WAIPAHU ESTATES SUBDIVISION UNIT II - PRELIMINARY SOIL REPORT
(for residential development)

WAIPIO, EWA, OAHU, HAWAII

TAX MAP KEY: 9-4-07: 9

To:
COMMUNITY PLANNING, INCORPORATED

By:
WALTER LUM ASSOCIATES, INCORPORATED
CIVIL, STRUCTURAL, SOILS ENGINEERS
December 26, 1969
December 26, 1969

COMMUNITY PLANNING, INC.
Suite 602, 810 Richards Street
Honolulu, Hawaii 96813

Gentlemen:

Subject: Waipahu Estates Subdivision Unit II
Preliminary Soil Report
(for residential development)
Waipio, Ewa, Oahu, Hawaii
Tax Map Key: 9-4-07: 9
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 Waipahu Estates Subdivision Unit II at Waipio, Ewa, Oahu, Hawaii.

From the field exploration and laboratory test results, it is our opinion that the site may be developed for residential housing. Houses can be supported either directly on stiff existing ground or on well constructed 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.

Ezra Koike
Professional Engineer
Hawaii No. 1450
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SCOPE OF EXPLORATION

The purpose of this exploration was to determine general soil conditions of the proposed site, Waipahu Estates Subdivision Unit II at Ewa, Oahu, Hawaii, for residential development.

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

PRELIMINARY FIELD EXPLORATION

Ten borings were made at the site. The locations of these borings and four borings made previously for Waipahu Estates Subdivision Unit I are shown on Figure 1, Boring Location Plan. Descriptions of the underlying soils encountered in the borings are shown on Boring Logs Nos. 1 thru 10. Also attached are the logs of four borings made for Waipahu Estates Subdivision Unit I.

Borings were made with 3-in. diameter augers with tungsten carbide drag bits. Soil samples were recovered with 2-in. thin wall tubes and standard split spoon samplers driven with 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; 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 and IB.

GENERAL SITE AND SOIL CONDITIONS

The project site is located along the north side of the new Waipahu Street and west of Waipahu Estates Subdivision Unit I in Waipio, Ewa, Oahu, Hawaii.

The site is presently used as a sugar cane field.

The existing ground generally slopes down toward the south at about 3 to 14 percent grades with steeper sections in localized areas along the drainage-ways and cane haul roadways.

An unlined drainage ditch sloping downward from north to south ran along the eastern boundary of the site.
From the field exploration and laboratory test results, the soils encountered in the borings may be generally described as follows:

A surface layer about 2 to 4 ft of medium to stiff, reddish-brown clayey silt or brown clay underlain by stiff to very stiff brown clay and reddish-brown clayey silt with decomposed rocks to about 11 to 26 ft, the depths drilled.

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

For more detailed descriptions of soils encountered, refer to the boring logs.

DISCUSSION AND RECOMMENDATIONS

In general, the present plan is to use cut or fill slopes of less than about 15 ft in height. The proposed grading generally indicates fills of less than about 10 ft in thickness.

In the opinion of the Soil Engineer, the on-site soils, in general, have sufficient strength to support the fills and the light residential structures proposed, provided the site is cleared, grubbed and drained and 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. Topsoil and stockpiled soils should be either (a) stripped to stiff natural ground or (b) scarified and recompacted before the placement of fills.

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

3. Where fills are proposed, the bottom and the sides of the low spots and natural drainage-ways should be stripped down to stiff natural ground or scarified and recompacted before the placement of fills.

4. Subdrain lines with laterals in a herringbone pattern should be placed along natural drainage-ways before the placement of fills. The final locations of subdrains should be determined in the field after clearing and grubbing.
5. All fills should be constructed in approximately level layers starting at the lower end and working upward. Where fills are made on sloping areas steeper than about 5 horizontal to 1 vertical, the ground at the toe of the fill should be benched to a generally level condition. As the fill is brought up, it should be continually keyed into the stiff natural ground by cutting steps into the slopes and compacting the fill into these steps.

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

Slopes
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.

If slope heights (toe to top) of greater than 15 ft are considered, 8-ft-wide benches should be placed at height intervals of about 15 ft or less in both cuts and fills.

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 with a sheepfoot roller or by cat-tracking.

Where slopes are cut thru rocky ground, all loose outcroppings should be removed. Loose pockets and hollow spots should be cleaned out and backfilled.

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

Foundations
If earthwork is carried out as specified, the stiff natural ground and well constructed fills should develop adequate bearing values to support the proposed light residential structures.

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

Recommendations for foundation construction are as follows:

1. For light residential structures, conventional type of house foundations such as slab-on-ground construction or post-and-beam construction may be used.

2. Bearing values for a given soil usually vary with the size and depth of the footings. For light residential structures, bearing values of 1500 p.s.f. on compacted fills and 2000 p.s.f. on stiff natural ground may be used.
3. Because of the downhill creep effect of soils on a slope, some settlement may occur near the tops of slopes. Therefore, for slopes of about 15 ft or higher, 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.

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

5. Good surface drainage away from the foundation of the proposed structures should be maintained.

Roadways

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 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.
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 basins which are placed in these low areas.
PROPOSED SPECIFICATION FOR EARTHWORK
WAIPAHU ESTATES SUBDIVISION UNIT II.

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 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 recompacted before the placement of fills. All topsoil encountered at finish grade shall be scarified and recompacted.

All hard surfaces along the existing access roads shall be scarified down to stiff soils and recompacted 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.

Subdrains and laterals shall be placed along the bottom and sides of natural drainageways before the construction of fills. The final locations of subdrains should be determined in the field after clearing and grubbing.
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 not less than 90% of maximum density in accordance with AASHO Test No. T-180-57 or other comparable density tests. Compaction shall be with sheepfoot 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 attainment of the desired density.

Field density tests shall be made by the Soil Engineer of the compaction of the fill. Where sheepfoot 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 reworked 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.

Unforeseen Conditions

If unforeseen or undetected soil conditions such as soft spots or seepage water are encountered during the field operations, corrective measures shall be made in the field as they are detected.

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 indicate that the moisture content and density are as previously specified.
BORING LOGS

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.
**WALTER LUM ASSOCIATES**

**Boring Log**

**PROJECT:** WAIPAHU ESTATES SUBDIVISION II  
**LOCATION:** WAIPIO, EWA, OAHU, HAWAII  
**TMK:** 9-4-07:9

**HAMMER:**  
- **Weight:** 140*  
- **Drop:** 30"  
- **Type of Boring:** AUGER (CONCONE)  
- **Diam.:** 82' T *

**SAMPLER:**  
- **2'5 - 2' THIN WALL TUBE**  
- **2'65 - 2' STANDARD SPLIT SPOON**

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**Penetration Data**

<table>
<thead>
<tr>
<th>Type of Boring</th>
<th>Blows Per Foot</th>
<th>Blows/0.5'</th>
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<td>STANARD PENETRATION TEST</td>
<td>2&quot; O.D. THIN WALL TUBE SAMPLER</td>
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**Penetration Data**

<table>
<thead>
<tr>
<th>Sample No.</th>
<th>Wet Bulk P.C.F.</th>
<th>Wet Bulk Cont.</th>
<th>Dry Bulk P.C.F.</th>
<th>Unconfined Comp.</th>
<th>P.S.F.</th>
<th>S.F.</th>
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<td>20</td>
<td>600</td>
<td>800</td>
<td>830</td>
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<td>I-B</td>
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<td>71</td>
<td>78</td>
<td>800</td>
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<td>800</td>
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<td>I-E</td>
<td>20</td>
<td>75</td>
<td>80</td>
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**Description**

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<th>E.L.E.V. = 82' T*</th>
<th>Sample No.</th>
<th>Depth (Ft.)</th>
<th>Sampler</th>
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<td>I-A</td>
<td>20</td>
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<td>CL: ML VERY STIFF BROWN CLAY</td>
<td>2'5</td>
<td>I-B</td>
<td>18</td>
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<tr>
<td>CH STIFF TO VERY STIFF, TAN-GRAY CLAY</td>
<td>2'66</td>
<td>I-C</td>
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<td>MH VERY STIFF BROWN SILTY CLAY</td>
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<td>I-D</td>
<td>31</td>
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<td>2'66</td>
<td>I-E</td>
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**Elevation Estimated From Topo Map.**
Boring Log

PROJECT: WAIPAHU ESTATES SUBDIVISION-2

LOCATION: MAKIP, EWA, OAHU, HAWAII

TMK: 9-4-07:9

HAMMER: WEIGHT: 140*

DROP: 30"

2" 6 - 2" D.P. THIN WALL TUBE

2" 66 - 2" STANDARD SPLIT SPOON

**ELEVATION ESTIMATED FROM TOPO MAP.**

<table>
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<tr>
<th>United Classification</th>
<th>DESCRIPTION</th>
<th>ELEV. = 89' *</th>
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<tr>
<td>CL</td>
<td>MEDIUM TO STIFF BROWN, CLAYEY SILT</td>
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<tr>
<td>(ML)</td>
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<tr>
<td>(ML)</td>
<td>VERY STIFF, BROWN CLAYEY SILT W/ TRACES OF DECOMPOSED ROCK</td>
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<td>END OF BORING @ 21'</td>
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**PENETRATION DATA**

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<tr>
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<td>5/5: 8/5</td>
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</tr>
<tr>
<td></td>
<td>4/5: 6/5</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>40'</td>
</tr>
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<td>40'</td>
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**STANDARD PENETRATION TEST**

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**VARIATION**

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<tr>
<td></td>
<td>49/5'</td>
<td>45/5'</td>
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<tr>
<td></td>
<td>30/5'</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>30/5'</td>
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**Boring Log**

**PROJECT**  
WAIPAHU ESTATES SUBDIVISION- II

**LOCATION**  
WAIPAHU, EWA, OAHU, HAWAII

**HMMER:**  

<table>
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<th>Weight</th>
<th>Drop</th>
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<td>140#</td>
<td>30&quot;</td>
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**SAMPLER:**  

- 2" S - 2" O.D. THIN WALL TUBE
- 2" S - 2" STANDARD SPLIT SPOON

**ELEV. NO.**  
76'±*

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<tr>
<td>0</td>
<td>2.5</td>
<td>3-A</td>
<td>105</td>
<td>22</td>
<td>81</td>
<td>8/5'</td>
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<td>5</td>
<td>2.5</td>
<td>3-B</td>
<td>112</td>
<td>29</td>
<td>87</td>
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<td>10</td>
<td>2.5</td>
<td>3-C</td>
<td>98</td>
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<td>15</td>
<td>2.5</td>
<td>3-D</td>
<td>97</td>
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<td>3-E</td>
<td>94</td>
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<td>55</td>
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<td>25</td>
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<td>3-F</td>
<td>92</td>
<td>-</td>
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**END OF BORING @ 21'**

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*ELEVATION ESTIMATED FROM TOPO MAP.*
Boring Log

PROJECT: WAIPAHU ESTATES SUBDIVISION-II
LOCATION: WAIPIO, EWA, OAHU, HAWAII
TMK: 9-4-07: 9

HAMMER:
Weight: 140*
Drop: 30"

SAMPLER:
2" Ø - 2" O.D. THIN WALL TUBE
2" Ø - 2" STANDARD SPLIT SPOON

BORING NO. A
Driller: WALTER LUM ASSOC.
Date: NOV. 21, 1969
Field Party: MAEGISHI, LUNING, HASHIDA

Type of Boring: AUGER (MOBILE)
Diam.: 3"
Datum: 73± *

ELEVATION ESTIMATED FROM TOPO MAP
Boring Log

**PROJECT:** WAIPAHU ESTATES SUBDIVISION-II  
**LOCATION:** WAIPIO, EWA, OAHU, HAWAII  
**TMK:** 9-4-07:9

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

**SAMPLER:**
- 2" S - 2" O.D. THIN WALL TUBE
- 2" SS - 2" STANDARD SPLI SPOON

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**ELEVATION ESTIMATED FROM TOPO MAP**

**BORING NO.: 5**  
**Sheets:** of **1**  
**Driller:** WAIPAHU ASSOCIATES  
**Date:** DEC. 2, 1969

**Field Party:** MAEGHIRO, HASHIDA  
**Type of Boring:** AUGER (MOBILE)  
**Elev.:** 83' ± *

**Drill Bit:** T.C. DRAG  
**Water Level:** N.S.F.  
**BLANK**

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<tr>
<td>CL</td>
<td>STIFF, BROWN CLAY</td>
<td>2.5</td>
<td>5-A</td>
<td>134</td>
<td>19</td>
<td>112</td>
<td>7070</td>
<td>4/5</td>
<td>4/5</td>
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<tr>
<td>(CL)</td>
<td>MEDIUM, BROWN CLAY</td>
<td>2.5</td>
<td>5-B</td>
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<td>96</td>
<td>3740</td>
<td>920</td>
<td>2/5</td>
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<td>CH</td>
<td>VERY STIFF, BROWN CLAY</td>
<td>20</td>
<td>5-C</td>
<td>27</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>23/5</td>
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<td>END OF BORING @ 21'</td>
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**ELEVATION ESTIMATED FROM TOPO MAP**

**PENETRATION DATA**

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<th>2&quot; O.D. THIN WALL TUBE</th>
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<td>4/5</td>
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<tr>
<td>30</td>
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<td>4/5</td>
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**END OF BORING @ 21'**
# Boring Log

**Project:** WAIPAHU ESTATES SUBDIVISION- II  
**Location:** WAIPIO, EWA, OAHU, HAWAII  
**TMK:** 9-4-07: 0

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

**Sampler:**  
- 2"S - 2" STANDARD SPLIT SPOON  
- 2"T - Ø "0.D. THIN WALL TUBE

**Elevation:** 01'  

## Penetration Data

<table>
<thead>
<tr>
<th>Sample</th>
<th>Depth (Ft)</th>
<th>Penetration Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0</td>
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</tr>
<tr>
<td>B</td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>1.25</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>2.5</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>2.75</td>
<td></td>
</tr>
</tbody>
</table>

**End of Boring @ 2.5**

*Elevation Estimated from Topo Map*
## Boring Log

**PROJECT:** WAIAPAHU ESTATES SUBDIVISION-II  
**LOCATION:** WAIPIO, EWA, OAHU, HAWAII  
**TMK:** 9-4-07:9  
**HAMMER:**  
- **Weight:** 14.0#  
- **Drop:** 20"  
**SAMPLER:** 2.5" - 2" O.D. THIN WALL TUBE  
2.5" - 2" STANDARD SPLIT SPOON

**BORING NO. 7**  
**Sheet No.** of  
**Driller:** WALTER LUM ASSOCIATES  
**WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931**  
**Drill Bit:** T.C. DRAG

<table>
<thead>
<tr>
<th>ELEV. = G5 '± x 2</th>
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</thead>
<tbody>
<tr>
<td><strong>DESCRIPTION</strong></td>
</tr>
<tr>
<td><strong>ELEV. = G5 '± x 2</strong></td>
</tr>
<tr>
<td><strong>CL-ML</strong></td>
</tr>
<tr>
<td><strong>CH</strong></td>
</tr>
<tr>
<td><strong>CL-HL</strong></td>
</tr>
<tr>
<td><strong>CH-MM</strong></td>
</tr>
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### PENETRATION DATA

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<td>86</td>
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<td>1200</td>
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<td>7-B</td>
<td>123</td>
<td>90</td>
<td>93</td>
<td>3070</td>
<td>1700</td>
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<td>7-C</td>
<td>98</td>
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</tr>
<tr>
<td>7-D</td>
<td>39</td>
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<tr>
<td>7-E</td>
<td>98</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**STANDARD PENETRATION TEST**  
2" O.D. THIN WALL TUBE SAMPLER  
Blows Per Foot  
0 10 20 30 40 BLOWS/0.5'

- **4" 4"**
- **5" 5"**
- **8" 8"**

*ELEVATION ESTIMATED FROM TOPO MAP*
WALTER LUM ASSOCIATES

Boring Log

PROJECT: WAIPAHU ESTATES SUBDIVISION-II
LOCATION: WAIPIO, EWA, OAHU, HAWAII
TMK: 9-4-07:9

HAMMER:
Weight
Drop

SAMPLE:
2" 8 - 2" O.D. THIN WALL TUBE
2" 38 - 2" STANDARD SPLIT SPOON

Type of Boring: AUGER (MIDGET) 3''

Elev. 72' +
Datum
Time 12-1-69

Drill Bit:
T.C. DRAG

Penetration Data
Blows Per Foot

Standard 2" O.D. Thin Wall Tube Sampler

Penetration Test
0 10 20 30 40

Sample No.
Sample Description
P.C.F. % Moist. Cont. % Dry Decay
Unconf. Comp. P.S.F. Liq. Limit P.S.E.

(CL) MEDIUM TO STIFF BROWN, CLAY

(ML) STIFF BROWN CLAYEY SILT W/ TRACES OF DECOMPOSED ROCK

(MH) VERY STIFF GRAY BROWN, CLAYEY SILT W/ DECOMPOSED ROCK

END OF BORING @ 21.5'

* ELEVATION ESTIMATED FROM TOPO MAP.
### Boring Log

**Project:** Waipahu Estates Subdivision-II  
**Location:** Waipio, Ewa, Oahu, Hawaii  
**Driller:** Walter Lum Associates  
**Date:** Nov. 26, 1969  
**Field Party:** Masahiro Hashida, Woods  
**Type of Boring:** Auger (Mobile)  
**Drill Bit:** T.C. Drag  
**Elevation:** 50'+*  
**Water Level:** Not Notified  
**Date:** 11-26-69

#### Penetration Data

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<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>Depth (ft)</strong></td>
<td>0</td>
<td>2'</td>
<td>4'</td>
<td>6'</td>
<td>8'</td>
</tr>
<tr>
<td><strong>Sample No.</strong></td>
<td>9-A</td>
<td>9-B</td>
<td>9-C</td>
<td>9-D</td>
<td>9-E</td>
</tr>
<tr>
<td><strong>Weight</strong></td>
<td>140#</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td><strong>Drop</strong></td>
<td>30'</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Sample</strong></td>
<td>2&quot; x 2&quot; O.D. Thin Wall Tube</td>
<td>2&quot; x 2&quot; Standard Split Spoon</td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>Elev.</strong></td>
<td>50'+*</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Water Level</strong></td>
<td>NOT NOTIFIED</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

#### Description

- **MH:** Stiff Brown Clayey Silt
- **MH:** Medium to Stiff Brown, Clayey Silt
- **ML:** Stiff Brown, Clayey Silt w/ Traces of Decomposed Rock

**End of Boring @ 21.5'**

*Elevation estimated from topo map.*
### Boring Log

**PROJECT:** WAIPAHU ESTATES SUBDIVISION-II  
**LOCATION:** WAIPIO, EWA, OAHU, HAWAII  
**TMK:** 9-4-07: 9  

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

**SAMPLER:**  
- 2"5 - 2" O.D. THIN WALL TUBE  
- 2"55 - 2" STANDARD SPLIT SPOON  

**BORING NO.** 10  
**Date:** NOV. 19, 1969  
**Type of Boring:** AUGER (MOBILE)  
**Date:** 11-19-69

<table>
<thead>
<tr>
<th>United States Classification</th>
<th>DESCRIPTION</th>
<th>Depth (ft.)</th>
<th>Sample No.</th>
<th>Wet Density</th>
<th>% Organic Mat.</th>
<th>% P.C.</th>
<th>Dr. Comp.</th>
<th>P.S.F.</th>
<th>L.C. Comp.</th>
<th>Penetration Test</th>
<th>Blows Per Foot</th>
<th>Blows/0.5ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>ML</td>
<td>STIFF, BROWN SILTY CLAY</td>
<td>2 1/2</td>
<td>10-A</td>
<td>116</td>
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<td>89</td>
<td>46</td>
<td>-</td>
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<tr>
<td>(ML)</td>
<td>VERY STIFF, BROWN SILTY CLAY</td>
<td>5</td>
<td>10-B</td>
<td>114</td>
<td>38</td>
<td>82</td>
<td>3120</td>
<td>-</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(MH)</td>
<td>VERY STIFF, REDDISH BROWN, CLAYEY SILT W/ TRACES OF DECOMP. ROCK</td>
<td>10</td>
<td>10-C</td>
<td>-</td>
<td>39</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>END. OF BORING @ 16.5'</td>
<td></td>
<td></td>
<td>10-D</td>
<td>-</td>
<td>47</td>
<td>-</td>
<td>-</td>
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<td>10-E</td>
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<td>36</td>
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**ELEVATION ESTIMATED FOR TOPO MAP.**
TABLE I - SUMMARY OF LABORATORY TEST RESULTS

<table>
<thead>
<tr>
<th>BORING NO.</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
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</thead>
<tbody>
<tr>
<td>SAMPLE NO.</td>
<td>C</td>
<td>C</td>
<td>A</td>
<td>C</td>
<td>C</td>
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</tr>
<tr>
<td>DEPTH BELOW SURFACE</td>
<td>10.0'-11.5'</td>
<td>10.0'-11.5'</td>
<td>10.0'-11.0'</td>
<td>10.0'-11.0'</td>
<td>10.0'-11.0'</td>
<td>10.0'-11.0'</td>
</tr>
<tr>
<td>DESCRIPTION</td>
<td>TAN-GRAY CLAY</td>
<td>BROWN CLAY W/ SAND</td>
<td>REDDISH BROWN CLAYY W/ SOME SAND</td>
<td>BROWN CLAY</td>
<td>BROWN CLAY</td>
<td></td>
</tr>
</tbody>
</table>

GRADING ANALYSIS (% Passing)

<table>
<thead>
<tr>
<th>Sieve</th>
<th>1&quot;</th>
<th>3/4&quot;</th>
<th>#4</th>
<th>#10</th>
<th>#20</th>
<th>#40</th>
<th>#100</th>
<th>#200</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>100</td>
<td>97.8</td>
<td>89.7</td>
<td>86.1</td>
<td>80.2</td>
<td>75.7</td>
<td>70.1</td>
<td>69.0</td>
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ATTERBERG LIMITS

<table>
<thead>
<tr>
<th>Air Dried or Natural</th>
<th>NATURAL</th>
<th>NATURAL</th>
<th>NATURAL</th>
<th>NATURAL</th>
<th>NATURAL</th>
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</thead>
<tbody>
<tr>
<td>Liquid Limit</td>
<td>8</td>
<td>45</td>
<td>41</td>
<td>48</td>
<td>70</td>
</tr>
<tr>
<td>Plastic Limit</td>
<td>24</td>
<td>24</td>
<td>34</td>
<td>25</td>
<td>32</td>
</tr>
<tr>
<td>Plasticity Index</td>
<td>52</td>
<td>21</td>
<td>21</td>
<td>23</td>
<td>38</td>
</tr>
</tbody>
</table>

| Dilatancy | NONE | SLOW-MED | QUICK | VERY SLOW | NONE |
| Toughness | HIGH | MEDIUM | SLIGHT | MEDIUM | HIGH |
| Dry Strength | HIGH | MEDIUM | SLIGHT | MEDIUM | HIGH |

UNIFIED SOIL CLASSIFICATION

| CH | CL | ML | CL | CH |

SPECIFIC GRAVITY

| 2.87 |

EXPANSION AND CBR TESTS

(Surcharge-51 P.S.F.)

| Molding Moisture Content, % | 18.8 |
| Molding Dry Density, P.C.F. | 108.3 |
| Swell upon saturation, % | 0.6 |
| CBR at 0.1" Penetration | 93.5 |

COMPACIION TEST

(AASHO T-180-57 Method)

| Dry to Wet or Wet to Dry | DRY TO WET |
| Max. Dry Density (P.C.F.) | 111.2 |
| Optimum Moisture (%) | 20.0 |

WAIPAHU ESTATES SUBDIVISION - II

WALTER LUM ASSOCIATES

CIVIL, STRUCTURAL, SOILS ENGINEERS
TABLE I-5 - SUMMARY OF LABORATORY TEST RESULTS

<table>
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<th>BORING NO.</th>
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<th>9</th>
<th>10</th>
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</thead>
<tbody>
<tr>
<td>DEPTH BELOW SURFACE</td>
<td></td>
<td>50-6.0'</td>
<td>20-21.5'</td>
<td>SURFACE</td>
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<tr>
<td>DESCRIPTION</td>
<td></td>
<td>BROWN CLAY</td>
<td>BROWN CLAYY Silt</td>
<td>BROWN Silt TRACES OF DECOMPOSED CLAY</td>
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<table>
<thead>
<tr>
<th>GRADING ANALYSIS (% Passing)</th>
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</thead>
<tbody>
<tr>
<td>Sieve 1&quot;</td>
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<td>$\frac{1}{2}$&quot;</td>
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<tr>
<td>#4</td>
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<th>ATTERBERG LIMITS</th>
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<tbody>
<tr>
<td>Air Dried or Natural</td>
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<tr>
<td>Liquid Limit</td>
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<td>46</td>
<td>44</td>
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<tr>
<td>Plastic Limit</td>
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<tr>
<td>Plasticity Index</td>
<td>21</td>
<td>17</td>
<td>11</td>
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</table>

| | | | |
| Dilatancy | NONE | VERY SLOW | SLOW |
| Toughness | MEDIUM HIGH | MEDIUM | MEDIUM |
| Dry Strength | MEDIUM | MEDIUM | MEDIUM |

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<tr>
<th>UNIFIED SOIL CLASSIFICATION</th>
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<td>ML</td>
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<table>
<thead>
<tr>
<th>SPECIFIC GRAVITY</th>
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<tr>
<th>EXPANSION AND CBR TESTS</th>
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</thead>
<tbody>
<tr>
<td>(Surcharge=51 P.S.F.)</td>
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<tr>
<td>Molding Moisture Content, %</td>
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<tr>
<td>Molding Dry Density, P.C.F</td>
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<td>103.5</td>
</tr>
<tr>
<td>Swell upon saturation, %</td>
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<td></td>
<td>2.3</td>
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<tr>
<td>CBR at 0.1&quot; Penetration</td>
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<td></td>
<td>30.7</td>
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<th>COMPACTION TEST</th>
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<tr>
<td>(AASHO T-180-57 Method)</td>
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</tr>
<tr>
<td>Dry to Wet or Wet to Dry</td>
<td></td>
<td></td>
<td>DRY TO WET</td>
</tr>
<tr>
<td>Max. Dry Density (P.C.F.)</td>
<td>103.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optimum Moisture (%)</td>
<td>24.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

WALTER LUM ASSOCIATES
CIVIL, STRUCTURAL, SOILS ENGINEERS
JOB: WAIPAHU ESTATES SUBDIVISION - II

LOCATION: WAPIO, EWA, OAHU, HAWAII

PLASTICITY CHART

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

PROJECT: WAIPAHU ESTATES SUBDIVISION - UNIT II
LOCATION: WAIPIO, EWA, OAHU, HAWAII
SAMPLE NO: 2 (SURFACE)
SAMPLE DESCRIPTION: BROWN CLAY WITH SAND

MAX DRY DENSITY - 111.2 P.C.F.

ZERO AIRE Voids CURVE SPECIFIC GRAVITY - 2.81

DRIY DENSITY (P.C.F.)

WATER CONTENT (%)

130
120
110
100
90
80
70
60
50
40
30
20
10
0

BY S.J. DATE 12-10-69

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

PROJECT: WAIPAHU ESTATES SUBDIVISION - UNIT II
LOCATION: WAIPIO, EWA, OAHU, HAWAII
SAMPLE NO: 10 (SURFACE)
SAMPLE DESCRIPTION: BROWN SILTY CLAY

MAXIMUM DRY DENSITY - 103.8 P.C.F.
OPTIMUM MOISTURE CONTENT - 24.96%
ZERO AIR voids CURVE
SPECIFIC GRAVITY 2.93

WATER CONTENT (%)
LOGS OF BORINGS

FROM

WAIPAHU ESTATES SUBDIVISION UNIT I
Boring Log

PROJECT: WAI'AHU ESTATES SUBDIVISION UNIT I
LOCATION: WAIPIO, EWA, OAHU, HAWAII

T.M.K. : 9-4-07 : 9

HAMMER:
Weight: 10-LB. SLEDGE HAMMER
Drop:

SAMLER: 2" STANDARD SPLI T SPOON

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<tr>
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<th></th>
<th></th>
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<tr>
<td>1-B</td>
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<tr>
<td>1-C</td>
<td>44</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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</tbody>
</table>

**ELEVATION ESTIMATED FROM TOPO MAP.**
Boring Log

PROJECT: WAIPAHU ESTATES SUBDIVISION UNIT 1
LOCATION: WAIPIO, EWA, OAHU, HAWAI'I
T.M.K.: 9-4-07: 9

HAMMER:
Weight: 10" SLEDGE HAMMER
Drop:

SAMPLER: 2" STANDARD SPLIT SPOON

ELEV. = 52' ± 2'

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>5A</td>
<td>40</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>5/15' 1/2'</td>
</tr>
<tr>
<td>5B</td>
<td>33</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>45/5'</td>
</tr>
<tr>
<td>5C</td>
<td>33</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>45/5'</td>
</tr>
</tbody>
</table>

END OF BORING @ 15.5'

*ELEVATION ESTIMATED FROM TOPO MAP
**Boring Log**

**PROJECT**: WAIPAHU ESTATES SUBDIVISION UNIT 1  
**LOCATION**: WAIPIO, EWA, OAHU, HAWAII  
**T.M.K.**: 9-4-0T; 9

<table>
<thead>
<tr>
<th>HAMMER:</th>
<th>WEIGHT</th>
<th>10 LB. SLEDGE HAMMER</th>
</tr>
</thead>
<tbody>
<tr>
<td>DROPS:</td>
<td>2&quot; STANDARD SPLIT SPOON</td>
<td></td>
</tr>
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<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>0</th>
<th>5</th>
<th>10</th>
<th>15</th>
<th>20</th>
<th>25</th>
<th>30</th>
<th>35</th>
<th>40</th>
<th>45</th>
<th>50</th>
<th>55</th>
<th>60</th>
</tr>
</thead>
<tbody>
<tr>
<td>ELEV. = 53' + 2</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>BROWN, CLAYEY SILT</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>WITH SUGAR CANE</td>
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*(1'H)*

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<tr>
<th>DESCRIPTION</th>
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<th>15</th>
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<th>30</th>
<th>35</th>
<th>40</th>
<th>45</th>
<th>50</th>
<th>55</th>
<th>60</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEDIUM, BROWN-GRAY SILTY CLAY</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

*(ML)*

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<thead>
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<th>10</th>
<th>15</th>
<th>20</th>
<th>25</th>
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<th>35</th>
<th>40</th>
<th>45</th>
<th>50</th>
<th>55</th>
<th>60</th>
</tr>
</thead>
<tbody>
<tr>
<td>STIFF, REDDISH BROWN CLAYEY SILT</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

**END OF BORING @ 11'*

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*ELEVATION ESTIMATED FROM TOPO MAP.*

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**BORING NO.**: 5A  
**Sheet No.**: of  
**Driller**: WALTER LUM ASSOC.  
**Date**: JAN. 17, 1969  
**Field Party**: P.A. MOENOA, SCHELLING  
**Type of Boring**: AUGER CHUTE BIT  
**Diam.**: 3"  
**Elev.**: 53' + 2  
**Datum**:  
**Drill Bit**: FINGER TYPE BIT  
**Water Level**: NOT NOTICED  
**Time**:  
**Date**: 1-17-69

---

**PENETRATION DATA**

<table>
<thead>
<tr>
<th>PENETRATION DATA</th>
<th>2&quot; STANDARD SPLIT SPOON W/10&quot; HAMMER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth (Ft.)</td>
<td>0 10 20 30 40</td>
</tr>
<tr>
<td>Wet Dens.</td>
<td></td>
</tr>
<tr>
<td>P.C.F.</td>
<td></td>
</tr>
<tr>
<td>Moil. Cont.</td>
<td></td>
</tr>
<tr>
<td>Dry Dens.</td>
<td></td>
</tr>
<tr>
<td>P.C.F.</td>
<td></td>
</tr>
<tr>
<td>P.S.F.</td>
<td></td>
</tr>
<tr>
<td>Visc. Shear</td>
<td></td>
</tr>
<tr>
<td>P.S.F.</td>
<td></td>
</tr>
</tbody>
</table>

---

5A-A | 42 |  |  |  |  | 7.4/4.4 |

5A-B | 37 |  |  |  |  | 17.2/24.5 |
# Boring Log

**PROJECT:** WAIPAHU ESTATES SUBDIVISION, UNIT 1

**LOCATION:** WAIPIO, EWA, OAHU, HAWAII

**T.M.K.:** 9-4-07:9

**HAMMER:**
- **Weight:** 140 lb
- **Drop:** 30" THIN WALL TUBE

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

---

### Description

|-----------|-------------|-----------|--------|--------------|-----------|-------|---------------|-------|-----------------|

**ELEVATION:**

- 52 ± 2

**End of Boring:** 16.5 ft

---

*ELEVATION ESTIMATED FROM TOPO MAP.*

---

**BORING NO.:** 12

**Driller:** WALTER LUM ASSOCIATES

**Date:** JAN. 15, 1969

**Field Party:** PA; MOENOA

**Type of Boring:** AUGER

**Datum:** 2±

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

**Water Level:** NOT NOTICED
GENERAL TESTING METHODS

EXPLORATORY BORINGS AND SAMPLING

Method for soil investigation and sampling by auger borings (Tentative)
ASTM Designation: D 1452-63T

Method for thin wall tube sampling of soils (Tentative)
ASTM Designation: D 1587-63T

Method for penetration test and split barrel sampling of soils (Tentative)
ASTM Designation: D 1586-64T

LABORATORY TESTING

Grading Analysis

Sieve analysis of fine and coarse aggregates
AASHO Designation: T 27-60

Amount of material finer than No. 200 sieve in aggregate
AASHO Designation: T 11-60

Atterberg Limits

Determining the liquid limit of soils
AASHO Designation: T 89-60

Modified as follows: Substitute Casagrande grooving tool. Tests conducted from natural moisture content unless noted otherwise.

Determining the plastic limit of soils
AASHO Designation: T 90-56

Calculating the plasticity index of soils
AASHO Designation: T 91-54

Specific Gravity

Specific gravity of soils
AASHO Designation: T 100-60

Modified as follows: 500 ML Pycnometer

Expansion and CBR Tests

Expansion test and California Bearing Ratio (CBR)

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

Compaction Test

Moisture-Density relations of soils using a 10 lb rammer and an 18" drop
AASHO Designation: T 180-57

Unified Soil Classification

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.
LEGEND

✦ BORING MADE FOR THIS REPORT
✦ BORING MADE FOR "WAIPAHU ESTATES SUBDIVISION UNIT I. PRELIMINARY SOIL REPORT" DATED FEB. 3, 1969.

FIG 1 - BORING LOCATION PLAN
WAIPAHU ESTATES SUBDIVISION-II
WAIPAHU, EWA, OAHU, HAWAII
TRK: 9-4-07, 9

WAIPAHU ASSOCIATES, INC.
3030 MAUNA AVE.

DRAWN:          CHECKED:          SCALE: 1/100
DATE: 9-4-07, 9
ELEV.: 1200 FEET
PLN.: 1969-078