HALE LUMI
PRELIMINARY SOIL REPORT

WAIPIO, EWA, OAHU, HAWAII
TAX MAP KEY: 9-4-07: POR. 19

To:
COMMUNITY PLANNING, INC.

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

JANUARY 18, 1974

MUNICIPAL REFERENCE & RECORDS CENTER
City & County of Honolulu
City Hall Annex, 525 S. King Street
Honolulu, Hawaii 96813
January 18, 1974

MR. GEORGE HOUGHTAILING
Community Planning, Inc.
700 Bishop Street, Suite 608
Honolulu, Hawaii 96813

Dear Mr. Houghtailing:

Subject: Hale Lumi
Preliminary Soil Report
(for site grading for multi-family development)
Waipio, Ewa, Oahu, Hawaii
Tax Map Key: 9-4-07: Par. 19

Transmitted herewith is our preliminary soil exploration report for site grading the proposed Hale Lumi multi-family development at Waipio, Ewa, Oahu, Hawaii.

This report includes a Boring Location Sketch, boring logs, laboratory test results, recommendations and limitations.

Respectfully submitted,

WALTER LUM ASSOCIATES, INC.

By [Signature]
Ezra Koike

CR/EK:rmf
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SCOPE OF EXPLORATION

The purpose of this exploration was to evaluate general soil conditions for site grading design for the proposed Hale Lumi multi-family development at Waipio, Ewa, Oahu, Hawaii.

This report includes field explorations, laboratory tests, general recommendations for site grading considerations and limitations.

FIELD EXPLORATION

Sixteen exploratory borings, 2 probings and 2 open pits were made at the site. The locations of these borings, probings and open pits are shown on the Boring Location Sketch. Descriptions of the underlying soils encountered are shown on the boring logs, open pit logs and probing logs.

Borings were made with 4-in. diameter augers using a carbide drag or finger type bits. Soil samples were recovered with 2-in. thin-wall tube samplers and a standard split spoon sampler driven with a 140-lb hammer falling 30 inches.
Probings were made with a 2-in. diameter blunt point attached to "A" rods driven with a 140-lb hammer falling 30 inches.

Open pits were made with an Allis-Chalmers HD-21 dozer by J. A. Thompson and Son, Inc.

LABORATORY TESTS
Laboratory tests included: natural water content and density, unconfined compression, Atterberg limit, grain-size analysis, specific gravity, AASHO T-180-73I density and CBR.

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

SOIL DESCRIPTIONS BY OTHERS
From a review of the U. S. Soil Conservation Service maps of the area, the surface soils described by others are as follows:

August 1972:

MuD, Molokai silty clay loam (ML soils),
15 to 25 percent slopes.
SOIL CLASSIFICATION SYSTEM

Soil samples were visually observed and subjected to appropriate tests in the laboratory. Based on visual observations and laboratory tests, the soil descriptions given on the boring logs are generally made in accordance with the "Unified Soil Classification System."

GENERAL SITE CONDITIONS

The proposed Hale Lumi development site is located on a terrace along the east side and below the existing Crestview Subdivision, about 4/10 mile northeast of Kamehameha Highway.

Portions of Panakauahi Gulch form the east boundary of the site. Along the east boundary, the side slopes of the gulch were noted at about 40 to 70% with variations in localized areas.

A Hawaiian Electric Company power line easement is located along the north boundary and cuts across the northeast corner.

Thru the central portion of the site, the existing ground slopes down eastward toward Panakauahi Gulch at about 10 to 15% gradients with variations in localized areas.

Along the west boundary, the existing ground slopes upward toward the existing Crestview Subdivision at about 25 to 50% gradients. Steeper slopes of about 100% were noted at the southwest corner of the site.
An existing soil fill about 5 to 7 ft in height with some miscellaneous material was noted at the site.

The site is generally covered with brush, haole koa and a few trees. Loose boulders were noted along the toe of slope along the west boundary of the site.

INTERPRETATION OF SOIL CONDITIONS

From the field exploration and laboratory test results, the soils encountered in the borings may be generally approximated as follows:

Over most of the site to be graded, stiff reddish-brown clayey silts and silty clays (MH or ML soils) with decomposed rocks and boulders.

"CH" clays were noted from about 7.5 to 18-ft depths in several borings.

Materials Noted in Existing Fill at the Site

Mostly medium to stiff, reddish-brown clayey silts and silty clays (MH soils). Some cobbles, boulders, asphalt and concrete rubble, and discarded appliances were noted in the fill.

Water was not noted in the borings during the field explorations.
Variations to the above soil conditions are to be expected. For more detailed descriptions of soils encountered in the borings, refer to the boring logs.

DISCUSSION AND RECOMMENDATIONS

In general, the present plan is to clear and grade the site for a multi-family residential development. The proposed grading is to use cuts and fills generally less than 12 ft in height and create relatively flat building sites.

The preliminary plans indicate that retaining walls are proposed for the various terraces.

Site Grading

The existing stockpiled soils in the central portion of the site should be stripped to stiff natural ground. Rubbish and unsuitable material should be removed. Select on-site material may be used in the construction of fills.

Surface vegetation and miscellaneous debris should be cleared and removed prior to site filling. Localized hard and soft pockets encountered during the site preparations should be excavated and replaced with select soils compacted in thin lifts.
Provisions to drain the site should be included during and after the completion of filling operations.

In general, the on-site soils may be used for the construction of the proposed fills. Grading work should be done as required by the Revised Ordinances of Honolulu, 1969 As Amended and as recommended below:

1. The area should be cleared and grubbed.

2. Topsoil and stockpiled soils should be stripped to stiff natural ground before the placement of fills.

3. Hard surfaces along existing haul roads should be scarified down to stiff soils and recom- pacted to match the density of the surrounding soil.

4. The bottom and sides of ditches should be stripped down to stiff natural ground or scarified and recom pacted before the placement of fills.

5. 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. If boulders are proposed to be used in the construction of fills, they should be generally placed along the toe sections of fill slopes and outside of probable building sites. Before placing any boulders, the subgrade should be stripped to stiff natural ground and shaped to drain. A transition layer of select granular material (6 in. to dust sizes) should be placed on the subgrade and the boulders placed on the select material. Earth fill may be used in the void spaces between boulders. A transition layer of select granular material should also
be placed against the boulders before any earth fills are placed against the boulders. See attached sketch, Figure 1.

7. In general, fills should be laid in 6-in. compacted layers to 90% of the maximum density determined by the AASHO T-180-73I test method. In roadway areas, the top 2 ft of fill should be compacted to 95% of the maximum density.

8. Provisions to drain the site should be included during and after the completion of filling operations.

**Slopes**

In general, cut and fill slopes of 2 horizontal to 1 vertical or flatter should be used.

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

To minimize erosion, the runoff from rainstorms should be diverted by berms or ditches away from slopes whenever practicable.
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.

Slope adjustments or other precautions may be necessary if seepage zones or expansive clay pockets are encountered in localized areas.

**Foundations**

In general, 2 and 3-story wood-frame structures are proposed in the eastern 3/4 of the site. Three concrete structures, 3 stories over ground level parking, are proposed along the toe of the slope below Crestview Subdivision in the western 1/4 of the site.

Low basement type walls are planned for some 3-story wood-frame structures and for the 4-story concrete structures. If practicable, buildings should be separated from retaining walls. Structural members, where practicable, should be designed with connections or joints that would allow some movements. Substantial well-drained walls should be considered.
In general, spread footings well-tied together or deep continuous footings may be considered for light, short-span structures. For long-span or heavy type structures, additional explorations should be made at each site for the particular structure after the site has been graded.

Where clay "CH" soils occur near finish grade, the area below the building and to about 5 ft beyond the perimeter of the building should be graded such that there is about 3 ft of selected non-expansive soils below finish grade and bottoms of footings.

General recommendations for preliminary foundation design considerations are as follows:

1. Footings should be placed on existing stiff ground or on well-compacted fill. The bottom of footings should be about 2 ft below finish grade. Minimum footing widths of about 2 ft should be considered for individual spread footings and about 18 in. for continuous wall footings.

2. To minimize effects of differential settlements, deep grade beams are recommended, particularly around the perimeter of the building.
3. Bearing values for a given soil usually vary with the size and depth of footings. For the proposed 2 to 3-story wood-frame and 4-story concrete structures, bearing values of about 3000 p.s.f. may be used for footings resting on stiff natural ground or on compacted fill.

4. Soft spots, clay "CH" soils and pockets of loose material encountered in footing excavations or below the building area should be excavated and replaced with selected on-site soils, well-graded granular material such as S4C or other approved material compacted in thin lifts.

5. The bottom of footing excavations should be recompacted before pouring concrete.

6. Because of the downhill creep effect of soils on a slope, some settlements may occur near the tops of slopes. Buildings and retaining walls should generally be placed about 15 ft or more from the tops of slopes.
7. Construction of retaining walls on slopes should generally be avoided or designed with care.

8. Good surface drainage away from the foundations of structures should be maintained and the site should be graded to prevent the ponding of water.

Retaining and Basement Type Walls

Retaining walls are planned along the entry roadway and next to parking areas in the central portion of the site.

Basement walls are planned for the Type C, 3-story, wood-frame buildings. These walls may be designed as retaining walls.

Basement walls are planned for the Type D, 4-story concrete structures. These walls may be designed as basement walls restrained at the top and bottom.

The walls should be kept as low as practicable and generally less than 8 ft high.

The excavation for walls should be made preferably after the site has been graded and compacted. Where walls occur, the
slopes should be overfilled, compacted and then excavated for retaining walls.

The bottom of walls should rest on stiff natural ground or on compacted select material. Soft or loose pockets at the bottom of wall footing excavations should be removed and replaced with well-graded granular material or low grade concrete.

To minimize the effects of ground moisture, subdrains behind and below the bottom of walls and waterproofing of the walls are recommended. Perimeter drains should be placed below the bottom of basement floor slabs to minimize seepage into the buildings.

Fairly well-graded granular material or select granular material should be used for backfilling against the wall.

Bearing values of about 3000 p.s.f. may be used for wall foundations resting on stiff natural ground or on compacted select fill. The bearing values may be somewhat increased for the toe pressures.
For lateral earth pressures, assuming select well-drained backfill, the following equivalent fluid pressures may be used:

1. 40 p.c.f. for retaining walls unrestrained at top.

2. 60 p.c.f. for basement walls restrained at top.

In addition, lateral earth pressures should be added for anticipated vehicular loads. For a sloping backfill, the lateral pressure should be increased according to the Rankine theory, or the earth pressure charts by Terzaghi & Peck, or other similar accepted theory. The center of pressure should be considered to act somewhat above the lower third of the triangular fluid pressure diagram, assuming that subdrainage and drainage of the backfill are provided.

For sliding resistance between the base and subgrade, a coefficient of friction of 0.40 may be used provided the base of the wall is well drained, and there is sufficient (2 times the base) stiff natural ground or compacted select material in front of the toe of the wall (see Figure 2).
Slab on Ground

Capillary moisture

To minimize the capillary rise of water from underlying soils, concrete slabs on ground should be placed over a base course of 4 in. of well-graded gravel less than 3/4-in. and greater than 1/4-in. in size or some form of capillary break. If practicable, the subgrade generally should be kept slightly higher than the finish grade outside the building and shaped to drain.

Expansive soils

The soils may be slightly expansive. To minimize the expansive effects, the subgrade below slabs on ground should be scarified and recompacted on the wet side of optimum and pre-wetted several days prior to pouring of concrete.

To minimize the heave or wavy surface effects at the ground floor level, non-bearing partitions, doors, cabinets, etc., should be designed with loose fits and other precautions taken to allow for some future adjustments or maintenance.
Roadways

In general, for light automobile traffic and drained subgrade conditions, an estimate of the roadway pavement thickness may be as follows:

2. Base course - 6-in. base course.
3. Subbase course - 0 in. over granular material.
   6-in. select borrow over a prepared subgrade.

Provisions should be made in the contract documents to allow for local adjustments regarding select borrow subbase and borrow requirements in the field in accordance with the design standards of the City and County of Honolulu. In fill areas, the use of select soils within the top 2 to 3 ft of the subgrade may reduce the thickness of or eliminate the need for the select borrow subbase or borrow courses.

The subgrade should 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.
Utilities

Utilities should be placed after the fills are constructed.

The bottoms of utility trenches should be daylighted for drainage and graded to drain water, particularly near the tops and toes of slopes. The backfill of trenches should be well compacted, particularly at the toes of slopes.

Utility lines should be designed with flexible joints, particularly where lines are connected to structures.

Unforeseen Conditions

Because of the variability of soil deposits, site improvements, designs and construction techniques, conditions may be encountered that cannot be foreseen with even the most exhaustive studies of site and project conditions. These unforeseen conditions should be recognized when encountered and then evaluated so that the designs or the construction methods may be modified accordingly, if necessary.

Unforeseen or undetected conditions such as soft spots, existing utility trenches, structure foundations, voids or cavities, boulders, expansive soil pockets or seepage water, etc., may occur in localized areas and will have to be adjusted and corrected in the field as they are detected.
Site Regrading

After mass grading work is done and cuts and fills are made according to the grading plans, regrading at some future date should be avoided unless done under the guidance of a soils engineer.
PROPOSED SPECIFICATION FOR EARTHWORK

HALE LUMI

General Description

This item shall consist of clearing and grubbing, preparing of land to be filled, excavating and filling of the land, spreading, compacting and testing of the fill, and subsidiary work for grading the site.

Clearing, Grubbing and Preparing Areas to be Filled

Vegetation, rubbish and miscellaneous material shall be removed and disposed of, leaving the disturbed area with a neat, debris-free appearance.

The existing fill, topsoil and stockpiled soils shall be stripped to stiff natural ground before the placement of fills. Loose surface soils encountered at finish grade shall be scarified and recompacted.

Hard surfaces of existing haul roads shall be scarified down to stiff soils and recompacted to match the density of the surrounding soil.

The bottom and sides of ditches, gullies or natural drainageways shall be stripped down to stiff natural ground before the placement of fills.

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 cutting steps into the slope and compacting the fill into these steps.

Materials

Fill material shall consist of selected on-site soils or approved borrow soils. The soils shall contain no more than a trace of organic and deleterious matter.
Borrow soils shall be select soils generally less than 6-in. maximum size, with more than 30% fines and a plasticity index generally less than 20.

Fill material placed in the top 2 ft of fills shall contain less than 30% gravel.

Placing, Spreading and Compacting Fill Material

The selected fill material shall be placed in level layers which, when compacted, is about 6 inches. Each layer shall be spread evenly and blade-mixed during the spreading to attain uniformity of material and water content within each layer.

Rocks or cobbles shall not be allowed to nest and voids between rocks shall be filled and compacted with small stones or earth.

When the water content of the fill material is well below the optimum for compacting purposes, water shall be added until the water content is near the optimum.

When the water content of the material is well above the optimum for compacting purposes, the fill material shall be aerated by blading or by other satisfactory methods until the water content is near the optimum.

After each layer has been placed, mixed and spread evenly, it shall be compacted to 90% of maximum density in accordance with AASHO Test No. T-180-73I or other comparable density tests. For fills in roadway areas, the top 2 ft of fill shall be compacted to 95% of the maximum density. 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

PS-2
specified density. Rolling shall be accomplished while the fill material is at the specified water content. The rolling of each layer shall be continuous over its entire area and the roller shall make sufficient passes to obtain the desired density.

Field density tests shall be made to get an indication 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. When these readings indicate that the density of any layer of fill or portion thereof is below the required 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.

**Boulder Fills**

If boulders are used for the construction of fills, they shall be generally placed along the toe section of slopes and outside of probable building sites. The subgrade shall be stripped to stiff natural ground, shaped to drain and a transition layer of select granular material (6 in. to dust sizes) shall be placed on it. Earth fill may be used in the void spaces between boulders. A transition layer of select granular material shall be placed against the boulder fill before construction of fills against it.
Excavation

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

Unforeseen Conditions

If unforeseen or undetected soil conditions such as soft spots, existing utility trenches, structure foundations, voids or cavities, boulders, seepage water or expansive soil pockets, etc., are encountered, corrective measures shall be made in the field as they are detected.

Rainy Weather

Fill material shall not 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 indicate that the water content and density are as previously specified.
BORING LOGS

The stratification lines shown on each of the boring logs represent the approximate boundary between soil types and the transition may be gradual.

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 limit or sieve analysis test results.
Boring Log

PROJECT: HALE LUMI
LOCATION: Waipio, Ewa, Oahu, Hawaii
Tax Map Key: 9-4-07: Por. 19

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

SAPIER: 2" STANDARD SPLIT SPOON

Hammer Bounces
- 20/0.0'
- 20/0.0'
- 25/0.5'
- 4/0.2
- 3/0.5'
- 4/0.2
- 4/0.2

Penetration Data

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<th>Vane Shear P.F.</th>
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*ELEVATION ESTIMATED FROM TOPO SURVEY BY R.M. TOWIL, CORP.
BORING NO. 2 Sheet No. __ of __
W. LUM ASSOC, INC. Date Nov. 13, 1973
Driller W. LUM ASSOC, INC. Date Nov. 13, 1973
Field Party METER, KAU, SHIGENAGA
Type of Boring AUGER (VERSA DRILL) Diam. 4"
Elev. 162' Datum __
Drill Bit T.C. DRAG

LOCATION Waipio, Ewa, Oahu, Hawaii
Tax Map Key: 9-4-07: Por. 19

PROJECT HALE LUMI

HAMMER:
Weight 140#
Drop 30"

SAMPLER: 2" STANDARD SPLIT SPOON

STIFF, MOTTED BROWN SANDY SILT & DECOMPOSED ROCK

GRAY FUKA FUKA ROCK OR BOULDER

COBBLE OR BOULDER

END OF BORING & 9'
11-13-73

*ELEVATION ESTIMATED FROM TOD SURVEY BY R.M. TOWILL, CORP.
Boring Log

PROJECT: HALE LUMI

LOCATION: Waipio, Ewa, Oahu, Hawaii

Tax Map Key: 9-4-07: Por. 19

HAMMER:

- Weight: 140 #
- Drop: 30"

SAMPLER: 2" STANDARD SPLIT SPOON

BORING NO. 3  Sheet No. of

Driller: W. LUM ASSOC., INC. Date: NOV. 13, 1973

Field Party: METER, KAU, SHIGENAGA

Type of Boring: AUGER (VERSA)

Diam.: 4"

Elev.: 172' 4" Datum: __

Drill Bit: T.C. DRAG

Water Level: NOT NOTICED

Time: __ Date: 11-13-73

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PENETRATION DATA

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*ELEVATION ESTIMATED FROM T.D. SURVEY BY R.M. FOWILL, C.G.*
# Boring Log

**PROJECT:** HALE LUMI  
**LOCATION:** Waipio, Ewa, Oahu, Hawaii  
**Tax Map Key:** 9-4-07: Por. 19

## BORING NO. 4

- **Driller:** W. LUM ASSOC. INC.  
- **Date:** NOV. 13, 1973  
- **Field Party:** MEYER, KAU, SHIGENAGA  
- **Type of Boring:** AUGER (VERA)  
- **Diam.:** 4"  
- **Elev.:** 110' + 0"  
- **Drill Bit:** T.C. DRAG  
- **Date:** 11-13-73

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

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

### PENETRATION DATA

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<thead>
<tr>
<th>Unified Soil Classification</th>
<th>DESCRIPTION</th>
<th>Depth (ft)</th>
<th>Sample No.</th>
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<th>Water Content</th>
<th>Liquid Limit</th>
<th>Unconfined Compress. P.S.I.</th>
<th>Vane Shear P.S.I.</th>
</tr>
</thead>
<tbody>
<tr>
<td>(ML)</td>
<td>Stiff, reddish brown clayey silt</td>
<td>0</td>
<td>4-A</td>
<td>19</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>(MH)</td>
<td>Stiff, mottled brown silty clay w/ decomposed rock &amp; gravel</td>
<td>5</td>
<td>4-B</td>
<td>19</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>(ML)</td>
<td>Stiff, reddish brown clayey silt</td>
<td>10</td>
<td>4-C</td>
<td>20</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>End of boring &amp; 15.9' 11-13-73</td>
<td>15</td>
<td>4-D</td>
<td>19</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

*Elevation estimated from T.D.I. survey by R.M. TOWILL, CORP.*
**Boring Log**

**PROJECT** | HALE LUMI
---|---
**LOCATION** | Waipio, Ewa, Oahu, Hawaii
**Location** | Tax Map Key: 9-4-07: Por. 19
**Hammer:** | Weight 14-0 #
| Drop 30'
**Sampler:** | 2" STANDARD SPLIT SPOON

<table>
<thead>
<tr>
<th>Unit Classification</th>
<th>Description</th>
</tr>
</thead>
</table>
| ML | STIFF, REDDISH BROWN CLAY ET SILT W/ TRACES OF ROOTS  
COBBLE OR BOULDER E' Y' DEPTH, MOVED BORING |
| MH | STIFF, REDDISH BROWN SILTY CLAY W/ TRACES OF DECOMPOSED ROCK |
| SL-CH | STIFF BROWN CLAY W/ TRACES OF DECOMPOSED ROCK  
END OF BORING @ 15.9' 11-14-73 |

**Penetration Data**

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Sample</th>
<th>Plastic Limit</th>
<th>Water Content</th>
<th>Liquid Limit</th>
<th>Unconfined Compressibility</th>
<th>Penetration Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>5-A</td>
<td>18</td>
<td>-</td>
<td>-</td>
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</tr>
<tr>
<td>5</td>
<td>5-B</td>
<td>19</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>10</td>
<td>5-C</td>
<td>18</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>15</td>
<td>5-D</td>
<td>19</td>
<td>50</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**Notes:**
- Elev. = 174.1 ± 2'
- Elevation estimated from top survey by R.M. Towill, Corp.
**Boring Log**

**PROJECT:** HALE LIMI

**LOCATION:** Waipio, Ewa, Oahu, Hawaii

**Tax Map Key:** 9-4-07: Pto. 19

**Driller:** W. LUM ASSOC, INC.  Date: NOV. 14, 1973

**Field Party:** MEYER, SHIGENAGA, KAUKU

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

**Elev.**  168' 3"  Datum:

**Drill Bit:** J.C. DRAG

**Water Level:** NOT NOTICED

**Time:**

**Date:** 11-14-73

---

**HAMMER:**

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

**SAMPLER:** 2" STANDARD SPLIT SPOON

---

<table>
<thead>
<tr>
<th>Unified Soil Classification</th>
<th>Description</th>
<th>Depth (Ft)</th>
<th>Sample No.</th>
<th>Plastic Limit</th>
<th>Water Cont.</th>
<th>Liquid Limit</th>
<th>Unconf. Comp.</th>
<th>Visc. Shear P.P.</th>
<th>PENETRATION DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>(MH)</td>
<td>STIFF, REDDISH BROWN CLAYET SILT</td>
<td>0</td>
<td>G A</td>
<td>20</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>N (Blows per foot)</td>
</tr>
<tr>
<td></td>
<td>W/ TRACES OF ROOTS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0 10 20 30 40</td>
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<tr>
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<td>STIFF, BROWN - RED SULTY CLAY</td>
<td>15</td>
<td>G C</td>
<td>19</td>
<td>-</td>
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<td>-</td>
<td>-</td>
<td>73</td>
</tr>
<tr>
<td></td>
<td>STIFF, REDDISH BROWN CLAYET SILT</td>
<td></td>
<td>G D</td>
<td>22</td>
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<tr>
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<td>HARD, MOTTLED BROWN SUEY CLAY W/ TRACES OF SAND</td>
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<td>G B</td>
<td>19</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>50%5</td>
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</tbody>
</table>

**END OF BORING @ 168' 3" 11-14-73**

---

*ELEVATION ESTIMATED FROM TUNG SURVEY BY R.M. TOWILL, C.G.*
Boring Log

PROJECT: HALE LUMI
LOCATION: Waipio, Ewa, Oahu, Hawaii

Driller: W. LUM ASSOC., INC.
Field Party: KAKU, CHOW
Date: SEPT. 12, 1973

Type of Boring: AUGER (M.O.B.)
Diam.: 4"
Elev.: 154.2'

Dust Bit: FINGER TYPE
Date: 9-12-73

Water Level: NOT NOTICED

Penetration Data

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Sample No.</th>
<th>Plastic Limit</th>
<th>Water Cont.</th>
<th>Liquid Limit</th>
<th>Unconfined Comp. P.S.F.</th>
<th>Vane Shear P.S.F.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-10</td>
<td>N (Blows per foot)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11-20</td>
<td>9/4.5</td>
<td>11.0.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.5-30</td>
<td>16/6.1</td>
<td>10/6.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10-15</td>
<td>50/4</td>
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<td></td>
</tr>
</tbody>
</table>

Note: Yw = WET DENSITY, P.A.T.
Yd = DRY DENSITY, P.A.T.

LOCATION: Tax Map Key: 9-4-07: Por. 19

HAMMER:
Weight: 140#
Drop: 30"

SAMPLER:
2" S. 2" O.D THIN WALL TUBE
2" SS. 2" STANDARD SPLIT SPOON

* ELEVATION ESTIMATED FROM TOWN SURVEY BY R.M. TROWELL, C.G.P.
Boring Log

PROJECT: HAILE LUMI
LOCATION: Waipio, Ewa, Oahu, Hawaii
Tax Map Key: 9-4-07: Por. 19

HAMMER: 12" SLEDGE HAMMER

SAMPLER: 2" O.D. THIN WALL TUBE

PIT BORING NO. 7A Sheet No. 1
Date Nov. 6, 1973
Field Party RAGUSA OMORI (W. LUM ASSOC. INC.)
Type of Boring PIT (ALLIS-CHALMERS)
Diam. 15 2 1/2" x 20 3/8".
Elev. Datum 152 1/2'
Date 11-6-73

Hammer: 1 1/2" HAMMER

Drill Bit

WATER LEVEL

Time

Date 11-6-73

UNITED SOIL CLASSIFICATION

DESCRIPTION

ELEV.: 152 1/2'

(MH)

MEDIUM, REDDISH BROWN
SILTY CLAY W/ROOTS (FILL)

(MH)

MEDIUM TO STIFF
REDDISH BROWN & BROWN
SILTY CLAY W/TRACES OF
COBBLES & Boulders (FILL)

BOTTOM OF PIT & G'1
11-6-73

PENETRATION DATA

Standard
Penetration Test

N (Blows per foot)

0 10 20 30 40


Note: WET DENSITY, P.G.

Note: DRY DENSITY, P.G.

* ELEVATION ESTIMATED FROM TOPO SURVEY BY R.M. TOWNELL, CORP.
Boring Log

PROJECT: HALE LUMI
LOCATION: Waipio, Ewa, Oahu, Hawaii

Tax Map Key: 9-4-07: Por. 19

HAMMER:
- Weight: 140#
- Drop: 90"

SAMPLER: 2" STANDARD SPLIT SPOON

---

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>0</td>
<td>CUBBLES &amp; BOULDERS</td>
</tr>
<tr>
<td>3.5</td>
<td>STIFF, REDDISH BROWN CLAYY SILT</td>
</tr>
<tr>
<td>14.7</td>
<td>HARD, BROWN SILTY CLAY W/ SOME DECOMPOSED PIKA ROCK</td>
</tr>
<tr>
<td>16.7</td>
<td>STIFF, BROWN CLAY</td>
</tr>
<tr>
<td>19.1</td>
<td>BOULDER (?)</td>
</tr>
<tr>
<td>25.0</td>
<td>END OF BORING @ 15.1'9-18-73</td>
</tr>
</tbody>
</table>

*ELEVATION ESTIMATED FROM TOTD SURVEY BY R.M. TOWILL, CORP.*
## Boring Log

**PROJECT**: HALE LUMI  
**LOCATION**: Waipio, Ewa, Oahu, Hawaii  
**Tax Map Key**: 9-4-07: Por. 19

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

### SAMPLER:
- **2” DIAM. BLUNT POINT**

### PENETRATION DATA

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Sampler</th>
<th>Sample No.</th>
<th>Plastic Limit</th>
<th>Water Cont.</th>
<th>Liquid Limit</th>
<th>Unconfined Comp.</th>
<th>P.S.F.</th>
<th>Vane Shear P.S.F.</th>
<th>N (Blows per foot)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
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<td></td>
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<td></td>
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<td></td>
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<td></td>
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<td>30</td>
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</tbody>
</table>

**END OF PENETRATION & 4.7’**  
11-16-73

---

*ELEVATION ESTIMATED FROM TOPO SURVEY BY R.M. TOWILL, CORP.*

---

**PROBING**  
**BORING NO.**: BA  
**Sheet No.**:  
**Date**: Nov. 16, 1973  
**Driller**: W. LUM ASSOC. INC.  
**Field Party**: MEYER, OMORI  
**Type of Boring**: **CONTINUOUS**  
**Diam.**: **2”**  
**Datum**: **16’2”**  
**Elev.** **16’2”**

---

**Water Level**  
**Time**: **11-16-73**  
**Date**: **11-16-73**
Boring Log

PROJECT  HALE LUMI
LOCATION  Waipio, Ewa, Oahu, Hawaii

Tax Map Key:  9-4-07: Por. 19

HAMMER:
Weight  140#
Drop  30'

SAMPLER:  2' STANDARD SPLIT SPOON

---

**UNIFIED SOIL CLASSIFICATION**

T.C.V. = 150' + 9'

**DESCRIPTION**

ML  HARD REDDISH BROWN Silty Clay w/Traces of Gravel, Roots, Wood & Decomposed Rock

MH  HARD, BROWN Silty Clay w/Traces of Decomposed Rock

CH  HARD, BROWN CLAY

Cobbles or Boulders

END OF BORING @ 16' 9-14-73

---

**PENETRATION DATA**

<table>
<thead>
<tr>
<th>Standard Penetration Test:</th>
<th>N (Blows per foot)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
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<td>20</td>
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<td></td>
<td>30</td>
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</tr>
</tbody>
</table>

---

*ELEVATION ESTIMATED FROM TITO SURVEY BY R.M. TOWILL, CORP.*
## Boring Log

**PROJECT**
- HALE LUMI

**LOCATION**
- Waipio, Ewa, Oahu, Hawaii
- Tax Map Key: 9-4-07: Por. 19

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

**SAMPLER:**
- 2" DIAM. BLUNT POINT

### Penetration Data

<table>
<thead>
<tr>
<th>Unit</th>
<th>Classification</th>
<th>Depth (ft)</th>
<th>Plastic Limit (%)</th>
<th>Water Content (%)</th>
<th>Liquid Limit (%)</th>
<th>Unconfined Compressibility (PSI)</th>
<th>Penetration Test</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>ELEV. = 154 1/2'</td>
<td>0</td>
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<tr>
<td></td>
<td></td>
<td>20</td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>30</td>
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<td>40</td>
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</tbody>
</table>

*ELEVATION ESTIMATED FROM TOP SURVEY BY R.M. TOWILL, COPY.*

**END OF PENETRATION = 10'**

**Date:** Nov. 16, 1973
## Boring Log

**PROJECT:** HALE LUMI  
**LOCATION:** Waipio, Ewa, Oahu, Hawaii  
**Tax Map Key:** 9-4-07; Poro. 19

### Hammer:
- **Weight:** 140 lbs  
- **Drop:** 20"

### Sampler:
- **2" Standard Split Spoon**

### Boring Log Data

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Sample No.</th>
<th>Plastic Limit</th>
<th>Water Cont.</th>
<th>Liquid Limit</th>
<th>Unconfined Comp.</th>
<th>P.S.F.</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>10-A</td>
<td>24</td>
<td>19</td>
<td>19</td>
<td>23</td>
<td>22</td>
</tr>
<tr>
<td>10</td>
<td>10-B</td>
<td>24</td>
<td>19</td>
<td>19</td>
<td>23</td>
<td>22</td>
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<tr>
<td>15</td>
<td>10-C</td>
<td>31</td>
<td>17</td>
<td>93</td>
<td>-</td>
<td>67</td>
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</tbody>
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**End of Boring: 15.7 ft  
Nov. 14, 1973**

### Penetration Data

<table>
<thead>
<tr>
<th>N (Blows per foot)</th>
<th>0</th>
<th>10</th>
<th>20</th>
<th>30</th>
<th>40</th>
</tr>
</thead>
</table>

**Elevation Estimated from Total Survey by R.M. Towill, Corp.**
## Boring Log

**Project:** HALE LUMI  
**Location:** Waipio, Ewa, Oahu, Hawaii  
**Tax Map Key:** 9-4-07: Por. 19

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

### Sampler
- **2" Standard Split Spoon**

### Boring Data
- **Boring No.:** 11  
- **Date:** Sept 15, 1973  
- **Hammer:** FINGER TYPE  
- **Drill Bit:** FINGER TYPE

### Penetration Data

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Sample No.</th>
<th>Plastic Limit</th>
<th>Water Cont.</th>
<th>Liquid Limit</th>
</tr>
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<tbody>
<tr>
<td>11-A</td>
<td>15</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>11-B</td>
<td>22</td>
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<td>11-C</td>
<td>21</td>
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<td>11-D</td>
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<tr>
<td>11-E</td>
<td>24</td>
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<td></td>
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</tbody>
</table>

### Description
- **Unified Soil Classification:**
  - (ML-MB) STIFF, REDDISH BROWN Silty Clay  
  - BOULDERS (3)  
  - STIFF, BROWN Silty Clay w/ traces of Sand & Gravel  
  - BOULDERS (3)  
  - FIRST ATTEMPT STOPPED AT 17.5' DEPTH; MOVED BORING 9' SOUTH.
  - HARD, REDDISH BROWN CLAY

- **Rock or Boulder:** (Drilled for 35 min. No Advancement)
  - End of Boring @ 17.5'  
  - 9-15-73

### Notes

* Elevation estimated from topographic survey by R.M. Towill, GCP.
Boring Log

PROJECT: HALE LUMI
LOCATION: Waipio, Ewa, Oahu, Hawaii

Tax Map Key: 9-4-07: Por. 19

HAMMER: 12# SLEDGE HAMMER

SAMPLER: 2" O.D. THIN WALL TUBE

---

PIT

BORING NO. 11A Sheet No. 1 of 1

Contractor J.A. THOMPSON Date NOV 4, 1973

Field Party RAGU-TA. OMORI (W. LUM ASSOCIATES, INC.)

Type of Boring OPEN ALLIS-CHAMBERS

Diam. 12' X 40'

Elevation 141'2 X Datum

Drill Bit

Water Level NOTICE

Time

Date 11-6-73

---

PENETRATION DATA

<table>
<thead>
<tr>
<th>Uniform Soil Classification</th>
<th>Description</th>
<th>Depth (Ft)</th>
<th>Sampler</th>
<th>Sample No.</th>
<th>Plastic Limit</th>
<th>Water Content</th>
<th>Liquid Limit</th>
<th>Undrained Comp.</th>
<th>P.S.F.</th>
<th>Wet Density</th>
<th>P.C.F.</th>
<th>Dry Density</th>
<th>P.C.F.</th>
<th>N (Blows per foot)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ELEV. 141'2 X</td>
<td>MEDIUM TO STIFF REDDISH BROWN SILTY CLAY W/ TRACES OF ROOTS &amp; COBBLES (FILL)</td>
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<td>11A</td>
<td>22</td>
<td>w = 0.190</td>
<td>y = 0.111</td>
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</tr>
<tr>
<td></td>
<td>BOTTOM OF PIT &amp; T' 11-6-73</td>
<td>5</td>
<td>11A</td>
<td>22</td>
<td>w = 0.90</td>
<td>y = 0.50</td>
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</tr>
</tbody>
</table>

---

NOTE

w = WET DENSITY, P.C.F.
D = DRY DENSITY, P.C.F.

---

Boring Log

PROJECT: HALE LUMI

LOCATION: Waipio, Ewa, Oahu, Hawaii

Tax Map Key: 9-4-07: Por. 19

HAMMER:
- Weight: 140#
- Drop: 50"

SAMPLER: 2" STANDARD SPLIT SPOON

PENETRATION DATA

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
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<tr>
<td>12-B</td>
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<td>12-C</td>
<td>RECOVERY</td>
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<td>12-E</td>
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ELEVATION ESTIMATED
FROM TOP SURVEY BY
R.M. TOWILL, C.P.E.

END OF BORING & 15.5'
9-15-73
Boring Log

PROJECT: HALE LUMI
LOCATION: Waipio, Ewa, Oahu, Hawaii

Tax Map Key: 9-4-07: Por. 19

HAMMER:
Weight: 140 #
Drop: 30'

SAMPLER: 2" STANDARD SPLIT SPOON

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

0 | 13-A | 10 | - | - | - | - | - | - | 51 |
5 | 13-B | 21 | - | - | - | - | - | - | 20/0.5' |
10 | 13-C | 12 | - | - | - | - | - | - | 4%/4' |
15 | 13-D | 23 | - | - | - | - | - | - | 2%/0.6' |
15 | 13-E | NO RECOVERY | - | - | - | - | - | - | HAMMER BOUNCES |

* ELEVATION ESTIMATED FROM TOPO SURVEY BY R.M. TOWILL, CORP.
Boring Log

PROJECT: HALE LUMI

LOCATION: Waipio, Ewa, Oahu, Hawaii

Tax Map Key: 9-4-07: Por. 19

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

SAMPLER: 2" STANDARD SPLIT SPOON

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<tr>
<td>ELEV. = 14' 5' 7 0</td>
<td>MOTTLED TAN BROWN DECOMPOSED ROCK (SOME CRUSHER TO SANDY SILT)</td>
<td>0 14-A</td>
<td>15</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>53</td>
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<td></td>
<td>COBBLE OR BOULDER @ 0' DEPTH (DRILLED FOR 90 MIN. NO ADVANCE.)</td>
<td>1 14-B</td>
<td>15</td>
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<td>-</td>
<td>90.4'</td>
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<td>MOVED BORING 6.5' SOUTH COBBLE OR BOULDER @ 4' DEPTH (DRILLED FOR 45 MIN. NO ADVANCE.)</td>
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<td>13</td>
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<td>40% 3'</td>
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<td>MOVED BORING 3.5 WEST COBBLE OR BOULDER @ 3.5-5.5 DEPTHS (DRILLED FOR 90 MIN.)</td>
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<td>BLUE GRAY ROCK FRAGMENTS W/SOME SANDY SILT</td>
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*ELEVATION ESTIMATED FROM TOPO SURVEY BY R.M. TOWILL, CORP.*
Boring Log

PROJECT: HALE LUMI

LOCATION: Waipio, Ewa, Oahu, Hawaii

Tax Map Key: 9-4-07: Por. 19

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

SAMPLER: 2" STANDARD SPLIT SPOON

---

LOCATION: Waipio, Ewa, Oahu, Hawaii

LOCATION: Field Party: M. M. HAMASHIGE, KAKU

LOCATION: Type of Boring: AUGER (DRILL)

LOCATION: Diameter: 4" 

LOCATION: Datum: 150' OD

LOCATION: Water Level: NS

LOCATION: Time: 11-15-73

LOCATION: Date: 11-15-73

---

LOCATION: Description:

- ELEV. = 150' 4" 3

- SERIES:
  - (MH)
    - STIFF, REDDISH BROWN CLAYEY Silt w/ TRACES OF ROOTS
  - (MH)
    - STIFF, BROWN CLAYEY Silt
      - Boulder at 7' DEPTH
      - Drill Time 10 MIN.
      - Moved 2' AWAY, Boulder at 4.5' DEPTH
      - Drill Time 10 MIN.
      - Moved 1' AWAY, Boulder at 7.5' DEPTH
      - Drill Time 10 MIN.
  - (MH)
    - STIFF, BROWN CLAYEY Silt w/ TRACES OF SAND
      - Boulder at 12' DEPTH
      - Drill Time 10 MIN.

- END OF BORING: 12'
- 11-15-73

---

LOCATION: Penetration Data

- N (Blows per foot)
  - 0
  - 10
  - 20
  - 30
  - 40
### Boring Log

**PROJECT**: HALE LUMI  
**LOCATION**: Waipio, Ewa, Oahu, Hawaii  
**Tax Map Key**: 9-4-07: Por. 19

#### HAMMER:
- **Weight**: 140 lbs
- **Drop**: 20"  

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

#### PENETRATION DATA

<table>
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<th>Penetration Data</th>
<th>Depth (ft)</th>
<th>ELEV = 154.4 X</th>
<th>Standard Penetration Test</th>
</tr>
</thead>
</table>

#### DESCRIPTION

- **MH**: Stiff, reddish brown clayey silt w/ traces of roots
- **MH**: Stiff dark brown clayey silt w/ traces of roots
- **MH**: Stiff, mottled brown silty clay w/ traces of sand  
- **MH**: Stiff, mottled tan brown clayey silt w/ decomposed rock

**Note**: Drill time 11-11-73, 20 min. Moved hole. Rock at 11-0', 19.0', 30 min.  
**Note**: End of boring & 13', 11-15-73

*Elevation estimated from top survey by R.M. Jowill, Corp.*
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<td>MOISTURE-DENSITY RELATIONS OF SOILS</td>
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<td>(AASHO T-180-73 Method)</td>
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WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS
## TABLE B - SUMMARY OF LABORATORY TEST RESULTS

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<tr>
<th>BORING NO.</th>
<th>SAMPLE NO.</th>
<th>DEPTH BELOW SURFACE</th>
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<td>REDDISH BROWN CLAYEY SILT WITRACES OF ROOTS &amp; DECOMP. ROCK &amp; WOOD</td>
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<td>4'- 10'</td>
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<td>10' - 11'</td>
<td>BROWN CLAY SILT WITRACES OF ROOTS &amp; DECOMP. ROCK &amp; WOOD</td>
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<td>11'- 11'</td>
<td>MOTTED BROWN CLAY SILT WITRACES OF ROOTS &amp; DECOMP. ROCK &amp; WOOD</td>
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### GRAIN-SIZE ANALYSIS (% Passing)

- **Sieve**
  - 1"
  - 1/2"
  - #4
  - #10
  - #20
  - #40
  - #100
  - #200

### ATTERBERG LIMITS

- **Air Dried or Natural**
  - Liquid Limit
  - Plastic Limit
  - Plasticity Index

### UNIFIED SOIL CLASSIFICATION

- **ML**

### APPARENT SPECIFIC GRAVITY

- 2.90

### CBR TESTS

- (Surcharge - 51 P.S.F.)
  - Molding Moisture, %
  - Molding Dry Density, P.C.F.
  - Swell upon saturation, %
  - CBR at 0.1" Penetration

### MOISTURE-DENSITY RELATIONS OF SOILS

- (AASHO T-180-73I Method)
  - Dry to Wet or Wet to Dry
  - Max. Dry Density (P.C.F.)
  - Optimum Moisture (%)

### REMARKS:

Date: 12-4-72  By: Walter Lum

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS
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Date 12-4-72 By K. Inouye
PLASTICITY CHART

PROJECT: HALE LUMI
LOCATION: WAI'ALI, EWA, OAHU, HAWAII

DATE 12-4-73  BY B. Takayama

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS
MOISTURE-DENSITY CURVE (AASHO T-180-78I, METHOD A)

PROJECT: HALE LUM

LOCATION: WAIPIO, EWA, OAHU, HAWAII

SAMPLE NO: 2 SURFACE

SAMPLE DESCRIPTION: BROWN CLAYEY SILT

MOISTURE SIZE: 120

WATER CONTENT (°/o)

MAX. DRY DENSITY: 96 P.C.F

OPTIMUM MOISTURE CONTENT: 27

ZERO AIR VOID CURVE

SPECIFIC GRAVITY = 2.77

AGGREGATE: 3/4" MINUS

MOLD SIZE: 4"X4"X12" HIGH

HAMMER: 10 LBS 16" DROP

LAYERS: 5

BLOWS: 25/LAYER

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

DATE 9-21-73  BY AH
MOISTURE-DENSITY CURVE (AASHO T-180-73I, METHOD A)

PROJECT: HALE LUMI

LOCATION: WAIPIO, EWA, OAHU, HAWAII

SAMPLE NO.: 5 SURFACE

SAMPLE DESCRIPTION: REDDISH-BROWN CLAYEY SILT WITH TRACES OF ROOTS

AGGREGATE: 1/4" MINUS

MOLD SIZE: 4"X4"X1" HIGH

HAMMER: 10 LBS. 16" DROP

LAYERS: 5

BLOWS: 25/LAYER

MAX. DRY DENSITY: 94 K.C.F.

OPTIMUM MOISTURE CONTENT: 24% CUM.

ZERO AIR VOIDS CURVE

SPECIFIC GRAVITY = 2.83

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

DATE 9-21-73 BY KII
MOISTURE–DENSITY CURVE (AASHO T-180–73, METHOD A)

PROJECT: HALE LUMI

LOCATION: WAIPIO, EWA, OAHU, HAWAII

SAMPLE NO.: 9 SURFACE

SAMPLE DESCRIPTION: REDDISH-BROWN CLAYEY SILT WITH traces of roots

MAX. DRY DENSITY: 106 P.C.F. SPECIFIC GRAVITY = 2.90

OPTIMUM MOISTURE CONTENT = 22.2%

ZERO AIR VOLUME CURVE

AGGREGATE: 3/4" MINUS
MOLD SIZE: 4.5 X 4.5 X 24" HIGH
HAMMER: 10 LBS., 18" DROP
LAYERS: 5
BLOWS: 25/LAYER

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

DATE 9-24-73 BY 111
MOISTURE–DENSITY CURVE (AASHO T-180–73I, METHOD A)

PROJECT: HALE LUMI

LOCATION: WAIPIO, WAIKA, OAHU, HAWAII

SAMPLE NO.: IG SURFACE

SAMPLE DESCRIPTION: REDDISH-BROWN SILTY CLAY WITRACES OF ROOTS

AGGREGATE: ¹⁄₄" MULLUS
MOLD SIZE: 4" X 4" X 5" HIGH
HAMMER: 10 LBS 16" DROP
LAYERS: 5
BLOWS: 85/LAYER

MAX DRY DENSITY: 99 RCF
SPECIFIC GRAVITY = 2.86

ZERO AIR Voids CURVE

WASHINGTON MOISTURE CONTENT = 4%
**CBR TEST**

**PROJECT:** HALE LUMI

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

**SAMPLE NO:** 2 SURFACE

**SAMPLE DESCRIPTION:** BROWN CLAYEY SILT W/NODDLE, ROCK

---

**TEST RESULTS:**

MOLDING MOISTURE, %: 24.6

MOLDING DRY DENSITY, P.C.F.: 95.8

CBR @ 0.1" PENETRATION: 12.7

DAYS SOAKED: 5

DATE 9-24-73 BY JY

DATE 9-25-73 BY NJ

---

**CBR PENETRATION DATA**

<table>
<thead>
<tr>
<th>PENETRATION (INCHES)</th>
<th>LOAD (LBS)</th>
<th>LOAD (PSI)</th>
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AGGREGATE 1/4" MAIN LINE

HAMMER WEIGHT 10 LBS

HAMMER DROP 18"

No. OF BLOWS 56/LAYER

No. OF LAYERS 5

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

PROJECT: HALE LUMI

LOCATION: WAIPIO, EWA, OAHU, HAWAII

SAMPLE NO: 5 SURFACE
SAMPLE DESCRIPTION: REDDISH-BROWN CLAYEY SILT
WITRACES OF ROOTS

CBR PENETRATION DATA

<table>
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<tr>
<th>PENETRATION (INCHES)</th>
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<th>LOAD (PSI)</th>
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AGGREGATE 1/4" MINUS
HAMMER WEIGHT 10 LBS
HAMMER DROP 18" NO. OF BLOWS 56/LAYER NO. OF LAYERS 5

TEST RESULTS:

MOLDING MOISTURE, %: 24.3
MOLDING DRY DENSITY, P.C.F.: 97.9
CBR @ 0.1" PENETRATION: 19.7
DAYS SOAKED: 4

DATE 9-24-73 BY LY
DATE 9-26-73 BY JS

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

PROJECT: HALL LUMi

LOCATION: WAIPIO, EWA, OAHU, HAWAII

SAMPLE NO: 9 SURFACE

SAMPLE DESCRIPTION: REDDISH-BROWN CLAYEY SILT WITH TRACES OF ROOTS

TEST RESULTS:

MOLDING MOISTURE, %: 23.5
MOLDING DRY DENSITY, P.C.F.: 104.0
CBR @ 0.1" PENETRATION: 28.5
DAYS SOAKED: 4

DATE 10-2-73 BY RH

DATE 10-3-73 BY JS

CBR PENETRATION DATA

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<th>PENETRATION (INCHES)</th>
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AGGREGATE 1/4" MINUS
HAMMER WEIGHT 10 LBS
HAMMER DROP 18"
NO. OF BLOWS 56/LAYER
NO. OF LAYERS 5

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

PROJECT: HALE LUMI
LOCATION: WAIPIO, OAHU, HAWAII
SAMPLE NO: 16 SURFACE
SAMPLE DESCRIPTION: REDDISH-BROWN SILTY CLAY WITH TRACES OF ROOTS

TEST RESULTS:
MOLDING MOISTURE, %: 24.8
MOLDING DRY DENSITY, P.C.F.: 99.3
CBR @ 0.1" PENETRATION: 8.0
DAYS SOAKED: 4

DATE: 9-17-73 BY RH
DATE: 9-20-73 BY N1

CBR PENETRATION DATA

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<th>PENETRATION (INCHES)</th>
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WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS
SCHEMATIC SECTION
NOT TO SCALE

FIGURE 1
SCHEMATIC SECTION - BOULDER FILL
HALE LUMI
WAIPIO, EWA, OAHU, HAWAII
TAX MAP KEY: 9-4-07: FOR. 19
FIGURE 2
SCHEMATIC SECTION - RETAINING STRUCTURES
HALE LUMI
WAIPIO, EWA, OAHU, HAWAII
TAX MAP KEY: 9-4-07: FOR. 19
LIMITATIONS

In general, soil formations are commonly erratic and rarely uniform or regular. The boring logs indicate the approximate subsurface soil conditions encountered only at the drill holes where the borings were made at the times designated on the logs and may not represent conditions at other locations or at other dates. Soil conditions and water levels may change with the passage of time and construction methods or improvements at the site.

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.

If there is a substantial lapse of time between the submission of this report and the start of work at the site, or if conditions have changed due to natural causes, plan changes, or construction operations at or adjacent to the site, it is recommended that this report be reviewed to determine the applicability of the recommendations considering the time lapse, changed conditions, and changes in the state of the art of soil engineering.

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