SOILS AND FOUNDATION INVESTIGATION
PROPOSED HALELOA UNIT 2 DEVELOPMENT
KULIOUOU, OAHU, HAWAII

FOR
COMMUNITY SYSTEMS CORPORATION

Dames & Moore Job No. 6378-001-11

MUNICIPAL REFERENCE RECORDS CENTER
City & County of Honolulu
City Hall Annex 550 S. King Street
Honolulu, Hawaii 96813
Community Systems Corporation  
1655 Makaloa Street  
Honolulu, Hawaii  96814

Attention: Mr. Paul Yamada

Gentlemen:

Four copies of our report, "Soils and Foundation Investigation, Proposed Haleloa Unit 2 Development, Kuliouou, Oahu, Hawaii, for Community Systems Corporation", are hereby submitted in accordance with our proposal dated December 6, 1973.

Selected soil samples were used in laboratory testing, and the remaining samples will be kept for a period of six months from this date in case subsequent examination is necessary.

We have appreciated the opportunity to serve you on this project. If you have any questions regarding this report, please contact us.

Yours very truly,

DAMES & MOORE

Mei-Ban Lo

MBL:RGH:gn
INTRODUCTION

GENERAL

This report presents the results of our soils and foundation engineering investigation for the above project.

The investigation included a review of the "Preliminary Soil Report" dated June 14, 1971 by Walter Lum Associates, Inc., a geological reconnaissance, subsurface borings, excavation inspection, laboratory testing and engineering analyses as outlined in our proposal dated December 6, 1973. Three progress reports with preliminary recommendation have been previously submitted to expedite design.

The purpose of this report is to provide site grading and foundation design information based on the existing site conditions and proposed development.

A Site Plan showing the approximate boring locations and other pertinent information is presented on...
Plate 2. A summary of our field investigation, laboratory testing and the results are presented in the Appendices.

PROJECT CONSIDERATIONS

The site is located on approximately 3.7 acres of land at the base of the west slope of Kuliouou Ridge at the end of Omealani Street in Kuliouou Valley, Oahu, Hawaii. The property is bounded by Kuliouou Stream on the west and the eastern boundary is approximately 250 feet east of the stream and runs parallel to it. The property is approximately 850 feet long in the north-south direction with the extension of Omealani Street approximately at the middle of the site. The general location of the site is shown on the Map of Area, Plate 1.

The proposed development includes six 3-story residential structures, a CRM retaining wall, parking and roadway facilities and utilities. The structures will be masonry block wall buildings with wall loads of approximately nine kips per lineal foot.

The site grading and retaining wall construction was completed prior to our involvement on the project.

SITE CONDITIONS

SURFACE CONDITIONS

The mass grading of the site has generally
been completed and consisted of cuts on the uphill portion of the property (to approximate Elevation +70 feet) and embankment fills on the downhill portion. The existing retaining wall, which runs the length of the property appears to have been constructed without a footing. The wall had not been backfilled, however, slope wash from above has filled the area behind the wall with erosional materials consisting of mainly clays and silts.

The natural slopes on the site vary from approximately 7 horizontal:1 vertical to 1 horizontal:1 vertical. Immediately above the site, steeper slopes rise to an elevation of +450 feet. This steeper area is formed in basalt with near vertical cliffs from 2 to 20 feet high. Loose boulders and talus piles litter these upper slopes.

**GEOLOGY**

The site is located in the southeastern portion of Oahu on the east side of Kulauou Valley. The valley was formed by erosion into the south flank of the Koolau Shield Volcano.

Sea level changes resulted in filling of the valley with marine sediments from coral-algal reefs and land derived sediments. Subsequent tropical weathering and erosion resulted in alluvial and colluvial clay, silt and boulders being deposited at the base of the slopes forming the valley walls.
A long period of volcanic inactivity was followed by eruptions of the Honolulu Volcanic Series. These eruptions blanketed the area with cinders and ash. Slope wash mixed the cinders and ash into the clays, silts and boulders and subsequent consolidation and cementation has produced a weak conglomerate. This conglomerate is overlain by a thin layer of black to dark grey, adobe-type expansive clay and silt and boulder mixture.

**SUBSURFACE CONDITIONS**

The area investigated may generally be divided into three areas for the purpose of discussion. (See Site Plan, Plate 2)

**Area "A"** generally covers the upper portion of the site and consists mainly of hard jointed, vesicular basalt outcrops which extend approximately from Elevation +80 feet to the crest of the slope of Elevation +450 feet. The basalt forms a "stairstep" topography with near vertical cliffs from 2 to 20 feet high. The average slope in this area is approximately 1 horizontal:1 vertical. Loose boulders and talus are present on these slopes.

**Area "B"** includes coalescing alluvial deposits composed of expansive clay, silt and boulders, and recently graded cut slopes from 3 horizontal:1 vertical to 1½ horizontal:1 vertical. This area is approximately between Elevations +45 feet to +80 feet. A gray-brown layer of
silty, sandy clay and boulders, approximately three feet thick, covers most of Area "B". A tan, dense to hard, moderately cemented silty clay and boulder conglomerate underlies the above material.

This area was previously covered by one to three feet of dark gray to black, expansive silty clay and boulders as evidenced by the exposed material at the top of the cut. Erratic deposit of expansive clayey silt to silty clay, adobe-type material, was observed in the colluvium.

The surface of this area was being rapidly eroded and erosional gullies as deep as three feet were observed during our investigation.

Area "C" generally covers the area between the existing CRM retaining wall and Kuliouou Stream. This area is covered by approximately 2 to 12 feet of gray, expansive, clay and silt fill with boulders. Underlying the fill, a gray-brown, clay and silt with boulders was encountered. This deposit varied from approximately 7 to 16 feet thick and consists generally of stream deposits and slope wash. Beneath this material a white coralline gravel debris mixed with land derived sediments was disclosed. These materials are partially cemented in some areas and usually fairly dense. All of the borings terminated in or above this stratum.
Groundwater was not encountered in any of the borings. Some seepage water was observed in the upper two feet of Boring 6. This water appeared to be the result of rainfall runoff, and it was easily sealed off.

CONCLUSIONS AND RECOMMENDATIONS

Based on the results of our review of the "Preliminary Soil Report", field investigation, laboratory testing and engineering analyses, the following conclusions and recommendations are presented.

GENERAL

The exploration program disclosed generally variable subsurface conditions across the site. In the area of the proposed structures, highly expansive soils (both fill and natural ground) were encountered.

The site has been graded and a CRM retaining wall constructed prior to our involvement on the project. The construction which has been performed is not in compliance with the recommendations in the "Preliminary Soil Report".

Generally, the recommendations presented in the "Preliminary Soil Report" by Walter Lum & Associates, Inc. are sound and reasonable, and those recommendations should be followed unless specifically superceded herein.
From a soils and foundation engineering viewpoint, the site could be developed provided that the recommendations are followed. With proper site preparation, remedial work and construction methods, deep spread footings and/or pier foundations can be utilized to support the proposed structures. Slab-on-grade construction is not recommended.

SITE PREPARATION AND REMEDIAL WORK

Rock and Boulder Removal - The numerous large boulder and talus piles which were observed on the ungraded steep slopes above the site are a potential hazard to the proposed structures below. We recommend that a boulder stabilization program be implemented prior to construction. Any loose boulders or talus piles which are close to the edge of rock terraces and/or are in a relatively unstable position should be stabilized by rolling them down the hill; stabilized in place with rock bolts, cables, or grout; or moving them back to a more stable position on the terrace. If this work is conscientiously performed, then the boulders should not constitute a significant hazard at the site.

An alternative means of providing protection would be the utilization of a boulder barrier. A well designed boulder barrier consisting of chain link fence
with additional reinforcing should be satisfactory. The top of the existing CRM wall would be the ideal location for installation of the proposed barrier.

**Erosion Protection** - In general, all cut and fill slopes should be protected from erosion. This can be accomplished by interceptor ditches, where necessary, and planting of the slopes with appropriate vegetation. Where erosion damage has already occurred, the areas should be repaired prior to planting. We recommend that a protective plant cover be established as soon as possible.

The proposed drainage structures shown on the plan as Lined Ditch No. 1 and Lined Ditch No. 2 are immediately below two alluvial fans which presumably extended downslope prior to grading. The alluvial fans contain multiple, radiating drainage channels, and are much wider than the proposed ditches. We recommend that the lined ditches be supplemented by lateral interceptor ditches which would run transversely across the slope beneath the alluvial fans, and drain into the lined ditches. The upper end of the interceptor ditches should begin near the limit of grading, and intersect the proposed lined ditch. The gradient of the interceptor ditch should be greater than 1½ percent to preclude ponding and saturation of the slope below the ditch.
Excavations - The existing 3 horizontal:1 vertical cut slope, which was graded prior to our work on this project, should remain stable without benching provided it is adequately protected from erosion damage.

Permanent cut slopes should be no steeper than 3 horizontal:1 vertical. Any additional grading on the site must be reviewed and approved by the soils engineer prior to commencing work.

Temporary cut slope for footing and utility excavations having the following maximum slopes may be utilized.

<table>
<thead>
<tr>
<th>Material</th>
<th>Maximum Temporary Slope</th>
</tr>
</thead>
<tbody>
<tr>
<td>brown clay and silt with boulders (natural ground)</td>
<td>½ horizontal:1 vertical</td>
</tr>
<tr>
<td>brown clay and silt with boulders (fill)</td>
<td>1 horizontal:1 vertical</td>
</tr>
</tbody>
</table>

All temporary excavations should be in accordance with the governing safety standards. Safety of temporary excavation should be made the contractor's responsibility since he is present at the site and can observe any changes in conditions and materials.

Unsupported Fill - Unsupported fills have been placed on the lower portion of the site to provide level pads for building construction. The fill material appears to be a heterogeneous mixture of clay, silt, sand and boulders. The clay and silt have a high expansive potential.
The conditions of the original ground prior to filling, the type of material used, and the method of fill placement apparently were not inspected and/or tested during construction. This precludes the use of these existing fill embankments for supporting the proposed structures.

**Structural Fill Placement** - Structural fills should consist of approved fill materials placed in maximum 8-inch lifts and compacted to 90 percent relative compaction (85 percent for expansive materials) using ASTM D-1557-70 as a standard. Areas to receive structural fills must be cleared, grubbed and stripped of all deleterious material, including old fill material. The areas should be scarified and recompacted prior to placing fills. Any local soft areas should be removed and replaced with compacted structural fill.

Fills on existing hillsides should be keyed into firm natural ground at the toe and benched into the hillside as the fills are brought up.

Fill slopes should be no steeper than 2 horizontal: 1 vertical and should be compacted to the required density by backrolling with the compaction equipment. Slope compaction should be accomplished progressively after every three foot (vertical) increment of fill has been placed. The fill slopes should be adequately protected from erosion.
All structural fills must be inspected and tested prior to and during construction by the soils engineer.

FOUNDATIONS

The existing in-place fill material, which consists of a heterogeneous mix of soft, highly expansive, clay and silt matrix with varying sizes of boulders and cobbles, is unsuitable for providing foundation or floor slab support. This material was apparently placed on an existing sloping ground surface, and is subject to downhill movement and erratic settlements.

There are basically two solutions regarding foundation and slab support for the proposed structures, deep foundations and compacted structural fills.

Deep Foundations - We recommend that the structures, including the ground floor slab, be supported on deep foundations extending through the existing fill and into firm natural ground. These footings should be designed for an allowable bearing pressure of 4,000 pounds per square foot. The structural design should be such that the maximum loads are imposed on the footings. The foundations must extend at least 18 inches into firm natural ground and must have a minimum soil cover of 4 feet.

The foundation must be designed to resist a downhill lateral load of 1,000 pounds per square foot.
by the existing fill. This load must be applied to all areas of the structure resisting downhill movement.

The ground floor slab for this alternate must be a structural, raised floor system with a minimum clear distance of 12 inches between the slab and ground surface.

Pier foundations were studied, however, this foundation system does not appear to be economically feasible. Based on the available subsurface information, bearing capacities greater than 4,000 pounds per square foot should not be utilized. This would result in relatively large piers with relatively small spacing.

Pile foundations are not considered practical due to the large boulders present both in the fill and natural ground. Driving piles would probably require predrilling. Also, the subsurface borings were not deep enough to provide sufficient information for a pile foundation system.

**Compacted Structural Fill** - As an alternate to deep foundations, removal of the existing heterogeneous fill material, and replacement with a properly keyed and benched, compacted structural fill could be utilized to support the proposed structures.

Continuous footings and floor slabs could then be supported on the structural fill in accordance with the recommendations presented in the "Preliminary Soil Report".

The existing fill is subject to downhill movements and erratic settlements and expansion. Therefore, we do
not recommend the use of a prestressed mat foundation on the existing fill material as a means of supporting the structures.

LATERAL EARTH PRESSURES

Observations made during our field investigation indicate that the recently constructed CRM retaining wall has not been properly constructed. The wall appears to be founded on the expansive surface materials without an actual footing. The excavation behind the wall has been filled with expansive materials washed down from the cut slopes above. A number of areas along the wall also appeared to have material eroded away from beneath the base of the wall. The wall did not appear to be reinforced and signs of distress (cracks along the top of the wall) were observed. It is our understanding that this wall has been designed for an equivalent fluid pressure of 50 pounds per cubic foot.

It is our recommendations that the wall be removed and reconstructed. The wall should be designed for an equivalent fluid pressure of 90 pounds per cubic foot and should have a minimum of 2 feet of non-expansive material behind the wall. The foundation requirements for the retaining walls should be in accordance with our foundation recommendations.

If the above recommendations are not economically feasible, then the following suggestions are made to improve the existing conditions.
Starting two feet from the base of the wall and extending uphill on a 1 horizontal to 1 vertical slope, all material should be removed from behind the wall. This prism should then be replaced with a loosely compacted 85 percent compaction-free draining granular material. Adequate outlet for drainage should be provided within the wall to preclude the possibility of hydrostatic pressures. The upper six to eight inches of material should consist of a non-expansive impermeable material. This area should be graded with a swale at least 12 inches away from the wall to remove runoff water and prevent ponding behind the wall (see Plate 3). The design pressures of 50 pounds per cubic foot would be adequate for these conditions.

However, Dames & Moore cannot evaluate the performance of this existing retaining wall because the foundation conditions were not observed prior to construction, and also, because the foundation for the wall is not in accordance with the recommendations for foundations to support structures.

Resistance to lateral forces can be obtained by using passive earth pressures and frictional resistance. An equivalent fluid pressure of 200 pounds per cubic foot may be used for design in natural ground or compacted structural fill, however, the surface 12 inches should be neglected in the calculations. A frictional coefficient of 0.3 may be used between concrete and the natural ground or compacted structural fill.

DAMES & MOORE
The following Plates and Appendices are attached and complete this report.

Plate 1 - Map of Area
Plate 2 - Site Plan
Plate 3 - Suggested Retaining Wall Details
Appendix A - Field Exploration
Appendix B - Laboratory Testing

Respectfully submitted,

DAMES & MOORE

Mai-Ban Lo
Associate

[Stamp: Registered Professional Engineer, No. 2547]

This work was prepared by Mai or under my supervision.

DAMES & MOORE
SUGGESTED RETAINING WALL DETAILS

(FOR IMPROVED PERFORMANCE OF EXISTING STRUCTURE)
APPENDIX A

FIELD EXPLORATION

The surface conditions at the site were investigated by performing a geological reconnaissance which included mapping pertinent geologic conditions and hazards that may affect the area. This phase was performed by an engineering geologist from our firm. Field mapping was done on a base map of 1 inch equals 20 feet. Geomorphology, potential rock and slope slides and falls, and various soil types were mapped during this phase of the work. This work began on December 7, 1973, and was completed on December 24, 1973. The work was delayed for approximately one week by heavy rains.

The subsurface conditions at the site were investigated by drilling 10 borings, ranging from 17 to 25 feet in depth. The drilling was performed by a subcontractor, Continental Drilling Company, utilizing truck-mounted B-61, B-51, and skid-mounted Boyles Hydraulic drill rigs. This equipment uses rotary wash methods or augers to advance the hole.

Relatively undisturbed and disturbed samples of the subsurface materials were recovered using the Dames & Moore Type U Sampler shown on Exhibit A-1. The sampler
was advanced with a 300 pound weight falling 30 inches. Drilling operations were performed under the direction of an engineering geologist from our firm who assisted in obtaining samples of the subsurface materials. Our representative maintained a log of each boring and made observations pertinent to the proposed development. All samples were classified according to the Unified Soil Classification System, which is described on Exhibit A-2. The approximate boring locations are shown on the Site Plan, Plate 2, and the Log of Borings are presented on Plates A-1 through A-10.

Shallow subsurface conditions at the site were investigated by observing the excavation of several utility trenches through the lower portions of the site. The trenching operations were done utilizing a crane-mounted backhole from Okada Trucking Company, Ltd., who had a contract with the owner. Several disturbed bulk samples were taken by our engineering geologist for subsequent examination and possible laboratory testing. The log of the trench excavations is presented on Plate A-11.
- A3 -

The following Exhibits and Plates are attached and complete Appendix A.

**Exhibit A-1** - Dames & Moore Type U Sampler

**Exhibit A-2** - Unified Soil Classification System

**Plate A-1** - Log of Boring 1

**Plate A-2** - Log of Boring 2

**Plate A-3** - Log of Boring 3

**Plate A-4** - Log of Boring 4

**Plate A-5** - Log of Boring 5

**Plate A-6** - Log of Boring 6

**Plate A-7** - Log of Boring 7

**Plate A-8** - Log of Boring 8

**Plate A-9** - Log of Boring 9

**Plate A-10** - Log of Boring 10

**Plate A-11** - Log of Trench Excavations
SOIL SAMPLER TYPE U
FOR SOILS DIFFICULT TO RETAIN IN SAMPLER

NOTE:
"HEAD EXTENSION" CAN BE INTRODUCED BETWEEN "HEAD" AND "SPLIT BARREL"
### SOIL CLASSIFICATION CHART

#### MAJOR DIVISIONS

<table>
<thead>
<tr>
<th>MAJOR DIVISIONS</th>
<th>GRADE SYMBOL</th>
<th>LETTER SYMBOL</th>
<th>TYPICAL DESCRIPTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>GRAVEL AND GRAVELY SOILS</td>
<td>GR</td>
<td>GM</td>
<td>Coarse sands, gravel, and sand, little or no fines</td>
</tr>
<tr>
<td>COARSE GRAINED SOILS</td>
<td>GW</td>
<td>GM</td>
<td>Well graded sands, gravel, and sand, little or no fines</td>
</tr>
<tr>
<td>SAND AND SANDY SOILS</td>
<td>SW</td>
<td>SM</td>
<td>Clean sand, little or no fines</td>
</tr>
<tr>
<td>SANDY SOILS</td>
<td>SW</td>
<td>SM</td>
<td>Clean sand, little or no fines</td>
</tr>
<tr>
<td>SILT AND CLAYS</td>
<td>ML</td>
<td>MH</td>
<td>Argillaceous silts and clays, very fine sands, or silts with a clay matrix</td>
</tr>
<tr>
<td>FINE GRAINED SOILS</td>
<td>ML</td>
<td>MH</td>
<td>Argillaceous silts and clays, very fine sands, or silts with a clay matrix</td>
</tr>
<tr>
<td>FINE CLAYS</td>
<td>OL</td>
<td>CH</td>
<td>Organic silts and clays, very fine sands, or silts with a clay matrix</td>
</tr>
<tr>
<td>CLAY</td>
<td>OL</td>
<td>CH</td>
<td>Organic silts and clays, very fine sands, or silts with a clay matrix</td>
</tr>
<tr>
<td>HIGHLY ORGANIC SOILS</td>
<td>PT</td>
<td>PT</td>
<td>Peaty, mucky, swamp soils with high organic contents</td>
</tr>
</tbody>
</table>

#### NOTES

1. GRADE SYMBOLS ARE USED TO IDENTIFY BORDON LINE CLARIFICATIONS.
2. GRADE SYMBOLS FOR THE CLASSIFICATIONS FOLLOWING TERMS ARE USED TO DESCRIBE THE CONSISTENCY OF COHESIVE SOILS AND THE RELATIVE COMPACTNESS OF NONCOHESIVE SOILS.

### UNIFIED SOIL CLASSIFICATION SYSTEM

- **CLAY**
  - **CH**
  - **CL**
  - **OL**
  - **ML**
  - **MH**
  - **OH**

### GRADATION CHART

#### PARTICLE SIZE

- **SAND**
  - **GC**
  - **GM**
  - **GT**

- **Silty沙d**
  - **GSP**
  - **GSM**
  - **GSPT**

#### MATERIAL SIZE

- **COBBLES**
  - **76.2 mm**
  - **3.00 mm**
  - **1.91 mm**
  - **0.76 mm**

- **BOULDERS**
  - **950 mm**
  - **191 mm**
  - **314 mm**

#### LIQUID LIMIT

- **CH**
- **CL**
- **OL**
- **ML**
- **MH**
- **OH**

### PLASTICITY CHART

- **SAND**
  - **GC**
  - **GM**
  - **GT**

- **Silty Sand**
  - **GSP**
  - **GSM**
  - **GSPT**

- **CLAY**
  - **ML**
  - **OL**
  - **MH**
  - **OH**

### SAMPLES

- **DISKED AND STANDING SAMPLE**
- **DISKED COMMINUTED**
- **DISKED SAMPLES STIRRING WITH PT RECOVERY**
- **DISKED LIMITS OF COMINUTED**

### UNIFIED SOIL CLASSIFICATION SYSTEM

- **CLAY**
  - **CH**
  - **CL**
  - **OL**
  - **ML**
  - **MH**
  - **OH**

### UNIFIED SOIL CLASSIFICATION SYSTEM

**DAMES & MOORE**
### Log of Borings

**BOARING 1**

#### Surface Elevation
31.0 Feet
MSL Datum

#### Description
- **Dark Grayish Brown Clayey Silt, Soft, with Sand, Gravel and Boulders, Fill (Expansive)**
- **Dark Brown Gravelly Silt, Hard, Containing Gravel and Boulders (Expansive)**
- Boulders grade out
- Grading to very stiff
- Grading with occasional gravel lenses
- Mottled Brown Sandy Silt, Very Stiff (Decomposed Alluvium)
- White Sand and Gravel Coral, Medium Dense, in a Brown Silt Matrix (Alluvium)
- Dark Brown Sandy Gravelly Silt, Hard (Expansive)

#### Boring Completed
- At 25.0 feet on 12-11-73
- Water level not encountered

#### Notes:
- **•** Depth at which undisturbed sample was taken
- **○** Depth at which disturbed sample was taken
- **□** Depth at which sample was lost during extraction
- **I** Depth and length of core run
- **Driving Energy - 300-lb weight dropping 30 inches**

---

### Table

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Moisture Content (%)</th>
<th>Dry Density (pcf)</th>
<th>Blows/ft. on sampler</th>
<th>Core and % Recovery</th>
<th>Depth in Feet</th>
<th>Graph Symbol</th>
<th>Letter Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>90</td>
<td>3/3&quot;</td>
<td>22</td>
<td>MH</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>39</td>
<td>81</td>
<td>24</td>
<td>22</td>
<td>MH</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>80</td>
<td>10</td>
<td>22</td>
<td>MH</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>44</td>
<td>78</td>
<td>15</td>
<td>22</td>
<td>MH</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>39</td>
<td>82</td>
<td>42</td>
<td>22</td>
<td>SM-GM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>45</td>
<td></td>
<td>20</td>
<td>22</td>
<td>MH</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>45</td>
<td></td>
<td>15</td>
<td>22</td>
<td>MH</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**BORING 1**

---
BORING 2

Surface Elevation 33.5 Feet
MSL Datum

Description

<table>
<thead>
<tr>
<th>Depth in Feet</th>
<th>Graph Symbol</th>
<th>Letter Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>MH</td>
<td>MH</td>
<td>Grayish brown silt, medium stiff, with sand and gravel, fill (expansive) grading with boulders and cobbles</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td>Grayish brown clayey silt, medium stiff</td>
</tr>
<tr>
<td>15</td>
<td>GP</td>
<td></td>
<td>White coral gravel mixed with brown silt, medium dense</td>
</tr>
<tr>
<td>20</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Boring completed at 21.5 feet on 12-19-73
Water level not encountered

LOG OF BORINGS

NOTES:

- Depth at which undisturbed sample was taken
- Depth at which disturbed sample was taken
- Depth at which sample was lost during extraction
- Depth and length of core run

Driving Energy - 300-lb weight dropping 30 inches
<table>
<thead>
<tr>
<th>Depth in Feet</th>
<th>Graph Symbol</th>
<th>Core and Recovery Samples and/or Cores</th>
<th>Blows/Ft. on Sampler</th>
<th>Dry Density inpcf</th>
<th>Moisture Content in %</th>
<th>Letter Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**LOG OF BORINGS**

**NOTES:**

- Width at which undisturbed sample was taken
- Width at which disturbed sample was taken
- Width at which sample was lost during extraction
- Width and length of core run
- Driving Energy - 300-lb weight dropping 30 inches

**Surface Elevation**: 32.8 Feet
**MSL Datum**

**Boring completed at 20.0 feet on 12-20-73**

**Water level not encountered**
<table>
<thead>
<tr>
<th>Depth in Feet</th>
<th>Letter Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>15/6&quot;</td>
<td>MH</td>
<td>BROWN SANDY GRAVELLY CLAYEY SILT, MEDIUM STIFF, FILL GRADING WITH COBBLES</td>
</tr>
<tr>
<td>11</td>
<td>MH</td>
<td>BROWN CLAYEY SILT, STIFF</td>
</tr>
<tr>
<td>11</td>
<td>C</td>
<td>GRADING WITH SOME GRAVEL</td>
</tr>
<tr>
<td>15/6&quot;</td>
<td>MH</td>
<td>BROWN CLAYEY SILT, VERY STIFF (DECOMPOSED ALLUVIUM) GRADING WITH BOULDERS</td>
</tr>
</tbody>
</table>

Boring completed at 15.0 feet on 11-20-73. Water level not encountered.

LOG OF BORINGS

NOTES:

- Depth at which undisturbed sample was taken
- Depth at which disturbed sample was taken
- Depth at which sample was lost during extraction
- Depth and length of core run

Driving energy - 300-lb weight dropping 30 inches
## BORING 5

<table>
<thead>
<tr>
<th>Depth in Feet</th>
<th>Graph Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>42</td>
<td>MH</td>
<td>Brown gravelly clayey silt, very stiff, fill grading with boulders</td>
</tr>
<tr>
<td>46</td>
<td>MH</td>
<td>18&quot; boulder</td>
</tr>
<tr>
<td>46</td>
<td>MH</td>
<td>Brown gravelly clayey silt, very stiff grading to very brown with some sand</td>
</tr>
<tr>
<td>21</td>
<td>SM</td>
<td>White silty gravelly sand, dense, coralline debris grading to no gravel</td>
</tr>
<tr>
<td>38</td>
<td></td>
<td></td>
</tr>
<tr>
<td>26/8&quot;</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NOTES:**
- Depth at which undisturbed sample was taken
- Depth at which disturbed sample was taken
- Depth at which sample was lost during extraction
- Depth and length of core run

**Driving Energy:** 300-lb weight dropping 30 inches

**Surface Elevation:** 36.5 feet MSL Datum

**Boring completed at 17.0 feet on 12-20-73
Water level not encountered**
## LOG OF BORINGS

<table>
<thead>
<tr>
<th>DEPTH</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>WHITE SILTY GRAVELY SAND, MEDIUM DENSE, CORALLINE DEBRIS</td>
</tr>
<tr>
<td>28/9&quot;</td>
<td>BUBBLE</td>
</tr>
<tr>
<td>15</td>
<td>BROWN SANDY CLAYEY SILT, STIFF (ALLUVIUM)</td>
</tr>
<tr>
<td>10</td>
<td>TRACE OF SEEPAGE WATER</td>
</tr>
<tr>
<td>5</td>
<td>GRADING WITH OCCASIONAL COBBLES</td>
</tr>
<tr>
<td>0</td>
<td>BROWN CLAYEY SILT, STIFF, FILL</td>
</tr>
<tr>
<td>19</td>
<td>BROWN SILTY SANDY GRAVEL, DENSE (CRUSHED ROCK FILL)</td>
</tr>
<tr>
<td>40.0 FEET</td>
<td>SURFACE ELEVATION</td>
</tr>
<tr>
<td>MSL DATUM</td>
<td></td>
</tr>
</tbody>
</table>

### NOTES:
- Depth at which undisturbed sample was taken
- Depth at which disturbed sample was taken
- Depth at which sample was lost during extraction
- Depth and length of core run

Driving energy: 300-lb weight dropping 30 inches

Boring completed at 20.0 feet on 12-20-73.

Water level not encountered.
LOG OF BORINGS

-DEPTH AT WHICH UNDISTURBED SAMPLE WAS TAKEN
-DEPTH AT WHICH DISTURBED SAMPLE WAS TAKEN
-DEPTH AT WHICH SAMPLE WAS LOST DURING EXTRACTION
-DEPTH AND LENGTH OF CORE RUN
DRIVING ENERGY = 300 -LB WEIGHT DROPPING 30 INCHES
BORING 8

Surface Elevation 65.0 Feet
MSL Datum

<table>
<thead>
<tr>
<th>Depth in Feet</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-10</td>
<td>MH Grayish brown clayey silt, stiff, containing cobbles (colluvium)</td>
</tr>
<tr>
<td>10-15</td>
<td>MH Grading with cobbles</td>
</tr>
<tr>
<td>15-20</td>
<td>MH Grayish brown clayey silt (alluvium) and boulders</td>
</tr>
<tr>
<td>20-25</td>
<td>MH Grading to very stiff and no boulders</td>
</tr>
<tr>
<td>25-30</td>
<td>MH Grading with occasional cobbles</td>
</tr>
<tr>
<td>30</td>
<td>MH Grading with a trace of clay</td>
</tr>
</tbody>
</table>

Red brown silt, hard

Boring completed at 20.0 feet on 12-26-73
Water level not encountered

LOG OF BORINGS

NOTES:
- Depth at which undisturbed sample was taken
- Depth at which disturbed sample was taken
- Depth at which sample was lost during extraction
- Depth and length of core run

Driving Energy - 300 - lb weight dropping 30 inches
<table>
<thead>
<tr>
<th>DEPTH</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5</td>
<td>Grayish brown clayey silt, medium stiff, with cobbles and boulders grading with many closely spaced cobbles</td>
</tr>
<tr>
<td>5-10</td>
<td>Graying with many cobbles and boulders</td>
</tr>
<tr>
<td>10-15</td>
<td>36&quot; boulder</td>
</tr>
</tbody>
</table>

Boring completed at 19.0 feet on 12-28-73. Water level not encountered.

**LOG OF BORINGS**

- Depth at which undisturbed sample was taken
- Depth at which disturbed sample was taken
- Depth at which sample was lost during extraction
- Depth and length of core run

Driving energy - 300-lb weight dropping 30 inches
**BORING 10**

**Surface Elevation 58.0 Feet**
**MSL Datum**

<table>
<thead>
<tr>
<th>Moisture Content in %</th>
<th>Dry Density in Pcf</th>
<th>Blows/Ft. on Sampler</th>
<th>Core and % Recovery</th>
<th>Samples and/or Cores</th>
<th>Depth in Feet</th>
<th>Graph Symbol</th>
<th>Letter Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>MH</td>
<td></td>
</tr>
<tr>
<td></td>
<td>45</td>
<td></td>
<td></td>
<td></td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>31</td>
<td></td>
<td></td>
<td></td>
<td>10</td>
<td>ML</td>
<td></td>
</tr>
<tr>
<td></td>
<td>55/1'</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Boring completed at 11.5 feet on 1-9-74*
*Water level not encountered*

**Description**

- Brown sandy silt, soft (colluvium) grading to very stiff
- Grading with gravel and cobbles
- Brown sandy silt, very stiff
- Basalt boulders

**LOG OF BORINGS**

**Notes:**
- Depth at which undisturbed sample was taken
- Depth at which disturbed sample was taken
- Depth at which sample was lost during extraction
- Depth and length of core run
- Driving energy - 300-lb weight dropping 30 inches
<table>
<thead>
<tr>
<th>TRENCH 1(L)</th>
<th>TRENCH 1(M)</th>
<th>TRENCH 1(H)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Surface Elevation</strong></td>
<td><strong>Surface Elevation</strong></td>
<td><strong>Surface Elevation</strong></td>
</tr>
<tr>
<td>32 Feet</td>
<td>37 Feet</td>
<td>32 Feet</td>
</tr>
<tr>
<td><strong>Graph Symbol</strong></td>
<td><strong>Graph Symbol</strong></td>
<td><strong>Graph Symbol</strong></td>
</tr>
<tr>
<td><strong>Depth in Feet</strong></td>
<td><strong>Depth in Feet</strong></td>
<td><strong>Depth in Feet</strong></td>
</tr>
<tr>
<td><strong>Letter Symbol</strong></td>
<td><strong>Letter Symbol</strong></td>
<td><strong>Letter Symbol</strong></td>
</tr>
<tr>
<td><strong>Description</strong></td>
<td><strong>Description</strong></td>
<td><strong>Description</strong></td>
</tr>
<tr>
<td>MH</td>
<td>MH</td>
<td>MH</td>
</tr>
<tr>
<td>Grayish Brown Clayey Silt with frequent cobbles and boulders to 18&quot;, medium stiff (contains some root pieces)</td>
<td>Grayish Brown Clayey Silt with cobbles and boulders to 12&quot;, medium stiff (fill)</td>
<td>Grayish Brown Clayey Silt with cobbles, medium stiff (Collovis, insitu)</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>MH</td>
<td>MH</td>
<td>MH</td>
</tr>
<tr>
<td>Grayish Brown Clayey Silt with some cobbles and boulders to 24&quot;, stiff to hard (natural ground)</td>
<td>Grayish Brown Clayey Silt with cobbles and boulders to 24&quot; insitu (boulders coated with white mineralization) Bottom of trench at 3.5 feet</td>
<td>Grayish Brown Clayey Silt with cobbles and boulders to 24&quot; insitu (boulders coated with white mineralization) Bottom of trench at 3.5 feet</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grayish Brown Silty Gravel (bedding for pipe). Bottom of trench at 14.0 feet</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TRENCH 2(L)</td>
<td>TRENCH 2(H)</td>
<td></td>
</tr>
<tr>
<td><strong>Surface Elevation</strong></td>
<td><strong>Surface Elevation</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Graph Symbol</strong></td>
<td><strong>Graph Symbol</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Depth in Feet</strong></td>
<td><strong>Depth in Feet</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Letter Symbol</strong></td>
<td><strong>Letter Symbol</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Description</strong></td>
<td><strong>Description</strong></td>
<td></td>
</tr>
<tr>
<td>MH</td>
<td>MH</td>
<td></td>
</tr>
<tr>
<td>Grayish Brown Clayey Silt with frequent cobbles and occasional roots, medium stiff (fill)</td>
<td>Grayish Brown Clayey Silt, stiff, with cobbles, insitu Gray interlocked boulders to 40&quot; with interstitial clayey silt, stiff</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>MH</td>
<td>MH</td>
<td></td>
</tr>
<tr>
<td>Brown Silt, Stiff, insitu (topsoil)</td>
<td>Gray interlocked boulders to 40&quot; with interstitial clayey silt, stiff</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>MH</td>
<td>MH</td>
<td></td>
</tr>
<tr>
<td>Grayish Brown Clayey Silt with cobbles and occasional boulders, very stiff (colluvium)</td>
<td>Bottom of trench at 6.0 feet</td>
<td>Bottom of trench at 6.0 feet</td>
</tr>
<tr>
<td>Bottom of trench at 9.0 feet</td>
<td></td>
<td>Bottom of trench at 9.0 feet</td>
</tr>
</tbody>
</table>

**LOG OF TRENCH EXCAVATIONS**
APPENDIX B

LABORATORY TESTING

Selected representative samples of the subsurface materials recovered during the exploration program were subjected to various laboratory tests to evaluate their engineering properties, and to provide necessary information for classification and correlation of various soil and rock types. The tests performed are described below, and the results are summarized in Table B-1.

Moisture Content and Dry Density - The moisture content and dry density of selected samples were determined. The results of these tests are presented on the Logs of Borings at the appropriate depths and on Table B-1.

Atterberg Limits - Liquid and plastic limits were determined for the purpose of classification and evaluation of plasticity. The tests were performed in accordance with ASTM D423-66 and D424-59.

Unconfined Compression Tests - Two unconfined compression tests were performed on selected samples. The testing method and apparatus are described on Exhibit B-1.

Triaxial Compression Tests - Two triaxial compression tests were performed on the in-situ silt materials.
to determine the shear strength parameters. The test method and apparatus is described in Exhibit B-1. The results are presented on Plates B-1 and B-2.

**Consolidation Test** - Two consolidation tests were performed on an undisturbed sample of silt to determine the compressibility of the material. Consolidation test procedures and apparatus are presented on Exhibit B-2, and the results are presented on Plate B-3.

**Expansion Tests** - Four expansion tests were performed on near-surface materials to determine the swelling characteristics on wetting. Three of the tests were performed by soaking a laterally confined sample with a 100 pounds per square foot surcharge load. The increase in volume is measured and reported as percentage of swell.

One constant volume expansion test was performed to measure the potential swell pressures. In this test, a laterally confined sample is soaked, and the surcharge is increased as required to maintain a constant volume. The test results are presented on Table B-1.
The following Table, Exhibits and Plates are attached and complete Appendix B.

Table B-1 - Summary of Laboratory Testing
Exhibit B-1 - Methods of Performing Unconfined Compression and Triaxial Compression Tests
Exhibit B-2 - Method of Performing Consolidation Tests
Plate B-1 - Triaxial Compression Test Results, Boring 1, Sample 4A and 5
Plate B-2 - Triaxial Compression Test Results, Boring 5, Sample 4
Plate B-3 - Consolidation Test Results
<table>
<thead>
<tr>
<th>Boring No.</th>
<th>Sample No.</th>
<th>Depth in Feet</th>
<th>Moisture Content in %</th>
<th>Dry Density in Pcf</th>
<th>Atterberg Limits</th>
<th>Unconf. Comp. Strength (PSF)</th>
<th>Shear Parameters</th>
<th>Compaction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Max. Dens. (PCF)</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>2.5</td>
<td>24</td>
<td>90</td>
<td></td>
<td></td>
<td></td>
<td>17</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>5.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6900</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>9.7</td>
<td>39</td>
<td>81</td>
<td></td>
<td></td>
<td></td>
<td>8700</td>
</tr>
<tr>
<td>1</td>
<td>3A</td>
<td>10.0</td>
<td>40</td>
<td>80</td>
<td>100</td>
<td>43</td>
<td>57</td>
<td>14</td>
</tr>
<tr>
<td>1</td>
<td>4A</td>
<td>5.3</td>
<td>44</td>
<td>78</td>
<td></td>
<td></td>
<td></td>
<td>400</td>
</tr>
<tr>
<td>1</td>
<td>5</td>
<td>18.9</td>
<td>39</td>
<td>82</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>1.8</td>
<td>28</td>
<td>91</td>
<td></td>
<td></td>
<td></td>
<td>12</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>2.0</td>
<td>31</td>
<td>86</td>
<td></td>
<td></td>
<td></td>
<td>0*</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>1.5</td>
<td>42</td>
<td>95</td>
<td></td>
<td></td>
<td></td>
<td>360</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>5.0</td>
<td>46</td>
<td>78</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Constant Volume Test - 0% swell under 3000 psf surcharge.
METHODS OF PERFORMING UNCONFINED COMPRESSION AND TRIAXIAL COMPRESSION TESTS

The shearing strengths of soils are determined from the results of unconfined compression and triaxial compression tests. In triaxial compression tests, the test method and the magnitude of the confining pressure are chosen to simulate anticipated field conditions.

Unconfined compression and triaxial compression tests are performed on undisturbed or remolded samples of soil approximately six inches in length and two and one-half inches in diameter. The tests are run either strain-controlled or stress-controlled. In a strain-controlled test the sample is subjected to a constant rate of deflection and the resulting stresses are recorded. In a stress-controlled test the sample is subjected to equal increments of load with each increment being maintained until an equilibrium condition with respect to strain is achieved.

Yield, peak, or ultimate stresses are determined from the stress-strain plot for each sample and the principal stresses are evaluated. The principal stresses are plotted on a Mohr's circle diagram to determine the shearing strength of the soil type being tested.

Unconfined compression tests can be performed only on samples with sufficient cohesion so that the soil will stand as an unsupported cylinder. These tests may be run at natural moisture content or on artificially saturated soils.

In a triaxial compression test, the sample is encased in a rubber membrane, placed in a test chamber, and subjected to a confining pressure throughout the duration of the test. Normally, this confining pressure is maintained at a constant level, although for special tests it may be varied in relation to the measured stresses. Triaxial compression tests may be run on soils at field moisture content or on artificially saturated samples. The tests are performed in one of the following ways:

Unconsolidated-undrained: The confining pressure is imposed on the sample at the start of the test. No drainage is permitted and the stresses which are measured represent the sum of the intergranular stresses and pore water pressures.

Consolidated-undrained: The sample is allowed to consolidate fully under the applied confining pressure prior to the start of the test. The volume change is determined by measuring the water and/or air expelled during consolidation. No drainage is permitted during the test and the stresses which are measured are the same as for the unconsolidated-undrained test.

Drained: The intergranular stresses in a sample may be measured by performing a drained, or slow, test. In this test the sample is fully saturated and consolidated prior to the start of the test. During the test, drainage is permitted and the test is performed at a slow enough rate to prevent the buildup of pore water pressures. The resulting stresses which are measured represent only the intergranular stresses. These tests are usually performed on samples of generally non-cohesive soils, although the test procedure is applicable to cohesive soils if a sufficiently slow test rate is used.

An alternate means of obtaining the data resulting from the drained test is to perform an undrained test in which special equipment is used to measure the pore water pressures. The differences between the total stresses and the pore water pressures measured are the intergranular stresses.
Method Of Performing Consolidation Tests

Consolidation tests are performed to evaluate the volume changes of soils subjected to increased loads. Time-consolidation and pressure-consolidation curves may be plotted from the data obtained in the tests. Engineering analyses based on these curves permit estimates to be made of the probable magnitude and rate of settlement of the tested soils under applied loads.

Each sample is tested within brass rings two and one-half inches in diameter and one inch in length. Undisturbed samples of in-place soils are tested in rings taken from the sampling device in which the samples were obtained. Loose samples of soils to be used in constructing earth fills are compacted in rings to predetermined conditions and tested.

In testing, the sample is rigidly confined laterally by the brass ring. Axial loads are transmitted to the ends of the sample by porous disks. The disks allow drainage of the loaded sample. The axial compression or expansion of the sample is measured by a micrometer dial indicator at appropriate time intervals after each load increment is applied. Each load is ordinarily twice the preceding load. The increments are selected to obtain consolidation data representing the field loading conditions for which the test is being performed. Each load increment is allowed to act over an interval of time dependent on the type and extent of the soil in the field.
TRIAXIAL COMPRESSION TEST
CONSOLIDATED, UNDRAINED, SATURATED

Normal Stress (PSF)
Boring 1, Sample 4.5
Brown (mottled) sandy silt
Moisture Content = 42 %
Dry Density = 80 PCF
Cohesion C = 400 PSF
Frictional Resistance φ = 17°
TRIAXIAL COMPRESSION TEST
CONSOLIDATED, UNDRAINED, SATURATED

Boring 5, Samples 1, 2
Brown gravelly silt
Moisture Content = 44 %
Dry Density = 91 PCF
Cohesion C = 360 PSF
Frictional Resistance $\theta = 12^\circ$
BORING 1, SAMPLE 3A, AT 10 FEET
DARK BROWN GRAVELLY SILT
MoISTURE CONTENT = 40 %
DRY DENSITY = 80 PCF

BORING 2, SAMPLE 1, AT 1.8 FEET
GRAY-BROWN SILT WITH SAND AND GRAVEL
MoISTURE CONTENT = 28 %
DRY DENSITY = 91 PCF