APPENDIX D

GEOTECHNICAL INVESTIGATION

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UPDATED GEOTECHNICAL INVESTIGATION
Northgate Town Square
San Rafael, California

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TABLE OF CONTENTS

TABLE OF CONTENTS
(Continued)

LIST OF FIGURES

LIST OF APPENDICES

UPDATED GEOTECHNICAL INVESTIGATION
Northgate Town Square
San Rafael, California

1.0 INTRODUCTION

This report presents the results of the geotechnical investigation performed by Langan Engineering and Environmental Services, Inc. (Langan) for the proposed Northgate Town Square in San Rafael, California. Our original geotechnical investigation report was dated 7 December 2021; this report updates that version to address comments from Dudek and MGP XI Northgate, LLC. The existing Northgate Shopping Center site (project site) is bordered by Las Gallinas Avenue to the north and to the east, and Northgate Drive to the west and to the south as shown on Figure 1. The site is irregularly-shaped site, occupies an area of about 44.7 acres.

The existing shopping center includes four main anchor stores (RH Outlet, Macy's, Kohls, and Homegoods) and a Century Theater (cinema) as shown on Figure 2. Numerous retail stores, shops and restaurant facilities occupy the areas between the anchor stores and cinema.

We understand the proposed Northgate Town Square development will be divided into two phases:

- 2025 Master Plan
- 2040 Vision Plan

2025 Master Plan

The 2025 Master Plan includes demolition of some of the existing retail structures; development of four residential parcels, each with its own parking component; construction of a new shop north of the cinema and a major retail space, and two new restaurant pads; and expansion of the existing cinema.

Residential parcels, denoted as Residential 1 through 4 on Figure 2, vary from 96 to 309 residential units with 96 to 541 parking stalls and are proposed to be constructed on the southern and eastern portions of the site. We understand that the number of residential units and parking stalls may slightly change as the project planning progresses. Residential 1 is planned as a 4-story structure over a podium. Residential 2 through Residential 4 are planned as 5-story buildings.

Restaurant pads, denoted as Pad 1 and 2 on Figure 2, are proposed on the northwestern portion of the site, along Las Gallinas Avenue, and occupy an area of approximately 4,200 square feet and 8,400 square feet, respectively.

2040 Vision Plan

We understand the 2040 Vision Plan includes demolition of some of the remaining existing retail structures; development of two residential parcels with parking components; construction of additional shops, a major retail space, and three new restaurant pads.

New shops are planned on the western portion of Residential 6, north of the cinema, and southeast of Residential 5. New major retail space is planned on the northern portion of Residential Parcel 6 (Figure 2).

Residential Parcels for this phase, denoted Residential 5 and 6 on Figure 2, have 264 and 145 residential units respectively, and 462 and 251 parking stalls, respectively. Similar to the Residential 1 through 4 developments, the number of residential units and parking stalls may slightly change as the project planning progresses. Residential 5 and Residential 6 are proposed on the eastern and western portions of the site, respectively. Both of these building are planned as 5-story structures.

Restaurant pads, denoted as Pad 3 and 4 on Figure 2, are proposed on the northern portion of the site, along Las Gallinas Avenue and will occupy an area of 5,000 square feet and 3,800 square feet, respectively. Pad 5 is proposed on the northwestern portion of the site (along Northgate Drive and will occupy an area of approximately 5,000 square feet.

2.0 SCOPE OF SERVICES

Our geotechnical investigation was performed in accordance with the scope of services included in our proposal dated 1 September 2021. Our scope of services consisted of evaluating subsurface conditions by reviewing the findings from previous investigations at the site and performing supplemental geotechnical exploration. Using the results of previous and current investigations and laboratory testing, we performed engineering evaluations to develop conclusions and recommendations for the geotechnical aspects of the proposed development (for both the 2025 and 2040 plans) regarding:

- soil and groundwater conditions at the site
- appropriate foundation type(s) for the buildings

- design criteria for the recommended foundation type(s), including values for vertical and lateral resistance
- required foundation embedment
- estimated foundation settlement, including total and differential settlements
- site seismicity and seismic hazards, including ground rupture, liquefaction, and cyclic densification
- mitigation of liquefaction potential
- site grading, including criteria for fill quality and compaction
- temporary and permanent cut and fill slopes
- floor slabs and exterior concrete flatwork
- seismic design criteria (mapped values) in accordance with the 2019 California Building Code, as appropriate
- corrosion potential of near-surface soil
- flexible and rigid pavement design
- groundwater/stormwater infiltration considerations
- construction considerations.

3.0 SITE CONDITIONS

The site currently consists of an active shopping center, which includes commercial and retail buildings, primarily occupying the middle portion of the site, surrounded by paved parking areas.

Based on our review of the Woodward-Clyde Consultants (WCC 1982), we understand the site was developed by cutting into a steep ridge that was present on the western side of the site. The excavated material was then placed as fill to level the site on the eastern portion of the site. Therefore, the western portion of the site is predominantly an area of cut with shallow bedrock, while the eastern portion of the site are fill areas, up to 20 feet thick.

The site is relatively level with ground surface elevations ranging from about Elevation 30 to 40 feet[1].

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[1] Elevations are based on a topographic site survey presented on Sheet No. C1.0 - "Existing Conditions" prepared by CSW/Stuber-Stroeh Engineering Group, Inc. and Will, dated May 14,2021, using the North American Vertical Datum 1988 (NAVD88). All elevations described herein reference NAVD88 datum.

4.0 FIELD INVESTIGATIONS

4.1 Current Field Investigation

Our subsurface investigation for the Northgate Town Square development included drilling 33 borings to supplement the existing subsurface data. Prior to performing our field investigation, we coordinated site access, performed a site walk and marked exploration points, notified Underground Service Alert (USA), retained a private utility locator to check the proposed exploration locations were clear of underground utilities, and performed work in general accordance with our drilling permit with Marin County Environmental Health Services (MCEHS).

The borings were drilled by Gulf Shore Construction Services, Inc. (Gulf Shore) of Rancho Cordova, California, using a truck-mounted hollow-stem auger drill rig between 20 October and 3 November 2021, under the supervision of a field engineer or geologist of Divis Consulting, Inc. (Divis), our subconsultant, with Langan oversight. A summary of the borings performed during this field investigation is presented in Table 1. The approximate locations of the borings are shown on Figure 2. The borings drilled in the proposed residential areas and pad areas are designated as R and P, respectively. Borings designated S and C were drilled in areas to near proposed shops and cinema expansion.

TABLE 1
Summary of Borings

Boring ID	Approximate Ground Surface Elevation (feet, NAVD88)	Depth of Boring (feet)	Approximate Bottom of Boring Elevation (feet, NAVD88)
C-1	36	35.3	0.7
P-1	30	11.5	18.5
P-2	29.5	11.5	18
P-3	28	16.5	11.5
P-4	27.5	21.5	6
P-5	39.5	10.5	29
R1-1	37	10.2	26.8
R1-2	37	5.2	31.8
R1-3	36.5	5.9	30.6
R2-1	38	11.25	26.75
R2-2	36	10.4	25.6
R2-3	35.5	16	19.5
R2-4	34	15.25	18.75
R2-5	36	20.9	15.1
R3-1	35	31.5	3.5
R3-2	32.5	25.7	6.8
R3-3	33.5	21	12.5
R3-4	33	21.5	11.5
R3-5	33	10.25	22.75
R4-1	36	30.4	5.6
R4-2	36	26.2	9.8
R4-3	33.5	41.2	-7.7
R4-4	32.5	30.5	2
R4-5	32	46	-14
R5-1	34.5	25.4	9.1
R5-2	35	41.25	-6.25
R5-3	34.5	45.3	-10.8
R5-4	30.5	35.25	-4.75
R5-5	30.5	46.5	-16
R6-1	40.5	5.8	34.7
R6-2	37	11.25	25.75
R6-3	37	10.2	26.8
S3-1	37	15.25	21.75

The borings were drilled into bedrock, to depths ranging from about 5 to 46.5 feet below the existing ground surface (bgs), which correspond to approximate Elevations 34.7 to -16 feet, respectively. During drilling, Divis field representative logged the soil encountered in the borings and obtained samples of the materials encountered for visual classification and laboratory testing. Logs of the borings are presented on Figures A-1 through A-33 in Appendix A. The soil encountered in the borings were classified in accordance with the classification charts shown on Figure A-34. Samples of the materials encountered were obtained using the following sampler types:

- Standard Penetration Test (SPT) split-barrel sampler with a 2.0-inch outside diameter (O.D.) and a 1-3/8-inch inside diameter (I.D.)
- Sprague and Henwood (S&H) split-barrel sampler with a 3.0-inch O.D. and 2.5-inch I.D., lined with 2.43-inch-I.D. steel tubes

The sampler types were chosen on the basis of soil type and desired sample quality for laboratory testing. In general, the SPT sampler was used to evaluate the relative density of sandy soil and the S&H sampler was used to obtain samples in medium stiff to very stiff cohesive soil.

The SPT and S&H samplers were driven with a 140-pound automatic safety hammer falling 30 inches. The samplers were driven up to 18 inches and the hammer blows required to drive the samplers every six inches of penetration were recorded and are presented on the boring logs. A “blow count” is defined as the number of hammer blows per six inches of penetration.

The blow counts required to drive the S&H and SPT samplers 12 inches were converted to approximate SPT N-values using factors of 0.8 and 1.3, respectively, to account for sampler type and hammer energy. The N-values are shown on the boring logs. The blow counts used for the conversions were: 1) the last two blow counts if the sampler was driven more than 12 inches, or 2) the last one blow count if the sampler was driven more than six inches but less than 12 inches.

Upon completion, the boreholes were backfilled with cement grout in accordance with MCEHS requirements. Soil cuttings generated during drilling of the borings were placed into 55-gallon drums, and temporarily stored onsite. Drum contents were tested for the presence of chemicals, were classified as non-hazardous, and subsequently disposed offsite.

4.2 Previous Field Investigations

4.2.1 Woodward-Clyde Consultants (WCC)

In 1982, WCC performed a geotechnical investigation for the site to develop geotechnical recommendations for new site improvements including, a one-story parking structure, Mervyn's Department store and Payless Drug store. The investigation included 16 exploratory borings ranging in depth from 6½ to 34½ feet.

The approximate locations of the exploration points are shown of Figure 2. Borings logs and laboratory testing from previous explorations are provided in Appendix B.

4.2.2 Kleinfelder

In 2007, Kleinfelder drilled eleven borings, designated K-1 through K-11, and two borings through concrete slabs, designated C-1 and C-2, to evaluate soil conditions for two restaurant buildings, a vehicular access road, a new Rite Aid store, and exterior hardscape rehabilitations. The borings were advanced to depths of approximately 2 feet to 20 feet. The approximate locations of the exploration points are shown on Figure 2. Borings logs and laboratory testing from previous explorations are provided in Appendix B.

5.0 LABORATORY TESTING

5.1 Current Investigation

The soil samples recovered from our geotechnical exploration were re-examined in the office for soil classifications and representative samples were selected for laboratory testing. Samples were tested to measure moisture content, dry density, Atterberg limits, fines content, shear strength, and resistance value. Results of the laboratory tests are included on the boring logs in Appendix A and on Figures C-1 through C4 in Appendix C.

Because corrosive soil can adversely affect underground utilities and foundation elements, laboratory testing was also performed to evaluate the corrosivity of the near-surface soil. The results of the corrosivity analysis are presented in Appendix D.

5.2 Laboratory Testing From Previous Investigations

Woodward-Clyde Consultants Inc. and Kleinfelder submitted select soil samples recovered from their respective geotechnical exploration programs for laboratory testing. Samples were tested to measure moisture content, dry density, Atterberg limits, fines content, shear strength, expansion index, sieve analysis, resistance value, and corrosivity. Results of the laboratory tests of the previous investigations are provided in Appendix B.

6.0 SUBSURFACE CONDITIONS

Subsurface conditions encountered during our exploratory drilling include asphalt concrete (AC), variable thicknesses of undocumented fill, native soil, residual soil, and variable bedrock types. Where explored, the pavement section of the parking lot consists of approximately two to eight inches of AC over up to 12 inches of aggregate base (AB). The subsurface soil and bedrock encountered during our investigation, including material types and general descriptions of their physical characteristics, are summarized below.

Undocumented Fill:

As previously discussed, the current grades at the Northgate Shopping Center were created by cutting into a hillside ridge that was present on the western side of the site and placing the excavated material as fill on the eastern side of the site. It is not known whether this fill was placed in a compacted (engineered) manner and no records were available at the time of this report to substantiate the nature of the fill placement; therefore, it is considered "undocumented".

Undocumented fill was encountered in all of the exploratory borings, except R1-2 and R6-1, where shallow bedrock was encountered directly beneath the pavement section. The thicknesses of undocumented fill encountered ranged from approximately 2 to 20½ feet and generally consists of medium to very stiff clay with varying amounts of sand and gravel with interbedded layers of medium dense to very dense sand and gravel with varying fines contents. Results of Atterberg limits tests performed on samples of the clayey fill indicate it is low to moderately expansive[2]. Contours of the bottom of fill elevation and depth are presented on Figures 3a and 3b, respectively.

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[2] Expansive soil will shrink and swell significantly with changes in moisture content.

Native Soil:

The undocumented fill is underlain by native soil characterized as alluvial deposits and residual soil. Where encountered, native soils vary in thickness from one to 22 feet.

Alluvial deposits generally consist of medium stiff to hard clays with varying amounts of sand. However, in Boring R5-5, a 4-foot thick layer of medium dense clayey silty sand was encountered at a depth of about 25 feet bgs (about Elevation 10.5 feet). In Borings R3-3, R3-4 and R5-3, soft clay was encountered immediately below the undocumented fill. Where encountered, the soft clay was 4 to 6.5 feet thick.

Soil formed from highly weathered rock, or residual soil, was encountered in Borings P-3, R3-1, and S3-1 at depths of about 6½, 24½, and 11 feet bgs, respectively (about Elevation 21.7, 11, and 26 feet, respectively). Where encountered, residual soil consists of very stiff sandy clay.

Bedrock: Bedrock was encountered beneath the site at depths ranging from about 1 to 41½ feet bgs and generally consists of interbedded shale and sandstone, shale, sandstone, siltstone, and claystone. Bedrock beneath the site is predominantly crushed to closely fractured, low to moderate hardness, friable to moderately strong, little to deeply weathered, and oxidized. Contours of the top of bedrock elevation and depth are presented on Figures 4a and 4b, respectively.

5.3.1 Groundwater

During drilling, groundwater was encountered at depths ranging between 15 and 33 feet bgs (corresponding to about Elevations 17½ and 2 feet, respectively). The groundwater levels measured during the current investigation and previous investigations by others are summarized in Table 2. Seasonal fluctuations in rainfall influence groundwater levels and may cause several feet of variation.

TABLE 2
Summary of Groundwater (GW) Depth and Elevation Data

Consultant	Location	Year of Exploration	Ground Surface Elevation (feet)	Exploration Depth (feet)	GW Depth (feet)	GW Elevation (feet)
Langan	C-1	2021	36	35.3	18.4	17.6
	R3-1	2021	35	31.5	20	15
	R4-1	2021	36	30.4	20	16
	R4-2	2021	36	26.2	23	13
	R4-3	2021	33.5	41.2	30	3.5
	R4-4	2021	32.5	30.5	15.5	17
	R4-5	2021	32	46	24	8
	R5-2	2021	35	41.3	33	2
	R5-3	2021	34.5	45.3	24.1	10.4
	R5-4	2021	30.5	35.3	20.4	10.1
	R5-5	2021	30.5	46.5	20	10.5
WCC	1	1982	--	34.5	15	--
	1	1982	--	34.5	20	--
	2	1982	--	26.5	20.5	--
	3	1982	--	28.5	11.5	--
Kleinfelder	K-10	2007	--	19.5	16	--

7.0 GEOLOGY AND SEISMICITY

Our evaluation of the geology and seismicity of the area is based on our review of published reports and information in our files from other sites in the vicinity.

7.1 Regional Geology

The San Francisco Bay Area is in the California Coastal Range Province, a region characterized by northwest-trending ridges and valleys that generally parallel the major geologic structures, such as the San Andreas and Hayward fault systems. These are controlled by folds and faults that resulted from the collision of the Farallon and North American plates, and subsequent strike-slip faulting and shearing along the San Andreas fault system.

7.2 Regional Seismicity

The project site is in a seismically active region. Numerous earthquakes have been recorded in the region in the past, and moderate to large earthquakes should be anticipated during the service life of the proposed development. The Hayward, San Andreas, and San Gregorio faults are the major faults closest to the site. These and other faults of the region in the UCERF3 source model are shown on Figure 5. For each of these faults, as well as other active faults within about 50 kilometers (km) of the site, the distance from the site and estimated mean characteristic Moment magnitude[3] are summarized in Table 3. The mean moment magnitude presented on Table 3 was computed assuming full rupture of the segment using Hanks and Bakun (2008) relationship.

TABLE 3
Regional Faults and Seismicity

Fault Name	Distance (km)	Direction from Site	Mean Moment Magnitude[3]
Total Hayward-Rodgers Creek Healdsburg	13	East	7.58
San Andreas 1906 event	16	Southwest	8.06
Total San Gregorio	16	West	7.61
Bennett Valley	26	Northeast	6.50
Franklin	27	East	6.68
Contra Costa (Vallejo)	29	East	5.60
Contra Costa (Dillon Point)	31	East	6.12
Contra Costa Shear Zone (connector)	31	East	6.57
Contra Costa (Lake Chabot)	32	East	5.63
West Napa	32	Northeast	6.75
Contra Costa (Lafayette)	39	East	6.07
Green Valley	40	East	6.78
Concord	40	East	6.42
Pilarcitos	41	South	6.66
Contra Costa (Larkey)	42	East	6.05
Mount Diablo Thrust	47	East	6.58
Total Calaveras	48	East	7.54

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[3] Moment magnitude is an energy-based scale and provides a physically meaningful measure of the size of a faulting event. Moment magnitude is directly related to average slip and fault rupture area.

Figure 5 also shows the earthquake epicenters for events with magnitude greater than 5.0 from January 1800 through August 2014. Since 1800, four major earthquakes have been recorded on the San Andreas Fault. In 1836, an earthquake with an estimated maximum intensity of VII on the Modified Mercalli (MM) scale (Figure 6) occurred east of Monterey Bay on the San Andreas fault (Toppozada and Borchardt 1998). The estimated Moment magnitude, $M_{w,}$ for this earthquake is about 6.25. In 1838, an earthquake occurred with an estimated intensity of about VIII-IX (MM), corresponding to an M_w of about 7.5. The San Francisco Earthquake of 1906 caused the most significant damage in the history of the Bay Area in terms of loss of lives and property damage. This earthquake created a surface rupture along the San Andreas fault, from Shelter Cove to San Juan Bautista, approximately 470 kilometers in length. It had a maximum intensity of XI (MM), an M_w of about 7.9, and was felt 560 kilometers away in Oregon, Nevada, and Los Angeles. The Loma Prieta Earthquake occurred on 17 October 1989 in the Santa Cruz Mountains with an M_w of 6.9, the epicenter of which is approximately 122 km from the site.

In 1868 an earthquake with an estimated maximum intensity of X on the MM scale occurred on the southern segment (between San Leandro and Fremont) of the Hayward fault. The estimated M_w for the earthquake is 7.0. In 1861, an earthquake of unknown magnitude (probably an M_w of about 6.5) was reported on the Calaveras fault. The most recent significant earthquake on this fault was the 1984 Morgan Hill earthquake ($M_w = 6.2$).

The most recent earthquake to affect the Bay Area occurred on 24 August 2014 and was located on the West Napa fault, approximately 31 kilometers northeast of the site, with an M_W of 6.0.

The 2014 Working Group for California Earthquake Probabilities (WGCEP) at the U.S. Geologic Survey (USGS) predicted a 72 percent chance of a magnitude 6.7 or greater earthquake occurring in the San Francisco Bay Area in 30 years (WGCEP 2015). More specific estimates of the probabilities for different faults in the Bay Area are presented in Table 4.

TABLE 4

WGCEP (2015) Estimates of 30-Year Probability (2014 to 2043) of a Magnitude 6.7 or Greater Earthquake

Fault	**Probability (percent)**
N. San Andreas	33
Hayward-Rodgers Creek	32
Calaveras	25
Green Valley	7
San Gregorio	6
Greenville	6
Mount Diablo Thrust	4

7.3 Geologic Hazards

During a major earthquake, strong to very strong ground shaking is expected to occur at the project site. Strong ground shaking during an earthquake can result in ground failure such as that associated with soil liquefaction, lateral spreading, cyclic densification, and fault rupture. We evaluated the potential for each of these phenomena to occur at the site, and the results of our evaluations are discussed in this section.

7.3.1 Liquefaction

When saturated soil with little to no cohesion liquefies during a major earthquake, it experiences a temporary loss of shear strength as a result of a transient rise in excess pore water pressure generated by strong ground motion. Flow failure, lateral spreading, differential settlement, loss of bearing, ground fissures, and sand boils are evidence of excess pore pressure generation and liquefaction. The northwest area of the site is located within a zone mapped as moderate liquefaction susceptibility as designated by the United States Geological Survey liquefaction susceptibility hazards map for the county of Marin titled *Map 2-11, Preliminary Maps of Quaternary Deposits and Liquefaction Susceptibility, Nine-County San Francisco Bay Region, California* dated 14 June 2005. The remainder of the site is located within an area mapped as low susceptibility to liquefaction. Because the materials at the site below the groundwater level are predominately clayey or bedrock, we judge that the potential for liquefaction settlement at the site is low.

7.3.2 Lateral Spreading

Lateral spreading is a phenomenon in which a surficial soil layer displaces along a shear zone that forms within a continuous underlying liquefied layer. The surficial blocks are transported downslope or in the direction of a free face, such as a channel, by earthquake and gravitational forces. Lateral spreading is generally the most pervasive and damaging type of liquefaction-induced ground failure generated by earthquakes.

Since the potential for liquefaction at the site is low, we likewise judge that potential for lateral spreading to occur at the site is low.

7.3.3 Cyclic Densification

Cyclic densification (also referred to as seismic densification and differential compaction) can occur during strong ground shaking in loose, clean granular deposits above the water table, resulting in ground surface settlement. The degree of susceptibility to cyclic densification is directly related to the relative density of the existing granular soil.

The borings indicate that loose to medium dense granular soil is present above the design groundwater level. We used the approach developed by Tokimatsu and Seed (1984) to evaluate the potential for cyclic densification of the medium dense clayey sand encountered in the fill above the anticipated water level. We judge that the materials encountered above the groundwater table are sufficiently cohesive and/or dense and as such the potential for cyclic densification at the site is low.

7.3.4 Fault Rupture

Historically, ground surface displacements closely follow the traces of geologically young faults. The site is not within an Earthquake Fault Zone, as defined by the Alquist-Priolo Earthquake Fault Zoning Act, and no known active or potentially active faults exist on the site. In a seismically active area, the remote possibility exists for future faulting in areas where no faults previously existed; however, we conclude the risk of surface faulting and consequent secondary ground failure at the site is low.

8.0 DISCUSSION AND CONCLUSIONS

From a geotechnical engineering standpoint, we judge the proposed site development is feasible, provided the recommendations presented in this report are incorporated into the project plans and specifications, and are implemented during construction.

The primary geotechnical issues of concern include:

- the presence undocumented fill
- varying depth of bedrock
- selection of an appropriate foundation type to support building loads
- construction considerations.

Our conclusions regarding these and other geotechnical issues are discussed in the remainder of this section.

8.1 Foundations and Settlement

As previously discussed, the western portion of the site is generally underlain by shallow bedrock, while the eastern portion of the site is underlain by undocumented fill which extends to a depth of about 20 feet bgs at some portions of the site. Where explored, the undocumented fill appears to be comprised of relatively stiff clay, however, we cannot confirm that the fill was placed in an engineered fashion across the entire site. Therefore, the undocumented fill, in its current condition and without documentation that it was appropriately placed, cannot be relied upon to provide adequate foundation support for the new structures. We conclude new foundations should bear in the native soil and bedrock below the undocumented fill.

In areas where the finished floor is close to the anticipated top of bedrock, the building foundations can bear on bedrock or bear on lean concrete extending to bedrock. Elsewhere, either shallow foundations bearing on ground improvement extending to competent native soil or bedrock or deep foundations extending into bedrock, should be used. If ground improvement is used, the ground improvement elements for a single structure should bear in the same material, either competent native soil or bedrock across the entire structure, i.e. no combination of ground improvement into bedrock in some areas and only into native soil (above bedrock) in other areas for a single structure.

Considering the variable depth to rock in portions of the site, a combination of shallow foundations, shallow foundations over ground improvement, and/or deep foundations, all bearing in rock, may be used across a single building footprint. The general contractor and structural engineer should review Figures 3a and 3b (depth/elevation of bottom of fill) and Figures 4a and 4b (depth/elevation of top of bedrock) and determine the most appropriate foundation type(s).

8.1.1 Shallow Foundations

Settlement of properly installed shallow foundations, consisting of footings or mats, bearing in bedrock should be small, less than ½ inch. We judge that settlement of new shallow foundations bearing in rock during an earthquake should also be relatively small. Settlement of properly constructed shallow foundations bearing on improved ground extending to rock is anticipated to be less than one inch.

8.1.2 Deep Foundations

New buildings may be supported on deep foundations (piles) primarily gaining support in the native soil (friction) and bedrock (friction and end-bearing, provided proper cleanout of the bottom can be confirmed) below the fill. As there is typically only 5 to 15 feet of native clayey soil between the fill and bedrock for buildings in the eastern portion of the site, we judge the piles would not gain adequate capacity in the native soil alone and therefore should be installed to bear in bedrock.

We judge augered-cast-in-place (ACIP) piles would be an appropriate deep foundation system that could be used to support the proposed buildings. ACIP piles are proprietary design-build piling systems and are installed by drilling to the required depth using a displacement or non-displacement drilling tool that displaces or removes soil, respectively. When the drilling tool reaches the required depth, cement grout or concrete is injected through ports in the bottom of the tool. After the grout is injected, steel reinforcing cages can be lowered into the pile while the grout is still fluid. ACIP piles can range in diameter; however, 18- and 24-inch-diameter ACIP piles are typical.

Assuming the deep foundation elements are socketed approximately 5 to 10 feet into rock, the elements will likely be about 15 to 50 feet long; however, variations in depth to and hardness of the bedrock should be expected, resulting in variable element lengths. The deep foundation elements will transfer building loads to relatively incompressible bedrock; however, some elastic shortening of the piles will still occur. We estimate the piles could settle and compress up to about one inch, depending on the loads, section properties, and lengths of the elements.

Differential settlement should be no more than about ½ inch between any adjacent columns, provided all foundations extend into bedrock.

8.2 Ground Improvement

As discussed in Section 8.1, ground improvement can be performed to transfer building loads down to competent native soil or bedrock and provide support for a shallow foundation system. On the basis of our experience with different methods of improvement, we judge that the most appropriate methods to perform ground improvement include:

- compacted aggregate piers (CAPs)
- drilled displacement columns (DDCs)

These ground improvement techniques could be used separately or in combination. CAP and DDC systems are installed under design-build contracts by specialty contractors, and as such we do not provide specific design recommendations or settlement estimates for these systems; however, we typically provide design guidelines that should be considered in the design of the ground improvement. Detailed discussions for each of the proposed methods are presented in the following subsections.

8.2.1 Compacted Aggregate Piers

CAPs are used to reduce settlement potential and increase allowable bearing capacities by strengthening the soil matrix with compacted aggregate (gravel) columns and by densifying the soil between the columns. CAPs are designed and installed by specialty contractors on a design-build basis. CAPs are typically installed by drilling 24- to 33-inch-diameter shafts with an auger or specialty vibration tooling and then backfilling the shaft with compacted aggregate material placed in lifts. CAPs should be installed to transmit the building loads down to bedrock.

8.2.2 Drilled Displacement Columns

DDCs are installed under design-build contracts by specialty contractors. They are constructed by using a displacement auger to create a soil shaft that is filled with CLSM (Controlled Low Strength Material) injected under pressure as the displacement auger is withdrawn from the hole. DDCs typically vary between 18 to 30 inches in diameter. The intent of the DDCs is to provide rigid inclusions and densify the surrounding soil, thereby transferring building loads down to competent native soil or bedrock. Installation of DDCs produces minimal soil cuttings because the soil is displaced during column installation.

8.3 Groundwater/Stormwater Infiltration Considerations

In general, the site is underlain by shallow bedrock and/or near-surface clayey soil, neither of which are conducive to infiltration. Therefore, some other means of handling stormwater, e.g. use of tanks or other systems, should be considered.

8.4 Groundwater

Groundwater was encountered during our field investigation in some of the borings. Where encountered, the groundwater level was measured at depths from 15 to 33 feet bgs (Elevation 17.5 to 2 feet) in the borings, these measured depths may not represent stabilized conditions. The groundwater elevation could be influenced by seasonal rainfall, wet and dry seasons, or climate change.

Based on our understanding of the site and the observed levels, we conclude a design high groundwater level of Elevation 20 feet is appropriate. This corresponds to depths of about 10½ to 16 feet below existing ground surfaces.

8.5 Corrosion Potential

Because corrosive soil can adversely affect underground utilities and foundation elements, laboratory testing was performed during previous investigations to evaluate the corrosivity of the near-surface soil. Cerco Analytical of Concord, California, performed tests on a soil sample to evaluate corrosion potential to buried metals and concrete. On the basis of the resistivity measurements, the near-surface soils were found to be moderately corrosive to corrosive. The results of the tests are presented in Appendix D and summarized in Table 5.

Unprotected steel elements placed below grade will corrode; protection of foundations, utilities, and other structural elements, which extend into these layers, will be required. A corrosion specialist should be retained to develop long-term corrosion control recommendations for the selected foundation system and proposed construction materials for the underground site utilities.

TABLE 5

Summary of Corrosivity Test Results

Test Boring	Sample Depth (feet)	pH	Sulfate (mg/kg)	Resistivity (ohm-centimeter)	Chloride (mg/kg)	Redox Potential (mV)
R2-4	2.5	6.9	65	3,000	39	330
P-5	2.5	7.9	210	1,100	N.D.	360

N.D. = None Detected

8.6 Construction Considerations

As previously discussed, the fill encountered at the site generally consists of medium to very stiff clay with varying amounts of sand and gravel with interbedded layers of medium dense to very dense sand and gravel with varying fines contents. This material can be excavated with conventional earth-moving equipment such as loaders and backhoes.

Where encountered, the bedrock was generally crushed to closely fractured with low to moderate hardness, and could be drilled using standard auger drilling equipment (specialty rock bits or cores were not required). However, the possibility exists that harder, more intact inclusions of rock will be encountered at the site than what was encountered in the borings. Where there will be shallow excavations, such as elevator pits, footings, and utility trenches, we judge it is likely that most of the bedrock should be excavatable or rippable using conventional or heavy duty equipment, such as a Caterpillar D9R with a single or multi shank No. 9 ripper. However, we anticipate additional equipment, such as a hydraulic hoe ram or jackhammer, may be required in some areas, especially narrow trenches and deeper excavations, to facilitate excavation and rippability.

During excavation, debris, concrete rubble, and foundation elements from previous structures that occupied the site may be encountered. Hoe-rams, jack-hammers, and other similar equipment could be needed to remove some of the larger obstacles and/or foundation elements. Soil containing hazardous material could be encountered during excavation and foundation installation. If encountered, these materials will require special handling and disposal.

We understand there are historically significant homes in the neighborhood southwest of the site. Construction activities could cause vibrations, which may cause settlement of the fill materials and/or could adversely affect nearby improvements. During ground improvement and/or deep foundation pre-production test programs and throughout construction, vibration monitoring should be performed to check for vibrations and evaluate the attenuation with distance from the construction activities. These programs should be reviewed by the geotechnical engineer, the general contractor and their ground improvement/foundation subcontractors to assess whether modifications need to be made to the construction activities to reduce the potential for damage to nearby improvements. The conditions of buildings and improvements within 150 feet of the site should be photographed and surveyed to document existing conditions prior to the start of construction and monitored periodically during construction. In addition, construction activities can create a high level of noise. Time and day of specific construction activities may be restricted.

9.0 RECOMMENDATIONS

Our recommendations regarding earthwork, foundations, ground improvement, floor slabs, pavement design, construction monitoring, seismic design, and other geotechnical aspects of this project are presented in the following sections.

9.1 Earthwork

This section presents earthwork recommendations for site preparation and grading. We anticipate earthwork will consist of site preparation, subgrade preparation for slabs and pavements, excavation for footings, engineered fill placement, backfill utility trenches, overexcavations, and general site grading.

9.1.1 Site Preparation

Site demolition should include the removal of all slabs, foundations, retaining walls, pavements, utilities, and other below-grade improvements that will interfere with the proposed construction. Following demolition or removal of existing structures, all areas to receive fill and improvements should be prepared in accordance with subgrade preparation recommendations in Section 9.1.3.

Demolished asphalt and concrete at the site may be crushed to provide recycled construction materials, including sand and Class 2 aggregate base (AB) provided it is acceptable from an environmental standpoint. Where recycled Class 2 AB will be used beneath pavements, it should meet requirements of the current Caltrans Standard Specifications.

Where utilities that are removed extend off site, they should be capped or plugged with lean concrete or cement grout at the property line. Where existing utility lines will not interfere with the planned construction, they may be abandoned in place, provided the lines are filled with lean concrete or cement grout to the limits of the project. Voids resulting from demolition activities should be properly backfilled with engineered fill, as recommended in Section 9.1.4, or lean concrete.

9.1.2 Excavation and Cut Slopes

Excavations deeper than five feet entered by workers should be shored or sloped for safety in accordance with the CAL-OSHA standards (29 CFR Part 1926). Inclinations of temporary slopes should not exceed those specified in local, state, or federal safety regulations. As a minimum, the requirements of the current OSHA Health and Safety Standards for Excavations (29 CFR Part 1926) should be followed. The contractor should be responsible for the design, construction, and safety of temporary shoring. We judge that temporary cuts in fill that are less than 10 feet in height, and inclined no steeper than 1.5:1 (horizontal to vertical) should be stable. We should evaluate cuts greater than 10 feet.

Temporary slopes should not be open for an extended period of time. If temporary slopes are open for extended periods of time, exposure to weathering and rain could result in sloughing and erosion.

All vehicles and other surcharge loads should be kept at least 10 feet away from the top of temporary slopes. During construction, the slopes should be protected from excessive saturation by rain or other external causes.

9.1.3 Subgrade Preparation

The material exposed at the bottom of the proposed excavations and cuts is expected to consist either rock or undocumented fill consisting of mainly medium stiff clay with varying amounts of sand and gravel. Soft or loose soil at the bottom of the excavations should be removed prior to placement of structural concrete. The resulting overexcavation may be backfilled with lean or structural concrete. If overexcavations are required outside the building footprint, they may be backfilled with engineered fill or lean concrete.

Within areas to receive new improvements (such as sidewalks, flatwork, slab-on-grade), we recommend the upper eight inches of the existing subgrade soil be scarified, moisture-conditioned to above optimum moisture content, and compacted to at least 90 percent relative compaction. The upper six inches in pavement areas should be compacted to at least 95 percent relative compaction. Clean sand (with less than 10 percent passing the No. 200 sieve) should also be compacted to 95 percent relative compaction. If the compacted subgrade is disturbed during utility trench or foundation installation, the subgrade should be re-rolled to provide a smooth, firm surface for slab support.

9.1.4 Engineered Fill Placement and Compaction

We anticipate earthwork will consist of fill placement and compaction, and utility trench backfill. Excavated on-site soil is generally not suitable from a geotechnical perspective for reuse as engineered fill or backfill due to the moderate expansion potential of the soil. However, this soil may be used as general fill outside of the building footprint if at least 12 inches of material is placed over it, provided that material meets the requirements herein. All materials to be used as engineered fill should have a low corrosion potential (unless the corrosion potential has been designed for), be non-hazardous, free of organic material, contain no rocks or lumps larger than three inches in greatest dimension, and have a low to moderate expansion potential (defined by a liquid limit of less than 40 and a plasticity index lower than 12), and is approved by Langan.

Fill should be placed in lifts not exceeding eight inches in loose thickness and compacted to at least 90 percent relative compaction[4]. However, if the total fill thickness will be thicker than five feet or the fill contains less than 10 percent fines (percent passing the No. 200 sieve) the fill should be compacted to at least 95 percent relative compaction.

During construction, we should check that the on-site and any proposed import material is suitable for use as fill; we expect that much of the on-site soil will likely be acceptable for re-use as engineered fill provided that it is free of hazardous material. Corrosivity tests indicate that the existing fill at the site is moderately corrosive to corrosive. Therefore, if it is placed around buried iron, steel, cast iron, ductile iron, galvanized steel, dielectric coated steel, or iron, the metal should be properly protected against corrosion. More information about the corrosivity of the fill is outlined in Appendix D.

Flowable cement grout, lean concrete, lightweight cellular concrete, or geofoam may be used to backfill areas not accessible to compaction equipment. Uniformly-graded, clean, ½- to ¾-inch crushed rock or angular gravel may also be used as backfill in these areas provided it is tamped in place and wrapped in filter fabric to prevent the migration of fines.

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[4] Relative compaction refers to the in-place dry density of soil expressed as a percentage of the maximum dry density of the same material, as determined by the ASTM D1557 laboratory compaction procedure.

All rigid, flexible, and interlocking pavements should be underlain by aggregate base thicknesses, as described in Section 9.5, compacted to at least 95 percent relative compaction. The aggregate base materials can contribute to the thickness of engineered fill.

Langan should approve all sources of fill at least three days before use at the site. The grading contractor should provide analytical test results or other suitable environmental documentation indicating the imported fill is free of hazardous materials at least three days before use at the site. If this data is not available, up to two weeks should be allowed to perform analytical testing on the proposed import material. A bulk sample of approved fill should be provided to us at least three working days before use at the site in order to obtain a compaction curve (ASTM D 1557).

9.1.5 Utilities and Utility Trenches

Utility trench excavations should conform to the current OSHA requirements for side slopes, shoring, and other safety concerns. Where necessary, trench excavations should be shored and braced, in accordance with all safety regulations, to prevent cave-ins. The thickness and type of bedding material required for utility conduits will depend on the soil or rock conditions at the utility trench bottom. As a minimum, bedding should extend at least D/4 (with D equal to the outside pipe diameter) below the bottom of the pipe and should be at least four inches thick. After the pipes and conduits are tested, inspected (if required), and approved, they should be covered to a depth of at least six inches with sand or fine gravel, which should be mechanically tamped to at least 90 percent relative compaction. If backfill material with less than 10 percent fines is used, or if the trench is greater than 5 feet deep, the entire depth of the fill should be compacted to at least 95 percent relative compaction. Jetting of trench backfill should not be permitted. Poor compaction could cause excessive settlements, resulting in damage to the improvements. Special care should be taken when backfilling utility trenches in pavement areas. Utilities should be designed for the corrosive soil conditions if installed in fill.

9.2 Foundations

As discussed in Section 8.1, and because of the presence of up to 20 feet of undocumented fill and variable depths to native soil and rock at the site, we recommend the following foundation systems be used:

- shallow foundations bearing in bedrock (or on lean concrete that extends to bedrock)

- shallow foundations on ground improvement bearing solely in either competent native soil or bedrock (for each individual structure, the ground improvement should extend to similar material)
- deep foundations to bedrock

Considering variable rock depths within portions of the site, a combination of shallow foundations, shallow foundations over ground improvement, and/or deep foundations, all bearing in rock, may be used across a single building footprint. As previously discussed, ground improvement elements may bear in competent native material, provided that ground improvements elements for a single structure bear in the same material i.e. competent native soil or bedrock. The general contractor and structural engineer should review Figures 3a and 3b (depth/elevation of bottom of fill) and Figures 4a and 4b (depth/elevation of top of bedrock) and determine the most appropriate foundation type(s).

9.2.1 Shallow Foundations

Footings bearing on bedrock may be designed for an allowable bearing capacity of 10,000 pounds per square foot (psf) for dead plus live loads, with a one-third increase for total design loads, including wind and/or seismic. The ground improvement design-build contractor should provide estimates of bearing pressures for their system; however, for preliminary estimating, we conclude footings bearing on improved ground, extending into native soil above bedrock, or into bedrock should be able to achieve allowable bearing capacities of 6,000 psf or 10,000 psf, respectively, for dead plus live loads, with a one-third increase for total design loads, including wind and/or seismic.

Overexcavations to remove soft, wet, loose, or otherwise deleterious material may be required to expose competent bearing material. The overexcavations should be backfilled with lean concrete. Allowable bearing capacity for improved ground should be confirmed by the design-build contractor. To design footings/mats using the modulus of subgrade reaction method, we recommend moduli of subgrade reaction of 240 kips per cubic foot (kcf) for a mat bearing on bedrock. For mats/footings bearing on ground improvement extending to native soil or bedrock, we judge moduli of 72 or 120 kcf, respectively, are appropriate starting points; these values should be reviewed and confirmed by ground improvement design-build contractor. The modulus value is representative of the anticipated settlement under the building loads. After the foundation analysis is completed, we should review the computed settlement and bearing pressure profiles to check that the modulus value is appropriate.

Continuous footings should be at least 18 inches wide and isolated footings should be at least 24 inches wide. Footings should be bottomed at least 12 inches into rock. Ground improvement elements should extent at least 12 inches into native competent soil or rock. If lean concrete is used to extend footings to rock, the lean concrete should also extend 12 inches into rock and should have a compressive strength of at least 150 psi. Footings adjacent to utility trenches or other footings should bear below an imaginary 1.5:1 (horizontal to vertical) plane projected upward from the bottom edge of the utility trench or adjacent footings.

9.2.2 Deep Foundations

Where the finished floor of buildings will be sufficiently above the top of bedrock, we recommend structures be supported on deep foundations consisting of ACIP piles. The piles would gain support through friction and end-bearing in bedrock.

9.2.2.1 Axial Capacity of Deep Foundations

Auger-Cast-in-Place (ACIP) piles in the San Francisco Bay Area are also designed and installed by design-build contractors. Therefore, we can only provide preliminary capacities; the foundation should be bid on a performance criteria basis. The piles will primarily gain capacity from skin friction in the stiff to hard clay and from a combination of skin friction and end bearing in bedrock. The vertical and lateral capacities presented below for auger cast piles are preliminary and may be used in pricing and estimating. Final design capacities should be verified by a load test program as discussed in Section 9.2.2.2.

For ACIP capacity estimating purposes, we recommend using ultimate skin friction values of 500 psf in the undocumented fill, 1,500 psf in the native soil and 5,000 psf in bedrock and a preliminary ultimate value of 20,000 psf end-bearing in bedrock could be used. Final design axial pile capacities for auger cast piles should be determined by the design-build contractor and confirmed by load testing. Load tests should be performed to confirm the allowable compression and uplift capacities. Factors of safety of 2.0 for dead plus live sustained loads and 1.5 may be used for total loads including seismic should be applied to ultimate load test values to obtain allowable, design values.

Piles should be spaced at least three pile diameters center-to-center to prevent vertical capacity reductions due to pile group interaction effects; the outer auger-tip diameter should be used when determining the pile spacing for auger cast piles. The piles should also be designed to account for the presence of corrosive soil; a corrosion consultant should be retained to provide specific recommendations regarding the long term corrosion protection of pile elements.

9.2.2.2 Indicator and Test Pile Program

We recommend a test pile program be performed to provide data for choosing production pile lengths. Test piles may be installed at column locations and can be used for support of the buildings. Test piles should be installed at locations selected by us and approved by the structural engineer. They should be installed with the same equipment that will be used to install the production piles.

We recommend at least one compression load tests and one tension load test per building be performed. The static compression load tests should be performed in accordance with ASTM D1143 and the tension tests should be performed in accordance with ASTM D3689. Equipment used for the test (load frame, jacks, and reaction piles) should be capable of applying at least two times the allowable dead plus live design load plus the contribution in soil friction and at least 1.5 times the total design load plus the contribution in soil friction. The load tests should be interpreted using accepted criteria per the 2019 CBC to determine the ultimate capacities of the piles. The test pile locations should be selected by us and approved by the structural engineer.

9.2.3 Lateral Load Resistance

9.2.3.1 Lateral Load Resistance of Shallow Foundations and Pile Caps

Lateral loads can be resisted by a combination of passive resistance acting against the vertical faces of the footings, mats or pile caps and friction along their bases.

The passive pressure mobilized against pile caps and shallow foundations/other below-grade elements is a function of the height (thickness) of the pile cap/below-grade element and the lateral movement of the pile cap/below-grade element. Table 6 presents the passive resistance and deformation relationship for use on this project based on the relationship presented in ASCE 41-17.

Passive resistance may be calculated using a uniform ultimate pressure (rectangular distribution) of 1,000 psf for undocumented fill, 2,000 psf in stiff to very stiff native soils, and 3,500 psf in bedrock; these values are for soils above the water table. The upper foot of soil should be ignored unless confined by a concrete slab or pavement. These ultimate passive pressures do not incorporate a factor of safety; they are, instead, intended to be used in the development of deformation-dependent spring values. If a deformation-based approach is not used, a factor of safety of 1.5 should be applied to the ultimate passive resistances discussed above.

TABLE 6
Passive Resistance and Deformation Relationship

Deformation (δ/H)	**P / P_{ult}**
0.0	0.00
0.002	0.32
0.005	0.46
0.01	0.55
0.02	0.70
0.03	0.83
0.04	0.90
0.05	0.96
0.06	1.00

Notes:
1. δ/H denotes the ratio of lateral deformation (δ) over the height of the foundation element (H).
2. P/P_{ult} denotes the ratio of mobilized passive resistance over the ultimate passive resistance.

To calculate a specific horizontal soil modulus (spring), the structural designer should iterate between the demand loading and allowable deformation performance of the walls.

Frictional resistance should be computed using a base friction coefficient of 0.5 for concrete to rock interfaces, or 0.3 if waterproofing is placed below the mat or footings if waterproofing is not used. These values represent ultimate values, i.e. no factor of safety. Mobilization of friction is also deformation-dependent; the full values should be realized at about ¼ inch of lateral movement of the structural element. Frictional stiffness, up to a ¼ inch of movement, can be calculated using the following relationships:

- Frictional Stiffness where waterproofing is used = 14 × σ_v', where σ_v' = normal load at the base of the mat/footings (psf/ft);
- Frictional Stiffness where waterproofing is not used = 24 × σ_v'.

Uplift loads may be resisted by the building loads, weight of the foundation, and any overlying soil. If foundations are inadequate to provide the necessary uplift resistance, drilled elements or anchors may be used. We can provide further uplift recommendations if needed.

9.2.3.2 Lateral Load Resistance of Piles

The piles should develop lateral resistance from the passive pressure acting on the upper portion of the piles and their structural rigidity. The allowable lateral capacity of the piles depends on:

- the pile stiffness
- the strength of the surrounding soil
- the estimated amount of settlement
- axial load on the pile
- the allowable deflection at the pile top and the ground surface
- the allowable moment capacity of the pile.

For estimating lateral capacities, we recommend the soil properties presented in the tables below, for use in the computer program L-Pile produced by Ensoft; if a different program will be used, we should review the appropriateness of this set of soil properties in a different program. We should review the appropriateness of this set of soil properties in a different program. L-Pile soil properties for the Residential 5 development located the east side of the existing Macy's department store (where top of bedrock is deepest) are presented in Table 7. Once a pile size and lateral demand have been determined for this project, we should can be retained to perform additional analyses, as needed.

TABLE 7
L-Pile Input Soil Properties – Residential 5

Soil/Bedrock Unit	L-Pile P-Y curve type	Elevation of Top of Layer (feet, NGVD29)	Effective Unit Weight (pcf)	Friction Angle (degrees)	Undrained Cohesion (psf)	ε_{50}
Undocumented Fill	Stiff Clay without Free Water (Reese)	33	130	N/A	1,000	0.005
Native Soil	Stiff Clay without Free Water (Reese)	17	53	N/A	2,000	0.005
Bedrock	Stiff Clay without Free Water (Reese)	5	73	N/A	3,500	0.005

* N/A – Not applicable

The lateral resistances computed using the program LPile are for single piles. Therefore, calculated lateral capacities are only appropriate for on isolated pile or a pile in a pile group with a pile spacing of at least six pile diameters.

To account for group effects, the lateral load capacity of a single pile should be multiplied by the appropriate reduction factors shown on Table 8. However, the maximum bending moment for a single pile with an unfactored load should be used to check the design of individual piles in a group. The reduction factors are based on a minimum center-to-center spacing of three piles diameters. Reduction for other pile group spacing can be provided once the number and arrangement of piles are known.

TABLE 8
Lateral Group Reduction Factors

Number of Piles	Lateral Group Reduction Factor
2	0.9
3 to 5	0.8
≥6	0.7

9.3 Ground Improvement

Where ground improvement is used for foundation support, the ground improvement should extend at least one foot into the native soil or bedrock. A qualified, design-build, specialty contractor, who has previously successfully performed ground improvement in similar subsurface soil conditions, should design and perform the ground improvement. We recommend the contractor be presented with our recommendations and the results of our site exploration.

If CAP or DDC ground improvement is used to support building loads, the ground improvement elements should be designed with sufficient strength and bearing to provide a bearing capacity factor of safety of at least 2.0 under dead plus live loads. The actual calculated bearing pressures from the project structural engineer should be used for this calculation. We recommend a minimum unconfined compressive strength (UCS) of 500 psi at 28 days for the CLSM used to construct DDCs; higher UCS may be required, depending on the foundation load requirements.

Installation of CAPs and DDCs will cause vibrations on adjacent sites. These vibrations can cause settlement of the fill materials surrounding the site or could adversely affect nearby improvements. We recommend that the conditions of buildings and improvements within 50 feet of the site be photographed and surveyed to document existing conditions prior to the start of construction and that they be monitored during the test section. Based on the results of the vibration monitoring during the test section, periodic vibration monitoring may also be required during production. The design-build contractor should determine the offset needed to prevent damage to adjacent buildings; however, at a minimum a 10-foot offset should be used for installing ground improvement elements adjacent to existing buildings.

We should be involved throughout the ground improvement contractor bidding and selection process and provide additional detailed recommendations and input on specifications and procedures.

9.3.1 Ground Improvement Criteria, Requirements, and Quality Control

We recommend at least two compression load tests per building be performed on ground improvement elements prior to production installation. Additionally, if the DDC elements will be used to resist uplift loads, we recommend at least one load test in tension be performed per building. We should choose the locations of the tests and review the ground improvement contractor's submittals for the proposed testing procedures.

Compression load tests should be performed in accordance with ASTM D1143, and the tension tests should be performed in accordance with ASTM D3689. We should review the load test parameters and confirm that the CAP or DDC elements have an acceptable factor of safety. We should also observe the installation and testing of the CAP or DDC elements. The installation of ground improvement elements should be consistent with the installation methods used to install the test sections.

9.4 Floor Slabs

Although the near-surface soil over large portions of the site is undocumented fill, we judge it is adequate to support new building slabs-on-grade. Likewise, where the building bears directly on native soil and/or bedrock, the slabs may be supported on grade. Slab-on-grade subgrade should be prepared as discussed in Section 9.1.3.

Moisture is likely to condense on the underside of the slabs, even though they will be above the design groundwater table. Consequently, a moisture barrier should be installed beneath the slabs if movement of water vapor through the slabs would be detrimental to its intended use. A typical moisture barrier consists of a capillary moisture break and a water vapor retarder. A capillary moisture break consists of at least four inches of clean, free-draining gravel or crushed rock. The vapor retarder should meet the requirements for Class C vapor retarders stated in ASTM E1745. The vapor retarder should be placed in accordance with the requirements of ASTM E1643. These requirements include overlapping seams by six inches, taping seams, and sealing penetrations in the vapor retarder. The particle size of the gravel/crushed rock and sand should meet the gradation requirements presented in Table 9.

TABLE 9
Gradation Requirements for Capillary Moisture Break

Sieve Size	Percentage Passing Sieve
Gravel or Crushed Rock	
1 inch	90 – 100
3/4 inch	30 – 100
1/2 inch	5 – 25
3/8 inch	0 – 6

If moisture is acceptable on the slab, the capillary break and vapor retarder can be replaced with at least 4 inches of Class 2 AB.

Concrete mixes with high water/cement (w/c) ratios result in excess water in the concrete, which increases the cure time and results in excessive vapor transmission through the slab. Therefore, concrete for the floor slab should have a low w/c ratio - less than 0.45. The slab should be properly cured. Before the floor covering is placed, the contractor should check that the concrete surface and the moisture emission levels (if emission testing is required) meet the manufacturer's requirements.

9.5 Pavement Design and Concrete Flatwork

We recommend that the exposed soil subgrade for exterior slabs, concrete flatwork, pavers and pavements be prepared in accordance with our recommendations in 9.1.3.

All rigid, flexible, and interlocking pavements should be underlain by aggregate base thicknesses as detailed in the following subsections and compacted as described in Section 9.1.4

Additional recommendations regarding rigid, flexible, and interlocking pavement, as well as permeable pavers, are included in the following subsections.

9.5.1 Rigid Pavement

Recommended thickness for Portland cement concrete pavement (PCCP) in vehicular areas, for various service levels are presented in Table 10. The concrete should be underlain by at least six inches of Class 2 aggregate base.

TABLE 10
Portland Cement Concrete

Service Level	**Portland Cement Concrete (inches)**
Light (Schools, office buildings, etc.)	5.0
Medium (Shopping centers, commercial areas with truck service drives)	6.0
Heavy (Industrial)	7.0

The modulus of rupture of the Portland cement concrete should be at least 500 pound per square inch (psi) at 28 days (corresponds to a 28-day unconfined compressive strength of about 3,000 psi). Contraction joints should be constructed at 15-foot spacing. Where the outer edge of a concrete pavement meets asphalt pavement, the concrete slab should be thickened by 50 percent at a taper not to exceed a slope of 1 to 10. The slab edges should be confined by curbs or pavement, and slabs should have dowels connecting adjacent slabs. In addition, at areas subject to vehicles with heavy axle loads, we recommend the slabs be reinforced with a minimum of No. 4 bars at 16-inch-spacing in both directions. Recommendations for subgrade preparation and aggregate base compaction are described in Section 9.1.3.

9.5.2 Flexible Pavement

The State of California flexible pavement design method was used to develop the recommended asphalt concrete pavement sections. We expect the final soil subgrade in asphalt-paved areas will generally consist of clay or clayey sand. A laboratory test indicates that the near-surface soil has a resistance value (R-value) of 7.

The State of California resistance value (R-value) method for asphaltic concrete (AC) pavement design was used to develop recommendations for asphalt concrete pavement sections.

Recommendations for pavement sections for Traffic Indices (TI) ranging from 4.0 to 8.0 are presented in Table 11, based on an R-Value of 7. We can provide pavement section recommendations for other TIs, if requested by the project civil engineer.

TABLE 11

AC Pavement Section
R-Value = 7

TI	**Asphalt Concrete (inches)**	**Class 2 Aggregate Base (R=78) (inches)**
4.0	3.0	6.5
5.0	3.5	8.5
6.0	3.5	12.5
7.0	4.0	15
8.0	5.0	17

Recommendations for subgrade preparation and aggregate base compaction are described in Section 9.1.3.

9.6 Site Drainage

Positive surface drainage should be provided around the buildings so that surface runoff is not permitted to pond, particularly adjacent to foundations, roadways, pavements, retaining walls, or slabs. Surface runoff should be directed away from foundations and other improvements and collected in lined ditches or drainage swales. In addition, roof downspouts should be discharged into controlled drainage facilities to keep the water away from the foundations. The water collected should be directed to a storm drain or stormwater detention areas.

9.7 2019 California Building Code Site Class and Seismic Design Criteria

In accordance with the 2019 California Building Code (CBC) and ASCE 7-16, we recommend the new buildings be designed using seismic Site Class C or D depending on the thickness of fill in the vicinity of the structure. Figure 7 presents a delineation plan indicating areas where Site

Class C or Site Class D should be used for design. For seismic design in accordance with the provisions of 2019 CBC, we recommend the following:

Site Class C:

- Risk-Targeted Maximum Considered Earthquake (MCE_R) S_s and S_1 of 1.500g and 0.600g, respectively.
- Site Coefficient F_a and F_v of 1.2 and 1.4, respectively, assuming the structure meets the exceptions of Section 11.4.8;
- MCE_R spectral response acceleration parameters at short periods, S_{MS}, and at one-second period, S_{M1}, of 1.8g and 0.84g, respectively
- Design Earthquake (DE) spectral response acceleration parameters at short period, S_{DS}, and at one-second period, S_{D1}, of 1.2g and 0.56g, respectively.
- PGA_M of 0.605g

Site Class D:

- Risk-Targeted Maximum Considered Earthquake (MCE_R) S_s and S_1 of 1.500g and 0.600g, respectively.
- Site Coefficient F_a and F_v of 1.0 and 2.5, respectively, assuming the structure meets the exceptions of Section 11.4.8;
- MCE_R spectral response acceleration parameters at short periods, S_{MS}, and at one-second period, S_{M1}, of 1.500g and 1.500g, respectively
- Design Earthquake (DE) spectral response acceleration parameters at short period, S_{DS}, and at one-second period, S_{D1}, of 1.000g and 1.000g, respectively.
- PGA_M of 0.554g

During the design-level study of the project, the project structural engineer will need to determine if the structure meets the exceptions in Section 11.4.8 of ASCE 7-16. If the structure does not meet the exceptions in Section 11.4.8 of ASCE 7-16, site-specific spectra will be required.

10.0 ADDITIONAL SERVICES DURING DESIGN, CONSTRUCTION DOCUMENTS, AND CONSTRUCTION QUALITY ASSURANCE

Langan should be retained to consult with the design team as geotechnical questions arise during final design. Technical specifications and design drawings should incorporate Langan's recommendations. Langan should assist the design team in preparing specification sections related to geotechnical issues such as earthwork, foundations, and excavation support. Langan should review the project plans, as well as Contractor submittals relating to materials and construction procedures for geotechnical work, to check that the designs incorporate the intent of our recommendations.

Langan has investigated and interpreted the site subsurface conditions and developed the foundation design recommendations contained herein, and is therefore best suited to perform quality assurance observation and testing of geotechnical-related work during construction. The work requiring quality assurance confirmation and/or special inspections per the Building Code includes, but is not limited to, earthwork, backfill, installation of ground improvement, and shallow foundations and pile installations. We will review monitoring data provided by the surveyor pertaining to settlement of adjacent structures.

Recognizing that construction observation is the final stage of geotechnical design, quality assurance observation during construction by Langan is necessary to confirm the design assumptions and design elements, to maintain our continuity of responsibility on this project, and allow us to make changes to our recommendations, as necessary. The foundation system and general geotechnical construction methods recommended herein are predicated upon Langan reviewing the final design and providing construction observation services for the owner. Should Langan not be retained for construction observation services, we cannot assume the role of geotechnical engineer of record during construction operations, and the entity providing the construction observation services must serve as the engineer of record instead.

11.0 CONTRACTOR RESPONSIBILITIES

Construction activities that can alter the existing ground conditions, such as excavation, fill placement, foundation construction, dewatering, etc., can also induce stresses, vibrations, and movements in nearby structures and utilities, and disturb occupants. Contractors should be responsible to ensure that their activities will not adversely affect the structures and utilities. Contractors should also take all necessary measures to protect the existing structures, utilities, etc. during construction.

12.0 LIMITATIONS

The conclusions and recommendations provided in this report result from our interpretation of the geotechnical conditions existing at the site inferred from a limited number of borings and data in the vicinity as well as information provided by the project team. Actual subsurface conditions may vary. Recommendations provided are dependent upon one another and no recommendation should be followed independent of the others. Any proposed changes in structures or their locations should be brought to Langan's attention as soon as possible so that we can determine whether such changes affect our recommendations. Information on subsurface strata and groundwater levels shown on the boring logs represent conditions encountered only at the locations indicated and at the time of investigation. If different conditions are encountered during construction, they should immediately be brought to Langan's attention for evaluation, as they may affect our recommendations.

This report has been prepared to assist the Owner, architect, and structural engineer in the design process and is only applicable to the design of the specific project identified. The information in this report cannot be used or depended on by engineers or contractors who are involved in evaluations or designs of facilities on adjacent properties, which are beyond the limits of that which is the specific subject of this report.

REFERENCES

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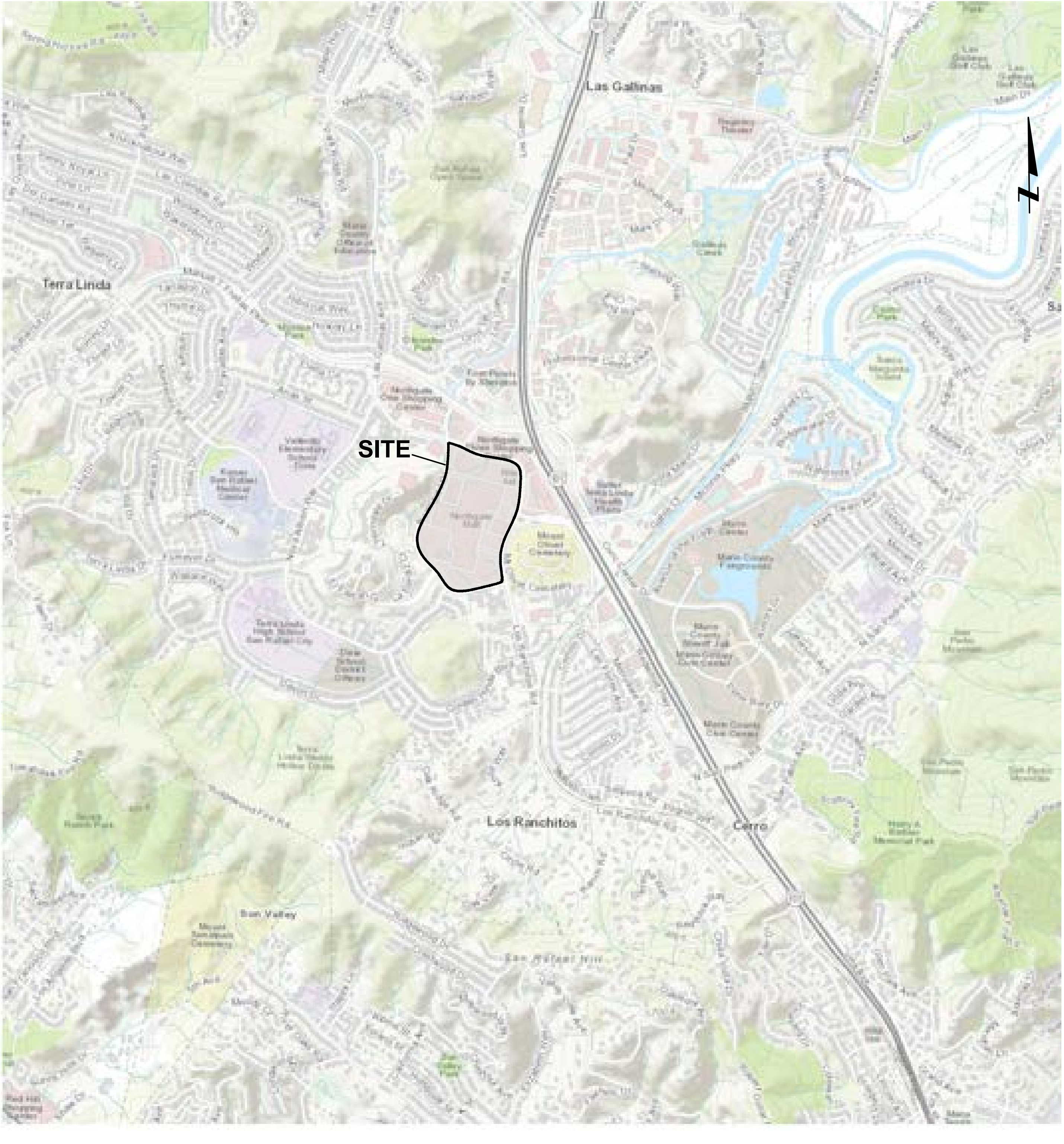
FIGURES



Note:
Topographic base map is provided through Langan's Esri
Arc GIS software licensing and Arc GIS online,
National Geographic Society, i-cubed.

0 2,000 Feet

Approximate scale

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Project

NORTHGATE
TOWN SQUARE

SAN RAFAEL

MARIN COUNTY CALIFORNIA

Figure Title

SITE LOCATION MAP

Project No. 731759601

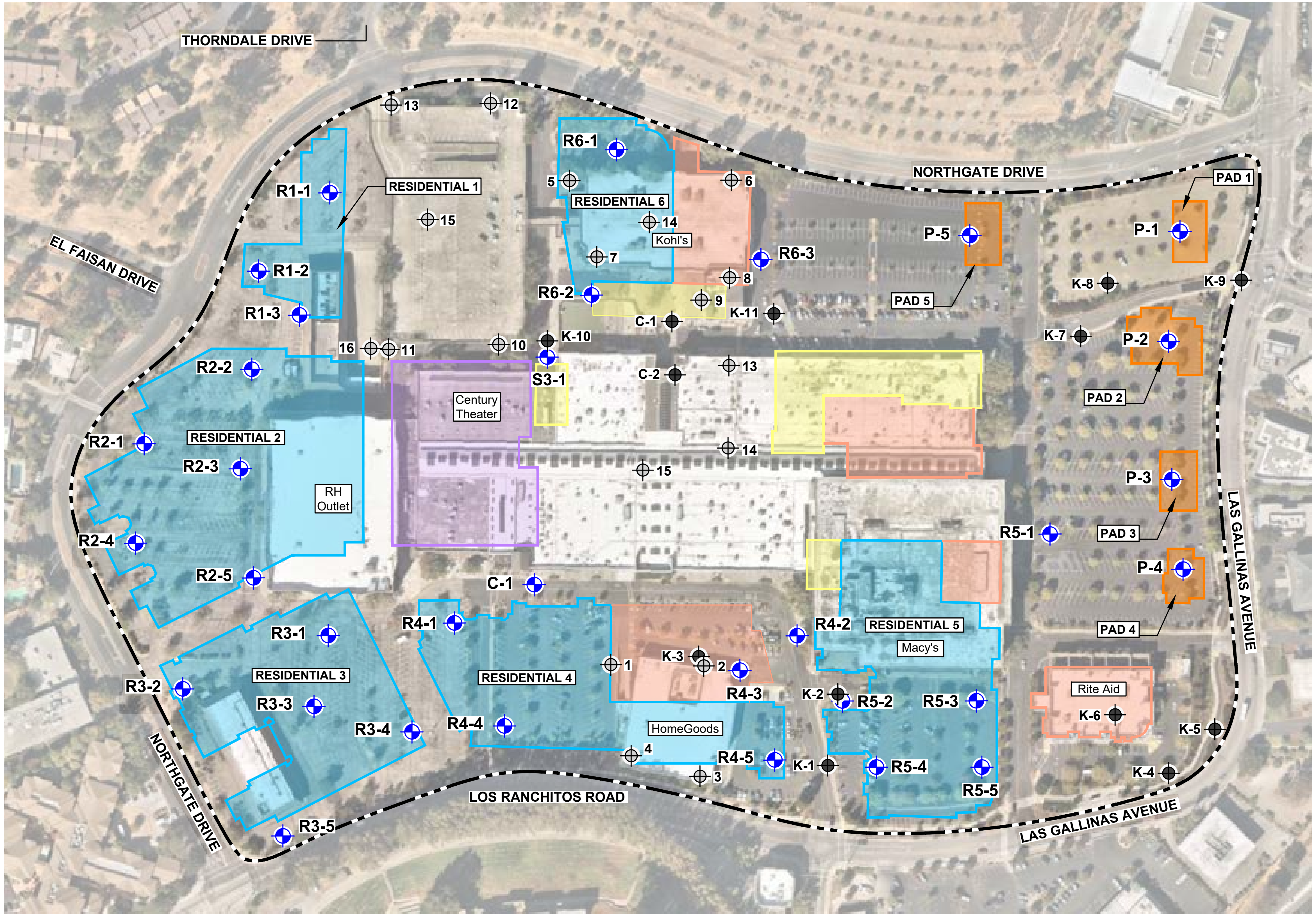
Date 11/11/2021

Drawn By AG

Checked By HS

Figure 1

Filename: \\langan.com\data\SFO\data6\731759601\Project Data\CAD\01\2D-DesignFiles\Geotechnical\731759601-B-GI0101-SLM-FM-MMS.dwg Date: 11/18/2021 Time: 17:21 User: agekas Style Table: Langan.stb Layout: Figure 1 Site Loc



EXPLANATION

C-1 P-1 R1-1 S-1 ⊕	Approximate location of borings by Langan, October and November 2021
C-1 K-1 ⊕	Approximate location of borings by Kleinfelder, August and October 2007
5 ⊕	Approximate location of borings by Woodward-Clyde Consultants, October 1982
🟦	Approximate area of proposed residential parcel
🟧	Approximate area of proposed restaurant pad
🟨	Approximate area of proposed retail shops
🟪	Approximate area of cinema
🟥	Approximate area of anchor stores
— · —	Site boundary

REFERENCE: Aerial by Nearmaps 2021.

0 180 Feet

Approximate scale

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Project
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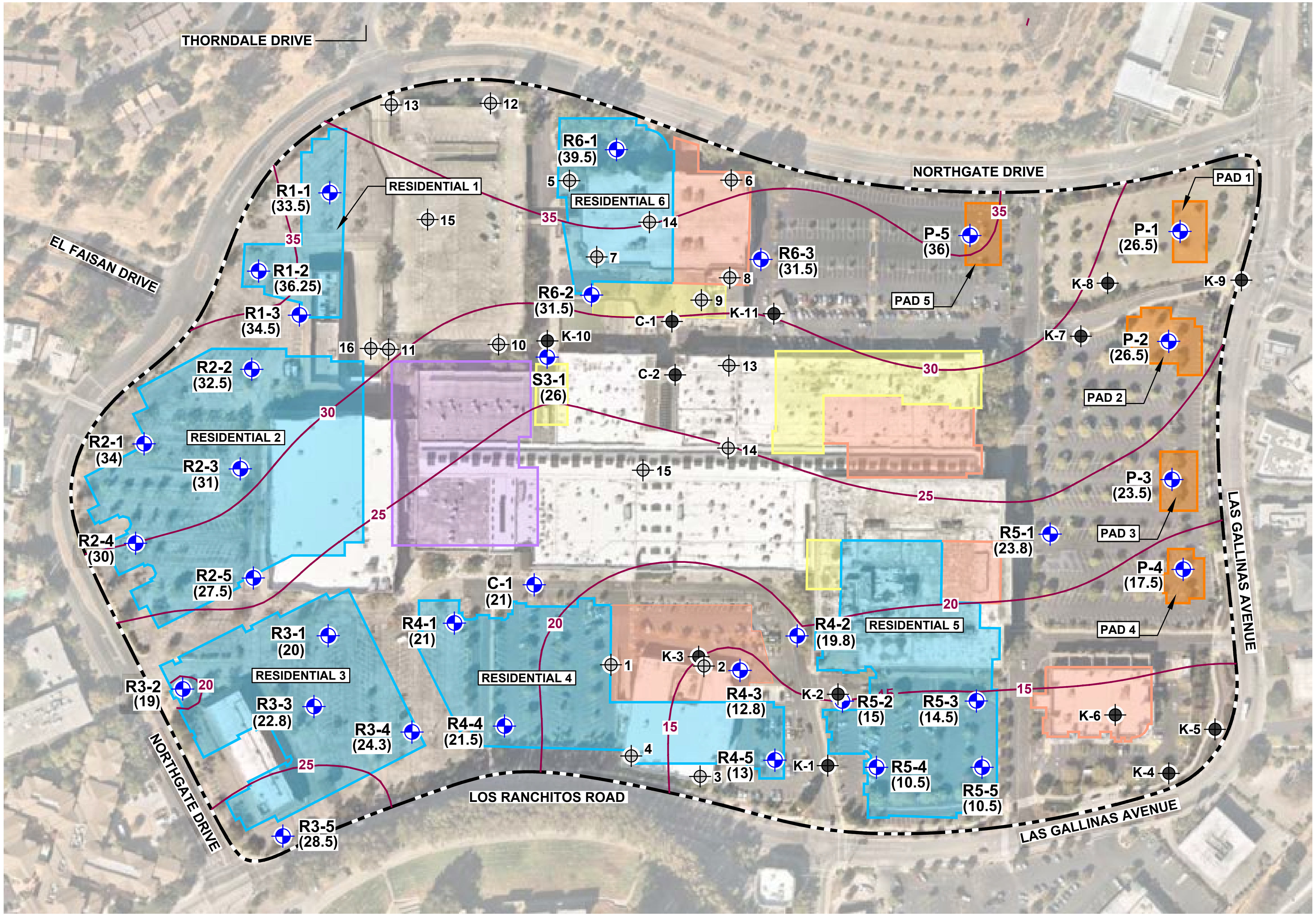
Figure Title
SITE PLAN

Project No. 731759601
Date 11/11/2021
Drawn By AG
Checked By HS

Figure
2
Sheet of

Filename: \\langan.com\data\SFO\data6\731759601\Project Data\CAD\01\2D-DesignFiles\Geotechnical\FG01-731759601-B-SP0101.dwg Date: 12/7/2021 Time: 15:35 User: agekas Style Table: Langan.stb Layout: Site Plan



EXPLANATION

C-1 / P-1 / R1-1 / S-1 ⊕ Approximate location of borings by Langan, October and November 2021

(3) Estimated bottom of fill elevation (feet)

C-1 / K-1 ⊕ Approximate location of borings by Kleinfelder, August and October 2007

5 ⊕ Approximate location of borings by Woodward-Clyde Consultants, October 1982

🟦 Approximate area of proposed residential parcel

🟧 Approximate area of proposed restaurant pad

🟨 Approximate area of proposed retail shops

🟪 Approximate area of cinema

🟥 Approximate area of anchor stores

— - — Site boundary

—10— Datum: North American Vertical Datum of 1988 (NAVD88)

REFERENCE: Aerial by Nearmaps 2021.

0 180 Feet

Approximate scale

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Project

NORTHGATE
TOWN SQUARE

SAN RAFAEL

MARIN COUNTY CALIFORNIA

Figure Title

CONTOUR OF
BOTTOM OF FILL
ELEVATION

Project No. 731759601

Date 11/11/2021

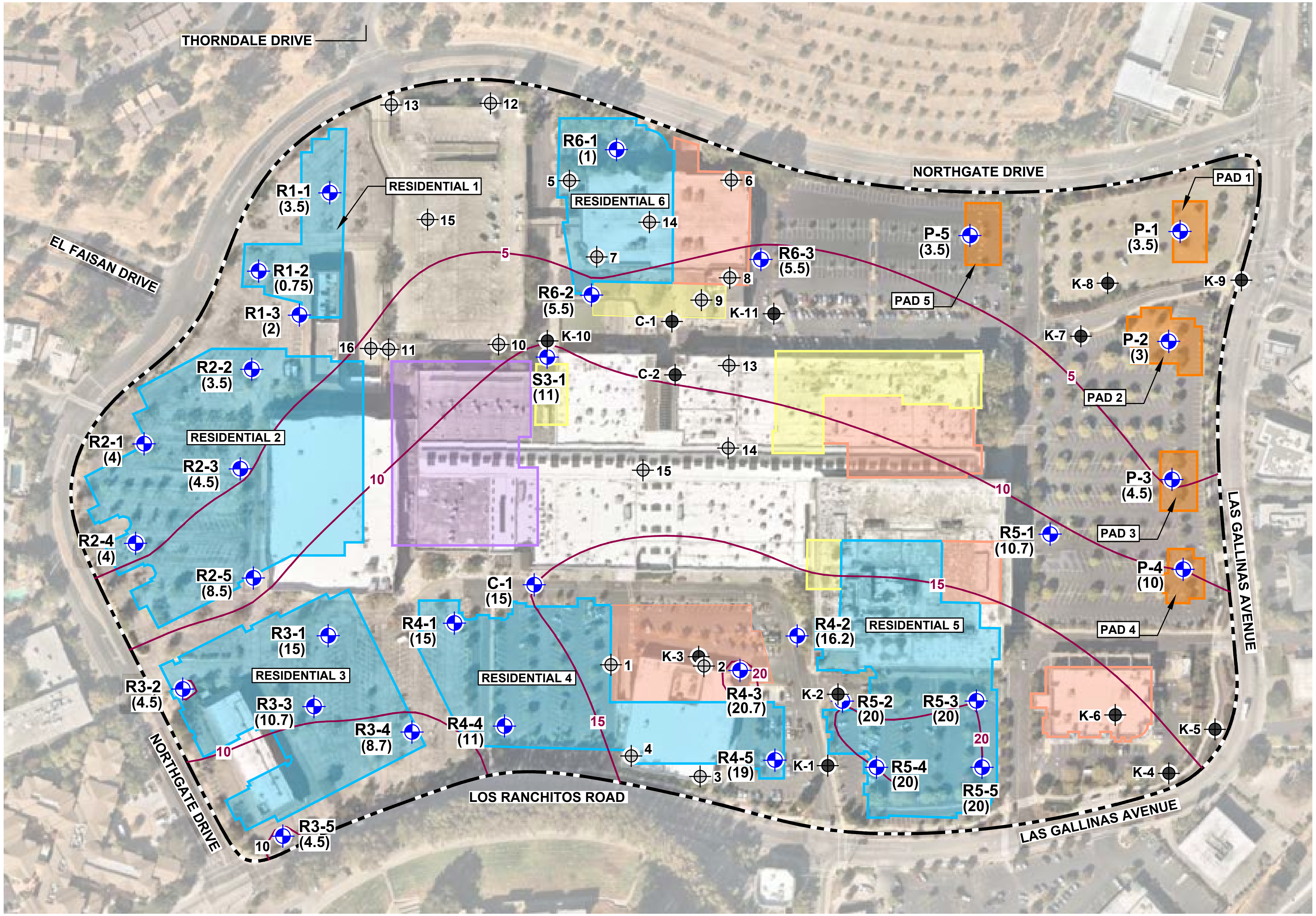
Drawn By AG

Checked By HS

Figure 3a

Sheet of

Filename: \\langan.com\data\SFO\data6\731759601\Project Data\CAD\01\2D-DesignFiles\Geotechnical\FG01-731759601-B-SP0101.dwg Date: 12/7/2021 Time: 15:34 User: agekas Style Table: Langan.stb Layout: Bottom Of FILL_3a



EXPLANATION

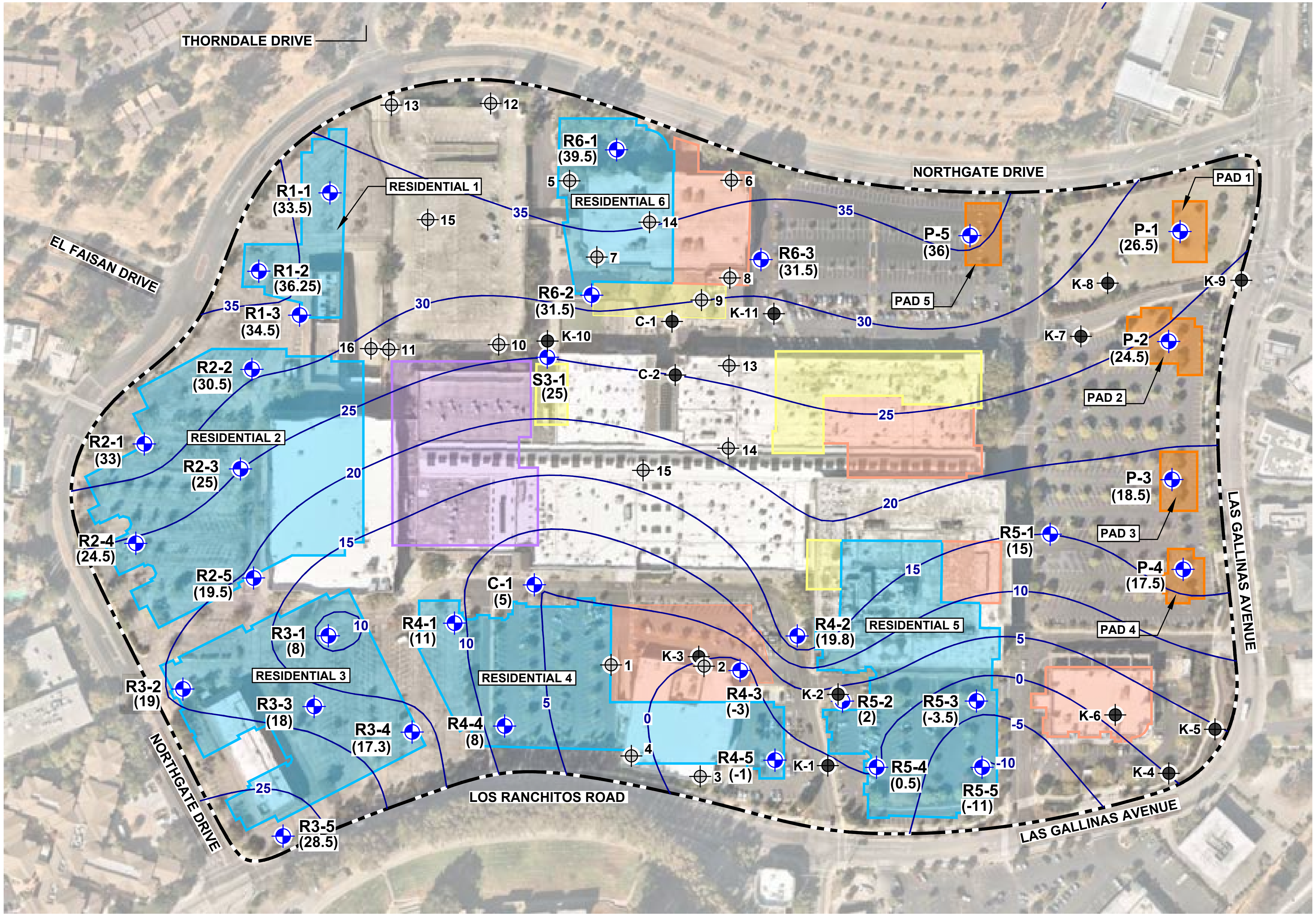
C-1 P-1 R1-1 S-1 ⊕	Approximate location of borings by Langan, October and November 2021
(3)	Estimated depth to bottom of fill below existing ground surface (feet)
C-1 K-1 ⊕	Approximate location of borings by Kleinfelder, August and October 2007
5 ⊕	Approximate location of borings by Woodward-Clyde Consultants, October 1982
🟦	Approximate area of proposed residential parcel
🟧	Approximate area of proposed restaurant pad
🟨	Approximate area of proposed retail shops
🟪	Approximate area of cinema
🟥	Approximate area of anchor stores
━ ‑ ━	Site boundary
—10—	Depth to bottom of fill contour (feet)

REFERENCE: Aerial by Nearmaps 2021.

0 180 Feet
Approximate scale

LANGAN Langan Engineering and Environmental Services, Inc. 135 Main Street, Suite 1500 San Francisco, CA 94105 T: 415.955.5200 F: 415.955.5201 www.langan.com	Project NORTHGATE TOWN SQUARE SAN RAFAEL MARIN COUNTY CALIFORNIA	Figure Title CONTOURS OF DEPTH TO BOTTOM OF FILL	Project No. 731759601 Date 11/11/2021 Drawn By AG Checked By HS	Figure 3b Sheet of

Filename: \\langan.com\data\SFO\data6\731759601\Project Data\CAD\01\2D-DesignFiles\Geotechnical\FG01-731759601-B-SP0101.dwg Date: 12/7/2021 Time: 15:33 User: agekas Style Table: Langan.stb Layout: Depth Of FILL_3b



EXPLANATION

C-1 P-1 R1-1 S-1 ⊕	Approximate location of borings by Langan, October and November 2021
(5)	Estimated top of bedrock elevation (feet)
C-1 K-1 ⊕	Approximate location of borings by Kleinfelder, August and October 2007
5 ⊕	Approximate location of borings by Woodward-Clyde Consultants, October 1982
🟦	Approximate area of proposed residential parcel
🟧	Approximate area of proposed restaurant pad
🟨	Approximate area of proposed retail shops
🟪	Approximate area of cinema
🟥	Approximate area of anchor stores
— - —	Site boundary
—10—	Datum: North American Vertical Datum of 1988 (NAVD88)

REFERENCE: Aerial by Nearmaps 2021.

0 180 Feet

Approximate scale

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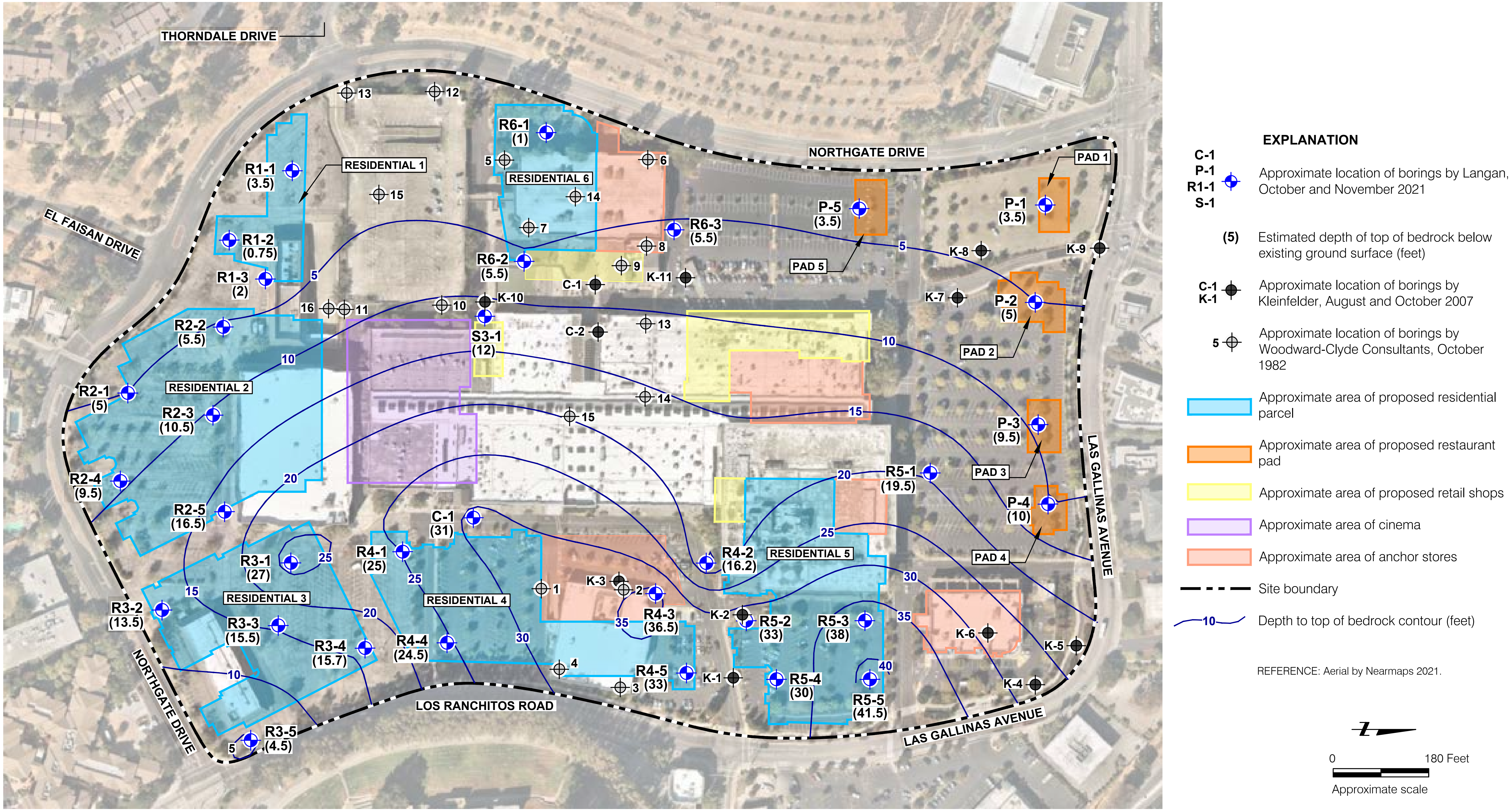
Figure Title
CONTOURS OF TOP OF BEDROCK ELEVATION

Project No. 731759601
Date 11/11/2021
Drawn By AG
Checked By HS

Figure 4a
Sheet of

Filename: \\langan.com\data\SFO\data6\731759601\Project Data\CAD\01\2D-DesignFiles\Geotechnical\FG01-731759601-B-SP0101.dwg Date: 12/7/2021 Time: 15:31 User: agekas Style Table: Langan.stb Layout: Top Of BEDROCK_4a



EXPLANATION

C-1
P-1
R1-1
S-1 ⊕ Approximate location of borings by Langan, October and November 2021

(5) Estimated depth of top of bedrock below existing ground surface (feet)

C-1
K-1 ⊕ Approximate location of borings by Kleinfelder, August and October 2007

5 ⊕ Approximate location of borings by Woodward-Clyde Consultants, October 1982

▭ Approximate area of proposed residential parcel

▭ Approximate area of proposed restaurant pad

▭ Approximate area of proposed retail shops

▭ Approximate area of cinema

▭ Approximate area of anchor stores

— - — Site boundary

—10— Depth to top of bedrock contour (feet)

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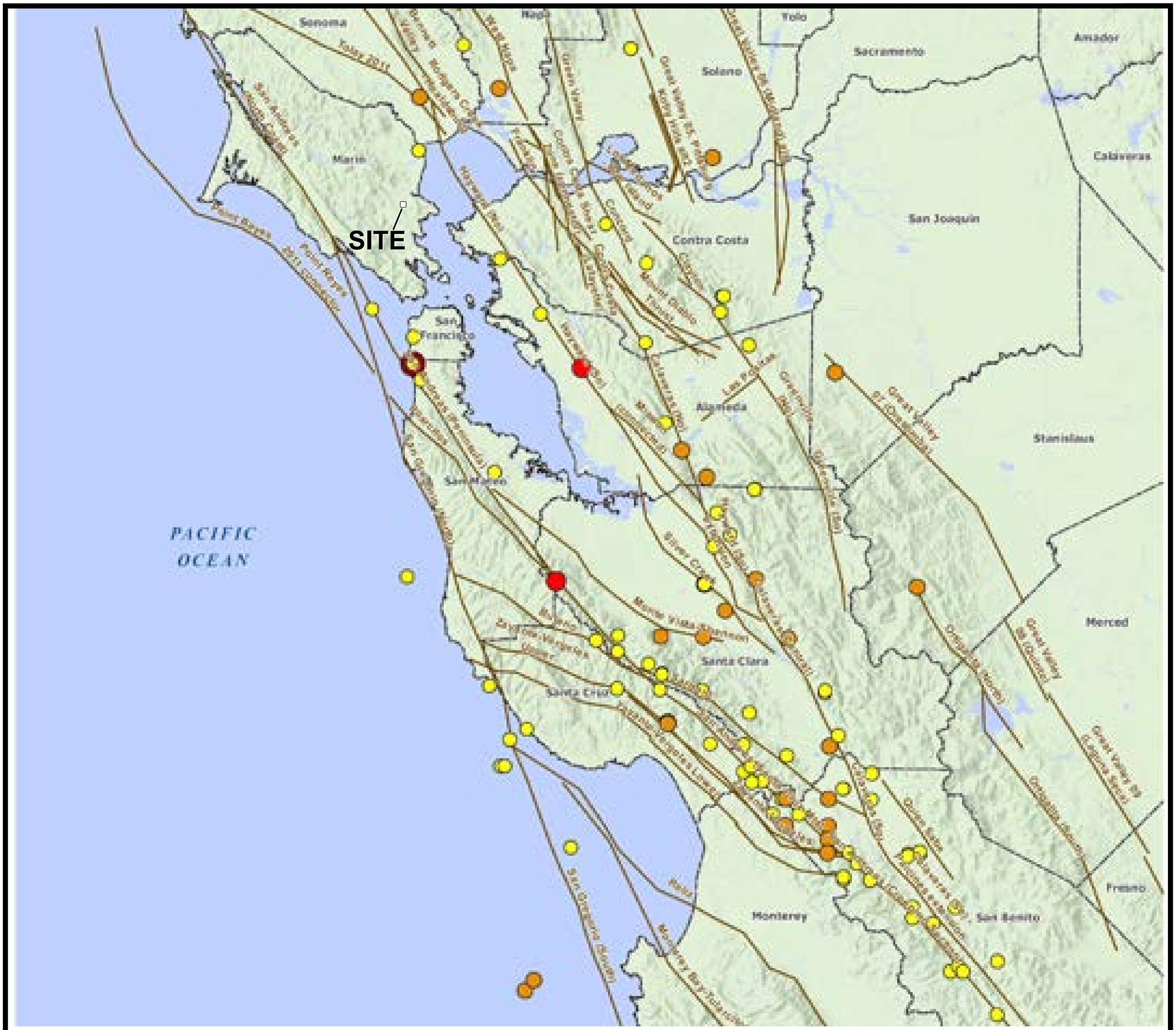
Figure Title
CONTOURS OF DEPTH
TO TOP OF BEDROCK

Project No. 731759601
Date 11/11/2021
Drawn By AG
Checked By HS

Figure
4b
Sheet of

Filename: \\langan.com\data\SFO\data6\731759601\Project Data\CAD\01\2D-DesignFiles\Geotechnical\FG01-731759601-B-SP0101.dwg Date: 12/7/2021 Time: 15:30 User: agekas Style Table: Langan.stb Layout: Depth Of BEDROCK_4b



LEGEND

⬚ County Boundary

— Fault

Earthquake Epicenter Magnitude

- ● Magnitude 5 to 5.9
- ● Magnitude 6 to 6.9
- ● Magnitude 7 to 7.4
- ● Magnitude 7.5 to 8

0 20 Miles

Approximate scale

Notes:

1. Quaternary fault data displayed are provided by the CGS Map Sheet 48: Fault based seismic sources used in the Uniform California Earthquake Rupture Forecast, Version (UCERF3).
2. The Earthquake Epicenter (Magnitude) data is provided by the U.S Geological Survey (USGS) and is current through 2015.
3. Basemap hillshade and County boundaries provided by USGS and California Department of Transportation.
4. Map displayed in California State Coordinate System, California (Teale) Albers, North American Datum of 1983 (NAD83), Meters.

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MARIN COUNTY CALIFORNIA

Figure Title
MAP OF MAJOR
FAULTS AND EARTHQUAKE
EPICENTERS IN THE
SAN FRANCISCO BAY AREA

Project No.
731759601
Date
11/11/2021
Drawn By
AG
Checked By
HS

Figure
5

I Not felt by people, except under especially favorable circumstances. However, dizziness or nausea may be experienced.

Sometimes birds and animals are uneasy or disturbed. Trees, structures, liquids, bodies of water may sway gently, and doors may swing very slowly.

II Felt indoors by a few people, especially on upper floors of multi-story buildings, and by sensitive or nervous persons.

As in Grade I, birds and animals are disturbed, and trees, structures, liquids and bodies of water may sway. Hanging objects swing, especially if they are delicately suspended.

III Felt indoors by several people, usually as a rapid vibration that may not be recognized as an earthquake at first. Vibration is similar to that of a light, or lightly loaded trucks, or heavy trucks some distance away. Duration may be estimated in some cases.

Movements may be appreciable on upper levels of tall structures. Standing motor cars may rock slightly.

IV Felt indoors by many, outdoors by a few. Awakens a few individuals, particularly light sleepers, but frightens no one except those apprehensive from previous experience. Vibration like that due to passing of heavy, or heavily loaded trucks. Sensation like a heavy body striking building, or the falling of heavy objects inside.

Dishes, windows and doors rattle; glassware and crockery clink and clash. Walls and house frames creak, especially if intensity is in the upper range of this grade. Hanging objects often swing. Liquids in open vessels are disturbed slightly. Stationary automobiles rock noticeably.

V Felt indoors by practically everyone, outdoors by most people. Direction can often be estimated by those outdoors. Awakens many, or most sleepers. Frightens a few people, with slight excitement; some persons run outdoors.

Buildings tremble throughout. Dishes and glassware break to some extent. Windows crack in some cases, but not generally. Vases and small or unstable objects overturn in many instances, and a few fall. Hanging objects and doors swing generally or considerably. Pictures knock against walls, or swing out of place. Doors and shutters open or close abruptly. Pendulum clocks stop, or run fast or slow. Small objects move, and furnishings may shift to a slight extent. Small amounts of liquids spill from well-filled open containers. Trees and bushes shake slightly.

VI Felt by everyone, indoors and outdoors. Awakens all sleepers. Frightens many people; general excitement, and some persons run outdoors.

Persons move unsteadily. Trees and bushes shake slightly to moderately. Liquids are set in strong motion. Small bells in churches and schools ring. Poorly built buildings may be damaged. Plaster falls in small amounts. Other plaster cracks somewhat. Many dishes and glasses, and a few windows break. Knickknacks, books and pictures fall. Furniture overturns in many instances. Heavy furnishings move.

VII Frightens everyone. General alarm, and everyone runs outdoors.

People find it difficult to stand. Persons driving cars notice shaking. Trees and bushes shake moderately to strongly. Waves form on ponds, lakes and streams. Water is muddied. Gravel or sand stream banks cave in. Large church bells ring. Suspended objects quiver. Damage is negligible in buildings of good design and construction; slight to moderate in well-built ordinary buildings; considerable in poorly built or badly designed buildings, adobe houses, old walls (especially where laid up without mortar), spires, etc. Plaster and some stucco fall. Many windows and some furniture break. Loosened brickwork and tiles shake down. Weak chimneys break at the roofline. Cornices fall from towers and high buildings. Bricks and stones are dislodged. Heavy furniture overturns. Concrete irrigation ditches are considerably damaged.

VIII General fright, and alarm approaches panic.

Persons driving cars are disturbed. Trees shake strongly, and branches and trunks break off (especially palm trees). Sand and mud erupts in small amounts. Flow of springs and wells is temporarily and sometimes permanently changed. Dry wells renew flow. Temperatures of spring and well waters varies. Damage slight in brick structures built especially to withstand earthquakes; considerable in ordinary substantial buildings, with some partial collapse; heavy in some wooden houses, with some tumbling down. Panel walls break away in frame structures. Decayed pilings break off. Walls fall. Solid stone walls crack and break seriously. Wet grounds and steep slopes crack to some extent. Chimneys, columns, monuments and factory stacks and towers twist and fall. Very heavy furniture moves conspicuously or overturns.

IX Panic is general.

Ground cracks conspicuously. Damage is considerable in masonry structures built especially to withstand earthquakes; great in other masonry buildings - some collapse in large part. Some wood frame houses built especially to withstand earthquakes are thrown out of plumb, others are shifted wholly off foundations. Reservoirs are seriously damaged and underground pipes sometimes break.

X Panic is general.

Ground, especially when loose and wet, cracks up to widths of several inches; fissures up to a yard in width run parallel to canal and stream banks. Landsliding is considerable from river banks and steep coasts. Sand and mud shifts horizontally on beaches and flat land. Water level changes in wells. Water is thrown on banks of canals, lakes, rivers, etc. Dams, dikes, embankments are seriously damaged. Well-built wooden structures and bridges are severely damaged, and some collapse. Dangerous cracks develop in excellent brick walls. Most masonry and frame structures, and their foundations are destroyed. Railroad rails bend slightly. Pipe lines buried in earth tear apart or are crushed endwise. Open cracks and broad wavy folds open in cement pavements and asphalt road surfaces.

XI Panic is general.

Disturbances in ground are many and widespread, varying with the ground material. Broad fissures, earth slumps, and land slips develop in soft, wet ground. Water charged with sand and mud is ejected in large amounts. Sea waves of significant magnitude may develop. Damage is severe to wood frame structures, especially near shock centers, great to dams, dikes and embankments, even at long distances. Few if any masonry structures remain standing. Supporting piers or pillars of large, well-built bridges are wrecked. Wooden bridges that "give" are less affected. Railroad rails bend greatly and some thrust endwise. Pipe lines buried in earth are put completely out of service.

XII Panic is general.

Damage is total, and practically all works of construction are damaged greatly or destroyed. Disturbances in the ground are great and varied, and numerous shearing cracks develop. Landslides, rock falls, and slumps in river banks are numerous and extensive. Large rock masses are wrenched loose and torn off. Fault slips develop in firm rock, and horizontal and vertical offset displacements are notable. Water channels, both surface and underground, are disturbed and modified greatly. Lakes are dammed, new waterfalls are produced, rivers are deflected, etc. Surface waves are seen on ground surfaces. Lines of sight and level are distorted. Objects are thrown upward into the air.

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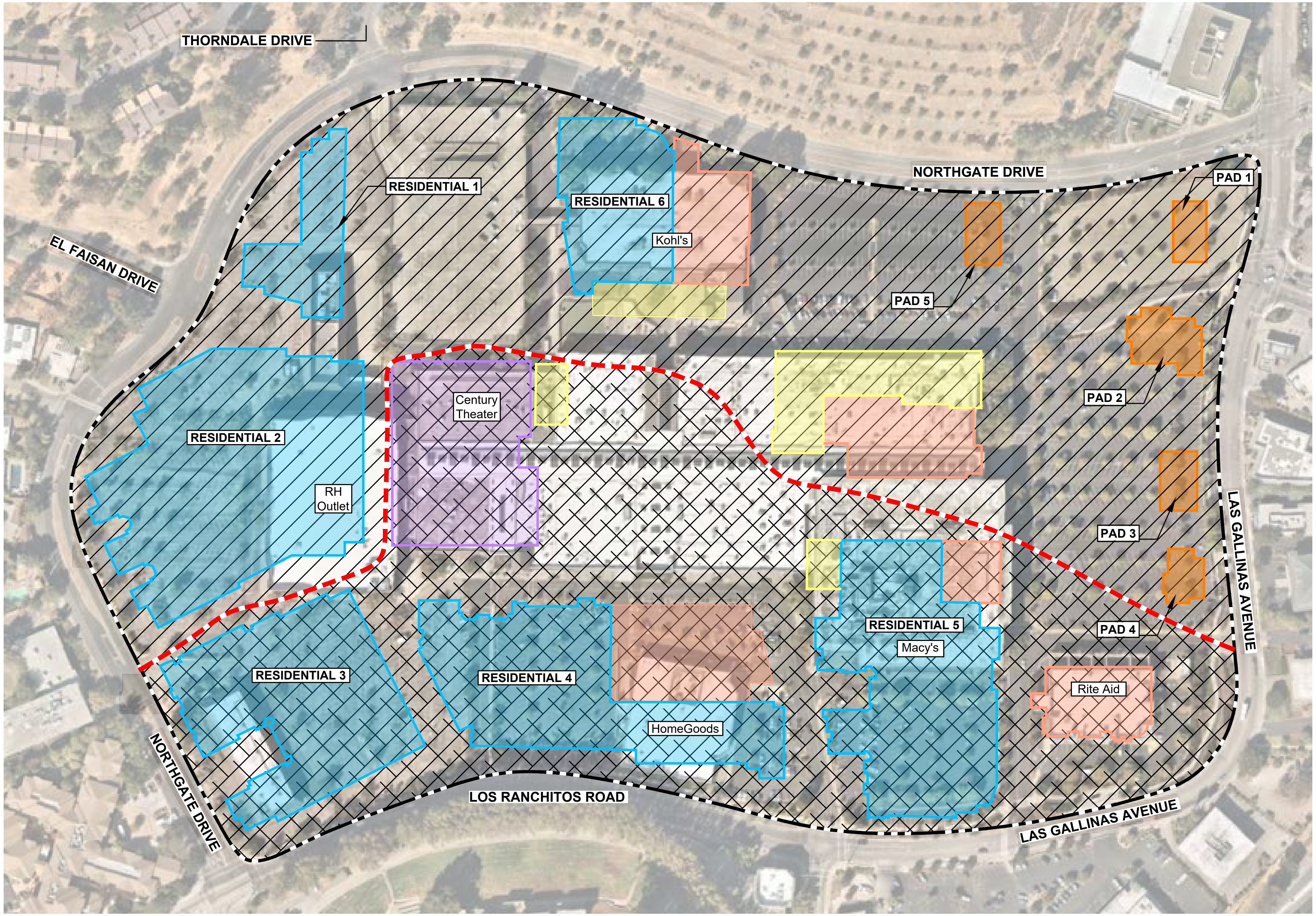
Project
**NORTHGATE
TOWN SQUARE**
SAN RAFAEL
MARIN COUNTY **CALIFORNIA**

Figure Title
**MODIFIED MERCALLI
INTENSITY SCALE**

Project No.
731759601
Date
11/11/2021
Drawn By
AG
Checked By
HS

Figure
6

Filename: \\langan.com\data\SFO\data6\731759601\Project Data\CAD\01\2D-DesignFiles\Geotechnical\731759601-B-GI0101-SLM-FM-MMS.dwg Date: 11/18/2021 Time: 17:21 User: agekas Style Table: Langan.stb Layout: Figure 6 MM Scale



EXPLANATION

- Approximate Delineation of Seismic Site Class
- ▨ Site Class C
- ▨ Site Class D
- 🟦 Approximate area of proposed residential parcel
- 🟧 Approximate area of proposed restaurant pad
- 🟨 Approximate area of proposed retail shops
- 🟪 Approximate area of cinema
- 🟥 Approximate area of anchor stores
- Site boundary

REFERENCE: Aerial by Nearmaps 2021.

0 180 Feet

Approximate scale

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Project

NORTHGATE TOWN SQUARE

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MARIN COUNTY CALIFORNIA

Figure Title

SEISMIC SITE CLASS DELINEATION PLAN

Project No. 731759601

Date 11/11/2021

Drawn By AG

Checked By HS

Figure 7

Sheet of

Filename: \\langan.com\data\SFO\data6\731759601\Project Data\CAD\01\2D-DesignFiles\Geotechnical\FG01-731759601-B-SP0101.dwg Date: 12/7/2021 Time: 17:08 User: agekas Style Table: Langan.stb Layout: Figure 7

APPENDIX A

LOGS OF BORINGS

PROJECT: **NORTHGATE TOWN SQUARE**
San Rafael, California

Log of Boring C-1

PAGE 1 OF 2

Boring location: See Site Plan, Figure 2

Date started: 10/29/21 | Date finished: 10/29/21

Drilling method: Hollow Stem Auger

Hammer weight/drop: 140 lbs./30 inches | Hammer type: Automatic

Samplers: Sprague & Henwood (S&H), Standard Penetration Test (SPT)

Logged by: R. Ford
Drilled By: Gulf Shore Consturction Service, Inc

DEPTH (feet)	SAMPLES Sampler Type	Sample	Blows/ 6"	SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION Ground Surface Elevation: 36 feet[2]	LABORATORY TEST DATA Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
						6 inches asphalt concrete (AC)						
1						6 inches aggregate base (AB)						
2						SANDY CLAY (CL) yellow-brown to brown, moist, fine sand [FILL]						
3	BAG	☒				LL = 26, PI = 11, see Figure C-3						
4												
5						very stiff, sandstone fragments						
6	S&H	■	10 10 11	17								
7												
8					CL							
9												
10						gray, with shale fragments						
11	S&H	■	4 8 10	14								
12												
13												
14												
15						SANDY CLAY (CL) light gray with orange mottling, medium stiff to stiff, moist, fine sand						
16	S&H	■	5 4 6	8			PP		1,000			
17					CL							
18						∇ (10/29/21, 8:30 AM)						
19												
20						∇ (10/29/21, 7:40 AM)						
						SANDY CLAY (CL) gray-brown, very stiff, wet, fine sand, some fine rounded gravel						
21	S&H	■	12 16 21	29			PP		>4,500		19.2	112
22												
23												
24												
25					CL	increased gravel content						
26	SPT	◪	5 10 12	29								
27												
28												
29												
30												

LANGAN

Project No.: 731759601 | Figure: A-1a

PROJECT: **NORTHGATE TOWN SQUARE**
San Rafael, California

Log of Boring C-1

PAGE 2 OF 2

DEPTH (feet)	SAMPLES				LITHOLOGY	MATERIAL DESCRIPTION	LABORATORY TEST DATA					
	Sampler Type	Sample	Blows/ 6"	SPT N-Value[1]			Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
31	SPT	◪	8 16 25	54	CL	SANDY CLAY (CL) (continued) hard						
32						SANDSTONE and SHALE yellow-brown to brown, crushed, low hardness, friable to weak, deeply to moderately weathered [BEDROCK]						
33												
34												
35	SPT	◪	50/ 4"	66/ 4"		gray, moderately hard, moderately strong, little weathered						
36												
37												
38												
39												
40												
41												
42												
43												
44												
45												
46												
47												
48												
49												
50												
51												
52												
53												
54												
55												
56												
57												
58												
59												
60												

Boring terminated at a depth of 35.3 feet below ground surface.
Boring backfilled with cement grout.
Groundwater encountered at 20 feet below ground surface at the time of drilling.
PP = Pocket penetrometer.

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.8 and 1.3, respectively to account for sampler type and hammer energy.

[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

LANGAN

Project No.: 731759601

Figure: A-1b

PROJECT: **NORTHGATE TOWN SQUARE**
San Rafael, California

Log of Boring P-1

PAGE 1 OF 1

Boring location: See Site Plan, Figure 2

Date started: 11/3/21 Date finished: 11/3/21

Drilling method: Hollow Stem Auger

Hammer weight/drop: 140 lbs./30 inches Hammer type: Automatic

Samplers: Standard Penetration Test (SPT)

Logged by: R. Ford
Drilled By: Gulf Shore Consturction Service, Inc

DEPTH (feet)	SAMPLES Sampler Type	Sample	Blows/ 6"	SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION Ground Surface Elevation: 30 feet[2]	LABORATORY TEST DATA Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
						6 inches asphalt concrete (AC)						
1						6 inches aggregate base (AB)						
2					SC	CLAYEY SAND (SC) gray, moist, fine-grained [FILL] LL = 29, PI = 15, see Figure C-3						
3	BAG	☒										
4						SANDSTONE and SHALE gray, crushed, low hardness, friable, moderately weathered [BEDROCK]						
5												
6	SPT	◩	32 27 21	63								
7												
8												
9												
10												
11	SPT	◩	29 30 31	80								
12												
13												
14												
15												
16												
17												
18												
19												
20												
21												
22												
23												
24												
25												
26												
27												
28												
29												
30												

Boring terminated at a depth of 11.5 feet below ground surface.
Boring backfilled with cement grout.
Groundwater not encountered at the time of drilling.

[1] SPT blow counts for the last two increments were converted to SPT N-Values using factors of 1.3, respectively to account for sampler type and hammer energy.

[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

LANGAN

Project No.: 731759601

Figure: A-2

PROJECT: **NORTHGATE TOWN SQUARE**
San Rafael, California

Log of Boring P-2

PAGE 1 OF 1

Boring location: See Site Plan, Figure 2
Date started: 11/3/21
Date finished: 11/3/21
Drilling method: Hollow Stem Auger
Hammer weight/drop: 140 lbs./30 inches
Hammer type: Automatic
Samplers: Sprague & Henwood (S&H), Standard Penetration Test (SPT)

Logged by: R. Ford
Drilled By: Gulf Shore Consturction Service, Inc

DEPTH (feet)	SAMPLES				LITHOLOGY	MATERIAL DESCRIPTION	LABORATORY TEST DATA					
	Sampler Type	Sample	Blows/ 6"	SPT N-Value[1]		Ground Surface Elevation: 29.5 feet[2]	Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
						6 inches asphalt concrete (AC)						
1						5 inches aggregate base (AB)						
2						SANDY CLAY (CL) olive-gray, moist, fine sand [FILL] R-Value Test, see Figure C-4						
3	GRAB	☒			CL							
4												
5	S&H	■	18 37 50/ 3"	69/ 9"		SANDSTONE and SHALE olive-gray to gray-brown, crushed, weak, deeply to moderately weathered [BEDROCK]						
6												
7												
8												
9												
10	SPT	◩	29 35 35	92		dark brown to yellow-brown						
11												
12												
13												
14												
15												
16												
17												
18												
19												
20												
21												
22												
23												
24												
25												
26												
27												
28												
29												
30												

Boring terminated at a depth of 11.5 feet below ground surface.
Boring backfilled with cement grout.
Groundwater not encountered at the time of drilling.

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.8 and 1.3, respectively to account for sampler type and hammer energy.

[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

LANGAN

Project No.: 731759601
Figure: A-3

PROJECT: **NORTHGATE TOWN SQUARE**
San Rafael, California

Log of Boring P-3

PAGE 1 OF 1

Boring location: See Site Plan, Figure 2
Date started: 11/3/21
Date finished: 11/3/21
Drilling method: Hollow Stem Auger
Hammer weight/drop: 140 lbs./30 inches
Hammer type: Automatic
Samplers: Sprague & Henwood (S&H), Standard Penetration Test (SPT)

Logged by: R. Ford
Drilled By: Gulf Shore Consturction Service, Inc

DEPTH (feet)	SAMPLES: Sampler Type	Sample	Blows/ 6"	SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION Ground Surface Elevation: 28 feet[2]	LABORATORY TEST DATA: Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
						4 inches asphalt concrete (AC)						
1						6 inches aggregate base (AB)						
2					CL	SANDY CLAY (CL) brown to yellow-brown, moist, fine sand [FILL]						
3	GRAB	☒										
4												
5					CL	SANDY CLAY (CL) gray-brown, stiff, wet						
6	S&H	■	2 5 13	14			PP PP		700 2,200			
7						SANDY CLAY (CL) light gray with red mottling, stiff, wet, fine sand [RESIDUAL SOIL]						
8					CL							
9												
10						SHALE gray, crushed, low hardness, weak, moderately to deeply weathered, oxidized [BEDROCK]						
11	S&H	■	17 20 22	33								
12												
13												
14												
15												
16	SPT	◪	16 21 45	86								
17												
18												
19												
20												
21												
22												
23												
24												
25												
26												
27												
28												
29												
30												

Boring terminated at a depth of 16.5 feet below ground surface.
Boring backfilled with cement grout.
Groundwater not encountered at the time of drilling.
PP = Pocket penetrometer.

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.8 and 1.3, respectively to account for sampler type and hammer energy.
[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

LANGAN

Project No.: 731759601
Figure: A-4

PROJECT: **NORTHGATE TOWN SQUARE**
San Rafael, California

Log of Boring P-4

PAGE 1 OF 1

Boring location: See Site Plan, Figure 2
Date started: 10/22/21
Date finished: 10/22/21
Drilling method: Hollow Stem Auger
Hammer weight/drop: 140 lbs./30 inches
Hammer type: Automatic
Samplers: Sprague & Henwood (S&H), Standard Penetration Test (SPT)

Logged by: R. Ford
Drilled By: Gulf Shore Consturction Service, Inc

Ground Surface Elevation: 27.5 feet[2]

DEPTH (feet)	SAMPLES Sampler Type	Sample	Blows/ 6"	SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	LABORATORY TEST DATA Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
						6 inches asphalt concrete (AC)						
1						3 inches aggregate base (AB)						
2						SANDY CLAY (CL) yellow-brown, moist, fine to medium sand [FILL]						
3	BAG	☒			CL							
4												
5						SANDY CLAY (CL) gray-brown to gray, stiff, moist, fine sand [FILL]						
6	S&H	■	6 8 7	12			PP		3,600		13.1	117
7												
8					CL							
9												
10												
11	S&H	■	18 29 28	45		SANDSTONE olive, crushed, low hardness, friable to weak, deeply to moderately weathered						
12												
13						SHALE gray-brown, crushed, low hardness, friable, moderately weathered [BEDROCK]						
14												
15												
16												
17												
18												
19												
20												
21	SPT	◪	14 15 25	53		gray						
22												
23												
24												
25												
26												
27												
28												
29												
30												

Boring terminated at a depth of 21.5 feet below ground surface.
Boring backfilled with cement grout.
Groundwater not encountered at the time of drilling.
PP = Pocket penetrometer.

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.8 and 1.3, respectively to account for sampler type and hammer energy.
[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

LANGAN

Project No.: 731759601
Figure: A-5

PROJECT: **NORTHGATE TOWN SQUARE**
San Rafael, California

Log of Boring P-5

PAGE 1 OF 1

Boring location: See Site Plan, Figure 2

Date started: 11/2/21 | Date finished: 11/2/21

Drilling method: Hollow Stem Auger

Hammer weight/drop: 140 lbs./30 inches | Hammer type: Automatic

Samplers: Standard Penetration Test (SPT)

Logged by: R. Ford
Drilled By: Gulf Shore Consturction Service, Inc

DEPTH (feet)	SAMPLES Sampler Type	Sample	Blows/ 6"	SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION Ground Surface Elevation: 39.5 feet[2]	LABORATORY TEST DATA Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
						6 inches asphalt concrete (AC)						
1						6 inches aggregate base (AB)						
					CL	SANDY CLAY (CL) brown to gray, moist						
2												
3	BAG	☒										
4						SANDSTONE and SHALE gray to gray-brown, crushed, low hardness, friable to weak, deeply to moderately weathered [BEDROCK]						
5												
6	SPT	◩	23 28 37	85								
7												
8												
9												
10	SPT	◩	50/ 5.5"	66/ 5.5"								
11												
12												
13												
14												
15												
16												
17												
18												
19												
20												
21												
22												
23												
24												
25												
26												
27												
28												
29												
30												

Boring terminated at a depth of 10.5 feet below ground surface.
Boring backfilled with cement grout.
Groundwater not encountered at the time of drilling.

[1] SPT blow counts for the last two increments were converted to SPT N-Values using factors of 1.3, respectively to account for sampler type and hammer energy.

[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

LANGAN

Project No.: 731759601 | Figure: A-6

PROJECT: **NORTHGATE TOWN SQUARE**
San Rafael, California

Log of Boring R1-1

PAGE 1 OF 1

Boring location: See Site Plan, Figure 2
Date started: 11/2/21
Date finished: 11/2/21
Drilling method: Hollow Stem Auger
Hammer weight/drop: 140 lbs./30 inches
Hammer type: Automatic
Samplers: Standard Penetration Test (SPT)

Logged by: R. Ford
Drilled By: Gulf Shore Consturction Service, Inc

DEPTH (feet)	SAMPLES: Sampler Type	Sample	Blows/ 6"	SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION Ground Surface Elevation: 37 feet[2]	LABORATORY TEST DATA: Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
						6 inches asphalt concrete (AC)						
1						6 inches aggregate base (AB)						
2					CL	SANDY CLAY with GRAVEL (CL) brown, moist, fine sand, coarse angular gravel [FILL]						
3	BAG	☒										
4						SHALE gray to olive-gray with red mottling, crushed, low hardness, weak, little weathered [BEDROCK]						
5	SPT	◩	28 35 50/ 2.5"	111/ 8.5"								
6												
7												
8												
9												
10	SPT	◩	56/ 2"	66/ 2"		dark gray, moderately hard, moderately strong						
11												
12												
13												
14												
15												
16												
17												
18												
19												
20												
21												
22												
23												
24												
25												
26												
27												
28												
29												
30												

Boring terminated at a depth of 10.2 feet below ground surface.
Boring backfilled with cement grout.
Groundwater not encountered at the time of drilling.

---

[1] SPT blow counts for the last two increments were converted to SPT N-Values using factors of 1.3, respectively to account for sampler type and hammer energy.
[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

LANGAN

Project No.: 731759601
Figure: A-7

PROJECT: **NORTHGATE TOWN SQUARE**
San Rafael, California

Log of Boring R1-2

PAGE 1 OF 1

Boring location: See Site Plan, Figure 2

Date started: 11/1/21

Date finished: 11/1/21

Drilling method: Hollow Stem Auger

Hammer weight/drop: 140 lbs./30 inches

Hammer type: Automatic

Samplers: Standard Penetration Test (SPT)

Logged by: R. Ford

Drilled By: Gulf Shore Consturction Service, Inc

DEPTH (feet)	SAMPLES Sampler Type	Sample	Blows/ 6"	SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION Ground Surface Elevation: 37 feet[2]	LABORATORY TEST DATA Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
						5 inches asphalt concrete (AC)						
						4 inches aggregate base (AB)						
1	SPT	◩	50/ 3"	66/ 3"		SANDSTONE olive-gray to gray, crushed, hard, moderately strong, little weathered [BEDROCK]						
2												
3												
4												
5	SPT	▭	50/ 2"	66/ 2"								
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												
16												
17												
18												
19												
20												
21												
22												
23												
24												
25												
26												
27												
28												
29												
30												

Boring terminated at a depth of 5.2 feet below ground surface.
Boring backfilled with cement grout.
Groundwater not encountered at the time of drilling.

[1] SPT blow counts for the last two increments were converted to SPT N-Values using factors of 1.3, respectively to account for sampler type and hammer energy.

[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

Project No.: 731759601

Figure: A-8

PROJECT: **NORTHGATE TOWN SQUARE**
San Rafael, California

Log of Boring R1-3

PAGE 1 OF 1

Boring location: See Site Plan, Figure 2

Date started: 11/1/21 | Date finished: 11/1/21

Drilling method: Hollow Stem Auger

Hammer weight/drop: 140 lbs./30 inches | Hammer type: Automatic

Samplers: Standard Penetration Test (SPT)

Logged by: R. Ford
Drilled By: Gulf Shore Consturction Service, Inc

DEPTH (feet)	SAMPLES: Sampler Type	SAMPLES: Sample	SAMPLES: Blows/ 6"	SAMPLES: SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION Ground Surface Elevation: 36.5 feet[2]	LABORATORY TEST DATA: Type of Strength Test	LABORATORY TEST DATA: Confining Pressure Lbs/Sq Ft	LABORATORY TEST DATA: Shear Strength Lbs/Sq Ft	LABORATORY TEST DATA: Fines %	LABORATORY TEST DATA: Natural Moisture Content, %	LABORATORY TEST DATA: Dry Density Lbs/Cu Ft
						6 inches asphalt concrete (AC)						
1						6 inches aggregate base (AB)						
2	BAG	☒			CL	SANDY CLAY with GRAVEL (CL) yellow-brown to gray, moist [FILL]						
3						SILTSTONE and SHALE olive-gray to gray, crushed, low to moderate hardness, weak, highly to moderately weathered [BEDROCK]						
4												
5	SPT	◩	18 50/ 5"	66/ 5"								
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												
16												
17												
18												
19												
20												
21												
22												
23												
24												
25												
26												
27												
28												
29												
30												

Boring terminated at a depth of 5.9 feet below ground surface.
Boring backfilled with cement grout.
Groundwater not encountered at the time of drilling.

[1] SPT blow counts for the last two increments were converted to SPT N-Values using factors of 1.3, respectively to account for sampler type and hammer energy.

[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

LANGAN

Project No.: 731759601

Figure: A-9

PROJECT: **NORTHGATE TOWN SQUARE**
San Rafael, California

Log of Boring R2-1

PAGE 1 OF 1

Boring location: See Site Plan, Figure 2
Date started: 11/1/21
Date finished: 11/1/21
Drilling method: Hollow Stem Auger
Hammer weight/drop: 140 lbs./30 inches
Hammer type: Automatic
Samplers: Sprague & Henwood (S&H), Standard Penetration Test (SPT)

Logged by: R. Ford
Drilled By: Gulf Shore Consturction Service, Inc

DEPTH (feet)	SAMPLES				LITHOLOGY	MATERIAL DESCRIPTION	LABORATORY TEST DATA					
	Sampler Type	Sample	Blows/ 6"	SPT N-Value[1]		Ground Surface Elevation: 38 feet[2]	Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
						6 inches asphalt concrete (AC) 6 inches aggregate base (AB)						
1						SANDY CLAY (CL) red-brown to gray with orange mottling, moist						
2												
3	BAG	☒			CL							
4												
5												
6	S&H	■	12 20 37	45		SANDSTONE yellow-brown to olive-gray with yellow mottling, crushed, low hardness, friable to weak, deeply to moderately weathered [BEDROCK]					14.4	121
7												
8												
9						SHALE gray with yellow mottling, crushed, low hardness, friable to weak, moderately weathered [BEDROCK]						
10	SPT	◩	15 29 50/ 3"	103/ 9"								
11												
12												
13												
14												
15												
16												
17												
18												
19												
20												
21												
22												
23												
24												
25												
26												
27												
28												
29												
30												

Boring terminated at a depth of 11.25 feet below ground surface.
Boring backfilled with cement grout.
Groundwater not encountered at the time of drilling.

---

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.8 and 1.3, respectively to account for sampler type and hammer energy.

[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

Project No.: 731759601
Figure: A-10

PROJECT: **NORTHGATE TOWN SQUARE**
San Rafael, California

Log of Boring R2-2

PAGE 1 OF 1

Boring location: See Site Plan, Figure 2

Date started: 11/2/21 | Date finished: 11/2/21

Drilling method: Hollow Stem Auger

Hammer weight/drop: 140 lbs./30 inches | Hammer type: Automatic

Samplers: Standard Penetration Test (SPT)

Logged by: R. Ford
Drilled By: Gulf Shore Consturction Service, Inc

DEPTH (feet)	SAMPLES Sampler Type	Sample	Blows/ 6"	SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION Ground Surface Elevation: 36 feet[2]	LABORATORY TEST DATA Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
						3 inches asphalt concrete (AC)						
						6 inches aggregate base (AB)						
1						SANDY CLAY with GRAVEL (CL) light gray with yellow mottling, moist, fine sand, coarse subangular gravel [FILL]						
2												
3	BAG	☒			CL							
4												
5	SPT	◩	15 33 50/ 2"	109/ 8"								
6						SHALE gray to yellow-brown, crushed, low hardness, friable to weak, deeply to moderately weathered [BEDROCK]						
7												
8												
9												
10	SPT	◩	50/ 5"	66/ 5"		deeply weathered						
11												
12												
13												
14												
15												
16												
17												
18												
19												
20												
21												
22												
23												
24												
25												
26												
27												
28												
29												
30												

Boring terminated at a depth of 10.4 feet below ground surface.
Boring backfilled with cement grout.
Groundwater not encountered at the time of drilling.

[1] SPT blow counts for the last two increments were converted to SPT N-Values using factors of 1.3, respectively to account for sampler type and hammer energy.

[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

LANGAN

Project No.: 731759601 | Figure: A-11

PROJECT: **NORTHGATE TOWN SQUARE**
San Rafael, California

Log of Boring R2-3

PAGE 1 OF 1

Boring location: See Site Plan, Figure 2
Date started: 11/2/21
Date finished: 11/2/21
Drilling method: Hollow Stem Auger
Hammer weight/drop: 140 lbs./30 inches
Hammer type: Automatic
Samplers: Sprague & Henwood (S&H), Standard Penetration Test (SPT)

Logged by: R. Ford
Drilled By: Gulf Shore Consturction Service, Inc

Ground Surface Elevation: 35.5 feet[2]

DEPTH (feet)	SAMPLES Sampler Type	Sample	Blows/ 6"	SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	LABORATORY TEST DATA Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
0 to 0.5						6 inches asphalt concrete (AC)						
0.5 to 1						6 inches aggregate base (AB)						
1 to 4.5					CL	SANDY CLAY (CL) gray-brown to yellow-brown, moist, trace fine gravel [FILL]						
3 to 4	BAG	☒										
4.5 to 10.5					CL	SANDY CLAY (CL) yellow-brown with orange mottling, hard, fine sand						
5 to 6.5	S&H	■	7 18 24	33								
6							PP		>4,500			
10 to 11.5	S&H	■	16 36 44	63								
10.5 to 16						SHALE gray to olive-brown, crushed, low hardness, friable to weak, deeply to moderately weathered [BEDROCK]						
15 to 16	SPT	◪	18 50/ 6"	66/ 6"								

Boring terminated at a depth of 16 feet below ground surface.
Boring backfilled with cement grout.
Groundwater not encountered at the time of drilling.
PP = Pocket penetrometer.

---

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.8 and 1.3, respectively to account for sampler type and hammer energy.

[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

LANGAN

Project No.: 731759601
Figure: A-12

TEST GEOTECH LOG 731759601_5800 NORTHGATE.GPJ TEMPLATE_CA-MODIFIED - COPY.GDT 12/6/21

PROJECT: **NORTHGATE TOWN SQUARE**
San Rafael, California

Log of Boring R2-4

PAGE 1 OF 1

Boring location: See Site Plan, Figure 2
Date started: 11/1/21
Date finished: 11/1/21
Drilling method: Hollow Stem Auger
Hammer weight/drop: 140 lbs./30 inches
Hammer type: Automatic
Samplers: Sprague & Henwood (S&H), Standard Penetration Test (SPT)

Logged by: R. Ford
Drilled By: Gulf Shore Consturction Service, Inc

DEPTH (feet)	SAMPLES Sampler Type	Sample	Blows/ 6"	SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION Ground Surface Elevation: 34 feet[2]	LABORATORY TEST DATA Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
						6 inches asphalt concrete (AC)						
1						6 inches aggregate base (AB)						
2						SANDY CLAY (CL) yellow-brown, moist [FILL]						
3	BAG	☒			CL							
4												
5						SANDY CLAY (CL) light gray to yellow-gray with orange mottling, very stiff						
6	S&H	■	9 15 22	29			PP		4,500			
7					CL							
8												
9												
10	S&H	■	32 50/ 5"	40/ 5"		SANDSTONE yellow-brown with light gray and light gray chlorite zones, crushed, low hardness, weak, deeply to moderately weathered [BEDROCK]						
11												
12												
13												
14												
15	SPT	◩	50/ 3"	66/ 3"		brown to gray-brown, crushed						
16												
17												
18												
19												
20												
21												
22												
23												
24												
25												
26												
27												
28												
29												
30												

Boring terminated at a depth of 15.25 feet below ground surface.
Boring backfilled with cement grout.
Groundwater not encountered at the time of drilling.
PP = Pocket penetrometer.

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.8 and 1.3, respectively to account for sampler type and hammer energy.
[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

LANGAN

Project No.: 731759601
Figure: A-13

PROJECT: **NORTHGATE TOWN SQUARE**
San Rafael, California

Log of Boring R2-5

PAGE 1 OF 1

Boring location: See Site Plan, Figure 2
Date started: 11/2/21 Date finished: 11/2/21
Drilling method: Hollow Stem Auger
Hammer weight/drop: 140 lbs./30 inches Hammer type: Automatic
Samplers: Sprague & Henwood (S&H), Standard Penetration Test (SPT)

Logged by: R. Ford
Drilled By: Gulf Shore Consturction Service, Inc

DEPTH (feet)	SAMPLES: Sampler Type	SAMPLES: Sample	SAMPLES: Blows/ 6"	SAMPLES: SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION Ground Surface Elevation: 36 feet[2]	LABORATORY TEST DATA: Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
0						6 inches asphalt concrete (AC)						
						6 inches aggregate base (AB)						
1–3	BAG	☒			CL	SANDY CLAY (CL) olive-gray, moist [FILL]						
4–8	S&H	■	8 10 10	16	GC	CLAYEY GRAVEL (GC) brown to gray, medium dense, moist, fine- to coarse-grained [FILL]				23.5	12.4	118
8–14	SPT	◩	1 2 2	5	CL	SANDY CLAY (CL) gray, medium stiff, moist, fine sand, trace fine gravel						
15–16	S&H	■	9 14 17	24	CL	SANDY CLAY (CL) light gray to yellow-brown, very stiff, moist, fine sand						
16–19						SHALE gray-brown to gray, crushed, low hardness, friable to weak, deeply to moderately weathered [BEDROCK]						
19–21	SPT	◩	30 50/ 5"	66/ 5"		SANDSTONE yellow-brown to gray-brown, crushed, low hardness, weak, deeply weathered [BEDROCK]						
22–30												

Boring terminated at a depth of 20.9 feet below ground surface.
Boring backfilled with cement grout.
Groundwater not encountered at the time of drilling.

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.8 and 1.3 respectively to account for sampler type and hammer energy.
[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

Project No.: 731759601
Figure: A-14

PROJECT: **NORTHGATE TOWN SQUARE**
San Rafael, California

Log of Boring R3-1

PAGE 1 OF 2

Boring location: See Site Plan, Figure 2
Date started: 10/28/21 Date finished: 10/28/21
Drilling method: Hollow Stem Auger
Hammer weight/drop: 140 lbs./30 inches Hammer type: Automatic
Samplers: Sprague & Henwood (S&H), Standard Penetration Test (SPT)

Logged by: PV
Drilled By: Gulf Shore Consturction Service, Inc

DEPTH (feet)	SAMPLES				LITHOLOGY	MATERIAL DESCRIPTION	LABORATORY TEST DATA					
	Sampler Type	Sample	Blows/ 6"	SPT N-Value[1]		Ground Surface Elevation: 35 feet[2]	Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
						4 inches asphalt concrete (AC)						
1						4 inches aggregate base (AB)						
2						SANDY CLAY (CL) gray, moist, fine to coarse sand [FILL]						
3	BAG	☒										
4												
5						gray-brown, stiff, shale fragments Triaxial Test, see Figure C-1						
6	S&H	■	19 7 8	12			TxUU	750	1,140		15.9	117
7												
8					CL							
9												
10												
11	S&H	⊡	3 7 8	12								
12												
13												
14												
15						SANDY CLAY (CL) brown with orange mottling, very stiff, moist						
16	S&H	■	7 12 14	21			PP		>4,500			
17												
18					CL							
19												
20						▽ (10/28/21, 14:53 PM) SANDY CLAY (CL) yellow-brown to orange mottling, very stiff, wet, fine sand						
21	SPT	◪	6 5 8	17								
22												
23					CL							
24												
25						SANDY CLAY (CL) yellow-brown to olive-brown, very stiff, wet, fine sand [RESIDUAL SOIL]						
26	SPT	◪	8 7 13	26	CL							
27						SANDSTONE gray, crushed, low hardness, friable to weak, deeply to moderately weathered [BEDROCK]						
28												
29						SHALE [BEDROCK]						
30												

LANGAN

Project No.: 731759601
Figure: A-15a

PROJECT: **NORTHGATE TOWN SQUARE**
San Rafael, California

Log of Boring R3-1

PAGE 2 OF 2

DEPTH (feet)	SAMPLES				LITHOLOGY	MATERIAL DESCRIPTION	LABORATORY TEST DATA					
	Sampler Type	Sample	Blows/ 6"	SPT N-Value[1]			Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
31	SPT	◩	26 36 40	100		SHALE (continued) gray, crushed, low hardness, friable to weak, moderately weathered [BEDROCK]						
32												
33												
34												
35												
36												
37												
38												
39												
40												
41												
42												
43												
44												
45												
46												
47												
48												
49												
50												
51												
52												
53												
54												
55												
56												
57												
58												
59												
60												

Boring terminated at a depth of 31.5 feet below ground surface.
Boring backfilled with cement grout.
Groundwater encountered at 20 feet below ground surface at the time of drilling.
PP = Pocket penetrometer.

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.8 and 1.3, respectively to account for sampler type and hammer energy.
[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

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Project No.: 731759601

Figure: A-15b

TEST GEOTECH LOG 731759601_5800 NORTHGATE.GPJ TEMPLATE_CA-MODIFIED - COPY.GDT 12/6/21

PROJECT: **NORTHGATE TOWN SQUARE**
San Rafael, California

Log of Boring R3-2

PAGE 1 OF 1

Boring location: See Site Plan, Figure 2
Date started: 10/21/21
Date finished: 10/21/21
Drilling method: Hollow Stem Auger
Hammer weight/drop: 140 lbs./30 inches
Hammer type: Automatic
Samplers: Sprague & Henwood (S&H), Standard Penetration Test (SPT)

Logged by: PV
Drilled By: Gulf Shore Consturction Service, Inc

DEPTH (feet)	SAMPLES: Sampler Type	SAMPLES: Sample	SAMPLES: Blows/ 6"	SAMPLES: SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION Ground Surface Elevation: 32.5 feet[2]
						4 inches asphalt concrete (AC)
1						2 inches aggregate base (AB)
2					CL	CLAY (CL) yellow-brown with orange mottling, moist, trace fine sand and fine gravel [FILL]
3	BAG	☒				
4						SILTY SAND (SM) yellow-brown with orange mottling, dense, moist, fine- to medium-grained, trace fine to coarse angular to rounded gravel and clay [FILL]
5					SM	
6	S&H	■	17 17 23	31		
7	SPT	◩	12 7 3	13	GP	GRAVEL (GP) yellow-brown, medium dense, moist, cobble [FILL]
8						SILTY SAND (SM) yellow-brown, medium dense, moist [FILL]
9					SM	
10						very dense
11	S&H	■	5 17 48	50	GP	GRAVEL (GP) yellow-brown, very dense, moist, cobble [FILL]
12					SM	SILTY SAND (SM) yellow-brown, very dense, moist, fine-grained [FILL]
13						
14						SHALE gray, crushed, low to moderate hardness, weak, moderately weathered [BEDROCK]
15						
16	SPT	◩	5 38 31	88		
17						
18						
19						
20						
21	SPT	◩	42 21 42	31		
22						
23						
24						
25	SPT	◩	19 50/ 3"	64/ 3"		
26						
27						
28						
29						
30						

LABORATORY TEST DATA

Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft

Boring terminated at a depth of 25.7 feet below ground surface.
Boring backfilled with cement grout.
Groundwater not encountered at the time of drilling.

---

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.8 and 1.3, respectively to account for sampler type and hammer energy.

[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

LANGAN

Project No.: 731759601
Figure: A-16

PROJECT: **NORTHGATE TOWN SQUARE**
San Rafael, California

Log of Boring R3-3

PAGE 1 OF 1

Boring location: See Site Plan, Figure 2
Date started: 10/20/21 Date finished: 10/20/21
Drilling method: Hollow Stem Auger
Hammer weight/drop: 140 lbs./30 inches Hammer type: Automatic
Samplers: Sprague & Henwood (S&H), Standard Penetration Test (SPT)

Logged by: PV
Drilled By: Gulf Shore Consturction Service, Inc

DEPTH (feet)	SAMPLES: Sampler Type	SAMPLES: Sample	SAMPLES: Blows/ 6"	SAMPLES: SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION Ground Surface Elevation: 33.5 feet[2]	LABORATORY TEST DATA: Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
0						4 inches asphalt concrete (AC)						
						2 inches aggregate base (AB)						
1						SANDY CLAY (CL) gray-brown, moist, fine to medium sand, trace coarse subangular grave [FILL]						
2					CL							
3	BAG	☒										
4						CLAY (CL) dark brown, medium stiff to stiff, moist, trace fine sand [FILL]						
5												
6	S&H	■	3 5 5	8			PP		500			
7					CL							
8												
9												
10						dark brown with orange mottling, soft to medium stiff						
11	S&H	■	3 2 3	4		SANDY CLAY (CL) olive-gray, soft to medium stiff, moist	PP		500		20.8	106
12												
13					CL							
14												
15												
16	S&H	■	6 14 37	39		SILTSTONE yellow-brown with orange mottling, moist, crushed, low hardness, friable, deeply weathered [BEDROCK]						
17												
18												
19						SHALE gray-brown, crushed, low hardness, friable, deeply weathered [BEDROCK]						
20	SPT	◩	30 50/ 6"	64/ 6"								
21					▽	(10/20/21, 11:00 AM)						
22												
23												
24												
25												
26												
27												
28												
29												
30												

Boring terminated at a depth of 21 feet below ground surface.
Boring backfilled with cement grout.
Groundwater encountered at 21 feet below ground surface at the time of drilling.
PP = Pocket penetrometer.

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.8 and 1.3, respectively to account for sampler type and hammer energy.
[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

LANGAN

Project No.: 731759601
Figure: A-17

PROJECT: **NORTHGATE TOWN SQUARE**
San Rafael, California

Log of Boring R3-4

PAGE 1 OF 1

Boring location: See Site Plan, Figure 2
Date started: 10/20/21
Date finished: 10/20/21
Drilling method: Hollow Stem Auger
Hammer weight/drop: 140 lbs./30 inches
Hammer type: Automatic
Samplers: Sprague & Henwood (S&H), Standard Penetration Test (SPT)

Logged by: PV
Drilled By: Gulf Shore Consturction Service, Inc

LABORATORY TEST DATA

Ground Surface Elevation: 33 feet[2]

DEPTH (feet)	SAMPLES: Sampler Type	Sample	Blows/ 6"	SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
						4 inches asphalt concrete (AC)						
						2 inches aggregate base (AB)						
1						CLAY (CL) gray and yellow-brown, moist, with asphalt debris [FILL]						
2												
3	BAG	☒										
4					CL							
5						very stiff						
6	S&H	☐	11 14 11	19		cobble fragments						
7												
8	S&H	■	5 4 5	7								
9						CLAY (CL) gray-brown with orange mottling, medium stiff, moist	PP		3,200			
10						soft						
11	S&H	■	4 2 1	2							22.1	102
12					CL							
13												
14												
15						very stiff	PP		2,500			
16	S&H	■	5 12 17	22		CLAYSTONE yellow-brown with orange and gray mottling, crushed, low hardness, low plasticity, deeply weathered [BEDROCK]						
17												
18												
19												
20												
21	SPT	◪	6 30 50/ 6"	102		SHALE gray, crushed, low hardness, friable, deeply weathered [BEDROCK]						
22												
23												
24												
25												
26												
27												
28												
29												
30												

Boring terminated at a depth of 21 feet below ground surface.
Boring backfilled with cement grout.
Groundwater not encountered at the time of drilling.
PP = Pocket penetrometer.

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.8 and 1.3, respectively to account for sampler type and hammer energy.
[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

LANGAN

Project No.: 731759601
Figure: A-18

PROJECT: **NORTHGATE TOWN SQUARE**
San Rafael, California

Log of Boring R3-5

PAGE 1 OF 1

Boring location: See Site Plan, Figure 2

Date started: 10/28/21 | Date finished: 10/28/21

Drilling method: Hollow Stem Auger

Hammer weight/drop: 140 lbs./30 inches | Hammer type: Automatic

Samplers: Sprague & Henwood (S&H), Standard Penetration Test (SPT)

Logged by: R. Ford
Drilled By: Gulf Shore Consturction Service, Inc

	SAMPLES					MATERIAL DESCRIPTION	LABORATORY TEST DATA					
DEPTH (feet)	Sampler Type	Sample	Blows/ 6"	SPT N-Value[1]	LITHOLOGY	Ground Surface Elevation: 33 feet[2]	Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
						3 inches asphalt concrete (AC)						
1						6 inches aggregate base (AB)						
2						SANDY CLAY (CL) yellow-brown to brown, moist, fine to course sand [FILL]						
3	BAG	☒			CL							
4												
5	S&H	■	35 50/ 6"	66/ 6"		SANDSTONE yellow-brown, crushed, low hardness, weak, deeply to moderately weathered [BEDROCK]						
6												
7												
8												
9												
10	SPT	◩	38 43 50/ 3"	123/ 9"		yellow-brown with orange mottling						
11												
12												
13												
14												
15												
16												
17												
18												
19												
20												
21												
22												
23												
24												
25												
26												
27												
28												
29												
30												

Boring terminated at a depth of 11.25 feet below ground surface.
Boring backfilled with cement grout.
Groundwater not encountered at the time of drilling.

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.8 and 1.3, respectively to account for sampler type and hammer energy.

[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

LANGAN

Project No.: 731759601 | Figure: A-19

PROJECT: **NORTHGATE TOWN SQUARE**
San Rafael, California

Log of Boring R4-1

PAGE 1 OF 2

Boring location: See Site Plan, Figure 2
Date started: 10/29/21 Date finished: 10/29/21
Drilling method: Hollow Stem Auger
Hammer weight/drop: 140 lbs./30 inches Hammer type: Automatic
Samplers: Sprague & Henwood (S&H), Standard Penetration Test (SPT)

Logged by: R. Ford
Drilled By: Gulf Shore Consturction Service, Inc

LABORATORY TEST DATA

DEPTH (feet)	SAMPLES Sampler Type	Sample	Blows/ 6"	SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION Ground Surface Elevation: 36 feet[2]	Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
						4 inches asphalt concrete (AC) 4 inches aggregate base (AB)						
1												
2						SANDY CLAY (CL) yellow-brown to light gray, moist, fine sand [FILL] R-value Test, see Figure C-4						
3	BAG	☒			CL							
4												
5						CLAYEY SAND (SC) yellow-brown, medium dense, moist, fine-grained, sandstone fragments [FILL]						
6	S&H	■	8 15 20	28							13.5	119
7												
8					SC							
9												
10												
11	SPT	◩	4 6 7	17		SANDY CLAY (CL) gray, very stiff, moist, coarse sand [FILL]						
12												
13					CL							
14												
15												
16	S&H	■	9 16 21	29		SANDY CLAY (CL) yellow-brown with orange mottling, very stiff, moist, fine sand						
17												
18												
19												
20						∇ (10/29/21, 10:00 AM) olive-gray to yellow-brown with orange mottling, very stiff, wet, fine sand						
21	S&H	■	9 14 18	25	CL							
22												
23												
24												
25												
26	SPT	◩	18 20 33	70		SANDSTONE brown to olive-brown, crushed, low hardness, friable to weak, deeply to moderately weathered [BEDROCK]						
27												
28												
29						SHALE gray, crushed, low hardness, friable, moderately weathered [BEDROCK]						
30												

LANGAN

Project No.: 731759601
Figure: A-20a

PROJECT: **NORTHGATE TOWN SQUARE**
San Rafael, California

Log of Boring R4-1

PAGE 2 OF 2

DEPTH (feet)	SAMPLES Sampler Type	Sample	Blows/ 6"	SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	LABORATORY TEST DATA Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
	SPT	◩	50/ 5"	66/ 5"		SHALE (continued)						
31												
32												
33												
34												
35												
36												
37												
38												
39												
40												
41												
42												
43												
44												
45												
46												
47												
48												
49												
50												
51												
52												
53												
54												
55												
56												
57												
58												
59												
60												

Boring terminated at a depth of 30.4 feet below ground surface.
Boring backfilled with cement grout.
Groundwater encountered at 20 feet below ground surface at the time of drilling.

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.8 and 1.3, respectively to account for sampler type and hammer energy.
[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

LANGAN

Project No.: 731759601

Figure: A-20b

PROJECT: **NORTHGATE TOWN SQUARE**
San Rafael, California

Log of Boring R4-2

Boring location: See Site Plan, Figure 2
Date started: 10/25/21 | Date finished: 10/25/21
Drilling method: Hollow Stem Auger
Hammer weight/drop: 140 lbs./30 inches | Hammer type: Automatic
Samplers: Sprague & Henwood (S&H), Standard Penetration Test (SPT)

Logged by: PV
Drilled By: Gulf Shore Consturction Service, Inc

DEPTH (feet)	SAMPLES Sampler Type	SAMPLES Sample	SAMPLES Blows/ 6"	SAMPLES SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION Ground Surface Elevation: 36 feet[2]	LABORATORY TEST DATA Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
						3 inches asphalt concrete (AC)						
						2 inches aggregate base (AB)						
1						SANDY CLAY with GRAVEL (CL) gray-brown, moist, fine to coarse sand, fine to coarse angular to rounded gravel [FILL]						
2												
3	BAG	☒										
4												
5						stiff						
6	S&H	▨	10 7 8	12			PP		1,500			
7												
8					CL							
9												
10						gray-brown to gray						
11	S&H	▨	8 7 10	13			PP		2,750			
12												
13												
14												
15												
16	S&H	▨	10 15 15	24		SHALE gray-brown, crushed, soft, plastic, deeply weathered [BEDROCK]						
17												
18												
19												
20						∇ (10/25/21, 2:30 PM)						
21	S&H	▨	5 10 12	17		SANDSTONE yellow-brown, crushed, low hardness, friable, deeply weathered [BEDROCK]						
22												
23						∇ (10/25/21, 2:50 PM)						
24												
25												
26	S&H	▨	13 18 28	36								
27												
28												
29												
30												

PROJECT: **NORTHGATE TOWN SQUARE**
San Rafael, California

Log of Boring R4-2

PAGE 2 OF 2

DEPTH (feet)	SAMPLES				LITHOLOGY	MATERIAL DESCRIPTION	LABORATORY TEST DATA					
	Sampler Type	Sample	Blows/ 6"	SPT N-Value[1]			Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
31	SPT	◩	12 25 34	77		SANDSTONE (continued) yellow-brown to gray-brown, crushed, low harness, friable, moderately weathered						
32												
33												
34												
35	SPT	◩	21 29 50/ 3"	103/ 9"								
36												
37												
38												
39												
40												
41												
42												
43												
44												
45												
46												
47												
48												
49												
50												
51												
52												
53												
54												
55												
56												
57												
58												
59												
60												

Boring terminated at a depth of 36.3 feet below ground surface.
Boring backfilled with cement grout.
Groundwater encountered at 20 feet below ground surface at the time of drilling.
PP = Pocket penetrometer.

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.8 and 1.3, respectively to account for sampler type and hammer energy.

[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

LANGAN

Project No.: 731759601

Figure: A-21b

PROJECT: **NORTHGATE TOWN SQUARE**
San Rafael, California

Log of Boring R4-3

PAGE 1 OF 2

Boring location: See Site Plan, Figure 2
Date started: 10/21/21 Date finished: 10/21/21
Drilling method: Hollow Stem Auger
Hammer weight/drop: 140 lbs./30 inches Hammer type: Automatic
Samplers: Sprague & Henwood (S&H), Standard Penetration Test (SPT)

Logged by: PV
Drilled By: Gulf Shore Consturction Service, Inc

Ground Surface Elevation: 33.5 feet[2]

DEPTH (feet)	SAMPLES Sampler Type	Sample	Blows/ 6"	SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	LABORATORY TEST DATA Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
						4 inches asphalt concrete (AC)						
						2 inches aggregate base (AB)						
2					GP	GRAVEL (GP) gray, moist, fine- to coarse-grained, angular to rounded gravel, trace medium-grained sand [FILL]						
3	BAG	☒				SANDY CLAY (CL) gray-brown, stiff to very stiff, moist, fine to medium sand, trave fine angular to rounded gravel [FILL]						
6	S&H	▨	4 8 11	15			PP		3,500			
8					CL							
11	S&H	▨	6 13 13	20			PP		3,500			
12						yellow-brown and olive-gray, very stiff asphalt debris						
14						CLAYEY SAND with GRAVEL (SC) gray, medium dense, moist, fine- to course-grained, subangular [FILL]						
16	S&H	▨	5 9 11	15		LL = 37, PI = 22, see Figure C-3				38.6	10.9	114
17					SC							
20						gray-brown, moist, fine-grained LL = 36, PI = 20, see Figure C-3				45.9	12.8	
21	S&H	▨	6 5 4	7		SANDY CLAY (CL) gray-brown, medium stiff, moist, fine sand	PP		1,250			
24					CL							
25						gray with orange mottling, very stiff						
26	S&H	▨	7 14 20	35								
27						SANDY CLAY (CL) light gray with orange mottling, stiff, moist, fine sand						
28	S&H	▨	5 7 10	13	CL							
30						▽ (10/21/21, 11:00 AM)						

LANGAN

Project No.: 731759601
Figure: A-22a

PROJECT: **NORTHGATE TOWN SQUARE**
San Rafael, California

Log of Boring R4-3

DEPTH (feet)	SAMPLES: Sampler Type	SAMPLES: Sample	SAMPLES: Blows/ 6"	SAMPLES: SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	LABORATORY TEST DATA: Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
31	S&H	●	7 11 17	22		SANDY CLAY (CL) (continued)						
32	SPT	◩	10 19 25	56		yellow-brown, wet, stiff to hard						
33					CL							
34												
35	SPT	◩	13 35 50/ 5"	104/ 11"								
36						SILTSTONE yellow-brown and gray-brown, crushed, low hardness, friable, deeply weathered [BEDROCK]						
37												
38												
39						SHALE gray, crushed, low hardness, friable, deeply weathered [BEDROCK]						
40	SPT	◩	14 40 50/ 2"	115/ 8"								
41												
42												
43												
44												
45												
46												
47												
48												
49												
50												
51												
52												
53												
54												
55												
56												
57												
58												
59												
60												

Boring terminated at a depth of 41.2 feet below ground surface.
Boring backfilled with cement grout.
Groundwater encountered at 30 feet below ground surface at the time of drilling.
PP = Pocket penetrometer.

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.8 and 1.3, respectively to account for sampler type and hammer energy.

[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

LANGAN

Project No.: 731759601

Figure: A-22b

PROJECT: **NORTHGATE TOWN SQUARE**
San Rafael, California

Log of Boring R4-4

PAGE 1 OF 2

Boring location: See Site Plan, Figure 2
Date started: 10/28/21 Date finished: 10/28/21
Drilling method: Hollow Stem Auger
Hammer weight/drop: 140 lbs./30 inches Hammer type: Automatic
Samplers: Sprague & Henwood (S&H), Standard Penetration Test (SPT)

Logged by: R. Ford
Drilled By: Gulf Shore Consturction Service, Inc

LABORATORY TEST DATA

Ground Surface Elevation: 32.5 feet[2]

DEPTH (feet)	Sampler Type	Sample	Blows/ 6"	SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
						3 inches asphalt concrete (AC)						
1						6 inches aggregate base (AB)						
2						SANDY CLAY (CL) yellow-brown to dark brown, moist, fine sand [FILL]						
3	BAG	☒										
4												
5						medium stiff to stiff						
6	S&H	■	4 4 6	8	CL		PP		2,500			
7												
8												
9												
10												
11	S&H	■	5 8 5	10			PP		750			
12						SANDY CLAY (CL) dark brown, stiff, moist, fine sand						
13					CL							
14												
15						▽ (10/28/21, 11:35 AM) ▽ (10/28/21, 12:10 PM)						
16	S&H	■	2 5 9	11		SANDY CLAY (CL) light gray to brown with orange mottling, stiff, wet, fine to medium sand						
17												
18												
19												
20					CL	very stiff						
21	S&H	■	16 14 16	24			PP		3,750			
22												
23												
24												
25						SANDSTONE yellow-brown to olive-gray, crushed, low hardness, friable to weak, moderately weathered [BEDROCK]						
26	SPT	◩	18 20 22	55								
27												
28												
29												
30												

LANGAN

Project No.: 731759601
Figure: A-23a

PROJECT: **NORTHGATE TOWN SQUARE**
San Rafael, California

Log of Boring R4-4

DEPTH (feet)	SAMPLES: Sampler Type	SAMPLES: Sample	SAMPLES: Blows/ 6"	SAMPLES: SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	LABORATORY TEST DATA: Type of Strength Test	LABORATORY TEST DATA: Confining Pressure Lbs/Sq Ft	LABORATORY TEST DATA: Shear Strength Lbs/Sq Ft	LABORATORY TEST DATA: Fines %	LABORATORY TEST DATA: Natural Moisture Content, %	LABORATORY TEST DATA: Dry Density Lbs/Cu Ft
	SPT	◩	50/ 6"	66/ 6"		SANDSTONE (continued) weak						
31												
32												
33												
34												
35												
36												
37												
38												
39												
40												
41												
42												
43												
44												
45												
46												
47												
48												
49												
50												
51												
52												
53												
54												
55												
56												
57												
58												
59												
60												

Boring terminated at a depth of 30.5 feet below ground surface.
Boring backfilled with cement grout.
Groundwater encountered at 15 feet below ground surface at the time of drilling.
PP = Pocket penetrometer.

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.8 and 1.3, respectively to account for sampler type and hammer energy.
[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

LANGAN

Project No.: 731759601
Figure: A-23b

PROJECT: **NORTHGATE TOWN SQUARE**
San Rafael, California

Log of Boring R4-5

PAGE 1 OF 2

Boring location: See Site Plan, Figure 2
Date started: 10/25/21
Date finished: 10/25/21
Drilling method: Hollow Stem Auger
Hammer weight/drop: 140 lbs./30 inches
Hammer type: Automatic
Samplers: Sprague & Henwood (S&H), Standard Penetration Test (SPT)

Logged by: PV
Drilled By: Gulf Shore Consturction Service, Inc

DEPTH (feet)	SAMPLES Sampler Type	SAMPLES Sample	SAMPLES Blows/ 6"	SAMPLES SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION Ground Surface Elevation: 32 feet[2]	LABORATORY TEST DATA Type of Strength Test	LABORATORY TEST DATA Confining Pressure Lbs/Sq Ft	LABORATORY TEST DATA Shear Strength Lbs/Sq Ft	LABORATORY TEST DATA Fines %	LABORATORY TEST DATA Natural Moisture Content, %	LABORATORY TEST DATA Dry Density Lbs/Cu Ft
						2 inches asphalt concrete (AC)						
1						3 inches aggregate base (AB)						
2					CL	SANDY CLAY (CL) olive-gray, moist, fine to coarse sand [FILL]						
3	BAG	☒										
4						SANDY CLAY (CL) brown, stiff, moist, fine to medium sand, trave fine to coarse gravel [FILL]						
5												
6	S&H	■	4 6 11	13		increase gravel content	PP		1,250			
7												
8												
9												
10						gray, very stiff, trace cobble						
11	S&H	■	9 18 11	23	CL							
12												
13												
14												
15												
16	S&H	■	6 8 10	14		stiff	PP		3,500			
17												
18												
19						SANDY SILTY CLAY (CL-ML) dark brown, stiff, moist, fine sand LL = 21, PI = 7, see Figure C-3						
20												
21	S&H	■	4 6 10	13						59.8	16.5	
22					CL-ML							
23												
24						∇ (10/25/21, 8:10 AM)						
25						SANDY CLAY (CL) yellow-brown with orange mottling, very stiff, wet, fine to medium sand						
26	S&H	■	14 16 14	24			PP		>4,500			
27					CL							
28												
29												
30												

LANGAN

Project No.: 731759601
Figure: A-24a

PROJECT: **NORTHGATE TOWN SQUARE**
San Rafael, California

Log of Boring R4-5

DEPTH (feet)	SAMPLES: Sampler Type	SAMPLES: Sample	SAMPLES: Blows/ 6"	SAMPLES: SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	LABORATORY TEST DATA: Type of Strength Test	LABORATORY TEST DATA: Confining Pressure Lbs/Sq Ft	LABORATORY TEST DATA: Shear Strength Lbs/Sq Ft	LABORATORY TEST DATA: Fines %	LABORATORY TEST DATA: Natural Moisture Content, %	LABORATORY TEST DATA: Dry Density Lbs/Cu Ft
						SANDY CLAY (CL) (continued)						
31	S&H	■	9 15 22	29	CL		PP		2,500			
32												
33						SILTSTONE olive-gray, crushed, low hardness, friable, deeply weathered [BEDROCK]						
34												
35	S&H	■	21 50/ 5"	40/ 5"								
36												
37												
38												
39						SHALE gray, crushed, low hardness, friable, deeply weathered [BEDROCK]						
40												
41	SPT	◩	14 24 31	71								
42												
43												
44												
45	SPT	◩	32 50/ 6"	66/ 6"								
46												
47												
48												
49												
50												
51												
52												
53												
54												
55												
56												
57												
58												
59												
60												

Boring terminated at a depth of 46 feet below ground surface.
Boring backfilled with cement grout.
Groundwater encountered at 24 feet below ground surface at the time of drilling.
PP = Pocket penetrometer.

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.8 and 1.3 respectively to account for sampler type and hammer energy.
[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

LANGAN

Project No.: 731759601
Figure: A-24b

PROJECT: **NORTHGATE TOWN SQUARE**
San Rafael, California

Log of Boring R5-1

PAGE 1 OF 1

Boring location: See Site Plan, Figure 2

Date started: 10/28/21 Date finished: 10/28/21

Drilling method: Hollow Stem Auger

Hammer weight/drop: 140 lbs./30 inches Hammer type: Automatic

Samplers: Sprague & Henwood (S&H), Standard Penetration Test (SPT)

Logged by: R. Ford
Drilled By: Gulf Shore Consturction Service, Inc

LABORATORY TEST DATA

Ground Surface Elevation: 34.5 feet[2]

DEPTH (feet)	SAMPLES Sampler Type	SAMPLES Sample	SAMPLES Blows/ 6"	SAMPLES SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
0						4 inches asphalt concrete (AC)						
						3 inches aggregate base (AB)						
1						SANDY CLAY (CL) yellow-brown, moist, fine sand, trace cobbles [FILL]						
3	BAG	☒										
5–6	S&H	■	3 8 12	16	CL	gray to gray-brown, very stiff	PP		2,700			
10–11	S&H	▨	9 9 10	15								
11					CL	SANDY CLAY (CL) gray-brown, stiff to very stiff, moist, fine to medium sand						
15–16	SPT	▨	5 8 12	26	CL	SANDY CLAY (CL) brown with orange mottling, very stiff, moist, fine sand						
20	SPT	▨	50/ 3"	66/ 3"		SANDSTONE yellow-brown, crushed, low hardness, weak, moderately weathered [BEDROCK]						
25	SPT	▨	50/ 4.5"	66/ 4.5"								

Boring terminated at a depth of 25.4 feet below ground surface.
Boring backfilled with cement grout.
Groundwater not encountered at the time of drilling.
PP = Pocket penetrometer.

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[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.8 and 1.3, respectively to account for sampler type and hammer energy.

[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

LANGAN

Project No.: 731759601

Figure: A-25

PROJECT: **NORTHGATE TOWN SQUARE**
San Rafael, California

Log of Boring R5-2

PAGE 1 OF 2

Boring location: See Site Plan, Figure 2

Date started: 10/26/21 Date finished: 10/26/21

Drilling method: Hollow Stem Auger

Hammer weight/drop: 140 lbs./30 inches Hammer type: Automatic

Samplers: Sprague & Henwood (S&H), Standard Penetration Test (SPT)

Logged by: R. Ford
Drilled By: Gulf Shore Consturction Service, Inc

MATERIAL DESCRIPTION

Ground Surface Elevation: 35 feet[2]

LABORATORY TEST DATA

DEPTH (feet)	SAMPLES Sampler Type	Sample	Blows/ 6"	SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
						3 inches asphalt concrete (AC)						
						3 inches aggregate base (AB)						
1						SANDY CLAY (CL) yellow-brown, moist, fine sand [FILL]						
2												
3	BAG	☒										
4												
5												
6	S&H	■	6 7 10	13		brown, stiff, moist	PP		3,700			
7												
8												
9						increase sand content yellow-brown with orange mottling, sandstone fragments						
10					CL							
11	S&H	■	7 12 20	25								
12												
13												
14												
15						gray, very stiff, shale fragments						
16	SPT	◩	4 8 14	29								
17												
18												
19												
20						SANDY CLAY (CL) dark brown, medium stiff, moist, fine sand						
21	SPT	◩	3 3 2	7								
22					CL							
23												
24												
25						SANDY CLAY (CL) yellow-brown with orange mottling, very stiff, moist, fine sand						
26	S&H	■	9 14 20	27								
27												
28					CL							
29												
30												

LANGAN

Project No.: 731759601

Figure: A-26a

PROJECT: **NORTHGATE TOWN SQUARE**
San Rafael, California

Log of Boring R5-2

PAGE 2 OF 2

	SAMPLES						LABORATORY TEST DATA					
DEPTH (feet)	Sampler Type	Sample	Blows/ 6"	SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
31	SPT	◪	6 10 13	30		SANDY CLAY (CL) (continued) yellow-brown to gray-brown with red mottling, very stiff to hard						
32					CL							
33						▽ (10/26/21, 9:00 AM)						
34						SANDSTONE and SHALE light gray to yellow-brown, crushed, low hardness, friable, deeply to moderately weathered [FBEDROCK]						
35												
36	SPT	◪	10 18 30	63								
37												
38												
39												
40	SPT	◪	14 35 50/ 3"	112/ 9"		friable to weak						
41												
42												
43												
44												
45												
46												
47												
48												
49												
50												
51												
52												
53												
54												
55												
56												
57												
58												
59												
60												

Boring terminated at a depth of 41.3 feet below ground surface.
Boring backfilled with cement grout.
Groundwater encountered at 33 feet below ground surface at the time of drilling.
PP = Pocket penetrometer.

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.8 and 1.3, respectively to account for sampler type and hammer energy.

[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

LANGAN

Project No.: 731759601

Figure: A-26b

PROJECT: **NORTHGATE TOWN SQUARE**
San Rafael, California

Log of Boring R5-3

PAGE 1 OF 2

Boring location: See Site Plan, Figure 2
Date started: 10/27/21 Date finished: 10/27/21
Drilling method: Hollow Stem Auger
Hammer weight/drop: 140 lbs./30 inches Hammer type: Automatic
Samplers: Sprague & Henwood (S&H), Standard Penetration Test (SPT)

Logged by: R. Ford
Drilled By: Gulf Shore Consturction Service, Inc

DEPTH (feet)	SAMPLES Sampler Type	Sample	Blows/ 6"	SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION Ground Surface Elevation: 34.5 feet[2]	LABORATORY TEST DATA Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
						3 inches asphalt concrete (AC)						
1						12 inches aggregate base (AB)						
2						GRAVEL (GW) yellow-brown, moist, fine- to coarse-grained subrounded, trace fine sand [FILL]						
3	GRAB	☒			GW							
4						SANDY CLAY (CL) gray, very stiff, moist,m fine sand stone fragments [FILL]						
5												
6	S&H	■	7 9 11	16								
7												
8												
9												
10						stiff increase in clay content						
11	SPT	◩	5 3 6	12								
12					CL							
13												
14												
15						trace wood fragments, rootlets						
16	S&H	■	9 11 11	17			PP		3,250			
17												
18												
19												
20						▽ (10/27/21, 9:30 AM)						
						SANDY CLAY (CL) olive-brown, soft to medium stiff, wet, fine sand						
21	S&H	■	1 2 3	4							18.7	112
22					CL							
23												
24						▽ (10/27/21, 10:25 AM)						
25						SANDY CLAY (CL) yellow-brown to olive-gray, very stiff, wet, fine to coarse sand						
26	S&H	◩	10 10 15	20								
27					CL							
28												
29												
30												

LANGAN

Project No.: 731759601
Figure: A-27a

PROJECT: **NORTHGATE TOWN SQUARE**
San Rafael, California

Log of Boring R5-3

PAGE 2 OF 2

DEPTH (feet)	SAMPLES: Sampler Type	SAMPLES: Sample	SAMPLES: Blows/ 6"	SAMPLES: SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	LABORATORY TEST DATA: Type of Strength Test	LABORATORY TEST DATA: Confining Pressure Lbs/Sq Ft	LABORATORY TEST DATA: Shear Strength Lbs/Sq Ft	LABORATORY TEST DATA: Fines %	LABORATORY TEST DATA: Natural Moisture Content, %	LABORATORY TEST DATA: Dry Density Lbs/Cu Ft
31	SPT	◩	5 6 10	21		SANDY CLAY (CL) (continued)						
32												
33												
34					CL							
35						increase clay content						
36	SPT	◩	5 9 10	25								
37												
38						SANDSTONE yellow-brown to dark brown, crushed, low hardness, friable to weak, moderately to deeply weathered [BEDROCK]						
39												
40												
41	SPT	◩	15 36 50/ 5"	114/ 11"								
42												
43												
44												
45	SPT	◩	50/ 4"	66/ 4"		weak, moderately weathered to intensely weathered						
46												
47												
48												
49												
50												
51												
52												
53												
54												
55												
56												
57												
58												
59												
60												

Boring terminated at a depth of 45.3 feet below ground surface.
Boring backfilled with cement grout.
Groundwater encountered at 20 feet below ground surface at the time of drilling.
PP = Pocket penetrometer.

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.8 and 1.3, respectively to account for sampler type and hammer energy.

[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

LANGAN

Project No.: 731759601

Figure: A-27b

PROJECT: **NORTHGATE TOWN SQUARE**
San Rafael, California

Log of Boring R5-4

PAGE 1 OF 2

Boring location: See Site Plan, Figure 2
Date started: 10/26/21 | Date finished: 10/26/21
Drilling method: Hollow Stem Auger
Hammer weight/drop: 140 lbs./30 inches | Hammer type: Automatic
Samplers: Sprague & Henwood (S&H), Standard Penetration Test (SPT)

Logged by: R. Ford
Drilled By: Gulf Shore Consturction Service, Inc

Ground Surface Elevation: 30.5 feet^2

DEPTH (feet)	SAMPLES Sampler Type	Sample	Blows/ 6"	SPT N-Value^1	LITHOLOGY	MATERIAL DESCRIPTION	LABORATORY TEST DATA Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
						3 inches asphalt concrete (AC)						
1						3 inches aggregate base (AB)						
						SANDY CLAY (CL) brown, moist, fine sand, trace fine subangular gravel [FILL]						
2												
3	BAG	☒										
4												
5						olive-gray to yellow-brown with orange mottling, stiff						
6	S&H	■	4 4 9	10								
7												
8												
9												
10					CL	gray, stiff to very stiff, shale fragments						
11	S&H	■	9 10 9	15								
12												
13												
14												
15						very stiff, sandstone fragments						
16	S&H	■	10 9 11	16								
17												
18												
19												
20						▽ (10/26/21, 12:00 PM)						
21	S&H	■	4 5 8	10		SANDY CLAY (CL) olive-brown, stiff, fine sand						
22						▽ (10/26/21, 11:20 AM)						
23					CL							
24												
25												
26	S&H	■	7 9 14	18		SANDY CLAY (CL) yellow-brown with brown and orange mottling, very stiff, moist, fine to coarse sand Triaxial Test, see Figure C-2	TxUU	2,800	825		19.5	111
27												
28					CL							
29												
30												

LANGAN

Project No.: 731759601
Figure: A-28a

PROJECT: **NORTHGATE TOWN SQUARE**
San Rafael, California

Log of Boring R5-4

DEPTH (feet)	SAMPLES: Sampler Type	Sample	Blows/ 6"	SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	LABORATORY TEST DATA: Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
	SPT	◪	50/ 6"	66/ 6"		SANDSTONE olive-brown, crushed, low hardness, weak, moderately weathered [BEDROCK]						
31												
32												
33												
34												
35	SPT	◪	50/ 3"	66/ 3"								
36												
37												
38												
39												
40												
41												
42												
43												
44												
45												
46												
47												
48												
49												
50												
51												
52												
53												
54												
55												
56												
57												
58												
59												
60												

Boring terminated at a depth of 35.3 feet below ground surface.
Boring backfilled with cement grout.
Groundwater encountered at 22 feet below ground surface at the time of drilling.

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.8 and 1.3, respectively to account for sampler type and hammer energy.

[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

LANGAN

Project No.: 731759601

Figure: A-28b

PROJECT: **NORTHGATE TOWN SQUARE**
San Rafael, California

Log of Boring R5-5

PAGE 1 OF 2

Boring location: See Site Plan, Figure 2
Date started: 10/26/21 Date finished: 10/26/21
Drilling method: Hollow Stem Auger
Hammer weight/drop: 140 lbs./30 inches Hammer type: Automatic
Samplers: Sprague & Henwood (S&H), Standard Penetration Test (SPT)

Logged by: R. Ford
Drilled By: Gulf Shore Consturction Service, Inc

Ground Surface Elevation: 30.5 feet^2

DEPTH (feet)	SAMPLES: Sampler Type	SAMPLES: Sample	SAMPLES: Blows/ 6"	SAMPLES: SPT N-Value^1	LITHOLOGY	MATERIAL DESCRIPTION	LABORATORY TEST DATA: Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
						3 inches asphalt concrete (AC)						
						3 inches aggregate base (AB)						
1						SANDY CLAY (CL) yellow-brown with orange mottling, moist, fine sand [FILL]						
2												
3	BAG	☒										
4												
5												
6	S&H	■	4 5 6	9		stiff	PP		1,500			
7					CL							
8												
9												
10												
11	SPT	□	6 4 4	11		sandstone fragments						
12												
13												
14						GRAVELLY CLAY (CL) gray-brown with orange mottling, very stiff, moist, fine subangular to subrounded gravel to cobbles [FILL]						
15												
16	S&H	■	12 12 11	18								
17					CL							
18												
19												
20						▽ (10/26/21, 15:15 PM) SANDY CLAY (CL) yellow-brown, stiff, wet, fine sand						
21	S&H	■	8 10 7	13								
22					CL							
23												
24												
25						CLAYEY SILTY SAND (SC-SM) brown with orange mottling, medium dense, wet, fine- to coarse-grained, trace coarse gravel LL = 22, PI = 7, see Figure C-3				28.6	16.2	
26	SPT	◩	7 11 10	28								
27					SC-SM							
28												
29						SANDY CLAY (CL)						
30					CL							

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Project No.: 731759601
Figure: A-29a

PROJECT: **NORTHGATE TOWN SQUARE**
San Rafael, California

Log of Boring R5-5

PAGE 2 OF 2

DEPTH (feet)	SAMPLES Sampler Type	Sample	Blows/ 6"	SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	LABORATORY TEST DATA Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
31	SPT	◩	6 9 11	26		SANDY CLAY (CL) (continued) brown to gray-brown with orange mottling, very stiff, wet, fine sand						
32												
33												
34												
35						hard						
36	SPT	◩	9 11 16	36	CL							
37												
38												
39												
40						increase sand content						
41	SPT	◩	12 15 41	74								
42						SHALE gray to olive, crushed, low hardness, weak, moderately weathered [BEDROCK]						
43												
44												
45						gray to olive with yellow oxidation						
46	SPT	◩	19 21 50/ 6"	94								
47												
48												
49												
50												
51												
52												
53												
54												
55												
56												
57												
58												
59												
60												

Boring terminated at a depth of 45.5 feet below ground surface.
Boring backfilled with cement grout.
Groundwater encountered at 20 feet below ground surface at the time of drilling.
PP = Pocket penetrometer.

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.8 and 1.3, respectively to account for sampler type and hammer energy.
[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

LANGAN

Project No.: 731759601

Figure: A-29b

PROJECT: **NORTHGATE TOWN SQUARE**
San Rafael, California

Log of Boring R6-1

PAGE 1 OF 1

Boring location: See Site Plan, Figure 2

Date started: 11/2/21 | Date finished: 11/2/21

Drilling method: Hollow Stem Auger

Hammer weight/drop: 140 lbs./30 inches | Hammer type: Automatic

Samplers: Standard Penetration Test (SPT)

Logged by: R. Ford
Drilled By: Gulf Shore Consturction Service, Inc

DEPTH (feet)	SAMPLES Sampler Type	Sample	Blows/ 6"	SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION Ground Surface Elevation: 40.5 feet[2]	LABORATORY TEST DATA Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
						6 inches asphalt concrete (AC)						
1						6 inches aggregate base (AB)						
2						SANDSTONE gray, intensely to closely fractured, moderately hard, weak to moderately strong, moderately to intensely weathered [BEDROCK]						
3	BAG	☒										
4												
5	SPT	◩	11 50/ 3"	66/ 3"								
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												
16												
17												
18												
19												
20												
21												
22												
23												
24												
25												
26												
27												
28												
29												
30												

Boring terminated at a depth of 5.8 feet below ground surface.
Boring backfilled with cement grout.
Groundwater not encountered at the time of drilling.

[1] SPT blow counts for the last two increments were converted to SPT N-Values using factors of 1.3, respectively to account for sampler type and hammer energy.

[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

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Project No.: 731759601 | Figure: A-30

PROJECT: **NORTHGATE TOWN SQUARE**
San Rafael, California

Log of Boring R6-2

PAGE 1 OF 1

Boring location: See Site Plan, Figure 2
Date started: 11/1/21 Date finished: 11/1/21
Drilling method: Hollow Stem Auger
Hammer weight/drop: 140 lbs./30 inches Hammer type: Automatic
Samplers: Sprague & Henwood (S&H), Standard Penetration Test (SPT)

Logged by: R. Ford
Drilled By: Gulf Shore Consturction Service, Inc

	SAMPLES					MATERIAL DESCRIPTION	LABORATORY TEST DATA					
DEPTH (feet)	Sampler Type	Sample	Blows/ 6"	SPT N-Value[1]	LITHOLOGY	Ground Surface Elevation: 37 feet[2]	Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
						8 inches asphalt concrete (AC)						
1						6 inches aggregate base (AB)						
2						CLAY with SAND (CL) light gray with orange mottling, moist [FILL]						
3	BAG	☒			CL	LL = 38, PI = 23, see Figure C-3						
4												
5												
6	S&H	■	2 13 17	24		SHALE and SANDSTONE gray to yellow-brown, oxidation, crushed, low hardness, friable to weak, deeply to moderately weathered [BEDROCK]					12.3	113
7												
8												
9												
10	SPT	◪	18 43 50/ 3"	123/ 9"		olive-gray to gray						
11												
12												
13												
14												
15												
16												
17												
18												
19												
20												
21												
22												
23												
24												
25												
26												
27												
28												
29												
30												

Boring terminated at a depth of 11.3 feet below ground surface.
Boring backfilled with cement grout.
Groundwater not encountered at the time of drilling.

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.8 and 1.3, respectively to account for sampler type and hammer energy.

[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

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Project No.: 731759601
Figure: A-31

TEST GEOTECH LOG 731759601_5800 NORTHGATE.GPJ TEMPLATE_CA-MODIFIED - COPY.GDT 12/6/21

PROJECT: **NORTHGATE TOWN SQUARE**
San Rafael, California

Log of Boring R6-3

PAGE 1 OF 1

Boring location: See Site Plan, Figure 2
Date started: 11/2/21
Date finished: 11/2/21
Drilling method: Hollow Stem Auger
Hammer weight/drop: 140 lbs./30 inches
Hammer type: Automatic
Samplers: Standard Penetration Test (SPT)

Logged by: R. Ford
Drilled By: Gulf Shore Consturction Service, Inc

DEPTH (feet)	SAMPLES Sampler Type	Sample	Blows/ 6"	SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION Ground Surface Elevation: 37 feet[2]	LABORATORY TEST DATA Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
						6 inches asphalt concrete (AC)						
						6 inches aggregate base (AB)						
1						SANDY CLAY (CL) gray, moist, fine sand, trace coarse gravel [FILL]						
2												
3	BAG	☒										
4	SPT	◩	6 13 12	33	CL							
5												
6	SPT	◩	15 18 25	56		SANDSTONE gray, crushed, fine to moderate hardness, weak to moderately strong, moderately to little weathered [BEDROCK]						
7												
8												
9												
10	SPT	◩	50/ 2"	66/ 2"								

Boring terminated at a depth of 10.2 feet below ground surface.
Boring backfilled with cement grout.
Groundwater not encountered at the time of drilling.

[1] SPT blow counts for the last two increments were converted to SPT N-Values using factors of 1.3, respectively to account for sampler type and hammer energy.

[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

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Project No.: 731759601
Figure: A-32

PROJECT: **NORTHGATE TOWN SQUARE**
San Rafael, California

Log of Boring S3-1

PAGE 1 OF 1

Boring location: See Site Plan, Figure 2
Date started: 11/1/21
Date finished: 11/1/21
Drilling method: Hollow Stem Auger
Hammer weight/drop: 140 lbs./30 inches
Hammer type: Automatic
Samplers: Standard Penetration Test (SPT)

Logged by: R. Ford
Drilled By: Gulf Shore Consturction Service, Inc

LABORATORY TEST DATA

DEPTH (feet)	SAMPLES: Sampler Type	SAMPLES: Sample	SAMPLES: Blows/ 6"	SAMPLES: SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION Ground Surface Elevation: 37 feet[2]	Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
0						6 inches asphalt concrete (AC)						
1						6 inches aggregate base (AB)						
1						SANDY CLAY (CL) yellow-brown, moist, fine sand [FILL]						
3	BAG	☒										
5	SPT	◩	6 6 9	20	CL	yellow-brown with orange mottling, very stiff, moist						
10	SPT	◩	4 6 8	18								
11					CL	SANDY CLAY (CL) light gray with yellow mottling, very stiff, moist, rock fragments [RESIDUAL SOIL]						
12.5						SANDSTONE yellow-brown to olive-gray, crushed, low to moderate hardness, weak to moderately strong, moderately weathered [BEDROCK]						
15	SPT	◩	50/ 4"	66/ 4"								
30												

Boring terminated at a depth of 15.3 feet below ground surface.
Boring backfilled with cement grout.
Groundwater not encountered at the time of drilling.

[1] SPT blow counts for the last two increments were converted to SPT N-Values using factors of 1.3, respectively to account for sampler type and hammer energy.

[2] Elevation based on North America Vertical Datum of 1988 (NAVD88).

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Project No.: 731759601
Figure: A-33

UNIFIED SOIL CLASSIFICATION SYSTEM

Major Divisions		Symbols	Typica l Names
Coarse-Grained Soils (more than half of soil > no. 200 sieve size	**Gravels** (More than half of coarse fraction > no. 4 sieve size)	**GW**	Well-graded gravels or gravel-sand mixtures, little or no fines
		GP	Poorly-graded gravels or gravel-sand mixtures, little or no fines
		GM	Silty gravels, gravel-sand-silt mixtures
		GC	Clayey gravels, gravel-sand-clay mixtures
	Sands (More than half of coarse fraction < no. 4 sieve size)	**SW**	Well-graded sands or gravelly sands, little or no fines
		SP	Poorly-graded sands or gravelly sands, little or no fines
		SM	Silty sands, sand-silt mixtures
		SC	Clayey sands, sand-clay mixtures
Fine -Grained Soils (more than half of soil < no. 200 sieve size)	**Silts and Clays** LL = < 50	**ML**	Inorganic silts and clayey silts of low plasticity, sandy silts, gravelly silts
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, lean clays
		OL	Organic silts and organic silt-clays of low plasticity
	Silts and Clays LL = > 50	**MH**	Inorganic silts of high plasticity
		CH	Inorganic clays of high plasticity, fat clays
		OH	Organic silts and clays of high plasticity
Highly Organic Soils		**PT**	Peat and other highly organic soils

GRAIN SIZE CHART

Classification	Range of Grain Sizes	
	U.S. Standard Sieve Size	**Grain Size in Millimeters**
Boulders	Above 12"	Above 305
Cobbles	12" to 3"	305 to 76.2
Gravel	3" to No. 4	76.2 to 4.76
coarse	3" to 3/4"	76.2 to 19.1
fine	3/4" to No. 4	19.1 to 4.76
Sand	No. 4 to No. 200	4.76 to 0.075
coarse	No. 4 to No. 10	4.76 to 2.00
medium	No. 10 to No. 40	2.00 to 0.420
fine	No. 40 to No. 200	0.420 to 0.075
Silt and Clay	Below No. 200	Below 0.075

SAMPLE DESIGNATIONS/SYMBOLS

⬒	Sample taken with Sprague & Henwood split-barrel sampler with a 3.0-inch outside diameter and a 2.43-inch inside diameter. Darkened area indicates soil recovered
◪	Classification sample taken with Standard Penetration Test sampler
◨	Undisturbed sample taken with thin-walled tube
⊠	Disturbed sample
⊙	Sampling attempted with no recovery
◫	Core sample
◉	Analytical laboratory sample
▥	Sample taken with Direct Push or Drive sampler
▥	Sonic

▽	Unstabilized groundwater level
▼	Stabilized groundwater level

SAMPLER TYPE

C Core barrel

CA California split-barrel sampler with 2.5-inch outside diameter and a 1.93-inch inside diameter

D&M Dames & Moore piston sampler using 2.5-inch outside diameter, thin-walled tube

O Osterberg piston sampler using 3.0-inch outside diameter, thin-walled Shelby tube

PT Pitcher tube sampler using 3.0-inch outside diameter, thin-walled Shelby tube

S&H Sprague & Henwood split-barrel sampler with a 3.0-inch outside diameter and a 2.43-inch inside diameter

SPT Standard Penetration Test (SPT) split-barrel sampler with a 2.0-inch outside diameter and a 1.5-inch inside diameter

ST Shelby Tube (3.0-inch outside diameter, thin-walled tube) advanced with hydraulic pressure

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Project
NORTHGATE TOWN SQUARE
SAN RAFAEL
MARIN COUNTY **CALIFORNIA**

Figure Title
SOIL CLASSIFICATION CHART

Project No. 731759601
Date 11/11/2021
Drawn By AG
Checked By HS

Figure
A-34

I FRACTURING

Intensity	Size of Pieces in Feet
Very little fractured	Greater than 4.0
Occasionally fractured	1.0 to 4.0
Moderately fractured	0.5 to 1.0
Closely fractured	0.1 to 0.5
Intensely fractured	0.05 to 0.1
Crushed	Less than 0.05

II HARDNESS

1. **Soft** - reserved for plastic material alone.
2. **Low hardness** - can be gouged deeply or carved easily with a knife blade.
3. **Moderately hard** - can be readily scratched by a knife blade; scratch leaves a heavy trace of dust and is readily visible after the powder has been blown away.
4. **Hard** - can be scratched with difficulty; scratch produced a little powder and is often faintly visible.
5. **Very hard** - cannot be scratched with knife blade; leaves a metallic streak.

III STRENGTH

1. **Plastic** or very low strength.
2. **Friable** - crumbles easily by rubbing with fingers.
3. **Weak** - an unfractured specimen of such material will crumble under light hammer blows.
4. **Moderately strong** - specimen will withstand a few heavy hammer blows before breaking..
5. **Strong** - specimen will withstand a few heavy ringing hammer blows and will yield with difficulty only dust and small flying fragments.
6. **Very strong** - specimen will resist heavy ringing hammer blows and will yield with difficulty only dust and small flying fragments.

IV WEATHERING - The physical and chemical disintegration and decomposition of rocks and minerals by natural processes such as oxidation, reduction, hydration, solution, carbonation, and freezing and thawing.

D. Deep - moderate to complete mineral decomposition; extensive disintegration; deep and thorough discoloration; many fractures, all extensively coated or filled with oxides, carbonates and/or clay or silt.

M. Moderate - slight change or partial decomposition of minerals; little disintegration; cementation little to unaffected. Moderate to occasionally intense discoloration. Moderately coated fractures.

L. Little - no megascopic decomposition of minerals; little of no effect on normal cementation. Slight and intermittent, or localized discoloration. Few stains on fracture surfaces.

F. Fresh - unaffected by weathering agents. No disintegration of discoloration. Fractures usually less numerous than joints.

ADDITIONAL COMMENTS:

V CONSOLIDATION OF SEDIMENTARY ROCKS: usually determined from unweathered samples. Largely dependent on cementation.

U = unconsolidated
P = poorly consolidated
M = moderately consolidated
W = well consolidated

VI BEDDING OF SEDIMENTARY ROCKS

Splitting Property	Thickness	Stratification
Massive	Greater than 4.0 ft.	very thick-bedded
Blocky	2.0 to 4.0 ft.	thick bedded
Slabby	0.2 to 2.0 ft.	thin bedded
Flaggy	0.05 to 0.2 ft.	very thin-bedded
Shaly or platy	0.01 to 0.05 ft.	laminated
Papery	less than 0.01	thinly laminated

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Project
NORTHGATE
TOWN SQUARE
SAN RAFAEL
MARIN COUNTY CALIFORNIA

Figure Title
PHYSICAL PROPERTIES CRITERIA
FOR ROCK DESCRIPTIONS

Project No.
731759601
Date
11/11/2021
Drawn By
AG
Checked By
HS

Figure
A-35

APPENDIX B

LOGS OF BORINGS AND LABORATORY TEST RESULTS BY OTHERS

NORTHGATE MALL ADDITIONS
San Rafael, California

Log of Boring No. 1

[illegible]: October 29, 1982
[illegible]ing: 6'' Auger
[illegible] Weight: 140 lbs.

Remarks: All sampling was performed with a Modified California Sampler (2-inch I.D., 2½-inch O.D.)

[illegible]	Samples	Blows/Ft	MATERIAL DESCRIPTION	LABORATORY TESTS Moisture Content, %	Dry Density, pcf	Unconfined Compressive Strength, psf
			Surface Elevation 30.5±			
			4'' Asphalt-Concrete and 6'' Sandstone Fragment Base			
			SILTY CLAY FILL (CL)			
	1	38	Very stiff, mottled brown and gray-brown, sandy	16	115	6240
5			With sandstone and shale rock fragments			
	2	29		-	-	-
10						
	3	25		12	124	2680
			Becoming less stiff			
15			Water Level at End of Drilling			
			(FILL)			
	4	18	SILTY CLAY (CL)	19	109	4300
			Very stiff, brown mottled orange-brown, sandy			
20			Water Level During Drilling			
	5	45	With fine rock fragments	-	-	-

Proj. No. 15494A

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Figure 2a

NORTHGATE MALL ADDITIONS
San Rafael, California

Log of Boring No. 1

(Continued

		Blows/Ft	MATERIAL DESCRIPTION	Moisture Content, %	Dry Density, pcf	Unconfined Compressive Strength
			SILTY CLAY (CL)......Cont'd			
25			SANDY CLAY (CL-SC) Very stiff, mottled light gray and orange-brown, with trace of fine gravel			
	6	35		17	114	3900
30						
			SHALE Very soft, weathered, gray			
	7	50/6"		-	-	-
			Becoming soft			
35			BOTTOM OF BORING @ 34½'			
40						
45						

Proj. No.

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Figure 2b

NORTHGATE MALL ADDITIONS
San Rafael, California

Log of Boring No. 2

ed: October 29, 1982
Boring: 6" Auger
r Weight: 140 lbs.

Remarks: See Figure 2a

Depth	Samples	Blows/Ft	MATERIAL DESCRIPTION	LABORATORY TESTS: Moisture Content, %	LABORATORY TESTS: Dry Density, pcf	LABORATORY TESTS: Unconfined Compressive Strength, psf
			Surface Elevation 30.5±			
			4" Asphalt-Concrete and 5" Sandstone Fragment Base			
			SILTY CLAY FILL (CL)			
			Very stiff, dark brown, sandy			
	1 ▨	34		15	118	8450
			With shale fragments			
5	2 ▨	27		13	121	2780
			FILL			
10	3 ▨	20	Silty clay and shale fragments, stiff, dark gray	11	121	3100
			Becoming brown			
15	4 ▨	28		13	119	4870
			(FILL)			
20			▽ CLAYEY SAND (SC)			
	5 ▨	40	Dense, orange-brown	-	-	-
			Water Level 10 Minutes After Drilling			
			SANDY CLAY (CL)			
			Very stiff, orange-brown mottled light gray			

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Figure 3a

RTHGATE MALL ADDITIONS
an Rafael, California

Log of Boring No. 2
(Continued)

		Blows/Ft.	MATERIAL DESCRIPTION	Moisture Content, %	Dry Density, pcf	Unconfined Compressive Strength, psf
	6	32	SANDY CLAY (CL)......Cont d ▽ Very stiff, orange-brown mottled light gray Water Level During Drilling	17	112	2470
			BOTTOM OF BORING @ 26½'			
30						
35						
40						
45						

Proj. No. 15494A

Woodward-Clyde Consultants

Figure 3b

ect NORTHGATE MALL ADDITIONS
San Rafael, California

Log of Boring No. 3

Date Drilled: October 29, 1982
Type of Boring: 6" Auger
Hammer Weight: 140 lbs.

Remarks: See Figure 2a

Surface Elevation 27.0±

Depth, Ft	Samples	Blows/Ft	MATERIAL DESCRIPTION	LABORATORY TESTS Moisture Content, %	LABORATORY TESTS Dry Density, pcf	LABORATORY TESTS Unconfined Compressive Strength, psf
			2-3/4" Asphalt and 7" Sandstone Fragment Base			
			FILL			
	1	13	Silty clay with shale and sandstone rock fragments, loose, dark gray and brown	-	-	-
5						
	2	50	FILL· Brown sandstone and dark gray shale fragments	-	-	-
10			SANDY CLAY FILL (CL)			
			Very stiff, dark brown			
			▽ Water Level at End of Drilling			
	3	20	(FILL) ↑	15	118	4050
15			SANDY CLAY (CL)			
			Very stiff, mottled orange-brown and light gray			
	4	37		18	112	5760
20						
			SHALE			
	5	57	Soft, dark brown	-	-	-

Proj. No. 15494A

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Figure 4a

THGATE MALL ADDITIONS
San Rafael, California

Log of Boring No. 3

(Continued)

	Blows/ft.	MATERIAL DESCRIPTION	Moisture Content, %	Dry Density, pcf	Unconfined Compressive Strength, psf
		SHALE (Cont'd): Soft, dark brown			
		Becoming moderately hard			
		BOTTOM OF BORING @ 28½'			
30					
35					
40					
45					

Proj. No. 15494A

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Figure 4b

ctober 30, 1982 Remarks: See Figure 2a

6" Auger

ight: 140 lbs.

	Sam	Blows/Ft.	MATERIAL DESCRIPTION	LABORATORY TESTS		
				Moisture Content, %	Dry Density, pcf	Unconfined Compressive Strength, psf
			Surface Elevation 27.7±			
			Asphalt-Concrete			
	1	14	FILL Silty clay with sandstone and shale fragments, loose, dark gray and brown	-	-	-
5	2	18	SANDY CLAY FILL (CL) Stiff, dark gray-brown	20	106	2490
			(FILL)			
10	3	30/6"	SILTY CLAY (CL) Very stiff, orange-brown mottled light gray, sandy	18	110	9690
15	4	60/4"	SANDSTONE Soft to moderately hard, yellow-brown to brown	-	-	-
20			BOTTOM OF BORING @ 20'			

Proj. No. 15494A **Woodward-Clyde Consultants** Figure 5

GATE MALL ADDITIONS
Rafael, California

Log of Boring No. 5

tober 28, 1982
6" Auger
140 lbs.

Remarks: See Figure 2a

		Blows/Ft	MATERIAL DESCRIPTION	LABORATORY TESTS Moisture Content, %	Dry Density, pcf	Unconfined Compressive Strength, psf
			Surface Elevation 35.6±			
			2¼" Asphalt-Concrete and 7" Sandstone Fragment Base			
	1	18	SILTY CLAY WITH SHALE FRAGMENTS Stiff, dark gray to dark brown (Reworked Material ?)	-	-	-
			SHALE			
	2	60/5"	Soft to moderately hard, highly fractured, dark gray	-	-	-
5						
			Becoming moderately hard			
			Seepage			
10	3	60/6"	Becoming soft	-	-	-
			BOTTOM OF BORING @ 10-3/4'			
15						
20						

Proj. No. 15494A

Woodward-Clyde Consultants

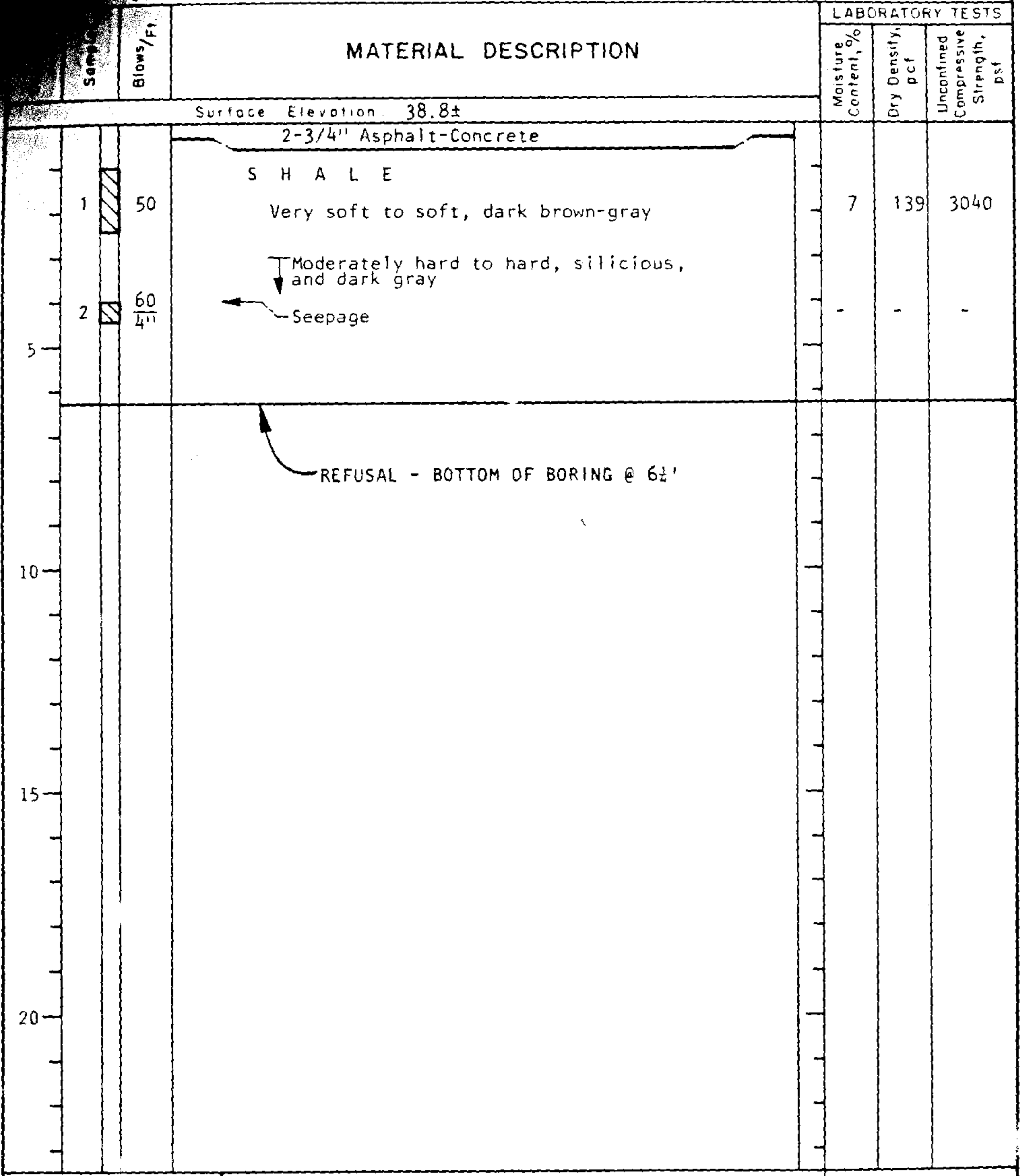
Figure 6

Rafael, California | Log of Boring No. 6

ctober 28, 1982 Remarks See Figure 2a

6" Auger

ght: 140 lbs.



Surface Elevation 38.8±

Depth	Sam	Blows/Ft	MATERIAL DESCRIPTION	Moisture Content, %	Dry Density, pcf	Unconfined Compressive Strength, psf
			2-3/4" Asphalt-Concrete			
			SHALE			
	1	50	Very soft to soft, dark brown-gray	7	139	3040
			Moderately hard to hard, silicious, and dark gray			
	2	60/4"	Seepage	-	-	-
5						
			REFUSAL - BOTTOM OF BORING @ 6½'			
10						
15						
20						

Proj. No. 15494A | **Woodward-Clyde Consultants** | Figure 7 ober 28, 1982

" Auger

140 lbs.

Remarks: See Figure 2a

Depth		Blows/Ft.	MATERIAL DESCRIPTION	LABORATORY TESTS Moisture Content, %	Dry Density, pcf	Unconfined Compressive Strength, psf
			Surface Elevation: 33.4±			
			1½" Asphalt-Concrete and 6½" Sand & Gravel Base			
	1	31	SHALE Very soft, weathered, dark gray-brown to brown	14	114	4800
	2	27/6"	-Becoming soft	-	-	-
5						
	3	60/2½"	SANDSTONE Moderately hard, silicious, brown	-	-	-
10						
	4	50/3"	SHALE Moderately hard, highly fractured, dark gray	-	-	-
			BOTTOM OF BORING @ 13½'			
15						
20						

Proj. No. 15494A

Woodward-Clyde Consultants

Figure 8

TE MALL ADDITIONS
afael, California

Log of Boring No. 8

ber 28, 1982
Auger
140 lbs.

Remarks: See Figure 2a

			Blows/ft	MATERIAL DESCRIPTION	LABORATORY TESTS		
					Moisture Content, %	Dry Density, pcf	Unconfined Compressive Strength, psf
				Surface Elevation 35.0±			
				2½" Asphalt-Concrete			
1		▨	10/1"	SILTY CLAY & SANDSTONE FRAGMENTS Dense, gray-brown (Reworked Material ?)	9	122	4080
				SANDSTONE: Moderately hard, gray-brown			
2		▨	60/2½"	SHALE	-	-	-
				Soft to moderately hard, dark brown			
				—With hard, silicious zones			
3		▨	60/2"		-	-	-
				BOTTOM OF BORING @ 10¼'			

j. No. 15494A

Woodward-Clyde Consultants

Figure 9

TE MALL ADDITIONS
afael, California

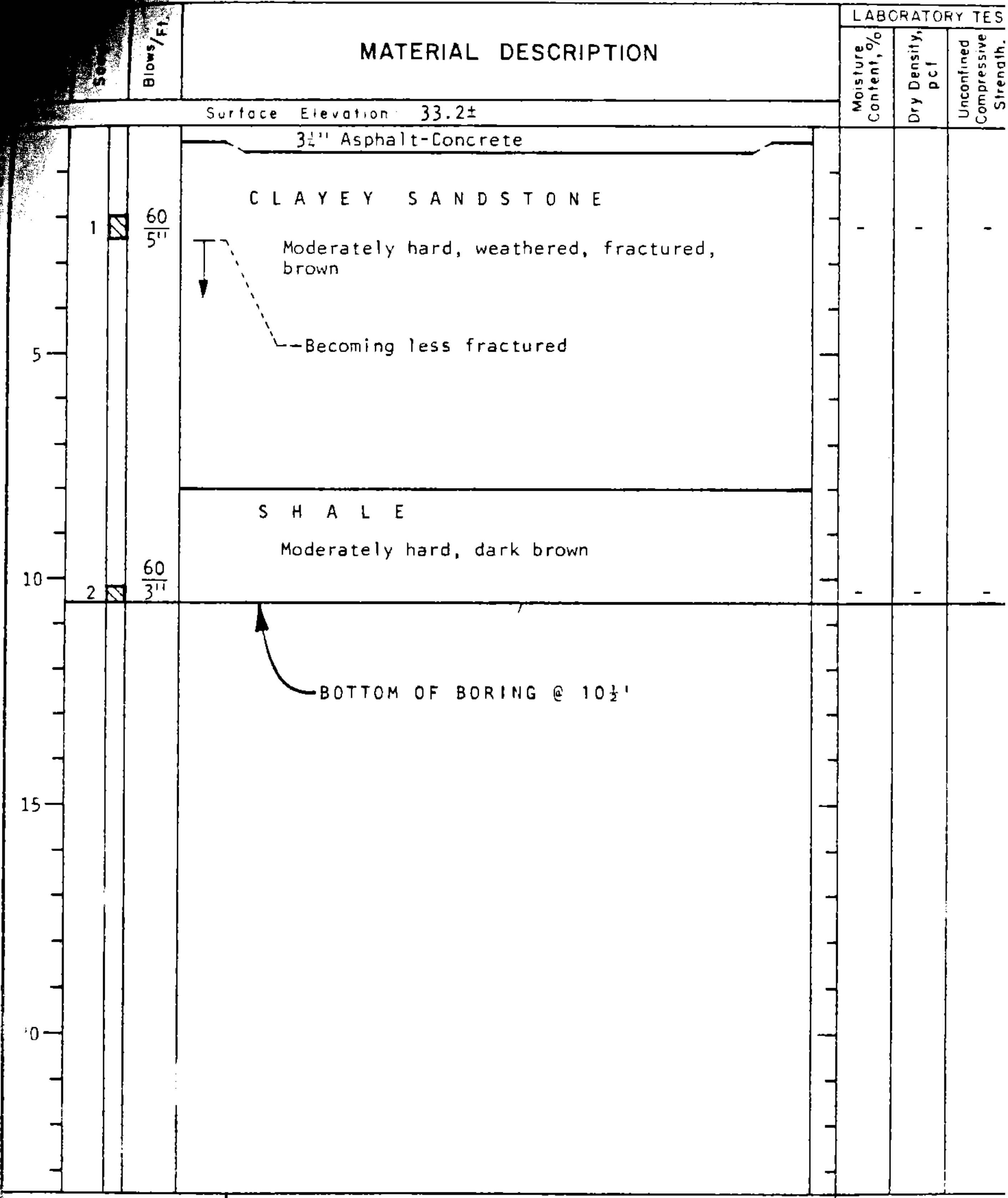
Log of Boring No. 9

ober 28, 1982

6" Auger

140 lbs.

Remarks: See Figure 2a



CLAYEY SANDSTONE

Moderately hard, weathered, fractured, brown

--Becoming less fractured

SHALE

Moderately hard, dark brown

BOTTOM OF BORING @ 10½'

Proj. No. 15494A

Woodward-Clyde Consultants

Figure 10

MALL ADDITIONS
ael, California

Log of Boring No. 10

r 29, 1982

Remarks See Figure 2a

Auger

40 lbs.

		Blows	MATERIAL DESCRIPTION	LABORATORY TESTS Moisture Content, %	Dry Density, pcf	Unconfined Compressive Strength psf
			Surface Elevation 33.4±			
			2" Asphalt-Concrete and 6" Sand & Gravel Base			
			SILTY CLAY (CL)			
	1	31	Very stiff to hard, orange-brown mottled brown, sandy	17	110	8860
5			Becoming sandier with fine rock fragments			
	2	26		11	115	2200
10						
	3	50/10½"	SHALE	12	120	5260
			Soft, weathered, brown			
15			Becoming moderately hard			
	4	60/2½"		-	-	-
			BOTTOM OF BORING @ 17½'			
20						

Proj. No. 15494A

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Figure 11

MALL ADDITIONS
el, California

Log of Boring No. 11

28, 1982

Remarks See Figure 2a

uger

lbs.

			MATERIAL DESCRIPTION	LABORATORY TESTS		
				Moisture Content, %	Dry Density, pcf	Unconfined Compressive Strength, psf
			Surface Elevation 34.4±			
			3" Asphalt-Concrete			
			SANDY CLAY (CL)			
	1	46/9"	Very stiff to hard, mottled brown, orange-brown, and light gray (Highly Weathered Sandstone)	16	114	8940
5	2	47		16	115	9660
10	3	40/6"	SANDSTONE Soft, brown -Becoming moderately hard	-	-	-
15	4	60/2"		-	-	-
			BOTTOM OF BORING @ 15½'			

roj. No. 15494A

Woodward-Clyde Consultants

Figure 12

ALL ADDITIONS
el, California

Log of Boring No. 12

r 28, 1982 Remarks. See Figure 2a
uger
40 lbs.

				MATERIAL DESCRIPTION	LABORATORY TESTS		
					Moisture Content, %	Dry Density, pcf	Unconfined Compressive Strength, psf
				Surface Elevation 39.4±			
	1	▨	61	Asphalt-Concrete SHALE FRAGMENTS Medium dense, dark gray (Reworked Material)	-	-	-
				SHALE Moderately hard, silicious, gray			
5	2	▨	40/6"	SHALE Soft to moderately hard, gray	-	-	-
				SHALE Hard, silicious, dark gray			
10				REFUSAL - BOTTOM OF BORING @ 8½'			
15							
20							

Proj. No. 15494A | **Woodward-Clyde Consultants** | Figure 13

MALL ADDITIONS
ael, California

Log of Boring No. 13

r 29, 1982
Auger
140 lbs.

Remarks: See Figure 2a

		Blo	MATERIAL DESCRIPTION	LABORATORY TESTS		
				Moisture Content, %	Dry Density, pcf	Unconfined Compressive Strength, psf
			Surface Elevation 38.8±			
			2" Asphalt-Concrete and 6" Shale Fragment Base			
1	▨	30/2½"	SHALE Soft, weathered, dark brown and brown	10	124	5195
			SHALE Soft to moderately hard, gray, with silicious zones			
			← Seepage			
2	▨	60/5"		-	-	-
			BOTTOM OF BORING @ 10½'			

No. 15494A

Woodward-Clyde Consultants

Figure 14

el, California

Log of Boring No. 14

28, 1982

der

lbs.

Remarks: See Figure 2a

			LABORATORY TESTS		
		MATERIAL DESCRIPTION	Moisture Content, %	Dry Density, pcf	Unconfined Compressive Strength, psf
		Surface Elevation: 34.8±			
		2-3/4" Asphalt-Concrete and 10" Sand & Gravel Base			
▨	30/6"	SHALE Very soft to soft, dark gray	6	134	4720
2 ▨	47/7"	Becoming moderately hard with silicious layers	-	-	-
		Becoming hard			
		BOTTOM OF BORING @ 10'			

j. No. 15494A

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Figure 15

[illegible], California

Log of Boring No. 15

[illegible] 29, 1982 Remarks: See Figure 2a

[illegible]ger

[illegible] lbs.

			MATERIAL DESCRIPTION	LABORATORY TEST		
			Surface Elevation 33.6±	Moisture Content, %	Dry Density, pcf	Unconfined Compressive Strength,
			2" Asphalt-Concrete and Sandstone Fragment Base			
			SHALE Very soft to soft, weathered, dark brown and brown			
	1 ▨	47		9	128	6590
5			SHALE Moderately hard, silicious, dark gray			
10						
	2 ▨	60/4"		-	-	-
			BOTTOM OF BORING @ 12½'			
15						
20						

Proj. No. 15494A

Woodward-Clyde Consultants

Figure 16

Project. NORTHGATE MALL ADDITIONS
San Rafael, California

Log of Boring No. 16

Date Drilled: October 30, 1982

Remarks: See Figure 2a

Type of Boring: 6" Auger

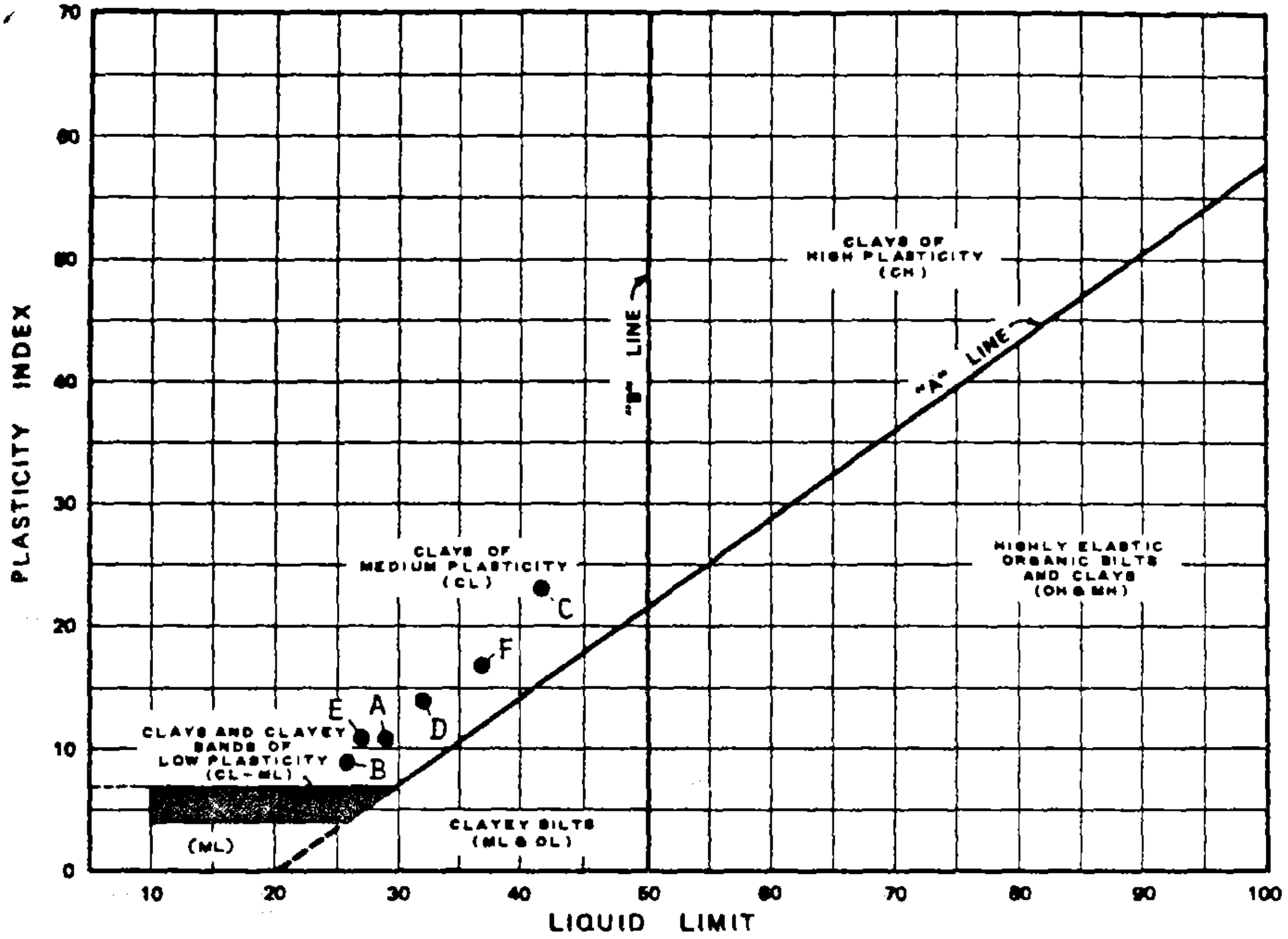
Hammer Weight: 140 lbs.

Depth, Ft	Samples	Blows/Ft	MATERIAL DESCRIPTION	LABORATORY TESTS		
				Moisture Content, %	Dry Density, pcf	Unconfined Compressive Strength, psf
			Surface Elevation 34.4±			
			SILTY CLAY FILL Stiff, dark gray-brown			
	1	40/6"	SILTY SAND FILL (SM-SP)	-	-	-
5			Coarse- to fine-grained, dense, brown, with fine gravel			
	2	18/6"		-	-	-
10			Becoming medium dense			
	3	27		-	-	-
15			SANDY GRAVEL FILL Loose, with cobbles			
			(FILL)			
	4	60/½"	CONCRETE	-	-	-
			BOTTOM OF BORING @ 18½'			
20						

Proj. No. 15494A

Woodward-Clyde Consultants

Figure 17



SAMPLE IDENTIFICATION				ATTERBERG LIMITS		
LETTER DESIG'N	BORING NO.	SAMPLE NO.	DEPTH, FT.	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
A	1	1	3	29	18	11
B	2	1	3	26	17	9
C	7	1	2	42	19	23
D	10	1	3	32	18	14
E	14	1	2	27	16	11
F	15	1	3	37	20	17

Project No. 15494A
Woodward-Clyde Consultants

PLASTICITY CLASSIFICATION
NORTHGATE MALL ADDITIONS

Figure 18

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS				DESCRIPTIVE NAMES
COARSE GRAINED SOILS More than Half > #200 sieve	**GRAVELS** MORE THAN HALF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE	CLEAN GRAVELS WITH LITTLE OR NO FINES	**GW**	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES
			GP	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES
		GRAVELS WITH OVER 15% FINES	**GM**	SILTY GRAVELS, POORLY GRADED GRAVEL-SAND-SILT MIXTURES
			GC	CLAYEY GRAVELS, POORLY GRADED GRAVEL-SAND-CLAY MIXTURES
	SANDS MORE THAN HALF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE	CLEAN SANDS WITH LITTLE OR NO FINES	**SW**	WELL GRADED SANDS, GRAVELLY SANDS
			SP	POORLY GRADED SANDS, GRAVELLY SANDS
		SANDS WITH OVER 15% FINES	**SM**	SILTY SANDS, POORLY GRADED SAND-SILT MIXTURES
			SC	CLAYEY SANDS, POORLY GRADED SAND-CLAY MIXTURES
FINE GRAINED SOILS More than Half < #200 sieve	**SILTS AND CLAYS** LIQUID LIMIT LESS THAN 50		**ML**	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS, OR CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC CLAYS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50		**MH**	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			**Pt**	PEAT AND OTHER HIGHLY ORGANIC SOILS

FIELD SAMPLING

◧	CALIFORNIA SAMPLE 2.5" I.D.
■	MODIFIED CALIFORNIA SAMPLE 2" I.D.
☒	DISTURBED, BAG OR BULK SAMPLE
◪	STANDARD PENETRATION TEST
⧄	SHELBY TUBE SAMPLE
◫	3-1/2" I.D. CONTINUOUS CORE SAMPLE
□	UNRETAINED PORTION OF SAMPLE
▼	WATER LEVEL OBSERVED IN BORING (at given post-drilling time)
▽	WATER LEVEL OBSERVED IN BORING (at time of drilling)

LABORATORY TESTS

LL	LIQUID LIMIT
PI	PLASTICITY INDEX
SA	SIEVE ANALYSIS
#200	PERCENT PASSING #200 SIEVE
RV	RESISTANCE VALUE
EI	EXPANSION INDEX
DS	DIRECT SHEAR
Tx/UU	TRIAXIAL SHEAR-UNCONSOLIDATED UNDRAINED
UC	UNCONFINED COMPRESSION
SG	SPECIFIC GRAVITY
PP	POCKET PENETROMETER SHEAR STRENGTH (tsf)

NOTES: Blow counts represent the number of blows of a 140-pound hammer falling 30-inches required to drive a sampler the last 12-inches of an 18-inch penetration. Field blow counts (not-converted).

The lines separating strata on the logs represent approximate boundaries only. The actual transition may be gradual. No warranty is provided as to the continuity of soil strata between borings. Logs represent the soil strata and groundwater observed at the boring location on the date of drilling only.

KLEINFELDER

PROJECT NUMBER **86393** DATE **Oct 2007**

BORING LOG LEGEND

Northgate Mall Improvements
Access Roads
San Rafael, California

PLATE
A-1

WEATHERING

Fresh - No visible sign of rock material weathering; perhaps slight discoloration on major discontinuity surfaces. **Weathering Grade I.**

Slightly Weathered - Discoloration indicates weathering of rock material and discontinuity surfaces. All the rock material may be discolored by weathering and may be somewhat weaker externally than in its fresh condition. **Weathering Grade II.**

Moderately Weathered - Less than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discolored rock is present either as a continuous framework or corestones. **Weathering Grade III.**

Highly Weathered - More than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discolored rock is present either as a discontinuous framework or as corestones. **Weathering Grade IV.**

Completely Weathered - All rock material is decomposed and/or disintegrated to a soil. The original mass structure is still largely intact. **Weathering Grade V.**

Residual Soil - All rock material is converted to a soil. The mass structure and material fabric are destroyed. There is a large change in volume, but the soil has not been significantly transported. **Weathering Grade VI.**

STRENGTH (OF INTACT ROCK PIECES

Grade	Description	Field Identification	Approx. UCS (Mpa)	Approx. UCS (psi)
R0	Extremely Weak Rock	Identified by thumbnail	0.25 - 1.0	50 - 150
R1	Very Weak Rock	Crumbles under firm blows with point of geological hammer	1.0 - 5.0	150 - 750
R2	Weak Rock	Can be peeled by a pocket knife, specimen can be fractured with single firm blow of geological hammer	5.0 - 25	750 - 3,500
R3	Moderately Strong Rock	Cannot be scraped or peeled with pocket knife, specimen can be fractured with single firm blow of geological hammer	25 - 50	3,500 - 7,500
R4	Strong Rock	Specimen requires more than one blow of geological hammer to fracture it	50 - 100	7,500 - 15,000
R5	Very Strong Rock	Specimen requires many blows of geological hammer to fracture it	100 - 250	15,000 - 35,000
R6	Extremely Strong Rock	Specimen can only be chipped with geological hammer	>250	>35,000

DISCONTINUITY SPACING

	English	Metric
1. Extremely close	<1.0 in.	(<20 mm)
2. Very close	1.0 - 2.5 in.	(20 - 60 mm)
3. Close	2.5 - 8.0 in.	(60 - 200 mm)
4. Moderately	8.0 in - 2.0 ft.	(200 - 600 mm)
5. Wide	2.0 - 6.5 ft.	(600 - 2,000 mm)
6. Very wide	6.5 - 20.0 ft.	(2 - 6 m)
7. Ext. wide	>20.0 ft.	(>6 m)

APERTURE WIDTH

Very tight	<1.0 mm
Tight	0.1 - 0.25 mm
Partly open	0.25 - 0.5 mm
Open	0.5 - 2.5 mm
Moderately wide	2.5 - 10 mm
Wide	10 mm - 1 cm
Very wide	1 - 10 cm
Extremely wide	10 - 100 cm
Cavernous	>1 m

ROCK QUALITY DESIGNATION

RQD%	Rock Quality
90 - 100	Excellent
75 - 90	Good
50 - 75	Fair
25 - 50	Poor
0 - 25	Very Poor

$$RQD = \frac{\text{Sum of Intact Pieces >4 inches (100 mm)}}{\text{Total Core Run Length}}$$

■	Hand-Driven Tube Sample
P.P. +4.5	Pocket Penetrometer (tons per square foot, tsf)

KLEINFELDER

ROCK DESCRIPTION CRITERIA

Northgate Mall Improvements
Access Roads
San Rafael, California

PLATE

A-2

PROJECT NUMBER **86393** DATE **Oct 2007**

LABORATORY				FIELD					
Dry Density (pcf)	Moisture Content (%)	Shear Strength (ksf)	Other Tests	Blows/foot *	Sample	Depth (feet)	Lithology Symbol	U.S.C.S. Designation	SOIL DESCRIPTION
								A.C.	**ASPHALT = 3.5 INCHES THICK**
								GM	**SILTY GRAVEL WITH SAND -** gray, moist, medium dense, fine to coarse sand to coarse subangular gravel to 1" diameter (Aggregate Baserock)
114	15.2			38				GC	**CLAYEY GRAVEL WITH SAND -** light brown, brown and yellow brown, moist, medium dense, fine to coarse sand to coarse subrounded to angular gravel to 1" diameter (Fill)
115	17.6			36				CH	**SANDY CLAY -** olive brown, moist, firm, fine to coarse sand
								CL	**SANDY CLAY -** mottled brown, gray and red-brown, moist, hard, fine to medium sand

BOTTOM OF BORING K-1 @ 5 FEET
No Free Water Encountered

* Field blow counts (not-converted).
**

SURFACE ELEVATION: **Not Available ****
TOTAL DEPTH: **5.0 feet**
GROUND WATER DEPTH: ▽ **feet at time of drilling**
▼ **feet**

LOGGED BY: **R. Padgett**
EQUIPMENT: **Mobile B-53**
DIAMETER of BORING: **6**
DATE DRILLED: **8-30-07**

KLEINFELDER

PROJECT NUMBER **86393** DATE **Oct 2007**

LOG OF EXPLORATION
BORING K-1

Northgate Mall Improvements
Access Roads
San Rafael, California

PLATE
A-3
1 of 1

LABORATORY				FIELD					
Dry Density (pcf)	Moisture Content (%)	Shear Strength (ksf)	Other Tests	Blows/foot *	Sample	Depth (feet)	Lithology Symbol	U.S.C.S. Designation	SOIL DESCRIPTION
								AC	**ASPHALT = 4 INCHES THICK**
						1		GM	**SILTY GRAVEL WITH SAND -** gray, moist, medium dense, fine to coarse sand to coarse angular gravel to 0.75 inch diameter (Aggregate Baserock)
120	13.1		LL=26			2		CL	**SANDY CLAY WITH GRAVEL -** brown, light brown and yellow brown, moist, hard, fine to coarse sand to fine subrounded gravel to 0.5 inch diameter
131	6.7		PI=12	48					
						3			
						4		GC	**CLAYEY GRAVEL WITH SAND -** olive gray, moist, medium dense, fine to coarse sand to coarse subangular gravel to 1" diameter
				34		5			>2.5 inch diameter sandstone gravel at 5.5 feet
						6			BOTTOM OF BORING K-2 @ 5.5 FEET No Free Water Encountered
						7			
						8			
						9			
						10			
						11			
						12			
						13			
						14			
						15			
						16			
						17			
						18			
						19			
						20			

* Field blow counts (not-converted).

**

SURFACE ELEVATION: **Not Available ****

TOTAL DEPTH: **5.5 feet**

GROUND WATER DEPTH: ☐ **feet at time of drilling**

☐ **feet**

LOGGED BY: **R. Padgett**

EQUIPMENT: **Mobile B-53**

DIAMETER of BORING: **6**

DATE DRILLED: **8-30-07**

KLEINFELDER

PROJECT NUMBER **86393** DATE **Oct 2007**

LOG OF EXPLORATION
BORING K-2

Northgate Mall Improvements
Access Roads
San Rafael, California

PLATE **A-4**

LABORATORY				FIELD					
Dry Density (pcf)	Moisture Content (%)	Shear Strength (ksf)	Other Tests	Blows/foot *	Sample	Depth (feet)	Lithology Symbol	U.S.C.S. Designation	SOIL DESCRIPTION
								AC	**ASPHALT = 4 INCHES THICK**
								GM	**SILTY GRAVEL WITH SAND -** gray, moist, dense, fine to coarse sand to coarse subangular gravel to 0.75 inch diameter (Aggregate Baserock)
119	14.1					1			
122	11.0		-200=34%	49		2		GC	**CLAYEY GRAVEL WITH SAND -** olive brown, red brown and yellow brown, moist, dense, fine to coarse sand to coarse subrounded to angular gravel to 1.5 inch diameter (Fill)
						3		SC	**CLAYEY SAND -** light brown, moist, medium dense, fine to coarse sand (Fill)
111	13.7								
129	13.2			49		4		CL	**SANDY CLAY -** light brown, moist, firm, fine to medium sand (Fill)
								GC	**CLAYEY GRAVEL WITH SAND -** olive brown, moist, dense, fine to coarse sand, to coarse subrounded to subangular gravel to 3 inch diameter
						5			BOTTOM OF BORING K-3 @ 5 FEET No Free Water Encountered
						6			
						7			
						8			
						9			
						10			
						11			
						12			
						13			
						14			
						15			
						16			
						17			
						18			
						19			
						20			

* Field blow counts (not-converted).
**

SURFACE ELEVATION: **Not Available ****
TOTAL DEPTH: **5.0 feet**
GROUND WATER DEPTH: ⊻ **feet at time of drilling**
⊻ **feet**

LOGGED BY: **R. Padgett**
EQUIPMENT: **Mobile B-53**
DIAMETER of BORING: **6**
DATE DRILLED: **8-30-07**

KLEINFELDER

PROJECT NUMBER **86393** DATE **Oct 2007**

LOG OF EXPLORATION
BORING K-3

Northgate Mall Improvements
Access Roads
San Rafael, California

PLATE
A-5
1 of 1

LABORATORY				FIELD					
Dry Density (pcf)	Moisture Content (%)	Shear Strength (ksf)	Other Tests	Blows/foot *	Sample	Depth (feet)	Lithology Symbol	U.S.C.S. Designation	SOIL DESCRIPTION
								AC	**ASPHALT = 5 INCHES THICK**
								GM	**SILTY GRAVEL WITH SAND -** gray, moist, medium dense, fine to coarse sand to coarse subangular to subrounded gravel to 1 inch diameter
						1			
102	6.6		-200=16%	62/9"					
						2		GC	**CLAYEY GRAVEL WITH SAND -** dark gray, moist, dense, fine to coarse sand to coarse angular shale gravel to 2 inch diameter (Fill)
						3			
				60/3"		4			sandstone gravel/cobble >2.5 inch diameter
									BOTTOM OF BORING K-7 @ 4.5 FEET No Free Water Encountered
						5			
						6			
						7			
						8			
						9			
						10			
						11			
						12			
						13			
						14			
						15			
						16			
						17			
						18			
						19			
						20			

* Field blow counts (not-converted).
**

SURFACE ELEVATION: **Not Available ****
TOTAL DEPTH: **4.5 feet**
GROUND WATER DEPTH: ∇ **feet at time of drilling**
▼ **feet**

LOGGED BY: **R. Padgett**
EQUIPMENT: **Mobile B-53**
DIAMETER of BORING: **6**
DATE DRILLED: **8-31-07**

KLEINFELDER

PROJECT NUMBER **86393** DATE **Oct 2007**

LOG OF EXPLORATION BORING K-7

Northgate Mall Improvements Access Roads San Rafael, California

PLATE

A-6

1 of 1

LABORATORY				FIELD					
Dry Density (pcf)	Moisture Content (%)	Shear Strength (ksf)	Other Tests	Blows/foot *	Sample	Depth (feet)	Lithology Symbol	U.S.C.S. Designation	SOIL DESCRIPTION
								AC	**ASPHALT = 4.5 INCHES THICK**
								GM	**SILTY GRAVEL WITH SAND -** gray, moist, dense, fine to coarse sand to coarse subangular gravel to 1 inch diameter (Aggregate Baserock)
						1		GC	**CLAYEY GRAVEL WITH SAND -** dark gray, moist, dense, fine to coarse sand to coarse subangular gravel to 1 inch diameter (Fill)
137	6.9			65/10"		2			
				50/2"		3			**SHALE -** dark gray, very fine grained, very weak (R1), fissile, finely laminated
						4			BOTTOM OF BORING K-8 @ 4 FEET No Free Water Encountered
						5			
						6			
						7			
						8			
						9			
						10			
						11			
						12			
						13			
						14			
						15			
						16			
						17			
						18			
						19			
						20			

* Field blow counts (not-converted).
**

SURFACE ELEVATION: **Not Available ****
TOTAL DEPTH: **4.0 feet**
GROUND WATER DEPTH: ∇ **feet at time of drilling**
▼ **feet**

LOGGED BY: **R. Padgett**
EQUIPMENT: **Mobile B-53**
DIAMETER of BORING: **6**
DATE DRILLED: **8-31-07**

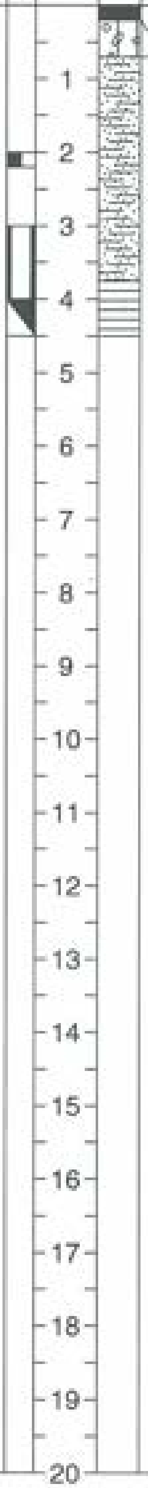
KLEINFELDER

PROJECT NUMBER **86393** DATE **Oct 2007**

LOG OF EXPLORATION
BORING K-8

Northgate Mall Improvements
Access Roads
San Rafael, California

PLATE
A-7
1 of 1



LABORATORY				FIELD					
Dry Density (pcf)	Moisture Content (%)	Shear Strength (ksf)	Other Tests	Blows/foot *	Sample	Depth (feet)	Lithology Symbol	U.S.C.S. Designation	SOIL DESCRIPTION
								AC	**ASPHALT = 2 INCHES THICK**
								GM	**SILTY GRAVEL WITH SAND -** gray, moist, dense, fine to coarse sand to coarse subangular gravel to 1 inch diameter (Aggregate Baserock)
				50/2"		2			**SANDSTONE -** gray, fine to medium grained, weak (R2)
				39		4			**SHALE -** dark gray, very fine grained, very weak (R1), fissile

BOTTOM OF BORING K-9 @ 4.5 FEET
No Free Water Encountered

* Field blow counts (not-converted).
**

SURFACE ELEVATION: **Not Available ****
TOTAL DEPTH: **4.5 feet**
GROUND WATER DEPTH: ▽ **feet at time of drilling**
▼ **feet**

LOGGED BY: **R. Padgett**
EQUIPMENT: **Mobile B-53**
DIAMETER of BORING: **6**
DATE DRILLED: **8-31-07**

KLEINFELDER

PROJECT NUMBER **86393** DATE **Oct 2007**

LOG OF EXPLORATION BORING K-9

Northgate Mall Improvements
Access Roads
San Rafael, California

PLATE
A-8
1 of 1

LABORATORY				FIELD					
Dry Density (pcf)	Moisture Content (%)	Shear Strength (ksf)	Other Tests	Blows/foot *	Sample	Depth (feet)	Lithology Symbol	U.S.C.S. Designation	SOIL DESCRIPTION
								AC	**ASPHALT = 4 INCHES THICK**
								GM	**SILTY GRAVEL WITH SAND -** gray, moist, medium dense, fine to coarse sand to coarse subrounded to subangular gravel to 1" diameter (Aggregate Baserock)
						1			
						2		GC	
						3			**CLAYEY GRAVEL WITH SAND -** olive brown, moist, dense, fine to coarse sand to coarse subangular gravel to 1 inch diameter (Fill)
124	12.6			50		4			
						5		CL	**SANDY CLAY -** mottled red brown, brown and yellow brown, moist, stiff, fine to medium sand (Fill)
						6		SC	**CLAYEY SAND WITH GRAVEL -** red brown, brown and olive gray, moist, very dense, fine to coarse sand to coarse angular gravel to 1 inch diameter (Fill)
159	7.3			55/8"		7			
						8			**CLAY WITH SAND -** mottled red brown, yellow brown and dark brown, moist, stiff, fine to medium sand, some manganese mineralization
						9			
						10			
				63		11			
						12			
						13		CH	
						14			
						15			Hard
				72		16			
						17			
						18			
						19			**SHALE -** reddish brown, very fine grained, very weak (R1), very closely fractured
				85/11"		20			
						21			BOTTOM OF BORING K-4 @ 21 FEET No Free Water Encountered
						22			
						23			
						24			
						25			

* Field blow counts (not-converted).
**

SURFACE ELEVATION: **Not Available ****
TOTAL DEPTH: **21.0 feet**
GROUND WATER DEPTH: ∇ **feet at time of drilling**
▼ **feet**

LOGGED BY: **R. Padgett**
EQUIPMENT: **Mobile B-53**
DIAMETER of BORING: **6**
DATE DRILLED: **8-30-07**

KLEINFELDER

PROJECT NUMBER **86393** DATE **Oct 2007**

LOG OF EXPLORATION BORING K-4

Northgate Mall Improvements
Proposed Rite Aid Building
San Rafael, California

PLATE
A-3
1 of 1

LABORATORY				FIELD					
Dry Density (pcf)	Moisture Content (%)	Shear Strength (ksf)	Other Tests	Blows/foot *	Sample	Depth (feet)	Lithology Symbol	U.S.C.S. Designation	SOIL DESCRIPTION
								AC	**ASPHALT = 5 INCHES THICK**
						1		GM	**SILTY GRAVEL WITH SAND -** gray, moist, medium dense, fine to coarse sand to coarse subangular gravel to 1 inch diameter (Aggregate Baserock)
131	10.8			61		2		CL	**SANDY CLAY WITH GRAVEL -** mottled red brown, olive gray and yellow brown, moist, very stiff, fine to coarse sand to fine angular gravel to 0.5 inch diameter, some organics (Fill)
						3		GC	**CLAYEY GRAVEL WITH SAND -** olive brown, moist, dense to very dense, fine to coarse sand to coarse subrounded gravel to 1 inch diameter (Fill)
140	7.6			46		4 5		GC	**CLAYEY GRAVEL WITH SAND -** light brown, moist, dense, fine to coarse sand to coarse subangular to angular gravel to >2.5 inch diameter
						6			BOTTOM OF BORING K-5 @ 5 FEET No Free Water Encountered

* Field blow counts (not-converted).
**

SURFACE ELEVATION: **Not Available ****
TOTAL DEPTH: **5.5 feet**
GROUND WATER DEPTH: ☐ **feet at time of drilling**
☐ **feet**

LOGGED BY: **R. Padgett**
EQUIPMENT: **Mobile B-53**
DIAMETER of BORING: **6**
DATE DRILLED: **8-30-07**

KLEINFELDER

PROJECT NUMBER **86393** DATE **Oct 2007**

LOG OF EXPLORATION
BORING K-5

Northgate Mall Improvements
Proposed Rite Aid Building
San Rafael, California

PLATE
A-4
1 of 1

LABORATORY				FIELD					
Dry Density (pcf)	Moisture Content (%)	Shear Strength (ksf)	Other Tests	Blows/foot *	Sample	Depth (feet)	Lithology Symbol	U.S.C.S. Designation	SOIL DESCRIPTION
						0		AC	**ASPHALT = 4 INCHES THICK**
						1		GM	**SILTY GRAVEL WITH SAND -** gray, moist, medium dense, fine to coarse sand to coarse subangular to angular gravel to 0.75 inch diameter (Aggregate Baserock)
	8.1 10.4		-200=22% LL=30 PI=14	43		2 3		GC	**CLAYEY GRAVEL WITH SAND -** red brown, brown, gray and yellow brown, moist, dense, fine to coarse sand to coarse subrounded gravel to 1 inch diameter (Fill)
	10.1			51		4 5 6		SC	**CLAYEY SAND WITH GRAVEL -** red brown, yellow brown and dark gray, moist, dense, fine to medium sand, some fine angular gravel to 0.5 inch diameter (Fill)
						7 8		GC	**CLAYEY GRAVEL WITH SAND AND COBBLES -** light brown and brown, moist, dense, fine to coarse sand to coarse subrounded gravel/cobbles to >2.5 inch diameter (Fill)
				52 26		9 10 11 12 13 14 15 16 17		GC	**CLAYEY GRAVEL WITH SAND -** olive, moist, dense, fine to coarse sand to coarse subangular gravel to 2 inch diameter
				50/3" 50/2"		18 19			**SHALE -** red brown, very fine grained, slightly weathered, weak (R2), fissile
						20 21 22 23 24 25			BOTTOM OF BORING K-6 @ 20 FEET No Free Water Encountered

* Field blow counts (not-converted).
**

SURFACE ELEVATION: **Not Available ****
TOTAL DEPTH: **20.0 feet**
GROUND WATER DEPTH: ▽ **feet at time of drilling**
▼ **feet**

LOGGED BY: **R. Padgett**
EQUIPMENT: **Mobile B-53**
DIAMETER of BORING: **6**
DATE DRILLED: **8-30-07**

KLEINFELDER

PROJECT NUMBER **86393** DATE **Oct 2007**

LOG OF EXPLORATION
BORING K-6

Northgate Mall Improvements
Proposed Rite Aid Building
San Rafael, California

PLATE
A-5
1 of 1

LABORATORY				FIELD					
Dry Density (pcf)	Moisture Content (%)	Shear Strength (ksf)	Other Tests	Blows/foot *	Sample	Depth (feet)	Lithology Symbol	U.S.C.S. Designation	SOIL DESCRIPTION
								AC	**ASPHALT = 4 INCHES THICK**
						1		GM	**SILTY GRAVEL WITH SAND -** gray, moist, medium dense, fine to coarse sand to coarse subangular gravel to 1 inch diameter
						2			**SANDY CLAY -** mottled red brown, brown and olive brown, moist, very stiff, fine sand (Alluvium)
						3		CL	
116	17.0		TXUU=7387psf	49		4			
						5			
						6			**SANDY CLAY -** mottled olive brown, red brown, moist, very stiff, fine to medium sand, trace rounded fine gravel to 0.25 inch diameter (Alluvium)
109	19.6			47		7		CL/CH	
						8			**CLAYEY SAND -** mottled brown, red brown and olive brown, moist to wet, medium dense, fine sand (Alluvium)
						9			
109	20.5			26		10		SC	
						11			
						12			**SHALE -** olive brown and red brown, very fine grained, extremely weak (R0), intensely fractured, fissile, slaky, Mn staining on fracture faces
						13			
				50/4"		14			
						15			
						16			▼harder drilling
						17			
						18			
				50/2"		19			▽
									BOTTOM OF BORING K-10 @ 19.5 FEET
						20			
						21			
						22			
						23			
						24			
						25			

* Field blow counts (not-converted).
**

SURFACE ELEVATION: **Not Available ****
TOTAL DEPTH: **19.5 feet**
GROUND WATER DEPTH: ▽ **19.0 feet at time of drilling**
▼ **16.0 feet +0.5 HR**

LOGGED BY: **R. Padgett**
EQUIPMENT: **Mobile B-53**
DIAMETER of BORING: **6**
DATE DRILLED: **8-31-07**

KLEINFELDER

PROJECT NUMBER **86393** DATE **Oct 2007**

LOG OF EXPLORATION BORING K-10

Northgate Mall Improvements
Proposed Restaurants
San Rafael, California

PLATE
A-3
1 of 1

LABORATORY				FIELD					
Dry Density (pcf)	Moisture Content (%)	Shear Strength (ksf)	Other Tests	Blows/foot *	Sample	Depth (feet)	Lithology Symbol	U.S.C.S. Designation	SOIL DESCRIPTION
						0		AC	**ASPHALT = 4 INCHES THICK**
								GM	**SILTY GRAVEL WITH SAND -** gray, dry, dense, fine to coarse sand to coarse subangular gravel to 1 inch diameter (Aggregate Baserock)
			LL=34 PI=16	50/6"		1			
						2			**SILTSTONE -** olive gray and brown, fine grained, slightly weathered, very weak (R1), very closely fractured, thinly laminated
				50/4"		3			
						4			
						5			
						6			
						7			
						8			**SANDSTONE -** gray, fine to medium grained, slightly weathered, weak (R2)
				50/1"		9			
						10			BOTTOM OF BORING K-11 @ 9.5 FEET No Free Water Encountered
						11			
						12			
						13			
						14			
						15			
						16			
						17			
						18			
						19			
						20			

* Field blow counts (not-converted).
**

SURFACE ELEVATION: **Not Available ****
TOTAL DEPTH: **9.5 feet**
GROUND WATER DEPTH: ▽ **feet at time of drilling**
▼ **feet**

LOGGED BY: **R. Padgett**
EQUIPMENT: **Mobile B-53**
DIAMETER of BORING: **6**
DATE DRILLED: **8-30-07**

KLEINFELDER

PROJECT NUMBER **86393** DATE **Oct 2007**

LOG OF EXPLORATION
BORING K-11

Northgate Mall Improvements
Proposed Restaurants
San Rafael, California

PLATE
A-4
1 of 1

LABORATORY				FIELD					
Dry Density (pcf)	Moisture Content (%)	Shear Strength (ksf)	Other Tests	Blows/foot *	Sample	Depth (feet)	Lithology Symbol	U.S.C.S. Designation	SOIL DESCRIPTION
									MORTAR - 0.25 inches thick
									BRICK - 4 inches thick red brick in mortar
									MORTAR -1 inch thick
						1			**CONCRETE** - 8.5 inches thick, porous, no steel observed
								GP	**SANDY GRAVEL** - gray brown, moist, medium dense (FILL)
			LL = 27 PI = 10					CL	**SANDY CLAY WITH GRAVEL** - medium brown, moist, medium stiff
112	17.0							CL	**SANDY CLAY** - medium brown, moist, medium stiff to stiff
			EI = 26			2			
115	15.8								
									BOTTOM OF BORING C-1 @ 2.1 FEET No Free Water Encountered
						3			

* Field blow counts (not-converted).
**

SURFACE ELEVATION: **
TOTAL DEPTH: **2.1 feet**
GROUND WATER DEPTH: ▽ **feet at time of drilling**
▼ **feet**

LOGGED BY: **S. Carroll**
EQUIPMENT: **4" core barrel**
DIAMETER of BORING: **4**
DATE DRILLED: **8-29-07**

KLEINFELDER

PROJECT NUMBER **86393** DATE **Oct 2007**

LOG OF EXPLORATION
BORING C-1

Northgate Mall Improvements
Proposed Restaurants
San Rafael, California

PLATE
A-5
1 of 1

LABORATORY				FIELD					
Dry Density (pcf)	Moisture Content (%)	Shear Strength (ksf)	Other Tests	Blows/foot *	Sample	Depth (feet)	Lithology Symbol	U.S.C.S. Designation	SOIL DESCRIPTION
									CONCRETE - 5.5 to 6 inches thick, no steel observed, visqueen at base of concrete
								SP	**SAND** - 3 inches thick with visqueen at base of sand, gray brown, moist, loose, fine grained (FILL)
111	13.5								**SANDY CLAY** - medium brown, moist, soft to medium stiff (FILL)
123	12.2								
						1			
			LL = 25 PI = 10					CL	
110	12.0								
									BOTTOM OF BORING C-2 @ 1.8 FEET No Free Water Encountered
						2			
						3			

* Field blow counts (not-converted).
**

SURFACE ELEVATION: **
TOTAL DEPTH: **1.8 feet**
GROUND WATER DEPTH: ∇ **feet at time of drilling**
∓ **feet**

LOGGED BY: **S. Carroll**
EQUIPMENT: **4" core barrel**
DIAMETER of BORING: **4**
DATE DRILLED: **8-29-07**

KLEINFELDER

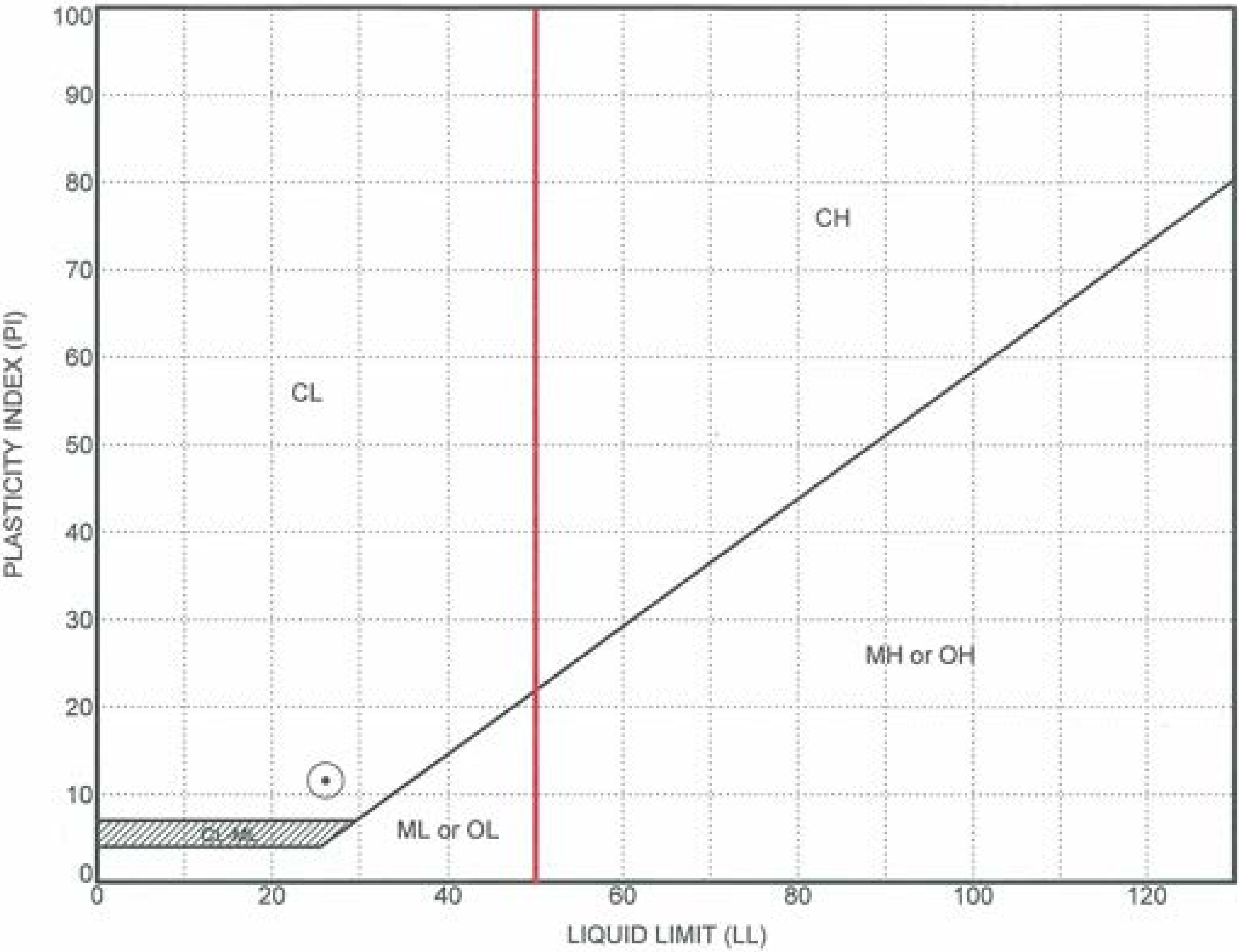
PROJECT NUMBER **86393** DATE **Oct 2007**

LOG OF EXPLORATION BORING C-2

Northgate Mall Improvements
Proposed Restaurants
San Rafael, California

PLATE **A-6**

1 of 1



SAMPLE SOURCE	CLASSIFICATION	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	% PASSING #200 SIEVE
⊙ K-2 @ 2.0'	Sandy Clay (CL)	26	15	12	

KLEINFELDER

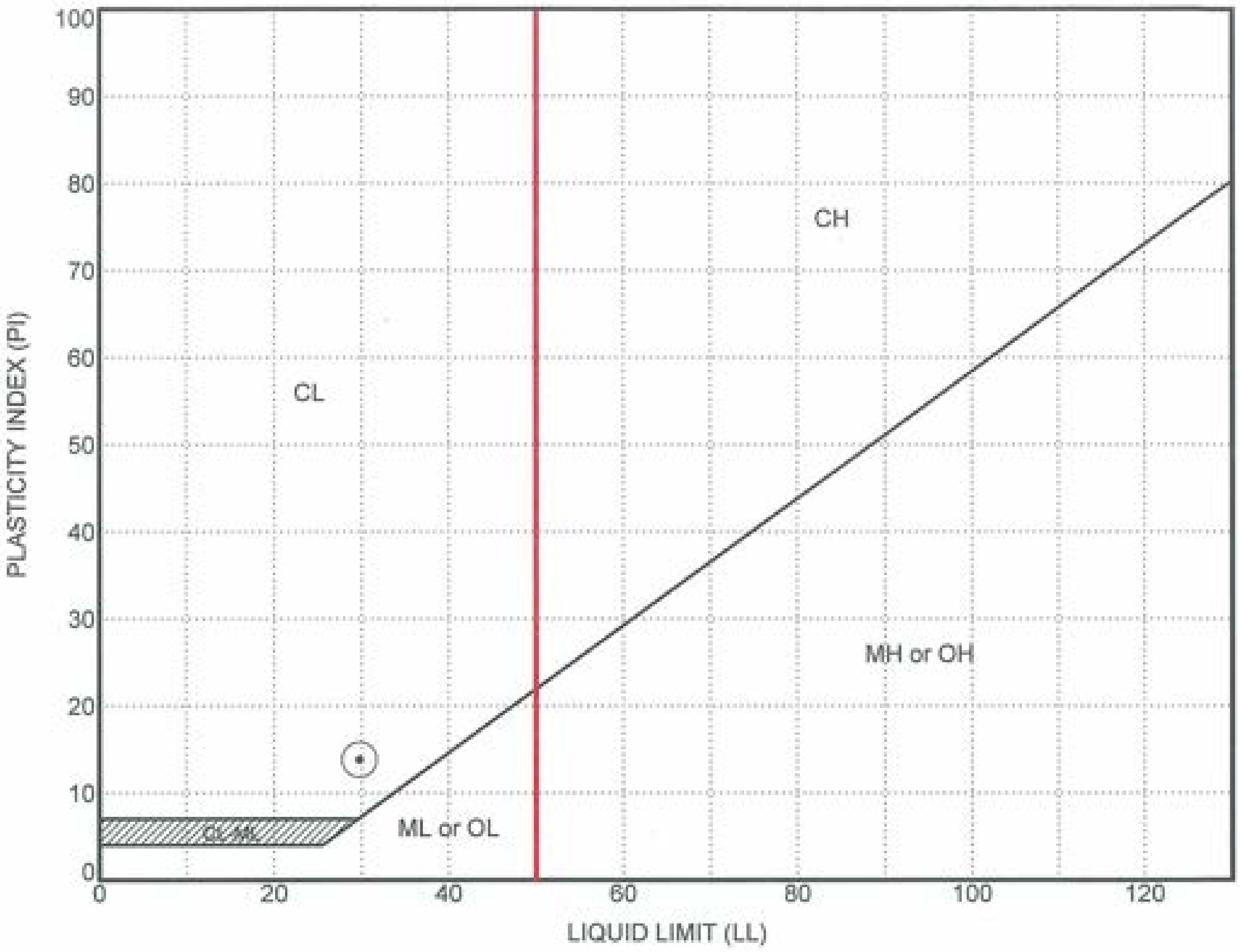
PROJECT NUMBER **86393** DATE **Oct 2007**

PLASTICITY CHART

Northgate Mall Improvements
Access Roads
San Rafael, California

PLATE

B-1



SAMPLE SOURCE	CLASSIFICATION	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	% PASSING #200 SIEVE
⊙ K-6 @ 3.0'	Clayey Sand (SC)	30	16	14	

KLEINFELDER

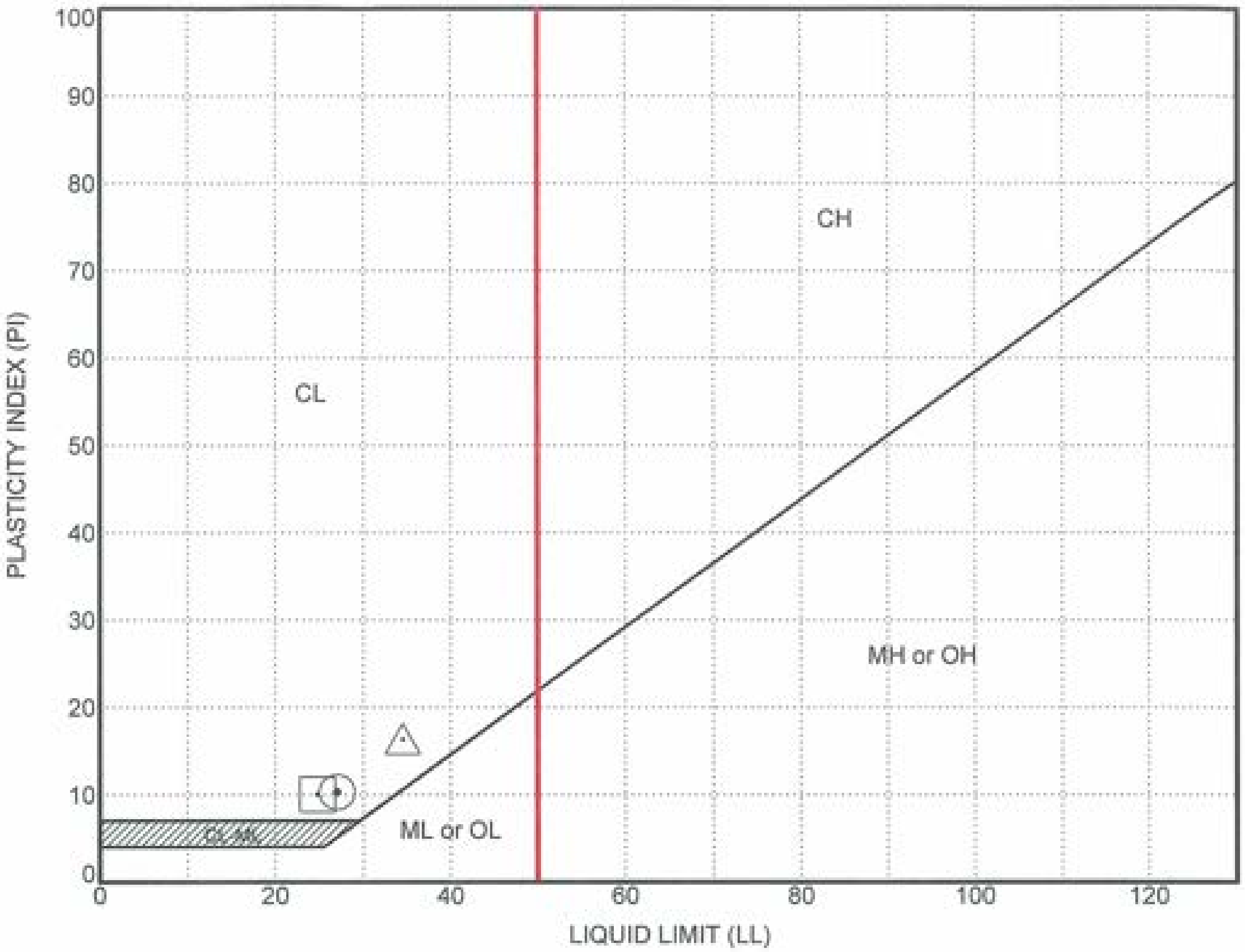
PROJECT NUMBER 86393 DATE Oct 2007

PLASTICITY CHART

Northgate Mall Improvements
Proposed Rite Aid Building
San Rafael, California

PLATE

B-2



SAMPLE SOURCE	CLASSIFICATION	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	% PASSING #200 SIEVE
⊙ C-1 @ 1.6'	Sandy Clay (CL)	27	17	10	
⊡ C-2 @ 1.3'	Sandy Clay (CL)	25	15	10	
△ K-11 @ 1.0'	Siltstone	34	18	16	

KLEINFELDER

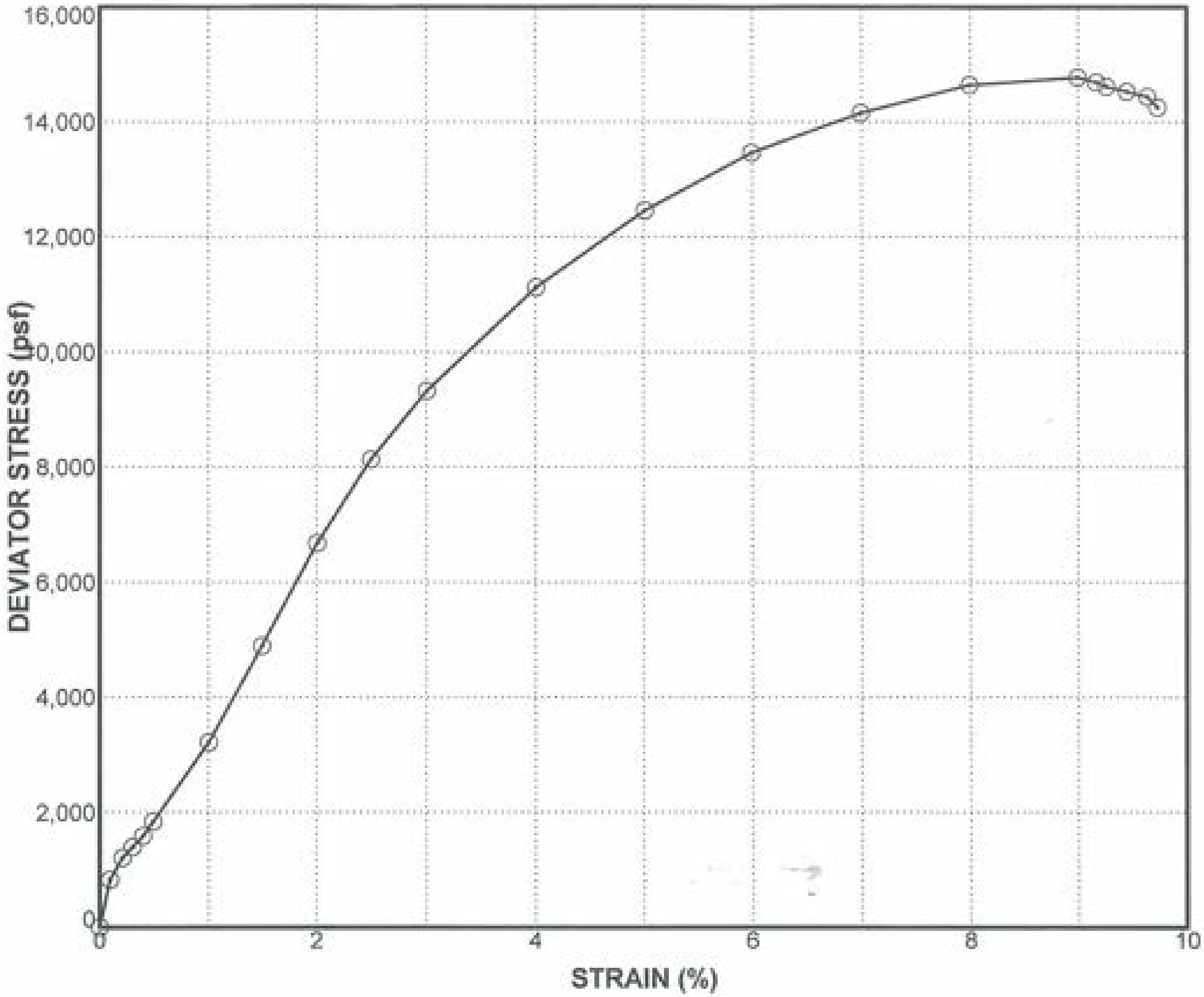
PLASTICITY CHART

Northgate Mall Improvements
Proposed Restaurants
San Rafael, California

PLATE

B-2

PROJECT NUMBER **86393** DATE **Oct 2007**



Sample Source	Classification	Type of Test	Confinement Pressure (psf)	Shear Strength (psf)	Strain (%)	Dry Density (pcf)	Moisture Content (%)
⊙ K-10 @ 4.0'	Sandy Clay (CL)	TXUU	576	7387	9	116	17.0

UC = Unconfined Compression

TX/UU = Unconsolidated Undrained Triaxial

KLEINFELDER

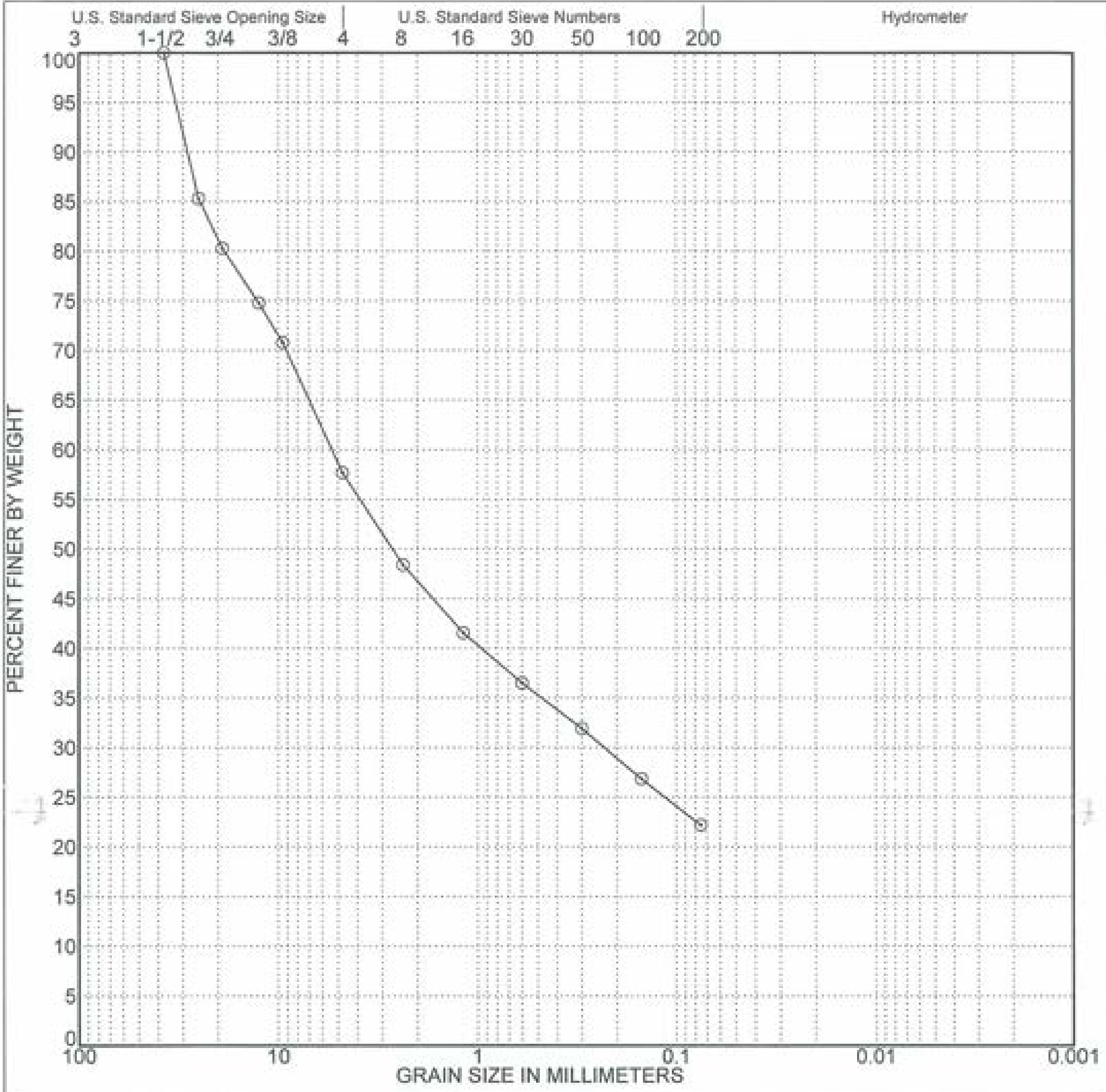
PROJECT NUMBER 86393 DATE Oct 2007

STRENGTH TEST DATA

Northgate Mall Improvements
Proposed Restaurants
San Rafael, California

PLATE

B-1



Cobbles	GRAVEL		SAND			SILT	CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE		

SYMBOL	SAMPLE SOURCE	CLASSIFICATION
⊙	K-6 @ 2.5'	CLAYEY GRAVEL with SAND (GC)

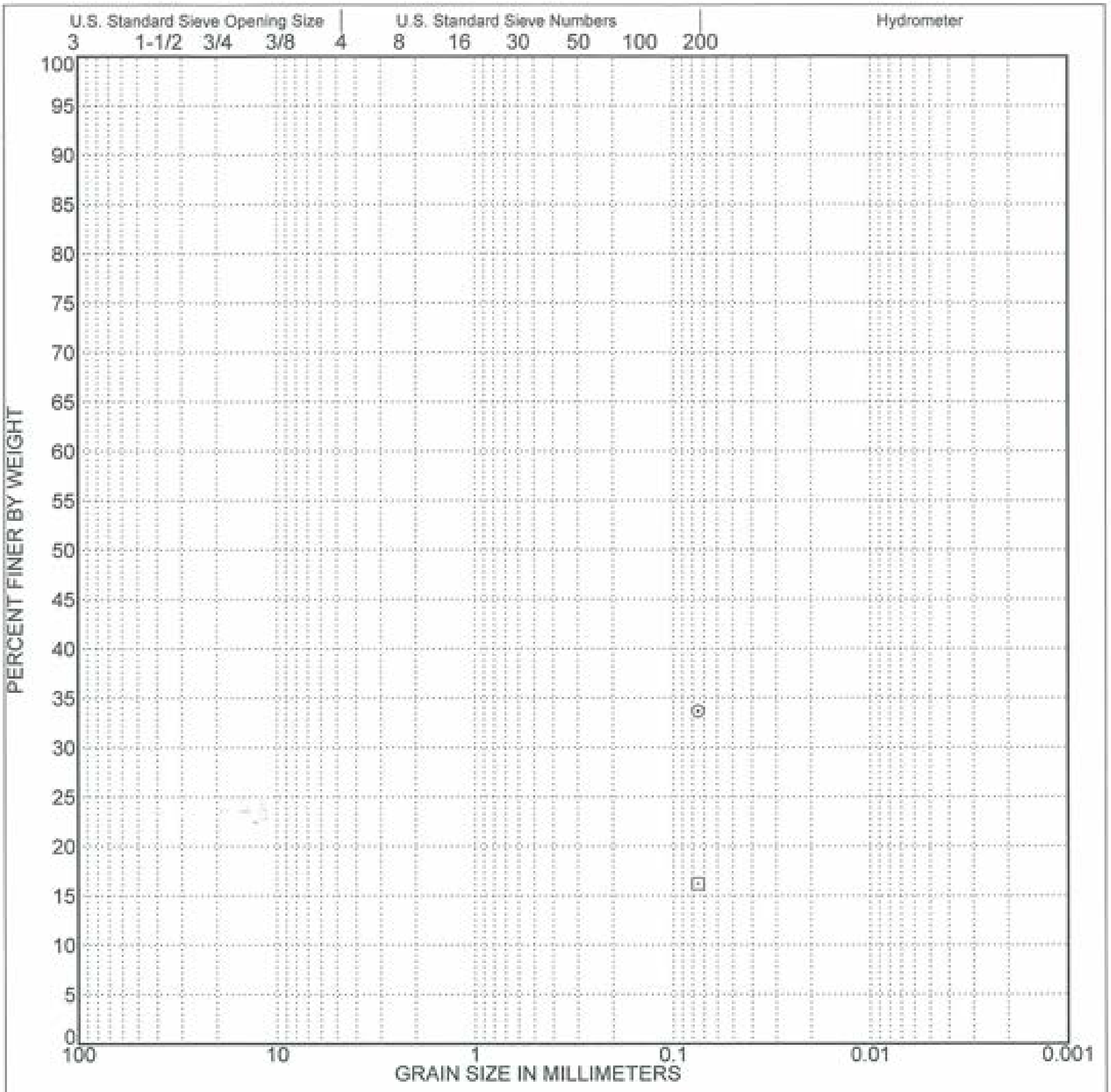
KLEINFELDER

PROJECT NUMBER 86393 DATE Oct 2007

PARTICLE SIZE ANALYSIS

Northgate Mall Improvements
Proposed Rite Aid Building
San Rafael, California

PLATE
B-1



Cobbles	GRAVEL		SAND			SILT	CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE		

SYMBOL	SAMPLE SOURCE	CLASSIFICATION
⊙	K3-2&K3-1 combined @ 1.0' - 2.0'	Clayey Gravel with Sand
⊡	K-7 @ 1.5'	Clayey Gravel with Sand

KLEINFELDER

PARTICLE SIZE ANALYSIS

Northgate Mall Improvements
Access Roads
San Rafael, California

PLATE **B-2**

PROJECT NUMBER **86393** DATE **Oct 2007**

KLEINFELDER
LABORATORY TESTING SERVICES

Project Name: Northgate Mall
Project Number: 86393
Report Date: 9/14/07
Sample ID: C1 @ 2.0'
Material Description: Sandy Clay

Expansion Index Test (UBC 18-2)

Expansion Index:	26
Dry Density (PCF):	112.9
Initial Moisture Content (%)	8.1
Final Moisture Content (%)	22.7

Classification of expansive soil

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

Reviewed By

KLEINFELDER	EXPANSION INDEX Northgate Mall Proposed Rite Aid Building San Rafael, California	PLATE **B-3**
PROJECT NUMBER 86393 DATE October 2007		

KLEINFELDER
LABORATORY TESTING SERVICES

September 26,2007

Project:	Northgate Mall
Job No.:	86393
Sample:	K-1,2,3 Combined Bulk A
Description:	Sandy Clay with Gravel to Clayey Gravel with Sand

Testing Program

The testing program included R-Value determination. The testing was performed in accordance with ASTM D2844. The results are presented below.

Note:
Material extruded under mold during loading operation. R-value reported as "Less than 5"
ref: ASTM D2844, Section 6, Note 2.

R- Value <5

Reviewed By

KLEINFELDER	RESISTANCE VALUE Northgate Mall Improvements Access Road San Rafael, California	PLATE **B-3**
PROJECT NUMBER 86393 DATE October 2007		

ETS

Environmental Technical Services

975 Transport Way, Suite 2
Petaluma, CA 94954
(707) 778-9605/FAX 778-9612

-Soil, Water & Air Testing & Monitoring
-Analytical Labs
-Technical Support

Serving people and the environment so that both benefit.

COMPANY: Kleinfelder Associates, 2240 Northpoint Parkway, Santa Rosa, CA 95407
ATTN: Mark H. Stanley
JOB SITE: Northgate Mall, Santa rosa, California.
FILE #: 86393

DATE RECEIVED: 9/6/2007
DATE of COMPLETION: 9/13/2007
ANALYST(S): D. Salinas, S. Santos
SUPERVISOR: D. Jacobson
LAB DIRECTOR: G.S. Conrad PhD

LAB SAMPLE NUMBER	SAMPLE ID	DESCRIPTION of SOIL and/or SEDIMENT	SOIL pH -log[H+]	NOMINAL RESISTIVITY ohm-cm	ELECTRICAL CONDUCTIVITY µmhos/cm	SULFATE SO4 ppm	CHLORIDE Cl ppm
02766-1	NM1/SR	KL1-1	**8.15**	**2,630**	**[380]**	**42**	**86**
Method	Detection	Limits --->	---	1	0.1	1	1

LAB SAMPLE NUMBER	SAMPLE ID	DESCRIPTION of SOIL and/or SEDIMENT	SALINITY ECe mmhos/cm	SOLUBLE SULFIDES (S=) ppm	SOLUBLE CYANIDES (CN=) ppm	REDOX mV	PERCENT MOISTURE %
02766-1	NM1/SR	KL1-1				**+298.6**	
Method	Detection	Limits --->	---	0.1	0.1	1	0.1

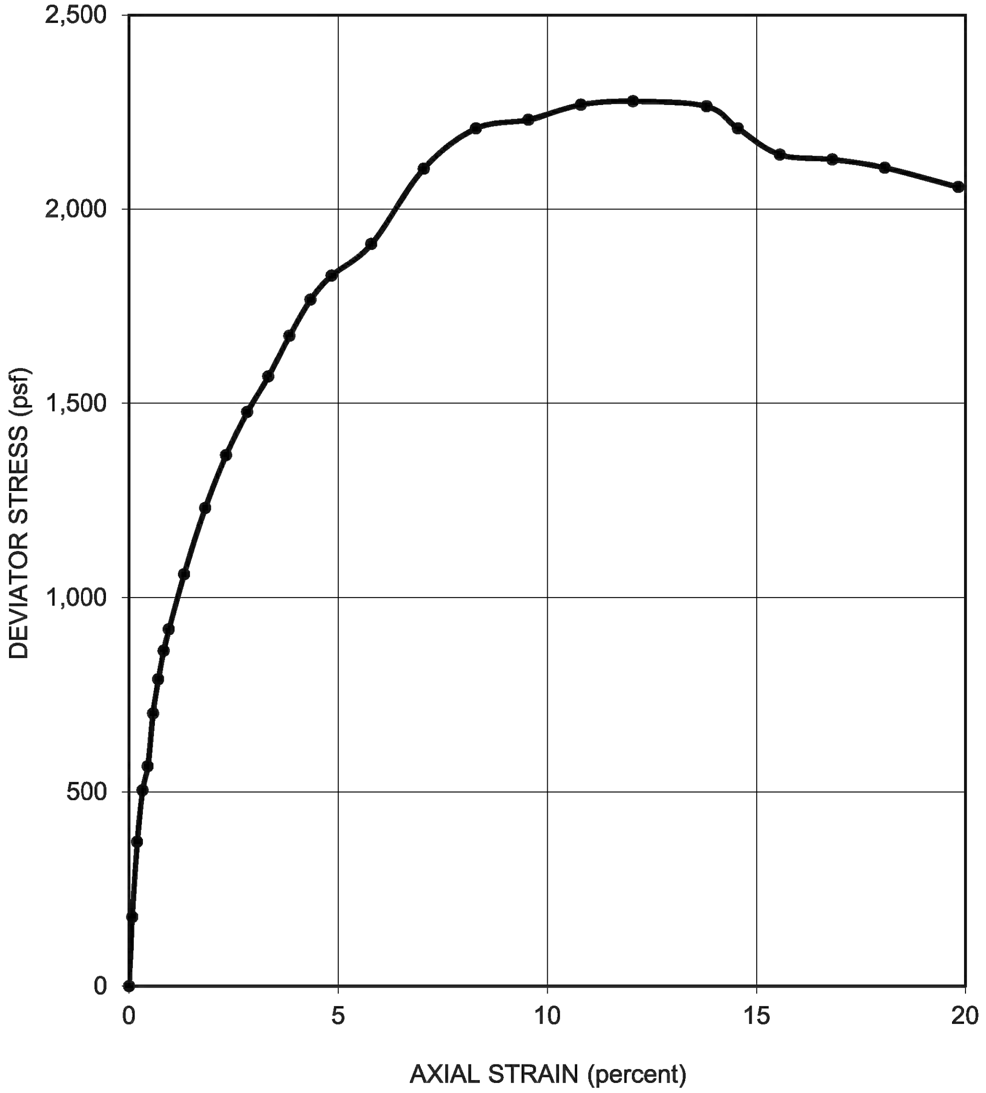
COMMENTS

Resistivity is over 2,000 ohm-cm but is mediocre, and soil reaction (i.e., pH) is moderately alkaline which does help; both sulfate and chloride are low; and redox is mild. The CalTrans times to perforation for this soil are as follows: for 18 ga steel the time to perforation is 37 yrs, and for 12 ga it goes up to over 81 yrs. The <u>average</u> pitting rate determination for steel in this soil is 0.07 mm/yr, thus pitting to a depth of 2 mm would be ≈28.5 yrs, and to a 4 mm depth it would be ≈57 yrs. Chlorides are so low that there should be no significant corrosion impact on concrete steel reinforcement; and sulfates are also low thus no measureable adverse impact should occur to concrete, mortar, grout or cement. The redox value is mild enough that no significant added adverse impact on construction materials should be expected. As concerns buried metals, this soil would not benefit at all from alkaline treatment since it pH is already alkaline enough. To increase metals longevity any more in this soil would require further upgrading (i.e., heavier gauge or more resistant steel); and/or other actions could be taken (e.g. special engineering fill, special coatings, cathodic protection, plastic pipe, etc.). Last, standard concrete mixes and related materials should be fine in this soil based on these results.

\\\NOTES: Methods are from following sources: extractions by Cal Trans protocols as per Cal Test 417 (SO4), 422 (Cl), and 532/643 (pH & resistivity); &/or by ASTM Vol. 4.08 & ASTM Vol. 11.01 (=EPA Methods of Chemical Analysis, or Standard Methods); pH - ASTM G 51; Spec. Cond. - ASTM D 1125; resistivity - ASTM G 57; redox - Pt probe/ISE; sulfate - extraction Title 22, detection ASTM D 516 (=EPA 375.4); chloride - extraction Title 22, detection ASTM D 512 (=EPA 325.3); sulfides - extraction by Title 22, and detection EPA 376.2 (= SMEWW 4500-S D); cyanides - extraction by Title 22, and detection by ASTM D 4374 (=EPA 335.2).

APPENDIX C

LABORATORY TEST RESULTS



SAMPLER TYPE: Sprague & Henwood		SHEAR STRENGTH:	1,140 psf
DIAMETER (in.): 2.38	HEIGHT (in.): 4.79	STRAIN AT FAILURE:	12.1 %
MOISTURE CONTENT: 15.9 %		CONFINING PRESSURE:	750 psf
DRY DENSITY: 117 pcf		STRAIN RATE:	0.75 % / min
DESCRIPTION: SANDY CLAY (CL), gray-brown		SOURCE:	R3-1 at 6 feet

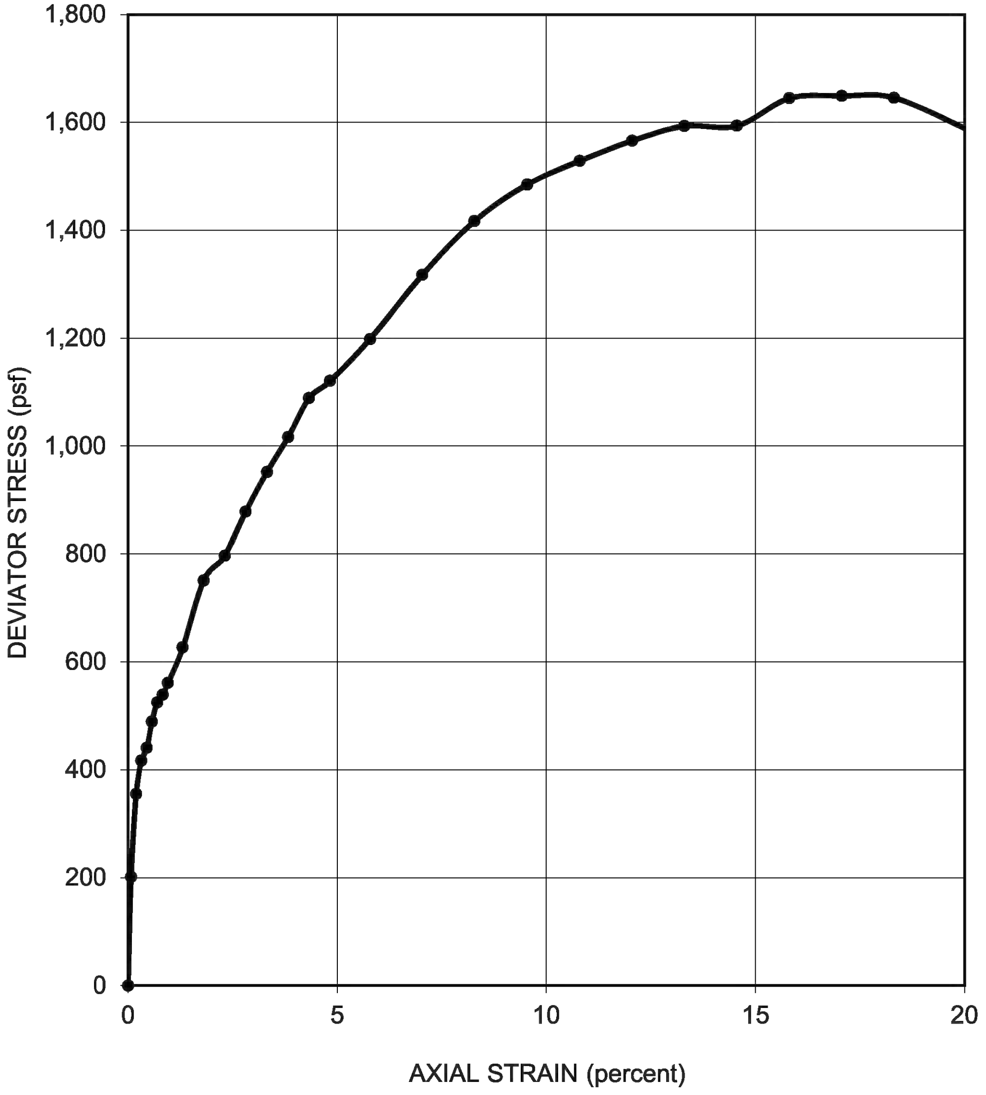
LANGAN
Langan Engineering and Environmental Services, Inc.
135 Main Street, Suite 1500
San Francisco, CA 94105
T: 415.955.5200 F: 415.955.5201 www.langan.com

Project
NORTHGATE TOWN SQUARE
SAN RAFAEL
MARIN COUNTY CALIFORNIA

Figure Title
UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST

Project No. 731759601
Date 11/11/2021
Drawn By AG
Checked By HS

Figure C-1



SAMPLER TYPE: Sprague & Henwood			SHEAR STRENGTH:	820	psf
DIAMETER (in.): 2.38	HEIGHT (in.): 6		STRAIN AT FAILURE:	17.1	%
MOISTURE CONTENT:	19.5	%	CONFINING PRESSURE:	2,800	psf
DRY DENSITY:	111	pcf	STRAIN RATE:	0.75	% / min
DESCRIPTION: SANDY CLAY (CL), yellow-brown with brown and orange mottling				SOURCE:	R5-4 at 26 feet

LANGAN
Langan Engineering and
Environmental Services, Inc.
135 Main Street, Suite 1500
San Francisco, CA 94105

T: 415.955.5200 F: 415.955.5201 www.langan.com

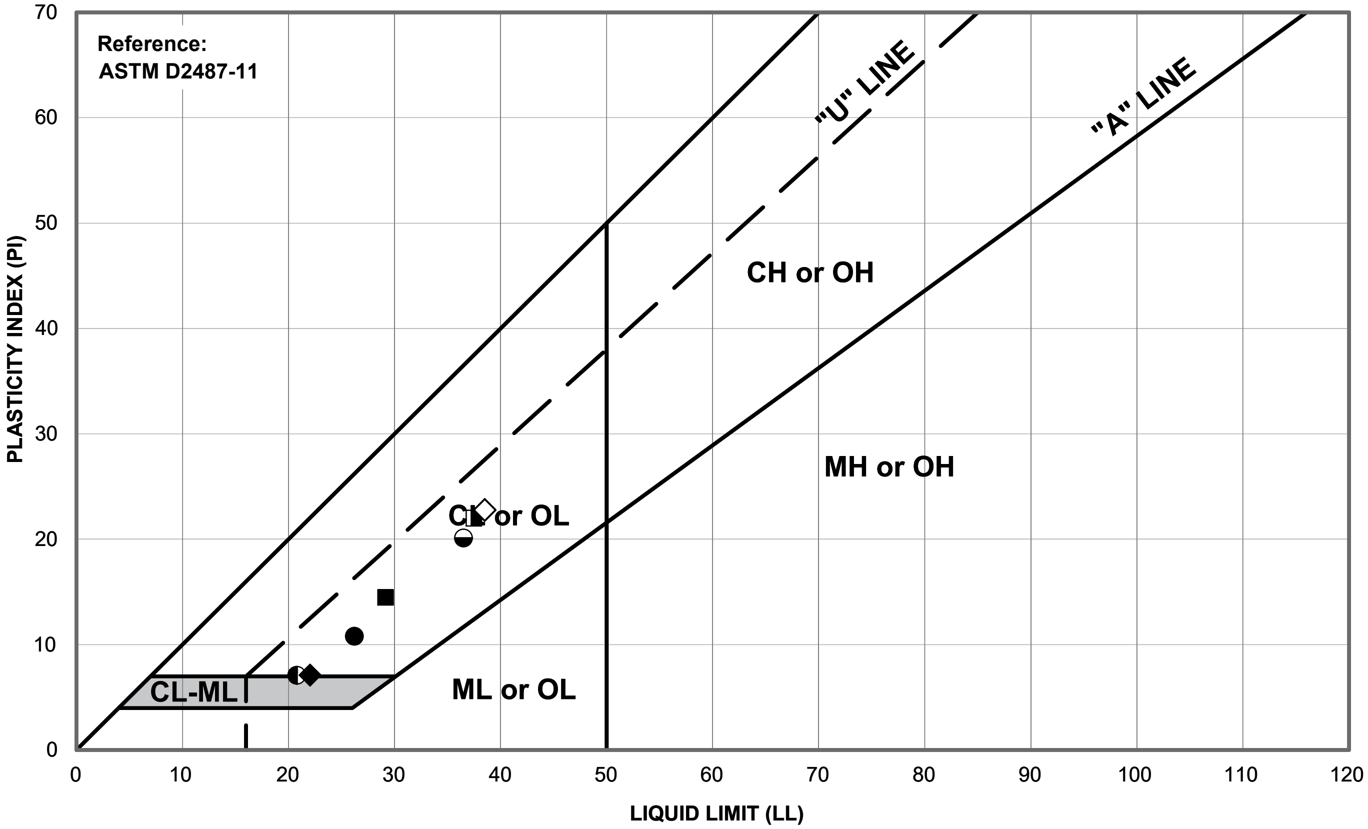
Project
NORTHGATE
TOWN SQUARE
SAN RAFAEL
MARIN COUNTY **CALIFORNIA**

Figure Title
UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST

Project No. 731759601
Date 11/11/2021
Drawn By AG
Checked By HS

Figure
C-2

PLASTICITY CHART



Symbol	Source	Description and Classification	Natural M.C. (%)	Liquid Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
●	C-1 at 2.5 feet	SANDY CLAY (CL), yellow-brown to brown	--	26	11	--
■	P-1 at 2.5 feet	CLAYEY SAND (SC), gray	--	29	15	--
◨	R4-3 at 16 feet	CLAYEY SAND with Gravel (SC), gray	10.9	37	22	38.6
◒	R4-3 at 20.5 feet	CLAYEY SAND with Gravel (SC), gray-brown	12.8	36	20	45.9
◐	R4-5 at 21 feet	SANDY SILTY CLAY (CL-ML), dark brown	16.5	21	7	59.8
◆	R5-5 at 25 feet	CLAYEY SILTY SAND (SC-SM), brown	16.2	22	7	28.6
◇	R6-2 at 2.5 feet	CLAY WITH SAND (CL), light gray with orange mottling	--	38	23	--

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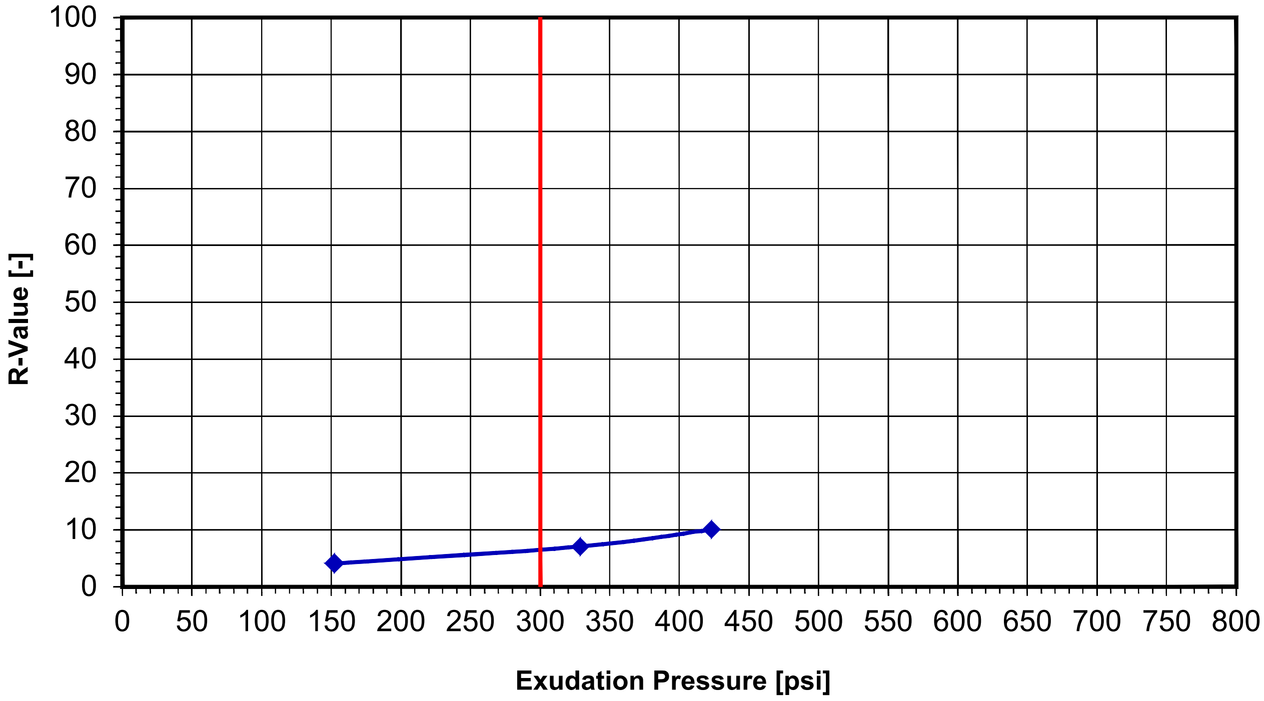
SAN RAFAEL
MARIN COUNTY CALIFORNIA

Figure Title
PLASTICITY
CHART

Project No.
731759601
Date
11/11/2021
Drawn By
AG
Checked By
HS

Figure
C-3



R-Value   300 psi exudation pressure

Sample ID	A	B	C	D
Water Content (%)	16.2	14.9	13.6	--
Dry Density (pcf)	114.5	118.6	121.0	--
Exudation Pressure (psi)	152	329	423	--
Expansion Pressure (psf)	0.0	0.0	0.0	--
Resistance Value (R)	4.0	7.0	10	--

Sample Source	Sample Description	Sand Equivalent	Expansion Pressure	R-Value
R4-1 and P-2 Composite at 1 to 5 feet	SANDY CLAY (CL), yellow-brown to olive-gray	--	--	7

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Figure Title
RESISTANCE VALUE
TEST REPORT

Project No. 731759601
Date 11/11/2021
Drawn By AG
Checked By HS

Figure
C-4

APPENDIX D

CORROSIVITY ANALYSIS WITH BRIEF EVALUATION

CERCO
analytical
1100 Willow Pass Court, Suite A
Concord, CA 94520-1006
925 **462 2771** Fax. 925 **462 2775**
www.cercoanalytical.com

Client: Langan
Client's Project No.: 731759601/700/030.0
Client's Project Name: Northgate Mall Redevelopment
Date Sampled: 11/1 & 2/21
Date Received: 11/09/21
Matrix: Soil
Authorization: Chain of Custody

Date of Report: 22-Nov-2021

Job/Sample No.	Sample I.D.	Redox (mV)	pH	Conductivity (umhos/cm)*	Resistivity (100% Saturation) (ohms-cm)	Sulfide (mg/kg)*	Chloride (mg/kg)*	Sulfate (mg/kg)*
2111013-001	R2-4, 2.5'	330	6.91	-	3,000	-	39	65
2111013-002	P-5, 2.5'	360	7.94	-	1,100	-	N.D.	210

Method:	ASTM D1498	ASTM D4972	ASTM D1125M	ASTM G57	ASTM D4658M	ASTM D4327	ASTM D4327
Reporting Limit:	-	-	10	-	50	15	15
Date Analyzed:	16-Nov-2021	16-Nov-2021	-	19-Nov-2021	-	16-Nov-2021	16-Nov-2021

* Results Reported on "As Received" Basis

N.D. - None Detected

Cy Shaun Moore

Cheryl McMillen
Laboratory Director

Quality Control Summary - **All laboratory quality control parameters were found to be within established limits**

CERCO
analytical
1100 Willow Pass Court, Suite A
Concord, CA 94520-1006
925 **462 2771** Fax. 925 **462 2775**
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22 November, 2021

Job No. 2111013
Cust. No. 12242

Mr. Herman Sok
Langan
1 Almaden Blvd., Suite 590
San Jose, CA 95113

Subject: Project No.: 731759601.700.030.0
Project Name: Northgate Mall Redevelopment
Corrosivity Analysis – ASTM Test Methods

Dear Mr. Sok:

Pursuant to your request, CERCO Analytical has analyzed the soil samples submitted on November 9, 2021. Based on the analytical results, a brief evaluation is enclosed for your consideration.

Based upon the resistivity measurements, Sample 002 is classified as "corrosive" and Sample 001 is "moderately corrosive". All buried iron, steel, cast iron, ductile iron, galvanized steel and dielectric coated steel or iron should be properly protected against corrosion depending upon the critical nature of the structure. All buried metallic pressure piping such as ductile iron firewater pipelines should be protected against corrosion.

The chloride ion concentrations are none detected and 39 mg/kg and they are determined to be insufficient to attack steel embedded in a concrete mortar coating.

The sulfate ion concentrations are 65 and 210 mg/kg and are determined to be sufficient to potentially be detrimental to reinforced concrete structures and cement mortar-coated steel at these locations. Therefore, concrete that comes into contact with this soil should use sulfate resistant cement such as Type II, with a maximum water-to-cement ratio of 0.55.

The pH of the soils are 6.91 and 7.94, which does not present corrosion problems for buried iron, steel, mortar-coated steel and reinforced concrete structures.

The redox potentials are 330 and 360-mV and are indicative of potentially "slightly corrosive" soils resulting from anaerobic soil conditions.

This corrosivity evaluation is based on general corrosion engineering standards and is non-specific in nature. For specific long-term corrosion control design recommendations or consultation, please call *JDH Corrosion Consultants, Inc. at (925) 927-6630.*

We appreciate the opportunity of working with you on this project. If you have any questions, or if you require further information, please do not hesitate to contact us.

Very truly yours,
CERCO ANALYTICAL, INC.

Andrew Moore
for J. Darby Howard, Jr., P.E.
President

JDH/jdl
Enclosure

Chain of Custody 2111013

Page 1 of 1

Concord, CA 94520-1006
925 462 2771
Fax: 925 462 2775

CERCO analytical

Job No.	CU#		Client Project I.D.
731759601/700/030.0			Northgate Mall Redevelopment

Schedule

Analyte

Date Sampled	Date Due
11/1-2/2021	Standard

Full Name 12242

Herman Sok, hsok@langan.com

Phone 408-283-3629 X

Fax

Cell ☒

Company and/or Mailing Address

Langan, 1 South Almaden Blvd, #590, San Jose, CA 95113

Sample Source

Hollow stem auger boring

ANALYSIS **ASTM**

Lab No.	Sample I.D.	Date	Time	Matrix	Contain.	Size	Preserv.	Qty.	Redox Potential	pH	Sulfate	Chloride	Resistivity-100% Saturated			Brief Evaluation
1	R2-4, 2.5'	11/1/21	11:00a	Soil	Bag			1	x	x	x	x	x			x
2	P-5, 2.5'	11/2/21	3:00p	Soil	Bag			1	X	X	X	X	X			X

MATRIX
- DW - Drinking Water
- GW - Ground Water
- SW - Surface Water
- WW - Waste Water
- Water
- SL - Sludge
- S - Soil
- Product

ABBREVIATIONS
- HB - Hosebib
- PV - Petcock Valve
- PT - Pressure Tank
- PH - Pump House
- RR - Restroom
- GL - Glass
- PL - Plastic
- ST - Sterile

SAMPLE RECEIPT

Total No. of Containers

Rec'd Good Cond/Cold

Conforms to Record

Temp. a t Lab -°C

Sampler

Relinquished By:		Date	2021-11-05	Time	2PM
Received By:		Date	11/9/21	Time	1130
Relinquished By:		Date		Time	
Received By:		Date		Time	
Relinquished By:		Date		Time	
Received By:		Date		Time	

Comments:

THERE IS AN ADDITIONAL CHARGE FOR EXTRUDING SOIL FROM METAL TUBES

Email Address hsok@langan.com

DISTRIBUTION

Electronic copy:	Andy Neff – Merlon Geier aneff@merlonegeier.com

QUALITY CONTROL REVIEWER

Ramin Golesorkhi, PhD, GE
Principal/Vice President