NANAKULI SUBDIVISION - PHASE I
PRELIMINARY SOIL REPORT

NANAKULI, OAHU, HAWAII
TAX MAP KEY: 8-9-07: 3

To:
WILSON, OKAMOTO & ASSOCIATES, INC.

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

DECEMBER 12, 1973
December 12, 1973

WILSON, OKAMOTO & ASSOCIATES, INC.
1150 South King Street, Suite 800
Honolulu, Hawaii 96814

Gentlemen:

Subject: Nanakuli Subdivision - Phase I
Preliminary Soil Report
(site grading for residential
development)
Nanakuli, Oahu, Hawaii
Tax Map Key: 8-9-07: 3

Transmitted herewith is our preliminary soil report for site grading for residential development purposes for the proposed Nanakuli Subdivision - Phase I.

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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SCOPE OF EXPLORATION

The purpose of this exploration was to evaluate general soil conditions for site grading for residential development for the proposed Nanakuli Subdivision - Phase I at Nanakuli, Oahu, Hawaii.

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

FIELD EXPLORATION AND LABORATORY TESTS

Thirteen exploratory borings and 5 logs of existing slopes were made at the site. The approximate locations of these borings and slope logs are shown on the Boring Location Sketch. Descriptions of the underlying soils encountered are shown on the boring logs.

Borings were made with 4-in. diameter augers using finger type bits. Soil samples were recovered with a 2-in. o.d. standard split spoon sampler driven with a 140-lb hammer falling 30 inches.

Laboratory tests included: natural water content, 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 IF.

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."

GEOLOGIC AND SOIL CLASSIFICATIONS BY OTHERS

From a review of geologic literature and the U. S. Soil Conservation Service maps of the area, the soils may be generally described as noncalcareous deposits.


- Pa - Consolidated noncalcareous deposits
- Ra - Unconsolidated noncalcareous deposits


- EaB - Ewa silty clay loam (ML or CL soils), 3 to 6% slopes
- LPE - Lualualei extremely stony clay (CH soils), 3 to 35% slopes
- PvC - Pulehu very stony clay loam (CL, SM or ML soils), 0 to 12% slopes
GENERAL SITE CONDITIONS

The proposed residential site is located between Nanakuli High School and the Tongg Ranch in Nanakuli Valley. The site is about 1/2 mile northeast (mauka) of Farrington Highway. The site is on the west side of Nanakuli Stream.

The existing ground slopes down in a southerly direction at about 5 to 15% gradients with localized variations. In some areas near the Nanakuli Stream, slopes as steep as about 65% (1-1/2:1) were noted.

An existing paved road that is an extension of Nanakuli Avenue is on the eastern section of the site. Dirt roads were also noted.

An occupied wooden house, a quonset hut and a few sheds are located on the northeast part of the site. Wire fences were observed on the northeastern border and along the stream.

The site is generally covered by tall grass, brush and trees with some abandoned cars and rubbish. Scattered cobbles and boulders were noted on the site, especially by the steep slopes near Nanakuli Stream.

INTERPRETATION OF SOIL CONDITIONS

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

A mixture of stiff dark brown to gray brown clays (CH), boulders, cobbles and decomposed rock with localized
pockets of reddish-brown clayey silt to about 8 to 20 ft, the depths drilled.

The drilled depths in Boring Nos. 4, 7, 11A and 14 were less than 6 ft due to boulder or decomposed rock encountered at the bottom of the drilled holes. Three or more attempts were made to drill thru the surface layer of cobble, boulders and decomposed rock at each of the boring locations.

The soils exposed on the stream cut slopes may be generally approximated as sandy silts and silty clays with boulders, cobbles and decomposed rock interspersed in the layers.

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 residential development. The preliminary plan generally indicates cuts to about 16 ft and fills to about 32 ft in some areas.
Since cobbles, boulders and decomposed rock were encountered near the surface in most borings, boulders and cobbles may be anticipated in most cuts. The deeper the cut, the greater quantity of boulders might be expected. If large quantities of cobbles and boulders are encountered during the grading work, a disposal site for the boulders and a source of off-site borrow may have to be considered. Boulders may be used to construct fill slopes away from building locations. Filter blankets of granular material should be placed between the boulder fills and natural or compacted earth fills. See Figure 1.

Because there is an occupied house and an existing road to the site, utility lines, cesspools, etc., may be encountered during clearing, grubbing and excavating operations.

Because of surface clay soils, the overall site grading design should consider the use of low and fairly gentle slopes. In sloping areas, grading design may consider excavating upper areas to remove driving forces and filling lower areas for resistance to downhill movement.

**Site Grading**

Surface vegetation and miscellaneous debris, abandoned cars and rubbish should be cleared and removed prior to site filling. Localized soft pockets encountered during site preparations should be excavated and replaced with
select soils compacted in thin lifts. Cesspools encountered during demolition and grubbing work should be backfilled as recommended under "Cesspools."

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

Grading work should be done in accordance with the Revised Ordinances of Honolulu, 1969 As Amended and as recommended below:

1. The area should be cleared and grubbed.

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

3. Hard surfaces such as along the existing unpaved road should be scarified down to stiff soils and recompacted to match the density of the surrounding soil.

4. Use of clay soils in fills on sloping areas should be avoided. On-site clay soils should generally be placed in the deeper portions of fills in flatter areas and away from the faces of slopes. Selected on-site soils or
borrow soils should be placed in the upper 2 ft of fills and in the outer portions of slopes, if practicable.

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 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 layer of select material or low grade concrete should be placed on the subgrade and
the boulders placed on the select material or low grade concrete. The void spaces between boulders should be filled with smaller granular material. A blanket of filter material should be placed against the boulders before any earth fills are placed against the boulders. See attached sketch, Figure 1.

7. Fills should be laid in 6-in. compacted layers to 90% of the maximum density determined by the AASHO T-180-73-I 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 3 horizontal to 1 vertical or flatter should be used for slopes less than about 6 ft in height in clay (CH) soils; otherwise, 2:1 slopes may be considered with removal of clay soils from the outer portion of slope and replacement with select soils.

Flatter slopes should generally be considered for higher slopes in the clay (CH) soils; otherwise, buttress slopes
with select materials should be considered. See attached sketch, Figure 2.

If slope heights (top to toe) 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 sheepfoot 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**

Because the surface soils at the site are generally clays (CH) and silty clays (CH-MH) that would tend to shrink and swell with moisture variations, post-and-beam type foundations are generally recommended.
To minimize the effects of heave and shrinkage of "CH" and "CH-MH" soils, excavations for the foot blocks should be made about 2 ft deep and about 1 ft 6 in. square or round and backfilled with compacted, select coral or an equivalent non-expansive granular material. The foot blocks may be placed on top of the select material. See Figure 3.

The select coral or granular material should be 1-1/2 in. to dust sizes with about 20% passing the No. 200 sieve.

If slab-on-ground construction is used on clayey soils (CH and CH-MH), the lot should be graded such that there will be a 2-ft layer of select coral or selected borrow material below the building area and extending about 3 ft beyond the perimeter of the building. The clay soils should be kept moist and not allowed to dry before placing and compacting the select material.

General guidelines for foundation design considerations may be as follows:

1. Bearing values for a given soil usually vary with the size and depth of footings. For
light, residential structures, bearing values of about 2000 p.s.f. may be used for footings resting on stiff natural ground or on compacted fill.

2. Soft spots or pockets of loose material encountered in footing excavations or below the building area should be excavated and replaced with select well-graded coral or granular material compacted in thin lifts.

3. Because of the downhill creep effect of soils on a slope, some settlements may occur near the tops of slopes. Buildings should generally be placed about 15 ft from the tops of slopes.

4. Construction of retaining walls on slopes should generally be avoided.

5. Good surface drainage away from the foundation of structures should be maintained and the site should be graded to prevent the ponding of water.
Roadway

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.
3. Subbase course - 6-in. subbase course.

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, weep holes should be placed at subgrade levels thru the walls of the catch basins.
Cesspools

Cesspools may be encountered during the site preparation work. When encountered, cesspools should be flagged and located on the plans. Sludge should be removed from the bottom and the cesspool backfilled with fairly well-graded granular materials. The materials should be placed in thin layers and rammed into place or compacted with vibratory equipment. The top 4 ft of fill should be compacted in 6-in. compacted layers.

Building foundations should be designed to bridge the cesspool.

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.

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

NANAKULI SUBDIVISION - PHASE I

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 the existing dirt road shall be scarified down to stiff soils and recompacted to match the density of the surrounding soil.

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-180-731 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 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 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 sheepfoot rollers are used, the soil may be disturbed to a depth of several inches. Density readings shall be taken as often as necessary in the compacted material below the disturbed surface. 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. The subgrade shall be stripped to stiff natural ground, shaped to drain and a layer of select material or low grade concrete shall be placed on it. Voids shall be filled with smaller granular soils. A blanket of filter 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 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.
BOURING 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**  
NANAKULI SUBDIVISION - PHASE I

**LOCATION**  
Nanakuli, Oahu, Hawaii

**Tax Map Key:** 8-9-07: 3

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

**SAMPLER:**  
2" STANDARD SPLIT SPOON

---

### PENETRATION DATA

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<th>Description</th>
<th>Elevation (ft)</th>
<th>Drift Rate</th>
<th>Sample No.</th>
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<th>Dry Density</th>
<th>Unconfined Comp.</th>
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*Note: Drilled 5 holes.*

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*Elev. Estimated from Topo Map by Wilson, Okamoto & Assoc., Inc.*
**Boring Log**

**PROJECT**  
NANAKULI SUBDIVISION - PHASE I

**LOCATION**  
Nanakuli, Oahu, Hawaii

**Tax Map Key:** 8-9-07: 3

---

**HAMMER:**

- **Weight:** 140#  
- **Drop:** 30’

**SAMPLER:** 2” STANDARD SPLT SPOON

---

**Location:** Nanakuli, Oahu, Hawaii  
**Field Party:** RADOVICH, SHIGENAGA, KAKU, MAYER

---

**Type of Boring:** AUGER (MOBILE)  
**Diam.:** 4’

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**Elev. Datum:**  
**Datum:**

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**Water Level:** Not Noted  
**Time:** —

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**Date:** 11-19-73

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**Unified Classification**

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**Penetration Data**

- Standard Penetration Test
- N (Blows per foot)
- 0 10 20 30 40

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*Elev. Estimated from Topo Map by Wilson, Okamoto & Assoc., Inc.*
**Boring Log**

**PROJECT**  NANAKULI SUBDIVISION – PHASE I

**LOCATION** Nanakuli, Oahu, Hawaii

**Tax Map Key:** 8-9-07: 3

**HAMMER:**
- **Weight:**
- **Drop:**

**SAMPLER:**

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<td>(GM)</td>
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* Elev. Estimated from Topo Map by Wilson, Okamoto & Assoc., Inc.
## Boring Log

**PROJECT**
NANAKULI SUBDIVISION - PHASE I

**LOCATION**
Nanakuli, Oahu, Hawaii

**Tax Map Key:** 8-9-07: 3

---

**HAMMER:**

- **Weight:**
- **Drop:**

**SAMPLER:**

---

### PENETRATION DATA

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<td>(CH)</td>
<td>TANNISH GRAY &amp; MOTTLED REDDISH BROWN CLAY W/SAND GRAVEL &amp; COBBLES &amp; DECOMPOSED ROCK</td>
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<td>13</td>
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<td>(CH)</td>
<td>MOTTLED REDDISH BROWN GRAY CLAY W/SILTY SAND Pockets, GRAVEL &amp; COBBLES &amp; SOME DECOMPOSED ROCK</td>
<td>15' 12</td>
<td>C</td>
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<td>BOTTOM OF SLOPE &amp; 16'</td>
<td>STREAM BED</td>
<td>11' 10' 73</td>
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**Note:**

LL = Liquid Limit
PL = Plastic Limit

---

*Elev. Estimated from Topo Map by Wilson, Okamoto & Assoc., Inc.*
Boring Log

PROJECT: NANA KULI SUBDIVISION - PHASE I
LOCATION: Nanakuli, Oahu, Hawaii

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

Sampler:
- 2" STANDARD_SPLIT_SPOON

LOCATION: Nanakuli, Oahu, Hawaii

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

Sampler:
- 2" STANDARD_SPLIT_SPOON

End of Boring: 212 + 0

**Note:** Drilled 3 holes to 3.5' depth.

**Elev. Estimated from Topo Map by Wilson, Okamoto & Assoc., Inc.**

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### PENETRATION DATA

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<td>-</td>
<td>N (Blows per foot)</td>
</tr>
<tr>
<td></td>
<td>BOULDER</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0 10 20 30 40</td>
</tr>
</tbody>
</table>

**END OF BORING:** 212 + 0

**Note:** Drilled 3 holes to 3.5' depth.

**Elev. Estimated from Topo Map by Wilson, Okamoto & Assoc., Inc.**
Boring Log

PROJECT: NANAKULI SUBDIVISION - PHASE I
LOCATION: Nanakuli, Oahu, Hawaii

Tax Map Key: 8-9-07: 3

HAMMER:
Weight: 140#
Drop: 30"

SAMPLER: 2" STANDARD SPLIT SPOON

<table>
<thead>
<tr>
<th>Unified Soil Classification</th>
<th>DESCRIPTION</th>
<th>Depth (ft)</th>
<th>Sampler</th>
<th>Sample No.</th>
<th>Wet Density (p.f.)</th>
<th>Water Cont. (%)</th>
<th>Dry Density (p.s.f.)</th>
<th>Unconfined Comp. (p.s.f.)</th>
<th>Vane Shear</th>
<th>Standard Penetration Test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>STIFF, BROWN, CLAY</td>
<td>0</td>
<td>G-A</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td></td>
<td>COBBLE &amp; BOULDER + CLAY POCKETS</td>
<td>5</td>
<td>G-B</td>
<td>13</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>COBBLES OR BOULDERS + MOTTLED BROWN CLAY, SAND &amp; DECOMPOSED ROCK</td>
<td>10</td>
<td>G-C</td>
<td>17</td>
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<td></td>
<td></td>
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<td></td>
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<tr>
<td></td>
<td>BROWN SILTY SAND + GRAVEL</td>
<td>15</td>
<td>G-D</td>
<td>11</td>
<td></td>
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<td></td>
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<td></td>
</tr>
</tbody>
</table>

END OF BORING 0.175'- 11-20-73

NOTE: HIT COBBLE & BOULDER AT 1.5'- 11-5-73; MOVED HOLE, SECOND ATTEMPT 11-20-73.

*Elev. Estimated from Topo Map by Wilson, Okamoto & Assoc., Inc.
# Boring Log

**PROJECT** | NANAKULI SUBDIVISION - PHASE I  
**LOCATION** | Nanakuli, Oahu, Hawaii  
**Tax Map Key:** | 8-9-07:3

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

**SAMPLER:** | 2" STANDARD SPLIT SPOON

**BORING NO.** | 7  
**Driller** | W. LUM ASSOC., INC.  
**Field Party** | MEYER, SHIGENAGA  
**Type of Boring** | AUGER (MOBILE)  
**Diam.** | 4"

**Elev.** | 214'  
**Datum** |

**Drill Bit** | FINGER TYPE  

**Water Level** | NOT NOTICED  
**Time** |

**Date** | 11-5-73

**LOCATION** | Nanakuli, Oahu, Hawaii  
**Field Party** | MEYER, SHIGENAGA  
**Type of Boring** | AUGER (MOBILE)  
**Diam.** | 4"

**Elev.** | 214'  
**Datum** |

**Drill Bit** | FINGER TYPE  

**Water Level** | NOT NOTICED  
**Time** |

**Date** | 11-5-73

---

### PENETRATION DATA

<table>
<thead>
<tr>
<th>Unit Load Classification</th>
<th>Soil Name</th>
<th>Description</th>
<th>ELEV.</th>
<th>Depth (ft)</th>
<th>Sample No.</th>
<th>Water Cont. P.C.F.</th>
<th>Dry Dens. P.C.F.</th>
<th>Unconf. Cons.</th>
<th>P.S.F.</th>
<th>Vane Shear</th>
<th>N (Blows per foot)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ML-GY</td>
<td>REDDISH BROWN SLIGHT GLAY</td>
<td>0.50</td>
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*Elev. Estimated from Topo Map by Wilson, Okamoto & Assoc., Inc.*
Boring Log

PROJECT: NANAKULI SUBDIVISION - PHASE I
LOCATION: Nanakuli, Oahu, Hawaii
Tax Map Key: 8-9-07: 3

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

SAMPLER: 2" STANDARD SPLIT SPOON

LOCATION: Nanakuli, Oahu, Hawaii

ELEV.: 198'+ 3" Datum

<table>
<thead>
<tr>
<th>Unified Classification</th>
<th>Description</th>
<th>Depth (ft)</th>
<th>Sampler</th>
<th>Sample No.</th>
<th>Wet Density</th>
<th>Water Cont.</th>
<th>Dry Density</th>
<th>Unconfined Comp.</th>
<th>P.S.F.</th>
<th>Penetration Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>ML</td>
<td>STIFF, MOTTLED REDDISH BROWN CLAYET SILT W/ DECOMPOSED ROCK</td>
<td>6</td>
<td>B-A</td>
<td>12</td>
<td>LL= 40</td>
<td>PL= 2.9</td>
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<td></td>
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<td>10</td>
<td>B-B</td>
<td>21</td>
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<td>B-C</td>
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<tr>
<td></td>
<td>COBBLES OR BOULDERS</td>
<td></td>
<td></td>
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<td></td>
<td></td>
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</tbody>
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END OF BORING: 11-5-73
10:15

*Elev. Estimated from Topo Map by Wilson, Okamoto & Assoc., Inc.
**Boring Log**

**PROJECT**  
NANAKULI SUBDIVISION - PHASE I

**LOCATION**  
Nanakuli, Oahu, Hawaii

**Tax Map Key:** 8-9-07: 3

**HAMMER:**
- **Weight:**
- **Drop:**

**SAMPLER:**

---

**UNIFIED SOIL CLASSIFICATION**

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<tr>
<th>Depth (ft)</th>
<th><strong>DESCRIPTION</strong></th>
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<tbody>
<tr>
<td>5</td>
<td>REDDISH BROWN, SILT CLAY</td>
</tr>
<tr>
<td></td>
<td>GRAY CLAYEY SILT</td>
</tr>
<tr>
<td></td>
<td>1/4 GRAVEL &amp; COBBLES</td>
</tr>
<tr>
<td></td>
<td>COBBLES &amp; GRAVEL &amp; BROWN, SILTY SAND</td>
</tr>
<tr>
<td>10</td>
<td>BOULDERS, COBBLES &amp; GRAVEL W/ SOME SANDY Silt</td>
</tr>
<tr>
<td>11-16-73</td>
<td>BOTTOM OF SLOPE @ 10'</td>
</tr>
</tbody>
</table>

---

**ELEV. ESTIMATED FROM**

Topo Map by Wilson, Okamato & Assoc., Inc.

---

**LOG OF SLOPE**

**BORING NO:** 10A  
**Sheet No.:** of

**Driller:** W. LUM ASSOC., INC.  
**Date:** Nov. 10, 1973

**Field Party:** LAI

**Type of Boring:** CUT SLOPE

**Elev:** 124 + 0

**Drill Bit:**

**Water Level:**

**Time:**

**Date:** 11-16-73

---

**PENETRATION DATA**

<table>
<thead>
<tr>
<th><strong>Standard Penetration Test</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>N (Blows per foot)</td>
</tr>
<tr>
<td>0 10 20 30 40</td>
</tr>
</tbody>
</table>

---

**NOTE**

LL = LIQUID LIMIT  
PL = PLASTIC LIMIT
**Boring Log**

**PROJECT**  NANAKULI SUBDIVISION - PHASE I

**LOCATION**  Nanakuli, Oahu, Hawaii

**Tax Map Key:**  8-9-07: 3

**HHammer:**
- **Weight:**
- **Drop:**

**Sampler:**

<table>
<thead>
<tr>
<th>Soil Classification</th>
<th>Description</th>
<th>ELEV.</th>
<th>Depth (ft)</th>
<th>Sampler</th>
<th>Sample No.</th>
<th>Wet Dens.</th>
<th>Dry Dens.</th>
<th>Unconf. Comp.</th>
<th>Vane Shear</th>
<th>P.S.F.</th>
<th>Standard Penetration Test</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>GW</strong></td>
<td>TAN BROWN GRAVEL W/SAND, COBBLES &amp; BOULDERS</td>
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<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>BOULDERS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

**LOG OP SLOPE**

**DRILLER:**  W. LUM ASSOC., INC.

**DATE:**  NOV. 16, 1973

**FIELD PARTY:**  LAI

**Type of Boring:**  STREAM

**Elev. @ 10' DOT SLOPE:**  130' + 0

**DATE:**  11-14-73

---

*Elev. Estimated from Topo Map by Wilson, Okamoto & Assoc., Inc.*
Boring Log

PROJECT  NANAKILI SUBDIVISION - PHASE I
LOCATION  Nanakuli, Oahu, Hawaii
Tax Map Key:  8-9-07: 3

HAMMER:
Weight
Drop

SAMPLER:

<table>
<thead>
<tr>
<th>Unified Classification</th>
<th>Description</th>
<th>Elev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SM</td>
<td>REDDISH BROWN, SILTY SAND, GRAVEL &amp; COBBLES</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MOTTLED BROWN &amp; GRAY, SILTY SAND, DECOMPOSED ROCK</td>
<td>9</td>
</tr>
<tr>
<td>(SM)</td>
<td>BROWN &amp; REDDISH BROWN, SILTY SAND, GRAVEL &amp; COBBLES</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>BOTTOM OF SLOPE @ 16' 2</td>
<td>15</td>
</tr>
</tbody>
</table>

*Elev. Estimated from Topo Map by Wilson, Okamoto & Assoc., Inc.
# Boring Log

**PROJECT:** Nanakuli Subdivision - Phase I  
**LOCATION:** Nanakuli, Oahu, Hawaii  
**Tax Map Key:** 8-9-07: 3  
**HAMMER:**  
- Weight: 140#  
- Drop: 30"  
**SAMPLER:** 2" Standard Split Spoon  

---

## Penetration Data

<table>
<thead>
<tr>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>202'</td>
<td>Stiff, Park Brown Clay w/ Decomposed Rock</td>
<td>0</td>
<td>11A</td>
<td>17</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>202'</td>
<td>Mottled Brown Clayey Silt w/ Decomposed Rock</td>
<td>5</td>
<td>11B</td>
<td>No Recovery</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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*Elev. Estimated from Topo Map by Wilson, Okamoto & Assoc., Inc.*
**Boring Log**

**PROJECT:** NANAKULI SUBDIVISION - PHASE I  
**LOCATION:** Nanakuli, Oahu, Hawaii  
**Tax Map Key:** 8-9-07: 3  
**Driller:** W. LUM ASSOC., INC.  
**Date:** Nov. 7, 1973  
**Field Party:** MEYER, KAKI, SHIGENAGA

**HAMMER:**
- **Weight:**  
- **Drop:**

**SAMPLER:**

---

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<tr>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ELEV. = 19' 6&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>DARK BROWN CLAY</td>
<td>2</td>
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<tr>
<td></td>
<td>LIGHT BROWN</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>DECOMPOSED ROCK</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>COBBLE OR BOULDER</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>END OF BORING @ 2'</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

**NOTE:** MOVED HOLE AND HIT BOULDER AT 2'.

---

*Elev. Estimated from Topo Map by Wilson, Okamoto & Assoc., Inc.*
<table>
<thead>
<tr>
<th>Soil Type</th>
<th>Description</th>
<th>Depth (ft)</th>
<th>Sample</th>
<th>Wet Density</th>
<th>Dry Density</th>
<th>Unconfined Comp.</th>
<th>Vane Shear</th>
<th>Standard Penetration Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>ML</td>
<td>Stiff, reddish brown clayey silt</td>
<td>0</td>
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<tr>
<td>CH(Gc)</td>
<td>Cobble or boulders w/ mottled brown clay, sand and decomposed rock</td>
<td>0-1</td>
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<td></td>
<td></td>
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<td></td>
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<tr>
<td></td>
<td>Cobble or boulders w/ brown, silty sand and gravel</td>
<td>1-3</td>
<td></td>
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<td>Cobble or boulders w/ mottled brown clay and sand</td>
<td>3-10</td>
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<tr>
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</table>

**Note:** Hit cobble or boulder at 6.0 ft, 11-20-75, moved hole, second attempt 11-20-75.

**Elev. Estimated from Topo Map by Wilson, Okamoto & Assoc., Inc.**
Boring Log

**PROJECT** NANAKULI SUBDIVISION - PHASE I

**LOCATION** Nanakuli, Oahu, Hawaii

**Tax Map Key:** 8-9-07: 3

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

**SAMPLER:** 2' STANDARD SPLIT SPOON

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>0</td>
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<td>19-A</td>
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<tr>
<td></td>
<td><strong>CLAY  &amp; COBBLES</strong></td>
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<td>-</td>
<td>-</td>
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<tr>
<td></td>
<td><strong>LIGHT BROWN</strong></td>
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<td></td>
<td><strong>DECOMPOSED ROCK</strong></td>
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<td>15</td>
<td><strong>COBBLES OR BOULDERS</strong></td>
<td>19-B</td>
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<td></td>
<td><strong>MOTTLED BROWN</strong></td>
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<td>5/3</td>
<td>-</td>
<td>HAMMER BOUNCES</td>
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<tr>
<td></td>
<td><strong>CLAYY Silt...SAND</strong></td>
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</tr>
<tr>
<td>20</td>
<td><strong>END OF BORING TO 20'</strong></td>
<td>19-D</td>
<td>-</td>
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<td>-</td>
<td>-</td>
<td>5/2</td>
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<td><strong>HIT COBBLE OR BOULDER AT 20'</strong></td>
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<td>HAMMER BOUNCES</td>
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<tr>
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<td><strong>MOVED HOLE SECOND ATTEMPT 11-16-73</strong></td>
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*Elev. Estimated from Topo Map by Wilson Okamoto & Assoc., Inc.*
Boring Log

PROJECT: NANAKULI SUBDIVISION - PHASE I
LOCATION: Nanakuli, Oahu, Hawaii
Tax Map Key: 8-9-07: 3

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>Sampler</th>
<th>Sample No.</th>
<th>Water Cont.</th>
<th>Wet Density</th>
<th>Unconf. Comp.</th>
<th>P.E.F.</th>
<th>True Shear</th>
<th>Vane Shear</th>
<th>Standard Penetration Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>GRAV. LIGHT BROWN DECOMPOSED ROCK</td>
<td>ELEV. = 190' 2&quot;</td>
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<td></td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>Boulders w/ Decomposed Rock Layer</td>
<td></td>
<td>5</td>
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<tr>
<td>END OF BORING &amp; 5.5' DEEPEST PENETRATION</td>
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</tr>
</tbody>
</table>

*Elev. Estimated from Topo Map by Wilson, Okamoto & Assoc., Inc.

---

Note: Moved hole 5 times. 5.5' Deepest Penetration

---

Driller: W. LUM ASSOC., INC.
Date: NOV. 6, 1973
Field Party: MEYER, SHIGENAGA
Type of Boring: AUGER (MOBILE)
Diam.: 4"

---

Penetration Data

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<th>10</th>
<th>20</th>
<th>30</th>
<th>40</th>
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<tbody>
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<td>Penetration</td>
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Note: Hammer Bounces
**Boring Log**

**PROJECT:** NANAKULI SUBDIVISION - PHASE I

**LOCATION:** Nanakuli, Oahu, Hawaii

**Tax Map Key:** 8-9-07: 3

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

**SAMPLER:** 2" STANDARD SPLIT SPOON

---

**Unified Soil Classification**

<table>
<thead>
<tr>
<th>Soil Classification</th>
<th>Description</th>
<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>Unit Comp.</th>
<th>Vane Shear (p.s.f.)</th>
<th>Standard Penetration Test</th>
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<td>DENSE, BROWN SILTY SAND W/GRAVEL</td>
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<td>15D</td>
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---

**Penetration Data**

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

---

*Elev. Estimated from Topo Map by Wilson, Okamot & Assoc., Inc.*
# Boring Log

**PROJECT**  
NANAKULI SUBDIVISION - PHASE I

**LOCATION**  
Nanakuli, Oahu, Hawaii

**Tax Map Key:** 8-9-07: 3

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

**SAMPLER:**  
2" STANDARD SPLIT SPOON

---

### PENETRATION DATA

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<tbody>
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*Elev. Estimated from Topo Map by Wilson, Okamoto & Assoc., Inc.*
<table>
<thead>
<tr>
<th>BORING NO.</th>
<th>SAMPLE NO.</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>
<th>REMARKS</th>
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<tr>
<td></td>
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<td>3B</td>
<td>3C</td>
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<td>0'-4'</td>
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<td>MOTLED REDDISH-</td>
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<td></td>
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<td>CLAY &amp; Silt</td>
<td>SILTY SAND,</td>
<td>BROWN &amp; GRAY</td>
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**Remarks:**

Date: 12-11-72     By: PCT
TABLE IV - SUMMARY OF LABORATORY TEST RESULTS

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<th>BORING NO.</th>
<th>SAMPLE NO.</th>
<th>DEPTH BELOW SURFACE</th>
<th>DESCRIPTION</th>
<th>GRAIN-SIZE ANALYSIS (% Passing)</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>
<th>REMARKS</th>
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### Table I.C - Summary of Laboratory Test Results

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<th>DESCRIPTION</th>
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<th>ATTERBERG LIMITS</th>
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<th>#10</th>
<th>#20</th>
<th>#40</th>
<th>#100</th>
<th>#200</th>
<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>Moisture-Density Relations of Soils</th>
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**Remarks:**

Date 12-1-73  By RJT
# TABLE I.D - SUMMARY OF LABORATORY TEST RESULTS

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<th>SAMPLE NO.</th>
<th>DEPTH BELOW SURFACE</th>
<th>DESCRIPTION</th>
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<tr>
<td>10C</td>
<td>A</td>
<td>0'-4'</td>
<td>REDDISH BROWN SILT SAND &amp; COBBLES</td>
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<td>0.5'-2'</td>
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<td>11</td>
<td>A</td>
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<td>DARK BROWN CLAY W/COMP. Boulders W/MOTTLED BROWN CLAY</td>
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<td>5.5'-9.5'</td>
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<td>12</td>
<td>P</td>
<td>SURFACE</td>
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## GRAIN-SIZE ANALYSIS (% Passing)

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## ATTERBERG LIMITS

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## DILATANCY

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## TOUGHNESS

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<th>HIGH</th>
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## DRY STRENGTH

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## UNIFIED SOIL CLASSIFICATION

| SM | CH | CH (GC)** | CH |

## APPARENT SPECIFIC GRAVITY

| 2.88 |

## CBR TEST

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<tr>
<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 0.1&quot; Penetration</th>
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## MOISTURE-DENSITY RELATIONS OF SOILS

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<tr>
<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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## REMARKS:

** SAMPLE TESTED ONLY ON THAT PORTION THAT PASSES THE #40 SIEVE. **

** UNIFIED SOIL CLASSIFICATION IN PARENTHESES BASED ON VISUAL IDENTIFICATION OF TOTAL SAMPLE. **

Date | 12-11-73   | By | T

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS
---NANAKULI SUBDIVISION-PHASE I---

**TABLE I.E - 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 (% Passing)</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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**BORING NO.**

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**SAMPLE NO.**

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<th>SURFACE</th>
<th>1'-2.5'</th>
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**DEPTH BELOW SURFACE**

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<tr>
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<th>BROWN</th>
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**DESCRIPTION**

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<th>SILTY CLAY</th>
<th>WIDECLAY</th>
<th>WIDEMORPH.ROCK</th>
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**GRAIN-SIZE ANALYSIS (% Passing)**

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<tr>
<th>Sieve</th>
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<th>1/2&quot;</th>
<th>#4</th>
<th>#10</th>
<th>#20</th>
<th>#40</th>
<th>#100</th>
<th>#200</th>
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<tbody>
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**ATTERBERG LIMITS**

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<tr>
<td>Plastic Limit</td>
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<td>Plasticity Index</td>
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<td>38</td>
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<table>
<thead>
<tr>
<th>Dilatancy</th>
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<td>Toughness</td>
<td>MEDIUM-HIGH</td>
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<tr>
<td>Dry Strength</td>
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**UNIFIED SOIL CLASSIFICATION**

<table>
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<tr>
<th>CH</th>
<th>2.98</th>
<th>CH</th>
<th>5M</th>
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**APPARENT SPECIFIC GRAVITY**

<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 0.1&quot; Penetration</th>
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<tbody>
<tr>
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<td>20.4</td>
<td>102.9</td>
<td>5.1</td>
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**MOISTURE-DENSITY RELATIONS OF SOILS**

<table>
<thead>
<tr>
<th>(AASHO T-180-731, Method)</th>
<th>DRY TO WET</th>
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<tr>
<td>Dry to Wet or Wet to Dry</td>
<td>104</td>
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<td>Max. Dry Density (P.C.F.)</td>
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**REMARKS:**

Date: 12-11-73  By: FJT

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

| BORING NO. | 16 |  |
| SAMPLE NO. | 5 |  |
| DEPTH BELOW SURFACE | 5'-5.9' |  |

**DESCRIPTION**

- BROWN SILTY SAND WELGRAVEL

**GRAIN-SIZE ANALYSIS**

(% Passing)

<table>
<thead>
<tr>
<th>Sieve</th>
<th>1&quot;</th>
<th>1/2&quot;</th>
<th>#4</th>
<th>#10</th>
<th>#20</th>
<th>#40</th>
<th>#100</th>
<th>#200</th>
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<td>100</td>
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<td>37.6</td>
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**ATTERBERG LIMITS**

- Air Dried or Natural
- Liquid Limit
- Plastic Limit
- Plasticity Index
- Dilatancy
- Toughness
- Dry Strength

**UNIFIED SOIL CLASSIFICATION**

- SM

**APPARENT SPECIFIC GRAVITY**

- 

**CBR TEST**

- (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 12-1-73   By DJ

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

PROJECT: NANAKULI SUBDIVISION - PHASE I
LOCATION: NANAKULI, OAHU, HAWAII

<table>
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<tr>
<th>DATE</th>
<th>12-11-73</th>
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<tbody>
<tr>
<td>BY</td>
<td>BST</td>
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WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS
GRAIN-SIZE ANALYSIS CURVE

PROJECT: NANAKULI SUBDIVISION - PHASE I

LOCATION: NANAKULI, OAHU, HAWAII

GRAIN SIZE IN MILLIMETERS

<table>
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<tr>
<th>GRAIN SIZE IN MILLIMETERS</th>
<th>COBBLE</th>
<th>GRAVEL</th>
<th>GRAVEL</th>
<th>SAND</th>
<th>SAND</th>
<th>SAND</th>
<th>SILT OR CLAY</th>
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</thead>
<tbody>
<tr>
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<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

DATE 12-11-73 BY R.T.
MOISTURE-DENSITY CURVE (AASHTO T-180-78I, METHOD A)

PROJECT: NANAKULI SUBDIVISION - PHASE I

LOCATION: NANAKULI, OAHU, HAWAII

SAMPLE NO.: 3 SURFACE

SAMPLE DESCRIPTION: MOTTLED REDDISH-BROWN CLAYEY SILT

AGGREGATE: 3/4" MINUS
MOLD SIZE: 4" x 4.524" HIGH
HAMMER: 10 LBS, 16" DROP
LAYERS: 5
BLOWS: 25/LAYER

MAX. DRY DENSITY: 105 P.C.F.

OPTIMUM MOISTURE CONTENT: 22.46%

ZER0 AIR VOIDS CURVE

SPECIFIC GRAVITY: 3.04

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

DATE 11-26-73  BY  N1
MOISTURE-DENSITY CURVE (AASHO T-180-73I, METHOD A)

PROJECT: NANAKULI SUBDIVISION - PHASE I
LOCATION: NANAKULI, OAHU, HAWAII
SAMPLE NO: 13 SURFACE
SAMPLE DESCRIPTION: DARK BROWN CLAY

AGGREGATE: 1/4" MINUS
MOLD SIZE: 6" Ø × 4.5" HIGH
HAMMER: 10 LBS, 18" DROP
LAYERS: 5
BLOWS: 25/LAYER

MAXIMUM DRY DENSITY - 95 PCF
OPTIMUM MOISTURE CONTENT - 28%

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

DATE 12-10-73 BY OT

9-470.
MOISTURE-DENSITY CURVE (AASHO T-180-73I, METHOD A)

PROJECT: NANAKULI SUBDIVISION - PHASE I

LOCATION: NANAKULI, OAHU, HAWAII

SAMPLE NO.: 15 SURFACE

SAMPLE DESCRIPTION: REDDISH-BROWN SILTY CLAY

MOISTURE DENSITY CURVE

DENSITY (P.C.F.)

130
120
110
100
90
80
70
60

WATER CONTENT (%)

0
10
20
30
40
50
60

OPTIMUM MOISTURE CONTENT: 22%

MAX DRY DENSITY: 104 P.C.F

ZERO AIR VOID CURVE

SPECIFIC GRAVITY = 2.48

MOLD SIZE: 4" X 4" X 8" HIGH
HAMMER: 10 LBS, 18" DROP
LAYERS: 5
BLOWS: 56/LAYER

DATE 11-23-73 BY AJI
CBR TEST

PROJECT: NANAKULI SUBDIVISION - PHASE I

LOCATION: NANAKULI, OAHU, HAWAII

SAMPLE NO: 6 SURFACE
SAMPLE DESCRIPTION: BROWN CLAY

TEST RESULTS:

MOLDING MOISTURE, %: 95.4
MOLDING DRY DENSITY, P.C.F.: 93.9
CBR @ 0.1'' PENETRATION: 1.3
DAYS SOAKED: 4

DATE 12-3-78 BY LV
DATE 12-4-78 BY NL

CBR PENETRATION DATA

<table>
<thead>
<tr>
<th>PENETRATION (INCHES)</th>
<th>LOAD (LBS)</th>
<th>LOAD (PSI)</th>
</tr>
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<tbody>
<tr>
<td>0.025</td>
<td>14</td>
<td>5</td>
</tr>
<tr>
<td>0.050</td>
<td>28</td>
<td>9</td>
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<tr>
<td>0.075</td>
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<td>13</td>
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<td>0.125</td>
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<tr>
<td>0.150</td>
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<td>17</td>
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<td>0.175</td>
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<td>18</td>
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<td>0.200</td>
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<td>20</td>
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<tr>
<td>0.300</td>
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<tr>
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<td>18</td>
</tr>
<tr>
<td>0.500</td>
<td>58</td>
<td>19</td>
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</tbody>
</table>

AGGREGATE 1/4" MINUS
HAMMER WEIGHT 10 LBS.
HAMMER DROP 18 IN.
NO. OF BLOWS 5/blayer
NO. OF LAYERS 5
CBR TEST

PROJECT: NANAKULI SUBDIVISION - PHASE I

LOCATION: NANAKULI, OAHU, HAWAII

SAMPLE NO: SURFACE

SAMPLE DESCRIPTION: MOTTLED REDDISH-BROWN CLAYEY SILT

---

**CBR PENETRATION DATA**

<table>
<thead>
<tr>
<th>PENETRATION (INCHES)</th>
<th>LOAD (LBS)</th>
<th>LOAD (PSI)</th>
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<tbody>
<tr>
<td>0.025</td>
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AGGREGATE 1/4" MINUS

HAMMER WEIGHT 10 LB.

HAMMER DROP 18 IN.

No. OF BLOWS 56/LAYER

No. OF LAYERS 5

---

**ADJUSTED COORDINATES**

**TEST RESULTS**

MOLDING MOISTURE, %: 21.8

MOLDING DRY DENSITY, P.C.F.: 104.1

CBR @ 0.1" PENETRATION: 41.6

DAYS SOAKED: 4

---

DATE: 11-23-73

DATE: 11-26-73

BY: LY

BY: JS

---

WALTER LUM ASSOCIATES, INC.

CIVIL, STRUCTURAL, SOILS ENGINEERS
CBR TEST

PROJECT: NANAKULI SUBDIVISION - PHASE I
LOCATION: NANAKULI, OAHU, HAWAII
SAMPLE NO: 13 SURFACE
SAMPLE DESCRIPTION: DARK BROWN CLAY

TEST RESULTS:

MOLDING MOISTURE, %: 30.0
MOLDING DRY DENSITY, P.C.F.: 92.9
CBR @ 0.1" PENETRATION: 1.8
DAYS SOAKED: 4

DATE: 12-11-73 BY LY
DATE: 12-11-73 BY PT

CBR PENETRATION DATA

<table>
<thead>
<tr>
<th>PENETRATION (INCHES)</th>
<th>LOAD (LBS)</th>
<th>LOAD (PSI)</th>
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<tr>
<td>0.025</td>
<td>15</td>
<td>5</td>
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<tr>
<td>0.050</td>
<td>21</td>
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</table>

AGGREGATE: 3/4" MINUS
HAMMER WEIGHT: 10 LBS
HAMMER DROP: 18"
NO. OF BLOWS: 50/LAYER
NO. OF LAYERS: 5

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

PROJECT: NANAKULI SUBDIVISION-PHASE I

LOCATION: NANAKULI, OAHU, HAWAII

SAMPLE NO: 14 SURFACE

SAMPLE DESCRIPTION: BROWN CLAY

TEST RESULTS:

MOLDING MOISTURE, %: 20.4
MOLDING DRY DENSITY, P.C.F: 102.9
CBR @ 0.1" PENETRATION: 15
DAYS SOAKED: 4

DATE 11-24-75 BY LY
DATE 11-26-75 BY JS

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

PROJECT: NANAKULI SUBDIVISION-PHASE I

LOCATION: NANAKULI, OAHU, HAWAII

SAMPLE NO: IS SURFACE

SAMPLE DESCRIPTION: REDDISH-BROWN SILTY CLAY W/ DECOMP. ROCK

CBR PENETRATION DATA

<table>
<thead>
<tr>
<th>PENETRATION (INCHES)</th>
<th>LOAD (LBS)</th>
<th>LOAD (PSI)</th>
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<tbody>
<tr>
<td>0.025</td>
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AGGREGATE 1/4" MINUS
HAMMER WEIGHT 10 LB
HAMMER DROP 18 IN
No. OF BLOWS 56/LAYER
No. OF LAYERS 5

ADJUSTED COORDINATES
TEST RESULTS:
MOLDING MOISTURE, %: 20.0
MOLDING DRY DENSITY, P.C.F: 105.0
CBR @ 0.1" PENETRATION: 7.8
DAYS SOAKED: 5

DATE 11-24-73 BY LY
DATE 11-26-73 BY JS
SECTION
NOT TO SCALE

FIGURE 1
PROPOSED BOULDER FILL
NANAKULI SUBDIVISION: PHASE I
NANAKULI, OAHU, HAWAII

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

DECEMBER, 1973
SECTION

NOT TO SCALE

FIGURE 2

TYPICAL SLOPE TREATMENT
FOR CUTS & FILLS IN ADOBE
NANAKULI SUBDIVISION - PHASE I
NANAKULI, OAHU, HAWAII

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

DECEMBER, 1973
PROPOSED FOOTING FOR SLAB-ON-GROUND ON EXPANSIVE SOIL

PROPOSED FOOTING FOR POST-AND-BEAM ON EXPANSIVE SOIL

FIGURE 3
PROPOSED FOOTING DETAILS
FOR LIGHT RESIDENTIAL STRUCTURES
ON EXPANSIVE SOILS
NANAKULI SUBDIVISION - PHASE I
NANAKULI, OAHU, HAWAII
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.