GEOTECHNICAL REPORT

PĀʻINA HAWAIʻI IRRADIATION FACILITY
92-1780V Kunia Road
Kunia, Oʻahu, Hawaiʻi

Weidig Geoanalysts Project No. 11-0006.001

RECEIVED
MAR - 8 2011
DNMS

Publicly available version

WEIDIG
Geoanalysts

GEOTECHNICAL REPORT
PĀʻINA HAWAIʻI IRRADIATION FACILITY
92-1780V KUNIA ROAD
KUNIA, OʻAHU, HAWAIʻI

Project No: 11-0006.001

Date: February 17, 2011

Prepared for:

Pāʻina Hawaiʻi, Inc.
Attn: Michael Kohn
3209 ʻUalena Street
Honolulu, Hawaiʻi 96820

RECEIVED
MAR - 8 2011
DNMS

Prepared by:

Weidig Geoanalysts
1150 North Nimitz Highway, Suite 4
Honolulu, Hawaiʻi 96817

Authored by:

Paul C. Weidig
Licensed Professional Engineer No. 8,047-C

PAUL COLIN WEIDIG
LICENSED PROFESSIONAL ENGINEER
No. 8047-C
HAWAII, U.S.A.

WEIDIG
Geoanalysts

WEIDIG
Geoanalysts

1150 North Nimitz Highway • Suite 4
Honolulu, Hawai'i 96817
Tel: (808) 524-5657 Fax: (808) 524-5658
www.geoanalysts.com

February 17, 2011

Project No. 11-0006.001

To: Pā'ina Hawai'i, Inc.
3209 'Ualena Street
Honolulu, Hawai'i 96820

Attn: Michael Kohn

Subject: Geotechnical Investigation
Pā'ina Hawai'i Irradiation Facility
92-1780V Kunia Road
Kunia, O'ahu, Hawai'i

Attached is our report of the geotechnical study we conducted for your new facility near Kunia. The principal conclusions and recommendations are as follow:

- The test borings revealed that the existing floor slab is about seven inches thick, and is reinforced with both corrugated steel webbing and reinforcing bars. Beneath the floor slab, surficial soils composed of a very stiff to hard, clayey silt was discovered to an average depth of about 5.5 feet beneath the floor level, below which uniformly very hard saprolite (intensely weathered volcanic rock) was penetrated to the maximum depth explore, approximately 26.5 feet. No ground water was intercepted in either boring.

- The proposed irradiation chamber can be supported as designed on a six-inch-thick concrete base slab founded on undisturbed saprolite at the design depth of 22 feet below the existing floor elevation. The existing ground floor slab and underlying surficial soil can sustain the loads that will be imposed by the trolley conveyor system and surge tank.

- We should be retained to review the final construction plans and specifications, to inspect the foundation excavations, and to test and observe the earthwork.

If you have any questions regarding this report, or if we can be of assistance to you in any other way, please do not hesitate to call. Mahalo for this opportunity to be of service.

Respectfully submitted,

Paul C. Weidig

Paul C. Weidig, P.E.
President

PCW/lr/11-0006.001

TABLE OF CONTENTS

EXECUTIVE SUMMARY

INTRODUCTION . . . . . Page 1
- Purpose 1
- Scope 1
- Project Description 2

FINDINGS 2
- Site Description 2
- Geologic Setting 2
- Earth Materials 3
- Ground Water 3
- Floor Slab Strength 3

CONCLUSIONS 4
- Expansive Soils 4
- Bearing Capacity 4
- Settlement 5
- Foundation Conditions 5

RECOMMENDATIONS 5
- Site Preparation and Grading 5
  - Demolition 5
  - Excavation and Shoring 5
  - Subgrade Preparation 6
- Foundations 7
- Chamber Walls 8
- Supplemental Services 8

LIMITATIONS 8

APPENDICES
- Appendix A - Field Exploration
  - Vicinity Map . . . . . Plate No. A1
  - Site Plan A2
  - Logs of Borings . . . . . A3 - A5
  - Unified Soil Classification System A6
- Appendix B - Laboratory Testing
  - Atterberg Limits Test Data . . . . . Plate No. B1
  - Direct Shear Test Data B2
  - Unconfined Compressive Strength Test Data . . . . . B3 - B5
- Appendix C - References

DISTRIBUTION

INTRODUCTION

Purpose

A geotechnical investigation has been conducted for a new produce irradiation facility for Pā'ina Hawai'i. The subject property is situated at 92-1780V Kunia Road near Kunia. The purposes of this study have been to gather information on the nature, distribution and characteristics of the subsurface earth materials and ground water conditions at the site, and to prepare specific recommendations for use in project design and construction.

Scope

The scope of this investigation is described in our proposal of January 24, 2011. On February 7 and 8, 2011, our field engineer conducted a reconnaissance of the property and mapped the locations of two test borings that were drilled and sampled to a depth of about 26.5 feet at diagonally opposed points inside the existing building which surrounds the site of the proposed facility. Coring through the building floor slab was required at both locations and a concrete core also was obtained for compression testing at a third point near the center of the proposed irradiation chamber. Our field representative logged, classified and recovered relatively undisturbed samples of the earth materials drawn from selected vertical intervals in each boring. Ground water level observations were recorded during and after completion of the borings, which were backfilled with tamped soil and capped with ready-mix concrete following exploration.

The samples retrieved from the borings were transported to our office for laboratory testing and further classification. The laboratory testing program comprised determinations of dry unit weight, natural moisture content, plasticity, direct shear strength and unconfined compressive strength determinations.

This report contains our findings regarding site soil, ground water and other geologic conditions; conclusions pertaining to expansive soils, bearing capacity, settlement and foundation conditions; and, recommendations for site preparation, excavation, shoring and foundations. A detailed description of the field exploration program is presented in Appendix A. The location of the project site is shown in relationship to surrounding landmarks and cultural features on Plate No. A1, Vicinity Map. The approximate locations of the test borings and floor core are depicted in relationship to the existing building and the proposed facility on Plate No. A2, Site Plan. Geotechnical descriptions and related data recorded during the field exploration phase of our study are displayed on Plates No. A3 and A4, Logs of Borings. A key to the soil symbols and identification criteria used on the logs is presented on Plate No. A5, Unified Soil Classification System.

The results of the natural moisture content and dry unit weight tests are posted on the Logs of Borings, on which are also indicated the types of other laboratory tests conducted on corresponding samples. The remaining laboratory test data are contained in Appendix B. The results of the plasticity tests are illustrated on Plate No. B1, Atterberg Limits Test Data. Summaries of the strength tests appear on Plate No. B2, Direct Shear Test Data, and on Plates No. B3 through B5, Unconfined Compressive Strength Test Data. References consulted during the course of our investigation are listed in Appendix C.

Project Description

According to preliminary plans, the proposed facility will include two offices and a treatment area housing an 80-inch- by 94-inch- by 22-foot-deep pool composed of inner and outer tanks fabricated of 0.25-inch-thick steel plates separated by ten structural "I" beams. The assembly is tested for leakage off-site prior to delivery and installation. After the pool is installed, the 6-inch-wide gaps between the inner and outer tank walls are filled with concrete. The nominal dimensions of the required excavation for the pool will approach eight feet by nine feet in plan view and 23 feet in depth. When filled with water, the pool will weigh about 45 tons, plus an estimated 12 tons accounting for a 12-inch-thick foundation slab (Clayton H. Landis Company, Inc., 2006).

The irradiation chamber will be coupled with a five-foot-high, rectangular steel surge tank measuring approximately seven feet by nine feet in plan view. The surge tank will be recessed below the floor level and supported on a six-inch-thick, reinforced concrete pad. The irradiation chamber and surge tank will be encircled by an overhead trolley delivery system composed of an elliptical track supported on steel columns bearing on 12-inch-square base plates bolted to the existing floor slab.

FINDINGS

Site Description

As shown on Plates No. A1 and A2, the site of the proposed facility is located within a converted pineapple processing building on the west side of Kunia Road near its intersection with Kunia Drive (State of Hawai'i, 1996). The space within the building to be occupied by the irradiation works is an abandoned refrigeration room presently occupied by storage racks reaching a ceiling height near 24 feet. The floor is a concrete slab on grade, the perimeter walls are of steel frame construction and the roof consists of corrugated metal sheathing (Hawai Industrial Structures, Inc., 2010).

Geologic Setting

The subject site lies on the O'ahu Central Plain, which is underlain by a coalescent series of lava flows issuing from the Wai'anae Range, to the west, and the Ko'olau Range, to the east. The Wai'anae flows are about 3.7 million years old, and the Ko'olau flows are about 2.6 million years old. Both series consist mainly of basalt and subordinate andesite formations intersected by crystalline igneous dikes. The lava flows have been deeply weathered to a formation called saprolite to a depth of more than 100 feet near the axis of the Central Plain (Stearns, 1985).

The surficial soil is indicated to consist of a silty clay loam assigned to the Wahiawā series. This soil is characterized by a low shrink/swell potential and a low corrosion potential with respect to uncoated steel but a moderate corrosion potential with respect to concrete (Foote, *et al.*, 1972).

Earth Materials

The borings revealed that the existing floor slab consists of a seven-inch-thick section of concrete reinforced by 1" by 2" corrugated steel webbing and a single curtain of No. 5 steel reinforcing bars, surmounted by a plain concrete wearing course from 0.5 inch to 1.5inches thick. The slab appears to have been cast on a prism of fill composed of a dusky reddish-brown, moist, chiefly very stiff to hard clayey silt (Unified Soil Classification: MH) that extends to an average depth approaching 5.5 feet below the floor level. This soil is identified as a derivative of the Wahiawā series described above.

Below the soil mantle, the borings penetrated a continuous profile of dusky reddish-orange to reddish-brown or light gray mottled, moist, very hard saprolite to the maximum depth explored, approximately 26.5 feet below the floor slab grade. Further subsurface details are presented on Plates No. A3 through A5.

Ground Water

Each test boring was checked for the presence of ground water during and at intervals following exploration. No free ground water was intercepted at either location.

Floor Slab Strength

A uniaxial compressive strength test performed on the concrete core extracted from the floor slab at the approximate location shown on Plate No. A2 attained an ultimate value of 4,030 pounds per square inch.

CONCLUSIONS

Expansive Soils

The results of the Atterberg limits tests, shown on Plate No. B1, indicate that the surficial soil has relatively low plasticity properties (plasticity index = 17 percent) and comparatively low water retention characteristics (liquid limit = 51 percent). The plasticity index is the maximum range of water contents which a soil can assume under natural conditions. The liquid limit is the maximum amount of water that a soil is capable of absorbing without becoming fluid. The plastic limit is the minimum amount of water a soil can hold without crumbling.

These results indicate that the surficial soil has low to marginal expansive tendencies. Expansive soils swell or heave when they absorb water and shrink or contract when they dry out. In light of the foregoing, it is our opinion that no special precautions designed to counteract the detrimental effects of soil swelling or shrinkage are warranted on the site.

Bearing Capacity

Laboratory direct shear strength tests conducted on selected samples of the surficial soil yielded an internal friction angle of about 21.2° and a low cohesion intercept of about 200 pounds per square foot, as shown on Plate No. B2. An unconfined compressive strength tests completed on another sample of the surficial soil reached an ultimate undrained shear strength on the order of 1,865 pounds per square foot, as illustrated on Plate No. B3. These test results confirm that the surficial soil can support structural loading increases of at least intermediate intensity. Assuming that the columns supporting the trolley conveyor system will be founded on 12-inch-square base plates, the ultimate bearing capacity of the subgrade soil at each leg is calculated at approximately 5,125 pounds per square foot based on the direct shear test results, or 5,130 pounds per square foot based on the unconfined compression results.

Additional unconfined compression tests performed on selected samples of the saprolite formation immediately beneath the soil mantle reached ultimate undrained shear strengths ranging from about 2,965 pounds per square foot at a depth of seven feet progressively increasing to approximately 7,050 pounds per square foot at a depth of about 22 feet, as portrayed on Plates No. B4 and B5. At a design depth of 22 feet below the existing floor slab elevation, the ultimate bearing capacity of the irradiation chamber is calculated at 27,800 pounds per square foot.

Settlement

The results of laboratory tests indicate that the minimum modulus of vertical subgrade reaction for the surficial soil is about 138 pounds per cubic inch, implying that it can compress up to one inch under a uniform load of about ten tons per square foot.

Similarly, the subgrade modulus for the saprolite formation at the design depth of 22 feet is computed at about 780 pounds per cubic inch, suggesting that it can compress up to one inch under a uniform load near 56 tons per square foot. Since the total pressure under full operating load at that level will be approximately 985 pounds per square foot, the predicted settlement will be insignificant.

Foundation Conditions

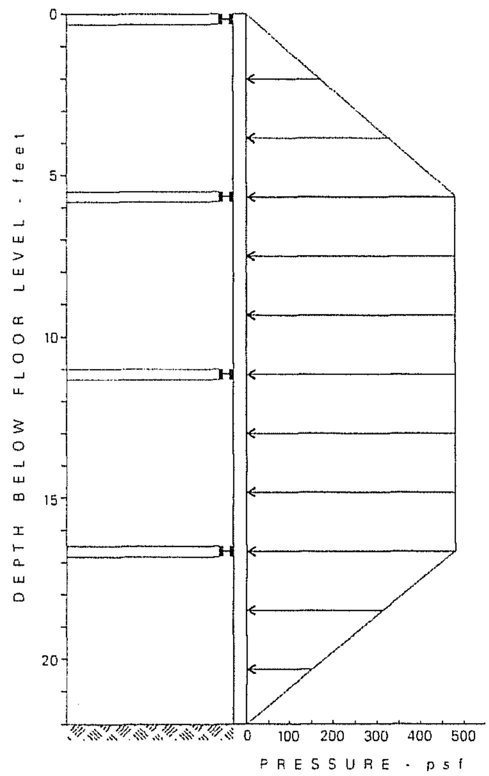
Our study indicates that the proposed irradiation chamber can be supported as designed on a six-inch-thick concrete base slab founded on undisturbed saprolite. We have also concluded that the existing ground floor slab and underlying surficial soil can sustain the loads that will be imposed by the trolley conveyor system and surge tank, provided that the recommendations presented below are followed.

RECOMMENDATIONS

Site Preparation and Grading

Demolition - Following removal of the storage racks and other unwanted fixtures, the existing floor slab should be saw cut to neat lines following the perimeters of the irradiation chamber, surge tank and (if necessary) the base plate footprints of the trolley conveyor system. The enclosed concrete slab sections should be broken up into manageable fragments and the resulting debris hauled to an approved disposal area.

Excavation and Shoring - The shaft required for the irradiation chamber can be excavated with vertical side slopes to terminal depth. To provide increased work crew protection, temporary shoring should be provided. Shoring should consist of steel uprights and horizontal hydraulic struts. The shoring should be designed in accordance with the following pressure diagram:



Subgrade Preparation - Soils exposed at subgrade level beneath the proposed surge tank and trolley conveyor column locations should be brought to at least the optimum moisture content and compacted to a minimum of 95 percent relative density in accordance with ASTM Designation D 1557-91.

Inability to achieve the stipulated minimum level of compaction should be used as a field criterion to identify areas of loose or disturbed soils that should be overexcavated and replaced with engineered backfill or stabilized in accordance with the recommendations of the project geotechnical engineer. If backfill is required, it should be approved by the project geotechnical engineer. On-site soils derived from excavation may be salvaged for reuse as engineered fill, provided that they are processed to remove rubble, rubbish, vegetation or other perishable substances, and stones or irreducible hard lumps greater than four inches in largest dimension. Imported fill, if required, should conform to the same criteria but in addition should have a plasticity index not exceeding 20, when tested in accordance with ASTM Designation D 4318-84, and at least 20 percent of the particles should pass the No. 100 sieve, when tested in accordance with ASTM Designation D 422-90.

All backfill material should be placed in horizontal lifts not exceeding eight inches in loose thickness. Each lift should be brought to at least the optimum moisture content and compacted to not less than 95 percent relative compaction, per ASTM Designation D 1557-91. All earthwork operations should be observed and the soils tested by the project geotechnical engineer or his representative. The further recommendations of this report are contingent upon adherence to this and the previous recommendations.

Foundations

The proposed irradiation chamber should be supported on a six-inch-thick, reinforced concrete base slab designed to impart a uniform bearing pressure not exceeding 9,300 pounds per square foot under full working load, or 12,400 pounds per square foot under total load including the effect of seismic forces. These values carry safety factors of 2.0 and 1.5, respectively. A total of 25 percent of the weight of foundation concrete extending below grade should be added to the net loads at that level to account for the difference in weight between structural concrete and earth.

Resistance to horizontal displacement of the irradiation chamber will be provided by passive earth pressures and sliding friction. Passive earth resistance should be assumed to act as a uniform pressure at 2,000 pounds per square foot exerted any appropriate vertical chamber face. Sliding friction should be computed at 0.38 times the applied dead load along any appropriate horizontal foundation base slab face. These values carry a safety factor of 1.5. If resistive components are combined, the larger should be reduced by half.

Resistance to horizontal displacement of auxiliary foundations based in recompacted surficial soils will also be provided by passive earth pressures and friction. In these cases, passive earth resistance should be assumed to act as a triangular distribution at 220 pounds per cubic foot and sliding friction should be calculated at 0.26 times the applied dead load. These values also carry a safety factor of 1.5. As stated previously, if resistive components are combined, the larger should be reduced by half.

Foundation resistance to uplift forces will be provided by the weight of foundation concrete; soil resistance developed along shear planes extending from the outer foundation edges and upward at 70° from the horizontal; and, the weight of soil overlying the pullout envelope enclosed by the foundation edges, shear planes and finished grade. The weight of foundation concrete should be assumed at 100 pounds per cubic foot, the weight of soil within the pullout envelope should be assumed at 65 pounds per cubic foot, and the resistance acting along the shear planes defining the pullout envelope should be assumed at 285 pounds per square foot. These values also carry a safety factor of 1.5.

Site Class C per Table 1615.1.1 of the *International Building Code* (2003) should govern earthquake design considerations.

Chamber Walls

The proposed irradiation chamber walls should be considered rigid elements designed to resist at-rest lateral soil pressures equivalent to those exerted by a fluid weighing 52 pounds per cubic foot. In addition to the static earth pressures, the walls may also be subject to surcharge pressures imposed by superjacent foundations.

Supplemental Services

Weidig Geoanalysts should be retained to review the construction plans and specifications to determine whether the recommendations contained in this report are adequately reflected in those documents. The results of our review would be described in writing. Weidig Geoanalysts also should be retained to test and observe the earthwork construction, and to inspect the foundation excavations.

LIMITATIONS

This report has been prepared for the exclusive use of Pā'ina Hawai'i, Inc. and its designated agents. The information contained in this report is intended for the project described. If any part of the project concept is changed, or if subsurface conditions different from those described in this report are discovered during construction, then the information presented herein shall be considered invalid, unless the changes are reviewed, and any supplemental or revised recommendations issued in writing by Weidig Geoanalysts.

Site conditions and cultural features described in the text are those existing at the time of our field reconnaissance and exploration on February 7 and 8, 2011, and may not necessarily be representative of such conditions at other places and times. Similarly, the test borings represent subsurface conditions at the times and locations indicated; it is not warranted that they are representative of such conditions at other locations and times.

The locations of the test borings and concrete floor core are referenced to a document titled: *Proposed Facility Floor Plan, Pi'ina* [sic] *Hawaii, Inc.* (scale: ⅛ = 1'-0"), Sheet A-200, date of last revision: December 15, 2010, by Hawaii Industrial Structures, Inc. and are to be considered approximate only.

Services performed by Weidig Geoanalysts conform to generally accepted practices of other consultants who undertake similar studies at the same time and in the same geographical area as does our firm. No other warranty is expressed or implied.

APPENDIX A

Field Exploration

WEIDIG
Geoanalysts

APPENDIX A

Field Exploration

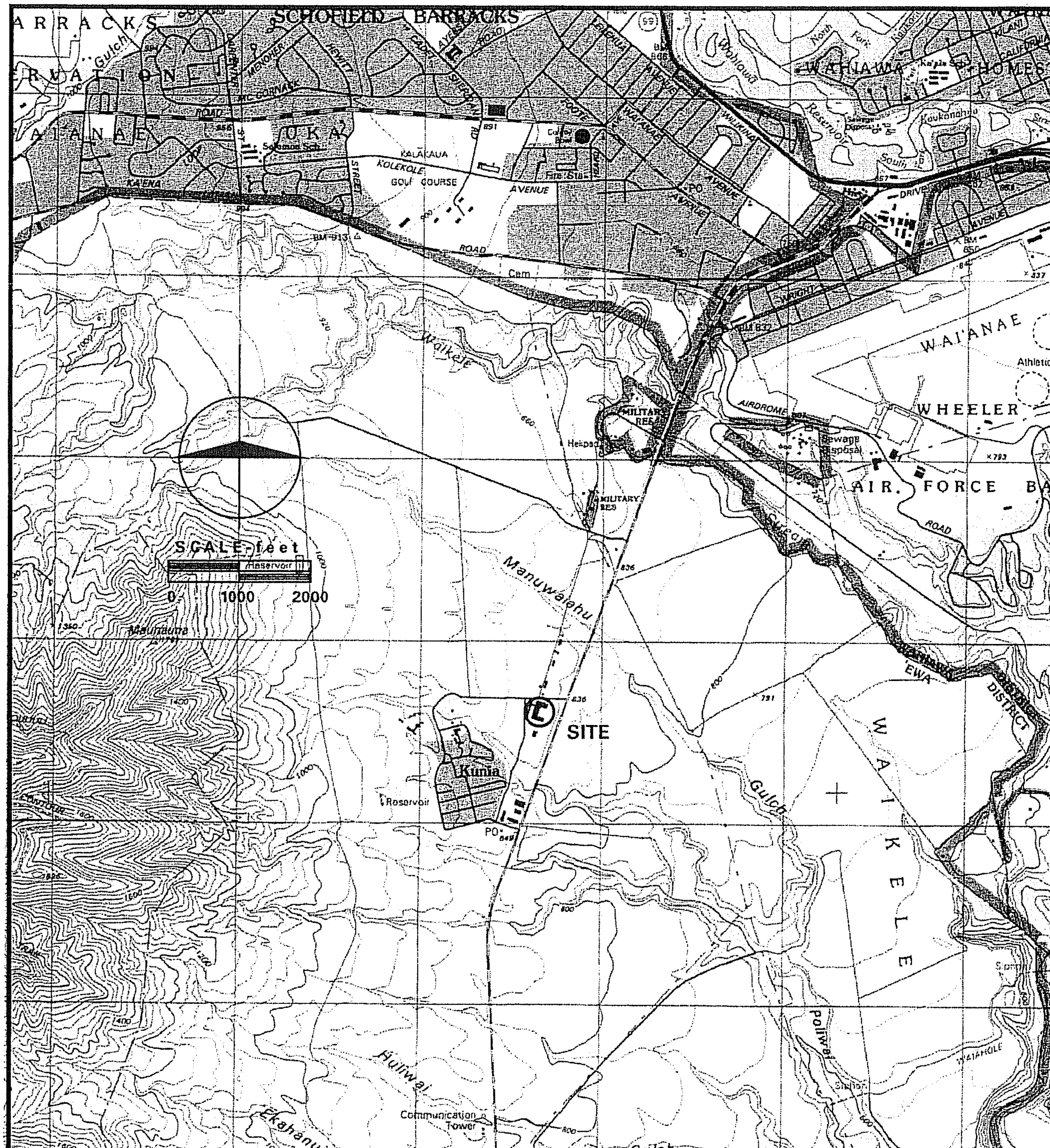
On February 7 and 8, 2011, our field engineer conducted a reconnaissance of the site and surrounding vicinity. The location of the project is shown in relationship to surrounding landmarks and cultural features on Plate No. A1, Vicinity Map.

Our geotechnical exploration program was conducted under the supervision of our field representative who logged, classified, and recovered relatively undisturbed samples of the earth materials drawn from selected vertical intervals in each of two test borings. Coring through the building floor slab was required at both locations and a concrete core also was obtained for compression testing at a third point near the center of the proposed irradiation chamber. The approximate locations of the test borings and floor core are depicted in relationship to the existing building and the proposed facility on Plate No. A2, Site Plan.

The borings were advanced to a depth of approximately 26.5 feet below existing grade. At selected vertical intervals in each boring, relatively undisturbed samples of the earth materials were obtained by means of a 3.0-inch O.D. (2.5-inch I.D.) split-barrel sampler containing stacks of thin-walled, brass rings, each one inch deep. The sampler was advanced by hammer blows produced by a 140-pound hammer freely falling 30 inches, in accordance with ASTM Designation D 1586-84. The number of blows required to drive the sampler a total distance of 18 inches was recorded, and the sum of the hammer blows for the second and third six-inch increments, or blow count, was recorded for each drive. The blow counts recorded for the split-barrel sampler are approximately twice those of the corresponding "Standard Penetration" blow counts. The samples were sealed in moisture-proof containers and transported in shock-resistant cases to our laboratory for further classification and testing.

The earth materials were classified by color, texture, consistency, tactile moisture, and other relevant characteristics. The field classifications were recorded on the field logs, which were edited for final presentation. Ground water level observations were made during drilling and upon completion of the borings, which were backfilled with tamped soil and capped with concrete following exploration.

The Logs of Borings are depicted on Plates No. A3 and A4. A key to the soils symbols and identification criteria used on the logs is presented on Plate No. A5, Unified Soil Classification System.



Base: United States Geological Survey, 1998, *Schofield Barracks Quadrangle, Hawai'i - Honolulu Co., Island of O'ahu, 7.5 Minute Series (Topographic)*

VICINITY MAP

WEIDIG Geoanalysts	**PA'INA HAWAI'I IRRADIATION FACILITY** 92-1780V Kunia Road Kunia, O'ahu, Hawai'i	
	DATE: February, 2011	PROJECT NO. 11-0006.001

PLATE NO. A1

The information in this page
has been redacted in its entirety

BORING LOCATION: See Site Plan	DRILLER: Weidig Geoanalysts	**BORING NO. B-1**
BORING ELEVATION:	LOGGED BY: Berwin Chow	
DATE DRILLED: February 7, 2011	TYPE DRILL RIG: Minuteman	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	UNCONFINED STRENGTH (ksf)	PLASTICITY INDEX (%)	BLOW COUNT (Blows per foot)	SAMPLE TYPE AND NUMBER
AL	93	30.2		17	73	SB-1
	97	30.7			143	SB-2
UC	94	28.2	2.97		137	SB-3
	75	32.5			107	SB-4
UC	77	26.8	4.24		195	SB-5
	76	27.9			188	SB-6
UC	75	28.3	5.02		113	SB-7
	78	27.1			167	SB-8
UC	76	28.7	6.77		193	SB-9

DEPTH IN FEET	UNIFIED SOIL CLASSIFICATION	GEOTECHNICAL DESCRIPTION
0		1½" plain concrete wearing course over 7" concrete slab with 1" x 2" corrugated steel webbing and No. 5 bars
	MH	**CLAYEY SILT**, dusky reddish-brown, moist, hard -Fill -
5		**SAPROLITE**, dusky reddish-orange, moist, very hard
10		dusky reddish-orange and reddish-brown mottled
15		
20		dark reddish-brown and light gray mottled
25		
		Bottom of Boring No. B-1 @ 26.5 ft. No free ground water observed.
30		

SAMPLE TYPE

BK - Bulk
CB - Core Barrel
DN - Denison Sampler
SB - Split Barrel
SP - Standard Penetration
ST - Shelby Tube

OTHER LABORATORY TESTS

AL - Atterberg Limits
CN - Consolidation
DS - Direct Shear Strength
SA - Sieve Analysis
SS - Shrink/Swell
UC - Unconfined Compression

LOG OF BORING

WEIDIG Geoanalysts

PA'INA HAWAI'I IRRADIATION FACILITY
92-1780V Kunia Road
Kunia, O'ahu, Hawai'i

DATE: February, 2011 | PROJECT NO. 11-0006.001

PLATE NO. A3

BORING LOCATION: See Site Plan	DRILLER: Weidig Geoanalysts	BORING NO. B-2
BORING ELEVATION:	LOGGED BY: Berwin Chow	
DATE DRILLED: February 8, 2011	TYPE DRILL RIG: Minuteman	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	UNCONFINED STRENGTH (ksf)	PLASTICITY INDEX (%)	BLOW COUNT (Blows per foot)	SAMPLE TYPE AND NUMBER	DEPTH IN FEET	UNIFIED SOIL CLASSIFICATION	GEOTECHNICAL DESCRIPTION
									½" plain concrete wearing course over 7" concrete slab with 1" x 2" corrugated steel webbing
UC	83	33.1	1.87		65	SB-1		MH	**CLAYEY SILT**, dusky reddish-brown, moist, hard -Fill-
DS	82	29.9			32	SB-2	5		very stiff
	76	29.5			92	SB-3			**SAPROLITE**, dusky reddish-orange, moist, very hard
UC	86	35.8	5.27		160	SB-4	10		dusky reddish-orange and reddish-brown mottled
	87	34.4			110	SB-5			
							15		
UC	85	36.3	6.18		143	SB-6			
	79	37.2			197	SB-7	20		dark reddish-brown and light gray mottled
UC	83	35.4	7.05		206	SB-8			
	84	33.9			183	SB-9	25		
									Bottom of Boring No. B-2 @ 26.5 ft. No free ground water observed.
							30		

SAMPLE TYPE

BK - Bulk
CB - Core Barrel
DN - Denison Sampler
SB - Split Barrel
SP - Standard Penetration
ST - Shelby Tube

OTHER LABORATORY TESTS

AL - Atterberg Limits
CN - Consolidation
DS - Direct Shear Strength
SA - Sieve Analysis
SS - Shrink/Swell
UC - Unconfined Compression

LOG OF BORING

WEIDIG Geoanalysts

PA'INA HAWAI'I IRRADIATION FACILITY
92-1780V Kunia Road
Kunia, O'ahu, Hawai'i

DATE: February, 2011 | PROJECT NO. 11-0006.001

PLATE NO. A4

MAJOR DIVISIONS			SYMBOLS ICON	SYMBOLS CODE	TYPICAL DESCRIPTIONS
COARSE-GRAINED SOILS More than 50% of material is larger than the No. 200 Sieve	**GRAVEL AND GRAVELLY SOILS** Less than 50% of coarse fraction passes the No. 4 Sieve	**CLEAN GRAVELS** Less than 12% of fine fraction passes the No. 200 Sieve		GW	Well-graded gravels, gravel-sand mixtures, little or no fines
				GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines
		SILTY OR CLAYEY GRAVELS At least 12% of fine fraction passes the No. 200 Sieve		GM	Silty gravels, gravel-sand-silt mixtures
				GC	Clayey gravels, gravel-sand-clay mixtures
	SAND AND SANDY SOILS At least 50% of coarse fraction passes the No. 4 Sieve	**CLEAN SANDS** Less than 12% of fine fraction passes the No. 200 Sieve		SW	Well-graded sands, gravelly sands, little or no fines
				SP	Poorly-graded sands, gravelly sands, little or no fines
		SILTY OR CLAYEY SANDS At least 12% of fine fraction passes the No. 200 Sieve		SM	Silty sands, sand-silt mixtures
				SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS More than 50% of material is smaller than the No. 200 Sieve	**SILTS AND CLAYS** Liquid Limit is less than 50	Plasticity index is above "A" Line		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
		Plasticity index is below "A" Line		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or slightly plastic clayey silts
				OL	Organic silts and organic silty clays of low plasticity
	SILTS AND CLAYS Liquid Limit is greater than 50	Plasticity index is above "A" Line		CH	Inorganic clays of high plasticity
		Plasticity index is below "A" Line		MH	Inorganic silts, micaceous or diatomaceous fine sands or silty soils
				OH	Organic clays of medium to high plasticity, organic silts
				Pt	Peat, humus, marsh soils with high organic content

UNIFIED SOIL CLASSIFICATION SYSTEM

WEIDIG
Geoanalysts

PA`INA HAWAI`I IRRADIATION FACILITY
92-1780V Kunia Road
Kunia, O`ahu, Hawai`i

DATE: February, 2011 | PROJECT NO. 11-0006.001

PLATE NO. A5

APPENDIX B

Laboratory Testing

WEIDIG
Geoanalysts

APPENDIX B

Laboratory Testing

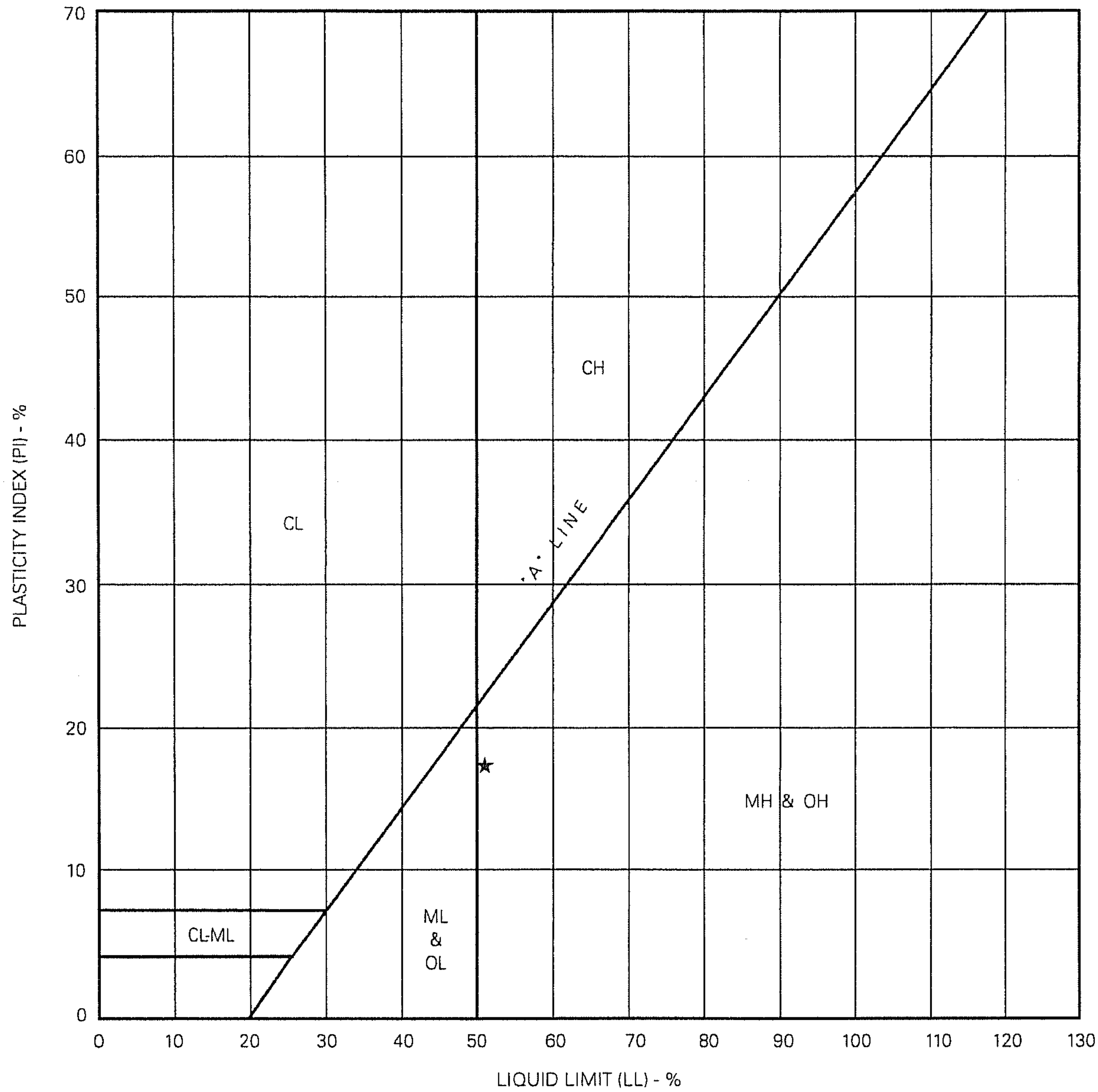
The laboratory testing program included natural moisture content, dry unit weight, plasticity, direct shear strength and unconfined compressive strength.

Natural moisture content tests (ASTM Designation D 2216-92) and dry unit weight tests (ASTM Designation D 2937-94) were conducted on selected samples of the earth materials recovered from each test boring. The results are posted on the Logs of Borings, opposite the depth appropriate to each sample.

Atterberg limits tests (ASTM Designation D 4318-84) were performed on a selected sample of the surficial soil to evaluate its plasticity characteristics. The results are depicted on Plate No. B1, Atterberg Limits Test Data.

Consolidated, drained direct shear tests (ASTM Designation D 3080-90) were conducted at normal pressures of 1,000, 2,000 and 3,000 pounds per square foot on selected samples of the surficial soil to evaluate its internal strength characteristics. The results are displayed on Plate No. B2, Direct Shear Test Data.

Unconfined compressive strength tests (ASTM Designation D 2166-91) were completed on selected samples of the surficial soil and underlying saprolite formation to estimate their undrained strength properties. The results are illustrated on Plates No. B3 through B5, Unconfined Compressive Strength Test Data.



Point Code	Boring No.	Sample No.	Depth (ft)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Unified Soil Classification
★	B-1	SB-1	1.0	51	34	17	MH

ATTERBERG LIMITS TEST DATA

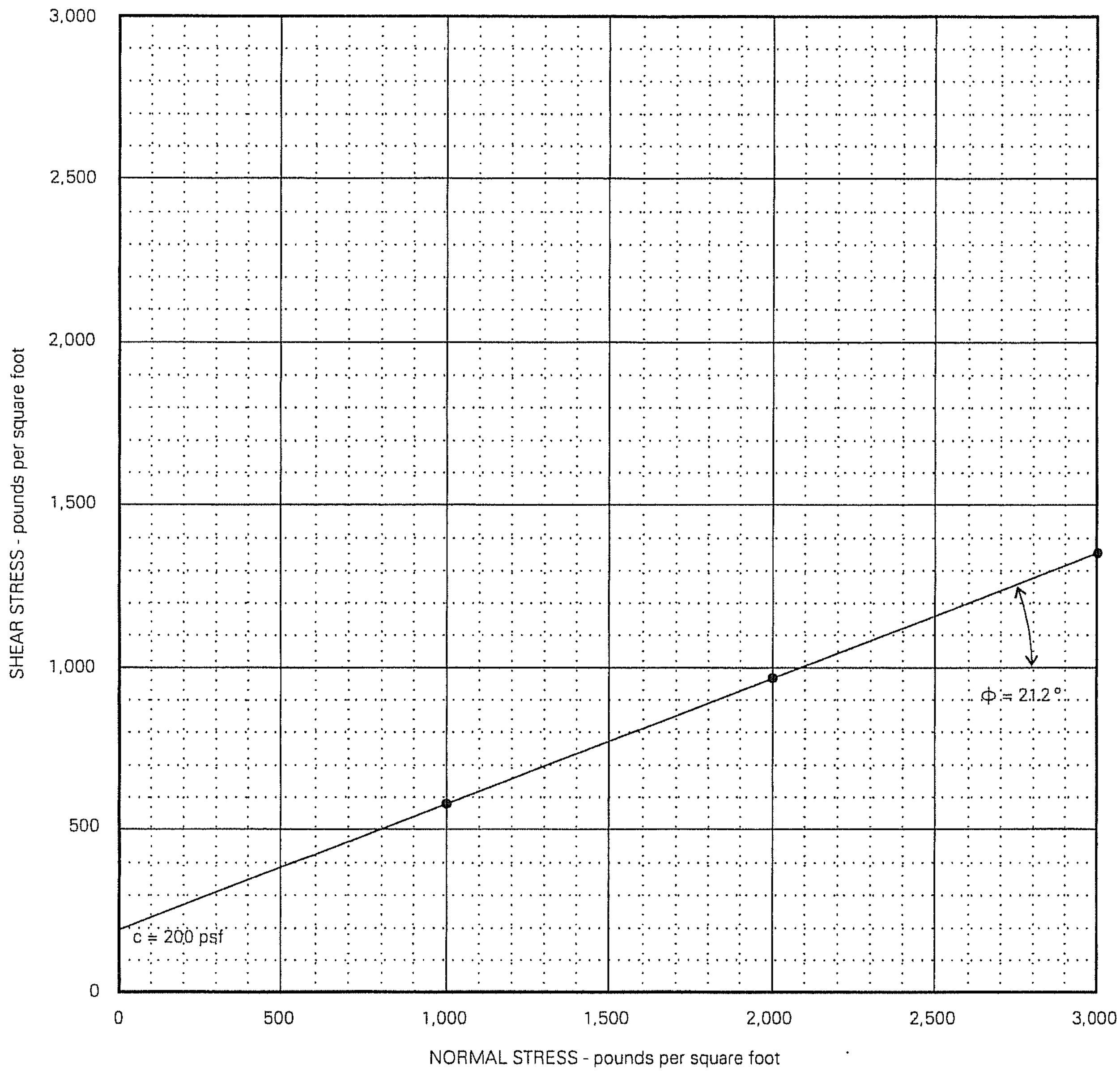
WEIDIG
Geoanalysts

PA`INA HAWAI`I IRRADIATION FACILITY
92-1780V Kunia Road
Kunia, O`ahu, Hawai`i

DATE: February, 2011

PROJECT NO. 11-0006.001

PLATE NO. B1



Boring No.	Sample No.	Depth (ft)	Dry Unit Weight (pcf)	Moisture Content (%)	Normal Stress (psf)	Shear Stress (psf)
B-2	SB-2	4.0	81	27.8	1,000	590
B-2	SB-2	4.0	75	32.1	2,000	925
B-2	SB-2	4.0	80	21.4	3,000	1,360

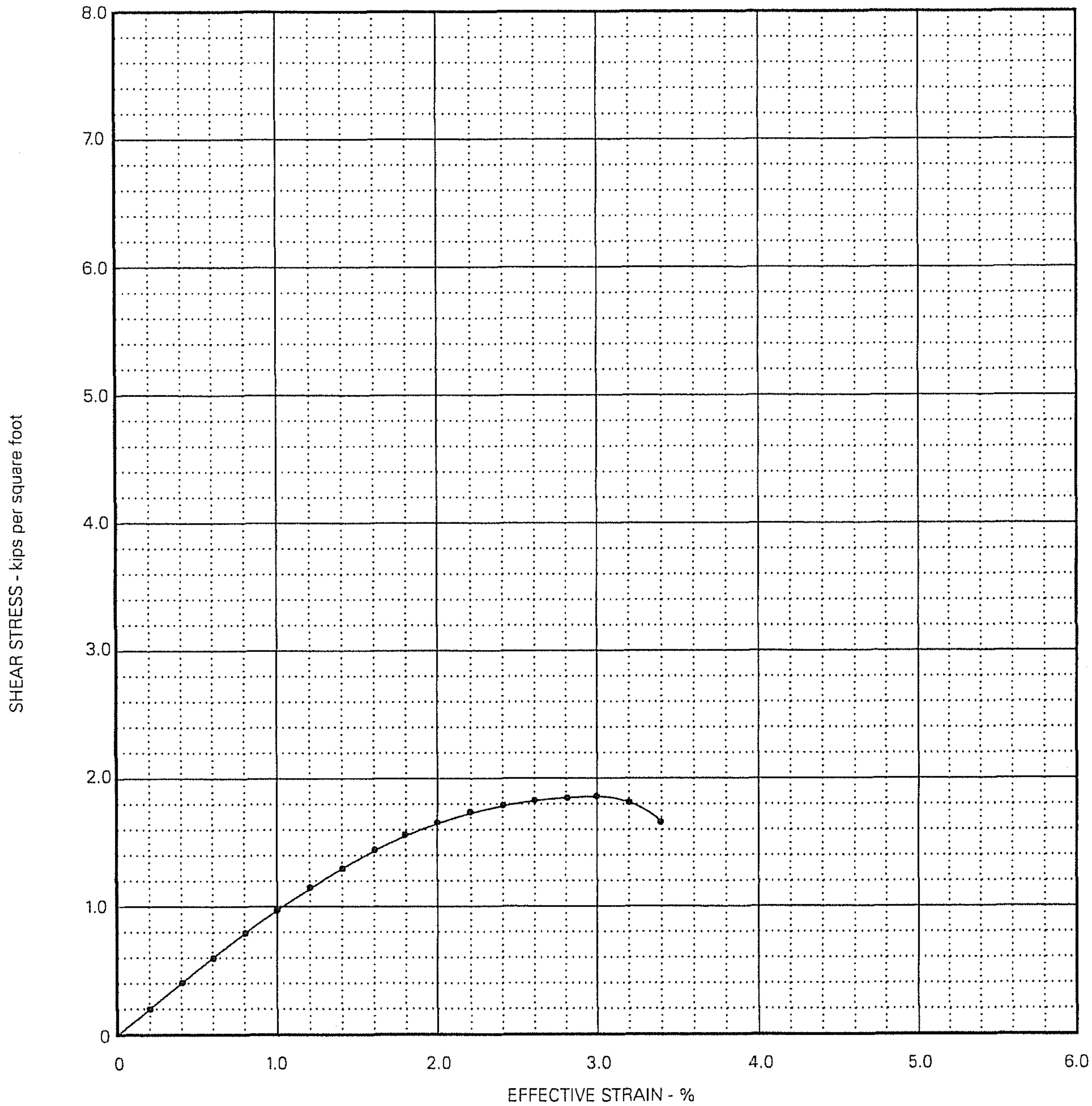
DIRECT SHEAR TEST DATA

WEIDIG
Geoanalysts

PA`INA HAWAI`I IRRADIATION FACILITY
92-1780V Kunia Road
Kunia, O`ahu, Hawai`i

DATE: February, 2011

PROJECT NO. 11-0006.001



Point Code	Boring No.	Sample No.	Depth (ft)	Dry Unit Weight (pcf)	Moisture Content (%)	Peak Effective Strain (%)	Unconfined Compressive Strength (psf)
•	B-2	SB-1	1.0	83	33.1	3.0	1,865

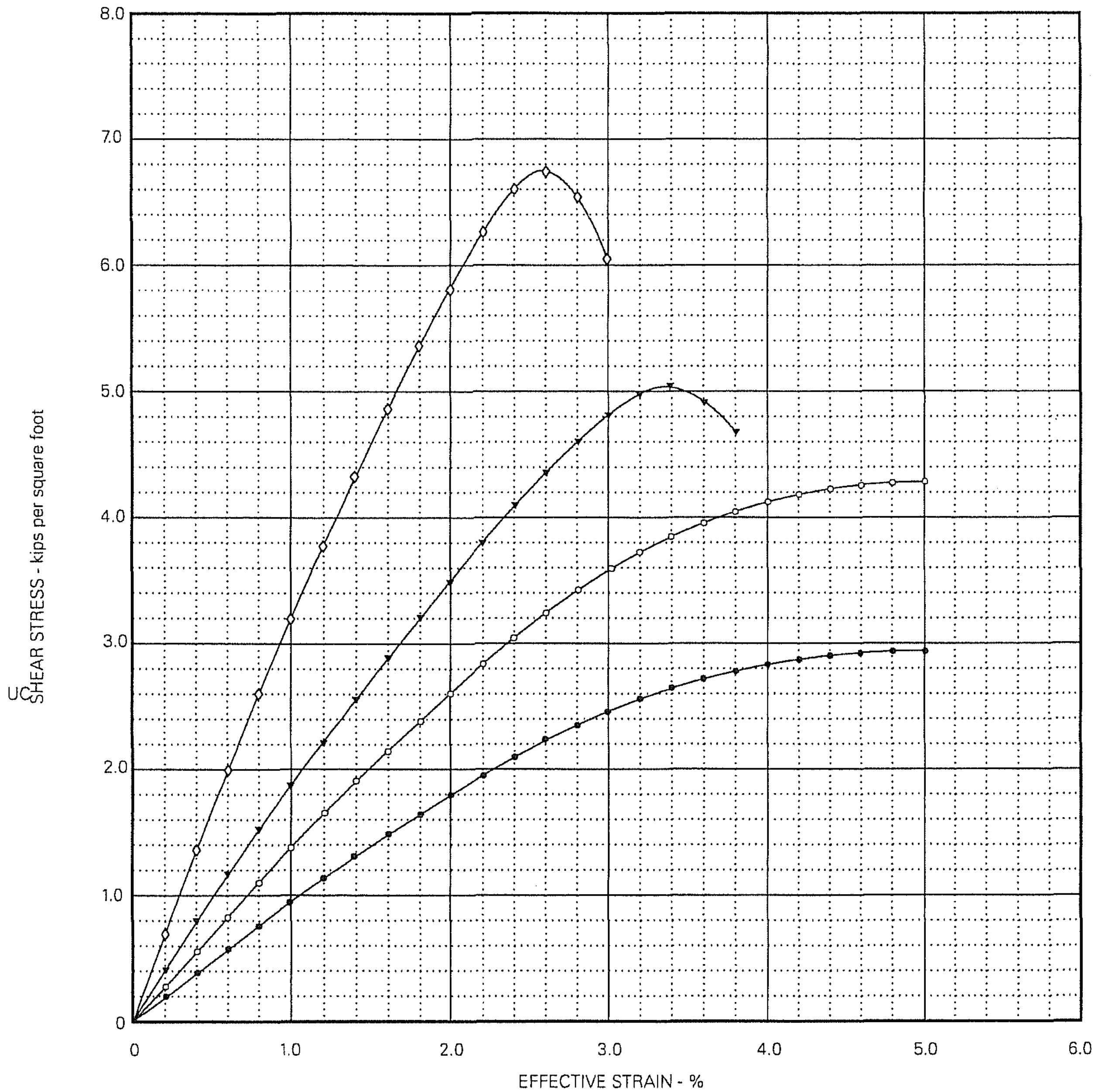
UNCONFINED COMPRESSIVE STRENGTH TEST DATA

WEIDIG
Geoanalysts

PA`INA HAWAI`I IRRADIATION FACILITY
92-1780V Kunia Road
Kunia, O`ahu, Hawai`i

DATE: February, 2011 | PROJECT NO. 11-0006.001

PLATE NO. B3



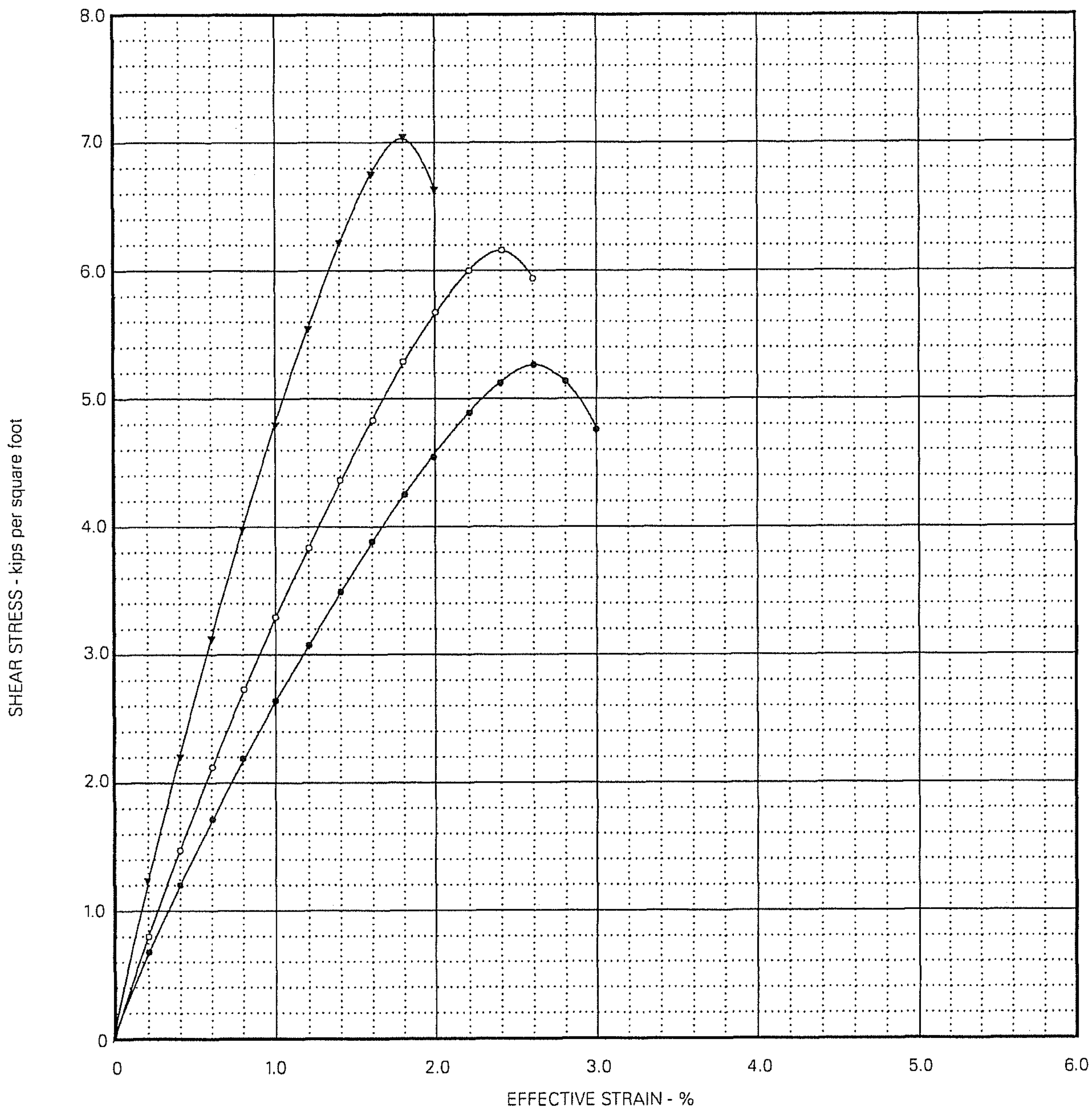
Point Code	Boring No.	Sample No.	Depth (ft)	Dry Unit Weight (pcf)	Moisture Content (%)	Peak Effective Strain (%)	Unconfined Compressive Strength (psf)
•	B-1	SB-3	7.0	94	28.2	5.0	2,965
o	B-1	SB-5	13.0	77	26.8	5.4	4,240
▼	B-1	SB-7	19.0	75	28.3	3.4	5,015
◊	B-1	SB-9	25.0	76	28.7	2.6	6,770

UNCONFINED COMPRESSIVE STRENGTH TEST DATA

WEIDIG
Geoanalysts

PA`INA HAWAI`I IRRADIATION FACILITY
92-1780V Kunia Road
Kunia, O`ahu, Hawai`i

DATE: February, 2011 | PROJECT NO. 11-0006.001



Point Code	Boring No.	Sample No.	Depth (ft)	Dry Unit Weight (pcf)	Moisture Content (%)	Peak Effective Strain (%)	Unconfined Compressive Strength (psf)
•	B-2	SB-4	10.0	86	35.8	5.0	5,270
o	B-2	SB-6	16.0	85	36.3	5.4	6,175
▾	B-2	SB-8	22.0	83	35.4	3.4	7,050

UNCONFINED COMPRESSIVE STRENGTH TEST DATA

WEIDIG
Geoanalysts

PA`INA HAWAI`I IRRADIATION FACILITY
92-1780V Kunia Road
Kunia, O`ahu, Hawai`i

DATE: February, 2011

PROJECT NO. 11-0006.001

PLATE NO. B5

APPENDIX C

References

WEIDIG
Geoanalysts

APPENDIX C

References

1. Foote, D.; Hill, E. L.; Nakamura, S.; and Stephens, F., 1972, *Soil Survey of the Islands of Kaua'i, O'ahu, Maui, Moloka'i and Lāna'i, State of Hawai'i*, United States Department of Agriculture.

2. Hawaii Industrial Structures, Inc., *2010, Proposed Facility Floor Plan, Pi'ina* [sic] *Hawaii, Inc.* (scale: ⅛ = 1'-0"), Sheet A-200, date of last revision: December 15, 2010.

3. Clayton H. Landis Company, Inc., 2006, *The Genesis II Irradiation Pool Installation Instructions*, 2 sheets, dated August 29, 2006.

4. State of Hawai'i, Department of Taxation, 1996, *Tax Maps Bureau Tax Map Key 9-2-05:02* (scale: 1"= 60').

5. Stearns, H. T., 1985, *Geology of the State of Hawai'i*, Pacific Books, Palo Alto, California.

6. United States Geological Survey, 1998, *Schofield Barracks Quadrangle, Hawai'i - Honolulu Co., Island of O'ahu, 7.5-Minute Series (Topographic)* (scale: 1:24,000).

DISTRIBUTION

Pā'ina Hawai'i, Inc. (4)
Attn: Michael Kohn
3209 'Ualena Street
Honolulu, Hawai'i 96820

WEIDIG Geoanalysts

Po'ina Hawaii, LLC
PO Box 30542
Honolulu, HI 96820
USA

U.S. POSTAGE
PAID
HONOLULU, HI
96820
MAR 03, 11
AMOUNT
$2.07
00051832-21

1000 76011

Jack Whitten
US Nuclear Regulatory Commission
612E.Lamar Blvd. Suite 400
Arlington, TX 76011-4125

RECEIVED
MAR - 8 2011
DNMS

RECEIVED
MAR - 8 2011
DNMS

FIRST CLASS
MAIL