CORNERSTONE
EARTH GROUP

Date:	September 18, 2017
Project No.:	206-51-2
Prepared For:	Ms. Heide Antonescu **TRUMARK HOMES LLC** 3001 Bishop Drive, Suite 100 San Ramon, California 94583
Re:	Geotechnical Feasibility Review Tassajara Nursery Property 2550 Camino Tassajara Danville, California

Dear Ms. Antonescu:

As requested, this letter presents the results of our geotechnical feasibility review for the above referenced project. Our services were performed in accordance with our agreement dated August 1, 2017.

The Project

We understand that Trumark is considering purchasing the approximately 5-acre property that is currently occupied by a retail nursery. A conceptual plan dated October 25, 2016, indicates up to 15 single-family homes would be considered.

The site is bordered by Sherburne Hills Road and residential development to the northwest, residential development with a drainage swale and open space beyond to the southwest, residential development to the southeast and Camino Tassajara to the northeast.

The purpose of our feasibility evaluation was to review available published regional geologic and geohazard maps, data available at the site and surrounding sites, and subsurface data in our files pertinent to the site conditions in the vicinity of the project in order to develop an opinion whether site development is feasible from a geotechnical viewpoint. A summary of our findings is presented below.

Regional Setting

Geologic Setting

The project site is located in the Tassajara Valley in the foothills of Mount Diablo, which is one the tallest peaks in the Diablo Range of the Coast Ranges structural and geomorphic province

of California. The Diablo Range represents one mountain range in a series of northwesterly-aligned mountains forming the Coast Ranges geomorphic province of California that stretch from the Oregon border nearly to Point Conception. In the San Francisco Bay area, most of the Coast Ranges have developed on a basement of tectonically mixed Cretaceous- and Jurassic-age (70- to 200-million years old) rocks of the Franciscan Complex, Coast Range Ophiolite, and Great Valley Sequence. Locally younger sedimentary and volcanic rocks cap these basement rocks. Still younger surficial deposits that reflect geologic conditions for the last million years or so cover most of the Coast Ranges.

Rocks of the Great Valley Sequence, Franciscan Complex and Coast Range Ophiolites are juxtaposed by major regional faults and exposed in the East Bay hills and Diablo Range. Ophiolite rocks are the remnants of arc-related oceanic crust; The Great Valley Sequence is composed of Jurassic and Cretaceous age turbidities consisting of sandstone, conglomerate and shale that were deposited on top of the crustal rocks. The Franciscan Complex, or "mélange", consists of generally Jurassic to Cretaceous aged heterogeneous igneous, metamorphic and sedimentary rocks that have been deformed through faulting and folding. These complexes are unconformably overlain by Mesozoic and Cenozoic sedimentary and volcanic rocks which are locally overlaid in low lying areas by Quaternary Alluvium (Qa).

The geologic structure area surrounding the site is severely complicated by folding and faulting associated with the Mt. Diablo anticline and related structures, which are part of an extensive belt of active deformation stretching from the northern Diablo Range to western Sacramento. Mt. Diablo is flanked by seismically active faults including the Greenville fault along its southeast side and by the Concord fault along its northwest side (Unruh, 2001; Jennings and Bryant, 2010).

Regional Seismicity

The San Francisco Bay area region is one of the most seismically active areas in the Country. While seismologists cannot predict earthquake events, the U.S. Geological Survey's Working Group on California Earthquake Probabilities 2015 revises earlier estimates from their 2008 (2008, UCERF2) publication. Compared to the previous assessment issued in 2008, the estimated rate of earthquakes around magnitude 6.7 (the size of the destructive 1994 Northridge earthquake) has gone down by about 30 percent. The expected frequency of such events statewide has dropped from an average of one per 4.8 years to about one per 6.3 years. However, in the new study, the estimate for the likelihood that California will experience a magnitude 8 or larger earthquake in the next 30 years has increased from about 4.7 percent for UCERF2 to about 7.0 percent for UCERF3.

UCERF3 estimates that each region of California will experience a magnitude 6.7 or larger earthquake in the next 30 years. Additionally, there is a 63 percent chance of at least one magnitude 6.7 or greater earthquake occurring in the Bay Area region between 2007 and 2036.

The faults considered capable of generating significant earthquakes are generally associated with the well-defined areas of crustal movement, which trend northwesterly. The table below presents the State-considered active faults within 20 kilometers of the site.

Table 1: Approximate Fault Distances

Fault Name	Distance	
	(miles)	(kilometers)
Calaveras	2.7	4.4
Concord-Green Valley	11.1	17.8
Greenville	11.2	18.0
Hayward	11.4	18.3

Site Conditions

Site History

Based on available historical aerial imagery, a 1939 photograph indicates the southeast half of the property used as an orchard. However, by 1946 orchard trees on the site and adjacent properties were cleared and the site appears to have been used for agricultural purposes such as growing row crops. Agriculture on the site appears to have continued until sometime between 1968 and 1979, when a rectangular commercial building was constructed near present day Camino Tassajara. Between 1979 and 1993, the site was developed as a nursery, including construction of a few moderately sized nursery and portable buildings. The site appears to have remained in this condition until the present day. Based on discussions with the property owner, an underground storage tank (UST) is reported located at the site. The exact location and depth of the tank are not known at this time.

General Site Conditions

Based on our site visit, the approximately 5-acre site is currently operating as a retail nursery that is occupied by several small to moderately sized buildings and an asphalt paved parking lot on the northwest corner of the property along Sherburne Hills Road. The remainder of the site is covered with asphalt pavement, exposed gravel access roads or mulch and landscaping fabric.

Detailed topographic information of the site was not available at this time; however, based on our review of available topographic information, site grades across the site range from approximately Elevation 500 feet along Camino Tassajara to about Elevation 509 feet towards the rear of the property (Google Earth, WGS84). Sycamore Creek is located approximately 150 to 260 feet south of the parcel near the base of nearby gently rolling open space terrain.

Subsurface Conditions

Based on our site observations and review of available geologic maps, surficial soils at the site are Holocene-aged alluvium (Qha) likely consisting of clay interbedded with localized layers of sand and gravel. Locally, the shallow clay soils are typically highly to very highly expansive. These younger alluvial soils are reported to be underlain by Miocene and Pliocene aged sedimentary rocks of the GrennValley and Tassajara Formations (Tgvt), as mapped by Graymer et. al (1994). The bedrock is described as non-marine sandstone, siltstone and conglomerate. The depth to bedrock is not known at this time, but based on the location of the site relative to the nearby hillsides, the bedrock depth is likely on the order of 30 to 50 feet deep or greater.

Due to the past site usage and presence of existing structures, pavements and a reported UST, there are likely localized undocumented (man-made) fills present at the site. The lateral extent and depth of these fills are not yet known, but are assumed to be on the order of 1 to 3 feet, with the exception of the UST backfill, which could be on the order of 6 to 10 feet deep.

Ground Water

Ground water depths are not well documented at the site or in the vicinity of the site. However, based on our review of the Geotracker database, ground water was encountered between 11 and 15 feet below the surface roughly 2.5 miles east of the site. The nearby Sycamore Creek may seasonally influence ground water levels. Fluctuations in ground water levels will occur due to many factors including seasonal fluctuation, irrigation practices, rainfall, underground drainage patterns, regional fluctuations, and other factors.

Geologic Hazards

Fault Rupture

As discussed above, several significant faults are located within 25 kilometers of the site. The site is not located within a State-designated Alquist-Priolo Earthquake Fault Zone. No known surface expression of fault traces is thought to cross the site; therefore, fault rupture hazard is not a significant geologic hazard at the site.

Estimated Ground Shaking

Moderate to severe (design-level) earthquakes can cause strong ground shaking, which is the case for most sites within the Bay Area. A peak ground acceleration (PGA) was estimated for preliminary analysis using $PGA_M = F_{PGA} \times PGA_G$ (Equation 11.8-1) as allowed in the 2016 California Building Code, with a PGA of about 0.84g.

Liquefaction Potential

The site is not currently mapped by the State of California, but is within a zone mapped as having a high liquefaction potential by the Association of Bay Area Governments (ABAG).

During strong seismic shaking, cyclically induced stresses can cause increased pore pressures within the soil matrix that can result in liquefaction triggering, soil softening due to shear stress loss, potentially significant ground deformation due to settlement within sandy liquefiable layers as pore pressures dissipate, and/or flow failures in sloping ground or where open faces are present (lateral spreading) (NCEER 1998). Limited field and laboratory data is available regarding ground deformation due to settlement; however, in clean sand layers settlement on the order of 2 to 3 percent of the liquefied layer thickness can occur. Soils most susceptible to liquefaction are loose, non-cohesive soils that are saturated and are bedded with poor drainage, such as sand and silt layers bedded with a cohesive cap.

As discussed in the "Subsurface" section above, the site is mapped as being underlain primarily by Holocene-aged alluvial deposits consisting primarily of clay interbedded layers of sand and gravel. Depending on the design ground water level, which is assumed to be at depths on the order of 10 to 15 feet below existing site grades, the high liquefaction potential previously mapped for the site by ABAG appears reasonable. We recommend that a subsurface exploration and analysis be performed during future investigations to confirm the potential for liquefaction triggering and any associated seismically-induced settlement.

Lateral Spreading

Lateral spreading is horizontal/lateral ground movement of relatively flat-lying soil deposits towards a free face such as an excavation, channel, or open body of water; typically lateral spreading is associated with liquefaction of one or more subsurface layers near the bottom of the exposed slope. As failure tends to propagate as block failures, it is difficult to analyze and estimate where the first tension crack will form.

Although there is a relatively shallow creek within 200 feet of rear of the property, it appears to be no more than 10 feet deep. Based on design ground water at least 10 feet below the current site surface, in our opinion, the potential for lateral spreading to affect the site is likely to be low to moderate. This should be confirmed during future investigations at the site.

Seismic Settlement/Unsaturated Sand Shaking

Loose unsaturated sandy soils can settle during strong seismic shaking. As the soils mapped at the site are predominantly cohesive soils with interbedded sand layers, in our opinion, the potential for differential seismic settlement to affecting the proposed improvements is likely to be low to moderate. The exception could be in the former underground storage tank area, where man-made fill of unknown origin and consistency exists. We recommend that additional subsurface investigation and analysis be performed during future investigations to confirm the potential for seismically-induced settlement.

Landsliding

Although the hills flanking the Sycamore Valley nearby the property may be prone to landsliding or slope instability, the closest hills are about 200 feet south of the property, and the site itself is generally flat. For these reasons, the potential for landslides to impact the property is considered low.

Flooding

Based on our internet search of the Federal Emergency Management Agency (FEMA) flood map public database, the site is located within Zone X, "areas determined to be outside of the 0.2 percent annual chance floodplain" (Panel 06013C0462F, 2009). We recommend the project civil engineer be retained to confirm this information and verify the base flood elevation, if appropriate.

Conclusions

Summary

From a geotechnical viewpoint, the proposed residential development project is feasible provided the concerns listed below are addressed during initial project planning and in the final project design. If site development is feasible, a detailed geotechnical investigation should be performed to confirm our findings and to provide design-level recommendations for the project. Descriptions of each geotechnical concern with brief outlines follow the listed concerns.

- Presence of expansive surficial soils
- Potential for seismic settlement
- Presence of relatively shallow ground water
- Localized undocumented fills

Expansive Soils

Based on our experience in the site vicinity, highly expansive clay soils are likely to blanket the site. Expansive soils can undergo significant volume change with changes in moisture content. They shrink and harden when dried and expand and soften when wetted. If structures are underlain by expansive soils it is important that foundation systems be capable of tolerating or resisting any potentially damaging soil movements. In addition, it is important to limit moisture changes in the surficial soils by using positive drainage away from buildings as well as limiting landscaping watering. The impacts due to expansive soils can likely be mitigated by supporting residential structures on stiffened post-tensioned mat foundations, compacting native clays at adequate moisture levels, and placing a layer of non-expansive fill beneath flatwork and driveways.

Seismic Settlement

Based on our review of the mapped subsurface conditions at the site and our experience in the vicinity, and assuming a high ground water level of about 10 feet below current site grades, liquefaction-induced settlement of interbedded sand and silt layers could be possible. In addition, seismic settlement of any unsaturated sands could potentially contribute to post-seismic settlement.

On a preliminary basis, residential foundations will likely need to be designed to tolerate increased total and differential settlement across a typical residential foundation. Rigid mat foundations appear to be a feasible foundation alternative; however, site specific investigation and seismic analysis will need to be performed to confirm the potential for seismically-induced settlement.

Shallow Ground Water

As discussed above, though limited ground water data is available in the site vicinity, ground water was measured between 11 and 15 feet below the surface within 2 miles of the site. A preliminary design ground water level of 10 feet should be considered.

Undocumented Fill

As discussed, we understand that an Underground Storage Tank (UST) is present at the site based on discussions with the property owner (refer to our Phase I ESA report for a more detailed discussion). Based on our experience with buried tanks, undocumented fills will be present above and surrounding the tank. It is also likely that localized undocumented fills will be present beneath existing buildings, within nursery buildings and within gravel parking areas. Undocumented fills will not likely provide uniform support for new improvements; therefore, fills will need to be over-excavated and re-compacted during site grading. Subsurface investigation should be performed as part of a design-level investigation to further identify potential fill areas.

Closure

We hope this provides the information you need at this time. Recommendations presented in this letter have been prepared for the sole use of Trumark Homes specifically for the property located at 2550 Camino Tassajara in Danville, California. Our professional services were performed, our findings obtained, and our recommendations prepared in accordance with generally accepted geotechnical engineering principles and practices at this time and location. No warranties are either expressed or implied.

If you have any questions or need any additional information from us, please call and we will be glad to discuss them with you.

Sincerely,

Cornerstone Earth Group, Inc.

John R. Dye, P.E., G.E.
Principal Engineer

Copies: Addressee (PDF by email)