PRELIMINARY FOUNDATION REPORT
AIKAHI GARDENS
KANEOHE BAY DRIVE, KANEOHE
W.O. 111 - JUNE 20, 1969

GEOLABS-HAWAII, INC.
1553 COLBURN STREET, SUITE 203
HONOLULU, HAWAII 96817

GEOLABS-HAWAII, Inc.
Geology, Soils and Foundation Engineering
1553 Colburn Street, Suite 203 • Honolulu, Hawaii 96817 • (808) 815-064

June 20, 1969

W. O. 111

Dan Ostrow Construction Company
126 Queen Street, Suite 202A
Honolulu, Hawaii 96813

Attention: Mr. George Yarberry

Subject: Foundation Investigation on Aikahi Gardens, Kaneohe Bay Drive, Kaneohe

Gentlemen:

Submitted herewith are the results of a subsurface soils investigation on the subject property. Preliminary site plans, as prepared by Charles Yoon & Associates, were utilized in this study.

SITE LOCATION & PROPOSED DEVELOPMENT

The subject property consists of about 17 acres of gently sloping ground with a steep slope at the rear of the property. The property generally has a slope of 10:1 or flatter except at the rear where a steep cut slope has been made. The cut slope has generally been cut at a 1:1 slope and the natural steep terrain above the cut slope varies from 1½:1 to 2:1. The western portion of the property is heavily brush covered while the eastern portion is presently occupied by a construction yard.

Proposed development has scheduled an apartment complex consisting of two story buildings. Site grading will be involved and will include lowering the cut slope at the rear of the property and a general cut and fill pad operation over most of the property. The maximum depth of fill will be on the order of ten (10) feet and the maximum depth of cut will be about twelve (12) feet. The new cut slope will be constructed at a slope of 1½:1 to a maximum height of 22 feet.

FIELD EXPLORATION

Thirteen (13) test pits were dug with a backhoe to various depths and one boring was drilled with a truck mounted hydraulic drill rig to a depth of 17.0 feet. The log of test pits is shown in Table I and the boring log is shown on Plate A. The exploratory hole locations are plotted on the enclosed grading plan.

Undisturbed samples were obtained with a 2.5 inch diameter split spoon sampler. These and representative bulk samples were brought to the laboratory for analysis.

DISCUSSION

The exploratory pits and boring indicate that relatively erratic soil and geologic conditions exist on the property. The higher or steeper portions of the property consist of basalt flows with a relatively thin soil cover. The lower portion of the property contains an emerged coral reef overlain by alluvial and soil deposits. The coral and basaltic materials are similar in nature and create no problems from a stability or bearing capacity standpoint; however, the alluvial materials in the lower portion of the property do create a problem as discussed below.

ALLUVIUM & TOP SOIL

Recent alluvium has been deposited in the lower central portion of the project as a result of erosion from the adjacent hills. This material consists of a fine grained soil which has been carried by surface runoff and then deposited in the flatter slopes on the lower portion of the property. The maximum depth of this deposit is about eight (8.0) feet adjacent to Kaneohe Bay Drive and gradually lessens in the uphill direction. The upper 3.5 to 4.0 feet in the lower area is extremely soft and wet and has not had time to normally consolidate. Thus this material, if not removed, could cause considerable settlement especially in fill areas.

As a general guide, elevation 35 may be used to delineate the poor soil area; ie, below the elevation most of the soft and wet soils are encountered and additionally poor drainage conditions were found.

Top soil overlying the basalt and/or coral in the higher areas generally varied from 1.5 to 4.0 feet. This material was

generally highly weathered and had a moderate to high moisture content. No top soil was encountered in the western most extreme of the property where an extensive borrow area was made creating an existing cut pad.

EMERGED CORAL REEF

An emerged coral reef was encountered on the eastern portion of the property. This reef apparently developed during a high stand of the sea, probably either the Waialae (Elevation +45) or Kahuku (Elevation +55). The coral consists of a dense, yellowish brown deposit becoming almost limestone. Some of these marine deposits are consolidated while others are nonconsolidated such as found in Pit No. 8. This material is generally porous and has excellent bearing capacity. The extent and depth of this deposit is not known.

BASALT

Basaltic rock from the Kailua volcanic series underlie most of the project and are exposed in the cuts at the rear of the property and also in the large cut westerly of the property. Careful inspection of the existing cuts indicated that this material was highly stable and very little talus was noted at the toe of the cut. This material is quite hard and in certain locations may require blasting. In the very least heavy ripping will be required particularly in the deeper cut areas. If a thick dike is encountered it is probable that blasting will be required unless extensive fracture patterns have developed.

RECOMMENDATIONS AND CONCLUSIONS

Based upon a study of the field conditions and analysis of laboratory test results, the following conclusions and recommendations are presented:

1. The property is underlain by basaltic flows in the higher areas and an emerged coral reef in the lower areas. Some top soil developed over these materials and in addition extensive alluvium (water carried sediments) has developed in the lower central portion of the project.

2. Prior to grading the site all brush and organic material should be removed from the site.

3. Prior to the placement of fill the following surface preparations should be made:

    a. Below Elevation 35 (approx) all soft and wet alluvial soils should be removed and dried or wasted. The approximate depth of this removal is 3.5 to 4.0 feet. To facilitate removal and drying of this material it is suggested that 3-4 trenches be dug to a depth of five feet in this area draining towards the existing culvert. If this material is not dried substantially it can not be used in compacted fills.

    b. Above Elevation 35 (approx) the upper 12 inches should be thoroughly scarified, processed and compacted to 90% relative compaction. Any soft and wet areas should be removed and recompacted.

4. If groundwater or seepage is encountered in the lower portion of the project, it may be necessary to install a subdrain system to control the groundwater.

5. All fill should be placed under the direct supervision of a soils engineer to a minimum relative compaction of 90%.

6. The existing surface soils are highly expansive (ie, subject to large volume change with change in moisture content); however since extensive grading is involved on the project no comment can be made until final pad grade is achieved. It is suggested; however, that the upper three (3.0) feet of fill in building areas consist of the less expansive materials to reduce future problems.

7. All structural footing should be founded at a minimum depth of eighteen inches below finished grade unless hard rock is encountered first. An allowable foundation pressure of 2000 lbs/sq.ft. may be utilized for footing in compacted fill with a minimum width of twelve inches. Footings entirely in basalt or hard rock may be designed for a value of 6000 lbs/sq.ft.

8. The proposed cut slope may be considered stable; however any loose talus or debris encountered in the cut should be removed from the slope.

9. Rocks larger than eight inches should either be broken up or hauled away. If rock disposal becomes a problem, an alternate plan will be worked out in the field. In no event should rocks be nested or piled together in fill areas.

10. Our general specifications are enclosed and should be followed unless specifically superceded herein above.

Respectfully submitted,

GEOLABS-HAWAII, INC.

Gary E. Rittenhouse

Gary E. Rittenhouse, P.E. 2335

TABLE I

Test Pit No.	Depth (ft)	Classification
1	0.0 - 3.0	Basalt, weathered, reddish brn, damp dense w/some thin zones of ash
	3.0 - 5.5	Basalt, fresh, fractured, brn, slightly damp, becoming very hard @ 5.0 ft.
2	0.0 - 4.0	Lean clay, blue-gray, soft, wet
	4.0 - 8.0	Basalt, brn, damp, dense, harder w/depth
3	0.0 - 4.0	Alluvium, lean clay, brn, wet, soft
	4.0 - 7.0	Lean clay, moist, brn, firm
	7.0 - 8.0	Basalt, weathered, lt yell brn, dense
4	0.0 - 4.0	Alluvium, lean clay, wet, soft, dk brn
	4.0 - 8.0	Lean clay, brn, moist, firm
	8.0 - 9.0	Emerged Coral Reef, tan, dense, soft at surface
5	0.0 - 4.0	Lean clay, brn to dk brn, moist, mod firm to soft
	4.0 - 6.0	Emerged Coral Reef, tan, soft at surface then denser w/depth
6	0.0 - 1.5	Lean clay, dk brn, moist, soft
	1.5 - 6.0	Basalt, weathered, brn, firmer below 3.5 ft, dense @ 5.5 ft
7	0.0 - 1.0	Top soil, silty clay, dk brn w/roots, moist, firm
	1.0 - 4.0	Clayey silt w/rocks to 10 inches, moist, firm
	4.0 - 4.5	Basalt, brn, weathered, damp, dense

TABLE I
(cont.)

Test Pit No.	Depth (ft)	Classification
8	0.0 - 3.5	Lean clay, brn, wet, soft to mod firm
	3.5 - 7.0	Coral materials, unconsolidated, clayey sand, reddish brn, traces of shells and coral, moist, firm w/small cobbles
	7.0 - 7.5	Basalt, lt brn, very dense
9	0.0 - 1.0	Lean clay, brn, moist, firm w/roots
	1.0 - 7.0	Lean clay, brn, wet, firm to mod firm
	7.0 - 9.0	Coral Reef, lt brn, weathered, moist, firm
10	0.0 - 3.0	Silty sand w/cobbles to 12 inches, lt brn, dry, too hard to dig deeper
11	0.0 - 1.0	Lean clay, dk brn w/rocks to 6 inches, slightly moist, firm to hard
	1.0 - 5.0	Basalt, olive brn, dense, too hard to dig deeper
12	0.0 - 0.5	Coral sand, brn, fairly moist, w/some rocks
	0.5 - 9.0	Basalt, brn, moist, firm becoming denser w/depth
13	0.0 - 0.5	Lean clay, brn, moist, loose w/roots
	0.5 - 1.5	Coral reef, lt brn, too hard to dig deeper

TABLE II

Laboratory Test Results

Pit No.	Depth (ft)	Classification	Laboratory 1/ Maximum Density (pcf)	Optimum Moisture (%)	Swell 2/ 60 psf (%)
7	4.0	Clayey sand (Basalt)	92.2	28.5	4.1
8	5.0	Clayey sand	108.0	20.0	11.8
14	3.0	Fat clay	100.5	23.5	28.7

1/ Standard - ASTMD 1557-64T

2/ Remolded to 90% relative compaction at optimum moisture and then saturated for at least 24 hours.

GEOLABS, INC.

BORING LOG

Boring No. 14 Date of Drilling 5-13-69

Surface Elev. 26 W. O. 111

Depth (ft.)	SAMPLE	CORE	CLASSIFICATION (% Sand, % Silt, % Clay)	DRY DENSITY pcf	% MOISTURE	RELATIVE COMPACTION	FRICTION ANGLE ∅	COHESION psf
0			Silty clay w/small rocks, moist, fairly firm					
	B		Fat clay, olive, wet, soft w/traces of organic (12-12-76)					
5		X	(8-19-73)	80.5	39.8			
			Clayey Sand, lt brn w/coral fragments, moist, firm					
10		X	(78-10-12)	80.0	9.7			
			Coral reef, lt brn, firm to hard @ 15.0' - very hard					
15		X	(Sample too rocky)					
			End of boring @ 17.0 feet No water					
20								
25								
30								

Plate A- _____

GRADING SPECIFICATIONS

GEOLABS, INC.

I GENERAL

A. The Soils Engineer and Engineering Geologist are the Owner's or Builder's representative on the project. For the purpose of these specifications, supervision by the Soils Engineer includes that inspection performed by any person or persons employed by, and responsible to, the licensed engineer signing the soil report.

B. All clearing, site preparation, or earthwork performed on the project should be conducted by the Contractor under the supervision of a qualified Soils Engineer.

C. It is the Contractor's responsibility to prepare the ground surface to receive the fills to the satisfaction of the Soils Engineer and to place, spread, mix, water, and compact the fill in accordance with the specifications of the Soils Engineer.

D. It is also the Contractor's responsibility to have suitable and sufficient compaction equipment on the job site to handle the amount of fill being placed. If necessary, excavation equipment will be shut down to permit completion of compaction. Sufficient watering apparatus will also be provided by the Contractor, with due consideration for the fill material, rate of placement, and time of year.

E. A final report shall be issued by the Soils Engineer and Engineering Geologist attesting to the Contractor's conformance with these specifications. Variations from these specifications or from the grading plan must be approved in writing by the Soils Engineer and Engineering Geologist. The Owner or Builder and the controlling Governmental Authorities should be notified prior to implementing any variation.

F. These specifications are of a general nature, and some items may not apply to each and every facet of a specific project. If there are any inconsistencies, the "Conclusions and Recommendations" section listed in the report takes precedence.

II SITE PREPARATION

A. All vegetation and deleterious material such as rubbish shall be disposed of offsite. This removal should be concluded prior to placing fill.

B. All houses, sheds, sewage disposal systems, large trees, or structures should be spotted in the field or on the grading plan to the best of the Soil Engineer's knowledge prior to preparing the ground surface.

C. Soil, alluvium, or rock materials determined by the Soils Engineer as being unsuitable for placement in compacted fills shall be removed and wasted from the site. Any material incorporated as a part of a compacted fill should be approved by the Soils Engineer.

D. After the ground surface to receive fill has been cleared, it should be scarified, disced, or bladed by the Contractor until it is uniform and free from ruts, hollows, hummocks, or other uneven features which may prevent uniform compaction.

E. The scarified ground surface should be brought to optimum moisture, mixed as required, and compacted as specified. If the scarified zone is greater than twelve inches in depth, the excess should be removed and placed in lifts restricted to six inches.

F. Prior to placing fill, the ground surface should be approved by the Soils Engineer. Water courses and gullies should be cleaned under the supervision of the Soils Engineer and/or Engineering Geologist.

G. Any underground structures such as cesspools, cisterns, mining shafts, tunnels, septic tanks, wells, pipe lines, or others not located prior to grading are to be removed or treated in a manner prescribed by the Soils Engineer.

III COMPACTED FILLS

A. Any material imported or excavated on the property may be utilized in the fill, provided each material has been determined to be suitable by the Soils Engineer. Roots, tree branches, and other matter missed during clearing shall be removed from the fill as directed by the Soils Engineer.

B. Rock fragments less than six inches in diameter may be utilized in the fill, provided:

1. They are not placed in concentrated pockets.

2. There is a sufficient percentage of fine-grained material imported to surround the rocks.

3. The distribution of the rocks is supervised by the Soils Engineer.

C. Rocks greater than six inches in diameter shall be taken off the site, or else be placed in accordance with the recommendations of the Soils Engineer in areas designated as suitable for rock disposal. Details for rock disposal such as location, moisture control, percentage of rock placed, etc., will be referred to in the "Conclusions and Recommendations" section of the soils report.

D. No material that is spongy, subject to decay, or otherwise considered unsuitable should be used in the compacted fill.

E. Representative samples of materials to be utilized as compacted fill should be analyzed in the laboratory by the Soils Engineer to determine its physical properties. If any material other than that previously tested is encountered during grading, the appropriate analysis of this material should be conducted by the Soils Engineer.

F. Material used in the compacting process should be evenly spread, watered, processed, and compacted in six-inch lifts to obtain a uniformly dense layer. The fill should be placed and compacted on a horizontal plane unless otherwise approved by the Soils Engineer.

G. If the moisture content or relative density varies from that required by the Soils Engineer, the Contractor will rework the fill until it is approved by the Soils Engineer. If the material is too wet, as determined by the Soils Engineer, it should either be dried by the Contractor or hauled away from the fill area.

H. Each layer should be compacted to 90 percent of the maximum density in compliance with the testing method specified by the controlling Governmental Authority. In general, ASTM D-1557-64T will be used with a 5-layer curve. If compaction to a lesser percentage is authorized by the controlling Governmental Authorities because of a specific land use or expansive soil conditions, the area to receive fill compacted to less than 90 percent should either be delineated on the grading plan, or appropriate reference made to the area in the soil report.

I. All fills should be keyed and benched into bedrock or firm material where the slope receiving fill exceeds a ratio of six horizontal to one vertical in accordance with the recommendations of the Soils Engineer.

J. The key for side hill fills should be a minimum of 15 feet within bedrock or firm materials, unless otherwise specified in the soils report.

K. Drainage terraces and subdrainage devices should be constructed in compliance with the ordinances of controlling Governmental Authorities or with the recommendations of the Soils Engineer and Engineering Geologist.

L. To insure the proper compaction on the face of fill slopes, the slope face should either be backrolled with sheepsfoot rollers at every three-foot vertical lift (and then grid rolled upon completion), or the fill slope should be overbuilt and cut back to the compacted core. Slope tests will be taken to insure compaction.

M. All fill slopes should be planted or protected from erosion by methods specified in the soils report.

N. Fill over cut slopes should be properly keyed into rock or firm material and the transition should be stripped of all soil prior to placing fill.

IV CUT SLOPES

A. The Engineering Geologist shall inspect all cut slopes excavated in rock, lithified, or formation material at vertical intervals not exceeding ten feet.

B. If any conditions not anticipated in the preliminary report such as perched water, seepage, lenticular or confined strata of a potentially adverse nature, unfavorably inclined bedding,

joints, or fault planes are encountered during grading, these conditions should be analyzed by the Engineering Geologist and Soils Engineer, and recommendations should be made to treat these problems.

C. Cut slopes that face in the same direction as the prevailing drainage should be protected from slope wash by a non-erosive interceptor swale placed at the top of slope.

D. Unless otherwise specified in the soils and geological report, no cut slopes should be excavated higher or steeper than that allowed by the ordinances of controlling Governmental Authorities.

E. Drainage terraces should be constructed in compliance with the ordinances of controlling Governmental Authorities or with the recommendations of the Soils Engineer or Engineering Geologist.

V GRADING CONTROL

A. Inspection of the fill placement should be provided by the Soils Engineer during the progress of grading.

B. Density tests should be made at intervals not exceeding two feet of fill height at every 500 cubic yards of fill placed.

C. Density tests should also be made on the surface material to receive fill if required by the Soils Engineer.

D. If the results of the density tests are unsatisfactory, the Contractor will rework the critical area until approved by the Soils Engineer.

VI CONSTRUCTION CONSIDERATIONS

A. Erosion control measures, when necessary, should be provided by the Contractor during grading and prior to the completion and construction of permanent drainage controls.

B. Upon completion of grading and termination of inspections by the Soils Engineer, no further filling or excavating, including that necessary for footings, foundations, large tree wells, retaining walls, or other features should be performed without the approval of the Soils Engineer or Engineering Geologist.

C. Care should be taken by the Contractor during final grading to preserve any berms, drainage terraces, interceptor swales, or other devices of a permanent nature on or adjacent to the property.