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

WALTER LUM
EDWARD WATANABE
EZRA KOIKE

3030 WAIALAE AVE., HONOLULU, HAWAII 96816 • TEL. 737-7931

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1969 OCT 13 AM 8 44
DIV. OF ENGINEERING

October 10, 1969

PARK ENGINEERING, INC.
1149 Bethel Street, Room 710
Honolulu, Hawaii 96813

Gentlemen:

Subject: Momilani Suburb Unit XI
Manana-Uka & Waimano, Ewa, Oahu, Hawaii
Grading Plans

The grading plans for Momilani Suburb Unit XI (Sheet Nos. 1, 2 and 3) were reviewed. The grading plan is in general conformance with the recommendations contained in the preliminary soil report, "Momilani Suburb Unit XI", dated March 11, 1968.

Local soft pockets or seepage pockets, if detected during construction, should be corrected out in the field as they are encountered.

Respectfully submitted,

WALTER LUM ASSOCIATES, INC.

Ezra Koike

Ezra Koike
Professional Engineer
Hawaii No. 1450

EK:vi

MUNICIPAL REFERENCE & RECORDS CENTER
City & County of Honolulu
City Hall Annex, 558 S. King Street
Honolulu, Hawaii 96813
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MOMILANI SUBURB UNIT XI - PRELIMINARY SOIL REPORT
(for residential development)

MANANA-UKA & WAIMANO, EWA, OAHU, HAWAII

TAX MAP KEY: 9-7-24: 1

To:
PARK ENGINEERING, INCORPORATED

By:
WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS
March 11, 1968

MUNICIPAL REFERENCE & RECORDS CENTER
City & County of Honolulu
City Hall Annex, 558 S. King Street
Honolulu, Hawaii 96813

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

WALTER LUM
EDWARD WATANABE
EZRA KOIKE

3030 WAIALAE AVE., HONOLULU, HAWAII 96816 • PH. 777-931

March 11, 1968

PARK ENGINEERING, INC.
1149 Bethel Street, Room 710
Honolulu, Hawaii 96813

Gentlemen:

Subject: Momilani Suburb Unit XI
Preliminary Soil Report
(for residential development)
Chapter 23, Revised Ordinances of Honolulu,
1961 As Amended

In accordance with your request, a preliminary soil exploration was made at the proposed residential development site for the Momilani Suburb Unit XI at Manana-Uka & Waimano, Ewa, Oahu, Hawaii, Tax Map Key: 9-7-24: 1.

From the field exploration and laboratory test results, it is our opinion that the site may be used for a residential housing development. Houses can be supported either directly on stiff existing ground or on properly compacted fills constructed from suitable on-site soils or approved borrow material.

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

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

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

Respectfully submitted,

WALTER LUM ASSOCIATES, INC.

Ezra Koike

Ezra Koike
Professional Engineer
Hawaii No. 1450

EK:vi

C O N T E N T S

MOMILANI SUBURB UNIT XI - PRELIMINARY SOIL REPORT
(for residential development)

MANANA-UKA & WAIMANO, EWA, OAHU, HAWAII

TAX MAP KEY: 9-7-24: 1

SCOPE OF EXPLORATION

The purpose of this exploration was to determine soil conditions of the proposed site, Momilani Suburb Unit XI at Manana-Uka & Waimano, Ewa, Oahu, Hawaii, for residential development.

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

FIELD EXPLORATION

Twelve borings were made at the site. The locations of these borings are shown on Figure 1, Boring Location Plan. Descriptions of the underlying soils are shown on Boring Logs Nos. 1 thru 12.

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

Soil samples were visually identified and tentatively classified in the field. In the laboratory, they were subjected to appropriate tests. The field 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: natural density, moisture content and unconfined compression; Atterberg limits; specific gravity; gradation; 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 Tables IA and IB.

SITE AND SOIL CONDITIONS

The project is located about 700 ft southeast of the intersection of Waimano Home Road and Komo Mai Drive and extends along the Ewa side of Momilani Suburb Unit X mauka of Komo Mai Drive.

The site is an abandoned cane field covered with grass and scattered sugar cane. The existing ground generally slopes down toward Komo Mai Drive at about 5 to 10 percent grades.

Along the western boundary is an existing gully sloping down toward the lower area adjacent to Komo Mai Drive.

From the field exploration and laboratory test results, the soil at the site may be generally described as follows:

A surface layer about 1 to 6 ft of medium to stiff, reddish-brown silty clays underlain by stiff to very stiff, reddish-brown and mottled brown, silty clays with decomposed rock to about 10 to 15 ft, the depths drilled.

Water was not noticed within the depths drilled during the field explorations.

For more detailed descriptions, refer to the boring logs.

DISCUSSION AND RECOMMENDATIONS

In general, the present plan is to construct fills up to about 20 ft in thickness along the lower areas. The fill materials will generally come from Momilani Suburb Unit VI. The soils in Unit VI have been previously identified in a soil report for Momilani Suburb Unit VI, dated August 4, 1967.

The proposed grading at this time is to use cut or fill slopes of less than about 20 ft in height.

In the opinion of the Soil Engineer, the on-site soils have, in general sufficient strength to support the fills and the light residential structures proposed.

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

Fills

In general, the proposed borrow materials from Momilani Suburb Unit VI and the on-site soils are suitable for the construction of the proposed fills. The construction of the proposed fills should be done as required by the F.H.A. Data Sheet 79-G; Revised Ordinances of Honolulu, 1961 As Amended; and as recommended below:

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

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

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

4. Subdrains should be placed along the bottom of the natural drainageway along the western boundary before the placement of fills. The final locations of subdrains should be decided in the field after clearing and grubbing.

5. All fills should be constructed in approximately level layers starting at the lower end and working upward.

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

Slopes

Cut and fill slopes of 2 horizontal to 1 vertical or flatter should be used.

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

If slope heights (top to toe) greater than 25 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 during construction, it is recommended that runoff water from rainstorms be controlled by berms or other approved methods.

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

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

Foundations

If earthwork is carried out as specified, the stiff natural ground and properly constructed fill should develop adequate bearing values to support the proposed light residential structures. Recommendations for foundation construction are:

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

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

bearing values of 1500 p.s.f. on compacted fills and 2000 p.s.f. on stiff natural ground may be used.

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

4. Construction of retaining walls on side slopes should be avoided unless the underlying materials are very stiff or hard.

5. Good surface drainage away from the foundations of the proposed structures should be maintained.

Roadways

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

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

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

It is recommended that the subgrades of roadways be compacted and shaped to drain. Outlets should be placed at low points of roadway profiles to avoid water pocketing by running bleeder pipes into catch basins at low points of the subgrade.

PROPOSED SPECIFICATION FOR EARTHWORK

MOMILANI SUBURB UNIT XI

General Description

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

Clearing, Grubbing and Preparing Areas to be Filled

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

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

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

Where fills are proposed, all loose material along the bottom and the sides of natural drainageways shall be stripped down to stiff natural ground and recompacted to match the density of the surrounding soils before the placement of fills.

Subdrains shall be placed along the bottom of natural drainageways near the western boundary before the construction of fills.

If unforeseen or undetected critical soil conditions are encountered during the site preparation, such as soft spots or seepage water, additional investigations shall be made by the Soil Engineer. Corrective measures shall be evaluated and field adjustments shall be made in these areas.

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 soils from Momilani Suburb Unit VI and on-site soils approved by the Soil Engineer and identified in the soil reports accepted by the F.H.A. The soils shall contain no more than a trace of organic matter and no particles larger than 6 in. in diameter. Also, it shall contain no more than 40% gravel (#4 sieve to 3 in. sieve sizes) and no more than 10% cobbles larger than gravel and smaller than 6 in. in diameter. Fill material placed in the top 2 ft of fills shall contain no more than 30% gravel and any material larger than gravel.

Placing, Spreading and Compacting Fill Material

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 moisture content within each layer.

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

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

When the moisture content of the material is above that specified by the Soil Engineer, the fill material shall be aerated by blading or by 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 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 at the specified moisture 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 by the Soil Engineer of the compaction of each layer of 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 as determined by the Soil Engineer. When these readings indicate that the density of any layer of fill or portion thereof is below the required 90% density, 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.

Excavation

If unforeseen critical soil formations are encountered at or near finish grades in cut areas, additional investigations shall be made by the Soil Engineer. Corrective measures shall be evaluated and field adjustments shall be made in these areas.

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

Soil Engineering Services

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

Rainy Weather

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

WALTER LUM ASSOCIATES 3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 777-931

Boring Log

PROJECT: MOMILANI SUBURB UNIT XI
LOCATION: MANANA-UKA & WAIMANO
EWA, OAHU, HAWAII
TMK: 9-7-24 : 1
HAMMER:
Weight: 140#
Drop: 30"
SAMPLER: 2"SS - 2" STANDARD SPLIT SPOON
2"S - 2" O.D. THIN WALL TUBE

BORING NO. 1 Sheet No. 1 of 1
Driller: WALTER LUM ASSOC. Date: JAN. 25, 1968
Field Party: BOND, SUZUKI
Type of Boring: AUGER (MOBILE MINUTEMAN) Diam.: 3"
Elev.: 307'± * Datum: —
Drill Bit: CLAY BIT
Water Level: NOT NOTICED
Time: —
Date: 1-25-68

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Moist. Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA: STANDARD PENETRATION TEST (Blows Per Foot 0 10 20 30 40)	PENETRATION DATA: 2" O.D. THIN WALL TUBE SAMPLER (Blows / 0.5')
	ELEV. = 307'± *	0									
MH	MEDIUM TO STIFF, BROWN, SILTY CLAY W/ ASH		2"S	15-A	-	30	-	5300	1900		1/.5' 3/.5'
MH	STIFF, REDDISH BROWN SILTY CLAY W/ TRACES OF DECOMPOSED ROCK	5	2"SS	15-B	-	31	-	-	-		
		10	2"SS	15-C	-	49	-	-	-		
	BROWN, DECOMPOSED ROCK	15									
	END OF BORING @ 16.5'		2"SS	15-D	-	50	-	-	-		

*ELEVATION ESTIMATED FROM CONTOUR PLAN

WALTER LUM ASSOCIATES

3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 777-931

Boring Log

PROJECT: MOMILANI SUBURB UNIT XI
LOCATION: MANANA-UKA & WAIMANO
EWA, OAHU, HAWAII
TMK: 9-7-24:1
HAMMER:
Weight 140#
Drop 30"
SAMPLER: 2" O.D. THIN WALL TUBE

BORING NO. 2 Sheet No. 1 of 1
Driller WALTER LUM ASSOC. Date FEB. 20, 1968
Field Party NELSON, GLORY
Type of Boring AUGER (MOBILE MINUTEMAN) Diam. 3"
Elev. 290'± * Datum —
Drill Bit ROCK BIT

Water Level	NOT NOTICED			
Time	—			
Date	2-20-68			

Unified Soil Classification	DESCRIPTION ELEV. = 290'± *	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Moist. Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA 2" O.D. THIN WALL TUBE SAMPLER Blows Per Foot 0 10 20 30 40	Blows/0.5'
CH-MH	STIFF, REDDISH BROWN SILTY CLAY W/ CLAY STREAKS	5		2-A	122	31	93	7020	–		2/5' 3/5'
				2-B	123	31	94	6240	–		5/5' 8/5'
CH	STIFF, REDDISH BROWN & GRAY CLAY	10		2-C	–	36	–	3900	–		6/5' 7/5'
MH	STIFF, BROWN & GRAY, CLAYEY SILT (DECOMPOSED ROCK)	15		2-D	103	54	67	3380	2000		3/5' 7/5'
	END OF BORING @ 16'										

* ELEVATION ESTIMATED FROM CONTOUR PLAN

WALTER LUM ASSOCIATES

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Boring Log

PROJECT: MOMILANI SUBURB UNIT XI
LOCATION: MANANA-UKA & WAIMANO
EWA, OAHU, HAWAII
TMK: 9-7-24:1

HAMMER:
Weight: 140#
Drop: 30"
SAMPLER: 2" ϕ - 2" O.D. THIN WALL TUBE
2" ϕϕ - 2" STANDARD SPLIT SPOON

BORING NO. 3 Sheet No. 1 of 1
Driller: WALTER LUM ASSOC. Date: FEB. 12, 1968
Field Party: BOND, MAKAULA
Type of Boring: AUGER (CONCORE ABJR) Diam.: 3"
Elev.: 372'± * Datum: —
Drill Bit: CLAY BIT

Water Level				
Time	—			
Date	2-12-68			

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Moist. Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA: STANDARD PENETRATION TEST Blows Per Foot (0 10 20 30 40)	PENETRATION DATA: 2" O.D. THIN WALL TUBE SAMPLER BLOWS/0.5'
	ELEV.= 372'± *	0									
			2"ϕ	3-A	114	28	89	13,020	-		5/.5' 9/.5'
CH-MH	STIFF, REDDISH BROWN SILTY CLAY w/ CLAY STREAKS	5	2"ϕ	3-B	125	31	95	8580	-		3/.5' 7/.5'
MH	VERY STIFF, REDDISH BROWN SILTY CLAY	10	2"ϕϕ	3-C	-	31	-	-	-		
	BOULDER OR ROCK		2"ϕϕ	3-D	-	NO RECOVERY			-		15/.0'
	END OF BORING @ 14'										

* ELEVATION ESTIMATED FROM CONTOUR PLAN

WALTER LUM ASSOCIATES

3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 777-931

Boring Log

PROJECT: MOMILANI SUBURB UNIT XI
LOCATION: MANANA-UKA & WAIMANO
EWA, OAHU, HAWAII
TMK: 9-7-24:1
HAMMER:
Weight: 140#
Drop: 30"
SAMPLER: 2" O.D. THIN WALL TUBE

BORING NO. 4 Sheet No. 1 of 1
Driller: WALTER LUM ASSOC. Date: FEB. 12, 1968
Field Party: GLORY, HASHIDA
Type of Boring: AUGER (MOBILE MINUTEMAN) Diam.: 3"
Elev.: 362'± * Datum: —
Drill Bit: ROCK BIT
Water Level: NOT NOTICED
Time: —
Date: 2-12-68

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Moist. Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA: 2" O.D. THIN WALL TUBE SAMPLER — Blows Per Foot (0 10 20 30 40) — BLOWS/0.5'
	ELEV. = 362'± *	0								
MH	STIFF, REDDISH BROWN SILTY CLAY			4-A	107	29	83	6760	-	4/.5' 7/.5'
		5		4-B	121	31	93	8320	-	6/.5' 10/.5'
MH	VERY STIFF, REDDISH BROWN SILTY CLAY	10		4-C	122	36	90	9100	-	13/.5' 25/.5'
	END OF BORING @ 15'	15								

* ELEVATION ESTIMATED FROM CONTOUR PLAN

WALTER LUM ASSOCIATES

3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 777-931

Boring Log

PROJECT: MOMILANI SUBURB UNIT XI
LOCATION: MANANA-UKA & WAIMANO
EWA, OAHU, HAWAII
TMK: 9-7-24 : 1

HAMMER:
Weight: 140#
Drop: 30"
SAMPLER: 2" SS - 2" O.D. THIN WALL TUBE
2" SS - 2" STANDARD SPLIT SPOON

BORING NO. 5 Sheet No. 1 of 1
Driller: WALTER LUM ASSOC. Date: JAN. 25, 1968
Field Party: BOND, SUZUKI
Type of Boring: AUGER (MOBILE MINUTEMAN) Diam.: 3"
Elev.: 340'± * Datum: —
Drill Bit: CLAY BIT
Water Level: NOT NOTICED
Time: —
Date: 1-25-68

Unified Soil Classification	DESCRIPTION (ELEV. = 340'±)	Depth (Ft.)	Elev.	Sample No.	Wet Dens. P.C.F.	Moist. Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA: STANDARD PENETRATION TEST Blows Per Foot (0 10 20 30 40)	PENETRATION DATA: 2" O.D. THIN WALL TUBE SAMPLER BLOWS/0.5'
MH	STIFF, BROWN, SILTY CLAY w/ ASH	0		5-A	-	31	-	-	-		
		5		5-B	-	29	-	9460	-		4/5 9/5
MH	STIFF, REDDISH BROWN SILTY CLAY w/ TRACES OF ASH	10		5-C	-	35	-	-	-		
	COBBLE OR BOULDER										
MH	STIFF TO VERY STIFF, REDDISH BROWN SILTY CLAY	15		5-D	117	43	82	9200	-		7/5 12/5
	END OF BORING @ 16'										

* ELEVATION ESTIMATED FROM CONTOUR MAP

WALTER LUM ASSOCIATES

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Boring Log

PROJECT: MOMILANI SUBURB UNIT XI
LOCATION: MANANA-UKA & WAIMANO
EWA, OAHU, HAWAII
TMK: 9-7-24:1
HAMMER:
Weight: 140#
Drop: 30"
SAMPLER: 2" O.D. THIN WALL TUBE

BORING NO. 6 Sheet No. 1 of 1
Driller: WALTER LUM ASSOC. Date: FEB 29, 1968
Field Party: MAESHIRO, SAM FONG
Type of Boring: AUGER Diam.: 3"
Elev.: 327'± * Datum:
Drill Bit: ROCK BIT

Water Level				
Time				
Date	2-29-68			

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Moist. Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA: Blows Per Foot (0 10 20 30 40)	2" O.D. THIN WALL TUBE SAMPLER: BLOWS / 0.5'
	ELEV. = 327'± *	0									
MH	MEDIUM TO STIFF REDDISH BROWN SILTY CLAY			6-A	119	36	88	4320	-		3/5 5/5
		5		6-B	122	29	95	7,020	-		5/5 8/5
		10		6-C	120	30	93	12,060	-		8/5 17/5
MH	STIFF TO VERY STIFF REDDISH BROWN SILTY CLAY										
		15		6-D	121	42	85	13,000	-		8/5 19/5
	END OF BORING @ 16'										

* ELEVATION ESTIMATED FROM CONTOUR PLAN

WALTER LUM ASSOCIATES

3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 777-931

Boring Log

PROJECT: MOMILANI SUBURB UNIT XI
LOCATION: MANANA-UKA & WAIMANO
EWA, OAHU, HAWAII
TMK: 9-7-24:1
HAMMER:
Weight: 140 #
Drop: 30"
SAMPLER: 2" O.D. THIN WALL TUBE

BORING NO. 7 Sheet No. 1 of 1
Driller: WALTER LUM ASSOC. Date: FEB. 19, 1968
Field Party: NELSON, GLORY
Type of Boring: AUGER (MOBILE MINUTEMAN) Diam.: 3"
Elev.: 318' ± * Datum: —
Drill Bit: ROCK BIT

Water Level				
Time	—			
Date	2-19-68			

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Moist. Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA: Blows Per Foot (0 10 20 30 40)	2" O.D. THIN WALL TUBE SAMPLER BLOWS / 0.5'
	ELEV. = 318' ± *	0									
MH	STIFF, REDDISH BROWN SILTY CLAY			7-A	111	34	83	1302D	–		2/5' 7/5'
MH	MEDIUM TO STIFF, REDDISH BROWN & GRAYISH BROWN SILTY CLAY	5		7-B	105	39	76	3740	–		2/5' 4/5'
MH	MEDIUM TO STIFF, REDDISH BROWN SILTY CLAY	10		7-C	111	40	79	7020	–		4/5' 8/5'
MH	STIFF, TANNISH BROWN SILTY CLAY										
	GRAYISH BROWN DECOMPOSED ROCK	15		7-D	118	29	91	–	–		15/5' 11/3'
	END OF BORING @ 16'										

* ELEVATION ESTIMATED FROM CONTOUR PLAN

WALTER LUM ASSOCIATES

3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 777-931

Boring Log

PROJECT: MOMILANI SUBURB UNIT XI
LOCATION: MANANA-UKA & WAIMANO
EWA, OAHU, HAWAII
TMK: 9-7-24:1
HAMMER:
Weight: 140*
Drop: 30"
SAMPLER: 2" O.D. THIN WALL TUBE

BORING NO. 8 Sheet No. 1 of 1
Driller: WALTER LUM ASSOC. Date: FEB. 17, 1968
Field Party: HASHIDA, GLORY
Type of Boring: AUGER (MOBILE MINUTEMAN) Diam.: 3"
Elev.: 415' ± * Datum: ——
Drill Bit: ROCK BIT
Water Level: NOT NOTICED
Time: ——
Date: 2-17-68

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Elev.	Sample No.	Wet Dens. P.C.F.	Moist. Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA: Blows Per Foot (0 10 20 30 40)	2" O.D. THIN WALL TUBE SAMPLER BLOWS/0.5'
	ELEV. = 415' ± *										
MH	MEDIUM TO STIFF, REDDISH BROWN SILTY CLAY	0		B-A	113	34	85	5720	-		1/5" 5/5"
MH	STIFF REDDISH BROWN SILTY CLAY	5		B-B	121	33	92	9100	-		6/5" 17/5"
MH	STIFF TO VERY STIFF TANNISH BROWN, CLAYEY SILT & DECOMPOSED ROCK	10		B-C	123	30	95	6760	-		12/5" 12/1"
MH	STIFF TO VERY STIFF, MOTTLED REDDISH BROWN, SILTY CLAY	15		B-D	123	37	90	7800	-		9/5" 19/5"
	END OF BORING @ 16'										

* ELEVATION ESTIMATED FROM CONTOUR MAP

WALTER LUM ASSOCIATES

3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 777-931

Boring Log

PROJECT: MOMILANI SUBURB UNIT XI
LOCATION: MANANA-UKA & WAIMANO
EWA, OAHU, HAWAII
TMK: 9-7-24:1
HAMMER:
Weight: 140#
Drop: 30"
SAMPLER: 2" O.D. THIN WALL TUBE

BORING NO. 9 Sheet No. 1 of 1
Driller: WALTER LUM ASSOC. Date: FEB. 16, 1968
Field Party: GLORY, NELSON
Type of Boring: AUGER (MOBILE MINUTEMAN) Diam.: 3"
Elev.: 396'± * Datum: —
Drill Bit: ROCK BIT

Water Level	NOT NOTICED		
Time	—		
Date	2-16-68		

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Moist. Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA: 2" O.D. THIN WALL TUBE SAMPLER — Blows Per Foot (0 10 20 30 40) — BLOWS / 0.5'
	ELEV. = 396'± *	0								
				9-A	—	33	—	11,700	—	9/.5' 12/.5'
MH	STIFF, REDDISH BROWN SILTY CLAY			9-B	110	33	83	8300	—	5/.5' 10/.5'
		5								
MH	STIFF, LIGHT BROWN SILTY CLAY									
	DECOMPOSED ROCK OR BOULDER									
	END OF BORING @ 8.5'									

* ELEVATION ESTIMATED FROM CONTOUR PLAN

WALTER LUM ASSOCIATES

3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 777-931

Boring Log

PROJECT: MOMILANI SUBURB UNIT XI
LOCATION: MANANA-UKA & WAIMANO
EWA, OAHU, HAWAII
TMK: 9-7-24:1
HAMMER:
Weight: 140#
Drop: 30"
SAMPLER: 2" O.D. THIN WALL TUBE

BORING NO. 10 Sheet No. 1 of 1
Driller: WALTER LUM ASSOC. Date: FEB. 17, 1968
Field Party: HASHIDA, GLORY
Type of Boring: AUGER (MOBILE MINUTEMAN) Diam.: 3"
Elev.: 384'± * Datum: —
Drill Bit: ROCK BIT
Water Level: NOT NOTICED
Time: —
Date: 2-17-68

Unified Soil Classification	DESCRIPTION ELEV. = 384'± *	Depth (Ft.)	Elev.	Sample No.	Wet Dens. P.C.F.	Moist. Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA: Blows Per Foot 0 10 20 30 40 — 2" O.D. THIN WALL TUBE SAMPLER BLOWS/0.5'
MH	MEDIUM TO STIFF REDDISH BROWN SILTY CLAY	0		10-A	120	32	91	7280	-	1/5 3/5 8/5
				10-B	115	33	86	4840	-	2/5 7/5
		5								
MH	STIFF TANNISH BROWN CLAYEY SILT	10		10-C	118	34	89	6240	-	6/5 17/5
MH	STIFF REDDISH BROWN SILTY CLAY	15		10-D	108	41	77	5980	-	12/5 12/5
	END OF BORING @ 16'									

*ELEVATION ESTIMATED FROM CONTOUR MAP

WALTER LUM ASSOCIATES

3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 777-931

Boring Log

PROJECT: MOMILANI SUBURB UNIT XI
LOCATION: MANANA-UKA & WAIMANO
EWA, OAHU, HAWAII
TMK: 9-7-24:1
HAMMER:
Weight: 140#
Drop: 30"
SAMPLER: 2" O.D. THIN WALL TUBE

BORING NO. 11 Sheet No. 1 of 1
Driller: WALTER LUM ASSOC. Date: FEB. 25, 1968
Field Party: HASHIDA, GLORY
Type of Boring: AUGER (MOBILE MINUTEMAN) Diam.: 3"
Elev.: 355'± * Datum: —
Drill Bit: ROCK BIT
Water Level: NOT NOTICED
Time: —
Date: 2-25-68

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Moist. Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA: Blows Per Foot (0 10 20 30 40) — 2" O.D. THIN WALL TUBE SAMPLER: Blows/0.5'
	ELEV. = 355'± *	0								
MH	STIFF, REDDISH BROWN SILTY CLAY	5		11-A	112	32	85	4480	-	2/.5' 6/.5'
				11-B	109	31	83	>13,000	-	10/.5' 25/.5'
		10		11-C	-	32	-	>13,000	-	12/.5' 24/.5'
MH	STIFF TO VERY STIFF, MOTTLED REDDISH BROWN, CLAYEY SILT									
		15		11-D	121	33	91	>13,000	-	10/.5' 30/.5'
MH	VERY STIFF, MOTTLED GRAYISH BROWN CLAYEY SILT									
	END OF BORING @ 16'									

* ELEVATION ESTIMATED FROM CONTOUR PLAN

WALTER LUM ASSOCIATES

3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 777-931

Boring Log

PROJECT: MOMILANI SUBURB UNIT XI
LOCATION: MANANA-UKA & WAIMANO
EWA, OAHU, HAWAII
TMK: 9-7-24:1
HAMMER:
Weight: 140*
Drop: 30"
SAMPLER: 2" O.D. THIN WALL TUBE

BORING NO. 12 Sheet No. 1 of 1
Driller: WALTER LUM ASSOC. Date: FEB. 23, 1968
Field Party: HASHIDA, GLORY
Type of Boring: AUGER Diam.: 3"
Elev.: 342' ± * Datum: —
Drill Bit: ROCK BIT
Water Level: NOT NOTICED
Time: —
Date: 2-23-68

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Moist. Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA 2" O.D. THIN WALL TUBE SAMPLER Blows Per Foot 0 10 20 30 40
	ELEV. = 342' ± *	0								
				12-A	121	31	92	8060	-	1/5" 4/5" 7/5"
CH-MH	STIFF, REDDISH BROWN SILTY CLAY w/ CLAY STREAKS	5		12-B	111	39	80	5200	-	5/5" 7/5"
		10		12-C	-	30	-	>13,000	-	6/5" 20/5"
MH	VERY STIFF, REDDISH BROWN & GRAY SILTY CLAY	15		12-D	119	33	89	>13,000	-	12/5" 18/5"
	END OF BORING @ 16'									

* ELEVATION ESTIMATED FROM CONTOUR PLAN

MOMILANI SUBURB UNIT XI

TABLE I A - SUMMARY OF LABORATORY TEST RESULTS

BORING NO.	2	2	2	2	3
SAMPLE NO.	A	B	C	D	A
DEPTH BELOW SURFACE	0.5' - 1.5'	5.0'-6.0'	10.0'-11.0'	15.0'-16.0'	0.0'-1.0'
DESCRIPTION	REDDISH BROWN CLAY	REDDISH BROWN SILTY CLAY	REDDISH BROWN & GRAY CLAY	BROWN & GRAY CLAYEY SILT (DECOMPOSED ROCK)	REDDISH BROWN CLAY
GRADING ANALYSIS (% Passing)					
Sieve					
1"				100	
½"				100	
#4				100	
#10				100	
#20				100	
#40				100	
#100				99.9	
#200				99.5	
ATTERBERG LIMITS					
Air Dried or Natural	NATURAL	NATURAL	NATURAL	NATURAL	NATURAL
Liquid Limit	59	53	87	76	70
Plastic Limit	29	31	34	47	32
Plasticity Index	30	22	53	29	38
Dilatancy	SLOW-MED.	SLOW-MED.	SLOW-MED.	MEDIUM	SLOW
Toughness	MED.-HIGH	MEDIUM	MED.-HIGH	MEDIUM	MEDIUM
Dry Strength	MEDIUM	MEDIUM	HIGH	SLIGHT-MED.	SLIGHT-MED.
UNIFIED SOIL CLASSIFICATION	CH	MH	CH	MH	CH
SPECIFIC GRAVITY					
EXPANSION AND CBR TESTS (Surcharge-51 P.S.F.)					
Molding Moisture Content, %					
Molding Dry Density, P.C.F.					
Swell upon saturation, %					
CBR at 0.1" Penetration (%)					
COMPACTION TEST (AASHO T-180-57 Method___)					
Dry to Wet or Wet to Dry					
Max. Dry Density (P.C.F.)					
Optimum Moisture (%)					

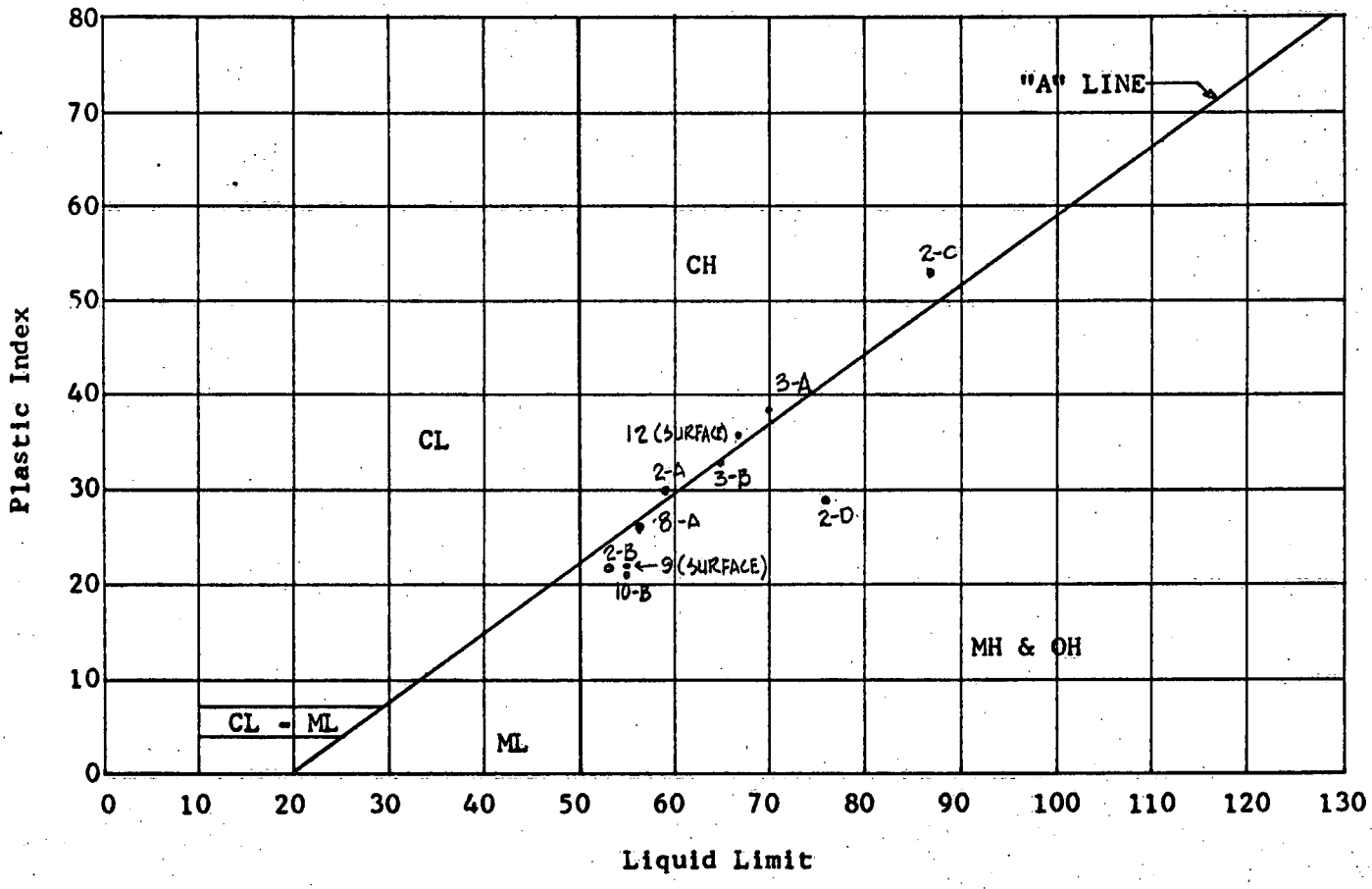
MOMILANI SUBURB UNIT XI

TABLE I B - SUMMARY OF LABORATORY TEST RESULTS

BORING NO.	3	8	9	10	12
SAMPLE NO.	B	A	A	B	A
DEPTH BELOW SURFACE	5.0'-6.0'	0.5'-1.5'	SURFACE	3.0'-4.0'	SURFACE
DESCRIPTION	REDDISH BROWN SILTY CLAY	REDDISH BROWN SILTY CLAY	REDDISH BROWN SILTY CLAY	REDDISH BROWN SILTY CLAY	REDDISH BROWN CLAY
GRADING ANALYSIS (% Passing) Sieve					
1"					
½"					
#4					
#10					
#20					
#40					
#100					
#200					
ATTERBERG LIMITS					
Air Dried or Natural	NATURAL	NATURAL	NATURAL	NATURAL	NATURAL
Liquid Limit	65	56	54	55	67
Plastic Limit	32	30	32	34	31
Plasticity Index	33	26	22	21	36
Dilatancy	SLOW-MED.	MEDIUM	SLOW	SLOW	SLOW
Toughness	MED.-HIGH	MEDIUM	MEDIUM	MEDIUM	MEDIUM-HIGH
Dry Strength	SLIGHT-MED.	SLIGHT-MED.	SLIGHT-MED.	SLIGHT-MED.	SLIGHT-MED.
UNIFIED SOIL CLASSIFICATION	MH	MH	MH	MH	CH
SPECIFIC GRAVITY					2.88
EXPANSION AND CBR TESTS (Surcharge-51 P.S.F.)					
Molding Moisture Content, %					31.0
Molding Dry Density, P.C.F.					93.8
Swell upon saturation, %					0.2
CBR at 0.1" Penetration (%)					10.0
COMPACTION TEST (AASHO T-180-57 Method ___)					A
Dry to Wet or Wet to Dry					DRY TO WET
Max. Dry Density (P.C.F.)					95.2
Optimum Moisture (%)					30.0

JOB: MOMILANI SUBURB UNIT XI

LOCATION: MANANA - UKA & WAIMANO
EWA, OAHU, HAWAII

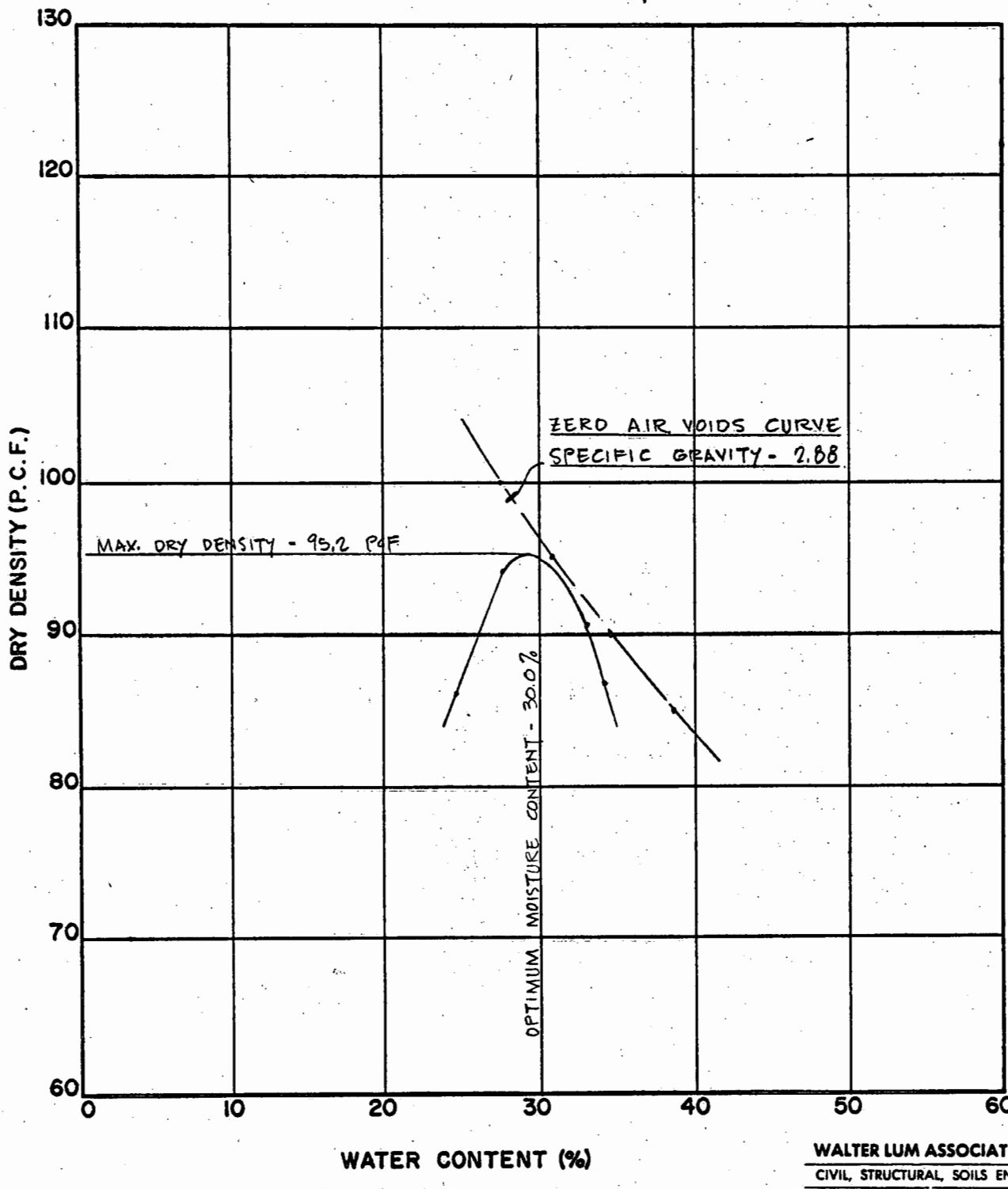


PLASTICITY CHART

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

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

PROJECT: MOMILANI SUBDIVISION - UNIT XI
LOCATION: MANANA-UKA & WAIMANO, EWA, OAHU, HAWAII
SAMPLE NO: B-12 SURFACE
SAMPLE DESCRIPTION: REDDISH-BROWN CLAY.



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

BY BT DATE 3-6-68

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

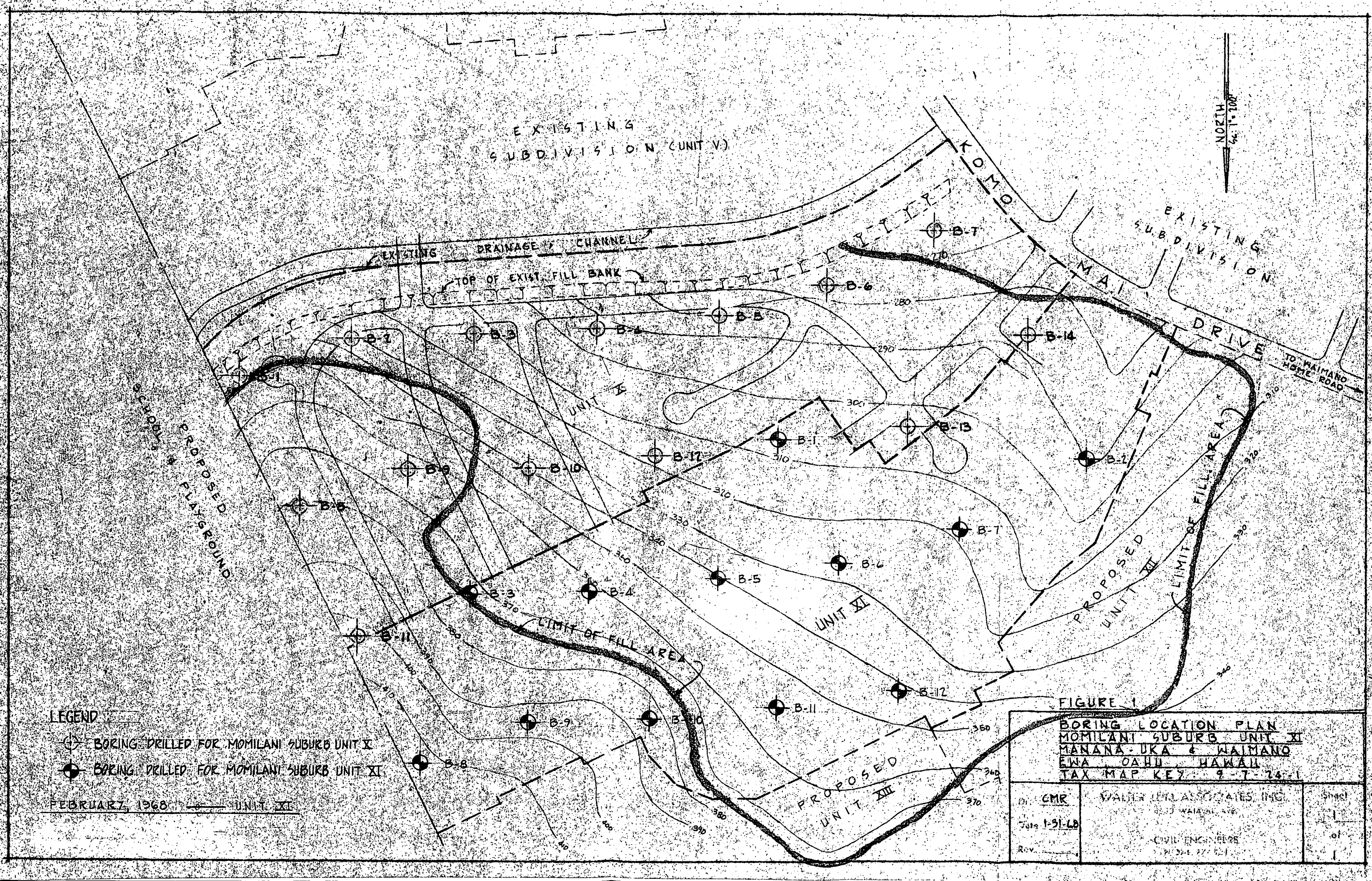


FIGURE 1

BORING LOCATION PLAN
MOMILANI SUBURB UNIT XI
MANANA - UKA & WAIMANO
EWA OAHU HAWAII
TAX MAP KEY 9-7-24-1

By CMR	WALTER LUM ASSOCIATES, INC.	Sheet 1
Date 1-31-68	WAIANAE, HAWAII	of 1
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