# Attachment D

# GEOTECHNICAL INVESTIGATION
## DESIGN PHASE

FOR
3406 17 MILE DRIVE
PEBBLE BEACH, MONTEREY COUNTY, CALIFORNIA

PREPARED FOR
JOHN HODGE
PROJECT NO. 23-168-M

PREPARED BY

BUTANO GEOTECHNICAL ENGINEERING, INC.
JUNE 2023

**BUTANO GEOTECHNICAL ENGINEERING, INC.**
**404 WESTRIDGE DRIVE, WATSONVILLE, CALIFORNIA 95076**
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June 20, 2023
Project No. 23-168-M

John Hodge
3406 17 Mile Drive
Pebble Beach, CA 93953

SUBJECT: **GEOTECHNICAL INVESTIGATION - DESIGN PHASE**
Proposed Residential Construction
3406 17 Mile Drive
Pebble Beach, Monterey County, California

Dear Mr. Hodge:

In accordance with your authorization, we have completed a geotechnical investigation for the subject project. This report summarizes the findings, conclusions, and recommendations from our field exploration, laboratory testing, and engineering analysis. It is a pleasure being associated with you on this project. If you have any questions, or if we may be of further assistance, please do not hesitate to contact our office.

Sincerely,

**BUTANO GEOTECHNICAL ENGINEERING, INC.**

GREG BLOOM
C.E. 58819

Greg Bloom, PE, GE
Principal Engineer

Appendices: 1. Appendix A Figures and Standard Details
2. Appendix B Field Exploration Program
3. Appendix C Laboratory Testing Program

Distribution: (4) Addressee

## 1.0 INTRODUCTION

This report presents the results of our geotechnical investigation for the proposed residential project at 3406 17 Mile Drive in Pebble Beach, Monterey County, California.

The purpose of our investigation is to provide preliminary geotechnical design parameters and recommendations for the construction of the proposed residential project. Conclusions and recommendations related to site grading, drainage, retaining walls and foundations are presented herein.

Anticipated construction consists of demolishing the existing residence and constructing a new single-family residence with a basement and associated improvements.

This work included site reconnaissance, subsurface exploration, soil sampling, laboratory testing, engineering analyses, and preparation of this report. The scope of services for this investigation is outlined in our agreement dated April 16, 2023.

The recommendations contained in this report are subject to the limitations presented in Section 8.0 of this report. The Association of Engineering Firms Practicing the Geosciences has produced a pamphlet for your information titled *Important Information About Your Geotechnical Report*. This pamphlet has been included with the copies of your report.

## 2.0 FIELD EXPLORATION AND LABORATORY TESTING PROGRAMS

Our field exploration program included drilling, logging, and interval sampling of three borings advanced with 6 inch solid stem auger on a tractor mounted drill rig. The borings were advanced on May 9, 2023. The borings were drilled to depths of 13 ½ and 17 ½ feet below existing grade. Details of the field exploration program, including the Boring Logs and the Key to the Logs, are presented in Appendix B, Figures B-3 through B-6.

Representative samples obtained during the field investigation were taken to the laboratory for testing. Laboratory tests were used to determine physical and engineering properties of the in-situ soils. Details of the laboratory testing program are presented in Appendix C. Test results are presented on the Boring Logs and in Appendix C.

# 3.0 SITE AND PROJECT DESCRIPTION

## 3.1 Location

The project site is located west of Highway 1 in Pebble Beach, Monterey County, California. The site location is shown on the Site Location Plan, Appendix B, Figure B-1.

## 3.2 Surface Conditions

The parcel is approximately rectangular in shape, 2.35 acres in size, slopes gently to the southwest, and is improved with a single-family residence, detached garage, and associated improvements.

## 3.3 Subsurface Conditions

A total of three borings were advanced for the project. The earth materials encountered at the site are mapped as volcanic rocks (Tvb). Our investigation did not encounter the volcanic rocks within the depths of the exploration and the earth materials encountered are interpreted as marine terrace deposits (Qmt).

Boring B1 was stiff to hard lean clay in the upper 5 feet. The soil graded to a very dense clayey sand at 5 feet to a depth of 13 ½ feet. Dense silty sand was encountered from 13 ½ feet to the bottom of the boring at 17 ½ feet.

Boring B2 encountered very loose to loose silty sand from the surface to a depth of 8 feet. Dense clayey sand was encountered from 8 feet to the bottom of the boring at 13 ½ feet.

Boring B3 encountered very loose silty sand from the surface to a depth of 2 ½ feet. Stiff to hard sandy lean clay was encountered from 2 ½ feet to 12 feet. Very dense silty sand was encountered from 12 feet to the bottom of the boring at 13 ½ feet.

A perched groundwater table was encountered in B2 at a depth of 3 feet. Groundwater was not encountered in B1 or B3. Groundwater conditions may change seasonally.

Complete soil profiles are presented on the Boring Logs, Appendix B, Figures B-4 through B-6. The boring locations are shown on the Boring Site Plan, Figure B-2.

## 4.0 PROJECT DESCRIPTION

Anticipated construction consists of demolishing the existing improvements and constructing a new single-family residence with a basement under a portion of the residence.

## 5.0 GEOTECHNICAL HAZARDS

### 5.1 General

In our opinion the geotechnical hazards that could potentially affect the proposed project are:

- Intense seismic shaking
- Collateral seismic hazards

#### 5.1.1 Intense Seismic Shaking

The hazard of intense seismic shaking is present throughout central California. Intense seismic shaking may occur at the site during the design lifetime of the proposed structure from an earthquake along one of the regions many faults. Generally, the intensity of shaking will increase the closer the site is to the epicenter of an earthquake, however, seismic shaking is a complex phenomenon and may be modified by local topography and soil conditions. The transmission of earthquake vibrations from the ground into the structure may cause structural damage.

The County of Monterey has adopted the seismic provisions set forth in the 2022 California Building Code to address seismic shaking. The seismic provisions in the 2022 CBC are minimum load requirements for the seismic design for the proposed structure. The provisions set forth in the 2022 CBC will not prevent structural and nonstructural damage from direct fault ground surface rupture, coseismic ground cracking, liquefaction and lateral spreading, seismically induced differential compaction, seismically induced landsliding, or seismically induced inundation.

Table 1 has been constructed based on the 2022 CBC requirements for the seismic design of the proposed structure. The Site Class has been determined based on our field investigation and laboratory testing.

**Table 1. Seismic Design Parameters**

| $S_S$ | $S_1$ | Site Class | $F_a$ | $F_v$ | $S_{DS}$ | $S_{D1}$ | $F_{PGA}$ | $PGA_M$ | Risk Category | Seismic Design Category |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.268 | 0.479 | D | 1 | Null* | 0.845 | Null* | 1.1 | 0.613 | II | Null |

Design Coordinates - (Lat: 36.5625955, Lng: -121.9317783)

*Site specific analysis required for site class D and building structures having a period within the velocity domain of the design response spectrum ($T_s$ <T<=$T_L$).

### 5.1.2 Collateral Seismic Hazards

In addition to intense seismic shaking, other seismic hazards that may have an adverse affect to the site and/or the structure are: fault ground surface rupture, coseismic ground cracking, seismically induced liquefaction and lateral spreading, seismically induced differential compaction, seismically induced landsliding, and seismically induced inundation (tsunami and seiche). It is our opinion that the potential for collateral seismic hazards to affect the site and to damage the proposed structure is low.

## 6.0 DISCUSSIONS AND CONCLUSIONS

The site is underlain by terrace deposits. The soil varied from loose silty sand to hard sandy lean clay within the depths of the proposed foundation elements. Based on our laboratory testing the clay has a low potential for expansion.

# 7.0 RECOMMENDATIONS

## 7.1 General

Based on the results of our field investigation, laboratory testing, and engineering analysis it is our opinion that from the geotechnical standpoint, the subject site will be suitable for the proposed construction.

## 7.2 Site Grading

### 7.2.1 Site Clearing

The site should be cleared of loose soil, existing foundation elements, organics, and debris within the project limits.

### 7.2.2 Preparation of On-Site Soils

Areas to receive fill should be scarified, moisture conditioned, and compacted to a minimum of 90 percent relative compaction.

### Site Grading-General

The excavation of the existing foundation system will cause a loose zone of soil approximately 24 inches deep. In areas to be developed outside of the basement footprint this soil should be over-excavated and replaced as engineered fill to design grade.

The relative compaction and required moisture content shall be based on the maximum dry density and optimum moisture content obtained in accordance with ASTM D1557.

In-situ soil to receive fill should be scarified, moisture conditioned, and compacted to a minimum of 90 percent relative compaction.

All fill should be compacted with heavy vibratory equipment to a minimum of 90 percent relative compaction. Fill should be compacted by mechanical means in uniform horizontal loose lifts not exceeding 8 inches in thickness.

The on-site soil may be used as engineered fill once it is processed to remove deleterious material. The material should be verified by a representative of Butano Geotechnical Engineering, Inc. in the field during grading operations. All soils, both existing on-site and imported, to be used as fill, should contain less than 3 percent organics and be free of debris and cobbles over 2½ inches in maximum dimension.

Imported fill material should be approved by a representative of Butano Geotechnical Engineering, Inc. prior to importing. Imported fill should be primarily granular with no material greater than 2½ inches in diameter and no more than 20 percent of the material passing the #200 sieve. The fines fraction of the fill should not consist of expansive material. The Geotechnical Engineer should be notified not less than 5 working days in advance of placing any fill or base course material proposed for import. Each proposed source of import material should be sampled, tested, and approved by the Geotechnical Engineer prior to delivery of any soils imported for use on the site.

The upper 6 inches of subgrade and aggregate baserock in paved areas should be compacted to a minimum of 95 percent relative compaction. This should extend a minimum of 2 feet laterally of all paved areas.

Any surface or subsurface obstruction, or questionable material encountered during grading, should be brought immediately to the attention of the Geotechnical Engineer for proper processing as required.

### 7.2.3 Cut and Fill Slopes

Cut slopes are anticipated for the basement excavation. The soil may be sloped at a maximum gradient of 1:1 gradient. It is recommended that the face of the cut be kept moist during construction.

Slopes steeper than 1:1 should be shored. The geotechnical engineer should review all cut-slopes.

Permanent cut and fill slopes should be graded no steeper than 2:1 (H:V). All disturbed slopes should be erosion controlled.

### 7.2.4 Excavating Conditions

The on-site soil may be excavated with standard earthwork equipment.

### 7.2.5 Surface Drainage

Positive drainage should be maintained away from the structures at a minimum gradient of 2 percent for 10 feet. If this is not feasible surface water should be directed away from the foundation into a swale.

### 7.2.6 Subsurface Drainage

The basement will be supported by retaining walls. The collected drainage from the basement should be directed to a sump pump system.

The subgrade should be proof-rolled just prior to construction to provide a firm, relatively unyielding surface, especially if the surface has been loosened by the passage of construction traffic. The subgrade should be fine graded so that it is directed toward the sump or outlet.

The bottom of the basement should be underlain by a manifold system. This should consist of 3 inch diameter schedule 40 perforated pvc pipe spaced no more than 8 feet on center. The pipe should be directed to the low spot of the basement and into the sump system. The pipe should be encased in a minimum of 10 inches of ¾ inch gravel.

### 7.2.7 Utility Trenches

Bedding material should consist of sand with a SE not less than 30 which may then be jetted. The thickness of sand bedding above and below utilities should comply with local building codes.

The on-site native soils may be utilized for trench backfill. Imported fill should be free of organic material and rocks over 2.5 inches in diameter.

If sand is used, a 3 foot concrete plug should be placed in each trench where it passes under the exterior footings.

Backfill of all exterior and interior trenches should be placed in thin lifts not to exceed 8 inches and mechanically compacted to achieve a relative compaction of not less than 95 percent in paved areas and 90 percent in other areas per ASTM D1557. Care should be taken not to damage utility lines.

Utility trenches that are parallel to the sides of a building should be placed so that they do not extend below a line sloping down and away at an inclination of 2:1 H:V from the bottom outside edge of all footings.

Trenches should be capped with 1 1/2 feet of relatively impermeable material. Import material must be approved by the Geotechnical Engineer prior to its use.

Trenches must be shored as required by the local regulatory agency, the State of California Division of Industrial Safety Construction Safety Orders, and Federal OSHA requirements.

## 7.3 Foundations

### 7.3.1 Conventional Shallow Foundations

**General**

Conventional shallow foundations may be used bearing on firm in-situ soil (basement foundation) or 36 inches engineered fill (near surface foundation elements) per section 7.2.2.

**Footing Dimensions**

Footing widths should be based on the allowable bearing value but not less than 15 inches. The minimum recommended depth of embedment is 12 inches. Footing trenches should be level and stepped up as necessary. Embedment depths should not be allowed to be affected adversely, such as through erosion, softening, digging, etc. Should local building codes require deeper embedment of the footings or wider footings, the local codes must apply.

**Bearing Capacity**

The allowable bearing capacity used should not exceed 4,500 psf and 2,000 psf for basement level footings and near surface footings, respectively. The allowable bearing capacity may be increased by one-third in the case of short duration loads, such as those induced by wind or seismic forces. In the event that footings are founded in structural fill consisting of imported materials, the allowable bearing capacities will depend on the type of these materials and should be re-evaluated.

**Lateral Resistance**

Friction coefficient – 0.35, for the in-situ soil and engineered fill. A passive resistance of 400 pcf may be assumed below a depth of 12 inches for in-situ soil and engineered fill. Where both friction and the passive resistance are utilized for sliding resistance, either of the values indicated should be reduced by one-third.

Footing excavations must be checked by the Geotechnical Engineer before steel is placed and concrete is poured.

### 7.3.2 Concrete Slabs-on-Grade and Basement Drainage

#### General

We recommend that concrete slab-on-grades be founded on in-situ soil (basement grade) or a minimum of 36 inches of engineered fill (near surface grade) per section 7.2.2. The basement drainage below the slab should be prepared per section 7.2.6.

The subgrade should be proof-rolled just prior to construction to provide a firm, relatively unyielding surface, especially if the surface has been loosened by the passage of construction traffic.

#### Capillary Break and Vapor Barrier

The following paragraphs outline the minimum capillary break and vapor barrier that shall be utilized for the basement slab-on-grade. Near surface interior slab-on-grades should have a minimum capillary break of 4 inches.

The subgrade should be proof-rolled just prior to construction to provide a firm, relatively unyielding surface, especially if the surface has been loosened by the passage of construction traffic. The subgrade should be fine graded so that it is directed toward the sump or outlet.

The bottom of the basement should be underlain by a manifold system. This should consist of 3 inch diameter schedule 40 perforated pvc pipe spaced no more than 8 feet on center. The pipe should be directed to the low spot of the basement and into the sump system. The pipe should be encased in a minimum of 10 inches of ¾ inch gravel.

The vapor barrier shall consist of a waterproof membrane (Stegowrap 15 Mil or equivalent) placed directly below the floor slab and in direct contact with the concrete. Sheet overlap for the vapor barrier shall be a minimum of 6 inches. A 6 inch layer of compacted Class II Baserock may be employed to prevent rips or tears in the vapor barrier if desired and to keep the subgrade from becoming saturated prior to pouring concrete.

If the manufacturer's recommendations or the project requirements for the capillary break and vapor barrier are more stringent than the minimum outlined above, the designer should follow those recommendations and requirements. Recommendations by the manufacturer may include but is not limited to specifications for; concrete mix design, puncture resistance of vapor barrier, permeance of vapor barrier, soil flatness, capillary break section, structural section, and testing recommendations.

### 7.3.3 Settlements

Total and differential settlements beneath are expected to be within tolerable limits under static conditions. Vertical movements are not expected to exceed 1 inch. Differential movements are expected to be within the normal range (½ inch) for the anticipated loads.

## 7.4 Retaining Structures

### 7.4.1 Lateral Earth Pressures

The lateral earth pressures presented in Table 2 are recommended for the design of retaining structures retaining the on-site soil. Should the slope behind the retaining walls be other than level, supplemental design criteria will be provided for the active earth or at-rest pressures for the particular slope angle.

**Table 2. Lateral Earth Pressures**

| Soil Profile | Soil Pressure (psf/ft) | |
|---|---|---|
| | Active | At-rest |
| Level | 45 | 65 |
| 2:1 | 60 | 80 |

Pressure due to any surcharge loads from adjacent footings, traffic, etc., should be analyzed separately. Pressures due to these loading can be supplied upon receipt of the appropriate plans and loads. Refer to Appendix A, Figure A-1-Surcharge Pressure Diagram.

An earthquake load (ultimate) may be considered for retaining walls as follows:

For unrestrained walls over 6 feet, as measured from the base of the footing, a seismic load of $10H^2$ may be applied at a height of 0.6H from the base of the wall.

No evaluation of seismic earth pressure is needed for restrained walls under 12 feet in height, as measured from the base of the footing, provided a minimum static factor of safety of 1.5 is achieved. For rigidly restrained walls over 12 feet a seismic load of $15H^2$ should be added to the active earth pressure and applied at a height of 0.3H from the base of the wall. The greater of the seismic loading and at rest loading conditions should be used for design. The recommendations for restrained retaining walls are based on the SEAOC 2010 Conventions Proceedings: *Seismic Earth Pressures on Deep Building Basements*, Lew, Sitar.

A factor of safety of 1.1 is considered appropriate with respect to earthquake loading.

### 7.4.2 Backfill

Backfill should be placed under engineering control. Backfill should be compacted per Subsection 7.2.2, however, precautions should be taken to ensure that heavy compaction equipment is not used immediately adjacent to walls, so as to prevent undue pressures against, and movement of, the walls.

The backfill should be capped with at least 12 inches of relatively impermeable material.

### 7.4.3 Backfill Drainage

Retaining structures must be fully drained. Backdrains should consist of 4 inch diameter Schedule 40, PVC pipe or equivalent, embedded in 3/8 inch to 3/4 inch, clean crushed gravel, enveloped in **Mirafi 180N** or approved equivalent. The drain should be a minimum of 12 inches in thickness and should extend to within 12 inches from the surface. The pipe should be 4± inches above the trench bottom; a gradient of 2± percent being provided to the pipe and trench bottom; discharging into suitably protected outlets. See Appendix A, Figure A-2 for the standard detail for the backdrain.

Perforations in backdrains are recommended as follows: 3/8 inch diameter, in 2 rows at the ends of a 120 degree arc, at 3 inch centers in each row, staggered between rows, placed downward.

Backdrains should be approved by the Geotechnical Engineer after placement of bedding and pipe and prior to the placement of clean crushed gravel.

An unobstructed outlet should be provided at the lower end of each segment of backdrain. The outlet should consist of an unperforated pipe of the same diameter, connected to the perforated pipe and extended to a protected outlet at a lower elevation on a continuous gradient of at least 1 percent.

## 7.5 Plan Review

The recommendations presented in this report are based on preliminary design information for the proposed project and on the findings of our geotechnical investigation. When completed, the Grading Plans, Foundation Plans and design loads should be reviewed by Butano Geotechnical Engineering, Inc. prior to submitting the plans and contract bidding. Additional field exploration and laboratory testing may be required upon review of the final project design plans.

## 7.6 Observation and Testing

Field observation and testing should be provided by a representative of Butano Geotechnical Engineering, Inc. to enable them to form an opinion regarding the adequacy of the site preparation, the adequacy of fill materials, and the extent to which the earthwork is performed in accordance with the geotechnical conditions present, the requirements of the regulating agencies, the project specifications, and the recommendations presented in this report.

Butano Geotechnical Engineering, Inc. should be notified **at least 5 working days** prior to any site clearing or other earthwork operations on the subject project in order to observe the stripping and disposal of unsuitable materials and to ensure coordination with the grading contractor. During this period, a preconstruction meeting should be held on the site to discuss project specifications, observation and testing requirements and responsibilities, and scheduling.

## 8.0 LIMITATIONS

The recommendations contained in this report are based on our field explorations, laboratory testing, and our understanding of the proposed construction. The subsurface data used in the preparation of this report was obtained from the borings drilled during our field investigation. Variation in soil, geologic, and groundwater conditions can vary significantly between sample locations. As in most projects, conditions revealed during construction excavation may be at variance with preliminary findings. If this occurs, the changed conditions must be evaluated by the Project Geotechnical Engineer, and revised recommendations be provided as required. In addition, if the scope of the proposed construction changes from the described in this report, our firm should also be notified.

Our investigation was performed in accordance with the usual and current standards of the profession, as they relate to this and similar localities. No other warranty, expressed or implied, is provided as to the conclusions and professional advice presented in this report.

This report is issued with the understanding that it is the responsibility of the Owner, or of his Representative, to ensure that the information and recommendations contained herein are brought to the attention of the Engineer for the project and incorporated into the plans, and that it is ensured that the Contractor and Subcontractors implement such recommendations in the field. The use of information contained in this report for bidding purposes should be done at the Contractor’s option and risk.

This firm does not practice or consult in the field of safety engineering. We do not direct the Contractor's operations, and we are not responsible for other than our own personnel on the site; therefore, the safety of others is the responsibility of the Contractor. The Contractor should notify the Owner if he considers any of the recommended actions presented herein to be unsafe.

The findings of this report are considered valid as of the present date. However, changes in the conditions of a site can occur with the passage of time, whether they are due to natural events or to human activities on this or adjacent sites. In addition, changes in applicable or appropriate codes and standards may occur, whether they result from legislation or the broadening of knowledge. Accordingly, this report may become invalidated wholly or partially by changes outside our control. Therefore, this report is subject to review and revision as changed conditions are identified.

The scope of our services mutually agreed upon did not include any environmental assessment or study for the presence of hazardous to toxic materials in the soil, surface water, or air, on or below or around the site. Butano Geotechnical Engineering, Inc. is not a mold prevention consultant; none of our services performed in connection with the proposed project are for the purpose of mold prevention. Proper implementation of the recommendations conveyed in our reports will not itself be sufficient to prevent mold from growing in or on the structures involved.

## REFERENCES

ASTM International (2016). *Annual Book of ASTM Standards, Section Four, Construction*. Volume 4.08, Soil and Rock (I): D 430 - D 5611.

ASTM International (2015). *Annual Book of ASTM Standards, Section Four, Construction*. Volume 4.09, Soil and Rock (II): D 5714 - Latest.

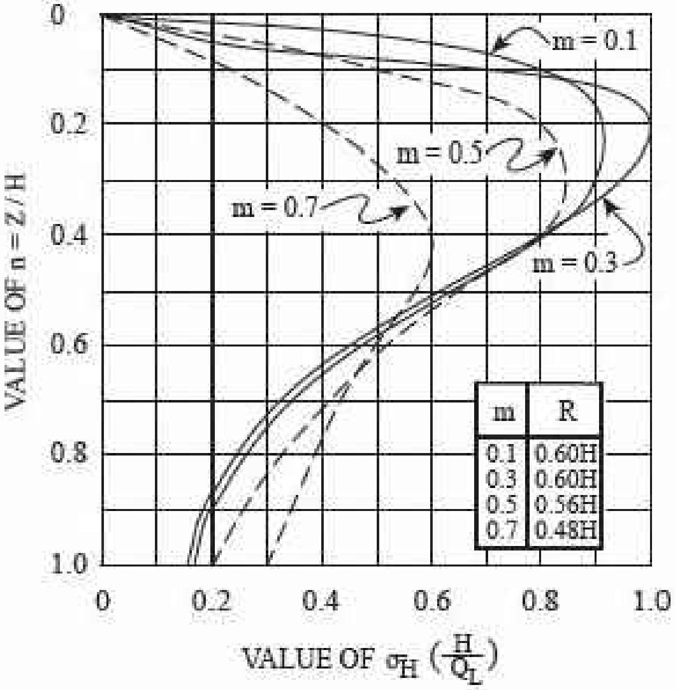
California Building Code (2022).

Dibblee, T.W., and Minch, J.A., 2007, Geologic map of the Monterey and Seaside quadrangles, Monterey County, California: Dibblee Geological Foundation, Dibblee Foundation Map DF-346, scale 1:24,000

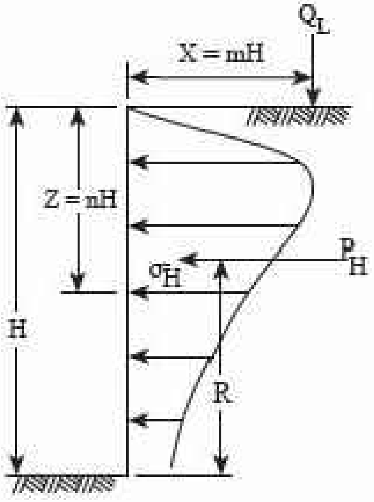
# APPENDIX A

## FIGURES AND STANDARD DETAILS

## LINE LOAD



| m | R |
|---|---|
| 0.1 | 0.60H |
| 0.3 | 0.60H |
| 0.5 | 0.56H |
| 0.7 | 0.48H |



FOR m ≦ 0.4:

$$\sigma_H \left(\frac{H}{Q_L}\right) = \frac{0.20\,n}{(0.16 + n^2)^2}$$

$$P_H = 0.55\,Q_L$$

FOR m > 0.4:

$$\sigma_H \left(\frac{H}{Q_L}\right) = \frac{1.28\,m^2\,n}{(m^2 + n^2)^2}$$

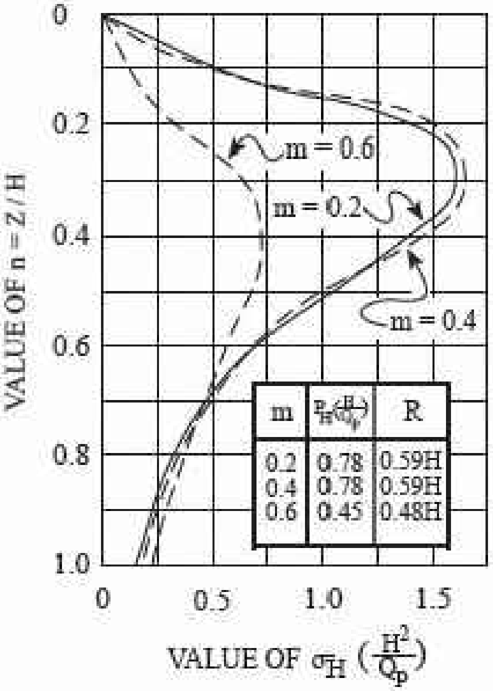
$$\text{RESULTANT } P_H = \frac{0.64\,Q_L}{(m^2 + 1)}$$

**PRESSURES FROM LINE LOAD $Q_L$**

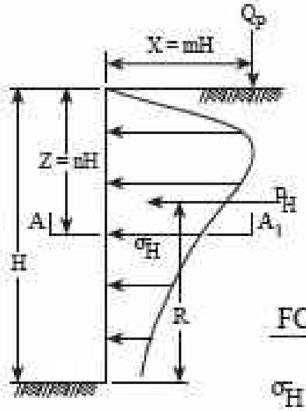
(BOISSINESQ EQUATION MODIFIED BY EXPERMENT)

REFERENCE: Design Manual
NAVFAC DM-7.02
Figure 11
Page 7.2-74

## POINT LOAD



| m | $P_H \left(\frac{H}{Q_p}\right)$ | R |
|---|---|---|
| 0.2 | 0.78 | 0.59H |
| 0.4 | 0.78 | 0.59H |
| 0.6 | 0.45 | 0.48H |



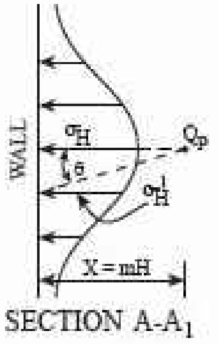
FOR m ≦ 0.4:

$$\sigma_H \left(\frac{H^2}{Q_p}\right) = \frac{0.28\,n^2}{(0.16 + n^2)^3}$$

FOR m > 0.4:

$$\sigma_H \left(\frac{H^2}{Q_p}\right) = \frac{1.77\,m^2 n^2}{(m^2 + n^2)^3}$$

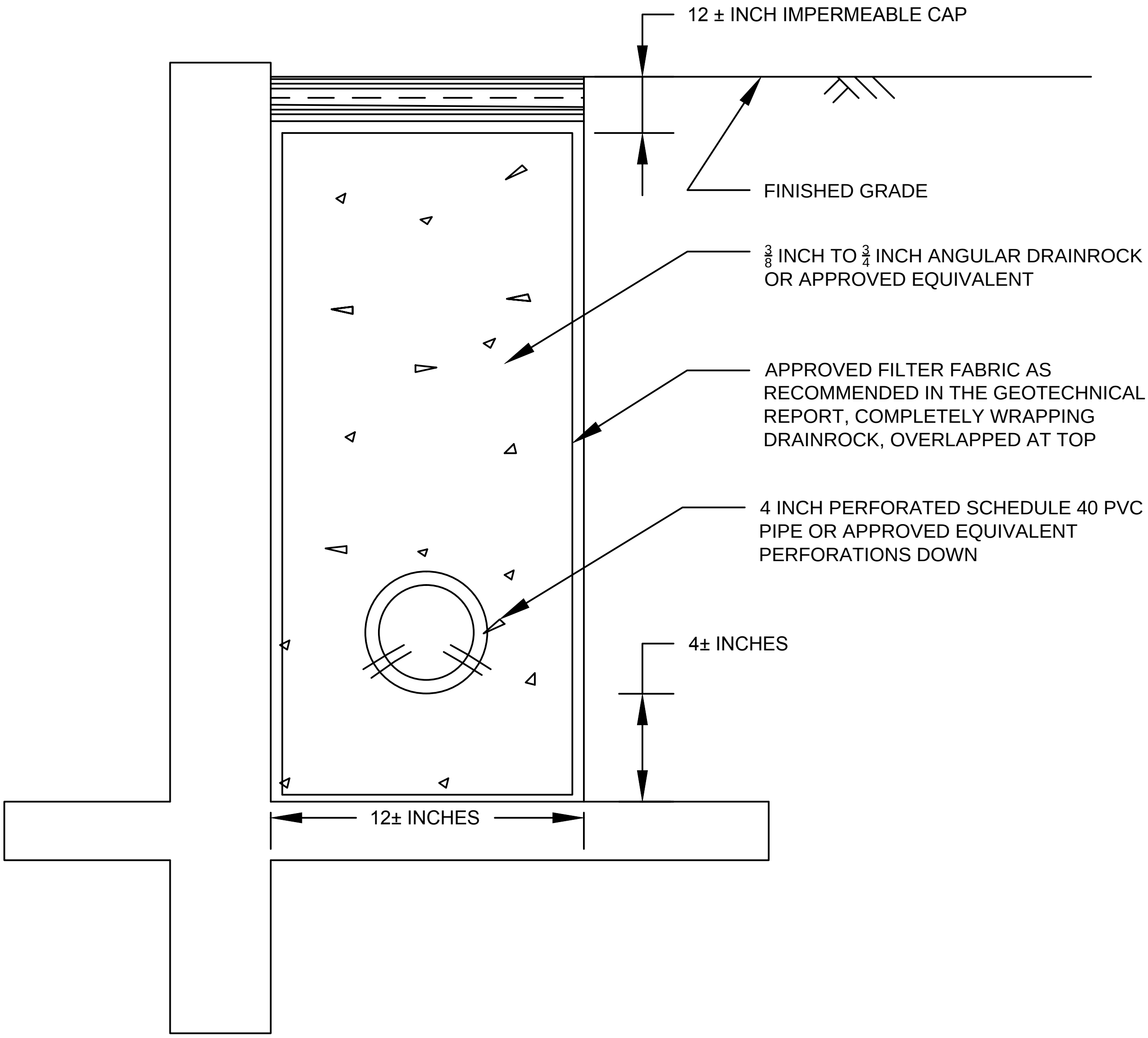
$$\sigma_H^1 = \sigma_H \cos^2(1.1\,\theta)$$



**PRESSURES FROM POINT LOAD $Q_P$**

(BOISSINESQ EQUATION MODIFIED
BY EXPERMENT)

| BUTANO<br>GEOTECHNICAL ENGINEERING, INC. | **SURCHARGE PRESSURE DIAGRAM** | FIGURE<br>A-1 |
|---|---|---|



NOTES:

1. DRAWING IS NOT TO SCALE.
2. 2±% GRADIENT TO PIPE AND TRENCH BOTTOM CONNECTED TO A CLOSED CONDUIT THAT DISCHARGES TO AN APPROVED LOCATION.

N.T.S.

| | | |
|---|---|---|
| BUTANO<br>GEOTECHNICAL ENGINEERING, INC. | **TYPICAL RETAINING WALL BACKDRAIN DETAIL** | FIGURE<br>A-2 |

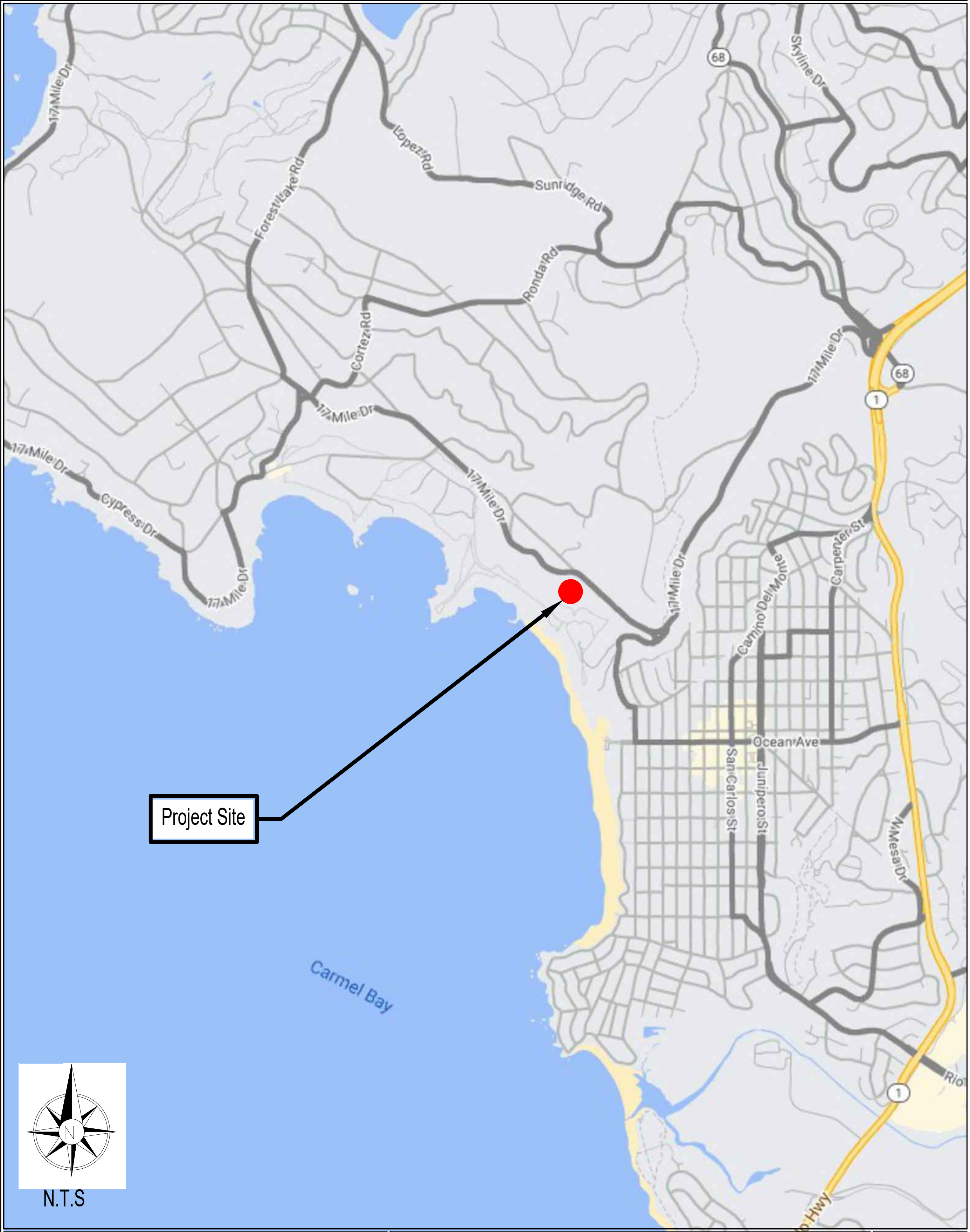
## APPENDIX B

## FIELD EXPLORATION PROGRAM

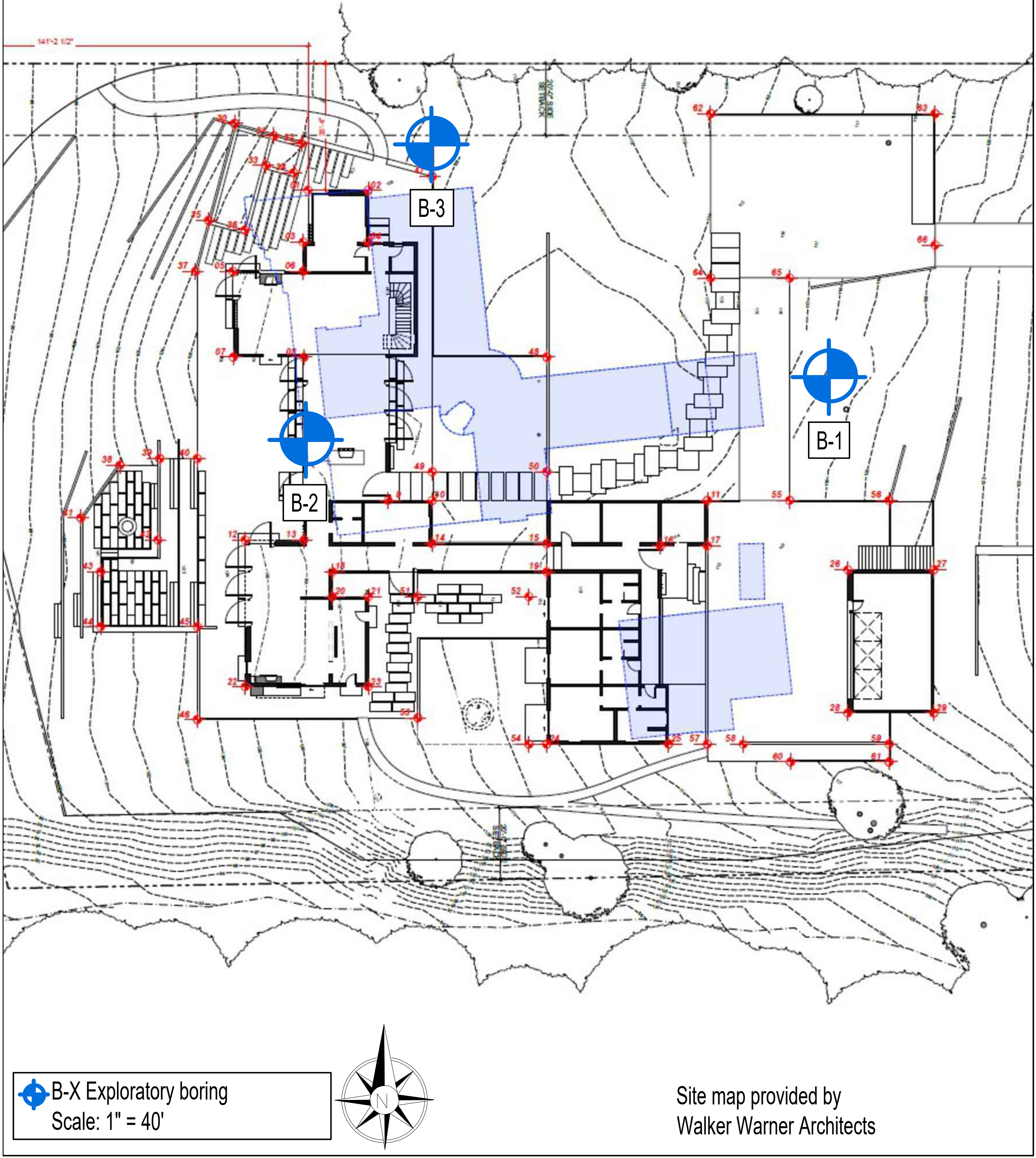
# FIELD EXPLORATION PROCEDURES

Subsurface conditions were explored by advancing three borings below existing grade. The borings were advanced using a six-inch solid stem auger on a tractor mounted drill rig. The Key to The Logs and the Logs of the Boring are included in Appendix B, Figures B-3 through B-6. The approximate location of the borings are shown on the Boring Site Plan, Figure B-2. The borings were located in the field by tape measurements from known landmarks. Their locations as shown are therefore within the accuracy of such measurement.

The soils encountered in the borings were continuously logged in the field by a representative of Butano Geotechnical Engineering, Inc. Bulk and relatively undisturbed soil samples for identification and laboratory testing were obtained in the field. These soils were classified based on field observations and laboratory tests. The classifications are accordance with the Unified Soil Classification System (USCS: Figure 3).



| | | |
|---|---|---|
| BUTANO | **SITE LOCATION PLAN** | FIGURE |
| GEOTECHNICAL ENGINEERING, INC. | 3406 17 Mile Drive | B-1 |



Site map provided by
Walker Warner Architects

BUTANO
GEOTECHNICAL ENGINEERING, INC.

**BORING SITE PLAN**

3406 17 Mile Drive

FIGURE
B-2

# KEY TO LOGS

## UNIFIED SOIL CLASSIFICATION SYSTEM

| PRIMARY DIVISIONS | | | GROUP SYMBOL | SECONDARY DIVISIONS |
|---|---|---|---|---|
| COARSE GRAINED SOILS<br>More than half of the material is larger than the No. 200 sieve | GRAVELS<br>More than half of the coarse fraction is larger than the No. 4 sieve | CLEAN GRAVELS (Less than 5% fines) | GW | Well graded gravels, gravel-sand mixtures, little or no fines |
| | | | GP | Poorly graded gravels, gravel-sand mixtures, little or no fines |
| | | GRAVEL WITH FINES | GM | Silty gravels, gravel-sand-silt mixtures, non-plastic fines |
| | | | GC | Clayey gravels, gravel-sand-clay mixtures, plastic fines |
| | SANDS<br>More than half of the coarse fraction is smaller than the No. 4 sieve | CLEAN SANDS (Less than 5% fines) | SW | Well graded sands, gravelly sands, little or no fines |
| | | | SP | Poorly graded sands, gravelly sands, little or no fines |
| | | SAND WITH FINES | SM | Silty sands, sand-silt mixtures, non-plastic fines |
| | | | SC | Clayey sands, sand-clay mixtures, plastic fines |
| FINE GRAINED SOILS<br>More than half of the material is smaller than the No. 200 sieve | SILTS AND CLAYS<br>Liquid limit less than 50 | | ML | Inorganic silts and very fine sands, silty or clayey fine sands or clayey silts with slight plasticity |
| | | | CL | Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays |
| | | | OL | Organic silts and organic silty clays of low plasticity |
| | SILTS AND CLAYS<br>Liquid limit greater than 50 | | MH | Inorganic silts, micaceous or diatomacaceous fine sandy or silty soils, elastic silts |
| | | | CH | Inorganic clays of high plasticity, fat clays |
| | | | OH | Organic clays of medium to high plasticity, organic silts |
| HIGHLY ORGANIC SOILS | | | Pt | Peat and other highly organic soils |

## GRAIN SIZE LIMITS

| SILT AND CLAY | SAND | | | GRAVEL | | COBBLES | BOULDERS |
|---|---|---|---|---|---|---|---|
| | FINE | MEDIUM | COARSE | FINE | COARSE | | |

No. 200 No. 40 No. 10 No. 4 3/4 in. 3 in. 12 in.

US STANDARD SIEVE SIZE

## RELATIVE DENSITY

| SAND AND GRAVEL | BLOWS/FT* |
|---|---|
| VERY LOOSE | 0 - 4 |
| LOOSE | 4 - 10 |
| MEDIUM DENSE | 10 - 30 |
| DENSE | 30 - 50 |
| VERY DENSE | OVER 50 |

## CONSISTENCY

| SILT AND CLAY | BLOWS/FT* |
|---|---|
| VERY SOFT | 0 - 2 |
| SOFT | 2 - 4 |
| FIRM | 4 - 8 |
| STIFF | 8 - 16 |
| VERY STIFF | 16 - 32 |
| HARD | OVER 32 |

## MOISTURE CONDITION

| | |
|---|---|
| CLAY | DRY |
| | MOIST |
| | SATURATED |
| SAND | DRY |
| | DAMP |
| | WET |
| | SATURATED |

* Number of blows of 140 pound hammer falling 30 inches to drive a 2 inch O.D. (1 3/8 inch I.D.) split spoon (ASTM D-1586).

BUTANO GEOTECHNICAL ENGINEERING, INC.

FIGURE
B-3

# LOG OF EXPLORATORY BORING

| | | | |
|---|---|---|---|
| Project No.: | 23-168-M | Boring: | B1 |
| Project: | 3406 17 Mile Drive | Location: | See figure B-2 |
| | | Elevation: | |
| Date: | May 9, 2023 | Method of Drilling: | 6-inch solid stem augers<br>tractor mounted drill rig |
| Logged By: | EJ | | |

⧄ 2" Ring Sample ⧅ 2.5" Ring Sample ◫ Terzaghi Split Spoon Sample ☒ Bulk Sample

Perched Water Table ▽ Static Water Table ▽ Water Encountered During Drilling ▼

Change in Soil Classification ——— Gradation or Minor Change in Classification - - - - -

| Depth (ft.) | Soil Type | Undisturbed | Bulk | Description | Blows / Foot | $N_{60}$ | Dry Density (pcf) | Moisture Content (%) | Expansion Index | Particle Size (% fines) | Unconfined - $q_u$ (psf) | Atterberg Limits L.L. | Atterberg Limits P.I. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | CL | ⧅ | | Dark brown Sandy LEAN CLAY, stiff, moist | 20 | 11 | 117.0 | 15.0 | 49 | | 5450 | | |
| | | ◫ | | Gray | 24 | 20 | | 16.0 | | | | | |
| 5 | SC | ⧅ | | Very dense, grades to a Clayey SAND with gravel | 50/6" | | 111.4 | 15.5 | | | | | |
| | | ◫ | | | 70 | 64 | | 14.1 | | | | | |
| | | ◫ | | | 61 | 55 | | 13.8 | | | | | |
| 10 | | | | | | | | | | | | | |
| | | ◫ | | Medium dense | 31 | 28 | | 19.3 | | | | | |
| 15 | SM | | | Reddish brown Silty SAND, dense, damp | | | | | | | | | |
| | | ◫ | | | 33 | 30 | | 13.6 | | | | | |
| 20 | | | | Boring terminated at a depth of 17 1/2 feet.<br>No groundwater encountered during drilling. | | | | | | | | | |
| 25 | | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | | |
| 35 | | | | | | | | | | | | | |

BUTANO GEOTECHNICAL ENGINEERING, INC.

FIGURE
B-4

# LOG OF EXPLORATORY BORING

| | | | |
|---|---|---|---|
| Project No.: | 23-168-M | Boring: | B2 |
| Project: | 3406 17 Mile Drive | Location: | See figure B-2 |
| | | Elevation: | |
| Date: | May 9, 2023 | Method of Drilling: | 6-inch solid stem augers<br>tractor mounted drill rig |
| Logged By: | EJ | | |

⧄ 2" Ring Sample ⧅ 2.5" Ring Sample ◫ Terzaghi Split Spoon Sample ⊠ Bulk Sample

Perched Water Table ▽ Static Water Table ▽ Water Encountered During Drilling ▼

Change in Soil Classification ——— Gradation or Minor Change in Classification - - - -

| Depth (ft.) | Soil Type | Undisturbed | Bulk | Description | Blows / Foot | $N_{60}$ | Dry Density (pcf) | Moisture Content (%) | Expansion Index | Particle Size (% fines) | Unconfined - $q_u$ (psf) | Atterberg Limits L.L. | Atterberg Limits P.I. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SM | ⧅ | | Dark brown Silty SAND, wet, very loose | 2 | 1 | | | | | | | |
| | | ◫ | | Loose, wet ▽ | 8 | 6 | | 17.6 | | | | | |
| 5 | | ◫ | | Loose | 9 | 7 | | 20.0 | | 43 | | | |
| | SC | ◫ | | Brown Clayey SAND, very dense, damp | 50/6" | | | 12.1 | | | | | |
| 10 | | | | | | | | | | | | | |
| | | ◫ | | Dense | 40 | 41 | | 13.6 | | | | | |
| 15 | | | | Boring terminated at a depth of 13 1/2 feet. Groundwater measured at a depth of 3 feet after drilling. | | | | | | | | | |
| 20 | | | | | | | | | | | | | |
| 25 | | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | | |
| 35 | | | | | | | | | | | | | |

# LOG OF EXPLORATORY BORING

| | | | |
|---|---|---|---|
| Project No.: | 23-168-M | Boring: | B3 |
| Project: | 3406 17 Mile Drive | Location: | See figure B-2 |
| | | Elevation: | |
| Date: | May 9, 2023 | Method of Drilling: | 6-inch solid stem augers<br>tractor mounted drill rig |
| Logged By: | GB | | |

⧄ 2" Ring Sample ⧅ 2.5" Ring Sample ◫ Terzaghi Split Spoon Sample ⊠ Bulk Sample

Perched Water Table ▽ Static Water Table ▽ Water Encountered During Drilling ▼

Change in Soil Classification ——— Gradation or Minor Change in Classification - - - -

| Depth (ft.) | Soil Type | Undisturbed | Bulk | Description | Blows / Foot | $N_{60}$ | Dry Density (pcf) | Moisture Content (%) | Expansion Index | Particle Size (% fines) | Unconfined - $q_u$ (psf) | Atterberg Limits L.L. | Atterberg Limits P.I. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SM | ⧅ | | Gray Silty SAND, very loose, wet | 5 | 2 | 112.1 | 13.2 | | | | | |
| | | ◫ | | | 14 | 11 | | 14.0 | | | | | |
| 5 | CL | ⧅ | | Brownish gray LEAN CLAY, stiff, moist<br>grades to a Sandy LEAN CLAY, very stiff | 32 | 19 | 121.5 | 13.9 | | | 4900 | | |
| | | ◫ | | Hard | 50/6" | | | 13.2 | | | | | |
| 10 | | | | | | | | | | | | | |
| | SM | ◫ | | Brown Silty SAND, dense, damp, trace clay | 55 | 50 | | 8.3 | | | | | |
| 15 | | | | Boring terminated at a depth of 13 1/2 feet.<br>No groundwater encountered during drilling. | | | | | | | | | |
| 20 | | | | | | | | | | | | | |
| 25 | | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | | |
| 35 | | | | | | | | | | | | | |

## APPENDIX C

# LABORATORY TESTING PROGRAM

## LABORATORY TESTING PROCEDURES

### Classification

Soils were classified according to the Unified Soil Classification System in accordance with ASTM D 2487 and D 2488. Moisture content and density determinations were made for representative samples in accordance with ASTM D 2216. Results of moisture density determinations, together with classifications, are shown on the Boring Logs, Figures B-4 through B-6.

### Swell Test

Two one-dimensional swell tests were performed on representative relatively undisturbed samples in accordance with ASTM D-4546. The results are presented in Figures C-2 and C-3.

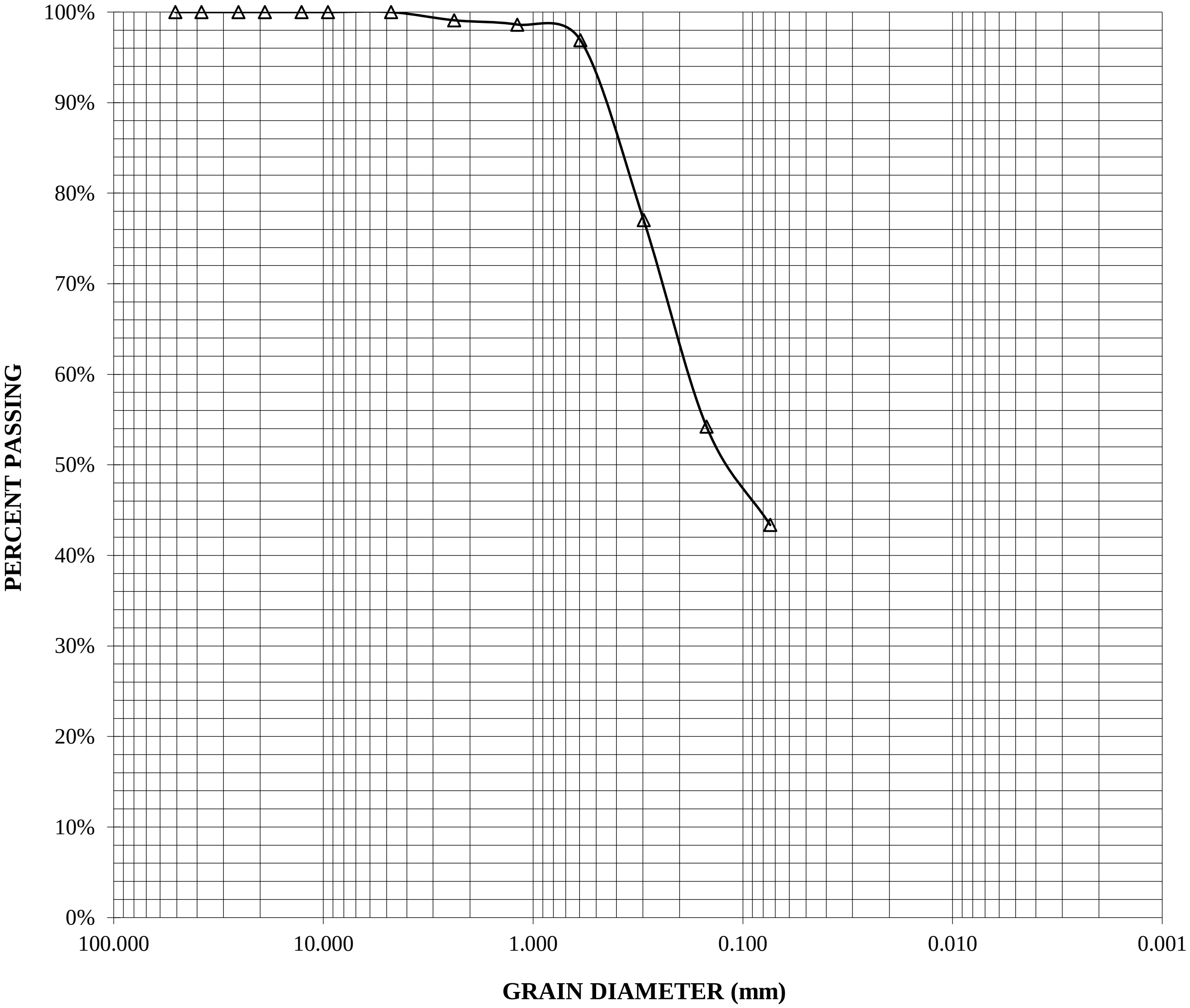
### Particle Size Analysis

One sieve was performed on representative sample in accordance with ASTM C 117 and C 136. The grain size distribution from the results of the particle size analyses is shown on Figure C-1.

### Expansion Index

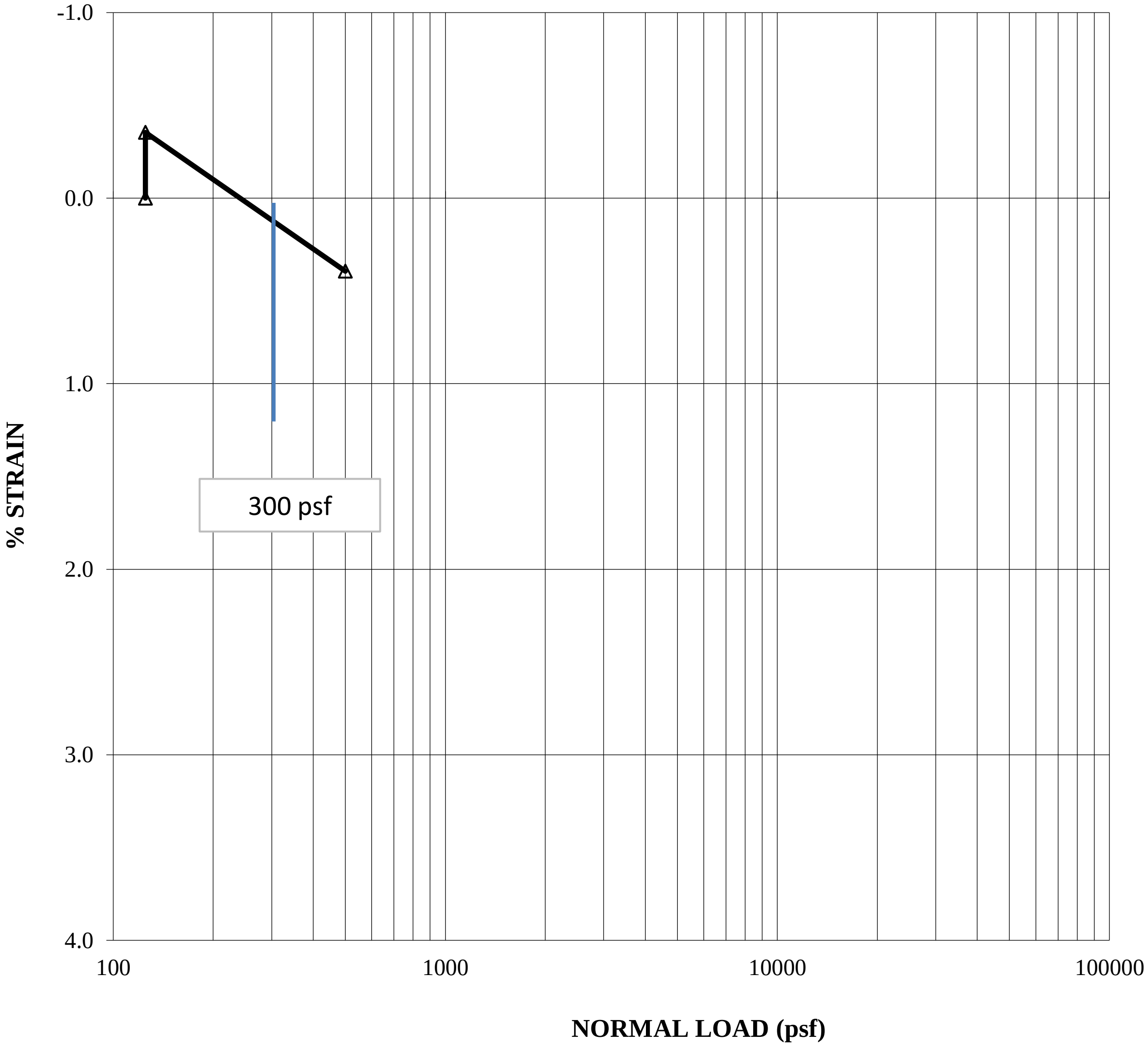
One expansion index test was performed on a representative bulk sample of the foundation zone soil in accordance with ASTM D 4829. The result is shown on the Boring Log, Figure B-4.

| BORING: | B2-3 | PERCENT | PERCENT |
|---|---|---|---|
| DEPTH (ft): | 4.0 | PASSING No. 4 | PASSING No. 200 |
| SOIL TYPE (USCS): | SM | 100.0% | 43.4% |



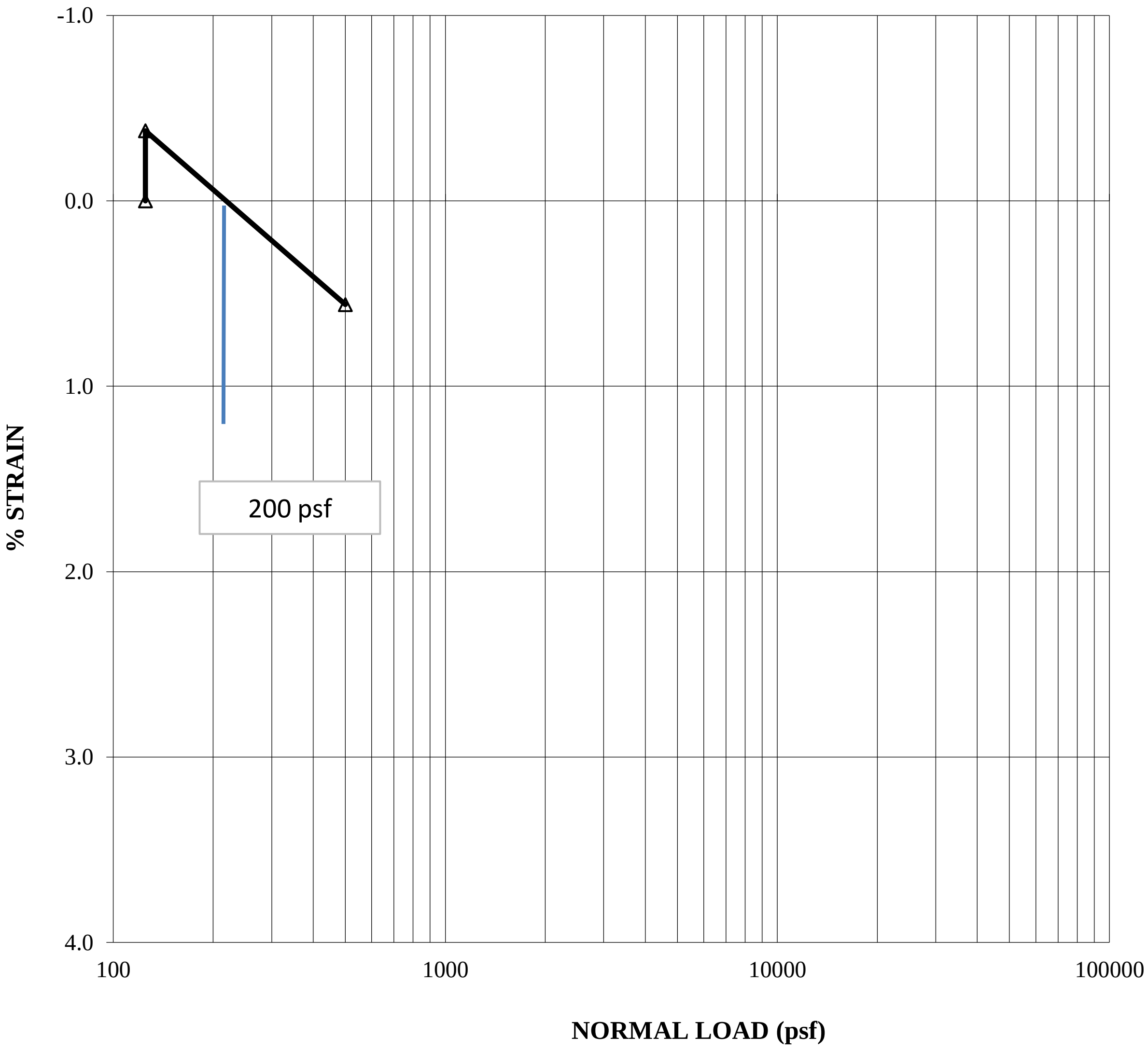
| BUTANO<br>GEOTECHNICAL ENGINEERING, INC. | **GRAIN SIZE DISTRIBUTION**<br>3406 17 mile Drive | FIGURE<br>C-1 |
|---|---|---|

| | | | |
|---|---|---|---|
| BORING: | B1-1 | ASTM D 4546-03 | |
| DEPTH (ft): | 1.0 | | |
| SOIL TYPE (USCS): | CL | FIELD MOISTURE: | 15.0% |
| | | FINAL MOISTURE: | 16.2% |



| | | |
|---|---|---|
| BUTANO<br>GEOTECHNICAL ENGINEERING, INC. | **SWELL TEST RESULTS**<br>3406 17 Mile Drive | FIGURE<br>C-2 |

|  |  |  |  |
|---|---|---|---|
| BORING: | B1-3 | ASTM D 4546-03 |  |
| DEPTH (ft): | 4.0 |  |  |
| SOIL TYPE (USCS): | CL | FIELD MOISTURE: | 17.3% |
|  |  | FINAL MOISTURE: | 22.2% |



| BUTANO<br>GEOTECHNICAL ENGINEERING, INC. | **SWELL TEST RESULTS**<br>3406 17 Mile Drive | FIGURE<br>C-3 |
|---|---|---|

# Important Information about Your

# Geotechnical Engineering Report

*Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.*

*While you cannot eliminate all such risks, you can manage them. The following information is provided to help.*

## Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you* — should apply the report for any purpose or project except the one originally contemplated.

## Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

## A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

## Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

## Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

## A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

## A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

## Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

## Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

## Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations" many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

## Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

## Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

## Rely, on Your ASFE-Member Geotechncial Engineer for Additional Assistance

Membership in ASFE/The Best People on Earth exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with your ASFE-member geotechnical engineer for more information.

**ASFE**
**THE BEST PEOPLE ON EARTH**

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