To: MILILANI TOWN, INC.

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

MARCH 11, 1974

MUNICIPAL REFERENCE RECORDS CENTER
City & County of Honolulu
City Hall Annex, 111 S. King Street
Honolulu, Hawaii 96813

WITHDRAWN
March 11, 1974

MR. GENE FERGUSON  
Mililani Town, Inc.  
130 Merchant Street  
Honolulu, Hawaii 96813

Dear Mr. Ferguson:

Subject: Mililani Town Unit 29-A  
Preliminary Soil Report  
(for site grading for residential development)  
Waipio, Ewa, Oahu, Hawaii  
Tax Map Key: 9-4-05: Por. 1

Transmitted herewith is our preliminary soil report for site grading design considerations for residential development at the proposed site for Mililani Town Unit 29-A at Waipio, Ewa, Oahu, Hawaii.

The surface soils at the site may be generally approximated as stiff to hard, reddish-brown clayey silts and silty clays (MH soils) and stiff brown clayey silt with decomposed rocks.

For one-story residential structures, spread or continuous footings may be used.

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

Respectfully submitted,

WALTER LUM ASSOCIATES, INC.

By Ezra Koike

SHL/EK:rmf
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MILILANI TOWN UNIT 29-A
PRELIMINARY SOIL REPORT
WAIPIO, EWA, OAHU, HAWAII
TAX MAP KEY: 9-4-05: POR. 1

SCOPE OF EXPLORATION

The purpose of this exploration was to evaluate general soil conditions for site grading design considerations for residential development for the proposed Mililani Town Unit 29-A at Waipio, Ewa, Oahu, Hawaii.

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

FIELD EXPLORATION AND LABORATORY TESTS

Six exploratory borings were made at the site. The locations of these borings are shown on the Boring Location Sketch. Descriptions of the underlying soils encountered are shown on Boring Logs Nos. 1 thru 6.

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.

Laboratory tests included: natural water content and density, unconfined compression, Atterberg limit, specific gravity, AASHO T-180-73I density and CBR.
A summary of the laboratory test results is given in Tables IA thru IC.

Logs of two borings from "Mililani Town - Unit 23," dated July 31, 1972, are attached for reference.

SOIL DESCRIPTION BY OTHERS

From a review of the U. S. Soil Conservation Service maps of the area, the soils may be generally described as follows:


WaA, Wahiawa silty clay (MA soils),

0 to 3 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 site, approximately 500 ft by 700 ft, is located about 1,000 ft west of Kamehameha Highway and 1/2 mile north of Kipapa Gulch Bridge.
The existing ground slopes down toward the southwest at gradients of about 2 to 3%.

The site is a field overgrown with weeds and brush and is crossed by haul roads and ditches.

A paved road was located along the north boundary.

**INTERPRETATION OF SOIL CONDITIONS**

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

- Stiff to hard, reddish-brown clayey silts and silty clays (MH soils) and stiff brown clayey silt with decomposed rock to 20 ft, the maximum depth drilled.

Water was not noted in the borings during 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**

The present plan is to clear and grade the site for a residential development of about 40 units. The proposed grading is to use cuts and fills generally less than 10 ft in height.
Site Grading

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 site should be cleared and grubbed.

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

3. Hard surfaces along existing haul roads should be scarified down to stiff soils and recompacted 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 recompacted 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 continually be 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 generally should be placed along the toe sections of fill slopes and outside of probable building sites. Before placement of 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 should be placed on the select material. Earth fill may be used in the void spaces between boulders. A transitional 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-180-73 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 during and after the completion of filling operations should be included.

Slopes

Generally, 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 away from slopes by berms or ditches wherever practicable. Slope planting is recommended on cut and fill slopes.

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

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

**Foundations**

For the proposed one-story residential structures, spread or continuous footing foundations may be generally considered.

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 one-story, wood frame 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 or pockets of loose material and clays (CH soils) encountered in footing excavations or below the building area should be excavated and replaced with select on-site soils, well-graded granular material such as S4C or other approved material compacted in thin lifts.
5. Because of the downhill creep effect of soils on a slope, some settlements may occur near the tops of slopes. Buildings should be placed about 15 ft from the tops of slopes.

6. Foundations located over or adjacent to a utility trench should be designed to span over the trench or the footings should extend below the bottom of the trench.

7. Construction of retaining walls on slopes usually should be avoided.

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.

Slab on Ground

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

The on-site soils are relatively dry and tight and may swell when covered with a concrete slab. In addition, pockets of the clay soils may be slightly expansive. To minimize the swelling effects, the subgrade below slabs on ground should be scarified and recompacted on the wet side of optimum and prewetted several days prior to pouring of concrete. Pockets of clay, when encountered, should be excavated to about 2 ft below subgrade level and the excavation backfilled with compacted select on-site or borrow soils.

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

Roadways

In general, for the 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 over a prepared subgrade.
Provisions in the contract documents should 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 placed in these low areas.

**Utilities**

Utilities should be placed after the fills are constructed.

The bottoms of utility trenches should be daylighted at low points 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 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
MILILANI TOWN UNIT 29-A

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 bottom and sides of 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 about 5 horizontal to 1 vertical, the toe of the fill shall be benched to a generally level condition. As the fill is brought up, it shall continually be 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. For fills in roadway areas, the top 2 ft of fill shall be compacted to 95% of the maximum density. Compaction shall be with sheepsfoot rollers, multiple-wheel pneumatic-tired rollers or other acceptable rollers that 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 entire area filled 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 is 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 building sites. The subgrade shall be stripped to stiff natural ground and shaped to drain. A transition layer of select granular material shall be placed on the subgrade and boulders placed on the select material. 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, structural foundations, voids or cavities, boulders, seepage water or expansive soil pockets, etc., are encountered, corrective measures shall be made in the field as conditions 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** MILILANI TOWN - UNIT 29-A

**LOCATION** Waipio, Oahu, Hawaii

Tax Map Key: 9-4-03: 5

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

**SAMPLER:**
- 2" 5-2" O.D. THIN WALL TUBE
- 2" 56-2" STANDARD SPLIT SPOON

**LOCATION** Waipio, Oahu, Hawaii

**FIELD PARTY** ASATO KAJ

**Type of Boring** AUGER (Mobile)

**Elev.** 564' ± *

**Drill Bit** T.O. DRAG

**Date** 2.22.14

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**NOTE:**
- LL = LIQUID LIMIT
- PL = PLASTIC LIMIT

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* Elevation estimated from grading plan by Belt, Collins & Associates, Ltd.

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**PROJECT** MILILANI TOWN - UNIT 29-A

**LOCATION** Waipio, Oahu, Hawaii

Tax Map Key: 9-4-03: 5

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

**SAMPLER:**
- 2" 5-2" O.D. THIN WALL TUBE
- 2" 56-2" STANDARD SPLIT SPOON

**LOCATION** Waipio, Oahu, Hawaii

**FIELD PARTY** ASATO KAJ

**Type of Boring** AUGER (Mobile)

**Elev.** 564' ± *

**Drill Bit** T.O. DRAG

**Date** 2.22.14

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**NOTE:**
- LL = LIQUID LIMIT
- PL = PLASTIC LIMIT

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* Elevation estimated from grading plan by Belt, Collins & Associates, Ltd.
Boring Log

PROJECT: MILILANI TOWN - UNIT 29-A

LOCATION: Waipio, Oahu, Hawaii

Tax Map Key: 9-4-05: 5

HAMMER: Weight 140 lbs

Drop 30" 

SAMPLER: 2" STANDARD SPLIT SPOON

BORING NO. 2  Sheet No. of 

Driller: W. LUM ASSOC. INC. Date: FEB. 26, 1974

Field Party: ASATO, SHIGENAGA

Type of Boring: AUGER (MOBILE) Diam: 4"

Elev. Datum: 500' 4

Drill Bit: T.C. DRAG

Water Level: NOT NOTICED

Date: 2-26-74

PENETRATION DATA

| ELEV. 500' 4' | MH | Stiff Dark Reddish Brown Silt Clay |
| 2-A | 29 |

| 2-B | LL = 37 PL = 52 |
| 2-C | 31 |

| 2-D | 35 |
| 2-E | 95 |

END OF BORING @ 16.5' 2-26-74

* Elevation estimated from grading plan by Belt, Collins & Associates, Ltd.
**Boring Log**

**PROJECT**  
MILILANI TOWN - UNIT 29-A

**LOCATION**  
Waipio, Oahu, Hawaii

**Tax Map Key:** 9-4-05: 5

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

**SAMPLER:**
- **2" x 2" O.D. THIN WALL TUBE**
- **2" x 4.2" STANDARD SPLIT SPOON**

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* Elevation estimated from grading plan by Belt, Collins & Associates, Ltd.
Boring Log

PROJECT: MILILANI TOWN - UNIT 29-A
LOCATION: Waipio, Oahu, Hawaii
Tax Map Key: 9-4-05: 5

HAMMER:
Weight: 140 lb
Drop: 30"

SAMPLER: 2" STANDARD SPLIT SPOON

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**Penetration Data**

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<td>33</td>
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<td>4-E</td>
<td>28</td>
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</table>

**ELEV. 5G G' E'**

- STIFF DARK REDDISH BROWN SILTY CLAY
- STIFF, REDDISH BROWN CLAYET SILT
- STIFF ORANGE-BROWN CLAYET SILT
- STIFF LIGHT REDDISH BROWN SILTY CLAY
- END OF BORING 16' 2-26-74

* Elevation estimated from grading plan by Belt, Collins & Associates, Ltd.
**Boring Log**

**PROJECT**  
MILILANI TOWN - UNIT 29-A

**LOCATION**  
Waipio, Oahu, Hawaii

**Tax Map Key:** 9-4-05: 5

---

**HAMMER:**
- **Weight:** 140 lbs
- **Drop:** 50'

**Sampler:**
- 2" 5" 2" O.D. Thin Wall Tube
- 2" S.S. 2" Standard Split Spoon

---

**BORING DATA**

<table>
<thead>
<tr>
<th>Penetration Test</th>
<th>Standard N (Blows per foot)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2&quot; O.D. Thin Wall Tube Sampler</td>
<td>0 10 20 30 40 BLOW/10.5</td>
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</tbody>
</table>

---

**SOIL DESCRIPTION**

- **(MH)**  
  - STIFF, REDDISH BROWN SILTY CLAY
  - STIFF, LIGHT REDDISH BROWN SILTY CLAY
  - STIFF, REDDISH BROWN SILTY CLAY
  - STIFF, REDDISH BROWN MOTTLED BROWN CLAYET SILT
  - **ROCK**

---

* Elevation estimated from grading plan by Belt, Collins & Associates, Ltd.

---

**Elev. Estimated from grading plan by Belt, Collins & Associates, Ltd.**

---

**WALTER LUM ASSOCIATES, INC.**  
3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931
**Boring Log**

**PROJECT:** MILILANI TOWN - UNIT 29-A

**LOCATION:** Waipio, Oahu, Hawaii

**Tax Map Key:** 9-6-05: 5

<table>
<thead>
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<th>HAMMER:</th>
<th>140#</th>
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<tr>
<td>Weight</td>
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<tr>
<td>Drop</td>
<td>30&quot;</td>
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</table>

**SAMPLER:** 2.5" 2.0 O.D. THIN WALL TUBE 2.5" 2.0 STANDARD SPLIT SPOON

---

### Penetration Data

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---

**NOTE:**

- LL = LIQUID LIMIT
- PL = ELASTIC LIMIT

---

* Elevation estimated from grading plan by Belt, Collins & Associates, Ltd.
MILILANI TOWN - UNIT 29A

TABLE I A - SUMMARY OF LABORATORY TEST RESULTS.

| BORING NO. | 1 | 1 | 1 |
| SAMPLE NO. | B | E |   |
| DEPTH BELOW SURFACE | SURFACE DARK REDDISH-BROWN SILTY CLAY | 25'-35' DARK REDDISH-BROWN SILTY CLAY | 15'-16'5' MOTIFLED BROWN CLAYEY SILT WEATHERED OR DECOMPOSED ROCK |
| DESCRIPTION |       |       |   |

GRAIN-SIZE ANALYSIS (% Passing)

<table>
<thead>
<tr>
<th>Sieve</th>
<th>1&quot;</th>
<th>1/2&quot;</th>
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<th>#10</th>
<th>#20</th>
<th>#40</th>
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ATTERBERG LIMITS

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Dilatancy

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<td>Dry Strength</td>
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<td>MED-HIGH</td>
<td>SLIGHT-MED</td>
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UNIFIED SOIL CLASSIFICATION

| MH | MH | MH |

APPARENT SPECIFIC GRAVITY

| 2.82 |

CBR TEST

(Surcharge-51 P.S.F.)

| Molding Moisture, % | 61.6 |
| Molding Dry Density, P.C.F. | 97.0 |
| Swell upon saturation, % | 0.1 |
| CBR at 0.1" Penetration | 19.7 |

MOISTURE-DENSITY RELATIONS OF SOILS

(AASHTO T-180-73, Method__)

| A | DRY TO WET |
|   |            |

| Dry to Wet or Wet to Dry |   |
| Max. Dry Density (P.C.F.) | 97 |
| Optimum Moisture (%) | 48 |

REMARKS:

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

Date 3-9-74 By J.D.
TABLE I - SUMMARY OF LABORATORY TEST RESULTS.

<table>
<thead>
<tr>
<th>BORING NO.</th>
<th>SAMPLE NO.</th>
<th>DEPTH BELOW SURFACE</th>
<th>DESCRIPTION</th>
<th>GRAIN-SIZE ANALYSIS</th>
<th>ATTERBERG LIMITS</th>
<th>UNIFIED SOIL CLASSIFICATION</th>
<th>APPARENT SPECIFIC GRAVITY</th>
<th>CBR TEST</th>
<th>MOISTURE-DENSITY RELATIONS OF SOILS</th>
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<td>5'-10'</td>
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<th>Toughness</th>
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<tr>
<th>Air Dried or Natural</th>
<th>Liquid Limit</th>
<th>Plastic Limit</th>
<th>Plasticity Index</th>
<th>Dilatancy</th>
<th>Toughness</th>
<th>Dry Strength</th>
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<table>
<thead>
<tr>
<th>CBR TEST</th>
<th>(Surcharge-51 P.S.F.)</th>
<th>Molding Moisture, %</th>
<th>Molding Dry Density, P.C.F</th>
<th>Swell upon saturation, %</th>
<th>CBR at 6.1&quot; Penetration</th>
<th>MOISTURE-DENSITY RELATIONS OF SOILS</th>
<th>(AASHO T-180-73I, Method )</th>
<th>Dry to Wet or Wet to Dry</th>
<th>Max. Dry Density (P.C.F.)</th>
<th>Optimum Moisture (%)</th>
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REMINDS:

Date 3-9-74 By PCT

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

| BORING NO. | 6 | 6 |
| SAMPLE NO. | 0 | 0 |
| DEPTH BELOW SURFACE | SURFACE | 2.9' |
| | DARK | REDDISH-BROWN |
| | REDDISH-BROWN | GILTY CLAY |

DESCRIPTION

GRAIN-SIZE ANALYSIS (% Passing)

<table>
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<tr>
<th>Sieve</th>
<th>1&quot;</th>
<th>1/2&quot;</th>
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</tr>
</tbody>
</table>

ATTERBERG LIMITS

| Air Dried or Natural | NATURAL | NATURAL |
| Liquid Limit         | 60      | 58      |
| Plastic Limit        | 30      | 30      |
| Plasticity Index     | 50      | 48      |

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

UNIFIED SOIL CLASSIFICATION

| CH | MH-CH |

APPARENT SPECIFIC GRAVITY

CBR TEST

(Surcharge-51 P.S.F.)

| Moisture, % | 26.6 |
| Dry Density, P.C.F. | 96.1 |
| Swell upon saturation, % | 0.1 |
| CBR at 0.1" Penetration | 76.5 |

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:

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

PROJECT: MILILANI TOWN - UNIT 29A
LOCATION: WAIPIO, OAHU, HAWAII

DATE 3-9-74 BY PST

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

PROJECT: MILILANI TOWN - UNIT 29A

LOCATION: WAIPIO, OAHU, HAWAI'I

SAMPLE NO.: SURFACE

SAMPLE DESCRIPTION: DARK REDDISH-BROWN SILTY CLAY

AGGREGATE: 1/4" MINUS
MOLD SIZE: 4"x4.5"x4 HIGH
HAMMER: 10 LBS. 18" DROP
LAYERS: 5
BLOWS: 25/LAYER

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

DATE 2-27-74  BY  N.I.
MOISTURE- DENSITY CURVE (AASHO T-180-73I, METHOD A)

PROJECT: MILILANI TOWN - UNIT 29A

LOCATION: WAIPIO, OAHU, HAWAII

SAMPLE NO: 5 SURFACE

SAMPLE DESCRIPTION: REDDISH-BROWN CLAYEY SILT

AGGREGATE: 1/4" MINUS
MOLD SIZE: 4¼" X 4¼" X 3" HIGH
HAMMER: 10 LBS., 18" DROP
LAYERS: 5
BLOWS: 25/LAYER

DATE 2-26-74  BY  WALTER LUM ASSOCIATES, INC.
CBR TEST

PROJECT: MILILANI TOWN - UNIT 29A

LOCATION: WAIPIO, OAHU, HAWAII

SAMPLE NO: 1 SURFACE

SAMPLE DESCRIPTION: DARK REDDISH-BROWN SILTY CLAY

TEST RESULTS:

MOLDING MOISTURE, %: 27.2

MOLDING DRY DENSITY, P.C.F.: 97.0

CBR @ 0.1" PENETRATION: 19.7

DAYS SOAKED: 4

DATE: 2-25-74 BY GS

DATE: 2-26-74 BY NJ

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

PROJECT: MILILANI TOWN - UNIT 29A

LOCATION: WAIPIO, OAHU, HAWAII

SAMPLE NO: 5 SURFACE

SAMPLE DESCRIPTION: REDDISH-BROWN CLAYEY SILT

---

TEST RESULTS:

MOLDING MOISTURE, %: 26.3
MOLDING DRY DENSITY, P.C.F.: 97.0
CBR @ 0.1" PENETRATION: 22.0
DAYS SOAKED: 4

DATE: 3-1-74 BY CL

DATE: 3-4-74 BY MJ

---

CBR PENETRATION DATA

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<th>PENETRATION (INCHES)</th>
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<th>LOAD (PSI)</th>
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<tr>
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<tr>
<td>0.500</td>
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AGGREGATE 1/4" MINUS
HAMMER WEIGHT 10 LBS.
HAMMER DROP 18 IN.
NO. OF BLOWS 5/ST/LAYER
NO. OF LAYERS 5

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

PROJECT: MILILANI TOWN - UNIT 29A

LOCATION: WAIPIO, EWA, HAWAII

SAMPLE NO: 6 SURFACE

SAMPLE DESCRIPTION: DARK REDDISH-BROWN CLAY

CBR PENETRATION DATA

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<th>LOAD (PSI)</th>
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AGGREGATE 3/4" MINS.
HAMMER WEIGHT 10 LBS.
HAMMER DROP 18 INCHES.
NO. OF BLOWS 56/LAYER
NO. OF LAYERS 5

ADJUSTED COORDINATES

TEST RESULTS:

MOLDING MOISTURE, %: 26.6
MOLDING DRY DENSITY, P.C.F.: 98.7
CBR @ 0.1" PENETRATION: 26.5
DAYS SOAKED: 4

DATE 4-25-74 BY GS

DATE 4-26-74 BY NL

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS
LOGS OF BORINGS

FROM

MILILANI TOWN - UNIT 23

(DATED JULY 31, 1972)
Boring Log

**PROJECT**  MILILANI TOWN - UNIT 23

**LOCATION**  Waipio, Oahu, Hawaii

Tax Map Key:  9-4-05: Por. 1 & 11

**HAMMER:**
- Weight: 140#
- Drop: 90°

**SAMPLER:**  2.5" - 2" O.D. THIN WALL TUBE
- 2.5" - 2" STANDARD SPLIT SPOON

**Boring No.**  9  
**Sheet No.**  of  
**Driller**  W. LUM ASSOCIATES, INC.  
**Date**  MAR. 24, 1972

**Type of Boring**  AUGER (ACE)
**Diam.**  5.76" ±

**Datum**  
**Elev.**  
**Drill Bit**  T.C. DRAG

**Water Level**  

**Time**  --

**Date**  3-24-72

---

**Penetration Data**

<table>
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<tr>
<th>Unified Soil Classification</th>
<th>Description</th>
<th>Depth (ft)</th>
<th>Sampler</th>
<th>Penetrometer Test</th>
<th>Sample</th>
<th>Water Cont.</th>
<th>Dry Cont.</th>
<th>Unconf. Comp.</th>
<th>Penetration Test Method</th>
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<td>(MH)</td>
<td>STIFF</td>
<td>0.0</td>
<td>G.3</td>
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<td>DARK REDDISH BROWN Silty Clay w/Roots</td>
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<td>G.3</td>
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<td>(MH)</td>
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**END OF BORING @ 11.5'**

---

**Penetration Data**

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<th>Standard Penetration Test</th>
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**PENETRATION DATA**

**SAMPLE**

- 2.5" O.D. THIN WALL TUBE SAMPLER

---

**ELEVATION ESTIMATED FROM PRELIM. PLAN DATED JAN. 17, 1972**
Boring Log

PROJECT: MILILANI TOWN - UNIT 23
LOCATION: Waipio, Oahu, Hawaii

HAMMER:
Weight: 140 #
Drop: 20"

SAMPLER:
2.5" O.D. THIN WALL TUBE
2.55" - 2" STANDARD SPLIT SPOON

LOCATION: Waipio, Oahu, Hawaii
Tax Map Key: 9-4-05: Par. 1 & 11

Boring No: 8
Driller W. LUM ASSOC., INC. Date: MAR. 24, 1973
Field Party: MEYER - ASATO
Type of Boring: AUGER TYPE
Diam: 4"

Elev: 572.5' Datum:

Hammer:

Water Level:

Time: 3-22-72

Penetration Data

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END OF BORING @ 11.5'

ELEVATION ESTIMATED FROM PRELIM. PLAN DATED JAN. 17, 1972.
SCHEMATIC SECTION

1'-0" TRANSITION MATERIAL
(FAIRLY WELL-GRADED
GRANULAR MATERIAL
G" TO DUST SIZES.)

EARTH FILL MAY BE USED
IN VOIDS BETWEEN BOULDERS
(3' BOULDERS MAXIMUM)

COMPACTED FILL

TRANSITION MATERIAL
(FAIRLY WELL-GRADED
GRANULAR MATERIAL
G" TO DUST SIZES.)

SLOPE TO DRAIN

STRIP OFF LOOSE MATERIAL
DOWN TO STIFF GROUND,
SLOPE TO DRAIN.

SCHEMATIC SECTION

NOT TO SCALE

FIGURE 1

SCHEMATIC SECTION: BOULDER FILL
MILILANI TOWN: UNIT 29 A
WAIPIO, OAHU, HAWAII
TAX MAP KEY: 9-4-05-5

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

MARCH 11, 1974
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.