Appendix D

Preliminary Geotechnical Feasibility Study (Furgo Consultants, Inc. 2016).

FUGRO CONSULTANTS, INC.

1777 Botehlo Drive
Suite 262
Walnut Creek, California 94596
T +1 925 949 7100
F +1 925 949 7010

December 01, 2016
Project No. 04.72160040

City of South San Francisco
Engineering Division
315 Maple Avenue
South San Francisco, California 94080

Attention: Mr. Sam Bautista

Subject: Preliminary Geotechnical Feasibility Study, Proposed Orange Park Storm Water Capture Project, South San Francisco, California

Dear Mr. Bautista:

In accordance with your request, Fugro Consultants, Inc. (Fugro) is pleased to present the results of the preliminary geotechnical feasibility study for the proposed Orange Park Storm Water Capture Project (Project 1) to be on the south side of Colma Creek in Orange Memorial Park located at Orange Avenue and Tennis Drive in South San Francisco, California.

1 PROJECT DESCRIPTION

Project 1 will consist of a subsurface infiltration chamber that will have a foot print of about ½ acre. The chamber will be constructed 15 feet below ground surface (bgs) with 3 feet of cover.

2 PRELIMINARY GEOTECHNICAL FEASIBILITY STUDY

A preliminary study was conducted to determine the feasibility of the project site for the proposed storm water capture project from a geotechnical and environmental standpoint. The scope of our services consisted of the following:

- We reviewed the geotechnical and geologic site conditions based on the subsurface data contained in our files, existing geologic and seismic hazard maps, and other generally available related materials.

- We performed a site reconnaissance to observe the existing site conditions from a geotechnical and geologic viewpoint, and drilled three exploratory borings between 20 and 25 feet deep.
- We performed three field percolation tests at a depth of 15 feet.
- Collected four (4) soil samples (two above the infiltration chamber and two below) from each boring for a total of 12 soil samples. Soil samples were obtained from the three (3) exploratory borings completed at the site. For the purposes of this preliminary project, it is assumed that the purpose of the testing is to preliminarily evaluate onsite soils for the presence of contaminants. Please note that the groundwater was not sampled or tested and the soil testing herein would not be sufficient to profile the soil for waste disposal acceptance or an unrestricted reuse scenario. Soil samples were tested for the following:
    - Total petroleum hydrocarbons as gasoline (TPHg) using EPA Method 8015m/8021,
    - Total petroleum hydrocarbons as diesel and motor oil (TPHd and TPHmo) using EPA Method 8015m with silica gel cleanup,
    - Volatile organic compounds (VOCs) using EPA Method 8260,
    - Semi-volatile organic compounds (SVOCs) using EPA Method 8270 SIM,
    - 17 Title 22 metals using EPA Methods 6020,
    - Organochlorine Pesticides using EPA Method 8081,
    - Polychlorinated Biphenyls (PCBs) using EPA Method 8082, and/or
    - Asbestos using CARB 435 Method with 400-point count.
- Identify the geotechnical and geologic conditions (e.g., soil, groundwater, fill thickness, potential for compressible soils, and geologic hazards such as surface fault rupture, seismic shaking and liquefaction) that could impact the development of the specific proposed project.
- We prepared this feasibility geotechnical report for the potential site, identifying the geotechnical, geologic, and environmental conditions that could impact the development of the specific proposed project. We note that the recommendations provided in this report are for preliminary feasibility level study only. A detailed geotechnical investigation will be required to develop recommendations for the design and construction of the structure once the site has been approved.

2.1 SITE CONDITIONS

2.1.1 Surface Conditions

The proposed locations for the storm water collection chamber is on a trapezoidal shaped property adjacent to the north-west corner of the Orange Memorial Park. The site is currently covered by loose topsoil/fill and some vegetation. The site is bound to the north by the Colma Creek canal, on the east by Orange Memorial Park, and the south and west by apartment developments.

2.1.2 Subsurface Conditions

At the location of our exploratory Borings B-01, B-02, and B-03, we generally encountered fill over native poorly-graded sands with clay and silty sands with clay over fat clay with sand. In Boring B-1, about 2 feet of poorly-graded sand with gravel and clay fill was encountered at the surface and overlaying approximately 18 feet of medium dense to dense poorly-graded sands and stiff to very stiff silty sands. Below 20 feet, very stiff fat clay was encountered to the termination depth of 26.5 feet below ground surface.

In Boring B-2, about 1 foot of poorly-graded sand with gravel and silt fill was encountered at the surface and overlaying approximately 17.5 feet of medium dense to dense poorly-graded sands with silt. Below 17.5 feet, stiff fat clay was encountered to the termination depth of 21.5 feet below ground surface.

In Boring B-3, about 2.5 feet of poorly-graded sand with gravel and silt fill was encountered at the surface and overlaying approximately 17.5 feet of medium dense poorly-graded sands with silt. Below 17.5 feet, stiff to very stiff fat clay was encountered to the termination depth of 21.5 feet below ground surface. The approximate locations of the borings can be found on Plate - 2, Site Plan.

The boring logs and related information depict the depth at which specific subsurface conditions were encountered during our field investigation. The approximate locations of the borings were determined by using a measuring tape and should be considered accurate only to the degree implied by the method used. The log of borings referenced and shown on Plate - 2 can be found in appendix A.

2.2 GROUNDWATER

Free groundwater was not encountered at the time of drilling. However, the borings were backfilled with lean cement grout on completion due to San Mateo County Environmental Health requirements. In addition, fluctuations in the groundwater level may occur due to change in seasons, variations in rainfall and other factors. The site is adjacent to Colma Creek canal and therefore, the groundwater level will be affected by the water level in the creek.

3 CONCLUSIONS AND PRELIMINARY RECOMMENDATIONS

We believe that the project is feasible from a geotechnical and engineering geologic standpoint, provided that the conclusions and recommendations presented in this report are used solely as preliminary guidance for what could be expected.

The principal geotechnical considerations are the potentially liquefiable layers, the soil percolation rate, and the soil contamination and are discussed in the following sections.

3.1 LIQUEFIABLE MATERIALS

Seismic liquefaction is a phenomenon in which saturated (submerged), cohesionless soil experiences a temporary loss of strength due to buildup of excess pore water pressure during cyclic loading induced by an earthquake. The susceptibility of a soil to liquefaction is a function of the gradation, density, aging/cementation, and fines content of the soil. The Orange Memorial Park area has been geologically mapped as alluvium consisting of sand and silt but locally containing clay, gravel or boulders. Also, the site is mapped in an area that has a high potential for liquefaction and is adjacent to Colma which is within the FEMA 100-Year Flood Area.

The subsurface conditions at the site consist primarily of sand / gravel and silty sand layers above the water table. However, those layers typically have relatively high blow counts. In addition, the layers generally appear to be at least clayey. Therefore, we anticipate limited to negligible liquefaction potential. Nonetheless, detailed liquefaction evaluation should be conducted for the project once site-specific geotechnical data are collected and seismic parameters are developed per the current building design code.

3.2 FIELD PERCOLATION TESTING

We performed three (3) field percolation tests within the project site to evaluate subsurface soil permeability. The percolation test locations were all performed in the area of the proposed Storm Water Capture Chamber, as shown on the Site Plan - Plate 2.

Exploration Geoservices, of San Joes, California, advanced the percolation test holes to a depth of about 15 feet below ground surface (bgs) with an 8-inch diameter hollow-stem auger. The augers were advanced to testing depth under rotary motion and imbedded approximately 1 to 2-inches into the native undisturbed soil at the bottom of the excavation. Before taking the readings of the percolation rate at each test location, water was poured into the auger for an initial soaking period of at least 60 minutes to saturate the soil within the test zone. Readings of the water level (head) drop after the soaking period were taken at multiple time intervals up to approximately 60 minutes, depending on test location

We estimated soil permeability (K) using procedures recommended in the U.S. Department of the Interior's *Engineering Geology Field Manual* (1998). Calculated soil permeability of the subsurface soils is presented in Table 1. Please note that the tests were performed below a depth of about 15

feet bgs and these results may not be indicative of the soil characteristics at different depths, or at other portions of the site. At the time of testing, the Colma Creek water surface was approximately 8 to 10 feet below existing site grade.

Table 1. Field Percolation Test Results

Percolation Test Location	Approximate Depth of Percolation Test from ground surface (feet)	Subsurface Conditions at test location	Water Level Drop (feet)	Estimated Soil Permeability, K (in/hour)
B-01B	15	greyish brown poorly-graded sand with silt and clay	9.3 (10 minutes)	3.4
B-02B	15	light brown silty sand with clay	4.8 (60 minutes)	0.3
B-03B	15	Light greyish brown silty clayey sand	4.3 (15 minutes)	1.0

3.3 LIMITED ENVIRONMENTAL ASSESSMENT

Based on information provided by the City, environmental studies were conducted at the Site in 2010 and 2011 by CSS Environmental Services, Inc. (CSS)[1] as part of a larger environmental assessment of a former nursery business which occupied parcels of land on both the north and south sides of Colma Creek. In CSS' report, the Site is identified as the Southern Parcel, and was thought to have been first developed sometime between 1956 and 1965 as a carnation nursery. Aerial photographs reviewed online through Google Earth confirm that greenhouses were present onsite from at least 1993 until they were demolished in the mid-2000's. Reports of the testing performed by CSS in 2010 and 2011, showed elevated concentrations of select organochlorine pesticides within onsite soils at depths between 1.5 to 4 feet bgs. Reportedly in 2011, a soil cap was placed over the Site. The soil cap comprises borrow soil from a local affordable housing development site in San Mateo. Based on CSS field investigations, the import fill cap varies from 2 feet thick near the center of the Site and tapers to 0 feet thick along the perimeter where natural grades were matched.

As requested by the City, Fugro completed a limited environmental assessment of onsite soils concurrent with our geotechnical investigation in order to preliminarily evaluate onsite soils for the presence of contaminants above and below the proposed infiltration chamber. It should be noted that the testing performed was limited and was solely conducted to provide a preliminary evaluation of the general quality of the onsite soils within the proposed construction zone. The testing program discussed below may not be considered sufficient to profile the soil for waste disposal acceptance and it was not conducted to address an unrestricted reuse of t the Site

[1] CSS Environmental, Inc. Site Assessment Report for Parcels Northwest of Orange Park, APNs 014-041-170 and -180, South of San Francisco, California, SMCo Site #559204, Global ID #T10000002366, dated April 16, 2012

Field Activities

From each exploratory boring, Fugro collected four (4) soil samples, with two (2) samples obtained from above the proposed infiltration chamber depth of 15 feet bgs and two (2) soil sample obtained below the proposed infiltration chamber. Accordingly, a total of twelve (12) soil samples were collected and analyzed during this investigation.

Soil samples were retained in new stainless steel liners, sealed with Teflon sheeting and plastic end-caps. Each sample container was filled to avoid headspace. Samples were placed in a chilled ice-chest pending delivery to the chemical testing laboratory. Drilling and sampling equipment were decontaminated before and after each use.

Chemical Testing Program

A total of twelve (12) soil samples were transported under chain-of-custody documentation to McCampbell Analytical Inc., a State of California-certified testing laboratory. Soil samples were analyzed for the following:

- Total petroleum hydrocarbons as gasoline (TPHg) using EPA Method 8015m/8021,
- Total petroleum hydrocarbons as diesel and motor oil (TPHd and TPHmo) using EPA Method 8015m with silica gel cleanup,
- Volatile organic compounds (VOCs) using EPA Method 8260,
- Semi-volatile organic compounds (SVOCs) using EPA Method 8270 SIM,
- 17 Title 22 metals using EPA Methods 6020,
- Organochlorine Pesticides using EPA Method 8081,
- Polychlorinated Biphenyls (PCBs) using EPA Method 8082, and
- Asbestos using CARB 435 Method with 400-point count.

Results of Analyses

Soil results were compared to the San Francisco Bay Regional Water Quality Control Board's (SFRWQCB's) Environmental Screening Levels (ESLs) for commercial/industrial soil exposure, as well as ESLs for Any Land Use/Any Soil Depth Exposure (Construction Worker)[2]. Results for heavy metals were also compared to Total Threshold Limit Concentrations (TTLCs) some of the criteria used to classify soil as hazardous waste.

[2] Environmental Screening Levels, SFRWQCB, User's Guide: Derivation and Application of Environmental Screening Levels, Interim Final February 2016. Direct Exposure Human Health Risk Levels Commercial/Industrial Soil and Any Land Use/Any Soil Depth Exposure (Construction Worker) (Table S-1).

For the purposes of this report we present a separate discussion of the results for samples collected from above the proposed infiltration chamber and results for samples from below the depth of the proposed chamber (15 feet bgs). Results of analyses for soil samples are summarized in Table 2. Copies of the laboratory reports with chain-of-custody documentation are presented in Appendix C.

Analytical Results – Soil Above In Filtration Chamber

No TPHg, TPHmo, TPHd, VOCs, SVOCs, PCBs, or asbestos were detected in any of the soil samples analyzed from above the proposed infiltration chamber.

Organochlorine pesticides were only detected in the soil samples collected from the three borings at depths between 2 and 3.5 feet bgs. This finding is consistent with known pesticide contamination at the Site. For these soil samples, analyses detected concentrations of DDD (at 0.0022 milligrams per kilogram [mg/kg]), DDE (up to 0.47 mg/kg), DDT (up to 0.38 mg/kg), and dieldrin (up to 0.17 mg/kg). Detected concentrations were at or below respective

ESLs for commercial shallow soil exposure and Any Land Use/Any Soil Depth Exposure (Construction Worker).

Concentrations of various metals detected in all 6 samples were all below their respective TTLCs. With the exception of arsenic, detected metals were also below respective ESLs for commercial shallow soil exposure and Any Land Use/Any Soil Depth Exposure (Construction Worker).

Analyses detected total arsenic ranging from 1.7 mg/kg to 2.9 mg/kg for all 6 samples, exceeding the commercial shallow soil exposure ESL of 0.31 mg/kg and the Any Land Use/Any Soil Depth Exposure (Construction Worker) ESL of 0.94 mg/kg. These arsenic concentrations exceed commercial and construction worker ESLs, however throughout California arsenic levels have been found to be higher than ESLs due to historic chemical usage as well as its presence in local bedrock materials which have been used as import fill. The concentrations detected do not appear to be related to a source release and are most likely associated with areal background arsenic concentrations.

Analytical Results – Soil Below Infiltration Chamber

No TPHg, TPHmo, TPHd, VOCs, SVOCs, organochlorine pesticides, PCBs, or asbestos were detected in any of the soil samples analyzed from below the proposed depth of the infiltration chamber.

Similar to samples collected from above the infiltration chamber, various metals were detected in all six (6) samples analyzed at concentrations below respective TTLC thresholds. Arsenic was detected at concentrations ranging from 1.0 mg/kg to 3.0 mg/kg, similar to areal background arsenic concentrations for California soils.

Recommendations

Due to the presence of organochlorine pesticides and arsenic, and the planned construction activities, Fugro recommends that a Site Mitigation Plan (SMP) be prepared for the project. The purposes of a SMP are to 1) mitigate potential exposures due to dust emissions or contact with unsaturated soils containing detected analytes and 2) provide standard construction guidelines for dust control and routine soil handling procedures. The SMP should address potential risks to construction workers due to identified Site contaminant, and should include provisions for managing soil as part of construction, including but not limited to excavating, stockpiling for waste profile characterization, erosion control measures, transportation of waste, tracking, dust control measures, PPE and decontamination procedures.

Copies of this report should be provided to the contractor working on the project. That contractor should prepare a Health and Safety Plan (HSP), which is reviewed and approved by a Certified Industrial Hygienist (CIH), and which notifies workers of the presence of detected chemicals at the Site.

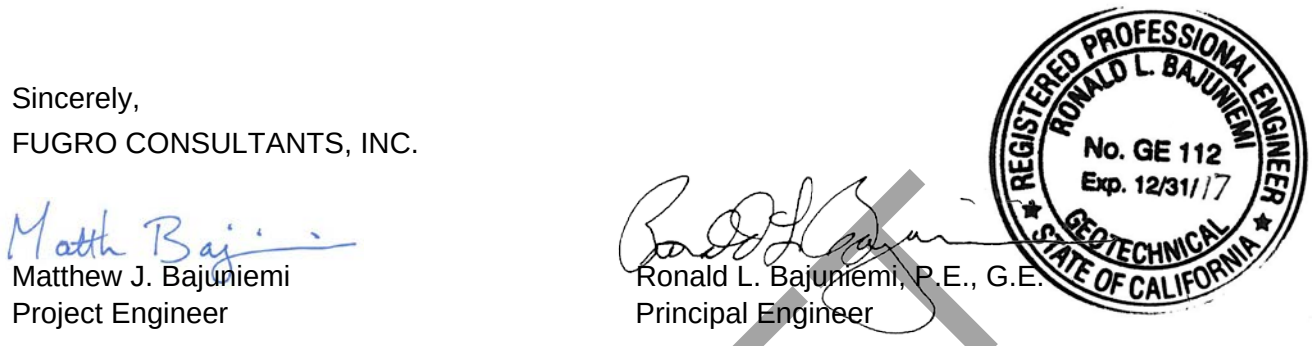
4 CLOSING

Based on the available geotechnical and limited environmental data, there does not appear to be limiting factors to determine the project as not being feasible. The percolation test results presented in this letter are meant to assist in the planning of the proposed project. The actual feasibility of the project should be determined by your engineering group and project team.

The above conclusions presented in this letter are meant to assist in the planning and feasibility of the proposed Storm Water Collection Chamber. The preliminary conclusions presented in this report are based on the field explorations at the three locations. The conclusions and recommendations provided in this report are for preliminary feasibility level study only. Once the site is chosen for development, a detailed geotechnical investigation should be conducted and recommendations for the design and construction of the structure should be developed.

The summarization of the geotechnical explorations contained within this data report were made in accordance with generally accepted local and current geotechnical engineering principles and practices are meant solely as an aide for planning the actual design of the proposed structures. We make no warranty, either express or implied. Should you have any questions or require additional information, please contact us.

Sincerely,
FUGRO CONSULTANTS, INC.



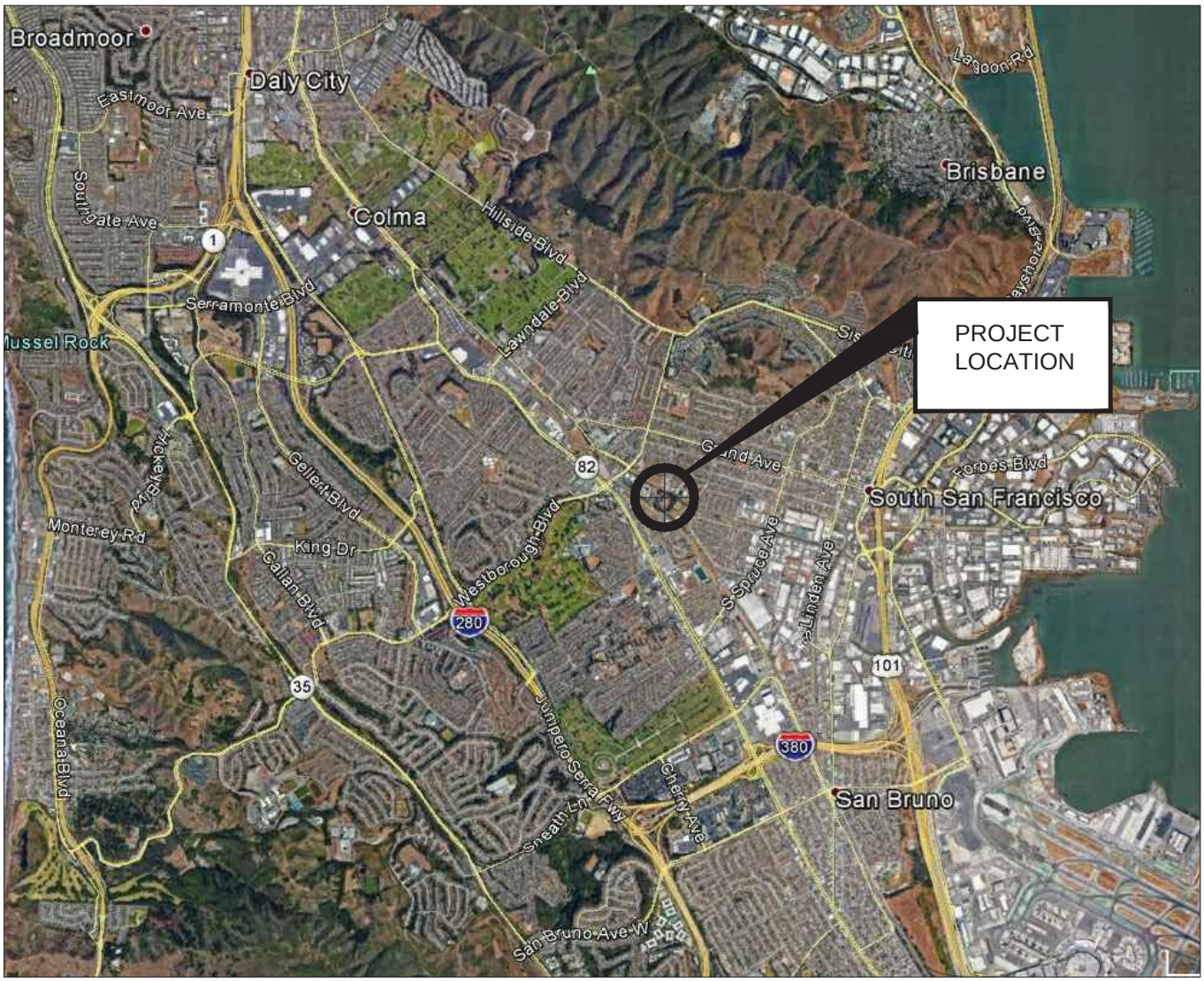
Matthew J. Bajuniemi
Project Engineer

Ronald L. Bajuniemi, P.E., G.E.
Principal Engineer

MJB/RLB:mb

Copies Submitted: (PDF) Addressee
Attachments: Plate 1. Vicinity Map
Plate 2. Site Plan
Appendices

PLATES



BASE MAP SOURCE: Vicinity Map is based on an image downloaded from Google Earth Pro, dated 11/15/2016

NORTH

0 1 2

MILES

G:\jobdocs\04.72160040 Orange Memorial Park Storm Water Capture Project\Drawings\A04.72160040_Plate01.dwg 11-15-2016 - 10:02am

VICINITY MAP

Orange Memorial Storm Water Capture Project
South San Francisco, California

PLATE 1

BASE MAP SOURCE: Site Plan is based on an image downloaded from Google Earth Pro, dated 11/16/2016

LEGEND

B–03 Approximate Boring Location

Approximate Percolation Test Location

NORTH
0 50
FEET

SITE PLAN

Orange Memorial Storm Water Capture Project
South San Francisco, California

PLATE 2

APPENDIX A
FIELD EXPLORATIONS

CLASSIFICATION AND MATERIAL SYMBOLS

MAJOR DIVISIONS PER ASTM D2488-06			MAJOR GROUP NAMES AND MATERIAL SYMBOLS		
COARSE-GRAINED SOILS (More than 50% retained on the No. 200 sieve)	GRAVELS (MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE)	Clean gravels less than 5% fines	GW		Well-Graded GRAVEL
			GP		Poorly Graded GRAVEL
		Gravels with more than 12% fines	GM		SILTY GRAVEL
			GC		CLAYEY GRAVEL
	SANDS (MORE THAN 50% OF COARSE FRACTION PASSING NO. 4 SIEVE)	Clean sand less than 5% fines	SW		Well-Graded SAND
			SP		Poorly Graded SAND
		Sands with more than 12% fines	SM		SILTY SAND
			SC		CLAYEY SAND
FINE-GRAINED SOILS (50% or more passes the No. 200 sieve)	SILTS AND CLAYS (Liquid Limit Less than 50%)		ML		SILT
			CL		Lean CLAY
			OL		ORGANIC SILT
	SILTS AND CLAYS (Liquid Limit Greater than 50%)		MH		Elastic SILT
			CH		Fat CLAY
			OH		ORGANIC CLAY
HIGHLY ORGANIC SOILS			PT		Peat or Highly Organic Soils

Notes:
Classification of soils on the boring logs is in general accordance with ASTM D2488, or D2487 if appropriate laboratory data are available.
The geologic formation is noted in bold font at the top of interpreted interval on the boring logs.

OTHER MATERIAL SYMBOLS

 Debris or Mixed Fill

 Pavement with Aggregate Base

SAMPLER TYPE

 SPT (Driven) 1-3/8" ID 2" OD

 Modified California (Driven) 2-3/8" ID 3" OD

 Modified California (Driven) 1-7/8" ID 2-1/2" OD

 Shelby Tube (Pushed) 2-7/8" ID 3" OD

 Pitcher Barrel (Rotary-cut) 2-7/8" ID

 Osterberg (Piston) 2-7/8" ID

 101 Geobarrel (Rotary-cut) 2-7/8" ID

 Rock Core (Rotary-cut) See log for size

 Vibracore (Vibrated) See log for size

 Push-core (Pushed) See log for size

 Collected from Auger

 Other See log for details

Note: Refer to text of report for additional details or other sampler types.

BLOW COUNT

Number of blows required to drive sampler each of three 6-in. intervals, as measured in the field (uncorrected). An SPT hammer (140 lb., falling 30-in.) was used unless otherwise noted on the boring log. For example:

Blow Count	Description
5 7 8	5, 7, and 8 blows for first, second, and third interval, respectively.
35 50/3"	35 blows for the first interval. 50 blows for the first 3 inches of the second interval. Lack of third value implies that driving was stopped 3 inches into the second interval.
WOH WOH 5	"WOH" indicates that the weight of the hammer was sufficient to advance the sampler over the first two intervals. 5 blows were required to advance the sampler over the third interval.

N-VALUE

The N-Value represents the blowcount for the last 12 inches of the sample drive if three 6-inch intervals were driven. N-value presented is independant of impact energy. If 50 hammer blows were insufficient to drive through either the second or the third interval, the total number of blows and total length driven are reported (excluding the first interval). "ref" (refusal) indicates that 50 blows were insufficient to drive through the first 6-inch interval.

Parenthesis indicate that an approximate correction has been applied for non-SPT drive samplers. For example, a factor of 0.63 is commonly used to adjust blow counts obtained using a 3-inch outside diameter modified California sampler to correspond to Standard Peneteration Test.

UNDRAINED SHEAR STRENGTH

A value of undrained shear strength is reported. The value is followed by a letter code indicating the type of test that was performed, as follows:

U - Unconfined Compression
Q - Unconsolidated Undrained Triaxial
T - Torvane
P - Pocket Penetrometer
M - Miniature Vane
F - Field Vane
R - R-value

OTHER TESTS

Field or laboratory tests without a dedicated column on the boring log are reported in the Other Tests column. A letter code is used to indicate the type of test. For certain tests, a value representing the test result is also provided. Typical letter codes are as follows. Additional codes may be used. Refer to the report text and the laboratory testing results for additional information.

k - Permeability (cm/s)
Consol - Consolidation
Gs - Specific Gravity
MA - Particle Size Analysis
EI - Expansion Index
OVM - Organic Vapor Meter

WATER LEVEL SYMBOLS

Initial water level
Final water level
Seepage encountered

INCREASING MOISTURE CONTENT

Dry
Moist
Wet

CONSISTENCY OF COHESIVE SOIL

CONSISTENCY	UNDRAINED SHEAR STRENGTH (KIPS PER SQUARE FOOT)
Very Soft	< 0.25
Soft	0.25 to 0.50
Medium Stiff	0.50 to 1.0
Stiff	1.0 to 2.0
Very Stiff	2.0 to 4.0
Hard	> 4.0

Note: In absence of test data, consistency has been estimated based on manual observation.

APPARENT DENSITY OF COHESIONLESS SOIL

APPARENT DENSITY	N-VALUE
Very Loose	0 to 4
Loose	5 to 9
Medium Dense	10 to 29
Dense	30 to 49
Very Dense	> 49

TERMS AND SYMBOLS USED ON BORING LOGS PLATE A-1

DEPTH, ft	MATERIAL SYMBOL	SAMPLER TYPE	BLOW COUNT OR PRESSURE, psi	N VALUE OR RQD%	RECOVERY	LOCATION: (Latitude, Longitude) MATERIAL DESCRIPTION	DRY UNIT WEIGHT, pcf	WATER CONTENT, %	% PASSING #200 SIEVE	LIQUID LIMIT, %	PLASTICITY INDEX	UNDRAINED SHEAR STRENGTH, S_u, ksf	OTHER TESTS
			16 24 24	30	18 18"	Poorly-graded SAND with SILT and GRAVEL (SP-SM): dense, light brown, dry, fine- to coarse-grained sand, gravel up to approx 2" diameter, with some wood debris [FILL]							
			8 6 7	13	18 18"	SILTY SAND (SM): medium dense, light brown, dry to moist, fine- to medium-grained sand		10	42				MA
5			8 8 10	11	18 18"								
			6 7 10	11	18 18"	Poorly-graded SAND with SILT (SP-SM): medium dense, light greyish brown, dry to moist, fine- to medium-grained sand							
			4 5 7	12	18 18"	fine- to coarse-grained sand							
			6 7 18	25	18 18"								
10			12 16 20	23	18 18"	with occaisional thin coarse sand lenses	101	8					
15			8 16 28	28	18 18"		103	9	10				MA
			14 7 12	19	18 18"	moist to wet SILTY SAND (SM): stiff to very stiff, brownish grey to dark grey, moist to wet, at approx. 17.5 feet: ~3" lense of Silty Fat Clay (CH-MH) then back to silty fine- to medium-grained sand							
20			8 12 14	16	18 18"	Fat CLAY (CH): very stiff, black, wet, with trace organics (grass/roots/wood)	86	30					
			8 6 12	18	18 18"								
25			5 6 11	11	18 18"		80	41		60	46		
						slight sulphur odor NOTES: 1. Terms and symbols defined on Plate A-1.							

BORING DEPTH: 26.5 ft
BACKFILL: Grout
DEPTH TO WATER: Not Encountered
FIELDWORK DATE: September 27, 2016
DRILLING METHOD: 8-in. dia. Hollow Stem Auger

HAMMER TYPE: Downhole
RIG TYPE: Mobile Drill B-53
DRILLED BY: Daniel Arballo
LOGGED BY: K. Herr
CHECKED BY: M. Bajuniemi

LOG OF BORING NO. B-01A
Orange Memorial Park Storm Water Capture Project
South San Francisco, California

DEPTH, ft	MATERIAL SYMBOL	SAMPLER TYPE	BLOW COUNT OR PRESSURE, psi	N VALUE OR RQD%	RECOVERY	LOCATION: (Latitude, Longitude) MATERIAL DESCRIPTION	DRY UNIT WEIGHT, pcf	WATER CONTENT, %	% PASSING #200 SIEVE	LIQUID LIMIT, %	PLASTICITY INDEX	UNDRAINED SHEAR STRENGTH, S_u, ksf	OTHER TESTS
			11 12 12	15	18/18"	Poorly-graded SAND with SILT (SP-SM): medium dense to dense, light brown, dry, [FILL]							
			4 4 4	8	18/18"	Poorly-graded SAND with SILT (SP-SM): loose to medium dense, light brown, dry to moist, fine- to medium-grained sand							
5			8 11 12	14	18/18"	SILTY SAND (SM): medium dense, light brown, dry to moist, fine- to coarse-grained sand							
			6 6 7	13	18/18"								
			6 8 14	14	18/18"	moist, fine- to medium-grained sand with occaisional thin silty sand lenses and trace rounded pea-gravel up to approx 1/4" diameter	93	20					
10			6 8 8	16	18/18"								
15			6 8 10	18	18/18"								
			8 16 22	24	18/18"		98	15	17				MA
						Fat CLAY (CH): stiff, black, moist to wet							
20			8 9 12	13	12/18"		70	47		57	37		
						NOTES: 1. Terms and symbols defined on Plate A-1.							

BORING DEPTH: 21.5 ft
BACKFILL: Grout
DEPTH TO WATER: Not Encountered
FIELDWORK DATE: September 27, 2016
DRILLING METHOD: 8-in. dia. Hollow Stem Auger

HAMMER TYPE: Downhole
RIG TYPE: Mobile Drill B-53
DRILLED BY: Daniel Arballo
LOGGED BY: K. Herr
CHECKED BY: M. Bajuniemi

LOG OF BORING NO. B-02A
Orange Memorial Park Storm Water Capture Project
South San Francisco, California

DEPTH, ft	MATERIAL SYMBOL	SAMPLER TYPE	BLOW COUNT OR PRESSURE, psi	N VALUE OR RQD%	RECOVERY	LOCATION: (Latitude, Longitude) MATERIAL DESCRIPTION	DRY UNIT WEIGHT, pcf	WATER CONTENT, %	% PASSING #200 SIEVE	LIQUID LIMIT, %	PLASTICITY INDEX	UNDRAINED SHEAR STRENGTH, S_u, ksf	OTHER TESTS
			4 8 15	23	18/18"	Well-graded SAND with SILT and GRAVEL (SW-SM): medium dense, light brown, dry, fine- to medium-grained sand with gravel up to approx. 1" diameter [FILL]							
			17 17 15	20	18/18"	SILTY SAND (SM): medium dense, light brown, dry, fine- to medium-grained sand	97	4	21				
5			4 6 7	13	18/18"								
			7 8 9	17	18/18"								
			5 6 8	9	18/18"	light greyish brown, dry to moist	66	3	16				
			5 6 8	14	18/18"	from approx. 8.25 feet to 8.5 feet: trace organics (roots)							
10			6 6 7	13	18/18"								
15			10 10 17	27	18/18"								
			12 17 32	31	18/18"	at approx. 17 feet: with some silt and organics (roots/grass/wood) at approx. 17.5 feet: fine- to coarse-grained clean sand with organics							
20			3 9 6	15	18/18"	Fat CLAY (CH): stiff to very stiff, black, moist to wet, with trace organics (roots/grass)							
			12 16 23	24	18/18"	at approx. 21 feet: gradual transition into and out of ~3" lense of fine- to medium-grained dark grey silty sand at approx. 23 feet: with fine- to medium-garined grey sand	89	32		36	21		
						NOTES: 1. Terms and symbols defined on Plate A-1.							

BORING DEPTH: 23.0 ft
BACKFILL: Grout
DEPTH TO WATER: Not Encountered
FIELDWORK DATE: September 27, 2016
DRILLING METHOD: 8-in. dia. Hollow Stem Auger

HAMMER TYPE: Downhole
RIG TYPE: Mobile Drill B-53
DRILLED BY: Daniel Arballo
LOGGED BY: K. Herr
CHECKED BY: M. Bajuniemi

LOG OF BORING NO. B-03A
Orange Memorial Park Storm Water Capture Project
South San Francisco, California

APPENDIX B
LABORATORY TESTING

DRILL HOLE	DEPTH, ft	SAMPLE NUMBER	MATERIAL DESCRIPTION	UWW pcf	UDW pcf	MC%	FINES %	ATTERBURG LIMITS		COMPACTION TEST		DIRECT SHEAR		COMPRESSIVE STRENGTH TESTS		CORROSIVITY TESTS				R-VALUE	EXPANSION INDEX	SAND EQUIVALENT (SE)	TEST LISTING
								LL	PI	MAX DD pcf	OPT MC %	C ksf	PHI deg	Qu, ksf	S_u (Cell Prs.) ksf	R	pH	Cl	So_4				
B-01A	2.5	3	SILTY SAND (SM), Olive Brown			10	42																M, S
B-01A	10.5	10	Poorly-graded SAND with SILT (SP-SM),	108	101	8																	T
			Olive Brown																				
B-01A	16.0	13	Poorly-graded SAND with SILT (SP-SM),	113	103	9	10																T, S
			Olive Brown																				
B-01A	20.5	15	SANDY SILT (ML), Very Dark Grayish Brown	112	86	30																	T
B-01A	25.5	18	Fat CLAY (CH), Black	113	80	41		60	46														T, A
B-02A	8.5	6	Silty SAND (SM), Dark Yellwoish Brown	111	93	20																	T
B-02A	17.0	10	SILTY SAND (SM), Light Olive Brown	112	98	15	17																T, S
B-02A	20.5	12	Fat CLAY with SAND (CH), Black	103	70	47		57	37														T, A
B-03A	3.0	2	SILTY SAND (SM), Light Olive Brown	101	97	4	21																T, F
B-03A	7.5	7	SILTY SAND (SM), Light Yellowish Brown	69	66	3	16																T, F
B-03A	22.5	15	Lean CLAY (CL), Very Dark Gray	118	89	32		36	21														T, A

Classification Tests
UWW = Unit Wet Weight
UDW = Unit Dry Weight
MC = Moisture Content
Fines = % Passing #200 Sieve
LL = Liquid Limit
PI = Plasticity Index

Direct Shear Test
C = Assigned Cohesion, ksf
PHI = Assigned Friction Angle, degrees

Compaction Test
MAX DD = Maximum Dry Density
OPT MC = Optimum Moisture Content

Compressive Strength Tests
Qu = Unconfined Compression
Su = Undrained Shear Strength
u = Unconsolidated Undrained
p = Pocket Penetrometer
t = Torvane
m = Miniature Vane

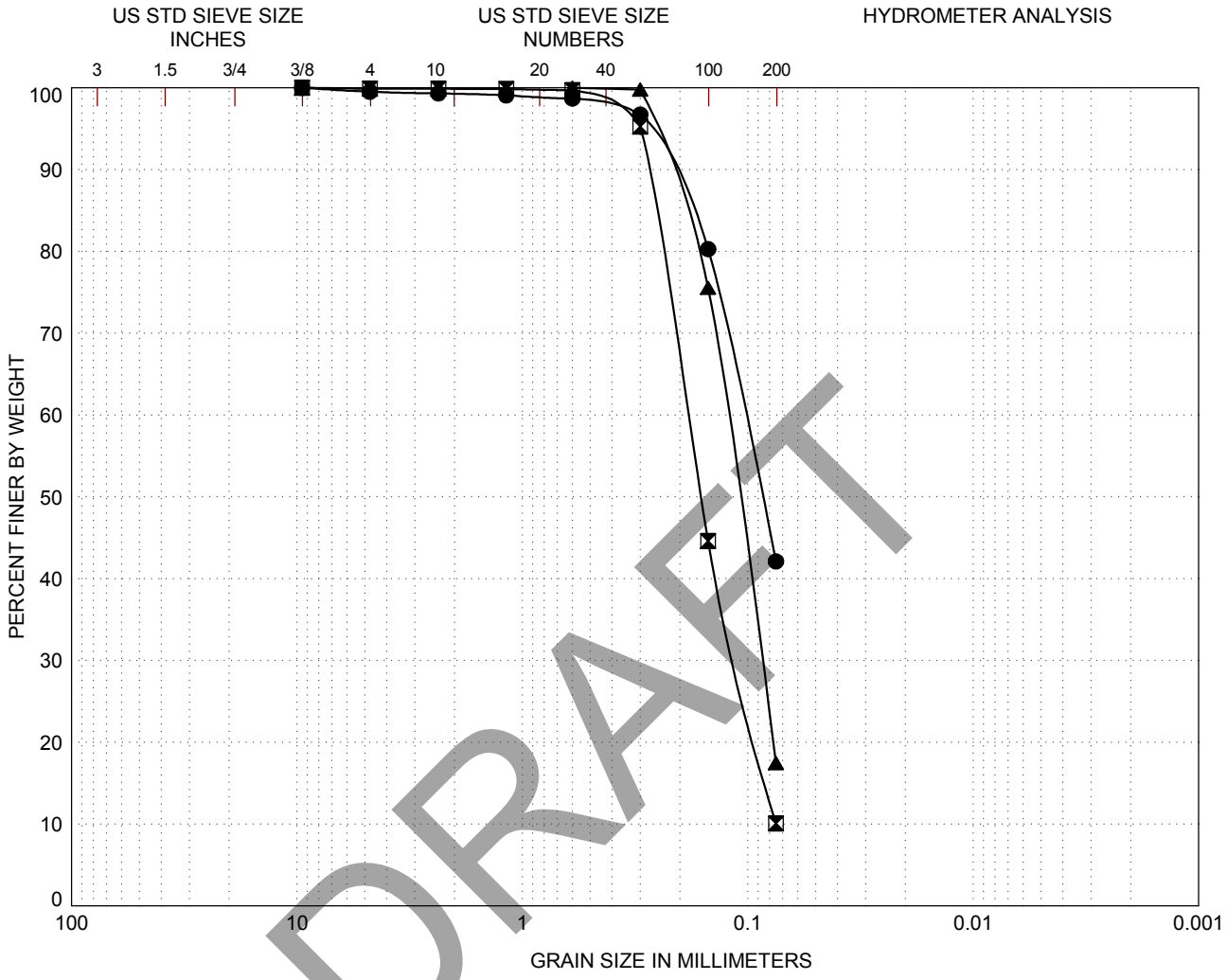
Corrosivity Tests
R = Resistivity, ohm-cm, satur.
pH = pH
Cl = Chloride, ppm
SO_4 = Sulfate, ppm

Test Listing Abbreviations
M = Moisture Content
T = Total & Dry Unit Weight
S = Sieve Analysis
FC = % Passing #200 Sieve
H = Hydrometer Analysis
A = Atterberg Limits
P = Compaction Test
D = Direct Shear Test
C = Consolidation Test
Co = Corrosivity Tests
CU = CU Triaxial
U = UU Triaxial
R = R-Value
SE = Sand Equivelant

SUMMARY OF LABORATORY TEST RESULTS

Orange Memorial Park Storm Water Capture Project
South San Francisco, California

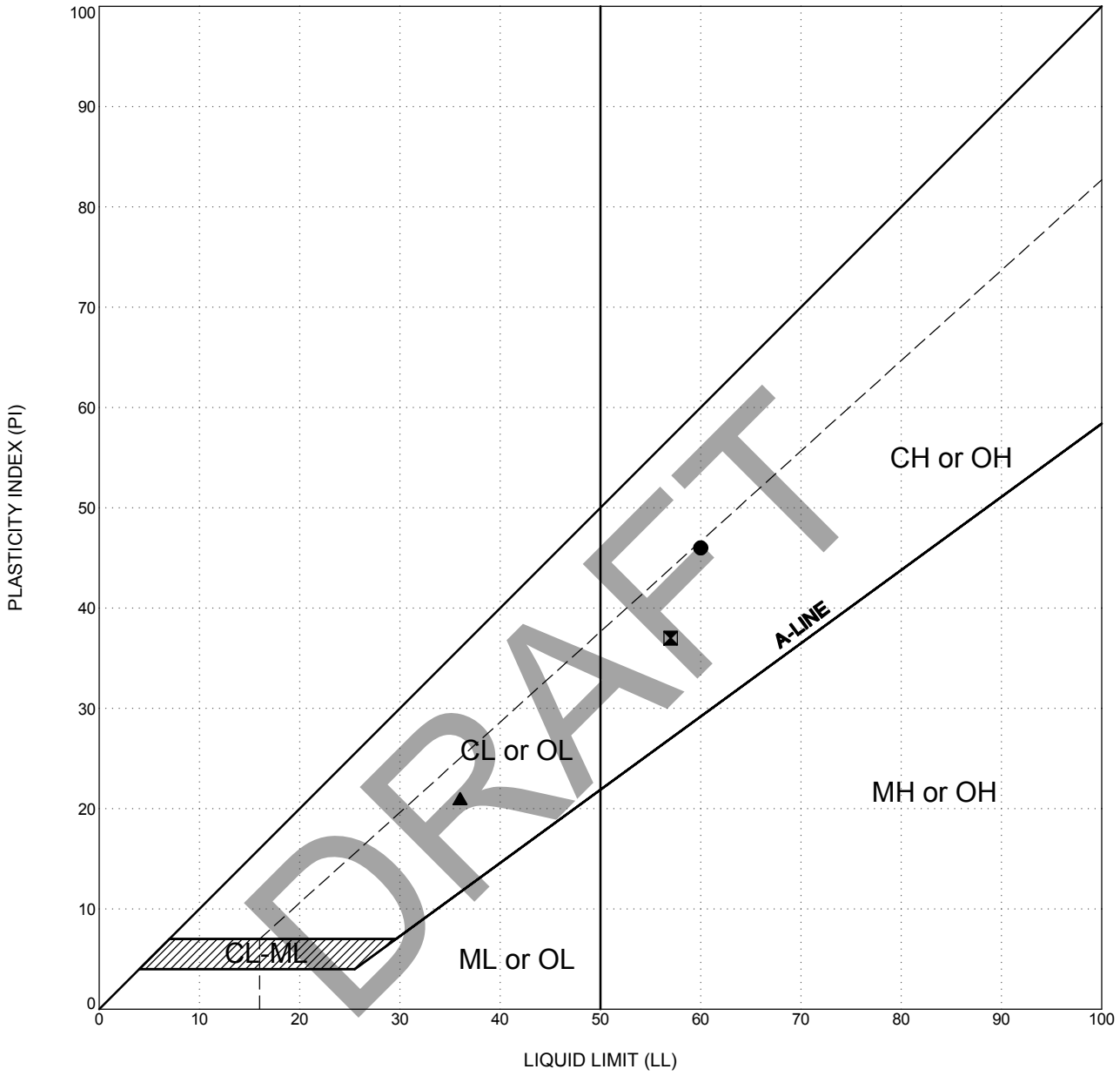
PLATE B-1



LEGEND	(location)	(depth,ft)	CLASSIFICATION	Cc	Cu	D10	D30	D60
●	B-01A	2.5	SILTY SAND (SM), Olive Brown					0.10
⊠	B-01A	16.0	Poorly-graded SAND with SILT (SP-SM), Olive Brown	0.9	2.5		0.11	0.19
▲	B-02A	17.0	SILTY SAND (SM), Light Olive Brown				0.09	0.12

GRAIN SIZE CURVES
Orange Memorial Park Storm Water Capture Project
South San Francisco, California

PLATE B-2



LEGEND	location	depth, ft	CLASSIFICATION	ATTERBERG LIMITS TEST RESULTS LIQUID LIMIT(LL)	PLASTIC LIMIT(PL)	PLASTICITY INDEX (PI)
●	B-01A	25.5	Fat CLAY (CH), Black	60	14	46
⊠	B-02A	20.5	Fat CLAY with SAND (CH), Black	57	20	37
▲	B-03A	22.5	Lean CLAY (CL), Very Dark Gray	36	15	21

PLASTICITY CHART
Orange Memorial Park Storm Water Capture Project
South San Francisco, California

PLATE B-3

APPENDIX C ENVIRONMENTAL TESTING

Table 2
Summary of Analytical Results - Soil
Orange Memorial Park Storm Water Capture Project
Oakland, California

		Sample ID												Screening Criteria		
Analyte	**Units**	B-01A@2	B-01A@5	B-02A@3	B-02A@6	B-03A@3.5	B-03A@7	B-01A@15.5	B-01A@21	B-02A@16.5	B-02A@20	B-03A@18	B-03A@22	ESL		TTLC
Sample Date		9/27/2016	9/27/2016	9/27/2016	9/27/2016	9/27/2016	9/27/2016	9/27/2016	9/27/2016	9/27/2016	9/27/2016	9/27/2016	9/27/2016	Com/Ind: Shallow Soil Exposure	Any Land Use / Any Soil Depth Exposure (CW)	
Sample Depth	ft	2.0	5.0	3.0	6.0	3.5	7.0	15.5	21	16.5	20	18	22			
Hydrocarbons																
TPHg	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	3,900	2,700	NE
TPHd	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1,100	850	NE
TPHmo	mg/kg	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	140,000	31,000	NE
Volatile Organic Compounds																
VOCs	mg/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	varies	varies	NE
Semi-Volatile Organic Compounds																
SVOCs	mg/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	varies	varies	varies
Organochlorine Pesticides																
p,p-DDD	mg/kg	<0.020	<0.0010	<0.0010	<0.0010	**0.0022**	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	12	81	[a]1.0
p,p-DDE	mg/kg	**0.47**	<0.0010	**0.0038**	<0.0010	**0.035**	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	8.5	57	[a]1.0
p,p-DDT	mg/kg	**0.38**	<0.0010	**0.0022**	<0.0010	**0.028**	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	8.5	57	[a]1.0
Dieldrin	mg/kg	**0.17**	<0.0010	**0.032**	<0.0010	**0.043**	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.17	1.1	8.0
Remaining Pesticides	mg/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	varies	varies	varies
Polychlorinated Biphenyls																
PCBs	mg/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.0	5.6	50
Metals																
Antimony	mg/kg	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	470	140	500
Arsenic	mg/kg	**2.9**	**2.9**	**2.9**	**1.7**	**2.8**	**2.5**	**1.7**	**2.3**	**1.7**	**3.0**	**2.2**	**1.0**	0.31	0.94	500
Barium	mg/kg	**28**	**32**	**30**	**16**	**22**	**34**	**1.7**	**63**	**20**	**69**	**18**	**62**	220,000	2,900	10,000
Beryllium	mg/kg	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	2,200	40	75
Cadmium	mg/kg	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	580	41	100
Chromium+	mg/kg	**34**	**32**	**33**	**21**	**42**	**32**	**23**	**46**	**24**	**49**	**25**	**53**	1,800,000#	510,000#	2,500+
Cobalt	mg/kg	**3.7**	**3.8**	**3.5**	**2.8**	**3.5**	**3.9**	**2.8**	**4.7**	**3.3**	**5.2**	**4.0**	**2.0**	350	27	8,000
Copper	mg/kg	**5.7**	**4.5**	**4.6**	**2.5**	**4.5**	**4.3**	**2.6**	**9.9**	**2.9**	**9.0**	**2.9**	**5.9**	47,000	14,000	2,500
Lead	mg/kg	**7.1**	**1.9**	**2.8**	**1.1**	**2.5**	**2.1**	**1.4**	**2.4**	**1.3**	**2.6**	**1.3**	**1.9**	320	320	1,000
Mercury	mg/kg	**0.06**	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	**0.13**	<0.050	**0.054**	<0.050	<0.050	190	42	20
Molybdenum	mg/kg	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	5,800	1,700	3,500
Nickel	mg/kg	**22**	**26**	**23**	**15**	**20**	**25**	**17**	**32**	**18**	**43**	**20**	**19**	11,000	83	2,000
Selenium	mg/kg	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	**0.52**	<0.50	**0.52**	<0.50	**0.52**	5,800	1,700	100
Silver	mg/kg	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	5,800	1,700	500
Thallium	mg/kg	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	12	3.4	700
Vanadium	mg/kg	**23**	**24**	**24**	**17**	**20**	**23**	**16**	**27**	**18**	**27**	**18**	**22**	600,000	600	2,400
Zinc	mg/kg	**28**	**18**	**21**	**11**	**19**	**19**	**12**	**23**	**12**	**25**	**13**	**13**	350,000	100,000	5,000
Asbestos																
	%	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NE	NE	1.0

Notes:
TPHg= Total Petroleum Hydrocarbons as gasoline
TPHd= Total Petroleum Hydrocarbons as diesel
TPHmo= Total Petroleum Hydrocarbons as motor oil
Detected Concentrations shown in **Bold**
<0.5 = Not detected above laboratory detection limit
mg/kg = Milligrams per kilogram
NE = Not Established
ND = Not detected
+ = Assumes Total Chromium
# = Assumes Chromium III

TTLC = Total Threshold Limit Concentration
ESL = Environmental Screening Levels, SFRWQCB, User's Guide: Derivation and Application of Environmental Screening Levels, Interim Final February 2016
Com/Ind: Shallow Soil Exposure and Direct Exposure Human Health Risk Levels Commercial/Industrial (Table S-1) Any Land Use/Any Soil Depth Exposure (Construction Worker)
[a]TTLC's are cumulative for 4,4' -DDD, -DDE, -DDT

=Concentrations in exceedence of Com/Ind: Shallow Soil Exposure ESLs
=Concentrations in exceedence of Any Land Use/Any Soil Depth Exposure (CW) ESLs
=Concentrations in exceedence of TTLC
= Concentration in exceedence of 2 or more regulatory criteria.