PRELIMINARY GEOTECHNICAL STUDY REPORT

CHALK VISTA SUBDIVISION
1276 JENSEN LANE
WINDSOR, CALIFORNIA

Project Number:

3909.01.01.1

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INTRODUCTION

This report presents the results of our preliminary geotechnical study for the proposed Chalk Vista Subdivision to be constructed at 1276 Jensen Lane in Windsor, California. The property is approximately 38 acres in size and is designated as APN 162-020-007. The property extends over relatively flat terrain at the end of Jensen Lane and then transitions up moderate to steeply sloping terrain. The site location is shown on Plate 1.

We understand that it is planned to subdivide the property into three large lots that range in size from about 10 to 15 acres. A topographic map showing the potential building site for each lot, including an alternative for Lot 1, is shown on Plate 2.

The purpose of our study as outlined in our proposal dated February 20, 2018, was to evaluate the geologic hazards within the property and comment on the geotechnical feasibility of the project. In addition, we were to recommend the geotechnical services needed for actual development, design and construction of the project.

SCOPE

Our scope of work was limited to a brief site reconnaissance, a review of selected published geologic data and LiDAR for the property and its vicinity, and preparation of this report. Site-specific subsurface exploration was not requested, authorized or performed for this phase of our services.

SERVICES PROVIDED

We reviewed LiDAR and select published geologic information pertinent to the site. A list of the geologic references reviewed is presented at the end of this report. On March 27, 2018, our engineering geologist and geotechnical engineer conducted a surficial reconnaissance of the property to observe exposed topographic features, surface soils, rock outcroppings and cut banks. A topographic map of the property showing the location of proposed building sites and mapped and observed features from our site reconnaissance are presented on Plate 2.

Based on the geologic literature review and site reconnaissance, we were to develop the following information:

1. A brief description of geologic, surface soil, and spring or other conditions observed during our reconnaissance;

2. Distance to nearby active faults and a discussion of geologic hazards that may affect the proposed project;

3. Our opinions regarding the geotechnical feasibility of the project; and

4. Preliminary conclusions and recommendations concerning;

a. Primary geotechnical engineering concerns and possible mitigation measures, as applicable;

b. Suitable foundation systems for new structures;

c. Stability of access routes to the site; and

d. Supplemental geotechnical engineering services.

SITE CONDITIONS

General

Sonoma County is located within the California Coast Range geomorphic province. This province is a geologically complex and seismically active region characterized by sub-parallel northwest-trending faults, mountain ranges and valleys. The oldest bedrock units are the Jurassic-Cretaceous Franciscan Complex and Great Valley sequence sediments originally deposited in a marine environment. Subsequently, younger rocks such as the Tertiary-age Sonoma Volcanics group, the Plio-Pleistocene-age Clear Lake Volcanics and sedimentary rocks such as the Guinda, Domengine, Petaluma, Wilson Grove, Cache, Huichica and Glen Ellen formations were deposited throughout the province. Extensive folding and thrust faulting during late Cretaceous through early Tertiary geologic time created complex geologic conditions that underlie the highly varied topography of today. In valleys, the bedrock is covered by thick alluvial soils. The site is located in the hills east of Windsor.

Geology

Published geologic maps (Delattre, 2011) indicate the property is underlain by Holocene to latest Pleistocene alluvial fan deposits (Qf) in the low-lying areas and early Pleistocene to Pliocene unnamed fluvial deposits (QTg). The alluvial fan deposits consist of moderately to poorly sorted deposits of sand, gravel, silt, and clay. The unnamed fluvial deposits consist of weakly consolidated gravel, tuffaceous sand, silt, clay, and reworked tuff. The extent of these units is shown on Plate 2.

Landslides

Published landslide maps (Delattre, 2011; and Huffman, 1980) indicate large-scale slope instability at the site. A review of LiDAR for the property and the surrounding area found indications of landslides at the property. During our reconnaissance of the property, we observed the landslides indicated on the LiDAR and additional features. The observed landslides are mapped on Plate 2.

Faulting

The site is not within a current Alquist-Priolo Earthquake Fault Zone for active faults as defined by the California Geological Survey (CGS). CGS defines active faults as those exhibiting evidence of surface displacement during Holocene time (last 11,000 years). Published maps (Delattre, 2011) indicate that traces of the Healdsburg fault extends into the property as shown on Plate 2. Prior to 1983, CGS Alquist-Priolo Special Studies Zones maps included the Healdsburg fault in their special studies zone for active faults. Subsequently, this fault was removed from zoning. However, studies performed along traces of the Healdsburg fault by private consultants indicate recent activity. The City of Healdsburg and Sonoma County Permit and Resource Management Department treat this fault as active and have adopted a zone similar to the one in place prior to 1983.

Surface

The property extends over relatively flat terrain at the end of Jensen Lane and then transitions up moderate to steeply sloping terrain. The vegetation consists of seasonal grasses and weeds with scattered mature trees. The proposed building sites are generally located in the moderately to steeply sloping terrain in the northern and eastern portions of the property.

In general, the ground surface is soft and spongy. This is a condition generally associated with weak, porous surface souls. The Natural Resources Conservation Service (2018) indicate the soils at the site have low to medium plasticity (LL = 25-40; PI = 13-20).

Natural drainage consists of overland flow over the ground surface that concentrates on a natural drainage element such as swales, ravines, and creeks. The drainage trends towards creeks that feed into the Russian River.

DISCUSSION AND CONCLUSIONS

Geologic Hazards

Landslides

As discussed previously, landslide features were mapped and observed at the project site. The observed landslide features are mapped on Plate 2. Development including roadway and utilities should avoid these areas unless remedial work is performed to stabilize the slopes. Remedial work could include removing the landslide debris and constructing a buttress. In addition, landslide features can have adverse impact on improvements constructed downslope if the feature were to reactivate. The design level geotechnical study should address these issues in detail.

Fault Rupture

We did not observe landforms within the area that would indicate the presence of active faults, and the site is not within a current Alquist-Priolo Earthquake Fault Zone. However, prior to 1983, the Healdsburg fault was considered active by the State of California. As discussed previously, the project site is located within the previous Healdsburg earthquake fault zone. Local geology consultants and governing jurisdictions consider the Healdsburg fault as active. Our experience with the Healdsburg fault also indicates that it is active. Based on the above information, we judge that there is a moderate to high potential for surface fault rupture at the site. Design level geotechnical studies for the residences should address this issue in detail.

Strong Ground Shaking

The site is within an area affected by strong seismic activity and future seismic shaking should be anticipated at the site. It will be necessary to design and construct the proposed improvements in strict adherence with current standards for earthquake-resistant construction.

Liquefaction

Liquefaction is a rapid loss of shear strength experienced in saturated, predominantly granular soils below the groundwater level during strong earthquake ground shaking due to an increase in pore water pressure. The occurrence of this phenomenon is dependent on many complex factors including the intensity and duration of ground shaking, particle size distribution and density of the soil. Review of published maps (Witter, et al., 2006) indicate that the property is located within an area delineated as having low susceptibility to liquefaction. Therefore, we judge that there is a low potential for liquefaction at the site. The final geotechnical study for the residences should address liquefaction in detail.

Densification

Densification is the settlement of loose, granular soils above the groundwater level due to earthquake shaking. Densification typically occurs in old fills and in soils that if saturated would be susceptible to liquefaction. As discussed previously, the property is located with a zone of low liquefaction potential. Therefore, the susceptibility to densification is likely low as well. The final geotechnical study for the residences should address densification in detail.

Lurching

Seismic slope failure or lurching is a phenomenon that occurs during earthquakes when slopes or man-made embankments yield and displace in the unsupported direction. Provided the improvements are located outside areas of identified slope instability and the foundations are installed as recommended herein, and planned fills are adequately keyed into underlying bedrock material, as subsequently discussed, we judge the potential for impact to the proposed improvements from the occurrence of these phenomena at the site is low. However, some of these secondary earthquake effects are unpredictable as to location and extent, as evidenced by the 1989 Loma Prieta Earthquake.

Geotechnical Issues

Based upon the results of our geologic data review and reconnaissance, we judge that it is geotechnically feasible to subdivide the property and construct single-family residences, leachfields and access roads on the new lots. The primary geotechnical considerations and potential mitigating measures recommended for parcel creation, building site development and roadway construction are discussed in the following sections of the report. These conclusions are preliminary and will need to be verified or modified during final design following detailed site-specific subsurface exploration, laboratory testing and geotechnical engineering evaluations, as recommended herein.

Residence Locations

The proposed building envelopes appear to be located outside of the traces of the Healdsburg fault and are outside of unstable areas in order to reduce the risks associated with slope instability. The locations of the building envelopes in relation to such areas are shown on Plate 2. The locations of the identified active fault traces and unstable areas are shown on Plate 2. Initially, a structural setback of approximately 50-feet from unstable areas and breaks in slope of 2:1 or steeper should be established. A site-specific study should finalize recommended structural set backs.

Weak, Porous Surface Soils

Weak, porous surface soils, such as those found likely present at the site, appear hard and strong when dry but will lose strength rapidly and settle under the load of fills, foundations, slabs and pavements as their moisture content increases and approaches saturation. The moisture content of these soils can increase as the result of rainfall, periodic irrigation or when the natural upward migration of water vapor through the soils is impeded by, and condenses under fills, foundations, pavements and slabs. The detrimental effects of such movements can be remediated by strengthening the soils during grading. This is typically achieved by excavating the weak soils and replacing them as properly compacted (engineered) fill. Alternatively, foundation support can be obtained by a foundation system that gains support below the weak surface soils.

Expansive Soils

Expansive surface soils, if present at the site, shrink and swell as they lose and gain moisture throughout the yearly weather cycle. Near the surface, the resulting movements can heave and crack lightly loaded shallow foundations (spread footings) and slabs. The zone of significant moisture variation (active layer) is dependent on the expansion potential of the soil and the extent of the dry season. In the project area, the active layer is generally considered to range in thickness from about 2 to 3 feet. Stable foundation support needs to be obtained below this layer.

Downslope Creep

On sloping terrain that is 5:1 (horizontal to vertical) or steeper, the weak and porous surface soils undergo a gradual downhill movement known as creep. Fills and foundations deriving support from these materials will be susceptible and contribute to the downslope creep and settlement unless properly embedded in bedrock or buttressed (keyed, benched, drained and compacted), respectively. The settlement causes cracks in the slabs and structural distress in the form of cracked plaster, and sticky doors and windows. Therefore, it will be necessary to obtain fill and/or foundation support below the creeping soils and design the foundations to resist stresses imposed by the creeping soils.

Fill Support

Hillside fills need to be constructed on level keyways and benches excavated entirely on rock. However, regardless of the care used during grading, buttressed fills of uneven thickness such as those typically built on hillsides, will settle differentially. Satisfactory performance of structural elements constructed on hillside fills, such as houses, pools, pool decks, garage slabs and driveways, will require the use of specialized grading techniques discussed in the following sections of this report. These include excavating all creeping soils and replacing said materials as a buttressed fill of even thickness or constructing said improvements entirely on cut.

Foundation Support

Satisfactory foundation support on sloping terrain can be obtained from spread footings that bottom at minimum depth on firm bedrock exposed by planned excavations, or in bedrock reached by footings excavated through the creeping soils, or from spread footings supported on buttressed fills of equal thickness. Where the creeping soils are not buttressed or removed by grading the residential footings must be designed to resist creep forces.

As an alternative, drilled piers gaining support in bedrock and designed to resist creeping forces, as needed, can be used for foundation support either under all parts of the structure or within areas of deep soils or buttressed fill of even thickness. Criteria for the design of such systems should be developed by a site-specific geotechnical study as recommended in the supplemental services section of this report.

Floor Systems

In general wood floors supported on joists above-grade can be used in living areas. Slab-on-grade floors can be used in the living area and garages provided that:

1. The planned grading either removes the weak surface soils or increases their supporting capacity by mechanical compaction; and

2. The slabs are reinforced to reduce cracks and span areas of uneven support;

Access Roads

In general, new driveways should be aligned to avoid steep slopes and areas of potential instability in order to reduce construction costs and future maintenance.

Erosion and Site Drainage

The long-term satisfactory performance of roadways, leachfields and residential development constructed on hillsides results primarily from strict control of surface runoff and subsurface seepage. The site's surface soils have the potential for erosion potential depending on slope inclination. Uncontrolled erosion could induce sloughing or landsliding. Downspouts from the future residence(s) should discharge into closed glued pipes that empty away from unstable areas and into nearby roadway or natural drainages. Discharge for roadway culverts and ditches and downspout points need to be protected against erosion and sloughing by energy dissipators such as rip-rap and gabions, or equivalent protective and energy dissipation measures, as appropriate.

Groundwater

Free groundwater seeps or springs were not observed during our reconnaissance. On hillsides, rainwater typically percolates through the porous topsoil and migrates downslope in the form of seepage at the interface of the topsoil and bedrock, and through cracks in the bedrock. Fluctuations in the seepage rates typically occur due to variations in rainfall and other factors such as periodic irrigation.

Flooding

Our review of the Federal Emergency Management Agency (FEMA) Flood Zone Map for Sonoma County, California, Unincorporated Areas (No. 060375-0545 B) dated April 2, 1991, indicates that the site is located within Zone "X", an area outside of the 500-year flood plain. If the building sites are located as shown on Plate 2, we judge the risk of flooding will be low. However, evaluation of flooding potential is typically the responsibility of the project civil engineer.

Supplemental Services

We should perform a detailed geotechnical study prior to the construction of the residence(s) and roadway. The study should include test borings or backhoe pits, fault trenches, laboratory testing and engineering analyses. The geotechnical study should address specific design and locating aspects of each planned residential location and the access road, and the data generated should be incorporated into project plans. The plans should then be reviewed by the geotechnical engineer and /or engineering geologist prior to receiving bids for planned work.

LIMITATIONS

This report has been prepared by RGH for the exclusive use of Famiglia Liberta, LLC and their consultants to evaluate the geotechnical feasibility of residential development within the proposed subdivision.

Our services consist of professional opinions and conclusions developed in accordance with generally accepted geotechnical engineering principles and practices. We provide no warranty, either expressed or implied. Our conclusions and recommendations are based on the information provided to us regarding the proposed parcel split; the results of our field reconnaissance and data review; and professional judgment. As such, our conclusions and recommendations should be considered preliminary and for feasibility and planning purposes only. A subsurface study, such as recommended herein, may reveal conditions different from those inferred by surface observation and data review only. Such subsurface study may warrant a revision to our preliminary conclusions.

Site conditions and cultural features described in the text of this report are those existing at the time of our field exploration on March 27, 2018 and may not necessarily be the same or comparable at other times.

It should be understood that slope failures including landslides, debris flows and erosion are on-going natural processes which gradually wear away the landscape. Residual soils and weathered bedrock can be susceptible to downslope movement, even on apparently stable sites. Such inherent hillside and slope risks are generally more prevalent during periods of intense and prolonged rainfall, which occasionally occur in northern California and/or during earthquakes. Therefore, it must be accepted that occasional slope failure and erosion and deposition of the residual soils and weathered bedrock materials are irreducible risks and hazards of building upon or near the base of any hillside or steep slope throughout northern California. By accepting this report, the client and other recipients acknowledge their understanding and acceptance of these risks and hazards.

The scope of our services did not include an environmental assessment or a study of the presence (or absence) of hazardous, toxic or corrosive materials in the soil, surface water, groundwater or air on, below, or around this site, nor did it include an evaluation or study for the presence (or absence) of wetlands.

APPENDIX A - PLATES

LIST OF PLATES

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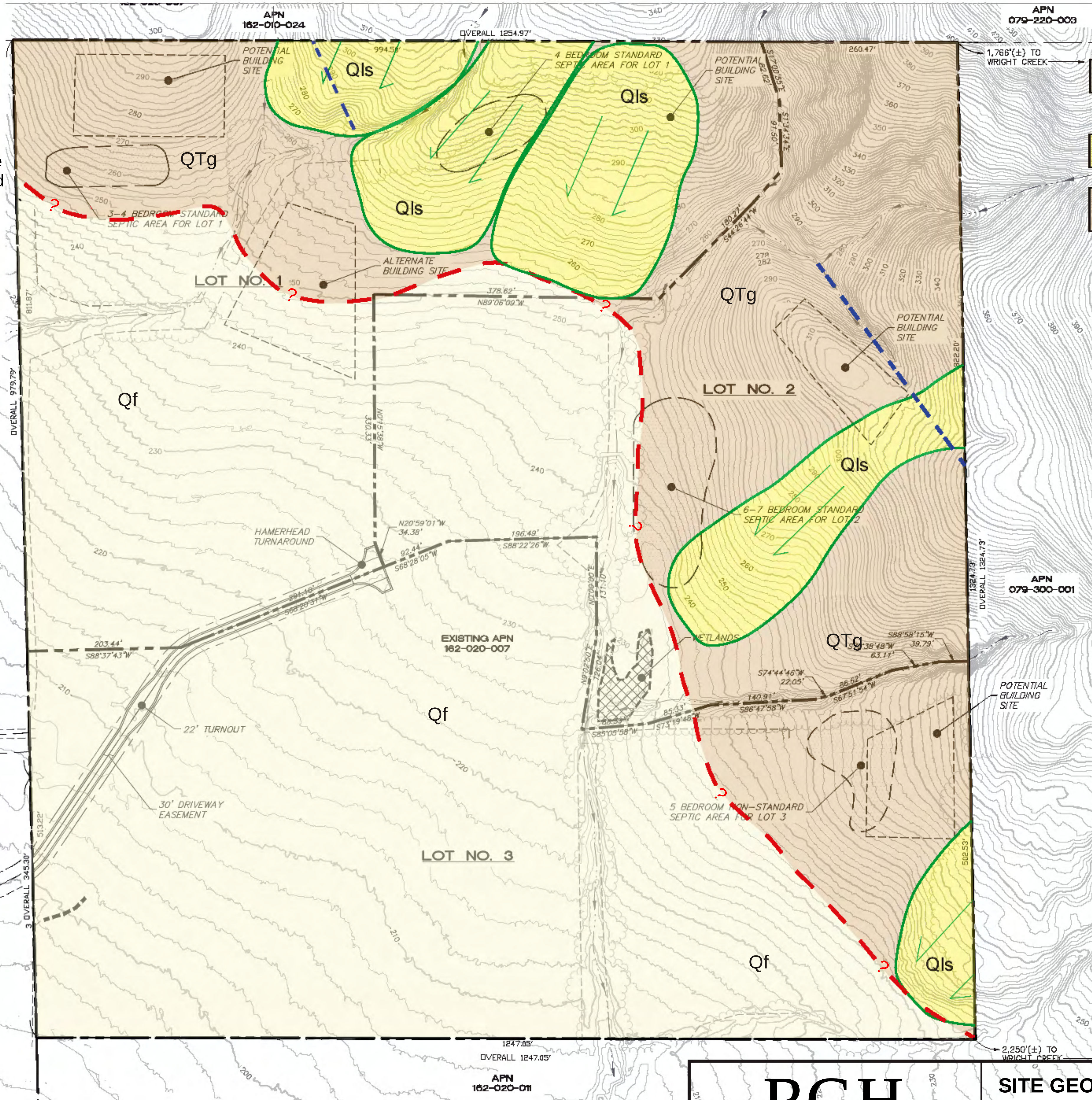
SITE LOCATION MAP
Chalk Vista Subdivision
1276 Jensen Lane
Windsor, California

PLATE
1

EXPLANATION

- Record Boundary Line
- Proposed Boundary Line
- Drainage Swale
- Existing Ground Contours (2' Elevation Intervals)
- Seasonal Drainage Course Not Shown on USGS Quad
- Landslide with Arrow Indicating Direction of Movement
- Healdsburg Fault Traces*
- Geologic Contact Dashed Where Approximate, Dotted Where Concealed, Queried Where Unknown



EXPLANATION

Reference: Preliminary Geologic Map of the Healdsburg 7.5' Quadrangle, Sonoma County, California, by Delattre, dated 2011

Qf — **Alluvial fan deposits (Holocene to latest Pleistocene)** - Moderately to poorly sorted deposits of sand, gravel, silt, and clay mapped on slopping, fan-shaped, slightly to moderately dissected, alluvial surfaces.

Qls — **Landslide deposits (historical to Pleistocene)** - Arrows indicate direction of movement; queried where landslide existence is questionable.

QTg — **Unnamed fluvial deposits (early Pleistocene to Pliocene)** – Light-brown to yellow-brown, weakly consolidated gravel, tuffaceous sand, silt, clay, and reworked tuff. Clasts are derived from Tertiary volcanic and Franciscan basement rocks. Includes gravels previously mapped as Glen Ellen and Huichica formations; names not used here because of unreliable lithologic and age criteria for distinguishing between the units and correlation with the formation type localities (McLaughlin and others, 2008). The unit includes obsidian pebbles (characteristic of the Glen Ellen Formation) in relative abundance throughout the southern portion of the quadrangle west of the Healdsburg Fault, becoming increasingly sparse or absent northward and to the east of the Healdsburg Fault. Gravels east of the Healdsburg Fault include interbeds of ash-flow and air fall tuff that appear to represent interfingering with the upper part of the Sonoma Volcanics (**Tsvt**).

80 0 80 feet

Scale: 1" = 80'

Reference: Tentative Map Layout, by Munselle Civil Engineering, dated 4/6/2018

*Fault traces approximately located from Delattre (2011)

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SITE GEOLOGIC MAP
Chalk Vista Subdivision
1276 Jensen Lane
Windsor, California

PLATE 2

APPENDIX B - REFERENCES

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APPENDIX C - DISTRIBUTION

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