Stevens Ferrone & Bailey
Engineering Company, Inc

Geotechnical Engineering
Engineering Geology
Storm Water Management
Construction Observation & Testing Services

April 14, 2021

Mr. Trent Sanson
DeNova Homes
1500 Willow Pass Court
Concord, CA 94520

Re: Geological and Geotechnical Engineering Assessment
19320 Sonoma Highway 12 – Sonoma, California
SFB Project No.: 155-108

Mr. Sanson:

In accordance with your request, Stevens, Ferrone & Bailey Engineering Company, Inc. (SFB) performed a geological and geotechnical engineering assessment of the property located at 19320 Sonoma Highway 12 in Sonoma, California. It is our understanding that the proposed project will consist of developing the property for about 50 living units housed within several buildings. Nominal grading is anticipated and associated infrastructure including underground utilities and assess roadways will be provided.

Our geological and geotechnical engineering assessment included the following scope of work:

- Review available published and unpublished geological and geotechnical literature relevant to the project area and surrounding vicinity;
- Review available aerial photographs and images of the property;
- Perform a visual reconnaissance of the site and immediate surrounding area to evaluate the geological and geotechnical conditions that impact the proposed development;
- Geotechnical engineering analyses and evaluation of the research and reconnaissance data in order to provide general geological and geotechnically related development recommendations for the project; and
- Preparation of this report.

1.0 SUMMARY OF GEOLOGICAL AND GEOTECHNICAL CONDITIONS

1.1 Surface Description

On April 9, 2021, SFB performed a visual reconnaissance of the site and surrounding area. At the time of our reconnaissance, the site was vacant except for an older home with associated

improvements located in the northwest corner of the site. The site was bounded by Highway 12 and a residence to the west, residential structures and associated improvements on the south and east, and commercial structures with associated improvements on the north. Wooden fencing bounded the site in most locations. Water spigots were observed in two locations onsite. A well appeared to have been destroyed (grouted closed) in the area of the existing residence in the northwest corner of the site. A chicken wire fence was located in the western portion of the site. Vegetation consisted of a thick growth of grasses and weeds over most of the site, along with both small and large diameter trees. Shrubs existed along the fencelines bounding the site.

Based on our review of historical aerial photographs and topographic maps of the site and vicinity, the site appears to have remained vacant except for the residence located in the northwest corner of the site. Our research indicates that the residence was built in about 1932.

1.2 Subsurface Conditions, Geology, and Seismicity

Pleistocene alluvial fan deposits (Qof) have been mapped onsite; the deposits are described as sand, gravel, silt and clay[1]. Based on visual observation only, the soils appear to have a medium plasticity and moderate expansion potential.

No landslides or landside associated deposits were observed to have a negative impact on the proposed development area. The U.S. Geological Survey maps the site outside of areas of mapped landslides and earth flows[2], and also outside of debris-flow source areas[3].

Earthquake intensities will vary throughout the San Francisco Bay Area, depending upon numerous factors including the magnitude of earthquake, the distance of the site from the causative fault, and the type of materials underlying the site. The U.S. Geological Survey (2016)[4] indicated that there is a 72 percent chance of at least one magnitude 6.7 or greater earthquake striking the San Francisco Bay region between 2014 and 2043. Therefore, the site will be subjected to earthquakes that can cause strong ground shaking.

According to the U.S. Geological Survey's Unified Hazard Tool and applying the Dynamic: Conterminous U.S. 2014 (v4.2.0) model (accessed 4/14/21), the resulting deaggregation calculations indicate that the site has a 10% probability of exceeding a peak ground acceleration

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[1] Wagner and Gutierrez, 2010, *Preliminary Geologic Map of the Napa 30' x 60' Quadrangle, California*, California Geological Survey.

[2] Wentworth, et al, 1997, *Summary Distribution of Slides and Earth Flows in Sonoma County, California*, U.S. Geological Survey Open-File Report 97-745C.

[3] Ellen, et al, 1997, *Map Showing Principal Debris-Flow Source Areas in Sonoma County, California*, U.S. Geological Survey Open-File Report 97-745E.

[4] Aagaard, Blair, Boatwright, Garcia, Harris, Michael, Schwartz, and DiLeo, *Earthquake Outlook for the San Francisco Bay Region 2014–2043*, USGS Fact Sheet 2016–3020, Revised August 2016 (ver. 1.1).

of about 0.54g in 50 years (design basis ground motion based on underlying stiff soil conditions; mean return time of 475 years). The actual ground surface acceleration might vary depending upon the local seismic characteristics of the underlying bedrock and the overlying unconsolidated soils.

1.3 Geologic Hazards

The site is not located in an earthquake fault zone. Due to the relatively level site and surrounding terrain, it is our opinion that the potential for landsliding impacting the property is very low. The liquefaction hazard has not been mapped by the State of California. According to the U.S. Geological Survey, the site is located in an area that has been characterized as having very low liquefaction susceptibility[5,6].

2.0 GEOLOGICAL AND GEOTECHNICAL ENGINEERING OPINIONS AND CONCLUSIONS

From a geological and geotechnical engineering standpoint, it is our opinion that the site can be developed for the proposed resident project and associated infrastructure. Below are our preliminary earthwork and foundation recommendations. We recommend a geotechnical investigation (including exploratory borings, soil sample retrieval, laboratory testing, and detailed geotechnical engineering analyses) be performed to supplement and confirm these preliminary recommendations. The results of the investigation should be summarized in a comprehensive report providing detailed geotechnical design and construction criteria for the project including any hazard mitigation measures if deemed necessary.

3.0 PRELIMINARY EARTHWORK RECOMMENDATIONS

Wherever grading will be performed, we recommend that the area of grading be cleared of all obstructions including existing utilities and pipelines and their associated backfill, designated pavements and underlying baserock, designated vegetation (including trees) and their root systems, and debris. Holes resulting from the removal of underground obstructions extending below the proposed finish grade should be cleared and backfilled with compacted fill materials. Wells and leach field systems, where abandoned, should be removed/abandoned in accordance with County requirements.

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[5]Witter, Knudsen, Sowers, Wentworth, Koehler, and Randolph, 2006, *Maps of Quaternary Deposits and Liquefaction Susceptibility in the Central San Francisco Bay Region, California*, USGS Open File Report 2006-1037.

[6]Knudsen, Sowers, Witter, Wentworth, and Helly, 2000, *Preliminary Maps of Quaternary Deposits and Liquefaction Susceptibility, Nine-County San Francisco Bay Region, California*, USGS Open File Report 00-444.

From a geotechnical engineering standpoint, any existing trench backfill materials, clay or concrete pipes, gravel, pavements, and concrete that are removed can be used as new fill provided debris is removed and it is broken up. Portions of the site containing vegetation that is not removed during clearing should be stripped to an appropriate depth to remove these materials.

All existing fill materials in areas of new development should be over-excavated to a depth where competent soil is encountered. In addition, existing surface soils will require over-excavation and re-compaction; we estimate, based on our visual observation only, that over-excavation depths of approximately 1 to 2 feet will be required.

From a geotechnical and mechanical standpoint, onsite soils and fills having an organic content of less than 3 percent by volume can be used as fill. Fill should not contain rocks or lumps larger than 6 inches in greatest dimension with not more than 15 percent larger than 2.5 inches.

Fill materials will likely require compacting to about 90 percent relative compaction and moisture conditioned approximately 3 percent over optimum water content. Fill material should be spread and compacted in lifts not exceeding approximately 8 to 12 inches in uncompacted thickness.

Pipeline trenches should be backfilled with fill placed in lifts of approximately 8 to 12 inches in uncompacted thickness. Thicker lifts can be used provided the method of compaction is approved by SFB and the required minimum degree of compaction is achieved. Backfill should be placed by mechanical means only. Jetting is not permitted. The upper 3 feet of trench backfill in foundation, slab, and pavement areas should be entirely compacted to at least 95 percent relative compaction.

We recommend that exterior slabs (including patios, sidewalks, walkways, and driveways) be placed directly on the properly compacted fills. We do not recommend using aggregate base, gravel, or crushed rock below these improvements. If imported granular materials are placed below these elements, subsurface water can seep through the granular materials and cause the underlying soils to saturate or pipe. Prior to placing concrete, subgrade soils should be moisture conditioned to increase their moisture content to approximately 3 percent above laboratory optimum moisture (ASTM D-1557). We recommend reinforcing exterior slabs with steel bars in lieu of wire mesh.

4.0 PRELIMINARY FOUNDATION & RETAINING WALL RECOMMENDATIONS

The proposed residential structures can be supported on a post-tensioned slab foundation that is designed for the expansion potential of the onsite soils. The slab foundation should bear entirely on properly prepared, compacted structural fill. The post-tensioned slab thickness should be determined by the Structural Engineer; however, we recommend the post-tensioned slabs be at least 10 inches thick. A vapor retarder must be placed between the subgrade soils and the bottom

of the slabs-on-grade. We recommend the vapor retarder consist of a single layer of Stego Wrap Vapor Barrier 15 mil Class A or equivalent.

In order to reduce the potential for vapor transmission through the concrete slab, we recommend the concrete mix design for the slabs have a maximum water/cement ratio of 0.45. If a higher water/cement ratio is being considered, we recommend higher vapor transmission be taken into account in the design and construction of the buildings. The actual water/cement ratio may need to be reduced if the concentration of soluble sulfates or chlorides in the supporting subgrade is detrimental to the concrete and/or reinforcing steel.

Where walls retain soil, they must be designed to resist both lateral earth pressures and any additional lateral loads caused by surcharging such as building and roadway loads. For retaining walls that need to resist earthquake induced lateral loads from nearby foundations, walls that are to be designed to resist earthquake loads, and any retaining walls that are higher than 6 feet (as required by the 2019 CBC), we recommend the walls also be designed to resist seismic pressures developed from a design basis earthquake. Some movement of the walls may occur during moderate to strong earthquake shaking and may result in distress as is typical for all structures subjected to earthquake shaking. Walls should be fully-back drained to prevent the build-up of hydrostatic pressures.

Retaining walls can be supported on drilled, cast-in-place, straight shaft friction piers that develop their load carrying capacity in the materials underlying the site. Alternatively, walls can be supported by footing foundations.

5.0 PRELIMINARY PAVEMENT RECOMMENDATIONS

The soils are likely moderately expansive which can result in R-values of about 10 to 15. We anticipate that roadway sections will consist of approximately 3 inches of asphalt concrete over 9 to 10 inches of Caltrans Class 2 baserock.

6.0 ADDITIONAL RECOMMENDATIONS, CONDITIONS, AND LIMITATIONS

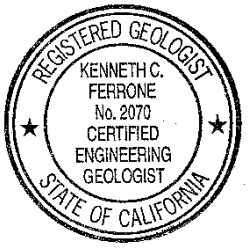
Exploratory borings, laboratory testing, and geotechnical engineering analyses will need to be performed in order to provide detailed geotechnical design and construction criteria for the project and to confirm the preliminary recommendations provided above. The future report should include the results of the site-specific liquefaction including providing mitigation measures if deemed necessary, and the report should provide detailed drainage, earthwork, foundation, and pavement recommendations for use in the design and construction of the project. Once the future, detailed investigation is complete, we recommend SFB review the project's design and specifications to verify that the recommendations presented in the future report have been properly interpreted and implemented in the design, plans, and specifications. We also recommend SFB be retained to

provide consulting services and to perform construction observation and testing services during the construction phase of the project to observe and test the implementation of our recommendations, and to provide supplemental or revised recommendations in the event conditions different than those described in our reports are encountered. We assume no responsibility for misinterpretation of our recommendations if we do not review the plans and specifications and are not retained during construction.

If you have any questions or need additional information, please call us.

Sincerely,

Stevens, Ferrone & Bailey Engineering Company, Inc.



Kenneth C. Ferrone, P.E., G.E., C.E.G.
Civil/Geotechnical Engineer
Certified Engineering Geologist

Copies: Addressee (1 via email)