RECREATION AREA
(NEWTOWN DEVELOPMENT)
PRELIMINARY SOIL REPORT

WAIMALU, EWA, OAHU, HAWAII
TAX MAP KEY: 9-8-02: POR. 9

To:
COMMUNITY PLANNING, INC.

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS
MARCH 25, 1974
MR. GEORGE HOUGHTAILING  
Community Planning, Inc.  
700 Bishop Street, Suite 608  
Honolulu, Hawaii 96813

Gentlemen:

Subject: Recreation Area  
(Newtown Development)  
Preliminary Soil Report  
(for site grading design for recreational development)  
Waimalu, Ewa, Oahu, Hawaii  
Tax Map Key: 9-8-02: Por. 9

Transmitted herewith is a preliminary soil report for site grading design considerations at the site of the Recreation Area (Newtown Development) at Waimalu, 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 Ezra Koike  
Ezra Koike

CR/EK:rmf
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RECREATION AREA
(NEWTOWN DEVELOPMENT)
PRELIMINARY SOIL REPORT

WAIMALU. EWA. OAHU, HAWAII
TAX MAP KEY: 9-8-02: POR. 9

SCOPE OF EXPLORATION

The purpose of this exploration was to evaluate general soil conditions for site grading design considerations for the proposed Recreation Area (Newtown Development) Waimalu, Ewa, Oahu, Hawaii.

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

FIELD EXPLORATION

Nine exploratory borings were made at the site. Descriptions of the underlying soils encountered are shown on Boring Logs Nos. 1 thru 9. The approximate locations of these borings are shown on the Boring Location Sketch.

The borings were made with 4-in. diameter augers using a carbide drag bit. Soil samples were recovered with 2-in. o.d. thin-wall tube samplers and a standard split spoon sampler driven with a 140-lb hammer falling 30 inches. Rock samples were recovered with an "AX" double tube core barrel using a carbide coring bit.
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 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."

SOIL DESCRIPTIONS BY OTHERS
From a review of geologic and soil maps of the area, the soils described by others are as follows:

Stearns, "Geologic and Topographic Map, Island of Oahu, USGA, 1938":
Tkb - Koolau volcanic series

MpE - Manana silty clay, 25 to 40 percent slopes
Unified Soil Classification - MH;
shrink-swell potential, moderate
GENERAL SITE CONDITIONS

Site Location
The proposed recreational site is part of the Newtown Development. The site is located about 2/10 mile northeast of the intersection of Komo Mai Drive and Kaahele Street (under construction).

Annual Rainfall
The average annual rainfall varies from about 40 to 50 inches.

Topography
The proposed recreational site is an existing gully. The bottom of the gully slopes downward towards the west at about 10 to 30% gradients with localized variations. The existing side slopes generally vary from about 15 to 35% gradients with localized variations.

The site is an abandoned sugarcane field. Irrigation ditches cross 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:

Surface layers of stiff reddish-brown silty clays (MH) and some clays (CH) with decomposed rock, cobbles and boulders.
Water was not noted in the borings during the field explorations.

Variations to the above soil conditions are to be expected in localized areas. 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 future recreational development. The preliminary plans generally indicate fills of up to about 30 to 50 ft in height in localized sections.

Because of the heights of fills contemplated, the grading design should consider care in the site preparation and construction of fills.

After clearing and grubbing, the bottoms and sides of the gully should be stripped of loose soils before the placement of fills.

Subdrains should be placed along the bottoms and sides of the gully in a herringbone pattern and the outlet daylighted well beyond the toe of the slope.

New fills should be keyed into stiff natural ground.

The fill at the low side of the gully should be constructed with a rock buttress, if practicable. The area under the outer portion of the slope
should be stripped down to stiff soils and to a fairly level condition. A blanket of fairly well-graded granular material should be placed on the bottom and a boulder fill constructed on it.

Settlement gages should be installed and periodic level readings taken to monitor the performance of the fills over the existing gully.

**Site Grading**

Selected on-site or approved off-site borrow soils may be considered for the fill construction.

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.
   
   Surface vegetation, rubbish, debris and abandoned structures should generally be cleared and removed prior to site filling.

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

3. Soft spots or "CH" clay pockets encountered during site preparation should be excavated and replaced with select material compacted in thin lifts.
4. Hard surfaces in localized areas should be scarified down to stiff soils and recompacted to match the density of the surrounding soil.

5. Loose surface soils along the bottoms and sides of the existing gully should be stripped down to stiff natural ground.

6. Trenches should be cut in a herringbone pattern along the bottoms and sides of the gully before the placement of fills. Subdrains should be placed in the trenches. The locations of subdrains should be determined in the field after clearing and grubbing.

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

8. 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 continually be keyed into the stiff natural ground by cutting steps into the slopes and compacting the fill into these steps.

9. If boulders are proposed to be used in the construction of fills, they should be generally placed along the toe section of the fill slope. 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. A transition layer of select granular material should also be placed against the boulders before earth fills are placed against the boulders. Earth fill may be used in void spaces between boulders. See attached sketch, Figure 1.

10. Fills should be laid in 6-in. compacted layers to 90% of the maximum density determined by the AASHO T-180-73I test method.
11. Provisions to drain the site should be included during and after the completion of filling operations.

Slopes

In general, for localized areas, fill slopes of 2 horizontal to 1 vertical or flatter should be used for heights of 15 ft or less.

For the buttress fill at the toe of the gully, a 3 to 1 slope with subdrains is recommended.

For the longitudinal slope up the gully, the average slope of the surface should be limited to about 5 to 1.

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

Where flatter slopes of about 4 horizontal to 1 vertical and flatter are designed, deletion of benches may be considered on an individual basis.

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. In general, when clay pockets are encountered in slopes, they should be removed and replaced with selected on-site or borrow soils compacted in thin lifts.

**Foundations**

In general, light recreational structures may be constructed on the compacted fill.

To minimize the possibility of undetected soft spots and other unforeseen conditions, should structures be planned at a later date, additional soil explorations should be considered on an individual basis at each building site.

In general, construction of buildings on fills over gullies should be delayed as long as practicable to allow the fills and surrounding ground to adjust to the new load environment.
Settlement observations should be considered to get an indication of the performance of the fills and to get an indication when movements may be within the tolerances for the structures planned.

Utilities
Utilities should be placed after the fills are constructed. Utility lines should be designed with flexible joints, particularly where lines are connected to structures.

Subdrains or filter material should be placed at the bottoms of trenches to provide drainage paths that daylight at low points.

To minimize erosion on the slope, drainage outlets should be placed well beyond the toe of slope.

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 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, old tunnels, 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

RECREATION AREA (NEWTOWN DEVELOPMENT)

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.

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 bottoms and sides of gullies or natural drainageways shall be stripped down to stiff natural ground before the placement of fills.

Trenches shall be cut in a herringbone pattern and subdrains placed in the trenches to provide drainage paths for the bottoms and sides of natural drainageways or dips 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 slopes 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, shall not exceed 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. Compaction shall be with sheepsfoot rollers, multiple-wheel pneumatic-tired rollers or other acceptable rollers which shall be able to compact the fill to the specified density. Rolling shall be accomplished while the fill material is at the specified water content. The rolling of each layer shall be continuous over the 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 a 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. The boulders shall be placed on the select granular material. A transition layer of select granular material shall be placed against the boulders before construction of earth fills against the boulders. Earth fill may be used in the void spaces between boulders.

**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, old tunnels, 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

**RECREATION AREA**

**PROJECT** (NEWTOWN DEVELOPMENT)

**LOCATION** Waimalu, Ewa, Oahu, Hawaii

**Tax Map Key:** 9-8-02: Por. 9

---

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

**SAMPER:**
- **2'' 5'' O.D. THIN WALL TUBE**
- **2'' 45- 3'' STANDARD SPLIT SPOON**

**BOERING NO.** 1

**Driller** KAKU, KAU

**Field Party** WALTER LUM ASSOC. INC.

**Date** MAR. 7, '74

**Type of Boring** AUGER (VERSA)

**Diam.** 4''

**Datum**

**Elev.**

**Date**

**Water Level**

**Time**

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**DESCRIPTION**

- **STIFF, REDDISH BROWN SITY CLAY**
- **STIFF, REDDISH BROWN W/ TRACES OF GRAY SITY CLAY**
- **STIFF, MOTTLED BROWN SITY CLAY**
- **STIFF, MOTTLED GRAY W/ RED SITY CLAY**
- **LIGHT GRAY W/ MOTTLED BROWN CLAYET SILT**
- **STIFF, MOTTLED BROWN W/ LIGHT GRAY CLAYET SILT W/ DECOMPOSED ROCK**
- **DENSE MOTTLED GRAY DECOMPOSED ROCK W/ SITY SAND**

**END OF BORING & DEBT? 3-20-74**

---

*Elev. Estimated from Grading Plan by Community Planning, Inc. Dated 1/11/74*
**Boring Log**

**RECREATION AREA**

**PROJECT (NEWTOWN DEVELOPMENT)**

**LOCATION**
Waimalu, Ewa, Oahu, Hawaii

**Tax Map Key:** 9-8-02: Por. 9

**HAMMER:**

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

**SAMPLER:**

- 2" 5 - 2" O.D. THIN WALL TUBE
- 2" 6 5 - 2" STANDARD SPLIT SPOON

---

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**Elev. Estimated from Grading Plan by Community Planning, Inc. Dated 1/11/74**
**Boring Log**

**RECREATION AREA**

**PROJECT** (NEWTOWN DEVELOPMENT)

**LOCATION** Waimalu, Ewa, Oahu, Hawaii

**Tax Map Key:** 9-8-02; Por. 9

---

**HAMMER:**

- **Weight:** 140 *
- **Drop:** 30°

**SAMPLER:**

- **2" 3. 2" O.D. THIN WALL TUBE**
  - **2" 44. 2" STANDARD SPLIT SPOON**

---

**Penetration Data**

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**Notes:**

- **End of Boring & 27' 2.25:74**

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*Elev. Estimated from Grading Plan by Community Planning, Inc. Dated 1/11/74*
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*Elev. Estimated from Grading Plan by Community Planning, Inc. Dated 1/11/74
**Boring Log**

**PROJECT** (NEWTON DEVELOPMENT)

**LOCATION** Waimalu, Ewa, Oahu, Hawaii

**Tax Map Key:** 9-8-02: Per. 9

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

**SAMPLER:** 2" STANDARD SPLIT SPOON

---

**LOCATION**

**Waimalu, Ewa, Oahu, Hawaii**

---

**UNITED STATES**

**CLASSIFICATION**

**DRILL RATE**

**DEEP**

**DESCRIPTION**

- **BASE**
  - 350' 2' *
  - **STIFF MOTTLED REDDISH BROWN SILTY CLAY WITRACES OF DECOMPOSED ROCK**
  - **DECOMPOSED COBBLE OR BOULDER?**
  - **STIFF MOTTLED REDDISH BROWN SILTY CLAY WITRACES OF DECOMPOSED ROCK**
  - **GRAY BROWN DECOMPOSED PIURA PIURA ROCK**
  - **BLUE PIURA PIURA ROCK**
  - **END OF BORING E 15.6' 3.9.74**

---

**PENETRATION DATA**

<table>
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---

**ELEVATION**

**Estimated from Grading Plan by Community Planning, Inc. Dated 1/11/74**
Boring Log

RECREATION AREA
(NEWTOWN DEVELOPMENT)

PROJECT

LOCATION
Waimalu, Ewa, Oahu, Hawaii

Tax Map Key: 9-8-02; Port. 9

HAMMER:
Weight 140 lbs
Drop 30"

"AX" - AX DOUBLE TUBE CORE BARREL
2" 6S - 2" STANDARD SPLIT SPOON

NOTE: SEE BORING 5. MOVED HOLE 5' AWAY ANDERED 0 TO 6'.

BOULDER OR LAVA ROCK

REDDISH BROWN CLINKER?

BOULDER OR LAVA ROCK

CLINKER?

REDDISH BROWN CLAY/SILT

BROWN PUKA PUKA ROCK

END OF BORING @ 25.1'
3 - 14 - 74

*Elev. Estimated from Grading Plan by Community Planning, Inc.
Dated 1/11/74
<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Description</th>
<th>Sample No.</th>
<th>Wet Dens. Pcf</th>
<th>Water Cont.</th>
<th>Dry Dens. Pcf</th>
<th>Unit Comp.</th>
<th>Penetration Test</th>
<th>N (Blows per foot)</th>
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</thead>
<tbody>
<tr>
<td>0</td>
<td>STIFF MOTTLED REDDISH BROWN GLAYET SILT &amp; DECOMPOSED ROCK</td>
<td>G-A</td>
<td>45</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<td>10/0.3</td>
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<td>2.5</td>
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<td>G-B</td>
<td>14</td>
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<td>4%</td>
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<td>2.56</td>
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<td></td>
<td>4%</td>
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<td>MOTTLED REDDISH BROWN GLAYET SILT &amp; DECOMPOSED ROCK</td>
<td>G-E</td>
<td>ROCK FRAGMENT</td>
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<td>4%</td>
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<td>DENSE, MOTTLED BROWN SILT &amp; DECOMPOSED ROCK</td>
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<td>15/6.5</td>
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<td>4.0</td>
<td>END OF BORING &amp; 40' 9-9-74</td>
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*Elev. Estimated from Grading Plan by Community Planning, Inc.
*Dated 1/11/74
### Boring Log

**Recreation Area**  
(NeWTOWN DEVELOPMENT)  

**Location**  
Waimalu, Ewa, Oahu, Hawaii  
Tax Map Key: 9-8-02: Por. 9

**Hammer:**  
- Weight: 120#  
- Drop: 50'-2"  
- Type: 2-3/4" OD TIN WALL TUBE  
- Sampler: 5/8" - 1/2" STANDARD SPLIT SPOON

**Description**

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
<th>Sample No.</th>
<th>Water Cont.</th>
<th>Blows per foot</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Stiff, mottled reddish brown silty clay w/decomposed rock</td>
<td>T-A</td>
<td>39</td>
<td>10 20 30 40</td>
</tr>
</tbody>
</table>
| 5     | Stiff, brown & gray silty clay w/puka puka rock  
  Cobbles or Boulder | T-B | 11 88 90 | 510 |
| 10    | Stiff, mottled brown silty clay w/decomposed rock | T-C | 47 | 25 30 35 |
| 15    | Stiff, brown clay | T-D | 31 | - |
| 20    | Stiff, mottled brown silty clay w/sand | T-E | 11 89 90 | 650 |
| 25    | Motled brown decomposed rock w/silty sand | T-F | 34 | - |
| 30    | Stiff, mottled reddish brown clay w/sand | T-G | 40 80 | - |
| 35    | Motled gray decomposed rock | T-H | 94 | - |
| 40    | End of boring & 40' 2-21-74 | T-I | 35 | - |

**Notes:**  
- Elev. Estimated from Grading Plan by Community Planning, Inc.  
- Dated 1/1/74

**Penetration Data**

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Blows per foot</th>
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<tr>
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<td>10 20 30 40</td>
</tr>
<tr>
<td>5</td>
<td>510</td>
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<tr>
<td>10</td>
<td>650</td>
</tr>
<tr>
<td>20</td>
<td>510</td>
</tr>
<tr>
<td>25</td>
<td>25 30 35</td>
</tr>
<tr>
<td>30</td>
<td>94</td>
</tr>
<tr>
<td>35</td>
<td>-</td>
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<tr>
<td>40</td>
<td>41/5</td>
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</tbody>
</table>

**Diagram:**  
- Standard penetration test (SPT) @ 10, 20, 30, 40 ft
- Note: LL = Liquid Limit  
  PL = Plastic Limit

**Driller:**  
- W. Lum Assoc., Inc.

**Date:**  
- Feb. 20 - 21, 1974

**Type of Boring:**  
- Auger (versa)  
- Diam. 4"
Boring Log

LOCATION: Waimalu, Ewa, Oahu, Hawaii

Tax Map Key: 9-8-02: Port. 9

HAMMER:
Weight: 140 lbs
Drop: 30"

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

LOCATION: Waimalu, Ewa, Oahu, Hawaii

Driller: KAKU SHIGENAGA
Type of Boring: AUGER (VERA) Diam.: 4"

Elev. Datum: 375' +/ -

WATER LEVEL:

PERCUTION DATA

UNITED STATES

ELEV. = 375' +/ -

Penetration Test

Water Level:

Penetration Data

N (Blows per foot)

0 10 20 30 40 Blows/0.5'

END OF BORING @ 25.3'
2-22-74

*Elev. Estimated from Grading Plan by Community Planning, Inc.
Dated 1/17/74
### Boring Log

**LOCATION**: Waimalu, Ewa, Oahu, Hawaii

**Project**: NEWTOWN DEVELOPMENT

**Tax Map Key**: 9-8-02; Port. 9

**Boring No.**: 9

**Driller**: W. LUM ASSOCIATES, INC.

**Datum**: 426' +

**Field Party**: KAKU, CHOW, SHIGENAGA

**Elev.**: 426'

**Type of Boring**: VERSA DRILL

**Diam.**: 4'

**Datum**: 426' +

**Drill Bit**: T.E. DRAG

**Time**: 

**Date**: 2-20-74

---

#### Penetration Data

<table>
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<tr>
<th>Depth (ft.)</th>
<th>Sample No.</th>
<th>Wet Density (p.c.f.)</th>
<th>Water Content %</th>
<th>Dry Density (p.c.f.)</th>
<th>Unconf. Comp. %</th>
<th>Unconf. P.C.</th>
<th>Penetration Test</th>
<th>2&quot; O.D. THIN WALL TUBE SAMPLER</th>
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<td>9-A</td>
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<td>2.55</td>
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<td>2.55</td>
<td>9-C</td>
<td>111</td>
<td>47</td>
<td>15</td>
<td>8110</td>
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<td>N (Blows per foot)</td>
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<tr>
<td>2.55</td>
<td>9-F</td>
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<td>-</td>
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<td>-</td>
</tr>
<tr>
<td>2.55</td>
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</table>

**Note**: LL = LIQUID LIMIT, PL = PLASTIC LIMIT

---

*Elev. Estimated from Grading Plan by Community Planning, Inc.

Dated 1/11/74
## TABLE I A - SUMMARY OF LABORATORY TEST RESULTS

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<th>BORING NO.</th>
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<th>3</th>
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<td>9'-11.5'</td>
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<td>MOTTL ED</td>
<td>MOTTL ED</td>
<td>MOTTL ED</td>
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<td>DESCRIPTION</td>
<td>REDDISH-BROWN</td>
<td>REDDISH-BROWN</td>
<td>BROWN</td>
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<tr>
<td>GRAIN-SIZE ANALYSIS</td>
<td>SILTY CLAY</td>
<td>SILTY CLAY</td>
<td>WIT TRESSES OF DECOMP. ROCK</td>
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<tr>
<td>(% Passing)</td>
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<td>Sieve</td>
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</tbody>
</table>

### ATTERBERG LIMITS

- **Air Dried or Natural**
  - Liquid Limit: 64
  - Plastic Limit: 34
  - Plasticity Index: 30

- **Dilatancy**
  - Molding: MEDIUM
  - Toughness: MEDIUM

- **Dry Strength**
  - Molding Dry Density, P.C.F.: 67.8
  - Swell upon saturation, %: 6.3
  - CBR at 0.1" Penetration: 8.5

### UNIFIED SOIL CLASSIFICATION

- MH

### APPARENT SPECIFIC GRAVITY

- CBR TEST
  - (Surcharge-51 P.S.F.)
  - Molding Moisture, %: 29.3
  - Molding Dry Density, P.C.F.: 67.8
  - Swell upon saturation, %: 6.3
  - CBR at 0.1" Penetration: 8.5

### 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**: 2-23-70  
**By**: 

WALTER LUM ASSOCIATES, INC.  
CIVIL, STRUCTURAL, SOILS ENGINEERS
### TABLE 1.B - SUMMARY OF LABORATORY TEST RESULTS

<table>
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<tr>
<th>SAMPLE NO.</th>
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<tbody>
<tr>
<td>7</td>
<td>20'-21'</td>
<td>MOTTED BROWN &amp; GRAY CLAYEN SILT WIDE COMP. ROCK</td>
</tr>
<tr>
<td>8</td>
<td>25'-27'</td>
<td>MOTTED BROWN CLAYEN SILT WIDE COMP. ROCK</td>
</tr>
<tr>
<td>10</td>
<td>15'-16'</td>
<td>REDDISH BROWN SILTY CLAY BROWN CLAY</td>
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### GRAIN-SIZE ANALYSIS (% Passing)

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### ATTERBERG LIMITS

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<th>Natural</th>
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<tr>
<td>Air Dried or Natural Liquid Limit</td>
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<td>Plastic Limit</td>
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### DILATANCY

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<td>Dilatancy</td>
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<td>Dry Strength</td>
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### UNIFIED SOIL CLASSIFICATION

| MH | MH | MH | MH |

### APPARENT SPECIFIC GRAVITY

| 2.78 |

### CBR TEST

| Surcharge-51 P.S.F. | 32.1 |
| Molding Moisture, % |       |
| Molding Dry Density, P.C.F. | 88.8 |
| Swell upon saturation, % | 1.7 |
| CBR at 0.1" Penetration | 9.4 |

### MOISTURE-DENSITY RELATIONS OF SOILS

(AASHO T-180-73I, Method__)

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

Date: 3-12-74    By: JT

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS
**TABLE I** — SUMMARY OF LABORATORY TEST RESULTS

<table>
<thead>
<tr>
<th>BORING NO.</th>
<th>OBSERVER</th>
<th>DATE</th>
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<td>SAMPLE NO.</td>
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<tr>
<td>DEPTH BELOW SURFACE</td>
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**GRAIN-SIZE ANALYSIS**

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**ATTERBERG LIMITS**

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<th>Liquid Limit</th>
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**UNIFIED SOIL CLASSIFICATION**

| MH | MH | MH |

**APPARENT SPECIFIC GRAVITY**

| 2.75 |

**CBR TEST**

(Surcharge-51 P.S.F.)

<table>
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<th>Molding Moisture, %</th>
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<table>
<thead>
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<th>Molding Dry Density, P.C.F.</th>
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<td>86.9</td>
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<table>
<thead>
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<th>Swell upon saturation, %</th>
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<tbody>
<tr>
<td>0.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CBR at 0.1&quot; Penetration</th>
</tr>
</thead>
<tbody>
<tr>
<td>11.0</td>
</tr>
</tbody>
</table>

**MOISTURE-DENSITY RELATIONS OF SOILS**

(AASHO T-180-73I, Method___)

<table>
<thead>
<tr>
<th>Dry to Wet or Wet to Dry</th>
</tr>
</thead>
<tbody>
<tr>
<td>59</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Max. Dry Density (P.C.F.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>32</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Optimum Moisture (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

**REMARKS:**

Date 3-23-74 By P.T.
PLASTICITY CHART

PROJECT: RECREATION AREA (NEWTOWN DEVELOPMENT)
LOCATION: WAIMEA, EWA, OAHU, HAWAII

DATE ____________________ BY ____________________

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS
MOISTURE-DENSITY CURVE (AASHO T-180-73, METHOD A)

PROJECT: RECREATION AREA (NEWTOWN DEVELOPMENT)

LOCATION: WAIMALU, EWA, OAHU, HAWAII

SAMPLE NO.: 1 SURFACE

SAMPLE DESCRIPTION: REDDISH-BROWN SILTY CLAY

AGGREGATE: 1/4" MINUS

MOLD SIZE: 4" x 4.58" x 11.54" HIGH

HAMMER: 10 LBS 15" DROP

LAYERS: 5

BLOWS: 25/LAYER

DRIED TYPICAL PCF

MAXIMUM DRY DENSITY: 91 PCF

OPTIMUM MOISTURE CONTENT: 22%

ZERO AIR VOID CURVE

SPECIFIC GRAVITY: 2.78
MOISTURE-DENSITY CURVE (AASHTO T-180-78I, METHOD A)

PROJECT: RECREATION AREA (HEWITOWN DEVELOPMENT)

LOCATION: WAIMALU, EWA, OAHU, HAWAII

SAMPLE NO: 8 SURFACE

SAMPLE DESCRIPTION: REDDISH BROWN SILTY CLAY

W/ROOTS

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

DATE 3-1-74  BY N1
CBR TEST

PROJECT: RECREATION AREA (NEWTOWN DEVELOPMENT)

LOCATION: WAIMALU, EWA, OAHU, HAWAII

SAMPLE NO: 2 SURFACE

SAMPLE DESCRIPTION: MOTTLED REDDISH-BROWN Silty CLAY

TEST RESULTS:

MOLDING MOISTURE, %: 33.3
MOLDING DRY DENSITY, P.C.F.: 67.6
CBR @ 0.1" PENETRATION: 8.3
DAYS SOAKED: 4

DATE 3-4-74 BY GS

DATE 3-5-74 BY JLI
CBR TEST

PROJECT: RECREATION AREA (NEWTOWN DEVELOPMENT)

LOCATION: WAIMALU, OAHU, HAWAII

SAMPLE NO: SURFACE

SAMPLE DESCRIPTION: REDDISH-BROWN SILTY CLAY

CBR PENETRATION DATA

<table>
<thead>
<tr>
<th>PENETRATION (INCHES)</th>
<th>LOAD (LBS)</th>
<th>LOAD (PSI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.025</td>
<td>50</td>
<td>17</td>
</tr>
<tr>
<td>0.050</td>
<td>110</td>
<td>37</td>
</tr>
<tr>
<td>0.075</td>
<td>190</td>
<td>63</td>
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<tr>
<td>0.100</td>
<td>260</td>
<td>87</td>
</tr>
<tr>
<td>0.125</td>
<td>330</td>
<td>110</td>
</tr>
<tr>
<td>0.150</td>
<td>400</td>
<td>133</td>
</tr>
<tr>
<td>0.175</td>
<td>460</td>
<td>157</td>
</tr>
<tr>
<td>0.200</td>
<td>530</td>
<td>173</td>
</tr>
<tr>
<td>0.250</td>
<td>630</td>
<td>210</td>
</tr>
<tr>
<td>0.300</td>
<td>720</td>
<td>240</td>
</tr>
<tr>
<td>0.350</td>
<td>810</td>
<td>270</td>
</tr>
<tr>
<td>0.400</td>
<td>880</td>
<td>293</td>
</tr>
<tr>
<td>0.450</td>
<td>960</td>
<td>317</td>
</tr>
<tr>
<td>0.500</td>
<td>1020</td>
<td>340</td>
</tr>
</tbody>
</table>

AGGREGATE 1/4" MINUS
HAMMER WEIGHT 101.8G
HAMMER DROP 18IN
No. OF BLOWS 50/LAYER
No. OF LAYERS 5

ADJUSTED COORDINATES

TEST RESULTS:

MOLDING MOISTURE, %: 32.1
MOLDING DRY DENSITY, P.C.F.: 88.8
CBR @ 0.1" PENETRATION
DAYS SOAKED: 4

DATE 3-12-74 BY RH
DATE 3-13-74 BY JS

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

PROJECT: RECREATION AREA (NEWTOWN DEVELOPMENT)

LOCATION: WAIMALL, EWA, OAHU, HAWAII

SAMPLE NO: B SURFACE

SAMPLE DESCRIPTION: REDDISH-BROWN SILTY CLAY

W/ROOTS

TEST RESULTS:

MOLDING MOISTURE, %: 24.4
MOLDING DRY DENSITY, P.C.F.: 86.9

CBR @ 0.1" PENETRATION: 11.0

DAYS SOAKED: 4

DATE 3-4-74 BY GS

DATE 3-5-74 BY NI

WALTER LUM ASSOCIATES, INC. CIVIL, STRUCTURAL, SOILS ENGINEERS
FIGURE 1
SCHEMATIC SECTION - BOULDER FILL
RECREATION AREA (NEWTOWN DEVELOPMENT)
WAIMALU, EWA, OAHU, HAWAII
TAX MAP KEY: 9-8-02: FOR. 9
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.