Appendix G

Geotechnical Reports

J. Yang and Engineers
Geotechnical
General Civil Engineers

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(925) 831-8678 • FAX (925) 831-3645

Project No. J14-1591
December 28, 2014

Mr. Mel Casey:

Subject: Proposed Roadway Improvment at
0 Canyon Lane
Redwood City, California
Geotechnical Site Investigation

Dear Mr. Casey:

In accordance with your authorization, J. Yang and Engineers has investigated the geotechnical site conditions at the subject site for the proposed roadway improvement development in Redwood City, California.

The accompanying report presents our conclusions and recommendations based on our investigation. Our evaluations indicate that the site is physically suitable for the proposed construction, provided the recommendations in this report are carefully followed and are incorporated into the plans and specifications.

Should you have any questions or require additional information, please contact our office (925)831-8678 at your convenience.

Very truly yours,

J. Yang and Engineers

Jae H. Yang, P.E.
Project Geo. Engineer

REGISTERED PROFESSIONAL ENGINEER
JAE H. YANG
No. 25337
Exp. 12.15
CIVIL
STATE OF CALIFORNIA

Project No. J14-1591

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Project No. J14-1591

I. INTRODUCTION

A. Location and Description of Site

This report presents the results of a geotechnical site investigation at 0 Canyon Lane (down stream of Emerald Lake dam), Redwood City, California. (Plate 1-Location Map). The site was investigated on December 11, 2014. The site is located at Canyon Lane paralleled with down stream of existing swale (Emerald Lake outlet or down below of Oak Knoll Dr. The site is currently developed dirt road to the Glenwood Ave.

Development plans call for improving of the existing dirt road for the future of housing access road.

B. Purpose and Scope of Work

The purpose of the site investigation was to determine surface and subsurface soil conditions at the subject access road site. Based on the results of the investigation, criteria were established for the grading of the access road site, the design of road structure for the planned traffic, and the construction of other related facilities on the property. Our investigation included the following:

1. Field reconnaissance by the Soil Engineer
2. Drilling and sampling of the subsurface soil.
3. Laboratory Testing.
4. Analysis of the data and formulation of conclusion and recommendations.
5. Preparation of this report.

II. FIELD EXPLORATION AND LABORATORY TESTING

Subsurface conditions were explored on December 11, 2014 by drilling seven boring. The boring locations were chosen to provide subsurface information at the random areas on the preliminary access road and fire department turnaround area.

The boring locations are shown on PLATE 3. The boring were drilled with B24 5" solid stem flyight auger. Our soil engineer logged the boring and obtained bulk and relatively undisturbed drive samples for visual classification and subsequent laboratory testing. Drive samples were obtained with the split barrel sampler (2-inch I.D.) equipped with brass liner tubes.

The samplers were driven with a 140-pound hammer falling 30 inches. Standard penetration test N-values obtained with the SPT sampler and the S&H split-barrel sampler results are shown on the boring logs in PLATE 4.

The soils encountered were described in accordance with the Unified Soils Classification System outlined in PLATE A1.

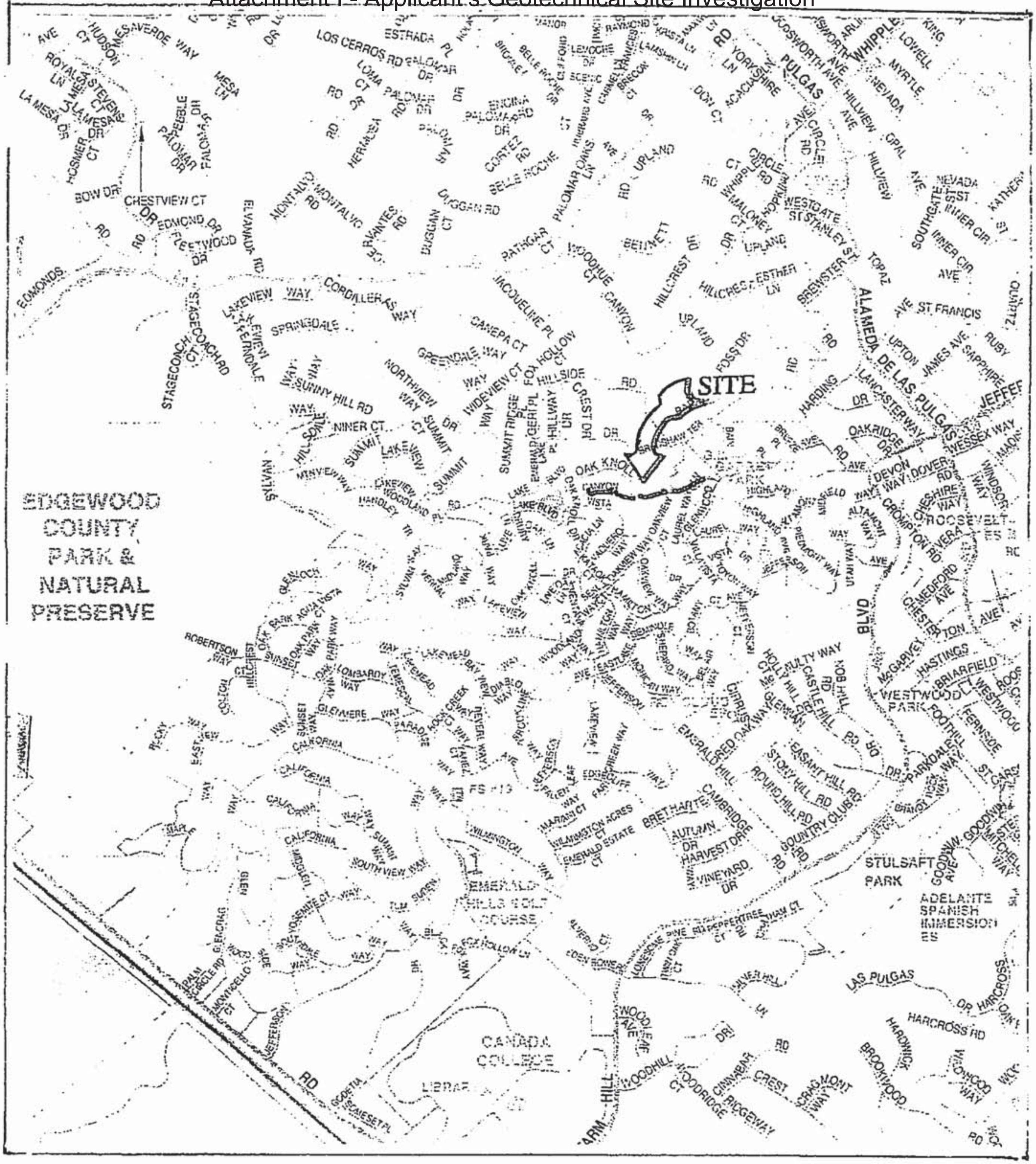


PLATE 1

LOCATION MAP

III. GEOTECHNICAL EVALUATION AND DISCUSSION

A. Assessment of Seismic Hazards

This site could be affected by an earthquake with its epicenter of the active faults in the Bay Area. At present, it is not possible to predict when or where movement will occur on these faults. It must be assumed, however, that movement along one or more of these faults will result in a moderate earthquake during the lifetime of any improvements at this site.

Two active fault systems are known to exist within the vicinity of the site. The approximate location of these faults are southwest 23 km from the siteas shown on Figures 1.

In the event of an earthquake, the seismic risk will depend on the distance of the structure from the epicenter and source fault, the character and magnitude of the earthquake, the groundwater and soil conditions underlying the structure and its immediate vicinity, and the nature of the construction.

The potential *seismic hazards in the tests area are* the effects of ground shaking resulting from earthquakes on nearby faults.

Regional subsidence or uplift caused by a differential vertical movement along a fault takes place over large areas. In the event of such a movement on the San Andreas Fault, the site would probably respond as a unit; resulting damage from this phenomenon is unlikely.

The potential structural damage due to ground shaking is caused by the transmission of earthquake vibrations from the ground into a structure. The variables which determine the extent of damage are: the characteristics of the underlying earth materials, the design of the structure, the quality of materials and workmanship used in construction, the location and magnitude of the earthquake, and the duration andintensity of shaking. The most destructive effects of an earthquake are usually seen where the ground is unstable and the structures are poorly designed and constructed.

Preliminary estimates of ground response characteristics at this site indicate that high accelerations can be expected during a moderate to major earthquake on the San Andreas Fault or a major earthquake on the Monte Vista-Shannon Fault or Any of these events could cause strong ground shaking at this site. The duration of shaking and the frequency components of the vibrational waves will depend upon the magnitude and location of the earthquake.

Structures should be designed to accommodate earthquake vibrations. If quality design and construction criteria are met, as set forth in the latest edition of the Uniform Building Code, CALTRANS Highway Design Manual and CALTRANS Standard Specifications.

B. Site Geologic and Site Stability

The natural slopes on the proposed site are relatively flat to gentle slope and show generally good site stability. In accordance with Geotechnical Hazards Synthesis map (12/'76), hazard area zone 11, San mateo County that geologic materials are Franciscan Sandstone. The Franciscan sandstone (undivided) consists of sandstone and lithic rock with interbedded siltstone and shale and local conglomerate.

The upper soils at the site are cohesive with grass roots and are relatively resistant to erosion. The materials could erode if slopes are left unplanted and subjected to fast flowing runoff. Recommendations are presented in this report to mitigate problems associated with erosion.

C. SUBSURFACE SOIL CONDITIONS

Based upon examination of the exploratory boring (see PLATE 4: Boring Logs), materials encountered in the seven borings at locations shown on PLATE 3. The subsurface soils consist generally of silty clay to mottled silty sand and siltstone bed layer as shown on the boring logs. These materials generally grade from stiff to hard in relative density.

Groundwater was not observed at the time of our investigation at average depth of 10 feet.

The current (December, 2014), groundwater was not observed at the time of our investigation at average depth of 10 feet. However, in our professional judgement, the highest projected groundwater level to be approximately bottom of existing creek.

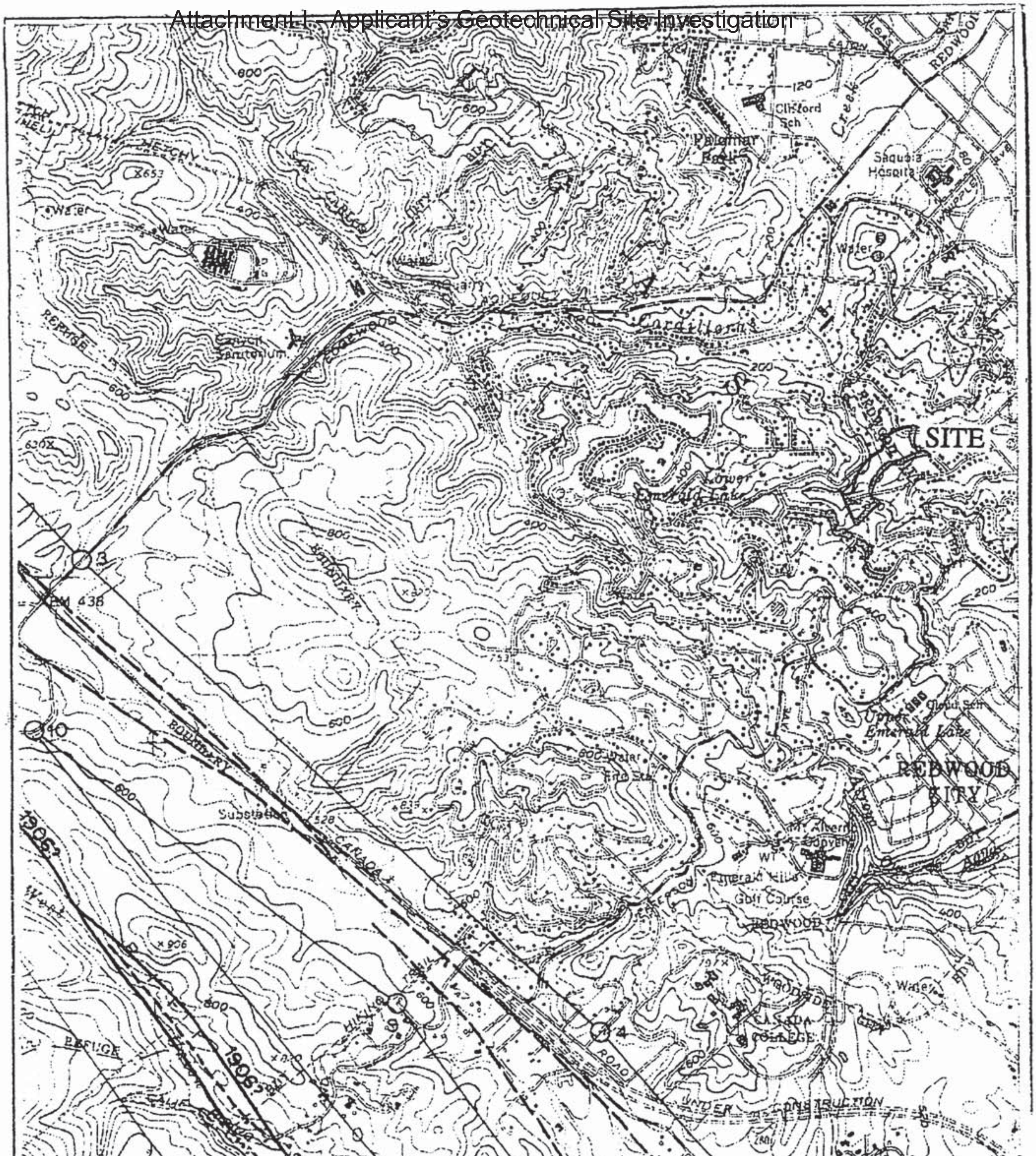
IV. CONCLUSIONS AND RECOMMENDATIONS

The following conclusions and recommendations are based on the investigation and evaluations described in this report. The recommendations and specifications presented herein should be incorporated into the project plans and documents during design and construction. Supplemental recommendations and/or modifications may be made at a later date, as more detailed development plans become available.

A. General Conclusions

1. The site is considered suitable from a geotechnical aspect for the proposed a preliminary access roadway improvement plan.

2. There were no soil or geologic conditions encountered during the investigation of the site which would preclude the planned construction.



SOURCES

STATE OF CALIFORNIA
EARTHQUAKE FAULT ZONES (1/94)

N

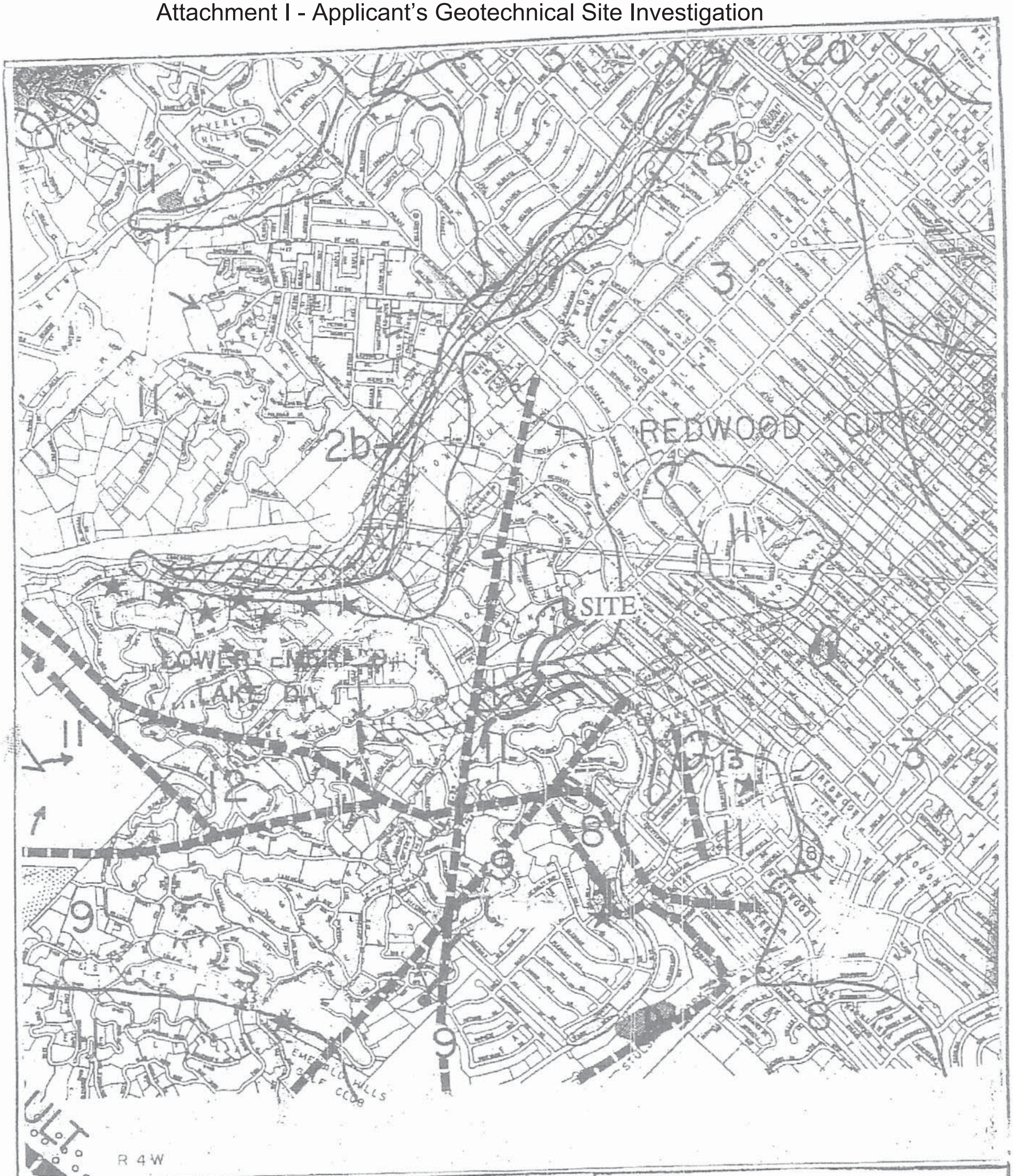
J. Yang and Engineers

SCALE:	FIGURE: 1
DATE: 12/16/14	

0 Canyon Lane
Redwood City, California

JOB NUMBER:

Attachment I - Applicant's Geotechnical Site Investigation



SOURCES

GEOTECHNICAL HAZARDS SYNTHESIS MAPS
SAN MATEO COUNTY (12/76)

Hazard Area Zone: 11

J. Yang and Engineers

SCALE:	FIGURE: 2
DATE: 12/16/14	

0 Canyon Lane
Redwood City, California

JOB NUMBER: J14-1591

3. The site, as is all the San Francisco region, is seismicall active. Ground shaking is expected to have the following characteristics at the site and parameters are noted in the 2013 California Building Code:

   a. Site Class: C
   b. Soil Profile: Very dense soil and soft rock
   c. N-Value: N > 50
   d. ss: 2.189, s1: 1.042
   e. Earthquake loads on retaining walls: 12H (H=height of wall)

4. The recommendations in this report are based on the assumption that grading will minimal for the building pads and appropriate building site. When final development plans and detailed grading plans are available, the conclusions and recommendations of this report should be reviewed and modified if necessary, to suit those plans.

<u>Site Clearing, Grubbing and Preparation of Areas to be Filled</u>.

5. All grading operations associated with the planned development should be carried out as described in the following paragraphs.

6. Remove 1.5 foot of the topsoils from the proposed building pads, asphaltic concrete, old foundation concrete, debris and contaminated soils, root systems and loose or soft soil in the areas of the planned development. Buried structures such as pipelines, or other underground facilities should be removed from areas of planned development. Any of the soft soil deposits should be removed and replaced with compacted fill. A final determination of the treatment of soft surface soil should be made the soil engineer at the time of grading.

7. All compaction requirements are based on maximum dry densities and optimum moisture determined by ASTM Test Procedure D1557-97.

8. The top 1.5 foot of soil should be removed from the existing access road ways. After stripping, areas to receive non expansive fill should be stripped to firm natural ground, scarified, moisture-conditioned to 3 to 5% above optimum moisture content, and compacted to at least 95% relative compaction. If soils are too wet, considerable drying time and discing may be required to reduce their moisture content to near optimum. Where cut natural ground is exposed beneath subgrade, the soil should be scarified to a depth of 4 inches minimum from the rough grade, moisture conditioned as above, and compacted at least 95% relative compaction.

9. Existing native soils may be used as compacted fill in road bed areas, provided it is free of organic or other deleterious material. All fill should be compacted to at least 90% relative compaction at moisture contents 3 to 5% above optimum. The upper 24 inches pavement right-of-way should be compacted to at least 95% relative compaction.

10. Import fill, if required, should be approved by the Soil Engineer, and should have soil properties equivalent to or better than the natural soil. Import fill should not contain rocks larger than 4 inches in diameter.

Surface and Subsurface Drainage

11. All grading at the site should be done in such a manner as to prevent ponding of water during or after construction. Areas adjacent to tops of slopes should be graded to direct runoff away from the slope and into established drainage patterns. In general, the soils at the site are cohesionless and are prone to erosion. Erodible surface materials may be exposed locally, however. Efforts should be made, therefore, to establish slope vegetation before the next rainy season after grading.

12. Valleys or swales behind the open retaining walls, which will be filled, should be provided with subdrains to collect and discharge the subsurface seepage flow.

Typically, subdrains will be perforated plastic pipe surrounded by select import filter gravel wrapped with filter fabric. The subdrains should be connected at their low points to a storm drainage system or to other approved discharge points. Subdrain outlets should be protected from erosion and siltation and be noted on "as-built" plans by the project Civil Engineer for future reference.

Placing Spreading and Compacting Fill Material

13. The selected fill material shall be place in layer which can be compacted satisfactorily with the equipment being used. Each layer shall be spread evenly and shall be thoroughly blade-mixed during the spreading to provide uniformity of material in each layer.

14. When the moisture content of the fill material is below that sufficient to achieve the desired compaction, water shall be added until the moisture content is as specified to assure thorough bonding during the compacting process. When the moisture content of the fill material is excessive, the fill material shall be aerated by blading or other satisfactory methods until the moisture content is as specified.

15. After each layer has been placed, mixed and spread evenly, it shall be thoroughly compacted. Unless specifically modified by the Soil Engineer, compaction shall be to a minimum relative compaction of 90%.

16. Compaction shall be by sheepsfoot rollers, multiple-wheel pneumatic-tired roller or other types of acceptable compaction rollers. Rollers shall be of such design that they will be able to compact the fill to the specified compaction. Tolling shall be accomplished while the fill material is at the approximate optimum or other specified moisture content. Rolling of each layer shall consist of sufficient passes to achieve the specified compaction.

17. Field density tests will be performed by the Soil Engineer during placement of the compacted fill Where sheepsfoot rollers are used, the soil may be disturbed to a depth of several inches. Density tests shall be taken in compacted material below the disturbed surface. When these tests indicated that the density of any layer of fill or portion thereof is below the required compaction, the particular layer or portion shall be reworked until the required density has been obtained.

18. The fill operation shall be continued in thin compacted layers, as specified above, until the fill has been brought up to the finished slopes and grades as shown on the accepted plans.

19. Earth moving and working operations shall be controlled to prevent water from running into excavated areas. Ponded water shall be promptly removed and the site kept at a workable moisture content.

Subdrains

20. Subdrains shall be placed as recommended by the Soil Engineer in the field and shall consist of approved pipes and approved filter material as specified in the current edition of California Standard Specifications(Caltrans).

21. Permeable material for use in backfilling trenches under, around or over subdrains and permeable material for blankets or other subdrainage purposes shall consist of hard, durable clean sand, gravel or crushed stone and shall be free from organic matter, clay balls, or other deleterious substances. It shall consist of aggregate meeting California Standard Specifications for Class 2 Permeable Material (Section 68). Other materials may be used if approved by the Soil Engineer after appropriate testing.

22. Trenches for subdrains shall be excavated to a width equal to the outside diameter of the perforated pipe plus 1 foot and to a depth established by the Soil Engineer. The bottom of the trench shall then be covered full width by 4 inches minimum of specified filter material and the drain pipe laid with perforations at the bottom. The pipe shall be installed with a minimum slope of 1%, discharged into positive drainage devices.

23. After the pipe has been placed, the subdrain pipe shall be covered with filter material to a minimum of 2 feet over the top of the pipe. The material shall then be covered for the full width of the trench or blanket by compacted fill material.

24. Unless otherwise recommended, the following minimum pipe diameters shall be used; Laterals up to 50 feet in length - 4 inches; and Laterals over 50 feet in length and Main Subdrains - 6 inches.

Slope Construction

25. Cut and fill slopes shall be constructed no steeper than 2:1 (horizontal to vertical), unless otherwise recommended in the body of the report. All cut or fill slopes in excess of 6 feet in height shall be reviewed by J. Yang and Engineers or slope stability.

26. Fill slopes shall not be constructed on natural slopes steeper than 2:1. Where fill is to be placed on sloping ground steeper than 6:1, the toe of the fill shall be initiated on a base key (bench) excavated into weathered bedrock or other competent material. The base key shall be at least 12 feet wide and sloped at least 2% into the hillside. Subsequent keys shall be continuously excavated through the soil zone and int the weathered bedrock or other competent material as the filling progresses. The width and frequency of these subsequent keys may vary with soil conditions and steepness of slopes.

27. The faces of cut and fill slopes shall be prepared and maintained to control erosion. This control may consist of effective planting. The protection for the slopes shall be installed as soon as practical after completion of slope grading.

Trench Backfill

28. Materials for trench backfill shall consist of: soil and rock materials from the excavation, free of organic and other deleterious substances, and free from rocks larger than 4 inches in greatest dimension; imported sand; crushed rock or gravel; or imported soil previously tested by the Soil Engineer. The approved backfill materials shall be used in those portions of the trenches described below.

29. Backfill for bedding and initial backfill (minimum depth of 13 inches over the pipes) shall consist of imported sand or crushed materials ("quarry fines") free from clay

or organic material. The material shall be well graded of such size that 90 to 100% will pass a No.4 sieve, and not more than 5% will pass a No.200 sieve. Stones or rock fragments larger than 2 inches will not be permitted in the bedding and initial backfill.

30. Subsequent backfill, defined as the backfill overlying initial backfill and extending to within 18 inches of subgrade elevation, shall consist of either approved on-site excavation, or approved granular import material. Subsequent backfill shall be free from organic and other deleterious substances, and be of such size (gradation) to allow uniform compaction to the specified relative compaction. Rocks larger than 4 inches in greatest dimension will not be permitted as subsequent backfill.

31. The final 18 inches of backfill (measured from subgrade elevation) in pavement areas shall consist of on-site clayey soils, or imported clayey soils, to provide a relatively impermeable cap over the underlying trench backfill. The final backfill shall be free from organic and other deleterious substances, and shall contain no rock fragments larger than 2 inches. The material shall be uniformly blended to allow compaction to the specified relative compaction.

32. Trench backfill in street or paved areas, unless specifically modified in the body of the soil report or by the appropriate local jurisdiction, shall be compacted to at least 90% relative compaction to within 18 inches of subgrade elevation. The uppermost 18 inches of backfill, measured from subgrade elevation, shall be compacted to a minimum relative compaction of 95%.

33. Unless specifically modified within the body of the soil report, subsequent and final trench backfill within building areas shall be compacted to a minimum relative compaction of 90% to the surface of the surrounding

ground. Trench backfill outside building areas, shall be compacted to a minimum relative compaction of 85% to the surface of the surrounding ground.

34. It is the intent of these specifications that utility trench backfill be mechanically compacted. Jetting may be permissible where subdrains are included within trench to discharge excess water, and the backfill materials have Sand Equivalent of 20 or greater. The Soil Engineer shall make subsequent recommendations on use of jetting based on field conditions exposed during trench excavation and further testing of backfill material.

35. Groundwater entering trenches at the time of excavation shall be removed by positive and permanent means t a controlled outlet as recommended by the Soil Engineer.

36. The Soil Engineer will observe and periodically test the backfill during the *underground construction* to asses that the work was constructed in essential compliance with these specifications.

Seasonal Limits

37. Fill material shall not be placed, spread or rolled during unfavorable weather conditions. When the work is interrupted by heavy rain, fill operations shall not be resumed until field tests by the Soil Engineer indicate that the moisture content and density of the fill are as previously specified.

Unusual Conditions

38. In the event that unusual conditions not covered by these specifications are encountered during grading operations, the Soil Engineer shall be immediately notified for evaluation and recommendations.

Foundations

39. The planned retaining wall structures such as Fire Department turnaround area or bridge abutment should be founded on the firm native soil. Recommendations for pier and cantilever or crib walls are presented in this report.

40. The following general foundation type may be used at this site. Final selection of appropriate foundation systems will depend on the project structural engineer's preference, actual soil conditions, and final foundation systems. When these features are known, a review by geotechnical engineer should be made to select the appropriate foundation type and final design parameter

Drilled Cast-In-Place Concrete Piers and Grade Beams

Footings for outside of the basement walls, it is recommended that the diameter of the piers should be a minimum of 16 inches and a minimum depth of 13 feet from the bottom of the wall base slab. The actual depths of piers will be determined at the time of drilling by a soil engineer. The piers for these foundation systems should be transfer structural loads to the subsurface soils. The drilled piers will derive their load carrying capacity from peripheral skin friction between the pier shaft and the surrounding soil. An allowable skin friction value of 500 pounds per square foot (psf) of embedment may be used for design purposes for combined dead plus live loads. Friction resistance in the upper portion of the pier within 18 inches of the ground surface should be ignored when determining the load carrying capacity of the piers. The pier should be spaced at least three pier diameters and stagger layout.

Retaining Walls

The retaining wall should be designed to resist lateral pressures exerted from a media having an equivalent fluid weight as follows:

Gradient of Back Slope	Equivalent Fluid Weight pcf	Passive Resistance pcf	Coefficient of friction	Angle of Internal Friction
Flat	45	400	0.3	25
2 : 1	55	400	0.3	25

Drainage behind retaining walls should consist of a 4-inch diameter perforated pipe surrounded by filter gravel, 1/2 inch to 1 inch in size wrapped with filter fabric.

Concrete Slab-on-Grade Floors

Concrete slab-on-grade floors should be supported on a minimum of 6 inches of Class 2 aggregate base. Aggregate for Class 2 aggregate base shall be free from vegetable matter and other deleterious substances, and shall be of such nature that it can be compacted readily under watering and rolling to form a firm, stable base. The Class 2 aggregate should be complied with latest CATRANS Specification Section 26-1.02B. At the option of the contractor, the grading for either the 1-1/2 inch maximum or 3/4 inch shall be used. The slab subgrade to receive aggregate base, should be rolled smooth prior to slab construction to provide a uniformly dense non-yielding surface.

Drainage

All ground surfaces, including pavements and sidewalks, should slope away from the structures at a minimum gradient of 2 percent. Surface runoff should be controlled by a system of swales and catch basins, and then conveyed off the property to suitable discharge facility.

Surface water should not be allowed to pond on the site.

Flexible Pavement Thicknesses

If flexible or rigid pavement is required as part of the project, the design criteria recommend based on an assumed R-value of 20 (typical clayey gravels, gravel-sand clay mixtures), Assumed Traffic Indexes (T.I.) and the CALTRANS design procedure for asphaltic concrete pavement, we recommend the following preliminary asphaltic concrete pavement thicknesses:

		Thickness (inches)	
		Asphaltic	Class 2
Location	T.I.	Concrete	AggregateBase*
Automobile Parking	4	2	6
Driveways and Service Areas	5	3	8

R-Value -78 minimum the subgrade soil may vary in quality and contain local areas of low shear strengths. We should observe the completed subgrade to check that the preliminary pavement design is applicable. Subgrade soils to receive pavement should be rolled to provide a smooth, unyielding surface compacted to at least 95% relative compaction. On site subgrade soils should be maintained in a moist condition until covered the completed pavement section. The Class 2 Aggregate Base should be placed in a manner to prevent segregation, uniformly moisture conditioned to near optimum and compacted to at least 95% relative compaction with a smooth and unyielding surface.

Trench Backfill

16. Underground utility trenches may be backfilled with on-site soils, provided they are moisture-conditioned to near optimum and are not in "chunks". Bedding and initial

backfilling should be done in accordance with local requirements and specifications. Subsequent backfilling should be done in accordance with local requirements and specifications. Subsequent backfill (generally one foot and higher above the utility) should be placed in layers and mechanically compacted as follows:

Trench Location	Minimum Relative Compaction
Natural ground, outside street and lot areas.	85%
Lot areas and streets, below upper 24 inches.	90%
Street areas, entire depths.	95%

Observation and Testing

17. All work connected with site grading, drainage and erosion control should be observed and tested by the soil engineer. The purpose of these services will be to confirm that the conditions exposed during grading are as anticipated and provide supplemental recommendations if required; and to determine that the site work is being done in general conformance with the recommendations of this report and the County of San Mateo and City of Redwood City requirements

Additional Soil Engineering Service

18. We should review the final design and specifications in order that earthwork and foundation recommendations may be properly interpreted and implemented in the design and specifications. We should provide engineering services during site preparation, grading, foundation and pavement construction phases of the work. This would allow us to observe compliance with the design concepts, specifications and to allow design changes in the event that surface conditions differ from those anticipated prior to the start of construction.

V. PLAN REVIEW, CONSTRUCTION OBSERVATION AND TESTING

We should be retained to review the earthwork and foundation plans and specifications for conformance with the intent of our recommendations. The review would enable us to modify our recommendations if final design conditions are not as we now understand them to be. During construction, we should observe and test the earthwork and foundation installation. As needed during construction, we should be retained to consult on geotechnical questions, construction problems, and unanticipated conditions. This will allow us to develop supplemental recommendations as appropriate for the actual soil conditions encountered and the specific construction techniques employed by contractor.

VI. GUIDELINES FOR REQUIRED SERVICES

The following list of services are the services required and must be provided by Yang and Associates, during the project development. These services are presented in check list format as a convenience to those entrusted with their implementation.

The items listed are included in the body of the report in detail. This list is intended only as an outlined of the required services and does not replace specific

recommendations and, therefore, must be used with reference to the total report.

The importance of careful adherence to the report recommendations cannot be overemphasized. It should be noted, however, that this report is issued with the understanding that each step of the project development will be performed under the direct observation of Yang and Engineers:.

The use of this report by others presumes that they have verified all information and assume full responsibility for the total project.

Project No. J14-1591

ITEM DESCRIPTION	REQUIRED	NOT REQUIRED
1. Provide foundation design parameters	X	
2. Review grading plans & specifications	X	
3. Review foundation plans & specs.	X	
4. Observe & provide demolition recommendation		X
5. Observe & provide site stripping recommendations	X	
6. Observe and provide recommendations on moisture conditioning, removal and/or precompaction of unsuitable existing soils	X	
7. Observe and provide recommendations on installation of subdrain facilities		X
8. Observe and provide testing services on fill areas and/or imported fill materials	X	
9. Review as-graded plans and provide additional foundation recommendations, if necessary	X	
10. Observe and provide compaction tests on sanitary sewers, storm drain, water lines and PG&E trenches	X	
11. Observe foundation excavations and provide supplemental recommendations, if necessary, prior to placing concrete	X	
12. Observe and provide moisture conditioning recommendations for foundation areas prior to placing concrete		X
13. Provide design parameters for retaining walls	X	
14. Provide geologic observations and recommendations for keyway excavations and cut slopes during grading	X	
15. Excavate and recompact all geologic trenches and/or test pits.		X

VII. LIMITATIONS AND UNIFORMITY OF CONDITIONS

A. The recommendations of this report are based upon the assumption that the soil conditions do not deviate from those disclosed in the borings and test pits. If and variations or undesirable conditions are encountered during construction, or if the actual construction will differ from that planned at the present time, J. Yang and Engineers should be notified so that supplemental recommendations can be given.

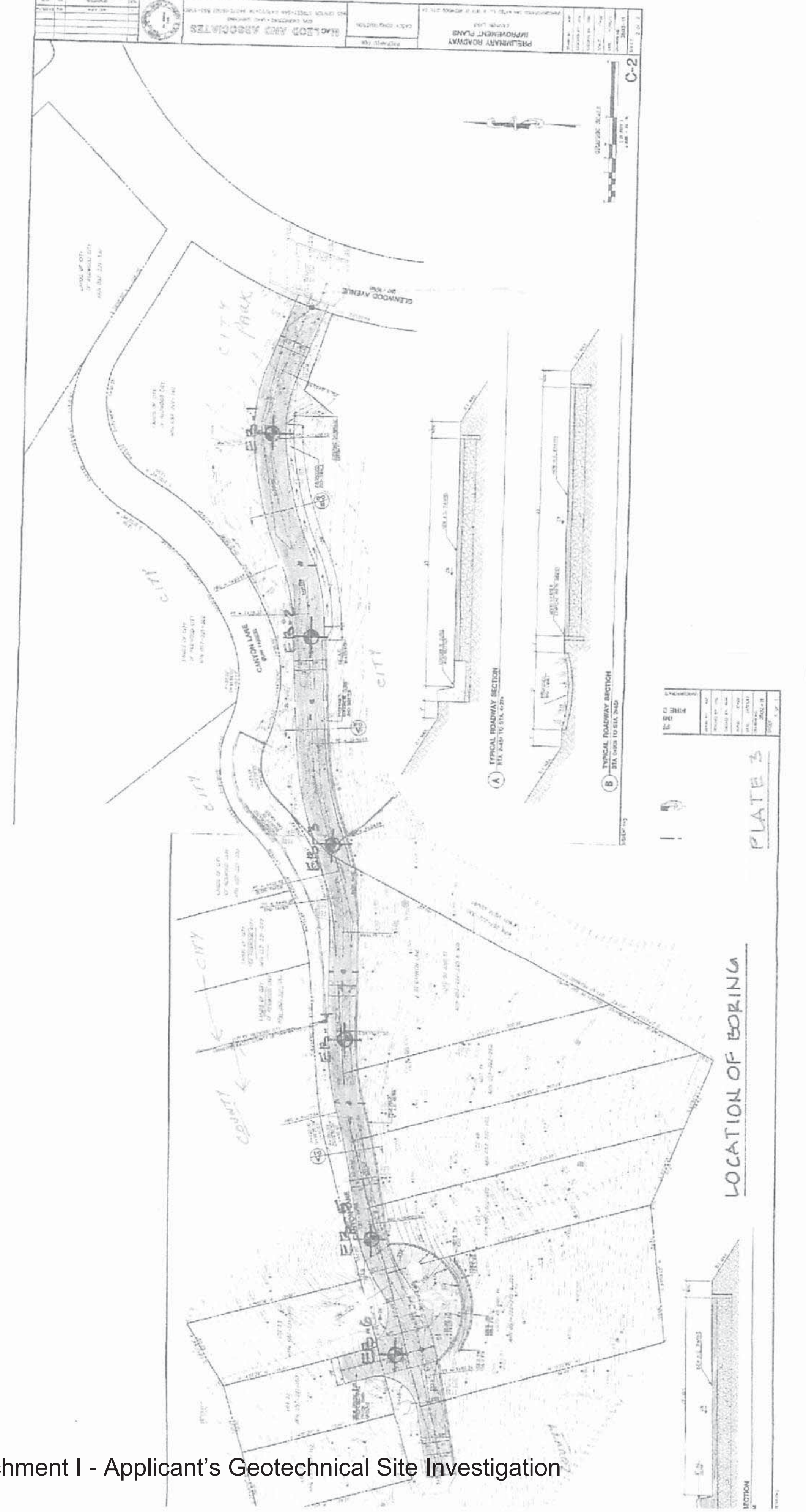
B. This report is issued the understanding that it is responsibility of the owner or of his representatives to ensure that the information and recommendations contained herein are called to the attention of the other members of the design team (architect and engineers) for the project and are incorporated into the plans, and that the necessary steps are taken to see that the contractors and subcontractors carry out such recommendations in the field.

C. The findings of this report are valid as of the present date. However, changes in the conditions can occur with the passage of time, whether they be due to natural processes or to the works of man, on this or adjacent properties. In addition, changes in applicable or appropriate standards may occur, whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated, wholly or in part, by changes outside of our control. Therefore, this report is subject to review by J. Yang and Engineers after a period of two(2) years has elapsed from date of issuance of this report.

D. The body of the report specifically recommends that J. Yang and Engineers be provided the opportunity for general review of the project plans and specifications, and that J. Yang and Engineers be retained to provide observation and testing services during construction. The validity of this report assumes that J. Yang and Engineers will be retained to provide these services.

E. This report was prepared at your request for our services, and in accordance with the currently accepted geotechnical engineering practice. No warranty based on the contents of this report is intended, and none shall be inferred from the statements or opinions expressed herein.

APPENDIX AA


MACLEOD AND ASSOCIATES
PRELIMINARY ROADWAY IMPROVEMENT PLANS
C-2
GLENWOOD AVENUE
CANYON LANE
CITY
PARK
COUNTY
EB-1
EB-2
EB-3
EB-4
EB-5
EB-6
TYPICAL ROADWAY SECTION
PLATE 3
LOCATION OF BORING

USCS SOIL CLASSIFICATION

PRIMARY DIVISIONS			SOIL TYPE	SECONDARY DIVISIONS
COARSE GRAINED SOILS (< 50 % Fines)	GRAVEL	CLEAN GRAVEL (< 5% Fines)	GW	Well graded gravel, gravel-sand mixtures, little or no fines.
			GP	Poorly graded gravel or gravel-sand mixtures, little or no fines.
		GRAVEL with FINES	GM	Silty gravels, gravel-sand-silt mixtures, non-plastic fines.
			GC	Clayey gravels, gravel-sand-clay mixtures, plastic fines.
	SAND	CLEAN SAND (< 5% Fines)	SW	Well graded sands, gravelly sands, little or no fines.
			SP	Poorly graded sands or gravelly sands, little or no fines.
		SAND WITH FINES	SM	Silty sands, sand-silt mixtures, non-plastic fines.
			SC	Clayey sands, sand-clay mixtures, plastic fines.
FINE GRAINED SOILS (> 50 % Fines)	SILT AND CLAY Liquid limit < 50%		ML	Inorganic silts and very fine sands, with slight plasticity.
			CL	Inorganic clays of low to medium plasticity, lean clays.
			OL	Organic silts and organic clays of low plasticity.
	SILT AND CLAY Liquid limit > 50%		MH	Inorganic silt, micaceous or diatomaceous fine sandy or silty soil.
			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.

RELATIVE DENSITY

SAND & GRAVEL	BLOWS/FOOT*
VERY LOOSE	0 to 4
LOOSE	4 to 10
MEDIUM DENSE	10 to 30
DENSE	30 to 50
VERY DENSE	OVER 50

CONSISTENCY

SILT & CLAY	STRENGTH^	BLOWS/FOOT*
VERY SOFT	0 to 0.25	0 to 2
SOFT	0.25 to 0.5	2 to 4
FIRM	0.5 to 1	4 to 8
STIFF	1 to 2	8 to 16
VERY STIFF	2 to 4	16 to 32
HARD	OVER 4	OVER 32

GRAIN SIZES

BOULDERS	COBBLES	GRAVEL		SAND			SILT & CLAY
		COURSE	FINE	COURSE	MEDIUM	FINE	

12" 3" 0.75" — SIEVE OPENINGS

4 10 40 200 — U.S. STANDARD SERIES SIEVE

Classification is based on the Unified Soil Classification System; fines refer to soil passing a No. 200 sieve.

* Standard Penetration Test (SPT) resistance, using a 140 pound hammer falling 30 inches on a 2 inch O.D. split spoon sampler; blow counts not corrected for larger diameter samplers.

^ Unconfined Compressive strength in tons/sq. ft. as estimated by SPT resistance, field and laboratory tests, and/or visual observation.

KEY TO SAMPLERS

Modified California Sampler (3-inch O.D.)
Mid-size Sampler (2.5-inch O.D.)
Standard Penetration Test Sampler (2-inch O.D.)

KEY TO TEST DATA

SOIL CLASSIFICATION CHART & KEY TO TEST DATA

PLATE A1

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE

PROJECT: 0 Canyon Lane, Redwood City, CA	**BORING NO.** EB - 1
BORING SUPERVISOR: J. Yang	**TYPE OF BORING:** B24 5" solid stem auger
HAMMER WEIGHT: 140#/30"drop	**DATE OF BORING:** 12-16-14
SURFACE ELEVATION: NA	
GROUNDWATER DEPTH	

DESCRIPTION OF MATERIALS	DEPTH IN FT.	SAMPLE	SAMPLE NUMBER-SAMPLE DIAMETER	DRIVING RESISTANCE BLOWS PER FT.	DRY DENSITY P.C.F.	MOISTURE CONTENT %	UNCONFINED COMPRESSIVE STRENGTH P.S.F.	OTHER TESTS
Silty Clay (topsoil)								
Clayey sand, dark grayish/ brown.	5	EB1 5	2"	50	102	21	1.2ksf	
W.L.								
Sandy clay, brownish/gray **	10	EB1 10	2"	50/2"	--	--	--	
Bottom of hole	15							
	20							
	25							
	30							

**: Unable to recover sample due to gravel.

Job No. J14-1591	J. Yang and Engineers	PLATE 4

PROJECT:	0 Canyon Lane, Redwood City, CA
BORING NO.	EB - 2
BORING SUPERVISOR:	J. Yang
TYPE OF BORING:	B24 5" solid stem auger
DATE OF BORING:	12-16-14
HAMMER WEIGHT.	140#/30"drop
SURFACE ELEVATION:	NA
GROUNDWATER DEPTH	

DESCRIPTION OF MATERIALS	DEPTH IN FT.	SAMPLE	SAMPLE NUMBER-SAMPLE DIAMETER	DRIVING RESISTANCE BLOWS PER FT.	DRY DENSITY P.C.F.	MOISTURE CONTENT %	UNCONFINED COMPRESSIVE STRENGTH P.S.F.	OTHER TESTS
Silty clay (topsoil)								
Clay, dark yellowish brown.	5	EB2 5	2"	52	101	21	1.7	
▽ W.L								
Sandy clay, gray								
Sandy gravel, gray **	10	EB2 10	2" 2"	50/2" 70	-- --	-- --	-- --	
Bottom of hole								
	15							
	20							
	25							
	30							

**: Unable to recover sample due to gravel

Job No. J14-1591

J. Yang and Engineers

PLATE 4

PROJECT: 0 Canyon Lane, Redwood City, CA

BORING NO. EB - 3

BORING SUPERVISOR: J. Yang

TYPE OF BORING: B24 5" solid stem auger

DATE OF BORING: 12-16-14

HAMMER WEIGHT: 140#/30"drop

SURFACE ELEVATION: NA

GROUNDWATER DEPTH

DESCRIPTION OF MATERIALS	DEPTH IN FT.	SAMPLE	SAMPLE NUMBER-SAMPLE DIAMETER	DRIVING RESISTANCE BLOWS PER FT.	DRY DENSITY P.C.F.	MOISTURE CONTENT %	UNCONFINED COMPRESSIVE STRENGTH P.S.F.	OTHER TESTS
Silty clay (topsoil)								
Sandy clay, dark brown.	5	EB 3	2"	87	122	12	1.5ksf	
Sandy clay, gray. refusal at 11' sandstone bedrock. **	10	EB3	2"	60/2"	--	--	--	
Bottom of hole	15							
	20							
	25							
	30							

**: Unable to recover sample due to bedrock.

Job No. J14-1591

J. Yang and Engineers

PLATE 4

Attachment I - Applicant's Geotechnical Site Investigation

PROJECT: 0 Canyon Lane, Redwood City, CA

BORING NO. EB - 4

BORING SUPERVISOR: J. Yang

TYPE OF BORING: B24 5" solid stem auger

DATE OF BORING: 12-16-14

HAMMER WEIGHT. 140#/30"drop

SURFACE ELEVATION: NA

GROUNDWATER DEPTH

DESCRIPTION OF MATERIALS	DEPTH IN FT.	SAMPLE	SAMPLE NUMBER-SAMPLE DIAMETER	DRIVING RESISTANCE BLOWS PER FT.	DRY DENSITY P.C.F.	MOISTURE CONTENT %	UNCONFINED COMPRESSIVE STRENGTH P.S.F.	OTHER TESTS
Silty clay (topsoil)								
Sandy clay/clayey sand, dark grayish brown.	5	EB4 5	2"	65	117	14	11ksf	
Silty sand, gray. refusal at 11' bedrock. **	10	EB4 10	2"	75/5"	--	--	--	
Bottom of hole	15							
**: Unable to recover sample due to bedrock	20							
	25							
	30							

Job No. J14-1591

J. Yang and Engineers

PLATE 4

PROJECT:	0 Canyon Lane Redwood City, CA	**BORING NO.**	EB - 5
BORING SUPERVISOR:	J. Yang	**TYPE OF BORING:** B24 5" solid stem auger	**DATE OF BORING:** 12-16-14
HAMMER WEIGHT.	140#/30"drop		
SURFACE ELEVATION:	NA		
GROUNDWATER DEPTH			

DESCRIPTION OF MATERIALS	DEPTH IN FT.	SAMPLE	SAMPLE NUMBER-SAMPLE DIAMETER	DRIVING RESISTANCE BLOWS PER FT.	DRY DENSITY P.C.F.	MOISTURE CONTENT %	UNCONFINED COMPRESSIVE STRENGTH P.S.F.	OTHER TESTS
Silty clay (topsoil)								
Sandy clay, dark brownish gray	5	EB5 5	2"	66	124	12	4ksf	
mottled silty sand, brown								
Mottled silty,gravel, ** Refusal at 10'	10							
Bottom of hole								
**: Unable to recover sample due to bedrock	15							
	20							
	25							
	30							

Job No. J14-1591 | J. Yang and Engineers | PLATE 4

PROJECT: 0 Canyon Lane, Redwood City, CA

BORING NO. EB - 6

BORING SUPERVISOR: J. Yang

TYPE OF BORING: B24 5" solid stem auger

DATE OF BORING: 12-16-14

HAMMER WEIGHT. 140#/30"drop

SURFACE ELEVATION: NA

GROUNDWATER DEPTH

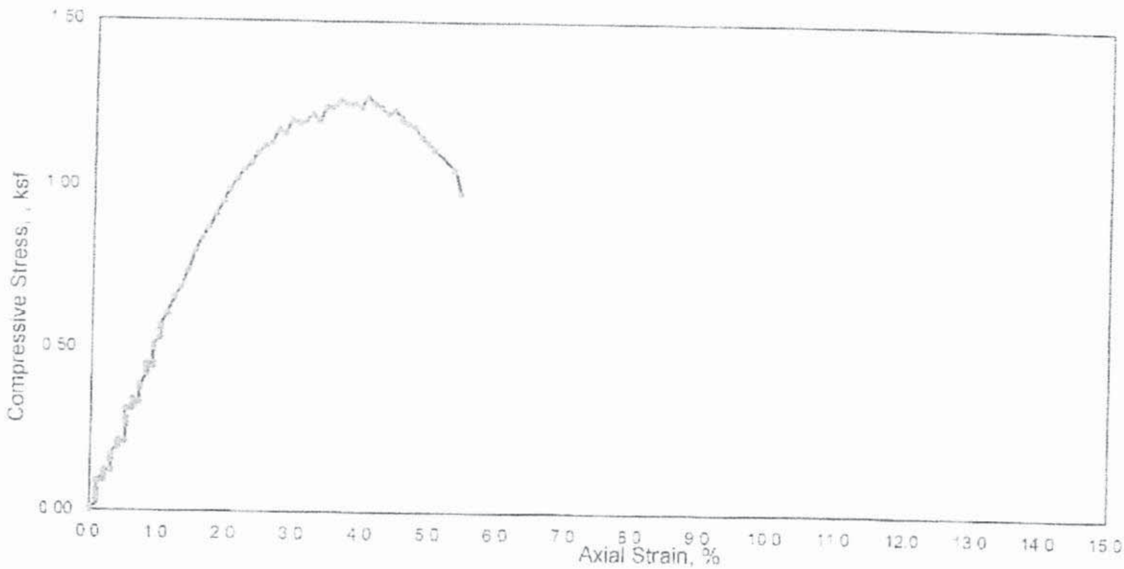
DESCRIPTION OF MATERIALS	DEPTH IN FT.	SAMPLE	SAMPLE NUMBER-SAMPLE DIAMETER	DRIVING RESISTANCE BLOWS PER FT.	DRY DENSITY P.C.F.	MOISTURE CONTENT %	UNCONFINED COMPRESSIVE STRENGTH P.S.F.	OTHER TESTS
Silty clay (topsoil)								
Sandy clay/clayey sand, dark brownish gray								
Refusal drilling at 5.5'**	5	EB5 5	2"	65/2"	--	--	--	
Bottom of hole								
**: Unable to recover sample due to bedrock	10							
	15							
	20							
	25							
	30							

Job No. J14-1591

J. Yang and Engineers

PLATE 4

Unconfined Compression Test Report



Specimen Failure Picture

Specimen No.			1
Initial	Diameter, in	D_0	1.90
	Height, in	H_0	4.54
	Water Content, %	ω_0	21.5
	Dry Density, lbs/ft^3	γ_{d_0}	102.9
	Saturation, %	S_0	93.7
	Void Ratio	e_0	0.607
Time to Failure, min		t_f	4.0
Unconfined Compressive Strength, ksf		q_u	1.27
Shear Strength, ksf		s_u	0.63
Strain at Failure, %		ε_f	4.0
Average Rate of Strain to Failure, %/min		ε	1.0

Description of Specimen: Dark Grayish Brown Clayey Sand (SC)

Amount of Material Finer than the No. 200, % nm

LL: nm | PL: nm | PI: nm | G_S: 2.65 Assumed | Specimen Type: Undisturbed | Test Method: ASTM D 2166

nm = not measured, na = not applicable

Limitations: Pursuant to applicable building codes, the results presented in this report are for the exclusive use of the client and the registered design professional in responsible charge. The results apply only to the samples tested. If changes to the specifications were made and not communicated to Kleinfelder, Kleinfelder assumes no responsibility for pass/fail statements (meets/did not meet), if provided. As the samples tested were sampled and/or transported to our laboratory by parties other than Kleinfelder staff, this report makes no representation of whether the samples are representative of the material onsite.

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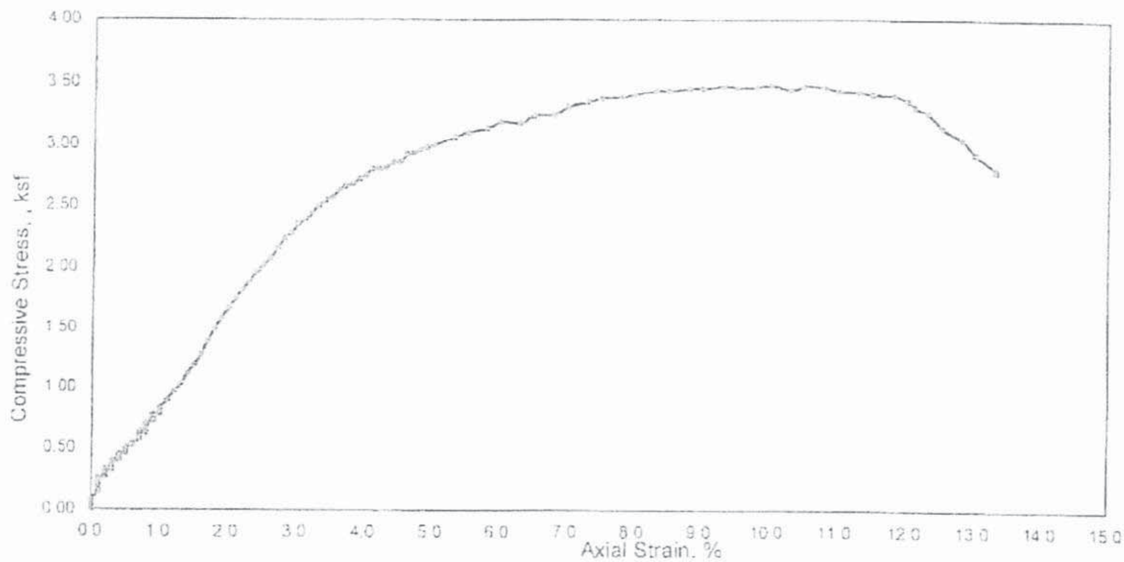
Hayward, CA 94545
p| 925 484 1700
f| 510 887 5932
kleinfelder.com

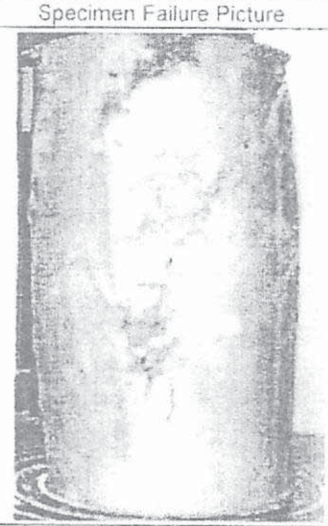
Project No.:	14648 - YANG & ENG.
Project Name:	CANYON LN
Sample:	EB-1
Depth, ft.:	5.0
Date:	December 23, 2014

Plate
1 of 1
A-01

Unconfined Compression Test Report



Specimen Failure Picture



Specimen No.			1
Initial	Diameter, in	D_0	1.92
	Height, in	H_0	4.30
	Water Content, %	ω_0	21.4
	Dry Density, lbs/ft^3	γ_{d_0}	101.4
	Saturation, %	S_0	89.7
	Void Ratio	e_0	0.631
Time to Failure, min.		t_f	10.0
Unconfined Compressive Strength, ksf		q_u	3.48
Shear Strength, ksf		s_u	1.74
Strain at Failure, %		ε_f	10.0
Average Rate of Strain to Failure, %/min		ε	1.0

Description of Specimen: Dark Yellowish Brown Lean Clay (CL)

Amount of Material Finer than the No. 200, % nm

LL: nm	PL: nm	PI: nm	G_s: 2.65 Assumed	Specimen Type: Undisturbed	Test Method: ASTM D 2166

nm = not measured, na = not applicable

Limitations: Pursuant to applicable building codes, the results presented in this report are for the exclusive use of the client and the registered design professional in responsible charge. The results apply only to the samples tested. If changes to the specifications were made and not communicated to Kleinfelder, Kleinfelder assumes no responsibility for pass/fail statements (meets/did not meet), if provided. As the samples tested were sampled and/or transported to our laboratory by parties other than Kleinfelder staff, this report makes no representation of whether the samples are representative of the material onsite.

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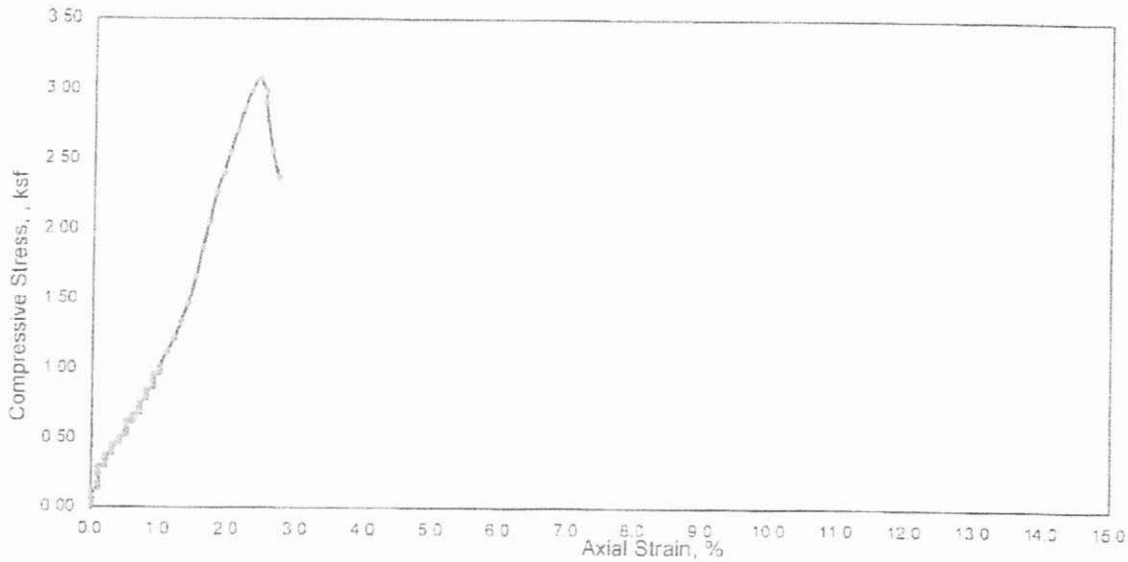
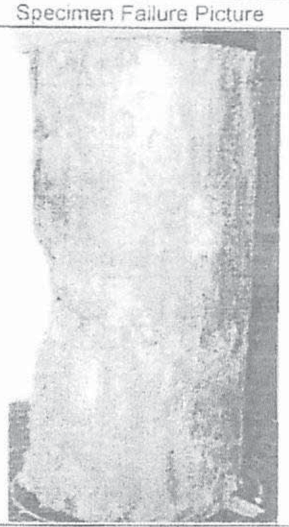
Project No.:	14648 - YANG & ENG.	Plate
Project Name:	CANYON LN	1 of 1
Sample:	EB-3	**A-02**
Depth, ft.:	5.0	
Date:	December 23, 2014	

Unconfined Compression Test Report



Specimen Failure Picture



Specimen No.			1
Initial	Diameter, in	D_o	1.86
	Height, in	H_o	4.33
	Water Content, %	ω_o	11.9
	Dry Density, lbs/ft³	γ_{d_o}	122.0
	Saturation, %	S_o	89.1
	Void Ratio	e_o	0.355
Time to Failure, min.		t_f	2.4
Unconfined Compressive Strength, ksf		q_u	3.08
Shear Strength, ksf		s_u	1.54
Strain at Failure, %		ε_f	2.4
Average Rate of Strain to Failure, %/min		ε	1.0

Description of Specimen: Dark Olive Brown Sandy Lean Clay (CL)

Amount of Material Finer than the No. 200, % nm

LL: nm | PL: nm | PI: nm | G_S: 2.65 Assumed | Specimen Type: Undisturbed | Test Method: ASTM D 2166

nm = not measured, na = not applicable

Limitations: Pursuant to applicable building codes, the results presented in this report are for the exclusive use of the client and the registered design professional in responsible charge. The results apply only to the samples tested. If changes to the specifications were made and not communicated to Kleinfelder, Kleinfelder assumes no responsibility for pass/fail statements (meets/did not meet), if provided. As the samples tested were sampled and/or transported to our laboratory by parties other than Kleinfelder staff, this report makes no representation of whether the samples are representative of the material onsite.

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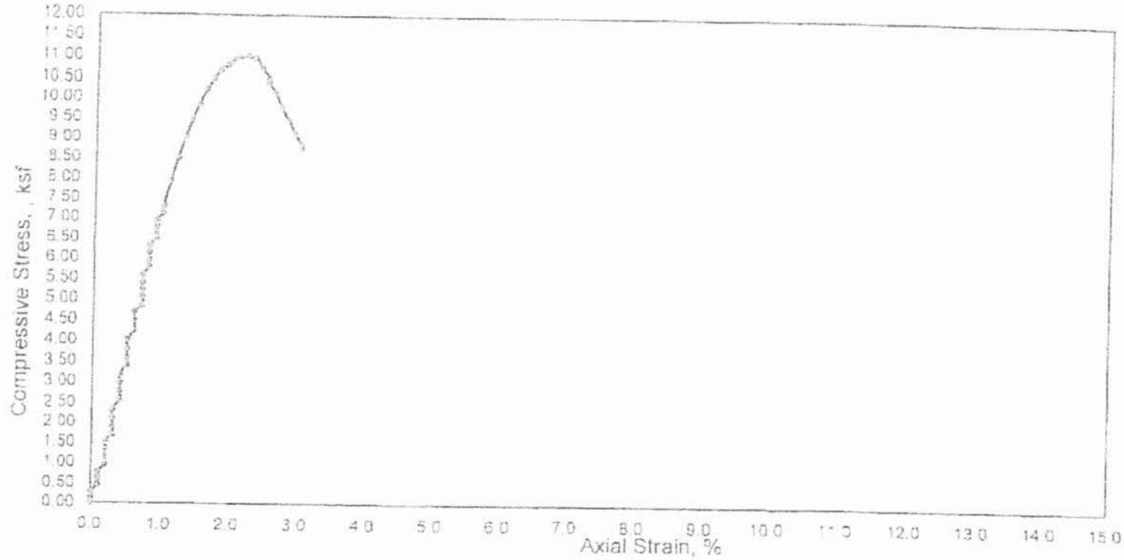
Project No.:	14648 - YANG & ENG.
Project Name:	CANYON LN.
Sample:	EB-4
Depth, ft.:	5.0
Date:	December 23, 2014

Plate
1 of 1
A-03

Unconfined Compression Test Report



Specimen Failure Picture

Specimen No.			1
Initial	Diameter, in	D_o	1.90
	Height, in	H_o	4.31
	Water Content, %	ω_o	14.4
	Dry Density, lbs/ft^3	γ_{do}	116.8
	Saturation, %	S_o	91.8
	Void Ratio	e_o	0.416
Time to Failure, min.		t_f	2.1
Unconfined Compressive Strength, ksf		q_u	11.00
Shear Strength, ksf		s_u	5.50
Strain at Failure, %		ε_f	2.1
Average Rate of Strain to Failure, %/min		$\dot{\varepsilon}$	1.0

Description of Specimen: *Dark Grayish Brown Sandy Lean Clay (CL)*

Amount of Material Finer than the No. 200, %: nm

LL: nm | PL: nm | PI: nm | G_s: 2.65 Assumed | Specimen Type: Undisturbed | Test Method: ASTM D 2166

nm = not measured, na = not applicable

Limitations: Pursuant to applicable building codes, the results presented in this report are for the exclusive use of the client and the registered design professional in responsible charge. The results apply only to the samples tested. If changes to the specifications were made and not communicated to Kleinfelder, Kleinfelder assumes no responsibility for pass/fail statements (meets/did not meet), if provided. As the samples tested were sampled and/or transported to our laboratory by parties other than Kleinfelder staff, this report makes no representation of whether the samples are representative of the material onsite.

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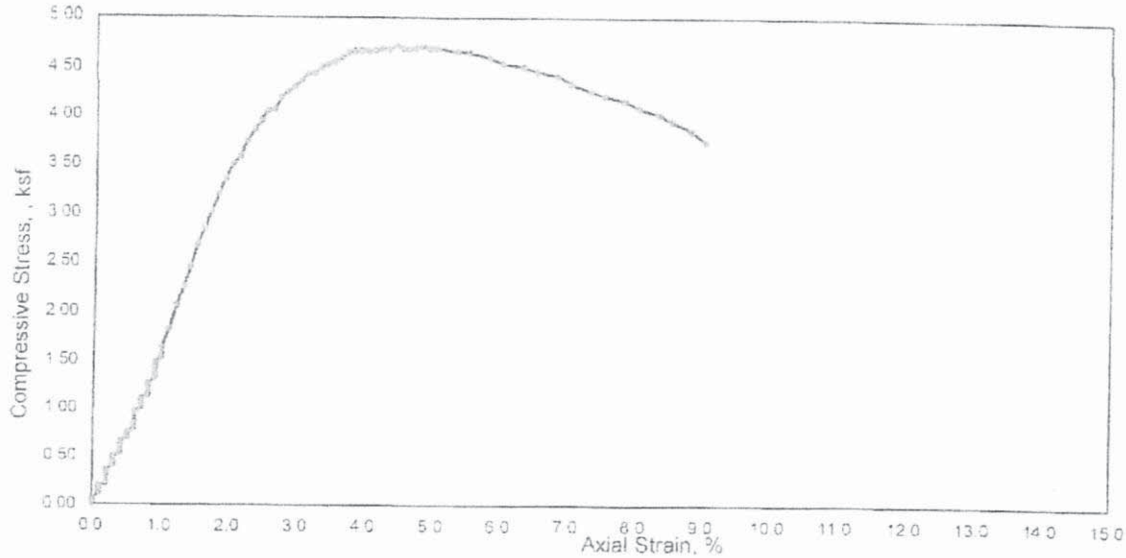
Project No.:	14648 - YANG & ENG	Plate 1 of 1
Project Name:	CANYON LN	
Sample:	EB-6	A-04
Depth, ft.:	5.0	
Date:	December 23, 2014	

Unconfined Compression Test Report



Specimen Failure Picture

Specimen No.			1
Initial	Diameter, in	D_0	1.92
	Height, in	H_0	3.94
	Water Content, %	ω_0	12.8
	Dry Density, lbs/ft^3	γ_{d_0}	124.0
	Saturation, %	S_0	101.8
	Void Ratio	e_0	0.334
Time to Failure, min.		t_f	4.4
Unconfined Compressive Strength, ksf		q_u	4.72
Shear Strength, ksf		s_u	2.36
Strain at Failure, %		ε_f	4.4
Average Rate of Strain to Failure, %/min		ε	1.0

Description of Specimen: Dark Grayish Brown Sandy Lean Clay (CL)

Amount of Material Finer than the No. 200, % nm

LL: nm | PL: nm | PI: nm | G_s: 2.65 Assumed | Specimen Type: Undisturbed | Test Method: ASTM D 2166

nm = not measured, na = not applicable

Limitations: Pursuant to applicable building codes, the results presented in this report are for the exclusive use of the client and the registered design professional in responsible charge. The results apply only to the samples tested. If changes to the specifications were made and not communicated to Kleinfelder, Kleinfelder assumes no responsibility for pass/fail statements (meets/did not meet), if provided. As the samples tested were sampled and/or transported to our laboratory by parties other than Kleinfelder staff, this report makes no represenation of whether the samples are representative of the material onsite.

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Project No.:	14648 - YANG & ENG.
Project Name:	CANYON LN
Sample:	EB-6
Depth, ft.:	10.0
Date:	December 23, 2014

Plate

1 of 1

A-05

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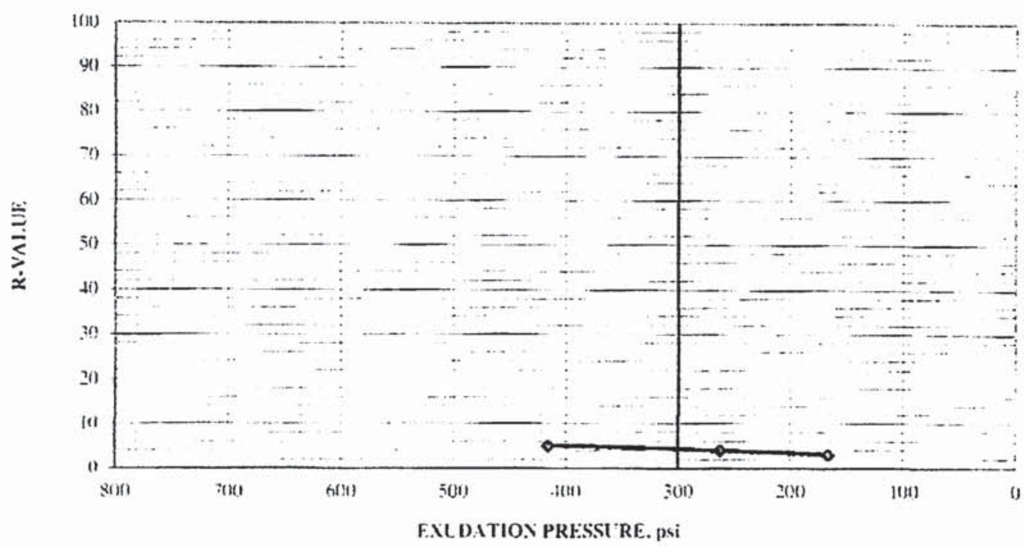
Laboratory Test Report

Project Name: YANG AND ENGINEERS - CANYON LN. RWC
Project No.: 14648
Lab No.: HL7416
Sample Date: December 16, 2014
Sample No.: HL7416 - BULK
Sample Location: BULK
Material Description: LEAN CLAY
Report Date: December 24, 2014

Resistance R-Value and Expansion Pressure of Compacted Soils (ASTM D2844, CTM 301)



Briquette No.	A	B	C
Moisture at Test, %	20.4	18.5	16.7
Dry Unit Weight at Test, pcf	105.4	108.1	112.1
Expansion Pressure, psf	26	48	65
Exudation Pressure, psi	167	262	415
Resistance Value	3	4	5
R - Value at 300 psi Exudation Pressure:			**4**

Reviewed By on 12/24/2014: ____________________

Aaron Kidd
Laboratory Manager

Limitations: Pursuant to applicable building codes, the results presented in this report are for the exclusive use of the client and the registered design professional in responsible charge. The results apply only to the samples tested. If changes to the specifications were made and not communicated to Kleinfelder, Kleinfelder assumes no responsibility for pass/fail statements (meets/did not meet), if provided.

J. Yang and Engineers
Geotechnical
General Civil Engineers
P.O.BOX 2148, SAN RAMON, CALIFORNIA
(925) 831-8678 • FAX (925) 831-3645

Project No. J14-1591
May 5, 2017

Casey Construction
619 Sylvan Way
Emerald Hills, CA 94062

Subject: Update for the Geotechnical Investigation Report
J14-1591, Dated December 28, 2014
Reference: Proposed Roadway Improvement at
0 Canyon Lane
Redwood City, California

GEOTECHNICAL SITE INVESTIGATION

Dear Mr. Casey:

In accordance with your request, we have performed a soil and foundation investigation and evaluation for the reference site. The site geotechnical investigation report have been prepared for the reference address previously for Mr. Mel Casey by J. Yang and Engineers, Job No. J14-1591, dated 12-28-14.

The subject report is still valid as of the present date and should be used as a project reference documents.

Should you have any questions or require additional information, please contact our office (925)831-8678 at your convenience.

Jae H. Yang - P.E.
Project Geo. Engineer

REGISTERED PROFESSIONAL ENGINEER
JAE H. YANG
No. 25337
Exp. 12.17
CIVIL
STATE OF CALIFORNIA

RECEIVED
2017 JUN 13 A 1:30
SAN MATEO COUNTY
PLANNING AND BUILDING
DEPARTMENT

Attachment I - Applicant's Geotechnical Site Investigation

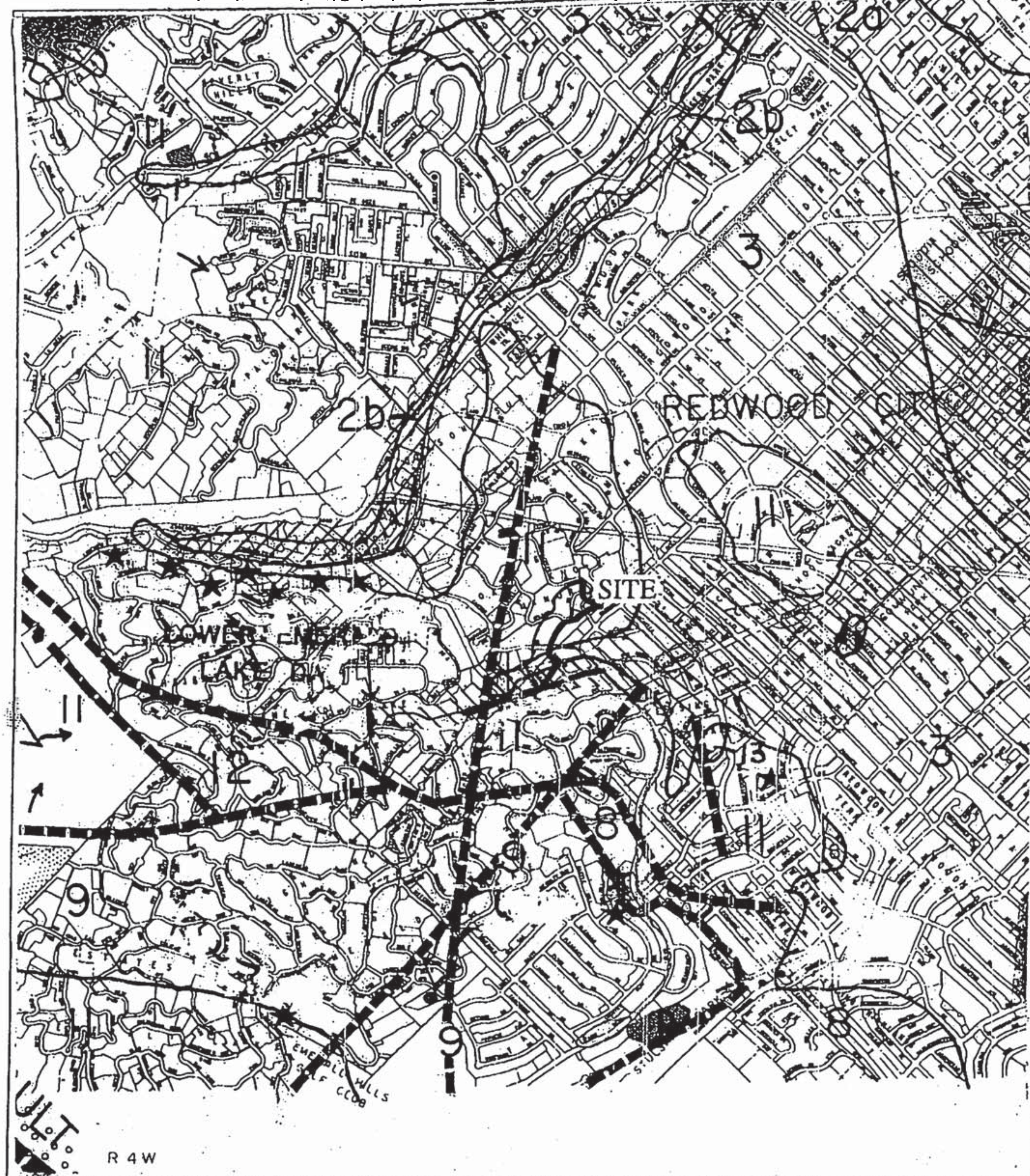
SOURCES

STATE OF CALIFORNIA
EARTHQUAKE FAULT ZONES (1/94)

N

J. Yang and Engineers

SCALE:	FIGURE: 1
DATE: 12/16/14	
0 Canyon Lane Redwood City, California	
JOB NUMBER:	



SOURCES

GEOTECHNICAL HAZARDS SYNTHESIS MAPS
SAN MATEO COUNTY (12/76)

Hazard Area Zone: 11

N

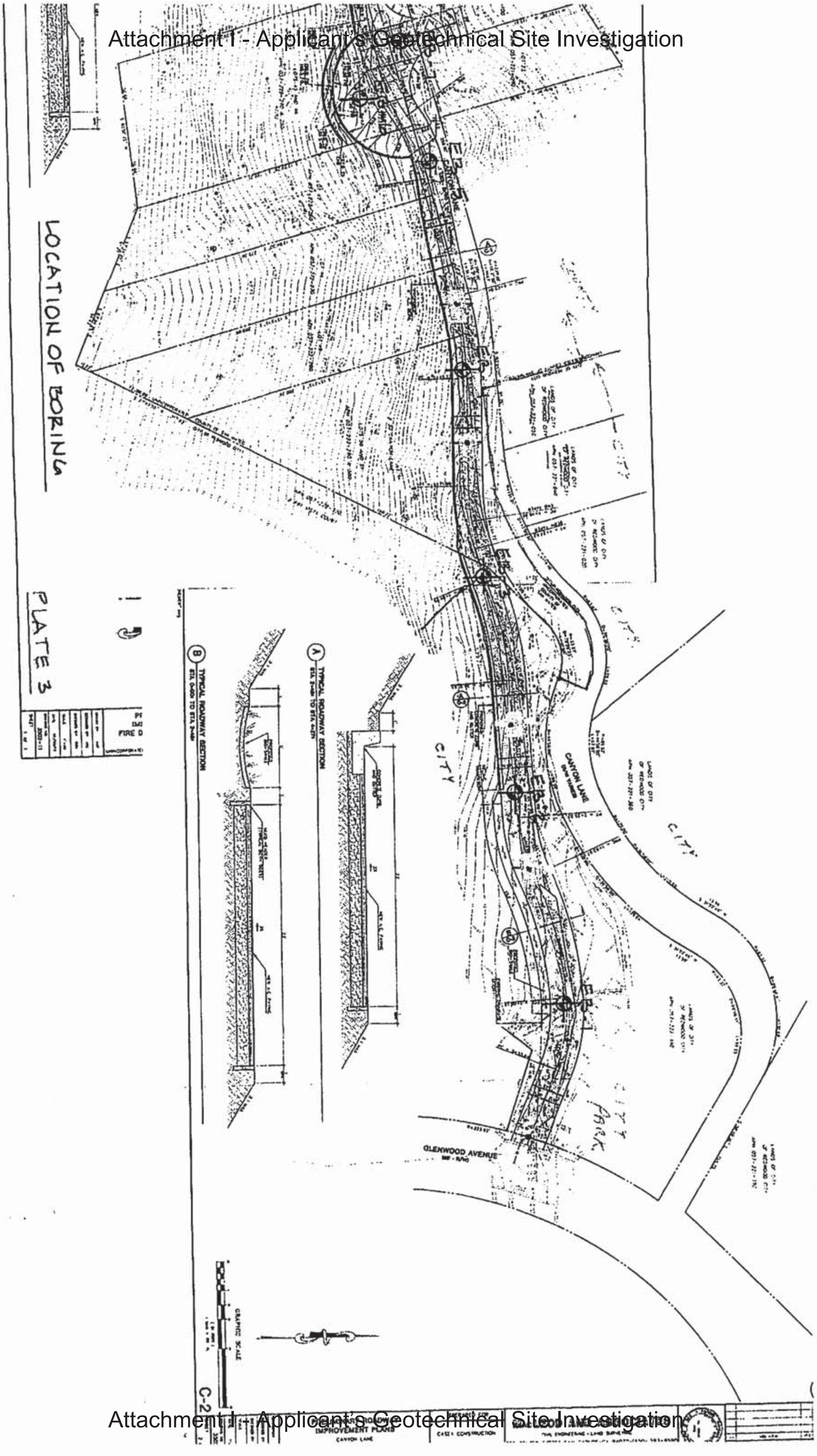
J. Yang and Engineers

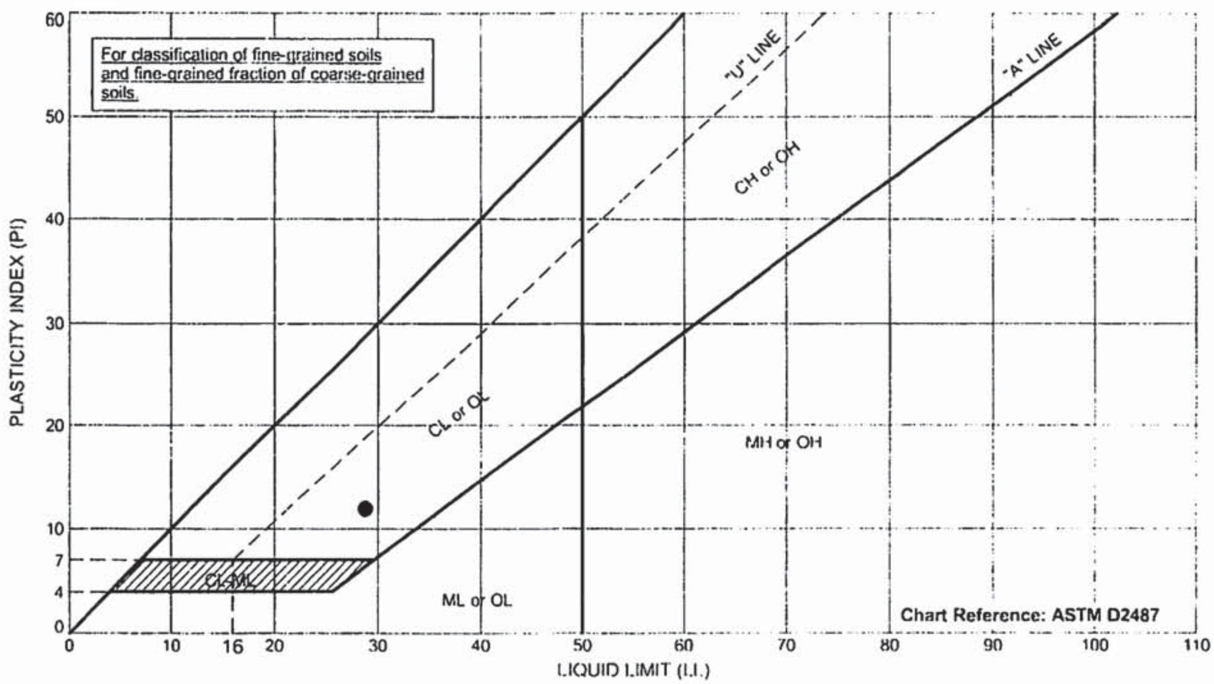
SCALE:	FIGURE: 2
DATE: 12/16/14	

0 Canyon Lane
Redwood City, California

JOB NUMBER: J14-1591

Attachment I - Applicant's Geotechnical Site Investigation


LOCATION OF BORING
PLATE 3
CITY
CANYON LANE
GLENWOOD AVENUE
PARK
TYPICAL ROADWAY SECTION
GRAPHIC SCALE
IMPROVEMENT PLANS
C-2



	Exploration ID	Depth (ft.)	Sample Description	Passing #200	LL	PL	PI
●	HL10137	0	OLIVE BROWN SANDY LEAN CLAY (CL)	NM	29	17	12

Testing perfomed in general accordance with ASTM D4318.
NP = Nonplastic
NM = Not Measured

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PROJECT NO.: 00014648	ATTERBERG LIMITS	FIGURE
DRAWN BY: CP		1
CHECKED BY: CP	YANG & ENGINEERS Canyon Lane	
DATE: 5/16/2017		
REVISED: -		

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

Memorandum

DATE: March 26, 2019

TO: Juliana Lehnen

FROM: Peter Connolly

RE: Dam Failure Inundation Hazard
Canyon Lane Roadway Improvements Development Project
San Mateo County, California
Ninyo & Moore Project No. 403433001

In accordance with your request, Ninyo & Moore has reviewed a Dam Break Inundation Study[1] and recent Inspection Reports[2,3] for the Emerald Lake 1 Lower Dam (Department of Water Resources Dam No. 612.000) at the Emerald Lake Country Club to assess the inundation hazard arising from a dam break on the proposed Canyon Lane Roadway Improvements Development project.[4]

The Emerald Lake 1 Lower Dam is a 57-foot tall earthen dam that was originally built in 1885 and re-built in 1929. The dam stores water for summer recreation with a capacity of approximately 45 acre-feet at the allowable storage pool elevation. The reservoir is drained by a siphon pipe and a spillway with a wier that is about 5¾ feet below the crest.

The dam was recently inspected by the Division of Safety of Dams (DSOD) on January 17, 2017 and on January 16, 2019. The dam, reservoir, and appurtenant structures were found to be safe for continued use as a result of these inspections based on known information and visual observations with no signs of seepage on the downstream face, groins, or embankment toe. The inspection reports included recommendations for continuation of vegetation and rodent control efforts on the upstream face of the dam and management of vegetation in the spillway approach.

Schaaf & Wheeler conducted a Dam Break Inundation Study using the recommended guidance prepared by the California Office of Emergency Services in Title 23, Division 2, Chapter 1, Article 6, Section 335 of the California Code of Regulations. This study, which is based on the downstream hazard potential and not the actual condition of the dam, considered a piping failure on a sunny day with the reservoir at the rated capacity. The study, which did not consider the grade modifications associated with the proposed project, concluded that the conjectured failure scenario would produce a peak flood wave of approximately 5,765 cubic feet per second and produced a dam break inundation map. A portion of the dam break inundation map is presented as Figure 1. The alignment of the proposed Canyon Lane improvements and associated parcels considered for development are noted on Figure 1. The inundation map indicates that the depth of inundation adjacent to most of the parcels considered for development as a result of the proposed project, may be up to 20 feet for the conjectured scenario. This potential level of inundation may impact the improved roadway and associated future residential development based on the proposed grading and existing channel topography on the improvement plans. The available topographic information in the roadway improvement plans indicates that the bottom of the channel that carries runoff from Lower Emerald Lake along the Canyon Lane alignment is generally no more than about 13 feet below the adjacent proposed street grade for Canyon Lane and the proposed pads for the developable parcels are generally no more than 1 or 2 feet above the adjacent street grade.

The inundation hazard can be mitigated by owner compliance with DSOD regulations, which includes periodic inspections and stability reviews, and implementation of recommended maintenance or remedial actions. Future studies may indicate that additional measures may also be feasible methods for mitigating the inundation hazard. These additional measures may include changing proposed grades for improvements to avoid levels subject to inundation or the construction of supplemental upstream structures to retain or manage dam failure flood waves.

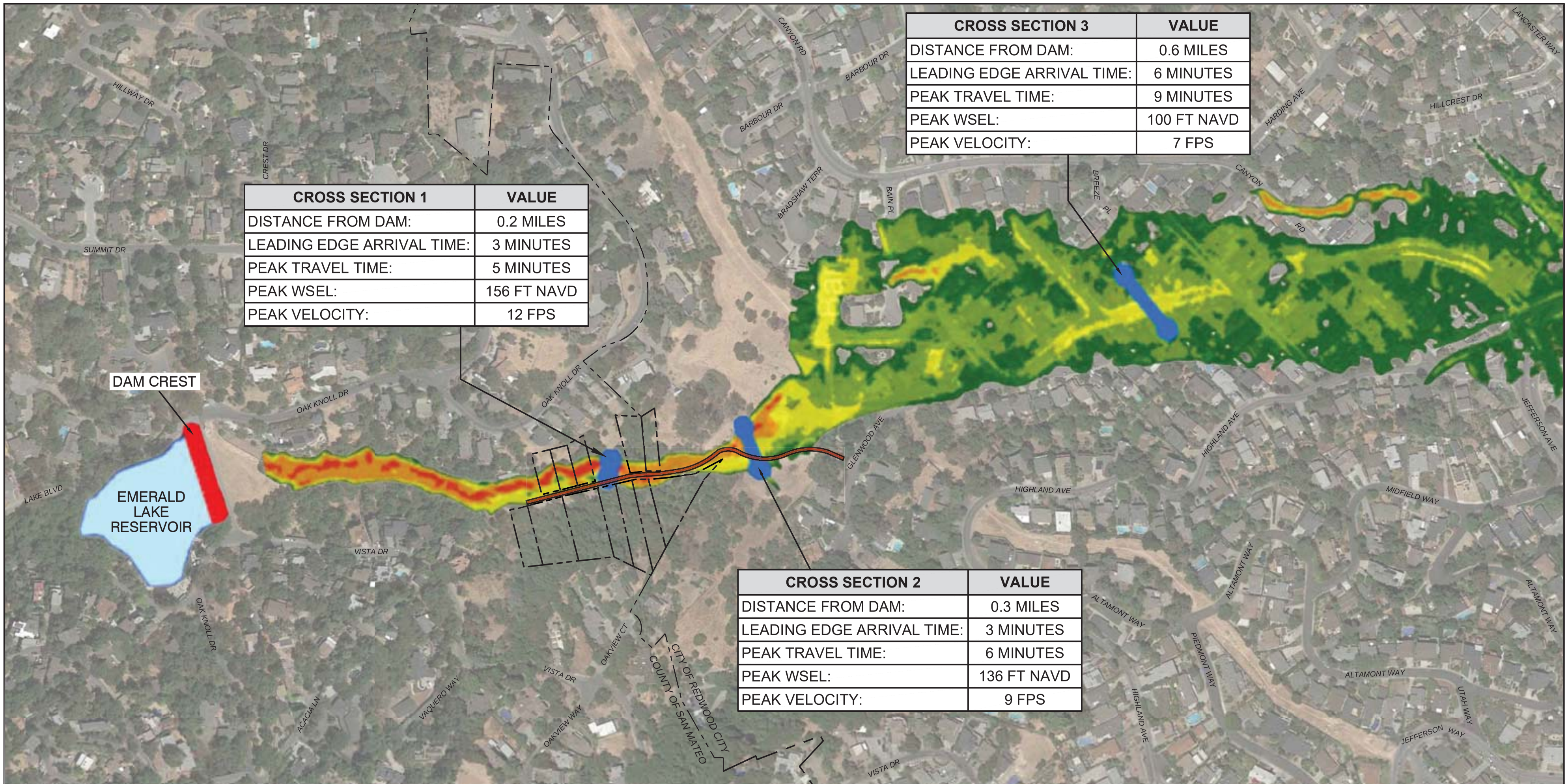
---

[1] Schaaf & Wheeler, 2018, Emerald Lake 1: Dam Break Inundation Study, Draft dated November.

[2] Division of Safety of Dams, 2019, Inspection of Dam and Reservoir in Certified Status, Emerald Lake #1 Lower, California Natural Resources Agency, Department of Water Resources, Report dated February 11.

[3] Division of Safety of Dams, 2017, Inspection of Dam and Reservoir in Certified Status, Emerald Lake #1 Lower, California Natural Resources Agency, Department of Water Resources, Report dated November 9.

[4] MacLeod and Associates, 2017, Roadway Improvement Plans, Canyon Lane, Redwood City and Unincorporated San Mateo County, California, 14 Sheets, Dated January 12.



CROSS SECTION 1	VALUE
DISTANCE FROM DAM:	0.2 MILES
LEADING EDGE ARRIVAL TIME:	3 MINUTES
PEAK TRAVEL TIME:	5 MINUTES
PEAK WSEL:	156 FT NAVD
PEAK VELOCITY:	12 FPS

CROSS SECTION 2	VALUE
DISTANCE FROM DAM:	0.3 MILES
LEADING EDGE ARRIVAL TIME:	3 MINUTES
PEAK TRAVEL TIME:	6 MINUTES
PEAK WSEL:	136 FT NAVD
PEAK VELOCITY:	9 FPS

CROSS SECTION 3	VALUE
DISTANCE FROM DAM:	0.6 MILES
LEADING EDGE ARRIVAL TIME:	6 MINUTES
PEAK TRAVEL TIME:	9 MINUTES
PEAK WSEL:	100 FT NAVD
PEAK VELOCITY:	7 FPS

LEGEND

MAXIMUM DEPTH (FT.)

1 - 2 | 3 | 4 - 5
6-9 | 10 - 20

PROPOSED ROADWAY IMPROVEMENT

PROPOSED DEVELOPMENT AND DEVELOPABLE PARCEL BOUNDARIES

NOTES:
FT = FEET
FPS = FEET PER SECOND
NAVD = NORTH AMERICAN VERTICAL DATUM 1988
WSEL = WATER SURFACE ELEVATION

N

SCALE (FEET)
0 425 850

NOTE: DIMENSIONS, DIRECTIONS, AND LOCATIONS ARE APPROXIMATE I REFERENCE: SCHAAF & WHEELER, 2018; GOOGLE EARTH, 2019

FIGURE 1

DAM BREAK INUNDATION HAZARD

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

EMERALD LAKE 1 LOWER DAM
SAN MATEO COUNTY, CALIFORNIA
403433001 I 03/19

403433001.dwg 03/15/2019 AEK

GEOTECHNICAL SITE INVESTIGATION
30 Canyon Lane
Redwood City, California

Y & A J19 - 1663

By

Jae H. Yang - Project Engineer

J. Yang and Engineers

Geotechnical

General Civil Engineers

P.O.BOX 2148, SAN RAMON, CALIFORNIA

(925) 831-8678 • FAX (925) 831-3645

Project No. J19-1663

February 11, 2019

Mr. Mel Casey:

Subject: Proposed New Residences at
Canyon Lane
Redwood City, California
Geotechnical Site Investigation

Dear Mr. Casey:

In accordance with your authorization, J. Yang and Engineers has investigated the geotechnical site conditions at the subject site for the proposed housing development in Redwood City, California.

The accompanying report presents our conclusions and recommendations based on our investigation. Our evaluations indicate that the site is physically suitable for the proposed construction, provided the recommendations in this report are carefully followed and are incorporated into the plans and specifications.

Should you have any questions or require additional information, please contact our office (925)831-8678 at your convenience.

Very truly yours,

J. Yang and Engineers

Jae H. Yang, P.E.
Project Geo. Engineer

TABLE OF CONTENTS

I. INTRODUCTION

A. Location and Description of Site

This report presents the results of a geotechnical site soil foundation investigation at 30 Canyon Lane, Redwood City, California (Plate 1-Location Map). The site was investigated on February 11, 2019. The site is located at southwest corner of Canyon Lane and Oak Knoll Dr. The ground slopes down in the east direction from the site. The site is currently developed rolling slope.

Development plans call for construction of the new single family residential buildings and facilities.

B. Purpose and Scope of Work

The purpose of the site investigation was to determine surface and subsurface soil conditions at the subject site. Based on the results of the investigation, criteria were established for the grading of the site, the design of foundations for the proposed structures, and the construction of other related facilities on the property. Our investigation included the following:

1. Field reconnaissance by the Soil Engineer
2. Drilling and sampling of the subsurface soil.
3. Laboratory Testing.
4. Analysis of the data and formulation of conclusion and recommendations.
5. Preparation of this report.

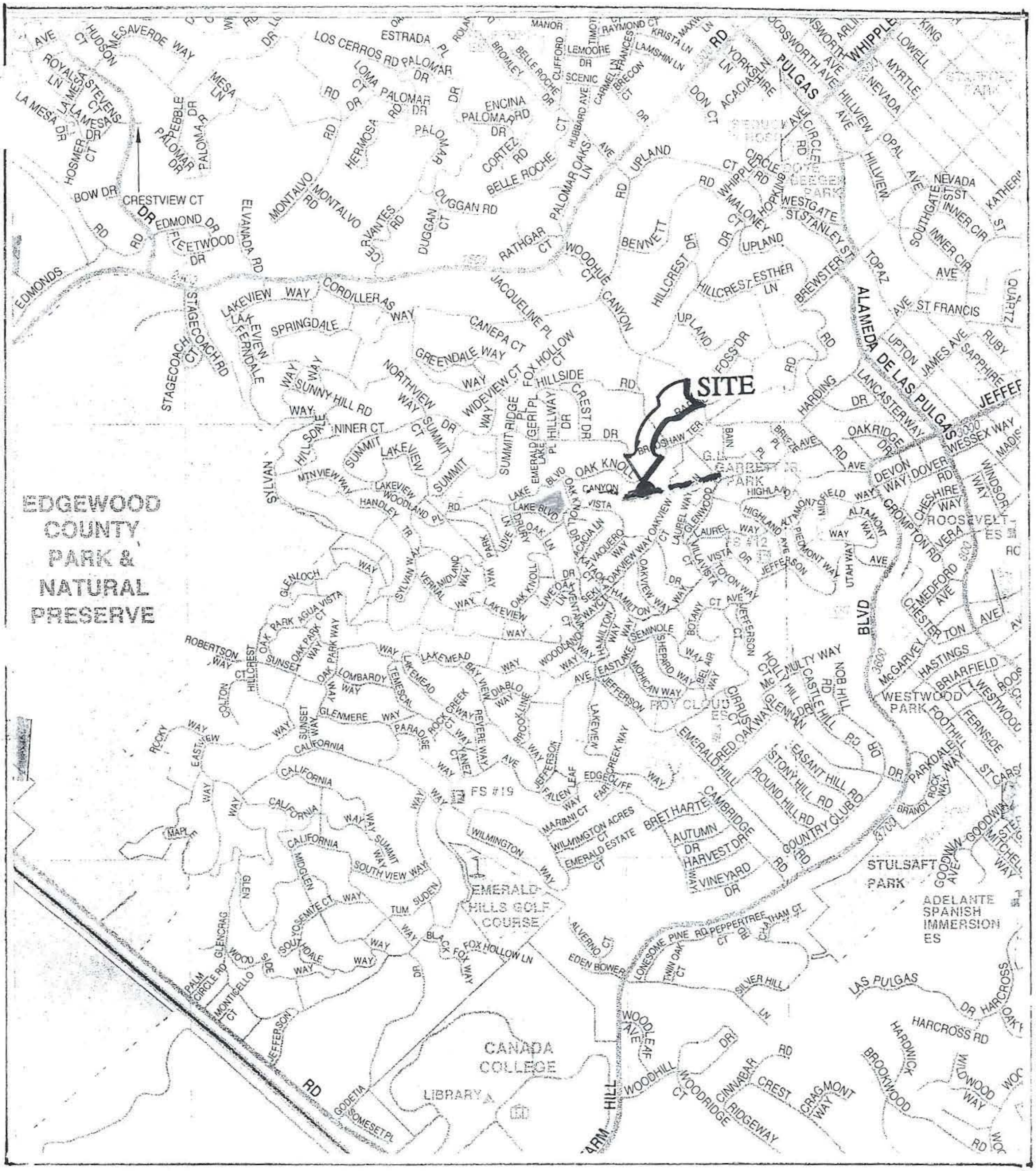
II. FIELD EXPLORATION AND LABORATORY TESTING

Subsurface conditions were explored on February 11, 2019 by drilling three boring. The boring locations were chosen to provide subsurface information at the major structure areas.

The boring locations are shown on PLATE 3. The boring were drilled with B24 5" solid stem flyight auger. Our soil engineer logged the boring and obtained bulk and relatively undisturbed drive samples for visual classification and subsequent laboratory testing. Drive samples were obtained with the split barrel sampler (2-inch I.D.) equipped with brass liner tubes.

The samplers were driven with a 140-pound hammer falling 30 inches. Standard penetration test N-values obtained with the SPT sampler and the S&H split-barrel sampler results are shown on the boring logs in PLATE 4.

The soils encountered were described in accordance with the Unified Soils Classification System outlined in PLATE A1.



LOCATION MAP

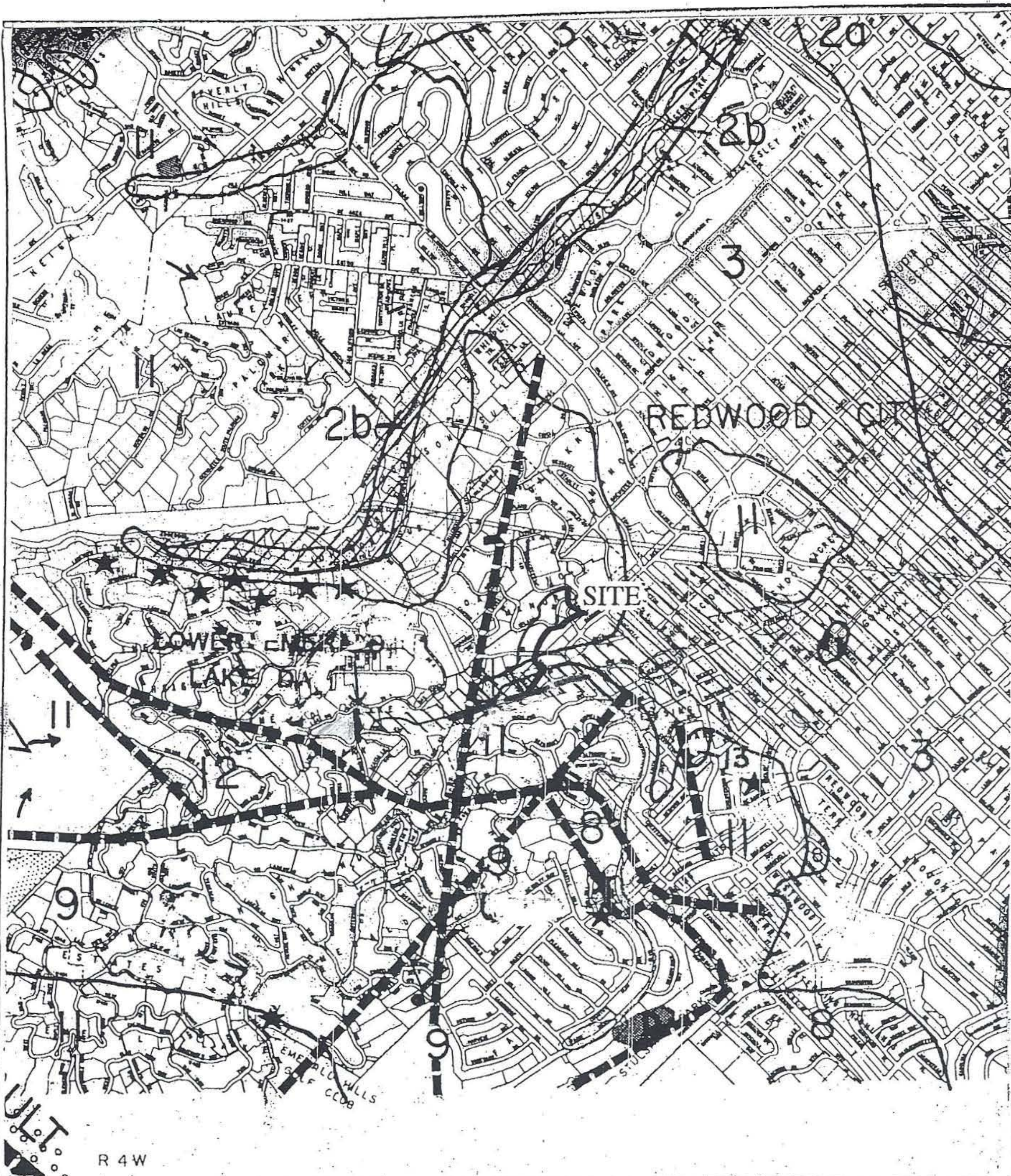
SOURCES

STATE OF CALIFORNIA
EARTHQUAKE FAULT ZONES (1/94)

N

J. Yang and Engineers

SCALE:	FIGURE: 1
DATE: 12/16/14	
30 Canyon Ln Redwood City, California	
JOB NUMBER: J19-1663	



SOURCES

GEOTECHNICAL HAZARDS SYNTHESIS MAPS
SAN MATEO COUNTY (12/76)

Hazard Area Zone: 11

N

J. Yang and Engineers

SCALE:	FIGURE:
DATE: 12/16/14	2

30 Canyon Ln
Redwood City, California

JOB NUMBER: J19-1663

III. GEOTECHNICAL EVALUATION AND DISCUSSION

A. Assessment of Seismic Hazards

This site could be affected by an earthquake with its epicenter of the active faults in the Bay Area. At present, it is not possible to predict when or where movement will occur on these faults. It must be assumed, however, that movement along one or more of these faults will result in a moderate earthquake during the lifetime of any improvements at this site.

Active fault systems are known to exist within the vicinity of the site. The approximate location of these faults are southwest 25km as shown on Figures 1.

In the event of an earthquake, the seismic risk will depend on the distance of the structure from the epicenter and source fault, the character and magnitude of the earthquake, the groundwater and soil conditions underlying the structure and its immediate vicinity, and the nature of the construction.

The potential seismic hazards in the tests area are the effects of ground shaking resulting from earthquakes on nearby faults.

Regional subsidence or uplift caused by a differential vertical movement along a fault takes place over large areas. In the event of such a movement on the San Andreas Fault, the site would probably respond as a unit; resulting damage from this phenomenon is unlikely.

The potential structural damage due to ground shaking is caused by the transmission of earthquake vibrations from the ground into a structure. The variables which determine the extent of damage are: the characteristics of the underlying earth materials, the design of the structure, the quality of materials and workmanship used in construction, the location and magnitude of the earthquake, and the duration and intensity of shaking. The most destructive effects of an earthquake are usually seen where the ground is unstable and the structures are poorly designed and constructed.

Preliminary estimates of ground response characteristics at this site indicate that high accelerations can be expected during a moderate to major earthquake on the San Andreas Fault or a major earthquake on the Monte Vista-Shannon Fault or Any of these events could cause strong ground shaking at this site. The duration of shaking and the frequency components of the vibrational waves will depend upon the magnitude and location of the earthquake.

Structures should be designed to accommodate earthquake vibrations. If quality design and construction criteria are met, as set forth in the latest edition of the Uniform Building Code, the potential for structural damage to wood-frame residential buildings can be substantially reduced.

B. Site Geologic and Site Stability

The natural slopes on the proposed site are relatively flat to gentle slope and show generally good site stability. In accordance with Geotechnical Hazards Synthesis map (12/'76), hazard area zone 11, San mateo County that geologic materials are Franciscan Sandstone. The Franciscan sandstone (undivided) consists of sandstone and lithic rock with interbedded siltstone and shale and local conglomerate.

The upper soils at the site are cohesive with grass roots and are relatively resistant to erosion. The materials could erode if slopes are left unplanted and subjected to fast flowing runoff. Recommendations are presented in this report to mitigate problems associated with erosion.

C. SUBSURFACE SOIL CONDITIONS

Based upon examination of the exploratory boring (see PLATE 4: Boring Logs), materials encountered in the four borings at locations shown on PLATE 3. The subsurface soils consist generally of silty clay to mottled silty sand and siltstone bed layer as shown on the boring logs. These materials generally grade from stiff to hard in relative density.

Groundwater was not observed at the time of our investigation at average depth of 15 feet.

The current (February, 2006), groundwater was not observed at The time of our investigation at average depth of 17 feet. However, in our professional judgement, the highest projected groundwater level to be approximately 20 feet fron the existing grade.

D. UNDERGROUND BASEMENT EXCAVATION AND SAFETY PLAN

If basement excavations are part of this project, attention is directed to Section 7-1.01E "Trench Safety" of State of California Department of Transportation or CAL/OSHA or City of Palo Alto Basement Construction requirements. Excavation for any hole 5 feet or more in depth shall not begin until the contractor has received approval from engineer of contractor's detailed plan for workers protection from the hazards of caving ground during the excavation of the basement. Deep holes in unstable soil conditions may require extra support (shoring) to prevent cave-ins.

Detailed descriptions of materials encountered in each of the test borings are presented on the logs in Plate 4. Changes in the condition of the property may occur with the passage of time due to natural processes and on the subject site of adjacent properties. Thus, the drilled boring logs and related information depict subsurface conditions only at the locations indicated and on the particular date designated on the logs. Soil conditions at other locations may differ from conditions at these locations.

IV. CONCLUSIONS AND RECOMMENDATIONS

The following conclusions and recommendations are based on the investigation and evaluations described in this report. The recommendations and specifications presented herein should be incorporated into the project plans and documents during design and construction. Supplemental recommendations and/or modifications may be made at a later date, as more detailed development plans become available.

A. General Conclusions

1. The site is considered suitable from a geotechnical aspect for the proposed a dwelling facilities.

2. There were no soil or geologic conditions encountered during the investigation of the site which would preclude the planned construction.

3. The site, as is all the San Francisco region, is seismicall active. Ground shaking is expected to have the following characteristics at the site and parameters are noted in the 2016 Building Code.

    a. Seismic zone factor (Z): 0.4
    b. Seismic coefficient (Ca): 0.44Na
    c. Seismic coefficient (Cv): 0.64Nv
    d. Soil profile type: Sd
    e. Near-source factor (Na): 1.4, (Nv): 1.7
    f. Expected seismic source type: A

4. The recommendations in this report are based on the assumption that grading will minimal for the building pads and appropriate building site. When final development plans and detailed grading plans are available, the conclusions and recommendations of this report should be reviewed and modified if necessary, to suit those plans.

Site Preparation and Grading

5. All grading operations associated with the planned development should be carried out as described in the following paragraphs.

6. Remove 1.5 foot of the topsoils from the proposed building pads, asphaltic concrete, old foundation concrete, debris and contaminated soils, root systems and loose or soft soil in the areas of the planned development. Buried structures such as pipelines, or other underground facilities should be removed from areas of planned development. Any of the soft soil deposits should be removed and replaced with compacted fill. A final determination of the treatment of soft surface soil should be made the soil engineer at the time of grading.

7. All compaction requirements are based on maximum dry densities and optimum moisture determined by ASTM Test Procedure D1557-90.

8. The top 1.5 foot of soil should be removed from the planned building pads and driveways. After stripping, areas to receive non expansive fill should be stripped to firm natural ground, scarified, moisture-conditioned to 3 to 5% above optimum moisture content, and compacted to at least 90% relative compaction. If soils are too wet, considerable drying time and discing may be required to reduce their moisture content to near optimum. Where cut natural ground is exposed beneath slabs-on-grade, the soil should be scarified to a depth of 4 inches from finished rough grade, moisture conditioned as above, and compacted at least 90% relative compaction.

9. Existing native soils may not be used as compacted fill in building and street areas, provided it is free of organic or other deleterious material. All fill should be compacted to at least 90% relative compaction at moisture contents 3 to 5% above optimum. The upper 24 inches pavement right-of-way should be compacted to at least 95% relative compaction.

10. Import fill, if required, should be approved by the Soil Engineer, and should have soil properties equivalent to or better than the natural soil. Import fill should not contain rocks larger than 4 inches in diameter.

Surface and Subsurface Drainage

11. All grading at the site should be done in such a manner as to prevent ponding of water during or after construction. Areas adjacent to tops of slopes should be graded to direct runoff away from the slope and into established drainage patterns. In general, the soils at the site are cohesionless and are prone to erosion. Erodible surface materials may be exposed locally, however. Efforts should be made, therefore, to establish slope vegetation before the next rainy season after grading.

12. Valleys or swales behind the open retaining walls, which will be filled, should be provided with subdrains to collect and discharge the subsurface seepage flow. Typically, subdrains will be perforated plastic pipe surrounded by select import filter gravel wrapped with filter fabric. The subdrains should be connected at their low points to a storm drainage system or to other approved discharge points. Subdrain outlets should be protected from erosion and siltation and be noted on "as-built" plans by the project Civil Engineer for future reference.

Foundations

13. The proposed building structures should be founded on the firm native soil. Recommendations for pier and grade beams are presented in this report.

14. The following general foundation type may be used at this site. Final selection of appropriate foundation systems will depend on the building structural engineer's preference, actual soil conditions, and final building

foundation systems. When these features are known, a review by geotechnical engineer should be made to select the appropriate foundation type and final design parameter

Drilled Cast-In-Place Concrete Piers and Grade Beams

Footings for outside of the basement walls, it is recommended that the diameter of the piers should be a minimum of 16 inches and a minimum depth of 14 feet from the bottom of the grade beam. The actual depths of piers will be determined at the time of drilling by a soil engineer. The piers for these foundation systems should be transfer structural loads to the subsurface soils. The drilled piers will derive their load carrying capacity from peripheral skin friction between the pier shaft and the surrounding soil. An allowable skin friction value of 500 pounds per square foot (psf) of embedment may be used for design purposes for combined dead plus live loads. Friction resistance in the upper portion of the pier within 18 inches of the ground surface should be ignored when determining the load carrying capacity of the piers. The pier should be spaced at least three pier diameters and reinforced their entire length.

Retaining Walls

The retaining wall should be designed to resist lateral pressures exerted from a media having an equivalent fluid weight as follows:

Gradient of Back Slope	Equivalent Fluid Weight pcf	Passive Resistance pcf	Coefficient of friction	Angle of Internal Friction
Flat	45	400	0.3	25
2 : 1	55	400	0.3	25

Drainage behind retaining walls should consist of a 4-inch diameter perforated pipe surrounded by filter gravel, 1/2 inch to 1 inch in size wrapped with filter fabric to the dewatering pump station or day light.

Concrete Slab-on-Grade Floors

Concrete slab-on-grade floors should be supported on a minimum of 6 inches of Class 2 aggregate base. Aggregate for Class 2 aggregate base shall be free from vegetable matter and other deleterious substances, and shall be of such nature that it can be compacted readily under watering and rolling to form a firm, stable base. The Class 2 aggregate should be complied with latest CATRANS Specification Section 26-1.02B. At the option of the contractor, the grading for either the 1-1/2 inch maximum or 3/4 inch shall be used. The slab subgrade to receive aggregate base, should be rolled smooth prior to slab construction to provide a uniformly dense non-yielding surface.

Drainage

All ground surfaces, including pavements and sidewalks, should slope away from the structures at a minimum gradient of 2 percent. Surface runoff should be controlled by a system of swales and catch basins, and then conveyed off the property to suitable discharge facility.

Surface water should not be allowed to pond on the site. In addition, roof downspouts should be connected to closed collector pipes which discharge into the storm water system or onto paved parking areas or dispose through lined ditch.

Flexible Pavement Thicknesses

If flexible pavement is required as part of the building, the design criteria recommend based on an assumed R-value of 20 (typical clayey gravels, gravel-sand clay mixtures), Assumed Traffic Indexes (T.I.) and the CALTRANS design procedure for asphaltic concrete pavement, we recommend the following preliminary asphaltic concrete pavement thicknesses:

		Thickness (inches)	
		Asphaltic	Class 2
Location	T.I.	Concrete	AggregateBase*
Automobile Parking	4	2	6
Driveways and Service Areas	5	3	8

R-Value -78 minimum the subgrade soil may vary in quality and contain local areas of low shear strengths. We should observe the completed subgrade to check that the preliminary pavement design is applicable. Subgrade soils to receive pavement should be rolled to provide a smooth, unyielding surface compacted to at least 95% relative compaction. On site subgrade soils should be maintained in a moist condition until covered the completed pavement section. The Class 2 Aggregate Base should be placed in a manner to prevent segregation, uniformly moisture conditioned to near optimum and compacted to at least 95% relative compaction with a smooth and unyielding surface.

Trench Backfill

16. Underground utility trenches may be backfilled with on-site soils, provided they are moisture-conditioned to near optimum and are not in "chunks". Bedding and initial backfilling should be done in accordance with local requirements and specifications. Subsequent backfilling should be done in accordance with local requirements and specifications. Subsequent backfill (generally one foot and higher above the utility) should be placed in layers and mechanically compacted as follows:

Trench Location	Minimum Relative Compaction
Natural ground, outside street and lot areas.	85%
Lot areas and streets, below upper 24 inches.	90%
Street areas, entire depths.	95%

Observation and Testing

17. All work connected with site grading, drainage and erosion control should be observed and tested by the soil engineer. The purpose of these services will be to confirm that the conditions exposed during grading are as anticipated and provide supplemental recommendations if required; and to determine that the site work is being done in general conformance with the recommendations of this report and the County of San Mateo and City of Redwood City requirements

Additional Soil Engineering Service

18. We should review the final design and specifications in order that earthwork and foundation recommendations may be properly interpreted and implemented in the design and specifications. We should provide engineering services during site preparation, grading, foundation and pavement construction phases of the work. This would allow us to observe compliance with the design concepts, specifications and to allow design changes in the event that surface conditions differ from those anticipated prior to the start of construction.

V. PLAN REVIEW, CONSTRUCTION OBSERVATION AND TESTING

We should be retained to review the earthwork and foundation plans and specifications for conformance with the intent of our recommendations. The review would enable us to modify our recommendations if final design conditions are not as we now understand them to be. During construction, we should observe and test the earthwork and foundation installation. As needed during construction, we should be retained to consult on geotechnical questions, construction problems, and unanticipated conditions. This will allow us to develop supplemental recommendations as appropriate for the actual soil conditions encountered and the specific construction techniques employed by contractor.

VI. GUIDELINES FOR REQUIRED SERVICES

The following list of services are the services required and must be provided by Yang and Associates, during the project development. These services are presented in check list format as a convenience to those entrusted with their implementation.

The items listed are included in the body of the report in detail. This list is intended only as an outlined of the required services and does not replace specific recommendations and, therefore, must be used with reference to the total report.

The importance of careful adherence to the report recommendations cannot be overemphasized. It should be noted, however, that this report is issued with the understanding that each step of the project development will be performed under the direct observation of Yang and Engineers.

The use of this report by others presumes that they have verified all information and assume full responsibility for the total project.

ITEM DESCRIPTION	REQUIRED	NOT REQUIRED
1. Provide foundation design parameters	X	
2. Review grading plans & specifications	X	
3. Review foundation plans & specs.	X	
4. Observe & provide demolition recommendation		X
5. Observe & provide site stripping recommendations	X	
6. Observe and provide recommendations on moisture conditioning, removal and/or precompaction of unsuitable existing soils	X	
7. Observe and provide recommendations on installation of subdrain facilities		X
8. Observe and provide testing services on fill areas and/or imported fill materials	X	
9. Review as-graded plans and provide additional foundation recommendations, if necessary	X	
10. Observe and provide compaction tests on sanitary sewers, storm drain, water lines and PG&E trenches	X	
11. Observe foundation excavations and provide supplemental recommendations, if necessary, prior to placing concrete	X	
12. Observe and provide moisture conditioning recommendations for foundation areas prior to placing concrete		X
13. Provide design parameters for retaining walls	X	
14. Provide geologic observations and recommendations for keyway excavations and cut slopes during grading	X	
15. Excavate and recompact all geologic trenches and/or test pits.		X

VII. LIMITATIONS AND UNIFORMITY OF CONDITIONS

A. The recommendations of this report are based upon the assumption that the soil conditions do not deviate from those disclosed in the borings and test pits. If and variations or undesirable conditions are encountered during construction, or if the actual construction will differ from that planned at the present time, J. Yang and Engineers should be notified so that supplemental recommendations can be given.

B. This report is issued the understanding that it is responsibility of the owner or of his representatives to ensure that the information and recommendations contained herein are called to the attention of the other members of the design team (architect and engineers) for the project and are incorporated into the plans, and that the necessary steps are taken to see that the contractors and subcontractors carry out such recommendations in the field.

C. The findings of this report are valid as of the present date. However, changes in the conditions can occur with the passage of time, whether they be due to natural processes or to the works of man, on this or adjacent properties. In addition, changes in applicable or appropriate standards may occur, whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated, wholly or in part, by changes outside of our control. Therefore, this report is subject to review by J. Yang and Engineers after a period of two(2) years has elapsed from date of issuance of this report.

D. The body of the report specifically recommends that J. Yang and Engineers be provided the opportunity for general review of the project plans and specifications, and that J. Yang and Associates be retained to provide observation and testing services during construction. The validity of this report assumes that J. Yang and Engineers will be retained to provide these services.

E. This report was prepared at your request for our services, and in accordance with the currently accepted geotechnical engineering practice. No warranty based on the contents of this report is intended, and none shall be inferred from the statements or opinions expressed herein.

APPENDIX A

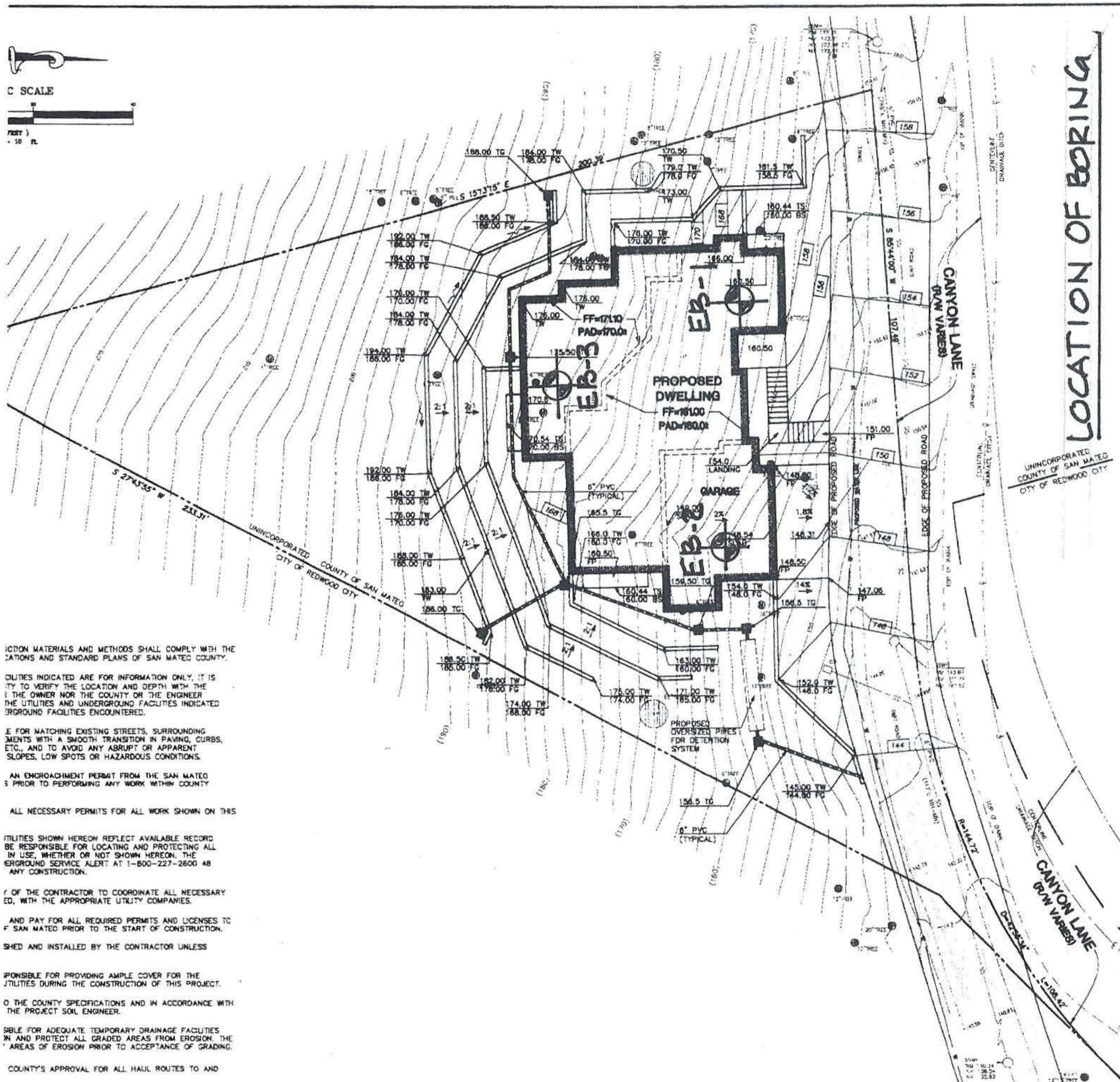


PLATE 3

LEGEND

	PROPERTY LINE
A.C. PAVE	ASPHALTIC CONCRETE PAVEMENT
BS	BOTTOM OF STEP
COTG	CLEANOUT TO GRADE
FG	FINISHED GRADE
FP	FINISHED PAVEMENT
FL	FLOWLINE
G.B.	GRADE BREAK
INV.	INVERT
SSMH	SANITARY SEWER MANHOLE
TG	TOP OF GRATE
TW	TOP OF WALL
TS	TOP OF STEP
20" TREE	TREE W/ SIZE
—X—X—	FENCE
—OH—	(E) OVERHEAD LINES
—G—	(E) GAS LINE
—SS—	SANITARY SEWER LINE
—W—	WATER LINE
150	NEW CONTOUR
	SURFACE RUNOFF DIRECTION
	SWALE
	NEW STORM DRAIN LINE

UTILITY NOTE:

THE UTILITIES EXISTING ON THE SURFACE AND SHOWN ON THIS DRAWING HAVE BEEN LOCATED BY FIELD SURVEY. ALL UNDERGROUND UTILITIES SHOWN ON THIS DRAWING ARE FROM RECORDS OF THE VARIOUS UTILITY COMPANIES AND THE SURVEYOR/ENGINEER DOES NOT ASSUME RESPONSIBILITY FOR THEIR COMPLETENESS, INDICATED LOCATION, OR SIZE. RECORD UTILITY LOCATION SHOULD BE CONFIRMED BY EXPOSING THE UTILITY.

GRADING QUANTITIES:

CUT – 2,540 C.Y. ±

EXPORT – 2,540 C.Y. ±

...ICTION MATERIALS AND METHODS SHALL COMPLY WITH THE ...CATIONS AND STANDARD PLANS OF SAN MATEO COUNTY.

...ILITIES INDICATED ARE FOR INFORMATION ONLY. IT IS ...TY TO VERIFY THE LOCATION AND DEPTH WITH THE ...R THE OWNER NOR THE COUNTY OR THE ENGINEER ...THE UTILITIES AND UNDERGROUND FACILITIES INDICATED ...ERGROUND FACILITIES ENCOUNTERED.

...E FOR MATCHING EXISTING STREETS, SURROUNDING ...EMENTS WITH A SMOOTH TRANSITION IN PAVING, CURBS, ETC., AND TO AVOID ANY ABRUPT OR APPARENT SLOPES, LOW SPOTS OR HAZARDOUS CONDITIONS.

... AN ENCROACHMENT PERMIT FROM THE SAN MATEO ...S PRIOR TO PERFORMING ANY WORK WITHIN COUNTY

... ALL NECESSARY PERMITS FOR ALL WORK SHOWN ON THIS

...TILITIES SHOWN HEREON REFLECT AVAILABLE RECORD ... BE RESPONSIBLE FOR LOCATING AND PROTECTING ALL ... IN USE, WHETHER OR NOT SHOWN HEREON. THE ...ERGROUND SERVICE ALERT AT 1-800-227-2600 48 ... ANY CONSTRUCTION.

...Y OF THE CONTRACTOR TO COORDINATE ALL NECESSARY ...ED, WITH THE APPROPRIATE UTILITY COMPANIES.

... AND PAY FOR ALL REQUIRED PERMITS AND LICENSES TO ...F SAN MATEO PRIOR TO THE START OF CONSTRUCTION.

...SHED AND INSTALLED BY THE CONTRACTOR UNLESS

...PONSIBLE FOR PROVIDING AMPLE COVER FOR THE ...UTILITIES DURING THE CONSTRUCTION OF THIS PROJECT.

...O THE COUNTY SPECIFICATIONS AND IN ACCORDANCE WITH THE PROJECT SOIL ENGINEER.

...SIBLE FOR ADEQUATE TEMPORARY DRAINAGE FACILITIES ...ON AND PROTECT ALL GRADED AREAS FROM EROSION. THE ... AREAS OF EROSION PRIOR TO ACCEPTANCE OF GRADING.

... COUNTY'S APPROVAL FOR ALL HAUL ROUTES TO AND

REV.	DESCRIPTION	BY:	DATE:

MACLEOD AND ASSOCIATES

CIVIL ENGINEERING · LAND SURVEYING

965 CENTER STREET · SAN CARLOS · CA 94070 · (650) 593-8580

PREPARED FOR: CASEY CONSTRUCTION

PRELIMINARY GRADING AND DRAINAGE PLAN

30 CANYON LANE

UNINCORPORATED SAN MATEO COUNTY CALIFORNIA

DRAWN BY:	AAP
DESIGNED BY:	VPG
CHECKED BY:	DGM
SCALE:	1" = 10'
DATE:	03/27/12
DRAWING NO.	3502-GRAD
SHEET	1 OF 1

C-1

USCS SOIL CLASSIFICATION

PRIMARY DIVISIONS			SOIL TYPE	SECONDARY DIVISIONS
COARSE GRAINED SOILS (< 50 % Fines)	GRAVEL	CLEAN GRAVEL (< 5% Fines)	GW	Well graded gravel, gravel-sand mixtures, little or no fines.
			GP	Poorly graded gravel or gravel-sand mixtures, little or no fines.
		GRAVEL with FINES	GM	Silty gravels, gravel-sand-silt mixtures, non-plastic fines.
			GC	Clayey gravels, gravel-sand-clay mixtures, plastic fines.
	SAND	CLEAN SAND (< 5% Fines)	SW	Well graded sands, gravelly sands, little or no fines.
			SP	Poorly graded sands or gravelly sands, little or no fines.
		SAND WITH FINES	SM	Silty sands, sand-silt mixtures, non-plastic fines.
			SC	Clayey sands, sand-clay mixtures, plastic fines.
FINE GRAINED SOILS (> 50 % Fines)	SILT AND CLAY Liquid limit < 50%		ML	Inorganic silts and very fine sands, with slight plasticity.
			CL	Inorganic clays of low to medium plasticity, lean clays.
			OL	Organic silts and organic clays of low plasticity.
	SILT AND CLAY Liquid limit > 50%		MH	Inorganic silt, micaceous or diatomaceous fine sandy or silty soil.
			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.

RELATIVE DENSITY

SAND & GRAVEL	BLOWS/FOOT*
VERY LOOSE	0 to 4
LOOSE	4 to 10
MEDIUM DENSE	10 to 30
DENSE	30 to 50
VERY DENSE	OVER 50

CONSISTENCY

SILT & CLAY	STRENGTH^	BLOWS/FOOT*
VERY SOFT	0 to 0.25	0 to 2
SOFT	0.25 to 0.5	2 to 4
FIRM	0.5 to 1	4 to 8
STIFF	1 to 2	8 to 16
VERY STIFF	2 to 4	16 to 32
HARD	OVER 4	OVER 32

GRAIN SIZES

BOULDERS	COBBLES	GRAVEL		SAND			SILT & CLAY
		COURSE	FINE	COURSE	MEDIUM	FINE	

12" 3" 0.75" 4 10 40 200

SIEVE OPENINGS — U.S. STANDARD SERIES SIEVE

Classification is based on the Unified Soil Classification System; fines refer to soil passing a No. 200 sieve.

* Standard Penetration Test (SPT) resistance, using a 140 pound hammer falling 30 inches on a 2 inch O.D. split spoon sampler; blow counts not corrected for larger diameter samplers.

^ Unconfined Compressive strength in tons/sq. ft. as estimated by SPT resistance, field and laboratory tests, and/or visual observation.

KEY TO SAMPLERS

Modified California Sampler (3-inch O.D.)
Mid-size Sampler (2.5-inch O.D.)
Standard Penetration Test Sampler (2-inch O.D.)

KEY TO TEST DATA

SOIL CLASSIFICATION CHART & KEY TO TEST DATA

PLATE **A1**

DRAWN | JOB NUMBER | APPROVED | DATE | REVISED | DATE

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Laboratory Test Report

Client:	**Yang & Associates**	Report No.:	**19-HAY-00125 Rev. 0**	Issued:	**2/15/2019**
Project:	**00014648.002A**			Field ID:	**HL11945**
	Yang & Associates 2017 Geotechnical Lab	Sampled by:	**J.Yang**	Date:	**2/11/2019**
	01-027L - HL11863 - Oakhurst Ave.	Submitted by:	**J.Yang**	Date:	**2/11/2019**

Expansion Index Test

Tested on **2/13/2019** by **M.Sacramento**

Material Description: **Olive Brown Sandy Lean Clay (CL)**

Sample Location: **BULK - HL11945**

Test Method:	**ASTM D4829**
Expansion Index :	**24**
Dry Density, pcf :	**115.2**
Water Content, as molded, %:	**8.5**
Final Water Content, %:	**18.6**
Initial Saturation, as molded %:	**49.8**

Classification of Potentially Expansive Soil

Expansion Index, EI	Potential Expansion
0 - 20	Very Low
21 - 50	Low
51 - 90	Medium
91 - 130	High
Above 130	Very High

Remarks:

Potential Expansion: LOW

Reviewed on 2/15/2019 by Aaron Kidd,
Materials Manager I

PROJECT: 30 Canyon Ln Redwood City, CA	BORING NO. EB - 1

BORING SUPERVISOR: J. Yang	TYPE OF BORING: B24 5" solid Stem Auger	DATE OF BORING: 2-11-19

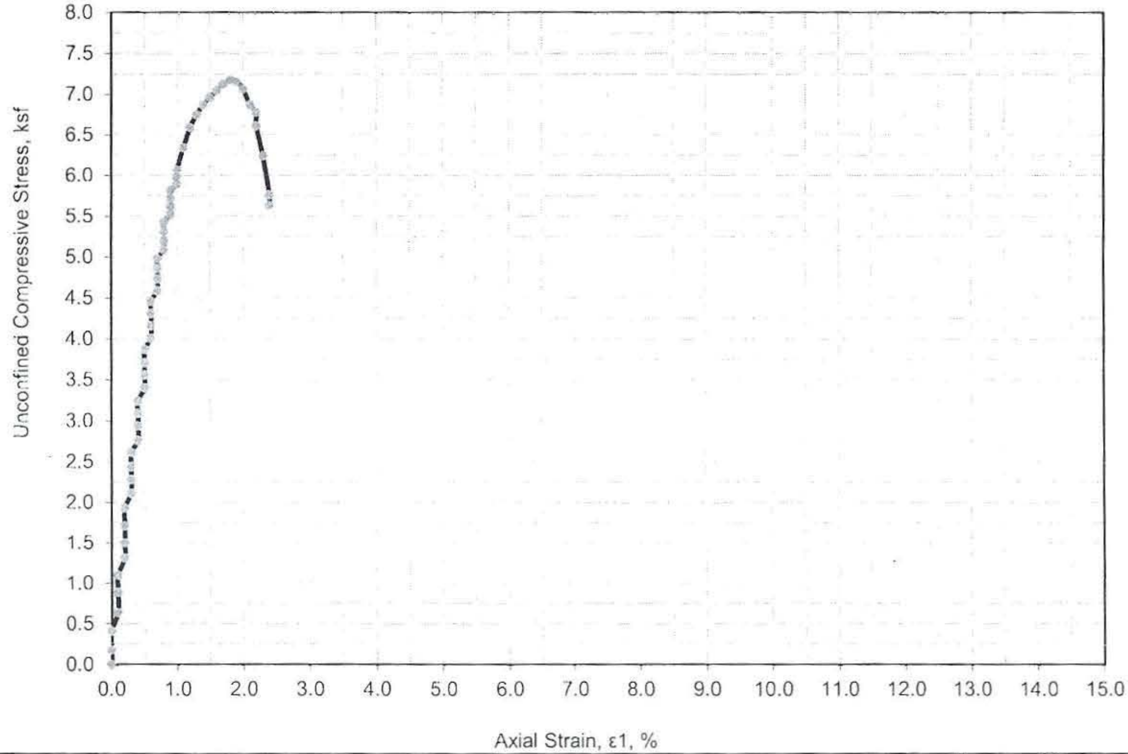
HAMMER WEIGHT: 140#/30" drop

SURFACE ELEVATION:

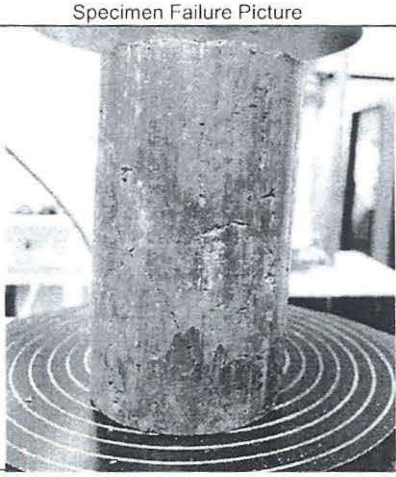
GROUNDWATER DEPTH:

DESCRIPTION OF MATERIALS	DEPTH IN FT.	SAMPLE	SAMPLE NUMBER- SAMPLE DIAMETER	DRIVING RESISTANCE BLOWS PER FT.	DRY DENSITY P.C.F.	MOISTURE CONTENT %	UNCONFINED COMPRESSIVE STRENGTH P.S.F.	OTHER TESTS
Clay (topsoil)								
Sandy clay, dark brown. (CL)	5	EB1 5	2"	37	111	17	7ksf	
Silty clay, brown (CL)	10	EB1 10	2"	23	115	17	4ksf	
Silty sand, small gravel, brown at 14' (CL) Refusal drilling at 15' **	15	EB1 15	2"	50/6"	--	--	--	
Bottom of hole **: Unable to recover sample due to broken soil.	20							
	25							
	30							

Job No. J19-1663	J. Yang and Engineers	PLATE 4



Specimen Failure Picture



	Specimen No.		1
Initial	Diameter, in	D_O	2.39
	Height, in	H_O	4.57
	Height to Diameter Ratio		1.91
	Water Content, %	ω_O	17.2
	Dry Density, lbs/ft³	γd_o	110.9
	Saturation, %	S_O	89.5
	Void Ratio	e_O	0.520
Time to Failure, min.		t_f	1.8
Unconfined Compressive Strength, ksf		q_u	7.18
Shear Strength, ksf		s_u	3.59
Strain at Failure, %		ε_f	1.8
Average Rate of Strain to Failure, %/min		ε	1.0

Description of Specimen: Dark Olive Brown Sandy Lean Clay (CL)

Amount of Material Finer than the No. 200, %: nm

LL: nm | PL: nm | PI: nm | G_S: 2.70 Assumed | Specimen Type: Intact | Test Method: ASTM D2166

Boring:	HL11945
Sample:	EB-1
Depth, ft:	5.0
Test Date:	2/12/19

Remarks: nm= not measured, na = not applicable

Height to Diameter ratio did not meet the specifications. H/D = 2 - 2.5

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Project Number:	0014648.002A
Date:	2/15/2019
Entry By:	MS
Checked By:	MS
File Name:	HL11945

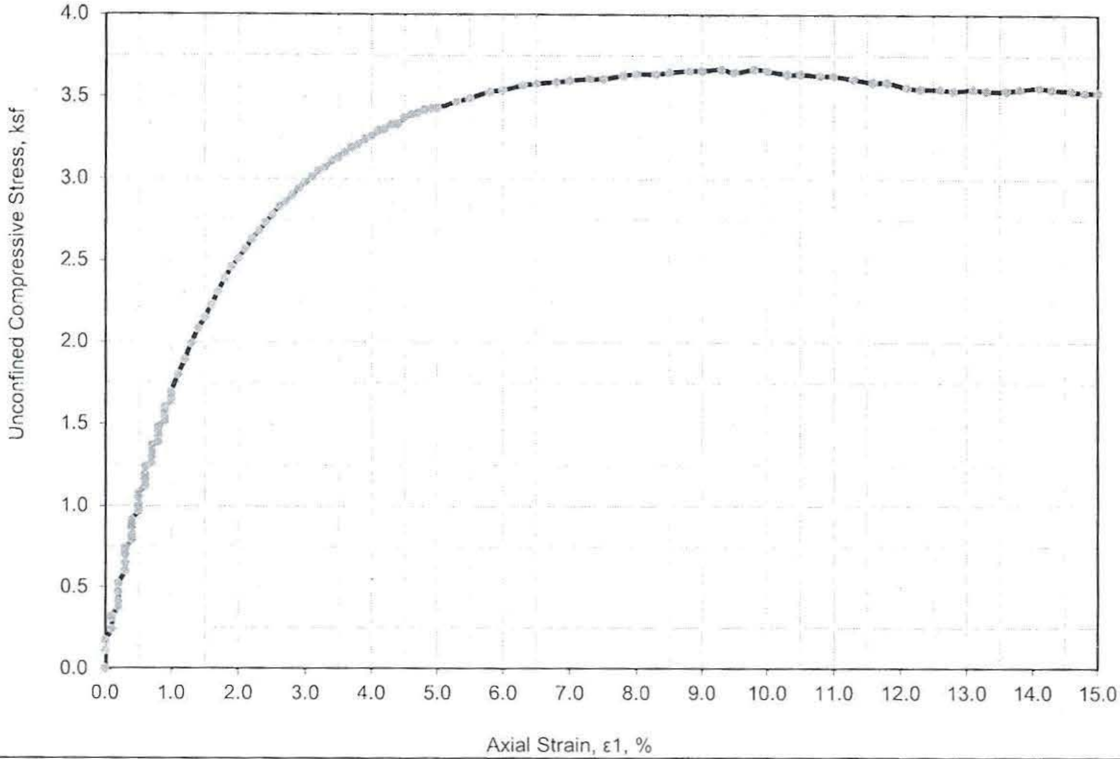
UNCONFINED COMPRESSION TEST (UC)

YANG AND ENGINEERS

30 Canyon Lane

Figure

1



Specimen Failure Picture	Specimen No.			1
	Initial	Diameter, in	D_o	2.39
		Height, in	H_o	5.18
		Height to Diameter Ratio		2.17
		Water Content, %	ω_o	16.7
		Dry Density, lbs/ft^3	γ_{d_o}	115.4
		Saturation, %	S_o	98.7
		Void Ratio	e_o	0.459
	Time to Failure, min.		t_f	9.8
	Unconfined Compressive Strength, ksf		q_u	3.67
	Shear Strength, ksf		s_u	1.84
	Strain at Failure, %		ε_f	9.8
	Average Rate of Strain to Failure, %/min		ε	1.0

Description of Specimen: Olive Sandy Lean Clay with Gravel (CL)

Amount of Material Finer than the No. 200, %: nm

LL: nm | PL: nm | PI: nm | G_s: 2.70 Assumed | Specimen Type: Intact | Test Method: ASTM D2166

Boring:	HL11945
Sample:	EB-1
Depth, ft:	10.0
Test Date:	2/12/19

Remarks: nm= not measured, na = not applicable

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Project Number:	0014648.002A
Date:	2/15/2019
Entry By:	MS
Checked By:	MS
File Name:	HL11945

UNCONFINED COMPRESSION TEST (UC)

YANG AND ENGINEERS

30 Canyon Lane

Figure
1 of 1
2

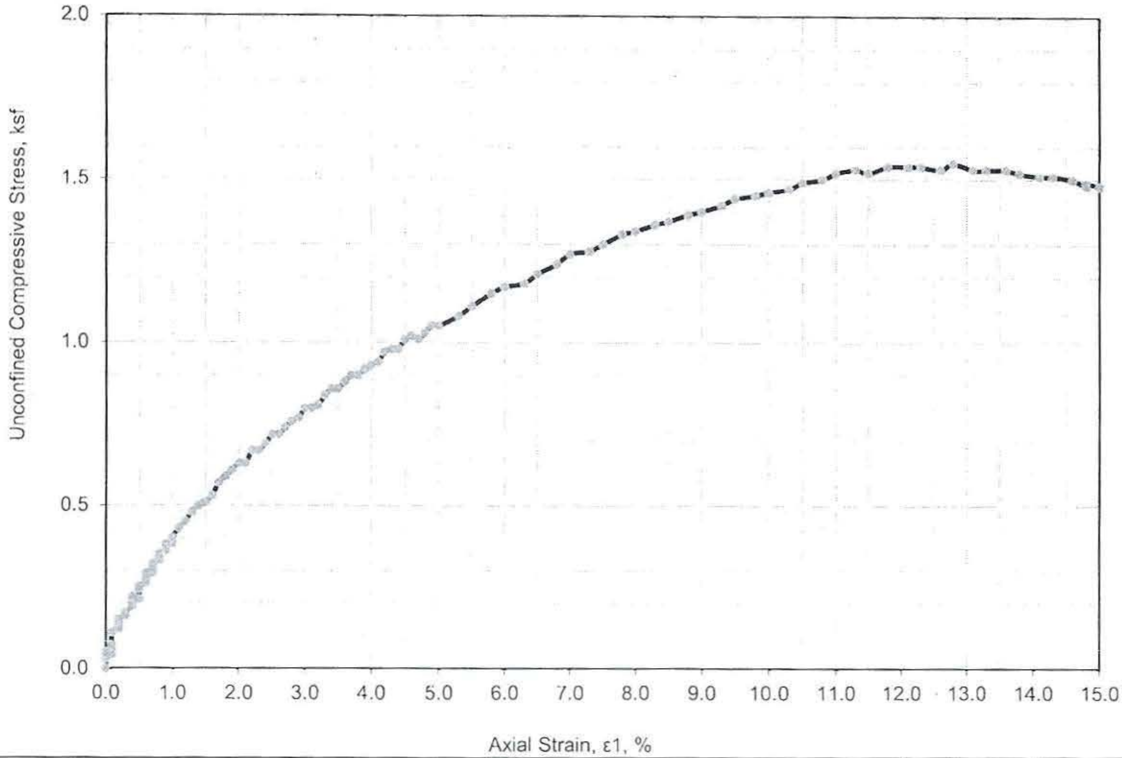
PROJECT: 30 Canyon Ln, Redwood City, CA		BORING NO. EB - 2
BORING SUPERVISOR: J. Yang	TYPE OF BORING: B24 5" solid Stem Auger	DATE OF BORING: 2-11-19
HAMMER WEIGHT: 140#/30" drop		
SURFACE ELEVATION:		
GROUNDWATER DEPTH		

DESCRIPTION OF MATERIALS	DEPTH IN FT.	SAMPLE	SAMPLE NUMBER-SAMPLE DIAMETER	DRIVING RESISTANCE BLOWS PER FT.	DRY DENSITY P.C.F.	MOISTURE CONTENT %	UNCONFINED COMPRESSIVE STRENGTH P.S.F.	OTHER TESTS
Clay (topsoil)								
Sandy lean clay, dark brown. (CL) **	5	EB2 5	2"	35	--	--	--	
Sandy clay, brown. (CL)	10	EB2 10	2"	37	102	25	2ksf	
Silty sand with small gravel. brown. ** Refusal drilling at 15	15	EB2 15	2"	50	--	--	--	
Bottom of hole								
**: Unable to recover sample due to broken soil.	20							
	25							
	30							

Job No. J19-1663

J. Yang and Engineers

PLATE 4



Specimen Failure Picture	Specimen No.			1
	Initial	Diameter, in	D_O	2.41
		Height, in	H_O	5.23
		Height to Diameter Ratio		2.17
		Water Content, %	ω_O	25.4
		Dry Density, lbs/ft^3	γd_o	100.2
		Saturation, %	S_O	101.8
		Void Ratio	e_O	0.681
	Time to Failure, min.		t_f	12.8
	Unconfined Compressive Strength, ksf		q_u	1.55
	Shear Strength, ksf		s_u	0.77
	Strain at Failure, %		ε_f	12.8
	Average Rate of Strain to Failure, %/min		ε	1.0

Description of Specimen: Olive Brown Lean Clay with Sand (CL)

Amount of Material Finer than the No. 200, %: nm

LL: nm | PL: nm | PI: nm | G_S: 2.70 Assumed | Specimen Type: Intact | Test Method: ASTM D2166

Boring:	HL11945
Sample:	EB-2
Depth, ft:	10.0
Test Date:	2/12/19

Remarks: nm= not measured, na = not applicable

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Project Number:	0014648.002A
Date:	2/15/2019
Entry By:	MS
Checked By:	MS
File Name:	HL11945

UNCONFINED COMPRESSION TEST (UC)

YANG AND ENGINEERS

30 Canyon Lane

Figure

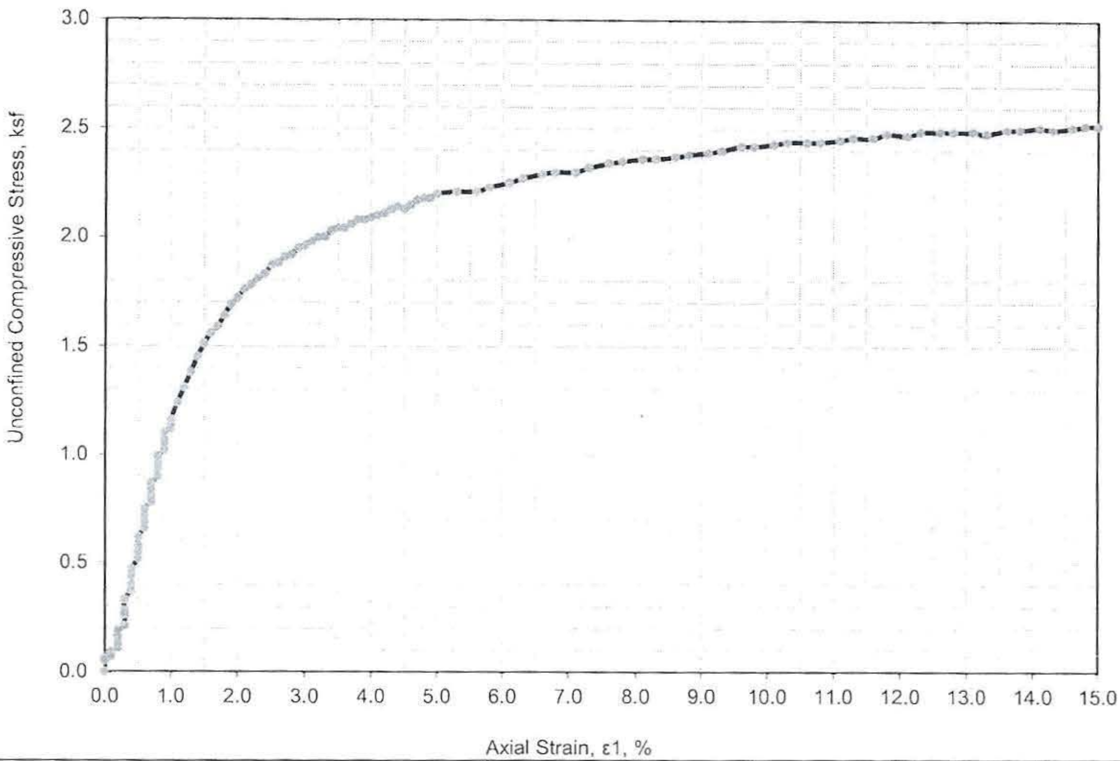
3

PROJECT: 30 Canyon Ln, Redwood City, CA								BORING NO. EB - 3
BORING SUPERVISOR: J. Yang	TYPE OF BORING: B24 5" solid Stem Auger						DATE OF BORING: 2-11-19	
HAMMER WEIGHT: 140#/30" drop								
SURFACE ELEVATION:								
GROUNDWATER DEPTH								
DESCRIPTION OF MATERIALS	DEPTH IN FT.	SAMPLE	SAMPLE NUMBER-SAMPLE DIAMETER	DRIVING RESISTANCE BLOWS PER FT.	DRY DENSITY P.C.F.	MOISTURE CONTENT %	UNCONFINED COMPRESSIVE STRENGTH P.S.F.	OTHER TESTS
Sandy clay (topsoil)								
Clay with sand, dark brown. (CL)								
Sandy clay, dark brown.	5	EB3 5	2"	40	105	21	3ksf	
Refusal drilling, rock. **		EB3 10	1.5	50	--	--	--	SPT
Bottom of hole	10							
**: Unable to recover sample due to rock.	15							
	20							
	25							
	30							

Job No. J19-1663

J. Yang and Engineers

PLATE 4



Specimen Failure Picture	Specimen No.			1
	Initial	Diameter, in	D_O	2.42
		Height, in	H_O	5.36
		Height to Diameter Ratio		2.21
		Water Content, %	ω_O	21.0
		Dry Density, lbs/ft^3	γd_o	105.6
		Saturation, %	S_O	95.6
		Void Ratio	e_O	0.596
	Time to Failure, min.		t_f	14.8
	Unconfined Compressive Strength, ksf		q_u	2.52
	Shear Strength, ksf		S_u	1.26
	Strain at Failure, %		ε_f	14.8
	Average Rate of Strain to Failure, %/min		ε	1.0

Description of Specimen: Brownish Black Lean Clay with Sand (CL)

Amount of Material Finer than the No. 200, %: nm

LL: nm | PL: nm | PI: nm | G_S: 2.70 Assumed | Specimen Type: Intact | Test Method: ASTM D2166

Boring:	HL11945	Remarks: nm= not measured, na = not applicable
Sample:	EB-3	
Depth, ft:	5.0	
Test Date:	2/12/19	

KLEINFELDER *Bright People. Right Solutions.*	Project Number:	0014648.002A	**UNCONFINED COMPRESSION TEST (UC)**	Figure
	Date:	2/15/2019		1 of 1
	Entry By:	MS	**YANG AND ENGINEERS**	
	Checked By:	MS	**30 Canyon Lane**	**4**
2601 Barrington Court, Hayward, California 94545	File Name:	HL11945		

STEVEN F. CONNELLY, C.E.G.
Consulting in Engineering Geology

May 26, 2017
Project #1704

REVISION #1

Casey Construction Inc.
619 Sylvan Way
Emerald Hills, CA 94062
Attention: Mr. Mel Casey

Subject: **ENGINEERING GEOLOGIC INVESTIGATION**
Proposed Road and Water Main
Canyon Lane
San Mateo County, California

Dear Mr. Casey,

At your request, I have prepared this Engineering Geologic Investigation for the proposed road and water main to be constructed on your property located on Canyon Lane in San Mateo County, California (see Figure 1, Site Location Map). I understand that you intend to construct a new road and water main to service several proposed new home sites on the property, as shown on plans by MacLeod and Associates (see Figure 4, Site Geologic Map and Figure 5, Water Line Geologic Map).

The property (see Photo 1 below) is located within hillside terrain susceptible to potential landsliding. According to a review letter, dated 3/8/17, prepared by the San Mateo County Reviewing Geologists, Cotton Shires and Associates, Inc., potential geologic hazards should be addressed by an Engineering Geologist. This Engineering Geologic Investigation consequently is intended to satisfy County requirements, to document potential landslide conditions, and to provide appropriate recommendations for construction of the proposed road and water line.

As part of this Engineering Geologic Investigation, I have reviewed published geologic maps; reviewed a previous Geotechnical Investigation report; consulted with Mr. Ted Sayre of Cotton Shires and Associates, Inc., the reviewing geologists for San Mateo County; consulted with you; completed site reconnaissance and mapping; reviewed historical aerial photographs; logged three test pits excavated along the proposed water line alignment; completed Engineering Geologic analysis, and completed drafting and report preparation to complete this Engineering Geologic Investigation letter report.

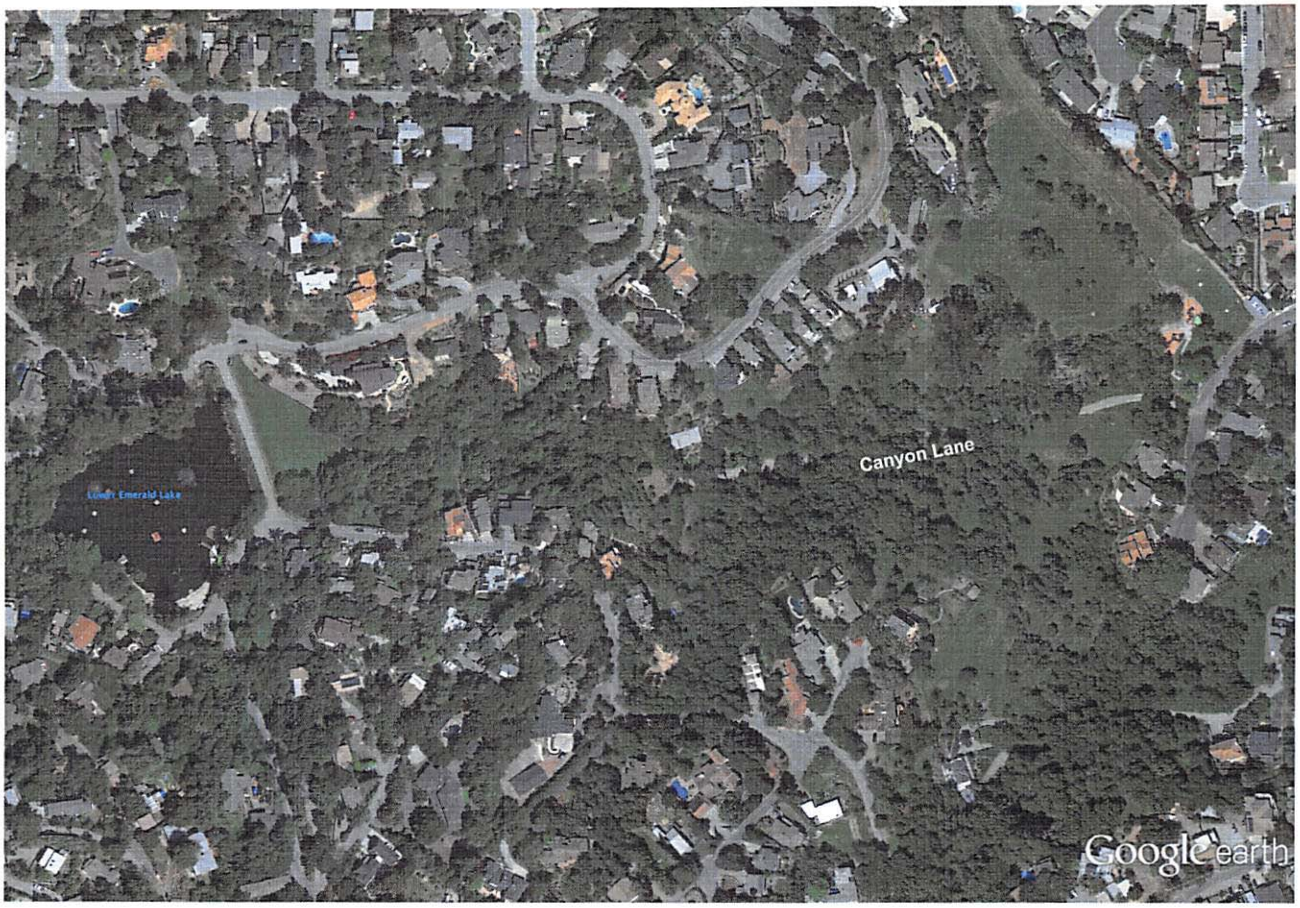


Photo 1: 2016 GoogleEarth image of Lower Emerald Lake and Canyon Lane, located downslope and to the east of Lower Emerald Lake Dam.

Site Conditions

Canyon Lane is a private roughly-paved road located along the northeast flank of the northwest-trending Santa Cruz Mountain Range, as shown on Figure 1, Site Location Map. The road is situated downslope and to the east of the Lower Emerald Lake Dam, as shown on Photo 1 above. Lower Emerald Lake Dam was constructed from artificial fill, as approximately shown on Figure 4, Site Geologic Map.

The existing Canyon Lane roadway is located parallel to an ephemeral drainage, situated along the northern side of the roadway. The roadway extends from Glenwood Drive and climbs gently uphill towards the west (see Photo 2 below). Portions of Canyon Lane appear to have been constructed by cut and fill methods with minor amounts of fill underlying the outer edge of the roadway.

Attachment J - Applicant's Engineering Geologic Investigation

Photo 2: View towards the east of the existing Canyon Lane near Glenwood Drive.

Proposed Development

Improvement of Canyon Lane is proposed to service several proposed homesites, identified by the proposed garage slabs, shown on Figure 4, Site Geologic Map. The upslope southern edge of the roadway will be widened with vertical cut slopes supported by proposed retaining walls. Three proposed home sites on the northern side of Canyon Lane will be accessed by proposed bridges crossing the ephemeral drainage.

A water line is proposed extending from an existing water main underneath Vista Drive, down a north-trending drainage swale to Canyon Lane and the proposed new homesites. An ephemeral drainage channel is located along the eastern side of the proposed water line alignment (see Figure 4). A drainage culvert beneath Vista Drive outlets into the head of the drainage channel.

Attachment J - Applicant's Engineering Geologic Investigation

Geology

According to the Brabb and others (1998), the Canyon Lane area is underlain by graywacke sandstone and sheared rock of the Franciscan Complex, as shown on Figure 2, Regional Geologic Map. Bedrock of the Whiskey Hill Formation, composed of coarse-grained sandstone and silty claystone, is mapped in the area of the proposed water line alignment. These rock units are separated by old inactive fault traces. The California Division of Mines and Geology (1974) does not map active faults in the site vicinity.

Stream channel deposits are mapped by Brabb and others (1998) within the drainage channel adjacent to Canyon Lane. Older alluvial fan deposits are identified in the low lying terrain at the eastern end of Canyon Lane.

The geologic information from Brabb and others (1998) is plotted on a San Mateo County Contour Map showing parcel boundaries on Figure 4, Site Geologic Map. Data from Brabb and others is also shown on Figure 5, Water Line Geologic Map. Geologic contacts and fault locations, however, should only be considered approximate.

Regional landslide mapping by Brabb and Pampeyan (1972) does not identify any landsliding in the site vicinity. The County of San Mateo (1976) also does not map landslides in the site vicinity (see Figure 3, County Geologic Hazards Map). The County of San Mateo (1976) maps Canyon Lane and the proposed homesites within a potential dam failure inundation zone, associated with Lower Emerald Lake Dam, as shown on Figure 3, County Geologic Hazards Map.

Air Photo Review

The following pairs of black & white and color aerial photographs were examined to observe site conditions and to aid in identifying potential landslide hazards.

Date	Photo Identification	Type	Scale
1930	C1025-63 & 64	B&W	1:14,400
9-26-48	GS-HR 2-43&44	B&W	1:23,600
6-9-56	DDB-3R-45 & 46	B&W	1:20,000
5-11-65	SM 2-60 & 61	B&W	1:12,000
6-7-73	3567-4-77&78	B&W	1:12,000
6-25-74	AREA 9 9-11 & 12	Color	1:20,000
2-21-81	GS-VEZR 3-283 & 284	B&W	1:24,000

Photo 3: 1965 air photo showing Lower Emerald Lake and Canyon Lane.

The subject property is visible in the air photos reviewed, however, the ground surface is generally obscured by thick tree cover, as shown on Photo 3 above. Canyon Lane and Lower Emerald Lake Dam were constructed sometime before the 1930 photo date. A quarry excavation is evident near the eastern end of Canyon Lane in the 1956 air photos. Evidence of active landsliding or faulting is not apparent in the air photos reviewed on or adjacent to Canyon Lane or the proposed water line alignment.

Geotechnical Investigation

J. Yang and Engineers (2017) completed a Geotechnical Site Investigation for the proposed roadway improvement. Six test borings were excavated to depths between 6 and 11 feet along Canyon Lane as part of the investigation. According to the boring logs, resistant materials were encountered at relatively shallow depths in all of the test borings. J. Yang found the proposed roadway improvement plan to be suitable from a geotechnical aspect.

Attachment J - Applicant's Engineering Geologic Investigation

Photo 4: View towards the north of resistant rock outcrop of Franciscan sandstone located near the eastern end of Canyon Lane.

Site Reconnaissance & Mapping

Four site reconnaissances were performed during May of 2017 as part of this Engineering Geologic Investigation. Evidence of an abandoned quarry is located along the south side of Canyon Lane near its junction with Glenwood Drive, as approximately shown on Figure 4, Site Geologic Map. A large rock outcrop of Franciscan sandstone is located on a ridge on the opposite side of Canyon Lane, as shown on Photo 4 below. Two additional sandstone rock outcrops are located to the west, as approximately shown on Figure 4.

Water was flowing in the ephemeral drainage adjacent to Canyon Lane at the time of the site visits. Water was also flowing down the recently constructed Vista Drive drainage culvert and the ephemeral drainage channel on the southern side of Canyon Lane. Minor amounts of fill appear to be located along the downslope edge of Canyon Lane. Existing slopes along the upslope side of Canyon Lane appear to be relatively stable.

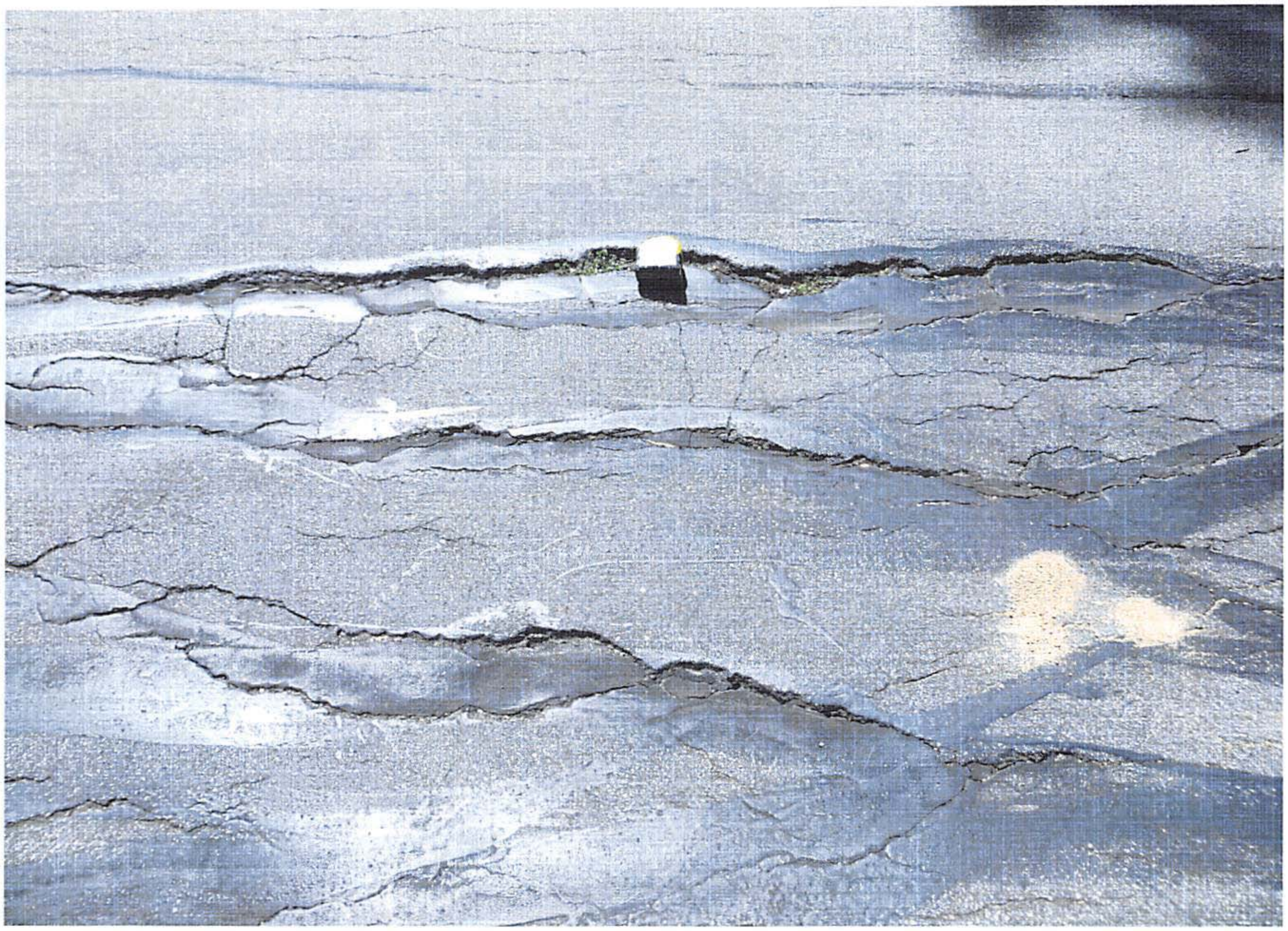


Photo 5: View of asphalt cracking in Vista Drive suggestive of landslide activity.

Cracking suggestive of recent and ongoing landslide activity (see Photo 5 above) is apparent in Vista Drive, as approximately shown on Figure 4, Site Geologic Map and Figure 5, Water Line Geologic Map. Cracks have been patched and subsequently reopened. Hummocky, disturbed ground indicative of active landsliding is located below the cracking in Vista Drive (see Figures 4 & 5).

Subsurface Investigation

Three test pits were excavated as part of this investigation, in the approximate locations shown on Figure 4, Site Geologic Map and Figure 5, Water Line Geologic Map, to assess soil, bedrock, and landslide conditions along the proposed water line alignment (see Photo 6 below). A side wall of the test pits was cleaned, carefully examined, and logged, as presented on Figures 6 through 8, Logs of Test Pits 1 through 3. Please refer to the pit logs for detailed descriptions.

Photo 6: View of backhoe excavating Test Pit 1.

Test Pit 1 encountered about 2.5 feet of colluvial soil composed of very dark grayish brown, silty clay. The colluvial soil is underlain by 2.5 feet of light olive brown, firm to stiff, very moist, highly plastic, silty clay. A slightly undulating landslide surface, trending N62W and plunging 9 degrees N, occurs at a depth of about 5 feet, as shown on Photo 7 below. The upper 5 feet of soil comprise an active landslide deposit (see Photo 8 below).

The soils in the active landslide deposit are dark-colored organic materials that appear to have been previous colluvial deposits. The active landslide debris is underlain by highly weathered bedrock of the Whiskey Hill Formation composed of moist to wet, dense to hard, clayey silt with siltstone rock fragments. Moderately hard to hard siltstone of the Whiskey Hill Formation was encountered at a depth of about 8 feet.

Attachment J - Applicant's Engineering Geologic Investigation

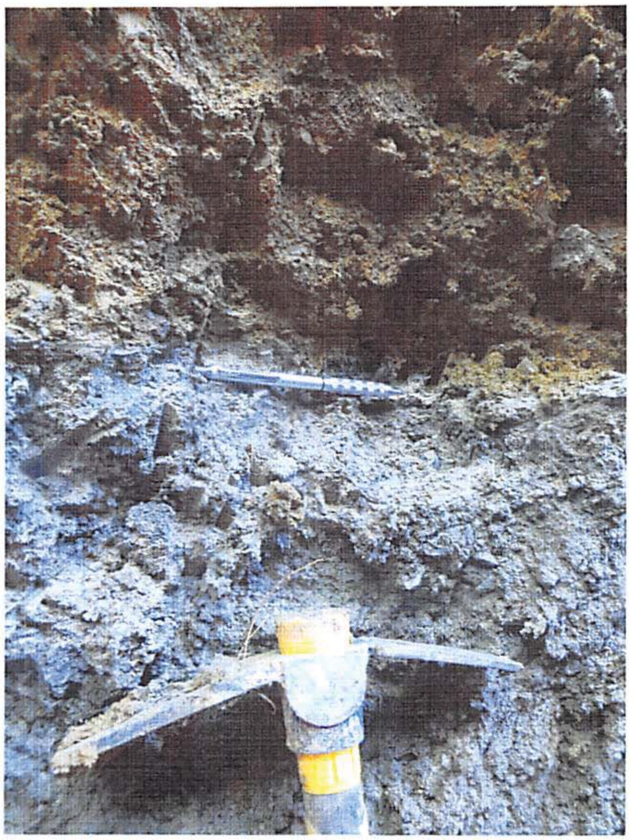


Photo 7:

View of Test Pit 1. Pencil marks thin gray, undulating active landslide surface. Highly weathered bedrock occurs below.

Photo 8:

View of Test Pit 1 with brown-colored active landslide deposit overlying gray-colored highly weathered bedrock.

Test Pit 2 encountered about 2.5 feet of colluvial soil composed of firm to stiff, highly plastic, silty clay. The colluvial soil is underlain by about 2 feet of residual soil composed of firm to stiff, moderately plastic, silty clay. About 3.5 feet of highly weathered bedrock of the Whiskey Hill Formation was encountered below the surface soils. Hard clayey siltstone of the Whiskey Hill Formation was encountered at a depth of 8 feet. Test Pit 3 encountered similar materials as Test Pit 2.

Discussion

Based upon the results of this Engineering Geologic Investigation, an active landslide deposit (probably moving within the last 50 years) is located just below Vista Drive. The landslide impacts the proposed water line alignment, as approximately shown on Figures 4 and 5. Information from Test Pit 1 and topographic data suggest that the active landslide deposit is about 8 feet deep, as approximately depicted on Figure 9, Geologic Cross-Section A-A'. Relatively resistant weathered bedrock of the Whiskey Hill Formation occurs below the landslide deposit. Cracking to the outer half of Vista Drive indicates that the landslide has impacted the roadway and may affect the underlying water line to be tapped for the proposed water line to service the proposed Canyon Lane development.

Findings and Recommendations

I did not observe evidence of landslide or fault activity that would impact the proposed road widening, proposed retaining walls, or proposed bridges for the proposed Canyon Lane development. The roadway and proposed home sites appear to be underlain by alluvial deposits and resistant weathered bedrock of the Franciscan Complex at relatively shallow depth.

A relatively shallow active landslide deposit is located at the head of the proposed water line alignment to service the proposed Canyon Lane Development. Three possible alternatives to mitigate the landslide problem would be to 1) move the proposed water line, 2) remove and replace the active landslide deposit as engineered fill, or 3) support the outer edge of Vista Drive with a stitch pier wall and locate the proposed water line at depth within the resistant bedrock underlying the landslide.

If alternatives 2 or 3 are pursued, further investigation and collaboration with the project Geotechnical Engineer will be required to develop findings and recommendations for the proposed mitigations. I would be glad to assist in any required geologic investigations for landslide mitigations or for site specific studies for proposed home sites.

★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★

LIMITATIONS

This Engineering Geologic Investigation letter report has been prepared for the exclusive use of the addressee, and project architects and engineers. The opinions, comments, and conclusions presented in this report were based upon information derived from office studies, site mapping, and limited subsurface investigation. My work has been conducted in general conformance with the standard of care in the field of engineering geology currently in practice in the San Francisco Bay Area. I make no other warranty either expressed or implied.

Attachment J - Applicant's Engineering Geologic Investigation

Thank you for the opportunity to prepare this Engineering Geologic Investigation letter report. Please call if you have any questions.

Sincerely,

Steven F. Connelly
Certified Engineering Geologist 1607

Copies: 7 - Addressee

Attachments

Figure 1: Site Location Map
Figure 2: Regional Geologic Map
Figure 3: County Geologic Hazards Map
Figure 4: Site Geologic Map
Figure 5: Water Line Geologic Map
Figure 6: Log of Test Pit 1
Figure 7: Log of Test Pit 2
Figure 8: Log of Test Pit 3
Figure 9: Geologic Cross-Section A-A'

References

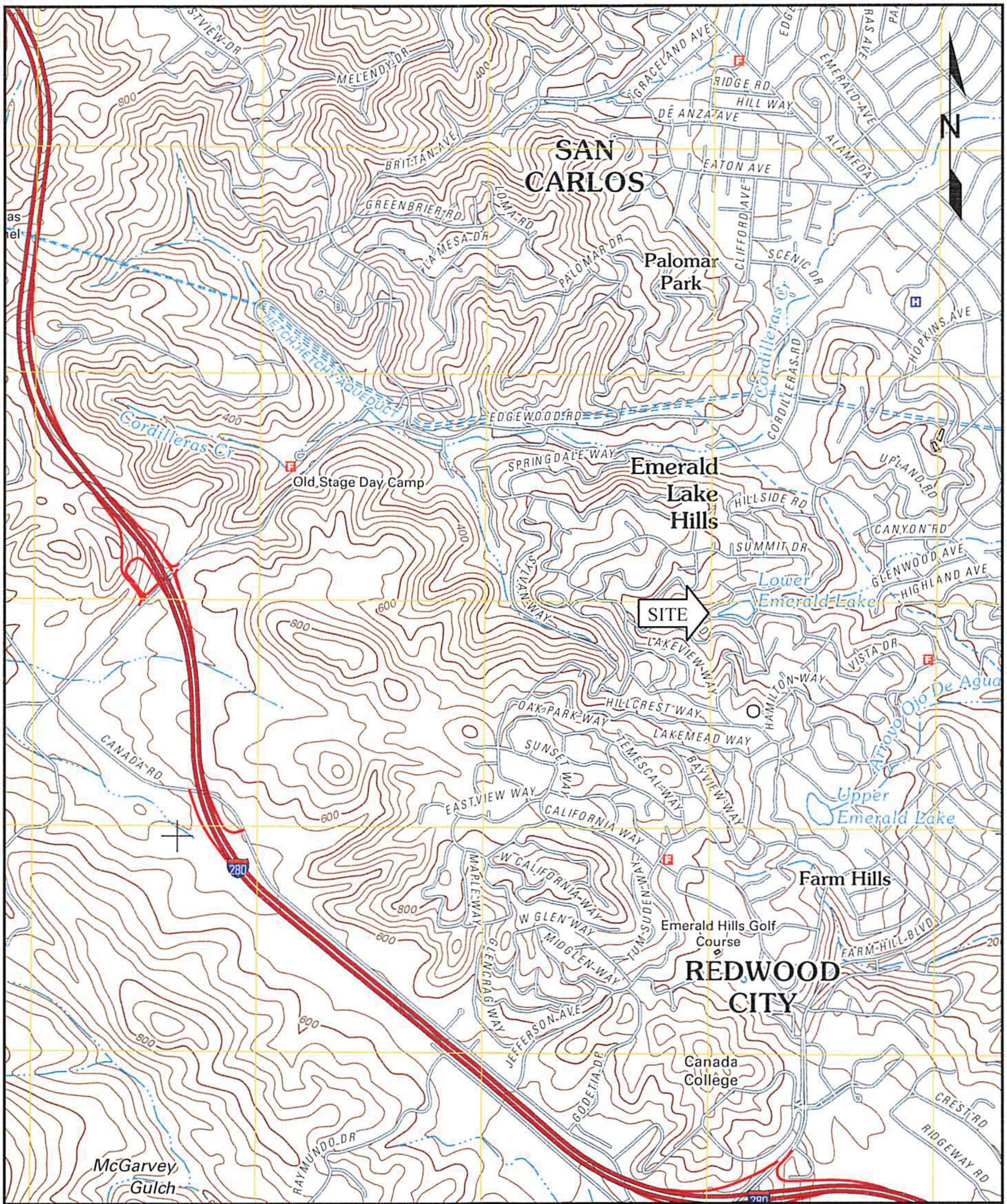
Brabb, E.E., Graymer, R.W., and Jones, D.L., 1998, Geology of the Palo Alto 30 X 60 Minute Quadrangle, California: A digital database, Open-File Report 98-348, Map Scale 1:100,000.

Brabb, Earl E. and Pampeyan, Earl H., 1972, Preliminary Map of Landslide Deposits in San Mateo County, California, U.S. Geological Survey Map MF-344, Map Scale 1:62.500.

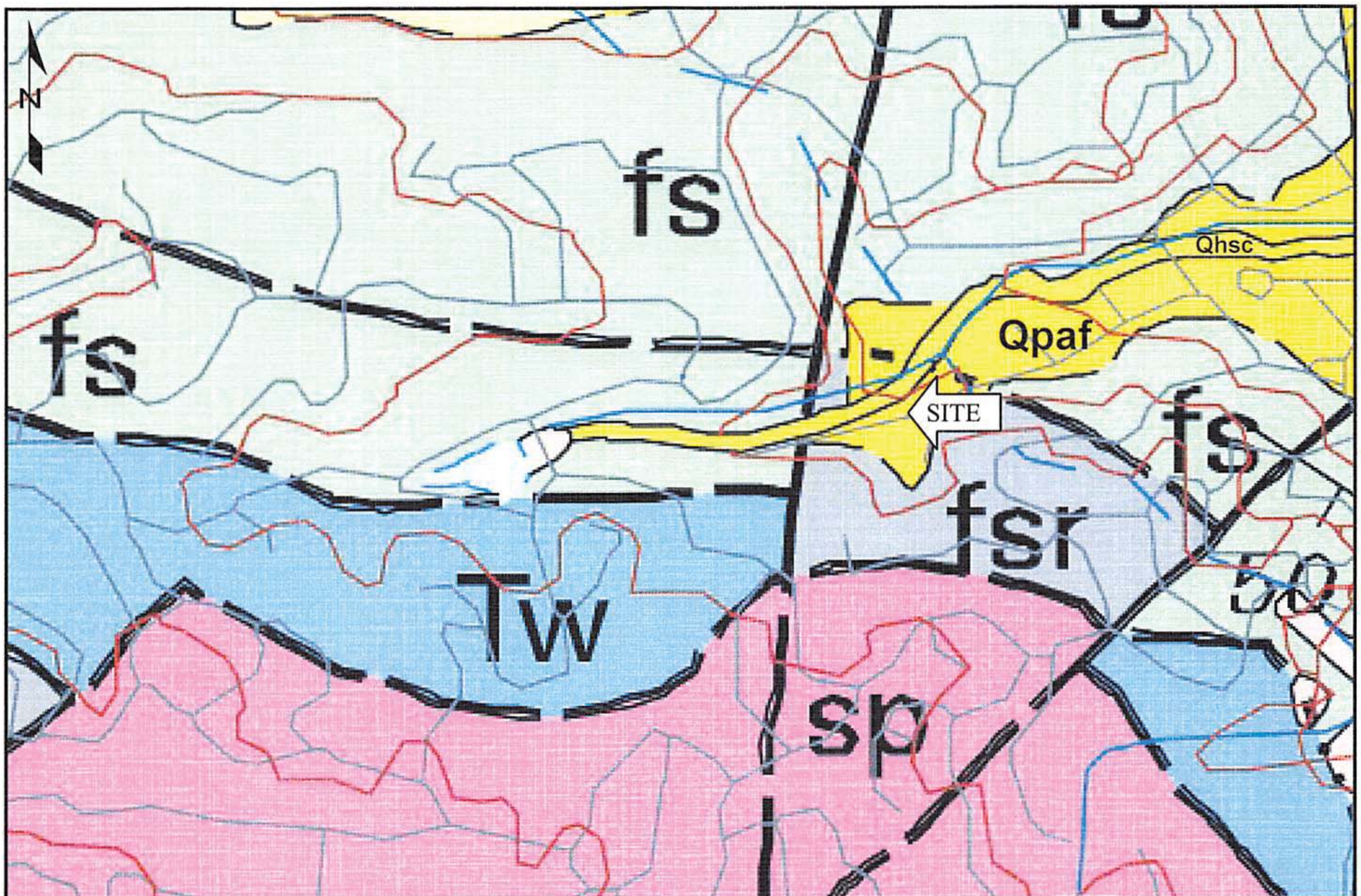
County of San Mateo, 1976, Geotechnical Hazard Synthesis Map, prepared by Leighton and Associates, the San Mateo County Planning Department, and the U.S. Geological Survey, Map Scale 1:24,000.

County of San Mateo, 3/8/17, Geotechnical Review Sheet, prepared by Cotton Shires and Associates.

J. Yang and Engineers, December 28, 2014, Geotechnical Site Investigation, Proposed Roadway Improvement at 0 Canyon Lane, Redwood City, California.



Regional Topographic Map	Proposed Road and Water Line Canyon Lane San Mateo County, California			
STEVEN F. CONNELLY, C.E.G. Consulting in Engineering Geology	Project #	Scale	Date	Figure
	1704	1 Inch = 2000 Feet	5/26/17	1



EXPLANATION

	Geologic Contact, dashed where approximate, dotted where concealed
?	Fault Trace, dashed where approximate, dotted where concealed, queried where uncertain
	Thrust or Reverse Fault
35	Strike and Dip of Bedding
35	Strike and Dip of Foliation

Qhsc	Stream channel deposits
Qpaf	Alluvial fan deposits
Tw	Whiskey Hill Formation
fsr	Sheared rock
fs	Sandstone
sp	Serpentinite

Source: Brabb, Graymer, and Jones, 1998

Regional Geologic Map

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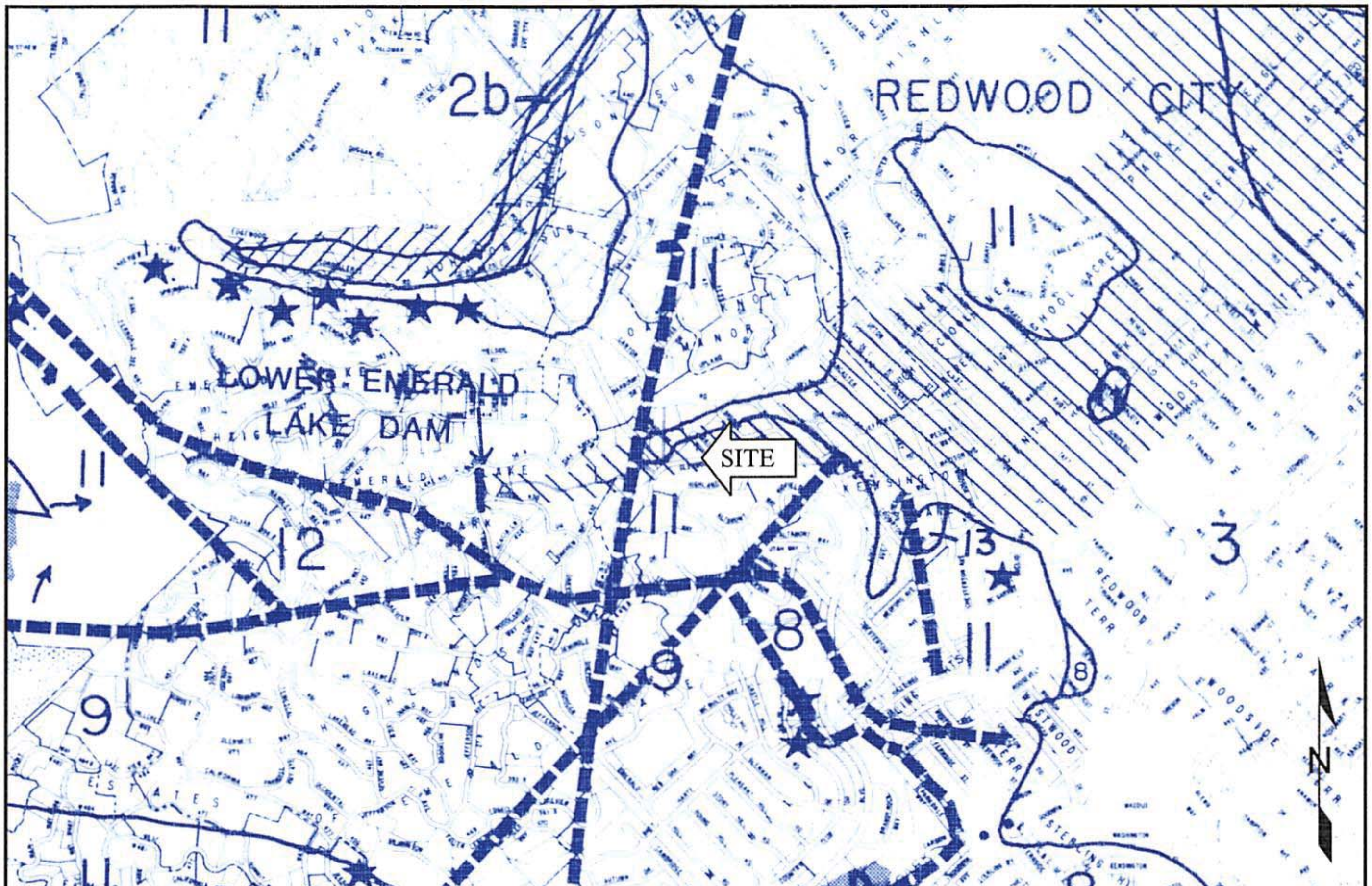
Consulting in Engineering Geology

Proposed Road and Water Line
Canyon Lane
San Mateo County, California

Project #	Scale	Date	Figure
1704	1 Inch = 2000 Feet	5/26/17	2

Attachment J - Applicant's Engineering Geologic Investigation



EXPLANATION

Geologic Contact, dashed where approx., dotted where concealed

Fault Trace, dashed where approximate, dotted where concealed, queried where uncertain

Thrust or Reverse Fault

35 Strike and Dip of Bedding

35 Strike and Dip of Foliation

D = Definite landslide
A = Active
F = Mapped in the field
P = Probable landslide deposit

Small landslide (50-500 ft. max. dimension mapped by photointerpretation)
Small landslide (50-500 ft.) mapped in the field
? Suspected or conjectured landslide.

Dam Failure Inundation Area

Source: County of San Mateo, 1976

County Geologic Hazards Map

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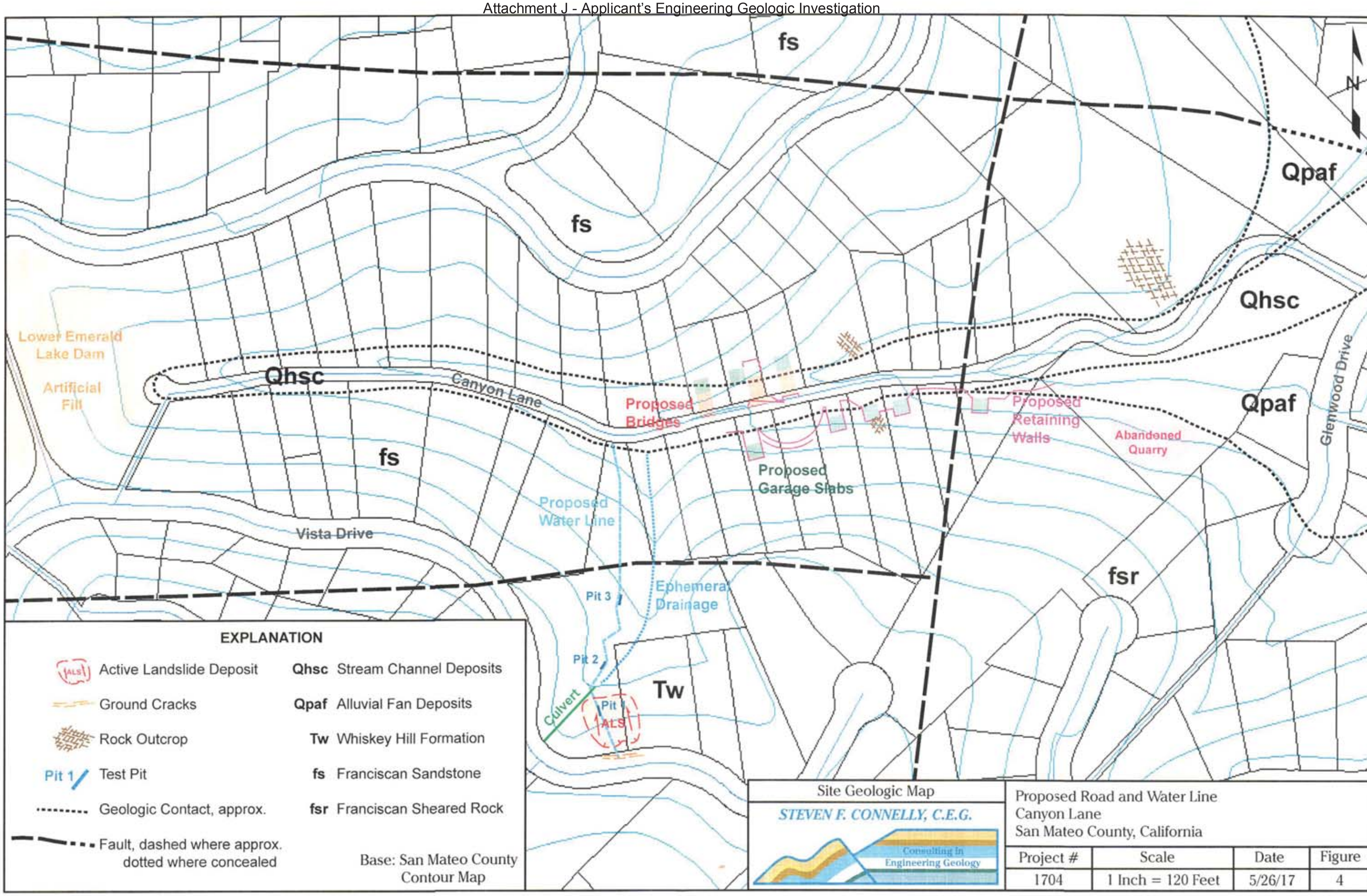
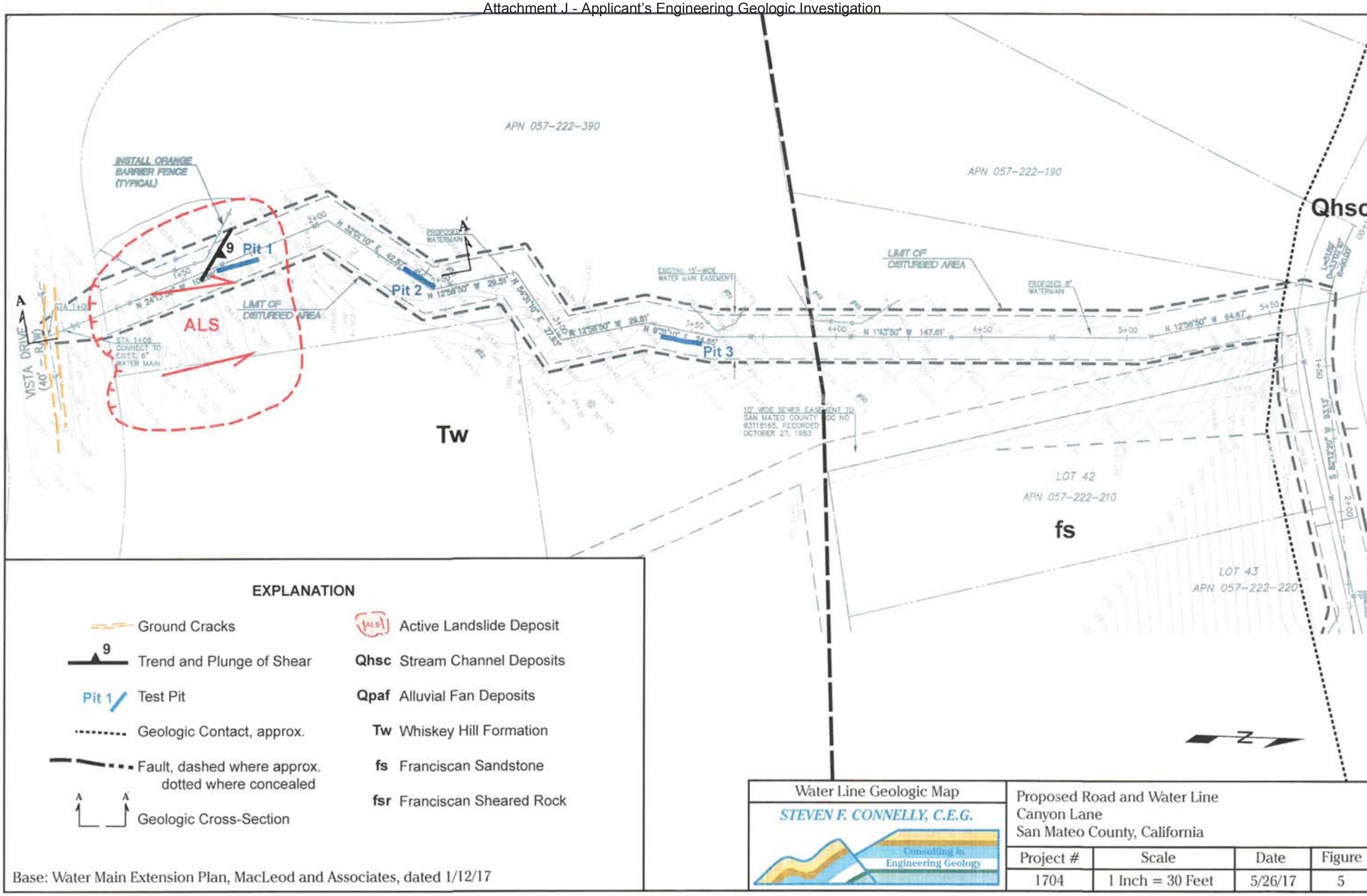
Proposed Road and Water Line
Canyon Lane
San Mateo County, California

Project #	Scale	Date	Figure
1704	1 Inch = 2000 Feet	5/26/17	3


N
fs
fs
fs
Qpaf
Qhsc
Qpaf
Qhsc
fsr
Tw
Glenwood Drive
Canyon Lane
Vista Drive
Lower Emerald Lake Dam
Artificial Fill
Proposed Bridges
Proposed Retaining Walls
Proposed Garage Slabs
Proposed Water Line
Abandoned Quarry
Ephemeral Drainage
Pit 1
Pit 2
Pit 3
ALS
Culvert
EXPLANATION
ALS Active Landslide Deposit
Ground Cracks
Rock Outcrop
Pit 1 Test Pit
Geologic Contact, approx.
Fault, dashed where approx. dotted where concealed
Qhsc Stream Channel Deposits
Qpaf Alluvial Fan Deposits
Tw Whiskey Hill Formation
fs Franciscan Sandstone
fsr Franciscan Sheared Rock
Base: San Mateo County Contour Map
Site Geologic Map
STEVEN F. CONNELLY, C.E.G.
Consulting in Engineering Geology
Proposed Road and Water Line
Canyon Lane
San Mateo County, California
Project # 1704
Scale 1 Inch = 120 Feet
Date 5/26/17
Figure 4


APN 057-222-390
APN 057-222-190
Qhsc
INSTALL ORANGE BARRIER FENCE (TYPICAL)
Pit 1
Pit 2
Pit 3
ALS
LIMIT OF DISTURBED AREA
PROPOSED WATERMAIN
EXISTING 15'-WIDE WATER MAIN EASEMENT
PROPOSED 8" WATERMAIN
VISTA DRIVE (40' - R/W)
Tw
LOT 42
APN 057-222-210
fs
LOT 43
APN 057-222-220
EXPLANATION
Ground Cracks
Trend and Plunge of Shear
Pit 1 Test Pit
Geologic Contact, approx.
Fault, dashed where approx. dotted where concealed
Geologic Cross-Section
Active Landslide Deposit
Qhsc Stream Channel Deposits
Qpaf Alluvial Fan Deposits
Tw Whiskey Hill Formation
fs Franciscan Sandstone
fsr Franciscan Sheared Rock
Base: Water Main Extension Plan, MacLeod and Associates, dated 1/12/17
Water Line Geologic Map
STEVEN F. CONNELLY, C.E.G.
Consulting in Engineering Geology
Proposed Road and Water Line
Canyon Lane
San Mateo County, California
Project # 1704
Scale 1 Inch = 30 Feet
Date 5/26/17
Figure 5

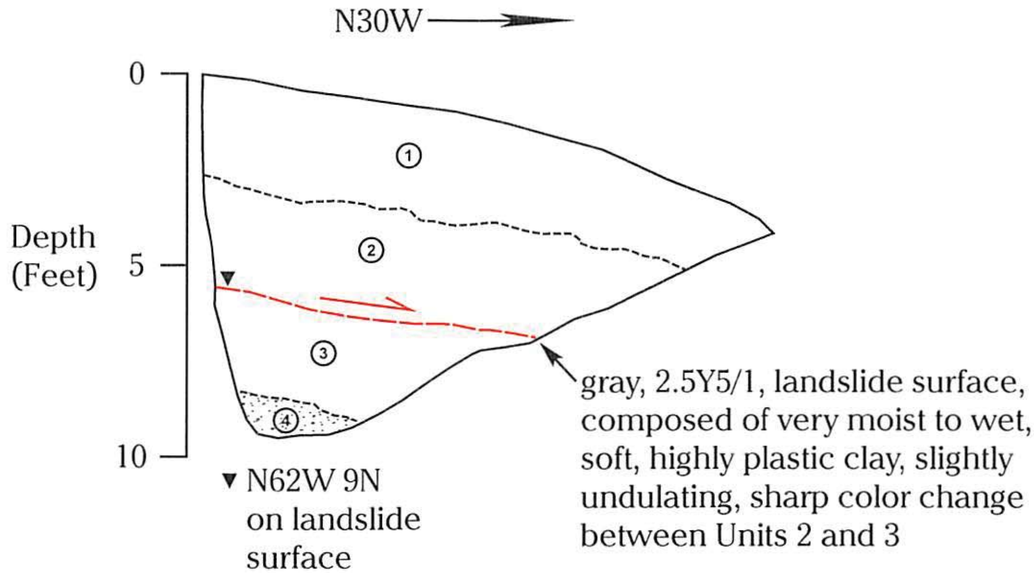
Symbols

gradational contact

relatively sharp contact

very sharp contact

N35W 9SW ▼ strike and dip of bedding or trend and plunge of shear surface



① very dark grayish brown, 2.5Y3/2, silty clay, very moist, soft to firm, some rootlets, high plasticity, roots and rootlets, trace rock fragments, CH (Colluvial Soil)

② light olive brown, 2.5Y5/4, silty clay, very moist, firm to stiff, high plasticity, abundant angular rock fragments of fine-grained sandstone, with angular grains, trace rootlets, CH (Active Landslide Deposit)

③ gray, 2.5Y5/1, to very dark gray, 2.5Y3/1, clayey silt, moist to wet, dense to hard, some fragments of weathered siltstone in a clayey matrix, CL (Highly Weathered Bedrock, Whiskey Hill Formation)

④ very dark gray, 2.5Y3/1, siltstone, fine-grained, moderately hard to very hard (Weathered Bedrock, Whiskey Hill Formation)

Logged by Steven F. Connelly, C.E.G., 5/18/17

Log of Test Pit 1	Proposed Road and Water Line Canyon Lane San Mateo County, California			
STEVEN F. CONNELLY, C.E.G. Consulting in Engineering Geology	**Project #**	**Scale**	**Date**	**Figure**
	1704	1 Inch = 5 Feet	5/26/17	6

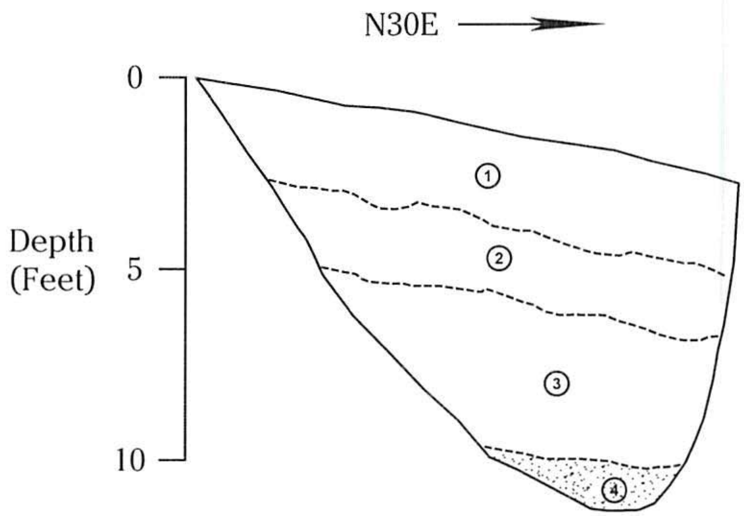
Symbols

gradational contact

relatively sharp contact

very sharp contact

N35W 9SW ▼ strike and dip of bedding or trend and plunge of shear surface



① very dark gray, 2.5Y3/1, silty clay, moist, firm to stiff, some rootlets, high plasticity, rootlets, CH (Colluvial Soil)

② dark gray, 2.5Y4/1, silty clay, moist, firm to stiff, trace rootlets, trace rock fragments of siltstone and sandstone, moderate plasticity, CH (Residual Soil)

③ dark gray, 2.5Y4/1, to dark grayish brown, 2.5Y4/2, clayey silt, moist, very stiff to hard, some rock fragments increasing with depth, low plasticity, CL (Highly Weathered Bedrock, Whiskey Hill Formation)

④ dark grayish brown, 2.5Y4/2, clayey siltstone, slightly moist, hard (Weathered Bedrock, Whiskey Hill Formation)

Logged by Steven F. Connelly, C.E.G., 5/18/17

Log of Test Pit 2

STEVEN F. CONNELLY, C.E.G.

Consulting in Engineering Geology

Proposed Road and Water Line
Canyon Lane
San Mateo County, California

Project #	Scale	Date	Figure
1704	1 Inch = 5 Feet	5/26/17	7

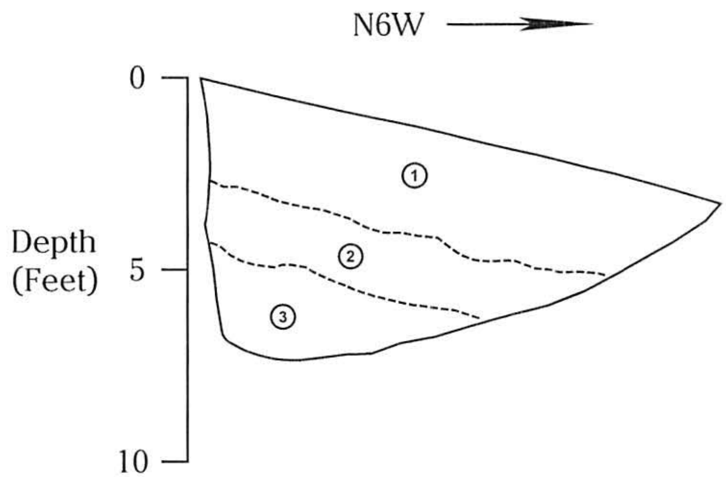
Symbols

gradational contact

relatively sharp contact

very sharp contact

N35W 9SW ▼ strike and dip of bedding or trend and plunge of shear surface



① very dark gray, 2.5Y3/1, silty clay, moist, firm to stiff, some rootlets, high plasticity, rootlets, CH (Colluvial Soil)

② dark gray, 2.5Y4/1, silty clay, moist, firm to stiff, trace rootlets, trace rock fragments of siltstone and sandstone, moderate plasticity, CH (Residual Soil)

③ dark gray, 2.5Y4/1, to dark grayish brown, 2.5Y4/2, clayey silt, moist, very stiff to hard, some rock fragments increasing with depth, low plasticity, CL (Highly Weathered Bedrock, Whiskey Hill Formation)

Logged by Steven F. Connelly, C.E.G., 5/18/17

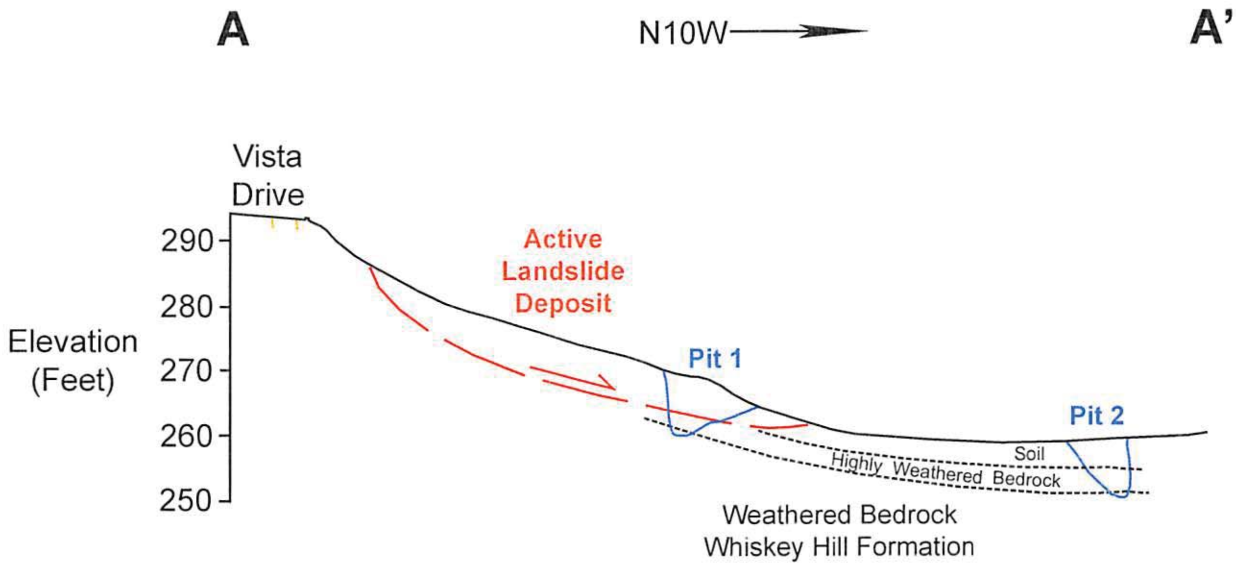
Log of Test Pit 3

STEVEN F. CONNELLY, C.E.G.

Consulting in Engineering Geology

Proposed Road and Water Line
Canyon Lane
San Mateo County, California

Project #	Scale	Date	Figure
1704	1 Inch = 5 Feet	5/26/17	8



Slope profile based on Water Main Extension Plan, MacLeod and Associates, dated 1/12/17

Geologic Cross-Section A-A'	Proposed Road and Water Line Canyon Lane San Mateo County, California			
STEVEN F. CONNELLY, C.E.G. Consulting in Engineering Geology	Project #	Scale	Date	Figure
	1704	1 Inch = 30 Feet	5/26/17	9