STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
AIRPORTS

ADDENDUM NO. 2
FOR
APRON LIGHT REPLACEMENT
AT
KAHULUI AIRPORT
KAHULUI, MAUI, HAWAII
AND
LANAI AIRPORT
LANAI CITY, LANAI, HAWAII
STATE PROJECT NO. AS1037-12R
AIP PROJECT NO. 3-15-0006-064-2025

April 17, 2026

This Addendum shall make the following amendment(s) to the Solicitation:

A. NOTICE TO BIDDERS

1. Prospective bidders are **hereby notified** that receiving of bids, scheduled for **April 21, 2026, at 2:00 p.m., Hawaii Standard Time (HST)**, is **HEREBY POSTPONED** until **May 29, 2026, at 2:00 p.m., HST**.

   The deadline for Request for Information (RFI) is **HEREBY EXTENDED** until **April 29, 2026, at 2:00 p.m., HST**.

   Delete **NOTICE TO BIDDERS**, HIePRO release date February 9, 2026, in its entirety and replace it with attached **NOTICE TO BIDDERS**, dated r04/17/26.

B. PROPOSAL SCHEDULE

1. Delete **PROPOSAL SCHEDULE** pages P-8 to P-14 and replace it with attached **PROPOSAL SCHEDULE** pages P-8 to P-14, dated r04/17/26.

The following is provided for information.

C. REPORTS

1. The attached **Geotechnical Reports** are provided for information.

Please acknowledge receipt of this **ADDENDUM NO. 2** by recording the date of its receipt in the space provided on **PAGE P-4** of the Proposal.

CURT T. OTAGURO
Deputy Director of Transportation for Airports

NOTICE TO BIDDERS

Hawaii Revised Statutes (HRS),
Chapter 103D

The receiving of bids for **APRON LIGHT REPLACEMENT AT KAHULUI AIRPORT, KAHULUI, MAUI, HAWAII, AND LANAI AIRPORT, LANAI CITY, LANAI, HAWAII, STATE PROJECT NO. AS1037-12R, AIP PROJECT NO. 3-15-0006-064-2025** will begin as of the HIePRO Release Date. Bidders shall register and submit complete bids through HIePRO only. Refer to the following HIePRO link for important information on Vendor Registration: https://hiepro.ehawaii.gov/welcome.html.

The solicitation plans, specifications, proposal, and additional documents designated or incorporated by reference shall be available in HIePRO.

HIePRO OFFER DUE DATE AND TIME scheduled for April 21, 2026, at 2:00 p.m., Hawaii Standard Time (HST) is **HEREBY POSTPONED** until **May 29, 2026, at 2:00 p.m., HST**. **Bidders shall submit and upload the complete proposal to HIePRO prior to the offer due date and time. Proposal received after said due date and time shall not be considered. Any additional support documents explicitly designated as confidential and/or proprietary shall be uploaded as a separate file to HIePRO. Bidders shall not include confidential and/or proprietary documents as part of their proposal. The record of each bidder and their respective proposal shall be open to public inspection. FAILURE TO UPLOAD THE PROPOSAL TO HIePRO SHALL BE GROUNDS FOR REJECTION**.

The scope of work consists of replacing the existing high pressure sodium high mast lights that illuminate the passenger terminal apron, cargo apron, various parking lots, and access and service roads at Kahului Airport and the passenger terminal apron, cargo apron, parking lot, and access road at Lanai Airport. The implementation of full cut-off light fixtures will minimize the impact on seabirds and ensure compliance with the Maui County Habitat Conservation Plan and with HRS Section 201-8.5 Night Sky

Protection Strategy. The estimated cost of construction is between $38,000,000.00 and $48,000,000.00.

To be eligible for award, bidders shall possess a valid State of Hawaii General Engineering "A" or Specialty Contractors "C-13 Electrical Contractor" license **prior to the award of contract.**

The Hawaii Department of Transportation, Air and Water Transportation Facilities Division, 2016 GENERAL PROVISIONS FOR CONSTRUCTION PROJECTS, applicable to this project are available on the internet at: http://hidot.hawaii.gov/administration/con/.

A virtual pre-bid conference is scheduled for February 18, 2026, at 9:00 a.m., HST. Interested bidders shall contact Wesley Shiroma, State Project Manager, directly at wesley.r.shiroma@hawaii.gov, no later than five working days prior to the scheduled pre-bid conference to receive the meeting invitation. All prospective bidders and/or their respective representatives are encouraged to attend, however, attendance is not mandatory. All information presented at the pre-bid conference shall be provided for clarification and information only. Any amendments to the solicitation shall be made by formal addendum and posted in HIePRO.

All Request for Information (RFI) questions and Substitution Requests shall be submitted in HIePRO **no later than April 29, 2026, at 2:00 p.m., HST.** RFI questions received after the stated deadline shall not be addressed. Substitution Requests received after the stated deadline shall not be considered. Verbal RFI(s) shall not receive a response. All responses to RFI questions shall be provided for clarification and information only and issued by formal addendum. Any amendments to the solicitation shall be made by formal addendum and posted in HIePRO.

If there is a conflict between the solicitation and information stated in the pre-bid conference, the meeting minutes, and/or the responses to RFI questions, the solicitation shall govern and control, unless as amended by formal addendum.

Campaign contributions by State and County Contractors. Contractors are hereby notified of the applicability of HRS § 11-355 which states that campaign contributions are prohibited from specified State or County government contractors during the term of the contract if the contractors are paid with funds appropriated by a legislative body. For more information, contact the Campaign Spending Commission at (808) 586-0285.

Protests. Any protest of this solicitation shall be submitted in writing to the Director of Transportation, in accordance with HRS § 103D-701 and Hawaii Administrative Rules § 3-126.

The Equal Employment Opportunity Regulations of the Secretary of Labor implementing Executive Order 11246, as amended, shall be complied with on this project.

The U.S. Department of Transportation Regulation entitled “Nondiscrimination in Federally Assisted Programs of the U.S. Department of Transportation,” Title 49, Code of Federal Regulations (CFR), Part 21, is applicable to this project. Bidders are hereby notified that the Department of Transportation shall affirmatively ensure that the contract entered into pursuant to this advertisement shall be awarded to the lowest responsible bidder without discrimination on the grounds of race, color, national origin, or sex (as directed by 23 CFR Part 200).

Disadvantaged Business Enterprise (DBE). The U.S. Department of Transportation Regulations entitled "Participation by Disadvantaged Business Enterprise in Department of Transportation Financial Assistance Programs," Title 49, CFR, Part 26, is applicable to this project. Bidders are hereby notified that the Department of Transportation shall strictly enforce full compliance with all the requirements of the Disadvantaged Business Enterprise program with respect to this project.

Bidders shall read the following included in the solicitation:

1. "CIVIL RIGHTS COMPLIANCE AND DISADVANTAGED BUSINESS ENTERPRISE SPECIAL PROVISIONS"

For additional information, contact Wesley Shiroma, State Project Manager, by phone at (808) 838-8876, or by email at wesley.r.shiroma@hawaii.gov.

The State reserves the right to reject any or all proposals and to waive any defects in said proposals in the best interest of the public.

CURT T. OTAGURO
Deputy Director of Transportation for Airports

HIePRO RELEASE DATE: April 17, 2026

APRON LIGHT REPLACEMENT
AT
KAHULUI AIRPORT
KAHULUI, MAUI, HAWAII AND
LANAI AIRPORT
LANAI CITY, LANAI, HAWAII
STATE PROJECT NO. AS1037-12R
PROPOSAL SCHEDULE

KAHULUI AIRPORT

Item No.	Description	Quantity (a)	Unit	Unit Price (c)	Total (a x c)
01010.1	Temporary Traffic Control & Signs	Allowance	Allowance	Allowance	$50,000.00
01010.2	Unforeseen Conditions	Allowance	Allowance	Allowance	$500,000.00
01001.3	Safety Risk Management Activities	Allowance	Allowance	Allowance	$50,000.00
01524.1	Construction Waste Management	L.S.	L.S.	L.S.	$______________
01561.1	Construction Site Pollution Controls	L.S.	L.S.	L.S.	$______________
01562.1	Management of Contaminated Media, Soil Disposal, and Soil Reuse	L.S.	L.S.	L.S.	$______________
01565.1	Security Measures	Allowance	Allowance	Allowance	$15,000.00
01700.1	Mobilization (Not to exceed 6% of sum of all items, excluding this item, all allowances and force account items)	L.S.	L.S.	L.S.	$______________
02232.1	Aggregate Base Course	3,255	S.Y.	$________	$______________
02232.2	Aggregate Subbase	400	S.Y.	$________	$______________
02450	Portland Cement Concrete Sidewalks	3,600	S.F.	$________	$______________
02513	Asphalt Pavement	3,695	S.Y.	$________	$______________
2528	Concrete Curbs and Gutters (Landside)	235	L.F.	$________	$______________
02578	Painted Pavement Markings	4,000	L.F.	$________	$______________
02620.1A	Pavement Markings – Full Application (OGG Airfield-Main Terminal)	1,300	L.F.	$________	$______________
02620.1B	Pavement Markings – Full Application (OGG Airfield-Cargo)	5	L.F.	$________	$______________
02721.1A	Subbase Course (OGG Airfield-Main Terminal)	4,355	S.Y.	$________	$______________
02752.2A	Portland Cement Concrete 15-inch Unreinforced (OGG Airfield-Main Terminal)	3,424	S.Y.	$________	$______________
02752.4A	Portland Cement Concrete 15-inch Reinforced (OGG Airfield-Main Terminal)	931	S.Y.	$________	$______________

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Item No.	Description	Quantity (a)	Unit	Unit Price (c)	Total (a x c)
02760.1A	Joint Sealing Filler (OGG Airfield-Main Terminal)	L.S.	L.S.	L.S.	$______________
03300.1	AL1 (OGG Airfield-Main Terminal) Light Pole Foundation	18	E.A.	$_______	$______________
03300.2	AL1(OGG Airfield-Commuter Terminal) Light Pole Foundation	4	E.A.	$_______	$______________
03300.3	PL1 Light Pole Foundation	30	E.A.	$_______	$______________
03300.4	PL2 (Pole w/ 2 arms) Light Pole Foundation	10	E.A.	$_______	$______________
03300.5	RL1 Light Pole Foundation	11	E.A.	$_______	$______________
03300.6	RL2 (Pole w/ 2 arms) Light Pole Foundation	31	E.A.	$_______	$______________
03300.7	OPL1-B Light Pole Foundation	70	E.A.	$_______	$______________
03300.8	OPL2-B Light Pole Foundation	37	E.A.	$_______	$______________
03300.8	OPL2-C Light Pole Foundation	12	E.A.	$_______	$______________
03300.12A	Concrete Bollard (OGG Airfield-Main Terminal)	144	E.A.	$_______	$______________
03300.12B	Concrete Bollard (OGG Airfield-Commuter Terminal)	32	E.A.	$_______	$______________
03300.12C	Concrete Bollard (OGG Airfield-Landside)	64	E.A.	$_______	$______________
16050.1A	Basic Materials and Method (OGG Airfield-Main Terminal)	L.S.	L.S.	L.S.	$______________
16050.1B	Basic Materials and Method (OGG Airfield-Cargo)	L.S.	L.S.	L.S.	$______________
16050.1C	Basic Materials and Method (OGG Airfield-Commuter Terminal Apron)	L.S.	L.S.	L.S.	$______________
16050.1D	Basic Materials and Method (OGG Airfield-Landside)	L.S.	L.S.	L.S.	$______________
16301.1A	Underground Electrical Work (OGG Airfield-Main Terminal)	L.S.	L.S.	L.S.	$______________

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LANAI CITY, LANAI, HAWAII
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Item No.	Description	Quantity (a)	Unit	Unit Price (c)	Total (a x c)
16301.1B	Underground Electrical Work (OGG Airfield-Cargo)	L.S.	L.S.	L.S.	$_____________
16301.1C	Underground Electrical Work (OGG Airfield-Commuter Terminal Apron)	L.S.	L.S.	L.S.	$_____________
16301.1D	Underground Electrical Work (OGG Airfield-Landside)	L.S.	L.S.	L.S.	$_____________
16500.1A	Lighting (OGG Airfield-Main Terminal)	L.S.	L.S.	L.S.	$_____________
16500.1B	Lighting (OGG Airfield-Cargo)	L.S.	L.S.	L.S.	$_____________
16500.1C	Lighting (OGG Airfield-Commuter Terminal Apron)	L.S.	L.S.	L.S.	$_____________
16500.1D	Lighting (OGG Airfield-Landside)	L.S.	L.S.	L.S.	$_____________
16500.2A	Airport Obstruction Light (OGG Airfield-Main Terminal)	18	E.A.	$_______	$_____________
16500.2A	Airport Obstruction Light (OGG Airfield-Commuter Terminal)	4	E.A.	$_______	$_____________
	KAHULUI SUBTOTAL				$_____________

APRON LIGHT REPLACEMENT
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LANAI CITY, LANAI, HAWAII
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LANAI AIRPORT

Item No.	Description	Quantity (a)	Unit	Unit Price (c)	Total (a x c)
01010.1	Temporary Traffic Control & Signs	Allowance	Allowance	Allowance	$ 20,000.00
01010.2	Unforeseen Conditions	Allowance	Allowance	Allowance	$ 100,000.00
01010.3	Safety Risk Management Activities	Allowance	Allowance	Allowance	$ 10,000.00
01524.1	Construction Waste Management	L.S.	L.S.	L.S.	$__________
01561.1	Construction Site Pollution Controls	L.S.	L.S.	L.S.	$__________
01562.1	Management of Contaminated Media, Soil Disposal, and Soil Reuse	L.S.	L.S.	L.S.	$__________
01565.1	Security Measures	Allowance	Allowance	Allowance	$ 150,000.00
01700.1	Mobilization (Not to exceed 6% of sum of all items, excluding this item, all allowances and force account items)	L.S.	L.S.	L.S.	$__________
02232.1	Aggregate Base Course	L.S.	L.S.	L.S.	$__________
02232.2	Aggregate Subbase	L.S.	L.S.	L.S.	$__________
02450	Portland Cement Concrete Sidewalks	L.S.	L.S.	L.S.	$__________
02513	Asphalt Pavement	L.S.	L.S.	L.S.	$__________
02578	Painted Pavement Markings	L.S.	L.S.	L.S.	$__________
02620.1D	Pavement Markings – Full Application (LNY)	L.S.	L.S.	L.S.	$__________
02721.1D	Subbase Course (LNY)	L.S.	L.S.	L.S.	$__________
02752.1D	Portland Cement Concrete 10-inch Unreinforced (LNY)	L.S.	L.S.	L.S.	$__________
02752.3D	Portland Cement Concrete 10-inch Reinforced (LNY)	L.S.	L.S.	L.S.	$__________
02760.1D	Joint Sealing Filler (LNY)	L.S.	L.S.	L.S.	$__________
03300.10	Lanai Apron Light Pole Foundation	7	E.A.	$______	$__________
03300.11	Lanai Parking Lot Light Pole Foundation	46	E.A.	$______	$__________
03300.12E	Concrete Bollard (LNY)	56	E.A.	$______	$__________

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Item No.	Description	Quantity (a)	Unit	Unit Price (c)	Total (a x c)
16050.1E	Basic Materials and Method (LNY)	L.S.	L.S.	L.S.	$_____________
16301.1E	Underground Electrical Work (LNY)	L.S.	L.S.	L.S.	$_____________
16500.1E	Lighting (LNY)	L.S.	L.S.	L.S.	$_____________
16500.2C	Airport Obstruction Light (LNY)	7	E.A.	$_______	$_____________
	LANAI SUBTOTAL				$_____________

PROPOSAL SCHEDULE SUMMARY

KAHULUI SUBTOTAL	$________________
LANAI SUBTOTAL	$________________
TOTAL AMOUNT FOR COMPARISON OF BIDS	$________________

PROPOSAL SCHEDULE NOTE

1. Bids shall include all Federal, State, County and other applicable taxes and fees.

2. The TOTAL AMOUNT FOR COMPARISON OF BIDS shall be used to determine the lowest responsible bidder.

3. Bidders shall complete all unit prices and amounts. Failure to do so shall be grounds for rejection of bid.

4. If a discrepancy occurs between unit bid price and the bid price, the unit bid price shall govern.

5. **Bidders shall submit and upload the complete proposal to HIePRO prior to the bid opening date and time. Proposals received after said due date and time shall not be considered.Any additional support documents explicitly designated as confidential and/or proprietary shall be uploaded as a separate file to HIePRO. Bidders shall not include confidential and/or proprietary documents with the proposal. The record of each bidder and respective bid shall be open to public inspection.** Original (wet ink, hard copy) proposal documents are not required to be submitted. **Contract award shall be based on evaluation of proposals submitted and uploaded to HIePRO.**

   FAILURE TO UPLOAD THE COMPLETE PROPOSAL TO HIePRO SHALL BE GROUNDS FOR REJECTION OF THE BID.

   If there is a conflict between the specification document and the HIePRO solicitation, the specifications shall govern and control, unless otherwise specified.

6. The bidder’s attention is directed to Section 2.11 – BID SECURITY of the “General Provisions”, as amended by the Special Provisions.

7. Bidders shall be paid for actual work performed as directed by the Engineer for allowance items. Bidder will not be paid overhead and profit for unused allowance funds.

8. If the lowest TOTAL AMOUNT FOR COMPARISON OF BIDS is less than, or approximately equal to the funds available for this project, an award will be made to the lowest responsible bidder.

9. If the TOTAL AMOUNT FOR COMPARISON OF BIDS exceeds the funds

available for the project, the State reserves the right to negotiate with the lowest, responsive, responsible bidder as permitted under Section 103D-302, Hawaii Revised Statutes, to further reduce the scope of work and award a contract thereafter.

10. The State reserves the right to reject any or all Bids and to waive any defects in said Bids in the best interest of the State.

11. Submission of a Bid is a warranty that the bidder has made an examination of the project site and is fully aware of all conditions to be encountered in performing the work and the requirements of the plans and specifications.

12. Proposal sheets P-1 through P-21 shall be submitted at the time of bid. Failure to submit all pages shall result in rejection of bid.

GEOTECHNICAL ENGINEERING EXPLORATION

APRON LIGHT REPLACEMENT – KAHULUI AIRPORT

KAHULUI, MAUI, HAWAII

STATE PROJECT NO. AS1037-12

W.O. 8859-00   NOVEMBER 13, 2024

Prepared for

RONALD N.S. HO & ASSOCIATES, INC.

GEOLABS, INC.
Geotechnical Engineering and Drilling Services

GEOTECHNICAL ENGINEERING EXPLORATION
APRON LIGHT REPLACEMENT – KAHULUI AIRPORT
KAHULUI, MAUI, HAWAII
STATE PROJECT NO. AS1037-12

W.O. 8859-00 NOVEMBER 13, 2024

Prepared for

RONALD N.S. HO & ASSOCIATES, INC.

JOHN Y. L. CHEN
No. 10029-C

THIS WORK WAS PREPARED BY
ME OR UNDER MY SUPERVISION.

John Chen 4-30-26
SIGNATURE EXPIRATION DATE
OF THE LICENSE

GEOLABS, INC.
Geotechnical Engineering and Drilling Services
94-429 Koaki Street, Suite 200 • Waipahu, HI 96797

Hawaii • California

GEOLABS, INC.

Geotechnical Engineering and Drilling Services

November 13, 2024
W.O. 8859-00

Mr. Billy J. Ornellas
Ronald N.S. Ho & Associates, Inc.
2153 North King Street, Suite 201
Honolulu, HI 96819

Dear **Mr. Ornellas:**

Geolabs, Inc. is pleased to submit our report entitled "Geotechnical Engineering Exploration, Apron Light Replacement – Kahului Airport, Kahului, Maui, Hawaii, State Project No. AS1037-12" prepared for the proposed project.

Our work was performed in general accordance with the scope of services outlined in our revised fee proposal dated January 17, 2023.

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

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

Very truly yours,

GEOLABS, INC.

John Y.L. Chen, P.E.
Vice President

JC:TO:as

94-429 Koaki Street, Suite 200 • Waipahu, Hawaii 96797
Telephone: (808) 841-5064 • E-mail: hawaii@geolabs.net

Hawaii • California

GEOTECHNICAL ENGINEERING EXPLORATION
APRON LIGHT REPLACEMENT – KAHULUI AIRPORT
KAHULUI, MAUI, HAWAII
STATE PROJECT NO. AS1037-12
W.O. 8859-00 NOVEMBER 13, 2024

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KAHULUI, MAUI, HAWAII
STATE PROJECT NO. AS1037-12
W.O. 8859-00 NOVEMBER 13, 2024

SUMMARY OF FINDINGS AND RECOMMENDATIONS

Our field exploration generally encountered surficial fills and alluvium overlying basalt formation extending to depths of about 12 to 22.5 feet below the existing ground surface. It should be noted that basalt formation was not encountered in some areas in the vicinity of Boring Nos. 4, 8, 12, and 16. Groundwater was not encountered at the time of our field exploration. However, it should be noted that groundwater levels are subject to change due to rainfall, time of year, seasonal precipitation, surface water runoff, and other factors.

We recommend designing a cast-in-place concrete drilled shaft foundation system to support the proposed new apron lighting structures. We envision that drilled shaft foundations with a minimum diameter of 30 inches may be used to support the new apron light structures extending to 10 to 20 feet below the design finished grade. It should be noted that some of the drilled shafts would likely be required to extend into the basalt formation. Very hard basalt rock formation should be anticipated with compressive strength up to 32,000 psi or higher.

The load-bearing capacities of the drilled shafts depend, to a significant extent, on the friction between the shaft and the surrounding soils. Therefore, proper construction techniques, especially during the drilling operations, are important. The contractor should exercise care in drilling the shaft holes and placing concrete into the drilled holes. It is imperative for a Geolabs representative to be present at the project site to observe the drilling and installation of the drilled shafts during construction to confirm the subsurface conditions and should be designated as a “Special Inspection” item in accordance with Section 1704 of the International Building Code (2018 Edition).

The text of this report should be referred to for detailed discussions and specific geotechnical recommendations.

END OF SUMMARY OF FINDINGS AND RECOMMENDATIONS

SECTION 1. GENERAL

This report presents the results of our geotechnical engineering exploration performed for the *Apron Light Replacement* project located at the Kahului Airport in the Kahului area on the Island of Maui, Hawaii. The project location and general vicinity are shown on the Project Location Map, Plate 1.

This report summarizes the findings and geotechnical recommendations resulting from our field exploration, laboratory testing, and engineering analyses for the project. These findings and geotechnical recommendations are intended for the design of the apron light pole foundations only. The findings and recommendations presented herein are subject to the limitations noted at the end of this report.

1.1 Project Considerations

The project site is located at the Kahului Airport (OGG) in Kahului on the Island of Maui, Hawaii. Based on the information provided, we understand that the existing apron lighting system will be replaced with a new lighting system to meet Maui County's new outdoor lighting standards. In addition, we understand that all street and building mounted exterior lighting on Kahului Airport property will be replaced as well.

The following structural loading information was provided by the structural engineer and used for the foundation design analyses of the new apron light pole structures.

FACTORED STRUCTURAL LOADING INFORMATION	
Axial Loading	23 kips
Shear Loading	6 kips
Moment Loading	166 kip-foot

1.2 Purpose and Scope

The purpose of our exploration was to obtain an overview of the surface and subsurface conditions at the site to develop a soil and/or rock data set to formulate geotechnical recommendations in support of the design of the Apron Light Replacement project at Kahului Airport. The work was performed in general accordance with our revised fee proposal dated January 17, 2023. The scope of work for this exploration included the following tasks and work efforts:

1. Research and review of the available reports/plans, in-house soil, and geologic information related to the project site.
2. Application for FAA 7460 permits and One–Call utility clearance.
3. Coordination of site access, boring stake out, and underground utility toning at the proposed boring locations by our geologist.
4. Preparation of an accident prevention plan with activity hazard analysis in support of our field exploration activities.
5. Provision of traffic control, including all required safety devices for closures within the AOA areas.
6. Retaining soil cuttings, drilling fluids, and safety disposables in DOT approved 55-gallon steel drums and storing at the site for disposal of by others.
7. Mobilization and demobilization of a truck-mounted drill rig, water truck, and operators to and from the project site.
8. Drilling and sampling of 17 borings, extending to depths of about 12 to 22.5 feet below the existing ground surface.
9. Backfilling boreholes with non-shrink grout and topped with fast-setting concrete upon completion of the drilling, sampling, and field testing work.
10. Coordination of the field exploration and logging of the borings by our geologist.
11. Geotechnical laboratory testing of selected samples obtained during the field exploration as an aid in classifying the materials and evaluating their engineering properties.
12. Analyses of the field and laboratory data to formulate geotechnical recommendations for the design of the project.
13. Preparation of a technical memorandum and this report summarizing our work and presenting our findings and geotechnical recommendations for the project.
14. Coordination of our overall work on the project by our engineer.
15. Quality assurance of our work and client/design team consultation by our principal engineer.

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

Detailed descriptions of our field exploration methodology and the Logs of Borings are presented in Appendix A. Results of the laboratory tests performed on selected soil samples are presented in Appendix B. Photographs of the core samples retrieved during our field exploration are presented in Appendix C.

END OF GENERAL

SECTION 2. SITE CHARACTERIZATION

2.1 Regional Geology

The Island of Maui was built by two major volcanoes, the older West Maui (Tertiary Epoch) and the more recent East Maui, also known as Haleakala (Pleistocene Epoch). The Isthmus of Maui is a narrow, gently sloping plain located between these two volcanoes. The project site is located in the northern area of this gently sloping plain.

The Isthmus of Maui was created by lava flows from Haleakala ponding on West Maui. It is comprised of alluvium washed from the slopes of West Maui and East Maui (Haleakala). The erosional processes are dominated by the detachment of soil and rock masses from the mountain walls, and the soil materials are transported downslope toward the Isthmus primarily by gravity as colluvium. Once these materials reach the stream in the central portion of a valley, alluvial processes become dominant, and the sediments are transported and deposited as alluvium.

In general, stream flows in Hawaii are intermittent and flashy, such that the stream flows transmit large volumes of water for a very short duration. Because of this, the transport of sediments is intermittent, and the bulk of the stream's hydraulic load consists of a poorly-sorted mixture of boulders, cobbles, gravel, sands, and fines. When the erosional base levels change, these sediment loads are left as deposits.

When deposits are left in-place for long periods of time, chemical processes begin to alter the materials, simultaneously causing a breakdown or weathering of the materials. Chemical processes also cause induration, or cementation, of the coarse-grained portion of the sediment into a poorly-consolidated sedimentary rock or conglomerate. Simultaneously, erosion continues in the areas above the valley floors and upstream in headwaters. This continued erosion generates material, which is transported downslope covering the older alluvial soil deposits. Depending on the local base level and rate of transport, these newer sediments are generally transient in terms of geologic time. In addition, their consistency and density are generally less than those of the older, partially consolidated deposits.

Underlying the alluvial soil deposits are overlapping lava from the West Maui and East Maui volcanoes. The bulk of the Haleakala Shield was built during the late Pliocene and early Pleistocene Epoch by thinly bedded basaltic lava flows of the Honomanu Volcanic Series. During the Pleistocene Epoch, the characteristics of the lava changed to very hard, thickly bedded flows of andesitic composition. These lavas have been grouped as the Kula Volcanic Series. Typically, the basalt rock formation consists of thinly to thickly bedded a’a and pahoehoe type lava flows. Development of the Kahului Airport in the past decades has brought the project site to its present condition.

2.2 Existing Site Conditions

The proposed project site is located at the existing Kahului Airport in the Kahului area on the Island of Maui, Hawaii. Our field exploration involved work within the Air Operation Area (AOA) as well as in the existing airport parking lots and terminal roadways as shown on the Overall Site Plan, Plate 2.

Majority of the project site was covered with asphalt concrete pavement. At the time of our field exploration, the parking area consisted mainly of passenger vehicles and pick-up trucks. The existing pavement was observed to be in fairly good condition. However, some minor pavement cracks were observed on the surface of the parking lots in isolated areas.

Based on Google Earth™, the majority of the airport site is slightly sloping from northeast to southwest with existing ground surface elevations ranging from about +39 to +13 feet Mean Sea Level (MSL), respectively.

2.3 Subsurface Conditions

We explored the subsurface conditions by drilling and sampling 17 borings, designated as Boring Nos. 1 through 17, extending to depths of about 12 to 22.5 feet below the existing ground surface. The approximate boring locations are shown on the Site Plans, Plates 3.1 through 3.8.

Based on our field exploration, the project site is generally underlain by surficial fills and alluvium overlying basalt formation. The subsurface generally consisted of 2 to 18 inches of asphaltic concrete or 8 to 9 inches of concrete, and soft to very stiff silty and clayey soils. The alluvial soils consisted of medium stiff to hard silty and clayey soils with various amounts of cobbles/boulders extending up to about 15.5 feet below the existing ground surface. Underlying the alluvium, our borings encountered soft to very hard basalt formation with various fractured conditions extending to a depth up to 22.5 feet below the ground surface. It should be noted that basalt formation was not encountered in some areas in the vicinity of Boring Nos. 4, 8, 12, and 16.

We did not encounter groundwater in the borings at the time of our field exploration. However, it should be noted that groundwater levels are subject to change due to rainfall, time of year, seasonal precipitation, surface water runoff, and other factors.

Detailed descriptions of the field exploration methodology and graphic representations of the materials encountered in the borings are presented on the Logs of Borings in Appendix A. We performed laboratory tests on selected soil samples obtained during our field exploration, and the test results are presented in Appendix B. Photographs of the core samples retrieved during our field exploration are presented in Appendix C.

2.4 Seismic Design Considerations

Based on the International Building Code (2018 Edition), the project site may be subject to seismic activity, and seismic design considerations will need to be addressed. The following provides discussion on the soil profile type for seismic design and liquefaction design consideration at the project site.

Based on the subsurface materials encountered at the project site and the geologic setting of the area, we believe that the project site may be classified as a “Soft Rock and Very Dense Soil Profile” from a seismic analysis standpoint. Therefore, we believe the seismic design of the building structures may be designed based on a Site Class C soil profile in accordance with Chapter 20, Site Classification Procedure for Seismic Design, contained in ASCE Minimum Design Loads for Buildings and Other Structures, 2010 Edition (ASCE 7-10).

Based on a Site Class C soil profile, the following seismic design parameters shown in the table below were estimated and may be used for the seismic analysis of the project site.

SEISMIC DESIGN PARAMETERS	
Parameter	**Value**
Peak Bedrock Acceleration, PBA (Site Class B)	0.365g
Mapped MCE Spectral Response Acceleration, S_S (Site Class B)	0.999g
Mapped MCE Spectral Response Acceleration, S_1 (Site Class B)	0.255g
Site Class	“C”
Site Coefficient, F_{pga}	1.200
Site Coefficient, F_a	1.200
Site Coefficient, F_v	1.500
Design Peak Ground Acceleration, PGA (Site Class C)	0.292g
Design Spectral Response Acceleration, S_{DS}	0.799g
Design Spectral Response Acceleration, S_{D1}	0.255g

Based on the subsurface conditions encountered, the phenomenon of soil liquefaction is not a design consideration for this project site. The risk for potential liquefaction is non-existent based on the subsurface conditions encountered (relatively stiff alluvial soils overlying basalt formation in the absence of groundwater).

END OF SITE CHARACTERIZATION

SECTION 3. DISCUSSION AND RECOMMENDATIONS

Based on our field exploration, the project site is generally underlain by surficial fills and alluvium overlying basalt formation extending to depths of about 12 to 22.5 feet below the existing ground surface. It should be noted that basalt formation was not encountered in some areas in the vicinity of Boring Nos. 4, 8, 12, and 16. Groundwater was not encountered at the time of our field exploration. However, it should be noted that groundwater levels are subject to change due to rainfall, time of year, seasonal precipitation, surface water runoff, and other factors.

We recommend designing a cast-in-place concrete drilled shaft foundation system to support the proposed new apron lighting structures. We envision that drilled shaft foundations with a minimum diameter of 30 inches may be used to support the new apron light structures extending to 10 to 20 feet below the designed finished grade.

It should be noted that some of the drilled shafts would likely be required to extend into the basalt formation. Very hard basalt rock formation should be anticipated with compressive strength up to 32,000 psi or higher.

Detailed discussions of these items and other geotechnical aspects of the project are further discussed in the following sections.

3.1 Drilled Shaft Foundations

In order to develop the required bearing and lateral load resistances, we recommend supporting the proposed new apron lighting structures on a deep foundation system consisting of cast-in-place concrete drilled shafts. Detailed discussions and recommendations for foundation design are presented in the following sections.

3.1.1 Compressive Load Capacity

Based on the structural load demands provided and the subsoil conditions encountered at the project site, we recommend installing 30-inch diameter drilled shaft foundations extending to 10 to 20 feet below the design finished grade to support the new apron lighting.

The load-bearing capacities of the drilled shafts will depend largely on the relative depth of the basalt rock formation within the bearing strata. If basalt rock is encountered, the drilled shafts should extend to achieve a minimum rock socket of about 5 feet into the basalt formation. Because local variations in the subsurface materials likely will occur at the site, we recommend implementing a probing program to better distinguish the depths of rock contour.

Our recommendations pertaining to the drilled shaft capacities and estimated lengths are presented in the table below.

COMPRESSIVE LOAD CAPACITIES OF DRILLED SHAFT FOUNDATIONS		
Drilled Shaft Diameter (feet)	**Drilled Shaft Length** (feet)	**Allowable Compressive Load Capacity** (kips)
30	20	75
	15 (min.5-foot rock socket)	110
	10 (min. 5-foot rock socket)	110

The allowable compressive load capacities for the drilled shafts presented above are for supporting dead-plus-live loads. The compressive load capacities may be increased by up to one-third (⅓) when considering transient loads, such as wind or seismic forces.

3.1.2 Lateral Load Resistance

The lateral load resistance of drilled shafts is a function of the stiffness of the surrounding soil, the stiffness of the drilled shaft, allowable deflection at the top of the drilled shaft, and the induced moment in the drilled shaft. The lateral load analyses were performed using the program *LPILE*, which is a microcomputer adaptation of a finite difference, laterally loaded deep foundation program originally developed at the University of Texas at Austin. The program solves for deflection and bending moment along a deep foundation under lateral loads as a function of depth. The analysis was carried out with the use of non-linear “p-y” curves to represent soil moduli. The lateral deflection was then computed using the appropriate soil moduli at various depths.

Based on the provided structural loads and the subsurface soil conditions encountered during our field exploration, we performed the lateral load analyses for the above drilled shaft foundations. The results of our analyses are summarized in the table below. The project structural engineer should verify the drilled shaft structural capacity for the calculated induced stresses.

LATERAL LOAD CAPACITY AND MAXIMUM INDUCED MOMENT			
Drilled Shaft Length (feet)	**Lateral Deflection** (inches)	**Maximum Induced Moment** (kip-feet)	**Depth to Maximum Moment** (feet)
20	0.3	172	2.0
15 (min.5-foot rock socket)	0.3	173	2.4
10 (min.5-foot rock socket)	0.1	172	2.0
NOTE: Lateral load analysis based on concrete compressive strength of 4,000 psi and a minimum of 1% longitudinal steel reinforcement.			

3.1.3 Foundation Settlement

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

3.1.4 Drilled Shaft Construction Considerations

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

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

The thickness and hardness of the basalt formation may vary significantly across the project site. Therefore, some difficult drilling conditions likely will be encountered and should be expected. The drilled shaft subcontractor will need to have the appropriate equipment and tools to drill through these types of natural obstructions, where encountered. The drilled shaft subcontractor will need to demonstrate that the proposed drilling equipment (and coring tools, where appropriate) will be capable of installing the drilled shafts to the recommended depths and dimension.

We recommend concrete placement by the tremie method during drilled shaft construction. A low-shrink concrete mix with a high slump (7 to 9-inch slump range) should be used to provide close contact between the drilled shafts and the surrounding soil/rock. The concrete should be placed in a suitable manner to reduce the potential for segregation of the aggregates from the concrete mix. In addition, the concrete should be placed promptly after drilling (within 24 hours after drilling the hole) to reduce the potential for softening of the sides of the drilled hole.

It is imperative for a Geolabs representative to be present at the project site to observe the probing, drilling, and installation of the drilled shafts during construction. Although the drilled shafts are designed based primarily on skin friction, the bottom of the drilled holes should be relatively free of loose materials prior to placement of concrete. Therefore, it is necessary for Geolabs to observe the drilled shaft installation operations to confirm the subsurface conditions and should be designated as a “Special Inspection” item in accordance with Section 1704 of the International Building Code (2018 Edition).

3.2 Corrosion Potential

Five sets of laboratory corrosivity tests, including pH (ASTM G51), Minimum Resistivity (ASTM G57), Chloride Content (EPA 300.0), and Sulfate Content (EPA 300.0), were performed (by our office and CERCO Analytical, Inc.) on selected soil samples obtained from our field exploration. The test results are summarized and presented on Plate B-12 of Appendix B.

Resistivity is generally recognized as one of the most significant soil characteristics with regard to the corrosivity of the soil to buried metallic objects. In general, the lower the resistivity, the greater the potential for corrosion of the buried metallic structure. Conversely, the higher the resistivity, the less likely the soil will contribute to the corrosion of metallic objects.

On the basis of the laboratory resistivity and pH results, the subsurface soils at the project site have resistivity values ranging from approximately 1,200 to 3,000 ohm-cm and pH values of between 8.0 and 8.4 within the upper 5 feet of soils, corresponding to a corrosion rating of 2 (Very Corrosive) based on the guidelines provided by the City & County of Honolulu – Board of Water Supply. Therefore, we recommend properly designing near-surface metallic substructures for protection against the potential for corrosion.

The method used to control the corrosion of underground concrete structures is dependent, in part, on the chloride content and sulfate content found in the soil. In general, soils with a chloride content of less than 500 parts per million (ppm), sulfate content of less than 2,000 ppm, and a pH greater than 5.0 may be considered “non-corrosive” to underground concrete pipelines and structures.

Based on the relatively low values of chloride content and sulfate content tested on the in-situ materials, we believe that the near-surface soils at the project site may be considered “non-corrosive” and either Type I or Type II (Type I/II) cement may be used for the concrete in contact with the ground. It may be appropriate to consult with a professional corrosion engineer to review the test results and provide detailed recommendations for corrosion protection.

3.3 Design Review

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

3.4 Construction Monitoring

Due to the variability in the subsurface conditions, it is recommended to retain Geolabs for geotechnical engineering services during the construction of the project. The following are critical items of construction monitoring that require "Special Inspection":

- Observation of foundation probing program
- Observation of drilled shaft foundation installation

A Geolabs representative should monitor other aspects of earthwork construction to observe compliance with the intent of the design concepts, specifications, and/or recommendations and to expedite suggestions for design changes that may be required in the event that subsurface conditions differ from those anticipated at the time this report was prepared. The recommendations presented herein are contingent upon such observations.

If the actual exposed subsurface soil conditions encountered during construction differ from those assumed or considered in this report, Geolabs should be contacted to review and/or revise the geotechnical recommendations presented herein.

END OF DISCUSSION AND RECOMMENDATIONS

SECTION 4. LIMITATIONS

The analyses and recommendations submitted herein are based in part upon information obtained from the drilled borings. Variations of the subsurface conditions between and beyond the field borings may occur, and the nature and extent of these variations may not become evident until construction is underway. If variations then appear evident, it will be necessary to re-evaluate the recommendations presented herein.

The field boring locations indicated herein are approximate, having been estimated by using a handheld Global Positioning System (GPS) to field-locate selected locations from referenced points shown on the Overall Site Electrical Plan by Ronald N.S. Ho & Associates dated May 2024. The field boring locations should be considered accurate only to the degree implied by the methods used.

The stratification breaks shown on the graphic representations of the borings depict the approximate boundaries between soil types and, as such, may denote a gradual transition. Groundwater was not encountered at the time of our field exploration. However, it should be noted that groundwater levels are subject to change due to rainfall, time of year, seasonal precipitation, surface water runoff, and other factors.

This report has been prepared for the exclusive use of Ronald N.S. Ho & Associates, Inc. and their project consultants for specific application to the design of the *Apron Lighting Replacement* project at the Kahului Airport in accordance with generally accepted geotechnical engineering principles and practices. No warranty is expressed or implied.

This report has been prepared solely for the purpose of assisting the architect and engineers in the design of the proposed project. Therefore, this report may not contain sufficient data, or the proper information, to serve as a basis for detailed construction cost estimates.

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

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

END OF LIMITATIONS

CLOSURE

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

Project Location Map	Plate 1
Overall Site Plan	Plate 2
Site Plans	Plates 3.1 thru 3.8
Field Exploration	Appendix A
Laboratory Tests	Appendix B
Photographs of Core Samples	Appendix C

-ΩΩΩΩΩΩΩΩΩ-

Respectfully submitted,

GEOLABS, INC.

By

Taylor Onizuka, P.E.
Project Engineer

By

John Y.L. Chen, P.E.
Vice President

JC:TO:as

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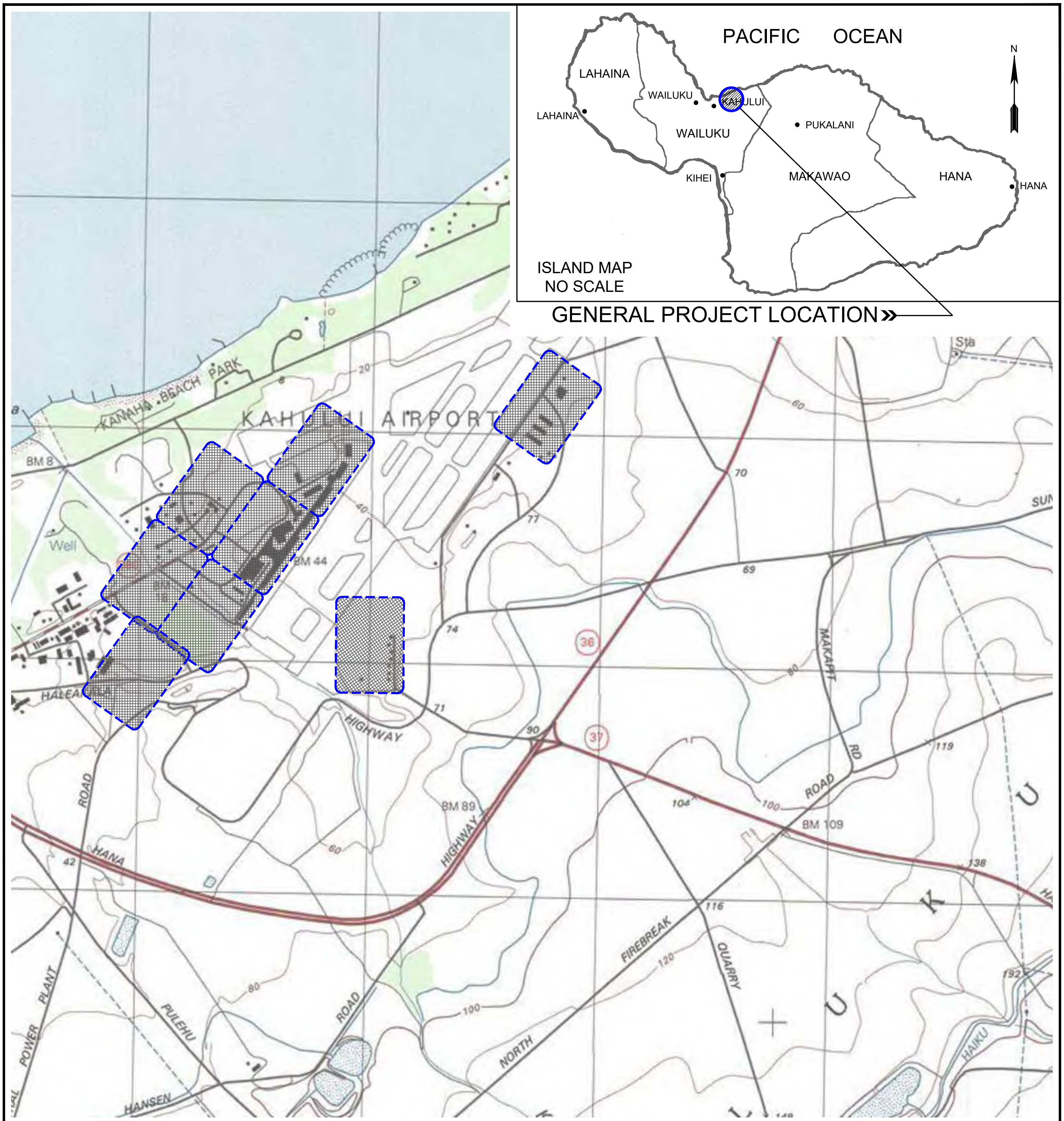
PLATES



▨ PROJECT LOCATION

2000 1000 0 2000 FT.

GRAPHIC SCALE

N

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

PROJECT LOCATION MAP

APRON LIGHTING REPLACEMENT
KAHULUI AIRPORT
KAHULUI, MAUI, HAWAII
STATE PROJECT NO. AS1037-12

GEOLABS, INC.
Geotechnical Engineering

DATE	DRAWN BY	PLATE
OCTOBER 2024	KHN	
SCALE	W.O.	
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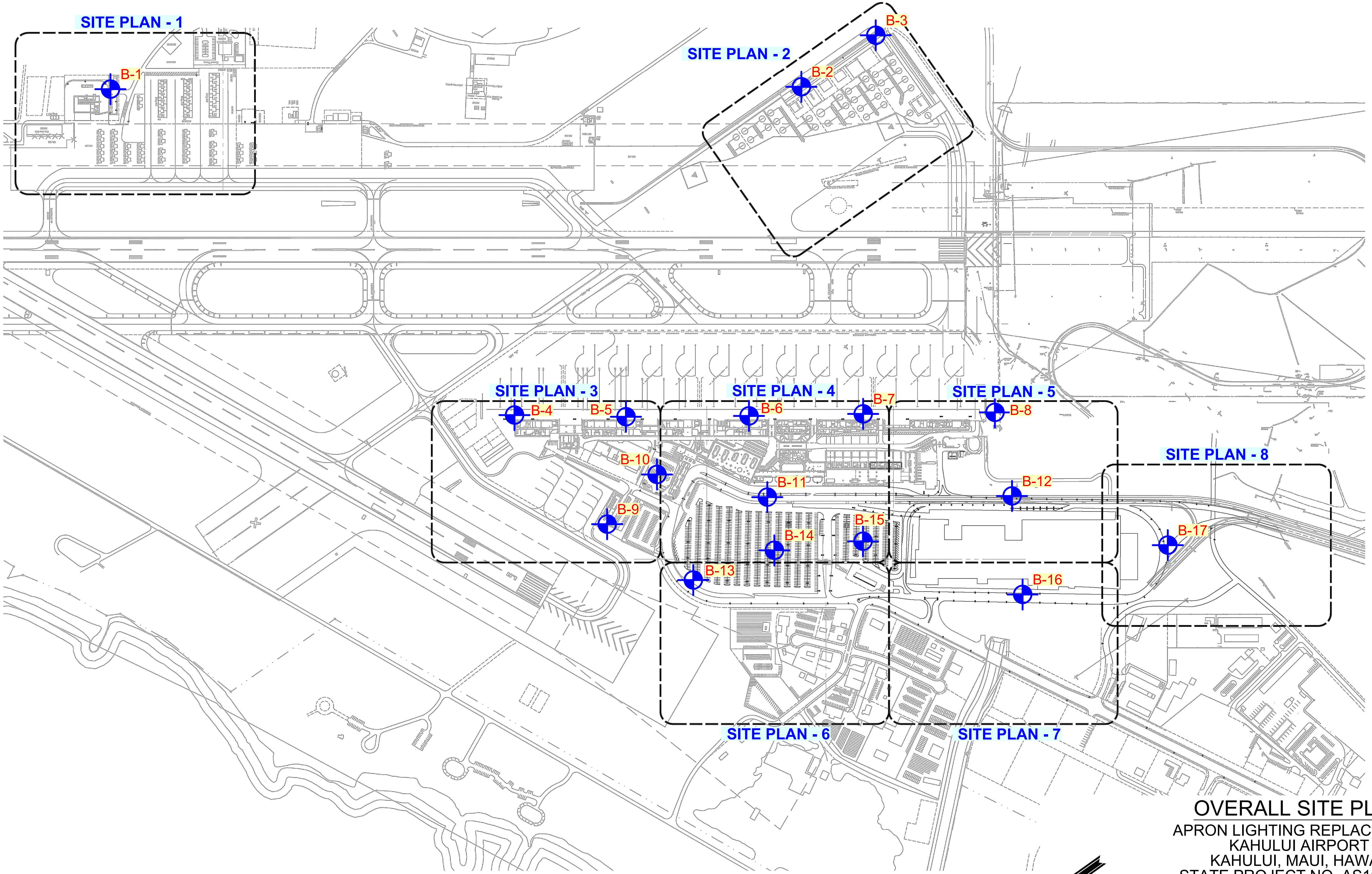

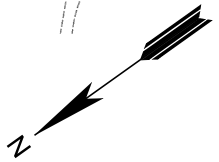

OVERALL SITE PLAN

APRON LIGHTING REPLACEMENT
KAHULUI AIRPORT
KAHULUI, MAUI, HAWAII
STATE PROJECT NO. AS1037-12

LEGEND:

⊕ APPROXIMATE BORING LOCATION

0 300 600 1200 1800 FT.

GRAPHIC SCALE

REFERENCE: OVERALL SITE ELECTRICAL PLAN BY RONALD N.S. HO & ASSOCIATES, INC. DATED MAY 2024.

GEOLABS, INC.
Geotechnical Engineering

DATE	DRAWN BY	PLATE
OCTOBER 2024	KHN	
SCALE	W.O.	
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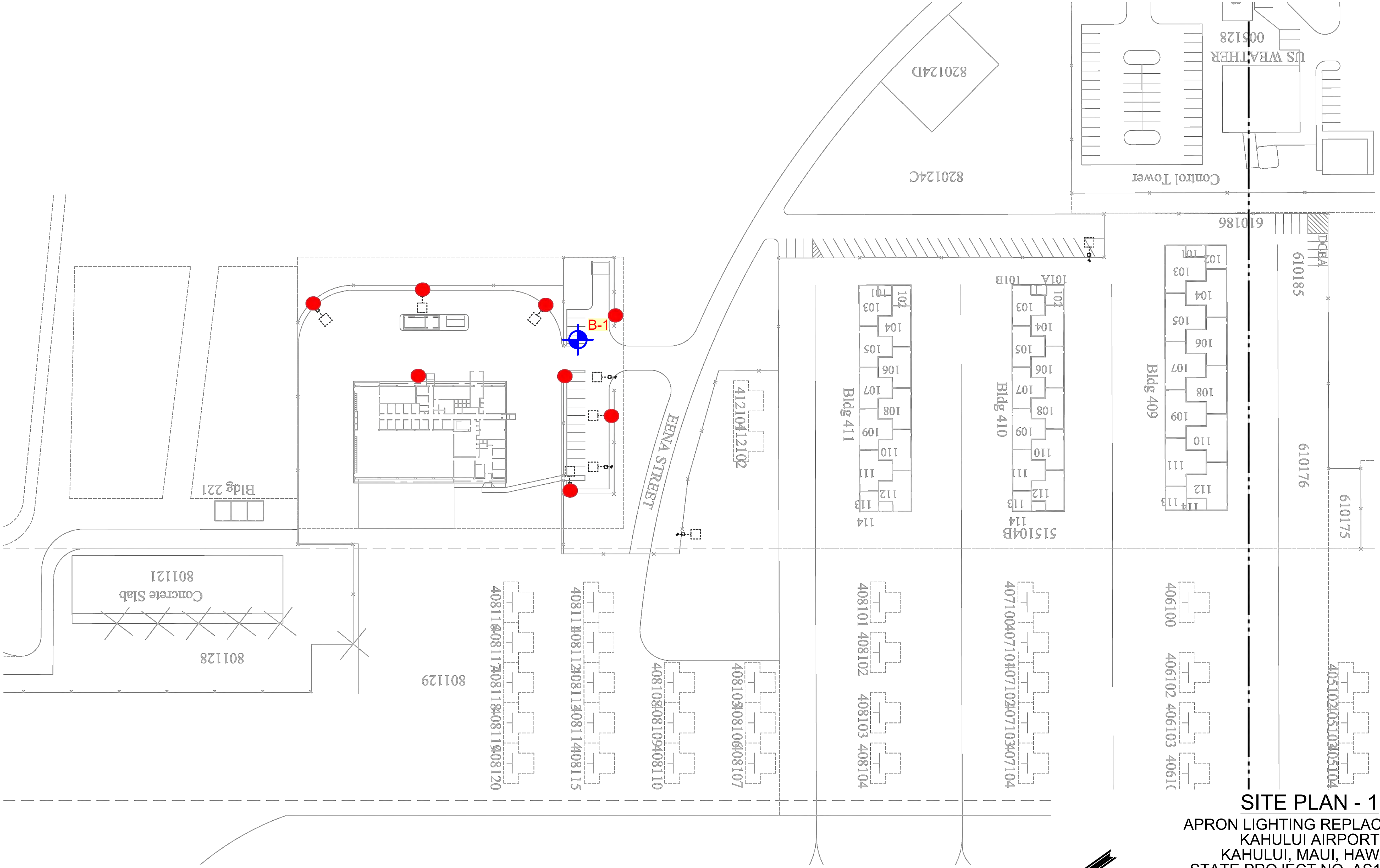

SITE PLAN - 1

APRON LIGHTING REPLACEMENT
KAHULUI AIRPORT
KAHULUI, MAUI, HAWAII
STATE PROJECT NO. AS1037-12

LEGEND:

⌖ APPROXIMATE BORING LOCATION

0 50 100 200 300 FT.

GRAPHIC SCALE

REFERENCE: APRON LIGHTING PLAN BY RONALD N.S. HO & ASSOCIATES, INC. DATED MAY 2024.

GEOLABS, INC.
Geotechnical Engineering

DATE	DRAWN BY	PLATE
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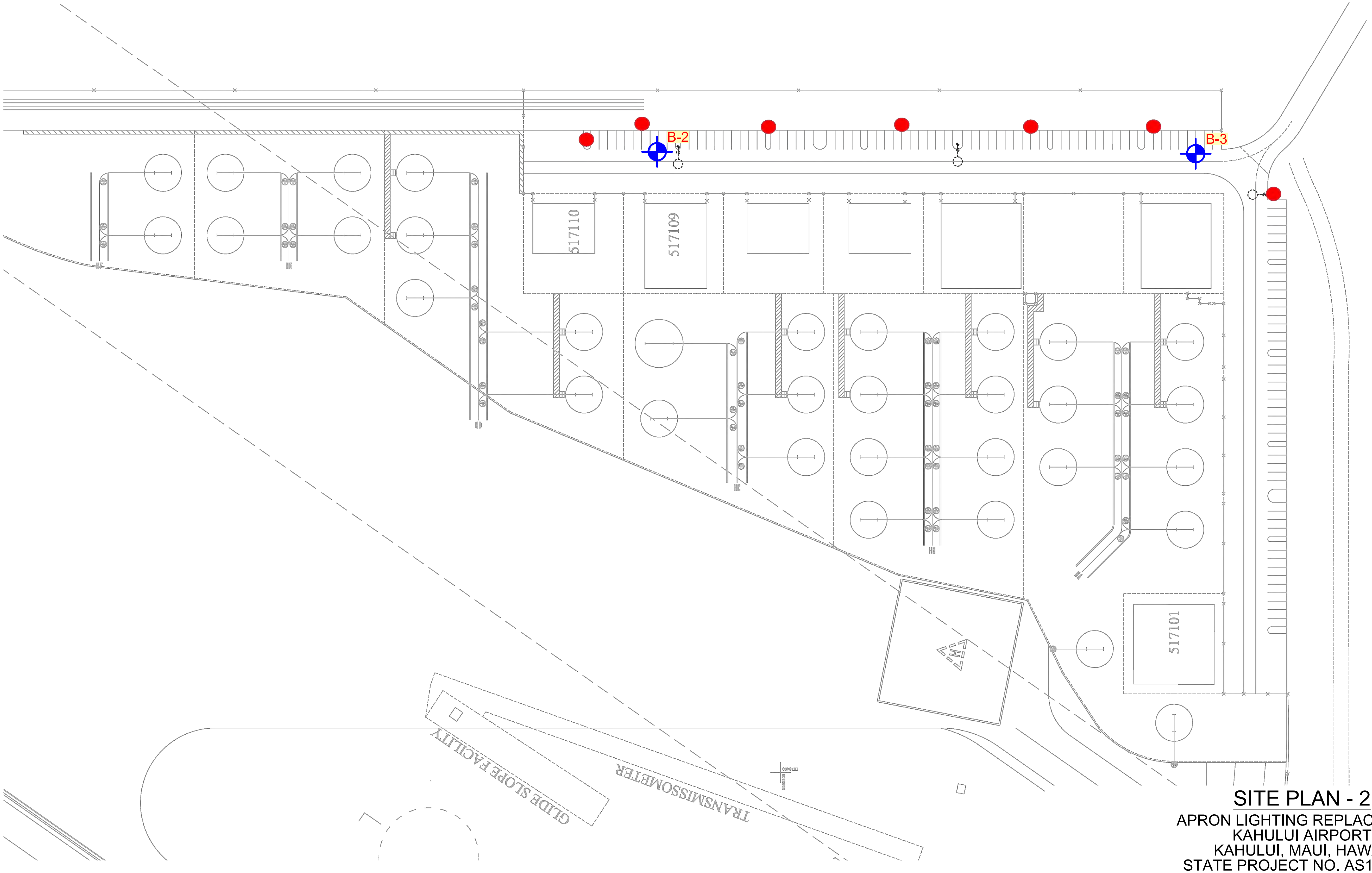

SITE PLAN - 2

APRON LIGHTING REPLACEMENT
KAHULUI AIRPORT
KAHULUI, MAUI, HAWAII
STATE PROJECT NO. AS1037-12

LEGEND:

⌖ APPROXIMATE BORING LOCATION

N

0 50 100 200 300 FT.

GRAPHIC SCALE

REFERENCE: APRON LIGHTING PLAN BY RONALD N.S. HO & ASSOCIATES, INC. DATED MAY 2024.

GEOLABS, INC.
Geotechnical Engineering

DATE	DRAWN BY	PLATE
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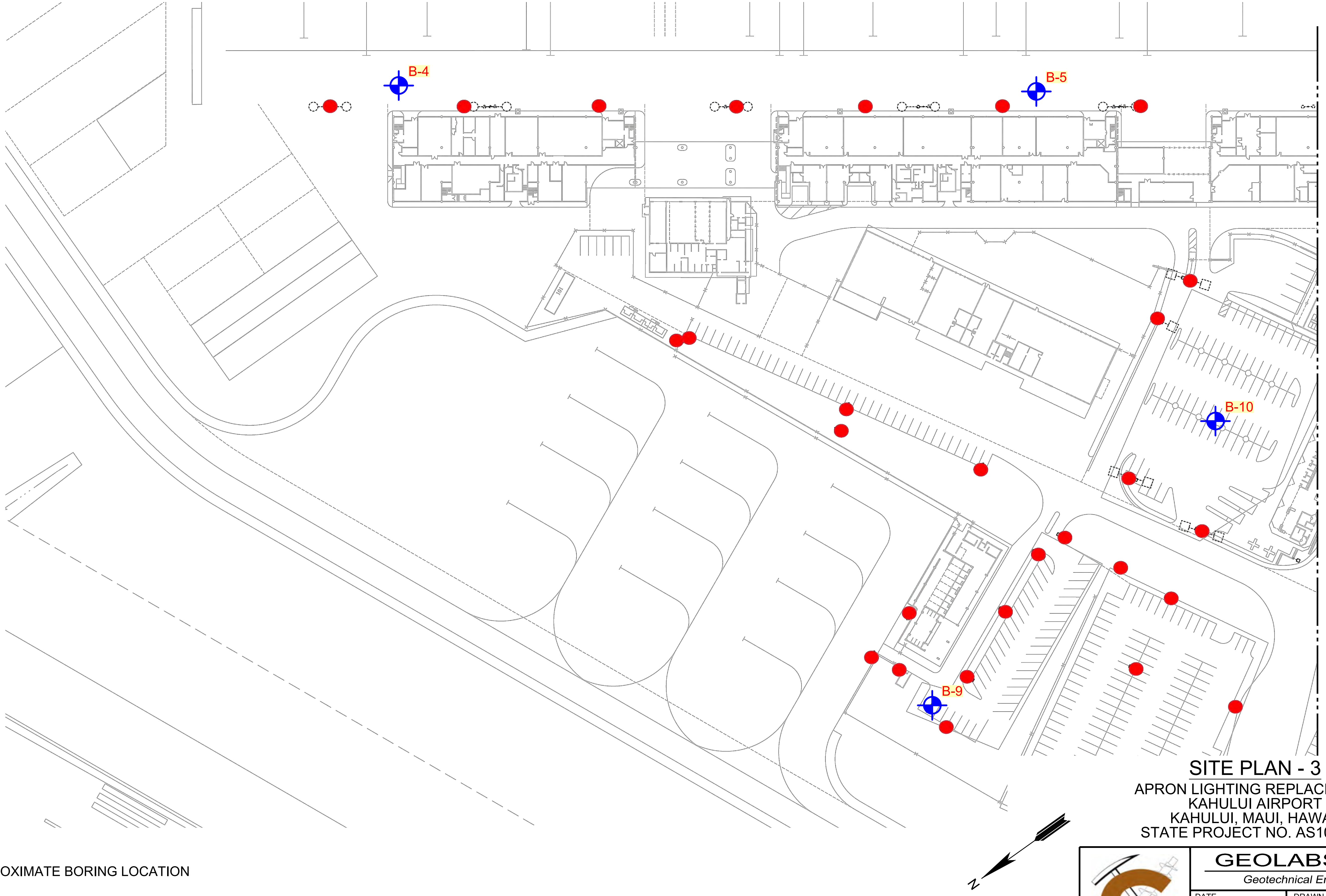

0 50 100 200 300 FT.

GRAPHIC SCALE

SITE PLAN - 3

APRON LIGHTING REPLACEMENT
KAHULUI AIRPORT
KAHULUI, MAUI, HAWAII
STATE PROJECT NO. AS1037-12

LEGEND:

⌖ APPROXIMATE BORING LOCATION

REFERENCE: APRON LIGHTING PLAN BY RONALD N.S. HO & ASSOCIATES, INC. DATED MAY 2024.

GEOLABS, INC.
Geotechnical Engineering

DATE	DRAWN BY	PLATE
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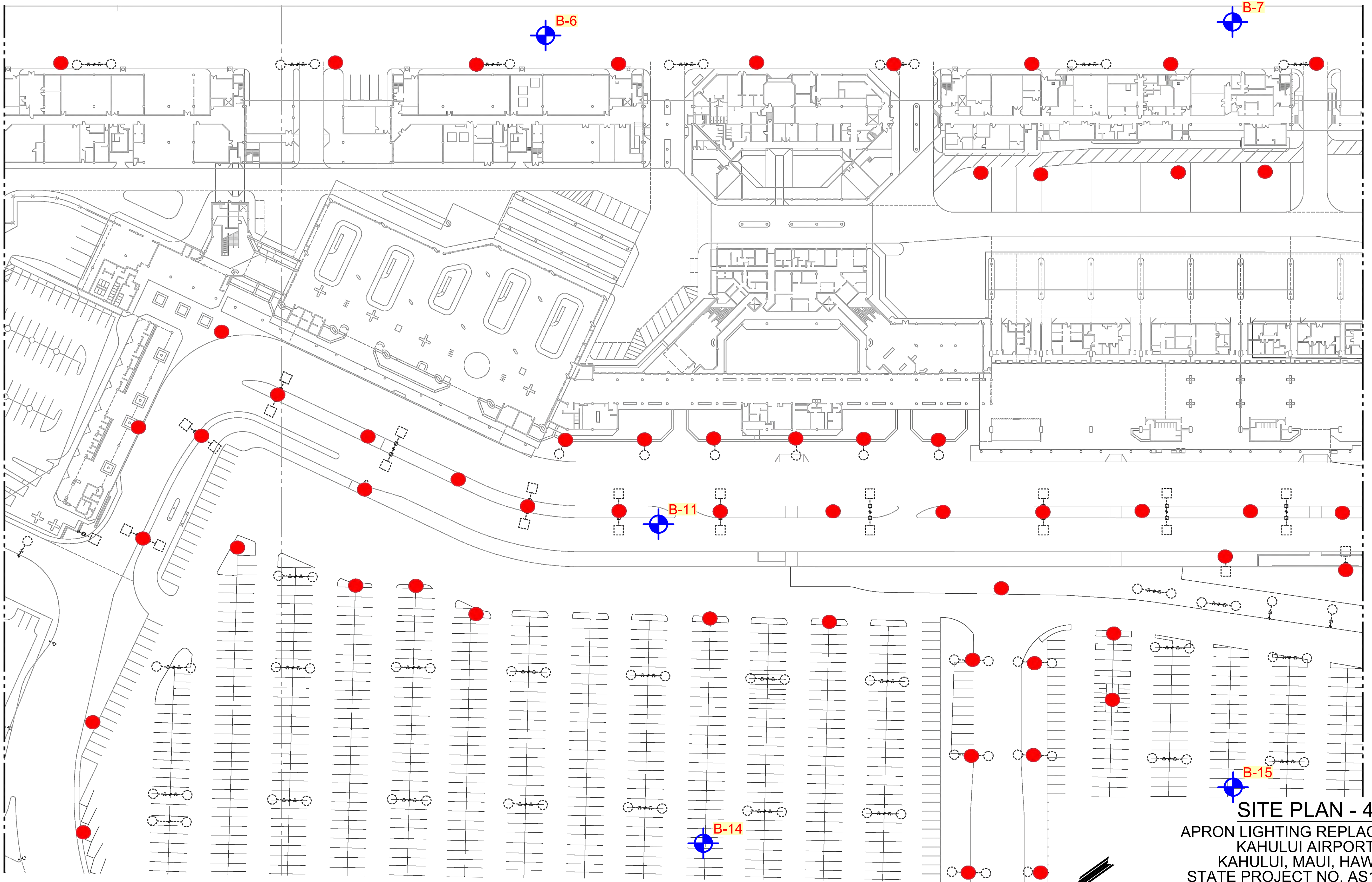

SITE PLAN - 4

APRON LIGHTING REPLACEMENT
KAHULUI AIRPORT
KAHULUI, MAUI, HAWAII
STATE PROJECT NO. AS1037-12

LEGEND:

⌖ APPROXIMATE BORING LOCATION

N

0 50 100 200 300 FT.
GRAPHIC SCALE

REFERENCE: APRON LIGHTING PLAN BY RONALD N.S. HO & ASSOCIATES, INC. DATED MAY 2024.

GEOLABS, INC.
Geotechnical Engineering

DATE	DRAWN BY	PLATE
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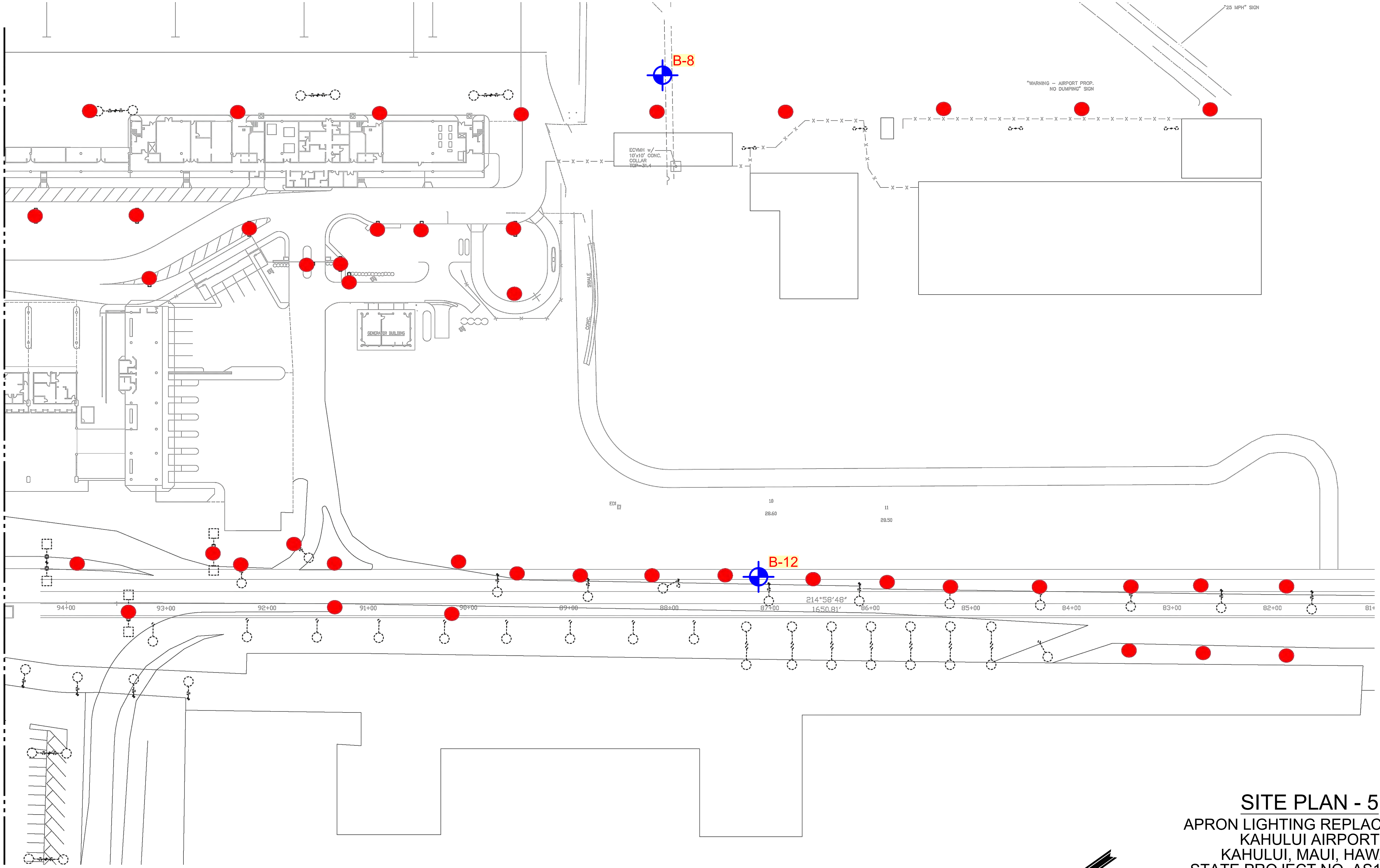

SITE PLAN - 5

APRON LIGHTING REPLACEMENT
KAHULUI AIRPORT
KAHULUI, MAUI, HAWAII
STATE PROJECT NO. AS1037-12

LEGEND:

⌖ APPROXIMATE BORING LOCATION

N

0 50 100 200 300 FT.

GRAPHIC SCALE

REFERENCE: APRON LIGHTING PLAN BY RONALD N.S. HO & ASSOCIATES, INC. DATED MAY 2024.

GEOLABS, INC.
Geotechnical Engineering

DATE	DRAWN BY	PLATE
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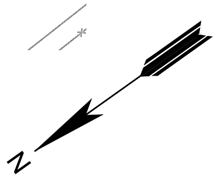

SITE PLAN - 6

APRON LIGHTING REPLACEMENT
KAHULUI AIRPORT
KAHULUI, MAUI, HAWAII
STATE PROJECT NO. AS1037-12

LEGEND:

⊕ APPROXIMATE BORING LOCATION

0 50 100 200 300 FT.
GRAPHIC SCALE

REFERENCE: APRON LIGHTING PLAN BY RONALD N.S. HO & ASSOCIATES, INC. DATED MAY 2024.

GEOLABS, INC.
Geotechnical Engineering

DATE	DRAWN BY	PLATE
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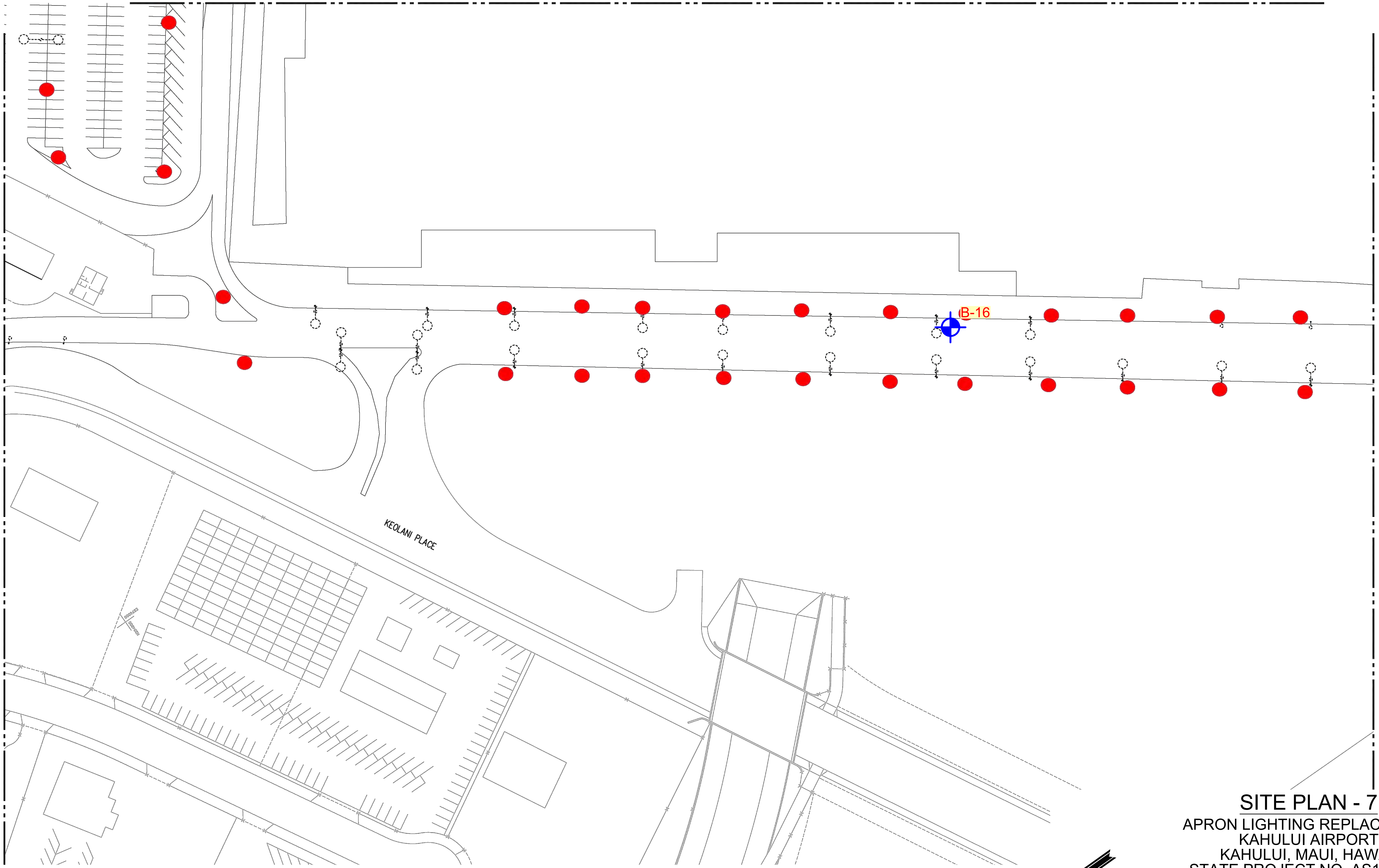


SITE PLAN - 7

APRON LIGHTING REPLACEMENT
KAHULUI AIRPORT
KAHULUI, MAUI, HAWAII
STATE PROJECT NO. AS1037-12

LEGEND:

⌖ APPROXIMATE BORING LOCATION

0 50 100 200 300 FT.
GRAPHIC SCALE

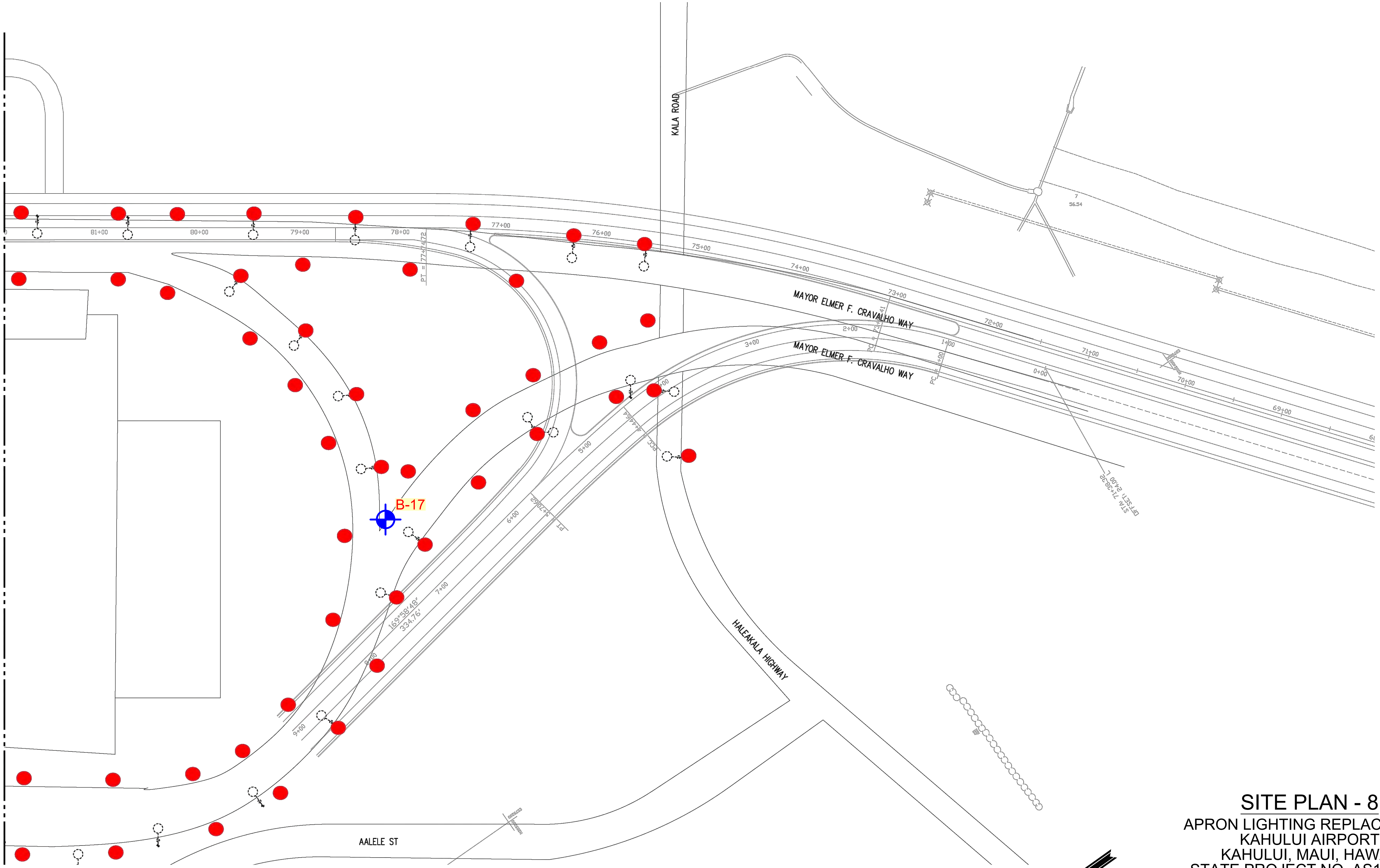
REFERENCE: APRON LIGHTING PLAN BY RONALD N.S. HO & ASSOCIATES, INC. DATED MAY 2024.

GEOLABS, INC.
Geotechnical Engineering

DATE	DRAWN BY	PLATE
OCTOBER 2024	KHN	
SCALE	W.O.	
1" = 100'	8859-00	3.7

CAD User: KIM File Last Updated: October 04, 2024 9:19:30pm Plot Date: October 04, 2024 - 9:24:49pm
File: T:\Drafting\Working\8859-00_Apron_Light_Replacement_Kahului_Airport\8859-00SitePlans.dwg\3.7
Plotter: DWG To PDF-GEO.pc3 Plotstyle: GEO-No-Dither-RBGC-HEAVY.ctb

CAD User: KIM File Last Updated: October 04, 2024 9:19:30pm Plot Date: October 04, 2024 - 9:25:05pm
File: T:\Drafting\Working\8859-00_Apron_Light_Replacement_Kahului_Airport\8859-00SitePlans.dwg\3.8
Plotter: DWG To PDF-GEO.pc3 Plotstyle: GEO-No-Dither-RBGC-HEAVY.ctb



LEGEND:

⌖ APPROXIMATE BORING LOCATION

REFERENCE: APRON LIGHTING PLAN BY RONALD N.S. HO & ASSOCIATES, INC. DATED MAY 2024.

0 50 100 200 300 FT.
GRAPHIC SCALE

SITE PLAN - 8

APRON LIGHTING REPLACEMENT
KAHULUI AIRPORT
KAHULUI, MAUI, HAWAII
STATE PROJECT NO. AS1037-12

GEOLABS, INC.
Geotechnical Engineering

DATE	DRAWN BY	PLATE
OCTOBER 2024	KHN	
SCALE	W.O.	
1" = 100'	8859-00	3.8

APPENDIX A

APPENDIX A

Field Exploration

We explored the subsurface conditions at the project site by drilling and sampling 17 borings, designated as Boring Nos. 1 through 17, extending to depths of about 12 to 22.5 feet below the existing ground surface. The approximate boring locations are shown on the Site Plan, Plate 2. The borings were drilled using a truck-mounted drill rig equipped with continuous flight augers and coring tools.

Our geologist classified the materials encountered in the borings by visual and textural examination in the field in general accordance with ASTM D2488, Standard Practice for Description and Identification of Soils, and monitored the drilling operations on a near-continuous (full-time) basis. These classifications were further reviewed visually and by testing in the laboratory. Soils were classified in general accordance with ASTM D2487, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System), as shown on the Soil Log Legend, Plate A-0.1. Deviations made to the soil classification in accordance with ASTM D2487 are described on the Soil Classification Log Key, Plate A-0.2. Graphic representations of the materials encountered are presented on the Logs of Borings, Plates A-1 through A-17.

Relatively “undisturbed” soil samples were obtained in general accordance with ASTM D3550, Ring-Lined Barrel Sampling of Soils, by driving a 3-inch OD Modified California sampler with a 140-pound hammer falling 30 inches. In addition, some samples were obtained from the drilled borings in general accordance with ASTM D1586, Penetration Test and Split-Barrel Sampling of Soils, by driving a 2-inch OD standard penetration sampler using the same hammer and drop. The blow counts needed to drive the sampler the second and third 6 inches of an 18-inch drive are shown as the “Penetration Resistance” on the Logs of Borings at the appropriate sample depths. The penetration resistance shown on the logs of borings indicates the number of blows required for the specific sampler type used. The blow counts may need to be factored to obtain the Standard Penetration Test (SPT) blow counts.

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

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

"Suggested Methods for the Quantitative Description of Discontinuities in Rock Masses" by the International Society for Rock Mechanics (March 1977).

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

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

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

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

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Soil Log Legend

UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)

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

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

LEGEND

◩	(2-INCH) O.D. STANDARD PENETRATION TEST
⧗	(3-INCH) O.D. MODIFIED CALIFORNIA SAMPLE
S	SHELBY TUBE SAMPLE
G	GRAB SAMPLE
▮	CORE SAMPLE
▽	WATER LEVEL OBSERVED IN BORING AT TIME OF DRILLING
▼	WATER LEVEL OBSERVED IN BORING AFTER DRILLING
▼	WATER LEVEL OBSERVED IN BORING OVERNIGHT

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

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Soil Classification Log Key

(with deviations from ASTM D2488)

GEOLABS, INC. CLASSIFICATION*

GRANULAR SOIL (- #200 <50%)

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

COHESIVE SOIL (- #200 ≥50%)

- **PRIMARY** constituents are based on plasticity. Primary constituents are capitalized and bold (i.e., **CLAY, SILT**)
- **SECONDARY** constituents are composed of a percentage less than the primary constituent, but more than 20 percent of the soil mass. Secondary constituents are capitalized and bold (i.e., **SANDY** CLAY, **SILTY** CLAY, **CLAYEY** SILT) and precede the primary constituent.
- **accessory descriptions** compose of the following:
with some: >12%
with a little: 5 - 12%
with traces of: <5%
accessory descriptions are lower cased and follow the Primary and Secondary Constituents
(i.e., SILTY CLAY **with some sand**)

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

RELATIVE DENSITY / CONSISTENCY

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

MOISTURE CONTENT DEFINITIONS

Dry:	Absence of moisture, dry to the touch
Moist:	Damp but no visible water
Wet:	Visible free water

ABBREVIATIONS

WOH:	Weight of Hammer
WOR:	Weight of Drill Rods
SPT:	Standard Penetration Test Split-Spoon Sampler
MCS:	Modified California Sampler
PP:	Pocket Penetrometer

GRAIN SIZE DEFINITION

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

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

ROCK DESCRIPTIONS

⟋	**BASALT**	∘	**CONGLOMERATE**
○	**BOULDERS**	▤	**LIMESTONE**
△	**BRECCIA**	⁘	**SANDSTONE**
× ○	**CLINKER**	×	**SILTSTONE**
○	**COBBLES**	▩	**TUFF**
☼	**CORAL**		**VOID/CAVITY**

ROCK DESCRIPTION SYSTEM

ROCK FRACTURE CHARACTERISTICS

The following terms describe general fracture spacing of a rock:

Massive:	Greater than 24 inches apart
Slightly Fractured:	12 to 24 inches apart
Moderately Fractured:	6 to 12 inches apart
Closely Fractured:	3 to 6 inches apart
Severely Fractured:	Less than 3 inches apart

DEGREE OF WEATHERING

The following terms describe the chemical weathering of a rock:

Unweathered:	Rock shows no sign of discoloration or loss of strength.
Slightly Weathered:	Slight discoloration inwards from open fractures.
Moderately Weathered:	Discoloration throughout and noticeably weakened though not able to break by hand.
Highly Weathered:	Most minerals decomposed with some corestones present in residual soil mass. Can be broken by hand.
Extremely Weathered:	Saprolite. Mineral residue completely decomposed to soil but fabric and structure preserved.

HARDNESS

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

Very Hard:	Specimen breaks with difficulty after several "pinging" hammer blows. Example: Dense, fine grain volcanic rock
Hard:	Specimen breaks with some difficulty after several hammer blows. Example: Vesicular, vugular, coarse-grained rock
Medium Hard:	Specimen can be broked by one hammer blow. Cannot be scraped by knife. SPT may penetrate by ~25 blows per inch with bounce. Example: Porous rock such as clinker, cinder, and coral reef
Soft:	Can be indented by one hammer blow. Can be scraped or peeled by knife. SPT can penetrate by ~100 blows per foot. Example: Weathered rock, chalk-like coral reef
Very Soft:	Crumbles under hammer blow. Can be peeled and carved by knife. Can be indented by finger pressure. Example: Saprolite

LOG LEGEND FOR ROCK 8859-00.GPJ GEOLABS.GDT 10/2/24

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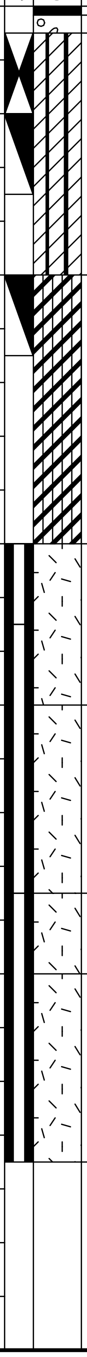
APRON LIGHT REPLACEMENT
KAHULUI AIRPORT
KAHULUI, MAUI, HAWAII
STATE PROJECT NO. AS1037-12

Log of Boring 1

Approximate Ground Surface Elevation : N/A



Laboratory		Field							
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
							0	GP	2-inch **ASPHALTIC CONCRETE**
	27	90			16			MH	Gray **SILTY GRAVEL (BASALTIC)** with a little sand, dry (fill)
						2.5			Reddish brown **CLAYEY SILT**, stiff, dry (fill)
					11				
LL=37 PI=13	38	79			11		5	CL	Brown with some multi-color mottling **SANDY CLAY** with some gravel (basaltic), stiff (saprolite)
						3.5			
UC= 5220 psi			67	33	13/0" Ref.		10		Brownish gray vesicular **BASALT**, slightly to moderately fractured, moderately to highly weathered, soft to medium hard (basalt formation)
			87	13					
									Gray vugular **BASALT**, slightly to moderately fractured, slightly weathered, hard (basalt formation)
							15		
			75	0					Brownish gray vesicular **BASALT**, slightly to moderately fractured, moderately weathered, soft to medium hard (basalt formation)
									Gray vugular **BASALT**, moderately to closely fractured, moderately weathered, medium hard (basalt formation)
							20		
									Boring terminated at 21.5 feet
							25		

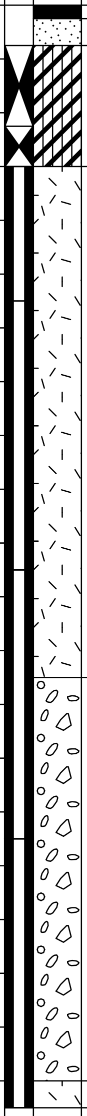
Date Started:	June 27, 2024	Water Level: ▼	Not Encountered
Date Completed:	June 27, 2024		
Logged By:	N. Mc Clean	Drill Rig:	CME-45C TRUCK
Total Depth:	21.5 feet	Drilling Method:	4" Casing & HQ Coring
Work Order:	8859-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 1

GEOLABS, INC. Geotechnical Engineering	APRON LIGHT REPLACEMENT KAHULUI AIRPORT KAHULUI, MAUI, HAWAII STATE PROJECT NO. AS1037-12	**Log of Boring** 2

Approximate Ground Surface
Elevation : N/A



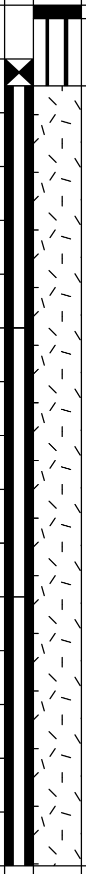
Laboratory			Field								
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Description
											3-inch **ASPHALTIC CONCRETE**
										SP	Reddish brown **GRAVELLY SAND** with some silt, m___ (fill)
LL=41 PI=19	31	92			7					CL	
	24				13/3"						Reddish brown with some multi-color mottling **SANDY CLAY** with some gravel (basaltic), soft to medium stiff, dry (alluvium)
			90	23							Gray dense **BASALT**, massive to moderately fractured, unweathered to slightly weathered, very hard (basalt formation)
UC= 13900 psi											
							5				
			73	38							
							10				
			57	10							
										GP	Dark reddish gray **SANDY GRAVEL (BASALTIC)**, very dense, dry (clinker)
UC= 32790 psi											
							15				
					8/0"						
							20				Gray dense **BASALT**, moderately fractured, moderately to highly weathered, medium hard (basalt formation)
					12/0" Ref.						
											Boring terminated at 20.5 feet
							25				

Date Started:	June 27, 2024	Water Level: ▼	Not Encountered	Plate
Date Completed:	June 27, 2024			
Logged By:	N. Mc Clean	Drill Rig:	CME-45C TRUCK	A - 2
Total Depth:	20.5 feet	Drilling Method:	4" Casing & HQ Coring	
Work Order:	8859-00	Driving Energy:	140 lb. wt., 30 in. drop	

GEOLABS, INC. Geotechnical Engineering	APRON LIGHT REPLACEMENT KAHULUI AIRPORT KAHULUI, MAUI, HAWAII STATE PROJECT NO. AS1037-12	Log of Boring 3

Approximate Ground Surface Elevation : N/A

Laboratory			Field								
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Description
											3-inch **ASPHALTIC CONCRETE**
	26	98			21/0" Ref.	4.5				ML	Reddish brown with some multi-color mottling **GRAVELLY SILT**, hard, dry (alluvium)
			83	11							Gray dense **BASALT**, massive to moderately fractured, unweathered to slightly weathered, very hard (basalt formation)
							5				
			97	43							
UC= 27000 psi											
							10				
			90	43							
UC= 21830 psi											
							15				
											Boring terminated at 16 feet
							20				
							25				



Date Started:	June 25, 2024	Water Level: ▼	Not Encountered	Plate A - 3
Date Completed:	June 25, 2024			
Logged By:	N. Mc Clean	Drill Rig:	CME-45C TRUCK	
Total Depth:	16 feet	Drilling Method:	4" Casing & HQ Coring	
Work Order:	8859-00	Driving Energy:	140 lb. wt., 30 in. drop	

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APRON LIGHT REPLACEMENT
KAHULUI AIRPORT
KAHULUI, MAUI, HAWAII
STATE PROJECT NO. AS1037-12

Log of Boring

4

Approximate Ground Surface
Elevation : N/A

Laboratory			Field								
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Description
											18-inch **ASPHALTIC CONCRETE**
	15	108			17					GP	Gray **GRAVEL (BASALTIC)**, dry (fill)
						2.5				ML	Brown with orange mottling **SANDY CLAY** with a little gravel (basaltic), stiff, dry (fill)
	23				14						
							5				
TXUU S_u=0.7 ksf	14	106			11						grades to medium stiff
						2.0					
							10				
LL=39 PI=17	30		0 0	0 0	16/0" Ref.					ML	Reddish brown **CLAYEY SILT** with traces of boulders (basaltic), stiff, dry (alluvium)
							15				
	43			0	13						
							20			ML	Dark brown **SANDY SILT**, soft to medium stiff, dry (alluvium)
	48				4						
											Boring terminated at 22.5 feet
							25				

Date Started:	June 18, 2024	Water Level: ▼	Not Encountered
Date Completed:	June 18, 2024		
Logged By:	N. Mc Clean	Drill Rig:	CME-45C TRUCK
Total Depth:	22.5 feet	Drilling Method:	3" Casing & HQ Coring
Work Order:	8859-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 4

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APRON LIGHT REPLACEMENT
KAHULUI AIRPORT
KAHULUI, MAUI, HAWAII
STATE PROJECT NO. AS1037-12

Log of Boring
5

Approximate Ground Surface
Elevation : N/A

Laboratory			Field								
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Description
											18-inch **ASPHALTIC CONCRETE**
	21	112			65					GP	Gray **SANDY GRAVEL (BASALTIC)**, dry (fill)
										MH	Brown with orange mottling **CLAYEY SILT** with a little gravel (basaltic), hard, dry (fill)
						2.5					
	11				25/0" Ref.						
			97	40							Gray dense **BASALT**, massive to moderately fractured, unweathered to slightly weathered, very hard (basalt formation)
							5				
UC= 12610 psi											
			93	60							
							10				
			93	43							
UC= 10640 psi											
							15				
			88	62							
							20				
											Boring terminated at 21 feet
							25				

Date Started:	June 20, 2024	Water Level: ▼	Not Encountered
Date Completed:	June 20, 2024		
Logged By:	N. Mc Clean	Drill Rig:	CME-45C TRUCK
Total Depth:	21 feet	Drilling Method:	3" Casing & HQ Coring
Work Order:	8859-00	Driving Energy:	140 lb. wt., 30 in. drop

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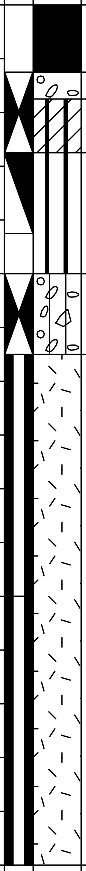
APRON LIGHT REPLACEMENT
KAHULUI AIRPORT
KAHULUI, MAUI, HAWAII
STATE PROJECT NO. AS1037-12

Log of Boring

6

Approximate Ground Surface
Elevation : N/A



Laboratory			Field						
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
									15-inch **ASPHALTIC CONCRETE**
	67	73			15			GP	Gray **SANDY GRAVEL (BASALTIC)**, dry (fill)
						4.5		MH	Reddish brown **CLAYEY SILT**, medium stiff to stiff, dry (fill)
LL=41 PI=15	42				15			ML	Brown **SANDY SILT** with traces of gravel (basaltic), stiff to very stiff, moist (alluvium)
Sieve - #200 = 12.3%	22	98			48	4.5	5	GM	Tannish brown **SILTY GRAVEL (BASALTIC)** with some sand, medium dense, moist (alluvium)
			83	0			10 15		Gray dense **BASALT**, massive to slightly fractured, unweathered, very hard (basalt formation)
							20 25		Boring terminated at 16 feet

Date Started:	June 19, 2024	Water Level: ▼	Not Encountered
Date Completed:	June 19, 2024		
Logged By:	N. Mc Clean	Drill Rig:	CME-45C TRUCK
Total Depth:	16 feet	Drilling Method:	3" Casing & HQ Coring
Work Order:	8859-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 6

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KAHULUI, MAUI, HAWAII
STATE PROJECT NO. AS1037-12

Log of Boring

7

Approximate Ground Surface
Elevation : N/A

Laboratory			Field						
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
									18-inch **ASPHALTIC CONCRETE**
	4	112			85	4.5		GP	Gray **GRAVEL (BASALTIC)**, dry (fill)
								SP-SM	Brown **GRAVELLY SAND (BASALTIC)** with a little silt, dense, dry (fill)
	26				7			CL	Reddish brown **SANDY CLAY** with traces of boulders (basaltic), medium stiff, dry (alluvium)
LL=38 PI=14	31	87			9		5		
						4.5			
			58	0	12/0" Ref.		10		Gray dense **BASALT**, massive to slightly fractured, unweathered, very hard (basalt formation)
			83	58					
UC= 28380 psi									
							15		
			97	57					
							20		
									Boring terminated at 21 feet
							25		

Date Started: June 18, 2024
Date Completed: June 19, 2024
Logged By: N. Mc Clean
Total Depth: 21 feet
Work Order: 8859-00

Water Level: ▼ Not Encountered

Drill Rig: CME-45C TRUCK
Drilling Method: 3" Casing & HQ Coring
Driving Energy: 140 lb. wt., 30 in. drop

Plate

A - 7

GEOLABS, INC.

Geotechnical Engineering

APRON LIGHT REPLACEMENT
KAHULUI AIRPORT
KAHULUI, MAUI, HAWAII
STATE PROJECT NO. AS1037-12

Log of Boring

8

Approximate Ground Surface Elevation : N/A

Laboratory			Field								
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Description
											18-inch **ASPHALTIC CONCRETE**
	27	90			13					GP	Gray **SANDY GRAVEL (BASALTIC)**, dry (fill)
						3.5				MH	Reddish brown **CLAYEY SILT** with traces of boulders (basaltic), medium stiff to stiff, dry (alluvium)
	26				11						
Direct Shear	28	86			13		5				
						4.0					
	33				9		10				
										ML	Brown **CLAYEY SILT**, stiff, moist (alluvium)
TXUU S_u=0.7 ksf	34	88			25		15				
						4.5					
										ML	Brown with some multi-color mottling **CLAYEY SILT** with a little gravel (basaltic), dry (alluvium)
										ML	Reddish brown **SANDY SILT**, very stiff, moist (alluvium)
LL=NP PI=NP	19				18		20				
											Boring terminated at 21.5 feet
							25				

Date Started:	June 20, 2024	Water Level: ▼	Not Encountered
Date Completed:	June 21, 2024		
Logged By:	N. Mc Clean	Drill Rig:	CME-45C TRUCK
Total Depth:	21.5 feet	Drilling Method:	3" Casing & HQ Coring
Work Order:	8859-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 8

GEOLABS, INC. Geotechnical Engineering	APRON LIGHT REPLACEMENT KAHULUI AIRPORT KAHULUI, MAUI, HAWAII STATE PROJECT NO. AS1037-12	**Log of Boring** 9

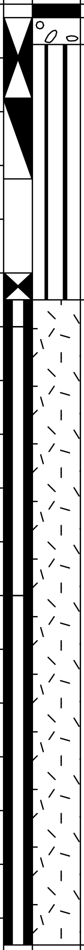
Approximate Ground Surface Elevation : N/A

Laboratory			Field								
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Description
											3-inch **ASPHALTIC CONCRETE**
										GP	Gray **SANDY GRAVEL (BASALTIC)**, dry (fill)
										MH	Brown with orange mottling **CLAYEY SILT** with a little gravel (basaltic), soft to stiff, dry (fill)
	35	84			6						
						3.0					
	45				12						
			92	75	12/0" Ref.		5				Gray dense **BASALT**, massive to slightly fractured, unweathered, very hard (basalt formation)
UC= 11530 psi			97	48							
							10				
			95	33							
							15				
			97	27							
											Gray dense **BASALT**, closely to severely fractured, slightly to moderately weathered, very hard (basalt formation)
											Gray dense **BASALT**, massive to slightly fractured, unweathered, very hard (basalt formation)
							20				
											Boring terminated at 21 feet
							25				

Date Started:	June 24, 2024	Water Level: ▼	Not Encountered	Plate A - 9
Date Completed:	June 24, 2024			
Logged By:	N. Mc Clean	Drill Rig:	CME-45C TRUCK	
Total Depth:	21 feet	Drilling Method:	4" Casing & PQ Coring	
Work Order:	8859-00	Driving Energy:	140 lb. wt., 30 in. drop	

GEOLABS, INC. Geotechnical Engineering	APRON LIGHT REPLACEMENT KAHULUI AIRPORT KAHULUI, MAUI, HAWAII STATE PROJECT NO. AS1037-12	Log of Boring 10

Approximate Ground Surface Elevation : N/A



Laboratory			Field						Description
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	
	33	101			21			GP	3-inch **ASPHALTIC CONCRETE**
						4.5		ML	Gray **SANDY GRAVEL (BASALTIC)**, dry (fill)
LL=35 PI=4	35				18				Brown with orange mottling **SANDY SILT** with a little gravel (basaltic), stiff to very stiff, dry (fill)
	40	74			22/0" Ref.	4.0	5		
			83 43	0 10					Gray dense **BASALT**, massive to slightly fractured, unweathered, very hard (basalt formation)
									VOID encountered at 8.5 feet
							10		
			49	33					
UC= 9890 psi									
							15		
									VOID encountered at 16 feet
									Boring terminated at 17.5 feet
							20		
							25		

Date Started:	June 17, 2024	Water Level: ▼	Not Encountered	Plate A - 10
Date Completed:	June 17, 2024			
Logged By:	N. Mc Clean	Drill Rig:	CME-45C TRUCK	
Total Depth:	17.5 feet	Drilling Method:	4" Casing & PQ Coring	
Work Order:	8859-00	Driving Energy:	140 lb. wt., 30 in. drop	

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APRON LIGHT REPLACEMENT
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Log of Boring

11

Approximate Ground Surface
Elevation : N/A

Laboratory			Field								
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Description
											8-inch **ASPHALTIC CONCRETE**
	10	110			27					GP	Gray **SANDY GRAVEL (BASALTIC)** with a little silt, dry (fill)
										MH	Brown **CLAYEY SILT** with some gravel and cobbles (basaltic), dry (fill)
	32				9	4.0				MH	Brown with some multi-color mottling **CLAYEY SILT**, stiff to very stiff, dry (alluvium)
TXUU S_u=1.0 ksf	37	71			8		5			MH	Brown **CLAYEY SILT** with a little sand, medium stiff, dry (alluvium)
						4.0					
	15				40/4"		10				grades with boulders
										ML	Light brown **GRAVELLY SILT** with a little sand, very stiff, dry (residual soil)
											Brownish gray **WEATHERED BASALT**, moderately to highly weathered, medium hard to hard (basalt formation)
							15				Boring terminated at 14 feet
							20				
							25				

Date Started: June 25, 2024
Date Completed: June 25, 2024
Logged By: N. Mc Clean
Total Depth: 14 feet
Work Order: 8859-00

Water Level: ▼ Not Encountered
Drill Rig: CME-45C TRUCK
Drilling Method: 4" Casing
Driving Energy: 140 lb. wt., 30 in. drop

Plate

A - 11

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Log of Boring

12

Approximate Ground Surface
Elevation : N/A

Laboratory			Field						
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
									8-inch **CONCRETE**
								GP	Gray **SANDY GRAVEL (BASALTIC)** with a little silt, dry (fill)
Direct Shear	14	121			26			ML	Brown **SANDY SILT** with some gravel and cobbles (basaltic), stiff to very stiff, dry (fill)
						4.5			
	11				20				
	14	105			23		5		
						4.0			
LL=NP PI=NP	11				24		10		
TXUU S_u=2.6 ksf	15	109			40		15		
								MH	Brown with some multi-color mottling **CLAYEY SILT**, very stiff, dry (alluvium)
								ML	Brown **SANDY SILT** with a little clay, very stiff, dry (alluvium)
	27				26		20		
									Boring terminated at 21.5 feet
							25		

Date Started: June 25, 2024
Date Completed: June 25, 2024
Logged By: N. Mc Clean
Total Depth: 21.5 feet
Work Order: 8859-00

Water Level: ▼ Not Encountered

Drill Rig: CME-45C TRUCK
Drilling Method: 4" Casing
Driving Energy: 140 lb. wt., 30 in. drop

Plate

A - 12

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APRON LIGHT REPLACEMENT
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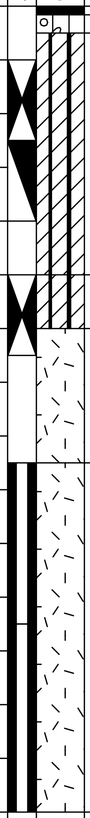
Log of Boring

13

Approximate Ground Surface
Elevation : N/A



Laboratory			Field						
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
									2-inch **ASPHALTIC CONCRETE**
								GM	Gray **SILTY GRAVEL (BASALTIC)** with a little sand, dry (fill)
	25	92			15	2.5		MH	Reddish brown **CLAYEY SILT**, medium stiff to stiff, dry (fill)
	34				7				
	38	83			17	4.0	5	MH	Dark reddish brown with some orange mottling **CLAYEY SILT** with some gravel (basaltic)
									Brownish gray dense **WEATHERED BASALT**, highly to extremely weathered, very soft to soft (basalt formation)
			89	69					Gray dense **BASALT**, massive to slightly fractured, unweathered to slightly weathered, very hard (basalt formation)
UC= 18940 psi							10		
			100	93					
							15		Boring terminated at 15 feet
							20		
							25		

Date Started:	June 26, 2024	Water Level: ▼	Not Encountered
Date Completed:	June 26, 2024		
Logged By:	N. Mc Clean	Drill Rig:	CME-45C TRUCK
Total Depth:	15 feet	Drilling Method:	4" Casing & HQ Coring
Work Order:	8859-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 13

GEOLABS, INC. Geotechnical Engineering	APRON LIGHT REPLACEMENT KAHULUI AIRPORT KAHULUI, MAUI, HAWAII STATE PROJECT NO. AS1037-12	Log of Boring	14

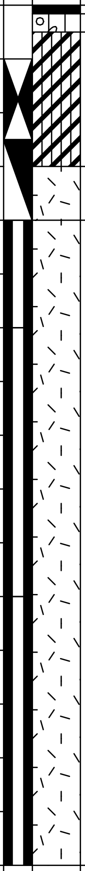
Approximate Ground Surface Elevation : N/A

Laboratory			Field								
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Description
											2-inch **ASPHALTIC CONCRETE**
	7	112			15					GM	Gray **SILTY GRAVEL (BASALTIC)** with a little sand, dry (fill)
										ML	Brown **SANDY SILT** with some gravel (basaltic), medium stiff to stiff, dry (fill)
			83	0							Brownish gray dense **WEATHERED BASALT**, highly to extremely weathered, very soft to soft (basalt formation)
							5				Gray dense **BASALT**, massive to slightly fractured, unweathered to slightly weathered, very hard (basalt formation)
			97	60							
UC= 28130 psi											
							10				
			95	47							
							15				
											Boring terminated at 16.5 feet
							20				
							25				

Date Started:	June 26, 2024	Water Level: ▼	Not Encountered	Plate
Date Completed:	June 26, 2024			
Logged By:	N. Mc Clean	Drill Rig:	CME-45C TRUCK	A - 14
Total Depth:	16.5 feet	Drilling Method:	4" Casing & HQ Coring	
Work Order:	8859-00	Driving Energy:	140 lb. wt., 30 in. drop	

GEOLABS, INC. Geotechnical Engineering	APRON LIGHT REPLACEMENT KAHULUI AIRPORT KAHULUI, MAUI, HAWAII STATE PROJECT NO. AS1037-12	Log of Boring 15

Approximate Ground Surface
Elevation : N/A



Laboratory			Field								
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Description
							0				2-inch **ASPHALTIC CONCRETE**
										GM	Gray **SILTY GRAVEL (BASALTIC)** with a little sand, dry (fill)
LL=32 PI=11	22	104			37					CL	Brown **SANDY CLAY** with some gravel (basaltic), very stiff, dry (fill)
	15				56						
											Brownish gray dense **WEATHERED BASALT**, highly to extremely weathered, very soft to soft (basalt formation)
			58	0							
							5				Gray dense **BASALT**, massive to slightly fractured, unweathered to slightly weathered, very hard (basalt formation)
			93	80							
							10				
			93	57							
							15				
UC= 22660 psi											Boring terminated at 16 feet
							20				
							25				

Date Started:	June 27, 2024	Water Level: ▼	Not Encountered	Plate
Date Completed:	June 28, 2024			
Logged By:	N. Mc Clean	Drill Rig:	CME-45C TRUCK	A - 15
Total Depth:	16 feet	Drilling Method:	4" Casing & HQ Coring	
Work Order:	8859-00	Driving Energy:	140 lb. wt., 30 in. drop	

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Log of Boring

16

Approximate Ground Surface Elevation : N/A

Laboratory			Field								
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Description
											9-inch **CONCRETE**
	12	127			77					GP	Gray **SANDY GRAVEL (BASALTIC)** with a little silt, dry (base material)
	10				33	4.5				MH	Reddish brown **CLAYEY SILT** with a little gravel (basaltic), hard, dry (fill)
Direct Shear	9	127			54	4.5	5				grades to very stiff
										ML	Orangish brown with some gray mottling **SANDY SILT**, hard, dry (alluvium)
LL=NP PI=NP	29				31		10				
										MH	Brown **CLAYEY SILT** with traces of sand, soft, dry (alluvium)
- #200 = 99.3%	48	58			5	3.0	15				
											Boring terminated at 16.5 feet
							20				
							25				

Date Started:	June 21, 2024
Date Completed:	June 21, 2024
Logged By:	N. Mc Clean
Total Depth:	16.5 feet
Work Order:	8859-00

Water Level: ▼	Not Encountered
Drill Rig:	CME-45C TRUCK
Drilling Method:	4" Solid-Stem Auger
Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 16

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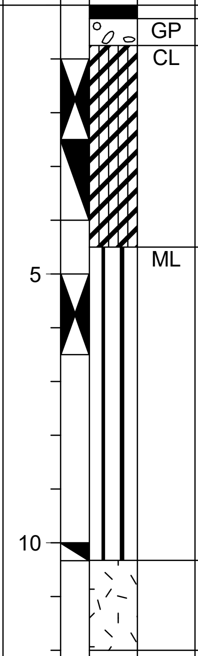
Log of Boring

17

Approximate Ground Surface
Elevation : N/A



Laboratory			Field								
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Description
											3-inch **ASPHALTIC CONCRETE**
										GP	Gray **SANDY GRAVEL (BASALTIC)** with a little silt, dry (base material)
	18	115			28	4.5				CL	Brown **SANDY CLAY** with a little gravel (basaltic), medium stiff to very stiff, dry (fill)
LL=35 PI=15	27				7						
	32	87			109	4.5	5			ML	Brown **SANDY SILT** with some cobbles (basaltic), hard (fill)
	14				40/4"		10				
											Gray dense **BASALT**, slightly weathered, very hard (basalt formation)
											Boring terminated at 12 feet
							15				
							20				
							25				

Date Started: June 24, 2024
Date Completed: June 24, 2024
Logged By: N. Mc Clean
Total Depth: 12 feet
Work Order: 8859-00

Water Level: ▼ Not Encountered

Drill Rig: CME-45C TRUCK
Drilling Method: 4" Casing
Driving Energy: 140 lb. wt., 30 in. drop

Plate

A - 17

APPENDIX B

APPENDIX B

Laboratory Tests

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

Eleven Atterberg Limits tests (ASTM D4318) were performed on selected soil samples to evaluate the liquid and plastic limits. The test results are summarized on the Logs of Borings at the appropriate sample depths. Graphic presentations of the test results are provided on Plates B-1 and B-2.

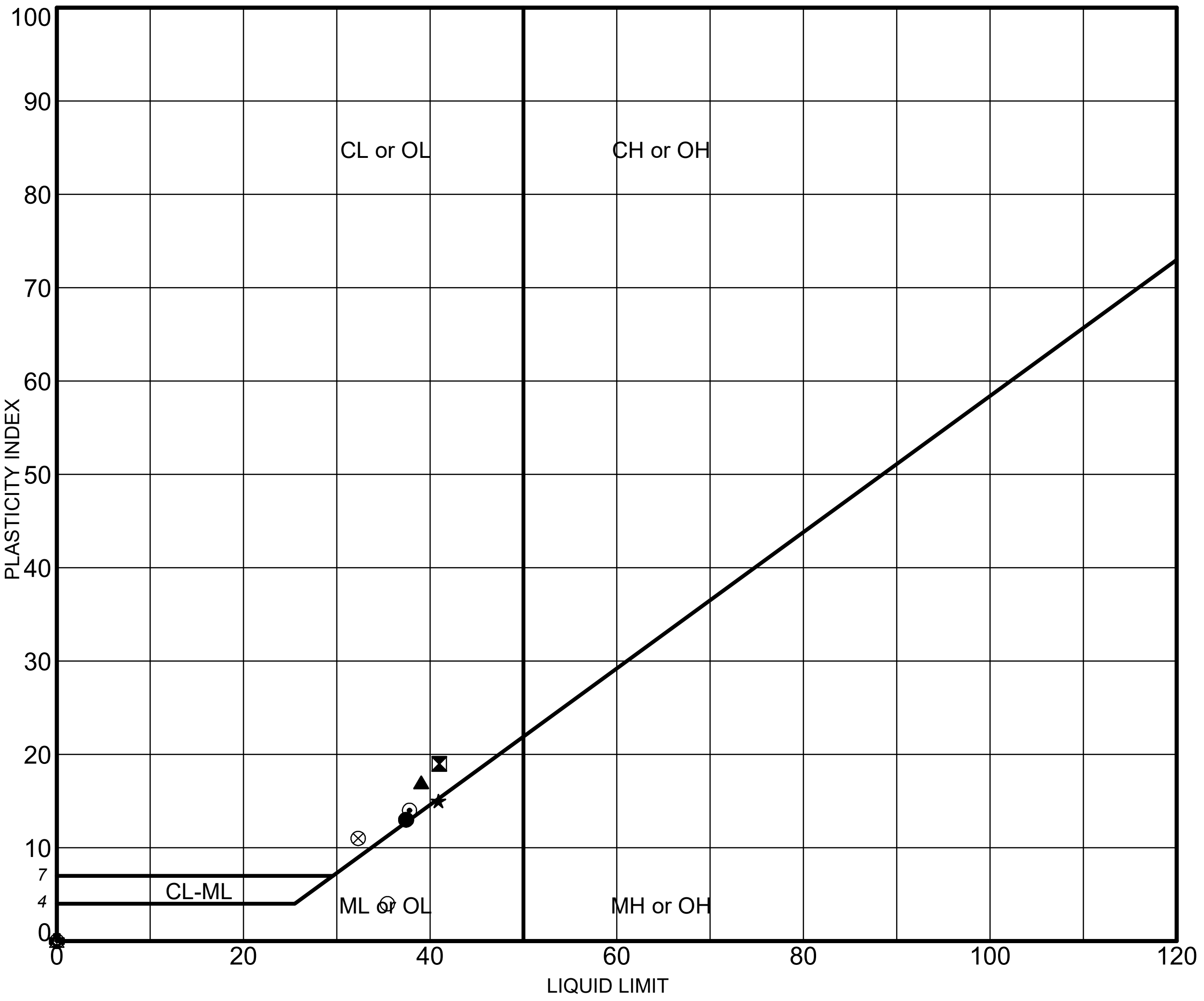
Two Sieve Analysis tests (ASTM C117 & C136) were performed on selected soil samples to evaluate the gradation characteristics of the soils and to aid in soil classification. Graphic presentations of the grain size distributions are provided on Plate B-3.

Three Direct Shear tests (ASTM D3080) were performed on selected samples to evaluate the shear strength characteristics of the materials tested. The test results are presented on Plates B-4 through B-6.

Four Unconsolidated Undrained Triaxial Compression tests (ASTM D2850) were performed on selected soil samples to evaluate the undrained shear strength of the in-situ soils. The approximate in-situ effective overburden pressure was used as the applied confining pressure for the relatively “undisturbed” soil sample. The test results and the stress-strain curves are presented on Plates B-7 through B-10.

Thirteen Uniaxial Compression tests (ASTM D7012, Method C) were performed on selected intact core runs to evaluate the unconfined compressive strength of the basalt formation encountered. The test results are presented on Plate B-11.

Five sets of Corrosivity tests, including pH (ASTM G51), Minimum Resistivity (ASTM G57), Chloride Content (EPA 300.0), and Sulfate Content (EPA 300.0), were performed by our office and CERCO Analytical, Inc. on selected soil samples obtained from our field exploration. The test results are summarized on Plate B-12.



	Sample	Depth (ft)	LL	PL	PI	Description
●	B-1	5.0-6.5	37	24	13	Brown w/ multi-color mottling sandy clay (CL) with some gravel
⧗	B-2	0.8-2.3	41	22	19	Red-brown w/ some multi-color mott. sandy clay (CL) w/ some gravel
▲	B-4	10.0-10.5	39	22	17	Brown with orange mottling sandy clay (CL)
★	B-6	2.8-4.3	41	26	15	Brown sandy silt (ML) with traces of gravel
⦿	B-7	5.0-6.5	38	24	14	Reddish brown sandy clay (CL)
✿	B-8	20.0-21.5	NP	NP	NP	Reddish brown sandy silt (NP)
○	B-10	1.8-3.3	35	31	4	Brown w/ orange mottling sandy silt (ML) with a little gravel
△	B-12	10.0-11.5	NP	NP	NP	Brown sandy silt (NP) with some gravel
⊗	B-15	1.0-2.5	32	21	11	Brown sandy clay (CL) with some gravel
⊕	B-16	10.0-11.5	NP	NP	NP	Orangish brown w/ gray mottling sandy silt (NP)

NP = NON-PLASTIC

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ATTERBERG LIMITS TEST RESULTS - ASTM D4318

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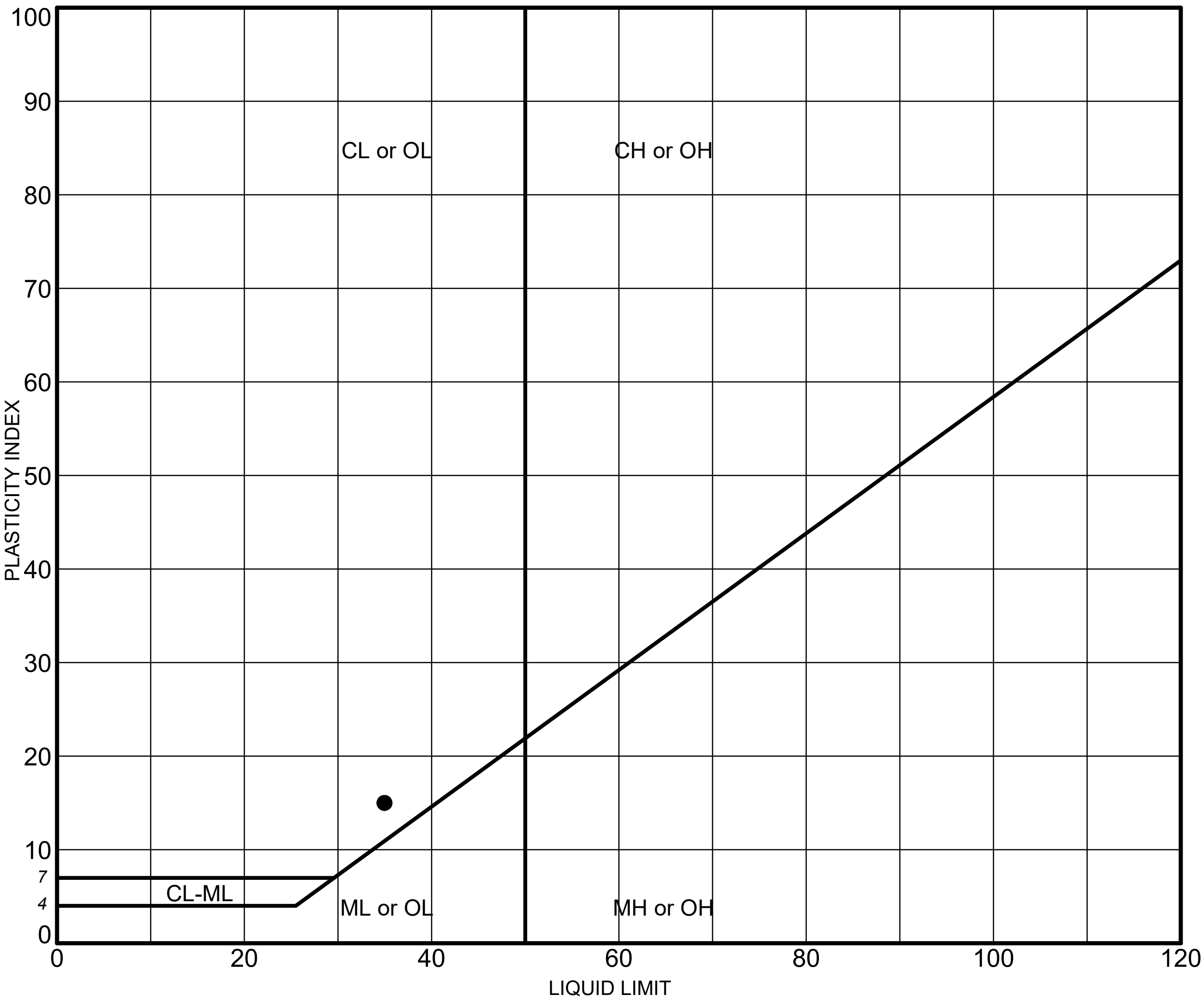
Plate
B - 1



	Sample	Depth (ft)	LL	PL	PI	Description
●	B-17	2.5-4.0	35	20	15	Brown sandy clay (CL) with a little gravel

NP = NON-PLASTIC

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ATTERBERG LIMITS TEST RESULTS - ASTM D4318

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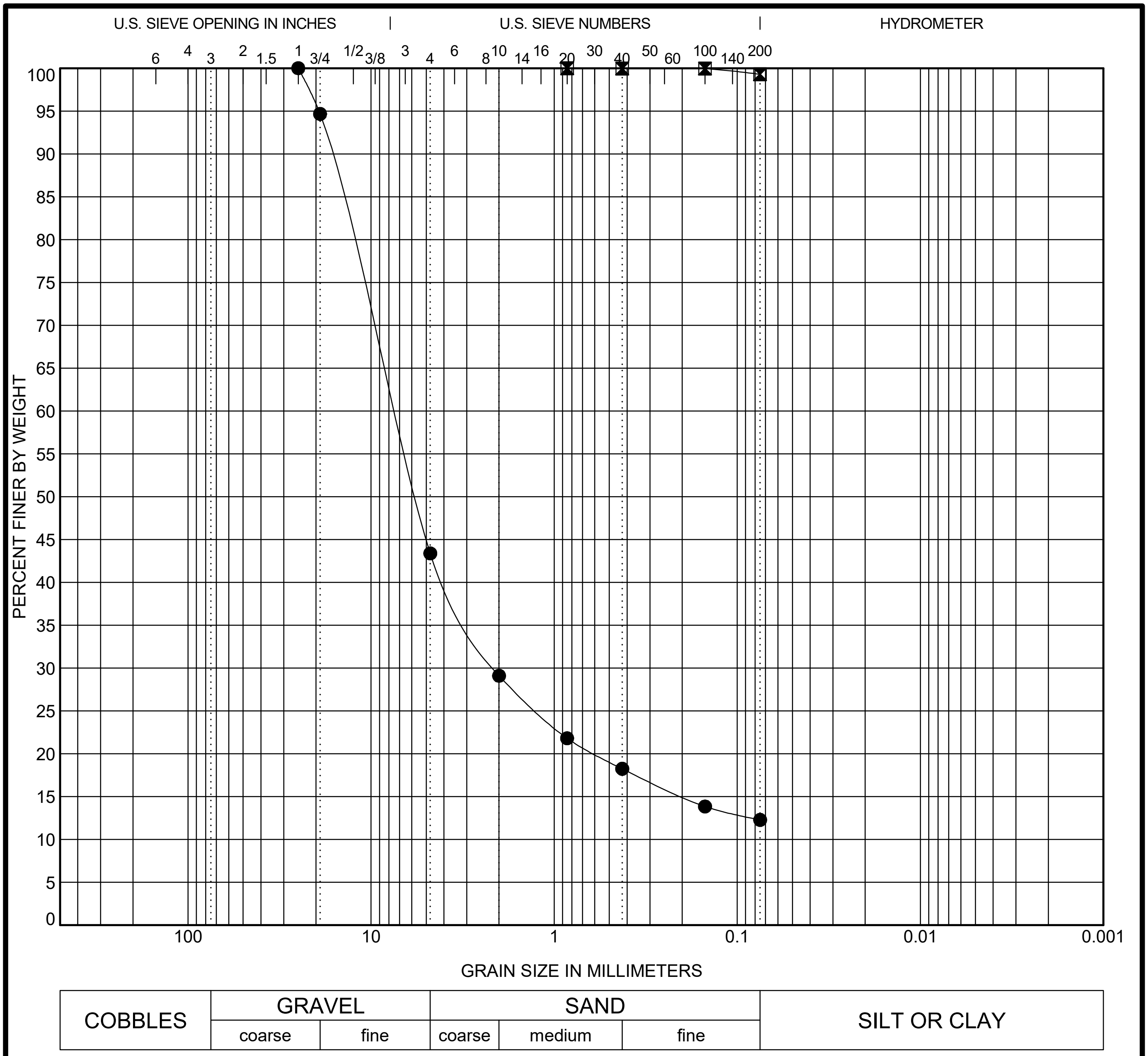
Plate
B - 2



	Sample	Depth (ft)	Description	LL	PL	PI	Cc	Cu
●	B-6	5.0-6.5	Tannish brown silty gravel (GM) with some sand				21.8	270.6
☒	B-16	15.0-16.5	Brown clayey silt (ML) with traces of sand					

	Sample	Depth (ft)	D100 (mm)	D60 (mm)	D30 (mm)	D10 (mm)	%Gravel	%Sand	%Fine
●	B-6	5.0-6.5	25	7.445	2.113		56.6	31.1	12.3
☒	B-16	15.0-16.5	0.85				0.0	0.7	99.3

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GRAIN SIZE DISTRIBUTION - ASTM C 117 & C 136

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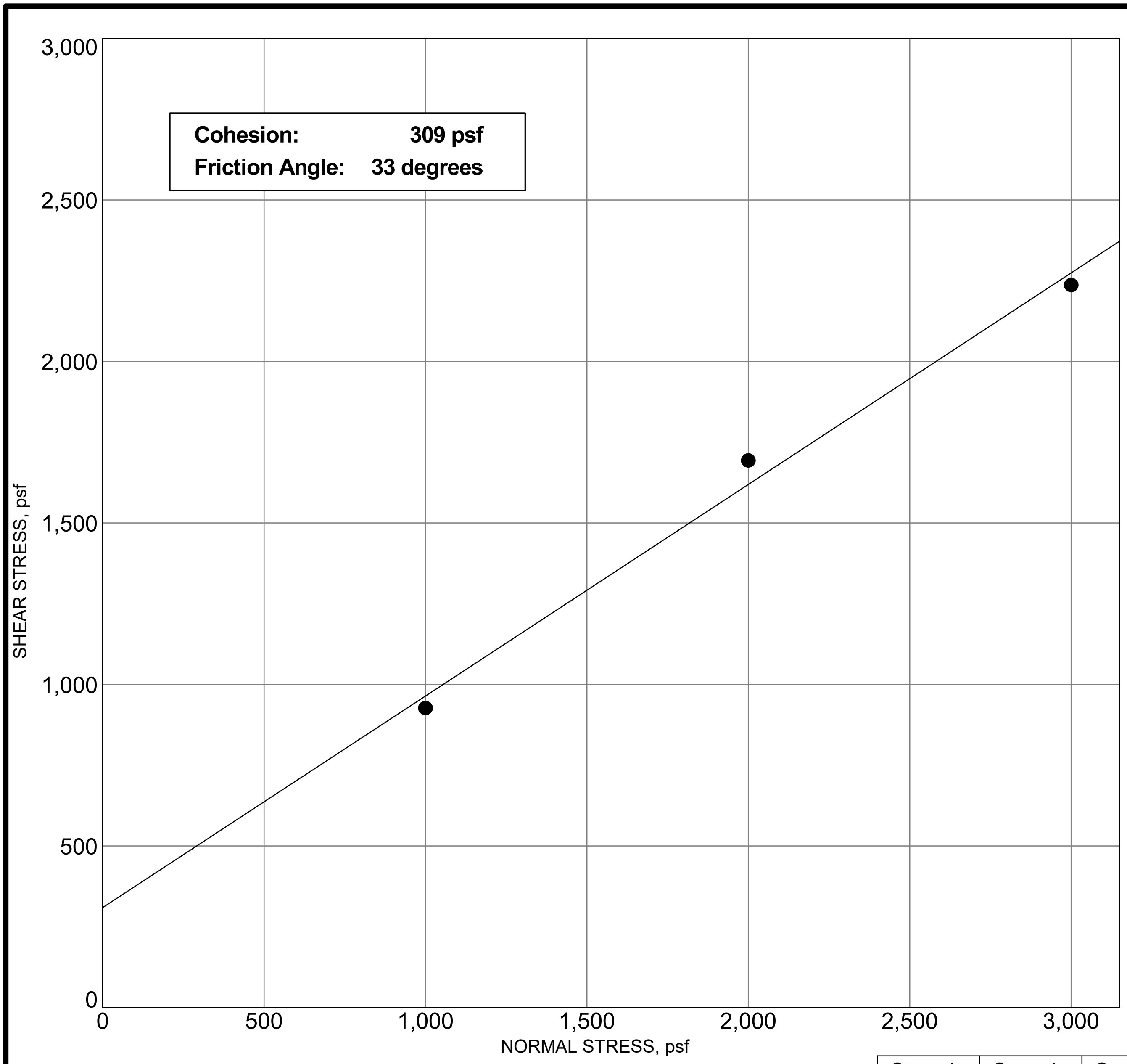
Plate
B - 3



		Sample #1	Sample #2	Sample #3
INITIAL	Moisture Content, %	28.7	29.2	29.5
	Dry Density, pcf	85.1	88.7	88.6
	Height, inches	1.00	1.00	1.00
FINAL	Moisture Content, %	35.6	33.0	31.8
	Dry Density, pcf	81.4	92.3	91.9
	Height, inches	1.045	0.961	0.964
	Diameter, inches	2.42	2.42	2.42
	Deformation Rate, inch/minute	0.0025	0.0022	0.0020
	Normal Stress, psf	**1000**	**2000**	**3000**
	Peak Shear Stress, psf	**927**	**1693**	**2237**
	Shear Displacement, inches	0.43	0.42	0.41

Sample:	B-8
Depth:	5.0 - 6.5 feet
Description:	Reddish brown clayey silt

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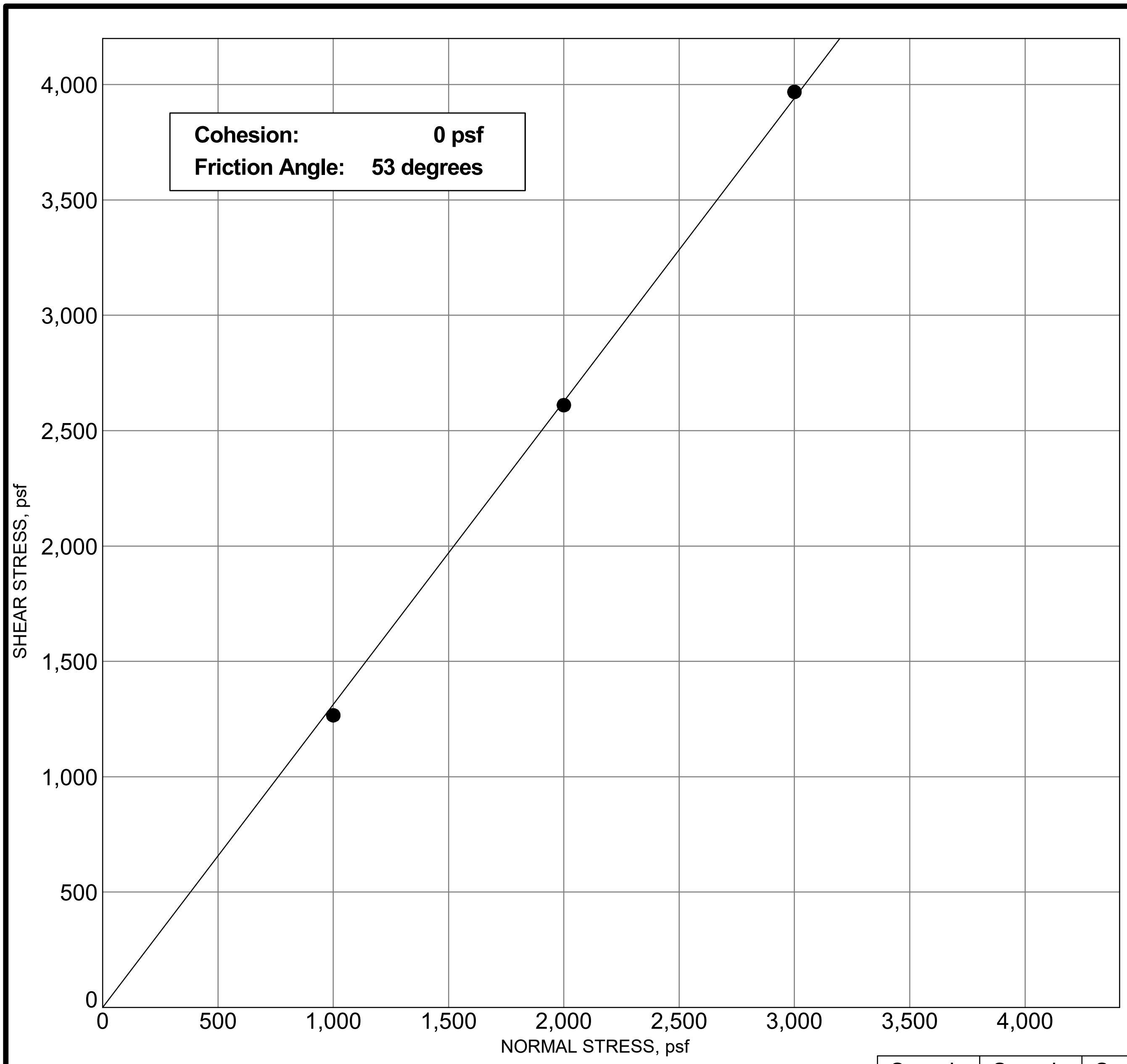
DIRECT SHEAR TEST - ASTM D3080

APRON LIGHT REPLACEMENT
KAHULUI AIRPORT
KAHULUI, MAUI, HAWAII
STATE PROJECT NO. AS1037-12

Plate
B - 4



		Sample #1	Sample #2	Sample #3
INITIAL	Moisture Content, %	21.7	22.6	15.1
	Dry Density, pcf	105.5	105.1	116.7
	Height, inches	1.00	1.00	1.00
FINAL	Moisture Content, %	26.8	24.6	17.8
	Dry Density, pcf	103.2	106.7	117.2
	Height, inches	1.023	0.985	0.996
	Diameter, inches	2.42	2.42	2.42
	Deformation Rate, inch/minute	0.0024	0.0020	0.0021
	Normal Stress, psf	**1000**	**2000**	**3000**
	Peak Shear Stress, psf	**1266**	**2611**	**3968**
	Shear Displacement, inches	0.43	0.40	0.40

Sample: B-12
Depth: 1.0 - 2.5 feet
Description: Brown silty clay with some gravel

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APRON LIGHT REPLACEMENT
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Plate
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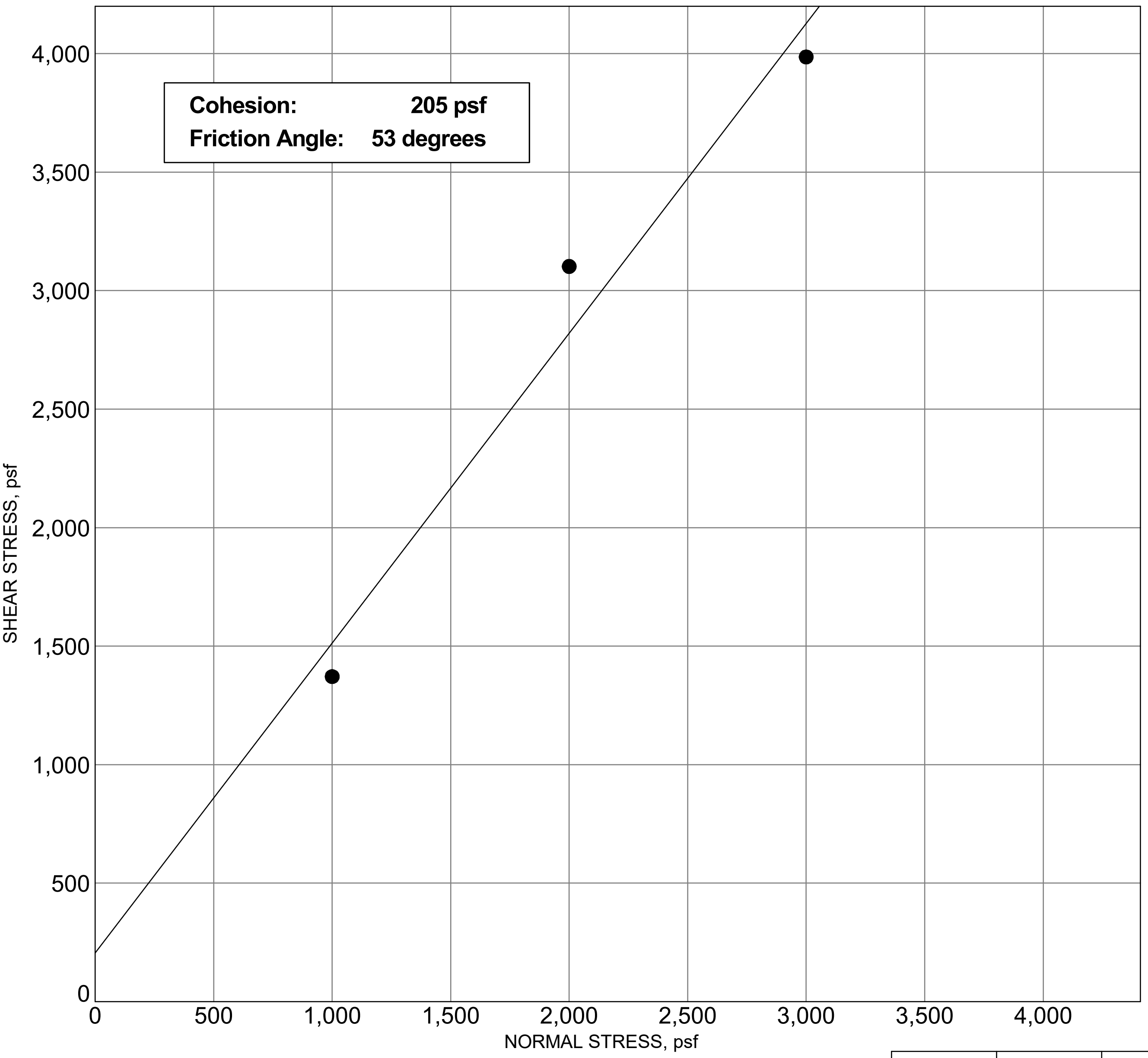

Sample: B-16
Depth: 5.0 - 6.5 feet
Description: Reddish brown clayey silt with a kittle gravel

		Sample #1	Sample #2	Sample #3
INITIAL	Moisture Content, %	14.7	14.6	14.2
	Dry Density, pcf	113.5	116.0	122.7
	Height, inches	1.00	1.00	1.00
FINAL	Moisture Content, %	20.2	17.8	16.9
	Dry Density, pcf	111.3	118.1	120.7
	Height, inches	1.019	0.981	1.017
	Diameter, inches	2.42	2.42	2.42
	Deformation Rate, inch/minute	0.0024	0.0022	0.0021
	Normal Stress, psf	**1000**	**2000**	**3000**
	Peak Shear Stress, psf	**1371**	**3102**	**3986**
	Shear Displacement, inches	0.42	0.39	0.39

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DIRECT SHEAR TEST - ASTM D3080

APRON LIGHT REPLACEMENT
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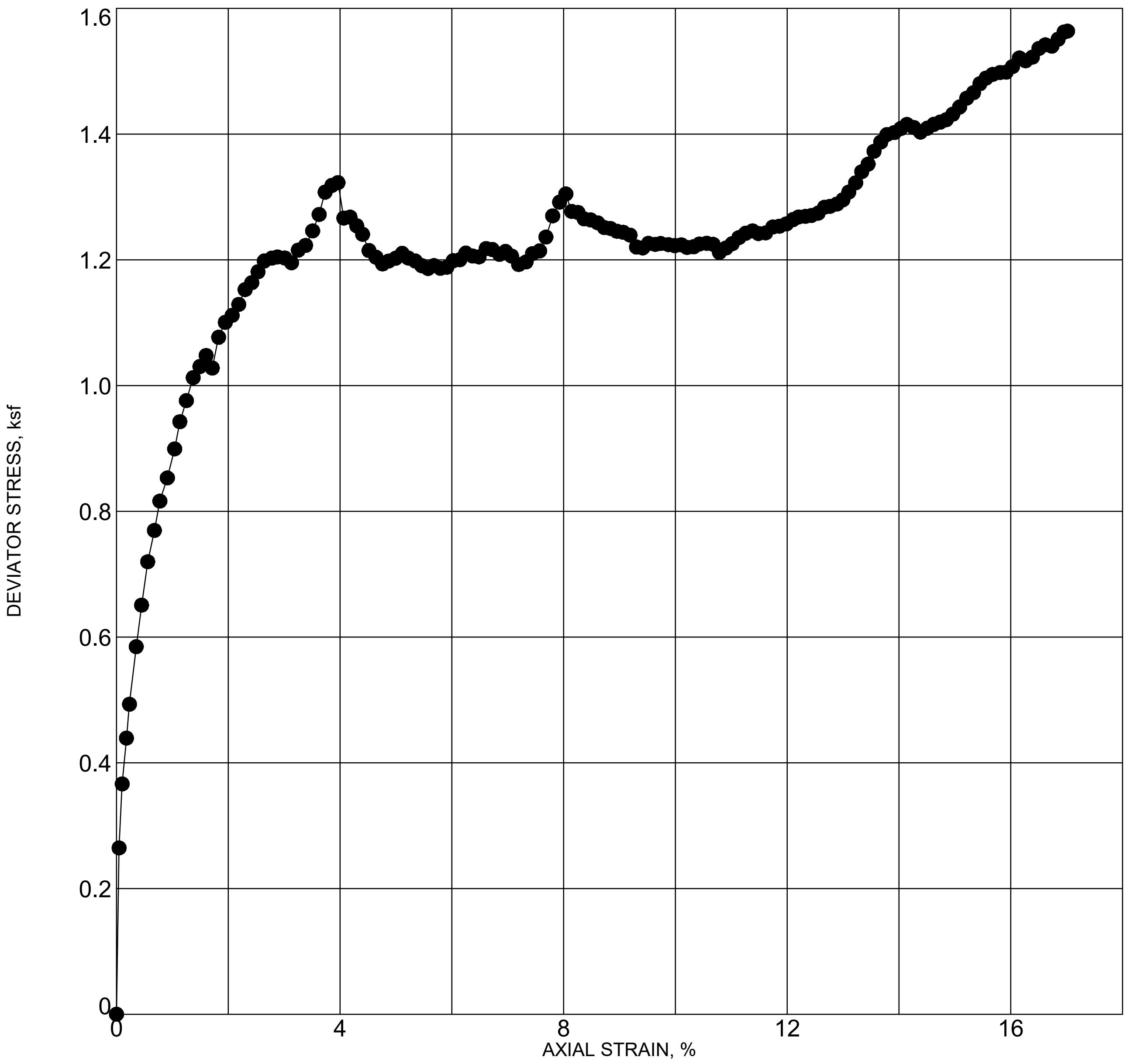
Plate
B - 6



Max. Deviator Stress (ksf):	1.4
Confining Stress (ksf):	0.7

Location: B-4
Depth: 5.0 - 6.5 feet
Description: Brown with orange mottling sandy clay with a little gravel
Test Date: 7/13/2024

Dry Density (pcf)	114.4	Sample Diameter (inches)	2.413
Moisture (%)	14.3	Sample Height (inches)	5.033
Axial Strain at Failure (%)	15.0	Strain Rate (% / minute)	0.70

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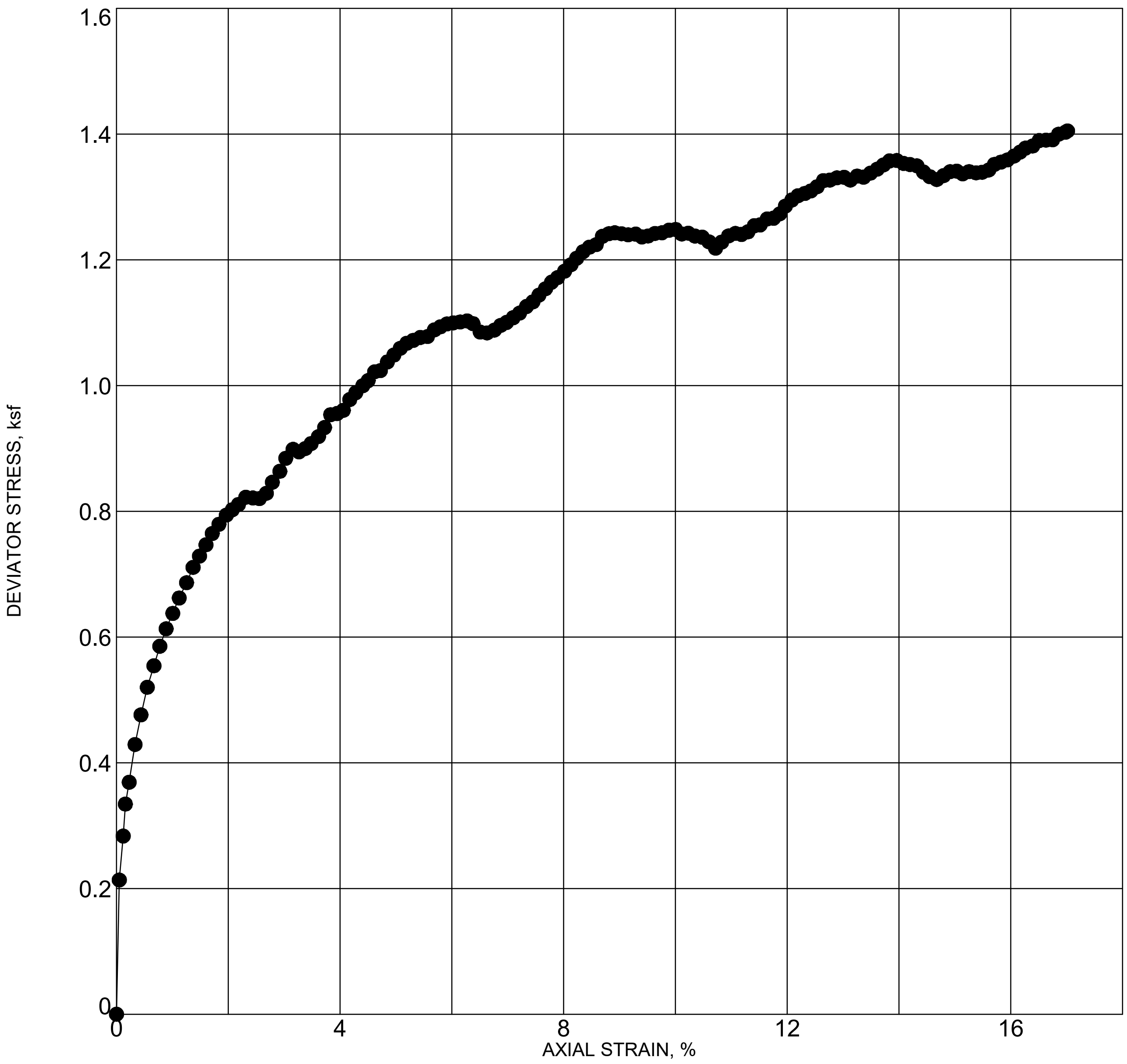
TRIAXIAL UU COMPRESSION TEST - ASTM D2850

APRON LIGHT REPLACEMENT
KAHULUI AIRPORT
KAHULUI, MAUI, HAWAII
STATE PROJECT NO. AS1037-12

Plate
B - 7

G_TXUU 8859-00.GPJ GEOLABS.GDT 10/2/24



Max. Deviator Stress (ksf):	1.3
Confining Stress (ksf):	1.7

Location:	B-8
Depth:	15.0 - 16.5 feet
Description:	Brown clayey silt
Test Date:	7/18/2024

Dry Density (pcf)	96.3	Sample Diameter (inches)	2.413
Moisture (%)	24.4	Sample Height (inches)	5.033
Axial Strain at Failure (%)	14.9	Strain Rate (% / minute)	0.70

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TRIAXIAL UU COMPRESSION TEST - ASTM D2850

APRON LIGHT REPLACEMENT
KAHULUI AIRPORT
KAHULUI, MAUI, HAWAII
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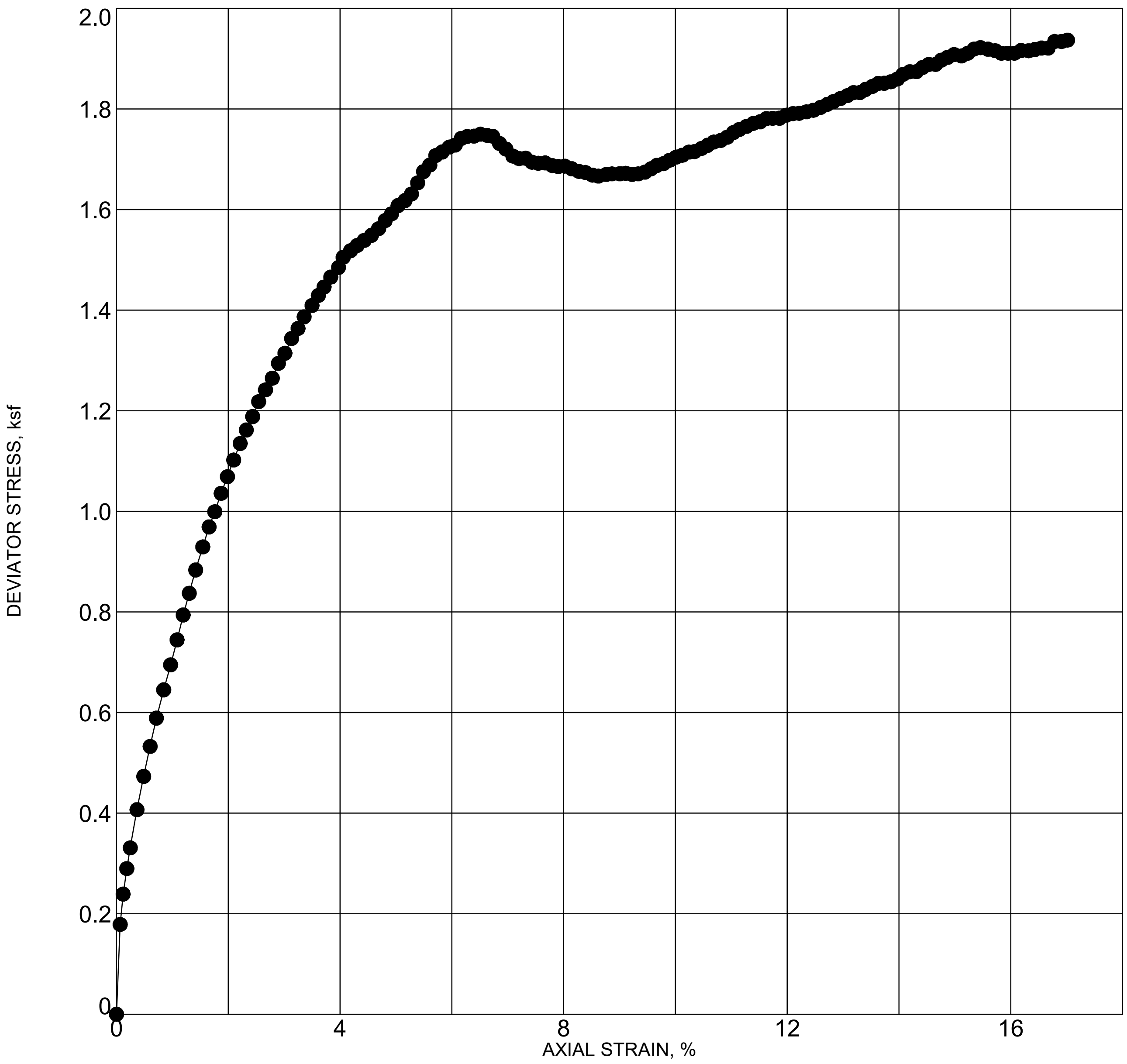

Max. Deviator Stress (ksf):	1.9
Confining Stress (ksf):	0.7

Location: B-11
Depth: 5.0 - 6.5 feet
Description: Brown clayey silt with a little sand
Test Date: 7/18/2024

Dry Density (pcf)	72.5	Sample Diameter (inches)	2.413
Moisture (%)	37.0	Sample Height (inches)	5.033
Axial Strain at Failure (%)	15.0	Strain Rate (% / minute)	0.67

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TRIAXIAL UU COMPRESSION TEST - ASTM D2850

APRON LIGHT REPLACEMENT
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KAHULUI, MAUI, HAWAII
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Plate
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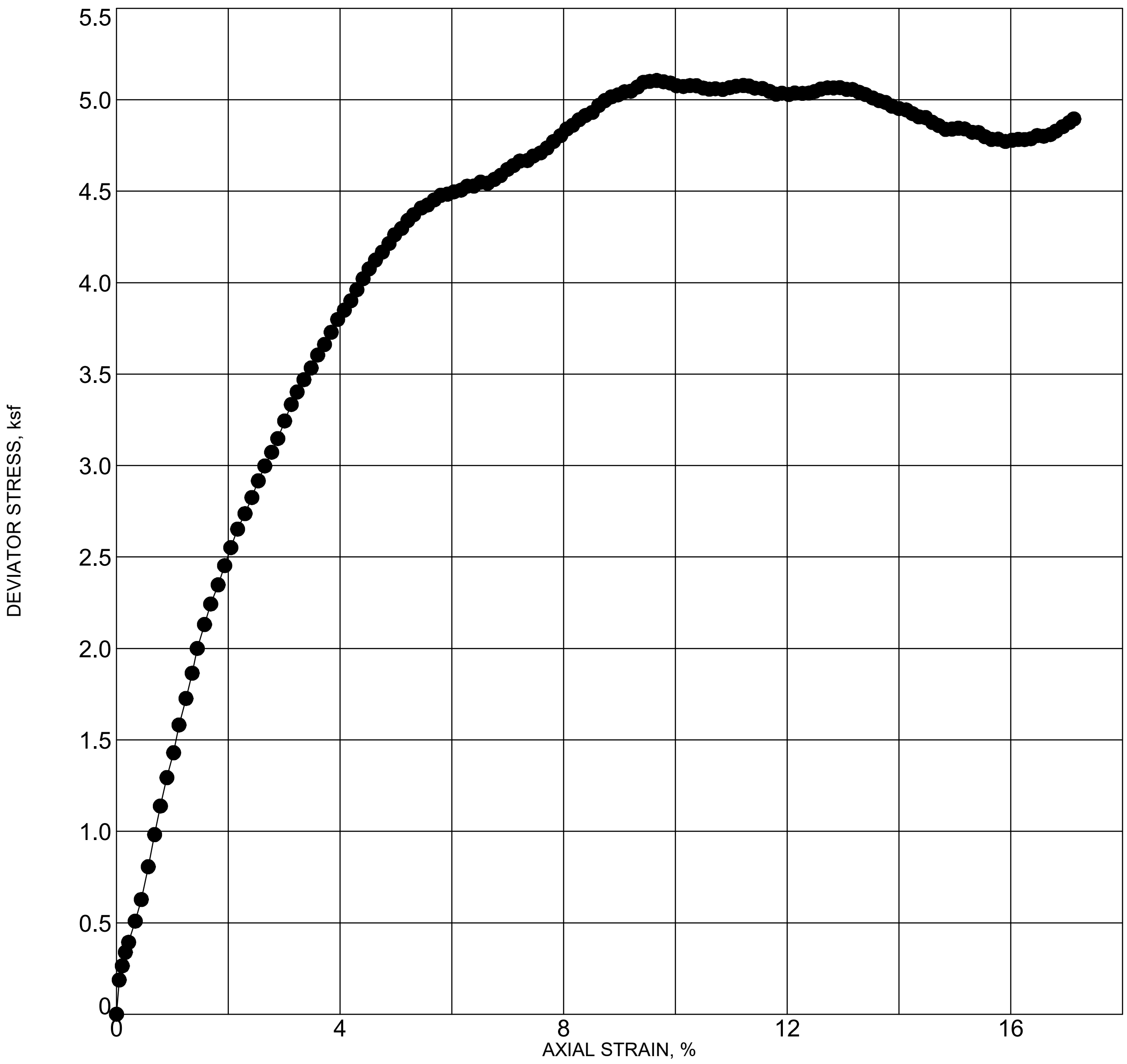
G_TXUU 8859-00.GPJ GEOLABS.GDT 10/2/24



Max. Deviator Stress (ksf):	5.1
Confining Stress (ksf):	1.7

Location: B-12
Depth: 15.0 - 16.5 feet
Description: Brown with some multi-color mottling clayey silt
Test Date: 7/18/2024

Dry Density (pcf)	103.6	Sample Diameter (inches)	2.413
Moisture (%)	22.8	Sample Height (inches)	5.033
Axial Strain at Failure (%)	9.7	Strain Rate (% / minute)	0.70

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TRIAXIAL UU COMPRESSION TEST - ASTM D2850

APRON LIGHT REPLACEMENT
KAHULUI AIRPORT
KAHULUI, MAUI, HAWAII
STATE PROJECT NO. AS1037-12

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Location	Depth	Length	Diameter	Length/ Diameter Ratio	Density	Load	Compressive Strength
	(feet)	(inches)	(inches)		(pcf)	(lbs)	(psi)
B-1	10.5 - 11	4.880	2.400	2.03	135.1	23,630	5,220
B-2	4 - 4.5	4.960	2.400	2.07	178.7	62,895	13,900
B-2	13 - 13.5	4.880	2.400	2.03	182.3	148,350	32,790
B-3	8 - 8.5	4.920	2.400	2.05	180.0	122,130	27,000
B-3	11.5 - 12	4.850	2.400	2.02	179.8	98,760	21,830
B-5	5 - 5.5	6.490	3.250	2.00	174.2	104,590	12,610
B-5	13 - 13.5	6.510	3.250	2.00	178.7	88,245	10,640
B-7	14 - 14.5	4.880	2.400	2.03	178.3	128,410	28,380
B-9	5.5 - 6	4.900	2.400	2.04	173.9	52,155	11,530
B-10	12 - 12.5	6.500	3.250	2.00	179.7	82,070	9,890
B-13	9.5 - 10	4.870	2.400	2.03	178.6	85,695	18,940
B-14	8.5 - 9	4.900	2.400	2.04	177.9	127,250	28,130
B-15	15.5 - 16	4.850	2.400	2.02	178.2	102,510	22,660

ASTM D7012 (METHOD C)

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

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UNIAXIAL COMPRESSIVE STRENGTH TEST

APRON LIGHT REPLACEMENT
KAHULUI AIRPORT
KAHULUI, MAUI, HAWAII
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Location	Depth (feet)	pH Value	Minimum Resistivity (ohm-cm)	Chloride Content (mg/kg)	Sulfate Content (mg/kg)
B-4	1.5 - 3.0	8.38*	3000*	ND	47
B-7	3.0 - 4.5	8.02*	1600*	ND	83
B-9	1.0 - 2.5	8.29*	2500*	16	21
B-13	1.0 - 2.5	8.18*	2700*	ND	38
B-16	1.0 - 2.5	8*	1200*	110	75

TEST METHODS (by CERCO Analytical, Inc.)

pH Value	Method 9045C
Minimum Resistivity	SM 2510B
Chloride Content	EPA 300.0
Sulfate Content	EPA 300.0

TEST METHODS (by Geolabs, Inc.)*

pH Value	ASTM G51
Minimum Resistivity	ASTM G57
Chloride Content	N/A
Sulfate Content	N/A

ND: Not Detected Within Reporting Limits

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SUMMARY OF CORROSIVITY TESTS

APRON LIGHT REPLACEMENT
KAHULUI AIRPORT
KAHULUI, MAUI, HAWAII
STATE PROJECT NO. AS1037-12

Plate
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APPENDIX C

APRON LIGHT REPLACMENT – KAHULUI AIRPORT
KAHULUI, MAUI, HAWAII

B-1   10.0’ TO 21.5’

10.0’

21.5’

B-2   3.0’ TO 20.5’

3.0’

20.5’

APRON LIGHT REPLACMENT – KAHULUI AIRPORT
KAHULUI, MAUI, HAWAII

B-3 1.5’ TO 16.0’

1.5’ 11.0’

11.0’ 16.0’

APRON LIGHT REPLACMENT – KAHULUI AIRPORT
KAHULUI, MAUI, HAWAII

B-5 3.5’ TO 21.0’

3.5’ 6.0’ 11.0’ 16.0’

6.0’ 11.0’ 16.0’ 21.0’

APRON LIGHT REPLACMENT – KAHULUI AIRPORT
KAHULUI, MAUI, HAWAII

B-7 10.0’ TO 21.0’

10.0’

21.0’

APRON LIGHT REPLACMENT – KAHULUI AIRPORT
KAHULUI, MAUI, HAWAII

B-9 5.0’ TO 21.0’

APRON LIGHT REPLACMENT – KAHULUI AIRPORT
KAHULUI, MAUI, HAWAII

B-10 5.5’ TO 16.0’

5.5’

16.0’

B-13 8.5’ TO 15.0’

8.5’

15.0’

APRON LIGHT REPLACMENT – KAHULUI AIRPORT
KAHULUI, MAUI, HAWAII

B-14 3.0' TO 16.5'

3.0' **11.5'**

11.5' **16.5'**

B-15 4.0' TO 16.0'

4.0'

16.0'

GEOTECHNICAL ENGINEERING EXPLORATION
APRON LIGHT REPLACEMENT – LANAI AIRPORT
ISLAND OF LANAI, HAWAII
STATE PROJECT NO. AS1037-12

W.O. 8860-00 NOVEMBER 12, 2024

Prepared for

RONALD N.S. HO & ASSOCIATES

GEOLABS, INC.
Geotechnical Engineering and Drilling Services

GEOTECHNICAL ENGINEERING EXPLORATION
APRON LIGHT REPLACEMENT – LANAI AIRPORT
ISLAND OF LANAI, HAWAII
STATE PROJECT NO. AS1037-12

W.O. 8860-00 NOVEMBER 12, 2024

Prepared for

RONALD N.S. HO & ASSOCIATES

JOHN Y. L. CHEN
LICENSED
PROFESSIONAL
ENGINEER
No. 10029-C

THIS WORK WAS PREPARED BY
ME OR UNDER MY SUPERVISION.

John Chen 4-30-26
SIGNATURE EXPIRATION DATE
OF THE LICENSE

GEOLABS, INC.
Geotechnical Engineering and Drilling Services
94-429 Koaki Street, Suite 200 • Waipahu, HI 96797

Hawaii • California

GEOLABS, INC.

Geotechnical Engineering and Drilling Services

November 12, 2024
W.O. 8860-00

Mr. Billy J. Ornellas
Ronald N.S. Ho & Associates
2153 North King Street, Suite 201
Honolulu, HI 96819

Dear **Mr. Ornellas:**

Geolabs, Inc. is pleased to submit our report entitled "Geotechnical Engineering Exploration, Apron Light Replacement – Lanai Airport, Island of Lanai, Hawaii, State Project No. AS1037-12," prepared for the proposed project.

Our work was performed in general accordance with the scope of services outlined in our revised fee proposal dated January 17, 2023.

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

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

Very truly yours,

GEOLABS, INC.

John Chen

John Y.L. Chen, P.E.
Vice President

JC:TO:lf

94-429 Koaki Street, Suite 200 • Waipahu, Hawaii 96797
Telephone: (808) 841-5064 • E-mail: hawaii@geolabs.net

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GEOTECHNICAL ENGINEERING EXPLORATION
APRON LIGHT REPLACEMENT – LANAI AIRPORT
ISLAND OF LANAI, HAWAII
STATE PROJECT NO. AS1037-12
W.O. 8860-00 NOVEMBER 12, 2024

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APPENDIX B

GEOTECHNICAL ENGINEERING EXPLORATION
APRON LIGHT REPLACEMENT – LANAI AIRPORT
ISLAND OF LANAI, HAWAII
STATE PROJECT NO. AS1037-12
W.O. 8860-00 NOVEMBER 12, 2024

SUMMARY OF FINDINGS AND RECOMMENDATIONS

Our field exploration generally encountered a thin layer of surficial fill overlying relatively stiff alluvium and residual soils extending to depths of about 16.5 to 21.5 feet below the existing ground surface. Groundwater was not encountered at the time of our field exploration. However, it should be noted that groundwater levels are subject to change due to rainfall, time of year, seasonal precipitation, surface water runoff, and other factors.

We recommend designing a cast-in-place concrete drilled shaft foundation system to support the proposed new apron lighting structures. We envision that drilled shaft foundations with a minimum diameter of 30 inches may be used to support the new apron light structures with a minimum embedment length of 20 feet below the designed finished grade.

The load-bearing capacities of the drilled shafts depend, to a significant extent, on the friction between the shaft and the surrounding soils. Therefore, proper construction techniques, especially during the drilling operations, are important. The contractor should exercise care in drilling the shaft holes and placing concrete into the drilled holes. It is imperative for a Geolabs representative to be present at the project site to observe the drilling and installation of the drilled shafts during construction to confirm the subsurface conditions and should be designated as a "Special Inspection" item in accordance with Section 1704 of the International Building Code (2018 Edition).

The text of this report should be referred to for detailed discussions and specific geotechnical recommendations.

END OF SUMMARY OF FINDINGS AND RECOMMENDATIONS

SECTION 1. GENERAL

This report presents the results of our geotechnical engineering exploration performed for the *Apron Light Replacement* project located at the Lanai Airport on the Island of Lanai, Hawaii. The project location and general vicinity are shown on the Project Location Map, Plate 1.

This report summarizes the findings and geotechnical recommendations resulting from our field exploration, laboratory testing, and engineering analyses for the project. These findings and geotechnical recommendations are intended for the design of the light pole foundations only. The findings and recommendations presented herein are subject to the limitations noted at the end of this report.

1.1 Project Considerations

The project site is located at the Lanai Airport on the Island of Lanai, Hawaii. Based on the information provided, we understand the existing apron lighting system will be replaced with a new lighting system to meet Maui County's new outdoor lighting standards. In addition, we understand that all street and building-mounted exterior lighting on Lanai Airport property will also be replaced.

The following structural loading information was provided by the structural engineer and used for the foundation design analyses of the new apron light pole structures.

FACTORED STRUCTURAL LOADING INFORMATION	
Axial Loading	23 kip
Shear Loading	6 kip
Moment Loading	166 kip-foot

1.2 Purpose and Scope

The purpose of our exploration was to obtain an overview of the surface and subsurface conditions at the site to develop a soil and/or rock data set to formulate geotechnical recommendations in support of the design of the Apron Light Replacement project at Lanai Airport. The work was performed in general accordance with our revised fee proposal dated January 17, 2023. The scope of work for this exploration included the following tasks and work efforts:

1. Research and review of the available reports/plans, in-house soil, and geologic information related to the project site.
2. Application for FAA 7460 permits and One–Call utility clearance.
3. Coordination of site access and underground utility toning by our engineer or geologist.
4. Preparation of an accident prevention plan with activity hazard analysis in support of our field exploration activities.
5. Retaining soil cuttings, drilling fluids, and safety disposables in the DOT-approved 55-gallon steel drums and stored them to be tested and disposed of by others as appropriate.
6. Mobilization and demobilization of a truck-mounted drill rig, support truck, and two operators from Honolulu to the project site and back.
7. Drilling and sampling of seven borings, each extending to depths of about 16.5 to 21.5 feet below the existing ground surface.
8. Backfilling the borings with non-shrink grout and topped with fast-setting concrete upon completion of the drilling, sampling, and field testing work.
9. Coordination of the field exploration and logging of the borings by our geologist.
10. Geotechnical laboratory testing of selected samples obtained during the field exploration as an aid in classifying the materials and evaluating their engineering properties.
11. Analyses of the field and laboratory data to formulate geotechnical recommendations for the design of the project.
12. Preparation of a technical memorandum and this report summarizing our work and presenting our findings and geotechnical recommendations for the project.
13. Coordination of our overall work on the project by our engineer.
14. Quality assurance of our work and client/design team consultation by our principal engineer.
15. Miscellaneous work efforts, such as drafting, word processing, and clerical support.

Detailed descriptions of our field exploration methodology and the Logs of Borings are presented in Appendix A. Results of the laboratory tests performed on selected soil samples are presented in Appendix B.

END OF GENERAL

SECTION 2. SITE CHARACTERIZATION

2.1 Regional Geology

The Island of Lanai is a shield volcano built by eruptions at the summit and along three rift zones more than 1.20 to 1.46 million years ago. The principal rift zone trends northwestward as a broad ridge and is responsible for the conspicuous elongation of the island in that direction. A less conspicuous bulge on the southern side of the island is the result of building on the southwest rift zone. The summit of the shield collapsed to form a caldera from which a shallow graben, bordered by an echelon of step faults, extends south-southeast toward Manele Bay. Numerous dikes exposed in the sea cliff indicate that this Manele Graben lies along another rift zone.

The caldera was largely, but not completely, filled by lava flows, and the present Palawai Basin is a remnant of the caldera. Just to the west of it, Miki Basin (with an average diameter of about 0.9 miles) is a nearly filled pit crater. The top of the ridge between these basins is about 140 feet above the floor of the Palawai Basin. On the south, the floor of Palawai Basin merges with the floor of the Manele Graben, where the most recent lava flows in the caldera overflowed onto the outer slope of the volcano.

The Island of Lanai was built by the extrusion of thin-bedded a’a and pahoehoe tholeiitic basaltic flows that are generally inclined at about 6 to 15 degrees from horizontal (where not disturbed by faulting). Volcanic rocks on the Island of Lanai are grouped as the Lanai Volcanic Series. The near-surface soils generally consist of well-drained, fine-textured, and moderately fine-textured soils derived from volcanic ash and the in-situ weathering of the igneous rocks. The formation of the Island of Lanai is also the result of large changes in sea-level that caused submergence and re-emergence of the land mass through geologic time. Faulting and stream erosion, in conjunction with changes in sea-level, are also responsible for the high sea cliffs along the southern and western coastlines.

The project site is westerly from the Palawai Basin and is near the foothills of the central mountain portion of the island. The existing Lanai Airport was built in terraces through the mountain range with Kapano Gulch traversing northeast of the site and

Kaiholena Gulch across the north of the airport limits in an east-west direction. Most of the soils in the project area are alluvium and residual/saprolitic soils, derived from the gulch/stream depositions and in-situ weathering of volcanic ash and igneous rock. In general, the residual and saprolitic soils grade to basaltic rock formation with depth.

2.2 Existing Site Conditions

The proposed project site is located at the existing Lanai Airport on the Island of Lanai, Hawaii. Our field exploration involved working within the Air Operation Area (AOA) as well as in the existing airport parking lots.

Majority of the project site was covered with asphalt concrete pavement. At the time of our field exploration, the parking area consisted mainly of passenger vehicles and pick-up trucks. The existing pavement was observed to be in fairly good condition. However, some minor pavement cracks were observed on the surface of the parking lots in isolated areas.

Based on Google Earth™, the project site terrain was relatively flat with existing ground surface elevations ranging from about +1,293 to +1,309 feet Mean Sea Level (MSL).

2.3 Subsurface Conditions

We explored the subsurface conditions by drilling and sampling seven borings, designated as Boring Nos. 1 through 7, extending to depths of about 16.5 to 21.5 feet below the existing ground surface. The approximate boring locations are shown on the Site Plan, Plate 2.

Based on our field exploration, the project site is generally underlain by a thin layer of surficial fills overlying alluvium and residual soils. The surficial fill soils generally consisted of 3 to 8 inches of asphaltic concrete and sandy gravel aggregate base. Underlying the asphalt pavement section, alluvial deposits consisting of medium stiff to very stiff clayey silt and silty clay were encountered at about 0.5 to 1 foot below the existing ground surface. The residual soils encountered in our borings drilled consisted of medium stiff to hard silty soils extending to depths of about 16.5 to 21.5 feet below the existing ground surface.

We did not encounter groundwater in the borings at the time of our field exploration. However, it should be noted that groundwater levels are subject to change due to rainfall, time of year, seasonal precipitation, surface water runoff, and other factors.

Detailed descriptions of the field exploration methodology and graphic representations of the materials encountered in the borings are presented on the Logs of Borings in Appendix A. We performed laboratory tests on selected soil samples obtained during our field exploration, and the test results are presented in Appendix B.

2.4 Seismic Design Considerations

Based on the International Building Code, 2018 Edition (IBC 2018), the project site may be subject to seismic activity, and seismic design considerations will need to be addressed. The following sections provide discussions on the soil profile type for seismic design and liquefaction design consideration at the project site.

Based on the subsurface materials encountered at the project site and the geologic setting of the area, we believe that the project site may be classified as a "Stiff Soil Profile" from a seismic analysis standpoint. Therefore, we believe the seismic design of the building structures may be designed based on a Site Class D soil profile in accordance with Chapter 20, Site Classification Procedure for Seismic Design, contained in ASCE Minimum Design Loads for Buildings and Other Structures, 2010 Edition (ASCE 7-10).

Based on a Site Class D soil profile, the following seismic design parameters shown in the table below were estimated and may be used for the seismic analysis of the project site.

SEISMIC DESIGN PARAMETERS

Parameter	Value
Peak Bedrock Acceleration, PBA (Site Class B)	0.309g
Mapped MCE Spectral Response Acceleration, S_S (Site Class B)	0.757g
Mapped MCE Spectral Response Acceleration, S_1 (Site Class B)	0.209g
Site Class	"D"
Site Coefficient, F_{pga}	1.291
Site Coefficient, F_a	1.197

SEISMIC DESIGN PARAMETERS	
Parameter	**Value**
Site Coefficient, F_v	2.182
Design Peak Ground Acceleration, PGA (Site Class D)	0.266g
Design Spectral Response Acceleration, S_{DS}	0.604g
Design Spectral Response Acceleration, S_{D1}	0.304g

Based on the subsurface conditions encountered, the phenomenon of soil liquefaction is not a design consideration for this project site. The risk for potential liquefaction is non-existent based on the subsurface conditions encountered (relatively stiff alluvium and residual soils in the absence of groundwater).

END OF SITE CHARACTERIZATION

SECTION 3. DISCUSSION AND RECOMMENDATIONS

Based on our field exploration, the project site is generally underlain by a thin layer of surficial fill overlying relatively stiff alluvium and residual soils extending to depths of about 16.5 to 21.5 feet below the existing ground surface. Groundwater was not encountered at the time of our field exploration. However, it should be noted that groundwater levels are subject to change due to rainfall, time of year, seasonal precipitation, surface water runoff, and other factors.

We recommend designing a cast-in-place concrete drilled shaft foundation system to support the proposed new apron lighting structures. We envision that drilled shaft foundations with a minimum diameter of 30 inches may be used to support the new apron light structures with a minimum embedment length of 20 feet below the designed finished grade.

A detailed discussion of these items and other geotechnical aspects of the project are further discussed in the following sections.

3.1 Drilled Shaft Foundations

To develop the required bearing and lateral load resistances, we recommend the new apron lighting structures be supported by a deep foundation system consisting of cast-in-place concrete drilled shafts. Detailed discussions and recommendations for foundation design are presented in the following sections.

3.1.1 Compressive Load Capacity

Based on the structural load demands provided and the subsoil conditions encountered at the project site, we recommend installing 30-inch diameter drilled shaft foundations with a minimum embedment length of 20 feet below the designed finished grade to support the new apron lighting.

The cast-in-place concrete drilled shafts would derive vertical support primarily from skin friction between the shaft and the surrounding soils. Allowable compressive load capacities of up to 75 kips may be achieved for the 30-inch diameter drilled shaft for dead-plus-live loads and may be increased by one-third (⅓) for transient loads, such as wind or seismic forces.

3.1.2 Lateral Load Resistance

The lateral load resistance of drilled shafts is a function of the stiffness of the surrounding soil, the stiffness of the drilled shaft, allowable deflection at the top of the drilled shaft, and the induced moment in the drilled shaft. The lateral load analyses were performed using the program *LPILE*, which is a microcomputer adaptation of a finite difference, laterally loaded deep foundation program originally developed at the University of Texas at Austin. The program solves for deflection and bending moment along a deep foundation under lateral loads as a function of depth. The analysis was carried out with the use of non-linear “p-y” curves to represent soil moduli. The lateral deflection was then computed using the appropriate soil moduli at various depths.

Based on the provided structural loads and the subsurface conditions encountered during our field exploration, we performed the lateral load analyses for the above drilled shaft foundations. The results of our analyses are summarized in the table below. The project structural engineer should verify the drilled shaft structural capacity for the calculated induced stresses.

<table>
<tr><th colspan="5">LATERAL LOAD CAPACITY AND MAXIMUM INDUCED MOMENT</th></tr>
<tr><th>Pile Diameter (inches)</th><th>Drilled Shaft Length (feet)</th><th>Lateral Deflection (inches)</th><th>Maximum Induced Moment (kip-feet)</th><th>Depth to Maximum Moment (feet)</th></tr>
<tr><td>30</td><td>20</td><td>0.2</td><td>170</td><td>1.5</td></tr>
<tr><td colspan="5">NOTE: Lateral load analysis based on concrete compressive strength of 4,000 psi and a minimum of 1% longitudinal steel reinforcement.</td></tr>
</table>

3.1.3 Foundation Settlement

Settlement of the drilled shaft foundations will result from elastic compression of the shaft and subgrade response of the foundation embedded in the soils encountered at the site. The total settlement of the drilled shaft is estimated to be less than 0.5

inches. We believe that a significant portion of the settlement will be elastic and should occur as the loads are applied.

3.1.4 Drilled Shaft Construction Considerations

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

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

We recommend concrete placement by using the tremie method during drilled shaft construction. A low-shrink concrete mix with a high slump (7 to 9-inch slump range) should be used to provide close contact between the drilled shafts and the surrounding soil. The concrete should be placed in a suitable manner to reduce the potential for segregation of the aggregates from the concrete mix. In addition, the concrete should be placed promptly after drilling (within 24 hours after drilling the holes) to reduce the potential for softening of the sides of the drilled hole.

It is imperative for a Geolabs representative to be present at the project site to observe the drilling and installation of the drilled shafts during construction. Although the drilled shafts are designed based primarily on skin friction, the bottom of the drilled holes should be relatively free of loose materials prior to placement of concrete. Therefore, it is necessary for Geolabs to observe the drilled shaft installation operations to confirm the subsurface conditions, and should be designated as a “Special Inspection” item in accordance with Section 1704 of the IBC 2018 Edition.

3.2 Corrosion Potential

Four sets of laboratory corrosivity tests, including pH (ASTM G51), Minimum Resistivity (ASTM G57), Chloride Content (EPA 300.0), and Sulfate Content (EPA 300.0), were performed (by our office and CERCO Analytical, Inc.) on selected soil samples obtained from our field exploration. The test results are summarized and presented on Plate B-12 of Appendix B.

Resistivity is generally recognized as one of the most significant soil characteristics with regard to the corrosivity of the soil to buried metallic objects. In general, the lower the resistivity, the greater the potential for corrosion of the buried metallic structure. Conversely, the higher the resistivity, the less likely the soil will contribute to the corrosion of metallic objects.

On the basis of the laboratory resistivity and pH results, the subsurface soils at the project site have resistivity values ranging from approximately 900 to 3,000 ohm-cm and pH values of between 6.5 and 8.0 within the upper 5 feet of soils, corresponding to a corrosion rating of 1 to 2 (Extremely Corrosive to Very Corrosive) based on the guidelines provided by the City & County of Honolulu – Board of Water Supply. Therefore, we recommend properly designing near-surface metallic substructures for protection against the potential for corrosion.

The method used to control the corrosion of underground concrete structures is dependent, in part, on the chloride content and sulfate content found in the soil. In general, soils with a chloride content of less than 500 parts per million (ppm), sulfate content of less than 2,000 ppm, and a pH greater than 5.0 may be considered “non-corrosive” to underground concrete pipelines and structures.

Based on the relatively low values of chloride content and sulfate content tested on the in-situ materials, we believe that the near-surface soils at the project site may be considered “non-corrosive” and either Type I or Type II (Type I/II) cement may be used for the concrete in contact with the ground. It may be appropriate to consult with a professional corrosion engineer to review the test results and provide detailed recommendations for corrosion protection.

3.3 Design Review

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

3.4 Construction Monitoring

Due to the variability in the subsurface conditions, it is recommended to retain Geolabs for geotechnical engineering services during the construction of the project. The following are critical items of construction monitoring that require "Special Inspection":

- Observation of drilled shaft foundation installation

A Geolabs representative should monitor other aspects of earthwork construction to observe compliance with the intent of the design concepts, specifications, and/or recommendations and to expedite suggestions for design changes that may be required in the event that subsurface conditions differ from those anticipated at the time this report was prepared. The recommendations presented herein are contingent upon such observations.

If the actual exposed subsurface soil conditions encountered during construction differ from those assumed or considered in this report, Geolabs should be contacted to review and/or revise the geotechnical recommendations presented herein.

END OF DISCUSSION AND RECOMMENDATIONS

SECTION 4. LIMITATIONS

The analyses and recommendations submitted herein are based in part upon information obtained from the field boring locations. Variations of the subsurface conditions between and beyond the field borings and bulk samples may occur, and the nature and extent of these variations may not become evident until construction is underway. If variations then appear evident, it will be necessary to re-evaluate the recommendations presented herein.

The field boring locations indicated herein are approximate, having been estimated by using a handheld Global Positioning System (GPS) to field-locate selected locations from referenced points shown on the Site Plan transmitted by Ronald N.S. Ho & Associates, Inc. in May 2024. The field boring locations should be considered accurate only to the degree implied by the methods used.

The stratification breaks shown on the graphic representations of the borings depict the approximate boundaries between soil types and, as such, may denote a gradual transition. Groundwater was not encountered at the time of our field exploration. However, it should be noted that groundwater levels are subject to change due to rainfall, time of year, seasonal precipitation, surface water runoff, and other factors.

This report has been prepared for the exclusive use of Ronald N.S. Ho & Associates and their project consultants for specific application to the design of the *Apron Lighting Replacement* project at the Lanai Airport in accordance with generally accepted geotechnical engineering principles and practices. No warranty is expressed or implied.

This report has been prepared solely for the purpose of assisting the architect and engineers in the design of the proposed project. Therefore, this report may not contain sufficient data or the proper information to serve as a basis for detailed construction cost estimates.

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

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

END OF LIMITATIONS

CLOSURE

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

-ΩΩΩΩΩΩΩΩΩ-

Respectfully submitted,

GEOLABS, INC.

By ____________________
Taylor Onizuka, P.E.
Project Engineer

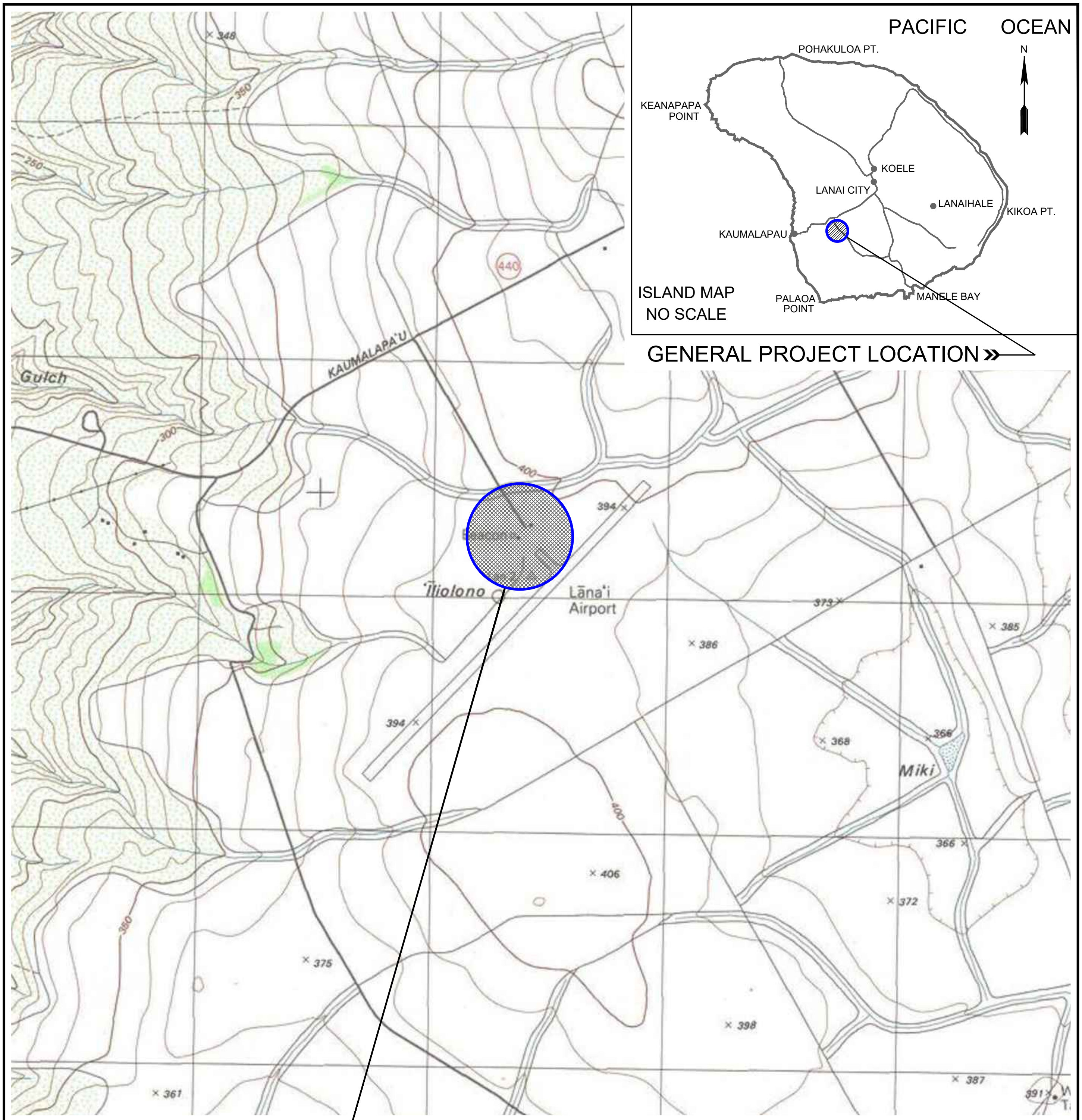
By ____________________
John Y.L. Chen, P.E.
Vice President

JC:TO:lf

h:\8800Series\8860.to1

PLATES

CAD User: KIM File Last Updated: September 19, 2024 7:30:53pm Plot Date: September 19, 2024 - 7:33:42pm
File: T:\Drafting\Working\8860-00_Lanai_Airport_Apron_Light\8860-00PLM.dwg\1
Plotter: DWG To PDF-GEO.pc3 Plotstyle: GEO-No-Dither-RBGC-HEAVY.ctb



PROJECT LOCATION »

2000 1000 0 2000 FT.

GRAPHIC SCALE

N

NOTE: CONTOURS ARE IN METERS.

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

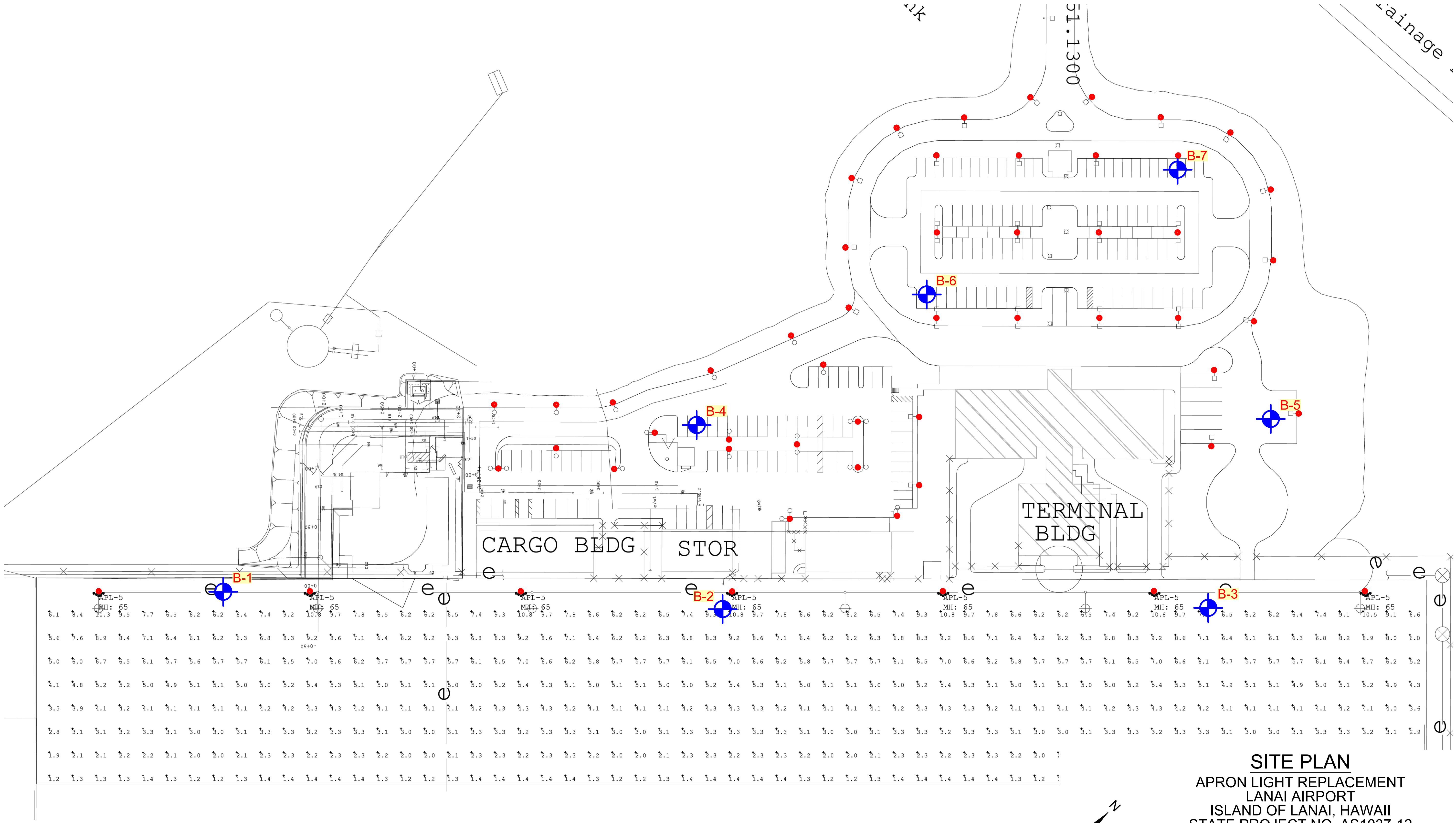
PROJECT LOCATION MAP

APRON LIGHT REPLACEMENT
LANAI AIRPORT
ISLAND OF LANAI, HAWAII
STATE PROJECT NO. AS1037-12

GEOLABS, INC.
Geotechnical Engineering

DATE	DRAWN BY	PLATE
SEPTEMBER 2024	KHN	
SCALE	W.O.	
1" = 2,000'	8860-00	1

CAD User: KIM File Last Updated: September 20, 2024 12:03:28am Plot Date: September 22, 2024 - 8:29:40pm
File: T:\Drafting\Working\8860-00_Lanai_Airport_Apron_Light\8860-00SitePlan.dwg\2
Plotter: DWG To PDF-GEO.pc3 Plotstyle: GEO-No-Dither-RBGC-HEAVY.ctb



SITE PLAN

APRON LIGHT REPLACEMENT
LANAI AIRPORT
ISLAND OF LANAI, HAWAII
STATE PROJECT NO. AS1037-12

LEGEND:

⌖	APPROXIMATE BORING LOCATION
●	LIGHT

REFERENCE: SITE PLAN TRANSMITTED BY RONALD N.S. HO & ASSOCIATES, INC. IN MAY, 2024.

N

0 40 80 160 240 FT.
GRAPHIC SCALE

GEOLABS, INC.
Geotechnical Engineering

DATE	DRAWN BY	PLATE
SEPTEMBER 2024	KHN	
SCALE	W.O.	
1" = 80'	8860-00	2

APPENDIX A

APPENDIX A

Field Exploration

We explored the subsurface conditions at the project site by drilling and sampling seven borings, designated as Boring Nos. 1 through 7, extending to depths of about 16.5 to 21.5 feet below the existing ground surface. The approximate boring locations are shown on the Site Plan, Plate 2. The borings were drilled using a truck-mounted drill rig equipped with continuous flight augers.

Our geologist classified the materials encountered in the borings by visual and textural examination in the field in general accordance with ASTM D2488, Standard Practice for Description and Identification of Soils, and monitored the drilling operations on a near-continuous (full-time) basis. These classifications were further reviewed visually and by testing in the laboratory. Soils were classified in general accordance with ASTM D2487, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System), as shown on the Soil Log Legend, Plate A-0.1. Deviations made to the soil classification in accordance with ASTM D2487 are described on the Soil Classification Log Key, Plate A-0.2. Graphic representations of the materials encountered are presented on the Logs of Borings, Plates A-1 through A-7.

Relatively “undisturbed” soil samples were obtained in general accordance with ASTM D3550, Ring-Lined Barrel Sampling of Soils, by driving a 3-inch OD Modified California sampler with a 140-pound hammer falling 30 inches. In addition, some samples were obtained from the drilled borings in general accordance with ASTM D1586, Penetration Test and Split-Barrel Sampling of Soils, by driving a 2-inch OD standard penetration sampler using the same hammer and drop. The blow counts needed to drive the sampler the second and third 6 inches of an 18-inch drive are shown as the “Penetration Resistance” on the Logs of Borings at the appropriate sample depths. The penetration resistance shown on the Logs of Borings indicates the number of blows required for the specific sampler type used. The blow counts may need to be factored to obtain the Standard Penetration Test (SPT) blow counts.

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

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Soil Log Legend

UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)

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

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

LEGEND

◩	(2-INCH) O.D. STANDARD PENETRATION TEST
⧗	(3-INCH) O.D. MODIFIED CALIFORNIA SAMPLE
S	SHELBY TUBE SAMPLE
G	GRAB SAMPLE
▮	CORE SAMPLE
▽	WATER LEVEL OBSERVED IN BORING AT TIME OF DRILLING
▼	WATER LEVEL OBSERVED IN BORING AFTER DRILLING
▼	WATER LEVEL OBSERVED IN BORING OVERNIGHT

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

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Soil Classification Log Key

(with deviations from ASTM D2488)

GEOLABS, INC. CLASSIFICATION*

GRANULAR SOIL (- #200 <50%)

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

COHESIVE SOIL (- #200 ≥50%)

- **PRIMARY** constituents are based on plasticity. Primary constituents are capitalized and bold (i.e., **CLAY, SILT**)
- **SECONDARY** constituents are composed of a percentage less than the primary constituent, but more than 20 percent of the soil mass. Secondary constituents are capitalized and bold (i.e., **SANDY** CLAY, **SILTY** CLAY, **CLAYEY** SILT) and precede the primary constituent.
- **accessory descriptions** compose of the following:
with some: >12%
with a little: 5 - 12%
with traces of: <5%
accessory descriptions are lower cased and follow the Primary and Secondary Constituents
(i.e., SILTY CLAY **with some sand**)

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

RELATIVE DENSITY / CONSISTENCY

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

MOISTURE CONTENT DEFINITIONS

Dry:	Absence of moisture, dry to the touch
Moist:	Damp but no visible water
Wet:	Visible free water

ABBREVIATIONS

WOH:	Weight of Hammer
WOR:	Weight of Drill Rods
SPT:	Standard Penetration Test Split-Spoon Sampler
MCS:	Modified California Sampler
PP:	Pocket Penetrometer

GRAIN SIZE DEFINITION

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

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

GEOLABS, INC. Geotechnical Engineering	APRON LIGHT REPLACEMENT LANAI AIRPORT ISLAND OF LANAI, HAWAII STATE PROJECT NO. AS1037-12	**Log of Boring** 1

Laboratory			Field								Approximate Ground Surface Elevation : N/A
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Description
											11-inch **CONCRETE**
	43	75			15	4.5				GW	Gray **SANDY GRAVEL (BASALTIC)**, dry (fill)
										MH	Brown **CLAYEY SILT**, medium stiff to stiff, dry (alluvium)
	41				7						
Direct Shear	39	67			12	3.0	5			MH	Reddish brown **CLAYEY SILT** with traces of sand, medium stiff, dry (residual soil)
TXUU S_u=2.0 ksf	43	72			13	3.0	10				
	39				23		15			MH	Grayish brown **CLAYEY SILT** with a little sand, very stiff, moist (residual soil)
	48	67			41	4.5	20				grades to reddish brown
											Boring terminated at 21.5 feet
							25				

Date Started:	July 1, 2024	Water Level: ▼	Not Encountered	Plate A - 1
Date Completed:	July 1, 2024			
Logged By:	D. Gremminger	Drill Rig:	CME-45C TRUCK	
Total Depth:	21.5 feet	Drilling Method:	4" Solid-Stem Auger	
Work Order:	8860-00	Driving Energy:	140 lb. wt., 30 in. drop	

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APRON LIGHT REPLACEMENT
LANAI AIRPORT
ISLAND OF LANAI, HAWAII
STATE PROJECT NO. AS1037-12

Log of Boring

2

Approximate Ground Surface
Elevation : N/A

Laboratory			Field								
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Description
											3-inch **ASPHALTIC CONCRETE**
										GM	Brownish gray **SANDY GRAVEL (BASALTIC)**, dry (fill)
	27	90			33	4.5				MH	Reddish brown **CLAYEY SILT**, very stiff, dry (alluvium)
LL=53 PI=23 TXUU S_u=1.4 ksf	32	76			13						grades to stiff
	16				16	2.5	5			MH	Brown with tan mottling **CLAYEY SILT** with traces of sand, stiff, moist (residual soil)
	46				5		10				grades to dark brown, medium stiff
	39	82			77	4.5	15			MH	Brown with reddish mottling **CLAYEY SILT** with a little sand and traces of decomposed gravel, hard, moist (residual soil)
	48				13		20			MH	Reddish brown **CLAYEY SILT**, stiff, moist (residual soil)
											Boring terminated at 21.5 feet
							25				

Date Started: July 1, 2024
Date Completed: July 1, 2024
Logged By: D. Gremminger
Total Depth: 21.5 feet
Work Order: 8860-00

Water Level: ▼ Not Encountered

Drill Rig: CME-45C TRUCK
Drilling Method: 4" Solid-Stem Auger
Driving Energy: 140 lb. wt., 30 in. drop

Plate

A - 2

GEOLABS, INC.

Geotechnical Engineering

APRON LIGHT REPLACEMENT
LANAI AIRPORT
ISLAND OF LANAI, HAWAII
STATE PROJECT NO. AS1037-12

Log of Boring
3

Approximate Ground Surface Elevation : N/A

Laboratory			Field								
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Description
											8-inch **ASPHALTIC CONCRETE**
										GW	Gray **SANDY GRAVEL (BASALTIC)**, dry (fill)
	26	90			26	4.5				CH	Reddish brown **SILTY CLAY**, stiff to very stiff, dry (alluvium)
	25				15						
										MH	Brown with orange mottling **CLAYEY SILT** with a little sand and traces of decomposed gravel, stiff to very stiff, moist (residual soil)
Direct Shear	27	83			20	3.5	5				
LL=55 PI=12	38	74			27	4.5	10				grades to reddish brown
	40				24		15				
										SM	Brown **SILTY SAND** with a little gravel, very dense, dry (saprolite)
Sieve - #200 = 45.5%	34	81			58		20				
											Boring terminated at 21.5 feet
							25				

Date Started:	July 1, 2024
Date Completed:	July 1, 2024
Logged By:	D. Gremminger
Total Depth:	21.5 feet
Work Order:	8860-00

Water Level: ▼	Not Encountered
Drill Rig:	CME-45C TRUCK
Drilling Method:	4" Solid-Stem Auger
Driving Energy:	140 lb. wt., 30 in. drop

GEOLABS, INC.

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APRON LIGHT REPLACEMENT
LANAI AIRPORT
ISLAND OF LANAI, HAWAII
STATE PROJECT NO. AS1037-12

Log of Boring

4

Approximate Ground Surface
Elevation : N/A

Laboratory			Field								
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Description
											6-inch **ASPHALTIC CONCRETE**
										GW	Grayish brown **SANDY GRAVEL (BASALTIC)**, dry (fill)
Direct Shear	25	84			22	4.5				MH	Brown **CLAYEY SILT**, medium stiff to stiff, dry (alluvium)
	30				11						
TXUU S_u=1.3 ksf	43	70			17	4.0	5				grades with orange mottling
										MH	Orangish brown **CLAYEY SILT**, stiff, dry (residual soil)
LL=51 PI=14	47				12		10				
	49	66			23		15				grades to brown with multi-color mottling
											Boring terminated at 16.5 feet
							20				
							25				

Date Started: July 2, 2024
Date Completed: July 2, 2024
Logged By: D. Gremminger
Total Depth: 16.5 feet
Work Order: 8860-00

Water Level: ⊻ Not Encountered

Drill Rig: CME-45C TRUCK
Drilling Method: 4" Solid-Stem Auger
Driving Energy: 140 lb. wt., 30 in. drop

Plate

A - 4

GEOLABS, INC. Geotechnical Engineering	APRON LIGHT REPLACEMENT LANAI AIRPORT ISLAND OF LANAI, HAWAII STATE PROJECT NO. AS1037-12	**Log of Boring**	5

Approximate Ground Surface
Elevation : N/A

Laboratory			Field								
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Description
											6-inch **ASPHALTIC CONCRETE**
										GW	Grayish brown **SANDY GRAVEL (BASALTIC)**, dry (fill)
										MH	Orangish brown **CLAYEY SILT** with traces of sand, medium stiff to stiff, dry (residual soil)
	30	80			17	4.0					
	39				8						
LL=55 PI=18	42	64			15	4.5	5				grades to brown with orange mottling
										MH	Dark grayish brown with red mottling **CLAYEY SILT** with some sand, medium stiff, moist (residual soil)
TXUU S_u=1.2 ksf	55	58			11	3.0	10				
	43				21		15				grades to orangish brown, very stiff
	47	71			31		20				grades to grayish brown with multi-color mottling
											Boring terminated at 21.5 feet
							25				

Date Started:	July 2, 2024	Water Level: ⊻	Not Encountered	Plate
Date Completed:	July 2, 2024			
Logged By:	D. Gremminger	Drill Rig:	CME-45C TRUCK	A - 5
Total Depth:	21.5 feet	Drilling Method:	4" Solid-Stem Auger	
Work Order:	8860-00	Driving Energy:	140 lb. wt., 30 in. drop	

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APRON LIGHT REPLACEMENT
LANAI AIRPORT
ISLAND OF LANAI, HAWAII
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Log of Boring

6

Approximate Ground Surface Elevation : N/A

Laboratory			Field								
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Description
							0				4-inch **ASPHALTIC CONCRETE**
										GW	Brownish gray **SANDY GRAVEL (BASALTIC)**, dry (fill)
	21	76			39	4.5				MH	Reddish brown **CLAYEY SILT** with a little sand, very stiff (residual soil)
	21				28						
	20	75			34	4.5	5				grades to orangish brown with some sand
										ML	Grayish brown **SANDY SILT** with some sand, very stiff, dry (residual soil)
LL=48 PI=4	30				28		10				
TXUU S_u=12.4 ksf	34	81			70	4.5	15			CH	Brown with multi-color mottling **SILTY CLAY**, hard, dry (residual soil)
											Boring terminated at 16.5 feet
							20				
							25				

Date Started: July 2, 2024
Date Completed: July 2, 2024
Logged By: D. Gremminger
Total Depth: 16.5 feet
Work Order: 8860-00

Water Level: ▼ Not Encountered
Drill Rig: CME-45C TRUCK
Drilling Method: 4" Solid-Stem Auger
Driving Energy: 140 lb. wt., 30 in. drop

Plate

A - 6

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APRON LIGHT REPLACEMENT
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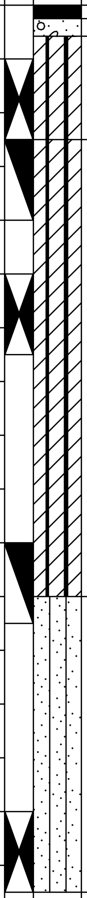
STATE PROJECT NO. AS1037-12

Log of Boring

7

Approximate Ground Surface
Elevation : N/A

Laboratory			Field						
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
									3-inch **ASPHALTIC CONCRETE**
								GW	Brownish gray **SANDY GRAVEL (BASALTIC)** with a little silt, dry (fill)
	29	72			43	4.5		MH	Brown **CLAYEY SILT** with a little sand and traces of decomposed gravel, very stiff, dry (residual soil)
	27				29			MH	Orangish brown with tan mottling **CLAYEY SILT** with a little sand, very stiff, dry (residual soil)
Direct Shear	30	75			37	4.5	5		
	29				14		10		grades to grayish brown with tan mottling, stiff
								SM	Grayish brown **SILTY SAND** with a little decomposed gravel, medium dense, dry (saprolite)
Sieve - #200 = 15.1%	23	81			43		15		
									Boring terminated at 16.5 feet
							20		
							25		



Date Started:	July 2, 2024	Water Level: ▼	Not Encountered
Date Completed:	July 2, 2024		
Logged By:	D. Gremminger	Drill Rig:	CME-45C TRUCK
Total Depth:	16.5 feet	Drilling Method:	4" Solid-Stem Auger
Work Order:	8860-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 7

APPENDIX B

APPENDIX B

Laboratory Tests

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

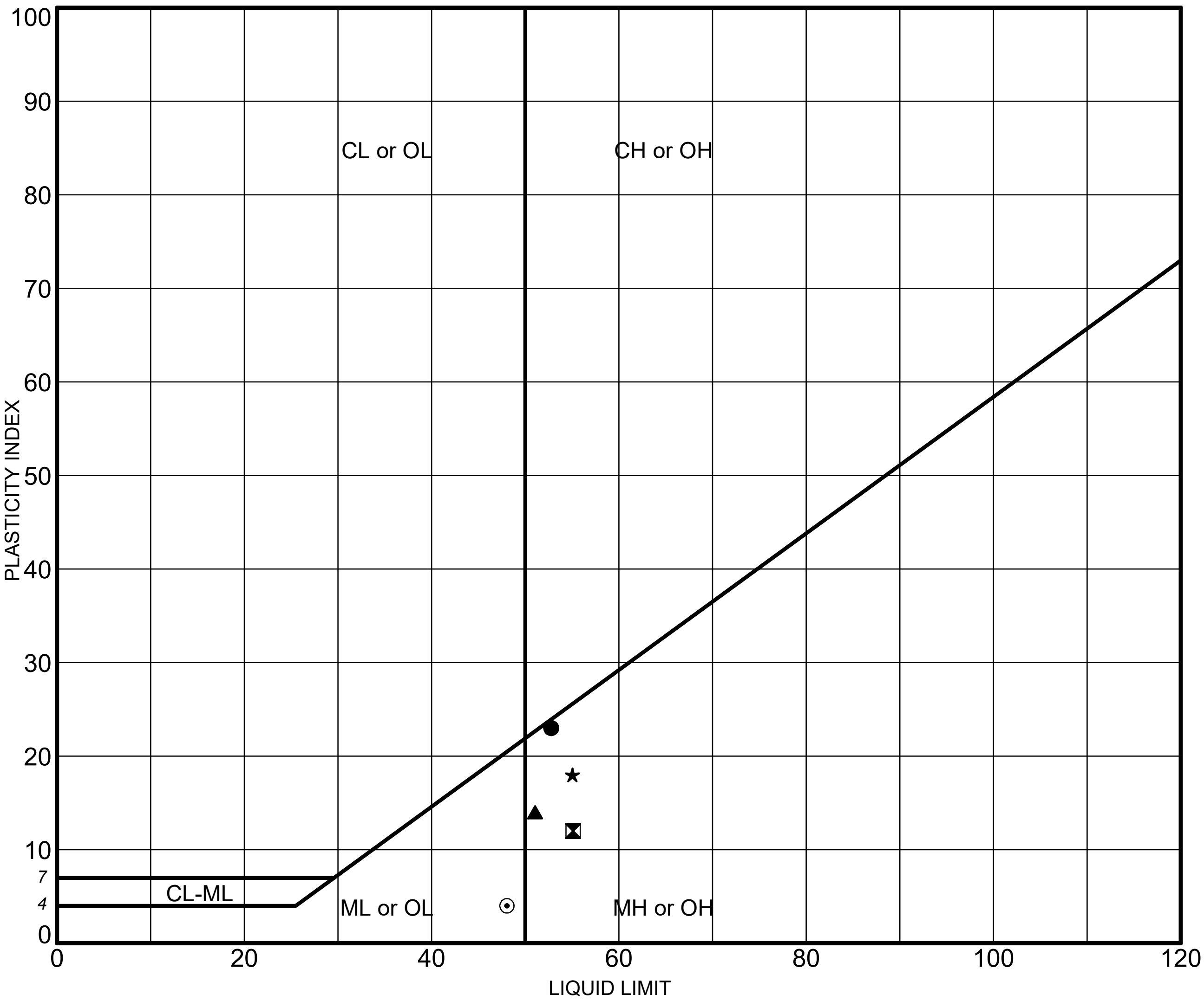
Five Atterberg Limits tests (ASTM D4318) were performed on selected soil samples to evaluate the liquid and plastic limits. The test results are summarized on the Logs of Borings at the appropriate sample depths. A graphic presentation of the test results is provided on Plate B-1.

Two Sieve Analysis tests (ASTM D6913) were performed on selected soil samples to evaluate the gradation characteristics of the soils and to aid in soil classification. Graphic presentations of the grain size distributions are provided on Plate B-2.

Four Direct Shear tests (ASTM D3080) were performed on selected samples to evaluate the shear strength characteristics of the materials tested. The test results are presented on Plates B-3 through B-6.

Five Unconsolidated Undrained Triaxial Compression tests (ASTM D2850) were performed on selected soil samples to evaluate the undrained shear strength of the in situ soils. The approximate in-situ effective overburden pressure was used as the applied confining pressure for the relatively “undisturbed” soil sample. The test results and the stress-strain curves are presented on Plates B-7 through B-11.

Four sets of Corrosivity tests, including pH (ASTM G51), Minimum Resistivity (ASTM G57), Chloride Content (EPA 300.0), and Sulfate Content (EPA 300.0), were performed by our office and CERCO Analytical, Inc. on selected soil samples obtained from our field exploration. The test results are summarized on Plate B-12.



	Sample	Depth (ft)	LL	PL	PI	Description
●	B-2	2.5-4.0	53	30	23	Reddish brown clayey silt (MH)
⧗	B-3	10.0-11.5	55	43	12	Brown w/ orange mottling clayey silt (MH) w/ a little sand & tr. gravel
▲	B-4	10.0-11.5	51	37	14	Orangish brown clayey silt (MH)
★	B-5	5.0-6.5	55	37	18	Orangish brown clayey silt (MH) w/ traces of sand
⊙	B-6	10.0-11.5	48	44	4	Grayish brown sandy silt (ML) with some sand

NP = NON-PLASTIC

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ATTERBERG LIMITS TEST RESULTS - ASTM D4318

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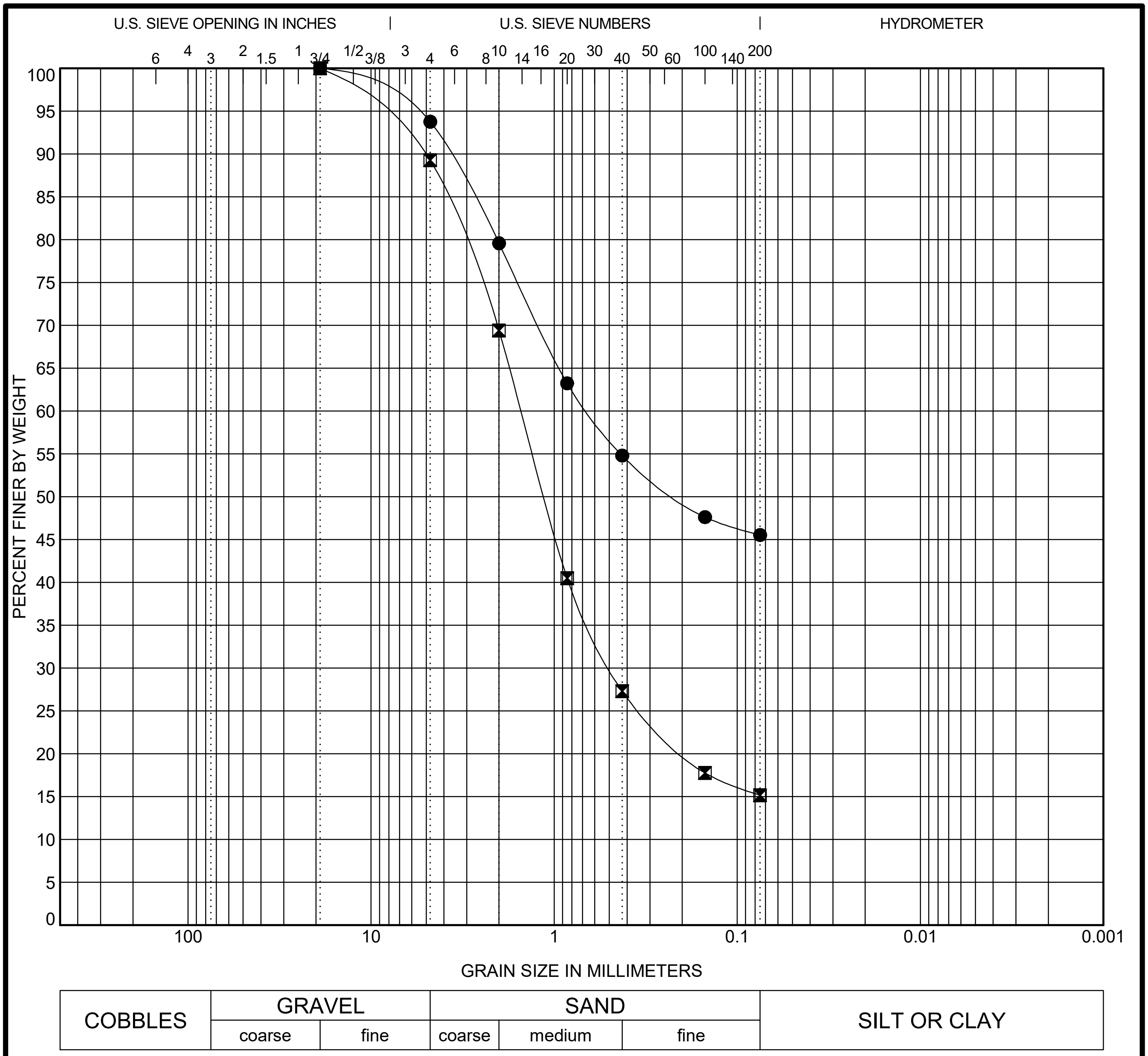
Plate
B - 1



	Sample	Depth (ft)	Description	LL	PL	PI	Cc	Cu
●	B-3	20.0-21.5	Brown silty sand (SM) with a little gravel					
☒	B-7	15.0-16.5	Grayish brown silty sand (SM) with a little gravel					

	Sample	Depth (ft)	D100 (mm)	D60 (mm)	D30 (mm)	D10 (mm)	%Gravel	%Sand	%Fine
●	B-3	20.0-21.5	19	0.652			6.2	48.2	45.5
☒	B-7	15.0-16.5	19	1.514	0.49		10.7	74.1	15.1

G GRAIN SIZE MOD 8860-00.GPJ GEOLABS.GDT 9/30/24

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GRAIN SIZE DISTRIBUTION - ASTM D6913

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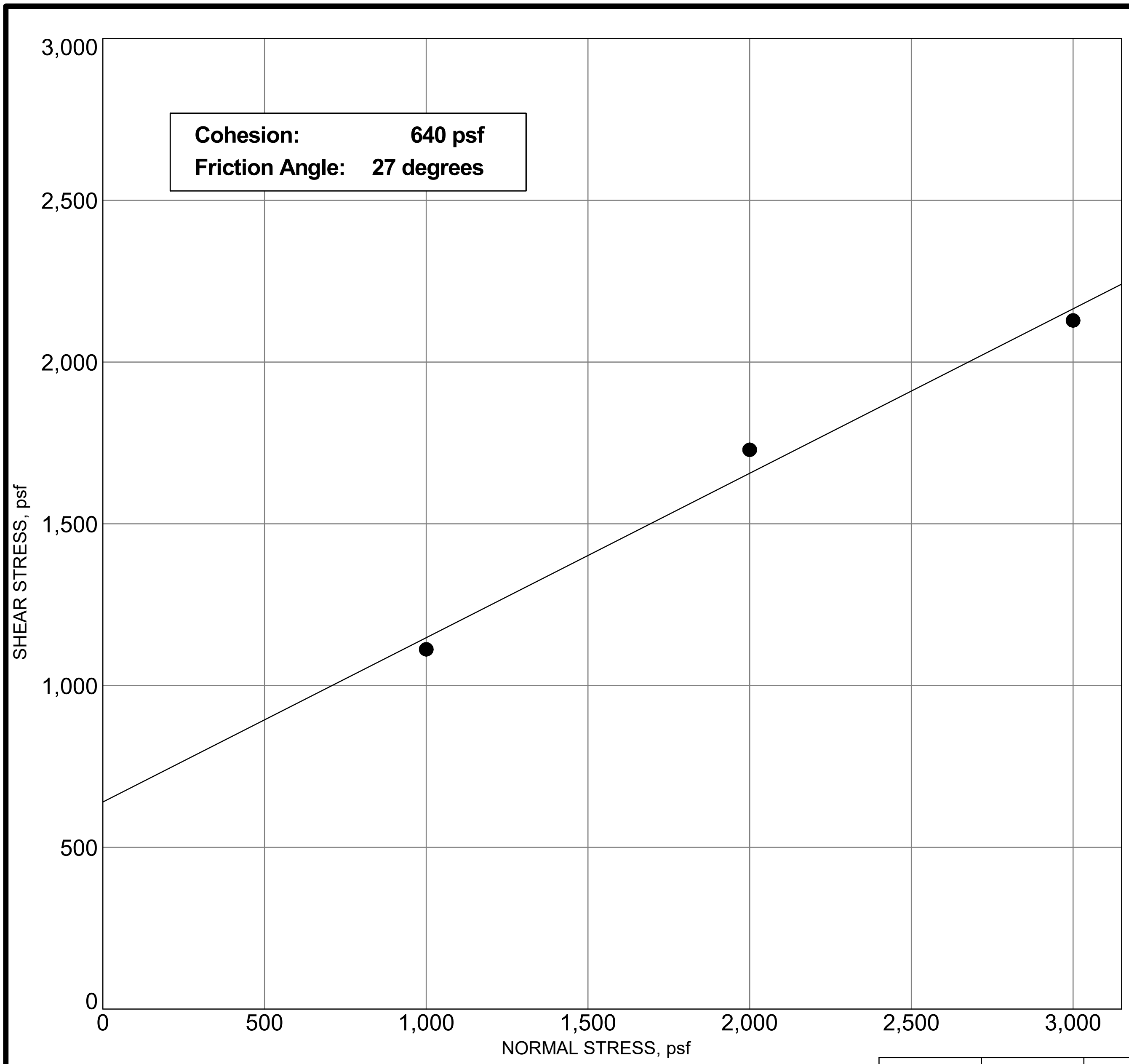
STATE PROJECT NO. AS1037-12

Plate
B - 2



Sample: B-1
Depth: 5.0 - 6.5 feet
Description: Reddish brown clayey silt with traces of sand

Description of Soil Structure: Undisturbed
Oversized material present in sample. Does not meet ASTM minimum sample height requirement

		Sample #1	Sample #2	Sample #3
INITIAL	Moisture Content, %	30.7	29.5	36.0
	Dry Density, pcf	69.2	68.7	71.7
	Height, inches	1.00	1.00	1.00
FINAL	Moisture Content, %	55.6	50.6	48.7
	Dry Density, pcf	68.3	70.2	74.6
	Height, inches	1.013	0.980	0.961
	Diameter, inches	2.42	2.42	2.42
	Deformation Rate, inch/minute	0.0024	0.0016	0.0023
	Normal Stress, psf	**1000**	**2000**	**3000**
	Peak Shear Stress, psf	**1112**	**1729**	**2128**
	Shear Displacement, inches	0.43	0.38	0.41

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DIRECT SHEAR TEST - ASTM D3080

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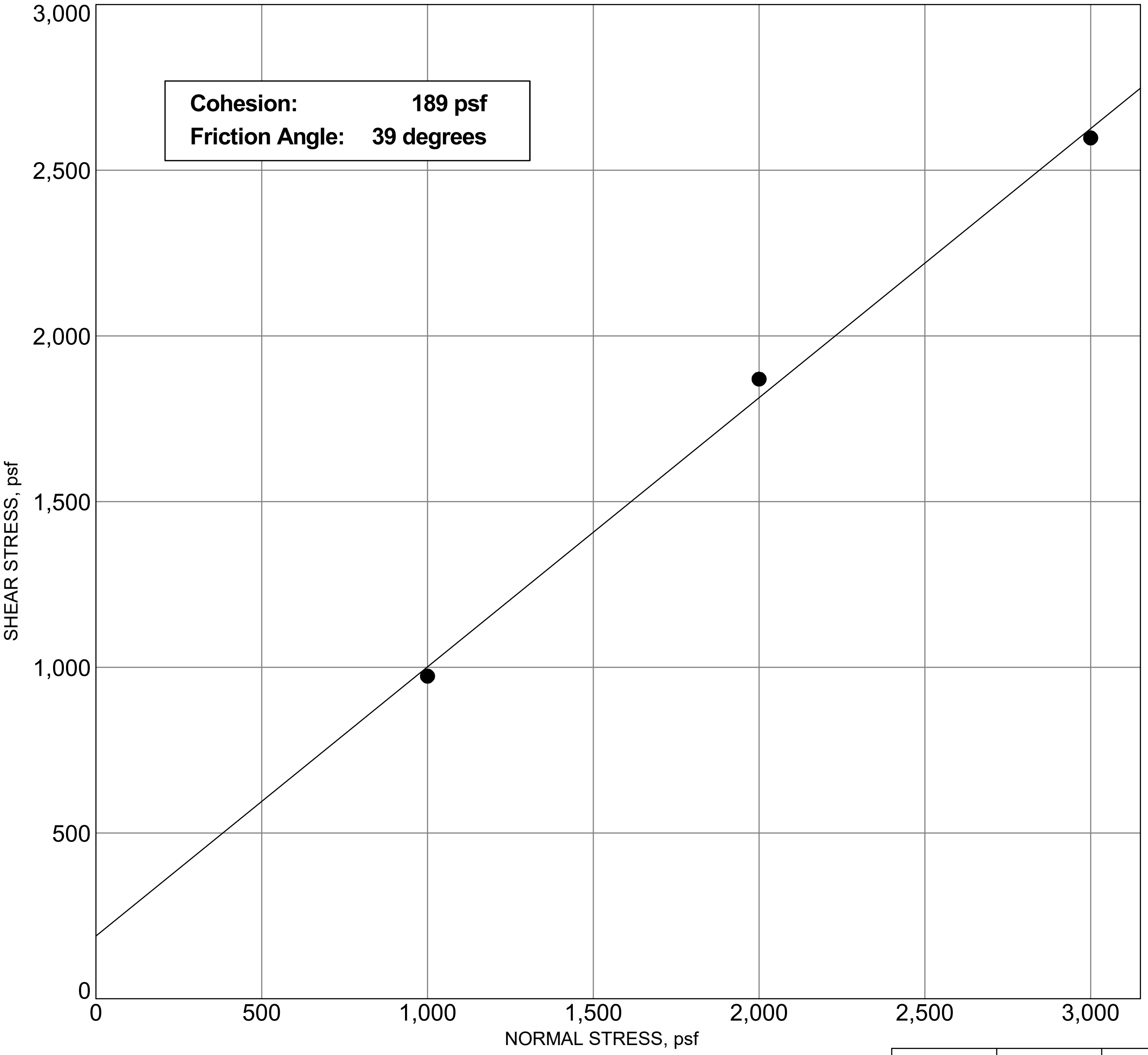
STATE PROJECT NO. AS1037-12

Plate
B - 3



Sample: B-3
Depth: 5.0 - 6.5 feet
Description: Brown with orange mottling clayey silt with a little sand and traces of gravel

Description of Soil Structure: Undisturbed

Oversized material present in sample. Does not meet ASTM minimum sample height requirement

		Sample #1	Sample #2	Sample #3
INITIAL	Moisture Content, %	20.5	25.3	21.8
	Dry Density, pcf	79.7	77.7	84.6
	Height, inches	1.00	1.00	1.00
FINAL	Moisture Content, %	44.8	43.3	37.2
	Dry Density, pcf	78.6	80.5	87.1
	Height, inches	1.014	0.965	0.972
	Diameter, inches	2.42	2.42	2.42
	Deformation Rate, inch/minute	0.0024	0.0016	0.0023
	Normal Stress, psf	**1000**	**2000**	**3000**
	Peak Shear Stress, psf	**973**	**1870**	**2597**
	Shear Displacement, inches	0.42	0.38	0.40

G DIRECT SHEAR 2 8860-00.GPJ GEOLABS.GDT 9/22/24

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DIRECT SHEAR TEST - ASTM D3080

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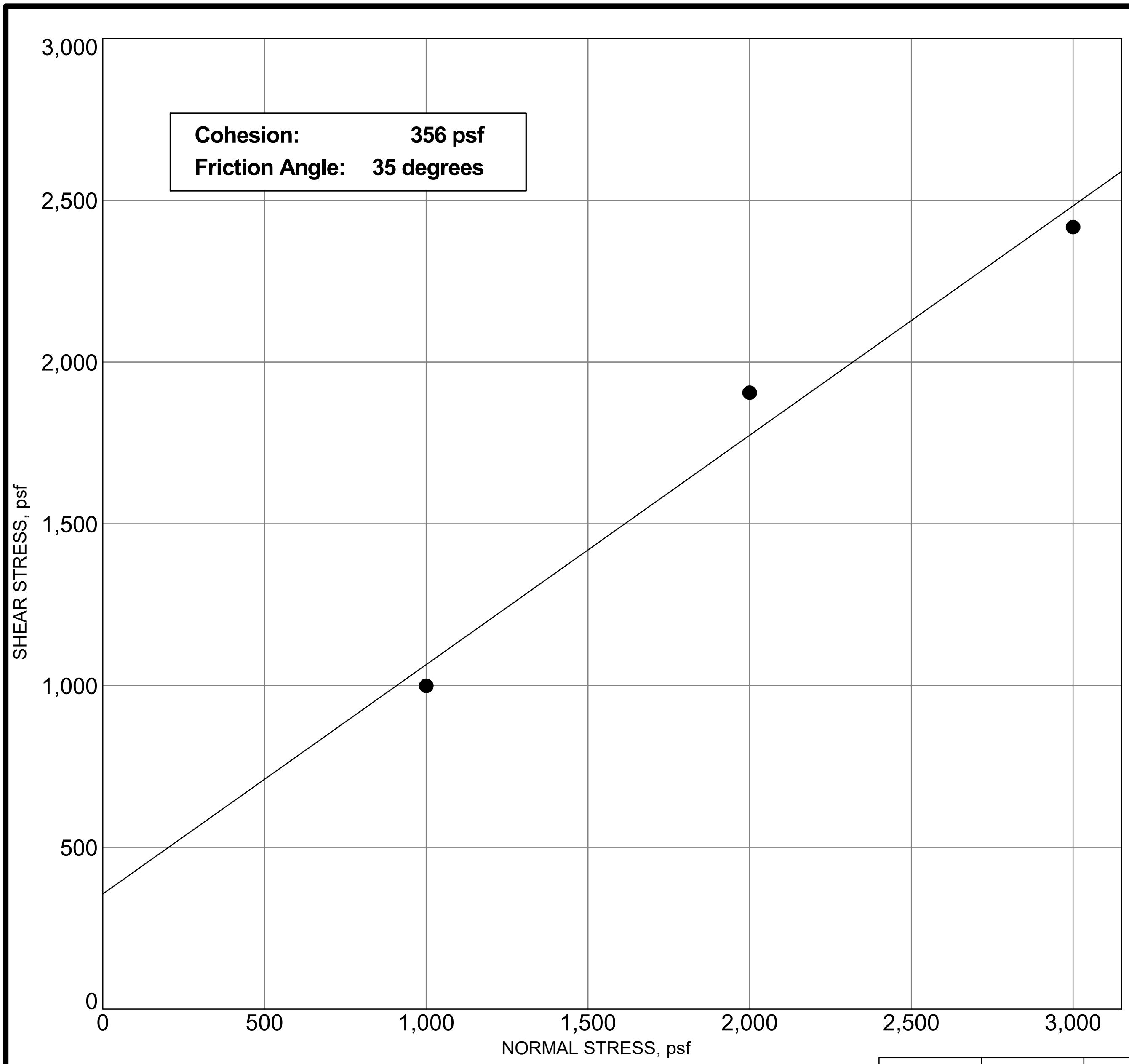
Plate
B - 4



Sample: B-4
Depth: 1.0 - 2.5 feet
Description: Brown clayey silt

Description of Soil Structure: Undisturbed
Oversized material present in sample. Does not meet ASTM minimum sample height requirement

		Sample #1	Sample #2	Sample #3
INITIAL	Moisture Content, %	21.9	21.2	20.5
	Dry Density, pcf	87.1	96.8	82.5
	Height, inches	1.00	1.00	1.00
FINAL	Moisture Content, %	36.2	31.2	31.8
	Dry Density, pcf	83.9	100.9	85.6
	Height, inches	1.039	0.959	0.964
	Diameter, inches	2.42	2.42	2.42
	Deformation Rate, inch/minute	0.0024	0.0022	0.0024
	Normal Stress, psf	**1000**	**2000**	**3000**
	Peak Shear Stress, psf	**999**	**1905**	**2417**
	Shear Displacement, inches	0.43	0.41	0.41

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DIRECT SHEAR TEST - ASTM D3080

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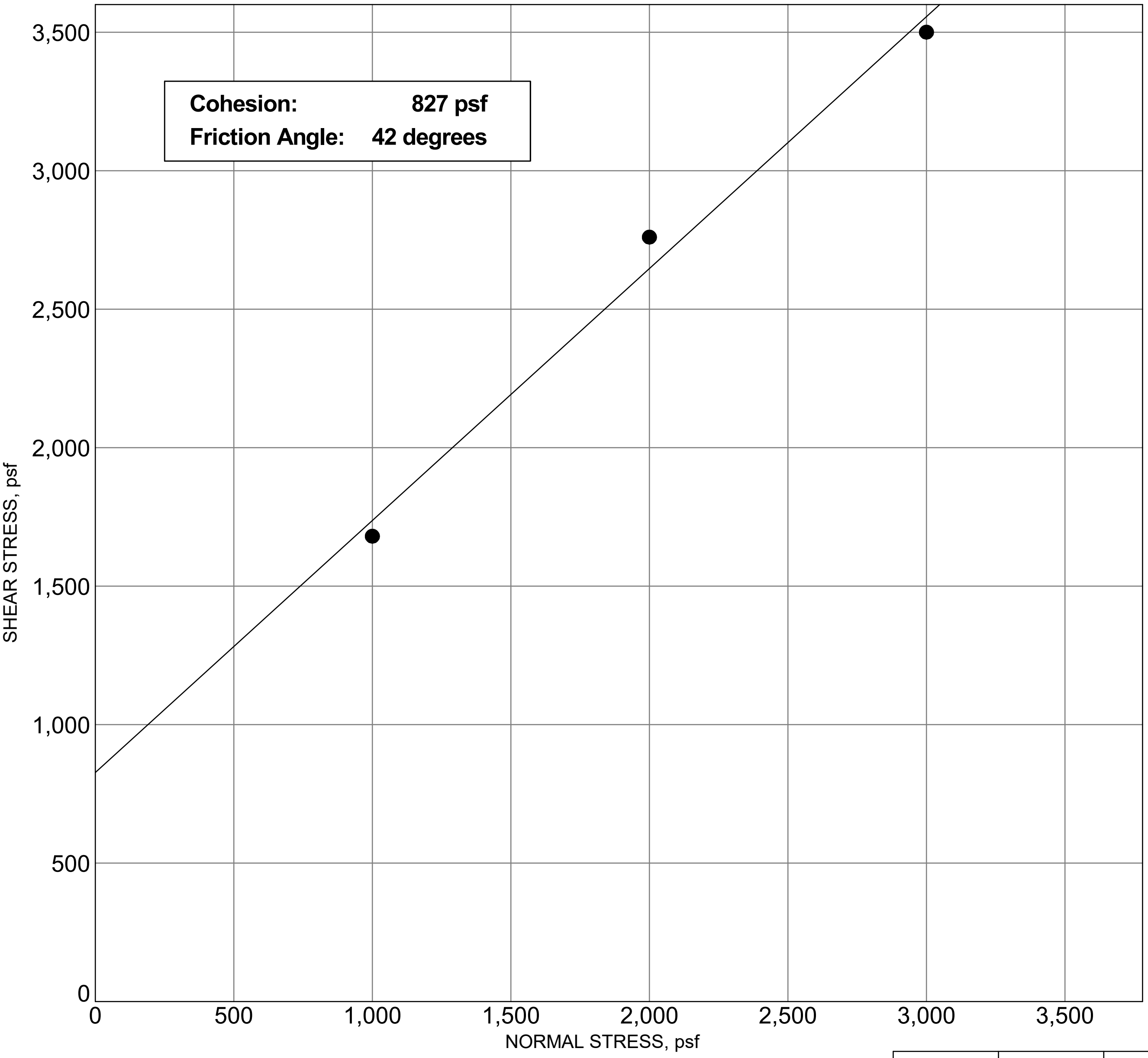
Plate
B - 5

G DIRECT SHEAR 2 8860-00.GPJ GEOLABS.GDT 9/22/24



Sample: B-7
Depth: 5.0 - 6.5 feet
Description: Orangish brown with tan mottling clayey silt with a little sand

		Sample #1	Sample #2	Sample #3
INITIAL	Moisture Content, %	26.5	25.9	24.4
	Dry Density, pcf	78.2	78.5	77.9
	Height, inches	1.00	1.00	1.00
FINAL	Moisture Content, %	49.9	50.8	50.3
	Dry Density, pcf	77.6	78.2	78.8
	Height, inches	1.008	1.004	0.988
	Diameter, inches	2.42	2.42	2.42
	Deformation Rate, inch/minute	0.0023	0.0024	0.0024
	Normal Stress, psf	**1000**	**2000**	**3000**
	Peak Shear Stress, psf	**1680**	**2760**	**3500**
	Shear Displacement, inches	0.50	0.50	0.50

Description of Soil Structure: Undisturbed

Oversized material present in sample. Does not meet ASTM minimum sample height requirement

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DIRECT SHEAR TEST - ASTM D3080

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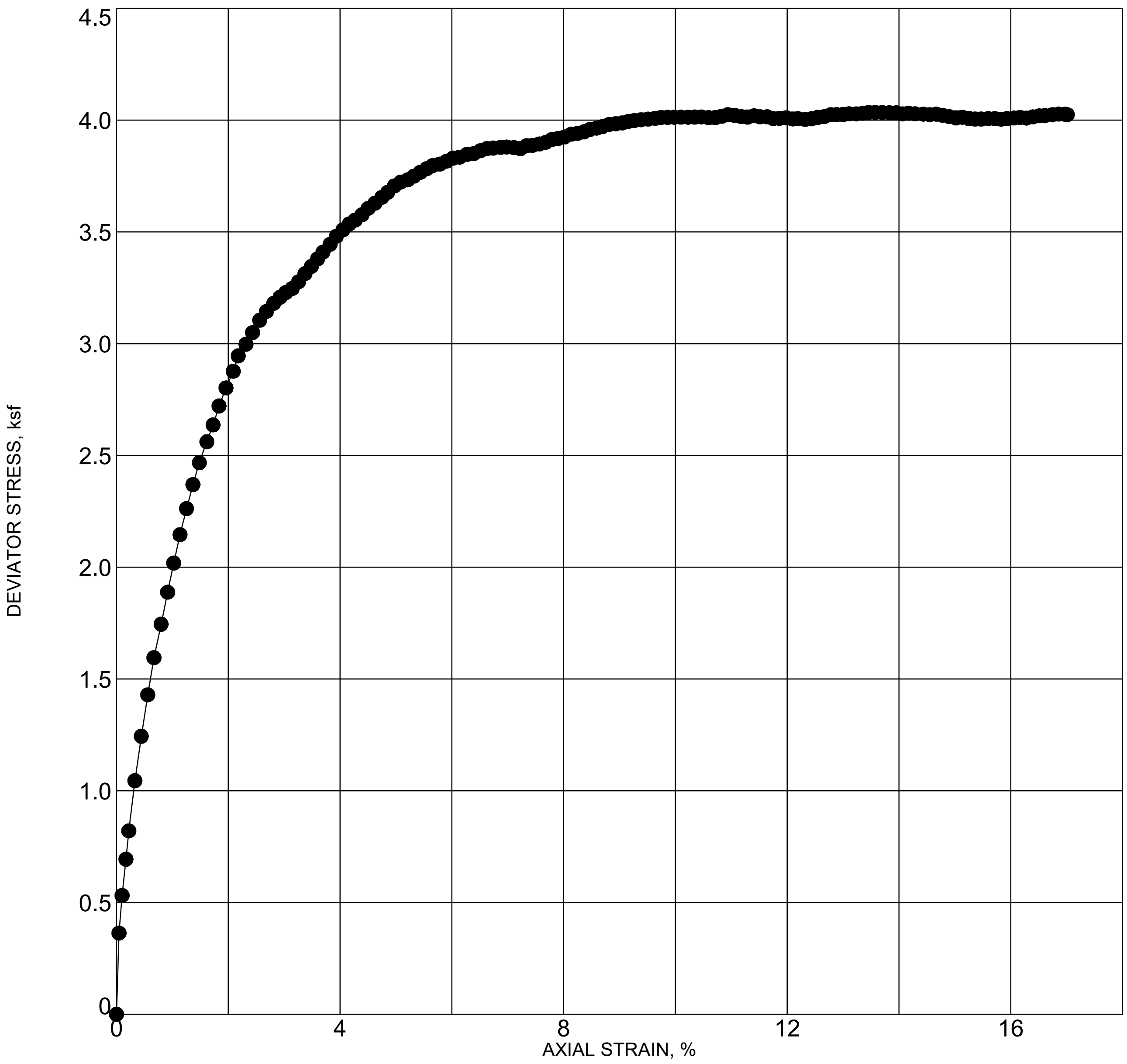
Plate
B - 6



Max. Deviator Stress (ksf):	4.0
Confining Stress (ksf):	1.2

Location: B-1
Depth: 10.0 - 11.5 feet
Description: Reddish brown clayey silt with traces of sand
Test Date: 7/13/2024

Dry Density (pcf)	75.4	Sample Diameter (inches)	2.413
Moisture (%)	39.9	Sample Height (inches)	5.033
Axial Strain at Failure (%)	14.7	Strain Rate (% / minute)	0.71

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TRIAXIAL UU COMPRESSION TEST - ASTM D2850

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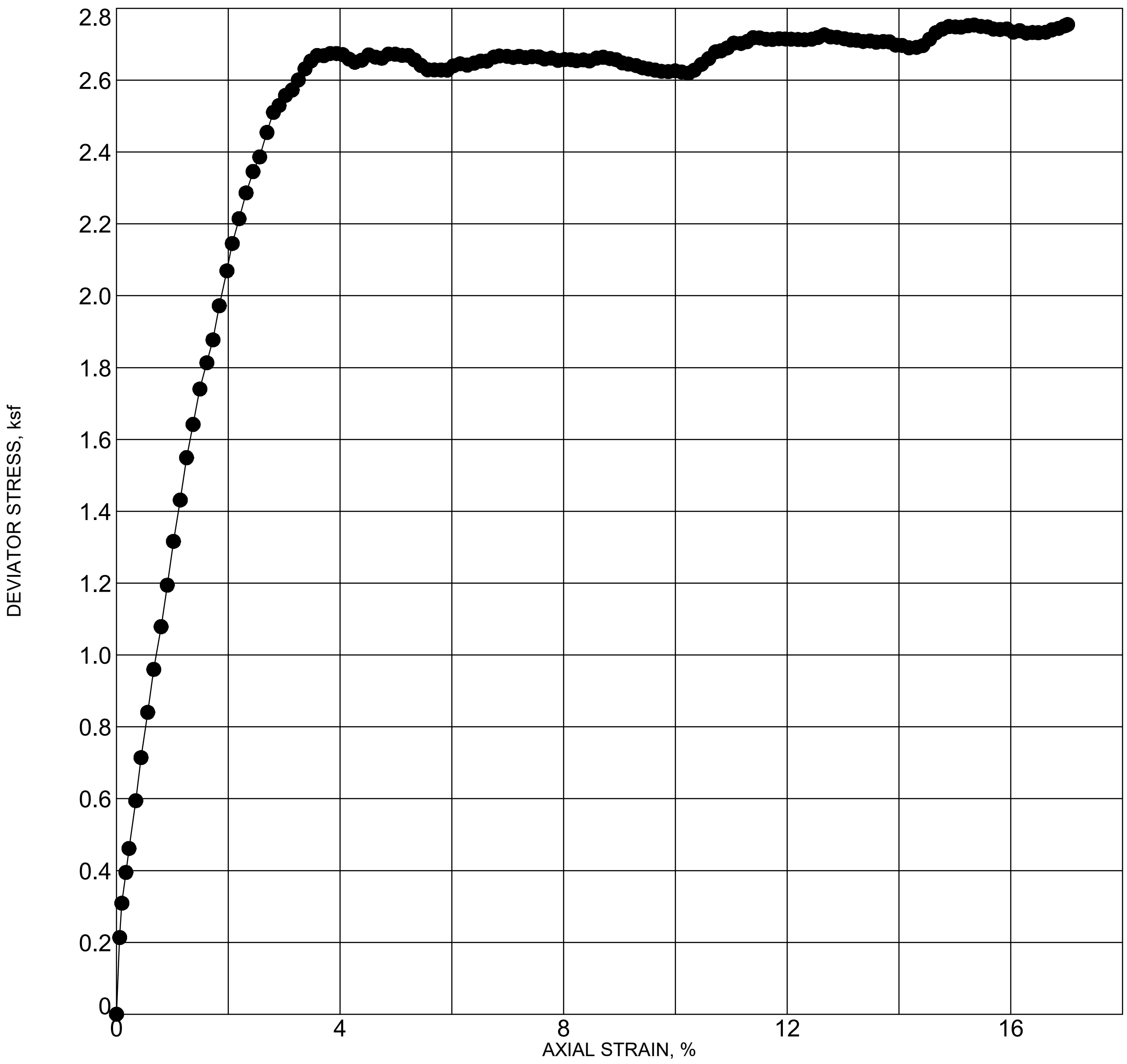
Plate
B - 7



Max. Deviator Stress (ksf):	2.7
Confining Stress (ksf):	0.7

Location: B-2
Depth: 2.5 - 4.0 feet
Description: Reddish brown clayey silt (MH)
Test Date: 7/15/2024

Dry Density (pcf)	75.1	Sample Diameter (inches)	2.413
Moisture (%)	36.6	Sample Height (inches)	5.033
Axial Strain at Failure (%)	14.9	Strain Rate (% / minute)	0.71

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TRIAXIAL UU COMPRESSION TEST - ASTM D2850

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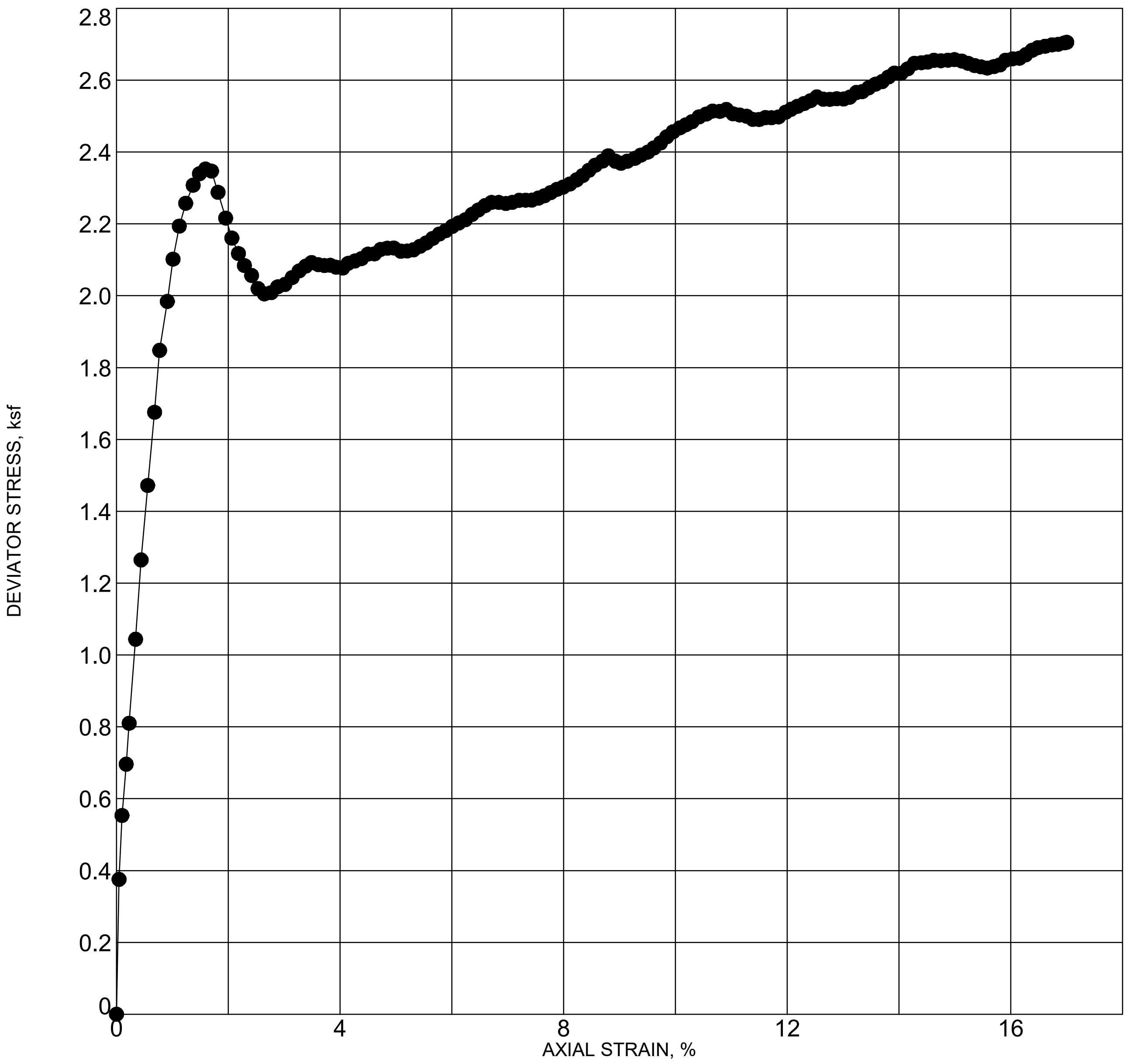
Plate
B - 8

G_TXUU 8860-00.GPJ GEOLABS.GDT 9/22/24



Max. Deviator Stress (ksf):	2.7
Confining Stress (ksf):	0.4

Location: B-4
Depth: 5.0 - 6.5 feet
Description: Brown with orange mottling clayey silt
Test Date: 7/16/2024

Dry Density (pcf)	72.5	Sample Diameter (inches)	2.413
Moisture (%)	39.7	Sample Height (inches)	5.033
Axial Strain at Failure (%)	15.0	Strain Rate (% / minute)	0.70

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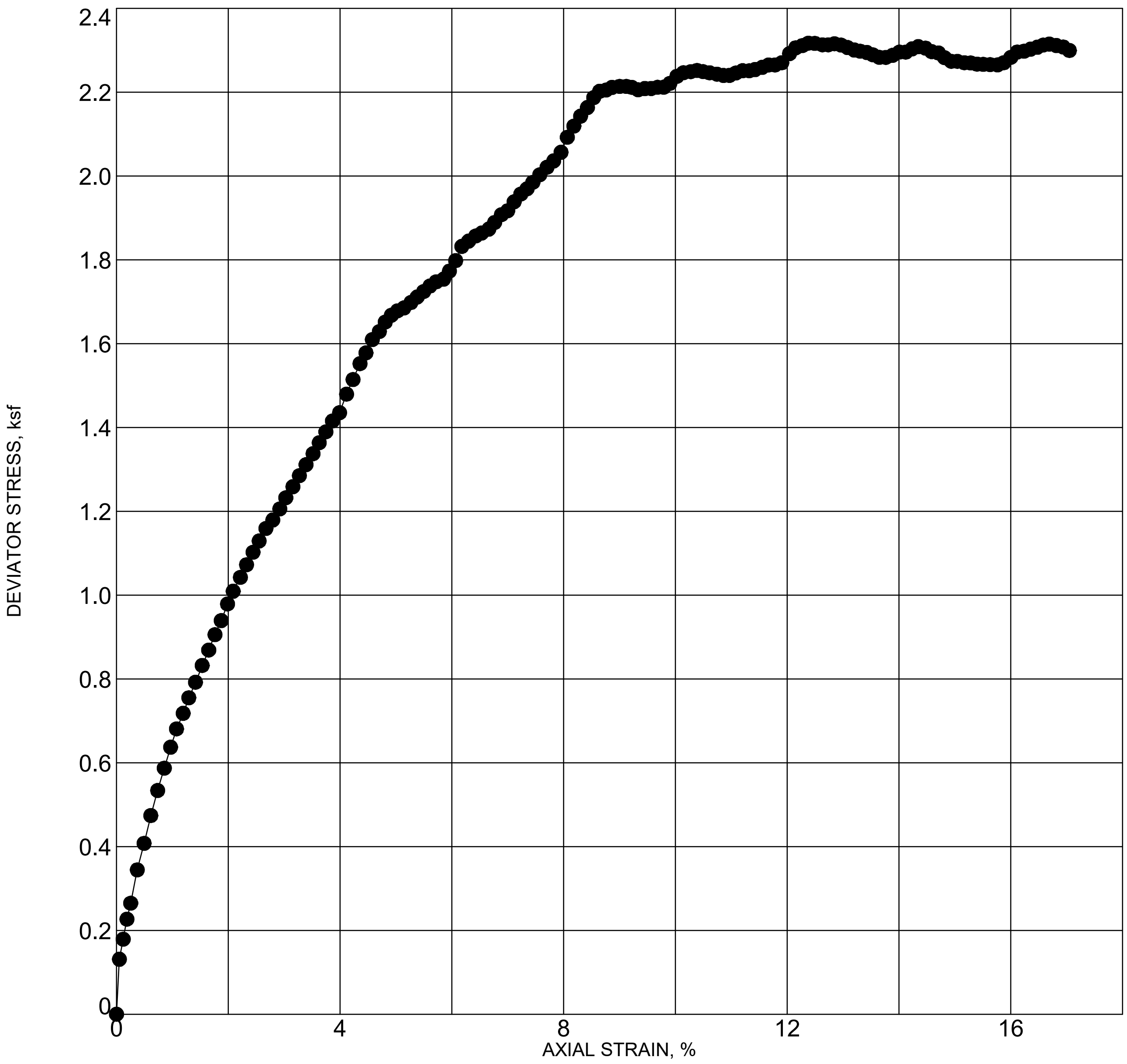
Plate
B - 9



Max. Deviator Stress (ksf):	2.3
Confining Stress (ksf):	1.2

Location: B-5
Depth: 10.0 - 11.5 feet
Description: Dark grayish brown with red mottling clayey silt with some sand
Test Date: 7/16/2024

Dry Density (pcf)	59.2	Sample Diameter (inches)	2.413
Moisture (%)	52.9	Sample Height (inches)	5.033
Axial Strain at Failure (%)	12.8	Strain Rate (% / minute)	0.70

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TRIAXIAL UU COMPRESSION TEST - ASTM D2850

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ISLAND OF LANAI, HAWAII
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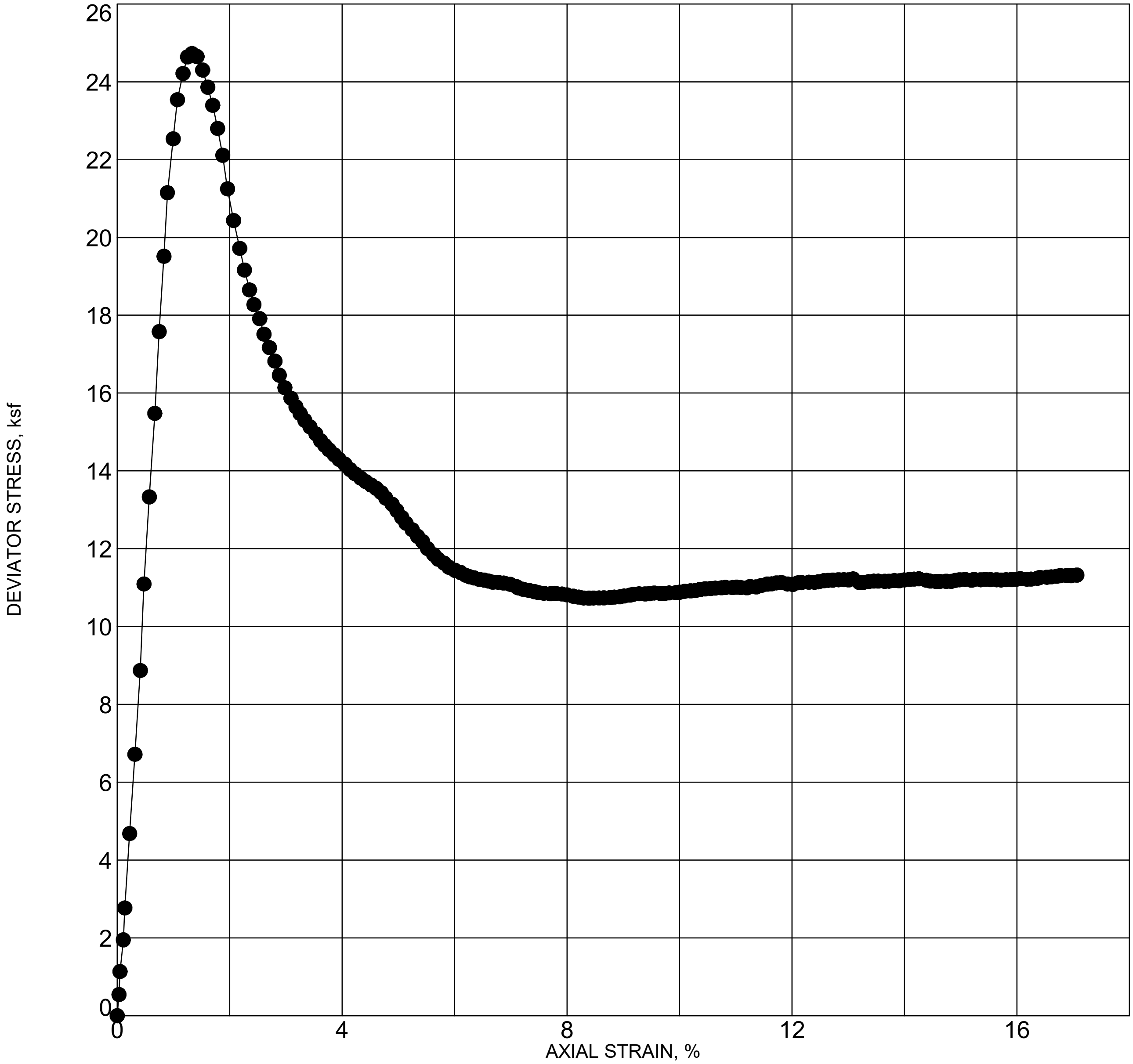
Plate
B - 10



Max. Deviator Stress (ksf):	24.7
Confining Stress (ksf):	1.7

Location: B-6
Depth: 15.0 - 16.5 feet
Description: Brown with multi-color mottling silty clay
Test Date: 7/16/2024

Dry Density (pcf)	82.2	Sample Diameter (inches)	2.413
Moisture (%)	32.2	Sample Height (inches)	5.033
Axial Strain at Failure (%)	1.3	Strain Rate (% / minute)	0.50

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TRIAXIAL UU COMPRESSION TEST - ASTM D2850

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Plate
B - 11

G_TXUU 8860-00.GPJ GEOLABS.GDT 9/22/24

Location	Depth (feet)	pH Value	Minimum Resistivity (ohm-cm)	Chloride Content (mg/kg)	Sulfate Content (mg/kg)
B-1	1.0 - 2.5	6.9*	3000*	25	87
B-3	1.0 - 2.5	7.14*	900*	37	ND
B-5	1.0 - 2.5	7.37*	2800*	32	82
B-6	1.0 - 2.5	7.72*	2100*	65	74

TEST METHODS (by CERCO Analytical, Inc.)

pH Value	Method 9045C
Minimum Resistivity	SM 2510B
Chloride Content	EPA 300.0
Sulfate Content	EPA 300.0

TEST METHODS (by Geolabs, Inc.)*

pH Value	ASTM G51
Minimum Resistivity	ASTM G57
Chloride Content	N/A
Sulfate Content	N/A

ND: Not Detected Within Reporting Limits

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SUMMARY OF CORROSIVITY TESTS

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LANAI AIRPORT
ISLAND OF LANAI, HAWAII
STATE PROJECT NO. AS1037-12

Plate
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