REPORT

TO

CHUNG DHO AHN & ASSOCIATES

HONOLULU, HAWAII

SOIL INVESTIGATION FOR RESIDENTIAL DEVELOPMENT

KULIOUOU TERRACE SUBDIVISION - UNIT I

KULIOUOU VALLEY, HONOLULU, OAHU, HAWAII

TAX MAP KEY: 3-8-06: 5 & 6

By

WALTER LUM ASSOCIATES, INCORPORATED

CIVIL ENGINEERS

March 30, 1965

WALTER LUM ASSOCIATES
CIVIL, STRUCTURAL, SOILS ENGINEERS

WALTER LUM
EDWARD WATANABE
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1019-A UNIVERSITY AVENUE • HONOLULU 14, HAWAII • PHONE, 990-471

March 30, 1965

MR. CHUNG DHO AHN
Chung Dho Ahn & Associates
Room 309, 1126 12th Avenue
Honolulu, Hawaii 96816

Dear Mr. Ahn:

Subject: Kuliouou Terrace Subdivision - 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 development site for the Kuliouou Terrace Subdivision - Unit I at Kuliouou Valley, Honolulu, Oahu, Hawaii, Tax Map Key: 3-8-06: 5 & 6.

From the field investigations and laboratory test results, it is our opinion that the area can be suitably developed for residential housing. Houses can be supported either directly on the native soils or on properly compacted fills constructed from the native soils.

Several old cesspools may be encountered at the site. Accurate location and proper backfilling of each cesspool will be necessary. The recommended procedure for backfilling is outlined in the report.

Several damaged areas were observed in the Kuliouou Stream bank lining. These damaged areas should be repaired.

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

Ezra Koike
Registered Engineer No. 1450

EK:es

C O N T E N T S

REPORT

ON

SOIL INVESTIGATION FOR RESIDENTIAL DEVELOPMENT

KULIOUOU TERRACE SUBDIVISION - UNIT I

KULIOUOU VALLEY, HONOLULU, OAHU, HAWAII

TAX MAP KEY: 3-8-06: 5 & 6

SCOPE OF INVESTIGATION

The purpose of this investigation was to determine the general suitability of the proposed site, Kuliouou Terrace Subdivision - Unit I at Kuliouou Valley, Honolulu, Oahu, Hawaii for residential housing construction.

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

FIELD INVESTIGATIONS

A series of five test borings were made at the site. The locations of these borings are shown on Figure 1. Descriptions of the underlying soils are shown on the Boring Logs Nos. 1 thru 5. 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 and IB.

SITE CONDITIONS

Soils

The project site is in Kuliouou Valley adjacent to the west bank of Kuliouou Stream. The existing ground slopes gently at about 3% toward the stream.

The borings generally indicated medium to stiff brown clayey silt mixed with sand, gravel and some small boulders to about 3' to 8' depths where hard rock or boulders were encountered.

No trace of seepage or ground water flow was noticed at the project site during boring operations. If water is discovered during excavation work, additional investigations should be conducted and the area properly drained before earthwork construction begins.

Cesspools

At the time of the field investigations, the site was occupied by old residences and a small dairy farm. Since the project site was not serviced by a general sewerage system, old cesspools may be encountered during clearing, grubbing and earthwork operations. The location of each cesspool should be flagged and accurately located on the grading plan and should be properly backfilled before grading work is started in the area.

Kuliouou Stream

The Kuliouou Stream bank was lined with grouted rubble paving. Damages in the lining were observed in several places. It is recommended that these damaged areas be repaired.

ROADWAYS

In general, a 6-inch base course on a 6-inch subbase course is sufficient for the light residential types of traffic anticipated. Adjustments regarding subbase requirements can be made in the field.

The design standards 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 F. H. A. Data Sheet 79-D and the "Guide Specification for Earthwork" attached hereto.

If the earthwork is carried out in the manner specified, the fill should develop bearing values adequate to support without undue settlement the type of light construction proposed.

All old cesspools should be accurately located on the grading plan and properly backfilled before any grading work is started. The recommended procedure for proper backfilling is outlined in the "Guide Specification for Earthwork". The soils engineer must be notified prior to the backfill operations so that observations and testing can be made during construction.

SLOPES

Cut slopes of 1½ horizontal to 1 vertical will be adequately stable in areas where no seepage water is encountered.

Standard fill slopes of 2 horizontal to 1 vertical should result in satisfactorily stable slopes.

Slope adjustments may be necessary if seepage zones are encountered.

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 against erosion, slope planting is recommended. The various grasses such as manienie grass, buffalo grass and hunnan 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, hunnan grass is preferable. For additional information, see the "Guide Specification for Planting" attached hereto.

FOUNDATIONS

Bearing Values

Unconfined compression test values generally ranged from about 2000 to 9000 p.s.f. It is our opinion that the undisturbed soils have the required bearing values to sustain the proposed low fills and building loads from light dwellings.

If earthwork operations are done carefully and properly, compacted fills will support without undue settlement light buildings or conventional types of house foundations such as slab-on-ground or post and beam construction.

Bearing values for a given soil usually vary with the size and depth of the footings. For light residential structures placed directly

on compacted fill, safe bearing values of about 2000 p.s.f. may be used for slab-on-ground construction or post and beams on individual block footings. For foundations on undisturbed ground, 3000 p.s.f. may be used.

Post and Beam Construction

For post and beam construction, it is recommended that the bottom of concrete footing blocks be carried down about 12" below finish grades. Good surface drainage away from the foundation areas is essential.

Slab-On-Ground Construction

For slab-on-ground construction, the floor slab should be laid on a 4-inch layer of select material, properly compacted. Good surface drainage away from the foundation area is essential.

CONCLUSIONS

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.

(2) Fills constructed properly from the native soils will have sufficient strength to adequately support light building or house foundations and structures common to subdivision developments.

(3) Existing cesspools at the site should be backfilled as recommended in this report.

(4) Damaged areas in the Kuliouou Stream bank lining should be repaired.

(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 residential development.

GUIDE SPECIFICATION FOR EARTHWORK

KULIOUOU TERRACE SUBDIVISION - 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 loose topsoil and mounds of stockpiled soils shall be stripped to stiff natural ground before placing any fills over the area. All loose topsoil encountered at finish grades shall be scarified and 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 that has been accepted by F.H.A. The soils shall contain not more than a trace of organic matter and shall contain no particles larger than 6 inches in diameter. In addition, it shall contain not more than 40% gravel (#4 x 3") and not more than 10% cobbles larger than gravel and smaller than 6 inches in diameter. Fill material placed in the top one foot of fills shall contain not more than 30% gravel (#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 nest 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 ninety percent (90%) of maximum density in accordance with AASHO Test No. T180-57 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 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 sheepsfoot rollers are used, the soil may be disturbed to a depth of several inches. Density reading shall be taken in the compacted material below the disturbed surface, and as often as necessary, as determined by the Soils Engineer, and found acceptable to the Federal Housing Administration. When these readings indicate that the density of any layer of fill or portion thereof is below the required ninety percent (90%) 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.

Backfill of Old Cesspools

The following procedures shall be followed for backfilling:

(1) Sludge Removal

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

(2) Granular Fill (Below 3' from Finished Grade)

Use granular material, preferably [illegible] The fines passing the No. 200 sieve shall be less than 10%. The materials shall be placed in dry layers (12" maximum) and compacted with vibratory equipment to 90% of AASHO T-180-57 density. Density each layer has place with a sandcone device will be utilized. The granular fill shall be tested before placing into the cesspools. Sufficient compaction tests shall be conducted to verify that the compaction is obtained by the construction method that is selected.

(3) Top 3' of Fill

Where linings are encountered in the cesspool, the lining within the top 3' from finish grade shall be removed. The fill within the top 3' from finish grade shall be constructed from on-site soil in thin layers (6" compacted thickness) to 90% of AASHO T-180-57 density. The material at finish grade shall blend with the surrounding soils.

Soil Engineering Services

The Soils Engineer sh[illegible] and make necessary tests so th[illegible] accordance with the specificat[illegible].

Rainy Weather

No fill material shall [illegible] unfavorable weather conditions. [illegible] fill operations, shall not be [illegible] Engineer indicate that the moi[illegible] 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:

Sieve	% Passing
3" Sq.	Not less than 95%
#40	Not more than 15%
#200	2 - 6%

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.

WALTER LUM ASSOCIATES

Boring Log

PROJECT KULIOUOU TERRACE SUBDIVISION

LOCATION KULIOUOU VALLEY, HONOLULU

TMK 3-8-06

HAMMER:

Weight 10 lb. SLEDGE HAMMER

Drop

SAMPLER: 2" O.D SHELBY TUBE

DESCRIPTION	Depth ft
MEDIUM TO STIFF DARK BROWN CLAYEY SILT W/ TRACES OF SAND	1
STIFF, BROWN CLAYEY SILT W/ TRACES OF SAND	2
	3
STOPPED BY HARD GRAY, ROCK OR BOULDER	4

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Boring Log

PROJECT KULIOUOU TERRACE SUBDIVISION - UNIT I

LOCATION KULIOUOU VALLEY, HONOLULU, OAHU, HAWAII

TMK 3-8-06: 5, 6

HAMMER:

Weight 10 lb. SLEDGE HAMMER

Drop

SAMPLER: 2" O.D. SHELBY TUBE

BORING NO. 4 Sheet No. of

Driller WALTER LUM ASSOC., INC. Date 3-12-65

Field Party KUSANO GLORIA GANZAGAN FUJII

Type of Boring 6 H.P. MOBILE DRILL Diam. 3"ϕ

Elev. Datum

Water Level NONE

Time

Date 3-13-65

DESCRIPTION	Depth (Ft.)	Elev	Sample No	Wet Dens. P.C.F.	Moist. Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Shear P.S.F.	Blows Per Foot 0 10 20 30 40
BROWN SILT CRUSHED CORAL BASE	0								
	1		4-A	115.4	36.6	84.5	5730		
STIFF, BROWN CLAYEY SILT W/ TRACES OF GRAVEL & SAND	2								
	3								
	4		4-B	106.3	41.2	75.3	4690		
STIFF, BROWN SILTY CLAY W/ RIVER GRAVEL & SMALL BOULDERS	5								
	6		4-C	116.3	36.5	85.2	5730		
STOPPED BY HARD ROCK OR BOULDER	7								

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Boring Log

PROJECT KULIOUOU TERRACE SUBDIVISION - UNIT I

LOCATION KULIOUOU VALLEY, HONOLULU, OAHU, HAWAII

TMK 3-8-06: 5, 6

HAMMER:

Weight 10 lb. SLEDGE HAMMER

Drop

SAMPLER: 2" O.D. SHELBY TUBE

BORING NO 5 Sheet No. of

Driller W.LUM ASSOC., INC. Date 3-13-65

Field Party KUSANO, GLORIA, GANZAGAN, FUJII

Type of Boring 6 H.P. MOBILE DRILL Diam. 3"ϕ

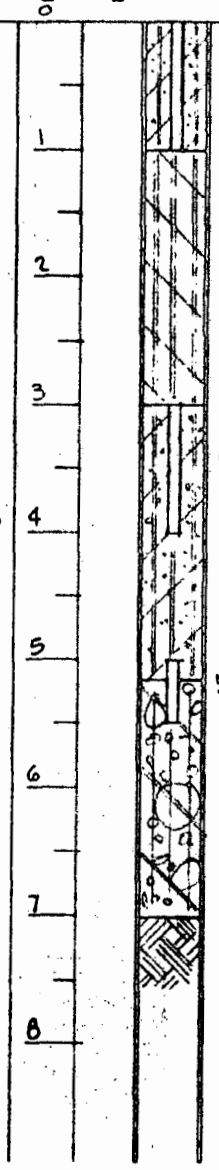
Elev. Datum

Water Level NONE

Time

Date 3-13-65

DESCRIPTION	Depth (Ft.)	Elev	Sample No.	Wet Dens. P.C.F.	Moist. Cont. %	Dry Dens P.C.F	Uncont Comp. P.S.F	Vane Shear P.S.F.	Blows Per Foot 0 10 20 30 40
STIFF DARK BROWN CLAYEY SILT W/TRACES OF SAND	0–1		5-A	116.1	34.4	86.4	10,420		
STIFF, BROWN CLAYEY SILT	1–3								
MEDIUM TO STIFF BROWN, CLAYEY SILT W/TRACES OF BLACK SAND	3–5		5-B	102.5	37.2	74.7	3640		
DENSE, DARK BROWN SILTY CLAY W/RIVER GRAVEL & SMALL BOULDERS	5–6		5-C	114.1	21.9	93.6	11560 SANDY		
STOPPED BY HARD ROCK OR BOULDER	6–8								



KULIOUOU TERRACE SUBDIVISION - UNIT I
KULIOUOU VALLEY, HONOLULU, OAHU, HAWAII

TABLE I A - SUMMARY OF LABORATORY TEST RESULTS

BORING NO.	1	1		2	
SAMPLE NO.		B			
DEPTH BELOW SURFACE	SURFACE	3.0' TO 4.5'		SURFACE	
DESCRIPTION	BROWN SANDY ORGANIC SIT	DARK BROWN SILTY CLAY W/SAND & GRAVEL		GRAYISH-BROWN CLAYEY ORGANIC SILT W/TRACES OF GRAVEL	
GRADING ANALYSIS (% Passing) Sieve					
1"					
½"					
#4					
#10					
#20					
#40					
#100					
#200					
ATTERBERG LIMITS					
Liquid Limit	97	73			
Plastic Limit	91	33			
Plasticity Index	6	40			
SPECIFIC GRAVITY				2.18	
EXPANSION TEST					
Swell upon saturation, % (Surcharge-51 P.S.F.)	4.7			2.3	
CBR at 0.1" Penetration (%) (Surcharge-51 P.S.F.)	8.5			12.5	
COMPACTION TEST (AASHO METHOD T-180-57)					
Max. Dry Density (P.C.F.)				63.2	
Optimum Moist. (%)				43.0	
UNIFIED SOIL CLASSIFICATION	OH	CH		OH	

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KULIOUOU TERRACE SUBDIVISION - UNIT I
KULIOUOU VALLEY, HONOLULU, OAHU, HAWAII

TABLE I B - SUMMARY OF LABORATORY TEST RESULTS

BORING NO.	4	4		5	5
SAMPLE NO.	A	C			B
DEPTH BELOW SURFACE	0.7' TO 1.5'	5.0' TO 6.0'		SURFACE	3.0' TO 4.5'
DESCRIPTION	BROWN SILTY CLAY W/TRACES OF SAND	BROWN SILTY CLAY W/ROCKS & RIVER GRAVEL		DARK BROWN CLAYEY SILT W/TRACES OF SAND	BROWN CLAYEY SILT W/TRACES OF ROCKS
GRADING ANALYSIS (% Passing) Sieve					
1"				100	
½"				100	
#4				95.1	
#10				91.1	
#20				85.0	
#40				78.3	
#100				67.2	
#200				62.5	
ATTERBERG LIMITS					
Liquid Limit	69	87		73	56
Plastic Limit	32	35		40	35
Plasticity Index	37	52		33	21
SPECIFIC GRAVITY				2.71	
EXPANSION TEST Swell upon saturation, % (Surcharge-51 P.S.F.)	4.0			2.8	
CBR at 0.1" Penetration (%) (Surcharge-51 P.S.F.)	7.3			9.7	
COMPACTION TEST (AASHO METHOD T-180-57)					
Max. Dry Density (P.C.F.)				92.2	
Optimum Moist. (%)				28.7	
UNIFIED SOIL CLASSIFICATION	CH	CH		MH	MH

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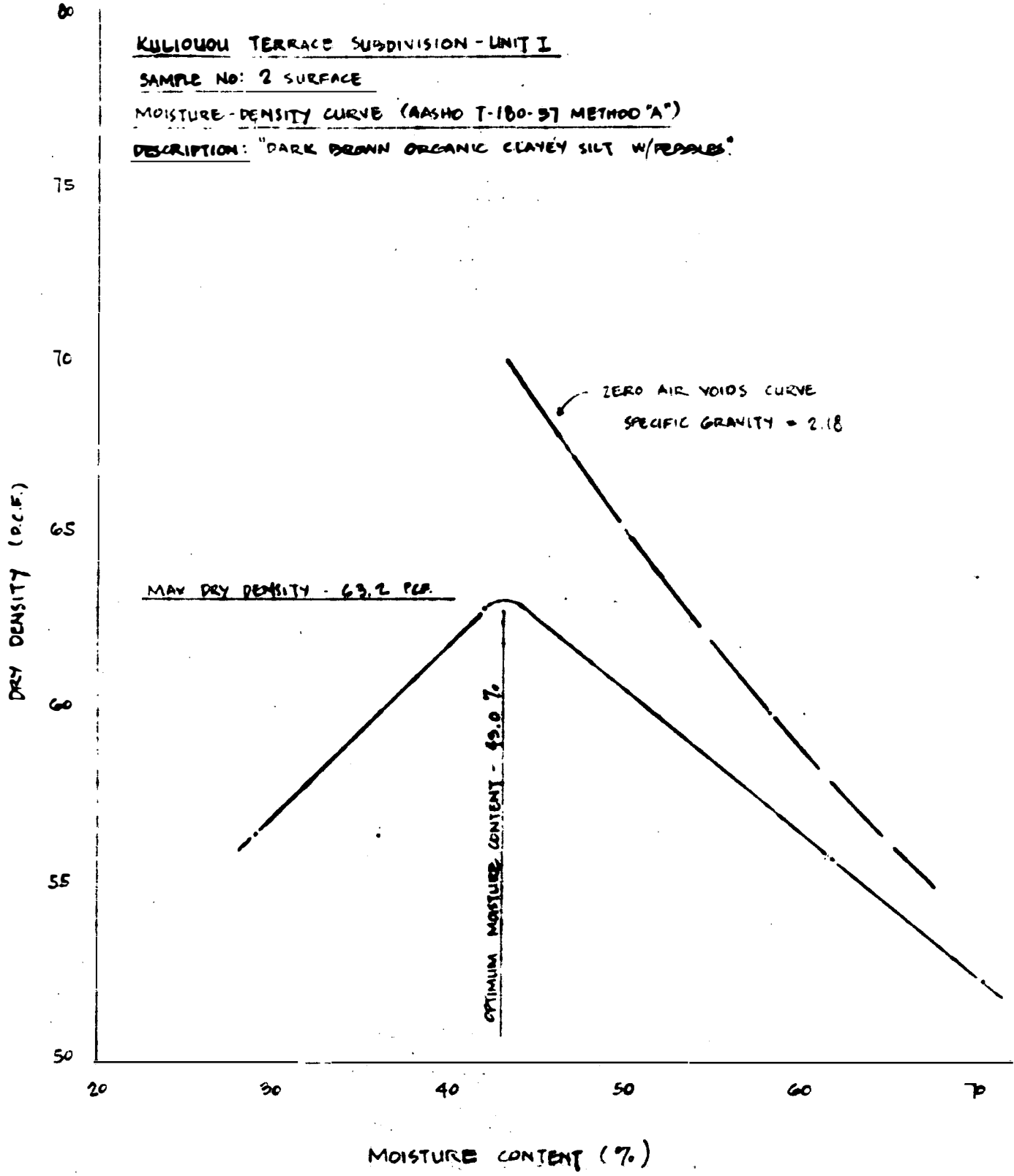
KULIOUOU TERRACE SUBDIVISION - UNIT I

SAMPLE NO: 2 SURFACE

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

DESCRIPTION: "DARK BROWN ORGANIC CLAYEY SILT W/PEBBLES"



KULIOUOU TERRACE SUBDIVISION - UNIT I

SAMPLE NO: 5 SURFACE

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

DESCRIPTION: "BROWN CLAYEY SILT W/SOME PEBBLES"