# GOLF COURSE SUBDIVISION UNIT NO. 2
# PRELIMINARY SOIL REPORT

MAUNALUA, OAHU, HAWAII
TAX MAP KEY: 3-9-11

To:
KAISER-AETNA

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

SEPTEMBER 19, 1970

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

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September 19, 1970

KAISER-AETNA
P. O. Box 2997
Honolulu, Hawaii 96802

Gentlemen:

Subject: Golf Course Subdivision Unit No. 2
Preliminary Soil Report
(for site grading design purposes)
Tax Map Key: 3-9-11
Chapter 23, Revised Ordinances of
Honolulu, 1961 As Amended

The Resort Division area consists of resort, apartment and residential subdivisions.

In accordance with your request, preliminary soil explorations were made to cover the general area. This report concerns only the preliminary soil explorations at the site for the proposed Golf Course Subdivision Unit No. 2, Maunalua, Oahu, Hawaii.

The borings generally indicated tan and brown sandy and clayey silts to about 10 to 20 ft, the depths drilled. Black sand was encountered in Boring Nos. 25 and 26 below 15 ft. Boulders or rock was encountered in Boring Nos. 29 and 34 below 15 ft.

A low ridge extending from Koko Crater cuts across the west side of the site.

Some grading and filling of the site are contemplated. The earthwork should be done in accordance with the requirements of Chapter 23, Revised Ordinances of Honolulu, 1961 As Amended and the recommendations contained herein.

Light apartment structures may be constructed with ordinary footings or foundations.

High-rise buildings in the area will probably require relatively simple foundations. However, additional explorations should be made for the design of a specific structure and location.

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

Respectfully submitted,

WALTER LUM ASSOCIATES, INC.

Ezra Koike

Ezra Koike
Professional Engineer
Hawaii No. 1450

EK:rmf

# CONTENTS

GOLF COURSE SUBDIVISION UNIT NO. 2
PRELIMINARY SOIL REPORT

MAUNALUA, OAHU, HAWAII
TAX MAP KEY: 3-9-11

## SCOPE OF EXPLORATION

The Resort Division area consists of resort, apartment and residential subdivisions. This report concerns only the preliminary soil explorations at the site for the proposed Golf Course Subdivision Unit No. 2 at Maunalua, Oahu, Hawaii. The limits of this area are shown on Figure 1. The purpose of this exploration was to determine general soil conditions for site grading.

This report includes field exploration, laboratory tests and general recommendations for site grading and light building foundation design.

## FIELD EXPLORATION

Twelve borings were made at the site. The locations of these borings are shown on Figure 1, Boring Location Plan.

The borings were made with 3 and 4-in. diameter augers using tungsten carbide bits. Soil samples were recovered with a standard split spoon driven with a 140-lb hammer falling 30 inches.

Soil samples were visually observed and subjected to appropriate tests in the laboratory. Based on visual observations and laboratory tests, the soil descriptions in the boring logs are generally made in accordance with the "Unified Soil Classification System."

## LABORATORY TESTS

Laboratory tests for on-site soils included: natural water contents, Atterberg limits, specific gravity, sieve analysis, AASHO T-180-57 density, expansion and CBR.

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 Table IA.

## GENERAL SITE CONDITIONS

The proposed subdivision site is about 1,500 ft north of Kalanianaole Highway and the center of the site is generally west of Ehukai Street.

The site generally slopes downward in a southeasterly direction at about 2 to 5% gradient.

A low ridge extending from the rim of Koko Crater cuts across the west side of the site.

Houses, sheds and pig pens were located along both sides of Ehukai Street. Pig farms were previously located in this area and a nursery was located on the west side of Ehukai Street.

At the time of the field exploration, ground cover consisted mostly of kiawe and koa with some areas of tall grass. Subsequent fires have burned off most of the growth and many of the existing structures.

## INTERPRETATION OF SOIL CONDITIONS

From the field exploration, the soils at the site may be described as follows:

> Tan and brown sandy and clayey silts with mudrock to about 10 to 20 ft, the depths drilled. Black sand was encountered in Boring Nos. 25 and 26 at about 15-ft depth. Boulders or rock was encountered in Boring Nos. 29 and 34 at about 15-ft depth.

Water was not noted in the borings during the field explorations.

For more detailed descriptions of soils encountered in the drill holes, refer to the boring logs.

## DISCUSSION AND RECOMMENDATIONS

The proposed plan is to grade the site for apartment development with cuts and fills generally less than about 10 to 15 ft in height.

### Site Grading

All surface vegetation and miscellaneous debris should be cleared and removed prior to site filling. Localized soft pockets encountered during site preparations should be excavated and backfilled with compacted select material. Provisions to drain the site should be included during and after the completion of filling operations.

Grading work should be done in general conformance with the requirements of Chapter 23, Revised Ordinances of Honolulu, 1961 As Amended.

For the construction of fills, the following is recommended:

1. Rubble, loose boulders and unsuitable materials should be removed.

2. Old cesspools should be accurately located on the grading plan and backfilled before any grading work is started.

3. Hard surfaces along existing access roads should be scarifed down to stiff soils and recompacted to match the density of the surrounding soils.

4. Loose surface soils along the sides and bottom of natural drainageways should be removed where fills are contemplated.

   Subdrains should be placed in a herringbone pattern along the bottom of natural drainageways or dips before the placement of fills.

5. Fill material may be approved on-site or borrow soils. If practicable, fill material imported to the site should be select soils with the plasticity index generally less than 20.

6. Fills should be constructed in approximately level layers starting at the lower end and working upward. Where fills are made on sloping areas steeper than about 5 horizontal to 1 vertical, the ground at the toe of the fill should be benched to a generally level condition. As the fill is brought up, it should be continually keyed into the stiff natural ground by cutting steps into the slopes and compacting the fill into these steps.

7. Fills should be laid in 6-in. compacted layers with a relative density of at least 90% of AASHO T-180-57 density.

8. If boulders are proposed to be used in the construction of fills, they should generally be placed along the toe sections of fill slopes and outside of probable building sites.

Before placing any boulders, the subgrade should be stripped to stiff natural ground and shaped to drain. A layer of granular filter material should be placed on the subgrade and the boulders placed on the filter layer. The void spaces between boulders should be filled with granular material. A blanket of filter material should be placed against the boulders before any earth fills are placed against the boulders. See attached sketch, Figure 2.

## Slopes

In general, cut and fill slopes of 2 horizontal to 1 vertical or flatter should be used.

If slope heights (top to toe) of greater than 15 ft are considered, 8-ft wide benches should be placed at height intervals of about 15 ft in both cuts and fills.

For protection against erosion, the runoff from rainstorms should be diverted by berms or ditches away from slopes whenever practicable.

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

In general, slope planting is recommended on cut and fill slopes to minimize erosion.

Foundations

Light, short-span apartment structures may be constructed at the site with ordinary footings or foundations.

High-rise buildings in the area will probably require relatively simple foundations. However, additional explorations should be made for the design of a specific structure and location.

For heavy or long-span or multiple-story structures, foundation explorations should be made at each building site to evaluate the ground conditions before foundations are designed.

The following may be used as a guide for foundation design for light, 2 to 3-story light structures:

1. Bearing values for a given soil vary with the size and depth of footings. For light, 2 to 3-story, short-span structures, bearing values of about 2000 p.s.f. may be used.

2. Any portion of a building that is over an old cesspool should be designed to span the cesspool.

3. If soft spots or pockets of loose material are encountered in footing excavations or below a

building area, they should be excavated and replaced with compacted select on-site or borrow soils.

4. Concrete slab on ground should be placed over a base course of 4 in. of well-graded gravel less than 3/4 in. and greater than 1/4 in. in size. The subgrade should be compacted and shaped to a level surface or to drain, if practicable, and generally should be kept slightly higher than the finish grade outside of the building.

5. In general, buildings and structures should be placed about 15 ft from the tops of slopes.

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

7. Good surface drainage away from the foundation of structures should be maintained and the site should be graded at all times to prevent ponding of water.

Roadway

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

1. Wearing course - 2-in. asphaltic concrete.
2. Base course - 6-in. base course over a prepared subgrade.

Provisions should be made in the contract documents to allow for local adjustments regarding subbase requirements in the field as ground conditions are exposed at subgrade levels. The subbase thickness will depend upon the type of material within the top 2 ft of subgrade.

The subgrade should be compacted and shaped to drain. To avoid the ponding of water and softening of the subgrade at low points, weep holes should be placed at subgrade levels through the walls of catch basins which are placed in these low areas.

Utilities

Although the probability of differential settlements in localized areas is slight in this area, utilities should be placed after the fills are constructed. Utility lines should be designed with flexible joints, particularly where lines are connected to structures. Gravity flow lines should be made as steep as practicable.

Unforeseen or undetected conditions may occur in localized areas and will have to be adjusted and corrected in the field as they are detected.

## PROPOSED SPECIFICATION FOR EARTHWORK

## GOLF COURSE SUBDIVISION UNIT NO. 2

### General Description

This item shall consist of 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 subsidiary work necessary to complete the grading.

### Clearing, Grubbing and Preparing Areas to be Filled

Vegetation, concrete slabs and rubbish shall be removed and disposed of, leaving the disturbed area with a neat, debris-free appearance.

Vegetable matter shall be removed from the surface upon which fill is to be placed. Topsoil and stockpiled soils shall be (1) stripped to stiff natural ground or (2) scarified and recompacted before the placement of fills. Topsoil encountered at finish grade shall be scarified and recompacted.

Hard surfaces along the existing access roads shall be scarified down to stiff soils and recompacted to match the density of the surrounding soil before the placement of fills.

Cesspools shall be flagged in the field and accurately located on the plans and backfilled before any grading work is started. The procedure for backfilling of cesspools follows in the section "Backfilling of Old Cesspools".

Where fills are proposed in sidehill areas and gullies, loose material along the bottom and the sides shall be stripped down to stiff natural ground before the placement of fills. New fills shall be keyed into the stiff natural ground.

Subdrains shall be placed along the bottom and sides of the natural drainageways before the construction of fills. The locations of subdrains should be determined in the field after clearing and grubbing.

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 the cutting of 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 shall consist of approved on-site or borrow soils. The soils shall contain no more than a trace of organic matter. Fill material imported to the site shall be select soils with a plasticity index less than 20.

## Placing, Spreading and Compacting Fill Material

The selected fill material shall be placed in level layers which, when compacted, shall not exceed 6 inches. Each layer shall be spread evenly and thoroughly blade-mixed during the spreading to insure uniformity of material and water content within each layer.

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

When the water content of the fill material is well below the optimum for compacting purposes, water shall be added until the water content assures a thorough bonding during the compacting process.

When the water content of the material is well above the optimum for compacting purposes, the fill material shall be aerated by blading or by other satisfactory methods until the water content is near the optimum.

After each layer has been placed, mixed and spread evenly, it shall be thoroughly compacted to no less than 90% of maximum density in accordance with AASHO Test No. T-180-57 or other comparable density tests. Compaction shall be with sheepsfoot rollers, multiple-wheel pneumatic-tired rollers or other acceptable rollers which shall be able to compact the fill to the specified density. Rolling shall be accomplished while the fill material is near the optimum water content. The rolling of each layer shall be continuous over its entire area and the roller shall make sufficient passes to insure the obtainment of the desired density.

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

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

Backfilling of Old Cesspools

The following procedures shall be followed for backfilling:

(1) Sludge Removal

Remove the sludge from the bottom of the old cesspool by (a) pumping or (b) by clamshell or any other suitable way. The material shall be disposed of away from the site. The completeness of removal shall be verified by probing and shall be less than 12 in. at the bottom.

(2) Granular Fill (below 3 ft from finish grade)

Use granular material, graded from 6 to 0 inches. The fines passing the No. 200 sieve shall be less than 10%. The materials shall be placed in thin layers (12 in. maximum) and compacted with vibratory equipment to 90% of AASHO T-180-57 density. Ramming each layer into place with a clamshell bucket will be allowed. The granular fill shall be wetted before placement into the cesspools. Sufficient compaction tests shall be conducted to verify that 90% compaction is obtained by the construction method selected.

(3) Top 3 Ft of Fill

Linings encountered in the cesspools within the top 3 ft from finish grade shall be removed. The fill within the top 3 ft from finish grade shall be constructed from on-site soil in thin layers (6-in. compacted thickness) to 90% of AASHO T-180-57 density. The material at finish grade shall blend with the surrounding soil.

Excavation

Suitable material from excavation shall be used in the fill and unsuitable material from excavation shall be diposed of.

Boulder Fills

If boulders are proposed to be used in the construction of fills, they shall be placed along the toe section of slopes and at locations indicated on the plan. The subgrade shall be stripped to stiff natural ground and shaped to drain. A layer of granular filter material shall be placed on it. All voids between boulders shall be filled with smaller granular soils. A blanket of filter material shall be placed against the boulder fill before construction of earth fills behind or above the boulders.

Unforeseen Conditions

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

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 indicate that the water content and density are as previously specified.

# BORING LOGS

## Symbols

Symbols used generally are in accordance with the Unified Soil Classification System.

Where a parenthesis "(MH)" is used, the soil sample was classified by visual observation of the sample recovered.

Where no parenthesis "MH" is used, the soil sample was classified from either the Atterberg limits or sieve analysis test results.

# WALTER LUM ASSOCIATES

3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

## Boring Log

PROJECT: GOLF COURSE SUBDIVISION UNIT NO. 2

LOCATION: Maunalua, Oahu, Hawaii

Tax Map Key: 3-9-11

HAMMER:

Weight: 140 #

Drop: 30"

SAMPLER: 2" STANDARD SPLIT SPOON

BORING NO. 22 Sheet No. ____ of ____

Driller: WALTER LUM ASSOC. Date: JULY 13, 1970

Field Party: HASHIDA, MAESHIRO

Type of Boring: AUGER (B-30-L) Diam. 4"

Elev. 142'± * Datum: —

Drill Bit: T.C. DRAG

| Water Level | NOT NOTED | | | |
|---|---|---|---|---|
| Time | — | | | |
| Date | 7-13-70 | | | |

| Unified Soil Classification | DESCRIPTION (ELEV. = 142'± *) | Depth (Ft.) | Sample No. | Wet Dens. P.C.F. | Water Cont. % | Dry Dens. P.C.F. | Unconf. Comp. P.S.F. | Vane Shear P.S.F. | Standard Penetration Test N (Blows per foot) |
|---|---|---|---|---|---|---|---|---|---|
| SM | MEDIUM DENSITY, BROWN, SILTY SAND W/MUDROCK FRAGMENTS | 0 | 22-A | - | 15 | - | - | - | |
| (SM) | MEDIUM DENSITY, BROWN SILTY SAND W/MUDROCK FRAGMENTS | 5 | 22-B | - | 16 | - | - | - | |
| (SM-GM) | MEDIUM DENSITY, TAN SILTY SAND W/GRAVEL & COBBLES (MUDROCK) | 10 | 22-C | - | 18 | - | - | - | |
| (ML) | STIFF, TAN SANDY SILT W/MUDROCK FRAGMENTS | 15 | 22-D | - | 28 | - | - | - | 30/.5' |
| (ML) | STIFF, BROWN FINE SANDY SILT W/MUDROCK FRAGMENTS | 20 | 22-E | - | 30 | - | - | - | 20/.5' |
| | END OF BORING @ 21.0' | | | | | | | | |

* ELEVATION ESTIMATED FROM CONTOUR PLAN

# WALTER LUM ASSOCIATES

3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

## Boring Log

PROJECT: GOLF COURSE SUBDIVISION UNIT NO. 2

LOCATION: Maunalua, Oahu, Hawaii
Tax Map Key: 3-9-11

HAMMER:
Weight: 140#
Drop: 30"

SAMPLER: 2" STANDARD SPLIT SPOON

BORING NO. 25 Sheet No. ____ of ____

Driller: WALTER LUM ASSOC. Date: JULY 14, 1970

Field Party: HASHIDA, MAESHIRO

Type of Boring: AUGER (B-30-L) Diam. 4"

Elev. 85'± * Datum —

Drill Bit: T.C. DRAG

Water Level: NOT NOTICED
Time: —
Date: 7-14-70

| Unified Soil Classification | DESCRIPTION ELEV. = 85'± * 0 | Depth (Ft.) | Sampler | Sample No. | Wet Dens. P.C.F. | Water Cont. % | Dry Dens. P.C.F. | Unconf. Comp. P.S.F. | Vane Shear P.S.F. | PENETRATION DATA Standard Penetration Test N (Blows per foot) 0 10 20 30 40 |
|---|---|---|---|---|---|---|---|---|---|---|
| (ML) | STIFF, TAN, CLAYEY SILT | | | 25-A | - | 14 | - | - | - | |
| (ML) | STIFF, BROWN, CLAYEY SILT & DECOMPOSED MUDROCK | 5 | | 25-B | - | 24 | - | - | - | 35/.5' |
| (ML) | STIFF, TAN, SANDY SILT (DECOMPOSED MUDROCK) | 10 | | 25-C | - | 22 | - | - | - | 25/.5' |
| (SP-SM) | DENSE, BLACK, SAND & TRACE OF CORAL | 15 | | 25-D | - | 8 | - | - | - | |
| | | 20 | | 25-E | | 7 | | | | |
| | END OF BORING @ 21.5' | | | | | | | | | |

* ELEVATION ESTIMATED FROM CONTOUR PLAN

# WALTER LUM ASSOCIATES

3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

## Boring Log

PROJECT: GOLF COURSE SUBDIVISION UNIT NO. 2

LOCATION: Maunalua, Oahu, Hawaii

Tax Map Key: 3-9-11

HAMMER:
Weight: 140#
Drop: 30"

SAMPLER: 2" STANDARD SPLIT SPOON

BORING NO. 26 Sheet No. ____ of ____

Driller: WALTER LUM ASSOC. Date: JULY 14, 1970

Field Party: PANG, MAKAULA

Type of Boring: AUGER (ACKER ACE) Diam. 4"

Elev. 83'± * Datum —

Drill Bit: T.C. DRAG

Water Level: NOT NOTICED

Time: —

Date: 7-14-70

| Unified Soil Classification | DESCRIPTION (ELEV. = 83'± *) | Depth (Ft.) | Sample No. | Wet Dens. P.C.F. | Water Cont. % | Dry Dens. P.C.F. | Unconf. Comp. P.S.F. | Vane Shear P.S.F. | PENETRATION DATA: Standard Penetration Test N (Blows per foot) |
|---|---|---|---|---|---|---|---|---|---|
| | | 0 | 26-A | - | 22 | - | - | - | |
| (ML) | STIFF, TAN CLAYEY SILT W/SAND & GRAVEL (DECOMPOSED MUDROCK) | 5 | 26-B | - | 27 | - | - | - | 55 |
| (ML) | STIFF, BROWN, CLAYEY SILT W/DECOMPOSED MUDROCK & GRAVEL | 10 | 26-C | - | 39 | - | - | - | 35/.5' |
| | ROCK | 15 | 26-D | ROCK FRAGMENTS | | | | | 56/.3' |
| (SP-SM) | DENSE, BLACK SILTY SAND | 20 | 26-E | - | 7 | - | - | - | |
| | END OF BORING @ 21.5' | | | | | | | | |

* ELEVATION ESTIMATED FROM CONTOUR PLAN

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

# Boring Log

PROJECT: GOLF COURSE SUBDIVISION UNIT NO. 2

LOCATION: Maunalua, Oahu, Hawaii

Tax Map Key: 3-9-11

HAMMER:
Weight: 140#
Drop: 30"

SAMPLER: 2" STANDARD SPLIT SPOON

BORING NO. 27 Sheet No. ____ of ____

Driller: WALTER LUM ASSOC. Date: JUNE 13, 1970

Field Party: ASATO, MAESHIRO

Type of Boring: AUGER (MOBILE MINUTEMAN) Diam. 3"

Elev. 96'± * Datum ____

Drill Bit: T.C. DRAG

Water Level: NOT NOTICED

Time: ——

Date: 6-13-70

| Unified Soil Classification | DESCRIPTION ELEV. = 96'± * | Depth (Ft.) | Sampler | Sample No. | Wet Dens. P.C.F. | Water Cont. % | Dry Dens. P.C.F. | Unconf. Comp. P.S.F. | Vane Shear P.S.F. | PENETRATION DATA: Standard Penetration Test, N (Blows per foot) 0 10 20 30 40 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 0 | | | | | | | | |
| ML | MEDIUM, TAN BROWN SANDY SILT W/MUDROCK | | | 27-A | - | 15 | - | - | - | |
| | | 5 | | 27-B | - | 21 | - | - | - | |
| (ML) | STIFF, TAN, CLAYEY SILT W/MUDROCK | 10 | | 27-C | | 28 | | | | 32/.5' |
| | END OF BORING @ 11' | | | | | | | | | |

* ELEVATION ESTIMATED FROM CONTOUR PLAN

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

# Boring Log

PROJECT: GOLF COURSE SUBDIVISION UNIT NO. 2

LOCATION: Maunalua, Oahu, Hawaii

Tax Map Key: 3-9-11

HAMMER:
Weight: 140#
Drop: 30"

SAMPLER: 2" STANDARD SPLIT SPOON

BORING NO. 28 Sheet No. ____ of ____
Driller: WALTER LUM ASSOC. Date: JUNE 12, 1970
Field Party: LUNING, MAESHIRO
Type of Boring: AUGER (MOBILE MINUTEMAN) Diam. 3"
Elev. 61'± * Datum —
Drill Bit: T.C. DRAG

| Water Level | NOT NOTICED | | | |
|---|---|---|---|---|
| Time | — | | | |
| Date | 6-12-70 | | | |

| Unified Soil Classification | DESCRIPTION ELEV. = 61'± * | Depth (Ft.) | Sampler | Sample No. | Wet Dens. P.C.F. | Water Cont. % | Dry Dens. P.C.F. | Unconf. Comp. P.S.F. | Vane Shear P.S.F. | PENETRATION DATA Standard Penetration Test N (Blows per foot) 0 10 20 30 40 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 0 | | 28-A | - | 18 | - | - | - | |
| (ML) | MEDIUM TO STIFF, TAN, SANDY SILT | 5 | | 28-B | - | 16 | - | - | - | 26/.5' |
| | END OF BORING @ 11.0' | 10 | | 28-C | - | 30 | - | - | - | 29/.5' |

* ELEVATION ESTIMATED FROM CONTOUR PLAN

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

# Boring Log

PROJECT: GOLF COURSE SUBDIVISION UNIT NO. 2

LOCATION: Maunalua, Oahu, Hawaii
Tax Map Key: 3-9-11

HAMMER:
Weight: 140#
Drop: 30"

SAMPLER: 2" STANDARD SPLIT SPOON

BORING NO. 20 Sheet No. ____ of ____
Driller: WALTER LUM ASSOC. Date: JUNE 8, 1970
Field Party: ASATO, MAKAULA
Type of Boring: AUGER (CONCORE AS-JR) Diam. 4"
Elev. 54' ± * Datum ____
Drill Bit: T.C. DRAG
Water Level: NOT NOTICED
Time: ——
Date: 6-8-70

| Unified Soil Classification | Description (ELEV. = 54' ± *) | Depth (Ft.) | Sample No. | Wet Dens. P.C.F. | Water Cont. % | Dry Dens. P.C.F. | Unconf. Comp. P.S.F. | Vane Shear P.S.F. | Standard Penetration Test N (Blows per foot) |
|---|---|---|---|---|---|---|---|---|---|
| MH | MEDIUM DENSITY, BROWN CLAYEY SILT W/SAND & GRAVEL (DECOMPOSED MUDROCK) | 0 | 20-A | - | 22 | - | - | - | |
| | | 5 | 20-B | - | 17 | - | - | - | 24/.5' |
| (ML) | DENSE, TAN, SANDY SILT W/ DECOMPOSED MUDROCK | 10 | 20-C | - | 24 | - | - | - | 44 |
| | ROCK | 15 | 20-D | - | 30 | - | - | - | 36/.5' HAMMER BOUNCES |
| | END OF BORING @ 15.5' | | | | | | | | |

* ELEVATION ESTIMATED FROM CONTOUR PLAN

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

## Boring Log

PROJECT: GOLF COURSE SUBDIVISION UNIT NO. 2

LOCATION: Maunalua, Oahu, Hawaii
Tax Map Key: 3-9-11

HAMMER:
Weight: 140#
Drop: 30"

SAMPLER: 2" STANDARD SPLIT SPOON

BORING NO. 30 Sheet No. ____ of ____
Driller: WALTER LUM ASSOC. Date: JUNE 9, 1970
Field Party: LUNING, MAESHIRO
Type of Boring: AUGER (ACKER ACE) Diam. 4"
Elev. 72'± * Datum ——
Drill Bit: T.C. DRAG

| Water Level | NOT NOTICED | | | |
|---|---|---|---|---|
| Time | —— | | | |
| Date | 6-9-70 | | | |

| Unified Soil Classification | DESCRIPTION ELEV. = 72'± * | Depth (Ft.) | Sample No. | Wet Dens. P.C.F. | Water Cont. % | Dry Dens. P.C.F. | Unconf. Comp. P.S.F. | Vane Shear P.S.F. | Penetration Data: Standard Penetration Test N (Blows per foot) |
|---|---|---|---|---|---|---|---|---|---|
| (GM) | MEDIUM DENSITY TO DENSE, TAN, SILTY SAND & MUDROCK | 0 | 30-A | - | 25 | - | - | - | |
| | | 5 | 30-B | - | 21 | - | - | - | |
| (ML) | STIFF, TAN, SANDY SILT w/ DECOMPOSED MUDROCK | 10 | 30-C | - | 25 | - | - | - | |
| | | 15 | 30-D | - | 31 | - | - | - | |
| | END OF BORING @ 16.5' | | | | | | | | |

* ELEVATION ESTIMATED FROM CONTOUR PLAN

# WALTER LUM ASSOCIATES

3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

## Boring Log

PROJECT: GOLF COURSE SUBDIVISION UNIT NO. 2

LOCATION: Maunalua, Oahu, Hawaii
Tax Map Key: 3-9-11

HAMMER:
Weight: 140#
Drop: 30"

SAMPLER: 2" STANDARD SPLIT SPOON

BORING NO. 31 Sheet No. ____ of ____

Driller ____ Date JUNE 4, 1970

Field Party ASATO, MAESHIRO

Type of Boring AUGER (ACKER ACE) Diam. 4"

Elev. 65' ± * Datum —

Drill Bit T.C. DRAG

Water Level NOT NOTICED

Time —

Date 6-4-70

| Unified Soil Classification | DESCRIPTION (ELEV. = 65' ± ?*) | Depth (Ft.) | Sample No. | Wet Dens. P.C.F. | Water Cont. % | Dry Dens. P.C.F. | Unconf. Comp. P.S.F. | Vane Shear P.S.F. | Standard Penetration Test N (Blows per foot) |
|---|---|---|---|---|---|---|---|---|---|
| (ML) | MEDIUM, TAN, SANDY SILT W/ MUDROCK | 0 | 31-A | - | 27 | - | - | - | |
| | | 5 | 31-B | - | 29 | - | - | - | |
| (MH) | STIFF, LIGHT BROWN, CLAYEY SILT W/ SAND & DECOMPOSED MUDROCK | 10 | 31-C | - | 37 | - | - | - | |
| | | 15 | 31-D | - | 46 | - | - | - | |
| | END OF BORING @ 16.5' | | | | | | | | |

* ELEVATION ESTIMATED FROM CONTOUR PLAN

# WALTER LUM ASSOCIATES

3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

## Boring Log

PROJECT: GOLF COURSE SUBDIVISION UNIT NO. 2

LOCATION: MAUNALUA, OAHU, HAWAII
TAX MAP KEY: 3-9-11

HAMMER:
Weight: 140#
Drop: 30"

SAMPLER: 2" STANDARD SPLIT SPOON

BORING NO. 32 Sheet No. ____ of ____
Driller WALTER LUM ASSOC. Date JUNE 8, 1970
Field Party LUNING, MAESHIRO
Type of Boring AUGER (ACKER ACE) Diam. 4"
Elev. 80' ±* Datum ____
Drill Bit T.C. DRAG

Water Level: NOT NOTICED
Time: —
Date: 6-8-70

| Unified Soil Classification | DESCRIPTION (ELEV. = 80'±*) | Depth (Ft.) | Sample No. | Wet Dens. P.C.F. | Water Cont. % | Dry Dens. P.C.F. | Unconf. Comp. P.S.F. | Vane Shear P.S.F. | Standard Penetration Test N (Blows per foot) |
|---|---|---|---|---|---|---|---|---|---|
| (ML-GM) | STIFF, TAN SANDY SILT W/MUDROCK | 0–5 | 32-A | - | 10 | - | - | - | |
| | | 5–10 | 32-B | - | 31 | - | - | - | |
| | | 10–15 | 32-C | - | 28 | - | - | - | |
| | | 15–16.5 | 32-D | - | 30 | - | - | - | |
| | END OF BORING @ 16.5' | | | | | | | | |

* ELEVATION ESTIMATED FROM CONTOUR PLAN

# WALTER LUM ASSOCIATES

3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

## Boring Log

PROJECT: GOLF COURSE SUBDIVISION UNIT NO. 2

LOCATION: Maunalua, Oahu, Hawaii
Tax Map Key: 3-9-11

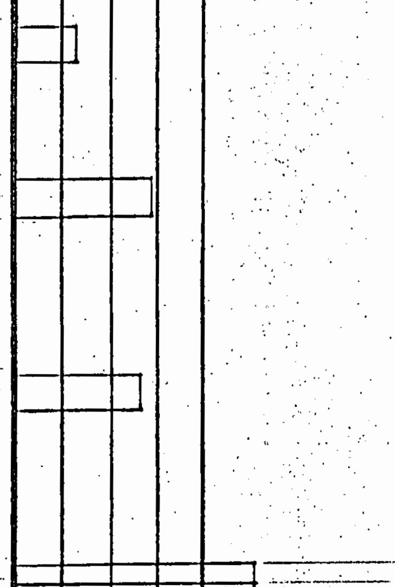
HAMMER:
Weight: 140#
Drop: 30"

SAMPLER: 2" STANDARD SPLIT SPOON

BORING NO. 33 Sheet No. ____ of ____
Driller: WALTER LUM ASSOC. Date: JUNE 8, 1970
Field Party: LUNING, MAESHIRO
Type of Boring: AUGER (ACKER ACE) Diam. 4"
Elev. 20'± * Datum ____
Drill Bit: T.C. DRAG
Water Level: NOT NOTICED
Time: ——
Date: 6-8-70

| Unified Soil Classification | Description (ELEV. ≈ 20'± *) | Depth (Ft.) | Sample No. | Wet Dens. P.C.F. | Water Cont. % | Dry Dens. P.C.F. | Unconf. Comp. P.S.F. | Vane Shear P.S.F. |
|---|---|---|---|---|---|---|---|---|
| | | 0 | 33-A | - | 20 | - | - | - |
| (ML) | STIFF, TAN, SANDY SILT W/MUDROCK | 5 | 33-B | - | 20 | - | - | - |
| | | 10 | 33-C | - | 30 | - | - | - |
| | END OF BORING @ 16' | 15 | 33-D | - | 31 | - | - | - |

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



* ELEVATION ESTIMATED FROM CONTOUR PLAN

# WALTER LUM ASSOCIATES

3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

## Boring Log

PROJECT: GOLF COURSE SUBDIVISION UNIT NO. 2

LOCATION: MAUNALUA, OAHU, HAWAII

TAX MAP KEY: 3-9-11

HAMMER:
Weight: 140#
Drop: 30"

SAMPLER: 2" STANDARD SPLIT SPOON

BORING NO. 34 Sheet No. ___ of ___

Driller: WALTER LUM ASSOC. Date: JUNE 8, 1970

Field Party: ASATO, MAKAULA

Type of Boring: AUGER (CONCORE AS-JR) Diam. 4"

Elev. 100'± * Datum ___

Drill Bit: T.C. DRAG

Water Level: NOT NOTICED
Time:
Date: 6-8-70

DESCRIPTION: ELEV. = 100'± *

| Unified Soil Classification | Description | Depth (Ft.) | Sample No. | Wet Dens. P.C.F. | Water Cont. % | Dry Dens. P.C.F. | Unconf. Comp. P.S.F. | Vane Shear P.S.F. | Standard Penetration Test N (Blows per foot) |
|---|---|---|---|---|---|---|---|---|---|
| (ML-GM) | STIFF, TAN, SANDY SILT & MUDROCK | 0 | 34-A | - | 20 | - | - | - | |
| | | 5 | 34-B | - | 21 | - | - | - | 23/.5' |
| | | 10 | 34-C | - | 25 | - | - | - | |
| | PUKA PUKA ROCK | 15 | 34-D | - | 23 | - | - | - | 35/.2' |
| | END OF BORING @ 15.7' | | | | | | | | |

* ELEVATION ESTIMATED FROM CONTOUR PLAN

# WALTER LUM ASSOCIATES

3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

## Boring Log

PROJECT: GOLF COURSE SUBDIVISION UNIT NO. 2

LOCATION: MAUNALUA, OAHU, HAWAII

TAX MAP KEY: 3-9-11

BORING NO. 35 Sheet No. ____ of ____

Driller ____ Date JUNE 4, 1970

Field Party ASATO, MAESHIRO

Type of Boring AUGER (ACKER ACE) Diam. 4"

Elev. 93' ± * Datum —

Drill. Bit T.C. DRAG

HAMMER:
Weight 140#
Drop 30"

SAMPLER: 2" STANDARD SPLIT SPOON

Water Level NOT NOTICED
Time
Date 6-4-70

DESCRIPTION: ELEV. = 93' ± *

| Unified Soil Classification | Description | Depth (Ft.) | Sample No. | Wet Dens. P.C.F. | Water Cont. % | Dry Dens. P.C.F. | Unconf. Comp. P.S.F. | Vane Shear P.S.F. | Standard Penetration Test N (Blows per foot) |
|---|---|---|---|---|---|---|---|---|---|
| (ML) | MEDIUM, TAN, CLAYEY SILT W/ MUDROCK | 0–5 | 35-A | - | 25 | - | - | - | |
| | | 5 | 35-B | - | 20 | - | - | - | |
| MH | MEDIUM TO STIFF, BROWN, CLAYEY SILT W/SAND | 10 | 35-C | - | 28 | - | - | - | 47 |
| | | 15 | 35-D | - | 28 | - | - | - | 50 |
| | END OF BORING @ 16.0' | | | | | | | | |

* ELEVATION ESTIMATED FROM CONTOUR PLAN

GOLF COURSE SUBDIVISION - UNIT 2

TABLE I A - SUMMARY OF LABORATORY TEST RESULTS

| | | | | |
|---|---|---|---|---|
| BORING NO. | 22 | 27 | 29 | 35 |
| SAMPLE NO. | | | | C |
| DEPTH BELOW SURFACE | SURFACE | SURFACE | SURFACE | 10'-11.5' |
| DESCRIPTION | BROWN SILTY SAND W/GRAVEL | TAN BROWN SANDY SILT | BROWN CLAYEY SILT W/SAND | BROWN CLAYEY SILT W/SAND |
| GRAIN-SIZE ANALYSIS (% Passing) Sieve | | | | |
| 1" | 100 | | 100 | |
| 1/2" | 91.0 | | 100 | |
| #4 | 81.4 | | 96.0 | |
| #10 | 73.4 | | 93.5 | |
| #20 | 64.5 | | 90.8 | |
| #40 | 53.9 | | 87.6 | |
| #100 | 40.2 | | 81.3 | |
| #200 | 34.0 | | 74.7 | |
| ATTERBERG LIMITS | | | | |
| Air Dried or Natural | NATURAL | NATURAL | NATURAL | NATURAL |
| Liquid Limit | 62 | 49 | 55 | 56 |
| Plastic Limit | 46 | 36 | 37 | 33 |
| Plasticity Index | 16 | 13 | 18 | 23 |
| Dilatancy | QUICK | QUICK | SLOW | SLOW |
| Toughness | SLIGHT | SLIGHT | MEDIUM | SLIGHT-MED |
| Dry Strength | SLIGHT | SLIGHT | MEDIUM | MEDIUM |
| UNIFIED SOIL CLASSIFICATION | SM | ML | MH | MH |
| APPARENT SPECIFIC GRAVITY | 2.72 | 2.87 | 2.89 | |
| EXPANSION AND CBR TESTS (Surcharge-51 P.S.F.) | | | | |
| Molding Moisture, % | 40.8 | 22.9 | 26.6 | |
| Molding Dry Density, P.C.F. | 74.0 | 94.6 | 84.7 | |
| Swell upon saturation, % | 1.7 | 1.5 | 1.2 | |
| CBR at 0.1" Penetration | 3.1 | 19.0 | 23.0 | |
| MOISTURE-DENSITY RELATIONS OF SOILS | | | | |
| (AASHO T-180-57 Method ___) | A | A | A | |
| Dry to Wet or Wet to Dry | DRY TO WET | DRY TO WET | DRY TO WET | |
| Max. Dry Density (P.C.F.) | 76.0 | 93.8 | 88.6 | |
| Optimum Moisture (%) | 37.4 | 26.0 | 29.1 | |

REMARKS:

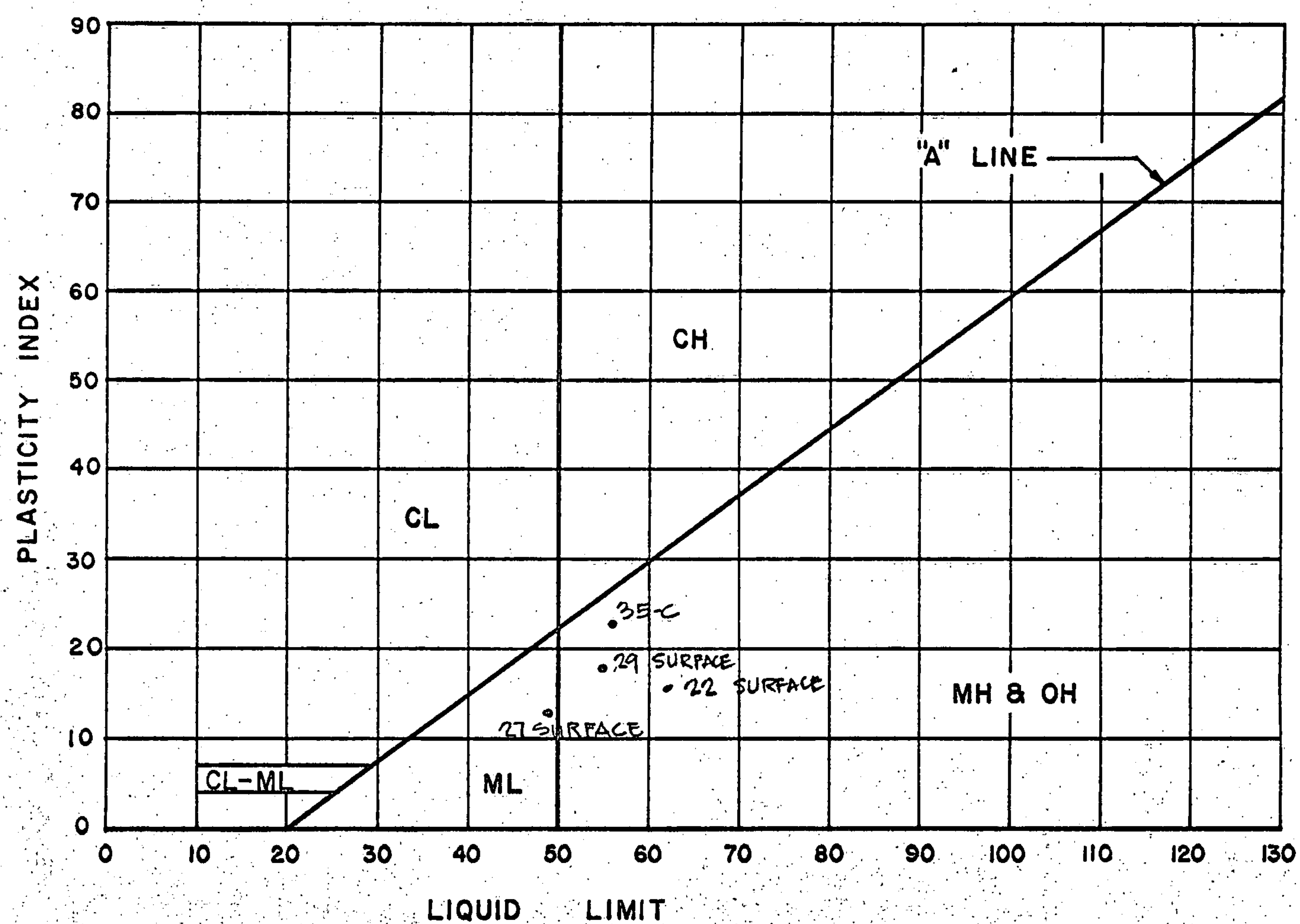
WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS

Date ____________ By ____________

# PLASTICITY CHART

PROJECT: GOLF COURSE SUBDIVISION - UNIT 2

LOCATION: MAUNALUA, OAHU, HAWAII




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

DATE 8-24-70 BY C.M.

2-470

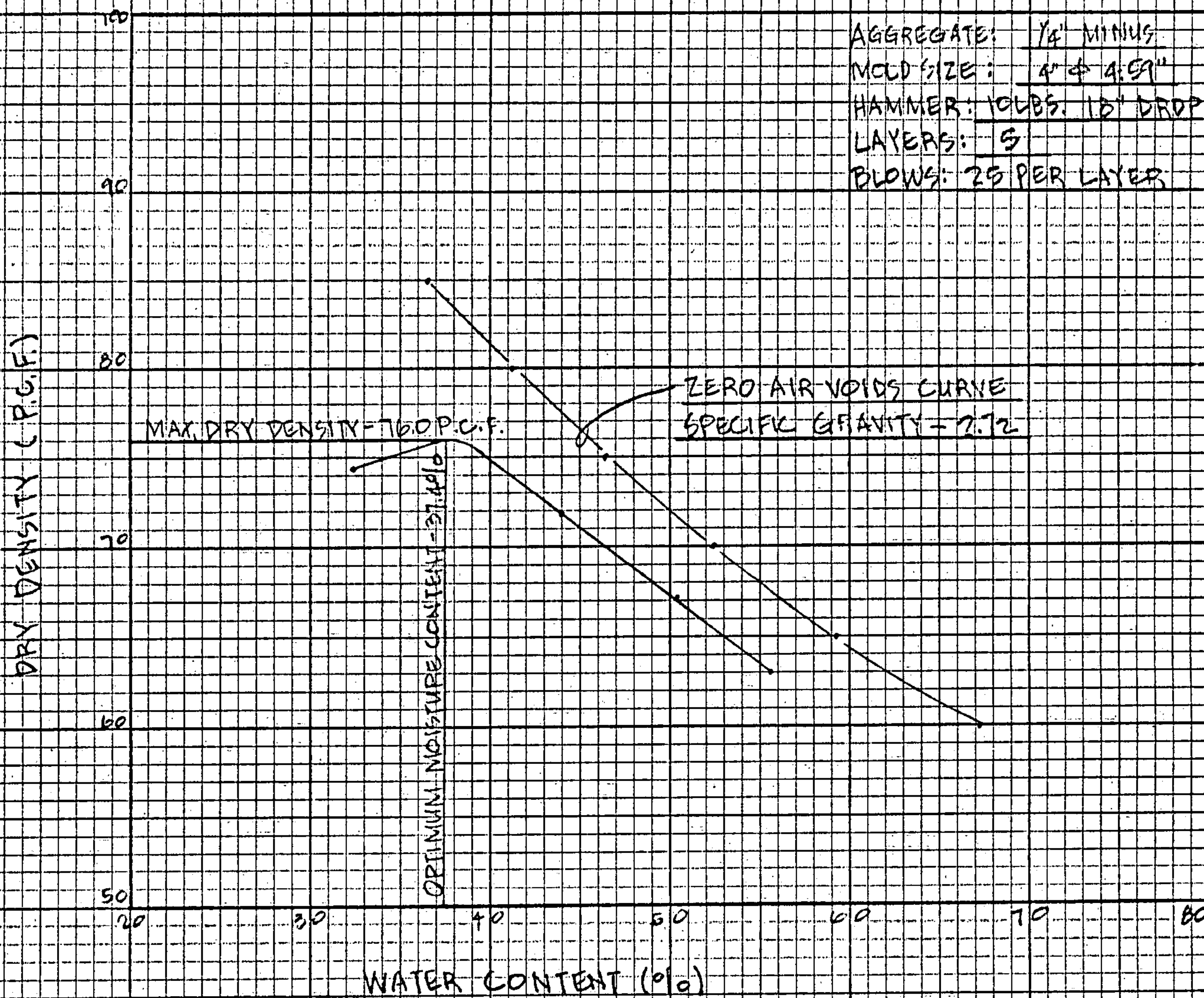
MOISTURE - DENSITY CURVE (AASHO T-180-57 METHOD A)

PROJECT: GOLF COURSE SUBDIVISION - UNIT 2

LOCATION: MAUNALUA, OAHU, HAWAII

SAMPLE NO. 22 - SURFACE

SAMPLE DESCRIPTION: BROWN SILTY SAND W/GRAVEL




DATE: 7-25-70 BY S.T.

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

## MOISTURE-DENSITY CURVE (AASHO T-180-57, METHOD A)

PROJECT: GOLF COURSE SUBDIVISION - UNIT 2

LOCATION: MAUNALUA, OAHU, HAWAII

SAMPLE NO.: 27 SURFACE

SAMPLE DESCRIPTION: TANNISH BROWN SANDY SILT

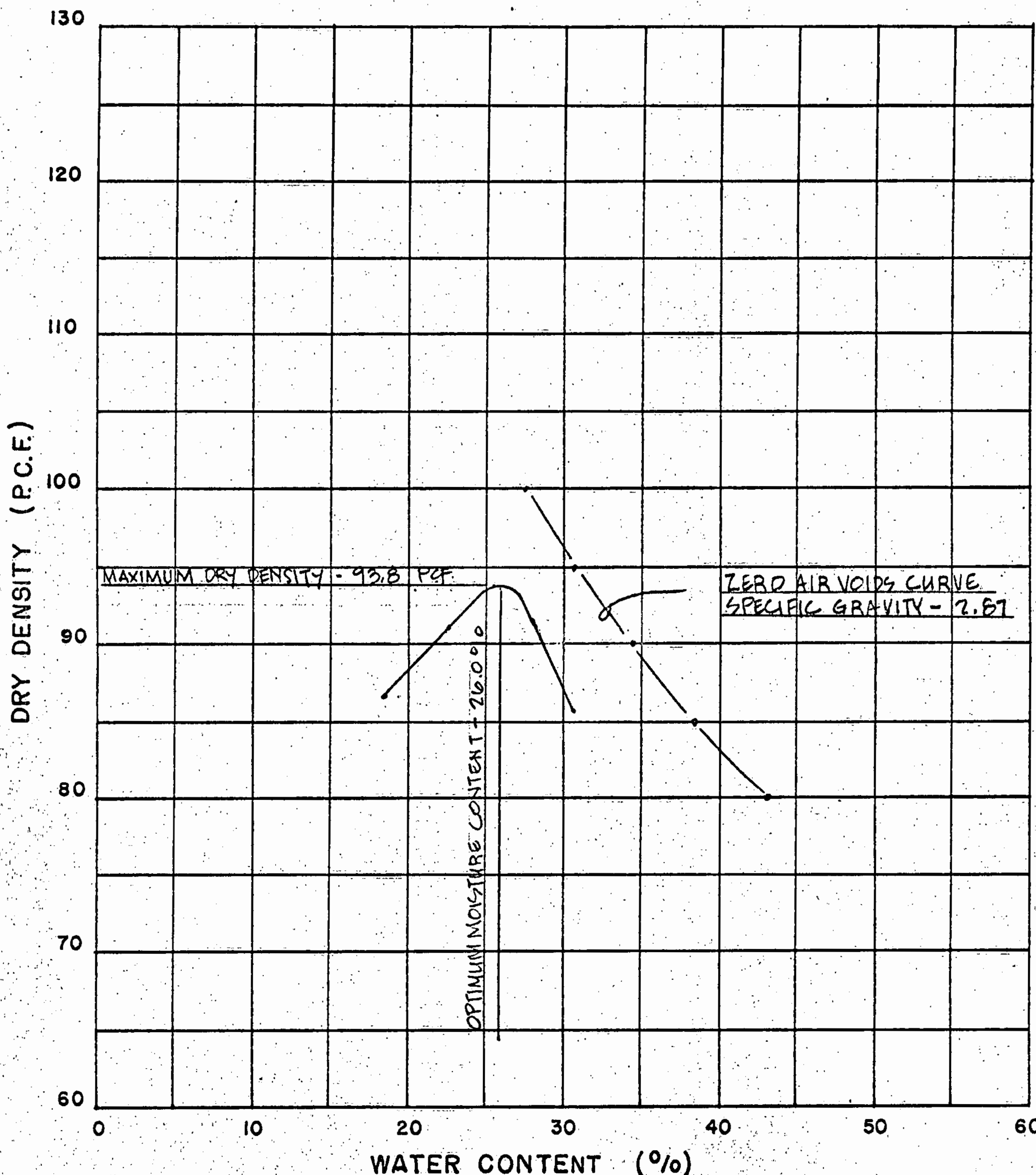
AGGREGATE: 1/4" MINUS

MOLD SIZE: 4" ⌀ 4.59"

HAMMER: 10 LBS 18" DROP

LAYERS: 5

BLOWS: 25 PER LAYER




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

DATE 9-1-70 BY B.T.

9-470

# MOISTURE–DENSITY CURVE (AASHO T-180-57, METHOD A)

PROJECT: GOLF COURSE SUBDIVISION – UNIT 2

LOCATION: MAUNALUA, OAHU, HAWAII

SAMPLE NO.: 29 SURFACE

SAMPLE DESCRIPTION: BROWN CLAYEY SILT WITH SAND

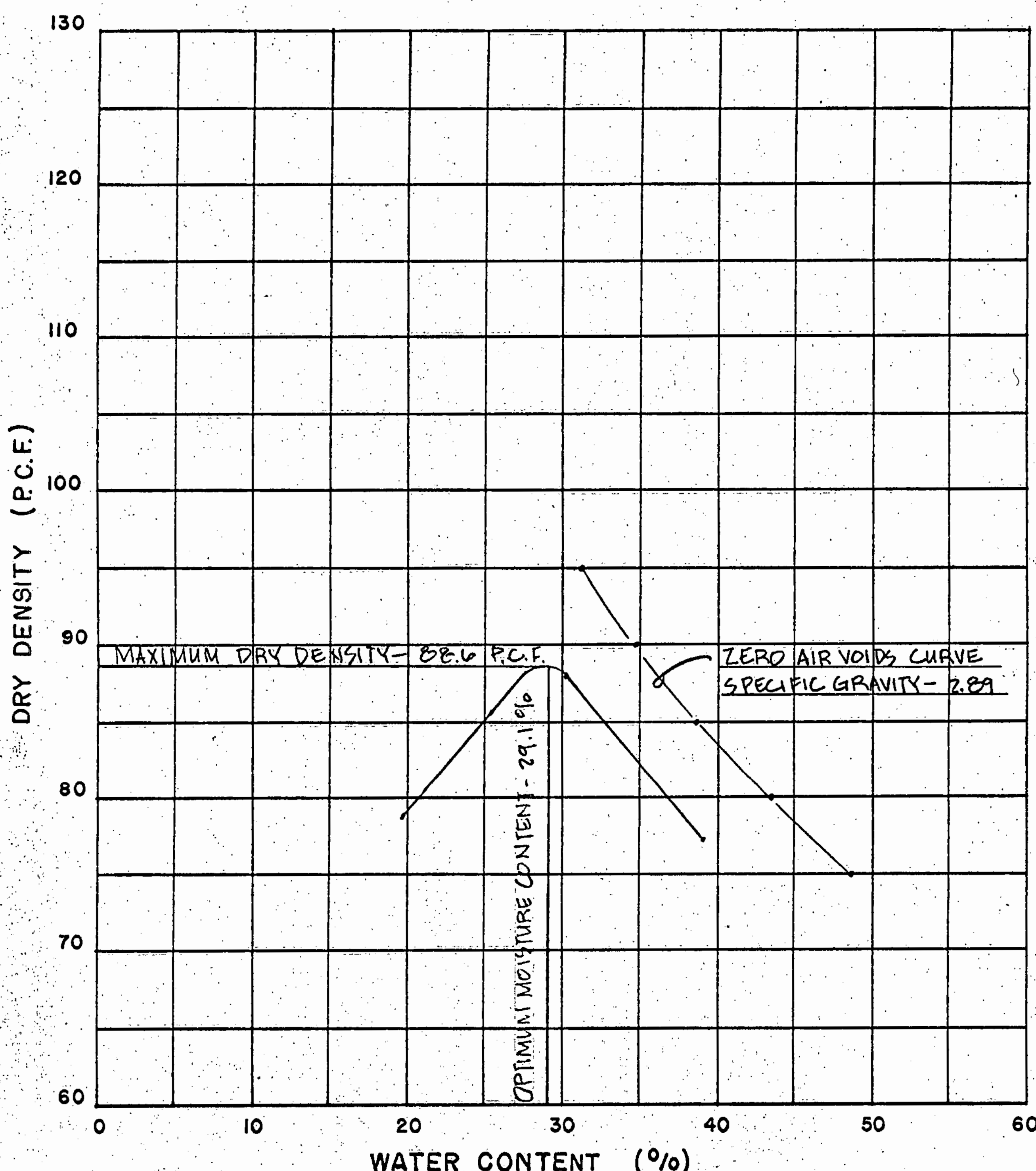
AGGREGATE: 1/4" MINUS

MOLD SIZE: 4" ϕ 4.59"

HAMMER: 10LBS. 18" DROP

LAYERS: 5

BLOWS: 25 PER LAYER




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

DATE 8-8-70 BY S.T.

9-470

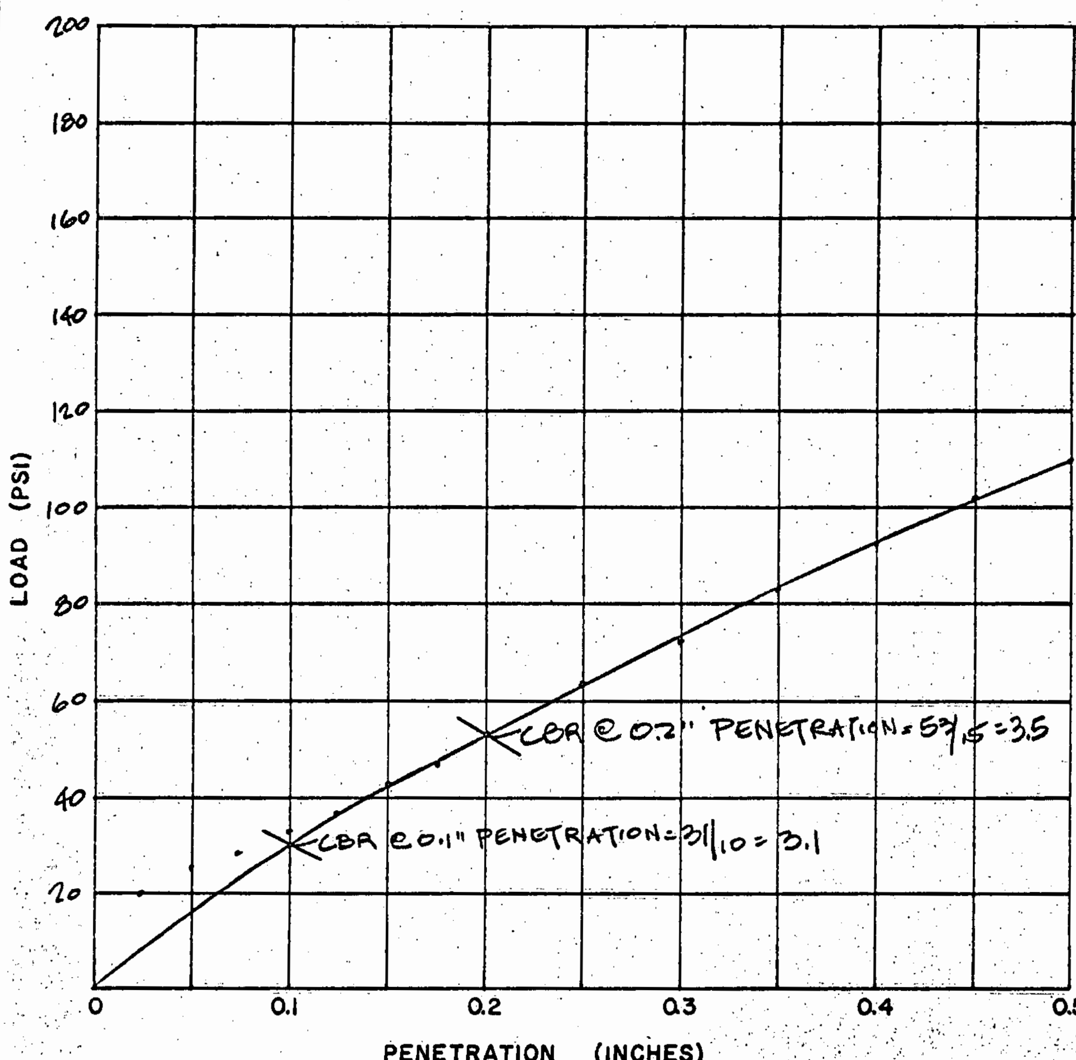
# CBR TEST

PROJECT: GOLF COURSE SUBDIVISION - UNIT 2

LOCATION: MAUNALUA, OAHU, HAWAII

SAMPLE NO: 22 - SURFACE

SAMPLE DESCRIPTION: BROWN SILTY SAND W/GRAVEL




CBR PENETRATION DATA

| PENETRATION (INCHES) | LOAD (LBS.) | LOAD (PSI) |
|---|---|---|
| 0.025 | 60 | 20 |
| 0.050 | 75 | 25 |
| 0.075 | 85 | 28 |
| 0.100 | 100 | 33 |
| 0.125 | 110 | 37 |
| 0.150 | 130 | 43 |
| 0.175 | 140 | 47 |
| 0.200 | 160 | 53 |
| 0.250 | 190 | 63 |
| 0.300 | 220 | 73 |
| 0.350 | 250 | 83 |
| 0.400 | 280 | 93 |
| 0.450 | 305 | 102 |
| 0.500 | 330 | 110 |

AGGREGATE 1/4" MINUS

HAMMER WEIGHT 10LBS

HAMMER DROP 18"

No. OF BLOWS 56

No. OF LAYERS 5

## TEST RESULTS:

MOLDING MOISTURE, %. 40.8

MOLDING DRY DENSITY, P.C.F. 74.0

CBR @ 0.1" PENETRATION 3.1

DATE 1-28-70 BY C.M.

DATE 8-3-70 BY S.T.

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

10-470

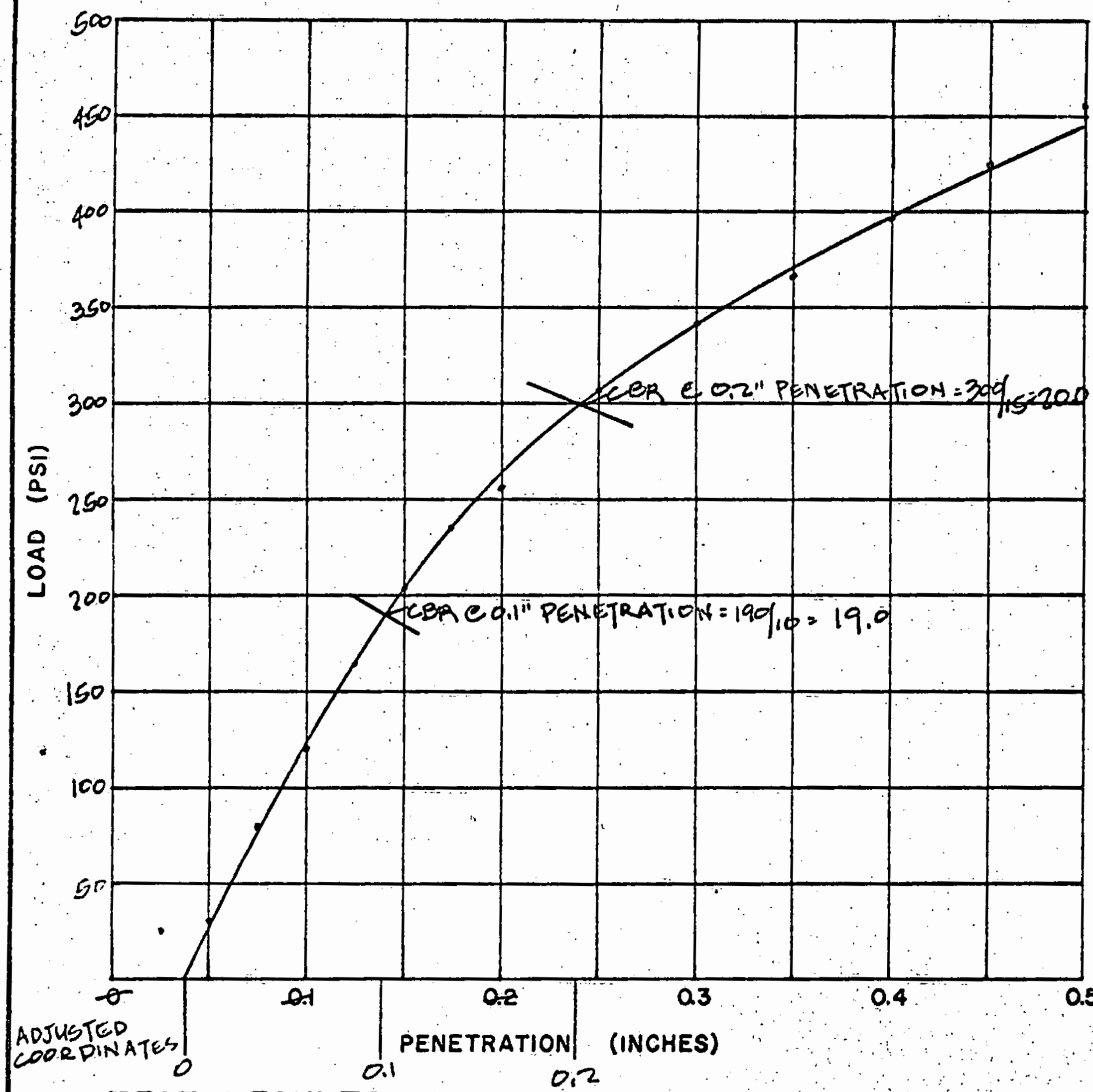
# CBR TEST

PROJECT: GOLF COURSE SUBDIVISION - UNIT 2

LOCATION: MAUNALUA, OAHU, HAWAII

SAMPLE NO: 27 SURFACE

SAMPLE DESCRIPTION: TAN-BROWN SILTY SAND




CBR PENETRATION DATA

| PENETRATION (INCHES) | LOAD (LBS) | LOAD (PSI) |
|---|---|---|
| 0.025 | 75 | 25 |
| 0.050 | 90 | 30 |
| 0.075 | 240 | 80 |
| 0.100 | 360 | 120 |
| 0.125 | 495 | 165 |
| 0.150 | 610 | 203 |
| 0.175 | 705 | 235 |
| 0.200 | 775 | 258 |
| 0.250 | 920 | 307 |
| 0.300 | 1025 | 342 |
| 0.350 | 1105 | 368 |
| 0.400 | 1190 | 397 |
| 0.450 | 1276 | 425 |
| 0.500 | 1365 | 455 |

AGGREGATE 1/4" MINUS

HAMMER WEIGHT 10 LBS

HAMMER DROP 18"

No. OF BLOWS 56

No. OF LAYERS 5

## TEST RESULTS:

MOLDING MOISTURE, %. 22.9

MOLDING DRY DENSITY, P.C.F. 94.6

CBR @ 0.1" PENETRATION 19.0

DATE 8-4-70 BY R.M.

DATE 8-10-70 BY S.T.

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

10-470

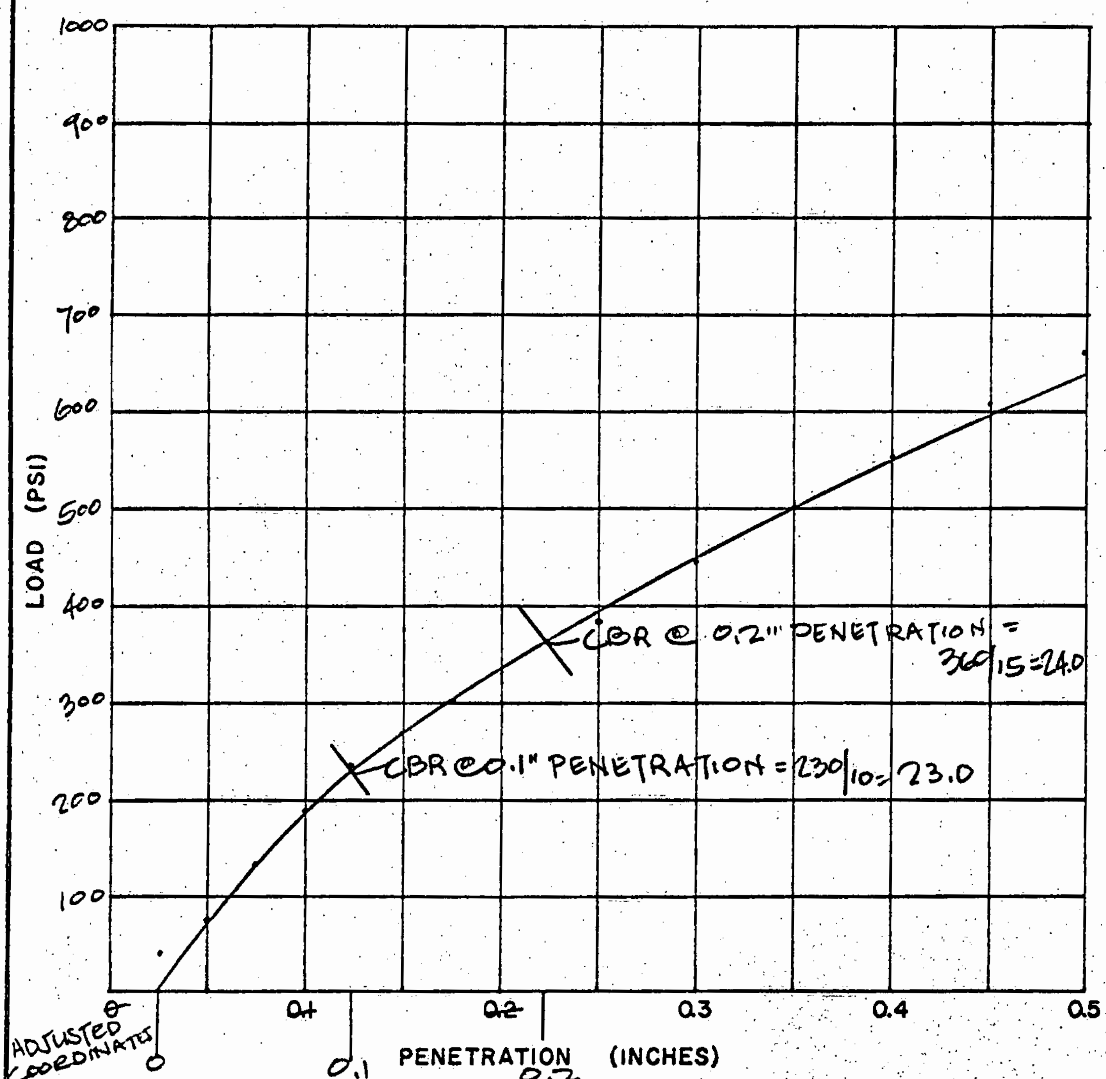
# CBR TEST

PROJECT: GOLF COURSE SUBDIVISION - UNIT 2

LOCATION: MAUNALUA, OAHU, HAWAII

SAMPLE NO: 29 SURFACE

SAMPLE DESCRIPTION: BROWN CLAYEY SILT W/SAND




CBR PENETRATION DATA

| PENETRATION (INCHES) | LOAD (LBS.) | LOAD (PSI) |
|---|---|---|
| 0.025 | 110 | 37 |
| 0.050 | 220 | 73 |
| 0.075 | 390 | 130 |
| 0.100 | 570 | 190 |
| 0.125 | 710 | 237 |
| 0.150 | 810 | 270 |
| 0.175 | 910 | 303 |
| 0.200 | 1000 | 333 |
| 0.250 | 1160 | 387 |
| 0.300 | 1340 | 447 |
| 0.350 | 1505 | 502 |
| 0.400 | 1670 | 557 |
| 0.450 | 1830 | 610 |
| 0.500 | 1990 | 663 |

AGGREGATE 1/4" MINUS

HAMMER WEIGHT 10 LBS

HAMMER DROP 18"

No. OF BLOWS 56

No. OF LAYERS 5

## TEST RESULTS:

MOLDING MOISTURE, %. 26.6

MOLDING DRY DENSITY, P.C.F. 84.1

CBR @ 0.1" PENETRATION 23.0

DATE 7-28-70 BY C.M.

DATE 8-3-70 BY S.T.

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

10-470

GENERAL TESTING METHODS

## EXPLORATORY BORINGS AND SAMPLING

| | |
|---|---|
| Method for soil investigation and sampling by auger borings (Tentative) | ASTM Designation: D 1452-63T |
| Method for thin wall tube sampling of soils (Tentative) | ASTM Designation: D 1587-63T |
| Method for penetration test and split barrel sampling of soils (Tentative) | ASTM Designation: D 1586-64T |

## LABORATORY TESTING

### Grading Analysis

| | |
|---|---|
| Sieve analysis of fine and coarse aggregates | AASHO Designation: T 27-60 |
| Amount of material finer than No. 200 sieve in aggregate | AASHO Designation: T 11-60 |

### Atterberg Limits

| | |
|---|---|
| Determining the liquid limit of soils Modified as follows: Substitute Casagrande grooving tool. Tests conducted from natural moisture content unless noted otherwise. | AASHO Designation: T 89-60 |
| Determining the plastic limit of soils | AASHO Designation: T 90-56 |
| Calculating the plasticity index of soils | AASHO Designation: T 91-54 |

### Specific Gravity

| | |
|---|---|
| Specific gravity of soils Modified as follows: 500 ML Pycnometer | AASHO Designation: T 100-60 |

### Expansion and CBR Tests

| | |
|---|---|
| Expansion test and California Bearing Ratio (CBR) | Section VIII - TM 5-530 "Materials Testing" by Headquarters, Dept. of the Army |

### Compaction Test

| | |
|---|---|
| Moisture-Density relations of soils using a 10# rammer and an 18" drop | AASHO Designation: T 180-57 |

### Unified Soil Classification

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

GENERAL TESTING METHODS

| | |
|---|---|
| Consolidation Test | Chapter IX<br>"Soil Testing for Engineers"<br>by T. William Lambe<br>The Massachusetts Institute of Technology |
| Laboratory Shear Test | |
| Laboratory shear test using the Torvane | Brochure by Soiltest, Inc. |

## LIMITATIONS

In general, soil formations are commonly erratic and rarely uniform or regular. The boring logs indicate the approximate subsurface soil conditions encountered only at the drill holes where the borings were made at the times designated on the logs and may not represent conditions at other locations or at other dates. Soil conditions and water levels may change with the passage of time and construction methods or improvements at the site.

During construction, should subsurface conditions much different from those in the borings be observed, encountered, or otherwise indicated, we should be advised immediately to review or reconsider our recommendations in light of the new developments.

Our professional services were performed, findings obtained and recommendations prepared in accordance with generally accepted engineering practices. This warranty is in lieu of all other warranties expressed or implied.

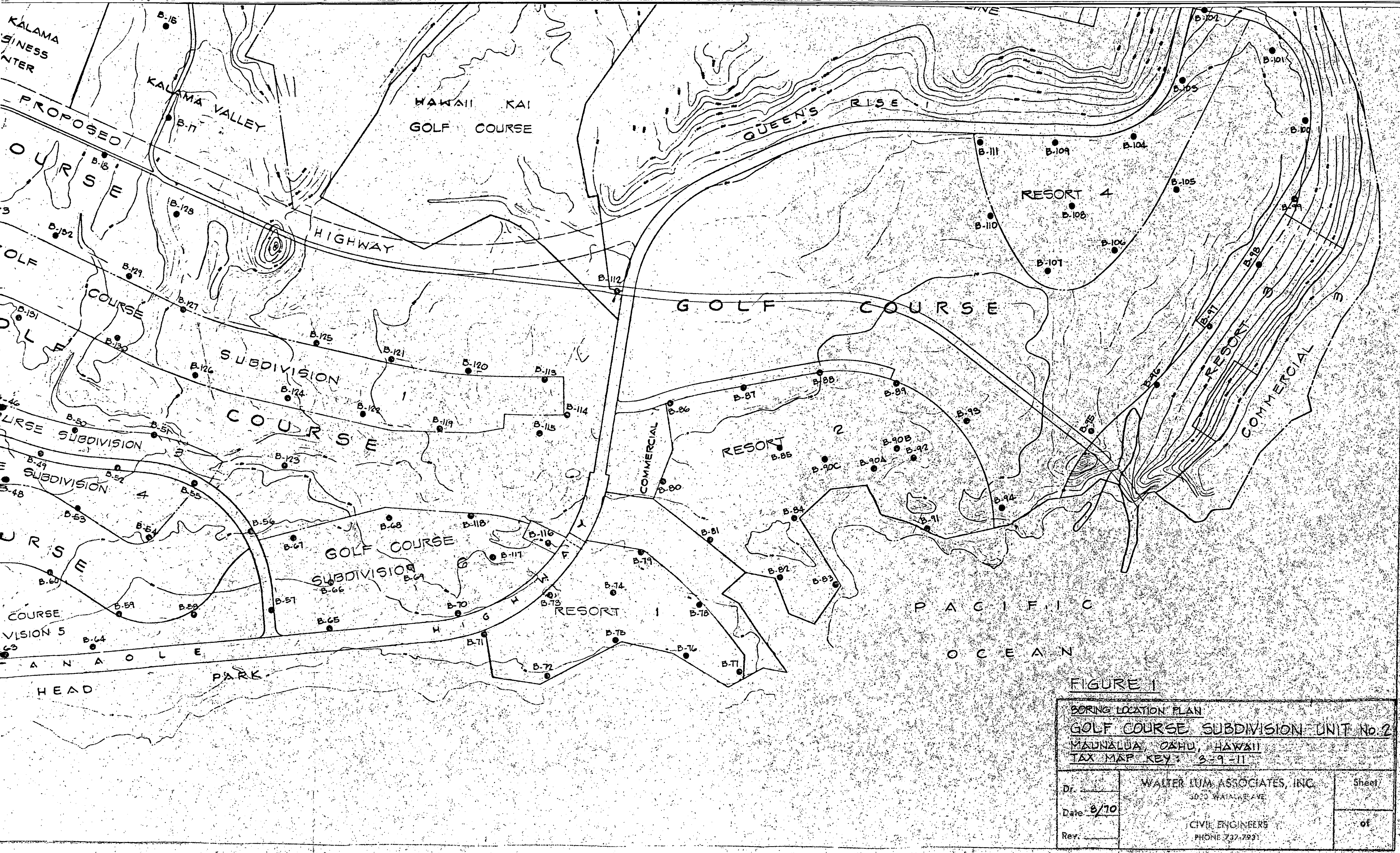



FIGURE 1

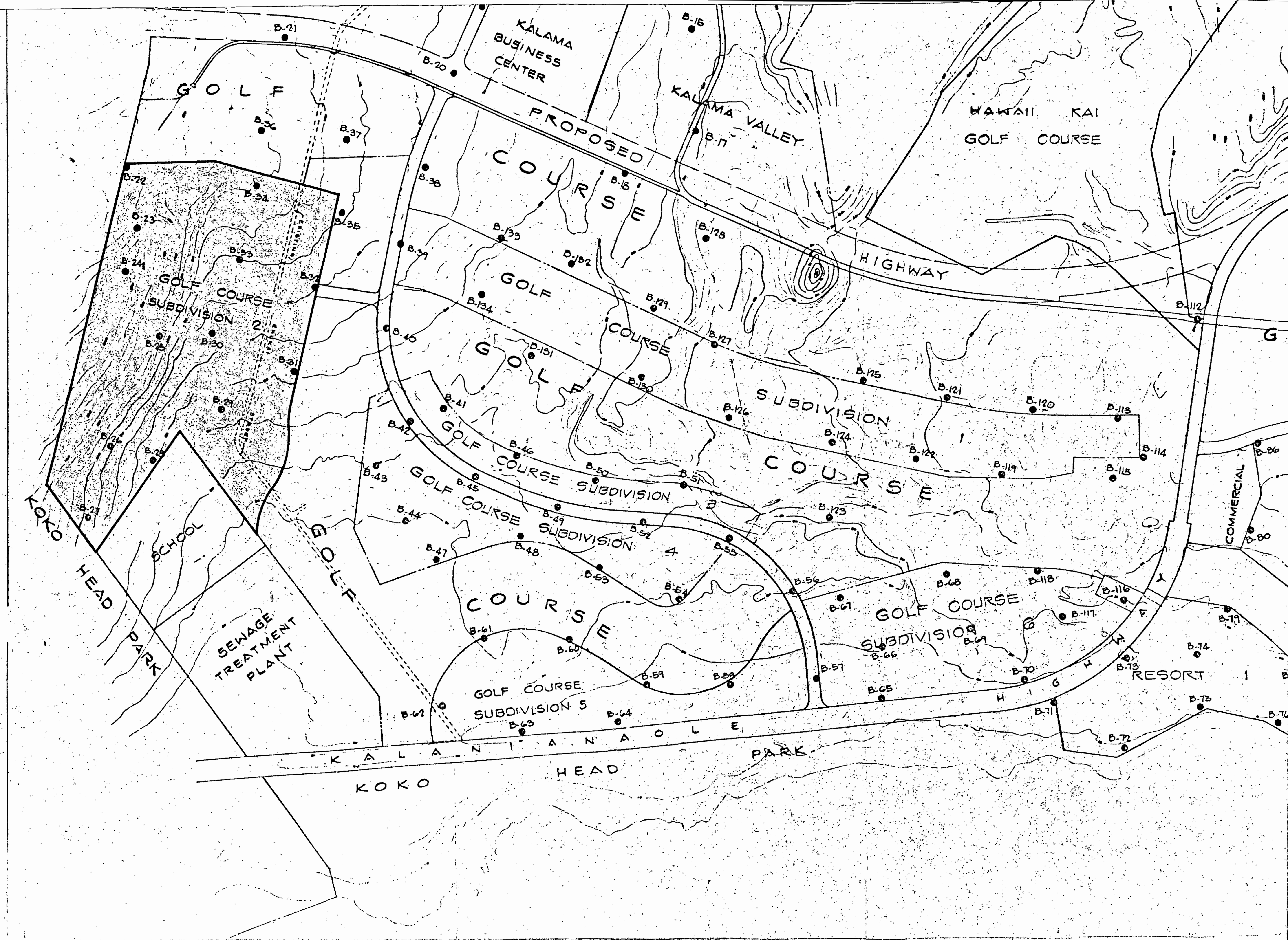
BORING LOCATION PLAN

GOLF COURSE SUBDIVISION UNIT No. 2

MAUNALUA, OAHU, HAWAII

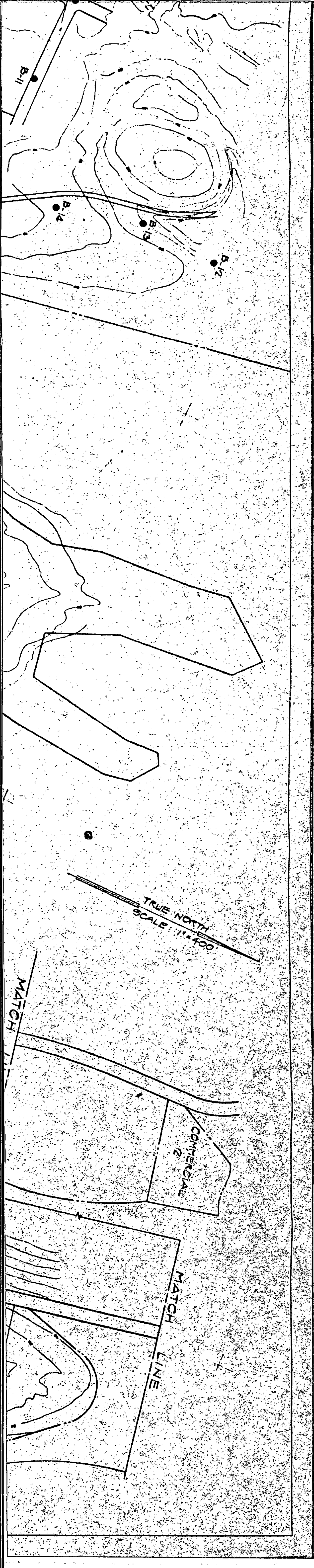
TAX MAP KEY: 3-9-11

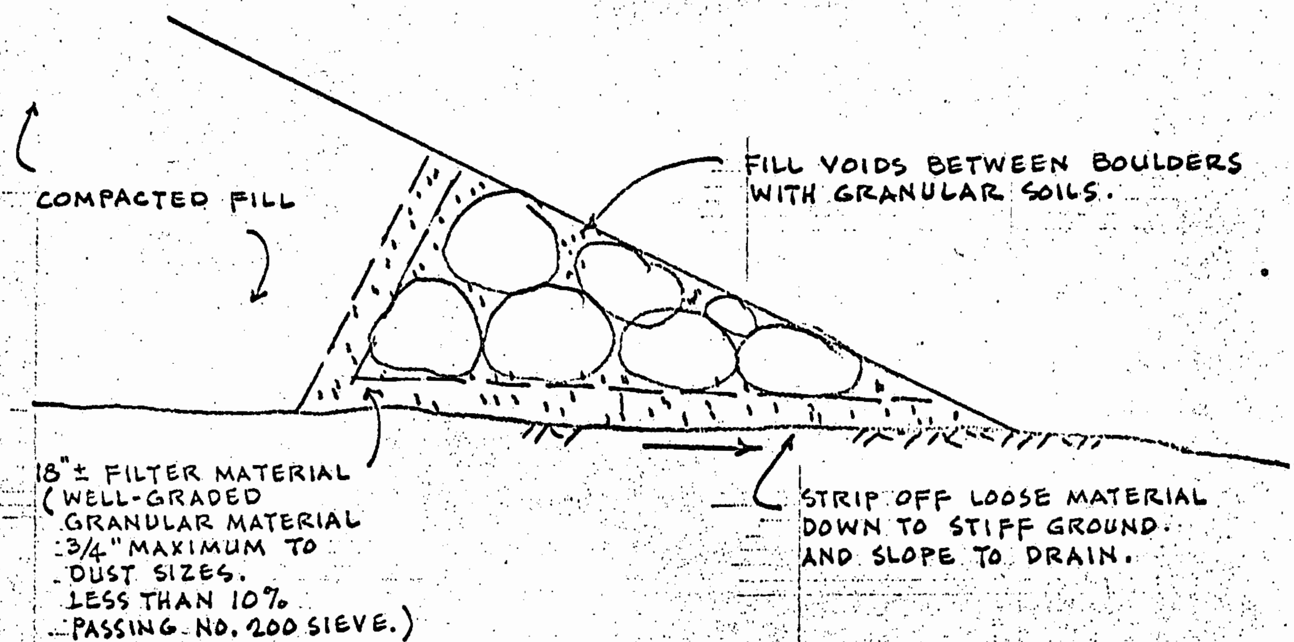
| Dr. | WALTER LUM ASSOCIATES, INC. CIVIL ENGINEERS PHONE 737-7931 | Sheet |
|---|---|---|
| Date 8/70 | | of |
| Rev. | | |



HAWAII KAI GOLF COURSE
KALAMA BUSINESS CENTER
KALAMA VALLEY
PROPOSED HIGHWAY
GOLF COURSE
GOLF COURSE SUBDIVISION 1
GOLF COURSE SUBDIVISION 2
GOLF COURSE SUBDIVISION 3
GOLF COURSE SUBDIVISION 4
GOLF COURSE SUBDIVISION 5
GOLF COURSE SUBDIVISION 6
COMMERCIAL
RESORT 1
SCHOOL
SEWAGE TREATMENT PLANT
KOKO HEAD PARK
KALANIANAOLE HIGHWAY


KALAMA VALLEY I
B-7
B-8
B-9
B-10
B-11
B-12
B-13
B-14


B-11
B-14
B-13
B-12
TRUE NORTH
SCALE: 1"=400'
MATCH
COMMERCIAL
2
MATCH LINE




SECTION

NOT TO SCALE

FIGURE 2

PROPOSED BOULDER FILL

GOLF COURSE SUBDIVISION UNIT No. 2

MAUNALUA, OAHU, HAWAII

TAX MAP KEY: 3-9-11

WALTER LUM ASSOCIATES, INC.

CIVIL, STRUCTURAL, SOILS ENGINEERS