PJC & Associates, Inc.
Consulting Engineers & Geologists

February 16, 2018 Job No. 5208.02

Kevin Baughman
kbaughman@sonic.net

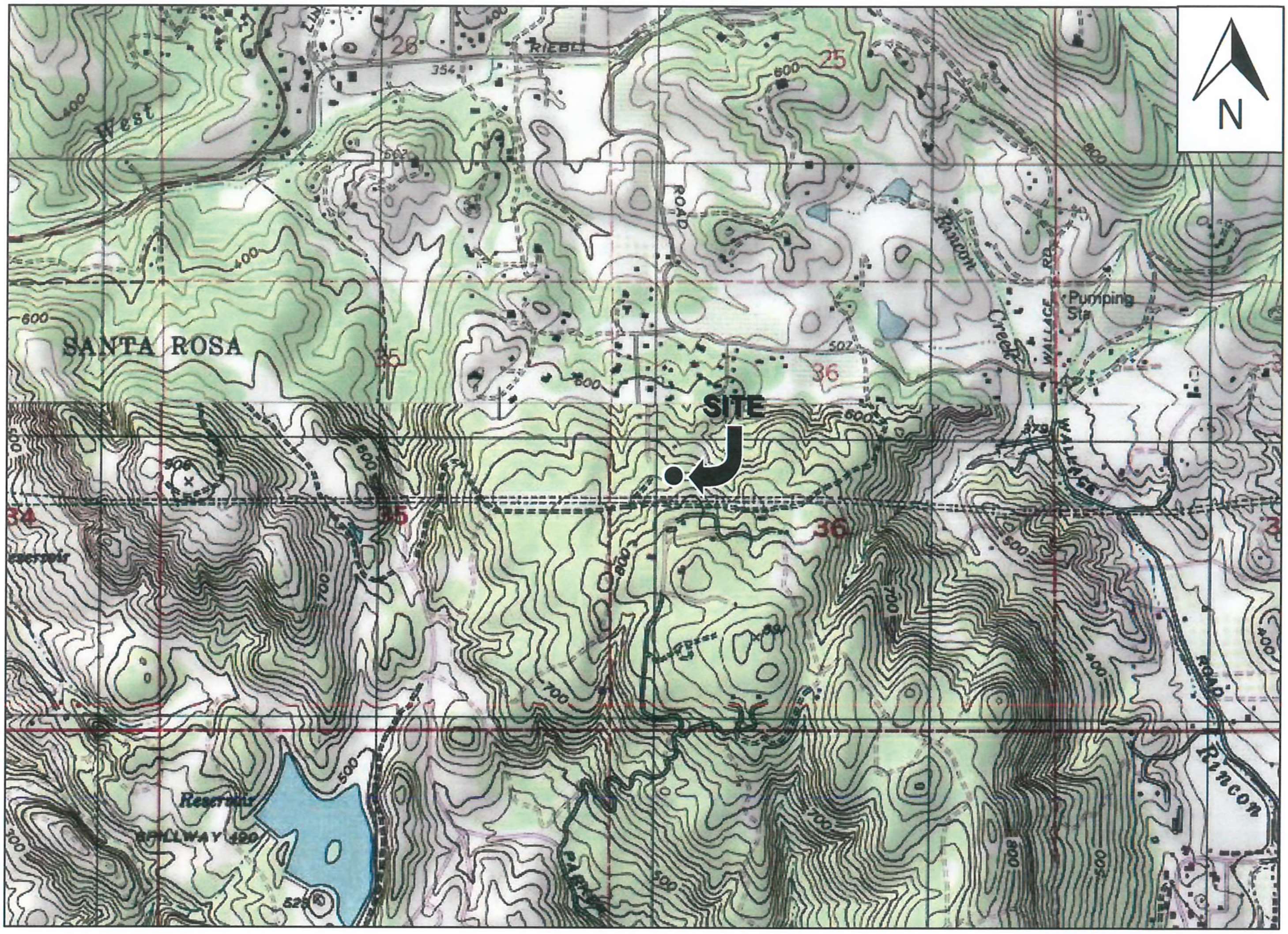
Subject: Geotechnical Investigation
Proposed Water Tank Replacement
212 Meadowcroft Way
Santa Rosa, California

Dear Kevin:

PJC and Associates, Inc. (PJC) is pleased to submit the results of our geotechnical investigation for the proposed water tank replacement located at 212 Meadowcroft Way in Santa Rosa, California. The approximate location of the project site is shown on the Site Location Map, Plate 1. The site corresponds to latitudinal and longitudinal coordinates of 38.50° north and 122.702° west, according to field GPS measurements performed at the site. Our services were completed in accordance with our proposal for geotechnical engineering services, dated January 17, 2018, and your authorization to proceed with the work dated January 23, 2018. This report presents our engineering opinions and recommendations regarding the geotechnical aspects of the design and construction of the proposed project. Based on the results of this study, it is our opinion that the project site can be developed from a geotechnical engineering standpoint provided the recommendations presented herein are incorporated in the design and carried out through construction.

1. PROJECT DESCRIPTION

The proposed project will consist of replacing the 40,000-gallon redwood tank that was damaged from the Tubbs wildfire. Plans of the new tank were not available at the time of this report. Information provided to us indicates that the tank will consist of a 68,000-gallon, unsecured steel tank with an approximate diameter of 31 feet and a height of 15 feet. According to civil engineering plans of the subdivision, dated July 15, 1969, the existing tank is supported on a 12-inch thick reinforced slab-on-grade foundation. Structural details of the slab were not available at this time. It is our understanding that it is proposed that the slab will remain and be utilized to support the new tank. The diameter of the new tank will be larger than the dimensions of the existing slab. Therefore, it is proposed to enlarge the existing slab to provide the adequate dimensions for support. This is proposed to be accomplished by doweling the new portion into the existing slab.



SCALE: 1:24,000

REFERENCE: USGS SANTA ROSA, CALIFORNIA 7.5 MINUTE QUADRANGLE, MAP REVISED 1994

PJC & Associates, Inc. Consulting Engineers & Geologists	SITE LOCATION MAP PROPOSED REPLACEMENT WATER STORAGE TANK 212 MEADOWCROFT WAY SANTA ROSA, CALIFORNIA	PLATE 1
	Proj. No: 5208.02 Date: 2/18 App'd by: PJC	

We anticipate that a full water tank will impose a uniform load not exceeding 1,000 pounds per square foot (psf) on the bearing soils. If this anticipated load varies significantly from the actual load, we should be consulted to review the actual loading conditions and, if necessary, revise the recommendations of this report.

The grading of the site was completed for construction of the existing tank. We anticipate that the tank will be constructed at or near existing grade. Therefore, we anticipate that grading of the site will be minimal and consist of cuts and fills of one foot and less to achieve the finish pad grade and provide adequate gradients for site drainage. We do not anticipate that retaining walls will be required for the project.

2. SCOPE OF SERVICES

The purpose of this study is to provide geotechnical criteria for the design and construction of the proposed project as described above. Specifically, the scope of our services included the following:

a. Excavating two exploratory test pits to depths of three and one-half to five feet below the existing ground surface to observe the soil, bedrock, and groundwater conditions underlying the project site. Our staff geologist was on site to log the materials encountered in the test pits and to obtain representative samples for visual classification and laboratory testing.

b. Laboratory observation and testing of representative samples obtained during the course of our field investigation to evaluate the engineering properties of the subsurface soils and bedrock underlying the site.

c. Review seismological and geologic literature on the site area, discuss site geology and seismicity, and evaluate potential geologic hazards and earthquake effects (i.e., liquefaction, densification, ground rupture, settlement, lurching and lateral spreading, expansive soils, slope stability, etc.).

d. Perform engineering analyses to develop geotechnical recommendations for site preparation and earthwork, foundation type(s) and design criteria, lateral earth pressures, settlement, concrete slab-on-grade recommendations, surface and subsurface drainage control and construction considerations. Our analyses did not include an evaluation of the existing concrete slab-on-grade for suitability of support of the new tank. That work is to be performed by others.

e. Preparation of this report summarizing our work on this project

3. SITE CONDITIONS

a. General. The site is located southeast and upslope of Meadowcroft Way in the Cross Creek residential subdivision of detached single estate homes of northeastern Santa Rosa. The tank site is located approximately 300 feet south of Meadowcroft Way and along the norther perimeter of the PG&E transmission lines.

b. Topography and Drainage. The site is occupied by a redwood tank that was damaged by the Tubbs wildfire. The site is located in the foothills of northeast Santa Rosa. The tank site consists of a north descending slope with a natural gradient of an estimated 20 percent. According to Google Earth Imagery, the site is located near an elevation of 777 feet above mean sea level (MSL). The pad was previously graded by cutting on the uphill side and placing fill on the downside to create a level pad.

No creeks or drainage swales were observed at or near the site. Site drainage appears to consist of sheet flow and surface infiltration. Drainage extends north and to tributaries of Rincon Creek.

4. GEOLOGIC SETTING

The site is located in the Coast Ranges Geomorphic Province of California. This province is characterized by northwest trending topographic and geologic features, and includes many separate ranges, coalescing mountain masses and several major structural valleys. The province is bounded on the east by the Great Valley and on the west by the Pacific Ocean. It extends north into Oregon and south to the Transverse Ranges in Ventura County.

The structure of the northern Coast Ranges region is extremely complex due to continuous tectonic deformation imposed over a long period of time. The initial tectonic episode in the northern Coast Ranges was a result of plate convergence, which is believed to have begun during the late Jurassic period. This process involved eastward thrusting of oceanic crust beneath the continental crust (Klamath Mountains and Sierra Nevada) and the scraping off of materials that are now accreted to the continent (northern Coast Ranges). East-dipping thrust and reverse faults were believed to be the dominant structures formed.

Right lateral, strike slip deformation was superimposed on the earlier structures beginning mid-Cenozoic time, and has progressed northward to the vicinity of Cape Mendocino in Southern Humboldt County (Hart, Bryant and Smith, 1983). Thus, the principal structures south of Cape Mendocino are northwest trending, nearly vertical faults of the San Andreas system.

According to the “Geologic Map of the Santa Rosa 7.5' Quadrangle” prepared by the United States Geologic Survey (USGS), the project site has been mapped to be underlain by late Tertiary volcanic rocks of the Sonoma Volcanics (Tsb). Our test pits confirmed that the site is underlain by bedrock units of the Sonoma Volcanics Group.

5. 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. According to computer fault modeling software program *EQFAUL*T, the four closest known active faults to the site are the Rodgers Creek, the Maacama fault, the West Napa and the Collayomi faults. The Rodgers Creek fault is located 2.5 miles to the west, the Maacama fault is located 2.5 miles to the east, the West Napa Fault is located 19.1 miles southeast of the site, and the Collayami fault is located 19.4 miles to the east. Table 1 outlines the closest known active faults and their associated maximum magnitudes.

TABLE 1
CLOSEST KNOWN ACTIVE FAULTS

Fault Name	Distance from Site (Miles)	Maximum Earthquakes (Moment Magnitude)
Rodgers Creek	2.5	7.0
Maacama	2.5	6.9
West Napa	19.1	6.5
Collayami	19.4	7.9

Reference - Blake, T.F, “EQFAULT” Ver 3.00, software program.

6. 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 Section 8 of this report.

7. SUBSURFACE CONDITIONS

a. Soils and Bedrock. The subsurface conditions at the project site were investigated by excavating two exploratory test pits adjacent to the building site. The test pits were excavated to depths of between three and one-half to five feet below the existing ground surface. The approximate test pit locations are shown on the Test Pit Location Plan, Plate 2. Test pits were excavated to observe the soil, bedrock, and groundwater conditions, and to collect samples of the underlying soils and bedrock for visual examination and laboratory testing. Detailed descriptions of the subsurface conditions are shown on the Test Pit Logs, Plates 3 and 4. The excavation and sampling procedures, laboratory procedures and descriptive test pit logs are included in Appendices A and B, respectively.

The test pits generally encountered top soils/artificial fill overlying basalt bedrock of the Sonoma Volcanic Group. A thin veener of top soil was encountered in TP-1 which consisted of a medium plastic sandy silt which extended to a depth of one-quarter feet below the existing ground surface. This layer appeared moist and very soft. The surface at TP-2 encountered a surface layer consisting of an artificial fill comprising a medium plastic sandy clay that extended to a depth of three and one-half feet below the existing ground surface. This layer appeared moist and loosely compacted. Underlying the soil deposits, the pits encountered basalt bedrock that extended to the maximum depths explored. The bedrock appeared hard, strong and moderately weathered.

b. Groundwater. The phreatic groundwater was not encountered during our subsurface investigation on January 15, 2018. The phreatic groundwater probably exists at a great depth below the site and should not impact the project. However, low flow seepage was encountered in TP-1 within the bedrock fractures. We judge that the seepage should dissipate following seasonal rainfall.

8. GEOLOGIC AND SEISMIC CONSIDERATIONS

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 design life of the project. The following discussion reflects the possible earthquake effects which could result in damage to the proposed project.

a. Surface Fault Rupture. Rupture of the ground surface is expected to occur along known active fault traces. No evidence of past surface faulting was observed during our field exploration or shown in our review of available geologic literature. Therefore, the risk of fault rupture at the site should be considered 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/Densification. The site is underlain by hard shallow bedrock. Therefore, the risk of soil liquefaction and densification at the site is non-existent.

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. No exposed vertical faces exist within the immediate vicinity of the project site. Therefore, we judge that the risk of lateral spreading and lurching at the project site is low.

e. Expansive Soils. Based on our field observations and laboratory analyses, the site surface soils exhibit medium plasticity characteristics and are considered to have a moderate expansion potential. However, evidence of structural distress to the existing slab due to expansive soils was not observed. The bedrock is not considered expansive.

f. Slope Stability. Landslide slumps, debris flows or earth slumps were not observed at or near the site. The site appears globally stable due to hard bedrock conditions.

9. CONCLUSIONS AND RECOMMENDATIONS

Based on the results of our investigation, we judge that the project is feasible from a geotechnical engineering standpoint provided the recommendations and criteria presented in this report are incorporated into design and construction of the project. The primary geotechnical consideration in design and construction is the presence of weak and compressible surface artificial fill. The basalt bedrock underlying the soils at the site has adequate strength and is incompressible for the anticipated loads of construction.

The pad was graded level by cutting on the uphill side of the pad and placing fill on the downhill side. Therefore, part of the pad consists of basalt bedrock and part is underlain by undocumented artificial fill, up to approximately three and one-half feet thick. The bedrock is firm and incompressible for the anticipated loads of construction. The fill appears loosely compacted and unsuitable for structural support of the slab. To provide adequate support for the tank, we recommend that weak soils should be subexcavated and recompacted according to the earthwork section of this report.

The following sections of this report present geotechnical recommendations and criteria for design and construction of the project.

10. EARTHWORK AND GRADING

It is our understanding that it is planned to support the structure on the existing slab. Furthermore, to accommodate the larger tank, the existing slab will be expanded. The structural integrity of the existing slab is beyond the scope of this report and will be performed by others.

a. Demolition and Stripping. The existing tank should be demolished and completely removed from the site. We recommend that structural areas be stripped of surface vegetation, man-made debris and the upper few inches of soil containing organic matter. These materials should be moved off site; some of them, if suitable, could be stockpiled for later use on graded slopes or in landscape areas. The thickness of the required stripping is expected to be generally on the order of a few inches. Deeper stripping depths may be required where pockets of organic soils are encountered. Voids created by demolition and stripping should be replaced with compacted engineered fill.

b. Excavation and Compaction. Following demolition and site stripping, excavation should be performed to achieve finish grade or prepare areas to receive fill. We recommend that the existing fill be subexcavated until bedrock is exposed. The depth to bedrock is approximately three and one-half feet. The actual depth should be determined by the geotechnical engineer in the field during construction. A level bench extending the width of the fill should be performed. The lateral extent of the sub-excavation should extend five feet beyond the toe of the fill slope.

   If practical, the exposed surface should be scarified to a depth of eight inches and compacted to provide a firm surface for engineered fill. The on-site soils, free of organics and rocks larger than six inches in plan dimension, may be considered suitable for use as engineered fill. The fill material should be spread in eight-inch thick loose lifts, moisture conditioned to within two percent of the optimum moisture content and compacted to at least 90 percent of the maximum dry density of the materials.

   It is recommended that any import fill to be used on site be of a low to non-expansive nature, and should meet the following criteria:

Plasticity Index	less than 12
Liquid Limit	less than 40
Percent Soil Passing #200 Sieve	between 15% and 40%

Maximum Aggregate Size 4 inches

Expansive clays must not be used for engineered fill. All fills should be placed in lifts no greater than eight inches in loose thickness and compacted to the general recommendations provided below. We do not anticipate the placement of fill greater than three feet on slopes greater than 20 percent, we should provide specific recommendations for placement.

c. Cut and Fill Slopes. Cut slopes should be graded to an inclination no steeper than 2H:1V. Steeper slopes should be retained. If potentially unstable subsurface conditions, such as adverse bedding, joint planes, zones of weakness, weak clay zones, or exposed seepage is encountered, it may be necessary to flatten slopes or provide other treatment. It is recommended that a geotechnical engineer observe the cut slopes and provide final recommendations for the control of adverse conditions during grading operations, if encountered. During the rainy season, the cut slopes should be checked for springs or seepage areas. The surfaces of the cut slopes should be treated as needed in order to minimize the possibility of slumping and erosion.

Fill slopes should not be graded to slopes steeper than 2H:1V. The surfaces of fill slopes should be treated in order to reduce erosion and slumping.

All site preparation and fill placement should be observed by a representative of PJC. It is important that during the stripping, sub-excavation and grading/scarifying processes, a representative of our firm be present to observe whether any undesirable material is encountered in the construction area.

Generally, grading is most economically performed 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 the on-site soils. Special and relatively expensive construction procedures should be anticipated if grading must be completed during the winter and early spring.

11. DRAINAGE

All final grades should be provided with positive gradients away from foundations and graded areas to provide rapid removal of surface water runoff to an adequate discharge point. No ponding of water should be allowed adjacent to the foundations, or at the toe or crown of cut and fill slopes.

12. SEISMIC DESIGN

Based on criteria presented in the 2016 edition of the California Building Code (CBC) and ASCE (American Society of Civil Engineers) STANDARD ASCE/SEI 7-10, the following minimum criteria should be used in seismic design:

a. Site Class: B

b. Mapped Acceleration Parameters: S_s = 2.168 g, S_1 = 0.894 g

c. Spectral Response Acceleration Parameters: S_{Ms} = 2.168 g, S_{M1} = 0.894 g

d. Design Spectral Acceleration Parameters: S_{Ds} = 1.445 g, S_{D1} = 0.596 g

13. CONCRETE SLABS-ON-GRADE

It is our understanding that it is proposed to use the existing slab-on-grade for foundation support. Furthermore, the existing slab-on-grade will be expanded to accommodate the larger slab. The structural integrity of the existing slab should be evaluated by the project structural engineer. The new section of concrete slab-on-grade should be supported on bedrock or compacted engineered fill and be designed by the project structural engineer. All slab subgrades should be moisture conditioned and rolled to produce a firm and unyielding subgrade. The slab subgrade should not be allowed to dry. The slab should be at least 12 inches thick and underlain with a capillary moisture break consisting of at least four inches of clean, free-draining crushed rock or gravel. The slab-on-grade should be designed by the project structural engineer. The rock should be graded so that 100 percent passes the one-inch sieve and no more than five percent passes the No. 4 sieve.

For slabs-on-grade with moisture sensitive surfacing, we recommend that a vapor barrier at least 10 mils thick be placed over the drain rock to prevent migration of moisture vapor through the concrete slabs. The gravel should be moistened slightly prior to placing concrete. Control joints should be provided to induce and control cracking. However, cosmetic cracking should be expected.

14. LIMITATIONS

The data, information, interpretations and recommendations contained in this report are presented solely as bases and guides to the geotechnical design of the proposed water tank located at 212 Meadowcroft Way in Santa Rosa, 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 and bedrock deposits may vary in type, strength, and many other important properties between 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 is based on the findings at the points of exploration and on 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. During the course of this investigation, several assumptions were made regarding development concepts. Should our assumptions differ significantly from the final intent of the project designers, our office should be notified of the changes to assess any potential need for revised recommendations. Observation and testing services should also be provided by PJC to verify that the intent of the plans and specifications are carried out during construction; these services should include observing grading and earthwork, approving foundation excavations, and observing construction of 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 we are not notified to observe.

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

Sincerely,

PJC & ASSOCIATES, INC.

Patrick J. Conway
Geotechnical Engineer
GE 2303, California

REGISTERED PROFESSIONAL ENGINEER
PATRICK J. CONWAY
No. 2303
Exp. 3/31/18
GEOTECHNICAL
STATE OF CALIFORNIA

PJC/hca

cc: Doug Donmon (Doug@d4e.net)
Mark Luzaich (MarkL@americantank.com)

APPENDIX A
FIELD INVESTIGATION

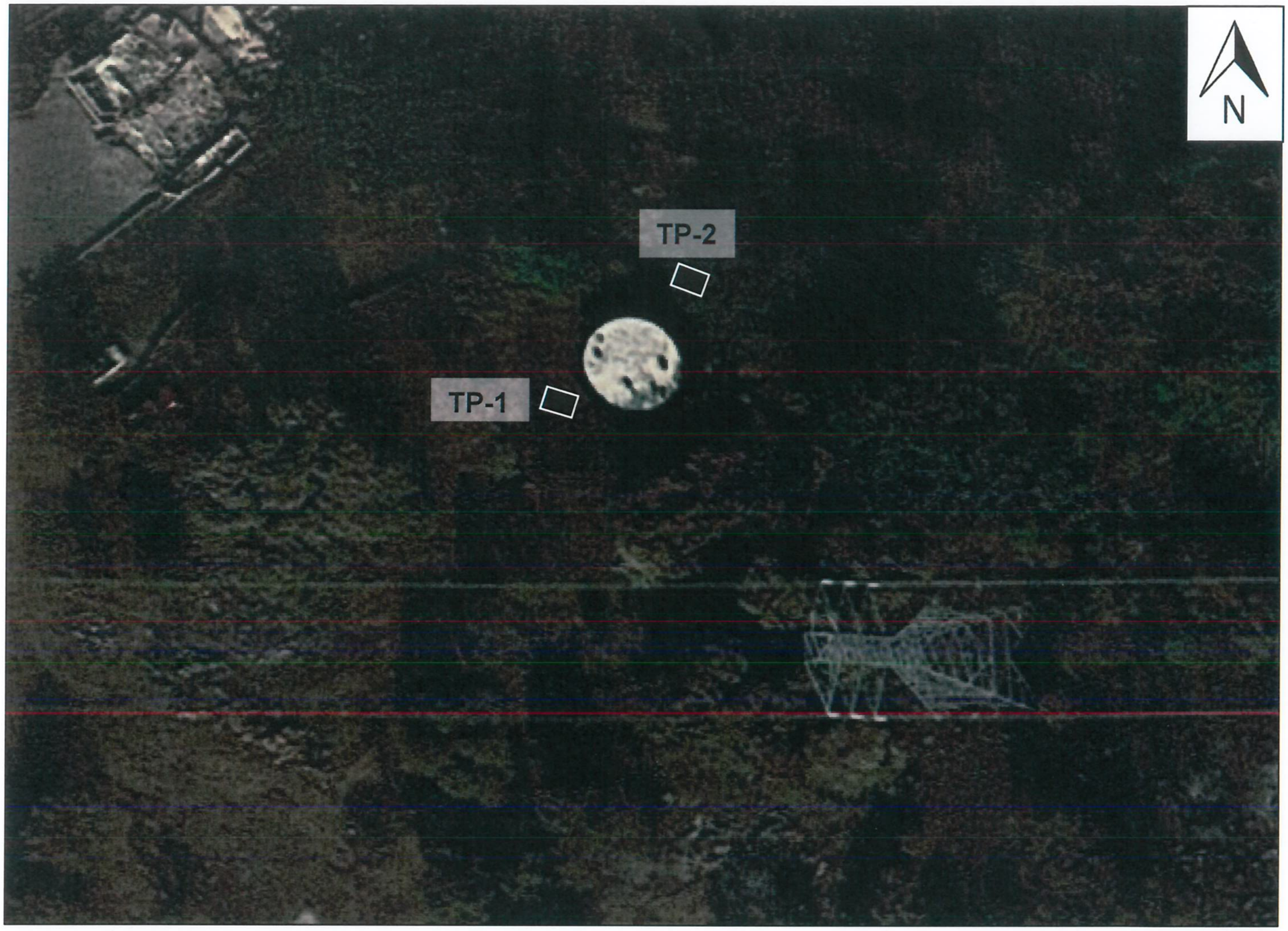
1. INTRODUCTION

The field program performed for this study consisted of excavation two exploratory test pits (TP-1 and TP-2) in the vicinity of the proposed project. The exploration was completed on January 15, 2018. The test pit locations are shown on the Test Pit Location Plan, Plate 2. Descriptive logs of the test pits are presented in this appendix as Plates 3 through 4.

2. TEST PITS

The test pits were excavated with a track-mounted mini excavator equipped with 24-inch bucket. Disturbed samples for logging and laboratory testing were collected. The excavation was performed under the observation of a staff geologist of PJC who maintained a continuous log of soil and bedrock conditions and obtained samples suitable for laboratory testing. The soils were classified according to Unified Soil Classification System as presented on Plate 5. The bedrock was classified according to Plate 6.

Disturbed samples used in the laboratory investigation were obtained from various locations during the course of the field investigation, as discussed in Appendix A of this report. Identification of each sample is by pit number, sample number and depth. All of the various laboratory tests performed during the course of the investigation are described below in Appendix B.



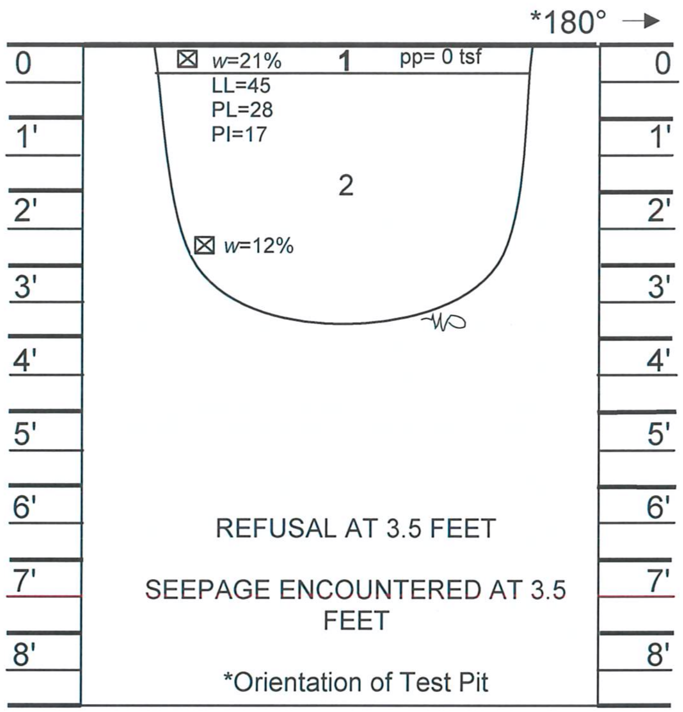
APPROXIMATE SCALE: 1" = 40'

EXPLANATION

■ TEST PIT LOCATION AND DESIGNATION

REFERENCE: GOOGLE EARTH PRO IMAGERY, DATED 10/17/17

PJC & Associates, Inc. Consulting Engineers & Geologists	TEST PIT LOCATION MAP PROPOSED REPLACEMENT WATER STORAGE TANK 212 MEADOWCROFT WAY SANTA ROSA, CALIFORNIA	PLATE 2
	Proj. No: 5208.02 Date: 2/18 App'd by: PJC	



LITHOLOGY

1) 0.0-0.25'; SANDY SILT (ML); reddish brown and black, moist, very soft, medium plasticity, porous, with roots (TOPSOIL).

2) 0.25'-3.5'; BASALT (Tsv); gray, hard, strong, moderately weathered, moderately fractured (BEDROCK).

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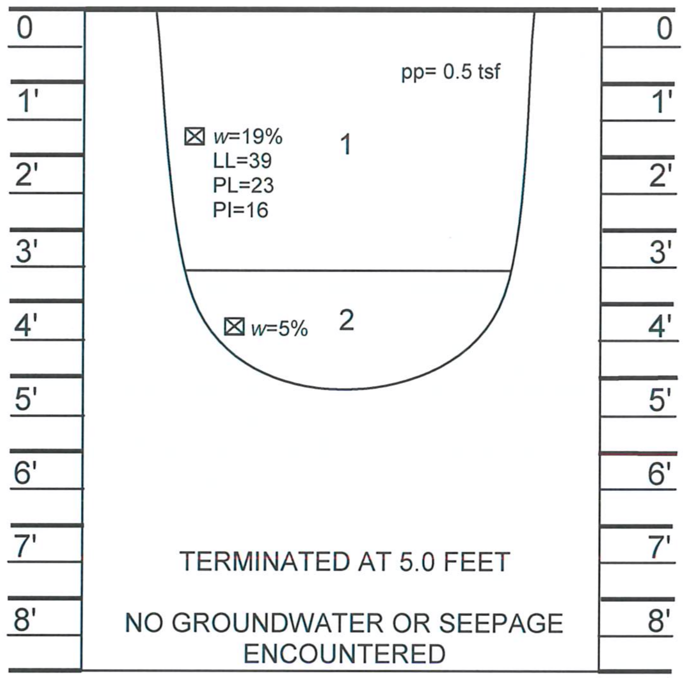
LOG OF TEST PIT 1
PROPOSED REPLACEMENT WATER STORAGE TANK
212 MEADOWCROFT WAY
SANTA ROSA, CALIFORNIA

PLATE 3

Proj. No: 5208.02 Date: 2/18 App'd by: PJC



LITHOLOGY

1) 0.0-3.5'; SANDY CLAY (CL); reddish brown, moist, loosely compacted, medium plasticity, porous, trace roots, with sub-rounded and sub-angular basalt gravels (FILL).

2) 3.5'-5.0'; BASALT (Tsv); gray, hard, strong, moderately weathered, highly fractured (BEDROCK).

MAJOR DIVISIONS				TYPICAL NAMES
COARSE GRAINED SOILS (More than half is larger than #200 sieve)	GRAVELS (more than half coarse fraction is larger than no. 4 sieve size)	CLEAN GRAVELS WITH LITTLE OR NO FINES	GW	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES
			GP	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES
		GRAVELS WITH OVER 12% FINES	GM	SILTY GRAVELS, POORLY GRADED GRAVEL-SAND MIXTURES
			GC	CLAYEY GRAVELS, POORLY GRADED GRAVEL-SAND MIXTURES
	SANDS (more than half coarse fraction is smaller than no. 4 sieve size)	CLEAN SANDS WITH LITTLE OR NO FINES	SW	WELL GRADED SANDS, GRAVELLY SANDS
			SP	POORLY GRADED SANDS, GRAVEL-SAND MIXTURES
		SANDS WITH OVER 12% FINES	SM	SILTY SANDS, POORLY GRADED SAND-SILT MIXTURES
			SC	CLAYEY SANDS, POORLY GRADED SAND-CLAY MIXTURES
FINE GRAINED SOILS (More than half is smaller than #200 sieve)	SILTS AND CLAYS (LIQUID LIMIT LESS THAN 50)		ML	INORGANIC SILTS, SILTY OR CLAYEY FINE SANDS, VERY FINE SANDS, ROCK FLOUR, CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS OR LEAN CLAYS
			OL	ORGANIC CLAYS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS (LIQUID LIMIT GREATER THAN 50)		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			Pt	PEAT AND OTHER HIGHLY ORGANIC SOILS

KEY TO TEST DATA

- LL — Liquid Limit (in %)
- PL — Plastic Limit (in %)
- G — Specific Gravity
- SA — Sieve Analysis
- Consol — Consolidation
- ■ "Undisturbed" Sample
- ☒ Bulk or Disturbed Sample
- ☐ No Sample Recovery

	Shear Strength, psf	Confining Pressure, psf	
*Tx	320	(2600)	Unconsolidated Undrained Triaxial
Tx CU	320	(2600)	Consolidated Undrained Triaxial
DS	2750	(2000)	Consolidated Drained Direct Shear
FVS	470		Field Vane Shear
*UC	2000		Unconfined Compression
LVS	700		Laboratory Vane Shear

Notes: (1) All strength tests on 2.8" or 2.4" diameter sample unless otherwise indicated

(2) * Indicates 1.4" diameter sample

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USCS SOIL CLASSIFICATION KEY
PROPOSED REPLACEMENT WATER STORAGE TANK
212 MEADOWCROFT WAY
SANTA ROSA, CALIFORNIA

PLATE 5

Proj. No: 5208.02 Date: 2/18 App'd by: PJC

ROCK TYPES

- CONGLOMERATE
- SHALE
- METAMORPHIC ROCKS
  HYDROTHERMALLY-ALTERED ROCKS
- SANDSTONE
- SHEARED SHALE MELANGE
- IGNEOUS ROCKS
- META-SANDSTONE
- CHERT

BEDDING THICKNESS

MASSIVE	Greater than 6 feet
THICKLY BEDDED	2 to 6 feet
MEDIUM BEDDED	8 to 24 inches
THINLY BEDDED	2-1/2 to 8 inches
VERY THINLY BEDDED	3/4 to 2-1/2 inches
CLOSELY LAMINATED	1/4 to 3/4 inches
VERY CLOSELY LAMINATED	Less than 1/4 inch

JOINT, FRACTURE, OR SHEAR SPACING

VERY WIDELY SPACED	Greater than 6 feet
WIDELY SPACED	2 to 6 feet
MODERATELY WIDELY SPACED	8 to 24 inches
CLOSELY SPACED	2-1/2 to 8 inches
VERY CLOSELY SPACED	3/4 to 2-1/2 inches
EXTREMELY CLOSELY SPACED	Less than 3/4 inch

HARDNESS

Soft - pliable: can be dug by hand

Slightly Hard - can be gouged deeply or carved with a pocket knife

Moderately Hard - can be readily scratched by a knife blade; scratch leaves heavy trace of dust and is readily visible after the powder has been blown away

Hard - can be scratched with difficulty; scratch produces little powder and is often faintly visible

Very Hard - cannot be scratched with pocket knife, leaves a metallic streak

STRENGTH

Plastic - capable of being molded by hand

Friable - crumbles by rubbing with fingers

Weak - an unfractured specimen of such material will crumble under light hammer blows

Moderately Strong - specimen will withstand a few heavy hammer blows before breaking

Strong - specimen will withstand a few heavy ringing hammer blows and usually yields large fragments

Very Strong - rock will resist heavy ringing hammer blows and will yield with difficulty only dust and small flying fragments.

DEGREE OF WEATHERING

Highly Weathered - abundant fractures coated with oxides, carbonates, sulphates, mud, etd., through discoloration, rock disintegration, mineral decomposition

Moderately Weathered - some fracture coating, moderate or localized discoloration, little to no effect on cementation, slight mineral decomposition

Slightly Weathered - a few strained fractures, slight discoloration, little or no effect on cementation, no mineral decomposition

Fresh - unaffected by weathering agents, no appreciable change with depth.

APPENDIX B
LABORATORY INVESTIGATION

1. INTRODUCTION

This appendix includes a discussion of test procedures and results of the laboratory investigation performed for the proposed project. The investigation program was carried out by employing, whenever practical, currently accepted test procedures of the American Society of Testing and Materials (ASTM).

Disturbed samples used in the laboratory investigation were obtained during the course of the field investigation as described in Appendix A of this report. Identification of each sample is by borehole number and depth.

2. INDEX PROPERTY TESTING

In the field of soil mechanics and geotechnical engineering design, it is advantageous to have a standard method of identifying soils and classifying them into categories or groups that have similar distinct engineering properties. The most commonly used method of identifying and classifying soils according to their engineering properties is the Unified Soil Classification System described by ASTM D-2487-83. The USCS is based on recognition of the various types and significant distribution of soil characteristics and plasticity of materials.

The index properties test discussed in this report is the determination of natural water content and Atterburg Limits testing.

a. Natural Water Content. Natural water content was determined on selected disturbed samples. The samples were extruded, visually classified, and accurately weighed to obtain wet weight. The samples were then dried, in accordance with ASTM D-2216-80, for a period of 24 hours in an oven maintained at a temperature of 100 degrees C. After drying, the weight of each sample was determined and the moisture content calculated.

b. Atterburg Limits. Liquid and plastic limits were determined on selected samples in accordance with ASTM D4318-83. The results of the limits are summarized on the test pit logs.

APPENDIX C
REFERENCES

1. Geologic Map of the Cotati 7.5' Quadrangle, Scale: 1:250,000, compiled by the California Geologic Survey.

2. "Soil Mechanics" Department of the Navy Design Manual 7.1 (NAVFAC DM-7.1), dated May 1982.

3. USGS Santa Rosa, California Quadrangle 7.5-Minute Topographic Map, dated 1979.

4. California Building Code (CBC), 2016 edition.

5. "Maps of Known Active Fault Near-Source Zones in California and Adjacent Portions of Nevada," California Department of Conservation Division of Mines and Geology, Dated February 1998.

6. Blake, T.F. (2000b), EQFault version 3.0 software program.

7. Civil Engineering Plans for Hidden Hills Estates, dated July 15, 1969, prepared by Frederick L. Browne.