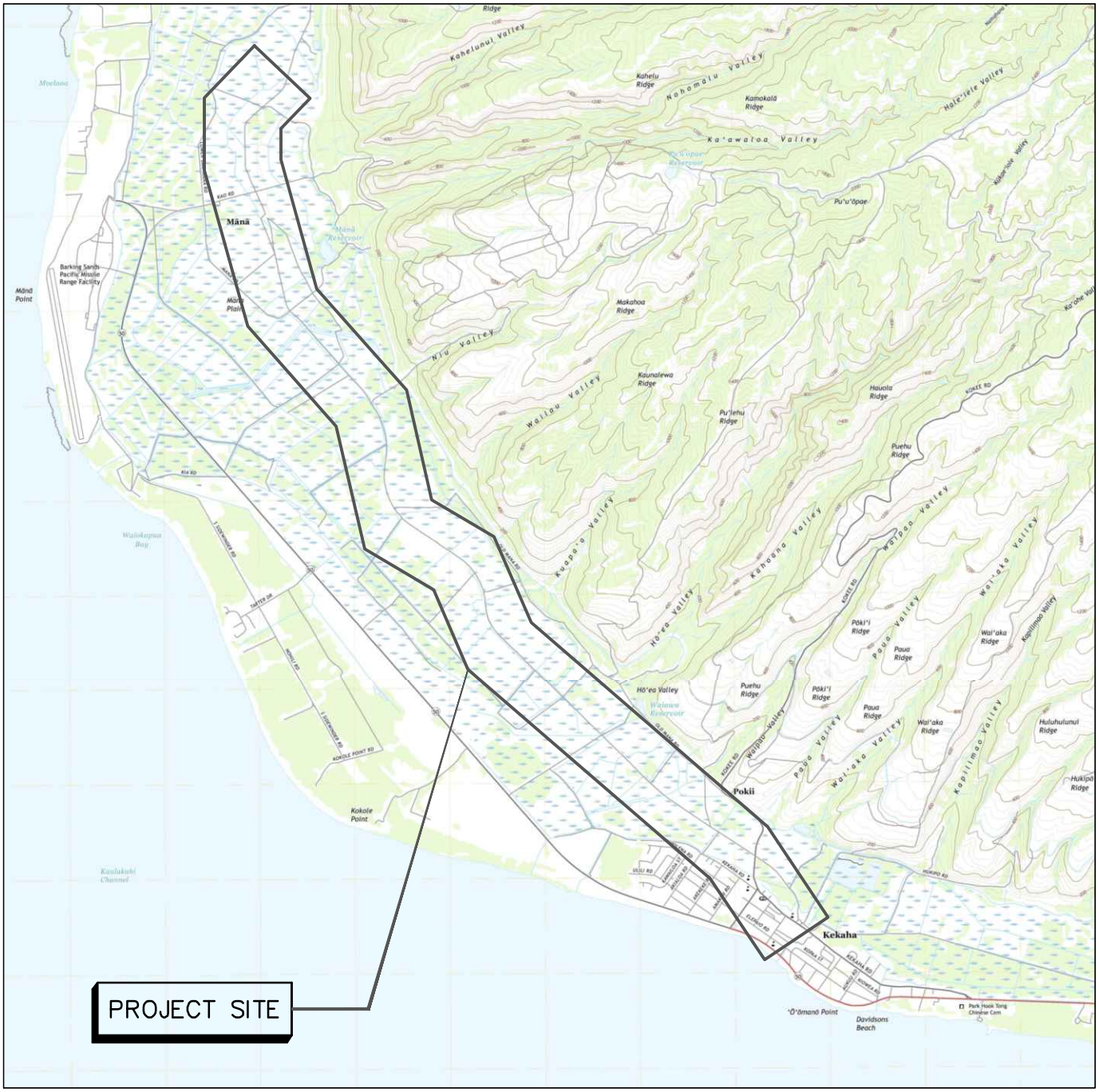
SOIL SAMPLING

Representative samples, as well as a bulk soil sample, 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 samplers the final 12 inches are recorded at the appropriate depths on the boring logs, unless noted otherwise.

DYNAMIC CONE PENETROMETER TESTS

Dynamic Cone Penetrometer (DCP) tests were performed in general accordance with ASTM D 6951 on the pavement subgrade in selected test borings. A conical-shaped tip was driven into the soil with a 17.6 pound weight, dropped from a height of 22.6 inches. The depth of penetration of the cone tip was measured along with the corresponding number of hammer drops required for that penetration. The test is used to evaluate the relative quality of the subgrade soils and to provide an estimation of in-situ CBR value. Test results are presented on Plates A5.1 through A5.12.



Reference: Topographic quadrangle map prepared by the United States Department of the Interior Geologic Survey

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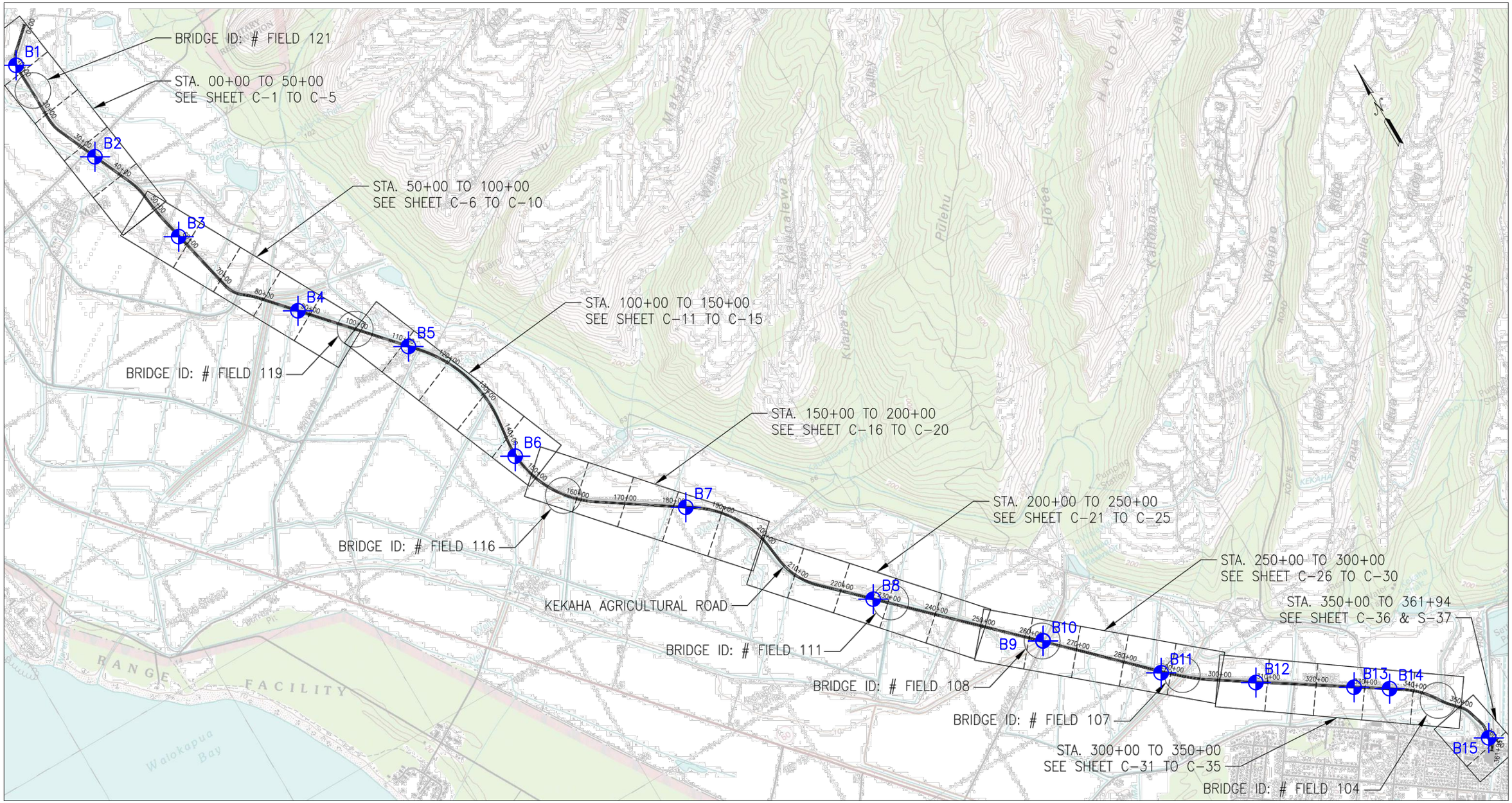
LOCATION MAP

Plate
A2.1



LEGEND:

Approximate location of borings

Reference: Kekaha Bridge Key Map provided by SSFM International.

GRAPHIC SCALE:

0 1000 2000 4000FT.

1" = 2000'

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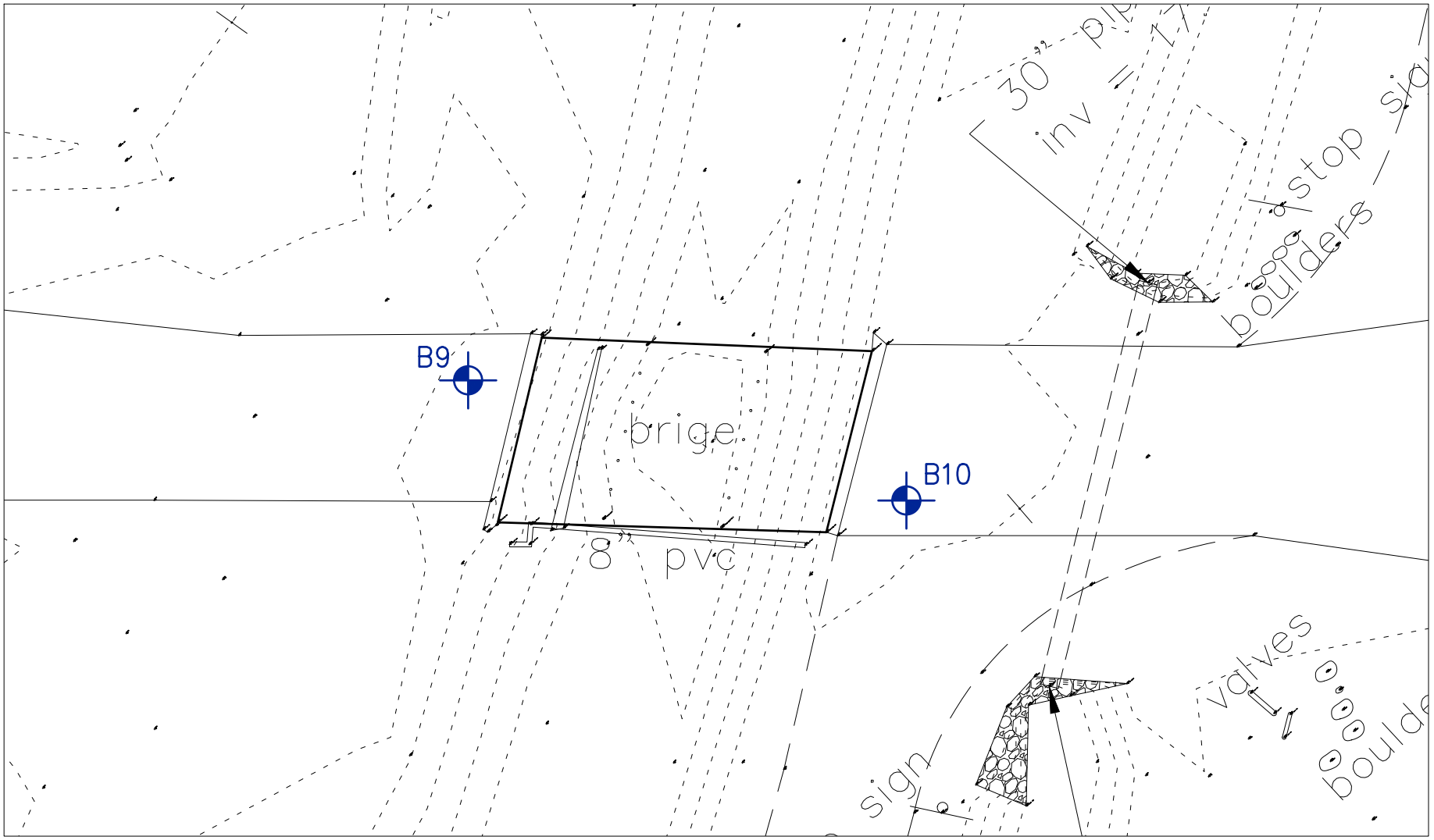
BORING LOCATION PLAN

Plate A2.2



LEGEND:

Approximate location of borings

GRAPHIC SCALE:

0 10 20 40 FT.

1" = 20'

Reference: Topographic survey map reprated by Esaki Surveying and Mapping, Inc., dated February 26, 2022.

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BORING LOCATION PLAN

Plate A2.3

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

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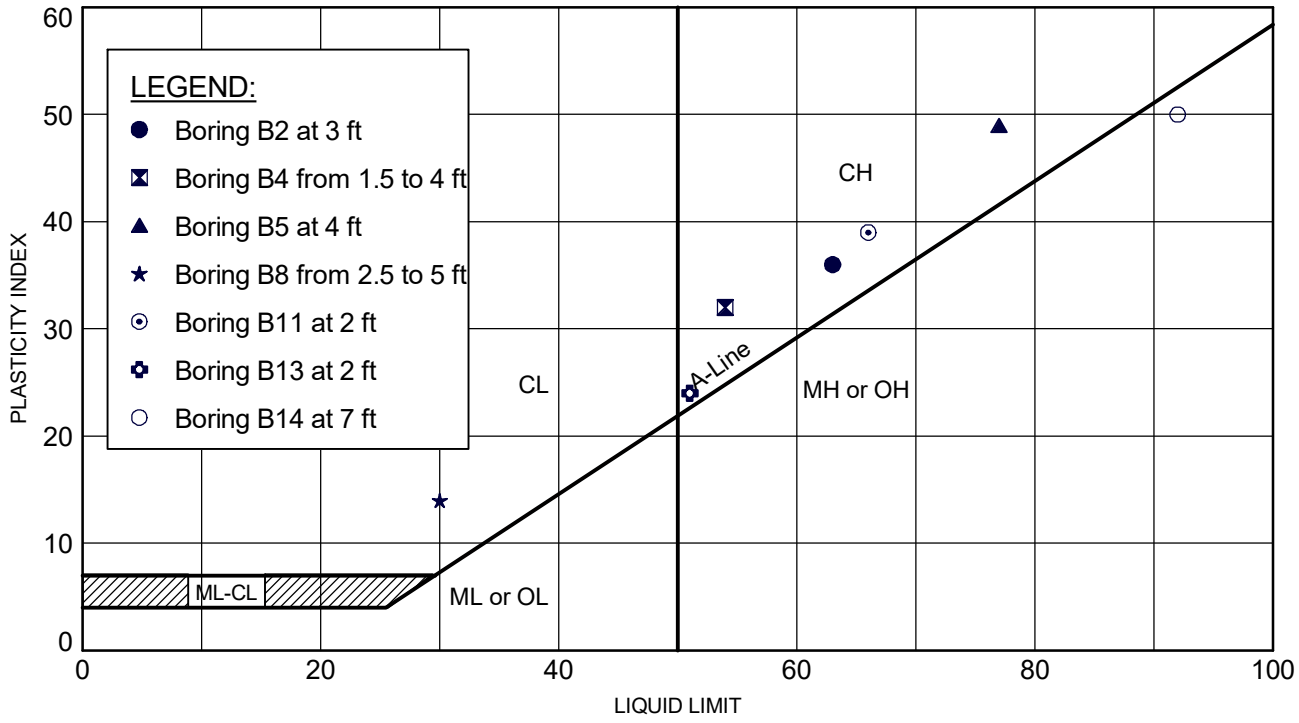
BORING LOG LEGEND

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)

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UNIFIED SOIL CLASSIFICATION SYSTEM

Plate A3.2

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Boring No.
B1

BORING LOG

PROJECT NAME Agriculture Roadway and Bridge #108 Repair, Kekaha Agriculture Association
WORK ORDER NO. 22-6746 DRIVING WT. 140 lb. START DATE 8/18/22
SURFACE ELEV. Not Available DROP 30 in. END DATE 8/18/22

REMARKS/ SAMPLE NO.	CORE RECOVERY (%)	RQD (%)	BLOWS PER FOOT	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	DEPTH (ft)	GRAPHIC LOG	SAMPLE	MATERIAL DESCRIPTION
			29	96	15				Silty SAND (SM) - Reddish brown, moist, medium dense, with trace of gravel. Covered by 6 inches of mottled tan coralline gravel.
			25	93	29	5			Silty CLAY (CH) - Brown, moist, stiff, with sand.
									End boring at 5.5 feet. Neither groundwater nor seepage water encountered.
						10			
						15			
						20			
						25			
						30			

Plate A4.1

Hirata & Associates, Inc.
GEOTECHNICAL ENGINEERING

Boring No.
B2

BORING LOG

PROJECT NAME Agriculture Roadway and Bridge #108 Repair, Kekaha Agriculture Association
WORK ORDER NO. 22-6746 DRIVING WT. 140 lb. START DATE 8/18/22
SURFACE ELEV. Not Available DROP 30 in. END DATE 8/18/22

REMARKS/ SAMPLE NO.	CORE RECOVERY (%)	RQD (%)	BLOWS PER FOOT	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	DEPTH (ft)	GRAPHIC LOG	SAMPLE	MATERIAL DESCRIPTION
				115	6				Silty SAND (SM) - Mottled tan, slightly moist, medium dense. Covered by 2 inches of AC over 7 inches of base material.
			38	104	16				
			49	99	26				Silty CLAY (CH) - Dark reddish brown, moist, stiff, with sand.
			45	97	27	5			
									End boring at 6.5 feet. Neither groundwater nor seepage water encountered.
						10			
						15			
						20			
						25			
						30			

Plate A4.2

Hirata & Associates, Inc.
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Boring No.
B3

BORING LOG

PROJECT NAME Agriculture Roadway and Bridge #108 Repair, Kekaha Agriculture Association
WORK ORDER NO. 22-6746 DRIVING WT. 140 lb. START DATE 8/18/22
SURFACE ELEV. Not Available DROP 30 in. END DATE 8/18/22

REMARKS/ SAMPLE NO.	CORE RECOVERY (%)	RQD (%)	BLOWS PER FOOT	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	DEPTH (ft)	GRAPHIC LOG	SAMPLE	MATERIAL DESCRIPTION
									Silty SAND (SM) - Mottled tan to gray, slightly moist, medium dense. Covered by 3 inches of AC over 8 inches of base material.
			22	75	35				Silty CLAY (CH) - Brown, moist, stiff, with sand.
			11	81	35	5			Siltier, medium stiff to soft from 4 feet.
									End boring at 5.5 feet. Neither groundwater nor seepage water encountered.

10
15
20
25
30

Plate A4.3

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Boring No.
B4

BORING LOG

PROJECT NAME Agriculture Roadway and Bridge #108 Repair, Kekaha Agriculture Association
WORK ORDER NO. 22-6746 DRIVING WT. 140 lb. START DATE 8/18/22
SURFACE ELEV. Not Available DROP 30 in. END DATE 8/18/22

REMARKS/ SAMPLE NO.	CORE RECOVERY (%)	RQD (%)	BLOWS PER FOOT	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	DEPTH (ft)	GRAPHIC LOG	SAMPLE	MATERIAL DESCRIPTION
									Silty SAND (SM) - Mottled tan, slightly moist, medium dense. Covered by 2.5 inches of AC over 6 inches of base material.
			20	101	21				
			16	75	42				Silty CLAY (CH) - Brown to reddish brown, moist, medium stiff, with sand. Soft at 2 feet.
			14	80	35	5			
									End boring at 6.5 feet. Neither groundwater nor seepage water encountered.
						10			
						15			
						20			
						25			
						30			

Plate A4.4

Hirata & Associates, Inc.
GEOTECHNICAL ENGINEERING

Boring No.
B5

BORING LOG

PROJECT NAME Agriculture Roadway and Bridge #108 Repair, Kekaha Agriculture Association
WORK ORDER NO. 22-6746 DRIVING WT. 140 lb. START DATE 8/18/22
SURFACE ELEV. Not Available DROP 30 in. END DATE 8/18/22

REMARKS/ SAMPLE NO.	CORE RECOVERY (%)	RQD (%)	BLOWS PER FOOT	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	DEPTH (ft)	GRAPHIC LOG	SAMPLE	MATERIAL DESCRIPTION
Petroleum odor at 0.5 to 1.5 feet.									Silty SAND (SM) - Tan to tannish brown, slightly moist, medium dense. Covered by 2.5 inches of AC over 6 inches of base material.
			16	87	33				Silty CLAY (CH) - Brown to reddish brown, moist, medium stiff, with sand.
			14	70	49	5			Grayish brown color from 3 feet.
									End boring at 5.5 feet. Neither groundwater nor seepage water encountered.
						10			
						15			
						20			
						25			
						30			

Plate A4.5

Hirata & Associates, Inc.
GEOTECHNICAL ENGINEERING

Boring No.
B6

BORING LOG

PROJECT NAME Agriculture Roadway and Bridge #108 Repair, Kekaha Agriculture Association
WORK ORDER NO. 22-6746 DRIVING WT. 140 lb. START DATE 8/18/22
SURFACE ELEV. Not Available DROP 30 in. END DATE 8/18/22

REMARKS/ SAMPLE NO.	CORE RECOVERY (%)	RQD (%)	BLOWS PER FOOT	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	DEPTH (ft)	GRAPHIC LOG	SAMPLE	MATERIAL DESCRIPTION
Petroleum odor at 1 foot.			25	118	9				Silty SAND (SM) - Tannish brown, slightly moist, medium dense. Covered by 2 inches of AC over 6 inches of base material.
				102	21				
			7	69	46	5			Silty CLAY (CH) - Dark reddish brown, moist, medium stiff, with sand. Soft from 2.5 feet.
			10	65	56				Soft to medium stiff from at 5 feet.
									End boring at 6.5 feet. Neither groundwater nor seepage water encountered.
						10			
						15			
						20			
						25			
						30			

Plate A4.6

Hirata & Associates, Inc.
GEOTECHNICAL ENGINEERING

Boring No.
B7

BORING LOG

PROJECT NAME Agriculture Roadway and Bridge #108 Repair, Kekaha Agriculture Association
WORK ORDER NO. 22-6746 DRIVING WT. 140 lb. START DATE 8/18/22
SURFACE ELEV. Not Available DROP 30 in. END DATE 8/18/22

REMARKS/ SAMPLE NO.	CORE RECOVERY (%)	RQD (%)	BLOWS PER FOOT	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	DEPTH (ft)	GRAPHIC LOG	SAMPLE	MATERIAL DESCRIPTION
									Silty SAND (SM) - Tannish brown, slightly moist, medium dense. Covered by 2.5 inches of AC over 6 inches of base material.
			13	93	20				Silty CLAY (CH) - Dark reddish brown, moist, medium stiff, with sand.
			13	64	57	5			Grayish brown color at 4 feet.
									End boring at 5.5 feet. Neither groundwater nor seepage water encountered.
						10			
						15			
						20			
						25			
						30			

Plate A4.7

Hirata & Associates, Inc.
GEOTECHNICAL ENGINEERING

Boring No.
B8

BORING LOG

PROJECT NAME Agriculture Roadway and Bridge #108 Repair, Kekaha Agriculture Association
WORK ORDER NO. 22-6746 DRIVING WT. 140 lb. START DATE 8/18/22
SURFACE ELEV. Not Available DROP 30 in. END DATE 8/18/22

REMARKS/ SAMPLE NO.	CORE RECOVERY (%)	RQD (%)	BLOWS PER FOOT	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	DEPTH (ft)	GRAPHIC LOG	SAMPLE	MATERIAL DESCRIPTION
				114	6				Silty SAND (SM) - Tannish brown, moist, medium dense, with gravel. Covered by 2.5 inches of AC over 4.5 inches of base material.
			35	104	17				
			17	88	31				Silty CLAY (CL) - Dark brown, moist, stiff, with sand. Mottled dark red and grayish brown color from 4 feet.
			21	80	38	5			
									End boring at 6.5 feet. Neither groundwater nor seepage water encountered.
						10			
						15			
						20			
						25			
						30			

Plate A4.8

Hirata & Associates, Inc.
GEOTECHNICAL ENGINEERING

Boring No.
B9

BORING LOG

PROJECT NAME Agriculture Roadway and Bridge #108 Repair, Kekaha Agriculture Association
WORK ORDER NO. 22-6746 DRIVING WT. 140 lb. START DATE 8/16/22
SURFACE ELEV. 24 ±* DROP 30 in. END DATE 8/16/22

REMARKS/ SAMPLE NO.	CORE RECOVERY (%)	RQD (%)	BLOWS PER FOOT	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	DEPTH (ft)	GRAPHIC LOG	SAMPLE	MATERIAL DESCRIPTION
			41	103	14				Silty CLAY (CH) - Brown, moist, stiff, with sand and gravel. Covered by 2 inches of AC over 8 inches of base material.
			22	87	21				Cobble at 4.5 feet.
			13	79	31	5			Dark reddish brown to dark gray from 5 feet, with sand.
			11	89	22	10			Silty SAND (SM) - Dark reddish brown, moist, medium dense to loose, with gravel.
			19	85	37	15			Silty CLAY (CH) - Brown, moist, medium stiff to stiff.
			80	103	11	▼ 20			SAND (SP-SM) - Mottled tan and gray, dense, poorly graded, with silt. Groundwater encountered at 18.6 feet on 8/16/22 at 8:32 am.
			40/6" 10/NP	114	17	25			
			50/6"	123	14	30			

Plate A4.9

(Continued Next Page)

Hirata & Associates, Inc.
GEOTECHNICAL ENGINEERING

Boring No.
B9
(continued)

BORING LOG

PROJECT NAME Agriculture Roadway and Bridge #108 Repair, Kekaha Agriculture Association
WORK ORDER NO. 22-6746 DRIVING WT. 140 lb. START DATE 8/16/22
SURFACE ELEV. 24 ±* DROP 30 in. END DATE 8/16/22

REMARKS/ SAMPLE NO.	CORE RECOVERY (%)	RQD (%)	BLOWS PER FOOT	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	DEPTH (ft)	GRAPHIC LOG	SAMPLE	MATERIAL DESCRIPTION
			10/NP						SAND (SP-SM) - Mottled tan and gray, dense, poorly graded, with silt. (continued)
			50/6" 10/NP	102	19	35			
			50/3"	99	23				
						40			End boring at 39.5 feet.
						45			* Elevation based on topographic survey map prepared by Esaki Surveying and Mapping, Inc., dated 2/26/22.
						50			
						55			
						60			

Plate A4.10

Hirata & Associates, Inc.
GEOTECHNICAL ENGINEERING

Boring No. B10

BORING LOG

PROJECT NAME Agriculture Roadway and Bridge #108 Repair, Kekaha Agriculture Association
WORK ORDER NO. 22-6746 DRIVING WT. 140 lb. START DATE 8/15/22
SURFACE ELEV. 24 ±* DROP 30 in. END DATE 8/16/22

REMARKS/ SAMPLE NO.	CORE RECOVERY (%)	RQD (%)	BLOWS PER FOOT	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	DEPTH (ft)	GRAPHIC LOG	SAMPLE	MATERIAL DESCRIPTION
			26	95	28				Silty CLAY (CH) - Brown, moist, stiff, with gravel.
									Reddish brown color from 2.5 feet, with sand.
			17	81	28	5			Medium stiff to stiff from 4 feet.
			14	84	28	10			Silty SAND (SM) - Dark reddish brown, moist, medium dense to loose.
			19	82	40	15			Silty CLAY (CH) - Brown, moist, medium stiff to stiff.
			28	100	9	20 ▼			SAND (SP-SM) - Mottled tan and gray, medium dense to dense, poorly graded, with silt.
									Groundwater encountered at 19.6 feet on 8/17/22 at 8:11 am.
NP = No Penetration			50/6" 10/NP		18	25			Dense from 22 feet.
			20/3" 10/NP			30			

Plate A4.11

(Continued Next Page)

Hirata & Associates, Inc.
GEOTECHNICAL ENGINEERING

Boring No.
B10
(continued)

BORING LOG

PROJECT NAME Agriculture Roadway and Bridge #108 Repair, Kekaha Agriculture Association
WORK ORDER NO. 22-6746 DRIVING WT. 140 lb. START DATE 8/15/22
SURFACE ELEV. 24 ±* DROP 30 in. END DATE 8/16/22

REMARKS/ SAMPLE NO.	CORE RECOVERY (%)	RQD (%)	BLOWS PER FOOT	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	DEPTH (ft)	GRAPHIC LOG	SAMPLE	MATERIAL DESCRIPTION
			50/3"						SAND (SP-SM) - Mottled tan and gray, medium dense to dense, poorly graded, with silt. (continued)
			80		20	35			
			50/6" 10/NP		22				
						40			End boring at 39.0 feet.
									* Elevation based on topographic survey map prepared by Esaki Surveying and Mapping, Inc., dated 2/26/22.
						45			
						50			
						55			
						60			

Plate A4.12

Hirata & Associates, Inc.
GEOTECHNICAL ENGINEERING

Boring No.
B11

BORING LOG

PROJECT NAME Agriculture Roadway and Bridge #108 Repair, Kekaha Agriculture Association
WORK ORDER NO. 22-6746 DRIVING WT. 140 lb. START DATE 8/18/22
SURFACE ELEV. Not Available DROP 30 in. END DATE 8/18/22

REMARKS/ SAMPLE NO.	CORE RECOVERY (%)	RQD (%)	BLOWS PER FOOT	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	DEPTH (ft)	GRAPHIC LOG	SAMPLE	MATERIAL DESCRIPTION
									Silty SAND (SM) - Mottled tan, slightly moist, medium dense. Covered by 2 inches of AC over 4 inches of base material.
			7	81	32				Silty CLAY (CH) - Dark brown to dark reddish brown, moist, medium stiff to soft, with sand.
			10	81	33	5			
									End boring at 5.5 feet. Neither groundwater nor seepage water encountered.
						10			
						15			
						20			
						25			
						30			

Plate A4.13

Hirata & Associates, Inc.
GEOTECHNICAL ENGINEERING

Boring No.
B12

BORING LOG

PROJECT NAME Agriculture Roadway and Bridge #108 Repair, Kekaha Agriculture Association
WORK ORDER NO. 22-6746 DRIVING WT. 140 lb. START DATE 8/19/22
SURFACE ELEV. Not Available DROP 30 in. END DATE 8/19/22

REMARKS/ SAMPLE NO.	CORE RECOVERY (%)	RQD (%)	BLOWS PER FOOT	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	DEPTH (ft)	GRAPHIC LOG	SAMPLE	MATERIAL DESCRIPTION
									Silty SAND (SM) - Tannish brown, moist, medium dense, with gravel. Covered by 3 inches of AC over 4 inches of base material.
			40	98	23				Silty CLAY (CH) - Dark reddish brown, moist, stiff, with sand.
			19	84	30	5			
			14	61	37				Grayish brown color at 5 feet, medium stiff.
									End boring at 6.5 feet. Neither groundwater nor seepage water encountered.
						10			
						15			
						20			
						25			
						30			

Plate A4.14

Hirata & Associates, Inc.
GEOTECHNICAL ENGINEERING

Boring No.
B13

BORING LOG

PROJECT NAME Agriculture Roadway and Bridge #108 Repair, Kekaha Agriculture Association
WORK ORDER NO. 22-6746 DRIVING WT. 140 lb. START DATE 8/17/22
SURFACE ELEV. Not Available DROP 30 in. END DATE 8/17/22

REMARKS/ SAMPLE NO.	CORE RECOVERY (%)	RQD (%)	BLOWS PER FOOT	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	DEPTH (ft)	GRAPHIC LOG	SAMPLE	MATERIAL DESCRIPTION
									Silty SAND (SM) - Tan to tannish brown, slightly moist, medium dense, with gravel. Covered by 2.5 inches of AC over 6 inches of base material.
			16	90	28				Silty CLAY (CH) - Dark reddish brown, moist, medium stiff, with sand.
			8	83	34	5			Soft to medium stiff from 4.5 feet.
									End boring at 5.5 feet. Neither groundwater nor seepage water encountered.
						10			
						15			
						20			
						25			
						30			

Plate A4.15

Hirata & Associates, Inc.
GEOTECHNICAL ENGINEERING

Boring No.
B14

BORING LOG

PROJECT NAME Agriculture Roadway and Bridge #108 Repair, Kekaha Agriculture Association
WORK ORDER NO. 22-6746 DRIVING WT. 140 lb. START DATE 8/17/22
SURFACE ELEV. Not Available DROP 30 in. END DATE 8/17/22

REMARKS/ SAMPLE NO.	CORE RECOVERY (%)	RQD (%)	BLOWS PER FOOT	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	DEPTH (ft)	GRAPHIC LOG	SAMPLE	MATERIAL DESCRIPTION
									Silty SAND (SM) - Grayish Tan, slightly moist, medium dense, with gravel. Covered by 3 inches of AC over 4 inches of base material.
			38	86	30				
			8	76	46	5			Silty CLAY (CH) - Dark reddish brown, moist, stiff, with sand. Medium stiff to soft from 3 feet.
			3	46	91				Clayey SILT (MH) - Light gray, wet, soft. Groundwater encountered at 7.2 feet on 8/17/22 at 9:41 am.
			10	52	70				Tannish white, medium stiff to soft, with sand from 7 feet.
									End boring at 8.5 feet.
						10			
						15			
						20			
						25			
						30			

Plate A4.16

Hirata & Associates, Inc.
GEOTECHNICAL ENGINEERING

Boring No.
B15

BORING LOG

PROJECT NAME Agriculture Roadway and Bridge #108 Repair, Kekaha Agriculture Association
WORK ORDER NO. 22-6746 DRIVING WT. 140 lb. START DATE 8/18/22
SURFACE ELEV. Not Available DROP 30 in. END DATE 8/18/22

REMARKS/ SAMPLE NO.	CORE RECOVERY (%)	RQD (%)	BLOWS PER FOOT	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	DEPTH (ft)	GRAPHIC LOG	SAMPLE	MATERIAL DESCRIPTION
									Silty SAND (SM) - Tannish brown, slightly moist, medium dense, with gravel. Covered by 2.5 inches of AC over 6 inches of base material.
			22/6" 50/2"	91	29				Silty CLAY (CH) - Dark reddish brown and gray, moist, stiff, with sand.
			11	79	36	5			Very stiff, with weathered rock fragments at 2.5 feet. Gray color, medium stiff to soft from 4 feet.
NP = No Penetration			10/NP						Silty SAND (SM) - Gray, moist, dense, slightly cemented.
			49	105	21				
						10			End boring at 8.5 feet. Neither groundwater nor seepage water encountered.
						15			
						20			
						25			
						30			

Plate A4.17

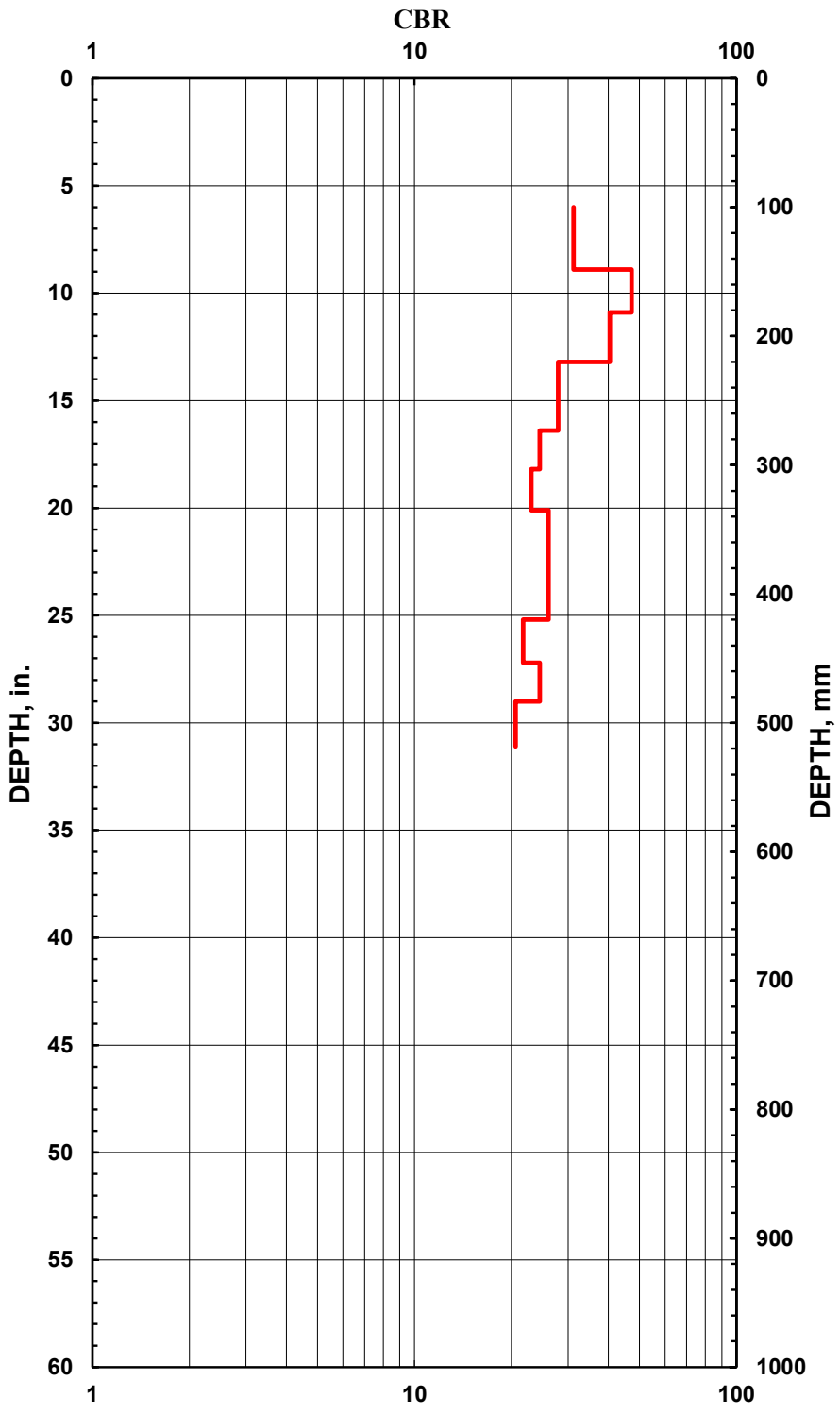
Boring No.

B1

Starting Depth: 6 in.

Date: 8/18/22

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
0	152	17.6 lbs
10	226	17.6 lbs
10	277	17.6 lbs
10	335	17.6 lbs
10	417	17.6 lbs
5	462	17.6 lbs
5	511	17.6 lbs
5	554	17.6 lbs
5	597	17.6 lbs
5	640	17.6 lbs
5	691	17.6 lbs
5	737	17.6 lbs
5	790	17.6 lbs



Agriculture Roadway and Bridge #108 Repair, Kekaha Agriculture Association

Hirata & Associates, Inc.
Geotechnical Engineering

W.O. 22-6746

DYNAMIC CONE PENETROMETER TEST

Plate A5.1

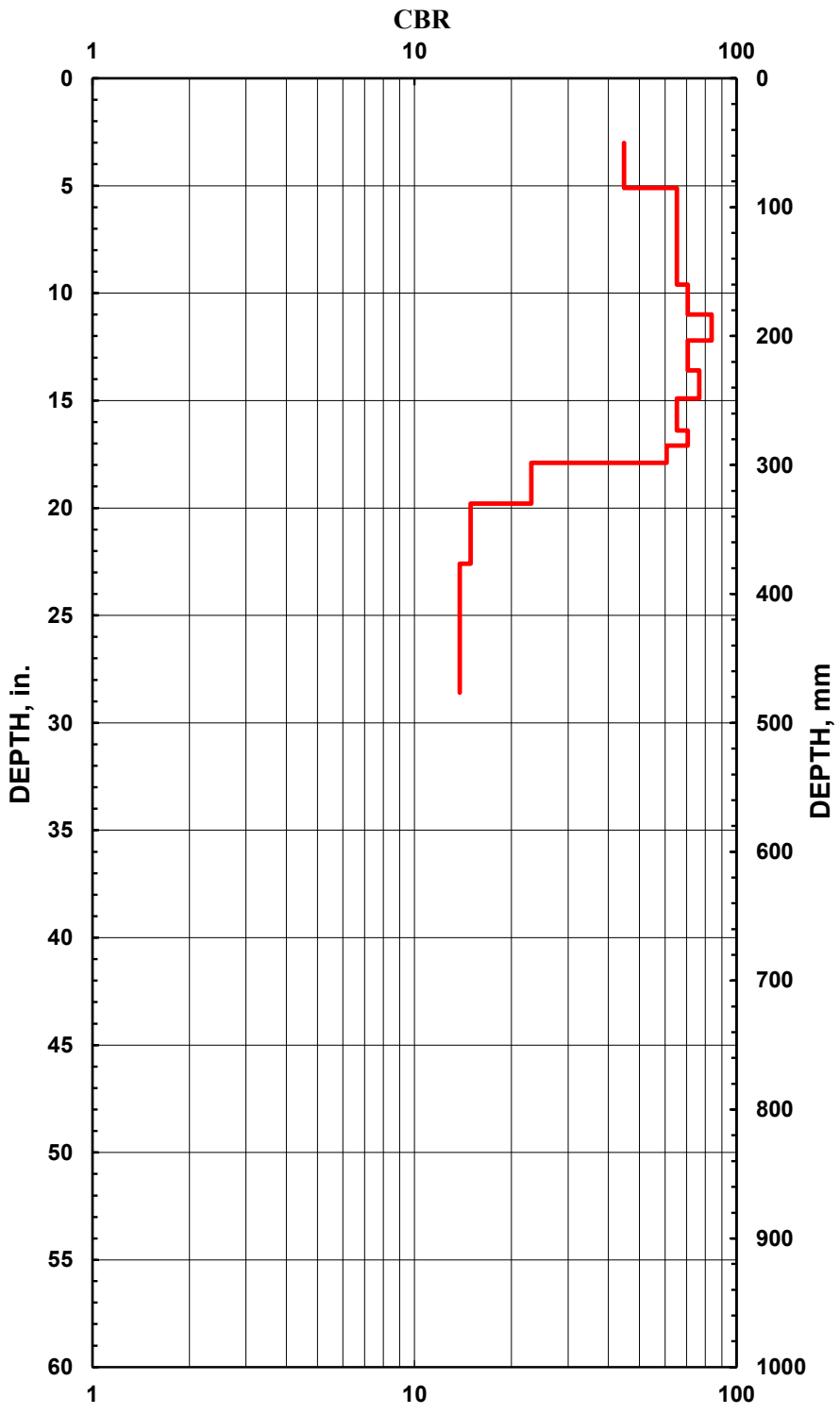
Boring No.

B2

Starting Depth: 3 in.

Date: 8/18/22

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
0	76	17.6 lbs
10	130	17.6 lbs
10	168	17.6 lbs
10	206	17.6 lbs
10	244	17.6 lbs
10	279	17.6 lbs
10	310	17.6 lbs
10	345	17.6 lbs
10	378	17.6 lbs
10	417	17.6 lbs
5	434	17.6 lbs
5	455	17.6 lbs
5	503	17.6 lbs
5	574	17.6 lbs
5	650	17.6 lbs
5	726	17.6 lbs



Agriculture Roadway and Bridge #108 Repair, Kekaha Agriculture Association

Hirata & Associates, Inc.
Geotechnical Engineering

W.O. 22-6746

DYNAMIC CONE PENETROMETER TEST

Plate A5.2

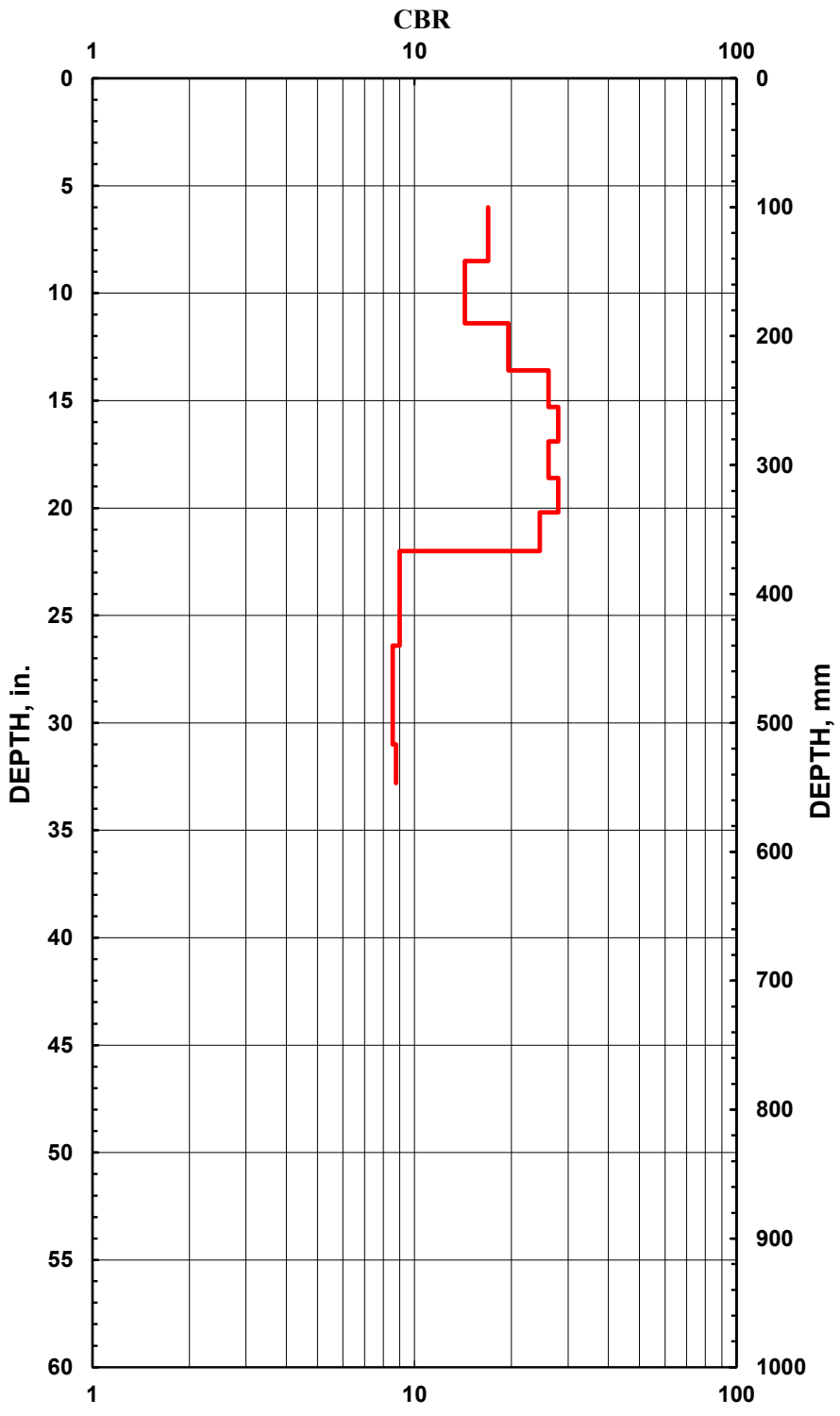
Boring No.

B3

Starting Depth: 6 in.

Date: 8/18/22

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
0	152	17.6 lbs
5	216	17.6 lbs
5	290	17.6 lbs
5	345	17.6 lbs
5	389	17.6 lbs
5	429	17.6 lbs
5	472	17.6 lbs
5	513	17.6 lbs
5	559	17.6 lbs
5	671	17.6 lbs
5	787	17.6 lbs
1	810	17.6 lbs
1	833	17.6 lbs
		17.6 lbs
		17.6 lbs
		17.6 lbs



Agriculture Roadway and Bridge #108 Repair, Kekaha Agriculture Association

Hirata & Associates, Inc.
Geotechnical Engineering

W.O. 22-6746

DYNAMIC CONE PENETROMETER TEST

Plate A5.3

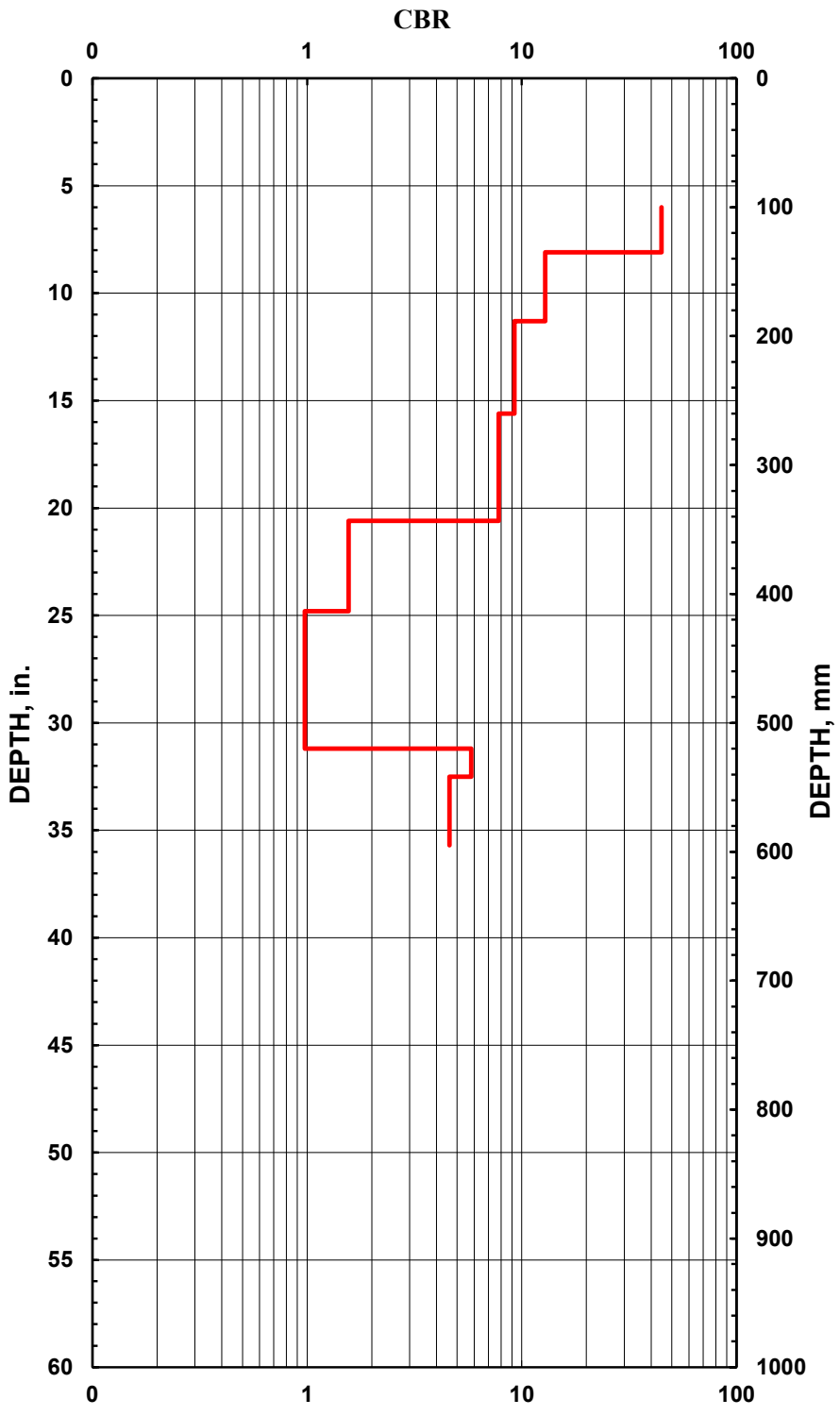
Boring No.

B4

Starting Depth: 6 in.

Date: 8/18/22

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
0	152	17.6 lbs
10	206	17.6 lbs
5	287	17.6 lbs
5	396	17.6 lbs
5	523	17.6 lbs
1	630	17.6 lbs
1	792	17.6 lbs
1	826	17.6 lbs
1	866	17.6 lbs
1	907	17.6 lbs
		17.6 lbs
		17.6 lbs
		17.6 lbs
		17.6 lbs
		17.6 lbs
		17.6 lbs
		17.6 lbs



Agriculture Roadway and Bridge #108 Repair, Kekaha Agriculture Association

Hirata & Associates, Inc.
Geotechnical Engineering

W.O. 22-6746

DYNAMIC CONE PENETROMETER TEST

Plate A5.4

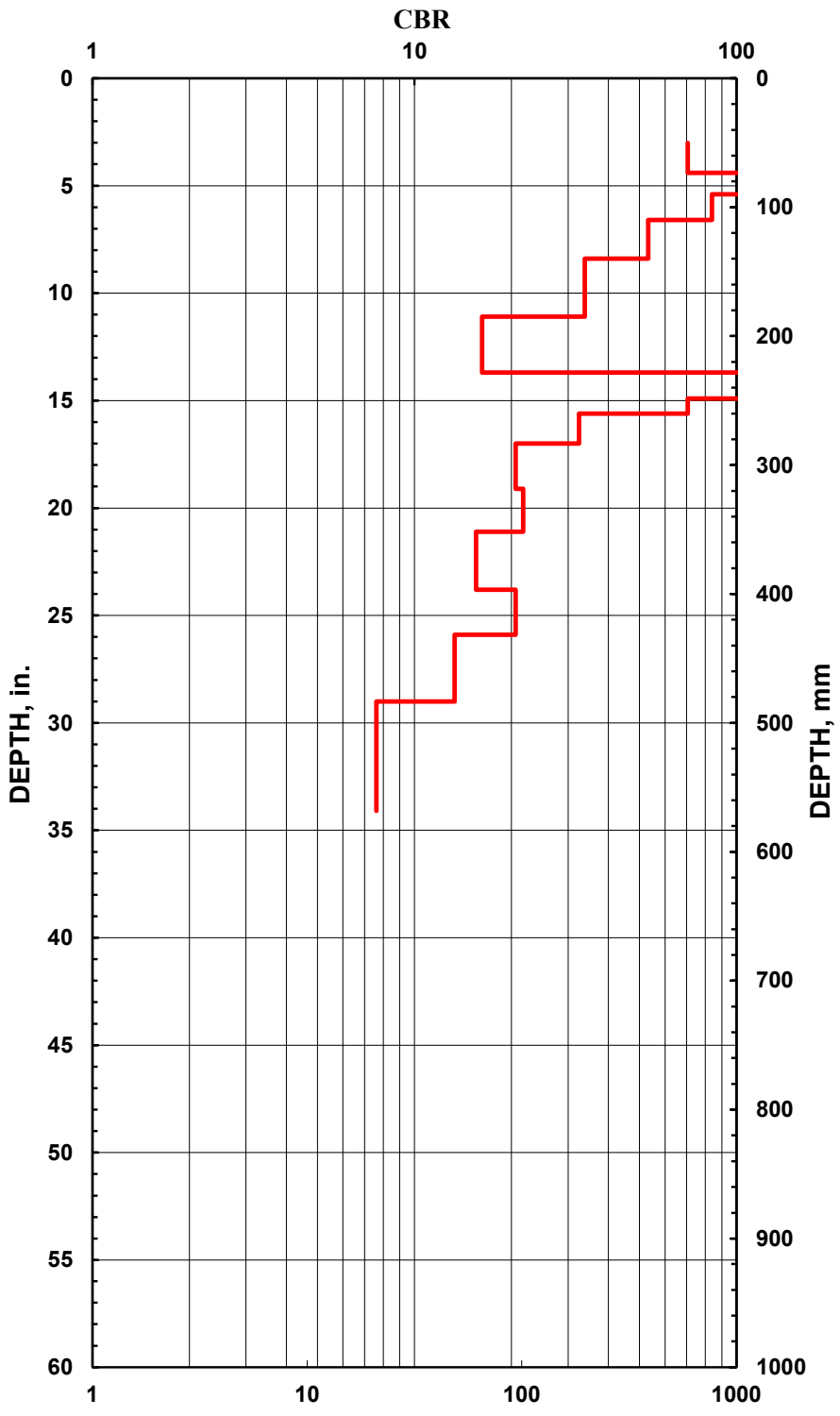
Boring No.

B5

Starting Depth: 3 in.

Date: 8/18/22

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
0	76	17.6 lbs
10	112	17.6 lbs
10	137	17.6 lbs
10	168	17.6 lbs
10	213	17.6 lbs
10	282	17.6 lbs
5	348	17.6 lbs
5	356	17.6 lbs
5	366	17.6 lbs
5	378	17.6 lbs
5	396	17.6 lbs
5	432	17.6 lbs
5	485	17.6 lbs
5	536	17.6 lbs
5	605	17.6 lbs
5	658	17.6 lbs



Agriculture Roadway and Bridge #108 Repair, Kekaha Agriculture Association

Hirata & Associates, Inc.
Geotechnical Engineering

W.O. 22-6746

DYNAMIC CONE PENETROMETER TEST

Plate A5.5

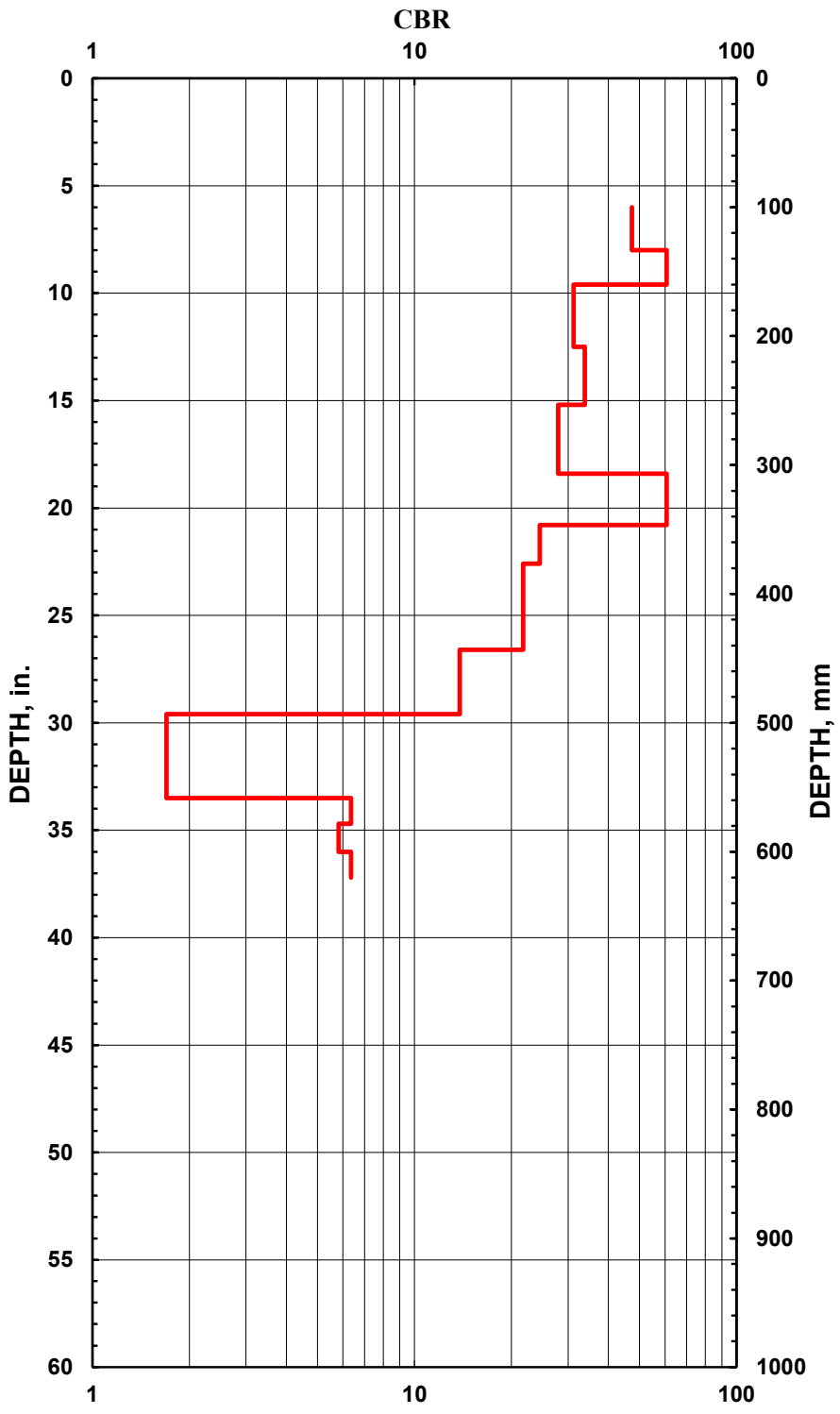
Boring No.

B6

Starting Depth: 6 in.

Date: 8/18/22

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
0	152	17.6 lbs
10	203	17.6 lbs
10	244	17.6 lbs
10	318	17.6 lbs
10	386	17.6 lbs
5	427	17.6 lbs
5	467	17.6 lbs
5	488	17.6 lbs
5	508	17.6 lbs
5	528	17.6 lbs
5	574	17.6 lbs
5	625	17.6 lbs
5	676	17.6 lbs
5	752	17.6 lbs
1	851	17.6 lbs
1	881	17.6 lbs



Agriculture Roadway and Bridge #108 Repair, Kekaha Agriculture Association

Hirata & Associates, Inc.
Geotechnical Engineering

W.O. 22-6746

DYNAMIC CONE PENETROMETER TEST

Plate A5.6

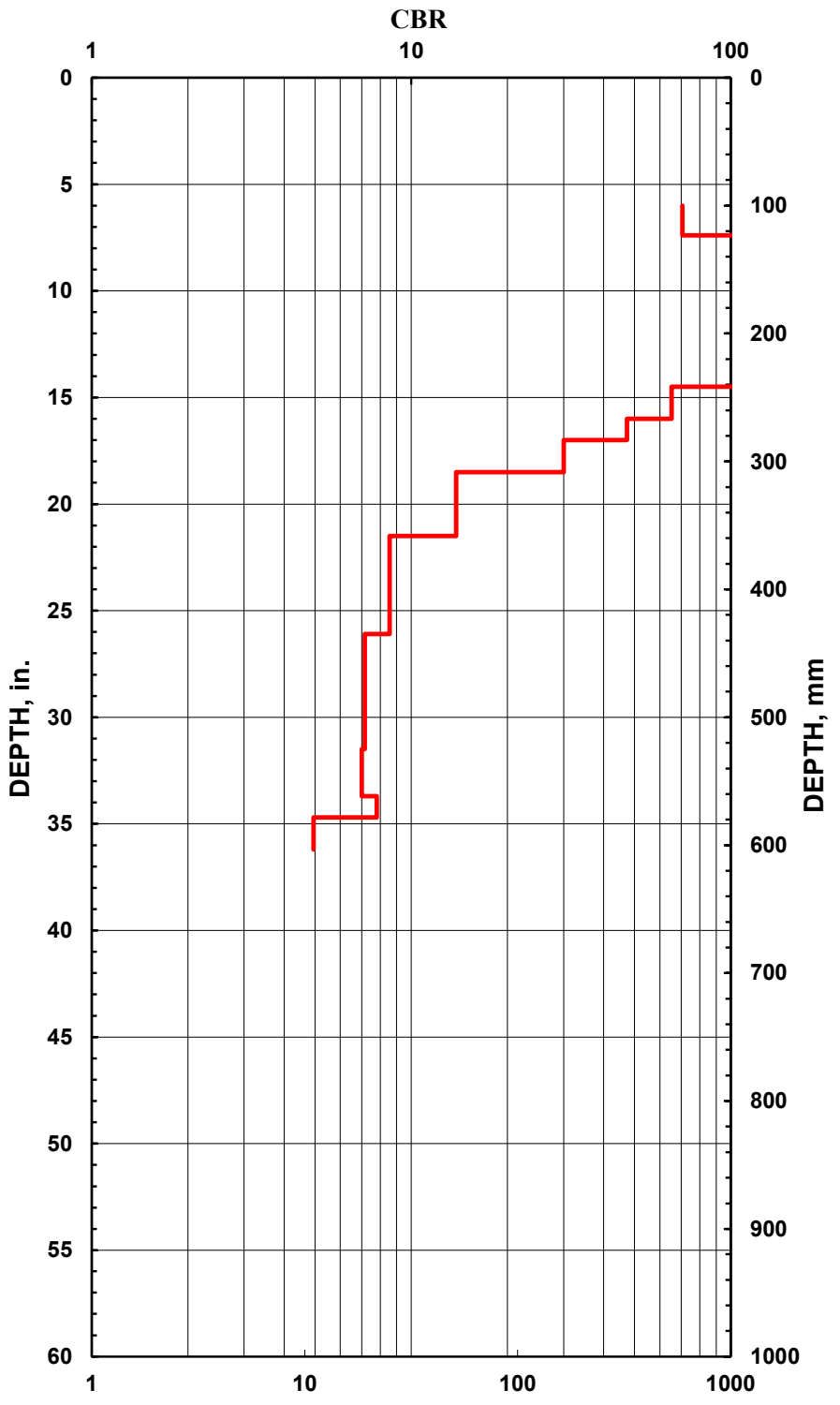
Boring No.

B7

Starting Depth: 6 in.

Date: 8/18/22

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
0	152	17.6 lbs
10	188	17.6 lbs
10	208	17.6 lbs
10	234	17.6 lbs
10	257	17.6 lbs
10	277	17.6 lbs
10	295	17.6 lbs
10	310	17.6 lbs
10	328	17.6 lbs
10	345	17.6 lbs
10	368	17.6 lbs
10	406	17.6 lbs
5	432	17.6 lbs
5	470	17.6 lbs
5	546	17.6 lbs
5	663	17.6 lbs



Agriculture Roadway and Bridge #108 Repair, Kekaha Agriculture Association

Hirata & Associates, Inc.
Geotechnical Engineering

W.O. 22-6746

DYNAMIC CONE PENETROMETER TEST

Plate A5.7

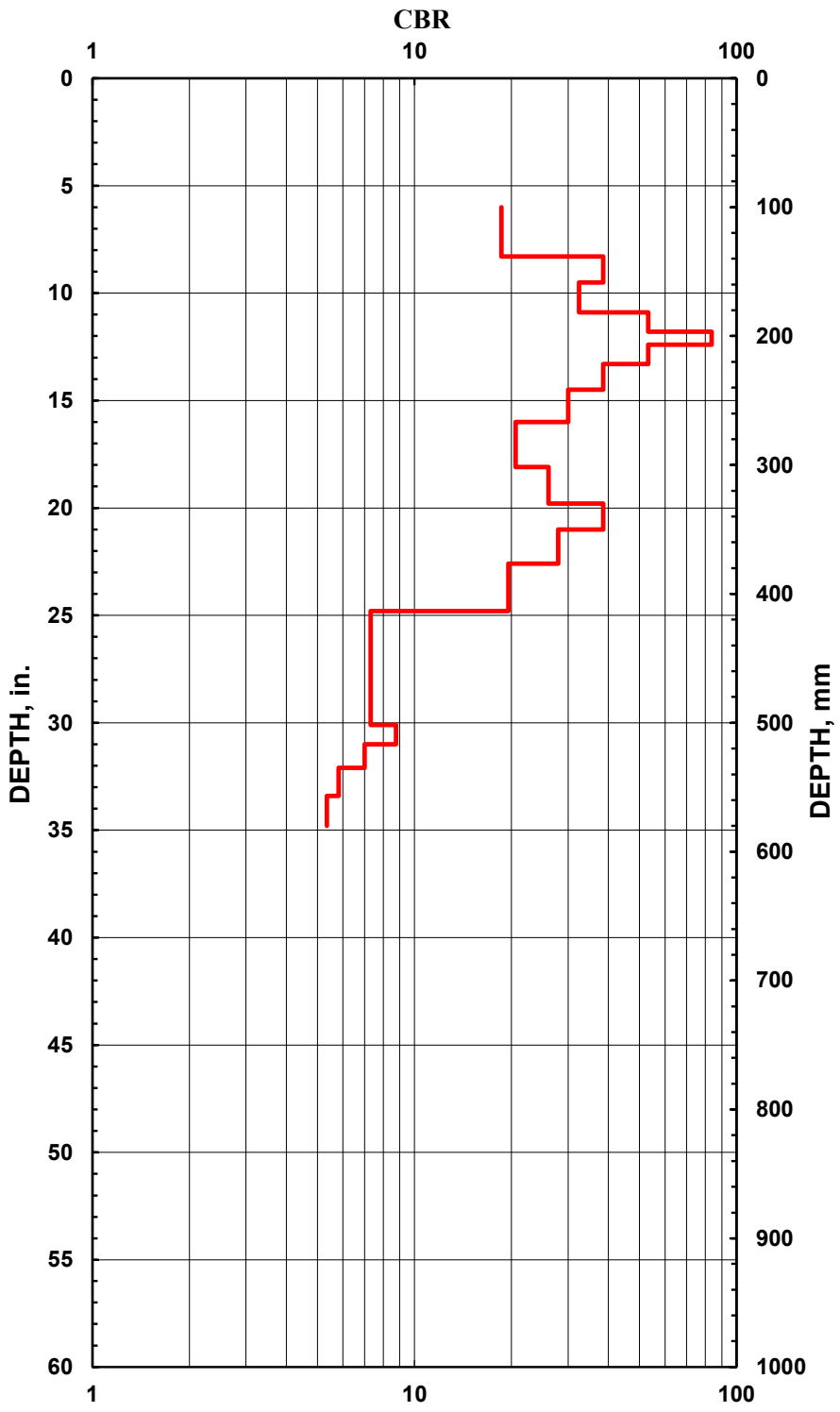
Boring No.

B8

Starting Depth: 6 in.

Date: 8/18/22

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
0	152	17.6 lbs
5	211	17.6 lbs
5	241	17.6 lbs
5	277	17.6 lbs
5	300	17.6 lbs
5	315	17.6 lbs
5	338	17.6 lbs
5	368	17.6 lbs
5	406	17.6 lbs
5	460	17.6 lbs
5	503	17.6 lbs
5	533	17.6 lbs
5	574	17.6 lbs
5	630	17.6 lbs
5	765	17.6 lbs
1	787	17.6 lbs



Agriculture Roadway and Bridge #108 Repair, Kekaha Agriculture Association

Hirata & Associates, Inc.
Geotechnical Engineering

W.O. 22-6746

DYNAMIC CONE PENETROMETER TEST

Plate A5.8

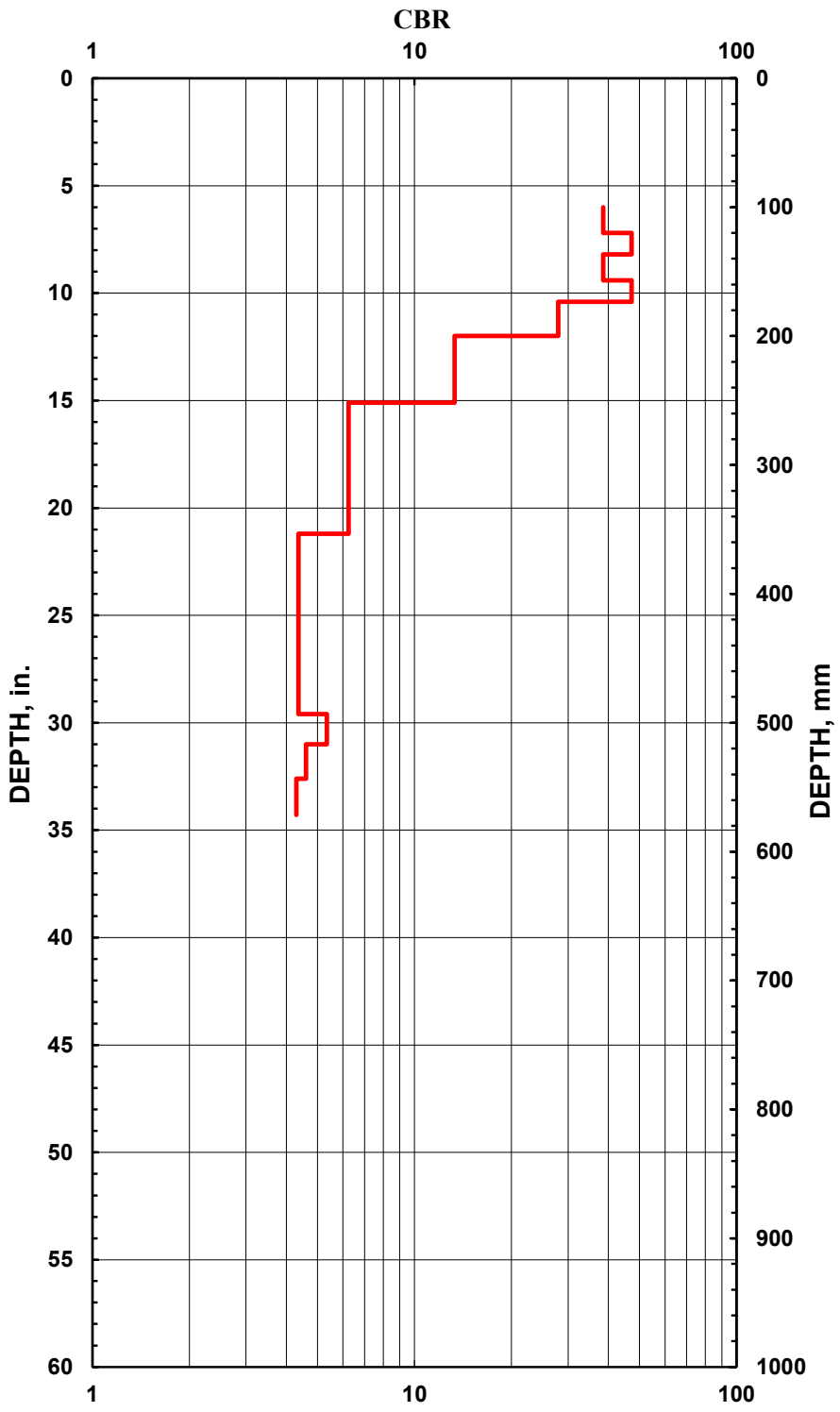
Boring No.

B11

Starting Depth: 6 in.

Date: 8/18/22

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
0	152	17.6 lbs
5	183	17.6 lbs
5	208	17.6 lbs
5	239	17.6 lbs
5	264	17.6 lbs
5	305	17.6 lbs
5	384	17.6 lbs
5	538	17.6 lbs
5	752	17.6 lbs
1	787	17.6 lbs
1	828	17.6 lbs
1	871	17.6 lbs
		17.6 lbs
		17.6 lbs
		17.6 lbs
		17.6 lbs
		17.6 lbs



Agriculture Roadway and Bridge #108 Repair, Kekaha Agriculture Association

Hirata & Associates, Inc.
Geotechnical Engineering

W.O. 22-6746

DYNAMIC CONE PENETROMETER TEST

Plate A5.9

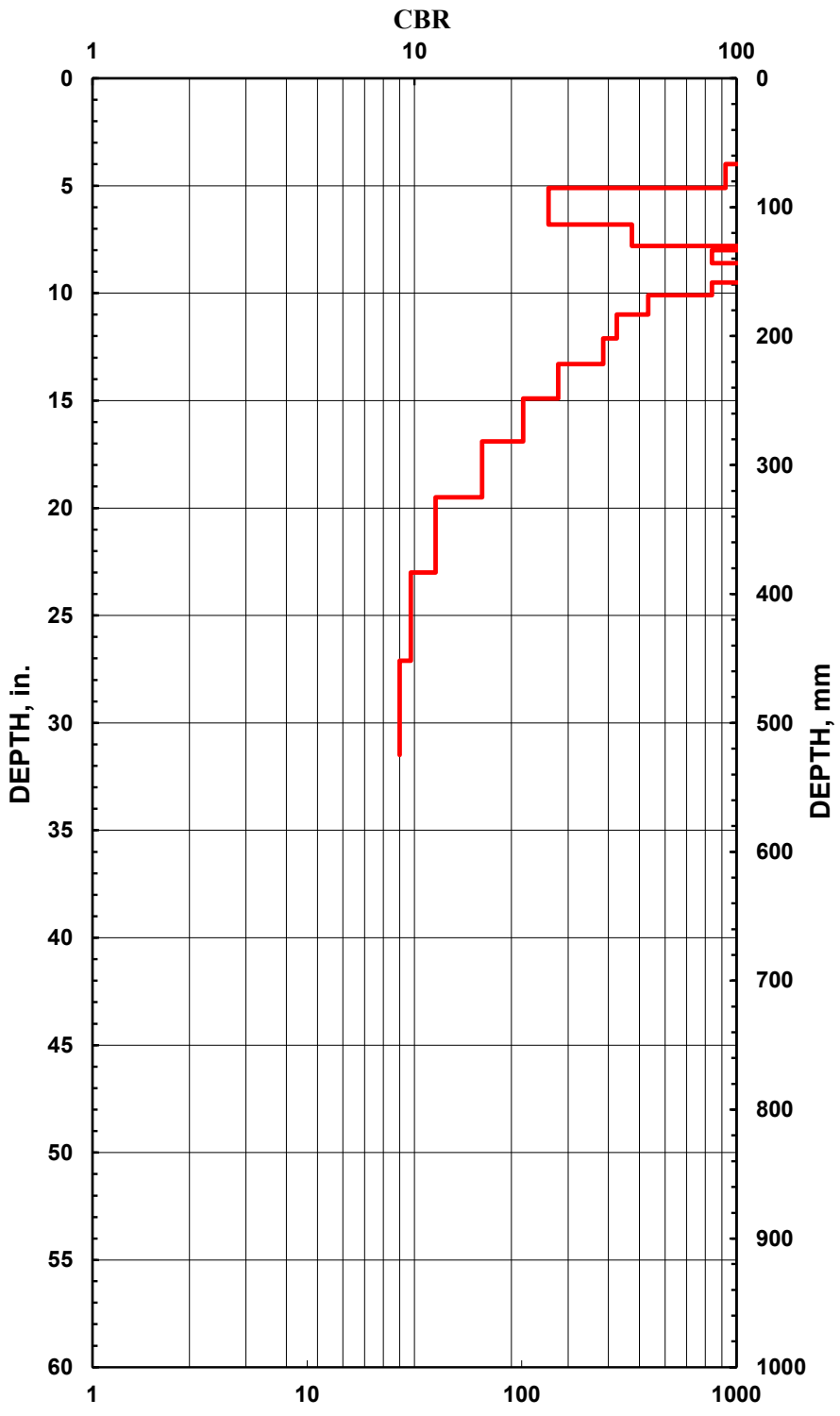
Boring No.

B12

Starting Depth: 3 in.

Date: 8/18/22

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
0	76	17.6 lbs
10	91	17.6 lbs
10	97	17.6 lbs
10	102	17.6 lbs
10	130	17.6 lbs
5	173	17.6 lbs
5	198	17.6 lbs
5	203	17.6 lbs
5	218	17.6 lbs
5	224	17.6 lbs
5	231	17.6 lbs
5	241	17.6 lbs
5	257	17.6 lbs
5	279	17.6 lbs
5	307	17.6 lbs
5	338	17.6 lbs



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DYNAMIC CONE PENETROMETER TEST

Plate A5.10

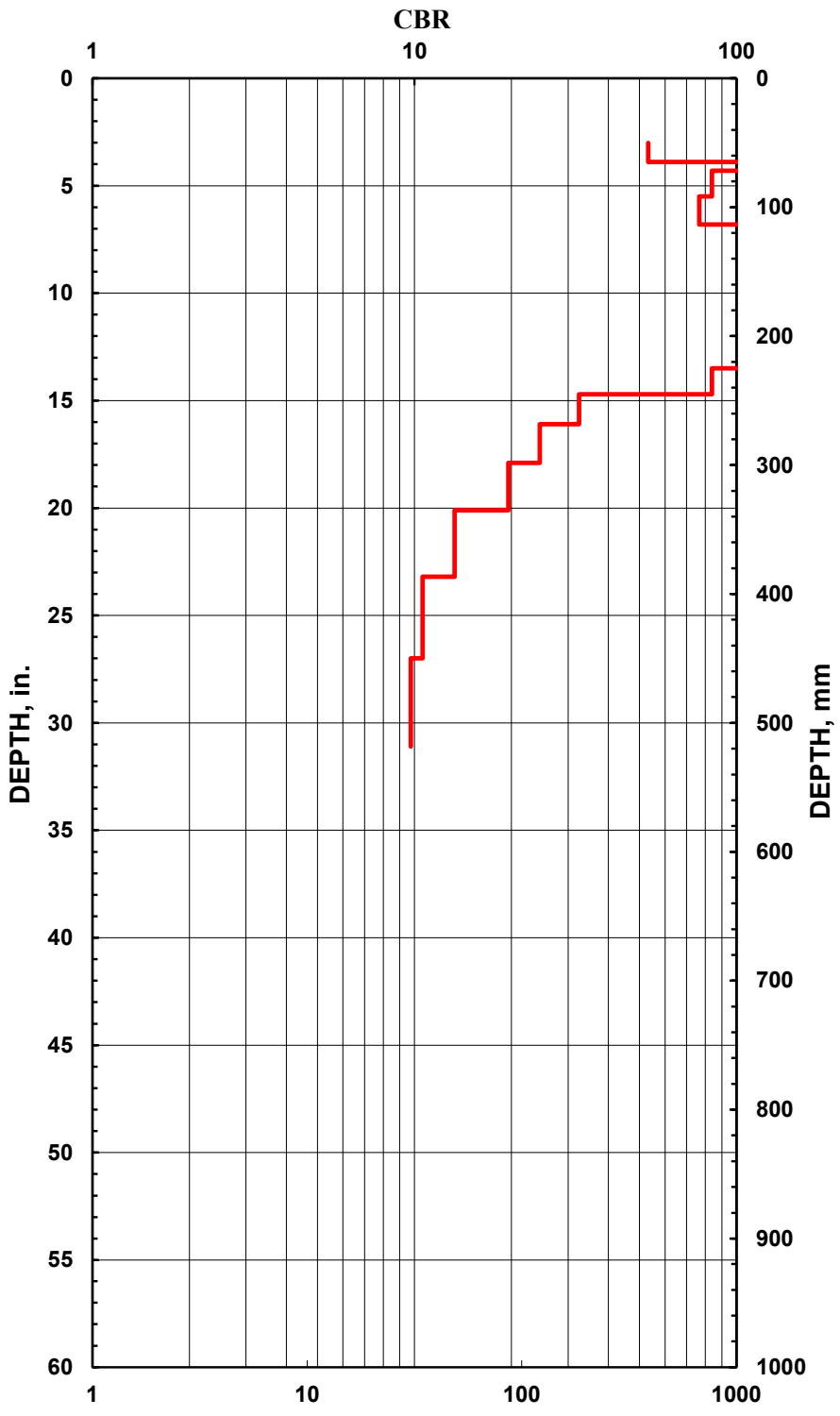
Boring No.

B13

Starting Depth: 3 in.

Date: 8/17/22

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
0	76	17.6 lbs
5	99	17.6 lbs
5	109	17.6 lbs
10	140	17.6 lbs
10	173	17.6 lbs
10	191	17.6 lbs
10	198	17.6 lbs
10	211	17.6 lbs
10	224	17.6 lbs
10	236	17.6 lbs
10	246	17.6 lbs
10	254	17.6 lbs
10	262	17.6 lbs
10	267	17.6 lbs
10	274	17.6 lbs
10	284	17.6 lbs



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DYNAMIC CONE PENETROMETER TEST

Plate A5.11

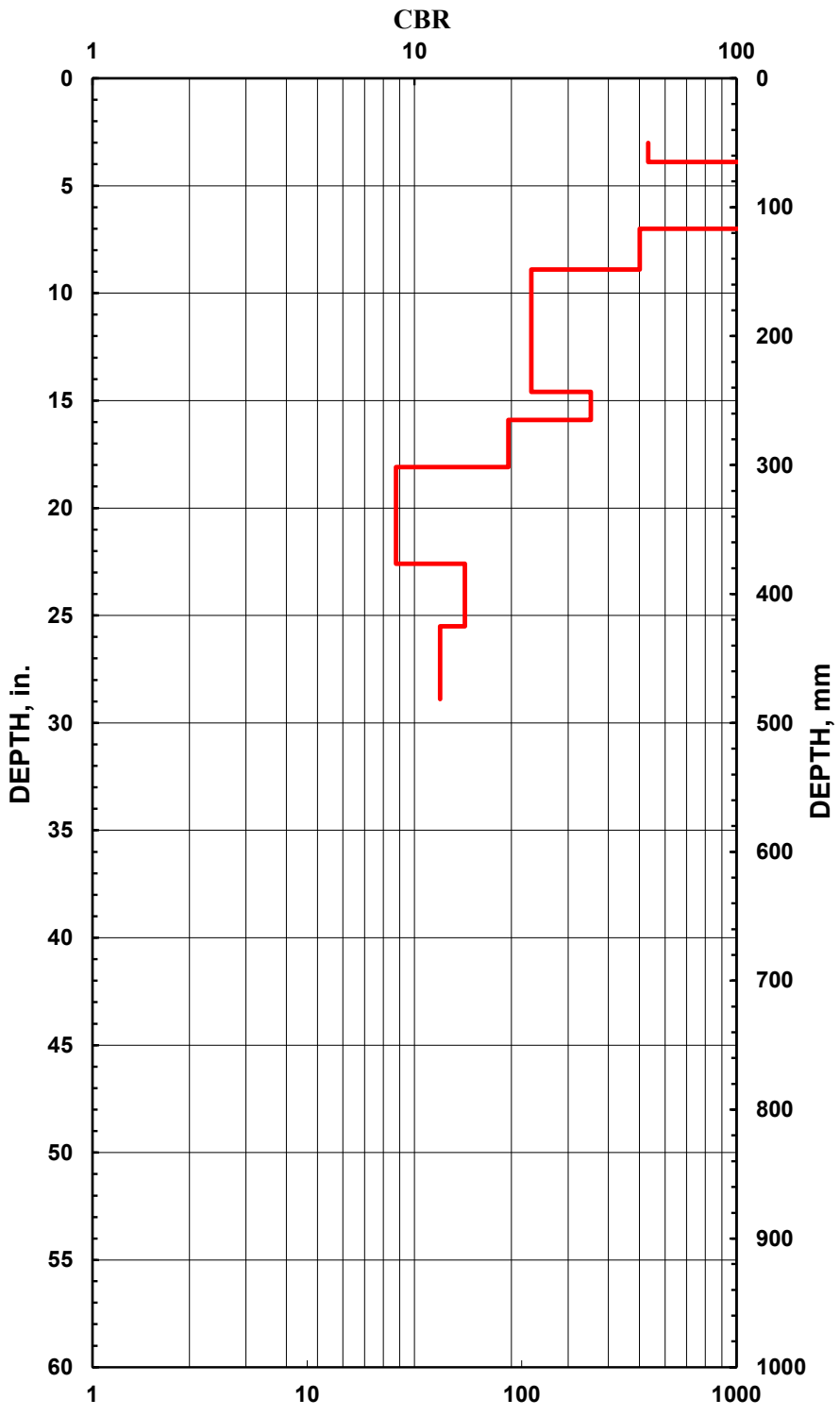
Boring No.

B14

Starting Depth: 3 in.

Date: 8/17/22

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
0	76	17.6 lbs
5	99	17.6 lbs
5	104	17.6 lbs
5	107	17.6 lbs
5	109	17.6 lbs
5	112	17.6 lbs
5	114	17.6 lbs
5	119	17.6 lbs
5	124	17.6 lbs
10	135	17.6 lbs
10	147	17.6 lbs
10	155	17.6 lbs
10	165	17.6 lbs
10	178	17.6 lbs
10	226	17.6 lbs
5	274	17.6 lbs



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DYNAMIC CONE PENETROMETER TEST

Plate A5.12

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 visual examination and Atterberg Limit tests. Atterberg Limit tests were 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 A4.17.

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. Representative 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 A4.17.

CONSOLIDATION

Representative samples were tested for their 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 samples 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 through B2.7.

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 Plate B3.1.

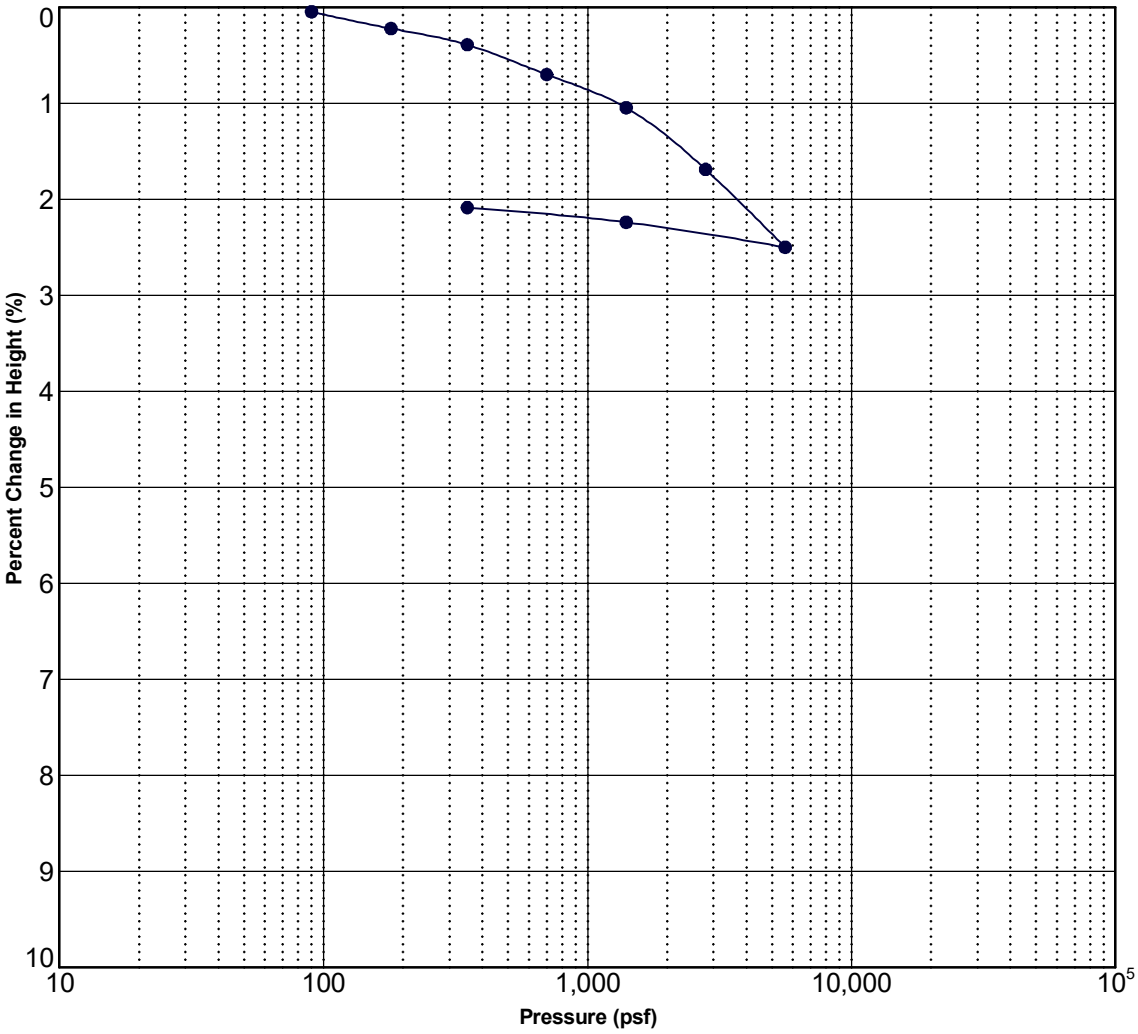
SIEVE ANALYSES

Sieve analyses tests were conducted on selected soil samples in general accordance with ASTM D 422. The test is used to determine the grain size distribution. Test results are presented on Plates B4.1 and B4.2.

CALIFORNIA BEARING RATIO TESTS

CBR tests were performed in general accordance with ASTM D 1883 on bulk samples of near surface soil obtained from selected borings. The test is used to evaluate the relative quality of subgrade soils to be used in the design of flexible pavements. Results are shown on Plates B5.1 through B5.7.

Consolidation Test Results



Sample Description

Boring No.: B3 Depth (ft): 4

Soil Description: Brown silty clay with sand

	Moisture Content (%)	Dry Density (pcf)
Initial	35.1	80.9
Final	32.2	82.6

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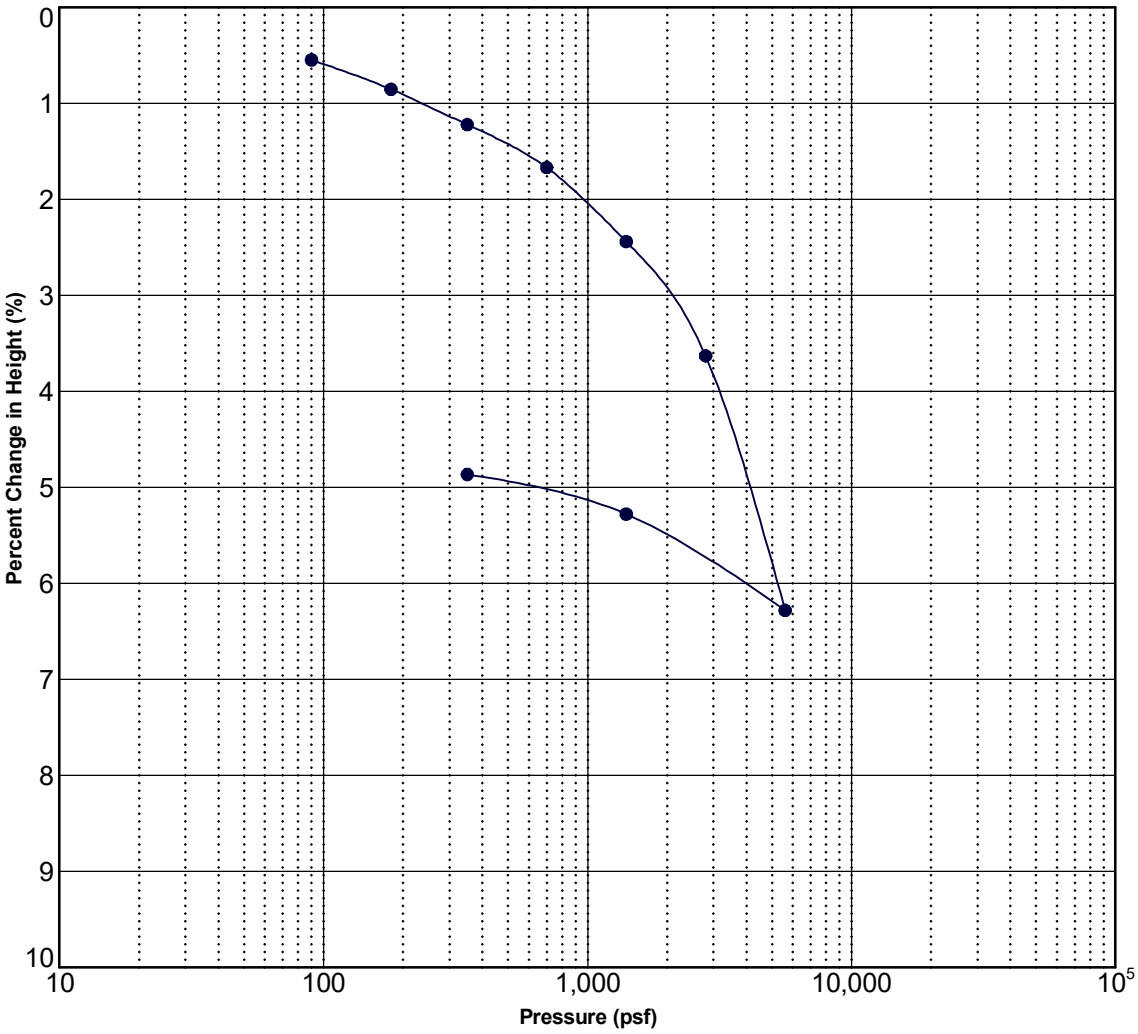
CONSOLIDATION TEST

ASTM D2435 / D2435M - 11

Plate B2.1

Consolidation Test Results



Sample Description

Boring No.: B6 Depth (ft): 5

Soil Description: Dark grayish brown silty clay with sand

	Moisture Content (%)	Dry Density (pcf)
Initial	56.5	65.4
Final	52.3	68.7

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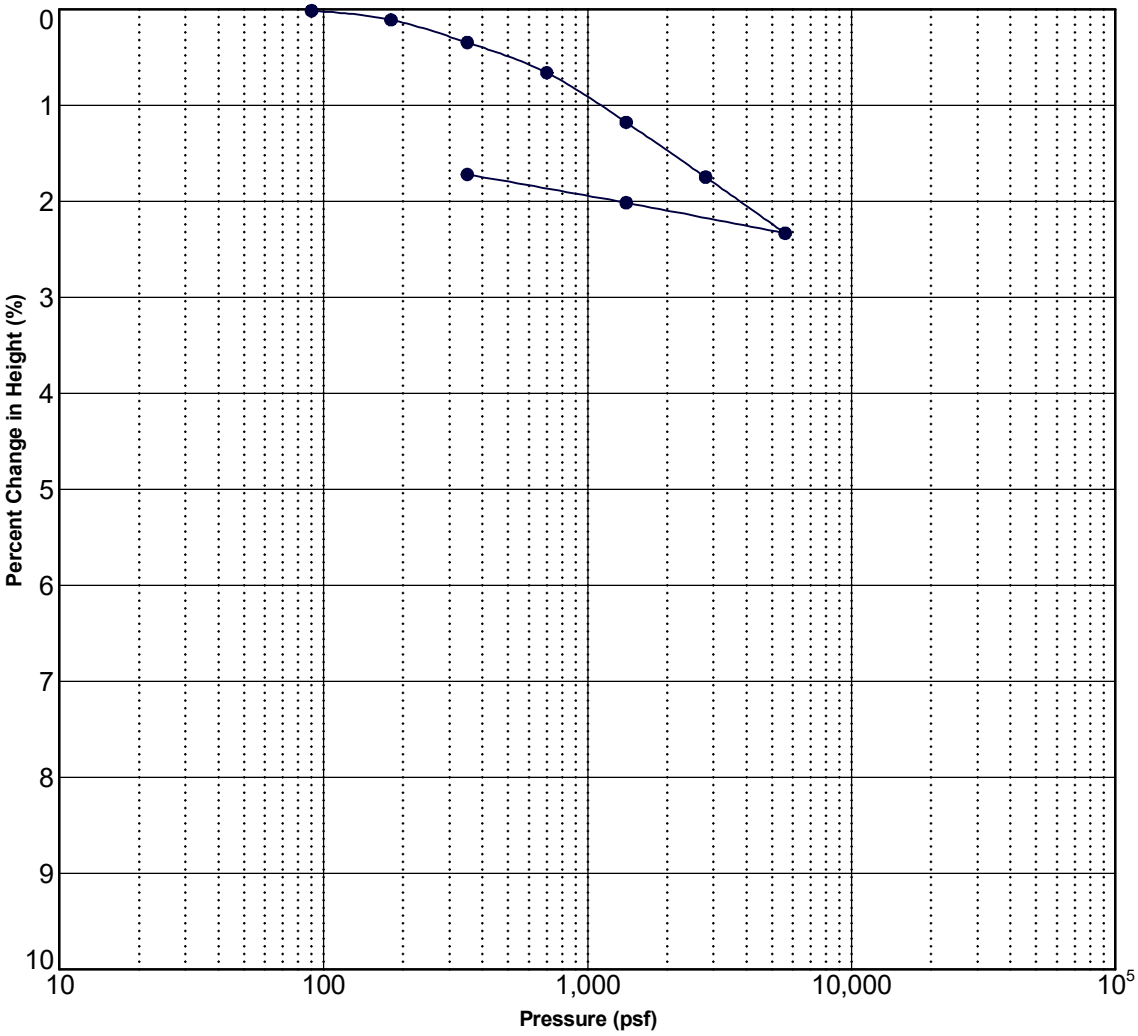
CONSOLIDATION TEST

ASTM D2435 / D2435M - 11

Plate B2.2

Consolidation Test Results



Sample Description

Boring No.: B9 Depth (ft): 5

Soil Description: Dark reddish brown to dark gray silty clay with sand

	Moisture Content (%)	Dry Density (pcf)
Initial	30.8	78.7
Final	28.6	80.1

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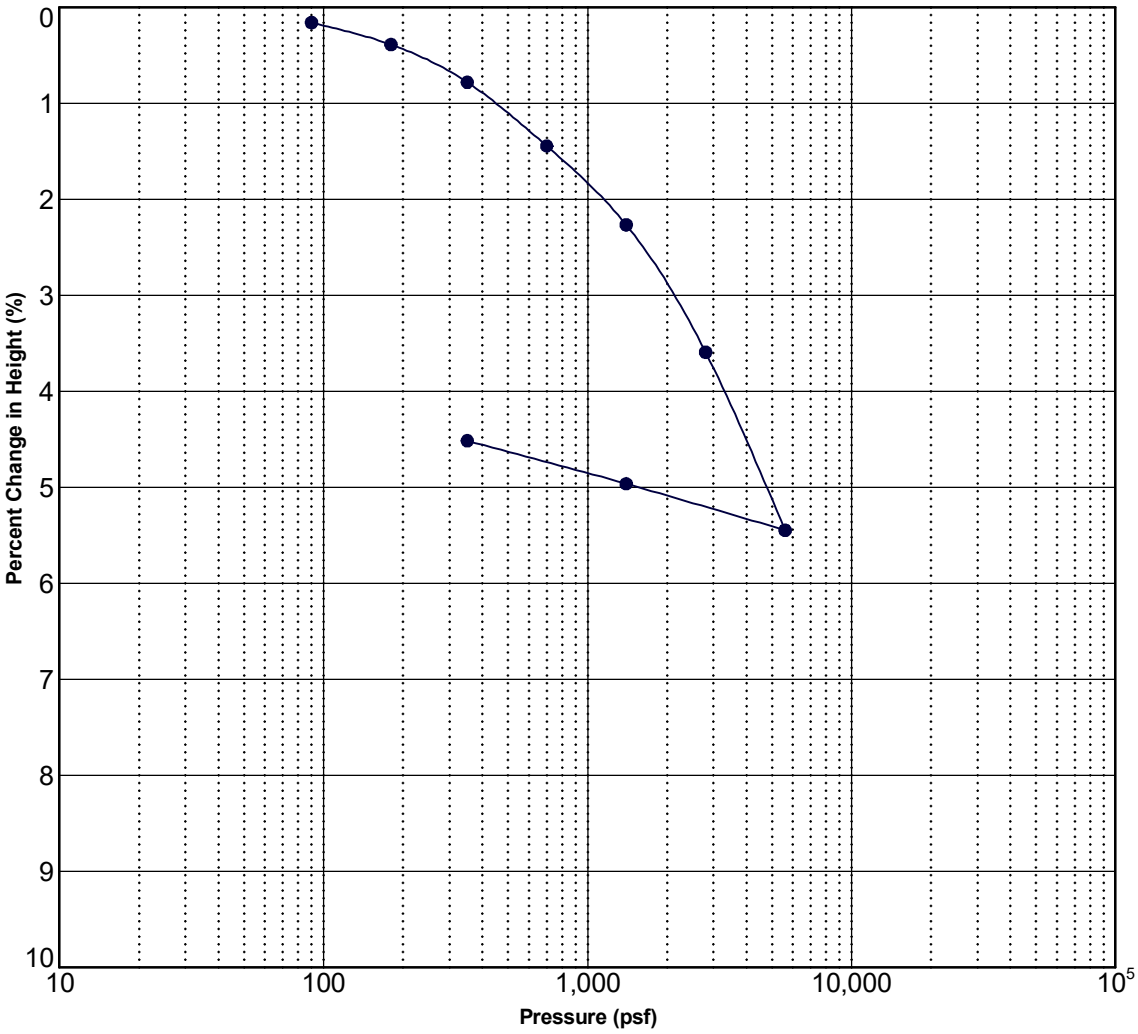
CONSOLIDATION TEST

ASTM D2435 / D2435M - 11

Plate B2.3

Consolidation Test Results



Sample Description

Boring No.: B9 Depth (ft): 9

Soil Description: Dark reddish brown silty sand with gravel

	Moisture Content (%)	Dry Density (pcf)
Initial	22.1	89.2
Final	18.8	93.4

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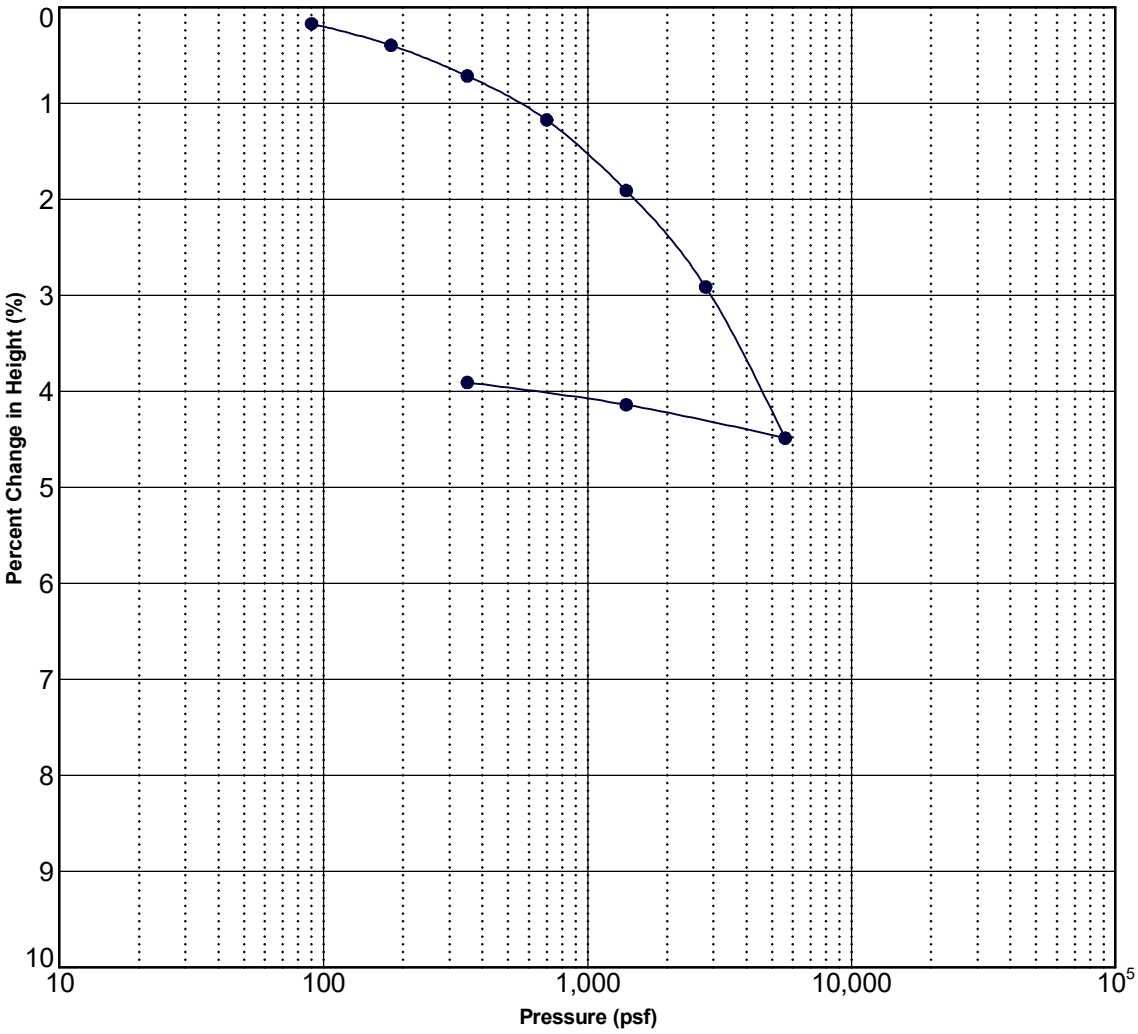
CONSOLIDATION TEST

ASTM D2435 / D2435M - 11

Plate B2.4

Consolidation Test Results



Sample Description

Boring No.: B10 Depth (ft): 8

Soil Description: Dark reddish brown silty sand

	Moisture Content (%)	Dry Density (pcf)
Initial	27.8	83.5
Final	24.0	86.9

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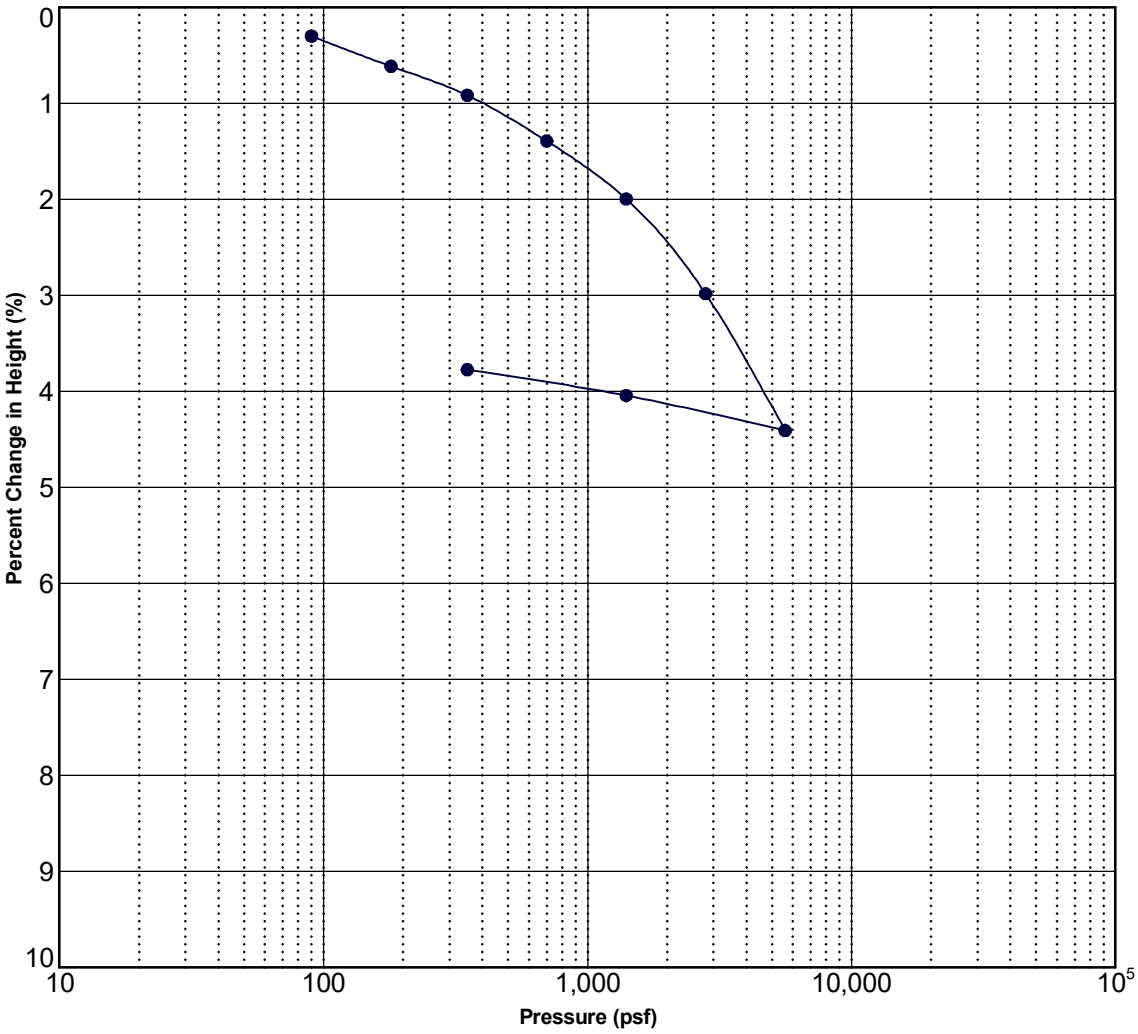
CONSOLIDATION TEST

ASTM D2435 / D2435M - 11

Plate B2.5

Consolidation Test Results



Sample Description

Boring No.: B13 Depth (ft): 4

Soil Description: Dark reddish brown silty clay with sand

	Moisture Content (%)	Dry Density (pcf)
Initial	33.6	82.6
Final	29.8	85.8

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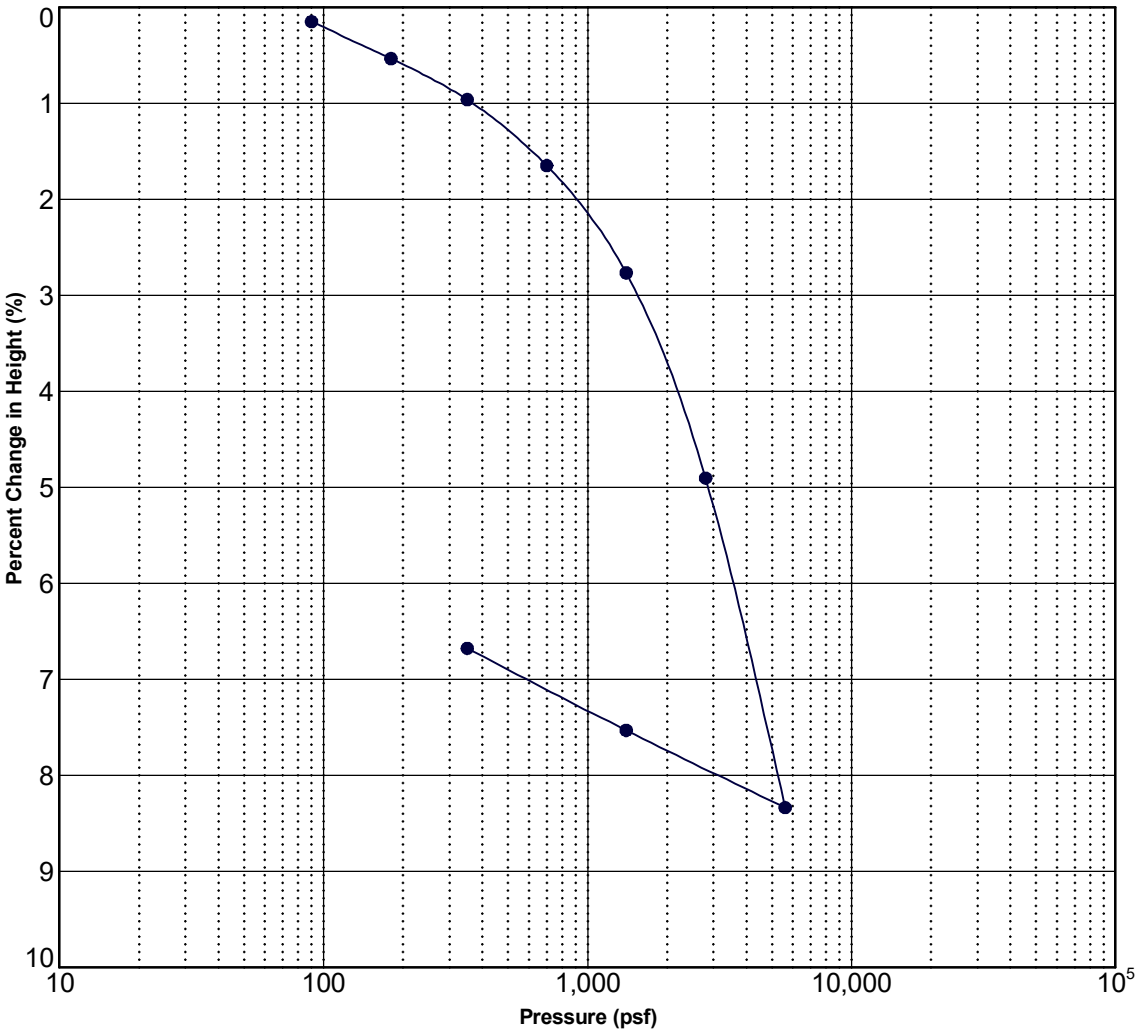
CONSOLIDATION TEST

ASTM D2435 / D2435M - 11

Plate B2.6

Consolidation Test Results



Sample Description

Boring No.: B14 Depth (ft): 5

Soil Description: Light gray clayey silt

	Moisture Content (%)	Dry Density (pcf)
Initial	91.0	45.7
Final	79.8	49.0

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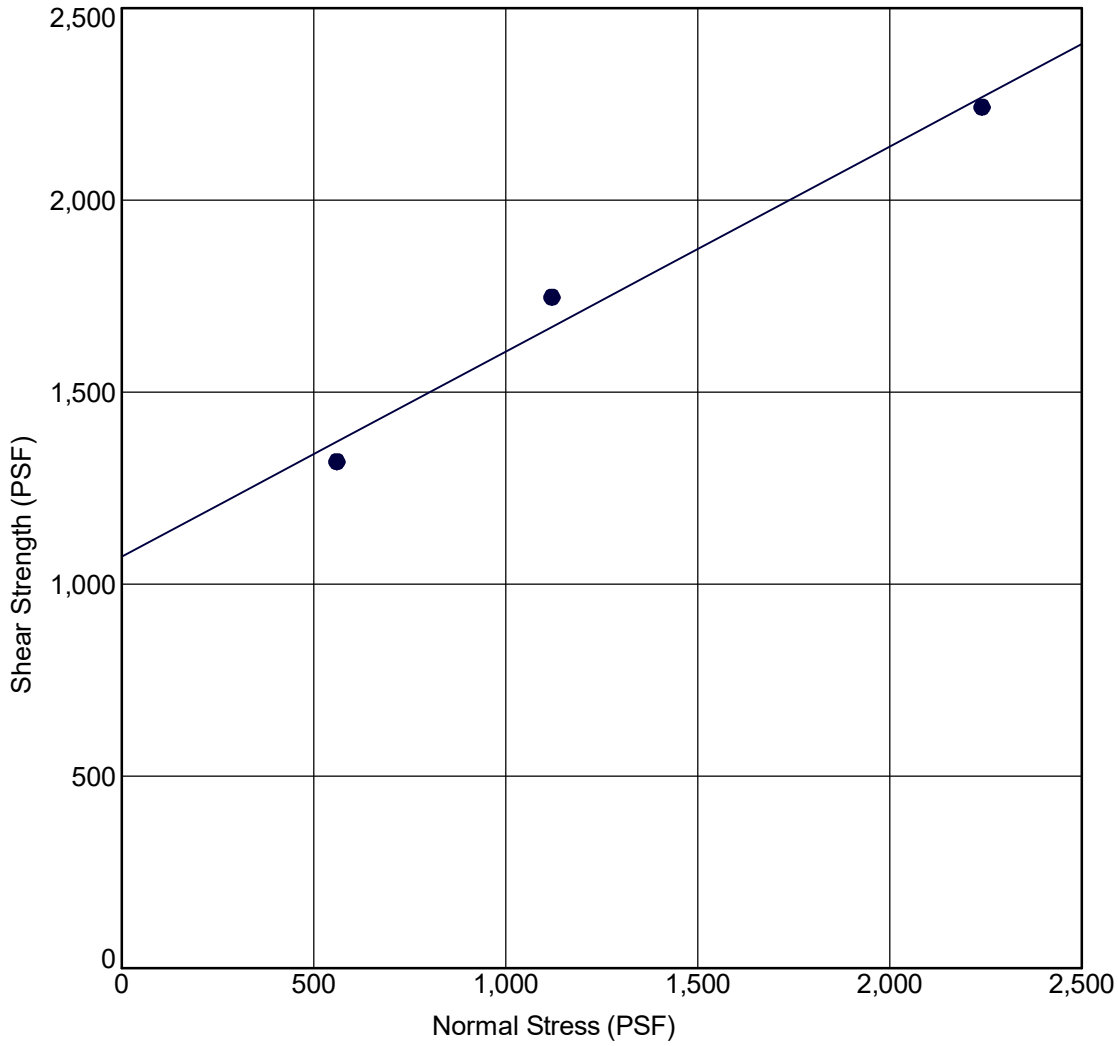
CONSOLIDATION TEST

ASTM D2435 / D2435M - 11

Plate B2.7

Direct Shear Test Results



Soil Data

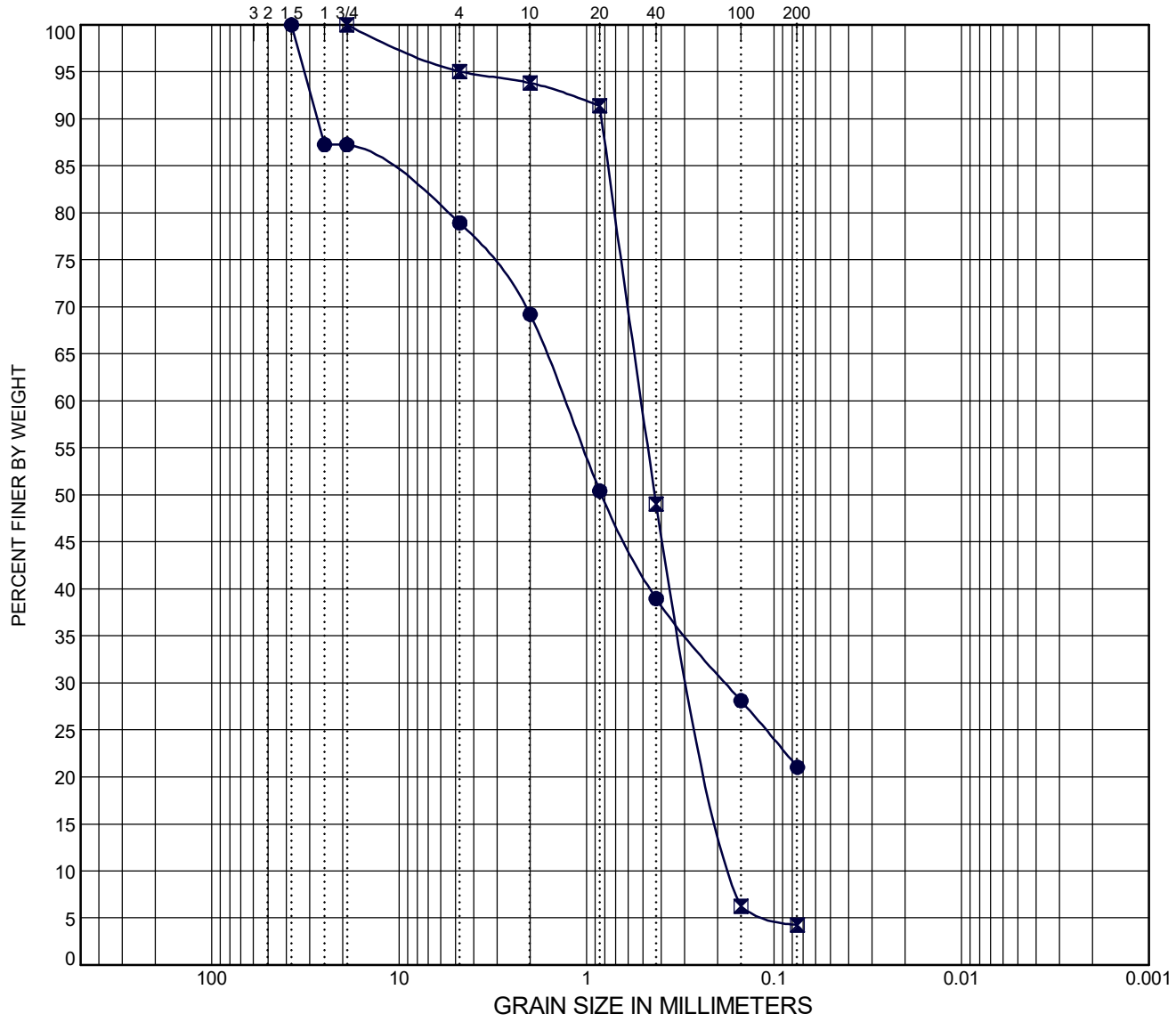
Boring No.: B10 Depth (ft): 4
Soil Description: Reddish brown silty clay

Test Results

Strength Intercept (c): 1071.5 PSF (Peak Strength)
Friction Angle (phi): 28.1 DEG (Peak Strength)

	Agriculture Roadway and Bridge #108 Repair, Kekaha Agriculture Association		
	HIRATA & ASSOCIATES, INC. Geotechnical Engineering	**DIRECT SHEAR TEST**	Plate B3.1
	W.O. 22-6746	*ASTM D3080*	

U.S. SIEVE OPENING IN INCHES | U.S. SIEVE NUMBERS | HYDROMETER



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Sample Location	Classification	%Gravel	%Sand	%Fines
● Boring B9 at 9 ft	Dark reddish brown silty sand with gravel	21.1	57.9	21.0
⊠ Boring B9 at 19 ft	Mottled tan and gray sand with silt	4.9	90.8	4.3

Sample Location	D100	D60	D30	D10	Cc	Cu
● Boring B9 at 9 ft	37.5	1.3	0.2	*	*	*
⊠ Boring B9 at 19 ft	19	0.5	0.3	0.2	0.86	3.09

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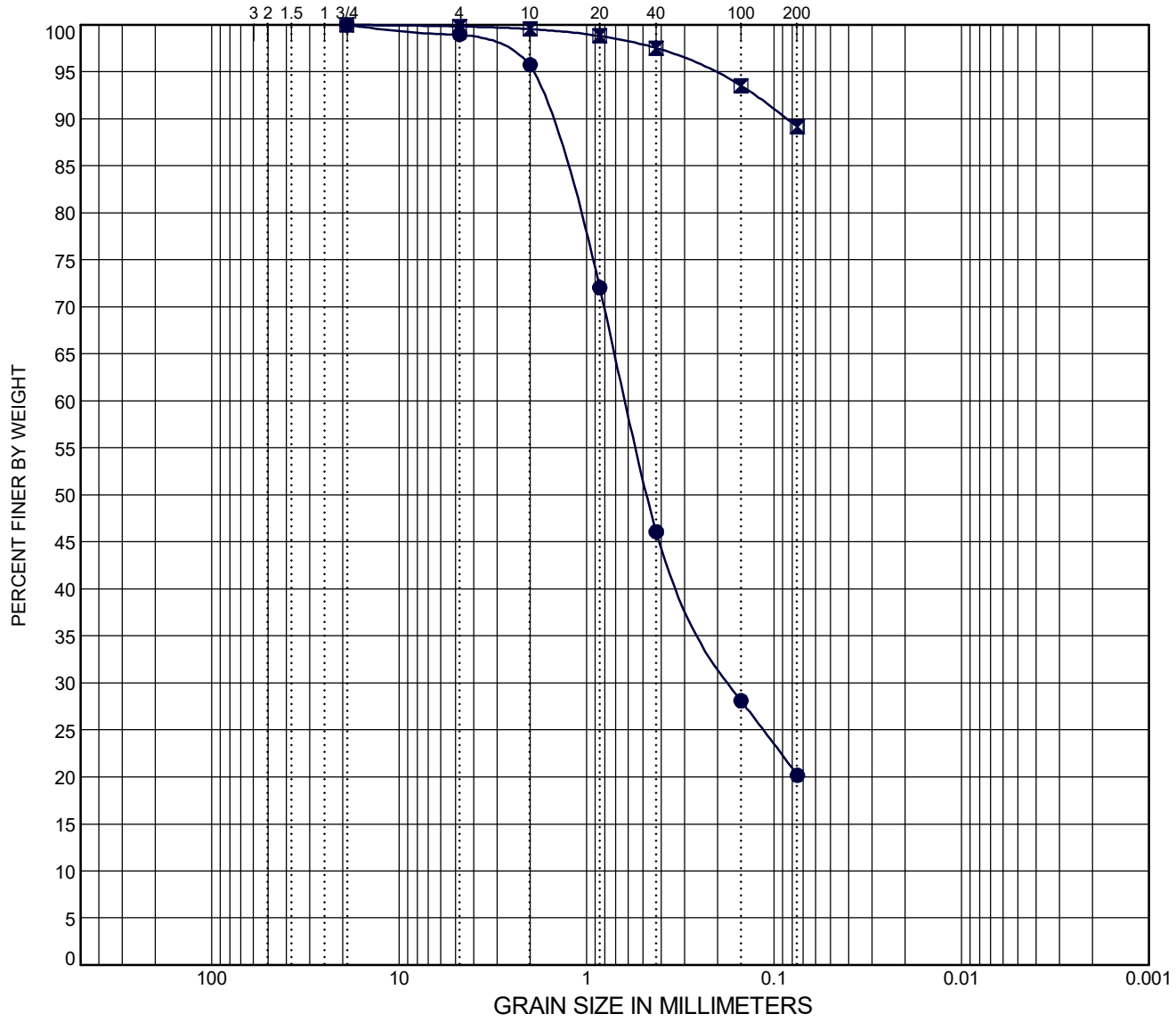
SIEVE ANALYSIS TEST

ASTM D422

Plate B4.1

U.S. SIEVE OPENING IN INCHES | U.S. SIEVE NUMBERS | HYDROMETER



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Sample Location	Classification	%Gravel	%Sand	%Fines
● Boring B10 at 8 ft	Dark reddish brown silty sand	1.0	78.8	20.2
⊠ Boring B10 at 13 ft	Brown silty clay	0.2	10.7	89.2

Sample Location	D100	D60	D30	D10	Cc	Cu
● Boring B10 at 8 ft	19	0.6	0.2	*	*	*
⊠ Boring B10 at 13 ft	19		*	*	*	*

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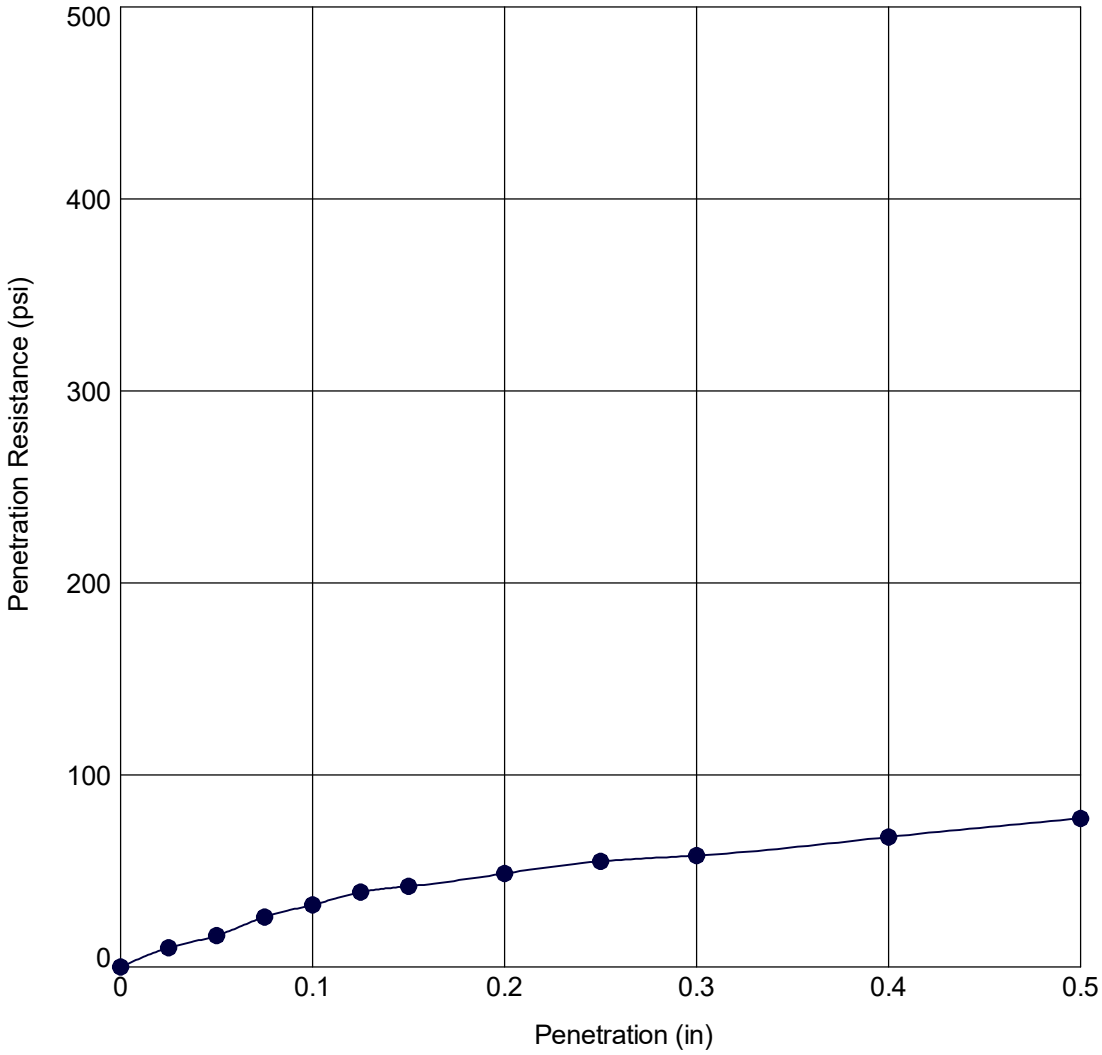
SIEVE ANALYSIS TEST

ASTM D422

Plate B4.2



Soil Data

Location:	Boring B2 at 1.5 to 3 ft
Description:	Dark reddish brown silty clay with sand
Sample Dry Density	110.4 pcf
Sample Moisture Content	17.2 %

Test Results

CBR Value:	3.2 %
Expansion:	7.9 %

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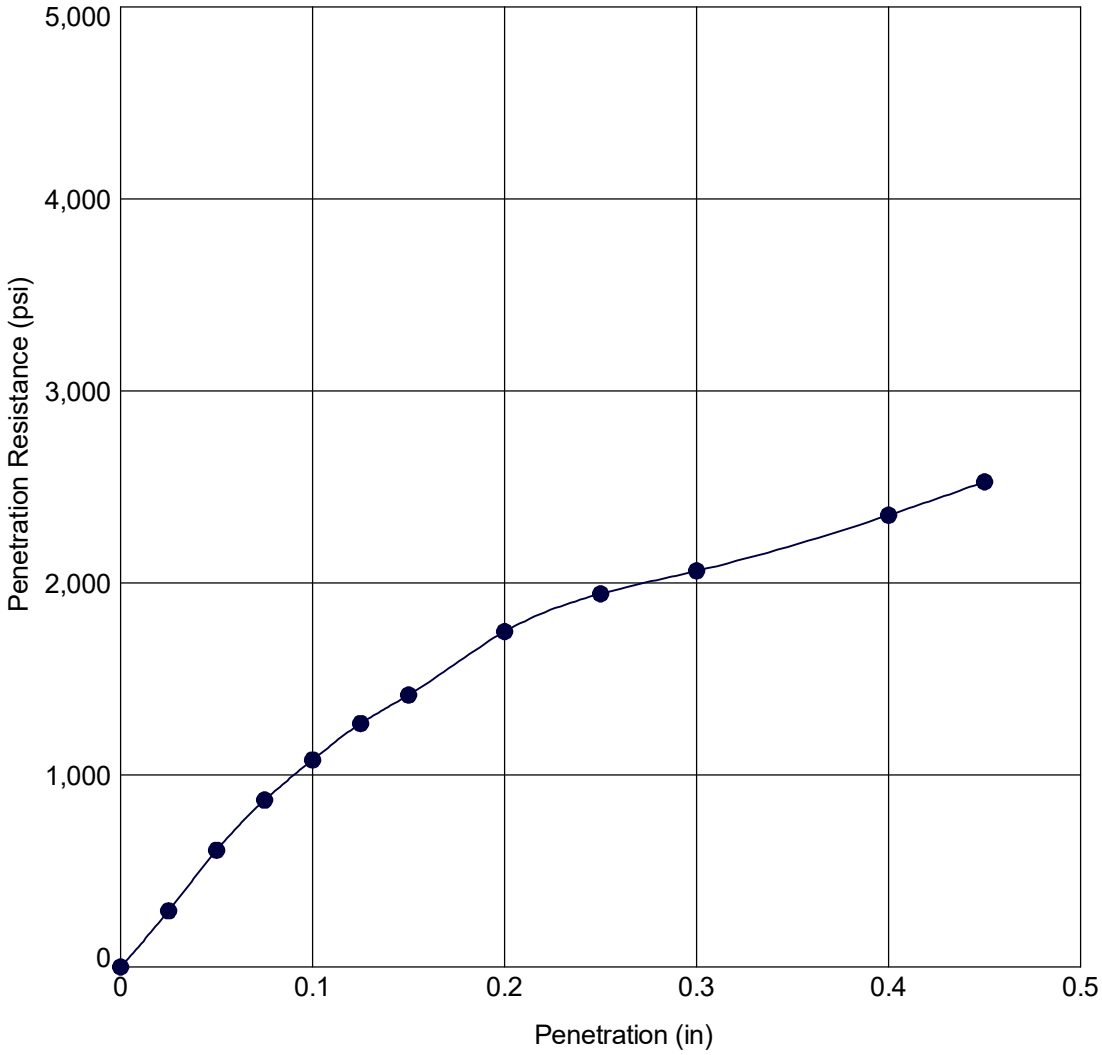
CBR STRESS PENETRATION TEST

ASTM D1883

Plate B5.1



Soil Data

Location:	Boring B3 at 1 to 2 ft
Description:	Mottled tan to gray silty sand
Sample Dry Density	120.7 pcf
Sample Moisture Content	11.0 %

Test Results

CBR Value: 107.8 %

Expansion: 0.0 %

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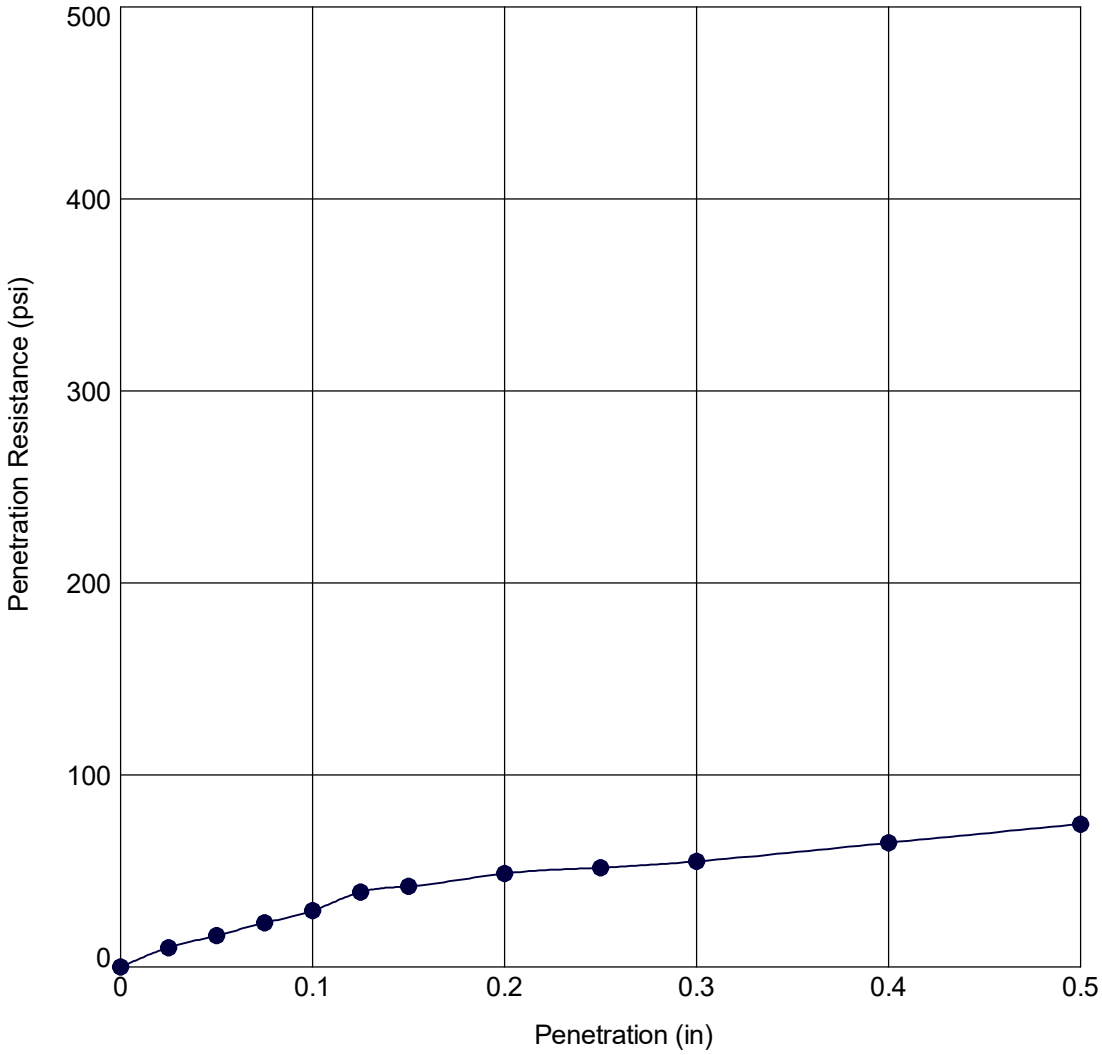
CBR STRESS PENETRATION TEST

ASTM D1883

Plate B5.2



Soil Data

Location:	Boring B4 at 1.5 to 4 ft
Description:	Brown to reddish brown silty clay with sand
Sample Dry Density	107.3 pcf
Sample Moisture Content	18.1 %

Test Results

CBR Value:	2.9 %
Expansion:	8.7 %

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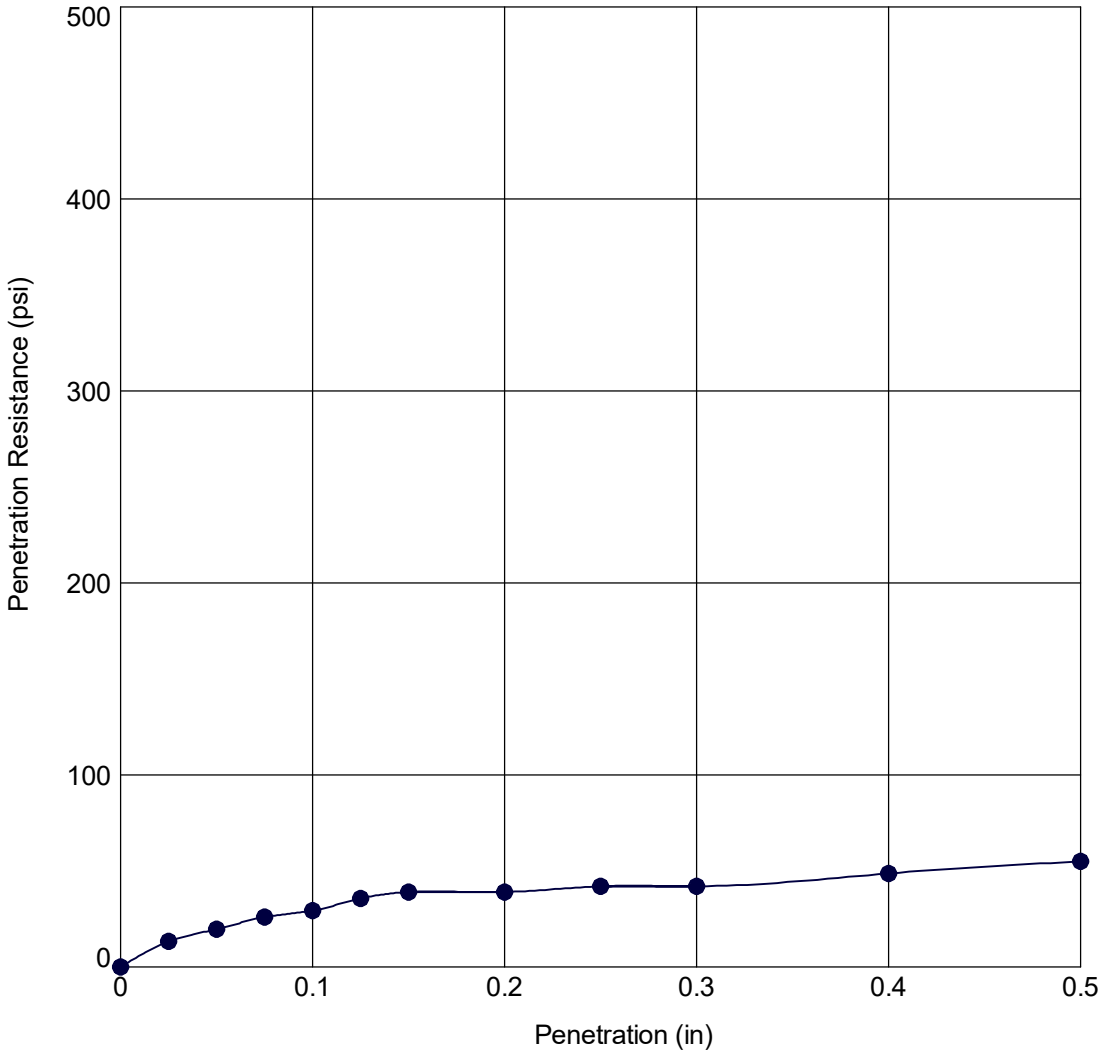
CBR STRESS PENETRATION TEST

ASTM D1883

Plate B5.3



Soil Data

Location:	Boring B5 at 2.5 to 5.5 ft
Description:	Brown to reddish brown silty clay with sand
Sample Dry Density	104.6 pcf
Sample Moisture Content	19.8 %

Test Results

CBR Value:	2.9 %
Expansion:	8.3 %

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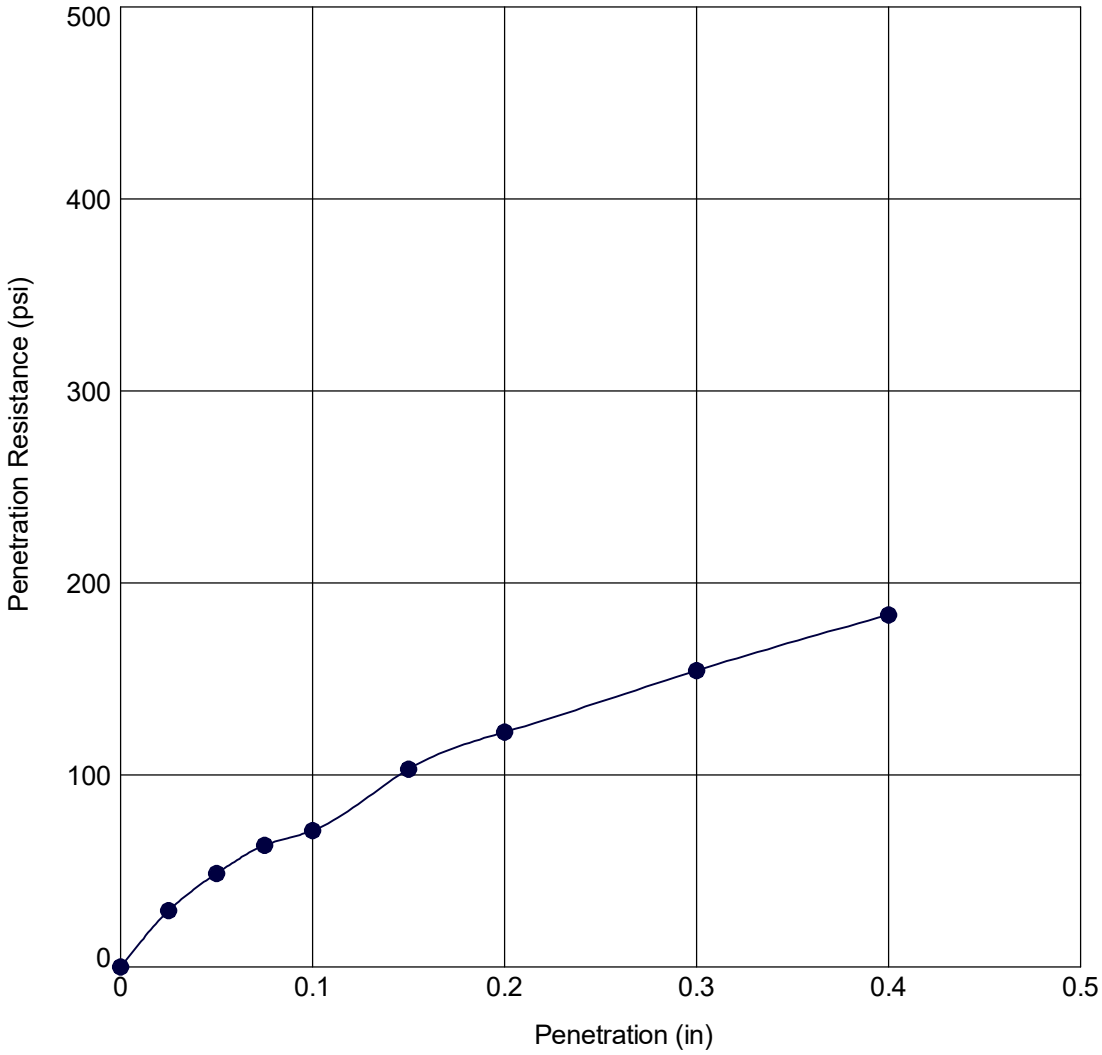
CBR STRESS PENETRATION TEST

ASTM D1883

Plate B5.4



Soil Data

Location:	Boring B8 at 2 to 5 ft
Description:	Dark brown silty clay with sand
Sample Dry Density	113.6 pcf
Sample Moisture Content	17.7 %

Test Results

CBR Value:	7.1 %
Expansion:	3.1 %

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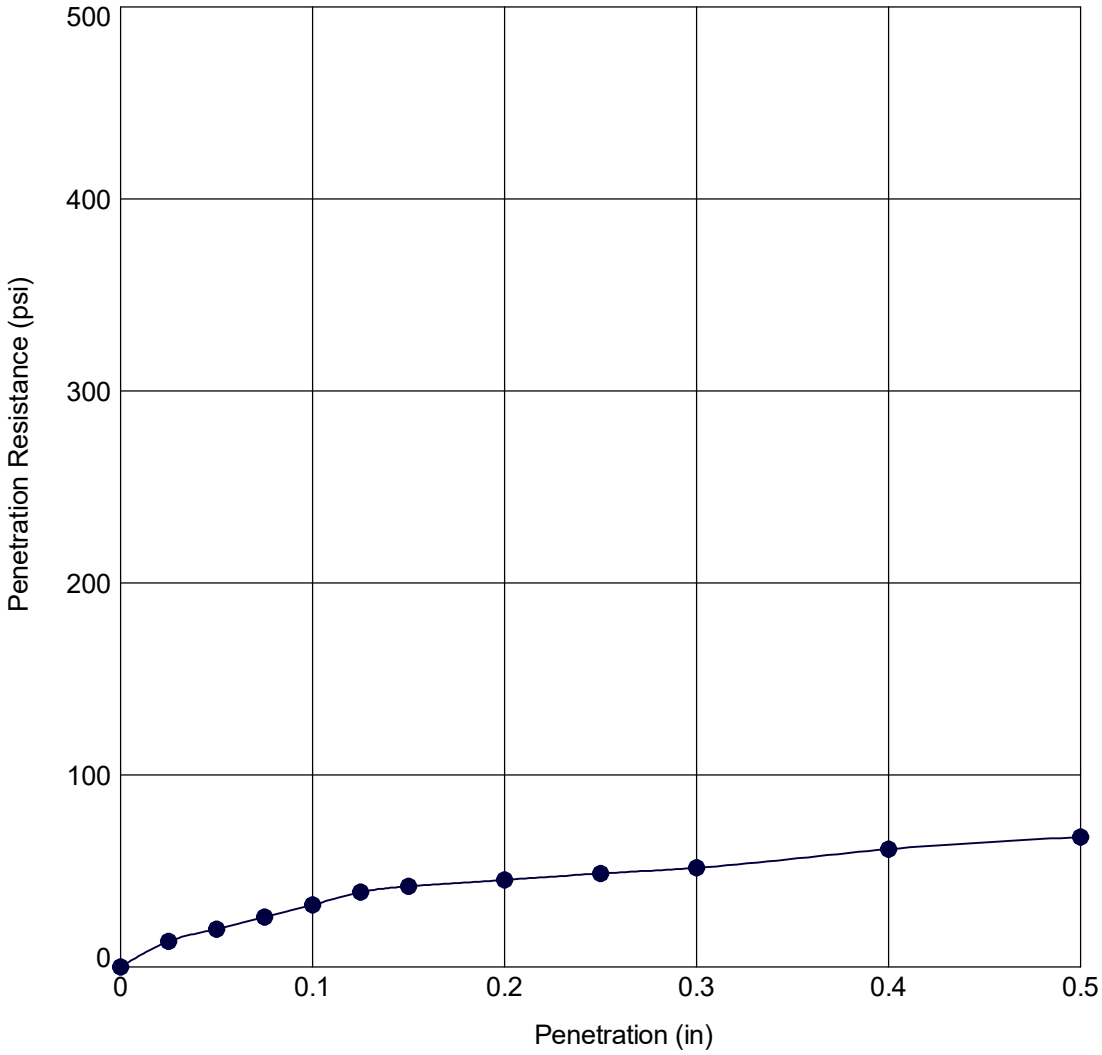
CBR STRESS PENETRATION TEST

ASTM D1883

Plate B5.5



Soil Data

Location:	Boring B12 at 3 to 5 ft
Description:	Dark reddish brown silty clay with sand
Sample Dry Density	102.4 pcf
Sample Moisture Content	19.1 %

Test Results

CBR Value:	3.2 %
Expansion:	5.7 %

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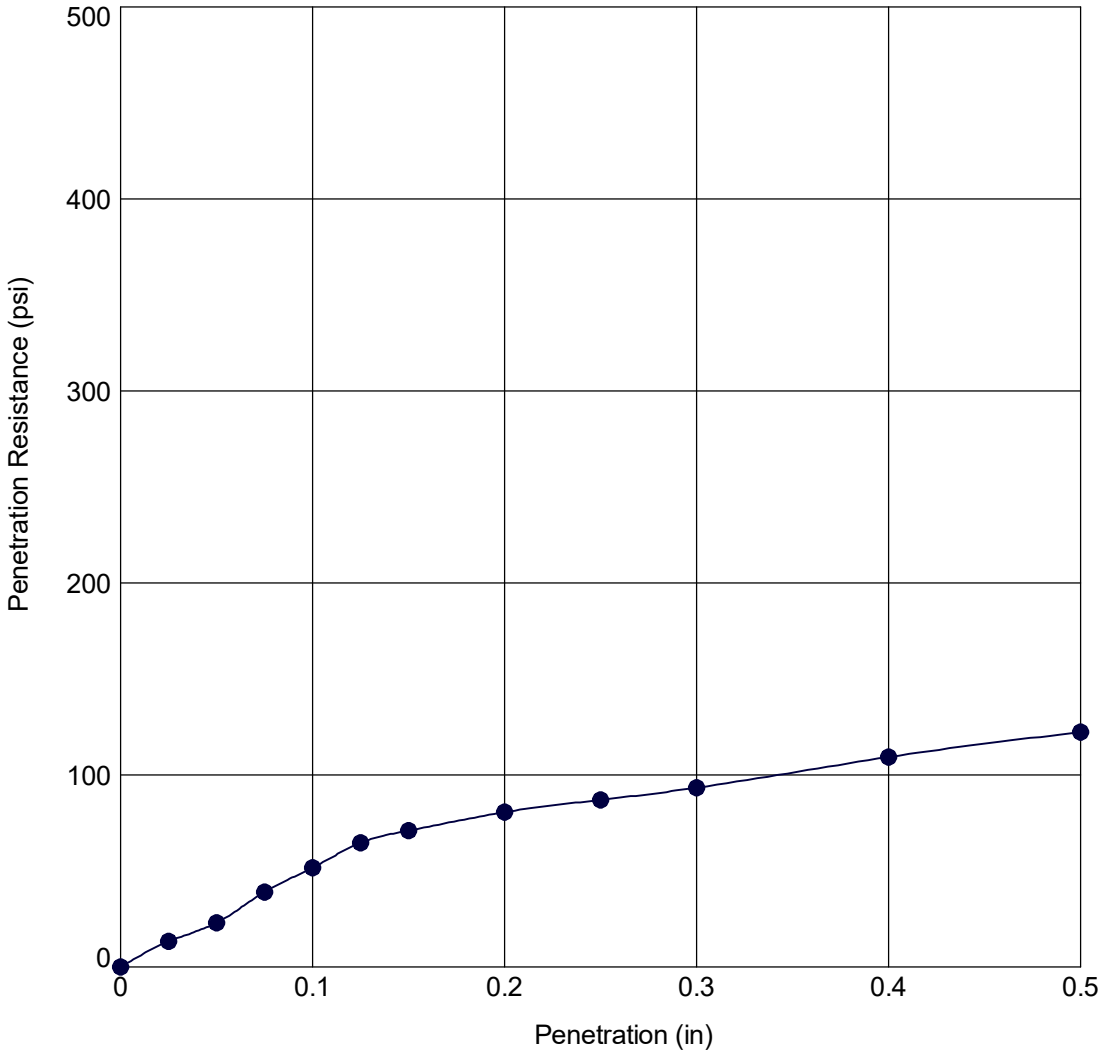
CBR STRESS PENETRATION TEST

ASTM D1883

Plate B5.6



Soil Data

Location:	Boring B14 at 3 to 5 ft
Description:	Dark reddish brown silty clay with sand
Sample Dry Density	105.1 pcf
Sample Moisture Content	20.4 %

Test Results

CBR Value:	5.2 %
Expansion:	3.8 %

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CBR STRESS PENETRATION TEST

ASTM D1883

Plate B5.7

APPENDIX C

DESIGN VEHICLE DATA

Kekaha Design Vehicle Data

Vehicle	Make	Model	Trailer/Attachment	GVWR (lbs)	Width	Overall Height	Overall Length	Average Daily Traffic
Kekaha Ag Association Vehicles								
Wheeled Loader	**Komatsu (typical)**	**WA320**		35,000	8'6"	10'6"	25'	occasional
Excavator	Komatsu	PC360		80,000	11'3"	11'2"	16'3"	occasional
Dump Truck & Equipment Trailer	Kenworth	T800		56,000	7'6"	8'	18'	4x
"			Towmaster T20	25,900	7'6"	36"	24'	4x
Pickup	Ford	F250		11,400				4x
Heavy Haul Semi	Kenworth (typical) GVW 68,000	7 axle set up (GVW is with load)	Trailking GVW 100,000	150,000				occasional
Medium Duty Offroad Truck	Military Surplus	M10178		29,000	8'	9'3"	24'	2x
Boom Mower	Case	145 hp		20,000	8'6'	7'	14'8"	2x
Tractor	John Deere	Model 6430	Diamond Batwing Mower	16,000	8'	7'	24'	2x
County								
Water wagon	Freightlinner			56,000				4x
Dump Truck	Kenworth			56,000			Dum	12x
Pick up trucks	Ford 250			11,400				4x

Kekaha Design Vehicle Data

Vehicle	GVWR (lbs)	GVWR (metric tons)	Front Axle Design Load	Rear Axle Design Load	Rear Tandem Axle	Wheel-base inches	Tandem Axle spacing	Tractor to Tiller Axle Spacing	Width	Overall Height	Overall Length	Turning Radius	Average Daily Traffic	Quantity
91-93 Seagrave	38,000	17	14,400	24,000		177			8'1"	9'4"	27'8"	28'	3	example vehicle
KAA														
JD6430 with Batwing	10,474	4.75	9,700	12,790		94.5			63" - 90"				2	
Case 145 Boom Mower													2	
F350 Ford Pickup	14,000									81"	266"		4	
Dump Truck (Kenworth)	52,000		12,000		40,000									
Kawasaki Mule														
Contractors														
Low Boy (typical)														
F250 Pickup														
Corteva Agriscience														
Regular vehicles (Class 1)	6,000				No		NA						2	3
1/2, 3/4 Ton Trucks & 1 Ton pass. Vans (Class 2)	10,000				No		NA						2	50
1 Ton Trucks (Class 3)	14,000				No		NA						2	2
2 Ton Trucks (Class 5)	19,500				No		NA						2	1
Water Truck (Class 8)	60,000				Yes								0	1
Irigation Trailers	10,000				Yes		NA						2	2
Equipment Trailers	14,000				Yes		NA						2	3
Enclosed Trailers	7,000				Yes		NA						2	2
4 Series JD Tractor w/ Implement (Max Weight)	10,000				No	73	NA			97.4	130.6		2	2
5 Series JD Tractor w/ Implement (Max Weight)	18,960				No	88.6	NA		87	106.1	147.8		2	3
6 Series JD Tractor w/ Implement (Max Weight)	33,069				No	114	NA		100.4	128	204.3		2	6
8 Series JD Tractor w/ Implement (max Weight)	39,683		17637	25353	No	120.1	NA		137.3	129.3	245		2	3
UTVs	3,400												2	10
Hagie Sprayer Loaded	41,100					152			154	120	336	17.3	2	3