



GEOTECHNICAL STUDY REPORT

FARMERS LANE WELL IMPROVEMENTS
751 AND 777 FARMERS LANE
SANTA ROSA, CALIFORNIA

Project Number:

5383.07.04.1

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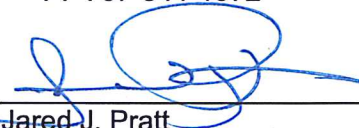
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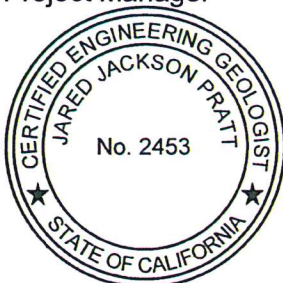
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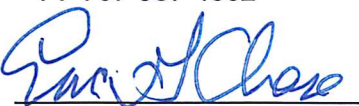
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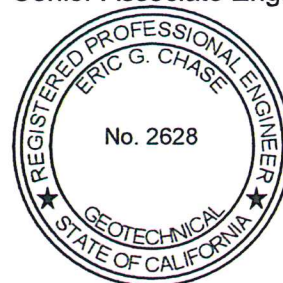
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INTRODUCTION

This report presents the results of our geotechnical study for the planned new well housing buildings to be constructed at 751 and 777 Farmers Lane (Well 4-1 and Well 4-2, respectively) in Santa Rosa, California. The two sites are located on the west side of Farmers Lane, behind different businesses that front the street. We will also present some preliminary findings regarding settlement related distress in the doorway at the City of Santa Rosa (City) facility located at 2260 Sonoma Avenue. The site locations are shown on Plate 1, Appendix A.

We understand it is planned to construct new block buildings over the two existing wells. Actual foundation loads are not known at this time. We anticipate the loads will be typical for the light to moderately heavy type of construction planned and that wall loads will range from about ½ to 1 ½ kips per lineal foot. We understand site grading will not be required. If grading is performed, it will be very little to even out the building pads.

SCOPE

The purpose of our study, as outlined in our Proposal dated August 16, 2016, and revised November 8, 2016, was to generate geotechnical information for the design and construction of the new well buildings, and to address the potential geotechnical causes for the settlement at the entrance door of the facility at 2260 Sonoma Avenue. Our scope of services included reviewing selected published geologic data pertinent to the site; evaluating the subsurface conditions with borings and laboratory tests; analyzing the field and laboratory data; and presenting this report with the following geotechnical information:

1. A brief description of the soil and groundwater conditions observed during our study;
2. A discussion of seismic hazards that may affect the proposed improvements, including liquefaction;
3. Seismic design criteria per the guidelines in the 2013 and 2016 California Building Code; and
4. Specific conclusions and recommendations regarding:
 - a. Primary geotechnical engineering concerns and mitigating measures, as applicable;
 - b. Site preparation and grading including treatment of weak, porous, compressible and/or expansive surface soils;
 - c. Alternative foundation types, design criteria, and estimated settlement behavior;
 - d. Support of concrete slabs-on-grade;
 - e. Utility trench backfill;
 - f. Geotechnical engineering drainage improvements; and

- g. Supplemental geotechnical engineering services.

STUDY

Site Exploration

We reviewed our previous geotechnical studies in the vicinity and selected geologic references pertinent to the site. The geologic literature reviewed is listed in Appendix B. On November 17, 2016, we made five separate attempts to advance a boring near the doorway at 2260 Sonoma Avenue. The borings were drilled using a portable, limited access rig equipped with 4-inch diameter, solid stem augers. On December 6, 2016, we performed a brief geotechnical reconnaissance of the well sites and explored the subsurface conditions by drilling one boring at each well site to depths of approximately 41½ feet each. The borings were drilled with a truck-mounted drill rig equipped with 6-inch diameter, hollow stem augers at the approximate locations shown on the Exploration Plan, Plate 2. The boring locations were determined approximately by pacing their distance from features shown on the Exploration Plan and should be considered accurate only to the degree implied by the method used. Our project geologist located and logged the borings and obtained samples of the materials encountered for visual examination, classification and laboratory testing.

Relatively undisturbed samples were obtained from the well site borings at selected intervals by driving a 2.43-inch inside diameter, split spoon sampler, containing 6-inch long brass liners, using a 140-pound hammer dropping approximately 30 inches. The sampler was driven 12 to 18 inches. The blows required to drive each 6-inch increment were recorded and the blows required to drive the last 12 inches, or portion thereof, were converted to equivalent Standard Penetration Test (SPT) blow counts for correlation with empirical data. Disturbed samples were also obtained at selected depths by driving a 1.375-inch inside diameter (2-inch outside diameter) SPT sampler, without liners or rings, using a 140-pound hammer dropping approximately 30 inches. The sampler was driven 12 to 18 inches, the blows to drive each 6-inch increment were recorded, and the blows required to drive the final 12 inches, or portion thereof, are provided on the boring logs.

At 2260 Sonoma Avenue, relatively undisturbed samples were recovered by driving a 2.43-inch inside diameter, split spoon sampler, containing 6-inch long brass liners, using a 70-pound hammer dropping approximately 30 inches. The sampler was driven 12 to 18 inches. The blows required to drive each 6-inch increment were recorded and the blows required to drive the last 12 inches, or portion thereof, were converted to equivalent Standard Penetration Test (SPT) blow counts for correlation with empirical data. Disturbed "bulk" samples were also obtained and placed in plastic bags.

The logs of the borings showing the materials encountered, groundwater conditions, converted blow counts and sample depths are presented on Plates 3 through 5. The soils are described in accordance with the Unified Soil Classification System, outlined on Plate 6.

The boring logs show our interpretation of the subsurface soil and groundwater conditions on the date and at the locations indicated. Subsurface conditions may vary at other locations and times. Our interpretation is based on visual inspection of soil samples, laboratory test results and interpretation of drilling and sampling resistance. The location of the soil boundaries should be considered approximate. The transition between soil types may be gradual.

Laboratory Testing

The samples obtained from the borings were transported to our office and re-examined to verify soil classifications, evaluate characteristics and assign tests pertinent to our analysis. Selected samples were laboratory tested to determine their water content, dry density, classification (Atterberg Limits, percent of silt and clay), shear strength and expansion potential (Expansion Index - EI). The test results are presented on the boring logs. Results of the classification tests are presented on Plate 7. Results of the strength tests are presented on Plates 8 through 11.

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 project sites are all located within the thick alluvial deposits that underlie the City of Santa Rosa.

Geology

Published geologic maps (McLaughlin, R.J., et al., 2008) indicate the group of sites are underlain by alluvial fan and fluvial terrace deposits. These alluvial sediments are generally comprised of gravel, sand, and silt. Mapping by Huffman and Armstrong (1980) indicates the alluvium may be up to 100 feet thick in the vicinity of the project sites.

Surface

The sites are located on the west side of Farmers Lane in Santa Rosa, beginning at the intersection with Sonoma Avenue at the north, and extending approximately 1000 feet south to 777 Farmers Lane. The entire area is relatively flat and comprises a developed business and

retail district. Where present, vegetation consists of ivy and trees that are part of parking lot landscaping. Well 4-1 (751 Farmers Lane) is located, in the northwestern corner of a parking lot for businesses that front Farmers Lane. Well 4-2 (777 Farmers Lane) is located approximately 450 feet south of Well 4-1, in the southeastern corner of the parking lot behind adjacent Farmers Lane businesses. The 2260 Sonoma Avenue site is located on the southwest corner of Sonoma Avenue and Farmers Lane.

The ground surface nearby each site includes concrete sidewalks and curbs, landscape areas and asphalt-pavement. Irrigation tubing was observed within the ivy near well 4-2. Some distress and cracking of the sidewalk surrounding the well house was observed at Well 4-2. The hardscapes surrounding Well 4-1 appear to be newer, however some vertical cracks in the curb were also noted there. At 2260 Sonoma Avenue, there is a tree in a small landscaped area adjacent to the doorway, as well as stone pavers and a concrete driveway. Immediately in front of the doorway, the pavers are pushed up and uneven.

In general, the ground surface in the landscape areas is moderately hard. However, soils in the area that appear hard and strong when dry will typically lose strength rapidly and settle under the loads of fills, foundations and slabs as their moisture content increases and approaches saturation. This typically occurs because the surface soils are weak, porous and compressible.

Natural drainage consists of sheet flow over the ground surface that concentrates in man made surface drainage elements such as gutters and storm drains.

Subsurface

Well Sites

Our borings and laboratory tests indicate that the portion of the well sites we studied is blanketed by weak, porous, compressible, clayey soils. Porous soils appear hard and strong when dry but become weak and compressible as their moisture content increases towards saturation. These soils exhibit high plasticity (LL = 42 to 49; PI = 66 to 69) and high to very high expansion potential (EI = 115 to 130). Where paved, the surface soils are covered with asphalt concrete (approximately 2½ inches) and silty gravel like aggregate base rock (about 8 inches). These surface materials are underlain by loose to medium dense clayey sands and soft to medium stiff clays to approximately 35 feet in boring WB4-1 and 40 feet in boring WB4-2. At these depths, the clays transition to dense silty to clayey gravels to the maximum depths explored (41 ½ feet).

2260 Sonoma Avenue

As described above, the doorway alcove is covered with square stone pavers that are about 12 inches on a side, and 2 inches thick. We lifted a paver at two different locations and attempted to advance borings. The pavers are underlain by about 1½ inches of clean sand bedding. Approximately 18 inches in front of the doorway, where the pavers are pushed up, the sand is directly underlain by silty, angular gravel, approximately 1½ inches in diameter. We encountered drilling refusal at about 1 foot within the gravels on what appeared to be a concrete footing. Approximately 2 feet further from the door, the sand is underlain by clean, large rounded gravels to cobbles, approximately 1½ to 3 inches in diameter. We immediately encountered drilling refusal in the cobbles.

We also advanced borings within the soil adjacent to the corner of the building at the doorway. Approximately 18 inches from the doorway corner, we encountered 12 inches of brown silty sand with gravel that is medium dense and dry. We encountered sampling refusal at 12 inches and abandoned the hole in case we had intercepted a utility. We moved 6 inches closer to the building corner and attempted another. At this location, we observed that the brown silty sand with gravel extended to about 1½ feet and was underlain by dark brown clay that is stiff and dry to moist. This soil exhibits high plasticity (LL = 56, PI = 35) and moderate expansion potential (EI = 80). We encountered sampling refusal at approximately 4 feet below the surface, again suspecting a possible utility, vault, or footing. A graphic log of this boring, including the depths of samples, is provided in Appendix A.

While on site, we learned from City personnel that significant caving occurred during a past excavation in the area now covered by pavers. This may explain some of the backfill materials we encountered.

Site Class

A detailed description of the subsurface conditions found in our borings is given on Plates 3 through 5, Appendix A. Based on Table 20.3-1 of American Society of Civil Engineers (ASCE) Standard 7-10, titled "Minimum Design Loads for Buildings and Other Structures" (2010), we have determined a Site Class of D should be used for the site.

Corrosion Potential

Mapping by the Natural Resources Conservation Service (2015) indicates that the corrosion potential of the near surface soil is high for uncoated steel and moderate for concrete. Samples from our exploration were provided to JDH Corrosion Consulting, Inc. for site specific corrosion testing.

Groundwater

Free groundwater was first detected in our well site borings at depths ranging from 9 to 18½ feet below the ground surface at the time of drilling. The holes were backfilled immediately after drilling was completed, thus stabilized groundwater levels were not observed. Groundwater was not observed in the borings at 2260 Sonoma Avenue. Fluctuation in the groundwater level typically occurs because of a variation in rainfall intensity, duration and other factors such as flooding and periodic irrigation.

Flooding

Our review of the Federal Emergency Management Agency (FEMA) Flood Zone Map for Sonoma County, California, Unincorporated Areas (Map No. 06097C0729E) dated December 2, 2008, indicates that the proposed building site is located within Zone "X," an area determined to be outside the 0.2 percent chance annual flood plain. Evaluation of flooding potential is typically the responsibility of the project civil engineer.

DISCUSSION AND CONCLUSIONS

Seismic Hazards

Seismicity

Data presented by the Working Group on California Earthquake Probabilities (2007) estimates the chance of one or more large earthquakes (Magnitude 6.7 or greater) in the San Francisco Bay region within the next 30 years to be approximately 63 percent. Therefore, 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.

Faulting

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 (Bryant and Hart, 2007). Therefore, we believe the risk of fault rupture at the site is low. However, the site is within an area affected by strong seismic activity. Several northwest-trending Earthquake Fault Zones exist in close proximity to and within several miles of the site (Bortugno, 1982). The shortest distances from the site to the mapped surface expression of these faults are presented in the table below.

ACTIVE FAULT PROXIMITY		
Fault	Direction	Distance-Miles
Healdsburg-Rodgers Creek	SW	1¼
Maacama	NE	2½
West Napa	E	18
San Andreas	WSW	21

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.

Granular soils were encountered at the site below the groundwater table. Therefore, we performed an analysis of the blow count data from our borings using the methods of Seed and Idriss (1982), Seed and others (1985), Youd and Idriss (2001), Idriss and Boulanger (2004) and Idriss and Boulanger (2008). These procedures normalize the blow counts to account for overburden pressure, rod length, hammer energy, and fines (percent of silt and clay) content. Once the blow counts are normalized and adjusted to a clean sand blow count, the cyclic resistance ratio (CRR) for each blow count is then determined using the same procedures

referenced above. The CRR is compared to the cyclic stress ratio (CSR) induced by the earthquake. Calculating the CSR requires a peak ground acceleration and design earthquake magnitude.

Peak ground acceleration (PGA) was determined using the methods in the 2013 and 2016 California Building Codes (CBC) and the American Society of Civil Engineers (ASCE) Standard 7-10, titled "Minimum Design Loads for Buildings and Other Structures" (2010). Using the U.S. Seismic Design Maps from the United States Geological Survey (USGS) website (<http://earthquake.usgs.gov/designmaps/us/application.php>), and the the sites' latitudes and longitudes, we developed the following information:

SITE	LATITUDE (°N)	LONGITUDE (°W),	SOIL CLASS	PGA
Well 4-1, 751 Farmers Lane	38.44297	-122.68797	D	0.959
Well 4-2, 777 Farmers Lane	38.44183	-122.68756	D	0.960

Using this information, the CSR for a M_M 7.5 earthquake at the sites ranged from 0.59 to 0.86. The Rodgers Creek fault is most likely controlling the ground motions at the sites. According to Petersen (1996), the Rodgers Creek fault is capable of a M_M 7.0 earthquake. Therefore, the CRR values at the site must be scaled to account for the difference between M_M 7.0 and M_M 7.5. When the scaling factor for magnitude and confining stress corrections presented in Idriss and Boulanger (2004) are applied, the CRR values at the site do not exceed the CSR values for a layer between about 18 and 25 feet at Well 4-1 and a layer between about 15 and 19 feet at Well 4-2. Therefore, we judge that there is potential for liquefaction at each well site.

There are three potential consequences of liquefaction: bearing capacity failure, lateral spreading toward a free face (e.g. riverbank) and settlement. Bearing capacity failure is sudden and extreme settlement of foundations that typically occurs when the liquefied layer is relatively close (typically within two times the footing width, depending on the loads) to the bottom of the foundation. Because the liquefiable layer is at least 15 feet below the ground surface, we judge that the potential for bearing capacity failure of each well house is low.

Lateral spreading can occur where continuous layers of liquefiable soil extend to a free face, such as a creek bank. There are no significant free faces in the vicinity of the site. Therefore, we judge the potential for liquefaction-induced lateral spreading at the site is low.

The third potential consequence of liquefaction is settlement due to densification of the liquefied soils. Potential settlements based on the blow count data and cyclic stress ratio were calculated using the methods of Ishihara and Yoshimine (1992). For the layers encountered at each well, we calculated total settlements of 2.4 inches at Well 4-1 and 1.3 inches at Well 4-2.

Densification

Densification is the settlement of loose, granular soils above the groundwater level due to earthquake shaking. Typically, granular soils that would be susceptible to liquefaction, if saturated, are susceptible to densification if not saturated. As discussed in the "Liquefaction"

section, the soils at the site have the potential for liquefaction. However, these layers are generally below the water table. If not below the water table, the layers could be susceptible to densification. Anticipated settlement would be on the order of that anticipated for liquefaction.

Geotechnical Issues

Well 4-1 and Well 4-2

Based on our study, we judge the proposed new well houses can be built as planned, provided the recommendations presented in this report are incorporated into their design and construction. The primary geotechnical concerns during design and construction of the project are the presence of up to about 2 feet of highly expansive, weak, porous, compressible, clayey surface soils at the well sites.

Weak, porous surface soils 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, slabs and pavements. The detrimental effects of such movements can be reduced by strengthening the soils during grading. Satisfactory foundation support can be obtained by excavating foundation elements to bear on firm native material below the weak surface soils. These materials are expansive and some seasonal heaving may occur. This can be reduced, but not eliminated, by installing foundation elements while the exposed soils are thoroughly moisture conditioned. If seasonal heaving is not acceptable, the foundations can be deepened to below the zone of significant moisture variation.

2260 Sonoma Avenue

The settlement observed at the Sonoma Avenue site may be the result of issues with a former vault, heterogeneous fill or highly expansive soils. Over the past several dry seasons, we have seen that expansive soil sites that have trees adjacent to building foundations, especially outside corner areas, have experienced above average settlements as the trees find moisture under the buildings. Ultimately, if the city is interested in arresting the settlement, the area around the entry can be underpinned. Regardless of the cause of the settlement, underpinning will decrease the advance of future settlement.

The gravel and cobbles we observed beneath the pavers at 2260 Sonoma Avenue appear to have been used as fill. The relayed history of a cave-in in that area supports the conclusion that the area had to be filled in so that the surface could be restored. Heterogeneous fills of unknown quality and unknown method of placement, such as those found at 2260 Sonoma Avenue, can settle and/or heave erratically under the load of fills, structures, slabs, and pavements. Footings, slabs, and pavements supported on heterogeneous fill could also crack as a result of such erratic movements. This condition, especially in combination with underlying expansive soils, could account for the structural problems with the doorway. It may be necessary to excavate the heterogeneous fill and replace it as an engineered fill if it is to be used for structural support.

RECOMMENDATIONS

Seismic Design

Seismic design parameters presented below are based on Section 1613 titled “Earthquake Loads” of the 2016 California Building Code (CBC). Based on Table 20.3-1 of American Society of Civil Engineers (ASCE) Standard 7-10, titled “Minimum Design Loads for Buildings and Other Structures” (2010), we have determined a Site Class of D should be used for both sites. Using the site latitudes and longitudes listed in the tables below, and the U.S. Seismic Design Maps from the United States Geological Survey (USGS) website (<http://earthquake.usgs.gov/designmaps/us/application.php>), we recommend that the following seismic design criteria be used for structures at the sites.

2016 CBC Seismic Criteria – Well 4-1, 751 Farmers Lane

Lat: 38.44293°N, Long: 122.68798°W

Spectral Response Parameter	Acceleration (g)
S _s (0.2 second period)	2.477
S ₁ (1 second period)	1.026
S _{MS} (0.2 second period)	2.477
S _{M1} (1 second period)	1.538
S _{DS} (0.2 second period)	1.652
S _{D1} (1 second period)	1.026

2016 CBC Seismic Criteria – Well 4-2, 777 Farmers Lane

Lat: 38.44183°N, Long: 122.68756°W

Spectral Response Parameter	Acceleration (g)
S _s (0.2 second period)	2.481
S ₁ (1 second period)	1.026
S _{MS} (0.2 second period)	2.481
S _{M1} (1 second period)	1.540
S _{DS} (0.2 second period)	1.654
S _{D1} (1 second period)	1.026

2016 CBC Seismic Criteria – 2260 Sonoma Avenue

Lat: 38.4442°N, Long: 122.6880°W

Spectral Response Parameter	Acceleration (g)
S _s (0.2 second period)	2.470
S ₁ (1 second period)	1.023
S _{MS} (0.2 second period)	2.470
S _{M1} (1 second period)	1.535
S _{DS} (0.2 second period)	1.647
S _{D1} (1 second period)	1.023

Excavations

Following initial site preparation, excavation should be performed as planned. Excavations extending below the proposed finished grade should be backfilled with suitable materials compacted to the requirements given below. At all times, temporary construction excavations should conform to the regulations of the State of California, Department of Industrial Relations, Division of Industrial Safety or other stricter governing regulations. The stability of temporary cut slopes, such as those constructed during the installation of underground utilities, should be the responsibility of the contractor. Depending on the time of year when grading is performed, and the surface conditions exposed, temporary cut slopes may need to be excavated to 1½:1, or flatter. The tops of the temporary cut slopes should be rounded back to 2:1 in weak soil zones.

Fill Quality and Placement

Fill Quality

Imported fill, if needed, should be select. Select fill should be free of organic matter, have a low expansion potential, and conform in general to the following requirements:

SIEVE SIZE	PERCENT PASSING (by dry weight)
6 inch	100
4 inch	90 – 100
No. 200	10 – 60

Liquid Limit – 40 Percent Maximum
Plasticity Index – 15 Percent Maximum

Fill Placement

The surface exposed by stripping and removal of weak, compressible, expansive surface soils should be scarified to a depth of at least 6 inches, uniformly moisture-conditioned to at least 4 percent above optimum and compacted to at least 90 percent of the maximum dry density of the materials as determined by ASTM Test Method D-1557. In expansive soil areas, moisture conditioning should be sufficient to completely close all shrinkage cracks for their full depth within pavement, exterior slab and building areas. If grading is performed during the dry season, the shrinkage cracks may extend to a few feet below the surface. Therefore, it may be necessary to excavate a portion of the cracked soils to obtain the proper moisture condition and degree of compaction. Approved fill material should then be spread in thin lifts, uniformly moisture-conditioned to near optimum and properly compacted. All structural fills, including those placed to establish site surface drainage, should be compacted to at least 90 percent relative compaction.

SUMMARY OF COMPACTION RECOMMENDATIONS	
Area	Compaction Recommendation (ASTM D-1557)
Preparation for areas to receive fill	After preparation in accordance with this report, compact upper 6 inches to a minimum of 90 percent relative compaction.
General fill (native or import)	Compact to a minimum of 90 percent relative compaction.
Structural fill beneath buildings	Compact to a minimum of 90 percent relative compaction.
Trenches	Compact to a minimum of 90 percent relative compaction. Compact the top 6 inches below vehicle pavement subgrade to a minimum of 95 percent relative compaction.
Pavements, extending outward to 3' beyond edge of pavement	Compact upper 6 inches of subgrade to a minimum of 95 percent relative compaction.
Concrete flatwork and exterior slabs, extending outward to 3' beyond edge of slab	Compact subgrade to a minimum of 90 percent relative compaction. Where subject to vehicle traffic, compact upper 6 inches of subgrade to at least 95 percent relative compaction.
Aggregate Base	Compact aggregate base to at least 95 percent relative compaction.

Wet Weather Grading

Generally, grading is performed more economically during the summer months when on-site soils are usually dry of optimum moisture content. Delays should be anticipated in site grading performed during the rainy season or early spring due to excessive moisture in on-site soils. Special and relatively expensive construction procedures, including dewatering of excavations and importing granular soils, should be anticipated if grading must be completed during the winter and early spring or if localized areas of soft saturated soils are found during grading in the summer and fall.

Open excavations also tend to be more unstable during wet weather as groundwater seeps towards the exposed cut slope. Severe sloughing and occasional slope failures should be anticipated. The occurrence of these events will require extensive clean up and the installation of slope protection measures, thus delaying projects. The general contractor is responsible for the performance, maintenance and repair of temporary cut slopes.

Foundation Support

The new well buildings should be supported on spread footings that bear on near surface firm, native soils or deeper footings (4 feet) that bear on firm, native soil below the zone of significant season moisture variation.

Spread Footings

Spread footings should be at least 12 inches wide and should bottom on firm, native soils at least 12 inches below pad subgrade. Where deeper footings are used to extend below the zone of significant moisture variation, a minimum depth of 4 feet should be used. Additional embedment or width may be needed to satisfy code and/or structural requirements.

The bottoms of all footing excavations should be thoroughly cleaned out or wetted and compacted using hand-operated tamping equipment prior to placing steel and concrete. This will remove the soils disturbed during footing excavations, restore their adequate bearing capacity and reduce post-construction settlements. Footing excavations should not be allowed to dry before placing concrete. If shrinkage cracks appear in soils exposed in the footing excavations, the soil should be thoroughly moistened to close all cracks prior to concrete placement. The moisture condition of the foundation excavations should be checked by the geotechnical engineer no more than 24 hours prior to placing concrete.

Bearing Pressures - Footings installed in accordance with these recommendations may be designed using allowable bearing pressures of 1,500, 2,250 and 3,000 pounds per square foot (psf), for dead loads, dead plus code live loads, and total loads (including wind and seismic), respectively.

Lateral Pressures - The portion of spread footing foundations extending into native soil may impose a passive equivalent fluid pressure and a friction factor of 300 pcf and 0.30, respectively, to resist sliding. Passive pressure should be neglected within the upper 6 inches, unless the soils are confined by concrete slabs or pavements.

Underpinning

Additional information regarding the location, extent, depth and cause of the caving in front of the building at 2260 Sonoma Avenue is needed to develop specific stabilization recommendations for the doorway. Regardless, due to the expansive near-surface soils and uneven support provided by the cobbly infill, unpinning will likely be the most sound geotechnical solution for the entry area. Underpinning can be achieved by installed drilled cast-in-place piers, push piles, helical anchors or a similar component. Based on the drilling that we performed, drilled cast-in-place piers would be difficult to install and would likely require casing of the holes. Our scope of services does not include providing underpinning recommendations, however, for estimating purposes we suggest that helical anchors be anticipated to be at least 15 feet deep and push piles to extend to at least 20 feet. These depths should be confirmed with additional drilling or a test pile program. These depths are based on our experience with similar projects and not based on the subsurface conditions at the site as we had difficulty drilling and did not reach these depths.

Slab-On-Grade

Slab-on-grade subgrade should be rolled to produce a dense, uniform surface. The future expansion potential of the subgrade soils should be reduced by thoroughly presoaking the slab subgrade prior to concrete placement. The moisture condition of the subgrade soils should be checked by the geotechnical engineer no more than 24 hours prior to placing the capillary moisture break. The slabs should be underlain with a capillary moisture break consisting of at least 4 inches of clean, free-draining crushed rock or gravel (excluding pea gravel) at least ¼-inch and no larger than ¾-inch in size. Class 2 aggregate base can be used for slab rock under exterior slabs.

Utility Trenches

The shoring and safety of trench excavations is solely the responsibility of the contractor. Attention is drawn to the State of California Safety Orders dealing with "Excavations and Trenches."

Site soils are too expansive for use as utility trench backfill. We anticipate import soils will be needed for trench backfill, as described in the "Fill Quality" section. Where utility trenches support pavements, slabs and foundations, trench backfill should consist of aggregate baserock. The baserock should comply with the minimum requirements in Caltrans Standard Specifications, Section 26 for Class 2 Aggregate Base. Trench backfill should be moisture-conditioned as necessary, and placed in horizontal layers not exceeding 8 inches in thickness, before compaction. Each layer should be compacted to at least 90 percent relative compaction as determined by ASTM Test Method D-1557. The top 6 inches of trench backfill below vehicle pavement subgrades should be moisture-conditioned as necessary and compacted to at least 95 percent relative compaction. Jetting or ponding of trench backfill to aid in achieving the recommended degree of compaction should not be attempted.

Geotechnical Drainage

Surface water should be diverted away from slopes, foundations and edges of pavements. Surface drainage gradients should slope away from building foundations in accordance with the requirements of the CBC or local governing agency. Where a gradient flatter than 2 percent for paved areas and 4 percent for unpaved areas is required to satisfy design constraints, area drains should be installed with spacing no greater than about 15 feet. Roofs should be provided with gutters and the downspouts should empty onto splash blocks that discharge directly onto paved areas or be connected to closed (glued Schedule 40 PVC or ABS with SDR of 35 or better) conduits discharging well away from foundations, onto paved areas, or into the site's surface drainage system.

Water seepage or the spread of extensive root systems into the soil subgrade of footings, slabs or pavements could cause differential movements and consequent distress in these structural elements. Landscaping should be planned with consideration for these potential problems.

Maintenance

Periodic land maintenance will be required. Surface and subsurface drainage facilities should be checked frequently, and cleaned and maintained as necessary or at least annually. A dense growth of deep-rooted ground cover must be maintained in landscaping areas to reduce erosion.

Supplemental Services

Pre-Bid Meeting

It has been our experience that contractors bidding on the project often contact us to discuss the geotechnical aspects. Informal contacts between RGH and an individual contractor could result in incomplete or misinterpreted information being provided to the contractor. Therefore, we recommend a pre-bid meeting be held to answer any questions about the report prior to submittal of bids. If this is not possible, questions or clarifications regarding this report should be directed to the project owner or their designated representative. After consultation with RGH, the project owner or their representative should provide clarifications or additional information to all contractors bidding the job.

Plan and Specifications Review

Coordination between the design team and the geotechnical engineer is recommended to assure that the design is compatible with the soil, geologic and groundwater conditions encountered during our study. RGH Consultants (RGH) recommends that we be retained to review the project plans and specifications to determine if they are consistent with our recommendations. In the event we are not retained to perform this recommended review, we will assume no responsibility for misinterpretation of our recommendations.

Construction Observation and Testing

Prior to construction, a meeting should be held at the site that includes, but is not limited to, the owner or owner's representative, the general contractor, the grading contractor, the foundation contractor, the underground contractor, any specialty contractors, the project civil engineer, other members of the project design team and RGH. This meeting should serve as a time to discuss and answer questions regarding the recommendations presented herein and to establish the coordination procedure between the contractors and RGH.

In addition, we should be retained to monitor all soils related work during construction, including:

- Site stripping, over-excavation, grading, and compaction of near surface soils;
- Placement of all engineered fill and trench backfill with verification field and laboratory testing;
- Observation of all foundation excavations; and
- Observation of foundation and subdrain installations.

If, during construction, we observe subsurface conditions different from those encountered during the explorations, we should be allowed to amend our recommendations accordingly. If different conditions are observed by others, or appear to be present beneath excavations, RGH should be advised at once so that these conditions may be evaluated and our recommendations reviewed and updated, if warranted. The validity of recommendations made in this report is contingent upon our being notified and retained to review the changed conditions.

If more than 18 months have elapsed between the submission of this report and the start of work at the site, or if conditions have changed because of natural causes or construction operations at, or adjacent to, the site, the recommendations made in this report may no longer be valid or appropriate. In such case, we recommend that we be retained to review this report and verify the applicability of the conclusions and recommendations or modify the same considering the time lapsed or changed conditions. The validity of recommendations made in this report is contingent upon such review.

These supplemental services are performed on an as-requested basis and are in addition to this geotechnical study. We cannot accept responsibility for items that we are not notified to observe or for changed conditions we are not allowed to review.

LIMITATIONS

This report has been prepared by RGH for the exclusive use of West Yost Associates and their consultants as an aid in the design and construction of the proposed improvements described in this report.

The validity of the recommendations contained in this report depends upon an adequate testing and monitoring program during the construction phase. Unless the construction monitoring and testing program is provided by our firm, we will not be held responsible for compliance with design recommendations presented in this report and other addendum submitted as part of this report.

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 construction, the results of our field exploration, laboratory testing program, and professional judgment. Verification of our conclusions and recommendations is subject to our review of the project plans and specifications, and our observation of construction.

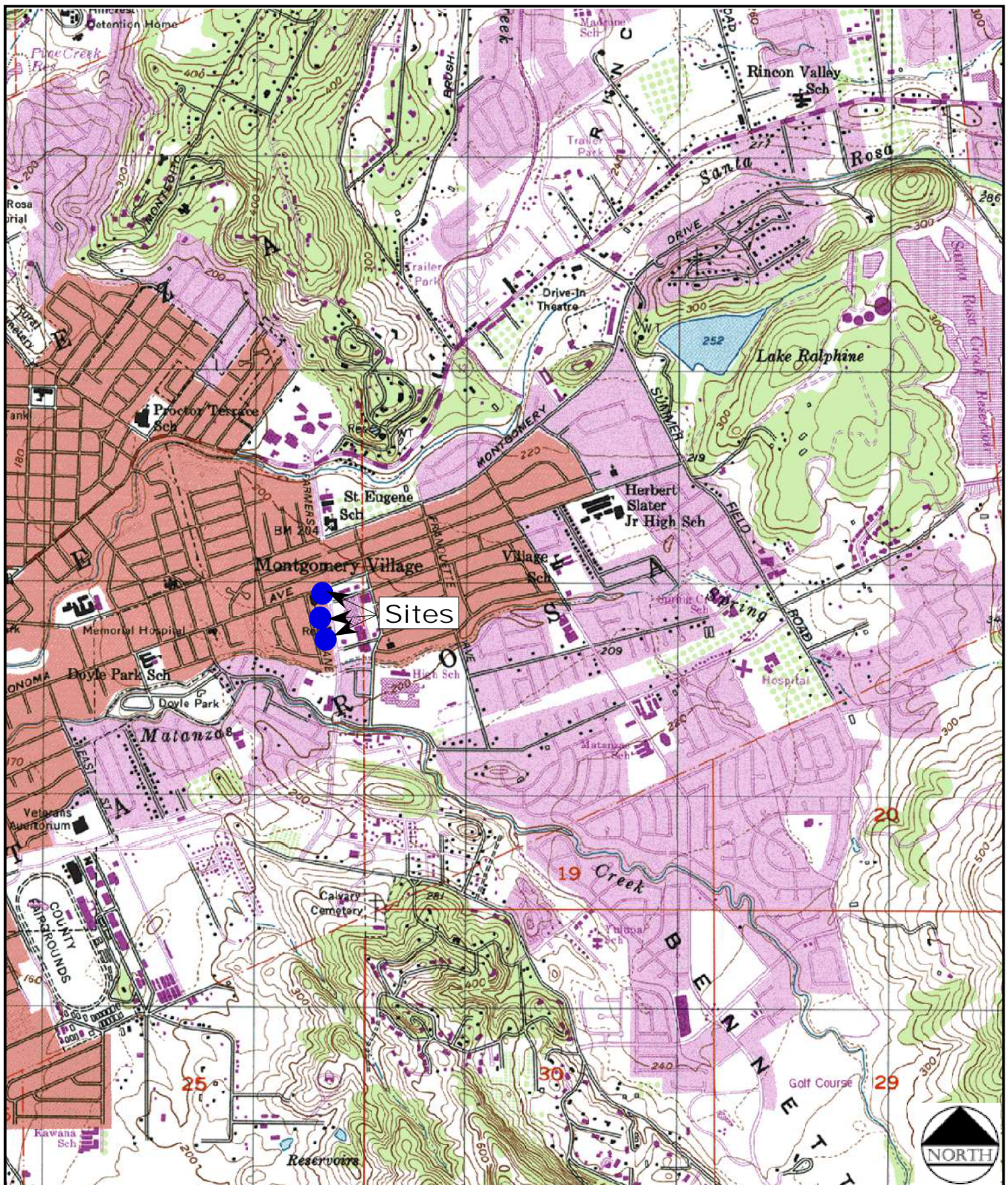
The borings represent subsurface conditions at the locations and on the date indicated. It is not warranted that they are representative of such conditions elsewhere or at other times. Site conditions and cultural features described in the text of this report are those existing at the time of our field explorations on November 17, and December 6, 2016, respectively, and may not necessarily be the same or comparable at other times.

The scope of our services did not include an environmental assessment or a study of the presence or absence of toxic mold and/or 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. These studies should be conducted under separate cover, scope and fee and should be provided by a qualified expert in those fields.

APPENDIX A - PLATES

LIST OF PLATES

Plate 1	Site Location Map
Plate 2	Exploration Plan
Plates 3 through 5	Logs of Borings WB4-1 and WB4-2
Plate 6	Soil Classification Chart and Key to Test Data
Plate 7	Classification Test Data
Plates 8 through 11	Strength Test Data



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SITE LOCATION MAP

Farmers Lane Well Improvements
751 and 777 Farmers Lane
Santa Rosa, California

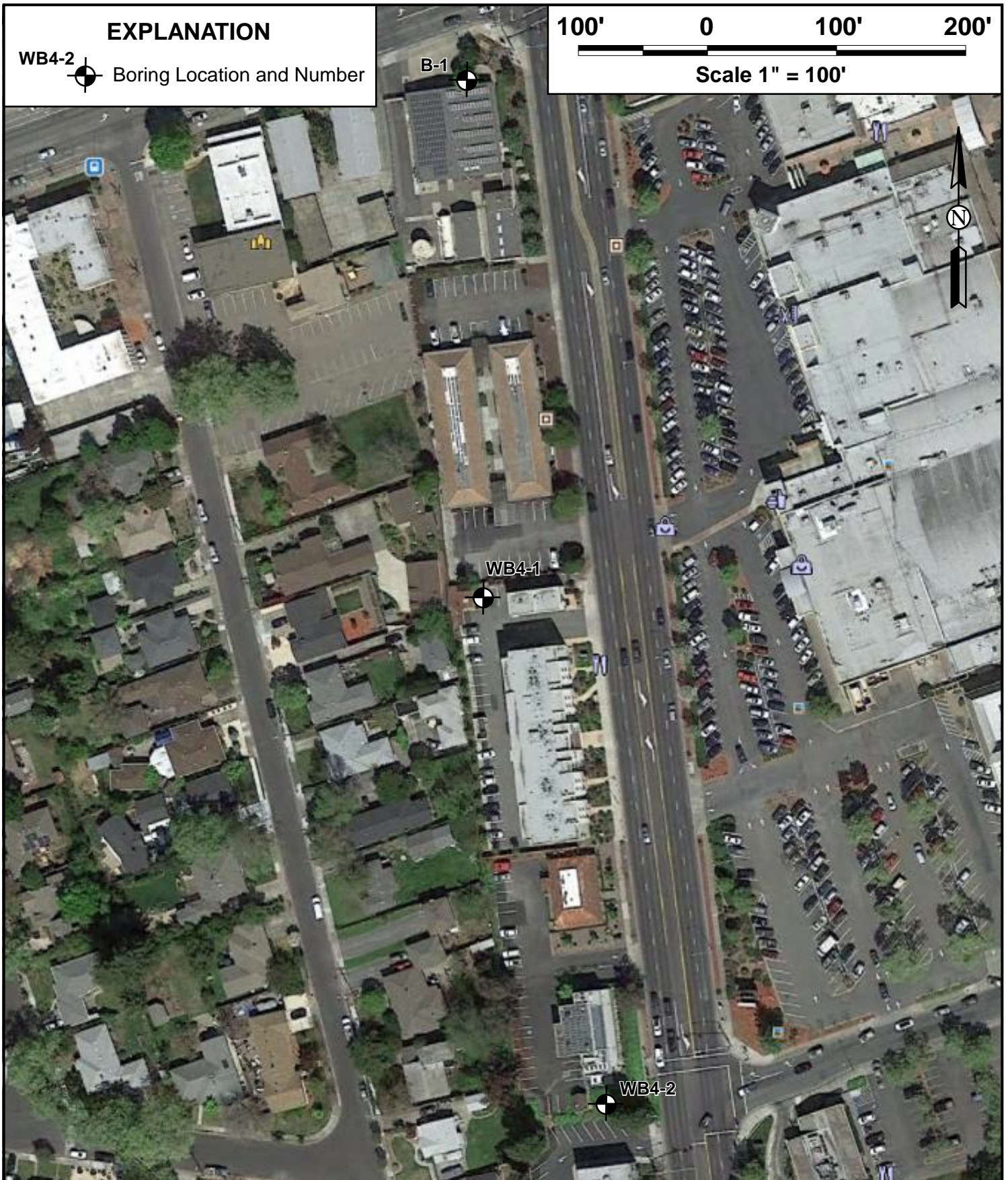
PLATE

1

EXPLANATION

WB4-2  Boring Location and Number

100' 0 100' 200'
Scale 1" = 100'



Reference: Google Earth 2016

Scale: 1" = 100'

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EXPLORATION PLAN
Farmers Lane Well Improvements
751 and 777 Farmers Lane
Santa Rosa, California

PLATE


2





Job No: 5383.07.04.1

Date: JAN 2017

Date(s) Drilled 12/6/2016		Logged By SCL		Checked By JJP	
Drilling Method Hollow Stem Auger		Drill Bit Size/Type 6" H.S.A.		Total Depth of Borehole 41-1/2 feet bgs	
Drill Rig Type Diedrich		Drilling Contractor Taber Drilling		Approximate Surface Elevation Existing Ground Surface	
Groundwater Level and Date Measured 9 feet bgs		Sampling Method(s) Modified California, SPT		Hammer Data 140lb, 30-inch autotrip	

Elevation (feet)	Depth (feet)	Sample Type	Sampling Resistance, blows/ft	Graphic Log	MATERIAL DESCRIPTION	Dry Density (pcf)	Water Content (%)	% <#200 Sieve	PI, %	LL, %	Expansion Index (EI)	UC, ksf	REMARKS AND OTHER TESTS
0					Asphalt, ~ 2 1/2".								
					GRAY SILTY GRAVEL (GM), medium dense, dry (FILL); approximately 8".								
	11				DARK BROWN CLAY WITH SAND (CH), stiff, dry, porous to about 2 feet, rootlets.	70.6	24.5		42	66	115		Su = 1959 psf
5			9		DARK GRAY TO DARK BROWN CLAY (CH), very stiff, moist, orange flecks.	79.1	35.7						Su = 2188 psf
					DARK BROWN CLAY WITH SAND (CH), medium stiff, moist, rust-colored flecks.								
10			9			91	26.4						
					GRAY BROWN CLAY WITH SAND (CH), medium stiff, moist.								
15			5										
					DARK GRAY CLAYEY SAND (SC), loose to medium dense, moist to wet, rounded gravels.			34.2	15	33			
20			5										
			10										
25			6		BLUE-GRAY CLAY WITH SAND (CH), medium stiff, wet.								

	LOG OF BORING WB4-1 Farmers Lane Well Improvements 751 and 777 Farmers Lane Santa Rosa, California		PLATE 3a
	Job No: 5383.07.04.1	Date: JAN 2017	

Elevation (feet)	Depth (feet)	Sample Type	Sampling Resistance, blows/ft	Graphic Log	MATERIAL DESCRIPTION	Dry Density (pcf)	Water Content (%)	% <#200 Sieve	PI, %	LL, %	Expansion Index (EI)	UC, ksf	REMARKS AND OTHER TESTS
	30		12		BLUE-GRAY CLAY WITH SAND (CH), medium stiff, wet.								
					BROWN CLAYEY SAND (SC), medium dense, wet.								
	35		57		GRAY SILTY GRAVEL WITH SAND (GM), very dense, wet.								
	40		55/10'		BLUE-GRAY CLAYEY GRAVEL WITH SAND (GC), very dense, wet.								
					Boring terminated at 41-1/2 feet. Free water encountered at 9 feet.								
	45												
	50												
	55												
	60												

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LOG OF BORING WB4-1
Farmers Lane Well Improvements
751 and 777 Farmers Lane
Santa Rosa, California




PLATE

3b

Date(s) Drilled 12/6/2016		Logged By SCL		Checked By JJP	
Drilling Method Hollow Stem Auger		Drill Bit Size/Type 6" H.S.A.		Total Depth of Borehole 41-1/2 feet bgs	
Drill Rig Type Diedrich		Drilling Contractor Taber Drilling		Approximate Surface Elevation Existing Ground Surface	
Groundwater Level and Date Measured 18-1/2 feet bgs		Sampling Method(s) Modified California, Not retained, SPT		Hammer Data 140lb, 30-inch autotrip	

Elevation (feet)	Depth (feet)	Sample Type	Sampling Resistance, blows/ft	Graphic Log	MATERIAL DESCRIPTION	Dry Density (pcf)	Water Content (%)	% <#200 Sieve	PI, %	LL, %	Expansion Index (EI)	UC, ksf	REMARKS AND OTHER TESTS
0					BLACK CLAY (CH), soft to medium stiff, wet, porous to about 2 feet, roots.								
	7		7			83.8	37.1		49	69	130		Su = 846 psf
5			12		GRAY-BROWN CLAY (CH), stiff, moist to wet.	82.8	36.4						Su = 1123.5 psf
					BROWN CLAYEY SAND (SC), loose to medium dense, wet, fine sand.								
10			7		DARK BROWN CLAY (CH), medium stiff, wet.								
					BROWN CLAYEY SAND (SC), loose, wet, fine sand.			30.0					
15			6					43.7					
			7		GRAY-BROWN CLAYEY SAND (SC), loose, wet, fine sand.								
					GRAY TO BLUE-GRAY CLAY (CL), medium stiff, wet.								
20			5										
25			8										No recovery of sample. Drilled to 27 feet and added 5 gallons of water.

	LOG OF BORING WB4-2 Farmers Lane Well Improvements 751 and 777 Farmers Lane Santa Rosa, California		PLATE 4a
	Job No: 5383.07.04.1	Date: JAN 2017	

Elevation (feet)	Depth (feet)	Sample Type	Sampling Resistance, blows/ft	Graphic Log	MATERIAL DESCRIPTION	Dry Density (pcf)	Water Content (%)	% <#200 Sieve	PI, %	LL, %	Expansion Index (EI)	UC, ksf	REMARKS AND OTHER TESTS
	30		7		GRAY TO BLUE-GRAY CLAY (CL), medium stiff, wet.								
	35		12		BLUE-GRAY SANDY CLAY (CL), medium stiff, wet, very fine sand.								
	40		40		BLUE-GRAY SILTY GRAVEL (GM), dense, wet.								
	41-1/2				Boring terminated at 41-1/2 feet. Water encountered at 18 1/2 feet.								
	45												
	50												
	55												
	60												

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LOG OF BORING WB4-2
Farmers Lane Well Improvements
751 and 777 Farmers Lane
Santa Rosa, California

PLATE

4b

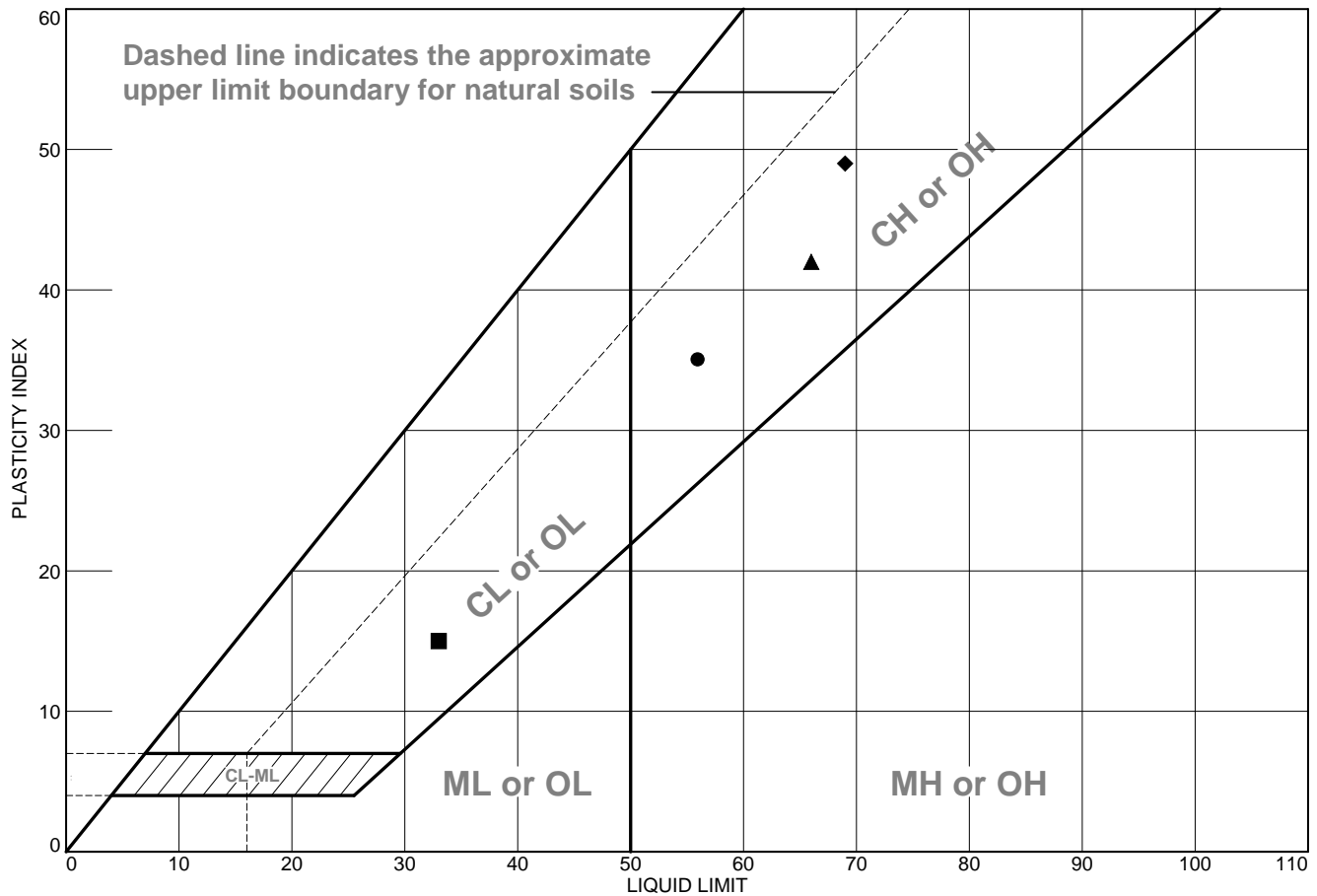
Date(s) Drilled 11/17/2016		Logged By SCL		Checked By JJP	
Drilling Method Solid Stem Auger		Drill Bit Size/Type 4" / Carbide tip		Total Depth of Borehole 4 feet bgs	
Drill Rig Type Little Beaver		Drilling Contractor Lone Pine Drilling		Approximate Surface Elevation Existing Ground Surface	
Groundwater Level and Date Measured NFWE		Sampling Method(s) Modified California		Hammer Data 70lb, 30-inch drop	

Elevation (feet)	Depth (feet)	Sample Type	Sampling Resistance, blows/ft	Graphic Log	MATERIAL DESCRIPTION	Dry Density (pcf)	Water Content (%)	% <#200 Sieve	PI, %	LL, %	Expansion Index (EI)	UC, ksf	REMARKS AND OTHER TESTS
0					[Wood chips]								
	24				BROWN-GRAY SILTY GRAVEL (GM), medium dense, dry to moist								
	26/7"				DARK BROWN CLAY (CH), hard, dry to moist; with tree roots.				35	56	80		
	15/3"												
5					No free water encountered. Sampling refusal at 4 feet on buried object.								
10													
15													
20													
25													

	LOG OF BORING B-1B Farmers Lane Well Improvements 751 and 777 Farmers Lane Santa Rosa, California		PLATE 5
	Job No: 5383.07.04.1	Date: JAN 2017	

Elevation (feet)	Depth (feet)	Sample Type	Sampling Resistance, blows/ft	Graphic Log	MATERIAL DESCRIPTION	Dry Density (pcf)	Water Content (%)	% <#200 Sieve	PI, %	LL, %	Expansion Index (EI)	UC, ksf	REMARKS AND • OTHER TESTS
1	2	3	4	5	6	7	8	9	10	11	12	13	14
<p>COLUMN DESCRIPTIONS</p> <div style="display: flex; justify-content: space-between;"> <div style="width: 48%;"> <p>1 Elevation (feet): Elevation (MSL, feet).</p> <p>2 Depth (feet): Depth in feet below the ground surface.</p> <p>3 Sample Type: Type of soil sample collected at the depth interval shown.</p> <p>4 Sampling Resistance, blows/ft: Number of blows to advance driven sampler one foot (or distance shown) beyond seating •interval using the hammer identified on the boring log.</p> <p>5 Graphic Log: Graphic depiction of the subsurface material encountered.</p> <p>6 MATERIAL DESCRIPTION: Description of material encountered. May include consistency, moisture, color, and •other descriptive text.</p> <p>7 Dry Density (pcf): Dry density, in pcf.</p> <p>8 Water Content (%): Water content, percent.</p> </div> <div style="width: 48%;"> <p>9 % <#200 Sieve: % <#200 Sieve</p> <p>10 PI, %: Plasticity Index, expressed as a water content.</p> <p>11 LL, %: Liquid Limit, expressed as a water content.</p> <p>12 Expansion Index (EI): Expansion Index (EI)</p> <p>13 UC, ksf: Unconfined compressive strength, in kips per square foot.</p> <p>14 REMARKS AND •OTHER TESTS: Comments and observations regarding drilling or sampling made by driller or field •personnel.</p> </div> </div> <p>FIELD AND LABORATORY TEST ABBREVIATIONS</p> <div style="display: flex; justify-content: space-between;"> <div style="width: 48%;"> <p>CHEM: Chemical tests to assess corrosivity</p> <p>COMP: Compaction test</p> <p>CONS: One-dimensional consolidation test</p> <p>LL: Liquid Limit, percent</p> </div> <div style="width: 48%;"> <p>PI: Plasticity Index, percent</p> <p>SA: Sieve analysis (percent passing No. 200 Sieve)</p> <p>UC: Unconfined compressive strength test, Qu, in ksf</p> <p>WA: Wash sieve (percent passing No. 200 Sieve)</p> </div> </div> <p>MATERIAL GRAPHIC SYMBOLS</p> <div style="display: flex; justify-content: space-between;"> <div style="width: 48%;"> <p> Asphaltic Concrete (AC)</p> <p> Fat CLAY, CLAY w/SAND, SANDY CLAY (CH)</p> <p> Lean CLAY, CLAY w/SAND, SANDY CLAY (CL)</p> </div> <div style="width: 48%;"> <p> Clayey GRAVEL (GC)</p> <p> Silty GRAVEL (GM)</p> <p> Artificial Fill</p> <p> Clayey SAND (SC)</p> </div> </div> <p>TYPICAL SAMPLER GRAPHIC SYMBOLS</p> <div style="display: flex; justify-content: space-between;"> <div style="width: 48%;"> <p> Bulk Sample</p> <p> 2.5-inch-ID Modified California w/ brass liners</p> <p> 2-inch-OD unlined split spoon (SPT)</p> </div> <div style="width: 48%;"> <p>OTHER GRAPHIC SYMBOLS</p> <p>—▽ Water level (at time of drilling, ATD)</p> <p>—▽ Water level (after waiting)</p> <p>⌋ Minor change in material properties within a stratum</p> <p>— — Inferred/gradational contact between strata</p> <p>— ? — Queried contact between strata</p> </div> </div> <p>GENERAL NOTES</p> <p>1: Soil classifications are based on the Unified Soil Classification System. Descriptions and stratum lines are interpretive, and actual lithologic changes may be gradual. Field descriptions may have been modified to reflect results of lab tests.</p> <p>2: Descriptions on these logs apply only at the specific boring locations and at the time the borings were advanced. They are not warranted to be representative of subsurface conditions at other locations or times.</p>													

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Brn Clay W/ Sand (CH)	56	21	35			CH
■	Grey Clayey Sand (SC)	33	18	15		34.2	SC
▲	Dk Brn Clay W/ Sand (CH)	66	24	42			CH
◆	Blk Clay (CH)	69	20	49			CH

Project No. 5383.07.04.1 **Client:** RGH Consultants

Project: Farmers Lane Well Improvements

● **Source of Sample:** B-1B

Depth: 2.0' & 3.0'

Sample Number: Composite

■ **Source of Sample:** WB4-1

Depth: 20.5'

▲ **Source of Sample:** WB4-1

Depth: 2.25' & 2.75'

Sample Number: Composite

◆ **Source of Sample:** WB4-2

Depth: 2.5' & 3.0'

Sample Number: Composite

Remarks:

● Expansion Index=80

▲ Expansion Index=115

◆ Expansion Index=130

Tested By: SW

Checked By: GEF

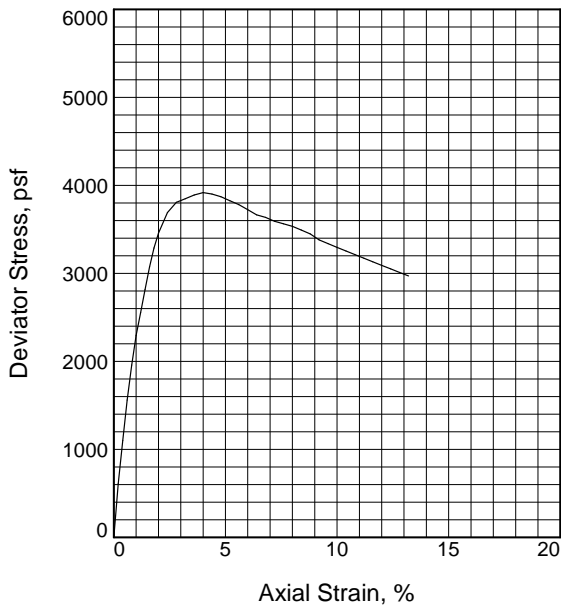
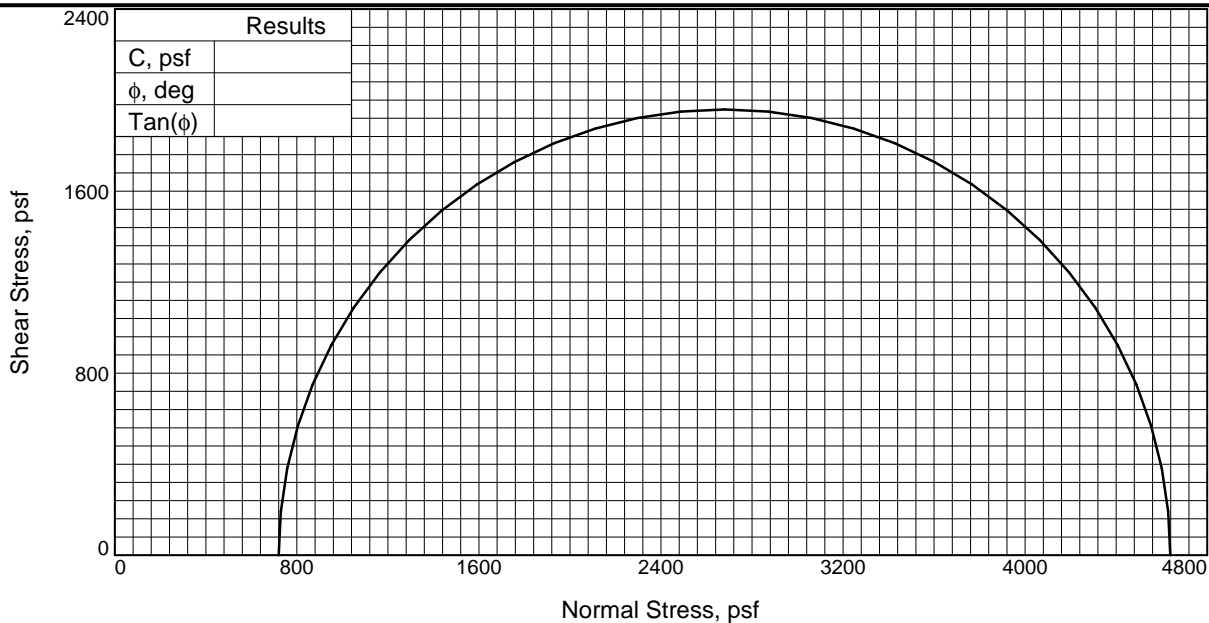
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CLASSIFICATION TEST DATA

Farmers Lane Well Improvements
751 and 777 Farmers Lane
Santa Rosa, California

PLATE

7



Sample No.		1
Initial	Water Content, %	24.5
	Dry Density, pcf	70.6
	Saturation, %	47.7
	Void Ratio	1.3873
	Diameter, in.	2.37
	Height, in.	5.00
At Test	Water Content, %	24.5
	Dry Density, pcf	70.6
	Saturation, %	47.7
	Void Ratio	1.3873
	Diameter, in.	2.37
	Height, in.	5.00
Strain rate, in./min.		0.06
Back Pressure, psf		0
Cell Pressure, psf		720
Fail. Stress, psf		3918
Ult. Stress, psf		3918
σ_1 Failure, psf		4638
σ_3 Failure, psf		720

Type of Test:

Unconsolidated Undrained

Sample Type: Undisturbed

Description: Dk Brn Clay W/ Sand (CH)

Specific Gravity= 2.70

Remarks:

Tested By: SW

Checked By: GEF

Project: Farmers Lane Well Improvements

Source of Sample: WB4-1

Depth: 2.75'

Proj. No.: 5383.07.04.1

Date Sampled: 12-6-2016

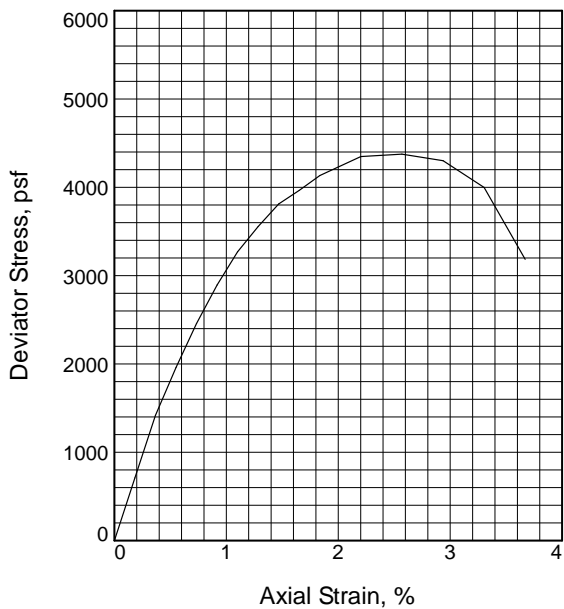
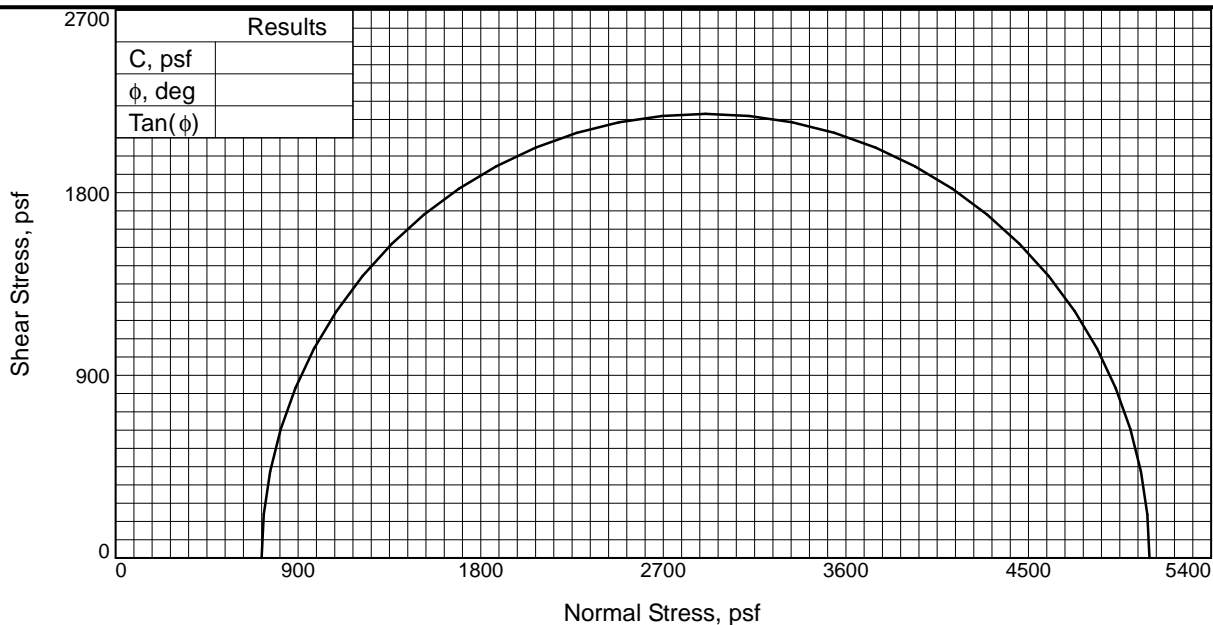
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STRENGTH TEST DATA

Farmers Lane Well Improvements
751 and 777 Farmers Lane
Santa Rosa, California

PLATE

8



Sample No.		1
Initial	Water Content, %	35.7
	Dry Density, pcf	79.1
	Saturation, %	85.2
	Void Ratio	1.1322
	Diameter, in.	2.38
	Height, in.	5.45
At Test	Water Content, %	35.7
	Dry Density, pcf	79.1
	Saturation, %	85.2
	Void Ratio	1.1322
	Diameter, in.	2.38
	Height, in.	5.45
Strain rate, in./min.		0.06
Back Pressure, psf		0
Cell Pressure, psf		720
Fail. Stress, psf		4376
Ult. Stress, psf		4376
σ_1 Failure, psf		5096
σ_3 Failure, psf		720

Type of Test:

Unconsolidated Undrained

Sample Type: Undisturbed

Description: Blk Clay (CH)

Specific Gravity= 2.70

Remarks:

Tested By: SW

Checked By: GEF

Project: Farmers Lane Well Improvements

Source of Sample: WB4-1

Depth: 5.5'

Proj. No.: 5383.07.04.1

Date Sampled: 12/6/2016

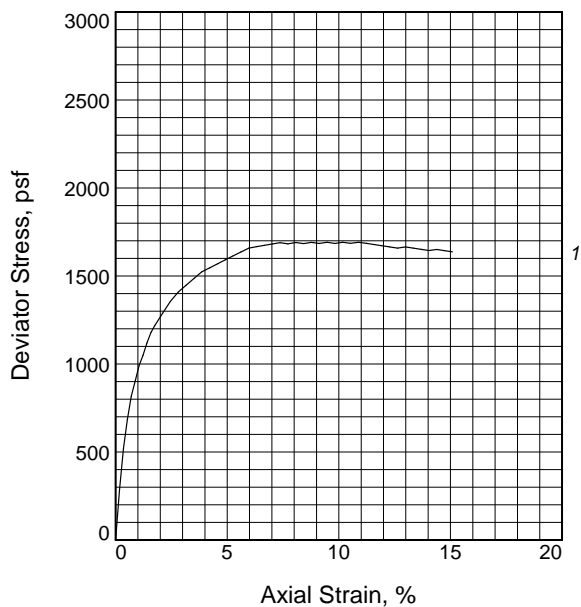
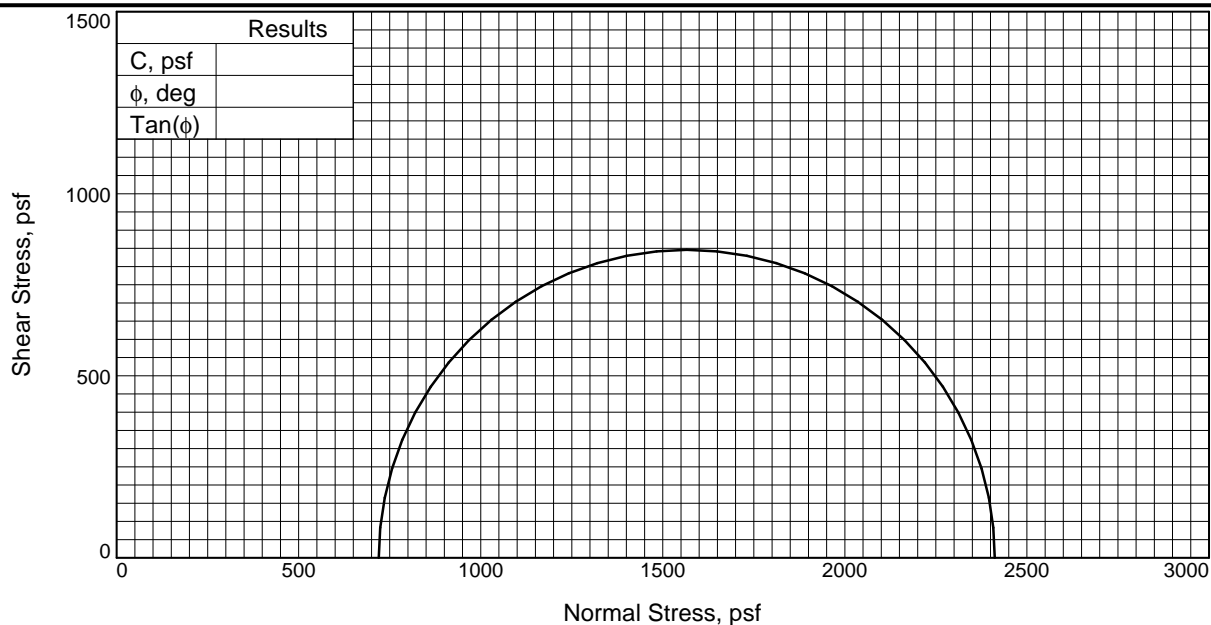
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STRENGTH TEST DATA

Farmers Lane Well Improvements
751 and 777 Farmers Lane
Santa Rosa, California

PLATE

9



Sample No.		1
Initial	Water Content, %	37.1
	Dry Density, pcf	83.8
	Saturation, %	99.0
	Void Ratio	1.0121
	Diameter, in.	2.37
	Height, in.	5.70
At Test	Water Content, %	37.1
	Dry Density, pcf	83.8
	Saturation, %	99.0
	Void Ratio	1.0121
	Diameter, in.	2.37
	Height, in.	5.70
Strain rate, in./min.		0.06
Back Pressure, psf		0
Cell Pressure, psf		720
Fail. Stress, psf		1692
Ult. Stress, psf		1692
σ_1 Failure, psf		2412
σ_3 Failure, psf		720

Type of Test:

Unconsolidated Undrained

Sample Type: Undisturbed

Description: Blk Clay (CH)

Specific Gravity= 2.70

Remarks:

Tested By: SW _____

Checked By: GEF _____

Project: Farmers Lane Well Improvements

Source of Sample: WB4-2

Depth: 3.0'

Proj. No.: 5383.07.04.1

Date Sampled: 12/6/2016

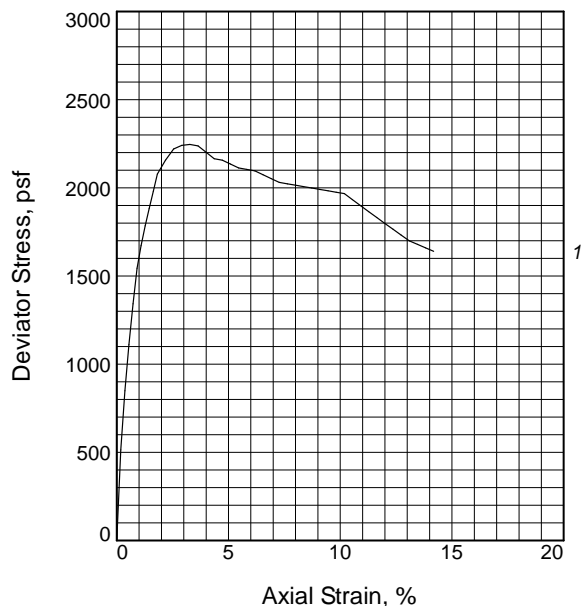
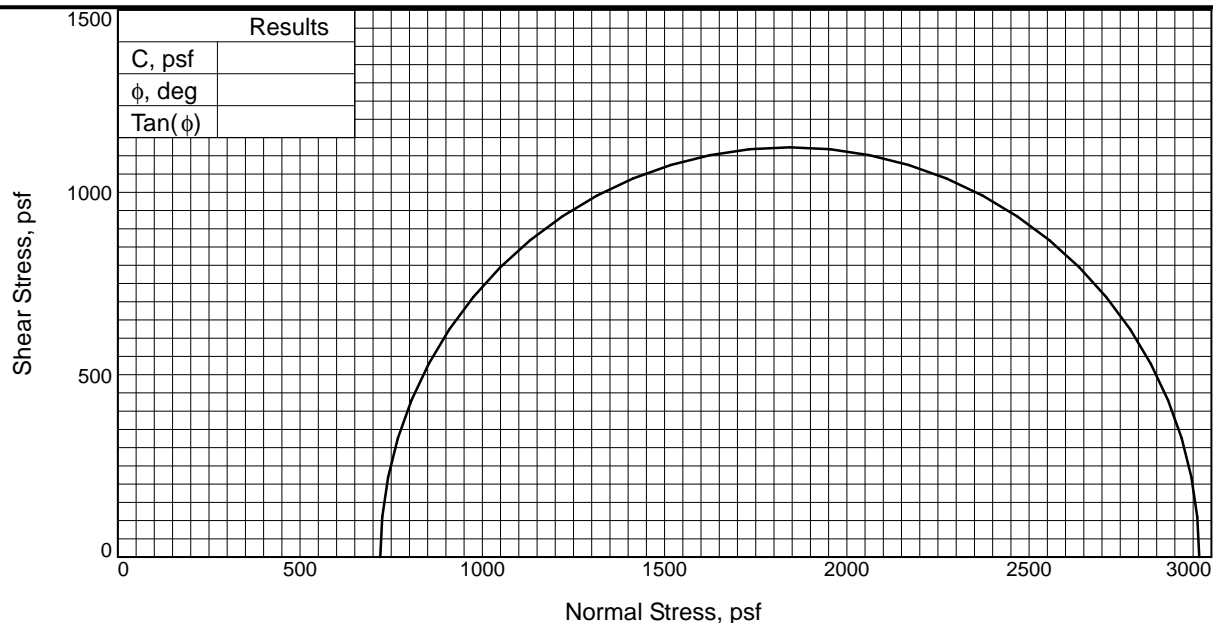
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STRENGTH TEST DATA

Farmers Lane Well Improvements
751 and 777 Farmers Lane
Santa Rosa, California

PLATE

10



Sample No.		1
Initial	Water Content, %	36.4
	Dry Density, pcf	82.8
	Saturation, %	94.8
	Void Ratio	1.0359
	Diameter, in.	2.39
	Height, in.	5.50
At Test	Water Content, %	36.4
	Dry Density, pcf	82.8
	Saturation, %	94.8
	Void Ratio	1.0359
	Diameter, in.	2.39
	Height, in.	5.50
Strain rate, in./min.		0.06
Back Pressure, psf		0
Cell Pressure, psf		720
Fail. Stress, psf		2247
Ult. Stress, psf		2247
σ_1 Failure, psf		2967
σ_3 Failure, psf		720

Type of Test:

Unconsolidated Undrained

Sample Type: Undisturbed

Description: Grey/ Brn Clay (CH)

Specific Gravity= 2.70

Remarks:

Tested By: SW _____

Checked By: GEF _____

Project: Farmers Lane Well Improvements

Source of Sample: WB4-2

Depth: 6.0'

Proj. No.: 5383.07.04.1

Date Sampled: 12/6/2016

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STRENGTH TEST DATA

Farmers Lane Well Improvements
751 and 777 Farmers Lane
Santa Rosa, California

PLATE

11

APPENDIX B - REFERENCES

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APPENDIX C - DISTRIBUTION

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