Geotechnical Engineering Study

CARLTON
Engineering Inc.

County of San Mateo CSA 11 Water Supply
San Mateo County, California

Project No. 6604-02-14
August 2014

Prepared for:

Mr. Curtis Lam, P.E., Principal
Hydroscience Engineers Inc.
10569 Old Placerville Road
Sacramento, CA 95827

2365 Iron Point Road, Folsom, CA 95630 Tel: (916) 932-7855 Fax: (916) 932-7845 Email: info@carlton-engineering.com

CARLTON
Engineering Inc.

August 21, 2014

Project No. 6604-02-14

Hydroscience Engineers, Inc.
10569 Old Placerville Road
Sacramento, California 95827

Attention: Mr. Curtis Lam, P.E., Principal

Re: Geotechnical Engineering Study
Proposed San Mateo County CSA 11 Water Tank
Pescadero, California

Dear Mr. Lam:

Carlton Engineering, Inc. is pleased to present the attached report containing the results of our geotechnical engineering study for the proposed water storage tank at the County of San Mateo CSA 11 Project in Pescadero, San Mateo County, California. It is our understanding that the proposed site improvements include the construction of one approximately 140,000 gallon steel water tank. The study was conducted in accordance with the Professional Services Authorization between Carlton Engineering, Inc. (Carlton) and Hydroscience Engineers, Inc. (HSe), dated July 11, 2014.

The accompanying report presents our findings, conclusions, and recommendations developed from our geotechnical engineering study. Contained in the report are geotechnical design criteria and recommendations for design and construction of the proposed structures, as well as site grading and earthwork. The results of the subsurface exploration and laboratory testing programs, which form the basis of our conclusions and recommendations, are also included in the report. On the basis of our study, the site is suitable, from a geotechnical perspective, to receive the planned improvements provided the recommendations included in this report are adhered to.

If you have any questions regarding the information contained in this report, or if we may be of further assistance, please do not hesitate to contact us.

Sincerely,
CARLTON ENGINEERING, INC.

PROFESSIONAL GEOLOGIST
DAVID B. JERMSTAD
No. E.G. 1727
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

REGISTERED PROFESSIONAL ENGINEER
CHRISTOPHER D. TRUMBULL
GE 2492
Exp. 6-30-15
GEOTECHNICAL
STATE OF CALIFORNIA

David B. Jermstad, P.G., C.E.G., R.E.A. II
Vice President/Geotechnical Manager

Christopher Trumbull, P.E., G.E., D.GE
Senior Geotechnical Engineer

TABLE OF CONTENTS

CSA 11 Water Supply Material: Brown Clayey Sand (SC) Preferred Tank Site Design Information (Note 1)			
Design Condition	Parameter	Criteria	Notes
Groundwater Conditions	Anticipated Groundwater Depth (bgs), feet	› 30'	
Seismic Design (ASCE 7-10) (Note 3)	Site Class	D	-
	Mapped MCE spectral response at short period (Ss)	2.079 g	-
	Mapped MCE spectral response at 1 sec period (S_1)	0.853 g	-
	Design Spectral Response Acceleration for short period (S_{DS})	1.386 g	-
	Design Spectral Response Acceleration for 1 sec period (S_{D1})	0.853 g	-
	MCE spectral response acceleration for short period (S_{MS})	2.079 g	-
	MCE spectral response acceleration for 1 sec period (S_{M1})	1.280 g	-
Soil Properties	Property	Native Soil (Note 4)	Notes
	Classification Foundation Layer	SC	-
	Total Unit Weight of Soil (pcf), γt	120.0	
	Internal Friction Angle, ø	32.0	
	Cohesion (psf), c	0	
	Percent Passing No. 200 (ASTM C 136 or D 422)	‹ 45%	
	Allowable Bearing Pressure (dead + live), psf	3,000	
	Passive Resistance, pcf	400	
	Frictional Coefficient	0.4	
	Maximum Cut Slope Geometry, (H:V)	2:1	-
	Static "Classic" Settlement (in)	‹ ¾	
	Corrosion Potential	Low	Note 4

Note 1: This table presents a Selection of Project Design Information and highlights a portion of the results of this specific Geotechnical Engineering Study for the proposed site improvements. The table identifies the pertinent reference section in the report for further design information. This table is provided as a reference to the Geotechnical Engineering Study and is therefore not intended to be used as a stand-alone document and should not be separated from this report. The following recommendations apply only to the preferred tank location next to the existing tank. Should the tank be constructed at the alternative tank location, Carlton should be contacted for alternate foundation recommendations.

Note 2: Mat foundations in engineered fill.

Note 3: Seismic Design is based on USGS Seismic Hazard Tool Website. Parameters are referenced from ASCE/SEI 7-10 "Minimum Design Loads for Buildings and Other Structures" and 2009 NEHRP

Note 4: Corrosion potential of soil based Caltrans Corrosion Guidelines and AWWA C-105.

This report presents the findings, conclusions, and recommendations developed from our geotechnical engineering study. The study was conducted in accordance with the Professional Services Agreement dated July 11, 2014, approving our scope of work.

1.1 PROJECT DESCRIPTION

Our understanding of the proposed project is based on discussions with Mr. Curtis Lam of HSe, and on schematic drawings of the CSA 11 Water Tank provided by HSe. The project site is shown on Figure G1. We understand that the County of San Mateo plans to construct a steel water tank with a capacity of approximately 140,000 gallons which is approximately 44 feet in diameter. Two possible tank sites were explored, a preferred tank site near the existing tank, and an alternative tank site approximately 300 feet to the north-east (site locations presented on figure G2, Appendix A). Based on discussions with HSe, we anticipate the utilization of PVC pipe below ground and ductile iron pipe above ground. We also anticipate flexible connection from the ductile iron pipe to the storage tank. We assume the tank is to be supported by a mat or ringwall foundation. Considering the tank capacity and geometry we anticipate a uniform pressure at the bottom of the tank to be 1,000 to 1,500 pounds per square foot (psf). Twelve foot wide access roads around both the existing and proposed tanks are to be planned to improve operation and maintenance activities. Based on the preliminary site plan the proposed tank is located at an elevation of approximately 186 feet mean sea level (msl).

1.2 PURPOSE AND SCOPE OF WORK

The purpose of this study was to evaluate the suitability of the project site, from a geotechnical perspective, for the proposed improvements. The main objectives of the study were to characterize the subsurface materials, perform engineering analyses, develop geotechnical recommendations and criteria to be used for design and construction, and document our findings, conclusions and recommendations in this report.

The scope of our geotechnical engineering study included the following:

- a review of published geologic and geotechnical material pertaining to the site vicinity;
- a review of Carlton's 2013 field exploration program consisting of four exploratory borings to depths of about 23 feet within the site;
- a field exploration program consisting of four exploratory borings drilled to depths of 25 to 50 feet within the site to characterize the subsurface conditions;
- Performing laboratory testing on select soil samples collected from the borings;
- engineering analyses to develop geotechnical design criteria and recommendations for the proposed project; and
- preparation of this report.

2.1 FIELD EXPLORATION

Four borings were initially drilled on January 25, 2013 for preliminary tank siting at the approximate locations shown in Figure G2. The borings were located in the field based on estimated distances to prominent landmarks. The borings were drilled to a depth of approximately 23 feet under the supervision of Mr. Dave Jermstad of Carlton. The borings were advanced with a truck mounted CME-45 drill rig equipped with 4-inch-diameter solid flight augers.

Four additional borings were drilled on July 22, 2014 for final tank siting at the approximate locations shown in Figure G2. The borings were located in the field as directed by HSe, County of San Mateo, and based on estimated distances to prominent landmarks. Four borings were drilled to a depth of approximately 25 to 50 feet under the supervision of Mr. Kyle Jermstad of Carlton. The borings were advanced with a truck mounted CME-45 drill rig equipped with 6-inch-diameter hollow-stem augers and 4-inch diameter solid flight augers.

During drilling, representative samples were obtained using Standard Penetration Test - SPT (1-3/8-inch I.D.) and Modified California (2.5-inch O.D.) split-spoon samplers. The samplers were driven into the soil a distance of 18 inches or shorter where resistance was encountered, using a 140-pound automatic hammer dropped from a height of 30 inches. The number of blows required for each 6 inch increment of drive were recorded and the cumulative blow count for the 12 inches of drive (following the first 6 inches of "seating" drive), or fraction thereof where resistance was encountered, is presented in the logs of borings (Appendix A). The blow counts presented in the logs are uncorrected and shown as they were recorded in the field. Both the samples and drill cuttings were visually classified based on the Unified Soil Classification System (USCS) in general accordance with ASTM D2487.

Logs of the borings were prepared based on the field logging, visual examination of the soil samples in the laboratory and the results of laboratory testing. The soil boring key and the logs of borings are presented in Appendix B.

2.2 LABORATORY TESTING

Laboratory testing was conducted on disturbed soil samples recovered during the site investigation. Tests conducted include:

- Standard Test Method for Particle-Size Analysis of Soils (ASTM D422);
- Standard Test Method for Amount of Material in Soils Finer Than the No. 200 (75-um) Sieve (ASTM D 1140);
- Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock by Mass (ASTM D 2216);
- Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method (ASTM D 2937);
- Standard Test Method for Direct Shear Test of Soils (ASTM D3080);

- Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils (ASTM D 4318);
- Method of Testing Soil and Waters for Sulfate Content (CA DOT 417);
- Method of Testing Soil and Waters for Chloride Content (CA DOT 422);
- Method for Estimating the Service Life of Steel Culverts (CA DOT 643);

Laboratory test results are presented in Appendix C, as well as shown on the logs of borings at the corresponding sample locations.

3.1 SITE CONDITIONS

The site is located southwest of the town of Pescadero in San Mateo County California. At the time of our site visit three existing structures were present, the steel water tank, a small masonry building, and a large equipment shelter. A large gravel area exists to the north-east of the existing tank which was covered with stockpiles in 2013 and clear in 2014. The site is relatively flat at the existing tank site sloping up to the west. There is a slough and pond to the south-west associated with the old quarry operations. Vegetation at the preferred tank site consisted of grasses less than two feet high. Photographs of the site are presented in Appendix A.

3.2 SUBSURFACE CONDITIONS

3.2.1 General Geology

The tank site is located at the reclaimed Pescadero Quarry. USGS Maps classify the site as being composed of mostly Basin Deposits (Qb) of the Holocene period. Basin Deposits consist of unconsolidated fine sand, silt, and clayey silt. Also mapped within the site proximity are Marine Terrace Deposits (Qmt) of the Pleistocene period, consisting of poorly consolidated, well-to-poorly sorted gravel. There are outcroppings of dark gray, Unnamed Volcanic Rocks (KJv) of the Jurassic or Cretaceous period. See Figure 5 in Appendix A for USGS Geological Mapping.

3.2.2 Subsurface Materials

The results of our field exploration and laboratory analysis indicate the subsurface materials generally consist of Clayey Sand (SC), Poorly Graded Sand (SP), and Silty Sand (SM) geologically mapped as Holocene Basin Deposits (Qb) at depths up to 50 feet bgs. Densities ranging from medium dense to dense were observed in the field generally increasing with depth. Details of subsurface materials are presented in the logs of borings in Appendix B.

3.2.3 Groundwater Conditions

Groundwater was encountered at a depth of 13 feet in Boring B1 in 2013. This level rose to a depth of 6 feet in 2½ hours. Groundwater was not encountered in the other borings during our field exploration in 2013. Given the time of the initial exploration (1/25/13), we consider the groundwater encountered is to be isolated to the area at boring B1 and thought to be seasonal.

Groundwater was encountered at a depth of 40-feet in Borings CE1 and CE4 drilled in 2014. Groundwater was not encountered in the other borings during our field exploration in 2014. The depth to groundwater could to vary seasonally or yearly based on drought conditions.

4.1 FOUNDATION SUPPORT AND SETTLEMENT

Based on our subsurface exploration, the proposed tank can be supported on conventional mat or ringwall foundation bearing on engineered fill. The results of our borings indicate that the foundation subgrade materials across the footprint of the proposed tank will transition from medium-dense to dense clayey sand. Due to the presence of potentially compressible near-surface clayey soils such as encountered at Boring CE2 (2014) and B1 (2013), it will be necessary to over-excavate the tank footprints to a depth of 5 feet below the proposed finish grade of the tank invert to reduce the potential for unacceptable total and differential settlements. The excavated material should be replaced with engineered fill. Recommendations for overexcavation of the tank footprint is presented in Section 5.2 of this report. For foundations and subgrade designed and prepared as recommended in this report, differential settlements are expected to be on the order of ½-inch over a horizontal distance of 50 feet. Total settlements of less than ¾ inch are anticipated.

4.3 GROUNDWATER AND WET WEATHER GRADING

Groundwater is deep and is not anticipated to be encountered during construction. At the time of our field exploration, the existing near surface soils were dry to moist. These soils will become unworkable during and shortly after periods of rainfall and require several days to dry back to a workable moisture content. The time required for drying can be reduced by discing, ripping, otherwise aerating the soil, or chemical treatment.

4.4 SEISMIC HAZARDS

The San Andreas Fault zone is located approximately 13 miles east of the project site. The San Andreas Fault zone is an active fault with historic fault displacement (CGS, 1994). Active Faults are described as faults which show evidence of Holocene displacement within the last 10,000 years.

According to the Alquist-Priolo Earthquake Fault Zone Act, the surrounding project area is not within a Special Studies Zone. The site vicinity is located in an area generally characterized as having high seismicity. According to the CGS Seismic Hazards Mapping Act, the project site is not with a Seismic Hazard Zone.

Peak Ground Accelerations	
Probability of exceedance in 50 years	Peak Ground Acceleration
50%	0.13
10%	0.48
2%	0.92

4.4.1 Fault Rupture

The site is not located within a special studies zone, and no active faults appear to be trending towards the site. Therefore, we consider the probability of ground surface rupture along a fault trace at the site to be low.

4.4.2 Ground Shaking

The site vicinity is located in an area generally characterized as having very high seismicity. The nearest active fault is the San Andreas Fault, located approximately 13 miles east of the site (CDMG, 1997). The nearest potentially active fault is the San Gregorio Fault, located approximately 0.17 miles east of the site (CDMG, 1997). Strong ground shaking at the site should be expected.

4.4.3 Liquefaction

Liquefaction occurs when excess pore pressures are generated in loose, saturated, generally cohesionless soil during earthquake shaking, causing the soil to experience a partial to complete loss of shear strength. Such a loss of shear strength can result in settlement and/or horizontal movement (lateral spreading) of the soil mass.

Two deep borings were drilled to characterize the subsurface materials regarding liquefaction. Boring CE1 was drilled at the preferred tank site and Boring CE4 was drilled at the alternate tank site. Groundwater was encountered at 40 feet in both borings.

The sand encountered below a depth of 35 feet in Boring CE1 was very dense. Therefore, since very dense sand was encountered below the groundwater, the potential for liquefaction below at the preferred tank site is low.

The sand encountered below the groundwater in Boring CE4 was medium dense, so a liquefaction evaluation was performed. The subsurface information in Boring CE4, a PGA of 0.48 (10% chance of exceedance in 50 years), and moment magnitude of 8.0 for the San Andreas Fault was evaluated using LiqIT (version 4.7.7.4) software. Based on the results of the analysis, the factor of safety against liquefaction is less than unity in the medium dense sand below the groundwater and liquefaction could occur at the alternate tank site where Boring CE4 was drilled. Therefore, based on the liquefaction potential at the alternative tank site, **we recommend siting the tank at the preferred tank site**. If, for some reason, the tank needs to be sited at the alternate location, Carlton should be contacted for alternate foundation and/or ground improvement recommendations.

4.4.4 Densification

Seismic settlement generally occurs when relatively loose to medium dense cohesionless soils come to a more compact or dense state under earthquake shaking. The settlement can occur as a result of liquefaction or in dry soils. Based on blow-counts encountered in the field, and engineered fill below the invert elevation of the proposed tank, the potential for seismic densification at the preferred tank site is low. However at the alternative site, seismic settlement could be realized due to the liquefaction potential.

4.5 CORROSION

Soils corrosivity analysis is important for estimating and mitigating the deterioration of buried ferrous metals and concrete. We performed corrosion testing on select soil samples as an indicator of the corrosive properties of the soil. The results are presented in Appendix C; the results from CE1 represent

the preferred tank location and the results from CE4 represent the alternative tank location. The test results should be reviewed by an engineer experienced in corrosion to determine how corrosive the soil is on the buried metals and concrete.

5.1 SEISMIC DESIGN

The seismic design criteria for the site (37.246 lat, -122.398 lon), listed in the table below, were developed in accordance with ASCE 7-10 and 2009 NEHRP based on the sub-surface information obtained from our geotechnical engineering study:

Parameter	Recommended Value	Reference (ASCE/SEI 7-05)
Site Class	D	Table 20.3-1
Mapped MCE spectral response at short period (S_S)	2.079 g	Equation 11-4-1
Mapped MCE spectral response at 1 sec period (S_1)	0.853 g[1]	Equation 11-4-3
Site coefficient (F_a)	1.0	Table 11.4-1
Site coefficient (F_v)	1.5	Table 11.4-2
MCE spectral response acceleration for short period (S_{MS})	2.079 g	Equation 11.4-5
MCE spectral response acceleration for 1 sec period (S_{M1})	1.280 g	Equation 11.4-6
Design Spectral Acceleration for short period (S_{DS})	1.386 g	Equation 11.4-7
Design Spectral Acceleration for 1 sec period (S_{D1})	0.853 g	Equation 11.4-8

1. The Mapped MCE spectral response for a 1 sec period is greater than 0.75g; therefore according to California Geological Survey – Note 48 a Seismic Design Category is required.

5.2 SITE PREPARATION AND EARTHWORK

5.2.1 Site Preparation

General site preparation should include removal of trash and debris, clearing of brush, and stripping of surface vegetation, including the root zone. Abandoned underground structures such as culverts or utility vaults should be removed and replaced with engineered fill, placed and compacted as recommended in Section 5.2.2. Existing utilities deeper than 5 feet below the proposed bottom of foundations and in properly compacted trenches may remain provided the ends are plugged with cement slurry. Existing utilities less than 5 feet below foundations should be evaluated by Carlton in the field on a case-by-case basis.

5.2.2 Earthwork

Tank Foundation Preparation

Materials within the footprint of the proposed tank, and five feet beyond, should be over-excavated to a depth of five feet below the tank invert. The exposed subgrade should be proof-rolled with high ground pressure equipment such as a loaded water truck or heavy roller compactor. Any soft or loose areas should be stabilized. Stabilization may be accomplished by excavating to firm, native material and replacing with engineered fill or using woven geosynthetics or geogrids. Proof-rolling and final verification of stabilization should be conducted under the observation of a Carlton representative. Upon completion of subgrade preparation, backfill with engineered fill as described below.

General Subgrade Preparation

Unsuitable native materials in areas of improvement should be removed and replaced with engineered fill. Any soft or loose areas should be stabilized. Stabilization may be accomplished by excavating to firm, native material and replacing with engineered fill or using woven geosynthetics or geogrids. Proof-rolling and final verification of stabilization should be conducted under the observation of a Carlton representative. Upon completion of subgrade preparation, backfill with engineered fill as described below.

Engineered Fill

Engineered fill should consist a homogenous mixture of soil and rock free of vegetation, organic material, rubbish, and/or rubble. Highly plastic or organic soils should not be used for engineered fill, but may be placed in landscape areas.

We anticipate that most of the materials generated from on-site excavations will be suitable for use as engineered fill. Material to be used as engineered fill should meet the specifications listed below after compaction:

Direct Shear (ASTM D 3080)	Atterberg Limits (ASTM D 4318)	Particle Size (ASTM C 136 or D 422)
>32°	PI < 15 LL < 40	100% passing the 6 in. sieve minimum of 85% passing the 2-1/2 in. sieve maximum of 30% passing the #200 sieve

Carlton Engineering should observe and approve fill material in writing prior to the material being brought on site. To the extent practical, engineered fill material should not contain rocks greater than 6 inches in largest dimension. In general, rocks placed in fill should be surrounded by a well-compacted soil matrix to prevent "nesting" and the creation of voids within the fill.

Compaction

Engineered fill should moisture conditioned as necessary, placed in horizontal loose lifts not exceeding 8 inches in thickness, and compacted to a minimum of 95 percent of the maximum dry density as determined by the ASTM D 1557 test method.

Fill Slopes

Fill slopes should be constructed at an inclination of not steeper than 2H:1V, should be laterally over-built at least one foot, and the slope face trimmed back to firm, compacted material.

Trench Backfill

Trench backfill should meet the Engineered Fill specifications detailed above. Trench backfill should be placed in lifts not exceeding 12 inches in thickness, and compacted to 90% of ASTM D1557 by mechanical means only (no jetting). In areas to receive paved improvements, 95% of ASTM D1557 is required. Pipe bedding shall conform to the pipe manufacturer's recommendations.

Thrust Blocks
Assuming a pipe depth of 3 feet bgs, a passive lateral resistance of 350 pcf may be used for design.

Pipe Design
Samples collected from the top five feet in our explorations consist of a moist density of 120 pcf. These in-situ densities correlate to a Modulus of Soil Reaction of native materials E'_n equal to 1000 pounds per square inch (psi). For backfill that has been compacted as engineered fill as described above, E'_B is equal to 2500 psi.

5.2.3 Temporary Slopes/Shoring

Temporary slopes and shoring should conform to OSHA standards. Shored excavations should be constructed from the top down in cuts not exceeding 5 vertical feet in depth. Excavation of subsequent cuts should not be performed until shoring of the adjacent upper cut has been completed. Protection of workers and adjacent structures, shoring design, and the stability of all temporary slopes should be contractually established as solely the responsibility of the contractor.

Foundation excavations for new structures may be near existing foundations. In order to minimize impacts on the existing facilities during excavation, Carlton recommends that trenching be located outside an imaginary 1.5:1 (H:V) plane from the base of the existing foundation in firm native undisturbed soil. In the event that this recommendation is not practical, the designer shall incorporate trench shoring or structural improvements such as sheet piling to protect the existing adjacent foundations. Trench support shall be designed by a Professional Engineer registered in the State of California and shall consider adjacent surcharge.

5.3 FOUNDATIONS

Provided herein are the soil parameters to be used for the foundation design at the preferred tank site shown of Figure G2. The parameters are based on subsurface borings, laboratory testing of collected samples and engineering judgment (See Appendix B and C).

Soil Parameters	Native Materials 1.5-5 feet	Native Materials 5 – 50feet
Dry Unit Weight of Soil (pcf), γ_d	105	120
Total Unit Weight of Soil (pcf), γ_t	120 [2]	132 [2]
Internal Friction Angle, ø	32°	35°
Cohesion (psf), c	0	0
Moisture Content	15%	10%

5.3.1 Tank Foundations

The following recommendations apply only to the preferred tank location next to the existing tank. Should the tank be constructed at the alternative tank location, Carlton should be contacted for alternate foundation recommendations. The proposed tank can be supported on a shallow mat or ringwall foundation designed to impose a bearing pressure of not more than 3,000 psf, dead plus live load. The

allowable bearing pressure can be increased by one-third for wind and seismic loads if allowed by applicable building codes. The proposed mat foundation should span the entire footprint of the tank, with a minimum depth of 12 inches below lowest adjacent grade. The proposed ringwall foundation should have a minimum width and depth of 24 inches. Adjacent foundations or parallel utility trenches should be located such that the bottom of the mat or ringwall foundations are below an imaginary 2:1 (H:V) plane projected up from the bottom of adjacent foundations or trenches.

5.3.2 Passive Resistance

Passive earth resistance or passive earth pressure is the amount of resistance provided by the soil in response to a movement of a structure resulting in a compressive force upon the soil. A few examples of these structures include retaining walls, foundations, and thrust blocks. A friction coefficient of 0.41 is recommended. A passive earth pressure of 400 pounds per cubic foot should be used if the upper foot of soils are ignored. If the foundation is poured against neatly excavated soil without the use of forms, both the friction coefficient, and the passive resistance may be used in design. Passive earth pressures provided herein this report assume that the zone of interest is above groundwater table and on a relatively level surface. If these conditions are not met in any of the foundation locations, Carlton shall be contacted to provide a reduced passive earth pressure value. A Carlton representative should be present prior to pouring of footings to verify the footing excavations meet the conditions listed in this report.

5.4 PAVEMENT

The scope of work at this site does not include an actual pavement design. However, a minimum 12-inch depth of crushed aggregate should be placed to facilitate light and intermittent vehicular traffic and parking at the site. The work to support this effort shall consist of furnishing, spreading and compacting Caltrans Class 2 aggregate base (AB). A design R-value of 20 was estimated for the AB.

Area	Subgrade	Traffic Index	AC	AB
Access Drives/Drive way	Clayey Sand (SC)	4.5	0	12

Native subgrade soils below proposed pavement areas should be scarified to a minimum depth of 8 inches, moisture conditioned as necessary, and compacted to a minimum relative compaction of 95 percent based on ASTM D 1557. Final moisture conditioning and compaction should be accomplished after the underground utilities have been installed, and immediately prior to placement of the AB.

All AB for roadways should be moisture conditioned as necessary and compacted to a minimum relative compaction of 95 percent based on ASTM D 1557. Subgrade should be stable (not pumping/yielding) at the time AB is placed. The performance of pavement is highly dependant on uniform and properly compacted subgrade, as well as proper compaction of trench backfill within the limits of the pavement. The exposed subgrade should be proof-rolled with high ground pressure equipment such as a loaded water truck or heavy roller compactor. Any soft or loose areas should be stabilized. Stabilization may be accomplished by excavating to firm, native material and replacing with engineered fill or using woven geosynthetics or geogrids. Proof-rolling and final verification of stabilization should be conducted under the observation of a Carlton representative. All earthwork within pavement areas should be performed in accordance with

the recommendations contained in this report. Materials, quality and construction of the structural pavement section should, at a minimum, conform to applicable provisions of the current Caltrans Standard Specifications.

5.5 SURFACE DRAINAGE AND EROSION CONTROL

Drainage around structures should be constructed in a way such that soils near the structures do not become saturated. Surfaces within 10 feet of structures should be sloped a minimum of 2 percent to direct water away and prevent ponding.

Erosion control measures should be implemented for exposed surfaces, which may be subject to soil erosion during periods of intensive rainfall. If structural improvements cannot be completed prior to the rainy season, erosion control and subgrade mitigation measures may be necessary. In general, all construction surfaces should be graded to drain to prevent water from ponding.

5.6 PLAN REVIEW AND CONSTRUCTION OBSERVATION

Our conclusions and recommendations are contingent upon Carlton being retained to review project plans and specifications during construction document phase to evaluate if they are consistent with our recommendations. They are also contingent upon Carlton being retained to provide intermittent observation, and appropriate field and laboratory testing during site preparation and grading, foundation excavation, fill placement and compaction, and sub-drain installation, to evaluate if the subsurface conditions are as anticipated and to check for conformance with our recommendations as follows:

Recommended Field Verification Testing for Engineered Fill

Material	Test Performed	Frequency	Purpose
Fill	In Situ Density/Moisture Test	1 per 100 cubic yards or at a minimum of 4 tests per day	Assess adequacy of compaction effort
	Confirmation of Nuclear Gauge	1 per 1,000 cubic yards	Assess reliability of field density
	Modified Proctor	1 per 1,000 cubic yards or 1 per import source, whichever is more appropriate	Assess material change
	Gradation test	1 per 1,000 cubic yards or per each import source	Assess particle size gradation adequacy

If the subsurface conditions are observed to be different from those described in this report, we should be notified immediately so that the changed conditions can be evaluated and our recommendations revised, if appropriate. The recommendations in this report are contingent upon our notification and review of changed conditions. These services are performed on an as-requested basis and are in addition to this geotechnical study. We cannot provide comment on conditions, situations or stages of construction that we are not notified to observe.

This report has been prepared by Carlton Engineering, Inc. (Carlton) under the professional supervision of those senior partners and/or senior staff whose seals and signatures appear herein.

Site exploration and testing characterizes subsurface conditions only at the locations where the explorations or tests are performed; actual subsurface conditions between explorations may be different than those described in this report. Variations of subsurface conditions from those analyzed or characterized in this report are not uncommon and may become evident during construction. In addition, changes in the condition of the site can occur over time as a result of either natural processes (such as earthquakes, flooding, or changes in ground water levels) or human activity (such as construction adjacent to the site, dumping of fill, or excavating). If changes to the site's surface or subsurface conditions occur since the performance of the field work described in this report, or if differing subsurface conditions are encountered, we should be contacted immediately to evaluate the differing conditions to assess if the opinions, conclusions, and recommendations provided in this report are still applicable or should be amended.

The geotechnical engineering study upon which this report is based was conducted for the proposed structures at the project site described in this report. The conclusions and recommendations contained in this report are not valid for other structures and/or project sites. If the proposed project is modified or relocated, or if the subsurface conditions found during construction differ from those described in this report, Carlton should be provided the opportunity to review the new information or changed conditions to determine if our conclusions and recommendations need revision.

The interpretations of data, findings, conclusions, recommendations and professional opinions in this report are based on the available information, site conditions and samples collected during our field exploration, and were developed in accordance with generally accepted geotechnical engineering principles and practices, and as prescribed by the client. There is no warranty, either expressed or implied. Carlton accepts no liability regarding completeness or accuracy of the information presented and/or provided to us, or any conclusions and decisions which may be made by the client or others regarding the subject site/project. Verification of our conclusions and recommendations is subject to our review of the project plans and specifications, and our observations of construction.

This report is considered valid for the proposed project for a period of two years from the report date provided that the site conditions and development plans remain unchanged. With the passage of time, changes in the conditions of a property can occur due to natural processes or the works of man on this or adjacent properties. Legislation or the broadening of knowledge may result in changes in applicable standards. Depending on the magnitude of any changes, Carlton may require that additional studies (at additional cost) be performed and that an updated report be issued. Additional studies may disclose information which may significantly modify the findings of this report. Carlton will retain untested samples collected during our field study for a period not to exceed 60 days unless other arrangements are made with the client.

Our scope of services was limited to the proposed work described in this report, and did not address other items or areas. Our scope of services did not include environmental site assessments or an investigation of the presence or absence of hazardous, toxic or corrosive materials in the soil, surface water, ground water or air, on or below, or around the site. Our scope of services did not include an evaluation or investigation of the presence or absence of wetlands.

This report was prepared solely for the use of our client. The use of, or reliance upon, this report by any party, other than the client, shall be solely at the risk of such party. The client is responsible to ensure that all relevant parties to the project, including designers, contractors, subcontractors, etc., are made aware of this report in its entirety. No other entity or person shall use or rely upon this report, or any of Carlton's work products, unless expressly authorized by Carlton.

Brabb, E.E. 1993. Preliminary geologic map of the onshore part of the Palo Alto 1:100,000 quadrangle, California

Jennings, Charles W., 1994. Fault Activity Map of California and Adjacent Areas, California Geologic Survey. 1:750,000 scale.

California Geological Survey, 1997. Fault Rupture Hazard Zones in California (supplemented 1999), Special Publication 42

California Department of Transportation (Caltrans). 2003. Corrosion Guidelines.

California Geologic Survey, 2006. Seismic Hazard Zone Report for the Palo Alto 7.5-Minute Quadrangle, San Mateo and Santa Clara Counties, California. Seismic Hazard Zone Report 111.

California Department of Transportation (Caltrans), 2009. Highway Design Manual.

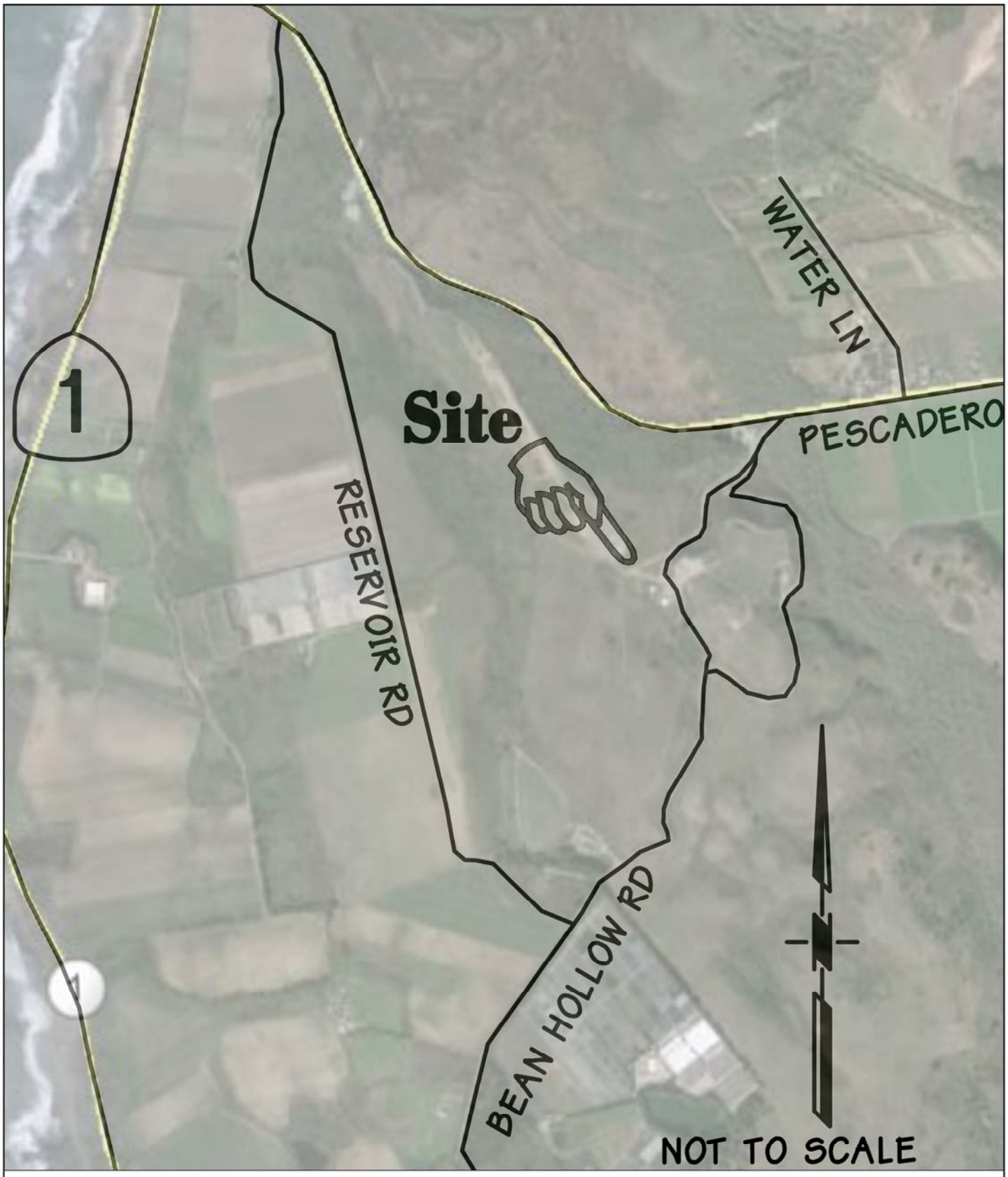
International Conference of Building Officials, 2013. California Building Code, Vol. 2.

U.S. Geologic Survey, 1999 Land Subsidence in the United States, Circular 1182, 177 pages.

U.S. Seismic Design Maps, June 12, 2014, U.S. Geologic Survey, ‹http://earthquake.usgs.gov/designmaps/us/application.php›

APPENDIX A

FIGURES AND PHOTOGRAPHS



6604-02-14	08/21/2014

CARLTON
Engineering Inc.
2365 Iron Point Road, Suite 220, Folsom, CA 95630
Voice 916.932.7855 Fax 916.932.7845

CSA 11 Water Supply Project

Pescadero

San Mateo, CA

Vicinity Map

FIGURE

G1

Legend

EXPLORATORY BORING LOCATION (2013)
EXPLORATORY BORING LOCATION (2014)

0 30' 60'

1500 feet to Pescadero Creek Road

CE4
CE3

Alternative tank site

Preferred tank site

(E) GRAVEL ROAD

184
185
186
187
188
189
190

CE1
CE2

NEW 140,000 GALLON TANK

NEW GRAVEL ACCESS ROAD 12' WIDE

10"DIP

(E) WV

(E) WATER TANK

6"DIP

(E) BUILDING

(E) WV

B1
B2
B3
B4

TOE OF SLOPE

(E) Equipment Storage Building

600 feet to Bean Hollow Road

22Aug2014 3:44pm 660401_G02

TEAM DRIVEN SOLUTIONS FOR THE BUILT ENVIRONMENT

CARLTON
Engineering Inc.

2365 Iron Point Road, Suite 220, Folsom, CA 95630
Voice 916.932.7855 Fax 916.932.7845

County of San Mateo
CSA 11 Water Supply Project

EXPLORATORY LOCATION PLAN

Project Location: Pescadero, California
Property Owner: County of San Mateo
APN:

DESIGN	DRAWN	RELEASE DATE
CT	KJ	08/15/2014
Hz SCALE		PROJECT
1"=30'		6604-02-14

CHECKED BY & DATE
CDT 8/20/14

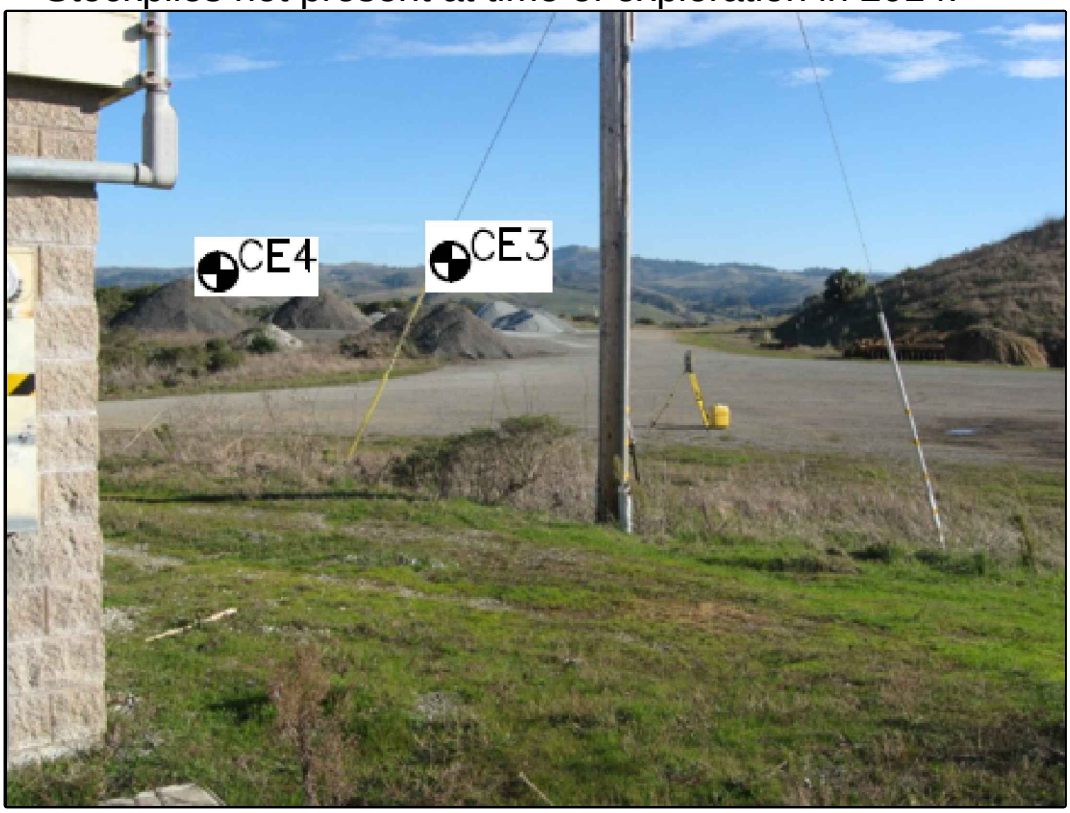
FIGURE
G2

Approximate location of CE1 and CE2 at preferred tank site looking west.

6604-02-14	08/21/2014	CSA 11 Water Supply Pescadero San Mateo, CA	FIGURE 1

CARLTON
Engineering Inc.
2365 Iron Point Road, Suite 220, Folsom, CA 95630
Voice 916.932.7855 Fax 916.932.7845

Approximate location of CE3 and CE4 at alternate tank site looking north-east. Stockpiles not present at time of exploration in 2014.



6604-02-14	08/21/2014	CSA 11 Water Supply Pescadero San Mateo County, CA	FIGURE 2

CARLTON Engineering Inc.
2365 Iron Point Road, Suite 220, Folsom, CA 95630
Voice 916.932.7855 Fax 916.932.7845

Approximate location of B1 and B2 drilled in 2013.

6604-02-14	08/21/2014	CSA 11 Water Supply Pescadero San Mateo County, CA	FIGURE 3

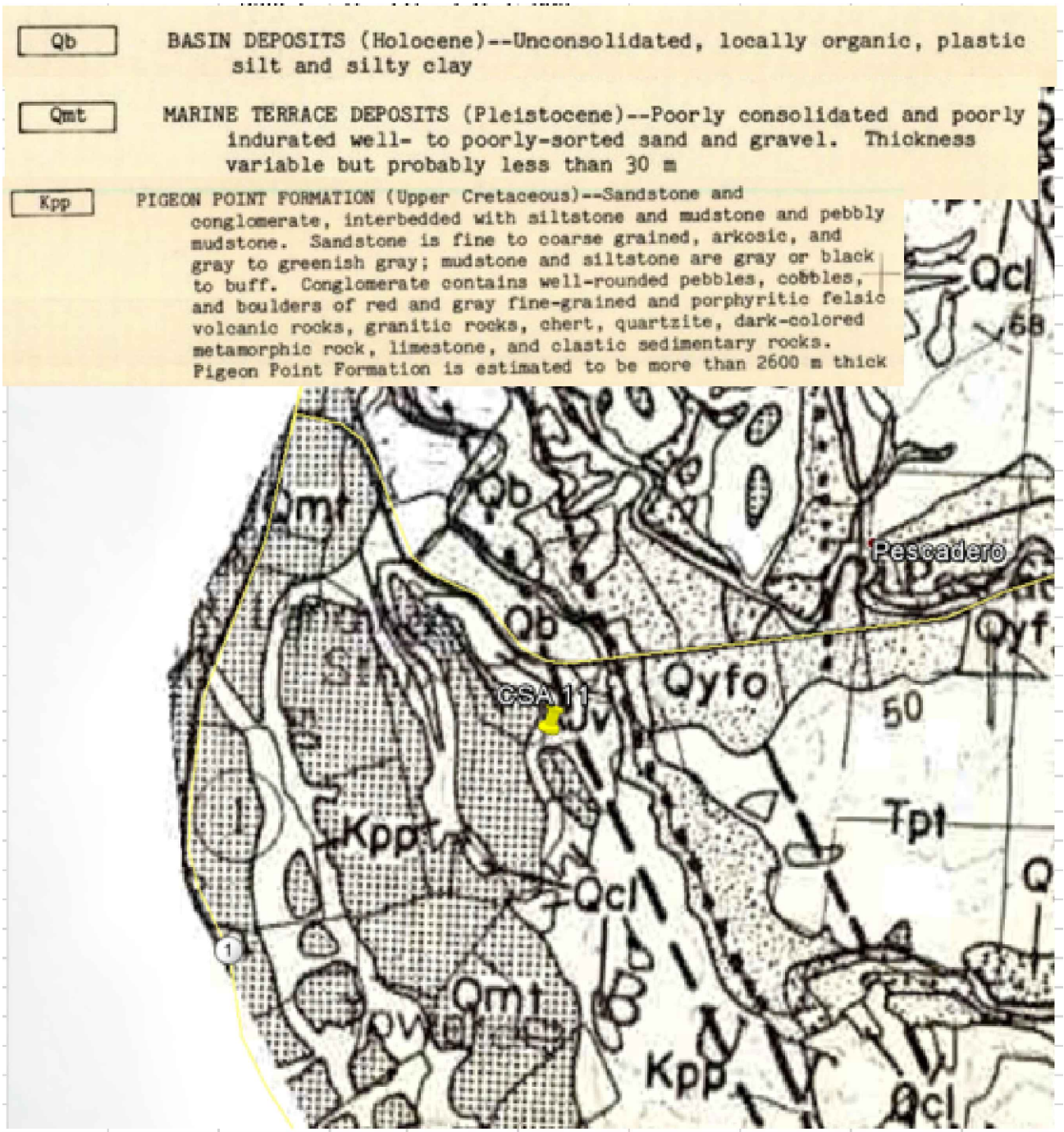
CARLTON
Engineering Inc.
2365 Iron Point Road, Suite 220, Folsom, CA 95630
Voice 916.932.7855 Fax 916.932.7845

Approximate location of B2, B3 and B4 drilled in 2013.

Example of weathered bedrock encountered at B3 (2013).

6604-02-14	08/21/2014	CSA 11 Water Supply Pescadero San Mateo County, CA	FIGURE 4

CARLTON Engineering Inc.
2365 Iron Point Road, Suite 220, Folsom, CA 95630
Voice 916.932.7855 Fax 916.932.7845



USGS Geological Map of the County of San Mateo Water Supply Project site. (Brabb, E.E. 1993)

KJv — UNNAMED VOLCANIC ROCKS (Jurassic or Cretaceous)--Dark-gray, dense, finely-crystalline felsic volcanic rock, with quartz and albite phenocrysts. Exposed only west of Pescadero. Thickness unknown

Qyfo — YOUNGER (OUTER) ALLUVIAL FAN DEPOSITS (Holocene)--Unconsolidated fine sand, silt, and clayey silt

Qcl — COLLUVIUM (Holocene)--Loose to firm, friable, unsorted sand, silt, clay, gravel, rock debris, and organic material in varying proportions

6604-02-14	08/21/2014	CSA 11 Water Supply Pescadero San Mateo County, CA	FIGURE 5

CARLTON Engineering Inc.
2365 Iron Point Road, Suite 220, Folsom, CA 95630
Voice 916.932.7855 Fax 916.932.7845

APPENDIX B

LOGS OF BORINGS

CARLTON
Engineering
2365 Iron Point Road, Suite 220, Folsom, CA 95630
Voice (916) 932-7855 Fax (916) 932-7845

LOG OF BORING B1

Sheet 1 of 1

Project: CSA 11 Water Supply

Location: **Pescadero, San Mateo County CA** Project Number: **6604-02-14**

Start Date:	**1/25/13**	Finish Date:	**1/25/13**	Total Depth Drilled (ft bgs):	**16.5**
Drilling Method:	**4-inch Flight Auger**	Drilling Contractor:	**Cal Nev Geoexploration**	Arbitrary Ground Surface Elevation:	**100**
Drill Rig:	**CME-45**	Hammer Type:	**Automatic Trip**	Hammer Weight / Drop:	**140 lbs. / 30 inches**
Logged By:	**D. Jermstad**	Reviewed By:	**N. Bowersox**	Borehole Backfill:	**Grout**
Remarks:					

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6"	Uncorrected N Value	Pocket Pen (tsf)	Water Content (%)	Dry Density (pcf)
100	0	Reddish brown Clayey Sand (SC), moist, loose to medium dense.	SC		CA	1-1B 1-1A 1-1	4 3 3	6	1.5		
98	2										
96	4				SS	1-2B 1-2A 1-2	0 1 6	7			
94	6	2.5 hrs Bluish brown Clayey Sand (SC), moist to wet, loose to medium dense			SS	1-3B 1-3A 1-3	15 12 9	21			
92	8										
90	10		SC		MC	1-4B 1-4A 1-4	3 4 5	9		23	100
88	12										
86	14	ATD									
84	16				MC	1-5A 1-5	5 6 6	12		29	94
		Boring Terminated in loose Clayey Sand (SC). Groundwater encountered at 13' bgs, rising to 6' bgs in 3.5 hours.									
82	18										
80	20										
78	22										
76	24										
74	26										
72	28										
70	30										

LOG OF BORING CSA 11.GPJ CARLTON ENGINEERING.GDT 8/22/14

CARLTON
Engineering
2365 Iron Point Road, Suite 220, Folsom, CA 95630
Voice (916) 932-7855 Fax (916) 932-7845

LOG OF BORING B2

Sheet 1 of 1

Project: CSA 11 Water Supply

Location: **Pescadero, San Mateo County CA**

Project Number: **6604-02-14**

Start Date:	**1/25/13**	Finish Date:	**1/25/13**	Total Depth Drilled (ft bgs):	**16.0**
Drilling Method:	**4-inch Flight Auger**	Drilling Contractor:	**Cal Nev Geoexploration**	Arbitrary Ground Surface Elevation:	**186**
Drill Rig:	**CME-45**	Hammer Type:	**Automatic Trip**	Hammer Weight / Drop:	**140 lbs. / 30 inches**
Logged By:	**D. Jermstad**	Reviewed By: **N. Bowersox**	Borehole Backfill:	**Grout**	
Remarks:	**Groundwater not encountered**				

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6"	Uncorrected N Value	% Passing No. 200 Sieve	Liquid Limit	Plasticity Index
186	0	Brown Clayey Sand (SC), moist, medium dense									
184	2				SS	2-1	11 12 11	23			
182	4										
180	6				SS	2-2	5 6 8	14			
178	8		SC								
176	10				SS	2-3	3 3 4	7	42	27	
174	12										
172	14										
		Sedimentary Bedrock, moist, completely weathered, medium strong to strong.	RX		SS	2-4	50/5.5	50+			
170	16	Boring Terminated at 16.5', No groundwater encountered.									
168	18										
166	20										
164	22										
162	24										
160	26										
158	28										
156	30										

LOG OF BORING CSA 11.GPJ CARLTON ENGINEERING.GDT 8/22/14

CARLTON Engineering
2365 Iron Point Road, Suite 220, Folsom, CA 95630
Voice (916) 932-7855 Fax (916) 932-7845

LOG OF BORING B3

Sheet 1 of 1

Project: CSA 11 Water Supply

Location: **Pescadero, San Mateo County CA**

Project Number: **6604-02-14**

Start Date:	**1/25/13**	Finish Date:	**1/25/13**	Total Depth Drilled (ft bgs):	**24.0**
Drilling Method:	**4-inch Flight Auger**	Drilling Contractor:	**Cal Nev Geoexploration**	Arbitrary Ground Surface Elevation:	**186**
Drill Rig:	**CME-45**	Hammer Type:	**Automatic Trip**	Hammer Weight / Drop:	**140 lbs. / 30 inches**
Logged By:	**D. Jermstad**	Reviewed By:	**N. Bowersox**	Borehole Backfill:	**Grout**
Remarks:	**Groundwater not encountered**				

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6"	Uncorrected N Value	Pocket Pen (tsf)	% Passing No. 200 Sieve	Liquid Limit	Plasticity Index
186	0	Brown Clayey Sand (SC), dry to moist, medium dense to dense										
					SS	3-1	5 15 24	39	4.5+			
184	2											
			SC									
182	4				SS	3-2	11 11 11	22	4.5+	31	22	
180	6											
178	8											
176	10	Sedimentary Bedrock, moist, completely weathered, medium strong to strong.			SS	3-3	20 23 43	66	4.5+			
174	12											
172	14											
170	16				SS	3-4	16 13 24	37				
			RX									
168	18											
166	20				SS	3-5	11 18 22	40				
164	22											
		Becomes moderately weathered, strong										
162	24				SS	3-6	50/1"	50+	4.5+			
		Boring Terminated at 24', No groundwater encountered.										
160	26											
158	28											
156	30											

LOG OF BORING CSA 11.GPJ CARLTON ENGINEERING.GDT 8/22/14

CARLTON Engineering
2365 Iron Point Road, Suite 220, Folsom, CA 95630
Voice (916) 932-7855 Fax (916) 932-7845

LOG OF BORING B4

Sheet 1 of 1

Project: CSA 11 Water Supply

Location: **Pescadero, San Mateo County CA**

Project Number: **6604-02-14**

Start Date:	**1/25/13**	Finish Date:	**1/25/13**	Total Depth Drilled (ft bgs):	**15.0**
Drilling Method:	**4-inch Flight Auger**	Drilling Contractor:	**Cal Nev Geoexploration**	Arbitrary Ground Surface Elevation:	**100**
Drill Rig:	**CME-45**	Hammer Type:	**Automatic Trip**	Hammer Weight / Drop:	**140 lbs. / 30 inches**
Logged By:	**D. Jermstad**	Reviewed By:	**N. Bowersox**	Borehole Backfill:	**Grout**
Remarks:	**Groundwater not encountered**				

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6"	Uncorrected N Value	Pocket Pen (tsf)	Water Content (%)	Dry Density (pcf)	% Passing No. 200 Sieve	Liquid Limit	Plasticity Index
100	0	Brown Clayey Sand (SC), moist, medium dense	SC		CA	4-1B	23							
						4-1A	25	53	4.5+	11	121			
						4-1	28							
98	2					4-2B	12							
					MC	4-2A	12	25			106			
						4-2	13			9				
96	4				SS	4-3	5 5	9						
							4 3							
94	6				SS		5 7	12				23	19	
							6							
					SS		7	14						
92	8						7 7							
					SS		4	9						
							5							
90	10				SS		4 5	11						
							6 6							
					SS		6	12						
88	12						6 9							
		Sedimentary Bedrock, moist, completely weathered, medium strong to strong.	RX		SS		16 26	42						
86	14	Becomes strong			SS		38 54	50+						
		Boring Terminated at 15', No groundwater encountered.					50/5"							
84	16													
82	18													
80	20													
78	22													
76	24													
74	26													
72	28													
70	30													

LOG OF BORING CSA 11.GPJ CARLTON ENGINEERING.GDT 8/22/14

CARLTON
Engineering
2365 Iron Point Road, Suite 220, Folsom, CA 95630
Voice (916) 932-7855 Fax (916) 932-7845

LOG OF BORING CE1

Project: CSA 11 Water Supply

Location: **Pescadero, San Mateo County CA**

Project Number: **6604-02-14**

Start Date:	**7/22/14**	Finish Date:	**7/22/14**	Total Depth Drilled (ft bgs):	**50.0**
Drilling Method:	**6-inch Hollow Stem Auger**	Drilling Contractor:	**Cal Nev Geoexploration**	Arbitrary Ground Surface Elevation:	**191**
Drill Rig:	**CME-45**	Hammer Type:	**Automatic Trip**	Hammer Weight / Drop:	**140 lbs. / 30 inches**
Logged By:	**K. Jermstad**	Reviewed By:	**C. Trumbull**	Borehole Backfill:	**spoils**
Remarks:	**Groundwater encountered at 40'**				

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6"	Uncorrected N Value	Torvane (psi)	Water Content (%)	Dry Density (pcf)	% Passing No. 4 Sieve	% Passing No. 200 Sieve	Liquid Limit	Plasticity Index
190	0	Yellow Brown Clayey Sand (SC) Moist, Medium Dense, Fine Grained													
	2														
188															
	4														
186					SS	1-1Z	10 10 6	16	.5						
	6														
184															
	8														
182															
	10		SC		MC	1-1B 1-1A 1-1	4 10 14	24	2.5	20 19	110	100	20		
180															
	12														
178															
	14														
176															
	16				MC	1-2A 1-2	5 6 18	24						39	
174															
	18														
172															
	20	Yellow / Olive Brown Mottled Silty Sand (SM) Moist, Medium Dense			SS	1-3Z	15 23 29	52	1.5						
170															
	22		SM		MC	1-3A 1-3	11 12 16	28		15	106				
168															
	24														
166															
	26	Olive Brown Clayey Sand (SC) Moist, Dense			MC	1-4A 1-4	10 17 29	46	1.5						
164															
	28		SC		SS	1-4Z	11 14 18	32		18			14		
162															
	30														

CARLTON
Engineering
2365 Iron Point Road, Suite 220, Folsom, CA 95630
Voice (916) 932-7855 Fax (916) 932-7845

LOG OF BORING CE1

Project: CSA 11 Water Supply

Location: **Pescadero, San Mateo County CA**

Project Number: **6604-02-14**

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6"	Uncorrected N Value	Torvane (psi)	Water Content (%)	Dry Density (pcf)	% Passing No. 4 Sieve	% Passing No. 200 Sieve	Liquid Limit	Plasticity Index
160	30	Olive Brown Clayey Sand (SC) Moist, Dense Becomes more dense and granular	SC		MC	NR 1-5	9 14 37	51		12	101				
158	32				SS	1-5Z	13 18 25	43							
156	34	Brown Poorly Graded Sand (SP) Moist, Very Dense, Medium Grained			MC	1-6A 1-6	50+ 50+								
154	36				SS	1-6Z	38 50+			11		100	5		
152	38														
150	40 ATD	Groundwater Encountered	SP		MC	1-7	13 50+			17	102				
148	42														
146	44	Brown Poorly Graded Sand (SP) Wet, Very Dense	SP		MC	1-8A 1-8	11 50+			16	101				
144	46														
142	48														
140	50	Yellow Brown Poorly Graded Sand (SP) Wet, Very Dense	SP		MC	1-9	50+			19			3		
138	52	Boring Terminated at 51.5', Groundwater encountered at 40'.													
136	54														
134	56														
132	58														
130	60														
128	62														
126	64														
	66														

CARLTON
Engineering
2365 Iron Point Road, Suite 220, Folsom, CA 95630
Voice (916) 932-7855 Fax (916) 932-7845

LOG OF BORING CE2

Sheet 1 of 1

Project: CSA 11 Water Supply

Location: **Pescadero, San Mateo County CA** Project Number: **6604-02-14**

Start Date:	**7/22/14**	Finish Date:	**7/22/14**	Total Depth Drilled (ft bgs):	**25.0**
Drilling Method:	**4-inch Flight Auger**	Drilling Contractor:	**Cal Nev Geoexploration**	Arbitrary Ground Surface Elevation:	**189**
Drill Rig:	**CME-45**	Hammer Type:	**Automatic Trip**	Hammer Weight / Drop:	**140 lbs. / 30 inches**
Logged By:	**K. Jermstad**	Reviewed By:	**C. Trumbull**	Borehole Backfill:	**spoils**
Remarks:	**No Groundwater Encountered**				

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6"	Uncorrected N Value	Water Content (%)	Dry Density (pcf)	% Passing No. 4 Sieve	% Passing No. 200 Sieve
188	0	Olive Brown Silty Sand (SM) Dry to Moist	SM									
186	2											
184	4	Gray Sandy Lean Clay (CL) Moist Olive Brown Sandy Lean Clay (CL) Moist, Medium Dense	CL		SS	2-1Z	3 2 8	10				
182	6											
180	8											
178	10				MC	2-2A 2-2	13 12 16	28	15 12	108 112		
176	12											
174	14	Becomes more granular										
172	16	Olive Brown Clayey Sand (SC) Moist, Medium Dense, Fine Grained	SC		SS	2-3Z	4 6 8	14	22		96	27
170	18											
168	20	Yellow brown Silty Sand (SM) Moist, Medium Dense	SM		MC	2-4A 2-4	14 15 19	34	16	104		
166	22											
164	24	Becomes dense and more granular										
162	26				SS	2-5Z	10 13 16	29	20			15
160	28	Boring terminated, no groundwater encountered										
	30											

LOG OF BORING CSA 11.GPJ CARLTON ENGINEERING.GDT 8/22/14

CARLTON
Engineering
2365 Iron Point Road, Suite 220, Folsom, CA 95630
Voice (916) 932-7855 Fax (916) 932-7845

LOG OF BORING CE3

Sheet 1 of 1

Project: CSA 11 Water Supply

Location: **Pescadero, San Mateo County CA**

Project Number: **6604-02-14**

Start Date:	**7/22/14**	Finish Date:	**7/22/14**	Total Depth Drilled (ft bgs):	**25.0**
Drilling Method:	**4-inch Flight Auger**	Drilling Contractor:	**Cal Nev Geoexploration**	Arbitrary Ground Surface Elevation:	**186**
Drill Rig:	**CME-45**	Hammer Type:	**Automatic Trip**	Hammer Weight / Drop:	**140 lbs. / 30 inches**
Logged By:	**K. Jermstad**	Reviewed By:	**C. Trumbull**	Borehole Backfill:	**spoils**
Remarks:	**No Groundwater Encountered**				

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6"	Uncorrected N Value	Torvane (psi)	Water Content (%)	Dry Density (pcf)	% Passing No. 4 Sieve	% Passing No. 200 Sieve
186	0	Yellow Brown Clayey Sand (SC) Dry to Moist											
184	2												
182	4												
180	6	Yellow Brown Clayey Sand (SC) Moist, Medium Dense	SC		SS	3-1Z	7 8 11	19		11			34
178	8												
176	10	Yellow / Olive Brown Mottled Clayey Sand (SC) Moist, Medium Dense	SC		MC	3-2A 3-2	9 13 19	32	6.5	11	110		
174	12												
172	14		SC										
170	16				SS	3-3Z	6 7 11	18		14		100	37
168	18												
166	20				MC	3-4A 3-4	13 20 29	49		15	107		
164	22												
162	24												
160	26	Yellow Brown Clayey Sand (SC) Moist, Dense	SC		SS	3-5Z	8 11 16	27		17			36
		Boring terminated, no groundwater encountered											
158	28												
156	30												

CARLTON Engineering
2365 Iron Point Road, Suite 220, Folsom, CA 95630
Voice (916) 932-7855 Fax (916) 932-7845

LOG OF BORING CE4

Project: CSA 11 Water Supply

Location: **Pescadero, San Mateo County CA** Project Number: **6604-02-14**

Start Date:	**7/23/14**	Finish Date:	**7/23/14**	Total Depth Drilled (ft bgs):	**50.0**
Drilling Method:	**6-inch Hollow Stem Auger**	Drilling Contractor:	**Cal Nev Geoexploration**	Arbitrary Ground Surface Elevation:	**187**
Drill Rig:	**CME-45**	Hammer Type:	**Automatic Trip**	Hammer Weight / Drop:	**140 lbs. / 30 inches**
Logged By:	**K. Jermstad**	Reviewed By:	**C. Trumbull**	Borehole Backfill:	**spoils**
Remarks:	**Groundwater encountered at 40'**				

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6"	Uncorrected N Value	Torvane (psi)	Water Content (%)	Dry Density (pcf)	% Passing No. 4 Sieve	% Passing No. 200 Sieve	Liquid Limit	Plasticity Index
186	0	Olive Brown Clayey Sand (SC) Dry to Moist													
184	2														
182	4														
180	6	Olive Brown Clayey Sand (SC) Moist, Loose to Medium Dense			MC	4-1A 4-1	6 10 11	21		10	119				
178	8				SS	4-1Z	4 6 6	12							
176	10				MC	4-2A 4-2	9 14 18	32		9	120	75	24		
174	12	Dark Brown Clayey Sand (SC) Moist, Medium Dense			SS	4-2Z	4 6 8	14		9					
	14				AUGER	4-C								28	
172	16	Olive Brown Clayey Sand (SC) Moist, Medium Dense to Dense	SC		MC	4-3A 4-3	3 8 14	22							
170	18	Becomes more plastic			SS	4-3Z	6 12 15	27							
168	20	Yellow / Olive Brown Mottled Clayey Sand (SC) Moist, Medium Dense to Dense			MC	4-4A 4-4	8 12 15	27		17	113				
166	22				SS	4-4Z	7 14 21	35		16			45		
164	24														
162	26				MC	4-5A 4-5	12 19 26	45							
160	28				SS	4-5Z	6 12 17	29						30	
158	30														

CARLTON
Engineering
2365 Iron Point Road, Suite 220, Folsom, CA 95630
Voice (916) 932-7855 Fax (916) 932-7845

LOG OF BORING CE4

Project: CSA 11 Water Supply

Location: **Pescadero, San Mateo County CA**

Project Number: **6604-02-14**

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6"	Uncorrected N Value	Torvane (psi)	Water Content (%)	Dry Density (pcf)	% Passing No. 4 Sieve	% Passing No. 200 Sieve	Liquid Limit	Plasticity Index
156	30	Olive Brown Clayey Sand (SC) Dry to Moist Yellow Brown Clayey Sand (SC) Moist, Medium Dense			MC	4-6A 4-6	8 12 18	30	6.0	18	110				
154	32														
152	34		SC												
150	36				MC	4-7A 4-7	5 9 15	24		19		99	24		
148	38														
146	40	ATD ▽ Ground Water Encountered Yellow Brown Clayey Sand (SC) Wet, Medium Dense			MC	4-8A 4-8	13 16 26	42		21	98				
144	42														
142	44														
140	46	Yellow / Red Brown Clayey Sand (SC) Wet, Medium Dense	SC		MC	4-9A 4-9	6 10 13	23	4.0	19			25		
138	48														
136	50	Yellow Brown Clayey Sand (SC) Wet, Medium Dense			MC	4-10A 4-10	6 10 12	22	3.5						
134	52	Boring terminated at 51.5', groundwater encountered at 40'													
132	54														
130	56														
128	58														
126	60														
124	62														
122	64														
	66														

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	Class-ification	Water Content (%)	Dry Density (pcf)	Satur-ation (%)	Void Ratio
B1	11.0							23.1	99.8		
B1	16.0							28.8	93.9		
B2	10.0	27	10	17	0.075	42	SC				
B3	5.0	22	13	9	0.075	31	SC				
B4	1.0							10.6	120.8		
B4	2.5							9.3	106.0		
B4	3.0	19	11	8	0.075	23	SC				
CE1	10.5				4.75	20					
CE1	11.0							19.2	109.9		
CE1	16.0	39	21	18							
CE1	20.0	NP	NP	NP							
CE1	22.5							14.5	106.2		
CE1	26.5				0.075	14					
CE1	31.0							12.2	101.2		
CE1	36.5				9.5	5	SP				
CE1	40.5							17.2	102.2		
CE1	45.5							15.8	100.6		
CE1	50.0				0.075	3					
CE2	10.5							14.6	108.2		
CE2	11.0							11.9	112.0		
CE2	15.0				19.1	27					
CE2	21.0							15.5	103.9		
CE2	25.0				0.075	15					
CE3	5.0				0.075	26					
CE3	11.0							11.3	110.0		
CE3	15.0				9.5	28					
CE3	21.0							11.3	106.5		
CE3	25.0				0.075	25					
CE4	6.0							9.9	118.6		
CE4	10.5				25.4	24					
CE4	11.0							8.9	119.8		
CE4	13.0	28	17	11							
CE4	21.0							16.5	113.4		
CE4	21.5				0.075	45					
CE4	26.5	30	14	16							
CE4	31.0							17.5	110.3		
CE4	35.5				9.5	24					
CE4	41.0							21.2	98.2		
CE4	46.0				0.075	25					

CARLTON Engineering

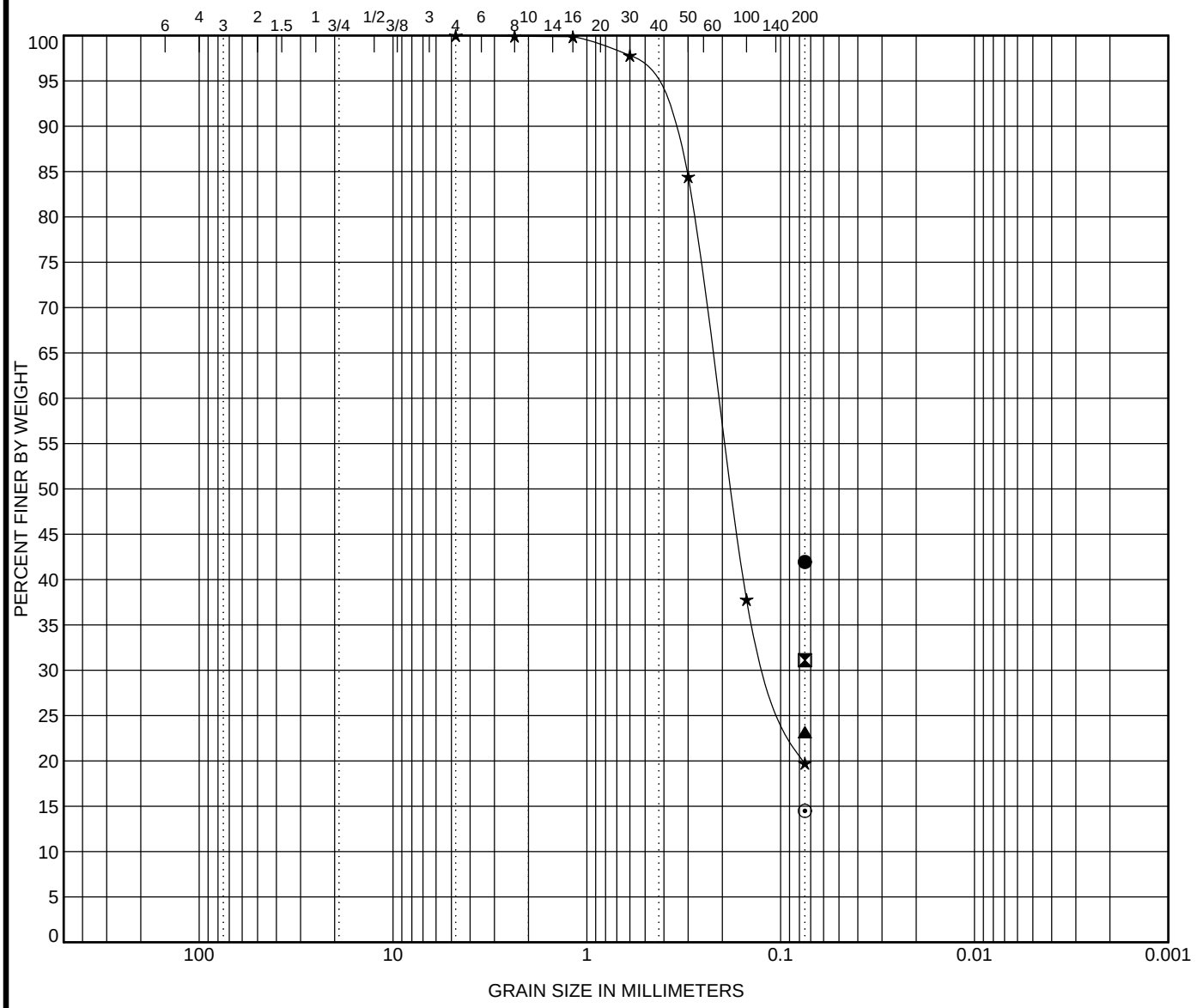
2365 Iron Point Road, Suite 220, Folsom, CA 95630
Voice (916) 932-7855 Fax (916) 932-7845

Summary of Laboratory Results

Project: CSA 11 Water Supply

Location: Pescadero, San Mateo County CA

Number: 6604-02-14



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	B2	10.0	Clayey Sand (SC)	27	10	17		
⊠	B3	5.0	Clayey Sand (SC)	22	13	9		
▲	B4	3.0	Clayey Sand (SC)	19	11	8		
★	CE1	10.5	Clayey Sand (SC)					
⊙	CE1	26.5	Clayey Sand (SC)					

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	B2	10.0	0.075				0.0	0.0	41.9	
⊠	B3	5.0	0.075				0.0	0.0	31.1	
▲	B4	3.0	0.075				0.0	0.0	23.2	
★	CE1	10.5	4.75	0.209	0.111		0.0	80.3	19.7	
⊙	CE1	26.5	0.075				0.0	0.0	14.5	

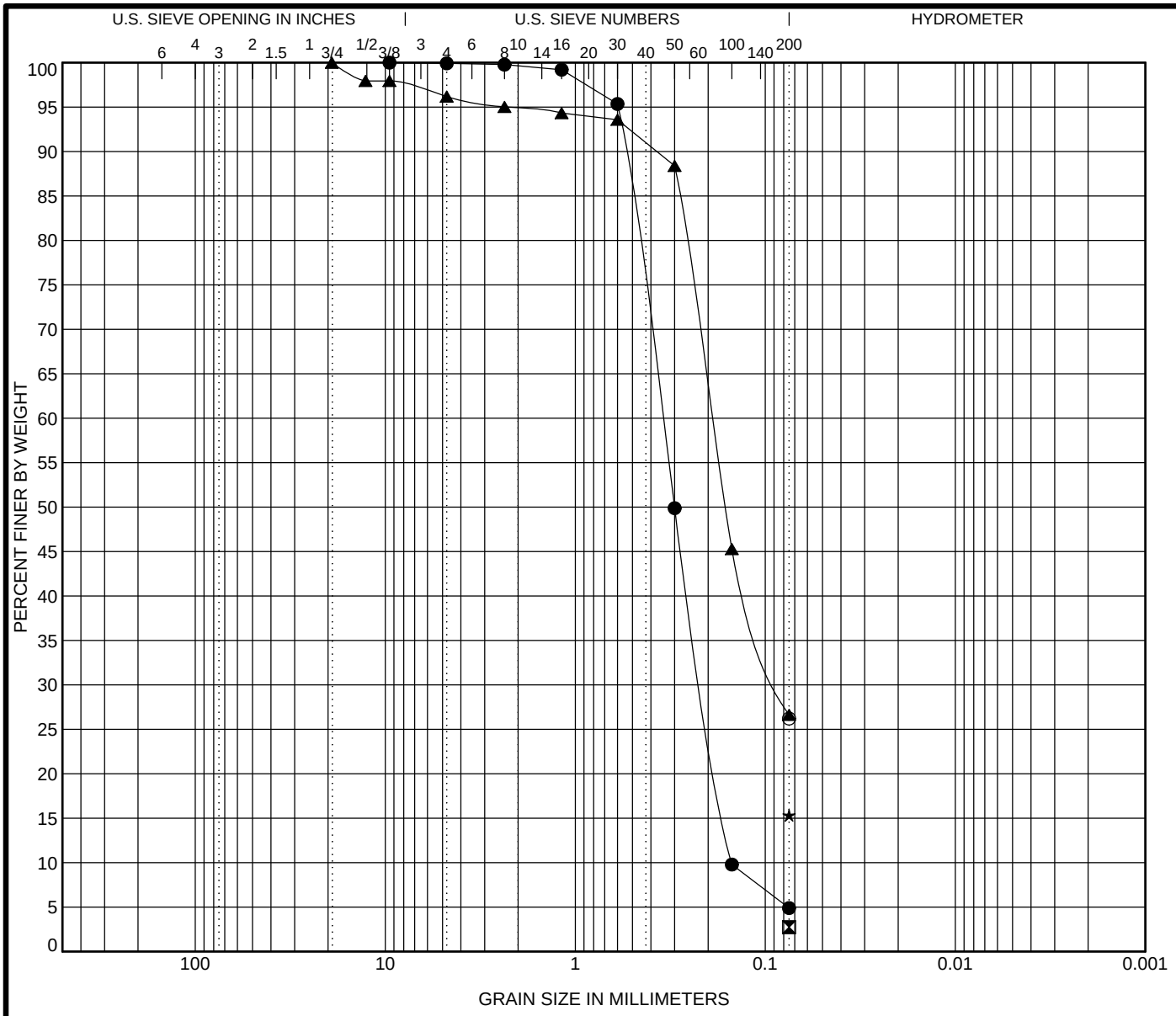
CARLTON
Engineering
2365 Iron Point Road, Suite 220, Folsom, CA 95630
Voice (916) 932-7855 Fax (916) 932-7845

GRAIN SIZE DISTRIBUTION

Project: CSA 11 Water Supply

Location: Pescadero, San Mateo County CA

Number: 6604-02-14



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	**CE1**	**36.5**	**Poorly Graded Sand (SP)**				**0.86**	**2.32**
⊠	**CE1**	**50.0**	**Poorly Graded Sand (SP)**					
▲	**CE2**	**15.0**	**Clayey Sand (SC)**					
★	**CE2**	**25.0**	**Silty Sand (SM)**					
⊙	**CE3**	**5.0**	**Clayey Sand (SC)**					

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**CE1**	**36.5**	**9.5**	**0.35**	**0.213**	**0.151**	**0.1**	**95.0**	**4.9**	
⊠	**CE1**	**50.0**	**0.075**				**0.0**	**0.0**	**2.7**	
▲	**CE2**	**15.0**	**19.1**	**0.19**	**0.085**		**3.8**	**69.6**	**26.6**	
★	**CE2**	**25.0**	**0.075**				**0.0**	**0.0**	**15.3**	
⊙	**CE3**	**5.0**	**0.075**				**0.0**	**0.0**	**26.2**	

CARLTON
Engineering
2365 Iron Point Road, Suite 220, Folsom, CA 95630
Voice (916) 932-7855 Fax (916) 932-7845

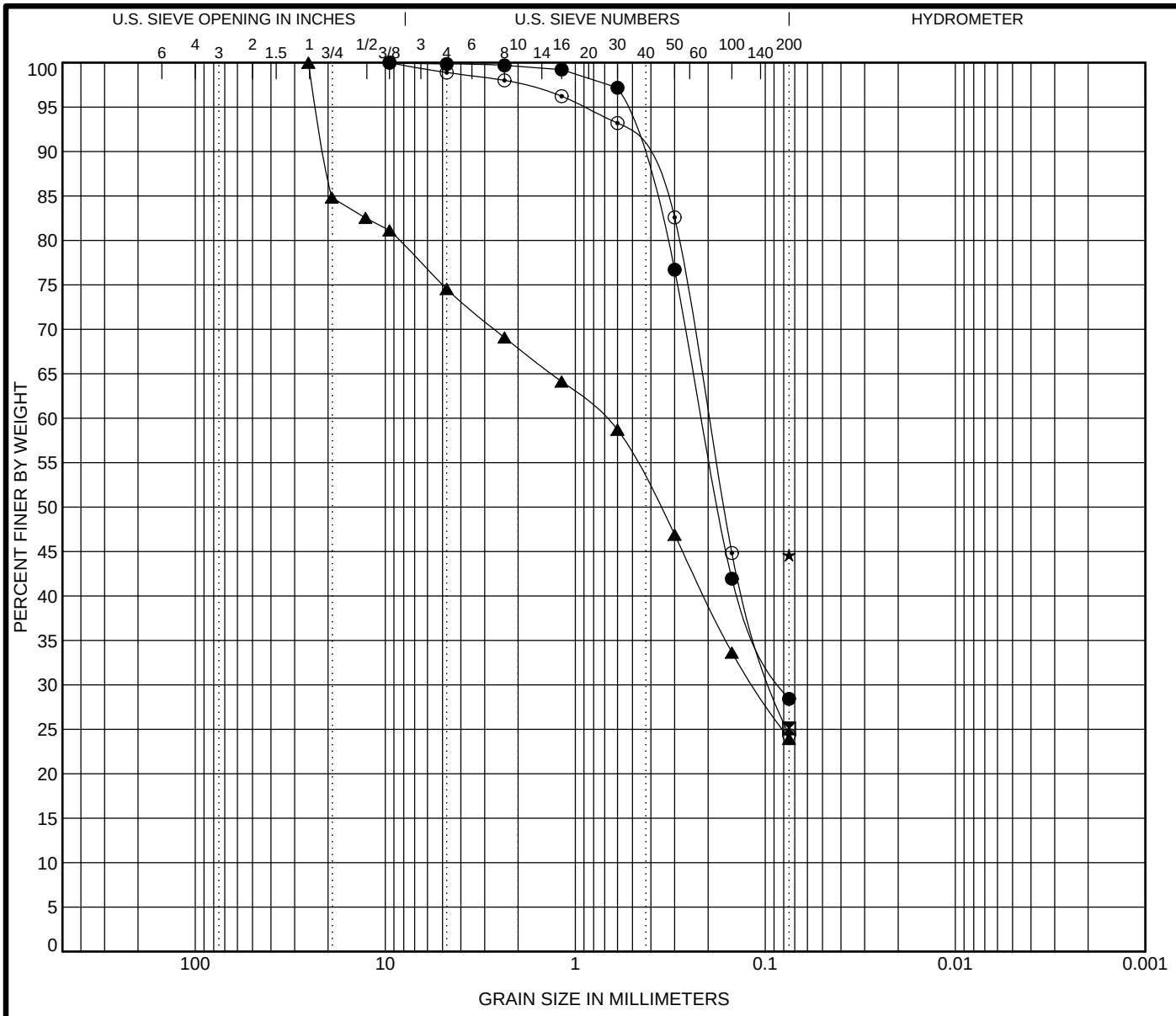
GRAIN SIZE DISTRIBUTION

Project: CSA 11 Water Supply

Location: Pescadero, San Mateo County CA

Number: 6604-02-14

US GRAIN SIZE CSA 11.GPJ US LAB.GDT 8/22/14



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	CE3	15.0	Clayey Sand (SC)					
⊠	CE3	25.0	Clayey Sand (SC)					
▲	CE4	10.5	Clayey Sand with Gravel (SC)					
★	CE4	21.5	Clayey Sand (SC)					
⊙	CE4	35.5	Clayey Sand (SC)					

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	CE3	15.0	9.5	0.215	0.081		0.1	71.4	28.4	
⊠	CE3	25.0	0.075				0.0	0.0	25.1	
▲	CE4	10.5	25.4	0.705	0.116		25.5	50.6	23.9	
★	CE4	21.5	0.075				0.0	0.0	44.6	
⊙	CE4	35.5	9.5	0.198	0.091		1.1	74.5	24.3	

CARLTON Engineering

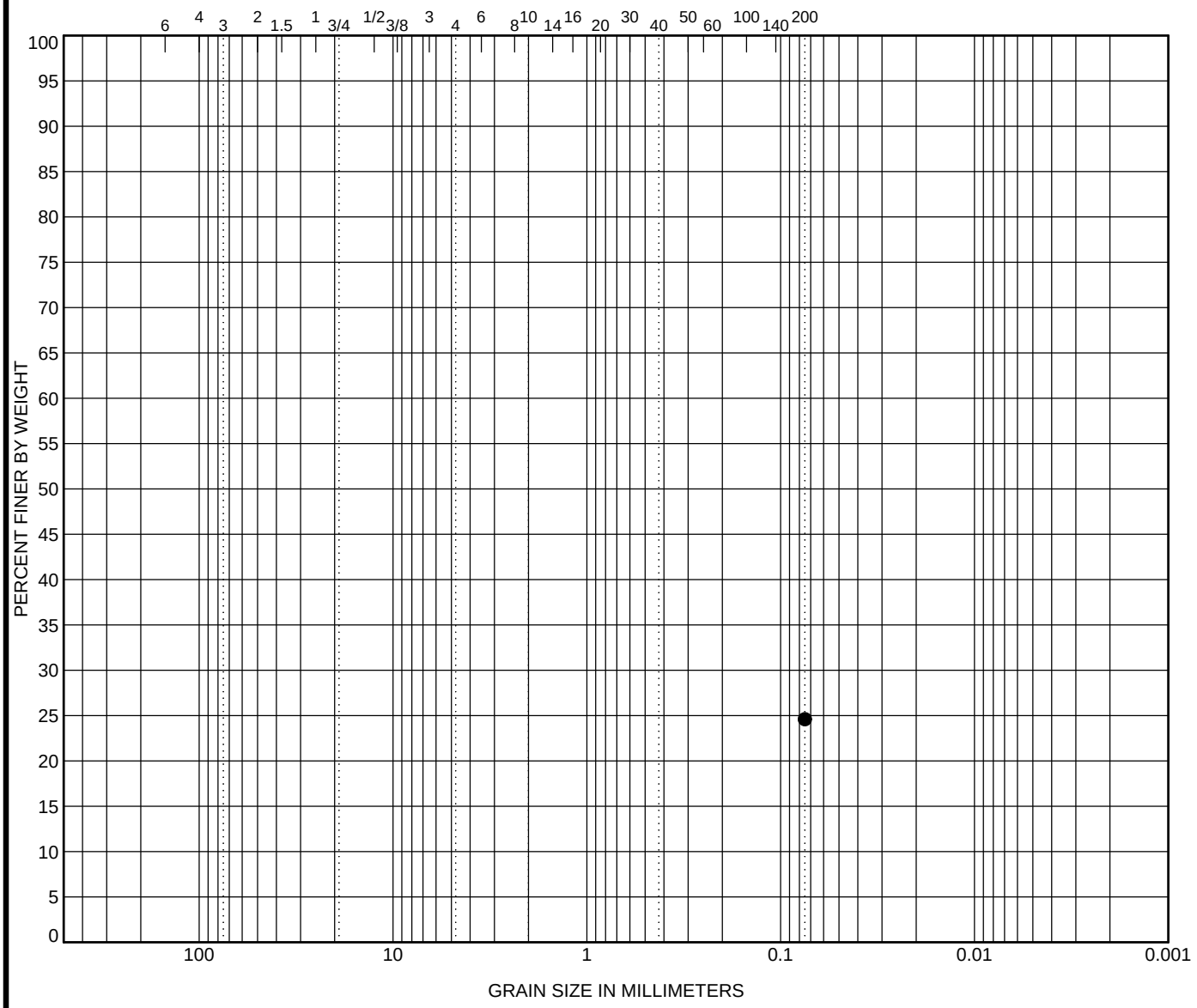
2365 Iron Point Road, Suite 220, Folsom, CA 95630
Voice (916) 932-7855 Fax (916) 932-7845

GRAIN SIZE DISTRIBUTION

Project: CSA 11 Water Supply

Location: Pescadero, San Mateo County CA

Number: 6604-02-14



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	**CE4**	**46.0**	**Clayey Sand (SC)**					

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**CE4**	**46.0**	**0.075**				**0.0**	**0.0**	**24.6**	

CARLTON Engineering

2365 Iron Point Road, Suite 220, Folsom, CA 95630
Voice (916) 932-7855 Fax (916) 932-7845

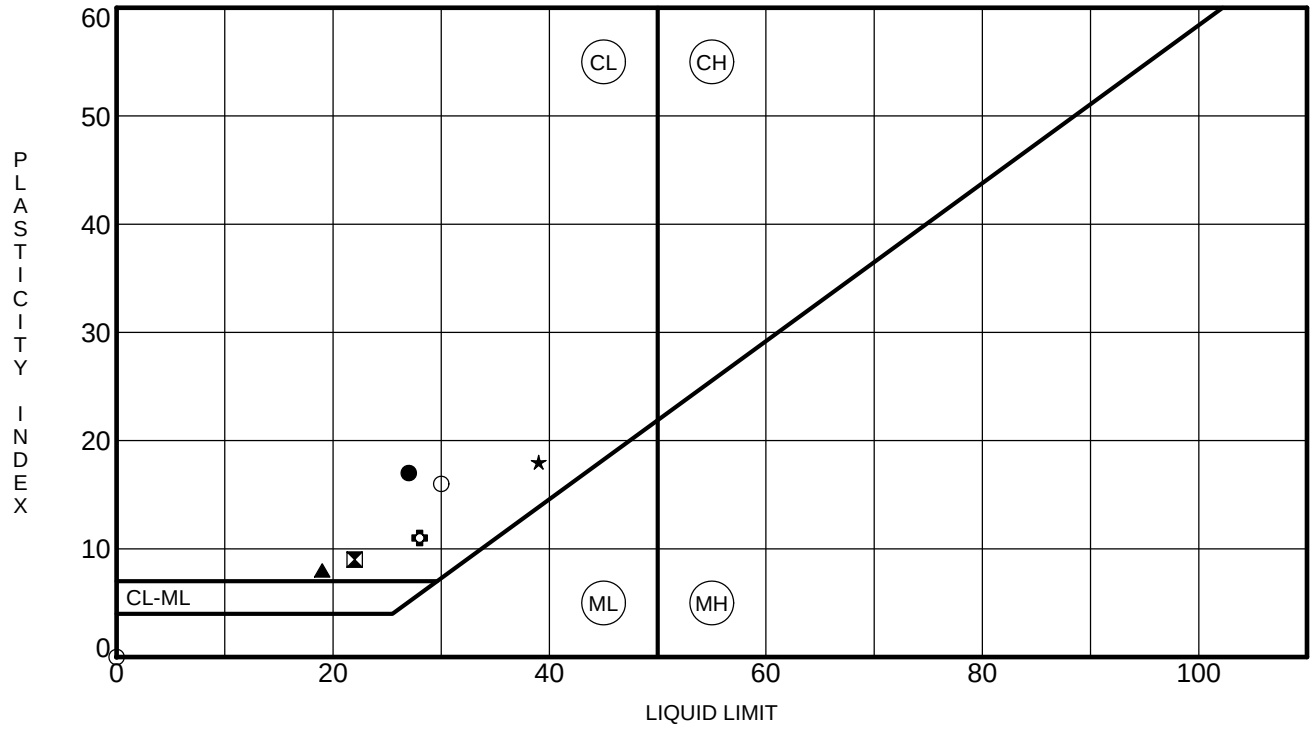
GRAIN SIZE DISTRIBUTION

Project: CSA 11 Water Supply

Location: Pescadero, San Mateo County CA

Number: 6604-02-14

US GRAIN SIZE CSA 11.GPJ US LAB.GDT 8/22/14



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**B2**	**10.0**	**27**	**10**	**17**	**42**	**Clayey Sand (SC)**
⊠	**B3**	**5.0**	**22**	**13**	**9**	**31**	**Clayey Sand (SC)**
▲	**B4**	**3.0**	**19**	**11**	**8**	**23**	**Clayey Sand (SC)**
★	**CE1**	**16.0**	**39**	**21**	**18**		**Clayey Sand (SC)**
⊙	**CE1**	**20.0**	**NP**	**NP**	**NP**		**Sandy Silt (SM)**
✿	**CE4**	**13.0**	**28**	**17**	**11**		**Clayey Sand (SC)**
○	**CE4**	**26.5**	**30**	**14**	**16**		**Clayey Sand (SC)**

CARLTON
Engineering

2365 Iron Point Road, Suite 220, Folsom, CA 95630
Voice (916) 932-7855 Fax (916) 932-7845

ATTERBERG LIMITS' RESULTS

Project: CSA 11 Water Supply

Location: Pescadero, San Mateo County CA

Number: 6604-02-14

US ATTERBERG LIMITS CSA 11.GPJ US LAB.GDT 8/22/14

MOISTURE CONTENT & UNIT WEIGHT TEST RESULTS

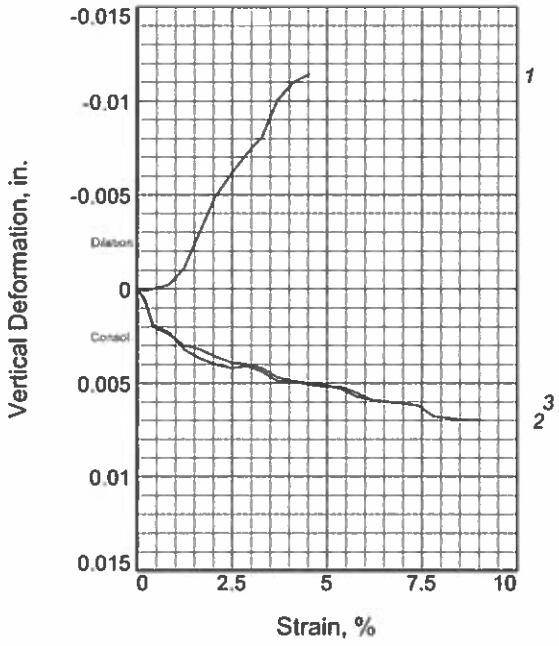
Sample Identification	Depth, ft.	Wet Unit Weight, lb/ft.^{3}	Dry Unit Weight, lb/ft.^{3}	Moisture Content, %
4-2-Z		126.9	109.7	15.7

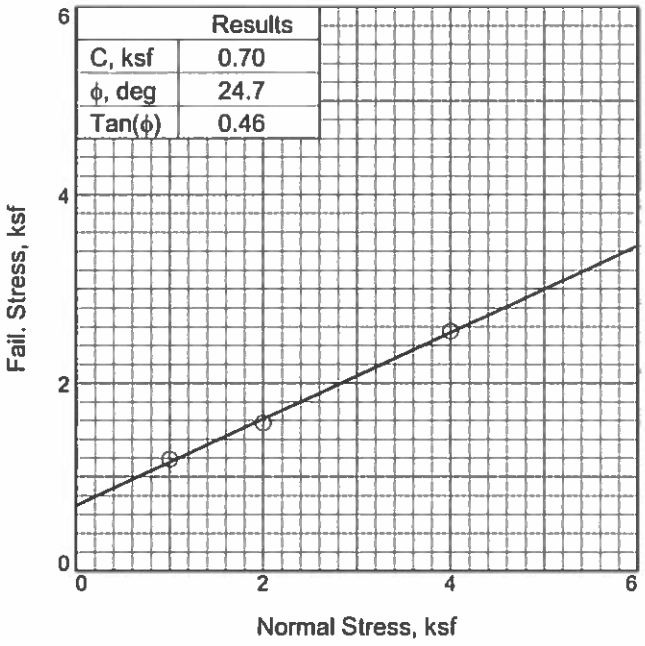
Test Method: ASTM D2216, ASTM D2937

PROJECT NUMBER:	14-084	July 29, 2014	CSA 11

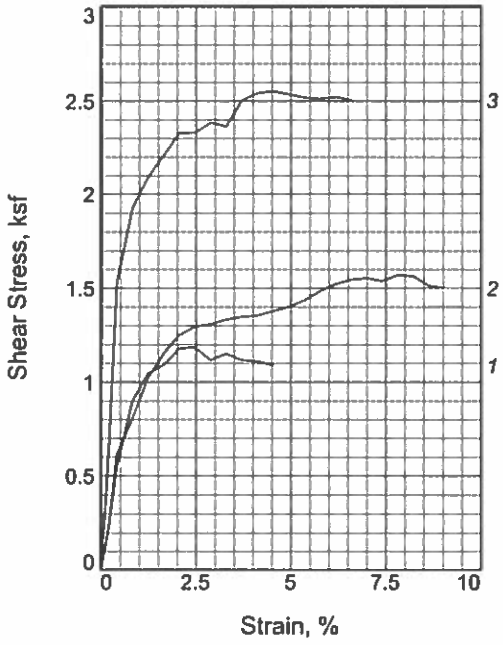
SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

485 Pierroz Rd, Unit D, Placerville, CA 95667
Ph 530-622-1101 Fax 530-622-1191





Results	
C, ksf	0.70
ϕ, deg	24.7
Tan(ϕ)	0.46



Sample No.		1	2	3
Initial	Water Content, %	15.7	15.7	15.7
	Dry Density, pcf	109.3	109.3	109.3
	Saturation, %	78.3	78.3	78.3
	Void Ratio	0.5417	0.5417	0.5417
	Diameter, in.	2.43	2.43	2.43
	Height, in.	1.00	1.00	1.00
At Test	Water Content, %	18.9	18.4	18.3
	Dry Density, pcf	111.6	112.6	112.9
	Saturation, %	99.9	100.0	99.9
	Void Ratio	0.5105	0.4970	0.4933
	Diameter, in.	2.43	2.43	2.43
	Height, in.	0.98	0.97	0.97
Normal Stress, ksf		1.00	2.00	4.00
Fail. Stress, ksf		1.19	1.57	2.55
Strain, %		2.5	7.8	4.5
Ult. Stress, ksf				
Strain, %				
Strain rate, in./min.		0.03	0.03	0.03

Sample Type: Remold
Description:

Assumed Specific Gravity= 2.70
Remarks:

Figure _____

Client: Carlton Engineering

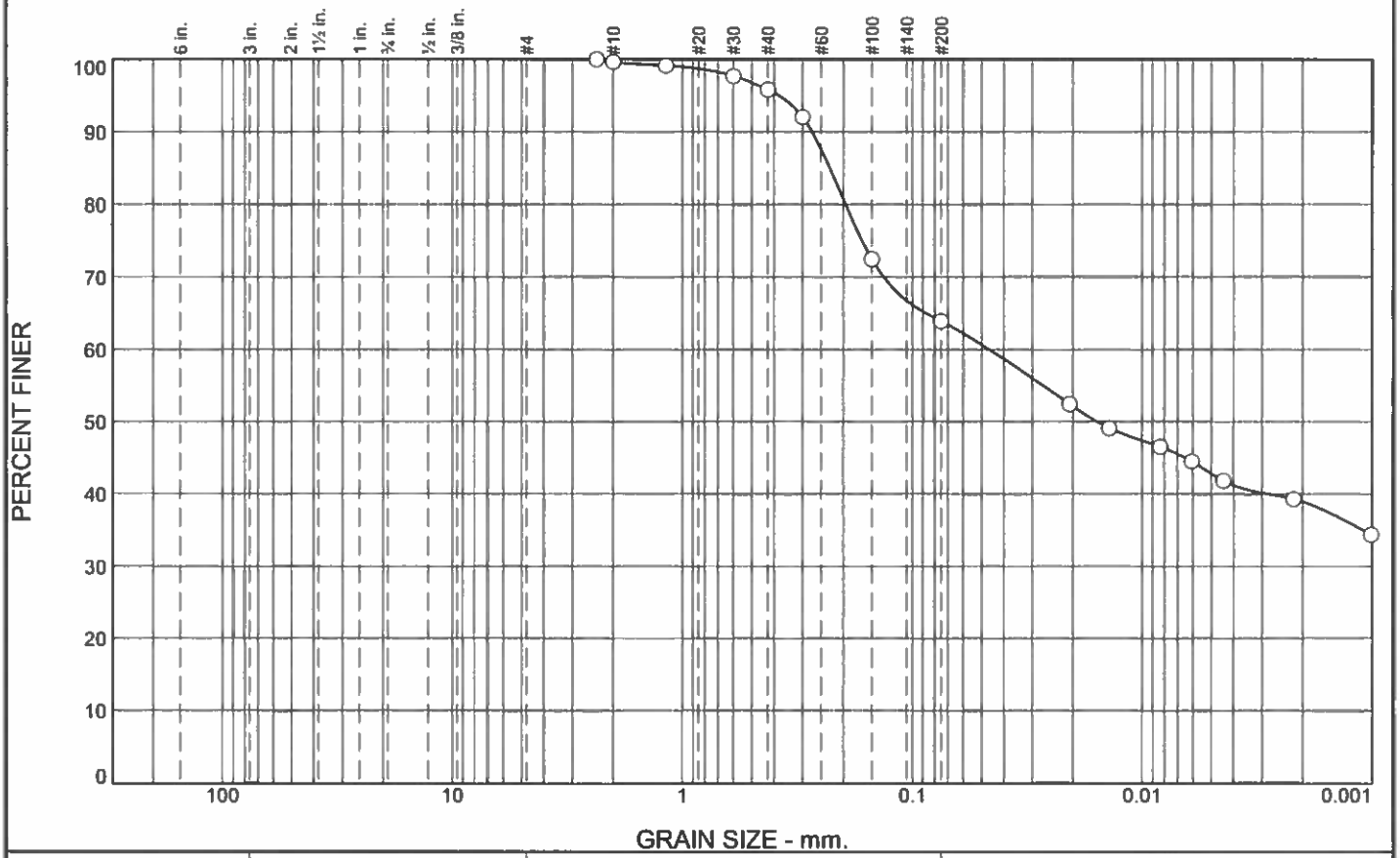
Project: CSA 11

Location: 4-2-Z
Sample Number: S43171
Proj. No.: 14-084 **Date Sampled:** 7/29/14

DIRECT SHEAR TEST REPORT
SIERRA TESTING LABS, INC.
El Dorado Hills, CA

Tested By: mw **Checked By:** MW

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.3	3.9	31.9	21.1	42.8

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#8	100.0		
#10	99.7		
#16	99.2		
#30	97.7		
#40	95.8		
#50	92.1		
#100	72.4		
#200	63.9		
0.0207 mm.	52.5		
0.0139 mm.	49.1		
0.0083 mm.	46.6		
0.0061 mm.	44.5		
0.0044 mm.	41.8		
0.0022 mm.	39.3		
0.0010 mm.	34.4		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.2728 D_{85}= 0.2283 D_{60}= 0.0463
D_{50}= 0.0157 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: 2-1-Z
Sample Number: S43170

Date: 7/29/14

SIERRA TESTING LABS, INC.
El Dorado Hills, CA

Client: Carlton Engineering
Project: CSA 11
Project No: 14-084

Figure

Tested By: mw/jm **Checked By:** MW