MPEG
MILLER PACIFIC
ENGINEERING GROUP

August 3, 2018
File: 2739.001ltr.doc

Parisi CSW Design Group
1936 University Avenue Ste. 250
Berkeley, CA 94704

Attn: Mr. Al Cornwell

Re: Geotechnical Investigation
MLK Park and Field
Sausalito, California

Introduction

We are pleased to present the results of our geotechnical investigation for the planned field improvements at MLK Park in Sausalito, California. The project site is located west of the intersection of Bridgeway and Colma Street in downtown Sausalito. A Site Location Map is shown on Figure 1. We are providing our services in accordance with agreement dated April 30, 2018. The purpose of our services is to explore soil and groundwater conditions and to provide geotechnical recommendations and criteria for use in the design and construction of the project. The scope of our geotechnical investigation includes:

- Review of readily available geotechnical and geologic reference materials, including geotechnical reports and other data in vicinity.
- Coordinate with Underground Service Alert (USA) to mark underground utilities in areas where we plan to conduct subsurface exploration.
- Subsurface exploration with a truck or track drill rig to determine the quality of the existing fill material and extent and depth of the underlying Bay Mud. We anticipate one day of drilling (roughly 4 borings to depths of about 10 to 30 feet below ground surface) to log geologic conditions and obtain soil samples.
- Laboratory testing to characterize subsurface soils and aid in our geotechnical evaluation. We anticipate laboratory testing would include basic index and strength testing.
- Evaluation of relevant geologic hazards and mitigation measures, including seismic shaking, settlement and other hazards.
- Preparation of a geotechnical Investigation report which summarizes our subsurface exploration and laboratory testing programs, evaluation of relevant geologic hazards, and geotechnical recommendations and design criteria for the project.

This letter completes our Phase 1 services. Supplemental services are anticipated to include geotechnical consultation during design, and geotechnical consultation, inspection, and testing during construction.

Project Description

We understand the planned improvements generally consist of a new natural grass soccer field and reconstruction of the existing softball field. A new pedestrian path is planned around the park with a new, adjacent grass lined drainage swale for improved surface water collection and drainage. We understand the field may occasionally be used for vehicular parking.

The project will likely include stripping of the existing grass/top soil, and re-grading involving cuts and fills less than a couple feet thick. We understand re-use of existing soils is desired. An existing cinder over aggregate baserock track will be removed.

Existing Conditions

The project site is currently developed with a natural grass softball field, dog park and running track with interior field area. There are several structures present on the west side of the park. These structures will remain and are not a part of the project scope. The existing site conditions are shown on the Site Plan, Figure 2.

Regional Geology

Marin County is located within the Coast Range Geomorphic Province of California. This area is characterized by northwest-southeast trending mountain ridges and intervening valleys that were formed from tectonic activity between the Pacific and North American Plates. Tectonic activity within the Coast Range Geomorphic Province is concentrated along the San Andreas Fault Zone.

The regional bedrock geology mostly consists of complexly folded, faulted, sheared, and altered sedimentary, igneous, and metamorphic rock of the Jurassic-Cretaceous age (65-190 million years ago) Franciscan Complex. The Franciscan is characterized by a diverse assemblage of greenstone, sandstone, shale, chert, and mélange, with lesser amounts of conglomerate, calc-silicate rock, schist and other metamorphic rocks.

As presented on Figure 3, regional geologic mapping[1] indicates that the site is underlain by a variety of materials. On the north-east side of the park, geology is mapped as artificial fill over Bay Mud. The fill is usually composed of varying amounts of gravel, sand, silt, clay, or garbage. The Bay Mud is very soft, highly compressible, highly plastic clay and silt with a high presence of organic material. The north-west portion of the site is mapped as Franciscan Melange, described above. The south-west side is mapped as shallow colluvial deposits over bedrock. Colluvium is primarily derived from the parent material and can include rock fragments from the nearby bedrock as well as gravel, sand, silt, and clay.

Subsurface Exploration and Laboratory Testing

We explored subsurface conditions with 8 borings within the park excavated with a small track drill rig on May 17, 2018. The approximate subsurface exploration locations are shown on the Site Plan, Figure 2. The soils encountered were logged and identified by our field geologist in general accordance with ASTM Standard D 2487, "Field Identification and Description of Soils

---

[1] Rice, Salem J. and Smith, Theodore C. (1976) “Geology of the Tiburon Peninsula, Sausalito, and Adjacent Areas in Marin County, California.” USGS, Scale 1:12,000.

(Visual-Manual Procedure)." This standard is briefly explained on the Soil Classification Chart, Figure A-1.

During our exploration, we collected select soil samples for laboratory testing. Laboratory testing included determination of moisture/density relations, unconfined compression, percentage of particles (fines) passing the No. 200 sieve, and sieve analysis of grain size.

The subsurface conditions encountered are described on the boring logs (Figures A-2 through A-13). The results of moisture content, dry density, unconfined strength, and percentage of particles (fines) passing the No. 200 sieve are presented on the boring logs. A sieve analysis is shown on Figure A-14. The subsurface exploration and laboratory testing programs are discussed in further detail in Appendix A.

Subsurface Conditions

During our field exploration, our geologist examined and logged the subsurface soil conditions. In general, our borings were consistent with the mapped geology. Fill over Bay Mud was encountered on the north east portion of the site. The fill material is about 10 feet thick composed mostly of medium dense, clayey gravel and sand. The underlying soft compressible Bay Mud varies in thickness from 0 to about 30 feet with increase thickness toward the north-east. West of the Bay Mud limits, subsurface conditions appear to be fill over colluvial soils.

The north-west edge of the existing track and the cut slope above encountered shallow Franciscan bedrock. Locations of our borings interpreted site geology and show approximate Bay Mud contours on the Site Plan, Figure 2.

Geologic Hazards Evaluation

The principal geologic hazards which could potentially affect the project site are strong seismic shaking, liquefaction, settlement, and expansive soils. Other commonly-considered geologic hazards, including fault surface rupture, erosion, flooding, and others are not considered significant regarding the proposed project. Potentially significant geologic hazards, their anticipated impacts, and recommended mitigation measures are discussed below.

Seismic Shaking

The site will likely experience seismic ground shaking from future earthquakes in the San Francisco Bay Area. Earthquakes along several active faults in the region, as shown on Figures 4 and 5, could cause moderate to strong ground shaking at the site.

Deterministic Seismic Hazard Analysis – Deterministic Seismic Hazard Analysis (DSHA) predicts the intensity of earthquake ground motions by analyzing the characteristics of nearby faults, distance to the faults and rupture zones, earthquake magnitudes, earthquake durations, and site-specific geologic conditions. Using the Caltrans ARS Online web application (2017), we have calculated the median peak ground acceleration for the various nearby active faults, as presented below in Table A. The acceleration values shown are for an earthquake originating on the closest portion of the fault to the site.

TABLE A
ESTIMATED DETERMINISTIC PEAK GROUND ACCELERATION
Parisi CSW– MLK Field
Sausalito, California

Fault	Moment Magnitude for Characteristic Earthquake(1)	Closest Estimated Distance(1)	Median Peak Ground Acceleration(1)
San Andreas	8.0	10 km	0.31 g
San Gregorio	7.4	13 km	0.25 g
Hayward	7.3	17 km	0.21 g
Rodgers Creek	7.3	34 km	0.14 g
Calaveras	6.9	40 km	0.10 g

(1) California Department of Transportation (Caltrans) (2017), "Caltrans ARS Online", http://dap3.dot.ca.gov/ARS_Online/, accessed August 8, 2018.
(2) Values calculated using Vs_{30} = 182.88 m/s for Site Class "E" per 2016 CBC.

Evaluation: *Less than significant with mitigation.*
Mitigation: *Minimum mitigation measures should include designing the structures and foundations in accordance with the most recent version of the California Building Code (2016). Recommended seismic design coefficients are presented in the Conclusions and Recommendations section of this report.*

Liquefaction and Seismic Densification

Liquefaction refers to the sudden, temporary loss of soil shear strength in saturated, loose, granular deposits during strong ground shaking. Liquefaction-related phenomena include liquefaction-induced settlement, flow failure, and lateral spreading. Seismic densification of loose sand and gravels can occur above the ground water level.

Recent advances in liquefaction studies indicate that liquefaction can occur in granular materials with a high, 35 to 50%, fines content (silt particles that pass the #200 sieve), provided the fines exhibit a plasticity less than 7. The site is mapped within the liquefaction susceptibility zone by the Association of Bay Area Governments (ABAG) as having high susceptibility to liquefaction. Based on the subsurface exploration, the potential for damaging settlements at the ground surface is low, since the Bay Mud is not susceptible to liquefaction and the fill was found to be moderately dense. We estimate seismic induced settlement would be less than a few inches.

Evaluation: *Less than significant with mitigation.*
Mitigation: *Mitigation to prevent liquefaction induced settlements within the field area are not practical. If they were to occur, mitigation measures could include minor grading to re-establish grades and slopes.*

Expansive Soil

Expansive soils will shrink and swell with fluctuations in moisture content and can exert significant expansion pressures on building foundations, interior floor slabs and exterior flatwork. Distress from expansive soil movement can include cracking of brittle wall coverings (stucco, plaster, drywall, etc.), racked door and/or window frames, and uneven floors and cracked slabs. Flatwork, pavements, and concrete slabs-on-grade are particularly vulnerable to distress due to their low bearing pressures. Our exploration encountered highly expansive Bay Mud below the fill layer at approximately 10 feet below the ground surface. However, this expansive soil should not impact the project so long as a minimum of 30 inches of non-expansive soils remain on top of the Bay Mud. Based on our subsurface exploration and laboratory testing, the surficial soils consist of clayey gravel fill that has little to no potential for expansive behavior. Therefore, the risk of expansive soil affecting the proposed improvements is low.

Evaluation: *Less than significant with mitigation.*
Mitigation: *Since no structures are not planned, unlikely to be a significant hazard. If new structures are incorporated, the foundation and grading recommendations provided later in this report should be followed to help mitigate the effects expansive soil conditions. If less than 30 inches of the existing fill is present over the expansive Bay Mud, mitigation measures may include lime treatment or replacement with select fill.*

Site Settlement / Subsidence

Significant settlement can occur when new loads are placed at sites that are located over soft compressible clays, such as Bay Mud. The amount and rate of settlement is dependent on the magnitude of additional new loads (i.e. new structures and/or new fill), the thickness of compressible material, and the inherent compressibility properties of the Bay Mud. The majority of project site is underlain by a thick layer of highly compressible Bay Mud.

Differential settlements are also possible due to variations in the thickness or properties of compressible Bay Mud, variations in new long-term loads (fill thickness or foundation loads) and variations in historic use of the land, i.e. old channels or low points through the site that may have required thicker fills, or previous “surcharges”, such as old structures or fill mounds. While no new structures are currently planned at this site, the grading plan does show up to several feet of new fill material.

Evaluation: *Less than significant with mitigation.*
Mitigation: *Settlement will occur if new fill is applied to the existing ground surface. Site grading and utilities need to be designed to account for anticipated settlements. Recommendations for settlement mitigation and foundation design are presented in the Discussion and Recommendations section of this report.*

Discussion and Recommendations

Based on our subsurface exploration and experience with similar projects, it is our opinion the construction of new soccer field, softball field, and path around the park is feasible from a geotechnical engineering standpoint. The primary geotechnical issues at the project site are the potential for soft, saturated subgrade conditions from active irrigation and long-term ground settlement from consolidation of the underlying Bay Mud.

Seismic Design

Minimum mitigation of seismic ground shaking includes design of new structures (if any) in conformance to the provisions of the most recent edition (2016) of the California Building Code. The magnitude and character of these ground motions will depend on the particular earthquake and the site response characteristics. Based on the interpreted subsurface conditions and proximity of the San Andreas and San Gregorio Faults, we recommend the CBC coefficients and site values shown in Table B below to calculate the design base shear of the new construction. To determine site seismic coefficients, we used the USGS Seismic Design Maps web application and the latitude and longitude coordinates shown on Figure 4.

TABLE B
2016 CBC SEISMIC DESIGN FACTORS
Parisi CSW – MLK Field
Sausalito, California

Factor Name	Coefficient	CBC Table/ Figure	Site Specific Value[(1)]
Site Class[(2)]	$S_{A,B,C,D,E,\text{ or } F}$	1613.5.2	S_E
Spectral Acc. (short)	S_s	1613.5(3)	1.865 g
Spectral Acc. (1-sec)	S_1	1613.5(4)	0.749 g
Site Coefficient	F_a	1613.5.3(1)	1.0
Site Coefficient	F_v	1613.5.3(2)	1.5

1) Values determined in accordance with the 2010 ASCE-7 standard.
2) Soil Profile Type S_E Description: Soft Soil, Shear Wave Velocity less than 600 feet per second, Standard Penetration blow counts less than 15, and undrained shear strength less than 1,000 psf.

The effects of earthquake shaking (i.e., protection of life safety) can be mitigated by close adherence to the seismic provisions of the current edition of the CBC. However, some structural damage may still occur during strong ground shaking.

Site Preparation and Grading

The existing track and field slope gently to the east and are founded on approximately 10 feet of moderately dense, gravelly fill. We do not anticipate that excavation into underlying Bay Mud will be required for the new field. The new work should all be contained within the upper couple feet of fill soils. Site grading should conform with the following.

1. **Surface Preparation** – Clear all sod, topsoil, oversize debris, and organic matter from the site. Any landscaping vegetation scraped from the project area should be stockpiled for reuse in landscaping or removed from the site. Based on the field boring the approximate depth of stripping to remove sod/topsoil is 6 inches about below existing grade. Any construction debris or abandoned utilities encountered during site grading should be removed from the site.

2. **Subgrade** – The existing clayey gravel and sand fill will provide a need to be regraded to achieve the planned slopes, properly moisture-conditioned and uniformly compacted to at least 90 percent relative compaction[2]. In areas where new asphalt-concrete paths will be installed, the upper 6-inches should be moisture conditioned to within 2 percent of the optimum moisture content and compacted to at least 95 percent relative compaction.

3. **Fill** – The existing clayey gravel and sand fill is suitable for re-use on-site as general fill. Current plans indicate a moderate amount of fill will be imported to the site.

   If imported fill is required, the material shall consist of soil and rock mixtures that: (1) are free of organic material, (2) have a Liquid Limit less than 30 and a Plasticity Index less than 15, (3) have a maximum particle size of 4-inches, and (4) has less than 30% passing the No. 200 sieve. We should test any imported fill material to determine its suitability for use as fill material. Anticipate the upper 6 inches of fill will need to be a special blend better suited for growing grass.

   Fill should be moisture conditioned with 3% of the optimum moisture content, spread in lifts less than 8 inches thick and compaction to at least 90% relative compaction.

   Considering the fields may be occasionally used as vehicle parking, imported fill should be predominately sand and/or gravel as specified below to provide a higher bearing capacity and less rutting from tire loads. There are geosynthetic reinforcement products, such as Grasspave, that can be placed within the fill and below sod layer that can significant increase the capacity of the grass field for vehicle loads.

Settlement / Subsidence

As discussed in the Geologic Hazards section, settlement can occur when new loads are placed at sites that are located over soft compressible clays, such as Bay Mud. The western portion appears to be founded predominantly on bedrock from an old cut, however, Bay Mud was encountered throughout the remainder of the site. Anticipated long term settlement from placement of new fill is summarized below.

Long Term Settlement from New Fill (Inches)					
		Thickness of New Fill (Feet)			
		1	2	3	4
Thickness Bay Mud (feet)	0	0	0	0	0
	10	1.5	3	4.5	5.5
	20	2.5	4.5	7	9
	30	3.5	6	9	11

---

[2] Relative compaction, maximum dry density, and optimum moisture content of fill materials should be determined in accordance with ASTM Test Method D 1557, "Moisture-Density Relations of soils and Soil-Aggregate Mixtures Using a 10-lb. Rammer and 18-in. Drop."

Exterior Concrete Slabs-on-Grade

It is our understanding that a concrete slab for outdoor gym area will be constructed. Exterior reinforced concrete slabs-on-grade can be placed directly on a properly prepared subgrade as described above. To improve slab performance, we recommend exterior slabs at least 5 inches thick and reinforced with steel bars. Exterior slabs should be underlain with 4 inches or more of Caltrans Class 2 Aggregate Base compacted to at least 92% relative compaction. Some movement should be expected for exterior concrete slabs as the underlying soils react to seasonal moisture changes.

Additional Services

During design, we will be available for consultation and plan/specification review. We can provide additional recommendations and criteria as needed, if potential bleacher and restroom area safety improvements include foundation or other geotechnical work. We anticipate we will be retained to provide construction services that would include submittal review, confirming subsurface conditions are as expected, and geotechnical inspection and testing.

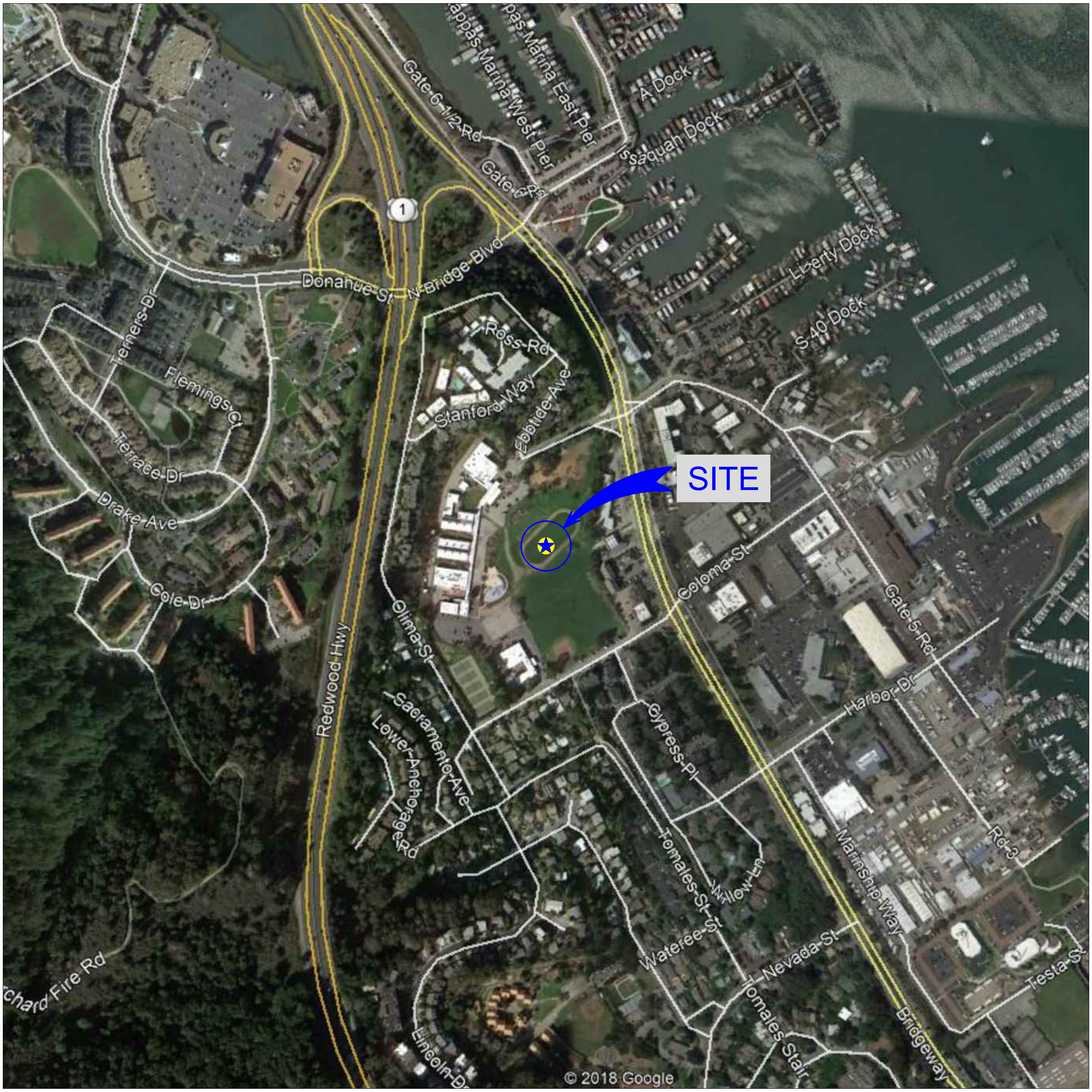
We hope this provides you with the information you require at this time. Please do not hesitate to call with any questions or if we can be of further assistance.

Very truly yours,
MILLER PACIFIC ENGINEERING GROUP

SCOTT A. STEPHENS
2398
Exp. 6/30/19

Scott Stephens
Geotechnical Engineer No. 2398
(Expires 6/30/19)

Attachments: Figures 1 through 5, Appendix A



SITE COORDINATES
LAT. 37.8686°
LON. -122.5043°

SITE LOCATION

N.T.S.

NORTH

REFERENCE: Google Earth, 2018

MILLER PACIFIC ENGINEERING GROUP

FILENAME: 2739.001 Figures.dwg

504 Redwood Blvd.
Suite 220
Novato, CA 94947
T 415 / 382-3444
F 415 / 382-3450
www.millerpac.com

SITE LOCATION MAP

Parisi - MLK Field
Sausalito, California

Drawn ZMS
Checked

1
FIGURE

Project No. 2739.001 Date: 8/9/2018

Exploration done by Miller Pacific, 5/17/18

– – – Approximate Bay Mud thickness contour

SCALE

0 35 70 140 FEET

MPEG
MILLER PACIFIC ENGINEERING GROUP

A CALIFORNIA CORPORATION, © 2016, ALL RIGHTS RESERVED

FILE: 2739.001 Figures.dwg

504 Redwood Blvd.
Suite 220
Novato, CA 94947
T 415 / 382-3444
F 415 / 382-3450
www.millerpac.com

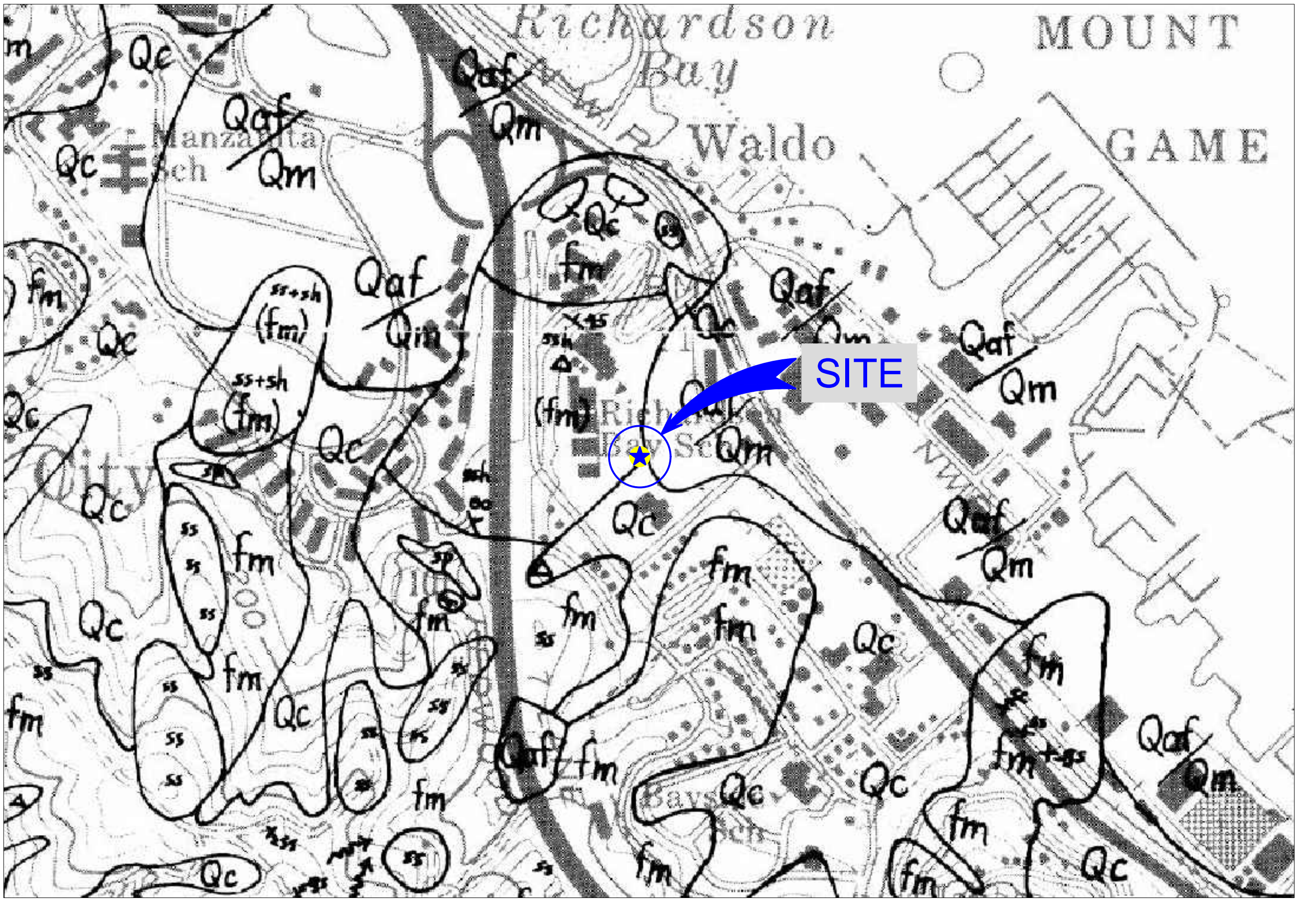
SITE PLAN

Parisi - MLK Field
Sausalito, California

Project No. 2739.001 Date: 8/7/2018

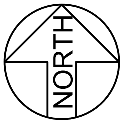
Designed SAS
Drawn JARS
Checked SAS

2
FIGURE



REGIONAL GEOLOGIC MAP

(NOT TO SCALE)



LEGEND

Qaf/Qm	Artificial Fill over Bay Mud: Deposits of rock or soil placed by man upon natural surfaces for engineering purposes overlying Bay Mud
Qc	Colluvium: Unconsolidated and unsorted soil material and weathered rock fragments accumulated at or on the base of slopes due to natural gravitational processes. It is usually derived from the underlying parent material.
fm	Franciscan Melange: A tectonic mixture consisting of small to large masses of resistant rock types, principally sandstone, greenstone, and chert, but including various exotic rock types embedded in a matrix of pervasively sheared shale.

Reference: Rice, Salem J. and Smith, Theodore C. 1976 "Geology of the Tiburon Peninsula,Sausalito and Adjacent areas in Marin County, California."

MPEG
MILLER PACIFIC
ENGINEERING GROUP

FILENAME: 2739.001 Figures.dwg

504 Redwood Blvd.
Suite 220
Novato, CA 94947
T 415 / 382-3444
F 415 / 382-3450
www.millerpac.com

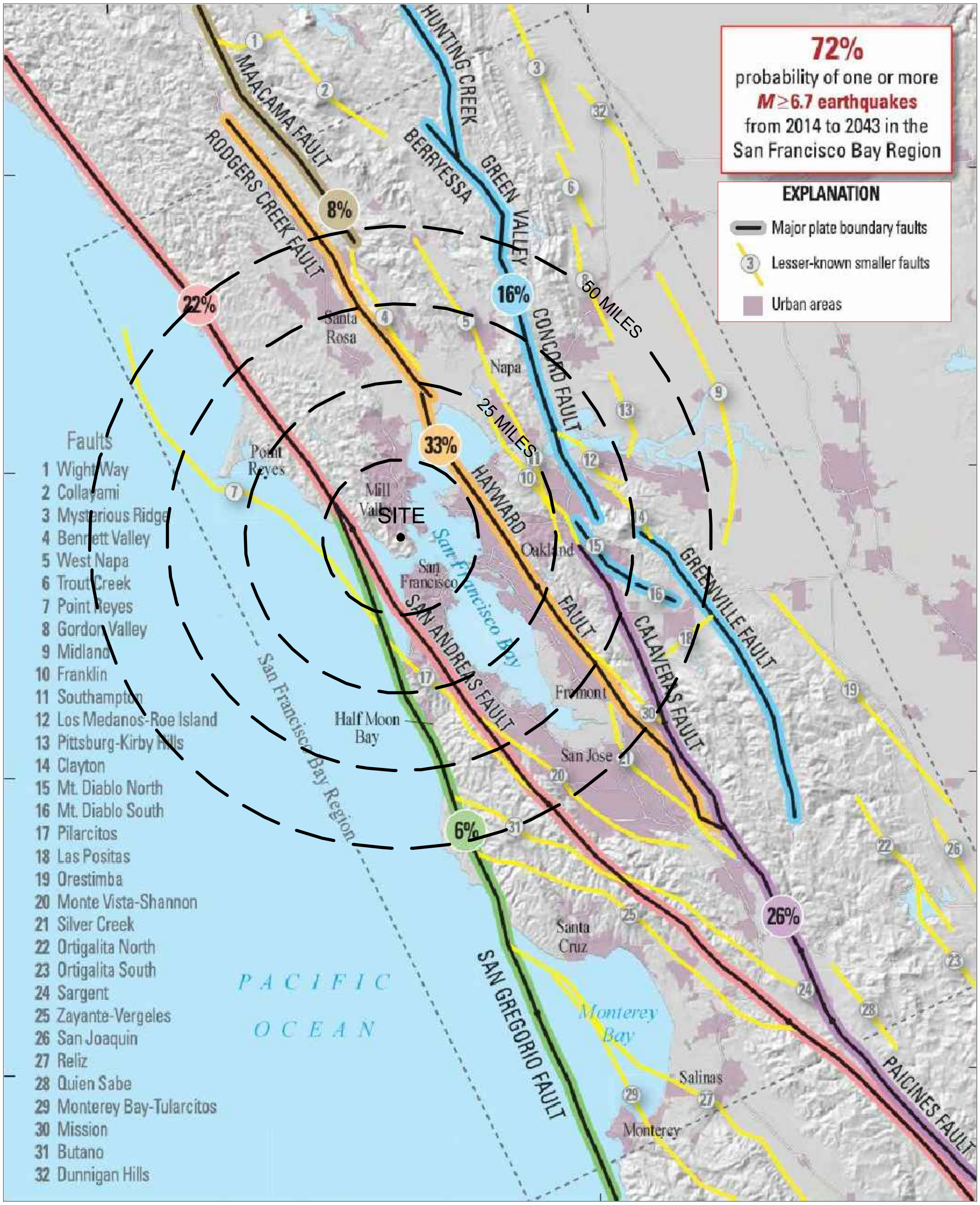
REGIONAL GEOLOGIC MAP

Parisi - MLK Field
Sausalito, California

Project No. 2739.001 Date: 8/9/2018

Drawn ZMS
Checked

3
FIGURE



SITE COORDINATES
LAT. 38.0000°
LON. -122.0000°

SCALE

0 12.5 25 50 MILES

NORTH

DATA SOURCE:

1) U.S. Geological Survey, U.S. Department of the Interior, "Earthquake Outlook for the San Francisco Bay Region 2014-2043", Map of Known Active Faults in the San Francisco Bay Region, Fact Sheet 2016-3020, Revised August 2016 (ver. 1.1).

MPEG
MILLER PACIFIC
ENGINEERING GROUP

FILENAME: 2739.001 Figures.dwg

504 Redwood Blvd.
Suite 220
Novato, CA 94947
T 415 / 382-3444
F 415 / 382-3450
www.millerpac.com

ACTIVE FAULT MAP

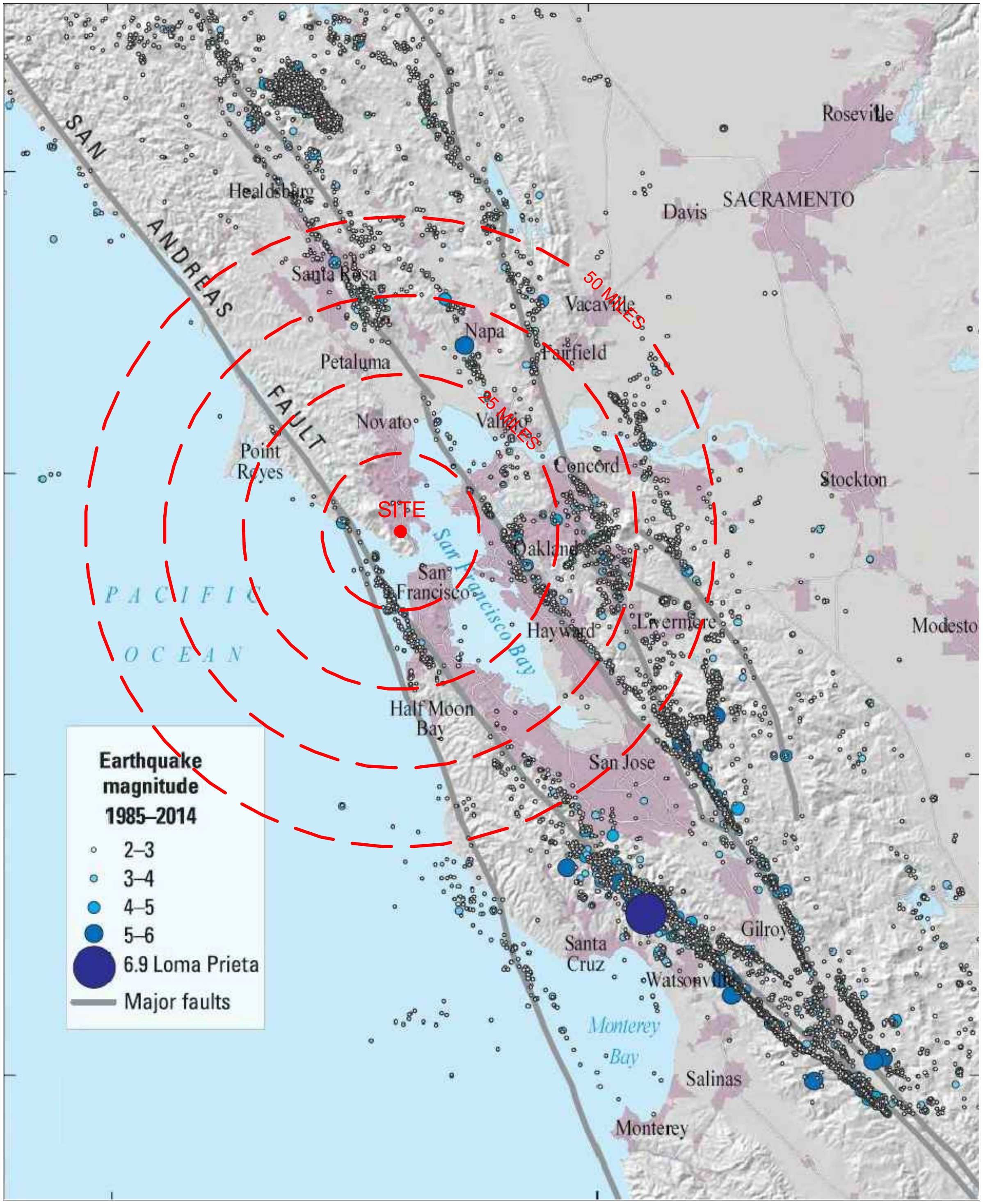
Parisi - MLK Field
Sausalito, California

Project No. 2739.001

Date: 8/9/2018

Drawn ZMS
Checked

4
FIGURE



SITE COORDINATES
LAT. 38.0000°
LON. -122.0000°

SCALE
0 12.5 25 50 MILES

NORTH

DATA SOURCE:
1) U.S. Geological Survey, U.S. Department of the Interior, "Earthquake Outlook for the San Francisco Bay Region 2014-2043", Map of Earthquakes Greater Than Magnitude 2.0 in the San Francisco Bay Region from 1985-2014, Fact Sheet 2016-3020, Revised August 2016 (ver. 1.1).

MPEG
MILLER PACIFIC ENGINEERING GROUP

FILENAME: 2739.001 Figures.dwg

504 Redwood Blvd.
Suite 220
Novato, CA 94947
T 415 / 382-3444
F 415 / 382-3450
www.millerpac.com

HISTORIC EARTHQUAKE MAP

Parisi - MLK Field
Sausalito, California

Project No. 2739.001
Date: 8/9/2018

Drawn ZMS
Checked

5
FIGURE

APPENDIX A
SUBSURFACE EXPLORATION AND LABORATORY TESTING

A. Soil and Rock Classification Systems

We explored subsurface conditions at the site with 8 exploratory borings drilled on May 17, 2018. Borings were excavated to depths between 3.5- and 36.5-feet below the ground surface by use of a 4.0-inch diameter solid flight auger. Borings were drilled at the approximate locations shown on Figure 2. The soils encountered were logged and identified by our field geologist in general accordance with ASTM Standard D 2487, "Field Identification and Description of Soils (Visual-Manual Procedure)." This standard is briefly explained on Figures A-1 and A-2, Soil Classification Chart and Rock Classification Chart. The exploratory boring logs are presented on Figures A-3 through A-13.

B. Laboratory Testing

We conducted laboratory tests on selected intact samples to verify field identifications and to evaluate engineering properties. The following laboratory tests were conducted in accordance with the ASTM standard test method cited:

- Laboratory Determination of Water (Moisture Content) of Soil, Rock, and Soil-Aggregate Mixtures, ASTM D 2216;
- Unconfined Compression Strength, ASTM D 2166;
- Grain Size Sieve Analysis, ASTM D 6913; and
- Amount of Material in Soils Finer than No. 200 (75-µm) Sieve, ASTM D 1140

The moisture content, dry density, grain size analysis, and percentage of particles finer than the no. 200 sieve test results are shown on the Boring Logs, Figures A-3 through A-13. Plasticity index results are shown on Figure A-6.

The exploratory boring logs, description of soils encountered, and the laboratory test data reflect conditions only at the location of the excavation at the time they were excavated or retrieved. Conditions may differ at other locations and may change with the passage of time due to a variety of causes including natural weathering, climate, and changes in surface and subsurface drainage.

MAJOR DIVISIONS		SYMBOL		DESCRIPTION
COARSE GRAINED SOILS over 50% sand and gravel	CLEAN GRAVEL	GW	▨	Well-graded gravels or gravel-sand mixtures, little or no fines
		GP	▨	Poorly-graded gravels or gravel-sand mixtures, little or no fines
	GRAVEL with fines	GM	▨	Silty gravels, gravel-sand-silt mixtures
		GC	▨	Clayey gravels, gravel-sand-clay mixtures
	CLEAN SAND	SW	▨	Well-graded sands or gravelly sands, little or no fines
		SP	▨	Poorly-graded sands or gravelly sands, little or no fines
	SAND with fines	SM	▨	Silty sands, sand-silt mixtures
		SC	▨	Clayey sands, sand-clay mixtures
FINE GRAINED SOILS over 50% silt and clay	SILT AND CLAY liquid limit <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, gravely clays, sandy clays, silty clays, lean clays
		OL	▨	Organic silts and organic silt-clays of low plasticity
	SILT AND CLAY liquid limit >50%	MH	▨	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts
		CH	▨	Inorganic clays of high plasticity, fat clays
		OH	▨	Organic clays of medium to high plasticity
HIGHLY ORGANIC SOILS		PT	▨	Peat, muck, and other highly organic soils
ROCK			▨	Undifferentiated as to type or composition

KEY TO BORING AND TEST PIT SYMBOLS

CLASSIFICATION TESTS

PI	PLASTICITY INDEX
LL	LIQUID LIMIT
SA	SIEVE ANALYSIS
HYD	HYDROMETER ANALYSIS
P200	PERCENT PASSING NO. 200 SIEVE
P4	PERCENT PASSING NO. 4 SIEVE

SAMPLER TYPE

■	MODIFIED CALIFORNIA	⊠	HAND SAMPLER
▯	STANDARD PENETRATION TEST	⊠	ROCK CORE
▨	THIN-WALLED / FIXED PISTON	X	DISTURBED OR BULK SAMPLE

NOTE: Test boring and test pit logs are an interpretation of conditions encountered at the excavation location during the time of exploration. Subsurface rock, soil or water conditions may vary in different locations within the project site and with the passage of time. Boundaries between differing soil or rock descriptions are approximate and may indicate a gradual transition.

STRENGTH TESTS

TV	FIELD TORVANE (UNDRAINED SHEAR)
UC	LABORATORY UNCONFINED COMPRESSION
TXCU	CONSOLIDATED UNDRAINED TRIAXIAL
TXUU	UNCONSOLIDATED UNDRAINED TRIAXIAL
	UC, CU, UU = 1/2 Deviator Stress

SAMPLER DRIVING RESISTANCE

Modified California and Standard Penetration Test samplers are driven 18 inches with a 140-pound hammer falling 30 inches per blow. Blows for the initial 6-inch drive seat the sampler. Blows for the final 12-inch drive are recorded onto the logs. Sampler refusal is defined as 50 blows during a 6-inch drive. Examples of blow records are as follows:

25	sampler driven 12 inches with 25 blows after initial 6-inch drive
85/7"	sampler driven 7 inches with 85 blows after initial 6-inch drive
50/3"	sampler driven 3 inches with 50 blows during initial 6-inch drive or beginning of final 12-inch drive

MPEG
MILLER PACIFIC
ENGINEERING GROUP

FILENAME: 2739.001 BL.dwg

504 Redwood Blvd.
Suite 220
Novato, CA 94947
T 415 / 382-3444
F 415 / 382-3450
www.millerpac.com

SOIL CLASSIFICATION CHART

MLK Park Improvements
Sausalito, California

Project No. 2739.001
Date: 6/5/2018

Drawn JARS
Checked

A-1
FIGURE

FRACTURING AND BEDDING

Fracture Classification	Spacing	Bedding Classification
Crushed	less than 3/4 inch	Laminated
Intensely fractured	3/4 to 2-1/2 inches	Very thinly bedded
Closely fractured	2-1/2 to 8 inches	Thinly bedded
Moderately fractured	8 to 24 inches	Medium bedded
Widely fractured	2 to 6 feet	Thickly bedded
Very widely fractured	greater than 6 feet	Very thickly bedded

HARDNESS

Low	Carved or gouged with a knife
Moderate	Easily scratched with a knife, friable
Hard	Difficult to scratch, knife scratch leaves dust trace
Very hard	Rock scratches metal

STRENGTH

Friable	Crumbles by rubbing with fingers
Weak	Crumbles under light hammer blows
Moderate	Indentations <1/8 inch with moderate blow with pick end of rock hammer
Strong	Withstands few heavy hammer blows, yields large fragments
Very strong	Withstands many heavy hammer blows, yields dust, small fragments

WEATHERING

Complete	Minerals decomposed to soil, but fabric and structure preserved
High	Rock decomposition, thorough discoloration, all fractures are extensively coated with clay, oxides or carbonates
Moderate	Fracture surfaces coated with weathering minerals, moderate or localized discoloration
Slight	A few stained fractures, slight discoloration, no mineral decomposition, no affect on cementation
Fresh	Rock unaffected by weathering, no change with depth, rings under hammer impact

NOTE: Test boring and test pit logs are an interpretation of conditions encountered at the location and time of exploration. Subsurface rock, soil and water conditions may differ in other locations and with the passage of time.

MPEG
MILLER PACIFIC
ENGINEERING GROUP

FILENAME: 2739.001 BL.dwg

504 Redwood Blvd.
Suite 220
Novato, CA 94947
T 415 / 382-3444
F 415 / 382-3450
www.millerpac.com

ROCK CLASSIFICATION CHART

MLK Park Improvements
Sausalito, California

Project No. 2739.001
Date: 6/5/2018

Drawn JARS
Checked

A-2
FIGURE

BORING 1

EQUIPMENT: Portable Hydraulic Drill Rig with 4.0-inch Solid Flight Auger
DATE: 05/17/18
ELEVATION: 12 feet
REFERENCE: Google Earth, 2018

DEPTH meters	DEPTH feet	SAMPLE	SYMBOL (4)		BLOWS / FOOT (1)	DRY UNIT WEIGHT pcf (2)	MOISTURE CONTENT (%)	SHEAR STRENGTH psf (3)	OTHER TEST DATA	OTHER TEST DATA
0	0		▨	GRAVEL with Clay/ CLAY with Gravel (GC/CL) Medium dark brown, slightly moist with gravel up to 1.5" with ~20% low plasticity clay [Fill]						
		■	▨		69	140	6.0			
1			▨							
		■	▨		50/5"	112	5.5			
	5			Boring terminated at 4.5 feet No groundwater encountered during exploration						
2										
3	10									
4										
	15									
5										
6	20									

▽ Water level encountered during drilling
▼ Water level measured after drilling

NOTES:
(1) UNCORRECTED FIELD BLOW COUNTS
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(4) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

MPEG
MILLER PACIFIC
ENGINEERING GROUP

FILENAME: 2739.001 BL.dwg

504 Redwood Blvd.
Suite 220
Novato, CA 94947
T 415 / 382-3444
F 415 / 382-3450
www.millerpac.com

BORING LOG

MLK Park Improvements
Sausalito, California

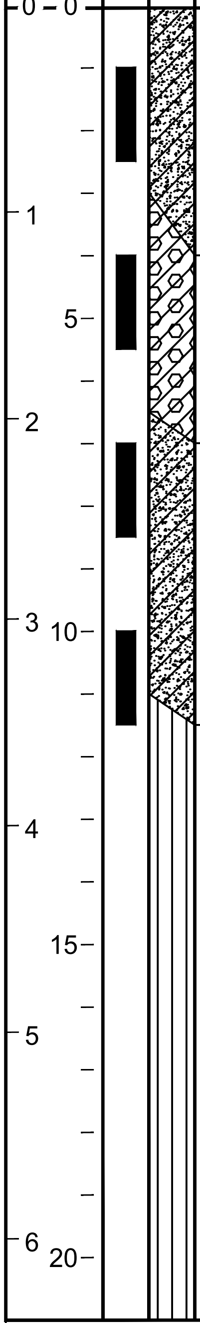
Project No. 2739.001
Date: 6/5/2018

Drawn JARS
Checked

A-3
FIGURE

BORING 2

EQUIPMENT: Portable Hydraulic Drill Rig with 4.0-inch Solid Flight Auger
DATE: 05/17/18
ELEVATION: 11 feet
REFERENCE: Google Earth, 2018



DESCRIPTION	BLOWS / FOOT (1)	DRY UNIT WEIGHT pcf (2)	MOISTURE CONTENT (%)	SHEAR STRENGTH psf (3)	OTHER TEST DATA	OTHER TEST DATA
Clayey SAND with Gravel (SC) Medium green-brown, slightly moist, fine to coarse sand with ~ 30-40% medium plasticity clay and ~30% gravels, subangular up to 1" [Fill]	34	96	13.5		-200 40.6%	
GRAVEL with Clay (GC) Well graded, medium grey and brown, with gravels up to 1.5", with ~30% medium plasticity clay	50/5"	124	9.9			
Clayey SAND with Gravel (SC) Medium blue-gray, saturated, fine to coarse sand with ~30% medium plasticity clay and ~35% gravels up to 2"	44	138	8.3	775	-200 18.8%	
	6					
BAY MUD (ML)						

▽ Water level encountered during drilling
▼ Water level measured after drilling

NOTES:
(1) UNCORRECTED FIELD BLOW COUNTS
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(4) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

MPEG
MILLER PACIFIC ENGINEERING GROUP

FILENAME: 2739.001 BL.dwg

504 Redwood Blvd.
Suite 220
Novato, CA 94947
T 415 / 382-3444
F 415 / 382-3450
www.millerpac.com

BORING LOG

MLK Park Improvements
Sausalito, California

Project No. 2739.001
Date: 6/5/2018

Drawn JARS
Checked

A-4
FIGURE

BORING 2
(CONTINUED)

DEPTH meters	DEPTH feet	SAMPLE	SYMBOL (4)	BORING 2 (CONTINUED)	BLOWS / FOOT (1)	DRY UNIT WEIGHT pcf (2)	MOISTURE CONTENT (%)	SHEAR STRENGTH psf (3)	OTHER TEST DATA	OTHER TEST DATA
	20			BAY MUD (ML)						
7										
	25									
8										
9	30									
				Grades to stiffer Bay Mud						
10										
	35	▯								
11					14		60.3			
				Boring terminated at 36.5 feet Groundwater encountered at 5 feet upon completion						
12	40									

▽ Water level encountered during drilling

▼ Water level measured after drilling

NOTES:
(1) UNCORRECTED FIELD BLOW COUNTS
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(4) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

MPEG MILLER PACIFIC ENGINEERING GROUP

FILENAME: 2739.001 BL.dwg

504 Redwood Blvd.
Suite 220
Novato, CA 94947
T 415 / 382-3444
F 415 / 382-3450
www.millerpac.com

BORING LOG

MLK Park Improvements
Sausalito, California

Project No. 2739.001
Date: 6/5/2018

Drawn JARS
Checked

A-5
FIGURE

BORING 3

EQUIPMENT: Portable Hydraulic Drill Rig with 4.0-inch Solid Flight Auger
DATE: 05/17/18
ELEVATION: 14 feet
REFERENCE: Google Earth, 2018

DEPTH meters feet	SAMPLE	SYMBOL (4)		BLOWS / FOOT (1)	DRY UNIT WEIGHT pcf (2)	MOISTURE CONTENT (%)	SHEAR STRENGTH psf (3)	OTHER TEST DATA	OTHER TEST DATA
0 – 0			2.5" Cinder over 2.5" Aggregate Base						
	■	▨	Gravel (GW) Green, Dry to slightly moist, subangular to angular gravels grading up to 3" [Fill]	72	82	3.6			
1 5 2 3 10 4 15 5 6 20			Boring terminated at 3.5 feet due to large gravels No groundwater encountered during exploration						

▽ Water level encountered during drilling
▼ Water level measured after drilling

NOTES:
(1) UNCORRECTED FIELD BLOW COUNTS
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(4) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

MPEG
MILLER PACIFIC ENGINEERING GROUP

FILENAME: 2739.001 BL.dwg

504 Redwood Blvd.
Suite 220
Novato, CA 94947
T 415 / 382-3444
F 415 / 382-3450
www.millerpac.com

BORING LOG

MLK Park Improvements
Sausalito, California

Project No. 2739.001
Date: 6/5/2018

Drawn JARS
Checked

A-6
FIGURE

BORING 4

EQUIPMENT: Portable Hydraulic Drill Rig with
4.0-inch Solid Flight Auger
DATE: 05/17/18
ELEVATION: 11 feet
REFERENCE: Google Earth, 2018

DEPTH meters / feet	SAMPLE	SYMBOL (4)		BLOWS / FOOT (1)	DRY UNIT WEIGHT pcf (2)	MOISTURE CONTENT (%)	SHEAR STRENGTH psf (3)	OTHER TEST DATA	OTHER TEST DATA
0 – 0		▨	Clayey GRAVEL (GC) medium grey brown, slightly moist, sub angular gravels up to 1.5" with 20-30% medium plasticity clay						
	■	▨		48	117	9.2		SA	
1		▨							
5	■	▨		24	121	10.4			
2			Boring terminated at 6.0 feet No groundwater encountered during exploration						
3 10									
4									
15									
5									
6 20									

▽ Water level encountered during drilling
▼ Water level measured after drilling

NOTES: (1) UNCORRECTED FIELD BLOW COUNTS
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(4) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

MPEG
MILLER PACIFIC
ENGINEERING GROUP

FILENAME: 2739.001 BL.dwg

504 Redwood Blvd.
Suite 220
Novato, CA 94947
T 415 / 382-3444
F 415 / 382-3450
www.millerpac.com

BORING LOG

MLK Park Improvements
Sausalito, California

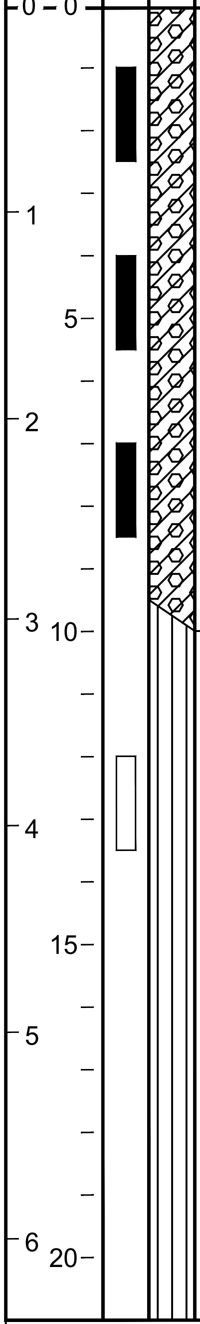
Project No. 2739.001
Date: 6/5/2018

Drawn JARS
Checked

A-7
FIGURE

BORING 5

EQUIPMENT: Portable Hydraulic Drill Rig with
4.0-inch Solid Flight Auger
DATE: 05/17/18
ELEVATION: 13 feet
REFERENCE: Google Earth, 2018



Clayey GRAVEL (GC)
Medium brown, slightly moist, ~30% fine to coarse sand, ~30% sub angular to angular gravels up to 1.5" in diameter, ~40% medium plasticity clay

BAY MUD (ML)
Medium gray and blue, high plasticity

BLOWS / FOOT (1)	DRY UNIT WEIGHT pcf (2)	MOISTURE CONTENT (%)	SHEAR STRENGTH psf (3)	OTHER TEST DATA	OTHER TEST DATA
38	118	8.2	575		
36	126	6.6			
37	116	8.1			
14	80	37.6	400		

∇ Water level encountered during drilling
▼ Water level measured after drilling

NOTES: (1) UNCORRECTED FIELD BLOW COUNTS
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(4) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

MPEG MILLER PACIFIC ENGINEERING GROUP

FILENAME: 2739.001 BL.dwg

504 Redwood Blvd.
Suite 220
Novato, CA 94947
T 415 / 382-3444
F 415 / 382-3450
www.millerpac.com

BORING LOG

MLK Park Improvements
Sausalito, California

Project No. 2739.001
Date: 6/5/2018

Drawn JARS
Checked

A-8
FIGURE

meters DEPTH	feet	SAMPLE	SYMBOL (4)	BORING 5 (CONTINUED)	BLOWS / FOOT (1)	DRY UNIT WEIGHT pcf (2)	MOISTURE CONTENT (%)	SHEAR STRENGTH psf (3)	OTHER TEST DATA	OTHER TEST DATA
	20			BAY MUD (ML)						
7										
	25									
8										
		▨			24					
9	30			Boring terminated at 29.5 feet No groundwater encountered during exploration						
10										
	35									
11										
12	40									

▽ Water level encountered during drilling

▼ Water level measured after drilling

NOTES:
(1) UNCORRECTED FIELD BLOW COUNTS
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(4) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

MPEG
MILLER PACIFIC
ENGINEERING GROUP

FILENAME: 2739.001 BL.dwg

504 Redwood Blvd.
Suite 220
Novato, CA 94947
T 415 / 382-3444
F 415 / 382-3450
www.millerpac.com

BORING LOG

MLK Park Improvements
Sausalito, California

Project No. 2739.001
Date: 6/5/2018

Drawn JARS
Checked

A-9
FIGURE

BORING 6

EQUIPMENT: Portable Hydraulic Drill Rig with 4.0-inch Solid Flight Auger
DATE: 05/17/18
ELEVATION: 14 feet
REFERENCE: Google Earth, 2018

DEPTH meters	DEPTH feet	SAMPLE	SYMBOL (4)	Description	BLOWS / FOOT (1)	DRY UNIT WEIGHT pcf (2)	MOISTURE CONTENT (%)	SHEAR STRENGTH psf (3)	OTHER TEST DATA	OTHER TEST DATA
0	0			**GRAVEL with Silt** Medium gray, slightly moist, sub angular gravel up to 1.5" in diameter with ~20% low plasticity silt [Fill]	35		3.6		SA	
1				Increase in medium plasticity clay and silt	32	118	5.6		-200 20.2%	
	5				36	117	8.2			
2				Boring terminated at 6.0 feet No groundwater encountered during exploration						
3	10									
4										
	15									
5										
6	20									

▽ Water level encountered during drilling
▼ Water level measured after drilling

NOTES: (1) UNCORRECTED FIELD BLOW COUNTS
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(4) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

MPEG
MILLER PACIFIC ENGINEERING GROUP

FILENAME: 2739.001 BL.dwg

504 Redwood Blvd.
Suite 220
Novato, CA 94947
T 415 / 382-3444
F 415 / 382-3450
www.millerpac.com

BORING LOG

MLK Park Improvements
Sausalito, California

Project No. 2739.001
Date: 6/5/2018

Drawn JARS
Checked

A-10
FIGURE

BORING 7

EQUIPMENT: Portable Hydraulic Drill Rig with 4.0-inch Solid Flight Auger
DATE: 05/17/18
ELEVATION: 13 feet
REFERENCE: Google Earth, 2018

DEPTH meters	DEPTH feet		BLOWS / FOOT (1)	DRY UNIT WEIGHT pcf (2)	MOISTURE CONTENT (%)	SHEAR STRENGTH psf (3)	OTHER TEST DATA	OTHER TEST DATA
0	0	GRAVEL (GW-GC) Medium gray and brown slightly moist, subangular to angular gravels up to 3" in diameter with ~10-15% medium plasticity clay [Fill]						
1			34	125	7.1		SA	
	5							
2		Silty/Clayey SAND (SC/SM) Medium blue gray to brown, moist, fine to coarse sand, with ~40% medium to high plasticity silt/clay [Alluvium]	21	104	12.8	435		
3	10	BAY MUD (ML) Blue gray green, high plasticity silt [Alluvium]						
4								
	15							
5								
6	20	Alluvium sand and gravel, blue gray green						

▽ Water level encountered during drilling
▼ Water level measured after drilling

NOTES:
(1) UNCORRECTED FIELD BLOW COUNTS
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(4) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

MPEG
MILLER PACIFIC
ENGINEERING GROUP

FILENAME: 2739.001 BL.dwg

504 Redwood Blvd.
Suite 220
Novato, CA 94947
T 415 / 382-3444
F 415 / 382-3450
www.millerpac.com

BORING LOG

MLK Park Improvements
Sausalito, California

Project No. 2739.001
Date: 6/5/2018

Drawn JARS
Checked

A-11
FIGURE

DEPTH meters	DEPTH feet	SAMPLE	SYMBOL (4)	BORING 7 (CONTINUED)	BLOWS / FOOT (1)	DRY UNIT WEIGHT pcf (2)	MOISTURE CONTENT (%)	SHEAR STRENGTH psf (3)	OTHER TEST DATA	OTHER TEST DATA
	20			Boring terminated at 29.5 feet Groundwater encountered at 16.0 feet	27		11.7			
7										
	25									
8										
9	30									
10										
	35									
11										
12	40									

▽ Water level encountered during drilling

▼ Water level measured after drilling

NOTES:
(1) UNCORRECTED FIELD BLOW COUNTS
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(4) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

MPEG
MILLER PACIFIC
ENGINEERING GROUP

FILENAME: 2739.001 BL.dwg

504 Redwood Blvd.
Suite 220
Novato, CA 94947
T 415 / 382-3444
F 415 / 382-3450
www.millerpac.com

BORING LOG

MLK Park Improvements
Sausalito, California

Project No. 2739.001
Date: 6/5/2018

Drawn JARS
Checked

A-12
FIGURE

BORING 8

EQUIPMENT: Portable Hydraulic Drill Rig with
4.0-inch Solid Flight Auger
DATE: 05/17/18
ELEVATION: 14 feet
REFERENCE: Google Earth, 2018

DEPTH meters	DEPTH feet	SAMPLE	SYMBOL (4)		BLOWS / FOOT (1)	DRY UNIT WEIGHT pcf (2)	MOISTURE CONTENT (%)	SHEAR STRENGTH psf (3)	OTHER TEST DATA	OTHER TEST DATA
0	0	■	▨	Clayey SAND (SC) Medium gray and brown, slightly moist, fine to coarse sand with ~20-30% medium plasticity clay and 15% gravels up to .5" in diameter [Fill]	21	117	13.1	1500		
1			▨		26	112	5.8		-200 14.4%	
	5			Boring terminated at 5.0 feet No groundwater encountered during exploration						
2										
3	10									
4										
	15									
5										
6	20									

∇ Water level encountered during drilling
▼ Water level measured after drilling

NOTES:
(1) UNCORRECTED FIELD BLOW COUNTS
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(4) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

MPEG
MILLER PACIFIC
ENGINEERING GROUP

FILENAME: 2739.001 BL.dwg

504 Redwood Blvd.
Suite 220
Novato, CA 94947
T 415 / 382-3444
F 415 / 382-3450
www.millerpac.com

BORING LOG

MLK Park Improvements
Sausalito, California

Project No. 2739.001
Date: 6/5/2018

Drawn JARS
Checked

A-13
FIGURE