APPENDIX 8.2
Preliminary Geotechnical Evaluation

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September 1, 2015
Project No. 1-0172

Attention: Mr. Alan Toffoli

Subject: **PRELIMINARY GEOTECHNICAL INVESTIGATION**
Proposed Residential Development, 929 Baker Street
City of Costa Mesa, California

References: See Appendix A

Mr. Toffoli:

Presented herein is Alta California Geotechnical, Inc.'s (Alta) preliminary geotechnical investigation report for a proposed residential development located at 929 Baker Street, in the City of Costa Mesa, County of Orange, California. This report is based on a recent subsurface investigation conducted by Alta, laboratory testing, and review of the referenced reports.

Alta's review of the data indicates that the proposed development is feasible, from a geotechnical perspective, provided that the recommendations presented in this report are incorporated into the grading and improvement plans and implemented during site development.

Also included in this report are:

- Discussion of the site geotechnical conditions;
- Recommendations for remedial and site grading, including unsuitable soil removals;
- Geotechnical site construction recommendations;
- Preliminary foundation design parameters.

If you have any questions or should you require any additional information, please contact the undersigned at (951) 509-7090. Alta appreciates the opportunity to provide geotechnical consulting services for your project.

Sincerely,
Alta California Geotechnical, Inc.

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1.0 INTRODUCTION

The following report presents Alta's findings, conclusions, and geotechnical recommendations for the proposed residential development, located at 929 Baker Street, in the City of Costa Mesa, California.

1.1 Purpose

The purpose of this report is to examine the existing onsite geotechnical conditions and assess the impacts that the geotechnical conditions may have on the proposed development. The property is depicted on the enclosed concept site study map (Plate 1) provided by Woodley Architectural Group, Inc. This report is suitable for use in developing grading plans and engineer's cost estimates.

1.2 Scope of Work

Alta's *Scope of Work* for this geotechnical investigation included the following:

- Reviewing the referenced reports (Appendix A);
- Site geologic mapping;
- Excavating, logging, and sampling seven (7) hollow-stem auger borings to a maximum depth of 31-feet below the existing surface (Appendix B);
- Conducting laboratory testing on samples obtained during our investigation (Appendix C);
- Performing an infiltration study to provide a preliminary assessment of the infiltration characteristics of the onsite soil and their impact on storm water disposal;
- Evaluating engineering geologic and geotechnical engineering data, including laboratory data, to develop recommendations for site remedial grading including specialized grading techniques for unsuitable soil removals along the property boundary, import soil, foundations and utilities;
- Preparing this report and accompanying exhibits.

1.3 Report Limitations

The conclusions and recommendations presented in this report are based on the field and laboratory information generated during this investigation, and a review of the referenced reports. The information contained in this report is intended to be used for development of grading plans and preliminary construction cost estimates.

2.0 PROJECT DESCRIPTION

2.1 Site Location and Existing Conditions

The 4.7-acre, flat, rectangular-shaped site is located at 929 Baker Street, in the City of Costa Mesa, California. Currently, the site is occupied by Baker Self-Storage and parking lots. The site is bounded by Baker Street to the north, commercial buildings to the east, residential houses to the west, and a flood control access road to the south. Buried private utility lines are likely present onsite.

2.2 Proposed Development

It is Alta's understanding that the existing structures and site improvements are to be redeveloped into a residential project consisting of 56 residential units, a 0.19-acre park, with interior roads and parking lots. Access to the project is via Baker Street. Alta anticipates that remedial grading will be required to develop the site for the support of wood-frame and stucco construction with shallow foundations and reinforced concrete slabs-on-grade, and associated improvements.

3.0 SITE INVESTIGATION

3.1 Investigation and Laboratory Testing

Alta conducted a subsurface investigation on August 14, 2015, consisting of the excavation, logging and select sampling of seven (7) hollow-stem auger borings.

The locations of the borings are shown on Plate 1 and the boring logs are presented in Appendix B.

Laboratory testing was performed on bulk and ring samples obtained during the field investigation. A brief description of the laboratory test procedures and the test results are presented in Appendix C.

3.2 Infiltration Testing

It is Alta's understanding that the site may utilize infiltration systems for storm water disposal. Details of the system are not known at this time.

Infiltration testing was undertaken using two five (5) foot-deep borings (P-1 and P-2, respectively). The testing was performed on August 17, 2015 in general conformance with the County of Orange Department of Public Works Administrative Manual for boring infiltration testing procedures. The two test wells were presoaked for more than 24-hours prior to testing. During the test water level readings were recorded every 30 minutes until the readings stabilized.

The data was then adjusted to provide an infiltration rate utilizing the Porchet Method. The resulting infiltration rate is 0 inches per hour for P-1 and P-2, when considering the standard Factory of Safety of 3 (per County of Orange, 2011). Recommendations for infiltration BMP design are presented in Section 6.2.

4.0 GEOLOGIC CONDITIONS

4.1 Geologic and Geomorphic Setting

Regionally, the subject site is located in the Peninsular Ranges geomorphic province, which characterizes the southwest portion of southern California where major right-lateral active fault zones predominately trend northwest-southeast. The Peninsular Ranges province is composed of plutonic and metamorphic rock, with lesser amounts of Tertiary volcanic and sedimentary rock, Quaternary drainage in-fills and sedimentary veneers.

4.2 Stratigraphy

Based on Alta's review of geologic literature and our subsurface investigation, the project site is underlain by undocumented artificial fills and Quaternary-aged very old marine deposits. The geologic units are briefly described below.

4.2.1 Artificial Fill - Undocumented (Map symbol Afu)

The site contains a large rectangular storage building that occupies most of the site. The area surrounding the storage unit is covered with asphalt. All borings drilled during the subsurface investigation were in the asphalt parking areas. The asphalt was approximately 2.5 to 6.5-inches thick on top of an aggregate base section that measured between 0 to 6-inches. The fill ranged from two to four feet in thickness and consisted of bluish black, dark gray and dark brown clay, sandy clay and silty clay in a moist, moderately firm to firm condition. The fill is underlain by very old marine deposits.

4.2.2 Very Old Marine Deposits (Map symbol Qvom)

The very old marine deposits observed at the site consist mainly of brown, dark brown and tan brown silty clay, sandy clay and clay, in a moist, firm to stiff condition. The unit was logged to a depth of 31 feet below the ground surface.

4.3 Geologic Structure

4.3.1 Tectonic Framework

Jennings and Bryant (2010) defined eight structural provinces within California that have been classified by predominant regional fault trends and similar fold structure. These provinces are in turn divided into blocks and sub-blocks that are defined by "major Quaternary faults." These blocks and sub-blocks exhibit similar structural features. Within this framework (Jennings and Bryant, 2010), the site is located within Structural Province I, which is controlled by the dominant northwest trend of the San Andreas Fault and is divided into two blocks, the Coast Range Block and the Peninsular Range Block. The Peninsular Range Block, on which the site is located, is characterized by a series of parallel, northwest trending faults that exhibit right lateral dip-slip movement. These faults are terminated by the Transverse Range block to the north and extend southward to the Baja Peninsula. These northwest trending faults divide the Peninsular Range block into eight sub-blocks. The site is located on the Santa Ana sub-block, one of the eight sub-blocks, which is bound on the east by the Elsinore-Whittier fault zone and on the west by the Newport-Inglewood fault zone.

The site is located on the northern portion of the Santa Ana sub-block, approximately 0.95 miles southeast of the San Joaquin fault, approximately 4.5 miles northeast of the Newport-Inglewood fault zone, approximately 13.4 miles southwest of the Puente Hills fault, and approximately 16.7 miles southwest of the Elsinore fault zone. The subject site is not located within an "Alquist-Priolo" Special Studies Zone. As such, the chances for surface rupture during or as a consequence of seismic activity are considered unlikely.

4.3.2 Regionally Mapped Active Faults

Several large, active fault systems, including the Elsinore-Whittier, the Newport-Inglewood, the San Jacinto, and the San Andreas, occur in the region surrounding the site. These fault systems have been studied extensively and in a large part control the geologic structure of southern California.

4.3.3 Geologic Structure

Based upon our site investigation and literature review, the onsite sediments are of Quaternary age, and are not fractured, folded, or faulted.

4.4 Groundwater

Groundwater was not encountered during the subsurface investigation. A review of a regional groundwater map indicates that historic groundwater level was at a depth of 30 feet (CDMG, 1997). A well that is located less than one mile from the site indicates that the current groundwater level is at a depth of approximately 30 feet (CDWR).

4.5 Earthquake Hazards

The subject site is located in southern California, which is a tectonically active area. The type and magnitude of seismic hazards affecting a site are dependent on the distance to the causative fault and the intensity and magnitude of the seismic event. The seismic hazard may be primary, such as surface rupture and/or ground shaking, or secondary, such as liquefaction and/or ground lurching.

4.5.1 Local and Regional Faulting

The closest mapped active fault is the San Joaquin Hills fault located 0.95 miles to the southeast. The site is not within an Alquist-Priolo Fault Hazard Zone (Bryant and Hart, 2007).

Ground shaking hazards caused by earthquakes along other active regional faults exist. The 2013 California Building Code requires use-modified spectral accelerations and velocities for most structural designs. Seismic design parameters using soil profile types identified in the 2013 California Building Code are presented in Section 7.3.

4.5.2 Surface Rupture

Active faults are not known to exist within the project and a review of Special Publication 42 indicates the site is not within the California State designated Alquist-Priolo earthquake fault zones (Bryant and Hart, 2007). Accordingly, the potential for fault surface rupture on the subject site is very low.

4.5.3 Liquefaction

Seismic agitation of relatively loose saturated sands, silty sands, and some silts can result in a buildup of pore pressure. If the pore pressure exceeds the overburden stresses, a temporary quick condition known as liquefaction can occur. Liquefaction effects can manifest in several ways including: 1) loss of bearing; 2) lateral spread; 3) dynamic settlement; and 4) flow failure. Lateral spreading has typically been the most damaging mode of failure.

In general, the more recent that a sediment has been deposited, the more likely it will be susceptible to liquefaction. Other factors that must be considered are: groundwater, confining stresses, relative density, and the intensity and duration of seismically-induced ground shaking.

Groundwater was not encountered during the subsurface investigation which extended to a depth of 31 feet. Historic high groundwater is at a depth of 30 feet below existing grade. Based on the density an fine-grained nature of the very old marine deposit, it is Alta's opinion that the potential for liquefaction is minimal at the site.

4.5.4 Dry Sand Settlement

Dry sand settlement is the process of non-uniform settlement of the ground surface during a seismic event. Based on the soil type present onsite and the dense nature of the marine deposits, dry sand settlement is not anticipated to be a significant constraint.

4.5.5 Seismically Induced Landsliding

Due to a lack of slopes within or nearby the property, seismically induced landsliding is not anticipated to pose a danger to the site.

5.0 ENGINEERING PROPERTIES AND ANALYSIS

5.1 Materials Properties

Presented herein is a general discussion of the engineering properties of the onsite materials that will be encountered during construction of the proposed project. Descriptions of the soil (Unified Soil Classification System) are presented on the boring logs in Appendix B.

5.1.1 Excavation Characteristics

Based on the data provided from the subsurface investigations, it is our opinion that the majority of the on-site materials possess favorable excavation characteristics such that conventional equipment can be utilized.

5.1.2 Compressibility

The artificial fill and upper portions of the very old marine deposits onsite are considered compressible and unsuitable to support the proposed improvements. Recommended removal depths are presented in Section 6.1.2.

5.1.3 Expansion Potential

Expansion index testing was performed on samples taken during our subsurface investigation. Based on the results, it is anticipated that the majority of materials onsite are "high" in expansion potential ($90 \leq EI \leq 130$, Appendix C) when tested per ASTM D: 4829.

5.1.4 Earthwork Adjustments

The values presented in Table 5-2 are deemed appropriate for estimating purposes and may be used in an effort to balance earthwork quantities. As is the case with every project, contingencies should be made to adjust the earthwork balance when grading is in-progress and actual conditions are better defined.

TABLE 5-2
Earthwork Adjustment Factors

Geologic Unit	Adjustment Factor Range	Average
Artificial Fill and Old Marine Deposits	Shrink 13% to 15%	14%

5.1.5 Chemical Analyses

Chemical testing was performed on samples of material underlying the proposed site. Soluble sulfate test results indicate that the soluble sulfate concentrations of the soils tested are classified as severe (Category S2) per ACI 318-11.

Negligible chloride levels were detected in the onsite soils. Resistivity testing conducted as part of this investigation, indicates that the soils are "severely corrosive" to buried metals (per Romanoff, 1989). Additional discussions on corrosion are presented in Section 7.9. Corrosion tests results are presented in Appendix C.

5.2 Engineering Analysis

Presented below is a general discussion of the engineering analysis methods that were utilized to develop the conclusions and recommendations presented in this report.

5.2.1 Bearing Capacity and Lateral Earth Pressures

Ultimate bearing capacity values were obtained using the graphs and formula presented in NAVFAC DM-7.1. Allowable bearing was determined by applying a factor of safety of at least 3 to the ultimate bearing capacity. Static lateral earth pressures were calculated using Rankine methods for active and passive cases. If it is desired to use Coulomb forces, a separate analysis specific to the application can be conducted.

6.0 CONCLUSIONS AND RECOMMENDATIONS

Based on Alta's findings during our subsurface investigation, the laboratory test results, our staff's previous experience in the area, it is Alta's opinion that the development of the site is feasible from a geotechnical perspective. Presented below are recommendations that should be incorporated into site development and construction plans.

6.1 General Earthwork Recommendations

All grading shall be accomplished under the observation and testing of the project geotechnical consultant in accordance with the recommendations contained herein and the City of Costa Mesa criteria.

6.1.1 Site Preparation

Vegetation, construction debris, and other deleterious materials are unsuitable as structural fill material and should be disposed of off-site prior to commencing grading/construction. Any septic tanks, seepage pits or wells should be abandoned as per the County of Orange Department of Health Services.

6.1.2 Unsuitable Soil Removals

The artificial fill and the upper portions of the very old marine deposits onsite are compressible and as such, are not suitable to support the proposed structures. Accordingly, it is recommended to remove and re-compact the upper five (5) to six (6) feet of existing soils on the building pads. This recommended removal combined with the foundation recommendations presented in Section 7.1 should provide suitable support for the proposed structures.

The Project Geotechnical Consultant should observe the removal bottom prior to placing fill. If unsuitable soils such as undocumented artificial fill are exposed upon the completion of the removals recommended above, additional removals may be required. This recommended removal is based on the assumptions that limited fill above the existing ground surface will be placed onsite.

6.1.3 Compaction Standards

All fill and processed natural ground shall be compacted to a minimum relative compaction of 90 percent, as determined by ASTM Test Method: D-1557. Fill material should be moisture conditioned to optimum moisture or above, and as generally discussed in Alta's Earthwork Specification Section presented in Appendix E. Compaction shall be achieved with the use of sheepsfoot rollers or similar kneading type equipment. Mixing and moisture conditioning will be required in order to achieve the recommended moisture conditions.

6.1.4 Groundwater/Seepage

It is anticipated that groundwater will not be encountered during construction. It is possible that perched water conditions could be encountered depending on the time of year construction occurs.

6.1.5 Documentation of Removals

All removal/over-excavation bottoms should be observed and approved by the project Geotechnical Consultant prior to fill placement. Consideration should be given to surveying the removal bottoms and undercuts after approval by the geotechnical consultant and prior to the placement of fill. Staking should be provided in order to verify undercut locations and depths.

6.1.6 <u>Treatment of Removal Bottoms</u>

At the completion of removals/over-excavation, the exposed removal bottom should be ripped to a minimum depth of eight (8) inches, moisture-conditioned to above optimum moisture content and compacted in-place to the project standards.

6.1.7 <u>Fill Placement</u>

After removals, scarification, and compaction of in-place materials are completed, additional fill may be placed. Fill should be placed in eight-inch bulk maximum lifts, moisture conditioned to optimum moisture content or above, compacted and tested as grading/construction progresses until final grades are attained.

6.1.8 <u>Mixing</u>

Mixing of materials may be necessary to prevent layering of different soil types and/or different moisture contents. The mixing should be accomplished prior to and as part of compaction of each fill lift.

6.1.9 <u>Import Soils</u>

Import soils, if necessary, should consist of clean, low expansive, structural quality, compactable materials similar to the on-site soils and should be free of trash, debris or other objectionable materials. The project Geotechnical Consultant should be notified not less than 72 hours in advance of the locations of any soils proposed for import. Import sources should be sampled, tested, and approved by the project Geotechnical Consultant at the source prior to the importation of the soils to the site. The project Civil Engineer should include these requirements on plans and specifications for the project.

6.1.10 Utility Trenches

6.1.10.1 Excavation

Utility trenches should be supported, either by laying back excavations or shoring, in accordance with applicable OSHA standards. In general, existing site soils are classified as Soil Types "B" per OSHA standards. Upon completion of the recommended removals and recompaction, the artificial fill will be classified as Soil Type "B". The Project Geotechnical Consulting should be consulted if geologic conditions vary from what is presented in this report.

6.1.10.2 Backfill

Trench backfill should be compacted to at least 90 percent of maximum dry density as determined by ASTM D-1557. Onsite soils will not be suitable for use as bedding material but will be suitable for use in backfill provided oversized materials are removed. No surcharge loads should be imposed above excavations. This includes spoil piles, lumber, concrete trucks, or other construction materials and equipment. Drainage above excavations should be directed away from the banks. Care should be taken to avoid saturation of the soils. Compaction should be accomplished by mechanical means. Jetting of native soils will not be acceptable.

Under-slab trenches should also be compacted to project specifications. If select granular backfill (SE > 30) is used, compaction by flooding will be acceptable.

6.1.11 Backcut Stability

Temporary backcuts, if required during unsuitable soil removals, should be made no steeper than 1:1 without review and approval of the geotechnical consultant. Flatter backcuts may be necessary where geologic conditions dictate and where minimum width dimensions are to be maintained.

Care should be taken during remedial grading operations in order to minimize risk of failure. Should failure occur, complete removal of the disturbed material will be required.

In consideration of the inherent instability created by temporary construction backcuts for removals, it is imperative that grading schedules are coordinated to minimize the unsupported exposure time of these excavations. Once started, these excavations and subsequent fill operations should be maintained to completion without intervening delays imposed by avoidable circumstances. In cases where five-day workweeks comprise a normal schedule, grading should be planned to avoid exposing at-grade or near-grade excavations through a non-work weekend. Where improvements may be affected by temporary instability, either on or offsite, further restrictions such as slot cutting, extending work days, implementing weekend schedules, and/or other requirements considered critical to serving specific circumstances may be imposed.

6.2 Storm Water Infiltration Systems

Municipalities have been increasing the requirement for onsite storm water infiltration, rather than allowing water to enter storm drain systems. From a geotechnical perspective, allowing storm water to infiltrate the onsite soil in concentrated areas increases the potential for settlement, liquefaction, and water-related damage to structures/improvements, such as wet slabs or pumping subgrade, and should be avoided where possible. If infiltration systems are required on this site, care should be taken in designing systems that control the storm water as much as possible.

Preliminary infiltration testing was conducted at the site as part of this investigation, and the methodology is discussed in Section 3.2. The resulting infiltration rates for P-1 and P-2 were calculated to be 0-inches per hour, at approximately 5-feet below the existing ground surface. Historic high groundwater is 30 feet below the existing ground surface.

The results from the infiltration testing indicate that the infiltration rates within the very old marine deposits onsite are below the County of Orange's minimum requirements (0.3 inches/hour or greater) to utilize infiltration-type BMP's. Additionally, as previously noted, the onsite soils are highly expansive. Using infiltration type-systems could increase the potential for these expansive soils to negatively affect the proposed improvements. As such, due to the low infiltration rates and the highly expansive nature of the soil, infiltration-type BMP systems are not recommended for this site.

6.3 Boundary Conditions

The site is bounded to the east by commercial buildings, to the west by residential houses and to the south by a flood control access road. Construction of retaining/screen walls in these areas may require additional geotechnical recommendations concerning unsuitable soil removals and foundation design parameters. Boundary conditions for the project should be reviewed by the Project Geotechnical Consultant as the design progresses.

7.0 DESIGN CONSIDERATIONS

7.1 Structural Design

It is anticipated that a one to two-story, wood-frame and masonry residential structure with slab on-grade and shallow foundations will be constructed. Upon the completion of rough grading, finish grade samples should be collected and tested in order to provide specific recommendations as they relate to the individual building pad. These test results and corresponding design recommendations should be presented in a final rough grading report. Final slab and foundation design recommendations should be made based upon specific structure sitings, loading conditions, and as-graded soil conditions.

It is anticipated that the majority of onsite soils will possess "high" expansion potential when tested in general accordance with ASTM Test Method D: 4829.

7.1.1 Foundations

Foundations may be preliminary designed based on the values presented in Table 7-1 below.

Table 7-1
Foundation Design Parameters*

Allowable Bearing	2000 lbs/ft^2 (based on a minimum footing width of 12 inches and a minimum embedment of 24 inches)
Lateral Bearing	200 lbs/ft^2 at a depth of 12 inches plus 200 lbs/ft^2 for each additional 12 inches of embedment to a maximum of 2000 lbs/ft^2
Sliding Coefficient	0.30
Differential Settlement	Dynamic: Differential = 1/2-inches in 40 feet Static: Differential = 1/2 inch in 40 feet

*These values may be increased as allowed by Code to resist transient loads such as wind or seismic. Building code and structural design considerations may govern depth and reinforcement requirements and should be evaluated.

7.1.2 Post-Tensioned Slabs/Foundation Design Recommendations

Based on the expansion potential, it is recommended to utilize post-tensioned slabs for the project. Post-tensioned slabs for the project may be preliminarily designed utilizing the parameters presented in Tables 7-1 and 7-2. The parameters presented herein are based on methodology provided in the Design of Post-Tensioned Slabs-On-Ground, Third Edition, by the Post-Tensioning Institute, in accordance with the 2013 CBC.

TABLE 7-2
POST-TENSION SLAB DESIGN PARAMETERS

Category	Expansion Potential	Minimum Embedment	Edge Lift		Center Lift	
			Em (ft)	Ym (inch)	Em (ft)	Ym (inch)
III	High	24 inches	4.8	1.58	9.0	0.65

Slab Subgrade Moisture

Category III	Minimum 130% of optimum moisture to a depth of 12 inches prior to pouring concrete

Embedment*

The minimum outer footing embedment presented herein are based on expansion indexes. The structural engineer should verify the minimum embedment based on the number of floors supported by the footings, the structural loading, and the requirements of the latest California Building Code. If mat slabs are utilized, alternate embedment depths can be provided.

Moisture Barrier

A moisture barrier should be provided in accordance with the recommendations presented in Section 7.2

The parameters presented herein are based on procedures presented in the Design of Post-Tensioned Slabs-On-Ground, Third Edition. No corrections for vertical barriers at the edge of the slab, or for adjacent vegetation have been assumed. The design parameters are based on a Constant Suction Value of 3.9 pF.

7.2 Moisture Barrier

A moisture and vapor retarding system should be placed below the slabs-on-grade in portions of the structure considered to be moisture sensitive and should be capable of effectively preventing the migration of water and reducing the transmission of water vapor to acceptable levels. Historically, a 10-mil plastic membrane, such as Visqueen, placed between two to four inches of clean sand, has been used for this purpose. The use of this system or other systems can be considered, at the discretion of the designer, provided the system reduces the vapor transmission rates to acceptable levels.

7.3 Seismic Design

The following seismic design parameters are presented to be code compliant to the California Building Code (2013). The site has been identified as "D" site class in accordance with CBC, 2013, Table 1613.5.3 (1). Utilizing this information, the computer program USGS Seismic Design Maps Version 3.1.0 and ASCE 7-10 criterion, the spectral response accelerations are as follows.

Table 7-3
Seismic Design Parameters
Latitude 33.6789° N and Longitude -117.8960° W

Ss (period 0.2 sec)	1.580
SMs (period 0.2 sec)	1.580
SDs (period 0.2 sec)	1.053
S1 (period 1.0 sec)	0.582
SM1 (period 1.0 sec)	0.873
SD1 (period 1.0 sec)	0.582

These parameters should be verified by the structural engineer. Additional parameters should be determined by the structural engineer based on the Occupancy Category of the proposed structures.

7.4 Fence and Garden Walls

Block walls, if used, should be embedded a minimum of 2 feet below the lowest adjacent grade. Construction joints (not more than 20 feet apart) should be included in the block wall construction. Side yard walls should be structurally separated from the rear yard wall.

7.5 Footing Excavations

Soils from the footing excavations should not be placed in slab-on-grade areas unless properly compacted and tested. The excavations should be cleaned of all loose/sloughed materials and be neatly trimmed at the time of concrete placement. The Project Geotechnical Consultant should observe the footing excavations prior to the placement of concrete to determine that the excavations are founded in suitably compacted material.

7.6 Retaining Walls

Retaining walls should be founded on engineered fill and should be backfilled with granular soils that allow for drainage behind the wall. Based on the fine-grained nature of the soils onsite, it is anticipated suitable free-draining backfill material will need to be imported to the site. Foundations may be designed in accordance with the recommendations presented in Table 7-1, above. Unrestrained walls, free to horizontally move 0.0005H (for dense cohesionless backfill), may be designed to resist lateral pressures imposed by a fluid with a unit weight determined in accordance with the Table 7-4 below. The table also presents design parameters for restrained (at-rest) retaining walls. These parameters may be used to design retaining walls that may be considered as restrained due to the method of construction or location (corner sections of unrestrained retaining walls).

TABLE 7-4
Equivalent Fluid Pressures for 90% Compacted Fill (Select Material)

Backfill	Active Pressure (psf/ft)	At-Rest Pressure (psf/ft)
Level	35	55

Per the requirements of the 2013 CBC, the seismic force acting on the retaining walls with backfill exceeding 6-feet in height may be resolved utilizing the formula $20H^2$ lb/lineal ft (H=height of the wall). This force acts at approximately 0.3H above the base of the wall. The seismic value can be converted as required by the retaining wall engineer. Retaining walls should be designed in general accordance with Section 1807A.2 of the 2013 CBC.

- Restrained retaining walls should be designed for "at-rest" conditions.
- The design loads presented in the above table are to be applied on the retaining wall in a horizontal fashion and as such friction between wall and retained soils should not be allowed in the retaining wall analyses.
- Additional allowances should be made in the retaining wall design to account for the influence of construction loads, temporary loads, and possible nearby structural footing loads.
- Select backfill should be granular, structural quality backfill with a Sand Equivalent of 20 or better and an ASCE Expansion Index of 20 or less. The backfill must encompass the full active wedge area. The upper one foot of backfill should be comprised of native on-site soils (see Plate A).
- The wall design should include waterproofing (where appropriate) and backdrains or weep holes for relieving possible hydrostatic pressures. The backdrain should be comprised of a 4-inch perforated PVC pipe in a 1 ft. by 1 ft., ¾-inch gravel matrix, wrapped with a geofabric. The backdrain should be installed with a minimum gradient of 2 percent and should be outletted to an appropriate location. For subterranean walls this may include drainage by sump pumps.
- No backfill should be placed against concrete until minimum design strengths are achieved in compression tests of cylinders.

It should be noted that the allowable bearing and lateral bearing values presented in Table 7-1 are based on level conditions at the toe. Modified design parameters can be presented for retaining walls with sloping condition at the toe. Other conditions should be evaluated on a case by case basis.

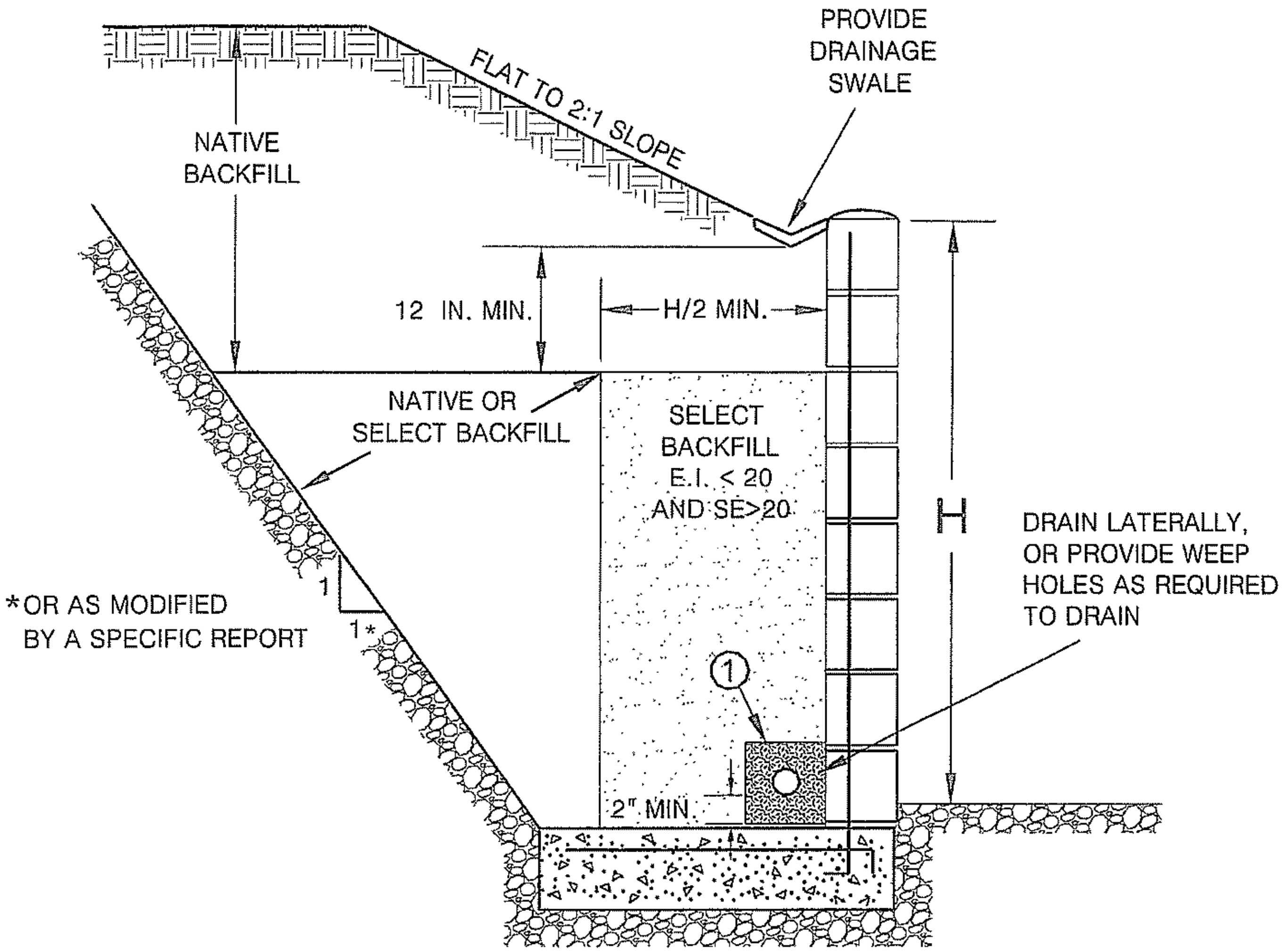
7.7 Exterior Slabs and Walkways

Exterior concrete slabs and walkways should be designed and constructed in consideration of the following recommendations.

7.7.1 Subgrade Compaction

The subgrade below exterior concrete slabs should be compacted to a minimum of 90 percent relative compaction as determined by ASTM Test Method: D 1557.

RETAINING WALL BACKFILL DETAIL



(1)

PIPE: 4-INCH PERFORATED PVC, SCHEDULE 40, SDR35 OR APPROVED ALTERNATE MINIMUM 8 PERFORATIONS (1/4-IN. DIA.) PER LINEAL FT. IN BOTTOM HALF OF PIPE

ROCK: MINIMUM VOLUME OF 1 CU. FT. OF 3/4-IN. MAX. ROCK PER. LINEAL FOOT OF PIPE, OR APPROVED ALTERNATE

FILTER FABRIC: MIRAFI 140 FILTER FABRIC OR APPROVED EQUIVALENT

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VER. 1/10

PLATE A

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7.7.2 Subgrade Moisture

The subgrade below concrete slabs should be moisture conditioned to a minimum of 130 percent of optimum moisture (high expansion) prior to concrete placement.

7.7.3 Concrete Slab Thickness

Concrete flatwork and driveways should be designed utilizing four-inch minimum thickness.

7.7.4 Concrete Slab Reinforcement

Due to the highly expansive nature of the onsite soils, consideration should be given to reinforcing concrete flatwork with #3 rebar spaced 24 inches on-center or 6x6/W1.4xW1.4 welded wire mesh.

7.7.5 Control Joints

Weakened plane joints should be installed on walkways at intervals of approximately eight feet (maximum) or less. Exterior slabs should be designed to withstand shrinkage of the concrete.

7.8 Concrete Design

As stated in Section 5.1.5, severe concentrations of sulfates were detected in the onsite soils. Therefore, the use of sulfate resistant concrete is required per ACI 318-11 at this time. Post-grading conditions should be evaluated and final recommendations made at that time.

7.9 Corrosion

Based on preliminary testing, the onsite soils are severely corrosive to buried metal objects. Buried ferrous metals should be protected against the effects of corrosive soils in accordance with the manufacture's recommendations. Typical measures may include using non-corrosive backfill, protective coatings, wrapping, plastic pipes, or a combination of these methods. A corrosion engineer should be consulted if specific design recommendations are required by the improvement designer.

Per ACI 318-11, an exposure class of C1 would be applicable to metals encased in concrete (rebar in footings) due to being exposed to moisture from surrounding soils.

8.0 LOT MAINTENANCE

Ongoing maintenance of the improvements is essential to the long-term performance of structures. As such, the owners must implement certain maintenance procedures. The attached " Maintenance and Improvement Considerations" presented in the Appendix D may be included as part of the sales packet to educate the owners in issues related to drainage, maintenance, backyard improvements, etc. The following recommendations should also be implemented.

8.1 Lot Drainage

Roof, pad and lot drainage should be collected and directed away from structures and slopes and toward approved disposal areas. Design fine grade elevations should be maintained through the life of the structure or if design fine grade elevations are altered, adequate area drains should be installed in order to provide rapid discharge of water, away from structures and slopes. Residents should be made aware that they are responsible for maintenance and cleaning of all drainage terraces, down drains, and other devices that have been installed to promote structure and slope stability.

8.2 Burrowing Animals

Residents or owners should undertake a program for the elimination of burrowing animals.

9.0 FUTURE PLAN REVIEWS

This report represents a geotechnical review of the site. As the project design for the project progresses, site specific geologic and geotechnical issues should be considered in the design and construction of the project. Consequently, future plan reviews may be necessary. These reviews may include reviews of:

- Grading Plans
- Foundation Plans
- Utility Plans

These plans should be forwarded to the project Geotechnical Consultant for review.

10.0 CLOSURE

10.1 Geotechnical Review

For the purposes of this report, multiple working hypotheses were established for the project, utilizing the available data and the most probable model is used for the analysis. Future information collected during the proposed grading operations is intended to evaluate the hypothesis and as such, some of the assumptions summarized in this report may need to be changed. Some modifications of the grading recommendations may become necessary, should the conditions encountered in the field differ from the conditions hypothesized in this report.

Plans and sections of the project specifications should be reviewed by Alta to evaluate conformance with the intent of the recommendations contained in this report. If the project description or final design varies from that described in herein, Alta must be consulted regarding the applicability of the recommendations contained herein and whether any changes are required. Alta accepts no liability for any use of its recommendations if the project description or final design varies and Alta is not consulted regarding the alterations.

10.2 Limitations

This report is based on the following: 1) the project as presented on the attached plan; 2) the information obtained from Alta's laboratory testing included herein; and 3) from the information presented in the referenced reports. The findings and recommendations are based on the results of the subsurface investigation, laboratory testing, and office analysis combined with an interpolation and extrapolation of conditions between and beyond the subsurface excavation locations. However, the materials adjacent to or beneath those observed may have different characteristics than those observed and no precise representations are made as to the quality or extent of the materials not observed. The results reflect an interpretation of the direct evidence obtained. Work performed by Alta has been conducted in a manner consistent with the level of care and skill ordinarily exercised by members of the geotechnical profession currently practicing in the same locality under similar conditions. No other representation, either expressed or implied, and no warranty or guarantee is included or intended.

The recommendations presented in this report are based on the assumption that an appropriate level of field review will be provided by a geotechnical consultant who is familiar with the design and site geologic conditions. That field review shall be sufficient to confirm that geotechnical and geologic conditions exposed during grading are consistent with the geologic representations and corresponding recommendations presented in this report.

The conclusions and recommendations included in this report are applicable to the specific design of this project as discussed in this report. They have no applicability to any other project or to any other location and any and all subsequent users accept any and all liability resulting from any use or reuse of the data, opinions, and recommendations without the prior written consent of Alta.

Alta has no responsibility for construction means, methods, techniques, sequences, procedures, safety precautions, programs in connection with the construction, acts or omissions of the CONTRACTOR or any other person performing any of the construction, or for the failure of any of them to carry out the construction in accordance with the final design drawings and specifications.

APPENDIX A

REFERENCES

APPENDIX A

Selected References

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APPENDIX B

Subsurface Investigation

APPENDIX B

Subsurface Investigation

Alta's subsurface investigation consisted of excavating, logging, and sampling seven (7) hollow-stem auger borings. Details of the subsurface investigation are presented in Table B-1. The approximate location of the exploratory excavation is shown on the accompanying site plan (Plate 1) and the Geotechnical Logs are attached.

TABLE B-1
SURFACE INVESTIGATION DETAILS

Equipment	Range of Depths	Sampling Methods	Sample Locations
Hollow-stem auger	Up to 31 feet	1. Bulk 2. Ring Samples	1. Bulk-Select Depth 2. Every 5-feet

UNIFIED SOIL CLASSIFICATION SYSTEM

Major Divisions		grf	ltr	Description
Coarse Grained Soils More than 50% retained on No. 200 sieve	Gravel and Gravelly Soils More than 50% of coarse fraction retained on No,. 4 sieve		GW	Well-graded gravels or gravel sand mixtures, little or no fines
			GP	Poorly-graded gravels or gravel sand mixture, little or no fines
			GM	Silty gravels, gravel-sand-silt mixtures
			GC	Clayey gravels, gravel-sand-clay mixtures
	Sand and Sandy Soils More than 50% of coarse fraction passes on No,. 4 sieve		SW	Well-graded sands or gravelly sands, little or no fines
			SP	Poorly-graded sands or gravelly sands, little or no fines
			SM	Silty sands, sand-silt mixtures
			SC	Clayey sands, and-clay mixtures

Major Divisions		grf	ltr	
Fine Grained Soils More than 50% passes on No. 200 sieve	Silts And Clays LL,<50		ML	Inorganic silts and very fine sands, rock flour, 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 silt-clays of low plasticity
	Silts And Clays LL,<50		MH	Inorganic silts, micaceous or diatomaceous fine or silty soils, elastic silts
			VH	Inorganic clays of high plasticity, fat clays
			OH	Organic clays of medium to high plasticity
Highly Organic Soils			PT	Peat and other highly organic soils

BOUNDARY CLASSIFICATION: Soils possessing characteristics of two groups are designated by combinations of group symbols.

PARTICLE SIZE LIMITS

U.S. STANDARD SERIES SIEVE — CLEAR SQUARE SIEVE OPENINGS

	200	40	10	4	3/4"	3"	12"
Silts and Clays	Sand			Gravel		Cobbles	Boulders
	Fine	Medium	Coarse	Fine	Coarse		

RELATIVE DENSITY

Sands and Gravels	Blows/Foot (SPT)
Very Loose	<4
Loose	4-10
Medium Dense	11-30
Dense	31-50
Very Dense	>50

CONSISTENCY CLASSIFICATION

Silts and Clays	Criteria
Very Soft	Thumb penetrates soil >1 in.
Soft	Thumb penetrates soil 1 in.
Firm	Thumb penetrates soil 1/4 in.
Stiff	Readily indented with thumbnail
Very Stiff	Thumbnail will not indent soil

HARDNESS

Bedrock
Soft
Moderately Hard
Hard
Very Hard

LABORATORY TESTS

Symbol	Test
DS	Direct Shear
DSR	Direct Shear (Remolded)
CON	
SA	Sieve Analysis
MAX	Maximum Density
RV	Resistance (R) Value
EI	Expansion Index
SE	Sand Equivalent
AL	Atterberg Limits
CHEM	Chemical Analysis
HY	Hydrometer Analysis

SOIL MOISTURE

Increasing Visual Moisture Content

- Dry - Dry to touch
- Moist - Damp, but no visible free water
- wet - Visible free water

SIZE PROPORTIONS

Trace - <5%

Few - 5 to 10%

Some - 15 to 25%

KEY TO EXPLORATORY BORING LOGS

ALTA CALIFORNIA GEOTECHNICAL INC.

PLATE B

GEOTECHNICAL BORING LOG

PROJECT NO.	1-0172	PROJECT NAME	Baker storage	BORING DESIG.	B-1
DATE STARTED	8/14/15	GROUND ELEV.		LOGGED BY	MT
DATE FINISHED	8/14/15	GW DEPTH (FT)		NOTE	
DRILLER	2R Drilling	DRIVE WT.	140 lbs		
TYPE OF DRILL RIG	Hollow stem auger	DROP	30 in.		

DEPTH (Feet)	ELEV	SAMPLE TYPE	BLOWS	LITHOLOGY	GROUP SYMBOL	GEOTECHNICAL DESCRIPTION	MOISTURE CONT (%)	DRY DENSITY (pcf)	SAT-URATION (%)	OTHER TESTS
					ASPHALT	6 inches of asphalt over 6 inches of base.				
		B			CL	**UNDOCUMENTED ARTIFICIAL FILL** (afu): SILTY CLAY, bluish black to dark gray, moist, moderately firm.				
					CL	@4 ft. **VERY OLD MARINE DEPOSITS** (Qvom)				
5		R	25			@5 ft. CLAY, brown and light brown with orange oxide stains, moist, firm.	19.7	108	98	
10		R	32		CL	@10 ft. SILTY CLAY, dark tan to light brown mottled dark gray with orange oxide stains, moist, firm to moderately stiff.	24.3	99	97	
15		R	27			@15 ft. greenish dark tan and light brown.	22.8	104	99	
20		R	56		SM	@20 ft. SILT to SAND, fine grained, grayish tan and yellow tan, moist, moderately stiff/dense.	10.2	107	50	
25		R	24		ML	@25 ft. CLAYEY SILT, brown and greenish tan with orange oxide stains, moist, firm.	35.2	85	98	
30		R	28		SM	@30 ft. SILTY SAND to SANDY SILT, fine grained, yellowish brown and tannish gray, moist, medium dense/firm.	21.2	104	96	
						TOTAL DEPTH 31 FEET NO GROUNDWATER ENCOUNTERED NO CAVING OBSERVED				

SAMPLE TYPES:
- R RING (DRIVE) SAMPLE
- S SPT (SPLIT SPOON) SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE

GROUNDWATER
SEEPAGE
J: JOINTING C: CONTACT
B: BEDDING F: FAULT
S: SHEAR RS: RUPTURE SURFACE

Alta California Geotechnical, Inc.

P.N. 1-0172 PLATE B-1

GEOTECHNICAL BORING LOG

PROJECT NO. 1-0172
DATE STARTED 8/14/15
DATE FINISHED 8/14/15
DRILLER 2R Drilling
TYPE OF DRILL RIG Hollow stem auger

PROJECT NAME Baker storage
GROUND ELEV.
GW DEPTH (FT)
DRIVE WT. 140 lbs
DROP 30 in.

BORING DESIG. B-2
LOGGED BY MT
NOTE

DEPTH (Feet)	ELEV	SAMPLE TYPE	BLOWS	LITHOLOGY	GROUP SYMBOL	GEOTECHNICAL DESCRIPTION	MOISTURE CONT (%)	DRY (pcf) DENSITY	SAT-URATION (%)	OTHER TESTS
					ASPHALT	6 inches of asphalt over 4 inches of base.				
					CL	**UNDOCUMENTED ARTIFICIAL FILL** (afu): CLAY, dark gray, moist, moderately firm.				
5		R	14		CL	@5 ft. **VERY OLD MARINE DEPOSITS** (Qvom): SILTY CLAY, brown and greenish gray mottled black with orange oxide stains, moist, firm, trace gravel.	22.8	102	97	
10		R	16		CL	@10 ft. SILTY CLAY and SILT, light brown, and tannish gray with orange oxide stains, moist, firm.	32.0	89	98	
15		R	26		SP	@15 ft. SAND and CLAYEY SILT, very fine grained, yellowish brown and light brown with oxide stains, moist, medium dense/firm.	16.5	109	83	
20		R	56		ML	@20 ft. SILT and SAND, fine grained, dark tan, yellow tan and yellow, moist, stiff/dense.	4.6	102	20	
						TOTAL DEPTH 21 FEET NO GROUNDWATER ENCOUNTERED NO CAVING OBSERVED				

SAMPLE TYPES:
R RING (DRIVE) SAMPLE
S SPT (SPLIT SPOON) SAMPLE
B BULK SAMPLE
T TUBE SAMPLE

▼ GROUNDWATER
➤ SEEPAGE
J: JOINTING C: CONTACT
B: BEDDING F: FAULT
S: SHEAR RS: RUPTURE SURFACE

GEOTECHNICAL BORING LOG

PROJECT NO.	1-0172	PROJECT NAME	Baker storage		
DATE STARTED	8/14/15	GROUND ELEV.		BORING DESIG.	B-3
DATE FINISHED	8/14/15	GW DEPTH (FT)		LOGGED BY	MT
DRILLER	2R Drilling	DRIVE WT.	140 lbs	NOTE	
TYPE OF DRILL RIG	Hollow stem auger	DROP	30 in.		

DEPTH (Feet)	ELEV	SAMPLE TYPE	BLOWS	LITHOLOGY	GROUP SYMBOL	GEOTECHNICAL DESCRIPTION	MOISTURE CONT (%)	DRY (pcf) DENSITY	SAT-URATION (%)	OTHER TESTS
0					ASPHALT	4 inches of asphalt, no base.				
					CL	**UNDOCUMENTED ARTIFICIAL FILL** (afu): SILTY CLAY, dark brown, moist, firm.				
5		R	16		CL	@5 ft. **VERY OLD MARINE DEPOSITS** (Qvom): SANDY CLAY, fine grained, brown with orange oxide stains, moist, firm.	16.5	114	97	
10		R	24		ML	@10 ft. CLAYEY SILT, light brown and greenish tan, moist, firm.	29.5	92	98	
15		R	27		SP	@15 ft. SAND and SILT, very fine grained, grayish tan and yellowish tan, moist, medium dense/firm.	23.1	102	98	
20		R	27		SP	@20 ft. SAND and CLAYEY SILT, very fine grained, dark tannish yellow and light brown, moist, medium dense/firm, micaceous.	30.1	93	99	
25		R	19		CL	@25 ft. SILTY CLAY, dark tan and light tan, moist, firm, some gravel.	22.9	98	88	
30		R	33		SM	@30 ft. SILTY SAND, very fine grained, tannish gray with orange oxide stains, moist, medium dense, micro micaceous.	19.9	106	95	
						TOTAL DEPTH 31 FEET NO GROUNDWATER ENCOUNTERED NO CAVING OBSERVED				

SAMPLE TYPES:
- R RING (DRIVE) SAMPLE
- S SPT (SPLIT SPOON) SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE

- ▼ GROUNDWATER
- ► SEEPAGE
- J: JOINTING C: CONTACT
- B: BEDDING F: FAULT
- S: SHEAR RS: RUPTURE SURFACE

Alta California Geotechnical, Inc.

P.N. 1-0172

PLATE B-3

GEOTECHNICAL BORING LOG

PROJECT NO.	1-0172	PROJECT NAME	Baker storage	BORING DESIG.	B-4
DATE STARTED	8/14/15	GROUND ELEV.		LOGGED BY	MT
DATE FINISHED	8/14/15	GW DEPTH (FT)		NOTE	
DRILLER	2R Drilling	DRIVE WT.	140 lbs		
TYPE OF DRILL RIG	Hollow stem auger	DROP	30 in.		

DEPTH (Feet)	ELEV	SAMPLE TYPE	BLOWS	LITHOLOGY	GROUP SYMBOL	GEOTECHNICAL DESCRIPTION	MOISTURE CONT (%)	DRY DENSITY (pcf)	SAT-URATION (%)	OTHER TESTS
					ASPHALT	4 inches of asphalt over 3 inches of base.				
					CL	**UNDOCUMENTED ARTIFICIAL FILL** (afu): CLAY, dark brown, most, moderately firm.				
5		R	6			@5 ft. brown and tannish brown, soft, found a piece of brick.	29.3	92	98	
					CL	@6 ft. **VERY OLD MARINE DEPOSITS** (Qvom): CLAY, brown to tannish light brown, moist, firm.				
10		R	22		CL	@10 ft. SILTY CLAY and SAND, fine grained, light brown and dark tannish brown, moist, firm/medium dense.	23.8	103	99	
15		R	35		SC	@15 ft. CLAYEY SAND, very fine grained, dark tannish brown and light brown, moist, medium dense.	17.4	110	92	
20		R	80		SP	@20 ft. SAND and SILTY SAND, very fine grained, dark ran and tannish yellow, moist, dense.	6.8	112	38	
						TOTAL DEPTH 21 FEET NO GROUNDWATER ENCOUNTERED NO CAVING OBSERVED				

SAMPLE TYPES:
- R RING (DRIVE) SAMPLE
- S SPT (SPLIT SPOON) SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE

▼ GROUNDWATER
➤ SEEPAGE
J: JOINTING C: CONTACT
B: BEDDING F: FAULT
S: SHEAR RS: RUPTURE SURFACE

Alta California Geotechnical, Inc.

P.N. 1-0172 PLATE B-4

GEOTECHNICAL BORING LOG

PROJECT NO.	1-0172	PROJECT NAME	Baker storage		
DATE STARTED	8/14/15	GROUND ELEV.		BORING DESIG.	B-5
DATE FINISHED	8/14/15	GW DEPTH (FT)		LOGGED BY	MT
DRILLER	2R Drilling	DRIVE WT.	140 lbs	NOTE	
TYPE OF DRILL RIG	Hollow stem auger	DROP	30 in.		

DEPTH (Feet)	ELEV	SAMPLE TYPE	BLOWS	LITHOLOGY	GROUP SYMBOL	GEOTECHNICAL DESCRIPTION	MOISTURE CONT (%)	DRY (pcf) DENSITY	SAT-URATION (%)	OTHER TESTS
					ASPHALT	6.5 inches of asphalt over 3 inches of base.				
					CL	**UNDOCUMENTED ARTIFICIAL FILL** (afu): CLAY, gray, moist, firm.				
5		R	12		CL	@5 ft. **VERY OLD MARINE DEPOSITS** (Qvom): SILTY CLAY, light brown and dark tannish brown, moist, firm.	19.8	106	94	
10		R	10		CL	@10 ft. SILTY CLAY and SILTY SAND, very fine grained, light brown and dark tannish yellow, moist, moderately dense/firm.	35.1	85	98	
15		R	21		SC	@15 ft. CLAYEY SAND and SILTY CLAY, very fine grained, light brown, brown and dark tan, moist, medium dense/firm.	25.1	98	96	
20		R	59		SP	@20 ft. SAND to SILTY SAND, very fine grained, dark tan to dark yellow, moist, dense.	12.4	110	65	
						TOTAL DEPTH 21 FEET NO GROUNDWATER ENCOUNTERED NO CAVING OBSERVED				

SAMPLE TYPES:
- R RING (DRIVE) SAMPLE
- S SPT (SPLIT SPOON) SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE

▼ GROUNDWATER
➤ SEEPAGE
J: JOINTING C: CONTACT
B: BEDDING F: FAULT
S: SHEAR RS: RUPTURE SURFACE

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P.N. 1-0172 PLATE B-5

GEOTECHNICAL BORING LOG

PROJECT NO.	1-0172	PROJECT NAME	Baker storage		
DATE STARTED	8/14/15	GROUND ELEV.		BORING DESIG.	P-1
DATE FINISHED	8/14/15	GW DEPTH (FT)		LOGGED BY	MT
DRILLER	2R Drilling	DRIVE WT.		NOTE	
TYPE OF DRILL RIG	Hollow stem auger	DROP			

DEPTH (Feet)	ELEV	SAMPLE TYPE	BLOWS	LITHOLOGY	GROUP SYMBOL	GEOTECHNICAL DESCRIPTION	MOISTURE CONT (%)	DRY (pcf) DENSITY	SAT-URATION (%)	OTHER TESTS
					ASPHALT	2.5 inches of asphalt over 1.5 inches of base.				
					CL	**UNDOCUMENTED ARTIFICIAL FILL** (afu): SANDY CLAY, fine grained, dark brown, moist, firm.				
					CL	@3 ft. **VERY OLD MARINE DEPOSITS** (Qvom): CLAY, brown, moist, firm, trace gravel.				
5										
						TOTAL DEPTH 5 FEET NO GROUNDWATER ENCOUNTERED NO CAVING OBSERVED				

SAMPLE TYPES:
- R RING (DRIVE) SAMPLE
- S SPT (SPLIT SPOON) SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE

▼ GROUNDWATER
► SEEPAGE
J: JOINTING C: CONTACT
B: BEDDING F: FAULT
S: SHEAR RS: RUPTURE SURFACE

Alta California Geotechnical, Inc.

P.N. 1-0172

GEOTECHNICAL BORING LOG

PROJECT NO.	1-0172	PROJECT NAME	Baker storage
DATE STARTED	8/14/15	GROUND ELEV.	
DATE FINISHED	8/14/15	GW DEPTH (FT)	
DRILLER	2R Drilling	DRIVE WT.	
TYPE OF DRILL RIG	Hollow stem auger	DROP	

BORING DESIG. P-2
LOGGED BY MT
NOTE

DEPTH (Feet)	ELEV	SAMPLE TYPE	BLOWS	LITHOLOGY	GROUP SYMBOL	GEOTECHNICAL DESCRIPTION	MOISTURE CONT (%)	DRY (pcf) DENSITY	SAT-URATION (%)	OTHER TESTS
					ASPHALT	6.5 inches of asphalt over 3 inches of base.				
					CL	**UNDOCUMENTED ARTIFICIAL FILL** (afu): CLAY, dark gray, moist, firm.				
5										
						TOTAL DEPTH 5 FEET NO GROUNDWATER ENCOUNTERED NO CAVING OBSERVED				

SAMPLE TYPES:
- R RING (DRIVE) SAMPLE
- S SPT (SPLIT SPOON) SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE

GROUNDWATER
SEEPAGE
J: JOINTING C: CONTACT
B: BEDDING F: FAULT
S: SHEAR RS: RUPTURE SURFACE

Alta California Geotechnical, Inc.

P.N. 1-0172 PLATE B-7

APPENDIX C

Laboratory Testing

LABORATORY TESTING

The following laboratory tests were performed on a representative sample in accordance with the applicable latest standards or methods from the ASTM, California Building Code (CBC) and California Department of Transportation.

Classification

Soils were classified with respect to the Unified Soil Classification System (USCS) in accordance with ASTM D-2487 and D-2488.

Particle Size Analysis

Modified hydrometer testing was conducted to aid in classification of the soil. The results of the particle size analysis are presented in Table C.

Maximum Density/Optimum Moisture

The maximum dry density and optimum moisture content of one representative bulk sample was evaluated in accordance with ASTM D-1557. The results are summarized in Table C.

Expansion Index Tests

One (1) expansion index test was performed to evaluate the expansion potential of typical on-site soil. Testing was carried out in general conformance with ASTM Test Method D-4829. The results are presented in Table C.

Consolidation Tests

Consolidation testing was performed on three (3) relatively "undisturbed" soil samples at their natural moisture content in accordance with procedures outlined in ASTM D-2435. The samples were placed in a consolidometer and loads were applied incrementally in geometric progression. The samples (2.42-inches in diameter and 1-inch in height) were permitted to consolidate under each load increment until the slope of the characteristic linear secondary compression portion of the thickness versus log of time plot was apparent. The percent consolidation for each load cycle was recorded as the ratio of the amount of vertical compression to the original 1-inch height. The consolidation test results are shown on Plates C-1 through C-3.

Direct Shear Tests

Direct shear test was performed by Group Delta on remolded sample at 90% from B-1 at 1 to 5 feet. The result of this test is presented on Plate C-4.

Chemical Analyses

Chemical testing of selected samples was performed by Group Delta. The results of these tests are presented on Plate C-5.

TABLE C
SUMMARY OF LABORATORY TEST DATA
P.N. 1-0172

Boring/Pit No.	Depth	Soil Description	Group Symbol - Unified Soil Classification System	Maximum Dry Density		Direct Shear	Grain Size Analysis				Expansion Index	Sulfate Content (%)	Consolidation	Other Tests Remarks
				Maximum Density (pcf)	Optimum Moisture (%)		Gravel (% + No. 4 Screen)	% Sand	%Silt (0.074 to 0.005mm)	% Clay (-0.005 mm)				
B-1	1-5	Silty Clay (af)	CL	120.8	12.8	See Plate C-4	6	24	27	43	97	0.86		Chems: Plate C-5
B-2	5	Silty Clay (Qvom)	CL				6	19	30	45			See Plate C-1	
B-3	5	Sandy Clay (Qvom)	CL				1	37	29	33			See Plate C-2	
B-5	10	Silty Clay (Qvom)	CL				1	11	26	62			See Plate C-3	

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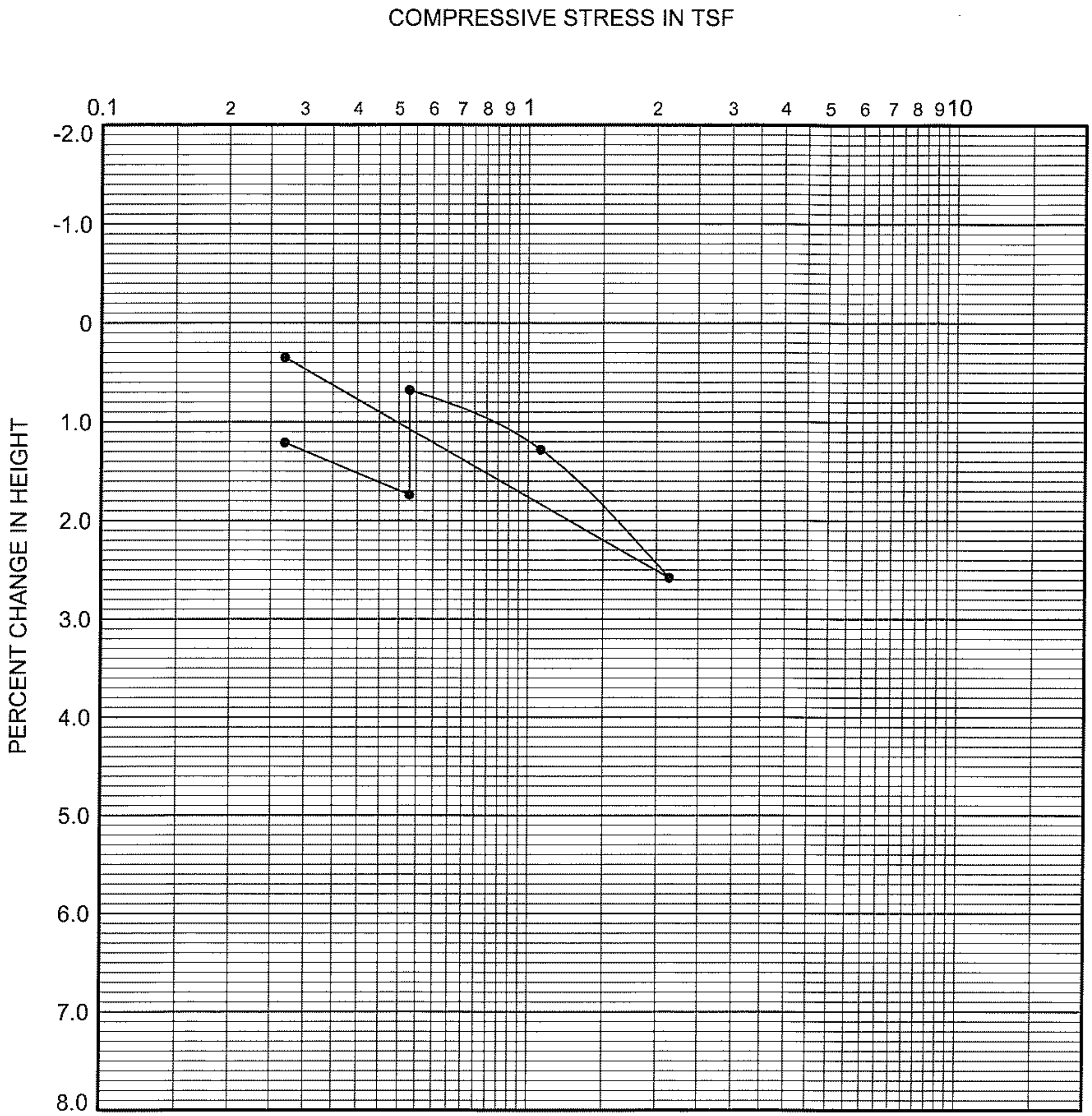


boring	depth (ft.)	dry density (pcf)	in situ moist. (%)	in situ satur. (%)	-200 sieve (%)	group symbol	typical names
B-2	5.0	102	22.8	97	75	CL	Silty clay (Qvom)

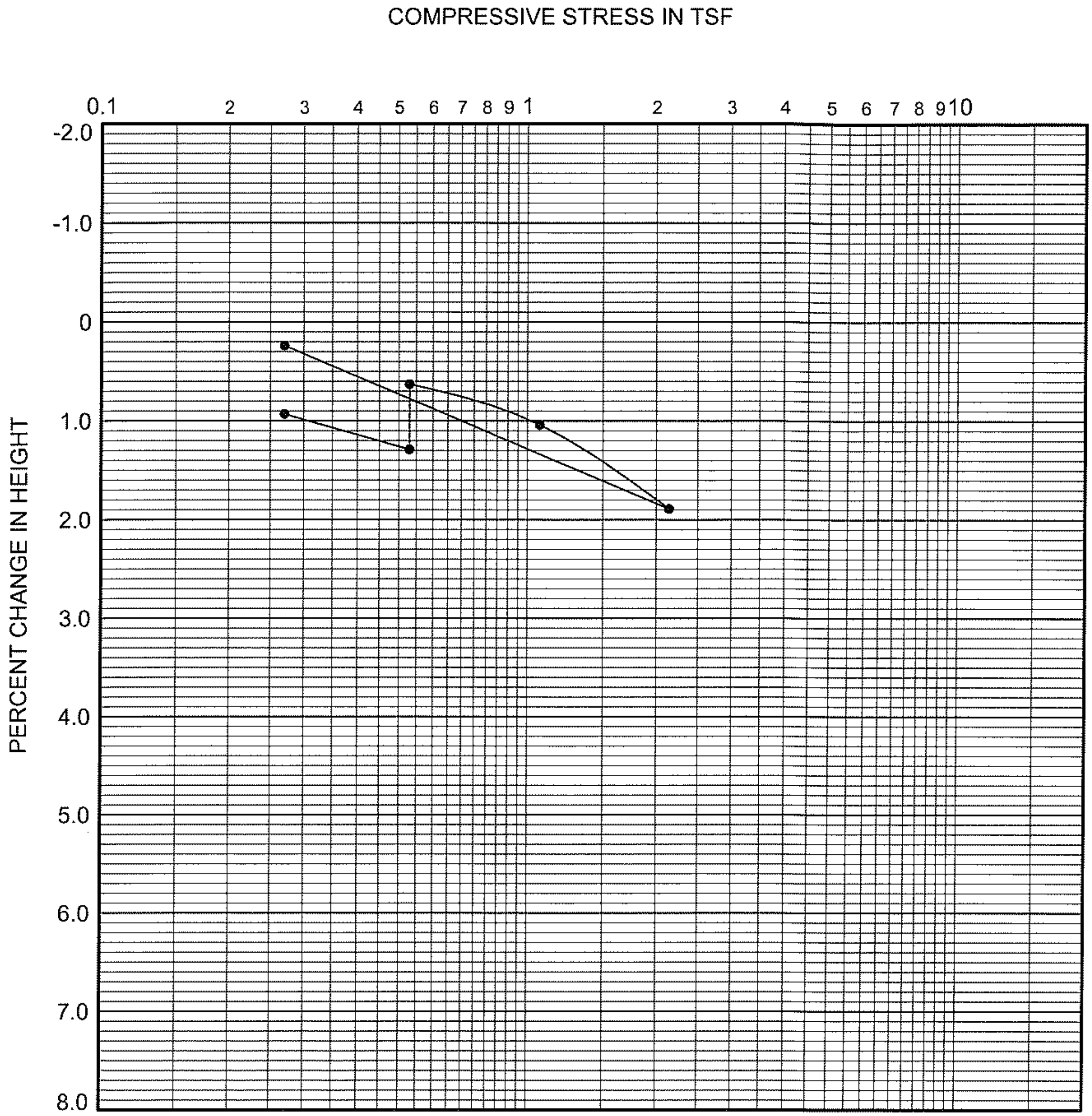
REMARKS: WATER ADDED AT 0.53 TSF

CONSOLIDATION CURVE

Alta California Geotechnical, Inc.

P.N. 1-0172

PLATE C-1



boring	depth (ft.)	dry density (pcf)	in situ moist. (%)	in situ satur. (%)	-200 sieve (%)	group symbol	typical names
B-3	5.0	114	16.5	97	62	CL	Sandy clay (Qvom)

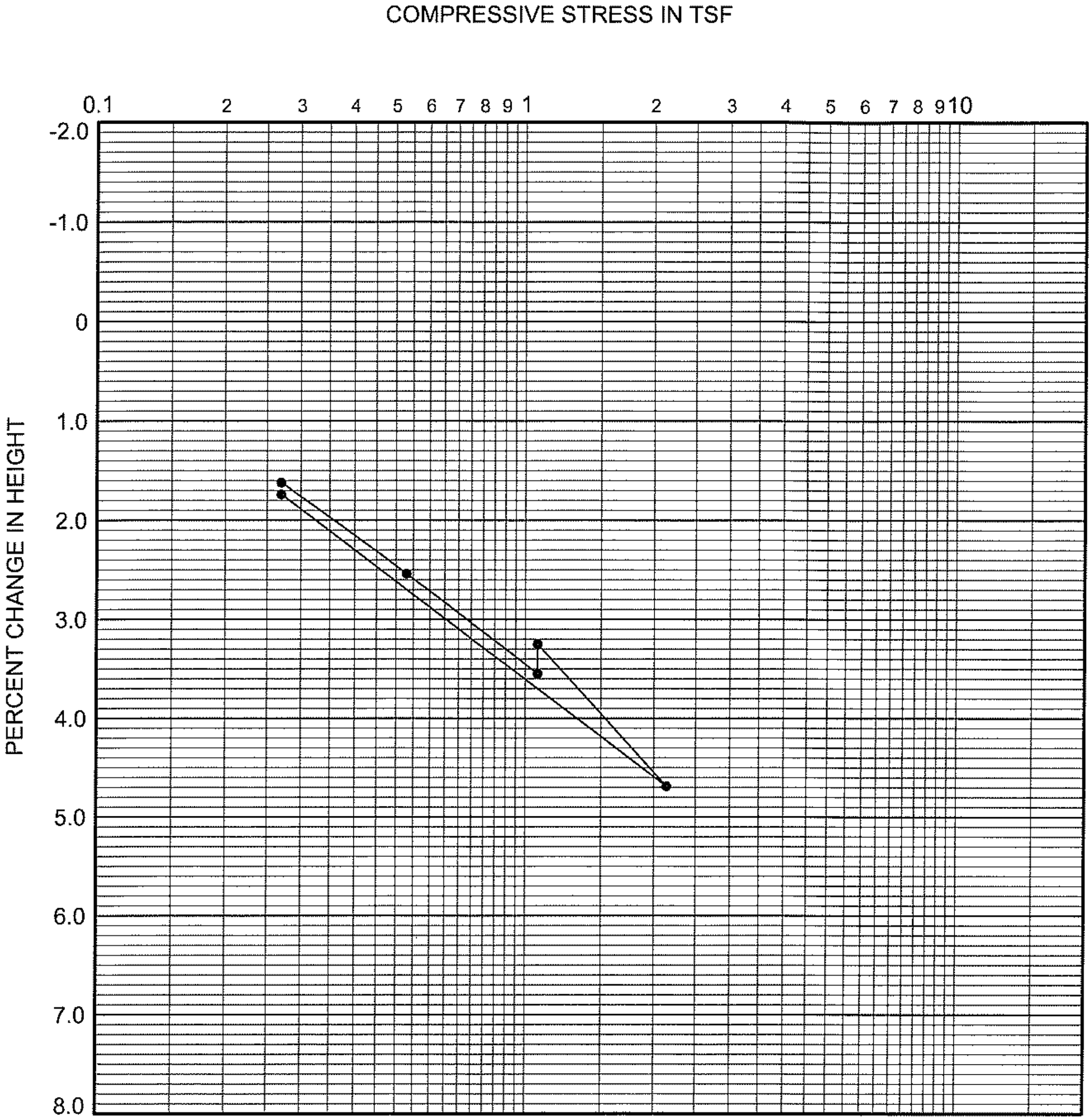
REMARKS: WATER ADDED AT 0.53 TSF

CONSOLIDATION CURVE

Alta California Geotechnical, Inc.

P.N. 1-0172

PLATE C-2



boring	depth (ft.)	dry density (pcf)	in situ moist. (%)	in situ satur. (%)	-200 sieve (%)	group symbol	typical names
B-5	10.0	85	35.1	98	88	CL	Silty clay (Qvom)

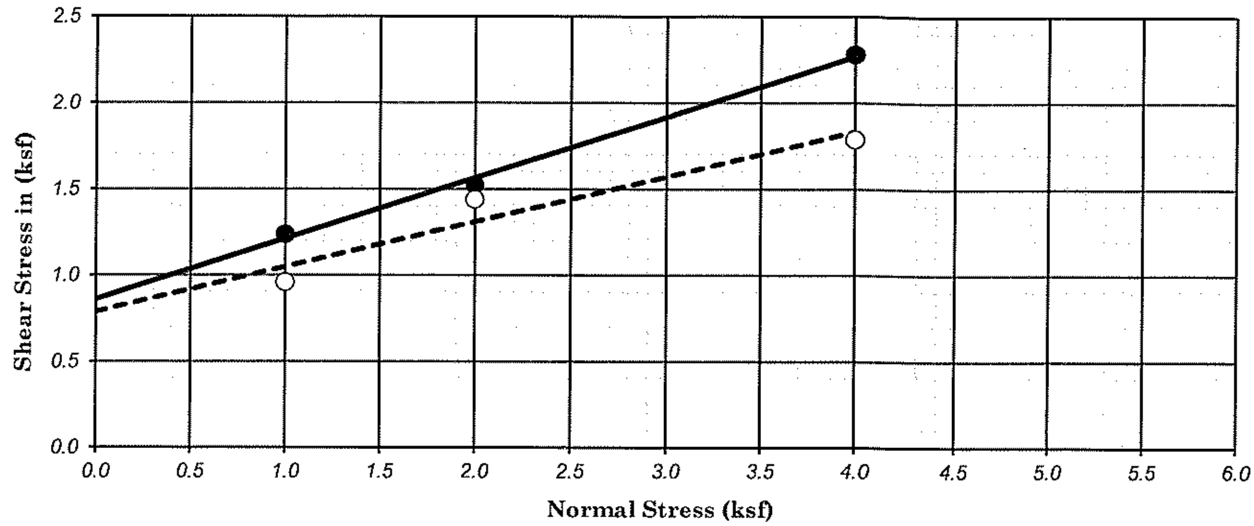
REMARKS: WATER ADDED AT 1.07 TSF

CONSOLIDATION CURVE

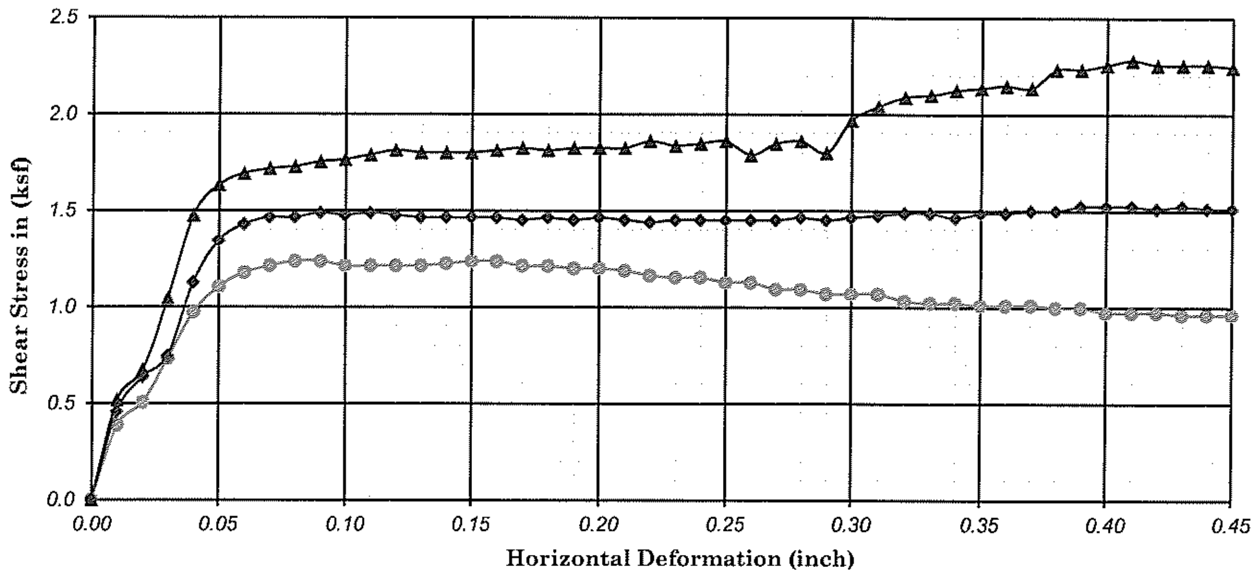
Alta California Geotechnical, Inc.

P.N. 1-0172

PLATE C-3



Ultimate : ○ | Shear Type : Saturated | Remolded @ 90% | Peak : ●



Boring No. : B-1 @ 1'-5'	Strength Intercept (C) :	0.86	(ksf)	Peak	0.79	(ksf)	Ultimate
Sample No. : SO3346		41.08	(kPa)		37.63	(kPa)	
Depth (ft/m) : 1-0172	Friction Angle (ϕ) :	19.41	Degree		14.65	Degree	
Description : Very Dark Gray Sandy Clay				Shear Rate (inch/minute) :	0.003		

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m³)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	24.19	109.29	17.20	0.63	1.00	47.88	1.24	59.18	0.96	45.96
◆	23.15	109.93	17.30	0.62	2.00	95.76	1.52	72.97	1.44	68.95
▲	21.01	111.03	17.48	0.60	4.00	191.52	2.28	109.17	1.79	85.61

GROUP DELTA

Alta Geotechnical

Project No. : AL153A | Date : 08/25/15

DIRECT SHEAR TEST
(ASTM D -3080)

Figure No. : 1

PLATE C–4

CORROSIVITY TEST RESULTS
(ASTM D516, CTM 643)

SAMPLE	Ph	RESISTIVITY (OHM-CM)	SULFATE CONTENT (%)	CHLORIDE CONTENT
WO #1-0172 / B-1 @ 1-5'	*7.60*	*265*	*1.00*	*0.02*

CORROSIVITY PERAMETERS

SULFATE CONTENT (%)	SULFATE EXPOSURE	CEMENT TYPE
0.00 to 0.10	Negligible	--
0.10 to 0.20	Moderate	II, IP(MS), IS(MS)
0.20 to 2.00	Severe	V
Above 2.00	Very Severe	V plus pozzolan

SOIL RESISTIVITY (OHM-CM)	GENERAL DEGREE OF CORROSIVITY TO FERROUS METALS
0 to 1,000	Very Corrosive
1,000 to 2,000	Corrosive
2,000 to 5,000	Moderately Corrosive
5,000 to 10,000	Mildly Corrosive
Above 10,000	Slightly Corrosive

CHLORIDE (Cl) CONTENT (%)	GENERAL DEGREE OF CORROSIVITY TO METALS
0.00 to 0.03	Negligible
0.03 to 0.15	Corrosive
Above 0.15	Severely Corrosive

GROUP DELTA

GROUP DELTA CONSULTANTS
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Anaheim, CA 92806
(714) 660-7500 office
(714) 660-7550 fax

Project Name: ***ALTA Geotechnical***
Project Number: ***AL-153A***
Laboratory Number: ***SO.3346***
Sample Number: ***WO #1-0172 / B-1 @ 1-5'***
Report Date: ***8/25/2015***

APPENDIX D

Maintenance and Improvement Considerations

MAINTENANCE AND IMPROVEMENT CONSIDERATIONS

General

Owners purchasing property must assume a certain degree of responsibility for improvements and for maintaining conditions around their home. Of primary importance from a geotechnical standpoint are maintaining drainage patterns and minimizing the soil moisture variation below all improvements. Such design, construction and owner maintenance provisions may include:

- Employing contractors for improvements who design and build in recognition of local building codes and specific site soils conditions.
- Establishing and maintaining positive drainage away from all foundations, walkways, driveways, patios, and other improvements.
- Avoiding the construction of planters adjacent to structural improvements. Alternatively, planter sides/bottoms can be sealed with an impermeable membrane and drained away from the improvements via subdrains into approved disposal areas.
- Sealing and maintaining construction/control joints within concrete slabs and walkways to reduce the potential for moisture infiltration into the subgrade soils.
- Utilizing landscaping schemes with vegetation that requires minimal watering. Watering should be done in a uniform manner, as equally as possible on all sides of the foundation, keeping the soil "moist" but not allowing the soil to become saturated.
- Maintaining positive drainage away from structures and providing roof gutters on all structures with downspouts that are designed to carry roof runoff directly into area drains or discharged well away from the foundation areas.
- Avoiding the placement of trees closer to the proposed structures than a distance of one-half the mature height of the tree.
- Observation of the soil conditions around the perimeter of the structure during extremely hot/dry or unusually wet weather conditions so that modifications can be made in irrigation programs to maintain relatively uniform moisture conditions.

Sulfates

Owners should be cautioned against the import and use of certain inorganic fertilizers, soil amendments, and/or other soils from offsite sources in the absence of specific information relating to their chemical composition. Some fertilizers have been known to leach sulfate compounds into soils and increase the sulfate concentrations to potentially detrimental levels.

Site Drainage

- The owners should be made aware of the potential problems that may develop when drainage is altered through construction of hardscape improvements. Ponded water, drainage over the slope face, leaking irrigation systems, overwatering, or other conditions which could lead to ground saturation must be avoided.
- No water should be allowed to flow over the slopes. No alteration of pad gradients should be allowed that would prevent pad and roof runoff from being directed to approved disposal areas.
- Drainage patterns have been established at the time of the fine grading should be maintained throughout the life of the structure. No alterations to these drainage patterns should be made unless designed by qualified professionals in compliance with local code requirements and site-specific soils conditions.

Slope Drainage

- Residents should be made aware of the importance of maintaining and cleaning all interceptor ditches, drainage terraces, down drains, and any other drainage devices, which have been installed to promote slope stability.
- Subsurface drainage pipe outlets may protrude through slope surfaces and/or wall faces. These pipes, in conjunction with the graded features, are essential to slope and wall stability and must be protected in-place. They should not be altered or damaged in any way.

Planting and Irrigation of Slopes

- Seeding and planting of the slopes should be planned to achieve, as rapidly as possible, a well-established and deep-rooted vegetal cover requiring minimal watering.
- It is the responsibility of the landscape architect to provide such plants initially and of the residents to maintain such planting. Alteration of such a planting scheme is at the resident's risk.
- The resident is responsible for proper irrigation and for maintenance and repair of properly installed irrigation systems. Leaks should be fixed immediately.
- Sprinklers should be adjusted to provide maximum uniform coverage with a minimum of water usage and overlap. Overwatering with consequent wasteful runoff and serious ground saturation must be avoided.
- If automatic sprinkler systems are installed, their use must be adjusted to account for seasonal and natural rainfall conditions.

Burrowing Animals

- Residents must undertake a program to eliminate burrowing animals. This must be an ongoing program in order to promote slope stability.

Owner Improvement

Owner improvements (pools, spas, patio slabs, retaining walls, planters, etc.) should be designed to account for the terrain of the project, as well as expansive soil conditions and chemical characteristics. Design considerations on any given lot may need to include provisions for differential bearing materials, ascending/descending slope conditions, bedrock structure, perched (irrigation) water, special geologic surcharge loading conditions, expansive soil stresses, and long-term creep/settlement.

All owner improvements should be designed and constructed by qualified professionals utilizing appropriate design methodologies, which account for the on-site soils and geologic conditions. Each lot and proposed improvement should be evaluated on an individual basis.

Setback Zones

Manufactured slopes maybe subject to long-term settlement and creep that can manifest itself in the form of both horizontal and vertical movement. These movements typically are produced as a result of weathering, erosion, gravity forces, and other natural phenomenon. A setback adjacent to slopes is required by most building codes, including the California Building Code. This zone is intended to locate and support the residential structures away from these slopes and onto soils that are not subject to the potential adverse effects of these natural phenomena.

The owner may wish to construct patios, walls, walkways, planters, swimming pools, spas, etc. within this zone. Such facilities may be sensitive to settlement and creep and should not be constructed within the setback zone unless properly engineered. It is suggested that plans for such improvements be designed by a professional engineer who is familiar with grading ordinances and design and construction requirements. In addition, we recommend that the designer and contractor familiarize themselves with the site specific geologic and geotechnical conditions on the specific lot.

APPENDIX E

Earthwork Specifications

ALTA CALIFORNIA GEOTECHNICAL, INC.
EARTHWORK SPECIFICATIONS

These specifications present the generally accepted standards and minimum earthwork requirements for the development of the project. These specifications shall be the project guidelines for earthwork except where specifically superceded in preliminary geology and soils reports, grading plan review reports or by the prevailing grading codes or ordinances of the controlling agency.

A. GENERAL

1. The Contractor shall be responsible for the satisfactory completion of all earthwork in accordance with the project plans and specifications.

2. The project Geotechnical Engineer and Engineering Geologist, or their representatives, shall provide observation and testing services, and Geotechnical consultation for the duration of the project.

3. All clearing, grubbing, stripping and site preparation for the project shall be accomplished by the Contractor to the satisfaction of the Geotechnical Engineer/Engineering Geologist.

4. It is the Contractor's responsibility to prepare the ground surface to receive fill to the satisfaction of the Geotechnical Engineer and to place, spread, mix, moisture condition, and compact the fill in accordance with the job specifications and as required by the Geotechnical Engineer. The Contractor shall also remove all material considered by the Geotechnical Engineer to be unsuitable for use in the construction of engineered fills.

5. The Contractor shall have suitable and sufficient equipment in operation to handle the amount of fill being placed. When necessary, equipment will be shut down temporarily in order to permit the proper preparation of fills.

B. PREPARATION OF FILL AREAS

1. Excessive vegetation and all deleterious material should be disposed of offsite as required by the Geotechnical Engineer.

   Existing fill, soil, alluvium or rock materials determined by the Geotechnical Engineer as being unsuitable for placement in compacted fills shall be removed and hauled from the site. Where applicable, the Contractor may obtain the approval of the Soils Engineer and the controlling authorities for the project to dispose of the above described materials, or a portion thereof, in designated areas onsite.

After removal of the deleterious materials have been accomplished, earth materials deemed unsuitable in their natural, in-place condition, shall be removed as recommended by the Geotechnical Engineer/Engineering Geologist.

2. Upon achieving a suitable bottom for fill placement, the exposed removal bottom shall be disced or bladed by the Contractor to the satisfaction of the Geotechnical Engineer. The prepared ground surfaces shall then be brought to the specified moisture content mixed as required, and compacted and tested as specified. In localities where it is necessary to obtain the approval of the controlling agency prior to placing fill, it will be the Contractor's responsibility to contact the proper authorities to visit the site.

3. Any underground structure such as cesspools, cisterns, mining shafts, tunnels, septic tanks, wells, pipelines or other structures not located prior to grading are to be removed or treated in a manner prescribed by the Geotechnical Engineer and/or the controlling agency for the project.

C. <u>ENGINEERED FILLS</u>

1. Any material imported or excavated on the property may be utilized as fill, provided the material has been determined to be suitable by the Geotechnical Engineer. Deleterious materials shall be removed from the fill as directed by the Geotechnical Engineer.

2. Rock or rock fragments less than twelve inches in the largest dimension may be utilized in the fill, provided they are not placed in concentrated pockets and the distribution of the rocks is approved by the Geotechnical Engineer.

3. Rocks greater than twelve inches in the largest dimension shall be taken offsite, or placed in accordance with the recommendations of the Geotechnical Engineer in areas designated as suitable for rock disposal.

4. All materials to be used as fill, shall be tested in the laboratory by the Geotechnical Engineer. Proposed import materials shall be approved by the Geotechnical Engineer 48 hours prior to importation.

5. The fill materials shall be placed by the Contractor in lifts, that when compacted, shall not exceed six inches. Each lift shall be spread evenly and shall be

thoroughly mixed to achieve a near uniform moisture condition and a uniform blend of materials.

All compaction shall be achieved at or above the optimum moisture content, as determined by the applicable laboratory standard. The Contractor will be notified if the fill materials are too wet or too dry to achieve the required compaction standard.

6. When the moisture content of the fill material is below the limit specified by the Geotechnical Engineer, water shall be added and the materials shall be blended until a uniform moisture content, within specified limits, is achieved. When the moisture content of the fill material is above the limits specified by the Geotechnical Engineer, the fill materials shall be aerated by discing, blading, mixed with dryer fill materials, or other satisfactory methods until the moisture content is within the specified limits.

7. Each fill lift shall be compacted to the minimum project standards, in compliance with the testing methods specified by the controlling governmental agency, and in accordance with recommendations of the Geotechnical Engineer.

   In the absence of specific recommendations by the Geotechnical Engineer to the contrary, the compaction standard shall be the most recent version of ASTM:D 1557.

8. Where a slope receiving fill exceeds a ratio of five-horizontal to one-vertical, the fill shall be keyed and benched through all unsuitable materials into sound bedrock or firm material, in accordance with the recommendations and approval of the Geotechnical Engineer.

9. Side hill fills shall have a minimum key width of 15 feet into bedrock or firm materials, unless otherwise specified in the soil report and approved by the Geotechnical Engineer in the field.

10. Drainage terraces and subdrainage devices shall be constructed in compliance with the ordinances of the controlling governmental agency and/or with the recommendations of the Geotechnical Engineer and Engineering Geologist.

11. The Contractor shall be required to maintain the specified minimum relative compaction out to the finish slope face of fill slopes, buttresses, and stabilization fills as directed by the Geotechnical Engineer and/or the governing agency for the project. This may be achieved by either overbuilding the slope and cutting

back to the compacted core; by direct compaction of the slope face with suitable equipment; or by any other procedure which produces the required result.

12. The fill portion of fill-over-cut slopes shall be properly keyed into rock or firm material; and the fill area shall be stripped of all soil or unsuitable materials prior to placing fill.

    The design cut portion of the slope should be made first and evaluated for suitability by the Engineering Geologist prior to placement of fill in the keyway above the cut slope.

13. Pad areas in cut or natural ground shall be approved by the Geotechnical Engineer. Finished surfaces of these pads may require scarification and recompaction, or over excavation as determined by the Geotechnical Engineer.

D. <u>CUT SLOPES</u>

1. The Engineering Geologist shall observe all cut slopes and shall be notified by the Contractor when cut slopes are to be started.

2. If, during the course of grading, unforeseen adverse or potentially adverse geologic conditions are encountered, the Engineering Geologist and Soil Engineer shall investigate, analyze and make recommendations to remediate these problems.

3. Non-erodible interceptor swales shall be placed at the top of cut slopes that face the same direction as the superjacent, prevailing drainage.

4. Unless otherwise specified in specific geotechnical reports, no cut slopes shall be excavated higher or steeper than that allowed by the ordinances of controlling governmental agencies.

5. Drainage terraces shall be constructed in compliance with the ordinances of the controlling governmental agencies, and/or in accordance with the recommendations of the Geotechnical Engineer or Engineering Geologist.

E. <u>GRADING CONTROL</u>

1. Fill placement shall be observed and tested by the Geotechnical Engineer and/or his representative during grading.

   Field density tests shall be made by the Geotechnical Engineer and/or his representative to evaluate the compaction and moisture compliance of each fill lift. Density tests shall be conducted at intervals not to exceed two feet of fill height. Where sheepsfoot rollers are used, the fill may be disturbed to a depth of several inches. Density determinations shall be taken in the compacted material below the disturbed surface at a depth determined by the Geotechnical Engineer or his representative.

2. Where tests indicate that the density of any layer of fill, or portion thereof, is below the required relative compaction, or improper moisture content is in evidence, that particular layer or portion thereof shall be reworked until the required density and/or moisture content has been attained. Additional fills shall not be placed over an area until the previous lift of fill has been tested and found to meet the density and moisture requirements for the project and the previous lift is approved by the Geotechnical Engineer.

3. When grading activities are interrupted by heavy rains, fill operations shall not be resumed until field observations and tests by the Geotechnical Engineer indicate the moisture content and density of the fill are within the specified limits.

4. During construction, the Contractor shall properly grade all surfaces to maintain good drainage and prevent the ponding of water. The Contractor shall take remedial action to control surface water and to prevent erosion of graded areas until such time as a permanent drainage and erosion devices have been installed.

5. Observation and testing by the Geotechnical Engineer and/or his representative shall be conducted during filling and compacting operations in order that he will be able to state in his opinion that all cut and filled areas are graded in accordance with the approved specifications.

6. Upon the completion of grading activities and after the Geotechnical Engineer and Engineering Geologist have finished their observations of the work, final reports shall be submitted. No further excavation or fill placement shall be undertaken without prior notification of the Geotechnical Engineer and/or Engineering Geologist.

F. <u>FINISHED SLOPES</u>

All finished cut and fill slopes shall be planted and irrigated and/or protected from erosion in accordance with the project specifications, governing agencies, and/or as recommended by a landscape architect.