

**APPENDIX D**  
*Geotechnical Report*





# **GEOTECHNICAL EVALUATION**

**INTEGRAL COMMUNITIES  
Proposed Residential Development  
700 West Grand Avenue  
Escondido, California**

**September 21, 2015**

**EEI Project No. IPF-72198.4**

**GEOTECHNICAL EVALUATION**

Prepared for:

Mr. Gil Miltenberger  
Integral Communities  
2235 Encinitas Boulevard, Suite 216  
Encinitas, California 92024

Project Site Location:

Proposed Residential Development  
Former Escondido Police Station  
700 West Grand Avenue  
Escondido, California 92069

Prepared by:



Matthew R. Love  
PE 84154 (exp. 9/30/17)  
Project Engineer



Jeffrey P. Blake  
CEG 2248 (exp. 10/31/15)  
Senior Engineering Geologist



Jerry L. Michal  
GE 2515 (exp. 3/31/16)  
Senior Geotechnical Engineer



**E EI**  
2195 Faraday Avenue, Suite K  
Carlsbad, California 92008-7207

E EI Project No. IPF-72198.4

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**Distribution:** (4) Addressee (one electronic copy and three hard copies)

## **1.0 INTRODUCTION**

### **1.1 Purpose**

The purpose of this evaluation was to provide geotechnical information to Integral Communities (hereinafter referred to as “Client”), regarding the proposed mixed use development located at 700 West Grand Avenue in Escondido, California. The information developed in this evaluation is intended to provide Integral Communities with an understanding of the physical conditions of site-specific subsurface soils, groundwater, and the regional geologic setting which could affect the cost or design of the proposed retail development (Site Vicinity Map-**Figure 1**, Aerial Site Map-**Figure 2**).

This Geotechnical Evaluation has been conducted in general accordance with the accepted geotechnical engineering principles and in general conformance with the approved proposal and cost estimate for the project by EEI, dated June 30, 2015.

EEI conducted an onsite field exploration on September 2 and 3, 2015, that included drilling, logging and sampling of seven (7) hollow stem auger (HSA) geotechnical borings for the proposed new residential development. This Geotechnical Evaluation has been prepared for the sole use of Integral Communities. Other parties, without the express written consent of EEI and Integral Communities, should not rely upon this geotechnical study.

### **1.2 Project Description**

The subject property is located within an existing retail/commercial plaza along the north side of West Grand Avenue at an address of 700 West Grand Avenue in the City of Escondido, County of San Diego, California. The property is currently occupied by a two-story structure which previously served as the Escondido Police station, along with paved drive and parking areas and other associated improvements.

Based on information provided by the Client, we understand that the proposed development will include the construction of new three-level residential buildings to accommodate a total of 148 new residential units. Related site improvements including paved parking and drive areas, and underground utilities are also planned. Foundation plans were not provided to EEI at the time of preparation of this report; however, foundation loads are assumed to be typical for the type of construction and will be conventional slab-on-grade construction.

### **1.3 Scope of Services**

The scope of our services included:

- A review of readily available data pertinent to the subject property, including published and unpublished geologic reports/maps, and soils data for the area.
- Conducting a geotechnical reconnaissance of the subject property and nearby vicinity.
- Coordination with Underground Service Alert to identify the presence of underground utilities for clearance of proposed boring locations.
- The drilling, logging, and sampling of seven (7) small diameter exploratory borings depths of approximately 7.0 to 18.0 feet below ground surface (bgs) within the subject property boundaries. The approximate locations of each boring are presented on **Figure 3** (Boring Location Map)

- Completion of laboratory testing of representative earth materials encountered onsite to ascertain their pertinent soils engineering properties, including corrosion potential (**Appendix B**).
- The preparation of this report which presents our preliminary findings, conclusions, and recommendations.

## 2.0 BACKGROUND

### 2.1 Property Description

Based on the review of information provided by the Client, the subject property is located at 700 West Grand Avenue in Escondido, San Diego County, California. The parcel comprises approximately 2.7-acres. The property is approximately situated at 33.1179° north latitude and 117.0902° west longitude (Google Earth®, 2015).

Based on our site reconnaissance, a review of online resources, a review of a GoogleEarth® online aerial photograph and information provided by Client, the subject property is currently occupied by a two-story structure which previously served as the Escondido Police station, along with paved drive and parking areas and other associated improvements. The property is bounded by West Grand Avenue to the south, West Valley Parkway to the north, and paved parking and drive areas to the east and a North County Transit District railway easement to the west.

### 2.2 Topography

The subject property is situated within the United States Geological Survey (USGS) Escondido, California 7.5 Minute Quadrangle map (USGS, 2005). A review of this topographic map indicates that the ground surface of the property is at an elevation of approximately 660 feet (NAVD88). Based solely on topography, surface runoff generated on the subject property would flow north, eventually ending up in the local storm drain system. An Aerial Site Map is attached as **Figure 2**.

### 2.3 Geologic Setting

Regionally, the subject property lies within the Peninsular Ranges Geomorphic Province of southern California. This province consists of a series of ranges separated by northwest trending valleys; sub parallel to branches of the San Andreas Fault (CGS, 2002). The Peninsular Ranges geomorphic province, one of the largest geomorphic units in western North America, extends from the Transverse Ranges geomorphic province and the Los Angeles Basin, south to Baja California. It is bound on the west by the Pacific Ocean, on the south by the Gulf of California and on the east by the Colorado Desert Province. The Peninsular Ranges are essentially a series of northwest-southeast oriented fault blocks (CGS, 2002). Major fault zones and subordinate fault zones found in the Peninsular Ranges Province typically trend in a northwest-southeast direction.

Regional geologic maps of the subject property and vicinity (published by the California Geological Survey, 2002) indicate the property is underlain by late Quaternary-aged older alluvial deposits and Cretaceous-age granitic rock materials. In the vicinity of the property, the deposits are locally mantled by artificial fill materials of varying thickness.

The subject property is located within an area of California known to contain a number of active and potentially active faults. Due to the proximity of the property area to several nearby active faults, strong ground shaking could occur at the property due to an earthquake on any one of the faults. Our review indicates that there are no known active faults crossing the property (Jennings, 1994, 2010) and the property is not situated within a State of California Earthquake Fault Zone (Hart and Bryant, 1997, CDMG, 2000).

**2.4 Groundwater**

A static groundwater condition was not encountered in any of our exploratory boring excavations performed during our study to the maximum depths explored of approximately 18.0 feet below the existing ground surface. We did, however, encounter a zone of perched groundwater in one of the exploratory borings (B-1) at an approximate depth of 15 feet below the ground surface. It should be noted that variations in subsurface water (including perched water zones and seepage) may result from fluctuations in the ground surface topography, subsurface stratification, precipitation, irrigation and other factors that may not have been evident at the time of our subsurface exploration.

In general, groundwater is expected to follow the direction of surface topography. Based on topography, regional groundwater flow direction can be expected to generally be in a south-southwesterly direction (USGS, 1996).

**3.0 FAULTING AND SEISMICITY**

The portion of Southern California that includes the subject property is considered to be seismically active. Due to the proximity of the property area to several nearby active faults, strong ground shaking could occur at the property as a result of an earthquake on any one of the faults. Our review indicates that there are no known active faults crossing the property and the property is not within an Earthquake Fault Zone (Hart and Bryant, 1997). While the potential risk of ground rupture cannot be completely ruled out, it is our opinion that the likelihood of surface fault rupture at the property is relatively low and the risk is considered similar to other sites in the vicinity.

**Table 1** provides a summary of active fault zones within an approximately 50 mile radius of the subject property that may have a considerable effect on the property in the event significant activity is experienced. Fault names and approximate distances are based upon information provided in applicable references (Blake, 2000; Jennings, 1994).

<b>TABLE 1 Summary of Major Active Faults</b>		
<b>Fault Name</b>	<b>Approximate Distance From Site miles (kilometers)</b>	<b>Maximum Moment Magnitude</b>
Rose Canyon	15.2 (24.5)	7.2
Elsinore (Julian)	17.0 (27.3)	7.1
Elsinore (Temecula)	18.5 (29.7)	6.8
Newport-Inglewood (Offshore)	19.8 (31.8)	7.1
Earthquake Valley	29.8 (47.9)	6.5
Coronado Bank	29.9 (48.1)	7.6
Elsinore (Glen Ivy)	39.2 (63.1)	6.8
San Jacinto – Anza	39.5 (63.6)	7.2
San Jacinto – Coyote Creek	41.0 (66.3)	6.6
Elsinore (Coyote Mountain)	43.4 (69.9)	6.8
San Jacinto – San Jacinto Valley	44.1 (71.0)	6.9
San Joaquin Hills	47.3 (76.1)	6.6

**3.1 Seismic Parameters and Peak Ground Acceleration**

Maximum considered ground motion maps provided in the California Building Code (CBC, 2013) were utilized with coordinates of 33.1179° north latitude and 117.0902° west longitude, to determine the subject property seismic parameters. EEI utilized seismic design criteria provided in the CBC (2013).

In accordance with the guidelines of the CBC (2013), the spectral parameters for the subject property (based on a Site Class B soil) are estimated to be  $S_s = 1.020g$  and  $S_1 = 0.396g$ . Review of the geotechnical data obtained during our subsurface exploration, however, indicates that the property should be classified as Class C per ASCE 7-10 (Table 20-3.1). Consequently, Site Coefficients  $F_a = 1.000$  and  $F_v = 1.404$  appear to be appropriate for the property. Based on this information, the adjusted maximum considered earthquake spectral response parameters  $S_{MS} = 1.020g$  and  $S_{M1} = 0.556g$  and the spectral acceleration parameters of  $S_{DS}$  value of  $0.680g$  and an  $S_{D1}$  value of  $0.370g$  are recommended for seismic design of the project.

Final selection of the appropriate seismic design coefficients should be made by the structural consultant based on the local laws and ordinances, expected building response, and desired level of conservatism.

Seismic Hazard Response Parameters are listed in **Table 2**.

<b>TABLE 2</b>			
<b>Seismic Hazard Response Parameters and Design Parameters CBC (2013)</b>			
<b>Seismic Parameter</b>	<b>Period (Sec)</b>		<b>Value</b>
Mapped Spectral Acceleration Value, Soil Class B	0.2	$S_s$	1.020g
Mapped Spectral Acceleration Value, Soil Class B	1.0	$S_1$	0.396g
Site Coefficient, Subject Site Soil Classification C per 2013 CBC Table 1613.3.3	--	$F_a$	1.000
Site Coefficient, Subject Site Soil Classification C per 2013 CBC Table 1613.3.3	--	$F_v$	1.404
Adjusted Maximum Considered Earthquake ( $MCE_R$ ) Spectral Response Acceleration Site Class C	0.2	$S_{MS}$	1.020g
Adjusted Maximum Considered Earthquake ( $MCE_R$ ) Spectral Response Acceleration Site Class C	1.0	$S_{M1}$	0.556g
Design Spectral Response Acceleration Occupancy Category II per 2013 CBC Table 1604.5	0.2	$S_{DS}$	0.680g
Design Spectral Response Acceleration Occupancy Category II per 2013 CBC Table 1604.5	1.0	$S_{D1}$	0.370g
Peak Ground Acceleration Adjusted For Site Class Effects.		$PGA_M$	0.388g

### 3.2 Ground Lurching or Shallow Ground Rupture

Based on the geography, topography and site-specific geotechnical conditions encountered during our preliminary geotechnical evaluation at the subject property, we consider the potential for ground lurching or shallow ground rupture at the property to be low; however, due to the active seismicity of California, this possibility cannot be completely ruled out. In light of this, the unlikely hazard of lurching or ground-rupture should not preclude consideration of “flexible” design for onsite utility lines and connections.

### 3.3 Liquefaction

Liquefaction is a phenomenon in which the strength and stiffness of a soil is reduced by earthquake shaking or other rapid loading. Liquefaction and related phenomena have been responsible for substantial structural damage in historical earthquakes, and are a design concern under certain conditions. Liquefaction occurs in saturated soils that are soils in which the space between individual particles is completely filled with water. This pore water exerts a pressure on the soil particles that influences how tightly the particles themselves are pressed together.

Prior to an earthquake, pore water pressure is typically low; however, earthquake motion can cause the pore water pressure to increase to the point where the soil particles can readily move with respect to each other. When liquefaction occurs; the strength of the soil decreases and the ability of a soil deposit to support structural loads are reduced.

Due to the lack of a near surface static ground water level at the subject property, and the relatively dense nature of the encountered materials comprising the older alluvium and Cretaceous-age granitic materials that underlie the property, it appears that liquefaction is not a significant geotechnical concern at the property.

### **3.4 Seismic Induced Settlement**

Seismically induced settlement can occur due to the reorientation of soil particles during strong shaking of unsaturated sands, as well as in response to liquefaction of saturated loose granular soils. As noted herein, the potential for liquefaction-induced settlement is considered very low. We estimate the total seismic induced settlement within the upper unsaturated soils to be less than a ½-inch across the subject property. Differential seismic induced settlements are estimated to be less than a ¼- inch across a 50-foot span.

## **4.0 FIELD EXPLORATION AND LABORATORY TESTING**

### **4.1 Field Exploration**

Field work for our Geotechnical Evaluation was conducted on September 2 and 3, 2015. A total of seven (7) hollow stem auger borings were advanced on the subject property. Boring depths ranged from approximately 7.0 to 18.0 feet bgs and were logged under the supervision of a Registered Professional Engineer and Certified Engineering Geologist at EEI. Refusal on the decomposed granitic rock occurred in all of the exploratory borings that the material was encountered. The approximate locations of the borings are shown on **Figure 3**.

Blow count (N) values were determined utilizing a 140 pound automatic hammer, falling 30-inches onto a Standard Penetration Test (SPT) split-spoon sampler and a Modified California split-tube sampler. A truck mounted Mobile-B53 drill rig and a limited access drill rig (i.e. tri-pod) was used during field work. The blows per foot (N value) required to advance the 18-inch long SPT and Modified California samplers was measured at various initial depths followed by 2.5-foot intervals, recorded on the boring logs, and are presented in **Appendix A-Soil Classification Chart and Boring Logs**. Relatively “undisturbed” samples were collected in a 2.42-inch (inside diameter) California Modified split-tube sampler for visual examination and laboratory testing. The soils were classified in accordance with the Unified Soil Classification System (ASTM, 2008). Representative bulk samples were also collected for appropriate laboratory testing.

### **4.2 Subsurface Conditions**

The subsurface materials encountered in our exploratory borings consisted of a relatively thin layer (approximately 1 to 3 feet) of artificial fill underlain by late Quaternary-aged older alluvial deposits, which in turn was underlain by middle Cretaceous-age decomposed granitic rock materials. The artificial fill materials were encountered in exploratory borings B-6 and B-7, and were observed to consist of light brown to brown, medium dense silty sand and sand. As encountered in our exploratory borings, the alluvial deposits were observed to consist of mixed brown, dark brown and reddish brown clay, silt, sandy-silt and sandy-clay, sand, clayey-sand and silty-sand. These materials were observed to be typically moist, medium stiff to hard and medium dense to very dense at the time of our subsurface exploration.

The granitic materials were encountered at depths ranging from 7 to 14 feet below the ground surface, and were observed to consist of light gray, greenish gray and reddish-brown, dense to very dense, moderately weathered, decomposed, coarse-grained granitic rock. Refusal on the decomposed granitic rock occurred in all of the exploratory borings that the material was encountered. Detailed descriptions of the encountered soils are provided on the boring logs included as **Appendix A**.

As previously discussed, perched groundwater was encountered in one of the exploratory borings (B-1) at an approximate depth of 15.0 feet below the ground surface. Static groundwater was not encountered during our field exploration to a maximum depth of approximately 18.0 feet below the existing ground surface and is not anticipated due to the presence of the very dense granitic material encountered at across the site. It should be noted that variations in groundwater may result from fluctuations in the ground surface topography, subsurface stratification, precipitation, irrigation and other factors that may not have been evident at the time of our subsurface exploration.

#### **4.3 Laboratory Testing and Classification**

Representative samples were selected for laboratory testing to confirm their field classification(s). Field descriptions and classifications were visually classified according to the American Society for Testing and Materials (ASTM) D2488 which classifies soils under the Unified Soil Classification System (USCS). Final classifications of soils can be found on the boring logs in **Appendix A** and the laboratory test data in **Appendix B**.

##### **4.3.1 Moisture Content and Dry Density**

The in-situ moisture content and dry density of soils was determined from soil samples obtained from the borings. In-place moisture content and dry density of soils help in the evaluation of engineering design parameters for foundations, retaining walls, and other engineering structures. The moisture content determination of soil samples was conducted in general accordance with ASTM D2216, and was recorded as a percentage. The determination of dry density of soil samples was conducted in accordance with ASTM 2937, and recorded in pounds per cubic foot. Moisture content and dry density for soil samples retrieved from the field can be found on the boring logs located in **Appendix A**.

##### **4.3.2 Grain Size Distribution**

To help check field classifications of soils, the grain size distribution of representative soil samples was determined. In order to find the percentages of different sized particles in a particular soil stratum, soils were tested in general accordance with ASTM D422-Standard Test Method for Particle-Size Analysis of Soils. Grain size distribution curves and gradation results are presented in **Appendix B**.

##### **4.3.3 Maximum Dry Density and Optimum Moisture Content**

The maximum dry density and optimum moisture content were determined from a bulk sample of the existing upper soils onsite. Our testing was performed in general accordance with ASTM D1557, Method A. Results of our testing are presented in **Appendix B**.

##### **4.3.4 Expansion Index**

One soil sample from the existing upper soils on site was tested for its expansion potential. Our expansion index testing was conducted in general accordance with ASTM D4829. The results of our expansion index testing are presented in **Appendix B**.

#### 4.3.5 Direct Shear

Direct shear testing was conducted on a representative remolded sample of the existing upper soils to measure the shear strength characteristics for engineering purposes. The samples were inundated for at least 18 hours. The samples were placed in a shear box and a normal load was applied (10, 20, and 40 kilogram weights were used). The samples were then sheared at a controlled strain rate in a direct shear apparatus that measures horizontal displacement and shear resistance. Shear testing was run in general accordance with ASTM D3080. The results of our testing are presented in **Appendix B**.

#### 4.3.6 Sulfate/Corrosion

One representative sample of the exiting upper soils was collected for analysis at Clarkson Laboratory and Supply, Inc. located in Chula Vista, California, for corrosion/soluble sulfate potential. This corrosion testing included soil minimum resistivity and pH by California Test 643, sulfate by California Test 417, and chloride by California Test 422. Results of these tests are presented in **Appendix B**.

It should be understood that the results provided in **Appendix B** are based upon pre-development conditions. Verification testing is recommended at the conclusion of grading on samples collected at or near finish grade.

### 5.0 CONCLUSIONS

Based on our field exploration, laboratory testing and engineering and geologic analysis, it is our opinion that the subject property is suitable for the proposed residential building development from a geotechnical engineering and geologic viewpoint. However, there are existing geotechnical conditions associated with the property that will warrant mitigation and/or consideration during planning stages. If the proposed development plans and/or the proposed building location are revised, additional field studies may be warranted to address proposed site-specific conditions. As a result, EEI is providing the following conclusions:

- According to our review of readily available regional geologic reports and maps, late Quaternary-aged older alluvial deposits and Cretaceous-age granitic rock materials underlie the subject property.
- A total of seven (7) exploratory hollow stem auger (HSA) borings were advanced within the subject property during this evaluation. Boring depths ranged from approximately 7.0 to 18.0 feet below ground surface (bgs). The property is underlain by a thin layer (approximately one to three feet) of artificial fill underlain by late Quaternary-aged older alluvial deposits, which are underlain by Cretaceous-age granitic rock materials. As encountered in our exploratory borings, the alluvial deposits were observed to consist of mixed brown, dark brown and reddish brown clay, silt, sandy-silt and sandy-clay, sand, clayey-sand and silty-sand. These materials were observed to be typically moist, medium stiff to hard and medium dense to very dense at the time of our subsurface exploration. The granitic materials were observed to consist of light gray, greenish gray and reddish-brown, dense to very dense, moderately decomposed, coarse-grained granitic rock. Refusal on the decomposed granitic rock occurred in all of the exploratory borings that the materials were encountered.

- Perched groundwater was encountered in exploratory boring B-1 at an approximate depth of 15.0 feet below the ground surface. Static groundwater was not encountered during our field exploration to a maximum depth of approximately 18.0 feet below the existing ground surface and is not anticipated due to the presence of the very dense granitic material encountered across the property. However, it should be noted that variations in groundwater including perched water zones and seepage may result from fluctuations in the ground surface topography, subsurface stratification, precipitation, irrigation and other factors that may not have been evident at the time of our subsurface exploration.
- Laboratory test results indicate that upper materials within the building pad areas are strongly alkaline (pH = 9.0) and are highly corrosive to ferrous metals with minimum resistivity values of 1,700 ohms-cm. Laboratory testing also yielded a soluble sulfate concentration of 0.015, respectively, indicating a negligible potential for sulfate attack on concrete. A chloride concentration of 0.004 percent was detected within the upper soils, indicating that the upper soils possess a negligible potential for corrosion of steel reinforcement in concrete.
- The results of our laboratory Expansion Index (EI) testing indicate an expansion index of 10 and 22 for the upper portions of the earth materials at the subject property, which represents a very low to low expansion potential.
- The subject property is located within an area of Southern California recognized as having a number of active and potentially-active faults located nearby. Our review of pertinent geologic literature indicates that there are no known active faults crossing the property and the property is not located within a State of California Earthquake Fault Zone. The closest active fault is the Rose Canyon Fault Zone, located approximately 15.2 miles from the property, which could generate severe ground shaking, should it be the source of an earthquake. Other nearby sources include (but are not limited to) the Temecula and Julian segments of the Elsinore Fault Zone, the Offshore segment of the Newport-Inglewood fault and the Earthquake Valley fault. A list of active faults within an approximate 50 mile radius is presented in **Table 1**.
- Based on EEI's evaluation, earth materials underlying the subject property are not considered susceptible to liquefaction or significant amounts of seismic settlement.
- A conventional shallow foundation system appears to be suitable for use to support the proposed buildings, provided the property is graded and improved in general conformance with guidelines presented herein, as well as the California Building Code (CBC, 2013).
- Due to the active seismicity of California, the possibility of lurching or ground-rupture cannot be completely ruled out, and should not preclude consideration of "flexible" design for onsite utility lines and connections.
- EEI evaluated static settlement utilizing results of laboratory testing and subsurface data to estimate settlement as a result of grading the pad(s) to a proposed finish slab grade, with a minor change in elevation for the proposed slab grade elevation from existing grade. Based upon our evaluation and our recommendations for remedial earthwork, and a conventional foundation system, EEI estimates total static settlement of less than 1-inch within the building envelope. Differential settlement is estimated to be approximately a ½ -inch or less over a distance of 50 feet.

## 6.0 RECOMMENDATIONS

The recommendations presented herein should be incorporated into the planning and design phases of development. Guidelines for site preparation, earthwork, and onsite improvements are provided in the following sections.

### 6.1 General

Grading should conform to the guidelines presented in the 2013 California Building Code (CBC, 2013), as well as the requirements of the City of Escondido. Additionally, general Earthwork and Grading Guidelines are provided herein as **Appendix C**.

During earthwork construction, removal and reprocessing of fill materials, as well as general grading procedures of the contractor should be observed and the fill placed selectively tested by representatives of the geotechnical engineer, EEI. If any unusual or unexpected conditions are exposed in the field, they should be reviewed by the geotechnical engineer and if warranted, modified and/or additional remedial recommendations will be offered. Specific guidelines and comments pertinent to the planned development are provided herein.

The recommendations presented herein have been completed using the preliminary information provided to us regarding site development. If information concerning the proposed development is revised, or any changes in the design and location of the proposed property improvements are made, the conclusions and preliminary recommendations contained in this report should not be considered applicable unless the changes are reviewed and conclusions of this report modified or approved in writing by this office.

### 6.2 Site Preparation and Grading

Debris and other deleterious material, such as organic soils, tree rootballs and/or environmentally impacted earth materials (if any) should be removed from the property prior to the start of grading. Areas to receive fill should be properly scarified and/or benched in accordance with current industry standards of practice and guidelines specified in the CBC (2013) and the requirements of the local jurisdiction.

Existing utilities and any undocumented fill soils should be removed within the proposed building envelope. Abandoned trenches should be properly backfilled and tested. If unanticipated subsurface improvements (utility lines, septic systems, wells, utilities, etc.) are encountered during earthwork construction, the geotechnical engineer should be informed and appropriate remedial recommendations would then be provided.

### 6.3 Remedial Earthwork

The encountered portions of the near surface existing fill materials and upper portions of the alluvial deposits were observed to be somewhat loose and variable in moisture content and relative density. As such, they are considered potentially compressible and unsuitable for the support of settlement-sensitive structures or additional fill in their current condition. Therefore, where not already removed by the proposed demolition and site grading, the upper soils should be completely removed and recompacted in the areas to receive the proposed building improvements and other settlement-sensitive improvements. Based on the results of our subsurface exploration, we recommend that these removals should extend to approximately 3 feet below existing site grades, or 18-inches below the bottoms of the proposed foundations, whichever is deeper. Following removal of the fill materials and upper soils, the bottom of the resulting excavation(s) should be observed by a representative of EEI to check that unsuitable materials have been sufficiently removed. It should be understood that based on the observations of our field representative, localized deeper removals may be recommended.

The base of the removal area should be level to avoid differential fill thicknesses under proposed improvements. This remedial earthwork should extend at least 5 feet outside the proposed building limits and/or 5 feet beyond the area to receive fill. Note that vertical sides exceeding 4 feet in depth may be prone to sloughing and may require laying back to an inclination of 1:1 (horizontal to vertical).

After removal of the upper soils and observation of the excavation bottoms, the over-excavated areas should be scarified to a minimum depth of 6-inches, moisture conditioned as needed to achieve at least optimum moisture content and re-compacted to at least 90 percent of the maximum dry density (based on ASTM D1557). The over-excavated areas should then be backfilled with onsite and/or imported soils that are placed and compacted as recommended herein until design finish grades are reached.

#### **6.4 Fill Placement**

Fill material should possess a low expansion potential (expansion index of less than 50 as determined by ASTM D4829), be free of organic matter (less than 3 percent organics by weight) and other deleterious material. Much of the onsite materials appear to be suitable for re-use as fill, provided they do not contain rocks greater than 6-inches in maximum dimension, organic debris and other deleterious materials. Rock fragments exceeding 6-inches in one dimension should be segregated and exported from the site, or utilized for landscaping. If encountered, rock fragments exceeding 6-inches in one dimension should be segregated and exported from the property, or utilized for landscaping.

If import soils are needed, the earthwork contractor should ensure that all proposed fill materials are approved by the Geotechnical Engineer prior to use. Representative soil samples should be made available for testing at least ten (10) working days prior to hauling to the subject property to allow for laboratory tests.

Fill materials should be placed in 6- to 8-inch loose lifts, moisture conditioned as necessary to at least optimum moisture and compacted to a minimum of 90 percent maximum density according to ASTM D1557. The upper 12-inches of pavement subgrade should be moisture conditioned to at least optimum moisture and compacted to at least 95 percent of the maximum dry density as determined by ASTM D1557. Suitable heavy grading equipment should be utilized to properly mix, spread, moisture condition or dry, and compact each fill lift.

Those areas to receive fill (including over-excavated areas) or surface improvements should be scarified at least 6-inches, moisture conditioned to at least one percent over optimum moisture content and recompacted to at least 90 percent of the maximum dry density (based on ASTM D1557).

#### **6.5 Yielding Subgrade Conditions**

The soils encountered at the property can often exhibit “pumping” or yielding once they become saturated. This can often occur in response to periods of significant precipitation or irrigation. If this occurs and in order to help stabilize the yielding subgrade soils within the bottom of the removal areas, the contractor can consider as an option, the placement of uniform sized, ¾- to 2-inch crushed rock within areas exhibiting the “pumping” conditions. The crushed rock should be properly tracked into the underlying soils such that it is adequately intruded into and interlocks with the soils. We expect that a 6- to 12-inch thick section of the crushed rock will be required. Following the placement and tracking of the gravel layer into the underlying “pumping” soils, it is recommended that Mirafi 600X stabilization fabric (or approved equivalent) then be placed upon the gravel layer.

Fill soils, which should be placed and compacted in accordance with the recommendations presented herein, should then be placed upon the fabric until design finish grades are reached. The gravel and stabilization fabric should extend at least 5 feet laterally beyond the limits of the “pumping” areas.

These operations should be performed under the observation and testing of a representative of EEI in order to evaluate the effectiveness of these measures and to provide additional recommendations for mitigative measures, as warranted.

### **6.6 Shrinkage and Bulking**

Several factors will impact earthwork balancing on the subject property, including shrinkage, bulking, subsidence, trench spoils from utilities and footing excavations, and final pavement section thickness as well as the accuracy of topography.

Shrinkage, bulking and subsidence are primarily dependent upon the degree of compactive effort achieved during construction. For planning purposes, the shrinkage factor is estimated to be on the order of 10 to 15 percent for the onsite natural soils to be utilized as fill. This shrinkage factor may vary with methods employed by the contractor. Subsidence is estimated to be on the order of 0.1 feet. Losses from property clearing and removal of existing property improvements may affect earthwork quantity calculation and should be considered.

The previous estimates are intended as an aid for the project engineers in estimating earthwork quantities. It is recommended that the site development be planned to include an area that could be raised or lowered to accommodate final site balancing.

### **6.7 Temporary Site Excavations**

All temporary excavations for grading purposes and installation of underground utilities should be constructed in accordance with OSHA guidelines and local safety codes. Temporary excavations within the onsite materials should be stable at 1H:1V inclinations for short durations during construction but should not exceed 15 feet in height.

Some sloughing of surface soils should be anticipated. Shoring will be required for areas where space for the slopes is not available. Proposed excavation materials should be observed by a representative of EEI prior to temporary cut slope construction.

## **7.0 PRELIMINARY FOUNDATION RECOMMENDATIONS**

### **7.1 General**

Plans concerning the proposed residential development have not been provided to EEI during the preparation of this report. The conclusions and recommendations contained in this report should not be considered valid unless the plans for the proposed residential development, once available, are reviewed, revised and/or approved in writing by EEI. The foundation recommendations provided herein are based on the soil materials near finish grade possessing a very low to low expansion potential ( $EI < 51$ ). In preparation for foundation construction, the earthwork contractor should ensure that the site has been prepared as recommended, and that field density tests have been performed to adequately document the relative compaction of the structural fill.

### **7.2 Preliminary Foundation Design**

The proposed three-story residential buildings and non-building improvements can be supported on conventional continuous or isolated spread footings bearing upon at least 18-inches of properly compacted fill materials. Foundations supporting three story structures should be constructed with an embedment of at least 24-inches below finish grade.

At these depths, footings may be designed for an allowable soil bearing value of 2,500 psf. This value may be increased by one-third for loads of short duration, such as wind and seismic forces. Continuous footings supporting three-story structures should have a minimum width of 18-inches. Based on geotechnical considerations, footings should be provided with reinforcement consisting of two No. 4 rebar, one top and one bottom. We recommend a minimum width of 24-inches for isolated spread footings.

In order to help reduce the potential for misalignment of proposed garage door openings, we recommend a grade beam be provided at each garage door opening. This grade beam should be designed in accordance with the structural engineer's requirements and have a minimum reinforcement of two No. 4 rebar (one top and one bottom).

Horizontal loads acting on foundations and stem walls cast in open excavations against undisturbed native soil or against properly placed and compacted fill will be resisted by friction acting along the base of the footing and by passive earth pressures against the side of the footing and stem wall.

The frictional resistance acting along the base of footings founded on suitable foundation soils may be computed using a friction coefficient equal to 0.25. Passive earth pressures acting against the side of footings and stem walls may be assumed to be equivalent to a fluid weighing 250 pounds per cubic foot. Passive pressure in the upper 1-foot should be neglected unless confined by concrete slabs-on-grade or asphalt concrete pavement. The values given above may be increased by one-third for transient wind or seismic loads.

### **7.3 Footing Setbacks**

All footings should maintain a minimum 7-foot horizontal setback from the base of the footing to any descending slope (if existing onsite). This distance is measured from the outside footing face at the bearing elevation. Footings should maintain a minimum horizontal setback of  $H/3$  ( $H$ =slope height) from the base of the footing to the descending slope face and no less than 7 feet, or greater than 40 feet.

Footings adjacent to unlined drainage swales or underground utilities (if any) should be deepened to a minimum of 6-inches below the invert of the adjacent unlined swale or utilities. This distance is measured from the footing face at the bearing elevation. Footings for structures adjacent to retaining walls should be deepened so as to extend below a 1:1 projection from the heel of the wall. Alternatively, walls may be designed to accommodate structural loads from buildings or appurtenances.

### **7.4 Construction**

The foundation construction considerations contained herein are presented as minimum recommendations from a soils engineering standpoint. Laboratory test results indicate the onsite soils' swell (expansion) potential is low.

During grading of the subject property, we recommend that no soil possessing an Expansion Index of more than 51 be placed within 24-inches of finish grade, if possible. As such, design parameters provided herein assume that finish grade soil materials will have a low expansion potential.

Recommendations by the project's design-structural engineer or architect, which may exceed the soils engineer's recommendations, should take precedence over the following minimum considerations. Final foundation design should be provided based on the expansion potential of the near surface soils encountered during grading.

## 7.5 Concrete Slab-on-Grade

Interior slabs can be grade supported by structural fill whose placement/compaction is documented by the project soils engineer/engineer geologist as recommended herein. The thickness of the slab should be in accordance with the structural engineer's design; however, based on geotechnical considerations, we recommend that concrete slabs be a minimum of 5-inches in thickness. Concrete slabs should be underlain by at least 2-inches of clean sand with a Sand Equivalent (SE) of at least 30. Where moisture condensation is undesirable, concrete slabs should be underlain with a moisture/vapor retarder consisting of a minimum 10-mil, visqueen membrane, with all laps sealed. The membrane should be underlain by a 2-inch layer of clean sand. The visqueen moisture barrier should then be overlain by a 2-inch layer of clean sand to aid in concrete curing. To reduce the potential for buildup of hydrostatic pressures, the free draining material under the slabs should have positive drainage with no low lying areas (i.e., depressions) created.

Floor slabs should be suitably reinforced and jointed (in accordance with Structural Engineer's recommendations) so that a small amount of independent movement can occur without causing damage. Based on the encountered geotechnical conditions, we recommend that floor slabs be reinforced with minimum No. 4 bars spaced on 18-inch centers (each way). The contractor should take the appropriate precautions to make sure that the reinforcement is placed and maintained within the middle one-third of the slab.

Exterior slabs, such as walkways and driveways, can be adequately supported on documented structural fill that is at minimum 12-inches in thickness, and placed and compacted in accordance with the recommendations contained herein.

In preparation for slab or flatwork construction, the earthwork contractor should ensure that the onsite soils have been prepared as recommended and that field density tests have been performed to adequately document the relative compaction of the structural fill. Preparation of the native soils should be documented prior to placement of aggregate, structural components and/or fill.

Some minor cracking of slabs can be expected due to shrinkage. The potential for this slab cracking can be reduced by careful control of water/cement ratios in the concrete. The contractor should take appropriate curing precautions during the pouring of concrete in hot or windy weather to reduce the potential for cracking of slabs. We recommend that a slipsheet (or equivalent) be utilized if grouted fill, tile, or other crack-sensitive floor covering is planned directly on concrete slabs. All slabs should be designed in accordance with structural considerations.

All dedicated exterior flatwork should conform to standards provided by the governing agency including section composition, supporting material thickness and any requirements for reinforcing steel. Concrete mix proportions and construction techniques, including the addition of water and improper curing, can adversely affect the finished quality of the concrete and result in cracking and spalling of the slab. We recommend that all placement and curing be performed in accordance with procedures outlined by the American Concrete Institute and/or Portland Cement Association.

Special consideration should be given to concrete placed and cured during hot or cold weather conditions. Proper control joints should be provided to reduce the potential for damage resulting from shrinkage.

Laboratory test results indicate that the upper materials contains a soluble sulfate concentration of 0.015 percent (150 ppm), which indicate a negligible sulfate corrosion potential of concrete that will be in contact with the onsite soils. Our analysis also indicates chloride concentrations of 0.004 (43 ppm), which indicates a negligible corrosion potential to concrete due to chloride in the soils. As such, Type II cement can be used in concrete elements that will be in contact with the upper materials.

## 7.6 Retaining Walls (if proposed)

The design parameters provided below assume that non-expansive soils ( $EI < 20$ ) are used to backfill any retaining walls. If expansive soils are used to backfill the proposed walls, increased active and at-rest earth pressures will need to be utilized for retaining wall design, and may be provided upon request. Building walls below grade should be waterproofed or damp-proofed, depending on the degree of moisture protection desired. The foundation system for the retaining walls should be designed in accordance with the recommendations presented in the preceding sections of this report, as appropriate. Footings should be embedded at a minimum of 18-inches below adjacent grade (excluding 6-inch landscape layer). There should be no increase in bearing for footing width. Recommendations pertaining to “landscape” walls (i.e., Crib, Loffel, Earthstone, Geogrid, etc.) may vary from those provided herein, and should be provided upon request.

The design active earth pressure on a retaining wall may be considered equivalent to that produced by a fluid weighing 40 pounds per cubic foot (pcf). This design equivalent fluid pressure of 40 pcf is appropriate for cantilevered walls retaining non-expansive granular soils with a level ground surface, subject to lateral deflection at distances above grade due to lateral earth pressures. Restrained walls (i.e., basement walls and re-entrant corners within cantilevered walls) with a level granular backfill should be designed for an equivalent fluid pressure of 60 pcf for at-rest conditions. If backfill conditions (including the slope of the retained ground surface) differ from those assumed herein, EEI should be consulted to provide additional evaluation and/or recommendations as warranted. A safety factor for sliding and overturning of 1.5 is typically incorporated into the design of a cantilevered structure as described herein. All retaining structures should be fully free draining.

For resistance to lateral loads, an allowable frictional coefficient equal to 0.25 at the base of the foundation elements and underlying material is recommended. In addition, an allowable passive resistance equal to an equivalent fluid weighing 250 pcf acting against the foundation may be used to resist lateral forces. Passive pressure in the upper 1.0-foot should be neglected unless confined by concrete slabs-on-grade or asphaltic pavement. These values may be increased by one-third for transient wind or seismic loads.

Utilizing the estimated Peak Ground Acceleration seismic parameter  $PGA_M$  (where  $PGA_M$  is the design peak ground acceleration adjusted for site class effects presented in **Section 3.1** of this report), we estimate the seismic resultant for lateral pressure for a wall with level backfill to be  $23H^2$  lbs, or  $28H^2$  for sloping backfill, where H is the retained height in (feet).

The seismic resultant is expected to be exerted in addition to the lateral earth pressures presented above. The seismic resultant may be assumed to be applied at a height of  $0.6H$  above the wall base. The magnitude and location of the seismic resultant are based on the assumption that the walls are constructed in accordance with the recommendations contained herein.

Adequate drainage should be provided behind all retaining walls. The drainage system should consist of a minimum of 4-inch diameter perforated PVC pipe (schedule 40 or approved equivalent) placed at the base of the retaining wall and surrounded by  $\frac{3}{4}$ -inch clean crushed rock wrapped in a Mirafi 140N filter fabric, or equivalent approved by the Geotechnical Engineer. The drain rock wrapped in fabric should be at least 12-inches wide and extend from the base of the wall to within 2 feet of the ground surface. The upper 2 feet of backfill should consist of compacted native soil. The retaining wall drainage system should be sloped to outfall to the storm drain system or other appropriate facility.

### 8.0 PRELIMINARY PAVEMENT DESIGN RECOMMENDATIONS

Deleterious material, excessively wet or dry pockets, concentrated zones of oversized rock fragments, and any other unsuitable yielding materials encountered during grading should be removed. Once compacted fill and/or native soils are brought to the proposed pavement subgrade elevations, the subgrade should be proof-rolled in order to check for a uniform firm and unyielding surface. Representatives of the project geotechnical engineer should observe all grading and fill placement.

The upper 12-inches of pavement subgrade soils should be scarified; moisture conditioned to at least optimum moisture content and compacted to at least 95 percent of the laboratory standard (ASTM D1557). If loose or yielding materials are encountered during subgrade preparation, evaluation should be performed by EEI.

Aggregate base materials should be properly prepared (i.e., processed and moisture conditioned) and compacted to at least 95 percent of the maximum dry density as determined by ASTM D1557. Aggregate base materials should conform to Caltrans specifications for Class 2 aggregate base.

All pavement section changes should be properly transitioned. Although not anticipated, if adverse conditions are encountered during the preparation of subgrade materials, special construction methods may need to be employed. A representative of the project geotechnical engineer should be present for the preparation of subgrade and aggregate base.

For design purposes we have assumed a Traffic Index (TI) of 5.5 for the drive areas and 4.5 for the parking stalls at the subject property. This assumed TI should be verified as necessary by the Civil Engineer or Traffic Engineer. For preliminary design purposes, we have assumed a preliminary R-Value of 20 for the materials likely to be exposed at subgrade. The modulus of subgrade reaction (K-Value) was estimated at 80 pounds per square inch per inch (psi/in) for an R-Value of 20 (Caltrans, 1974). Pavement design was calculated for the parking lot structural section requirements for asphaltic concrete in accordance with the guidelines presented in the Caltrans Highway Design Manual. Rigid pavement sections were evaluated in general accordance with ACI 330R-08, based on an average daily truck traffic value of 10.

<b>TABLE 3</b>		
<b>Preliminary Pavement Design Recommendations</b>		
<b>Traffic Index (TI)</b>	<b>Pavement Surface</b>	<b>Aggregate Base Material <sup>(1)</sup></b>
4.5 – Parking Stalls	3.0-inches Asphalt Concrete	6.0-inches
5.5 – Drive Areas	4.0-inches Asphalt Concrete	7.0-inches
Trash Area and Concrete Pavement	5.5-inches Portland Cement Concrete <sup>(2)</sup>	4-inches
(1) R-Value of 78 for Caltrans Class 2 aggregate base (2) Reinforcement and control joints placed in accordance with the structural engineer's requirements		

The recommended pavement sections provided above are intended as a minimum guideline. If thinner or highly variable pavement sections are constructed, increased maintenance and repair could be expected. If the ADT (average daily traffic) or ADTT (average daily truck traffic) increases beyond that intended, as reflected by the assumed traffic index used for design, increased maintenance and repair could be required for the pavement section. Final pavement design should be verified by testing of soils exposed at subgrade after grading has been completed. Thicker pavement sections could result if R-Value testing indicates lower values.

## **9.0 DEVELOPMENT RECOMMENDATIONS**

### **9.1 Landscape Maintenance and Planting**

Water is known to decrease the physical strength of earth materials, significantly reducing stability by high moisture conditions. Surface drainage away from foundations and graded slopes should be maintained. Only the volume and frequency of irrigation necessary to sustain plant life should be applied.

Consideration should be given to selecting lightweight, deep rooted types of landscape vegetation which require low irrigation that are capable of surviving the local climate. From a soils engineering viewpoint, “leaching” of the onsite soils is not recommended for establishing landscaping. If landscape soils are processed for the addition of amendments, the processed soils should be re-compacted to at least 90 percent relative compaction (based on ASTM D1557).

### **9.2 Site Drainage**

Positive property drainage should be maintained at all times. Drainage should not flow uncontrolled over slopes or the property. Runoff should be channeled away from slopes and structures and not allowed to pond and/or seep uncontrolled into the ground. Pad drainage should be directed toward an acceptable outlet. Although not required, roof gutters and down spouts may be considered to control roof drainage, discharging a minimum of 10 feet from the proposed structures, or into a subsurface drainage system. Consideration should be given to eliminating open bottom planters directly adjacent to proposed structures for a minimum distance of 10 feet. As an alternative, closed-bottom type planters could be utilized, with a properly designed drain outlet placed in the bottom of the planter.

### **9.3 Site Runoff Considerations - Stormwater Disposal Systems**

It is EEI understanding that the Client is considering that runoff generated from the facility be disposed of in multiple engineered subsurface features onsite.

#### **9.3.1 Percolation Testing**

Following the drilling of exploratory boring B-6, a 3-inch diameter perforated polyvinyl chloride (PVC) pipe was placed in the hole and gravel was placed around the pipe. The test hole was presoaked in general accordance with County of San Diego DEH Guidelines. During the presoaking process, it was observed that more than 30 minutes was required for a minimum 12-inch high column of water to seep away. Consequently, the boring was allowed to presoak and the test in the boring was run at 30 minute intervals for a period of approximately two hours, when the highest and lowest readings from three consecutive readings were noted to be within 10 percent of each other. The reading obtained from the final 30 minute interval was then used to calculate the pre-adjusted percolation rate for that test hole. Upon conclusion of testing, the perforated pipe was removed from the test hole and the test excavation was backfilled.

We note that a soil profile’s percolation rate is not the same as its infiltration rate. Therefore, the measured/calculated percolation rate was converted to an estimated infiltration rate. Therefore, the measured/calculated field percolation rate was converted to an estimated infiltration rate utilizing a reduction factor known as the Porchet method. The following table presents the measured percolation rate and corresponding infiltration rate calculated for the test hole.

<b>Location</b>	<b>Depth (ft)</b>	<b>Pre-Adjusted Percolation Rate (in/hr)</b>	<b>Infiltration Rate (in/hr)</b>
B-6	~7	2.52	0.15

### 9.3.2 Summary of Findings

Based on the results of our field percolation testing, and the overall dense and clayey nature of some of the upper soils underlying earth materials encountered during our field exploration, it appears that the percolation/infiltration rates presented above may be not conducive to direct infiltration of subsurface stormwater for the preliminary design of subsurface storm water retention/disposal devices at the specific locations at the subject property as listed in **Table 4**.

### 9.3.3 Structural Setback from Retention Devices

It is recommended that retention/disposal devices be situated at least three times their depth, or a minimum of 15 feet (whichever is greater), from the outside bottom edge of structural foundations. Structural foundations include (but are not limited to) buildings, loading docks, retaining walls, and screen walls.

All stormwater disposal systems, including pervious pavement areas should be checked and maintained on regular intervals. Stormwater devices including bioswales that are located closer than 10 feet from any foundations/footings should be lined with an impermeable membrane to reduce the potential for saturation of foundation soils (also refer to **Section 7.3**).

## 9.4 Additional Site Improvements

Recommendations for additional grading, exterior concrete flatwork design and construction can be provided upon request. If in the future, additional property improvements were planned for the site, recommendations concerning the design and construction of improvements would be provided upon request.

## 9.5 Trenching

All temporary excavations for grading purposes and installation of underground utilities should be constructed in accordance with OSHA guidelines and local safety codes. Temporary excavations over 4 feet in height should be evaluated by the project engineer, and could require shoring, sloping, or a combination thereof. Temporary excavations within the onsite materials should be stable at 1:1 inclinations for cuts less than 10 feet in height.

Footing trench excavations for structures and walls should be observed and approved by a representative of the project soils engineer prior to placing reinforcement. Footing trench spoil and excess soils generated from utility trench excavations should be compacted to a minimum relative compaction of 90 percent (based on ASTM D1557) if not removed from the subject property. All excavations should conform to OSHA and local safety codes.

## 9.6 Utility Backfill

Fill around the pipe should be placed in accordance with details shown on the drawings, and should be placed in layers not to exceed 8-inches loose (unless otherwise approved by the geotechnical engineer) and compacted to at least 90 percent of the maximum dry density as determined in accordance with ASTM D1557 (Modified Proctor). The geotechnical engineer should approve all backfill material. Select material should be used when called for on the drawings, or when recommended by the geotechnical engineer. Care should be taken during backfill and compaction operations to maintain alignment and prevent damage to the joints. The backfill should be kept free from oversized material, chunks of highly plastic clay, or other objectionable material. Backfill soils should be non-expansive, non-corrosive, and compatible with native earth materials. Backfill materials and testing should be in accordance with the CBC (2013), and the requirements of the local governing jurisdiction.

Pipe backfill areas should be graded and maintained in such a condition that erosion or saturation will not damage the pipe bed or backfill. Flooding trench backfill is not recommended. Heavy equipment should not be operated over any pipe until it has been properly backfilled with a minimum of 2 to 3 feet of cover. The utility trench should be systematically backfilled to allow maximum time for natural settlement. Backfill should not occur over porous, wet, or spongy subgrade surfaces. Should these conditions exist, the areas should be removed, replaced and recompact.

## 10.0 PLAN REVIEW

Once detailed site and grading plans are available, they should be submitted to this office for review and comment, to reduce the potential for discrepancies between plans and recommendations presented herein. If conditions are found to differ substantially from those stated, appropriate recommendations would be provided. Additional field studies may be warranted.

## 11.0 LIMITATIONS

This Preliminary Geotechnical Evaluation has been conducted in accordance with generally accepted geotechnical engineering principles and practices. Findings provided herein have been derived in accordance with current standards of practice, and no warranty is expressed or implied. Standards of practice are subject to change with time. This report has been prepared for the sole use of Integral Communities (Client), within a reasonable time from its authorization. Subject property conditions, land use (both onsite and offsite), or other factors may change as a result of manmade influences, and additional work may be required with the passage of time.

This Preliminary Geotechnical Evaluation should not be relied upon by other parties without the express written consent of EEI and the Client; therefore, any use or reliance upon this Preliminary Geotechnical Evaluation by a party other than the Client should be solely at the risk of such third party and without legal recourse against EEI, its employees, officers, or directors, regardless of whether the action in which recovery of damages is brought or based upon contract, tort, statute, or otherwise. The Client has the responsibility to see that all parties to the project, including the designer, contractor, subcontractor, and building official, etc. are aware of this report in its complete form.

This report contains information that may be used in the preparation of contract specifications; however, the report is not designed as a specification document, and may not contain sufficient information for use without additional assessment. EEI assumes no responsibility or liability for work or testing performed by others. In addition, this report may be subject to review by the controlling authorities.

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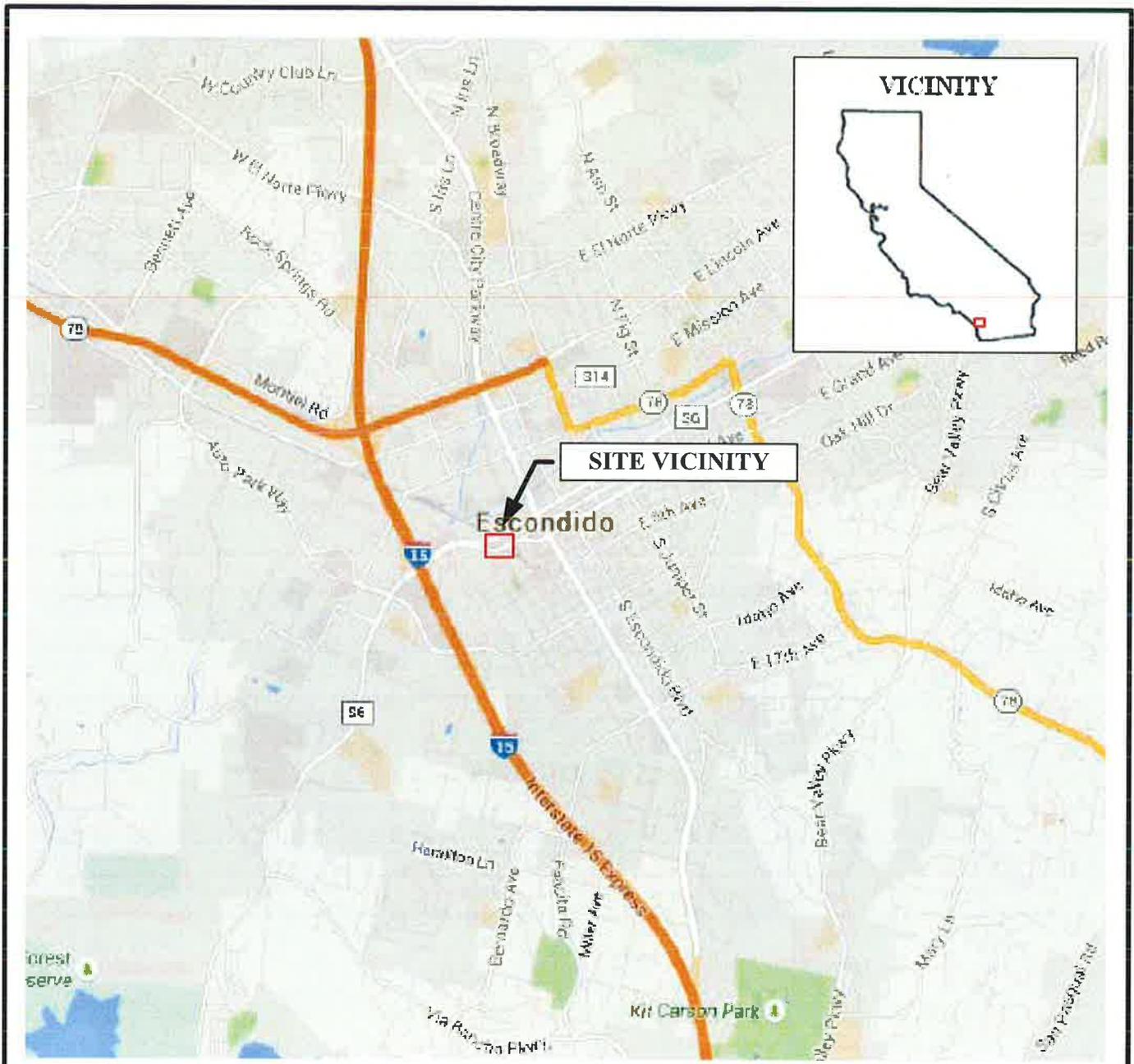
**Geotechnical Evaluation – Integral Communities**  
**700 West Grand Avenue, Escondido, California**

**September 21, 2015**  
**EEI Project No. IPF-72198.4**

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**FIGURES**

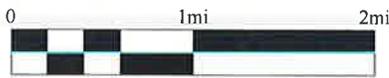


Map Source: Google Maps®; Accessed 2015

**LEGEND**



**Scale: 1" = 1mi**



Note: All Locations Are Approximate

**SITE VICINITY MAP**

**Integral Communities**  
 700 West Grand Avenue  
 Escondido, California 92069  
 EEI Project No. IPF-72198.4  
 Created September 2015



**FIGURE 1**



Source: Google Earth, 2015; Image Date: September 8, 2015

**LEGEND**



**Scale: 1" = 75'**



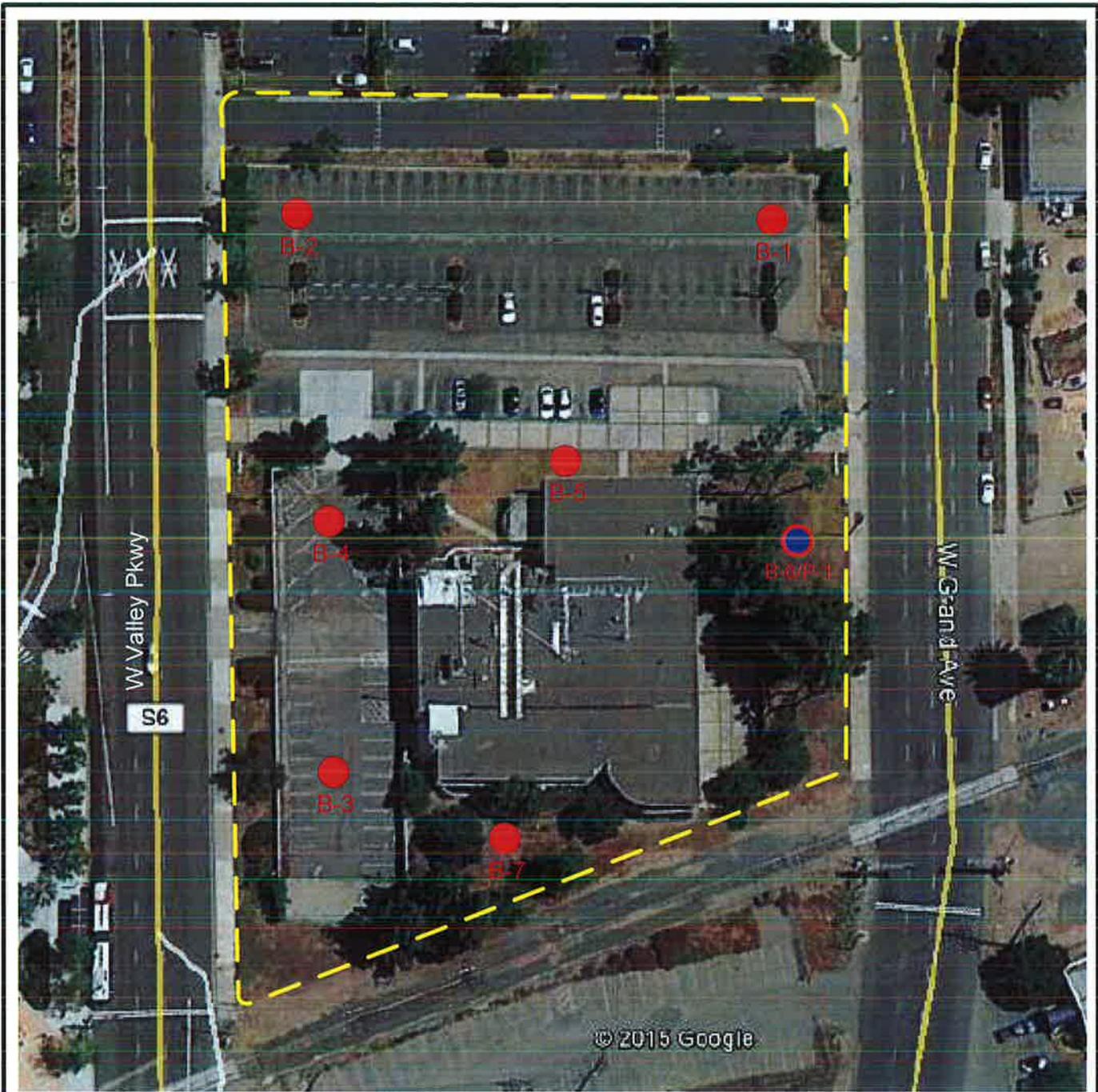
Note: All Locations Are Approximate

**AERIAL SITE MAP**

**Integral Communities**  
 700 West Grand Avenue  
 Escondido, California 92069  
 EEI Project No. IPF-72198.4  
 Created September 2015



**FIGURE 2**



Source: Google Earth, 2015; Image Date: September 8, 2015

**LEGEND**

-  **Approximate Boring Locations**
- B-7**
-  **Approximate Percolation Boring Location**
- B-6/P-1**

**Scale: 1" = 75'**



Note: All Locations Are Approximate



**BORING LOCATION PLAN**

**Integral Communities**  
 700 West Grand Avenue  
 Escondido, California 92069  
 EEI Project No. IPF-72198.4  
 Created September 2015



**FIGURE 3**

**APPENDIX A  
SOIL CLASSIFICATION CHART AND  
BORING LOGS**

# SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
<b>COARSE GRAINED SOILS</b>  MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	<b>GRAVEL AND GRAVELLY SOILS</b>  MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS  (LITTLE OR NO FINES)		<b>GW</b>	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES  (APPRECIABLE AMOUNT OF FINES)		<b>GP</b>	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES  (APPRECIABLE AMOUNT OF FINES)		<b>GM</b>	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
	<b>SAND AND SANDY SOILS</b>  MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS  (LITTLE OR NO FINES)		<b>SW</b>	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
		SANDS WITH FINES  (APPRECIABLE AMOUNT OF FINES)		<b>SP</b>	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES  (APPRECIABLE AMOUNT OF FINES)		<b>SM</b>	SILTY SANDS, SAND - SILT MIXTURES
<b>FINE GRAINED SOILS</b>  MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	<b>SILTS AND CLAYS</b>  LIQUID LIMIT LESS THAN 50	CLEAN SANDS  (LITTLE OR NO FINES)		<b>ML</b>	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
		SANDS WITH FINES  (APPRECIABLE AMOUNT OF FINES)		<b>CL</b>	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
		SANDS WITH FINES  (APPRECIABLE AMOUNT OF FINES)		<b>OL</b>	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	<b>SILTS AND CLAYS</b>  LIQUID LIMIT GREATER THAN 50	SANDS WITH FINES  (APPRECIABLE AMOUNT OF FINES)		<b>MH</b>	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
		SANDS WITH FINES  (APPRECIABLE AMOUNT OF FINES)		<b>CH</b>	INORGANIC CLAYS OF HIGH PLASTICITY
		SANDS WITH FINES  (APPRECIABLE AMOUNT OF FINES)		<b>OH</b>	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
<b>CLAYSTONE</b>				<b>CL</b>	CLAYSTONE, Pliocene Fernando Formation/late Miocene Puente Formation

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS



# BOREHOLE LOG

Number:

B-1

Client:

Integral Communities

Sheet:

1 of 1

Location:

700 W. Grand Avenue  
Escondido, CA

Date Started:

9/2/2015

Date Finished:

9/2/2015

EEI Rep:

ML

Project No.:

IPF-72198.4

Drill Rig/Sampling Method

CalPac Mobile B53 / 140 pound Auto-hammer

Borehole Diameter:

6-inch

## SAMPLE LOG

## BOREHOLE LOG

Bulk	Sample Type	Blows Per 6"	Dry Unit Wt. (pcf)	Moisture (%)	Depth In Feet	USCS Symbol	Graphic Log	Geologic Description (Soil Type, Color, Grain, Minor Soil Component, Moisture, Density, Odor, Etc.)
					1			A/C (4") over SAND base material
	MC	3 5 11	114	14	2	CL-ML		<b>ALLUVIUM</b> CLAYEY-SILT, brown mottled, moist, stiff
	MC	3 6 12	86	24	5	CL		@ 5' CLAY, reddish brown, moist, stiff
	MC	11 23 50/6"	120	9	7			<b>WEATHERED GRANITICS</b> @ 7' DECOMPOSED GRANITICS ("DG"), light gray and reddish brown, moist, dense; micaceous, trace clay, heavily weathered
	MC	32 50/2"	114	6	10			@ 10' Becomes very dense
	MC	50/4"	121	17	15			@ 15' Becomes light gray and dark brown, perched water encountered
					18			@ 18' Refusal on weathered granitics
					19			Total depth: 18-feet Perched groundwater encountered at 15' bgs Boring backfilled with cuttings on 9/2/2015

BOREHOLE LOG IPF-72198.4.GPJ EELGDT 9/17/15



# BOREHOLE LOG

Number:  
B-2

Client:  
Integral Communities

Sheet:  
1 of 1

Location:  
700 W. Grand Avenue  
Escondido, CA

Date Started:  
9/2/2015

Date Finished:  
9/2/2015

EEI Rep:  
ML

Project No.:  
IPF-72198.4

Drill Rig/Sampling Method  
CalPac Mobile B53 / 140 pound Auto-hammer

Borehole Diameter:  
6-inch

## SAMPLE LOG

## BOREHOLE LOG

Bulk	Sample Type	Blows Per 6"	Dry Unit Wt. (pcf)	Moisture (%)	Depth In Feet	USCS Symbol	Graphic Log	Geologic Description (Soil Type, Color, Grain, Minor Soil Component, Moisture, Density, Odor, Etc.)
					1			A/C (4") over SAND base material
	MC	12 10 18	103	11	2	SM		<b>ALLUVIUM</b> SILTY SAND, brown, moist, fine grained sand, medium dense
	MC	9 15 19	113	14	3			
	MC	8 50/6"	104	22	4			
	MC	13 50/6"	110	10	5			
					6	CL		@ 7.5' SILTY CLAY, reddish brown, moist, hard
					7			
					8	SC		@ 10' CLAYEY SAND, reddish brown, moist, fine to medium grained sand, very dense
					9			
					10			
					11			
	MC	50/5"	103	10	12			<b>WEATHERED GRANITICS</b> @ 14' DECOMPOSED GRANITICS ("DG"), light gray and reddish brown, moist, very dense; micaceous, trace clay, heavily weathered
					13			@ 16.5' Refusal on weathered granitics
					14			
					15			
					16			
					17			
					18			
					19			
								Total depth: 16.5-feet No groundwater encountered Boring backfilled with cuttings on 9/2/2015

BOREHOLE LOG IPF-72198.4.GPJ EEI/GDT 9/17/15



# BOREHOLE LOG

Number:  
B-3

Client:  
Integral Communities

Sheet:  
1 of 1

Location:  
700 W. Grand Avenue  
Escondido, CA

Date Started:  
9/2/2015

Date Finished:  
9/2/2015

EEI Rep:  
ML

Project No.:  
IPF-72198.4

Drill Rig/Sampling Method  
CalPac Mobile B53 / 140 pound Auto-hammer

Borehole Diameter:  
6-inch

## SAMPLE LOG

## BOREHOLE LOG

Bulk	Sample Type	Blows Per 6"	Dry Unit Wt. (pcf)	Moisture (%)	Depth In Feet	USCS Symbol	Graphic Log	Geologic Description (Soil Type, Color, Grain, Minor Soil Component, Moisture, Density, Odor, Etc.)
					1			A/C (4") over SAND base material
	MC	8 6 10	106	13	2	ML		<b>ALLUVIUM</b> SANDY SILT, dark gray, moist, fine grained sand, loose
	MC	9 12 13	89	14	3			
	MC	10 21 50/6"	117	7	4			
	MC	14 33 34	113	15	5	CL		@ 5' SANDY CLAY, dark reddish brown, moist, fine grained sand, very stiff
	MC	15 50/6"	123	12	6			
					7			
					8			@ 7.5' CLAYEY SAND, reddish brown, moist, fine to medium grained sand, dense
					9			
					10			@ 10' Becomes mottled
					11	SC		
					12			
					13			
					14			<b>WEATHERED GRANITICS</b>
					15			@ 14' DECOMPOSED GRANITICS ("DG"), greenish gray and reddish brown, moist, very dense; micaceous, trace clay, heavily weathered
					16			@ 16' Refusal on weathered granitics
					17			
					18			
					19			
								Total depth: 16-feet No groundwater encountered Boring backfilled with cuttings on 9/2/2015

BOREHOLE LOG IPF-72198.4.GPJ EELGDT 9/17/15



# BOREHOLE LOG

**Number:**  
B-4

**Client:** Integral Communities

**Sheet:**  
1 of 1

**Location:** 700 W. Grand Avenue  
Escondido, CA

**Date Started:** 9/2/2015  
**Date Finished:** 9/2/2015

**EEl Rep:** ML  
**Project No.:** IPF-72198.4

**Drill Rig/Sampling Method:** CalPac Mobile B53 / 140 pound Auto-hammer

**Borehole Diameter:** 6-inch

## SAMPLE LOG

## BOREHOLE LOG

Bulk	Sample Type	Blows Per 6"	Dry Unit Wt. (pcf)	Moisture (%)	Depth In Feet	USCS Symbol	Graphic Log	Geologic Description (Soil Type, Color, Grain, Minor Soil Component, Moisture, Density, Odor, Etc.)
					1			A/C (3") over SAND base material
	MC	17 20 21	114	15	2	ML		<b>ALLUVIUM</b> SANDY SILT, brown mottled, moist, fine grained sand, medium dense
	MC	8 14 14	114	14	3			
	MC	10 20 50/5"	120	9	4			
	MC	50/5"	125	5	5	SM		@ 5' SILTY SAND, reddish brown, moist, fine grained sand, medium dense
					6			
					7			
					8			<b>WEATHERED GRANITICS</b> @ 7.5' DECOMPOSED GRANITICS ("DG"), greenish gray and light reddish brown, moist, dense; micaceous, trace clay, heavily weathered
					9			
					10			@ 10' Becomes very dense, refusal on weathered granitics
					11			
					12			
					13			
					14			
					15			
					16			
					17			
					18			
					19			
Total depth: 10.5-feet No groundwater encountered Boring backfilled with cuttings on 9/2/2015								

BOREHOLE LOG IPF-72198.4.GPJ EEIGDT 9/17/15



# BOREHOLE LOG

**Number:**  
B-5

**Sheet:**  
1 of 1

**Client:** Integral Communities

**Location:** 700 W. Grand Avenue  
Escondido, CA

**Date Started:** 9/2/2015  
**Date Finished:** 9/2/2015

**EEl Rep:** ML  
**Project No.:** IPF-72198.4

**Drill Rig/Sampling Method:** CalPac Mobile B53 / 140 pound Auto-hammer

**Borehole Diameter:** 6-inch

## SAMPLE LOG

## BOREHOLE LOG

Bulk	Sample Type	Blows Per 6"	Dry Unit Wt. (pcf)	Moisture (%)	Depth In Feet	USCS Symbol	Graphic Log	Geologic Description (Soil Type, Color, Grain, Minor Soil Component, Moisture, Density, Odor, Etc.)
					1			<b>ALLUVIUM</b> SANDY SILT, dark brown, moist, fine grained sand, dense
	MC	17 26 32	106	15	2			
					3			
					4	ML		
	MC	7 12 15	112	14	5			@ 5' Becomes medium dense
					6			
					7			
	MC	4 6 10	114	15	8			@ 7.5' SAND, dark brown, moist to wet, fine to medium grained, loose
					9	SP		
					10			
	MC	7 15 19	123	6	11			@ 10' SAND WITH CLAY, reddish brown, moist to wet, fine to medium grained, medium dense
					12	SP-SC		
					13			
					14			<b>WEATHERED GRANITICS</b> @ 13' DECOMPOSED GRANITICS ("DG"), greenish gray and light reddish brown, moist, very dense; micaceous, trace clay, heavily weathered
					15			
	MC	50/5"	108	7	15.5			@ 15.5' Refusal on weathered granitics
					16			
					17			
					18			
					19			
Total depth: 15.5-feet No groundwater encountered Boring backfilled with cuttings on 9/2/2015								

BOREHOLE LOG IPF-72198.4.GPJ EELGDT 9/17/15



# BOREHOLE LOG

**Number:**  
B-6

**Client:** Integral Communities

**Sheet:**  
1 of 1

**Location:** 700 W. Grand Avenue  
Escondido, CA

**Date Started:** 9/2/2015  
**Date Finished:** 9/2/2015

**EEl Rep:** BM  
**Project No.:** IPF-72198.4

**Drill Rig/Sampling Method:** Native Drilling Tri-Pod / 140 pound Auto-hammer

**Borehole Diameter:** 6-inch

### SAMPLE LOG

### BOREHOLE LOG

Bulk	Sample Type	Blows Per 6"	Dry Unit Wt. (pcf)	Moisture (%)	Depth In Feet	USCS Symbol	Graphic Log	Geologic Description <small>(Soil Type, Color, Grain, Minor Soil Component, Moisture, Density, Odor, Etc.)</small>
					1	ML		<b>FILL</b> SILT, brown, moist, fine scattered gravels, medium dense
	MC	50/6"	104	12	2			<b>ALLUVIUM</b> @ 2' SANDY SILT, dark brown, moist, medium dense; gravel caught in sampler
					3	ML		
					4	ML		
	MC	10 11 15	110	4	5			@ 5' SILT, dark brown, moist, trace fine grained sand, medium dense
					6	ML		
					7			
					8			Total depth: 7.0-feet No groundwater encountered Percolation test performed  Boring backfilled with cuttings on 9/3/2015
					9			
					10			
					11			
					12			
					13			
					14			
					15			
					16			
					17			
					18			
					19			

BOREHOLE LOG IPF-72198.4.GPJ EEIGDT 9/17/15



# BOREHOLE LOG

Number:  
B-7

Client:  
Integral Communities

Sheet:  
1 of 1

Location:  
700 W. Grand Avenue  
Escondido, CA

Date Started:  
9/2/2015

Date Finished:  
9/2/2015

EEI Rep:  
BM

Project No.:  
IPF-72198.4

Drill Rig/Sampling Method  
Native Drilling Tri-pod / 140 pound Auto-hammer

Borehole Diameter:  
6-inch

## SAMPLE LOG

## BOREHOLE LOG

Bulk	Sample Type	Blows Per 6"	Dry Unit Wt. (pcf)	Moisture (%)	Depth In Feet	USCS Symbol	Graphic Log	Geologic Description (Soil Type, Color, Grain, Minor Soil Component, Moisture, Density, Odor, Etc.)
					1			<b>FILL</b> SILTY SAND, light brown, damp, fine to medium grained sand, medium dense
	MC	14 14 22	103	11	2	SM		
					3			<b>ALLUVIUM</b> @ 3' SILT, dark orange brown, moist, medium dense
	MC	9 11 11	106	13	4	ML		
					5			@ 5' CLAYEY SILT, dark brown, moist, very stiff
	MC	4 4 4	93	25	6	CL-ML		
					7			@ 7.5' Becomes wet, medium stiff
	MC	14 15 17	109	19	8			@ 10' SILTY SAND, orange brown, wet, medium dense
					9			
					10	SM		@ 11' Perched water encountered
					11			
					12			
					13			<b>WEATHERED GRANITICS</b> @ 12.5' DECOMPOSED GRANITICS ("DG"), gray and light brown, wet, very dense; micaceous, trace clay, heavily weathered
					14			
	MC	50/6"		13	15			@ 15.5' Refusal on weathered granitics
					16			
					17			
					18			
					19			
Total depth: 15.5-feet No groundwater encountered Boring backfilled with cuttings on 9/3/2015								

BOREHOLE LOG IPF-72198.4.GPJ EELGDT 9/17/15

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**APPENDIX B  
LABORATORY TEST DATA**

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# DIRECT SHEAR TEST ASTM D 3080

### Job Data

Job No.: IPF-72198.4  
 Client: Integral Communities  
 Date: 9/14/15

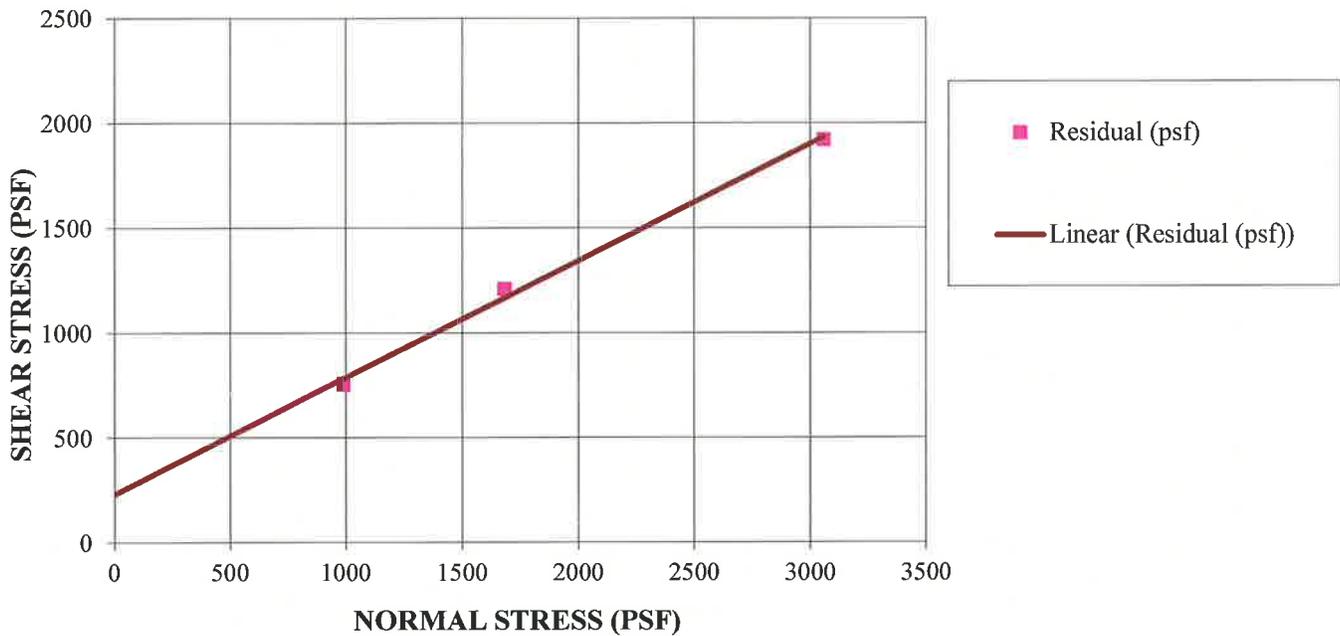
### Sample Data

Sample: B-2 @ 1 - 6 ft  
 Remolded: 90%  
 Remarks: Sample Innundated Prior to Testing  
 Soil Description: Brown Silty Sand



2195 Faraday Avenue, Suite K, Carlsbad, CA 92008

## SHEAR TEST DIAGRAM



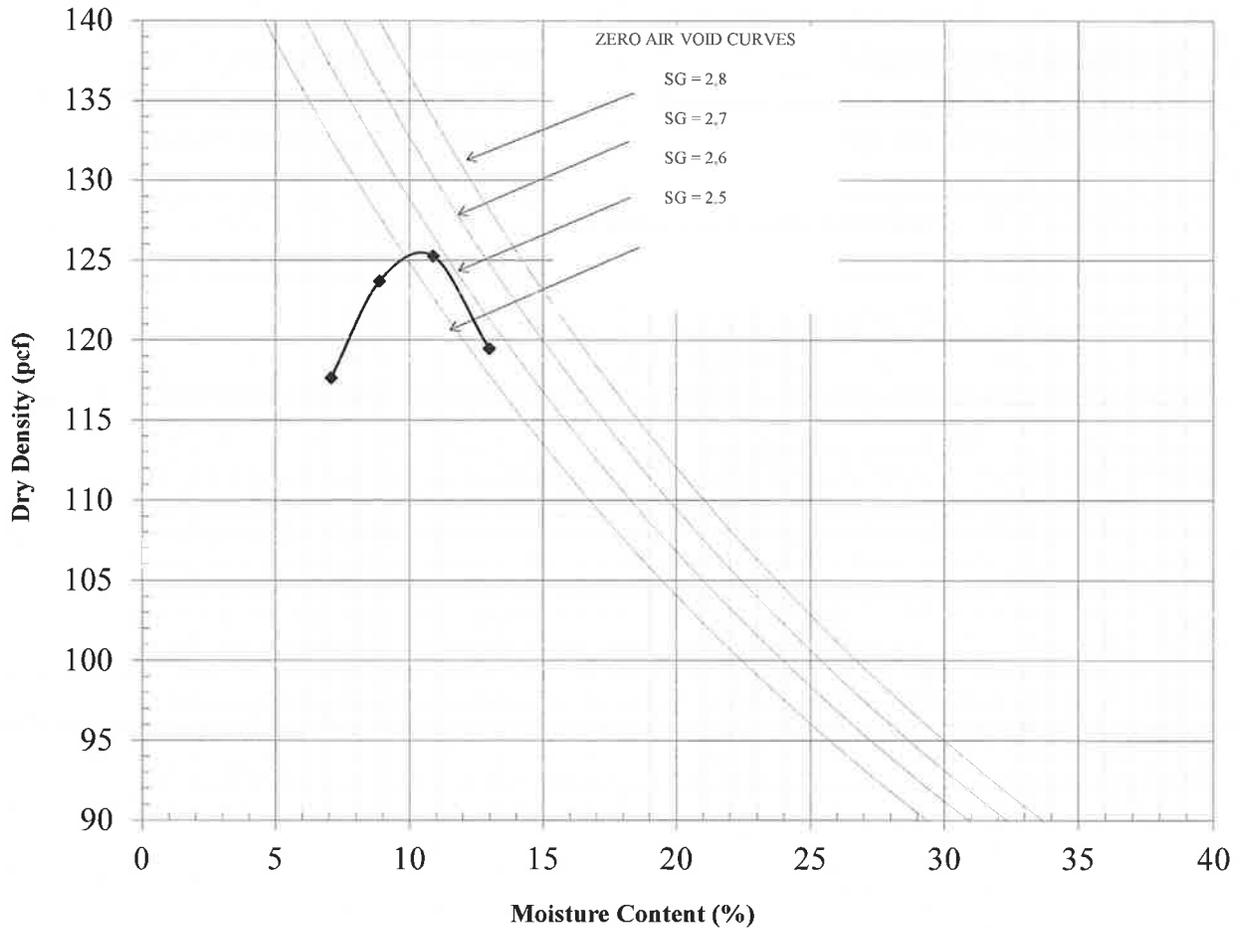
### Test Results

	Phi		Cohesion	
Ultimate (psf)	29	degrees	229	psf

Average Initial Moisture	10.0%
Average Dry Density	113.3 pcf
Average Final Moisture	15.3%

## LABORATORY COMPACTION ASTM D 1557

Sample	1	2	3	4
Mold and wet soil (lbs.)	8.490	8.780	8.920	8.790
Mold (lbs.)	4.290	4.290	4.290	4.290
Wet Soil (lbs.)	4.200	4.490	4.630	4.500
Wet Density (pcf)	126.00	134.70	138.90	135.00
Moisture (%)	7.1	8.9	10.9	13.0
Dry Density (pcf)	117.6	123.7	125.2	119.5



2195 Faraday, Suite K, Carlsbad, CA 92008

Client: Integral Communities

Project Name: 700 W. Grand Ave.

Procedure: Method A

Job Number: IPF-72198.4

Date: 9/14/15

Boring Number: B-2

Location: 1-6 ft.

Soil Description: Brown Silty Sand

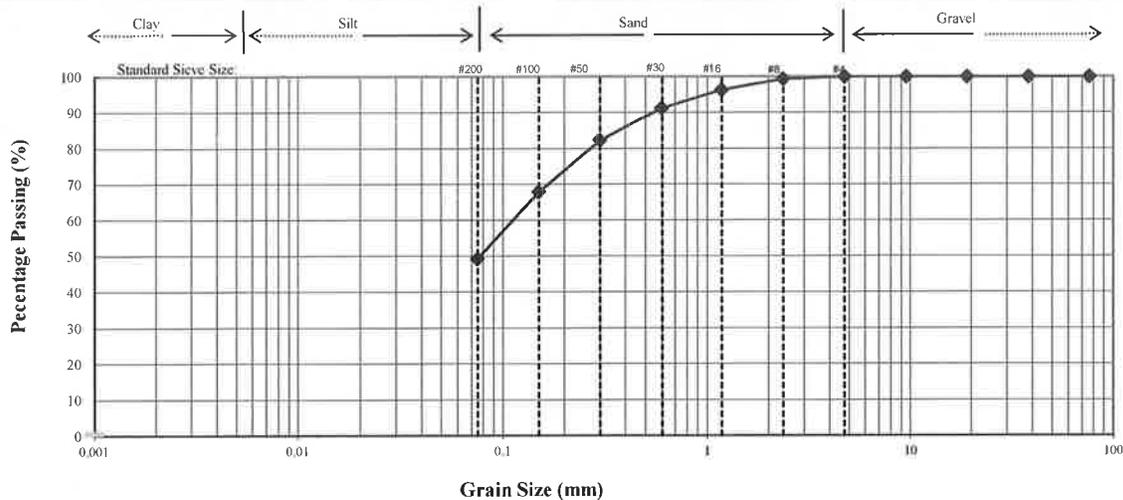
Tested by: B D

# PARTICLE-SIZE ANALYSIS OF SOILS

## ASTM METHOD D 422 (SIEVE ANALYSIS)

<b>Sample :</b>	B-2 @ 1-6 ft.		D10 (mm)	N/A
<b>Total Weight (g)</b>	106.2		D30 (mm)	N/A
<b>Dry Weight (g)</b>	97.0		D60 (mm)	0.12
<b>Wet Sieve Weight (g)</b>	46.1		Cu	N/A
<b>Initial Moisture (%)</b>	9.5		Cc	N/A

According to ASTM D 2487 Unified Soil Classification System (USCS) and ASTM D 422 (Standard Test Method for Particle-Size Analysis) test method results, soil sample B-2 at 1-6 feet is classified as Silty Sand (SM)



Sieve Size (in)	Sieve Size (mm)	Cumulative Weight of dry soil (gm)	Percent Retained (%)	Percent Passing (%)
3"	76.2	0.0	0.0	100.0
1.5"	38.1	0.0	0.0	100.0
3/4"	19.05	0.0	0.0	100.0
3/8"	9.53	0.0	0.0	100.0
#4	4.75	0.0	0.0	100.0
#8	2.36	0.6	0.6	99.4
#16	1.18	3.5	3.6	96.4
#30	0.6	8.5	8.8	91.2
#50	0.3	17.2	17.7	82.3
#100	0.15	31.2	32.2	67.8
#200	0.075	49.2	50.7	49.3



2195 Faraday Avenue, Suite K, Carlsbad CA 92008

Client: Integral Communities

Project Name: W. Grand Ave.

Job Number: IpF-72198.4

Date: 9/14/15

Boring Number: B-2

Depth: 1-6 ft.

Soil Description: Brown Silty Sand SM

Tested by: B D

# EXPANSION INDEX TEST

## ASTM METHOD D 4829

**Sample B-2 @ 1-6 ft.**

Moisture Content of Initial Sample	% Saturation of Re-molded Sample	Moisture Content of Final Sample
Tare No. - 52	Wt. of Soil and Ring (g) - 604.5	Wt. of Soil and Ring (g) - 630.5
Wet Weight and Tare (g) - 154.2	Ring Weight (g) - 198.9	Ring Weight (g) - 198.9
Dry Weight and Tare (g) - 145.3	Wet Weight of Soil (g) - 405.6	Wet Weight of Soil (g) - 431.6
Tare Weight (g) - 49.9	Dry Weight of Soil (g) - 371.0	Dry Weight of Soil (g) - 371.0
Water Loss (g) - 8.9	Volume of Ring (ft <sup>3</sup> ) - 0.0073	Weight of Water (g) - 60.6
Dry Weight (g) - 95.4	Dry Density (pcf) - 112.0	Final Moisture (%) - 16.3
Initial Moisture (%) - 9.3	Initial Saturation (%) - 50.0	Final Saturation (%) - 87.6

Expansion Test - UBC (144 PSF)			
	Date	Time	Reading
Add Weight	9/14/2015	5:40	0.000
10 Minutes		5:50	0.000
Add Water		7:45	0.009
		11:20	0.010
	9/15/2015	5:35	0.010

Initial Reading  
  
  
  
Final Reading

<b>EI<sub>measured</sub></b>	=	10
<b>EI<sub>50</sub></b>	=	10

Expansion Index, EI <sub>50</sub>	Potential Expansion
0-20	Very Low
21-50	Low
51-90	Medium
91-130	High
>130	Very High



2195 Faraday Avenue, Suite K, Carlsbad, CA 92008

Client: Integral Communities

Project Name: 700 W. Grand Ave.

Job Number: IPF-72198.4

Date: 9/14/15

Sample Number: B-2

Location: 1-6 ft.

Description: Brown Silty Sand

Tested by: BD

# EXPANSION INDEX TEST

## ASTM METHOD D 4829

**Sample B-3 @ 5-7 ft.**

Moisture Content of Initial Sample	% Saturation of Re-molded Sample	Moisture Content of Final Sample
Tare No. - 57	Wt. of Soil and Ring (g) - 595.3	Wt. of Soil and Ring (g) - 623.2
Wet Weight and Tare (g) - 156.7	Ring Weight (g) - 189.0	Ring Weight (g) - 189.0
Dry Weight and Tare (g) - 147.5	Wet Weight of Soil (g) - 406.3	Wet Weight of Soil (g) - 434.2
Tare Weight (g) - 50.5	Dry Weight of Soil (g) - 371.1	Dry Weight of Soil (g) - 371.1
Water Loss (g) - 9.2	Volume of Ring (ft <sup>3</sup> ) - 0.0073	Weight of Water (g) - 63.1
Dry Weight (g) - 97.0	Dry Density (pcf) - 112.1	Final Moisture (%) - 17.0
Initial Moisture (%) - 9.5	Initial Saturation (%) - 50.9	Final Saturation (%) - 91.2

Expansion Test - UBC (144 PSF)			
	Date	Time	Reading
Add Weight	9/14/2015	6:45	0.000
10 Minutes		6:55	0.000
Add Water		7:45	0.016
		11:20	0.017
	9/15/2015	5:22	0.022

Initial Reading

Final Reading

<b>EI<sub>measured</sub></b>	=	22
<b>EI<sub>50</sub></b>	=	22

Expansion Index, EI <sub>50</sub>	Potential Expansion
0-20	Very Low
21-50	Low
51-90	Medium
91-130	High
>130	Very High



2195 Faraday Avenue, Suite K, Carlsbad, CA 92008

Client: Intergral Communities

Project Name: W. Grand Ave.

Job Number: IPF-72198.4

Date: 9/14/15

Sample Number: B-3

Location: 5-7 ft.

Description: Reddish Brown Sandy Clay

Tested by: BD

L A B O R A T O R Y   R E P O R T

Telephone (619) 425-1993      Fax 425-7917      Established 1928

C L A R K S O N   L A B O R A T O R Y   A N D   S U P P L Y   I N C.  
350 Trousdale Dr. Chula Vista, Ca. 91910 www.clarksonlab.com  
A N A L Y T I C A L   A N D   C O N S U L T I N G   C H E M I S T S

Date: September 16, 2015  
Purchase Order Number: IPF-72198-4  
Sales Order Number: 28478  
Account Number: EEI  
To:

\*-----\*  
EEI Environmental Equalizers Inc  
2195 Faraday Avenue Suite K  
Carlsbad, CA 92008  
Attention: Jeff Blake

Laboratory Number: SO5797      Customers Phone: 760-431-3747

Sample Designation:  
\*-----\*  
One soil sample received on 09/14/15 at 3:00pm,  
from Grand Ave. Project# IPF-72198-4  
marked as B-2 @ 1'-6' SM.

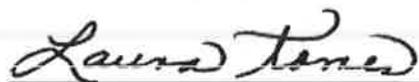
Analysis By California Test 643, 1999, Department of Transportation  
Division of Construction, Method for Estimating the Service Life of  
Steel Culverts.

pH 9.0

Water Added (ml)	Resistivity (ohm-cm)
10	6000
5	4100
5	2500
5	2100
5	1800
5	1700
5	1900
5	2500

38 years to perforation for a 16 gauge metal culvert.  
49 years to perforation for a 14 gauge metal culvert.  
68 years to perforation for a 12 gauge metal culvert.  
87 years to perforation for a 10 gauge metal culvert.  
106 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417      0.015% (150ppm)  
Water Soluble Chloride Calif. Test 422      0.004% ( 43ppm)

  
\_\_\_\_\_  
Laura Torres  
LT/dbb

**Geotechnical Evaluation – Integral Communities  
700 West Grand Avenue, Escondido, California**

**September 21, 2015  
EEI Project No. IPF-72198.4**

**APPENDIX C  
EARTHWORK AND GRADING GUIDELINES**



## **EARTHWORK AND GRADING GUIDELINES**

### **GENERAL**

These guidelines present general procedures and recommendations for earthwork and grading as required on the approved grading plans, including preparation of areas to be filled, placement of fill and installation of subdrains and excavations. The recommendations contained in the geotechnical report are applicable to each specific project, are part of the earthwork and grading guidelines and would supersede the provisions contained hereafter in the case of conflict. Observations and/or testing performed by the consultant during the course of grading may result in revised recommendations which could supersede these guidelines or the recommendations contained in the geotechnical report. Figures A through O are provided at the back of this appendix, exhibiting generalized cross sections relating to these guidelines.

The contractor is responsible for the satisfactory completion of all earthworks in accordance with provisions of the project plans and specifications. The project soil engineer and engineering geologist (geotechnical consultant) or their representatives should provide observation and testing services, and geotechnical consultation throughout the duration of the project.

### **EARTHWORK OBSERVATIONS AND TESTING**

#### **Geotechnical Consultant**

Prior to the commencement of grading, a qualified geotechnical consultant (a soil engineer and engineering geologist) should be employed for the purpose of observing earthwork procedures and testing the fills for conformance with the recommendations of the geotechnical report, the approved grading plans, and applicable grading codes and ordinances.

The geotechnical consultant should provide testing and observation so that determination may be made that the work is being completed as specified. It is the responsibility of the contractor to assist the consultant and keep them aware of work schedules and predicted changes, so that the consultant may schedule their personnel accordingly.

All removals, prepared ground to receive fill, key excavations, and subdrains should be observed and documented by the project engineering geologist and/or soil engineer prior to placing any fill. It is the contractor's responsibility to notify the engineering geologist and soil engineer when such areas are ready for observation.

## **Earthwork and Grading Guidelines**

### **Laboratory and Field Tests**

Maximum dry density tests to determine the degree of compaction should be performed in accordance with American Standard Testing Materials test method ASTM designation D-1557-78. Random field compaction tests should be performed in accordance with test method ASTM designations D-1556-82, D-2937 or D-2922 & D-3017, at intervals of approximately two (2) feet of fill height per 10,000 sq. ft. or every one thousand cubic yards of fill placed. These criteria would vary depending on the soil conditions and the size of the project. The location and frequency of testing would be at the discretion of the geotechnical consultant

### **Contractor's Responsibility**

All clearing, site preparation, and earthwork performed on the project should be conducted by the contractor, with observation by geotechnical consultants and staged approval by the appropriate governing agencies. It is the contractor's responsibility to prepare the ground surface to receive the fill to the satisfaction of the soil engineer, and to place, spread, moisture condition, mix and compact the fill in accordance with the recommendations of the soil engineer. The contractor should also remove all major deleterious material considered unsatisfactory by the soil engineer.

It is the sole responsibility of the contractor to provide adequate equipment and methods to accomplish the earthwork in accordance with applicable grading guidelines, codes or agency ordinances, and approved grading plans. Sufficient watering apparatus and compaction equipment should be provided by the contractor with due consideration for the fill material, rate of placement, and climatic conditions. If, in the opinion of the geotechnical consultant, unsatisfactory conditions such as questionable weather, excessive oversized rock, deleterious material or insufficient support equipment are resulting in a quality of work that is not acceptable, the consultant will inform the contractor, and the contractor is expected to rectify the conditions, and if necessary, stop work until conditions are satisfactory.

The contractor will properly grade all surfaces to maintain good drainage and prevent ponding of water. The contractor will take action to control surface water and to prevent erosion control measures that have been installed.

## **SITE PREPARATION**

All vegetation including brush, trees, thick grasses, organic debris, and other deleterious material should be removed and disposed of offsite, and must be concluded prior to placing fill. Existing fill, soil, alluvium, colluvium, or rock materials determined by the soil engineer or engineering geologist as unsuitable for structural in-place support should be removed prior to fill placement. Depending upon the soil conditions, these materials may be reused as compacted fills. Any materials incorporated as part of the compacted fills should be approved by the soil engineer.

Any underground structures 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 recommended by the soil engineer. Soft, dry, spongy, highly fractured, or otherwise unsuitable ground extending to such a depth that surface processing cannot adequately improve the condition should be over excavated down to firm ground and approved by the soil engineer before compaction and filling operations continue. Over excavated and processed soils which have been properly mixed and moisture-conditioned should be recompacted to the minimum relative compaction as specified in these guidelines.

## **Earthwork and Grading Guidelines**

Existing ground which is determined to be satisfactory for support of the fills should be scarified to a minimum depth of six (6) inches, or as directed by the soil engineer. After the scarified ground is brought to optimum moisture (or greater) and mixed, the materials should be compacted as specified herein. If the scarified zone is greater than 6 inches in depth, it may be necessary to remove the excess and place the material in lifts restricted to six (6) inches in compacted thickness.

Existing grind which is not satisfactory to support compacted fill should be over excavated as required in the geotechnical report or by the onsite soils engineer and/or engineering geologists. Scarification, discing, or other acceptable form of mixing should continue until the soils are broken down and free of large fragments or clods, until the working surface is reasonably uniform and free from ruts, hollows, hummocks, or other uneven features which would inhibit compaction as described above.

Where fills are to be placed on ground with slopes steeper than 5:1 (horizontal to vertical) gradient, the ground should be benched. The lowest bench, which will act as a key, should be a minimum of 12 feet wide and should be at least two (2) feet deep into competent material, approved by the soil engineer and/or engineering geologist. In fill over cut slope conditions, the recommended minimum width of the lowest bench or key is at least 15 feet with the key excavated on competent material, as designated by the Geotechnical Consultant. As a general rule, unless superseded by the Soil Engineer, the minimum width of fill keys should be approximately equal to one-half ( $\frac{1}{2}$ ) the height of the slope.

Standard benching is typically four feet (minimum) vertically, exposing competent material. Benching may be used to remove unsuitable materials, although it is understood that the vertical height of the bench may exceed four feet. Pre stripping may be considered for removal of unsuitable materials in excess of four feet in thickness.

All areas to receive fill, including processed areas, removal areas, and toe of fill benches should be observed and approved by the soil engineer and/or engineering geologist prior to placement of fill. Fills may then be properly placed and compacted until design grades are attained.

## **COMPACTED FILLS**

Earth materials imported or excavated on the property may be utilized as fill provided that each soil type has been accepted by the soil engineer. These materials should be free of roots, tree branches, other organic matter or other deleterious materials. All unsuitable materials should be removed from the fill as directed by the soil engineer. Soils of poor gradation, undesirable expansion potential, or substandard strength characteristics may be designated unsuitable by the consultant and may require mixing with other earth materials to serve as a satisfactory fill material.

Fill materials generated from benching operations should be dispersed throughout the fill area. Benching operations should not result in the benched material being placed only within a single equipment width away from the fill/bedrock contact.

## **Earthwork and Grading Guidelines**

Oversized materials, defined as rock or other irreducible materials with a maximum size exceeding 12 inches in one dimension, should not be buried or placed in fills unless the location of materials and disposal methods are specifically approved by the soil engineer. Oversized material should be taken offsite or placed in accordance with recommendations of the soil engineer in areas designated as suitable for rock disposal. Oversized material should not be placed vertically within 10 feet of finish grade or horizontally within 20 feet of slope faces.

To facilitate trenching, rock should not be placed within the range of foundation excavations or future utilities unless specifically approved by the soil engineer and/or the representative developers.

If import fill material is required for grading, representative samples of the material should be analyzed in the laboratory by the soil engineer to determine its physical properties. If any material other than that previously analyzed is imported to the fill or encountered during grading, analysis of this material should be conducted by the soil engineer as soon as practical.

Fill material should be placed in areas prepared to receive fill in near-horizontal layers that should not exceed six (6) inches compacted in thickness. The soil engineer may approve thicker lifts if testing indicates the grading procedures are such that adequate compaction is being achieved. Each layer should be spread evenly and mixed to attain uniformity of material and moisture suitable for compaction.

Fill materials at moisture content less than optimum should be watered and mixed, and "wet" fill materials should be aerated by scarification, or should be mixed with drier material. Moisture conditioning and mixing of fill materials should continue until the fill materials have uniform moisture content at or above optimum moisture.

After each layer has been evenly spread, moisture-conditioned and mixed, it should be uniformly compacted to a minimum of 90 percent of maximum density as determined by ASTM test designation, D 1557-78, or as otherwise recommended by the soil engineer. Compaction equipment should be adequately sized and should be reliable to efficiently achieve the required degree of compaction.

Where tests indicate that the density of any layer of fill, or portion thereof, is below the required relative compaction or improper moisture content, the particular layer or portion will be reworked until the required density and/or moisture content has been attained. No additional fill will be placed in an area until the last placed lift of fill has been tested and found to meet the density and moisture requirements, and is approved by the soil engineer.

Compaction of slopes should be accomplished by over-building the outside edge a minimum of three (3) feet horizontally, and subsequently trimming back to the finish design slope configuration. Testing will be performed as the fill is horizontally placed to evaluate compaction as the fill core is being developed. Special efforts may be necessary to attain the specified compaction in the fill slope zone. Final slope shaping should be performed by trimming and removing loose materials with appropriate equipment. A final determination of fill slope compaction should be based on observation and/or testing of the finished slope face.

## **Earthwork and Grading Guidelines**

If an alternative to over-building and cutting back the compacted fill slope is selected, then additional efforts should be made to achieve the required compaction in the outer 10 feet of each lift of fill by undertaking the following:

- Equipment consisting of a heavy short-shanked sheepsfoot should be used to roll (horizontal) parallel to the slopes continuously as fill is placed. The sheepsfoot roller should also be used to roll perpendicular to the slopes, and extend out over the slope to provide adequate compaction to the face slope.
- Loose fill should not be spilled out over the face of the slope as each lift is compacted. Any loose fill spilled over a previously completed slope face should be trimmed off or be subject to re-rolling.
- Field compaction tests will be made in the outer two (2) to five (5) feet of the slope at two (2) to three (3) foot vertical intervals, subsequent to compaction operations.
- After completion of the slope, the slope face should be shaped with a small dozer and then re-rolled with a sheepsfoot to achieve compaction to near the slope face. Subsequent to testing to verify compaction, the slopes should be grid-rolled to achieve adequate compaction to the slope face. Final testing should be used to confirm compaction after grid rolling.
- Where testing indicates less than adequate compaction, the contractor will be responsible to process, moisture condition, mix and recompact the slope materials as necessary to achieve compaction. Additional testing should be performed to verify compaction.
- Erosion control and drainage devices should be designed by the project civil engineer in compliance with the ordinances of the controlling governmental agencies, and/or in accordance with the recommendations of the soil engineer or engineering geologist.

## **EXCAVATIONS**

Excavations and cut slopes should be observed and mapped during grading by the engineering geologist. If directed by the engineering geologist, further excavations or over-excavation and refilling of cut areas should be performed. When fills over cut slopes are to be graded, the cut portion of the slope should be observed by the engineering geologist prior to placement of the overlying fill portion of the slope. The engineering geologist should observe all cut slopes and should be notified by the contractor when cut slopes are started.

If, during the course of grading, unanticipated adverse or potentially adverse geologic conditions are encountered, the engineering geologist and soil engineer should investigate, evaluate and make recommendations to mitigate (or limit) these conditions. The need for cut slope buttressing or stabilizing should be based on as-grading evaluations by the engineering geologist, whether anticipated previously or not.

Unless otherwise specified in soil and geological reports, no cut slopes should be excavated higher or steeper than that allowed by the ordinances of controlling governmental agencies. Additionally, short-term stability of temporary cut slopes is the contractor's responsibility.

## **Earthwork and Grading Guidelines**

Erosion control and drainage devices should be designed by the project civil engineer and should be constructed in compliance with the ordinances of the controlling governmental agencies, and/or in accordance with the recommendations of the soil engineer or engineering geologist.

### **SUBDRAIN INSTALLATION**

Subdrains should be installed in accordance with the approved embedment material, alignment and details indicated by the geotechnical consultant. Subdrain locations or construction materials should not be changed or modified without approval of the geotechnical consultant. The soil engineer and/or engineering geologist may recommend and direct changes in subdrain line, grade and drain material in the field, pending exposed conditions. The location of constructed subdrains should be recorded by the project civil engineer.

### **COMPLETION**

Consultation, observation and testing by the geotechnical consultant should be completed during grading operations in order to state an opinion that all cut and filled areas are graded in accordance with the approved project specifications.

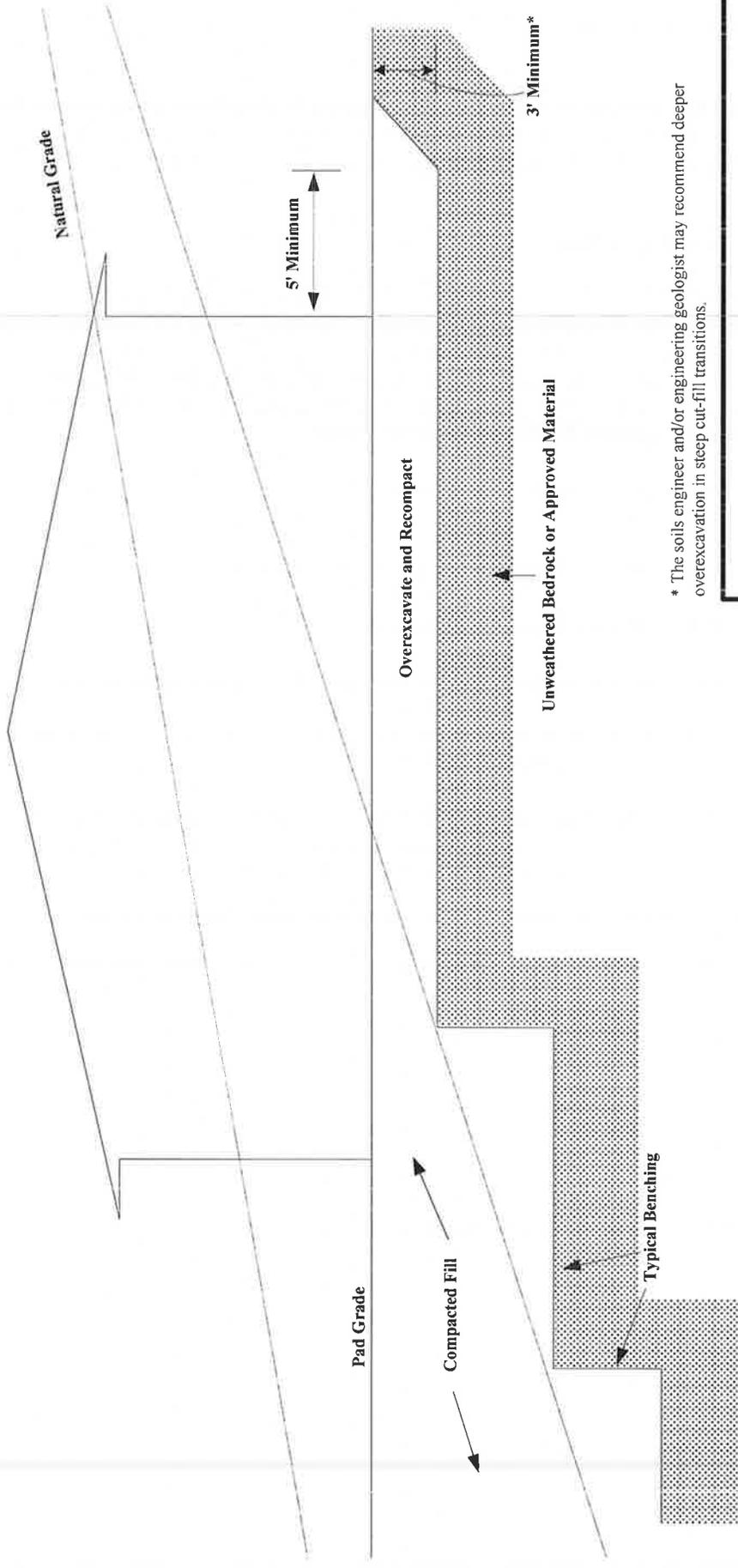
After completion of grading and after the soil engineer and engineering geologist have finished their observations, final reports should be submitted subject to review by the controlling governmental agencies. No additional grading should be undertaken without prior notification of the soil engineer and/or engineering geologist.

All finished cut and fill slopes should be protected from erosion, including but not limited to planting in accordance with the plan design specifications and/or as recommended by a landscape architect. Such protection and/or planning should be undertaken as soon as possible after completion of grading.

### **ATTACHMENTS**

- Figure A – Transition Lot Detail Cut Lot
- Figure B – Transition Lot Detail Cut - Fill
- Figure C – Rock Disposal Pits
- Figure D – Detail for Fill Slope Toeing out on a Flat Alluviated Canyon
- Figure E – Removal Adjacent to Existing Fill
- Figure F – Daylight Cut Lot Detail
- Figure G – Skin Fill of Natural Ground
- Figure H – Typical Stabilization Buttress Fill Design
- Figure I – Stabilization Fill for Unstable Material Exposed in Portion of Cut Slope
- Figure J – Fill Over Cut Detail
- Figure K – Fill Over Natural Detail
- Figure L – Oversize Rock Disposal
- Figure M – Canyon Subdrain Detail
- Figure N – Canyon Subdrain Alternate Details
- Figure O – Typical Stabilization Buttress Subdrain Detail
- Figure P – Retaining Wall Backfill

**TRANSITION LOT DETAIL  
CUT LOT – MATERIAL TYPE  
TRANSITION**



\* The soils engineer and/or engineering geologist may recommend deeper overexcavation in steep cut-fill transitions.

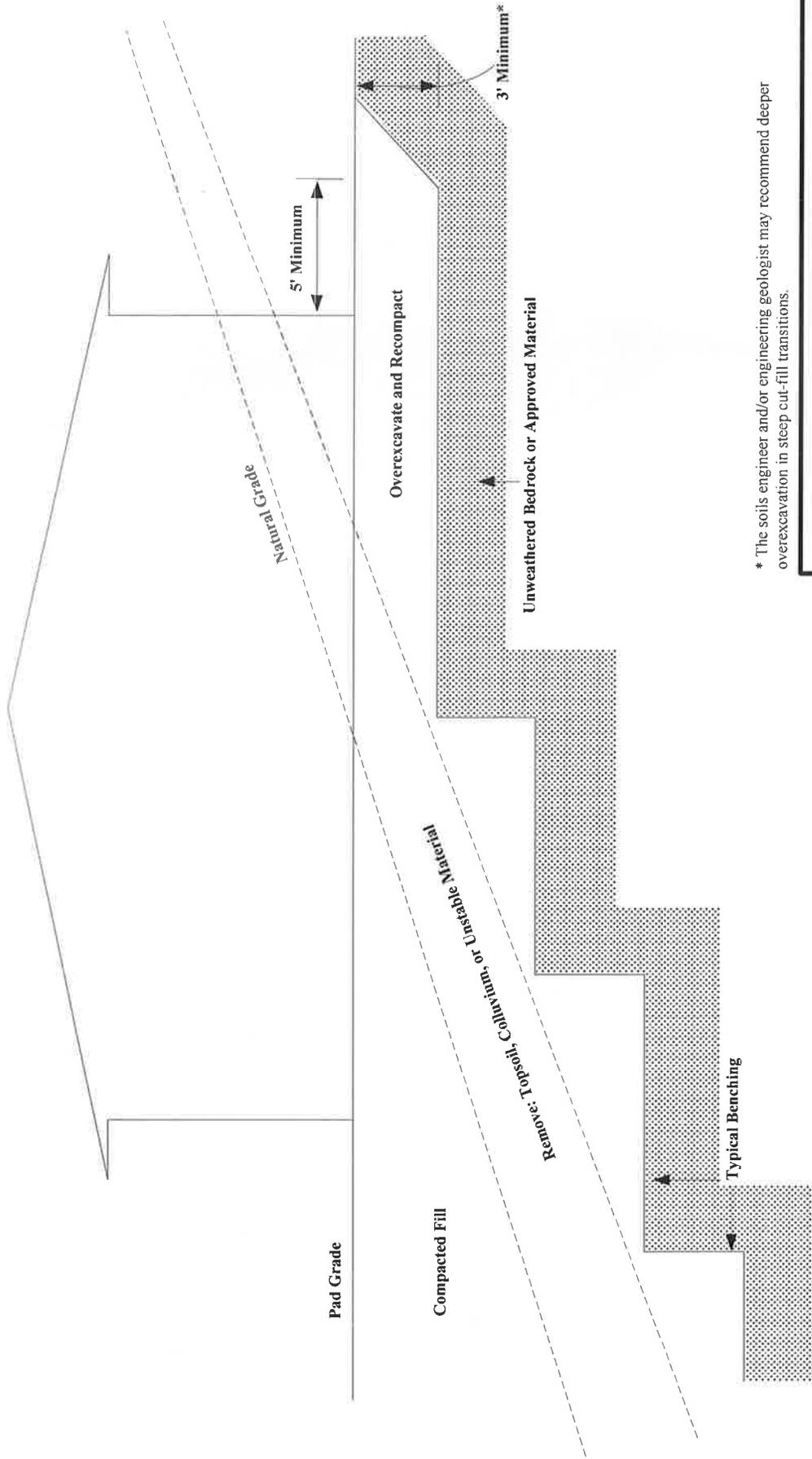
**EARTHWORK AND GRADING GUIDELINES  
TRANSITION LOT DETAIL  
CUT LOT – MATERIAL TYPE TRANSITION**



**FIGURE A**

Note: Figure not to scale

**TRANSITION LOT DETAIL  
CUT – FILL – DAYLIGHT TRANSITION**



\* The soils engineer and/or engineering geologist may recommend deeper overexcavation in steep cut-fill transitions.

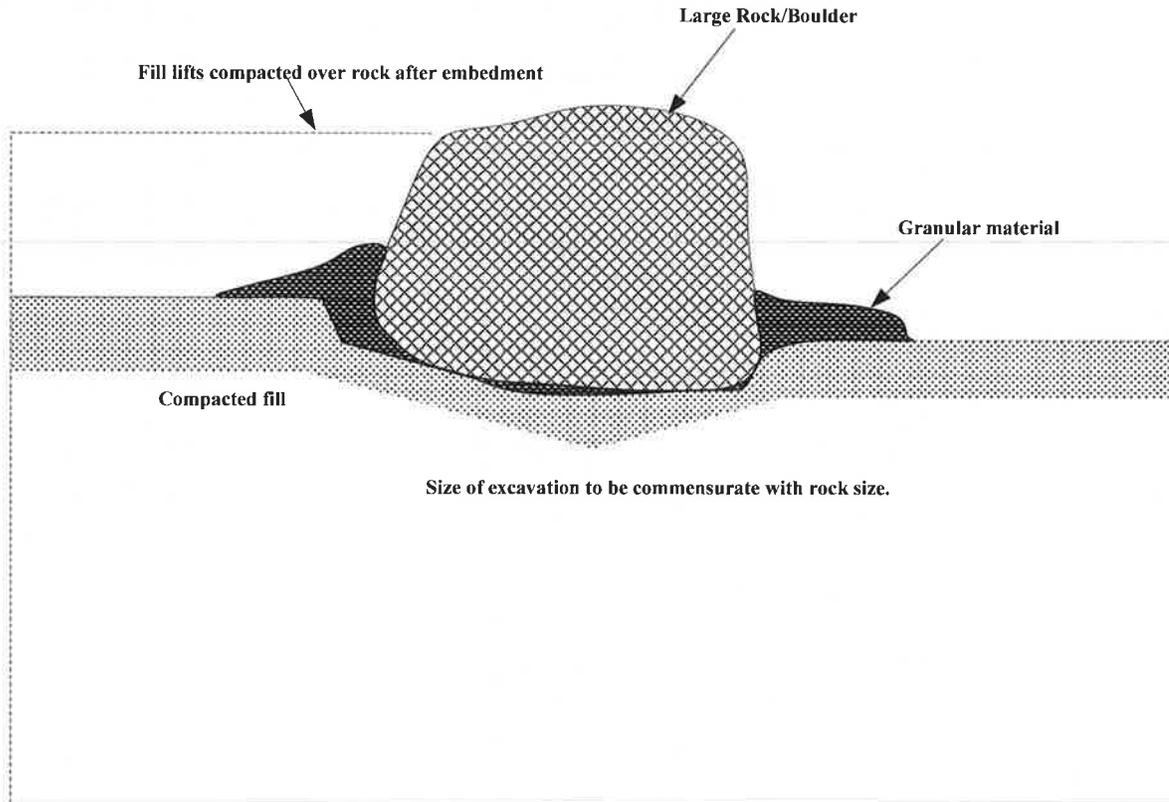
**EARTHWORK AND GRADING GUIDELINES  
TRANSITION LOT DETAIL  
CUT – FILL – DAYLIGHT TRANSITION**



**FIGURE B**

Note: Figure not to scale

## ROCK DISPOSAL PITS



- Note:
- (1) Large rock is defined as having a diameter larger than 3 feet in maximum size.
  - (2) Pit shall be excavated into compacted fill to a depth equal to half of the rock size.
  - (3) Granular soil shall be pushed into the pit and then flooded around the rock using a sheep'sfoot to help with compaction.
  - (4) A minimum of 3 feet of compacted fill should be laid over each pit.
  - (5) Pits shall have at least 15 feet of separation between one another, horizontally.
  - (6) Pits shall be placed at least 20 feet from any fill slope.
  - (7) Pits shall be used only in deep fill areas.

### EARTHWORK AND GRADING GUIDELINES ROCK DISPOSAL PITS



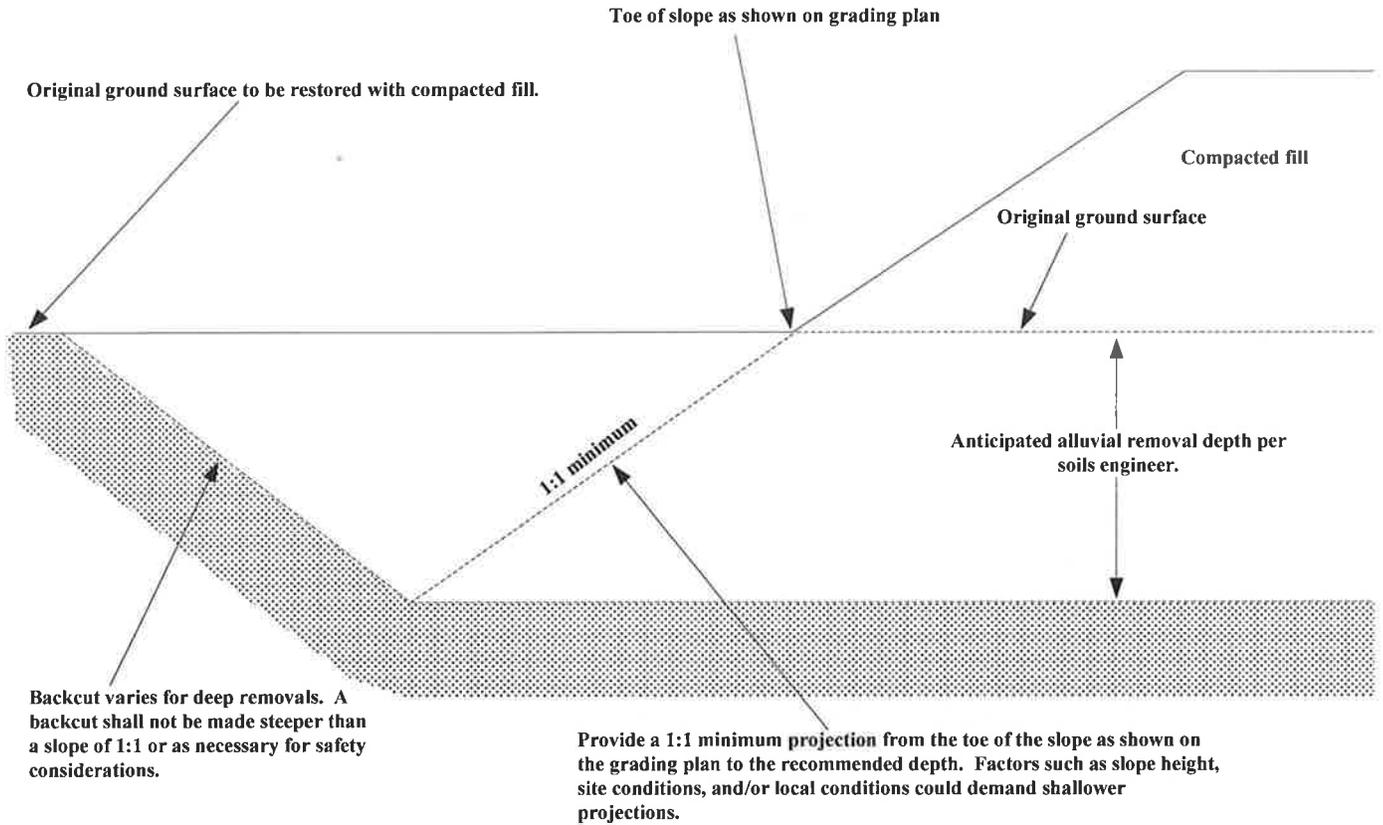
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**FIGURE C**

Note: Figure not to scale

**DETAIL FOR FILL SLOPE TOEING OUT ON  
FLAT ALLUVIATED CANYON**



**EARTHWORK AND GRADING GUIDELINES  
DETAIL FOR FILL SLOPE TOEING OUT ON A FLAT  
ALLUVIATED CANYON**



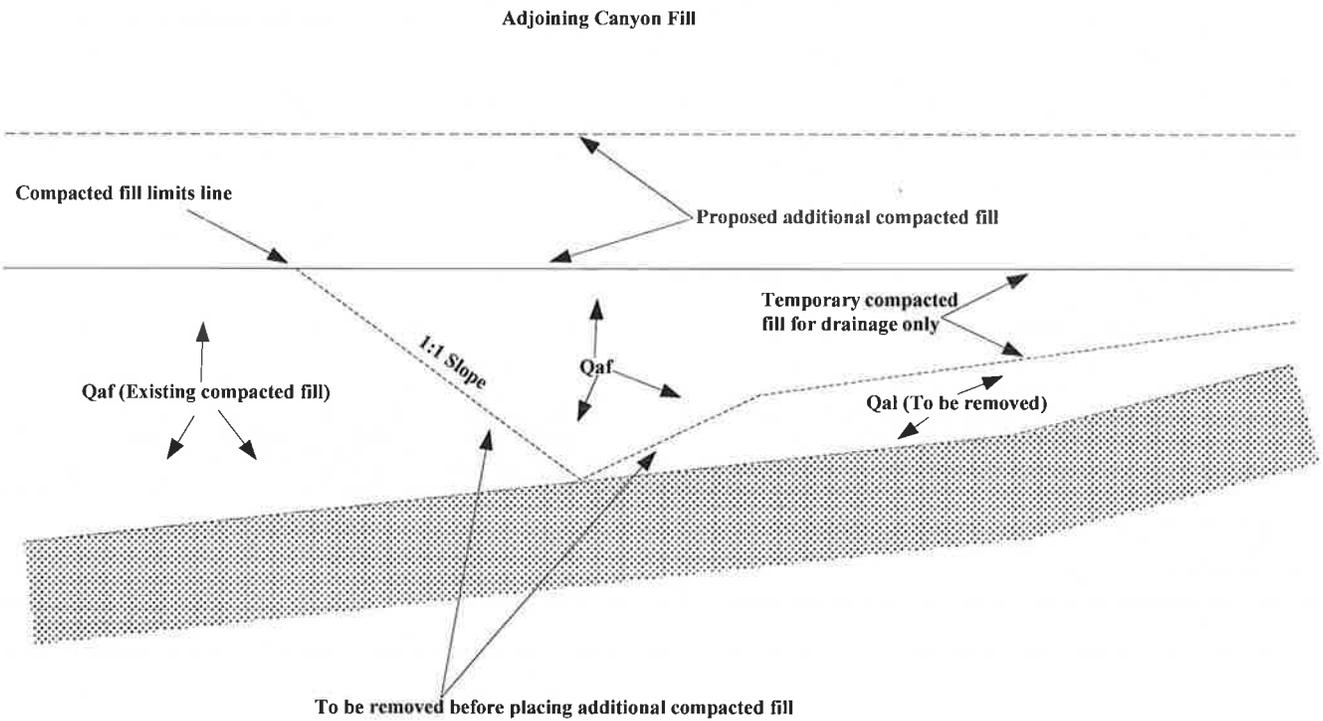
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**FIGURE D**

Note: Figure not to scale

# REMOVAL ADJACENT TO EXISTING FILL



Legend	
Qaf -	Artificial Fill
Qal -	Alluvium

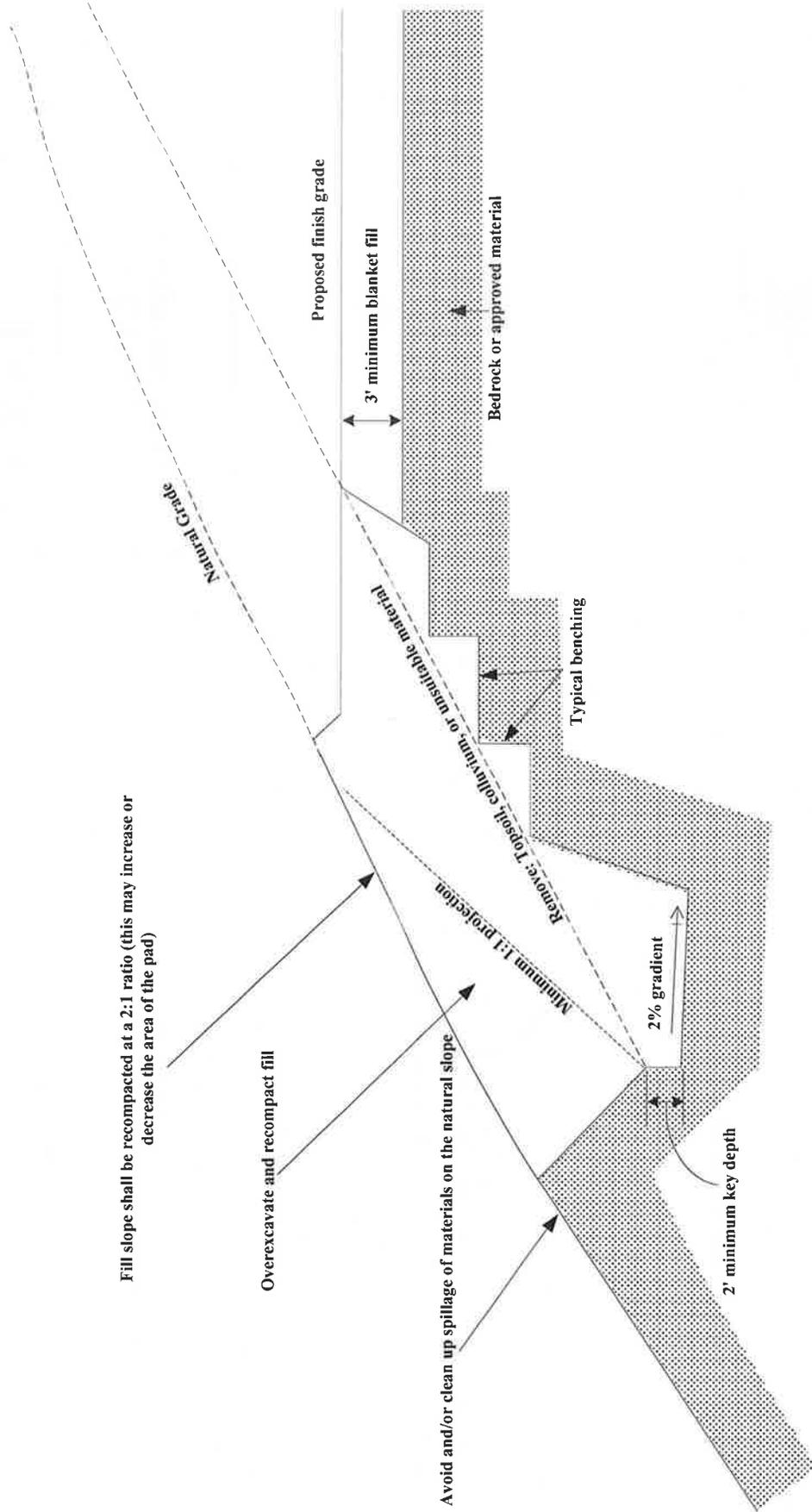
Note: Figure not to scale

**EARTHWORK AND GRADING GUIDELINES**  
**REMOVAL ADJACENT TO EXISTING FILL**



**FIGURE E**

# DAYLIGHT CUT LOT DETAIL



Fill slope shall be recompacted at a 2:1 ratio (this may increase or decrease the area of the pad)

Overexcavate and recompact fill

Avoid and/or clean up spillage of materials on the natural slope

- Note:
- (1) Subdrain and key width requirements shall be determined based on exposed subsurface conditions and the thickness of overburden.
  - (2) Pad overexcavation and recompaction shall be completed if determined as necessary by the soils engineer and/or engineering geologist.

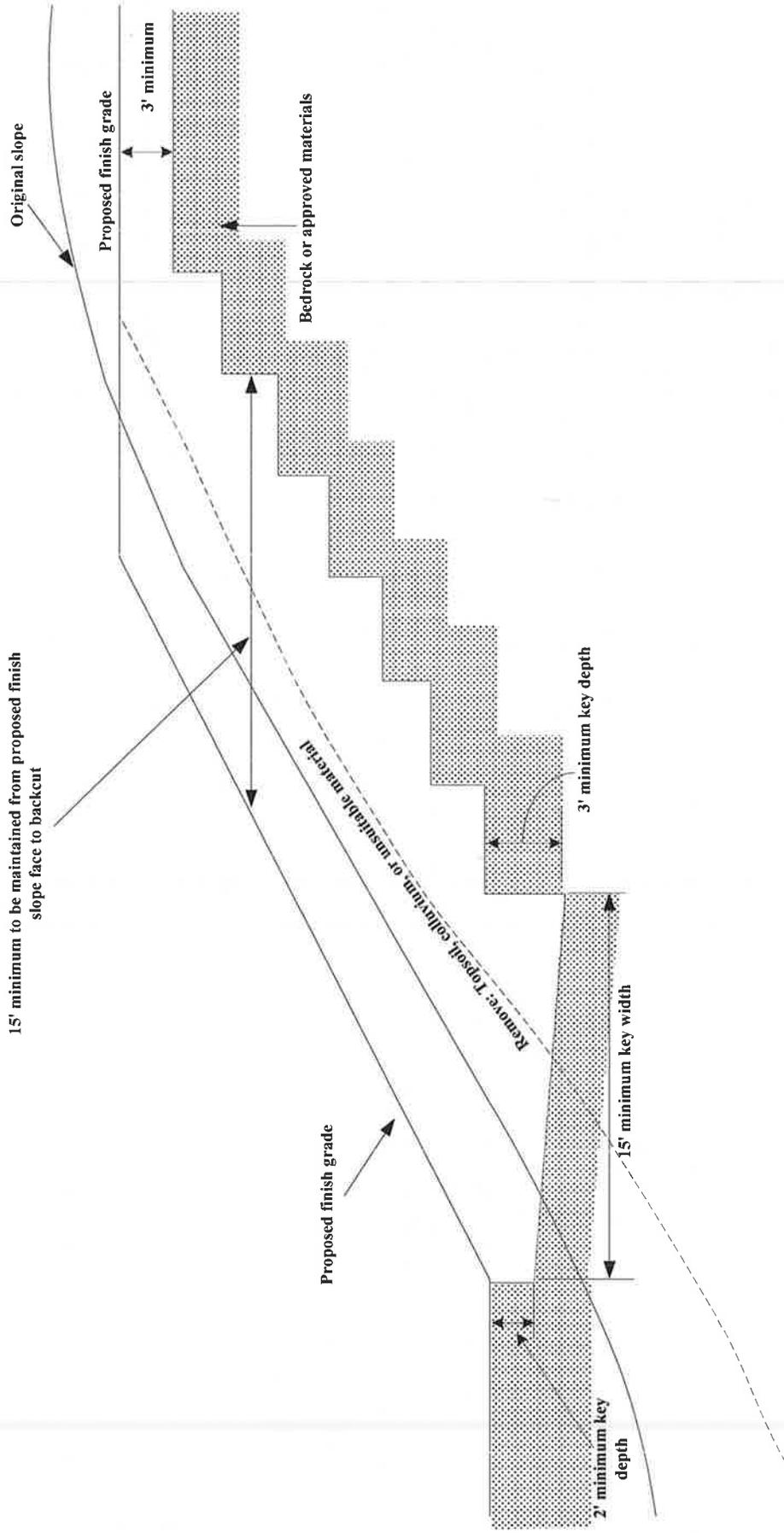
## EARTHWORK AND GRADING GUIDELINES DAYLIGHT CUT LOT DETAIL



FIGURE F

Note: Figure not to scale

# SKIN FILL OF NATURAL GROUND



- Note:
- (1) The need and disposition of drains will be determined by the soils engineer and/or engineering geologist based on site conditions.
  - (2) Pad overexcavation and recompaction shall be completed if determined as necessary by the soils engineer and/or engineering geologist.

## EARTHWORK AND GRADING GUIDELINES SKIN FILL OF NATURAL GROUND

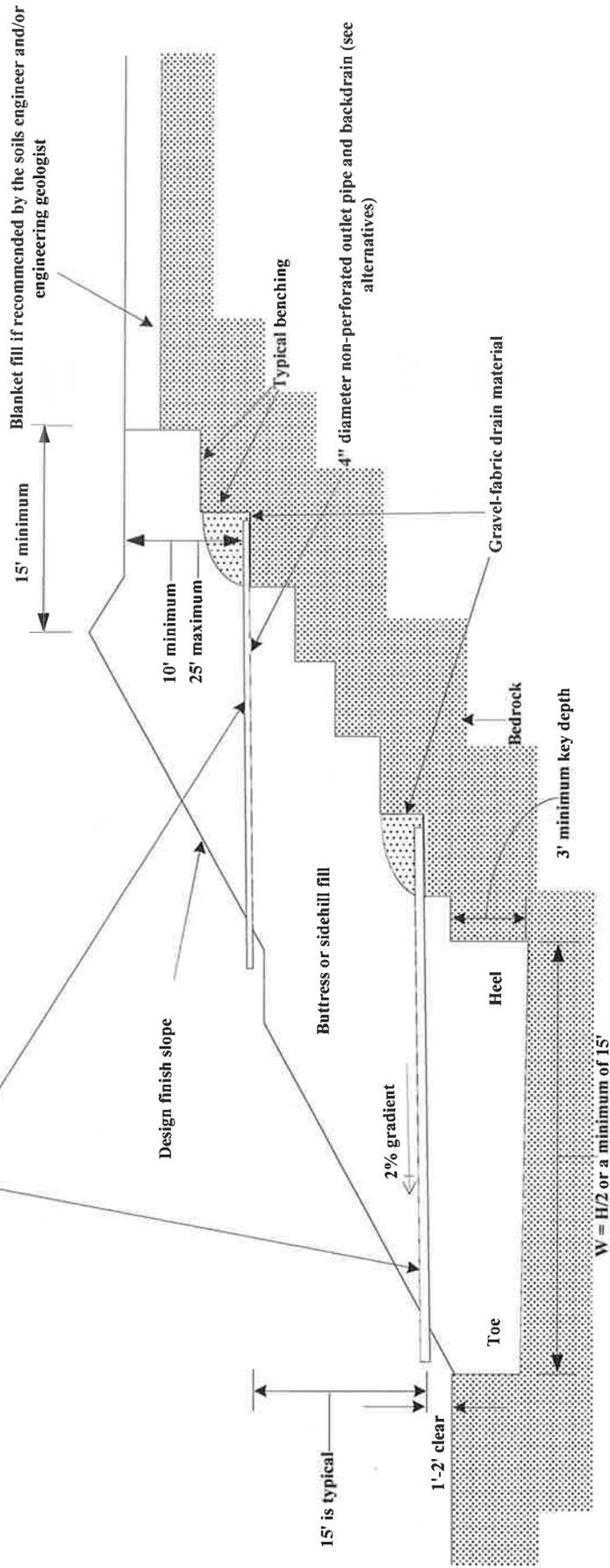


FIGURE G

Note: Figure not to scale

# TYPICAL STABILIZATION BUTTRESS FILL DESIGN

Outlets shall be spaced at 100' maximum intervals, and should extend 12" beyond the face of the slope at the finish of of rough grading



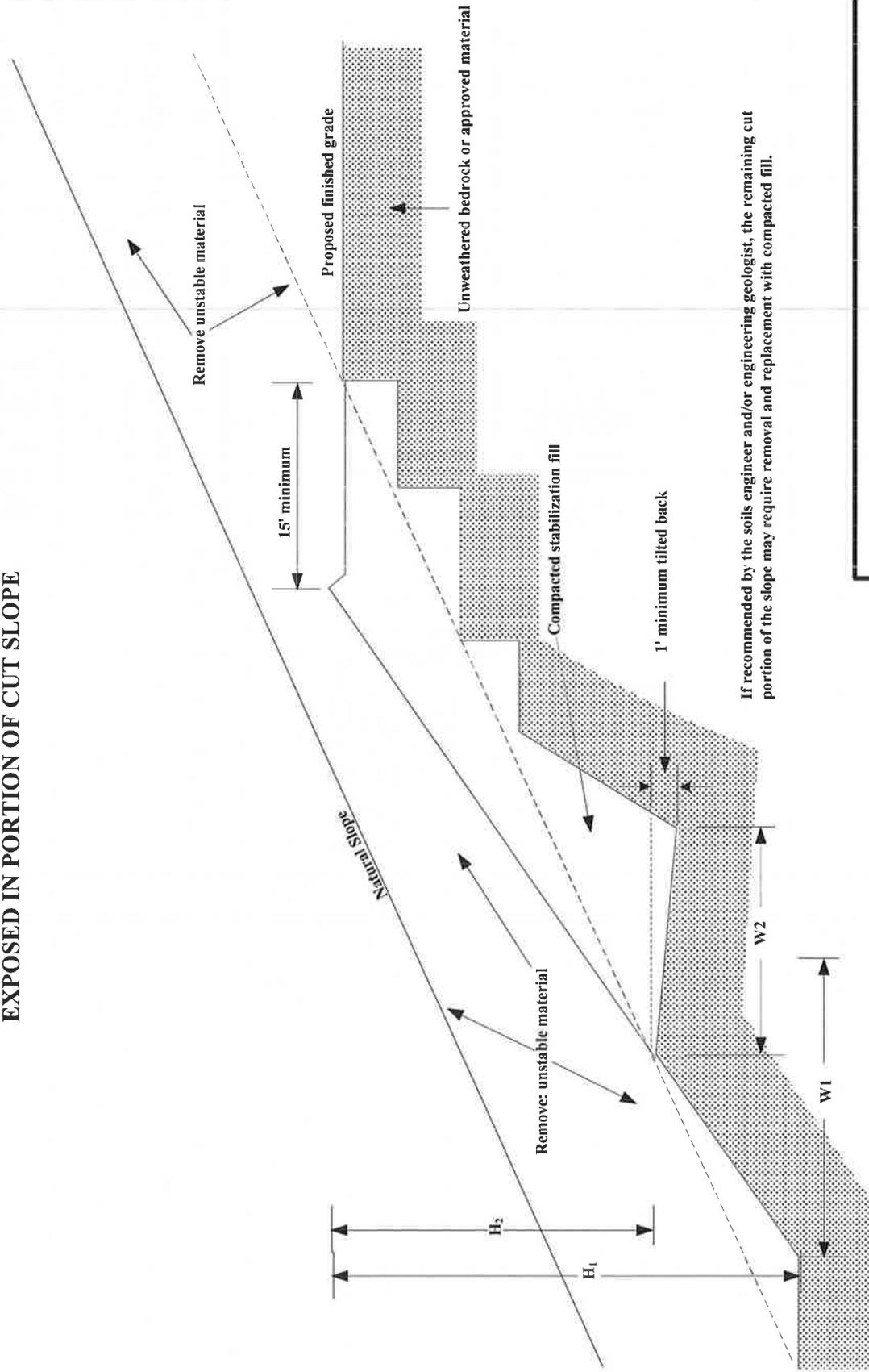
**EARTHWORK AND GRADING GUIDELINES**  
**TYPICAL STABILIZATION BUTTRESS FILL DESIGN**



**FIGURE H**

Note: Figure not to scale

**STABILIZATION FILL FOR UNSTABLE MATERIAL  
EXPOSED IN PORTION OF CUT SLOPE**



Note: (1) Subdrains are required only if specified by the soils engineer and/or engineering geologist.  
 (2) "W" shall be the equipment width (15') for slope heights less than 25 feet. For slopes greater than 25 feet "W" shall be determined by the project soils engineer and/or the engineering geologist. "W" shall never be less than H/2.

If recommended by the soils engineer and/or engineering geologist, the remaining cut portion of the slope may require removal and replacement with compacted fill.

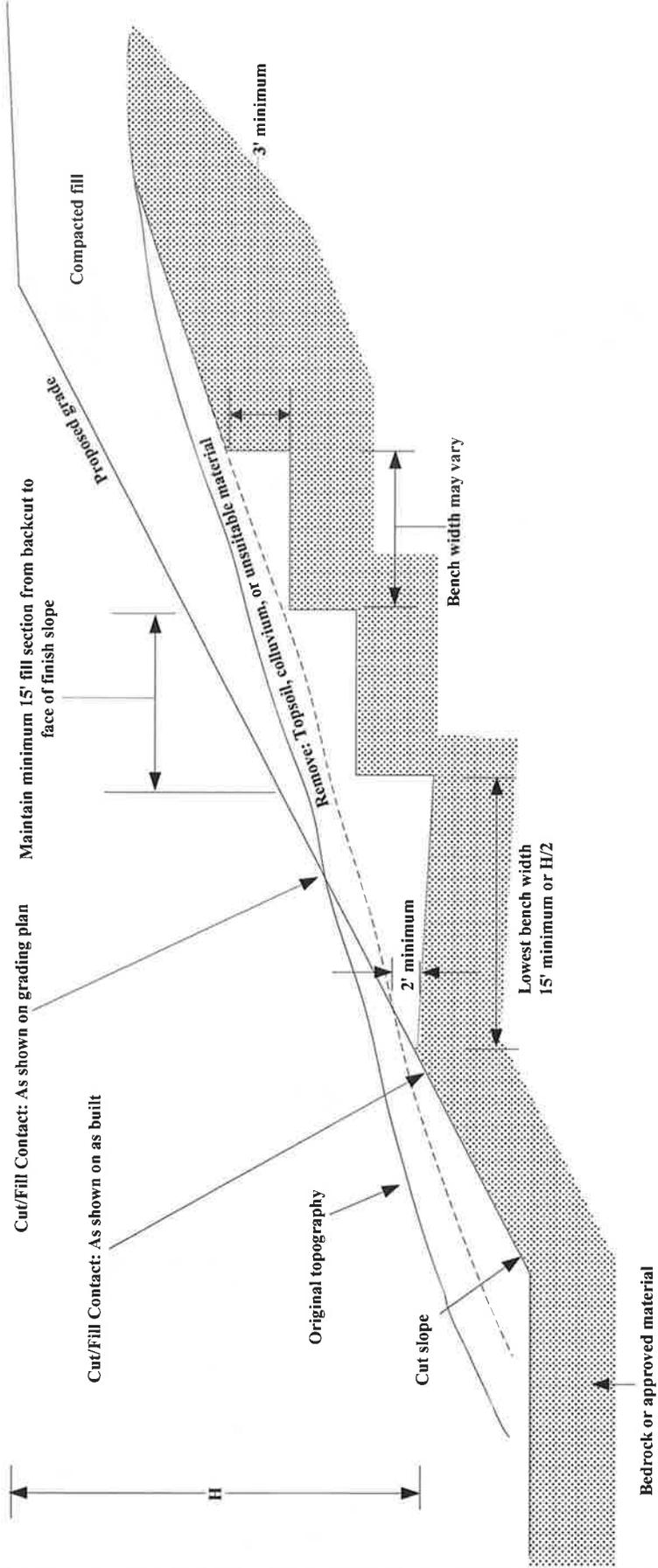
**EARTHWORK AND GRADING GUIDELINES  
STABILIZATION FILL FOR UNSTABLE MATERIAL  
EXPOSED IN PORTION OF CUT SLOPE**



**FIGURE I**

Note: Figure not to scale

# FILL OVER CUT DETAIL



Note: The cut section shall be excavated and evaluated by the soils engineer/engineering geologist prior to constructing the fill portion.

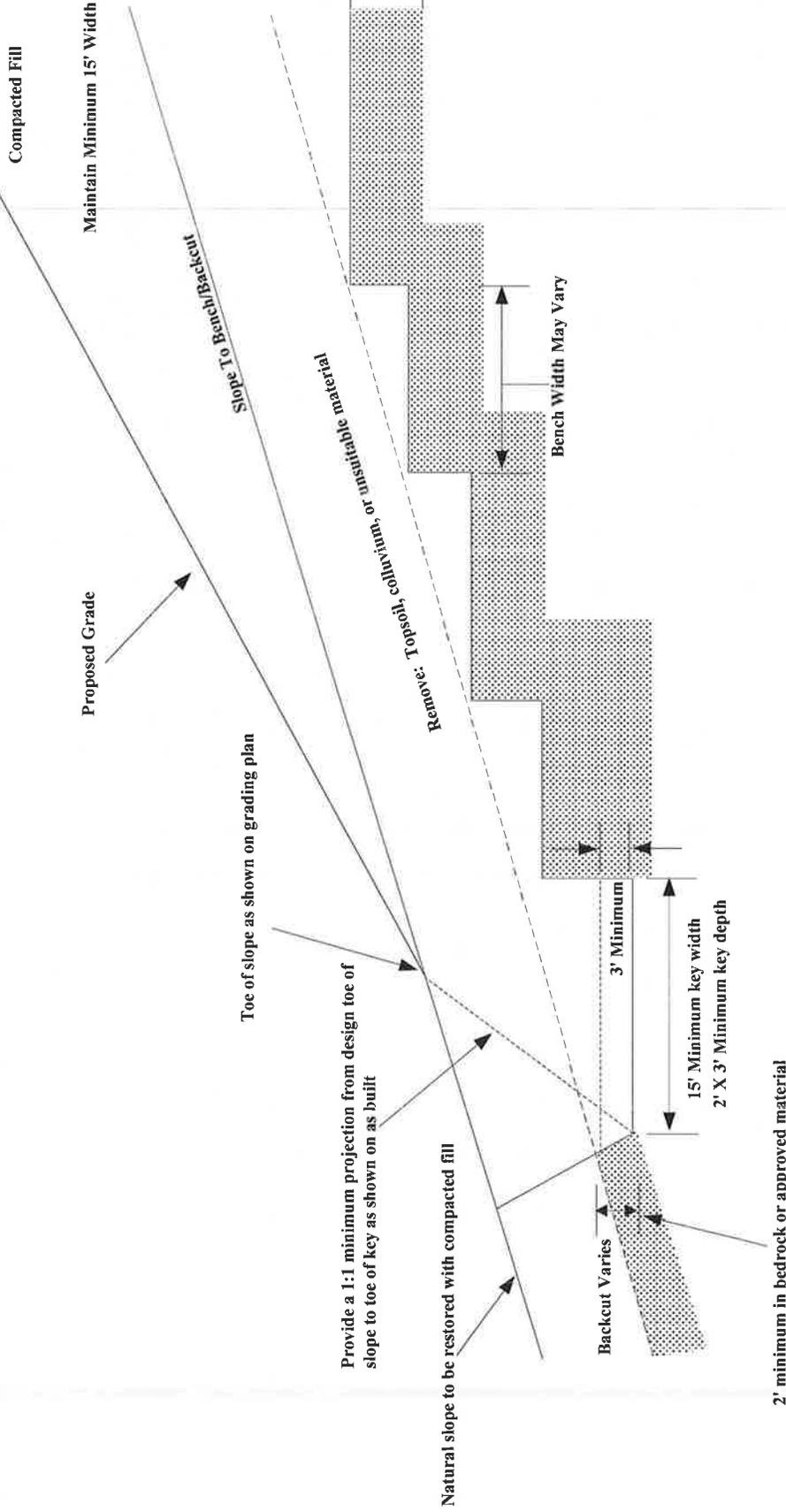
## EARTHWORK AND GRADING GUIDELINES FILL OVER CUT DETAIL



FIGURE J

Note: Figure not to scale

# FILL OVER NATURAL DETAIL SIDEHILL FILL



Note:

- (1) Special recommendations shall be provided by the soils engineer/engineering geologist where the natural slope approaches or exceeds the design slope ratio.
- (2) The need for and disposition of drains would be determined by the soils engineer/engineering geologist based upon exposed conditions.

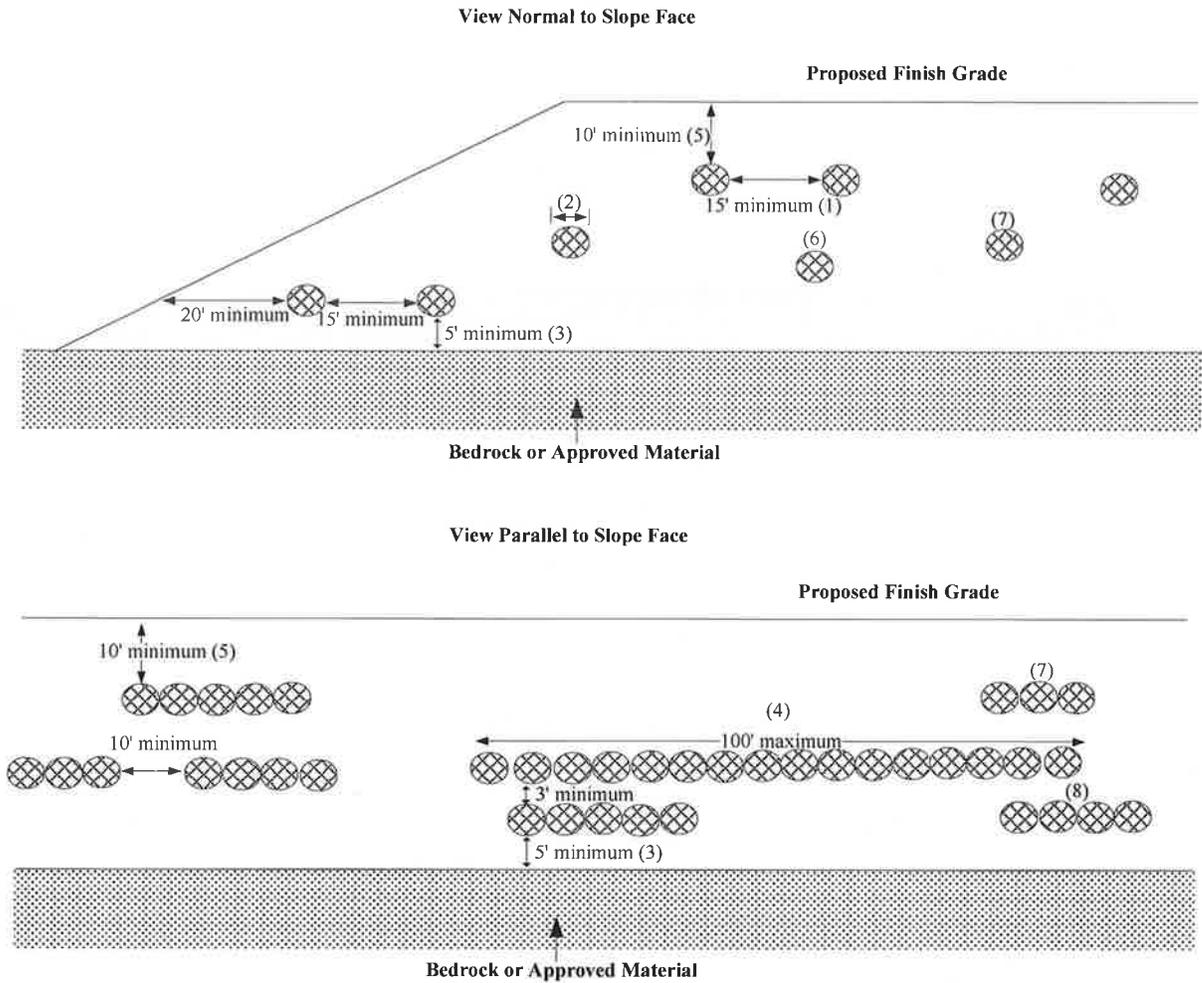
## EARTHWORK AND GRADING GUIDELINES FILL OVER NATURAL DETAIL SIDEHILL FILL



FIGURE K

Note: Figures not to scale

# OVERSIZE ROCK DISPOSAL



- Note:
- (1) One Equipment width or a minimum of 15 feet.
  - (2) Height and width may vary depending on rock size and type of equipment used. Length of windrow shall be no greater than 100 feet maximum.
  - (3) If approved by the soils engineer and/or engineering geologist.
  - (4) Orientation of windrows may vary but shall be as recommended by the soils engineer and/or engineering geologist. Unless recommended staggering of windrows is not necessary.
  - (5) Areas shall be cleared for utility trenches, foundations, and swimming pools.
  - (6) Voids in windrows shall be filled by flooding granular soil into place. Granular soil shall be any soil which has a unified soil classification system (Universal Building Code (UBC) 29-1). Designation of SM, SP, SW, GP, or GW.
  - (7) After fill between windrows is placed and compacted with the lift of fill covering windrow, windrow shall be proof rolled with a D-9 dozer or equivalent.
  - (8) Oversized rock is defined as larger than 12", and less than 4 feet in size.

Approximate Scale: 1" = 30'



Note: All distances are approximate

## EARTHWORK AND GRADING GUIDELINES OVERSIZE ROCK DISPOSAL

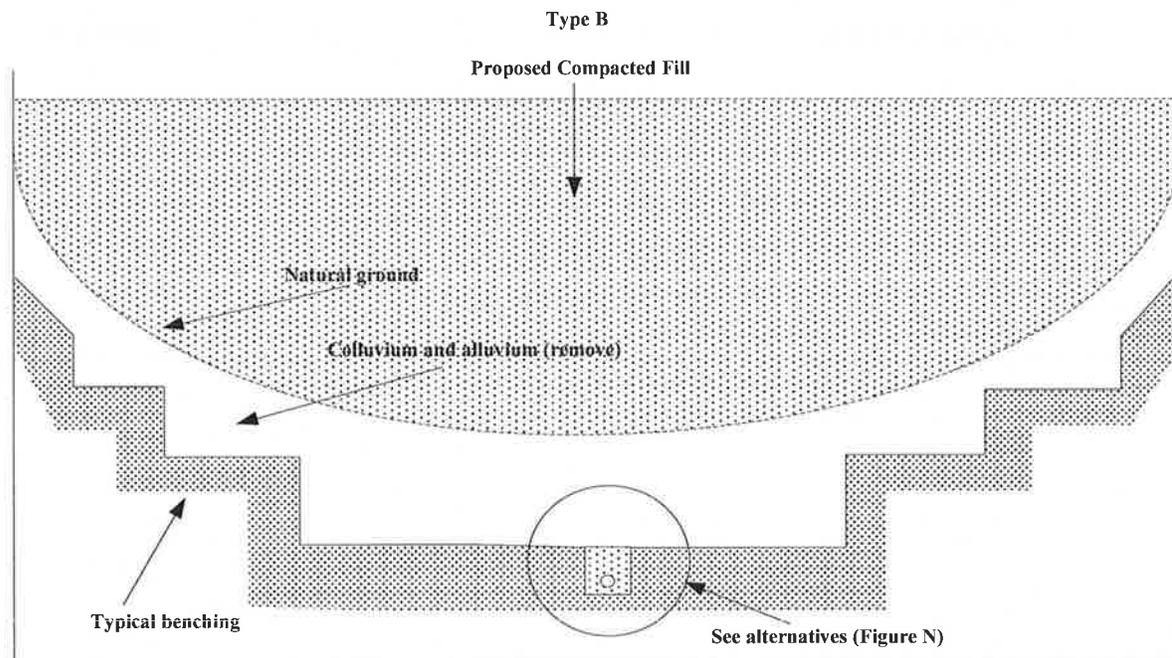
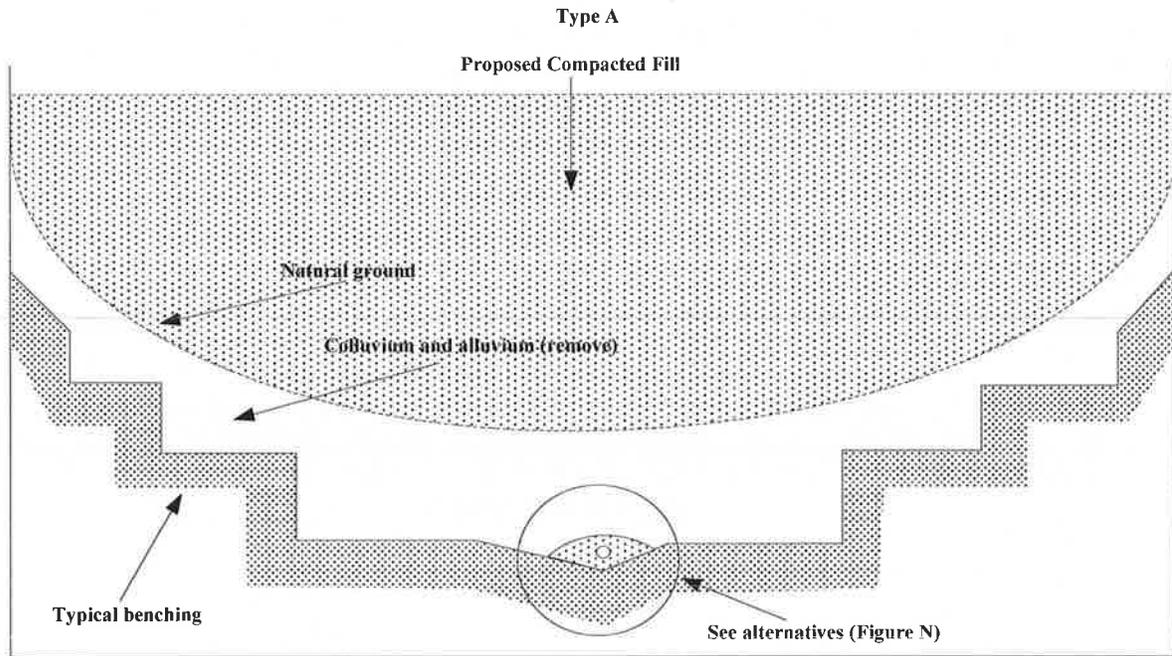


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FIGURE L

# CANYON SUBDRAIN DETAIL



Note: Alternatives, locations, and extent of subdrains should be determined by the soils engineer and/or engineering geologist during actual grading.

## EARTHWORK AND GRADING GUIDELINES CANYON SUBDRAIN DETAIL



**E.E.I.**

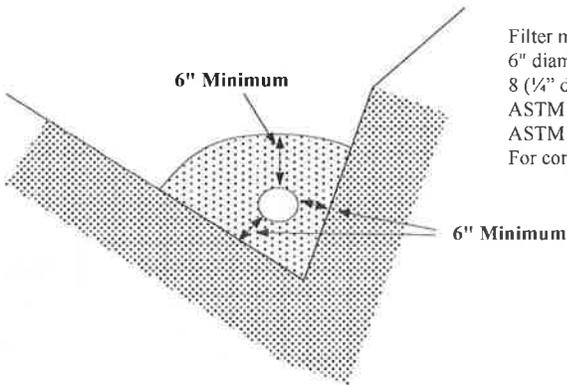
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FIGURE M

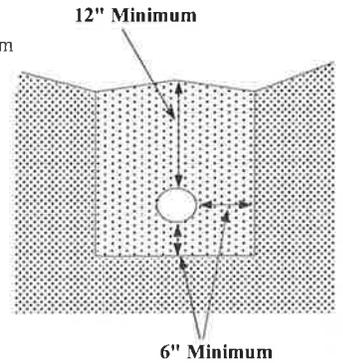
Note: Figures not to scale

## CANYON SUBDRAIN ALTERNATE DETAILS

### Alternate 1: Perforated Pipe and Filter Material



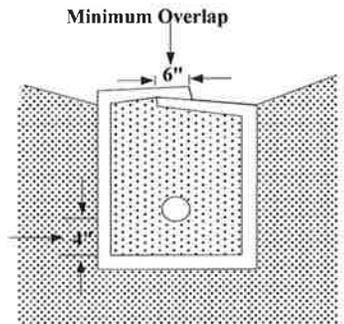
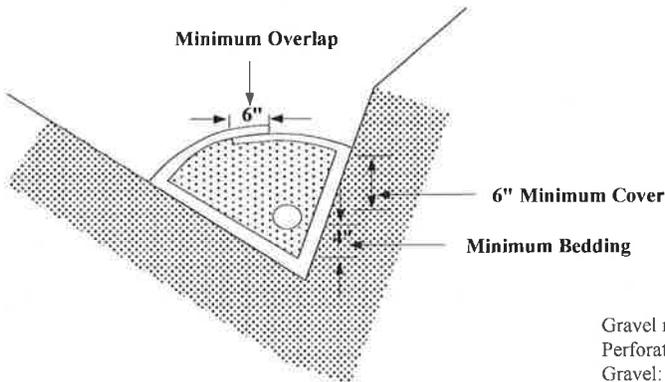
Filter material: Minimum volume of 9 feet<sup>3</sup>/linear foot.  
 6" diameter ABS or PVC pipe or approved substitute with minimum  
 8 (¼" diameter) perforations per linear foot in bottom half of pipe.  
 ASTM D 2751, SDR 35 or ASTM D 1527, Schedule 40.  
 ASTM D 3034, SDR 35 or ASTM D 1785, Schedule 40.  
 For continuous run in excess of 500 feet use 8" diameter pipe.



Filter Material

<u>Sieve Size</u>	<u>Percent Passing</u>
1"	100
¾"	90-100
3/8"	40-100
No. 4	25-40
No. 8	18-33
No. 30	5-15
No. 50	0-7
No. 200	0-3

### Alternate 2: Perforated Pipe, Gravel and Filter Fabric



Gravel material 9 feet<sup>3</sup>/linear foot.  
 Perforated pipe: see alternate 1.  
 Gravel: Clean ¾" rock or approved substitute.  
 Filter Fabric: Mirafi 140 or approved substitute.

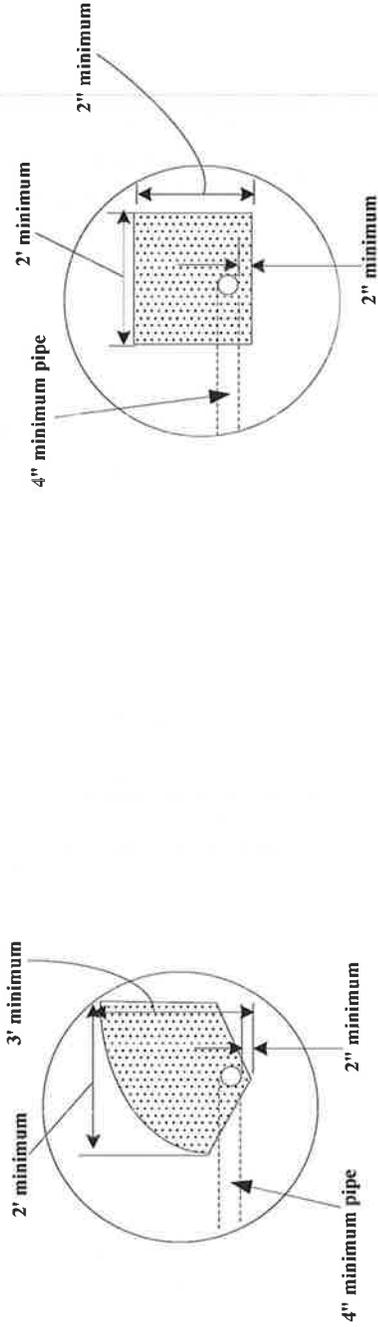
## EARTHWORK AND GRADING GUIDELINES CANYON SUBDRAIN ALTERNATE DETAILS

Note: Figures not to scale



FIGURE N

## TYPICAL STABILIZATION BUTTRESS SUBDRAIN DETAIL



**Filter Material:** Minimum of 5 ft<sup>3</sup>/linear foot of pipe or 4 ft<sup>3</sup>/linear foot of pipe when placed in square cut trench.

**Alternative In Lieu Of Filter Material:** Gravel may be encased in approved filter fabric. Filter fabric shall be mirafix 140 or equivalent. Filter fabric shall be lapped a minimum of 12" on all joints.

**Minimum 4" Diameter Pipe:** ABS-ASTM D-2751, SDR 35 or ASTM D-1527 schedule 40 PVC-ASTM D-3034, SDR 35 or ASTM D-1785 schedule 40 with a crushing strength of 1,000 pounds minimum, and a minimum of 8 uniformly spaced perforations per foot of pipe installed with perforations at bottom of pipe. Provide cap at upstream end of pipe. Slope at 2% to outlet pipe. Outlet pipe shall be connected to the subdrain pipe with tee or elbow.

- Note:**
- (1) Trench for outlet pipes shall be backfilled with onsite soil.
  - (2) Backdrains and lateral drains shall be located at the elevation of every bench drain. First drain shall be located at the elevation just above the lower lot grade. Additional drains may be required at the discretion of the soils engineer and/or engineering geologist.

Note: Figures not to scale

**Filter Material** – Shall be of the following specification or an approved equivalent:

Sieve Size	Percent Passing
1"	100
3/4"	90-100
3/8"	40-100
No. 4	25-40
No. 8	18-33
No. 30	5-15
No. 50	0-7
No. 200	0-3

**Filter Material** – Shall be of the following specification or an approved equivalent:

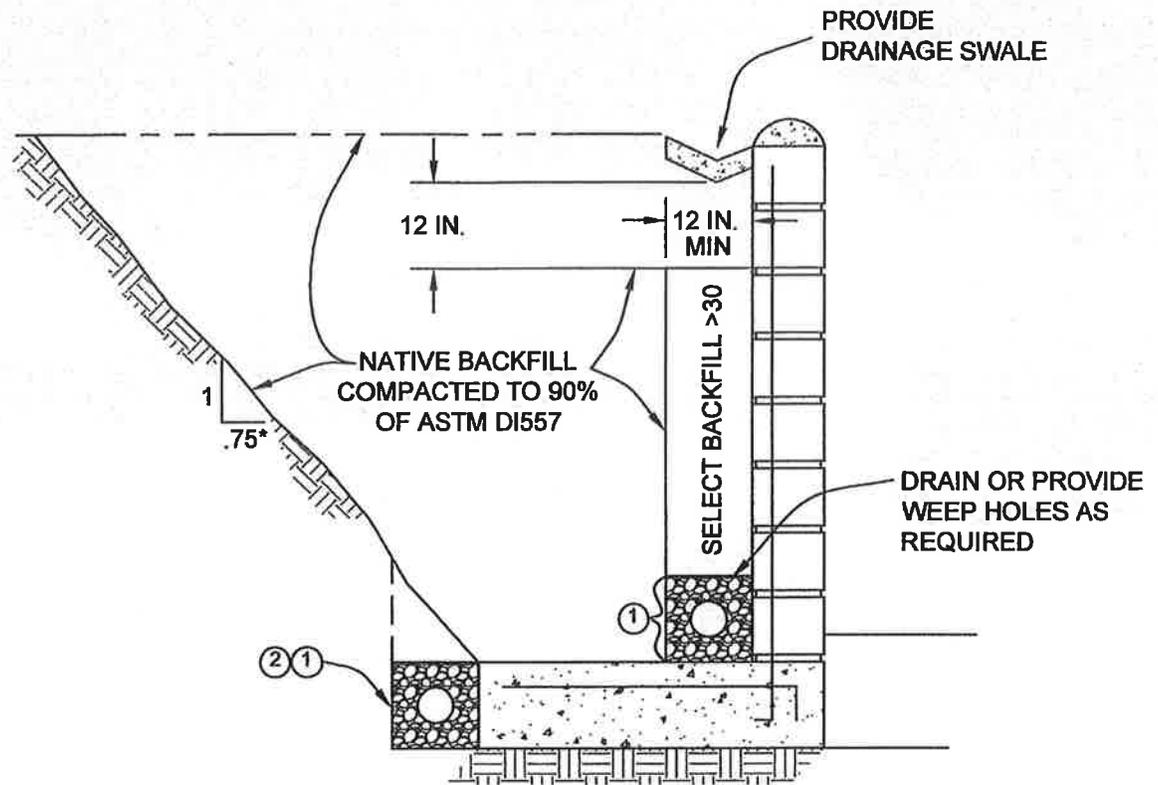
Sieve Size	Percent Passing
1/2"	100
No. 4	50
No. 200	8

Sand equivalent: Minimum of 50

## EARTHWORK AND GRADING GUIDELINES TYPICAL STABILIZATION BUTTRESS SUBDRAIN DETAIL



**FIGURE O**



\* OR AS REQUIRED FOR SAFETY

### NOTES

- ① 4-INCH PERFORATED PVC SCHEDULE 40 OR APPROVED ALTERNATE. PLACE PERFORATION DOWN AND SURROUND WITH A MINIMUM OF 1 CUBIC FOOT PER LINEAL FOOT (1 FT. /FT.) OF 3/4 INCH ROCK OR APPROVED ALTERNATE AND WRAPPED IN FILTER FABRIC.
- ② PLACE DRAIN AS SHOWN WHERE MOISTURE MIGRATION THROUGH THE WALL IS UNDESIRABLE.

## EARTHWORK & GRADING GUIDELINES

TYPICAL RETAINING WALL BACKFILL

NOTE: FIGURE NOT TO SCALE



**EEI**

Expertise...Service...Solutions

**FIGURE P**

