PROPOSED BORROW SITE
WAIHEE VALLEY
TAX MAP KEY: 4-7-06: 1 and 8
SOIL RECONNAISSANCE REPORT

Wahee Grading

To:
R. M. TOWILL CORPORATION

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

SEPTEMBER 26, 1974
MEMORANDUM

TO: MR. R. M. TOWILL
R. M. Towill Corporation

FROM: Jerald W. Shumaker, Engineering Geologist

RE: Proposed Borrow Site
Waiehe Valley
Tax Map Key: 4-7-06: 1 and 8
Soil Reconnaissance Report

A reconnaissance of soil conditions was made at the above site for use as a borrow site.

The reconnaissance consisted of visual observations by walking the site, a review of selected soil and geologic maps and air photos and random soil samples for laboratory tests.

PROJECT SITE

Location

The proposed site is located on a ridge above the end of Waiehe Road in Waiehe Valley. Access to the site is from Waiehe Road at the eastern boundary of the site.

Topography

In general, the site is located on the northern side of Waiehe Valley about one mile from the ocean near the end of Waiehe Road.
The site is a narrow ridge that slopes down towards the ocean at about 25 to 50% gradients. The sides of the ridge slope in northerly and southerly directions at about 60 to 100% gradients with steeper slopes in localized areas.

A landslide mass is located along the southwest slope of the ridge. The upper scarp for the slide nearly reaches the top of the ridge.

A borrow site is located on the northeast slope of the ridge near Waihee Road.

Fractured, decomposed lava rock is exposed in the slide scarps and the cut slopes made for the borrow site and Waihee Roadway.

The site is generally covered with grass and brush except the slide and borrow site areas are mostly free of vegetation.

Annual Rainfall

The average annual rainfall for the area may vary from about 50 to 100 inches.

Geologic and soil descriptions by others follow:

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

Southeast slope of ridge

Pa - Consolidated noncalcareous deposits, chiefly older alluvium.
Remainder of ridge

Tkdc - Koolau volcanics, lava flows, area within rift zone (dike complex).


WpF - Waikane, silty clay, 40 to 70% slopes, erosion hazard severe.

Unified Soil Classification System - MH.

The U. S. Soil Conservation Service describes the soils in this area may be subject to severe erosion hazards from rapid storm runoff.

INTERPRETATION OF SOIL CONDITIONS

From visual observations and random soil samples at the site, soils in the area may generally be described as thin layers of silty clays over fractured, lava rock flows. Outcrops of highly fractured rock were noted in the slide area and along the cut slope for the roadway and existing borrow site.

Variations to the above soil conditions are to be expected in localized areas.

DISCUSSION AND RECOMMENDATIONS

The present plan is to excavate along the ridgeline from about the existing Waihee Road for approximately 1,100 feet up the ridge.
Portions of the site were formerly used as a borrow area. Materials taken from the toe of slope have undercut the support for soils on the sidehill. Soils on the slope have slid down and have left scars in the natural hillside.

The proposed borrow site in effect will lower the ridge, remove the uphill or potential slide material and flatten the toe of slope to increase the stability of the slope.

Grading work should be done in accordance with the requirements of the Revised Ordinances of Honolulu, 1969 As Amended. Other guidelines and recommendations for preliminary design considerations are given below:

**Cut Slopes**

The existing slopes along the ridge are fairly steep (60 to 100% or more).

Along the upper grading limits (above about elevation 500), a slope ratio of about 1-1/2 horizontal to 1 vertical or flatter is recommended. Below elevation 500, slope ratios of about 2 horizontal to 1 vertical or flatter should be used. In general, the overall average slope should be flatter than 2-1/2 or 3 to 1.

The grading plan, April 16, 1971, for this project more or less follows these guidelines. The grading plan indicates cuts up to about 120 ft deep. The proposed finished slopes will slope down towards Waihee Road at about 15 to 50% gradients.

The proposed ridge will be cut to the following slopes:

<table>
<thead>
<tr>
<th>Elevations</th>
<th>Slopes</th>
</tr>
</thead>
<tbody>
<tr>
<td>160 to 200 ft</td>
<td>7:1</td>
</tr>
<tr>
<td>200 to 425 ft</td>
<td>2-1/2:1</td>
</tr>
<tr>
<td>425 to 500 ft</td>
<td>2:1</td>
</tr>
<tr>
<td>500 to 590 ft</td>
<td>1-1/2:1</td>
</tr>
</tbody>
</table>

The Grading Ordinance of the City requires benches along the slope. If benches are not used, the slopes should be gradually flattened to build up resistive forces at the toe of slope.
Contour drains and planting will be required to stabilize the ground surface and minimize erosion. Surface runoff may be collected in ditches contoured along the finished slopes. Ground cover should be planted to lessen the erosion hazard.

Siltling ponds or other measures may be required if large areas are opened up by the construction operations which may create potential silt problems.

Some boulders, decomposed to fresh lava rock, may be anticipated in the deeper excavations. Should blasting be required, it should be done with care because of the close proximity of the soil screening operations going on at the present time near the southern limits of the site.

Unforeseen Conditions

Because of the variability of soil deposits, site improvements, designs 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, voids or cavities, 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.

Site Regrading

After the grading work is done and cuts are made according to the grading plan, regrading at some future date should be avoided unless done under the guidance of a soils engineer.
MR. R. M. TOWILL, September 26, 1974

Liability Insurance Coverage

R. M. Towill Corporation and the soil engineer should be included in the Contractor's general liability insurance to save R. M. Towill Corporation and its consultants harmless in case a claim should arise from the construction and/or blasting operations.

Attached is the Location Sketch, laboratory test results and limitations.

Respectfully submitted,

WALTER LUM ASSOCIATES, INC.

By

Jerald W. Shumaker
## Table Ia - Summary of Laboratory Test Results

<table>
<thead>
<tr>
<th>BORING NO.</th>
<th>SAMPLE NO.</th>
<th>DEPTH BELOW SURFACE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>MOTTLED BROWN DECOMPOSED ROCK (SOME CRUSHED TO CLAYEY SILT)</td>
</tr>
</tbody>
</table>

### Grain-Size Analysis (% Passing)

<table>
<thead>
<tr>
<th>Sieve</th>
<th>&quot;A&quot;</th>
<th>&quot;B&quot;</th>
<th>&quot;C&quot;</th>
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</thead>
<tbody>
<tr>
<td>1&quot;</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>1/2&quot;</td>
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<tr>
<td>#200</td>
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</table>

### Atterberg Limits

<table>
<thead>
<tr>
<th>Category</th>
<th>&quot;A&quot;</th>
<th>&quot;B&quot;</th>
<th>&quot;C&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Dried or Natural Liquid Limit</td>
<td>81</td>
<td>81</td>
<td>97</td>
</tr>
<tr>
<td>Plastic Limit</td>
<td>53</td>
<td>51</td>
<td>51</td>
</tr>
<tr>
<td>Plasticity Index</td>
<td>28</td>
<td>30</td>
<td>26</td>
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### Unified Soil Classification

<table>
<thead>
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<th>&quot;A&quot;</th>
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<th>&quot;C&quot;</th>
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<tbody>
<tr>
<td>MH</td>
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### Apparent Specific Gravity

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### CBR Test

| (Surcharge-5 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-180-731, Method) Dry to Wet or Wet to Dry Max. Dry Density (P.C.F.) Optimum Moisture (%) |     |     |     |

### Remarks:

Date: 3-20-74  By: [Signature]
PLASTICITY CHART

PROJECT: PROPOSED BORROW SITE
LOCATION: WAIHEE VALLEY, OAHU, HAWAII

PLASTICITY INDEX

"A" LINE

CL - ML  ML  CH  MH 8  OH

LIQUID LIMIT

DATE 9-30-74  BY

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

In general, soil formations are commonly erratic and rarely uniform or regular. The location sketch indicates the approximate surface soils generally noticed during on-site field observations. Soil conditions and water levels may change with the passage of time and construction methods or improvements at the site.

If there is a substantial lapse of time between the submission of this report, 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 and the changed conditions.

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.