Appendix D

Geotechnical Study

GEOTECHNICAL FEASIBILITY STUDY
FOR
CREEKSIDE VILLAGE
Latrobe Road, APN 117-010-012
El Dorado Hills, California

Project No. E20064.000
March 2020

YOUNGDAHL
ESTABLISHED 1984

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Project No. E20064.000
16 March 2020

Attention: Mr. Anthony Gon

Subject: **CREEKSIDE VILLAGE**
Latrobe Road, APN 117-010-012, El Dorado Hills, California
GEOTECHNICAL FEASIBILITY STUDY

Reference: Proposal and Executed Contract for Creekside Village, prepared by Youngdahl Consulting Group, Inc., dated 11 February 2020 (Proposal No. PE20-070).

Dear Mr. Gon:

In accordance with your authorization, Youngdahl Consulting Group, Inc. has performed a Geotechnical Feasibility Study for the project site located at APN 117-010-012 on Latrobe Road in El Dorado Hills, California. The purpose of this study was to address the feasibility, from a geotechnical standpoint, of constructing the proposed development. Our scope was limited to a site reconnaissance, review of available published archival geotechnical data, and preparation of this report per the referenced proposal.

Based upon our site reconnaissance and geotechnical data review, it is our opinion that the primary geotechnical issues to be addressed consist of excavations into bedrock and drainage related to the anticipated shallow bedrock conditions. 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, and conclusions provided in this report are formulated as a whole; specific conclusions 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 Winn Communities 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.

REGISTERED PROFESSIONAL ENGINEER
KYLE J. MARTINEZ
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Project Engineer

Distribution: PDF to Client

Attachments: Figure 1 - Vicinity Map
Figure 2 - Site Map

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GEOTECHNICAL FEASIBILITY STUDY
FOR
CREEKSIDE VILLAGE

1.0 INTRODUCTION

This report presents the results of our Geotechnical Feasibility Study performed for the proposed residential housing development planned to be constructed at APN 117-010-012 on Latrobe Road in El Dorado Hills, California. Annotated vicinity and site maps are provided on attached Figures 1 and 2 to identify the approximate project location.

Purpose and Scope

The scope of work for the geotechnical feasibility study included an initial geotechnical site reconnaissance, review of available published and Youngdahl Consulting Group, Inc. archival geotechnical data for the approximate project area, and assessment of potential geotechnical constraints. The study is based, in part, upon information provided by the client.

The purpose of the geotechnical feasibility study was to assess the major geotechnical issues that could potentially affect the project, thus providing a framework for continued project planning. The intent of this report is to provide information regarding general site characteristics, including identification of any geotechnical characteristics that could constitute a constraint to the use of the land for the proposed residential development, and to provide guidance for a future geotechnical engineering study. This report is not intended to fulfill the criteria for geotechnical reports outlined in Chapter 18 of the 2019 California Building Code (CBC) or other jurisdictional requirements; investigations fulfilling those criteria will still need to be completed when the project reaches its appropriate stage. This report is intended to be used by the client in planning the project.

In the event that there are any changes in the proposed development concept, or if any of the assumptions used in the preparation of this report prove to be incorrect, the conclusions contained in this report shall not be considered valid unless the changes are reviewed and the conclusions of this report verified or modified by this firm in writing. The conclusions presented in this report are considered qualitative until such time as they are modified or verified by additional study such as that performed during a design-level geotechnical engineering investigation.

Project Understanding

We understand that Winn Communities is currently seeking entitlements for development of a future master planned community at the above referenced site. The planned community will likely consist of 700 to 800 residential units, a community gathering place, parks, trails, and open space. The residential units will likely consist of one to two-story wood framed structures, supported by conventional shallow foundations and slab-on-grade floors. Additional improvements will consist of asphalt and concrete roadways, sitework retaining walls, underground utilities, and pedestrian flatwork.

Background

Based on a limited review of aerial photography, the project site has remained undeveloped. 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.

2.0 SITE CONDITIONS

The following section describes our findings regarding the site conditions that we observed during our site reconnaissance, and the anticipated subsurface and groundwater conditions based upon our experience in the area.

<u>Surface Observations</u>

The project site is generally located on the west side of Latrobe Road in El Dorado Hills, California. Specifically, the area of development extends west from the southwest intersection of Avanti Drive and Latrobe Road to approximately 3000 feet southwest and as far south as the northwest intersection of Wetsel Oviatt Drive and Latrobe Road The site is bounded to the north by a commercial business park development, to the west by a new residential development, to the south by Wetsel-Oviatt Road, and the east by Latrobe Road fronting a large planned residential development eastward. The undeveloped site is approximately 174 acres in size, an irregularly shaped polygon, and generally slopes to the west.

The terrain consists of gently rolling hills with broad valleys and low gradient drainages and generally slopes toward the west at varying gradients with a maximum gradient of approximately 5H:1V (Horizontal:Vertical). The elevation ranges from a low of approximately 470 feet above mean sea level (AMSL) in the west to a maximum of 640 feet AMSL in the southeast. Occasional depressions and hills were observed throughout the site which appears to have served as mining prospect pits and springs. The vegetation throughout the project generally consisted of seasonal tall grasses with sparse trees and riparian type plants near the seasonal drainage courses.

These drainages cross the site and converge near the northwest corner of the site. Several near-vertical cut banks of the drainages were observed across the site. In general, the soils observed in cut banks were very steep to near vertical and extended to shallow bedrock in the streambed.

Shallow bedrock was observed across the site with numerous outcrops and “headstones” protruding out of the ground along the northeastern side of the project site. Most of the bedrock appears to be very moderately weathered to fresh in a moderately to widely spaced fractured condition.

<u>Anticipated Subsurface Conditions</u>

Our firm has performed several subsurface explorations near the vicinity of the project site. Based upon these explorations, we anticipate that the subsurface conditions will consist of soil overlying bedrock. The surface soils will likely entail silty clay and clayey silt in a soft to medium stiff condition. Underlying the soil, soft to hard metavolcanic bedrock in a highly to slightly weathered condition is expected. A thorough subsurface investigation is recommended once the project reaches its appropriate stage to more accurately determine the subsurface conditions.

<u>Anticipated Groundwater Conditions</u>

Based upon our review of the California Department of Water Resources website, permanently elevated groundwater is anticipated to be in excess 100 feet below the existing ground surface. Generally, subsurface water conditions vary in the region because of many factors such as, the proximity to bedrock, topographic elevations, and proximity to surface water. 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, perched water conditions are *highly anticipated* near the soil and bedrock contact at the site.

3.0 CONCLUSIONS

In our opinion, the site appears suitable, from a geotechnical standpoint, for the proposed resdidential housing project. No conditions were observed that would constitute a sufficiently severe geotechnical constraint that constructing the proposed project would be precluded. The primary geotechnical concerns anticipated at this site are excavations into bedrock and drainage related to the anticipated shallow bedrock condition. The potential for excessive total and differential settlement, liquefaction, slope stability, soil expansion, asbestos, and excavation considerations are also discussed below. The degree to which the above constraints will affect the project should be assessed within a design-level investigation and report once the project reaches its appropriate stage.

Excavations into Bedrock

Based on our experience in the area, we expect that the site soils can be excavated using conventional earthmoving equipment such as a Caterpillar D6 to D8 for grading and rubber tired backhoe for trench excavations not extending to the underlying bedrock materials. The underlying bedrock materials can likely be excavated to depths of several feet using a Caterpillar D9, equipped with a single or multiple shank rippers, or similar equipment. However, blasting cannot be ruled out in areas of resistant rock. Pre-ripping during mass grading may be beneficial and should be considered with the Geotechnical Engineer prior to, or during mass grading.

Utility trenches will likely encounter hard rock excavation conditions especially in deeper cut areas. Utility contractors should be prepared to use special rock trenching equipment such as large excavators (Komatsu PC400 or CAT 345 or equivalent). Blasting to achieve utility line grades, especially in planned cut areas, cannot be precluded. Water inflow into any excavation approaching the hard rock surface is very likely to be experienced in all but the driest summer and fall months.

Drainage

Proper application of drainage practices is considered to be of paramount concern for the effective development of the project site and to provide long term stability of the structural improvements. 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. Potential sources of groundwater may not be present or observed during the site grading procedures, but can appear later as more persistent seepage as water becomes perched or flows through fractures of the bedrock. These conditions generally become more prevalent following up gradient development and the addition of moisture sources (i.e. landscape irrigation, run-off, etc.).

To reduce the potential of these issues, application of the drainage provisions provided in the 2019 CBC are imperative, as well as additional drainage improvements. Swales and natural hillside drainage at the site which is to receive engineered fill will likely require the installation of canyon style drains. Additionally, in developments with the potential for a perched groundwater condition, underground utilities can become collection points for subsurface water. Therefore, we will likely recommend that plug and drains be installed within the utility trenches 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. Lastly, proper surface drainage, and careful installation of subdrains and back of retaining wall drains will be necessary to provide long term stability of the structural improvements as well as mitigate nuisance seepage. Once plans are developed, the civil engineer should coordinate with us to discuss the locations of plug and drains.

Total and Differential Settlement

Total and differential settlement under static conditions can occur when foundations span materials having variable compression and/or low density characteristics. Based upon the subsurface conditions anticipated and our experience in the area, the upper soils at the site are expected to be in a soft to medium stiff condition. When subjected to additional loading, soft soils tend to settle more than soils in a stiff condition or bedrock, and are more susceptible to higher amounts of total and differential settlement, which can stress and possibly damage foundations, often resulting in cracks and displacement. To reduce the potential for excessive total and differential settlement under static conditions, a program of overexcavation and recompaction in the building and other improvement areas will likely be necessary. Typically, mass grading operations for foothill subdivisions generally mitigate these conditions; however, professional observation during grading operations will be necessary.

Liquefaction

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 anticipated 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 negligible. For the above-mentioned reasons mitigation for these potential hazards is not considered necessary for the development of this project.

Slope Stability

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

Expansive Soils

The materials at the site are anticipated to be generally non-plastic (rock, sand, and non-plastic silt), which are considered to be nonexpansive; however, occasional pockets of plastic materials (clay soils) may be encountered. Expansive soils tend to swell with seasonal increases in soil moisture and shrink during the dry season as soil moisture decreases. The volume changes that the soils undergo in this cyclical pattern can stress and damage slabs, foundations, and other improvements if precautionary measures are not incorporated into the design and construction procedure.

To reduce the potential for damage related to expansive soils, if present at the site, special design considerations may be necessary. These may include the mixing of expansive and nonexpansive soils during mass grading operations, focused clay excavations, and/or special foundation and slab preparation recommendations. Typically, mass grading operations for foothill subdivisions generally mitigate expansive soil conditions; however, professional observation during grading operations will be necessary.

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. El Dorado County published a map dated 24 August 2018 that qualitatively indicates the likelihood for NOA in western El Dorado County. The project site is not identified as being in a NOA review zone based on the published map. Therefore, NOA mitigation is not anticipated to be necessary for development of the site.

Summary
The site is considered feasible for the planned residential project. In our opinion, no significant geotechnical engineering constraints are apparent. It will be necessary to provide additional geotechnical work for this site (exploratory test pits, laboratory testing, analyses, etc.) in order to complete the final geotechnical engineering study. The geotechnical engineering study should provide specific preliminary geotechnical recommendations pertaining to the design and construction of the earthwork, structures, and improvements associated with this site.

4.0 ANTICIPATED DESIGN CRITERIA

The following anticipated design criteria are intended to be used by the architect/engineer for cost estimation purposes only. Additional field and laboratory work is needed to provide preliminary geotechnical recommendations for site preparation, grading, utility trenches, foundations, interior slabs-on-grade and pedestrian flatwork, retaining walls, pavement sections, and drainage.

Seismic Criteria
Based on the 2019 California Building Code, Chapter 16, and our experience in the area, the following seismic parameters may be utilized for preliminary structural design.

Table 1: 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 (MCE_C) PGA	0.169g
	Table 11.8-1	Site Coefficient F_{PGA}	1.231
	Equation 11.8-1	$PGA_M = F_{PGA}$ PGA	0.208g
2019 CBC	Figure 22-1 **	Short-Period MCE at 0.2s, S_S	0.396g
	Figure 22-2 **	1.0s Period MCE, S_1	0.205g
	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, $S_{MS} = F_aS_s$	0.515g
	Equation 16 -37	Adjusted MCE Spectral Response Parameters, $S_{M1} = F_vS_1$	0.308g
	Equation 16-39	Design Spectral Acceleration Parameters, $S_{DS} = \frac{2}{3}S_{MS}$	0.344g
	Equation 16-40	Design Spectral Acceleration Parameters, $S_{D1} = \frac{2}{3}S_{M1}$	0.205g
	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/
** Section 1613.1 of the CBC indicates that either Section 1613 or ASCE 7-16 may be used for determination of seismic design categories.

Shallow Conventional Foundations
Shallow conventional foundation systems are anticipated to be suitable for construction of the planned structures. An allowable dead plus live load bearing pressure of 2,500 psf may be used for preliminary design purposed of conventional shallow foundations. An ultimate passive

equivalent fluid pressure of 300 pcf and a coefficient of friction of 0.35 are anticipated for the foundations. These are ultimate values that may require application of appropriate safety factors, load factors, depth factors, and/or other factors as deemed appropriate by the architect/engineer.

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

Conventional shallow foundations may be planned to be a minimum of 12 inches wide and founded a minimum of 12 inches below the lowest adjacent soil grade for buildings up to two-stories in height. Isolated pad (spread) footings should be a minimum of 24 inches square and founded a minimum of 12 inches below the lowest adjacent soil grade.

Retaining Walls

Retaining walls may be designed to resist lateral pressure exerted from a soil media having an equivalent fluid weight provided in the table below. In accordance with Section 1803.5.12.1 of the 2109 California Building Code, application of the seismic design values for earthquake loading are required for retaining walls supporting more than 6 feet of backfill. The values presented below are for conditions when engineered fill is used within the zone behind the wall defined as twice the height of the retaining wall.

Table 2: Retaining Wall Pressures

Wall Type	Wall Slope Configuration	Equivalent Fluid Weight (pcf)	Lateral Pressure Coefficient	Earthquake Loading (plf)**	
Free Cantilever	Flat	35	0.28	$4H^2$	Applied 0.6H above the base of the wall
	2H:1V	50	0.41		
Restrained*	Flat	50	0.41	$12H^2$	

* 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.

** Section 1803.5.12 of the 2019 California Building Code states that a determination of lateral pressures on basement and retaining walls due to earthquake loading shall be provided for structures to be designed in Seismic Design Categories D, E or F (Load value derived from Wood (1973) and modified by Whitman (1991)).

If keyed or interlocking non-mortared walls such as Keystone, Baselite, Allen Block, or rockery walls are utilized, the following soil parameters may be applicable for design within on-site, native materials:

Table 3: Modular Retaining Wall Design Parameters

Internal Angle of Friction	Cohesion	Bulk Unit Weight
32°	0 psf	125 psf

Asphalt Concrete Pavement Design

The pavement sections listed in the table below were based upon an assumed soil resistance value, or “R-Value,” of 35, and were calculated in accordance with the methods presented in the Sixth Edition of the California Department of Transportation Highway Design Manual.

Table 4: Asphalt Pavement Section Recommendations

Design Traffic Indices	Alternative Pavement Sections (Inches)	
	Asphalt Concrete *	Aggregate Base **
5.0	2.5 3.0	6.0 4.5
5.5	3.0 3.5	6.0 5.0
6.0	3.0 3.5	7.5 6.5
6.5	3.5 4.0	8.0 7.0
7.0	4.0 4.5	8.5 7.5
7.5	4.5 5.0	9.0 8.0
8.0	4.5 5.0	10.0 9.5
8.5	5.0 5.5	10.5 10.0
9.0	5.5 6.0	11.0 10.5

* 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)

<u>Portland Cement Concrete Pavement Design</u>
The pavement sections listed in the table below were based upon an assumed soil resistance value, or "R-Value," of 35, and were calculated in accordance with the methods presented in the American Concrete Institute (ACI) Concrete Pavement Design (ACI 330R-08).

Table 5: Concrete Pavement Section Recommendations

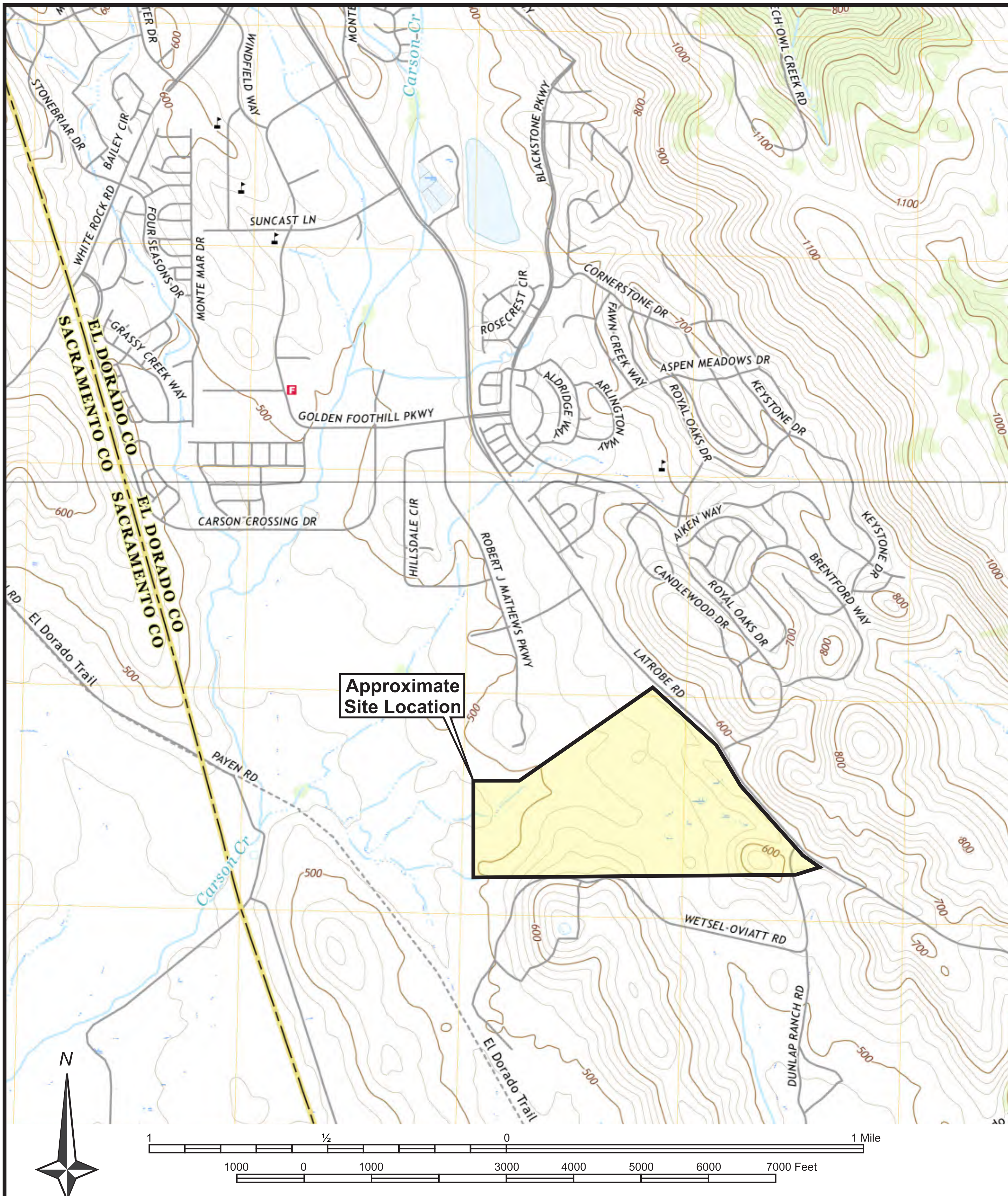
Category	ADTT*	Pavement Traffic Description	Thickness (inches)	
			3000 psi**	4000 psi**
A	1	Car parking areas and access lanes Autos, pickups, and panel trucks only	4.0	4.0
A	10		5.0	4.5
B	25	Shopping center entrance and service lanes Bus parking areas and interior lanes Single-unit truck parking areas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

* Average Daily Truck Traffic
** 28-day concrete compressive strength

5.0 CLOSURE

This report is valid for conditions as they exist at this time for planning the type of project described herein. Our intent was to assess the geotechnical feasibility in a manner consistent with the level of care and skill ordinarily exercised by members of the profession currently practicing in the locality of this project under similar conditions at this time. No representation, warranty, or guarantee is either expressed or implied. This report is intended for the exclusive use by the client, as discussed in the "Purpose and Scope" section of this report. Application beyond the stated intent is strictly at the user's risk.

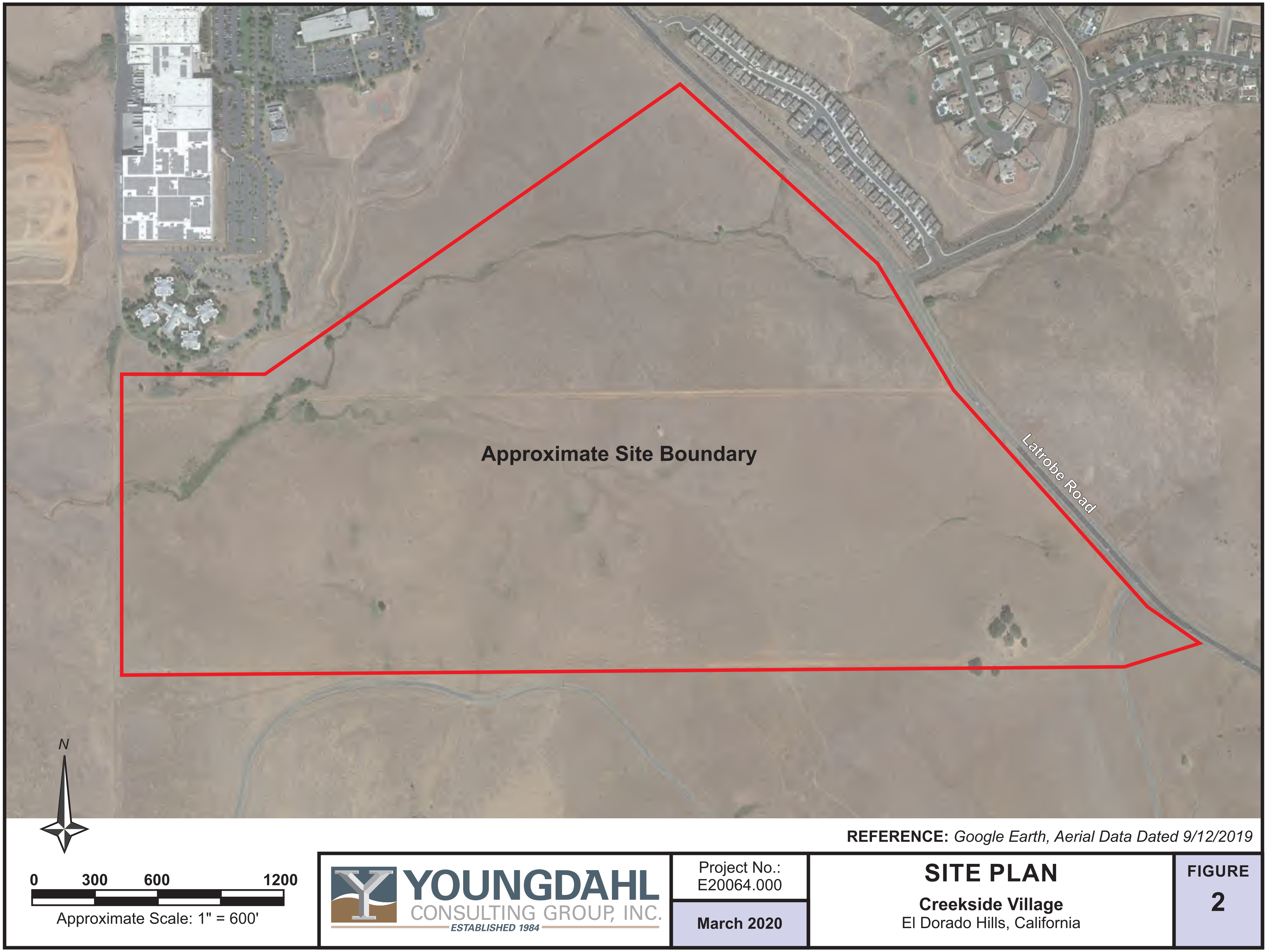
The preliminary opinions and conclusions of this feasibility report are based upon a site reconnaissance, review of available published and Youngdahl Consulting Group, Inc. own archival geotechnical data for the approximate project area, and our knowledge of the area. These opinions and conclusions should be confirmed and augmented by a geotechnical engineering study once the project reaches an appropriate stage.



Scale: 1:24,000

BASE MAP REFERENCE: *U.S.G.S. 7.5 Minute Topographic Series, Clarksville & Folsom SE Quadrangles, Dated 2018*

YOUNGDAHL CONSULTING GROUP, INC. ESTABLISHED 1984	Project No.: E20064.000 **March 2020**	**VICINITY MAP** **Creekside Village** El Dorado Hills, California	**FIGURE** **1**



REFERENCE: *Google Earth, Aerial Data Dated 9/12/2019*

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SITE PLAN

Creekside Village
El Dorado Hills, California

FIGURE 2