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**BOUGAINVILLE INDUSTRIAL PARK OFF-SITE SEWERS
SOIL EXPLORATION REPORT**

HALAWA, EWA, OAHU, HAWAII

TAX MAP KEY: 9-9-02: 2, 3, 18 & 25

TA 710.3

H3

H64

No. 762

To:

COMMUNITY PLANNING, INC.

WALTER LUM ASSOCIATES, INC.

CIVIL, STRUCTURAL, SOILS ENGINEERS

APRIL 11, 1975

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WALTER LUM ASSOCIATES, INC.

CIVIL, STRUCTURAL, SOILS ENGINEERS

WALTER LUM
EDWARD WATANABE
EZRA KOIKE
WALLACE WAKAHIRO

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

July 29, 1975

MR. GEORGE HOUGHTAILING
Community Planning, Inc.
700 Bishop Street, Suite 608
Honolulu, Hawaii 96813

Dear Mr. Houghtailing:

Subject: Addendum No. 1 to Bougainville
Industrial Park Off-site Sewers
Soil Exploration Report
Dated April 11, 1975
Halawa, Ewa, Oahu, Hawaii
Tax Map Key: 9-9-02: 2, 3, 18 & 25

It has been brought to our attention that the proposed sewer line will cross over an existing Navy utility tunnel near Boring No. 8. The proposed sewer invert will be about 8-1/2 ft above the crown of the tunnel.

Boring No. 8, which may be about 10 to 20 ft from the tunnel, indicated mudrock down to about the crown of the tunnel, then underlain with stiff clays.

It is our understanding that the tunnel at the crossing is lined. The tunnel lining in the vicinity of the sewer line crossing should be observed and evaluated for the proposed construction. Based on the evaluation, the tunnel lining may have to be reinforced.

The sewer line should be jacketed or reinforced to span across the tunnel.

The contractor should be advised to exercise care when working near the tunnel. Blasting or excavation procedures that may disturb the in-place mudrock should be avoided to reduce possible damages to the tunnel.

Respectfully submitted,

WALTER LUM ASSOCIATES, INC.

By Ezra Koike
Ezra Koike

EK:vl

WALTER LUM ASSOCIATES, INC.

CIVIL, STRUCTURAL, SOILS ENGINEERS

WALTER LUM
EDWARD WATANABE
EZRA KOIKE
WALLACE WAKAHIRO

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

April 11, 1975

MR. GEORGE HOUGHTAILING
Community Planning, Inc.
700 Bishop Street, Suite 608
Honolulu, Hawaii 96813

Dear Mr. Houghtailing:

Subject: Bougainville Industrial Park
Off-Site Sewers
Soil Exploration Report
(for sewer pipe bedding design purposes)
Halawa, Ewa, Oahu, Hawaii
Tax Map Key: 9-9-02: 2, 3, 18 & 25

Transmitted herewith is our soil exploration report for the design of the proposed Bougainville Industrial Park Off-Site Sewers at Halawa, Ewa, Oahu, Hawaii.

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

Respectfully submitted,

WALTER LUM ASSOCIATES, INC.

By Ezra Koike
Ezra Koike

FM/EK:vl

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BOUGAINVILLE INDUSTRIAL PARK OFF-SITE SEWERS
SOIL EXPLORATION REPORT

HALAWA, EWA, OAHU, HAWAII
TAX MAP KEY: 9-9-02: 2, 3, 18 & 25

SCOPE OF EXPLORATION

The purpose of this soil exploration was to evaluate general soil conditions for design considerations for the proposed Bougainville Industrial Park Off-Site Sewers at Halawa, Ewa, Oahu, Hawaii.

This report includes field explorations, laboratory tests, general pipe bedding design recommendations and limitations.

FIELD EXPLORATION

Nine exploratory borings were made along the proposed alignment. The approximate locations of the borings are shown on the Boring Location Sketch.

Borings were made with 4-in. diameter augers using tungsten carbide drag bits and finger type bits. Soil samples were recovered with 3-in. thin-wall tubes and 2-in. standard split spoon samplers driven with a 140-lb hammer falling 30 inches.

LABORATORY TESTS

Laboratory tests included: natural water content and density, unconfined compression, laboratory vane shear, Atterberg limit, grain-size analysis, triaxial and consolidation.

SOIL CLASSIFICATION SYSTEM

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

GEOLOGIC AND SOIL CLASSIFICATIONS BY OTHERS

From a review of geologic literature and the U. S. Soil Conservation Service maps of the area, the soils are generally described by others as follows:

Stearns, H. T. and U. S. Geological Survey, "Geologic and Topographic Map, Island of Oahu," USGS 1938:

Qht - (Honolulu Volcanic Series)

Consolidated gray, lavender and brown bedded
only slightly permeable deposits of basic
vitric - crystal - lithic tuff

U. S. Soil Conservation Service, "Soil Survey of Islands of Kauai, Oahu, Maui, Molokai and Lanai, State of Hawaii,"
August 1972:

MdB - Makalapa clay, 2 to 6% slopes

Unified Soil Classification - CH

KTKE - Kokokahi very stony clay, 0 to 35% slopes

Unified Soil Classification - CH

rRK - Rockland

GENERAL SITE CONDITIONS

A sewer line about 3,600 ft in length is proposed from Bougainville Road (under construction) to Salt Lake Boulevard. The route crosses the back (westerly) portions of Hale Keiki School, Radford High School and Makalapa Elementary School grounds.

A 30-ft wide energy corridor and the proposed H-1 Freeway are located on the west side of the proposed route. A shallow unlined ditch generally follows alongside the freeway and energy corridor.

A 30-in. Navy water line, some sewer lines and drainage culverts cross portions of the site near Hale Keiki School. Some highway construction work was in progress south of the Hale Keiki school grounds during the field explorations.

The route crosses a depression behind (west) Hale Keiki School and Radford High School. Some water was ponded in localized pockets during the field exploration. Several mounds of miscellaneous soils, boulders, etc. were stockpiled along this section. An earth surcharge about 10 to 12 ft in height was noted in the H-1 Freeway right-of-way about 75 to 100 ft west of the proposed sewer.

A track field, bleachers, floodlights, classroom building, parking lot, basketball court, Navy water lines and some concrete structures occur along the proposed route in back of (west) Radford High School and Makalapa Elementary School grounds.

INTERPRETATION OF SOIL CONDITIONS

From the field exploration and laboratory test results, the soils encountered in the borings may be generally approximated as follows:

B-1 & B-2 (Fills over mudrock)

Surface fills of clays, sands and gravels to about 8 to 9 ft, then dense silty sands and mudrock to about 25 to 30-ft, the depths drilled.

B-3, B-4, B-5, B-6 (Fills over soft clay deposits)

Surface fills of clayey silty materials mixed with sand, gravel, coral and occasional boulders about 5 to 10 ft thick, then soft clay deposits to about 25 to 30 ft or more. Below this, stiffer materials of clay and/or decomposed mudrock (?) were noted.

B-7, B-8, B-9 (Fills over mudrock)

Surface fills of clayey silts, sands and gravel to about 3 to 7 ft, then dense silty sands and mudrock to about 38 to 42-ft depths.

In Boring Nos. 7 and 8, stiff brown clay and silty sand were noted below the mudrock to about 46 to 50 ft, the depths drilled.

Water was noted in Boring Nos. 3 thru 6 at about 5 to 25-ft depths during the field explorations.

Variations to the above soil conditions are to be expected between borings and in localized areas. For more detailed descriptions of soils encountered in the borings, refer to the boring logs.

DISCUSSION AND RECOMMENDATIONS

A 12-in. diameter gravity flow sewer line about 3,600 ft in length is proposed.

The profile of the ground starts about elevation 52, slopes generally to about elevation 33 about the middle of the line, then rises to elevation 64 for most of the latter half of the line. The ground slopes down to about elevation 25 ft at the end of the project.

The invert of the sewer line generally varies from about elevation 34 ft at the beginning (Bougainville Road) to about elevation 24 ft at the end (Salt Lake Boulevard).

The depth to the pipeline will be about 13 ft at the beginning of the Bougainville Road to a few feet along the depressed area of the middle section and deepens to about 35 ft at the ending half of the project.

At the beginning (from about B-1 to B-2), the invert of the pipeline will probably be in dense silty sands and mudrock. In the middle (B-3 thru B-6), the pipeline will probably be in soft to medium clay soils. In the ending one-third of the project, the invert of the pipeline will probably be in mudrock or dense silty sands.

For about one-half of the project, about the middle of the route, the invert of the sewer line will be in soft clays. Settlements of several inches to over a foot may occur in this area depending what loads are placed over the line at the ground surface. Also, the line may be disturbed from construction activities next door along the energy corridor.

General Design Guidelines

The sewer line will be in mudrock at the beginning, then soft mud and end in mudrock or dense sands.

Because of the hard and soft materials, the sewer lines should be constructed with flexible joints, particularly where the lines are connected to sewer manholes.

Where the sewer is underlain with soft clay deposits, some waving of the line from differential settlements are anticipated, particularly where the underlying material transitions from the soft deposits to dense silty sand and mudrock formations. In general, the sewer line profile should be steep so that the overall line would function even with some localized sags or dips.

If grading work, particularly the construction of fills are planned along the sewer line route, it should be done as soon as practicable over the soft area to allow time for

the ground to consolidate and settle prior to the start of pipeline construction. Preferably, a surcharge should be placed over the sewer easement prior to the installation of the line.

Because of potential slope creep, manholes should generally be avoided on or near tops of slopes.

Subbase for Sewer Line

In general, because the soil conditions would vary along the proposed route, the subbase thickness should be adjusted according to the material below the sewer invert.

Guidelines for the thickness of the subbase may be as follows:

<u>Material below invert</u>	<u>Subbase thickness</u>
Soft clayey silty soils	36 $\pm$ in.
Gravel, boulders, mudrock or decomposed rock	6 $\pm$ in.

The granular materials for the subbase should generally be equivalent to base course rock, 1-1/2 in. to dust sizes. The fines passing the No. 200 sieve should be less than about 15% of the fraction passing the 1-in. sieve.

If the contractor's excavation and dewatering methods weaken or disturb the subgrade, the above thicknesses should be increased.

Provisions should be made in the contract documents to allow for local adjustments for subbase in the field where soft or weak spots are encountered during construction.

Pipe bedding

In general, crushed rock cradle or concrete cradle may be considered over the subbase. A crushed rock cradle would be preferable.

In general, the sewer pipe should be set in a bed of granular materials beginning from about 6 in. below the pipe invert to about 1 ft over the top of the pipe.

The granular materials should preferably be equivalent to base course rock, well graded from about 1-1/2 to 0 in. with less than about 15% passing the No. 200 sieve.

Backfill

Backfill above the pipe may be made with soils compacted to about 90% of AASHTO T-180-73I if fine-grained soils are used.

Where water is encountered, the backfill material should be constructed with fairly well-graded granular materials. The granular materials may be placed by sluicing with water, provided there is good drainage for the water to flow.

Construction Considerations

Care should be exercised when working near existing utilities, particularly along the energy corridor where oil and gas lines are located and near Navy water mains by Boring Nos. 1 and 8.

Caution should be taken and support provided to minimize damage to existing buildings, walls, fences and utility lines that are located mostly along the developed sections of the school grounds. Some underpinning may be required.

Work should also be coordinated with the respective utilities to minimize damages and interference with their operations.

Support at excavations in soft area

The excavation depths will vary from shallow to fairly deep. The sidewalls of the excavations in the soft clayey deposits should be well supported.

To minimize settlements if sheeting or soldier piles are used, the portion of sheets or soldier piles that extend below the top of the sewer line should be left in place. (See Figure 1.)

Dewatering

Water was generally noted over the soft deposits at the middle portion at various elevations. Some dewatering will probably be done to install the sewer line.

Unforeseen Conditions

Because of the variability of soil deposits, site improvements, design and construction techniques, conditions may be encountered that cannot be foreseen with even the most exhaustive studies of site and project conditions. These unforeseen conditions should be recognized when encountered and then evaluated so that the designs or the construction methods may be modified accordingly, if necessary.

Unforeseen or undetected conditions such as soft spots, existing utility trenches, underground structures, boulders, expansive soil pockets or seepage water, etc., may occur in localized areas and will have to be adjusted and corrected in the field as they are detected.

BORING LOGS

The stratification lines shown on each of the boring logs represent the approximate boundary between soil types and the transition may be gradual.

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 limit or grain-size analysis test results.

Boring Log

PROJECT BOUGAINVILLE INDUSTRIAL PARK
OFFSITE SEWERS

LOCATION Halawa, Ewa, Oahu, Hawaii

Tax Map Key: 9-9-02: 2, 3, 18

HAMMER:

Weight 140 #

Drop 30"

SAMPLER:

2" STANDARD SPLIT SPOON

BORING NO. 1

Sheet No. 1

Driller W. LUM ASSOC., INC.

Date FEBRUARY 28
MARCH 3, 1975

Field Party CHOW, KAU, SHIGENAGA, ASATO

Type of Boring AUGER (YERSA DRILL)

Diam. 4"

Elev. 46' ± *

Datum -

Drill Bit T.C. DRAG

Water Level NOT NOTICED

Time 12:00 NOON

Date 3-3-75

PENETRATION DATA

Standard Penetration Test

N (Blows per foot)

0 10 20 30 40

Unified Soil Classification

DESCRIPTION

ELEV. = 46' ±

Depth (Ft.)

Sampler

Sample No.

Plastic Limit

Water Cont. %

Liquid Limit

Unconf. Comp. P.S.F.

Vane Shear P.S.F.

(SM)

MEDIUM DENSITY BROWN
 SILTY SAND & GRAVEL
 (MUDROCK FILL)

5

1-A

-

23

-

-

-

10

1-B

-

21

-

-

-

15

(ML)

DENSE, GRAY BROWN
 SANDY SILT
 W/MUDROCK

15

1-C

-

22

-

-

-

20 35/0.5

20

1-D

-

21

-

-

-

25 50/0.5

HAMMER
 BOUNCES

25

1-E

MUDROCK FRAGMENTS

-

-

-

-

-

30 50/0.15

HAMMER
 BOUNCES

GRAY
 MUDROCK

30

1-F

NO RECOVERY

-

-

-

-

-

30/0.0

HAMMER
 BOUNCES

END OF BORING @ 30'
 3-3-75

* Elevation estimated from
 topographic survey dated
 6-5-74.

Boring Log

PROJECT BOUGAINVILLE INDUSTRIAL PARK

PROJECT OFFSITE SEWERS

LOCATION Halawa, Ewa, Oahu, Hawaii

Tax Map Key: 9-9-02: 2, 3, 18

HAMMER:

Weight 140#

Drop 30"

SAMPLER:

2" STANDARD SPLIT SPOON

BORING NO. 2

Sheet No.

of

Driller W. LUM ASSOC., INC.

Date SEPT. 4, 1974

Field Party MEYER, CHOW, SEAWELL

Type of Boring AUGER (MOBILE B-40)

Diam. 4"

Elev. 43' ± *

Datum —

Drill Bit T.C. DRAG

Water Level NOT NOTICED

Time —

Date 9-4-74

Unified Soil Classification	DESCRIPTION	Depth (ft.)	Sampler	Sample No.	Plastic Limit	Water Cont. %	Liquid Limit	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA				
										Standard Penetration Test				
										N (Blows per foot)				
ELEV. = 43' ± *										0	10	20	30	40
(CH)	MEDIUM GRAY BROWN CLAY W/ SOME CORAL GRAVEL & SAND (FILL)	0		2-A	-	17	-	-	-					
		5		2-B	-	34	-	-	-					
(SM)	DENSE, GRAY BROWN SILTY SAND W/ GRAVEL (MUDROCK?)	10		2-C	-	20	-	-	-					67
		15		2-D	-	30	-	-	-					50/0.3'
(ML-MH)	DENSE, BROWN SANDY SILT W/ DECOMPOSED ROCK	20		2-E	-	21	-	-	-					40/0.1'
		25		2-F	-	25	-	-	-					50/0.3'
END OF BORING @ 25.3'														
9-4-74														
* Elevation estimated from topographic survey dated 6-5-74.														

BOUGAINVILLE INDUSTRIAL PARK
OFFSITE SEWERS

PROJECT OFFSITE SEWERS
LOCATION Halawa, Ewa, Oahu, Hawaii
Tax Map Key: 9-9-02: 2, 3, 18

HAMMER: _____ & 25
Weight 140#
Drop 30"

SAMPLER: 3" S - 3" O.D. THIN WALL TUBE

BORING NO. 3 Sheet No. _____ of _____
 Driller W. LUM ASSOC., INC. Date SEPT. 4, 1974
 Field Party METER, CHOW, SEAWELL
 Type of Boring AUGER (MOBILE) B-40 Diam. 4"
 Elev. 42' ± * Datum —
 Drill Bit T.O. DRAG

Water Level	<u>24.0'</u>				
Time	<u>—</u>				
Date	<u>9-4-74</u>				

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Sampler	Sample No.	Plastic Limit	Water Cont. %	Liquid Limit	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA					
										Standard Penetration Test					3" O.D. THIN WALL TUBE SAMPLER
										N (Blows per foot)					BLOWS / 0.5'
										0	10	20	30	40	
(GC)	MOTTLED BROWN CLAY & CORAL W/ SAND & GRAVEL (FILL MATERIAL)	2"	SS	3-A	-	22	-	-	-						
		5	2"	SS	3-B	-	16	-	-	-					
CH	MEDIUM GRAY BROWN CLAY	10	2"	SS	3-C	35	54	93	-	-					
		15	2"	SS	3-D	38	65	98	-	-					
CH	SOFT TO MEDIUM GRAY CLAY (PARTLY ORGANIC)	20	3"	S	3-E	-	77	-	-	-					3/0.5' 4/0.5' 5/0.5'
		25	2"	SS	3-F	-	64	-	-	-					
										CONTINUOUS PENETRATION TEST W/ 2" DIAM. BLUNT POINT					

BOUGAINVILLE INDUSTRIAL PARK

BORING NO. 4 Sheet No. _____ of _____

Driller W. LUM ASSOC., INC. Date SEPT. 4, 1974

Field Party MEYER, CHOW, SEAWELL

Type of Boring AUGER (MOBILE B-40) Diam. 4"

Elev. 32' ± * Datum —

Drill Bit T.C. DRAG

Water level	4.8'				
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Water Level	1.5				
Time	1				

[illegible]

Date	9-4-74				
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* Elevation estimated from topographic survey dated 6-5-74.

Boring Log

BOUGAINVILLE INDUSTRIAL PARK
OFFSITE SEWERS

LOCATION Halawa, Ewa, Oahu, Hawaii

Tax Map Key: 9-9-02: 2, 3, 18

HAMMER: & 25

Weight 140#

Drop 30"

SAMPLER: 2" SS-2" STANDARD SPLIT SPOON
3" S-3" O.D. THIN WALL TUBE

BORING NO. 5 Sheet No. of
 Driller W. LUM ASSOC., INC. Date FEBRUARY 27 TO MARCH 4, 1975
 Field Party CHOW, KAU, SHIGENAGA, ASATO
 Type of Boring AUGER (VERSA DRILL) Diam. 4"
 Elev. 47' ± * Datum —
 Drill Bit T.C. DRAG
 Water Level NOT MEASURED 10'
 Time 3:45 PM 3:00 PM
 Date 3-3-75 3-4-75

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Sampler	Sample No.	Plastic Limit	Water Cont. %	Liquid Limit	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA					
										Standard Penetration Test	3" O.D. THIN WALL TUBE SAMPLER				
										N (Blows per foot)					
										0	10	20	30	40	BLOWS/0.5'
MH-GH	STIFF, MOTTLED BROWN SILTY CLAY W/ MUDROCK, DECOMPOSED ROCK, GRAVEL, SAND & SOME CORAL (FILL) COBBLE OR BOULDER	2"	2"SS	5-A	-	22	-	-	-						
	NOTE: MOVED HOLE 4 TIMES. COBBLES & BOULDERS ENCOUNTERED	5"	2"SS	5-B	-	NO RECOVERY	-	-	-						30/0.0
		10"	2"SS	5-C	-	70	-	-	-						
MH-GH	MEDIUM, GRAY-BROWN SILTY CLAY	15"	3"SS	5-D	-	80 γ _w = 98 γ _d = 54	-	-	900 1050 1060						2/0.5' 4/0.5' 4/0.5'
GH	SOFT TO MEDIUM GRAY BROWN, CLAY (PARTLY ORGANIC)	20"	3"SS	5-E	41	86 γ _w = 97 γ _d = 52	104	-	700 760						2/0.5' 2/0.5' 3/0.5'
		25"	3"SS	5-F	-	90 γ _w = 97 γ _d = 51	-	-	600 620						3/0.5' 3/0.5' 5/0.5'
		30"	2"SS	5-G	-	56	-	-	-	1/0.5' 3/0.5'					
(GH)	SOFT TO MEDIUM GRAY, CLAY	35"	2"SS	5-H	-	51	-	-	-						
(GH)	MEDIUM, GRAY CLAY	40"	2"SS	5-I	-	50	-	-	-						
(GH)	STIFF MOTTLED TAN BROWN CLAY W/ TRACES OF DECOMPOSED ROCK														
	END OF BORING @ 41.5'														
	3-4-75														
NOTE: γ _w = WET DENSITY, P.C.F., γ _d = DRY DENSITY, P.C.F.															

* Elevation estimated from topographic survey dated 6-5-74.

BOUGAINVILLE INDUSTRIAL PARK
OFFSITE SEWERS

PROJECT OFFSITE SEWERS

LOCATION Halawa, Ewa, Oahu, Hawaii

Tax Map Key: 9-9-02: 2, 3, 18

HAMMER:

& 25

Weight 140 lb

Drop 30"

SAMPLER: 3" S - 3" O.D. THIN WALL TUBE

3" S - 3" CE THIN WALL THREE

BORING NO. 6 Sheet No. _____ of _____

Driller W. LUM ASSOC., INC. Date FEB. 26, 1975

Field Party: SUZUKI, CHOW, CRITA

Type of Boring: AUGER (MOBILE) Diam. 4"

Elev. 52' ± * Datum —

Drill Bit: FINGER TYPE

Water Level	10.5				
-------------	------	--	--	--	--

Time 3:30 PM

Date	2-26-75				
------	---------	--	--	--	--

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Sampler	Sample No.	Plastic Limit	Water Cont. %	Liquid Limit	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA						
										Standard Penetration Test				3" O.D. THIN WALL TUBE SAMPLER		
										N (Blows per foot)				BLOW/0.5'		
										0	10	20	30	40		
MA-GH)	STIFF, MOTTLED BROWN SILTY CLAY w/ GRAVEL CORAL & SAND (FILL) COBBLE	2"	SS	G-A	-	29	-	-	-							
MA)	LOOSE, GRAY BROWN SILTY CLAY w/ SAND & GRAVEL (FILL) WOOD PIECE, CAVITY OR VOID 5'-7'	5"	SS	G-B	-	14	-	-	-							
						31	-	-	-							25/0.1'
GC)	BROWN CLAYEY GRAVEL (FILL)	10"	SS	G-C	-	24	-	-	-							
	NOTE: MOVED HOLE 3 TIMES TO AUGER PASS 10.5' DEPTH. HIT SCRAP METAL(?) & BOULDER.															
		15"	SS	G-D	-	88	-	-	-							
CH)	SOFT, LIGHT GRAY CLAY	20"	SS	G-E	-											2 MAN PUSH/0.5' 3/0.5'
		25"	SS	G-F	-	81	-	-	-							2 MAN PUSH/0.5' 1.5'
CH)	MEDIUM, GRAY CLAY	30"	SS	G-G	-	91	-	-	540							2 MAN PUSH/0.5' 3/0.5' 4/0.5'
						$\gamma_w = 105$										
						$\gamma_d = 55$										
CH)	STIFF, GRAY CLAY	35"	SS	G-H	-	52	-	-	-							5/0.5' 12/0.5'
						$\gamma_w = 120$										
						$\gamma_d = 79$										
	END OF BORING @ 36' 2-26-75															
										NOTE:						
										γ_w = WET DENSITY, P.C.F.						
										γ_d = DRY DENSITY, P.C.F.						
* Elevation estimated from topographic survey dated 6-5-74.																

Boring Log

BORING NO. 7 Sheet No. _____ of _____
Driller W. LUM ASSOC., INC. Date FEB. 25, 1975

Field Party SUZUKI, CHOW, ORITA

Type of Boring AUGER (MOBILE) B-40 Diam. 4"

Elev. 61' ± * Datum —

Drill Bit FINGER TYPE

Water Level	NOTICED			
Time				

Date	2-25-75			
------	---------	--	--	--

Water Level	NOTICED			
Time				

Date	2-25-75			
------	---------	--	--	--

	PENETRATION DATA
--	------------------

* Elevation estimated from
topographic survey dated
6-5-74.

Boring Log

PROJECTBOUGAINVILLE INDUSTRIAL PARK
OFFSITE SEWERS

LOCATIONHalawa, Ewa, Oahu, Hawaii

Tax Map Key: 9-9-02: 2, 3, 18

HAMMER:
Weight140#
Drop30"

SAMPLER:2" STANDARD SPLIT SPOON

BORING NO. 8Sheet No. of

DrillerW. LUM ASSOC. INC.Date MAR. 10 & 11, 1975

Field PartyASATO, SHIGENAGA, ORITA

Type of BoringAUGER (VERSA DRILL)Diam. 4"

Elev. 58' ± *Datum

Drill BitT.C. DRAG

Water LevelNOT RECD

Time

Date3-10-75

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Sampler	Sample No.	Plastic Limit	Water Cont. %	Liquid Limit	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA					
										Standard Penetration Test					
										N (Blows per foot)					
ELEV. = 58' ± * ↓											0	10	20	30	40
(GM)	STIFF, BROWN CLAY & MUDROCK W/ SAND (FILL)			B-A	-	29	-	-	-						
(SM)	DENSE, BROWN SILTY SAND & GRAVEL (MUDROCK?)	5		B-B	-	27	-	-	-				15/0.5'		20/0.3'
		10		B-C	-	24	-	-	-					50/0.3'	HAMMER BOUNCES
	BROWN SILTY SAND & GRAVEL (MUDROCK)	15		B-D	-	24	-	-	-					50/0.3'	HAMMER BOUNCES
		20		B-E	ROCK FRAGMENTS									50/0.2'	HAMMER BOUNCES
		25		B-F	NO RECOVERY									50/0.2'	HAMMER BOUNCES
	BROWN SILTY SAND & MUDROCK	30		B-G	-	43	-	-	-					50/0.3'	HAMMER BOUNCES
		35		B-H	-	33	-	-	-					40/0.3'	
CH	STIFF, BROWN CLAY	40		B-I	-	34	-	-	-					79	
	END OF BORING @ 46.5 3-11-75	45		B-J	-	44	-	-	-						

* Elevation estimated from

* Elevation estimated from topographic survey dated 6-5-74.

Boring Log

PROJECT BOUGAINVILLE INDUSTRIAL PARK
OFFSITE SEWERS

LOCATION Halawa, Ewa, Oahu, Hawaii
Tax Map Key: 9-9-02: 2, 3, 18
 & 25

HAMMER:
 Weight 140 #
 Drop 30"

SAMPLER: 2" STANDARD SPLIT SPOON

BORING NO. 9 Sheet No. of

Driller W. LUM ASSOC., INC. Date FEB. 27 & 28, 1975

Field Party CHOW, KAI, SHIGENAGA

Type of Boring AUGER (VERSA DRILL) Diam. 4"

Elev. 26' ± * Datum

Drill Bit T.O. DRAG

Water Level NOT NOTICED

Time

Date 2-28-75

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Sampler	Sample No.	Plastic Limit	Water Cont. %	Liquid Limit	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA				
										Standard Penetration Test				
										N (Blows per foot)				
										0	10	20	30	40
(CH)	MEDIUM MOTTLED BROWN CLAY w/ WOOD & DECOMPOSED ROCK (FILL)			9-A	-	32	-	-	-					
		5		9-B	-	27	-	-	-					40/0.5
	DENSE, BROWN SILTY SAND & MUDROCK													HAMMER BOUNCES
(MH)	DENSE, BROWN SANDY SILT & DECOMPOSED MUDROCK	10		9-C	-	33	-	-	-					
(SM)	DENSE, MOTTLED BROWN SILTY SAND & DECOMPOSED MUDROCK	15		9-D	-	31	-	-	-					50/0.5
	MOTTLED DARK GRAY DECOMPOSED MUDROCK w/ LIGHT YELLOW CLAY POCKETS	20		9-E	-	50	-	-	-					50/0.4
														HAMMER BOUNCES
	DARK GRAY MUDROCK	25		9-F	-	31	-	-	-					40/0.3
														HAMMER BOUNCES
	END OF BORING @ 25.5'													
	2-28-75													

* Elevation estimated from topographic survey dated 6-5-74.

BOUGAINVILLE INDUSTRIAL
PARK - OFFSITE SEWERS

TABLE I A - SUMMARY OF LABORATORY TEST RESULTS

BORING NO.	3	3	4	4
SAMPLE NO.	C	D	C	E
DEPTH BELOW SURFACE	10'-11.5'	15'-16.5'	10'-11.5'	20'-21.5'
DESCRIPTION	GRAY-BROWN CLAY	GRAY CLAY (PARTLY ORGANIC)	GRAY CLAY (PARTLY ORGANIC)	GRAY CLAY (PARTLY ORGANIC)
GRAIN-SIZE ANALYSIS (% Passing)				
Sieve				
1"				
1/2"				
#4				
#10				
#20				
#40				
#100				
#200				
ATTERBERG LIMITS				
Air Dried or Natural	NATURAL	NATURAL	NATURAL	NATURAL
Liquid Limit	93	98	117	122
Plastic Limit	35	38	38	40
Plasticity Index	58	60	79	82
Dilatancy	SLOW	SLOW	MED-QUICK	NONE
Toughness	MEDIUM	MEDIUM	MEDIUM	MED-HIGH
Dry Strength	HIGH	HIGH	HIGH	HIGH
UNIFIED SOIL CLASSIFICATION	CH	CH	CH	CH
APPARENT SPECIFIC GRAVITY			2.84	
CBR TEST				
(Surcharge-51 P.S.F.)				
Molding Moisture, %				
Molding Dry Density, P.C.F.				
Swell upon saturation, %				
CBR at 0.1" Penetration				
MOISTURE-DENSITY RELATIONS OF SOILS (AASHTO T-180-73I, Method)				
Dry to Wet or Wet to Dry				
Max. Dry Density (P.C.F.)				
Optimum Moisture (%)				

REMARKS:

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

Date 3-21-75 By R.T

BOUGAINVILLE INDUSTRIAL
PARK - OFFSITE SEWERS

TABLE 1⁰ - SUMMARY OF LABORATORY TEST RESULTS

BORING NO.	5			
SAMPLE NO.	E			
DEPTH BELOW SURFACE	20'-21.5'			
DESCRIPTION	GRAY-BROWN CLAY (PARTLY ORGANIC)			
GRAIN-SIZE ANALYSIS				
(% Passing)				
Sieve				
1"				
1/2"				
#4				
#10				
#20				
#40				
#100				
#200				
ATTERBERG LIMITS				
Air Dried or Natural	NATURAL			
Liquid Limit	104			
Plastic Limit	41			
Plasticity Index	63			
Dilatancy	NONE			
Toughness	HIGH			
Dry Strength	HIGH			
UNIFIED SOIL CLASSIFICATION	CH			
APPARENT SPECIFIC GRAVITY				
CBR TEST				
(Surcharge-51 P.S.F.)				
Molding Moisture, %				
Molding Dry Density, P.C.F.				
Swell upon saturation, %				
CBR at 0.1" Penetration				
MOISTURE-DENSITY RELATIONS OF SOILS				
(AASHO T-180-73I, Method)				
Dry to Wet or Wet to Dry				
Max. Dry Density (P.C.F.)				
Optimum Moisture (%)				

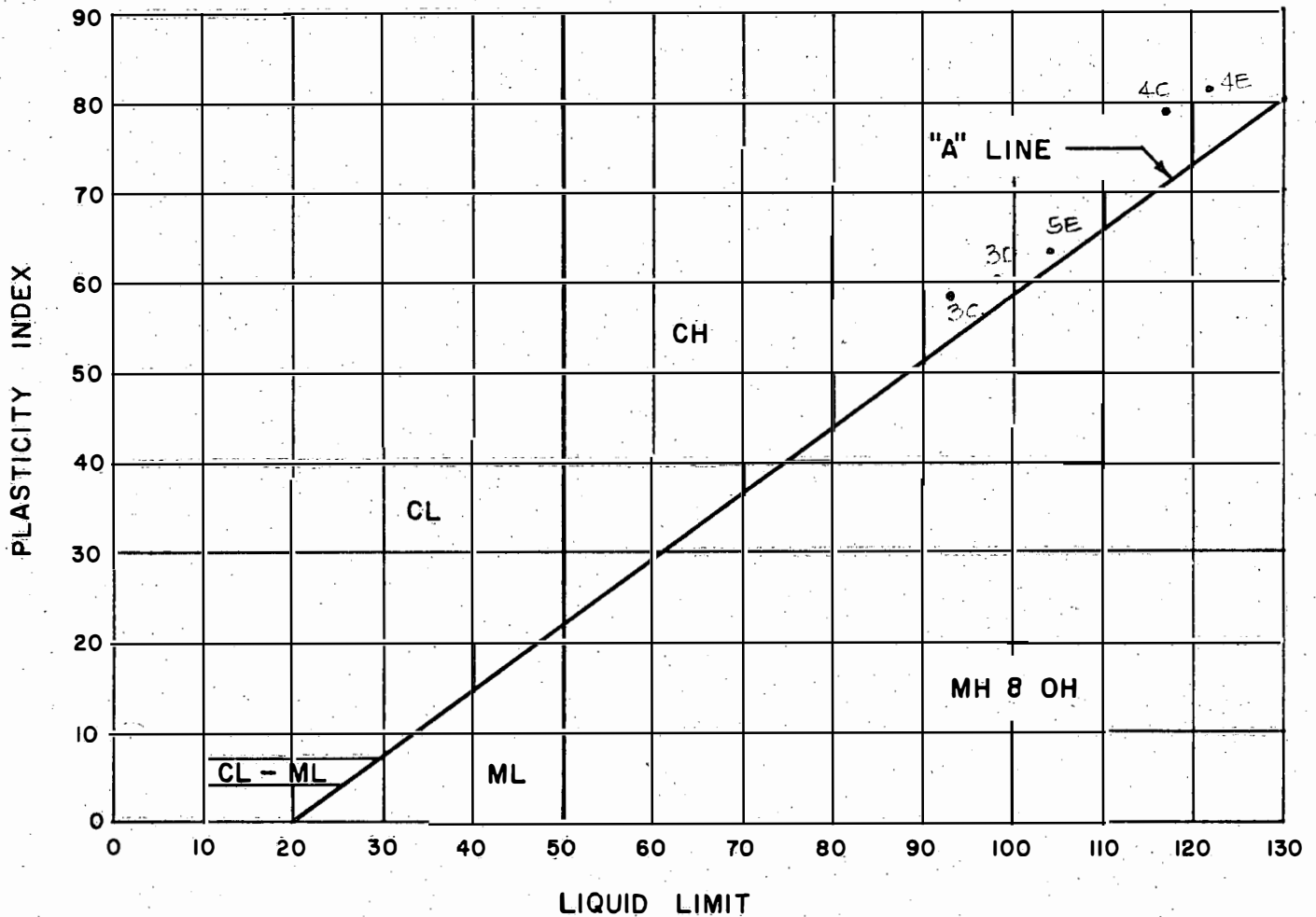
REMARKS:

WALTER LUM ASSOCIATES, INC.
CIVIL STRUCTURAL SOILS ENGINEERS

Date 3-21-75 By BT

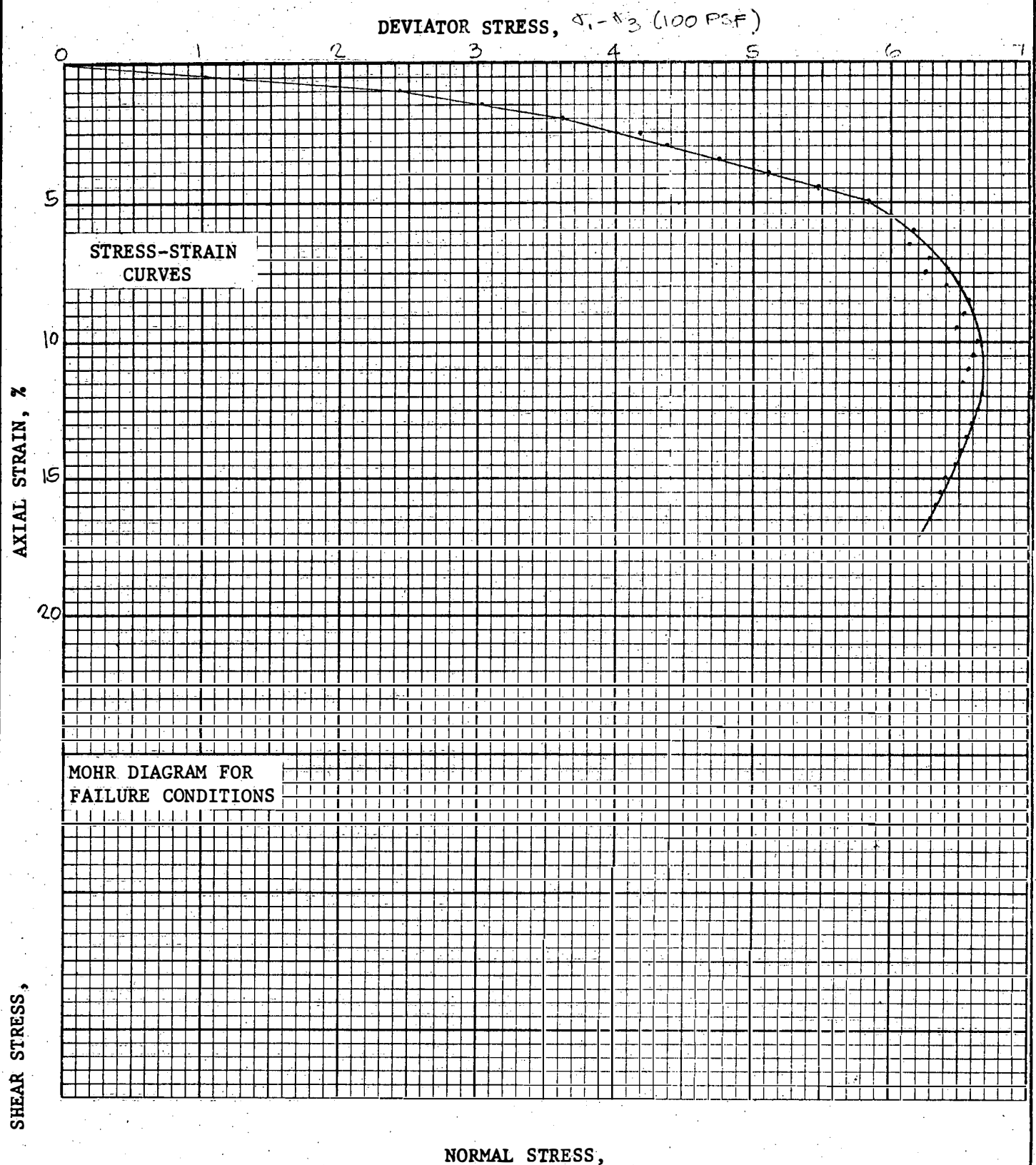
PLASTICITY CHART

PROJECT: BOUGAINVILLE INDUSTRIAL
PARK - OFFSITE SEWERS
LOCATION: HALAWA, EWA, OAHU, HAWAII



DATE 3-21-75 BY BJ

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



SAMPLE DESCRIPTION						SAMPLE SIZE	ATTERBERG LIMITS	REMARKS		
GRAY-BROWN CLAY (PARTLY ORGANIC)						2 7/8" x 6"	LL= 104 PL= 41 PI= 63			
KEY	BORING NO.	SAMPLE NO.	DEPTH	TEST TYPE	LATERAL PRESSURE PSF	DEVIATOR STRESS PSF	WATER CONTENT, % INITIAL FINAL	DEGREE OF SATURATION, % INITIAL FINAL	AXIAL STRAIN %	TEST TYPE
	S	E	20' To 21.5'	Q	1440	615	84 -	- -	6.0	'Q'-UNCONSOLIDATED, UNDRAINED
WALTER LUM ASSOCIATES, INC.										

deflection in inches (thick sample)

CONSOLIDATION TEST LOAD-DEFLECTION CURVE

PROJECT: BOUGAINVILLE INDUSTRIAL
PARK-OFFSITE SEWERS

LOCATION: HALAWA, EWA, OAHU, HAWAII

Sample No. 4C

Depth: 10'-11.5'

Water Content (Before Test) 87 %

Water Content (After Test) 76 %

Sample Dry Weight 59 g

Height of Sample: 1.00 "

Diameter of Sample: 2.375 "

Area of Sample: 4.430

Specific Gravity: 2.84

ATTERBERG LIMITS:

Liquid Limit 117

Plastic Limit 38

Plasticity Index 79

UNLOADING
CYCLE

LOADING CYCLE

Load in P.S.F.

WALTER LUM ASSOCIATES, INC.

STRUCTURAL & SOIL ENGINEERS

Consolidation in inches (thick sample)

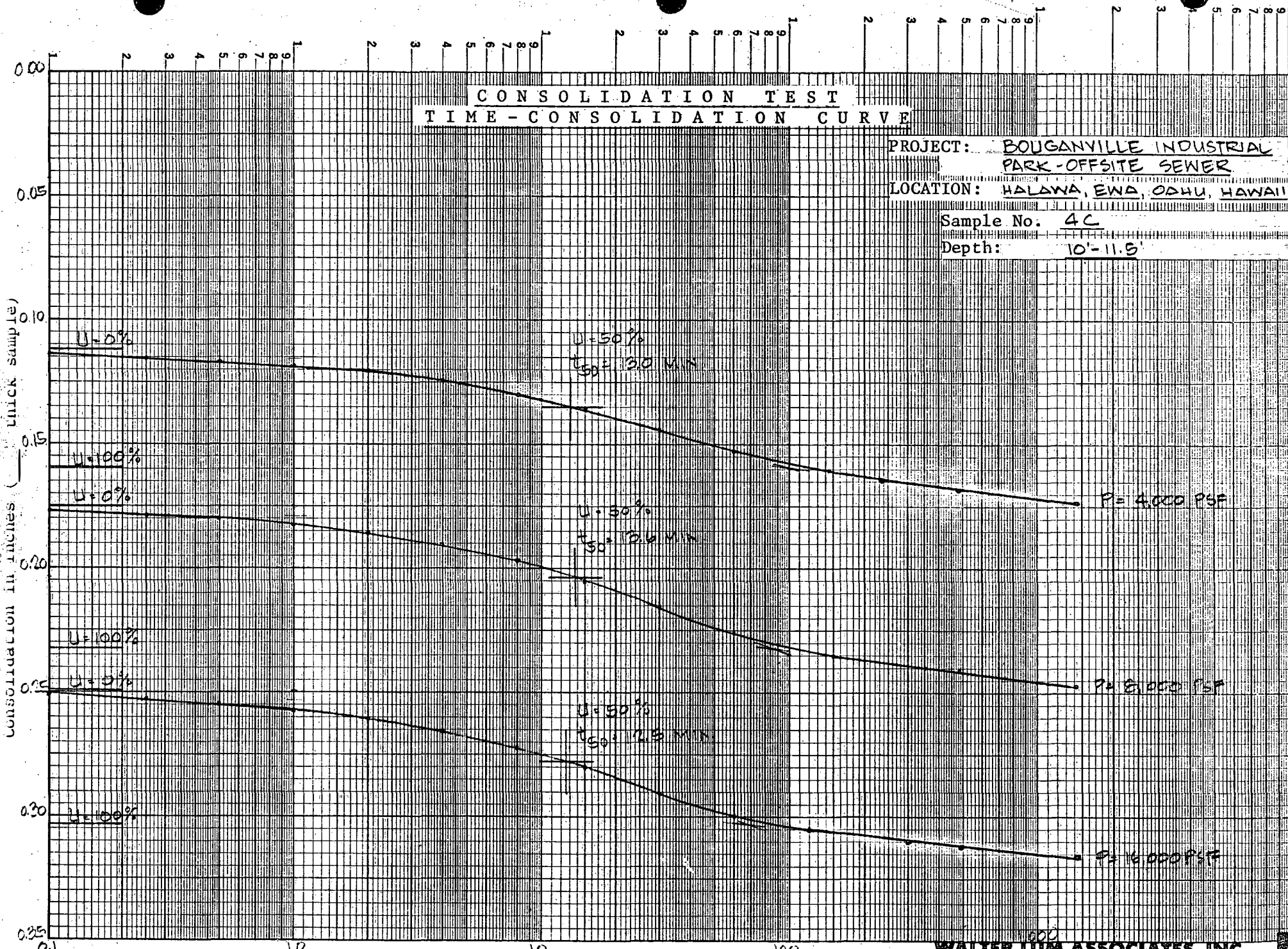
CONSOLIDATION TEST
TIME-CONSOLIDATION CURVE

PROJECT: BOUGANVILLE INDUSTRIAL
PARK-OFFSITE SEWER

LOCATION: HALAWA, EWA, OAHU, HAWAII

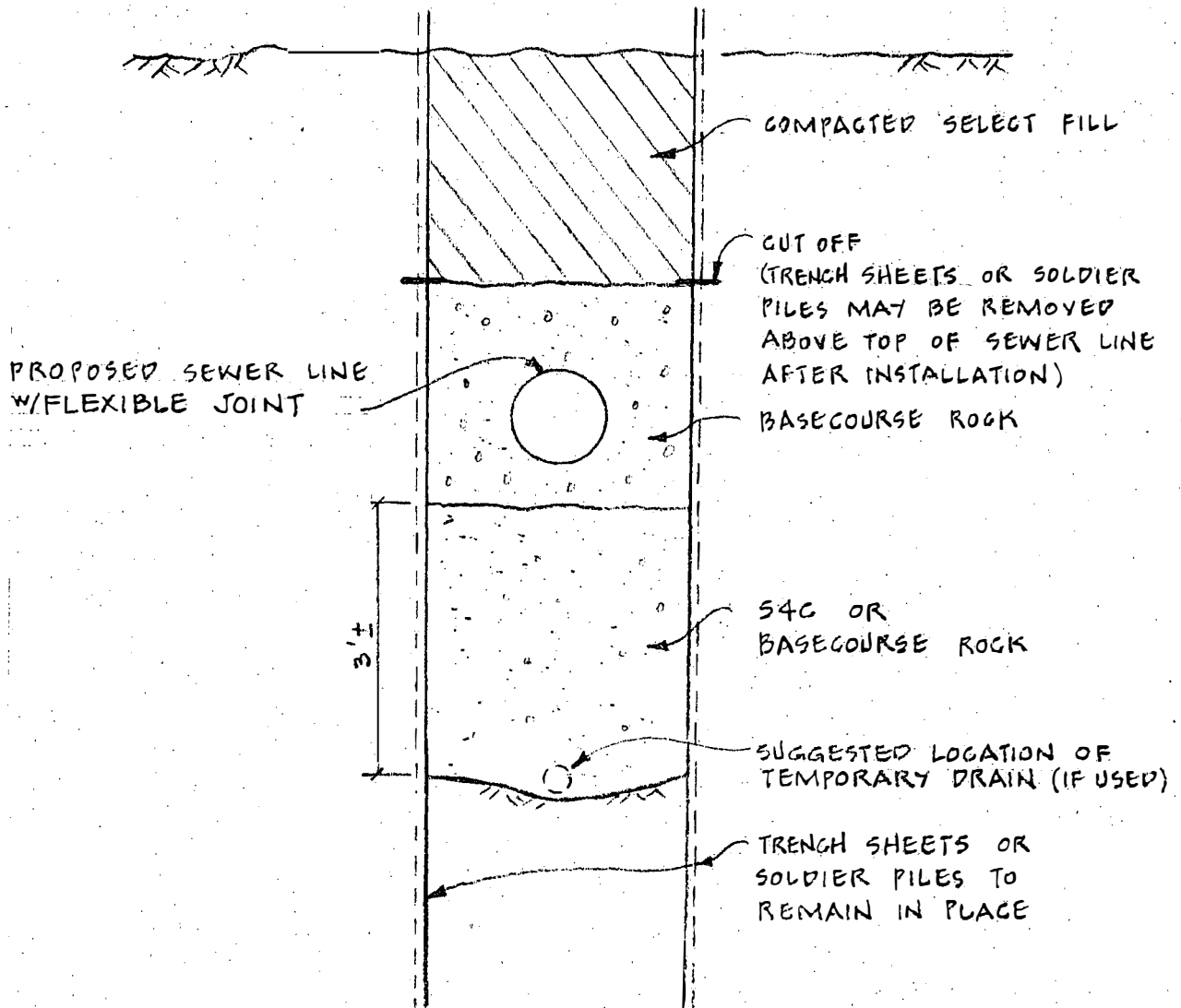
Sample No. 4C

Depth: 10'-11.6'



WALTER LUM ASSOCIATES, INC.

STRUCTURAL & SOIL ENGINEERS

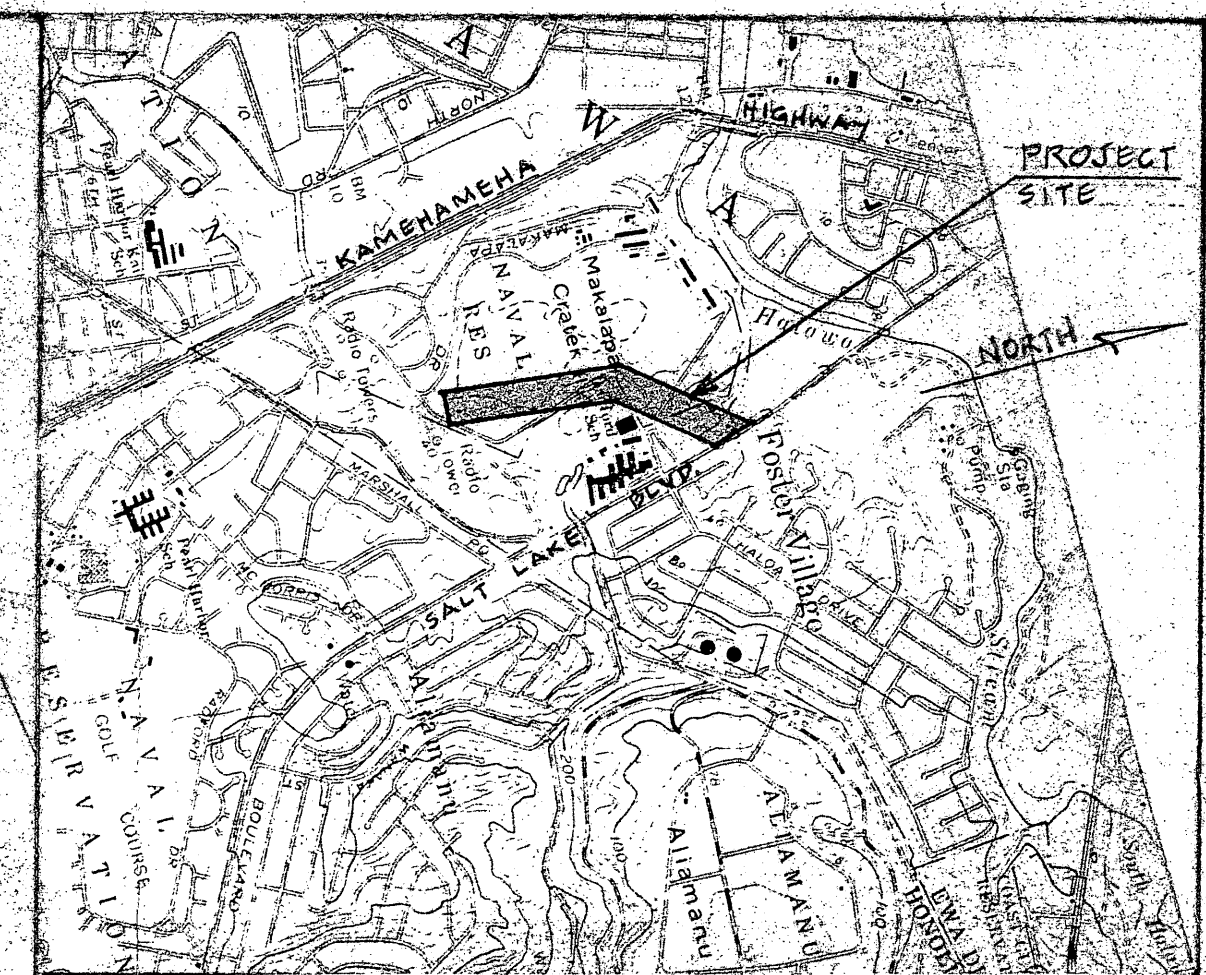
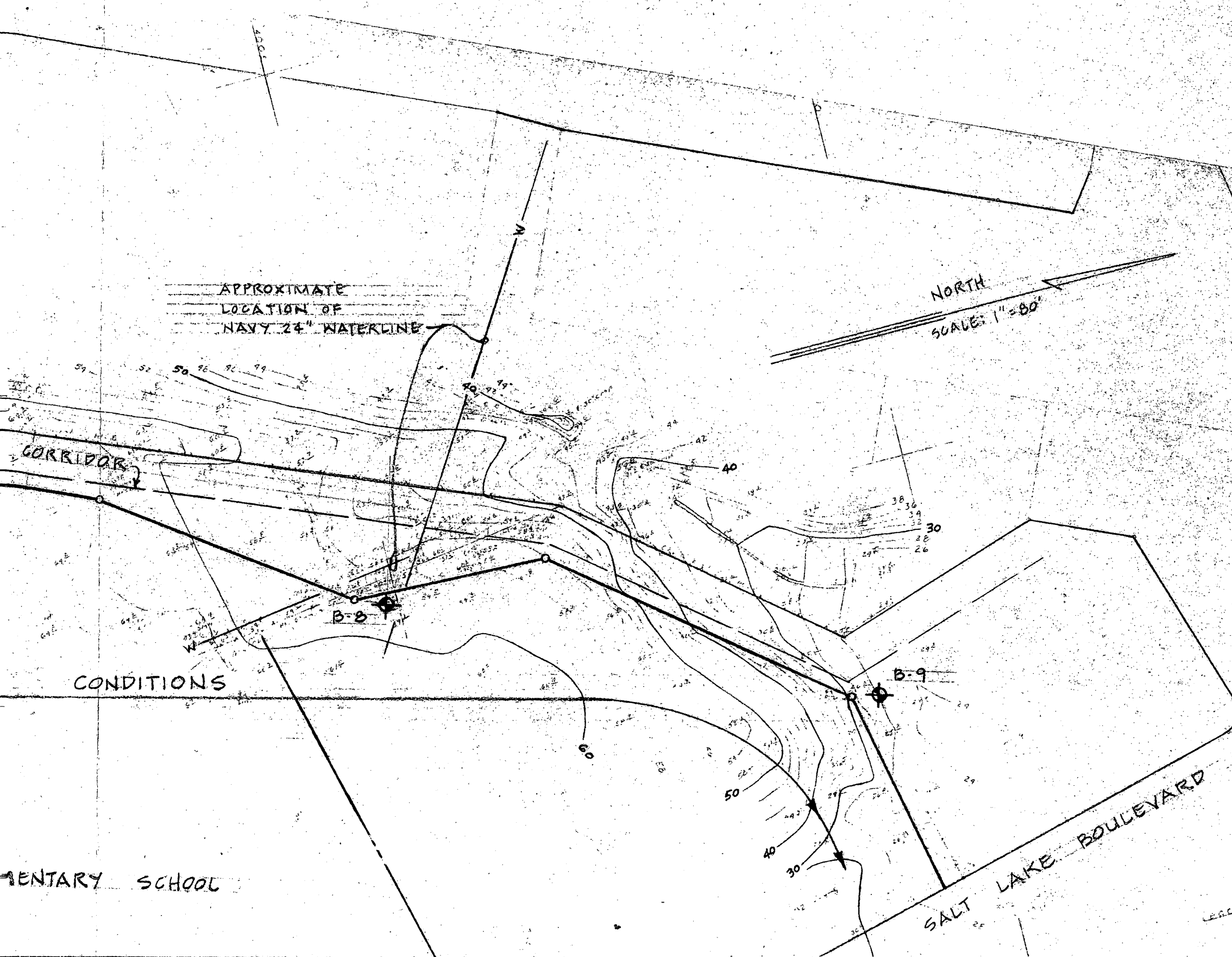


NOT TO SCALE

FIGURE 1
SCHEMATIC SECTION-SUGGESTED
SEWER PIPE BEDDING OVER SOFT GROUND
BOUGAINVILLE INDUSTRIAL PARK
OFFSITE SEWERS
HALAWA, EWA, OAHU, HAWAII

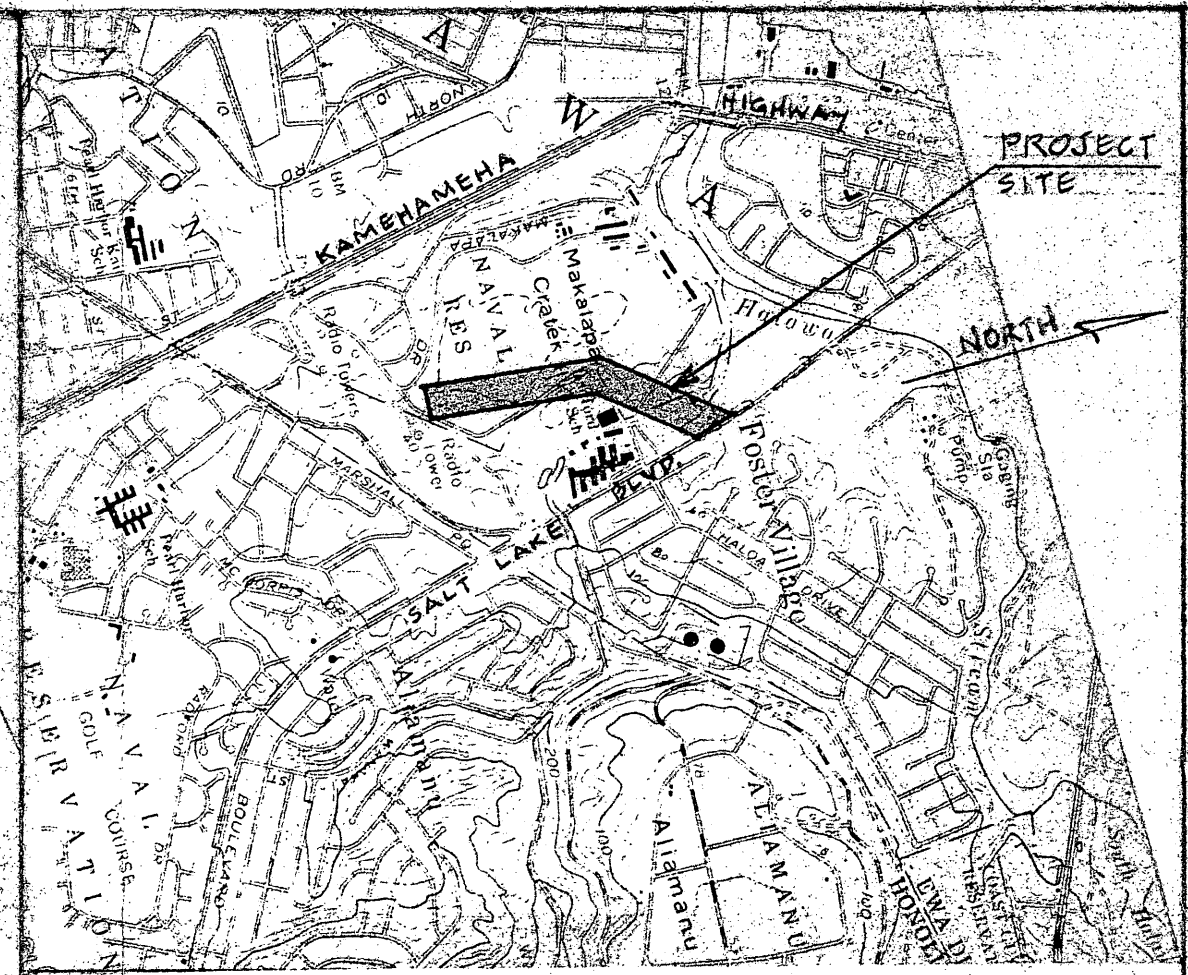
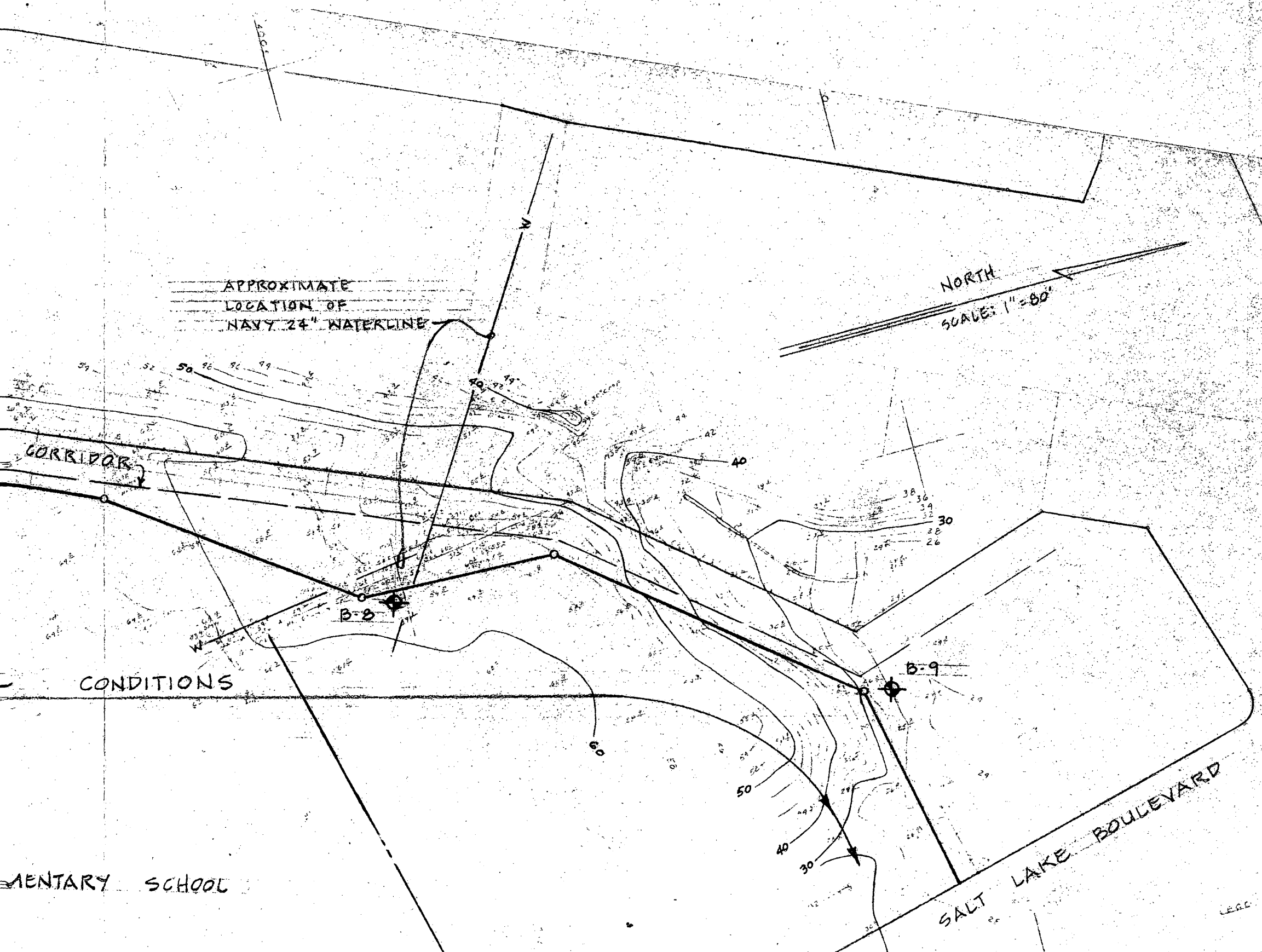
WALTER LUM ASSOCIATES, INC.
 CIVIL, STRUCTURAL, SOILS ENGINEERS

APRIL, 1975



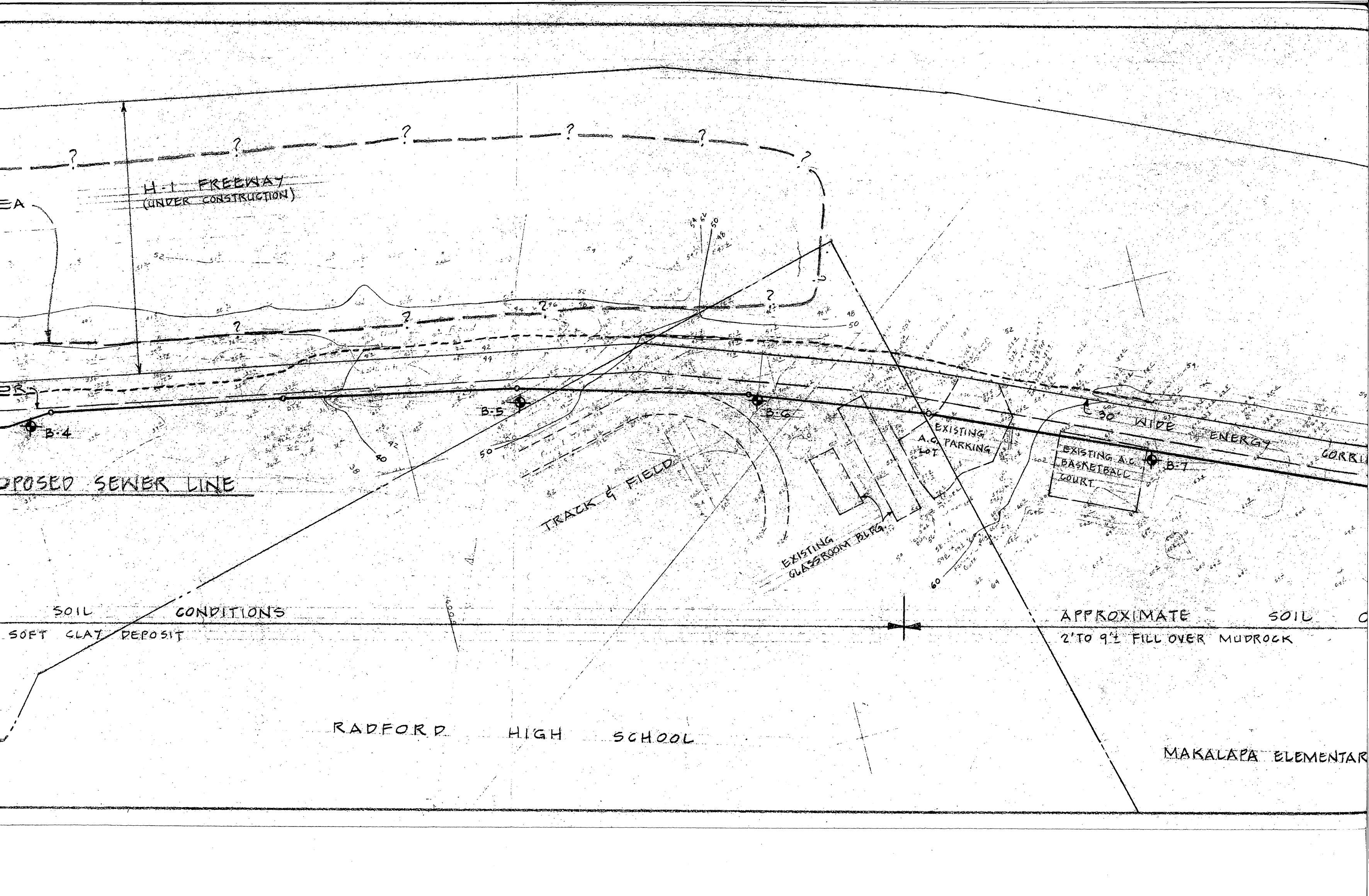
PROJECT LOCATION SKETCH
NOT TO SCALE

BORING LOCATION SKETCH BOUGAINVILLE INDUSTRIAL PARK OFFSITE SEWERS HALAWA, EWA, OAHU, HAWAII TAX MAP KEY: 9-9-02: 2, 3, 18 & 25		
Dr. _____	WALTER ILM ASSOCIATES, INC. 2030 WAIALAE AVE. CIVIL ENGINEERS PHONE 737-7931	Sheet _____
Date 4/15		of _____
Rev. _____		



PROJECT LOCATION SKETCH
NOT TO SCALE

BORING LOCATION SKETCH		
BOUGAINVILLE INDUSTRIAL PARK		
OFFSITE SEWERS		
HALAWA, EWA, OAHU, HAWAII		
TAX MAP KEY: 9-9-02: 2, 3, 18 & 25		
Dr. _____	WALTER ILM ASSOCIATES, INC. 2030 WATAKAE AVE. CIVIL ENGINEERS PHONE 734-7031	Sheet
Date 4/15		of
Rev. _____		



H-1 FREEWAY
(UNDER CONSTRUCTION)

PROPOSED SEWER LINE

TRACK & FIELD

EXISTING CLASSROOM BLDG.

EXISTING A.C. PARKING LOT

EXISTING A.C. BASKETBALL COURT

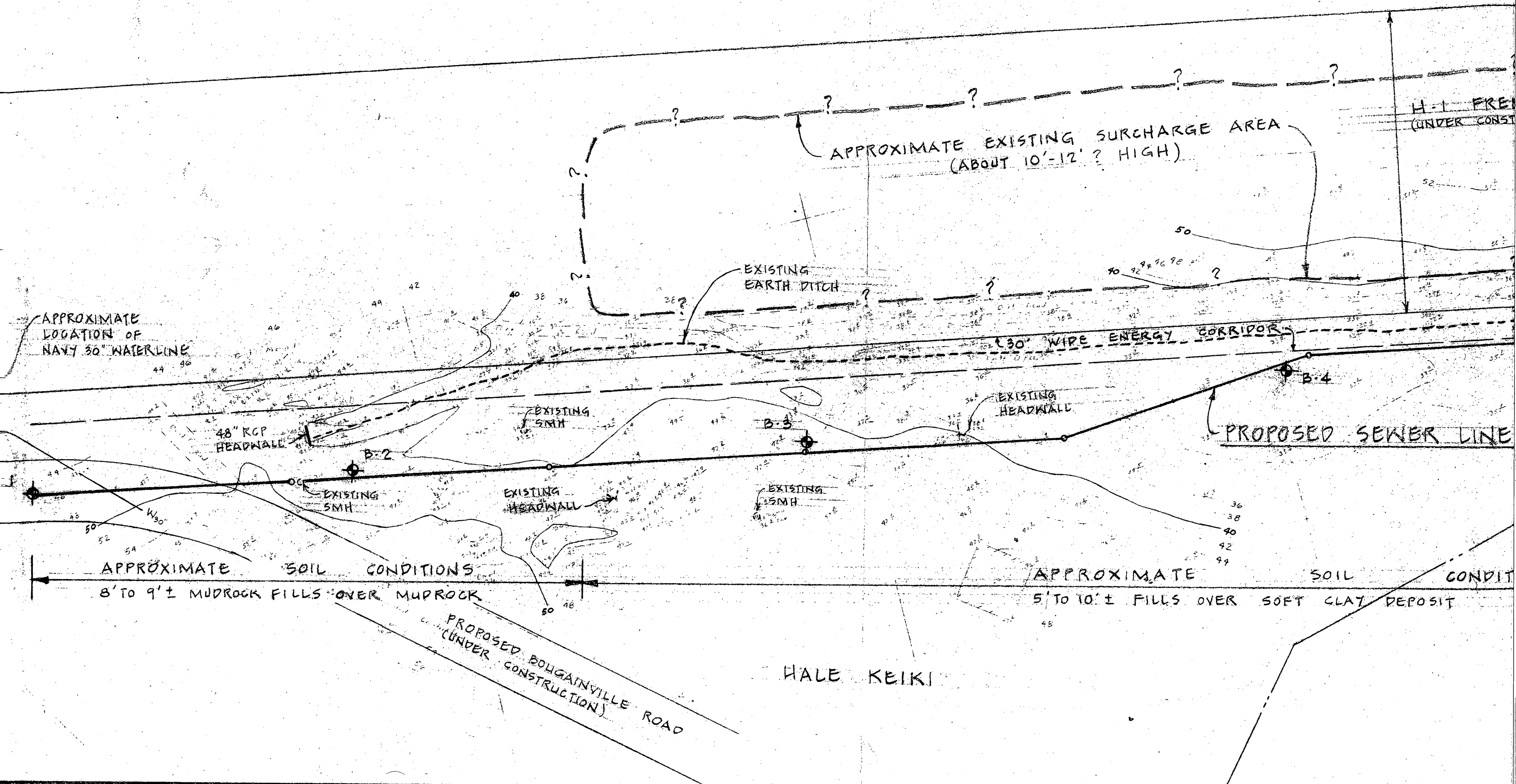
30' WIDE ENERGY CORRI.

SOIL CONDITIONS
SOFT CLAY DEPOSIT

APPROXIMATE SOIL
2' TO 9 1/2' FILL OVER MUDROCK

RADFORD HIGH SCHOOL

MAKALAPA ELEMENTAR



APPROXIMATE EXISTING SURCHA
(ABOUT 10'-12' ? HIGH

EXISTING
EARTH DITCH

APPROXIMATE
LOCATION OF
NAVY 30" WATERLINE

(30' WIDE ENERGY

48" RCP
HEADWALL

EXISTING
SMH

EXISTING
HEADWALL

EXISTING
SMH

EXISTING
HEADWALL

EXISTING
SMH

APPROXIMATE SOIL CONDITIONS
8' TO 9' ± MUDROCK FILLS OVER MUDROCK

APPROXIMATE
5' TO 10' ± FILL

PROPOSED BOUGAINVILLE ROAD
(UNDER CONSTRUCTION)

HALE KEIKI

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.

If there is a substantial lapse of time between the submission of this report and the start of work at the site, or if conditions have changed due to natural causes, plan changes, or construction operations at or adjacent to the site, it is recommended that this report be reviewed to determine the applicability of the recommendations considering the time lapse, changed conditions, and changes in the state of the art of soil engineering.

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.