SOIL INVESTIGATION FOR RESIDENTIAL AND APARTMENT DEVELOPMENT

HALE'IIMA RESORT DEVELOPMENT - UNIT I

KAHALOA, KALALUA, OAHU, HAWAI'I

TAX MAP KEY: 6-2-01: 1 & 10

By

WALTER LUM ASSOCIATES, INCORPORATED

CIVIL ENGINEERS

April 5, 1963
April 5, 1965

Mr. George Houghtaling
Community Planning, Inc.
233 Merchant Street
Honolulu, Hawaii 96813

Dear Mr. Houghtaling:

Subject: Haleiwa Resort Development - Unit I
Chapter 23, Revised Ordinances of Honolulu, 1961 As Amended

In accordance with your request, an investigation was made of the
underlying soil conditions at the proposed residential and apartment
development site for the Haleiwa Resort Development - Unit I at
Kawaihae, Waialua, Oahu, Hawaii, Tax Map Key: 6-2-01: 1 & 10.

From the field investigations and laboratory test results, it is our
opinion that the area can be suitably developed for the proposed project.
The proposed houses and light buildings can be supported either directly
on the native soils or on properly compacted fills constructed from
the native soils.

In our opinion, if the site conditions do not vary greatly from that
indicated by the borings, the above site can be developed without
objectionable effects upon surrounding properties or upon public health
or safety. All earthwork should be done in accordance with Chapter 23,
Revised Ordinances of Honolulu, 1961 As Amended and the recommendations
contained herein.

The accompanying report includes a boring location plan, logs of the
subsurface explorations, laboratory test results, conclusions and
recommendations.

Respectfully submitted,

WALTER LUM ASSOCIATES, INC.

Ezra Koike
Registered Engineer No. 1450

ER:es
# CONTENTS

| SCOPE OF INVESTIGATION | 1 |
| FIELD INVESTIGATIONS | 1 |
| LABORATORY TESTS | 2 |
| SOIL CONDITIONS | 2 |
| ROADWAYS | 3 |
| FILLS | 4 |
| SLOPES | 5 |
| PLANTING | 6 |
| FOUNDATIONS FOR HOUSING UNITS | 6 |
| CONCLUSIONS AND RECOMMENDATIONS | 7 |

GUIDE SPECIFICATION FOR EARTHWORK

GUIDE SPECIFICATION FOR PLANTING

GUIDE SPECIFICATION FOR SELECT MATERIAL

APPENDICES:

A. BORING LOCATION PLAN -- Figure 1

B. LOGS OF BORINGS -- Borings No. 1 thru 13

C. SUMMARY OF LABORATORY TEST RESULTS -- Tables IA thru IC
REPORT

ON

SOIL INVESTIGATION FOR RESIDENTIAL AND APARTMENT DEVELOPMENT

HALEIWA RESORT DEVELOPMENT - UNIT I

KAMEHALOA, WAIALUA, OAHU, HAWAII

TAX MAP KEY: 6-2-01: 1 & 10

SCOPE OF INVESTIGATION

The purpose of this investigation was to determine the general suitability of the proposed site, Haleiwa Resort Development - Unit I at Kawailoa, Waialua, Oahu, Hawaii for residential and apartment development.

This report includes field investigations, laboratory tests, conclusions and recommendations regarding the native soils at the site.

FIELD INVESTIGATIONS

A series of thirteen test borings were made at the site. The locations of these borings are shown on Figure 1. Ground conditions as indicated by these borings are shown on the Boring Logs Nos. 1 thru 13. Both disturbed and undisturbed samples were collected during the boring operations.
Soil samples were visually identified and tentatively classified in the field. In the laboratory, these samples were further subjected to appropriate tests. The field identifications 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: in-place natural density, moisture content, and unconfined compression; Atterberg limits; specific gravity; gradation; AASHO T-180-57 density; expansion and C. B. R.

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

SOIL CONDITIONS

The project site lies between Kamohama Highway and the Pacific Ocean about 2500 feet north of Haleiwa Beach Park. The ground generally slopes gently upward from the Kamohama Highway area toward a low berm-like strip along the shoreline.

In general, the site is an abandoned air field now used as a beach park. A portion of an old air strip crosses the south corner of the site where small rubbish piles were evident along the edges. An old abandoned sewage treatment plant was encountered near the ocean side of the site. Old sorghum cane fields and pasture areas occupied the east
portion of the site. An old sand borrow pit partially backfilled with
some boulders and crushed rock was found in the southwest corner of
the site.

The borings generally indicated varying surface layers of beach
sand and silt underlain by coral rock formations. The thickness of the
silt and sand soils varied from a few feet in the lower areas near
Kamahameha Highway to over 15' in the berm-like area near the shoreline.
The coral rock was generally soft to medium with pockets of dense sand
and streaks of hard coral.

No trace of seepage water was noticed at the project site during
the boring operations. The ground water table was encountered in most
of the borings at about elevation 1'.

Blow counts during sampling operations indicated that the sandy
soils below the topsoil layer were generally medium dense. The coral
rock formations generally recorded very high blow counts. These
penetration-resistance readings indicate that the in-place strengths
of the soils are adequate to support the proposed fills and light
buildings without undue settlement. When properly compacted into fills,
the native soils will adequately support the proposed light structures.

ROADWAYS

In general, a 6-inch base course on 6 inches of compacted on-site
sandy soils is sufficient for the light traffic anticipated. Silt soils
encountered at subgrade levels may be replaced with on-site sandy soils. The thickness of subgrade replacement can be adjusted in the field.

The design standard of the City and County of Honolulu require the following:

1. A 6-inch base course on 6 inches of compacted existing soil where the expansion of the existing soil is less than 1%.

2. A 6-inch base course on a 6-inch subbase of select material where the expansion of the existing soil is greater than 1% and less than 3%.

3. A 6-inch base course and a 4-inch select borrow subbase course on a 12-inch subbase of select material where the expansion of the existing soil is greater than 3% and less than 6%.

FILLS

It is essential that all fills be constructed and compacted according to Chapter 23 of the Revised Ordinances of Honolulu, 1961 As Amended, and the "Guide Specification for Earthwork" attached hereto.

For this project, the following is recommended:

1. For compaction of sandy soils, the material should be wetted and compacted with vibratory equipment.
(2) Boulders from the sand borrow pit may be used in the deeper fills but should be kept at least 3' below the finish grades. Boulders should be spread so that no nesting occurs and sandy on-site soils should be compacted between them to fill all voids.

(3) Existing pavements should be stripped and the subgrade scarified and recompacted to match the surrounding ground before placing fills over the area. The existing pavement may be ripped and crushed into small pieces to be used in the deeper fill areas. On-site sandy soils should be mixed thoroughly with the crushed rocks to fill all voids.

SLOPES

Cut slopes of 1\(\frac{1}{4}\) horizontal to 1 vertical in medium dense sandy soils should be adequately stable against slides. Cut slopes of 3/4 horizontal to 1 vertical in coral rock formations should be adequately stable. However, abrupt slope changes should be avoided within the same slope.

Fill slopes of 1\(\frac{1}{4}\) horizontal to 1 vertical should result in satisfactorily stable slopes.

For protection against erosion during construction, it is recommended that runoff water during times of rain be controlled by berms or other approved methods.
PLANTING

In order to protect both cut and fill slopes in sandy and silty soils, early slope planting is recommended. The various grasses such as manienie grass, buffalo grass and human grass are suitable for this purpose. For a dry site, manienie grass is probably best provided it can be watered regularly. In shady areas, buffalo grass is better. For moist ground, human grass is preferable. For additional information, see the "Guide Specification for Planting" attached hereto.

FOUNDATIONS FOR HOUSING UNITS

If earthwork operations are controlled properly, the soils will support without undue settlement the proposed light building construction.

Bearing values for a given soil usually vary with the size and depths of the footing. It is recommended that footings extend at least 18" below finish grades. Bottom of footing excavations should be tamped before pouring of concrete.

Bearing values of about 3000 p.s.f. may be used in undisturbed ground and about 2000 p.s.f. on properly compacted fills.

Floor slabs should be laid on a 4-inch layer of select material, properly compacted. The edges of slabs should be turned down at least 12" below finish grades.

Good surface drainage, away from the building area is essential in all cases.
CONCLUSIONS AND RECOMMENDATIONS

From the results of field investigations and laboratory tests, the following conclusions have been drawn:

(1) The native soils have sufficient bearing values to support the proposed fills, buildings and appurtenances. Fills constructed properly from the native soils will have sufficient strength to adequately support the proposed light buildings and structures.

(2) Abandoned concrete structures and A. C. pavements should be removed from the surface upon which fill is to be placed. The cleared surface should be scarified and recompacted to match the surrounding ground before fill construction.

(3) All rubbish piles and loose stockpiles should be stripped to stiff ground. Loose topsoil should be recompacted before placing of fills over the area. All loose topsoil at finish grades should be recompacted.

(4) Early slope planting is recommended to protect the sandy soils from erosion.

(5) Adequate drainage to protect cut and fill areas and all slopes should be provided.

In view of the above, it is concluded that the site is suitable for the proposed development.
GUIDE SPECIFICATION FOR EARTHWORK

HALEIWA RESORT DEVELOPMENT - UNIT I

General Description

This item shall consist of all clearing and grubbing, removal of existing structures, preparation of land to be filled, filling of the land, spreading, compaction and testing of the fill, and all subsidiary work necessary to complete the grading of the filled areas to conform with the lines, grades and slopes as shown on the accepted plans.

Clearing, Grubbing, and Preparing Areas to be Filled

All timber, logs, trees, brush and other rubbish shall be removed, piled and burned or otherwise disposed of so as to leave the areas that have been disturbed with a neat and finished appearance free from unsightly debris.

All abandoned concrete structures and pavements shall be removed from the surface upon which the fill is to be placed. The cleared surface shall be scarified and recompacted to match the surrounding soils. All loose mounds of stockpiled soils shall be stripped to natural ground before placing any fills over the area. All loose topsoil encountered at finish grades shall be recompacted.

Where fills are made on the sloping areas steeper than 5 horizontal to 1 vertical, the ground at the toe of the slope shall be benched to an essentially level condition before filling is started. Fill as it is brought up 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 5:1 shall be benched when considered necessary by the Soils Engineer.
Materials

Fill material shall consist of on-site or off-site soil which is approved by the Soils Engineer, and which has been identified in a soil engineering report. The soils shall contain not more than a trace of organic matter. Fill material placed in the top one foot of fills shall contain not more than 30% gravel (0.4 x 3"), and it shall contain no material larger than gravel.

Placing, Spreading and Compacting Fill Material

The selected fill material shall be placed in level layers which, when compacted, shall not exceed six inches (6"). 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 shall be allowed to rest and all voids between rocks must be carefully filled with small stones or earth and properly compacted. No rocks will be permitted higher than twenty-four inches (24") below the finished grade.

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

When the moisture content of the fill material is above that specified by the Soils Engineer, the fill material shall be aerated by blading or other satisfactory methods until the moisture content is as specified.
After each layer has been placed, mixed and spread evenly, it shall be thoroughly compacted to not less than eighty-five percent (85\%) of maximum density in accordance with AASHO Test No. T-130-57 or other density tests which will obtain equivalent results. Compaction shall be with vibratory rollers, sheepfoot 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 roller shall make sufficient passes to insure that the desired density has been obtained.

Field density tests shall be made by the Soils Engineer of the compaction of each layer of fill. Density tests may be made at intervals not exceeding two feet (2') of fill height provided all layers are tested. Where sheepfoot rollers are used, the soil 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 Soils Engineer. When these readings indicate that the density of any layer of fill or portion thereof is below the required eighty-five percent (85\%) density, the particular layer or portion shall be reworked until the required density has been obtained.

The fill operation shall be continued in six-inch (6") compacted layers, as specified above, until the fill has been brought to the finished slopes and grades as shown on the accepted plans.
Soil Engineering Services

The Soils Engineer shall observe the fill and compacting operation and make necessary tests so that he can certify that the fill was made 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 Soils Engineer indicate that the moisture content and density of the fill are as previously specified.
GUIDE SPECIFICATION FOR PLANTING

Planting materials shall be hunnan grass, buffalo grass, or manienie. In damp areas where manienie will not thrive, hunnan grass shall be planted. In shaded areas, buffalo grass shall be planted.

Planting materials shall be obtained by digging up luxuriant growths thereof from areas that are free of seeds, roots, plants, and grasses that are objectionable. Plant and water within twenty-four (24) hours after digging from original growing position.

Grasses for planting shall be in short lengths of approximately four-inch (4") runners. Planting shall be done in staggered rows twelve inches (12") apart over areas previously topsoiled. After planting, cover with one-half inch (1/2") of additional topsoil. Flat areas shall be rolled with lawn roller. Water soon after planting and continue daily until growth sufficient to form complete cover has been achieved. Any area that does not catch, shall be replanted.

Apply 10-10-2 fertilizer after two (2) to three (3) months at the rate of eight hundred (800) pounds per acre. Initial maintenance shall be continued until stabilization has been completed.
GUIDE SPECIFICATION FOR SELECT MATERIAL

Materials

The select material for use under floor slabs shall consist of crushed rock, quarry waste, dredged coral, black sand, or other material as approved by the Soils Engineer. It shall be free from adobe, organic matter, and other such deleterious substances.

Grading

The select material shall conform to the following gradations:

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<th>Sieve</th>
<th>% Passing</th>
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<td>3&quot; Sq.</td>
<td>Not less than 95%</td>
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<td>#40</td>
<td>Not more than 15%</td>
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<tr>
<td>#200</td>
<td>2 - 6%</td>
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</table>

The portion passing the #40 sieve shall have a liquid limit and plasticity index not exceeding 45 and 10 respectively.

Compacting

The select material shall be properly moistened, if necessary, and thoroughly compacted with hand and/or pneumatic tools.
Boring Log

PROJECT: HALEIWA RESORT DEVELOPMENT
LOCATION: KAWAILOA, WAIKALUA

HRC: G-2.01 14:16

HAMMER:
Weight: 10 lb. SLEDGE HAMMER
Drop:...

SAMPLER: 2" o.d. SHELBY TUBE

DESCRIPTION

LOOSE, BROWN SILTY SAND
HARD CORAL CRUST

MEDIUM DENSE
LIGHT GRAY SAND & SHELLS
(HOLE PARTIALLY CAVED IN AT 3')

SOFT TO MEDIUM
CORAL ROCK
W/POCKETS OF DENSE SAND
& STREAMS OF HARD CORAL
Boring Log

PROJECT: HALEIWA RESORT DEVELOPMENT - UNIT I
LOCATION: KAWAILOA, WAIALUA, OAHU, HAWAII
TMK: G-2-01: 19 10

HAMMER:
- Weight: 10 lb. SLEDGE HAMMER
- Drop: 

SAMPLER: 2" O.D. SHELBY TUBE

DESCRIPTION

Loose, Brown, Silty Sand

Medium Brown Clayey Silt

SOFT TO MEDIUM CORAL ROCK
W/ POCKETS OF DENSE SAND
& STREAKS OF HARD CORAL
## Boring Log

**PROJECT:** HALEIWA RESORT DEVELOPMENT - UNIT I  
**LOCATION:** KANAWA, WAIALUA, OAHU, HAWAII  
**HAMMER:** WEIGHT: 10 16, SLEDGE HAMMER  
**SAMPLER:** 2" O.D. SHELBY TUBE  
**Driller:** W. LUM ASSOC., INC.  
**Field Party:** KUSANO, MORALES  
**Type of Boring:** GHP MOBILE DRILL  
**Date:** 3-25-65

### DESCRIPTION

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**Soft to Medium Coral Rock w/ pockets of sand & streaks of hard coral**  
**Medium Dense Brownish White Silty, Beach Sand**  
**Hard White Coral Rock**  
**Water**
Boring Log

PROJECT: HALEIWA RESORT DEVELOPMENT - UNIT I
LOCATION: KAWAILOA, WAIALUA, OAHU, HAWAII

TMK 6-2-01: 1410

HAMMER:
- Weight: 140 lb. HAMMER
- Drop: 30”

SAMPLER: 2” O.D. SHELBY TUBE

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BORING NO.  5  Sheet No.  of  
Driller: W. LUM ASSOCIATES, INC.  Date 3-18-65
Field Party: KUSANO, GLORIA, GANZAGAN
Type of Boring: C.N.P. MOBILE DELL
Date: 3-18-65

Water Level: NONE
Time:

Blows Per Foot: 0 10 20 30 40

Datum: 0

Elev.

Date: 3-18-65
Boring Log

**PROJECT**  
Haleiwa Resort Development - Unit I

**LOCATION**  
Kaaawa, Waialua, Oahu, Hawaii

**HAMMER:**  
Weight: 140 lb. hammer  
Drop: 30°

**SAMPLER:**  
2" O.D. Shelby Tube

**DESCRIPTION**

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LOOSE WHITE BEACH SAND

MEDIUM DENSE BROWN Silty SAND

SOFT TO MEDIUM CORAL ROCK

W/PocketS OF Silty SAND & streaks OF HARD CORAL

MEDIUM CORAL ROCK

---

**ELEV.**

Water Level 5.4'

Time 1:00 P.M.

Date 3-19-65
# Boring Log

**Project:** Haleiwa Resort Development - Unit I  
**Location:** Kawailoa, Wailua, Oahu, Hawaii  
**TMK:** G-2-01-1410  
**Hammer:**  
- Weight: 140 lb. Hammer  
- Drop: 30"  
**Sampler:** 2" O.D. Shelby Tube  
**Date:** 3-23-65  
**Field Party:** Kusano, Gloria, Ganagan  
**Type of Boring:** C.H.P. Mobile Drill  
**Diam.:** 3"  

## Description of Sediments

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- **Drill Log**: Continuous Dynamic Penetration Test with 2.4" Cone Point  
- **Blows Per Foot**: 0 10 20 30 40

- **Remarks**:  
  - Loose to Medium Dense Light Brown Silty Sand  
  - Loose Brownish White Sandy, Clay-Silt W/Coral Fragments  
  - Medium Dense to Dense Brownish White Silty, Beach Sand W/Coral Fragments  
  - Water (Hole Caved in at 10')  
  - Drilling Stopped at 12'
### Boring Log

**PROJECT**
Haleiwa Resort Development - Unit 1

**LOCATION**
Kawailoa, Wai'alua, Oahu, Hawaii

**TMK**
G-2-01: 1 4 10

**HAMMER:**
- Weight: 10 lb. Sledge Hammer
- Water Level: None

**Boring No.**
8

**Sheet No.**
1

**Date**
3-25-65

**Type of Boring**
G.L.P. Mobile Drill

**Diam.**
3"

**Elev.**

**Datum**

**DESCRIPTION**

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**MEDIAN DENSE WHITE SAND W/ CORAL FRAGMENTS**

**MEDIUM DENSE SAND, GRAVEL CORAL & SHELLS**
Boring Log

PROJECT: HALEIWA RESORT DEVELOPMENT - UNIT I
LOCATION: KAWAILOA, KAIALUA, OAHU, HAWAII
TMK 6-2-011 1 & 10

HAMMER:
- Weight: 10 lb. SLEDGE HAMMER
- Drop:

SAMPLER: 2" O.D. SHELBY TUBE

<table>
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<th>20</th>
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<td>MEDIUM DENSE LIGHT BROWN SILTY SAND</td>
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<td>WHITE CORAL ROCK</td>
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<td>MEDIUM BROWN SANDY SILT</td>
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<td>DENSE GRAVEL W/BROWN SANDY SILT</td>
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<td>GRAY GRAVEL &amp; BOULDERS</td>
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<td>MEDIUM DENSE WHITE BEACH SAND &amp; CORAL FRAGMENTS</td>
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BORING NO. 9 Sheet No. of _______

Driller: W. LUM ASSOC., INC.
Field party: KUSANO, GLORIA, MORALES
Type of Boring: G.H.P. MOBILE DRILL
Diam. 3”

Water Level: 10.5
Time: 11:15 A.M.
Date: 3-26-85
Elev. __________ Datum __________
## Boring Log

**Project:** Haleiwa Resort Development - Unit I  
**Location:** Kawailoa, Waialua, Oahu, Hawaii  
**Boring No.:** 10  
**Sheet No.:** of  
**Driller:** W. Lum Assoc., Inc.  
**Field Party:** Kusano, Gloria, Morales  
**Date:** 3-25-65  
**Type of Boring:** H.P. Mobile Drill  
**Diam.:** 3"  
**Hammer:** Weight: 10 lb.  
Sledge Hammer  
**Drop:**  
**Water Level:** None  
**Time:**  
**Date:** 3-25-65  
**Sampler:** 2" O.D. Shelby Tube

### Description

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<td>10</td>
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<td>36.7</td>
<td>69.9</td>
<td>1300</td>
<td>BRITTLE</td>
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<td></td>
<td>10-F</td>
<td>NO RECOVERY TUBE</td>
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**Remarks:** Bouncing
# Boring Log

**PROJECT**: HALEIWA RESORT DEVELOPMENT - UNIT 1  
**LOCATION**: KAWAILOA, WAIALUA, OAHU, HAWAII  
**TMK**: G-2-01: I & J0

**HAMMER:**  
- **Weight**: 10 lb. SLEDGE HAMMER  
- **Drop**

**SAMPLER**: 2” O.D. SHELBY TUBE

## Description

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<td>11-C</td>
<td>82.2</td>
<td>10.2</td>
<td>74.6</td>
<td>-</td>
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<td>11-D</td>
<td>104.4</td>
<td>28.1</td>
<td>117.0</td>
<td>-</td>
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**Additional Details**

- **Water Level**: 8.5  
- **Time**: 10:00 A.M.  
- **Date**: 2-26-65

**Field Party**: KUSANO, GLORIA, MORALES

**Type of Boring**: G.H.P. MOBILE DRILL  
**Diam.**: 3”Ø
### Boring Log

**PROJECT:** Haleiwa Resort Development - Unit I  
**LOCATION:** Kualoa, Waialua, Oahu, Hawaii  
**Hammmer:** Weight 10 lb. Sledge Hammer  
**Sampler:** 2" O.D. Shelby Tube

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<td>1284</td>
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<tr>
<td>Stiff, Light Brown Sandy Silt</td>
<td>12-B</td>
<td>116.7</td>
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<td>17.5</td>
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<td>Small Boulder</td>
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<td>102.1</td>
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<td>3/20</td>
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<td>Medium to Stiff Dark Brown Clayby Silt w/ Small Boulders</td>
<td>12-D</td>
<td>-</td>
<td>19.2</td>
<td>-</td>
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<td>Medium Reddish Brown Clayby Silt w/ Small Boulders</td>
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<td>140.8</td>
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<td>-</td>
<td>-</td>
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<td>Medium Dense White Beach Sand</td>
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<td>28.4</td>
<td>91.3</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Medium Coral Rock</td>
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### Boring Log

**PROJECT:** HALEIWA RESORT DEVELOPMENT - UNIT I  
**LOCATION:** KAWAILOA, WAIALUA, OAHU, HAWAII  
**TMK:** G-2, OI: 1 & 10

**HAMMER:**  
- **Weight:** 10 lb. SLEDGE HAMMER  
- **Drop:**  
- **Sampler:** 2” O.D. SHELBY TUBE

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<td>LOOSE, LIGHT BROWN SILTY SAND</td>
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<td>13-A</td>
<td>99.1</td>
<td>13.9</td>
<td>87.0</td>
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<td>MEDIUM DENSE WHITE SAND W/ TRACES OF CORAL</td>
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<td>104.2</td>
<td>8.6</td>
<td>95.9</td>
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<tr>
<td>(WAILEA CONVO IN @ 92%)</td>
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<td></td>
<td>13-C</td>
<td>123.9</td>
<td>26.5</td>
<td>97.5</td>
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<td>MEDIUM DENSE COARSE WHITE SAND W/ TRACES OF SHELLS &amp; CORAL</td>
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## HALEIWA RESORT DEVELOPMENT - UNIT I

### TABLE 1-A - SUMMARY OF LABORATORY TEST RESULTS

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<td>SAMPLE NO.</td>
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<tr>
<td>DEPTH BELOW SURFACE</td>
<td>SURFACE</td>
<td>3.0' TO 4.5'</td>
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<tr>
<td>DESCRIPTION</td>
<td>BROWN</td>
<td>WHITE</td>
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<td>GRADING ANALYSIS (% Passing)</td>
<td>SILTY SAND</td>
<td>BEACH SAND</td>
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<tr>
<td>Sieve</td>
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<tr>
<td>1&quot;</td>
<td>100</td>
<td>95.4</td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>97.4</td>
<td>94.4</td>
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<td>#4</td>
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<td>#100</td>
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### ATTERBERG LIMITS

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<th>Liquid Limit</th>
<th>Plastic Limit</th>
<th>Plasticity Index</th>
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<tr>
<td>N.P.</td>
<td>N.P.</td>
<td>N.P.</td>
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### SPECIFIC GRAVITY

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<th>2.71</th>
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</table>

### EXPANSION TEST

| Swell upon saturation, % (Surcharge-51 P.S.F.) | 0.4 |

### CBR at 0.1" Penetration (%) (Surcharge-51 P.S.F.)

<table>
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<tr>
<th>32.5</th>
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</thead>
</table>

### COMPACTION TEST (AASHTO METHOD T-180-57)

| Max. Dry Density (P.C.F.) | 91.2 |
| Optimum Moist. (%) | 28.1 |

### UNIFIED SOIL CLASSIFICATION

| SP-5M | SP | SP | SW | SP |
# TABLE I - SUMMARY OF LABORATORY TEST RESULTS

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<th>SAMPLE NO.</th>
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<tr>
<td>E</td>
<td>G</td>
<td>G</td>
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<tr>
<td>5</td>
<td>12.0' to 12.5'</td>
<td>0.5' to 2.0'</td>
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<th>DESCRIPTION</th>
<th>GRADING ANALYSIS ( % Passing )</th>
<th>ATTERBERG LIMITS</th>
<th>SPECIFIC GRAVITY</th>
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<tr>
<td>WHITE BEACH SAND</td>
<td>WHITE BEACH SAND</td>
<td>BROWN CORAL SAND &amp; FRAGMENTS</td>
<td>HARD CORAL</td>
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<td>W/CORAL FRAGMENTS</td>
<td>W/CORAL FRAGMENTS</td>
<td>SAND &amp; FRAGMENTS OF HARD CORAL</td>
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<th>Sieve</th>
<th>1&quot;</th>
<th>½&quot;</th>
<th>¼</th>
<th>⅛</th>
<th>1/20</th>
<th>1/100</th>
<th>1/200</th>
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<td></td>
<td>100</td>
<td>96.9</td>
<td>74.2</td>
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<td>64.0</td>
<td>53.4</td>
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<td>71.2</td>
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<td>53.4</td>
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<td>1/100</td>
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<td>1/200</td>
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<th>SPECIFIC GRAVITY</th>
<th>EXPANSION TEST</th>
<th>COMPaction TEST</th>
<th>UNIFIED SOIL CLASSIFICATION</th>
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<td></td>
<td>Swell upon saturation, % (Surcharge-51 P.S.F.)</td>
<td>CBR at 0.1&quot; Penetration (%) (Surcharge-51 P.S.F.)</td>
<td>SM - SW</td>
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<td>Max. Dry Density (P.C.P.)</td>
<td>Optimum Moist. (%)</td>
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<td>DEPTH BELOW SURFACE</td>
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<td>DESCRIPTION</td>
<td>LT BROWN SILT SAND</td>
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<tr>
<td>GRADING ANALYSIS</td>
<td>( Passing)</td>
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<tr>
<td>Sieve</td>
<td>1&quot;</td>
<td>½&quot;</td>
<td>¼&quot;</td>
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<td>Atterberg Limits</td>
<td>Liquid Limit</td>
<td>Plastic Limit</td>
<td>Plasticity Index</td>
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<td>Specific Gravity</td>
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<td>Expansion Test</td>
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<td>CBR at 0.1&quot; Penetration (%) (Surcharge-51 P.S.F.) 66.0</td>
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<td>Compaction Test (AASHO METHOD T-180-57)</td>
<td>Max. Dry Density (P.C.F.) 99.4</td>
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<td>Optimum Moist. (%) 22.3</td>
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<td>Unified Soil Classification</td>
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HALEIWA SUBDIVISION - UNIT I

MOISTURE-DENSITY CURVE (AASHO T-180-57 METHOD A"

SAMPLE NO. 1 SURFACE

DESCRIPTION: "DARK-BROWN SILTY SAND"

\[ \text{Dry Density (pcf)} \]

\[ \begin{align*}
90 & \quad \text{Max. Dry Density} = 91.3 \, \text{pcf} \\
85 & \\
80 & \\
75 & \\
0 & \quad \text{Optimum Moisture Content} = 2.61 \% \\
20 & \\
25 & \\
30 & \\
35 & \\
40 & \\
0 & \\
100 & \\
95 & \\
90 & \\
85 & \\
80 & \\
75 & \\
0 & \\
\end{align*} \]

\[ \text{Moisture Content (Percent)} \]

\[ \text{Zero Air Voids Curve} \]

\[ \text{Specific Gravity} = 2.71 \]
HALEIWA SUBDIVISION - UNIT I
SAMPLE NO: 13 SURFACE
MOISTURE DENSITY CURVE (AASHO T-180-57 METHOD "A")
DESCRIPTION: "SAND"

ZERO AIR VOIDS CURVE
SPECIFIC GRAVITY = 2.71

MAX DRY DENSITY = 99.4 PCF

OPTIMUM MOISTURE CONTENT = 11.3 %

DENSITY (P.C.F.)

MOISTURE CONTENT (%)