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FEASIBILITY LEVEL  
SOILS AND GEOLOGY INVESTIGATION  
LILIPUNA HILLSIDE RESIDENTIAL DEVELOPMENT  
KANEHOHE, OAHU, HAWAII  
TAX MAP KEY: 4-6-01  
W. O. 435-00 DECEMBER 18, 1972

FOR

BRIAN GRAY AND ASSOCIATES

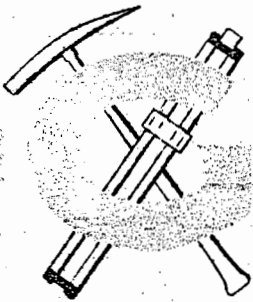
GEOLABS-HAWAII, INC.  
1553 COLBURN STREET, SUITE 203  
HONOLULU, HAWAII 96817

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City Hall Annex, 655 S. King Street  
Honolulu, Hawaii 96813

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# GEOLABS-HAWAII, Inc.

Soils and Foundation Engineering, Geology  
1553 Colburn Street, Suite 203 • Honolulu, Hawaii 96817 • (808) 841-5064

December 18, 1972

W. O. 435-00

Brian Gray & Associates  
116 South King Street, Room 508  
Honolulu, Hawaii 96813

Attention: Mr. Brian Gray

Subject: Feasibility Level - Soils and Geology  
Investigation  
Lilipuna Hillside Residential Development  
Kaneohe, Oahu, Hawaii  
Tax Map Key: 4-6-01

Gentlemen:

Submitted herein are the results of our feasibility level - soils and geology investigation of the proposed Lilipuna Hillside residential development site as requested and authorized by your company (November 22, 1972, W. O. 435-00). This report summarizes our work and presents our preliminary general recommendations for determining the feasibility and for planning the project's site development. A more detailed investigation, in accordance with our proposal, is recommended prior to construction when more detailed development plans are prepared. Items needing additional investigations are delineated in the recommendations of this report.

SITE DESCRIPTION

The approximately 33 acre site is located adjacent to Lilipuna Road, and consists of the northwest side of Puu Pahu Ridge, roughly between Yacht Club Street on the southwest and the lots bordering Kaneohe Bay on the northeast. The property is located in Kaneohe, Oahu, Hawaii. Slope gradients vary from very steep near the ridge top to relatively flat in places adjacent to Lilipuna road. The site is extremely overgrown with a variety of vegetation. The abundance of vegetation made surface mapping very difficult. Therefore, geologic contacts, shown on Plate I are considered only approximate.

The site is heavily vegetated with keawe, ornamental banana, pine, guava, plum, mango, palm and other trees.

Piles of trash consisting of discarded automobiles and appliances and other debris are located in the lower portions of the property and have been noted on the map, included with this report as Plate 1. Existing dwellings occupy a portion of the site adjacent to Lilipuna Road. Cesspools probably exist and should be taken into account during construction.

### PROPOSED DEVELOPMENT

According to the plot plan supplied by Brian Gray and Associates, the proposed development will consist of 266 units in two and three story residential structures. Considerable grading and retaining wall construction will be required to provide level pads for construction.

### FIELD EXPLORATION

Due to the overgrown nature of the property, two days of surface geologic mapping were performed on the site in an effort to delineate rock and soil types, condition and distribution. A backhoe was also utilized to provide additional subsurface data, as requested. However, without the preliminary use of a dozer to construct exploration roads on the property, it was only possible to excavate two test pits in the areas shown on Plate 1. Logs of the test pits are presented on Table A, Appendix A. The mapping, based upon the visual geologic reconnaissance, is contained on Plate 1 of this report.

### SUBSURFACE CONDITIONS

#### A. Geology

During the late Tertiary Period, Koolau Volcanic series

basalts covered the Pohakea Peninsula. These basalts were subsequently injected by basalt dikes.

A prolonged period of weathering, erosion and deposition followed, resulting in the deposition of mottled, brown, clayey silts and very weathered basalt boulders ("Older Alluvium") disconformably over the Koolau basalts.

A Post-Pleistocene (Recent) Period of sub-tropical weathering, erosion and deposition has resulted in the formation of a residual weathering crust (red clayey silts) over the basalts and transported alluvium (loosely consolidated) in the lower portion of the property.

B. Soils

Based upon our preliminary geologic mapping and limited subsurface investigation, the onsite soils appear to consist of the following general types:

- 1) Fill-Trash Piles - The lower portions of the property contain some car and truck bodies, sheet metal and trash piles, and possibly some fill.

- 2) Brown SILT (Older Alluvium) - red, yellow and predominantly brown, very stiff, silts found on the lower slopes of the hillside.
- 3) Red Silty CLAY and Clayey SILT - very stiff to hard, red, clayey SILT and silty CLAY on the southwestern portions of the property.
- 4) BASALT - weathered (soft enough to be cut by a D-8, 9 Cat or equivalent), unweathered (may not be rippable with a D-8, 9 Cat or equivalent) found on the higher portions of the property and the northeast corner of the property (see map, Plate 1).

#### PRELIMINARY CONCLUSIONS AND RECOMMENDATIONS

Based upon the results of the geologic field reconnaissance and limited subsurface investigation, the following preliminary conclusions and recommendations are presented:

##### A. General

The soil types and conditions encountered during the field investigation indicate that development of the property by

means of cuts and fills is feasible from a geology and soils engineering standpoint provided that the recommendations given below are followed. The conditions appear generally to be similar to those encountered on an adjacent piece of property located to the south west (Refer to Geolabs report for Puu Alii Residential PUD, W. O. 436-00, dated December 13, 1972). Both selective borings and test pits were excavated on that property due to the much sparser vegetation and easier access.

B. Grading

1) Clearing and Grubbing

All deleterious material, i.e. vegetation topsoil, trash, etc., should be removed from borrow and fill areas and wasted from the site. This must include the sizeable trash piles encountered in areas of the site bordering Lilipuna Road and indicated on Plate 1. Due to the abundance of vegetation, removal and wasting of vegetation could be quite expensive.

2) Preparation

Prior to placement of compacted fill in the flatter,



lower lying portions of the site, it will also be necessary to remove all unsatisfactory and soft materials. It is anticipated that these materials will mainly consist of the old fills placed to create the existing building pads, recent alluvium in the small stream channels, surficial topsoils and existing trash piles. When more definite plans are developed, the property should be further investigated to determine actual limits and depths of removal. Any excavated natural materials should be approved by the soils engineer prior to recompaction as structural fill. Materials of high organic content should not be used.

Local soft spots encountered anywhere on the site, in areas to receive fill, should be removed and replaced with compacted structural fill. Our general specifications for fill placements, compaction and supervision are contained in the grading specifications, included with this report as Appendix B. Recommended construction procedures for fill above cut slope and fill above natural slope are included as Plates GS-2 and GS-3.

It is expected that all encountered weathered bedrock can be ripped with conventional earth moving equipment except for the outcrops of harder basalt encountered in the northerly portion of the property and delineated on Plate 1.

3) Slopes

For preliminary planning purposes, cut and fill slopes should not be designed steeper than 2 : 1. It is recommended that specific subsurface boring data be obtained from large proposed cut and fill areas to determine the overall stability of these slopes at planned slope gradients. This data should be obtained in conjunction with a design level investigation and grading plan review of the project, prior to construction.

Compaction of any fill slope should be performed progressively after each three-foot increment of fill has been placed by backrolling with the compaction equipment, or should be overbuilt and subsequently cut back to the compacted core.

Slopes higher than 15 feet in vertical height should contain 6 feet (minimum) wide benches every 15 feet of vertical height. All slopes should be planted immediately after construction to minimize erosion.

4) Drainage

Provisions for site drainage, both during and after construction, must be considered. If springs are encountered during excavation, subdrains may be required.

5) Inspection and Testing

Inspection and testing during grading should be performed under the supervision of a soils engineer to ensure that the recommendations are followed.

C. Retaining Walls (if planned)

Any unsurcharged basement and retaining walls less than 10 feet high should be designed for an equivalent fluid pressure of 35 pounds per cubic foot, provided only moderate compaction of backfill is required. If a high degree of backfill compaction is required or the walls cannot yield even slightly, an equivalent fluid pressure of 60

pounds per cubic foot should be used.

Surcharges due to adjacent footings, hydrostatic pressure, construction equipment, slopes, etc. must be added to the above values.

Retaining walls greater than 10 feet high should be evaluated on an individual basis during the design level phase of the investigation to determine the earth pressure distribution. The recommended analyses should be performed after final grading plans are completed and more detailed information concerning the walls is available.

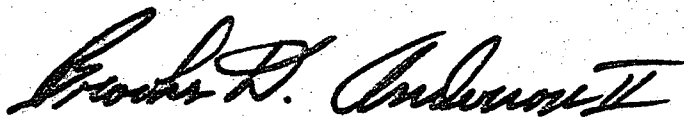
D. Foundations

Spread or continuous footings on cut and fill areas, acceptably prepared, can be utilized. Recommended bearing values, footing depths and reinforcement will be included in the design level foundation report, when more definite development plans are available. Preliminary data indicates that the onsite materials are moderately expansive.

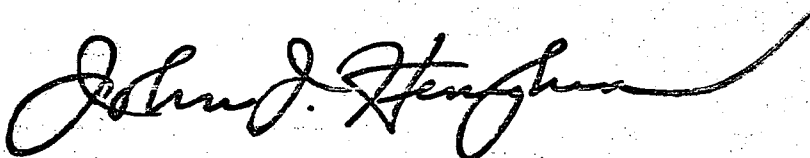
The opportunity to be of service is appreciated. If you  
have any questions, please call.

Very truly yours,

GEOLABS-HAWAII, INC.



Brooks D. Anderson II  
Geologist



John J. Heneghan, P. E.

BDA/JJH:hlg

Test Pit Logs

A P P E N D I X A

T A B L E A

Log of Test Pits

<u>Test Pit Number</u>	<u>Depth (ft)</u>	<u>Soil Description</u>
1	0 - 8.0	Red, brown, very stiff clayey silt (CH-MH) (Older Alluvium)
2	0 - 6.0	Red, Brown, very stiff clayey silt (CH-MH) (older alluvium)

Grading Specifications

A P P E N D I X B



GRADING SPECIFICATIONS  
LILIPUNA HILLSIDE RESIDENTIAL DEVELOPMENT  
KANEHOHE, OAHU, HAWAII  
TAX MAP KEY: 4-6-01

The work under this section includes:

1. Clearing and grubbing of site
2. Preparation of natural ground
3. Preparation of fill areas
4. Placement and control of fill operations
5. Compaction equipment
6. Removal and backfill of underground structures
7. Supervision of earthwork
8. Seasonal requirements

1. Clearing

All areas within contract limit lines shall be cleared of trash, debris and organic matter, and such material shall be burned and removed from the site.

2. Preparation of Natural Ground

In areas where the bottom of footings are designed on or below existing natural ground, the soils shall be scarified to a depth as determined by the soils engineer until the material is free of all uneven features and shall be precompacted as outlined in the following Section #4b.

3. Preparation of Fill Areas

All areas upon which fill is to be placed after clearing, as outlined in Section #1 of these specifications, shall be scarified until free of uneven features to a depth as determined by the soils engineer, and watered and compacted according to Section #4 of these specifications.

4. Placement of Fill

a. Material for fill shall consist of onsite soils.

Fill material shall be free of all organic matter and other deleterious material, and shall not contain rocks or lumps in excess of four inches (4") in diameter.

b. Compaction of Fill

After the base for the fill has been prepared as described above, it shall be brought to the proper moisture content and compacted to not less than 90% of maximum density in accordance with Test ASTM D-1557-70.

c. Depth of Fill

Fill shall be placed in horizontal layers which,

when compacted, will not exceed six inches (6").

5. Compaction Equipment

The soils engineer shall determine the type of compacting equipment which will attain the specified results in the most efficient manner. Sheepsfoot, vibratory, or pneumatic tire rollers may be used in the test section and the equipment which produces the specified results in the most expedient manner as determined by the soils engineer shall be employed by the contractor. The equipment used in rolling shall be in good working condition, fully ballasted, and self cleaning. Fill material placed in an unsatisfactory condition and not within the enclosed specifications shall be rejected by the soils engineer and the contractor shall rework the fill placed such that the specifications are followed.

6. Removal and Backfill of Underground Structures

Any underground structures such as cesspools, cisterns, septic tanks, wells, pipe lines, etc. shall be removed under the direction of the soils engineer. Backfill of the excavation shall be in accordance with these specifications.

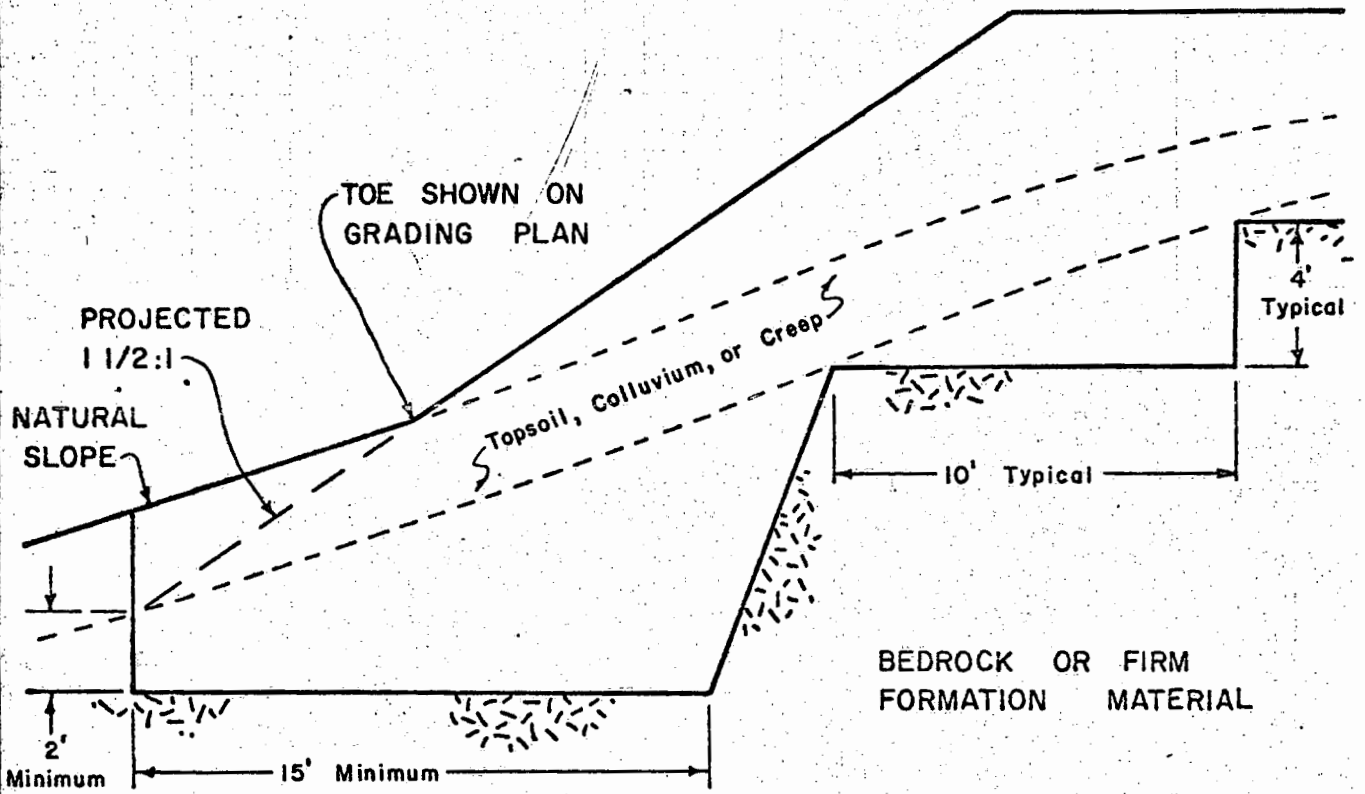
7. Supervision of Earthwork

Field density tests shall be made by the soils engineer during the earthwork operation such that he may certify that the fill was placed according to accepted specifications. In the event that field density tests of a layer or any portion thereof is less than the required density, the particular layer or portion shall be reworked until the required density is obtained.

8. Seasonal Requirements

No fill shall be placed during unfavorable weather conditions as determined by the soils engineer. After interruption of work due to heavy rain, the soils engineer shall approve previously placed fill before resumption of earthmoving operations.

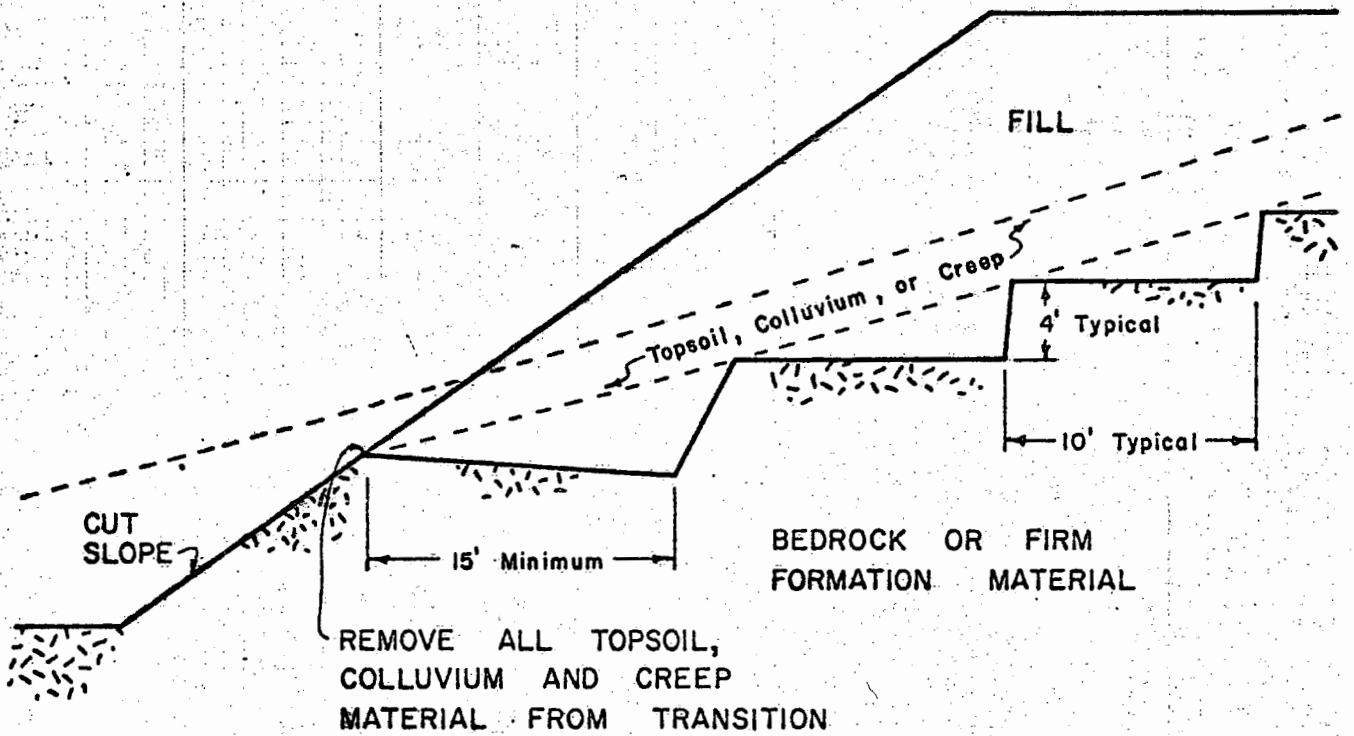
# TYPICAL FILL OVER NATURAL SLOPE



NOTE : WHERE NATURAL SLOPE GRADIENT IS 5:1 OR LESS BENCHING IS NOT NECESSARY, UNLESS STRIPPING DID NOT REMOVE ALL COMPRESSIBLE MATERIAL .

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SCALE	W.O.	
NONE		435-00

# TYPICAL FILL OVER CUT SLOPE



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NONE		435-00