PJC & Associates, Inc.
Consulting Engineers & Geologists

September 12, 2017 Job No. S1116.01

Step One Residential Design & Construction
Attention: Craig Walker
527 Broadway, #201
Sonoma, CA 95476

Subject: Geotechnical Plan Review
Proposed Stair Addition
905 Robertson Road
Glen Ellen, California

References: Report titled, "Geotechnical Recommendations & Design Criteria, Proposed Structural Upgrade & Residential Addition, 1127 London Ranch Road, Glen Ellen, California," prepared PJC & Associates, revision dated August 8, 2015.

Grading Plan, Sheet C1, prepared by Bear Flag Engineering, Inc., dated August 2, 2017.

PJC & Associates, Inc. (PJC) is pleased to submit this letter presenting our geotechnical review of the grading plan for the above captioned project. PJC previously provided geotechnical recommendations and design criteria in a written report dated August 8, 2015. The purpose of our review was to confirm that the recommendations of our report were incorporated into the grading plan.

Based on the results of our review, the grading plan is in general conformance with our recommendations. However, we have the following comments. Conventional concrete slabs constructed on the surface or near surface expansive clays will be prone to heave, cracking and settlement. If the owner understands and accepts this risk, convention concrete slabs-on-grade may be adequately supported on properly moisture conditioned and compacted surface soils in exterior flatwork areas. If this is not acceptable, the slabs should be structurally designed or the expansive soils should be removed and replaced with at least 30 inches of non-expansive engineered fill. Furthermore, observation and testing services should be provided by PJC to verify that the intent of the project plans and specifications is carried out during construction; these services should include observing the foundation excavations, field density testing of engineered fill and installation of the subsurface drainage facilities.

We trust that this is the information that you require at this time. If you have any questions concerning the content of this letter please call.

Sincerely,

PJC & Associates

Anthony J. DeMartini
Geotechnical Engineer
GE 2750, California

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PJC & Associates, Inc.

Consulting Engineers & Geologists

July 21, 2015 Job No. S1116.01
Revised August 8, 2015

Step One Residential Design & Construction
Attention: Craig Walker
527 Broadway, #201
Sonoma, CA 95476

Subject: Geotechnical Recommendations & Design Criteria
Proposed Structural Upgrade & Residential Addition
1127 London Ranch Road
Glen Ellen, California

Reference: Report titled, "Geotechnical Investigation, Proposed Perry Residence, 1123 & 1125 London Ranch Road, Glen Ellen, California," prepared by AJD & Associates, dated April 30, 2013.

PJC and Associates, Inc. (PJC) is pleased to present the geotechnical recommendations and design criteria for the proposed structural upgrade and residential addition located at 1127 London Ranch Road in Glen Ellen, California. Our services were completed in accordance with our written agreement for geotechnical engineering services, dated July 7, 2015. The purpose of our work was to review the above referenced geotechnical report, observe the shallow subsurface conditions at the site and provide recommendations and geotechnical criteria for design and construction of the proposed structural upgrade and residential addition. The opinions, recommendations and geotechnical design criteria presented in this report were based on our review of the above reference geotechnical report, observations of the existing cut slope, geotechnical engineering analysis and our experience with other projects in the area.

1. PROJECT DESCRIPTION

Based on the preliminary floor plan and information provided by you, it is our understanding that the project will consist of upgrading the existing foundation, framing and constructing an approximately 200 square-foot residential addition to the west side of the first floor of the residence. It is our understanding that the existing structure has experienced some lateral distortion, therefore it is our understanding that the project will include upgrading some of the existing foundations and framing to help correct some of the lateral distortion. This will probably require the construction of new foundations and other structural improvements. The addition will consist of wood frame construction with a concrete slab-on-grade floor. Furthermore, new retaining wall construction will be required to support the generated cut slope. The project will be serviced by underground municipal utilities.

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Structural foundation loading information for the project was not available at the time of this report. For our analysis, we anticipate that structural foundation loads will be light with dead plus live continuous wall loads less than two kips per lineal foot (plf) and dead plus live isolated column loads less than 50 kips. If these assumed loads vary significantly from the actual loads, we should be consulted to review the actual loading conditions and, if necessary, revise the recommendations of this report.

Due to the scope of the project, we do not anticipate significant filling will be required. However, cuts of six feet and less will be required to achieve the desired pad grades. We anticipate any additional grading will consist of minor cuts and fills to provide adequate gradients for site drainage.

2. SITE CONDITIONS

The site is located in a residential area west of downtown Glen Ellen. The site is bounded by a single family residences to the north, south and west, and Robertson Road to the east. At the time of our investigation, the site was occupied by an existing single-family residence, and landscape areas. According to the United States Geological Survey (USGS) Glen Ellen, California, 7.5 Minute Quadrangle Map (Topographic), the site is situated near an elevation of 240 feet above mean sea level (MSL). Site drainage generally consists of sheet flow and surface infiltration. Regional drainage is provided by Sonoma Creek, which is located approximately 500 feet northeast of the site.

3. WORK PERFORMED AND SUBSURFACE CONDITIONS

On July 7, 2015, we visually observed the shallow subsurface conditions at the site by observing the existing cut slope at the west uphill side of the proposed addition. At the surface, we observed a colluvial layer consisting of sandy clays that extended to depths between three and four feet below the existing ground surface. The surface sandy clay appeared dry to slightly moist, very stiff to hard and exhibited high plasticity characteristics. Based on the presence of significant desiccation cracking, visual observations of the colluvial clays and our previous experience with similar soils at nearby sites, the colluvial clays are considered highly expansive. Underlying the surface stratum, we observed sandstone bedrock of the Glen Ellen Formation that extended to the bottom of the cut slope, approximately five feet below the original ground surface. The sandstone bedrock appeared soft, friable, and highly weathered. Based on our Atterburg limits testing (PI=7), the sandstone is not considered expansive.

Groundwater was not encountered during our site reconnaissance on July 7, 2015. However, seepage within the upper soil layers and bedrock fractures should be anticipated in the winter and early spring, and may vary depending on the amount of rainfall.

4. FAULTING

Geologic structures in the region are primarily controlled by northwest trending faults. No known active fault passes through the site. The site is not located in the Alquist-Priolo Earthquake Fault Studies Zone. Based on our research, the three closest potentially active faults to the site are the Rodgers Creek, West Napa and Maacama faults. The Rodgers Creek fault is located three miles to the southwest, the West Napa fault is located 11 miles east and the Maacama fault is located 16 miles northwest of the site. Table 1 outlines the closest known active faults and their associated maximum magnitude.

TABLE 1
CLOSEST KNOWN ACTIVE FAULTS

Fault Name	Distance from Site (Miles)	Maximum Earthquakes (Moment Magnitude)	Peak Site Acceleration (g)
Rodgers Creek	3	7.0	0.48
West Napa	11	6.5	0.18
Maacama	16	6.9	0.17

5. SEISMICITY

The site is located within a zone of high seismic activity related to the active faults that transverse through the surrounding region. Future damaging earthquakes could occur on any of these fault systems during the lifetime of the proposed project. In general, the intensity of ground shaking at the site will depend upon the distance to the causative earthquake epicenter, the magnitude of the shock, the response characteristics of the underlying earth materials and the quality of construction. Seismic considerations and hazards are discussed in the following subsections of this report.

6. SEISMIC CONSIDERATIONS & GEOLOGIC HAZARDS

The site is located within a region subject to a high level of seismic activity. Therefore, the site could experience strong seismic ground shaking during the lifetime of the project. The following discussion reflects the possible earthquake effects which could result in damage to the proposed project.

a. Fault Rupture. Rupture of the ground surface is expected to occur along known active fault traces. No evidence of existing faults or previous ground displacement on the site due to fault movement is indicated in the geologic literature or field exploration. Therefore, the likelihood of ground rupture at the site due to faulting is considered to be low.

b. Ground Shaking. The site has been subjected in the past to ground shaking by earthquakes on the active fault systems that traverse the region. It is believed that earthquakes with significant ground shaking will occur in the region within the next several decades. Therefore, it must be assumed that the site will be subjected to strong ground shaking during the design life of the project.

c. Liquefaction. Our field exploration revealed no loose, saturated, granular soil stratums at the site. Furthermore, the site is underlain by shallow bedrock deposits not considered susceptible to soil liquefaction that likely extend to great depths below the site. Therefore, it is judged that liquefaction is not likely to occur at the site.

d. Lateral Spreading and Lurching. Lateral spreading is normally induced by vibration of near-horizontal alluvial soil layers adjacent to an exposed face. Lurching is an action, which produces cracks or fissures parallel to streams or banks when the earthquake motion is at right angles to them. There are no exposed faces or a creek embankment adjacent to the site. Therefore, we judge that the potential for lateral spreading and lurching at the site is low.

e. Expansive Soils. Based on our visual observations and our experience with projects on nearby sites, the surface soils at the site exhibited high plasticity characteristics and are judged to have a high expansion potential. However, based on our Atterburg limits testing (PI=7), the sandstone is considered to have a low expansion potential.

7. CONCLUSIONS

Based on our field and office studies, we judge that from a geotechnical engineering standpoint, the project is feasible provided the recommendations presented in this report are incorporated into the design and carried out through construction. The primary geotechnical concern in design and construction of the project is the presence of weak and expansive colluvial soils.

The colluvial soils are weak and expansive, and are not suitable for support of fills, foundations, or slabs. Below the colluvial soils are sandstone bedrock deposits of the Glen Ellen Formation, which are considered incompressible for the anticipated foundation loads. Therefore, it will be necessary to extend the footings through any unsuitable soils and into the underlying bedrock.

Concrete slabs-on-grade will be used for the addition. As previously mentioned, the colluvial soils are weak and expansive. However, we anticipate that site grading will remove the unsuitable soils and expose bedrock adequate for support of concrete slabs on grade. If site grading does not remove the weak and expansive soils, the unsuitable soils should be removed and replaced with non-expansive compacted engineered fill.

Detailed geotechnical engineering recommendations for use in design and construction of the project are presented in the subsequent sections of this report.

8. FOUNDATIONS: SPREAD FOOTINGS

a. Vertical Loads. The addition and new foundations for the structural upgrade may be adequately supported by spread footing foundations extending through the surface soils and at least 12 inches into bedrock. All footings should be reinforced. The recommended soil bearing pressures, depth of minimum embedment, and minimum widths of spread footings are presented in Table 2. The bearing values provided have been calculated assuming that all footings uniformly bear on firm bedrock.

TABLE 2
FOUNDATION DESIGN CRITERIA

Footing Type	Bearing Pressure (psf)*	Minimum Embedment (in)**	Minimum Width (in)
Continuous Wall	2000	12	12
Isolated Column	2500	12	18

*Dead plus live load
** Into bedrock

The allowable soil bearing pressures are net values. The weight of foundation may be neglected when computing dead loads. Allowable soil bearing pressures may be increased by one-third for transient loads such as wind and seismic.

We recommend that the footing excavations not be left open longer than necessary and should be maintained in a moist condition at all times.

b. Lateral Loads. Resistance to lateral forces may be computed using friction or passive pressure. A friction factor of 0.35 is considered appropriate between the bottom of concrete structures and the bedrock. A passive pressure equivalent to that exerted by a fluid weighing 350 pounds per square foot per foot of depth (psf/ft) may be used. Unless restrained at the surface, the upper six inches of the bedrock should be neglected for passive resistance. There should be at least seven feet of horizontal confinement between the bottom of the footing and the face of the nearest slope.

Footing concrete should be placed neat against bedrock. Footing excavations should not be allowed to dry before placing concrete. If shrinkage cracks appear in the footing excavations, the bearing material should be thoroughly moistened to close all cracks prior to concrete placement.

c. Settlement. Total settlement of individual foundations will vary depending on the width of the foundation and the actual load supported. Foundation settlements have been estimated based on the bearing values provided. Maximum settlements of shallow foundations designed and constructed in accordance with the preceding recommendations are estimated to be less than one inch. Differential settlement between similarly loaded, adjacent footings are expected to be less than one-half of one inch. The majority of the settlement is expected to occur during construction and placement of dead loads.

The geotechnical engineer should observe the bearing surfaces of the spread footings after the cleaning and prior to placement of concrete and steel to assess the conditions of the foundation bearing materials.

9. SLAB-ON-GRADE

Concrete slab-on-grade floors will be used for the addition. We anticipate that site grading will remove the colluvial soil and expose sandstone bedrock adequate for support of the proposed concrete slabs. If site grading does not remove the weak and expansive colluvial soils, the unsuitable soils should be removed and replaced with non-expansive compacted engineered fill under the direction of the geotechnical engineer in the field during construction. Regardless, the slab subgrade should be moisture conditioned to over optimum moisture content and rolled to produce a firm and unyielding surface. We recommend that the slabs-on-grade be provided with floor subdrains as shown on Plate 1.

Slabs-on-grade should be at least four inches thick and underlain by a four inch layer of compacted clean gravel or crushed rock. The rock will serve as a capillary break; however moisture may accumulate in the base course. Therefore, a plastic vapor barrier should be provided over the rock where moisture protection is desired. To control cracking, the slabs should be reinforced as determined by the project structural engineer.

10. RETAINING WALLS

Retaining walls free to rotate on the top and supporting a level backfill may be designed to resist an active equivalent fluid pressure of 45 pcf acting in a triangular pressure distribution. Retaining walls supporting steeply sloping backfill should be designed for an active equivalent fluid pressure of 60 pcf acting in a triangular pressure distribution. These pressures do not consider surcharge loads resulting from adjacent foundations, traffic loads or earthquake loads. If additional surcharge loading is anticipated, we can assist in evaluating their effects.

We recommend that a backdrain be provided behind all retaining walls or the walls should be designed for full hydrostatic pressures. The backdrain should consist of a heavy walled, four inch diameter, perforated pipe sloped to drain to outlets by gravity, and of clean, free-draining, three-quarter to one-inch crushed rock or gravel. The crushed rock or gravel should extend to within one foot of the surface. The upper foot should be backfilled with compacted, fine grained soil to exclude surface water intrusion. A drainage filter cloth should be placed between the soil and the drain rock or Class II permeable material be used in lieu of the filter fabric and drain rock.

We recommend that the ground surface behind the retaining walls be sloped to drain. Under no circumstances should the surface water be diverted into back drains. Where migration of moisture through walls would be detrimental, the walls should be waterproofed.

11. RETAINING WALLS-SEISMIC LOADING

PJC has performed analysis to estimate the anticipated dynamic load due to seismic shaking on retaining walls at the site. Based on our pseudostatic analysis, the walls should be designed for a dynamic lateral force equivalent to a uniform point load, P_e, as determined by the following equation:

$$P_e=6.9*H^2$$

Where:

H = height of retaining wall in feet

P_e = pseudostatic seismic loading in lbs/ft

The pseudostatic force, P_e should be applied at a distance of (2/3)*H above the base of the retaining wall.

12. SEISMIC DESIGN

Geologic structures in the region are primarily controlled by northwest trending faults. No known active fault passes through the site. The site is not located in the Alquist-Priolo Earthquake Fault Studies Zone. Based on the data reviewed, it is concluded that the project site could be subjected to seismic shaking resulting from earthquakes on the active faults primarily in the Coast Ranges. For design, a site class type D, and spectral accelerations of S_S of 1.50 g and S_1 of 0.60 g are recommended.

13. DRAINAGE

All final grades should be provided with positive gradients away from foundations to provide rapid removal of surface water runoff to an adequate discharge point. No ponding of water should be allowed on the pad or adjacent to foundations. Furthermore, we recommend that the slabs-on-grade be provided with floor subdrains as shown on Plate 1.

If the residence does not have functioning foundation subdrains, we recommend that foundation subdrains be placed adjacent to all foundations, except the downhill foundation. The foundation subdrains should extend at least 12 inches below the interior adjacent grade. The subdrain should consist of a heavy walled four-inch diameter perforated pipe. The bottom of the trench should be sloped to drain by gravity and lined with a few inches of three quarter to one and a half inch-drain rock. The trench should then be backfilled to within six inches of finished surface with drain rock. The upper few inches should consist of compacted soil to reduce surface water inclusion. We recommend that a drainage filter cloth be placed between the soil and the drain rock or Class II permeable material be used in lieu of the filter fabric and drain rock.

Roof downspouts and surface drains must be maintained entirely separate from the foundation subdrains. The outlets should discharge onto erosion resistant areas.

14. LIMITATIONS

The data, information, interpretations and recommendations contained in this report are presented solely as bases and guides to the geotechnical design for the proposed residential addition located at 1127 London Ranch Road in Glen Ellen, California. The conclusions and professional opinions presented herein were developed by PJC in accordance with generally accepted geotechnical engineering principles and practices. No warranty, either expressed or implied, is intended.

This report has not been prepared for use by parties other than the designers of the project. It may not contain sufficient information for the purposes of other parties or other uses. If any changes are made in the project as described in this report, the conclusions and recommendations contained herein should not be considered valid, unless the changes are reviewed by PJC, and the conclusions and recommendations are modified or approved in writing. This report and the figures contained herein are intended for design purposes only. They are not intended to act, by themselves, as construction drawings or specifications.

Soil deposits may vary in type, strength, and many other important properties between the points of observation and exploration. Additionally, changes can occur in groundwater and soil moisture conditions due to seasonal variations, or for other reasons. Therefore, it must be recognized that we do not and cannot have complete knowledge of the subsurface conditions underlying the subject site. The criteria presented are based upon the findings at the points of exploration and upon interpretative data, including interpolation and extrapolation of information obtained at points of observation.

15. ADDITIONAL SERVICES

Upon completion of the project plans, they should be reviewed by our firm to determine that the design is consistent with the recommendations of this report. Observation and testing services should also be provided by PJC to verify that the intent of the plans and specifications is carried out during construction; these services should include observing the foundation excavations, field density testing of fill, and installation of the subsurface drainage facilities.

These services will be performed only if PJC is provided with sufficient notice to perform the work. PJC does not accept responsibility for items that they are not notified to observe.

It has been a pleasure working with you on this project. Please call us if you have any questions regarding the results of this investigation, or if we can be of further assistance.

Sincerely,

PJC & ASSOCIATES

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Geotechnical Engineer
GE 2750, California

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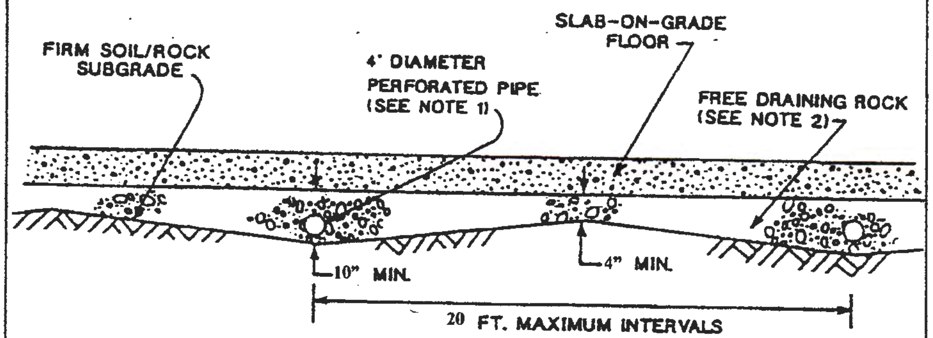

Notes:

1. PERFORATED PIPE (PVC OR EQUIVALENT) SHOULD BE PLACED WITH PERFORATIONS DOWN. THE PIPE SHOULD BE SLOPED FOR GRAVITY FLOW AND OUTLET THROUGH SOLID PIPE TO DAYLIGHT.

2. DRAIN ROCK SHOULD BE AT LEAST 4" THICK AND A MINIMUM OF 10" WHERE PIPES ARE LOCATED. THE DRAIN ROCK SHOULD BE ½ OR ¾ INCH DRAIN ROCK ON FILTER FABRIC OR CONSIST OF CLASS II PERMEABLE MATERIAL.

PJC & Associates, Inc. *Consulting Engineers & Geologists*	SLAB UNDERDRAIN SYSTEM PROPOSED RESIDENTIAL ADDITION 1127 LONDON RANCH ROAD GLEN ELLEN, CALIFORNIA	PLATE 1
	Proj. No: S1116.01 Date: 7/15 App'd by: PJC	