GEOTECHNICAL ENGINEERING STUDY
FOR
PROSPECTOR PARK

4578 Sparrow Drive
Folsom, California

Project No. E17053.156
September 2022

YOUNGDAHL
ESTABLISHED 1984

YOUNGDAHL
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Project No. E17053.156
1 September 2022

Attention: Mr. Brad Nelson

Subject: **PROSPECTOR PARK**
4578 Sparrow Drive, Folsom, California
GEOTECHNICAL ENGINEERING STUDY

References: See page ii.

Dear Mr. Nelson:

In accordance with your authorization, Youngdahl Consulting Group, Inc. has prepared this geotechnical engineering study for the project site located at 4578 Sparrow Drive in Folsom, California. The purpose of this study was to prepare a site-specific geotechnical report that can be incorporated into 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 7 proposal.

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

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.

Ian Kitamura
Ian T. Kitamura
Staff Engineer

Reviewed by:

Brandon K. Shimizu, P.E., G.E.
Senior Engineer

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Distribution: PDF to Client

References:

1. Phase I Site Assessment for Mangini Property, prepared by Youngdahl Consulting Group, Inc., dated March 2007 (Project No. E07077.000).
2. Folsom SOI – NOA Overview, Geologic Overview and Summary of NOA Potential, prepared by Youngdahl Consulting Group, Inc., dated February 2007 (Project No. E07006.000).
3. Preliminary Geotechnical Engineering Study for White Road/Scott Road 1,400 Acres, prepared by Youngdahl Consulting Group, Inc., dated 22 May 2007 (Project No. E07145.000).
4. Geotechnical Engineering Study for Mangini Ranch, Phase I, prepared by Youngdahl Consulting Group, Inc., dated 31 July 2014 (Project No. E07145.001).
5. Rough Grading Plans for Mangini Ranch-Phase I, prepared by MacKay & Somps, dated February 2017.
6. Summary of Compaction Test Results During Earthwork Operations for Mangini Ranch Phase 1B Park Site, prepared by Youngdahl Consulting Group, Inc., dated 3 January 2020 (Project No. E17053.031).
7. Proposal for Prospector Park, prepared by Youngdahl Consulting Group, Inc., dated 2 May 2022 (Proposal No. PE22-221/17053).
8. Executed Services Agreement, prepared by City of Folsom, dated 23 August 2022.

TABLE OF CONTENTS

GEOTECHNICAL ENGINEERING STUDY
FOR
PROSPECTOR PARK

1.0 INTRODUCTION

This report presents the results of our geotechnical engineering study performed for the proposed improvements planned to be constructed at 4578 Sparrow Drive in Folsom, California. The vicinity map provided on Figure A-1, Appendix A shows the approximate project location.

Project Understanding

We understand that proposed development will consist of the construction of a recreational park in Folsom, California. The park is proposed to consist of the following: a restroom building, post & footing shade structures, tennis courts, a basketball court, playground structures, a synthetic turf volleyball court, ball field, 60- and 70-foot field lights, a dog park, parking lot lights, pathway lights, asphalt paved parking lots, and concrete walks. The building structures are anticipated to be supported by conventional shallow foundations with concrete slab-on-grade floors, and isolated pad or pier foundations for the remaining structures. For the purposes of this report, cuts and fills on the order of 5 feet or less are anticipated to complete site grading.

Background

Based on a limited review of aerial photography dating back to 1993, the site appears to have remained in a relatively undisturbed condition until circa 2017 when grading activities began at the site. We observed grading operations at the site on an intermittent basis between April 2017 and January 2020 (Reference 6). Based on our observations and test results, the grading performed for the project had been completed in general accordance with the recommendations provided in the referenced geotechnical engineering study (Reference 4). The site appears to have remained relatively unchanged since.

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 recommendations provided in this update supersede those provided in the previous geotechnical reports. 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;
- A field study consisting of a site reconnaissance, followed by an exploratory boring program 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 geotechnical recommendations regarding earthwork construction including, site preparation and grading, excavation characteristics, soil moisture conditions, compaction equipment, engineered fill criteria, slope configuration and grading, underground improvements, and drainage;

- Development of geotechnical design criteria for code-based seismicity, foundations, slabs on grade, retaining walls, and pavements;
- 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 explorations.

Surface Observations

The project site is located at 4578 Sparrow Drive in Folsom, California. The irregularly shaped site is approximately 11.89 acres and is bounded by Mangini Parkway to the north, Mangini Ranch Elementary School to the east, Sparrow Drive to the south, and a drainage channel and single-family residential subdivision to the west.

Topography at the site generally gently slopes down to the south/southwest from Mangini Parkway towards Sparrow Drive and the drainage channel with a maximum slope gradient of approximately 10H:1V (Horizontal:Vertical) or flatter. Vegetation generally consists of short to medium dry seasonal grasses with occasional patches of green grasses. Cobbles and boulders with a maximum clast size of 24 inches from previous site grading operations are scattered across the site.

Subsurface Conditions

Our field study included a site reconnaissance by a representative of our firm followed by a subsurface exploration program conducted 31 May 2022. The exploration program included the advancement of 11 exploratory borings under the direction of our representative at the approximate locations shown on Figure A-2, Appendix A. A description of the field exploration program is provided in Appendix A.

The soils at the site generally consisted of silty sands with high rock contents (engineered fills). The boring did not penetrate the engineered fill layer, however, based on our experience on the site, weathered bedrock should be anticipated below these materials. The sands were generally observed to be in a medium dense to dense and dry condition. Silt was encountered underlying the silty sands in boring B-2. The silt was generally observed to be in a hard and dry condition. Essential boring refusal was encountered within the rock fragments present within the fills at various depths as noted on the boring logs. Boring B-6 was unable to drill beneath the surficial materials due to the high density of rocks in the surrounding area.

A more detailed description of the subsurface conditions encountered during our subsurface exploration is presented graphically on the “Exploratory Boring Logs", Figures A-3 through A-13, Appendix A. These logs show a graphic interpretation of the subsurface profile, and the location, blow counts, 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. 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 and observations 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	B-3 & 8 @ 0-4’	Φ = 35.3°, c = 78 psf (90%RC)
Maximum Dry Density	ASTM D1557	B-3 & 8 @ 0-4’	DD = 134.0 pcf, MC = 8.8%
Resistance “R” Value	CTM 301	B-3 & 8 @ 0-4’	R = 25
Corrosivity Suite	CA DOT Tests 417, 422 and 643	See Soil Corrosivity Section	

Soil Expansion Potential

The materials encountered in our explorations were generally non-plastic (rock and sand). 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. If necessary, recommendations can be made based on our observations at the time of construction, should 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
B-3 & B-8	0 – 4	7.52	1.74	6.2	49.4	Non-Corrosive	S0 (Not a Concern)

According to Caltrans Corrosion Guidelines Version 3.0, March 2018, the test results appear to indicate a non-corrosive environment for concrete structures. 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. Accordingly, Type I/II Portland cement is appropriate for use in concrete construction. 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

The site is located within the western foothills region of the Sierra Nevada Mountain Range. According to the Geologic Map of the Sacramento Quadrangle, California (D.L. Wagner, et al., 1981), this portion of the foothills is underlain by interbedded belts of Gopher Ridge Volcanics, Salt Springs Slate, and nearby Copper Hill Volcanics of the Mesozoic era to the north of the site.

Naturally Occurring Asbestos

Asbestos is classified by the EPA as a known human carcinogen. Naturally occurring asbestos (NOA) has been identified as a potential health hazard. According to the map of Relative Likelihood for the Presence of Naturally Occurring Asbestos in Eastern Sacramento County (C.T. Higgins, et. al, 2006), the project site is identified as being in an area moderately likely to contain NOA.

The Sacramento Metropolitan Air Quality Management District (SMAQMD) is the lead agency for regulating NOA in Sacramento County, and has implemented the construction Air Toxic Control Measure (ATCM) (CCR Section 93015) for projects in East Folsom located within the metavolcanic Copper Hill Formation. Following release of the generalized geologic map of eastern Sacramento County by the California Geologic Survey in 2006, the SMAQMD established a policy of applying the construction ATCM (CCR Section 93105) to all areas identified on the map as being underlain by rocks moderately likely to contain NOA.

The relative likelihood for the presence of NOA is considered to be moderately likely for the Copper Hill Formation. The low-grade, greenschist facies regional metamorphism, with hydrothermal alteration is characteristic of NOA containing rocks of this region. Trace levels of asbestos (less than 0.25% as measured by California Air Resources Board Test Method 435) are not uncommon in the Folsom area north of US Highway 50 but has been rare in all testing completed to date by Youngdahl south of US Highway 50.

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 38.627533, -121.105336 to identify the project site.

<u>Alquist-Priolo Regulatory Faults</u>

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, however, 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	0.171g
	Table 11.8-1	Site Coefficient F_{PGA}	1.229
	Equation 11.8-1	$PGA_M = F_{PGA}$ PGA	0.210g
2019 CBC	Figure 1613.2.1(1)	Short-Period MCE at 0.2s, S_S	0.402g
	Figure 1613.2.1(2)	1.0s Period MCE, S_1	0.208g
	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, $S_{MS} = F_aS_s$	0.523g
	Equation 16-37	Adjusted MCE Spectral Response Parameters, $S_{M1} = F_vS_1$	0.312g
	Equation 16-38	Design Spectral Acceleration Parameters, $S_{DS} = \frac{2}{3}S_{MS}$	0.349g
	Equation 16-39	Design Spectral Acceleration Parameters, $S_{D1} = \frac{2}{3}S_{M1}$	0.208g
	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. 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.

Geotechnical Considerations for Development

The project site is generally comprised of layers of soils of varying thicknesses 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.

Based on the anticipated development, it appears that the proposed buildings will likely be below the road and be supported by engineered fills with a high rock content. For these conditions, we have included the comments below. The geotechnical recommendations for this project are presented in the following sections.

- Buildings constructed below the road elevation may be more subject to seepage and poor drainage. Special attention should be given to configuring the landscaping to drain away from the foundations and how underground utilities are configured to prevent water from migrating through the trench and becoming impounded against the foundation. The installation of subdrains and plug and drains is anticipated to provide increased protection against unwanted water conditions.
- Due to the fills composed of high rock contents and underlying rock conditions, it may be difficult to excavate utilities. Consideration may be given to pre-excavating utility alignments during the building pad grading when larger equipment could be used and there is more site access. Some sites with shallow rock overexcavate the rock approximately 2 feet from finish grade during grading to improve landscape performance and later utility installations.

6.0 SITE GRADING AND EARTHWORK IMPROVEMENTS

Excavation Characteristics

Any utility trenches excavated through the rocky engineered fill zone or within bedrock materials may encounter hard rock excavation conditions. Utility contractors should be prepared to use special rock trenching equipment such as large excavators (Komatsu PC400 or CAT 345 or larger). Blasting to achieve utility line grades with bedrock 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.

In addition, due to rocky nature of the on-site fill materials, any utility line excavations deeper than 5 feet may encounter larger rock fragments. Utility contractors should have the equipment capable of excavating/lifting large boulders within the deeper excavations.

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.

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 existing fills and loose/soft native soils, expansive clay mitigation, 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) and ATCM requirements. 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.**

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 Loose/Soft Existing Fills and Native Soils

Following general site clearing, any loose/soft existing fills or saturated native soils in encountered within the development footprint should be overexcavated down to firm materials or engineered fill and backfilled with engineered fill as detailed in the engineered fill section below. 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.

Expansive Clay Mitigation

Expansive clays, if encountered, should be mixed thoroughly with less expansive on-site materials (silts, sands, and gravels) and should not be present in concentration within 5 feet of the building envelope, either vertically or laterally. Proper disposition of clays on site should be observed and documented by a representative of Youngdahl Consulting Group, Inc.

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.

Compaction Equipment

Due to the significant quantity of rock materials that will comprise a majority of the fills on the project site, a Caterpillar 825 steel-wheel compactor or approved equivalent should be employed as a minimum to facilitate breakdown of oversize bedrock materials and generation of soil fines during the fill placement process. If the quantity of rock fragments in the fills preclude traditional compaction testing, then the proposed fills should be compacted using method specifications as indicated in the Engineered Fill Criteria section below.

In focused or isolated areas where significant rock quantities will not be present, we anticipate that a large vibratory padded drum compactor or approved equivalent will be capable of achieving the compaction requirements for engineered fill provided the soil is placed and compacted within 0 to 3 percent of the optimum moisture content as determined by the ASTM D1557 test method and in lifts not greater than 12 inches in uncompacted thickness. The use of handheld equipment such as jumping jack or plate vibration compactors may require thinner lifts of 6 inches or less to achieve the desired relative compaction parameters.

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 anticipate that a moderate amount of onsite soils will be generated during mass grading operations. 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 the maximum size specifications listed below.

Rock fragments or boulders exceeding 24 inches in maximum dimension should not be placed within the upper five feet of site grades or utility corridors. The upper two feet of the site grades and within the zone of proposed underground facilities should consist of predominantly rocks and rock fragments less than 12 inches in maximum dimension. Boulders over 24 inches in maximum dimension should be placed within the deeper portions of fill embankments below a depth of 5 feet and a minimum of 5 feet from the finish slope face. The individual boulders should be spaced such that compaction of finer rock and soil materials between the boulders can be achieved with the equipment being used for compaction. Materials placed between the boulders should consist of predominantly soil and rock less than 12 inches in maximum dimension. The soil/rock mixture should be thoroughly mixed and placed between the boulders so as to preclude nesting or the formation of voids. Should insufficient deep fill areas exist for oversize rock disposal, the contractor should either dispose of the excess materials to an offsite location or mechanically reduce the rocks to less than 12 inches.

Fill Placement and Compaction

Engineered fills should be placed in thin horizontal lifts not to exceed 12 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 relative compaction of engineered fills is based on the maximum density and optimum moisture determined through the ASTM D1557 test method. The fill should be compacted to a relative compaction of not less than 90 percent. The upper 8 inches of fills placed under proposed pavement areas should be compacted to a relative compaction of not less than 95 percent. 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 evaluated as earthwork progresses, or by method specification if the quantity of rock fragments in the fills preclude traditional compaction testing.

Method Specification

Soils exceeding 30 percent rock by mass may be considered non-testable by conventional methods. The materials may be placed as engineered fill if placed in accordance with the following method specification during full time observation by a representative of our firm.

Soils should be moisture conditioned and compacted in place by a minimum of four completely covering passes with a Caterpillar 825, or approved equivalent. The compactor’s last two passes should be at 90 degrees to the initial passes. In areas where 95 percent relative compaction is designated, an additional two passes should be applied in each direction, with three completely covering passes made at 90 degrees to the initial three passes. Engineered fill should be constructed in lifts not exceeding 12 inches in uncompacted thickness, moisture conditioned and compacted in accordance with the above specification. Additional passes as deemed necessary during fill placement to achieve the desired condition based upon field conditions may be recommended.

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 4: Select Import Criteria

Behavior Property	Reference Document	Recommendation
Direct Shear Strength	ASTM D3080	≥ 34° when compacted
Resistance "R" Value	CTM 301	≥ 25
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	≤ 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.

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. Refer to the Excavation Characteristics section of Site Grading and Improvements of this report for anticipated excavation conditions.

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, for any structures 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.

A common problem occurs on sites graded with large equipment and rocky fill materials where the excavated spoils from the lot utilities are too rocky to place as engineered fill back in the trench with the common compaction practices employed by the subcontractors installing these utilities. We recommend that, where excavated soils are too rocky to place and compact to a tight condition with low void space, these materials be replaced with a proper import material for compaction.

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 95 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. Where this condition is encountered, we recommend plug and drains within the utility trenches (Figure C-1, 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. ***As the observed site conditions dictate, representatives from our firm, the contractor, City of Folsom, and the civil engineer should coordinate the locations of plug and drains.***

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 5: 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 Fiction Factor*	0.45	1.5
	Allowable Passive Resistance	280 psf/ft	1.5
Rock	Allowable Bearing Capacity	4,000 psf	3.0
	Allowable Fiction Factor	0.45	1.5
	Allowable Passive Resistance*	400 psf/ft	1.5
* Friction Factor is calculated as tan(ϕ)			

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. Where foundations will span from bearing on non-like materials such as weathered bedrock to engineered fill, or vice versa, differential settlement may approach 0.75 inches in 25 feet. 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 18 inches below the lowest adjacent soil. Isolated pad foundations should be a minimum of 24 inches in plan dimension.

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 be reinforced with four No. 4 reinforcing bars, two located near the bottom of the footing and two 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.

Pier Foundations

Deep foundations, such as CIDH piles, are considered suitable for construction of the light pole foundations. 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 Configuration

CIDH piles, having a minimum diameter of 24 inches and extending a minimum of 5 feet below the existing flatwork, may be used to support the planned light poles.

Foundation Capacities

The piles may be constructed based on end bearing capacities. An end bearing capacity of 2,500 psf into firm fill materials may be utilized for the design of the piles. The dead weight of the piles may be utilized for resistance of uplift. The following passive equivalent fluid weight may be used to resist lateral forces.

Table 5: Lateral Capacities (CIDH Piles)

Soil Type	Design Value	Applied Factor of Safety
Fill	280 pcf	1.5

Construction Considerations

Precautions should be taken during pile excavations to reduce caving and raveling. The following recommendations are presented and should be followed where applicable.

- Piles should be installed under the full-time observation of our firm.
- Pile excavations should be filled with concrete as soon as possible following drilling. Pile excavations should not be left open for extended periods of time.
- In the event of soil caving or water seepage into the pile excavation, casing should be used. Casing may be pulled as the pile excavation is filled with concrete. The use of “wet” construction, such as “super-mud” is not recommended.
- Concrete should be placed and vibrated throughout the full length of the pile so that voids do not exist in either the pile base or the shaft. Placement procedures, such as tremie, should be used so that the concrete is not allowed to fall freely more than 5 feet and to prevent concrete from striking the walls of the excavations and possibly causing caving.
- Where the drilling operation might affect the concrete in an adjacent pile (i.e. where pile spacing is less than 3 diameters), drilling should not be carried out before the previously poured pile concrete has set for at least 24 hours, or as permitted by our firm at the time of construction.

Estimated Settlement

The piles, constructed as recommended above are anticipated to have negligible settlement.

Slab-on-Grade Construction

It is our opinion that soil-supported slab-on-grade floors could be used for the main floor of the structures, 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 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 ¾-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 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 6: Retaining Wall Pressures

Wall Type	Wall Slope Configuration	Equivalent Fluid Weight (pcf)	Lateral Pressure Coefficient	Earthquake Loading (plf)	
Free Cantilever	Flat	40	0.28	$3H^2$	Applied 0.6H above the base of the wall
	2H:1V	60	0.44	$15H^2$	
Restrained*	Flat	60	0.44		

* 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.

Design Values for Dry Stacked Walls

Dry stacked walls do not generally 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. The walls could include keyed or interlocking non-mortared walls such as segmental block (Basalite, Keystone, Allan Block, etc.), rockery walls, or specialty designs for proprietary systems. 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 7: Generalized Design Parameters

Internal Angle of Friction	Cohesion	Bulk Unit Weight	Seismic Coefficient, Kh
34°	0 psf	135 pcf	0.105g

<u>Wall Drainage</u>

The criteria presented above is based on fully drained conditions as detailed in the attached Figure C-2, 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 building 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 and sports courts. 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 the R-Value test (CTM 301) performed on a bulk sample 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 25 was determined for the soils tested and was used 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 8: Asphalt Pavement Section Recommendations

Design Traffic Indices	Alternative Pavement Sections (Inches)	
	Asphalt Concrete *	Aggregate Base **
4.5	3.0	5.5
5.0	3.0	7.0
5.5	3.0 3.5	8.5 7.5
6.0	3.0 3.5	10.0 9.0

* 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.

<u>Design Criteria for Tennis and Basketball Courts</u>
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 recommended design thicknesses presented in the following section are in accordance with the practice methods presented in the Tenth Edition of the American Sports Builders Association (ASBA) Tennis Courts Construction and Maintenance Manal. Excavation, filling, grading and compaction of the site and construction of the subgrade should be performed in such a way that the finished court surface is 6 inches to 12 inches above the surrounding adjacent ground per ASBA. Final elevation is the purview of the civil engineer.

<u>Footing/Court Edging Configuration for Tennis and Basketball Courts</u>
We recommend a perimeter edge moisture barrier be provided for the basketball and tennis courts. This is anticipated to be a deepened curb extending a minimum of 16 inches below the lowest adjacent site grade. 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 curbs be reinforced in accordance with American Sports Builders (ASBA) standards, or as required by the structural engineer.

<u>Asphalt Pavement for Tennis and Basketball Courts</u>
The Asphalt pavement section should be a minimum of 3 inches of asphalt concrete on 9 inches of aggregate baserock (or thicker, if required by the sport court design standards).

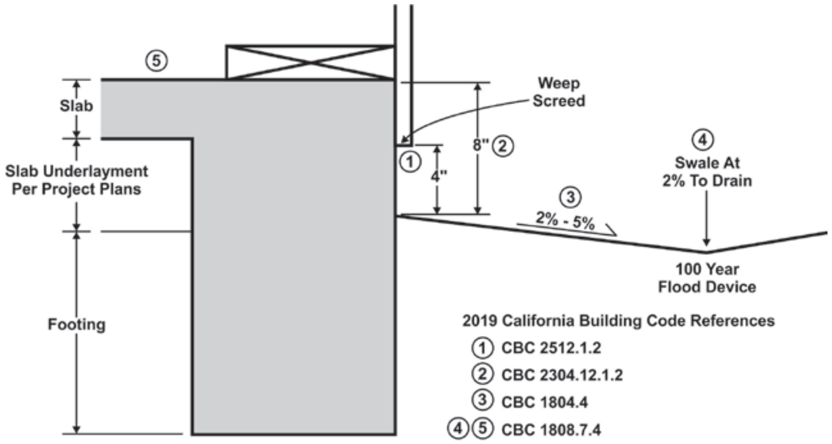
Drainage
In order to maintain the engineering strength characteristics of the soil presented for use in this Geotechnical Engineering Study, maintenance of the site will need to be performed. This maintenance generally includes, but is not limited to, proper drainage and control of surface and subsurface 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 structures.

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 on the bedrock horizon or present in fractures in the weathered bedrock. 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 build up of moisture include, but are not limited to; proper backfill materials and compaction of utility trenches on the site and within the footprint of the proposed structures (potentially minimizing the transmission of moisture through these areas); 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

It has been our experience that sites constructed within this area generally have an increased potential for moisture related issues related to water perched on the bedrock horizon and/or present in the fractures of the bedrock as well as moisture transmission through utility trenches. To mitigate for the potential of these issues, subdrains can be constructed 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-3, Appendix C. The water collected in the subdrain pipe would be directed to an appropriate non-erosive outlet. When subdrains are constructed, 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.

Parking Lot Landscaping Drainage

In developments built on relatively poor draining soils (i.e. shallow bedrock), prolonged water seepage into pavement sections can result in softening of subgrade soils and subsequent pavement distress. In addition, where shallow bedrock conditions are present, water can become perched on the relatively impermeable soil horizon and eventually inundate utility trench backfill. The variable support condition between native soils and compacted trench backfill materials, coupled with prolonged water exposure can lead to subsidence of trench backfill materials if bridging of trench backfill occurs during placement or natural jetting of soils into voids around pipes occurs. Joint utility trenches are generally more susceptible to the jetting issues due to the quantity of pipe placed in the trench.

It is anticipated that heavy landscape watering could enter and pond within the parking lot aggregate base section as it permeates through the aggregate base under the sidewalks and/or curbs. Prolonged seepage within the pavement section could cause distress to pavements in heavy traffic areas. Some measures that can be employed to minimize the saturation of the subgrade and aggregate base materials include, but are not limited to, construction of cut-off drains or moisture barriers alongside the roadway adjacent to the roadway interface, construction of subdrains within landscape medians and installation of plug and drain systems within utility trenches. Due to the elusive and discontinuous nature of drainage related issues, a risk-based approach should be determined by the developer based on consultation and discussions with the design professionals and the amount of protection of facilities that the developer may want to provide against potential moisture related issues.

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 may contribute to groundwater levels rising, which 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. In order to mitigate these conditions, additional drainage measures than those detailed in the California Building Code may be necessary, which could include but is not limited to, installation of subdrainage provisions.

Low Impact Development Standards
Low Impact Development or LID standards have become a consideration for many projects in the region. LID standards are intended to address and mitigate urban storm water quality concerns. These methods include the use of Source Controls, Run-off Reduction and Treatment Controls. For the purpose of this report use of Run-off Reduction measures and some Treatment Controls may impact geotechnical recommendations for the project.

Youngdahl Consulting Group, Inc. did not perform any percolation or infiltration testing for the site as part of the Geotechnical Investigation. A review of soil survey and the data collected from the borings indicate that soils within the project are Hydrologic Soil Group D (very slow infiltration). Based on this condition, use of infiltration type LID methods (infiltration trenches, dry wells, infiltration basins, permeable pavements, etc.) should not be considered without addressing applicable geotechnical considerations/implications. As such, use of any LID measure that would require infiltration of discharge water to surfaces adjacent to structures/pavement or include infiltration type measures should be reviewed by Youngdahl Consulting Group, Inc. during the design process.

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, 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 9 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.

5. 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. Unforeseen subsurface conditions containing soft native soils, loose or previously placed non-engineered fills should be a consideration while preparing for the grading of the property. It should be noted that it is the responsibility of the owner or his/her representative to notify Youngdahl Consulting Group, Inc., in writing, a minimum of 48 hours before any excavations commence at the site.

6. 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.

7. Following site development, additional water sources (i.e. landscape watering, downspouts) are generally present. The presence of low permeability materials can prohibit rapid dispersion of surface and subsurface water drainage. Utility trenches typically provide a conduit for water distribution. Provisions may be necessary to mitigate adverse effects of perched water conditions. Mitigation measures may include the construction of cut-off systems and/or plug and drain systems. Close coordination between the design professionals regarding drainage and subdrainage conditions may be warranted.

   Seepage may be observed emanating from the cut slopes following their excavation during the following rainy season or following development of the areas above the cut. Generally this seepage is not enough flow to be a stability issue to the cut slope, but may be an issue for the owner of the lot at the base of the cut from a surface drainage and standing water (damp spot) standpoint. This amount of water is generally collected easily with landscaping drainage, surface drainage at the toe of the slope, or subsurface toe drains. Recommendations may be provided at the time of observed seepage; however, we recommend that the developer of the property disclose this possibility to future owners.

Table 9: 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
Logs of Exploratory Borings
Soil Classification Chart and Log Explanation

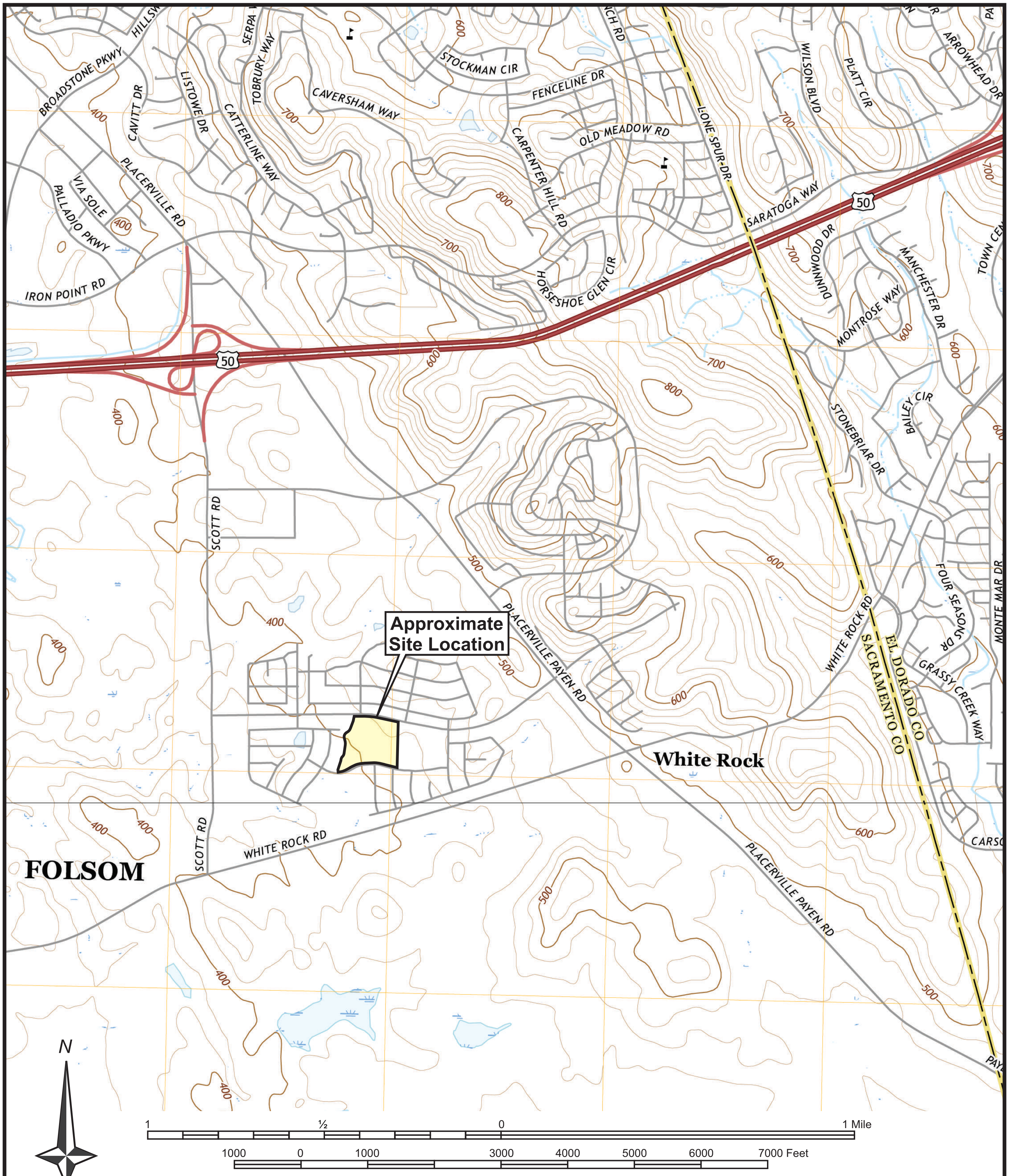
Introduction

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 31 May 2022, which included the excavation of 11 borings under his direction at the approximate locations shown on Figure A-2, this Appendix. Drilling of the exploratory borings was accomplished with a CME 55 truck mounted drill rig.

Throughout the drilling operation, soil samples were obtained at 5-foot depth intervals by means of a Modified California Sampler. This testing and sampling procedure consists of driving the steel sampler 18 inches into the soil with a 140-pound hammer free-falling 30 inches. The number of blows required to drive the sampler through each 6-inch interval is counted, and the total number of blows struck during the final 12 inches is recorded. If a total of 50 blows are struck within any 6-inch interval, the driving is stopped and the blow count is recorded as 50 blows for the actual penetration distance.

The soils encountered were logged during drilling and provide the basis for the "Boring Logs," Figures A-3 through A-13, this Appendix. The enclosed Boring Logs describe the vertical sequence of soils and materials encountered in each boring, based primarily on our field classifications and supported by our subsequent laboratory examination and testing. Where a soil contact was observed to be gradational, our logs indicate the average contact depth. Where a soil type changed between sample intervals, we inferred the contact depth. Our logs also graphically indicate the blow count, sample type, sample number, and approximate depth of each soil sample obtained from the borings, as well as any laboratory tests performed on these soil samples. If any groundwater was encountered in a borehole, the approximate groundwater depth is depicted on the boring log. Groundwater depth estimates are typically based on the moisture content of soil samples, the wetted height on the drilling rods, and the water level measured in the borehole after the auger has been extracted



Scale: 1:24,000

BASE MAP REFERENCE: *U.S.G.S. 7.5 Minute Topographic Series, Clarksville & Folsom SE Quadrangles, Dated 2021*

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E17053.156

September 2022

VICINITY MAP

Prospector Park
Folsom, California

FIGURE
A-1

REFERENCE: *Site Plan provided by Client; Google Earth, Aerial Data Dated 6/1/2021*

YOUNGDAHL CONSULTING GROUP, INC. ESTABLISHED 1984	Project No.: E17053.156	**SITE PLAN**	**FIGURE**
	September 2022	**Prospector Park** Folsom, California	**A-2**

Logged By: **MAP** | Date: **31 May 2022** | Lat / Lon: **N 38.62805° / W 121.10596°** | Boring No. **B-1**

Equipment: **CME 55 Drill Rig - 4" Solid Flight Auger** | Elevation: **~**

Depth (Feet)	Graphic Log	Ground Water	Geotechnical Description & Unified Soil Classification	Sample	Blow Counts	Pocket Pen (tsf)	Dry Density (pcf)	Moisture Content (%)	Tests & Comments
0–7	▨		Dark brown silty fine to medium **SAND (SM)** with cobble, 6" max clast size, angular, medium dense, dry (ENGINEERED FILL)						
2.5–4				⧅	25				
5–6.5				⧅	26				
7			Boring terminated at 7' (practical refusal) No groundwater encountered						

Note: The boring 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.

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E17053.156

September 2022

EXPLORATORY BORING LOG

Prospector Park
Folsom, California

FIGURE
A-3

Logged By: **MAP**
Date: **31 May 2022**
Lat / Lon: **N 38.62816° / W 121.10462°**
Boring No. **B-2**
Equipment: **CME 55 Drill Rig - 4" Solid Flight Auger**
Elevation: **~**

Depth (Feet)	Graphic Log	Ground Water	Geotechnical Description & Unified Soil Classification	Sample	Blow Counts	Pocket Pen (tsf)	Dry Density (pcf)	Moisture Content (%)	Tests & Comments
1			Dark brown silty fine to medium **SAND (SM)** with gravel, angular, medium dense, dry (ENGINEERED FILL)						
2									
3				⧄					
4					19				
5			Grey **SILT (ML)**, low plasticity, low toughness, hard, dry (NATIVE)	⧄	50/5"				
6									
7									
8				⧄	50/4"				
9									
10				⧄	50/3"				
11									
12									
13			Boring terminated at 11.5' (practical refusal) No groundwater encountered						
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									

Note: The boring 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.

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Project No.:
E17053.156

September 2022

EXPLORATORY BORING LOG

Prospector Park
Folsom, California

FIGURE
A-4

Logged By: **MAP**	Date: **31 May 2022**	Lat / Lon: **N 38.62741° / W 121.10651°**	Boring No. **B-3**
Equipment: **CME 55 Drill Rig - 4" Solid Flight Auger**		Elevation: **~**	

Depth (Feet)	Graphic Log	Ground Water	Geotechnical Description & Unified Soil Classification	Sample	Blow Counts	Pocket Pen (tsf)	Dry Density (pcf)	Moisture Content (%)	Tests & Comments
1 2 3 4	▨		Dark brown silty fine to medium **SAND (SM)** with gravel, angular, medium dense, dry (ENGINEERED FILL)	◪	76				**Bulk B-3** @ 0' - 4' ϕ = 35.3°, c = 78 psf DDmax = 134.0 pcf MCopt = 8.8% R-Value = 25 Corrosion Tests
5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25			Boring terminated at 4' (practical refusal) No groundwater encountered						

Note: The boring 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.

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Project No.:
E17053.156

September 2022

EXPLORATORY BORING LOG

Prospector Park
Folsom, California

FIGURE
A-5

Logged By: **MAP**	Date: **31 May 2022**	Lat / Lon: **N 38.62743° / W 121.10599°**	Boring No.
Equipment: **CME 55 Drill Rig - 4" Solid Flight Auger**		Elevation: **~**	**B-4**

Depth (Feet)	Graphic Log	Ground Water	Geotechnical Description & Unified Soil Classification	Sample	Blow Counts	Pocket Pen (tsf)	Dry Density (pcf)	Moisture Content (%)	Tests & Comments
0 – 13			Dark brown silty fine to medium **SAND (SM)** with gravel, angular, dense, dry (ENGINEERED FILL)						
4				⧅	82				
6				⧅	14				
11				⧅	60				
13			Boring terminated at 13' (practical refusal) No groundwater encountered						

Note: The boring 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.

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Project No.:
E17053.156

September 2022

EXPLORATORY BORING LOG

Prospector Park
Folsom, California

FIGURE
A-6

Logged By: **MAP**	Date: **31 May 2022**	Lat / Lon: **N 38.62734° / W 121.10566°**	Boring No. **B-5**
Equipment: **CME 55 Drill Rig - 4" Solid Flight Auger**		Elevation: **~**	

Depth (Feet)	Graphic Log	Ground Water	Geotechnical Description & Unified Soil Classification	Sample	Blow Counts	Pocket Pen (tsf)	Dry Density (pcf)	Moisture Content (%)	Tests & Comments
1	▨		Dark brown silty fine to medium **SAND (SM)** with cobble, angular, dense, dry (ENGINEERED FILL)						
2	▨								
3	▨			◺					
4	▨				50/5"				
5			Boring terminated at 4' (practical refusal) No groundwater encountered						
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									

Note: The boring 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.

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Project No.:
E17053.156

September 2022

EXPLORATORY BORING LOG

Prospector Park
Folsom, California

FIGURE
A-7

Logged By: **MAP**

Date: **31 May 2022**

Lat / Lon: **N 38.62724° / W 121.10537°**

Boring No. **B-6**

Equipment: **CME 55 Drill Rig - 4" Solid Flight Auger**

Elevation: **~**

Depth (Feet)	Graphic Log	Ground Water	Geotechnical Description & Unified Soil Classification	Sample	Blow Counts	Pocket Pen (tsf)	Dry Density (pcf)	Moisture Content (%)	Tests & Comments
			Boring terminated at Surface (practical refusal) No groundwater encountered						Abundant rock fragments at surface prevent drilling
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									

Note: The boring 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.

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E17053.156

September 2022

EXPLORATORY BORING LOG

Prospector Park
Folsom, California

FIGURE
A-8

Logged By: **MAP**	Date: **31 May 2022**	Lat / Lon: **N 38.62729° / W 121.10503°**	Boring No. **B-7**
Equipment: **CME 55 Drill Rig - 4" Solid Flight Auger**		Elevation: **~**	

Depth (Feet)	Graphic Log	Ground Water	Geotechnical Description & Unified Soil Classification	Sample	Blow Counts	Pocket Pen (tsf)	Dry Density (pcf)	Moisture Content (%)	Tests & Comments
1			Yellow brown silty fine to coarse **SAND (SM)** with gravel, angular, medium dense to dense, dry (ENGINEERED FILL)						
2									
3									
4					14				
5					50/3"				
6									
7			Boring terminated at 6' (practical refusal) No groundwater encountered						
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									

Note: The boring 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. ESTABLISHED 1984	Project No.: E17053.156 **September 2022**	**EXPLORATORY BORING LOG** **Prospector Park** Folsom, California	**FIGURE** **A-9**

Logged By: **MAP**	Date: **31 May 2022**	Lat / Lon: **N 38.62714° / W 121.10634°**	Boring No. **B-8**
Equipment: **CME 55 Drill Rig - 4" Solid Flight Auger**		Elevation: **~**	

Depth (Feet)	Graphic Log	Ground Water	Geotechnical Description & Unified Soil Classification	Sample	Blow Counts	Pocket Pen (tsf)	Dry Density (pcf)	Moisture Content (%)	Tests & Comments
1			Dark brown silty fine to medium **SAND (SM)** with gravel, angular, medium dense, dry (ENGINEERED FILL)						**Bulk B-8** @ 0' - 4'
2									ϕ = 35.3°, c = 78 psf
3									DDmax = 134.0 pcf MCopt = 8.8% R-Value = 25
4					28				Corrosion Tests
5									
6					18				
7									
8					50/6"				
9									
10									
11					23				
12									
13									
14									
15					50/5"				
16									
17			Boring terminated at 16' (practical refusal) No groundwater encountered						
18									
19									
20									
21									
22									
23									
24									
25									

Note: The boring 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.

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Project No.:
E17053.156

September 2022

EXPLORATORY BORING LOG

Prospector Park
Folsom, California

FIGURE
A-10

Logged By: **MAP**	Date: **31 May 2022**	Lat / Lon: **N 38.62695° / W 121.10524°**	Boring No. **B-9**
Equipment: **CME 55 Drill Rig - 4" Solid Flight Auger**		Elevation: **~**	

Depth (Feet)	Graphic Log	Ground Water	Geotechnical Description & Unified Soil Classification	Sample	Blow Counts	Pocket Pen (tsf)	Dry Density (pcf)	Moisture Content (%)	Tests & Comments
1 2			Dark brown silty fine to medium **SAND (SM)** with gravel, angular, medium dense, dry (ENGINEERED FILL)						
3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25			Boring terminated at 2.5' (practical refusal) No groundwater encountered						

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Project No.:
E17053.156

September 2022

EXPLORATORY BORING LOG

Prospector Park
Folsom, California

FIGURE
A-11

Logged By: **MAP**
Date: **31 May 2022**
Lat / Lon: **N 38.62680° / W 121.10469°**
Boring No. **B-10**
Equipment: **CME 55 Drill Rig - 4" Solid Flight Auger**
Elevation: **~**

Depth (Feet)	Graphic Log	Ground Water	Geotechnical Description & Unified Soil Classification	Sample	Blow Counts	Pocket Pen (tsf)	Dry Density (pcf)	Moisture Content (%)	Tests & Comments
1			Dark brown silty fine to medium **SAND (SM)** with cobble, angular, 6" max clast size, medium dense to dense, dry (ENGINEERED FILL)						
2									
3									
4					32				
5					50/6"				
6									
7			Boring terminated at 5.5' (practical refusal) No groundwater encountered						
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									

Note: The boring 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.

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Project No.:
E17053.156

September 2022

EXPLORATORY BORING LOG

Prospector Park
Folsom, California

FIGURE
A-12

Logged By: **MAP**	Date: **31 May 2022**	Lat / Lon: **N 38.62658° / W 121.10650°**	Boring No. **B-11**
Equipment: **CME 55 Drill Rig - 4" Solid Flight Auger**		Elevation: **~**	

Depth (Feet)	Graphic Log	Ground Water	Geotechnical Description & Unified Soil Classification	Sample	Blow Counts	Pocket Pen (tsf)	Dry Density (pcf)	Moisture Content (%)	Tests & Comments
1			Dark brown silty fine to medium **SAND (SM)** with cobble, angular, 6" max clast size, medium dense to dense, dry (ENGINEERED FILL)						
2									
3									
4					85				
5			Boring terminated at 4.5' (practical refusal) No groundwater encountered						
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									

Note: The boring 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.

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Project No.:
E17053.156

September 2022

EXPLORATORY BORING LOG

Prospector Park
Folsom, California

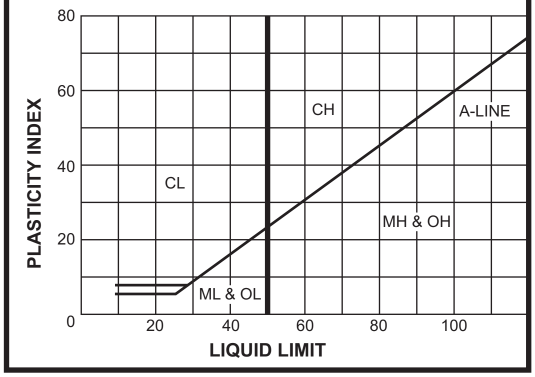
FIGURE
A-13

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 diamacious 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	
	BOULDER	COBBLE	GRAVEL		SAND			SILT	CLAY
			COARSE	FINE	COARSE	MEDIUM	FINE		
SOIL GRAIN SIZE IN MILLIMETERS	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
P ▽	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

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Project No.:
E17053.156

September 2022

SOIL CLASSIFICATION CHART AND LOG EXPLANATION
Prospector Park
Folsom, California

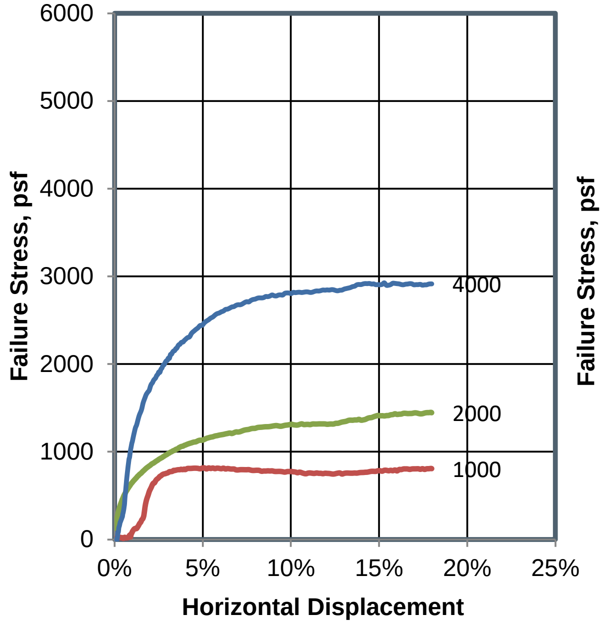
FIGURE
A-14

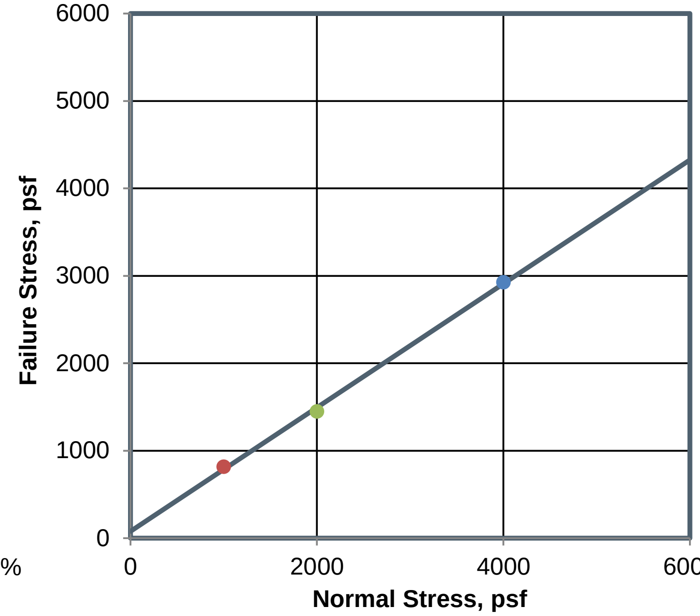
APPENDIX B

Laboratory Testing

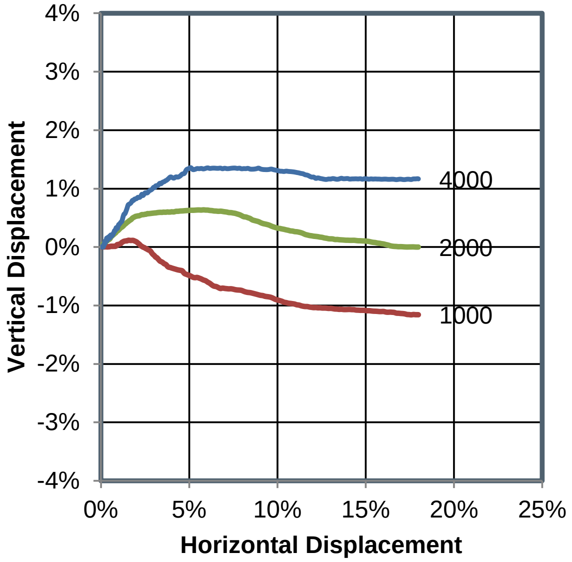
Direct Shear Test
Modified Proctor Test
R-Value Test
Corrosivity Tests

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





Direct Shearbox Results
Friction Angle
35.3°
Cohesion
78 psf



Test No.		1	2	3
Initial	Wet Density, pcf	131.1	131.1	131.1
	Dry Density, pcf	120.6	120.6	120.6
	Moisture Content, %	8.7	8.7	8.7
	Diameter, in	2.50	2.50	2.50
	Height, in	1.00	1.00	1.00
Pre Shear	Wet Density, pcf	145.0	146.0	147.2
	Dry Density, pcf	121.0	121.6	123.3
	Moisture Content, %*	19.8	20.0	19.4
	Diameter, in	2.50	2.50	2.50
	Height, in	1.00	0.99	0.98
Normal Stress, psf		1000	2000	4000
Failure Stress, psf		817	1450	2927
Failure Strain, %		5.09	17.95	15.30
Rate, in/min			0.002	

*Based on post shear moisture content

Sample Type: Remolded to 90% RC

Material Description: **Olive Brown Silty SAND with Gravel**

Source:

Notes: Gravel removed from test sample.

Sample No./Depth:	B-3 & B-8 @ 0-4'			USCS Class.	Liquid Limit	Plasticity Index	% Greater than No. 4	% Less than No. 200
Date Sampled:	5/31/2022	Date Test Started:	6/15/2022				32	

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Project: **Prospector Park GES**

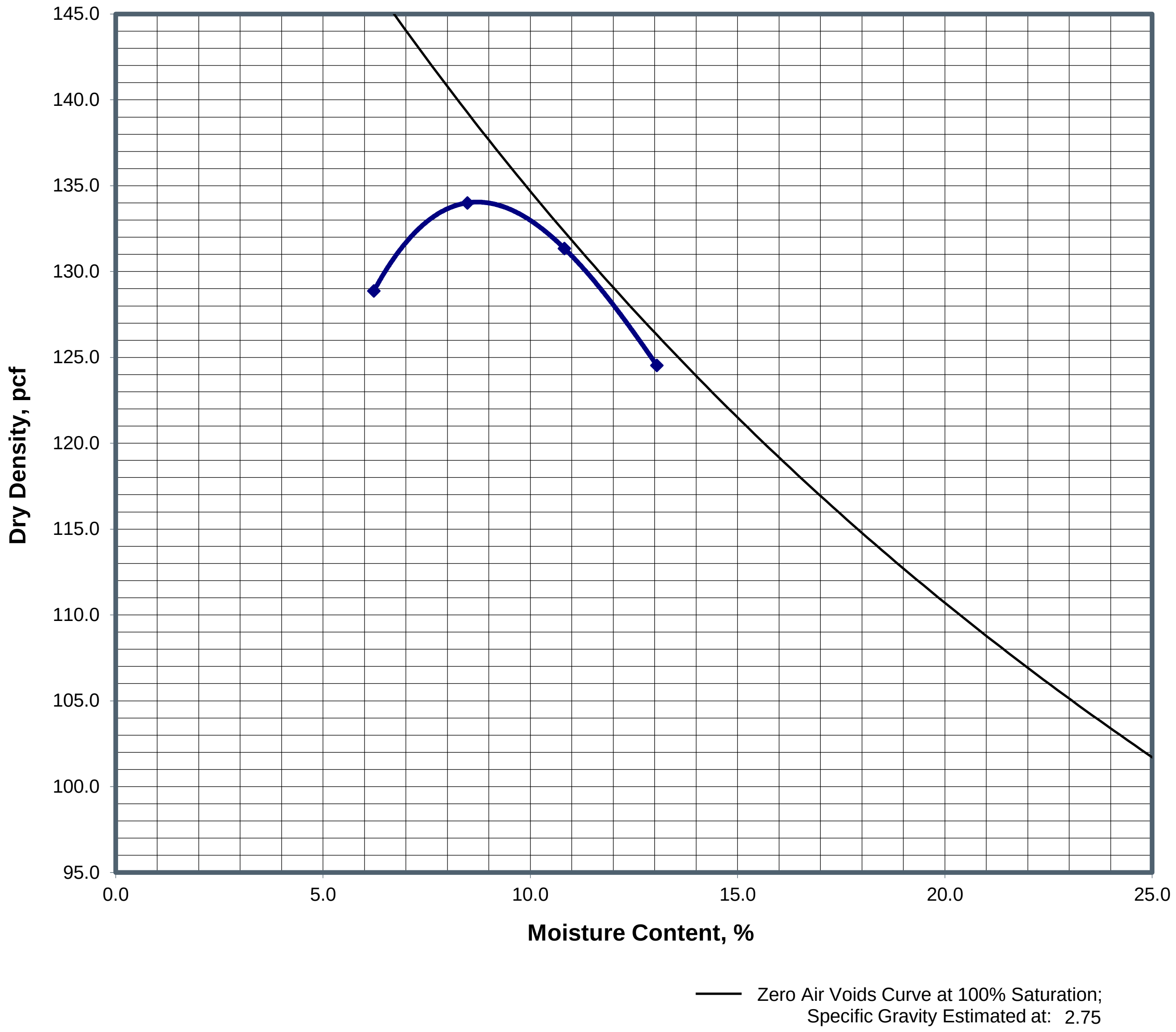
Project No.: **E17053.156**

Reviewed By: DN

Date: 6/17/2022

Figure **B-1**

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



Maximum Dry Density, pcf:	**134.0**	Optimum Moisture Content, %:	**8.8**

Material Description: **Olive Brown Silty SAND with Gravel**

Source:

Notes:

				USCS Class.	Liquid Limit	Plasticity Index	% Greater than No. 4 :	% Less than No. 200
Sample No./Depth:	B-3 & B-8 @ 0-4'							
Date Sampled:	5/31/2022	Date Test Started:	6/1/2022				32	

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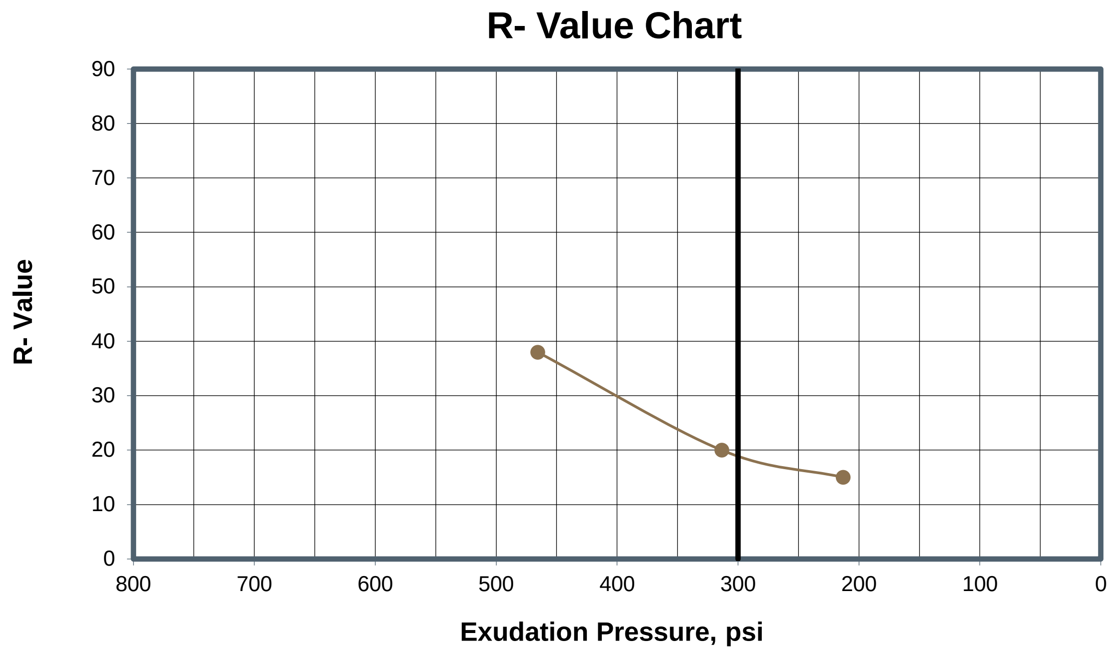
Project:	**Prospector Park GES**		
Project No.:	**E17053.156**		Figure
Reviewed By: JGR	Date: 6/2/2022		**B-2**

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



Test Specimen No.:	1	2	3
Moisture Content at Test, %	10.1	11.2	12.2
Dry Density at Test, pcf	136.4	132.7	128.3
Expansion Pressure, psf	225	100	39
Exudation Pressure, psi	466	314	213
Resistance "R" Value	38	20	15
"R" Value at 300 psi Exudation Pressure			**25**

Material Description: **Olive Brown Silty SAND with Gravel**

Source:

Notes:

Sample No./Depth: B-3 & B-8 @ 0-4'		USCS Class.	Liquid Limit	Plasticity Index	% Greater than No. 4	% Less than No. 200
Date Sampled: 5/31/2022	Date Test Started: 6/8/2022				30	

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Project: **Prospector Park GES**

Project No.: **E17053.156**

Figure **B-3**

Reviewed By: JLC

Date: 6/13/2022

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

Date Reported 06/08/2022
Date Submitted 06/01/2022

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 : E17053.156PROSPECTOR Site ID : B-6,8 @ 0-4.
Thank you for your business.

* For future reference to this analysis please use SUN # 87491-181938.

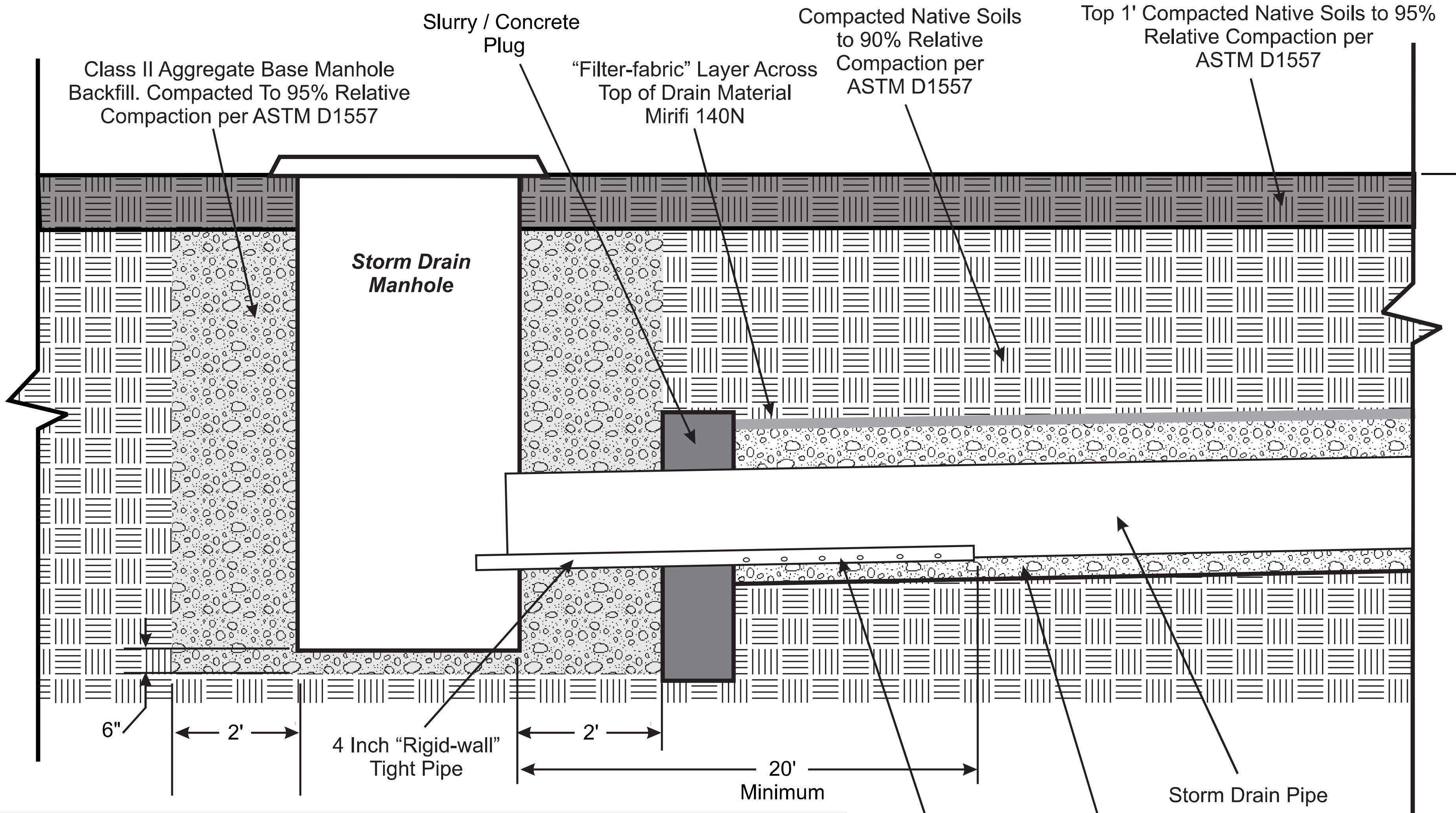
EVALUATION FOR SOIL CORROSION

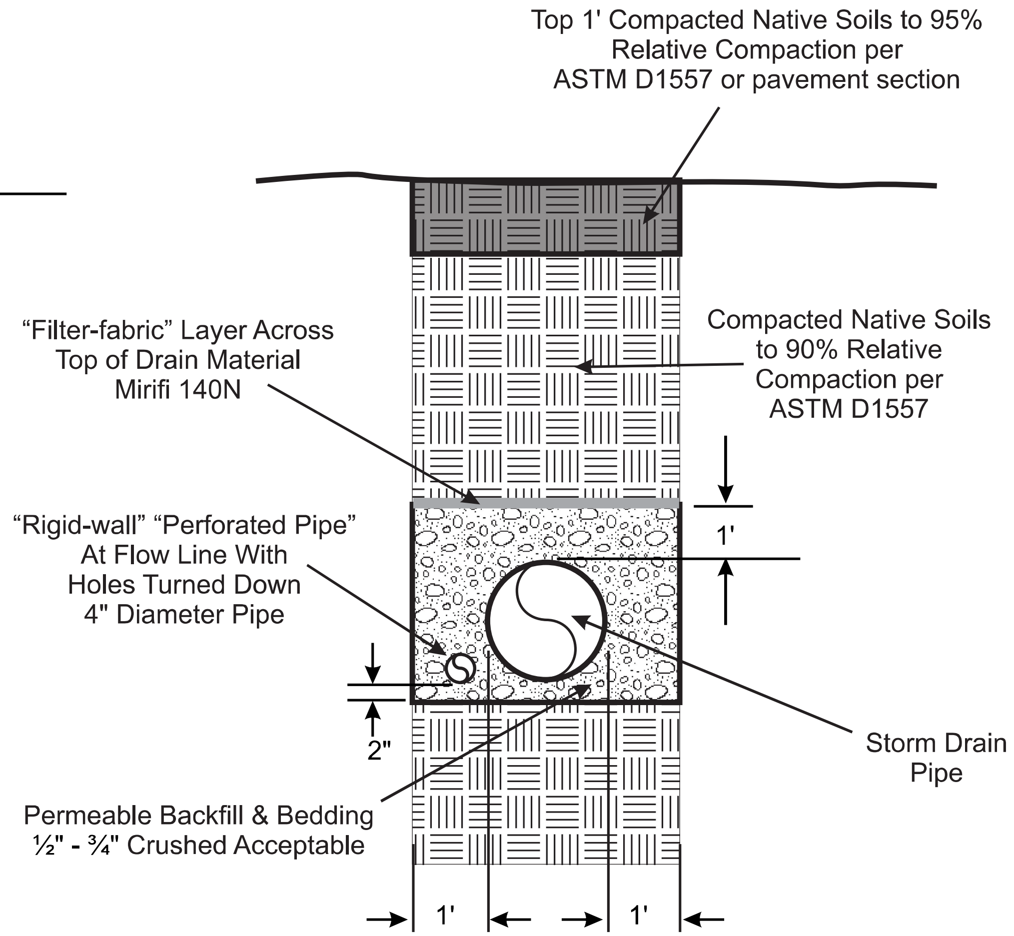
Soil pH	7.52	
Minimum Resistivity	1.74 ohm-cm (x1000)	
Chloride	6.2 ppm	00.00062 %
Sulfate	49.4 ppm	00.00494 %

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

APPENDIX C
Details

Plug and Drain
Site Wall Drainage
Subdrain

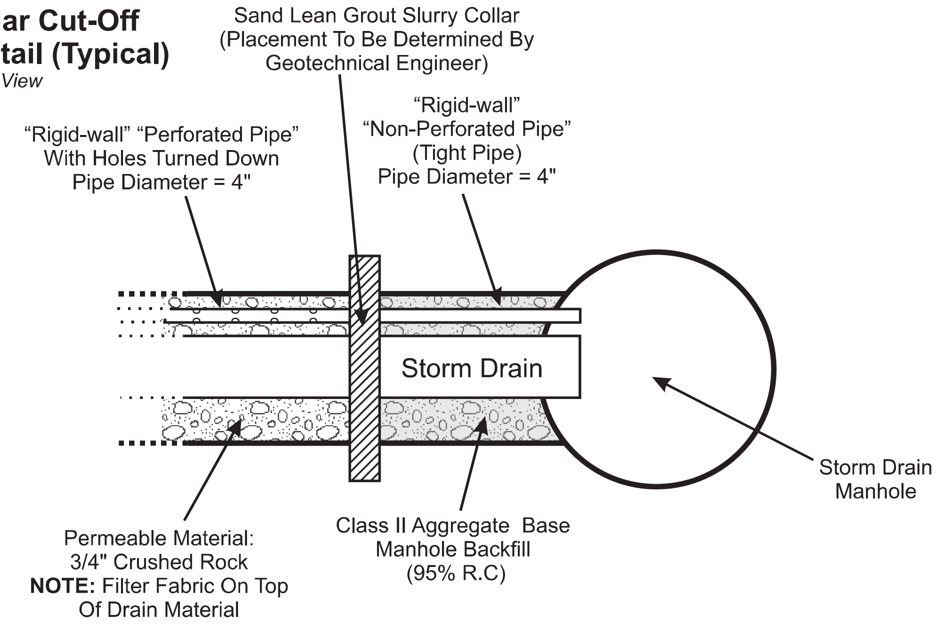




Notes: *Slope trench and "rigid-wall" pipes at least 1% gradient to drain.*

Grout Collar Cut-Off Subdrain Detail (Typical)

Plan View



Notes: ***1. Slope trench and "rigid-wall" pipes at least 1% gradient to drain.***
2. Washed clean permeable material.
3. Slurry collar to extend into trench sidewalls and to top of pipe envelope.

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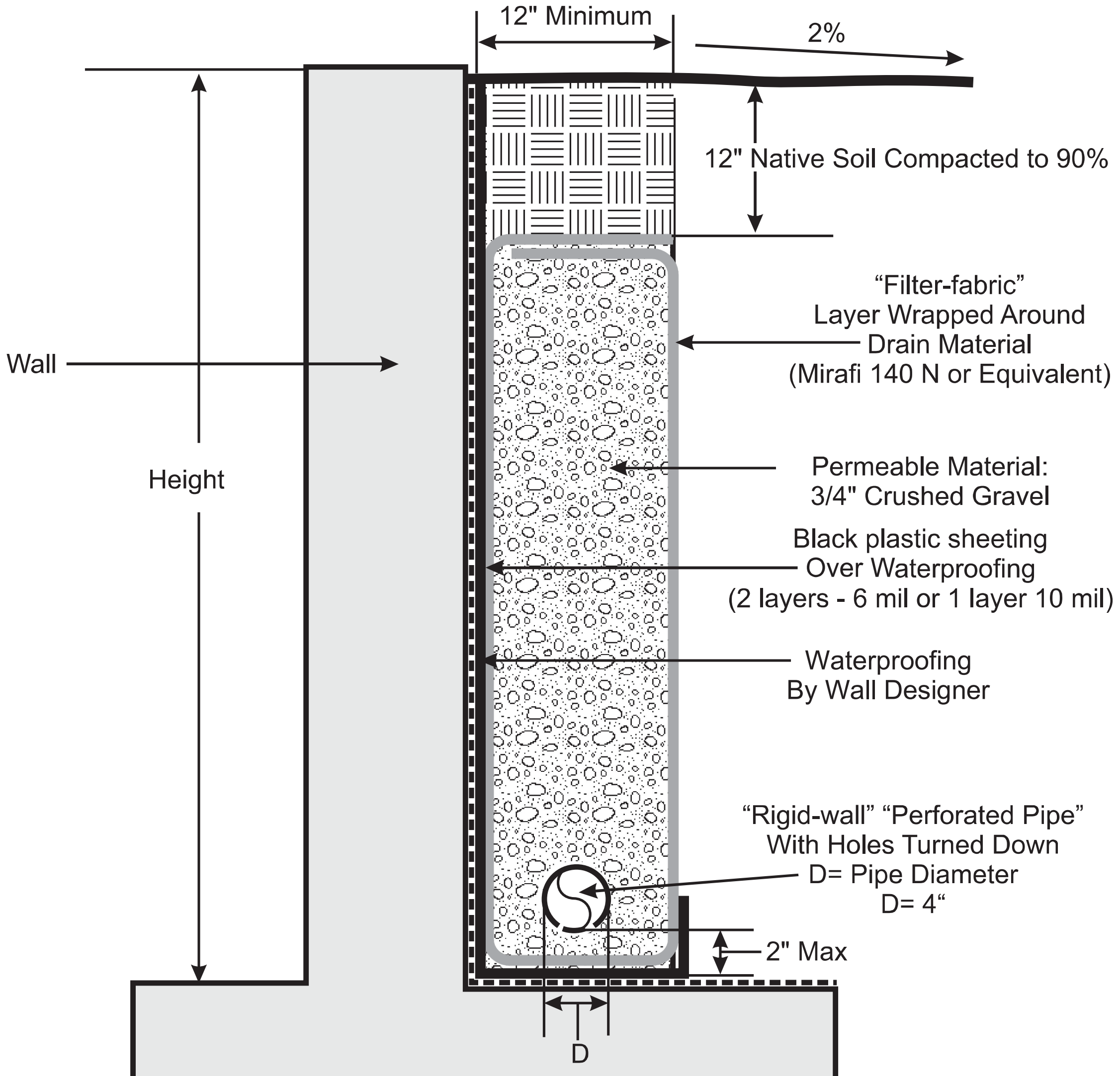
Retaining Wall With "Perforated Pipe Sub-Drain"

(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

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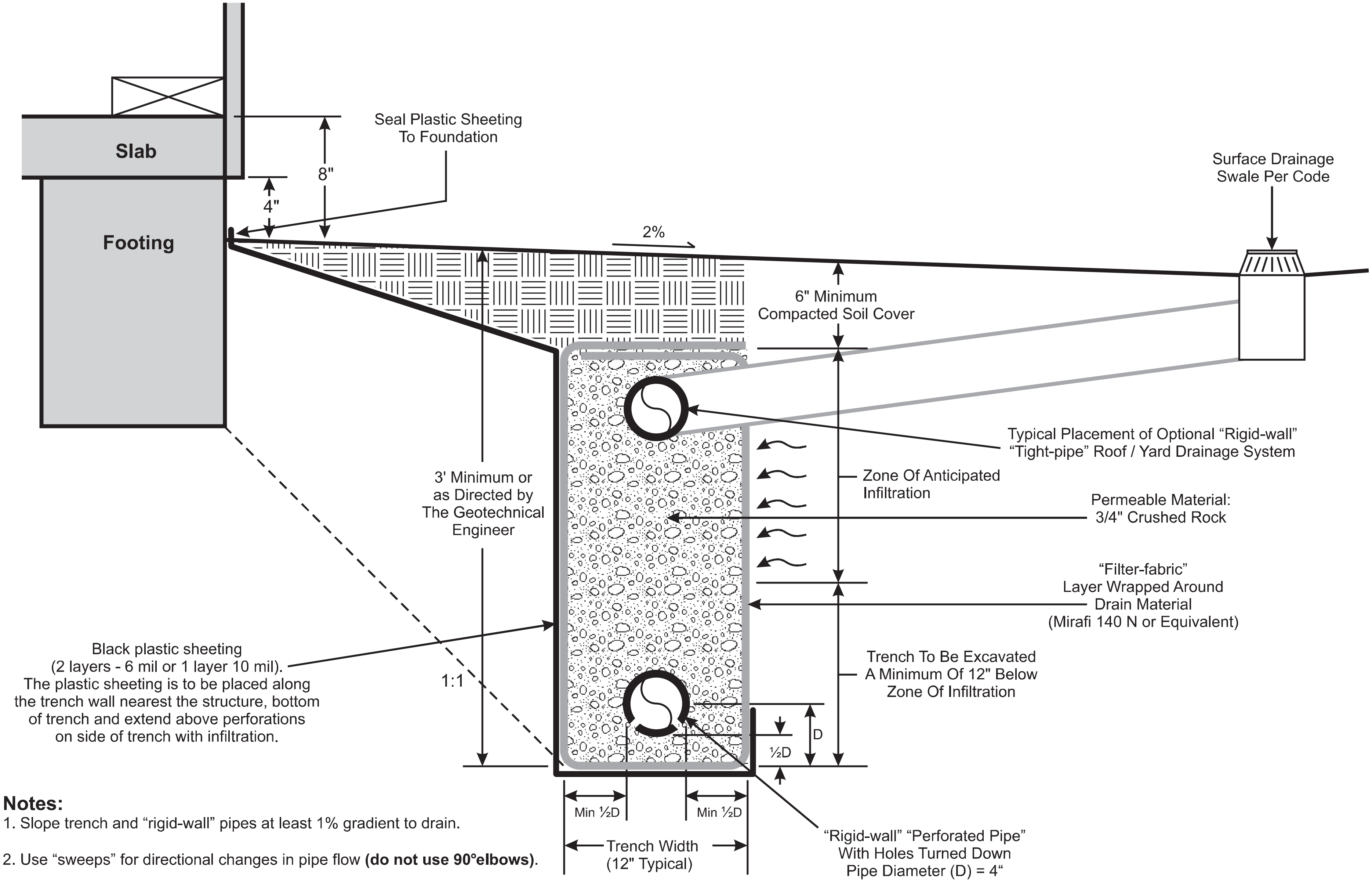

Notes:

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

2. Use "sweeps" for directional changes in pipe flow **(do not use 90°elbows)**.

3. Provide sweeps to periodic "clean-outs".

4. Washed clean permeable material.

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Project No.:
E17053.156

September 2022

SUB-DRAIN DETAIL

Prospector Park

Folsom, California

FIGURE

C-3