WAIAU SUBDIVISION - UNIT 1 - PRELIMINARY SOIL REPORT
(for residential development)

WAIAU, EWA, OAHU, HAWAII

TAX MAP KEY: 9-8-02: 3

To:
COMMUNITY PLANNING, INCORPORATED

By:
WALTER LUM ASSOCIATES, INCORPORATED
CIVIL, STRUCTURAL, SOILS ENGINEERS
September 23, 1969
MR. GEORGE HOUGHTAILING  
Community Planning, Inc.  
Suite 602, 810 Richards Street  
Honolulu, Hawaii 96813

Dear Mr. Houghtailing:

Subject: Waiau Subdivision - Unit 1  
Preliminary Soil Report  
(for residential development)  
Waiau, Ewa, Oahu, Hawaii  
Tax Map Key: 9-8-02: 3  
Chapter 23, Revised Ordinances of Honolulu, 1961 As Amended

In accordance with your request, a preliminary soil exploration was made at the proposed residential development site for the Waiau Subdivision - Unit 1 at Waiau, Ewa, Oahu, Hawaii.

From the field explorations and laboratory test results, it is our opinion that the site may be developed for the proposed residential housing. One to 2-story, light buildings can be supported either directly on stiff existing ground or on compacted fills constructed from suitable on-site soils.

Unforeseen or undetected conditions such as soft spots or seepage water may occur in localized areas and will have to be adjusted and corrected in the field as they are detected.

All earthwork should be done in accordance with the requirements of Chapter 23, Revised Ordinances of Honolulu, 1961 As Amended and the recommendations contained herein.

The report includes a Boring Location Plan, boring logs, laboratory test results and recommendations.

Respectfully submitted,

WALTER LUM ASSOCIATES, INC.

[Signature]

Ezra Koike  
Professional Engineer  
Hawaii No. 1450

EK:vi
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SCOPE OF EXPLORATION

The purpose of this exploration was to determine general soil conditions of the proposed site, Waiau Subdivision - Unit 1 at Waiau, Ewa, Oahu, Hawaii, for light residential development.

This report includes preliminary field exploration, laboratory tests and general recommendations regarding the soils at the site.

PRELIMINARY FIELD EXPLORATION

Forty-eight exploratory borings were made at the site. The locations of these borings are shown on Figure 1, Boring Location Plan. Descriptions of the underlying soils encountered are shown on Boring Logs Nos. 1 thru 48.

Borings were made with 3-in. and 4-in. diameter augers using finger bits and tungsten carbide drag bits. Soil samples were recovered with a 2-in. thin-walled tube sampler and a standard split spoon sampler driven by a 140-lb hammer falling 30 inches.

Soil samples were visually identified and tentatively classified in the field. In the laboratory, they were subjected to appropriate tests.
The field identifications and classifications were then reviewed and modified to conform with the results of the laboratory tests in accordance with the "Unified Soil Classification System."

LABORATORY TESTS

Laboratory tests included: natural density, water content and unconfined compression; laboratory torvane shear; Atterberg limits; specific gravity; gradation; AASHO T-180-57 density; expansion and CBR.

A list of the standard field and laboratory test methods used for this project is given in the Appendix.

A summary of the laboratory test results is given in Tables IA thru IE.

GENERAL SITE AND SOIL CONDITIONS

The project site is located in Waiau, Diamond Head of Hoomalu Street and mauka of the proposed Interstate Defense Highway. The ground generally slopes from north to south at about 5 to 15 percent grades with steeper slopes in localized areas along the southeastern section of the site.

Almost all the site is utilized for sugar cane production at the present time. Irrigation ditches, flumes and cane haul roads cross the site. Three earth fill reservoirs are prominent features along the westerly boundary of the site.

Loose soils were noted in the cultivated windrows to a depth of approximately 18 inches. The soil is red in color, probably because of a high content of iron oxide.
From the field explorations and laboratory test results, the soils at the site may be generally described as follows:

A surface layer about 1 to 5 ft of medium to stiff, reddish-brown silty clay and clayey silt underlain by stiff to very stiff mottled reddish-brown clayey silt with decomposed rock to about 15 to 20 ft, the depths drilled. Boulders or rocky materials were encountered in several of the borings.

Water was not noticed within the depths drilled during the field explorations.

For more detailed descriptions of soils encountered in the drill holes, see the boring logs.

DISCUSSION AND RECOMMENDATIONS

In general, the present plan is to clear and grade the site for residential development. The proposed grading at this time is to use cut and fill slopes of generally less than 10 ft in height.

In the opinion of the Soil Engineer, the on-site soils, in general, have sufficient strength to support the fills and proposed light, one and 2-story residential structures, provided the site is cleared and grubbed, drained, and localized soft spots are removed.

Unforeseen or undetected conditions such as soft spots or seepage water may occur in localized areas and will have to be adjusted and corrected in the field as they are detected.
Fills

In general, the on-site soils are suitable for the construction of the proposed fills. The construction of the proposed fills should be done as required by the F.H.A. Data Sheet 79-G; Revised Ordinances of Honolulu, 1961 As Amended; and as recommended below:

(1) All trash piles, concrete slab on ground, rubble walls, scrap metals and unsuitable fill materials should be removed.

(2) Topsoil and stockpiled soils should be either (a) stripped to stiff natural ground or (b) scarified and recompacted before the placement of fills.

(3) In all sidehill and gully areas where fills are proposed, care should be taken to strip off all loose materials along the side and bottom and to key all new fills into stiff natural ground.

(4) All hard surfaces along existing access roads should be scarified down to stiff soils and recompacted to match the density of the surrounding soil.

(5) Thin sidehill fills (sliver fills) on sloping areas should be avoided.

(6) Along drainage and irrigation ditches where fills are proposed, the bottom and sides should be stripped down to stiff natural ground or scarificed and recompacted before the placement of fills.
(7) Subdrains should be placed in a herringbone pattern along the bottom and sides of natural drainageways and gullies before the placement of fills. The final locations of subdrains should be determined in the field after clearing and grubbing.

(8) All fills should be constructed in approximately level layers starting at the lower end and working upward.

(9) All fills should be laid in 6-in. compacted layers with a relative density of at least 90% of AASHO T-180-57 density.

(10) The abandoned reservoirs should be drained and dried. All loose and soft material should be stripped away from the bottom and sides before placing of fills. Where boulder linings are encountered, they should be removed to about 4 ft below finish grades to minimize effects of localized hard spots.

(11) If abandoned irrigation conduits or old wells are encountered on the site, they should be located on the construction plans. All conduits within 4 ft or within 2 times the diameter of a conduit from finish grade should be removed and the excavations backfilled with compacted fill.
(12) If boulders are proposed to be used in the construction of fills, they should be generally placed along the toe section of slopes. The subgrade should be stripped to stiff natural ground, shaped to drain and a layer of filter material placed on it. Nesting of boulders should be avoided. All voids should be filled with smaller granular soils. A blanket of filter material should be placed against the boulder fill before construction of fine soil fills against it. See sketch on the attached Figure 2.

**Slopes**

For the soils at this site, cut and fill slopes of 2 horizontal to 1 vertical or flatter should be used.

Slope adjustments or other precautions may be necessary if seepage zones or soft spots are encountered in localized areas.

For protection against erosion during construction, it is recommended that runoff water from rainstorms be controlled by berms or other approved methods.

The surface of fill slopes should be compacted by cat-tracking or with a sheepsfoot roller.

Slope planting is recommended on cut and fill slopes to minimize erosion.
Foundations

If earthwork is carried out as specified, the stiff natural ground and well constructed fill should develop adequate bearing values to support the proposed light, one to 2-story residential structures.

For light one and 2-story houses, differential settlements will probably be negligible and within the settlement tolerances of residential structures.

General recommendations for foundation construction are as follows:

(1) For proposed light one-story residential structures, conventional types of house foundations such as slab-on-ground construction or post-and-beam construction may be used.

(2) For 2-story light structures with bearing wall loads greater than 800 lbs per lineal ft, slabs on ground should be separated from grade walls, beams and column footings.

(3) Bearing values for a given soil usually vary with the size and depth of footings. For light, one and 2-story structures, bearing values of about 2000 p.s.f. may be used.

(4) All soft spots or pockets of loose material encountered in footing excavations or below the building area should
be excavated and backfilled with well-graded granular material such as S4C or other approved material.

(5) For concrete slabs on ground, a base course of 4 in. of well-graded gravel is recommended. To avoid capillary moisture, the gravel should be greater than 1/4 in. in size. The subgrade should be compacted and shaped to drain.

The elevation of the subgrade should be kept higher than the surrounding ground outside the building whenever practicable.

(6) Because of the downhill creep effect of soils on a slope, some settlements may occur near the tops of slopes. Therefore, buildings should be placed about 15 ft from the tops of slopes. This distance may be reduced for lower slope heights, e.g., 10 ft for 10-ft-high slopes, but in no case closer than 5 ft from the top of a slope.

(7) Construction of retaining walls on side slopes should be avoided unless the underlying materials are very stiff or hard.

(8) Good surface drainage away from the foundations of the proposed structures should be maintained.
Roadway

In general, a rough estimate of the roadway pavement thickness for the light residential traffic anticipated is as follows:

2. Base course - 6-in. base course.
3. Subbase - 6-in. subbase course over a prepared subgrade.

Provisions should be made in the contract documents to allow for local adjustments regarding subbase requirements in the field in accordance with the design standards of the City and County of Honolulu if unforeseen soil conditions are encountered at subgrade level. In fill areas, the use of select soils within the top 4 ft of the subgrade may be considered to reduce the thickness or eliminate the subbase course.

It is recommended that subgrades be compacted and shaped to drain. To avoid the ponding of water and softening of the subgrade at low points, weep holes should be placed at subgrade levels thru the walls of the catch basin which are placed in these low areas.
PROPOSED SPECIFICATION FOR EARTHWORK

WAIAU SUBDIVISION - UNIT 1

General Description

This item shall consist of all clearing and grubbing, removing of existing structures, preparing of land to be filled, excavating and filling of the land, spreading, compacting and testing of the fill, and all subsidiary work necessary to complete the grading.

Clearing, Grubbing and Preparing Areas to be Filled

All vegetation, concrete slabs, rubble walls, scrap metals and rubbish shall be removed and disposed of, leaving the disturbed area with a neat, debris-free appearance.

All vegetable matter shall be removed from the surface upon which fill is to be placed. All topsoil and stockpiled soils shall be (1) stripped to stiff natural ground or (2) scarified and recompressed before the placement of fills. All topsoil encountered at finish grade shall be scarified and recompressed.

All hard surfaces along the existing access roads shall be scarified down to stiff soils and recompressed to match the density of the surrounding soil before the placement of fills.

Where fills are proposed in all sidehill areas, gullies, and along drainage and irrigation ditches, all loose material along the bottom and the sides shall be stripped down to stiff natural ground before the placement of fills. All new fills shall be keyed into the stiff natural ground.
The abandoned reservoirs shall be drained and dried and all loose or soft material shall be stripped away from the bottom and sides before placing of fills. If boulder linings are encountered, they shall be removed to about 4 ft below the finished grades.

Subdrains shall be placed along the bottom and sides of the natural drainageways before the construction of fills. The final locations of subdrains should be determined in the field after clearing and grubbing.

If abandoned irrigation conduits are detected during construction, they shall be located on the construction plans. All conduits within 4 ft of finish grades shall be removed and the excavations backfilled with compacted fill.

Where fills are made on sloping areas steeper than 5 horizontal to 1 vertical, the ground at the toe of the slope shall be benched to a generally level condition. As the fill is brought up, it shall be continually keyed into the stiff natural ground by the cutting of steps into the hillside and compacting the fill into these steps. Ground slopes which are flatter than 5 horizontal to 1 vertical shall be benched when considered necessary by the Soil Engineer.

Materials

Fill materials shall consist of on-site soils approved by the Soil Engineer and identified in the soil report accepted by the F.H.A. The soils shall contain no more than a trace of organic matter and no particles larger than 6 in. in diameter. Also, it shall contain no more than 40% gravel (#4 sieve to 3 in. sieve sizes) and no more than 10% cobbles larger than gravel and smaller than 6 in. in diameter. Fill material placed in the top 2 ft of fills shall contain no more than 30% gravel and any material larger than gravel.
Placing, Spreading and Compacting Fill Material

The selected fill material shall be placed in level layers which, when compacted, shall not exceed 6 inches. Each layer shall be spread evenly and thoroughly blade-mixed during the spreading to insure uniformity of material and moisture content within each layer.

No rocks or cobbles shall be allowed to nest and all voids between rocks must be carefully filled and compacted with small stones or earth.

When the moisture content of the fill material is below that specified by the Soil Engineer, water shall be added until the moisture content is as specified and assures a thorough bonding during the compacting process.

When the moisture content of the material is above that specified by the Soil Engineer, the fill material shall be aerated by blading or by other satisfactory methods until the moisture content is as specified.

After each layer has been placed, mixed and spread evenly, it shall be thoroughly compacted to no less than 90% of maximum density in accordance with AASHO Test No. T-180-57 or other comparable density tests. Compaction shall be with sheepsfoot rollers, multiple-wheel pneumatic-tired rollers or other acceptable rollers which shall be able to compact the fill to the specified density. Rolling shall be accomplished while the fill material is at the specified moisture content. The rolling of each layer shall be continuous over its entire area and the roller shall make sufficient passes to insure the obtainment of the desired density.

Field density tests shall be made by the Soil Engineer of the compaction of the fill. Where sheepsfoot rollers are used, the soil may
be disturbed to a depth of several inches. Density readings shall be taken as often as necessary in the compacted material below the disturbed surface as determined by the Soil Engineer. When these readings indicate that the density of any layer of fill or portion thereof is below the required 90% density, that layer or portion shall be re-worked until the required density has been obtained.

The fill operation shall be continued in 6-in. compacted layers as specified above, until the fill has been brought to the finished slopes and grades as shown on the accepted plans.

Excavation

Suitable material from excavation shall be used in the fill and all unsuitable material from excavation shall be disposed of.

Boulder Fills

If boulders are proposed to be used in the construction of fills, they shall be generally placed along the toe section of slopes. The subgrade shall be stripped to stiff natural ground, shaped to drain and a layer of filter material shall be placed on it. Nesting of boulders shall be avoided. All voids shall be filled with smaller granular soils. A blanket of filter material shall be placed against the boulder fill before construction of fine soil fills against it.

Unforeseen Conditions

If unforeseen or undetected critical soil conditions such as soft spots or seepage water are encountered during the field operation, additional investigations shall be made by the Soil Engineer. Corrective
measures shall be evaluated and field adjustments shall be made in these areas.

**Rainy Weather**

No fill material shall be placed, spread or rolled during unfavorable weather conditions. When the work is interrupted by heavy rain, fill operations shall not be resumed until field tests by the Soil Engineer indicates that the moisture content and density are as previously specified.
Symbols

Symbols used generally are in accordance with the Unified Soil Classification System.

Where a parenthesis "(MH)" is used, the soil sample was classified by visual observation of the sample recovered.

Where no parenthesis "MH" is used, the soil sample was classified from either the Atterberg limits or sieve analysis test results.
**Boring Log**

**PROJECT**  WAIAU DEVELOPMENT-UNIT I

**LOCATION**  WAIAU, EWA, OAHU, HAWAII

**TMK:**  9-8-02-3

**HAMMER:**
- **Weight:** 140 lbs
- **Drop:** 3'-6" - 2" O.D. THIN WALL TUBE
- **Drop:** 2'-6" - 2" STANGER SPLIT SPOON

**SAMPLER:**
- **Type:** AUGER CASKER

**ELEV. 108' +**

**DESCRIPTION**
- **BASE COURSE**
- **STIFF REDDISH BROWN CLAYEY SILT**
- **DARK MOTTLED GRAY-BROWN SANDY SILT & DECOMPOSED ROCK**
- **ROCK OR BOULDER END OF BORING @ 15.6'**

**PENETRATION DATA**

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**M**

**ELEV. 108' +**

**DESCRIPTION**
- **STIFF REDDISH BROWN CLAYEY SILT**

**PENETRATION DATA**

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**H**

**ELEV. 108' +**

**DESCRIPTION**
- **DARK MOTTLED GRAY-BROWN SANDY SILT & DECOMPOSED ROCK**
- **ROCK OR BOULDER END OF BORING @ 15.6'**

**PENETRATION DATA**

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**END OF BORING @ 15.6'**

*ELEVATION ESTIMATED FROM SURVEY MAP*
# Boring Log

**PROJECT**: WAIAU DEVELOPMENT-UNIT 1  
**LOCATION**: WAIAU, EWA, OAHU, HAWAII  
**TMK**: 9-8-02:3

**HAMMER**:  
- **Weight**: 140 lb  
- **Drop**: 30"  
**SAMPLER**: 2" STANDARD SPLIT SPOON

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**PENETRATION DATA**  
- 2" O.D. TUBE SAMPLER  
- ELEVATION ESTIMATED FROM CONTOUR MAP

**REMARKS**
- MEDIUM TO STIFF REDDISH BROWN CLAYEY SILT
- STIFF BROWN CLAYEY SILT
- MEDIUM TO STIFF REDDISH BROWN CLAYEY SILT
- ROCK OR BOULDER END OF BORING @ 22.5

**ELEVATION ESTIMATED FROM CONTOUR MAP**
Boring Log

PROJECT: WAI'ALI DEVELOPMENT-UNIT I
LOCATION: WAI'ALI, EWA, OAHU, HAWAII
TMK: 9-6-02-3

HAMMER:
Weight 140#
Drop 30" SAMPLER: 2" STANDARD SPLIT SPOON

ELEV = 154'1*

STIFF MOTTLED BROWN CLAYEY SILT

BROWN CLAYEY SILT W/ DECOMPOSED ROCK

ROCK OR BOULDER END OF BORING @ 14'

*ELEVATION ESTIMATED FROM CONTOUR MAP
**Boring Log**

**PROJECT:** WAIALU DEVELOPMENT-UNIT I  
**LOCATION:** WAIALU, EWA, OAHU, HAWAII  
**TMKI:** 9-8-02-B

**HAMMER:**
- **Weight:** 140 lbs
- **Drop:** 30"

**SAMPLER:** 2" STANDARD SPLIT SPOON

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**ELEVATION ESTIMATED FROM CONTOUR MAP**
**Boring Log**

**PROJECT:** WAIALU DEVELOPMENT-UNIT I  
**LOCATION:** WAIALU, EWA, OAHU, HAWAII  
**TMK:** 9-8-02: 3

**HAMMER:**  
- **Weight:** 140 #  
- **Drop:** 30"

**SAMPLER:** 2" STANDARD SPLIT SPOON

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**DESCRIPTION:**  
- **ELEV. 185' +:**  
  - **(MI)** VERY STIFF, REDDISH BROWN, CLAYEY SILT  
  - **(ML)** VERY STIFF REDDISH BROWN CLAYEY SILT W/ DECOMPOSED ROCK  
  - **(ML)** STIFF MOTTLED REDDISH BROWN CLAYEY SILT W/ DECOMPOSED ROCK

**END OF BORING @ 17'**

---

**ELEVATION ESTIMATED FROM CONTOUR MAP**

---

**BORING NO. 5 **  
**Sheet No. 1 of 1 **  
**Date: August 20, 1969 **  
**Driller: WALTER LUM ASSOC. **  
**Field Party: HASHIDA MAU, MAKALUA **  
**Type of Boring: AUGER (MOBILE) **  
**Elev.: 185' + **  
**Datum:** -  
**Water Level:** NOT NOTICED  
**Time:** -  
**Date:** 8-20-69

---

**PENETRATION DATA**  
**STANDARD PENETRATION TEST**

<table>
<thead>
<tr>
<th>Blows Per Foot</th>
<th>0</th>
<th>10</th>
<th>20</th>
<th>30</th>
<th>40</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Blows/0.5</strong></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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</tr>
</tbody>
</table>
Boring Log

PROJECT: WAI'ALI DEVELOPMENT-UNIT I
LOCATION: WAI'ALI, EW, OAHU, HAWAII

TMK: 9-8-023

HAMMER:
- Weight: 140 lbs
- Drop: 30°
- Sampler: 2.5 - 2" STANDARD SPLIT SPOON

ELEVATION: 190' ±

DESCRIPTION

(ML) Stiff Mottled reddish brown, clayey silt

Sample: G-A
- Depth: 2.55
- P.C.: 20

(ML) Very stiff reddish brown, clayey silt

Sample: G-B
- Depth: 2.55
- P.C.: 25

Sample: G-C
- Depth: 2.55
- P.C.: 30

Sample: G-D
- Depth: 2.55
- P.C.: 34

Sample: G-E
- Depth: 2.55
- P.C.: (No recovery)

END OF BORING @ 211'

ELEVATION ESTIMATED FROM CONTOUR MAP

*
Boring Log

PROJECT: WAIAU DEVELOPMENT-UNIT I
LOCATION: WAIAU, EWA, OAHU, HAWAII
TMK: 9-8-02:3

HAMMER:
Weight: 140 lb
Drop: 30'

SAMPLER: 2" STANDARD SPLIT SPOON

ELEV = 212' +

(VML)

VERY STIFF, REDDISH BROWN CLAYEY Silt

21

7-A

(VML)

VERY STIFF, DARK MOTTLED BROWN CLAYEY SILT W/ DECOMPOSED ROCK

30

7-B

(VML)

VERY STIFF REDDISH BROWN, CLAYEY SILT

38

7-C

(VML)

STIFF, MOTTLED BROWN, CLAYEY SILT W/ DECOMPOSED ROCK

44

7-D

7-E

END OF BORING @ 21.5'
### Boring Log

**PROJECT:** WAIAU DEVELOPMENT - UNIT I  
**LOCATION:** WAIAU, EWA, OAHU, HAWAII  
**TMK:** 9-8-02:3

**HAMMER:**  
- **Weight:** 140 *  
- **Drop:** 30"  
**SAMPLER:** 2" STANDARD SPLIT SPOON

<table>
<thead>
<tr>
<th>Unit</th>
<th>Soil Description</th>
<th>ELEV.</th>
<th>Penetration Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>(ML)</td>
<td>VERY STIFF REDDISH BROWN, CLAYEY SILT</td>
<td>236'</td>
<td></td>
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<tr>
<td>(ML)</td>
<td>STIFF BROWN CLAYEY SILT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(ML)</td>
<td>STIFF REDDISH BROWN, CLAYEY SILT</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>ROCK OR BOULDER END OF BORING AT 14'</td>
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</table>

* ELEVATION ESTIMATED FROM CONTOUR MAP

**BORING NO.** 8  
**Driller:** WALTER LUM ASSOC.  
**Date:** AUG. 18, 1969

**Field Party:** HASHIDA SUZUKI

**Type of Boring:** AUGER (ACKEE)  
**Diam.:** 4"

**Elev.:** 236' + *  
**Datum:** 

**Drill Bit:** T.C. DRAG  
**Water Level:** NOTICED  
**Time:**  
**Date:** B-18-69

<table>
<thead>
<tr>
<th>Penetration Test</th>
<th>2&quot; O.D. Thin Wall Tube Sampler</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blows Per Foot</td>
<td>BLOW/0.5</td>
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<tr>
<td>0</td>
<td>10</td>
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<tbody>
<tr>
<td>(ML)</td>
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<td>B-A</td>
<td>80</td>
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<tr>
<td>(ML)</td>
<td>34</td>
<td>B-C</td>
<td>80</td>
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</table>

* ELEVATION ESTIMATED FROM CONTOUR MAP
### Boring Log

**PROJECT**  WAIALU DEVELOPMENT-UNIT I  
**LOCATION**  WAIALU, EWA, OAHU, HAWAII  
**TMK:**  9-8-02:3  

**HAMMER:**  
- **Weight:** 140 lb  
- **Drop:** 30"

**SAMPLER:**  2" STANDARD SPLIT SPOON  

<table>
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</thead>
<tbody>
<tr>
<td>ML</td>
<td>VERY STIFF REDDISH BROWN, CLAYEY SILT</td>
<td>9-A</td>
<td>21</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>ML</td>
<td>STIFF, BROWN CLAYEY SILT</td>
<td>9-B</td>
<td>31</td>
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</tr>
<tr>
<td>ML</td>
<td>MEDIUM TO STIFF, MOTTLED BROWN CLAYEY SILT W/TRACE OF DECOMPOSED ROCK</td>
<td>9-C</td>
<td>33</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ML</td>
<td>END OF BORING @ 21.5'</td>
<td>9-D</td>
<td>40</td>
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<td></td>
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<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>END OF BORING @ 21.5'</td>
<td>9-E</td>
<td>42</td>
<td></td>
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</tbody>
</table>

* Elevation estimated from contour map
**Boring Log**

**PROJECT:** WAIAU DEVELOPMENT-UNIT I  
**LOCATION:** WAIAU, EWA, OAHU, HAWAII  
**TMK:** 9-8-023  

**HAMMER:**  
- **Weight:** 140 lbs  
- **Drop:** 30"  

**SAMPLER:** 2" STANDARD SPLIT SPOON  

---

**Hammer Information:**  
- **No.** 10  
- **Type of Boring:** AUGER (MINUETMAN)  
- **Dia.:** 3"  
- **Elev.:** 260 ft  
- **Drill Bit:** T.G. DRAG  
- **Date:** 8-21-69  

**Penetration Data:**

<table>
<thead>
<tr>
<th>Sample</th>
<th>Penetration</th>
<th>Depth (ft)</th>
</tr>
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<tbody>
<tr>
<td>10-A</td>
<td>29</td>
<td>10</td>
</tr>
<tr>
<td>10-B</td>
<td>31</td>
<td>15</td>
</tr>
<tr>
<td>10-C</td>
<td>29</td>
<td>15</td>
</tr>
<tr>
<td>10-D</td>
<td>33</td>
<td>15</td>
</tr>
</tbody>
</table>

**Sample Notes:**

- **STIFF, REDDISH BROWN, CLAYEY SILT**  
- **STIFF BROWN CLAYEY SILT**  
- **STIFF LIGHT BROWN CLAYEY SILT**  

**Penetration Test:**

- **Blows/0.5 ft:**
  - 0  
  - 10  
  - 20  
  - 30  
  - 40  

---

**Elev.:** 260 ft  

---

*Elevation Estimated from Contour Map*
Boring Log

PROJECT WAI'AU DEVELOPMENT-UNIT I

LOCATION WAI'AU, EWA, OAHU, HAWAII

TMK: 9-8-02:3

HAMMER: Weight 140 #
Drop 30"

SAMPLER: 2" STANDARD SPLIT SPOON

---

FIELD PARTY: HASHIDA LEE MAU

DRILLER: WALTER LUM ASSOCIATES

Date AUG. 21, 1969

LOCATION: ALI'I KALUA, OAHU, HAWAII

ELEV. 270' ± *

SAMPLER: 2" STANDARD SPLIT SPOON

PENETRATION TEST

<table>
<thead>
<tr>
<th>Depth (ft.)</th>
<th>Wet Density</th>
<th>P.C.</th>
<th>Moist. Cont.</th>
<th>Dry Density</th>
<th>P.C.</th>
<th>Specific Gravity</th>
<th>2&quot; O.D. TUBE</th>
<th>EMBLOWS/0.5</th>
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<tbody>
<tr>
<td>11-A</td>
<td>29</td>
<td>-</td>
<td>-</td>
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<td>-</td>
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<td>11-B</td>
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<td>11-C</td>
<td>32</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>11-D</td>
<td>44</td>
<td>36</td>
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</tbody>
</table>

* ELEVATION ESTIMATED FROM CONTOUR MAP
# WALTER LUM ASSOCIATES

## Boring Log

**PROJECT:** WAIAU DEVELOPMENT-UNIT I  
**LOCATION:** WAIAU, EWA, OAHU, HAWAII  
**TMK:** 9-8-02-3

**HAMMER:**  
- **Weight:** 140 lbs  
- **Drop:** 20'

**SAMPLER:** 2' STANDARD SPLIT SPOON

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>(ML)</td>
<td>MEDIUM REDDISH BROWN CLAYEY SILT</td>
<td></td>
<td></td>
<td></td>
<td>12-A</td>
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<tr>
<td>(MH)</td>
<td>VERY STIFF REDDISH BROWN CLAYEY SILT</td>
<td></td>
<td></td>
<td></td>
<td>12-B</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>GRAY-BROWN ROCK &amp; DECOMPOSED ROCK</td>
<td></td>
<td></td>
<td></td>
<td>12-C</td>
<td></td>
<td></td>
<td></td>
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<td>12-D</td>
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</tbody>
</table>

**END OF BORING @ 18.0'**

---

**BORING NO.** 12  
**Sheet No.** 1 of 1  
**Driller:** WALTER LUM ASSOC.  
**Date:** AUGUST 6, 1969

- **Type of Boring:** AUGER  
- **Diam.:** 3”  
- **Elev.:** 104'  
- **Datum:**

**Drill Bit:** T.C. DRAG  
**Sample:**

**Water Level:**

**Time:**

**Date:** 8-6-69

---

**PENETRATION DATA**

<table>
<thead>
<tr>
<th>STANDARD PENETRATION TEST</th>
<th>2” O.D. THIN WALL TUBE SAMPLER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blows Per Foot</td>
<td>Blows/0.3'</td>
</tr>
</tbody>
</table>

---

*ELEVATION ESTIMATED FROM CONTOUR MAP*
**Boring Log**

**PROJECT**: WAIAU DEVELOPMENT-UNIT I
**LOCATION**: WAIAU, EWA, OAHU, HAWAII
**TMK**: 9-8-02:3

**HAMMER**:
- **Weight**: 40#
- **Drop**: 30"

**SAMPLER**: 2" STANDARD SPLIT SPOON

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>10</td>
<td>13-A</td>
<td></td>
<td>21</td>
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<td></td>
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</tr>
<tr>
<td>13</td>
<td>13-B</td>
<td></td>
<td>28</td>
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<td></td>
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</tr>
<tr>
<td>16</td>
<td>13-C</td>
<td></td>
<td>35</td>
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</tr>
<tr>
<td>16.5</td>
<td>13-D</td>
<td></td>
<td>42</td>
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<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

**DESCRIPTION**
- **STIFF REDDISH BROWN CLAYEY SILT**
- VERY STIFF, BROWN CLAYEY SILT W/ DECOMPOSED ROCK
- VERY STIFF, REDDISH BROWN & BROWN DECOMPOSED ROCK W/ CLAYEY SILT
- END OF BORING @ 16.5

**ELEVATION ESTIMATED FROM CONTOUR MAP**
**Project:** WAIAU DEVELOPMENT - UNIT I

**Location:** WAIAU, EWA, OAHU, HAWAII

**TMK:** 9-8-02-3

**Hammer:**
- **Weight:** 140#
- **Drop:** 20" - 2" O.D. THIN WALL TUBE
- **SAMPLER:** 2.5" STANDARD SPLIT SPOON

**Type of Boring:** AUGER (ACRE

**Elevation:** 134' +

**Driller:** WALTER LUM ASSOC.

**Date:** JULY 30, 1969

**Field Party:** MAU HASHIDA, SUZUKI

**Date:** 7-30-69

**Water Level:** NOT MARKED

**Penetration Data**

<table>
<thead>
<tr>
<th>ELEV.</th>
<th>PENETRATION TEST</th>
<th>2&quot; O.D. THIN WALL TUBE SAMPLER</th>
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</thead>
<tbody>
<tr>
<td>Blows</td>
<td>Per Foot</td>
<td>Blows/0.5'</td>
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<tr>
<td>0</td>
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<td>20</td>
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**Sample Data**

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<tbody>
<tr>
<td>2'5&quot;</td>
<td>14-A</td>
<td>26</td>
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<td>-</td>
</tr>
<tr>
<td>2'5&quot;</td>
<td>14-B</td>
<td>31</td>
<td>33</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2'5&quot;</td>
<td>14-C</td>
<td>34</td>
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<tr>
<td>2'5&quot;</td>
<td>14-D</td>
<td>26</td>
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<tr>
<td>2'5&quot;</td>
<td>14-E</td>
<td>29</td>
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<tr>
<td>2'5&quot;</td>
<td>14-F</td>
<td>29</td>
<td>-</td>
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</table>

**Description**

- **(ML)**
  - STIFF, REDDISH BROWN CLAYEY SILT
  - COBBLE
  - BROWN - GRAY DECOMPOSED ROCK
  - MEDIUM TO STIFF, REDDISH BROWN CLAYEY SILT W/ TRACES OF DECOMPOSED ROCK
  - GRAY DECOMPOSED ROCK

**Elevation Estimated from Contour Map**
**Boring Log**

**PROJECT**  
WAIAU DEVELOPMENT-UNIT I

**LOCATION**  
WAIAU, EWA, OAHU, HAWAII

**TMK:** 9-3-02:3

**HAMMER:**  
- **Weight:** 140 lbs
- **Drop:** 20 ft

**SAMPLER:** 2" STANDARD SPLIT SPOON

**Type of Boring**  
AUGER (MOBILE)

**Datum:** 152.5 +

**Drill Bit**  
T.C. DRAGE

**Field Party**  
GONG, MAKALUA, LUNING

**Date:** JULY 30, 1949

---

**Penetration Data**

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Sample No.</th>
<th>Sample Description</th>
<th>Penetration Test</th>
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</thead>
<tbody>
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<td>15.0</td>
<td>15.1</td>
<td>BLACK, DECOMPOSED ROCK</td>
<td>22 blows/0.5'</td>
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<tr>
<td>15.6</td>
<td>15.2</td>
<td>STIFF, REDDISH BROWN CLAYEY SILT</td>
<td>30 blows/0.5'</td>
</tr>
<tr>
<td>16.2</td>
<td>16.3</td>
<td>VERY STIFF, BROWN CLAYEY SILT W/ DECOMPOSED ROCK</td>
<td>35 blows/0.5'</td>
</tr>
</tbody>
</table>

---

**Elevation Estimated from Contour Map**
# Boring Log

**PROJECT:** WAIAU DEVELOPMENT - UNIT I  
**LOCATION:** WNAU, EWA, OAHU, HAWAII

**Hammer:**
- **Weight:** 140 lbs
- **Drop:** 30"  
**Sampler:** 2" Standard Split Spoon

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</thead>
<tbody>
<tr>
<td>(ML)</td>
<td>Stiff Brown Clayey Silt w/ Traces of Decomposed Rock</td>
<td>170' *</td>
<td>16-A</td>
<td>29</td>
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<tr>
<td>(ML)</td>
<td>Medium reddish Brown Clayey Silt</td>
<td>170' *</td>
<td>16-B</td>
<td>35</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Mottled Gray Decomposed Rock</td>
<td>170' *</td>
<td>16-C</td>
<td>36</td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>END OF BORING @ 16'</td>
<td>170' *</td>
<td>16-D</td>
<td>31</td>
<td>17</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

* Elevation estimated from contour map

---

**Driller:** WALTER LUM ASSOC.  
**Date:** Aug. 28, 1969

**Field Party:** MAKUULA, HUHIDA, NELSON

**Type of Boring:** AUGER (MOBILE)  
**Diam.:** 3"

**Elev. Drill:** T.C. DRAG

**Water Level:** Noted

**Date:** 3-15-69
Boring Log

PROJECT: WAIAU DEVELOPMENT-UNIT I
LOCATION: WAIAU, EWA, OAHU, HAWAII
TMK: 9-8-02:3

HAMMER:
Weight: 140 lb
Drop: 30"

SAMPER: 2" STANDARD SPLIT SPOON

ELEV. 188.1 *

<table>
<thead>
<tr>
<th>STIFF REDDISH BROWN, CLAYEY SILT</th>
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</thead>
<tbody>
<tr>
<td>MEDIUM TO STIFF REDDISH BROWN - GRAY CLAYEY SILT W/ DECOMPOSED ROCK</td>
</tr>
<tr>
<td>MOTTLED GRAY, DECOMPOSED ROCK</td>
</tr>
</tbody>
</table>

END OF BORING @ 21.0'

* ELEVATION ESTIMATED FROM CONTOUR MAP

BORING NO. 17  Sheet No. 1 of 1
Driller: WALTER LUM ASSOCIATES  Date: AUGUST 4, 1969
Field Party: GONG, MAKALUA, LEE
Type of Boring: AUGER (HORSE)  Diameter: 3"
Elev.: 188'  Datum: 
Drill Bit: T.C. DRAG

PENETRATION DATA

<table>
<thead>
<tr>
<th>PENETRATION TEST</th>
<th>Standard Penetration Test</th>
<th>2&quot; O.D. Thin Wall Tube Sampler</th>
<th>BLOWs/0.5'</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>0 10 20 30 40</td>
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</table>
**Boring Log**

**PROJECT**: WAIALU DEVELOPMENT-UNIT I

**LOCATION**: WAIALU, EWA, OAHU, HAWAII

**TMK**: 9-8-08:3

**HAMMER**: Weight 140#, Drop 70°

**SAMPLER**: 2” STANDARD SPLIT SPOON

**ELEVATION**: 187' ± *

---

**DESCRIPTION**

- **ML**
  - VERY STIFF
  - REDDISH BROWN CLAYEY SILT

- **MH**
  - STIFF, MOTTLED
  - REDDISH BROWN CLAYEY SILT

- GRAY-BROWN DECOMPOSED ROCK

**END OF BORING**: 150'

---

**PENETRATION DATA**

- **Blows Per Foot**
  - 0 10 20 30 40

**THIN WALL TUBE SAMPLER**

---

*ELEVATION ESTIMATED FROM CONTOUR MAP*
# Boring Log

**PROJECT:** WAIAU DEVELOPMENT-UNIT I  
**LOCATION:** WAIAU, EWA, OAHU, HAWAII  
**TMK:** 9-8-023  
**HARMER:**  
- **Weight:** 140 lb  
- **Drop:** 20"  
**SAMPLER:** 2" STANDARD SPLIT SPOON

| Driller | WALTER LUM ASSOC.  
|---------|-------------------  
| Date    | JULY 30, 1969  

**Type of Boring**  
- AUGER (MOBILE)  
- **Diam.:** 3"

**Elev.**  
- 112' +  
- Datum:

**Drill Bit**  
- T.C. DRAG  
- **Date:** 1-30-69

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<thead>
<tr>
<th>PENETRATION DATA</th>
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<tr>
<td><strong>STANDARD PENETRATION TEST</strong></td>
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<td><strong>2&quot; O.D. THIN WALL TUBE SAMPLER</strong></td>
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### PENETRATION DATA

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<thead>
<tr>
<th>Blows Per Foot</th>
<th>Blows/0.3'</th>
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<td>40</td>
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### PENETRATION DATA

- **STIFF TO VERY STIFF, REDDISH BROWN CLAYEY SILT**  
- **STIFF, MOTTLED BROWN CLAYEY SILT**  
- **BROWN, DECOMPOSED ROCK w/CLAYEY SILT**  
- **MEDIUM TO STIFF, MOTTLED BROWN CLAYEY SILT w/ DECOMPOSED ROCK**  
- **ROCK OR BOULDER END OF BORING @ 20'1"**

**ELEVATION ESTIMATED FROM CONTOUR MAP**
**Boring Log**

**PROJECT:** WAIAU DEVELOPMENT - UNIT I  
**LOCATION:** WAIAU, EWA, OAHU, HAWAII  
**HAMMER:**  
- Weight: 140 lbs  
- Drop: 80"  
**SAMPLER:** 2" STANDARD SPLIT SPOON  

**ELEV. = 126' ±**

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<td>20-A</td>
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<td>20-C</td>
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</table>

**STIFF, REDDISH BROWN CLAYEY SILT**

**very stiff, reddish brown, clayey silt**

**very stiff, gray clayey silt w/ decomposed rock**

**End of Boring @ 16.5’**

**ELEVATION ESTIMATED FROM CONTOUR MAP**
**Boring Log**

**PROJECT:** WAIALU DEVELOPMENT-UNIT I  
**LOCATION:** WAIALU, EWA, OAHU, HAWAII  
**TMK:** 9-8-02-3

**HAMMER:**  
- **Weight:** 140 lb  
- **Drop:** 30"  

**SAMPER:** 2" STANDARD SPLIT SPOON

**HAMMER:**  
- **Weight:** 140 lb  
- **Drop:** 30"  

**SAMPER:** 2" STANDARD SPLIT SPOON

---

**STIFF, REDDISH BROWN CLAYEY SILT**

**ELEV.**: 148' 1"  
**SAMPLE NO.**: 21-A  
**SAMPLER**: 2" STANDARD SPLIT SPOON

**MEDIUM REDDISH BROWN CLAYEY SILT**

**ELEV.**: 152' 1"  
**SAMPLE NO.**: 21-B  
**SAMPLER**: 2" STANDARD SPLIT SPOON

**GRAY-BROWN DECOMPOSED ROCK W/ CLAYEY SILT**

**ELEV.**: 156' 2"  
**SAMPLE NO.**: 21-C  
**SAMPLER**: 2" STANDARD SPLIT SPOON

**END OF BORING AT 205'**

---

**STIFF, REDDISH BROWN CLAYEY SILT**

**ELEV.**: 148' 1"  
**SAMPLE NO.**: 21-A  
**SAMPLER**: 2" STANDARD SPLIT SPOON

**MEDIUM REDDISH BROWN CLAYEY SILT**

**ELEV.**: 152' 1"  
**SAMPLE NO.**: 21-B  
**SAMPLER**: 2" STANDARD SPLIT SPOON

**GRAY-BROWN DECOMPOSED ROCK W/ CLAYEY SILT**

**ELEV.**: 156' 2"  
**SAMPLE NO.**: 21-C  
**SAMPLER**: 2" STANDARD SPLIT SPOON

---

**PENETRATION DATA**

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<thead>
<tr>
<th>Penetration Test</th>
<th>Blows Per Foot</th>
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<tbody>
<tr>
<td>2&quot; O.D. TUBE SAMPLER</td>
<td>0 10 20 30 40</td>
</tr>
</tbody>
</table>

**ELEVATION ESTIMATED FROM CONTOUR MAP**
**PROJECT:** WAIKAU DEVELOPMENT-UNIT I  
**LOCATION:** WAIKAU, EWA, OAHU, HAWAII  
**TMK:** 9-8-02:3  

### HAMMER:
- **Weight:** 140#  
- **Drop:** 30"  

### SAMPLER:
- **2" STANDARD SPLIT SPOON**  

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</table>

**DESCRIPTIO**

- **ELEV. = 172'1 ***

  - MEDIUM, REDDISH BROWN, CLAYEY SILT  
  - STIFF, REDDISH BROWN, CLAYEY SILT w/ DECOMPOSED ROCK  
  - VERY STIFF REDDISH BROWN CLAYEY SILT  
  - VERY STIFF GRAY CLAYEY SILT w/ DECOMPOSED ROCK  
  - ROCK OR BOULDER  
  - END OF BORING @ 18.1'  

---

**PENETRATION DATA**

- **STANDARD PENETRATION TEST**  
- **2" O.D. THIN WALL TUBE SAMPLER**  

---

**NOTES:**

- ELEVATION ESTIMATED FROM CONTINUOUS MAP
Boring Log

**PROJECT:** WAIAU DEVELOPMENT-UNIT 1

**LOCATION:** WAIAU, EWA, OAHU, HAWAII

**TMK:** 9-8-02:3

**HAMMER:**
- **Weight:** 140 lb
- **Drop:** 30"

**SAMPLER:** 2" STANDARD SPLIT SPOON

**Boring No. 23**

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<tbody>
<tr>
<td></td>
<td>MEDIUM REDDISH BROWN, CLAYEY SILT</td>
<td></td>
<td></td>
<td>23-A</td>
<td>29</td>
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<tr>
<td></td>
<td>STIFF REDDISH BROWN CLAYEY SILT W/ DECOMPOSED ROCK</td>
<td></td>
<td></td>
<td>23-B</td>
<td>32</td>
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<td>VERY STIFF GRAY CLAYEY SILT W/ DECOMPOSED ROCK</td>
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<td>23-C</td>
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<tr>
<td></td>
<td>ROCK OR BOULDER END OF BORING @ 4.3'</td>
<td></td>
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<td>23-D</td>
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</table>

*ELEVATION ESTIMATED FROM CONTOUR MAP*
# Boring Log

**PROJECT:** WAI'AU DEVELOPMENT-UNIT I  
**LOCATION:** WAI'AU, EWA, OAHU, HAWAII  
**TMK:** 9-8-02:4  

**HAMMER:**  
- Weight: 140 lb  
- Drop: 30"  
**SAMPLER:** 2" STANDARD SPLIT SPOON

**BORING NO. 24**  
**Driller:** WALTER LUM ASSOC.  
**Date:** AUGUST 18, 1969  
**Field Party:** SUZUKI, HASHIDA  
**Type of Boring:** AUGER (ACIER)  
**Diam.:** 4"  
**Elev.:** 197' + 0  
**Drill Bit:** T.C. DRAG  
**Water Level:** NOT FIELD

**LOCATION:** FIELD PARry

**Typical Drill Dia.:**
- 2"  
- 3"  
- 4"  

**Hammer: Elv.**
- 17"  
- 21"

**Weight of Drill Bit:**
- 20 lb  
- 30 lb  
- 40 lb

**Drop:**
- 18"  
- 24"  
- 30"

**End of Boring @ 26.5'**

---

**Penetration Data**

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<tr>
<th>Depth (ft)</th>
<th>Sample No.</th>
<th>P.C.</th>
<th>Density</th>
<th>Description</th>
<th>Blows/0.3'</th>
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</thead>
<tbody>
<tr>
<td>20</td>
<td>24-A</td>
<td>24</td>
<td></td>
<td>VERY STIFF, REDDISH BROWN, CLAYEY SILT</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>24-B</td>
<td>39</td>
<td>35%</td>
<td>VERY STIFF, DARK GRAY CLAYEY SILT w/ DECOMPOSED ROCK</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>24-C</td>
<td>35</td>
<td>40%</td>
<td>STIFF, LIGHT REDDISH BROWN, CLAYEY SILT</td>
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</tr>
<tr>
<td>24</td>
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<td>40%</td>
<td>VERY STIFF, BROWN CLAYEY SILT w/ DECOMPOSED ROCK</td>
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</tr>
<tr>
<td>26</td>
<td>24-E</td>
<td>37</td>
<td>40%</td>
<td>VERY STIFF, GRAY-BROWN CLAYEY SILT w/ DECOMPOSED ROCK</td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**  
- Elevation estimated from contour map
**Boring Log**

**PROJECT**: WAIAU DEVELOPMENT-UNIT I

**LOCATION**: WAIAU, EWA, OAHU, HAWAII

**HAMMER**:
- Weight: 140 lbs
- Drop: 30"

**SAMPLER**: 2" STANDARD SPLIT SPOON

**BORING NO.**: 25  
**Sheet No.**: 1 of 1  
**Date**: AUGUST 15, 1961

**Driller**: WALTER LUM ASSOC.  
**Field Party**: LEE, NELSON, MAKULA

**Type of Boring**: AUGER (INJECTOR)  
**Diam.**: 3"

**Elev.**: 204'  
**Datum**:  
**Date**: 8-15-61

**Type of Boring**: T.C. DRAG

**Water Level**: 9.9' D.P.

---

**Penetration Data**

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<thead>
<tr>
<th>Penetration Test</th>
<th>Standard Penetration</th>
<th>Thin Wall Tube Sampler</th>
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</thead>
<tbody>
<tr>
<td>Blows Per Foot</td>
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</tbody>
</table>

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**Description**

- **(ML)** STIFF MOTTLED REDDISH BROWN, CLAYEY SILT
- **(ML)** STIFF DARK BROWN CLAYEY SILT
- **(MH)** VERY STIFF REDDISH BROWN, CLAYEY SILT
- **(MH)** VERY STIFF REDDISH BROWN, CLAYEY SILT WITH TRACES OF GRAY CLAY
- **(MH)** VERY STIFF GRAY REDDISH BROWN, CLAYEY SILT WITH DECOMPOSED ROCK

**End of Boring @ 20.7'**
# Boring Log

**Project:** WAI'AU DEVELOPMENT-UNIT I  
**Location:** WAI'AU, EWA, OAHU, HAWAII  
**TMK:** 9-8-02:3

## Hammer
- **Weight:** 140 lbs  
- **Drop:** 30"  
- **Sampler:** 2" STANDARD SPLIT SPOON

## Penetration Data

<table>
<thead>
<tr>
<th>Sample</th>
<th>Depth (ft)</th>
<th>Blows Per Foot</th>
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<tr>
<td>26A</td>
<td>21</td>
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<td>26B</td>
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<td>26C</td>
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<td>26D</td>
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<tr>
<td>26E</td>
<td>34</td>
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</tr>
</tbody>
</table>

---

**Notes:**  
- **Elevation:** 236' T  
- **Type of Boring:** AUGER (MOBILE)  
- **Drill Bit:** T.C. DRAG  
- **Water Level:** NOT NOTICED  
- **Date:** 8-14-89

---

**Description:**  
- **ML**  
  - VERY STIFF, REDDISH BROWN, CLAYEY SILT  
  - VERY STIFF, BROWN CLAYEY SILT  
  - STIFF, REDDISH BROWN GRAY, CLAYEY SILT  
  - STIFF, BROWN CLAYEY SILT W/ DECOMPOSED ROCK  
  - VERY STIFF, GRAY BROWN, DECOMPOSED ROCK  
- **ML**  
- **MH**  
- **ML**  
  - END OF BORING @ 21.5'  

---

**Penetration Test:**

- **2" O.D. Thin Wall Tube Sampler**

---

**Schematic Diagram:**

- Various symbols and lines indicating borehole depths and samples.

---

**Additional Notes:**

- *Elevation Estimated From Contour Map*
Boring Log

Project: WAIAU DEVELOPMENT-UNIT I
Location: WAIAU, EWA, OAHU, HAWAII

TMK: 9-8-02:3

Hammer:
- Weight: 140 lbs
- Drop: 30"

Sampler:
- 2" STANDARD SPLIT SPOON

**BOARING NO. 27**

Driller: WALTER LUM ASSOC. Date: AUGUST 14, 1969

Field Party: MAKANAL, NELSON, LEE

Type of Boring: AUGER (MOBILE) Diam.: 3"

Elevation: 238 ± *, Datum: -

Drill Bit: T.C. DRAKE

Water Level: NOT NOTED

Time: -

Date: 8-14-69

---

**Penetration Data**

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<thead>
<tr>
<th>Depth (ft)</th>
<th>Sample No.</th>
<th>Wet Density</th>
<th>Moist. Cont.</th>
<th>Dry Density</th>
<th>Lab. Test</th>
</tr>
</thead>
</table>

| ELEV. = 238 ± * |

**Description**

- (ML) **STIFF, MOTTLED, REDDISH BROWN CLAYEY SILT**
- (MH) **VERY STIFF, BROWN CLAYEY SILT**
- (MH) **STIFF, BROWN CLAYEY SILT**

**End of Boring @ 21.5'**

*ELEVATION ESTIMATED FROM CONTOUR MAP*
Boring Log

PROJECT: WAIAU DEVELOPMENT-UNIT I
LOCATION: WAIAU, EWA, OAHU, HAWAII
TNK: 9-B-02:3

HAMMER:
Weight: 140 #
Drop: 30"

SAMPLER: 2" STANDARD SPLIT SPOON

BORING NO. 28  Sheet No. of

Driller: WALTER LUM  Date AUG.18, 1969
Field Party: LEE, MAU, MAKALUA
Type of Boring: AUGER (MINING) Diam: 3"
Elev. Datum:

Drill Bit: T.C. DRAG

Water Level: NOTICED

Time:
Date: 8-18-69

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<tr>
<th>Depth (ft)</th>
<th>Sample No.</th>
<th>Weight</th>
<th>P.C.F.</th>
<th>Moist. Cont.</th>
<th>Blows Per Foot</th>
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<td>34-41</td>
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END OF BORING @ 21.5'
Boring Log

PROJECT: WAIAU DEVELOPMENT-UNIT I

LOCATION: WAIAU, EWA, OAHU, HAWAII

TNK: 9-8-02-13

HAMMER:
Weight: 140#
Drop: 30"

SAMPLER: 2" STANDARD SPLIT SPOON

ELEV. = 270'1*

DESCRIPTION
MEDIUM, REDDISH BROWN, CLAYEY SILT

VERY STIFF, DARK REDDISH BROWN, CLAYEY SILT

STIFF, REDDISH BROWN, CLAYEY SILT

END OF BORING @16.5'

* ELEVATION ESTIMATED FROM CONTOUR MAP
BOULDER FILLS SHOULD BE PLACED WITH FINER MATERIALS TO FILL THE Voids.

STRIP OFF LOOSE MATERIALS DOWN TO STIFF GROUND AND SLOPE TO DRAIN.

COMPACTED GENERAL FILL

18" MINIMUM FILTER MATERIAL (WELL-GRADED CRUSHED ROCK SUCH AS "S4C")

TYPICAL SECTION

NOT TO SCALE

FIGURE 2

PROPOSED BOULDER FILL
WAIAU DEVELOPMENT - UNIT 1
WAIAU, EWA, OAHU, HAWAII
TMK 9-8-02:3
Boring Log

Project: WAIAU DEVELOPMENT-UNIT 1
Location: WAINU, EWA, OAHU, HAWAII

BMK: 9-8-02:3

Hammer:
- Weight: 140 lb
- Drop: 30" 5B - 2" Standard Split Spoon
- ST - 2" Thin Wall Tube

Sampler:

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Sample No.</th>
<th>Sample</th>
<th>Wet Density</th>
<th>Gt Vol.</th>
<th>Dry Density</th>
<th>Unconf. Comp.</th>
<th>Lab Test</th>
<th>Field Test</th>
<th>Average Penetration</th>
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<td>30-B</td>
<td>110</td>
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<td>81</td>
<td>6000</td>
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<td>30-C</td>
<td>43</td>
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<td>30-D</td>
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Boring No. 80
Driller: WALTER LUM 5605C
Date: AUG. 28, 1969

Field Party: NELSON, HASHIDA, MAKALUA

Type of Boring: AUGER (Minn. Thin) Diam: 3"

Elev. T.C. Drag

Wat. Level: N.A.

Date: 8-28-69

Location: WAIAU, EWA, OAHU, HAWAII

Penetration Data:

- Standard Penetration Test
- Thin Wall Tube Sampler
- 2" O.D. Tube Sampler
- Blows per foot
- Blows / 0.5 ft

Very Stiff, Reddish Brown, Clayey Silt w/ Decomposed Rock

Reddish Brown-Gray Decomposed Rock

End of Boring @ 16.5 ft

Elevation Estimated from Contour Map
Boring Log

PROJECT: WAI'AU DEVELOPMENT-UNIT I
LOCATION: WAI'AU, EWA, OAHU, HAWAII
TMK: 9-8-02:3

HAMMER:
Weight: 140 #
Drop: 30" 

SAangler:

ELEV. = 220' T *

**DESCRIPTION**

(ML) STIFF REDDISH BROWN CLAYEY SILT

(VH) VERY STIFF, REDDISH BROWN, CLAYEY SILT
with DECOMPOSED ROCK

(TH) STIFF, BROWN-GRAY CLAYEY SILT

LIGHT BROWN, DECOMPOSED ROCK

END OF BORING @ 16.5'

* ELEVATION ESTIMATED FROM CONTOUR MAP
### Boring Log

**Project:** WAIALU DEVELOPMENT - UNIT I  
**Location:** WAIALU, EWA, OAHU, HAWAI  
**TMK:** 9-6-02-3  
**Driller:** WALTER LUM ASSOC.  
**Date:** AUG. 26, 1969  
**Drill Party:** WOODS LUNING MAESHIRO  
**Type of Boring:** AUGER (MOBILE)  
**Diam.:** 3"  
**Elev.:** 220'  
**Datum:**  
**Drop Bit:** T.C. DRAG  
**Water Level:**  
**Date:** 8-26-69  
**Sampler:** 2" STANDARD SPLIT SPOON

<table>
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<th>Strata Classification</th>
<th>Description</th>
<th>Depth (Ft)</th>
<th>Samples</th>
<th>Sample No.</th>
<th>Penetration</th>
<th>Blows/0.5'</th>
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</thead>
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<tr>
<td>(ML)</td>
<td>STIFF, REDDISH BROWN, CLAYEY SILT</td>
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<td>32A</td>
<td>28</td>
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<tr>
<td>(ML)</td>
<td>VERY STIFF, LIGHT BROWN, CLAYEY SILT W/ DECOMPOSED ROCK</td>
<td>5</td>
<td>32B</td>
<td>28</td>
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<tr>
<td>(ML)</td>
<td>STIFF, BROWN CLAYEY SILT</td>
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<td>32C</td>
<td>32</td>
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<tr>
<td>(MH)</td>
<td>MEDIUM, BROWN CLAYEY SILT W/ DECOMPOSED ROCK END OF BORING @ 165'</td>
<td>15</td>
<td>32D</td>
<td>35</td>
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</table>

**Penetration Data:**  
**Standard Penetration Test:**  
**Thin Wall Tube Sampler:**  
**2" O.D.:**  
**C.O.D.:**  
**Blows Per Foot:** 0, 10, 20, 30, 40  
**Blows/0.5':**
**WALTER LUM ASSOCIATES**

**Boring Log**

**PROJECT:** WAIAU DEVELOPMENT-UNIT I

**LOCATION:** WAIAU, EWA, OAHU, HAWAII

**TMK:** 9-8-02-3

**HAMMER:**
- **Weight:** 140 lb
- **Drop:** 30"

**SAMPLER:**
- **2½" - 2" STANDARD SPLIT SPOON**
- **2½" - 2" THIN WALL TUBE**

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>2'55</td>
<td>STIFF, REDDISH BROWN CLAYEY SILT</td>
<td>33-A</td>
<td>24</td>
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<tr>
<td>2'55</td>
<td>VERY STIFF, REDDISH BROWN, SILTY CLAY</td>
<td>33-B</td>
<td>30</td>
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<tr>
<td>2'55</td>
<td>ROCK OR BOULDER</td>
<td>33-C</td>
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<tr>
<td>2'56</td>
<td>END OF BORING @ 137'</td>
<td>33-D</td>
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**BORING NO.** 33

**Driller:** WALTER LUM ASSOC., Date: AUG 28, 1969

**Field Party:** WOODS, LUNING, MAESHIRO

**Type of Boring:** ANGER (MINIATURE) Diam.: 3"

**Elev.:** 248' +*

**Drill Bit:** T.C. DRAG

**Water Level:** NOT NOTED

**Time:** -

**Date:** 8-28-69

**Penetration Data**

**Sample No.**
- **Wet Den.:** 24
- **P.C.F.:** -
- **A. C%:** -
- **Dry Den.:** -
- **P.C.F.:** -
- **U. S.Er:** -
- **P. S.Er:** -
- **Lab. Torvane P.S.Er:** -

**BLOWES/0.3'**
- **3½' 3½' 3½'**

*[ELEVATION ESTIMATED FROM CONTOUR MAP]*
Boring Log

PROJECT: WAIAU DEVELOPMENT-UNIT I
LOCATION: WAIAU, EWA, OAHU, HAWAII

HAMMER:
- Weight: 140 lbs
- Drop: 30'

SAMPLER: 2" STANDARD SPLIT SPOON

PENETRATION DATA

<table>
<thead>
<tr>
<th>Unified Soil Classification</th>
<th>Description</th>
<th>ELEV. = &quot;268' I&quot;</th>
<th>Depth (ft)</th>
<th>Sampler</th>
<th>Sample No.</th>
<th>Plastic Limit</th>
<th>Liquid Limit</th>
<th>Unit Cons.</th>
<th>P.S.I.</th>
<th>Standard Penetration Test</th>
<th>Blows Per Foot</th>
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</thead>
<tbody>
<tr>
<td>(ML)</td>
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<td>34-A</td>
<td>25</td>
<td>34-B</td>
<td>30</td>
<td>34-C</td>
<td>39</td>
<td>34-D</td>
<td>47</td>
<td>34-E</td>
<td>42</td>
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<tr>
<td>(ML)</td>
<td>VERY STIFF, REDDISH BROWN, CLAYEY SILT</td>
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<tr>
<td></td>
<td>ROCK</td>
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</tr>
<tr>
<td>(MH)</td>
<td>STIFF, REDDISH BROWN CLAYEY SILT W/ DECOMPOSED ROCK</td>
<td>34-D</td>
<td>47</td>
<td>34-E</td>
<td>42</td>
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<tr>
<td></td>
<td>END OF BORING @ 21.5'</td>
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</tbody>
</table>

* ELEVATION ESTIMATED FROM CONTOUR MAP

WALTER LUM ASSOCIATES

3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 727-7921
**Boring Log**

**PROJECT:** WAIAU DEVELOPMENT-UNIT I

**LOCATION:** WAIAU, EWA, OAHU, HAWAII

**TMK:** 9-8-02-B

**HAMMER:**
- **Weight:** 140 #
- **Drop:** 30"

**SAMPLER:** 2" STANDARD SPLIT SPOON

---

**DESCRIPTION**

**ELEV. = 201'**

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<td>3.5</td>
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<td>10.5</td>
<td>35-C</td>
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<td>15.5</td>
<td>35-D</td>
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<tr>
<td>20.5</td>
<td>35-E</td>
<td>(NO RECOVERY)</td>
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**PENETRATION DATA**

- **STIFF, DARK BROWN, CLAYEY SILT**
- **VERY STIFF, DARK BROWN, CLAYEY SILT**
- **END OF BORING @ 20'**

---

*ELEVATION ESTIMATED FROM CONTORU MAP*
Boring Log

PROJECT: WAIKU DEVELOPMENT-UNIT I
LOCATION: WAIKU, EWA, OAHU, HAWAII
TMK: 9-8-02:3

HAMMER:
Weight: 140 lbs
Drop: 30"

SAMPLER: 2" STANDARD SPLIT SPOON

ELEV. = 217' ± *

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<td>36B</td>
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</table>

DESCRIPTION:

(ML) STIFF, REDDISH BROWN CLAYEY SILT

(ML) VERY STIFF, REDDISH BROWN CLAYEY SILT W/ DECOMPOSED ROCK

ROCK OR BOULDER

NOTE:
FIRST ATTEMPT HIT BOULDER @ 3', MOVED BORING 3' EAST, SECOND ATTEMPT HIT BOULDER @ 6', MOVED BORING 3'

* ELEVATION ESTIMATED FROM CONTOUR MAP
Boring Log

**PROJECT:** WAIAU DEVELOPMENT-UNIT I

**LOCATION:** WAINI, EWA, OAHU, HAWAII

**TMK:** 9-8-02-B

**HISAMER:**
- **Weight:** 40 #
- **Drop:** 30" 

**SAMPLER:** 2" STANDARD SPLIT SPOON

---

### PENETRATION DATA

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<th>Depth (ft)</th>
<th>Sample No.</th>
<th>Penetration</th>
<th>Sample</th>
<th>Wet Dens.</th>
<th>P.C%</th>
<th>Void Vol.</th>
<th>P.C%</th>
<th>Density</th>
<th>P.C%</th>
<th>Penetration</th>
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<td>37-C</td>
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<td>37-D</td>
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<td>37-E</td>
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<td>37-F</td>
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</table>

**STANDARD PENETRATION TEST**

- **Blows Per Foot:**
  - 0
  - 10
  - 20
  - 30
  - 40

**2" O.D. TUBE SAMPLER**

- **Blows/0.5':**
  - END OF BORING @ 26'

---

**END OF BORING @ 26'**

---

**ELEVATION ESTIMATED FROM CONTINUOUS MAP**

---

### CLAYEY SILT

- **ML:** MEDIUM TO STIFF, REDDISH BROWN, CLAYEY SILT
- **(MH):** STIFF TO VERY STIFF, BROWN, CLAYEY SILT
- **(MH):** STIFF TO VERY STIFF, TAN-BROWN, CLAYEY SILT

---

**BORING NO.:** 37  
**Sheet No.:**  of  
**Driller:** WALTER LUM  
**Date:** AUG. 11, 1969  
**Field Party:** MAKANL LEE, MEYER  
**Type of Boring:** AUGER (MOBILE)  
**Diam:** 3" 
**Elev:** 230'  
**Datum:**  
**Drill Bit:** T.C. DRAG  
**Date:** 8-11-69
**Boring Log**

**PROJECT:** WAIAU DEVELOPMENT-UNIT I  
**LOCATION:** WAIAU, EWA, OAHU, HAWAII  
**TMK:** 9-8-02-3

**HANMER:**  
- Weight: 140 lb  
- Drop: 30"  
**SAMPLER:** 2" STANDARD SPLIT SPOON

**BORING NO.** 38  
**Driller:** WALTER LUM ASSOC.  
**Date:** AUG 9, 1969  
**Field Party:** LEE. KAKU. HASHIDA

**Type of Boring** AUGER (MOBILE)  
**Diam.** 3"  
**Elev.** 244'  
**Drill Bit** T.C. DRAG  
**Datum:**  

**Water Level**  
**Time:**  
**Date:** 8-3-69

---

**ELEVATION:** 244'  

**DESCRIPTION**  
**Sample No.**  
**Wet. Dens.**  
**P.C.I.**  
**Wash. Cont.**  
**Dry. Dens.**  
**P.C.I.**  
**Unconf. Comp.**  
**Lab. Test Dens.**  
**Sample**  
**Penetration Data**  
**STANDARD PENETRATION TEST**  
**2" O.D. THIN WALL TUBE SAMPLER**  
**Blows Per Foot**

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<td>38-B</td>
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<td>38-C</td>
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<td>38-D</td>
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**END OF BORING @ 21.5**

---

*ELEVATION ESTIMATED FROM CONTOUR MAP*
Boring Log

**PROJECT:** WAIAU DEVELOPMENT - UNIT I

**LOCATION:** WAIAU, EWA, OAHU, HAWAII

**TMK:** 9-8-02:3

**HAMMER:**
- **Weight:** 140 lbs
- **Drop:** 30" "

**SAMPLER:** 2" STANDARD SPLIT SPOON

---

**ELEV. = 261'1"**

<table>
<thead>
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<th>Sample</th>
<th>Description</th>
<th>Visc. Cons.</th>
<th>Unit Cons.</th>
<th>P.C. %</th>
<th>Penetration Test</th>
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<td>MEDIUM, REDDISH BROWN, CLAYEY SILT</td>
<td>35</td>
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<tr>
<td>39-B</td>
<td>VERY STIFF, REDDISH BROWN, CLAYEY SILT</td>
<td>32</td>
<td>-</td>
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<tr>
<td>39-C</td>
<td>MEDIUM, REDDISH BROWN, CLAYEY SILT</td>
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<td>39-D</td>
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<td>40</td>
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</tbody>
</table>

**END OF BORING @ 17'**

---

**ELEVATION ESTIMATED FROM CONTOUR MAP**
Boring Log

PROJECT: WAIAU DEVELOPMENT-UNIT I
LOCATION: WAIAU, EWA, OAHU, HAWAII
TMK: 9-8-02:3

HAMMER:
Weight: 140 lbs
Drop: 30"

SAMPLER: 2" STANDARD SPLIT SPOON

BOARING NO. 40  Sheet No. of
Driller WALTER LUM, Date AUG 27, 1969
Field Party MAKAILA, HASHIDA, NELSON
Type of Boring AUGER, (MUD) Diam. 3"
Elev. 1901 * Datum -
Drill Bit T.C. DRAG

Water Level NOT MTD
Time -
Date 8-27-69

<table>
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<th>Depth (Ft.)</th>
<th>Sampler</th>
<th>Sample No.</th>
<th>Wet Dens. P.C.F.</th>
<th>Moist. Cont.</th>
<th>% Dry Dens.</th>
<th>T.C.F.</th>
<th>Uncomp. Comp.</th>
<th>Hardness \</th>
<th>Penetration Data</th>
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(ML)
STIFF, REDDISH BROWN CLAYEY SILT

(ML)
VERY STIFF, DARK BROWN, CLAYEY SILT

(MH)
VERY STIFF, DARK BROWN, SILTY CLAY

(MH)
VERY STIFF, DARK BROWN, SILTY CLAY W/ DECOMPOSED ROCK

END OF BORING @ 16.5'

* ELEVATION ESTIMATED FROM CONTOUR MAP
**Boring Log**

**PROJECT**  WAIAU DEVELOPMENT-UNIT I  
**LOCATION**  WAIAU, EWA, OAHU, HAWAII  
**TMK:**  9-8-02:3  
**HAMMER:**  
- **Weight:** 140 #  
- **Drop:** 30"  
**SAMPLER:**  2" STANDARD SPLIT SPOON  

---

**ELEV. = 214' +**

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<th>Sample No.</th>
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<th>P.C.F.</th>
<th>Moist. Cont. %</th>
<th>Dry Density</th>
<th>P.C.F.</th>
<th>Britt. Comp.</th>
<th>Lab. Comp.</th>
<th>Penetration Test</th>
<th>Blows per foot</th>
<th>Blows/0.5'</th>
</tr>
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<tr>
<td>41-A</td>
<td>STIFF TO VERY STIFF, REDDISH BROWN, CLAYEY SILT</td>
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<td>41-B</td>
<td>MEDIUM, REDDISH BROWN, CLAYEY SILT w/ TRACES OF DECOMPOSED ROCK</td>
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<td>STIFF, MOTTED BROWN CLAYEY SILT w/ DECOMPOSED ROCK</td>
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**NOTES:**
- **Water Level Noted:**
- **Drill Bit:** T.C. DRAG  
- **Date:** 8-17-69  

---

**ELEVATION ESTIMATED FROM CONTOUR MAP**
## Boring Log

**Project:** WAIAU DEVELOPMENT-UNIT I  
**Location:** WAIAU, EWA, OAHU, HAWAII  
**TMK:** 9-8-02:3

### HAMMER:
- **Weight:** 140 #  
- **Drop:** 30"  
- **Sampler:** 2" STANDARD SPLIT SPOON

### PENETRATION DATA

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<th>Depth (ft)</th>
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</tr>
<tr>
<td></td>
<td>42D</td>
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### ELEVATION ESTIMATED FROM Contour Map

* Elevation Estimated from Contour Map

---

**BORING NO.: 42**  
**Sheet No.: of**

**Driller:** WALTER LUM ASSOCIATES  
3020 WAIALAE AVENUE • HONOLULU, HAWAII 96816 •

**Date:** AUG 26, 1969  
**Type of Boring:** AUGER (MOBILE)  
**Diam.:** 3"  
**T.C. DRAG**

**Elev.:** 228' *  
**Datum:** —

**Water Level:** —

**Time:** —  
**Date:** 8-26-69

---

**STANDARD PENETRATION TEST**

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<thead>
<tr>
<th>Blows Per Foot</th>
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<tbody>
<tr>
<td>0 10 20 30 40</td>
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<tr>
<td>BLOWS/O.5'</td>
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</table>

---

**STIFF, REDDISH BROWN CLAYEY SILT**

**MEDIUM TO STIFF, DARK REDDISH BROWN CLAYEY SILT**

**VERY STIFF, REDDISH BROWN, CLAYEY SILT**

**VERY STIFF, BROWN, CLAYEY SILT w/ DECOMPOSED ROCK**

**END OF BORING @ 165'**
**Boring Log**

**PROJECT:** WAIALU DEVELOPMENT-UNIT I

**LOCATION:** WAIAlU, EWA, OAHU, HAWAII

**TMK:** 9-B-02:3

**HAMMER:**
- **Weight:** 140 lbs
- **Drop:** 30".

**SAMPLER:** 2" STANDARD SPLIT SPOON

---

**ELEV. 108'1"**

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<th>Sample No.</th>
<th>Wet Dens. (p.c.f.)</th>
<th>Moist. Cond.</th>
<th>Dry Dens. (p.c.f.)</th>
<th>Unb. Comp. (v.p.s.f.)</th>
<th>Blows, Per Foot</th>
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<tr>
<td>MH</td>
<td>VERY STIFF, BROWN, CLAYEY Silt</td>
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<td>47-B</td>
<td>30</td>
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<tr>
<td>ML</td>
<td>STIFF, MOTTLED BROWN, CLAYEY Silt</td>
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<td>47-C</td>
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<td>MH</td>
<td>STIFF TO VERY STIFF DARK GRAY-BROWN Silty Clay w/ Decomposed Rock</td>
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<td>33</td>
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---

**Penetration Data**

- **Standard Penetration Test:**
- **2" O.D. Thin Wall Tube Sampler Blows/0.5'**

---

**ELEVATION ESTIMATED FROM CONTOUR MAP**
Boring Log

PROJECT: WAI'AU DEVELOPMENT-UNIT I
LOCATION: WAI'AU, EWA, OAHU, HAWAII

**HAMMER:**
- Weight: 140 lbs
- Drop: 30"

**SAMPER:** 2" STANDARD SPLIT SPOON

**TYPE OF BORING:** AUGER (MOBILE)
- Diam.: 3"
- ELEV.: 217' *
- Datum: _

**DRILL BIT:** T.C. DRAG

**WATER LEVEL:** NOT NOTICED

**DATE:** 7-31-69

---

**UNIT CLASSIFICATION**

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<td>44-B</td>
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</table>

**PENETRATION DATA**

**STANDARD PENETRATION TEST:**
- BLOWS PER FOOT: 0 10 20 30 40

**TUBE SAMPLER:**
- BLOWS/0.5

**DESCRIPTION**

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<td><strong>STIFF TO VERY STIFF REDDISH BROWN CLAYEY SILT</strong></td>
</tr>
<tr>
<td><strong>VERY STIFF, MOTTLED BROWN, CLAYEY SILT W/ DECOMPOSED ROCK</strong></td>
</tr>
<tr>
<td><strong>VERY STIFF, DARK BROWN, SILTY CLAY W/ DECOMPOSED ROCK</strong></td>
</tr>
</tbody>
</table>

**END OF BORING, @ 21.5'**

---

*ELEVATION ESTIMATED FROM CONTOUR MAP*
**Boring Log**

**PROJECT**  WAIJAU DEVELOPMENT-UNIT I  
**LOCATION**  WAIJAU, EWA, OAHU, HAWAII  
**TMK:**  9-8-02:3  
**HAMMER:**  
  - Weight: 140 #  
  - Drop: 30"  
**SAMPLER:**  2" STANDARD SPLIT SPOON  

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- **ELEVATION ESTIMATED FROM CONTOUR, MAP**

---

**ELEVATION ESTIMATED FROM CONTOUR, MAP**

---

**Type of Boring:** AUGER (MOBILE)  
**Drill Bit:** T.C. DRAG  
**Elev.:** 236 ft  
**Date:** August 1, 1969  
**Field Party:** WINING, MAK&AULA  

---

**DESCRIPTION**

- **(ML)** VERY STIFF REDDISH BROWN CLAYEY Silt.  
- **(ML)** STIFF BROWN CLAYEY Silt W/ DECOMPOSED ROCK  
- **(ML)** BROWN, CLAYEY Silt DECOMPOSED ROCK  
- **Rock Boulder** END OF BORING @ 18.0  

---

**PENETRATION DATA**

- **BORING NO.:** 45  
- **Sheet No.:** 1 of 1  
- **Weight:** 140 #  
- **Drop:** 30"  
- **Date:** August 1, 1969  

---

**Additional Notes:**  
- **Water Level:** NOT NOTED  
- **Time:** ---  
- **Location:** WAIJAU, EWA, OAHU, HAWAII  

---

**Additional Details:**  
- **Penetration Test:**  
  - **2" O.D.**  
  - **Thin Wall Tube Sampler**  
  - **Blows/ft:** ---  

---

**General Observations:**  
- **3"**  
- **Hammer Bounces**
Boring Log

**PROJECT:** WAIALU DEVELOPMENT-UNIT I

**LOCATION:** WAIALU, EWA, OAHU, HAWAII

**TMK:** 9-B-02"B

**PROJECT:** WAIALU DEVELOPMENT-UNIT I

**LOCATION:** WAIALU, EWA, OAHU, HAWAII

**TMK:** 9-B-02"B

**HAMMER:**
- **Weight:** 140 #
- **Drop:** 30"

**SAMPLER:** 2" STANDARD SPLIT SPOON

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END OF BORING @ 21'

* ELEVATION ESTIMATED FROM CONTOUR MAP

**BORING NO.** 46 | **Sheet No.** 1 of 1

**Driller:** WALTER LUM ASSOC., Date: AUGUST 2, 1969

**Field Party:** KAVU OSHIE

**Type of Boring:** AUGER, DIAM. 3"

**Elev.:** 247' * | **Datum:**

**Drill Bit:** T.C. DRAG

**Water Level:** NOT

**Time:**

**Date:** 8-2-69

**O.D. D. Thin Wall Tube Sampler**

**2 O.D. Thin Wall Tube Sampler**

**Penetration Data**

**Standard Penetration Test**

**Blows Per Foot**

0 10 20 30 40

**Blows/0.5'**

**Notes:**
**Boring Log**

**PROJECT:** WAIALU DEVELOPMENT-UNIT I  
**LOCATION:** WAIALU, EWA, OAHU, HAWAII  
**TMK:** 9-8-02-B

**HAMMER:**  
- **Weight:** 140 lbs  
- **Drop:** 30"  
**SAMPLER:** 2" STANDARD SLIT SPOON

**DESCRIPTION**  
- **ELEV. 246' + 0**
  - **(ML)** STIFF REDDISH BROWN CLAYEY SILT
  - **(MH)** STIFF, DARK BROWN CLAYEY SILT
  - **(MH)** STIFF BROWN CLAYEY SILT
  - **(MH)** VERY STIFF BROWN CLAYEY SILT W/ DECOMPOSED ROCK
  - **(MH)** VERY STIFF, DARK BROWN, SILTY CLAY & DECOMPOSED ROCK

**END OF BORING @ 26'**

**ELEVATION ESTIMATED FROM CONTOUR MAP**

**PENETRATION DATA**

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**WALTER LUM ASSOCIATES**

**Boring Log**

**PROJECT**
WI'ALI DEVELOPMENT-UNIT I

**LOCATION**
WI'ALI, EWA, OAHU, HAWAII

**TMK:** 9-8-02:3

**HAMMER:**
- Weight: 140 lbs
- Drop: 30"

**SAMPLER:** 2" STANDARD SPLIT SPON

**BORING NO.** 48  

**Sheet No.** 1 of 1

**Driller** WALTER LUM ASSOC.  
**Date** AUGUST 19, 1969

**Field Party** MAKALUA, MAU, LEE

**Type of Boring** AUGER (MóBILE)  
**Diam.** 3"

**Elev.** 2701' *

**Drill Bit** T.C. DRAG

**Water Level** NOT NOTICED

**Time** --

**Date** 8-7-69

**PENETRATION DATA**

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<th>Sample No.</th>
<th>Wet Test</th>
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<th>Wet Test Cont.</th>
<th>P.C.F.</th>
<th>Wet Test Comp.</th>
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**END OF BORING @ 21.5'**

*ELEVATION ESTIMATED*  
**KESIKI CRESCENT MAP**
# WAI'AU DEVELOPMENT - UNIT I

## TABLE IA - SUMMARY OF LABORATORY TEST RESULTS

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<th>4</th>
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</thead>
<tbody>
<tr>
<td>SAMPLE NO.</td>
<td>A</td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>DEPTH BELOW SURFACE</td>
<td>0.5' - 1'</td>
<td>1' - 2.5'</td>
<td>5' - 6.5'</td>
</tr>
<tr>
<td>DESCRIPTION</td>
<td>REDDISH BROWN</td>
<td>REDDISH - BROWN</td>
<td>TAN CLAYEY SILT</td>
</tr>
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</table>

### GRADING ANALYSIS (% Passing)

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>1&quot;</th>
<th>1/2&quot;</th>
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<th>#10</th>
<th>#20</th>
<th>#40</th>
<th>#100</th>
<th>#200</th>
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<tbody>
<tr>
<td>Percentage</td>
<td>100</td>
<td>98.1</td>
<td>97.1</td>
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<td>95.3</td>
<td>94.7</td>
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### ATTERBERG LIMITS

<table>
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<tr>
<th>TEST</th>
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<tr>
<td>Air Dried or Natural Liquid Limit</td>
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<td>16</td>
<td>17</td>
<td>11</td>
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<tr>
<td>Dilatancy</td>
<td>MEDIUM</td>
<td>QUICK</td>
<td>QUICK</td>
</tr>
<tr>
<td>Toughness</td>
<td>MEDIUM</td>
<td>MEDIUM</td>
<td>SLIGHT-MED</td>
</tr>
<tr>
<td>Dry Strength</td>
<td>SLIGHT-MED</td>
<td>SLIGHT-MED</td>
<td>SLIGHT-MED</td>
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</tbody>
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### UNIFIED SOIL CLASSIFICATION

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### SPECIFIC GRAVITY

<table>
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### EXPANSION AND CBR TESTS

(Surcharge-51 P.S.F.)

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<tbody>
<tr>
<td>Molding Moisture Content, %</td>
<td>74.5</td>
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<tr>
<td>Molding Dry Density, P.C.F.</td>
<td>101.6</td>
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<tr>
<td>Swell upon saturation, %</td>
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<tr>
<td>CBR at 0.1&quot; Penetration</td>
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### COMPACTION TEST

(AASHO T-180-57 Method)

<table>
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<th>TEST</th>
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<tbody>
<tr>
<td>Dry to Wet or Wet to Dry</td>
<td>DRY TO WET</td>
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<tr>
<td>Max. Dry Density (P.C.F.)</td>
<td>104.0</td>
</tr>
<tr>
<td>Optimum Moisture (%)</td>
<td>23.0</td>
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WALTER LUM ASSOCIATES
CIVIL, STRUCTURAL, SOILS ENGINEERS
TABLE I.B - SUMMARY OF LABORATORY TEST RESULTS

<table>
<thead>
<tr>
<th>BORING NO.</th>
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<th>18</th>
<th>18</th>
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</thead>
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<tr>
<td>SAMPLE NO.</td>
<td>A</td>
<td>B</td>
<td>C</td>
<td>A</td>
<td>D</td>
</tr>
<tr>
<td>DEPTH BELOW SURFACE</td>
<td>0.5'-1'</td>
<td>5'-6.5'</td>
<td>10'-11.5'</td>
<td>0.5'-1'</td>
<td>3'-6.5'</td>
</tr>
<tr>
<td>DESCRIPTION</td>
<td>REDDISH BROWN CLAY</td>
<td>LIGHT BROWN CLAY SILT</td>
<td>GRAY BROWN SALT</td>
<td>REDDISH BROWN CLAY SILT</td>
<td>MOTTLED REDDISH-BROWN CLAY SILT</td>
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</table>

GRADING ANALYSIS

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<td>0.5&quot;</td>
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<tr>
<td>#200</td>
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ATTERBERG LIMITS

<table>
<thead>
<tr>
<th>Air Dried or Natural</th>
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<th>NATURAL</th>
<th>NATURAL</th>
<th>NATURAL</th>
<th>NATURAL</th>
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</thead>
<tbody>
<tr>
<td>Liquid Limit</td>
<td>49</td>
<td>55</td>
<td>53</td>
<td>49</td>
<td>51</td>
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<tr>
<td>Plastic Limit</td>
<td>28</td>
<td>40</td>
<td>36</td>
<td>31</td>
<td>36</td>
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<tr>
<td>Plasticity Index</td>
<td>21</td>
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</table>

Dilatancy

<table>
<thead>
<tr>
<th>Toughness</th>
<th>MEDIUM</th>
<th>MEDIUM</th>
<th>QUICK-MED.</th>
<th>QUICK-MED.</th>
<th>QUICK-MED.</th>
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</thead>
</table>

Dry Strength

<table>
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<th>MH</th>
<th>MH</th>
<th>ML</th>
<th>MH</th>
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</table>

SPECIFIC GRAVITY

| 2.85 | 2.85 |

EXPANSION AND CBR TESTS

<table>
<thead>
<tr>
<th>Expansion and CBR Tests (Surcharge-51 P.S.F.)</th>
<th>23.1</th>
<th>23.8</th>
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</thead>
<tbody>
<tr>
<td>Molding Moisture Content, %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Molding Dry Density, P.C.F.</td>
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<td>94.9</td>
</tr>
<tr>
<td>Swell upon saturation, %</td>
<td>1.7</td>
<td>2.2</td>
</tr>
<tr>
<td>CBR at 0.1&quot; Penetration</td>
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<td>11.3</td>
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</tbody>
</table>

COMPACTION TEST

<table>
<thead>
<tr>
<th>Compaction Test (AASHO T-180-57 Method)</th>
<th>A</th>
<th>A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry to Wet or Wet to Dry</td>
<td>DRY TO WET</td>
<td>DRY TO WET</td>
</tr>
<tr>
<td>Max. Dry Density (P.C.F.)</td>
<td>101.8</td>
<td>100.3</td>
</tr>
<tr>
<td>Optimum Moisture (%)</td>
<td>24.6</td>
<td>24.5</td>
</tr>
</tbody>
</table>

WALTER LUM ASSOCIATES
CML, STRUCTURAL, SOILS ENGINEERS
| BORING NO. | 20 | 25 | 37 |
| DEPTH BELOW SURFACE | 10' - 11.5' | 1' - 2' | 5' - 6.5' |
| DESCRIPTION | REDDISH- BROWN-GRAY | REDDISH- BROWN | REDDISH- BROWN |
| GRADING ANALYSIS | | | |
| Sieve | | | |
| 1" | | | |
| 1/4" | | | |
| #4 | | | |
| #10 | | | |
| #20 | | | |
| #40 | | | |
| #100 | | | |
| #200 | | | |
| ATTERBERG LIMITS | | | |
| Air Dried or Natural | | | |
| Liquid Limit | 63 | 47 | 43 |
| Plastic Limit | 39 | 30 | 31 |
| Plasticity Index | 24 | 17 | 12 |
| DILATANCY | MEDIUM | MEDIUM | QUICK |
| Toughness | MEDIUM | SLIGHT-MED | SLIGHT-MED |
| Dry Strength | SLIGHT-MED | SLIGHT-MED | SLIGHT-MED |
| UNIFIED SOIL CLASSIFICATION | MH | ML | ML |
| SPECIFIC GRAVITY | | | |
| EXPANSION AND CBR TESTS | | | |
| (Surcharge - 51 P.S.F.) | | | |
| Molding Moisture Content, % | | | 26.1 |
| Molding Dry Density, P.C.F. | | | 98.1 |
| Swell upon saturation, % | | | 0.4 |
| CBR at 0.1" Penetration | | | 15.0 |
| COMPACTION TEST | | | |
| (AASHTO T-180-57 Method) | | | |
| Dry to Wet or Wet to Dry | | | 8 |
| Max. Dry Density (P.C.F.) | | | 98.1 |
| Optimum Moisture (%) | | | 26.2 |

WALTER LUM ASSOCIATES
CIVIL, STRUCTURAL, SOILS ENGINEERS
## TABLE I.D - SUMMARY OF LABORATORY TEST RESULTS

<table>
<thead>
<tr>
<th>BORING NO.</th>
<th>43</th>
<th>43</th>
<th>43</th>
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<th>43</th>
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</thead>
<tbody>
<tr>
<td>SAMPLE NO.</td>
<td>A</td>
<td>B</td>
<td>C</td>
<td>D</td>
<td>E</td>
</tr>
<tr>
<td>DEPTH BELOW SURFACE</td>
<td>1'-2'</td>
<td>5'-6.5'</td>
<td>10'-11.5'</td>
<td>15'-16.5'</td>
<td>20'-21.5'</td>
</tr>
<tr>
<td>DESCRIPTION</td>
<td>REDDISH BROWN</td>
<td>MOTTLED BROWN</td>
<td>GRAY-BROWN BROWN</td>
<td>SILTY CLAY CLAYEY SILT</td>
<td>WIDESP. WIDESP.</td>
</tr>
<tr>
<td>DESCRIPTION</td>
<td>CLAYEY SILT</td>
<td>CLAYEY SILT</td>
<td>WIDESP. WIDESP.</td>
<td>ROCK</td>
<td>ROCK</td>
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### Grading Analysis (% Passing)

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<tbody>
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<tr>
<td>#10</td>
<td>99.9</td>
</tr>
<tr>
<td>#20</td>
<td>99.7</td>
</tr>
<tr>
<td>#40</td>
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<tr>
<td>#100</td>
<td>98.5</td>
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<tr>
<td>#200</td>
<td>98.1</td>
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</table>

### Atterberg Limits

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Dried or Natural</td>
<td>NATURAL</td>
</tr>
<tr>
<td>Liquid Limit</td>
<td>44</td>
</tr>
<tr>
<td>Plastic Limit</td>
<td>27</td>
</tr>
<tr>
<td>Plasticity Index</td>
<td>17</td>
</tr>
<tr>
<td>Dilatancy</td>
<td>QUICK</td>
</tr>
<tr>
<td>Toughness</td>
<td>MEDIUM</td>
</tr>
<tr>
<td>Dry Strength</td>
<td>SLIGHT-MED</td>
</tr>
</tbody>
</table>

### Unified Soil Classification

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>ML</td>
<td>MH</td>
</tr>
<tr>
<td>ML</td>
<td>MH</td>
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</table>

### Specific Gravity

|   | 2.69 |

### Expansion and CBR Tests

<p>| | |</p>
<table>
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<tr>
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<td>(Surcharge-51 P.S.F.)</td>
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<td>Molding Moisture Content, %</td>
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<td>Molding Dry Density, P.C.F.</td>
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<td>Swell upon saturation, %</td>
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### Compaction Test

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<table>
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</tr>
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<tr>
<td>Dry to Wet or Wet to Dry</td>
<td>WET TO DRY</td>
</tr>
<tr>
<td>Max. Dry Density (P.C.F.)</td>
<td>183.5</td>
</tr>
<tr>
<td>Optimum Moisture (%)</td>
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**Table I.6 - Summary of Laboratory Test Results**

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<td>Depth Below Surface</td>
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**Description**
Reddish Brown Clayey Silt

**Grading Analysis** (% Passing)

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<th>Sieve Size</th>
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<th>100</th>
<th>100</th>
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<th>99.7</th>
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<tr>
<td>#200</td>
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**Atterberg Limits**

<table>
<thead>
<tr>
<th>Condition</th>
<th>Plastic Limit</th>
<th>Plasticity Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Dried or Natural</td>
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<td>17</td>
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<tr>
<td>Liquid Limit</td>
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<tr>
<td>Plastic Limit</td>
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**Unified Soil Classification**
ML

**Specific Gravity**
2.88

**Expansion and CBR Tests**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Molding Moisture Content, %</td>
<td>27.7</td>
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<tr>
<td>Molding Dry Density, P.C.F.</td>
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<tr>
<td>Swell upon saturation, %</td>
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**Compaction Test**

<table>
<thead>
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<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Dry to Wet or Wet to Dry</td>
<td>WET TO DRY</td>
</tr>
<tr>
<td>Max. Dry Density (P.C.F.)</td>
<td>101.5</td>
</tr>
<tr>
<td>Optimum Moisture (%)</td>
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</tr>
</tbody>
</table>

**Walter Lum Associates**
Civil, Structural, Soils Engineers
JOB: WAIAU DEVELOPMENT - UNIT 1

LOCATION: WAIAU, EWA, OAHU, HAWAII

PLASTICITY CHART

* INDICATES BAG SAMPLE TESTED TAKEN
ADJACENT TO BORING NO.
JOB: WAIAU DEVELOPMENT - UNIT I

LOCATION: WAIAU, EWA, OAHU, HAWAII

PLASTICITY CHART

* INDICATES BAG SAMPLES TESTED TAKEN ADJACENT TO BORING NO.
MOISTURE-DENSITY CURVE (AASHO T-180-57, METHOD A)

PROJECT: WAIKAU DEVELOPMENT - UNIT I
LOCATION: WAIKAU, EWA, OAHU, HAWAII
SAMPLE NO: 1-A (0.5'Y)
SAMPLE DESCRIPTION: REDDISH-BROWN CLAYEY Silt (ML)

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS
MOISTURE-DENSITY CURVE (AASHO T-180-57, METHOD A)

PROJECT: WAIKU DEVELOPMENT - UNIT 1
LOCATION: WAIKU, EWA, OAHU, HAWAII
SAMPLE NO: 11-A (0.5'-1')
SAMPLE DESCRIPTION: REDDISH-BROWN SILTY CLAY (ML)

10" RAMMER
15" DROP
75 BLOWS PER LAYER
5 LAYERS
MOULD SIZE: 4" DIAM
4.59" HIGH

MAX DRY DENSITY: 101.8 P.C.F.
OPTIMUM MOISTURE CONTENT: 24.6 %
ZERO AIR VOIDS CURVE
SPECIFIC GRAVITY: 2.65

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS
MOISTURE-DENSITY CURVE (AASHO T-180-57, METHOD A)

PROJECT: WAIAU DEVELOPMENT - UNIT I
LOCATION: WAIAU, EWA, OAHU, HAWAII
SAMPLE NO: 18-A (0.5'-1')
SAMPLE DESCRIPTION: REDDISH-BROWN CLAYEY Silt (ML)

10# RAMMER
18" DROP
75 BLOWS PER LAYER
5 LAYERS
MOLD SIZE: 4" DIAM
4.5" HIGH

ZERO AIR Voids CURVE
SPECIFIC GRAVITY - 2.85

MAX DRY DENSITY: 100.0 Pcf

OPTIMUM MOISTURE CONTENT - 14.5%
MOISTURE-DENSITY CURVE (AASHO T-180-57, METHOD A)

PROJECT: WAIAU DEVELOPMENT - UNIT 1
LOCATION: WAIAU, EWA, OAHU, HAWAII
SAMPLE NO: 35-A (1'-2')
SAMPLE DESCRIPTION: REDDISH-BROWN CLAYEY SILT (ML)

10" RAMMER
18" DROP
95 BLOWS PER LAYER
5 LAYERS
MOLD SIZE: 4" DIAM 1.59" HIGH

MAX DRY DENSITY: 95.9 pcf

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS

BY  B.T.  DATE  3-15-69
MOISTURE-DENSITY CURVE (AASHO T-180-57, METHOD A)

PROJECT: WAIAU SUBDIVISION UNIT-I
LOCATION: WAIAU, EWA, OAHU, HAWAII
SAMPLE NO: 43-A (1'-2')
SAMPLE DESCRIPTION: REDDISH BROWN CLAYEY Silt (ML)

10" RAMMER
15" DROP
45 BLOWS PER LAYER
5 LAYERS
MOLD SIZE
DIAMETER: 4"
HEIGHT: 4.59"

ZERO AIR VOIDS CURVE
SPECIFIC GRAVITY: 2.89

MAX. DRY DENSITY: 103.5 P.C.F.
OPTIMUM MOISTURE CONTENT: 4%
MOISTURE-DENSITY CURVE (AASHO T-180-57, METHOD A)

PROJECT: WAIKU SUBDIVISION UNIT-1
LOCATION: WAIKU, EWA, OAHU, HAWAII
SAMPLE NO: 48-2 (1'-2')
SAMPLE DESCRIPTION: REDDISH BROWN CLAYEY SILT (ML)

MAXIMUM DRY DENSITY - 101.5 SCP

OPTIMUM MOISTURE CONTENT - 25.16

ZERO AIR VOID CURVE
SPECIFIC GRAVITY - 2.88

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS

BY AF DATE 3-4-69
GENERAL TESTING METHODS

EXPLORATORY BORINGS AND SAMPLING

Method for soil investigation and sampling by auger borings (Tentative)

Method for thin wall tube sampling of soils (Tentative)

Method for penetration test and split barrel sampling of soils (Tentative)

ASTM Designation: D 1452-63T

ASTM Designation: D 1587-63T

ASTM Designation: D 1586-64T

LABORATORY TESTING

Grading Analysis

Sieve analysis of fine and coarse aggregates

Amount of material finer than No. 200 sieve in aggregate

Atterberg Limits

Determining the liquid limit of soils
Modified as follows: Substitute Casagrande grooving tool. Tests conducted from natural moisture content unless noted otherwise.

Determining the plastic limit of soils

Calculating the plasticity index of soils

Specific Gravity

Specific gravity of soils
Modified as follows: 500 ML Pycnometer

Expansion and CBR Tests

Expansion test and California Bearing Ratio (CBR)

Compaction Test

Moisture-Density relations of soils using a 10# rammer and an 18" drop

Unified Soil Classification

AASHO Designation: T 27-60

AASHO Designation: T 11-60

AASHO Designation: T 89-60

AASHO Designation: T 90-56

AASHO Designation: T 91-54

AASHO Designation: T 100-60

Section VIII - TM 5-530
"Materials Testing" by Headquarters, Dept. of the Army

AASHO Designation: T 180-57

Designation E-3 from "Earth Manual" by the United States Department of the Interior Bureau of Reclamation
LIMITATIONS

In general, soil formations are commonly erratic and rarely uniform or regular. The borings indicate the subsurface soil conditions encountered only at the drill holes where the borings were made. During construction, should subsurface conditions much different from those in the borings be observed, encountered, or otherwise indicated, we should be advised immediately to review or reconsider our recommendations in light of the new developments. The owner, architect, or engineer should make certain that the recommendations are incorporated into the plans and are properly carried out during construction.