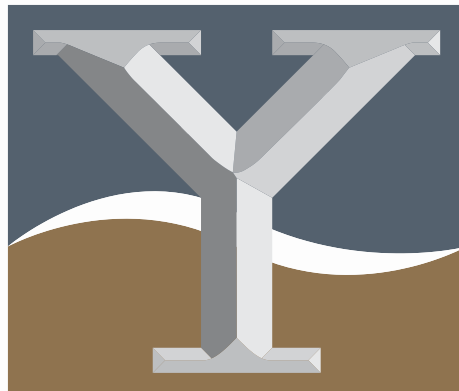


**GEOTECHNICAL ENGINEERING STUDY
FOR
PREMIER MONTAIRE**
5500 Barton Road
Loomis, California

Project No. E22325.000
September 2022



YOUNGDAHL
ESTABLISHED 1984

Premier 40, LLC
8483 Douglas Plaza Drive
Granite Bay, California 95746

Project No. E22325.000
6 September 2022

Attention: Stefan Horstschaer

Subject: **PREMIER MONTAIRE**
5500 Barton Road, Loomis, California
GEOTECHNICAL ENGINEERING STUDY

References: 1. Site Plan for Loomis Basin Charter – Option 1, prepared by Rainforth Grau Architects, dated 17 May 2022.
2. Proposal and Executed Contract for Barton Road Subdivision, prepared by Youngdahl Consulting Group, Inc., dated 2 August 2022.

Dear Mr. Horstschaer:

In accordance with your authorization, Youngdahl Consulting Group, Inc. has prepared this geotechnical engineering study for the project site located at 5500 Barton Road in Loomis, California. The purpose of this study was to prepare a site-specific geotechnical report based on new information that can be incorporated into the design of the proposed site. To complete this task, our firm completed a subsurface exploration, laboratory testing, and prepared this report in accordance with the Reference 2 proposal and contract.

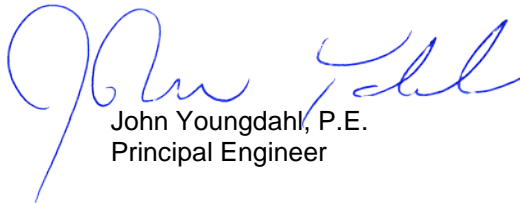
Based upon our observations, the geotechnical aspects of the site appear to be suitable for support of the proposed improvements provided the recommendations presented in this report are incorporated into the design and construction. Geotechnical conditions associated with the site development are anticipated to include processing existing grades for preparation to receive engineered fills, shallow equipment refusal, the placement of engineered fills, and improvements for drainage controls.

Due to the non-uniform nature of soils, other geotechnical issues may become more apparent during grading operations which are not listed above. The descriptions, findings, conclusions, and recommendations provided in this report are formulated as a whole; specific conclusions or recommendations should not be derived or used out of context. Please review the limitations and uniformity of conditions section of this report.

This report has been prepared for the exclusive use of the addressee of this report and their consultants, for specific application to this project, in accordance with generally accepted geotechnical engineering practice. Should you have any questions or require additional information, please contact our office at your convenience.

Very truly yours,
Youngdahl Consulting Group, Inc.


Pavel Fomin
Staff Engineer


John Youngdahl, P.E.
Principal Engineer



Distribution: PDF to Client

9-6-22

TABLE OF CONTENTS

1.0	INTRODUCTION.....	1
	Project Understanding	1
	Background	1
	Purpose and Scope	1
2.0	SITE CONDITIONS	2
	Surface Observations	2
	Subsurface Conditions	2
	Groundwater Conditions	2
3.0	GEOTECHNICAL SOIL CHARACTERISTICS.....	2
	Laboratory Testing.....	3
	Soil Expansion Potential	3
	Soil Corrosivity	3
4.0	GEOLOGY AND SEISMICITY.....	4
	Geologic Conditions	4
	Seismicity	4
	Earthquake Induced Liquefaction, Settlement, and Surface Rupture Potential	4
	Static and Seismically Induced Slope Instability	5
5.0	DISCUSSION AND CONCLUSIONS	5
	Geotechnical Considerations for Development.....	5
6.0	SITE GRADING AND EARTHWORK IMPROVEMENTS.....	5
	Excavation Characteristics	5
	Soil Moisture Considerations	6
	Site Preparation.....	6
	Engineered Fill Criteria	7
	Slope Configuration and Grading.....	9
	Underground Improvements	9
7.0	DESIGN RECOMMENDATIONS.....	10
	Shallow Conventional Foundations.....	10
	Slab-on-Grade Construction	12
	Exterior Flatwork	13
	Retaining Walls	13
	Asphalt Concrete Pavement Design	15
	Portland Cement Concrete Pavement Design	16
	Drainage.....	17
8.0	DESIGN REVIEW AND CONSTRUCTION MONITORING.....	19
	Plan Review	19
	Construction Monitoring.....	19
	Post Construction Drainage Monitoring	19
9.0	LIMITATIONS AND UNIFORMITY OF CONDITIONS.....	20
	APPENDIX A.....	22
	Introduction	23
	Vicinity Map (Figure A-1)	24
	Site Plan (Figure A-2)	25
	Logs of Exploratory Test Pits (Figures A-3 through A-8).....	26
	Soil Classification Chart and Log Explanation (Figure A-9).....	31



APPENDIX B.....	32
Direct Shear Test (Figure B-1).....	33
Modified Proctor Test (Figure B-2).....	34
R-Value Test (Figures B-3).....	35
Expansion Index Test (Figure B-4)	36
Corrosivity Tests.....	37
APPENDIX C.....	38
Keyway and Bench with Drain (Figure C-1)	39
Plug and Drain (Figure C-2).....	40
Site Wall (Figure C-3)	41
Subdrain (Figure C-4).....	42

GEOTECHNICAL ENGINEERING STUDY FOR PREMIER MONTAIRE

1.0 INTRODUCTION

This report presents the results of our geotechnical engineering study performed for the proposed improvements planned to be constructed at 5500 Barton Road in Rocklin, California. The vicinity map provided on Figure A-1, Appendix A shows the approximate project location.

Project Understanding

We understand that the proposed development will consist of the construction of residential subdivision. We anticipate that the single-family residences will be one- to two-stories, of wood frame construction, and supported by conventional shallow foundations with concrete slab-on-grade floors. Appurtenant construction is expected to include underground utilities, roadways, site retaining walls, and improvements for drainage.

Background

Based on a review of aerial photography, the site appears to have been mostly undeveloped with the exception of a man-made pond developed during the 1950's in the southwest portion of the site, a single residence developed during the early 1980's in the northwest portion of the site, and a relatively small agricultural plot in the northeastern corner developed in the early 2000's. Surface disturbances were observed in 2007 which generally resulted in a fill stockpile north of the pond and are anticipated to be from the grading operations of a bordering property, north of Rocklin Road.

If studies or plans pertaining to the site exist and are not cited as a reference in this report, we should be afforded the opportunity to review and modify our conclusions and recommendations as necessary.

Purpose and Scope

Youngdahl Consulting Group, Inc. has prepared this report to provide geotechnical engineering recommendations and considerations for incorporation into the design and development of the site. The following scope of services were developed and performed for preparation of this report:

- A review of geotechnical and geologic data available to us at the time of our study;
- Performance of a field study consisting of a site reconnaissance and subsurface exploration to observe and characterize the subsurface conditions;
- Laboratory testing on representative samples collected during our field study;
- Evaluation of the data and information obtained from our field study, laboratory testing, and literature review for geotechnical conditions;
- Development of the following geotechnical recommendations and considerations regarding earthwork construction including, site preparation and grading, engineered fill criteria, seasonal moisture conditions, excavation characteristics, and drainage;
- Development of geotechnical design criteria for code-based seismicity, foundations, slabs on grade, and retaining walls;
- Preparation of this report summarizing our findings, conclusions, and recommendations regarding the above-described information.



2.0 SITE CONDITIONS

The following section describes our findings regarding the site conditions that we observed during our site reconnaissance and subsequent subsurface exploration.

Surface Observations

The project site is located at 5500 Barton Road in Loomis, California and is bounded by Barton Road to the east, single residences to the south and west, a pond to the southwest, and Rocklin Road to the north. Topography at the site generally consists of relatively gentle undulating terrain sloping to the southwest. A creek runs the from the north to the southwest into the existing pond. At the time of our visit, the vegetation at the site consisted of seasonal grasses with scattered trees and water-loving shrubs along the creek and pond. A large approximately fifteen foot high and one hundred foot long, non-engineered stockpile is located on the western region of the site, north of the pond.

Subsurface Conditions

Our field study included a site reconnaissance by a representative of our firm followed by a subsurface exploration program conducted on 2 July 2021. The exploration program included the excavation of eleven exploratory test pits under the direction of our representative at the approximate locations shown on Figure A-2, Appendix A.

Subsurface soil conditions at the project site primarily included sands and occasional silts overlying relatively shallow bedrock. The upper soil layers were generally observed to be medium dense or medium stiff to depths up to approximately 1.5 feet below the existing ground surface. Weathered bedrock was typically encountered within approximately 0.5 to 2 feet below existing ground surface and was observed to be in a highly weathered and soft to very hard condition. The fill stockpile consisted of clayey sands and sandy silts with clay. The fill stock pile and some residual surface fills were encountered in Test Pits 5 and 6, respectively.

A more detailed description of the subsurface conditions encountered during our subsurface exploration is presented graphically on the "Exploratory Test Pit Logs", Figures A-3 through A-8, Appendix A. These logs show a graphic interpretation of the subsurface profile, and the location and depths at which samples were collected.

Groundwater Conditions

A permanent groundwater table was not encountered at the project site and is expected to be relatively deep with no impact to the development of the site.

Due to the shallow depth and low permeability of the underlying rock, perched water is common to the area and could be encountered during grading operations. We did not observe perched water during our recent subsurface exploration program. The presence of perched water can vary because of many factors such as, the proximity to rock, topographic elevations, and the presence of utility trenches. Some evidence of past repeated exposure to subsurface water may include black staining, clay deposits, and surface markings indicating previous seepage. Based on our experience in the area, water may be perched on the bedrock horizon found beneath the site and could vary through the year with higher concentrations during or following precipitation.

3.0 GEOTECHNICAL SOIL CHARACTERISTICS

The geotechnical soil characteristics presented in this section of the report are based on laboratory testing from previous studies and observation of samples collected from subsurface soils.



Laboratory Testing

Laboratory testing of the collected samples was directed towards determining the physical and engineering properties of the soil underlying the site. The associated test results are presented in Appendix B. In summary, the following tests were performed for the preparation of this report:

Table 1: Laboratory Tests

Laboratory Test	Test Standard	Summary of Results	
Direct Shear	ASTM D3080	TP-4 @ 0-1.5'	$\Phi = 40.8^\circ$, $c = 25$ psf (90%RC)
Maximum Dry Density	ASTM D1557	TP-4 @ 0-1.5'	DD = 121.1 pcf, MC = 8.9%
Resistance "R" Value	CTM 301	TP-1 @ 0-2'	R = 67
Expansion Index	ASTM D4829	TP-5 @ 4-10'	EI = 61 (Medium Potential)
Corrosivity Suite	CA DOT Tests 417, 422 and 643	See Soil Corrosivity Section	

Soil Expansion Potential

The native materials encountered in our explorations were generally non-plastic (rock, sand, and non-plastic silt). The non-plastic materials are generally considered to be non-expansive; therefore, we do not anticipate that special design considerations for expansive soils will be necessary for the design or construction of the proposed improvements. The stockpiled previously imported material was sampled and tested for expansion potential. Our results showed a medium potential for expansion with an expansion index (EI) of 61. These clays can cause damage to shallow rigid improvements if deposited in concentration. We have prepared recommendations to address the clay by either blending or disposal in non-structural areas. If necessary, further recommendations can be made based on our observations at the time of construction should more expansive soils be encountered at the project site which were not encountered during our study.

Soil Corrosivity

A corrosivity testing suite consisting of soil pH, resistivity, sulfate, and chloride content tests were performed on selected soil samples collected during our site exploration. We are not corrosion specialists and recommend that the results be evaluated by a qualified corrosion expert. The laboratory test results (provided by Sunland Analytical) are provided in Appendix B and are summarized in Table 2, below.

Table 2: Corrosivity Summary

Location	Depth (ft)	Soil pH	Minimum Resistivity ohm-cm (x1000)	Chloride (ppm)	Sulfate (ppm)	Caltrans Environment	ACI Environment
TP-2	2-3	5.25	14.74	3.0	1.5	Non-Corrosive	S0 (Not a Concern)

According to Caltrans Corrosion Guidelines Version 3.2, May 2021, the test results, specifically soil pH, appear to indicate a potential corrosive environment for structural elements. According to the 2019 California Building Code Section 1904.1 and ACI 318-14 Table 19.3.1.1, the test results indicate the onsite soils have a negligible potential for sulfide attack of concrete. A certified corrosion engineer should be consulted to review the above tests and site conditions in order to develop specific mitigation recommendations if metallic pipes or structural elements are designed to be in contact with or buried in soil.



4.0 GEOLOGY AND SEISMICITY

The geologic portion of this report includes a review of geologic data pertinent to the site based on an interpretation of our observations of the surface exposures and our observations in our exploratory test pits.

Geologic Conditions

According to the Geologic Map of the South Half of the Auburn 15-Minute Quadrangle (F.H. Olmsted, 1971), the subject property and vicinity are underlain by quartz diorite of the Penryn Pluton.

Seismicity

Our evaluation of seismicity for the project site included reviewing existing fault maps and obtaining seismic design parameters from the USGS online calculators and databases. For the purpose of this study, we used a latitude and longitude of 38.786621, -121.194939 to identify the project site.

Alquist-Priolo Regulatory Faults

Based upon the records currently available from the California Department of Conservation, the project site is not located within an Alquist-Priolo Regulatory Review Zone and there are no known faults located at the subject site. We do not anticipate special design or construction requirements for faulting at this project site.

Code Based Seismic Criteria

Based upon the subsurface conditions encountered during our study and our experience in the area, the site should be classified as Site Class C. The final choice of design parameters remains the purview of the project structural engineer.

Table 3: Seismic Design Parameters*

	Reference	Seismic Parameter	Recommended Value
ASCE 7-16	Table 20.3-1	Site Class	C
	Figure 22-7	Maximum Considered Earthquake Geometric Mean (MCEC) PGA	0.183g
	Table 11.8-1	Site Coefficient F_{PGA}	1.217
	Equation 11.8-1	$PGA_M = F_{PGA} PGA$	0.222g
2019 CBC	Figure 1613.2.1(1)	Short-Period MCE at 0.2s, S_S	0.427g
	Figure 1613.2.1(2)	1.0s Period MCE, S_1	0.216g
	Table 1613.2.3(1)	Site Coefficient, F_a	1.300
	Table 1613.2.3(2)	Site Coefficient, F_v	1.500
	Equation 16-36	Adjusted MCE Spectral Response Parameters, $S_{MS} = F_a S_S$	0.555g
	Equation 16-37	Adjusted MCE Spectral Response Parameters, $S_{M1} = F_v S_1$	0.324g
	Equation 16-38	Design Spectral Acceleration Parameters, $S_{DS} = \frac{2}{3} S_{MS}$	0.370g
	Equation 16-39	Design Spectral Acceleration Parameters, $S_{D1} = \frac{2}{3} S_{M1}$	0.216g
	Table 1613.2.5(1)	Seismic Design Category (Short Period), Occupancy I to III	C
	Table 1613.2.5(1)	Seismic Design Category (Short Period), Occupancy IV	D
	Table 1613.2.5(2)	Seismic Design Category (1-Sec Period), Occupancy I to IV	D

*Based on the online calculator available at <https://earthquake.usgs.gov/ws/designmaps/>

Earthquake Induced Liquefaction, Settlement, and Surface Rupture Potential

Liquefaction is the sudden loss of soil shear strength and sudden increase in porewater pressure caused by shear strains, as could result from an earthquake. Research has shown that saturated,



loose to medium-dense sands with a silt content less than about 25 percent and located within the top 40 feet are most susceptible to liquefaction and surface rupture/lateral spreading.

Due to the absence of permanently elevated groundwater table, the relatively low seismicity of the area, and the relatively shallow depth to rock, the potential for seismically induced damage due to liquefaction, surface ruptures, and settlement is considered low. For the above-mentioned reasons mitigation for these potential hazards is not considered necessary for the development of this project.

Static and Seismically Induced Slope Instability

The existing slopes on the project site were observed to have adequate vegetation on the slope face, appropriate drainage away from the slope face, and no apparent tension cracks or slump blocks in the slope face or at the head of the slope. No other indications of slope instability such as seeps or springs were observed. Additionally, due to the absence of permanently elevated groundwater table, the relatively low seismicity of the area, and the relatively shallow depth to bedrock, the potential for seismically induced slope instability for the existing slopes is considered low.

5.0 DISCUSSION AND CONCLUSIONS

Based upon the results of our field explorations, findings, and analysis described above, it is our opinion that construction of the proposed improvements is feasible from a geotechnical standpoint, provided the recommendations contained in this report are incorporated into the design plans, specifications, and implemented during construction. The native soils, once processed and compacted as recommended below, may be considered “engineered” and suitable for support of the planned improvements.

Geotechnical Considerations for Development

The project site is generally comprised of a thin layer of soils over shallow rock which is considered suitable for support of the proposed improvements. Generally, issues associated with development on similar sites are associated with the excavation of shallow rock and the presence of seepage at the soil to rock contact. The geotechnical recommendations for this project are presented in the following sections. ***The non-engineered fill stockpile on site will need to be addressed according to Section 6 of this report.***

6.0 SITE GRADING AND EARTHWORK IMPROVEMENTS

Excavation Characteristics

Exploratory test pits were excavated using a John Deere 410G equipped with a 12-inch-wide bucket. The degree of difficulty encountered in excavating our test pits is an indication of the effort that will be required for excavation during construction. Site soils were observed to be approximately 0.5- to 1-foot-thick overlying the bedrock horizon in various weathered conditions. The John Deere 410G was able to excavate between approximately 3 to 7 feet into bedrock materials before meeting practical refusal.

Where hard rock cuts in fractured rock are proposed, the orientation and direction of ripping will likely play a large role in the rippability of the material. When hard rock is encountered, we should be contacted to provide additional recommendations prior to performing an alternative such as blasting.

Utility trenches will likely encounter hard rock excavation conditions especially in deeper cut areas. Utility contractors should be prepared to use special rock trenching equipment such as large excavators (Komatsu PC400 or CAT 345 or equivalent). Blasting to achieve utility line



grades, especially in planned cut areas, cannot be precluded. Water inflow into any excavation approaching the hard rock surface is likely to be experienced in all but the driest summer and fall months.

Soil Moisture Considerations

The compaction of soil to a desired relative compaction is dependent on conditioning the soil to a target range of moisture content. Moisture contents that are excessively dry or wet could limit the ability of the contractor to compact soils to the requirements for engineered fill. When dry, moisture should be added to the soil and the soils blended to improve consistency. Wet soil will need to be dried to become compactable. Generally, this includes blending and working the soil to avoid trapping moisture below a dryer surficial crust. Other options are available to reduce the time involved but typically have higher costs and require more evaluation prior to implementation.

The largest contributor to excessive soil moisture is generally precipitation and seepage during the rainy season. In recognition of this, we suggest that consideration be given to the seasonal limitations and costs of winter grading operations on the site. Special attention should be given regarding the drainage of the project site. If the project is expected to work through the wet season, the contractor should install appropriate temporary drainage systems at the construction site and should minimize traffic over exposed subgrades due to the moisture-sensitive nature of the on-site soils. During wet weather operations, the soil should be graded to drain and should be sealed by rubber tire rolling to minimize water infiltration.

Site Preparation

Preparation of the project site should involve site drainage controls, dust control, clearing and stripping, overexcavation and compaction of non-engineered fill or loose/soft soils, and exposed grade compaction considerations. The following paragraphs state our geotechnical comments and recommendations concerning site preparation.

Site Drainage Controls

We recommend that initial site preparation involve intercepting and diverting any potential sources of surface or near-surface water within the construction zones. Because the selection of an appropriate drainage system will depend on the water quantity, season, weather conditions, construction sequence, and methods used by the contractor, final decisions regarding drainage systems are best made in the field at the time of construction. All drainage and/or water diversion performed for the site should be in accordance with the Clean Water Act and applicable Storm Water Pollution Prevention Plan.

Dust Control

Dust control provisions should be provided for as required by the local jurisdiction's grading ordinance (i.e., water truck or other adequate water supply during grading). Dust control is the purview of the grading contractor.

Clearing and Stripping of Organic Materials

Clearing and stripping operations should include the removal of all organic laden materials including trees, bushes, root balls, root systems, and any soft or loose soil generated by the removal operations. Short or mowed dry grasses may be pulverized and lost within fill materials provided no concentrated pockets of organics result. It is the responsibility of the grading contractor to remove excess organics from the fill materials. **No more than 2 percent of organic material, by weight, should be allowed within the fill materials at any given location.** Preserved trees may require tree root protection which should be addressed on an individual basis by a qualified arborist.



Our recommendations are based on limited windows into the surface and interpretations thereof; therefore, a representative of our firm should be present during site clearing operations to identify the location and depth of potential fills or loose soils, some of which may not have been found during our evaluation. We should also be present to observe removal of deleterious materials, and to identify any existing site conditions which may require mitigation or further recommendations prior to site development.

Overexcavation and Compaction of Non-Engineered Fill or Loose/Soft Native Soils

Following general site clearing, all existing non-engineered fill (including fill stockpile), loose/soft or saturated native soils within the development footprint should be overexcavated down to firm native materials and backfilled with engineered fill as detailed in the engineered fill section below.

Based on our explorations, the stockpile located on the western portion of the site varies in height to a maximum of about 15 feet thick and is composed of clayey soils, not otherwise encountered at the project site. These soils can cause differential foundation movement if compacted in concentration in future building pad or rigid improvement areas. At the time of this report, a grading plan was not available for review to see where cut and fills are proposed. We recommend placing this stockpiled soil as an engineered fill in future landscape areas where foundations and rigid improvements are not anticipated. As an alternative, these soils could be blended with the sandy native soils such that their expansion properties are diminished. This could be performed in deeper roadway fills if available during mass grading. It is preferable that these materials be blended with proposed fills in the road areas below 18 inches from rough subgrade to avoid having to design the road section for the altered R-Value of the blended soil conditions. If the blended fills are placed in building pad areas, we recommend that the top 3 feet of the building pads be composed of non-expansive soils (no blended soils unless new expansion index testing of the blended soils results in very low expansive results).

Based on our interpretation, the areas with a thinner layer of loose surface soils appear to be associated with the stockpiled material previously imported and within the existing creek bed and the surrounding area. It may also be possible that the area of the former residences at the north side of the site may have loose soils. Any depressions extending below final grade resulting from the removal of fill materials or other deleterious materials should be properly prepared as discussed below and backfilled with engineered fill.

Exposed Grade Compaction

Exposed soil grades following initial site preparation activities and overexcavation operations should be scarified to a minimum depth of 8 inches and compacted to the requirements for engineered fill. Generally, where rock conditions are exposed, no scarification should be necessary; however, these surfaces should be moisture conditioned and compacted to mitigate disturbance resulting from site preparation. Prior to placing fill, the exposed grades should be in a firm and unyielding state. Any localized zones of soft or pumping soils observed within the exposed grade should either be scarified and recompacted or be overexcavated and replaced with engineered fill as detailed in the engineered fill section below.

Engineered Fill Criteria

All materials placed as fills on the site should be placed as "Engineered Fill" which is observed, tested, and compacted as described in the following paragraphs.

Suitability of Onsite Materials

We expect that soil generated from excavations on the site, excluding deleterious material, may be used as engineered fill provided the material does not exceed 8 inches in maximum dimension.



Oversized rock fragments should be mechanically reduced in size or exported to an offsite location.

Fill Placement and Compaction

Engineered fills should be placed in thin horizontal lifts not to exceed 8 inches in uncompacted thickness. If the contractor can achieve the recommended relative compaction using thicker lifts, the method may be judged acceptable based on field verification by a representative of our firm using standard density testing procedures. Lightweight compaction equipment may require thinner lifts to achieve the recommended relative compaction. The following table presents the recommended relative compaction for various aspects of the project.

Table 4: Recommended Relative Compaction

Fill Materials	Minimum Relative Compaction	Method
Engineered Fill, General	90 percent	ASTM D1557
Engineered Fill > 10' Below Finished Grade	95 percent	ASTM D1557
Utility Trench Backfill*	95 percent	ASTM D1557
Subgrade	95 percent	ASTM D1557
Aggregate Baserock Grade	95 percent	ASTM D1557
Asphalt Concrete Pavement	92 to 96 percent	ASTM D2041 or CTM 309

* Unless otherwise noted by the governing agency.

Depending on the moisture condition of the soils, the engineered fills may require moisture conditioning to be within a suitable compaction range. Our firm should be requested for consultation, observation, and testing for the earthwork operations prior to the placement of any fills. Fill soil compaction should be evaluated by means of in-place density tests performed during fill placement so that adequacy of soil compaction efforts may be determined as earthwork progresses.

Import Materials

The recommendations presented in this report are based on the assumption that the import materials will be similar to the materials present at the project site. High quality materials are preferred for import; however, these materials can be more dependent on source availability. Import material should be approved by our firm prior to transporting it to the project site.

Material for this project should consist of a material with the geotechnical characteristics presented below. If these requirements are not met, additional testing and evaluation may be necessary to determine the appropriate design parameters for foundations, pavement, and other improvements.



Table 5: Select Import Criteria

Behavior Property	Reference Document	Recommendation
Direct Shear Strength	ASTM D3080	$\geq 36^\circ$ when compacted
Resistance Value	CTM 301	≥ 40
Plasticity Index	ASTM D4318	≤ 12
Expansion Index	ASTM D4829	≤ 20
Sieve Analysis	ASTM D1140	Not more than 30% Passing the No. 200 sieve
Maximum Aggregate Size	ASTM D1140	$\leq 6''$

Slope Configuration and Grading

Generally, a cut slope orientation of 2H:1V (Horizontal:Vertical) is considered stable with the material types encountered on the site. A fill slope constructed at the same orientation is considered stable if compacted to the engineered fill recommendations as stated in the recommendations section of this report. All slopes should have appropriate drainage and vegetation measures to minimize erosion of slope soils.

Placement of Fills on Slopes

Placement of fill material on natural slopes should be stabilized by means of keyways and benches. Where the slope of the original ground equals or exceeds 5H:1V, a keyway should be constructed at the base of the fill. The keyway should consist of a trench excavated to a depth of at least 2 feet into firm, competent materials. The keyway trench should be at least 10 feet wide or as designated by our firm based on the conditions at the time of construction. Benches should be cut into the original slope as the filling operation proceeds. Each bench should consist of a level surface excavated at least 6 feet horizontally into firm soils or 4 feet horizontally into rock. The rise between successive benches should not exceed 36 inches. The need for subdrainage should be evaluated at the time of construction. Refer to Figure C-1 in Appendix C for typical keyway and bench construction.

Slope Face Compaction

All slope fills should be laterally overbuilt and cut back such that the required compaction is achieved at the proposed finish slope face. As a less preferable alternative, the slope face could be track walked or compacted with a wheel. If this second alternative is used, additional slope maintenance may be necessary.

Slope Drainage

Surface drainage should not be allowed to flow uncontrolled over any slope face. Adequate surface drainage control should be designed by the project civil engineer in accordance with the latest applicable edition of the CBC. All slopes should have appropriate drainage and vegetation measures to minimize erosion of slope soils.

Underground Improvements

Trench Excavation

Trenches or excavations in soil should be shored or sloped back in accordance with current OSHA regulations prior to persons entering them. Where clay rind in combination with moist conditions is encountered in fractured bedrock, the project engineering geologist should be consulted for appropriate mitigation measures. The potential use of a shield to protect workers cannot be precluded.



Backfill Materials

Backfill materials for utilities should conform to the requirements of the local jurisdiction. It should be realized that permeable backfill materials will likely carry water at some time in the future.

When backfilling within structural footprints, compacted low permeability materials are recommended to be used a minimum of 5 feet beyond the structural footprint to minimize moisture intrusion. If the materials are too rocky, they may need to be screened prior to backfill in order to limit pipe damage. If a permeable material is used as backfill within this zone, subdrainage mitigation may be required. In addition, if the structure is oriented below the roadway and associated utilities, grout cutoffs and/or plug and drains around all utility penetrations are useful to keep moisture out from underneath the structure.

Backfill Compaction

Backfill compaction should conform to the requirements of the local jurisdiction. Where backfill compaction is not specified by the local jurisdiction, the backfill should be compacted to a minimum of 90 percent relative compaction per the ASTM D1557 test method. Compaction should be accomplished using lifts which do not exceed 12 inches when compacting with a backhoe or larger equipment equipped with a compaction wheel. However, thickness of the lifts should be determined by the contractor. If the contractor can achieve the required compaction using thicker lifts, the method may be judged acceptable based on field verification by a representative of our firm using standard density testing procedures. Lightweight compaction equipment may require thinner lifts to achieve the required densities.

Drainage Considerations

In developments with the potential for a perched groundwater condition (i.e., shallow bedrock), underground utilities can become collection points for subsurface water. Due to this condition, we recommend plug and drains within the utility trenches (Figure C-2, Appendix C) to collect and convey water to the storm drain system or other approved outlet. Temporary dewatering measures may be necessary and could include the installation of submersible pumps and/or point wells. Plug and drain systems should not be used in storm drainage systems that are designed to hold water during storm events as this could cause backflow into the trench backfills.

7.0 DESIGN RECOMMENDATIONS

The contents of this section include recommendations for foundations, slabs-on-grade, retaining walls, pavements, and drainage.

Shallow Conventional Foundations

Shallow conventional foundation systems are considered suitable for construction of the planned improvements, provided that the site is prepared in accordance with the recommendations discussed in Section 6.0 of this report.

The provided values do not constitute a structural design of foundations which should be performed by the structural engineer. In addition to the provided recommendations, foundation design and construction should conform to applicable sections of the 2019 California Building Code.

Foundation Capacities

The foundation bearing and lateral capacities are presented in the table below. The allowable bearing capacity is for support of dead plus live loads based on the foundation configuration presented in this report. The allowable capacity may be increased by 1/3 for short-term wind and seismic loads. Lateral forces on structures may be resisted by passive pressure acting against



the sides of shallow footings and/or friction between the foundation bearing material and the bottom of the footing. Section 1806.3 of the 2019 CBC allows for the combination of the friction factor and passive resistance value to lateral resistance. Consideration should be given to ignoring passive resistance where soils could be disturbed later or within 6 feet horizontally of the slope face.

Table 6: Foundation Capacities

Soil Type	Design Condition	Design Value	Applied Factor of Safety
Engineered Fill or Firm Native Soil	Allowable Bearing Capacity	2,500 psf	3.0
	Allowable Friction Factor*	0.45	1.5
	Allowable Passive Resistance	280 psf/ft	1.5
Rock	Allowable Bearing Capacity	4,000 psf	3.0
	Allowable Friction Factor*	0.50	1.5
	Allowable Passive Resistance	350 psf/ft	1.5

* Friction Factor is calculated as $\tan(\phi)$

Foundation Settlement

A total settlement of less than 1 inch is anticipated; a differential settlement of 0.5 inches in 25 feet is anticipated where foundations are bearing on like materials. The settlement criteria are based upon the assumption that foundations will be sized and loaded in accordance with the recommendations in this report.

Foundation Configuration

Conventional shallow foundations should be a minimum of 12 inches wide and founded a minimum of 12 inches below the lowest adjacent soil grade for one- and two-story slab-on-grade residences and 18 inches for foundations supporting a second floor (e.g., two-story with raised wood floors). Isolated pad foundations should be a minimum of 24 inches in plan dimension. A grade beam, having the same depth as the continuous footings, should also be cast across the vehicle openings of the residence garage.

Foundation reinforcement should be provided by the structural engineer. The reinforcement schedule should account for typical construction issues such as load consideration, concrete cracking, and the presence of isolated irregularities. At a minimum, we recommend that continuous footing foundations for single family residences be reinforced with two No. 4 reinforcing bars, one located near the bottom of the footing and one near the top of the stem wall.

Foundation Influence Line and Slope Setback

All footings should be founded below an imaginary 2H:1V plane projected up from the bottoms of adjacent footings and/or parallel utility trenches, or to a depth that achieves a minimum horizontal clearance of 6 feet from the outside toe of the footings to the slope face, whichever requires a deeper excavation.

Subgrade Conditions

Footings should never be cast atop soft, loose, organic, slough, debris, nor atop subgrades covered by ice or standing water. A representative of our firm should be retained to observe all subgrades during footing excavations and prior to concrete placement so that a determination as to the adequacy of subgrade preparation can be made.



Shallow Footing / Stemwall Backfill

All footing/stemwall backfill soil should be compacted to the criteria for engineered fill as recommended in Section 6.0 of this report.

Slab-on-Grade Construction

It is our opinion that soil-supported slab-on-grade floors could be used for the main floor of the structure, contingent on proper subgrade preparation. Often the geotechnical issues regarding the use of slab-on-grade floors include proper soil support and subgrade preparation, proper transfer of loads through the slab underlayment materials to the subgrade soils, and the anticipated presence or absence of moisture at or above the subgrade level. We offer the following comments and recommendations concerning support of slab-on-grade floors. The slab design (concrete mix design, curing procedures, reinforcement, joint spacing, moisture protection, and underlayment materials) is the purview of the project Structural Engineer.

Slab Subgrade Preparation

All subgrades proposed to support slab-on-grade floors should be prepared and compacted to the requirements of engineered fill as discussed in Section 6.0 of this report.

Slab Underlayment

As a minimum for slab support conditions, the slab should be underlain by a minimum 4-inch-thick crushed rock layer that is covered by a minimum 10-mil thick moisture retarding plastic membrane. The membrane may only be functional when it is above the vapor sources. The bottom of the crushed rock layer should be above the exterior grade to act as a capillary break and not a reservoir, unless it is provided with an underdrain system. The slab design and underlayment should be in accordance with ASTM E1643 and E1745.

An optional 1-inch blotter sand or pea gravel layer placed above the plastic membrane, is sometimes used to aid in curing of the concrete. Although historically common, this blotter layer is not currently included in slabs designed according to the 2019 Green Building Code. When omitted, special wet curing procedures will be necessary. If installed, the blotter layer can become a reservoir for excessive moisture if inclement weather occurs prior to pouring the slab, excessive water collects in it from the concrete pour, or an external source of water enters above or bypasses the membrane.

Our experience has shown that vapor transmission through concrete is controlled through proper concrete mix design. As such, proper control of moisture vapor transmission should be considered in the design of the slab as provided by the project architect, structural or civil engineer. It should be noted that placement of the recommended plastic membrane, proper mix design, and proper slab underlayment and detailing per ASTM E1643 and E1745 will not provide a waterproof condition. If a waterproof condition is desired, we recommend that a waterproofing expert be consulted for slab design.

Slab Thickness and Reinforcement

Geotechnical reports have historically provided minimums for slab thickness and reinforcement for general crack control. The concrete mix design and construction practices can additionally have a large impact on concrete crack control. All concrete should be anticipated to crack. As such, these minimums should not be considered to be standalone items to address crack control, but are suggested to be considered in the slab design methodology.

In order to help control the growth of cracks in interior concrete from becoming significant, we suggest the following minimums. Interior concrete slabs-on-grade not subject to heavy loads,



should be a minimum of 4-inches thick and reinforced. A minimum of No. 3 deformed reinforcing bars placed at 24 inches on center both ways, at the center of the structural section is suggested. Joint spacing should be provided by the structural engineer. Troweled joints recovered with paste during finishing or “wet sawn” joints should be considered every 10 feet on center. Expansion joint felt should be provided to separate floating slabs from foundations and at least at every third joint. Cracks will tend to occur at recurrent corners, curved or triangular areas and at points of fixity. Trim bars can be utilized at right angle to the predicted crack extending 40 bar diameters past the predicted crack on each side.

Vertical Deflections

Soil-supported slab-on-grade floors can deflect downward when vertical loads are applied, due to elastic compression of the subgrade. For preliminary design of concrete floors, a modulus of subgrade reaction of $k = 150$ psi per inch would be applicable for engineered fills.

Exterior Flatwork

Exterior concrete flatwork is recommended to have a 4-inch-thick rock cushion. This could consist of vibroplate compacted crushed rock or compacted $\frac{3}{4}$ -inch aggregate baserock. If exterior flatwork concrete is against the floor slab edge without a moisture separator it may transfer moisture to the floor slab. Expansion joint felt should be provided to separate exterior flatwork from foundations and at least at every third joint. Contraction / groove joints should be provided to a depth of at least $\frac{1}{4}$ of the slab thickness and at a spacing of less than 30 times the slab thickness for unreinforced flatwork, dividing the slab into nearly square sections. Cracks will tend to occur at recurrent corners, curved or triangular areas and at points of fixity. Trim bars can be utilized at right angle to the predicted crack extending 40 bar diameters past the predicted crack on each side.

Retaining Walls

Our design recommendations and comments regarding retaining walls for the project site are discussed below. *Retaining wall foundations should be designed in accordance with the Shallow Conventional Foundations section above.*

Retaining Wall Lateral Pressures

Based on our observations and testing, the retaining wall should be designed to resist lateral pressure exerted from a soil media having an equivalent fluid weight provided in the table below. The values presented below are not factored and are for conditions when firm native soil or engineered fill is used within the zone behind the wall defined as twice the height of the retaining wall. Additionally, the values do not account for the friction of the backfill on the retaining wall which may or may not be present depending on the wall materials and construction.

The lateral pressures presented in the table below include recommendations for earthquake loading which is required for structures to be designed in Seismic Design Categories D, E, or F per Section 1803.5.12.1 of the 2019 California Building Code. The lateral pressures presented have been calculated using the Mononobe-Okabe Method derived from Wood (1973) and modified by Whitman et al. (1991). The values are intended to be used as the multiplier for uniformly distributed loads and the parameter “H” is the total height of the wall including the footing but excluding any key, if used.



Table 7: Retaining Wall Pressures

Wall Type	Wall Slope Configuration	Equivalent Fluid Weight (pcf)	Lateral Pressure Coefficient	Earthquake Loading (plf)	
Free Cantilever	Flat	33	0.27	3H ²	Applied 0.6H above the base of the wall
	2H:1V	46	0.37	14H ²	
Restrained*	Flat	52	0.41		

* Restrained conditions shall be defined as walls which are structurally connected to prevent flexible yielding, or rigid wall configurations (i.e., walls with numerous turning points) which prevent the yielding necessary to reduce the driving pressures from an at-rest state to an active state.

Generalized Design Values

Some software and design methods do not use the equivalent fluid weight method presented above; instead, they use design soil properties for a given soil condition such as the internal friction angle, cohesion, and bulk unit weight. Generally, this occurs for keyed or interlocking non-mortared walls such as segmental block (Basalite, Keystone, Allan Block, etc.) or rockery walls. When this occurs, the following soil parameters would be applicable for design with the onsite native materials in a firm condition or for engineered fills. The seismic coefficient is considered to be ½ of the adjusted peak ground acceleration for the site conditions is given in Section 4.0 of this report. Some software allows for the extension of the Mononobe-Okabe Method beyond the conventional limitations and, if the method is applied, could calculate seismic values significantly higher than those provided by the multiplier method provided above.

Table 8: Generalized Design Parameters

Internal Angle of Friction	Cohesion	Bulk Unit Weight	Seismic Coefficient, Kh
36°	0 psf	125 pcf	0.111g

Wall Drainage

The criteria presented above is based on fully drained conditions as detailed in the attached Figure C-3, Appendix C. For these conditions, we recommend that a blanket of filter material be placed behind all proposed walls. Permeable materials are specified in Section 68 of the California Department of Transportation Standard Specifications, current edition. The filter material should conform to Class 1, Type B permeable material in combination with a filter fabric to separate the open graded gravel/rock from the surrounding soils. Generally, a clean ¾ inch crushed rock should be acceptable. Consistent with Caltrans Standards, when Class 2 permeable materials are used, the filter fabric may be omitted unless otherwise designed.

The blanket of filter material should be a minimum of 12-inches thick and should extend from the bottom of the wall to within 12 inches of the ground surface. The top 12 inches of wall backfill should consist of a compacted soil cap. A filter fabric having specifications equal to or greater than those for Mirafi 140N should be placed between the gravel filter material and the surrounding soils to reduce the potential for infiltration of soil into the gravel. A 4-inch diameter drain pipe should be installed near the bottom of the filter blanket with perforations facing down. The drainpipe should be underlain by at least 4 inches of filter-type material. An adequate gradient should be provided along the top of the foundation to discharge water that collects behind the retaining wall to a controlled discharge system.

The configuration of a long retaining wall generally does not allow for a positive drainage gradient within the perforated drain pipe behind the wall since the wall footing is generally flat with no gradient for drainage. Where this condition is present, to maintain a positive drainage behind the walls, we recommend that the wall drains be provided with a discharge to an appropriate non-erosive outlet a maximum of 50 feet on center. **In addition, if the wall drain outlets are**



temporarily stubbed out in front of the walls for future connection during construction, it is imperative that the outlets be routed into the tight pipe area drainage system and not buried and rendered ineffective.

Asphalt Concrete Pavement Design

We understand that asphalt pavements will be used for the associated roadways. The following comments and recommendations are given for pavement design and construction purposes. All pavement construction and materials used should conform to applicable sections of the latest edition of the California Department of Transportation Standard Specifications.

Subgrade Compaction

After installation of any underground facilities, the upper 8 inches of subgrade soils under pavements sections should be compacted to a minimum relative compaction of 95 percent based on the ASTM D1557 test method at a moisture content near or above optimum. Aggregate bases should also be compacted to a minimum relative compaction of 95 percent based on the aforementioned test method.

Subgrade Stability

All subgrades and aggregate base should be proof-rolled with a full water truck or equivalent immediately before paving, in order to evaluate their condition. If unstable subgrade conditions are observed, these areas should be overexcavated down to firm materials and the resulting excavation backfilled with suitable materials for compaction (i.e., drier native soils or aggregate base). Areas displaying significant instability may require geotextile stabilization fabric within the overexcavated area, followed by placement of aggregate base. Final determination of any required overexcavation depth and stabilization fabric should be based on the conditions observed during subgrade preparation.

Design Criteria

Critical features that govern the durability of a pavement section include the stability of the subgrade; the presence or absence of moisture, free water, and organics; the fines content of the subgrade soils; the traffic volume; and the frequency of use by heavy vehicles. Soil conditions can be defined by a soil resistance value, or "R-Value," and traffic conditions can be defined by a Traffic Index (TI).

Design Values

The following table provides recommended pavement sections based on R-Value test (CTM 301) performed on bulk samples representative of the materials expected to be exposed at subgrade, as well as our experience with similar materials in the area. An R-value of 67 was determined for the soil tested. Due to the variability of soils and the potential redistribution of material typically encountered during grading, we used an R-Value of 40 in our design.

Design values provided are based upon properly drained subgrade conditions. Although the R-Value design to some degree accounts for wet soil conditions, proper surface and landscape drainage design is integral in performance of adjacent street sections with respect to stability and degradation of the asphalt. If clay soils are encountered and cannot be sufficiently blended with non-expansive soils, we should review pavement subgrades to determine the appropriateness of the provided sections, and provide additional pavement design recommendations as field conditions dictate. Even minor clay constituents will greatly reduce the design R-Value.

The recommended design thicknesses presented in the following table were calculated in accordance with the methods presented in the Sixth Edition of the California Department of



Transportation Highway Design Manual. A varying range of traffic indices are provided for use by the project Civil Engineer for roadway design.

Table 9: Asphalt Pavement Section Recommendations

Design Traffic Indices	Alternative Pavement Sections (Inches)	
	Asphalt Concrete *	Aggregate Base **
4.5	3.0	4.0
5.0	3.0	4.0
5.5	3.0	5.0
	3.5	4.0
6.0	3.0	6.5
	3.5	5.5
6.5	3.5	7.0
	4.0	6.0
7.0	4.0	7.0
	4.5	6.0

* Asphalt Concrete: must meet specifications for Caltrans Hot Mix Asphalt Concrete

** Aggregate Base: must meet specifications for Caltrans Class II Aggregate Base (R-Value = minimum 78)

Due to the redistribution of materials that occurs during mass grading operations, we should review pavement subgrades to determine the appropriateness of the provided sections.

Portland Cement Concrete Pavement Design

We understand that Portland cement concrete pavements may be considered for various aspects of exterior paving for the site. The American Concrete Institute (ACI) Concrete Pavement Design method (ACI 330R-08) was used for design of the exterior concrete (rigid) pavements at the site. The pavement thicknesses were evaluated based on the soil design parameters provided in the following table.

Table 10: Soil Parameters

Subgrade Soil Description	k, Modulus of Subgrade Reaction*	Base Course
Silty SAND	200 pci	6 inches

* Based on an R-Value of 40 as recommended above and correlated to a k-Value recommended by ACI 330R.

Based on the subgrade soil parameters shown in the above table, the recommended concrete thicknesses for various traffic descriptions are presented in the table below. The recommended thicknesses provided below assume the use of plain (non-reinforced) concrete pavements.

We recommend that the rigid pavement be placed on at least 6 inches of aggregate base compacted to at least 95 percent of the maximum dry density per the ASTM D 1557 test method. From a geotechnical perspective, contraction joints should be placed in accordance with the American Concrete Institute (ACI) recommendations which include providing a joint spacing about 30 times the slab thickness up to a maximum of 10 feet. The joint patterns should also divide the slab into nearly square panels. If increased joint spacing is desired, reinforcing steel should be installed within the pavement in accordance with ACI recommendations. Final determination of steel reinforcement configurations (if used within the pavements) remains the purview of the Project Structural Engineer.



Table 11: Concrete Pavement Section Recommendations

Category	ADTT*	Pavement Traffic Description	Thickness (inches)	
			3000 psi**	4000 psi**
A	1	Car parking areas and access lanes Autos, pickups, and panel trucks only	4.0	4.0
A	10		5.0	4.5
B	25	Shopping center entrance and service lanes Bus parking areas and interior lanes Single-unit truck parking areas and interior lanes	5.5	5.0
B	300		6.0	5.5
C	100	Roadway Entrances and Exterior Lanes	6.5	6.0
C	300		6.5	6.0
C	700		6.5	6.5

* Average Daily Truck Traffic

** 28-day concrete compressive strength

Drainage

In order to maintain the engineering strength characteristics of the soil presented for use in this report, maintenance of the site will need to be performed. This maintenance generally includes, but is not limited to, proper drainage and control of surface and subsurface water which could affect structural support and fill integrity. A difficulty exists in determining which areas are prone to the negative impacts resulting from high moisture conditions due to the diverse nature of potential sources of water; some of which are outlined in the paragraph below. We suggest that measures be installed to minimize exposure to the adverse effects of moisture, but this will not guarantee that excessive moisture conditions will not affect the structure.

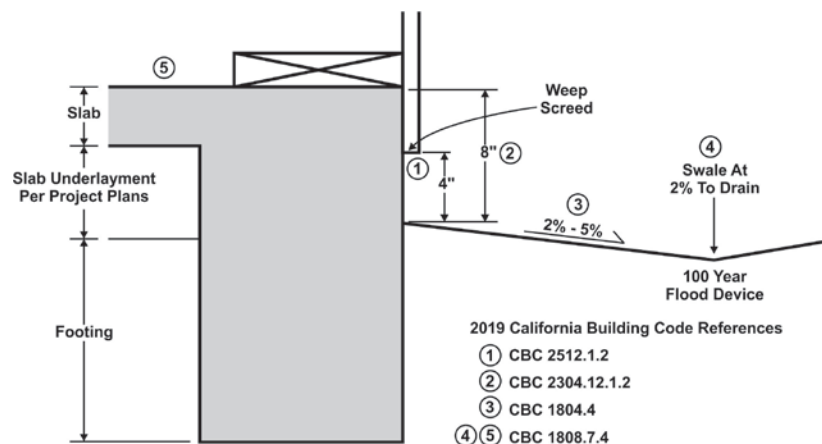
Some of the diverse sources of moisture could include water from landscape irrigation, annual rainfall, offsite construction activities, runoff from impermeable surfaces, collected and channeled water, and water perched in the subsurface soils. Some of these sources can be controlled through drainage features installed either by the owner or contractor. Others may not become evident until they, or the effects of the presence of excessive moisture, are visually observed on the property.

Some measures that can be employed to minimize the buildup of moisture include, but are not limited to proper backfill materials and compaction of utility trenches within the footprint of the proposed structures; grout plugs at foundation penetrations; collection and channeling of drained water from impermeable surfaces (i.e. roofs, concrete or asphalt paved areas); installation of subdrain/cut-off drain provisions; utilization of low flow irrigation systems; education to the proposed owners of proper design and maintenance of landscaping and drainage facilities that they or their landscaper installs.



Drainage Adjacent to Buildings

All grades should provide rapid removal of surface water runoff; ponding water should not be allowed on building pads or adjacent to foundations or other structural improvements (during and following construction). All soils placed against foundations during finish grading should be compacted to minimize water infiltration. Finish and landscape grading should include positive drainage away from all foundations. Section 1808.7.4 of the 2019 California Building Code (CBC) states that for graded soil sites, the top of any exterior foundation shall extend above the elevation of the street gutter at the point of discharge or the inlet of an approved drainage device a minimum of 12 inches plus 2 percent. If overland flow is not achieved adjacent to buildings, the drainage device should be designed to accept flows from a 100-year event. Grades directly adjacent to foundations should be no closer than 8 inches from the top of the slab (CBC 2304.12.1.2), and weep screeds are to be placed a minimum of 4 inches clear of soil grades and 2 inches clear of concrete or other hard surfacing (CBC 2512.1.2). From this point, surface grades should slope a minimum of 2 percent away from all foundations for at least 5 feet but preferably 10 feet, and then 2 percent along a drainage swale to the outlet (CBC 1804.4). Downspouts should be tight piped via an area drain network and discharged to an appropriate non-erosive outlet away from all foundations.



Typical 2019 California Building Code
Drainage Requirements

The above referenced elements pertaining to drainage of the proposed structures is provided as general acknowledgement of the California Building Code requirements, restated and graphically illustrated for ease of understanding. Surface drainage design is the purview of the Project Architect/Civil Engineer. Review of drainage design and implementation adjacent to the building envelopes is recommended as performance of these improvements is crucial to the performance of the foundation and construction of rigid improvements.

Subdrainage

Reduction of potential moisture related issues could be addressed by the construction of subdrains in addition to the drainage provisions provided in the 2019 CBC. Typical subdrain construction would include a 3 feet deep trench (or depth required to intercept the bottom of utility trenches) constructed as detailed on Figure C-4, Appendix C. The water collected in the subdrain pipe would be directed to an appropriate non-erosive outlet. We recommend that a representative from our firm be present during the subdrain installation procedures to document that the drain is installed in accordance with the observed field conditions, as well as to provide additional consultation as the conditions dictate.



As noted in the previous discussions, the moisture conditions may not manifest until after the site is developed. As such, any recommendations for the subdrain orientation and location to mitigate the moisture conditions can be provided on an as requested basis as the conditions arise.

Post Construction

All drainage related issues may not become known until after construction and landscaping are complete. Therefore, some mitigation measures may be necessary following site development. Landscape watering is typically the largest source of water infiltration into the subgrade. Given the soil conditions on site, excessive or even normal landscape watering could contribute to moisture related problems and/or cause distress to foundations and slabs, pavements, and underground utilities, as well as creating a nuisance where seepage occurs.

8.0 DESIGN REVIEW AND CONSTRUCTION MONITORING

Geotechnical engineering can be affected by natural variability of soils and, as with many projects, the contents of this report could be used and interpreted by many design professionals for the application and development of their plans. For these reasons, we recommend that our firm provide support through plan reviews and construction monitoring to aid in the production of a successful project.

Plan Review

The design plans and specifications should be reviewed and accepted by Youngdahl Consulting Group, Inc. prior to contract bidding. A review should be performed to determine whether the recommendations contained within this report are still applicable and/or are properly interpreted and incorporated into the project plans and specifications. Modifications to the recommendations provided in this report or to the design may be necessary at the time of our review based on the proposed plans.

Construction Monitoring

Construction monitoring is a continuation of geotechnical engineering to confirm or enhance the findings and recommendations provided in this report. It is essential that our representative be involved with all grading activities in order for us to provide supplemental recommendations as field conditions dictate. Youngdahl Consulting Group, Inc. should be notified at least two working days before site clearing or grading operations commence, and should observe the stripping of deleterious material, overexcavation of soft soils and existing fills (if present), and provide consultation, observation, and testing services to the grading contractor in the field. At a minimum, Youngdahl Consulting Group, Inc. should be retained to provide services listed in Table 12 below.

The recommendations included in this report have been based in part on assumptions about strata variations that may be tested only during earthwork. Accordingly, these recommendations should not be applied in the field unless Youngdahl Consulting Group, Inc. is retained to perform construction observation and thereby provide a complete professional geotechnical engineering service through the observational method. Youngdahl Consulting Group, Inc. cannot assume responsibility or liability for the adequacy of its recommendations when they are used in the field without Youngdahl Consulting Group, Inc. being retained to observe construction.

Post Construction Drainage Monitoring

Due to the elusive nature of subsurface water, the alteration of water features for development, and the introduction of new water sources, all drainage related issues may not become known until after construction and landscaping are complete. Youngdahl Consulting Group, Inc. can



provide consultation services upon request that relate to proper design and installation of drainage features during and following site development.

9.0 LIMITATIONS AND UNIFORMITY OF CONDITIONS

1. This report has been prepared for the exclusive use of the addressee of this report for specific application to this project. The addressee may provide their consultants authorized use of this report. Youngdahl Consulting Group, Inc. has endeavored to comply with generally accepted geotechnical engineering practice common to the local area. Youngdahl Consulting Group, Inc. makes no other warranty, expressed or implied.
2. As of the present date, the findings of this report are valid for the property studied. With the passage of time, changes in the conditions of a property can occur whether they be due to natural processes or to the works of man on this or adjacent properties. Legislation or the broadening of knowledge may result in changes in applicable standards. Changes outside of our control may cause this report to be invalid, wholly or partially. Therefore, this report should not be relied upon after a period of three years without our review nor should it be used or is it applicable for any properties other than those studied.
3. Section [A] 107.3.4 of the 2019 California Building Code states that, in regard to the design professional in responsible charge, the building official shall be notified in writing by the owner if the registered design professional in responsible charge is changed or is unable to continue to perform the duties.

WARNING: Do not apply any of this report's conclusions or recommendations if the nature, design, or location of the facilities is changed. If changes are contemplated, Youngdahl Consulting Group, Inc. must review them to assess their impact on this report's applicability. Also note that Youngdahl Consulting Group, Inc. is not responsible for any claims, damages, or liability associated with any other party's interpretation of this report's subsurface data or reuse of this report's subsurface data or engineering analyses without the express written authorization of Youngdahl Consulting Group, Inc.

4. The analyses and recommendations contained in this report are based on limited windows into the subsurface conditions and data obtained from subsurface exploration. The methods used indicate subsurface conditions only at the specific locations where samples were obtained, only at the time they were obtained, and only to the depths penetrated. Samples cannot be relied on to accurately reflect the strata variations that usually exist between sampling locations. Should any variations or undesirable conditions be encountered during the development of the site, Youngdahl Consulting Group, Inc. will provide supplemental recommendations as dictated by the field conditions.



Table 12: Checklist of Recommended Services

Item Description		Recommended	Not Anticipated
1	Provide foundation design parameters	Included	
2	Review grading plans and specifications	✓	
3	Review foundation plans and specifications	✓	
4	Observe and provide recommendations regarding demolition		✓
5	Observe and provide recommendations regarding site stripping	✓	
6	Observe and provide recommendations on moisture conditioning, removal, and/or recompaction of unsuitable existing soils	✓	
7	Observe and provide recommendations on the installation of subdrain facilities	✓	
8	Observe and provide testing services on fill areas and/or imported fill materials	✓	
9	Review as-graded plans and provide additional foundation recommendations, if necessary	✓	
10	Observe and provide compaction tests on storm drains, water lines and utility trenches	✓	
11	Observe foundation excavations and provide supplemental recommendations, if necessary, prior to placing concrete	✓	
12	Observe and provide moisture conditioning recommendations for foundation areas and slab-on-grade areas prior to placing concrete		✓
13	Provide design parameters for retaining walls	Included	
14	Observe retaining wall drain installation	✓	
15	Provide finish grading and drainage recommendations	Included	
16	Provide geologic observations and recommendations for keyway excavations and cut slopes during grading	✓	
17	Excavate and recompact all test pits within structural areas	✓	

APPENDIX A

Field Study

Vicinity Map

Site Plan

Exploratory Test Pit Logs

Soil Classification Chart and Log Explanation



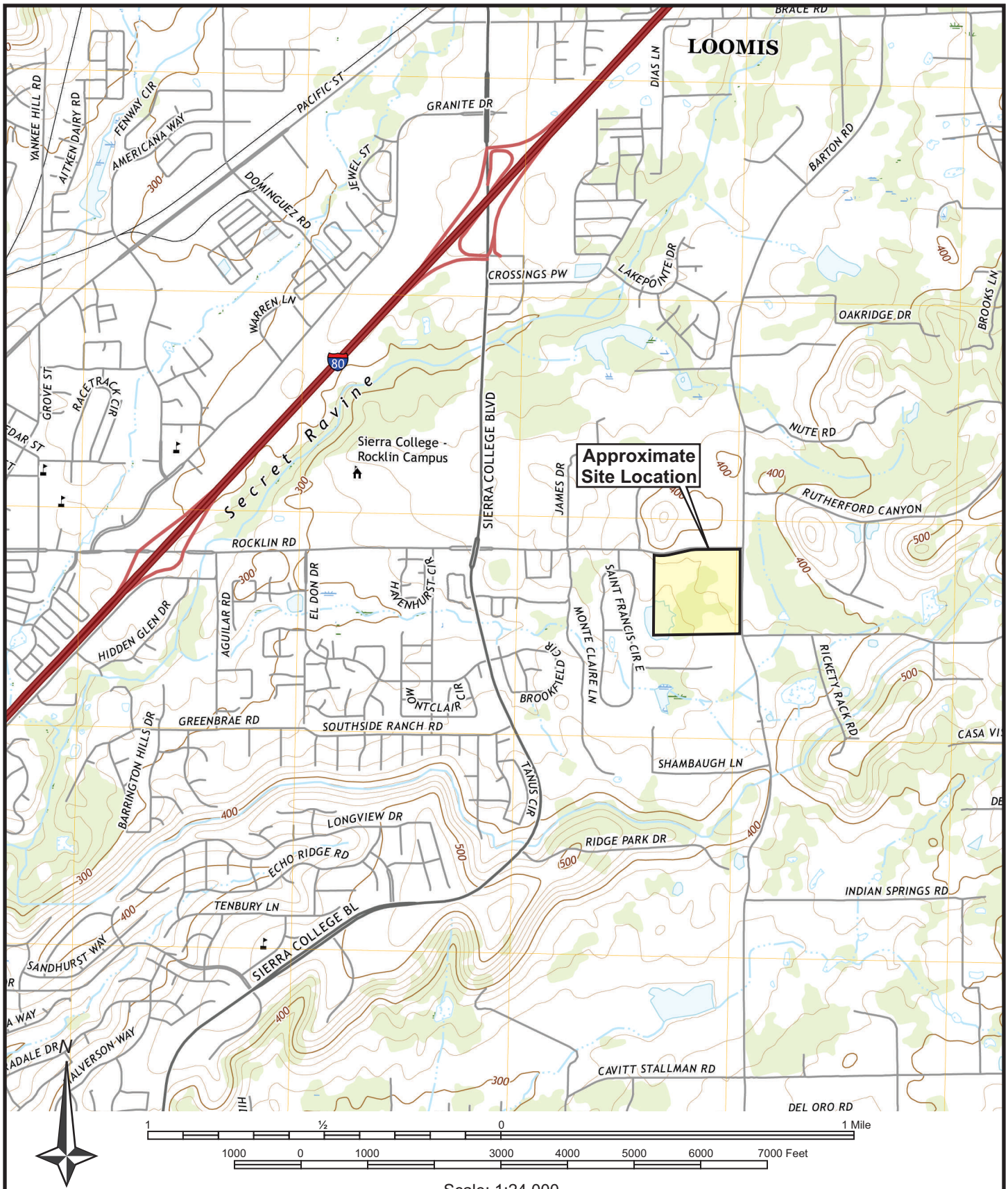
Introduction

The contents of this appendix shall be integrated with the Geotechnical Engineering Study of which it is a part. They shall not be used in whole or in part as a sole source for information or recommendations regarding the subject site.

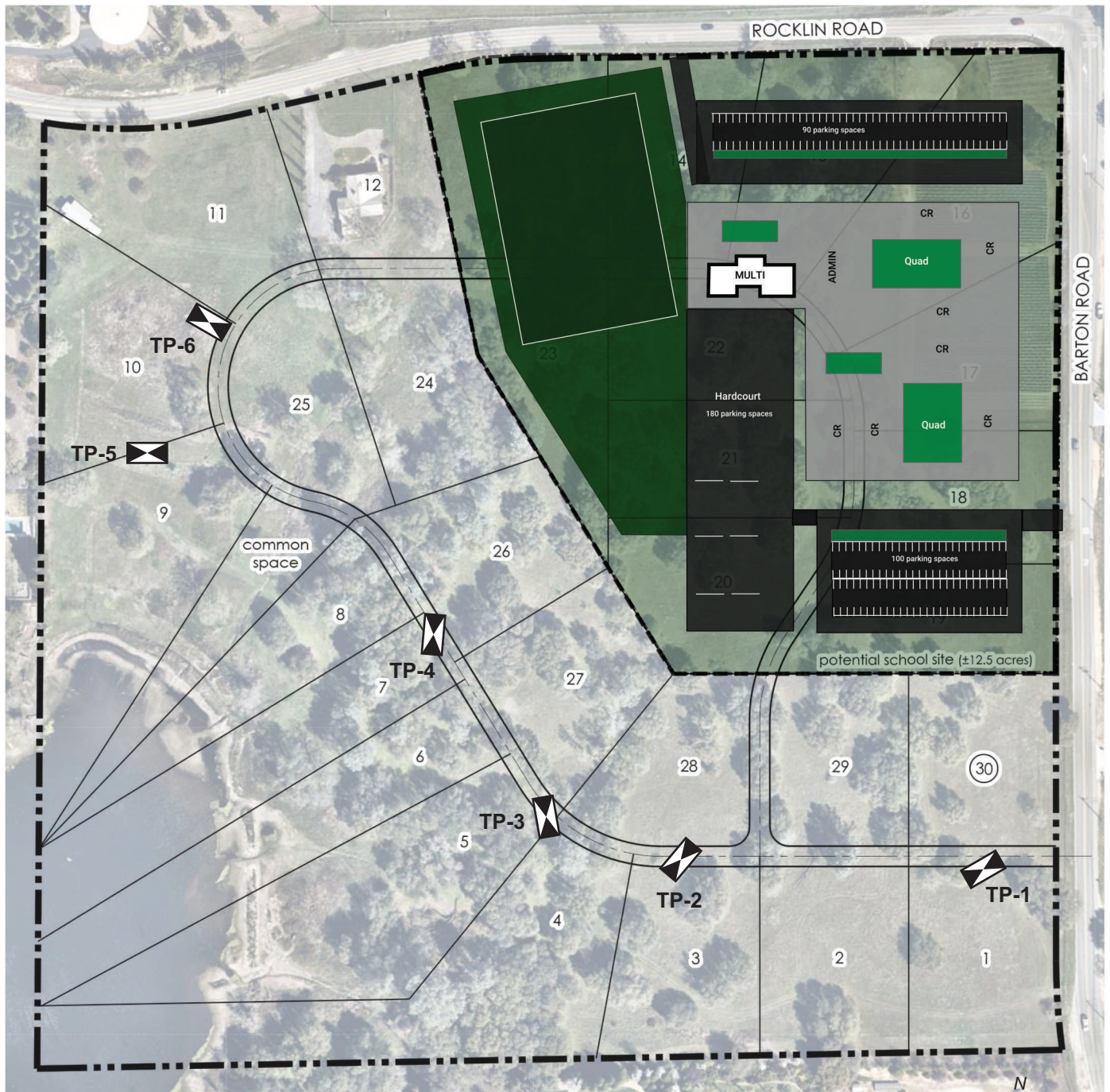
Our field study included a site reconnaissance by a Youngdahl Consulting Group, Inc. representative followed by a subsurface exploration program conducted on 9 August 2022, which included the excavation of six test pits under his direction at the approximate locations shown on Figure A-2, this Appendix. Excavation of the test pits was accomplished with a John Deere 410G equipped with a 24-inch-wide bucket. The bulk and bag samples collected from the test pits were returned to our laboratory for further examination and testing.


The Exploratory Test Pit Logs describe the vertical sequence of soils and materials encountered in each test pit, based primarily on our field classifications and supported by our subsequent laboratory examination and testing. Where a soil contact was observed to be gradual, our logs indicate the average contact depth. Our logs also graphically indicate the approximate depth of each soil sample obtained from the test pits.

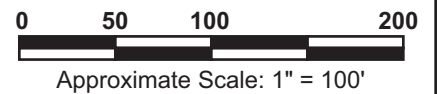
The soils encountered were logged during excavation and provide the basis for the "Exploratory Test Pit Logs", Figures A-3 through A-8, this Appendix. These logs show a graphic representation of the soil profile and the depths at which samples were collected.




BASE MAP REFERENCE: U.S.G.S. 7.5 Minute Topographic Series, Rocklin Quadrangle, Dated 2021

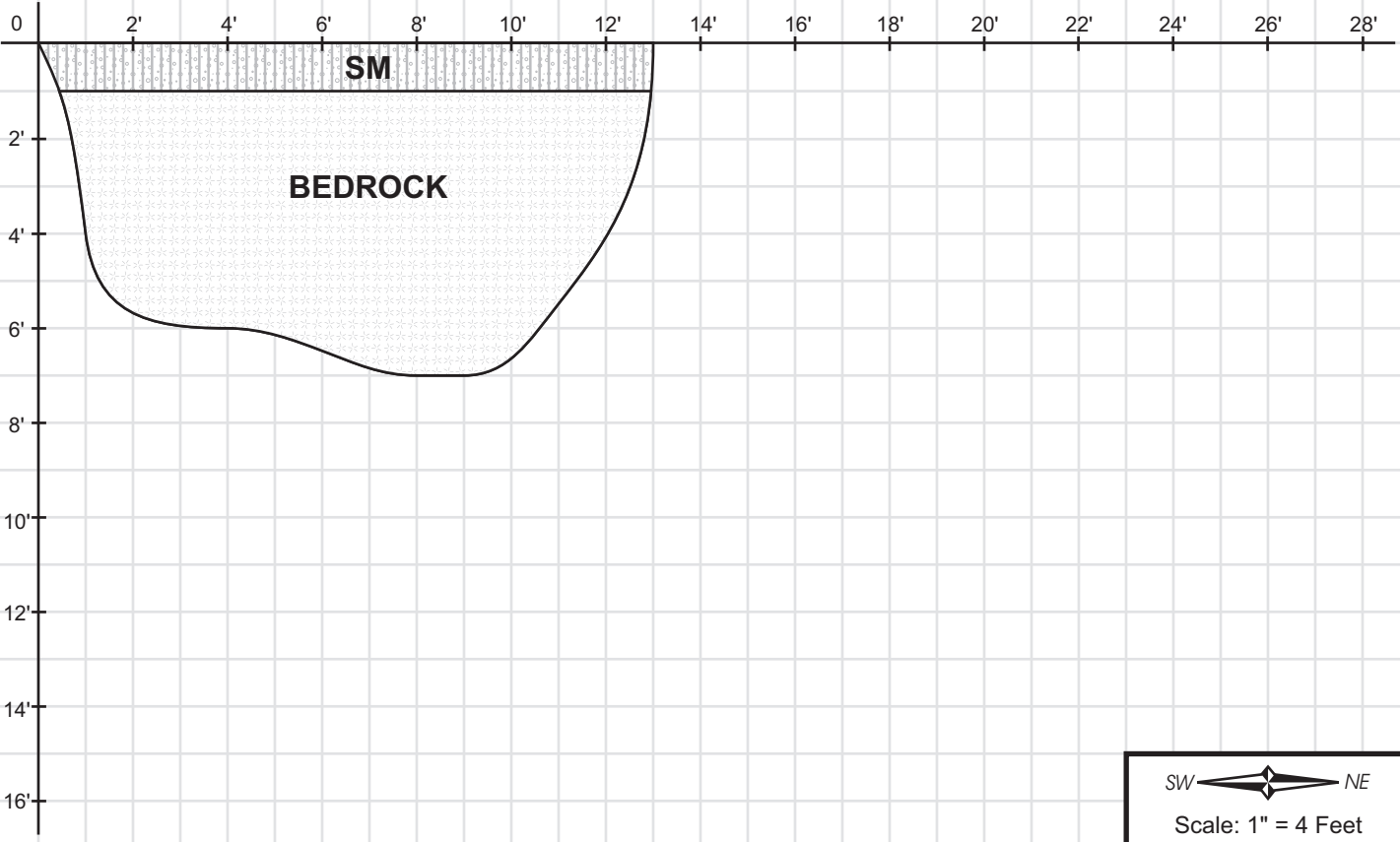



TP-1  = Approximate Test Pit Locations




REFERENCE: Site Plan, Loomis Basin Charter, Rainforth Grau Architects, Dated 5/17/2022

Logged By: PF		Date: 9 August 2022		Lat / Lon: N 38.785732° / W 121.192454°		Pit No. TP-1	
Equipment: John Deere 410G with 12" Bucket				Pit Orientation: 240°		Elevation: ~	
Depth (Feet)	Geotechnical Description & Unified Soil Classification			Sample	Tests & Comments		
@ 0' - 1'	Brown silty SAND (SM) with trace gravel, medium dense to dense, dry			 TP-1 @ 0-2'	TP-1 @ 0-2' R-Value = 67		
@ 1' - 2.5'	Yellow brown granitic BEDROCK , highly weathered, soft to moderately soft, dry						
@ 2.5' - 6'	<i>Grades moderately weathered, moderately hard</i>						
@ 6' - 7'	<i>Grades hard to very hard</i>						
	Test pit terminated at 7' (practical refusal) No free groundwater encountered No caving noted						





SW  NE
 Scale: 1" = 4 Feet

Note: The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations. Note, too, that the passage of time may affect conditions at the sampling locations.

 YOUNGDAHL CONSULTING GROUP, INC. <small>ESTABLISHED 1984</small>	Project No.: E22325.000	EXPLORATORY TEST PIT LOG Premier Montaire Loomis, California	FIGURE A-3
	September 2022		


Logged By: PF		Date: 9 August 2022		Lat / Lon: N 38.785772° / W 121.193808°		Pit No. TP-2	
Equipment: John Deere 410G with 12" Bucket				Pit Orientation: 220°		Elevation: ~	

Depth (Feet)	Geotechnical Description & Unified Soil Classification	Sample	Tests & Comments
@ 0' - 1'	Yellow brown silty SAND (SM) , medium dense to dense, dry	 TP-2 @ 2-3'	TP-2 @ 2-3' Corrosivity Suite
@ 1' - 2.5'	Red yellow granitic BEDROCK , highly weathered, moderately soft to moderately hard, dry to slightly moist		
@ 3.5' - 5'	<i>Grades moderately weathered, moderately hard to hard</i>		
	Test pit terminated at 5' (practical refusal) No free groundwater encountered No caving noted		



Scale: 1" = 4 Feet

Note: The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations. Note, too, that the passage of time may affect conditions at the sampling locations.

 YOUNGDAHL CONSULTING GROUP, INC. <small>ESTABLISHED 1984</small>	Project No.: E22325.000	EXPLORATORY TEST PIT LOG Premier Montaire Loomis, California	FIGURE A-4
	September 2022		


Logged By: PF		Date: 9 August 2022		Lat / Lon: N 38.785955° / W 121.194470°		Pit No. TP-3	
Equipment: John Deere 410G with 12" Bucket				Pit Orientation: 350°		Elevation: ~	


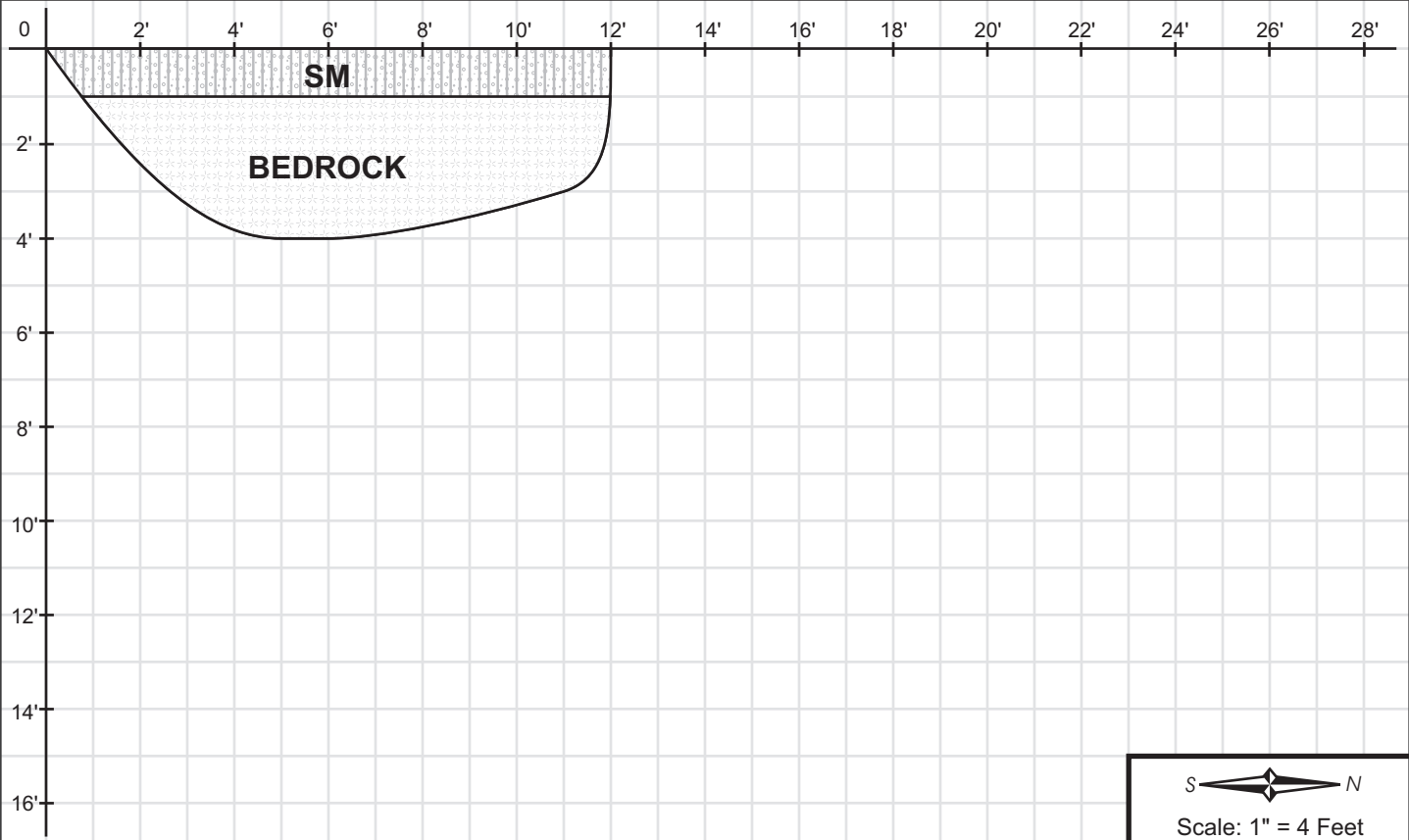


Depth (Feet)	Geotechnical Description & Unified Soil Classification	Sample	Tests & Comments
@ 0' - 1'	Red yellow silty SAND (SM) , medium dense to dense, dry		
@ 1' - 2.5'	Red yellow granitic BEDROCK , highly to moderately weathered, moderately hard to very hard, dry		
@ 0.75' - 3'	<i>Grades red yellow, highly to moderately weathered, moderately hard to very hard, dry</i>		
	Test pit terminated at 3' (practical refusal) No free groundwater encountered No caving noted		

S N



Scale: 1" = 4 Feet

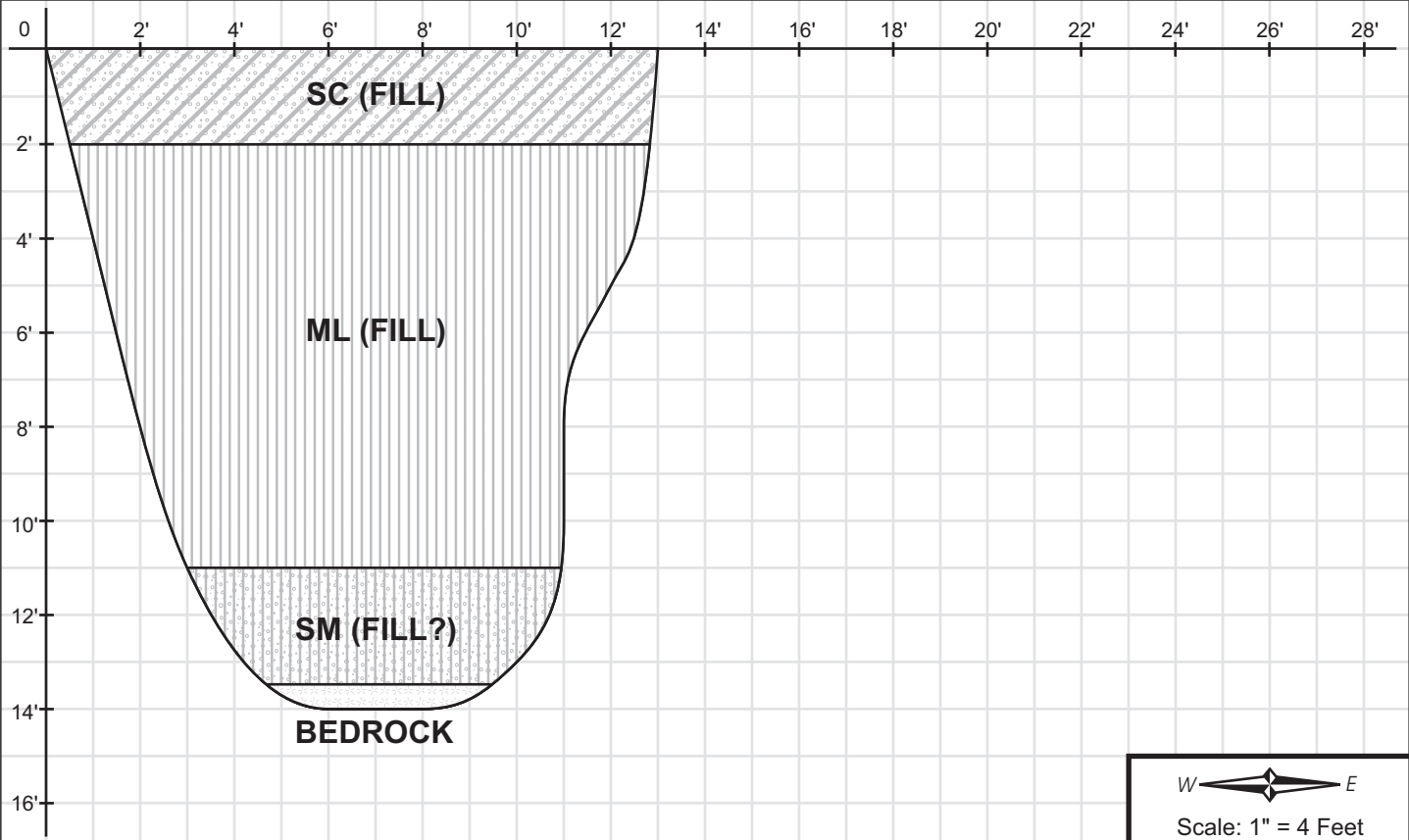
Note: The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations. Note, too, that the passage of time may affect conditions at the sampling locations.


 YOUNGDAHL CONSULTING GROUP, INC. <small>ESTABLISHED 1984</small>	Project No.: E22325.000	EXPLORATORY TEST PIT LOG Premier Montaire Loomis, California	FIGURE A-5
	September 2022		

Logged By: PF		Date: 9 August 2022		Lat / Lon: N 38.786608° / W 121.194939°		Pit No. TP-4	
Equipment: John Deere 410G with 12" Bucket				Pit Orientation: 5°		Elevation: ~	
Depth (Feet)	Geotechnical Description & Unified Soil Classification			Sample	Tests & Comments		
@ 0' - 1'	Dark brown silty SAND (SM) , medium dense to dense, dry			 TP-4 @ 0-1.5'	TP-4 @ 0-1.5' $\phi = 40.8^\circ$, $c = 25$ psf DDmax = 121.1 pcf MCopt = 8.9%		
@ 1' - 4'	Brown to red yellow granitic BEDROCK , highly to moderately weathered, moderately hard to very hard, dry						
	Test pit terminated at 4' (practical refusal) No free groundwater encountered No caving noted						
 <div style="text-align: right; margin-top: 10px;">  Scale: 1" = 4 Feet </div>							
Note: The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations. Note, too, that the passage of time may affect conditions at the sampling locations.							
 YOUNGDAHL CONSULTING GROUP, INC. <small>ESTABLISHED 1984</small>				Project No.: E22325.000 September 2022		EXPLORATORY TEST PIT LOG Premier Montaire Loomis, California	
						FIGURE A-6	

Logged By: PF		Date: 9 August 2022		Lat / Lon: N 38.787207° / W 121.196185°		Pit No. TP-5	
Equipment: John Deere 410G with 12" Bucket				Pit Orientation: 275°		Elevation: ~	


Depth (Feet)	Geotechnical Description & Unified Soil Classification	Sample	Tests & Comments
@ 0' - 2'	Olive yellow to pink clayey SAND (SC) with cobbles, medium dense, dry (FILL)	 TP-5 @ 0-2'  TP-5 @ 4-10'	TP-5 @ 4-10' EI = 61 (medium)
@ 2' - 11'	Pale olive sandy SILT (ML) with clay and trace gravel, medium stiff, slightly moist (FILL)		
@ 11' - 13.5'	Grey to brown silty SAND (SM) with clay, dense, slightly moist (FILL?)		
@ 13.5' - 14'	Black and brown granitic BEDROCK , completely to highly weathered, moderately hard, slightly moist		
	Test pit terminated at 14' (max reach) No free groundwater encountered No caving noted		





Scale: 1" = 4 Feet

Note: The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations. Note, too, that the passage of time may affect conditions at the sampling locations.


 YOUNGDAHL CONSULTING GROUP, INC. <small>ESTABLISHED 1984</small>	Project No.: E22325.000	EXPLORATORY TEST PIT LOG Premier Montaire Loomis, California	FIGURE A-7
	September 2022		

Logged By: PF		Date: 9 August 2022		Lat / Lon: N 38.787641° / W 121.195819°		Pit No. TP-6	
Equipment: John Deere 410G with 12" Bucket				Pit Orientation: 125°		Elevation: ~	

Depth (Feet)	Geotechnical Description & Unified Soil Classification	Sample	Tests & Comments
@ 0' - 0.5'	Brown sandy SILT (ML) , medium stiff, dry (FILL?)		
@ 0.5' - 4.5'	Grey to brown silty SAND (SM) , dense, slightly moist		
@ 4.5' - 5'	Black and brown granitic BEDROCK , highly weathered, moderately soft		
	Test pit terminated at 5' No free groundwater encountered No caving noted		

Diagram showing the test pit profile. The horizontal axis represents distance in feet (0 to 28'). The vertical axis represents depth in feet (0 to 16'). The pit is 12 feet wide and 5 feet deep. The soil layers are labeled: ML (FILL?) at the surface, SM (SAND) below it, and BEDROCK at the bottom. A scale bar at the bottom right indicates 1 inch = 4 feet.

Note: The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations. Note, too, that the passage of time may affect conditions at the sampling locations.

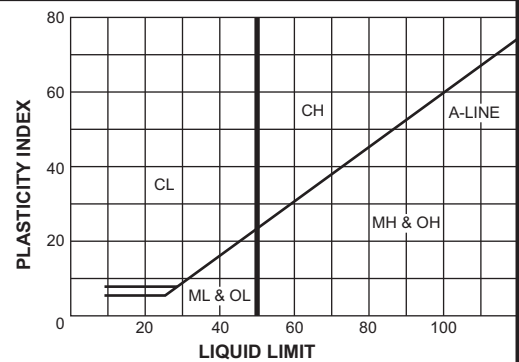
 YOUNGDAHL CONSULTING GROUP, INC. <small>ESTABLISHED 1984</small>	Project No.: E22325.000	EXPLORATORY TEST PIT LOG Premier Montaire Loomis, California	FIGURE A-8
	September 2022		

UNIFIED SOIL CLASSIFICATION SYSTEMS

MAJOR DIVISION		SYMBOLS		TYPICAL NAMES
COARSE GRAINED SOILS Over 50% > #200 sieve	GRAVELS Over 50% > #4 sieve	Clean GRAVELS With Little Or No Fines	GW	Well graded GRAVELS, GRAVEL-SAND mixtures
			GP	Poorly graded GRAVELS, GRAVEL-SAND mixtures
		GRAVELS With Over 12% Fines	GM	Silty GRAVELS, poorly graded GRAVEL-SAND-SILT mixtures
			GC	Clayey GRAVELS, poorly graded GRAVEL-SAND-CLAY mixtures
	SANDS Over 50% < #4 sieve	Clean SANDS With Little Or No Fines	SW	Well graded SANDS, gravelly SANDS
			SP	Poorly graded SANDS, gravelly SANDS
		SANDS With Over 12% Fines	SM	Silty SANDS, poorly graded SAND-SILT mixtures
			SC	Clayey SANDS, poorly graded SAND-CLAY mixtures
FINE GRAINED SOILS Over 50% < #200 sieve	SILTS & CLAYS Liquid Limit < 50	ML	Inorganic SILTS, silty or clayey fine SANDS, or clayey SILTS with plasticity	
		CL	Inorganic CLAYS of low to medium plasticity, gravelly, sandy, or silty CLAYS, lean CLAYS	
		OL	Organic CLAYS and organic silty CLAYS of low plasticity	
	SILTS & CLAYS Liquid Limit > 50	MH	Inorganic SILTS, micaceous or diamaceous fine sandy or silty soils, elastic SILTS	
		CH	Inorganic CLAYS of high plasticity, fat CLAYS	
		OH	Organic CLAYS of medium to high plasticity, organic SILTS	
	HIGHLY ORGANIC CLAYS		PT	PEAT & other highly organic soils

PLASTICITY CHART

USED FOR CLASSIFICATION OF FINE GRAINED SOILS



SAMPLE DRIVING RECORD

BLOWS PER FOOT	DESCRIPTION
25	25 Blows drove sampler 12 inches, after initial 6 inches of seating
50/7"	50 Blows drove sampler 7 inches, after initial 6 inches of seating
50/3"	50 Blows drove sampler 3 inches during or after initial 6 inches of seating

Note: To avoid damage to sampling tools, driving is limited to 50 blows per 6 inches during or after seating interval.

SOIL GRAIN SIZE

U.S. STANDARD SIEVE	6"	3"	¾"	4	10	40	200		
SOIL GRAIN SIZE IN MILLIMETERS	BOULDER	COBBLE	GRAVEL		SAND			SILT	CLAY
			COARSE	FINE	COARSE	MEDIUM	FINE		
	150	75	19	4.75	2.0	.425	0.075	0.002	

KEY TO PIT & BORING SYMBOLS

	Standard Penetration test
	2.5" O.D. Modified California Sampler
	3" O.D. Modified California Sampler
	Shelby Tube Sampler
	2.5" Hand Driven Liner
	Bulk Sample
	Water Level At Time Of Drilling
	Water Level After Time Of Drilling
	Perched Water

KEY TO PIT & BORING SYMBOLS

	Joint
	Foliation
	Water Seepage
NFWE	No Free Water Encountered
FWE	Free Water Encountered
REF	Sampling Refusal
DD	Dry Density (pcf)
MC	Moisture Content (%)
LL	Liquid Limit
PI	Plasticity Index
PP	Pocket Penetrometer
UCC	Unconfined Compression (ASTM D2166)
TVS	Pocket Torvane Shear
EI	Expansion Index (ASTM D4829)
Su	Undrained Shear Strength

APPENDIX B

Laboratory Testing

Direct Shear Test

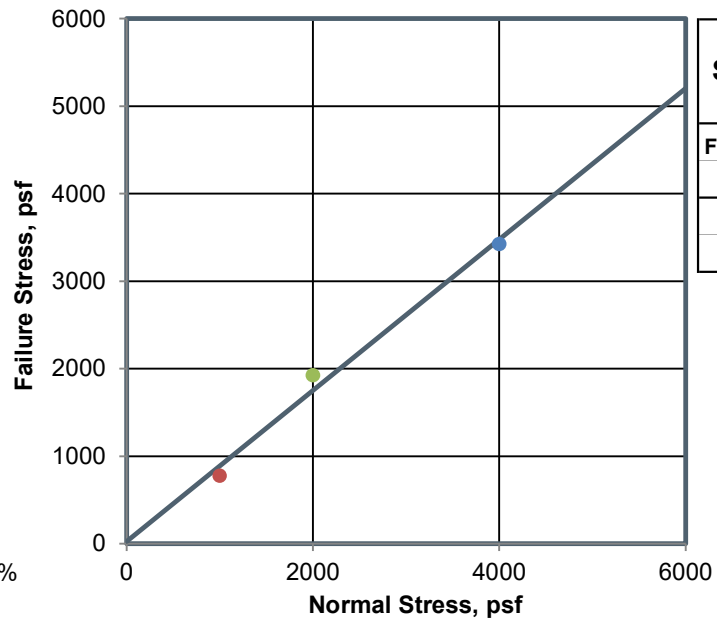
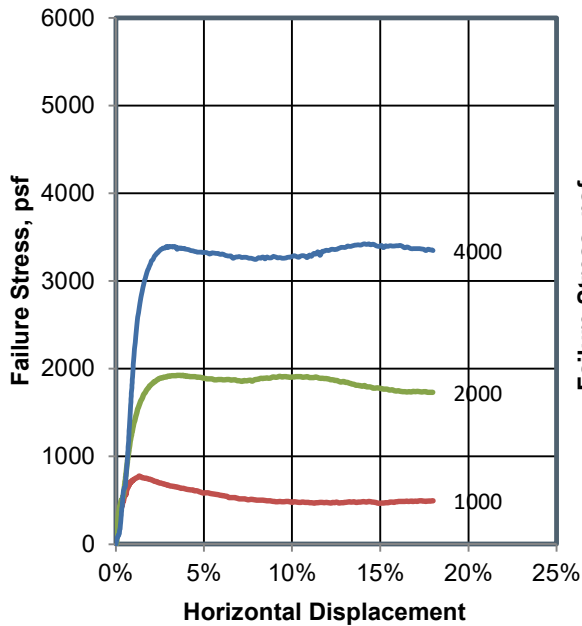
Modified Proctor Test

R-Value Test

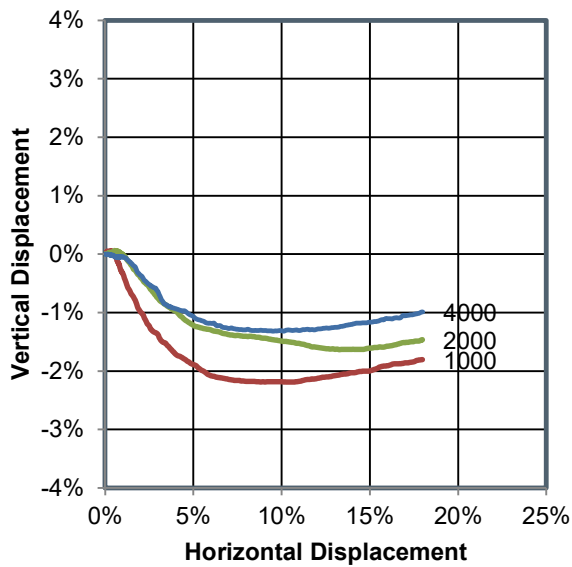
Expansion Index Test

Corrosivity Tests

Direct Shear Test of Soils Under Consolidated Drained Conditions, ASTM D3080



Direct Shearbox Results	
Friction Angle	40.8°
Cohesion	25 psf



Test No.		1	2	3
Initial	Wet Density, pcf	118.7	118.7	118.7
	Dry Density, pcf	109.0	109.0	109.0
	Moisture Content, %	8.9	8.9	8.9
	Diameter, in	2.50	2.50	2.50
	Height, in	1.00	1.00	1.00
Pre Shear	Wet Density, pcf	129.1	128.7	129.6
	Dry Density, pcf	109.6	110.2	111.5
	Moisture Content, %*	17.8	16.9	16.3
	Diameter, in	2.50	2.50	2.50
	Height, in	0.99	0.99	0.98
Normal Stress, psf		1000	2000	4000
Failure Stress, psf		775	1925	3426
Failure Strain, %		1.31	3.66	14.11
Rate, in/min		0.0025		

*Based on post shear moisture content

Sample Type: Remolded to 90% RC

Material Description: Dark Brown Silty SAND (Decomposed Granite)

Source: Native

Notes: Gravel removed from test sample.

Sample No./Depth: TP-4 @ 0-1.5'	USCS Class.	Liquid Limit	Plasticity Index	% Greater than No. 4	% Less than No. 200
Date Sampled: 8/9/2022 Date Test Started: 8/25/2022				0	



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Project: Premier Montaire

Project No.: E22325.000

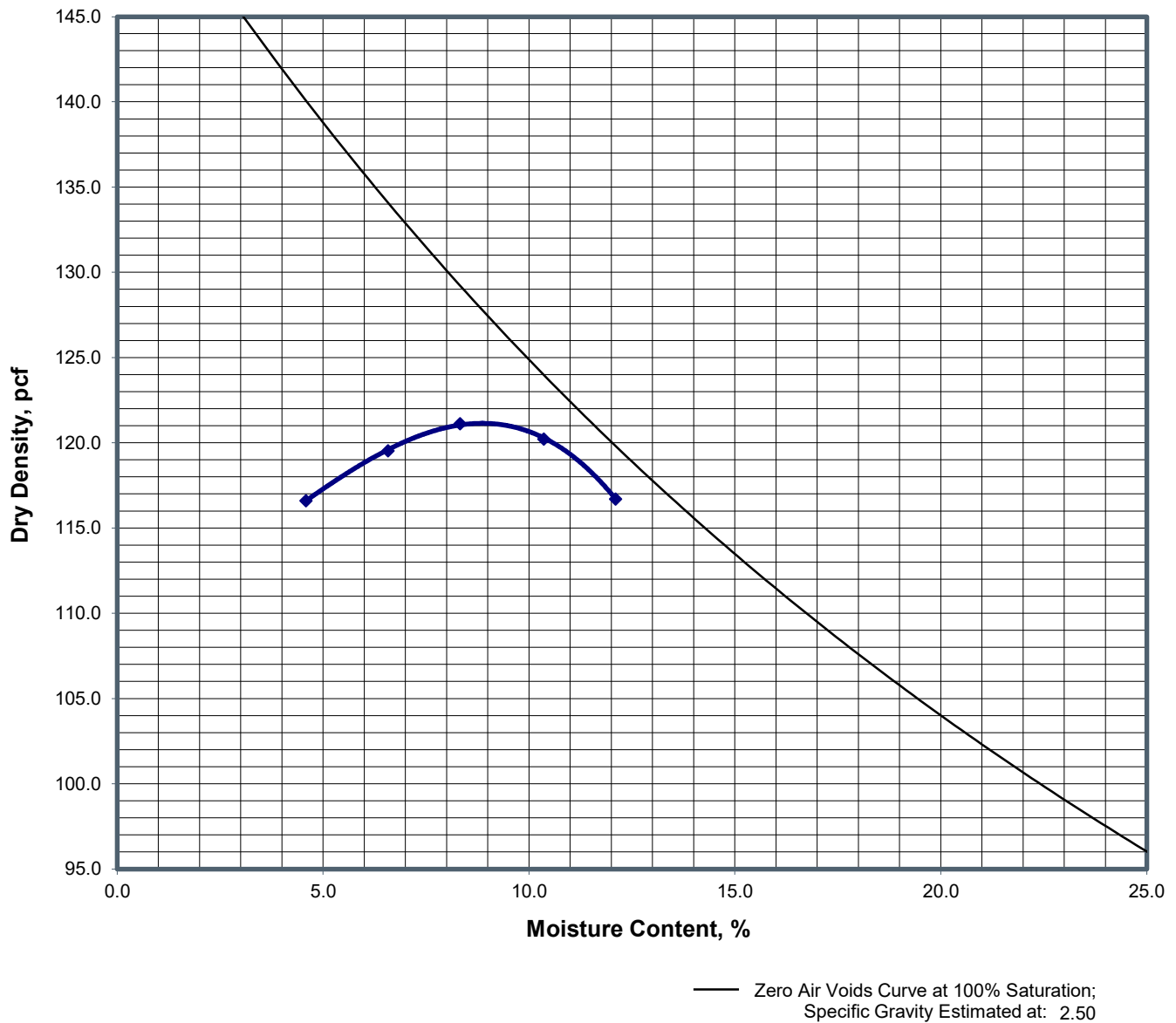
Reviewed By: DN


Date: 8/31/2022

Figure

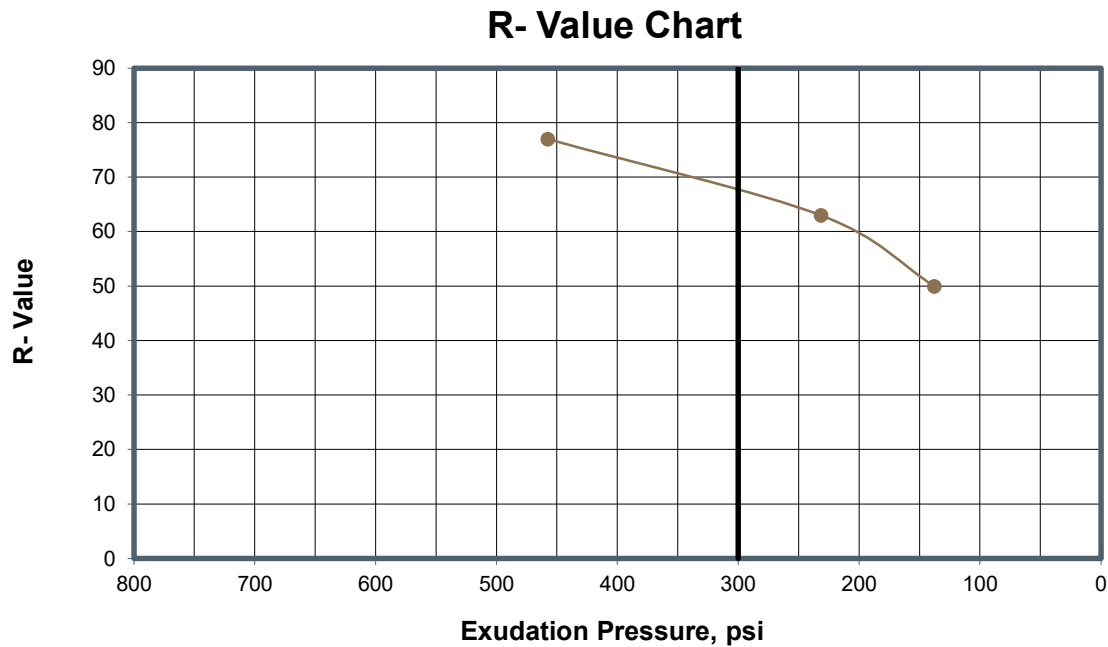
B-1

**Laboratory Compaction Characteristics of Soil
Using Modified Effort (56,000 lbf/ft³), ASTM D1557, Method A**



Maximum Dry Density, pcf:		121.1		Optimum Moisture Content, %:		8.9			
Material Description: Dark Brown Silty SAND (Decomposed Granite)									
Source: Native									
Notes:									
Sample No./Depth: TP-4 @ 0-1.5'				USCS Class.	Liquid Limit	Plasticity Index	% Greater than No. 4 :	% Less than No. 200	
Date Sampled: 8/9/2022		Date Test Started: 8/23/2022					0		
<div> YOUNGDAHL CONSULTING GROUP, INC. <i>ESTABLISHED 1984</i></div> <div>1234 Glenhaven Court, El Dorado Hills, CA 95762 ph 916.933.0633 ▪ fx 916.933.6482 ▪ www.youngdahl.net</div>				Project: Premier Montaire					
				Project No.: E22325.000					Figure B-2
				Reviewed By: DN		Date: 8/9/2022			

Resistance "R" Value of Soil and Soil-Aggregate Mixtures, CTM 301



Test Specimen No.:	1	2	3
Moisture Content at Test, %	9.7	10.7	11.7
Dry Density at Test, pcf	126.3	125.2	124.1
Expansion Pressure, psf	39	22	0
Exudation Pressure, psi	458	232	138
Resistance "R" Value	77	63	50
"R" Value at 300 psi Exudation Pressure	67		

Material Description: **Brown Silty SAND with trace Gravel (Decomposed Granite)**

Source:

Notes:

Sample No./Depth:	TP-1 @ 0-2'	USCS Class.	Liquid Limit	Plasticity Index	% Greater than No. 4	% Less than No. 200
Date Sampled:	8/9/2022	Date Test Started:	8/23/2022		1	



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Project: **Premier Montaire**

Project No.: **E22325.000**

Reviewed By: JLC

Date: 8/31/2022

Figure

B-3

Expansion Index of Soils, ASTM D4829

Test Results

Expansion Index	61
Dry Density, as molded, pcf	102.7
Moisture Content, as molded, %	12.0
Final Moisture Content, %	23.2
Initial Saturation, as molded, %	50.6

Classification of Potentially Expansive Soil

Expansion Index, EI	Potential Expansion
0 - 20	Very Low
21 - 50	Low
51 - 90	Medium
91 - 130	High
Above 130	Very High

Material Description: **Pale Olive Sandy SILT with Clay and trace Gravel**

Source:

Notes:

Sample No./Depth: TP-5 @ 4-10'	USCS Class.	Liquid Limit	Plasticity Index	% Greater than No. 4	% Less than No. 200
Date Sampled: 8/9/2022 Date Test Started: 8/16/2022				1	



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ph 916.933.0633 ■ fx 916.933.6482 ■ www.youngdahl.net

Project: **Premier Montaire**

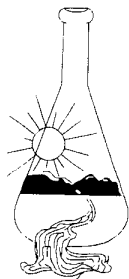
Project No.: **E22325.000**

Reviewed By: DN

Date: 8/25/2022

Figure

B-4



Sunland Analytical

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

Date Reported 08/17/2022
Date Submitted 08/12/2022

To: Jeffry Cannon
Youngdahl Consulting Group
1234 Glenhaven Ct.
El Dorado Hills, CA 95630

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : E22325.000 BARTON RD Site ID : TP-2 @ 2-3.
Thank you for your business.

* For future reference to this analysis please use SUN # 87960-182898.

EVALUATION FOR SOIL CORROSION

Soil pH	5.25		
Minimum Resistivity	14.74	ohm-cm (x1000)	
Chloride	3.0 ppm	00.00030	%
Sulfate	1.5 ppm	00.00015	%

METHODS

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

APPENDIX C

Details

Keyway and Bench with Drain

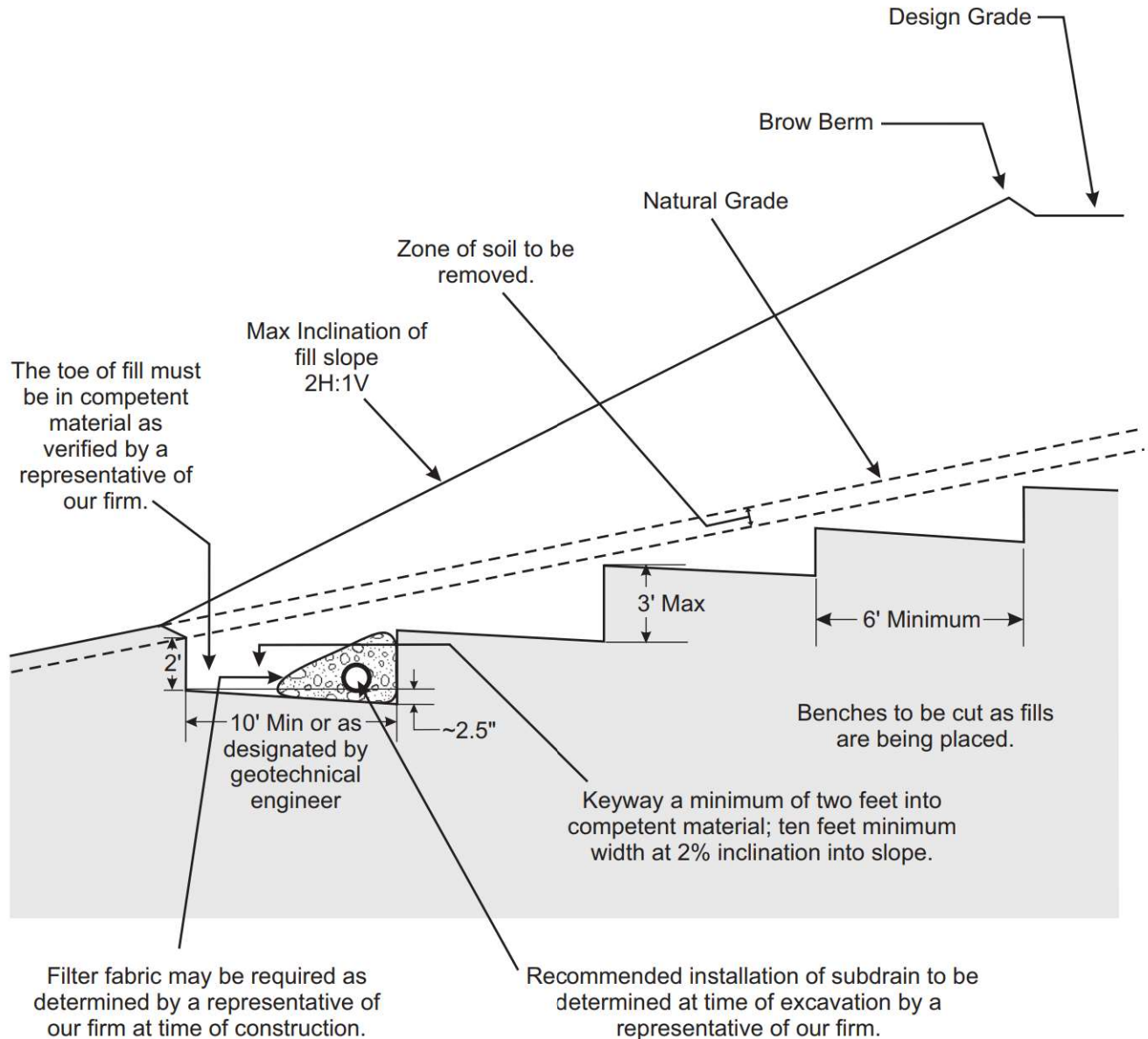
Plug and Drain

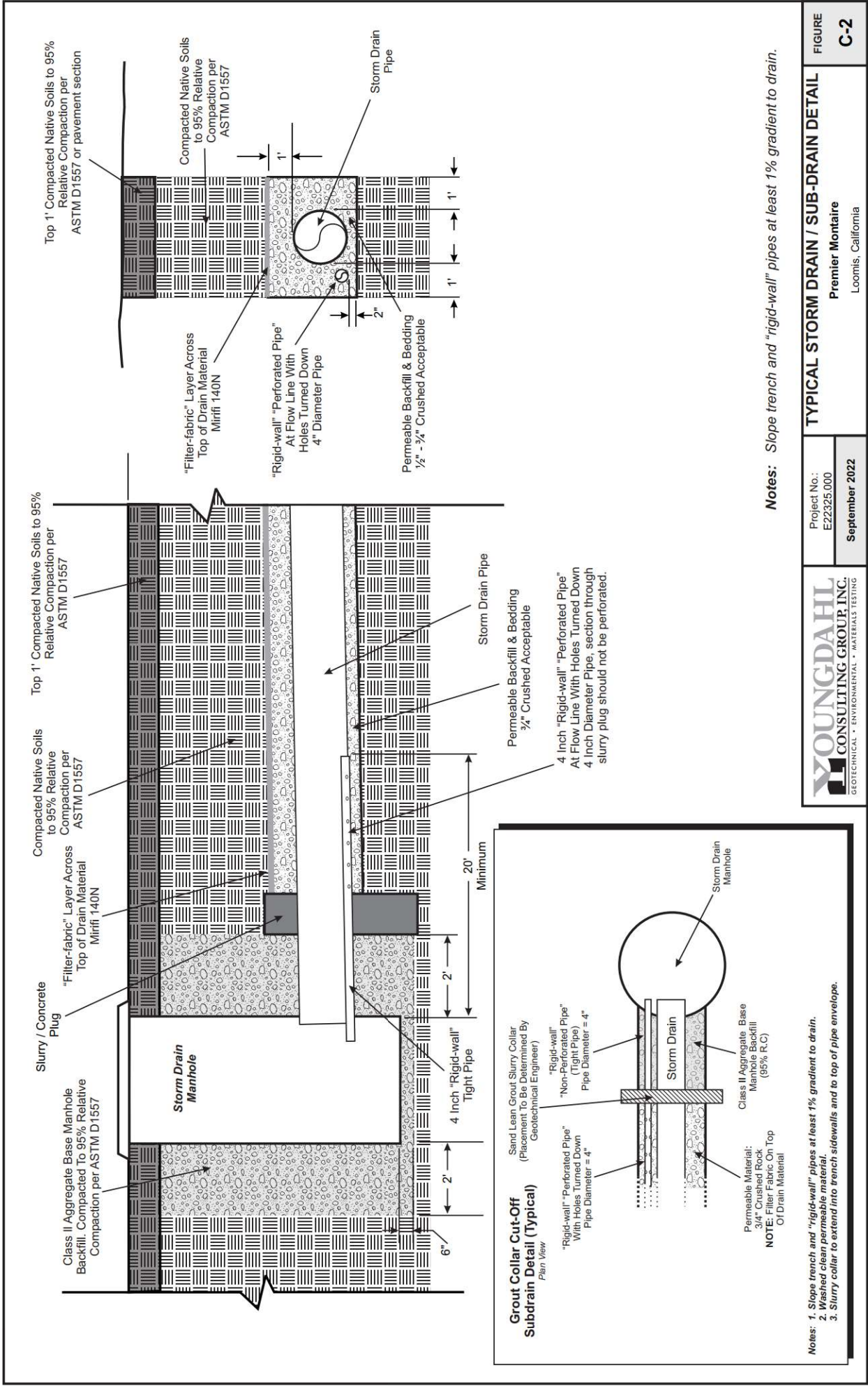
Site Wall Drainage

Subdrain

PLACEMENT OF FILL ON NATURAL SLOPE (Typical)

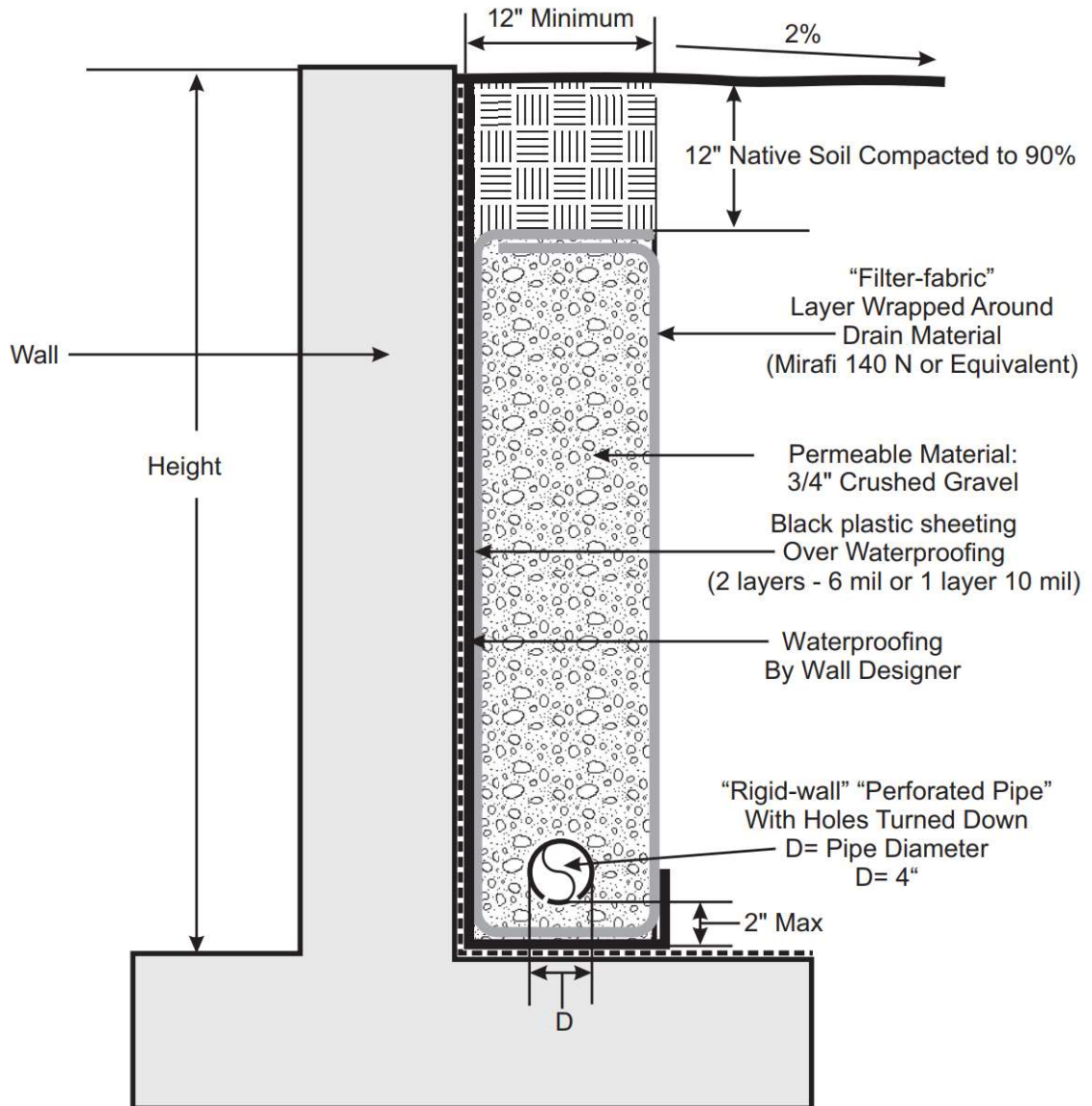
All keyways should be observed and approved prior to placement of fill.
A keyway is required by CBC for fills on natural slopes of 5H:1V or steeper.





Notes: Slope trench and "rigid-wall" pipes at least 1% gradient to drain.

Retaining Wall With “Perforated Pipe Sub-Drain” (Typical Cross Section)



- Notes:
1. Slope footing and “rigid-wall” pipes along flow line parallel to wall at least 1% gradient to drain to an appropriate outfall area away from residence.
 2. Use “sweeps” for directional changes in pipe flow (**do not use 90°elbows**).
 3. Provide periodic “clean-outs”.
 4. Washed clean permeable material.

Not To Scale

