Allerion
Consulting Group, Inc.

Services Geotechnical Engineering Study

Project Proposed 3-Story Apartment Building

Location Fort Bragg, California

Client Pacific West Communities, Inc.

Project No. 05-24059G

Date September 19, 2024

Roseville I Redding I Yreka I San Leandro
Geotechnical I Consulting Services I Quality Control Management I Environmental

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A Report Prepared for:

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GEOTECHNICAL ENGINEERING STUDY
PROPOSED 3-STORY APARTMENT BUILDING
860 HAZELWOOD STREET
FORT BRAGG, CALIFORNIA

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INTRODUCTION

PURPOSE AND SCOPE OF STUDY

Allerion Consulting Group, Inc. (ACG) prepared this Geotechnical Engineering Study for the proposed improvements to be designed and constructed on the above referenced subject site (refer to the Location Plan, Figure 1, Appendix A). The purpose of the study is to evaluate the general conditions of the earth materials at the site to provide conclusions and recommendations related to the geotechnical and geological aspects of the project as discussed in ACG's proposal/agreement of August 7, 2024, and client's acceptance agreement of August 20, 2024, executed August 20, 2024.

The scope of our work included a site reconnaissance, review of client provided documents and readily available published documents (including aerial images, topographic maps, and nearby groundwater levels), obtaining drilling permit, exploring and sampling the general subsurface earth and groundwater conditions, performing percolation testing, performing soil mechanics laboratory tests, assessing potential for geological and seismic hazards (including liquefaction and expansive soil conditions), performing geotechnical analysis, and making recommendations for earthworks, foundation design criteria, lateral resistance, floor slab-on-grade support, exterior flatwork, and on-site asphaltic-concrete and concrete pavements.

The attached Appendices contain further information including graphic presentations (Site Vicinity Map and Map of Explorations - Appendix A); field exploration procedures and logs of subsurface explorations (Appendix B); laboratory testing, and procedures used (Appendix C); Guide Specifications for Earthwork (Appendix D); and SEAOC/OSHPD U.S. Seismic Design Maps (Appendix E).

PROJECT LOCATION

ACG understands the project is proposed on an approximately 2.83 acres and consists of one parcel identified as Mendocino County Assessor's Parcel Number 018-210-29-00. The subject site is located at 860 Hazelwood Street in Fort Bragg, California. The site is bounded by Hazelwood Street to the west, beyond which are residential properties; residential development to the north; Mendocino Coast

Recreation and Park District to the south, beyond which are residential properties; and residential property with mostly vacant land to the east, beyond which is Noyo River to the southeast.

PROPOSED PROJECT INFORMATION

In preparing this report we reviewed a preliminary site plan provided by the client (untitled and undated) and historic Google Earth aerial images related to the subject site. Based on the referenced preliminary site plan and information provided by the client, the proposed project consists of design/construction of one (1) 3-story apartment building. Additional improvements include paved driveways and parking spaces, a dog park, a community garden, a bocce ball court, an open space, and covered trash enclosures.

The site grading is anticipated to be in order of about 2 to 4 feet of fill based on the topography of the site, but the grading plans were not available for review at the time of this report preparation.

FINDINGS

SITE HISTORICAL BACKGROUND

The Google Earth aerial images dated back to June 1998 indicate the site was generally similar to that described below in the Site Description section.

SITE DESCRIPTION

During ACG's exploration on September 3, 2024, the subject site in the northwestern portion if the property was occupied by an abandoned house and a nearby storage container. The northwestern portion was fenced with a gravel driveway providing access to the residence. The remainder of the site was vacant and covered with grasses and weeds, with some trees near the boundaries of the site and one tree near the center of the site.

The northern portion of the site at the proposed building location was relatively flat-lying with elevations that varied from approximately +117 to +120 feet above mean sea level (MSL) per Google Earth elevation profiles. The southern portion of the site was gently sloped down towards Noyo River to the southeast with elevations that varied from approximately +105 to +117 feet above MSL per Google Earth elevation profiles.

SITE GEOLOGY

Based on our review of readily available published geologic literature/maps (California Geological Survey "Geologic map of California: Ukiah sheet", 1960; 1:250,000) the site is mapped to be underlain by Quaternary Pleistocene marine and marine terrace deposits (Map Symbol: Qm). The total thickness of the formation was not determined and is beyond the scope of this study. ACG considers the native earth materials discovered in the explorations are consistent with the mapped earth materials.

EARTH MATERIAL CONDITIONS

As shown on the Exploratory Logs (Appendix B), the subsurface earth material conditions exhibited variability. Generally, the uppermost soils consisted of loose to medium dense, moist, brown, Silty SAND (Unified Soil Classification: SM) to depths varying between approximately 5½ to 6 feet below existing ground surface (begs). Below the uppermost soils to depths varying between 25 to 26 feet begs, the earth materials consisted of interbedded layers of medium dense, moist, light brown to brown with rust staining, Silty SAND (SM)/ SAND with Silt (SP-SM)/ SAND (SP); and stiff, light gray with rust staining, Lean CLAY (CL). Below these layers was encountered dense to very dense, moist to wet, gray and light brown to red-brown with rust staining, Silty SAND (SM) to the maximum explored depth of about 30½ feet begs.

Since the earth material profile is generalized, the reader is advised to consult the Boring and CPT Logs contained in Appendix B, if the earth material conditions at a specific depth and location are desired. The logs contain a more detailed earth material description regarding color, earth material type, and Unified Soil Classification System (USCS) symbol.

Earth material conditions cannot be fully determined by surface and subsurface explorations and earth material sampling. Hence, unexpected earth material conditions might be encountered during construction. If earth material conditions are encountered during construction which vary from earth materials encountered during the investigation, then appropriate recommendations will be needed during construction. Therefore, we suggest a contingency fund for additional expenditures that might have to be made due to unforeseen conditions.

SOIL CORROSION SCREENING

A representative sample of the near surface soil was selected and transported to Sunland Analytical in Rancho Cordova, California, for testing soil corrosivity potential. The test methods for pH, minimum resistivity (CA DOT Test #643), sulfate content (CA DOT Test #417), and chloride content (CA DOT Test #422m) are shown in the following table.

TABLE 1. CORROSIVITY TEST RESULTS	
Sample ID / Depth: B-4/1 @ 2' – 3.5' begs	
Constituent	Test Result
Soil pH	5.43
Minimum Resistivity (ohm-cm)	11.26
Chloride Content (ppm)	6.2
Sulfate Content (ppm)	3.6

Notes: ohm-cm = Ohm centimeters
ppm = Parts per million

The California Department of Transportation Corrosion and Structural Concrete Field Investigation Branch, May 2021 Corrosion Guidelines (Version 3.2), considers a site to be corrosive to foundation elements if one or more of the following conditions exists for the representative soil and/or water samples taken: has a chloride concentration greater than or equal to 500 ppm, sulfate concentration greater than or equal to 2000 ppm, or the pH is 5.5 or less. Based on this criterion, the on-site soils tested are considered corrosive to reinforced concrete. The presence of high acidity (pH values less than 5.5) indicates the soil (or water) can react with the lime in concrete to form soluble reaction products that can leach out of the concrete, resulting in a more porous and weaker concrete.

Table 4.2.1 – *Exposure Categories and Classes*, American Concrete Institute (ACI) 318, Section 4.2, as referenced in Section 1904.1 of the 2022 CBC, indicates the severity of sulfate exposure for the sample tested is *Not Applicable*. The low pH (acidic) soil conditions suggest that Type II modified or Type V cement along with higher cement contents and a specific water-cement ratio (around 4.5) likely will be required for this project.

Allerion is not a corrosion engineering firm. We recommend a licensed Corrosion Engineer be consulted to evaluate the above test results, assess the soil corrosion potential, and design resistant materials. We can provide references to a licensed Corrosion Engineer, upon request.

GROUNDWATER CONDITIONS

Observations of groundwater conditions were made during and just after drilling the exploratory borings. Groundwater was encountered after drilling at depths varying between approximately 11 and 13 feet below existing ground surface. It is possible that some borings may not have been left open long enough for groundwater to reach equilibrium.

Groundwater levels at the site should be expected to fluctuate throughout the year due to seasonal precipitation, local pumping, and other factors.

PERCOLATION TEST RESULTS

Two (2) percolation test borings (P-1 and P-2) were drilled using 4-inch outer-diameter continuous flight helical solid stem augers (SSA), to approximate depths as indicated in the table below. The percolation test locations and depths were provided by project's Civil Engineer. Please refer to the Appendix A – Figure 2 "Explorations Location Map" for approximate locations of the percolation test holes.

The soils encountered in the percolation test borings are consistent with the conditions found in the exploratory borings. The sidewalls of each boring were scored along the outer walls to reduce the effects of smearing. Approximately six (6)-inches of clean pea gravel was added to the bottom of each test hole. In each test hole a 2-inch inner diameter (ID) slotted PVC pipe was installed on top of the gravel. Pea gravel was placed in the annular space between the boring wall and pipe. Each hole was filled with water to let the soils presoak before performing the tests. Following the presoak time each test boring was filled with water to at least 12 inches above the bottom of the boring. The drop in water level was measured at specific time intervals until a steady rate of drop in water level was obtained when at least three consecutive readings were within 10 percent from each other. Pre-adjusted percolation rates were determined by dividing the drop in water level over the time required for the drop in water level. The infiltration rates were estimated using the percolation rate divided by a Conversion Factor to convert the percolation rate to infiltration rate. The test results are shown on Table 2, below.

TABLE 2. RESULTS OF PERCOLATION TESTS			
PERCOLATION TEST NO.	**APPROXIMATE DEPTH – from Top of AC (ft)**	**CALCULATED INFILTRATION RATE (in/hr)**	**TESTED SOIL DESCRIPTION**
P-1	5	1.03	Silty Fine SAND (SM)
P-2	5	0.94	Silty Fine SAND (SM)

The infiltration rates of water into the soils (per the test method referenced and results on Table 2, above) could be used by the project Civil Engineer as a preliminary infiltration rate at the locations indicated. A safety factor was not applied to these values. During construction of the stormwater infiltration systems, ACG recommends confirmation infiltration testing be performed with a double ring infiltrometer, if feasible, within the area of the proposed stormwater infiltration system.

CONCLUSIONS AND DISCUSSIONS

SITE SUITABILITY AND GEOTECHNICAL CONSIDERATIONS

From a geotechnical standpoint, the site is considered suitable for the proposed construction provided the conclusions and recommendations presented in this report are incorporated into the design and construction of the project. Geotechnical considerations that were evaluated by our office include undocumented fill, loose/soft native soils, and soils disturbed by removal of the existing structures and pavements. Mitigation measures for these items are discussed in the following sections of this report.

BEARING CAPABILITY

Field and laboratory tests show that the affirmed undisturbed, native earth materials encountered at the exploration locations are considered competent for support of the proposed construction. The upper loose / soft soils and any disturbed soils (includes undocumented fill) that are present at the time of construction are not considered stable and should not be utilized to directly support new structural elements. Mitigation measures for unsuitable soil conditions are discussed in the Recommendations section of this report. Mitigation measures considered include removal and replacing the disturbed and/or loose soils with engineered fill; or, foundation elements designed to extend through the unsuitable soils.

Engineered fill, composed of approved materials placed and compacted according to the following recommendations, is considered competent for support of low to moderate loading increases.

COMPRESSIBLE AND EXPANSIVE SOILS

Compressible materials consisting of surficial disturbed material (e.g., from razing structures, demolition of other features/pavements, etc.), loose/soft soils, undocumented fills, debris, rubble, rubbish, etc., are considered unsuitable materials for support of the proposed structure and pavements. Such materials can differentially settle. We consider that any undocumented fill encountered and disturbed and / or loose/soft soil materials in the construction areas should be removed and replaced with engineered fill. Overexcavated earth materials deemed suitable for re-use as engineered fill could be stockpiled. If the unsuitable materials are not removed, then ground improvement systems should be designed to account for the potential settlements. In areas where unsuitable or loose/soft, wet soils are encountered, remedial grading should be undertaken to remove the loose / soft soils and ensure the removal of the entire disturbed soils.

Engineered fill, composed of approved granular materials placed and compacted according to those discussed in the recommendations section, below, are considered competent for support of moderate loading increases anticipated for this project.

Based on visual observation and on laboratory test results performed on representative uppermost soil samples, we consider the expansion potential of uppermost subsurface soils to be low.

GROUNDWATER AND SEASONAL MOISTURE

The groundwater levels could be seasonal – varying between the winter and summer months. It is our opinion that perched groundwater could have an impact on the proposed design or construction depending on the foundation system selected by designers and depths of underground structures. If groundwater is encountered in excavations (especially if wet-season construction is undertaken), then groundwater seepage into the excavations is expected to be generally controllable by pumping/diversion; likewise, inflow from surface waters (dependent on quantity and duration of storm intensity/rainfall) is expected to be similarly controllable as temporarily necessary. **If the uppermost soils should become saturated, then this condition would likely impede or delay grading operations**.

Groundwater levels can fluctuate on a seasonal basis due to changes in precipitation, irrigation, pumping, tides, etc. We consider groundwater levels might change based on site topography and the time our investigation was performed. Excavations below perched groundwater (if encountered) might be impacted by seepage; therefore, we recommend grading and utility excavations be performed during dry season when groundwater levels are lowest.

SEISMIC HAZARDS

Seismic ground shaking of the earth materials underlying the site can cause ground failures, including fault rupture, liquefaction and densification, lateral spreading, landsliding, and tsunamis / seiches. The following sections discuss our conclusions / opinions regarding these conditions based on our findings and literature review.

Fault Rupture

Fault rupture hazards are important near active faults and tend to reoccur along the surface traces of previous fault movements. The site is not located within an Alquist-Priolo Special Studies Zone. We consider the potential for fault rupture, damage from fault displacement, or fault movement directly below the site to be low. However, the site is located within an area where shaking from earthquake generated ground motion waves should be considered likely.

Seismic Ground Shaking

The mapped and design spectral response accelerations (refer to Appendix E) presents seismic design criteria for the subject project site obtained from the SEAOC/OSHPD Seismic Design Maps (https://seismicmaps.org) that are based on data provided by ASCE 7-16 and are for use with the 2022 California Building Code (CBC). The values for spectral response accelerations with a Risk Category of II are summarized on the following table.

Table 3. Mapped and Design Spectral Accelerations

Description	Value
Site Soil Classification[1]	D
Site Latitude, Longitude	39.4286097, -123.8020746
S_S – Spectral Acceleration for a Short Period	1.505 g
S_1 – Spectral Acceleration for a 1-Second Period	0.607 g
S_{MS} – MCE_R, 5% damped Spectral Acceleration for a Short Period	1.505 g
S_{M1} – MCE_R, Spectral Acceleration for a 1-Second Period[1]	1.032 g
S_{DS} – design, 5% damped, Spectral Acceleration for a Short Period	1.003 g
S_{D1} – design, 5% damped, Spectral Accel. For a 1-Second Period[1]	0.688 g
Seismic Design Category[2]	D
T_L	12
PGA	0.654 g
PGA_M	0.719 g
F_{PGA}	1.1

[1] The *2022 CBC* requires an earth material profile determination extending to a depth of 100 feet for site soil classification. ACG's explorations extended to depth of about 30.5 feet begs, and Site Class D was selected based on soils conditions encountered in our explorations. Exception 2 of ASCE 7-16 Section 11.4.8 for Site Class D is used to calculate S_{MS}, S_{M1}, S_{DS} and S_{D1}. [2] In general accordance with the 2022 CBC (refers to *ASCE 7-16*) Seismic Design Category is based on spectral acceleration for a 1-sec Period, short & 1-sec period response acceleration parameters (S_1, S_{DS} & S_{D1}, respectively) and corresponding Risk Category. Please refer to ASCE/SEI 7-16 Section 11.4.8 for base shear (V) calculations. Please refer to Appendix E for the U.S. Seismic Design Maps.

Liquefaction and Seismic Settlement Evaluation

Liquefaction occurs when saturated fine-grained sands and/or silts lose their physical strength temporarily during earthquake induced shaking and behave as a liquid. This is due to loss of point-to-point grain contact and transfer of normal stress to the pore water. Liquefaction potential varies with water level, soil type, material gradation, relative density, and probable intensity and duration of ground shaking. Dynamic settlement of the soils that experience liquefaction may occur after earthquake shaking has ceased.

The California Geological Survey (CGS) has designated certain areas within California as potential liquefaction hazard zones. These are areas considered at risk of liquefaction-related ground failure during a seismic event based upon mapped surficial deposits and the depth to the areal groundwater table. The project site is not currently mapped for potential liquefaction hazard by the CGS (refer to CGS website: https://www.conservation.ca.gov/cgs/earthquakes).

Based on the information for this study, it is our opinion that dynamic settlement due to an earthquake event might affect the proposed improvements. Total vertical settlements due to earthquake shaking (i.e., seismic induced settlements) were estimated as part of ACG's investigation and analysis in general accordance with the Recommended Procedures for Implementation of DMG Special Publication 117A, "Guidelines for Analyzing and Mitigating Liquefaction in California.". The seismic settlement evaluation was performed using the software program NovoLiq 4.0.2021.311 (Novo Tech Software Ltd. ©2009 - 2021). The analysis conducted estimated total seismic induced settlements at the highest anticipated groundwater depth of 10 feet begs, which should be considered in design and construction. USGS Unified Hazard Tool was used to estimate seismic parameters used in the analysis (https://earthquake.usgs.gov/hazards/interactive/). The analysis is based on return period of 975 years (5% occurrence in 50 years) and peak ground acceleration (PGA) of 0.6435 g. Based on the summary statistics analysis per USGS Unified Hazard Tool for the highest seismic contribution, the earthquake magnitude of 7.71 at an approximate fault distance of 9.6 kilometers from the subject site were used in the analysis.

The analysis results indicate that the subsurface soils at the site are variably susceptible to liquefaction under the criteria indicated above. The loose to medium silty sand and sand with silt soils encountered at depths between 10 and 25 feet begs are considered the most susceptible to liquefaction. The estimated vertical liquefaction induced settlement is estimated at about 3 inches and relatively small lateral displacement. Provided the foundations are designed and constructed with seismic ties, the risk of structural collapse because of soil liquefaction is considered low and not a life safety concern.

The consequences of one-dimensional seismic induced settlement may be largely mitigated by the presence of a relatively thick non-liquefied layer above the potentially liquefiable soils (Ishihara 1985, Naesgaard et al. 1998, Bouckovalas and Dakoulas 2007). **It is our opinion that the presence of the 5 feet engineered fill layer (per the Earthwork recommendations section of this report) may act as a bridging layer that redistributes stresses and therefore results in more uniform ground surface settlement beneath the proposed structures, as well as decreasing the amount of potential seismic induced settlement.**

Ground Lurching

Ground lurching is a result of the rolling motion imparted to the ground surface due to seismic waves released by an earthquake that can cause cracks in weaker soils. The potential for cracking at this site is considered low due to the generally stiff soil consistencies and medium dense to very dense relative densities.

Earthquake Induced Landsliding

Based on information available on the California Geological Survey (CGS) website the subject site is not currently within a State of California Seismic Hazard Zone for seismically induced landsliding. In addition, there are no steep slopes on or adjacent to the subject site. Therefore, seismically induced and/or other landslides are not considered a significant hazard at the site.

ON-SITE EARTH MATERIALS SUITABILITY

On-site soils like those encountered in the test borings are considered suitable for re-use as engineered fill. Rubble, rubbish, oversize materials, significant organic matter, highly plastic soil, or any other substance deemed unsuitable should not be used as engineered fill.

POTENTIAL SLOPE STABILITY

No landslides, slumps, or other indications of slope instabilities were observed on the site area during our field investigation. We consider the potential for slope instability to be negligible.

EXCAVATION CONDITIONS

The on-site soils are considered to be readily excavatable with conventional construction equipment to at least the maximum depth explored of approximately 30.5 feet begs. In our opinion, shallow excavations into native soils less than four feet in depth should stand at a near-vertical inclination for the short periods of time required for foundation and shallow utility construction. However, sloughing and "running" conditions could occur if the soils are saturated, where loose fills are encountered, or where zones of clean (cohesionless) sands are encountered, especially when subjected to construction vibrations or allowed to dry significantly.

Excavations deeper than four feet that will be entered by workers should be sloped, braced, or shored in accordance with current Occupational Safety and Health Administration (OSHA) and Cal/OSHA regulations. The contractor must provide an adequately constructed and braced shoring system in accordance with federal, state, and local safety regulations for individuals working in an excavation that may expose them to the danger of moving ground.

Temporarily sloped excavations less than 20 feet deep should be constructed no steeper than a one and one-half horizontal to one vertical (1½H:1V) inclination. Temporary slopes might stand at this inclination for the short-term duration of construction, provided loose sands/sandy silts, soft clays, and/or saturated granular soils are not encountered. Flatter slopes would be required if these conditions are encountered.

Excavated materials should not be stockpiled directly adjacent to an open trench to prevent surcharge loading of the trench sidewalls. Excessive truck and equipment traffic also should be avoided near open trenches. If material is stored or heavy equipment is operated near an excavation, stronger shoring would be needed to resist the extra pressure due to the superimposed loads.

RECOMMENDATIONS

Recommendations for earthworks and the design and construction of the proposed structure(s) and associated improvements follow. All recommendations could require modifications based on conditions encountered during earthworks and general construction. In addition, changes in the locations of the proposed structures and pavements could also necessitate modifications to the recommendations provided herein.

EARTHWORK

Earthwork specifications which may be used as a guide in the preparation of contract documents for site preparation / grading are included in Appendix D. However, recommendations in the text of this report supersede those presented in Appendix D. **The conclusions and recommendations contained in this report should be incorporated into the guide specifications.**

We consider it essential that our office review grading and structural foundation plans to verify the applicability of the following recommendations, and to provide supplemental recommendations, if necessary.

The recommendations presented below are considered appropriate for proposed construction in the late spring through fall months. The on-site soils likely will be saturated by rainfall in the winter and early spring months and will not be compactable without drying by aeration or the addition of lime (or a similar product). Should the construction schedule require work to continue during the wet months, additional recommendations can be provided, as conditions dictate.

Site preparation should be accomplished in accordance with the recommendations of this report. A representative of the Geotechnical Engineer should be present during earthworks to evaluate compliance with the recommendations presented in this report and the approved project plans and specifications. The Geotechnical Engineer of Record referenced herein should be considered the Geotechnical Engineer that is retained to provide geotechnical engineering observations and testing services during construction.

Site Clearing and Stripping

The building pad is considered to extend laterally away from (outside of) all perimeter foundation/building edges at least five (5) feet in plan view, or to edges of any adjacent features restricting this width. We recommend the construction areas be cleared of all obstructions or unsuitable materials, including all loose, wet, or disturbed soil, undocumented fill, rubble, rubbish, vegetation, structural elements (includes foundations, pavements) to be razed, and any buried utility lines to be removed. Any foundations, pavements, cisterns, septic tanks, leach fields, water wells, etcetera that might be encountered and are to be abandoned should be removed. **Any undocumented fill and loose soils overlying the underlying firm earth materials should be overexcavated and, if deemed suitable, be re-processed as engineered fill or off-hauled.** The excavated soils could be evaluated for reuse as engineered fill. The resulting subgrades of excavation(s) should be prepared and filled to planned project subgrade level with engineered fill as discussed in the following sections.

Excavations resulting from the removal of unsuitable materials and/or loose soils should be cleared to expose firm, stable material. The surface of the resulting excavations should be scarified to a depth of 12 inches, moisture conditioned, and then compacted to the recommendations given below under subgrade preparation.

Existing utilities that extend into the construction area and are scheduled to be abandoned should be properly capped or plugged with grout at the perimeter of the construction zone or moved as directed in the plans. It may be feasible to abandon on-site utilities in-place by filling them with grout, provided they will not interfere with future utilities or affect building foundations. The utility lines should be addressed on a case-by-case basis.

In conjunction with clearing, the improvement areas should be stripped to sufficient depth to remove all organic laden topsoil. The actual stripping depth should be determined by our representative at the time of construction. The cleared and stripped materials should be removed from the site or stockpiled for possible use as landscape materials. In areas where trees and tree roots 2-inches or greater have been cleared, depressions resulting from site clearing operations, as well as any loose, soft, disturbed, saturated, or organically contaminated soils, as identified by the Geotechnical Engineer's representative, should be cleaned out to firm, undisturbed soils and backfilled with engineered fill placed and compacted in accordance with the recommendations of this report.

It is important that the Geotechnical Engineer's representative be present during clearing operations to verify adequate removal of the surface and subsurface items, as well as the proper backfilling of resulting excavations.

Over-excavation Recommendations

Due to differential movement considerations, we recommend building foundations, slabs-on-grade, concrete flatwork, and structural pavements bear on engineered fill. We recommend uppermost loose native earth materials be overexcavated to estimated depth of at least five (5) feet below existing ground surface (begs), or at least 3 feet below the bottom of the structure's foundation, whichever is deeper. Geogrids (e.g. Tensar InterAx NX750 or NX850)

should be placed at the exposed bottom of over-excavations, and the geogrids should be installed per the manufacture criteria. The resulting overexcavation should be backfilled with engineered fill comprised of low to non-expansive soil. The overexcavation limits should extend laterally to at least 5 feet beyond the proposed building footprint, or to where practical, as affirmed by ACG's representative.

We recommend concrete slabs-on-ground, flatwork and structural pavements bear on at least 18-inches of engineered fill comprised of low to non-expansive soil.

Soils to be used for engineered fill should be per the criteria in the following recommendations *"Material for Fill"* section. All materials should be placed and compacted per the *"Fill Placement and Compaction"* section.

Subgrade Preparation

Once the construction areas have been cleared, any unsuitable soils over-excavated, and any other excavations made, then subgrades that will receive engineered fill, that are to be left at existing grade, or that represent final subgrades in soil achieved by excavation should be scarified to at least 12 inches. Suitability of soils exposed in the bottom of all subgrades should be verified by an ACG special inspector during site grading. The scarified soils should be uniformly moisture conditioned as determined by ACG's field representative based upon the compaction characteristics of the earth material (typically 1 to 3 percent over optimum for granular soils and 2 to 4 percent over optimum for fine grained, silty/clayey soils) and compacted to at least 90 percent relative compaction per ASTM D 1557.

The geotechnical engineer's special inspector should observe the recompacted subgrades be proof-rolled with very heavy construction equipment (e.g., loaded water truck) in order to verify subgrade earth material stability. Inability to achieve the stated moisture content, compaction, or instability of the subgrade materials unsuitable conditions and would be used as criteria for the removal of loose, wet, or soft soils, or for the need of special stabilizing measures.

If unanticipated unsuitable materials are encountered at subgrade such that they are unstable and/or proper compaction cannot be obtained, then mitigation measures, such as over excavations or use of a geotextile material, would be recommended. In addition, construction equipment on saturated soils could destabilize the earth materials, sometimes to several feet of depth, which might necessitate further over excavation and/or special stabilization.

An ACG special inspector should observe and approve the bottoms of all excavations and overexcavations to confirm adequate conditions have been reached and should observe and approve the scarification, moisture conditioning and recompaction of the exposed excavated surfaces.

Material for Fill

All fill materials should be inorganic, granular soils free of vegetation, debris, and fragments larger than three inches in size. Pea gravel or other similar non-cementitious, poorly graded materials should not be used as fill or backfill without the prior approval of the geotechnical engineer. Imported earth materials and or earth materials from onsite borrow areas may be used as engineered fill material for general site grading, foundation backfill, foundation areas, trench backfill, slab areas, and pavement areas, provided the materials meet the criteria on the following table. All fill materials from any source (on-site or off-site) to be used for engineered fill should be meet the criteria on the following table, be pre-approved by this firm, and should be observed by our representative and samples obtained for laboratory testing (if needed) at least four days prior to any materials being used for engineered fill.

Table 4. Material for Fill Criteria	
3” (ASTM D 6913)	100 Percent Passing
Standard No. 4 Sieve (ASTM C136)	25 to 100 (% finer by weight)
Standard No. 200 Sieve (ASTM D 1140)	10 to 35 (% finer by weight)
Liquid Limit (ASTM D 4318)	Less than 30
Plasticity Index (ASTM D 4318)	Less than 15
Expansion Index (ASTM D 4829)	Less than 40

Fill Placement and Compaction

Engineered fill should be placed and compacted in horizontal lifts, using equipment and procedures that will produce recommended moisture contents and densities throughout the lift. Materials for engineered fill should be spread and compacted in lifts not exceeding 8 inches in uncompacted thickness. Engineered fill placed at the site and subgrades requiring recompaction should be uniformly compacted to at least 90 percent relative compaction in building areas, and to at least 95 percent relative compaction in the upper 18-inches of pavement and flatwork areas, as determined by ASTM Test Designation D 1557, or to the method as might be determined by an ACG special inspector. The moisture content of engineered fill materials should be determined by ACG's field representative based upon the compaction characteristics of the earth material (typically 1 to 3 percent over optimum for granular soils and 2 to 4 percent over optimum for fine grained, silty/clayey soils). ACG should continuously observe and test the grading and earthwork operations. Such observations and tests are essential to identify field conditions that differ from those predicted by this investigation, to adjust these recommendations to actual field conditions encountered, and to verify that the grading is in overall accordance with the recommendations presented in this report and the 2022 CBC.

If construction proceeds during or shortly after the wet winter months, it may require time to dry the on-site soils since their moisture content will probably be appreciably above the optimum. In addition, if subgrade soils are wet at the time of construction, they could be rutted, loosened, or otherwise disturbed to several feet of depth by the construction equipment and may need additional over-excavation and/or stabilization.

Construction occurring in later summer or early fall (after on-site earth materials becoming dry) may require substantial amounts of water to be added during earthwork operations to enable the appropriate moisture content and compaction to be achieved.

Upon completion of filling and grading, care should be taken to maintain the subgrade moisture content prior to construction of foundations, exterior flatwork/slabs, and pavements. Construction traffic over the completed subgrade should be avoided in order to prevent disturbance of subgrade soils. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. If the subgrade consisting of engineered fill should become desiccated, saturated, or disturbed, the affected material should be removed, or these materials should be scarified, moisture conditioned, and recompacted prior to construction.

The geotechnical engineer should be retained during the earthwork construction phase of the project to continuously observe earthwork and to perform necessary tests and observations during subgrade preparation, backfilling of excavations to the completed subgrade, placement and compaction of engineered fills, proof-rolling, backfilling of utility trenches, etc.

Utility Trench Backfill

Generally, utility trenches should be backfilled with mechanically compacted fill placed in lifts not exceeding 6 inches in uncompacted thickness. Water content of the fill material should be adjusted (typically 1 to 4 percent over optimum) during the trench backfilling operations to obtain compaction. If on-site soil or import fill material is used, then the material should be compacted to at least 90 percent relative compaction. Imported sand or gravel could also be used for bedding and shading backfill in trenches provided the granular material is compacted to at least 95 percent relative compaction. Public and private utility companies' standard plans and specifications should be adhered to when backfilling their utility trenches.

Utility trenches should be plugged with lean concrete wherever the utility line passes beneath the perimeters of the structures. The plug should be at least one foot on either side of the perimeter of the building perimeter foundation and extend from the bottom of the building foundation to the bottom of the trench.

Finish Grading and Site Drainage

On-site soils are considered to be slightly susceptible to erosion where drainage concentrations occur. Concentrated flowing water should be either dissipated or channeled to appropriate discharge facilities. Appropriate erosion control measures should be provided, where applicable, by the general civil engineer on his grading and/or winterization plan.

Positive surface gradients should be provided adjacent to the building and pavement areas (includes flatwork) to direct surface water away from the buildings and pavements for at least ten feet and toward suitable discharge facilities. Ponding of surface water should not be allowed adjacent to the building or pavements or on top of pavement. Positive drainage should be provided during construction and maintained throughout the life of the project. Infiltration of water into utility trenches or foundation excavations should be prevented during construction. Backfill against foundations, exterior walls, and in utility and sprinkler line trenches should be well compacted as previously recommended and free of all construction debris to reduce the possibility of moisture infiltration. We recommend a horizontal setback distance of at least 10 feet from the perimeter of any building and the high-water elevation of the nearest storm-water retention.

Downspouts, roof drains or scuppers should discharge into splash blocks or extensions when the ground surface beneath such features is not protected by exterior slabs or paving. Sprinkler systems should not be installed within 5 feet of foundation walls. Landscaped irrigation adjacent to the foundation system should be minimized or eliminated.

All grades must provide effective drainage away from the building during and after construction. Water permitted to pond next to a building can result in greater soil movements than those discussed in this report. These greater movements can result in unacceptable differential floor slab movements, cracked slabs and walls, vapor transmission issues in interior slabs, and roof leaks. Estimated movements described in this report are based on effective drainage for the life of the structure and cannot be relied upon if effective drainage is not maintained.

Per 2022 CBC Section 1804.4, the soil ground surface should be sloped at least 5 percent (2 percent for pavement) down and away from the building for at least of 10 feet beyond the perimeter of the building or pavement. After building construction and landscaping, we recommend the Civil Engineer and/or surveyor verify final grades to document that effective drainage has been achieved. Grades around the structure should also be periodically inspected as part of the structure's maintenance program and adjusted, as may be necessary.

Cut and Fill Slopes

Cut/fill slopes are not anticipated. If slopes should be needed, then permanent excavation and embankment slopes up to 10 feet of height in soil should be graded at an inclination of 2 horizontal to 1 vertical (2H: 1V) or flatter. The crowns of all slopes should be constructed so that surface run-off water is not allowed to flow over the faces of the slopes. All cut slopes should be observed during grading by the Geotechnical Engineer and/or Engineering Geologist to determine if any adverse defects are present. If defects are observed, then additional study and/or recommendations would be made at that time.

For temporary excavations, the individual contractor(s) is/are responsible for designing and constructing stable, temporary excavations as required to maintain stability of both the excavation sides and bottom. Excavations should be sloped or shored in the interest of safety following local and federal regulations, including current OSHA excavation and trench safety standards.

Earthwork Construction Considerations

At the time of our study, moisture contents of the surface and near-surface native soils were moderate. Based on these moisture contents, some moisture conditioning might be needed for the project to make the soil compactible and suitable for use as engineered fill. The soils may need to be dried by aeration during wet weather conditions, or a chemical treatment, such as cement, lime, or kiln dust, may be needed to stabilize the soil. The soils may need more moisture and water during the dry season to make the soil compactible and suitable. Subgrade conditions may need a rock protective mat covering exposed subgrades in order to limit disturbance of site soils as well as provide a stable base for construction equipment.

Although the exposed subgrades are anticipated to be relatively stable upon initial exposure, on site soils may pump and unstable subgrade conditions could develop during general construction operations, particularly if the soils are wet and/or subjected to repetitive construction traffic. The use of light construction equipment would aid in reducing subgrade disturbance. The use of remotely operated equipment, such as a backhoe, would be beneficial to perform cuts and reduce subgrade disturbance. If unstable subgrade conditions develop, then stabilization measures will need to be employed. Upon completion of filling and grading, care should be taken to maintain the subgrade moisture content just prior to construction of the floor slabs and pavements. Construction traffic over the completed subgrades should be avoided to the extent practical. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. If the subgrade should become desiccated, saturated, or disturbed, the affected material should be removed, or these materials should be scarified, moisture conditioned, and recompacted prior to floor slab and pavement construction. We anticipate that site grading for concrete foundations, slab construction, pavements and shallow utility trenches could be performed with conventional earthmoving equipment.

We emphasize the contractor is responsible for designing and constructing stable, temporary excavations (including utility trenches) as required to maintain stability of both the excavation sides and bottom and should be in accordance with OSHA excavation and trench safety standards.

We recommend that the earthwork portion of this project be completed during extended periods of dry weather if possible. If earthwork is completed during the wet season (typically November through May) it may be necessary to take extra precautionary measures to protect subgrade soils. Wet season earthwork may require additional mitigation measures beyond that which would be expected during the drier summer and fall months. This could include diversion of surface runoff around exposed soils and draining of ponded water on the site. Once subgrades are established, it may be necessary to protect the exposed subgrade soils from construction traffic.

Geotechnical Engineering Earthwork Construction Observation

As previously discussed, variations in subsurface conditions are possible and may be encountered during construction. In order to permit correlation between the preliminary subsurface data obtained during this investigation and the actual subsurface conditions encountered during construction, as well as affirm substantial conformance with the plans and specifications, a representative of this firm should be present during all phases of the site earthwork to make tests and observations of the site preparation, selection of satisfactory fill materials, proof rolling, placement and compaction of controlled compacted fills, backfilling of excavations to the completed subgrade, etc. Additionally, if lime or cement treatment is needed to stabilize or dry the soil, then our representative should perform observations during mixing, remixing, and compaction.

Any site earthwork performed without the presence of our representative will be entirely at the grading contractor's and/or owner's risk and no responsibility for such operations will be accepted by our firm. Sufficient notification **(at least two working days)** is necessary so that our special inspections and testing will coincide with the construction schedule.

We emphasize the importance of ACG's presence during the observation and testing of the grading operations. ACG's observation of the subsurface soil conditions, especially under the loads imposed by construction equipment, is considered an extension of our investigation, particularly within those areas away from the subsurface explorations.

Guide Specifications

Earthwork guide specifications which may be used as a guide in the preparation of contract documents for site grading are included in Appendix D. **The conclusions and recommendations contained in this report should be incorporated into the guide specifications.**

CRITERIA FOR FOUNDATION DESIGN

Based on the field and laboratory information for this study, we recommend that the proposed 3-story building be supported upon isolated and/or continuous spread footings that penetrate below the lowest adjacent building pad soil grade into the approved engineered fill bearing earth materials at least 18-inches. Foundation dimensions and reinforcement should be based on allowable dead plus live soil bearing values of 2,000 pounds per square foot (psf) for continuous footings of at least 18 inches in width and isolated footings at least 30 inches wide (both directions). **The footings should be supported on at least 3 feet of engineered fill per Over-excavation Recommendations section of this report.** An increase in the bearing capacity of 200 psf per every 12 inches of additional footing depth to a maximum 2,600 psf is allowed. The allowable foundation bearing pressures apply to dead loads plus design live load conditions. The design bearing pressure may be increased by one-third when considering total loads that include short duration wind or seismic conditions. The weight of the foundation concrete below grade may be neglected in dead load computations.

Total settlement is estimated at about 1-inch for static and seismic compression and the static settlement is expected to occur as the structure is built. Foundations should be proportioned to reduce differential foundation movement estimated at ½-inch over 40 linear feet. We recommend that all footings be reinforced as designed by the structural engineer to accommodate potential differential movements. Proportioning based on equal total settlement is recommended; however, proportioning to relative constant dead-load pressure would reduce differential settlement between adjacent foundations.

Lateral Resistance

Foundations placed in approved soil bearing materials could be designed using a coefficient of friction of 0.30 for granular soils. A design passive resistance value of 300 pounds per square foot per foot (psf/ft) of depth (with a maximum value of 3,000 pounds per square foot) is recommended for engineered fill per the Earthwork section, above. If both friction and passive pressures are combined, then the smaller value should be halved. The lateral sliding resistance for clay soils should not exceed one-half the dead load.

The sides of the excavations for the foundations should be nearly vertical and the concrete should be placed neat against these vertical faces for the passive earth pressure values to be valid. If the loaded side is sloped or benched in the soil, and then backfilled with engineered fill, then the nominal passive pressure should be reduced to the soil frictional or adhesive resistance.

General Foundation Considerations

ACG's geotechnical engineer or ACG's representative should observe earth material conditions exposed in foundation excavations to confirm the adequacy for structural foundation bearing, confirm the appropriateness of these recommendations, and to allow for an opportunity to provide additional recommendations if deemed necessary. If the earth material conditions encountered differ significantly from those presented in this report, then supplemental recommendations will be required.

An important factor in soils supporting structural improvements is a change in moisture content. The recommendations herein are predicated on the soil moisture beneath and within five feet of the building perimeters, slabs and pavements being maintained in a uniform condition during and after construction. Please be advised that over watering or under watering, types of plants (trees should be at least the distance away from the improvement equal to their maximum height), altering design site drainage, etc., might be detrimental to the foundation, slabs, and/or pavements. We suggest that automatic timing devices be utilized on irrigation systems; however, provision should be made to interrupt the normal watering cycle during and following periods of rainfall. Additional foundation movements could occur if water, from any source, saturates the foundation soils; therefore, proper drainage should be provided during in the final design, during construction, and maintained for the life of the development.

Static and seismic settlement could affect various aspects of the planned development, including utilities, building entrances, sidewalks, footings, and grade beams. Design of these elements should incorporate features to mitigate the effects of the predicted settlements. Because of the anticipated settlements during an earthquake, it may be necessary to replace esthetic features, sheetrock, glazing, exterior flatwork, etc., after a major earthquake.

The foundation excavations should be clean (i.e., free of all loose slough) and maintained in a moist condition between 2 to 4 percent over optimum moisture just prior to placing steel and concrete. The concrete for the foundation should not be placed against a dry excavation surface.

The base of all foundation excavations should be free of water, loose soil, and gravel prior to placing concrete. Concrete should be placed soon after excavating and placement of engineered fill (and lime treatment, if needed) to reduce bearing soil disturbance. Should the soils at bearing level become excessively dry, disturbed, or saturated, the affected soil should be removed prior to placing concrete. In addition, as previously described, unsuitable soils should be completely removed from any proposed construction areas prior to construction. Concrete should not be chuted against the excavation sidewalls. Concrete should be pumped or placed by means of a tremie or elephant's trunk to avoid aggregate segregation and earth contamination. Rebar reinforcement should be properly supported with proper clearances maintained during concrete placement. The concrete should be properly vibrated to mitigate formation of voids and to promote bonding of the concrete to steel reinforcing. These recommendations are predicated upon ACG’s representative observing the bearing materials as well as the manner of concrete placement.

Foundation Setback

The bottoms of utility trenches placed along the perimeter of the foundation should be above an imaginary plane that projects at a 2H:1V angle projected down from 9-inches above the bottom edge of the lowest outermost edge of the foundation per 2022 CBC Section 1809.14. Where trenches pass through the plane, the trench should be installed perpendicular to the face of the foundation for at least the distance of the depth of the foundation. Alternatively, the foundation could be deepened to attain the recommended setback. Foundation details under the influence of this recommendation should be forwarded along with the structural load information to the geotechnical engineer for review.

INTERIOR FLOOR SLAB-ON-GROUND SUPPORT

On most project sites, the site mass grading is generally accomplished early in the construction phase. However, as construction proceeds, the subgrade soils may be disturbed due to utility excavations, construction traffic, desiccation, rainfall, etc. As a result, the floor slab subgrade soils may not be suitable for placement of base rock and concrete and corrective action may be required.

We recommend the engineered fill underlying the floor slab be rough graded and then thoroughly proof rolled with a loaded tandem axle dump truck or water truck prior to final grading and placement of base rock. Particular attention should be paid to high traffic areas that were rutted and disturbed earlier and to areas where backfilled trenches are located. Areas where unsuitable conditions are located should be repaired by removing and replacing the affected material as engineered fill.

A building pad comprised of engineered fill (constructed in accordance with the criteria contained within the above "Earthwork" section) is considered suitable for support of the slabs-on-ground of the building. In all cases the floor slab should not be placed on a dry subgrade. The subgrade soils should be maintained at 1 to 4 percent above the compaction moisture content in the upper 12 inches as verified by ACG prior floor slab concrete placement. In all cases the floor slab should not be placed on a dry subgrade.

The lightly loaded building floor slab-on-grade design, thickness and reinforcement should be designed by the structural designer for the anticipated loadings based on a modulus of subgrade soil reaction (k) estimated at 90 pounds per square inch per inch (psi/in) for engineered fill. The concrete slabs should be at least 4-inches thick for light duty use. The slabs should be supported on at least 4-inches thick ¾-inch crushed rock underlain by approved engineered fill subgrade soils prepared per the recommendations of this report.

The exterior ground surface should be at least 6 inches below the top of the floor slab. We emphasize that all surfaces should slope to drain away from all sides of the building. Slabs subjected to heavier loads may require thicker slab sections and/or increased reinforcement per the structural engineer's design.

Slabs-on-grade subject to low frequency, light to medium vehicle traffic should be at least five inches thick, or as per the project structural engineer, and have at least a six-inch-thick layer of Class 2 aggregate base (compacted to at least 95 percent relative compaction) placed beneath the slabs. If elastic design is utilized for designing slabs-on-grade founded on at least a six-inch thick layer of Class 2 aggregate base compacted to at least 95 percent relative compaction, then the design k value may be increased to 125 pci. The modulus was provided based on the slab being supported on 6 inches or more of compacted aggregate base and estimates obtained from NAVFAC 7.1 design charts. This value is for a small, loaded area (1 sq. foot or less) such as for small truck wheel loads or point loads. Slabs subjected to heavier loads (e.g., forklifts) would require thicker slab sections and/or increased reinforcement. The slabs could be separated from the foundations supporting the structure to allow for differential movements between the two elements unless the structural designer designs the slab - footing to be monolithic. We suggest the structural designer consider slab reinforcement consist of at least #4 reinforcing bars placed on maximum 18-inch centers at mid-slab height.

Moisture Penetration Resistance

We are not experts regarding measures for mitigating (or preventing) moisture intrusion into building's slab-on-grade. If such should be desired, then an expert regarding moisture intrusion should be consulted.

We suggest the following measures for mitigating (not preventing) moisture intrusion into moisture sensitive interior floor slab(s). For slab-on-grade floor slab, we recommend the slab be underlain by a 4-inch-thick layer of crushed washed rock which is intended to serve as a capillary mitigating moisture break and to provide uniform slab support. Gradation of this material should be such that 100 percent will pass a 1-inch sieve and 0 to 5 percent passes the No. 4 sieve.

When conditions warrant the use of a vapor retarder, the slab designer should refer to ACI 302 and/or ACI 360 for procedures and cautions regarding the use and placement of a vapor retarder. At a minimum, we recommend in areas where it is desired to reduce floor dampness where moisture-sensitive coverings are anticipated, construction should have a suitable waterproof vapor retarder (at least 15 mils thick polyethylene vapor retarder sheeting, Raven Industries "VaporBlock 15, Stego Industries 15 mil "StegoWrap" or W.R. Meadows Sealtight 15 mil "Perminator") incorporated into the slab design. The water vapor retarder should be decay resistant material complying with ASTM E96 not exceeding 0.04 perms, ASTM E154 and ASTM E1745 Class A. The vapor barrier should be placed between the concrete slab and the compacted granular aggregate subbase material. The water vapor retarder (vapor barrier) should be installed in accordance with ASTM Specification E 1643-94 or the manufacturer's recommendations, whichever is more stringent. If maximum two-inches of clean sand should be placed above the vapor retarder (not recommended), then we recommend a moisture barrier be placed against the outer face of the perimeter foundation. Please note that the sand can be a conduit for water beneath the slab. In addition, the sand can form boils/pockets in the slab concrete. If proposed floor areas or coverings are considered especially sensitive to moisture emissions, additional recommendations from a specialty consultant should be obtained. If desired, further resistance to moisture vapor intrusion could be achieved with proper curing of the concrete, adding a sealant to the mix (e.g., Moxie), having a mix design with low slump (e.g., 2 to 4 inches), low water/cement ratio (we suggest not greater than 0.48), and high strength (we suggest at least 3000 psi).

The structural engineer/architect and contractor should refer to ACI 302 and ACI 360 for procedures and cautions regarding the use and placement of a vapor barrier. In areas of exposed concrete, control joints should be saw-cut into the slab after concrete placement in accordance with ACI Design Manual, Section 302.1R-37 8.3.12 (tooled control joints are not recommended). To control the width of cracking, continuous slab reinforcement should be considered in exposed concrete slabs.

Positive separations and/or isolation joints should be provided between slabs and all foundations, columns, or utility lines to allow independent movement. Interior trench backfill placed beneath slabs should be compacted in accordance with recommendations outlined in the Earthwork section of this report and Appendix D. Other design and construction considerations, as outlined in the ACI Design Manual, Section 302.1R are recommended.

RETAINING WALL DESIGN CRITERIA

Retaining wall(s) (if proposed) should be designed to resist lateral pressures of soils having equivalent fluid weights given in the table below. Per 2022 California Building Code (CBC) Section 1803.5.12, for retaining walls supporting more than 6 feet backfill, lateral earth pressures due to earthquake loading should be considered for structures to be designed in Seismic Design Categories E or F.

Lateral pressures from surcharge loads in psf should be equal to lateral pressure coefficient (provided in the table below) multiply by vertical surcharge pressure in psf from surcharge loads located within ten lateral feet of the retaining wall.

TABLE 5: Retaining Walls Soil Parameters					
WALL TYPE	EQUIVALENT FLUID UNIT WEIGHTS (pounds per cubic foot)		Lateral Pressure Coefficient	Earthquake Loading - Dynamic Thrust Increment (plf)*	Total Soil Unit Weight
	LEVEL BACKFILL	2H:1V BACKFILL			
CANTILEVER WALL (YIELDING)	40	62	0.33	$9H^2$	120 pcf
RESTRAINED WALL	60	86	0.50	$24H^2$	

* Where H = height of retaining wall. Lateral pressures on cantilever retaining walls (yielding walls) are calculated based on work by Seed and Whitman (1970). Lateral pressures on non-yielding (or "restrained") retaining walls are calculated based on work by Wood (1973). The increment of dynamic thrust in both cases should be based on a trapezoidal distribution (essentially an inverted triangle), with a line of action located at 0.6H above the bottom of the wall.

Measures should be designed to prevent moisture buildup behind all retaining walls. We recommend drainage measures could include free draining backfill materials and sloped, perforated drains. These drains should discharge at least 10 feet away from the structure(s) to an appropriate discharge location. The wall permeable back drain could consist of either CalTrans Class 2 permeable materials or with ¾-inch up to 2-inch size drainage rock wrapped in geotextile filter fabric. The back drain should be placed behind the entire wall height to within 18 inches of ground surface at the top of the wall. The width of free draining permeable materials behind the wall should be at least two feet. Alternatively, a prefabricated drainage system (e.g., Mira-drain) could be considered behind the wall to collect the water. Water passing through the back drain system should be directed into perforated/slotted pipes that direct the collected water to an appropriate outlet for disposal away from the wall. The pipes should be placed behind and at the bottom of the wall.

Waterproofing of the wall, if needed, should be specified by the project architect/engineer. Adequate drainage should be provided behind the below-grade retaining walls to collect water from irrigation, landscaping, surface runoff, or other sources, to achieve a free-draining backfill condition.

PAVEMENT SECTION ALTERNATIVES

The R-value test result by exudation at 300 psi is 63 for Silty SAND (SM) subgrade soil obtained from R-1 shown in Figure 2 – Explorations Map. Based on the maximum R-value of 50 per the CalTrans "Highway Design Manual" and the Traffic indices (T.I.'s) indicated below, pavement section alternatives for the on-site pavement were evaluated in general conformance with Chapters 600 to 670 per the

CalTrans "Highway Design Manual" (July 1, 2020). A factor of safety per CalTrans HDM was **not** applied for on-site pavements. The Traffic Index selected for the final pavement design should be based upon the CalTrans "Highway Design Manual" - latest revision and/or edition including consideration of the vehicular traffic anticipated, number of repetitions, etc., as determined by the project civil engineer or per regulatory agency requirements. Additional traffic index pavement design alternatives may be provided, upon request.

Table 6. RECOMMENDED PAVEMENT SECTION ALTERNATIVES

Design Traffic Index	Non-treated Subgrade (12"+ Engineered Fill)		Non-treated Subgrade (12"+ Engineered Fill)	
	Asphalt Concrete (AC) (Type B)	Aggregate Base (AB) (Class 2[1])	Portland Cement Concrete[2]	Aggregate Base (AB) (Class 2[1])
5.0	2.5"	6"	4"	5"
6.0	2.5"	6"	5"	6"
7.0	3"	6"	6"	7"

([1]Caltrans Class 2 aggregate base (AB). [2]Portland Cement Concrete (PCC) should have a modulus of rupture of at least 600 psi and the concrete reinforced per the pavement designer).

The above sections should be used for preliminary design and planning purposes only. We recommend representative subgrade sample(s) be obtained and "R" Value test(s) be performed on actual earth materials exposed once pavement areas have been pioneered. These additional test results may then be used to evaluate pavement sections for construction. It is possible that significant variations in pavement sections (vs. those listed above) could result if the resulting test(s) is/are different than that used for this study.

The preliminary sections above should be reviewed and approved by the owner, the civil engineer, and the governing authorities prior to construction. In addition, other recommendations for the stated traffic indices are available, if needed. The total thickness of most sections would closely approximate those given. Thinner sections than those recommended could result in increased maintenance and/or shorter pavement life. If desired, please contact this office for further analysis.

Asphaltic-concrete paved areas should be designed, constructed, and maintained in accordance with, for example, the recommendations of the Asphalt Institute, CalTrans Highway Design Manual, or other widely recognized authority. Concrete paved areas should be designed and constructed in accordance with the recommendations of the American Concrete Institute, CalTrans Highway Design Manual, or other widely recognized authority, particularly regarding thickened edges, joints, and drainage.

Materials and compaction requirements within the structural sections should conform to the applicable provisions of the CalTrans Standard Specifications (latest edition) including at least 95 percent relative compaction of at least the uppermost twelve inches of subgrade earth materials. Asphalt concrete pavement should conform to the specifications of Type A or B per section 39, and aggregate base should conform to the specifications of Class II per Section 26 of the referenced specifications.

Concrete pavements could be reinforced with nominal rebar, such as at least #4 bars spaced no greater than 24 inches, on center, both ways, placed at above mid-slab height, but with proper concrete cover, as designed by the pavement engineer or structural engineer. If concrete pavements are to be unreinforced, then we suggest the designer use expansion/contraction and/or construction joints spaced no greater than 24 times the pavement thickness, both ways, in nearly square patterns, and detailed in general accordance with ACI Guidelines. Doweling of concrete pavements at critical pathways is also recommended.

We recommend that reinforced concrete pads be provided for truck pad areas in front of and beneath trash receptacles as determined by the structural designer. The trash collection trucks should be parked on the rigid concrete pavement when the trash receptacles are lifted. The concrete pads should be at least 5 inches thick and properly reinforced. Thickened edges should be used along outside edges of concrete pavements. Edge thickness should be at least 2 inches thicker than concrete pavement thickness and taper to the actual concrete pavement thickness 36 inches inward from the edge. Integral curbs may be used in lieu of thickened edges.

The above pavement section alternatives were estimated on the basis that a comparable soil type with R-value indicated above would constitute the final subgrade of the pavement. ACG should be retained to observe and test final subgrade soil(s) exposed to affirm that the soil is comparable to that indicated above. Where differing earth materials are encountered, they should be tested to affirm that they will also provide the same or better support for pavement sections like those recommended above for preliminary design.

We emphasize that the performance of the pavement is dependent upon uniform and adequate compaction of the soil subgrade, as well as all engineered fill and utility trench backfill within the limits of the pavements. Pavement subgrade preparation (i.e., scarification, moisture conditioning and compaction) be performed after underground utility construction is complete, and just prior to aggregate base placement.

The upper 12 inches of pavement subgrade soils should be compacted to at least 95 percent relative compaction at no less than the optimum moisture content for granular soils, maintained in a moist condition, and protected from disturbance. Aggregate base should also be compacted to at least 95 percent of the ASTM D1557 maximum dry density at the optimum moisture content or above.

Final pavement subgrades should be stable and unyielding under construction traffic prior to aggregate base placement and be protected from disturbance or desiccation until covered by aggregate base. To help identify unstable pavement subgrades within the pavement limits, a proof-roll should be performed with a fully loaded, 4000-gallon water truck (or equivalent) on the exposed subgrades prior to placement of aggregate base. The proof-roll should be observed by the Geotechnical Engineer's representative.

In the summer heat, high axle loads coupled with shear stresses induced by sharply turning tire movements can lead to failure in asphalt concrete pavements. Therefore, Portland cement concrete (PCC) pavements should be used in areas subjected to concentrated heavy wheel loading, such as entry driveways, and/or in storage/unloading areas. Alternate PCC pavement sections have been provided in the table above.

We recommend concrete slabs be constructed with thickened edges in accordance with American Concrete Institute (ACI) design standards, latest edition. Reinforcing for crack control, if desired, should be provided in accordance with ACI guidelines. Reinforcement must be located at mid-slab depth to be effective. Joint spacing and details should conform to the current PCA or ACI guidelines. PCC should achieve a minimum compressive strength of 3,500 pounds per square inch at 28 days.

All pavement materials and construction methods of structural pavement sections should conform to the applicable provisions of the Caltrans Standard Specifications, latest edition.

Pavement Drainage

Base course or pavement materials should not be placed when the subgrade surface is wet. Surface drainage should be provided away from the edge of paved areas to minimize lateral moisture transmission into the subgrade.

Adequate drainage systems should be provided to prevent both surface and subsurface saturation of the subgrade soils. As a design option, a subdrain system beneath and along the edges of the pavements might be considered. The purpose of the system would be to mitigate saturation and loss of strength/stability of the subgrade soils. Subdrains should be especially considered beneath valley drains, if utilized for the project. As an alternate to edge drains (especially around landscape planters), barrier curbing that extends to at least four inches into the soil subgrade below the bottom of the aggregate base layer could be considered to limit infiltration of water beneath the adjacent pavement. Drainage inlets should be perforated (weep holes installed) at the level of the aggregate base layer. A layer of geotextile fabric should be placed on the outside of the drain inlet over the weep holes to reduce the potential for migration or piping of fines through the holes.

Base course or pavement materials should not be placed when the subgrade surface is wet. Surface drainage should be provided away from the edge of paved areas to minimize lateral moisture transmission into the subgrade.

Pavement Construction Considerations

On most project sites, the site grading is generally accomplished early in the construction phase. However, as construction proceeds, the subgrades may become disturbed due to utility excavations, construction traffic, rainfall, etc. As a result, the pavement subgrade may not be suitable for placement of aggregate base and pavement. We recommend the area underlying the pavement be rough graded and proof-rolled prior to placement of aggregate base material. Particular attention should be paid to high traffic areas and utility trenches that were backfilled.

Areas where disturbance has occurred and materials are unsuitable, they should be removed and replaced with compacted structural fill.

The aggregate base should be uniformly moisture-conditioned and compacted to at least 95 percent relative compaction (modified proctor) in accordance with this report. Base course or pavement materials should not be placed when the surface is wet. Surface drainage should be provided away from the edge of paved areas to minimize lateral moisture transmission into the subgrade.

Minimizing subgrade saturation is an important factor in maintaining subgrade strength. Water allowed to pond on or adjacent to pavements could saturate the subgrade and cause premature pavement deterioration. The pavement should be sloped to provide rapid surface drainage, and positive surface drainage should be maintained away from the edge of the paved areas. Design alternatives which could reduce the risk of subgrade saturation and improve long-term pavement performance include crowning the pavement subgrades to drain toward the edges, rather than to the center of the pavement areas; and installing surface drains next to any areas where surface water could pond. Properly designed and constructed subsurface drainage will reduce the time subgrade soils are saturated and can also improve subgrade strength and performance. In areas where there will be irrigation adjacent to pavements, we recommend the owner consider installing perimeter drains for the pavements.

Preventative maintenance should be planned and provided for through an on-going pavement management program to enhance future pavement performance. Preventative maintenance activities are intended to slow the rate of pavement deterioration, and to preserve the pavement investment.

EXTERIOR FLATWORK

Final subgrade areas for exterior concrete flatwork (i.e., sidewalks, patios, etc.) should be prepared in accordance with the recommendations of Earthwork sections included in this report. Proper moisture conditioning of the subgrade soils is considered essential to the performance of the exterior flatwork. At least 5-inch layer of aggregate base (AB) compacted to at least 95 percent relative compaction should be used as a leveling course beneath the exterior flatwork. The AB should be supported on at least 12 inches of engineered fill subgrade compacted to at least 95 percent relative compaction per the Earthwork section of this report.

All exterior flatwork concrete should be at least four inches thick. Consideration should be given to thickening the edge of the slab to at least twice the slab thickness where wheel traffic is expected over the slabs. Expansion joints should be provided to allow for minor vertical movement of the flatwork. Exterior flatwork should be constructed independent of perimeter building foundations by the placement of a layer of felt material between the flatwork and the foundation. The slab designer should determine the final thickness, strength and joint spacing of exterior slab-on-grade concrete. The slab designer should also determine if slab reinforcement for crack control is required and determine final slab reinforcing requirements.

Practices recommended by the Portland Cement Association (PCA) for proper placement, curing, joint depth and spacing, construction, and placement of concrete should be followed during exterior concrete flatwork construction.

Areas adjacent to new exterior flatwork should be landscaped to maintain more uniform soil moisture conditions adjacent to and under flatwork. We recommend final landscaping plans not allow fallow ground adjacent to exterior concrete flatwork.

SITE DRAINAGE

Final site grading should be designed to provide positive drainage of surface water away from structures and prevent ponding of water adjacent to foundations, slabs and pavements. The grade adjacent to structures should be sloped away from foundations at least two percent slope for a distance of at least five feet, where possible. Roof gutter downspouts and surface drains should drain onto pavements or sidewalks, or be connected to rigid non-perforated piping directed to an appropriate drainage point away from the structure(s). Ponding of surface water should not be allowed adjacent to the building(s) or pavements. Landscape berms, if planned, should not be constructed in such a manner as to promote drainage toward structures.

SUBDRAINAGE

Subdrains might be needed to control subsurface water that might become perched in top and/or fill soils. Each case should be evaluated by the Geotechnical Engineer so that he/she could make appropriate mitigation recommendations.

LIMITATIONS

This report contains statements regarding opinions, conclusions, and recommendations, all of which involve certain risks and uncertainties. These statements are often, but are not always, made through the use of words or phrases such as “anticipates”, “intends”, “estimates”, “plans”, “expects”, “we believe”, “we consider”, “it is our opinion”, “mitigation or mitigate”, “suggest”, “may be”, “expected”, “predicated”, “advised”, and similar words or phrases, or future or conditional verbs such as “will”, “would”, “should”, “potential”, “can continue”, “could”, “may”, or similar expressions. Actual results may differ significantly from the expectations contained in the statements. Among the factors that may result in differences are the inherent uncertainties associated with earth material conditions, groundwater, project development activities, regulatory requirements, and changes in the planned development.

The analysis and recommendations submitted in this report are based in part upon the data from the exploratory borings at the indicated locations and in part on information provided by the client. The nature and extent of subsurface variations between the test borings across the site (or due to the modifying effects of weather and/or man) may not become evident until further exploration or during construction. If variations then appear evident, then the conclusions, opinions, and recommendations in this report shall be considered invalid, unless the variations are reviewed and the conclusions, opinions, and recommendations are modified or approved in writing.

This report was prepared to assist the client in the evaluation of the site and to assist the architect and/or engineer in the design of the improvements. ACG recommends that we be retained to review the project plans and specifications to assess that the recommendations of this report have been properly interpreted and implemented in the plans and specifications.

If there are any significant changes in the project as described herein, then the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed, and conclusions and recommendations modified or verified in writing.

This report is issued for the client’s use only. In addition, it is his responsibility to ensure that the information and recommendations contained herein are called to the attention of the designer for the project; and, that necessary steps are taken to implement the recommendations during construction.

The findings in this report were developed on the date(s) indicated. Changes in the conditions of the property can occur with the passage of time, whether they are due to natural processes or the works of man, on this or adjacent properties. In addition, changes in applicable or appropriate standards may occur, whether they result from legislation or from the broadening of knowledge. Accordingly, the findings in this report might be invalidated, wholly or partially, by changes outside of our control. Therefore, this report and the findings on which it is based are subject to our review at the onset of and during construction, or within two years, whichever first occurs.

We recommend having a pre-construction meeting, including the owner, design professionals, contractor(s), and ACG, to discuss the planned work and scheduling. In addition, we should be retained to observe the geotechnical construction, particularly site earthworks and foundation excavations, as well as to perform observations and testing. If, during construction, subsurface conditions are discovered to be different from those described herein, or appear to be present beneath excavations, then we should be advised at once so that those conditions may be observed and our recommendations reconsidered.

The scope of services of this project does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria, etc.) assessment of the site and adjacent properties or identification or prevention of pollutants, hazardous materials, or any other adverse conditions. If the owner is concerned about the potential of such contamination or pollution, other studies should be undertaken. In addition, our work scope does not include an evaluation or investigation of the presence or absence of wetlands or flood zone considerations.

No warranties, either expressed or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. If any changes in the nature, design, or location of the project as outlined in this report are planned, the conclusion and recommendations contained in this report shall not be considered valid unless ACG reviews the changes, and either verifies or modifies the conclusions of this report in writing.

This report is applicable only for the project and site studied and should not be used for design and/or construction on any other site.

Our work scope does not include obtaining permits for any aspect of the subject project. The owner of the project or his representative is responsible for obtaining permits necessary for the project.

We appreciate this opportunity to be of service on this project. If you have any questions regarding this report, then please do not hesitate to contact us.

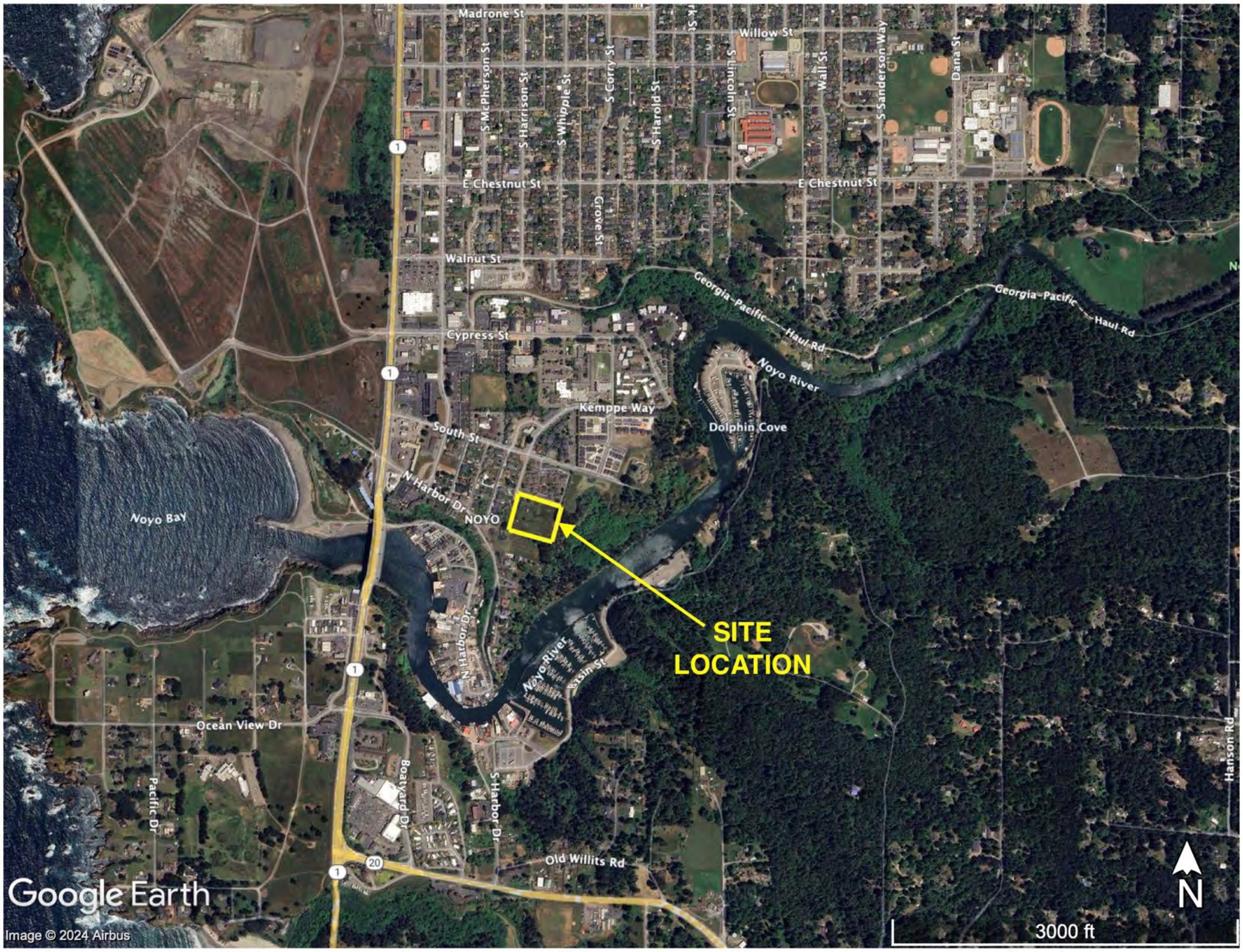
REFERENCES

1. American Concrete Institute (ACI), April 2010, “Guide to Design of Slabs-on-Ground”, ACI 360-10.
2. American Concrete Institute (ACI), June 2015, “Guide to Concrete Floor and Slab Construction”, ACI 302.1R-15.
3. American Society for Civil Engineers, 2016 “Minimum Design Loads for Buildings and Other Structures”, ASCE/SEI 7-16.
4. ASTM, “Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort”, Volume 04.08
5. California Building Code, 2022, “California Code of Regulations, Title 24, Part 2, Volume 2 of 2”, California Building Standards Commission, published by ICBO.
6. California Department of Transportation (Caltrans), 2023, Standard Specifications.
7. California Department of Transportation (Caltrans), July 2020, “Highway Design Manual”.
8. California Geological Survey, 1960, “Geologic map of California : Ukiah sheet”, Scale 1:250,000
9. CGS website (https://www.conservation.ca.gov/cgs/earthquakes) for Regulatory Maps, Reports and GIS data that includes Earthquake Fault Zones, Landslide and Liquefaction Zones.
10. Hart, Earl W., Revised 1994, "Fault-Rupture Hazard Zones in California, Alquist Priolo, Special Studies Zones Act of 1972,” California Division of Mines and Geology, Special Publication 42.
11. Jennings, Charles W. and Bryant, William A., 2010, “Fault Activity Map of California” (scale 1: 750,000) published by CGS, Geologic Data Map No. 6.
12. SEAOC/OSHPD U.S. Seismic Hazard Maps (reference ASCE/SEI 7-16).
13. Pacific West Communities, Inc., undated, Preliminary Site Plan.
14. Google Earth Aerial Photography of the Subject Site.

APPENDIX A

VICINITY MAP

EXPLORATIONS MAP



NOTES:

1- Location of site (designated by yellow border) is approximate.
2- Source for base map: Imagery from Google Earth 2024©.

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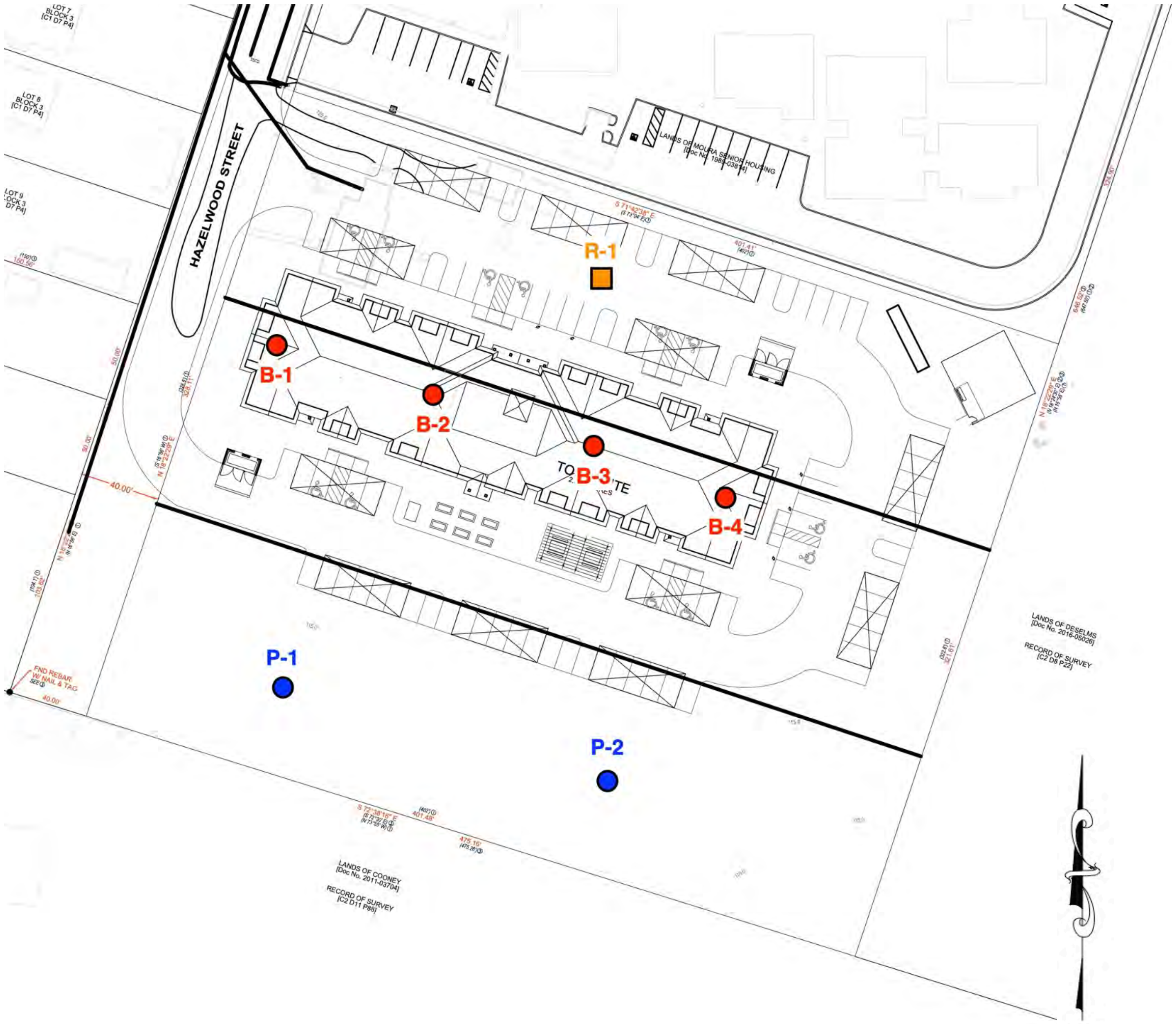
VICINITY MAP
Proposed 3-Story Apartment Building
860 Hazelwood Street
Fort Bragg, California

ACG JOB NO.	05-24059G
DATE	September 2024
FIGURE	1



LEGEND:

- B-x Approximate Location - Number of Boring
- P-x Approximate Location - Number of Percolcation Test
- R-1 Approximate Location of R-value Sample

NOTE:
Source for base map: Preliminary Site Plan provided by the client.

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EXPLORATIONS MAP

Proposed 3-Story Apartment Building
860 Hazelwood Street
Fort Bragg, California

ACG JOB NO.
05-24059G

DATE
September 2024

FIGURE
2

APPENDIX B

FIELD EXPLORATION METHODS

LOGS OF SUBSURFACE EXPLORATIONS

FIELD EXPLORATION METHODS

Field exploration included a general geotechnical engineering reconnaissance within the study area, as well as the excavation of subsurface explorations at approximate locations shown on the Explorations Map, Figure 2, Appendix A. Locations of explorations were determined in the field by estimating from the existing site features shown on an aerial photo. The exploration locations should only be considered accurate to the degree implied by the means and methods used to define them. The explorations were accomplished, and the soil logging and sampling performed by, a Staff Geologist and/or Engineer under the direct supervision of a California licensed Geotechnical Engineer. The explorations were conducted to determine the geometry and geotechnical characteristics of subsurface geologic deposits at the site.

The exploratory borings were advanced with 7-inch outer-diameter continuous flight helical hollow stem augers (HSA) powered by a truck mounted drill rig. Relatively undisturbed soil samples were recovered from the borings at selected intervals by either a 1.4-inch SPT (standard penetration) or 2-inch inner-diameter samplers (Modified California) advanced with an automatic hammer driving a 140 lb. hammer freely falling 30 inches (standard 350-foot/lb. striking force). The number of blows of the hammer required to drive the samplers each 6-inch to 18-inch interval of each drive is denoted as the penetration resistance or "blow count" and provides a field estimate of soil consistency/relative density. Blow counts shown on the logs have not been corrected/converted. Selected undisturbed samples were retained in moisture-proof containers for laboratory testing and reference. Bulk soil samples were recovered directly from excavation cuttings and placed in sealed plastic sample bag(s).

Soils were logged in the field by the Staff Geologist or Engineer and were field classified based on inspection of samples and auger cuttings per the Unified Soil Classification System (ASTM D2487) by color, gradation, texture, type, etc. Groundwater observations were made in the explorations during and after drilling. Exploration log prepared for the exploration provides soil descriptions and field estimated depths. The exploration logs are included in this Appendix B which also contains the Explorations Log Legend. This log includes visual classifications of the materials encountered during drilling as well as the field engineer's interpretation of the subsurface conditions. Final exploration logs included with this report represents the geotechnical engineer's interpretation of the field logs.

Samples of the subsurface soil earth materials were obtained from the exploratory borings for use in laboratory testing to further determine the soil's engineering properties and geotechnical design parameters to be used for future site improvements. The samples were tagged for identification, sealed to reduce moisture loss, and taken to our laboratory for further examination, testing, and classification. Bulk soil samples were recovered directly from excavation cuttings and placed in a plastic sample bag. Soil samples were then transported to ACG's soil mechanics laboratory for further testing. Field descriptions within the exploration logs have been modified, where appropriate, to reflect laboratory test results.

Upon completion of drilling the test borings the resulting holes were backfilled with cement grout from final test boring depth up to original ground surface.

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Geotechnical Log - Borehole

B-1

Latitude	: 39.428455	Drill Rig	: CME 55	Job Number	: 05-24059G
Longitude	: -123.802230	Driller Supplier	: V&W Drilling, Inc.	Client	: Pacific West Communities
Ground Elevation	: 119 (ft)	Logged By	: JC	Project	: Proposed 3-Story Apartment Building
Total Depth	: 26 ft BGL	Reviewed By	: MK	Location	: Fort Bragg, Caliornia
		Date	: 09/04/2024	Loc Comment	: Refer to Explorations Map

Drilling Method: 7-inch Hollow Stem Auger (0 to 25 ft)

Elevation (ft)	Depth (ft)	SPT Sample	Mod Cal Sample	COMMENT	TYPE	BLOWS per 6 in (140 lb hammer 30 Inch drop)	N	REC	Classification Code	Material Description	Groundwater	Water Content, %	Dry Unit Weight, pcf	% Fines	Remarks
119	0								SM	Loose, moist, brown, fine grained sand, SILTY SAND.					
117–116	2–3.5	B1/1			SPT	3-3-5	8	18				9.7	93	24.8	
114–113	5–6.5		B1/2		Mod Cal	9-7-10	17	12							
113	6								SP-SM	Medium dense, moist, brown and light brown, fine grained sand, POORLY GRADED SAND WITH SILT, trace gravel.					
110	9								SM	Medium dense, moist, brown, fine grained sand, SILTY SAND.					
109–108	10–11.5	B1/3			SPT	6-7-10	17	18			▼ (11 ft, after drilling)				
106	13									- wet.	▽ (13 ft, during drilling)				
104–103	15–16.5		B1/4		Mod Cal	6-6-9	15	6							
99	20								SP-SM	Loose to medium dense, moist, orange brown, POORLY GRADED SAND WITH SILT, fine grained sand.					
99–98	20–21.5	B1/5			SPT	2-4-5	9	18							
97	22									- dense to very dense, brown					
94–93	25–26		B1/6		Mod Cal	17-50	50/6"	12							

B-1 Terminated at 26ft (Groundwater was encountered at a depth of approximately 13 feet during drilling and 11 feet after drilling. Boring was backfilled with cement grout and topped with soil cuttings.)

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Geotechnical Log - Borehole

B-2

Latitude	: 39.428372	**Drill Rig**	: CME 55
Longitude	: -123.801972	**Driller Supplier**	: V&W Drilling, Inc.
Ground Elevation	: 119 (ft)	**Logged By**	: JC
Total Depth	: 30.5 ft BGL	**Reviewed By**	: MK
		Date	: 09/04/2024

Job Number	: 05-24059G
Client	: Pacific West Communities
Project	: Proposed 3-Story Apartment Building
Location	: Fort Bragg, Caliornia
Loc Comment	: Refer to Explorations Map

Elevation (ft)	Depth (ft)	Drilling Method	Samples: SPT Sample	Samples: Mod Cal Sample	COMMENT	TYPE	BLOWS per 6 in (140 lb hammer 30 Inch drop)	N	REC	Classification Code	Material Description	Groundwater	Water Content, %	Dry Unit Weight, pcf	% Fines	Remarks
119–114.5	0–4.5	7-inch Hollow Stem Auger (0–29.5)		B2/1 (2–3.5)		Mod Cal	3-4-4	8	12	SM	Loose, moist, brown, fine grained, SILTY SAND.				31	
114.5–113	5.5		B2/2 (5–6.5)			SPT	5-6-9	15	18	SP	Medium dense, moist, light brown with rust staining, fine grained, POORLY GRADED SAND.					
109–108	10			B2/3 (10–11.5)		Mod Cal	4-7-7	14	18.0	CL	Stiff, moist, grey and brown with orange, LEAN CLAY, with 6 inches Silty Sand lenses at 10.5 feet.	▼ (12 ft)				
104–103	15		B2/4 (15–16.5)			SPT	2-4-7	11	18	SM	Medium dense, moist, grey with rust staining, fine grained sand, SILTY SAND, trace fine sized gravel.		24.9	104	32	
99–98	20			B2/5 (20–21.5)		Mod Cal	3-5-10	15	18.0		- brown with rust staining.		27.1	99	16	
94–93	25		B2/6 (25–26.5)			SPT	7-15-50	65	16		- very dense.					
92.5	26.5										- red-brown with rust staining.					
89.5	29.5										- wet, gray.	▽ (30 ft)				
89–88.5	30–30.5			B2/7		Mod Cal	50/6"	50/6"	6							

B-2 Terminated at 30.5ft (Groundwater was encountered at a depth of approximately 30 feet during drilling and 12 feet after drilling. Boring was backfilled with cement grout and topped with soil cuttings.)

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Geotechnical Log - Borehole

B-3

Latitude : 39.428321
Longitude : -123.801688
Ground Elevation : 118 (ft)
Total Depth : 26.5 ft BGL

Drill Rig : CME 55
Driller Supplier :
Logged By : JC
Reviewed By : MK
Date : 09/04/2024

Job Number : 05-24059G
Client : Pacific West Communities
Project : Proposed 3-Story Apartment Building
Location : Fort Bragg, Caliornia
Loc Comment : Refer to Explorations Map

Elevation (ft)	Depth (ft)	Drilling Method	SPT Sample	Mod Cal Sample	COMMENT	TYPE	BLOWS per 6 in (140 lb hammer 30 Inch drop)	N	REC	Classification Code	Graphic Log	Material Description	Groundwater	Water Content, %	Dry Unit Weight, pcf	Remarks
118	0	7-inch Hollow Stem Auger (0–25 ft)								SM		Medium dense, moist, brown, fine grained sand, SILTY SAND.				
116	2		B3/1			SPT	4-5-7	12	12							
113	5			B3/2		Mod Cal	5-5-8	13	18							
112	6									SP-SM		Medium dense, moist, light brown with rust staining, fine grained sand, POORLY GRADED SAND WITH SILT.		12.6	102	
108	10		B3/3			SPT	3-3-5	8	18							
107.5	10.5									CL		Medium stiff, moist, light brown with rust staining, LEAN CLAY.				
105	13												▼			
103	15			B3/4		Mod Cal	4-10-14	24	18	SM		Medium dense, moist to wet, light brown with gray to orange brown with rust staining, fine grained sand, SILTY SAND.				
101	17												▽			
99	19									SP		Medium dense, brown, wet, POORLY GRADED SAND, fine to coarse grained sand.				
98	20		B3/5			SPT	8-10-15	25	18							
93	25			B3/6		Mod Cal	9-11-16	27	12			- light brown, trace gravel.				

B-3 Terminated at 26.5ft (Groundwater was encountered at a depth of approximately 17 feet during drilling and 13 feet after drilling. Boring was backfilled with cement grout and topped with soil cuttings.)

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Geotechnical Log - Borehole

B-4

Latitude	: 39.428263	Drill Rig	: CME 55	Job Number	: 05-24059G
Longitude	: -123.801453	Driller Supplier	: V&W Drilling, Inc.	Client	: Pacific West Communities
Ground Elevation	: 118 (ft)	Logged By	: JC	Project	: Proposed 3-Story Apartment Building
Total Depth	: 21.5 ft BGL	Reviewed By	: MK	Location	: Fort Bragg, Caliornia
		Date	: 09/03/2024	Loc Comment	: Refer to Explorations Map

Drilling Method: 5-inch Solid Stem Auger (0 to 20 ft)

Elevation (ft)	Depth (ft)	SPT Sample	Mod Cal Sample	COMMENT	TYPE	BLOWS per 6 in (140 lb hammer 30 Inch drop)	N	REC	Classification Code	Material Description	Groundwater	Water Content, %	Dry Unit Weight, pcf	Remarks
118–115.5	0–2.5								SM	Loose, moist, brown, fine grained, SILTY SAND.				
116–114.5	2–3.5		B4/1		Mod Cal	2-3-3	6	18				11.3	90	
113–111.5	5–6.5	B4/2			SPT	2-3-5	8	12						
112.5	5.5								SP	Loose, moist, light brown, fine grained, POORLY GRADED SAND.				
109.5	8.5									- brown, fine to medium grained, fine to medium to grained sand.				
108–106.5	10–11.5		B4/3		Mod Cal	2-5-8	13	18						
107.5	10.5								CL	Stiff, moist, light gray with rust staining, LEAN CLAY.				
104.5	13.5										▼ / ▽			
103–101.5	15–16.5	B4/4			SPT	4-7-10	17	18	SP	Medium dense, moist to wet, gray with white, fine grained, POORLY GRADED SAND.				
98–96.5	20–21.5		B4/5		Mod Cal	8-9-17	26	18		- wet, brown with orange, medium to coarse grained.				

B-4 Terminated at 21.5ft (Groundwater was encountered at a depth of approximately 13.5 feet during drilling and 13 feet after drilling. Boring was backfilled with cement grout and topped with soil cuttings.)

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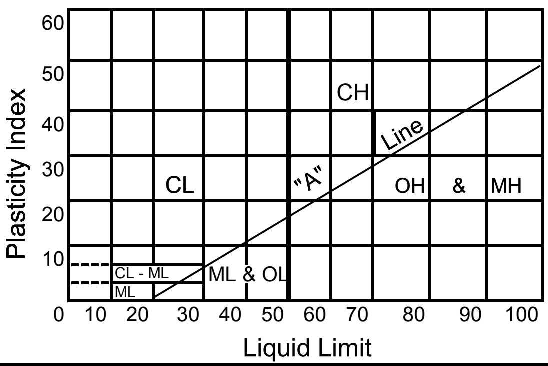
UNIFIED SOIL CLASSIFICATION

PT	OH	CH	MH	OL	CL	ML	SC	SM	SP	SW	GC	CM	GP	GW
Highly organic soils	Silts and Clays (Liquid Limit > 50)			Silts and Clays (Liquid Limit < 50)			Sands with fines > 12% fines		Clean sands < 5% fines		Gravels with fines > 12% Fines		Clean gravels < 5% fines	
							Sands - more than 50% of coarse fraction is smaller than No. 4 sieve.				Gravels - more than 50% of coarse fraction is larger than No. 4 sieve.			
Fine grained soils (more than 50% is smaller than No. 200 sieve)							Coarse grained soils (more than 50% is larger than No. 200 sieve)							



LABORATORY CLASSIFICATION CRITERIA

GW and SW-$C_u = \frac{D_{60}}{D_{10}}$ greater than 4 for GW & 6 for SW; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 & 3

GP and SP - Clean gravel or sand not meeting requirements for GW and SW.

GM and SM - Atterberg limits below "A" line or P.I. less than 4.

GC and SC - Atterberg limits above "A" line with P.I. greater than 7.

Fines (silt or clay)	Fine Sand	Medium Sand	Coarse Sand	Fine Gravel	Coarse Gravel	Cobbles	Boulders
Sieve sizes	> # 200	> # 40	> # 10	> # 4	> 3/4"	> 3"	> 10"

Classification of earth materials shown on this sheet is based on field inspection and should not be construed to imply laboratory analysis so stated.

MATERIAL SYMBOLS

WELL GRADED GRAVEL or GRAVEL WITH SAND (GW)
POORLY GRADED GRAVEL or GRAVEL WITH SAND (GP)
SILTY GRAVEL or SILTY GRAVEL WITH SAND (GM)
CLAYEY GRAVEL or CLAYEY GRAVEL WITH SAND (GC)
WELL-GRADED SAND or SAND WITH GRAVEL (SW)
POORLY GRADED SAND or SAND WITH GRAVEL (SP)
SILTY SAND or SILTY SAND WITH GRAVEL (SM)
CLAYEY SAND or CLAYEY SAND WITH GRAVEL (SM)
INORGANIC LOW PLASTIC CLAY, SANDY CLAY, or CLAY WITH SAND/GRAVEL (CL)
INORGANIC LOW PLASTIC SILT, SANDY SILT, or SILT WITH SAND/GRAVEL (ML)
INORGANIC HIGH PLASTIC CLAY, SANDY CLAY, or CLAY WITH SAND/GRAVEL (CH)
INORGANIC HIGH PLASTIC SILT, SANDY SILT, or SILT WITH SAND/GRAVEL (MH)
ORGANIC LOW/HIGH PLASTIC CLAY or SILT (OL or OH)
PEAT (PT)

RELATIVE DENSITY / CONSISTENCY CLASSIFICATION FOR SOILS

According to the Standard Penetration Test and AASHTO 1988

No. of Blows	Granular	PP (tsf)	No. of Blows	Cohesive
0 - 4	Very Loose	< 0.25	< 2	Very Soft
5 - 10	Loose	0.25 - 0.5	3 - 4	Soft
11 - 30	Medium Dense	0.5 - 1	5 - 8	Medium Stiff
31 - 50	Dense	1 - 2	9 - 15	Stiff
> 50	Very Dense	2 - 4	16 - 30	Very Stiff
		> 4	> 30	Hard

Where the standard penetration test has not been performed, consistencies shown on the logs are estimated and given in parenthesis, e.g., (Very Stiff).

FIELD AND LABORATORY TEST ABBREVIATIONS

REC: Sample recovery in inches.
PP: Field Pocket Penetrometer in tsf.
LL: Liquid Limit, expressed as a water content.
PI: Plasticity Index, expressed as a water content.
%Fines: percent passing No. 200 Sieve)
UC: Unconfined compressive strength test in tsf.
Dry Unit Weight, pcf: Dry weight per unit volume of soil sample.

TYPICAL SAMPLER GRAPHIC SYMBOLS

2-inch-OD split spoon (SPT)
Bulk Sample
3-inch-OD California Modified w/ 2.38-inch-ID Stainless Steel Tube
2.5-inch-OD Modified California w/ 1.91-inch-ID stainless steel tube
Grab Sample

OTHER GRAPHIC SYMBOLS

Groundwater level (during drilling)
Groundwater level (after drilling)
Inferred/gradational contact between strata
? Queried contact between strata

GENERAL NOTES

1: Soil classifications are based on the Unified Soil Classification System (USCS). Descriptions and stratum lines are interpretive, and actual lithologic changes may be gradual. Field descriptions may have been modified to reflect results of lab tests.
2: Descriptions on these logs apply only at the specific exploration locations and at the time the explorations were advanced. They are not warranted to be representative of subsurface conditions at other locations or times.

LEGEND FOR EXPLORATIONS LOGS

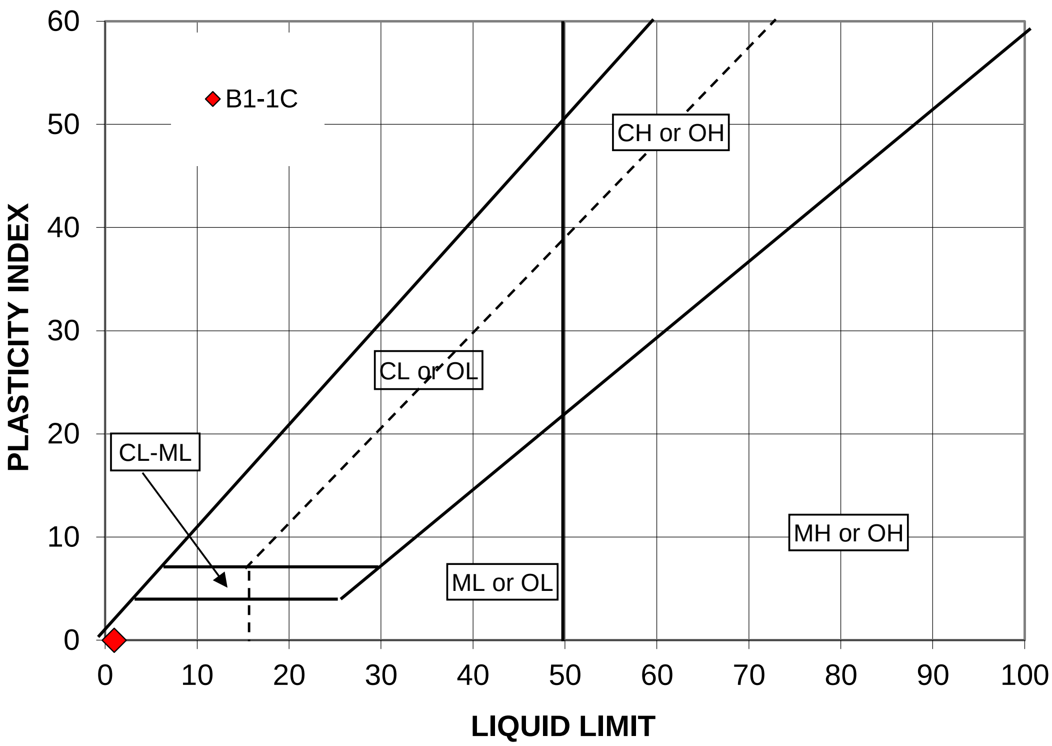
APPENDIX C

LABORATORY TESTING

LABORATORY TESTING

Samples retrieved during the field exploration were taken to the soil mechanics laboratory for further observation by the project geotechnical engineer and were classified in accordance with the Unified Soil Classification System (USCS) described in Appendix B. An applicable laboratory testing program was formulated for classification testing and to determine engineering properties of the subsurface earth materials. The field descriptions were confirmed or modified based on the test results.

Soil mechanics laboratory tests were performed on soil samples recovered from the explorations to further determine the physical and engineering properties of the soils. These tests included materials R-value test (CTM 301), sieve analysis (ASTM D6913), finer than no. 200 sieve (ASTM D 1140), dry density (ASTM D 2937), Atterberg limits (ASTM D4318), natural moisture content (ASTM D 2216) and evaluation for soil corrosion, including pH and minimum resistivity (CA DOT Test #643), sulfate content (CA DOT Test #417), and chloride content (CA DOT Test #422m). The results of these tests are shown on the Exploration Log at the depth that each sample was recovered. The Atterberg limits, sieve analysis, R-value, and soil corrosion test results are attached. The laboratory test results were used to assess the relative soil and geologic conditions of the site of the proposed construction and to provide geotechnical design criteria for foundations, slabs, grading and drainage.



GROUP SYMBOL	UNIFIED SOIL CLASSIFICATION FINE-GRAINED SOIL
OL	Organic silts and organic silty clays of low plasticity
ML	Inorganic clayey silts to very fine sands of slight plasticity
CL	Inorganic clays of low to medium plasticity
OH	Organic sillts and clays of medium to high plasticity
MH	Inorganic silts, clayey silts, and sandy silts
CH	Inorganic clays of high plasticity

SAMPLE ID	DEPTH (feet)	Content (%)	% Fines	LL	PL	PI
B1/1	2-3.5	9.7	25	Non-Plastic		

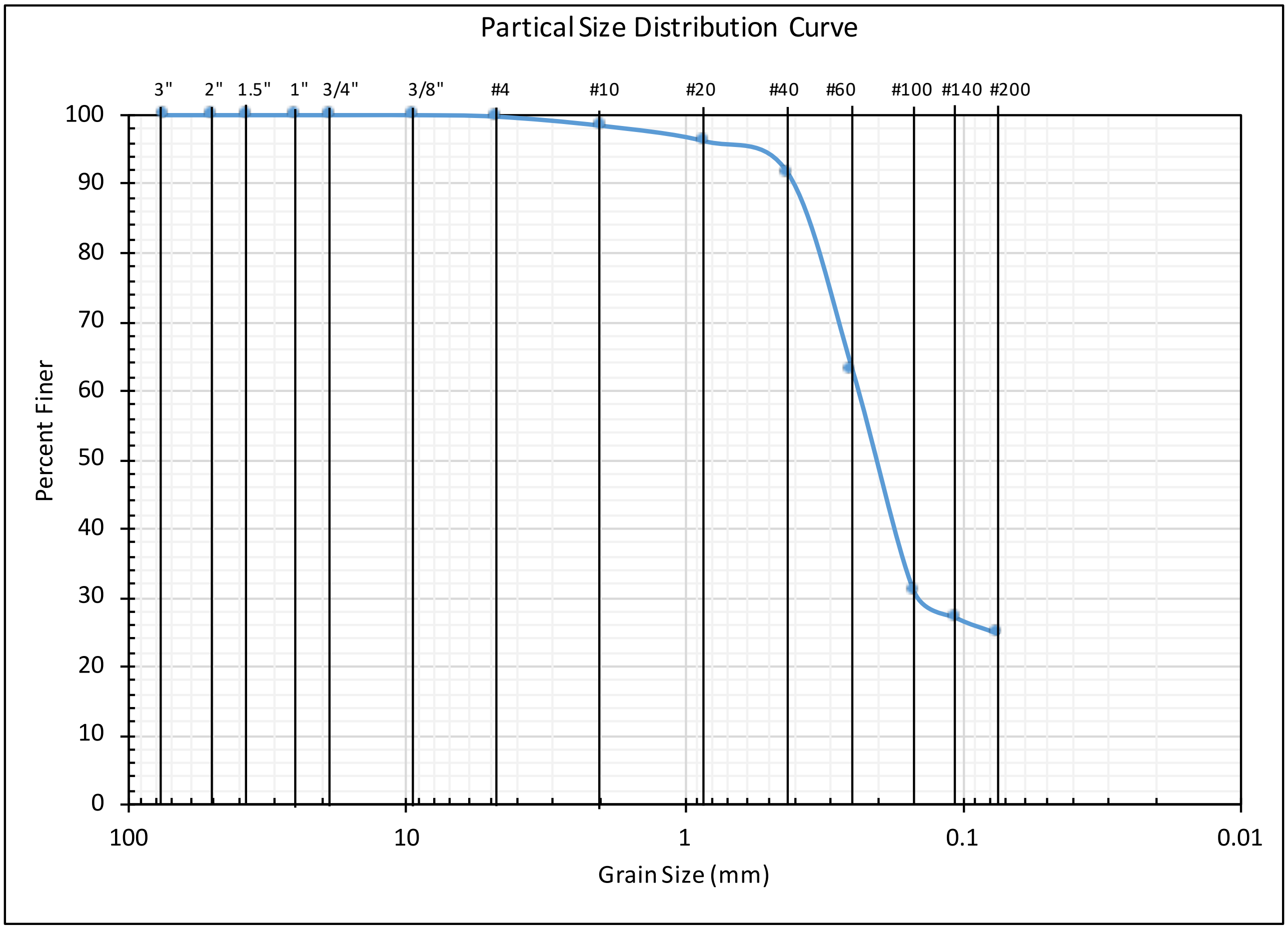
Lab No.:	118G
Project Name:	860 Hazelwood Avenue
Project No.:	05-24059G
Tested By:	RP
Reviewed By:	MK
Sample Date:	9/4/24
Test Date:	9/12/24

ATTERBERG LIMITS (ASTM - D4318)

MATERIAL FINER THAN #200 SIEVE (ASTM D-1140)

Allerion Consulting Group, Inc.

Sheet 1



% +3"	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt & Clay
0	0	0.2	1.3	6.9	66.7	24.8
0	0.2		75.0			24.8

SEIVE DESIGNATION	PERCENT FINER
3"	100.0
2"	100.0
1.5 inch	100.0
1 inch	100.0
3/4 inch	100.0
3/8 inch	100.0
#4	99.8
#10	98.5
#20	96.2
#40	91.5
#60	63.2
#100	30.9
#140	27.1
#200	24.8

Soil Description:

Silty Fine SAND (SM)

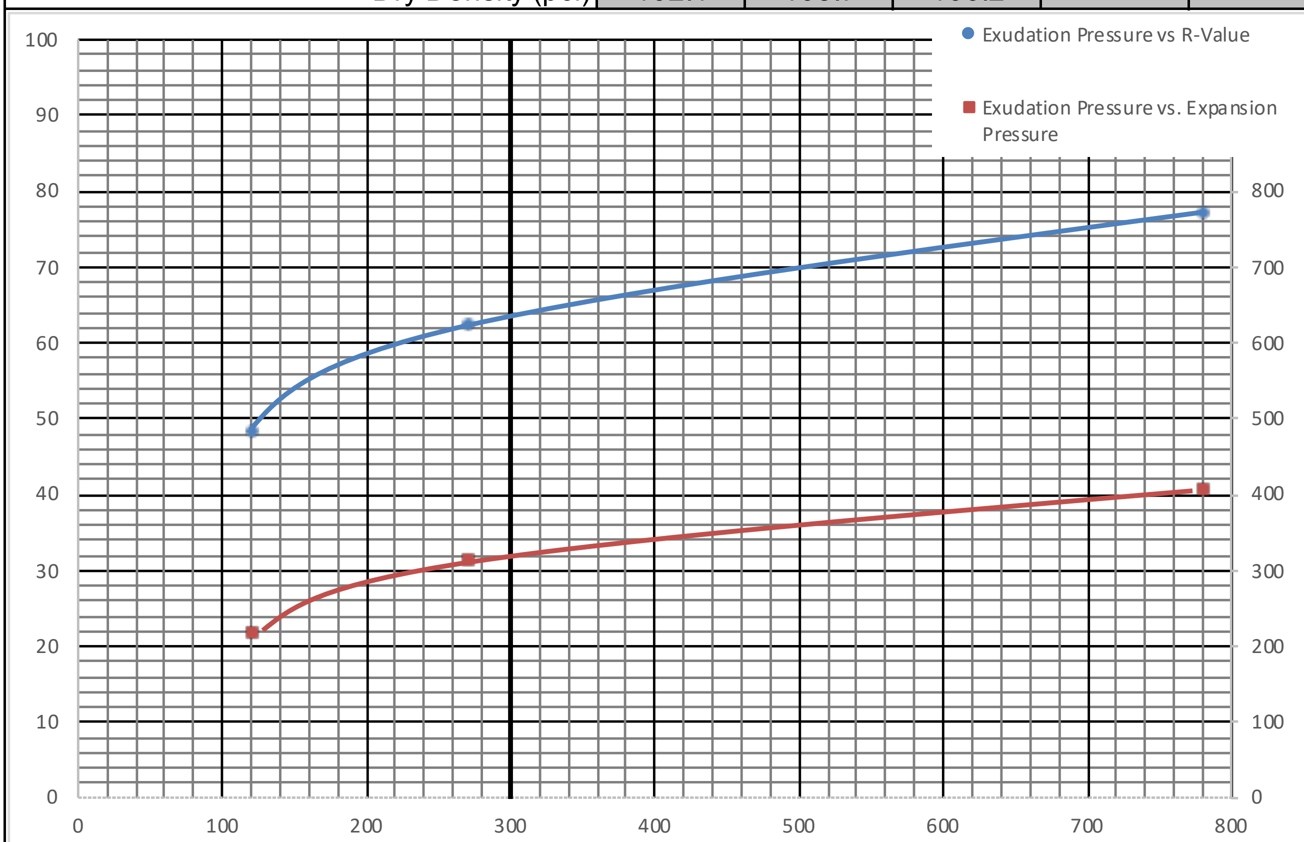
Lab No.:	118G	**Gradation of Soils Using Sieve Anaylsis (ASTM - D6913)**	
Project Location:	Fort Bragg, California		
Project No.:	05-24059G		
Tested By:	RP	Boring Number:	B-1
Reviewed By:	MK	Sample Number:	B1/1
Sample Date:	9/4/24	Sample Depth:	2 - 3.5'
Test Date:	9/12/24		

Sheet 2

R-Value
CTM 301

CTL Job No.:	1191-054	Boring:	NA	Reduced By:	RU
Client:	Allerion Consulting Group	Sample:	R-1	Checked By:	PJ
Project Number:	05-24059G	Depth:	0-3'	Date:	9/16/24
Project Name:	860 Hazelwood Street			**R-Value**	**63**
Soil Description:	Dark Reddish Brown Silty SAND				
Remarks:				**Expansion Pressure**	**320**

Specimen Designation	A	B	C	D	E
Compactor Foot Pressure (psi)	150	180	280		
Exudation Pressure (psi)	122	272	782		
Exudation Load (lbf)	1533	3418	9827		
Height After Compaction (in)	2.52	2.44	2.40		
Expansion Pressure (psf)	215	310	404		
Stabilometer @ 2000	66	40	26		
Turns Displacement	3.82	4.40	3.56		
R-value	48	63	78		
Corrected R-Value	48	62	77		
Moisture Content (%)	20.0	18.1	16.3		
Wet Density (pcf)	122.6	122.5	123.6		
Dry Density (pcf)	102.1	103.7	106.2		



Sunland Analytical

11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 09/13/2024
Date Submitted 09/10/2024

To: Mohammed Khalid
Allerion Consulting Group, Inc.
1050 Melody Lane Suite 160
Roseville, CA 95678

From: Gene Oliphant, Ph.D. \ Ty Bui
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 05-24059G Site ID : B4-1B+A.
Thank you for your business.

* For future reference to this analysis please use SUN # 93059-192716.

EVALUATION FOR SOIL CORROSION

Soil pH	5.43	
Minimum Resistivity	11.26 ohm-cm (x1000)	
Chloride	6.2 ppm	00.00062 %
Sulfate	3.6 ppm	00.00036 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422m

APPENDIX D

GUIDE SPECIFICATIONS FOR EARTHWORK

GUIDE SPECIFICATIONS FOR EARTHWORK

A. General Description

1. This item shall consist of all clearing and grubbing, removal of existing obstructions, preparation of the land to be filled, filling the land, spreading, compaction and control of the fill, and all subsidiary work necessary to complete the grading of the cut and fill areas to conform with the lines, grades and slopes as shown on the accepted plans.

2. The Geotechnical Engineer is not responsible for determining line, grade elevations or slope gradients. The property owner or his representative shall designate the party that will be responsible for those items of work.

B. Geotechnical Report

1. The Geotechnical Report has been prepared for this project by Allerion Consulting Group (ACG), Roseville, California, (916-742-5096). This report was for design purposes only and may not be sufficient to prepare an accurate bid. A copy of the report is available for review at **ACG's** office.

2. Contents of these guide specifications shall be integrated with the Geotechnical Report of which they are a part and shall not be used as a self-contained document. Where a conflict occurs between these guide specifications and the conclusions and recommendations contained in the report, then the conclusions and recommendations shall take precedence and these guide specifications adjusted accordingly.

C. Site Preparation

1. Clearing Area(s) to be Filled: All trees, brush, logs, rubbish, and other debris shall be removed and disposed of to leave the areas that have been disturbed with a neat appearance. Underground structures shall be removed or may be crushed in place upon approval by the Geotechnical Engineer. Excavations and depressions resulting from the removal of the above items shall be cleaned out to firm undisturbed soil and backfilled with suitable materials in accordance with the specifications contained herein. Stockpiles of clean soil may be reused as filled material provided the soil is free of significant vegetation, debris, rubble, and rubbish and is approved by the Geotechnical Engineer.

2. Surfaces upon which fill is to be placed, as well as subgrades of structure pad(s) left at existing grade, shall have all organic material removed; or, with permission of the Geotechnical Engineer, closes cut and remove vegetation and thoroughly disc and blend the remaining nominal organics into the upper soil. Discing must be thorough enough so that no concentrations of organics remain, which may require re-discing or cross-discing several times.

3. Organic laden material removed per paragraph C.2. above, may be used as fill in landscaped areas provided that the material shall not extend closer than ten (10) feet to any structure, shall not exceed two (2) feet in thickness or be used where the material could, in the opinion of the Geotechnical Engineer, create a slope stability problem, and shall be compacted to at least eighty-two (82) percent relative compaction per ASTM Test Designation D 1557. Alternatively, the organic laden material may be hauled off-site and suitably disposed of.

4. Upon completion of the organic removal, exposed surface shall be plowed or scarified to a depth of at least six (6) inches, and until the surface is free from ruts, hummocks, or other uneven features which would tend to prevent uniform compaction by the equipment to be used. Where vegetation has been close cut and removed and remaining organics blended with the upper soil, further scarifying may not be necessary. Where fills are to be placed on hill slopes, scarifying shall be to depths adequate to provide bond between fill and fill foundation. Where considered necessary by the Geotechnical Engineer, (typically where the slope ratio of the original ground is steeper than five (5) horizontal to one (1) vertical), the ground surface shall be stepped or benched to achieve this bond. Vertical dimension of the required benches shall be as determined by the Geotechnical Engineer, based upon location, degree, and condition of the hill slope.

5. After the foundation for the fill has been cleared and scarified, it shall be disced or bladed until it is uniform and free from large clods, uniformly moisture conditioned to the range specified by the Geotechnical Engineer, and compacted to not less than [refer to report -- if not recommended, use 90] percent of maximum dry density as determined by ASTM D 1557, or to such other density as may be determined appropriate for the materials and conditions and acceptable to the Geotechnical Engineer and the owner or his representative.

D. Fill Materials

1. Materials for fill shall consist of material approved by the Geotechnical Engineer.

2. The materials used for fill shall be free from organic matter and other deleterious substances and shall not contain rocks, clods, lumps, or cobbles exceeding four (4) inches in greatest dimension with not more than fifteen (15) percent larger than two and one-half (2-1/2) inches.

3. Imported materials to be used for fill shall be non-expansive [typically, have a plasticity index not exceeding twelve (12)], shall be of maximum one (1) inch size, and shall be tested and approved by the Geotechnical Engineer prior to commencement of grading and before being imported to the site.

4. The Contractor shall notify the Geotechnical Engineer at least four (4) working days in advance of the Contractor's intention to import soil; shall designate the borrow area; and, shall permit the Geotechnical Engineer to sample the borrow area for the purposes of examining the material and performing the appropriate tests to evaluate the quality and compaction characteristics of the soil. Compaction requirements for the material shall be based upon the characteristics of the material as determined by the Geotechnical Engineer.

E. Placement of Fill

1. The selected fill material shall be placed in level, uniform layers (lifts) which, when compacted, shall not exceed six (6) inches in thickness. Water shall be added to the fill, or the fill allowed to dry as necessary to obtain fill moisture content at which compaction as specified can be achieved. Each layer shall be thoroughly mixed during the spreading to obtain uniformity of moisture in each layer.

2. The fill material shall be compacted within the appropriate moisture content range (typically optimum to slightly above the optimum) as determined by the Geotechnical Engineer for the soil(s) being used.

3. Each layer of fill shall be compacted to not less than [refer to report; if not recommended, use 90] percent of maximum dry density as determined by ASTM Test Designation D 1557. Compaction equipment shall be of such design that it will be able to compact the fill to the specified density. Compaction shall be accomplished while the fill material is within the specified moisture content range. Compaction of each layer shall be continuous over its entire area and the compaction equipment shall make sufficient trips to ensure that the required density has been obtained. No ponding or jetting is permitted.

4. If work has been interrupted for any reason, the Geotechnical Engineer shall be notified by the contractor at least two (2) working days prior to the intended resumption of grading.

F. Geotechnical Engineer

1. Owner is retaining Geotechnical Engineer to make observations and tests to determine general compliance with Plans and Specifications, to verify expected or unexpected variations in subsurface conditions, and to give assistance in appropriate decisions. Cost of Geotechnical Engineer will be borne by the Owner, except costs incurred for re-tests and/or re-observations caused by failure of the Contractor to meet specified requirements will be paid by the Owner and back charged to Contractor.

G. Observation and Testing

1. Field density tests shall be made by the Geotechnical Engineer or his representative of the compaction of each layer of fill. Density tests shall be taken in the compacted material below any surfaces disturbed by the construction equipment. When these tests indicate that the density of any layer of fill or portion thereof is below the required density or moisture content, the particular layer or portion shall be reworked until the required density or moisture content has been obtained.

2. All aspects of the site earthwork shall be observed and tested as deemed necessary by the Geotechnical Engineer or his representative so that he can render a professional opinion of the completed fill for substantial compliance with plans and specifications and design concepts. The grading contractor shall give the Geotechnical Engineer at least two (2) working days' notice prior to beginning any site earthwork to allow proper scheduling of the work.

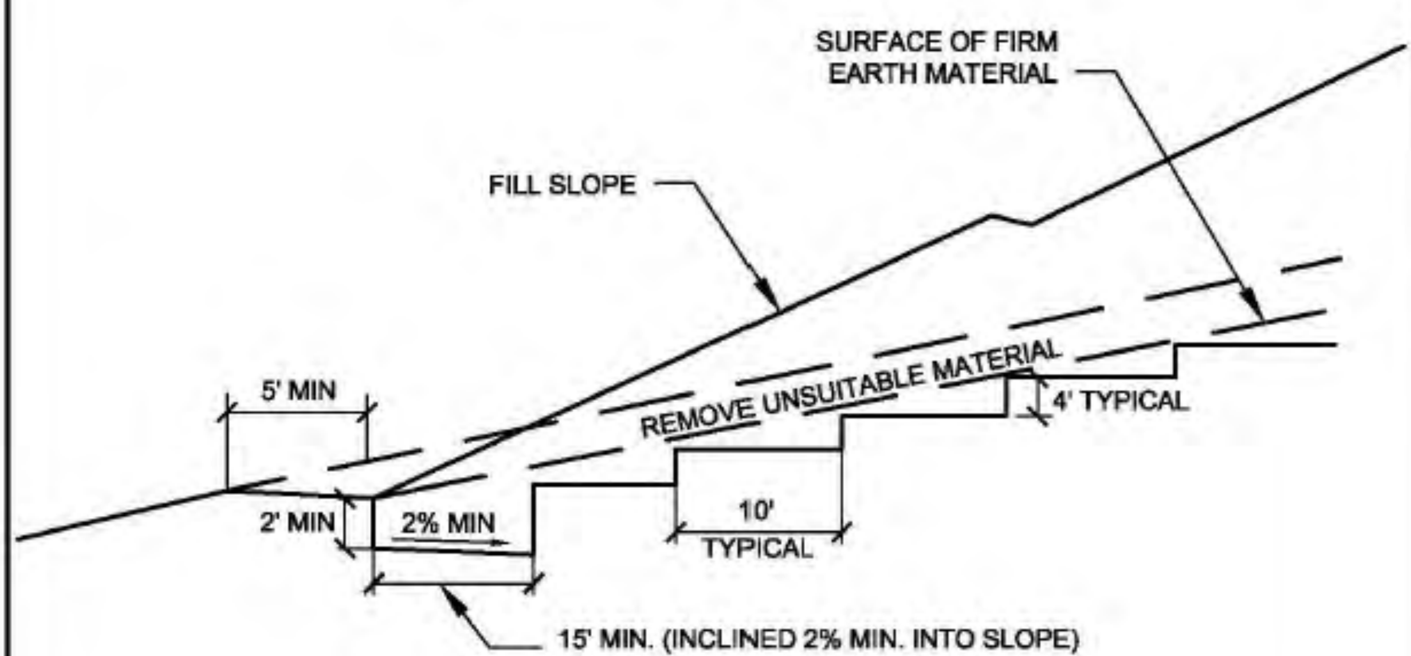
H. Seasonal Limits

1. No fill material shall be placed, spread, or compacted during unfavorable weather conditions. When work is interrupted by heavy rain, fill operations shall not be resumed until the Geotechnical Engineer or his representative indicates that the moisture content and density of the previously placed fill are as specified.

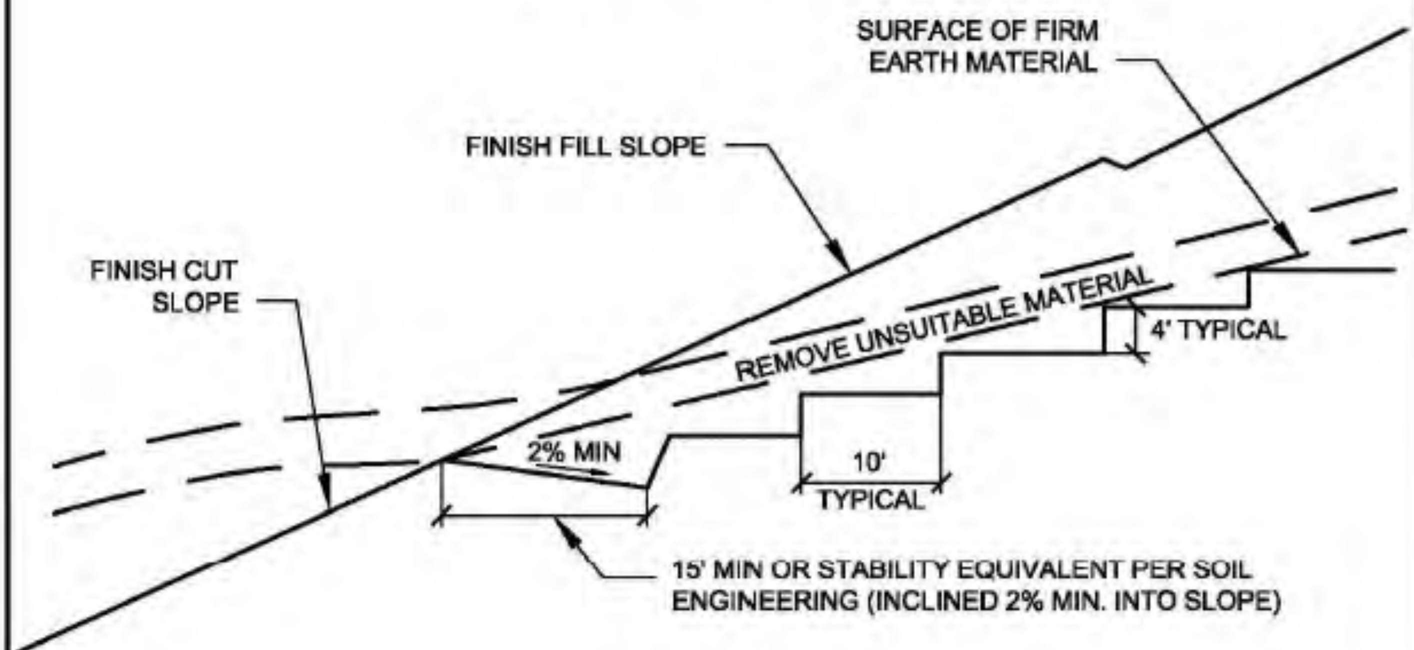
GRADING DETAILS

(On following pages)

BENCHING FILL OVER NATURAL

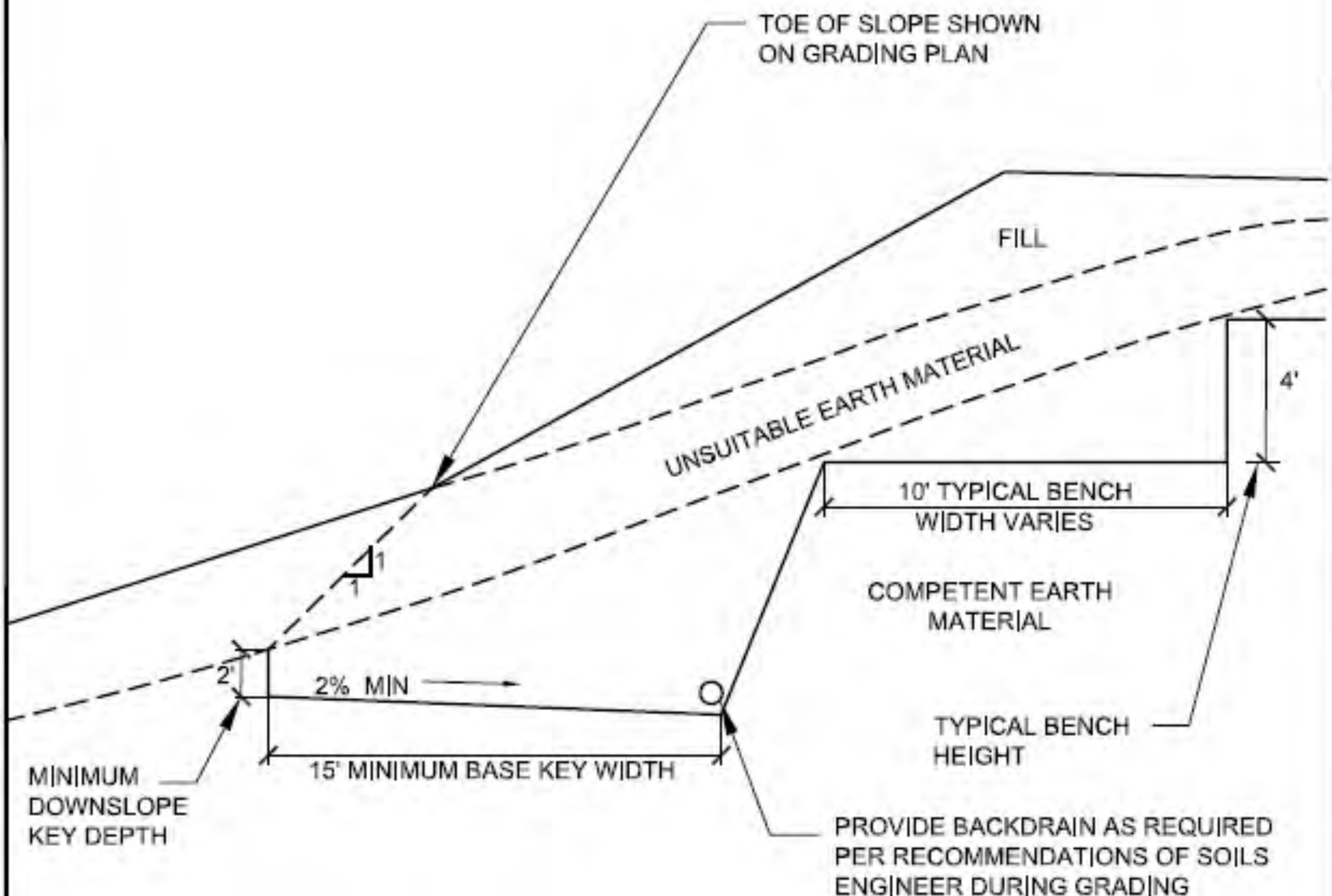


BENCHING FILL OVER CUT



NOT TO SCALE

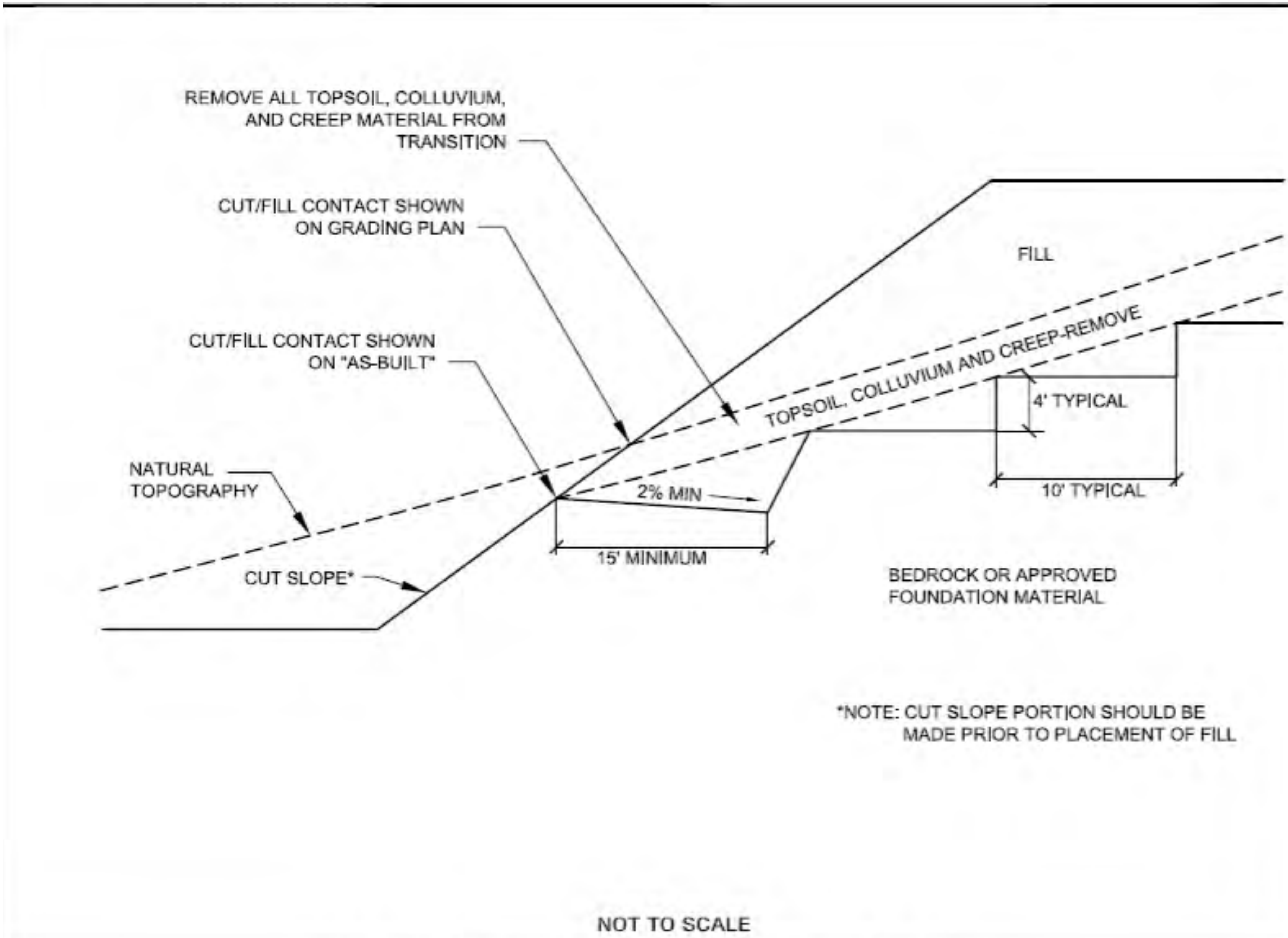
BENCHING FOR COMPACTED FILL DETAIL



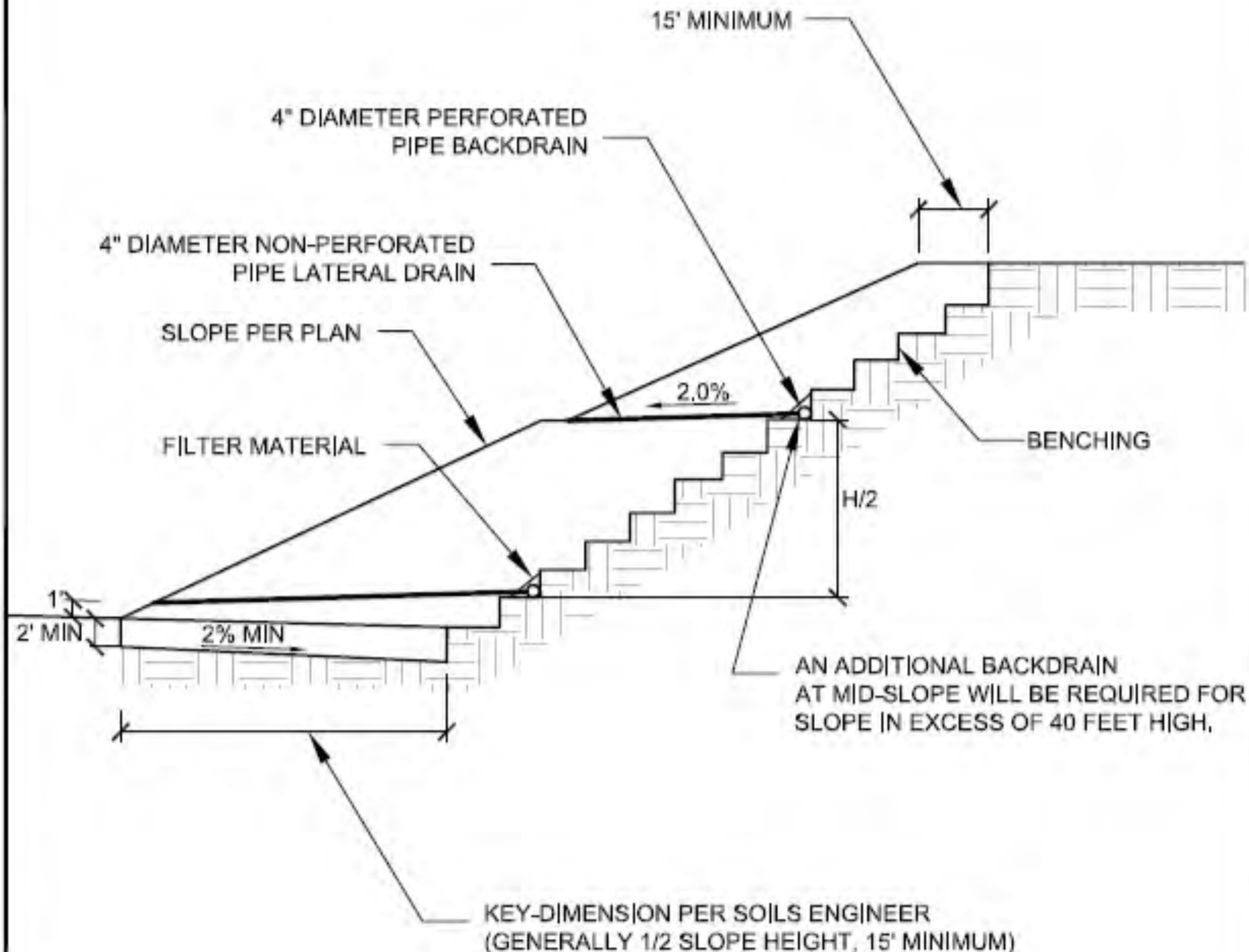
WHERE NATURAL SLOPE GRADIENT IS 5:1 OR LESS, BENCHING IS NOT NECESSARY. FILL IS NOT TO BE PLACED ON COMPRESSIBLE OR UNSUITABLE MATERIAL.

NOT TO SCALE

FILL SLOPE ABOVE NATURAL GROUND DETAIL



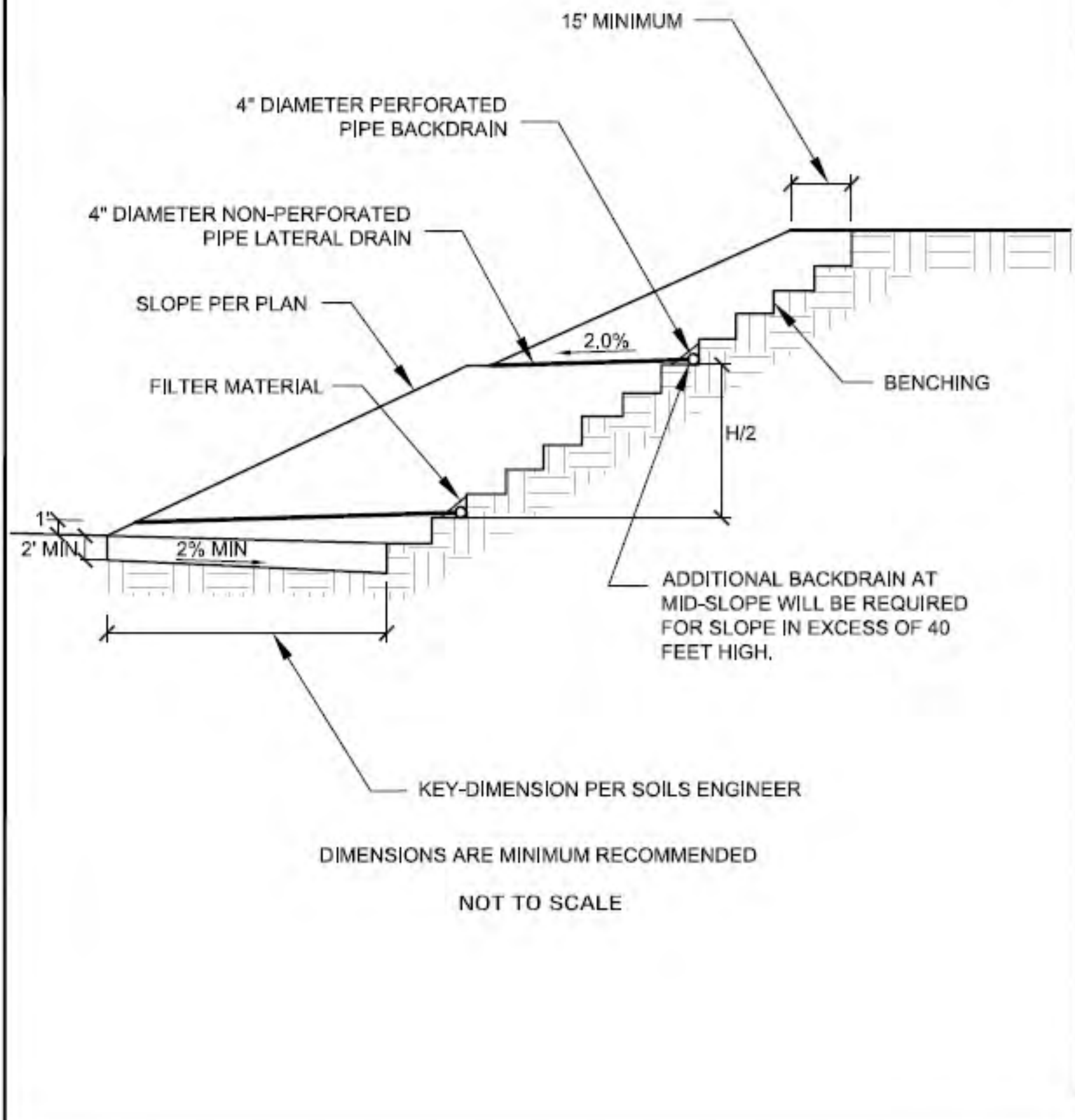
FILL SLOPE ABOVE CUT SLOPE DETAIL



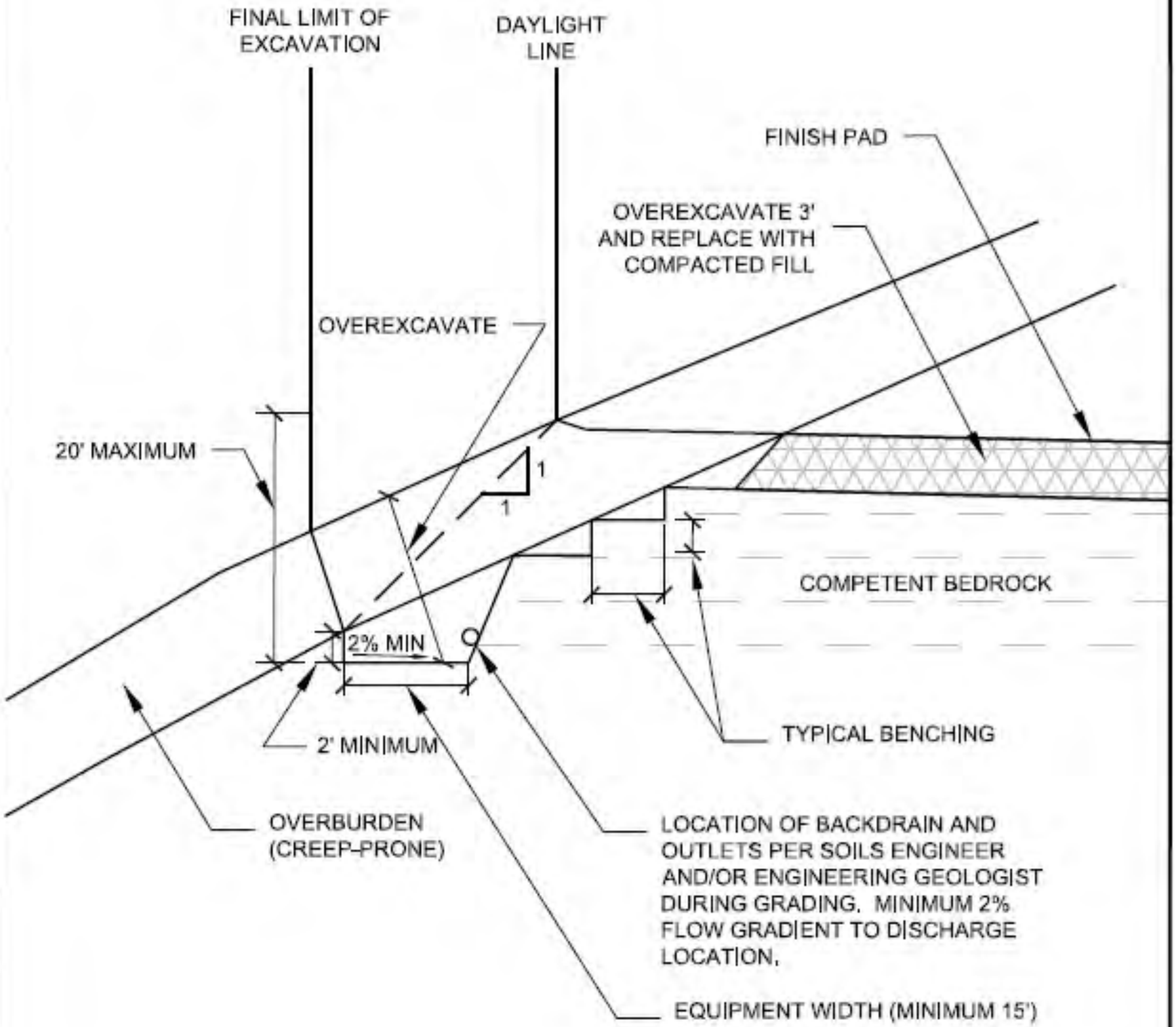
DIMENSIONS ARE MINIMUM RECOMMENDED

NOT TO SCALE

TYPICAL SLOPE STABILIZATION FILL DETAIL

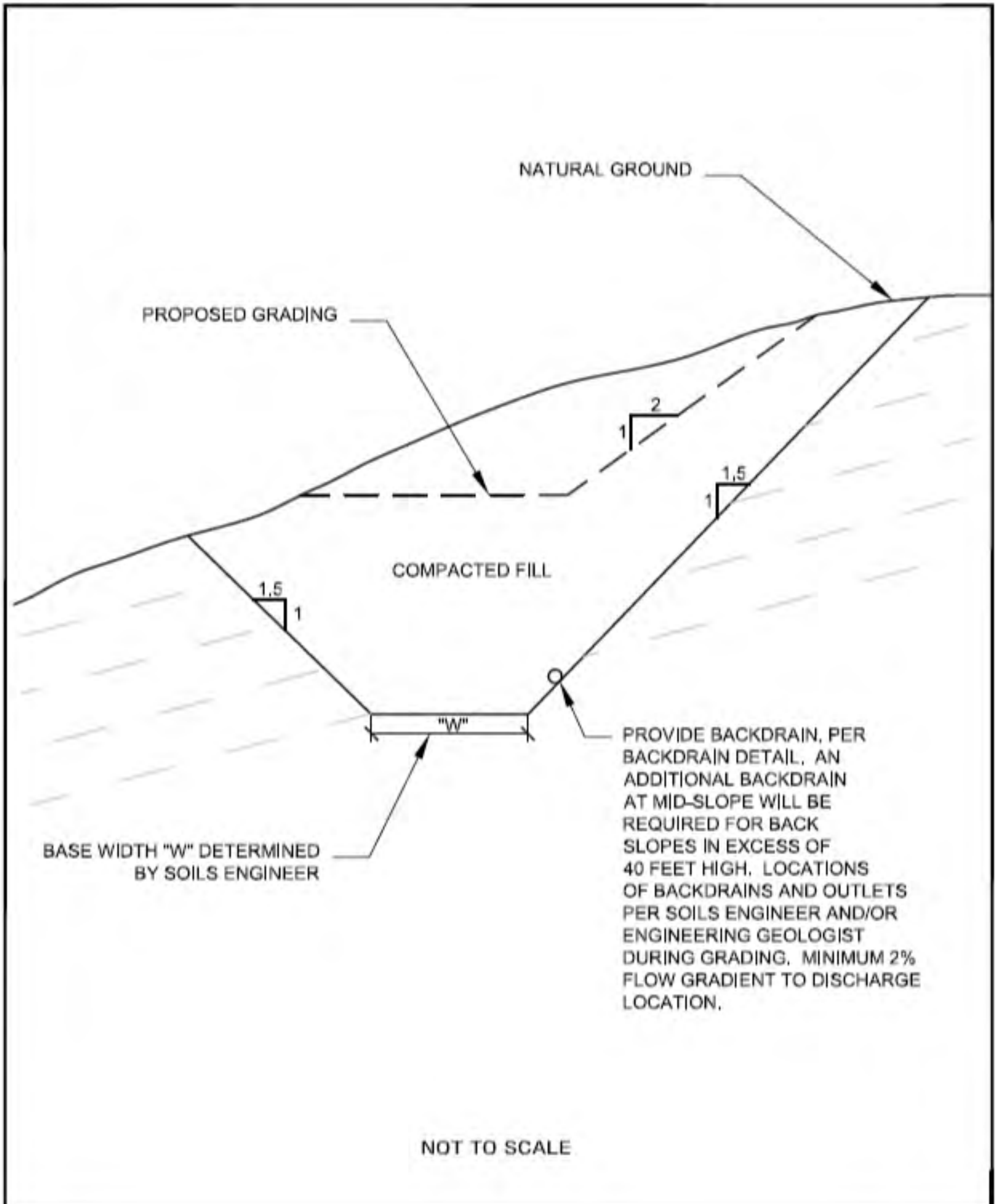


TYPICAL BUTTRESS FILL DETAIL

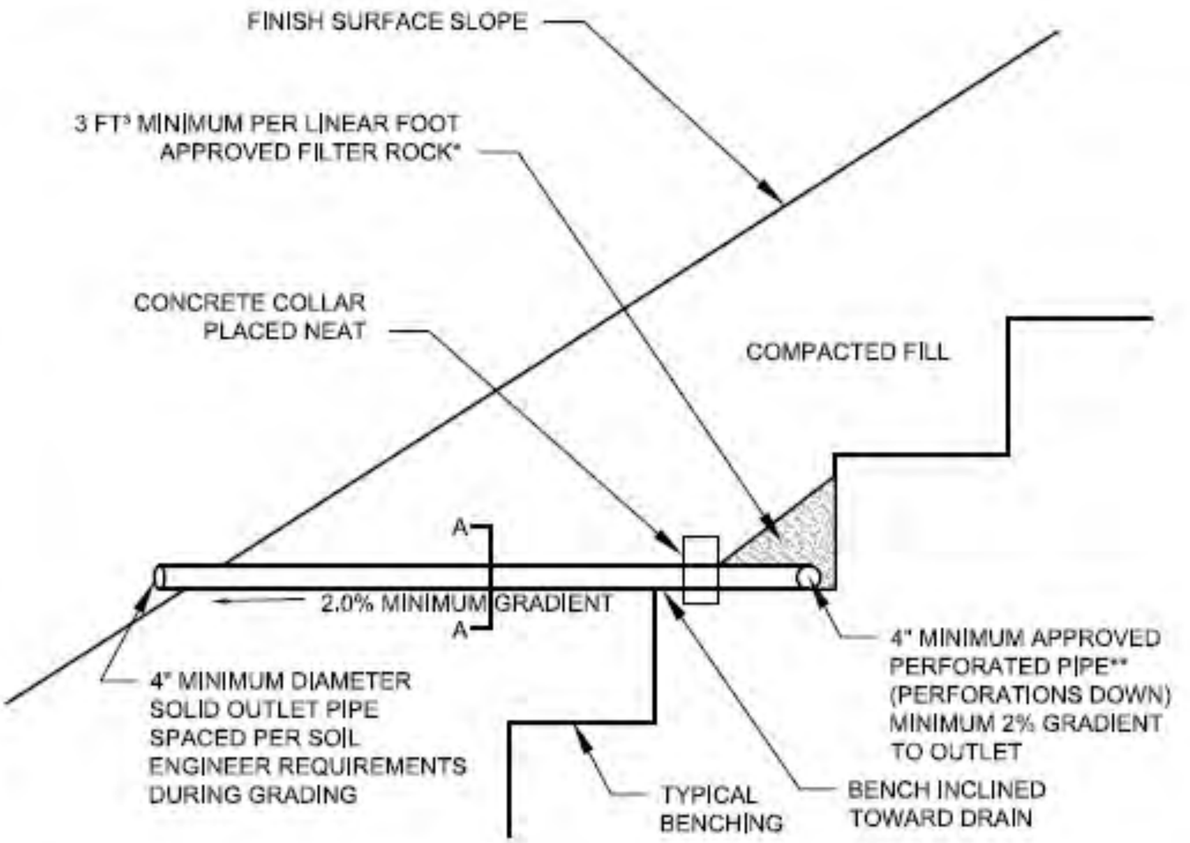


NOT TO SCALE

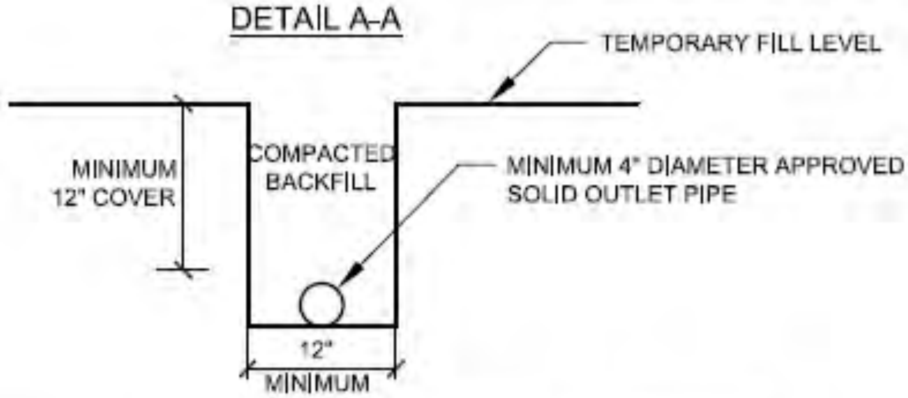
DAYLIGHT SHEAR KEY DETAIL



TYPICAL SHEAR KEY DETAIL



DETAIL A-A



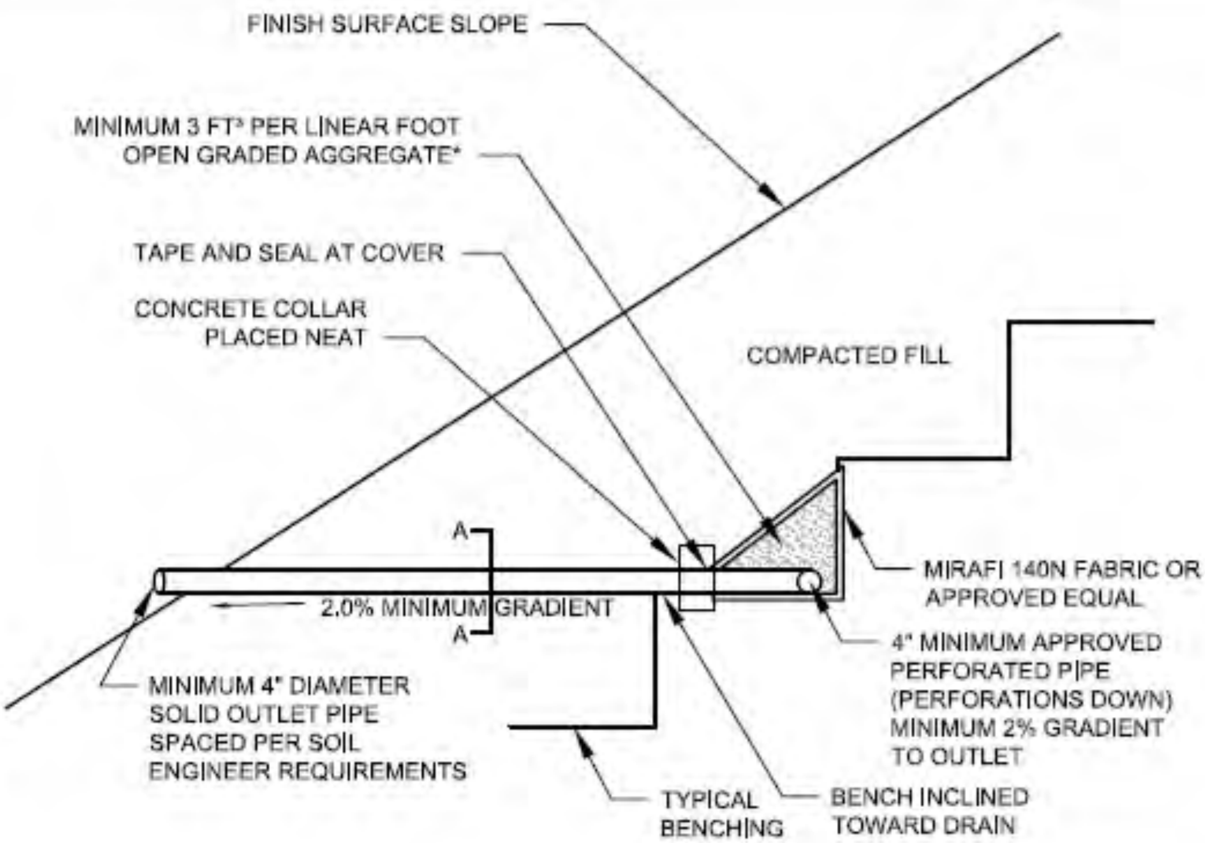
**APPROVED PIPE TYPE:
SCHEDULE 40 POLYVINYL CHLORIDE
(P.V.C.) OR APPROVED EQUAL.
MINIMUM CRUSH STRENGTH 1000 PSI

*FILTER ROCK TO MEET FOLLOWING
SPECIFICATIONS OR APPROVED EQUAL:

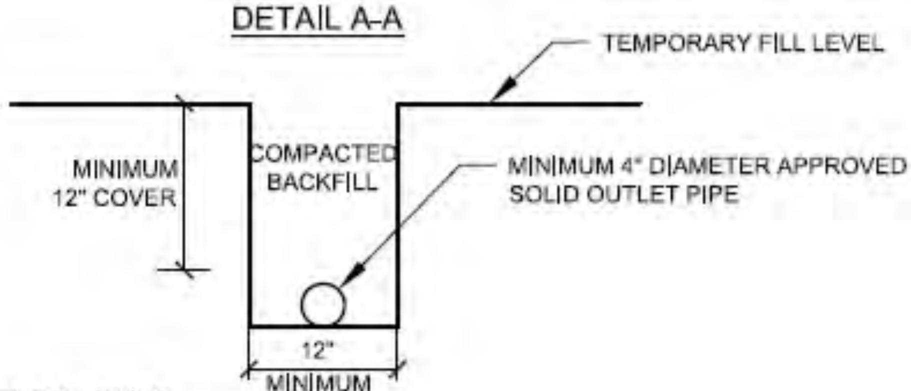
SIEVE SIZE	PERCENTAGE PASSING
1"	100
¾"	90-100
⅜"	40-100
NO. 4	25-40
NO. 30	5-15
NO. 50	0-7
NO. 200	0-3

NOT TO SCALE

TYPICAL BACKDRAIN DETAIL



DETAIL A-A

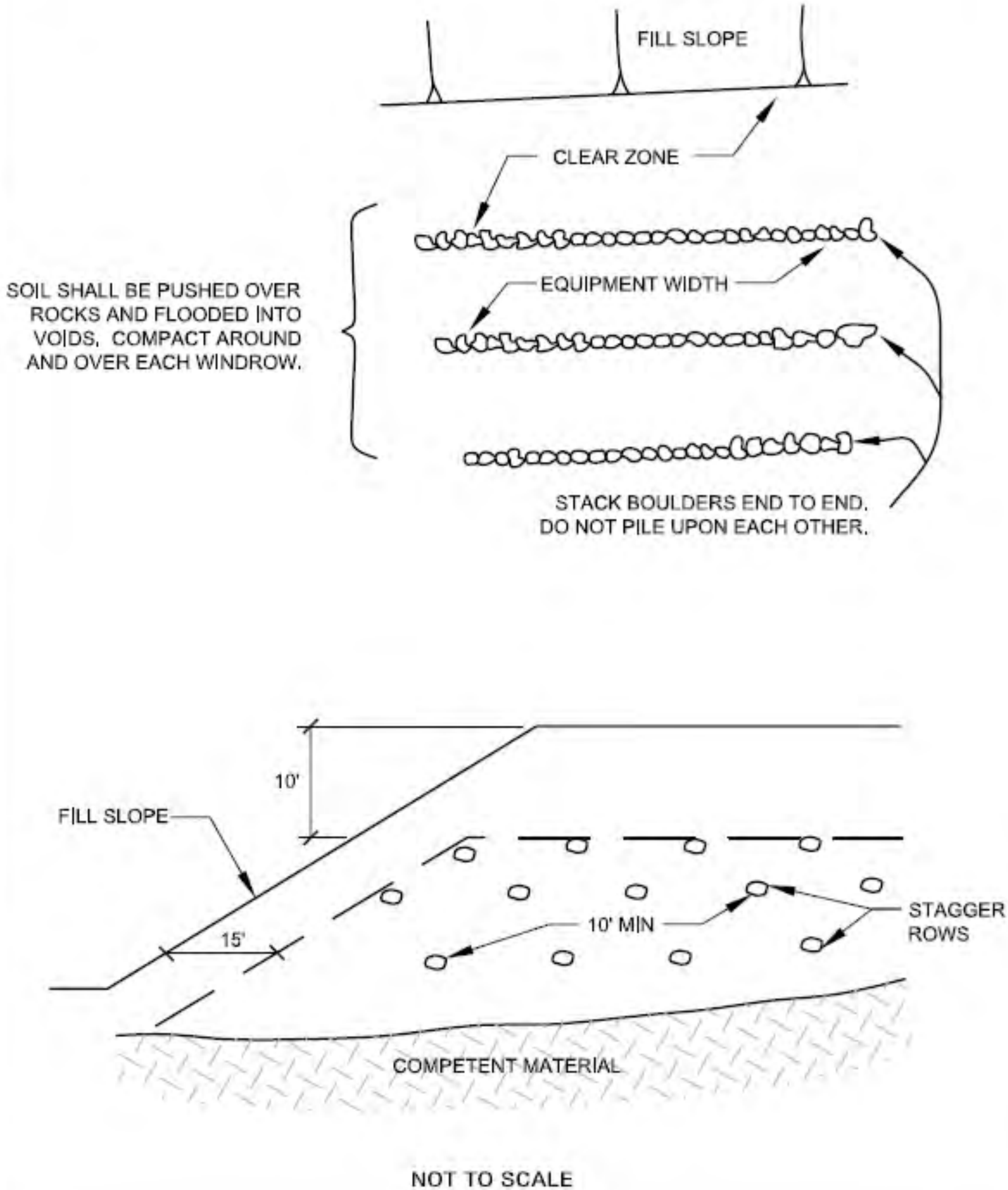


*NOTE: AGGREGATE TO MEET FOLLOWING SPECIFICATIONS OR APPROVED EQUAL:

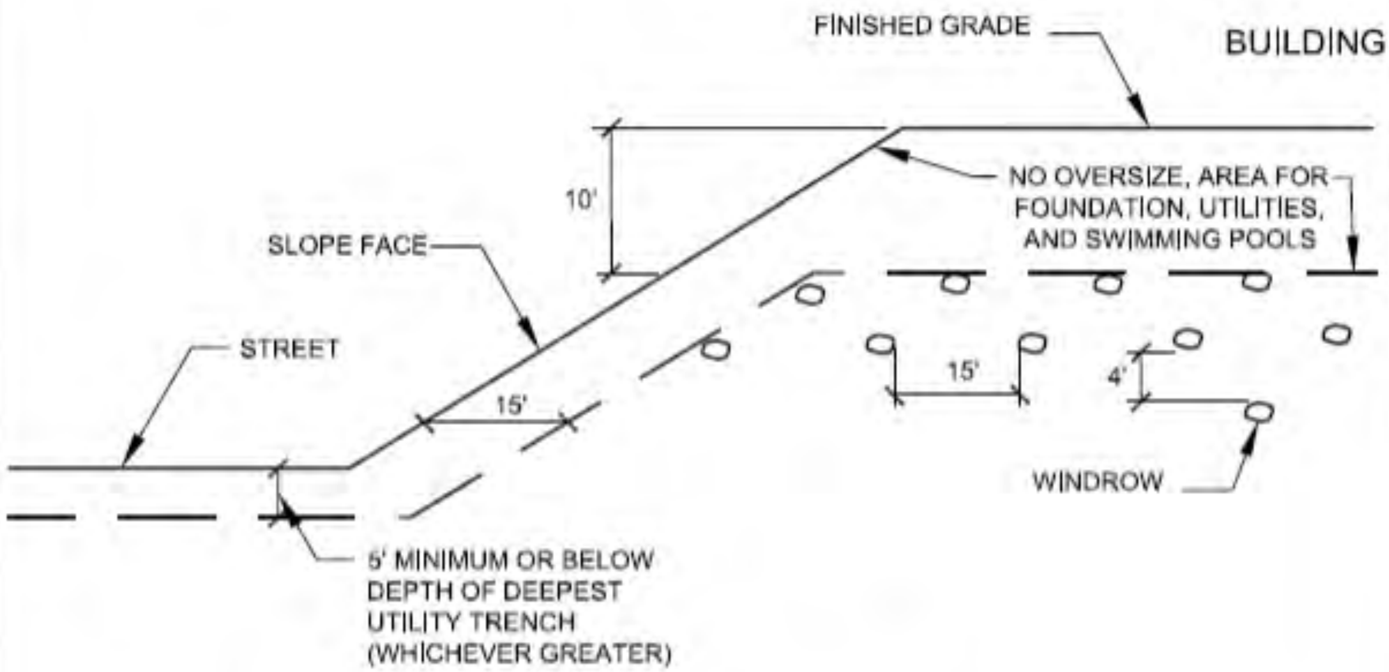
SIEVE SIZE	PERCENTAGE PASSING
1 ½"	100
1"	5-40
¾"	0-17
⅜"	0-7
NO. 200	0-3

NOT TO SCALE

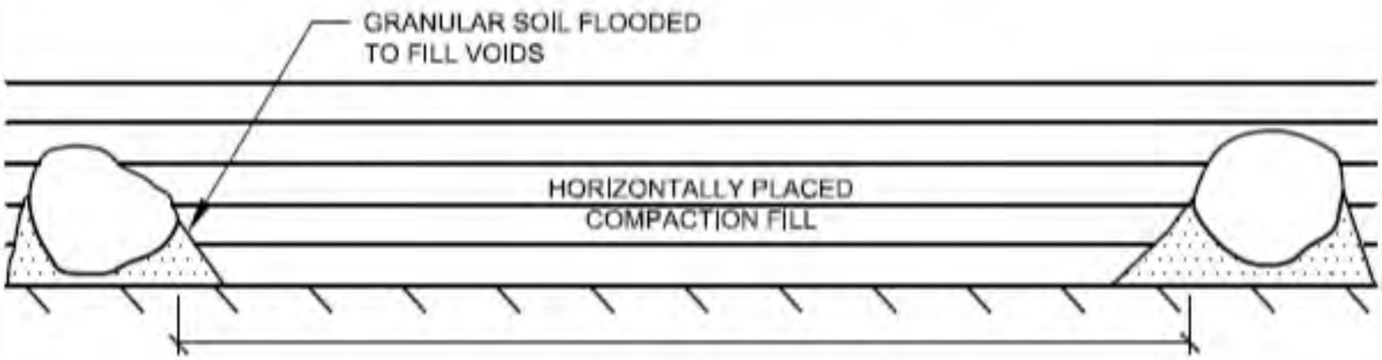
BACKDRAIN DETAIL (GEOFRABIC)



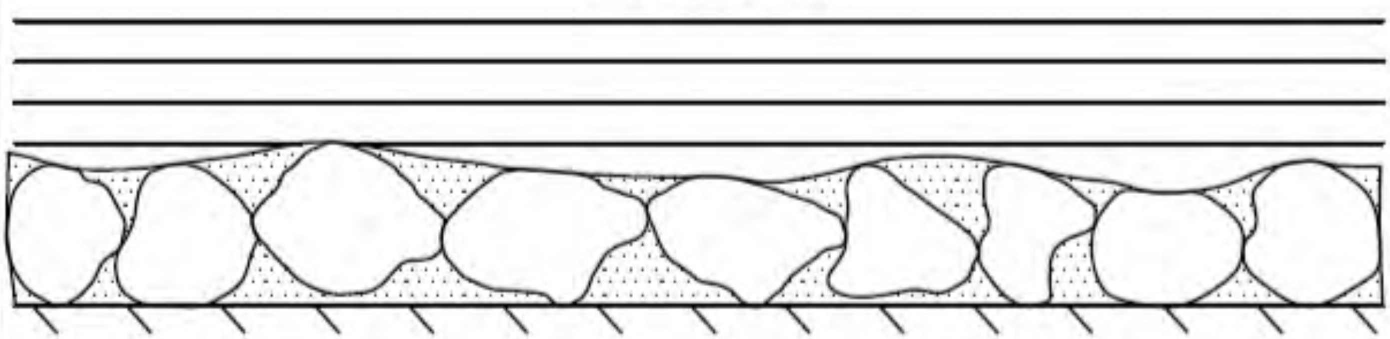
ROCK DISPOSAL DETAIL



TYPICAL WINDROW DETAIL (EDGE VIEW)



PROFILE VIEW

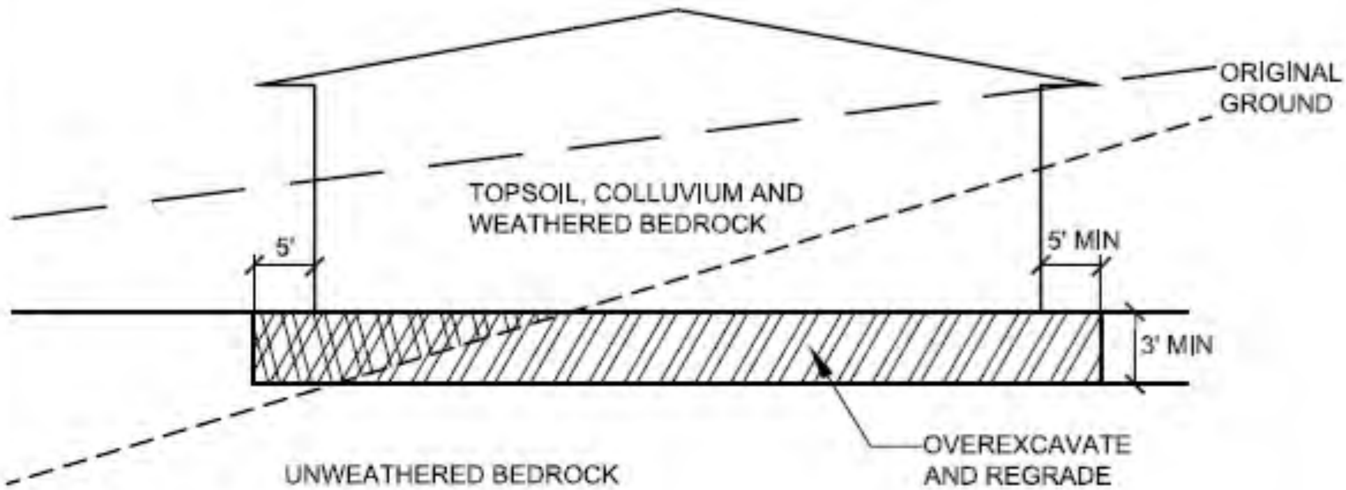


NOT TO SCALE

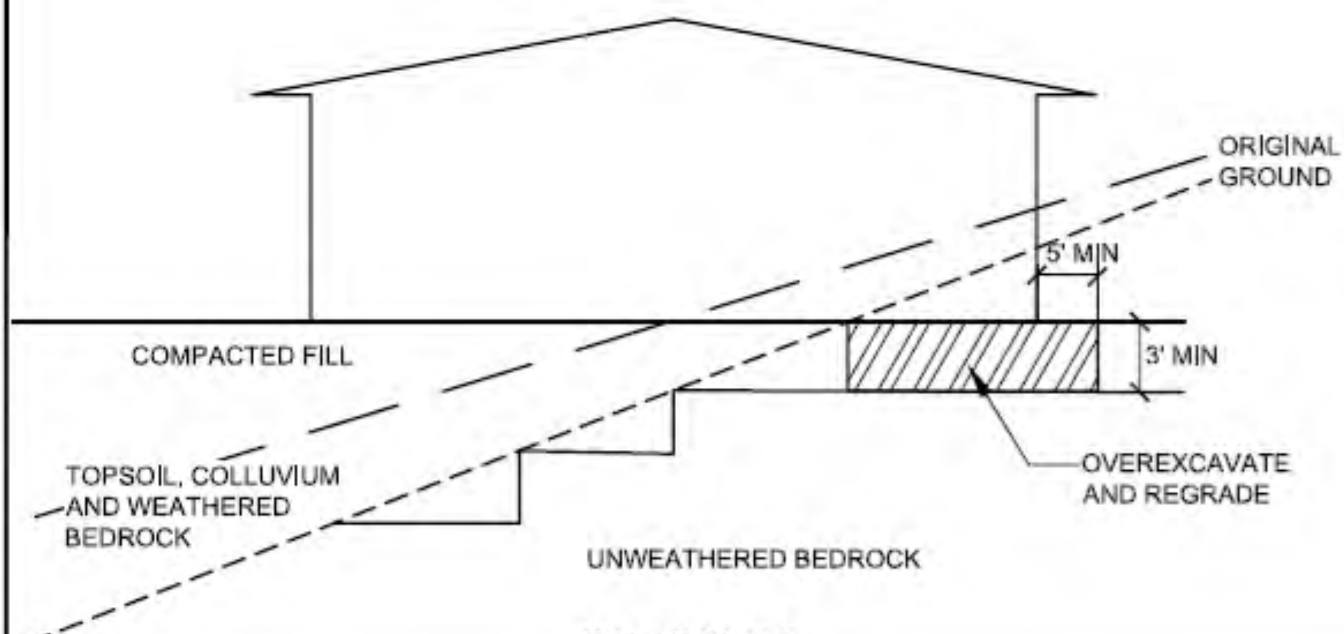
ROCK DISPOSAL DETAIL

GENERAL GRADING RECOMMENDATIONS

CUT LOT

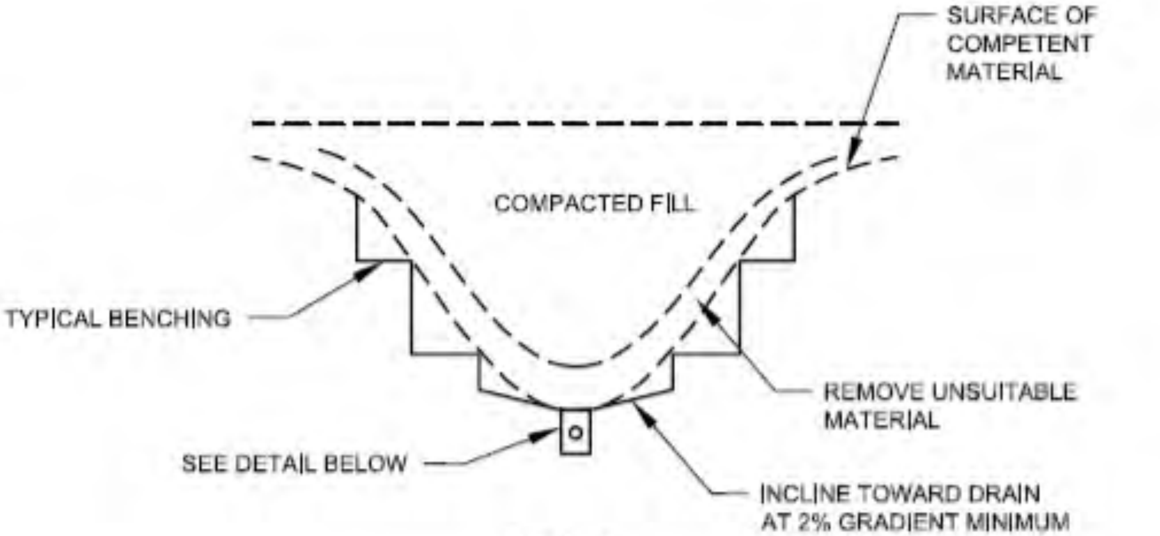


CUT/FILL LOT (TRANSITION)

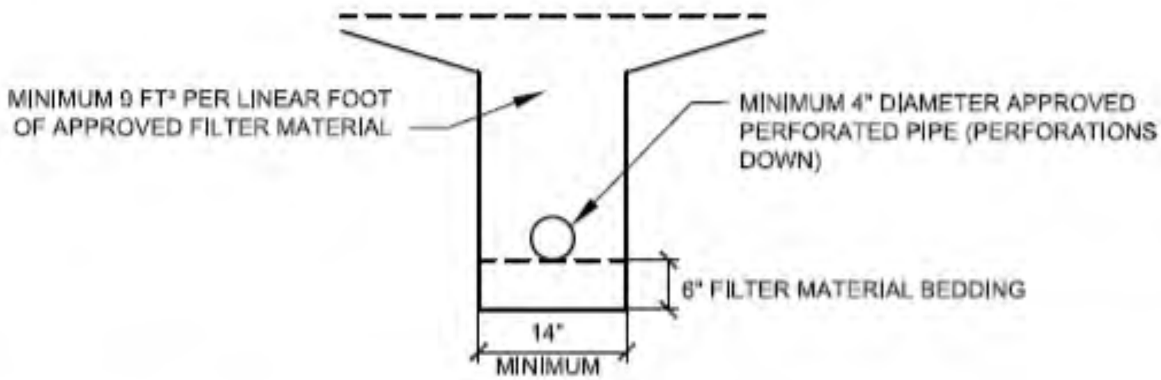


NOT TO SCALE

TRANSITION LOT DETAIL



DETAIL



FILTER MATERIAL TO MEET FOLLOWING SPECIFICATION OR APPROVED EQUAL:

SIEVE SIZE	PERCENTAGE PASSING
1"	100
¾"	90-100
⅜"	40-100
NO. 4	25-40
NO. 30	18-33
NO. 8	5-15
NO. 50	0-7
NO. 200	0-3

APPROVED PIPE TO BE SCHEDULE 40 POLY-VINYL-CHLORIDE (P.V.C.) OR APPROVED EQUAL. MINIMUM CRUSH STRENGTH 1000 psi

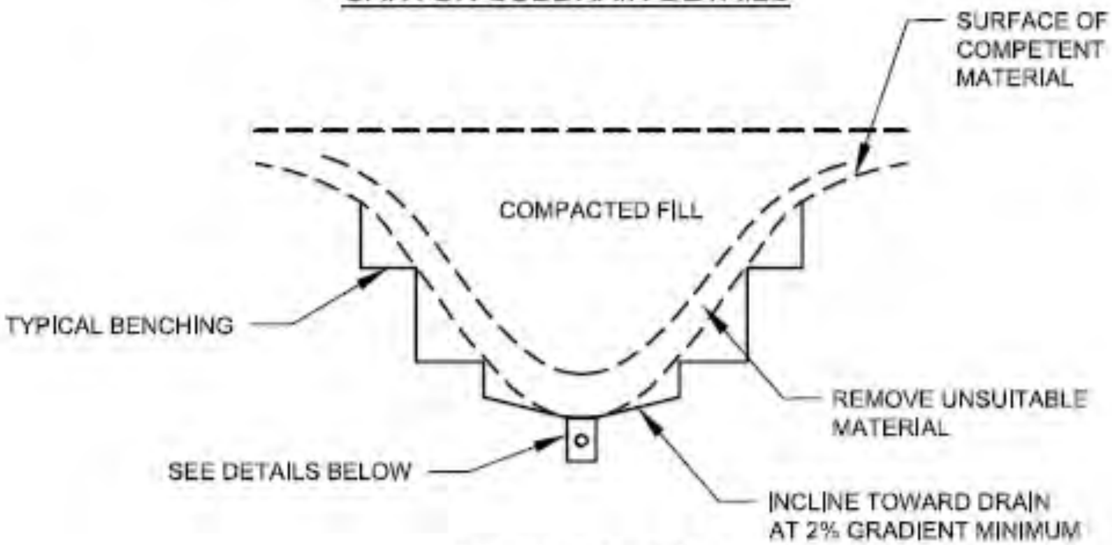
PIPE DIAMETER TO MEET THE FOLLOWING CRITERIA, SUBJECT TO FIELD REVIEW BASED ON ACTUAL GEOTECHNICAL CONDITIONS ENCOUNTERED DURING GRADING

LENGTH OF RUN	PIPE DIAMETER
INITIAL 500'	4"
500' TO 1500'	6"
> 1500'	8"

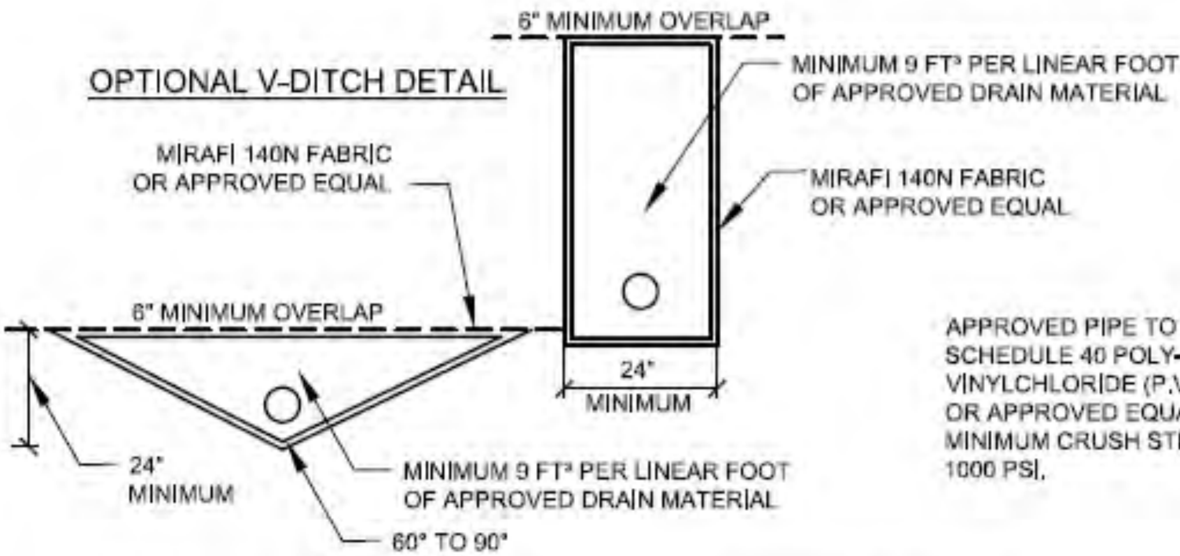
NOT TO SCALE

TYPICAL CANYON SUBDRAIN DETAIL

CANYON SUBDRAIN DETAILS



TRENCH DETAILS



APPROVED PIPE TO BE SCHEDULE 40 POLY-VINYLCHLORIDE (P.V.C.) OR APPROVED EQUAL. MINIMUM CRUSH STRENGTH 1000 PSI.

DRAIN MATERIAL TO MEET FOLLOWING SPECIFICATION OR APPROVED EQUAL:

SIEVE SIZE	PERCENTAGE PASSING
1 ½"	88-100
1"	5-40
¾"	0-17
⅜"	0-7
NO. 200	0-3

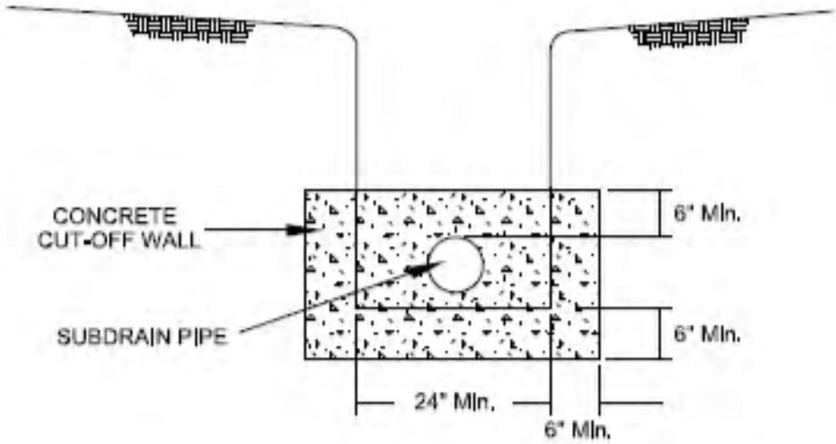
PIPE DIAMETER TO MEET THE FOLLOWING CRITERIA, SUBJECT TO FIELD REVIEW BASED ON ACTUAL GEOTECHNICAL CONDITIONS ENCOUNTERED DURING GRADING

LENGTH OF RUN	PIPE DIAMETER
INITIAL 500'	4"
500' TO 1500'	6"
> 1500'	8"

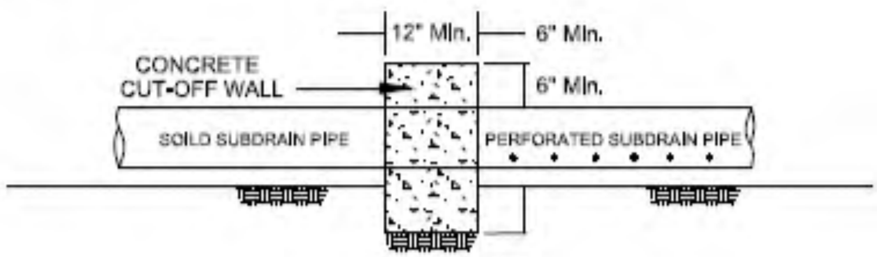
NOT TO SCALE

GEOFABRIC SUBDRAIN

FRONT VIEW



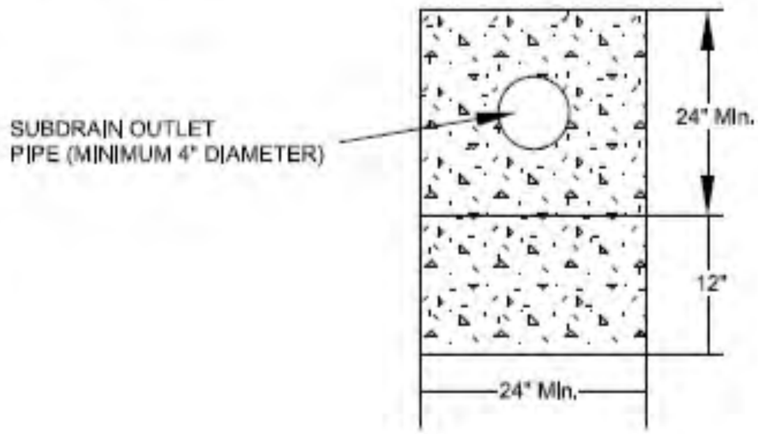
SIDE VIEW



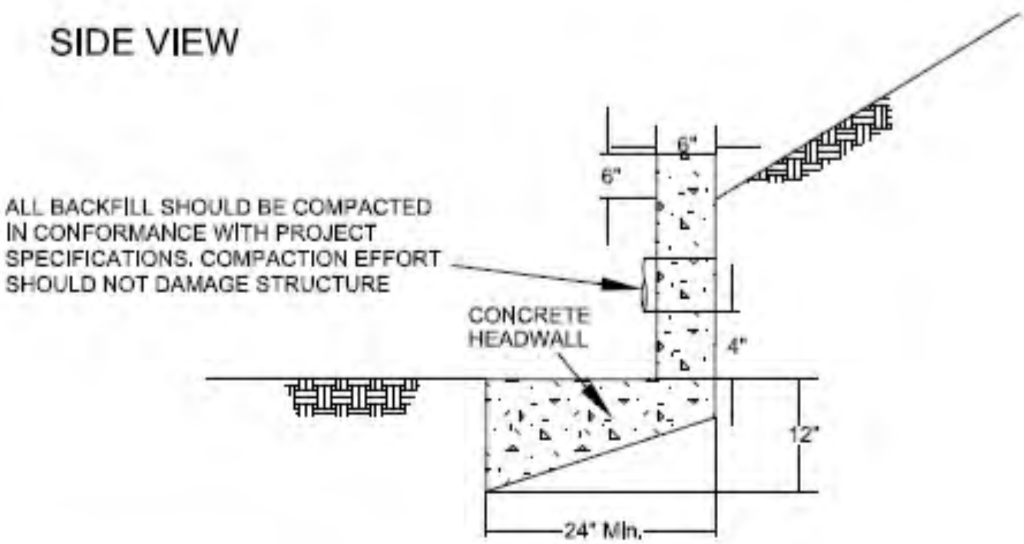
NOT TO SCALE

RECOMMENDED SUBDRAIN CUT-OFF WALL

FRONT VIEW



SIDE VIEW



NOTE: HEADWALL SHOULD OUTLET AT TOE OF SLOPE
OR INTO CONTROLLED SURFACE DRAINAGE DEVICE

ALL DISCHARGE SHOULD BE CONTROLLED

THIS DETAIL IS A MINIMUM DESIGN AND MAY BE
MODIFIED DEPENDING UPON ENCOUNTERED
CONDITIONS AND LOCAL REQUIREMENTS

NOT TO SCALE

TYPICAL SUBDRAIN OUTLET HEADWALL DETAIL

Allerion
Consulting Group, Inc.

APPENDIX E

SEAOC/OSHPD U.S. Seismic Hazard Maps

USGS web services were down for some period of time and as a result this tool wasn't operational, resulting in *timeout* error.
USGS web services are now operational so this tool should work as expected.

860 Hazelwood St, Fort Bragg, CA 95437, USA

Latitude, Longitude: 39.4286097, -123.8020746

Date	9/18/2024, 2:25:21 PM
Design Code Reference Document	ASCE7-16
Risk Category	II
Site Class	D - Stiff Soil

Type	Value	Description
S_S	1.505	MCE_R ground motion. (for 0.2 second period)
S_1	0.607	MCE_R ground motion. (for 1.0s period)
S_{MS}	1.505	Site-modified spectral acceleration value
S_{M1}	null -See Section 11.4.8	Site-modified spectral acceleration value
S_{DS}	1.003	Numeric seismic design value at 0.2 second SA
S_{D1}	null -See Section 11.4.8	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	null -See Section 11.4.8	Seismic design category
F_a	1	Site amplification factor at 0.2 second
F_v	null -See Section 11.4.8	Site amplification factor at 1.0 second
PGA	0.654	MCE_G peak ground acceleration
F_{PGA}	1.1	Site amplification factor at PGA
PGA_M	0.719	Site modified peak ground acceleration
T_L	12	Long-period transition period in seconds
SsRT	1.868	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	2.075	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	1.505	Factored deterministic acceleration value. (0.2 second)
S1RT	0.777	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.871	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.607	Factored deterministic acceleration value. (1.0 second)
PGAd	0.654	Factored deterministic acceleration value. (Peak Ground Acceleration)
PGA_{UH}	0.821	Uniform-hazard (2% probability of exceedance in 50 years) Peak Ground Acceleration
C_{RS}	0.9	Mapped value of the risk coefficient at short periods
C_{R1}	0.892	Mapped value of the risk coefficient at a period of 1 s
C_V	1.401	Vertical coefficient

DISCLAIMER

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