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SOILS INVESTIGATION **752**
NANAKULI ROAD IMPROVEMENTS &
EXTENSION OF EXISTING FARRINGTON
HIGHWAY DRAINAGE CULVERTS
NANAKULI, OAHU, HAWAII

for

AUSTIN, TSUTSUMI & ASSOCIATES, INC.

W. O. 410

March 21, 1977

EH

ERNEST K. HIRATA & ASSOCIATES, INC.

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Soils and Foundation Engineering

1236 South King Street • Honolulu, Hawaii 96814 • Phone 531-5733

March 21, 1977

W. O. 410

Austin, Tsutsumi & Associates, Inc.
Suite 900
745 Fort Street Mall
Honolulu, Hawaii 96813

Gentlemen:

Our report, "Soils Investigation, Nanakuli Road Improvements & Extension of Existing Farrington Highway Drainage Culverts, Nanakuli, Oahu, Hawaii", dated March 21, 1977, our Work Order 410 is enclosed. This is the report requested by you and planned in cooperation with personnel of your staff.

A discontinuity in subsurface soil conditions exist over the project site. The northern third of the site consists of a 6 to 12 inch layer of silty sand underlain by hard coral. The southern two thirds consist of a highly expansive brown silty clay exhibiting poor load supporting capacity for roadways. The approximate location of the discontinuity is delineated on the Site Plan.

Pavement recommendations are presented in this report for both types of soil conditions.

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

Very truly yours,

Ernest K. Hirata & Associates, Inc.


Ernest K. Hirata President

EKH:yk

SOILS INVESTIGATION
NANAKULI ROAD IMPROVEMENTS &
EXTENSION OF EXISTING FARRINGTON
HIGHWAY DRAINAGE CULVERTS
NANAKULI, OAHU, HAWAII

INTRODUCTION

This report presents the results of our soils investigation performed on the subject property. The purpose of this investigation was to determine the nature of the soils underlying the site, to ascertain their engineering properties, and to provide recommendations for pavement design.

This investigation included drilling seven exploratory test borings, obtaining representative soil samples, laboratory testing and analysis, and the preparation of this report. The exploratory boring locations are shown on the enclosed Site Plan, Plate 1.

PROJECT CONSIDERATIONS

Information concerning the proposed project was furnished by personnel of your staff.

The proposed project will include improvements to the roadway, existing drainage culverts, and utility systems. We understand

that the proposed roadway grades will be relatively similar to existing grades and will include minimal grading. Roadway improvements will be limited to Pohakunui, Piliokahi, Laumania and Keaulana Avenues.

SITE CONDITIONS

The project site is located on the makai side of Farrington Highway and is bounded on the south by Kalaniana'ole Beach Park.

Total relief over the site is approximately 16 feet with drainage flowing in a westerly direction. The existing roadways are presently surfaced with concrete, asphaltic concrete, and coral.

FIELD EXPLORATION

The site was explored on March 8th, 1977 by drilling seven exploratory test borings with a truck mounted rotary drilling machine. The borings varied in depth from 4.5 to 5 feet. The soils were continuously logged by our field engineer and classified by visual examination in accordance with the Unified Soil Classification System. The boring locations are shown on Plate 1, and the soils encountered are logged on Plates A1 through A7.

Undisturbed and bag samples were recovered from the borings for laboratory testing and analyses. Undisturbed samples were

obtained by driving a 3 inch O.D. thin-walled split tube sampler with a 140 pound hammer from a height of 30 inches. The required blow count for each six inches of penetration is shown on the enclosed Boring Logs.

SOIL CONDITIONS

A discontinuity in subsurface soil conditions was encountered in our exploratory borings. Boring numbers B1, B2, B3, and B4, located in the northern third of the site, encountered a thin surface layer of silty sand ranging in thickness from 6 to 12 inches. Underlying the surface silty sand was a hard coral stratum. Boring numbers B5, B6, and B7 encountered a brown to dark brown silty clay in a medium stiff to stiff condition. Boring B6 encountered the coral stratum at a depth of 4.5 feet below existing ground.

Groundwater was not encountered in any of the exploratory borings down to the maximum depths drilled.

CONCLUSIONS AND RECOMMENDATIONS

A discontinuity in subsurface soil conditions exist over the project site. The northern third of the site consists of a thin surface layer of silty sand underlain by hard coral. The southern two thirds consist of highly expansive brown silty clay exhibiting poor bearing capacity for supporting roadways.

Visual inspection of surface soil conditions indicates that the discontinuity occurs approximately 280 feet north and west of the intersection of Pohakunui and Piliokahi Avenues. We have indicated the approximate location of the discontinuity on the Site Plan, Plate 1.

Pavement Recommendations

The following pavement section may be used in the design of roadways for Laumania, Keaulana, and portions of Pohakunui and Piliokahi Avenues where the subgrade will be founded on either the silty sand or coral stratum.

- 2" Asphaltic Concrete
- 6" Base Course (Compacted to field
CBR of 85%)

The upper 6 inches of subgrade shall be compacted to 95% of maximum density.

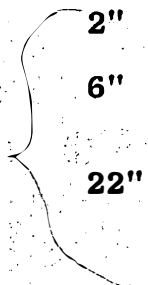
The following pavement section or alternate may be used for portions of Pohakunui and Piliokahi Avenues where the subgrade

will be founded on the brown silty clay.

- 2" Asphaltic Concrete
- 6" Base Course (Compacted to field CBR of 85%)
- 6" Select Borrow (Compacted to 95% of maximum density)
- 24" Borrow (Compacted to 95% of maximum density)

The upper 6 inches of subgrade compacted to 95% of maximum density.

Alternate Section

- 
- 2" Asphaltic Concrete
 - 6" Base Course (Compacted to field CBR of 85%)
 - 22" Select Borrow (Compacted to 95% of maximum density)

The upper 6 inches of subgrade compacted to 95% of maximum density.

Limitations

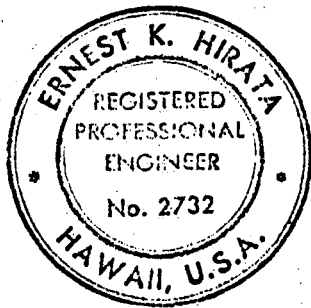
The boring logs indicate the approximate subsurface soil conditions encountered only at those locations where the borings were made, and may not represent conditions at other locations.

During construction, should subsurface conditions differ from those encountered in the borings, we should be advised immediately in order to review and to revise our recommendations.

Our professional services were performed, findings obtained, and recommendations prepared in accordance with generally accepted engineering practices. This warranty is in lieu of all other warranties expressed or implied.

Respectfully submitted,

Ernest K. Hirata & Associates, Inc.



Ernest K. Hirata
Ernest K. Hirata P.E. 2732

EKH:yk

Enc: Boring Logs
Consolidation Test
Laboratory Test Results
CBR Stress-Penetration Curve
Site Plan

Plates A1 through A7
Plate B
Plate C
Plate D
Plate 1



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BORING LOG

BORING NO. B1

DRIVING WT. 140 lb.

DATE OF DRILLING 3-8-77

SURFACE ELEV. 14.5*

DROP 30 in.

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DEPTH FEET	CORE	BAG	PENETRATION RESIST. BLOWS/6 inches	DRY DENSITY PCF	MOISTURE CONTENT %	RELATIVE COMPACTION %	DIRECT SHEAR STRENGTH PARAMETERS		CLASSIFICATION (% Sand, % Silt, % Clay)
							ϕ	c	
	x		20/No Penetration						Silty SAND (SM)-Tan, slightly moist, loose.
	x		42/1"						CORAL-Tan, slightly moist, hard.
5									End boring at 5 feet.
10									* Elevations based on Topographic Survey by Austin, Tsutsumi & Associates, Inc.
15									
20									
25									
30									



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BORING LOG

BORING NO. B2

DRIVING WT. 140 lb.

DATE OF DRILLING 3-8-77

SURFACE ELEV. 12.3*

DROP 30 in.

W.O. 410

DEPTH FEET	CORE	BAG	PENETRATION RESIST. BLOWS/6 inches	DRY DENSITY PCF	MOISTURE CONTENT %	RELATIVE COMPACTION %	DIRECT SHEAR STRENGTH PARAMETERS		CLASSIFICATION (% Sand, % Silt, % Clay)
							ϕ	c	
									Silty SAND (SM)-Tan, slightly moist, dense.
	x		4						CORAL-Tan, slightly moist, hard, 8 inch pocket of brown clayey silt at 2 feet.
			39	97.3	9.0				
			50/2"						
	x		86	98.0	17.4				
5									End boring at 4.5 feet.
									* Elevations based on Topographic Survey by Austin, Tsutsumi & Associates, Inc.
10									
15									
20									
25									
30									



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BORING LOG •

BORING NO. B3

DRIVING WT. 140 lb.

DATE OF DRILLING 3-8-77

SURFACE ELEV. 16.4*

DROP 30 in.

W. O. 410

DEPTH FEET	CORE	BAG	PENETRATION RESIST. BLOWS/6 inches	DRY DENSITY PCF	MOISTURE CONTENT %	RELATIVE COMPACTION %	DIRECT SHEAR STRENGTH PARAMETERS		CLASSIFICATION (% Sand, % Silt, % Clay)
							σ	C	
	x		40/No Penetration						Silty SAND (SM)-Tan, slightly moist, loose with gravels.
	x		32 60	112.6	10.8				CORAL-Tan, slightly moist, hard. Grading to soft coral from 4 feet.
5									End boring at 5 feet.
10									
15									
20									
25									
30									

* Elevations based on Topographic Survey by Austin, Tsutsumi & Associates, Inc.



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BORING LOG

BORING NO. B4

DRIVING WT. 140 lb.

DATE OF DRILLING 3-8-77

SURFACE ELEV. 10.0*

DROP 30 in.

W.O. 410

DEPTH FEET	CORE	BAG	PENETRATION RESIST BLOWS/6 inches	DRY DENSITY PCF	MOISTURE CONTENT %	RELATIVE COMPACTION %	DIRECT SHEAR STRENGTH PARAMETERS		CLASSIFICATION (% Sand, % Silt, % Clay)
							ϕ	C	
	x		81/5"	98.4	11.2				Silty SAND (SM)-Brown, moist, medium dense.
	x		32/1"						CORAL-Tan, moist, medium hard. Grading hard from 2.5 feet.
5									End boring at 5 feet.
10									
15									
20									
25									
30									

* Elevations based on Topographic Survey by Austin, Tsutsumi & Associates, Inc.



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BORING LOG

BORING NO. B5

DRIVING WT. 140 lb.

DATE OF DRILLING 3-8-77

SURFACE ELEV. 9.8*

DROP 30 in.

W.O. 410

DEPTH FEET	CORE	BAG	PENETRATION RESIST BLOWS/6 inches	DRY DENSITY PCF	MOISTURE CONTENT %	RELATIVE COMPACTION %	DIRECT SHEAR STRENGTH PARAMETERS		CLASSIFICATION (% Sand, % Silt, % Clay)
							ϕ	C	
	X		17 22 27	65.8	40.3				Silty CLAY (CL)-Brown, moist medium stiff, with some roots.
	X		10 11 18	69.5	51.3				
5									End boring at 5 feet.
									* Elevations based on Topographic Survey by Austin, Tsutsumi & Associates, Inc.
10									
15									
20									
25									
30									



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BORING LOG

BORING NO. B6

DRIVING WT. 140 lb.

DATE OF DRILLING 3-8-77

SURFACE ELEV. 13.0*

DROP 30 in.

W.O. 410

DEPTH FEET	CORE	BAG	PENETRATION RESIST. BLOWS/6 inches	DRY DENSITY PCF	MOISTURE CONTENT %	RELATIVE COMPACTION %	DIRECT SHEAR STRENGTH PARAMETERS		CLASSIFICATION (% Sand, % Silt, % Clay)
							ϕ	C	
	X		8	69.8	45.7				Silty CLAY (CL)-Brown, moist, medium stiff.
			10						
			12						
	X		8	72.3	49.4				CORAL-Tan, moist, medium hard.
			20						
5			28						End boring at 5 feet.
									* Elevations based on Topographic Survey by Austin, Tsutsumi & Associates, Inc.
10									
15									
20									
25									
30									



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BORING LOG

BORING NO. B7

DRIVING WT. 140 lb.

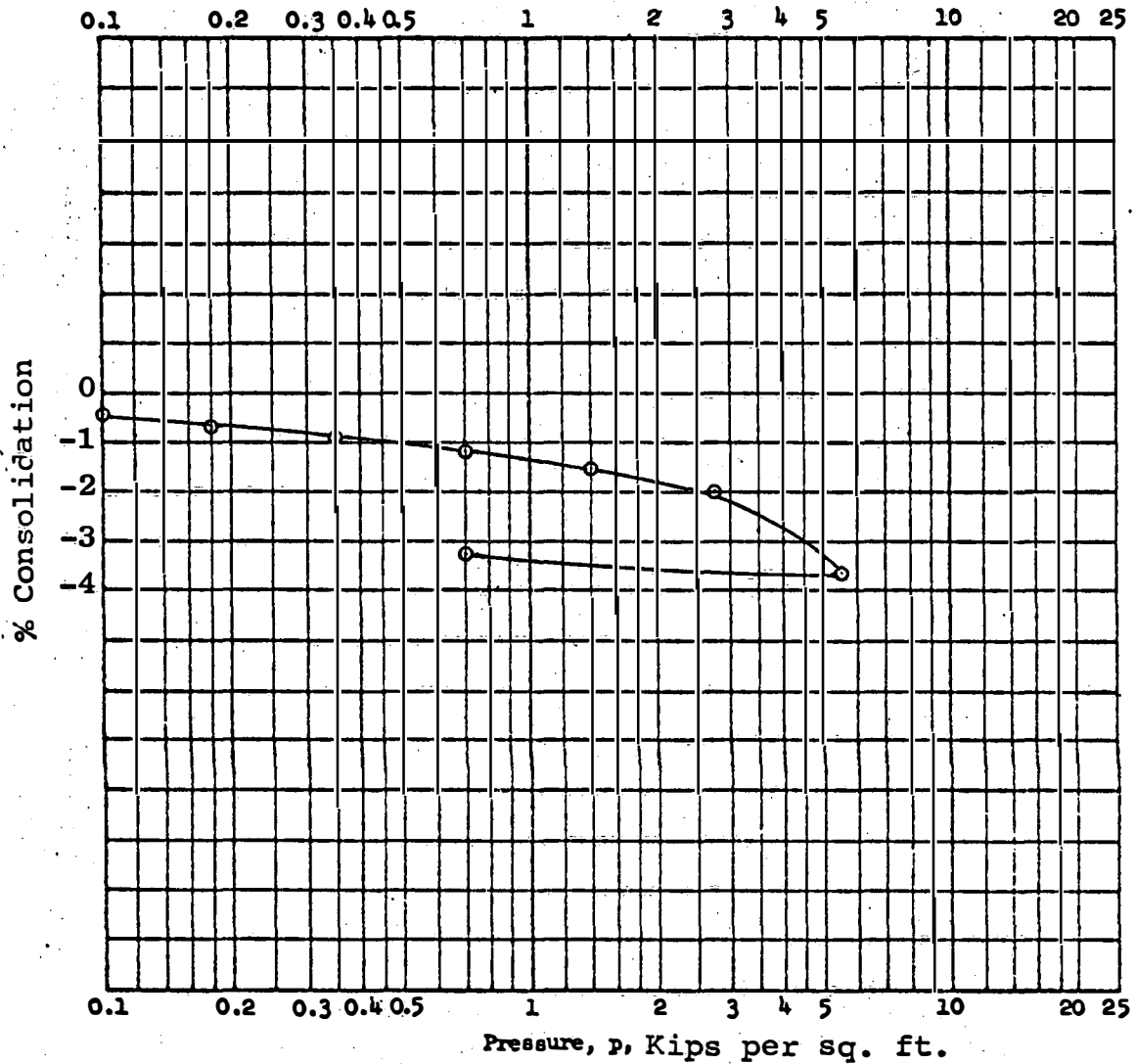
DATE OF DRILLING 3-8-77

SURFACE ELEV. 17.0*

DROP 30 in.

W.O. 410

DEPTH FEET	CORE	BAG	PENETRATION RESIST. BLOWS/6 inches	DRY DENSITY PCF	MOISTURE CONTENT %	RELATIVE COMPACTION %	DIRECT SHEAR STRENGTH PARAMETERS		CLASSIFICATION (% Sand, % Silt, % Clay)
							ϕ	c	
	x		12	78.7	30.7				Silty CLAY (CL)-Dark brown, moist, stiff. Mixed with coral fragments at 1.5 feet.
			24						
			31						
	x		28	89.4	30.5				End boring at 5 feet. * Elevations based on Topographic Survey by Austin, Tsutsumi & Associates, Inc.
			44						
			37						
5									
10									
15									
20									
25									
30									



Type of Specimen: Undisturbed		Before Test		After Test	
Diam 2.40 in.	Ht 1.0 in.	Water Content, v_o	40.3 %	v_f	%
Overburden Pressure, p_o	T/sq ft	Void Ratio, e_o		e_f	
Preconsol. Pressure, p_c	T/sq ft	Saturation, S_o	%	S_f	%
Compression Index, C_c		Dry Density, γ_d	65.8 lb/ft ³		
Classification CL					
LL		Project Nanakuli Road Improvements			
PL		Hawaiian Home Lands			
Remarks		Area W. O. 410			
		Boring No. B5	Sample No.		
		Depth El 1'	Date 3-19-77		
CONSOLIDATION TEST REPORT					

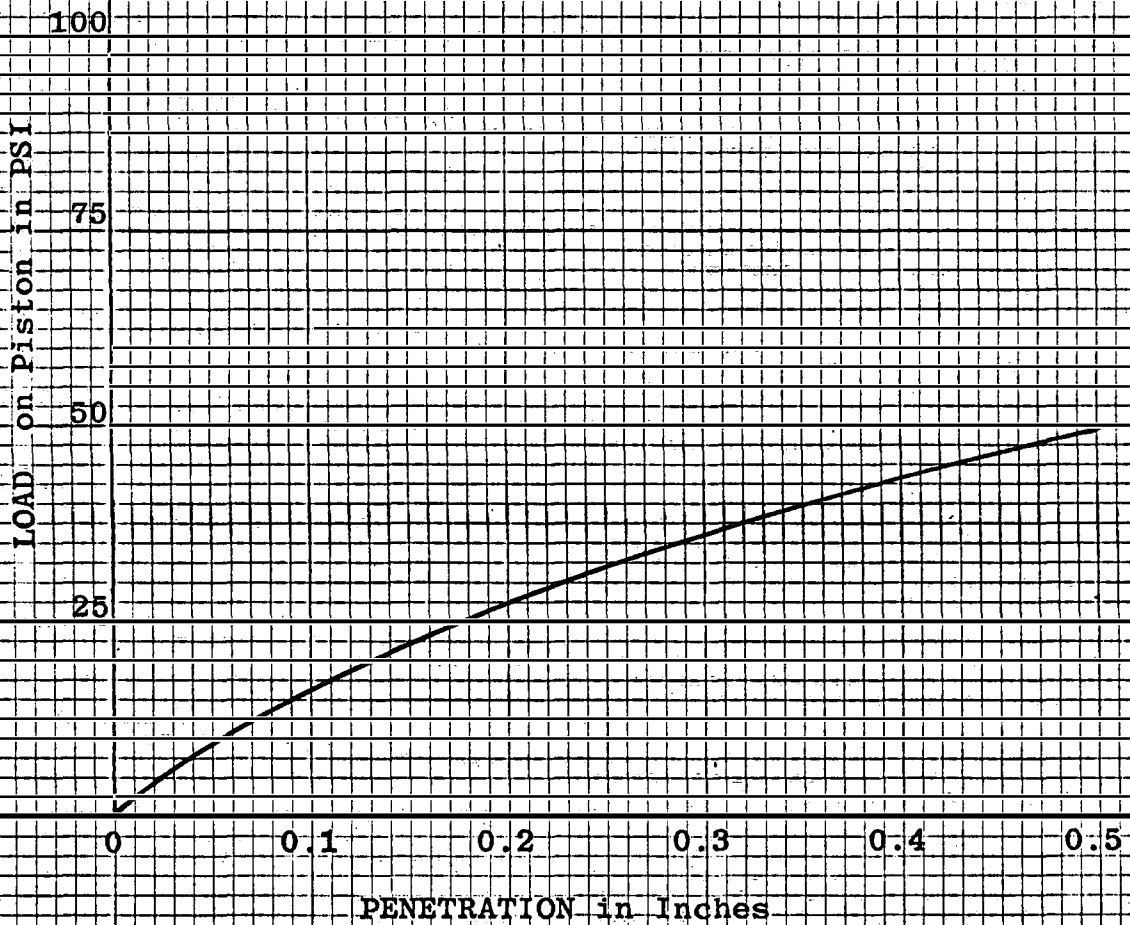
LABORATORY TEST RESULTS

Project: Nanakuli Road Improvements

W.O. 410

Boring or Test Pit No.	B1	B7	B7		
Depth (ft.)	Surface	Surface	1		
Atterburg Limit Tests					
Liquid Limit					
Plastic Limit					
Plastic Index					
Soil Classification	SM	CL	CL		
Expansion @ 90 PSF					
Natural			9.3%		
Remolded					
Expansion @ PSF					
Natural					
Remolded					
Unconfine Stress (PSF)					
Proctor					
Max. Dry Unit Wt. (PCF)	127.0	90.5			
Optimum Water (%)	9.0	27.5			
Wet Density In-Place (PCF)			102.9		
Moisture In-Place (%)			30.7		
Dry Unit Wt. In-Place (PCF)			78.7		

CBR STRESS-PENETRATION CURVE



Soil Description: Brown Silty CLAY

Location: B7 - Surface

Max. Density = 90.5

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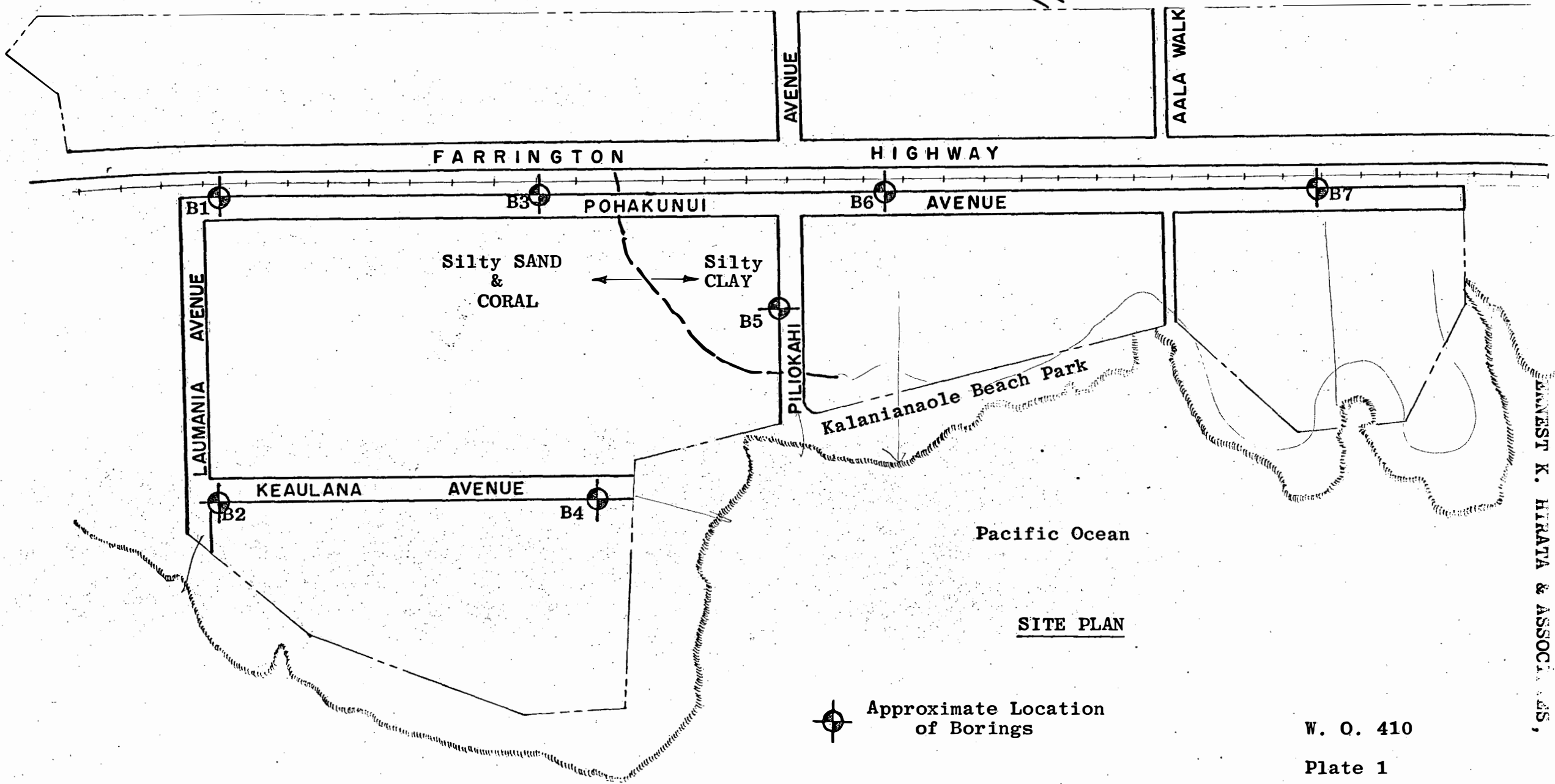
Opt. Moisture = 27.5

Swell = 9.3%

CBR @ 0.1 = 1.6

Plate: D

Scale: 1" = 200'



SITE PLAN

⊕ Approximate Location of Borings

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Plate 1

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