ALII SHORES SUBDIVISION - SECTIONS "F" AND "G" - PRELIMINARY SOIL REPORT
(for residential development)

KANEOHE, OAHU, HAWAII

TAX MAP KEY: 4-6-02, 03 & 23

To:
R. M. TOWILL CORPORATION

By:
WALTER LUM ASSOCIATES, INCORPORATED
CIVIL, STRUCTURAL, SOILS ENGINEERS
August 5, 1968
R. M. TOWILL CORPORATION
233 Merchant Street
Honolulu, Hawaii 96813

Gentlemen:

RE: Alii Shores Subdivision - Sections "F" and "G"
Preliminary Soil Report
(for residential development)
Kaneohe, Oahu, Hawaii
Tax Map Key: 4-5-02, 03 & 23
Chapter 23, Revised Ordinances of Honolulu,
1961 As Amended

In accordance with your request, a preliminary soil exploration was made at the proposed residential development site for the Alii Shores Subdivision - Sections "F" and "G" at Kaneohe, Oahu, Hawaii.

For this report, the site is separated into two sections: 1) lower area, generally below Elevation +6 ft along the shoreline of Kaneohe Bay and 2) upper area, generally above Elevation +6 ft.

In the lower area, some soft underlying material was encountered along the shoreline of Kaneohe Bay. In this area, fill heights should be kept as low as practicable and subdrains should be installed to drain wet areas and natural drainageways. Settlement observations should be made to evaluate the rate of settlement for timing the start of house construction.

From the field exploration and laboratory test results, it is our opinion that the area can be developed for residential housing construction.

After earthwork is completed in accordance with the recommendations of the soil exploration report, houses can be supported either directly on stiff natural ground or on properly compacted fills. Post-and-beam construction is recommended in the lower area, particularly along the waterway perimeter and the transition areas from stiff to soft subsoils.

Unforeseen or undetected conditions such as soft spots or seepage water may occur in localized areas and will have to be adjusted and corrected in the field as they are detected.
All grading should be done in accordance with the requirements of Chapter 23, Revised Ordinances of Honolulu, 1961 As Amended and the recommendations contained herein.

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

Respectfully submitted,

WALTER LUM ASSOCIATES, INC.

Ezra Koike
Professional Engineer
Hawaii No. 1450
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ALII SHORES SUBDIVISION - SECTIONS "F" AND "G" - PRELIMINARY SOIL REPORT
(for residential development)

KANEHOE, OAHU, HAWAII

TAX MAP KEY: 4-6-02, 03 & 23

SCOPE OF EXPLORATION
The purpose of this exploration was to determine general soil conditions
of the proposed site, Alii Shores Subdivision - Sections "F" and "G" at
Kaneohe, Oahu, Hawaii, for residential development.

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

PRELIMINARY FIELD EXPLORATION
Thirty-one borings were made at the site. The locations of these borings
are shown on Figure 1, Boring Location Plan. Descriptions of the under-
lying soils are shown on the Boring Logs Nos. 1 thru 31.

Borings were made with 3-in. and 4-in. diameter augers using clay and rock
type bits. Soil samples were recovered with a standard split spoon sampler
and 2-in. and 3-in. thin-wall-tube samplers driven with a 140-lb hammer
falling 30 inches.

Soil samples were visually identified and tentatively classified in the field.
In the laboratory, they were subjected to appropriate tests. The field iden-
tifications and classifications were then reviewed and modified to conform
with the results of the laboratory tests in accordance with the "Unified
Soil Classification System."
LABORATORY TESTS

Laboratory tests included: natural density, water content, unconfined compression and laboratory torvane shear; Atterberg limits; specific gravity; gradation; AASHO T-180-57 density; expansion; CBR and consolidation.

A list of the standard field and laboratory test methods used for this project is given in the Appendix.

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

GENERAL SITE AND SOIL CONDITIONS

The proposed subdivision extends along Kaneohe Bay and Lilipuna Road from about 1000 to 2800 ft west of Kamehameha Highway. Except for a few houses, several fish ponds and banana groves, the site is undeveloped.

Excluding two low ridges which rise above Elevation 10 ft, the ground surface along the bay shore generally rises at a gentle gradient from offshore to a distance about 100 to 200 ft back from the shore. Here, the ground rises at about 15 to 40 percent gradient to the top of the ridge which is just outside the project area along the southern boundary.

Portions of the low area appear to have been filled. The ground surface was relatively dry, consisting of loose to medium density sand and coral or sandy silt with gravel and boulders. Other portions of the low area were wet and marshy and the surface soil was generally very soft silty clay with organic material.
Geologically, this area is underlain by decomposed rock which outcrops in most of the higher ridges and existing road cuts. The decomposed rock is extremely weathered and outcrops locally in relatively harder nodular masses.

From the field exploration and laboratory test results, the soils at the site may be separated into two sections and generally described as follows:

**Lower Area (Generally below Elevation +6 ft)**

Along the low lying area adjacent to the shoreline, the underlying soils are of very loose silty and clayey sand with fragments of finger coral, and pockets or layers of silty clay. These soft soils vary from one to more than 25 ft thick and generally overlie boulders or decomposed rock.

Water lies at or near the surface in most of the borings in the low area. The depth of water is affected by the tides as observed in Boring No. 2.

**Upper Area (Generally above Elevation +6 ft)**

In the higher area which lie more than 100 to 200 ft back from the shoreline, the soils are generally stiff to very stiff reddish-brown clayey silts which, in most cases, appear to be decomposed rock.

Water was not noticed in the borings made in the higher area.

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

In general, the present plan is to construct low fills less than 8 ft in the lower area. In the upper area, the present plan is to do minor grading work except in localized areas where cuts up to about 30 ft and fills up to about 25 ft are proposed.

The fill material will generally come from offshore areas that are to be dredged for marina waterways and from parts of the upper area where regrading involves excavations.

In the opinion of the Soil Engineer, the on-site soils, in general, have sufficient strength to support the proposed low fills and light residential structures proposed, provided that the site is cleared, grubbed and drained, and soft spots are removed.

In the lower area, settlements of several inches to a foot or more may occur. However, much of the settlements due to fill loads would generally occur during the construction period and within several months after the fills are in place. Settlement observations should be made during and after the construction of fills to evaluate the extent and rates of movements and to be used as a guide for the construction of surface structures.

Unforeseen or undetected conditions such as soft spots or seepage water may occur in localized areas and slides or settlements will have to be adjusted and corrected in the field as they are detected.

All grading should be done in accordance with the requirements of Chapter 23, Revised Ordinances of Honolulu, 1961 As Amended and the recommendations contained herein.
**Fills**

**Fill Construction - Lower Area**

Fill construction in the lower area, particularly along the waterway perimeters, should be kept as low as practicable.

For the construction of fills, the following are recommended:

1. All vegetation, decomposed organic matter, rubbish and other unsuitable material should be removed.

2. The ground surface should be scarified, recompacted and shaped to drain where the ground is above the high water line (about Elevation +3 ft or higher).

3. Where ponded water or a sump condition is encountered, trenches should be cut to drain the area, and a sub-drain should be installed as a permanent drain before any fill construction is started.

4. In wet or marshy areas and along the Kaneohe Bay shoreline, well-graded granular material (percentage passing No. 200 mesh of less than 15%) should be used to construct the lower portion of the fills. This material should be placed up to about 2 ft above the high water line. The surface of this fill should be proof-rolled and all soft spots dug out and replaced with select material.
Above this, the fills should be constructed at relatively slow rates in thin even lifts compacted to 90% of AASHO T-180-57 density.

5. Stockpiling and concentration of loads should be avoided. Fills should not be constructed over Elevation +8 ft M.S.L. datum.

**Fill Construction - Upper Area**

The construction of fills in the upper area should be done as follows:

1. Topsoil and stockpiled soils should be either (a) stripped to stiff natural ground or (b) scarified and recompacted before the placement of fills.

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

3. Where fills are proposed, the bottom and the sides of natural gullies and drainageways should be stripped to stiff natural ground or scarified and recompacted before the placement of fill.

4. Subdrains should be placed along the bottom of natural gullies and drainageways before the placement of fill. The final locations of subdrains should be decided in the field after clearing and grubbing.
5. All fills should be constructed in approximately level layers starting at the lower end and working upward. Where fills are made on sloping areas steeper than 5 horizontal to 1 vertical, the ground at the toe of the slope should be benched to a generally level condition. As the fill is brought up, it should be keyed into the stiff natural ground by the cutting of steps into the hillside and compacting the fill into these steps.

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

7. Sidehill or sliver fills that are less than 10 ft in width should be avoided or approached with the understanding that such fills are calculated risks and may or may not have to be repaired. Each case of sliver fills should be considered individually.

Slopes

For the construction of slopes, the following are recommended:

1. Cut and fill slopes of 2 horizontal to 1 vertical or flatter should generally be used in areas away from the waterway perimeter.

A driveway with cut slopes generally less than 15 ft in height is proposed along the southern boundary. In this area, slope ratios of about 1.5 horizontal to 1 vertical
or flatter may be considered for cuts made thru decomposed rock. It is recommended that the top of the slope be rounded off and cleared of loose boulders and debris.

2. Slopes along the waterway perimeter that extend below water should be gradual and as flat as practicable.

Cut and fill slopes of 4 horizontal to 1 vertical or flatter should be used where the slope extends below water and is constructed of well-graded coarse-grained material. A flatter slope ratio should be considered if fine-grained material is used.

3. Rip-rap underlain with a blanket of filter type material should be placed along the bayside of all waterway slopes.

4. In the upper areas, if slope heights (top to toe) of greater than 20 ft are considered, 8-ft-wide benches should be placed at height intervals of about 15 ft or less in both cuts and fills.

5. Slope adjustments or other precautions may be necessary if seepage zones or soft spots are encountered in localized areas.

6. For protection against erosion during construction, runoff water from rainstorms should be controlled by berms or other approved methods.
7. Where slopes are cut thru rocky ground, all loose outcroppings should be removed. Loose pockets and hollow spots should be cleaned out and backfilled.

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

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

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

Foundations - Lower Area
Recommendations for construction in the lower area are as follows:

1. Settlement readings should be taken during and after the placement of fills to evaluate the extent and rate of settlements. It is estimated that the primary settlements due to consolidation of the underlying compressible material will vary from several inches to a foot or more. Much of the settlements will occur during the construction period and within several months after the fills are in place.
2. House construction should be delayed until the settlement readings indicate that much of the construction settlement has taken place and that the estimated remaining settlements can be tolerated according to the limits defined by the designer for the structures and utilities.

3. Underground utilities should be constructed after the fills are constructed and before house construction starts. Flexible connections are recommended especially where lines cross structures and where lines pass from compressible to rigid ground.

4. Building foundations should be set back at least 15 ft from the top edges of waterway perimeter slopes.

5. For light residential structures placed directly on compacted fill, bearing values of about 1000 p.s.f. may be used for either slab-on-ground construction or post-and-beam construction.

Post-and-beam type of construction, however, is preferable to slab on ground on the perimeter lots, and in areas where there are transitions from compressible to non-compressible subsoils.

6. Good surface drainage away from the foundations of the proposed structures should be maintained.
7. Regrading, particularly the raising of grades along the waterway perimeter, should be avoided or done under close control.

**Foundations - Upper Area**

Recommendations for construction in the upper area are as follows:

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

2. Bearing values for a given soil usually vary with the size and depth of the footings. For light residential structures, bearing values of 1500 p.s.f. on compacted fills and 2000 p.s.f. on stiff natural ground may be used.

3. Because of the downhill creep effect of soils on a slope, some settlement may occur near the tops of slopes. Therefore, for slopes of about 15 ft or higher, buildings should be placed about 15 ft from the tops of slopes. This distance may be reduced for lower slope heights, e.g., 10 ft for 10-ft-high slopes, but in no case closer than 5 ft from the top of a slope.

4. Construction of retaining walls on side slopes should be avoided unless the underlying materials are very stiff or hard.
5. Good surface drainage away from the foundations of the proposed structures should be maintained.

Roadways

In general, a rough estimate of the roadway pavement thickness for the light residential traffic anticipated is as follows:

2. Base course - 6-in. base course.
3. Subbase course - 6-in. subbase course over a prepared subgrade.

Local adjustments regarding subbase requirements can be made in the field in accordance with the design standards of the City and County of Honolulu as the various soil conditions are encountered at subgrade levels.

It is recommended that subgrades be compacted and shaped to drain. To avoid the ponding of water and softening of the subgrade at low points, weep holes should be placed at subgrade levels thru the walls of the catch basins which are placed in these low areas.
PROPOSED SPECIFICATION FOR EARTHWORK
ALII SHORES SUBDIVISION - SECTIONS "F" AND "G"

General Description

This item shall consist of all clearing and grubbing, removing of existing structures, preparing of land to be filled, excavating and filling of the land, spreading, compacting and testing of the fill, and all subsidiary work necessary to complete the grading.

Clearing, Grubbing and Preparing Areas to be Filled

All vegetation and rubbish shall be removed, piled and burned or disposed of, leaving the disturbed areas with a neat, debris-free appearance.

All vegetable matter shall be removed from the surface upon which fill is to be placed. All topsoil and stockpiled soils shall be (1) stripped to stiff natural ground or (2) scarified and recompacted. All topsoil encountered at finish grade shall be scarified and recompacted.

All hard surfaces along the existing access roads shall be scarified down to stiff soils to match the densities of the surrounding soils.

Natural drainageways and depressions shall be stripped of loose materials. Subdrains with laterals in a herringbone pattern or filter rock blankets shall be placed before construction of fills. The final location of subdrains shall be determined in the field after clearing and grubbing.

Where ponded water or sump condition is encountered, trenches shall be cut to drain the area and a subdrain shall be installed as a permanent drain before any fill construction is started.
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 hillside and compacting the fill into these steps. Ground slopes which are flatter than 5 horizontal to 1 vertical shall be benched when considered necessary by the Soil Engineer.

**Materials**

**Fill Materials below Elevation +3 ft and in Wet Areas**

Fill material below Elevation +3 ft and in wet areas shall consist of crushed rock, coral or well-graded granular material (6-in. maximum size and less than 15% passing No. 200 sieve).

**Fill Materials above Elevation +3 ft in Dry Areas**

Fill materials shall consist of on-site or borrow soils approved by the Soil Engineer. The soils shall contain not more than a trace of organic matter and no particles larger than 6 in. in diameter. Also, it shall contain no more than 40% gravel ("4 sieve to 3 in. sieve sizes) and no more than 10% cobbles larger than gravel and smaller than 6 in. in diameter. Fill material in the top 2 ft of fills shall contain no more than 30% gravel and any material larger than gravel.

**Placing, Spreading and Compacting Fill Material**

Below Elevation +3 ft, the granular fill material may be end dumped onto the existing surface and rolled into place by equipment movement. The surface of this fill should be proof-rolled and all soft spots dug out and replaced with select material.
Above Elevation +3 ft., the select fill material shall be placed in level layers which, when compacted, shall not exceed 6 in. in thickness. Each layer shall be spread evenly and shall be thoroughly blade-mixed during the spreading to insure uniformity of material and uniformity of moisture content in each layer.

No rocks or cobbles shall be allowed to nest and all voids between rocks shall be carefully filled with small stones or earth and properly compacted.

When the moisture content of the fill material is below that specified by the Soil Engineer, water shall be added until the moisture content is as specified to assure thorough bonding during the compacting process.

After each layer has been placed, mixed and spread evenly, it shall be thoroughly compacted to not less than 90% of maximum density in accordance with AASHO Test No. T-180-57 or other density tests which will obtain equivalent results. Compaction shall be with sheepsfoot rollers, multiple-wheel pneumatic-tired rollers or other types of acceptable rollers. Rollers shall be such design that they will be able to compact the fill to the specified density. Rolling shall be accomplished while the fill material is at the specified moisture content. Rolling of each layer shall be continuous over its entire area and the rollers shall make sufficient passes to insure that the desired density has been obtained.

Field density tests shall be made by the Soil Engineer of the compaction of each layer of fill. Where sheepsfoot rollers are used, the soils may be disturbed to a depth of several inches. Density readings shall be taken in the compacted material below the disturbed surface, and as often as necessary, as determined by the Soil Engineer. When these readings indicate that the
density of any layer of fill or portion thereof is below the required 90% density, the particular layer or portion shall be reworked until the required density has been obtained.

The fill operation shall be continuous in 6-in. compacted layers, as specified above, until the fill has been brought to the finished slopes and grades as shown on the accepted plans.

Excavation

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

Unforeseen Conditions

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

Soil Engineering Services

The Soil Engineer shall observe the filling and compacting operations and make necessary tests in accordance with the specifications.

Rainy Weather

No fill material shall be placed, spread or rolled during unfavorable weather conditions. When the work is interrupted by heavy rain, fill operations shall not be resumed until field tests by the Soil Engineer indicate that the moisture content and density are as previously specified.
**Boring Log**

**PROJECT**
ALII SHORES

**SECTIONS**
F & G

**LOCATION**
HEEIA, Koolaupoko, OAHU, HAWAII

**TMK:** 4 - G - 02, 03 & 04

**HAMMER:**
Weight: 140 lb
Drop: 30 ft

**SAMPLER:**
2" STANDARD SPLIT SPOON
2" DIAMETER BLIGHT POINT

**LOCATION**
E: E.1.;
L: 60 LAUPAKOU, OAHU

**FIELD PARTY**
GLORY INOUYE, FRANK

**ELEVATION**
Datum: M.S.L.

**DEPTH**

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<th>Blows Per Foot</th>
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<td>SM</td>
<td>MEDIUM BROWN SANDY SILT, W/ GRAVEL, CORAL &amp; BOULDER</td>
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<tr>
<td>SM</td>
<td>MEDIUM DENSITY, WHITE FINE SAND &amp; CORAL</td>
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<td>SM</td>
<td>MEDIUM DENSITY GRAY SILTY SAND W/ CORAL</td>
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<tr>
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*ELEVATION ESTIMATED FROM CONTOUR PLAN*
### Boring Log

**ALII SHORES**  
**PROJECT**: SECTIONS "F" & "G"  
**LOCATION**: HEEIA, Koolaupoko, Oahu, Hawaii  
**TMK**: 4-6-02, 03 & 23

**HAMMER**:  
- **Weight**: 140#  
- **Drop**: 3.0"  
- **3/8 3" O.D. THIN WALL TUBE**

**SAMPLER**:  
- **2' 55 2' STANDARD SPLIT SPOON**

**BORING NO.**: 2  
**Driller**: WALTER LUM ASSOC.  
**Date**: 6-21-68  
**Fluid Party**: GLORY, P.A. INOUYE  
**Type of Boring**: AUGER (WINNERTMAN)  
**Diam.** 4"  
**Elev.**: 4'  
**Datum**: M.S.L.

**DRILL BIT**: T.C. ROCK BIT  
**Water Level**: 0.5' 3.0'

**Time**: 10:30 AM 4:20 PM  
**Date**: 6-21-68  

#### Penetration Data

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<td><strong>3/4&quot; O.D. Thin Wall Tube Sampler</strong></td>
<td><strong>Blows per Foot</strong></td>
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| Push / 1.5' | Push / 1.0' | Push / 0.5'

#### Description

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<td>Push / 0.5'</td>
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<td>2-F</td>
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**END OF BORING @ 26.5'**

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* Elevation estimated from contour plan
Boring Log

**ALII SHORES**

**PROJECT**

SECTIONS "F" & "G"

**LOCATION**

HEEIA, KOOLAUPOKO, OAHU, HAWAII

**TMK:** A-G-02, 03 & 03

**HAMMER:**

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

**SAMPLER:**

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

**Driller:** WALTER LUM ASSOCIATES

**Date:** 6-19-68

**Field Party:** MEYER, FRANK, SOUZA

**Type of Boring:** AUGER (MOBILE)

**Datum:** M.S.L.

**ELEVATION:** 4' - 7'

**DESCRIPTION**

- **ELEV. 4' - 7'**
- **MH:** MEDIUM, BROWN CLAYEY SILT W/DECOMPOSED ROCK
- **MH:** VERY STIFF, BROWN CLAYEY SILT W/DECOMPOSED ROCK
- **CH:** STIFF TO VERY STIFF GRAY, CLAY W/DECOMPOSED ROCK
- **ROCK OR BOULDER**
- **END OF BORING @ 11'**

**SAMPLE**

- **2.5**
- **2.5**
- **2.3**

**Sample No.**

- **3-A**
- **3-B**
- **3-C**

**Sample P.E.D.**

- **87**
- **87**
- **41**

**Sample Wet Dens.**

- **20**
- **20**
- **41**

**Sample Moist. Cont.**

- **67**
- **67**
- **67**

**Sample P.E.C.**

- **3196**
- **3196**
- **3196**

**Sample Penetration Test**

- **0**
- **0**
- **0**

**Blows Per Foot**

- **0**
- **0**
- **0**

**2" O.D. THIN WALL TUBE SAMPLER**

- ** blows / 0.5'**

**ELEVATION ESTIMATED FROM CONTOUR PLAN**
**Boring Log**

**ALII SHORES**

**PROJECT**  
SECTIONS "F" & "G"

**LOCATION**  
NIEIA, Koolaupoko, Oahu, Hawaii  
TUk: 4 - G - 02, 03 & 23

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

**SAMPLER:**  
2" DIAMETER BLUNT POINT

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**END OF BORING @ 21'**

---

* ELEVATION ESTIMATED FROM CONTOUR PLAN
**Boring Log**

**PROJECT:** ALL SHORES

**LOCATION:** HEEIA, KOOLAUPOKO, OAHU, HAWAII

**TMK:** 4-6-02, 03 & 23

---

**HAMMER:**

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

**SAMPLER:**

- 2"-5 - 2" O.D. THIN WALL TUBE
- 3"-65 - 2" STANDARD SPLIT SPOON

---

**Boring No. G**

- **Driller:** WALTER LUM ASSOC.
- **Date:** 6-7-68

**Field Party:** GLORY, INOUE, LOO

**Type of Boring:** AUGER (MINUTEMAN)

**Diam.:** 3"

**Datum:** M.S.L.

**Elev.:** T + *

**Dial Bit:** CLAY BIT

**Water Level:** 3.5'

**Time:** 3:15 PM

**Date:** 6-7-68

---

**Penetration Data:**

- **Standard Penetration Test**

---

**United Soil Classification**

- **SP:** SOFT, BROWN SANDY SILT
  - MEDIUM DENSITY WHITE, SAND & CORAL

- **SM:** STIFF, REDISH BROWN SILTY CLAY w/TRACES OF ORGANIC MATERIAL & DECOMPOSED ROCK
  - VERY LOOSE TO LOOSE LIGHT GRAY SILTY FINE SAND w/ SHELL FRAGMENTS

- **MH:** STIFF, BROWN & GRAY CLAY w/ TRACES OF DECOMPOSED ROCK

- **SH:** END OF BORING & 16'

---

**Sample No.**

- G-A
- G-B 112
- G-C 36
- G-D 111

**Blows per Foot:**

- 0
- 10
- 20
- 30
- 40

**Blows/6.5**: 2 1/2, 2 1/2, 2 1/2

---

**Elevation Estimated from Contour Plan**
**Boring Log**

**Alli Shores**

**Sections F & G**

**Project:**

**Location:** Heiau, Ko'olupoko, Oahu, Hawaii

**TMK:** 4-G-02,03 & 23

**Hammer:**

- **Weight:** 140 lb
- **Drop:** 30" (1 foot)

**Sampler:** 2' by double core, barrel tube

---

**Penetration Data**

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<td>0</td>
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<td>10</td>
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<td>NO SAMPLES RECOVERED</td>
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</table>

- **Elevations Estimated From Contour Plan**

- **Samples Obtained by Driving by Casing in Bay**

---

**Notes:**

- **Driller:** WALTER LUM ASSOC.
- **Date:** 6-28-68
- **Type of Boring:** Continuous
- **Diam.:** 2"
- **Elev.:** -2' *
- **Datum:** M.S.L.
- **Water Level:** 1.0'
- **Date & Time:** 4-28-68

---

**United Soil Classification:**

- **SP:** Medium density silty sand & coral fragments (Driller's Log)
- **SM:** Loose, gray silty sand w/ some clay & coral fragments (Driller's Log)
- **GC:** Very loose, gray clayey coral & gravel w/ sand (Cuttings)
- **SG:** Loose, gray clayey, medium to coarse sand w/shells
- **CH:** Loose, gray fine sandy clay & shells
- **SC:** Medium density gray, fine to medium clayey sand w/shells

**End of Hole @ 20'**
Boring Log

**ALII SHORES**

**PROJECT** SECTIONS 'F' & 'G'

**LOCATION** WEEIA, KOOLAUPOKO, OAHU, HAWAII

TNK: 4 - 6, 02, 03 & 23

**HAMMER:**
- Weight: 140 #
- Drop: 36"

**SA bourer:** 2" DIAMETER BLUNT POINT

---

**PEN ET RATION DATA**

- **ELEVATION:** -2' + 2'
- **Depth:** (ft)
- **Blows Per Foot**
  - 3 BLOWS PER FOOT
  - 3 BLOWS PER FOOT
  - 2 BLOWS PER FOOT
  - 2 BLOWS PER FOOT
  - 1 BLOW PER 3.00'

**END OF HOLE @ 40′**

* ELEVATION ESTIMATED FROM CONTOUR PLAN
### Boring Log

**Project:** Alii Shores Sections 'E' & 'G'  
**Location:** Kewia, Koolaupoko, Oahu, Hawaii  
**TMK:** 4-G-02, OS & 23  
**Driller:** Walter Lum Associates  
**Date:** 6-17-68  
**Field Party:** Meyer Souza  
**Type of Boring:** Auger (Portable)  
**Diam.:** 3"  
**Elev.:** 3.5'  
**Datum:** M.S.L.  
**Drill Bit:** Clay Bit  
**Water Level:** 0'  
**Time:** 12:00 PM  
**Date:** 6-17-68

### Penetration Data

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<td>10</td>
<td>3.5</td>
<td>8-A</td>
<td>78</td>
<td>157</td>
<td>29</td>
<td>364</td>
<td>300</td>
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<td>4/5</td>
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<tr>
<td>6.5</td>
<td>9.5</td>
<td>8-B</td>
<td>103</td>
<td>64</td>
<td>66</td>
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<td></td>
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<tr>
<td>5</td>
<td>15</td>
<td>8-C</td>
<td>114</td>
<td>51</td>
<td>76</td>
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<tr>
<td>16</td>
<td>16</td>
<td>8-D</td>
<td>114</td>
<td>52</td>
<td>75</td>
<td>1040</td>
<td>800</td>
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**End of Boring @ 16.'**

* Elevation estimated from contour plan.
# Boring Log

## Project
- **Sections:** "F" & "G"
- **Location:** Heeia, Koolaupoko, Oahu, Hawaii
- **TMK:** 4-6-02, 03, 4-23

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

## Sampler
- **2'5" 2" D.O.D. Thin Wall Tube
- **2'5" 2" Standard Split Spoon**

## Driller
- **Walter Lum Associates**
- **Date:** 6-12-13-68

## Field Party
- **Souza, Meyer**
- **Elev:** 5' 2"
- **Datum:** M.S.L.
- **Drill Bit:** T.C. Rockbit

## Water Level
- **Time:** 12:30 PM
- **Date:** 6-12-68

## Penetration Data

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<tr>
<th>Depth (ft)</th>
<th>Sample No.</th>
<th>Wet Density</th>
<th>P.C.F.</th>
<th>Blows Per Foot</th>
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<td>2/5</td>
<td>9-A</td>
<td>102</td>
<td>6</td>
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<tr>
<td>10</td>
<td>2/5</td>
<td>9-B</td>
<td>53</td>
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<tr>
<td>15</td>
<td>2/5</td>
<td>9-C</td>
<td>110</td>
<td>57</td>
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<tr>
<td>20</td>
<td>2/5</td>
<td>9-D</td>
<td>100</td>
<td>65</td>
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<td>25</td>
<td>2/5</td>
<td>9-E</td>
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<td>58</td>
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<td>9-F</td>
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<td>35</td>
<td>2/5</td>
<td>9-G</td>
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## Description

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<tr>
<th>Elevation</th>
<th>Description</th>
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<tr>
<td>5' 2&quot;</td>
<td>Loose to medium density, white coral fragments, sand, brown silty clay.</td>
</tr>
<tr>
<td>6&quot;-12'</td>
<td>Very soft tan silty sand.</td>
</tr>
<tr>
<td>15'</td>
<td>Very soft gray &amp; brown clayey silts, sand &amp; shells.</td>
</tr>
<tr>
<td>15'</td>
<td>Very soft gray &amp; brown clayey silts, sand &amp; shells.</td>
</tr>
<tr>
<td>20'</td>
<td>Very soft, gray &amp; brown. sandy silts &amp; traces of shells.</td>
</tr>
<tr>
<td>20'</td>
<td>Very soft, gray. silty, clay.</td>
</tr>
<tr>
<td>30'</td>
<td>Very soft, gray silty clay, gravel &amp; sand.</td>
</tr>
<tr>
<td>35'</td>
<td>Dense, brown clayey sand, gravel &amp; gravel.</td>
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</table>

END OF BORING @ 36'

* Elevation estimated from contour plan.
**Boring Log**

**PROJECT:** All Shores Section 'F' & 'G'  
**LOCATION:** Heeia, Koolauloko, Oahu, Hawaii  
**HAMILER:**  
- **Weight:** 140 lb  
- **Drop:** 30 ft  
**SAMPLER:** 2" O.D. Thin Wall Tube

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<tr>
<td>SM</td>
<td>7' 2&quot;</td>
<td>10-A</td>
<td>102</td>
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<td>LOOSE TO MEDIUM DENSITY GRAY - BROWN SILT SAND W/ CORAL FRAGMENTS</td>
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<tr>
<td>GM</td>
<td>7' 2&quot;</td>
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<td>LOOSE, GRAY - BROWN SILT CORAL W/ SAND</td>
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<tr>
<td>SC</td>
<td>7' 2&quot;</td>
<td>10-C</td>
<td>101</td>
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<td>42</td>
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<td>PUSH/1.5</td>
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<td>LOOSE, GRAY CLAYBY SAND W/ CORAL FRAGMENTS</td>
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<tr>
<td>CH</td>
<td>7' 2&quot;</td>
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<td>103</td>
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<td>PUSH/1.5</td>
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<td>VERY SOFT, GRAY CLAY W/ CORAL FRAGMENTS</td>
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<td>MH</td>
<td>7' 2&quot;</td>
<td>10-E</td>
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<td>4'/5'/5'/4'/5'/</td>
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<td>VERY SOFT TO SOFT, GRAY CLAY W/ CORAL FRAGMENTS</td>
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<td>4940</td>
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<td>1'/5'/1'5'/</td>
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<tr>
<td>END OF BORING @ 22'</td>
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* ELEVATION ESTIMATED FROM CONTOUR PLAN

**BORING NO.:** 10  
**Driller:** WALTER LUM ASSOC.  
**Date:** 6-14-86

**Field Party:** MEYER & FRANK SOUZA  
**Type of Boring:** ANGER GUGGENHEIM  
**Diam.:** 3"  
**Datum:** M.S.L.  
**Water Level:** 3.0'  
**Time:** 3:15 PM  
**Date:** 6-14-86

---

**PENETRATION DATA**

**2" O.D. TIN WALL TUBE**

**SAMPLER:**
**Boring Log**

**ALII SHORES**

**PROJECT SECTIONS 'F' & 'G'**

**LOCATION** HEEIA, KOOLAUPOKO, OAHU, HAWAII

**TMK:** 4-6-02, 03 & 23

---

**HAMMER:**

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

**SAMPLER:** 2" 5/8 STANDARD SPLIT SPOON

---

**LOCATION:** HE nei, Koolau Poko, Oahu, Hawaii

**DRILLER:** WALTER LUM

**DATE:** 6-26-63

---

**Description**

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<td>2' 3&quot;</td>
<td>11-A</td>
<td>95</td>
<td>55</td>
<td>41</td>
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<td>-</td>
<td>BLOW/1.5'</td>
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<tr>
<td>2' 5&quot;</td>
<td>11-B</td>
<td>108</td>
<td>57</td>
<td>11%</td>
<td>760</td>
<td>500</td>
<td>-</td>
<td>BLOW/1.0'</td>
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<tr>
<td>2' 5&quot;</td>
<td>11-C</td>
<td>107</td>
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<td>-</td>
<td>4' 5' - 4' 5'</td>
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<td>2' 5&quot;</td>
<td>11-E</td>
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**END OF BORING @ 21' 6''**

---

**PENDENTIATION DATA**

**STANDARD PENETRATION TEST**

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<tr>
<th>Blows per Foot</th>
<th>0</th>
<th>10</th>
<th>20</th>
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<th>40</th>
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<tr>
<td>Push/1.5'</td>
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<td>10</td>
<td>20</td>
<td>30</td>
<td>40</td>
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<tr>
<td>Push/1.0'</td>
<td></td>
<td>10</td>
<td>20</td>
<td>30</td>
<td>40</td>
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</tbody>
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---

*** ELEVATION ESTIMATED FROM CONTOUR PLAN**
# Boring Log

**Project:** All Shores  
**Sections:** "F" & "G"  
**Location:** Heeia, Koolau Poku, Oahu, Hawaii  
**TMK:** 4-6-02, 03, & 23

## Hammer:
- **Weight:** 140 lb  
- **Drop:** 30°

## Sampler:
- **2" O.D. Thin Wall Tube**

## Driller:
- Driller: WALTER LUM ASSOC.  
- Date: 6-13-63

## Field Party:
- **Name:** MEYER, FRANK, SOUZA  
- **Date:** 6-13-63

## Type of Boring:
- Auger (4-5 Jr. Diam. 3"

## Elev.:
- **Datum:** M.S.L.

## Hammer:
- **Clay Bit**

## Penetration Data:

<table>
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<td>3276</td>
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## Description:
- **MH**
  - Stiff Gray & Brown Clayey Silt w/ Decomposed Rock
  - Soft Gray & Brown Clayey Silt w/ Traces of Decomposed Rock
  - Medium to Stiff Gray & Brown Clay

## Elevation Estimated from Contour Plan
### Boring Log

**Project:** ALII SHORES  
**Sections:** "F" & "G"  
**Location:** HEEIA, KOKAUPOKO, OAHU, HAWAII  
**TMK:** 4-6-02, 03, 4-23  
**Driller:** WALTER LUM ASSOC.  
**Date:** 6-12-68

#### Hammer:
- **Weight:** 14 G#  
- **Drop:** 20"  
- **Sampler:** 2" 3/4 STANDARD SPLIT SPOON  
- **Drill Bit:** CLAY BIT

#### Penetration Data

<table>
<thead>
<tr>
<th>ELEV.</th>
<th>2' 2/7'</th>
<th>Depth (ft)</th>
<th>Sample No.</th>
<th>Wet Dens. (pcf)</th>
<th>Dry Dens. (pcf)</th>
<th>Moist. %</th>
<th>P.C.F.</th>
<th>Grav. Comp.</th>
<th>Vane Shear</th>
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<tr>
<td>M.H.</td>
<td>SOFT BROWN CLAYEY SILT W/ DECOMPOSED ROCK &amp; ORGANIC MATERIAL</td>
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<td>13-A</td>
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<td>C.H.</td>
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END OF BORING @ 16' 5"  

*ELEVATION ESTIMATED FROM CONTOUR PLAN*
## Boring Log

**ALII SHORES**  
**PROJECT**  
**LOCATION**  
**BORING NO.**  
**Sheet No.**  
**Driller**  
**Field Party**  
**Type of Boring**  
**Elev.**  
**Datum**  
**Weight**  
**Drop**  
**Sampler**  

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**LOCATION**  
**FIELD PARTY**  
**TYPE OF BORING**  
**ELEV.**  
**DATE**  

| ELEVATION ESTIMATED FROM CONTOUR PLAN |

---

**ELEVATION TEST**  
**THIN WALL TUBE SAMPLER**  
**Blows Per Foot**

- 0 10 20 30 40

---

**HARD **  
**SOFT, BROWN SILTY CLAY & ORGANIC MATERIAL**

**HARD**  
**SOFT, BROWN GRAY & TAN CLAYEY SILT**

**HARD**  
**SOFT, GRAY CLAYEY SILT (DECOMPOSED ROCK)**

**HARD**  
**COBBLES OR BOULDER**

**HARD**  
**MEDIUM REDDISH BROWN CLAYEY SILT (DECOMPOSED ROCK)**

**END OF BORING @ 24'**
**WALTER LUM ASSOCIATES**

**Boring Log**

**PROJECT**
ALL SHORES

**SECTIONS** "F" & "G"

**LOCATION**
HEEIA, KOLOAMOKO, OAHU, HAWAI

**TMK:** 4-6-02, 03, & 13

**HAMMER:**

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

**SAMPLER:** 2" O.D. THIN WALL TUBE

---

**ELEVATION ESTIMATED FROM CONTOUR PLAN**

---

<table>
<thead>
<tr>
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<td>15-A 104 31</td>
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<td>1060</td>
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<tr>
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<td>MEDIUM TO STIFF MOTTLED REDDISH BROWN &amp; GRAY CLAYEY SILT</td>
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<td>2912</td>
<td>1240</td>
<td>3/6 2/6 7/6</td>
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<td>MEDIUM TO STIFF MOTTLED REDDISH BROWN &amp; GRAY CLAYEY SILT</td>
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<td>72</td>
<td>2080</td>
<td>1200</td>
<td>2/6 4/6 1/6</td>
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**PENETRATION DATA**

- **Driller:** WALTER LUM ASSOC.
- **Date:** 6-7-68
- **Field Party:** GLORY, INOUE, LOO
- **Type of Boring:** AUGER (MOISTENED)
- **Diam.:** 3"
- **Datum:** M.S.L.
- **Water Level:** 6’O’
- **Time:** 12:15 PM
- **Date:** 6-7-68

---

*ELEVATION ESTIMATED FROM CONTOUR PLAN*
**Boring Log**

**PROJECT**
ALII SHORES
SECTIONS 'F' & 'G'

**LOCATION**
HEIAI KOKOAPOKO OAHU HAWAII
TMK: 4-6-02, 03 & 23

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

**Sampler:**
2" O.D. Thin Wall Tube

---

**Penetration Data**

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<td>16-A</td>
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<td>84</td>
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<td>16-B</td>
<td>116</td>
<td>50</td>
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<td>16-C</td>
<td>112</td>
<td>45</td>
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<tr>
<td>16-D</td>
<td>117</td>
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<td>82</td>
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**Blows Per 0.5'**

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<td>7/5</td>
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</table>

---

**Description**

- **MH**
  - MEDIUM, BROWN CLAYEY SILT 40% DECOMPOSED ROCK
  - MEDIUM TO STIFF BROWN & TAN CLAYEY SILT (DECOMPOSED ROCK)
  - SOFT TO MEDIUM TAN & GRAY CLAYEY SILT (DECOMPOSED ROCK)
  - STIFF TO VERY STIFF BROWN & GRAY CLAYEY SILT

**Elevation:** 8' 7" 7 *

---

**End of Boring @ 16'**
Boring Log

ALII SHORES

PROJECT

SECTIONS 'P' & 'G'

LOCATION  
HILIA, KOOLAUPUKU, OAHU, HAWAII

TMK: 4-6-02, 03 & 23

HAMMER:

Weight 140#
Drop 50

SAMPLER: 2" O.D. THIN WALL TUBE

BORING NO. 17  Sheet No. 1 of 1
Driller WALTER LUM ASSOC. Date 6-18-68
Field Party MEYER, SAUZA
Type of Boring AUGER (MOTORIZED) Diam. 3"
Elev. 44'-5" Datum M.S.L.
Drill Bit CLAY BIT
Water Level NOT NOTICED
Time
Date 6-17-68

Penetration Data

MISSION DATA

MEDIUM TO STIFF
BROWN
CLAYEY Silt
(DECOMPOSED ROCK)

ELEV. + 44' - 7'

MEDIUM TO STIFF
RED & TAN
CLAYEY Silt
(DECOMPOSED ROCK)

MEDIUM TO STIFF
RED & GRAY
Silty, Clay
(DECOMPOSED ROCK)

END OF BORING @ 16'

# ELEVATION ESTIMATED FROM CONTOUR PLAN
**Boring Log**

**ALII SHORES**  
**SECTION F & G**

**PROJECT**  
**HEEIA, KAAULUPOLO, OAHU, HAWAII**  
**TMK: 4-6-02,03 & 23**

**LOCATION**

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

**SAMPLER:**  
- 2" O.D. THIN WALL TUBE

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<th>Depth (ft)</th>
<th>Elev.</th>
<th>Penetration Data</th>
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<tr>
<td>30</td>
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**DESCRIPTION**

- **MH**
  - VERY STIFF, BROWN Silty CLAY w/ Decomposed Rock
  - STIFF, RED & TAN CLAYEY Silt w/ Decomposed Rock
  - MEDIUM TO STIFF, BROWN & GRAY CLAYEY Silt w/ Decomposed Rock

**ELEVATION ESTIMATED FROM CONTOUR PLAN**

**END OF BORING @ 16'**
# Boring Log

**ALII SHORES**

**PROJECT**  | SECTIONS 'E' & 'F'
---|---
**LOCATION**  | HEEIA, KOOLAUPOKO, OAHU, HAWAII
**TMK**  | 4-G-02, 03 & 23

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<td>140#</td>
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<td>Drop</td>
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| SAMPLER: | 2" O.D. TWIN WALL TUBE |

| PENETRATION DATA |
|---|---|
| 2" O.D. TWIN WALL TUBE |
| Sampler Tube | Blows Per Foot |
| 0 10 20 30 40 | 6/5 5/5 |

| ELEVATION ESTIMATED FROM CONTOUR PLAN |
|---|---|
| END OF BORING @ 16' | |

---

**BORING NO. 17**

**Driller**  | WALTER LUM ASSOCIATES
**Date**  | 6-19-68
**Field Party**  | MEYER & SOUZA
**Type of Boring**  | AUGER |
**Diameter**  | 3" |
**Datum**  | MSL |

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<td>6/5 5/5</td>
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<td>2'5&quot;</td>
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<td>1100</td>
<td>1520</td>
<td>4/5 7/5</td>
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<td>4/5 6 7/5</td>
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**UNITED CLASSIFICATION**

- **MH**: Stiff, reddish brown clayey silt w/decomposed rock
- **MH**: Stiff yellow-brown clayey silt (decomposed rock)
- **MH**: Very stiff gray-brown clayey silt (decomposed rock)

---

**NOTES**

- Water level not noted
- Time -
- Date: 6-19-68
**Boring Log**

**ALII SHORES SECTIONS "F" & "G"**

**PROJECT**
HEEIA, KOOLAUPOKO, OAHU, HAWAII

**LOCATION**
TMK: 4-6-02, 03, 4-23

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

**SAMPLER:**
2" O.D. THIN WALL TUBE

**BOARING NO.**
- Sheet No. __ of __
- Driller: WALTER LUM ASSOCIATES
- Date: 6-3-68

**FIELD PARTY:**
- GLORY, LOO, INOYE

**Type of Boring:**
- JUSER (MINUTEMAN)

**Elev.**
- 35' +

**Datum:**
- M.S.L.

**Drill Bit:**
- CLAY BIT

**Water Level:**
- NOTED

**Time:**
- __

**Date:**
- 6-3-68

---

**UNITED CLASSIFICATION**

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<td>MH STIFF, TAN, GRAY CLAYEY SILT</td>
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<td>44</td>
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<tr>
<td>MH MEDIUM TO STIFF, TAN, RED &amp; GRAY CLAYEY SILT ½ DECOMPOSED ROCK</td>
<td>20-C</td>
<td>102</td>
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<td>MH MEDIUM GRAY &amp; TAN CLAYEY SILT END OF BORING @ 14.5</td>
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**PENETRATION DATA**

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* ELEVATION ESTIMATED FROM CONTOUR PLAN
Boring Log

**PROJECT**
SECTIONS "F" & "G"

**LOCATION**
HEEIA, KOOLAUPOKO, OAHU, HAWAII

**TML:** 4 - 6 - 02, 03 & 23

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

**SAMPLER:** 2' O.D. THIN WALL TUBE

---

**DESCRIPTION**

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<th>Depth (ft.)</th>
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<th>Weight Cond.</th>
<th>Dry Den. (p.c.f.)</th>
<th>Unconf. Comp.</th>
<th>Wet Shear</th>
<th>Vane Shear</th>
<th>Blows Per Foot</th>
<th>End of Boring</th>
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**ELEVATION ESTIMATED FROM CONTOUR PLAN**
### Boring Log

**ALII SHORES**

**PROJECT**

- HEEHA, Koolaupoko, Oahu, Hawaii
- TMK: 4-6-02, 03 & 23

**LOCATION**

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

**SAMPLER:** 2" O.D. Thin Wall Tube

---

#### BORING NO. 22

**Sheet No.** of **Date**

- Boring No.: 22
- Sheet No: 5
- Date: 5-30-68

**Driller:** WALTER LUM ASSOC

**Field Party:** GLORY INOUYE

**Type of Boring:** Auger (Moblie)

**Elev.:** 47' ±

**Datum:** M.S.L.

**Doll Bit:** Clay Bit

**Water Level:** Not Noticed

---

#### Penetration Data

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<th>Depth (ft)</th>
<th>Weight</th>
<th>P.C.F.</th>
<th>Moist. Cont.</th>
<th>Blows Per Foot</th>
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<td>11,400</td>
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<tr>
<td>22-B</td>
<td>122</td>
<td>33</td>
<td>92</td>
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<tr>
<td>22-C</td>
<td>110</td>
<td>46</td>
<td>76</td>
<td>6400</td>
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<tr>
<td>22-D</td>
<td>110</td>
<td>34</td>
<td>82</td>
<td>3440</td>
<td>1740</td>
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</tbody>
</table>

**Blows 0.5'**

- 3/6, 5', 5%
- 3/6, 5', 5%
- 3/6, 5', 5%
- 3/6, 5', 5%

---

**Description**

- MEDIUM REDDISH BROWN CLAYEY Silt
- VERY STIFF REDDISH BROWN & GRAY CLAYEY Silt. Traces of Decomposed Rock
- STIFF TAN - RED - YELLOW CLAYEY Silt. Decomposed Rock
- STIFF YELLOW & BROWN CLAYEY Silt. Decomposed Rock
- END OF BORING @ 16.5'

---

*Elevation Estimated from Contour Plan*
**Boring Log**

**ALII SHORES**

**PROJECT**

SECTIONS "F" & "G"

**LOCATION**

HEEIA, KOOLAUPOKO, OAHU, HAWAII

TMK: 4-4-02, 03 & 23

**HAMMER:**

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

**SAMPLER:**

- 2.5" - 2" O.D. THIN WALL TUBE
- 2.64" - 2" STANDARD SPLIT SPOON

**Boring No. 23**

- **Driller:** WALTER LUM ASSOC
- **Date:** 5-31-68

**Field Party:** GLORY, INDY

**Type of Boring:** AUGER (MINITOWER)

**Elev.:** 60' M.S.L.

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

**Water Level:** Not Noticed

**Date:** 5-31-68

**Penetration Data**

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Sampler</th>
<th>Blows Per Foot</th>
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</thead>
<tbody>
<tr>
<td>2.5</td>
<td>23-A</td>
<td>132</td>
</tr>
<tr>
<td>5</td>
<td>23-B</td>
<td>-</td>
</tr>
</tbody>
</table>

**Very Stiff Brown Clayey Silt**

- **End of Boring @ 7.0'**

---

**Elevation Estimated From Contour Plan**
**Boring Log**

**PROJECT**
ALLI SHORES

**SECTIONS** "F" & "G"

**LOCATION**
HEEIA, KOOKUPUKO, OAHU, HAWAII

**TMK:** 4-6-02.03.4-23

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

**SAMPLER:** 2" O.D. THIN WALL TUBE

<table>
<thead>
<tr>
<th>Penetration Data</th>
<th>2&quot; O.D. THIN WALL TUBE SAMPLER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blows Per Foot</td>
<td>20 30 40 50 60</td>
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</table>

**Penetration Data**

- **HD 105 43**
- **HD 110 42 77**
- **HD 115 54**
- **HD 109 59**

**Sample No.**

- **24-A 105 43 74 10710 -**
- **24-B 110 42 77 13000 -**
- **24-C 115 54 - 24% 1000 1000**
- **24-D 109 59 69 2132 1040**

**Blows/0.5'**

- **%**
- **%**
- **%**

**Notes:**

- **ELEVATION ESTIMATED FROM CONTOUR PLAN**

Boring Log

PROJECT: SECTIONS "F" & "G"

LOCATION: KOLAUPoko, OAHU, HAWAIi

TMK: 4-6-02, 03, & 23

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

SAMPER: 2" O.D. THIN WALL TUBE

ELEV. = 92' ± 2' 0"

PENDENTIOWN DATA

2" O.D. THIN WALL TUBE SAMPLER

END OF BORING @ 31.5'

* ELEVATION ESTIMATED FROM CONTOUR PLAN
### Boring Log

**PROJECT**
ALL SHORES

**LOCATION**
HEEIA, KOOLAUPIKO, OAHU, HAWAII

**LOCATION**
TMK: 4-6-02, 03 & 23

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

**SAMPLER**
- 2" O.D. THIN WALL TUBE

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>MH</td>
<td>VERY STIFF REDDISH BROWN Silty Clay</td>
<td>5'</td>
<td>24-A</td>
<td>103</td>
<td>42</td>
<td>73</td>
<td>3.000</td>
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<tr>
<td>MH</td>
<td>STIFF TO VERY STIFF REDDISH BROWN &amp; YELLOW CLAYEY Silt (DECOMPOSED ROCK)</td>
<td>10'</td>
<td>26-B</td>
<td>102</td>
<td>37</td>
<td>75</td>
<td>5380</td>
<td>2240</td>
<td>1890</td>
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<td></td>
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<tr>
<td></td>
<td></td>
<td>15'</td>
<td>26-C</td>
<td>117</td>
<td>18</td>
<td>97</td>
<td>1760</td>
<td>1700</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>20'</td>
<td>26-D</td>
<td>92</td>
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<td>75</td>
<td>3900</td>
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**NOTES**
- ELEVATION ESTIMATED FROM CONTOUR PLAN
- PENETRATION DATA for 2" O.D. THIN WALL TUBE SAMPLER

**REMARKS**
- END OF BORING @ 16'
Boring Log

All Shores

Sections "F" & "G"

PROJECT

HEEIA, Koolaupoko, Oahu, Hawaii

LOCATION

TMK: 4-602, 03 & 23

Hammer:

Weight: 140 lbs

Drop: 30"

Sampler: 2" o.d. Thin Wall Tube

Boring No.: 27

Sheet No.: 6 of 6

Driller: WALTER LUM

Date: 6-3-62

Field Party: GLORY, ITOYUE, Loo

Type of Boring: AUGER (MOBILE)

Elev.: 57' +

Datum: M.S.L.

Drill Bit: CLAY BIT

Water Level: HILOD

Time:

Date: 6-3-62

Penetration Data

2" O.D. Thin Wall Tube Sampler

MH

Stiff to Very Stiff Brown Silty Clay

Very Stiff Reddish Brown & Gray Silty Clay (Decomposed Rock)

End of Boring @ 15.7'

Elevation Estimated From Contour Plan
Boring Log

**ALII SHORES**

**PROJECT** SECTIONS 'F' & 'G'

**LOCATION** HEIA, KOOLAUPOKO, OAHU, HAWAII

**TMK:** 4-G-02, 03 & 23

---

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

**SAMPLER:** 2' O.D. THIN WALL TUBE

---

**DESCRIPTION**

<table>
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<tr>
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<th></th>
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</thead>
<tbody>
<tr>
<td>28-A</td>
<td>34</td>
<td>71</td>
<td>8580</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4' 6&quot;</td>
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<tr>
<td>28-B</td>
<td>119</td>
<td>35</td>
<td>88</td>
<td>15020</td>
<td></td>
<td></td>
<td></td>
<td>11' 4&quot;</td>
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<td></td>
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<tr>
<td>28-C</td>
<td>110</td>
<td>39</td>
<td>79</td>
<td>35301700</td>
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<td>1240</td>
<td></td>
<td>5' 7&quot;</td>
<td></td>
<td></td>
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<tr>
<td>28-D</td>
<td>107</td>
<td>50</td>
<td>71</td>
<td>3700</td>
<td></td>
<td></td>
<td></td>
<td>3' 7&quot;</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**END OF BORING @ 14' 6"**

---

**ELEVATION ESTIMATED FROM CONTOUR PLAN**
## Boring Log

**ALII SHORES**  
**SECTIONS "F" & "G"**

### PROJECT
HEEIA, Koolaupoko, Oahu, Hawaii  
TMK: 4-6-02, 03, § 23

### LOCATION

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

### SAMPLER:
- **2" O.D. Thin Wall Tube**

### PENETRATION DATA

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<tbody>
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<td>0</td>
<td>29-A</td>
<td>99</td>
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<td>107</td>
<td>56</td>
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<td>15</td>
<td>0</td>
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<td>101</td>
<td>58</td>
<td>64</td>
<td>2800 880</td>
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<tr>
<td>20</td>
<td>0</td>
<td>29-D</td>
<td>102</td>
<td>56</td>
<td>65</td>
<td>4940</td>
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</tbody>
</table>

### DESCRIPTION

- **MH**  
  - VERY STIFF  
  - REDDISH BROWN  
  - CLAYEY SILT  

- **MH**  
  - STIFF  
  - MOTTLED REDDISH BROWN 
  - CLAYEY SILT  
  - (DECOMPOSED ROCK)

- **MH**  
  - LIGHT RED 
  - CLAYEY SILT  
  - (DECOMPOSED ROCK)

*ELEVATION ESTIMATED FROM CONTOUR PLAN*
**Boring Log**

**Alii Shores**  
**Sections F & G**

**Project:**  
**Location:** HEEIA, KOOALAPOKO, OAHU, HAWAII

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

**Sampler:** 2" O.D. Thin Wall Tube

---

**Penetration Data**

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<th>Depth (ft)</th>
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<th>20</th>
<th>30</th>
<th>40</th>
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</thead>
<tbody>
<tr>
<td><strong>MH</strong></td>
<td>MEDIUM TO STIFF REDDISH BROWN CLAYEY SILT (DECOMPOSED ROCK)</td>
<td>103'</td>
<td>7'</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>30-A</td>
<td>92</td>
<td>36</td>
<td>68</td>
<td>8736</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>30-B</td>
<td>103</td>
<td>50</td>
<td>73</td>
<td>5720</td>
<td>-</td>
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<tr>
<td></td>
<td>30-C</td>
<td>118</td>
<td>51</td>
<td>78</td>
<td>3276</td>
<td>1900</td>
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<td></td>
<td>30-D</td>
<td>108</td>
<td>50</td>
<td>72</td>
<td>2600</td>
<td>1640</td>
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</tbody>
</table>

**MH** | STIFF TO VERY STIFF RED CLAYEY SILT (DECOMPOSED ROCK) | 10 | 9' | | | |
| | 30-E | 118 | 51 | 78 | 3276 | 1900 | | | | | |
| | 30-F | 108 | 50 | 72 | 2600 | 1640 | | | | | |

**END OF BORING @ 165'**

---

**Elevation Estimated from Contour Plan.**
**Boring Log**

**Project:** Alii Shores

**Location:** Heeia, Koolau, Oahu, Hawaii

**TMK:** 4-6-02, 03, & 23

---

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

**Sampler:** 2" O.D. Thin Wall Tube

---

**Penetration Data**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Heeia</td>
<td>86'</td>
<td>5&quot;</td>
<td>31-A</td>
<td>106</td>
<td>41</td>
<td>75</td>
<td>1,630</td>
<td>1,900</td>
<td>7/5</td>
<td>7/5</td>
<td>7/5</td>
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<tr>
<td>Heeia</td>
<td>90'</td>
<td>10&quot;</td>
<td>31-B</td>
<td>102</td>
<td>39</td>
<td>72</td>
<td>1,800</td>
<td>1,800</td>
<td>7/5</td>
<td>7/5</td>
<td>7/5</td>
</tr>
<tr>
<td>Heeia</td>
<td>95'</td>
<td>15&quot;</td>
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<td>111</td>
<td>49</td>
<td>74</td>
<td>3,540</td>
<td>1,880</td>
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<td>Heeia</td>
<td>100'</td>
<td>20&quot;</td>
<td>31-D</td>
<td>102</td>
<td>52</td>
<td>67</td>
<td>2,840</td>
<td>1,000</td>
<td>7/5</td>
<td>7/5</td>
<td>7/5</td>
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<td>Heeia</td>
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<td>7/5</td>
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<td>Heeia</td>
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<td>35&quot;</td>
<td>31-G</td>
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<td>89</td>
<td>2,180</td>
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<td>7/5</td>
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*Elevation Estimated from Contour Plan*
# TABLE I-A - SUMMARY OF LABORATORY TEST RESULTS

<table>
<thead>
<tr>
<th>BORING NO.</th>
<th>SAMPLE NO.</th>
<th>DEPTH BELOW SURFACE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>F</td>
<td>33'-34.5'</td>
<td>GRAY BROWN CLAYEY Silt</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10'-11.5'</td>
<td>GRAY BROWN CLAYEY CERAL</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15'-16'</td>
<td>GRAY BROWN CLAYEY SAND</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15'-16'</td>
<td>SANDY Silt ORGANIC MAT</td>
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## GRADING ANALYSIS (% Passing)

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<tr>
<th>Sieve</th>
<th>1&quot;</th>
<th>1.5&quot;</th>
<th>1/4&quot;</th>
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<th>#20</th>
<th>#40</th>
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<td>100</td>
<td>100</td>
<td>100</td>
<td>77.5</td>
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<td>77.5</td>
<td>60.7</td>
<td>60.2</td>
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<td>99.9</td>
<td>97.7</td>
<td>65.9</td>
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<td>58.1</td>
<td>55.0</td>
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<td></td>
<td>99.3</td>
<td>97.7</td>
<td>94.6</td>
<td>64.8</td>
<td>60.7</td>
<td>57.1</td>
<td>55.0</td>
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<td>96.1</td>
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<td>93.7</td>
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<td>60.7</td>
<td>57.1</td>
<td>55.0</td>
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<td>75.7</td>
<td>83.7</td>
<td>83.7</td>
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<td>49.2</td>
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<td>20.0</td>
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## ATTERBERG LIMITS

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<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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<tr>
<td></td>
<td>NATURAL</td>
<td>68</td>
<td>45</td>
<td>25</td>
<td>QUICK</td>
<td>SLIGHT-MED</td>
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<td>NATURAL</td>
<td>78</td>
<td>45</td>
<td>25</td>
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<td>SLIGHT-MED</td>
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<td>78</td>
<td>40</td>
<td>37</td>
<td>SLOW</td>
<td>MEDIUM</td>
<td>MEDIUM</td>
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## UNIFIED SOIL CLASSIFICATION

|        | MH                | MH-CH          | GC            | GC             | SC          |

## SPECIFIC GRAVITY

|        |                   |                |               |                |             |

## EXPANSION AND CBR TESTS

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

## COMPACTION TEST

(AASHO T-180-57 Method)
- Dry to Wet or Wet to Dry
- Max. Dry Density (P.C.F.)
- Optimum Moisture (%)
### TABLE I-9 - SUMMARY OF LABORATORY TEST RESULTS

<table>
<thead>
<tr>
<th>BORING NO.</th>
<th>3</th>
<th>4</th>
<th>A*</th>
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<tbody>
<tr>
<td>SAMPLE NO.</td>
<td>C</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>DEPTH BELOW SURFACE</td>
<td>1'-10.5</td>
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<td>SURFACE</td>
</tr>
<tr>
<td>DESCRIPTION</td>
<td>GRAY CLAY WASTE COMPOUND</td>
<td>ROCK</td>
<td></td>
</tr>
</tbody>
</table>

#### GRADING ANALYSIS (% Passing)

<table>
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<tr>
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<th>½&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>Pass</td>
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#### ATTERBERG LIMITS

<table>
<thead>
<tr>
<th>Air Dried or Natural</th>
<th>Liquid Limit</th>
<th>Plastic Limit</th>
<th>Plasticity Index</th>
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<tbody>
<tr>
<td></td>
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<tr>
<td></td>
<td>77</td>
<td>75</td>
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<tr>
<td>Dilatancy</td>
<td>SLOW</td>
<td>NONE</td>
<td>MED-QUICK</td>
</tr>
<tr>
<td>Toughness</td>
<td>HIGH</td>
<td>MED-HIGH</td>
<td>SLIGHT-MED</td>
</tr>
<tr>
<td>Dry Strength</td>
<td>MEDIUM</td>
<td>MEDIUM</td>
<td>SLIGHT-MED</td>
</tr>
</tbody>
</table>

#### UNIFIED SOIL CLASSIFICATION

| CH | CH | OH |

#### SPECIFIC GRAVITY

| 2.58 |

#### EXPANSION AND CBR TESTS

(Surcharge-51 P.S.F.)

| Molding Moisture Content, % | 46.8 |
| Molding Dry Density, P.C.F. | 69.8 |
| Swell upon saturation, %    | 1.2  |
| CBR at 0.1" Penetration     | 5.3  |

#### COMPACTION TEST

(AASHO T-180-57 Method)

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

*Indicates samples taken adjacent to boring no.
**TABLE I C - SUMMARY OF LABORATORY TEST RESULTS**

<table>
<thead>
<tr>
<th>BORING NO.</th>
<th>9</th>
<th>9</th>
<th>9</th>
<th>11</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAMPLE NO.</td>
<td>B</td>
<td>C</td>
<td>E</td>
<td>A*</td>
<td>B*</td>
</tr>
<tr>
<td>DEPTH BELOW SURFACE</td>
<td>5'-6.5'</td>
<td>10'-12'</td>
<td>20'-22'</td>
<td>BORE</td>
<td>GRAY &amp; BROWN</td>
</tr>
<tr>
<td>DESCRIPTION</td>
<td>GRAY-BROWN CLAYEY SILT</td>
<td>BROWN &amp; SHELLS</td>
<td>SILTY CLAY</td>
<td>W/FRAC. OF DECOM. ROCK</td>
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</tr>
<tr>
<td>DESCRIPTION</td>
<td>TAN SILTY SAND</td>
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<td></td>
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</table>

**GRADING ANALYSIS** (% Passing)

<table>
<thead>
<tr>
<th>Sieve</th>
<th>1&quot;</th>
<th>½&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>
<tr>
<td></td>
<td>100</td>
<td>100</td>
<td>93.0</td>
<td>72.4</td>
<td>77.7</td>
<td>66.8</td>
<td>46.9</td>
<td>39.5</td>
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</tbody>
</table>

**ATTERBERG LIMITS**

| Air Dried or Natural Liquid Limit | Natural | 62 | 94 | 81 | 98 |
| Plastic Limit | 35 | 42 | 71 | 48 |
| Plasticity Index | 27 | 52 | 54 | 53 |

| Dilatancy | MEDIUM | SLOW-MED | MEDIUM | SLOW |
| Toughness | SLIGHT | HIGH | MEDIUM | MEDIUM |
| Dry Strength | SLIGHT | MEDIUM | SLOW-MED | SLOW-MED |

**UNIFIED SOIL CLASSIFICATION**

| SM | MH | MH | CH | MH |

**SPECIFIC GRAVITY**

| | | | | | |

**EXPANSION AND CBR TESTS** (Surcharge-51 P.S.F.)

| Molding Moisture Content, % | | | | | | 28.7 |
| Molding Dry Density, P.C.F. | | | | | 102.4 |
| Swell upon saturation, % | | | | | | 0.1 |
| CBR at 0.1" Penetration | | | | | | 7.7 |

**COMPACITION TEST** (AASHO T-180-57 Method)

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

* Indicates sample taken adjacent to Boring No.
TABLE I.D. — SUMMARY OF LABORATORY TEST RESULTS

<table>
<thead>
<tr>
<th>BORING NO.</th>
<th>15</th>
<th>18</th>
<th>24</th>
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<tbody>
<tr>
<td>SAMPLE NO.</td>
<td>A</td>
<td>A</td>
<td>C</td>
<td>B</td>
<td>A</td>
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<td>DEPTH BELOW SURFACE</td>
<td>0'-2'</td>
<td>0'-1.2'</td>
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<td>5'-6'</td>
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<tr>
<td>DESCRIPTION</td>
<td>REDDISH-BROWN</td>
<td>BROWN</td>
<td>REDDISH-BROWN &amp; GRAY</td>
<td>RED</td>
<td>CLAYEY SILT (DECOMP. ROCK)</td>
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<tr>
<td></td>
<td>SULTY CLAY</td>
<td>WEDCOMP. ROCK</td>
<td>SULTY CLAY</td>
<td>SULTY CLAY</td>
<td>(DECOMP. ROCK)</td>
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<table>
<thead>
<tr>
<th>GRADING ANALYSIS</th>
<th>(%) Passing</th>
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<tr>
<td>Sieve 1&quot;</td>
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<tr>
<td>1/2&quot;</td>
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<table>
<thead>
<tr>
<th>ATTERBERG LIMITS</th>
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<tbody>
<tr>
<td>Liquid Limit</td>
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<td>Plastic Limit</td>
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<td>Plasticity Index</td>
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<table>
<thead>
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<th>SLOW-MED</th>
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<tr>
<td>Toughness</td>
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<td>MEDIUM</td>
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<td>SLIGHT-MED</td>
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<tr>
<td>Dry Strength</td>
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<td>MEDIUM</td>
<td>SLIGHT-MED</td>
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<table>
<thead>
<tr>
<th>UNIFIED SOIL CLASSIFICATION</th>
<th>MH</th>
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<tbody>
<tr>
<td>SPECIFIC GRAVITY</td>
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<thead>
<tr>
<th>EXPANSION AND CBR TESTS</th>
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<tbody>
<tr>
<td>(Surcharge-51 P.S.F.)</td>
<td></td>
</tr>
<tr>
<td>Molding Moisture Content, %</td>
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<tr>
<td>Molding Dry Density, P.C.F.</td>
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</tr>
<tr>
<td>Swell upon saturation, %</td>
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</tr>
<tr>
<td>CBR at 0.1&quot; Penetration (%)</td>
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<table>
<thead>
<tr>
<th>COMPACTION TEST</th>
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<tbody>
<tr>
<td>(AASHO T-180-57 Method)</td>
<td></td>
</tr>
<tr>
<td>Dry to Wet or Wet to Dry</td>
<td></td>
</tr>
<tr>
<td>Max. Dry Density (P.C.F.)</td>
<td></td>
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<tr>
<td>Optimum Moisture (%)</td>
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</tr>
</tbody>
</table>

* Indicates sample taken adjacent to Boring No.
JOB: ALL SHORES, SECTIONS "F" & "G"

LOCATION: HEEIA, Koolaupoko, Oahu, Hawaii

---

PLASTICITY CHART

* INDICATES SAMPLE TAKEN ADJACENT TO BORING NO.
CONSOLIDATION TEST
LOAD-DEFLECTION CURVE

ALL SHORES
SECTIONS "F" & "G"
HEEIA, KUALUPUKU
OAHU, HAWAII

SAMPLE: 196.5'78

BEFORE TEST:
WATER CONTENT = 70%
DRY DENSITY = 112 lb/ft³

AFTER TEST:
WATER CONTENT = 36%
DRY DENSITY = 178 lb/ft³

LIQUID LIMIT = 43
PLASTIC LIMIT = 45
PLASTIC INDEX = 72
CONSOLIDATION TEST
LOAD-DEFLECTION CURVE

ALL SHORES
SECTIONS "F" & "G"
HEEIA, "KOOLAUPOKO"
OAHU, HAWAII

SAMPLE 1-F & 25-64.5

BEFORE TEST:
WATER CONTENT = 71%
DRY DENSITY = 64.10%

AFTER TEST:
WATER CONTENT = 58%
DRY DENSITY = 66.90%

LIQUID LIMIT = 17
PLASTIC LIMIT = 15
PLASTIC IND vivid. 18
GENERAL TESTING METHODS

EXPLORATORY BORINGS AND SAMPLING

Method for soil investigation and sampling by auger borings (Tentative)

Method for thin wall tube sampling of soils (Tentative)

Method for penetration test and split barrel sampling of soils (Tentative)

LABORATORY TESTING

Grading Analysis

Sieve analysis of fine and coarse aggregates

Amount of material finer than No. 200 sieve in aggregate

Atterberg Limits

Determining the liquid limit of soils
Modified as follows: Substitute Casagrande grooving tool. Tests conducted from natural moisture content unless noted otherwise.

Determining the plastic limit of soils

Calculating the plasticity index of soils

Specific Gravity

Specific gravity of soils
Modified as follows: 500 ML Pycnometer

Expansion and CBR Tests

Expansion test and California Bearing Ratio (CBR)

Compaction Test

Moisture-Density relations of soils using a 10# rammer and an 18" drop

Unified Soil Classification

ASTM Designation: D 1452-63T

ASTM Designation: D 1587-63T

ASTM Designation: D 1586-64T

AASHO Designation: T 27-60

AASHO Designation: T 11-60

AASHO Designation: T 89-60

AASHO Designation: T 90-56

AASHO Designation: T 91-54

AASHO Designation: T 100-60

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

AASHO Designation: T 180-57

Designation E-3 from "Earth Manual" by the United States Department of the Interior Bureau of Reclamation
LIMITATIONS

In general, soil formations are commonly erratic and rarely uniform or regular. The borings indicate the subsurface soil conditions encountered only at the drill holes where the borings were made. During construction, should subsurface conditions much different from those in the borings be observed, encountered, or otherwise indicated, we would be advised immediately to review or reconsider our recommendations in light of the new developments. The owner, architect, or engineer should make certain that the recommendations are incorporated into the plans and are properly carried out during construction.