APPENDIX C

Monterey Peninsula Water Supply Project Hydrogeologic Investigation Technical Memorandum (TM-1) – Summary of Results – Exploratory Boreholes

Monterey Peninsula Water Supply Project
Hydrogeologic Investigation

Technical Memorandum (TM1)
Summary of Results - Exploratory Boreholes

PREPARED FOR:

California American Water
RBF Consulting

July 8, 2014

GEOSCIENCE Support Services, Inc., **Ground Water Resources Development**
P.O. Box 220, Claremont, CA 91711 | P (909) 451-6650 | F (909) 451-6638 | www.gssiwater.com

GEOSCIENCE

THIS REPORT IS RENDERED TO CALIFORNIA AMERICAN WATER AND RBF CONSULTING AS OF THE DATE HEREOF, SOLELY FOR THEIR BENEFIT IN CONNECTION WITH ITS STATED PURPOSE AND MAY NOT BE RELIED ON BY ANY OTHER PERSON OR ENTITY OR BY THEM IN ANY OTHER CONTEXT. ALL CALCULATIONS WERE PERFORMED USING ACCEPTED PROFESSIONAL STANDARDS.

AS DATA IS UPDATED FROM TIME TO TIME, ANY RELIANCE ON THIS REPORT AT A FUTURE DATE SHOULD TAKE INTO ACCOUNT UPDATED DATA.

BRIAN A. VILLALOBOS
NO. 794
CERTIFIED HYDROGEOLOGIST
4/30/16

Brian Villalobos, CEG, CHG
Senior Geohydrologist
CHG No. 794

DENNIS E. WILLIAMS
NO. 139
8/31/15

Dennis E. Williams, Ph.D., CHG
President
CHG No. 139

In Cooperation with the Monterey Peninsula Water Supply Project Hydrogeology Working Group:

Mr. Tim Durbin
Mr. Martin Feeney, CEG, CHG
Mr. Peter Leffler, CHG
Dr. Dennis Williams, CHG

CALIFORNIA AMERICAN WATER / RBF CONSULTING
MONTEREY PENINSULA WATER SUPPLY PROJECT HYDROGEOLOGIC INVESTIGATION
TECHNICAL MEMORANDUM (TM 1)
SUMMARY OF RESULTS - EXPLORATORY BOREHOLES

CONTENTS

FIGURES, TABLES, and APPENDICES

FIGURES

FIGURES (continued)

FIGURES (continued)

FIGURES (continued)

TABLES

TABLES (continued)

TABLES (continued)

APPENDICES

CALIFORNIA AMERICAN WATER / RBF CONSULTING
MONTEREY PENINSULA WATER SUPPLY PROJECT HYDROGEOLOGIC INVESTIGATION
TECHNICAL MEMORANDUM (TM 1)
SUMMARY OF RESULTS - EXPLORATORY BOREHOLES

1.0 EXECUTIVE SUMMARY

1.1 Introduction

The investigation and findings described in this Technical Memorandum are the result of collaborative planning and discussions among the hydrogeologic experts that represent key stakeholders for groundwater use and management in the Salinas Valley and Monterey Peninsula area of central California. The Hydrogeology Working Group (HWG) consisted of the following experts: Mr. Tim Durbin and Mr. Martin Feeney (both representing the Salinas Valley Water Coalition and the Monterey County Farm Bureau), Mr. Peter Leffler (representing CalAm), and Dr. Dennis Williams (representing the CPUC CEQA Team). The HWG was formed as a result of a 2013 Settlement Agreement among parties to an ongoing CPUC-proceeding resulting from CalAm's proposed Monterey Peninsula Water Supply Project, to review and approve the scope of field investigation and development of a hydrogeologic conceptual model from which to construct the groundwater modeling tools. The names of the HWG members are presented here to indicate the general agreement among the members on the core findings of the investigative work described herein.

The work completed for this investigation was described in the Hydrogeologic Investigation Workplan (Workplan), Attachment 1, dated 18-Dec-2013. This investigation represents the first phase of field data gathering to develop a hydrogeologic conceptual model for the project area that is accepted by the stakeholders. The conceptual model will be used to refine the existing North Marina Ground Water Model (NMGWM) and construct a new focused model (CEMEX model). These models will be used to evaluate proposed project operations and impacts. Additional phases of field testing are planned and outlined in the Workplan.

Since September 2013, six exploratory boreholes were drilled at the CEMEX facility. Total borehole depth ranged from 250 feet (ft) below ground surface (bgs) to 350 ft bgs. Three of the boreholes were used to collect continuous soil cores, undisturbed soils samples, samples for mechanical grading analysis, and geophysical logs. Two borings were used to construct isolated zones[1] for collecting water quality samples from aquifers at discrete depths and the last borehole (CX-B4) was used to collect continuous soil cores, undisturbed soils samples, samples for mechanical grading analysis, geophysical logs, and to collect water quality samples. A total of fifteen (15) aquifer zone tests have been completed at the CEMEX site. Water quality samples collected from the isolated aquifer zones were analyzed for the same suite of analytes outlined in the Workplan and included general physical, general mineral, volatile organic compounds, pesticides, tritium, and stable isotopes of oxygen and hydrogen.

Since September 2013, seven exploratory boreholes were drilled in the Moss Landing area. Six borings were drilled to a depth of 200 ft bgs. One boring (MDW-1) was drilled to a depth of 300 ft bgs. Each borehole was used to collect continuous soil cores, undisturbed soil samples, samples for mechanical grading analysis, and geophysical logs. Two isolated aquifer zones were constructed in boreholes ML-1, ML-2, ML-3, ML-4, ML-6, and PR-1 (for a total of 12 zones) to collect depth-specific groundwater quality samples. Four isolated aquifer zones were constructed to collect groundwater samples from Boring MDW-1.

1.2 Findings

1.2.1 General

- The conceptual hydrogeologic model developed from this investigation suggests that a feedwater supply system using slant wells at the CEMEX site is feasible and can utilize the Dune Sand Aquifer and underlying terrace deposits (180-Foot Equivalent Aquifer) as conduits to extract water through the seafloor beneath Monterey Bay.
- This opinion will be tested using the newly constructed CEMEX Model and the refined NMGWM and will be field tested using a test slant well and groundwater monitoring system as described in the Hydrogeologic Investigation Workplan.
- The conceptual model also indicates that the Perched “A” Aquifer between the Molera and Sandholt Road Salinas River State Beach parking lots could provide an alternative target for construction of a subsurface feedwater supply system.

1.2.2 CEMEX Area

The CEMEX facility is located on the westernmost edge of the 180/400-Foot Aquifer Subbasin of the Salinas Valley Groundwater Basin, as currently mapped by DWR (2003) and the MCWRA (2011). The findings of the investigation at CEMEX are summarized below:

---

[1] An isolated zone is constructed by the installation of well screen at a selected depth interval and isolating the well screen above and below using bentonite seals. Construction of isolated zones allows depth specific sampling of groundwater.

- A significant clay layer is not present beneath the Dune Sand Aquifer at the CEMEX site at elevations commonly attributed to the Salinas Valley Aquitard (SVA), suggesting a different depositional environment than that of the 180-Foot Aquifer in the Salinas Valley. The water quality data suggests groundwater in the Dune Sand Aquifer may be in hydraulic continuity with the underlying aquifer units. The degree of hydraulic continuity will be determined by construction of aquifer specific monitoring wells and the long-term pumping test of the test slant well.

- Stratigraphic relationships and lithologic observations indicate that the aquifer system underlying the Dune Sand Aquifer consists of terrace deposits that are older than the inland 180-Foot Aquifer deposits, since they underlie the Older Dune Sand.

- The terrace deposits appear to be a distinct lithologic unit in terms of geologic history and depositional environment in the Dune Highland area and may be hydrostratigraphically equivalent to the 180-Foot Aquifer in the Salinas Valley.

- For purposes of this document, the alluvial materials encountered near the coast (in the CEMEX area) are based solely on analyses of borehole samples (and geophysical borehole logs). As of yet, no direct correlation can be made between these coastal alluvial deposits and the standard naming convention found further inland (e.g., 180-Foot Aquifer, 400-Foot Aquifer, SVA, etc). Consequently, the naming convention agreed upon by the HWG, includes the word “equivalent” since the lithologic units that make up the aquifers at CEMEX and in the Salinas Valley are chronologically different, but stratigraphically equivalent.

- As a hydrogeologic unit, the terrace deposits will be designated as the 180-Foot Equivalent (180-FTE) Aquifer. The extent of hydrostratigraphic equivalence will be evaluated through a pumping test utilizing the test slant wells and a monitoring network.

- The current interpretation of the distinctive dark greenish-gray clay found at depths ranging from 241 to 282 ft bgs at CEMEX is that it may represent a change in the depositional history and is underlain by a unit equivalent to the Aromas Sand(?)/400-Foot Aquifer.

- Both the Dune Sand Aquifer and the underlying 180-FTE Aquifer extend seaward beneath the Monterey Bay.

- Groundwater in the Dune Sand Aquifer and most of the groundwater in the 180-FTE Aquifer exhibit high concentrations of total dissolved solids (TDS), ranging from 24,000 to 32,000 mg/L, indicating a seawater source.

- Hydraulic conductivity for the Dune Sand at CEMEX ranged from an average low value of 273 ft/day to an average high value of 779 ft/day.

- Hydraulic conductivity for the Older Dune Sand at CEMEX ranged from an average low value of 136 ft/day to an average high value of 372 ft/day.
- Hydraulic conductivity of the terrace deposits that make up the 180-FTE Aquifer ranged from an average low value of 113 ft/day to an average high value of 342 ft/day.
- Hydraulic conductivity values will be further refined based on the long-term test slant well pumping test.
- Analysis of cation/anion ratios indicates that groundwater in the lower portion of 180-FTE Aquifer and in the 400-Foot Aquifer have been geochemically altered due to seawater intrusion.
- Tritium results indicate that groundwater in the lower portion of the 180-FTE Aquifer is older than groundwater in the upper portion of the 180-FTE Aquifer and the Dune Sand Aquifer.
- Analysis of oxygen and hydrogen isotopes suggests that at both the CEMEX and Moss Landing sites, saltwater from the ocean is mixing with a freshwater source that has not undergone significant evaporation (as would be expected of a surface water source).
- Hydrostratigraphic relationships indicate that slant wells drilled into the Dune Sand Aquifer and 180-FTE Aquifer will receive recharge primarily from ocean sources through vertical leakage from the sea floor and horizontal recharge from offshore subsea aquifers. This will be tested by the CEMEX and refined NMGWMs as well as field pumping tests.

1.2.3 Moss Landing Area

The Moss Landing area is located north of the mouth of the Salinas River, which overlies the westernmost edge of the 180/400-Foot Aquifer Subbasin. Borings were drilled and sampled at Moss Landing Harbor and at the Molera, Potrero Road, and Sandholt Road parking lots of Salinas River State Beach. The exploratory borings primarily penetrated fluvial sediments associated with Holocene and Late Pleistocene Salinas River deposition.

The Perched[2] "A" Aquifer is ascribed to the Holocene river alluvium and considered to be the hydrostratigraphic equivalent of the Dune Sand Aquifer located to the south.

- The Perched "A" Aquifer in the Moss Landing area is composed of interbedded river and floodplain deposits.

---

[2] The term Perched "A" Aquifer refers to the shallow aquifer above the Salinas Valley Aquitard. Traditionally, the term "perched" aquifer refers to a hydrogeologic condition where an aquifer is formed by groundwater being present above (perching on) an impermeable unit such as clay but with an unsaturated portion of an aquifer between the bottom of the clay and the underlying saturated portion of a lower aquifer.

- With the exception of the sediments penetrated in Boring PR-1 and MDW-1, individual sand and sand and gravel lenses do not appear to be either vertically or areally extensive in Moss Landing.

- Significant variations in TDS concentrations suggest that groundwater is mixed with seawater, and is likely present in semi-isolated lenticular deposits.

- In general, the upper isolated aquifer test zones were above a depth of 110 ft bgs. TDS concentrations ranged from 3,200 mg/L to 34,000 mg/L.

- The lower isolated aquifer zones were generally constructed at depths exceeding 150 ft bgs. With the exception of Zone 1 of PR-1 (190-200 feet) at 630 mg/L, the TDS concentrations ranged from 7,400 mg/L to 34,000 mg/L.

- Boring PR-1 penetrated a very permeable unit in the Perched “A” Aquifer from 54 to 139 ft bgs. Groundwater in this interval approximated seawater quality (i.e., 34,000 mg/L). This unit is interpreted to continue, but decrease in thickness southward towards Boring MDW-1. To the north, the unit is interbedded with fine-grained units.

- It is interpreted that the lowest portion of Boring PR-1 penetrated the SVA. Very low TDS concentrations (630 mg/L) encountered in the lowest zone in Boring PR-1 suggest that isolated zones of freshwater may exist within the 180-Foot Aquifer or that the sand unit is laterally discontinuous and may be interbedded with the SVA. In this last interpretation, Boring PR-1 did not completely penetrate the SVA.

- Hydraulic conductivity values for the permeable portion of the Perched “A” Aquifer penetrated in PR-1 ranged from 194 ft/day to 717 ft/day, based upon relationships between grain size distribution and hydraulic conductivity.

- The permeable unit between Boring PR-1 and MDW-1 represents a potential location for slant wells.

- The Moss Landing Borings (ML-1, ML-2, ML-3, ML-4, and ML-6) did not penetrate significant thicknesses of permeable deposits to produce the required feedwater supply volume for the MPWSP.

1.2.4 Refinement of NMGWM and Development of Focused CEMEX Model

The geologic and hydrogeologic data collected during this investigation was used to prepare the interpretations of hydrostratigraphic relationships in the Moss Landing and CEMEX areas. A conceptual model of the hydrostratigraphic units from the Moss Landing to CEMEX area as interpreted from data collected from this investigation is shown below on Figure 1-1

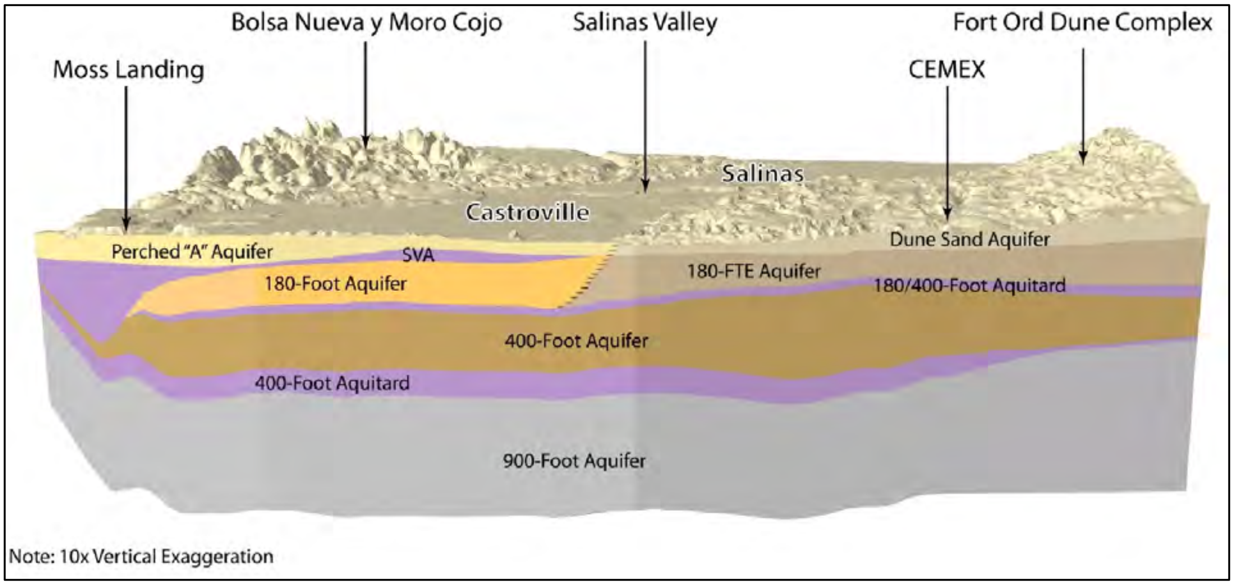


Figure 1-1. Hydrostratigraphic Model – Moss Landing to CEMEX Area

The following table provides a correlation of the geologic and hydrostratigraphic units to groundwater model layers of the Salinas Valley Integrated Groundwater and Surface Water Model (SVIGSM) and the NMGWM. In addition, the project technical advisory group described in Section 2.4 requested that a third model (a focused model) be constructed in the CEMEX area. The new focused model is designated as the CEMEX Model (CM) and will be discussed in Section 6. The model layers of the CM, as correlated to the SVIGSM and NMGWM, are also shown on Table 1-1.

Table 1-1.
Correlation of Geologic and Hydrostratigraphic with SVIGSM, NMGWM, and CM Model Layers

180/400-Foot Aquifer Subbasin			CEMEX Area					
Surface Geologic Units	Surface Geologic Units Map Symbol	Hydro-stratigraphic Units	Surface Geologic Units	Surface Geologic Units Map Symbol	Hydro-stratigraphic Units	SVIGSM Layer[1]	NMGWM Layer	CEMEX Model Layer
Benthic Zone	-	Benthic Zone	-	-	Benthic Zone	Constant Head	1	1
Alluvium	Qal[2]	Perched “A” Aquifer	Dune Sand	Qd	Dune Sand Aquifer	1a	2	2
			Older Dune Sand	Qod				3
								4
Older Alluvium	Qo	Salinas Valley Aquitard	Older Terrace/ Marine Terrace	Qt (Qmt?)	180-FTE Aquifer	1a	3	5
		180-Foot Aquifer				1	4	6
Older Alluvium/ Marine Terrace	Qo/Qmt							7
Older Alluvium/ Older Alluvium Fan – Antioch	Qo/Qfa							8
Older Alluvial Fan – Placentia	Qfp	180/400-Foot Aquitard	Aromas Sand (undifferenciated) (?)	Qar (?)	180/400-Foot Aquitard	2a	5	9
Aromas Sand (undifferentiated)	Qar	400-Foot Aquifer			400-Foot Aquifer	2	6	10
Aromas Sand – Eolian/Fluvial Lithofacies	Qae/Qaf							
Paso Robles Formation	QT	400/900-Foot Aquitard	Paso Robles Formation	QT	400/900-Foot Aquitard	3a	7	11
		900-Foot Aquifer			900-Foot Aquifer	3	8	12

[1] SVIGSM considers “a” layers to be aquitards (vertical hydraulic conductivity and thickness are input)

[2] Subsurface Holocene geologic unit not mapped at surface

2.0 INTRODUCTION

2.1 Background

The California American Water Company (CalAm) is proposing the Monterey Peninsula Water Supply Project (MPWSP, or proposed project) for the purpose of developing water supplies to replace those portions of CalAm's existing supplies that have been constrained by legal decisions regarding CalAm's diversions from the Carmel River and pumping from the Seaside Groundwater Basin. The MPWSP would include construction of a subsurface Seawater Intake System and a desalination plant with a rated capacity of 9.6 million gallons per day (MGD) or 6.4 MGD, which is approximately 10,800 acre-ft per year and 7,200 acre-ft per year, respectively.

On April 23, 2012, CalAm filed an application with the California Public Utilities Commission (CPUC) for the MPWSP (A.12-04-019), seeking a Certificate of Public Convenience and Necessity (CPCN) to construct, own, and operate a desalination facility for water supply on the Monterey Peninsula. The MPWSP application to the CPUC proposed a subsurface intake feedwater system consisting of slant wells located at the CEMEX sand mining property in Marina, CA.

In a letter dated September 26, 2012, the CPUC asked the State Water Resources Control Board (SWRCB) whether CalAm has the legal right to extract desalination feedwater for the proposed MPWSP. The CPUC requested an opinion on whether Cal-Am has a credible legal claim to extract feedwater for the proposed MPWSP in order to inform the CPUC's determination regarding the legal feasibility of the MPWSP. The SWRCB concluded in July 2013, that the conditions in the aquifer where MPWSP feedwater would be extracted could be either confined or unconfined. However, there was not enough information at that time to determine what types of conditions exist at the location of the proposed MPWSP wells. The SWRCB recommended that studies are needed to determine the extent of the Dune Sand Aquifer, the water quality and water quantity of the Dune Sand Aquifer, the extent and thickness of the Salinas Valley Aquitard, and the extent of the 180-Foot Aquifer, if present.

In August 2013, a Settlement Agreement was signed by several of the Parties associated with the CPUC proceeding. The parties agreed that CalAm and Salinas Valley Water Coalition's (SVWC) hydrogeologists would work with other experts to develop and implement a workplan for the proposed source water intake sites consistent with the study recommendations presented in SWRCB's July 2013 Review of the MPWSP.

2.2 Extracting Seawater from Subsea Aquifers for Feedwater Supply

The intake system proposed by CalAm is expected to supply a high percentage of ocean water from aquifer units that are in hydraulic continuity with the ocean floor. The feasibility of extracting seawater from the aquifers that underlie the ocean floor using slant wells is directly dependent on the vertical and horizontal distribution of hydrostratigraphic units in the project areas and their hydraulic properties.

Previous studies have indicated that in the vicinity of the CEMEX facility, the shallow Dune Sand Aquifer may directly overlie the 180-Foot Aquifer, or may be separated from the 180-Foot Aquifer by low permeability material of the hydrostratigraphic unit designated as the Salinas Valley Aquitard (SVA). Therefore, a key aspect of the exploratory boring program at the CEMEX facility was to evaluate the presence and vertical distribution of hydrostratigraphic units. If the Dune Sand Aquifer directly overlies the 180-Foot Aquifer or an equivalent hydrostratigraphic unit (i.e., no intervening clay layer of significant thickness), and if both units are in hydraulic connection with the ocean floor, feedwater can be obtained directly from the subsea portion of both aquifers with little or no impact on the inland aquifers.

A groundwater model was developed by GEOSCIENCE in 2008 and is called the North Marina Ground Water Model (NMGWM). The NMGWM was developed based on existing data and conceptual models of the hydrogeology in the region, and has been used to evaluate several proposed projects in the area. The NMGWM is a three dimensional variable density finite difference model that uses industry standard computer codes (MODFLOW, MT3DMS and SEAWAT). Regional boundary conditions for the model are obtained from the Salinas Valley Integrated Groundwater and Surface Water Model (SVIGSM). Construction of a third model, a focused model centered at CEMEX, was requested by the Hydrogeology Working Group (HWG). The new model will have additional model layers and a finer grid size than the NMGWM. The new focused model is herein referred to as the CEMEX Model (CM). The CM will be constructed with the field data collected from this investigation. The NMGWM includes the area of the current investigation (i.e., CEMEX and Moss Landing) and will be refined (based on recent field data). Both the CM and the NMGWM will be used to support the CPUC's environmental review process, and to design a subsurface feedwater supply system.

2.3 Subsurface Intakes

Subsurface intakes are generally favored among regulatory agencies because of: (1) the natural water filtration and pretreatment provided by ocean floor sediments, which reduce the need for some treatment chemicals during the desalination process, and (2) the minimal growth of marine organisms that occurs inside the intake pipeline. The slant well subsurface intake system is also a primary consideration because the system will allow for a feedwater supply to be obtained from ocean sources (i.e., vertical leakage through the sea floor and horizontal recharge from offshore aquifers). In general, source water derived from subsurface wells requires significantly less filtration when compared to raw seawater. Subsurface wells are also generally considered a low-impact technology with respect to impingement and entrainment.

The subsurface intake site proposed by CalAm is located at the CEMEX property in Marina. Alternative intake sites have been proposed in the Moss Landing area. Therefore, this technical memorandum addresses the potential feasibility of subsurface intakes in both areas.

Figure 1 is a general location map for the current study. Figure 2 shows the locations of borings completed in both the CEMEX and the Moss Landing areas. Area maps specific to CEMEX facility and the Moss Landing area are shown in Figures 3 and 4, respectively.

2.4 Formation of Hydrogeology Working Group and Formation of the Hydrogeologic Investigation Workplan

As noted earlier, the Settlement Agreement laid the ground work for a collaborative effort by recognized experts in geology, hydrogeology and modeling, representing stakeholders of groundwater use and management in the project area. This led to the development of the Hydrogeology Working Group[3] (HWG). The HWG first met on April 25, 2013, to discuss conceptual models and to form a collaborative plan of investigation to assess the hydrogeologic conditions in the project area. As with any collaborative group, individual opinions need to be evaluated against actual field data and testing to arrive at a conceptual model that reflects a common understanding at the areas of concern. A draft workplan was prepared which provides a phased approach to progressively investigate the hydrogeology and the potential effects to aquifers from the use of subsurface slant wells for obtaining feedwater supply. The draft workplan was submitted to the HWG on August 2, 2013, for review and comment. The final workplan incorporated comments and recommendations by members of the HWG, covered the investigative steps needed to evaluate the project impacts, and was submitted to the HWG on December 18, 2013. This final workplan became the hydrogeology investigation roadmap.

2.5 Project Documents

2.5.1 Hydrogeologic Investigation Workplan

The process adopted by the HWG for the workplan consists of on-going steps of data collection and analysis. The data collected from this initial phase of investigation will be used to construct the CM and to refine the NMGWM. Each subsequent step of data collection will be followed by refinement of the CM and NMGWM, which are the tools being developed to evaluate the short- and long-term hydrogeologic impacts in the project area from operation of the MPWSP. Each step of data gathering will be preceded by an update of the workplan as appropriate, describing the proposed work and

---

[3] The HWG participants include: Tim Durbin and Martin Feeney (representing the Salinas Valley Water Coalition and the Monterey County Farm Bureau), Peter Leffler (representing CalAm), and Dennis Williams (representing the CPUC CEQA Team).

desired outcomes. Results will be documented by a technical memorandum describing the methods of data collection, findings and recommendations, and the results of the model refinements.

The MPWSP Hydrogeologic Investigation Workplan (HWP) is the main working document for all exploratory, testing, and modeling work, including:

- Attachment 1 - Technical Specifications – Exploratory Boreholes
- Attachment 2 - Technical Specifications – Test Slant Well
- Attachment 3 - Technical Specifications – Monitoring Wells
- Attachment 4 - Technical Specifications – Long Term Pumping Test and Monitoring Program
- Attachment 5 - Technical Specifications – Full Scale Slant Well Field

As such, the HWP is a "living document" which will be modified as appropriate as the project progresses.

To date, technical specifications for the boreholes (Attachment 1) was submitted to the HWG for review and comment, forming the basis for the current investigation. Preliminary Technical Specifications (Attachment 1 of the Hydrogeologic Investigation Report) for the test slant well and two monitoring wells were prepared and submitted to Cal Am for planning purposes. Subsequently, it was decided by CalAm to prepare separate technical specifications for the test slant well and for the monitoring wells. These documents were recently submitted for review. Therefore, after review of the findings of the current document by the HWG, the Technical Specifications for the Test Slant Well and Technical Specifications for the Monitoring Wells (Attachment 2 and Attachment 3 of the Hydrogeologic Investigation Workplan) will be updated if appropriate.

2.5.2 Hydrogeologic Investigation Report

The companion document to the Workplan will be the Hydrogeologic Investigation Report (HIR) and will include technical memorandums documenting all exploratory and testing activities as well as progressive model refinements and impacts. This document will include the following:

The Hydrogeologic Investigation Report will include a series of technical memorandum's which provide the data and analysis conducted throughout the study period including the following:

- Attachment 1 - Technical Memorandum (TM) – Summary of Results – Exploratory Boreholes
- Attachment 2 - Technical Memorandum (TM) – Summary of Results – Test Slant Well and Monitoring Wells
- Attachment 3 - Technical Memorandum (TM) – Summary of Results – Long Term Pumping Test and Monitoring Well Program

- Attachment 4 - Technical Memorandum (TM) – Refined ground water model results following exploratory boreholes, monitoring wells, test slant well and full scale system

The current document is Attachment 1 of the Hydrogeologic Investigation Report.

2.6 Purpose and Scope

2.6.1 Purpose

As part of the Workplan, a geotechnical borehole investigation was undertaken at several sites along the Monterey coast. The purpose of the exploratory boreholes was to obtain information on the lithologic and hydraulic character of the hydrostratigraphic units and the vertical and horizontal distribution of the units. The data gathered from the boreholes will be used to update the NMGWM. The model layers will be refined using the site-specific depth and thickness information of the hydrostratigraphic units. The hydraulic properties of the units obtained from the field work and the water quality data will be used for model input. In other words, the borehole data will help to:

- Characterize the aquifer units,
- Characterize the water contained in the aquifer units (to determine if it is seawater, groundwater, or seawater intruded groundwater), and
- Determine if the Salinas Valley Aquitard (a blue clay layer) exists between the aquifer units at this location.

This technical memorandum:

1. Presents the results from the exploratory borings at the CEMEX facility (see Figure 2) and the Moss Landing area (see Figure 3),
2. Provides an interpretation of the geologic units encountered in the boreholes as they relate to the conceptual hydrogeologic model, and
3. Provides recommendations for refinements to the NMGWM based on the newly collected data.

2.6.2 Scope

The Moss Landing area investigation included drilling of exploratory borings at the Molera, Potrero Road, and Sandholt Road Salinas River State Beach parking lots and along Pacific Coast Highway and along Sandholt Road at Moss Landing Harbor. The CEMEX area investigation included exploratory borings drilled on the CEMEX facility at locations approved by CEMEX. The approved scope of work for the investigation included the following:

- Drilling of sonic boreholes from depths ranging approximately 200 to 350 feet (ft) below ground surface (bgs)
- Collecting continuous soil cores from all borings
- Preparation of lithologic logs of the materials penetrated in each borehole
- Photographs of soil cores
- Geophysical borehole logs
- Construction of two groundwater quality sampling zones in each borehole in the Moss Landing area and collection of water samples from each zone
- Figures, maps, and photographs showing site locations and conditions
- Borehole destruction details
- Mechanical grading analysis
- Analysis of hydraulic conductivity using the Hazen Approximation, Krumbein-Monk, and Kozeny-Carman methods
- Laboratory vertical and horizontal permeameter testing
- Evaluation of groundwater quality conditions
- Preparation of recommendations for model layer revisions

2.6.3 Added Scope

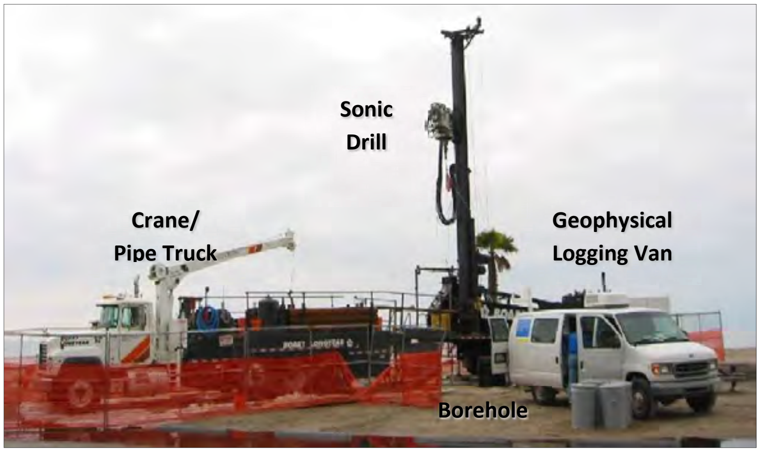
At the initiation of this study, exploratory borings at the CEMEX facility were limited to the collection of lithologic and geophysical data only. More recently, the scope was expanded to include two additional boreholes at the CEMEX facility to collect groundwater quality samples for borings not previously sampled for groundwater quality (see Section 3.1.6). A water quality boring (CX-B1WQ) was drilled adjacent to Boring CX-B1. A second water quality boring (CX-B2WQ) was drilled near Boring CX-B2. A fourth boring (CX-B4, third water quality boring) was also drilled at CEMEX to obtain continuous core and geophysical logs for lithologic logging and to collect groundwater quality samples. The locations of the water quality borings at CEMEX are shown on Figure 2 and Figure 3. In addition, to further explore the area south of Potrero Road, an exploratory boring (MDW-1) was drilled in the Molera parking lot of Salinas River State Beach located at Monterey Dunes Way. Four isolated zones were constructed in MDW-1 to collect water quality samples.

3.0 FIELD INVESTIGATION

3.1 Borehole Drilling and Sampling

3.1.1 Drilling

The sonic drilling method was used for all 13 boreholes for this investigation. All of the sonic drilling was completed by Cascade Drilling of Upland, California. Drilling commenced at the Potrero Road site in September 2013. Sonic drilling produced continuous core samples that were minimally disturbed. The cores from all borings were logged by the field geologist, photographed, and placed in wooden core boxes. Detailed borehole logs for each borehole are provided in Appendix A1. The cores were placed in storage at the Cal Am facility in Pacific Grove, California. Sediment samples were collected of each lithologic unit encountered in the boreholes by the field geologist. Photographs of the core are provided in Appendix B. Table 3-1 below provides a summary of drilling dates for each exploratory boring.



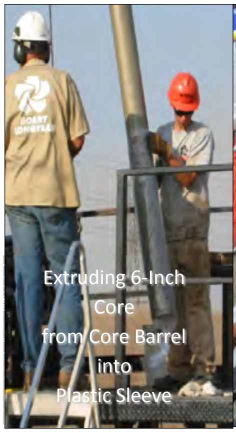
Sonic Drilling Rig and Support Equipment

Table 3-1. Chronology of Field Investigation

Borehole	Location	Drill Dates
PR-1	Moss Landing: SR State Beach Portrero Road Parking Lot	September 20-26, 2013
ML-1	Moss Landing: SR State Beach Sandholt Road Parking Lot	October 1-8, 2013
CX-B1	CEMEX	October 21-26, 2013
CX-B2	CEMEX	November 4-8, 2013
CX-B3	CEMEX	November 9-13, 2014
ML-6	Moss Landing (MBARI)	November 18-24, 2013
ML-4	Moss Landing (Coast Highway)	November 25,26 and December 2-8, 2013
ML-2	Moss Landing (Del Mar Fisheries)	December 9-20, 2013
ML-3	Moss Landing (Coast Highway)	January 6-14, 2014
CX-B1WQ	CEMEX	February 17-26, 2014
CX-B2WQ	CEMEX	March 4-7, 2014
CX-B4	CEMEX	March 20 -April 10, 2014
MDW-1	Moss Landing: SR State Beach Molera Parking Lot	April 23-May 10, 2014

3.1.2 Core Sampling

The core sampling was conducted using a 4-inch to 6-inch diameter inner casing. The core barrel is attached to small-diameter drill rods and is vibrated ahead of the outer casing collecting undisturbed formation materials as the core samples. With each 10-ft advance of the casing, the core barrel was extracted and brought to the surface to retrieve the core. Soil core samples were collected continuously during drilling of all the exploratory boreholes. Upon collection, all soil cores were placed in 6-mil polyethylene plastic sleeves measuring approximately 2 ft in length. Each bag was photographed and properly labeled in the field with the client name, boring number, sample depth interval, and date of collection. The core samples were then split longitudinally in half and visually classified (logged) in the field in accordance with the Unified Soil Classification System (USCS).



Extruding 6-Inch Core from Core Barrel into Plastic Sleeve

6-inch Sonic Casing Advanced to Hold Borehole Open

Sonic Drill Rig and Pipe Truck

3.1.3 California-Modified Split-Spoon Sampling

Split-spoon samples were collected at specified depths from each borehole to obtain undisturbed samples of the formation materials for the purpose of estimating hydraulic conductivity using a laboratory permeameter. Samples were collected from the Dune Sand Aquifer, fine-grained aquitard material, and coarse-grained material.

Split Spoon Sampler with Brass Sleeves

The split-spoon sampler holds three thin-walled metal (brass or stainless steel) sleeves measuring approximately 6 inches in length and 2.5 inches in diameter. The sampler was attached to a small diameter drill rod that is pushed through 18- to 24-inches of undisturbed formation material ahead of the drilling bit. Each time the split-spoon sampler is retrieved, the sampling sleeves were removed and the exposed ends were covered with Teflon® sheets, covered with plastic caps, and taped to preserve the sample for laboratory testing. Each sleeve was marked with the project name, borehole name, sample depth and number, and the date. The sample tubes were submitted to PTS Laboratories, Inc. of Santa Fe Springs, California under chain of custody protocol for analysis of vertical and horizontal soil hydraulic conductivity and selected soil parameters. Chain of custody forms are provided in Appendix C, along with the results of the laboratory testing.

3.1.4 Mechanical Grading Analysis

Representative samples of coarse-grained intervals were collected from core samples for mechanical grading analysis. The samples were sieved in the GEOSCIENCE soil laboratory and the grain size distribution was plotted on charts. The depth intervals at which samples were collected for mechanical grading analysis are shown on the corresponding lithologic log (see Appendix A1). Samples were sieved using U.S. Standard sieves with mesh sizes ranging from 0.0740 mm (0.0029 inches) to 9.525 mm (0.375 inches). Grain size distribution plots are provided as Appendix D. Grain size distribution was used to estimate the hydraulic conductivity; discussed in Section 3.2.3. Table 1 (attached) provides a summary of mechanical grading analysis and hydraulic conductivity estimates. Table 1 includes depth interval, lithology, geologic formation, conductivity direction, and the average hydraulic conductivity value for each sample interval. Soil types listed are based upon the results of the mechanical grading analyses.

3.1.5 Geophysical Borehole Logging

Once each borehole target depth was reached, the core barrel was removed and a 4-inch diameter PVC screen was installed within the borehole prior to removing the outer sonic casing. The PVC screen ensured that the borehole remained open during geophysical logging.

Geophysical logs were run throughout the total depth of each borehole. Each geophysical run included the following suite of logs:

- Dual Induction,
- Gamma,
- Temperature, and
- Fluid Resistivity.

Dual induction logs (DIL) were used to determine resistivity of formation materials by measuring conductivity adjacent to the induction tool.[4] The induction tool focuses alternating electromagnetic

---

[4] Conductivity is measured as (mho/m) and is the inverse of resistivity.

currents into the formation, with medium and deep measurements determined by transmitter/receiver spacing. The DIL is comprised of six (6) separate measurements:

- **RILM** - *Resistivity, Induction Log Medium*
- **RILD** - *Resistivity, Induction Log Deep*
- **CILM** - *Conductivity, Induction Log Medium*
- **CILD** - *Conductivity, Induction Log Deep*
- **SP** - *Spontaneous Potential*
- **GR** - *Gamma Ray*

Gamma ray (GR) logs were used to augment and aid identification of lithologic units encountered within each borehole.

A temperature log measures absolute fluid temperature within a borehole. A calculated differential measurement is provided with the log, which allows detection of vertical fluid movement within a borehole, including fluid entry and exit points.

Fluid resistivity logs provide a measure of the resistivity of borehole fluid (in units of ohm-m) and provide a calculated differential curve. This log was used for correlation of temperature measurements, to assist in locating the presence of borehole water with higher total dissolved solids (TDS) concentrations, and to differentiate between waters from various contributing aquifer zones.

All geophysical logs are provided in Appendix E. The geophysical borehole logs and lithologic descriptions were used to determine recommended depth intervals for zone testing and to delineate the aquifer systems in the study area. The results will be used to design project monitoring wells for long-term aquifer testing.

3.1.6 Isolated Aquifer Zone Testing for Water Quality Sample Collection

Following completion of geophysical logging, the lithologic and geophysical logs were reviewed to select depth intervals that would likely yield groundwater with the lowest and highest salinity. Depth intervals selected were used to construct isolated aquifer zones for groundwater quality sampling. An isolated aquifer zone test consists of constructing a temporary well with a 10-foot well screen interval placed at the depth of the lithologic unit to be tested. A seal is constructed above and below the well screen to isolate the portion of the aquifer for water quality testing. Two depth intervals were selected for groundwater sampling zones for each Moss Landing borehole (Borings Ml-1, ML-2, ML-3, ML-4, ML-6, and PR-1). Four isolated zones were constructed in Boring MDW-1. For the CEMEX area, a water quality boring was drilled near Boring CX-B1 and designated Boring CX-B1WQ. Another boring was drilled near Boring CX-B2 and designated as Boring CX-B2WQ. A third boring, Boring CX-B4 was drilled approximately 1,500 feet inland from CX-B2WQ and used to collect water quality samples. The locations of the water quality borings (CX-B1WQ, CX-B2WQ, and CX-B4) are shown on Figure 3. Six zones were selected for construction in Boring CX-B1WQ in an effort to assess potential water quality changes between the Dune Sand Aquifer and the underlying aquifer units. The groundwater quality samples were sent to the laboratory with an expedited request. After receipt of groundwater quality results for samples from Boring CX-B1WQ, and after reviewing the geophysical logs and lithologic logs, four zones were selected for Boring CX-B2WQ. The zones were selected to confirm and augment water quality data collected from Boring CX-B1WQ, and to develop an overall profile of groundwater quality at the CEMEX site. Five zones were selected for Boring CX-B4.

Each isolated zone was constructed by placing a bentonite seal below the selected zone interval. A 10-ft PVC screen was placed opposite the selected sampling interval and filter pack consisting of Monterey Sand #3 was placed opposite, above, and below the well screen. A second bentonite seal was placed above the filter pack interval. The bentonite seals effectively isolated the groundwater quality interval from groundwater above and below the selected interval. Each isolated aquifer zone is constructed specifically for the hydrogeologic conditions at the borehole site. The isolated aquifer zone testing forms are provided in Appendix F. Table 3-2 below summarizes the depth of zones by boring selected for the water quality sampling. A total of 31 zones were constructed for water quality sampling.

Table 3-2. Isolated Aquifer Zone Depth Intervals

Zone No.	ML-1	ML-2	ML-3	ML-4	ML-6	PR-1	MDW-1	CX-B1 WQ	CX-B2 WQ	CX-B4
Zone 1 (ft bgs)	113.5-118.5	167-177	180-190	163.5-173.5	152-162	190-200	237-247	274-284	215-225	306-316
Zone 2 (ft bgs)	90-100	90-100	103-113	74.5-84.5	100-110	125-135	187-197	237-247	161-171	248-258
Zone 3 (ft bgs)	-	-	-	-	-	-	152-162	182-192	104-114	155-165
Zone 4 (ft bgs)	-	-	-	-	-	-	60-70	134-144	55-65	110-120
Zone 5 (ft bgs)	-	-	-	-	-	-		84-94	-	58-68
Zone 6 (ft bgs)	-	-	-	-	-	-		51-61	-	
Total Depth (ft bgs)	200	200	200	201	200	200	300	306	250	350

See Appendix F for zone construction details.

Once a zone was constructed, the aquifer unit across from the well screen was developed using a swab and brush to remove fine sediment. A submersible pump was placed in the temporary well and pumped. Field measurements of groundwater quality were collected to evaluate when the groundwater quality had stabilized, and a representative sample of the aquifer unit was collected. Groundwater quality parameters measured and recorded in the field are provided in Table 3-3.

Table 3-3. Field Groundwater Quality Parameters

Parameters and Units	
Time (minutes)	Salinity (ppt)
Water Level (depth in feet, bgs)	Dissolved Oxygen (DO) (mg/L)
Temperature (degrees F)	pH
Conductivity (us/cm)	Oxygen Reduction Potential (ORP) (mV)
Calculated Total Dissolved Solids (TDS) (mg/L)	Turbidity (NTU)

The field measurements were collected approximately every three to five minutes, until at least three field parameters stabilized. The stabilization criteria are provided in Table 3-4.

Table 3-4. Parameter Stabilization Criteria

Parameters and Units	
pH	+/- 0.1 unit
Conductivity	+/- 3%
ORP	+/- 10 mV
Turbidity	+/- 10%
DO	+/- 10%

Groundwater samples were not collected until the turbidity reading was less than 1 NTU in order to avoid the potential for additional metal concentrations from sediments within the sample. Copies of the field data sheets used to record field parameters during zone testing are provided in Appendix F. The results of the laboratory testing are summarized in Table 3a and Table 3b. Copies of the groundwater quality laboratory reports are provided in Appendix G.

3.1.7 Borehole Destruction

Each exploratory borehole was destroyed immediately following completion of geophysical logging (Borings CX-B1, CX-B2 and CX-B3) or after isolated aquifer zone testing (remainder of borings). Each borehole was destroyed by filling with neat cement and native materials. To prevent material bridging during placement, all materials used for borehole destruction were placed through a tremie pipe. Borehole destruction was accomplished in accordance with the approved borehole destruction plan submitted by Cascade Drilling to Monterey County Health Department and in accordance with DWR Bulletins 74-81 and 74-90. The fine-grained units (i.e., aquitards) encountered beneath the Dune Sand Aquifer were sealed using a neat cement grout to insure that mixing of groundwater does not occur between aquifer units.

3.2 Estimates of Hydraulic Conductivity

Multiple estimates of hydraulic conductivity were made using mechanical grading analysis properties and vertical and horizontal conductivity/permeability values from laboratory analyses of relatively undisturbed soil samples.

3.2.1 Mechanical Grading Analysis

Mechanical grading analyses were used to determine the distribution of sediment grain sizes from samples collected from the continuous core. Three analytical methods were used to estimate hydraulic conductivity from the distribution of grain size in the samples. The Hazen Approximation, Krumbein-Monk, and Kozeny-Carman methods were used to estimate hydraulic conductivity from grain size distribution curves. A brief description of these methods is provided below.

Hazen Approximation

Hazen's Approximation is an empirical equation that estimates hydraulic conductivity to be proportional to the square of the effective grain size, which is expressed as:

$$K = C\,(d_{10})^2$$

Where:

K = Hydraulic conductivity (cm/s)

C = Hazen's constant, approximately 1 (dimensionless)

d_{10} = Grain size in mm for which 10% of the particle pass by weight

This method is applicable to sands where the effective grain size (d_{10}) is between approximately 0.1 and 0.3 mm. Hazen's Approximation was originally determined for uniformly graded sands, but it can provide rough but useful estimates for most soils in the fine-grained sand to gravel range (Freeze and Cherry, 1979).

Krumbein-Monk

Krumbein and Monk (1942) described hydraulic conductivity in the form of Darcies for unconsolidated sands with a log-normal grain size distribution. Using this description, they used a semi empirical equation assuming forty percent porosity, which is expressed as:

$$K = \frac{\rho_\omega g}{\mu} \cdot \left[\frac{\phi^3}{1-\phi^2}\right] \cdot \frac{d_m^2}{180}$$

where:

ρ_ω = Fluid density (kg/m^3 or ft/s^3), assumed to be the average temperature of groundwater (22 degrees Celsius)

d_m = Particle diameter or characteristic length of a given material (m or ft)

ϕ = Porosity

μ = Dynamic viscosity (Pa-s pr lbs-s/ft^2), also assumed to be the average temperature of groundwater (22 degrees Celsius)

g = Gravitational constant (m/s^2 or ft /s^2)

Kozeny-Carman

One of the most widely used equations for determining hydraulic conductivity from characteristic lengths is the Kozeny-Carman Equation. Kozeny proposed in 1927, which was later modified by Carman in 1956, a method for determining hydraulic conductivity from the following:

$$K = \frac{\rho_\omega g}{\mu}\left[\frac{n^3}{(1-n)^2}\right]\frac{d_m^2}{180}$$

where:

ρ_ω = Fluid density (kg/m^3 of ft/s^3), assumed to be the average temperature of groundwater (22 degrees Celsius)

n = Total Porosity

μ = Dynamic viscosity (Pa-s or lbs-s/ft^2), also assumed to be the average temperature of groundwater (22 degrees Celsius)

g = Gravitational constant (m/s^2 or ft/s^2)

d_m = Harmonic mean particle diameter calculated from the particle size distribution (m or ft)

and

$$d_m = 100\% / \left[\sum \left(\frac{f_i}{D_{ave,i}} \right) \right]$$

where:

f_i = fraction of particles between two sieve sizes; larger [l] and smaller [s] (%)

$D_{ave,i}$ = average particle size between two sieve sizes (cm) = $D_{li}^{0.5} \times D_{si}^{0.5}$

Table 1 (attached) provides a summary of hydraulic conductivity calculations based on mechanical grading analyses from the three methods. The soil types listed may not represent the complete lithologic interval from which they were obtained since the lithology is generally bedded and gradational.

3.2.2 Summary of Hydraulic Conductivity Values

Table 3-5 summarizes the hydraulic conductivity estimates from mechanical grading analyses for ten soil types collected from both the CEMEX and Moss Landing sites. First, the average hydraulic conductivity was calculated separately for all soil types using each method. Secondly, the range of horizontal hydraulic conductivity shown in the Table 3-5 for each type of soil was determined by the method yielding the minimum average and the method yielding the maximum average hydraulic conductivity.

Table 3-5. Summary of Average Hydraulic Conductivity Estimates by Soil Type

Summary of Hydraulic Conductivity Estimates from Mechanical Grading Analysis	
Soil Type (Unified Soils Classification System Designation)	**Horizontal Hydraulic Conductivity Range (ft/day)**
Organic Clay (CH)	NA
Silty Clay (CL)	NA
Silt (ML)	NA
Silty Sand (SM)	77 - 223
Poorly Graded Sand (SP)	112 - 349
Well Graded Sand (SW)	468 - 1,440
Sand with Silt (SP-SM)	33 - 135
Sand with Gravel (SP+Gravel)	342 - 817
Silty Sand Sand + Gravel (SM+ Gravel)	311 - 1,150
Well Graded Sand + Gravel (SW + Gravel)	469 - 859
Well Graded Sand + Gravel (SW + Gravel)	445 - 1,322
Sand with Clay + Gravel (SW-SC + Gravel)	446 - 1,511
Gravel (GW)	334 - 849

Table 3-6 summarizes the hydraulic conductivity estimates using the same approach as Table 3-5 but separately for samples collected from CEMEX and samples collected from Moss Landing. Not all soil types were represented at both sites. In the case where a sample was represented at only one site (i.e., GW: Gravel at CEMEX) the range of hydraulic conductivity was taken from Table 3-5. If a soil type was obtained from both CEMEX and Moss Landing sites (i.e., SW: Well- Graded Sand), the average hydraulic conductivity was calculated separately for each site from the range of values estimated from the samples collected at each site. For the SW: Well-Graded Sand example, the range of average hydraulic conductivity values reported in Table 3-5 falls between the range of average values calculated from each site individually, as shown in Table 3-6.

Table 3-6. Range of Hydraulic Conductivity from Mechanical Grading Analysis (MGA)

Lithology	MGA, CEMEX[1]		MGA, Moss Landing[1]	
	Min Avg Permeability, K [ft/day]	Max Avg Permeability, K [ft/day]	Min Avg Permeability, K [ft/day]	Max Avg Permeability, K [ft/day]
GW: Gravel	334	849	-	-
SM: Silty Sand	50	144	146	421
SM: Silty Sand with Gravel	-	-	311	1,150
SP: Sand	113	331	112	356
SP: Sand with Gravel	176	549	397	907
SP-SM: Sand with Silt	-	-	33	135
SP-SM: Sand with Silt and Gravel	-	-	445	1,322
SW: Well-Graded Sand	286	1,012	619	3,364
SW: Well-Graded Sand with Gravel	-	-	469	859
SW-SC: Sand with Clay and Gravel	-	-	446	1,511

[1] Mechanical grading analysis of formation samples performed by GEOSCIENCE Support Services, Inc. CEMEX MGA includes samples from boreholes CX-B1, CX-B2, CX-B3, and CX-B4. Moss Landing MGA includes samples from boreholes PR-1, ML-1, ML-2, ML-3, ML-4, and ML-6, and MDW-1.

Only one hydraulic conductivity value calculated from pumping test data is available for the aquifer units at CEMEX. Staal, Gardner, and Dunne (SGD, 1992) completed a pumping test in the Dune Sand Aquifer in 1992. Their reported hydraulic conductivity value is 1,750 gpd/ft^2, or approximately 230 ft/day. Table 3-7 provides a summary of the minimum and maximum hydraulic conductivity values for the CEMEX area. The value reported by SGD is comparable to the value estimated for the CEMEX borehole samples for the Older Dune Sand.

Table 3-7. Hydraulic Conductivity for Geologic Units at CEMEX

Geologic Unit	Minimum K-Value (ft/day)	Maximum K-Value(ft/day)
Dune Sand (Qd)*	273	779
Older Dune Sand (Qod)	136	372
Terrace Deposits (Qt)	113	342

*Data from Moss Landing for Qd used here.

Table 3-8 provides a summary of minimum and maximum hydraulic conductivity values for the Moss Landing area.

Table 3-8. Hydraulic Conductivity for Geologic Units at Moss Landing

Geologic Unit	Minimum K-Value (ft/day)	Maximum K-Value (ft/day)
Dune Sand (Qd)	227	619
Perched "A" Aquifer (Qal)	194	717

3.2.3 Laboratory Permeameter Estimates

Undisturbed drive samples were collected from each exploratory boring. A total of 41 samples were submitted for laboratory vertical and horizontal permeameter testing. Samples were selected to represent the Dune Sand Aquifer, fine-grained units such as clay layers, and the aquifer units underlying the Dune Sand Aquifer. The laboratory test reports are provided in Appendix C. Table 2 (attached) summarizes the laboratory vertical and horizontal permeability results. Table 3-9 below summarizes the range of laboratory permeability values based on soil type. The laboratory results in general are much lower than anticipated. The horizontal values appear significantly lower than an anticipated increase of 10 to 20 times the vertical permeability values.

The values provided from both the laboratory permeameter test and the mechanical grading analyses are approximate and will be revisited during the long-term aquifer test. However, the values estimated using the mechanical grading analysis are much closer to those anticipated from future aquifer testing and will form the starting point for refinements to the model in the CEMEX and Moss Landing area.

Table 3-9. Summary of Laboratory Hydraulic Conductivity Results by Soil Type

Summary of Laboratory Hydraulic Conductivity Results by Soil Type		
Soil Type (Unified Soils Classification System Designation)	Vertical Hydraulic Conductivity Range (ft/day)	Horizontal Hydraulic Conductivity Range (ft/day)
Organic Clay (CH)	0.003 - 0.014	NA
Silty Clay (CL)	0.005 - 0.283	NA
Silt (ML)	0.03	0.02
Silty Sand (SM)	0.20 - 1.38	0.37 - 4.34
Poorly Sorted Sand (SP)	0.28 - 17.29	1.80 - 36.56
Sand + Gravel (SP+ Gravel)	0.26 - 14.91	0.17 - 14.51
Sand/ Silty Sand (SP/SM)	0.13	0.31
Sand/Silty Sand/Gravel (SP/SM + Gravel)	24.15	17.74
Well Graded Sand + Gravel (SW + Gravel)	13.18	11.34

4.0 GEOHYDROLOGIC SETTING

4.1 Historical Background

This study includes an investigation of the geohydrologic conditions along the coast at the mouth of the Salinas River from Moss Landing south to the CEMEX facility (see Figure 1). Groundwater is present in multiple aquifer systems in several subbasins in the project area. Data from this study indicates that water quality is variable both in vertical and areal distribution. Historically, a large proportion of groundwater was extracted for agricultural purposes in the Salinas Valley. The Salinas Valley Groundwater Basin underlies the long linear Salinas Valley, which extends approximately 100 miles from headwaters in the southeast to Monterey Bay in the northwest at Moss Landing.

The relatively flat fertile floodplains along the Salinas River were developed for farming; therefore, wells were drilled to supply water for the agricultural development. The hydrogeologic nomenclature and hydrogeologic conceptual model was initially developed as a result of the subsurface information obtained from the drilling of the wells for agriculture.

The California Department of Water Resources (1946) cites the Eleventh Census for 1890 regarding irrigation in Monterey County:

> *…near the mouth of the Salinas River there were reported to be 60 flowing wells upon farms in 1890 most of them being not far from Castroville. They range in depth from 60 to 189 feet, the average being 136 feet…..They are reported to fluctuate with the season, many of them ceasing to flow in the summer….. At Salinas at about 10 miles from the coast, most deep wells are pumped by windmills.*

This historical description of groundwater use clearly conveys groundwater use in the Salinas Valley started early, and, as is the case for many parts of California, wells were drilled into the shallow upper aquifers first, followed by wells into deeper aquifers as greater quantities of water were required for supply. The flowing wells described in 1890 confirm that these early wells were drilled beneath an upper confining layer. DWR (1946) reports that the number of farms in the Valley increased from 21 farms in 1889 to 803 farms by 1929. In 1933, it was reported “that the quality of water in Salinas Valley as a whole was excellent.” However, with the advancement in well pump technology, many new large capacity pumping plants (wells) were brought into use. This resulted in an increasing number of wells being placed out of use from seawater intrusion by 1944. The description of the depths of the wells shows that the upper aquifer within the Salinas Valley was the first to be intruded by seawater, and experienced the furthest migration of seawater with time. Seawater intrusion maps published by the Monterey County Water Resources Agency (MCWRA) support this condition.

The historical conditions are significant to the current project because seawater was introduced into the freshwater aquifers beginning at the coast, with a continuous landward migration. This condition appears to correlate with the lowering of inland groundwater levels induced from agricultural pumping. It is our understanding, that a well at CEMEX has historically been included for monitoring seawater intrusion.

4.2 Groundwater Subbasins

4.2.1 "Pressure" Subarea and 180/400-Foot Aquifer

Both the Moss Landing and CEMEX areas lie within the 180/400-Foot Aquifer Subbasin as delineated by the DWR. DWR Bulletin 118 describes the 180/400-Foot Aquifer Subbasin as follows:

> *180/400-Foot Aquifer – Boundary with Corral de Tierra represents the contact between the Quaternary Paso Robles Formation or Aromas Red Sands and the Quaternary Alluvium or Terrace Deposits. Boundary with Seaside Area Subbasin represents seaward projection of the King City Fault (may act as barrier to flow). Northern boundary is the Pajaro Valley Groundwater Basin and coincides with inland projection of a 400-ft deep, buried clay-filled paleodrainage of the Salinas River. Northeastern boundary generally coincides with the northeastern limit of confining conditions in the 180/400-Foot Aquifer Subbasin and Highway 101. Southeastern boundary is the approximate limit of confining conditions in an up-valley direction. Boundaries generally coincide with those of the Pressure Subarea of MCWRA.*

The 180/400-Foot Aquifer Subbasin is characterized by confined groundwater conditions both historically and as described in DWR Bulletin 118.

The 180/400-Foot Aquifer Subbasin is bounded by groundwater divides on the south by the Seaside and the Corral de Tierra Subbasins.

4.2.2 Seaside and Corral de Tierra Subbasins

The Seaside Subbasin borders the 180/400-Foot Aquifer Subbasin to the south. The Seaside Subbasin is described by DWR as:

> The Seaside Subbasin *"northeast boundary is the Salinas Valley proper (180/400-Foot Aquifer), southeast boundary roughly represents the extent of Quaternary sand."*

The Corral de Tierra Subbasin borders the 180/400-Foot Aquifer Subbasin on the south, further inland than the Seaside Subbasin. The Corral de Tierra Subbasin is described by DWR as:

> *The Salinas Valley-Corral de Tierra Area Subbasin comprises the eastern portion of the former Fort Ord and other unincorporated areas. The subbasin includes outcrops of Plio-Pleistocene nonmarine units, including the Aromas Sands, the Paso Robles Formation. The subbasin is bounded on the northwest by the Seaside Area subbasin and on the northeast by the 180/400 foot aquifer subbasin. On the south and southwest the subbasin is bounded by Middle Miocene marine rock units, and a portion of the eastern boundary is a small area of Mesozoic granitic rocks (DWR, 2004).*

4.4 Regional Geologic Setting

Older geologic maps from the 1970s are available which show the onshore and offshore area of Monterey Bay and the description and distribution of stratigraphic units in the area. Seminal work in evaluating the Quaternary geology in the study area was completed by John Tinsley III and William R. Dupré in 1975 as doctoral dissertations submitted to Stanford University. Both dissertations address the distribution and genesis of Quaternary geologic units in the study area and will be referred to later in this section. More recently, the California Geological Survey published a report in 2002 titled “Geologic Map of the Monterey 30’x 60’ Quadrangle and Adjacent Areas”. Geologic maps are available at scales ranging from 1:100,000 to 1:24,000. These maps form the basis for the current conceptual model of geologic conditions in the vicinity of the project site. A geologic map of the project area is provided as Figure 6a.

In general, the geologic units mapped at the surface in the study area include, from oldest to youngest:

- Aromas Sand
- Quaternary Marine Terrace Deposits
- Quaternary Terrace Deposits
- Older Dune Sand
- Older Alluvium
- Younger Dune Deposits
- Quaternary Basin Fill Alluvium and Floodplain Deposits

A discussion of geologic units is provided in the following sections.

4.4.1 Aromas Sand (Qar, Qae, and Qaf)

The Aromas Sand designated as Qar (undiffentiated Aromas Sand), Qae (eolian lithofacies of the Aromas Sand) and Qaf (fluvial lithofacies of the Aromas Sand) is present near the study area. The Aromas Sand is early Pleistocene in age and crops out north of the Salinas Valley proper on southwest facing slopes above Castroville. The Aromas Sand in this area is overlain by Older Dune Sand deposits, terrace deposits, the Antioch Alluvial Fan, and the Chualar Alluvial Fan (see Figure 6a). Due to the current uncertainty associated with the location and/or extent of the Aromas Sand in the CEMEX area and the regional dune highlands, the USGS (Tinsley, 2014) recommends using a question mark (?) following the name Aromas to denote that a type section for the units formally designated as the Aromas Sand in the Moss Landing and Watsonville areas has not been established in the area south of the Salinas River and the Aromas (?) unit south of the Salinas River is likely an equivalent unit. The Aromas Sand (?) crops out in the eastern part of the Ford Ord area. The unit in this area is underlain by the Paso Robles Formation and overlain by Older Dune Sand deposits. Overall, the outcrops of the Aromas Sand form an arcuate shape from south of the Salinas River to the north. The unit has been eroded in the Salinas Valley during lowering of sea levels to elevations between -200 and -300 ft amsl (Kennedy/Jenks, 2004) which roughly corresponds with the Wisconsinan sea level lowstand offshore at -300 ft amsl at 17,000 years before present (bp; USGS, 1991). With sea level rise in the Holocene (11,000 years bp), the Salinas River Valley was backfilled with Valley Fill deposits. According to Tinsley, the "Base of Holocene marine transgression at this locality (Leonardini Well) occurs at approximately 150 ft below mean sea level (-150 ft above mean sea level, amsl)."

4.4.2 Quaternary Marine Terrace Deposits (Qmt)

According to Dupré, marine terraces flank both the northern and southern margins of Monterey Bay. They formed in response to glacioeustatic fluctuations in sea level. The youngest terraces in the Santa Cruz area were formed during the Sangamon sea level highstands (at 102,000 and 118,000 years bp; Dupré, 1990). Quaternary Marine Terraces are mapped near Moss Landing (see Figure 6a and Figure 8) and north of Elkhorn Slough.

4.4.3 Quaternary Terrace Deposits (Qt)

Terrace deposits are present along and elevated above the Salinas River floodplain. The terrace deposits represent former alluvial fan and river floodplain surfaces, and range in age from early to mid-Pleistocene. Terrace surfaces and their relative stratigraphic positions were mapped by Tinsley (1975) using soil stratigraphic methods. The stratigraphic positions of the terraces associated with the alluvial fans in the northern Salinas Valley were used to interpret the stratigraphic relationships shown on Figure 8. According to Tinsley a distinguishing feature of the Salinas River deposits originating from below the Arroyo Seco drainage which enters the Salinas Valley approximately 40 miles upstream from the south, is an abundance of porcellaneous chert from the Monterey Formation. The clast type can occur both in older terrace deposits (Tinsley, 2014) as well as younger fluvial deposits which lie beneath the Salinas Valley.

4.4.4 Older Dune Sand (Qod)

The Older Dune Sand (late Pleistocene) is also present in project area. These deposits are much more extensive in the project area south of the Salinas River Valley, extending inland as far as the East Garrison of former Fort Ord (approximately 5 miles inland). However, north of the Salinas River, the Older Dune Sand is limited in extent and crops out in small non-contiguous areas. Further north, nearing the Watsonville area, Older Dune Sand deposits are again extensive, occupying much of the coastal areas. Work completed by Dupré (1975) included study of the Manressa and Sunset Dunes, which are the coastal dunes located north of the Salinas River in the Watsonville area. These dunes are similar to what is called the Fort Ord ERG Dune Complex present in the CEMEX and Fort Ord areas. The term “ERG” is used to describe the landform which is made up of a large dune field. The Older Dune Sand deposits in the Fort Ord area are reported to be as much as 250 ft thick (HLA, 2001). The Dupré work has shown that the Older Dune Sand deposits rest on top of terrace deposits (Santa Cruz Terrace).

Dupré (1975) reports:

> *The Manressa Coastal Dunes conformably overlie the Santa Cruz coastal terrace deposits, hence were deposited during lowering sea level…The Manressa dunes are probably late Sangamonian/early Wisconsinan. The Sunset Dunes are similar in form and probably in origin to the Manressa Dunes, thus they record an interval of dropping sea level following a mid-wisconsinan interstadial highstand.*

Dupré notes that the Older Dune Sand deposits (in the Watsonville area) were deposited during a lowering of sea level between the interglacial Sangamon sea level highstand (125,000 - 85,000 years bp) and glacial Wisconsinan sea level lowstand (85,000 - 11,000 years bp). The current Holocene (11,000 years bp to present) represents the most recent interglacial period.

4.4.5 Older Alluvium (Qo)

Older alluvial deposits are not mapped at the surface in the study area, but underlie the Holocene deposits in the Salinas River Valley. These deposits are late Pleistocene and are likely in erosional contact with terrace deposits. The Older Alluvium contains organic “blue clay” horizons located beneath the Holocene floodplain of the Salinas River, and is typically referred to as the Salinas Valley Aquitard (SVA). According to Tinsley (1975), the presence of this “blue clay” indicates that shallow marine to brackish water estuarine environments prevailed during the deposition of the horizons, forming the principle aquicludes and aquitards in the 180/400 Foot Aquifer Subbasin.

4.4.6 Younger Dune Deposits (Qd)

Younger dune and beach sand deposits extend along the shoreline of Monterey Bay from the southern end of the Bay, northward to Moss Landing. The deposits are absent in the immediate vicinity of the mouth of the Salinas River (USGS Open File Report 02-373). The dune sand deposits extend landward approximately 0.1 to 0.5 miles inland. The Younger Dune Sand is Holocene in age and overlies older Dune Sand south of the Salinas River and older alluvial deposits along the mouth of the Salinas River Valley. It is likely that the recent dune sand rests over fluvial deposits (which form a shallow aquifer) in the area where the Salinas River Valley meets the ocean. However, to the south of the Salinas River Valley near the community of Marina and Fort Ord, the recent dune sand directly overlies older dune sand deposits.

4.4.7 Quaternary Basin Fill (Qb) Alluvium (Q) and Floodplain Deposits (Qfl)

The Quaternary basin fill, alluvium, and floodplain deposits are Holocene in age, consisting of sedimentary material deposited by the Salinas River and/or its tributaries. These units are mapped within the central portion of the Salinas Valley.

4.5 Local Geology

4.5.1 CEMEX Area

In the CEMEX area, younger and older dune deposits overlie Quaternary terrace deposits. The area is within the western edge of the Older Dune Complex, which is bounded by the Salinas River Valley to the north and extends from the coast to a maximum distance of five miles inland (see Figure 6a). The CEMEX area has been dominated by eolian (wind blown) depositional processes, while the Salinas River Valley is dominated by riverine fluvial depositional processes. The CEMEX area represents a distinct geomorphic area from the Salinas River Valley.

The concept of the formation of coastal dunes during the lowering of sea level as reported by Dupré (1975) suggests that the Older Dune deposits are either equivalent in age or older than the sand, silt, and gravel which form the 180-Foot Aquifer in the Salinas Valley to the north. These fluvial deposits which make up the 180-Foot Aquifer deposits were laid down as the Salinas River Valley degraded its channel during Wisconsinan time. The 180-Foot Aquifer was subsequently capped as sea levels rose at the beginning of the Holocene, forming an estuary and the SVA. The geologic units which form the 180-Foot Aquifer are stratigraphically equivalent but chronologically younger than the terrace deposits which underlie the Older Dune deposits at the CEMEX site.

DWR (2004) notes the "180-Foot Aquifer may in part be correlative to older portions of Quaternary terrace deposits or the upper Aromas Sand". Cross-Section 1-1' (Figure 7a) depicts the relationship between the geologic units that make up the 180-Foot Aquifer present beneath the Salinas Valley and the stratigraphic units encountered in the CEMEX boreholes. The degree of hydraulic connection will be initially evaluated using the CM and the NMGWM but, more significantly, will be field investigated with the test slant well program.

4.5.1.1 Findings from CEMEX Boreholes

Four boreholes were drilled to depths between 306 and 350 ft bgs. The locations are shown on Figure 3. Boring CX-B1 was located closest to the ocean. Boring CX-B2 was located 600 ft inland from CX-B1 along the CEMEX haul road. Boring CX-B3 was located near the CEMEX maintenance shop approximately 1,800 feet from Boring CX-B1, and CX-B4 is located 500 feet east of CX-B3 and approximately 2,700 feet from the shoreline. Lithologic units were found to be similar in all four borings (see boring logs in Appendix A1). The table below summarizes the geologic units encountered in the CEMEX borings CX-B1, CX-B2, CX-B3, and CX-B4.

Table 4-1. Depths of Geologic Units in CEMEX Borings (ft bgs)

Depths of Geologic Units in CEMEX Borings (ft bgs)				
Geologic Unit	Borehole			
	CX-B1	CX-B2	CX-B3	CX-B4
Qd	0-25	0-28	0-20	0-27
Qod	25-85	28-90	20-90	27-95
Qt	85-245	90-240	90-253	95-255
Qar	below 265	below 270	below 287	below 292

Geologic Cross-Section 1-1' (Figure 7a) illustrates the extent of the geologic units in the subsurface and indicates the hydrostratigraphic units associated with each geologic unit. Figure 7b is a close up in the CEMEX area.

4.5.2 Moss Landing Area

The investigation at Moss Landing is inclusive of the area from the Salinas River State Beach Molera parking Lot at Monterey Dunes Way (Boring MDW-1) to the Monterey Bay Aquarium Research Institute (MBARI) located at the northern terminal end of Sandholt Road (Boring ML-6). The geologic units include Younger Dune Deposits (Qd), recent alluvium (Qal), and basin fill deposits (Qb) near the coast. The area around the Pacific Coast Highway is underlain by Older Dune Deposits (Qod) and Quaternary Marine Terrace Deposits (Qmt). Further to the northeast, as land surface elevation increase, the alluvial fan deposits (Qfa) predominate and are underlain by the Aromas Sand (Qar) which crops out near Elkhorn and Prunedale. The distribution of surface geologic units is shown on Figure 6a.

4.5.2.1 Findings from Moss Landing Boreholes

A total of seven exploratory borings were drilled at the Moss Landing study area. The locations of all of the borings are shown on Figure 2. The five borings drilled in Moss Landing Harbor are shown on Figure 4. Lithologic logs of the borings are presented in Appendix A1. Geologic Cross-Sections 2-2' and 3-3' provided as Figure 8 and Figure 9, respectively, depict the geologic relationships in the Moss Landing area. Cross-Section 2-2' shows Pleistocene Alluvial Fan deposits overlain by Quaternary Marine Terrace Deposits, and in erosional contact with Older Alluvium which contains the 180-Foot Aquifer and the Perched "A" Aquifer. The Older Alluvial deposits are interpreted to extend seaward and be exposed in the walls of Monterey Canyon to the west.

Cross-Section 3-3' parallels the coast extending from the City of Marina to Moss Landing Harbor, and depicts mixed units of sand, silt, clay, and gravel which do not appear to be laterally or vertically extensive. The sand and gravel units encountered in Boring PR-1 showed the greatest thickness (99 ft) of permeable alluvium. The unit appears to decrease in thickness to the south and pinch out south of Boring MDW-1. Deposits interpreted as the SVA were penetrated in Boreholes MDW-1, PR-1, and ML-1 (see Figure 9). Figure 4-1 (Tinsley, 1975) provides a schematic depicting the relationship between the Pleistocene alluvial deposits and the alluvium which contains the SVA and 180-Foot Aquifer beneath the Salinas Valley near Salinas.

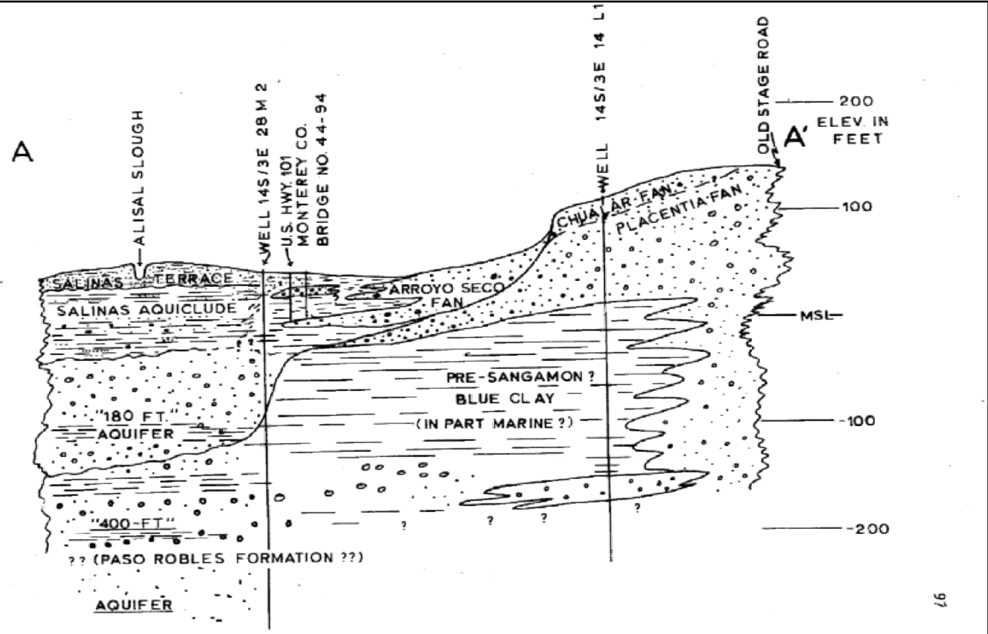


Fig. IV-2. Stratigraphic relationships in the vicinity of Gabilan Creek valley at Salinas, California. Line of section shown as A-A' on figure IV-1.

Figure 4-1. Reproduced from Figure IV-2 of Tinsley, 1975

4.6 Hydrostratigraphy

Traditionally, aquifers in the Salinas Valley Groundwater Basin have been named for the average depth at which they occur (e.g., 180-Foot Aquifer). Water-bearing materials in the area, from oldest to youngest, consist of the Pliocene marine Purisima Formation, Plio-Pleistocene Paso Robles Formation, Pleistocene Aromas Sands, and Holocene Valley Fill materials (Greene, 1970).

Table 4-2 below provides a correlation of surface mapped geologic units shown on Figure 6a and the hydrostratigraphic unit associated with the geologic unit. These units correlate with the CM and NMGWM, and are discussed in Section 6.

Table 4-2. Correlation of Geologic and Hydrostratigraphic Units

180/400-Foot Aquifer Subbasin			CEMEX Area		
Geologic Unit	**Geologic Unit Map Symbol**	**Hydrostratigraphic Units**	**Geologic Units**	**Geologic Unit Map Symbol**	**Hydrostratigraphic Units**
Benthic Zone	--	Benthic Zone	Benthic Zone	--	Benthic Zone
Alluvium	Qal[1]	Perched “A” Aquifer	Dune Sand	Qd	Dune Sand Aquifer
			Older Dune Sand	Qod	
Older Alluvium	Qo	Salinas Valley Aquitard	Older Terrace/ Marine Terrace	Qt (Qmt?)	180-FTE[2]
		180-Foot Aquifer			
Older Alluvium/ Marine Terrace	Qo/Qmt				
Older Alluvium/ Older	Qo/Qfa				
Older Alluvial Fan – Placentia	Qfp	180/400-Foot Aquitard	Aromas Sand (undifferentiated) (?)	Qar (?)	180/400-Foot Aquitard
Aromas Sand (undifferentiated)	Qar	400-Foot Aquifer			400-Foot Aquifer
Aromas Sand – Eolian/ Fluvial Lithofacies	Qae/Qaf				
Paso Robles Formation	QT	400/900-Foot Aquitard	Paso Robles Formation	QT	400/900-Foot Aquitard
		900-Foot Aquifer			900-Foot Aquifer

[1] Subsurface Holocene geologic unit not mapped at surface
[2] See Section 4.6.4

In the 180/400-Foot Aquifer Subbasin, the aquifer units from oldest to youngest include the 900-Foot Aquifer, 400-Foot Aquifer (generally thought to be contained in the upper part of the Aromas Sand), and the 180-Foot Aquifer present with the Older Alluvium and separated from the overlying Perched “A” Aquifer by the Salinas Valley Aquitard. Thicknesses of individual aquifer units vary in previous work by others. For example, Table 4-3 below provides the estimated thickness of the 180-Foot Aquifer suggested by the work of previous investigators. The information summarized in the Table 4-3 below indicates that identifying the elevation range and thickness of the 180-Foot Aquifer varies and depends on the specific investigator and location.

Table 4-3. Previous Estimates of Thickness and Elevation Ranges for the 180-Foot Aquifer

Previous Investigator	180-Foot Aquifer Near CEMEX	
	Thickness (ft)	Elevation Range (ft amsl)
Greene, 1970	50-250	20 to -220
DWR, 1973	50-150	0 to -300
Tinsley, 1975	100-150	Base of aquifer at -150
Staal, Gardner, Dunne*, 1991	Not reported	Top of aquifer at -110
Fugro West, 1996*	Not reported	Top of aquifer at -135
Harding ESE, 2001	Combines Dune Sand with 180-Foot Aquifer	Base of aquifer at -250
Kennedy Jenks, 2004	100	-100 to -180

* The depth to the 180-Foot Aquifer was determined for a site south of CEMEX.

4.6.1 900-Foot Aquifer

The 900-Foot Aquifer is contained within the Plio-Pleistocene Paso Robles Formation. HLA (2001) notes that the 900-Foot Aquifer is part of a "Deep" aquifer system, which also includes what has been called the 800-Foot, 1,000-Foot, and 1,500-Foot Aquifers. For purposes of groundwater modeling, these aquifers will be collectively termed and simulated as the 900-Foot Aquifer.

4.6.2 400-Foot Aquifer

Within the project area, the 400-Foot Aquifer is the aquifer unit which is contained in the upper and lower portions of the Aromas Sand (USGS, 2003). The thickness of the unit has been reported to be approximately 200 ft (HLA, 2001) but may be as thick as 500 feet (USGS, 2003). The unit is separated from the overlying 180-Foot Aquifer by zones of discontinuous aquifers and aquitards which are approximately 10 to 70 ft thick. The aquitards in this area have been designated as the 180/400-Foot Aquitard.

4.6.3 180-Foot Aquifer

As noted previously, the 180-Foot Aquifer has various reported thicknesses. The aquifer is separated from the overlying Perched "A" Aquifer by the SVA. DWR (2003) states that the 180-Foot Aquifer may, in part, be correlative to older portions of Quaternary Terrace Deposits or the upper Aromas Sand. Work completed for this study suggests that the 180-Foot Aquifer is correlative with terrace deposits of Quaternary age that are older but in erosional contact with younger Salinas River fluvial deposits containing the 180-Foot Aquifer in the Salinas Valley.

According to Tinsley (1975), "extrapolation of the stratigraphic position of the 180-Foot Aquifer offshore shows that it lies within the seismic unit which represents the deltaic deposits" reported by Greene in 1970. The work prepared by Greene suggested approximately 200 ft (60m) to 280 ft (85m) (maximum) thickness of the Holocene deltaic deposits. Tinsley (1975) reported that foraminera[5] from data collected from the water well cuttings suggested that there is 200 ft (60m) to 250 ft (75m) of Holocene sediments near the coast in the southern Salinas River Valley, which correlates well with the work by Greene. However, more recent work by Chin (USGS, 1988) using seismic methods suggests that the offshore Holocene Deltaic deposits are about 70 ft in thickness.

4.6.3.1 Historical Approaches for Identifying the 180-Foot Aquifer

The 180-Foot Aquifer has been historically defined using four separate approaches. The four approaches are: tradition, facies, groundwater flow system, and institutional. A brief description of the approaches applied to water bearing deposits encountered below the Dune Sand at CEMEX is provided below.

Tradition: Traditionally, the 180-Foot Aquifer has been described in narrative, map, and cross-sectional formats. While the descriptions differ among various authors, generally the 180-Foot Aquifer is described as resting beneath the SVA at an average depth of 180 ft bgs, extending offshore, and cropping out on the floor of Monterey Bay. The mapping of seawater intrusion by the MCWRA represents an implied extent of the traditional 180-Foot and 400-Foot Aquifers. At CEMEX, the terrace deposits which underlie dune sand are not capped by the SVA and therefore do not match the traditional description of the 180-Foot Aquifer.

Facies: Some authors have defined the 180-Foot Aquifer in terms of facies. According to Reading (1996) "a facies is a distinctive rock unit that forms under certain conditions of sedimentation, reflecting a particular process or environment." Authors who have described the 180-Foot Aquifer as a sedimentary facies have associated the 180-Foot Aquifer with Salinas River fluvial deposits which were deposited in the pre-Holocene Salinas Valley. Some authors have extended the 180-Foot Aquifer across facies changes.

A "facies change" is a lateral or vertical variation in lithologic or paleontologic characteristics of contemporaneous sedimentary deposits. It is caused by, or reflects, a change in depositional environment" (Neuendorf et al., 2005). For example, in a fluvial system, the center of a river channel may contain sand and gravel while the edges of the river may contain silt and clay deposited in quiet water conditions. A facies change, or change in the sedimentary environment, occurs within the same

---

[5] Foraminifera (foraminifers or, informally, just forams) are single-celled organisms (amoeboid protists) with shells (plankton).

time-stratigraphic unit. Therefore, including various facies changes in the 180-Foot Aquifer is appropriate. The terrace deposits which underlie the CEMEX property are not a facies change within the fluvial sediments which contain the 180-Foot Aquifer since they represent a different time-stratigraphic unit. The terrace deposits are older and are in erosional contact within the various fluvial facies which contain the 180-Foot Aquifer.

Groundwater-flow system: Under pre-development conditions, groundwater flowed horizontally toward Monterey Bay both within the Salinas Valley and within the Dune Highland area in the vicinity of CEMEX. Under post-development conditions, a reversal in groundwater gradient has resulted in groundwater flowing from Monterey Bay inland, causing seawater intrusion. The groundwater flow systems will cross different facies as well as different time-stratigraphic units. The terrace deposits are likely in hydraulic continuity with the 180-Foot Aquifer. Therefore, groundwater flow will occur across the erosional contact from the 180-Foot Aquifer into the terrace deposits (referred to here as the 180-Foot Equivalent Aquifer, or 180-FTE Aquifer) and vice-versa. The degree of flow between the aquifers will be assessed during the test slant well program.

Institutional: The boundaries of the 180-Foot Aquifer may be defined or implied by legislation or ordinances. It is duly recognized that institutional boundaries have been prepared based on the historical conceptual models of the regional hydrogeology and based on the historical data available. For purposes of this document, the alluvial materials encountered near the coast (in the CEMEX area) are based solely on analyses of borehole samples (and geophysical borehole logs). As of yet, no direct correlation can be made between these coastal alluvial deposits and the standard naming convention found further inland (e.g., 180-Foot Aquifer, 400-Foot Aquifer, SVA, etc.). Therefore, in this document, the upper materials have been classified as the Dune Sand Aquifer and the alluvial materials below have been referred to as stratigraphically equivalent to the inland 180-Foot Aquifer (or 180-FTE Aquifer) and should not be construed to alter institutional interpretations.

4.6.4 180-Foot Equivalent Aquifer (Terrace Deposits)

The terrace deposits are water bearing materials beneath the Dune Sand Aquifer in the CEMEX area. The terrace deposits are approximately 160 ft thick at the CEMEX site, thinning seaward. Hydraulic conductivity values are lower than those attributed to the 180-Foot Aquifer. Based on the data collected in this study, the terrace deposits are interpreted to be stratigraphically equivalent to the 180-Foot Aquifer of the Salinas Valley, and may likely be in hydraulic continuity with the 180-Foot Aquifer. Therefore, for the purposes of this investigation, the aquifer interval within the terrace deposits is referred to as 180-Foot Equivalent (180-FTE) Aquifer. The 180-FTE Aquifer is believed to be in hydraulic continuity with the overlying Dune Sand Aquifer; both units extend seaward beneath Monterey Bay and have similar water quality.

4.6.5 Salinas Valley Aquitard

The SVA consists of discontinuous layers of clays ranging in thickness from 0 to 100 ft. It defines the Pressure Area from Chualar to the coast. In the inland areas, the SVA is generally present overlying the 180-Foot Aquifer, separating the 180-Foot Aquifer from the Perched “A” Aquifer (discussed below). The SVA is present beneath the Moss Landing area but not beneath the CEMEX site.

4.6.6 Dune Sand Aquifer

The Dune Sand Aquifer is present beneath the CEMEX site and represents the water bearing units of both the Younger and Older Dune Sand. Based on groundwater quality data collected at the CEMEX site, and the absence of the SVA, the groundwater in the Dune Sand Aquifer is believed to be hydraulically connected to the underlying 180-FTE Aquifer (terrace deposits). The high salinity suggests that the Dune Sand Aquifer is also connected to the ocean. According to HLA (2001), the Dune Sand Aquifer is hydrostratigraphically equivalent to the Perched “A” Aquifer. Work completed by Emcon (1991) for the Marina Peninsula Class III Landfill suggests that there are multiple perched aquifers within the Older Dune Sand. The aquifer designated as the -2 Foot Aquifer at the landfill appears to correlate with the Perched “A” Aquifer of the Salinas Valley. Recent groundwater levels for the -2 Foot Aquifer are shown on Cross-Section 1-1’ (Figure 7a).

4.6.7 Perched “A” Aquifer

The Perched “A” Aquifer is found within the Salinas Valley overlying the SVA. According to HLA (2001), an equivalent unit designated as the “A-aquifer” is found exclusively in the Older Dune Sand beneath the former Fort Ord. This relationship further suggests that groundwater within the Perched “A” Aquifer in the Salinas Valley may be hydraulically connected to the groundwater found in the Older Dune Sand.

4.7 Hydrostratigraphic Interpretation of CEMEX Borehole Data

The CEMEX borings encountered groundwater from slightly below ground surface to the bottom of each borehole. The Dune Sand Aquifer is present to a depth of approximately 90 ft bgs. Groundwater quality data indicates that TDS concentrations for the Dune Sand Aquifer range from approximately 4,800 mg/L inland to 27,000 mg/L near the ocean.

Terrace deposits in the 180-FTE Aquifer underlie the Dune Sand Aquifer and consist of a range of fluvial lithologic units, including thin gravel channels and laminated silt and very fine sand deposits. The base of the terrace deposits appears to be marked by a transition to thicker clay units (10-15 ft thick) with interbedded sand and gravel units (about 10-ft thick) above a distinct “blue” clay layer. TDS concentrations in this unit vary from 16,000 mg/L to near sea water (32,000 mg/L). TDS concentrations in the terrace deposits appear to be similar to those in the Dune Sand Aquifer. The high and low values of TDS appear to represent groundwater within more isolated channels and lenses within the unit.

The units below the "blue" clay[6] are interpreted to be the 400-Foot Aquifer within the Aromas Sand. TDS concentrations obtained from two isolated zones in this aquifer were approximately 25,000 mg/L to 30,000 mg/L. Table 4-4 below provides a summary of water quality by geologic unit. The TDS concentrations with depth and by geologic unit are shown on Figures 7a and 7b. A detailed discussion of groundwater quality is provided in Section 5.

Table 4-4. Summary of Laboratory Water Quality Results from Boreholes at CEMEX

TDS Concentrations by Zone	Borehole CX-B1 WQ					
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6
Depth (ft bgs)	274-284	237-247	182-192	134-144	84-94	51-61
TDS (mg/L)	**25,200**	**14,600**	**35,600**	**26,500**	**27,400**	**24,800**
TDS Concentrations by Zone	**Borehole CX-B2 WQ**					
	Zone 1	**Zone 2**	**Zone 3**	**Zone 4**		
Depth (ft bgs)	215-225	160.5-170.5	104-114	55-65		
TDS (mg/L)	**26,500**	**16,200**	**26,800**	**26,700**		
TDS Concentrations by Zone	**Borehole CX-B4**					
	Zone 1	**Zone 2**	**Zone 3**	**Zone 4**	**Zone 5**	
Depth (ft bgs)	306-316	248-258	155-165	110-120	58-68	
TDS (mg/L)	**29,800**	**27,200**	**20,500**	**24,000**	**4,815**	

4.8 Hydrostratigraphic Interpretation of Moss Landing Boreholes Data

A total of seven borings were drilled in the Moss Landing study area. Figure 8 and Figure 9 are geologic cross-sections constructed from borehole data, and were used to interpret the subsurface stratigraphic and hydrostratigraphic relationships in the Moss Landing area. Cross-Section 2-2' is drawn perpendicular to the shoreline and makes use of the lithologic log from Boring PR-1 and mapped surface geology. The geologic relationships depicted include recent alluvium and older alluvium containing the

---

[6] The "blue clay" refers to a distinct lithologic unit encountered in CEMEX borings that was dark greenish gray, a Munsell color of 5GY 3/1. Munsell soil color charts are commonly used in the industry to describe soil colors.

Perched “A” Aquifer, SVA, and the 180-Foot Aquifer present beneath the Salinas River in erosional contact with older alluvial fan deposits located on the northern portion of the Salinas Valley. This relationship was reported by Tinsley (1975) for the area around Salinas and indicates that the aquifers in the Salinas Valley may be in hydraulic connection with groundwater in terrace and alluvial fan deposits. The older alluvial deposits and alluvial fan deposits overlie the Aromas Sand which contains the 400-Foot Aquifer.

Cross-Section 3-3’ is drawn parallel to the shoreline and extends from Moss Landing south to the City of Marina. Cross Section 3-3’ makes use of the lithologic logs from Boreholes MDW-1, PR-1, ML-1, ML-2, and ML-6. Further south, borehole information from previous studies and driller’s logs and data recently collected from CEMEX were used to construct the cross-section. The cross-section depicts a thicker sequence of recent alluvium consisting of permeable sand and gravel material present at depths between 58 ft and 139 ft bgs in PR-1. In the Moss Landing area, the recent alluvium is interbedded with silt, silty sand, and clay. To the south of Boring PR-1, the permeable deposits encountered in Boring PR-1 decrease in thickness and pinch out and the Older Alluvium which contains the SVA and the 180-Foot Aquifer is in erosional contact with the terrace deposits. The alluvial deposits are channel and floodplain deposits near the mouth of the Salinas River. The alluvium is underlain by older alluvium which contains the SVA, and the underlying 180-Foot Aquifer. The 180-Foot Aquifer is cut off to the north by clay gorge fill reported by DWR (1973) associated with Elkhorn Slough.

Table 4-5 below summarizes basic groundwater quality data for the Moss Landing borings. The zones above approximately 100 ft bgs had TDS concentrations ranging from freshwater (423 mg/L) to near seawater (29,000 mg/L). Borings ML-2, ML-3 ML-4 contained brackish water (approximately 5,000 mg/L to 9,000 mg/L). With the exception of Zone 1 from ML-3, the lower zones consistently contained high TDS concentrations ranging from approximately 19,000 mg/L to 34,000 mg/L (ML-6). A detailed discussion of groundwater quality is provided in Section 5.

Table 4-5. Summary of Laboratory Water Quality Results from the Moss Landing Borings

Water Quality Parameters	MDW-1				PR-1		ML-1	
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 1	Zone 2	Zone 1	Zone 2
Depth (ft bgs)	237-247	187-197	152-162	60-70	190-200	125-135	113.5-118.5	90-100
TDS (mg/L)	**31,000**	**30,200**	**26,600**	**21,900**	**630**	**34,000**	**22,000**	**3,200**
Water Quality Parameters	**ML-2**		**ML-3**		**ML-4**		**ML-6**	
	Zone 1	**Zone 2**	**Zone 1**	**Zone 2**	**Zone 1**	**Zone 2**	**Zone 1**	**Zone 2**
Depth (ft bgs)	167-177	90-100	180-190	103-113	163.5-173.5	74.5-84.5	152-162	100-110
TDS (mg/L)	**19,000**	**8,100**	**7,400**	**4,200**	**21,000**	**8,600**	**34,000**	**28,000**

4.9 Updated Conceptual Model

The geologic and hydrogeologic data collected during this investigation was used to prepare the interpretations of hydrostratigraphic relationships in the Moss Landing and CEMEX areas. A conceptual model of the hydrostratigraphic units in the Moss Landing to CEMEX area as interpreted from data collected from this investigation is shown on Figure 4-2.

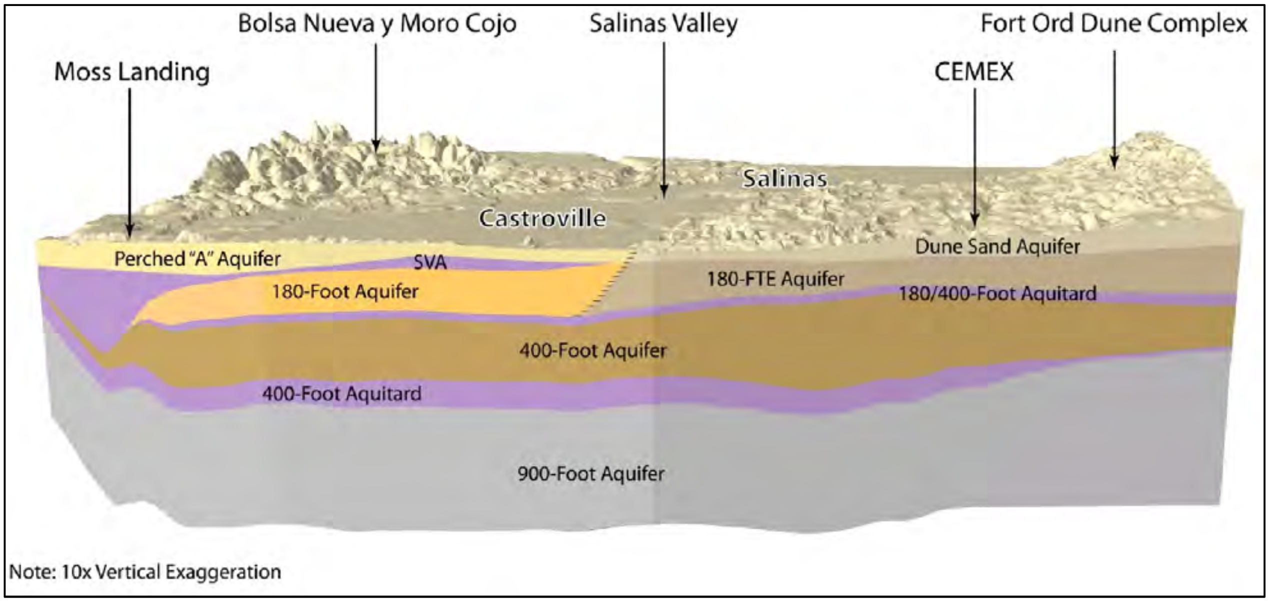


Figure 4-2. Hydrostratigraphic Model Moss Landing to CEMEX Area

5.0 GROUNDWATER QUALITY

5.1 General

5.1.1 Groundwater Levels

Groundwater was encountered in all of the borings drilled during this investigation. Groundwater levels were not established with certainty during this investigation. The groundwater level was measured in the well casing after aquifer zone testing if the zone was left over night to allow full recovery after pumping. In some cases, the zones were removed at the end of pumping to allow for construction of a subsequent zone or for borehole destruction to move the drilling rig to the next location. The installation of permanent monitoring wells during the next phase of investigation will allow an accurate evaluation of groundwater elevations. Table 5-1 below provides groundwater level measurements (depth in ft, bgs) from most of the zones. These are provided as an estimate of depth to water encountered in the temporary well (zone) but may vary with tidal influences or seasonally. In general, the depth to water measured in the boreholes reflects a groundwater surface elevation at or near sea level.

Table 5-1. Depth to Water from Isolated Aquifer Test Zones

	Depth to Water (ft bgs)					
Borehole	**Zone 1**	**Zone 2**	**Zone 3**	**Zone 4**	**Zone 5**	**Zone 6**
Moss Landing						
PR-1	-	-				
ML-1		3.6				
ML-2	3.3	1.6				
ML-3	12.57	10.86				
ML-4	28.68					
ML-6	8.09	9.58				
MDW-1	20.8	19.2	20.9	14.65		
CEMEX						
CX-B1WQ	26		19.53	21.5	19.3	19.9
CX-B2WQ	28.4	26.31	24.3	24.7		

5.1.2 Groundwater Sampling and Analysis

Groundwater samples collected from the isolated aquifer zone tests were submitted for laboratory analysis. Table 5-2 lists the suite of analyses conducted on each sample. The results of the water quality and age dating analyses will partially form the basis for the interpretations of the hydrogeology in the study area discussed in the sections below. The laboratory analytical data are summarized in Table 3a and Table 3b. Copies of the field data sheets used to record field parameters during zone testing are provided in Appendix G.

Table 5-2. Water Quality Analyses for Exploratory Boreholes

Constituent	Units	Method Reporting Limit	Method
Physical Properties			
Color	Color Units	3	SM 2120B/EPA 110.2
Odor	T.O.N.		EPA 140.1
Oxidation-Reduction Potential (Field)	mV	-	Field Meter - Myron L 6PII
pH (Lab)	Units	0.1	SM 4500 H+B
pH (Field)	Units	-	Field Meter - YSI Pro Plus
Turbidity (Laboratory)	NTU	0.2	EPA 180.1/SM 2130B
Turbidity (Field)	NTU	-	Field Meter - Hach 2100P
Temperature (Field)	°C	-	Field Meter - YSI Pro Plus
Dissolved Oxygen (Field)	mg/L	-	Field Meter - YSI Pro Plus
Silt Density Index (Field)	-	-	ASTM D4189-07
Threshold Odor Number	T.O.N.	1	EPA 140.1/SM 2150
Total Dissolved Solids (Lab)	mg/L	10	SM 2540 C
Total Dissolved Solids (Field)	mg/L	-	Field Meter - YSI Pro Plus
Specific Conductance (Lab)	μmhos/cm	1	SM 2510 B
Specific Conductance (Field)	μS/cm	-	Field Meter - YSI Pro Plus
General Minerals			
Total Cations	meq/L	-	Calculation
Total Anions	meq/L	-	Calculation
Alkalinity as $CaCO_3$	mg/L	3	SM 2320 B
Bicarbonate Alkalinity as HCO_3	mg/L	3	SM 2320 B
Carbonate Alkalinity as $CaCO_3$	mg/L	3	SM 2320 B
Hydroxide Alkalinity as $CaCO_3$	mg/L	3	SM 2320 B
Total Hardness as $CaCO_3$	mg/L	3	Calculation
Aluminum	μg/L	1	EPA 200.7
Arsenic	μg/L	1	EPA 200.7 / EPA 200.8
Barium, Dissolved	μg/L	0.01	EPA 200.7
Boron, Dissolved	μg/L	0.5	EPA 200.8

Bromide, Dissolved	mg/L	0.1	EPA 326.0
Calcium, Dissolved	mg/L	1	EPA 200.7
Chloride, Dissolved	mg/L	1	EPA 300.0
Copper, Total	µg/L	50	EPA 200.7
Fluoride, Dissolved	mg/L	0.1	EPA 300.0 / SM 4500 FC
Iodide, Dissolved	mg/L	0.1	USGS I-2371 / EPA 9056A
Iron, Dissolved	µg/L	100	EPA 200.7 / EPA 200.8
Iron, Total	µg/L	100	EPA 200.7 / EPA 200.8
Lithium	µg/L	10	EPA 200.7 / EPA 6010B
Magnesium, Dissolved	mg/L	1	EPA 200.7
Manganese, Dissolved	µg/L	20	EPA 200.7 / EPA 200.8
Manganese, Total	µg/L	20	EPA 200.7 / EPA 200.8
MBAS	mg/L	0.05	SM 5540 C / EPA 200.8
Nitrogen, Nitrate as NO_3	mg/L	1	EPA 353.2 / EPA 300.0
Nitrogen, Nitrite, Dissolved	mg/L as N	1	SM 4500 NO_2B
Nitrogen, NO_2 + NO_3	mg/L as N	1	EPA 300.0
Nitrogen, Ammonia, Dissolved	mg/L as N	0.1	SM 4500 NH_3H / EPA 350.1
Nitrogen, Ammonia + Organic, Diss. (TKN)	mg/L as N	0.1	EPA 351.2
Phosphorus, Dissolved	mg/L as P	0.01	EPA 365.3
Phosphorus, ortho, Dissolved	mg/L as P	0.01	EPA 365.3
Potassium, Dissolved	mg/L	1	EPA 200.7
Silica, Dissolved	mg/L	1	SM 4500 SiE
Sodium, Dissolved	mg/L	1	EPA 200.7
Strontium, Dissolved	mg/L	0.1	EPA 200.7 / EPA 200.8
Sulfate as SO_4, dissolved	mg/L	0.5	EPA 300.0
Zinc, Total	µg/L	50	EPA 200.7
Radiology / Age Dating Methods			
Delta-Deuterium	δ^2H	-	TC/EA/IRMS
Delta Oxygen-18	$\delta^{18}O$	-	TC/EA/IRMS
Tritium	TU	-	-
Tritium, prec. est.	TU	-	-
Volatile Organic Compounds			
VOCs plus Oxygenates (MTBE)	µg/L	varies	EPA 524.2
EPA Organic Methods			
EDB and DBCP	µg/L	varies	EPA 504.1
Chlorinated Pesticides & PCB’s as DCP	µg/L	varies	EPA 508
Chlorinated Acid Herbicides	µg/L	varies	EPA 515
Nitrogen & Phosphorus Pesticides DEHP, DEHA, Benzo(a)Pyrene	µg/L	varies	EPA 525

Carbamates	µg/L	varies	EPA 531.1
Glyphosate	µg/L	varies	EPA 547
Endothall	µg/L	varies	EPA 548.1
Diquat	µg/L	varies	EPA 549.1
Dioxin (2,3,7,8 TCDD)	µg/L	varies	EPA 1613

NTU = Nephelometric Turbidity Units
mg = Milligram
µS = Microsiemens

Due to time constraints, the need to work through weekends, and the need to submit samples to laboratories on the weekend, several laboratories were used for the analytical work. In addition, specialist laboratories were used for age dating using the tritium and oxygen/deuterium isotope analyses. The following are the State Certified Laboratories and specialist laboratories used for analytical testing.

- BSK Associates
- Ceres Analytical Laboratory
- Maxxam Analytics
- Monterey Bay Analytical Services
- Pace Analytical
- SIRFER Stable Isotope Ratio Facility for Environmental Research (University of Utah)
- Weck Laboratories, Inc.
- GEOCHRON Laboratories
- McCampbell Analytical, Inc.

5.2 Groundwater Quality - CEMEX Area

Lithologic, geophysical, and groundwater quality data was collected from borings drilled at the CEMEX facility. The geologic data and geophysical data were used with other published data and driller's logs to construct Cross-Section 1-1' (see Figures 7a and 7b). The cross-section extends from offshore, eastward, through the CEMEX facility and the Monterey Peninsula Landfill into the Salinas Valley. The stratigraphic relationships indicate that groundwater aquifers beneath the CEMEX facility are present in the Younger and Older Dune Sand, in terrace deposits below the Dune Sand, and in what is interpreted as Aromas Sand (?) below the terrace deposits. The terrace deposits are separated from the underlying Aromas Sand (?) by a distinct "blue" clay unit which suggests a change in depositional environment at an elevation of approximately -220 ft amsl. The groundwater present in the terrace deposits appears to be hydrostratigraphically equivalent to the 180-Foot Aquifer is therefore termed 180-FTE Aquifer to be consistent with the nomenclature used in this region. As interpreted, the 180-FTE Aquifer transitions eastward and is in erosional contact with the older alluvium (which contains the 180-Foot Aquifer) in the Salinas Valley. The sedimentary transition eastward towards the Salinas Valley is shown in Figure 7a. The 180-FTE and 180-Foot Aquifers, although depositionally and chronologically different, are hydrostratigraphically equivalent. The degree of hydrostratigraphic equivalence will be evaluated by the long-term test slant well aquifer testing program.

Table 5-3 summarizes TDS concentrations by depth and interpreted hydrostratigraphic unit at CEMEX. TDS concentrations in the Dune Sand Aquifer range from approximately 28,000 mg/L near the shore to approximately 4,800 mg/L inland in the vicinity of the CEMEX Office (see Figure 3).

Table 5-3 Summary of Water Quality by Hydrostratigraphic Unit-CEMEX

Hydrostratigraphic Unit	CX-B1WQ			CX-B2WQ			CX-B4		
	Zone	Depth(ft, bgs)	TDS (mg/L)	Zone	Depth(ft, bgs)	TDS (mg/L)	Zone	Depth(ft, bgs)	TDS (mg/L)
Dune Sand Aquifer	6	51-61	24,452	4	55-65	26,700	5	58-68	4,815
	5	84-94	28,111						
180-FTE	4	134-144	26,921	3	104-114	26,800	4	110-120	24,000
	3	182-192	32,034	2	160.5-170.5	16,200	3	155-165	20,500
180-400-Aquitard (?)	2	237-247	16,122						
400-FT Aquifer	1	274-284	24,888	1	215-225	26,500	2	248-258	27,200
							1	306-316	29,800

This condition indicates that the Dune Sand Aquifer is directly influenced by the ocean. This influence decreases inland where the infiltration of precipitation and applied agricultural water provide the greater influence.

Groundwater in the 180-FTE Aquifer ranges in TDS concentration, from approximately 16,000 mg/L to approximately 32,000 mg/L. The TDS concentration is generally consistent from the near shore area to the inland area near the CEMEX office. This condition indicates that surface water does not influence the TDS concentration and that the groundwater is influenced by seawater intrusion. The old CEMEX well was reportedly screened in the 180-FTE Aquifer and was abandoned due to high TDS content. However, the driller’s log shows that the well was perforated from 246 to 506 ft bgs, which would have placed the perforations in the 400-Foot Aquifer based on the current interpretation. Similar TDS concentrations in the Dune Sand Aquifer within at least 1,500 ft of the shore and the underlying 180-FTE Aquifer, suggest that the two aquifers are in hydraulic connection. In addition, the range of TDS concentrations in the lower portion of the 180-FTE Aquifer suggests that groundwater is present in sediment lenses that may be more isolated from each other and potentially locally isolated from the overlying aquifers.

The Dune Sand Aquifer and upper portion of the 180-FTE Aquifer contain groundwater that is enriched in calcium and strontium, suggesting that geochemical transformation from seawater intrusion has impacted the groundwater in approximately the upper 200 ft. The tritium analysis for samples from CX-B1WQ and CX-B2WQ is discussed in Section 5.8 and indicates that groundwater in the Dune Sand Aquifer is youngest, which is consistent with influence from rainfall and irrigation. The groundwater in the upper portion of the 180-FTE Aquifer may be slightly older and apparently has not had time for geochemical processes from seawater intrusion to impact the quality. The complete age dating analysis will be provided as an addendum to this technical memorandum.

The Dune Sand Aquifer extends seaward and merges with Holocene deltaic deposits beneath the seafloor of Monterey Bay. The base of the terrace deposits in the 180-FTE Aquifer also extend seaward and are unconformably overlain by the Holocene Deltaic deposits at an elevation of approximately -220 ft amsl.

5.3 Groundwater Quality - Moss Landing Area

The Moss Landing area is located at the mouth of the Salinas River, which overlies the 180/400-Foot Aquifer Subbasin. The six exploratory borings primarily penetrated fluvial sediments associated with Holocene Salinas River deposition.

The Perched "A" Aquifer is ascribed to the Holocene river alluvium and considered to be the hydrostratigraphic equivalent of the Dune Sand Aquifer located to the south. The Perched "A" Aquifer in the Moss Landing area is composed of interbedded river and floodplain deposits. With the exception of the sediments penetrated in Boring PR-1, individual sand and sand and gravel lenses do not appear to be either vertically or areally extensive. Significant variations in TDS concentrations suggest that fresh groundwater is mixed with seawater, and is likely present in semi-isolated lenticular deposits.

Table 5-4 provides a summary of TDS concentrations by hydrostratigraphic unit in the Moss Landing area. TDS concentrations in the Perched "A" Aquifer appear to be influenced by fresh or brackish water in the Moss Landing Harbor area, as indicated by TDS concentrations ranging from 3,200 mg/L to 8,600 mg/L in Borings ML-1, Ml-2, ML-3 and ML-4 located near waterways. Groundwater samples from Borings MDW-1, PR-1 and ML-6 were at near seawater quality, reflecting proximity to the ocean.

Boring PR-1 penetrated a very permeable unit in the Perched "A" Aquifer between 58 ft to 139 ft bgs. Groundwater in this zone interval approximated seawater quality (i.e., 34,000 mg/L TDS). It is interpreted that the lowest portion of Boring PR-1 penetrated the SVA. Very low TDS concentrations (630 mg/L) encountered in the lowest zone in Boring PR-1 suggests that isolated zones of freshwater may exist within the 180-Foot Aquifer or that the sand unit is laterally discontinuous and may be interbedded with the SVA. In this last interpretation, Boring PR-1 did not completely penetrate the SVA.

Table 5-4. Summary of Water Quality by Hydrostratigraphic Unit- Moss Landing

Hydrostratigraphic Unit	MDW-1			PR-1			ML-1		
	Zone	Depth(ft, bgs)	TDS (mg/L)	Zone	Depth(ft, bgs)	TDS (mg/L)	Zone	Depth(ft, bgs)	TDS (mg/L)
Perched A Aquifer	4	60-70	21,900						
				2	125-135	34,000	2	90-100	3,200
							1	113.5-118.5	22,000
180-FT Aquifer	3	152-162	26,600						
	2	187-197	30,200						
	1	237-247	31,000	1	190-200	630*			

Hydrostratigraphic Unit	ML-2			ML-3			ML-4			ML-6		
	Zone	Depth(ft, bgs)	TDS (mg/L)	Zone	Depth(ft, bgs)	TDS (mg/L)	Zone	Depth(ft, bgs)	TDS (mg/L)	Zone	Depth(ft, bgs)	TDS (mg/L)
Perched A Aquifer	2	90-100	8,100	2	103-113	4,200	2	74.5-84.5	8,600	2	100-110	28,000
	1	167-177	19,000	1	189-190	7,400	1	163.5-173.5	21,000	1	152-162	34,000

*Groundwater from Zone of PR-1 may be contained in an isolated zone within the SVA

Boring MDW-1 penetrated the 180-Foot Aquifer. Groundwater collected from three depth intervals within the 180-Foot Aquifer had TDS concentrations close to seawater.

5.4 Determining Average Central California Coast Seawater Quality

Average salinity estimates for the central California coastal region were established based on historical salinity measurements taken at the Granite Canyon monitoring station operated by the Moss Landing Marine Laboratory (Shore Stations Monitoring Program, 2014). Daily salinity measurements were made based on samples collected near the intake for the Marine Pollution Studies Laboratory. An average 33.69 Practical Salinity Units (PSU) salinity was calculated from the Granite Canyon monitoring data based on the average of daily salinity measurements from January 1986 through January 2011.

The composition of major chemical constituents in central California coastal seawater was then calculated from the major chemical constituent concentrations in standard seawater (JGOFS, 1997) multiplied by the ratio of the average local salinity (approximately 33.69) to standard seawater salinity (approximately 35.17). Standard seawater composition and average central California coastal seawater composition is listed in Table 5-5.

Table 5-5. Standard Seawater and Central California Coast Seawater

Parameter	Units	Mean Seawater Values	Central California Coast Average Seawater Values **
Total Dissolved Solids	mg/L	35,176	33,694
Salinity	PSU*	35.17	33.69
Potassium	mg/L	399	382
Sodium	mg/L	10,784	10,329
Magnesium	mg/L	1,284	1,230
Calcium	mg/L	412	395
Strontium	mg/L	7.9	7.57
Bicarbonate	mg/L	108	103
Chloride	mg/L	19,352	18,537
Fluoride	mg/L	1.3	1.25
Sulfate	mg/L	2,712	2,598
Total Boron	mg/L	4.55	4.35
Bromide	mg/L	67.3	64.5

* PSU = Practical Salinity Unit

** Ocean water composition calculated from mean salinities measured at the Granite Canyon Monitoring Station by Moss Landing Marine Laboratories. Average Salinity based on 1988 – 2011 monitoring data.

5.5 Borehole Water Quality Results

Table 5-6 lists the boreholes where water quality samples were collected and the corresponding depth intervals, measured TDS, and calculated TDS. Complete water quality analysis from borehole testing is included in Appendix G. Measured TDS values listed in Table 5-6 were determined using Standard Method 2540, and the calculated TDS values were determined from the water quality analysis for each borehole. Calculated water quality included bicarbonate and all other major and minor ions. Trilinear groundwater plots for the water quality data from CEMEX borings (Boring CX-B1WQ, CX-B2WQ, and CX-B4) are presented on Figure 10. Trilinear groundwater plots for the water quality data from the Moss Landing borings (ML-1, ML-2, ML-3, ML-4, ML-6, PR-1, and MDW-1) are presented on Figure 11. The water quality from the CEMEX borings and the Moss Landing borings plot similarly, suggesting a common source water.

Table 5-6. Comparison of Measured TDS and Calculated TDS for Borehole Water Quality Samples

Zone	Depth Interval (ft)	Measured Total Dissolved Solids mg/L	Calculated Total Dissolved Solids mg/L	Agreement Between Calculated and Measured TDS % Difference
CEMEX Boreholes				
CX-B1WQ-1	274-284	25,200	24,606	-2.4%
CX-B1WQ-2	237-247	14,600	15,177	3.8%
CX-B1WQ-3	182-192	35,600	32,719	-8.8%
CX-B1WQ-4	134-144	26,500	25,547	-3.7%
CX-B1WQ-5	84-94	27,400	26,458	-3.6%
CX-B1WQ-6	51-61	24,800	23,663	-4.8%
CX-B2WQ-1	215 - 225	26,500	23,041	-15.0%
CX-B2WQ-2	161 - 171	16,200	12,599	-28.6%
CX-B2WQ-3	104 - 114	26,800	24,790	-8.1%
CX-B2WQ-4	55 - 65	26,700	25,153	-6.2%
CX-B4-1	306 - 316	29,800	25,130	-18.6%
CX-B4-2	248 - 258	27,200	25,072	-8.5%
CX-B4-3	155 - 165	20,500	18,293	-12.1%
CX-B4-4	110 - 120	24,000	19,744	-21.6%
CX-B4-5	58 - 68	4,815	3,884	-24.0%
Moss Landing Boreholes				
ML-1-1	113.5-123.5	22,000	21,399	-2.8%
ML-1-2	90-100	3,200	3,094	-3.4%
ML-2-1	167-177	19,000	21,870	13.1%
ML-2-2	90-100	8,100	6,872	-17.9%
ML-3-1	180-190	7,400	6,732	-9.9%
ML-3-2	103-113	4,200	4,229	0.7%
ML-4-1	163.5-173.5	21,000	18,542	-13.3%
ML-4-2	74.5-84.5	8,600	8,002	-7.5%
ML-6-1	152-162	34,000	33,230	-2.3%
ML-6-2	100-110	28,000	28,580	2.0%
PR-1-1	190-200	630	760	17.1%
PR-1-2	125-135	34,000	33,767	-0.7%
MDW-1-1	237 - 247	31,000	28,789	-7.7%
MDW-1-2	187 - 197	30,200	29,778	-1.4%
MDW-1-3	152 - 162	26,600	24,772	-7.4%
MDW-1-4	60 - 70	21,900	20,814	-5.2%

5.6 Distinguishing Water Quality from Upper and Lower Aquifers

One of the objectives of the sampling effort was to determine if water quality measured in the upper aquifers could be distinguished from that in the lower aquifers. Several water quality analytical and age dating methods were used to aid in differentiating the upper aquifers from the lower aquifers. Vengosh (2002) used ratios of calcium, magnesium, and lithium to evaluate the source of increased salinity in the Salinas Valley. The methods employed by Vengosh were applied to the water quality samples collected for this investigation. The results are discussed below.

Groundwater samples collected were analyzed for tritium content for determining relative age as well as oxygen ($\delta^{18}O$) and hydrogen ($\delta^{2}H$) isotopes to evaluate the relative contribution of different source waters. The results of these analyses are discussed in Section 5.8 and 5.7.3, respectively.

5.7 Evaluation of Source Waters

5.7.1 CEMEX Boreholes

Prior work in Salinas Valley and coastal central California by Vengosh (2002) had evaluated the geochemical interactions, which occur when seawater intrudes into inland aquifers. When compared to the local seawater values, shifts in some chemical constituents including calcium, sodium, strontium, and boron occur in intruded seawater. Vengosh reported that intruded seawater had enriched ratios of calcium, magnesium, and lithium when compared to those seen in standard seawater.

Water quality data from CEMEX boreholes were analyzed by comparing chloride ratios of the major ion groups with those of standard seawater for the central California coastal region. Chloride is used as a reference in these comparisons, as it is generally conservative and has not been reported to undergo water/rock exchange reactions. Figures 12 through 18 show the ratios of chloride to TDS, Sodium, Calcium, Sulfate, Bromide, Boron, and Strontium measured at different depths in CEMEX borehole CX-B1WQ, CX-B2WQ-1, and CX-B4-1. The dashed line shown in each figure represents the ratio of chloride to the given ion based on the average ocean water values measured for the central California coast (see Table 5-3).

TDS levels in CX-B1WQ zones 1, 4, 5, and 6 are similar (approximately 23,000 to 26,000 mg/L) whereas Zone 2 is substantially lower (15,177 mg/L) and Zone 3 is substantially higher at 32,700 mg/L (see Table 5-3). The chloride/TDS ratio in all six of the zones measured in CEMEX Borehole CX-B1 generally corresponds to diluted seawater (Figure 12). With the exception of Zone 2, chloride/TDS ratios from CX1-B2WQ are similar and tightly clustered around 25,000 mg/L TDS. Each of the zones sampled in Borehole CX-B4 is consistent with diluted seawater ratios for chloride/TDS over a range of TDS values ranging from approximately 4,000 mg/L in the upper zone to 25,000 mg/L in the two lower zones (Figure 12).

When comparing the relative ratios of chloride/sodium and chloride/calcium for Boreholes CX-B1WQ, CX-B2WQ, and CX-B4, there is a clear departure from the local seawater ratios for most of the borehole zones sampled. Figure 13 shows that sodium is comparably depleted in borehole water samples as the chloride/sodium ratios are generally below the local seawater ratio. The relative depletion in sodium is greater in the lower zone samples of all three boreholes as compared to the upper zones (Figure 13). Chloride/calcium ratios shown on Figure 14 indicate that calcium enrichment has occurred as chloride/calcium ratios are well above the diluted seawater line. The trend in relative calcium enrichment is greater at lower zone and decreases in the upper zones for all three boreholes in the CEMEX area.

Figure 15 shows the relative depletion and enrichment of sodium and calcium in the three CEMEX area boreholes as calculated using the ΔCa and ΔNa values, which are determined based on the measured and calculated values based on the standard seawater ratio.

Calcium enrichment and sodium depletion was reported by Vengosh in intruded seawater and was attributed to a base-exchange reaction with clay minerals where calcium is exchanged with sodium between the solid and liquid phase. Figure 14 suggests that the shallower zones in Boreholes CX-B1WQ, CX-B2WQ, and CX-B4 have undergone less calcium enrichment and the lowermost zones have seen the highest amount of calcium enrichment relative to diluted seawater.

Figures 16 and 17 show the ratio of chloride/boron and chloride/strontium, respectively in the Cemex area boreholes. The boron and strontium ratios in the upper zones in Borehole CX-B1WQ (Zones 4, 5, and 6) have similar depletion magnitudes (with respect to Boron, Figure 16) and enrichment with respect to Strontium (Figure 17). Boreholes CX-B4 and CX-B2WQ shows a similar trend to that of CX-B1WQ where the lower zones show a greater departure from the seawater dilution line that the upper zones.

In summary, the results from Boreholes CX-B1WQ, CX-B2WQ, and CX-B4 suggest that the water from the shallower zones (above 144 ft) may be distinguished from water from the deeper zones even if they are at the same TDS level. Water from the deepest zone (274-284 ft) shows a marked distinction in the amount of calcium and strontium enrichment, and sodium depletion when compared to shallower zones. The difference in the amount of calcium and strontium enrichment and sodium depletion between the upper zones and lower zones in the CEMEX area boreholes is likely a function of the relative abundance of clay formation materials in the lower formation as well as groundwater age.

5.7.2 Moss Landing Boreholes

Moss Landing water quality analysis is discussed in two general regions; the Moss Landing Harbor area (Borings ML-1, ML-2, ML-3, ML-4, and ML-5) and the area south of Potrero Road (Borings PR-1 and MDW-1). Water quality samples were collected from a shallow and deep zone in each of the five boreholes drilled in the immediate Moss Landing area (ML boreholes). Results from water quality samples in the Moss Landing Area are listed in Table 5-6.

5.7.2.1 Moss Landing Harbor Area

Chloride ratios of the major ions were compared against the average coastal seawater values to determine if water quality from the upper and lower zones could be distinguished from each other.

TDS results for the Moss Landing boreholes show that the deeper zones in Boreholes ML-1, ML 2, and ML-4 have substantially higher TDS levels than the shallow zones. Borehole ML-3 and ML-6 both showed less variation between TDS measured in the upper and lower zones (Table 5 4).

Figure 19 shows the chloride/TDS ratios from water samples collected from the Moss Landing area boreholes. The dashed line on Figure 19 represents the chloride/TDS ratio of average diluted seawater along the central California coast. The TDS/chloride ratios measured in the Moss Landing boreholes are in relatively close agreement with the seawater dilution line, which indicates the water is consistent with intruded seawater, which has been diluted.

Relative sodium depletion and calcium enrichment is shown on Figure 20 and Figure 21. Results indicate that a relative enrichment of calcium and depletion of sodium has occurred, similar to trends seen in the CEMEX area boreholes. Figure 21 shows a comparison of the net calcium enrichment compared against the net sodium depletion where it can be seen that this phenomena is occurring to some extent in nearly all samples. These data do not show a clear trend with respect to relative enrichment values seen in the upper and lower samples in the ML boreholes.

Figures 22 and 23 show the ratios of chloride to boron and strontium. Enrichment and depletion relative to diluted seawater may also be seen in these constituents in the ML boreholes. The relative depletion of boron and enrichment of strontium in lower zones of the Moss Landing Area boreholes correlate with CEMEX area borehole results and suggest base ion exchange with underlying clay formation materials.

The chloride/sulfate ratios (Figure 24) are generally lower in the Moss Landing boreholes, which may indicate sulfate reduction or some other geochemical transformations are occurring.

Water quality data from the Moss Landing area boreholes do show similar geochemical transformations as seen in the CEMEX area, however, there is not a clear trend between the upper and lower zones in the ML- boreholes. Although a substantial difference in TDS between the upper and lower zones is seen in some of the ML- boreholes, the ratios of chloride to the other major ions do not show a reliable trend with respect to relative enrichment or depletion at the Moss Landing site.

5.7.2.2 Molera and Potrero Road Parking Lots, Salinas River State Beach

Water quality samples were collected from a shallow zone and deep zone at the Potrero Road borehole (PR-1) and from four zones at the Molera Parking Lot located approximately one mile south of the Potrero Road parking lot.

Water quality data for Borehole PR-1 show that the lower zone sample is fresh water (TDS = 630 mg/L) and the upper zone sample is consistent with undiluted seawater (TDS = 34,000 mg/L). When comparing the chloride/major ion ratios in the high TDS sample at Potrero Road, there is not a substantial enrichment or depletion with respect to local seawater ratios (see Figures 19 through 24). This indicates that the geochemical transformations of intruded seawater into freshwater, which results in enrichment or depletion, are not occurring at this site.

TDS values in the MDW-1 borehole ranged from approximately 21,000 mg/L in the lowermost zone to approximately 29,000 mg/L in the upper zone. With respect to relative sodium depletion and calcium enrichment, a clear trend (Figure 21 and 22) is seen in the MDW-1 borehole were relative sodium depletion increases from the lower zones to the upper zones

Ratios of chloride to boron and strontium (Figures 23 and 24) indicate that the uppermost zone in the MDW-1 borehole (MDW-1-4, 60'-70') is consistent with diluted seawater for chloride/boron ratios and chloride/strontium ratios. The lower zones in the MDW-1 borehole show a greater departure from the diluted seawater line as a function of depth.

The chloride/sulfate ratios (Figure 25) for the MDW-1 borehole samples show close agreement with the diluted seawater line suggesting that geochemical and/or biological sulfate transformations are not occurring.

5.7.3 Results of δ^2H and δ^{18}O Analysis

Stable isotopes of oxygen and hydrogen were analyzed in water samples collected from the CEMEX borehole (CX-B1WQ), Moss Landing boreholes, and Potrero Road borehole. Isotope data were measured for all borehole water quality samples collected except ML-1 Zone 1 and ML-1 Zone 2. Water quality samples from ML-1 were not collected because the samples containers were not made available by the firm responsible for the sampling. Isotopic results from Boreholes CX-B2WQ, CX-B4 and MDW-1 is forthcoming and will be provided as an addendum to this report when they are available. Table 5-7 lists the results of the available oxygen and hydrogen isotopic analyses for groundwater samples collected from CEMEX and Moss Landing.

Table 5-7. Results of Oxygen and Hydrogen Isotope Analyses

Borehole and Zone Designation	Delta-Deuterium (δ^2H) (‰)*	Delta-Oxygen 18 ($\delta^{18}O$) (‰)*
CX-B1WQ-1	-18.4	-2.6
CX-B1WQ-2	-29.1	-4.26
CX-B1WQ-3	-6.21	-0.84
CX-B1WQ-4	-14	-2.03
CX-B1WQ-5	-12	-1.56
CX-B1WQ-6	-15.1	-2.08
ML-2-1	-19.2	-3.07
ML-2-2	-37.6	-5.3
ML-3-1	-40.1	-6.04
ML-3-2	-43.6	-6.43
ML-4-1	-24.5	-3.57
ML-4-2	-35.9	-5.23
ML-6-1	-5.55	-0.59
ML-6-2	-11	-1.33
PR-1-1	-42.5	-6.35
PR-1-2	-3	-0.4

The ratio of $\delta^{18}O$ and δ^2H may be used in geochemical analysis to evaluate the relative contribution of different source waters (e.g., surface water and ground water) when evaluating water mixtures. The relative enrichment or depletion of a given source water with respect to δ^2H and $\delta^{18}O$ may be used as a "fingerprint". If there is a sufficient distinction between different water sources, then the relative contribution from a given source may be estimated.

Results from isotopic analyses of borehole water samples for the CEMEX borehole are shown in Figure 26 and results from the Moss Landing boreholes and Potrero Road borehole is shown in Figure 27. The $\delta^{18}O$ and δ^2H data in both Figures are plotted against the Global Meteoric Water Line (GMWL) for reference. Isotopic data are referenced to Vienna Standard Mean Ocean Water (VSMOW) values, which is shown as $\delta^{18}O=0‰$ and $\delta^2H=0‰$ values on both plots.

Isotopic data measured at the CEMEX site and at Moss Landing show a linear trend with respect to $\delta^{18}O$ and δ^2H. At the CEMEX facility, $\delta^{18}O/\delta^2H$ data show a linear relationship with the upper end points corresponding to Borehole CX-B1WQ Zone 3, which had the highest TDS (32,700 mg/L) and Borehole CX-B1WQ Zone 2 which had the lowest TDS (14,600 mg/L) (see Figure 26). Data measured at Moss Landing were bracketed by endpoints corresponding to 4,200 mg/L and 33,200 mg/L TDS in Boreholes ML-3 Zone 2 and ML-6 Zone 1, respectively (see Figure 27).

Isotopic results from the relatively low TDS boreholes (Boreholes ML-3 Zone 2 and PR-1 Zone 1) indicate that groundwater has not undergone significant evaporation, or geochemical isotopic fractionation, as the values are near the GMWL. For both the CEMEX site and Moss Landing sites, the trend of the borehole data intercepts the GMWL at similar values (δ^2H values ranging from -46 ‰ to approximately -52 ‰), which suggests that the fresh groundwater, which is mixing with intruded seawater at the CEMEX facility, closely corresponds to the GMWL.

Isotopic values measured in samples CX-B1WQ Zone 3, ML-6 Zone 1, and PR-1 Zone 2 represent a local endpoint for intruded seawater, which varies slightly between the sites. Samples from PR-1 Zone 2 are closest to VSMOW values (δ^{18}O = -0.4 ‰ and δ^2H= -3.0 ‰) while ML-6 Zone 1 and CXB1WQ Zone 3 show slightly more depletion in both δ^{18}O and δ^2H with respect to VSMOW.

5.8 Results of Tritium Analysis

5.8.1 Background: Tritium Source and Interpretation

Tritium is the radioactive isotope of hydrogen, which is often used as a tracer to target young waters (less than about 50 to 60 years old) and to show if there is a presence of modern recharge. The reported half-life of tritium varies; the current recommended half-life is 12.32 years, but some sources use the older half-life of 12.43 years (Kazemi et al., 2006; Tritium Laboratory, 2010). Tritium is produced through the natural cosmic ray bombardment of nitrogen and deuterium in the upper atmosphere, through the natural neutron radiation of lithium in rocks (especially granitic rocks), and through certain anthropogenic activities.

One of the most important and significant sources of tritium is from thermonuclear tests which were conducted in the northern hemisphere by the United States, United Kingdom, and former Soviet Union beginning in 1952 and peaking around 1963-1964. Additional French and Chinese tests were also conducted in the late 1970s. At the northern hemisphere peak in 1963, the tritium concentrations arising from thermonuclear weapons were three orders of magnitude greater than natural tritium concentrations, which usually range between 3-10 TU in the northern hemisphere and 1-5 TU in the southern hemisphere (Kazemi et al., 2006; Happle, 2010). This bomb pulse tritium signature can be traced into the subsurface and is sometimes used to provide information on the rate of groundwater recharge. However, waters younger than the mid-1960s will not show the bomb tritium peak.

Most methods used for analyzing tritium content yield only qualitative or semi-quantitative results; the precise age cannot be determined. Much of the reason for this is caused by uncertainty due to spatial and temporal variations in initial tritium concentrations at the time of recharge. In addition, it is possible to get similar tritium results from waters recharged before and after the tritium peak. This non-uniqueness is another uncertainty that has to be taken into consideration when analyzing the tritium results. The presence of tritium itself, however, indicates the presence of “young” water (i.e., less than about 50-60 years old) due to recharge, or possibly borehole leakage. Waters older than about the mid-1950s will generally yield values at or below the tritium detection level of 0.8 TU. The absence of tritium does not in itself necessarily indicate an absence of modern recharge. All groundwater samples from wells represent a mixture of water molecules that may have a very wide range of age distributions arising from differences in flow paths. Therefore, the reported concentrations represent some sort of an average that may be produced from the mixing of water of different ages.

Measured tritium concentrations are expressed in Tritium Units (TU) where one TU is the equivalent of one tritium atom (or one THO molecule) per 1018 atoms of hydrogen (or 1018 H2O molecules). Tritium concentrations are also commonly reported in terms of Tritium Ratios (TR), where 1TR = 1TU. One TU is also equivalent to 0.1181 Becquerel per kilogram (Bq/kg), where 1 Becquerel is equal to one decay per second (Tritium Laboratory, 2010).

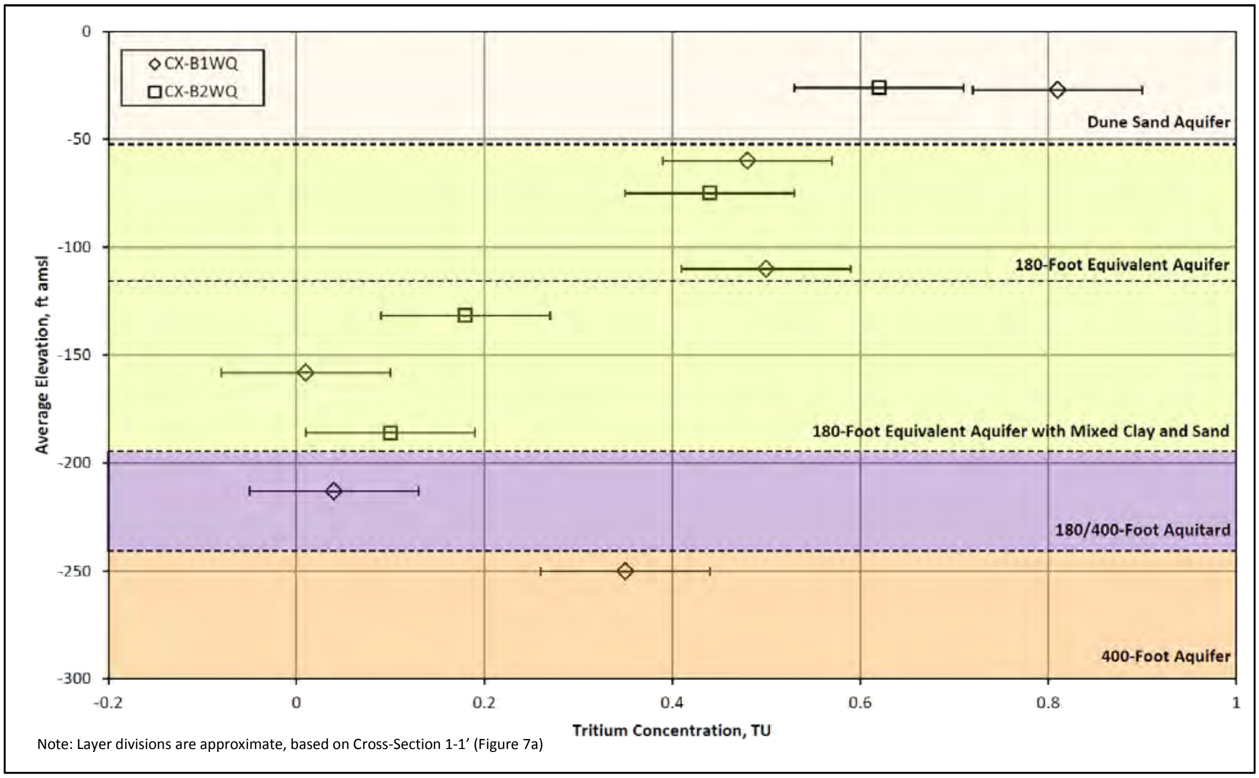
5.8.2 Tritium Results CX-B1WQ and CX-B2WQ

Tritium samples were taken from all borings conducted during this investigation. Tritium results for the Moss Landing borings are being re-run using a different method to reduce the detection limits. The results from Moss Landing and Borehole CX-B4 from CEMEX will be provided as an addendum to this report. Groundwater samples were analyzed for tritium at Geochron Laboratories in Chelmsford, Massachusetts using a half-life of 12.43 years. The measured tritium concentrations from CX-B1WQ and CX-B2WQ are presented in Table 5-8.

Table 5-8. Results of Tritium Analyses – CX-B1 WQ and CX-B2WQ

Boring	Water Quality Zone Zone	Depth Interval (ft, bgs)	Tritium Activity [TU] units	Error [TU] units
CX-B1WQ	1	274-284	0.35	±0.09
CX-B1WQ	2	237-247	0.04	±0.09
CX-B1WQ	3	182-192	0.01	±0.09
CX-B1WQ	4	134-144	0.5	±0.09
CX-B1WQ	5	84-94	0.48	±0.09
CX-B1WQ	6	51-61	0.81	±0.09
CX-B2WQ	1	215-225	0.1	±0.09
CX-B2WQ	2	161-171	0.18	±0.09
CX-B2WQ	3	104-114	0.44	±0.09
CX-B2WQ	4	55-65	0.62	±0.09

These values are also displayed graphically on Figure 5-1 as the tritium concentration versus the average sample depth.



Note: Layer divisions are approximate, based on Cross-Section 1-1' (Figure 7a)

Figure 5-1. Tritium Concentration vs. Sample Elevation – CX-B1WQ and CX-B2WQ

Tritium concentration measured in groundwater samples from Boreholes CX-B1WQ and CX-B2WQ generally decreases with depth, indicating that water possibly takes longer to reach these locations. However, samples taken from elevations between -132 and -213 ft amsl (CX-B1WQ Zones 2 and 3, and CX-B2WQ Zones 1 and 2) have the lowest tritium concentrations. This depth at the base of the 180-FTE Aquifer contains a higher percentage of fine-grained materials and is underlain by the 180/400-Foot Aquitard. This implies that the presence of fine-grained sediments in the lower zone of the 180-FTE Aquifer and the 180/400-Foot Aquitard impedes the movement of water, resulting in water with an older age.

In a study conducted by Michel and others (1997), tritium concentrations along the coast of the Oxnard Plain in California were analyzed. All of the tritium samples came back with very low values and there was no apparent tritium spike in the data, which is similar to the results seen here. Michel et al. interpreted this to mean that the water at the sampled locations entered the subsurface prior to the 1963 tritium peak. Therefore, assuming there is no mixing with different source water, all of the borehole tritium results from this study indicate that the water is older than the 1960s, with the exception of CX-B1WQ Zone 6 sample collected at 51 to 61 ft bgs.

6.0 NORTH MARINA AND CEMEX GROUNDWATER MODELS

GEOSCIENCE developed the NMGWM which covers the region of the current project, (see Figure 28). The NMGWM has been used to evaluate several proposed projects in the region and will be used, in part, to simulate the effects of slant well pumping. The model was developed in 2008 using computer codes MODFLOW and MT3DMS. In order to accurately model local effects of slant well pumping, a focused model, designated as the CM, is proposed. The CM will be located within the NMGWM centered at the CEMEX site. It will be constructed using the SEAWAT computer code (SEAWAT is a generic MODFLOW/MT3DMS-based computer program designed to simulate three-dimensional variable-density groundwater flow coupled with solute transport) to allow the simulation of sea water intrusion. The CM model will consist of 540 rows and columns with a uniform cell size of 20 feet to a side (see Figure 28), which is a significant refinement over the uniform grid size of 200 ft by 200 ft in the NMGWM. The decreased grid size will allow for a very accurate calibration by matching changes in groundwater levels and quality with historical data.

The exploratory boring information collected during this study has provided valuable data needed to determine the thickness and extent of the Dune Sand Aquifer, Perched “A” Aquifer, and the 180-FTE Aquifer and hydraulic conductivity data for model input. The model layers representing the Dune Sand Aquifer, Perched “A” Aquifer, SVA, and 180-FTE Aquifer will be refined using the new data. Aquifer parameters used in the model will be updated during and after the test slant well program as appropriate to reflect the water level changes occurring in the aquifers during the test slant well pumping.

6.1 Aquifer Characteristics

Hydraulic conductivity values for sediments encountered in the borings were evaluated using both laboratory permeameter test results and using grain-size distribution versus hydraulic conductivity relationship methods published by four different workers. The results are discussed in Section 3.2. Our experience has shown that laboratory permeameter testing typically results in much lower hydraulic conductivity values than those determined by grain-size distribution. Work recently completed by GEOSCIENCE in a coastal aquifer in Southern California, similar to the aquifers encountered in the current study, showed that hydraulic conductivity values calculated from pumping test data closely matched the hydraulic conductivity values using grain-size relationships (GEOSCIENCE, 2013). However, the hydraulic conductivity values determined by grain size distribution can vary significantly from pumping test results depending on the formation tested and selected grain size relationship used for analysis. Nonetheless, the hydraulic conductivity values assigned to the various geologic and aquifer units represent the best available data and will be used for constructing the CM and refining the

NMGWM. The hydraulic conductivity values will be updated with data obtained from the test slant well program.

For groundwater modeling, typical storativity values will be assigned to the aquifer units. Site specific storativity values will be calculated from data to be collected from the long-term pumping test which will be conducted during a subsequent phase of field investigations.

6.2 Model Layer Boundaries

Model layer boundaries and layer extents were defined using the cross-sections prepared from borehole data (see location map Figure 28, Cross-Sections 1-1', 2-2', and 3-3' on Figures 7a through 9, and Cross-Sections A-A' through G-G' on Figures 30 through 36) prepared using lithologic logs and wells from Kennedy/Jenks (2004), DWR and USGS WRIR 02-4003 (2002). The correlation of geologic and hydrostratigraphic units with the regional and local models is summarized in Table 6-1. As seen in the table, the NMGWM will further be refined in the CEMEX Model through the addition of model layers. The NMGWM layers 2 and 4 will each be modeled by 3 layers in the CEMEX Model (layers 2 through 4 and layers 6 through 8, respectively). This division allows for the refinement of aquifer parameters to more accurately reflect the different geologic layers present in these hydrostratigraphic units.

Table 6-1. Correlation of Geologic and Hydrostratigraphic with SVIGSM, NMGWM, CM Model Layers

180/400-Foot Aquifer Subbasin			CEMEX Area			SVIGSM Layer[1]	NMGWM Layer	CEMEX Model Layer
Surface Geologic Units	Surface Geologic Units Map Symbol	Hydro-stratigraphic Units	Surface Geologic Units	Surface Geologic Units Map Symbol	Hydro-stratigraphic Units			
Benthic Zone	-	Benthic Zone	-	-	Benthic Zone	Constant Head	1	1
Alluvium	Qal[2]	Perched "A" Aquifer	Dune Sand	Qd	Dune Sand Aquifer	1a	2	2
			Older Dune Sand	Qod				3
								4
Older Alluvium	Qo	Salinas Valley Aquitard	Older Terrace/ Marine Terrace	Qt (Qmt?)	180-FTE Aquifer	1a	3	5
		180-Foot Aquifer				1	4	6
Older Alluvium/ Marine Terrace	Qo/Qmt							7
Older Alluvium/ Older Alluvium Fan-Antioch	Qo/Qfa							8
Older Alluvial Fan – Placentia	Qfp	180/400-Foot Aquitard	Aromas Sand (undifferenciated) (?)	Qar (?)	180/400-Foot Aquitard	2a	5	9
Aromas Sand (undifferentiated)	Qar	400-Foot Aquifer			400-Foot Aquifer	2	6	10
Aromas Sand – Eolian/Fluvial Lithofacies	Qae/Qaf							
Paso Robles Formation	QT	400/900-Foot Aquitard	Paso Robles Formation	QT	400/900-Foot Aquitard	3a	7	11
		900-Foot Aquifer			900-Foot Aquifer	3	8	12

[1] SVIGSM considers "a" layers to be aquitards (vertical hydraulic conductivity and thickness are input)

[2] Subsurface Holocene geologic unit not mapped at surface

Ninety One (91) control points were used to develop the thickness of each model layer and were based on data from all of the cross-sections. The points were then contoured to provide the rest of the model layer surface. The elevation of each model layer is the top elevation minus the determined thickness.

For example, the bottom elevation of model layer 1 is the surface elevation minus the thickness of model layer 1; the bottom elevation of model layer 2 is the bottom elevation of model layer 1 minus the thickness of model layer 2, etc. The layer thicknesses for the NMGWM are shown on Figures 37 through 43.

6.3 Hydraulic conductivity

Initial model values for the refinement of horizontal hydraulic conductivity were estimated based on the descriptions of borehole samples, laboratory data, and grain size distribution and hydraulic conductivity relationships. A discussion of the development of the horizontal hydraulic conductivity values is provided in Section 3.2.

6.3.1 Vertical Hydraulic Conductivity

Values for the refinement of model layer vertical hydraulic conductivity were estimated based on the descriptions of borehole samples and a series of curves developed to show the relationship between sediment texture and hydraulic conductivity. These curves, representing maximum and minimum horizontal and vertical hydraulic conductivity values, were developed using the following equation (Durbin, 2013; Faunt, 2009):

$$\mathrm{K_i} = \left(\mathrm{K_c}^{\mathrm{p}}\,\mathrm{F_{c,i}} + \mathrm{K_f}^{\mathrm{p}}\mathrm{F_{f,i}}\right)^{1/\mathrm{p}}$$

where:

Ki = Hydraulic conductivity for cell i [ft/day]

Kc = Horizontal hydraulic conductivity for coarse-grained material [ft/day]

Kf = Horizontal hydraulic conductivity for fine-grained material [ft/day]

Fc,i = Fraction of coarse-grained material in cell i [unitless]

Ff,i = Fraction of fine-grained material in cell i [unitless]

p = Empirical parameter

Lithologic log intervals from the borings were classified as either being “coarse-grained” or “fine-grained” based on the sediment texture described in the logs and texture classification procedures observed in the USGS Professional Paper 1766 (Faunt ed., 2009). Coarse-grained sediment was defined as having a grain size of fine sand or greater (i.e., sand, gravel, pebbles, and cobbles). Fine-grained material was defined as any texture that consisted predominately (greater than 50%) of silt or clay.

To determine the Kc and Kf, the individual lithologic intervals for each borehole were first assigned a maximum or minimum hydraulic conductivity value based on the soil classification for that interval and the estimates of horizontal conductivity made from borehole sample grain size distribution curves. The methods used to estimate the sample hydraulic conductivities are described in greater detail in Section 3.2.1. The weighted Kc and Kf were then calculated for each borehole and each model layer using both the minimum and maximum hydraulic conductivities in order to provide a possible range of Kc and Kf that could be expected for each area (i.e., CEMEX area and Moss Landing area). The results for the CEMEX area are provided in Tables 6 and 7 for the maximum and minimum hydraulic conductivity values respectively and the results for the Moss Landing area are provided in Tables 8 and 9 for the maximum and minimum hydraulic conductivity values, respectively.

The empirical parameter shown in the equation above imparts a particular textural structure to help approximate flow in a heterogeneous anisotropic groundwater system. P values of 0.93 and -0.62 were used for calculating horizontal and vertical hydraulic conductivity, respectively, based on numerical experiments conducted by Durbin (2013).

Figures 44 through 47 show the different curves for the calculation of hydraulic conductivity, and the ranges shown represent the initial values for horizontal and vertical hydraulic conductivity which will be used for the refinement of model aquifer parameters. These values will be modified during model calibration. Figures 44 and 45 show the sediment texture versus hydraulic conductivity at the CEMEX site for the Dune Sand Aquifer and 180-FTE Aquifer, respectively. For the Dune Sand Aquifer, it was estimated that the average percentage of coarse-grained deposits was 98%. Therefore, the horizontal hydraulic conductivity is expected to range from 109 to 304 ft/day with an average of 207 ft/day, while the vertical hydraulic conductivity is expected to range from approximately 8 to 12 ft/day with an average of approximately 10 ft/day. It was estimated that for the 180-FTE Aquifer, the average percentage of coarse-grained deposits was 78%. This correlates with a horizontal hydraulic conductivity value ranging from 71 to 216 ft/day and averaging 143 ft/day. The vertical hydraulic conductivity for this aquifer is expected to range from 0.11 to 0.21 ft/day with an average of 0.16 ft/day.

The sediment texture versus hydraulic conductivity curves for the Dune Sand/Perched “A” Aquifer near the Moss Landing site is shown on Figure 46. These two aquifers are combined because they represent a single model layer. Based on the borehole grain size analysis presented above, the average percentage of coarse-grained deposits is estimated at 49%. As shown, this correlates to a horizontal hydraulic conductivity ranging from 101 to 333 ft/day with an average of 217 ft/day and a vertical hydraulic conductivity ranging from 0.04 to 0.06 ft/day with an average of 0.05 ft/day.

Figure 47 shows the sediment texture versus hydraulic conductivity at the Potrero Road site for the Dune Sand/Perched “A” Aquifer. It was estimated that the average percentage of coarse-grained deposits here was 93%. Therefore, the horizontal hydraulic conductivity is expected to range from 367 to 1,205 ft/day with an average of 786 ft/day, while the vertical hydraulic conductivity is expected to range from 0.92 to 1.5 ft/day with an average of 1.2 ft/day.

7.0 FINDINGS

7.1 General

- The conceptual hydrogeologic model developed from this investigation suggests that a feedwater supply system using slant wells at the CEMEX site is feasible and can utilize the Dune Sand Aquifer and the underlying terrace deposits as conduits to extract water through the seafloor beneath Monterey Bay.
- This opinion will be tested using the newly constructed CEMEX Model and the refined NMGWM and should be field tested using a test slant well and groundwater monitoring system as described in the Hydrogeologic Investigation Workplan.
- A permeable unit of significant thickness containing groundwater of seawater quality was penetrated in the Moss Landing Boring PR-1 near Boring ML-1. To the north, this unit pinches out and mixes with fine-grained sediments. To the south, the unit decreases in thickness to approximately 25 feet in boring MDW-1 over a distance of approximately one mile.
- The conceptual model also indicates that the Perched “A” Aquifer between the Molera and Sandholt Road Salinas River State Beach parking lots could provide an alternative target for construction of a subsurface feedwater supply system.

7.2 CEMEX Area

The CEMEX facility is located on the westernmost edge of the 180/400-Foot Aquifer Subbasin of the Salinas Valley Groundwater Basin, as currently mapped by DWR (2003) and the MCWRA (2011). The findings of the investigation at CEMEX are summarized below:

- A significant clay layer is not present beneath the Dune Sand Aquifer at the CEMEX site at elevations commonly attributed to the SVA, suggesting a different depositional environment than that of the 180-Foot Aquifer in the Salinas Valley. The water quality data suggests groundwater in the Dune Sand Aquifer may be in hydraulic continuity with the underlying aquifer units. The degree of hydraulic continuity will be determined by construction of aquifer specific monitoring wells and the long-term pumping test of the test slant well.
- Stratigraphic relationships and lithologic observations indicate that the aquifer system underlying the Dune Sand Aquifer consists of terrace deposits that are older than the inland 180-Foot Aquifer deposits, since they underlie the Older Dune Sand.

- The terrace deposits appear to be a distinct lithologic unit in terms of geologic history and depositional environment in the Dune Highland area and may be hydrostratigraphically equivalent to the 180-Foot Aquifer in the Salinas Valley.
- For purposes of this document the alluvial materials encountered near the coast (in the CEMEX area) are based solely on analyses of borehole samples (and geophysical borehole logs). As of yet, no direct correlation can be made between these coastal alluvial deposits and the standard naming convention found further inland (e.g., 180-Foot Aquifer, 400-Foot Aquifer, SVA, etc.).
- As a hydrogeologic unit, the terrace deposits will be designated as the 180-FTE Aquifer. The extent of hydrostratigraphic equivalence will be evaluated through a pumping test utilizing the test slant wells and a monitoring network.
- The current interpretation of the distinctive dark greenish-gray clay found at depths ranging from 241 to 282 ft bgs at CEMEX is that it may represent a change in the depositional history and is underlain by a unit equivalent to the Aromas Sand(?)/400-Foot Aquifer. However, results of groundwater quality sampling from the 400-Foot Aquifer have results similar to that of the overlying Dune Sand Aquifer and 180-FTE Aquifer.
- Both the Dune Sand Aquifer and the underlying 180-FTE Aquifer extend seaward beneath the Monterey Bay.
- Groundwater in the Dune Sand Aquifer and most of the groundwater in the 180-FTE Aquifer exhibit high concentrations of TDS, ranging from 24,000 to 32,000 mg/L.
- Hydraulic conductivity for the Dune Sand at CEMEX ranged from an average low value of 273 ft/day to an average high value of 779 ft/day.
- Hydraulic conductivity for the Older Dune Sand at CEMEX ranged from an average low value of 136 ft/day to an average high value of 372 ft/day.
- Hydraulic conductivity for the 180-FTE terrace deposits ranged from an average low value of 113 ft/day to an average high value of 342 ft/day.
- Hydraulic conductivity values will be further refined based on the long-term test slant well pumping test.
- Analysis of cation/anion ratios indicates that groundwater in the lower portion of 180-FTE Aquifer and in the 400-Foot Aquifer have been geochemically altered due to seawater intrusion.
- Tritium results indicate that groundwater in the lower portion of the 180-FTE Aquifer is older than groundwater in the upper portion of the 180-FTE Aquifer and the Dune Sand Aquifer.

- Analysis of oxygen and hydrogen isotopes suggests that in both the CEMEX and Moss Landing sites, saltwater from the ocean is mixing with a freshwater source that has not undergone significant evaporation (as would be expected of a surface water source).
- Hydrostratigraphic relationships indicate that slant wells drilled into the Dune Sand Aquifer and 180-FTE Aquifer will receive recharge primarily from ocean sources through vertical leakage from the sea floor and horizontal recharge from offshore subsea aquifers. This will be tested by the CM and refined NMGWM as well as field pumping tests.

7.3 Moss Landing Hydrogeologic Conditions

The Moss Landing area is located north of the mouth of the Salinas River, which overlies the westernmost edge of the 180/400-Foot Aquifer Subbasin. Borings were drilled and sampled at Moss Landing Harbor and at the Molera, Potrero Road, and Sandholt Road parking lots of Salinas River State Beach. The exploratory borings primarily penetrated fluvial sediments associated with Holocene and Late Pleistocene Salinas River deposition.

The Perched[7] “A” Aquifer is ascribed to the Holocene river alluvium and considered to be the hydrostratigraphic equivalent of the Dune Sand Aquifer located to the south.

- The Perched “A” Aquifer in the Moss Landing area is composed of interbedded river and floodplain deposits.
- With the exception of the sediments penetrated in Boring PR-1 and MDW-1, individual sand and sand and gravel lenses do not appear to be either vertically or areally extensive in Moss Landing.
- Significant variations in TDS concentrations suggest that groundwater is mixed with seawater, and is likely present in semi-isolated lenticular deposits.
- In general, the upper isolated aquifer test zones were above a depth of 110 ft bgs. TDS concentrations ranged from 3,200 mg/L to 34,000 mg/L.
- The lower isolated aquifer zones were generally constructed at depths exceeding 150 ft bgs. With the exception of Zone 1 of PR-1 (190-200 ft bgs) at 630 mg/L, the TDS concentrations ranged from 7,400 mg/L to 34,000 mg/L.

---

[7] The term Perched “A” Aquifer refers to the shallow aquifer above the Salinas Valley Aquitard. Traditionally, the term “perched” aquifer refers to a hydrogeologic condition where an aquifer is formed by groundwater being present above (perching on) an impermeable unit such as clay but with an unsaturated portion of an aquifer between the bottom of the clay and the underlying saturated portion of a lower aquifer.

- Boring PR-1 penetrated a very permeable unit in the Perched “A” Aquifer from 54 to 139 ft bgs. Groundwater in this interval approximated seawater quality (i.e., 34,000 mg/L). This unit is interpreted to continue, but decrease in thickness southward towards Boring MDW-1. To the north, the unit is interbedded with fine-grained units.
- It is interpreted that the lowest portion of Boring PR-1 penetrated the SVA. Very low TDS concentrations (630 mg/L) encountered in the lowest zone in Boring PR-1 suggest that isolated zones of freshwater may exist within the 180-Foot Aquifer or that the sand unit is laterally discontinuous and may be interbedded with the SVA. In this last interpretation, Boring PR-1 did not completely penetrate the SVA.
- Hydraulic conductivity values for the permeable portion of the Perched “A” Aquifer penetrated in PR-1 ranged from 194 ft/day to 717 ft/day, based upon relationships between grain size distribution and hydraulic conductivity.
- The permeable unit between Boring PR-1 and MDW-1 represents a potential location for slant wells.
- The Moss Landing Borings (ML-1, ML-2, ML-3, ML-4, and ML-6) did not penetrate significant thicknesses of permeable deposits to produce the required feedwater supply volume for the MPWSP.

7.4 Groundwater Models

The geologic and hydrogeologic data collected during this investigation was used to prepare the interpretations of hydrostratigraphic relationships in the Moss Landing and CEMEX areas which will be used to refine the NMGWM and to develop the CEMEX focused groundwater model. Table 6-1 summarizes the correlation of geologic and hydrostratigraphic units with model layers.

8.0 REFERENCES

California Department of Public Works, Division of Water Resources, 1946. “Salinas Basin Investigation, Bulletin No. 52.”

California Department of Water Resources, 1969. *Geology of the Lower Portion of the Salinas Valley Ground Water Basin*. Office Report, Central District Office.

California Department of Water Resources, 1973. Lower Salinas Valley Seawater Intrusion Investigation.

California Department of Water Resources, 1977. North Monterey Water Resources Investigation.

Prepared pursuant to cooperative agreement between Department of Water Resources and Monterey County Flood Control and Water Conservation District, March 23, 1977.

California Department of Water Resources (DWR), 2003. California’s Groundwater - Bulletin 118, Update 2003. Dated October, 1, 2003.

CDM, 2004. *Monterey Peninsula Water Management District Sand City Desalination Project Feasibility Study Executive Summary*. Dated March 25, 2004.

California Geological Survey, 2002. “Geologic Map of the Monterey 30’x 60’ Quadrangle and Adjacent Areas”

Carman, P.C., 1956. "Flow of gases through porous media."

Chin, John, L., and Steven C. Wolf, 1988 “Reconnaissance high-resolution geophysical survey of the Monterey Bay, California, inner shelf: Implications for sand resources” USGS Open-File Report 88-410

Coastal Groundwater Consulting, 2012. *Natural Isotope Tracer Study Test Slant Well Phase 3 Extending Pumping Test, South Orange County Desalination Project*. Prepared for Metropolitan Water District of Orange County.

Durbin, T.J, G.W. Kapple, and J.R. Freckleton, 1978. Two Dimensional and Three Dimentional Digital Flow Models of the Salinas Valley Ground-Water Basin, California. United States Geological Survey Water-Resources Investigations 78-113.

Durbin, T.J., 2012. California-American Water Company – Comments on proposal to pumpgroundwater from the Salinas Valley groundwater basin. Prepared for the Salinas Valley Water Coalition.

Durbin, T., 2013, Conaway Ranch Groundwater Model – Power-Law Averaging of Hydraulic Conductivity. Draft Technical Memorandum, November 2013.

Dupré, William R., 1975. *Quaternary History of the Watsonville Lowlands North-Central Monterey Bay Region, California*.

Dupré, William R., 1990. *Quaternary Geology of the Monterey Bay Region California*. AAPG Pacific Section, 2009 – Geology and Tectonics of the Central California Coast Region.

Eittreim, S. L.; Anima, R. J.; Stevenson, A. J., 2002. Seafloor Geology of the Monterey Bay Area Continental Shelf. Marine Geology, 181: 3 – 34.

Emcon, 1991. Monterey Regional Waste Management District, Marina Class III Landfill Geologic and Hydrogeologic Study, Monterey County, California

Faunt, C.C., ed., 2009, Groundwater Availability of the Central Valley Aquifer, California: U.S. Geological Survey Professional Paper 1766, 225 p.

Fetter, C.W., 1994. *Applied Hydrogeology*

Feeney and Rosenberg, 2002. *Deep Aquifer Investigation – Hydrogeologic Data Inventory, Review, Interpretation and Implications* (TECHNICAL REVIEW DRAFT).

Freeze, R. Allen and John A. Cherry, 1979. Groundwater

Fugro West, Inc., 1995. *Volume I Hydrogeologic Study Seawater Intake/Brine Disposal System, Marina, California*. Prepared for Marina Coast Water District.

Fugro West, Inc., 1996a. *Marina Coast Water District Seawater Desalination Project: Initiation of Inland Groundwater Monitoring.*

Fugro West, Inc., 1996b. *Marina Coast Water District Seawater Desalination Project: Establishment of Monitoring Well Network*.

Fugro West, Inc., 1996c. *Summary of Operations Construction and testing of Seawater Intake Well and Brine Injection Well prepared for Marina Coast Water District.*

GEOSCIENCE Support Services, Inc., 2004. *Feasibility of Using HDD Wells to Supply Water for the CoastalWater Project Desalination Plant at Moss Landing*. Prepared for RBF Consulting / California American Water, August 3, 2004.

GEOSCIENCE Support Services, Inc., 2005. *Feasibility of Using HDD Wells for Water Supply and BrineDischarge for the Coastal Water Project Desalination Plant, North Marina Site.*

GEOSCIENCE Support Services, Inc., 2008. *North Marina Groundwater Model Evaluation of Potential Projects*.

GEOSCIENCE Support Services, Inc., 2010. *Summary of Historical Erosion Rates in the Vicinity of the Marina Coast Water District Office - Marina State Beach, Marina California*.

GEOSCIENCE Support Services, Inc., 2010. Sonic *Exploratory Soil Borings and Monitoring Well Completion,* prepared for the South Coast Water District.

GEOSCIENCE Support Services, Inc., 2013 *Hydrogeology Investigation and Subsurface Intake System Feasibility Evaluation Proposed Camp Pendleton Seawater Desalination Project – Technical Studies*

Greene, Gary H., 1970. *Geology of Southern Monterey Bay and its Relationship to Ground Water Basin and Sea Water Intrusion*. U.S. Geologic Survey Open-File Report.

Greene, Gary H., 1977. *Geology of the Monterey Bay Region*. U.S. Geologic Survey Open-File Report 77-718.

Greene, Gary H., 1990. *Regional Tectonics and Structural Evolution of the Monterey Bay Region, Central California. Geology and Tectonics of the Central California Coast Region, San Francisco to Monterey*. Pacific Section of the American Association of Petroleum Geologists. June.

Greene, Gary H, et al, 1991. Offshore and onshore liquefaction at Moss Landing spit, central California-result of the October 17, 1989 Loma Prieta earthquake-Geology, v19 p. 945-949, September 1991.

Grossman, E. E.; Eittreim, S. L.; Field, M. E.; Wong, F. L., 2006. Shallow Stratigraphy and Sedimentation History During High-frequency Sea-level Changes on the Central California Shelf. Continental Shelf Research, 26: 1217 – 1239.

Happle, J., 2010. Personal Communication. Research Associate Professor and Director, Rosentiel School of Marine and Atmospheric Science Tritium Laboratory, University of Miami, Florida.

Harding Lawson Associates (HLA), 1994. *Final Basewide Remedial Investigation/Feasibility Study (RI/FS), Fort Ord, California, Volume II, Remedial Investigation Basewide Hydrogeologic Characterization, Appendixes, Appendix D: Ford Ord Groundwater Model.*

Harding Lawson Associates (HLA), 2001. *Final Report: Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina, Salinas Valley, California.*

Hornberger, Michelle I, 1991. *Paleoenvironment of Elkhorn Slough and Surrounding Wetland Habitats: a geological study using an ecological approach*. San Jose State Master's Thesis.

JGOFS (Joint Global Ocean Flux Study). 1997. *Chapter 5, Physical and Thermodynamic Data. Version 2.13.*

Johnson, M., 1983. Ground Water in North Monterey County, California, 1980. U.S.G.S.Water-Resources Investigations Report 83-4023.

Kazemi, G.A., Lehr, J.H., and Perrochet, Pierre, 2006. Groundwater Age: Hoboken, NJ, John Wiley & Sons, Inc.

Kennedy-Jenks Consultants, 2004. *Hydrostratigraphic Analysis of the Northern Salinas Valley*.

Kozeny J., 1927. "Ueber kapillare Leitung des Wassers im Boden." Sitzungsber Akad. Wiss.

Krumbein, W.C., and G.G. Monk, 1942. “Permeability as a Function of the Size of Unconsolidated Sand.”

Monterey County Water Resources Agency, 2011. “Salinas Valley Basin- Lines of Equal Groundwater Elevation in the Pressure 180-Foot and East Side Shallow Aquifers

Monterey County Water Resources Agency, 2011. “Salinas Valley Basin- Lines of Equal Groundwater Elevation in the 400-Foot and East Side Deep Aquifers

Montgomery Watson, 1994. *Salinas River Basin Water Resources Management Plan Task 1.09 Salinas Valley Groundwater Flow and Quality Model Report*. Prepared for Monterey County Water Resources Agency. Dated February 1994.

Montgomery Watson, 1997. Final *Report – Salinas Valley Integrated Ground Water and Surface ModelUpdate*. Prepared for Monterey County Water Resources Agency. Dated May 1997.

Neuendorf, Klaus K.E., James P. Mehl Jr., Julia A. Jackson, 2005. Glossary of Geology, Fifth Edition, American Geological Institute.

RBF Consulting, 2012. *Contingency Planning for the Monterey Peninsula Water Supply Project*. Prepared for California American Water.

Reading, H.G. editor, 1978. Sedimentary Environments-Processes, Facies, and Stratigraphy. Third edition. Published by Blackwell Science.

Reading, H. G. (1996). Sedimentary Environments and Facies. Blackwell Scientific Publications.

RMC Geoscience, 2013. “Monterey Peninsula Landfill Second 2013 Semiannual Water Quality Monitoring Report, April 2013-September 2013

Shlemon, R. J., 1978*. Late Quaternary Evolution of the Camp Pendleton-San Onofre State Beach Coastal Area, Northwestern San Diego County, California*. Prepared for: Southern California Edison Company and San Diego Gas and Electric Company.

Shlemon, R.J., 1979. *Late Pleistocene Channel of the Lower Santa Margarita River, San Diego County, California. Geological Guide of the San Onofre Nuclear Generating Station and Adjacent Regions of Southern California*. Pacific Sections, American Association of Petroleum Geologists Society.

Shore Stations Monitoring Program. 2014. Active Stations. Granite Canyon Monitoring Station. fttp://ccsweb1.ucsd.edu/shore/active_data/granite_canyon/salinity

Staal, Garner, and Dunne, Inc. (SGD), 1991. Feasibility Study – Seawater Intake Wells Marina County Water District Wastewater Treatment Facility, Marina, California. Prepared for Marina County Water District. February.

Staal, Garner, and Dunne, Inc. (SGD), 1992. Feasibility Study – Saline Ground Water Intake System

Monterey Sand Company Site, Marina, California. Prepared for Monterey Peninsula Water Management District. February.

Tinsley, John III, 1975. *Quaternary Geology of the Northern Salinas Valley, Monterey County, California*.

Tinsley, John III, (2014) Personal Communication.

Tritium Laboratory, 2010. General Comments on Tritium Results. University of Miami Tritium Laboratory, Rosenstiel School of Marine and Atmospheric Science, Miami, Florida.California Department of Public Works, Water Resources Division, 1946. Salinas Basin Investigation, Bulletin 52.

United States Department of Commerce (DOC), National Oceanic and Atmospheric Administration (NOAA), National Ocean Service (NOS), and National Geodetic Survey (NGS), 2011. Continually Updated Shoreline Shapefile.

United States Geological Survey, 1983. *Ground Water in North Monterey County, California, 1980. U.S.G.S. Water-Resources Investigations.* Report 83-4023. Prepared in cooperation with the Monterey County Flood Control and Water Conservation District. Dated July 1983.

United States Geological Survey, 1988. *Reconnaissance High-resolution Geophysical Survey of the Monterey Bay, California, Inner Shelf--Implications for Sand Resources*. Chin, J. L.; Wolf, S. C., USGS Open-File Report: 88-410.

United States Geological Survey, 1991. *Molluscan and Foraminerferal Evidence of Late Pleistocene Sea Level lowstand in Monterey Bay, Central California*.

United States Geological Survey, 2002a. *Seafloor Rocks and Sediments of the Continental Shelf from Monterey Bay to Point Sur, California.* by Eittreim, S.L., Anima, R.J., Stevenson, A.J., and Wong, F.L. USGS Miscellaneous Field Studies Map-2345.

United States Geological Survey, 2002b. *Geohydrology of a Deep-Aquifer System Monitoring Well Site in Marina, Monterey County, California*. Water Resources Investigation Report 02-4003.

United States Geological Survey, 2003. *Geohydrologic Framework of Recharge and Seawater Intrusionin the Pajaro Valley, Santa Cruz and Monterey Counties, California*. U.S.G.S. Water-Resources Investigations. Report 03-4096.

United States Geological Survey, Hapke C., Reid, D., 2006. *National Assessment of Shoreline Change: AGIS Compilation of Vector Shorelines and Associated Shoreline Change Data for the Sandy Shorelines of the California Coast.* Open File Report-1251, 2006.

United States Geological Survey, Hapke C., Reid, D., and Borrelli, M., 2007 revised 2008. *NationalAssessment of Shoreline Change: A GIS Compilation of Vector Cliff Edge and Associated Cliff Erosion Data for the California Coast*. Open File Report-1112, 2008.

United States Geological Survey, 2009. *Map of the Rinconada and Reliz Fault Zones, Salinas River Valley, California*. Scientific Investigations Report 3059.

United States Geological Survey, 2002. *Isostatic Gravity Map of the Monterey 30'x60' Quadrangle and Adjacent Areas, California* USGS Open-File Report 02-373.

Vengosh, A. et. Al. 2002. A Multi-isotope (B, Sr, O, H, and C) and age dating (^{3}H-^{3}He and ^{14}C) study of ground water from Salinas Valley, California: Hydrochemistry, dynamics, and contamination processes. Water Resources Research, Vol. 38, No.1.

Water Resources and Information Management Engineering, Inc. (WRIME), 2003. *Deep Aquifer Investigative Study*. Prepared for the Marina Coast Water District.

Wong, F. L.; Eittreim, S. L., 2001. Continental Shelf GIS for the Monterey Bay National Marine Sanctuary. USGS Open-File Report 01-179.

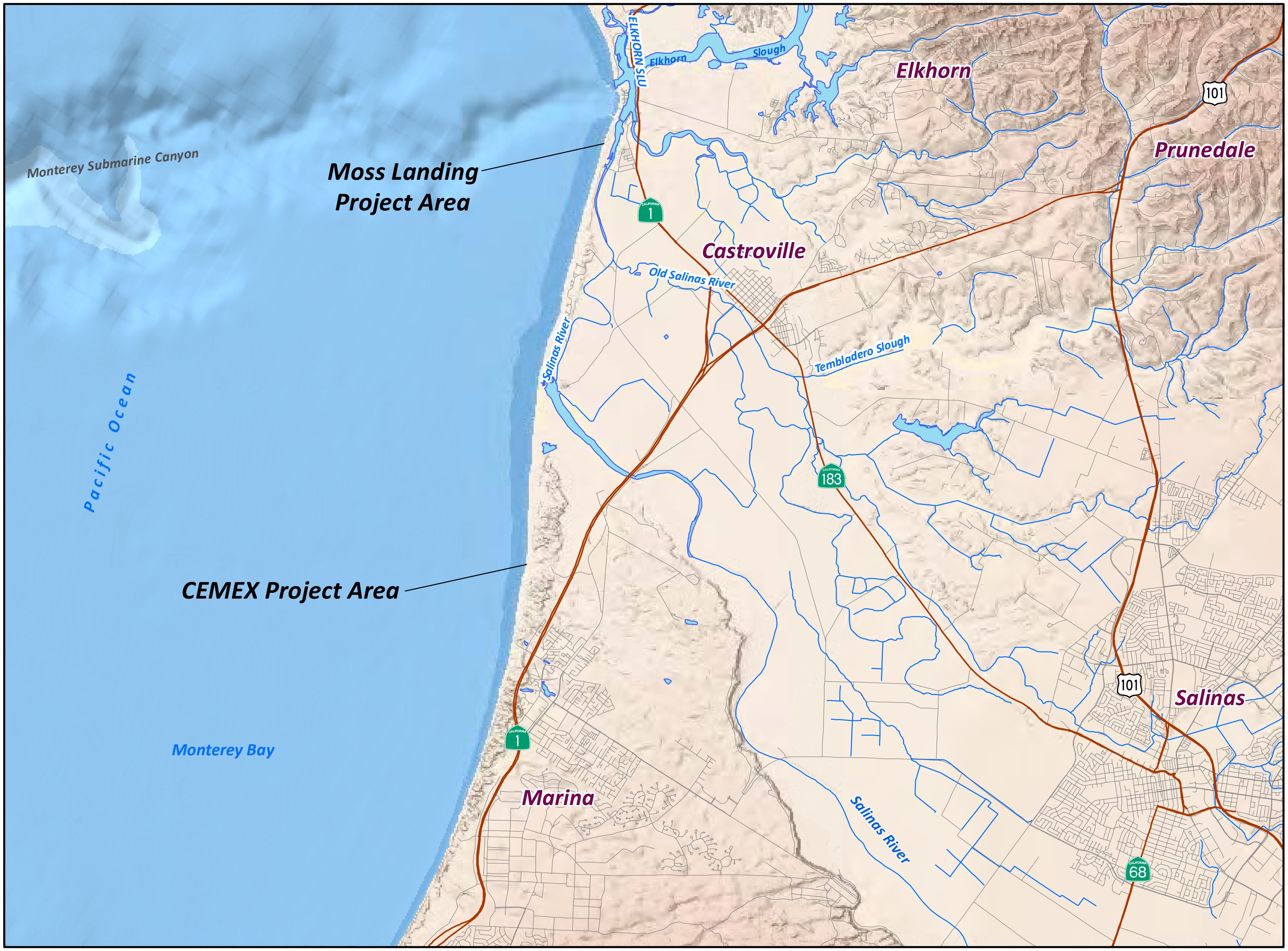
FIGURES

GEOSCIENCE

CALIFORNIA AMERICAN WATER &
RBF CONSULTING

MONTEREY PENINSULA WATER SUPPLY PROJECT HYDROGEOLOGIC INVESTIGATION
ATTACHMENT 1 - TECHNICAL MEMORANDUM (TM 1) - SUMMARY OF RESULTS - EXPLORATORY BOREHOLES

GENERAL PROJECT LOCATION



GEOSCIENCE

GEOSCIENCE Support Services, Inc.
P.O. Box 220, Claremont, CA 91711
Tel: (909) 451-6650 Fax: (909) 451-6638
www.gssiwater.com

8-Jul-14

Prepared by: DWB. Map Projection: State Plane 1983, Zone IV.

Figure 1

GIS_proj/mcwsp_cal_am/rbf_boring_tech_memo_7-14/4_Fig_1_gen_loc_8x11_7-14.mxd

GENERAL NOTES:

1. LOCATION OF EXISTING FACILITIES SHOWN ON THIS MAP IS APPROXIMATE AND INTENDED FOR PURPOSES OF BIDDING. CONTRACTOR IS RESPONSIBLE FOR VERIFYING ACTUAL LOCATION PRIOR TO CONSTRUCTION.

⌖ PROPOSED EXPLORATORY BORING LOCATIONS

◉ EXISTING WELLS

NORTH

0 1000 2000 3000

APPROXIMATE HORIZONTAL SCALE (FEET)

GEOSCIENCE

"SETTING THE STANDARD IN WATER WELL DESIGN SINCE 1978"

909.451.6650 | gssiwater.com

MONTEREY PENINSULA WATER SUPPLY PROJECT

HYDROGEOLOGIC INVESTIGATION REPORT -ATTACHMENT 1

GENERAL LOCATION OF MOSS LANDING, POTRERO RD, AND CEMEX AREAS

Rev.	Date	By	Description
1			
2			
3			
4			

Date: 08-JUL-14

Designed: MDW

Checked: DEW

File: MSL-CLAM-3-0.dwg

FIGURE

2

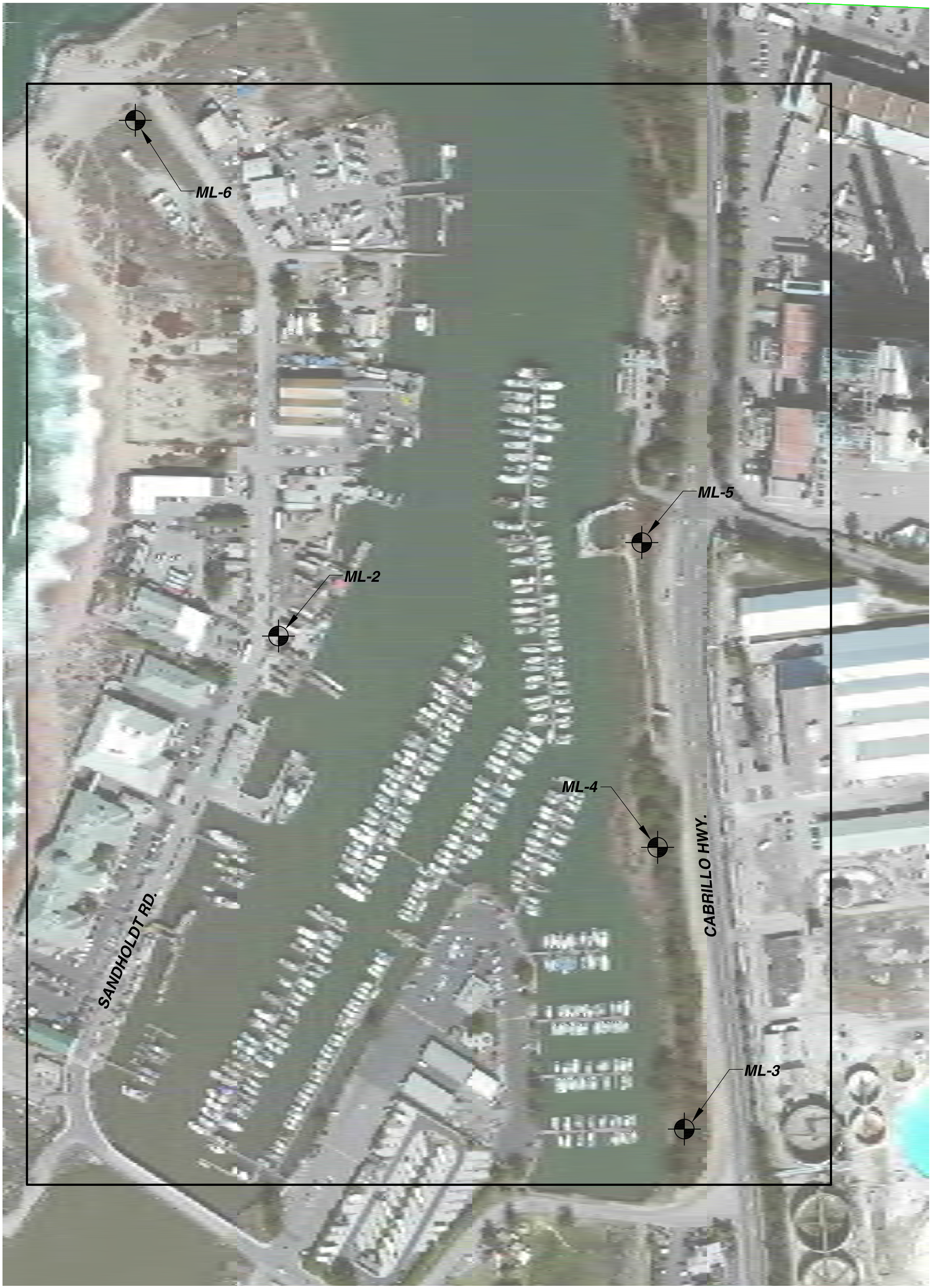
GEOSCIENCE

"SETTING THE STANDARD IN WATER WELL DESIGN SINCE 1978"
909.451.6650 | gssiwater.com

MONTEREY PENINSULA WATER SUPPLY PROJECT
HYDROGEOLOGIC INVESTIGATION REPORT -ATTACHMENT 1
PROPOSED CEMEX AREA BOREHOLES

Date: 08-JUL-14
Designed: MDW
Checked: DEW
File: MSL-CLAM-3-4.dwg

FIGURE
3



LEGEND:

⊕ PROPOSED EXPLORATORY BORING LOCATIONS

NORTH

0 200 400

APPROXIMATE HORIZONTAL SCALE (FEET)

GEOSCIENCE

"SETTING THE STANDARD IN WATER WELL DESIGN SINCE 1978"
909.451.6650 | gssiwater.com

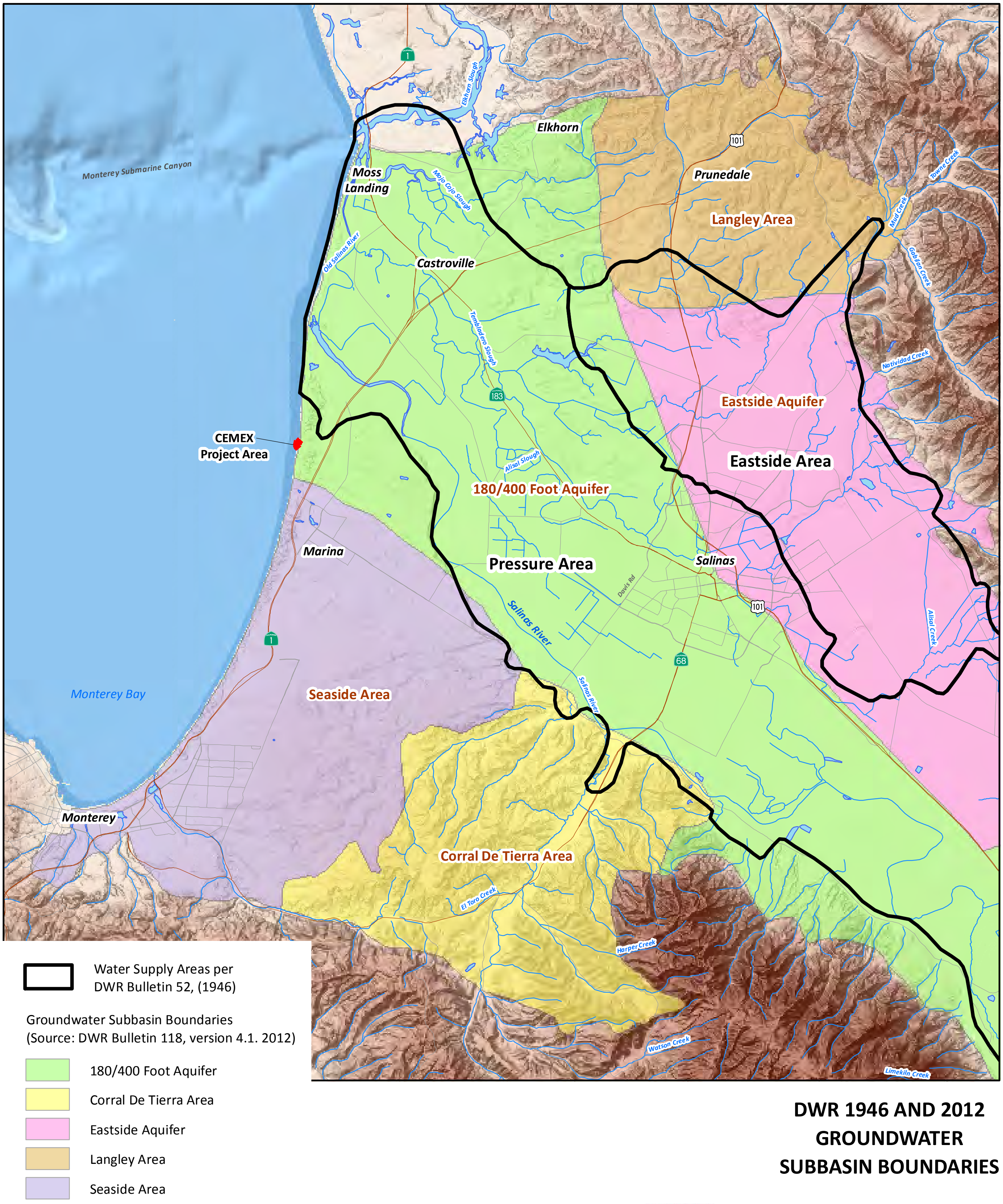
MONTEREY PENINSULA WATER SUPPLY PROJECT

HYDROGEOLOGIC INVESTIGATION REPORT -ATTACHMENT 1

MOSS LANDING HARBOR AREA BOREHOLES

Date: 08-JUL-14
Designed: MDW
Checked: DEW
File: MSL-CLAM-3-5.dwg

FIGURE 4



DWR 1946 AND 2012 GROUNDWATER SUBBASIN BOUNDARIES

NORTH

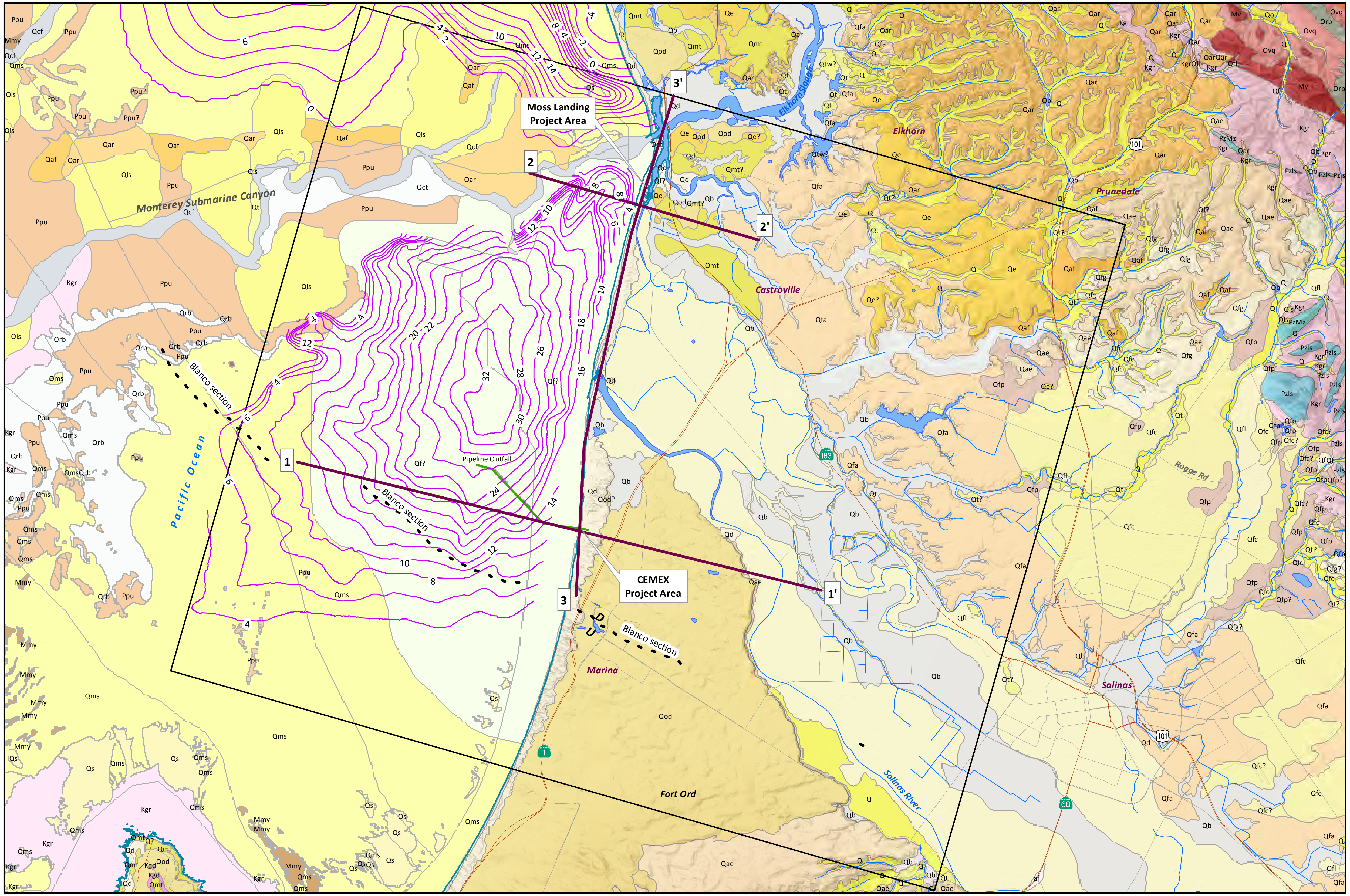
0 2 4 Miles

8-Jul-14

GEOSCIENCE
GEOSCIENCE Support Services, Inc.
P.O. Box 220, Claremont, CA 91711
Tel: (909) 451-6650 Fax: (909) 451-6638
www.gssiwater.com

Figure 5

GEOLOGIC SETTING



EXPLANATION

1 1' Cross-Section Location (See Figures 7a-9)

Holocene Sediment Thickness (meters) Source (USGS OFR 01-179)

Fault - Blanco Section of the Reliz Fault (Source: USGS SIM 3059)

Pipeline Outfall

North Marina Groundwater Model Boundary

-10 Elevation of Sea Floor, meters (Wong, F.L. and Eittreim, S.L., 2001)

Mean High Tide (DOC et al., 2011)

Geology from: (California Geological Survey. "Geologic Map of the Monterey 30'x60' Quadrangle and Adjacent Areas, California. Regional Geologic Map Series, 1:100,000 Scale. Map No. 1. 2002). See Figure 2b for Geologic Legend.

8-Jul-14

Prepared by: DWB. Map Projection: State Plane 1983, Zone IV.

NORTH

0 2 4 Miles

GEOSCIENCE
GEOSCIENCE Support Services, Inc.
P.O. Box 220, Claremont, CA 91711
Tel: (909) 451-6650 Fax: (909) 451-6638
www.gssiwater.com

Figure 6a

GIS_proj/mcwsp_cal_am/rbf_boring_tech_memo_7-14/4_Fig_6a_geology_7-14.mxd

CALIFORNIA AMERICAN WATER &
RBF CONSULTING

MONTEREY PENINSULA WATER SUPPLY PROJECT HYDROGEOLOGIC INVESTIGATION
ATTACHMENT 1 - TECHNICAL MEMORANDUM (TM 1) -
SUMMARY OF RESULTS - EXPLORATORY BOREHOLES

California Geological Survey
GEOLOGIC MAP OF THE MONTEREY 30'x60' QUADRANGLE
AND ADJACENT AREAS, CALIFORNIA
Compiled by David L. Wagner, H. Gary Greene, George J. Saucedo
and Cynthia L. Pridmore. 2002

⬜ af - Artificial Fill

Holocene

🟨 Q - Alluvium
🟨 Qfl - Flood Plain Deposits
⬜ Qb - Basin Deposits
🟨 Qs - Sand
🟧 Qe - Eolian Sand
⬜ Qd - Dune Sand
⬜ Qcf - Canyon Fill (offshore)
🟫 Qal (*) - River Alluvium

Pleistocene

🟨 Qo - Older Alluvium
🟨 Qls - Landslide Deposits
🟨 Qms - Marine Sediments
🟨 Qt - Terrace Deposits
🟨 Qod - Older Dune Sand
🟨 Qmt - Marine Terrace Deposits
⬜ Qrb - Relict Beach Deposits (offshore)
⬜ Qf - Alluvial Fan Deposits (Deltaic deposits offshore)
🟨 Qtw - Terrace Deposits of Watsonville Terrace
⬜ Qct - Submarine Canyon Terrace
🟧 Qfa - Fan Deposits of Antioch
🟨 Qfc - Fan Deposits of Chular
🟫 Qfp - Fan Deposits of Placentia
⬜ Qfg - Fan Deposits of Gloria
🟧 Qar - Aromas Sand (undivided)
🟨 Qae - Eolian Facies
🟧 Qaf - Fluvial Facies

* NOTE: Qal is not shown as a map unit.
Stratigraphic relationships indicate
its position in the subsurface.

Pliocene

🟧 QT - Plio-Pleistocene Continental Deposits
🟧 Ppu - Purisma Formation

Miocene

🟫 MPe - Etchegoin Formation
🟥 Mv - Unnamed Miocene Volcanic Rocks
🟫 Mmy - Monterey Formation
🟥 Tv - Tertiary Volcanic Rocks
🟥 Mus - Unnamed Miocene Sandstone

Oligocene

🟩 Orb - Red Beds
🟥 Ovq - Vaqueros Sandstone

Paleocene-Eocene

🟧 EOsj - San Juan Bautista Formation
🟦 Ebu - Unnamed Eocene Sedimentary Rocks
🟩 Ec - Carmelo Formation

Cretaceous

🟪 Kgr - Granitic Rocks
🟪 Kqm - Quartz Monzonite
🟪 Kgd - Granodiorite

Jurassic

🟦 PzMz - Prebatholithic Metasedimentary Rocks
🟦 Pzls - Carbonate Rocks
🟥 Tectonic Disturbance

⬛ Pipeline
🟦 water

GEOLOGIC MAP LEGEND

GEOSCIENCE
GEOSCIENCE Support Services, Inc.
P.O. Box 220, Claremont, CA 91711
Tel: (909) 451-6650 Fax: (909) 451-6638
www.gssiwater.com

8-Jul-14

Figure 6b

GIS_proj/mcwsp_cal_am/rbf_boring_tech_memo_7-14/4_Fig_6b_geology_legend_7-14.mxd

Source: Kennedy Jenks, 2004.

GEOSCIENCE

GEOSCIENCE Support Services, Incorporated
P.O. Box 220, Claremont, CA 91711
Tel: (909) 451-6650 Fax: (909) 451-6638
www.gssiwater.com

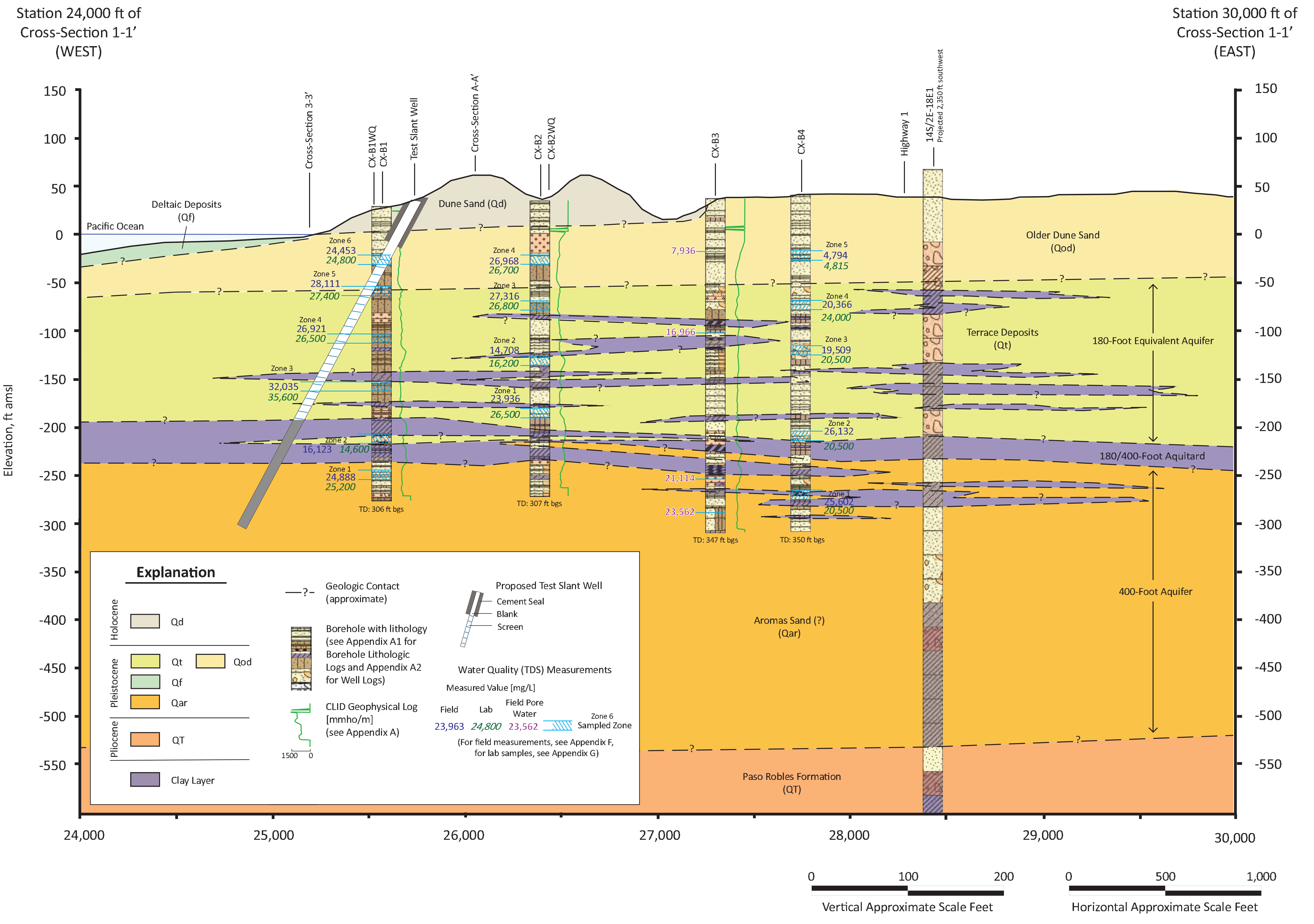
CALIFORNIA AMERICAN WATER & RBF CONSULTING

GEOLOGIC CROSS-SECTION 1-1'

Drawn: LC
Checked:
Approved:
Date: 8-Jul-14

Figure 7a

Projects\MONTEREY AREA DESAL STUDIES\02)ESA_and_ESA-CalAm\11) Logs_x-sections\GSSI_cross-sections_11-13\Fig_7a_LARGE_x-section_1-1'_May-14.ai



GEOSCIENCE

GEOSCIENCE Support Services, Incorporated
P.O. Box 220, Claremont, CA 91711
Tel: (909) 451-6650 Fax: (909) 451-6638
www.gssiwater.com

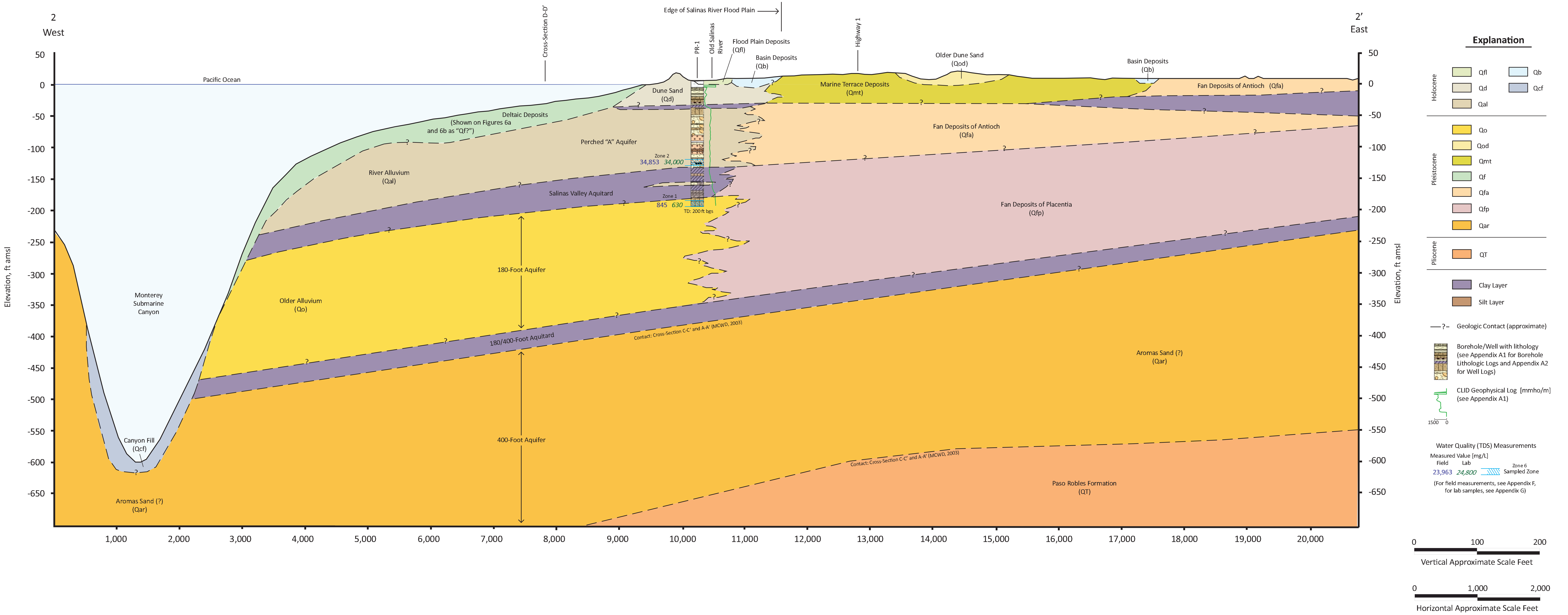
CALIFORNIA AMERICAN WATER & RBF CONSULTING

CEMEX AREA PORTION OF GEOLOGIC CROSS-SECTION 1-1'

Drawn: LC
Checked:
Approved:
Date: 8-Jul-14

Figure 7b

Projects\MONTEREY AREA DESAL STUDIES\02)ESA_and_ESA-CalAm\11) Logs_x-sections\GSSI_cross-sections_11-13\Fig_7b_x-section_1-1'_CEMEXarea_May-14.ai



GEOSCIENCE

GEOSCIENCE Support Services, Incorporated
P.O. Box 220, Claremont, CA 91711
Tel: (909) 451-6650 Fax: (909) 451-6638
www.gssiwater.com

CALIFORNIA AMERICAN WATER & RBF CONSULTING

GEOLOGIC CROSS-SECTION 2-2'

Drawn: LC
Checked:
Approved:
Date: 8-Jul-14

Figure 8

Projects\MONTEREY AREA DESAL STUDIES\02)ESA_and_ESA-CalAm\11) Logs_x-sections\GSSI_cross-sections_11-13\Fig_8_LARGE_x-section_2-2'_May-14.ai

GEOSCIENCE

GEOSCIENCE Support Services, Incorporated
P.O. Box 220, Claremont, CA 91711
Tel: (909) 451-6650 Fax: (909) 451-6638
www.gssiwater.com

CALIFORNIA AMERICAN WATER & RBF CONSULTING

GEOLOGIC CROSS-SECTION 3-3'

Drawn: LC
Checked:
Approved:
Date: 8-Jul-14

Figure 9

Projects\MONTEREY AREA DESAL STUDIES\02)ESA_and_ESA-CalAm\11) Logs_x-sections\GSSI_cross-sections_11-13\Fig_9_Combined_x-section_3-3'_May-14.ai

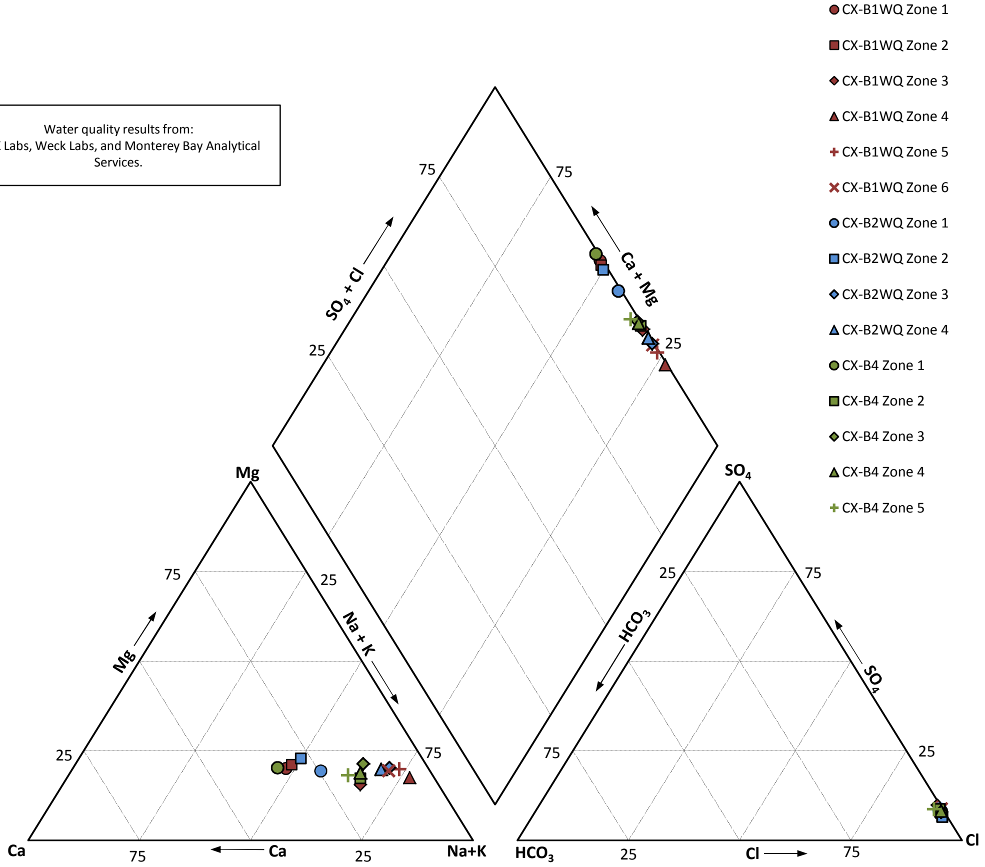
Cal Am / RBF

Monterey Peninsula Water Supply Project Hydrogeologic Investigation

Attachment 1 - Technical Memorandum (TM 1) - Summary of Results - Exploratory Boreholes

Figure 10

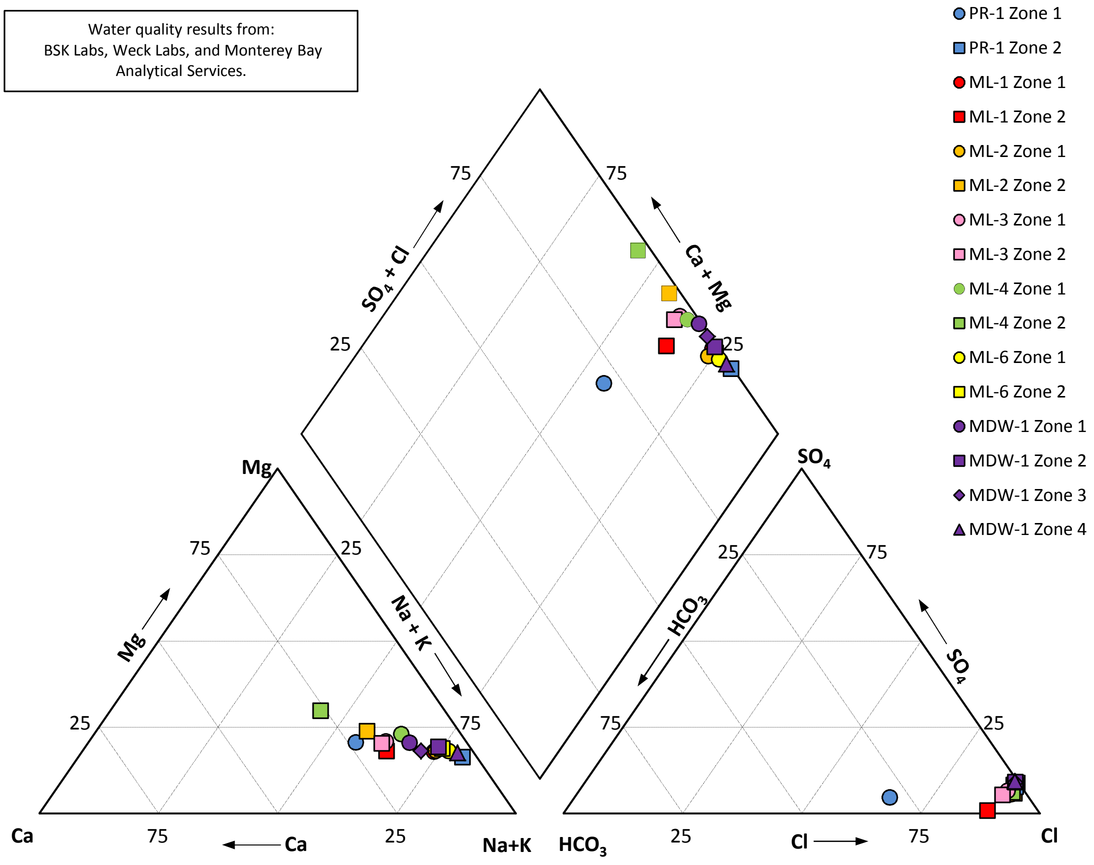
Trilinear Diagram
CEMEX Isolated Aquifer Zone Tests



Water quality results from:
BSK Labs, Weck Labs, and Monterey Bay Analytical Services.

Figure 11

Trilinear Diagram
Moss Landing Isolated Aquifer Zone Tests



Water quality results from:
BSK Labs, Weck Labs, and Monterey Bay
Analytical Services.

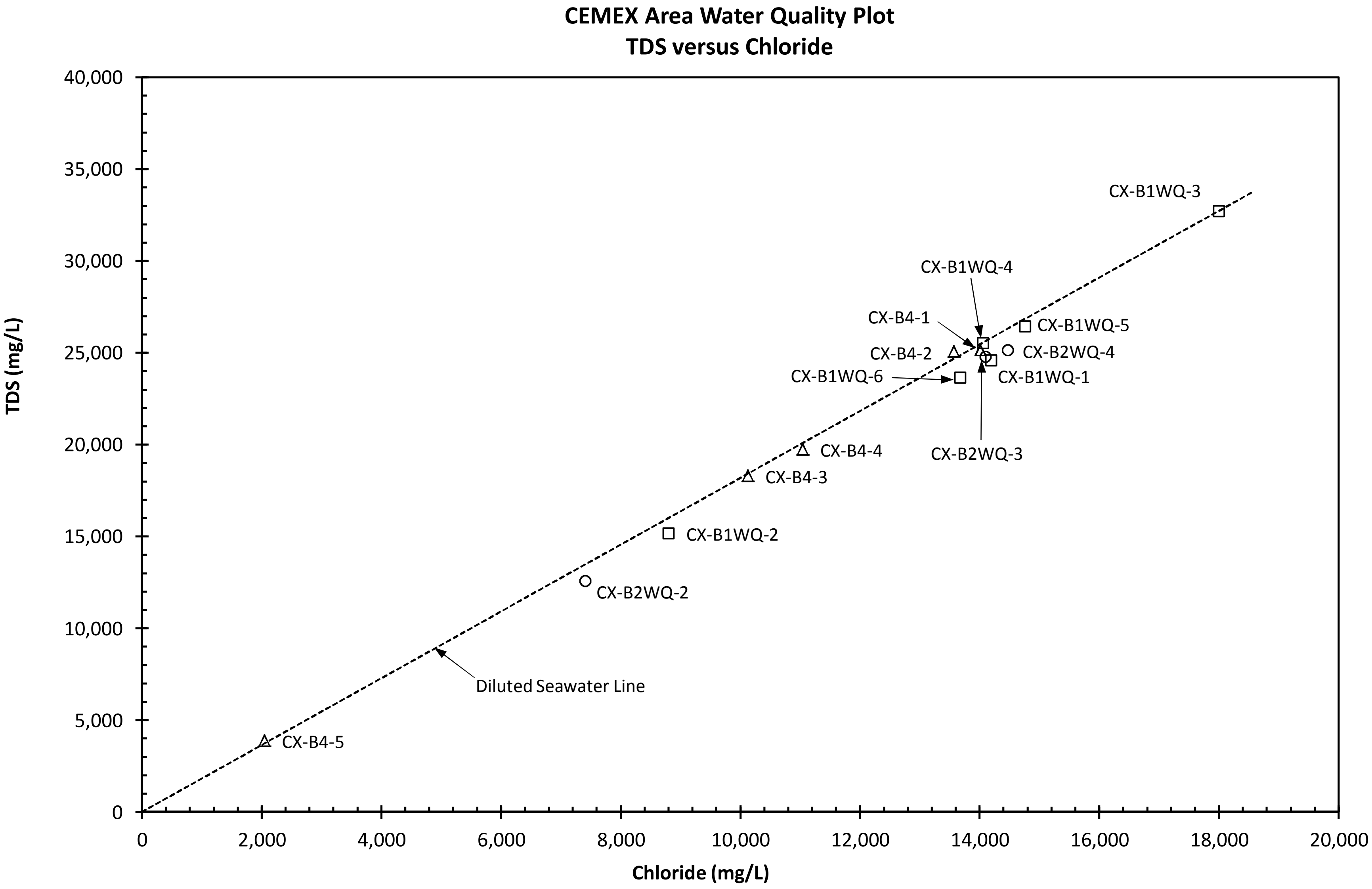

CEMEX Area Water Quality Plot
TDS versus Chloride
TDS (mg/L)
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
Chloride (mg/L)
0
2,000
4,000
6,000
8,000
10,000
12,000
14,000
16,000
18,000
20,000
CX-B1WQ-3
CX-B1WQ-4
CX-B4-1
CX-B1WQ-5
CX-B4-2
CX-B2WQ-4
CX-B1WQ-6
CX-B1WQ-1
CX-B2WQ-3
CX-B4-4
CX-B4-3
CX-B1WQ-2
CX-B2WQ-2
Diluted Seawater Line
CX-B4-5

Figure 12

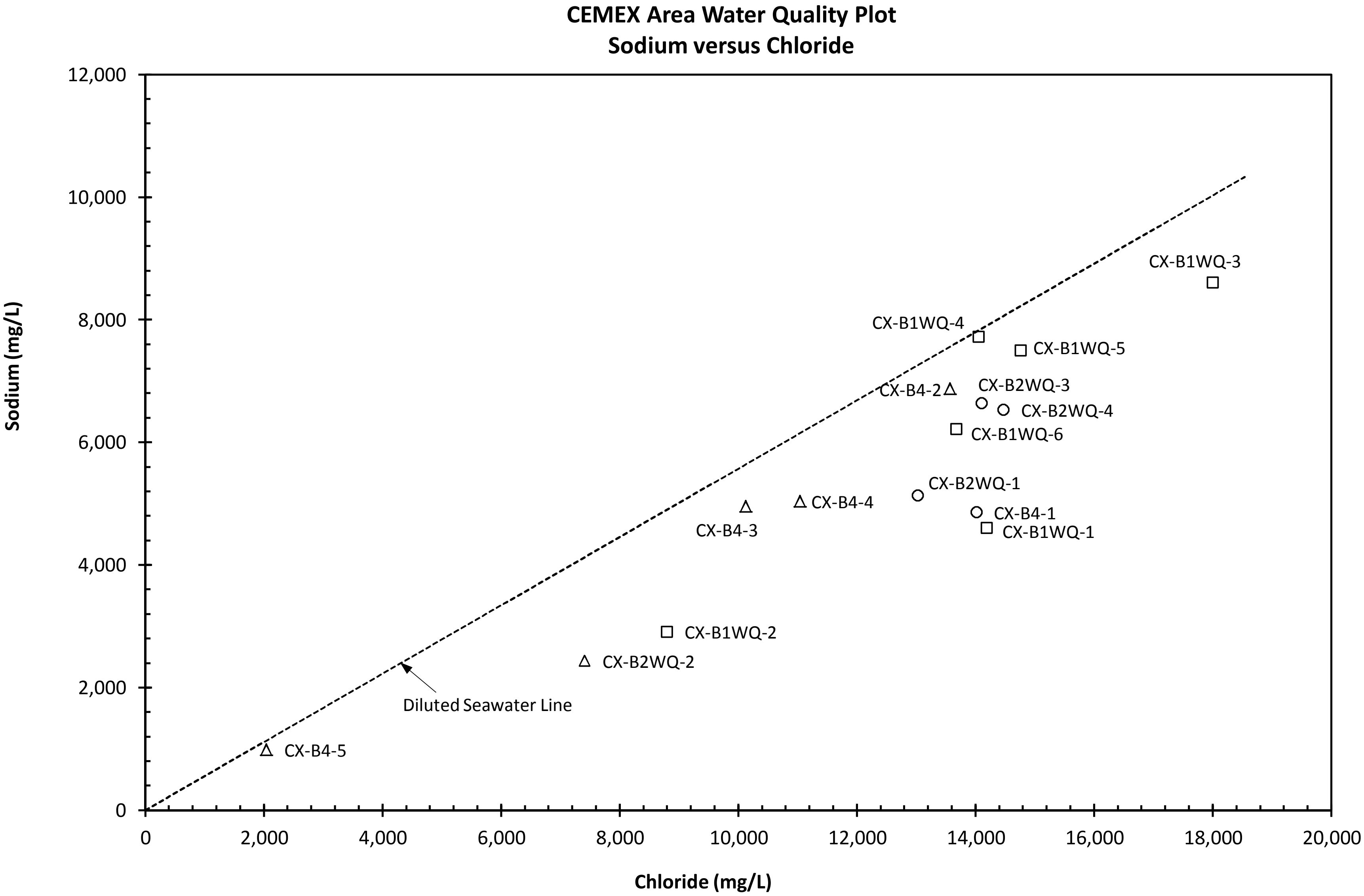

CEMEX Area Water Quality Plot
Sodium versus Chloride
Sodium (mg/L)
0
2,000
4,000
6,000
8,000
10,000
12,000
Chloride (mg/L)
0
2,000
4,000
6,000
8,000
10,000
12,000
14,000
16,000
18,000
20,000
CX-B1WQ-3
CX-B1WQ-4
CX-B1WQ-5
CX-B4-2
CX-B2WQ-3
CX-B2WQ-4
CX-B1WQ-6
CX-B2WQ-1
CX-B4-4
CX-B4-3
CX-B4-1
CX-B1WQ-1
CX-B1WQ-2
CX-B2WQ-2
Diluted Seawater Line
CX-B4-5

Figure 13

CEMEX Area Water Quality Plot
Calcium versus Chloride

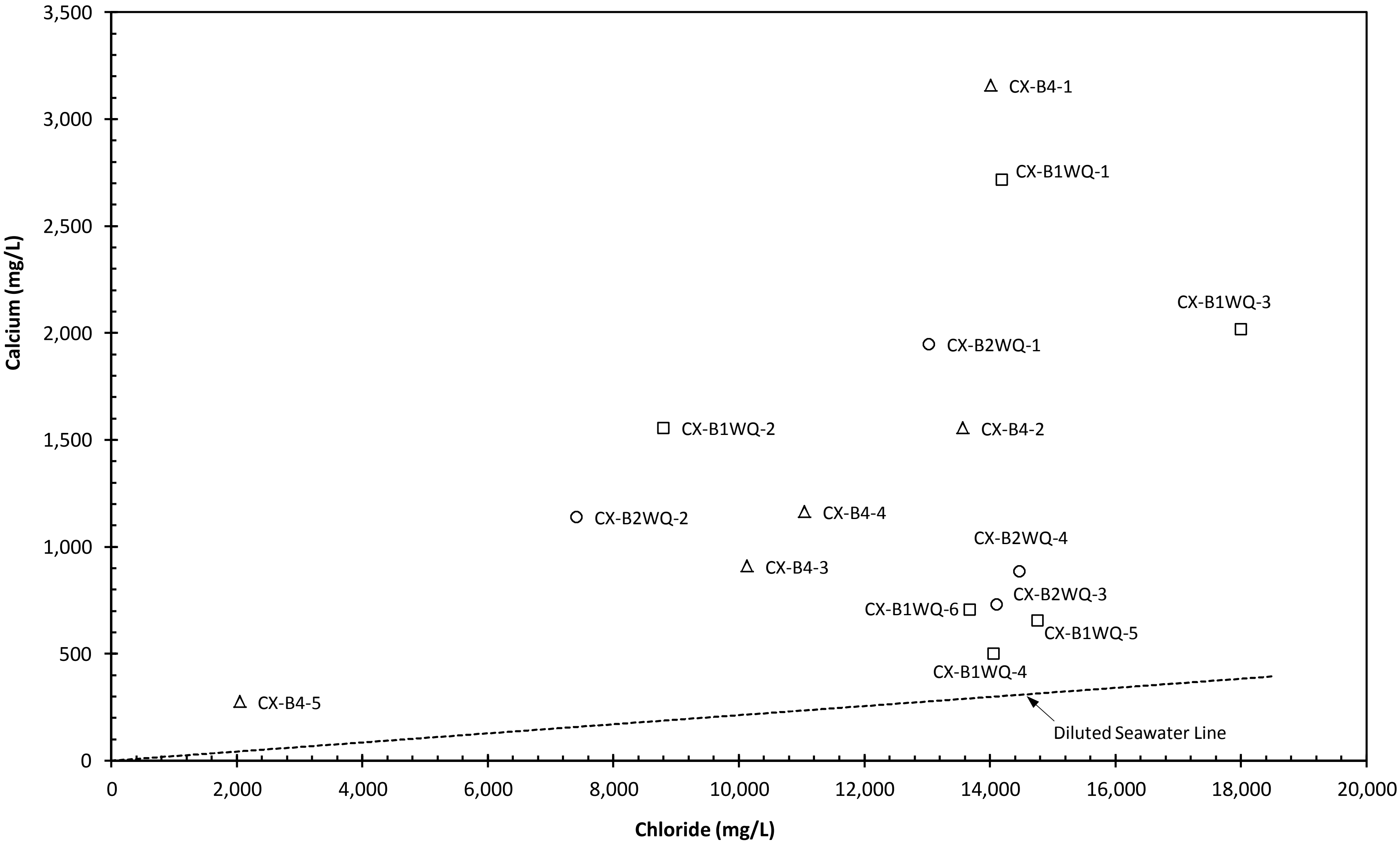


Figure 14

CEMEX Area Water Quality Plot
ΔSodium versus ΔCalcium

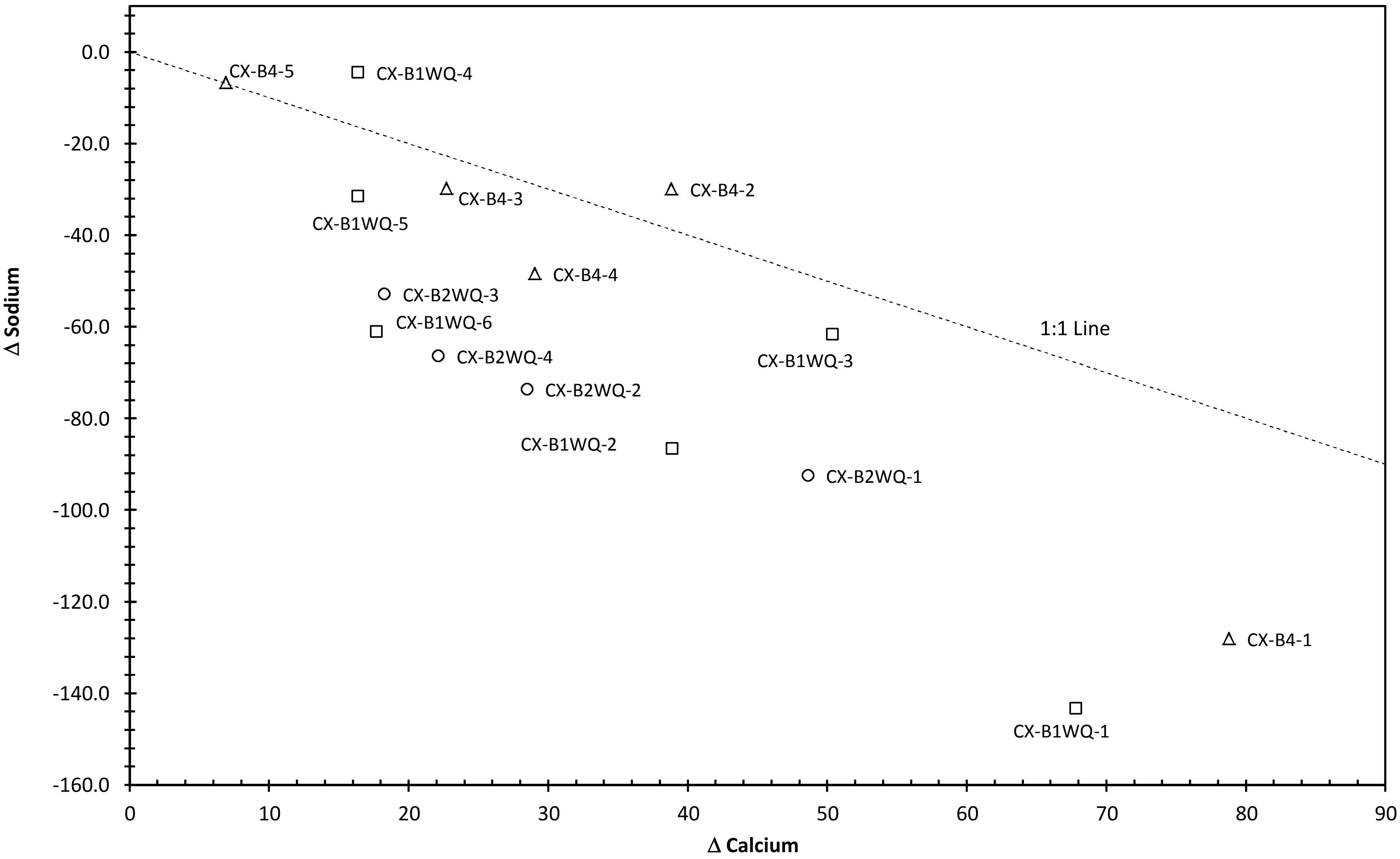


Figure 15

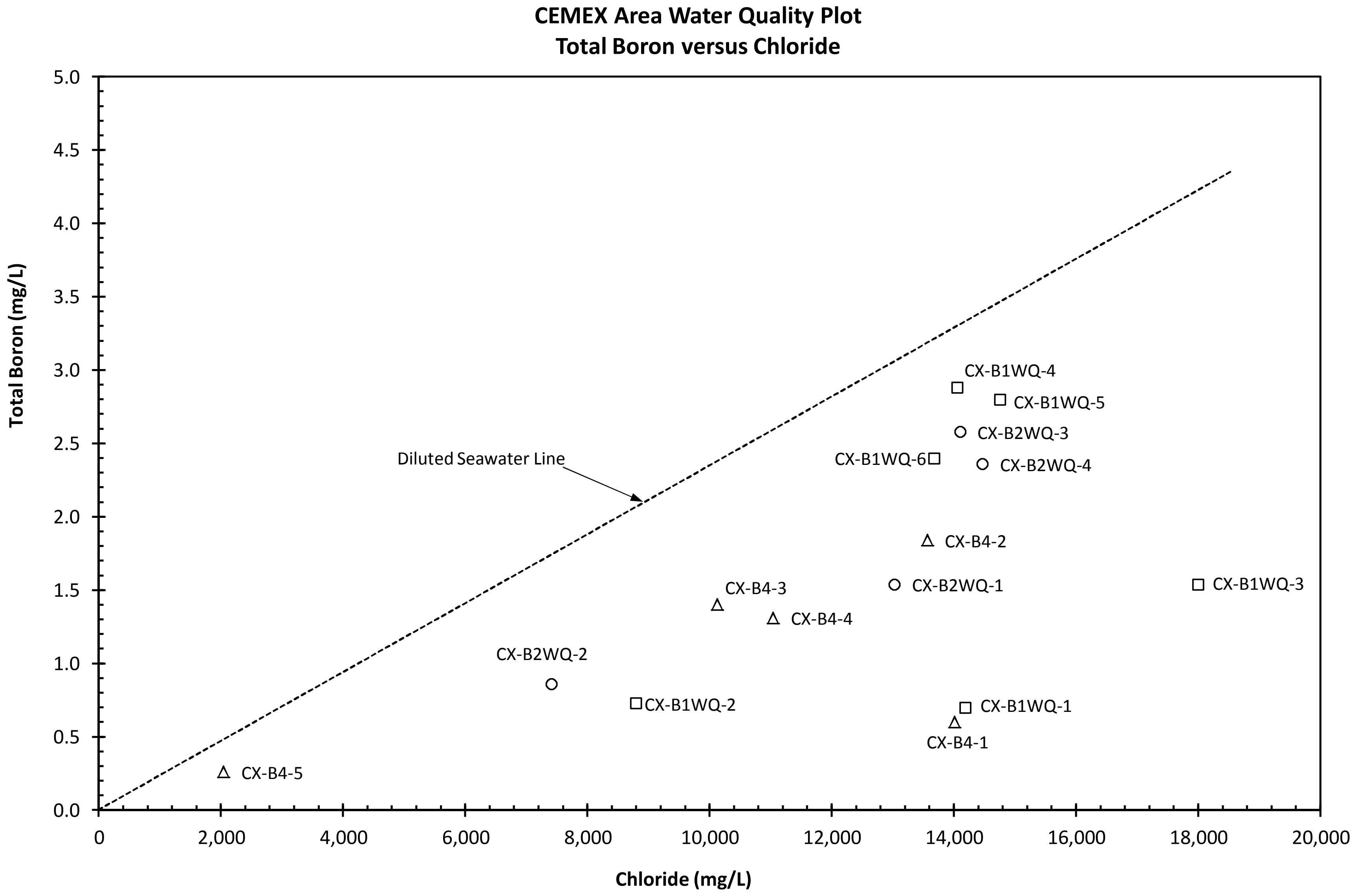

CEMEX Area Water Quality Plot
Total Boron versus Chloride
Total Boron (mg/L)
Chloride (mg/L)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
0
2,000
4,000
6,000
8,000
10,000
12,000
14,000
16,000
18,000
20,000
Diluted Seawater Line
CX-B1WQ-4
CX-B1WQ-5
CX-B2WQ-3
CX-B1WQ-6
CX-B2WQ-4
CX-B4-2
CX-B4-3
CX-B2WQ-1
CX-B1WQ-3
CX-B4-4
CX-B2WQ-2
CX-B1WQ-2
CX-B1WQ-1
CX-B4-1
CX-B4-5

Figure 16

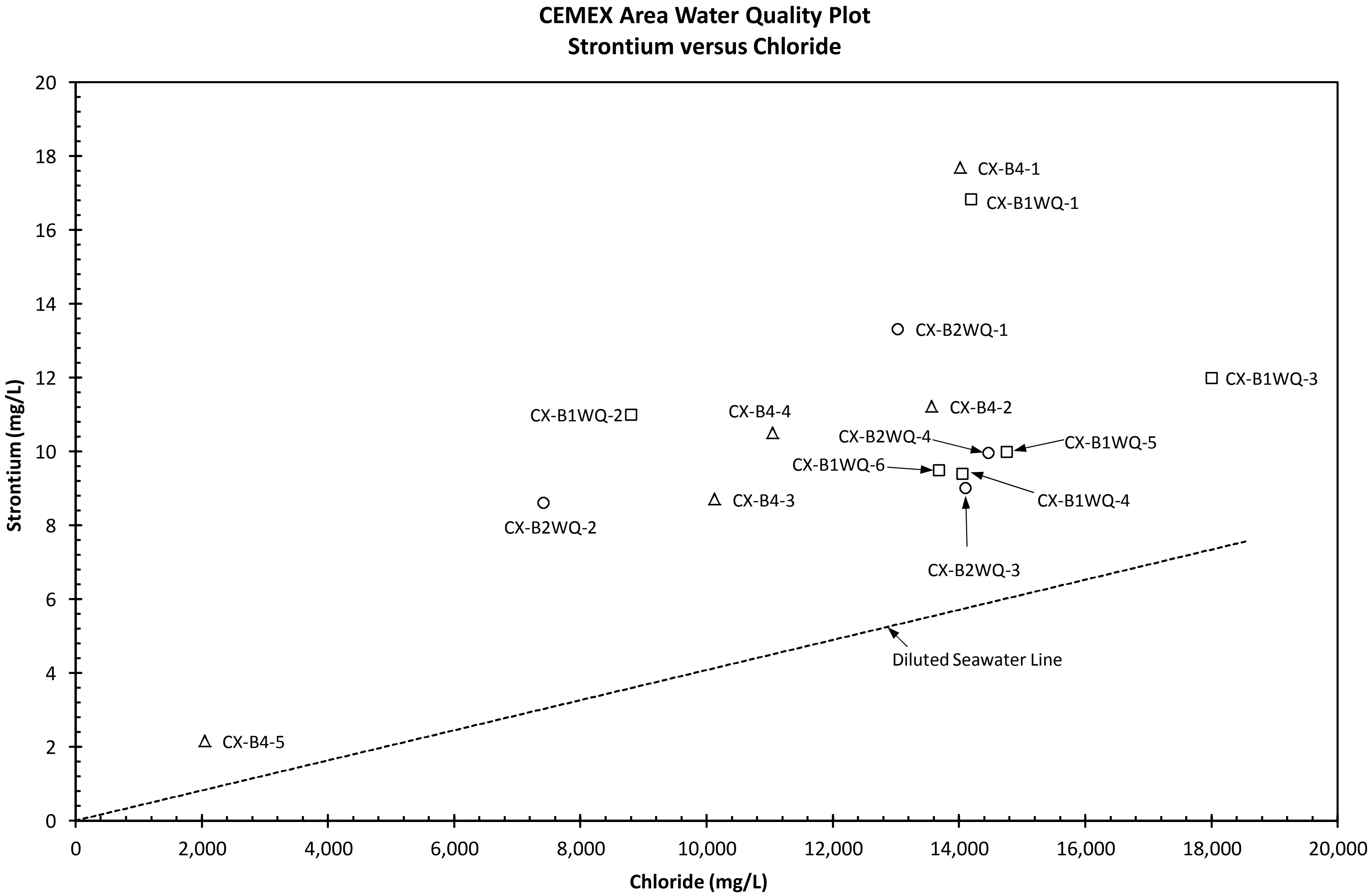

CEMEX Area Water Quality Plot
Strontium versus Chloride
Strontium (mg/L)
Chloride (mg/L)
0
2
4
6
8
10
12
14
16
18
20
0
2,000
4,000
6,000
8,000
10,000
12,000
14,000
16,000
18,000
20,000
CX-B4-1
CX-B1WQ-1
CX-B2WQ-1
CX-B1WQ-3
CX-B1WQ-2
CX-B4-4
CX-B4-2
CX-B2WQ-4
CX-B1WQ-5
CX-B1WQ-6
CX-B1WQ-4
CX-B2WQ-2
CX-B4-3
CX-B2WQ-3
Diluted Seawater Line
CX-B4-5

Figure 17

CEMEX Area Water Quality Plot
Sulfate versus Chloride

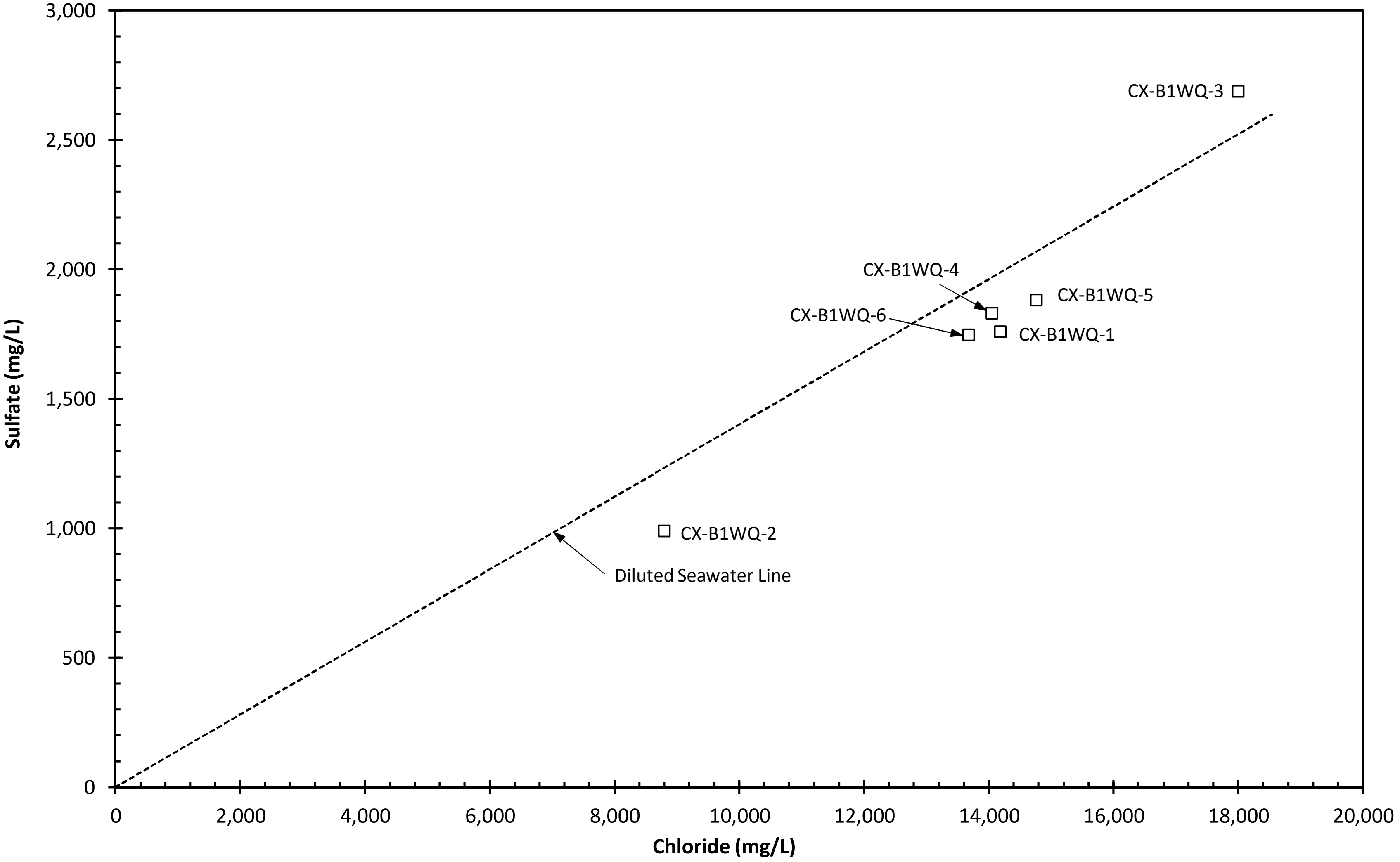


Figure 18

Moss Landing Area Water Quality Plot
TDS versus Chloride

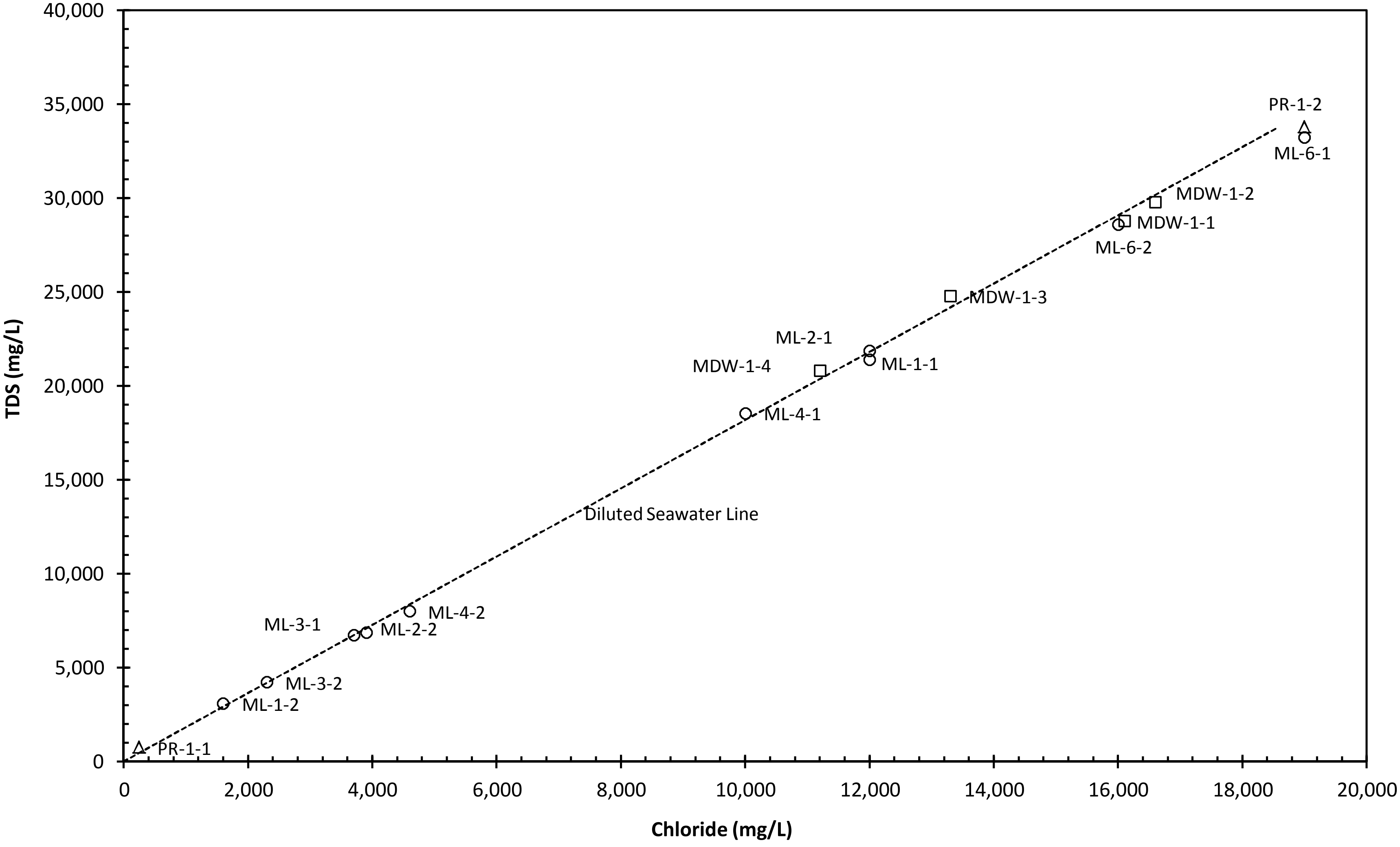


Figure 19

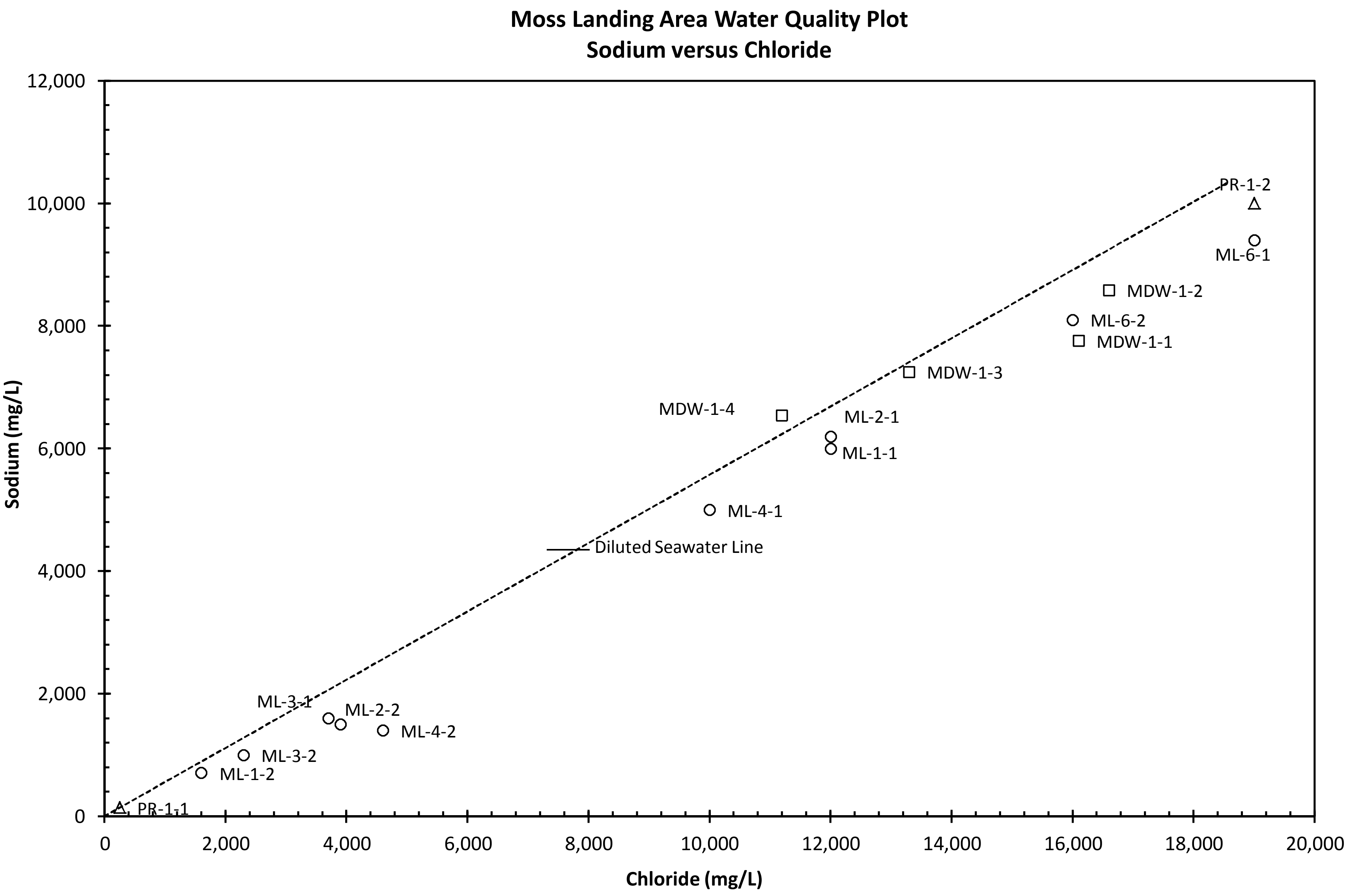

Moss Landing Area Water Quality Plot
Sodium versus Chloride
Sodium (mg/L)
Chloride (mg/L)
0
2,000
4,000
6,000
8,000
10,000
12,000
14,000
16,000
18,000
20,000
PR-1-2
ML-6-1
MDW-1-2
ML-6-2
MDW-1-1
MDW-1-3
MDW-1-4
ML-2-1
ML-1-1
ML-4-1
Diluted Seawater Line
ML-3-1
ML-2-2
ML-4-2
ML-3-2
ML-1-2
PR-1-1

Figure 20

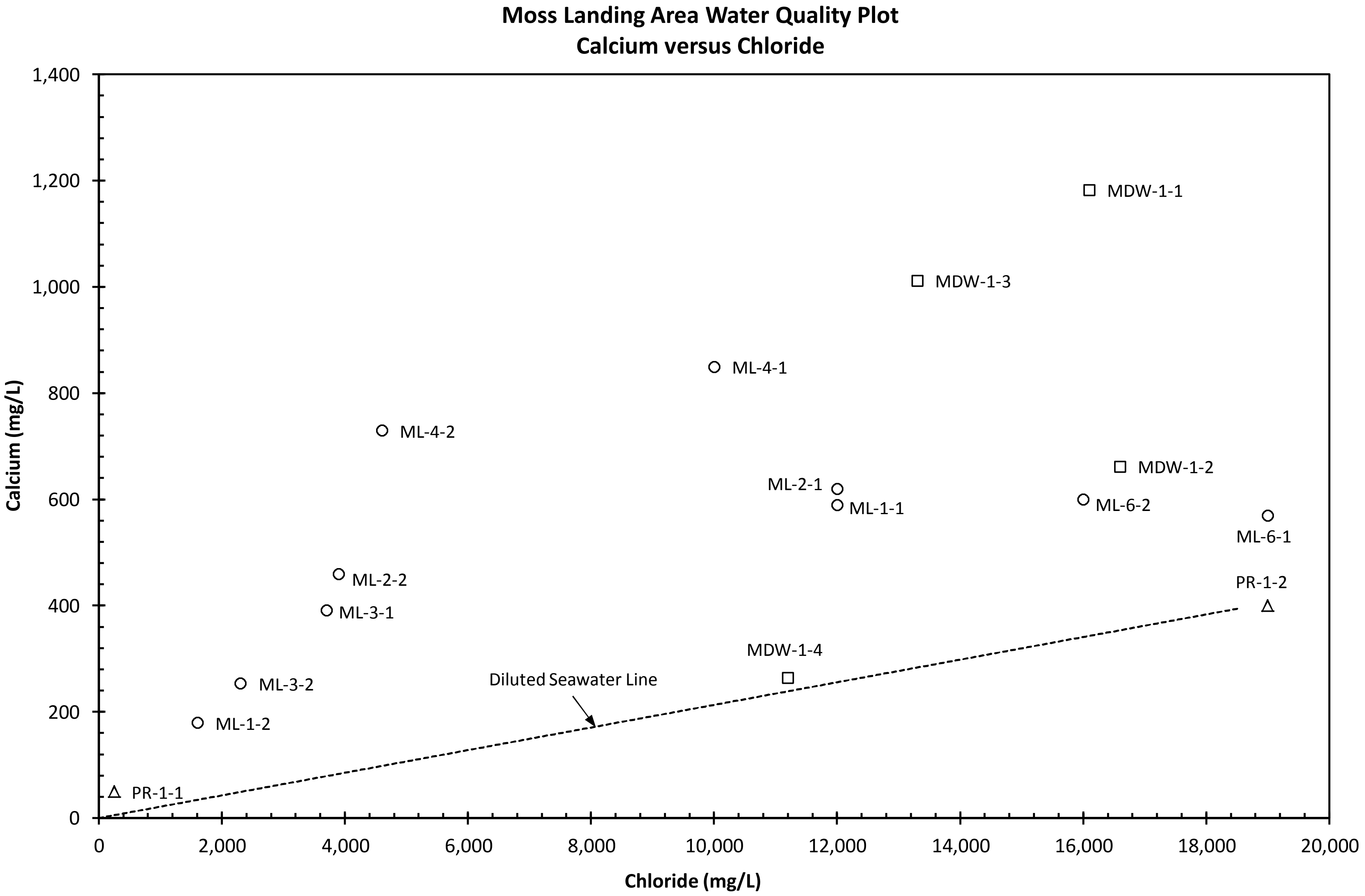

Moss Landing Area Water Quality Plot
Calcium versus Chloride
Calcium (mg/L)
1,400
1,200
1,000
800
600
400
200
0
Chloride (mg/L)
0
2,000
4,000
6,000
8,000
10,000
12,000
14,000
16,000
18,000
20,000
MDW-1-1
MDW-1-3
ML-4-1
ML-4-2
MDW-1-2
ML-2-1
ML-1-1
ML-6-2
ML-6-1
ML-2-2
PR-1-2
ML-3-1
MDW-1-4
Diluted Seawater Line
ML-3-2
ML-1-2
PR-1-1

Figure 21

Moss Landing Area Water Quality Plot
ΔSodium versus ΔCalcium

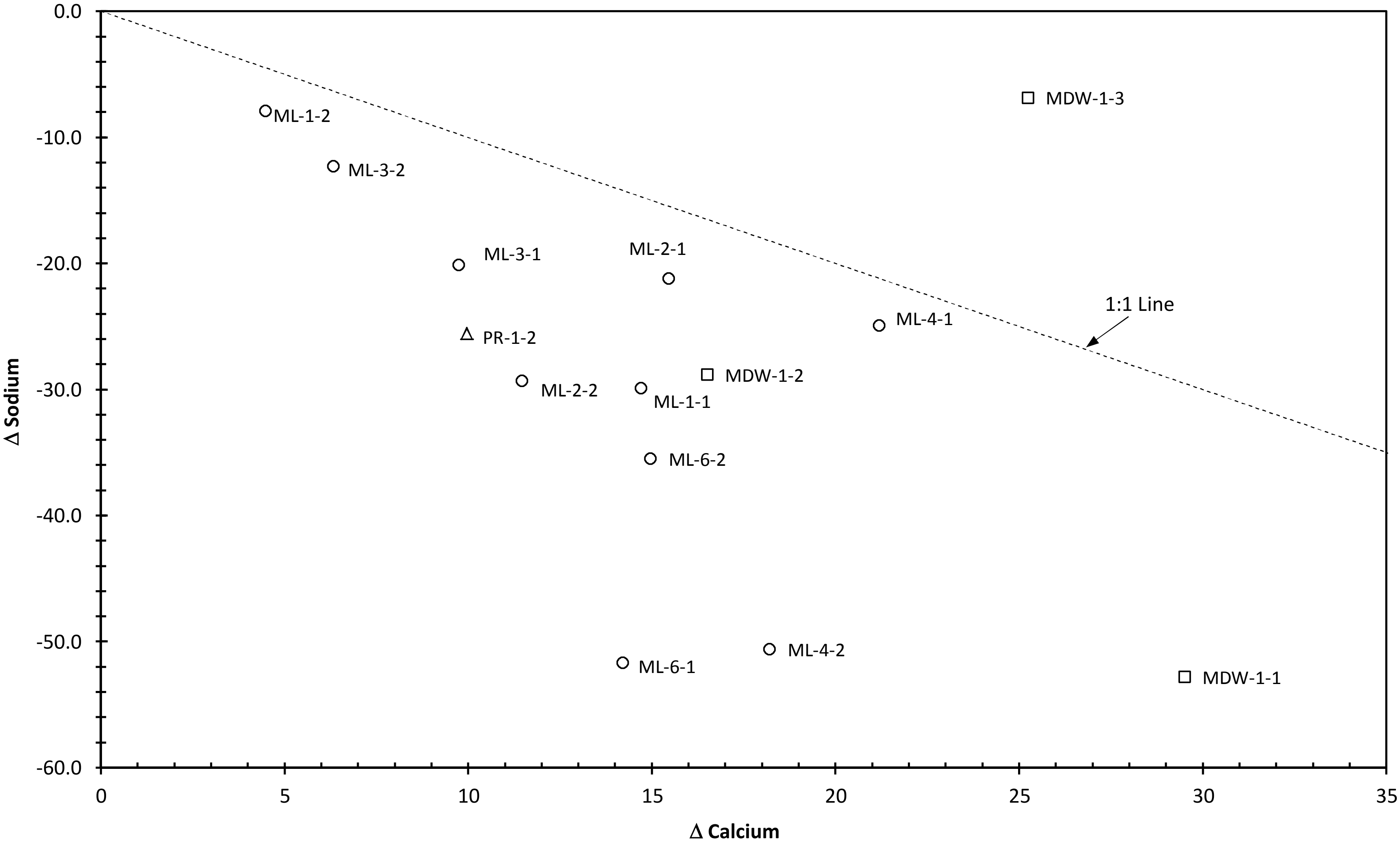


Figure 22

Moss Landing Area Water Quality Plot
Total Boron versus Chloride

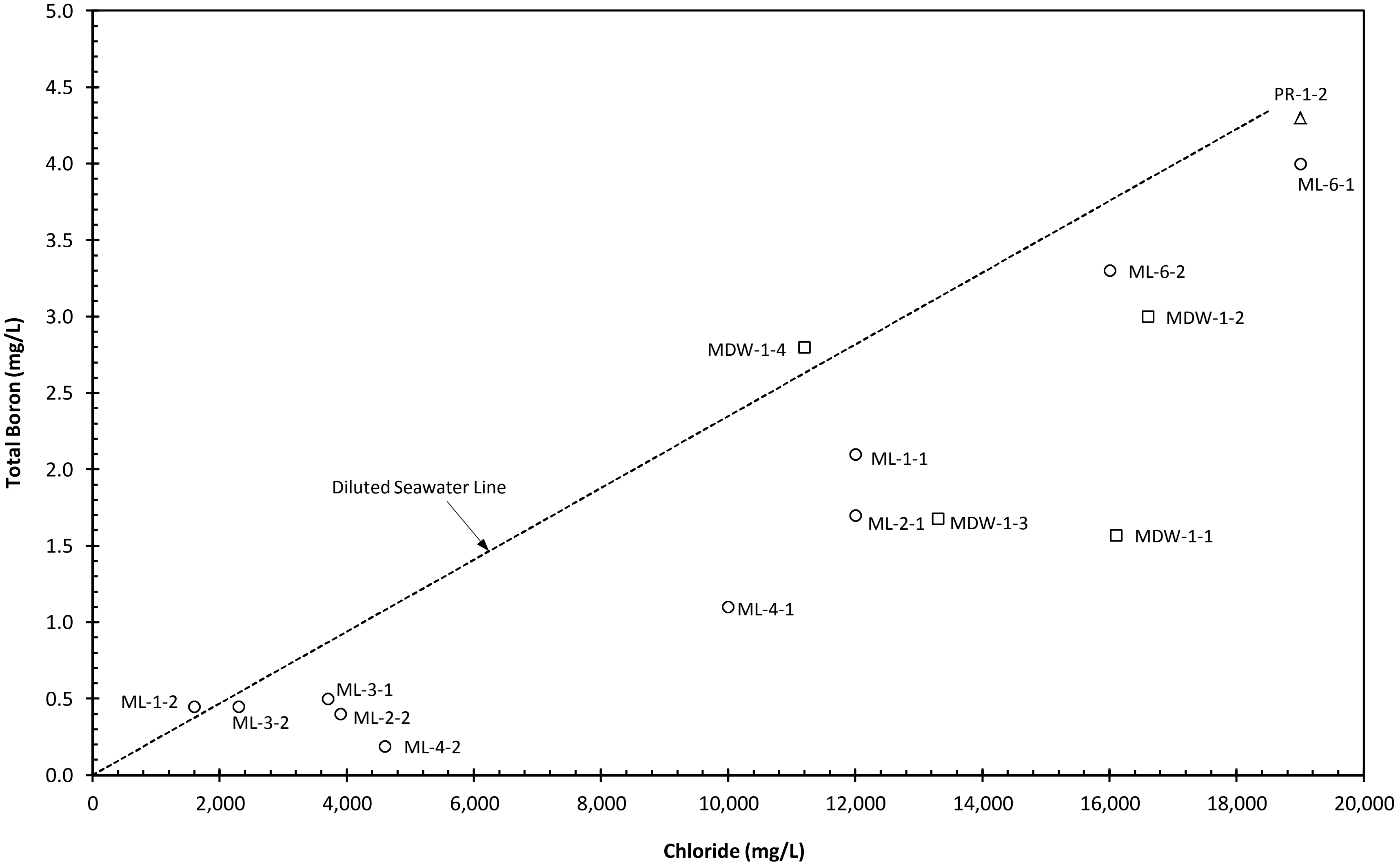


Figure 23

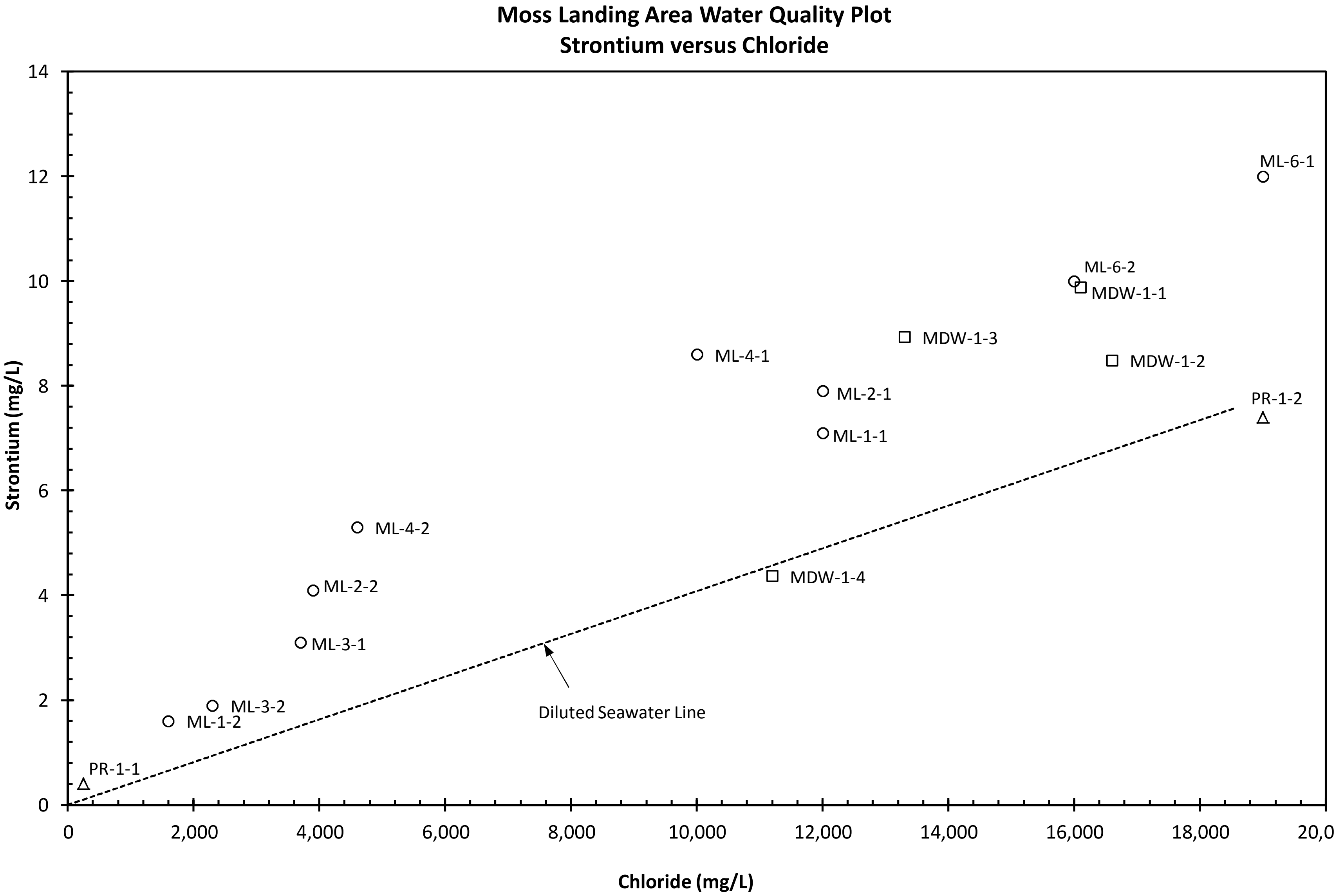

Moss Landing Area Water Quality Plot
Strontium versus Chloride
Strontium (mg/L)
Chloride (mg/L)
0
2
4
6
8
10
12
14
0
2,000
4,000
6,000
8,000
10,000
12,000
14,000
16,000
18,000
20,000
ML-6-1
ML-6-2
MDW-1-1
MDW-1-3
ML-4-1
MDW-1-2
ML-2-1
PR-1-2
ML-1-1
ML-4-2
MDW-1-4
ML-2-2
ML-3-1
ML-3-2
ML-1-2
Diluted Seawater Line
PR-1-1

Figure 24

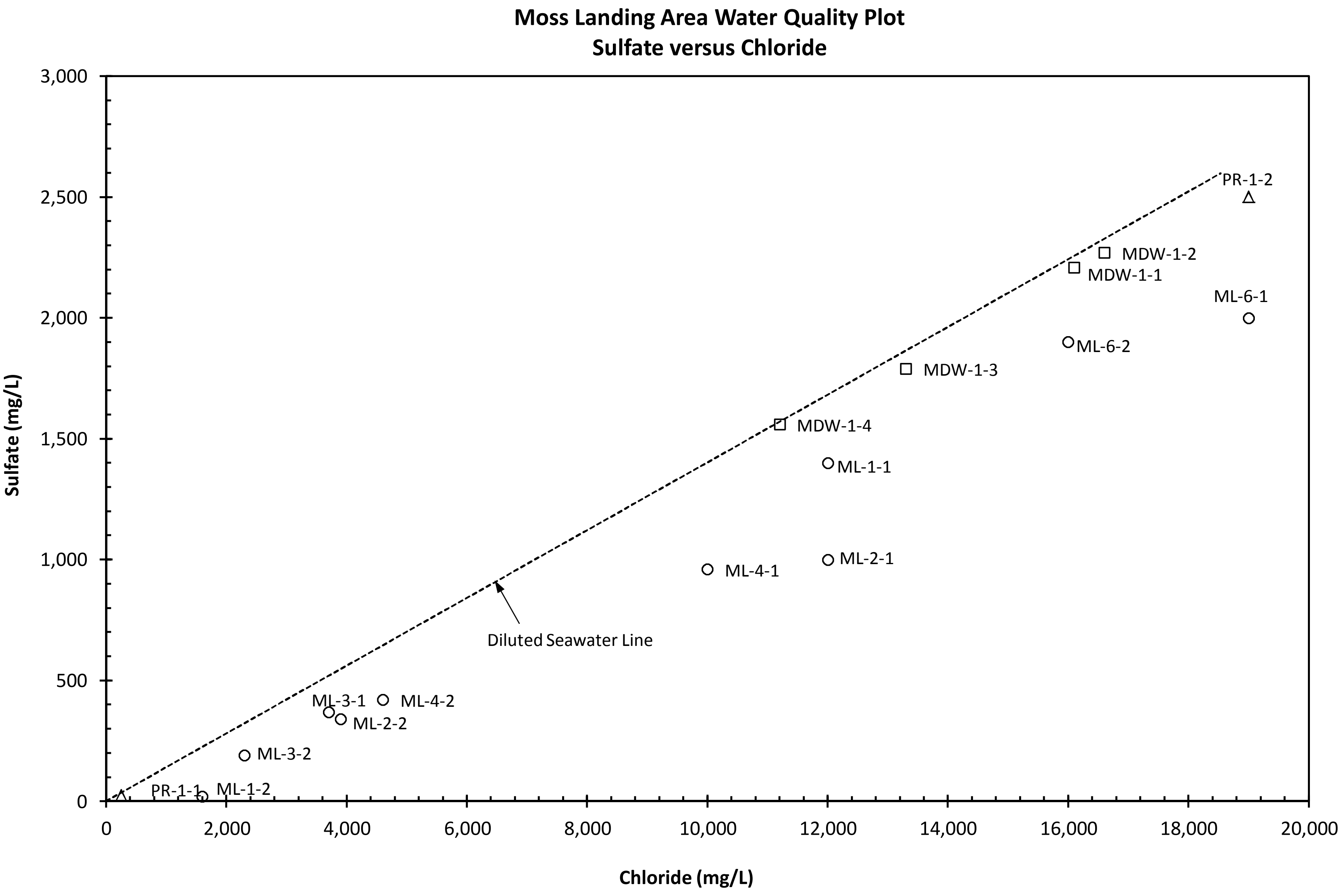

Moss Landing Area Water Quality Plot
Sulfate versus Chloride
Sulfate (mg/L)
Chloride (mg/L)
0
500
1,000
1,500
2,000
2,500
3,000
0
2,000
4,000
6,000
8,000
10,000
12,000
14,000
16,000
18,000
20,000
PR-1-2
MDW-1-2
MDW-1-1
ML-6-1
ML-6-2
MDW-1-3
MDW-1-4
ML-1-1
ML-2-1
ML-4-1
Diluted Seawater Line
ML-3-1
ML-4-2
ML-2-2
ML-3-2
PR-1-1
ML-1-2

Figure 25

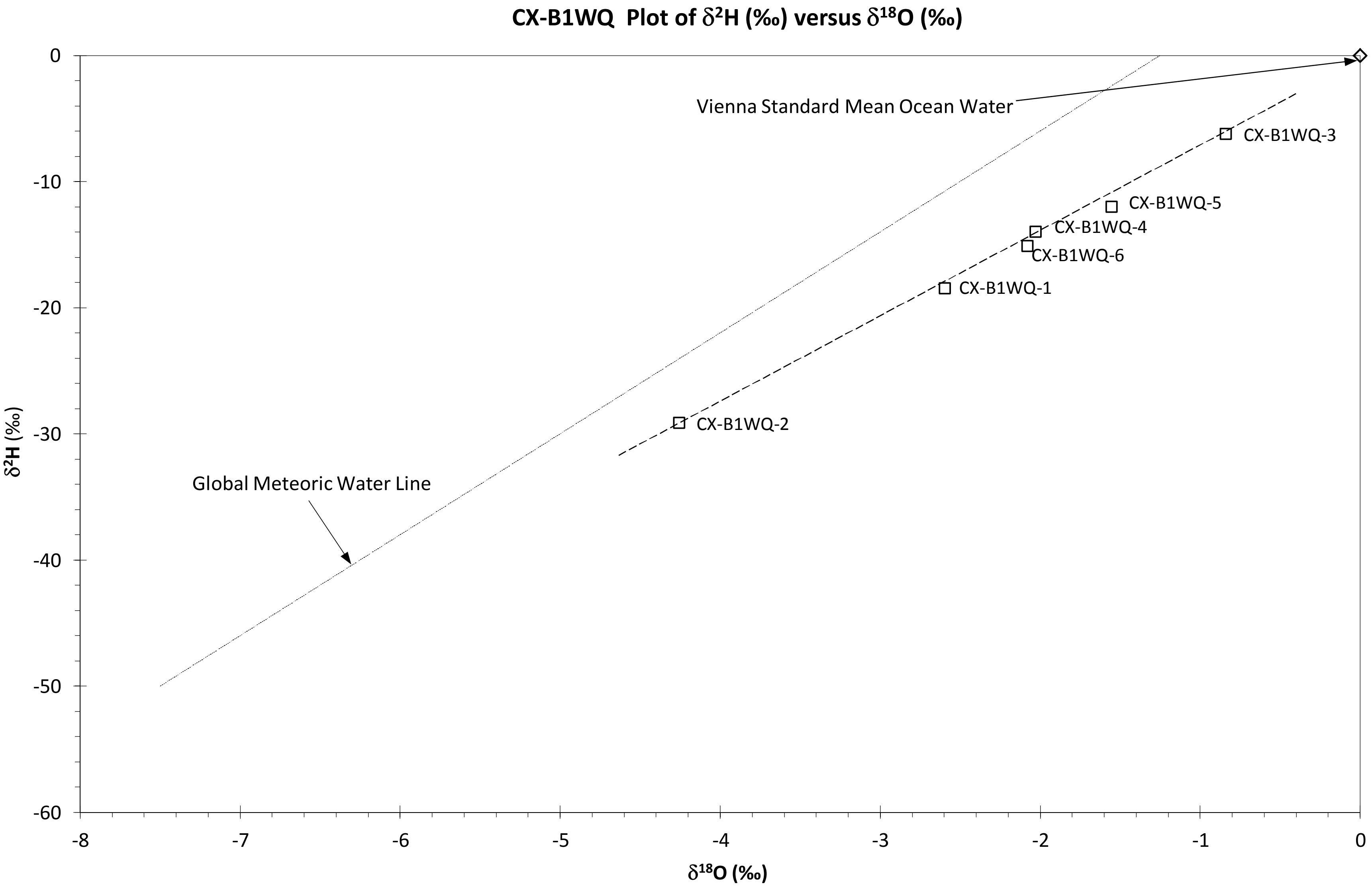

CX-B1WQ Plot of δ²H (‰) versus δ¹⁸O (‰)
Vienna Standard Mean Ocean Water
CX-B1WQ-3
CX-B1WQ-5
CX-B1WQ-4
CX-B1WQ-6
CX-B1WQ-1
CX-B1WQ-2
Global Meteoric Water Line
δ²H (‰)
δ¹⁸O (‰)
0
-10
-20
-30
-40
-50
-60
-8
-7
-6
-5
-4
-3
-2
-1
0

Figure 26

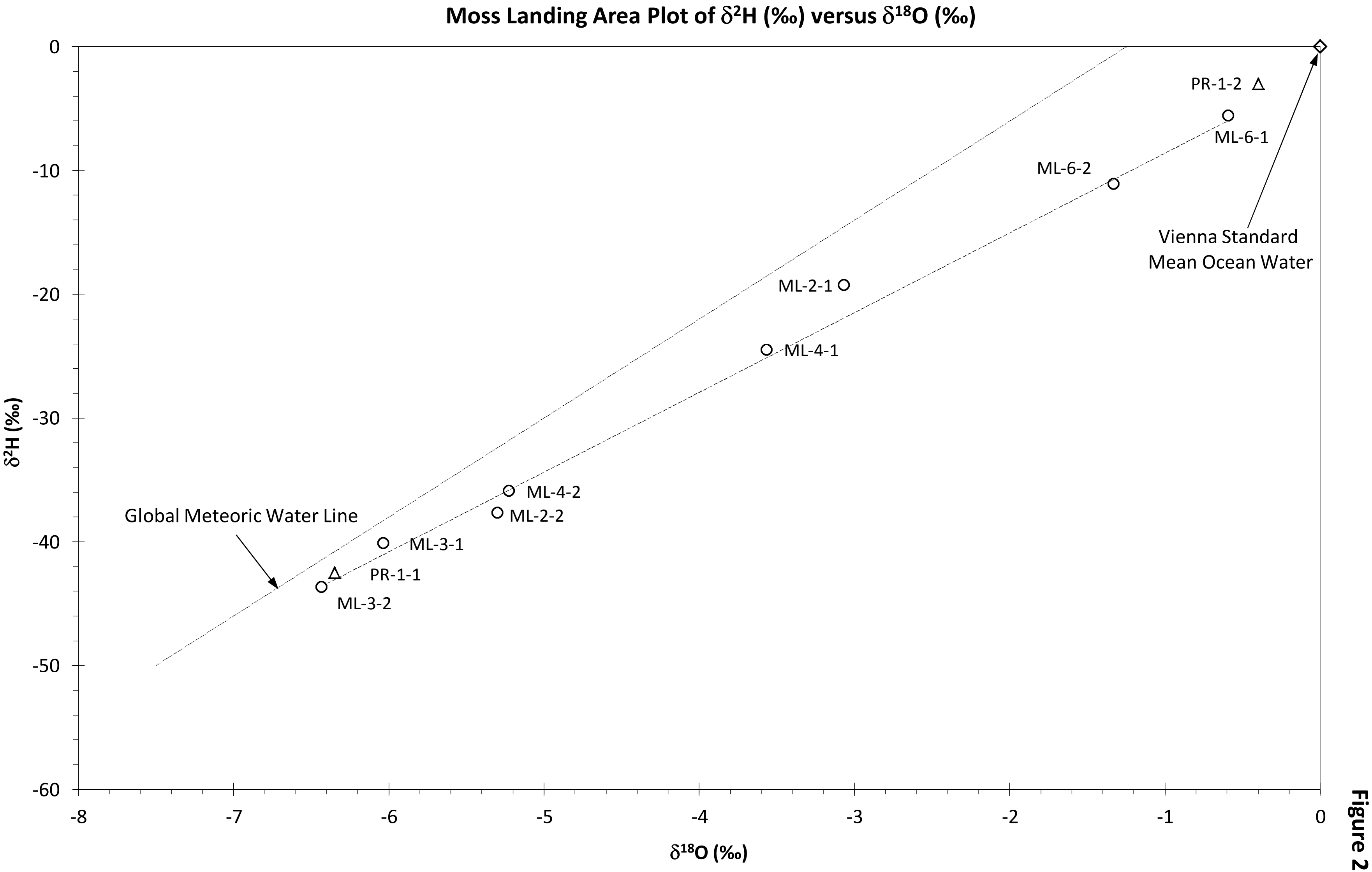
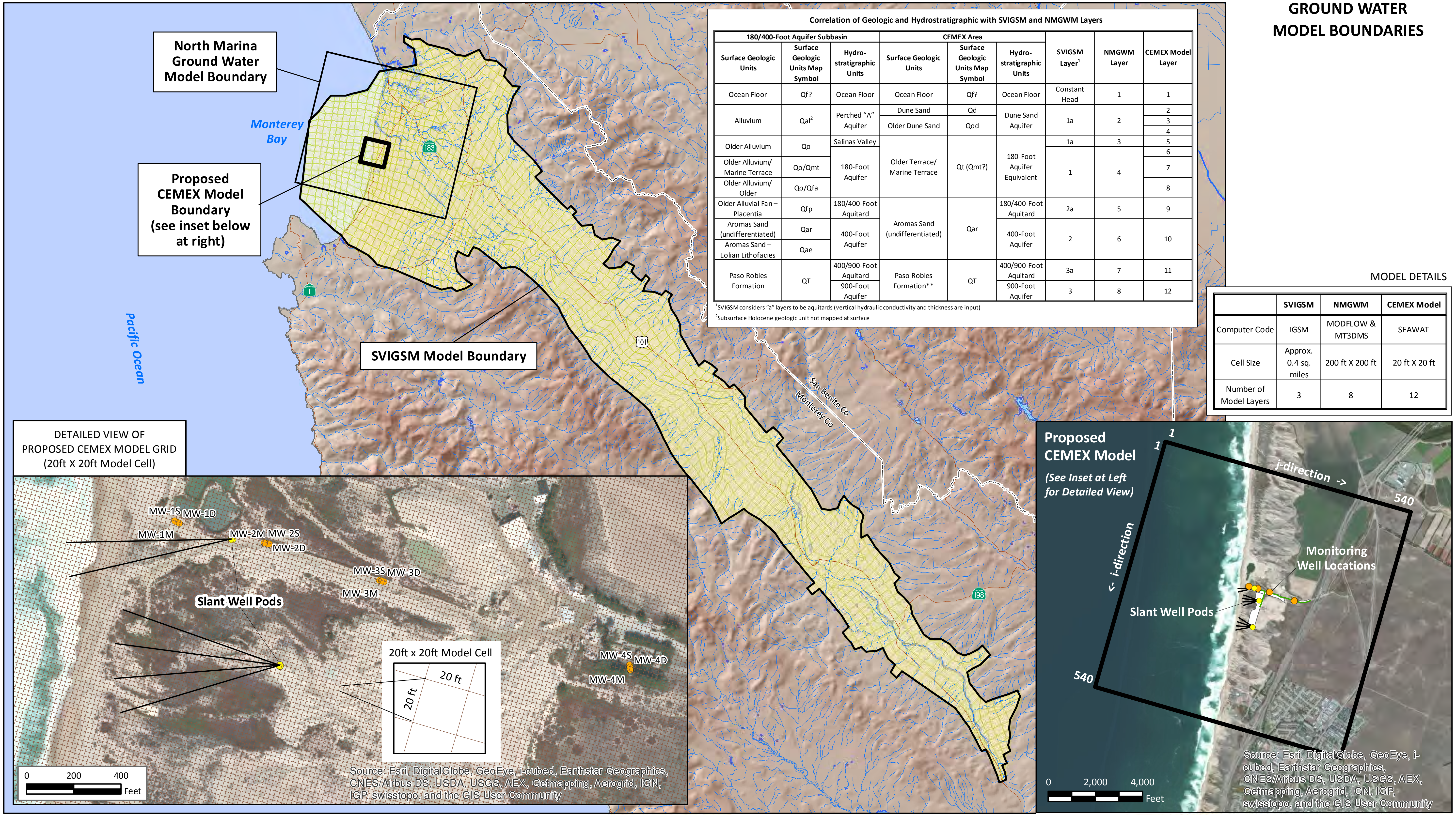

Moss Landing Area Plot of δ²H (‰) versus δ¹⁸O (‰)
δ²H (‰)
δ¹⁸O (‰)
0
-10
-20
-30
-40
-50
-60
-8
-7
-6
-5
-4
-3
-2
-1
0
PR-1-2
ML-6-1
ML-6-2
Vienna Standard Mean Ocean Water
ML-2-1
ML-4-1
ML-4-2
ML-2-2
Global Meteoric Water Line
ML-3-1
PR-1-1
ML-3-2

Figure 27

CALIFORNIA AMERICAN WATER & RBF CONSULTING

MONTEREY PENINSULA WATER SUPPLY PROJECT HYDROGEOLOGIC INVESTIGATION
ATTACHMENT 1 - TECHNICAL MEMORANDUM (TM 1) - SUMMARY OF RESULTS - EXPLORATORY BOREHOLES

GROUND WATER MODEL BOUNDARIES



Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Correlation of Geologic and Hydrostratigraphic with SVIGSM and NMGWM Layers

180/400-Foot Aquifer Subbasin			CEMEX Area					
Surface Geologic Units	**Surface Geologic Units Map Symbol**	**Hydro-stratigraphic Units**	**Surface Geologic Units**	**Surface Geologic Units Map Symbol**	**Hydro-stratigraphic Units**	**SVIGSM Layer[1]**	**NMGWM Layer**	**CEMEX Model Layer**
Ocean Floor	Qf?	Ocean Floor	Ocean Floor	Qf?	Ocean Floor	Constant Head	1	1
Alluvium	Qal[2]	Perched "A" Aquifer	Dune Sand	Qd	Dune Sand Aquifer	1a	2	2
			Older Dune Sand	Qod				3
								4
Older Alluvium	Qo	Salinas Valley	Older Terrace/ Marine Terrace	Qt (Qmt?)	180-Foot Aquifer Equivalent	1a	3	5
Older Alluvium/ Marine Terrace	Qo/Qmt	180-Foot Aquifer				1	4	6
Older Alluvium/ Older	Qo/Qfa							7
								8
Older Alluvial Fan – Placentia	Qfp	180/400-Foot Aquitard	Aromas Sand (undifferentiated)	Qar	180/400-Foot Aquitard	2a	5	9
Aromas Sand (undifferentiated)	Qar	400-Foot Aquifer			400-Foot Aquifer	2	6	10
Aromas Sand – Eolian Lithofacies	Qae							
Paso Robles Formation	QT	400/900-Foot Aquitard	Paso Robles Formation**	QT	400/900-Foot Aquitard	3a	7	11
		900-Foot Aquifer			900-Foot Aquifer	3	8	12

[1] SVIGSM considers "a" layers to be aquitards (vertical hydraulic conductivity and thickness are input)

[2] Subsurface Holocene geologic unit not mapped at surface

MODEL DETAILS

	SVIGSM	**NMGWM**	**CEMEX Model**
Computer Code	IGSM	MODFLOW & MT3DMS	SEAWAT
Cell Size	Approx. 0.4 sq. miles	200 ft X 200 ft	20 ft X 20 ft
Number of Model Layers	3	8	12

8-Jul-14

Prepared by: DWB. Map Projection: State Plane 1983, Zone IV.

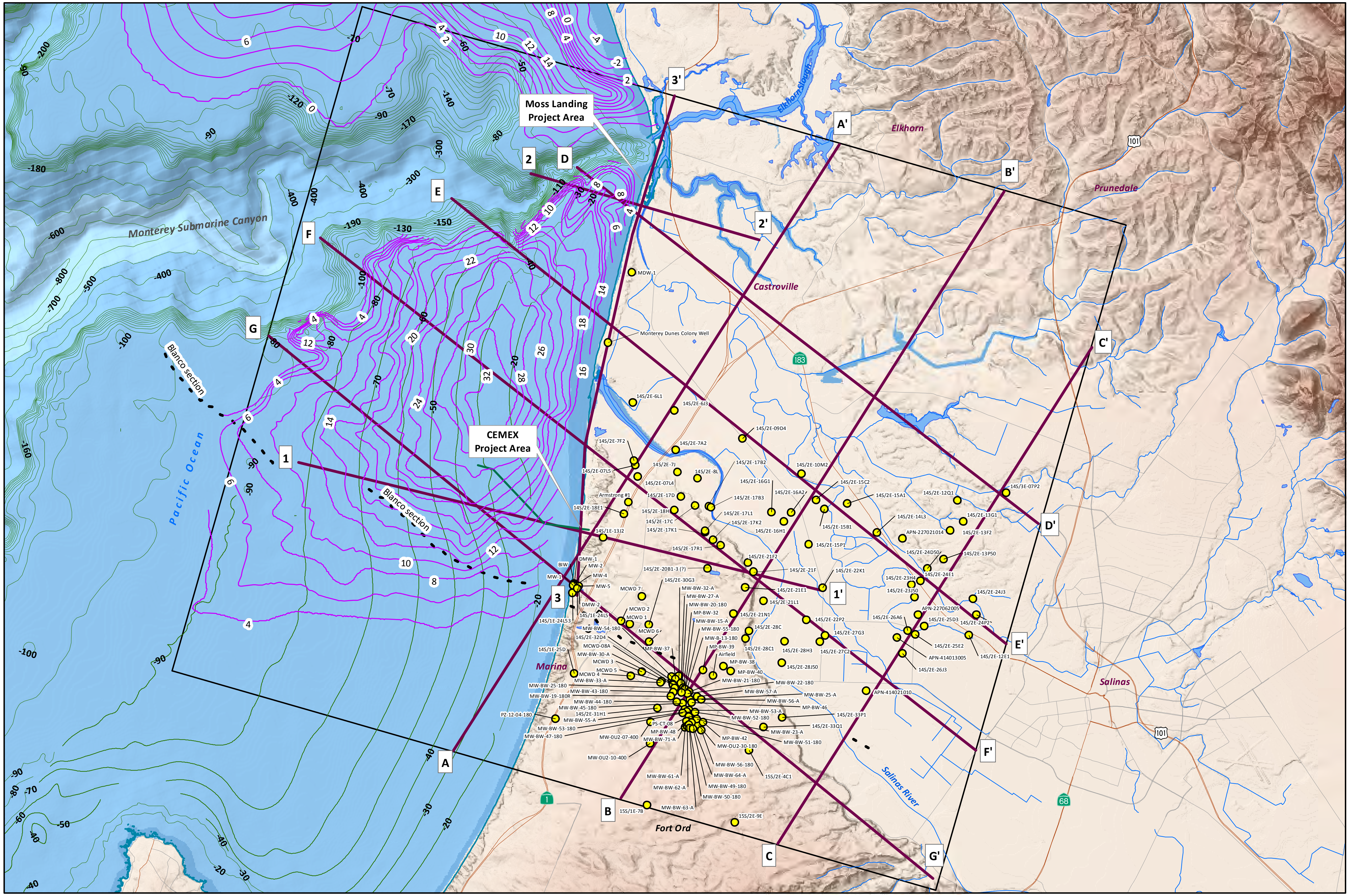
GEOSCIENCE
GEOSCIENCE Support Services, Inc.
P.O. Box 220, Claremont, CA 91711
Tel: (909) 451-6650 Fax: (909) 451-6638
www.gssiwater.com

Figure 28

GIS_proj/mcwsp_cal_am/rbf_boring_tech_memo_7-14/4_Fig_28_model_bndys_7-14.mxd

CALIFORNIA AMERICAN WATER & RBF CONSULTING

MONTEREY PENINSULA WATER SUPPLY PROJECT HYDROGEOLOGIC INVESTIGATION
ATTACHMENT 1 - TECHNICAL MEMORANDUM (TM 1) - SUMMARY OF RESULTS - EXPLORATORY BOREHOLES



WELL AND CROSS-SECTION LOCATIONS

EXPLANATION

●	Well Location
1 1'	Cross-Section Location (See Figures 7-9 and 30-36)
	Holocene Sediment Thickness (meters) Source (USGS OFR 01-179)
- - -	Fault - Blanco Section of the Reliz Fault (Source: USGS SIM 3059)
	Pipeline Outfall
☐	North Marina Groundwater Model Boundary
-10	Elevation of Sea Floor, meters (Wong, F.L. and Eittreim, S.L., 2001)
	Mean High Tide (DOC et al., 2011)

8-Jul-14

Prepared by: DWB. Map Projection: State Plane 1983, Zone IV.

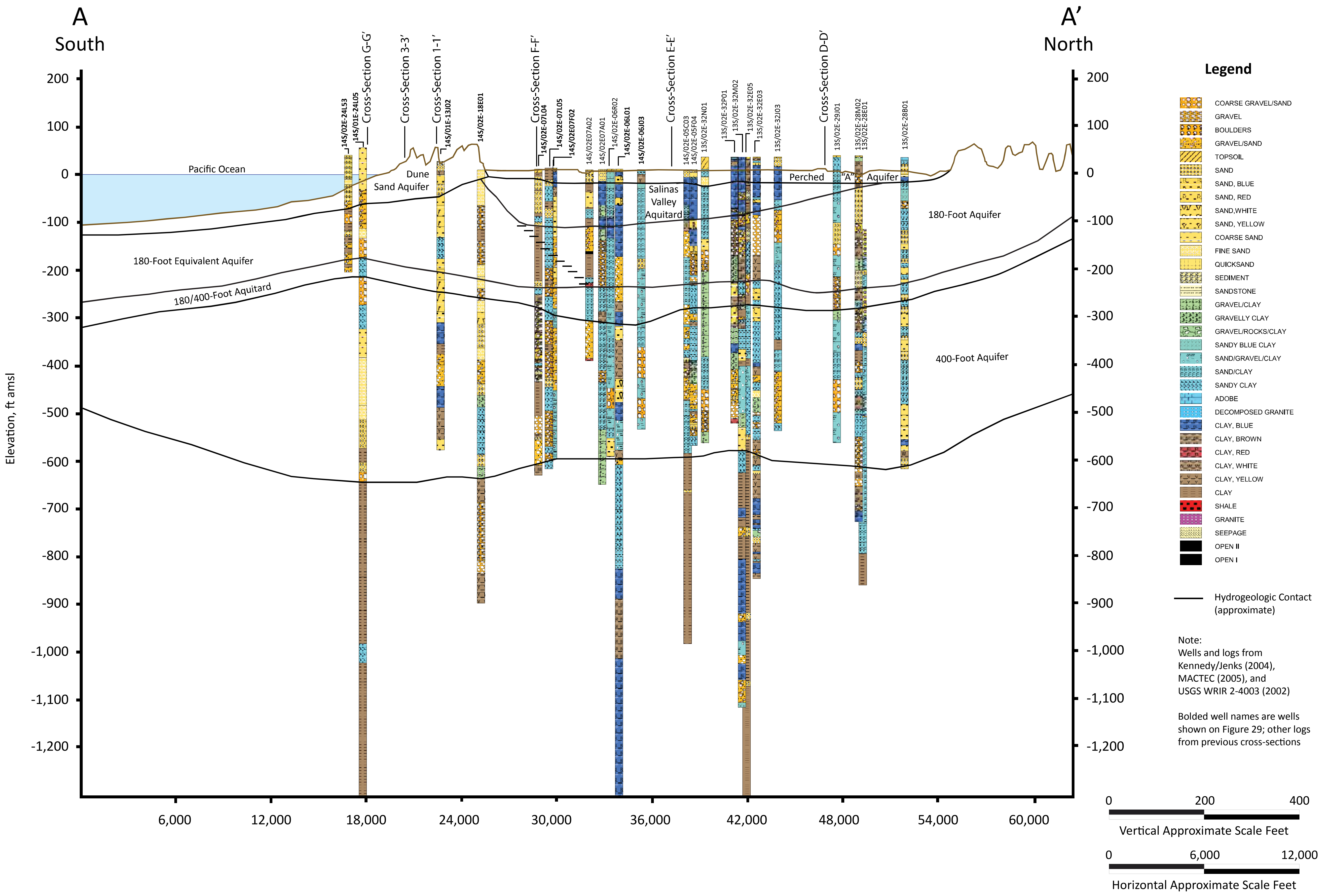
NORTH

0 2 4
Miles

GEOSCIENCE
GEOSCIENCE Support Services, Inc.
P.O. Box 220, Claremont, CA 91711
Tel: (909) 451-6650 Fax: (909) 451-6638
www.gssiwater.com

Figure 29

GIS_proj/mcwsp_cal_am/rbf_boring_tech_memo_7-14/4_Fig_29_wells_and_x-secs_7-14.mxd



Note:
Wells and logs from
Kennedy/Jenks (2004),
MACTEC (2005), and
USGS WRIR 2-4003 (2002)

Bolded well names are wells
shown on Figure 29; other logs
from previous cross-sections

GEOSCIENCE
GEOSCIENCE Support Servicès, Incorporated
P.O. Box 220, Claremont, CA 91711
Tel: (909) 451-6650 Fax: (909) 451-6638
www.gssiwater.com

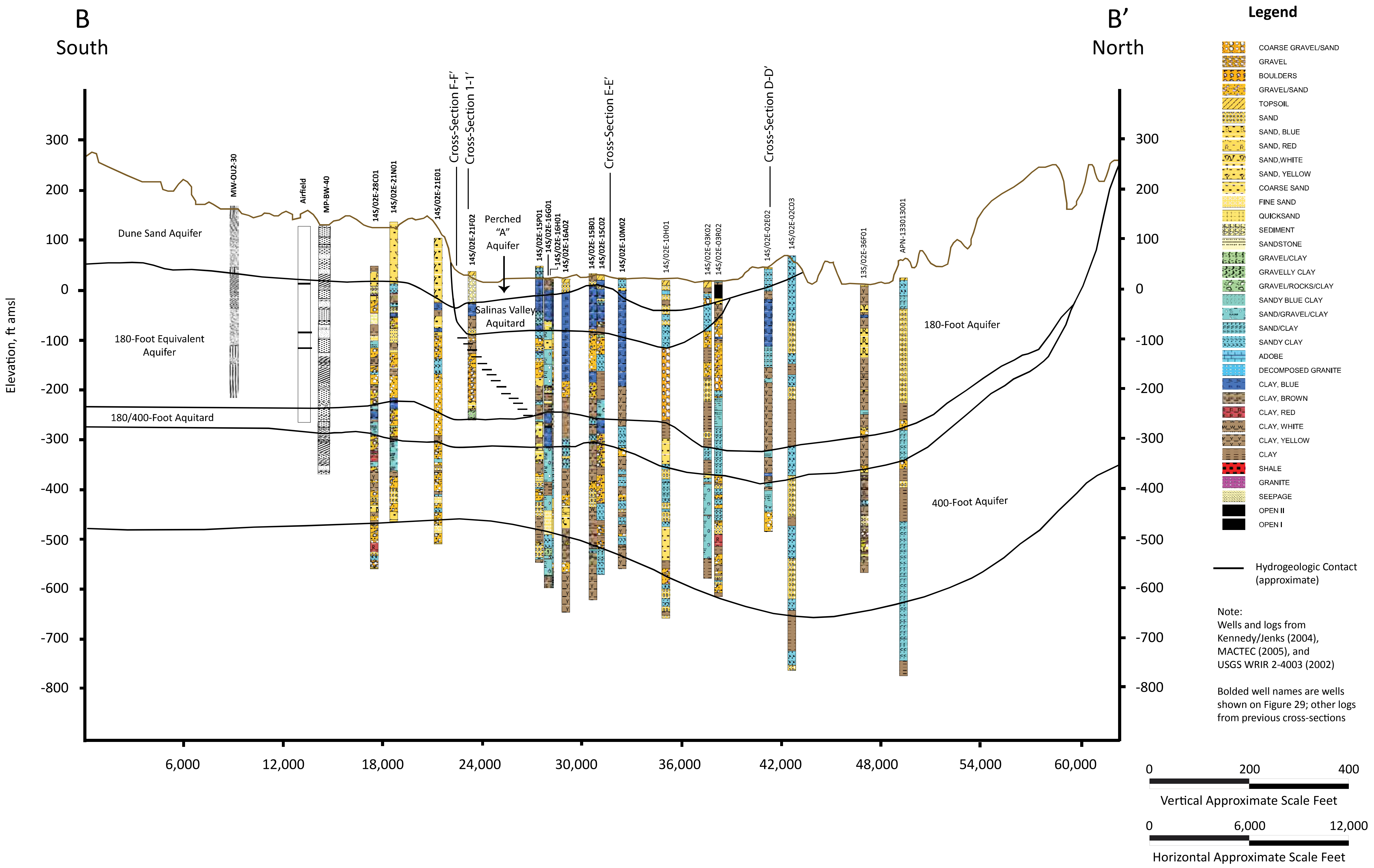
CALIFORNIA AMERICAN WATER & RBF CONSULTING

HYDROGEOLOGIC CROSS-SECTION A-A'

Drawn: TC
Checked:
Approved:
Date: 8-Jul-14

Figure 30

Projects\ESA_and_ESA-CalAm\01) MPWSP\11) Logs_x-sections\x-section_A-A'_scale_MW



Note:
Wells and logs from Kennedy/Jenks (2004), MACTEC (2005), and USGS WRIR 2-4003 (2002)

Bolded well names are wells shown on Figure 29; other logs from previous cross-sections

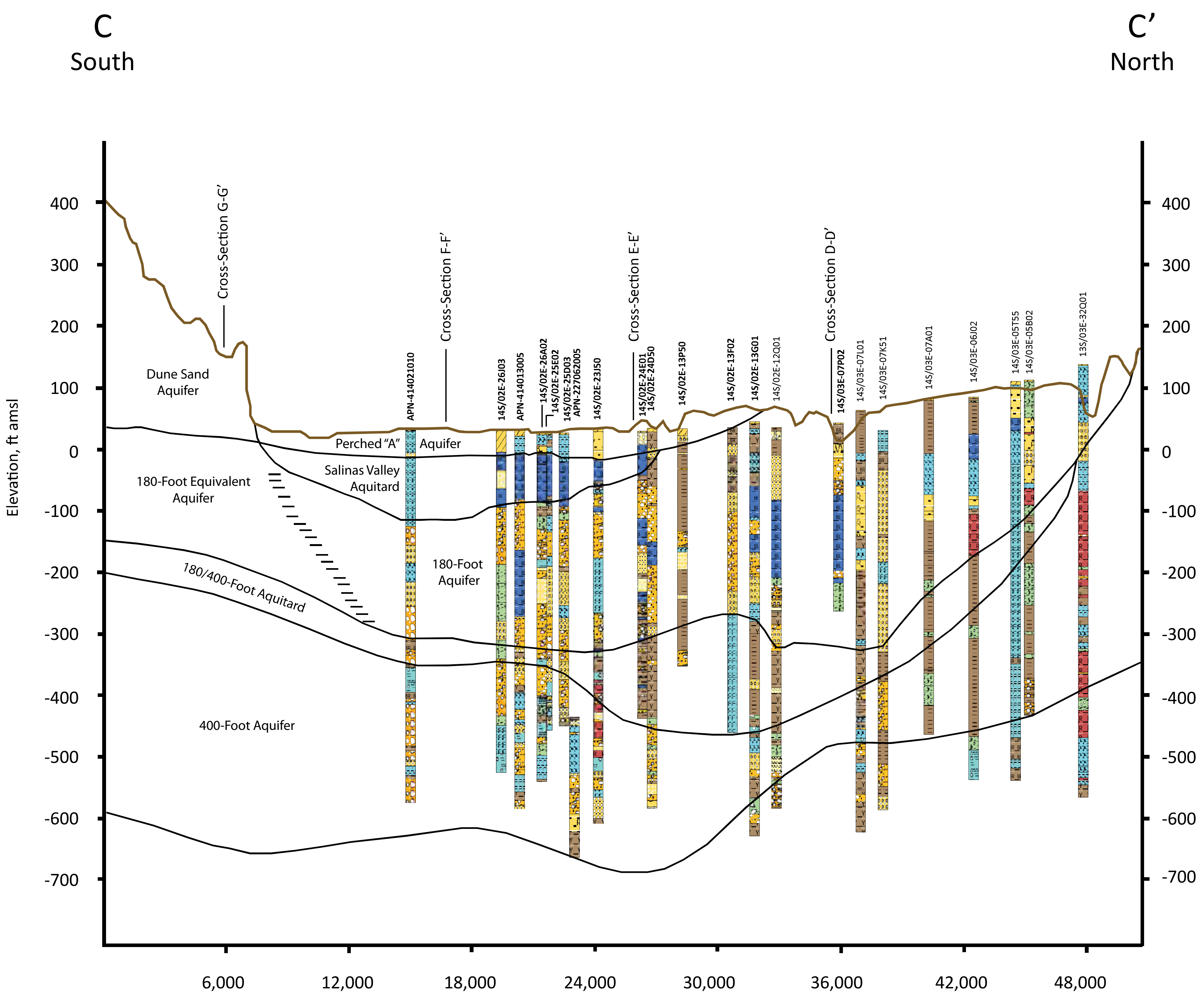
GEOSCIENCE Support Services, Incorporated
P.O. Box 220, Claremont, CA 91711
Tel: (909) 451-6650 Fax: (909) 451-6638
www.gssiwater.com

CALIFORNIA AMERICAN WATER & RBF CONSULTING

HYDROGEOLOGIC CROSS-SECTION B-B'

Drawn: TC
Checked:
Approved:
Date: 8-Jul-14

Figure 31



Legend

- COARSE GRAVEL/SAND
- GRAVEL
- BOULDERS
- GRAVEL/SAND
- TOPSOIL
- SAND
- SAND, BLUE
- SAND, RED
- SAND,WHITE
- SAND, YELLOW
- COARSE SAND
- FINE SAND
- QUICKSAND
- SEDIMENT
- SANDSTONE
- GRAVEL/CLAY
- GRAVELLY CLAY
- GRAVEL/ROCKS/CLAY
- SANDY BLUE CLAY
- SAND/GRAVEL/CLAY
- SAND/CLAY
- SANDY CLAY
- ADOBE
- DECOMPOSED GRANITE
- CLAY, BLUE
- CLAY, BROWN
- CLAY, RED
- CLAY, WHITE
- CLAY, YELLOW
- CLAY
- SHALE
- GRANITE
- SEEPAGE
- OPEN II
- OPEN I

Hydrogeologic Contact (approximate)

Note:
Wells and logs from
Kennedy/Jenks (2004),
MACTEC (2005), and
USGS WRIR 2-4003 (2002)

Bolded well names are wells
shown on Figure 29; other logs
from previous cross-sections

0 200 400
Vertical Approximate Scale Feet

0 6,000 12,000
Horizontal Approximate Scale Feet

GEOSCIENCE

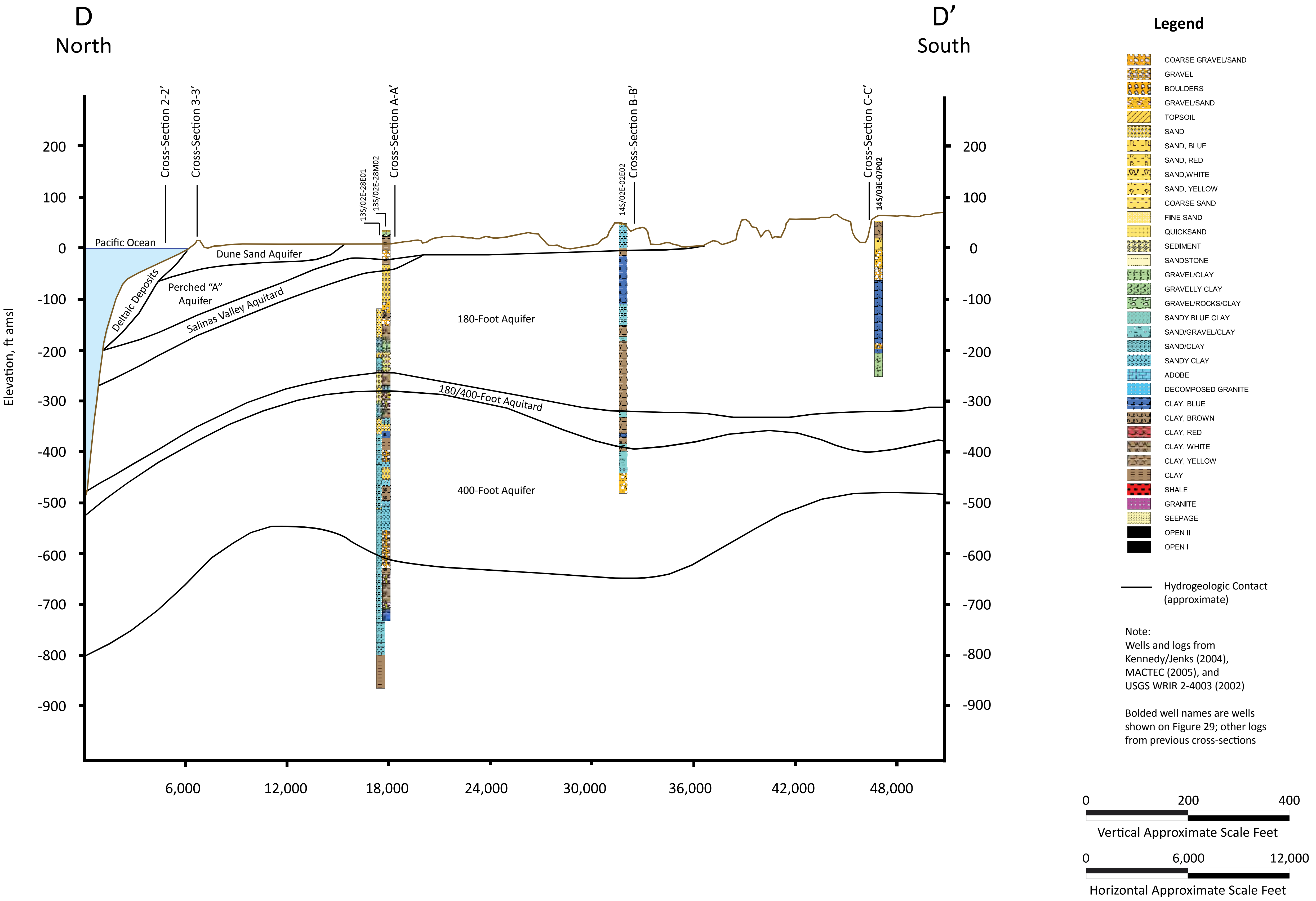
GEOSCIENCE Support Services, Incorporated
P.O. Box 220, Claremont, CA 91711
Tel: (909) 451-6650 Fax: (909) 451-6638
www.gssiwater.com

CALIFORNIA AMERICAN WATER & RBF CONSULTING

HYDROGEOLOGIC CROSS-SECTION C-C’

Drawn: TC
Checked:
Approved:
Date: 8-Jul-14

Figure 32



Note:
Wells and logs from
Kennedy/Jenks (2004),
MACTEC (2005), and
USGS WRIR 2-4003 (2002)

Bolded well names are wells
shown on Figure 29; other logs
from previous cross-sections

GEOSCIENCE

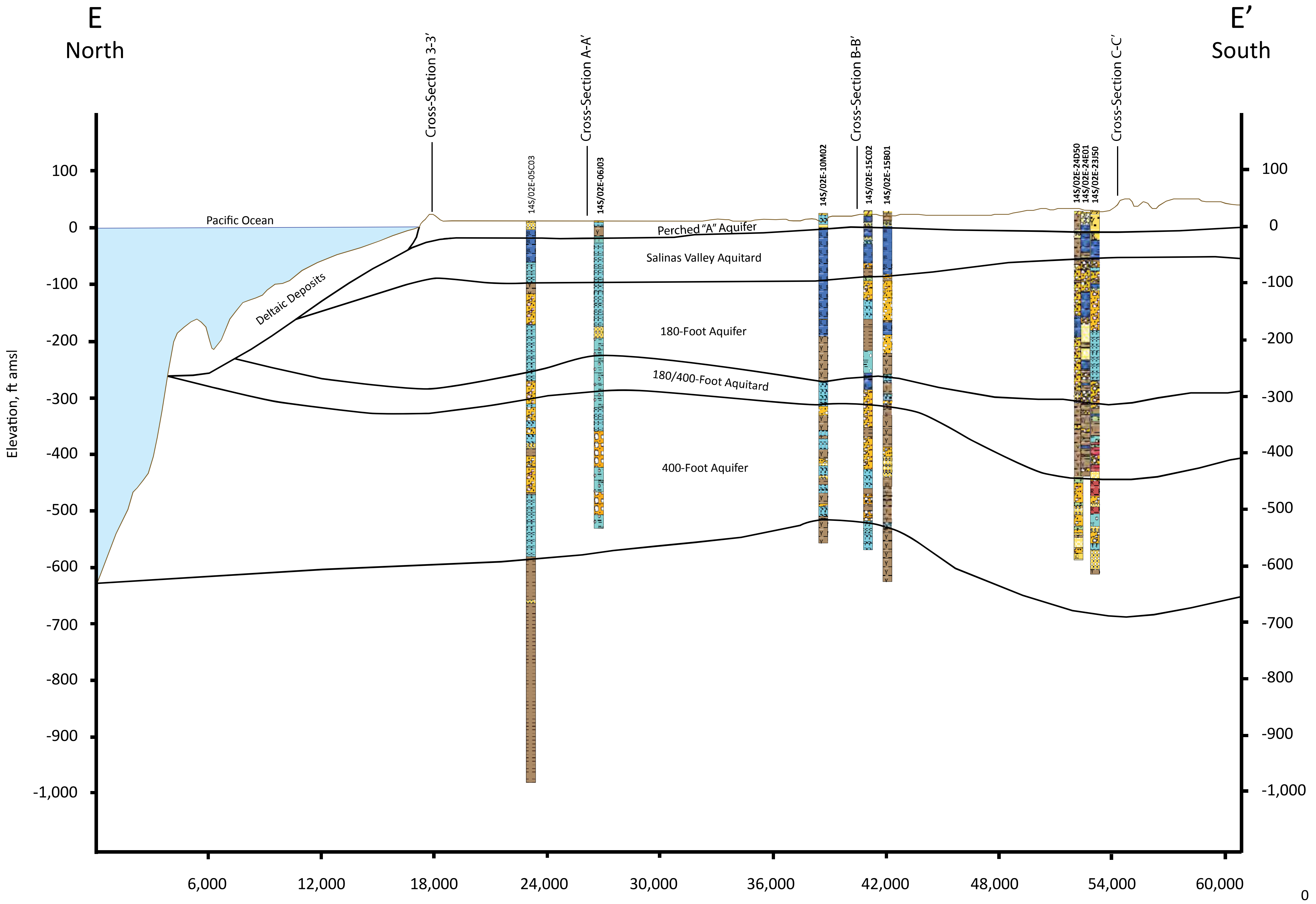
GEOSCIENCE Support Services, Incorporated
P.O. Box 220, Claremont, CA 91711
Tel: (909) 451-6650 Fax: (909) 451-6638
www.gssiwater.com

CALIFORNIA AMERICAN WATER & RBF CONSULTING

HYDROGEOLOGIC CROSS-SECTION D-D'

Drawn: TC
Checked:
Approved:
Date: 8-Jul-14

Figure 33



Legend

- ▨ COARSE GRAVEL/SAND
- ▨ GRAVEL
- ▨ BOULDERS
- ▨ GRAVEL/SAND
- ▨ TOPSOIL
- ▨ SAND
- ▨ SAND, BLUE
- ▨ SAND, RED
- ▨ SAND,WHITE
- ▨ SAND, YELLOW
- ▨ COARSE SAND
- ▨ FINE SAND
- ▨ QUICKSAND
- ▨ SEDIMENT
- ▨ SANDSTONE
- ▨ GRAVEL/CLAY
- ▨ GRAVELLY CLAY
- ▨ GRAVEL/ROCKS/CLAY
- ▨ SANDY BLUE CLAY
- ▨ SAND/GRAVEL/CLAY
- ▨ SAND/CLAY
- ▨ SANDY CLAY
- ▨ ADOBE
- ▨ DECOMPOSED GRANITE
- ▨ CLAY, BLUE
- ▨ CLAY, BROWN
- ▨ CLAY, RED
- ▨ CLAY, WHITE
- ▨ CLAY, YELLOW
- ▨ CLAY
- ▨ SHALE
- ▨ GRANITE
- ▨ SEEPAGE
- ■ OPEN II
- ■ OPEN I

— Hydrogeologic Contact (approximate)

Note:
Wells and logs from
Kennedy/Jenks (2004),
MACTEC (2005), and
USGS WRIR 2-4003 (2002)

Bolded well names are wells
shown on Figure 29; other logs
from previous cross-sections

0 200 400
Vertical Approximate Scale Feet

0 6,000 12,000
Horizontal Approximate Scale Feet

GEOSCIENCE Support Services, Incorporated
P.O. Box 220, Claremont, CA 91711
Tel: (909) 451-6650 Fax: (909) 451-6638
www.gssiwater.com

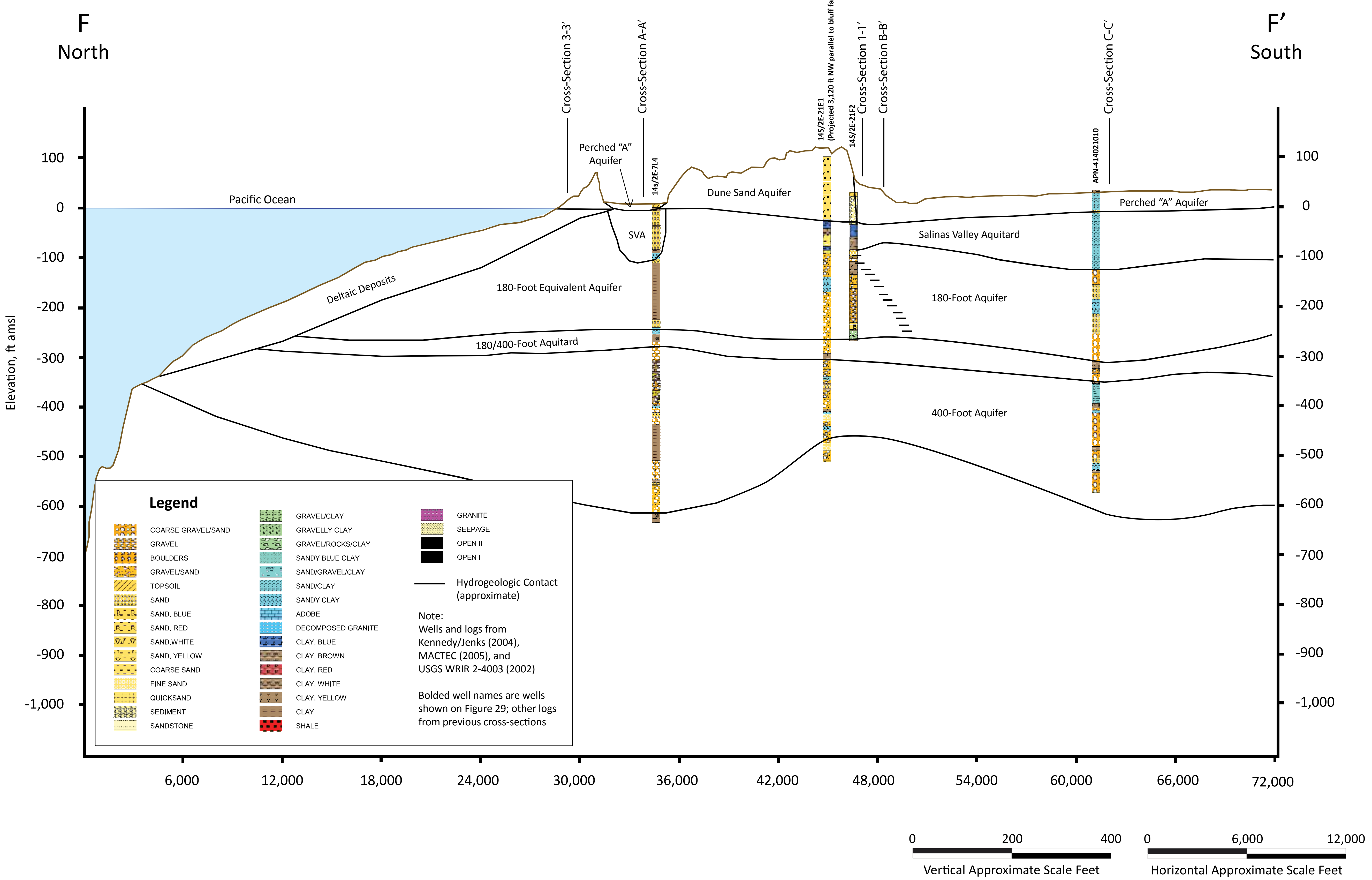
CALIFORNIA AMERICAN WATER & RBF CONSULTING

HYDROGEOLOGIC CROSS-SECTION E-E'

Drawn: TC
Checked:
Approved:
Date: 8-Jul-14

Figure 34

Projects\ESA_and_ESA-CalAm\01) MPWSP\11) Logs_x-sections\x-section_E-E'_rev



Note:
Wells and logs from Kennedy/Jenks (2004), MACTEC (2005), and USGS WRIR 2-4003 (2002)

Bolded well names are wells shown on Figure 29; other logs from previous cross-sections

GEOSCIENCE Support Services, Incorporated
P.O. Box 220, Claremont, CA 91711
Tel: (909) 451-6650 Fax: (909) 451-6638
www.gssiwater.com

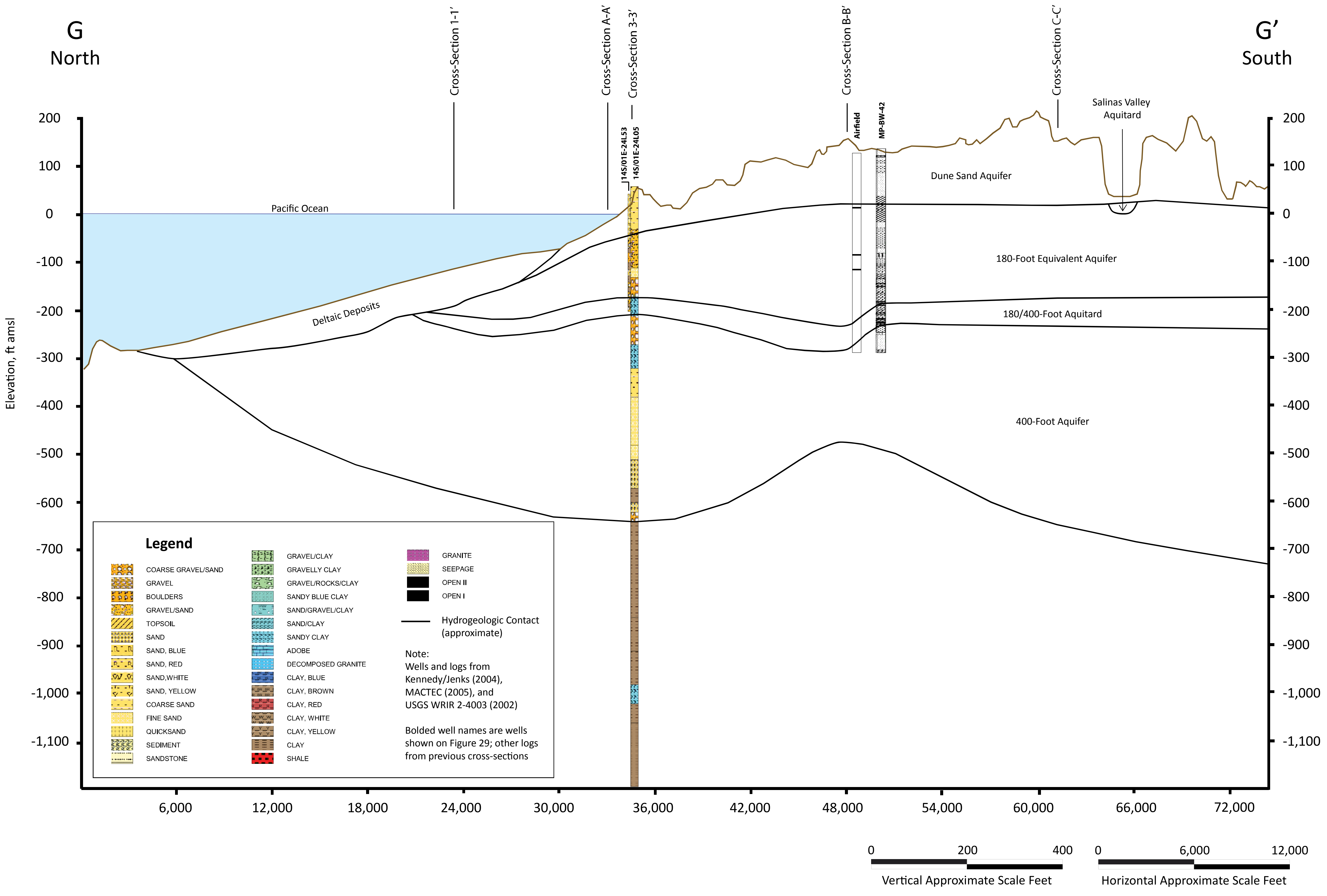
CALIFORNIA AMERICAN WATER & RBF CONSULTING

HYDROGEOLOGIC CROSS-SECTION F-F'

Drawn: TC
Checked:
Approved:
Date: 8-Jul-14

Figure 35

Projects\ESA_and_ESA-CalAm\01) MPWSP\11) Logs_x-sections\x-section_F-F'_rev



Note:
Wells and logs from
Kennedy/Jenks (2004),
MACTEC (2005), and
USGS WRIR 2-4003 (2002)

Bolded well names are wells
shown on Figure 29; other logs
from previous cross-sections

GEOSCIENCE
GEOSCIENCE Support Services, Incorporated
P.O. Box 220, Claremont, CA 91711
Tel: (909) 451-6650 Fax: (909) 451-6638
www.gssiwater.com

CALIFORNIA AMERICAN WATER & RBF CONSULTING

HYDROGEOLOGIC CROSS-SECTION G-G’

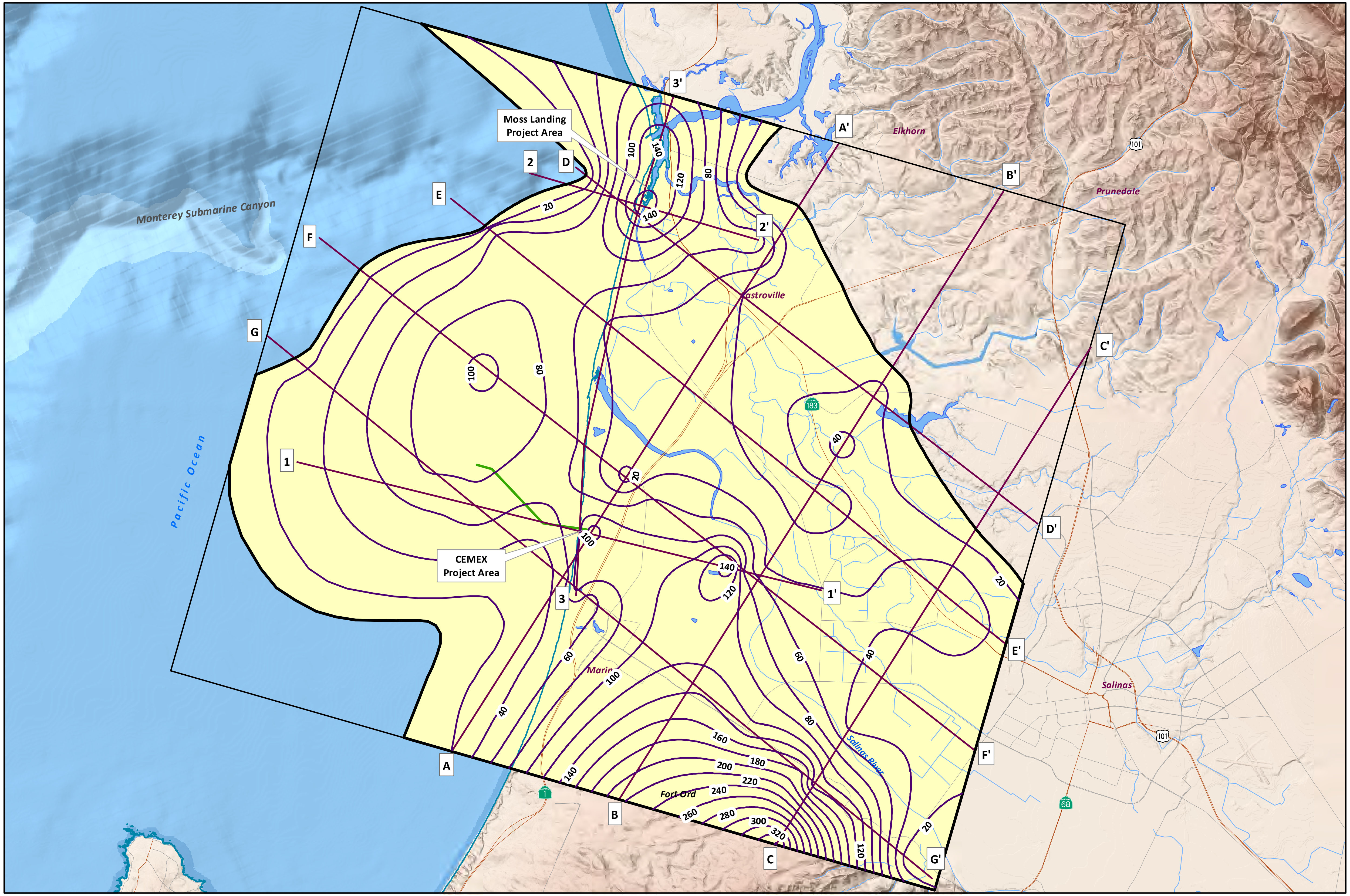
Drawn: TC
Checked:
Approved:
Date: 8-Jul-14

Figure 36

CALIFORNIA AMERICAN WATER & RBF CONSULTING

MONTEREY PENINSULA WATER SUPPLY PROJECT HYDROGEOLOGIC INVESTIGATION
ATTACHMENT 1 - TECHNICAL MEMORANDUM (TM 1) - SUMMARY OF RESULTS - EXPLORATORY BOREHOLES

THICKNESS OF DUNE SAND, PERCHED "A", AND DELTAIC DEPOSIT AQUIFERS (MODEL LAYER 2)



EXPLANATION

🟨	Boundary of Dune Sand, Perched "A", and Deltaic Deposit Aquifers
20	Aquifer Thickness (ft)
1 1'	Cross-Section Location (See Figures 7-9 and 30-36)
	Pipeline Outfall
☐	North Marina Groundwater Model Boundary
	Mean High Tide (DOC et al., 2011)

NORTH

0 2 4 Miles

8-Jul-14

Prepared by: DWB. Map Projection: State Plane 1983, Zone IV.

GEOSCIENCE
GEOSCIENCE Support Services, Inc.
P.O. Box 220, Claremont, CA 91711
Tel: (909) 451-6650 Fax: (909) 451-6638
www.gssiwater.com

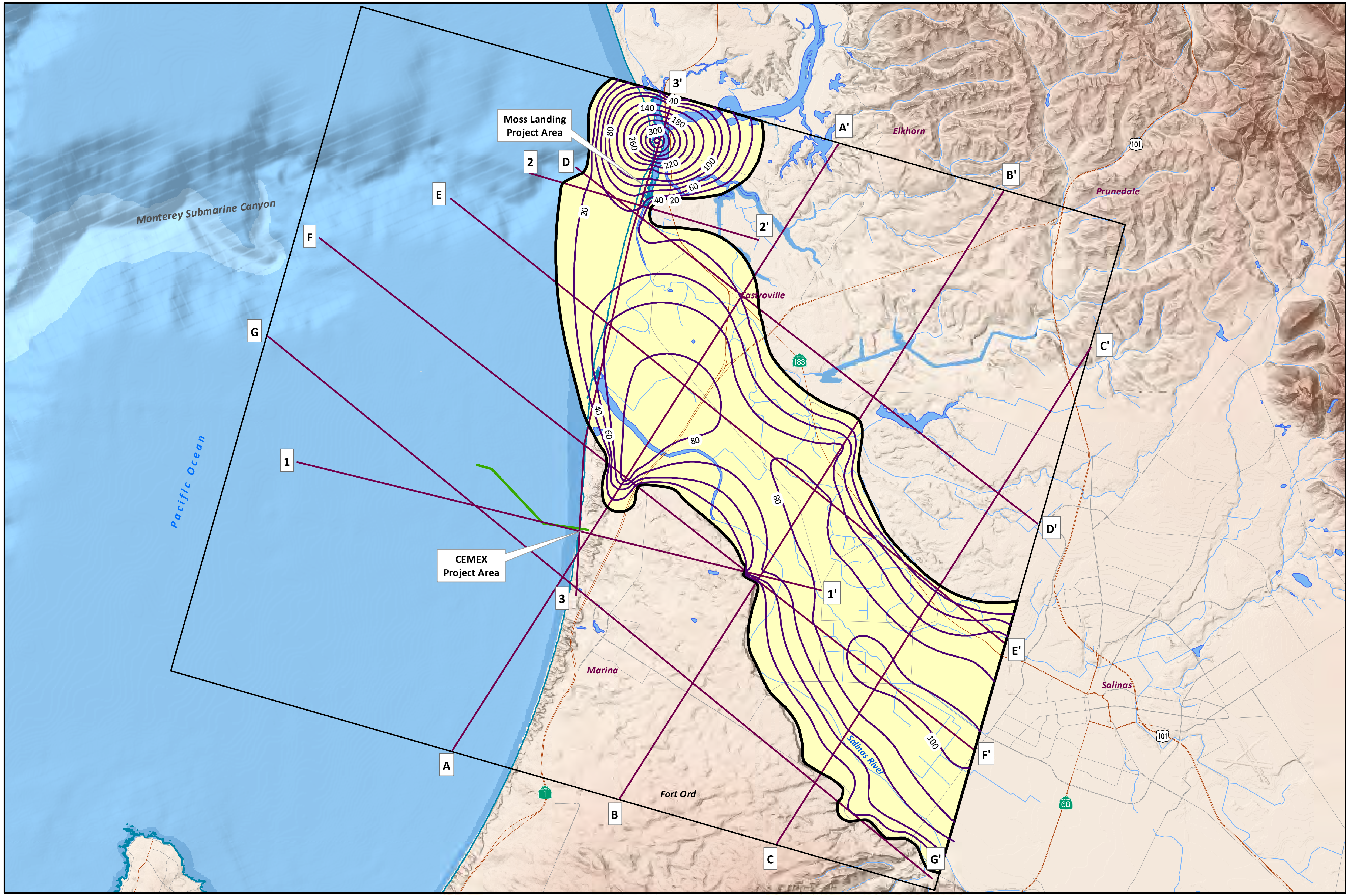
Figure 37

GIS_proj/mcwsp_cal_am/rbf_boring_tech_memo_7-14/4_Fig_37_layer2_Thickness_7-14.mxd

CALIFORNIA AMERICAN WATER & RBF CONSULTING

MONTEREY PENINSULA WATER SUPPLY PROJECT HYDROGEOLOGIC INVESTIGATION
ATTACHMENT 1 - TECHNICAL MEMORANDUM (TM 1) - SUMMARY OF RESULTS - EXPLORATORY BOREHOLES

THICKNESS OF SALINAS VALLEY AQUITARD (MODEL LAYER 3)



EXPLANATION

Boundary of Salinas Valley Aquitard

20 Aquitard Thickness (ft)

1 1' Cross-Section Location (See Figures 7-9 and 30-36)

Pipeline Outfall

North Marina Groundwater Model Boundary

Mean High Tide (DOC et al., 2011)

NORTH

0 2 4 Miles

8-Jul-14

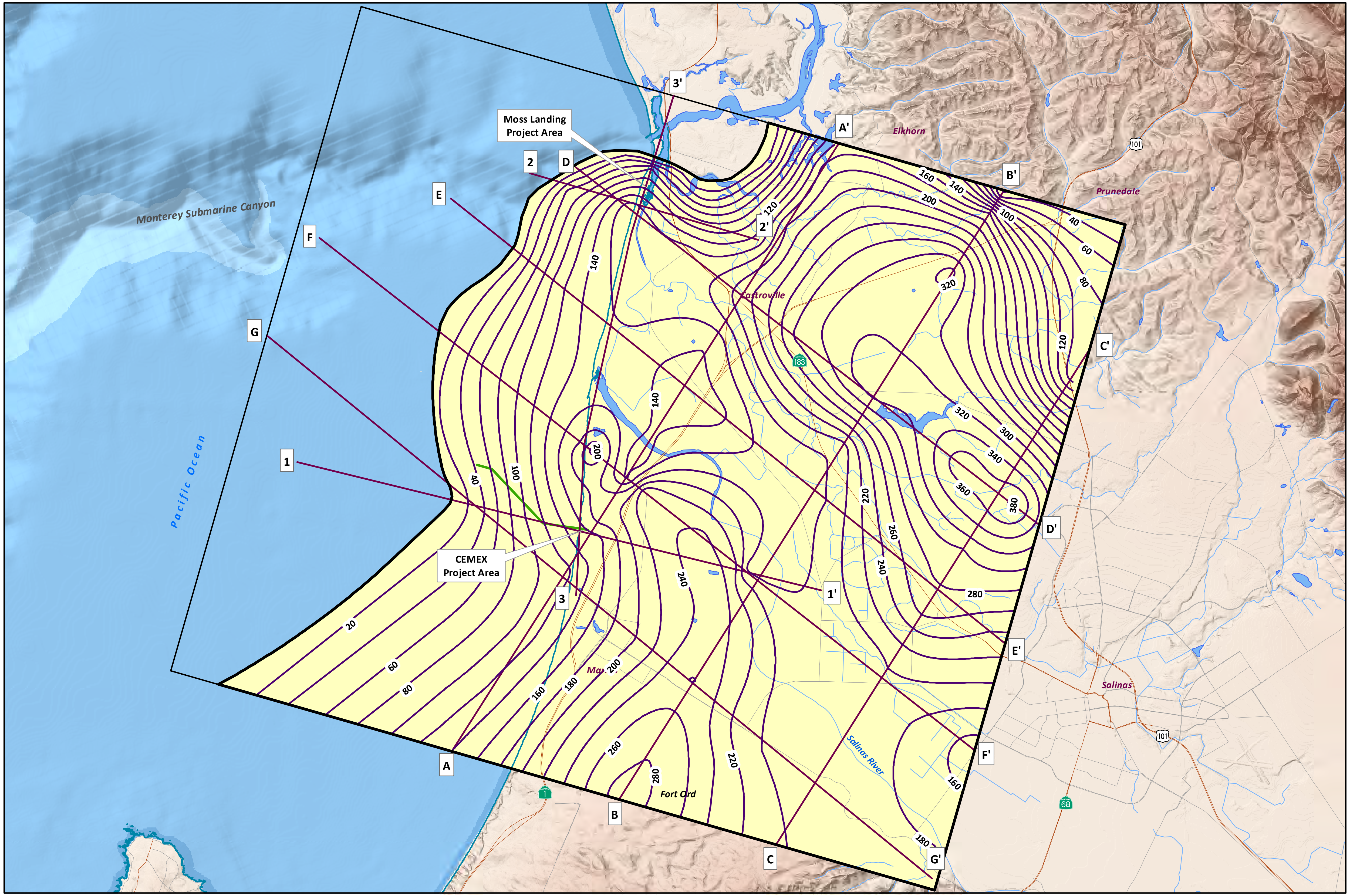
Prepared by: DWB. Map Projection: State Plane 1983, Zone IV.

GEOSCIENCE
GEOSCIENCE Support Services, Inc.
P.O. Box 220, Claremont, CA 91711
Tel: (909) 451-6650 Fax: (909) 451-6638
www.gssiwater.com

Figure 38

GIS_proj/mcwsp_cal_am/rbf_boring_tech_memo_7-14/4_Fig_38_layer3_Thickness_7-14.mxd

THICKNESS OF 180-FOOT AND 180-FOOT EQIVALENT AQUIFERS (MODEL LAYER 4)



EXPLANATION

▭	Boundary of 180-Foot and 180-Foot Equivalent Aquifers
—20—	Aquifer Thickness (ft)
1 1'	Cross-Section Location (See Figures 7-9 and 30-36)
—	Pipeline Outfall
▭	North Marina Groundwater Model Boundary
—	Mean High Tide (DOC et al., 2011)

8-Jul-14

Prepared by: DWB. Map Projection: State Plane 1983, Zone IV.

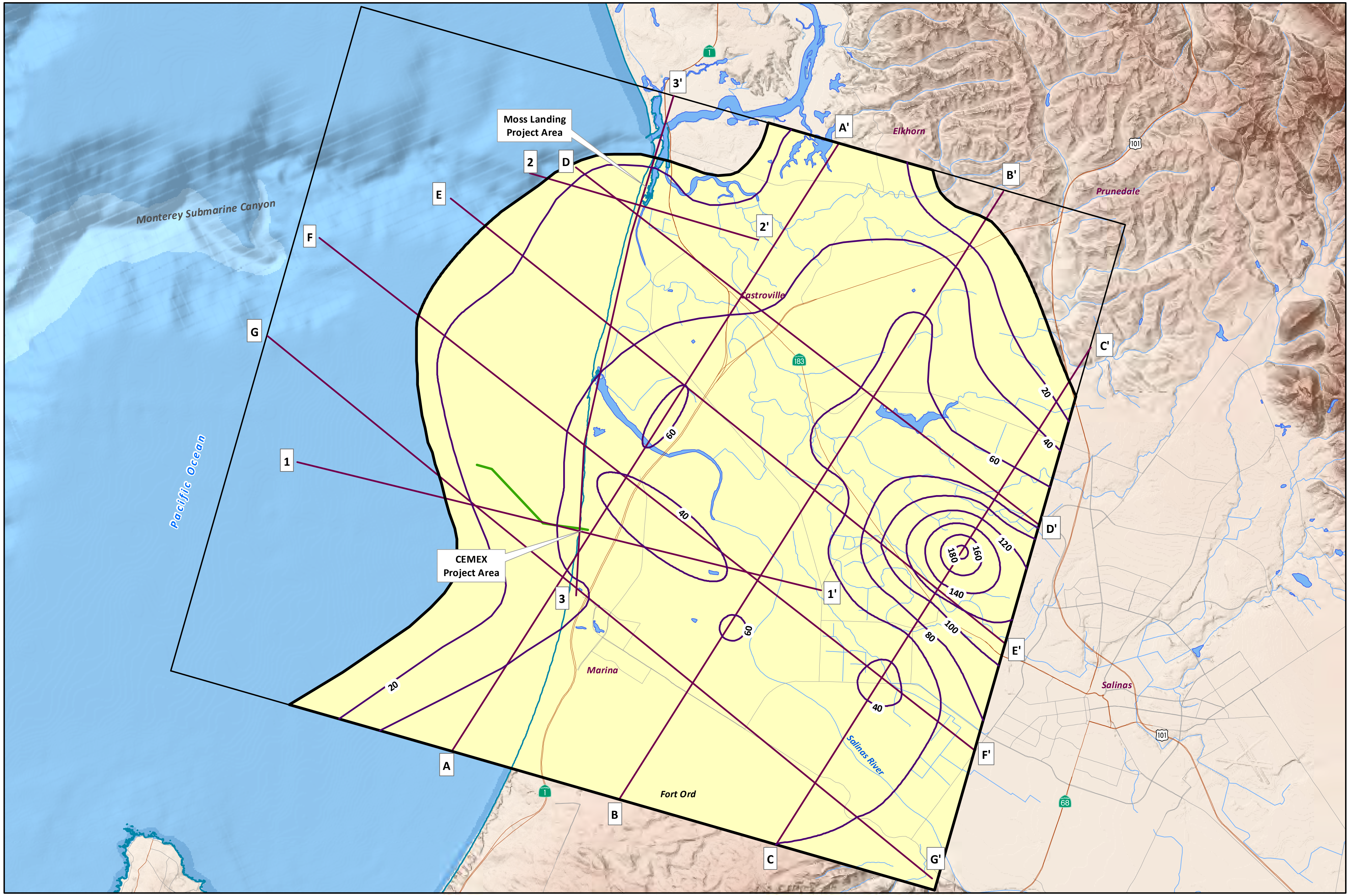
NORTH

0 2 4 Miles

GEOSCIENCE
GEOSCIENCE Support Services, Inc.
P.O. Box 220, Claremont, CA 91711
Tel: (909) 451-6650 Fax: (909) 451-6638
www.gssiwater.com

Figure 39

THICKNESS OF 180/400-FOOT AQUITARD (MODEL LAYER 5)



EXPLANATION

▭ Boundary of 180/480-Foot Aquitard

—20— Aquitard Thickness (ft)

1 1' Cross-Section Location (See Figures 7-9 and 30-36)

— Pipeline Outfall

▭ North Marina Groundwater Model Boundary

— Mean High Tide (DOC et al., 2011)

8-Jul-14

Prepared by: DWB. Map Projection: State Plane 1983, Zone IV.

NORTH

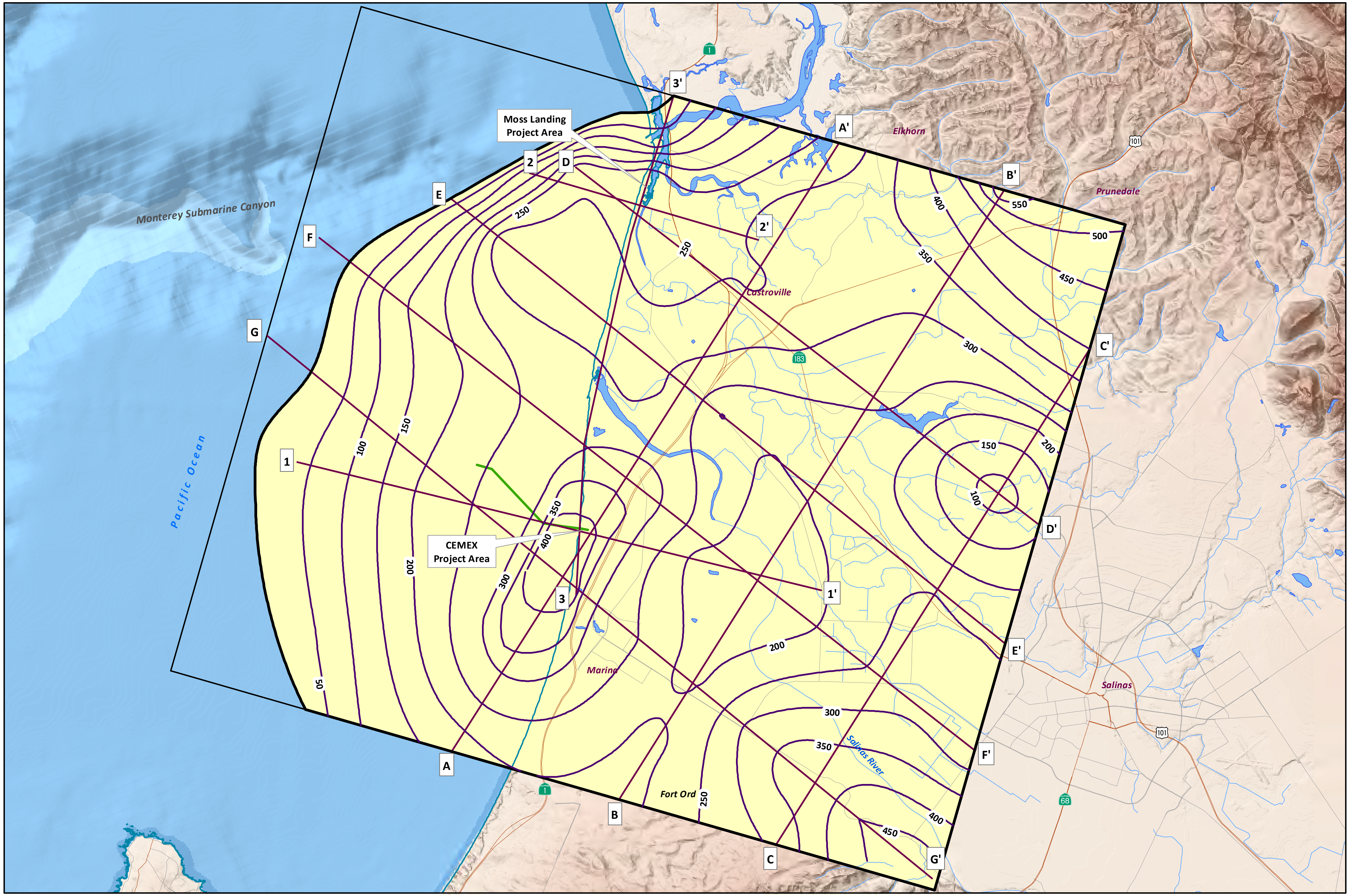
0 2 4
Miles

GEOSCIENCE
GEOSCIENCE Support Services, Inc.
P.O. Box 220, Claremont, CA 91711
Tel: (909) 451-6650 Fax: (909) 451-6638
www.gssiwater.com

Figure 40

GIS_proj/mcwsp_cal_am/rbf_boring_tech_memo_7-14/4_Fig_40_layer4_Thickness_7-14.mxd

THICKNESS OF 400-FOOT AQUIFER (MODEL LAYER 6)



EXPLANATION

▭ Boundary of 400-Foot Aquifer

— 20 — Aquifer Thickness (ft)

1 1' Cross-Section Location (See Figures 7-9 and 30-36)

— Pipeline Outfall

▭ North Marina Groundwater Model Boundary

— Mean High Tide (DOC et al., 2011)

8-Jul-14

Prepared by: DWB. Map Projection: State Plane 1983, Zone IV.

NORTH

0 2 4 Miles

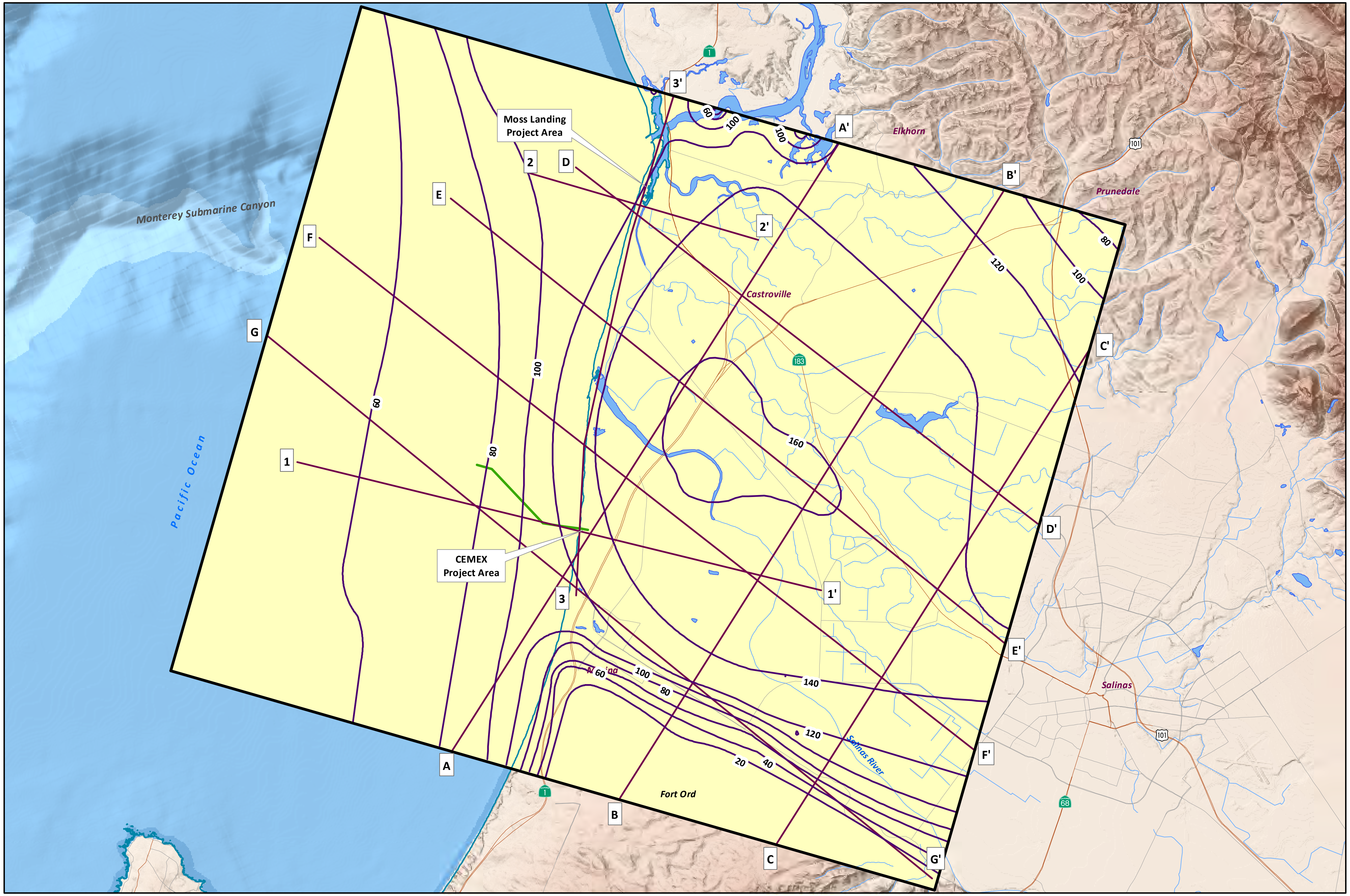
GEOSCIENCE
GEOSCIENCE Support Services, Inc.
P.O. Box 220, Claremont, CA 91711
Tel: (909) 451-6650 Fax: (909) 451-6638
www.gssiwater.com

Figure 41

CALIFORNIA AMERICAN WATER & RBF CONSULTING

MONTEREY PENINSULA WATER SUPPLY PROJECT HYDROGEOLOGIC INVESTIGATION
ATTACHMENT 1 - TECHNICAL MEMORANDUM (TM 1) - SUMMARY OF RESULTS - EXPLORATORY BOREHOLES

THICKNESS OF 400/900-FOOT AQUITARD (MODEL LAYER 7)



EXPLANATION

▭	Boundary of 400/900-Foot Aquitard and North Marina Groundwater Model Boundary
—20—	Aquitard Thickness (ft)
1 — 1'	Cross-Section Location (See Figures 7-9 and 30-36)
—	Pipeline Outfall
—	Mean High Tide (DOC et al., 2011)

8-Jul-14

Prepared by: DWB. Map Projection: State Plane 1983, Zone IV.

GEOSCIENCE Support Services, Inc.
P.O. Box 220, Claremont, CA 91711
Tel: (909) 451-6650 Fax: (909) 451-6638
www.gssiwater.com

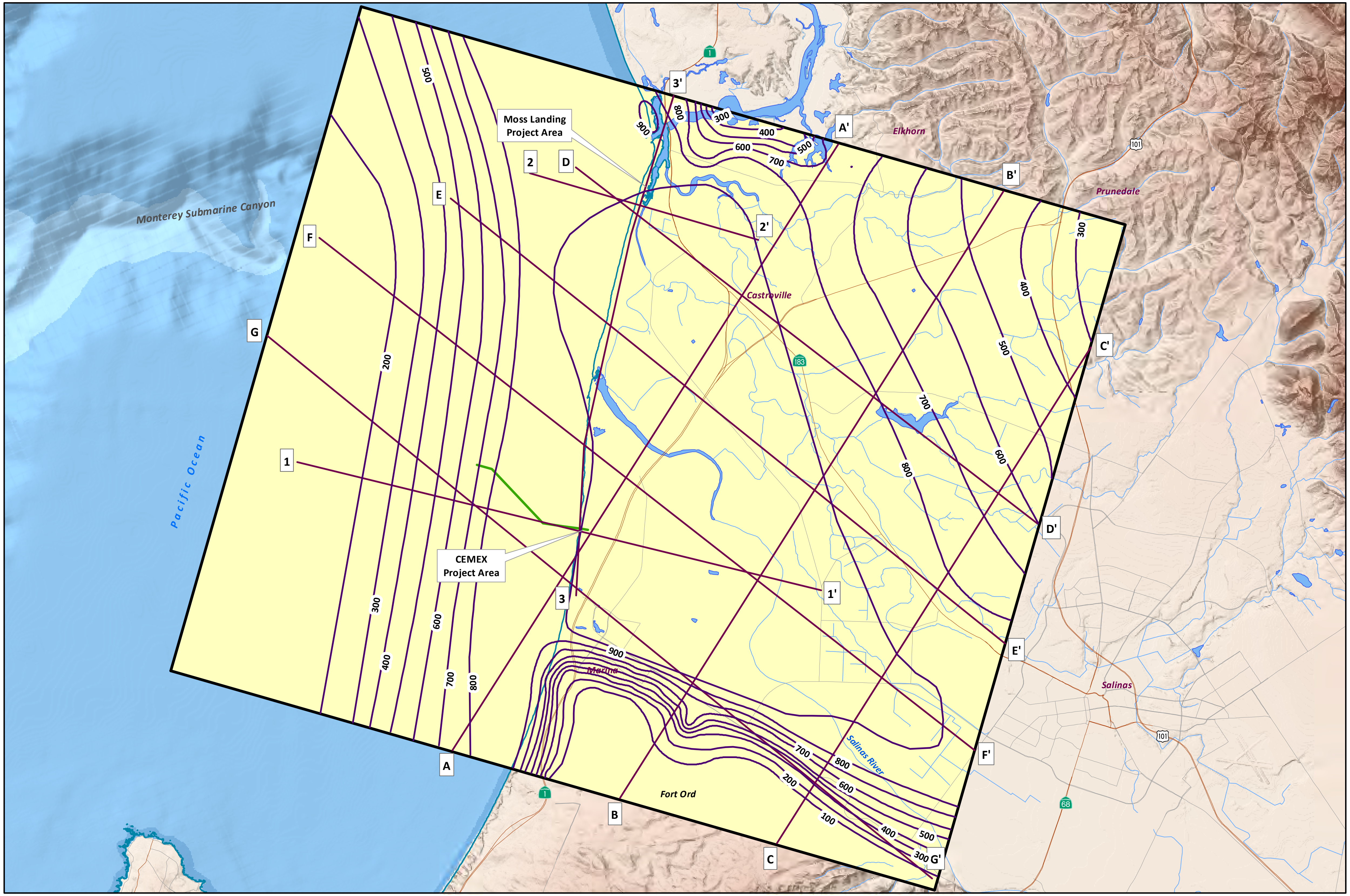
Figure 42

GIS_proj/mcwsp_cal_am/rbf_boring_tech_memo_7-14/4_Fig_42_layer7_Thickness_7-14.mxd

CALIFORNIA AMERICAN WATER & RBF CONSULTING

MONTEREY PENINSULA WATER SUPPLY PROJECT HYDROGEOLOGIC INVESTIGATION
ATTACHMENT 1 - TECHNICAL MEMORANDUM (TM 1) - SUMMARY OF RESULTS - EXPLORATORY BOREHOLES

THICKNESS OF 900-FOOT AQUIFER (MODEL LAYER 8)



EXPLANATION

▭	Boundary of 900-Foot Aquifer and North Marina Groundater Model Boundary
—20—	Aquifer Thickness (ft)
1 1'	Cross-Section Location (See Figures 7-9 and 30-36)
—	Pipeline Outfall
—	Mean High Tide (DOC et al., 2011)

NORTH

0 2 4 Miles

8-Jul-14

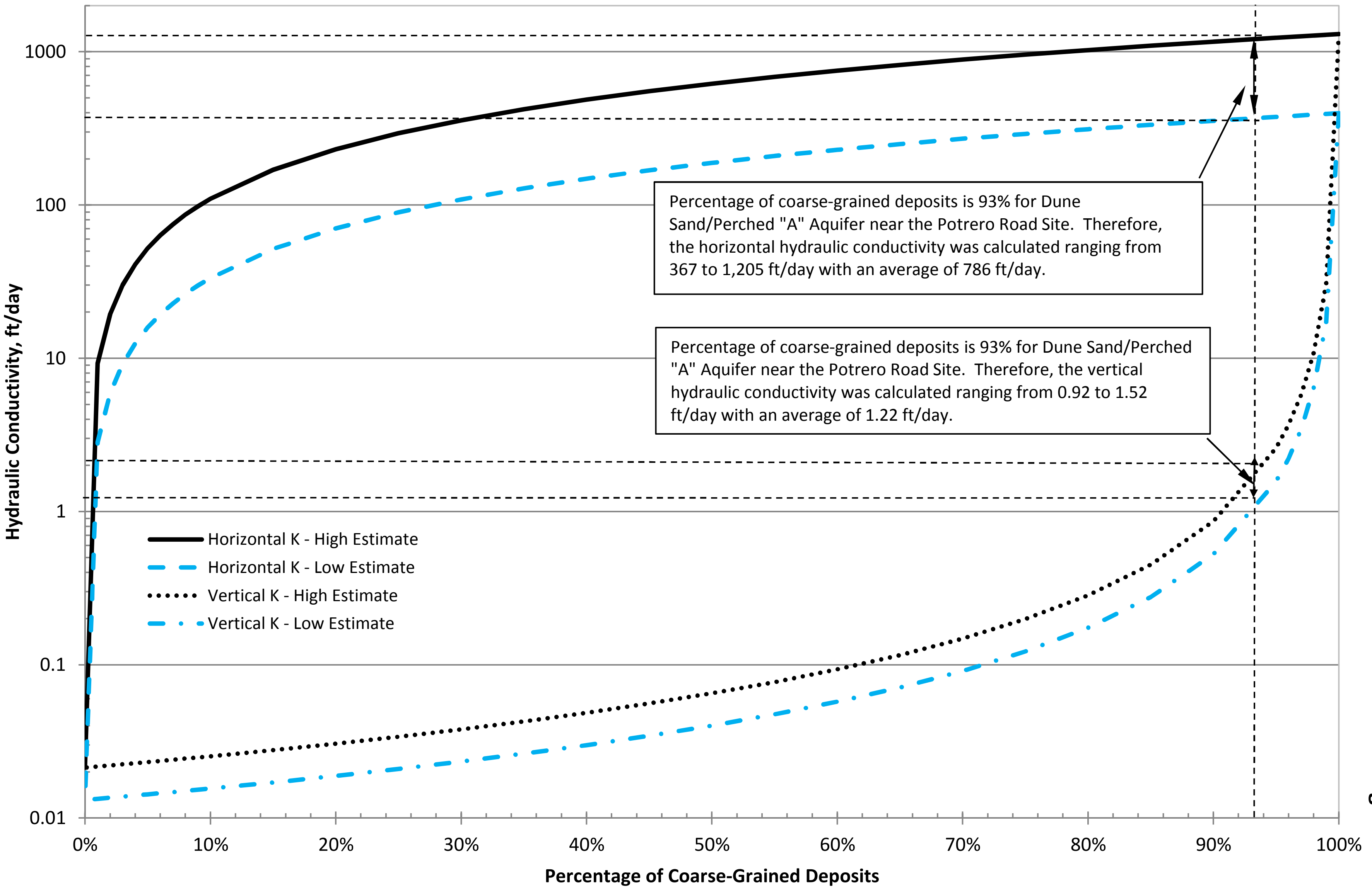
Prepared by: DWB. Map Projection: State Plane 1983, Zone IV.

GEOSCIENCE
GEOSCIENCE Support Services, Inc.
P.O. Box 220, Claremont, CA 91711
Tel: (909) 451-6650 Fax: (909) 451-6638
www.gssiwater.com

Figure 43

GIS_proj/mcwsp_cal_am/rbf_boring_tech_memo_7-14/4_Fig_43_layer8_Thickness_7-14.mxd

Sediment Texture versus Horizontal and Vertical Hydraulic Conductivity Values
Dune Sand/Perched "A" Aquifer near Potrero Road Site

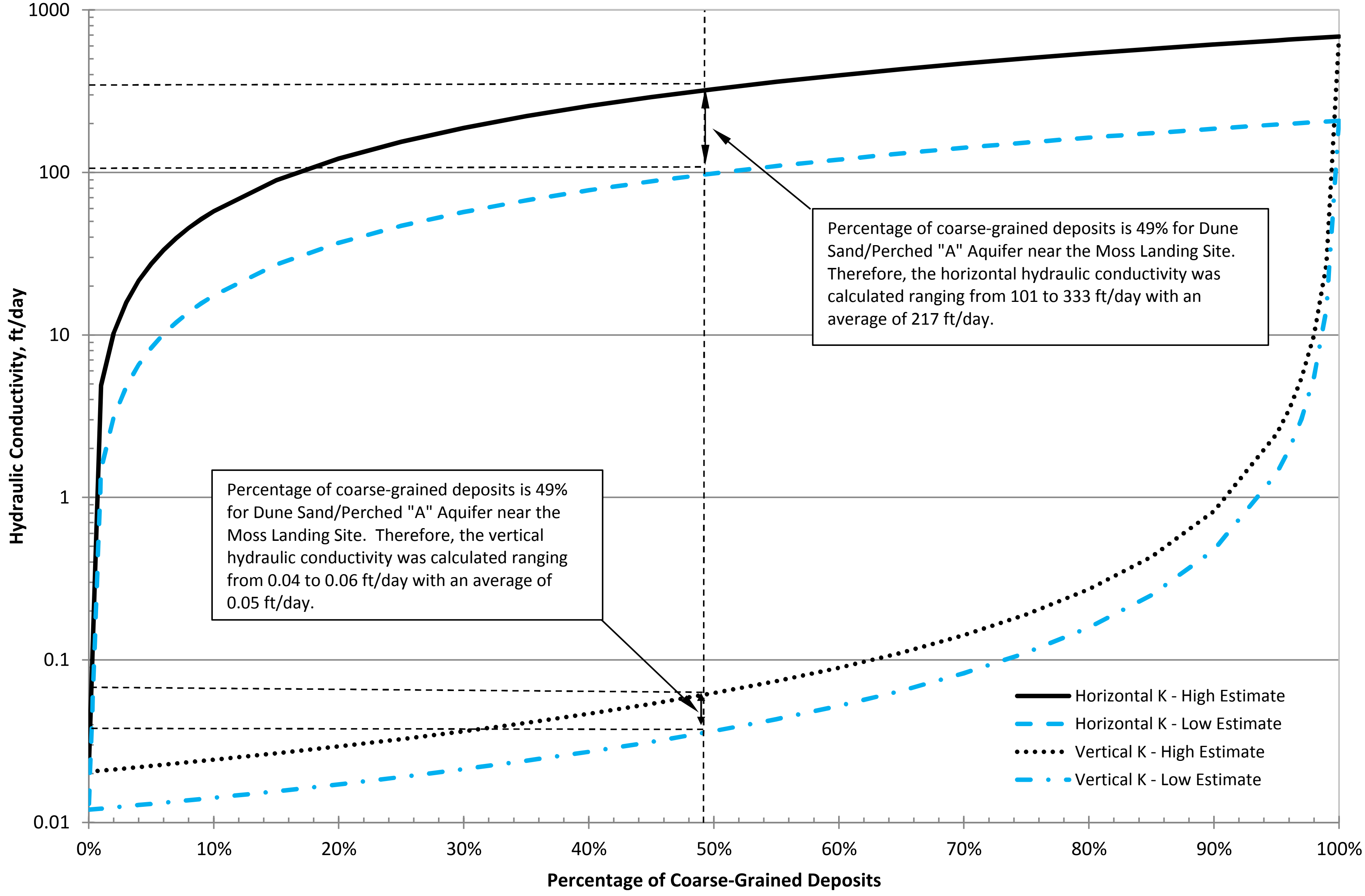


Percentage of coarse-grained deposits is 93% for Dune Sand/Perched "A" Aquifer near the Potrero Road Site. Therefore, the horizontal hydraulic conductivity was calculated ranging from 367 to 1,205 ft/day with an average of 786 ft/day.

Percentage of coarse-grained deposits is 93% for Dune Sand/Perched "A" Aquifer near the Potrero Road Site. Therefore, the vertical hydraulic conductivity was calculated ranging from 0.92 to 1.52 ft/day with an average of 1.22 ft/day.

Figure 47

Sediment Texture versus Horizontal and Vertical Hydraulic Conductivity Values
Dune Sand/Perched "A" Aquifer near Moss Landing Site

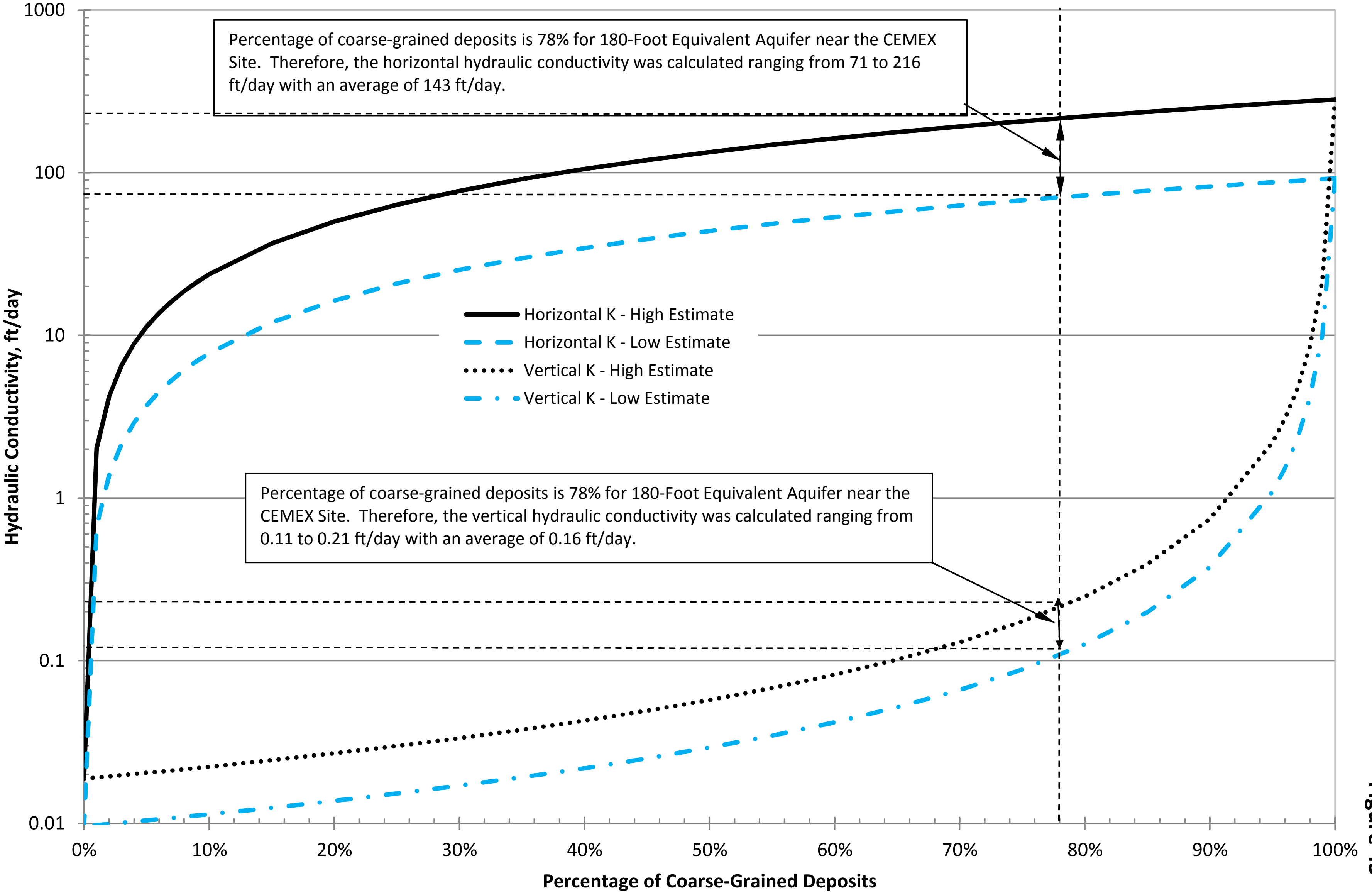


Percentage of coarse-grained deposits is 49% for Dune Sand/Perched "A" Aquifer near the Moss Landing Site. Therefore, the horizontal hydraulic conductivity was calculated ranging from 101 to 333 ft/day with an average of 217 ft/day.

Percentage of coarse-grained deposits is 49% for Dune Sand/Perched "A" Aquifer near the Moss Landing Site. Therefore, the vertical hydraulic conductivity was calculated ranging from 0.04 to 0.06 ft/day with an average of 0.05 ft/day.

Figure 46

Sediment Texture versus Horizontal and Vertical Hydraulic Conductivity Values
180-Foot Equivalent Aquifer near CEMEX Site

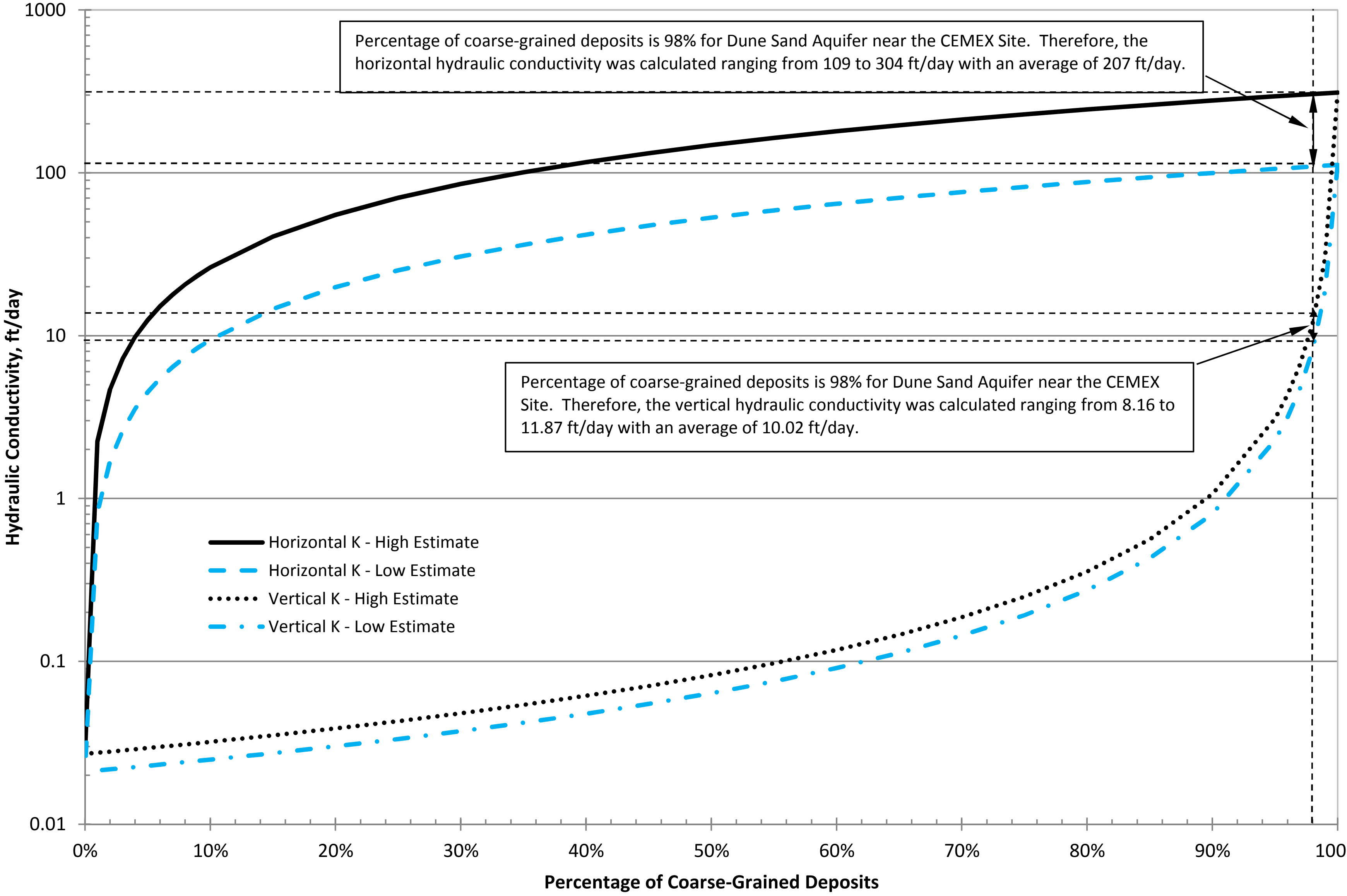


Percentage of coarse-grained deposits is 78% for 180-Foot Equivalent Aquifer near the CEMEX Site. Therefore, the horizontal hydraulic conductivity was calculated ranging from 71 to 216 ft/day with an average of 143 ft/day.

Percentage of coarse-grained deposits is 78% for 180-Foot Equivalent Aquifer near the CEMEX Site. Therefore, the vertical hydraulic conductivity was calculated ranging from 0.11 to 0.21 ft/day with an average of 0.16 ft/day.

Figure 45

Sediment Texture versus Horizontal and Vertical Hydraulic Conductivity Values
Dune Sand Aquifer near CEMEX Site



Percentage of coarse-grained deposits is 98% for Dune Sand Aquifer near the CEMEX Site. Therefore, the horizontal hydraulic conductivity was calculated ranging from 109 to 304 ft/day with an average of 207 ft/day.

Percentage of coarse-grained deposits is 98% for Dune Sand Aquifer near the CEMEX Site. Therefore, the vertical hydraulic conductivity was calculated ranging from 8.16 to 11.87 ft/day with an average of 10.02 ft/day.

Figure 44

TABLES

GEOSCIENCE

Table 1

Hydraulic Conductivity Calculations

Borehole	Interval [ft bgs]	Method	Sample Type	K Direction	Hydraulic Conductivity, K [ft/day]	Lithology
CX-B1	79-79.5	Hazen	MGA	Horizontal	86	SM: Silty Sand
CX-B1	79-79.5	Krumbein-Monk	MGA	Horizontal	45	SM: Silty Sand
CX-B1	79-79.5	Kozeny-Carman	MGA	Horizontal	130	SM: Silty Sand
				Average :	**87**	
CX-B1	88-88.5	Hazen	MGA	Horizontal	535	SW: Well-Graded Sand
CX-B1	88-88.5	Krumbein-Monk	MGA	Horizontal	491	SW: Well-Graded Sand
CX-B1	88-88.5	Kozeny-Carman	MGA	Horizontal	2,115	SW: Well-Graded Sand
				Average :	**1,047**	
CX-B1	104.5-105	Hazen	MGA	Horizontal	79	SM: Silty Sand
CX-B1	104.5-105	Krumbein-Monk	MGA	Horizontal	40	SM: Silty Sand
CX-B1	104.5-105	Kozeny-Carman	MGA	Horizontal	112	SM: Silty Sand
				Average :	**77**	
CX-B1	115-116	Hazen	MGA	Horizontal	351	SW: Well-Graded Sand
CX-B1	115-116	Krumbein-Monk	MGA	Horizontal	249	SW: Well-Graded Sand
CX-B1	115-116	Kozeny-Carman	MGA	Horizontal	624	SW: Well-Graded Sand
				Average :	**408**	
CX-B1	187-188	Hazen	MGA	Horizontal	150	SM: Silty Sand
CX-B1	187-188	Krumbein-Monk	MGA	Horizontal	127	SM: Silty Sand
CX-B1	187-188	Kozeny-Carman	MGA	Horizontal	344	SM: Silty Sand
				Average :	**207**	
CX-B1	245-245	Hazen	MGA	Horizontal	399	GW: Gravel
CX-B1	245-245	Krumbein-Monk	MGA	Horizontal	334	GW: Gravel
CX-B1	245-245	Kozeny-Carman	MGA	Horizontal	849	GW: Gravel
				Average :	**527**	
CX-B1	295-296	Hazen	MGA	Horizontal	176	SP: Sand with Gravel
CX-B1	295-296	Krumbein-Monk	MGA	Horizontal	176	SP: Sand with Gravel
CX-B1	295-296	Kozeny-Carman	MGA	Horizontal	549	SP: Sand with Gravel
				Average :	**300**	
CX-B2	53	Hazen	MGA	Horizontal	371	SW: Well-Graded Sand
CX-B2	53	Krumbein-Monk	MGA	Horizontal	292	SW: Well-Graded Sand
CX-B2	53	Kozeny-Carman	MGA	Horizontal	770	SW: Well-Graded Sand
				Average :	**477**	
CX-B2	116	Hazen	MGA	Horizontal	24	SM: Silty Sand
CX-B2	116	Krumbein-Monk	MGA	Horizontal	16	SM: Silty Sand
CX-B2	116	Kozeny-Carman	MGA	Horizontal	65	SM: Silty Sand
				Average :	**35**	
CX-B2	141	Hazen	MGA	Horizontal	117	SP: Sand
CX-B2	141	Krumbein-Monk	MGA	Horizontal	95	SP: Sand
CX-B2	141	Kozeny-Carman	MGA	Horizontal	241	SP: Sand
				Average :	**151**	
CX-B2	203	Hazen	MGA	Horizontal	102	SP: Sand

Hydraulic Conductivity Calculations

Borehole	Interval [ft bgs]	Method	Sample Type	K Direction	Hydraulic Conductivity, K [ft/day]	Lithology
CX-B2	203	Krumbein-Monk	MGA	Horizontal	72	SP: Sand
CX-B2	203	Kozeny-Carman	MGA	Horizontal	181	SP: Sand
				Average :	**118**	
CX-B2	273	Hazen	MGA	Horizontal	258	SW: Well-Graded Sand
CX-B2	273	Krumbein-Monk	MGA	Horizontal	206	SW: Well-Graded Sand
CX-B2	273	Kozeny-Carman	MGA	Horizontal	725	SW: Well-Graded Sand
				Average :	**396**	
CX-B3	45	Hazen	MGA	Horizontal	99	SP: Sand
CX-B3	45	Krumbein-Monk	MGA	Horizontal	74	SP: Sand
CX-B3	45	Kozeny-Carman	MGA	Horizontal	224	SP: Sand
				Average :	**132**	
CX-B3	121	Hazen	MGA	Horizontal	26	SM: Silty Sand
CX-B3	121	Krumbein-Monk	MGA	Horizontal	21	SM: Silty Sand
CX-B3	121	Kozeny-Carman	MGA	Horizontal	69	SM: Silty Sand
				Average :	**39**	
CX-B3	240	Hazen	MGA	Horizontal	191	SP: Sand
CX-B3	240	Krumbein-Monk	MGA	Horizontal	130	SP: Sand
CX-B3	240	Kozeny-Carman	MGA	Horizontal	509	SP: Sand
				Average :	**277**	
CX-B3	291	Hazen	MGA	Horizontal	373	SW: Well-Graded Sand
CX-B3	291	Krumbein-Monk	MGA	Horizontal	191	SW: Well-Graded Sand
CX-B3	291	Kozeny-Carman	MGA	Horizontal	829	SW: Well-Graded Sand
				Average :	**464**	
CX-B3	312	Hazen	MGA	Horizontal	258	SP: Sand
CX-B3	312	Krumbein-Monk	MGA	Horizontal	206	SP: Sand
CX-B3	312	Kozeny-Carman	MGA	Horizontal	725	SP: Sand
				Average :	**396**	
CX-B4	46-47	Hazen	MGA	Horizontal	374	SP: Sand
CX-B4	46-47	Krumbein-Monk	MGA	Horizontal	230	SP: Sand
CX-B4	46-47	Kozeny-Carman	MGA	Horizontal	628	SP: Sand
				Average :	**411**	
CX-B4	72-73	Hazen	MGA	Horizontal	45	SP: Sand
CX-B4	72-73	Krumbein-Monk	MGA	Horizontal	40	SP: Sand
CX-B4	72-73	Kozeny-Carman	MGA	Horizontal	102	SP: Sand
				Average :	**62**	
CX-B4	115-116	Hazen	MGA	Horizontal	31	SP: Sand
CX-B4	115-116	Krumbein-Monk	MGA	Horizontal	25	SP: Sand
CX-B4	115-116	Kozeny-Carman	MGA	Horizontal	74	SP: Sand
				Average :	**43**	
CX-B4	190-191	Hazen	MGA	Horizontal	121	SP: Sand
CX-B4	190-191	Krumbein-Monk	MGA	Horizontal	97	SP: Sand

Hydraulic Conductivity Calculations

Borehole	Interval [ft bgs]	Method	Sample Type	K Direction	Hydraulic Conductivity, K [ft/day]	Lithology
CX-B4	190-191	Kozeny-Carman	MGA	Horizontal	248	SP: Sand
				Average :	**156**	
CX-B4	248-249	Hazen	MGA	Horizontal	202	SP: Sand
CX-B4	248-249	Krumbein-Monk	MGA	Horizontal	163	SP: Sand
CX-B4	248-249	Kozeny-Carman	MGA	Horizontal	380	SP: Sand
				Average :	**248**	
MDW-1	22-23	Hazen	MGA	Horizontal	163	SP: Sand
MDW-1	22-23	Krumbein-Monk	MGA	Horizontal	135	SP: Sand
MDW-1	22-23	Kozeny-Carman	MGA	Horizontal	300	SP: Sand
				Average :	**199**	
MDW-1	59-60	Hazen	MGA	Horizontal	113	SP: Sand
MDW-1	59-60	Krumbein-Monk	MGA	Horizontal	90	SP: Sand
MDW-1	59-60	Kozeny-Carman	MGA	Horizontal	224	SP: Sand
				Average :	**142**	
MDW-1	70-71	Hazen	MGA	Horizontal	385	SP: Sand
MDW-1	70-71	Krumbein-Monk	MGA	Horizontal	250	SP: Sand
MDW-1	70-71	Kozeny-Carman	MGA	Horizontal	730	SP: Sand
				Average :	**455**	
MDW-1	153-154	Hazen	MGA	Horizontal	394	SP: Sand with Gravel
MDW-1	153-154	Krumbein-Monk	MGA	Horizontal	302	SP: Sand with Gravel
MDW-1	153-154	Kozeny-Carman	MGA	Horizontal	984	SP: Sand with Gravel
				Average :	**560**	
MDW-1	181-182	Hazen	MGA	Horizontal	202	SP: Sand
MDW-1	181-182	Krumbein-Monk	MGA	Horizontal	161	SP: Sand
MDW-1	181-182	Kozeny-Carman	MGA	Horizontal	553	SP: Sand
				Average :	**305**	
ML-1	52-53	Hazen	MGA	Horizontal	411	SP: Sand
ML-1	52-53	Krumbein-Monk	MGA	Horizontal	227	SP: Sand
ML-1	52-53	Kozeny-Carman	MGA	Horizontal	951	SP: Sand
				Average :	**530**	
ML-1	58-59	Hazen	MGA	Horizontal	75	SP: Sand
ML-1	58-59	Krumbein-Monk	MGA	Horizontal	51	SP: Sand
ML-1	58-59	Kozeny-Carman	MGA	Horizontal	124	SP: Sand
				Average :	**83**	
ML-1	65-66	Hazen	MGA	Horizontal	85	SP: Sand
ML-1	65-66	Krumbein-Monk	MGA	Horizontal	57	SP: Sand
ML-1	65-66	Kozeny-Carman	MGA	Horizontal	140	SP: Sand
				Average :	**94**	
ML-1	88-89	Hazen	MGA	Horizontal	185	SP: Sand
ML-1	88-89	Krumbein-Monk	MGA	Horizontal	134	SP: Sand
ML-1	88-89	Kozeny-Carman	MGA	Horizontal	521	SP: Sand

Hydraulic Conductivity Calculations

Borehole	Interval [ft bgs]	Method	Sample Type	K Direction	Hydraulic Conductivity, K [ft/day]	Lithology
				Average :	**280**	
ML-1	104-106	Hazen	MGA	Horizontal	125	SP: Sand
ML-1	104-106	Krumbein-Monk	MGA	Horizontal	93	SP: Sand
ML-1	104-106	Kozeny-Carman	MGA	Horizontal	312	SP: Sand
				Average :	**177**	
ML-1	108-109	Hazen	MGA	Horizontal	445	SP-SM: Sand with Silt and Gravel
ML-1	108-109	Krumbein-Monk	MGA	Horizontal	445	SP-SM: Sand with Silt and Gravel
ML-1	108-109	Kozeny-Carman	MGA	Horizontal	1,322	SP-SM: Sand with Silt and Gravel
				Average :	**738**	
ML-1	117-118	Hazen	MGA	Horizontal	469	SP: Sand with Gravel
ML-1	117-118	Krumbein-Monk	MGA	Horizontal	654	SP: Sand with Gravel
ML-1	117-118	Kozeny-Carman	MGA	Horizontal	1,175	SP: Sand with Gravel
				Average :	**766**	
ML-2	24-24.5	Hazen	MGA	Horizontal	497	SW: Well-Graded Sand
ML-2	24-24.5	Krumbein-Monk	MGA	Horizontal	383	SW: Well-Graded Sand
ML-2	24-24.5	Kozeny-Carman	MGA	Horizontal	1,090	SW: Well-Graded Sand
				Average :	**656**	
ML-2	50-50.5	Hazen	MGA	Horizontal	92	SP: Sand
ML-2	50-50.5	Krumbein-Monk	MGA	Horizontal	56	SP: Sand
ML-2	50-50.5	Kozeny-Carman	MGA	Horizontal	151	SP: Sand
				Average :	**100**	
ML-2	110.5-111	Hazen	MGA	Horizontal	517	SW: Well-Graded Sand with Gravel
ML-2	110.5-111	Krumbein-Monk	MGA	Horizontal	484	SW: Well-Graded Sand with Gravel
ML-2	110.5-111	Kozeny-Carman	MGA	Horizontal	949	SW: Well-Graded Sand with Gravel
				Average :	**650**	
ML-2	152-152.5	Hazen	MGA	Horizontal	21	SP: Sand
ML-2	152-152.5	Krumbein-Monk	MGA	Horizontal	12	SP: Sand
ML-2	152-152.5	Kozeny-Carman	MGA	Horizontal	53	SP: Sand
				Average :	**29**	
ML-2	188.5-189	Hazen	MGA	Horizontal	30	SP-SM: Sand with Silt
ML-2	188.5-189	Krumbein-Monk	MGA	Horizontal	18	SP-SM: Sand with Silt
ML-2	188.5-189	Kozeny-Carman	MGA	Horizontal	93	SP-SM: Sand with Silt
				Average :	**47**	
ML-3	109.5-110	Hazen	MGA	Horizontal	95	SP: Sand
ML-3	109.5-110	Krumbein-Monk	MGA	Horizontal	60	SP: Sand
ML-3	109.5-110	Kozeny-Carman	MGA	Horizontal	214	SP: Sand
				Average :	**123**	
ML-3	111.5-112	Hazen	MGA	Horizontal	337	SP: Sand
ML-3	111.5-112	Krumbein-Monk	MGA	Horizontal	273	SP: Sand
ML-3	111.5-112	Kozeny-Carman	MGA	Horizontal	914	SP: Sand
				Average :	**508**	

Hydraulic Conductivity Calculations

Borehole	Interval [ft bgs]	Method	Sample Type	K Direction	Hydraulic Conductivity, K [ft/day]	Lithology
ML-3	182.5-183	Hazen	MGA	Horizontal	446	SW-SC: Sand with Clay and Gravel
ML-3	182.5-183	Krumbein-Monk	MGA	Horizontal	452	SW-SC: Sand with Clay and Gravel
ML-3	182.5-183	Kozeny-Carman	MGA	Horizontal	1,511	SW-SC: Sand with Clay and Gravel
				Average :	**803**	
ML-3	189-189.5	Hazen	MGA	Horizontal	118	SP: Sand
ML-3	189-189.5	Krumbein-Monk	MGA	Horizontal	95	SP: Sand
ML-3	189-189.5	Kozeny-Carman	MGA	Horizontal	355	SP: Sand
				Average :	**189**	
ML-3	195-195.5	Hazen	MGA	Horizontal	192	SW: Well-Graded Sand with Gravel
ML-3	195-195.5	Krumbein-Monk	MGA	Horizontal	367	SW: Well-Graded Sand with Gravel
ML-3	195-195.5	Kozeny-Carman	MGA	Horizontal	480	SW: Well-Graded Sand with Gravel
				Average :	**346**	
ML-4	28-28.5	Hazen	MGA	Horizontal	164	SP: Sand
ML-4	28-28.5	Krumbein-Monk	MGA	Horizontal	171	SP: Sand
ML-4	28-28.5	Kozeny-Carman	MGA	Horizontal	468	SP: Sand
				Average :	**268**	
ML-4	71-71.5	Hazen	MGA	Horizontal	25	SP: Sand
ML-4	71-71.5	Krumbein-Monk	MGA	Horizontal	21	SP: Sand
ML-4	71-71.5	Kozeny-Carman	MGA	Horizontal	79	SP: Sand
				Average :	**42**	
ML-4	112-112.5	Hazen	MGA	Horizontal	152	SP: Sand
ML-4	112-112.5	Krumbein-Monk	MGA	Horizontal	129	SP: Sand
ML-4	112-112.5	Kozeny-Carman	MGA	Horizontal	345	SP: Sand
				Average :	**208**	
ML-4	152-152.5	Hazen	MGA	Horizontal	189	SP: Sand
ML-4	152-152.5	Krumbein-Monk	MGA	Horizontal	229	SP: Sand
ML-4	152-152.5	Kozeny-Carman	MGA	Horizontal	785	SP: Sand
				Average :	**401**	
ML-4	180-180.5	Hazen	MGA	Horizontal	89	SP: Sand
ML-4	180-180.5	Krumbein-Monk	MGA	Horizontal	63	SP: Sand
ML-4	180-180.5	Kozeny-Carman	MGA	Horizontal	296	SP: Sand
				Average :	**149**	
ML-6	94-94.5	Hazen	MGA	Horizontal	48	SP-SM: Sand with Silt
ML-6	94-94.5	Krumbein-Monk	MGA	Horizontal	49	SP-SM: Sand with Silt
ML-6	94-94.5	Kozeny-Carman	MGA	Horizontal	178	SP-SM: Sand with Silt
				Average :	**91**	
ML-6	104-104.5	Hazen	MGA	Horizontal	306	SW: Well-Graded Sand
ML-6	104-104.5	Krumbein-Monk	MGA	Horizontal	149	SW: Well-Graded Sand
ML-6	104-104.5	Kozeny-Carman	MGA	Horizontal	610	SW: Well-Graded Sand
				Average :	**355**	
ML-6	121-121.5	Hazen	MGA	Horizontal	37	SP: Sand

Table 1

Hydraulic Conductivity Calculations

Borehole	Interval [ft bgs]	Method	Sample Type	K Direction	Hydraulic Conductivity, K [ft/day]	Lithology
ML-6	121-121.5	Krumbein-Monk	MGA	Horizontal	28	SP: Sand
ML-6	121-121.5	Kozeny-Carman	MGA	Horizontal	83	SP: Sand
				Average :	**49**	
ML-6	141-141.5	Hazen	MGA	Horizontal	36	SP: Sand
ML-6	141-141.5	Krumbein-Monk	MGA	Horizontal	29	SP: Sand
ML-6	141-141.5	Kozeny-Carman	MGA	Horizontal	88	SP: Sand
				Average :	**51**	
ML-6	166-166.5	Hazen	MGA	Horizontal	43	SP: Sand
ML-6	166-166.5	Krumbein-Monk	MGA	Horizontal	38	SP: Sand
ML-6	166-166.5	Kozeny-Carman	MGA	Horizontal	106	SP: Sand
				Average :	**62**	
PR-1	56-57	Hazen	MGA	Horizontal	271	SP: Sand
PR-1	56-57	Krumbein-Monk	MGA	Horizontal	165	SP: Sand
PR-1	56-57	Kozeny-Carman	MGA	Horizontal	396	SP: Sand
				Average :	**277**	
PR-1	66-67	Hazen	MGA	Horizontal	328	SP: Sand with Gravel
PR-1	66-67	Krumbein-Monk	MGA	Horizontal	302	SP: Sand with Gravel
PR-1	66-67	Kozeny-Carman	MGA	Horizontal	561	SP: Sand with Gravel
				Average :	**397**	
PR-1	76-77	Hazen	MGA	Horizontal	311	SM: Silty Sand with Gravel
PR-1	76-77	Krumbein-Monk	MGA	Horizontal	836	SM: Silty Sand with Gravel
PR-1	76-77	Kozeny-Carman	MGA	Horizontal	1,150	SM: Silty Sand with Gravel
				Average :	**766**	
PR-1	110-111	Hazen	MGA	Horizontal	699	SW: Well-Graded Sand with Gravel
PR-1	110-111	Krumbein-Monk	MGA	Horizontal	703	SW: Well-Graded Sand with Gravel
PR-1	110-111	Kozeny-Carman	MGA	Horizontal	1,148	SW: Well-Graded Sand with Gravel
				Average :	**850**	
PR-1	124-125	Hazen	MGA	Horizontal	1,055	SW: Well-Graded Sand
PR-1	124-125	Krumbein-Monk	MGA	Horizontal	9,561	SW: Well-Graded Sand
PR-1	124-125	Kozeny-Carman	MGA	Horizontal	2,579	SW: Well-Graded Sand
				Average :	**4,398**	
PR-1	188-189	Hazen	MGA	Horizontal	160	SM: Silty Sand
PR-1	188-189	Krumbein-Monk	MGA	Horizontal	160	SM: Silty Sand
PR-1	188-189	Kozeny-Carman	MGA	Horizontal	429	SM: Silty Sand
				Average :	**249**	
PR-1	197-198	Hazen	MGA	Horizontal	170	SM: Silty Sand
PR-1	197-198	Krumbein-Monk	MGA	Horizontal	132	SM: Silty Sand
PR-1	197-198	Kozeny-Carman	MGA	Horizontal	413	SM: Silty Sand
				Average :	**238**	

Cal Am / RBF
Monterey Peninsula Water Supply Project Hydrogeologic Investigation
Attachment 1 - Technical Memorandum (TM 1) - Summary of Results - Exploratory Boreholes

Summary of Horizontal and Vertical Permeability Test

Table 2

Borehole	Interval [ft bgs]	Method	Sample Type	K Direction	Permeability, K [ft/day]	Lithology
CX-B1	66.5-67	EPA9100	Core	Vertical	0.782	SM: Silty Sand
CX-B1	66.5-67	EPA9100	Core	Horizontal	4.337	SM: Silty Sand
CX-B1	166.5-167	EPA9100	Core	Vertical	1.380	SM: Silty Sand
CX-B1	166.5-167	EPA9100	Core	Horizontal	1.729	SM: Silty Sand
CX-B1	257.5-258	EPA9100	Core	Vertical	0.005	CL: Clay
CX-B2	207.5-208	EPA9100	Core	Vertical	10.657	SP: Sand
CX-B2	207.5-208	EPA9100	Core	Horizontal	3.997	SP: Sand
CX-B2	259-259.5	EPA9100	Core	Vertical	0.005	CL: Clay
CX-B3	107.5-108	EPA9100	Core	Vertical	14.909	SP: Sand with Gravel
CX-B3	107.5-108	EPA9100	Core	Horizontal	14.512	SP: Sand with Gravel
CX-B3	129-129.5	EPA9100	Core	Vertical	0.008	CH: Fat Clay
CX-B3	197.5-198	EPA9100	Core	Vertical	0.283	SP: Sand
CX-B3	197.5-198	EPA9100	Core	Horizontal	1.797	SP: Sand
ML-1	76-76.5	EPA9100	Core	Vertical	0.014	CH: Fat Clay
ML-1	107.5-108	EPA9100	Core	Vertical	24.149	SP-SM: Sand with Silt and Gravel
ML-1	107.5-108	EPA9100	Core	Horizontal	17.744	SP-SM: Sand with Silt and Gravel
ML-1	147-147.5	EPA9100	Core	Vertical	0.006	CL: Clay
ML-2	87-87.5	EPA9100	Core	Vertical	0.283	CL: Clay
ML-2	117.5-118	EPA9100	Core	Vertical	0.133	SP-SM: Sand with Silt
ML-2	117.5-118	EPA9100	Core	Horizontal	0.312	SP-SM: Sand with Silt
ML-2	157.5-158	EPA9100	Core	Vertical	0.312	SP: Sand
ML-2	157.5-158	EPA9100	Core	Horizontal	9.099	SP: Sand
ML-3	106.5-107	EPA9100	Core	Vertical	5.300	SP: Sand
ML-3	106.5-107	EPA9100	Core	Horizontal	2.387	SP: Sand
ML-3	166.5-167	EPA9100	Core	Vertical	0.027	ML: Silt

Summary of Horizontal and Vertical Permeability Test

Borehole	Interval [ft bgs]	Method	Sample Type	K Direction	Permeability, K [ft/day]	Lithology
ML-3	166.5-167	EPA9100	Core	Horizontal	0.021	ML: Silt
ML-4	76.5-77	EPA9100	Core	Vertical	2.690	SP: Sand
ML-4	76.5-77	EPA9100	Core	Horizontal	2.460	SP: Sand
ML-4	126.5-127	EPA9100	Core	Vertical	0.003	CH: Fat Clay
ML-4	146.5-147	EPA9100	Core	Vertical	17.290	SP: Sand
ML-4	146.5-147	EPA9100	Core	Horizontal	36.564	SP: Sand
ML-6	79.5-80	EPA9100	Core	Vertical	0.007	CL: Clay
ML-6	107.5-108	EPA9100	Core	Vertical	13.180	SW: Well-Graded Sand with Gravel
ML-6	107.5-108	EPA9100	Core	Horizontal	11.338	SW: Well-Graded Sand with Gravel
ML-6	167.5-168	EPA9100	Core	Vertical	0.205	SM: Silty Sand
ML-6	167.5-168	EPA9100	Core	Horizontal	0.368	SM: Silty Sand
PR-1	67-67.5	EPA 9100	Core	Vertical	0.259	SP: Sand with Gravel
PR-1	67-67.5	EPA 9100	Core	Horizontal	0.171	SP: Sand with Gravel
PR-1	145.5-146	EPA 9100	Core	Vertical	0.006	CL: Clay
PR-1	152-152.5	EPA 9100	Core	Vertical	0.006	CL: Clay
PR-1	200.5-201	EPA 9100	Core	Vertical	14.456	Not Determined
PR-1	200.5-201	EPA 9100	Core	Horizontal	0.774	Not Determined

Table 2

Summary of Isolated Aquifer Zone Testing Field and Laboratory Water Quality Results - Moss Landing Area

Borehole:		**PR-1**		**ML-1**		**ML-2**		**ML-3**		**ML-4**		**ML-6**		**MDW-1**			
Zone #:		1	2	1	2	1	2	1	2	1	2	1	2	1	2	3	4
Screen Interval (ft bgs):		190 - 200	125 - 135	113.5 - 118.5	90 - 100	167 - 177	90 - 100	180 - 190	103 - 113	163.5 - 173.5	74.5 - 84.5	152 - 162	100 - 110	237 - 247	187 - 197	152 - 162	60 - 70
Sample Date:		24-Sep-13	25-Sep-13	5-Oct-13	7-Oct-13	17-Dec-13	19-Dec-13	11-Jan-14	13-Jan-14	5-Dec-13	6-Dec-13	22-Nov-13	23-Nov-13	1-May-14	7-May-14	8-May-14	10-May-14
Constituent[1]	**Units**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
1,1,1,2-Tetrachloroethane	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1,1-Trichloroethane	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1,2,2-Tetrachloroethane	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1,2-Trichloro-1,2,2-trifluoroethane	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1,2-Trichloroethane	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethane	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethene	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloropropene	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3-Trichlorobenzene	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3-Trichloropropane	µg/L	-	-	-	-	-	ND	ND	ND	-	ND	-	-	-	-	-	-
1,2,4-Trichlorobenzene	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,4-Trimethylbenzene	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dichlorobenzene	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dichlorobenzene-d4	µg/L	4.6	4.8	4.7	4.8	4.6	7.81	9.69	10.1	4.8	8.06	4.6	4.8	5.3	4.9	5.0	5.1
1,2-Dichloroethane	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dichloropropane	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,3,5-Trimethylbenzene	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,3-Dichlorobenzene	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,3-Dichloropropane	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,3-Dichloropropene, Total	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,3-Dimethyl-2-nitrobenzene	µg/L	5.2	5.1	5.6	5.3	4.6	5.0	5.31	5.34	4.9	4.94	4.8	4.7	4.7	5.1	4.7	5.0
1,4-Dichlorobenzene	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1-Br-2-Nitrobenzene	µg/L	-	-	-	-	-	-	-	-	-	-	-	-	0.42	0.48	0.47	0.47
2,2-Dichloropropane	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4,5-T	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4,5-TP (Silvex)	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4-D	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4-DB	µg/L	-	-	-	-	-	-	ND	ND	-	ND	-	-	-	-	-	-
2,4-DCAA	µg/L	-	-	-	-	-	-	9.66	9.96	-	8.27	-	-	-	-	-	-
2-Butanone	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Chloroethyl vinyl ether	µg/L	-	-	-	-	-	ND	ND	ND	-	ND	-	-	-	-	-	-
2-Chlorotoluene	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Hexanone	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3,5-Dichlorobenzoic acid	µg/L	-	-	-	-	-	-	ND	ND	-	ND	-	-	-	-	-	-
3-Hydroxycarbofuran	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4,4´-DDD	µg/L	-	-	-	-	-	-	ND	ND	-	ND	-	-	ND	ND	ND	ND
4,4´-DDE	µg/L	-	-	-	-	-	-	ND	ND	-	ND	-	-	ND	ND	ND	ND
4,4´-DDT	µg/L	-	-	-	-	-	-	ND	ND	-	ND	-	-	ND	ND	ND	ND
4-Chlorotoluene	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4-Methyl-2-pentanone	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acetone	µg/L	ND	ND	ND	ND	ND	-	-	-	ND	-	ND	ND	ND	ND	ND	ND
Acifluorfen	µg/L	-	-	-	-	-	-	ND	ND	-	ND	-	-	-	-	-	-
Alachlor	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aldicarb	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aldicarb Sulfone	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aldicarb Sulfoxide	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aldrin	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Alkalinity as CaCO3	mg/L	190	150	330	320	750	180	210	190	460	200	560	410	158	176	149	118
alpha-BHC	µg/L	-	-	-	-	-	-	ND	ND	-	ND	-	-	ND	ND	ND	ND
Aluminum	µg/L	ND	68	ND	150	82	ND	950	47	ND	17	52	ND	120	62	147	ND
Ammonia as N, Dissolved	mg/L	0.14	0.78	15	7.5	14	1.0	10	1.7	9.5	1.7	6.8	1.9	ND	3.22	3.40	ND
AMPA	µg/L	110	110	110	100	87	100	-	-	95	-	100	95	93	100	110	110
Aroclor 1016	µg/L	-	-	-	-	-	-	ND	ND	-	ND	-	-	ND	ND	ND	ND
Aroclor 1221	µg/L	-	-	-	-	-	-	ND	ND	-	ND	-	-	ND	ND	ND	ND
Aroclor 1232	µg/L	-	-	-	-	-	-	ND	ND	-	ND	-	-	ND	ND	ND	ND

Summary of Isolated Aquifer Zone Testing Field and Laboratory Water Quality Results - Moss Landing Area

Borehole:		PR-1		ML-1		ML-2		ML-3		ML-4		ML-6		MDW-1			
Zone #:		1	2	1	2	1	2	1	2	1	2	1	2	1	2	3	4
Screen Interval (ft bgs):		190 - 200	125 - 135	113.5 - 118.5	90 - 100	167 - 177	90 - 100	180 - 190	103 - 113	163.5 - 173.5	74.5 - 84.5	152 - 162	100 - 110	237 - 247	187 - 197	152 - 162	60 - 70
Sample Date:		24-Sep-13	25-Sep-13	5-Oct-13	7-Oct-13	17-Dec-13	19-Dec-13	11-Jan-14	13-Jan-14	5-Dec-13	6-Dec-13	22-Nov-13	23-Nov-13	1-May-14	7-May-14	8-May-14	10-May-14
Constituent[1]	**Units**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
Aroclor 1242	µg/L	-	-	-	-	-	-	ND	ND	-	ND	-	-	ND	ND	ND	ND
Aroclor 1248	µg/L	-	-	-	-	-	-	ND	ND	-	ND	-	-	ND	ND	ND	ND
Aroclor 1254	µg/L	-	-	-	-	-	-	ND	ND	-	ND	-	-	ND	ND	ND	ND
Aroclor 1260	µg/L	-	-	-	-	-	-	ND	ND	-	ND	-	-	ND	ND	ND	ND
Arsenic, Total	µg/L	ND	13	3.4	ND	ND	ND	1.0	5.1	ND	0.71	4.5	4.3	39	54	44	40
Atrazine	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Barium, Dissolved	µg/L	110	ND	160	270	74	380	150	92	84	340	ND	89	94	93	134	ND
Bentazon	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzene	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo(a)pyrene	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
beta-BHC	µg/L	-	-	-	-	-	-	ND	ND	-	ND	-	-	ND	ND	ND	ND
Bicarbonate as CaCO3	mg/L	190	150	330	320	750	180	-	-	460	-	560	410	-	-	-	-
Bicarbonate as HCO3	mg/L	-	-	-	-	-	-	250	230	-	240	-	-	193	215	182	144
Bis(2-ethylhexyl) adipate (DEHA)	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bis(2-ethylhexyl) phthalate (DEHP)	µg/L	ND	ND	ND	ND	ND	ND	4.0	ND	ND	ND	ND	ND	ND	ND	ND	ND
Boron, Dissolved	µg/L	ND	4300	2100	450	1700	400	500	450	1100	190	4000	3300	1570	3000	1680	2800
Bromacil	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bromide, Dissolved	mg/L	0.80	65	43	5.7	45	14	13	7.7	43	16	68	59	54.0	52	40.0	32.4
Bromobenzene	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bromochloromethane	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bromodichloromethane	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bromofluorobenzene	µg/L	4.9	5.0	5.0	4.9	51	7.70	8.54	9.13	51	9.69	52	53	50	51	52	53
Bromoform	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bromomethane	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Butachlor	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Calcium, Dissolved	mg/L	50	400	590	180	620	460	391	254	850	730	570	600	1183	662	1012	264
Calcium, Total	mg/L	52	340	590	180	570	450	409	259	860	734	550	580	1211	676	973	257
Captan	µg/L	-	-	-	-	-	-	ND	ND	-	ND	-	-	-	-	-	-
Carbaryl	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Carbofuran	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Carbon Tetrachloride	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Carbonate as CaCO3	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chlordane	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chloride, Dissolved	mg/L	250	19000	12000	1600	12000	3900	-	-	10000	-	19000	16000	16100	16600	13300	11200
Chloride, Total	mg/L	-	-	-	-	-	-	3700	2300	-	4600	-	-	-	-	-	-
Chlorobenzene	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chloroethane	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chloroform	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chloromethane	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chloropropham	µg/L	-	-	-	-	-	-	ND	ND	-	ND	-	-	-	-	-	-
Chlorothalonil	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
cis-1,2-Dichloroethene	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
cis-1,3-Dichloropropene	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Color	CU	5.0	20	250	30	45	10	ND	ND	40	ND	20	10	23	50	25	15
Conductivity (Field)	µS/cm	1080	44440	29716	545	29650	9635	10507	6701	26437	11141	40389	35246	36237	38793	31014	26662
Copper, Total	µg/L	ND	54	37	ND	38	15	10	3.4	37	11	58	58	210	201	219	152
Cyanazine	µg/L	-	-	-	-	-	-	ND	ND	-	ND	-	-	-	-	-	-
Dalapon	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
DCPA	µg/L	-	-	-	-	-	-	ND	ND	-	ND	-	-	-	-	-	-
DCPAA	µg/L	71	63	46	48	49	47	-	-	47	-	47	46	42	62	66	64
Decachlorobiphenyl	µg/L	-	-	-	-	-	-	0.0228	0.0295	-	0.0788	-	-	39%	0.0206	0.00734	0.0650
Delta Oxygen-18	δ^{18}O (‰)	-6.4	-0.5	-	-	-3.1	-5.3	-6.0	-6.4	-3.6	-5.2	-0.6	-1.3	-2.0	-1.0	-2.2	-2.5
delta-BHC	µg/L	-	-	-	-	-	-	ND	ND	-	ND	-	-	ND	ND	ND	ND
Delta-Deuterium	δ^{2}H (‰)	-42.0	-3.0	-	-	-19.2	-37.6	-40.1	-43.6	-24.5	-35.9	-5.5	-11.0	-13	-9	-16	-19
Diazinon	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Summary of Isolated Aquifer Zone Testing Field and Laboratory Water Quality Results - Moss Landing Area

Borehole:		**PR-1**		**ML-1**		**ML-2**		**ML-3**		**ML-4**		**ML-6**		**MDW-1**			
Zone #:		1	2	1	2	1	2	1	2	1	2	1	2	1	2	3	4
Screen Interval (ft bgs):		190 - 200	125 - 135	113.5 - 118.5	90 - 100	167 - 177	90 - 100	180 - 190	103 - 113	163.5 - 173.5	74.5 - 84.5	152 - 162	100 - 110	237 - 247	187 - 197	152 - 162	60 - 70
Sample Date:		24-Sep-13	25-Sep-13	5-Oct-13	7-Oct-13	17-Dec-13	19-Dec-13	11-Jan-14	13-Jan-14	5-Dec-13	6-Dec-13	22-Nov-13	23-Nov-13	1-May-14	7-May-14	8-May-14	10-May-14
Constituent[1]	**Units**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
Dibromochloromethane	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dibromochloropropane (DBCP)	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dibromomethane	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dicamba	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dichloroacetate	mg/L	10.6	539	108	10.8	100	25.3	0.5	0.505	140	0.48	132	131	-	-	-	-
Dichlorodifluoromethane (Freon 12)	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dichloromethane	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dichloroprop	µg/L	-	-	-	-	-	-	ND	ND	-	ND	-	-	-	-	-	-
Dieldrin	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Di-isopropyl ether (DIPE)	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dimethoate	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dinoseb	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dioxin (2,3,7,8 TCDD)	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	ND	ND	ND	ND	ND	ND
Diphenamid	µg/L	-	-	-	-	-	-	ND	ND	-	ND	-	-	-	-	-	-
Diquat	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dissolved Oxygen (Field)	mg/L	N/A	N/A	N/A	N/A	0	0	3.7	0.1	0	0.1	0.1	0.1	0.2	0.2	0.1	2.5
Disulfoton	µg/L	-	-	-	-	-	-	ND	ND	-	ND	-	-	-	-	-	-
Endosulfan I	µg/L	-	-	-	-	-	-	ND	ND	-	ND	-	-	ND	ND	ND	ND
Endosulfan II	µg/L	-	-	-	-	-	-	ND	ND	-	ND	-	-	ND	ND	ND	ND
Endosulfan sulfate	µg/L	-	-	-	-	-	-	ND	ND	-	ND	-	-	ND	ND	ND	ND
Endothall	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endrin	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endrin aldehyde	µg/L	-	-	-	-	-	-	ND	ND	-	ND	-	-	ND	ND	ND	ND
EPTC	µg/L	-	-	-	-	-	-	ND	ND	-	ND	-	-	-	-	-	-
Ethyl tert-Butyl Ether (ETBE)	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ethylbenzene	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ethylene Dibromide (EDB)	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fluoride, Dissolved	mg/L	0.10	ND	0.12	0.20	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.6
gamma-BHC (Lindane)	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Glyphosate	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hardness as CaCO3	mg/L	240	5300	4700	920	4800	2500	1020	647	6100	1830	6400	6000	8208	6658	6498	3887
Heptachlor	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Heptachlor Epoxide	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hexachlorobenzene	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hexachlorobutadiene	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hexachlorocyclopentadiene	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hydroxide as CaCO3	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Iodide, Dissolved	µg/L	64	ND	ND	180	920	360	100	200	640	51	620	380	ND	ND	ND	ND
Iron, Dissolved	µg/L	ND	ND	6000	ND	ND	140	ND	1700	ND	ND	ND	ND	365	13059	20051	ND
Iron, Total	µg/L	200	650	20000	1800	3000	500	6900	3500	1200	10000	3900	560	492	13532	26720	178
Isopropylbenzene	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Lithium	µg/L	27	150	140	34	270	78	110	86	240	91	390	330	226	153	120	142
m,p-Xylenes	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Magnesium, Dissolved	mg/L	27	1200	810	110	900	360	298	173	970	507	1200	1100	1211	1168	1020	796
Magnesium, Total	mg/L	28	1100	780	110	820	340	310	178	960	512	1200	1100	1259	1207	988	788
Manganese, Dissolved	µg/L	180	1700	5200	790	2600	710	1400	1300	6400	5000	3900	3600	1605	4694	6512	ND
Manganese, Total	µg/L	190	1500	5300	790	2400	680	1500	1400	6400	5100	3800	3500	1653	4817	6303	ND
Mass Balance, Total	meq/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mass Balance-Dissolved Anions	meq/L	12	580	380	51	390	120	-	-	320	-	590	500	504	520	416	351
Mass Balance-Dissolved Cations	meq/L	11	570	360	50	380	120	-	-	340	-	550	480	497	507	452	370
MBAS (Surfactants)	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methiocarb	µg/L	-	-	-	-	-	-	ND	ND	-	ND	-	-	ND	ND	ND	ND
Methomyl	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methoxychlor	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methyl tert-butyl ether (MTBE)	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Summary of Isolated Aquifer Zone Testing Field and Laboratory Water Quality Results - Moss Landing Area

Borehole:		PR-1		ML-1		ML-2		ML-3		ML-4		ML-6		MDW-1			
Zone #:		1	2	1	2	1	2	1	2	1	2	1	2	1	2	3	4
Screen Interval (ft bgs):		190 - 200	125 - 135	113.5 - 118.5	90 - 100	167 - 177	90 - 100	180 - 190	103 - 113	163.5 - 173.5	74.5 - 84.5	152 - 162	100 - 110	237 - 247	187 - 197	152 - 162	60 - 70
Sample Date:		24-Sep-13	25-Sep-13	5-Oct-13	7-Oct-13	17-Dec-13	19-Dec-13	11-Jan-14	13-Jan-14	5-Dec-13	6-Dec-13	22-Nov-13	23-Nov-13	1-May-14	7-May-14	8-May-14	10-May-14
Constituent[1]	**Units**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
Metolachlor	μg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Metribuzin	μg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Molinate	μg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Naphthalene	μg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
n-Butylbenzene	μg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Nitrate as NO3	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2	18	8
Nitrate+Nitrite as N	mg/L	-	-	-	-	-	-	ND	ND	-	ND	-	-	ND	0.5	4.2	1.8
Nitrite as NO2-N, Dissolved	mg/L	ND	ND	ND	ND	ND	ND	-	-	ND	-	ND	ND	ND	ND	ND	ND
n-Propylbenzene	μg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Odor	TON	2.0	10	20	50	1.0	1.0	4.0	2.0	1.0	1.0	ND	ND	2	4	1	1
Orthophosphate as P, Dissolved	mg/L	0.14	0.042	ND	0.16	0.20	0.079	0.0039	0.012	0.12	0.077	0.14	0.14	ND	0.08	ND	0.06
Oxamyl	μg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Oxidation-Reduction Potential (Field)	mV	-50.5	-110.8	N/A	N/A	-99.2	30.1	-105.8	-151.4	-13.8	-92.8	-90.5	60.6	2.33	-106.0	-131.8	-10.1
o-Xylene	μg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PCB Aroclor Screen	μg/L	ND	ND	ND	ND	ND	ND	-	-	ND	-	ND	ND	-	-	-	-
PCBs, Total	μg/L	-	-	-	-	-	-	ND	ND	-	ND	-	-	ND	ND	ND	ND
Pentachlorophenol	μg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Perylene-d12	μg/L	-	-	-	-	-	-	5.08	4.75	-	1.38	-	-	-	-	-	-
pH	pH Units	8.2	7.7	7.4	7.8	7.7	7.6	7.49	7.22	7.6	6.79	7.4	7.4	7.2	6.9	6.9	7.4
pH (Field)	pH Units	6.87	6.66	6.92	7.24	6.86	6.67	7.32	6.94	6.76	6.57	6.63	6.58	7.12	6.80	6.9	7.32
pH Temperature in °C	°C	21.7	21.9	21.6	21.3	20.1	19.9	-	-	21.9	-	21.4	21.0	-	-	-	-
Phosphorus, Dissolved	mg/L	0.11	ND	0.18	0.21	ND	ND	0.078	0.20	ND	0.047	ND	0.12	ND	0.08	ND	0.08
Picloram	μg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
p-Isopropyltoluene	μg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Potassium, Dissolved	mg/L	6.0	380	92	31	130	34	58	27	98	36	250	270	36	158	81	246
Potassium, Total	mg/L	-	-	-	-	-	-	60	27	-	37	-	-	-	-	-	-
Prometon	μg/L	-	-	-	-	-	-	ND	ND	-	ND	-	-	-	-	-	-
Prometryn	μg/L	-	-	-	-	-	-	ND	ND	-	ND	-	-	ND	ND	ND	ND
Propachlor	μg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Propoxur (Baygon)	μg/L	-	-	-	-	-	-	ND	ND	-	ND	-	-	ND	ND	ND	ND
QC Ratio TDS/SEC		-	-	-	-	-	-	-	-	-	-	-	-	0.70	0.67	0.70	0.66
sec-Butylbenzene	μg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Silica as SiO2, Dissolved	mg/L	30	25	26	35	34	38	36	40	34	40	32	32	32	30	34	15
Simazine	μg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sodium, Dissolved	mg/L	140	10000	6000	710	6200	1500	1600	1000	5000	1400	9400	8100	7758	8588	7254	6541
Sodium, Total	mg/L	-	-	-	-	-	-	1700	1000	-	1400	-	-	-	-	-	-
Specific Conductance (EC)	μmhos/cm	1200	43000	30000	4900	31000	11000	12000	7800	29000	13000	43000	38000	44180	45230	38100	32970
Specific Conductance (EC) (Field)	μS/cm	1296	53620	35169	647	34730	11508	11704	7439	30671	12933	48132	42650	42787	45875	37546	32173
Strontium, Dissolved	μg/L	400	7400	7100	1600	7900	4100	3100	1900	8600	5300	12000	10000	9880	8490	8936	4369
Styrene	μg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sulfate as SO4, Dissolved	mg/L	24	2500	1400	21	1000	340	370	190	960	420	2000	1900	2208	2270	1790	1560
TCMX	μg/L	2.3	2.2	2.4	1.2	4.9	5.1	0.0783	0.104	3.5	0.0877	4.6	4.5	-	0.0961	0.0770	0.0796
Temperature (Field)	°C	16.3	15.4	16.9	16.8	17.3	16.4	19.7	19.8	17.8	17.7	16.5	15.9	17.0	16.8	15.9	16
Terbacil	μg/L	-	-	-	-	-	-	ND	ND	-	ND	-	-	-	-	-	-
tert-Amyl Methyl Ether (TAME)	μg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
tert-Butyl alcohol (TBA)	μg/L	ND	ND	ND	ND	ND	-	-	-	ND	-	ND	ND	ND	ND	ND	ND
tert-Butylbenzene	μg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tetrachloroethene (PCE)	μg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tetrachloro-meta-xylene (TCMX)	%	150	146	165	79	111	115	78	104	80	92	103	103	87	101	81	84
Thiobencarb	μg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Toluene	μg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Anions	meq/L	-	-	-	-	-	-	120	73	-	140	-	-	-	-	-	-
Total Cations	meq/L	11	120	-	-	-	-	120	73	-	140	-	-	520	522	437	368
Total Dissolved Solids	mg/L	630	34000	22000	3200	19000	8100	7400	4200	21000	8600	34000	28000	31000	30200	26600	21900
Total Dissolved Solids (Field)	mg/L	845	34853	22847.5	422.5	23616.4	7826.8	7942.4	5059.2	20855.6	8799.2	31284.5	29002	29097.2	31198.4	25513.6	21875.1

Summary of Isolated Aquifer Zone Testing Field and Laboratory Water Quality Results - Moss Landing Area

Borehole:		**PR-1**		**ML-1**		**ML-2**		**ML-3**		**ML-4**		**ML-6**		**MDW-1**			
Zone #:		1	2	1	2	1	2	1	2	1	2	1	2	1	2	3	4
Screen Interval (ft bgs):		190 - 200	125 - 135	113.5 - 118.5	90 - 100	167 - 177	90 - 100	180 - 190	103 - 113	163.5 - 173.5	74.5 - 84.5	152 - 162	100 - 110	237 - 247	187 - 197	152 - 162	60 - 70
Sample Date:		24-Sep-13	25-Sep-13	5-Oct-13	7-Oct-13	17-Dec-13	19-Dec-13	11-Jan-14	13-Jan-14	5-Dec-13	6-Dec-13	22-Nov-13	23-Nov-13	1-May-14	7-May-14	8-May-14	10-May-14
Constituent[1]	**Units**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
Total Kjehldahl Nitrogen, Dissolved	mg/L	ND	ND	16	8.1	14	1.5	9.7	1.6	11	0.15	7.3	2.3	ND	3.3	3.6	ND
Total Oxidizable Nitrogen, as N	mg/L	ND	ND	ND	ND	ND	ND	-	-	ND	-	ND	ND	-	-	-	-
Total Trihalomethanes	μg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Toxaphene	μg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
trans-1,2-Dichloroethene	μg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
trans-1,3-Dichloropropene	μg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Trichloroethene (TCE)	μg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Trichlorofluoromethane	μg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Trifluralin	μg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Triphenyl phosphate	μg/L	-	-	-	-	-	-	6.30	6.10	-	5.24	-	-	-	-	-	-
Trithion	μg/L	-	-	-	-	-	-	ND	ND	-	ND	-	-	-	-	-	-
Tritium	pCi/L	-68.2 ± 108 (199)	38.7 ± 122 (212)	47.5 ± 127 (220)	-17.9 ± 117 (210)	-4.86±115 (204)	32.8±122 (212)	-2.52 ± 125 (221)	58.9 ± 121 (207)	-118±123 (231)	-110±130 (240)	10.3±129 (226)	-15.7±129 (230)	-	-	-	-
Tritium, prec. est.[2]	TU	-	-	pending	pending	pending	pending	pending	pending	pending	pending	pending	pending	pending	pending	pending	pending
Turbidity	NTU	0.67	5.1	150	19	6.0	2.7	160	11	6.6	2.8	6.5	1.6	0.85	9.7	150	0.60
Turbidity (Field)	NTU	0.89	1.56	0.7	2.52	1.68	0.72	65.2	0.99	0.48	0.94	1.26	1.73	2.33	0.64	0.84	0.83
Vinyl Chloride	μg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Xylenes, Total	μg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Zinc, Total	μg/L	ND	ND	ND	ND	ND	ND	240	31	ND	29	ND	ND	ND	ND	ND	ND

Notes:

°C = Degrees Celsius
CU = Color Units
$\delta^{18}O$ (‰) = Delta Oxygen-18
$\delta^{2}H$ (‰) = Delta-Deuterium
meq/L = Milliequivalents per Liter
mg/L = Milligrams per Liter
mV = Millivolts
NTU = Nephelometric Turbidity Units
pCi/L = Pico Curies per Liter
pg/L = Picograms per Liter
TON = Threshold Odor Number
TU = Tritium Units
μg/L = Micorgrams per Liter
μmhos/cm = Micromhos per Centimeter
μS/cm = MicroSiemens per Centimeter

ND = NOT DETECTED at or above the Reporting Limit or Practical Quantitation Limit. If J-value reported, then NOT DETECTED at or above the Method Detection Limit (MDL)

[1] See laboratory water quality reports in Appendix G for method numbers, dilution factors, Method Detection Limits, and Reporting Limits.
[2] Laboratory water quality results pending.

Summary of Isolated Aquifer Zone Testing Field and Laboratory Water Quality Results - CEMEX - Marina, CA

Borehole:		**CX-B1WQ**						**CX-B2WQ**				**CX-B4**				
Zone #:		1	2	3	4	5	6	1	2	3	4	1	2	3	4	5
Screen Interval (ft bgs):		274 - 284	237 - 247	182 - 192	134 - 144	84 - 94	51 - 61	215 - 225	161 - 171	104 - 114	55 - 65	306 - 316	248 - 258	155 - 165	110 - 120	58 - 68
Sample Date:		18-Feb-14	19-Feb-14	21-Feb-14	22-Feb-14	23-Feb-14	25-Feb-14	8-Mar-14	10-Mar-14	11-Mar-14	12-Mar-14	5-Apr-14	6-Apr-14	8-Apr-14	9-Apr-14	10-Apr-14
Constituent[1]	**Units**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
1,1,1,2-Tetrachloroethane	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1,1-Trichloroethane	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1,2,2-Tetrachloroethane	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1,2-Trichloro-1,2,2-trifluoroethane	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1,2-Trichloroethane	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethane	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethene	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloropropene	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3-Trichlorobenzene	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3-Trichloropropane	µg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1,2,4-Trichlorobenzene	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,4-Trimethylbenzene	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dichlorobenzene	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dichlorobenzene-d4	µg/L	5.0	4.8	4.9	5.0	4.8	4.8	5.0	4.9	4.8	4.6	4.9	4.7	4.8	5.2	5.0
1,2-Dichloroethane	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dichloropropane	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,3,5-Trimethylbenzene	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,3-Dichlorobenzene	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,3-Dichloropropane	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,3-Dichloropropene, Total	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,3-Dimethyl-2-nitrobenzene	µg/L	5.0	5.3	5.6	5.1	5.5	5.4	5.0	4.8	5.2	5.0	5.4	5.2	4.1	4.3	5.0
1,4-Dichlorobenzene	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1-Br-2-Nitrobenzene	µg/L	-	3.7	3.8	3.7	3.9	2.2	2.4	2.3	0.60	0.64	0.49	0.49	0.44	0.42	0.43
2,2-Dichloropropane	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4,5-T	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4,5-TP (Silvex)	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4-D	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4-DB	µg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2,4-DCAA	µg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Butanone	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Chloroethyl vinyl ether	µg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Chlorotoluene	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Hexanone	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3,5-Dichlorobenzoic acid	µg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-Hydroxycarbofuran	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4,4´-DDD	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4,4´-DDE	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4,4´-DDT	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4-Chlorotoluene	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4-Methyl-2-pentanone	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acetone	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acifluorfen	µg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Alachlor	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aldicarb	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aldicarb Sulfone	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aldicarb Sulfoxide	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Summary of Isolated Aquifer Zone Testing Field and Laboratory Water Quality Results - CEMEX - Marina, CA

	Borehole:	**CX-B1WQ**						**CX-B2WQ**				**CX-B4**				
	Zone #:	1	2	3	4	5	6	1	2	3	4	1	2	3	4	5
	Screen Interval (ft bgs):	274 - 284	237 - 247	182 - 192	134 - 144	84 - 94	51 - 61	215 - 225	161 - 171	104 - 114	55 - 65	306 - 316	248 - 258	155 - 165	110 - 120	58 - 68
	Sample Date:	18-Feb-14	19-Feb-14	21-Feb-14	22-Feb-14	23-Feb-14	25-Feb-14	8-Mar-14	10-Mar-14	11-Mar-14	12-Mar-14	5-Apr-14	6-Apr-14	8-Apr-14	9-Apr-14	10-Apr-14
Constituent[1]	**Units**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
Aldrin	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Alkalinity as CaCO3	mg/L	118	132	167	96	126	103	147	129	102	104	112	118	103	98	62
alpha-BHC	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aluminum	µg/L	77	ND	ND	ND	ND	ND	84	74	156	204	ND	ND	ND	31	20
Ammonia as N, Dissolved	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.1	ND	ND	ND	ND	ND
AMPA	µg/L	110	100	110	98	89	110	120	98	100	76	98	110	110	96	110
Aroclor 1016	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aroclor 1221	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aroclor 1232	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aroclor 1242	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aroclor 1248	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aroclor 1254	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aroclor 1260	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Arsenic, Total	µg/L	38	ND	ND	ND	ND	ND	46	28	59	55	33	32	27	26	5
Atrazine	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Barium, Dissolved	µg/L	138	210	ND	120	ND	100	109	346	85	90	174	123	84	179	222
Bentazon	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzene	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo(a)pyrene	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
beta-BHC	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bicarbonate as CaCO3	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bicarbonate as HCO3	mg/L	144	161	204	117	154	126	179	157	124	127	137	144	126	120	76
Bis(2-ethylhexyl) adipate (DEHA)	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bis(2-ethylhexyl) phthalate (DEHP)	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Boron, Dissolved	µg/L	700	730	1540	2880	2800	2400	1540	860	2580	2360	600	1840	1400	1310	260
Bromacil	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bromide, Dissolved	mg/L	41	24	49.6	38	41	38	38	23	45	44	43	39	29	31	6.1
Bromobenzene	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bromochloromethane	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bromodichloromethane	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bromofluorobenzene	µg/L	52	50	51	52	50	48	51	51	51	48	50	49	49	52	51
Bromoform	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bromomethane	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Butachlor	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Calcium, Dissolved	mg/L	2718	1558	2018	502	656	709	1948	1141	732	886	3158	1557	911	1164	277
Calcium, Total	mg/L	2718	1581	2090	505	674	710	1961	1181	712	896	3125	1516	938	1081	261
Captan	µg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Carbaryl	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Carbofuran	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Carbon Tetrachloride	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Carbonate as CaCO3	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chlordane	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chloride, Dissolved	mg/L	14184	8796	17995	14050	14755	13675	13026	7408	14099	14464	14013	13566	10128	11044	2045
Chloride, Total	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chlorobenzene	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chloroethane	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Summary of Isolated Aquifer Zone Testing Field and Laboratory Water Quality Results - CEMEX - Marina, CA

	Borehole:	CX-B1WQ						CX-B2WQ				CX-B4				
	Zone #:	1	2	3	4	5	6	1	2	3	4	1	2	3	4	5
	Screen Interval (ft bgs):	274 - 284	237 - 247	182 - 192	134 - 144	84 - 94	51 - 61	215 - 225	161 - 171	104 - 114	55 - 65	306 - 316	248 - 258	155 - 165	110 - 120	58 - 68
	Sample Date:	18-Feb-14	19-Feb-14	21-Feb-14	22-Feb-14	23-Feb-14	25-Feb-14	8-Mar-14	10-Mar-14	11-Mar-14	12-Mar-14	5-Apr-14	6-Apr-14	8-Apr-14	9-Apr-14	10-Apr-14
Constituent[1]	**Units**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
Chloroform	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chloromethane	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chloropropham	µg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chlorothalonil	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
cis-1,2-Dichloroethene	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
cis-1,3-Dichloropropene	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Color	CU	7	14	ND	10	5	4	21	7	ND	23	23	4	9	16	14
Conductivity (Field)	µS/cm	32361	20869	41546	34907	35167	30803	31029	18875	34532	34162	34754	34291	25663	26466	6208
Copper, Total	µg/L	15	ND	ND	ND	ND	ND	ND	ND	150	136	107	140	111	90	18
Cyanazine	µg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dalapon	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
DCPA	µg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DCPAA	µg/L	48	51	42	43	45	41	45	56	47	47	53	55	56	59	58
Decachlorobiphenyl	µg/L	0.00769	0.0667	0.0149	0.0690	0.0727	71%	0.0277	0.0308	0.0727	0.0680	0.0205	0.0504	0.0417	0.0364	0.0585
Delta Oxygen-18	$\delta^{18}O$ (‰)	-2.6	-4.3	-0.8	-2.0	-1.6	-2.1	-2.3	-3.7	-1.8	-1.4	-3.0	-2.8	-4.3	-4.0	-5.9
delta-BHC	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Delta-Deuterium	$\delta^{2}H$ (‰)	-18.4	-29.1	-6.2	-14.0	-12.0	-15.1	-18.0	-29.2	-13.3	-12.6	-19	-17	-28	-26	-40
Diazinon	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dibromochloromethane	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dibromochloropropane (DBCP)	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dibromomethane	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dicamba	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dichloroacetate	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dichlorodifluoromethane (Freon 12)	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dichloromethane	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dichloroprop	µg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dieldrin	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Di-isopropyl ether (DIPE)	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dimethoate	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dinoseb	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dioxin (2,3,7,8 TCDD)	pg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Diphenamid	µg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Diquat	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dissolved Oxygen (Field)	mg/L	1	1	0.1	3.6	3.6	3.5	0.9	1.4	5.7	4.7	0.6	2.5	4.5	5.1	28.3
Disulfoton	µg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Endosulfan I	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endosulfan II	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endosulfan sulfate	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endothall	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endrin	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endrin aldehyde	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
EPTC	µg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ethyl tert-Butyl Ether (ETBE)	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ethylbenzene	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ethylene Dibromide (EDB)	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fluoride, Dissolved	mg/L	0.2	0.1	ND	ND	0.4	0.3	ND	0.2	0.5	0.5	ND	ND	ND	ND	0.2

Summary of Isolated Aquifer Zone Testing Field and Laboratory Water Quality Results - CEMEX - Marina, CA

Borehole:		**CX-B1WQ**						**CX-B2WQ**				**CX-B4**				
Zone #:		1	2	3	4	5	6	1	2	3	4	1	2	3	4	5
Screen Interval (ft bgs):		274 - 284	237 - 247	182 - 192	134 - 144	84 - 94	51 - 61	215 - 225	161 - 171	104 - 114	55 - 65	306 - 316	248 - 258	155 - 165	110 - 120	58 - 68
Sample Date:		18-Feb-14	19-Feb-14	21-Feb-14	22-Feb-14	23-Feb-14	25-Feb-14	8-Mar-14	10-Mar-14	11-Mar-14	12-Mar-14	5-Apr-14	6-Apr-14	8-Apr-14	9-Apr-14	10-Apr-14
Constituent[1]	**Units**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
gamma-BHC (Lindane)	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Glyphosate	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hardness as CaCO3	mg/L	11070	6723	9880	5350	6748	5561	8776	5486	5995	6405	12494	7768	5950	5928	1278
Heptachlor	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Heptachlor Epoxide	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hexachlorobenzene	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hexachlorobutadiene	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hexachlorocyclopentadiene	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hydroxide as CaCO3	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Iodide, Dissolved	µg/L	ND	ND	190	ND	160	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Iron, Dissolved	µg/L	362	2539	1780	814	171	57	246	148	ND	121	775	ND	151	130	148
Iron, Total	µg/L	362	2643	1928	922	178	162	367	238	138	164	878	241	205	389	185
Isopropylbenzene	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Lithium	µg/L	218	120	140	120	170	140	149	75	173	164	191	127	63	31	5
m,p-Xylenes	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Magnesium, Dissolved	mg/L	1041	683	1078	981	1215	928	936	605	1056	1015	1146	988	839	845	162
Magnesium, Total	mg/L	1040	674	1132	993	1230	920	942	616	1024	1012	1139	967	876	784	152
Manganese, Dissolved	µg/L	127	166	361	349	ND	172	ND	ND	ND	ND	657	133	204	172	345
Manganese, Total	µg/L	134	187	382	387	78	131	ND	ND	ND	ND	650	128	210	164	320
Mass Balance, Total	meq/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mass Balance-Dissolved Anions	meq/L	439.7	271.9	567.6	436.9	458.5	424.8	405.7	226.8	439	449	432.7	422.8	313.2	342	64.9
Mass Balance-Dissolved Cations	meq/L	423.3	261.6	564.9	458.9	464.6	387.0	399.0	215.5	418	418	464.8	459.7	331.6	349	70.3
MBAS (Surfactants)	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methiocarb	µg/L	-	-	-	-	-	-	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methomyl	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methoxychlor	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methyl tert-butyl ether (MTBE)	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Metolachlor	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Metribuzin	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Molinate	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Naphthalene	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
n-Butylbenzene	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Nitrate as NO3	mg/L	ND	ND	ND	2	2	3	ND	2	2	ND	ND	2	3	4	21
Nitrate+Nitrite as N	mg/L	ND	0.2	ND	0.4	0.4	0.8	ND	0.6	0.5	ND	ND	0.3	0.7	0.9	4.9
Nitrite as NO2-N, Dissolved	mg/L	ND	ND	ND	ND	ND	ND	0.4	0.2	ND	ND	ND	ND	ND	ND	0.2
n-Propylbenzene	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Odor	TON	1	1	1	1	1	1	1	2	1	1	2	3	1	1	4
Orthophosphate as P, Dissolved	mg/L	0.05	0.09	0.08	0.07	0.07	ND	ND	ND	ND	0.05	ND	ND	ND	ND	ND
Oxamyl	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Oxidation-Reduction Potential (Field)	mV	61.1	-32.4	-253.3	-56.6	7.9	-67.3	49	30.9	45.6	16.2	-38.4	36.8	34	74.9	6.5
o-Xylene	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PCB Aroclor Screen	µg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PCBs, Total	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pentachlorophenol	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Perylene-d12	µg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
pH	pH Units	6.7	6.9	6.9	6.9	7.2	7.3	7.0	7.4	7.2	7.2	6.8	6.9	6.9	6.6	7.1

Summary of Isolated Aquifer Zone Testing Field and Laboratory Water Quality Results - CEMEX - Marina, CA

Borehole:		**CX-B1WQ**						**CX-B2WQ**				**CX-B4**				
Zone #:		1	2	3	4	5	6	1	2	3	4	1	2	3	4	5
Screen Interval (ft bgs):		274 - 284	237 - 247	182 - 192	134 - 144	84 - 94	51 - 61	215 - 225	161 - 171	104 - 114	55 - 65	306 - 316	248 - 258	155 - 165	110 - 120	58 - 68
Sample Date:		18-Feb-14	19-Feb-14	21-Feb-14	22-Feb-14	23-Feb-14	25-Feb-14	8-Mar-14	10-Mar-14	11-Mar-14	12-Mar-14	5-Apr-14	6-Apr-14	8-Apr-14	9-Apr-14	10-Apr-14
Constituent[1]	**Units**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
pH (Field)	pH Units	6.54	6.79	6.79	6.82	7.05	7.18	6.71	6.69	6.96	7.12	6.61	6.66	6.75	6.63	6.92
pH Temperature in °C	°C	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Phosphorus, Dissolved	mg/L	0.06	0.10	0.08	0.07	0.07	ND	ND	ND	ND	0.05	ND	0.09	ND	ND	ND
Picloram	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
p-Isopropyltoluene	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Potassium, Dissolved	mg/L	53	35	34	256	221	186	55	73	201	226	52	67	56	98	9.6
Potassium, Total	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Prometon	µg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Prometryn	µg/L	-	-	-	-	-	-	ND	ND	ND	ND	ND	ND	ND	ND	ND
Propachlor	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Propoxur (Baygon)	µg/L	-	-	-	-	-	-	ND	ND	ND	ND	ND	ND	ND	ND	ND
QC Ratio TDS/SEC		0.68	0.59	0.73	0.67	0.67	0.67	0.72	0.73	0.66	0.66	0.78	0.71	0.78	0.80	0.70
sec-Butylbenzene	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Silica as SiO2, Dissolved	mg/L	34	ND	25	27	19	18.0	34	30	20	19	34	32	30	27	28
Simazine	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sodium, Dissolved	mg/L	4612	2914	8612	7968	7500	6219	5135	2437	6643	6536	4864	6747	4958	5041	987
Sodium, Total	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Specific Conductance (EC)	µmhos/cm	36940	24570	48770	39610	40900	37260	36680	22060	40720	40270	38270	38210	26270	29810	6910
Specific Conductance (EC) (Field)	µS/cm	36601	23705	47112	39592	41336	35952	35199	21620	40173	39657	37688	38354	28707	29933	6988
Strontium, Dissolved	µg/L	16834	11,000	12000	9400	10000	9500	13328	8621	9020	9966	17696	11232	8713	10508	2167
Styrene	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sulfate as SO4, Dissolved	mg/L	1760	991	2688	1832	1882	1748	1674	713	1855	1822	1663	1789	1202	1358	269
TCMX	µg/L	0.0677	0.110	0.0753	0.0752	0.0796	-	0.112	0.111	0.112	0.0770	0.0855	0.0933	0.0960	0.100	0.0943
Temperature (Field)	°C	18.9	18.7	18.8	18.8	17.2	17.5	18.8	18.3	17.6	17.8	20.9	19.4	19.4	18.9	19.1
Terbacil	µg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
tert-Amyl Methyl Ether (TAME)	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
tert-Butyl alcohol (TBA)	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
tert-Butylbenzene	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tetrachloroethene (PCE)	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tetrachloro-meta-xylene (TCMX)	%	71	115	79	79	84	111	117	116	118	81	90	98	102	105	99
Thiobencarb	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Toluene	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Anions	meq/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Cations	meq/L	424.7	262.0	596.2	463.6	463.4	387.9	406.1	222.0	407	415	463.4	450.4	347.4	319	64.0
Total Dissolved Solids	mg/L	25200	14600	35600	26500	27400	24800	26500	16200	26800	26700	29800	27200	20500	24000	4815
Total Dissolved Solids (Field)	mg/L	24888	16122.8	32034.8	26921.2	28111.2	24452.8	23936	14708.4	27315.6	26968.3	25629.2	26084.8	19522.8	20352.4	4760
Total Kjehldahl Nitrogen, Dissolved	mg/L	ND	0.4	0.3	0.4	0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Oxidizable Nitrogen, as N	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Trihalomethanes	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Toxaphene	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
trans-1,2-Dichloroethene	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
trans-1,3-Dichloropropene	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Trichloroethene (TCE)	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Trichlorofluoromethane	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Trifluralin	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Triphenyl phosphate	µg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Summary of Isolated Aquifer Zone Testing Field and Laboratory Water Quality Results - CEMEX - Marina, CA

Borehole:		**CX-B1WQ**						**CX-B2WQ**				**CX-B4**				
Zone #:		1	2	3	4	5	6	1	2	3	4	1	2	3	4	5
Screen Interval (ft bgs):		274 - 284	237 - 247	182 - 192	134 - 144	84 - 94	51 - 61	215 - 225	161 - 171	104 - 114	55 - 65	306 - 316	248 - 258	155 - 165	110 - 120	58 - 68
Sample Date:		18-Feb-14	19-Feb-14	21-Feb-14	22-Feb-14	23-Feb-14	25-Feb-14	8-Mar-14	10-Mar-14	11-Mar-14	12-Mar-14	5-Apr-14	6-Apr-14	8-Apr-14	9-Apr-14	10-Apr-14
Constituent[1]	**Units**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
Trithion	µg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tritium	pCi/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tritium, prec. est.[2]	TU	0.35 ± 0.09	0.04 ± 0.09	0.01 ± 0.09	0.50 ± 0.09	0.48 ± 0.09	0.81 ± 0.09	0.10 ± 0.09	0.18 ± 0.09	0.44 ± 0.09	0.62 ± 0.09	pending	pending	pending	pending	pending
Turbidity	NTU	1.6	2.9	0.70	4.6	0.75	0.45	0.40	0.65	0.65	1.5	0.20	1.3	0.65	1.0	1.4
Turbidity (Field)	NTU	0.57	1.20	0.25	0.24	0.47	0.33	0.91	0.49	0.57	0.63	0.54	1.46	0.18	0.85	1.12
Vinyl Chloride	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Xylenes, Total	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Zinc, Total	µg/L	99	ND	ND	ND	ND	ND	218	217	384	356	ND	ND	ND	38	ND

Notes:

°C = Degrees Celsius
CU = Color Units
$\delta\ ^{18}O$ (‰) = Delta Oxygen-18
$\delta\ ^{2}H$ (‰) = Delta-Deuterium
meq/L = Milliequivalents per Liter
mg/L = Milligrams per Liter
mV = Millivolts
NTU = Nephelometric Turbidity Units
pCi/L = Pico Curies per Liter
pg/L = Picograms per Liter
TON = Threshold Odor Number
TU = Tritium Units
µg/L = Micorgrams per Liter
µmhos/cm = Micromhos per Centimeter
µS/cm = MicroSiemens per Centimeter

ND = NOT DETECTED at or above the Reporting Limit or Practical Quantitation Limit. If J-value reported, then NOT DETECTED at or above the Method Detection Limit (MDL)

[1] See laboratory water quality reports in Appendix G for method numbers, dilution factors, Method Detection Limits, and Reporting Limits.

[2] Laboratory water quality results pending.

Hydraulic Conductivity for Geologic Units at CEMEX

	Borehole	**CX-B1**				**CX-B2**				**CX-B3**				**CX-B4**			
Q_{od}	Weighed average K for each soil Type[1]	% thickness	Lithology	Min K [ft/day]	Max [ft/day]	% thickness	Lithology	Min K [ft/day]	Max [ft/day]	% thickness	Lithology	Min K [ft/day]	Max [ft/day]	% thickness	Lithology	Min K [ft/day]	Max [ft/day]
		1.00	SM: Silty Sand	45	130	1.00	SW: Well-Graded Sand	292	770	1.00	SP: Sand	74	224	1.00	SP: Sand	135	365
	Total K value [ft/day]			**45**	**130**			**292**	**770**			**74**	**224**			**135**	**365**
Q_t	**Borehole**	**CX-B1**				**CX-B2**				**CX-B3**				**CX-B4**			
	Weighed average K for each soil Type[1]	% thickness	Lithology	Min K [ft/day]	Max [ft/day]	% thickness	Lithology	Min K [ft/day]	Max [ft/day]	% thickness	Lithology	Min K [ft/day]	Max [ft/day]	% thickness	Lithology	Min K [ft/day]	Max [ft/day]
		0.25	GW: Gravel	334	849	0.67	SP: Sand	16	65	0.50	SP: Sand	21	69	1.00	SP: Sand	95	234
		0.38	SW: Well-Graded Sand	330	1,121	0.33	SM: Silty Sand	83	211	0.50	SM: Silty Sand	130	509				
		0.38	SM: Silty Sand	98	266												
	Total K value [ft/day]			**244**	**732**			**38**	**114**			**76**	**289**			**95**	**234**

[1] For each soil type, an average is calculated for each method (Hazen, Krumbein-Monk, and Kozeny-Carman) with a weighed factor of thickness. The min K and max K for each soil type is the minimum and maximum among these three weighed average K value.

Table 4

Cal Am / RBF
Monterey Peninsula Water Supply Project Hydrogeologic Investigation
Attachment 1 - Technical Memorandum (TM 1) - Summary of Results - Exploratory Boreholes

Hydraulic Conductivity for Geologic Units at MOSS LANDING

	Borehole	**MDW-1**				**ML-1**				**ML-2**				**ML-3**			
		% thickness	Lithology	Min K [ft/day]	Max [ft/day]	% thickness	Lithology	Min K [ft/day]	Max [ft/day]	% thickness	Lithology	Min K [ft/day]	Max [ft/day]	% thickness	Lithology	Min K [ft/day]	Max [ft/day]
Dune Sand	Weighed average K for each soil Type[1]	1.00	SP: Sand	135	300					1.00	SW: Well-Graded Sand	383	1,090				
	Total K value [ft/day]			**135**	**300**							**383**	**1,090**				
	Borehole	**MDW-1**				**ML-1**				**ML-2**				**ML-3**			
		% thickness	Lithology	Min K [ft/day]	Max [ft/day]	% thickness	Lithology	Min K [ft/day]	Max [ft/day]	% thickness	Lithology	Min K [ft/day]	Max [ft/day]	% thickness	Lithology	Min K [ft/day]	Max [ft/day]
Perched "A" Aquifer	Weighed average K for each soil Type[1]	1.00	SP: Sand	170	477	0.13	SP: Sand with Gravel	469	1,175	0.33	SW: Well-Graded Sand with Gravel	484	949	1.00	SP: Sand	166	564
						0.13	SP-SM: Sand with Silt and Gravel	445	1,322	0.67	SP: Sand	34	102				
						0.75	SP: Sand	109	393								
	Total K value [ft/day]			**170**	**477**			**196**	**607**			**184**	**385**			**166**	**564**

[1] For each soil type, an average is calculated for each method (Hazen, Krumbein-Monk, and Kozeny-Carman) with a weighed factor of thickness. The min K and max K for each soil type is the minimum and maximum among these three weighed average K value.

Table 5

Hydraulic Conductivity for Geologic Units at MOSS LANDING

	Borehole	**ML-4**				**ML-6**				**PR-1**			
Dune Sand	Weighed average K for each soil Type[1]	% thickness	Lithology	Min K [ft/day]	Max [ft/day]	% thickness	Lithology	Min K [ft/day]	Max [ft/day]	% thickness	Lithology	Min K [ft/day]	Max [ft/day]
		1.00	SP: Sand	164	468								
	Total K value [ft/day]			**164**	**468**								
	Borehole	**ML-4**				**ML-6**				**PR-1**			
Perched "A" Aquifer	Weighed average K for each soil Type[1]	% thickness	Lithology	Min K [ft/day]	Max [ft/day]	% thickness	Lithology	Min K [ft/day]	Max [ft/day]	% thickness	Lithology	Min K [ft/day]	Max [ft/day]
		1.00	SP: Sand	75	212	0.60	SP: Sand	32	92	0.20	SW: Well-Graded Sand with Gravel	699	1,148
						0.20	SW: Well-Graded Sand	149	610	0.20	SM: Silty Sand with Gravel	311	1,150
						0.20	SP-SM: Sand with Silt	48	178	0.20	SP: Sand with Gravel	302	561
										0.20	SP: Sand	165	396
										0.20	SW: Well-Graded Sand	1,055	9,561
	Total K value [ft/day]			**75**	**212**			**59**	**213**			**506**	**2563**

Table 5

CEMEX Area - Maximum K Values

Well	Dune Sand Aquifer					180-Foot Aquifer (or Equivalent)				
	Thickness [ft]	% Coarse	% Fine	Kc [ft/d]	Kf [ft/d]	Thickness [ft]	% Coarse	% Fine	Kc [ft/d]	Kf [ft/d]
CX-B1	86	1.00	0.00	270	na	160	0.81	0.18	508	0.0149
CX-B2	91	0.98	0.02	373	0.0270	148	0.77	0.23	152	0.0190
CX-B3	91	0.95	0.05	308	0.0270	164	0.77	0.23	277	0.0185
CX-B4	90	1.00	0.00	295	na	195	0.77	0.23	190	0.0227
Average	90	0.98	0.02	311	0.0270	167	0.78	0.22	282	0.0188

Table 6

CEMEX Area - Minimum K Values

Well	Dune Sand Aquifer					180-Foot Aquifer (or Equivalent)				
	Thickness [ft]	% Coarse	% Fine	Kc [ft/d]	Kf [ft/d]	Thickness [ft]	% Coarse	% Fine	Kc [ft/d]	Kf [ft/d]
CX-B1	86	1.00	0.00	96	na	160	0.81	0.18	156	0.0043
CX-B2	91	0.98	0.02	136	0.0210	148	0.77	0.23	52	0.0100
CX-B3	91	0.95	0.05	110	0.0210	164	0.77	0.23	90	0.0092
CX-B4	90	1.00	0.00	105	na	195	0.77	0.23	71	0.0150
Average	90	0.98	0.02	112	0.0210	167	0.78	0.22	92	0.0096

Table 7

Moss Landing Area - Maximum K Values

Well	Dune Sand Aquifer/ Perched "A" Aquifer				
	Thickness [ft]	% Coarse	% Fine	Kc [ft/d]	Kf [ft/d]
ML-1	146	0.32	0.68	485	0.0222
ML-2	200	0.65	0.35	783	0.0199
ML-3	200	0.30	0.70	841	0.0201
ML-4	201	0.63	0.37	618	0.0183
ML-6	200	0.64	0.36	704	0.0220
Average	189	0.51	0.49	686	0.0205
PR-1	139	0.93	0.07	1303	0.0213

Table 9

Moss Landing Area - Minimum K Values

Well	Dune Sand Aquifer/ Perched "A" Aquifer				
	Thickness [ft]	% Coarse	% Fine	Kc [ft/d]	Kf [ft/d]
ML-1	146	0.32	0.68	166	0.0144
ML-2	200	0.65	0.35	228	0.0112
ML-3	200	0.30	0.70	235	0.0114
ML-4	201	0.63	0.37	200	0.0089
ML-6	200	0.64	0.36	210	0.0140
Average	189	0.51	0.49	208	0.0120
PR-1	139	0.93	0.07	397	0.0131

APPENDIX A1

Borehole Lithologic Logs

GEOSCIENCE

APPENDIX A1:

BOREHOLE LITHOLOGIC LOGS

CONTENTS

Description **Page**

GEOSCIENCE
P.O. Box 220
Claremont, CA 91711
Telephone: (909) 451-6650
Fax: (909) 451-6638
www.gssiwater.com

BOREHOLE NAME **CX-B1**

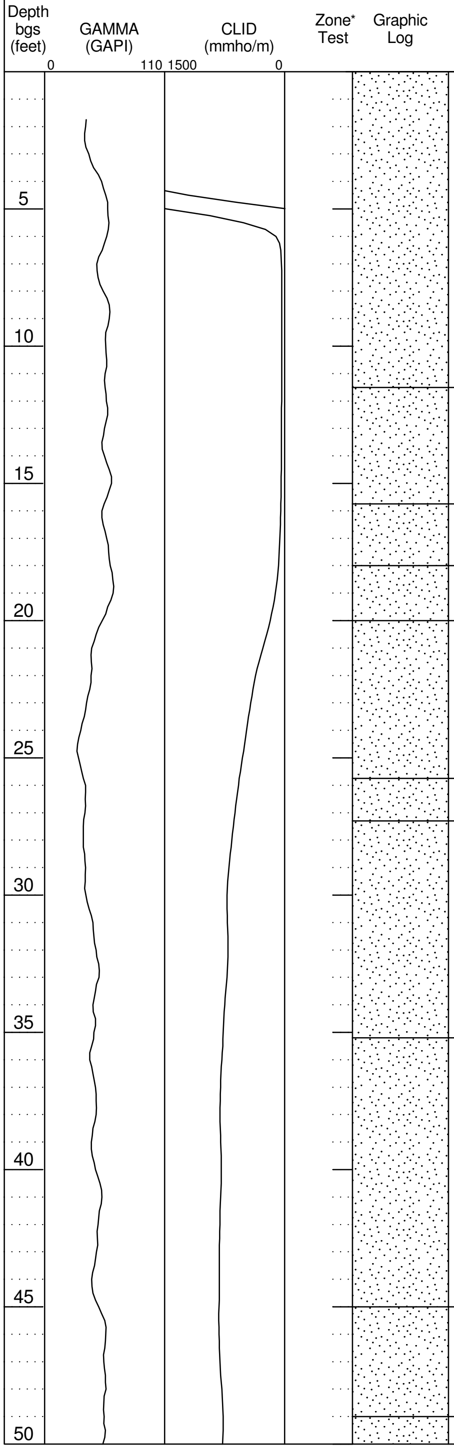
BOREHOLE LITHOLOGIC LOG

CLIENT	California American Water	LOCATION	**Marina, CA** **CEMEX Lapis Plant** **36° 42' 47.3796", -121° 48' 21.2364"** **Geographic NAD83**
PROJECT NUMBER	13017-13		
REPORT DATE	7/8/2014		
DRILLING CONTRACTOR	Cascade Drilling	LOGGED BY	**B. Villalobos**
DRILLER	Jose Munguia		

DRILLING RIG TYPE	Prosonic 600T	DRILLING METHOD	Sonic	START DATE	10/22/13	BOREHOLE DIAMETER	9 in/8 in
SURFACE ELEVATION	28.0 ft	TOTAL DEPTH	306 ft bgs	FINISH DATE	10/29/13	CORE SIZE	6 in

Lithologic Log

NOTE: Grain size distribution percentages are approximate. Material code (e.g. SP) reference Unified Soil Classification visual method. Color code (e.g. 10YR 5/2) reference Munsell Soil Color Charts.



SAND (SP): brown (10YR 4/3) and dark grayish brown (10YR 4/2), 100% fine to medium grained sand, subrounded, poorly graded, <5% dark mineral sand grains; trace silt, interbedded; medium sorted; dry sample; contains feldspar and amphibole.

SAND (SP): yellowish brown (10YR 5/8), 100% fine grained sand, subrounded, poorly graded, <2% dark mineral sand grains; well sorted; dry sample; contains quartz.

SAND (SP): yellowish brown (10YR 5/4), 100% fine to medium grained sand, subrounded; trace silt, silty sand interbedding; medium sorted; dry sample; contains feldspar and amphibole.

SAND (SP): yellowish brown (10YR 5/6), 100% fine to medium grained sand, subrounded; medium sorted; moist sample; contains quartz, feldspar and amphibole.

SAND (SP): dark yellowish brown (10YR 4/6), 100% medium grained sand; trace silt, trace gray silt lenses; wet sample; contains quartz, feldspar and amphibole.

SAND (SP): greenish gray (5GY 5/1), 100% medium grained sand, subrounded, <5% dark mineral sand grains, <0.5% coarse sand grains; well sorted; wet sample; contains quartz, feldspar and amphibole.

SAND (SP): yellowish brown (10YR 5/8), 100% medium grained sand, subrounded, poorly graded, <5% dark mineral sand grains; well sorted; wet sample; contains quartz, feldspar and amphibole.

SAND (SP): yellowish brown (10YR 5/4), 100% medium grained sand, subrounded, poorly graded, beds of medium to coarse sand; trace fine gravel up to 12.7 mm, subrounded; trace silt, brown and gray streaks of silty sand; medium sorted; wet sample; contains quartz, feldspar, amphibole, siltstones, and chert.

SAND (SP): grayish brown (2.5Y 5/2), 100% medium to coarse grained sand, subrounded to rounded; trace fine gravel up to 4.8 mm, subrounded to rounded; poorly sorted; wet sample; contains quartz, feldspar, and chert; granitic.

SAND (SP): yellowish brown (10YR 5/4), 90% medium to coarse grained sand, subrounded;

Depth bgs (feet): 5, 10, 15, 20, 25, 30, 35, 40, 45, 50

Sample Type

SS: Splitspoon sample GRAB: Grab sample PTS: Splitspoon submitted for analysis SIEVE: Grab sieved by GSSI

*Zone test details are for CX-B1WQ, approximately 80 ft west of CX-B1

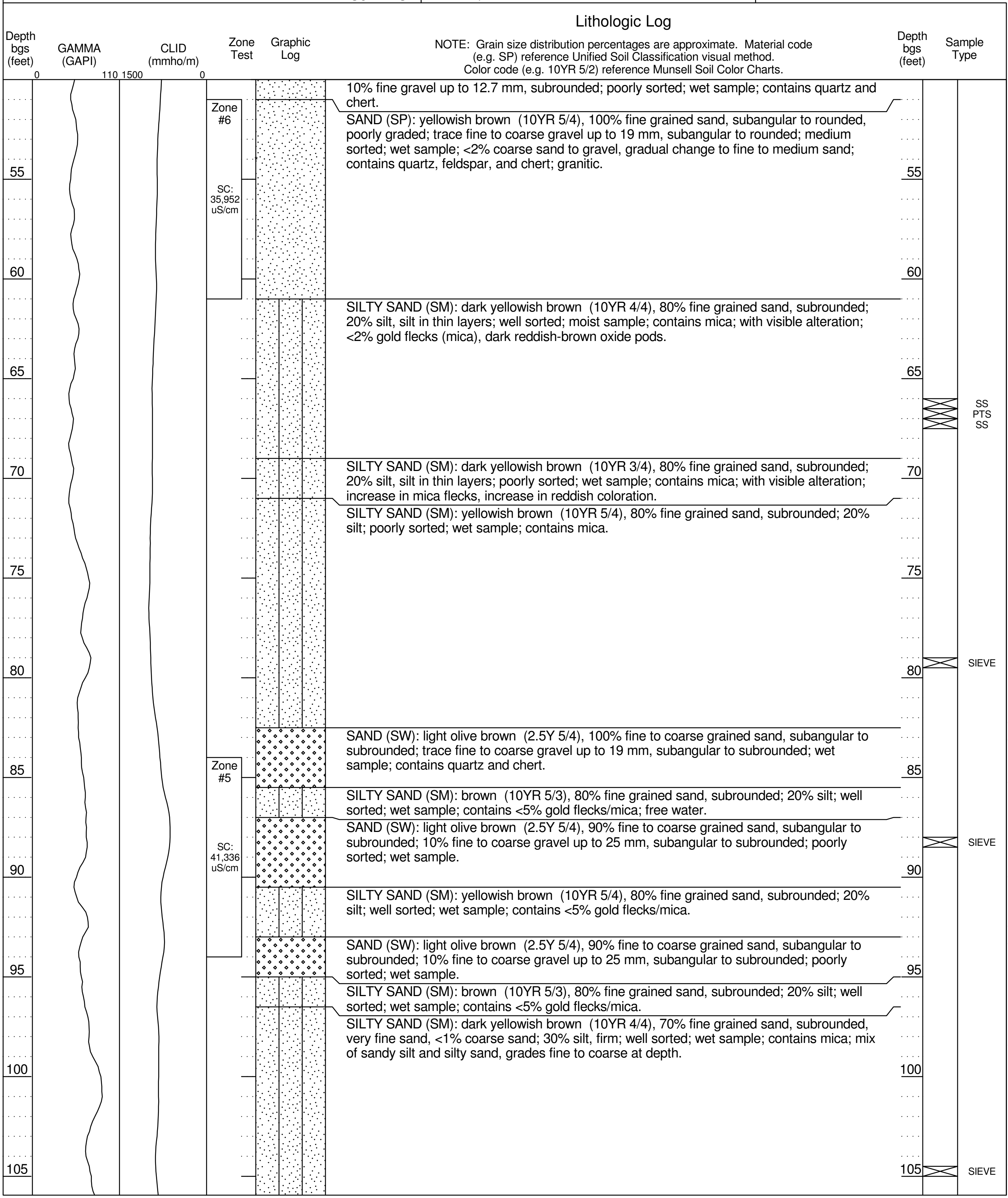
GEOSCIENCE
P.O. Box 220
Claremont, CA 91711
Telephone: (909) 451-6650
Fax: (909) 451-6638
www.gssiwater.com

BOREHOLE LITHOLOGIC LOG (continued)

BOREHOLE NAME **CX-B1**
CLIENT California American Water
PROJECT NUMBER 13017-13
LOCATION **Marina, CA**

Lithologic Log

NOTE: Grain size distribution percentages are approximate. Material code (e.g. SP) reference Unified Soil Classification visual method. Color code (e.g. 10YR 5/2) reference Munsell Soil Color Charts.



10% fine gravel up to 12.7 mm, subrounded; poorly sorted; wet sample; contains quartz and chert.

SAND (SP): yellowish brown (10YR 5/4), 100% fine grained sand, subangular to rounded, poorly graded; trace fine to coarse gravel up to 19 mm, subangular to rounded; medium sorted; wet sample; <2% coarse sand to gravel, gradual change to fine to medium sand; contains quartz, feldspar, and chert; granitic.

SILTY SAND (SM): dark yellowish brown (10YR 4/4), 80% fine grained sand, subrounded; 20% silt, silt in thin layers; well sorted; moist sample; contains mica; with visible alteration; <2% gold flecks (mica), dark reddish-brown oxide pods.

SILTY SAND (SM): dark yellowish brown (10YR 3/4), 80% fine grained sand, subrounded; 20% silt, silt in thin layers; poorly sorted; wet sample; contains mica; with visible alteration; increase in mica flecks, increase in reddish coloration.

SILTY SAND (SM): yellowish brown (10YR 5/4), 80% fine grained sand, subrounded; 20% silt; poorly sorted; wet sample; contains mica.

SAND (SW): light olive brown (2.5Y 5/4), 100% fine to coarse grained sand, subangular to subrounded; trace fine to coarse gravel up to 19 mm, subangular to subrounded; wet sample; contains quartz and chert.

SILTY SAND (SM): brown (10YR 5/3), 80% fine grained sand, subrounded; 20% silt; well sorted; wet sample; contains <5% gold flecks/mica; free water.

SAND (SW): light olive brown (2.5Y 5/4), 90% fine to coarse grained sand, subangular to subrounded; 10% fine to coarse gravel up to 25 mm, subangular to subrounded; poorly sorted; wet sample.

SILTY SAND (SM): yellowish brown (10YR 5/4), 80% fine grained sand, subrounded; 20% silt; well sorted; wet sample; contains <5% gold flecks/mica.

SAND (SW): light olive brown (2.5Y 5/4), 90% fine to coarse grained sand, subangular to subrounded; 10% fine to coarse gravel up to 25 mm, subangular to subrounded; poorly sorted; wet sample.

SILTY SAND (SM): brown (10YR 5/3), 80% fine grained sand, subrounded; 20% silt; well sorted; wet sample; contains <5% gold flecks/mica.

SILTY SAND (SM): dark yellowish brown (10YR 4/4), 70% fine grained sand, subrounded, very fine sand, <1% coarse sand; 30% silt, firm; well sorted; wet sample; contains mica; mix of sandy silt and silty sand, grades fine to coarse at depth.

SS: Splitspoon sample GRAB: Grab sample PTS: Splitspoon submitted for analysis SIEVE: Grab sieved by GSSI

*Zone test details are for CX-B1WQ, approximately 80 ft west of CX-B1

GEOSCIENCE
P.O. Box 220
Claremont, CA 91711
Telephone: (909) 451-6650
Fax: (909) 451-6638
www.gssiwater.com

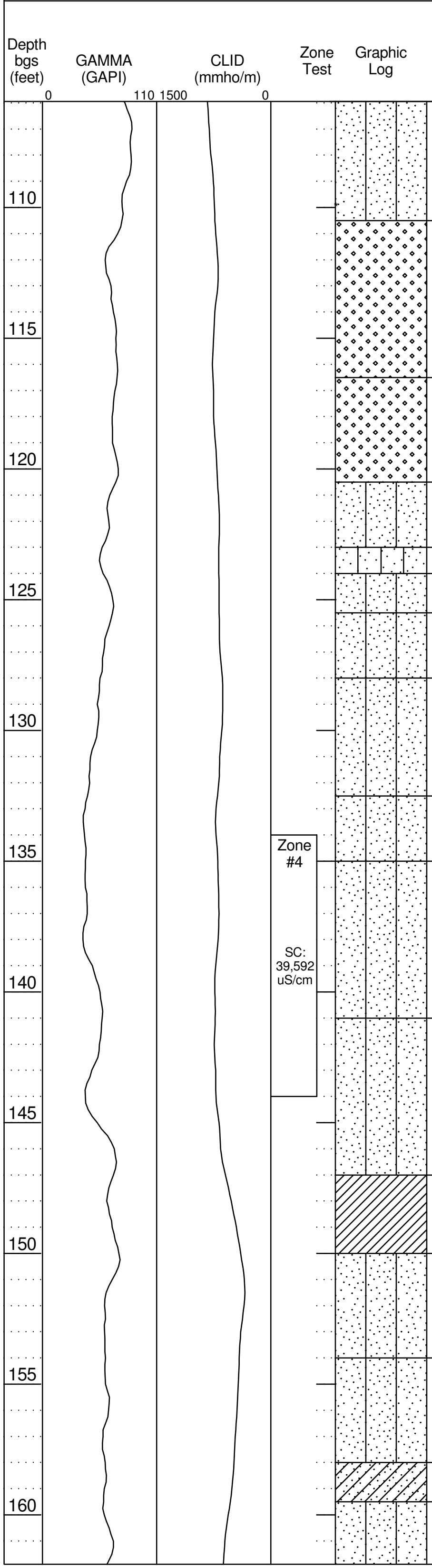
BOREHOLE NAME
CX-B1

BOREHOLE LITHOLOGIC LOG (continued)

CLIENT	California American Water	LOCATION
PROJECT NUMBER	13017-13	**Marina, CA**

Lithologic Log

NOTE: Grain size distribution percentages are approximate. Material code (e.g. SP) reference Unified Soil Classification visual method. Color code (e.g. 10YR 5/2) reference Munsell Soil Color Charts.



Depth bgs (feet)	Lithologic Log	Sample Type
110–116	SAND (SW): brownish yellow (10YR 6/6), 100% fine to coarse grained sand, subangular to subrounded, <5% feldspar and dark mineral sand grains; poorly sorted; wet sample; contains quartz, feldspar, mica and amphibole.	SIEVE (115–116)
116–120	SAND (SW): light gray (10YR 7/2), 100% fine to coarse grained sand, subangular to subrounded, <5% feldspar and dark mineral sand grains; poorly sorted; contains quartz, feldspar, mica and amphibole.	
120–122.5	SILTY SAND (SM): yellowish brown (10YR 5/8), 80% fine grained sand, subrounded to rounded; 20% silt, medium stiffness; trace fine gravel up to 4.8 mm, subrounded to rounded, <5% pebbles; well sorted.	
122.5–125	SANDY SILT (ML): yellowish brown (10YR 5/8), 60% silt; 40% fine grained sand, subrounded; thin fine sand layers, reddish-brown, faint dark brown laminations.	
125–127.5	SILTY SAND (SM): yellowish brown (10YR 5/8), 75% fine to coarse grained sand, subangular to subrounded; 20% silt; 5% fine to coarse gravel up to 25 mm, subangular to subrounded, chert, granitic and volcanic gravel; poorly sorted; contains quartz, feldspar, mica and amphibole; clasts imbricated in horizontal bedding.	
127.5–131.5	SILTY SAND (SM): yellowish brown (10YR 5/4), 80% fine grained sand, subangular to subrounded; 15% silt; 5% clay; poorly sorted; moist sample; with visible alteration; thinly bedded to laminated, grey to yellowish-brown oxidized color, thin silty sand and clayey sand layers; grades to fine.	
131.5–135	SILTY SAND (SM): grayish brown (10YR 5/2), 70% fine to coarse grained sand, subangular to subrounded, trace coarse red sand; 15% silt; 10% clay; 5% fine to coarse gravel up to 51 mm, subangular to subrounded, flat siliceous shale; poorly sorted; consists of silt, sands, and clayey sands.	
135–136	SILTY SAND (SM): yellowish red (5YR 4/6), 80% fine to medium grained sand, subangular to subrounded, poorly sorted; 15% silt; 5% clay, gray clay balls up to 13 mm, likely thin beds.	
136–141	SILTY SAND (SM): strong brown (7.5YR 4/6), 85% fine grained sand, subangular to subrounded; 15% silt; trace fine gravel up to 13 mm, subangular to subrounded; trace clay; well sorted.	GRAB (139–140)
141–147	SILTY SAND (SM): dark yellowish brown (10YR 4/6), 85% fine grained sand, subangular to subrounded; 15% silt; trace fine gravel up to 13 mm, subangular to subrounded; trace clay; well sorted.	
147–150	CLAY (CL): olive gray (5Y 4/2), 80% clay, firm, massive; 20% silt; moist sample; yellowish-brown (10YR 5/4) mottling.	
150–154	SILTY SAND (SM): light olive brown (2.5Y 5/4), 80% fine to medium grained sand, subangular to subrounded, predominantly fine grain; 15% silt; 5% clay; medium sorted; moist sample; firm; some clayey sand.	
154–158	SILTY SAND (SM): dark yellowish brown (10YR 3/4), 60% fine grained sand, subangular to subrounded; 40% silt; well sorted; moist sample; contains mica/trace gold flecks, reddish-brown (2.5YR 5/4) mottling.	
158–159.5	CLAYEY SAND (SC): yellowish brown (10YR 5/6), 80% fine grained sand, subangular to subrounded; 15% clay; 5% silt, large amounts of silt; well sorted; rolls very slightly.	
159.5–161	SILTY SAND (SM): yellowish brown (10YR 5/6), 85% fine grained sand, subangular to subrounded; 15% silt; well sorted; does not roll.	

SS: Splitspoon sample GRAB: Grab sample PTS: Splitspoon submitted for analysis SIEVE: Grab sieved by GSSI

*Zone test details are for CX-B1WQ, approximately 80 ft west of CX-B1

GEOSCIENCE
P.O. Box 220
Claremont, CA 91711
Telephone: (909) 451-6650
Fax: (909) 451-6638
www.gssiwater.com

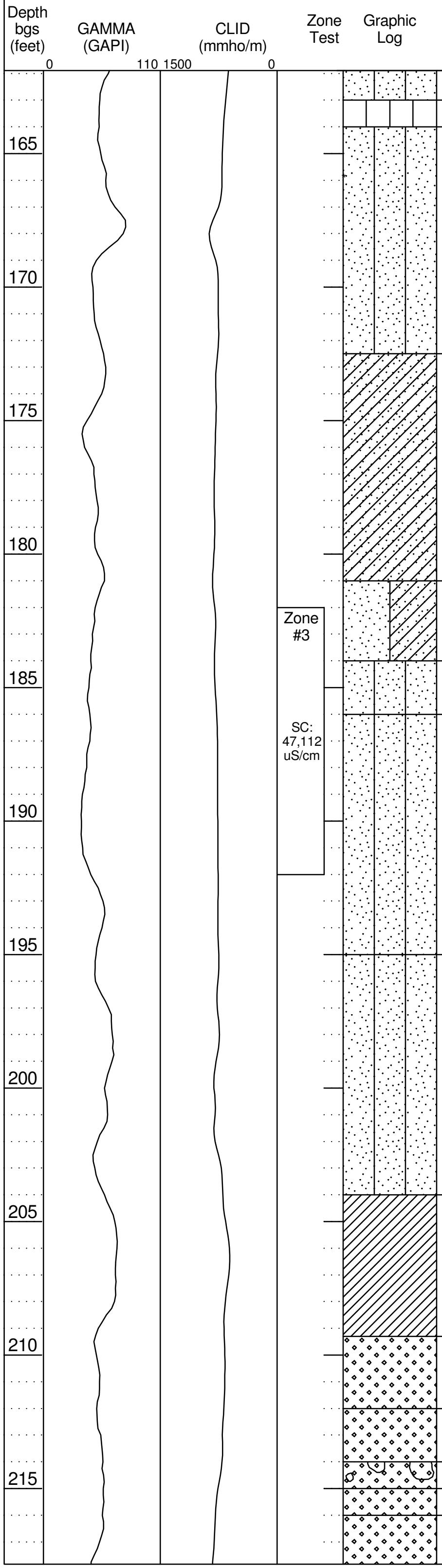
BOREHOLE NAME **CX-B1**

BOREHOLE LITHOLOGIC LOG (continued)

CLIENT	California American Water	LOCATION	**Marina, CA**
PROJECT NUMBER	13017-13		

Lithologic Log

NOTE: Grain size distribution percentages are approximate. Material code (e.g. SP) reference Unified Soil Classification visual method. Color code (e.g. 10YR 5/2) reference Munsell Soil Color Charts.



SANDY SILT (ML): dark yellowish brown (10YR 4/4), 50% fine grained sand, subangular to subrounded; 40% silt; 10% clay; well sorted; thin dark gray (10YR 4/1) clayey silt balls.

SILTY SAND (SM): yellowish brown (10YR 5/6), 85% fine grained sand, subangular to subrounded; 15% silt; well sorted.

CLAYEY SAND (SC): yellowish brown (10YR 5/6), 80% fine grained sand, subangular to subrounded, fine, soft, dark yellowish brown (10YR 5/4) sand; 15% clay; 5% silt; well sorted; wet sample; consisting of silty sands and clayey sands, rolls slightly.

SAND WITH CLAY (SP-SC): dark yellowish brown (10YR 4/4), 90% fine grained sand, subangular to subrounded; 10% clay; well sorted; moderately indurated, slightly less clay.

SILTY SAND (SM): dark yellowish brown (10YR 4/4), 85% fine grained sand, subangular to subrounded, well sorted; 15% silt.

SILTY SAND (SM): dark grayish brown (10YR 4/2), 80% fine grained sand, subangular to subrounded, well sorted; 20% silt; moist sample; free water, material does not roll.

SILTY SAND (SM): dark yellowish brown (10YR 4/4), 80% fine grained sand, subangular to subrounded; 20% silt; well sorted; moist sample; material does not roll, contact oxidized 204 ft bgs, reddish-brown.

CLAY (CL): olive gray (5Y 5/2), 60% clay, stiff, 1 to 2 mm black clay balls (10YR 2/1); 40% silt, increases with depth.

SAND (SW): brown (10YR 5/3), 100% fine to coarse grained sand, subangular to subrounded; trace fine gravel up to 5 mm, subangular to subrounded, <5% small gravel; poorly sorted; contains quartz, siliceous shale clasts, and chert.

SAND (SW): brown (10YR 5/3), 90% fine to coarse grained sand, subangular to subrounded; 10% fine to coarse gravel up to 38 mm, subangular to subrounded; poorly sorted; contains quartz, siliceous shale clasts, chert, and possibly tuff.

SAND WITH GRAVEL (SW): brown (10YR 5/3), 85% fine to coarse grained sand, subangular to subrounded; 15% fine to coarse gravel up to 38 mm, subangular to subrounded; poorly sorted; contains quartz, siliceous shale clasts, and chert.

SAND (SW): dark yellowish brown (10YR 4/6), 90% fine to coarse grained sand, subangular

Depth bgs (feet)	Sample Type
165	
	SS PTS SS
170	
175	
180	
185	
	SIEVE
190	
195	
200	
205	SS
210	
215	

SS: Splitspoon sample GRAB: Grab sample PTS: Splitspoon submitted for analysis SIEVE: Grab sieved by GSSI

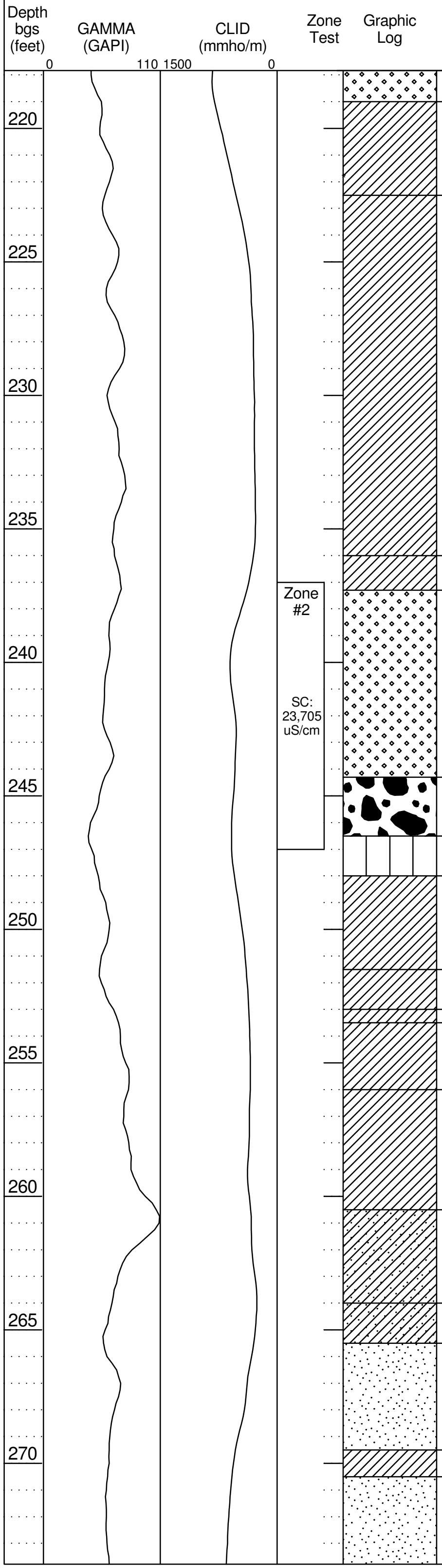
*Zone test details are for CX-B1WQ, approximately 80 ft west of CX-B1

GEOSCIENCE
P.O. Box 220
Claremont, CA 91711
Telephone: (909) 451-6650
Fax: (909) 451-6638
www.gssiwater.com

BOREHOLE NAME
CX-B1

BOREHOLE LITHOLOGIC LOG (continued)

CLIENT: California American Water
PROJECT NUMBER: 13017-13
LOCATION: **Marina, CA**



Lithologic Log

NOTE: Grain size distribution percentages are approximate. Material code (e.g. SP) reference Unified Soil Classification visual method. Color code (e.g. 10YR 5/2) reference Munsell Soil Color Charts.

to subrounded; 10% fine to coarse gravel up to 38 mm, subangular to subrounded; poorly sorted; contains quartz; oxidized layer.

SAND (SW): olive (5Y 5/3), 90% fine to coarse grained sand, subangular to subrounded; 10% fine to coarse gravel up to 38 mm, subangular to subrounded; poorly sorted; contains quartz.

CLAY (CL): light olive brown (2.5Y 5/3), 80% clay, medium plasticity; 20% silt; firm, massive.

CLAY (CL): light olive brown (2.5Y 5/4), 80% clay, medium plasticity; 20% silt; with visible alteration; very faint laminations, gray and yellowish-brown slicken sides, 1 to 3 mm balls of reddish-brown oxide stains (vertical).

CLAY (CL): light olive brown (2.5Y 5/6), 80% clay; 20% silt; transition in color, increase in yellow, very stiff.

SAND (SW): light yellowish brown (10YR 6/4), 100% fine to coarse grained sand, subangular to subrounded, 5% coarse grains; poorly sorted; wet sample; contains quartz, volcanic, and chert.

GRAVEL (GW): light yellowish brown (10YR 6/4), 90% fine to coarse gravel up to 75 mm, subrounded; 10% medium to coarse grained sand, subrounded; poorly sorted; moist sample; contains quartz; basal gravel.

SILT (ML): olive yellow (2.5Y 6/8), 80% silt; 20% clay; yellowish-brown and light gray mottling, thinly laminated, very stiff.

CLAY (CL): pale olive (5Y 6/4), 80% clay; 20% silt; with visible alteration; oxidized, thinly laminated.

CLAY (CL): very dark greenish gray (5GY 3/1), 100% clay, high plasticity; moist sample; massive.

CLAY (CL): dark olive gray (5Y 3/2), 100% clay, high plasticity; moist sample.

CLAY (CL): very dark greenish gray (5GY 3/1), 100% clay, high plasticity; moist sample; massive.

CLAY (CL): pale olive (5Y 6/4), 80% clay; 20% silt; with visible alteration; oxidized, thinly laminated.

SANDY CLAY (CL): olive (5Y 5/3), 70% clay, stiff, massive, oxidized clay balls, 1 to 2 mm; 30% medium to coarse grained sand; contains evaporites, gypsum, with visible alteration; yellowish-brown mottling; compression slicken sides.

SANDY CLAY (CL): olive (5Y 5/3), 70% clay, stiff; 30% medium to coarse grained sand, subangular to subrounded, <2% coarse grains, predominantly quartz.

SAND (SP): olive gray (5Y 5/2), 90% medium to coarse grained sand, subangular, poorly graded; 10% fine to coarse gravel up to 25 mm, subangular, granitic; trace silt; trace clay; contains quartz, feldspar and mica.

CLAY (CL): olive (5Y 5/3), 85% clay, low plasticity; 15% silt; moist sample.

SAND (SP): pale olive (5Y 6/3), 100% medium to coarse grained sand, subangular to subrounded, trace dark minerals, water film on sand grains; trace fine gravel up to 4.8 mm, subangular to subrounded; wet sample; contains quartz, feldspar, mica, amphibole, and chert; yellowish-brown and reddish-brown mottling.

Depth bgs (feet)	Sample Type
245	SIEVE
258	PTS

SS: Splitspoon sample GRAB: Grab sample PTS: Splitspoon submitted for analysis SIEVE: Grab sieved by GSSI

*Zone test details are for CX-B1WQ, approximately 80 ft west of CX-B1

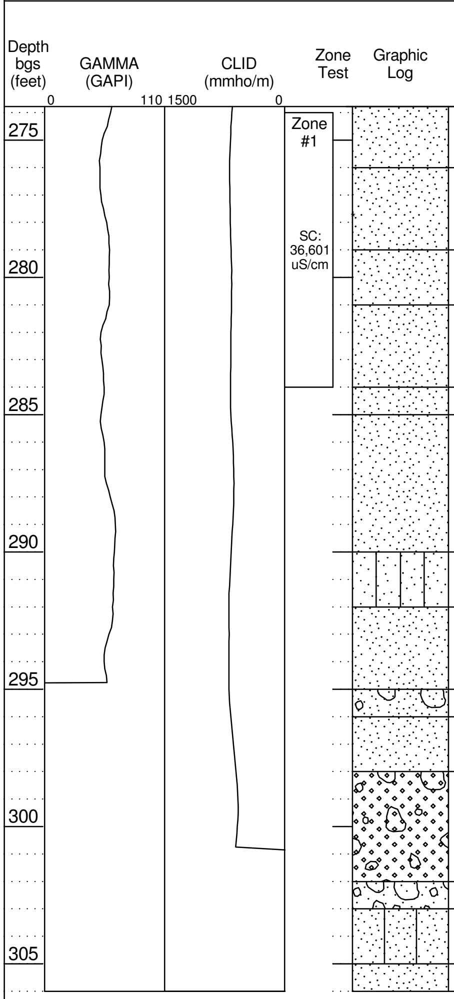
BOREHOLE NAME
CX-B1

BOREHOLE LITHOLOGIC LOG (continued)

CLIENT California American Water
PROJECT NUMBER 13017-13
LOCATION **Marina, CA**

Lithologic Log

NOTE: Grain size distribution percentages are approximate. Material code (e.g. SP) reference Unified Soil Classification visual method. Color code (e.g. 10YR 5/2) reference Munsell Soil Color Charts.



SAND (SP): pale olive (5Y 6/3), 90% medium to coarse grained sand, subangular to subrounded; 10% fine to coarse gravel up to 38 mm, subangular to subrounded; wet sample; contains quartz, feldspar, mica, amphibole, and chert; yellowish-brown and reddish-brown mottling.

SAND (SP): pale olive (5Y 6/3), 95% medium to coarse grained sand, subangular to subrounded; 5% fine gravel up to 4.8 mm, subangular to subrounded; moist sample; contains quartz, feldspar, mica and amphibole.

SAND (SP): pale olive (5Y 6/3), 95% medium to coarse grained sand, subangular to subrounded; 5% silt; moist sample; contains quartz, feldspar, mica and amphibole.

SAND (SP): pale olive (5Y 6/3), 95% medium to coarse grained sand; 5% clay, light gray and olive gray clay clasts/balls; moist sample; contains quartz, feldspar, mica and amphibole.

SAND (SP): yellowish brown (10YR 5/4), 90% fine to medium grained sand, subangular to subrounded, <2% coarse grain dark minerals; 5% fine gravel up to 4.8 mm, subangular to subrounded, trace red gravel; 5% silt; moist sample; contains quartz, feldspar, mica and amphibole; yellowish-brown coarse grain chert.

SANDY SILT (ML): dark yellowish brown (10YR 4/4), 70% silt; 30% fine grained sand, subangular to subrounded, water film on sand grains; moist sample; contains feldspar, mica and amphibole; yellowish-brown and gray mottling.

SAND (SP): light olive brown (2.5Y 5/6), 100% fine to medium grained sand, <1% dark minerals, yellowish-brown grains; trace fine gravel up to 13 mm; trace silt; poorly sorted; contains quartz, feldspar, mica and amphibole.

SAND WITH GRAVEL (SP): light olive brown (2.5Y 5/6), 70% fine to medium grained sand, angular to rounded; 30% fine to coarse gravel up to 75 mm, angular to rounded; poorly sorted; moist sample; contains quartz, feldspar, mica and amphibole; faint imbrications, armored pebbles, granitic, tuff, siliceous shale, and chert.

SAND (SP): light olive brown (2.5Y 5/6), 100% fine to medium grained sand, <1% dark minerals, yellowish-brown grains; trace fine gravel up to 13 mm; trace silt; poorly sorted; contains quartz, feldspar, mica and amphibole.

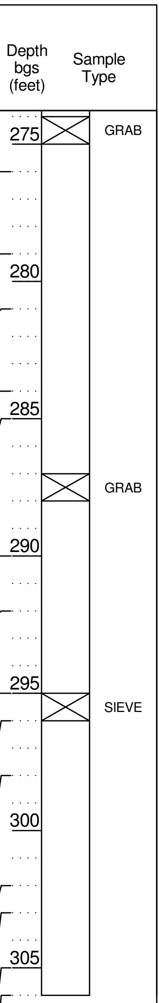
SAND WITH GRAVEL (SW): light olive brown (2.5Y 5/6), 80% fine to coarse grained sand, subangular to subrounded; 15% fine to coarse gravel up to 19 mm, subangular to subrounded; 5% clay; poorly sorted; moist sample; contains quartz, mafic gravel, and other; granitic.

GRAVEL WITH SAND (GW): light olive brown (2.5Y 5/6), 80% fine to coarse gravel up to 38 mm, subrounded; 20% fine to medium grained sand, subrounded; trace silt; trace clay; poorly sorted; contains quartz, feldspar, mica and amphibole.

SILTY SAND (SM): dark yellowish brown (10YR 4/4), 80% fine grained sand, subangular to subrounded; 20% silt; well sorted; contains quartz, feldspar, mica, amphibole, granite, tuff, chert, and siliceous shale.

SAND (SP): light olive brown (2.5Y 5/4), 100% fine to medium grained sand, subangular, poorly graded; trace fine gravel up to 6 mm, subangular; trace clay, dark gray clay balls; poorly sorted; contains quartz, feldspar, mica, amphibole, granite, chert, and siliceous shale.

Bottom of borehole at 306 feet.



SS: Splitspoon sample GRAB: Grab sample PTS: Splitspoon submitted for analysis SIEVE: Grab sieved by GSSI

*Zone test details are for CX-B1WQ, approximately 80 ft west of CX-B1

GEOSCIENCE
P.O. Box 220
Claremont, CA 91711
Telephone: (909) 451-6650
Fax: (909) 451-6638
www.gssiwater.com

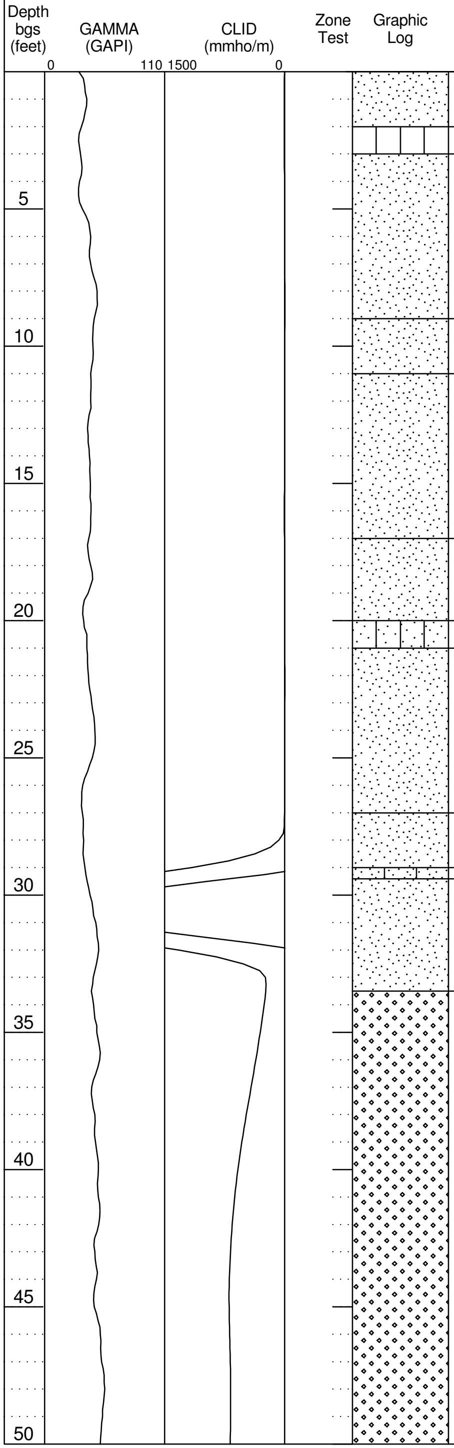
BOREHOLE NAME **CX-B2**

BOREHOLE LITHOLOGIC LOG

CLIENT: California American Water
PROJECT NUMBER: 13017-13
REPORT DATE: 7/8/2014
LOCATION: **Marina, CA**
CEMEX Lapis Plant
36° 42' 46.2636", -121° 48' 13.4316" Geographic NAD83
DRILLING CONTRACTOR: Cascade Drilling
DRILLER: Jose Munguia
LOGGED BY: **N. Reynolds**
DRILLING RIG TYPE: Prosonic 600T
DRILLING METHOD: Sonic
START DATE: 11/04/13
BOREHOLE DIAMETER: 6.25 in
SURFACE ELEVATION: 32.0 ft
TOTAL DEPTH: 307 ft bgs
FINISH DATE: 11/07/13
CORE SIZE: 4 in

Lithologic Log

NOTE: Grain size distribution percentages are approximate. Material code (e.g. SP) reference Unified Soil Classification visual method. Color code (e.g. 10YR 5/2) reference Munsell Soil Color Charts.



SAND (SP): light olive brown (2.5Y 5/4), 100% fine to medium grained sand, subangular to rounded; trace fine to coarse gravel up to 28 mm, rounded; trace silt; poorly sorted; contains quartz, feldspar and amphibole; shell fragments.

SILT (ML): light olive brown (2.5Y 5/3), 90% silt; 10% fine grained sand, subangular to subrounded; moderate cementation; decomposing minerals, shell fragments.

SAND (SP): light olive brown (2.5Y 5/4), 95% fine to medium grained sand, subangular to subrounded, predominantly fine; 5% silt; well sorted; contains quartz, feldspar and amphibole.

SAND (SP): brown (7.5YR 4/4), 95% fine to medium grained sand, subangular to subrounded; 5% silt; medium sorted; contains quartz, feldspar and amphibole.

SAND (SP): light yellowish brown (2.5Y 6/4), 100% fine to medium grained sand, subangular to subrounded, predominantly fine; medium sorted; contains quartz, feldspar and amphibole.

SAND (SP): olive (5Y 5/3), 100% fine to medium grained sand, subangular to subrounded, predominantly fine; well sorted; contains quartz, feldspar and amphibole.

SANDY SILT (ML): olive (5Y 5/3), 70% silt; 30% fine to medium grained sand, subangular to subrounded; contains quartz, feldspar and amphibole; interbed.

SAND (SP): light yellowish brown (2.5Y 6/4), 100% fine to medium grained sand, subangular to subrounded; medium sorted; contains quartz, feldspar and amphibole; gray interbeds.

SAND (SP): olive (5Y 5/3), 100% fine to medium grained sand, subangular to subrounded, predominantly fine; well sorted; contains quartz, feldspar and amphibole.

SILTY SAND (SM): gray (5Y 5/1), 85% fine grained sand, subangular to subrounded; 15% silt; medium sorted; dry sample; contains quartz, feldspar and amphibole; ; powdery.

SAND (SP): light yellowish brown (2.5Y 6/4), 100% medium grained sand, subangular to subrounded; medium sorted; contains quartz, feldspar and amphibole.

SAND (SW): light yellowish brown (2.5Y 6/4), 100% fine to coarse grained sand, subangular to subrounded, predominantly medium to coarse; poorly sorted; contains quartz, feldspar, mica and amphibole.

Depth bgs (feet): 5, 10, 15, 20, 25, 30, 35, 40, 45, 50

Sample Type

SS: Splitspoon sample GRAB: Grab sample PTS: Splitspoon submitted for analysis SIEVE: Grab sieved by GSSI

*Zone test details are for CX-B2WQ, approximately 60 ft west of CX-B2

GEOSCIENCE
P.O. Box 220
Claremont, CA 91711
Telephone: (909) 451-6650
Fax: (909) 451-6638
www.gssiwater.com

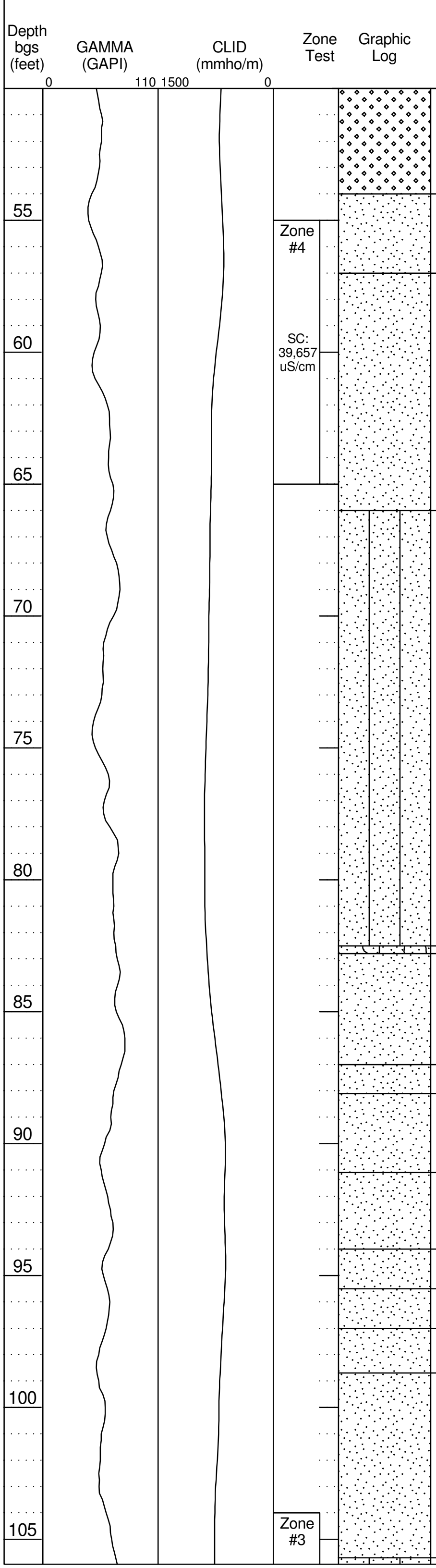
BOREHOLE NAME **CX-B2**

BOREHOLE LITHOLOGIC LOG (continued)

CLIENT California American Water
PROJECT NUMBER 13017-13
LOCATION **Marina, CA**

Lithologic Log

NOTE: Grain size distribution percentages are approximate. Material code (e.g. SP) reference Unified Soil Classification visual method. Color code (e.g. 10YR 5/2) reference Munsell Soil Color Charts.



SAND (SP): light yellowish brown (2.5Y 6/3), 100% fine to medium grained sand, subangular to subrounded; trace silt; poorly sorted; contains quartz, feldspar, mica and amphibole.

SAND (SP): light olive brown (2.5Y 5/4), 100% fine grained sand, subangular to subrounded; trace silt; well sorted; contains quartz, feldspar, mica and amphibole; higher mica content.

SILTY SAND (SM): light olive brown (2.5Y 5/3), 85% fine grained sand, subangular to subrounded, predominantly very fine grain; 15% silt; trace fine gravel up to 12 mm, rounded, at 76 ft; trace clay, clay lenses; well sorted; contains quartz, feldspar, mica and amphibole; altered shell fragments at 75 ft.

SAND WITH GRAVEL (SP): light olive brown (2.5Y 5/3), 80% fine grained sand, subangular to subrounded; 15% fine to coarse gravel up to 25 mm, subangular to subrounded, rounded; 5% clay, clay lenses; trace silt; well sorted; contains quartz, feldspar, mica and amphibole; altered minerals.

SAND (SP): light olive brown (2.5Y 5/3), 100% fine grained sand, subangular to subrounded, predominantly very fine grain; trace silt; well sorted; contains quartz, feldspar, mica and amphibole; trace shell fragments at 86 to 87 ft.

SAND (SP): olive (5Y 5/3), 100% fine to medium grained sand, subangular to subrounded; medium sorted; contains quartz, feldspar, mica and amphibole.

SAND (SP): light olive brown (2.5Y 5/6), 95% medium to coarse grained sand, subangular to rounded, predominantly coarse grain; 5% fine to coarse gravel up to 35 mm, rounded, at 90 to 91.1 ft; medium sorted; contains quartz, feldspar, mica and amphibole.

SAND (SP): light olive brown (2.5Y 5/4), 100% fine grained sand, subangular to subrounded; well sorted; contains quartz, feldspar, mica and amphibole; alteration visible with rusty coloration at 93.3 ft.

SAND (SP): light yellowish brown (2.5Y 6/4), 100% fine to coarse grained sand, subangular to rounded; trace fine to coarse gravel up to 35 mm, rounded; poorly sorted; contains quartz, feldspar, mica and amphibole.

SAND (SP): light olive brown (2.5Y 5/3), 100% fine grained sand, subangular to subrounded; trace fine to coarse gravel up to 37 mm, subangular to subrounded; well sorted; contains quartz, feldspar, mica and amphibole; moderately cemented sand and gravel at 96.4-96.8 ft.

SAND (SP): light olive brown (2.5Y 5/3), 90% fine to coarse grained sand, subangular to rounded, predominantly medium and coarse; 10% fine to coarse gravel up to 45 mm, subangular to rounded; poorly sorted; contains quartz, feldspar, mica and amphibole.

SAND (SP): light olive brown (2.5Y 5/3), 100% fine grained sand, subangular to subrounded, medium and coarse grain interbeds; trace clay, green-gray clay balls at 102.4 to 103.2 ft; poorly sorted; contains quartz, feldspar, mica and amphibole; clay and alteration at 100 ft.

Depth bgs (feet): 55, 60, 65, 70, 75, 80, 85, 90, 95, 100, 105

Sample Type
SIEVE
GRAB
GRAB

SS: Splitspoon sample GRAB: Grab sample PTS: Splitspoon submitted for analysis SIEVE: Grab sieved by GSSI

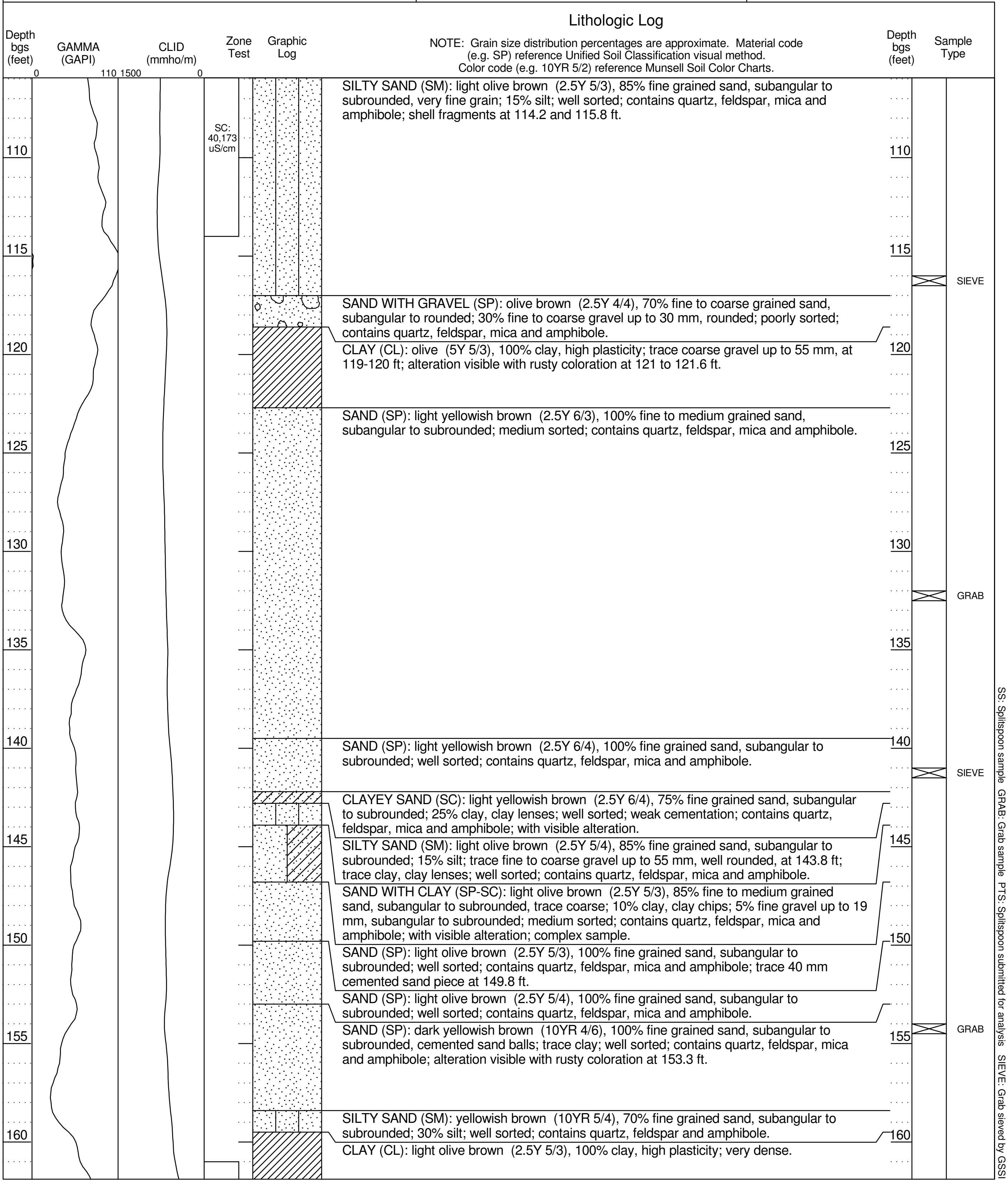
*Zone test details are for CX-B2WQ, approximately 60 ft west of CX-B2

GEOSCIENCE
P.O. Box 220
Claremont, CA 91711
Telephone: (909) 451-6650
Fax: (909) 451-6638
www.gssiwater.com

BOREHOLE NAME
CX-B2

BOREHOLE LITHOLOGIC LOG (continued)

CLIENT: California American Water
PROJECT NUMBER: 13017-13
LOCATION: **Marina, CA**



NOTE: Grain size distribution percentages are approximate. Material code (e.g. SP) reference Unified Soil Classification visual method. Color code (e.g. 10YR 5/2) reference Munsell Soil Color Charts.

SILTY SAND (SM): light olive brown (2.5Y 5/3), 85% fine grained sand, subangular to subrounded, very fine grain; 15% silt; well sorted; contains quartz, feldspar, mica and amphibole; shell fragments at 114.2 and 115.8 ft.

SAND WITH GRAVEL (SP): olive brown (2.5Y 4/4), 70% fine to coarse grained sand, subangular to rounded; 30% fine to coarse gravel up to 30 mm, rounded; poorly sorted; contains quartz, feldspar, mica and amphibole.

CLAY (CL): olive (5Y 5/3), 100% clay, high plasticity; trace coarse gravel up to 55 mm, at 119-120 ft; alteration visible with rusty coloration at 121 to 121.6 ft.

SAND (SP): light yellowish brown (2.5Y 6/3), 100% fine to medium grained sand, subangular to subrounded; medium sorted; contains quartz, feldspar, mica and amphibole.

SAND (SP): light yellowish brown (2.5Y 6/4), 100% fine grained sand, subangular to subrounded; well sorted; contains quartz, feldspar, mica and amphibole.

CLAYEY SAND (SC): light yellowish brown (2.5Y 6/4), 75% fine grained sand, subangular to subrounded; 25% clay, clay lenses; well sorted; weak cementation; contains quartz, feldspar, mica and amphibole; with visible alteration.

SILTY SAND (SM): light olive brown (2.5Y 5/4), 85% fine grained sand, subangular to subrounded; 15% silt; trace fine to coarse gravel up to 55 mm, well rounded, at 143.8 ft; trace clay, clay lenses; well sorted; contains quartz, feldspar, mica and amphibole.

SAND WITH CLAY (SP-SC): light olive brown (2.5Y 5/3), 85% fine to medium grained sand, subangular to subrounded, trace coarse; 10% clay, clay chips; 5% fine gravel up to 19 mm, subangular to subrounded; medium sorted; contains quartz, feldspar, mica and amphibole; with visible alteration; complex sample.

SAND (SP): light olive brown (2.5Y 5/3), 100% fine grained sand, subangular to subrounded; well sorted; contains quartz, feldspar, mica and amphibole; trace 40 mm cemented sand piece at 149.8 ft.

SAND (SP): light olive brown (2.5Y 5/4), 100% fine grained sand, subangular to subrounded; well sorted; contains quartz, feldspar, mica and amphibole.

SAND (SP): dark yellowish brown (10YR 4/6), 100% fine grained sand, subangular to subrounded, cemented sand balls; trace clay; well sorted; contains quartz, feldspar, mica and amphibole; alteration visible with rusty coloration at 153.3 ft.

SILTY SAND (SM): yellowish brown (10YR 5/4), 70% fine grained sand, subangular to subrounded; 30% silt; well sorted; contains quartz, feldspar and amphibole.

CLAY (CL): light olive brown (2.5Y 5/3), 100% clay, high plasticity; very dense.

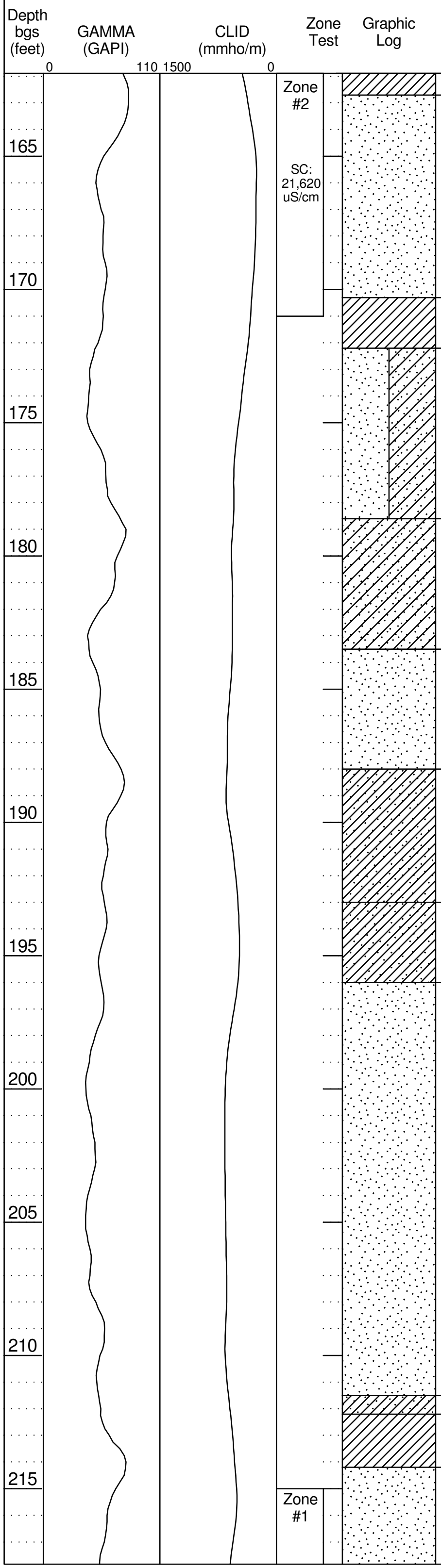
*Zone test details are for CX-B2WQ, approximately 60 ft west of CX-B2

BOREHOLE LITHOLOGIC LOG (continued)

BOREHOLE NAME **CX-B2**		
CLIENT PROJECT NUMBER	California American Water 13017-13	LOCATION **Marina, CA**

Lithologic Log

NOTE: Grain size distribution percentages are approximate. Material code (e.g. SP) reference Unified Soil Classification visual method. Color code (e.g. 10YR 5/2) reference Munsell Soil Color Charts.



SAND (SP): light olive brown (2.5Y 5/3), 100% fine grained sand, subangular to subrounded; well sorted; contains quartz, feldspar, mica and amphibole.

CLAY WITH SAND (CL): light olive brown (2.5Y 5/3), 85% clay, medium plasticity; 15% fine grained sand, subangular to subrounded; contains quartz, feldspar and mica; some rust colored alteration; moderate cementation.

SAND WITH CLAY (SP-SC): light yellowish brown (2.5Y 6/3), 90% fine grained sand, subangular to subrounded; 10% clay; trace fine gravel up to 14 mm, subangular to subrounded; well sorted; contains quartz, feldspar, mica and amphibole.

CLAYEY SAND (SC): brown (10YR 4/3), 70% fine grained sand, subangular to subrounded; 30% clay; well sorted; contains quartz, feldspar, mica and amphibole.

SAND (SP): yellowish brown (10YR 5/4), 100% fine grained sand, subangular to subrounded, predominantly very fine grain; trace silt; well sorted; contains quartz, feldspar, mica and amphibole; with visible alteration.

SANDY CLAY (CL): dark yellowish brown (10YR 4/4), 60% clay, low plasticity, soft; 40% fine grained sand, subangular to subrounded; wet sample; contains quartz, feldspar and amphibole; trace cemented sandy clay balls.

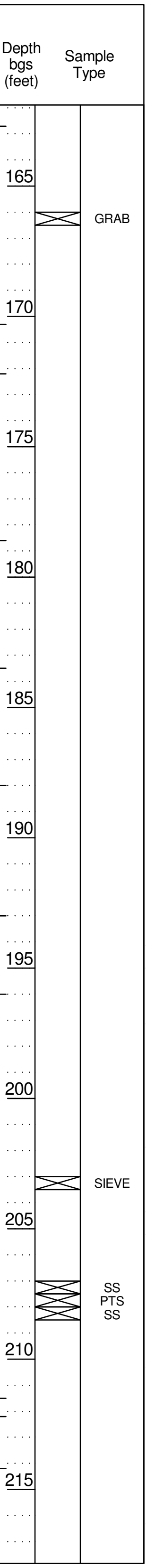
SANDY CLAY (CL): light olive brown (2.5Y 5/4), 60% clay, no plasticity, hard/dense; 40% fine grained sand, subangular to subrounded; moderate cementation; contains quartz, feldspar and amphibole; some visible alteration.

SAND (SP): light olive brown (2.5Y 5/3) and brown (7.5YR 4/4), 100% fine grained sand, subangular to subrounded; trace silt; well sorted; contains quartz, feldspar, mica and amphibole; with visible alteration; transition from olive to brown; laminations.

SANDY CLAY (CL): strong brown (7.5YR 4/6), 70% clay, hard; 30% fine grained sand, subangular to subrounded; moderate cementation; contains quartz, feldspar, mica and amphibole; rust colored alteration/laminations.

CLAY (CL): light yellowish brown (2.5Y 6/3) and olive gray (5Y 4/2), 100% clay; with visible alteration; 1 in. dark reddish gray layer at 212.2 ft.

SAND (SP): light yellowish brown (2.5Y 6/3), 100% fine to medium grained sand, subangular to rounded; trace fine to coarse gravel up to 48 mm, rounded, at 218 ft; trace clay; poorly sorted; contains quartz, feldspar, mica and amphibole.



SS: Splitspoon sample GRAB: Grab sample PTS: Splitspoon submitted for analysis SIEVE: Grab sieved by GSSI

*Zone test details are for CX-B2WQ, approximately 60 ft west of CX-B2

GEOSCIENCE
P.O. Box 220
Claremont, CA 91711
Telephone: (909) 451-6650
Fax: (909) 451-6638
www.gssiwater.com

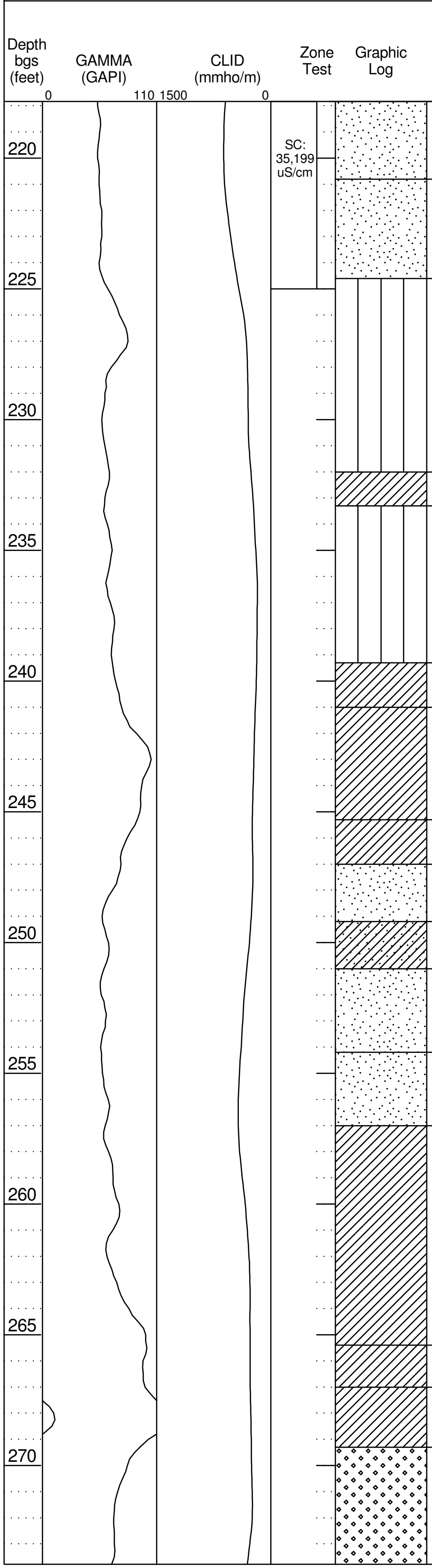
BOREHOLE NAME
CX-B2

BOREHOLE LITHOLOGIC LOG (continued)

CLIENT	California American Water	LOCATION
PROJECT NUMBER	13017-13	**Marina, CA**

Lithologic Log

NOTE: Grain size distribution percentages are approximate. Material code (e.g. SP) reference Unified Soil Classification visual method. Color code (e.g. 10YR 5/2) reference Munsell Soil Color Charts.



SAND (SP): light yellowish brown (2.5Y 6/3), 100% fine to coarse grained sand, angular to subrounded; trace fine to coarse gravel up to 23 mm, rounded; poorly sorted; contains quartz, feldspar, mica and amphibole; trace rounded cobbles up to 80 mm at 223.8 ft.

SILT (ML): light olive brown (2.5Y 5/4), 100% silt, dense; trace fine grained sand, subangular to subrounded; contains mica; with visible alteration.

CLAY (CL): light olive brown (2.5Y 5/3), 100% clay, no plasticity, dense.

SILT (ML): olive gray (5Y 5/2), 100% silt; trace fine grained sand, subangular to subrounded; trace clay; thin interbeds of clay and fine sand.

CLAY (CL): olive (5Y 5/3), 100% clay, very dense.

CLAY (CL): dark greenish gray (10Y 4/1) and greenish black (10Y 2.5/1), 100% clay, very dense; the blue clay.

CLAY (CL): olive (5Y 5/3), 100% clay, very dense; many thin rust colored laminations.

SAND (SP): olive (5Y 5/3), 100% fine to medium grained sand, subangular to subrounded, trace cemented sand balls to 19 mm; trace fine gravel up to 9 mm, subangular to subrounded; medium sorted; contains quartz, feldspar, mica and amphibole; rusty alteration points.

SANDY CLAY (CL): olive gray (5Y 5/2), 70% clay; 30% fine grained sand, subangular to subrounded, interbedded; moderate cementation; contains quartz, feldspar, mica and amphibole; with visible alteration; rust colored alteration.

SAND WITH GRAVEL (SP): light olive brown (2.5Y 5/4), 70% fine to coarse grained sand, subangular to subrounded; 30% fine to coarse gravel up to 45 mm, well rounded; trace clay, clay balls; poorly sorted; contains quartz, feldspar, mica, amphibole, and other; weakly cemented sand with gravel, some alteration.

SAND (SP): light yellowish brown (2.5Y 6/3), 100% medium to coarse grained sand, subangular to subrounded; trace fine to coarse gravel up to 19 mm, well rounded; poorly sorted; contains quartz, feldspar and amphibole.

CLAY (CL): olive gray (5Y 5/2), 100% clay, no plasticity, very dense; alteration visible with rusty coloration at 257 to 261 ft.

CLAY (CL): very dark greenish gray (5GY 3/1), 100% clay, no plasticity, dense; friable.

CLAY (CL): olive gray (5Y 5/2) and dark gray (5Y 4/1), 100% clay, no plasticity, dense; some alteration, especially at sand/clay interface.

SAND (SW): olive (5Y 5/3), 90% fine to coarse grained sand, subangular to rounded; 10% fine to coarse gravel up to 54 mm, well rounded; poorly sorted; wet sample; contains quartz, feldspar, mica, amphibole, and other.

Depth bgs (feet)	Sample Type
220	
225	
230	
235	
240	
245	
250	
255	
260	PTS
265	
	SS
270	
	SIEVE

SS: Splitspoon sample GRAB: Grab sample PTS: Splitspoon submitted for analysis SIEVE: Grab sieved by GSSI

*Zone test details are for CX-B2WQ, approximately 60 ft west of CX-B2

GEOSCIENCE
P.O. Box 220
Claremont, CA 91711
Telephone: (909) 451-6650
Fax: (909) 451-6638
www.gssiwater.com

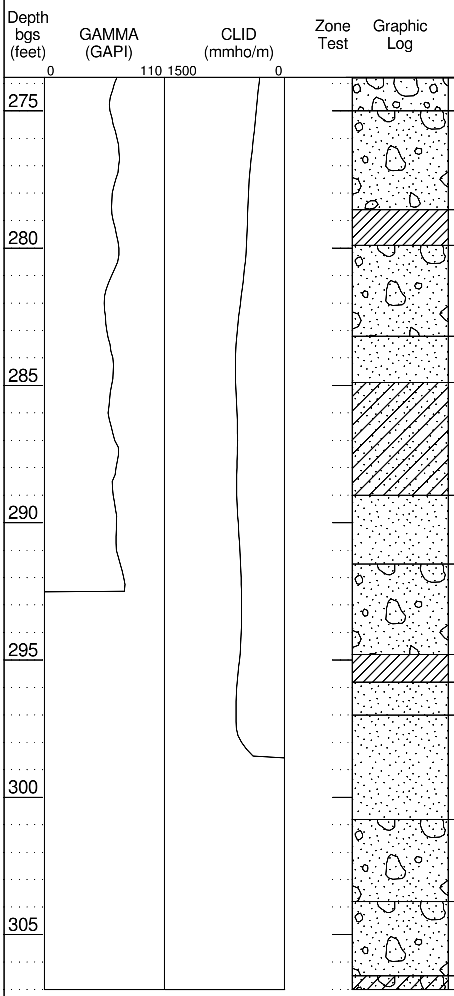
BOREHOLE NAME
CX-B2

BOREHOLE LITHOLOGIC LOG (continued)

CLIENT: California American Water
PROJECT NUMBER: 13017-13
LOCATION: **Marina, CA**

Lithologic Log

NOTE: Grain size distribution percentages are approximate. Material code (e.g. SP) reference Unified Soil Classification visual method. Color code (e.g. 10YR 5/2) reference Munsell Soil Color Charts.



GRAVEL WITH SAND (GP): light yellowish brown (2.5Y 6/3), 70% fine to coarse gravel up to 72 mm, well rounded, predominantly coarse; 30% fine to coarse grained sand, subangular to rounded; poorly sorted; wet sample; contains quartz, feldspar, mica, amphibole, and other; includes well rounded quartz gravel.

SAND WITH CLAY AND GRAVEL (SP-SC): light olive brown (2.5Y 5/3), 75% fine to coarse grained sand, subangular to rounded, predominantly medium to coarse grain; 15% fine to coarse gravel up to 52 mm, well rounded; 10% clay; poorly sorted; wet sample; contains quartz, feldspar, mica, amphibole, and other; with some visible alteration.

CLAY (CL): light olive brown (2.5Y 5/3), 100% clay, medium plasticity; trace fine to coarse gravel up to 22 mm, subangular to rounded, interbeds.

SAND WITH CLAY AND GRAVEL (SP-SC): light yellowish brown (2.5Y 6/3), 75% fine to medium grained sand, subangular to rounded; 15% fine to coarse gravel up to 58 mm, well rounded; 10% clay; poorly sorted; contains quartz, feldspar, mica, amphibole and other; transition of sand with trace gravel and clay to sand with clay and gravel.

SAND (SP): light yellowish brown (2.5Y 6/3), 100% fine to medium grained sand, subangular to subrounded; well sorted; contains quartz, feldspar, mica, amphibole and other.

CLAYEY SAND (SC): light yellowish brown (2.5Y 6/3), 75% fine to coarse grained sand, subangular to subrounded; 15% clay, clay balls; 10% fine to coarse gravel up to 40 mm, well rounded; poorly sorted; contains quartz, feldspar, mica, amphibole and other; 5 in. sandy clay layers at 286.6 and 288.3 ft.

SAND (SP): light yellowish brown (2.5Y 6/3), 85% fine to coarse grained sand, subangular to subrounded; 10% fine to coarse gravel up to 28 mm, well rounded; 5% clay, clay balls; poorly sorted; contains quartz, feldspar, mica, amphibole and other.

SAND WITH CLAY AND GRAVEL (SP-SC): light olive brown (2.5Y 5/3), 65% fine to coarse grained sand, subangular to subrounded, predominantly medium to coarse grained; 25% fine to coarse gravel up to 60 mm, well rounded; 10% clay, clay/sandy clay balls; trace cobbles up to 80mm; poorly sorted; moderate cementation; contains quartz, feldspar, mica, amphibole and other; with visible alteration.

CLAY (CL): light olive brown (2.5Y 5/4), 100% clay, medium plasticity; dense brown clay.

SAND (SP): light yellowish brown (2.5Y 6/3), 100% fine to medium grained sand, subangular to subrounded; trace fine gravel up to 17 mm, subangular to subrounded; medium sorted; contains quartz, feldspar, mica, amphibole and other.

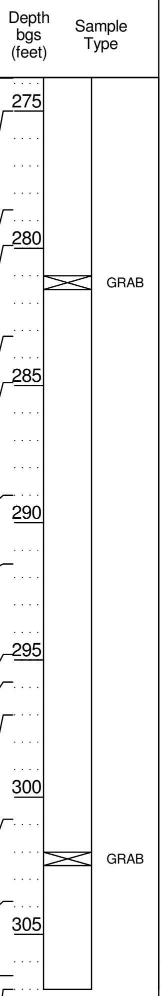
SAND (SP): light yellowish brown (2.5Y 6/4), 90% fine to coarse grained sand, subangular to rounded; 10% fine to coarse gravel up to 50 mm, well rounded; trace cobbles up to 80mm; poorly sorted; contains quartz, feldspar, mica, amphibole and other; with visible alteration.

SAND WITH GRAVEL (SP): pale yellow (2.5Y 7/4), 85% coarse grained sand, subrounded to well rounded, trace medium grain; 15% fine to coarse gravel up to 26 mm, well rounded; medium sorted; wet sample; contains quartz, feldspar, mica, amphibole and other.

SAND WITH GRAVEL (SP): olive gray (5Y 4/2), 80% coarse grained sand, subrounded to rounded; 20% fine to coarse gravel up to 43 mm, well rounded; medium sorted; wet sample; contains quartz, feldspar, mica, amphibole and other.

CLAYEY SAND WITH GRAVEL (SC): light yellowish brown (2.5Y 6/4), 70% fine to coarse grained sand, subangular to rounded; 15% fine to coarse gravel up to 45 mm, rounded; 15% clay, clay balls; poorly sorted; wet sample; contains quartz, feldspar, mica, amphibole and other.

Bottom of borehole at 307 feet.



SS: Splitspoon sample GRAB: Grab sample PTS: Splitspoon submitted for analysis SIEVE: Grab sieved by GSSI

*Zone test details are for CX-B2WQ, approximately 60 ft west of CX-B2

GEOSCIENCE
P.O. Box 220
Claremont, CA 91711
Telephone: (909) 451-6650
Fax: (909) 451-6638
www.gssiwater.com

BOREHOLE LITHOLOGIC LOG

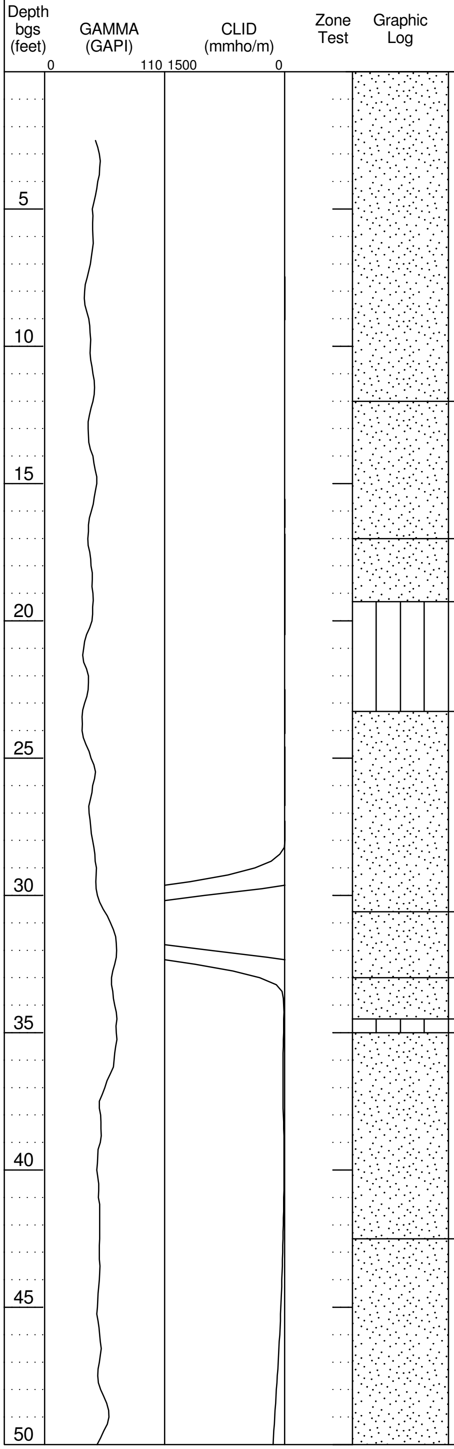
BOREHOLE NAME **CX-B3**

CLIENT: California American Water
PROJECT NUMBER: 13017-13
REPORT DATE: 7/8/2014
LOCATION: **Marina, CA**
CEMEX Lapis Plant
36° 42' 43.1316", -121° 47' 59.9316" Geographic NAD83
DRILLING CONTRACTOR: Cascade Drilling
DRILLER: Jose Munguia
LOGGED BY: **N. Reynolds**

DRILLING RIG TYPE	Prosonic 600T	DRILLING METHOD	Sonic	START DATE	11/09/13	BOREHOLE DIAMETER	6.25 in
SURFACE ELEVATION	39.0 ft	TOTAL DEPTH	347 ft bgs	FINISH DATE	11/14/13	CORE SIZE	4 in

Lithologic Log

NOTE: Grain size distribution percentages are approximate. Material code (e.g. SP) reference Unified Soil Classification visual method. Color code (e.g. 10YR 5/2) reference Munsell Soil Color Charts.



SAND (SP): dark brown (10YR 3/3), 95% fine to medium grained sand, subangular to rounded, predominantly fine grained; 5% silt; medium sorted; contains quartz, feldspar and amphibole; first 7 ft disturbed sample.

SAND (SP): pale yellow (2.5Y 7/4), 100% fine to medium grained sand, subangular to subrounded, predominantly fine grained; medium sorted; contains quartz, feldspar and amphibole.

SAND (SP): light olive brown (2.5Y 5/3), 100% fine to medium grained sand, subangular to rounded, predominantly fine grained; medium sorted; contains quartz, feldspar and amphibole.

SILT WITH SAND (ML): light gray (5Y 7/2), 85% silt; 15% fine grained sand, subrounded; dry sample/powdery.

SAND (SP): pale yellow (2.5Y 7/4), 100% fine grained sand, subangular to subrounded; well sorted; contains quartz, feldspar and amphibole.

SAND (SP): light yellowish brown (2.5Y 6/4), 95% fine to medium grained sand, subangular to subrounded; 5% silt; medium sorted; contains quartz, feldspar and amphibole.

SAND (SP): light olive brown (2.5Y 5/3), 100% fine to medium grained sand, subangular to rounded, predominantly fine grained; medium sorted; contains quartz, feldspar and amphibole.

SILT (ML): light gray (5Y 7/2), 100% silt; trace fine grained sand; dry sample; powdery.

SAND (SP): light yellowish brown (2.5Y 6/4), 100% fine to medium grained sand, subrounded to rounded; medium sorted; contains quartz, feldspar and amphibole.

SAND (SP): light yellowish brown (2.5Y 6/3), 100% fine grained sand, subangular to subrounded, trace medium grained; well sorted; contains quartz, feldspar, mica and amphibole.

Depth bgs (feet)	Sample Type
45	SIEVE

SS: Splitspoon sample GRAB: Grab sample PTS: Splitspoon submitted for analysis SIEVE: Grab sieved by GSSI

GEOSCIENCE
P.O. Box 220
Claremont, CA 91711
Telephone: (909) 451-6650
Fax: (909) 451-6638
www.gssiwater.com

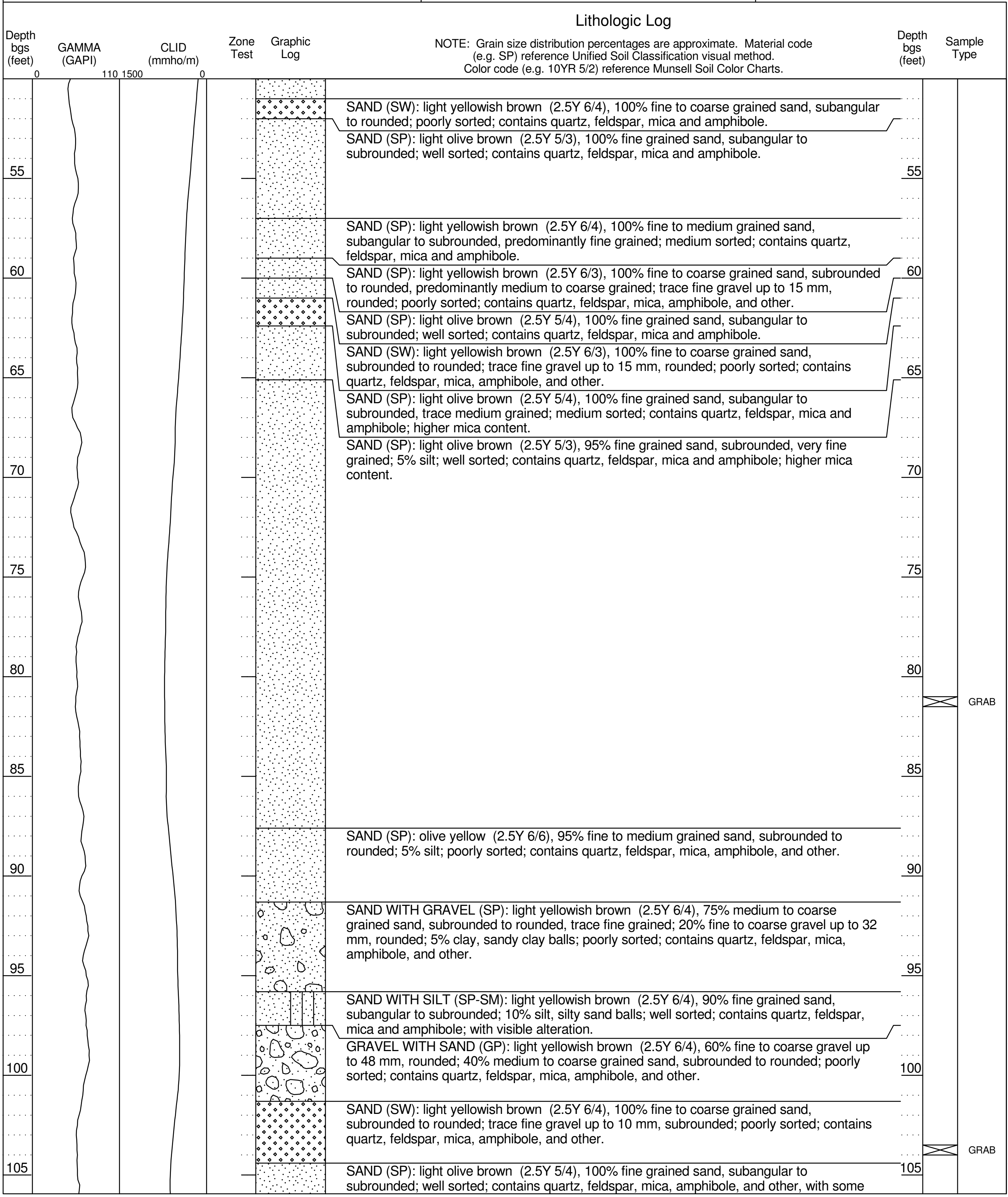
BOREHOLE NAME **CX-B3**

BOREHOLE LITHOLOGIC LOG (continued)

CLIENT California American Water
PROJECT NUMBER 13017-13
LOCATION **Marina, CA**

Lithologic Log

NOTE: Grain size distribution percentages are approximate. Material code (e.g. SP) reference Unified Soil Classification visual method. Color code (e.g. 10YR 5/2) reference Munsell Soil Color Charts.



SAND (SW): light yellowish brown (2.5Y 6/4), 100% fine to coarse grained sand, subangular to rounded; poorly sorted; contains quartz, feldspar, mica and amphibole.

SAND (SP): light olive brown (2.5Y 5/3), 100% fine grained sand, subangular to subrounded; well sorted; contains quartz, feldspar, mica and amphibole.

SAND (SP): light yellowish brown (2.5Y 6/4), 100% fine to medium grained sand, subangular to subrounded, predominantly fine grained; medium sorted; contains quartz, feldspar, mica and amphibole.

SAND (SP): light yellowish brown (2.5Y 6/3), 100% fine to coarse grained sand, subrounded to rounded, predominantly medium to coarse grained; trace fine gravel up to 15 mm, rounded; poorly sorted; contains quartz, feldspar, mica, amphibole, and other.

SAND (SP): light olive brown (2.5Y 5/4), 100% fine grained sand, subangular to subrounded; well sorted; contains quartz, feldspar, mica and amphibole.

SAND (SW): light yellowish brown (2.5Y 6/3), 100% fine to coarse grained sand, subrounded to rounded; trace fine gravel up to 15 mm, rounded; poorly sorted; contains quartz, feldspar, mica, amphibole, and other.

SAND (SP): light olive brown (2.5Y 5/4), 100% fine grained sand, subangular to subrounded, trace medium grained; medium sorted; contains quartz, feldspar, mica and amphibole; higher mica content.

SAND (SP): light olive brown (2.5Y 5/3), 95% fine grained sand, subrounded, very fine grained; 5% silt; well sorted; contains quartz, feldspar, mica and amphibole; higher mica content.

SAND (SP): olive yellow (2.5Y 6/6), 95% fine to medium grained sand, subrounded to rounded; 5% silt; poorly sorted; contains quartz, feldspar, mica, amphibole, and other.

SAND WITH GRAVEL (SP): light yellowish brown (2.5Y 6/4), 75% medium to coarse grained sand, subrounded to rounded, trace fine grained; 20% fine to coarse gravel up to 32 mm, rounded; 5% clay, sandy clay balls; poorly sorted; contains quartz, feldspar, mica, amphibole, and other.

SAND WITH SILT (SP-SM): light yellowish brown (2.5Y 6/4), 90% fine grained sand, subangular to subrounded; 10% silt, silty sand balls; well sorted; contains quartz, feldspar, mica and amphibole; with visible alteration.

GRAVEL WITH SAND (GP): light yellowish brown (2.5Y 6/4), 60% fine to coarse gravel up to 48 mm, rounded; 40% medium to coarse grained sand, subrounded to rounded; poorly sorted; contains quartz, feldspar, mica, amphibole, and other.

SAND (SW): light yellowish brown (2.5Y 6/4), 100% fine to coarse grained sand, subrounded to rounded; trace fine gravel up to 10 mm, subrounded; poorly sorted; contains quartz, feldspar, mica, amphibole, and other.

SAND (SP): light olive brown (2.5Y 5/4), 100% fine grained sand, subangular to subrounded; well sorted; contains quartz, feldspar, mica, amphibole, and other, with some

SS: Splitspoon sample GRAB: Grab sample PTS: Splitspoon submitted for analysis SIEVE: Grab sieved by GSSI

BOREHOLE NAME **CX-B3**

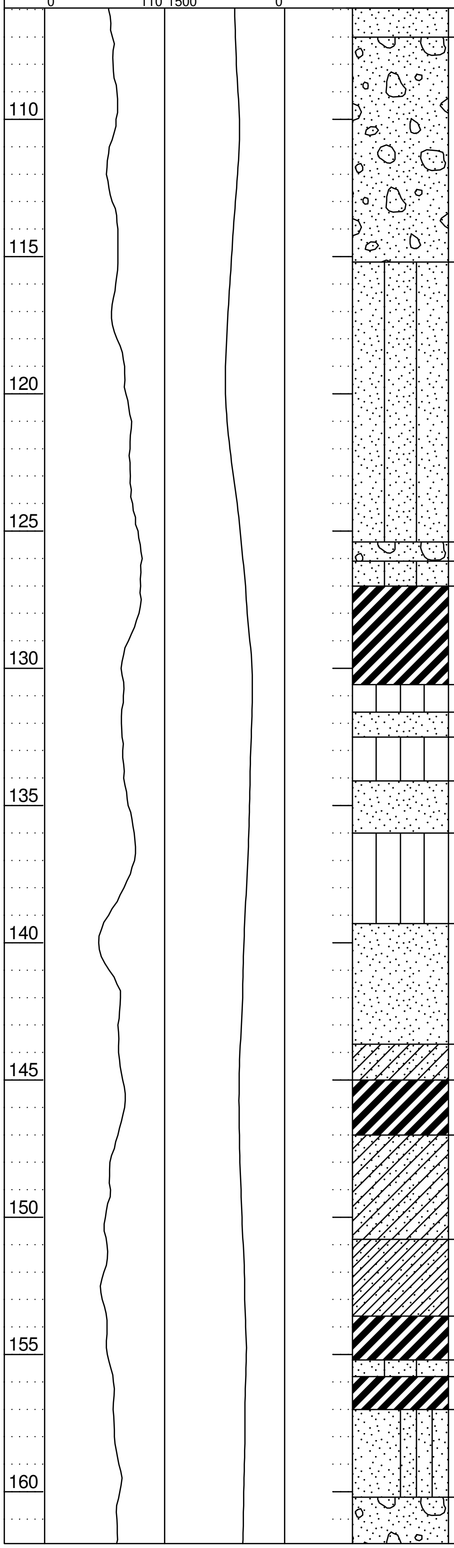
BOREHOLE LITHOLOGIC LOG (continued)

CLIENT: California American Water
PROJECT NUMBER: 13017-13
LOCATION: **Marina, CA**

Depth bgs (feet) | GAMMA (GAPI) 0–110 | CLID (mmho/m) 1500–0 | Zone Test | Graphic Log | Lithologic Log | Depth bgs (feet) | Sample Type

Lithologic Log

NOTE: Grain size distribution percentages are approximate. Material code (e.g. SP) reference Unified Soil Classification visual method. Color code (e.g. 10YR 5/2) reference Munsell Soil Color Charts.



visible alteration.

SAND WITH GRAVEL (SP): light yellowish brown (2.5Y 6/4), 80% fine to coarse grained sand, subangular to rounded, predominantly medium to coarse grained; 20% fine to coarse gravel up to 58 mm, subrounded to rounded; trace clay; poorly sorted; contains quartz, feldspar, mica, amphibole, and other.

SILTY SAND (SM): light olive brown (2.5Y 5/3), 85% fine grained sand, subrounded, very fine grained; 15% silt; well sorted; contains quartz, feldspar, mica and amphibole.

SAND WITH SILT AND GRAVEL (SP-SM): light olive brown (2.5Y 5/3), 75% fine grained sand, subrounded; 15% fine to coarse gravel up to 27 mm, rounded, multi-colored; 10% silt; well sorted; contains quartz, feldspar, mica and amphibole; with visible alteration.

SILTY SAND (SM): light olive brown (2.5Y 5/3), 85% fine grained sand, subrounded, very fine grained; 15% silt; well sorted; contains quartz, feldspar, mica and amphibole.

FAT CLAY (CH): dark gray (5Y 4/1), 100% clay, medium plasticity, dense/hard.

SILT (ML): pale olive (5Y 6/3), 100% silt, dense; visible alteration/rust colored laminations.

SAND (SP): light olive brown (2.5Y 5/4), 100% fine grained sand, subrounded, very fine grained; well sorted; contains quartz, feldspar, mica and amphibole; with visible alteration.

SILT (ML): olive gray (5Y 5/2), 100% silt; with visible alteration.

SAND (SP): light yellowish brown (2.5Y 6/4), 95% fine to medium grained sand, subangular to subrounded, grades to predominantly medium grained sand at 135 ft; 5% silt; poorly sorted; contains quartz, feldspar, mica and amphibole.

SILT (ML): olive (5Y 5/3), 100% silt; visible alteration/rust colored laminations.

SAND (SP): pale olive (5Y 6/3), 100% fine to medium grained sand, subangular to subrounded, predominantly medium grained; medium sorted.

CLAYEY SAND (SC): pale olive (5Y 6/3), 70% fine to coarse grained sand, subangular to rounded; 20% clay; 10% fine to coarse gravel up to 40 mm, well rounded, especially at 144.5 to 145 ft; poorly sorted; contains quartz, feldspar, mica, amphibole, and other, visible rust colored alteration.

FAT CLAY (CH): pale olive (5Y 6/3), 100% clay, dense; medium plasticity.

CLAYEY SAND (SC): pale olive (5Y 6/3), 70% fine to coarse grained sand, subrounded to rounded; 30% clay; trace fine to coarse gravel up to 25 mm, subangular; poorly sorted; with visible alteration; contains quartz, feldspar, amphibole, and other.

SANDY FAT CLAY (CH): pale olive (5Y 6/3), 70% clay, medium plasticity; 30% fine to medium grained sand, subangular to subrounded; contains quartz, feldspar, amphibole, and other; some visible alteration with rusty coloration.

FAT CLAY (CH): pale olive (5Y 6/3), 100% clay, medium plasticity; visible alteration/rust colored laminations.

SILTY SAND (SM): pale olive (5Y 6/3), 85% fine grained sand, subrounded to rounded; 15% silt; well sorted; contains quartz, feldspar and amphibole.

FAT CLAY (CH): olive (5Y 5/3), 100% clay, low plasticity; trace fine grained sand, subangular to subrounded; some rust colored alterations.

SAND WITH SILT (SP-SM): pale olive (5Y 6/3), 90% fine grained sand, subangular to subrounded, altered sand layers, rust and white coloration; 10% silt; trace fine to coarse gravel up to 38 mm, rounded; trace clay, clay balls; well sorted; contains quartz, feldspar, mica, amphibole, and other.

SS: Splitspoon sample GRAB: Grab sample PTS: Splitspoon submitted for analysis SIEVE: Grab sieved by GSSI

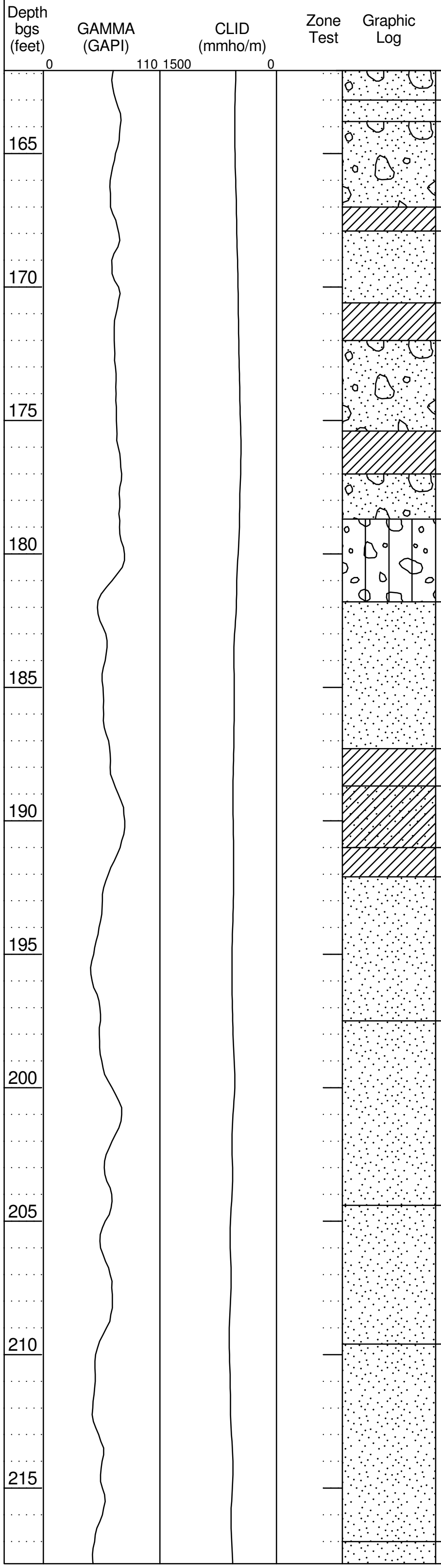
BOREHOLE NAME
CX-B3

BOREHOLE LITHOLOGIC LOG (continued)

CLIENT California American Water
PROJECT NUMBER 13017-13
LOCATION **Marina, CA**

Lithologic Log

NOTE: Grain size distribution percentages are approximate. Material code (e.g. SP) reference Unified Soil Classification visual method. Color code (e.g. 10YR 5/2) reference Munsell Soil Color Charts.



SAND WITH CLAY AND GRAVEL (SW-SC): yellowish brown (10YR 5/4), 75% fine to coarse grained sand, subangular to rounded; 15% fine to coarse gravel up to 68 mm, rounded; 10% clay; poorly sorted; contains quartz, feldspar and amphibole; visible alteration of sands.

SAND (SP): strong brown (7.5YR 5/8), 85% medium to coarse grained sand, subrounded to rounded, predominantly coarse grained; 10% fine to coarse gravel up to 28 mm, rounded; 5% clay; poorly sorted; contains quartz, feldspar, amphibole, and other; bright rust colored alteration.

SAND WITH CLAY AND GRAVEL (SP-SC): pale olive (5Y 6/3), 75% medium to coarse grained sand, subangular to rounded; 15% fine to coarse gravel up to 36 mm, rounded; 10% clay; poorly sorted; contains quartz, feldspar, amphibole, and other; contains altered sands.

CLAY (CL): light yellowish brown (2.5Y 6/4), 95% clay, low plasticity; 5% fine to coarse gravel up to 42 mm, subrounded to rounded, interbedded; trace medium grained sand, subrounded to rounded.

SAND (SP): pale olive (5Y 6/3), 100% fine to medium grained sand, subangular to subrounded; trace fine to coarse gravel up to 40 mm, subrounded to rounded; trace clay; poorly sorted; contains quartz, feldspar, amphibole, and other, with visible alteration; trace weakly cemented sands.

CLAY WITH GRAVEL (CL): pale olive (5Y 6/3), 85% clay; 10% fine to coarse gravel up to 50 mm, subangular to rounded; 5% fine grained sand, subangular to subrounded; fine sand alteration of minerals/rock.

CLAYEY SAND WITH GRAVEL (SC): pale olive (5Y 6/3), 70% fine to coarse grained sand, subangular to subrounded; 15% fine to coarse gravel up to 75 mm, rounded; 15% clay, clay balls; poorly sorted; well graded; contains quartz, feldspar, amphibole, and other; visible alteration of minerals/rock.

SANDY CLAY (CL): pale olive (5Y 6/3), 70% clay; 25% fine to coarse grained sand, subangular to subrounded; 5% fine to coarse gravel up to 25 mm, subrounded to rounded; contains quartz, feldspar, amphibole, and other, visible alteration with rusty coloration.

CLAYEY SAND WITH GRAVEL (SC): pale olive (5Y 6/3), 70% fine to coarse grained sand, subangular to subrounded; 15% fine to coarse gravel up to 33 mm, subrounded to rounded; 15% clay; poorly sorted; well graded; contains quartz, feldspar, amphibole, and other; moderately cemented sand layer at 178.2-178.7 ft.

GRAVELLY SILT (ML): light yellowish brown (2.5Y 6/3), 60% silt; 30% fine to coarse gravel up to 70 mm, rounded, coarse grained at 179.6 ft; 10% fine grained sand, subangular to subrounded; moderately cemented sand and gravel layer at 180.8-181.8 ft; contains quartz, feldspar, amphibole, and other.

SAND (SP): light yellowish brown (2.5Y 6/4), 100% fine to medium grained sand, subangular to subrounded, predominantly medium grained; trace fine gravel up to 18 mm, rounded; trace clay, clay lens; medium sorted; contains quartz, feldspar, amphibole, and other; rust colored alteration of sands at 186.8 to 187.3 ft.

CLAY (CL): olive (5Y 5/3), 100% clay, low plasticity; trace fine grained sand, subangular to subrounded; some alteration visible with rusty coloration.

SANDY CLAY (CL): pale olive (5Y 6/3), 70% clay, low plasticity; 30% fine to coarse grained sand, subangular to subrounded; trace fine to coarse gravel up to 30 mm, subangular to subrounded; contains quartz, feldspar, mica, amphibole, and other, with visible alteration.

CLAY (CL): olive (5Y 5/3), 100% clay, low plasticity, dense; with visible rust colored alteration.

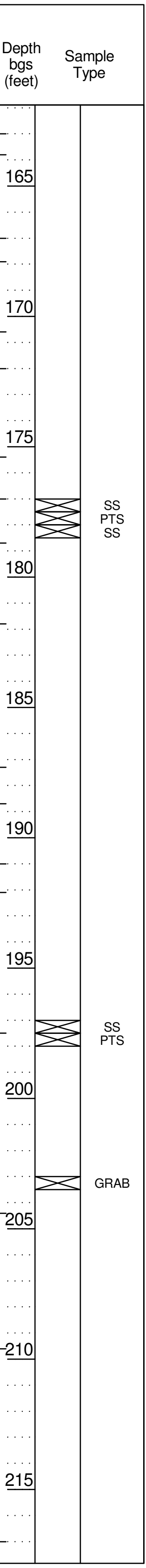
SAND (SP): yellowish brown (10YR 5/4), 95% fine grained sand, subangular to subrounded; 5% silt; well sorted; contains quartz, feldspar and amphibole.

SAND (SP): dark yellowish brown (10YR 4/4), 95% fine grained sand, subangular to subrounded; 5% silt; well sorted; contains quartz, feldspar and amphibole.

SAND (SP): brown (7.5YR 4/3), 95% fine grained sand, subangular to subrounded; 5% silt; well sorted; contains quartz, feldspar and amphibole.

SAND (SP): dark brown (10YR 3/3), 95% fine grained sand, subangular to subrounded; 5% silt; well sorted; contains quartz, feldspar and amphibole.

SAND (SP): dark grayish brown (10YR 4/2), 95% fine grained sand, subangular to



SS: Splitspoon sample GRAB: Grab sample PTS: Splitspoon submitted for analysis SIEVE: Grab sieved by GSSI

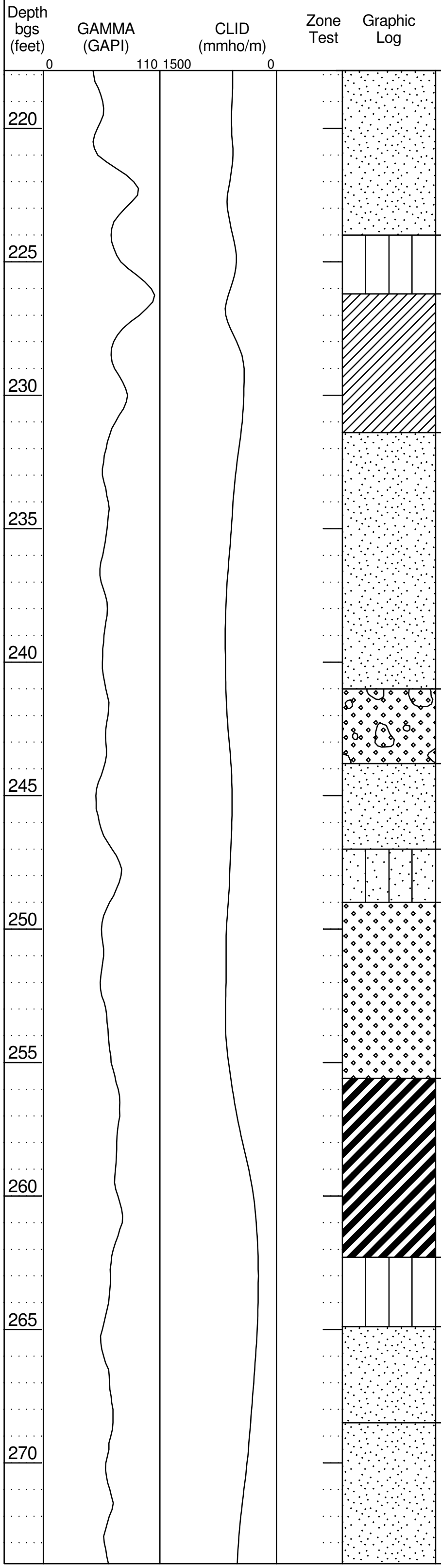
BOREHOLE NAME **CX-B3**

BOREHOLE LITHOLOGIC LOG (continued)

CLIENT California American Water
PROJECT NUMBER 13017-13
LOCATION **Marina, CA**

Lithologic Log

NOTE: Grain size distribution percentages are approximate. Material code (e.g. SP) reference Unified Soil Classification visual method. Color code (e.g. 10YR 5/2) reference Munsell Soil Color Charts.



subrounded; 5% silt; well sorted; contains quartz, feldspar and amphibole; with some visible alteration; cementation at 219 and 224 ft.

SILT (ML): dark brown (10YR 3/3), 95% silt; 5% fine grained sand, subangular to subrounded.

CLAY (CL): olive (5Y 5/3), 100% clay, no plasticity, dense; alteration visible with rust colored laminations below 230 ft.

SAND (SP): pale olive (5Y 6/3), 90% fine to coarse grained sand, subangular to subrounded, predominantly medium grained; 10% fine to coarse gravel up to 70 mm, rounded, interbedded; poorly sorted; contains quartz, feldspar, mica and amphibole; gravel layers at 237, 237.8, and 238.6 to 239.7 ft.

SAND WITH GRAVEL (SW): pale olive (5Y 6/3), 85% fine to coarse grained sand, subangular to rounded; 15% fine to coarse gravel up to 68 mm, rounded; poorly sorted; contains quartz, feldspar, mica, amphibole, and other; with visible alteration.

SAND (SP): dark grayish brown (2.5Y 4/2), 100% fine grained sand, subrounded; trace silt, cemented brown silt at 246.6 ft; well sorted; contains quartz, feldspar, amphibole, and other.

SANDY SILT (ML): olive (5Y 5/3), 70% silt; 30% fine grained sand, subangular to subrounded; with some visible rust colored alteration.

SAND (SW): pale olive (5Y 6/3), 85% fine to coarse grained sand, subangular to subrounded; 10% fine to coarse gravel up to 42 mm, rounded; 5% clay; poorly sorted; contains quartz, feldspar, mica, amphibole, and other; with some visible alteration; thin sandy clay layers.

FAT CLAY (CH): pale olive (5Y 6/3), 100% clay, low plasticity, very dense; some darker fine laminations.

SILT (ML): pale olive (5Y 6/3), 100% silt; trace fine grained sand, subangular to subrounded; trace clay; silt with fine sand and altered sand and trace clay clasts from 262.8 to 263.9 ft; high mica content.

SAND (SP): olive (5Y 5/3), 100% fine to medium grained sand, subangular to subrounded; trace fine to coarse gravel up to 33 mm, rounded; medium sorted; contains quartz, feldspar, mica, amphibole, and other; visible rust colored alteration of sands at 268.5 ft(3in.).

SAND (SP): pale olive (5Y 6/3), 90% medium to coarse grained sand, subangular to subrounded; 10% fine to coarse gravel up to 50 mm, rounded; poorly sorted; contains quartz, feldspar, mica, amphibole, and other.

Depth bgs (feet)	Sample Type
240	SIEVE
255	GRAB
	GRAB

SS: Splitspoon sample GRAB: Grab sample PTS: Splitspoon submitted for analysis SIEVE: Grab sieved by GSSI

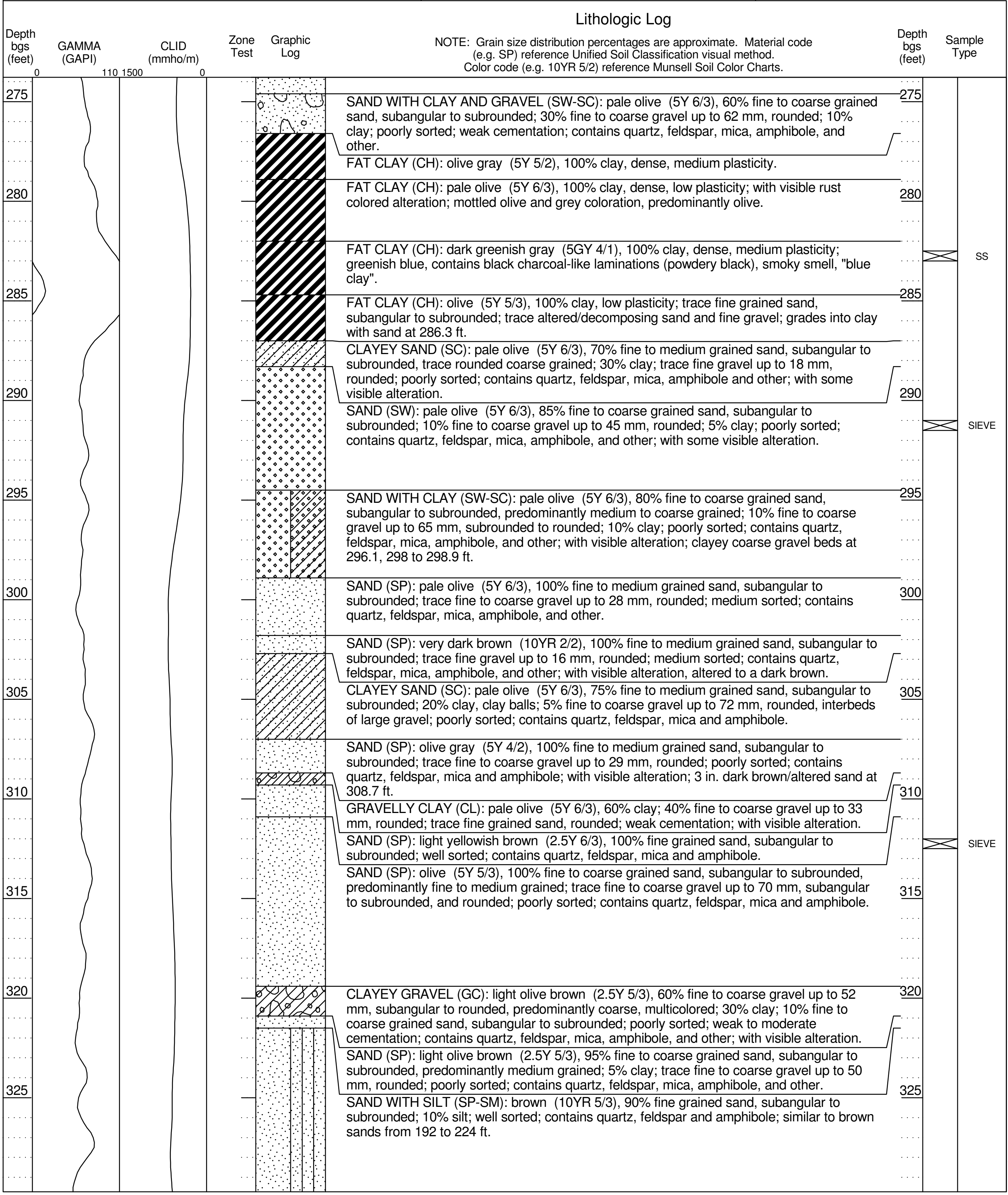
BOREHOLE NAME
CX-B3

BOREHOLE LITHOLOGIC LOG (continued)

CLIENT: California American Water
PROJECT NUMBER: 13017-13
LOCATION: **Marina, CA**

Lithologic Log

NOTE: Grain size distribution percentages are approximate. Material code (e.g. SP) reference Unified Soil Classification visual method. Color code (e.g. 10YR 5/2) reference Munsell Soil Color Charts.



SAND WITH CLAY AND GRAVEL (SW-SC): pale olive (5Y 6/3), 60% fine to coarse grained sand, subangular to subrounded; 30% fine to coarse gravel up to 62 mm, rounded; 10% clay; poorly sorted; weak cementation; contains quartz, feldspar, mica, amphibole, and other.

FAT CLAY (CH): olive gray (5Y 5/2), 100% clay, dense, medium plasticity.

FAT CLAY (CH): pale olive (5Y 6/3), 100% clay, dense, low plasticity; with visible rust colored alteration; mottled olive and grey coloration, predominantly olive.

FAT CLAY (CH): dark greenish gray (5GY 4/1), 100% clay, dense, medium plasticity; greenish blue, contains black charcoal-like laminations (powdery black), smoky smell, "blue clay".

FAT CLAY (CH): olive (5Y 5/3), 100% clay, low plasticity; trace fine grained sand, subangular to subrounded; trace altered/decomposing sand and fine gravel; grades into clay with sand at 286.3 ft.

CLAYEY SAND (SC): pale olive (5Y 6/3), 70% fine to medium grained sand, subangular to subrounded, trace rounded coarse grained; 30% clay; trace fine gravel up to 18 mm, rounded; poorly sorted; contains quartz, feldspar, mica, amphibole and other; with some visible alteration.

SAND (SW): pale olive (5Y 6/3), 85% fine to coarse grained sand, subangular to subrounded; 10% fine to coarse gravel up to 45 mm, rounded; 5% clay; poorly sorted; contains quartz, feldspar, mica, amphibole, and other; with some visible alteration.

SAND WITH CLAY (SW-SC): pale olive (5Y 6/3), 80% fine to coarse grained sand, subangular to subrounded, predominantly medium to coarse grained; 10% fine to coarse gravel up to 65 mm, subrounded to rounded; 10% clay; poorly sorted; contains quartz, feldspar, mica, amphibole, and other; with visible alteration; clayey coarse gravel beds at 296.1, 298 to 298.9 ft.

SAND (SP): pale olive (5Y 6/3), 100% fine to medium grained sand, subangular to subrounded; trace fine to coarse gravel up to 28 mm, rounded; medium sorted; contains quartz, feldspar, mica, amphibole, and other.

SAND (SP): very dark brown (10YR 2/2), 100% fine to medium grained sand, subangular to subrounded; trace fine gravel up to 16 mm, rounded; medium sorted; contains quartz, feldspar, mica, amphibole, and other; with visible alteration, altered to a dark brown.

CLAYEY SAND (SC): pale olive (5Y 6/3), 75% fine to medium grained sand, subangular to subrounded; 20% clay, clay balls; 5% fine to coarse gravel up to 72 mm, rounded, interbeds of large gravel; poorly sorted; contains quartz, feldspar, mica and amphibole.

SAND (SP): olive gray (5Y 4/2), 100% fine to medium grained sand, subangular to subrounded; trace fine to coarse gravel up to 29 mm, rounded; poorly sorted; contains quartz, feldspar, mica and amphibole; with visible alteration; 3 in. dark brown/altered sand at 308.7 ft.

GRAVELLY CLAY (CL): pale olive (5Y 6/3), 60% clay; 40% fine to coarse gravel up to 33 mm, rounded; trace fine grained sand, rounded; weak cementation; with visible alteration.

SAND (SP): light yellowish brown (2.5Y 6/3), 100% fine grained sand, subangular to subrounded; well sorted; contains quartz, feldspar, mica and amphibole.

SAND (SP): olive (5Y 5/3), 100% fine to coarse grained sand, subangular to subrounded, predominantly fine to medium grained; trace fine to coarse gravel up to 70 mm, subangular to subrounded, and rounded; poorly sorted; contains quartz, feldspar, mica and amphibole.

CLAYEY GRAVEL (GC): light olive brown (2.5Y 5/3), 60% fine to coarse gravel up to 52 mm, subangular to rounded, predominantly coarse, multicolored; 30% clay; 10% fine to coarse grained sand, subangular to subrounded; poorly sorted; weak to moderate cementation; contains quartz, feldspar, mica, amphibole, and other; with visible alteration.

SAND (SP): light olive brown (2.5Y 5/3), 95% fine to coarse grained sand, subangular to subrounded, predominantly medium grained; 5% clay; trace fine to coarse gravel up to 50 mm, rounded; poorly sorted; contains quartz, feldspar, mica, amphibole, and other.

SAND WITH SILT (SP-SM): brown (10YR 5/3), 90% fine grained sand, subangular to subrounded; 10% silt; well sorted; contains quartz, feldspar and amphibole; similar to brown sands from 192 to 224 ft.

SS: Splitspoon sample GRAB: Grab sample PTS: Splitspoon submitted for analysis SIEVE: Grab sieved by GSSI

GEOSCIENCE
P.O. Box 220
Claremont, CA 91711
Telephone: (909) 451-6650
Fax: (909) 451-6638
www.gssiwater.com

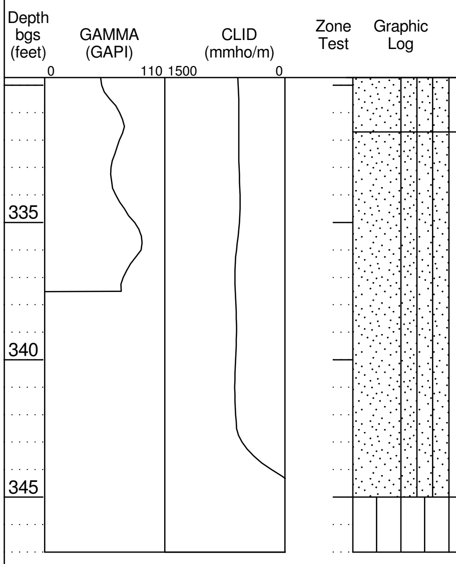
BOREHOLE NAME
CX-B3

BOREHOLE LITHOLOGIC LOG (continued)

CLIENT	California American Water	LOCATION
PROJECT NUMBER	13017-13	**Marina, CA**

Lithologic Log

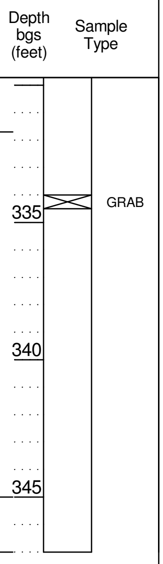
NOTE: Grain size distribution percentages are approximate. Material code (e.g. SP) reference Unified Soil Classification visual method. Color code (e.g. 10YR 5/2) reference Munsell Soil Color Charts.



SAND WITH SILT (SP-SM): dark yellowish brown (10YR 4/4), 90% fine grained sand, subangular to subrounded; 10% silt; well sorted; contains quartz, feldspar and amphibole; similar to brown sands from 192 to 224 ft.

SILT (ML): olive (5Y 5/3), 100% silt, very dense; weak to moderate cementation; with some visible rust colored alteration.

Bottom of borehole at 347 feet.

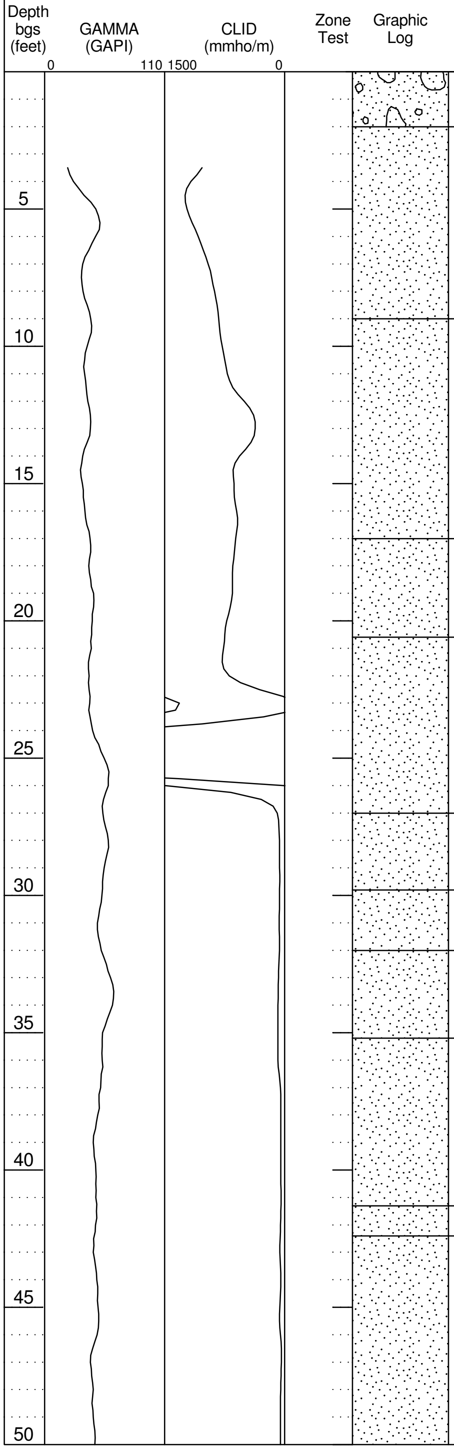


SS: Splitspoon sample GRAB: Grab sample PTS: Splitspoon submitted for analysis SIEVE: Grab sieved by GSSI

BOREHOLE NAME **CX-B4**

BOREHOLE LITHOLOGIC LOG

CLIENT California American Water
PROJECT NUMBER 13017-13
REPORT DATE 7/8/2014
LOCATION **Marina, CA**
CEMEX Lapis Plant
36° 42' 42.1848", -121° 47' 55.2192" Geographic NAD83
DRILLING CONTRACTOR Cascade Drilling
DRILLER Jose Munguia
LOGGED BY **N. Reynolds**
DRILLING RIG TYPE Prosonic 600T
DRILLING METHOD Sonic
START DATE 3/20/14
BOREHOLE DIAMETER 8 in
SURFACE ELEVATION 39.0 ft
TOTAL DEPTH 350 ft bgs
FINISH DATE 4/10/14
CORE SIZE 6 in



Lithologic Log

NOTE: Grain size distribution percentages are approximate. Material code (e.g. SP) reference Unified Soil Classification visual method. Color code (e.g. 10YR 5/2) reference Munsell Soil Color Charts.

SAND WITH GRAVEL (SP): light olive brown (2.5Y 5/3) and pale yellow (2.5Y 7/3), 65% fine to medium grained sand, subangular to rounded; 30% fine to coarse gravel up to 70 mm, subangular to rounded; 5% silt; medium sorted; contains quartz, feldspar and amphibole; trace cobbles; trace organics/roots.

SAND (SP): very dark grayish brown (10YR 3/2), 95% fine grained sand, subrounded to rounded; 5% silt; trace fine to coarse gravel up to 52 mm, subrounded to rounded, at 8.5 ft bgs; well sorted; contains quartz, feldspar, amphibole and other.

SAND (SP): pale yellow (5Y 7/4), 100% fine to medium grained sand, subangular to subrounded; trace silt, trace silt balls; medium sorted; contains quartz, feldspar, amphibole and other.

SAND (SP): olive gray (5Y 4/2), 100% fine to medium grained sand, subangular to rounded; medium sorted; contains quartz, feldspar, amphibole and other.

SAND (SP): pale yellow (5Y 7/4), 100% fine to medium grained sand, subangular to subrounded; medium sorted; contains quartz, feldspar, amphibole and other.

SAND (SP): light olive brown (2.5Y 5/3), 100% fine to medium grained sand, subangular to subrounded; medium sorted; contains quartz, feldspar, amphibole and other.

SAND (SP): light olive brown (2.5Y 5/4), 95% fine grained sand, subangular to subrounded; 5% silt, gray silt pieces; well sorted; contains quartz, feldspar, mica and amphibole.

SAND (SP): light yellowish brown (2.5Y 6/4), 100% fine to medium grained sand, subangular to subrounded; medium sorted; contains quartz, feldspar, amphibole and other.

SAND (SP): light yellowish brown (2.5Y 6/3), 100% medium grained sand, subangular to subrounded, trace fine grained; trace silt; medium sorted; contains quartz, feldspar, mica, amphibole and other; trace weakly cemented olive silty sand layer from 37.5 to 37.8 ft bgs; coarser than above.

SAND (SP): light yellowish brown (2.5Y 6/3), 100% fine grained sand, subangular to subrounded; trace silt; well sorted; contains quartz, feldspar, mica and amphibole; trace thin olive/gray horizontal silt lenses at 42.1 ft bgs.

SAND (SP): light yellowish brown (2.5Y 6/4), 100% fine to medium grained sand, subangular, predominantly medium grained, trace coarse grained; trace fine gravel up to 10 mm, subrounded; medium sorted; contains quartz, feldspar, mica, amphibole and other.

Depth bgs (feet)	Sample Type
25	☒ GRAB
46–47	☒ SIEVE

SS: Splitspoon sample GRAB: Grab sample PTS: Splitspoon submitted for analysis SIEVE: Grab sieved by GSSI

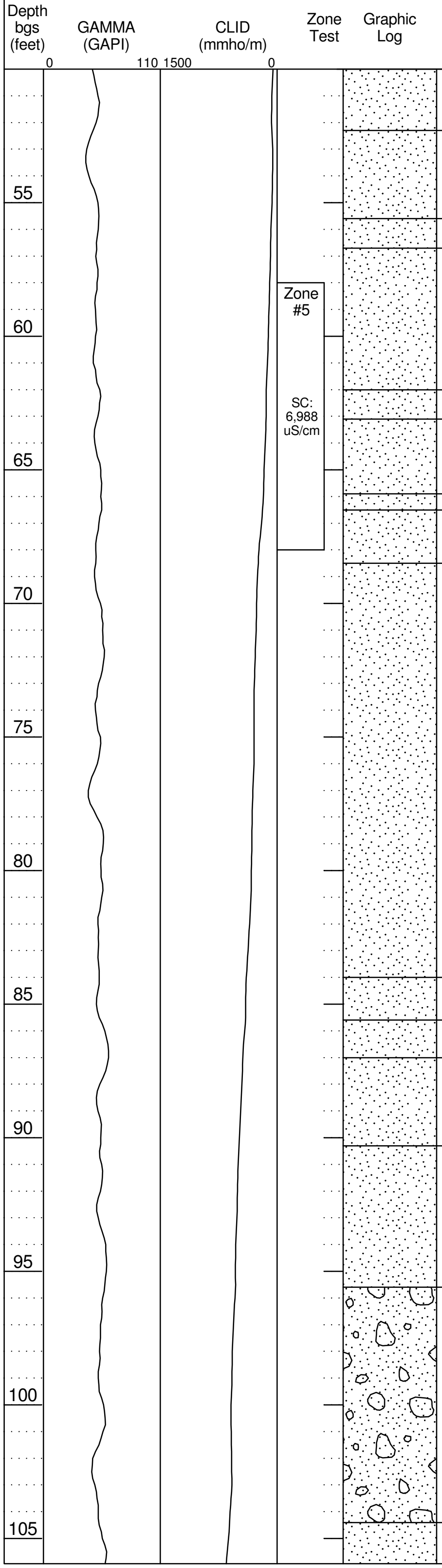
BOREHOLE NAME
CX-B4

BOREHOLE LITHOLOGIC LOG (continued)

CLIENT California American Water
PROJECT NUMBER 13017-13
LOCATION **Marina, CA**

Lithologic Log

NOTE: Grain size distribution percentages are approximate. Material code (e.g. SP) reference Unified Soil Classification visual method. Color code (e.g. 10YR 5/2) reference Munsell Soil Color Charts.



SAND (SP): light olive brown (2.5Y 5/3), 100% fine grained sand, subangular to subrounded, trace medium grained; well sorted; contains quartz, feldspar, mica and amphibole.

SAND (SP): light yellowish brown (2.5Y 6/3), 100% fine to medium grained sand, subangular to rounded, trace coarse grained; medium sorted; contains quartz, feldspar, mica and amphibole.

SAND (SP): olive (5Y 5/3), 100% fine grained sand, subangular to subrounded, fine to medium grained at 59 to 59.7 ft bgs; trace silt; well sorted; contains quartz, feldspar, mica and amphibole; higher mica content.

SAND (SP): olive (5Y 5/3), 100% fine to coarse grained sand, subangular to subrounded, predominantly coarse grained; poorly sorted; contains quartz, feldspar, mica and amphibole; higher mica content.

SAND (SP): olive (5Y 5/3), 100% fine to medium grained sand, subangular to subrounded; trace silt; medium sorted; contains quartz, feldspar, mica and amphibole; higher mica content.

SAND (SP): olive (5Y 5/3), 100% fine to coarse grained sand, subangular to subrounded, predominantly coarse grained; poorly sorted; contains quartz, feldspar, mica and amphibole; higher mica content.

SAND (SP): olive (5Y 5/3), 100% fine to coarse grained sand, subangular to subrounded, predominantly fine to medium grained, fine sand at 66.5 to 67 ft bgs; poorly sorted; contains quartz, feldspar, mica and amphibole.

SAND (SP): olive (5Y 5/3), 95% fine grained sand, subangular to subrounded, very fine grained, trace fine to medium grained interbeds; 5% silt; well sorted; contains quartz, feldspar, mica and amphibole; higher mica content; trace thin pink horizontal laminations.

SAND (SP): olive (5Y 5/3), 100% fine to coarse grained sand, subangular to subrounded; poorly sorted; contains quartz, feldspar, mica and amphibole; very high mica content.

SAND (SP): olive gray (5Y 5/2), 95% fine grained sand, subangular to subrounded, very fine grained; 5% silt; well sorted; contains quartz, feldspar, mica and amphibole.

SAND (SP): light olive brown (2.5Y 5/6), 100% fine to medium grained sand, subangular to subrounded; trace fine gravel up to 11 mm, rounded; poorly sorted; contains quartz, feldspar, mica, amphibole and other; orange colored alteration.

SAND (SP): light yellowish brown (2.5Y 6/4), 95% medium to coarse grained sand, subangular to rounded, trace fine grained; 5% fine to coarse gravel up to 30 mm, rounded; trace silt; poorly sorted; contains quartz, feldspar, mica, amphibole and other; free water.

SAND WITH GRAVEL (SP): pale yellow (2.5Y 7/3) and light yellowish brown (2.5Y 6/4), 80% fine to coarse grained sand, subangular to rounded, predominantly medium to coarse grained; 15% fine to coarse gravel up to 43 mm, rounded; 5% silt; poorly sorted; contains quartz, feldspar, mica, amphibole and other; chert, many mineral types; free water.

SAND (SP): pale olive (5Y 6/3), 100% fine to medium grained sand, subangular to subrounded; trace fine to coarse gravel up to 23 mm, rounded; poorly sorted; contains

Depth bgs (feet)	Sample Type
55	
	SS
60	
	GRAB
65	
70	
	SIEVE
75	
80	
85	
90	
95	
100	GRAB
105	

SS: Splitspoon sample GRAB: Grab sample PTS: Splitspoon submitted for analysis SIEVE: Grab sieved by GSSI

GEOSCIENCE
P.O. Box 220
Claremont, CA 91711
Telephone: (909) 451-6650
Fax: (909) 451-6638
www.gssiwater.com

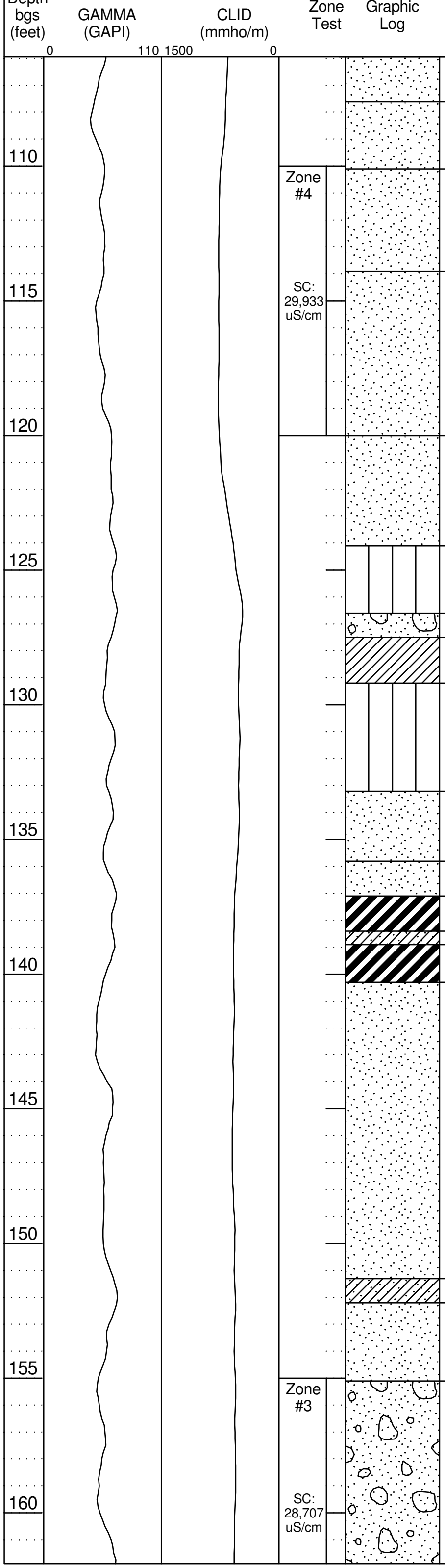
BOREHOLE NAME **CX-B4**

BOREHOLE LITHOLOGIC LOG (continued)

CLIENT: California American Water
PROJECT NUMBER: 13017-13
LOCATION: **Marina, CA**

Lithologic Log

NOTE: Grain size distribution percentages are approximate. Material code (e.g. SP) reference Unified Soil Classification visual method. Color code (e.g. 10YR 5/2) reference Munsell Soil Color Charts.



quartz, feldspar, mica, amphibole and other.

SAND (SP): light yellowish brown (2.5Y 6/3), 90% fine to coarse grained sand, subangular to rounded; 10% fine to coarse gravel up to 30 mm, rounded; poorly sorted; contains quartz, feldspar, mica, amphibole and other.

SAND (SP): light olive brown (2.5Y 5/4), 100% fine grained sand, subangular to subrounded; well sorted; contains quartz, feldspar, mica and amphibole.

SAND (SP): light olive brown (2.5Y 5/4), 95% fine grained sand, subangular to subrounded, very fine grained; 5% silt; well sorted; contains quartz, feldspar, mica and amphibole.

SAND (SP): olive (5Y 5/3), 100% fine grained sand, subangular to subrounded; well sorted; contains quartz, feldspar, mica and amphibole; increase in olive coloration.

SILT (ML): pale olive (5Y 6/3), 95% silt; 5% fine grained sand, subangular to subrounded, highly altered, rust, tan and black from 124.1 to 124.9 ft bgs; low plasticity; thin rusty and black horizontal alteration/lamination.

SAND WITH SILT AND GRAVEL (SP-SM): pale olive (5Y 6/3), 75% fine grained sand, subangular to subrounded, fine grained grading to medium to coarse grained silty gravelly sand; 15% fine to coarse gravel up to 41 mm, rounded; 10% silt; poorly sorted; contains quartz, feldspar, mica and amphibole; highly altered at 127.5 ft bgs.

CLAY (CL): dark gray (5Y 4/1), 100% clay, medium plasticity, dense; trace thin rust colored horizontal lamination; highly altered at 129.2 ft bgs.

SILT WITH SAND (ML): olive (5Y 5/3), 80% silt, silt bed from 132.2 to 132.7 ft bgs; 20% fine grained sand, subangular to subrounded, very fine grained; contains quartz, feldspar and mica; trace thin rust colored horizontal alteration/lamination.

SAND (SP): pale olive (5Y 6/3), 100% fine grained sand, subangular to subrounded, grades to fine to medium grained; trace silt; poorly sorted; contains quartz, feldspar, mica and amphibole.

SAND (SP): olive (5Y 5/3), 100% fine grained sand, subangular to subrounded; well sorted; contains quartz, feldspar, mica and amphibole; highly altered/rust colored at 137.1 ft bgs.

FAT CLAY (CH): olive gray (5Y 5/2), 100% clay, high plasticity, dense; trace black and rust colored lamination; trace black ashy deposits.

SANDY CLAY (CL): pale olive (5Y 6/3), 60% clay, no plasticity; 40% fine grained sand, subangular to subrounded; contains quartz and feldspar; thin black and rust colored lamination.

FAT CLAY (CH): pale olive (5Y 6/3), 100% clay, high plasticity, dense; thin black and rust colored lamination.

SAND (SP): pale yellow (2.5Y 7/3), 100% fine grained sand, subangular to subrounded; well sorted; contains quartz, feldspar and amphibole; trace rust colored alteration.

SANDY CLAY (CL): pale olive (5Y 6/3), 60% clay, no plasticity; 40% fine grained sand, subangular to subrounded; contains quartz and feldspar; thin black and rust colored lamination.

SAND (SP): pale olive (5Y 6/3), 95% fine to medium grained sand, subangular to subrounded; 5% silt; trace fine to coarse gravel up to 22 mm, subangular; poorly sorted; contains quartz, feldspar, mica and amphibole; 2.5 in. horizontal rusty/altered band at 154 ft bgs.

SAND WITH GRAVEL (SP): pale olive (5Y 6/3), 80% fine to coarse grained sand, subangular; rusty/altered from 160.4 to 160.7 ft bgs; 15% fine to coarse gravel up to 52 mm, subrounded to rounded; 5% clay; poorly sorted; contains quartz, feldspar, amphibole and other.

Depth bgs (feet)	Sample Type
115–116	SIEVE
147–148	SS

SS: Splitspoon sample GRAB: Grab sample PTS: Splitspoon submitted for analysis SIEVE: Grab sieved by GSSI

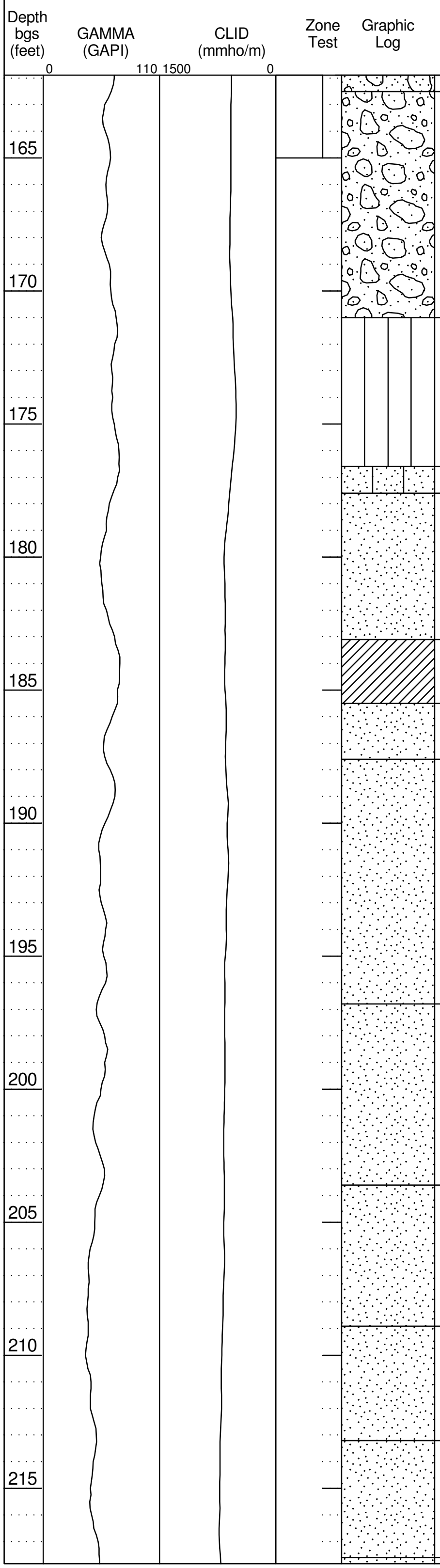
BOREHOLE NAME
CX-B4

BOREHOLE LITHOLOGIC LOG (continued)

CLIENT California American Water
PROJECT NUMBER 13017-13
LOCATION **Marina, CA**

Lithologic Log

NOTE: Grain size distribution percentages are approximate. Material code (e.g. SP) reference Unified Soil Classification visual method. Color code (e.g. 10YR 5/2) reference Munsell Soil Color Charts.



GRAVEL WITH CLAY AND SAND (GP-GC): pale olive (5Y 6/3), 60% fine to coarse gravel up to 60 mm, subrounded to rounded; 30% medium to coarse grained sand, subangular; 10% clay; trace cobbles; poorly sorted; contains quartz, feldspar, amphibole and other; trace round cobbles up to 85 mm at 163 to 166 ft bgs; many mineral types; trace rusty alteration.

SILT (ML): olive (5Y 5/3), 100% silt, very dense; friable; rust colored alteration and lamination.

SILTY SAND (SM): pale olive (5Y 6/3), 85% fine grained sand, subangular to subrounded; 15% silt, from 177.3 to 177.6 ft bgs; no plasticity; well sorted; contains quartz, feldspar and amphibole.

SAND (SP): light olive gray (5Y 6/2), 100% fine grained sand, subangular to subrounded, grades to fine to medium grained; trace fine gravel up to 18 mm, rounded; well sorted; contains quartz, feldspar, mica and amphibole; rusty alteration at 177.6 ft bgs.

CLAY WITH SAND (CL): pale olive (5Y 6/3), 85% clay, low plasticity; 10% fine to medium grained sand, subangular to subrounded; 5% fine to coarse gravel up to 36 mm, rounded; contains quartz, mica and amphibole; clay with sand and gravel interbeds; weakly cemented clay and gravel at 183.5 ft bgs; trace rusty alteration/nodules.

SAND (SP): olive gray (5Y 5/2), 100% fine to medium grained sand, subangular to subrounded; medium sorted; contains quartz, feldspar, mica and amphibole.

SAND (SP): yellowish brown (10YR 5/6), 100% fine grained sand, subangular to subrounded; well sorted; contains quartz, feldspar and amphibole; start of "the brown sand".

SAND (SP): dark yellowish brown (10YR 4/6), 100% fine grained sand, subangular to subrounded; well sorted; contains quartz, feldspar and amphibole; redder coloration than above.

SAND (SP): dark yellowish brown (10YR 3/4), 95% fine grained sand, subangular to subrounded; 5% silt; well sorted; contains quartz, feldspar and amphibole; trace weakly cemented sands and sand nodules; mottled coloration.

SAND (SP): brown (10YR 4/3), 100% fine grained sand, subangular to subrounded; well sorted; contains quartz, feldspar and amphibole.

SAND (SP): strong brown (7.5YR 4/6), 100% fine grained sand, subangular to subrounded; well sorted; contains quartz, feldspar and amphibole; faint thin rusty horizontal lamination; more red.

Depth bgs (feet)	Sample Type
165	
	☒ GRAB
170	
175	
180	
185	
190	
	☒ SIEVE
195	
200	
205	
210	
	☒ GRAB
215	

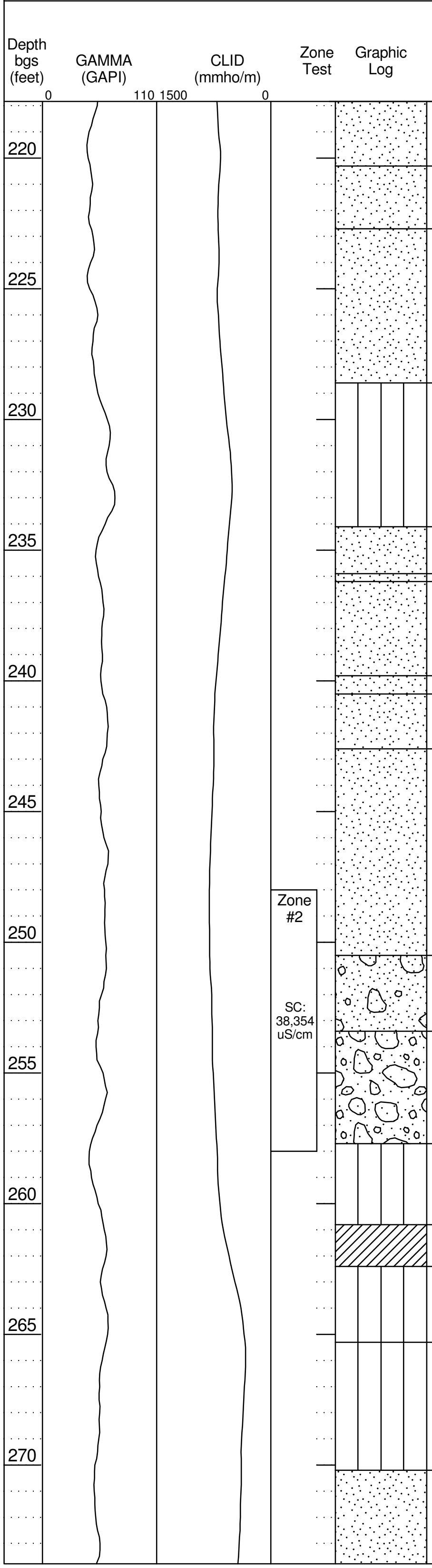
SS: Splitspoon sample GRAB: Grab sample PTS: Splitspoon submitted for analysis SIEVE: Grab sieved by GSSI

GEOSCIENCE
P.O. Box 220
Claremont, CA 91711
Telephone: (909) 451-6650
Fax: (909) 451-6638
www.gssiwater.com

BOREHOLE NAME **CX-B4**

BOREHOLE LITHOLOGIC LOG (continued)

CLIENT California American Water
PROJECT NUMBER 13017-13
LOCATION **Marina, CA**



Lithologic Log

NOTE: Grain size distribution percentages are approximate. Material code (e.g. SP) reference Unified Soil Classification visual method. Color code (e.g. 10YR 5/2) reference Munsell Soil Color Charts.

SAND (SP): grayish brown (2.5Y 5/2), 95% fine grained sand, subangular to subrounded; 5% silt; well sorted; contains quartz, feldspar and amphibole; weakly cemented sand and sand nodules at 220.0 to 220.3 ft bgs.

SAND (SP): olive brown (2.5Y 4/4), 100% fine grained sand, subangular to subrounded; well sorted; contains quartz, feldspar and amphibole; trace thin reddish horizontal laminations.

SAND (SP): dark olive brown (2.5Y 3/3), 100% fine grained sand, subangular to subrounded; well sorted; contains quartz, feldspar and amphibole; darker color/more black minerals.

SILT (ML): pale olive (5Y 6/3), 100% silt, very dense; less dense from 233.4 to 234.1 ft bgs; low plasticity; rusty/highly altered at 228.6 to 229.3 ft bgs; trace thin black horizontal lamination especially at 232.5 to 233.4 ft bgs.

SAND (SP): olive (5Y 5/3), 95% fine to medium grained sand, subangular to subrounded; 5% fine to coarse gravel up to 26 mm, well rounded; trace silt, siltstone; poorly sorted; contains quartz, feldspar, mica, amphibole and other; high mica content.

SAND (SP): dark grayish brown (2.5Y 4/2), 95% medium to coarse grained sand, trace fine grained, subangluar to subrounded; 5% fine to coarse gravel up to 26 mm, well rounded; trace silt, siltstone; poorly sorted; contains quartz, feldspar, mica, amphibole and other; altered to a dark brown.

SAND (SP): pale olive (5Y 6/3), 90% fine to medium grained sand, subangular to subrounded; 10% fine to coarse gravel up to 65 mm, subrounded to rounded, coarse grained gravel bed at 238.4 ft bgs; poorly sorted; contains quartz, feldspar, mica, amphibole and other; includes flat siltstone and granite.

SAND (SP): dark brown (7.5YR 3/3), 90% fine to coarse grained sand, predominantly medium to coarse grained, subangular to subrounded; 10% fine to coarse gravel up to 26 mm, subrounded to rounded; trace silt; poorly sorted; contains quartz, feldspar, mica, amphibole and other; altered to a dark brown.

SAND (SP): light yellowish brown (2.5Y 6/3), 90% medium to coarse grained sand, subangular to subrounded; 10% fine to coarse gravel up to 72 mm, rounded; poorly sorted; contains quartz, feldspar, mica, amphibole and other; trace weakly cemented silt chips; siltstones; many mineral types.

SAND (SP): pale olive (5Y 6/3), 95% fine to medium grained sand, subangular to subrounded; 5% fine to coarse gravel up to 30 mm, subangular to subrounded; poorly sorted; contains quartz, feldspar, mica, amphibole and other; medium to coarse sand and gravelly interbeds; many mineral types.

SAND WITH GRAVEL (SP): pale olive (5Y 6/3), 70% fine to coarse grained sand, subangular to subrounded; 30% fine to coarse gravel up to 45 mm, well rounded; poorly sorted; contains quartz, feldspar, mica, amphibole and other; trace 70 mm clay ball at 252.3 ft bgs; siltstone; many mineral types.

GRAVEL WITH CLAY AND SAND (GP-GC): pale olive (5Y 6/3), 50% fine to coarse gravel up to 55 mm, well rounded, predominantly coarse grained, coarse grained gravel and cobble bed from 254.9 to 255.6 ft bgs; trace cobble measured at 83 mm; 40% fine to coarse grained sand, subangular to subrounded; 10% clay, trace clay balls; trace cobbles; poorly sorted; contains quartz, feldspar, mica, amphibole and other; siltstone; many mineral types.

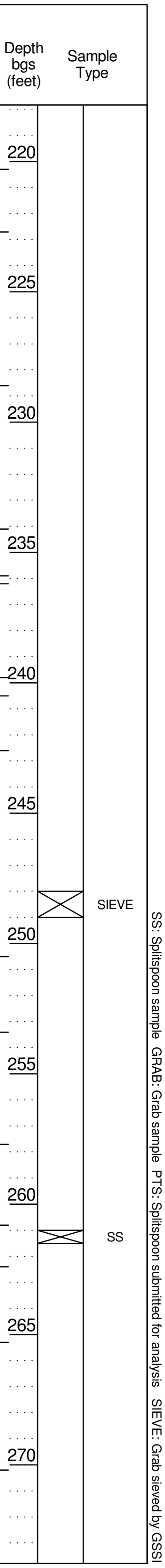
SILT (ML): pale olive (5Y 6/3), 100% silt, very dense; low plasticity; trace thin horizontal black/ashy laminations.

CLAY (CL): olive gray (5Y 5/2), 100% clay, low plasticity, dense.

SILT (ML): pale olive (5Y 6/3), 100% silt, dense; trace thin ashy black colored horizontal laminations; trace small rusty globular deposits.

SILT (ML): pale olive (5Y 6/3), 90% silt, less dense than above; 10% fine grained sand, subangular to subrounded, very fine grained; silt with interbedded very fine grained sands; high mica content.

SAND (SP): light olive gray (5Y 6/2), 90% fine to coarse grained sand, subangular to subrounded, predominantly medium to coarse grained; 10% fine to coarse gravel up to 50 mm, subrounded to rounded, coarse gravel deposit at 279.4 ft bgs; trace silt, flat/round siltstones; poorly sorted; contains quartz, feldspar, amphibole and other.



SS: Splitspoon sample GRAB: Grab sample PTS: Splitspoon submitted for analysis SIEVE: Grab sieved by GSSI

GEOSCIENCE
P.O. Box 220
Claremont, CA 91711
Telephone: (909) 451-6650
Fax: (909) 451-6638
www.gssiwater.com

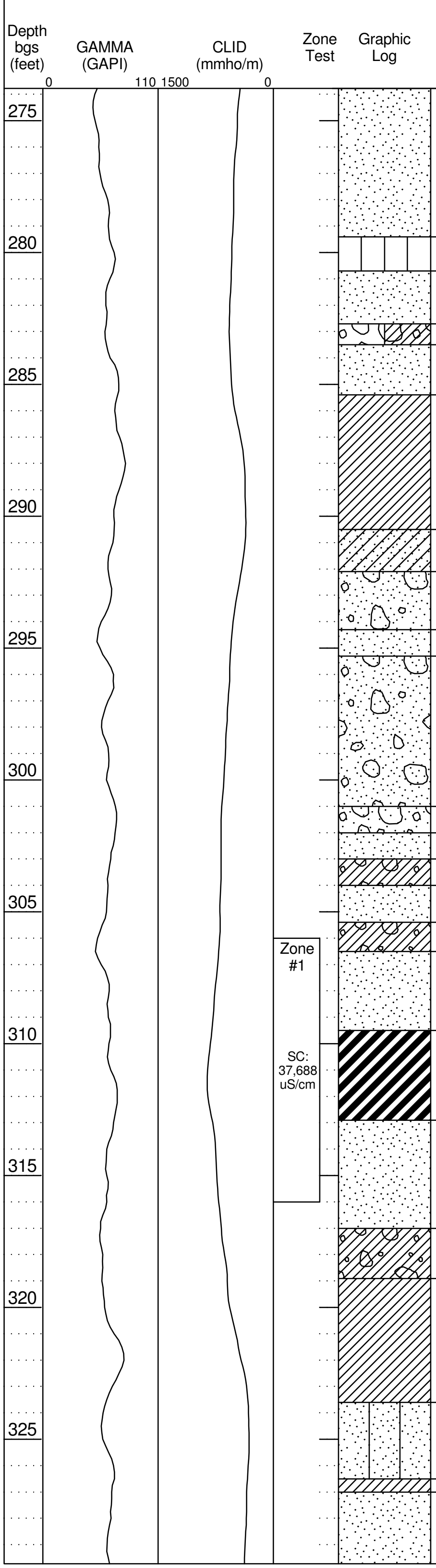
BOREHOLE NAME **CX-B4**

BOREHOLE LITHOLOGIC LOG (continued)

CLIENT: California American Water
PROJECT NUMBER: 13017-13
LOCATION: **Marina, CA**

Lithologic Log

NOTE: Grain size distribution percentages are approximate. Material code (e.g. SP) reference Unified Soil Classification visual method. Color code (e.g. 10YR 5/2) reference Munsell Soil Color Charts.



SILT (ML): pale olive (5Y 6/3), 100% silt; low plasticity; thin rusty and black laminations.

SAND (SP): pale yellow (5Y 7/3), 100% fine to coarse grained sand, subangular to subrounded; trace fine to coarse gravel up to 22 mm, rounded; trace silt, silt balls; poorly sorted; contains quartz, feldspar, amphibole and other; trace well rounded 90 mm cobble at 281.8 ft bgs.

GRAVEL WITH CLAY (GP-GC): pale olive (5Y 6/3), 90% fine to coarse gravel up to 55 mm, rounded, predominantly coarse grained; 10% clay; trace fine grained sand; poorly sorted; contains quartz, feldspar and other.

SAND (SP): pale yellow (5Y 7/3), 90% medium to coarse grained sand, subangular to subrounded; 10% fine to coarse gravel up to 60 mm, well rounded; poorly sorted; contains quartz, feldspar and other.

CLAY (CL): pale olive (5Y 6/3), 100% clay, low plasticity, very dense/hard; thin black/ashy horizontal laminations; trace rusty/altered layers, especially at 288.7 to 289.4 ft bgs.

CLAYEY SAND (SC): light yellowish brown (2.5Y 6/3), 65% fine grained sand, trace medium to coarse grained, subangular to subrounded; 30% clay; 5% fine to coarse gravel up to 35 mm, well rounded; medium sorted; contains quartz, feldspar and other; trace 0.25 in. gray and rusty bands; siltstone.

SAND WITH CLAY AND GRAVEL (SP-SC): light yellowish brown (2.5Y 6/3), 70% fine to coarse grained sand, subangular to subrounded; 20% fine to coarse gravel up to 65 mm, well rounded; 10% clay, trace clay balls; poorly sorted; contains quartz, feldspar, mica, amphibole and other.

SAND (SP): pale olive (5Y 6/3), 100% fine to medium grained sand, subangular to subrounded; trace fine to coarse gravel up to 31 mm, well rounded; poorly sorted; contains quartz, feldspar, mica, amphibole and other.

SAND WITH GRAVEL (SP): pale olive (5Y 6/3), 60% medium to coarse grained sand, subangular to subrounded; 35% fine to coarse gravel up to 70 mm, subrounded to well rounded, coarse grained bed at 300.3 to 301.0 ft bgs; 5% clay; trace cobbles; poorly sorted; contains quartz, feldspar, mica, amphibole and other; trace cobble to 75 mm at 298.0 ft bgs.

CLAYEY GRAVEL WITH SAND (GC): pale olive (5Y 6/3), 60% fine to coarse gravel up to 70 mm, subrounded to well rounded; 25% fine to medium grained sand, subangular to subrounded; 15% clay; poorly sorted; contains quartz, feldspar, mica, amphibole and other; trace siltstone gravel.

SAND (SP): light olive gray (5Y 6/2), 95% fine to medium grained sand, subangular to subrounded; 5% fine to coarse gravel up to 45 mm, subrounded to rounded, some flat rounded; trace clay; poorly sorted; contains quartz, feldspar, mica, amphibole and other.

GRAVELLY CLAY (CL): pale olive (5Y 6/3), 55% clay, low plasticity; 40% fine to coarse gravel up to 25 mm, rounded; 5% fine to medium grained sand; contains quartz, feldspar, mica, amphibole and other.

SAND (SP): light olive gray (5Y 6/2), 95% fine to medium grained sand, trace coarse grained, subangular to subrounded; 5% fine to coarse gravel up to 33 mm, rounded; poorly sorted; contains quartz, feldspar, mica, amphibole and other.

GRAVELLY CLAY (CL): pale olive (5Y 6/3), 50% clay, low plasticity; 40% fine to coarse gravel up to 60 mm, rounded; 10% fine to medium grained sand, subangular to rounded; contains quartz, feldspar, mica, amphibole and other; altered brown sand layer from 305.8 to 306.0 ft bgs.

SAND (SP): pale olive (5Y 6/3), 90% fine to coarse grained sand, subangular to rounded; 5% fine to coarse gravel up to 39 mm, rounded; 5% clay; poorly sorted; contains quartz, feldspar, amphibole and other; rusty/altered clay and gravel bed 309.0 to 309.2 ft bgs.

FAT CLAY (CH): pale olive (5Y 6/3), 100% clay, high plasticity, soft; thin rusty horizontal lamination and point deposits.

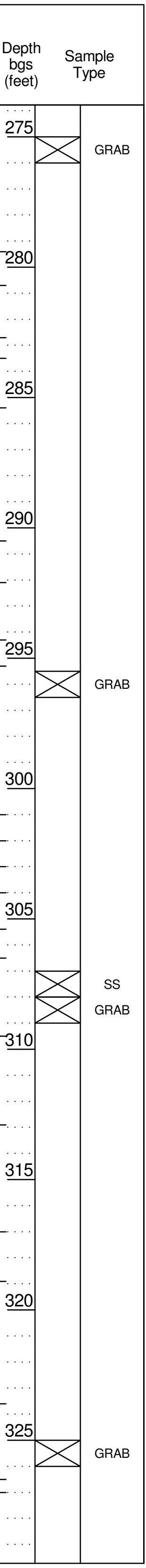
SAND (SP): pale olive (5Y 6/3), 100% fine to medium grained sand, subangular to rounded; medium sorted; contains quartz, feldspar, mica, amphibole and other; rusty/altered medium to coarse grained sand at 312.9 ft bgs.

GRAVELLY CLAY (CL): light yellowish brown (2.5Y 6/4), 70% clay, low plasticity; 30% coarse gravel up to 55 mm, well rounded; trace fine grained sand; contains quartz and feldspar; rusty horizontal alteration/lamination.

CLAY (CL): pale olive (5Y 6/3), 100% clay, low plasticity, dense; trace fine grained sand; rusty horizontal alteration/lamination; silty/sandy clay layer from 321.8 to 323.6 ft bgs; rusty nodules.

SILTY SAND (SM): pale olive (5Y 6/3), 85% fine grained sand, very fine grained; 15% silt; well sorted; contains quartz, feldspar, mica and amphibole.

CLAY (CL): pale olive (5Y 6/3), 100% clay, low plasticity; trace silt; trace very fine grained sand; thin interbeds of silt and fine grained sand with some thin rusty horizontal



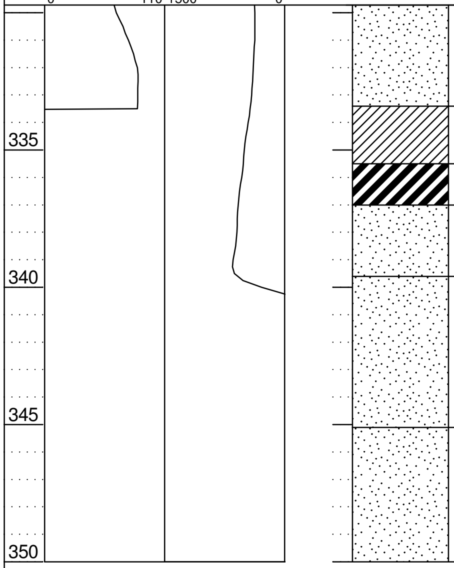
SS: Splitspoon sample GRAB: Grab sample PTS: Splitspoon submitted for analysis SIEVE: Grab sieved by GSSI

BOREHOLE NAME	**CX-B4**
CLIENT	California American Water
PROJECT NUMBER	13017-13
LOCATION	**Marina, CA**

BOREHOLE LITHOLOGIC LOG (continued)

Lithologic Log

NOTE: Grain size distribution percentages are approximate. Material code (e.g. SP) reference Unified Soil Classification visual method. Color code (e.g. 10YR 5/2) reference Munsell Soil Color Charts.



lamination/alteration.

SAND (SP): pale olive (5Y 6/3), 100% fine grained sand, subangular to subrounded, trace clay pods; well sorted; contains quartz, feldspar, mica and amphibole; higher mica content; more black minerals.

CLAY (CL): olive gray (5Y 5/2), 70% clay, medium plasticity; 30% silt; trace fine grained sand; clay with 2 to 3 in. silt/fine grained sand with thin rusty horizontal lamination/alteration.

FAT CLAY (CH): light olive gray (5Y 6/2), 100% clay, medium plasticity.

SAND (SP): brown (10YR 4/3), 100% fine grained sand, subangular to subrounded; trace silt; well sorted; contains quartz, feldspar and amphibole; weakly cemented, especially near rusty horizontal laminations; start of the second "brown sand" layer, similar to sand at 187.6 ft bgs.

SAND (SP): brown (10YR 5/3), 100% fine grained sand, subangular to subrounded; well sorted; contains quartz, feldspar and amphibole; less red, more gray-brown.

SAND (SP): brown (10YR 4/3), 100% fine grained sand, subangular to subrounded; trace silt; well sorted; contains quartz, feldspar and amphibole; faint thin rusty horizontal laminations; weak to moderately cemented below 348.3 ft bgs, especially in areas of rusty alteration; more red; moderately cemented at 350 ft bgs.

Depth bgs (feet)	Sample Type
335	
340	
345	
	☒ GRAB
350	

Bottom of borehole at 350 feet.

SS: Splitspoon sample GRAB: Grab sample PTS: Splitspoon submitted for analysis SIEVE: Grab sieved by GSSI

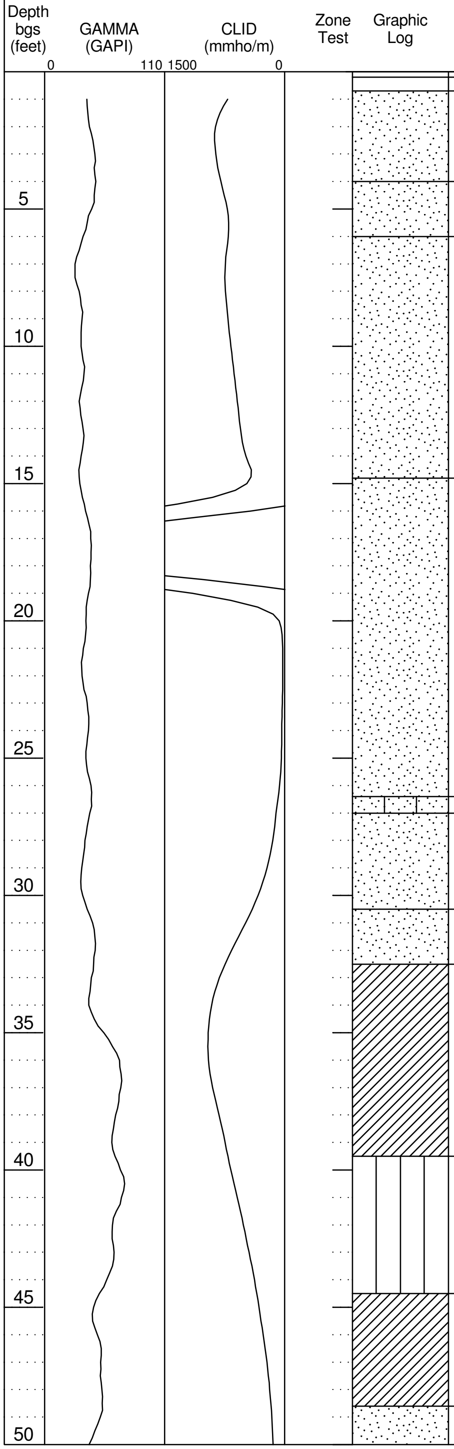
BOREHOLE NAME
MDW-1

BOREHOLE LITHOLOGIC LOG

CLIENT: California American Water
PROJECT NUMBER: 13017-13
REPORT DATE: 7/8/2014
LOCATION: **Castroville, CA**
Salinas River State Beach
36° 46' 32.3688", -121° 47' 41.4816" Geographic NAD83
DRILLING CONTRACTOR: Cascade Drilling
DRILLER: Jose Munguia
LOGGED BY: **N. Reynolds**
DRILLING RIG TYPE: Prosonic 600T
DRILLING METHOD: Sonic
START DATE: 4/23/14
BOREHOLE DIAMETER: 8 in
SURFACE ELEVATION: 20.0 ft
TOTAL DEPTH: 300 ft bgs
FINISH DATE: 4/27/14
CORE SIZE: 6 in

Lithologic Log

NOTE: Grain size distribution percentages are approximate. Material code (e.g. SP) reference Unified Soil Classification visual method. Color code (e.g. 10YR 5/2) reference Munsell Soil Color Charts.



NO SAMPLE: asphalt.

NO SAMPLE: gravel road base.

SAND (SP): dark grayish brown (2.5Y 4/2), 100% fine grained sand, subangular to subrounded; well sorted; contains quartz, feldspar and amphibole.

SAND (SP): light yellowish brown (2.5Y 6/3), 100% fine grained sand, subangular to subrounded; well sorted; contains quartz, feldspar and amphibole.

SAND (SP): very dark grayish brown (2.5Y 3/2), 100% fine grained sand, subangular to subrounded; well sorted; contains quartz, feldspar and amphibole.

SAND (SP): light olive brown (2.5Y 5/3), 100% fine grained sand, subangular to subrounded; well sorted; contains quartz, feldspar and amphibole.

SILTY SAND (SM): black (10YR 2/1) and dark gray (5Y 4/1), 80% fine grained sand, subangular to subrounded; 20% silt; well sorted; contains quartz, feldspar and amphibole; organic rich (wood).

SAND (SP): olive gray (5Y 5/2), 100% fine grained sand, subangular to subrounded; well sorted; contains quartz, feldspar and amphibole.

SAND (SP): dark greenish gray (10Y 4/1), 100% fine grained sand, subangular to subrounded, trace medium grained; well sorted; contains quartz, feldspar and amphibole.

CLAY (CL): dark greenish gray (10Y 4/1), 100% clay, medium plasticity, soft, silty; trace silt; abundance of horizontal black/ashy deposits between 34.5 - 36.4 ft bgs; mica present; trace white flakes (shells?); bluish coloration.

SILT (ML): dark greenish gray (10Y 4/1), 100% silt; no to low plasticity; clayey interbeds with horizontal black/ashy laminations; trace white ashy deposits from 39.5 -40.0 ft bgs; mica present.

CLAY (CL): very dark greenish gray (10Y 3/1), 95% clay, medium plasticity, soft, trace horizontal black/ashy deposits; 5% fine grained sand, subangular to subrounded, interbedded; contains quartz, feldspar and amphibole.

SAND (SP): dark greenish gray (10Y 4/1), 95% fine grained sand, subangular to subrounded, trace medium grained; 5% clay, clayey interbeds at 52.8 - 53.4 ft bgs and 54.4

Depth bgs (feet)	Sample Type
5	
10	
15	
20	
	SIEVE
25	
30	
35	
40	SS
45	
50	

SS: Splitspoon sample GRAB: Grab sample PTS: Splitspoon submitted for analysis SIEVE: Grab sieved by GSSI

GEOSCIENCE
P.O. Box 220
Claremont, CA 91711
Telephone: (909) 451-6650
Fax: (909) 451-6638
www.gssiwater.com

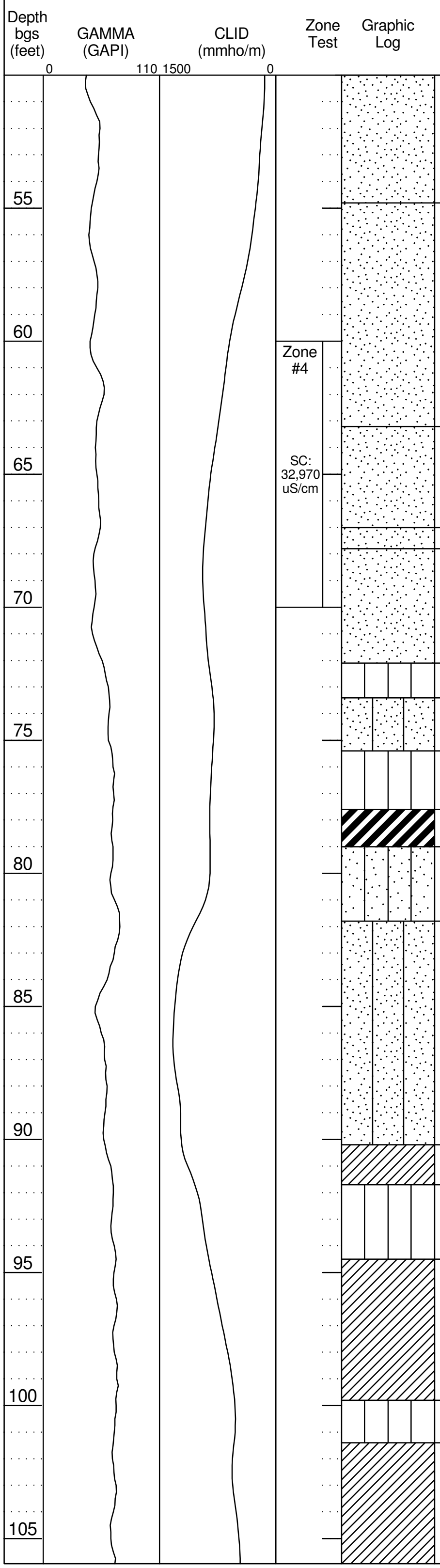
BOREHOLE NAME **MDW-1**

BOREHOLE LITHOLOGIC LOG (continued)

CLIENT: California American Water
PROJECT NUMBER: 13017-13
LOCATION: **Castroville, CA**

Lithologic Log

NOTE: Grain size distribution percentages are approximate. Material code (e.g. SP) reference Unified Soil Classification visual method. Color code (e.g. 10YR 5/2) reference Munsell Soil Color Charts.



- 54.8 ft bgs; well sorted; contains quartz, feldspar and amphibole.

SAND (SP): pale olive (5Y 6/3), 100% fine to medium grained sand, subangular to subrounded, predominantly fine grained; medium sorted; contains quartz, feldspar, mica, amphibole and other; trace gray mottling.

SAND (SP): light yellowish brown (2.5Y 6/4), 100% fine to coarse grained sand, subrounded to rounded; trace fine to coarse gravel up to 50 mm, subrounded to rounded; poorly sorted; contains quartz, feldspar, mica, amphibole and other; trace shell fragments; orange interbed at 64.8 - 65.5 ft bgs.

SAND (SP): dark gray (5Y 4/1), 100% fine to medium grained sand, subrounded to rounded, tan mottling; trace fine gravel up to 12 mm, rounded; poorly sorted; contains quartz, feldspar, mica, amphibole and other; trace shell fragments.

SAND (SP): light yellowish brown (2.5Y 6/4), 100% fine to coarse grained sand, predominantly medium grained, subrounded to rounded; trace fine gravel up to 17 mm, rounded; poorly sorted; contains quartz, feldspar, mica, amphibole and other; contains shells and shell fragments.

SILT (ML): very dark greenish gray (5GY 3/1), 95% silt; 5% sand, very fine grained, subangular to subrounded; trace clay; contains quartz, feldspar and mica; trace shell fragments and black/ashy point deposits.

SILTY SAND (SM): very dark greenish gray (5GY 3/1), 85% fine grained sand, subangular to subrounded; 15% silt; well sorted; contains quartz and feldspar; abundance of shells and shell fragments.

SILT (ML): very dark greenish gray (5GY 3/1), 90% silt; 10% fine grained sand, subangular to subrounded; trace clay, no to low plasticity; trace shell fragments.

FAT CLAY (CH): very dark greenish gray (5GY 3/1), 100% clay, high plasticity, soft; trace horizontal black/ashy laminations.

SANDY SILT (ML): dark greenish gray (5GY 4/1), 70% silt; 30% sand, very fine grained, subangular to subrounded; contains quartz and mica; trace thin clay layers; trace horizontal black/ashy deposits; trace shell fragments.

SILTY SAND (SM): dark greenish gray (10Y 4/1), 85% sand, very fine to fine grained, subangular to subrounded; 15% silt; trace clay, trace clay layers, clayey beds at 82.8 - 83.3 ft bgs and 89.5 - 90.2 ft bgs; well sorted; contains quartz, feldspar and mica; trace horizontal black/ashy deposits; higher mica content; trace shell fragments.

CLAY (CL): dark greenish gray (5GY 4/1), 100% clay, medium plasticity; trace silt; horizontal black/ashy laminations; trace shell fragments and possible organic matter.

SILT (ML): dark greenish gray (10Y 4/1), 100% silt; trace sand, very fine grained, subangular to subrounded; trace clay; contains mica; trace horizontal black/ashy laminations.

CLAY (CL): dark greenish gray (5GY 4/1), 100% clay, medium to high plasticity; trace silt; trace horizontal and point black/ashy deposits; trace organic matter.

SILT (ML): dark greenish gray (5GY 4/1), 100% silt; trace sand, very fine grained, subangular to subrounded; trace mica.

CLAY (CL): dark greenish gray (10Y 4/1), 100% clay, medium plasticity, dense; trace silt, 1 - 3 in. interbeds between 102 - 103.7 ft bgs; trace shell fragments below 106.0 ft bgs; trace black/ashy point deposits.

Depth bgs (feet)	Sample Type
	GRAB
60	SIEVE
	SS
	SIEVE

SS: Splitspoon sample GRAB: Grab sample PTS: Splitspoon submitted for analysis SIEVE: Grab sieved by GSSI

GEOSCIENCE
P.O. Box 220
Claremont, CA 91711
Telephone: (909) 451-6650
Fax: (909) 451-6638
www.gssiwater.com

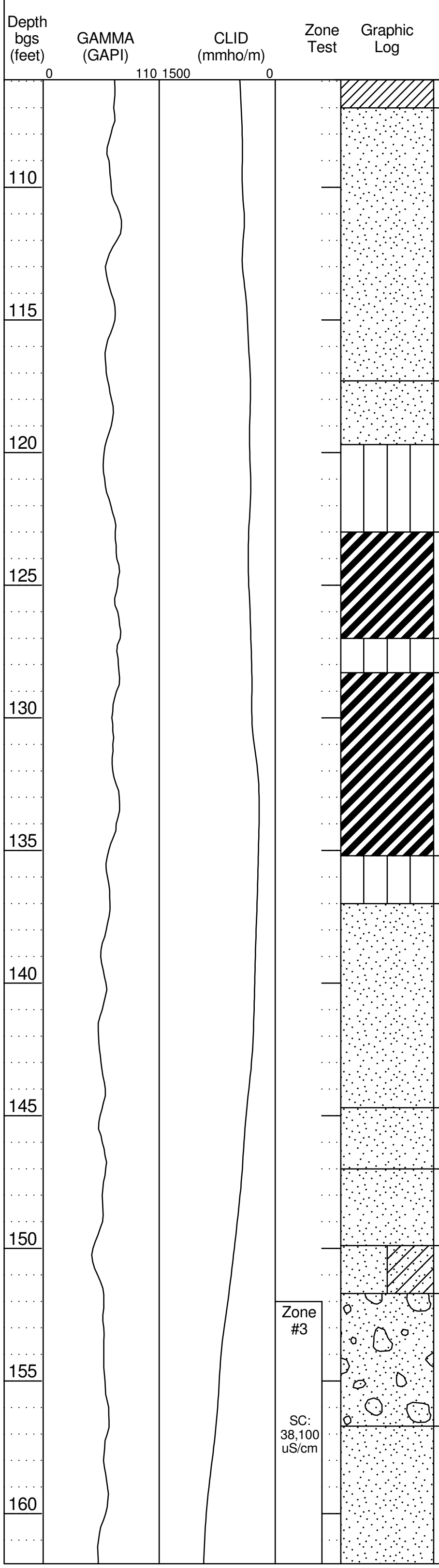
BOREHOLE NAME
MDW-1

BOREHOLE LITHOLOGIC LOG (continued)

CLIENT: California American Water
PROJECT NUMBER: 13017-13
LOCATION: **Castroville, CA**

Lithologic Log

NOTE: Grain size distribution percentages are approximate. Material code (e.g. SP) reference Unified Soil Classification visual method. Color code (e.g. 10YR 5/2) reference Munsell Soil Color Charts.



SAND (SP): greenish gray (10Y 5/1), 100% sand, very fine grained, subangular to subrounded; trace silt; well sorted; contains quartz, feldspar and mica.

SAND (SP): greenish gray (5GY 5/1), 100% fine to coarse grained sand, predominantly medium grained, subrounded to rounded; trace fine to coarse gravel up to 32 mm, rounded; poorly sorted; contains quartz, feldspar, mica, amphibole and other; includes siltstone and chert.

SILT (ML): dark greenish gray (5GY 4/1), 100% silt; trace fine grained sand; trace clay, 1 in. clay interbeds; contains mica; thin horizontal black/ashy laminations in clays.

FAT CLAY (CH): dark greenish gray (5GY 4/1), 100% clay, high plasticity, dense; very dense from 124.3 - 127.0 ft bgs; thin rusty and black/ashy horizontal lamination from 126.0 - 127.0 ft bgs.

SILT (ML): dark greenish gray (10Y 4/1), 100% silt; trace thin clayey interbeds; thin horizontal black/ashy lamination.

FAT CLAY (CH): dark greenish gray (10Y 4/1), 100% clay, medium to high plasticity, soft clay from 128.3 - 129.6 ft bgs, dense clay from 129.6 - 135.2 ft bgs; trace silt, dark brown silty deposit from 132.2 - 133.4 ft bgs within clay; trace horizontal laminations and point black/ashy deposits.

SILT (ML): dark greenish gray (10Y 4/1), 95% silt; 5% sand, very fine grained, subangular to subrounded; trace clay; contains mica; trace thin horizontal black/ashy laminations.

SAND (SP): greenish gray (5GY 5/1), 95% fine to medium grained sand, subangular to subrounded, trace rounded coarse grained; 5% fine to coarse gravel up to 25 mm, rounded; medium sorted; contains quartz, feldspar, mica, amphibole and other; many mineral types.

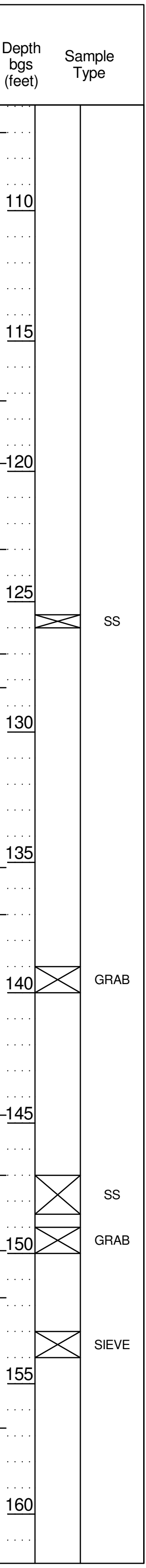
SAND (SP): greenish gray (10Y 5/1), 100% fine to medium grained sand, subangular to rounded; trace fine to coarse gravel up to 35 mm, rounded; medium sorted; contains quartz, feldspar, mica, amphibole and other; trace rounded cobbles up to 75 mm at 145.2 ft bgs; includes chert and siltstone; many mineral types.

SAND (SP): dark greenish gray (10Y 4/1), 100% fine to medium grained sand, subrounded to rounded; trace fine gravel up to 17 mm, rounded; well sorted; contains quartz, feldspar, mica, amphibole and other; trace clay balls; includes siltstone.

SAND WITH CLAY (SP-SC): dark greenish gray (5GY 4/1), 85% fine to medium grained sand, subangular to rounded, trace coarse grained; 10% clay; 5% fine to coarse gravel up to 65 mm, rounded; contains quartz, feldspar, mica, amphibole and other; many mineral types; included siltstone.

SAND WITH GRAVEL (SP): light olive gray (5Y 6/2), 60% fine to coarse grained sand, subangular to rounded; 40% fine to coarse gravel up to 70 mm, rounded; poorly sorted; contains quartz, feldspar, mica, amphibole and other; gravel with sand from 152.6 - 153.5 ft bgs.

SAND (SP): olive gray (5Y 5/2), 100% fine grained sand, subangular to subrounded; trace fine to coarse gravel up to 21 mm, subrounded to rounded; well sorted; contains quartz, feldspar, amphibole and other; silt at 156.7 - 157 ft bgs.



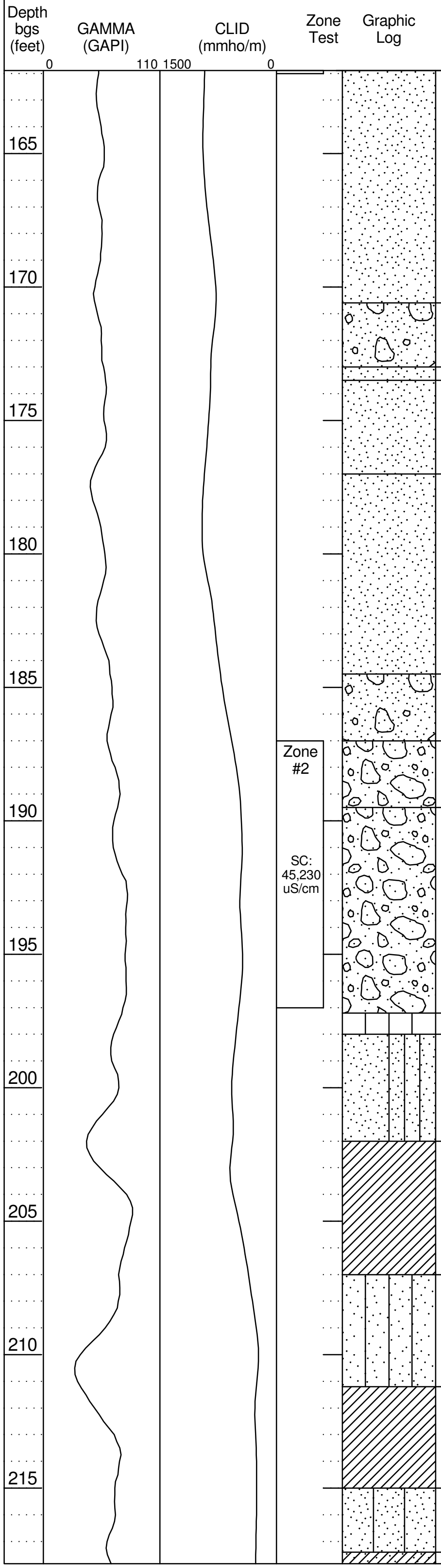
SS: Splitspoon sample GRAB: Grab sample PTS: Splitspoon submitted for analysis SIEVE: Grab sieved by GSSI

GEOSCIENCE
P.O. Box 220
Claremont, CA 91711
Telephone: (909) 451-6650
Fax: (909) 451-6638
www.gssiwater.com

BOREHOLE NAME **MDW-1**

BOREHOLE LITHOLOGIC LOG (continued)

CLIENT: California American Water
PROJECT NUMBER: 13017-13
LOCATION: **Castroville, CA**



Lithologic Log

NOTE: Grain size distribution percentages are approximate. Material code (e.g. SP) reference Unified Soil Classification visual method. Color code (e.g. 10YR 5/2) reference Munsell Soil Color Charts.

SAND WITH GRAVEL (SP): light olive gray (5Y 6/2), 70% fine to coarse grained sand, subangular to rounded; 30% fine to coarse gravel up to 58 mm, rounded; poorly sorted; contains quartz, feldspar, mica, amphibole and other; trace clay balls; many mineral types; includes siltstone.

SAND (SP): olive gray (5Y 5/2), 100% fine grained sand, subangular to subrounded, trace medium and coarse grained; trace fine gravel up to 18 mm, subrounded to rounded; well sorted; contains quartz, feldspar, amphibole and other; contains chert.

SAND (SP): light olive gray (5Y 6/2), 100% fine to medium grained sand, subrounded to rounded; trace fine to coarse gravel up to 35 mm, rounded; trace clay; contains quartz, feldspar, amphibole and other.

SAND (SP): olive gray (5Y 5/2), 95% fine to coarse grained sand, subangular to rounded; 5% fine to coarse gravel up to 55 mm, rounded; poorly sorted; wet sample; contains quartz, feldspar, mica, amphibole and other.

SAND WITH GRAVEL (SP): olive gray (5Y 5/2), 60% medium to coarse grained sand, subangular to rounded; 40% fine to coarse gravel up to 50 mm, subrounded to rounded; contains quartz, feldspar, mica, amphibole and other; many mineral types, includes chert, siltstone, and granite.

GRAVEL WITH SAND (GP): olive gray (5Y 5/2), 60% fine to coarse gravel up to 50 mm, subrounded to rounded; 40% medium to coarse grained sand, subangular to rounded, predominantly coarse grained; trace cobbles, trace cobble up to 99 mm; contains quartz, feldspar, mica, amphibole and other; many mineral types, includes granite and chert.

GRAVEL WITH SAND AND COBBLES (GP): olive (5Y 5/3), 55% fine to coarse gravel up to 75 mm, subangular to rounded; 30% fine to coarse grained sand, subangular to rounded; 15% cobbles, cobbles up 120 mm; trace clay; poorly sorted; contains quartz, feldspar, mica, amphibole and other; many mineral types, includes granite, and chert.

SILT (ML): light olive brown (2.5Y 5/4), 100% silt; trace fine grained sand, subangular to subrounded; contains mica; clayey and dense from 197.2 - 197.6 ft bgs; rusty orange mottling.

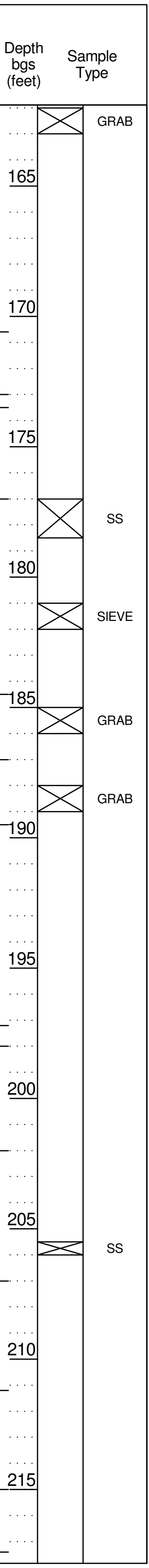
SAND WITH SILT (SP-SM): light olive brown (2.5Y 5/3), 90% fine grained sand, subangular to subrounded; 10% silt; trace fine to coarse gravel up to 32 mm, rounded; well sorted; contains quartz, feldspar, mica and amphibole; some orange mottling.

CLAY (CL): light olive brown (2.5Y 5/4), 100% clay, very dense/hard; orangish brown mottling; trace thin horizontal black/ashy laminations; possible evaporites at 204.3 - 205.0 ft bgs; moderate cementation.

SANDY SILT (ML): light olive brown (2.5Y 5/3), 70% silt; 30% sand, very fine grained; contains quartz, mica and amphibole.

CLAY (CL): light olive brown (2.5Y 5/3), 100% clay, no plasticity, dense/hard; trace thin black/ashy and rust colored lamination and point deposits.

SILTY SAND (SM): yellowish brown (10YR 5/4), 80% fine grained sand, subangular to subrounded; 20% silt; well sorted; contains quartz, feldspar, mica and amphibole.



SS: Splitspoon sample GRAB: Grab sample PTS: Splitspoon submitted for analysis SIEVE: Grab sieved by GSSI

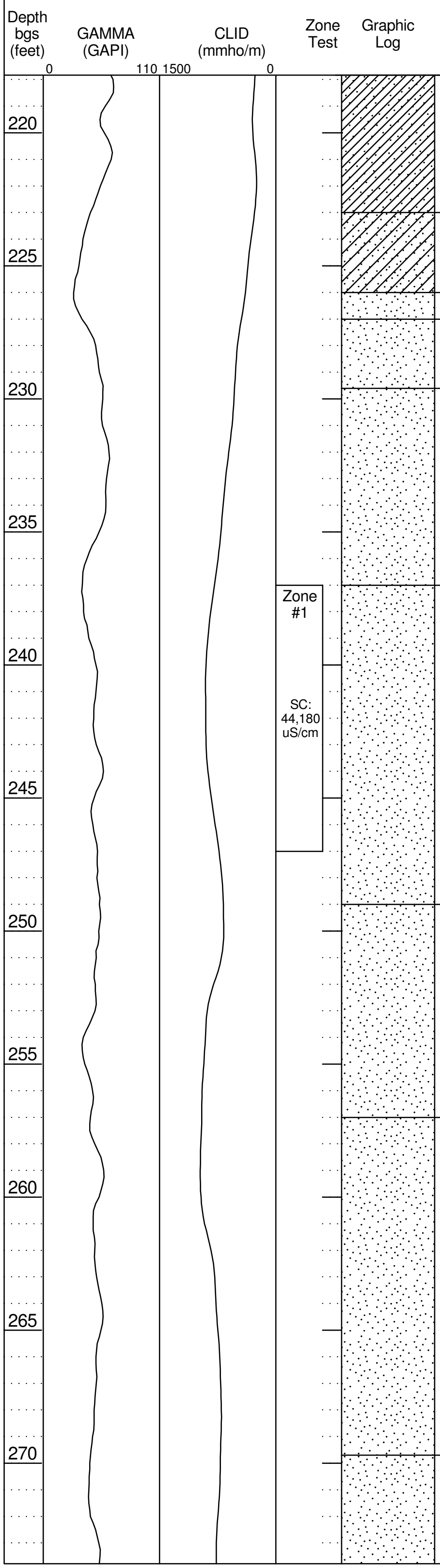
BOREHOLE NAME
MDW-1

BOREHOLE LITHOLOGIC LOG (continued)

CLIENT: California American Water
PROJECT NUMBER: 13017-13
LOCATION: **Castroville, CA**

Lithologic Log

NOTE: Grain size distribution percentages are approximate. Material code (e.g. SP) reference Unified Soil Classification visual method. Color code (e.g. 10YR 5/2) reference Munsell Soil Color Charts.



SANDY CLAY (CL): brown (7.5YR 4/4) and yellowish red (5YR 4/6), 60% clay, no plasticity, dense/hard; 40% fine grained sand, subangular to subrounded; contains quartz, feldspar and amphibole; rust colored mottling.

CLAYEY SAND (SC): strong brown (7.5YR 4/6), 80% fine grained sand, subangular to subrounded; 20% clay; well sorted; contains quartz, feldspar and amphibole; some rust colored mottling.

SAND (SP): yellowish brown (10YR 5/4), 95% fine grained sand, subangular to subrounded; 5% clay; well sorted; contains quartz, feldspar and amphibole; compact/tight.

SAND (SP): light olive brown (2.5Y 5/3), 100% fine grained sand, subangular to subrounded; well sorted; contains quartz, feldspar, amphibole and other; moderately cemented sand pieces from 229.0 - 229.6 ft bgs.

SAND (SP): grayish brown (2.5Y 5/2) and weak red (2.5YR 5/2), 100% fine grained sand, subangular to subrounded; trace clay; well sorted; contains quartz, feldspar, amphibole and other; purplish mottling with some fines.

SAND (SP): light olive brown (2.5Y 5/3), 100% fine grained sand, subangular to subrounded; well sorted; contains quartz, feldspar, amphibole and other; abundance of spherical (~5/8 in.) cemented sand balls from 240.5 - 242.0 ft bgs, up to 3 balls fused, possible storm event; small irregular cemented sand balls at 248.0 -248.7 ft bgs, moderately cemented.

SAND (SP): olive brown (2.5Y 4/4), 100% fine grained sand, subangular to subrounded; well sorted; contains quartz, feldspar, amphibole and other; small moderately cemented sand balls at 249.8 ft bgs and 254.4 - 256.5 ft bgs.

SAND (SP): dark yellowish brown (10YR 4/4), 100% fine to medium grained sand, subangular to subrounded; trace clay; well sorted; contains quartz, feldspar, amphibole and other; abundance (~1/2) of moderately to strongly cemented sand pieces/fragments up to 65 mm; some rusty/brown lamination; no cementation from 260 - 262 ft bgs.

SAND (SP): brown (10YR 4/3), 100% fine to medium grained sand, subangular to subrounded; trace clay; well sorted; contains quartz, feldspar, amphibole and other; some small moderately to strongly cemented sand balls and fragments at 272.0 - 272.4 ft bgs and 273.5 - 274.5 ft bgs.

Depth bgs (feet)	Sample Type
220	
225	
230	
235	GRAB
240	
245	GRAB
250	
255	
260	
265	GRAB
270	

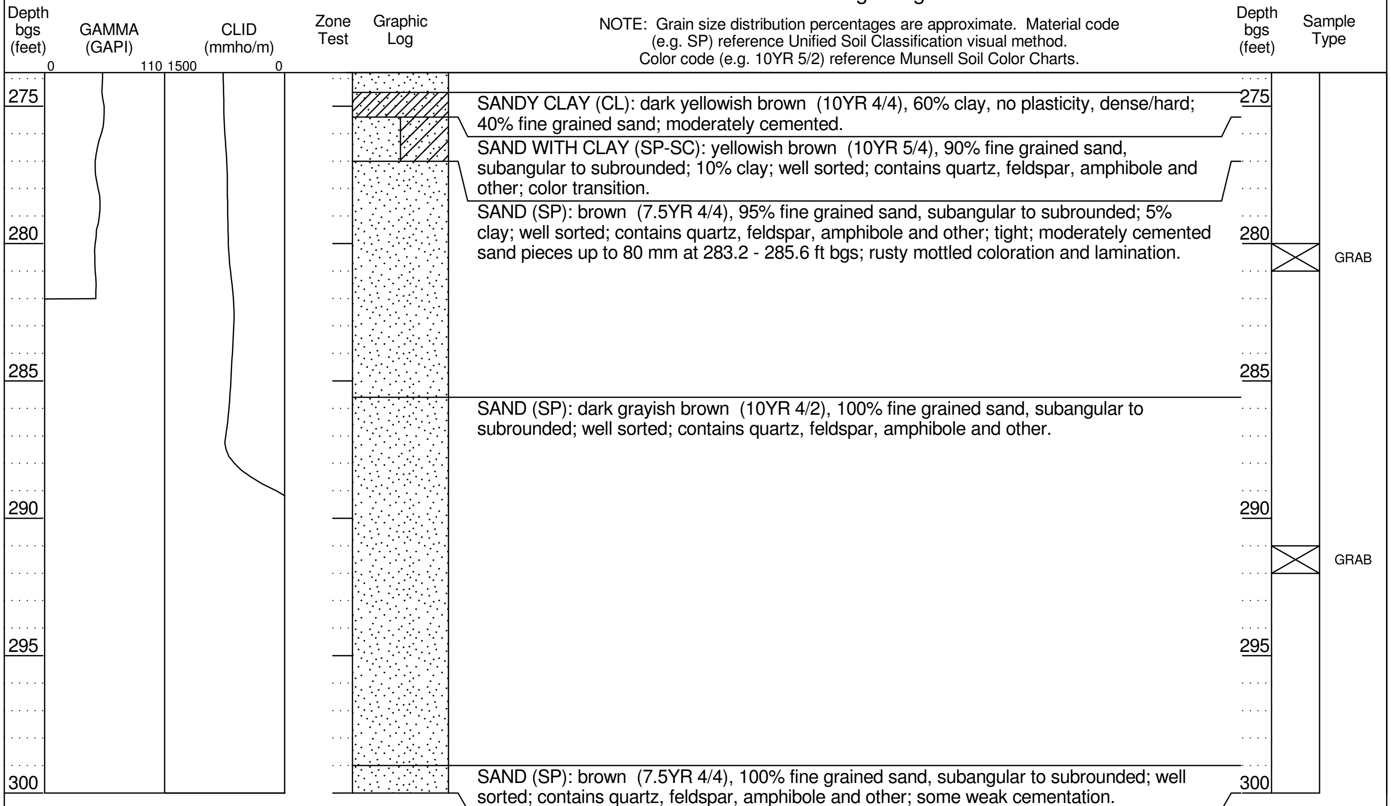
SS: Splitspoon sample GRAB: Grab sample PTS: Splitspoon submitted for analysis SIEVE: Grab sieved by GSSI

GEOSCIENCE
P.O. Box 220
Claremont, CA 91711
Telephone: (909) 451-6650
Fax: (909) 451-6638
www.gssiwater.com

BOREHOLE NAME
MDW-1

BOREHOLE LITHOLOGIC LOG (continued)

CLIENT PROJECT NUMBER	California American Water 13017-13	LOCATION **Castroville, CA**



Lithologic Log

NOTE: Grain size distribution percentages are approximate. Material code (e.g. SP) reference Unified Soil Classification visual method. Color code (e.g. 10YR 5/2) reference Munsell Soil Color Charts.

SANDY CLAY (CL): dark yellowish brown (10YR 4/4), 60% clay, no plasticity, dense/hard; 40% fine grained sand; moderately cemented.

SAND WITH CLAY (SP-SC): yellowish brown (10YR 5/4), 90% fine grained sand, subangular to subrounded; 10% clay; well sorted; contains quartz, feldspar, amphibole and other; color transition.

SAND (SP): brown (7.5YR 4/4), 95% fine grained sand, subangular to subrounded; 5% clay; well sorted; contains quartz, feldspar, amphibole and other; tight; moderately cemented sand pieces up to 80 mm at 283.2 - 285.6 ft bgs; rusty mottled coloration and lamination.

SAND (SP): dark grayish brown (10YR 4/2), 100% fine grained sand, subangular to subrounded; well sorted; contains quartz, feldspar, amphibole and other.

SAND (SP): brown (7.5YR 4/4), 100% fine grained sand, subangular to subrounded; well sorted; contains quartz, feldspar, amphibole and other; some weak cementation.

Bottom of borehole at 300 feet.

SS: Splitspoon sample GRAB: Grab sample PTS: Splitspoon submitted for analysis SIEVE: Grab sieved by GSSI

GEOSCIENCE
P.O. Box 220
Claremont, CA 91711
Telephone: (909) 451-6650
Fax: (909) 451-6638
www.gssiwater.com

BOREHOLE NAME
ML-1

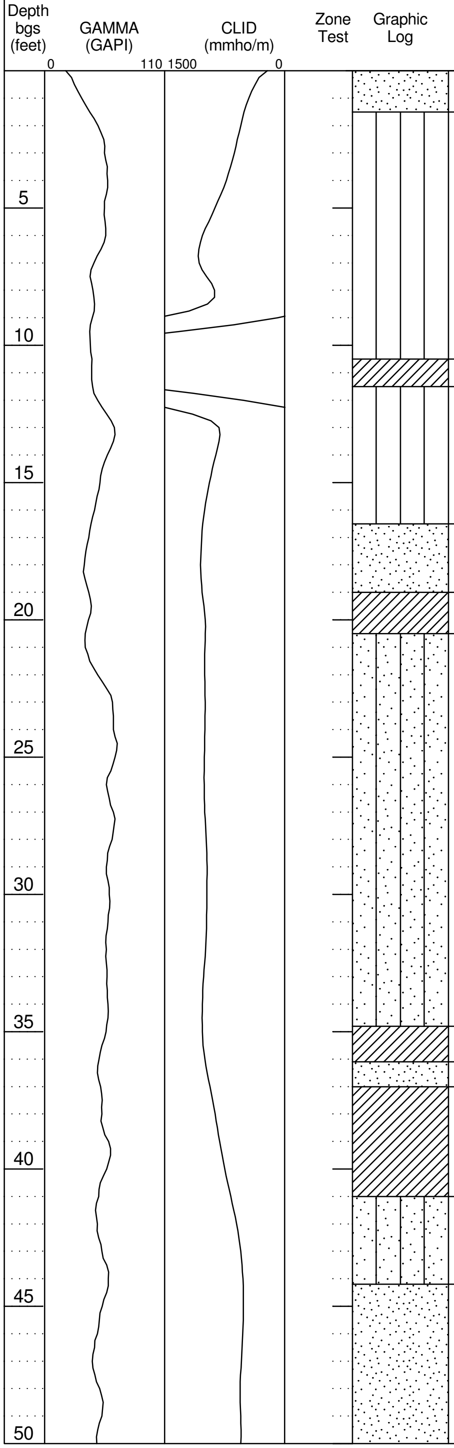
BOREHOLE LITHOLOGIC LOG

CLIENT PROJECT NUMBER	California American Water 13017-13	LOCATION **Moss Landing, CA** **Sandholdt Rd** **36° 47' 58.0632", -121° 47' 20.31"** **Geographic NAD83**	
REPORT DATE	7/8/2014		
DRILLING CONTRACTOR DRILLER	Cascade Drilling Jose Munguia	LOGGED BY **N. Reynolds**	

DRILLING RIG TYPE	Prosonic 600T	DRILLING METHOD	Sonic	START DATE	10/02/13	BOREHOLE DIAMETER	8 in
SURFACE ELEVATION	8.0 ft	TOTAL DEPTH	200 ft bgs	FINISH DATE	10/07/13	CORE SIZE	6 in

Lithologic Log

NOTE: Grain size distribution percentages are approximate. Material code (e.g. SP) reference Unified Soil Classification visual method. Color code (e.g. 10YR 5/2) reference Munsell Soil Color Charts.



SAND (SP): light olive brown (2.5Y 5/3), 100% fine grained sand, subrounded, trace medium to coarse grained; trace fine to coarse gravel up to 35 mm, subrounded; medium sorted.

SILT (ML): dark gray (5Y 4/1), 100% silt.

CLAY (CL): dark gray (5Y 4/1), 100% clay, high plasticity; with visible alteration.

SILT (ML): very dark gray (5Y 3/1), 100% silt; with shells.

SAND (SP): light yellowish brown (2.5Y 6/4), 100% medium to coarse grained sand, subangular to rounded; trace fine to coarse gravel up to 30 mm, rounded; poorly sorted; trace shells up to 120 mm.

CLAY WITH SAND (CL): very dark gray (5Y 3/1), 85% clay; 10% fine to coarse grained sand, subrounded to rounded; 5% fine to coarse gravel up to 25 mm, rounded; trace shell fragments.

SANDY SILT (ML): very dark gray (2.5Y 3/1), 60% silt; 40% fine grained sand, subangular to subrounded; shells at 31.6 and 34.0 ft, trace organics at 29.4 ft.

CLAY (CL): very dark gray (5Y 3/1), 100% clay, medium plasticity.

SAND (SP): dark gray (5Y 4/1), 100% fine to medium grained sand, subangular; poorly sorted.

CLAY (CL): very dark gray (2.5Y 3/1), 100% clay, high plasticity; trace shell fragments.

SANDY SILT (ML): very dark gray (2.5Y 3/1), 70% silt; 30% fine grained sand, subrounded; abundant shell fragments.

SAND (SP): dark gray (5Y 4/1), 100% fine to medium grained sand, subangular, trace coarse grained; trace fine to coarse gravel up to 25 mm, subrounded to rounded; poorly sorted; abundance of shells and shell fragments.

Depth bgs (feet): 5, 10, 15, 20, 25, 30, 35, 40, 45, 50

Sample Type

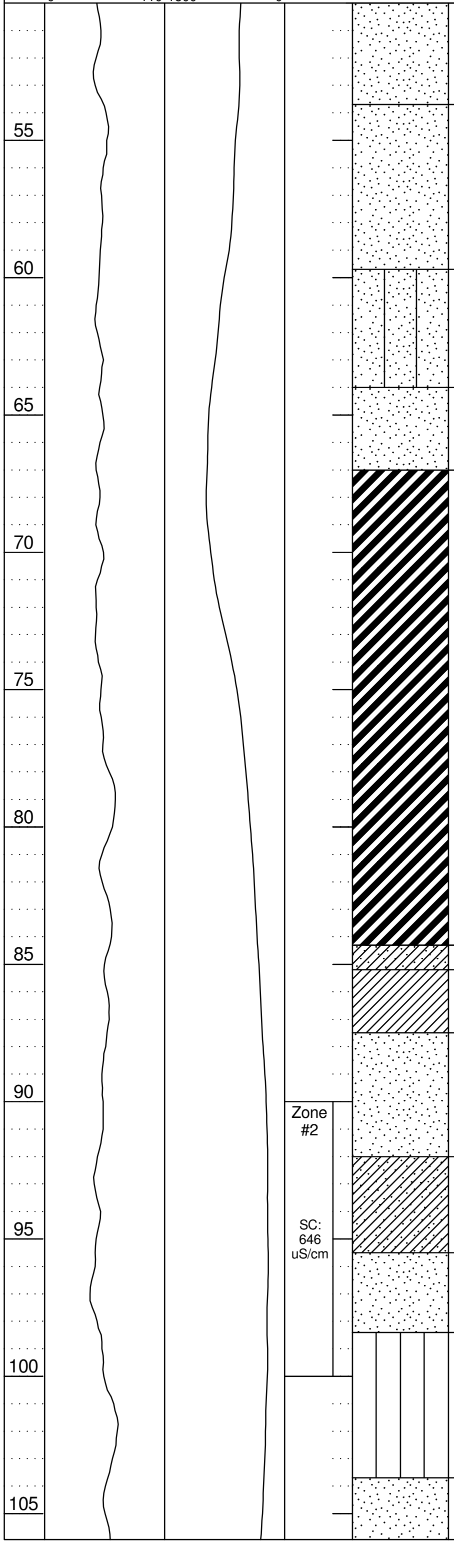
SS: Splitspoon sample GRAB: Grab sample PTS: Splitspoon submitted for analysis SIEVE: Grab sieved by GSSI

GEOSCIENCE
P.O. Box 220
Claremont, CA 91711
Telephone: (909) 451-6650
Fax: (909) 451-6638
www.gssiwater.com

BOREHOLE LITHOLOGIC LOG (continued)

BOREHOLE NAME **ML-1**
CLIENT California American Water
PROJECT NUMBER 13017-13
LOCATION **Moss Landing, CA**

Depth bgs (feet) | GAMMA (GAPI) 0–110 | CLID (mmho/m) 1500–0 | Zone Test | Graphic Log



Lithologic Log

NOTE: Grain size distribution percentages are approximate. Material code (e.g. SP) reference Unified Soil Classification visual method. Color code (e.g. 10YR 5/2) reference Munsell Soil Color Charts.

SAND (SP): dark gray (5Y 4/1), 100% fine grained sand, subrounded; trace fine to coarse gravel up to 45 mm, rounded, at 54.5 ft; well sorted; trace shell fragments.

SILTY SAND (SM): very dark gray (5Y 3/1), 70% fine grained sand, subrounded; 30% silt; well sorted.

SAND (SP): dark greenish gray (10Y 4/1), 100% fine grained sand, subrounded; well sorted; trace shell fragments.

FAT CLAY (CH): very dark greenish gray (10Y 3/1), 100% clay, high plasticity, very dense; trace shell fragments.

SANDY CLAY (CL): very dark greenish gray (10Y 3/1), 70% clay; 30% fine grained sand, subrounded; trace shell fragments.

CLAY (CL): very dark greenish gray (10Y 3/1), 100% clay, high plasticity, dense; trace shell fragments.

SAND (SP): very dark greenish gray (10Y 3/1), 100% fine to medium grained sand, subrounded; poorly sorted; abundant shell fragments.

SANDY CLAY (CL): very dark greenish gray (10Y 3/1), 60% clay; 40% fine grained sand, subrounded; abundance of shells.

SAND (SP): very dark greenish gray (10Y 3/1), 100% fine grained sand, subangular to subrounded; trace fine to coarse gravel up to 45 mm, subangular to rounded, includes quartz and black minerals; medium sorted; contains quartz and amphibole; trace shell fragments and organics.

SILT (ML): olive gray (5Y 5/2), 100% silt; trace fine grained sand, subangular to subrounded; alteration visible with streaks of rust coloration (10YR 5/8).

SAND (SP): yellowish brown (10YR 5/8) and olive (5Y 5/3), 100% fine grained sand, subangular to subrounded; trace fine to coarse gravel up to 23 mm, subangular to rounded, includes quartz and black minerals; well sorted; contains quartz and amphibole, with visible

Depth bgs (feet): 55, 60, 65, 70, 75, 80, 85, 90, 95, 100, 105

Sample Type:
SIEVE
SIEVE
SIEVE
PTS
SIEVE
SIEVE

SS: Splitspoon sample GRAB: Grab sample PTS: Splitspoon submitted for analysis SIEVE: Grab sieved by GSSI

GEOSCIENCE
P.O. Box 220
Claremont, CA 91711
Telephone: (909) 451-6650
Fax: (909) 451-6638
www.gssiwater.com

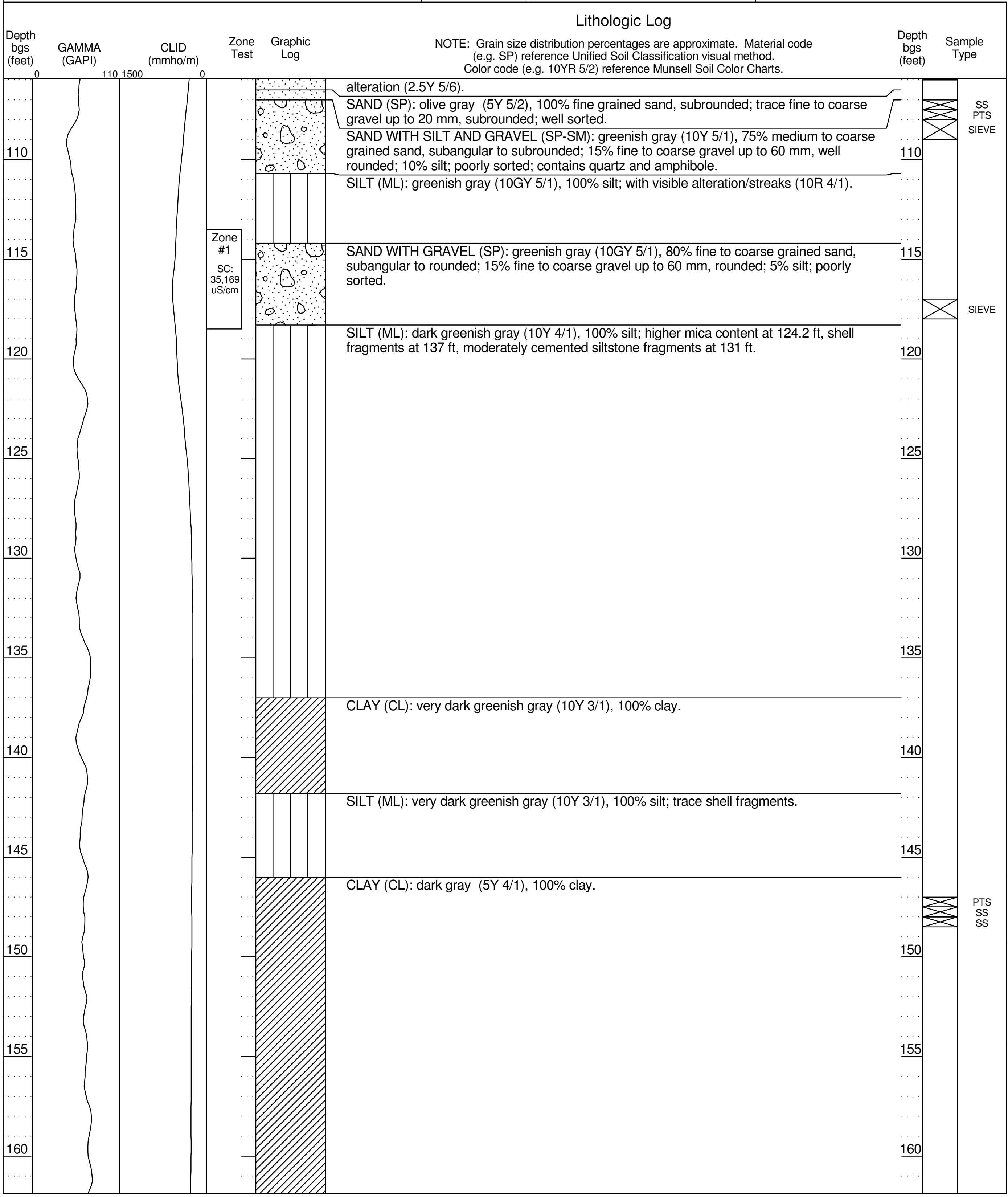
BOREHOLE NAME **ML-1**

BOREHOLE LITHOLOGIC LOG (continued)

CLIENT California American Water
PROJECT NUMBER 13017-13
LOCATION **Moss Landing, CA**

Lithologic Log

NOTE: Grain size distribution percentages are approximate. Material code (e.g. SP) reference Unified Soil Classification visual method. Color code (e.g. 10YR 5/2) reference Munsell Soil Color Charts.



alteration (2.5Y 5/6).

SAND (SP): olive gray (5Y 5/2), 100% fine grained sand, subrounded; trace fine to coarse gravel up to 20 mm, subrounded; well sorted.

SAND WITH SILT AND GRAVEL (SP-SM): greenish gray (10Y 5/1), 75% medium to coarse grained sand, subangular to subrounded; 15% fine to coarse gravel up to 60 mm, well rounded; 10% silt; poorly sorted; contains quartz and amphibole.

SILT (ML): greenish gray (10GY 5/1), 100% silt; with visible alteration/streaks (10R 4/1).

SAND WITH GRAVEL (SP): greenish gray (10GY 5/1), 80% fine to coarse grained sand, subangular to rounded; 15% fine to coarse gravel up to 60 mm, rounded; 5% silt; poorly sorted.

SILT (ML): dark greenish gray (10Y 4/1), 100% silt; higher mica content at 124.2 ft, shell fragments at 137 ft, moderately cemented siltstone fragments at 131 ft.

CLAY (CL): very dark greenish gray (10Y 3/1), 100% clay.

SILT (ML): very dark greenish gray (10Y 3/1), 100% silt; trace shell fragments.

CLAY (CL): dark gray (5Y 4/1), 100% clay.

SS: Splitspoon sample GRAB: Grab sample PTS: Splitspoon submitted for analysis SIEVE: Grab sieved by GSSI

GEOSCIENCE
P.O. Box 220
Claremont, CA 91711
Telephone: (909) 451-6650
Fax: (909) 451-6638
www.gssiwater.com

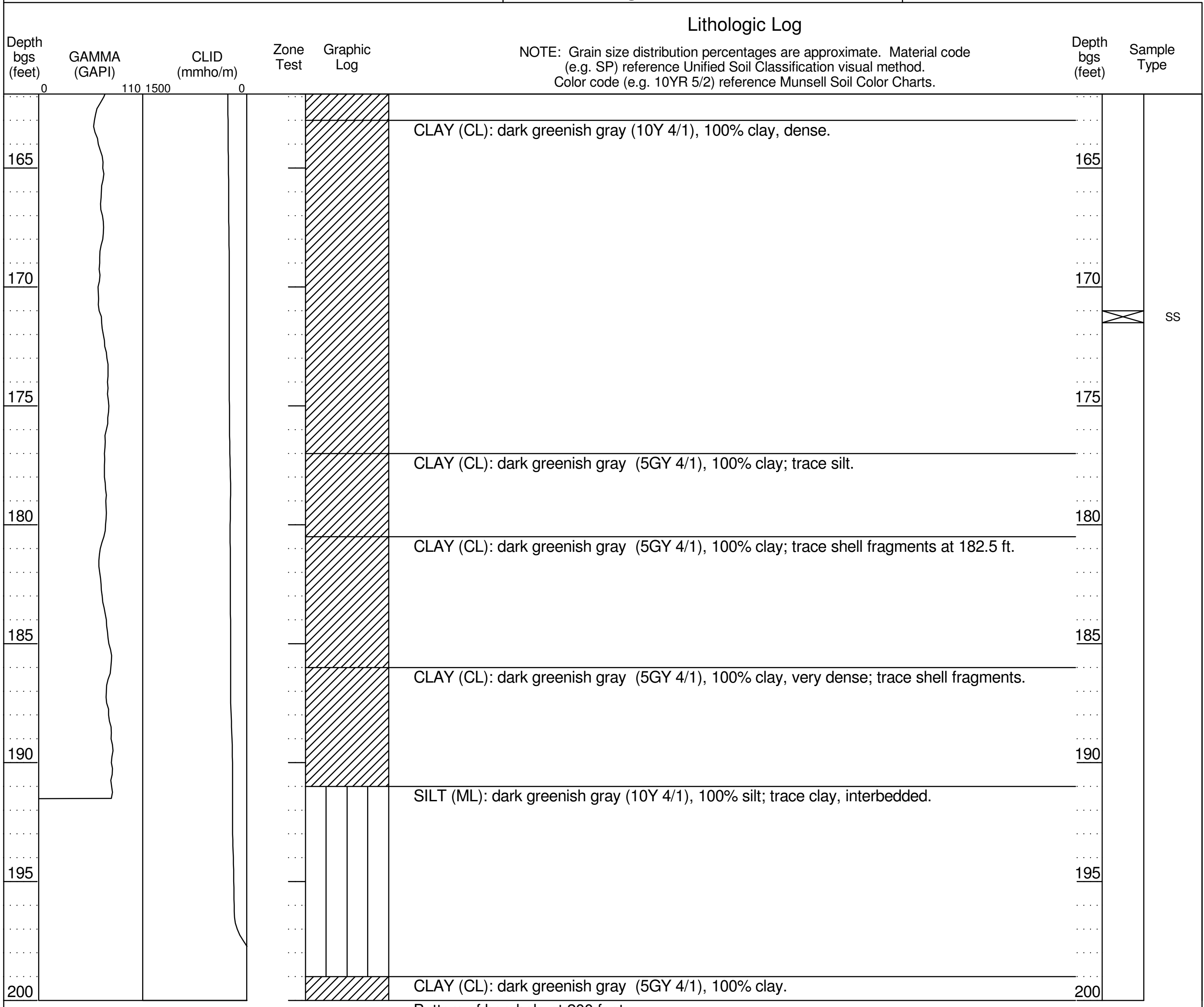
BOREHOLE LITHOLOGIC LOG (continued)

BOREHOLE NAME **ML-1**

CLIENT California American Water
PROJECT NUMBER 13017-13
LOCATION **Moss Landing, CA**

Lithologic Log

NOTE: Grain size distribution percentages are approximate. Material code (e.g. SP) reference Unified Soil Classification visual method. Color code (e.g. 10YR 5/2) reference Munsell Soil Color Charts.



CLAY (CL): dark greenish gray (10Y 4/1), 100% clay, dense.

CLAY (CL): dark greenish gray (5GY 4/1), 100% clay; trace silt.

CLAY (CL): dark greenish gray (5GY 4/1), 100% clay; trace shell fragments at 182.5 ft.

CLAY (CL): dark greenish gray (5GY 4/1), 100% clay, very dense; trace shell fragments.

SILT (ML): dark greenish gray (10Y 4/1), 100% silt; trace clay, interbedded.

CLAY (CL): dark greenish gray (5GY 4/1), 100% clay.

Bottom of borehole at 200 feet.

SS: Splitspoon sample GRAB: Grab sample PTS: Splitspoon submitted for analysis SIEVE: Grab sieved by GSSI

GEOSCIENCE
P.O. Box 220
Claremont, CA 91711
Telephone: (909) 451-6650
Fax: (909) 451-6638
www.gssiwater.com

BOREHOLE NAME
ML-2

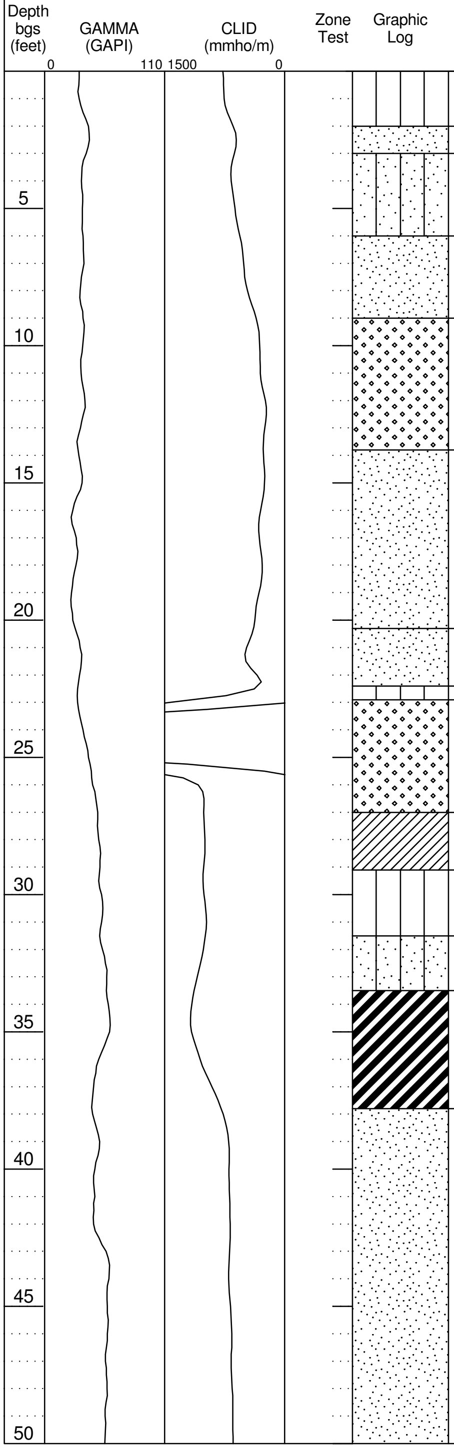
BOREHOLE LITHOLOGIC LOG

CLIENT	California American Water	LOCATION	**Moss Landing, CA**
PROJECT NUMBER	13017-13		**Del Mar Fisheries**
REPORT DATE	7/8/2014		36° 48' 11.7648", -121° 47' 12.4368" Geographic NAD83
DRILLING CONTRACTOR	Cascade Drilling	LOGGED BY	**N. Reynolds**
DRILLER	Jose Munguia		

DRILLING RIG TYPE	Prosonic 600T	DRILLING METHOD	Sonic	START DATE	12/09/13	BOREHOLE DIAMETER	8 in
SURFACE ELEVATION	7.0 ft	TOTAL DEPTH	200 ft bgs	FINISH DATE	12/19/13	CORE SIZE	6 in

Lithologic Log

NOTE: Grain size distribution percentages are approximate. Material code (e.g. SP) reference Unified Soil Classification visual method. Color code (e.g. 10YR 5/2) reference Munsell Soil Color Charts.



SANDY SILT (ML): olive gray (5Y 4/2), 65% silt; 25% fine to medium grained sand, subangular; 10% fine to coarse gravel up to 26 mm, subangular; contains quartz, feldspar, and other; asphalt present.

SAND (SP): light yellowish brown (2.5Y 6/4), 100% fine to medium grained sand, subangular to subrounded, predominantly fine grained; trace silt; medium sorted; contains quartz and feldspar.

SANDY SILT (ML): very dark grayish brown (10YR 3/2), 60% silt; 40% fine grained sand, subangular to subrounded; trace fine to coarse gravel up to 29 mm, subangular to subrounded; contains quartz and feldspar; red brick and concrete block to 90 mm.

SAND (SP): very dark grayish brown (2.5Y 3/2) and dark grayish brown (2.5Y 4/2), 100% fine to medium grained sand, subrounded to rounded, trace coarse grained; trace fine to coarse gravel up to 41 mm, subangular; trace silt; poorly sorted; contains quartz, feldspar, amphibole, and other.

SAND (SW): light yellowish brown (2.5Y 6/4), 100% fine to coarse grained sand, subrounded to rounded; trace fine to coarse gravel up to 27 mm, subrounded to rounded; poorly sorted; contains quartz, feldspar, amphibole, and other; well rounded coarse sand and fine gravel layer with shells at 13.7 ft.

SAND (SP): olive gray (5Y 4/2), 100% fine to medium grained sand, subangular to rounded; trace silt; medium sorted; contains quartz, feldspar, amphibole, and other; trace shell fragments.

SAND (SP): light olive gray (5Y 6/2), 100% fine to medium grained sand, subangular to rounded; trace silt, trace thin silt lens; medium sorted; contains quartz, feldspar, amphibole, and other; trace organics/wood.

SILT (ML): very dark greenish gray (10Y 3/1), 100% silt; trace fine grained sand, subrounded; contains mica; organics/wood.

SAND (SW): light yellowish brown (2.5Y 6/3), 100% fine to coarse grained sand, subrounded to rounded; trace fine gravel up to 5 mm, rounded; poorly sorted; contains quartz, feldspar, amphibole, and other; trace shell fragments.

CLAY (CL): dark greenish gray (5GY 4/1), 80% clay, medium plasticity, soft; 20% silt; silty clay with an abundance of shells.

SILT (ML): dark greenish gray (5G 4/1), 100% silt, low plasticity; abundant shells and shell fragments.

SANDY SILT (ML): dark greenish gray (5GY 4/1), 51% silt; 49% fine grained sand, subrounded; trace fine gravel up to 18 mm, rounded; contains quartz, feldspar, and other; alternating fine sand and silt; abundance of shells and shell fragments; thin black/dark brown laminations (organics/wood).

FAT CLAY (CH): dark greenish gray (5GY 4/1), 100% clay, high plasticity; trace shells.

SAND (SP): greenish gray (5GY 5/1) and dark greenish gray (5GY 4/1), 100% fine grained sand, subangular to subrounded; trace silt; trace clay; well sorted; interbeded clays and silts approx. every foot, thin black laminations in clays, trace shell and organics(wood), large shells up to 61 mm at 39.0 ft; silt at 41.0 to 41.5, 46.3 to 46.6, 50.6 to 51.5 ft; clay at 52.5 to 54.1 ft.

Depth bgs (feet)	Sample Type
25	SIEVE

SS: Splitspoon sample GRAB: Grab sample PTS: Splitspoon submitted for analysis SIEVE: Grab sieved by GSSI

GEOSCIENCE
P.O. Box 220
Claremont, CA 91711
Telephone: (909) 451-6650
Fax: (909) 451-6638
www.gssiwater.com

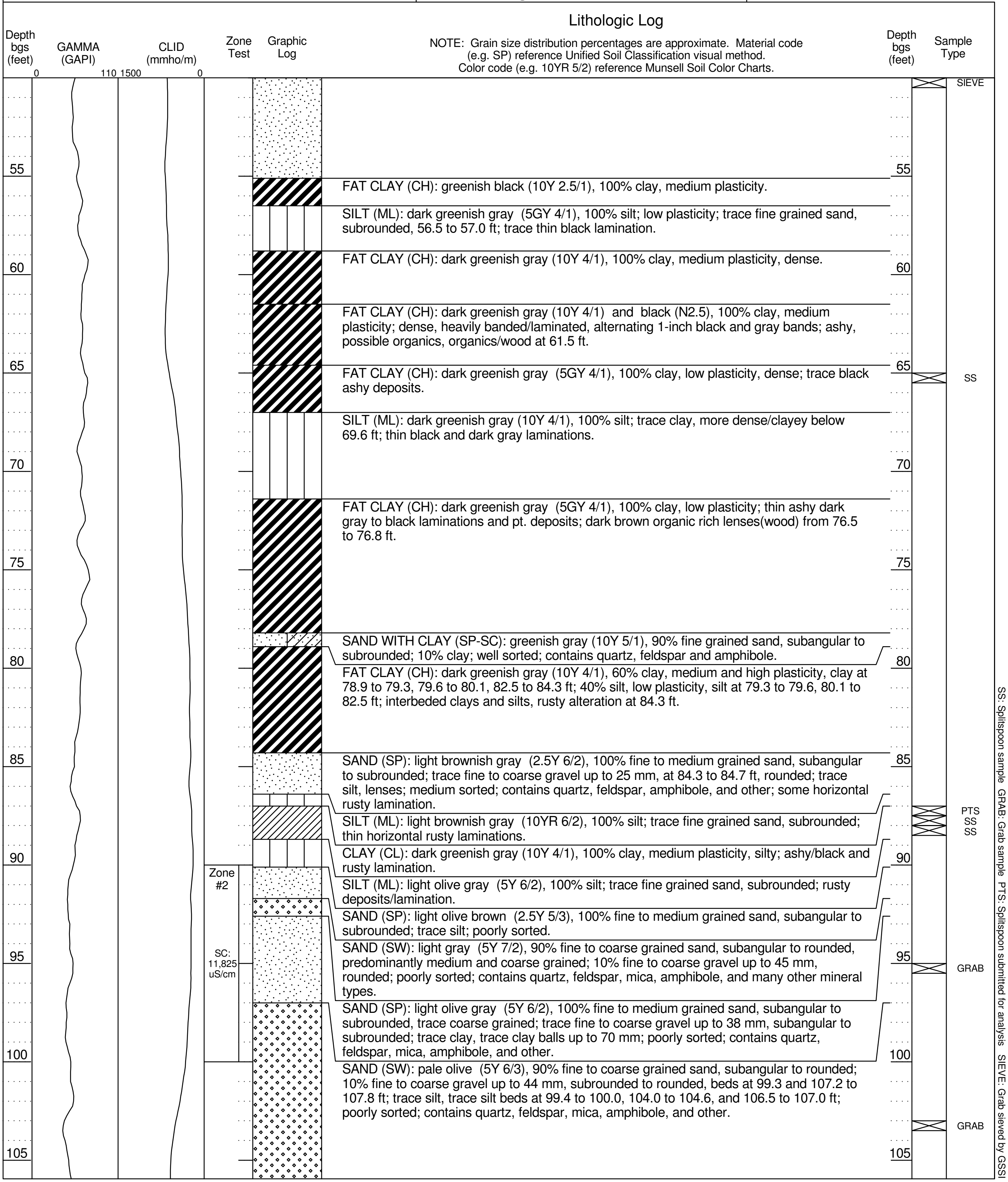
BOREHOLE NAME **ML-2**

BOREHOLE LITHOLOGIC LOG (continued)

CLIENT California American Water
PROJECT NUMBER 13017-13
LOCATION **Moss Landing, CA**

Lithologic Log

NOTE: Grain size distribution percentages are approximate. Material code (e.g. SP) reference Unified Soil Classification visual method. Color code (e.g. 10YR 5/2) reference Munsell Soil Color Charts.



FAT CLAY (CH): greenish black (10Y 2.5/1), 100% clay, medium plasticity.

SILT (ML): dark greenish gray (5GY 4/1), 100% silt; low plasticity; trace fine grained sand, subrounded, 56.5 to 57.0 ft; trace thin black lamination.

FAT CLAY (CH): dark greenish gray (10Y 4/1), 100% clay, medium plasticity, dense.

FAT CLAY (CH): dark greenish gray (10Y 4/1) and black (N2.5), 100% clay, medium plasticity; dense, heavily banded/laminated, alternating 1-inch black and gray bands; ashy, possible organics, organics/wood at 61.5 ft.

FAT CLAY (CH): dark greenish gray (5GY 4/1), 100% clay, low plasticity, dense; trace black ashy deposits.

SILT (ML): dark greenish gray (10Y 4/1), 100% silt; trace clay, more dense/clayey below 69.6 ft; thin black and dark gray laminations.

FAT CLAY (CH): dark greenish gray (5GY 4/1), 100% clay, low plasticity; thin ashy dark gray to black laminations and pt. deposits; dark brown organic rich lenses(wood) from 76.5 to 76.8 ft.

SAND WITH CLAY (SP-SC): greenish gray (10Y 5/1), 90% fine grained sand, subangular to subrounded; 10% clay; well sorted; contains quartz, feldspar and amphibole.

FAT CLAY (CH): dark greenish gray (10Y 4/1), 60% clay, medium and high plasticity, clay at 78.9 to 79.3, 79.6 to 80.1, 82.5 to 84.3 ft; 40% silt, low plasticity, silt at 79.3 to 79.6, 80.1 to 82.5 ft; interbeded clays and silts, rusty alteration at 84.3 ft.

SAND (SP): light brownish gray (2.5Y 6/2), 100% fine to medium grained sand, subangular to subrounded; trace fine to coarse gravel up to 25 mm, at 84.3 to 84.7 ft, rounded; trace silt, lenses; medium sorted; contains quartz, feldspar, amphibole, and other; some horizontal rusty lamination.

SILT (ML): light brownish gray (10YR 6/2), 100% silt; trace fine grained sand, subrounded; thin horizontal rusty laminations.

CLAY (CL): dark greenish gray (10Y 4/1), 100% clay, medium plasticity, silty; ashy/black and rusty lamination.

SILT (ML): light olive gray (5Y 6/2), 100% silt; trace fine grained sand, subrounded; rusty deposits/lamination.

SAND (SP): light olive brown (2.5Y 5/3), 100% fine to medium grained sand, subangular to subrounded; trace silt; poorly sorted.

SAND (SW): light gray (5Y 7/2), 90% fine to coarse grained sand, subangular to rounded, predominantly medium and coarse grained; 10% fine to coarse gravel up to 45 mm, rounded; poorly sorted; contains quartz, feldspar, mica, amphibole, and many other mineral types.

SAND (SP): light olive gray (5Y 6/2), 100% fine to medium grained sand, subangular to subrounded, trace coarse grained; trace fine to coarse gravel up to 38 mm, subangular to subrounded; trace clay, trace clay balls up to 70 mm; poorly sorted; contains quartz, feldspar, mica, amphibole, and other.

SAND (SW): pale olive (5Y 6/3), 90% fine to coarse grained sand, subangular to rounded; 10% fine to coarse gravel up to 44 mm, subrounded to rounded, beds at 99.3 and 107.2 to 107.8 ft; trace silt, trace silt beds at 99.4 to 100.0, 104.0 to 104.6, and 106.5 to 107.0 ft; poorly sorted; contains quartz, feldspar, mica, amphibole, and other.

SS: Splitspoon sample GRAB: Grab sample PTS: Splitspoon submitted for analysis SIEVE: Grab sieved by GSSI

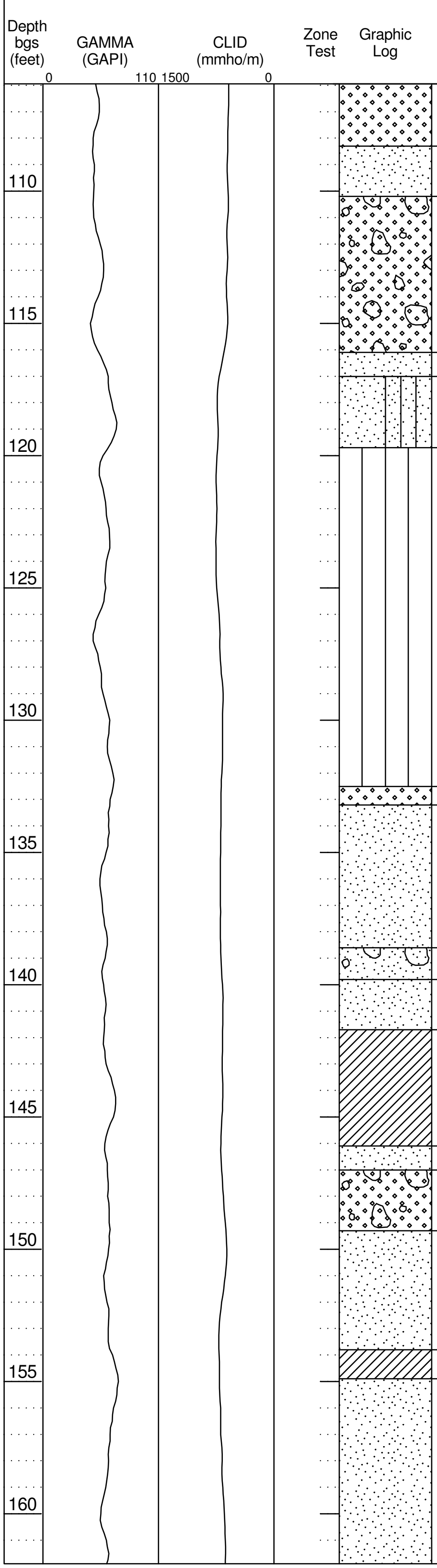
GEOSCIENCE
P.O. Box 220
Claremont, CA 91711
Telephone: (909) 451-6650
Fax: (909) 451-6638
www.gssiwater.com

BOREHOLE NAME	
ML-2	
CLIENT	California American Water
PROJECT NUMBER	13017-13
LOCATION	**Moss Landing, CA**

BOREHOLE LITHOLOGIC LOG (continued)

Lithologic Log

NOTE: Grain size distribution percentages are approximate. Material code (e.g. SP) reference Unified Soil Classification visual method. Color code (e.g. 10YR 5/2) reference Munsell Soil Color Charts.



SAND (SP): olive gray (5Y 5/2), 100% fine grained sand, subangular to subrounded; trace fine to coarse gravel up to 26 mm, rounded; trace clay; well sorted; clayey gravel layer at 108.7 ft.

SAND WITH GRAVEL (SW): pale olive (5Y 6/4), 85% fine to coarse grained sand, subangular to rounded, altered sand to dark brown at 115.3 to 115.7 ft; 15% fine to coarse gravel up to 71 mm, rounded; trace cobbles; trace clay; poorly sorted; contains quartz, feldspar, mica, amphibole, and other; cobbles to 80 mm at 111.0 ft.

SAND (SP): olive gray (5Y 5/2), 100% fine grained sand, subangular to subrounded, very fine grained; trace fine to coarse gravel up to 31 mm, well rounded; well sorted; contains quartz, feldspar, mica, amphibole, and other.

SAND WITH SILT (SP-SM): olive gray (5Y 5/2), 90% fine to medium grained sand, subangular to subrounded; 10% silt; trace fine gravel up to 5 mm, subangular to subrounded; poorly sorted; contains quartz, feldspar, amphibole, and other.

SILT (ML): olive gray (5Y 5/2), 100% silt; trace fine to coarse gravel up to 51 mm, well rounded; trace fine to coarse grained sand, subangular to subrounded; trace clay; gravel and silt bed at 121.3 to 122.2 ft; clays at 123.4 to 123.8 , 130.2 to 130.5, and 131.4 to 131.6 ft; altered rusty sand at 125.5 to 126.2 ft.

SAND (SW): olive gray (5Y 5/2), 90% fine to coarse grained sand, subangular to rounded, predominantly fine grains; 10% fine to coarse gravel up to 42 mm, rounded; poorly sorted; contains quartz, feldspar, mica, amphibole, and other.

SAND (SP): olive gray (5Y 5/2), 95% fine grained sand, subangular to subrounded; 5% fine to coarse gravel up to 40 mm, rounded; trace clay, trace clay layer at 136.2 to 136.5 ft; well sorted; contains quartz, feldspar, mica, amphibole, and other; thin rusty laminations, transition from olive brown to gray at 138.6 ft.

SAND WITH SILT AND GRAVEL (SP-SM): greenish gray (5GY 5/1), 70% fine grained sand, subangular to subrounded, trace medium and coarse grains; 20% fine to coarse gravel up to 45 mm, rounded; 10% silt; trace clay; well sorted; contains quartz, feldspar, mica, amphibole, and other; clay and gravel at 139.3 to 139.8 ft.

SAND (SP): greenish gray (5GY 5/1), 100% fine grained sand, subangular to subrounded; trace clay; well sorted; contains quartz, feldspar, and other; clay at 140.1 to 140.4 ft.

CLAY (CL): dark gray (N4), 60% clay, low plasticity; 40% silt; trace fine grained sand, subrounded; alternating silt and clay beds with black and dark gray horizontal laminations; contains organics/wood; trace thin fine sand beds.

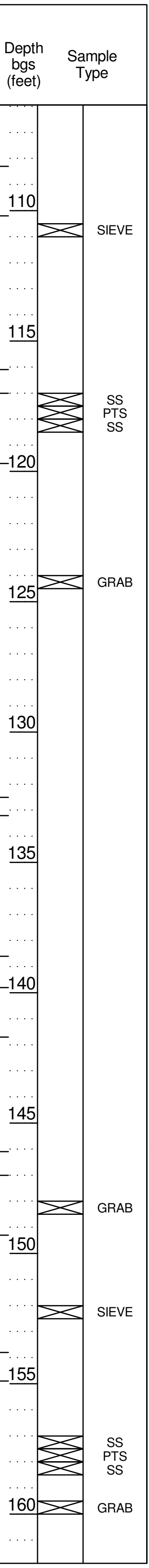
SAND (SP): pale olive (5Y 6/3), 100% fine grained sand, subangular to subrounded; trace fine gravel up to 18 mm, subangular to rounded; trace clay, trace clay lens at 146.1 ft; well sorted.

SAND WITH GRAVEL (SW): light olive gray (5Y 6/2), 70% fine to coarse grained sand, subangular to rounded; 25% fine to coarse gravel up to 37 mm, rounded; 5% silt; poorly sorted; contains quartz, feldspar, mica, amphibole, and other.

SAND (SP): olive gray (5Y 5/2), 95% fine grained sand, subangular to subrounded; 5% silt; trace fine to coarse gravel up to 19 mm, rounded; well sorted; contains quartz, feldspar, mica, amphibole, and other.

CLAY (CL): olive gray (5Y 5/2), 70% clay; 30% silt; dense silty clay; no plasticity; olive brown with gray lamination, trace rusty deposits.

SAND (SP): olive (5Y 5/3), 90% fine grained sand, subangular to subrounded; 10% fine to coarse gravel up to 68 mm, subrounded to rounded; trace clay; well sorted; contains quartz, feldspar, mica, amphibole, and other; higher mica; contains chert, many mineral types, gravel from 157.0-158.5 ft; clay from 162.2 to 163.1 and 164.2 to 164.6 ft.



SS: Splitspoon sample GRAB: Grab sample PTS: Splitspoon submitted for analysis SIEVE: Grab sieved by GSSI

GEOSCIENCE
P.O. Box 220
Claremont, CA 91711
Telephone: (909) 451-6650
Fax: (909) 451-6638
www.gssiwater.com

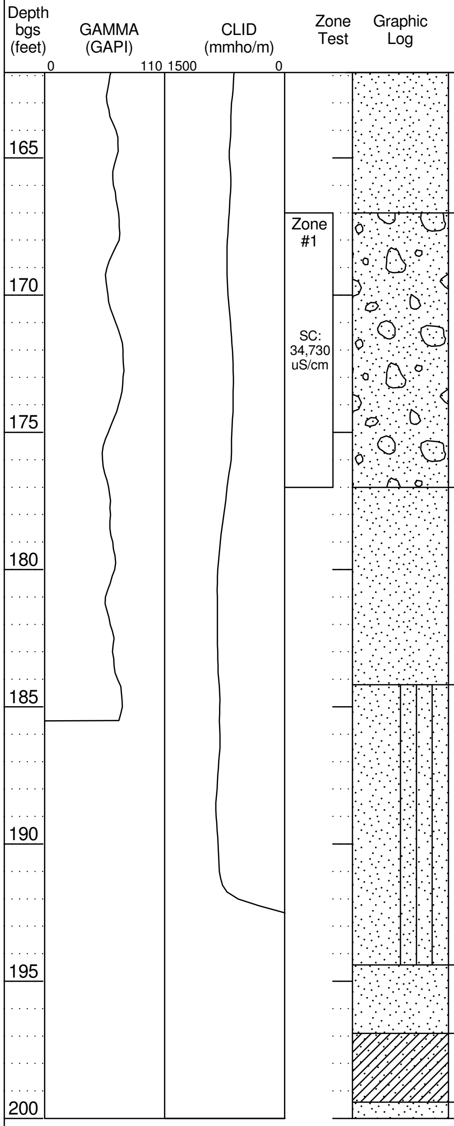
BOREHOLE NAME
ML-2

BOREHOLE LITHOLOGIC LOG (continued)

CLIENT California American Water
PROJECT NUMBER 13017-13
LOCATION
Moss Landing, CA

Lithologic Log

NOTE: Grain size distribution percentages are approximate. Material code (e.g. SP) reference Unified Soil Classification visual method. Color code (e.g. 10YR 5/2) reference Munsell Soil Color Charts.



SAND WITH GRAVEL (SP): olive gray (5Y 5/2), 85% fine grained sand, subangular to subrounded; 15% fine to coarse gravel up to 60 mm, subrounded to rounded, predominantly coarse grained; trace cobbles; well sorted; trace cobbles, contains quartz, feldspar, mica, amphibole, and other; coarse grained gravel and cobble bed at 173.7 ft; well rounded cobbles up to 96 mm, gravel increases at 171.0 to 177.0 ft; chert, granite, and siltstone.

SAND (SP): dark greenish gray (5GY 4/1), 95% fine grained sand, subangular to subrounded; 5% fine to coarse gravel up to 35 mm, rounded and flat, gravelly from 180.5 to 182.0 ft; trace clay, clay at 182.0 to 182.3 ft; well sorted; contains quartz, feldspar, mica, and amphibole; high mica; more purple and green minerals; contains rounded siltstones.

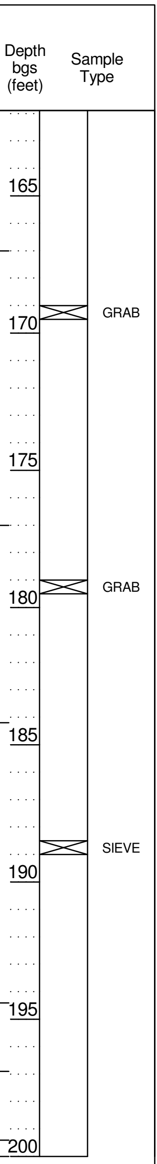
SAND WITH SILT (SP-SM): dark gray (N4), 90% fine grained sand, subangular to subrounded; 10% silt, thin silty laminations (black and gray); trace fine to coarse gravel up to 60 mm, rounded and flat; trace clay, laminated clay at 184.2 to 184.5 ft, and 186.0 to 186.4 ft; well sorted.

SAND (SP): dark gray (N4), 100% fine to coarse grained sand, subangular to rounded, alternating well sorted and well graded beds; trace fine to coarse gravel up to 45 mm, rounded and flat; contains quartz, feldspar, mica, amphibole, and other; trace shell fragments.

SANDY CLAY (CL): dark greenish gray (10Y 4/1), 51% clay; 49% fine grained sand, subangular to subrounded; contains quartz, feldspar, mica, amphibole, and other; alternating 1-inch bands of clay and fine sand; thin black/ashy lamination.

SAND (SP): dark gray (N4), 100% fine to medium grained sand, subangular to subrounded; medium sorted; contains quartz, feldspar, mica, amphibole, and other; trace shell fragments.

Bottom of borehole at 200 feet.



SS: Splitspoon sample GRAB: Grab sample PTS: Splitspoon submitted for analysis SIEVE: Grab sieved by GSSI

GEOSCIENCE
P.O. Box 220
Claremont, CA 91711
Telephone: (909) 451-6650
Fax: (909) 451-6638
www.gssiwater.com

BOREHOLE NAME
ML-3

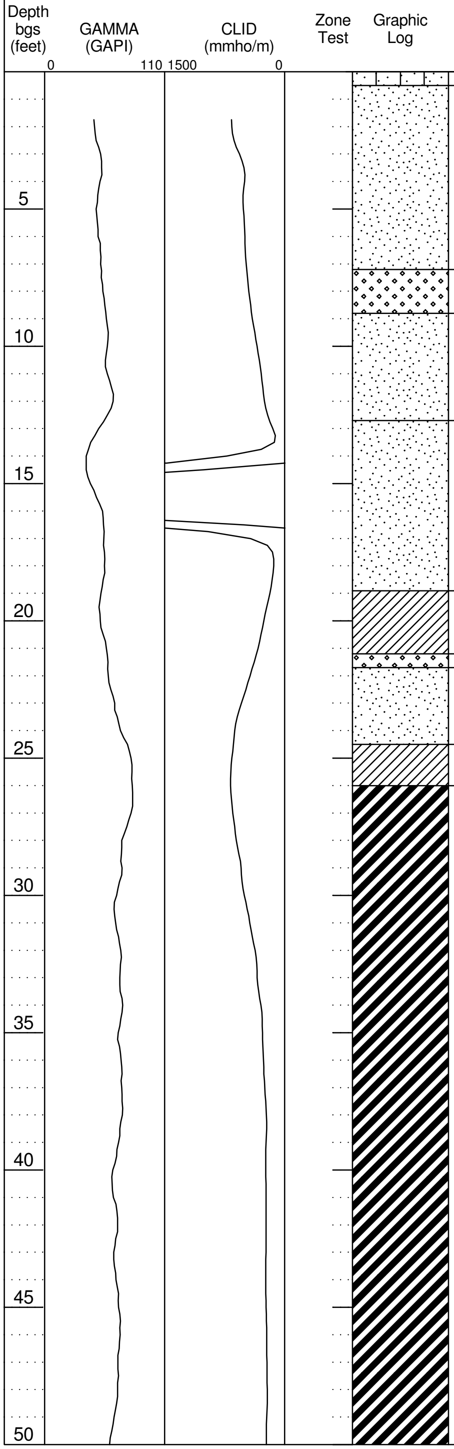
BOREHOLE LITHOLOGIC LOG

CLIENT	California American Water	LOCATION	**Moss Landing, CA** **Nadar Agha Property** **36° 48' 00.6768", -121° 47' 00.7656" Geographic NAD83**
PROJECT NUMBER	13017-13		
REPORT DATE	7/8/2014		
DRILLING CONTRACTOR	Cascade Drilling	LOGGED BY	**N. Reynolds**
DRILLER	Jose Munguia		

DRILLING RIG TYPE	Prosonic 600T	DRILLING METHOD	Sonic	START DATE	1/07/14	BOREHOLE DIAMETER	8 in
SURFACE ELEVATION	16.0 ft	TOTAL DEPTH	200 ft bgs	FINISH DATE	1/13/13	CORE SIZE	6 in

Lithologic Log

NOTE: Grain size distribution percentages are approximate. Material code (e.g. SP) reference Unified Soil Classification visual method. Color code (e.g. 10YR 5/2) reference Munsell Soil Color Charts.



SANDY SILT (ML): light olive brown (2.5Y 5/3), 70% silt; 30% fine grained sand, subangular to subrounded; trace fine to coarse gravel up to 22 mm, subangular; contains quartz, feldspar, mica and amphibole.

SAND (SP): light yellowish brown (2.5Y 6/4), 100% fine to medium grained sand, predominantly fine, subangular to subrounded; trace fine to coarse gravel up to 25 mm, flat and rounded; trace silt; medium sorted; contains quartz, feldspar, mica and amphibole.

SAND (SW): light yellowish brown (2.5Y 6/3), 100% fine to coarse grained sand, subangular to subrounded; trace fine gravel up to 15 mm, subrounded; trace silt, some silty sand beds; poorly sorted; contains quartz, feldspar, mica and amphibole.

SAND (SP): light brownish gray (2.5Y 6/2), 95% fine to medium grained sand, subangular to subrounded; 5% silt, 1-inch alternating dry powdery grey silt beds from 10.3 to 11.1 ft; trace coarse gravel up to 60 mm, rounded, at 10.5 ft; medium sorted; contains quartz, feldspar and mica.

SAND (SP): light yellowish brown (2.5Y 6/3), 100% fine to medium grained sand, subangular to subrounded; trace coarse gravel up to 60 mm, rounded; medium sorted; contains quartz, feldspar, mica and amphibole; higher mica content; rust colored altered sand at 18.9 ft contact.

CLAY (CL): light yellowish brown (2.5Y 6/3), 95% clay, medium plasticity, silty clay; 5% fine to coarse grained sand, subrounded to rounded; trace fine to coarse gravel up to 30 mm, rounded, interbeds; contains quartz, feldspar, mica and amphibole; high mica content, some horizontal ashy deposits.

SAND (SW): light olive gray (5Y 6/2), 95% fine to coarse grained sand, subangular to rounded; 5% fine gravel up to 18 mm, rounded; poorly sorted; contains quartz, feldspar, mica, amphibole, and other, higher mica content.

SAND (SP): olive (5Y 5/3), 95% fine grained sand, subangular to subrounded; 5% fine to coarse gravel up to 39 mm, subrounded to rounded; well sorted; contains quartz, feldspar, mica, amphibole, and other, high mica content.

CLAY (CL): pale olive (5Y 6/3), 85% clay, no plasticity; 15% silt, thin silty interbeds; thin black and rust colored laminations.

FAT CLAY (CH): dark greenish gray (10Y 4/1), 100% clay, medium plasticity, dense; trace fine grained sand, subangular to subrounded, sand layer from 32.0 to 32.3 ft; dense clay with trace ashy deposits/horizontal laminations; organics (wood) at 32.7, 36.0, 38.1, 40.1, and 46.6 ft.

Depth bgs (feet)	Sample Type
23.5	GRAB

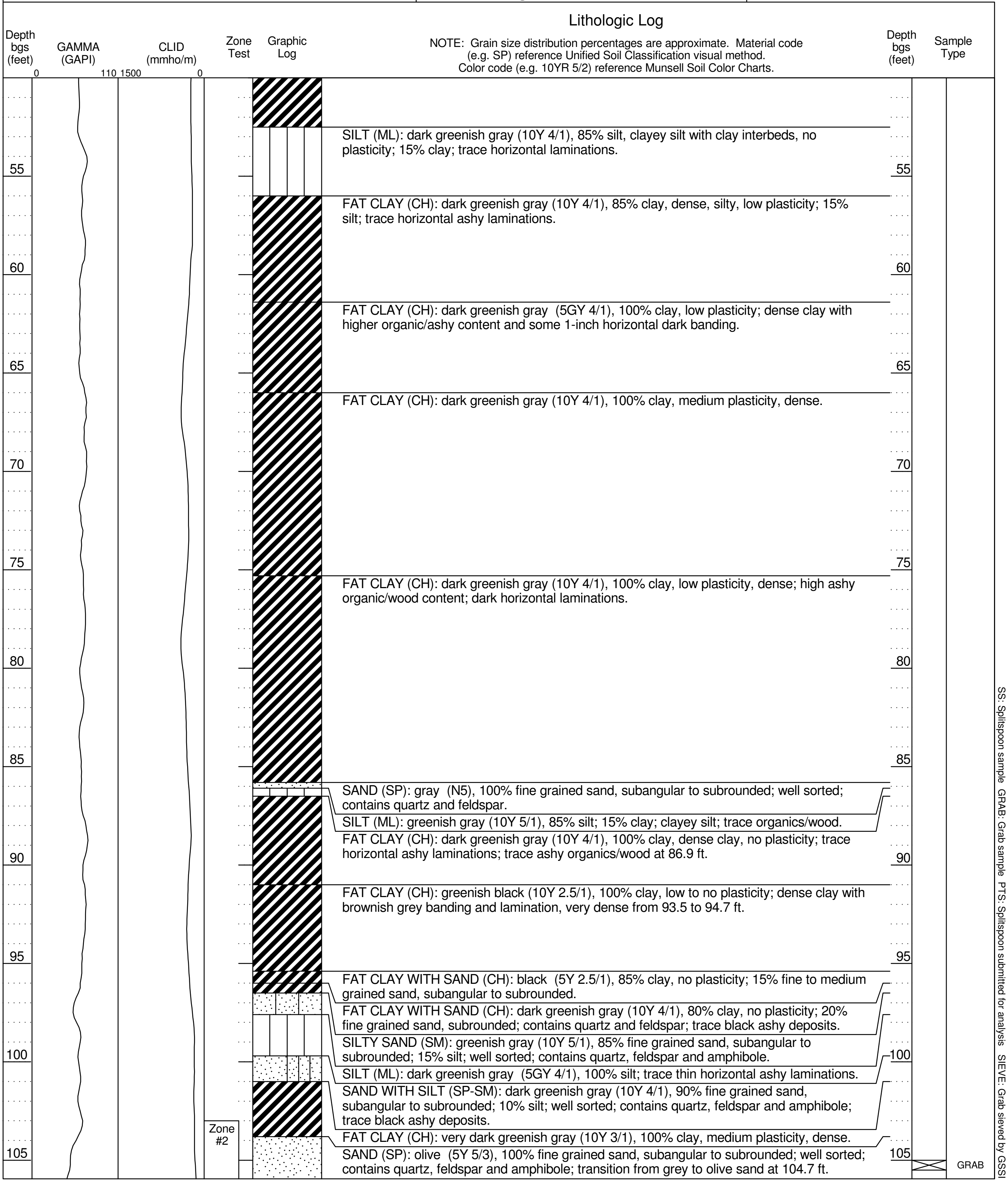
SS: Splitspoon sample GRAB: Grab sample PTS: Splitspoon submitted for analysis SIEVE: Grab sieved by GSSI

GEOSCIENCE P.O. Box 220
Claremont, CA 91711
Telephone: (909) 451-6650
Fax: (909) 451-6638
www.gssiwater.com

BOREHOLE NAME **ML-3**

BOREHOLE LITHOLOGIC LOG (continued)

CLIENT California American Water
PROJECT NUMBER 13017-13
LOCATION **Moss Landing, CA**



NOTE: Grain size distribution percentages are approximate. Material code (e.g. SP) reference Unified Soil Classification visual method. Color code (e.g. 10YR 5/2) reference Munsell Soil Color Charts.

SILT (ML): dark greenish gray (10Y 4/1), 85% silt, clayey silt with clay interbeds, no plasticity; 15% clay; trace horizontal laminations.

FAT CLAY (CH): dark greenish gray (10Y 4/1), 85% clay, dense, silty, low plasticity; 15% silt; trace horizontal ashy laminations.

FAT CLAY (CH): dark greenish gray (5GY 4/1), 100% clay, low plasticity; dense clay with higher organic/ashy content and some 1-inch horizontal dark banding.

FAT CLAY (CH): dark greenish gray (10Y 4/1), 100% clay, medium plasticity, dense.

FAT CLAY (CH): dark greenish gray (10Y 4/1), 100% clay, low plasticity, dense; high ashy organic/wood content; dark horizontal laminations.

SAND (SP): gray (N5), 100% fine grained sand, subangular to subrounded; well sorted; contains quartz and feldspar.

SILT (ML): greenish gray (10Y 5/1), 85% silt; 15% clay; clayey silt; trace organics/wood.

FAT CLAY (CH): dark greenish gray (10Y 4/1), 100% clay, dense clay, no plasticity; trace horizontal ashy laminations; trace ashy organics/wood at 86.9 ft.

FAT CLAY (CH): greenish black (10Y 2.5/1), 100% clay, low to no plasticity; dense clay with brownish grey banding and lamination, very dense from 93.5 to 94.7 ft.

FAT CLAY WITH SAND (CH): black (5Y 2.5/1), 85% clay, no plasticity; 15% fine to medium grained sand, subangular to subrounded.

FAT CLAY WITH SAND (CH): dark greenish gray (10Y 4/1), 80% clay, no plasticity; 20% fine grained sand, subrounded; contains quartz and feldspar; trace black ashy deposits.

SILTY SAND (SM): greenish gray (10Y 5/1), 85% fine grained sand, subangular to subrounded; 15% silt; well sorted; contains quartz, feldspar and amphibole.

SILT (ML): dark greenish gray (5GY 4/1), 100% silt; trace thin horizontal ashy laminations.

SAND WITH SILT (SP-SM): dark greenish gray (10Y 4/1), 90% fine grained sand, subangular to subrounded; 10% silt; well sorted; contains quartz, feldspar and amphibole; trace black ashy deposits.

FAT CLAY (CH): very dark greenish gray (10Y 3/1), 100% clay, medium plasticity, dense.

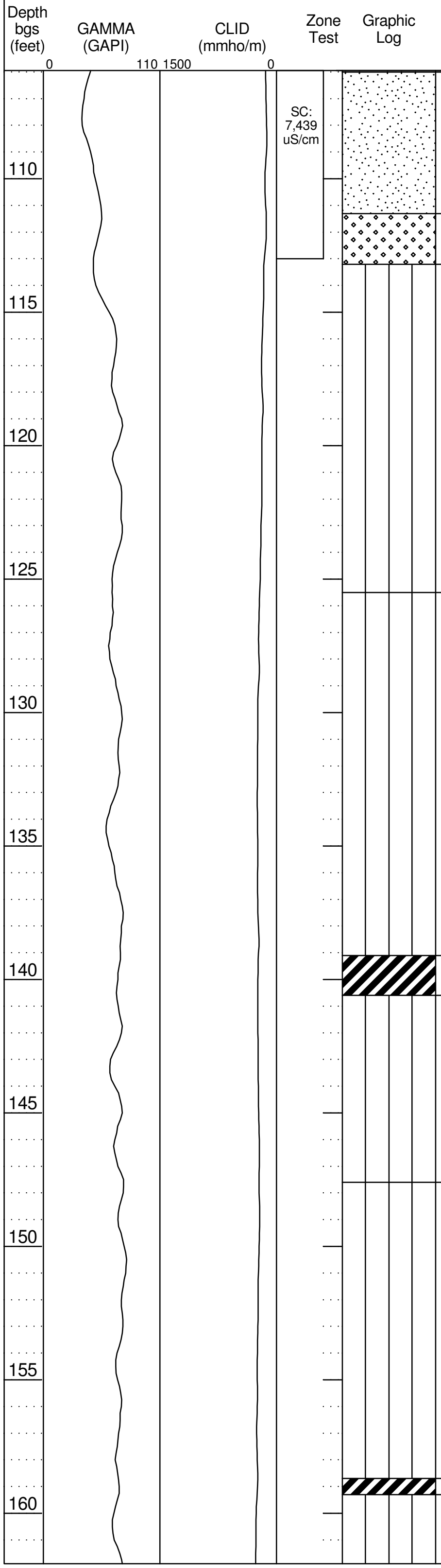
SAND (SP): olive (5Y 5/3), 100% fine grained sand, subangular to subrounded; well sorted; contains quartz, feldspar and amphibole; transition from grey to olive sand at 104.7 ft.

GEOSCIENCE
P.O. Box 220
Claremont, CA 91711
Telephone: (909) 451-6650
Fax: (909) 451-6638
www.gssiwater.com

BOREHOLE NAME **ML-3**

BOREHOLE LITHOLOGIC LOG (continued)

CLIENT California American Water
PROJECT NUMBER 13017-13
LOCATION **Moss Landing, CA**



Lithologic Log

NOTE: Grain size distribution percentages are approximate. Material code (e.g. SP) reference Unified Soil Classification visual method. Color code (e.g. 10YR 5/2) reference Munsell Soil Color Charts.

SAND (SP): olive gray (5Y 5/2), 100% fine grained sand, subangular to subrounded; trace fine to coarse gravel up to 30 mm, subrounded; trace clay, trace clay lenses; well sorted; contains quartz, feldspar, amphibole, and other; trace rust and purple colored lamination/alteration.

SAND (SW): pale olive (5Y 6/3), 100% fine to coarse grained sand, subangular to subrounded, fining upward; trace fine to coarse gravel up to 25 mm, subrounded; poorly sorted; contains quartz, feldspar, amphibole, and other.

SILT (ML): dark greenish gray (5GY 4/1), 100% silt; trace clay; trace thin ashy laminations; shell fragments from 116.1 to 117.0, 117.8 to 118.2, and 119.6 ft; clayey from 122.7 to 123.3 and 124.6 to 125.1 ft.

SILT (ML): dark greenish gray (10Y 4/1), 85% silt, dense; 15% clay; trace thin black ashy lamination/deposits; clayey.

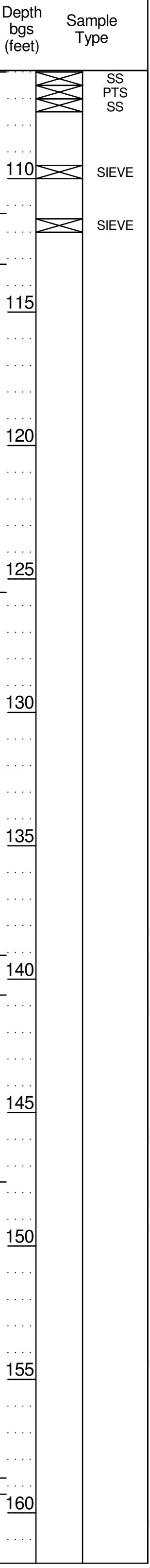
FAT CLAY (CH): dark greenish gray (5GY 4/1), 85% clay, low plasticity; 15% silt; silty; trace thin horizontal ashy laminations.

SILT (ML): dark greenish gray (5GY 4/1), 100% silt; contains mica; trace thin horizontal ashy laminations; trace shell fragments.

SILT (ML): dark greenish gray (5GY 4/1), 85% silt, clayey; 15% clay; trace round gravel to 21mm at 157.6 ft; trace thin horizontal ashy laminations/deposits.

FAT CLAY (CH): dark greenish gray (5GY 4/1), 100% clay, low plasticity; trace silt; horizontal ashy black lamination.

SILT (ML): dark greenish gray (5GY 4/1), 100% silt; trace clay; trace thin horizontal ashy laminations; organics/wood at 163.5 ft.



SS: Splitspoon sample GRAB: Grab sample PTS: Splitspoon submitted for analysis SIEVE: Grab sieved by GSSI

GEOSCIENCE
P.O. Box 220
Claremont, CA 91711
Telephone: (909) 451-6650
Fax: (909) 451-6638
www.gssiwater.com

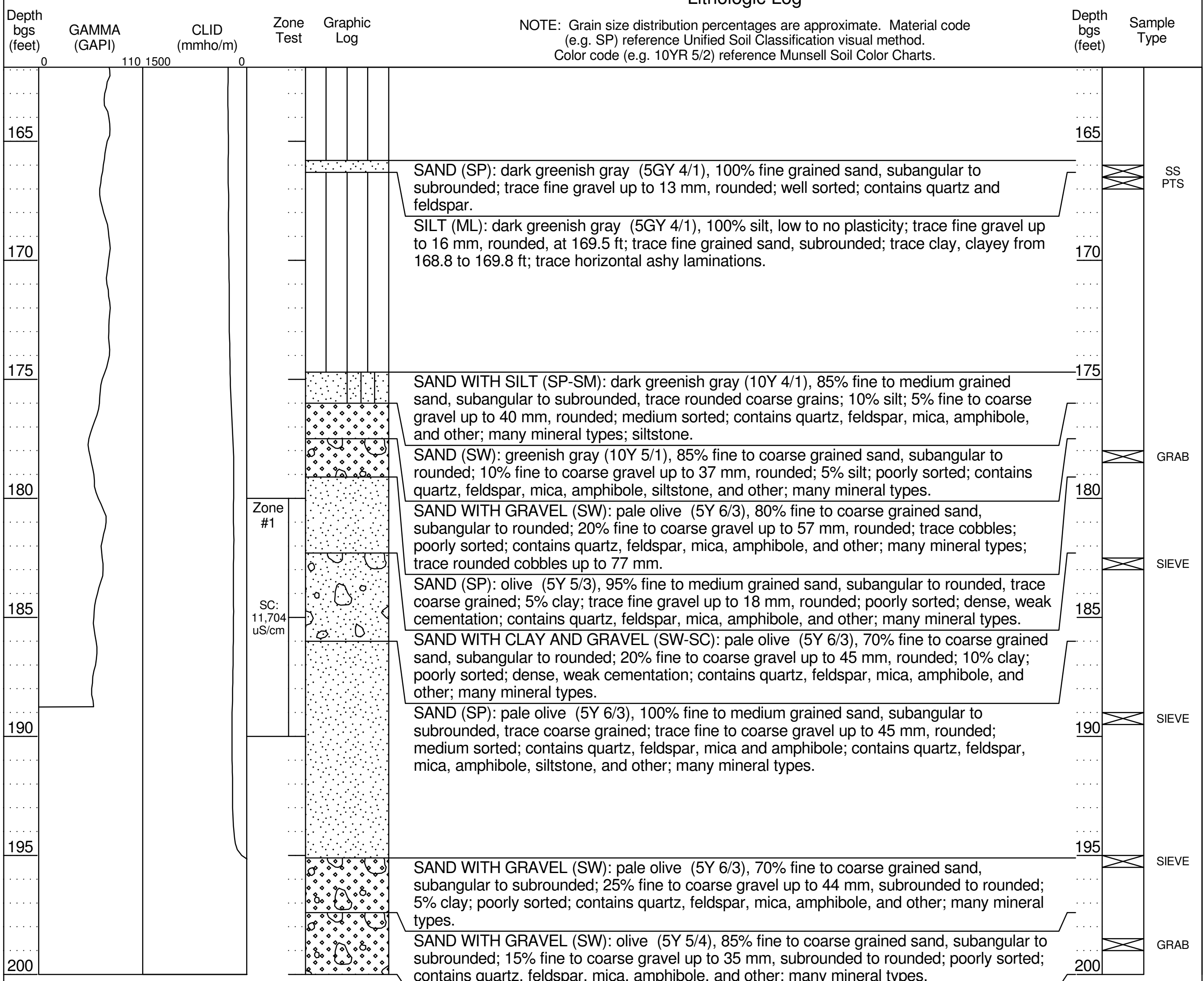
BOREHOLE NAME **ML-3**

BOREHOLE LITHOLOGIC LOG (continued)

CLIENT California American Water
PROJECT NUMBER 13017-13
LOCATION **Moss Landing, CA**

Lithologic Log

NOTE: Grain size distribution percentages are approximate. Material code (e.g. SP) reference Unified Soil Classification visual method. Color code (e.g. 10YR 5/2) reference Munsell Soil Color Charts.



SAND (SP): dark greenish gray (5GY 4/1), 100% fine grained sand, subangular to subrounded; trace fine gravel up to 13 mm, rounded; well sorted; contains quartz and feldspar.

SILT (ML): dark greenish gray (5GY 4/1), 100% silt, low to no plasticity; trace fine gravel up to 16 mm, rounded, at 169.5 ft; trace fine grained sand, subrounded; trace clay, clayey from 168.8 to 169.8 ft; trace horizontal ashy laminations.

SAND WITH SILT (SP-SM): dark greenish gray (10Y 4/1), 85% fine to medium grained sand, subangular to subrounded, trace rounded coarse grains; 10% silt; 5% fine to coarse gravel up to 40 mm, rounded; medium sorted; contains quartz, feldspar, mica, amphibole, and other; many mineral types; siltstone.

SAND (SW): greenish gray (10Y 5/1), 85% fine to coarse grained sand, subangular to rounded; 10% fine to coarse gravel up to 37 mm, rounded; 5% silt; poorly sorted; contains quartz, feldspar, mica, amphibole, siltstone, and other; many mineral types.

SAND WITH GRAVEL (SW): pale olive (5Y 6/3), 80% fine to coarse grained sand, subangular to rounded; 20% fine to coarse gravel up to 57 mm, rounded; trace cobbles; poorly sorted; contains quartz, feldspar, mica, amphibole, and other; many mineral types; trace rounded cobbles up to 77 mm.

SAND (SP): olive (5Y 5/3), 95% fine to medium grained sand, subangular to rounded, trace coarse grained; 5% clay; trace fine gravel up to 18 mm, rounded; poorly sorted; dense, weak cementation; contains quartz, feldspar, mica, amphibole, and other; many mineral types.

SAND WITH CLAY AND GRAVEL (SW-SC): pale olive (5Y 6/3), 70% fine to coarse grained sand, subangular to rounded; 20% fine to coarse gravel up to 45 mm, rounded; 10% clay; poorly sorted; dense, weak cementation; contains quartz, feldspar, mica, amphibole, and other; many mineral types.

SAND (SP): pale olive (5Y 6/3), 100% fine to medium grained sand, subangular to subrounded, trace coarse grained; trace fine to coarse gravel up to 45 mm, rounded; medium sorted; contains quartz, feldspar, mica and amphibole; contains quartz, feldspar, mica, amphibole, siltstone, and other; many mineral types.

SAND WITH GRAVEL (SW): pale olive (5Y 6/3), 70% fine to coarse grained sand, subangular to subrounded; 25% fine to coarse gravel up to 44 mm, subrounded to rounded; 5% clay; poorly sorted; contains quartz, feldspar, mica, amphibole, and other; many mineral types.

SAND WITH GRAVEL (SW): olive (5Y 5/4), 85% fine to coarse grained sand, subangular to subrounded; 15% fine to coarse gravel up to 35 mm, subrounded to rounded; poorly sorted; contains quartz, feldspar, mica, amphibole, and other; many mineral types.

Bottom of borehole at 200 feet.

SS: Splitspoon sample GRAB: Grab sample PTS: Splitspoon submitted for analysis SIEVE: Grab sieved by GSSI

GEOSCIENCE P.O. Box 220
Claremont, CA 91711
Telephone: (909) 451-6650
Fax: (909) 451-6638
www.gssiwater.com

BOREHOLE LITHOLOGIC LOG

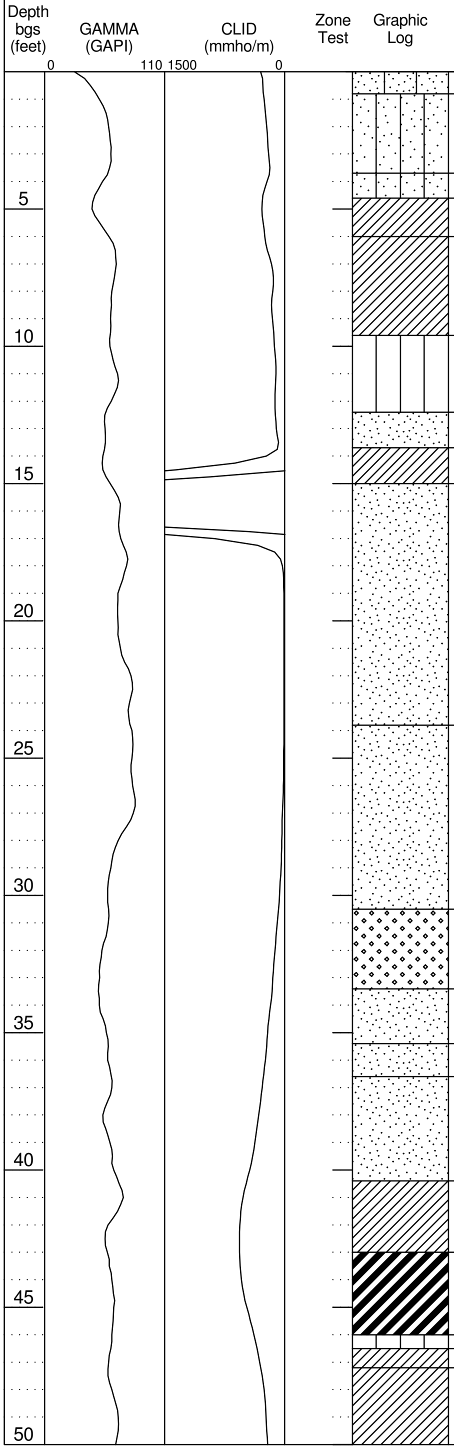
BOREHOLE NAME **ML-4**

CLIENT	California American Water	LOCATION	**Moss Landing, CA**
PROJECT NUMBER	13017-13		**Nadar Agha Property**
REPORT DATE	7/8/2014		36° 48' 09.342", -121° 47' 02.526" Geographic NAD83
DRILLING CONTRACTOR	Cascade Drilling	LOGGED BY	**N. Reynolds**
DRILLER	Jose Munguia		

DRILLING RIG TYPE	Prosonic 600T	DRILLING METHOD	Sonic	START DATE	12/02/13	BOREHOLE DIAMETER	8 in
SURFACE ELEVATION	32.0 ft	TOTAL DEPTH	201 ft bgs	FINISH DATE	12/06/13	CORE SIZE	7 in

Lithologic Log

NOTE: Grain size distribution percentages are approximate. Material code (e.g. SP) reference Unified Soil Classification visual method. Color code (e.g. 10YR 5/2) reference Munsell Soil Color Charts.



SILTY SAND (SM): yellowish brown (10YR 5/4), 80% fine grained sand, subangular to subrounded; 20% silt; trace fine to coarse gravel up to 20 mm, subangular to subrounded; well sorted; contains quartz, feldspar, mica and amphibole; trace organics/roots.

SANDY SILT (ML): dark brown (10YR 3/3), 70% silt; 30% fine grained sand, subangular to subrounded; trace fine gravel up to 5 mm, subangular to subrounded; contains quartz and feldspar; trace organics/roots.

SANDY SILT (ML): very dark brown (10YR 2/2), 70% silt; 30% fine grained sand, subangular to subrounded; trace fine gravel up to 5 mm, subangular to rounded; contains quartz and feldspar; trace organics/roots.

CLAY (CL): olive (5Y 5/3), 90% clay, low plasticity; 10% fine grained sand, subangular to subrounded; contains quartz and feldspar; some rusty alteration.

CLAY (CL): light yellowish brown (2.5Y 6/4), 90% clay, low plasticity, trace cemented clay; 10% silt; trace fine grained sand, subangular to subrounded; friable, organics (black), evaporite minerals (spherical).

SILT (ML): light yellowish brown (2.5Y 6/3), 90% silt, clayey silt; 10% fine to medium grained sand, subangular to subrounded, 4-inch rusty sand interbeds; contains quartz and feldspar; trace rusty alteration and organics.

SAND (SP): light yellowish brown (2.5Y 6/4), 100% fine grained sand, subangular to subrounded; well sorted; dry sample; contains quartz, feldspar, mica and amphibole; with visible rust colored alteration.

CLAY (CL): olive (5Y 5/3), 100% clay, clay with silty interbeds; trace fine grained sand, subangular to subrounded, rusty alteration; rust and black horizontal laminations.

SAND (SP): light yellowish brown (2.5Y 6/4), 95% fine to medium grained sand, subangular to subrounded, predominantly fine grained, some rusty alteration; 5% silt; trace fine gravel up to 18 mm, rounded; medium sorted; dry sample; contains quartz, feldspar, mica and amphibole; trace weakly cemented sand and silt interbeds.

SAND (SP): pale olive (5Y 6/3), 100% fine to medium grained sand, subangular to subrounded, trace coarse grained; trace fine gravel up to 18 mm, subangular to rounded; medium sorted; contains quartz, feldspar, mica and amphibole.

SAND (SW): pale olive (5Y 6/3), 95% fine to coarse grained sand, subangular to rounded; 5% fine to coarse gravel up to 65 mm, subangular to rounded, coarse subrounded gravel at 30.7 and 32.1 ft; poorly sorted; contains quartz, feldspar, mica and amphibole.

SAND (SP): light olive brown (2.5Y 5/3), 100% fine grained sand, subangular to subrounded; well sorted; contains quartz, feldspar and amphibole; higher mica content.

SAND (SP): light olive gray (5Y 6/2), 100% fine to medium grained sand, subangular to rounded, trace coarse grained; trace fine gravel up to 18 mm, rounded; trace clay, trace clay balls; poorly sorted; contains quartz, feldspar, mica, amphibole, and other.

SAND (SP): olive gray (5Y 5/2), 100% fine grained sand, subangular to subrounded, trace coarse black grains; well sorted; contains quartz, feldspar, mica and amphibole; high mica.

CLAY (CL): olive gray (5Y 5/2), 100% clay, low to no plasticity; alteration visible, rusty horizontal laminations.

FAT CLAY (CH): dark greenish gray (5GY 4/1), 100% clay, medium plasticity, dense; alteration visible, dark gray laminations.

SILT WITH SAND (ML): olive gray (5Y 5/2), 85% silt; 15% fine grained sand, subangular to subrounded; alteration visible, rusty horizontal laminations; contains mica.

CLAY (CL): olive gray (5Y 5/2), 100% clay, medium plasticity; trace silt; alteration visible, rusty horizontal laminations (silt).

CLAY (CL): dark greenish gray (10Y 4/1), 100% clay, medium plasticity; gray to black

Depth bgs (feet)	Sample Type
5	
10	
15	
20	
25	
	SIEVE
30	
35	
40	GRAB
45	
50	

SS: Splitspoon sample GRAB: Grab sample PTS: Splitspoon submitted for analysis SIEVE: Grab sieved by GSSI

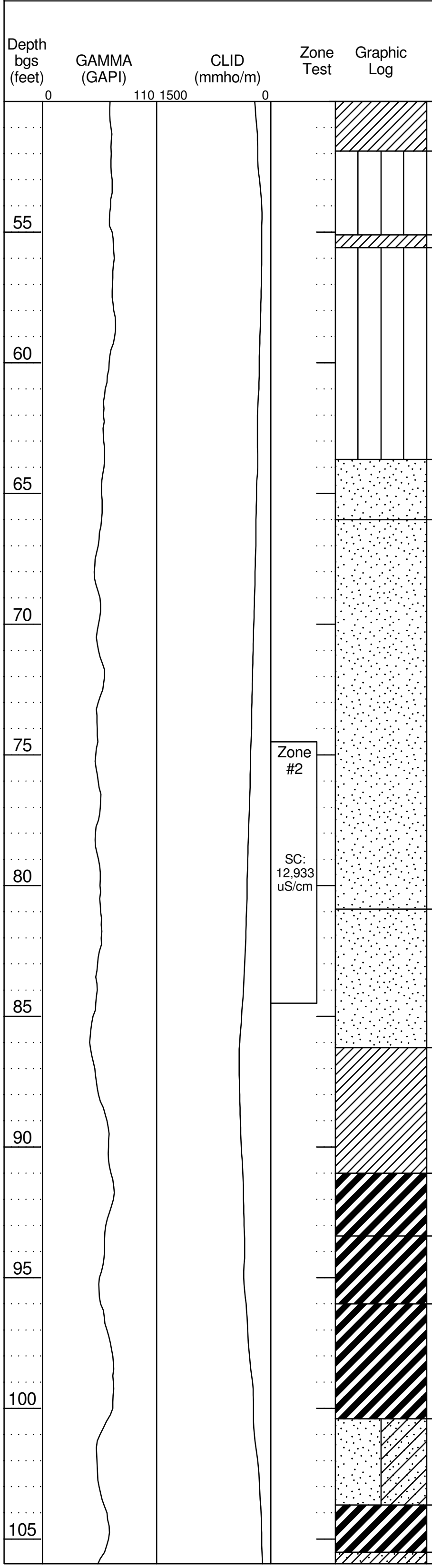
BOREHOLE NAME **ML-4**

BOREHOLE LITHOLOGIC LOG (continued)

CLIENT California American Water
PROJECT NUMBER 13017-13
LOCATION **Moss Landing, CA**

Lithologic Log

NOTE: Grain size distribution percentages are approximate. Material code (e.g. SP) reference Unified Soil Classification visual method. Color code (e.g. 10YR 5/2) reference Munsell Soil Color Charts.



horizontal laminations.

SILT (ML): dark greenish gray (10Y 4/1), 100% silt; grey silt with black horizontal laminations, trace mica.

CLAY (CL): dark greenish gray (10Y 4/1), 80% clay, low plasticity; 20% silt; silty clay, trace mica.

SILT WITH SAND (ML): dark greenish gray (10Y 4/1), 80% silt; 15% fine grained sand, subangular to subrounded; 5% clay, trace clay lenses; silt with alternating thin fine sand lenses and thin black horizontal laminations; trace woody organics.

SAND (SP): greenish gray (5GY 5/1), 100% fine to medium grained sand, subangular to rounded; trace fine to coarse gravel up to 44 mm, flat and rounded; medium sorted; contains quartz, feldspar and amphibole; contains quartz, feldspar, amphibole, and other; trace organics/wood at 65.5 ft.

SAND (SP): greenish gray (5GY 5/1), 100% fine grained sand, subangular to subrounded; trace silt, silt lenses; trace clay, clay lenses; well sorted; contains quartz, feldspar and mica; trace organics/wood at 75.2 and 80.2 ft.

SAND (SP): greenish gray (5GY 6/1), 100% fine grained sand, subangular to subrounded; trace fine gravel up to 10 mm, rounded; trace silt, silt lenses; trace clay, clay lenses; well sorted; contains quartz, feldspar and mica; trace organics/wood 83.3 ft.

CLAY (CL): dark greenish gray (10Y 4/1), 100% clay, low plasticity; dense clay with black horizontal laminations.

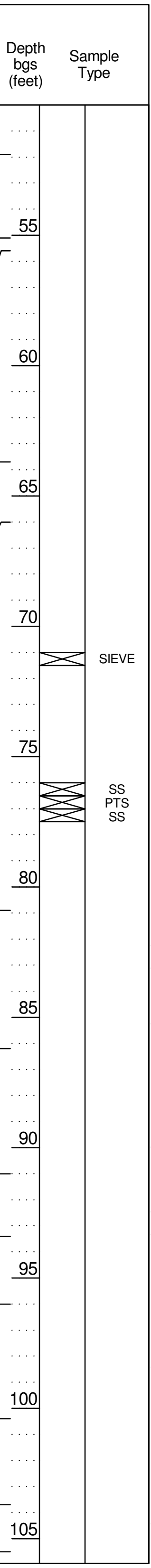
FAT CLAY (CH): dark greenish gray (10Y 4/1), 100% clay, high plasticity, very dense and waxy.

FAT CLAY (CH): dark greenish gray (5GY 4/1) to greenish black (10Y 2.5/1), 100% clay, high plasticity; very dense and waxy clay with partially cemented black/brown laminations (3/4-inch alternating).

FAT CLAY (CH): dark greenish gray (10Y 4/1), 100% clay, medium plasticity, dense and waxy; brownish gray laminations from 98.5 to 100.4 ft.

SAND WITH CLAY (SP-SC): greenish gray (10Y 5/1), 90% fine to medium grained sand, subangular to subrounded; 10% clay, 4 to 6 inch sandy clay interbeds; medium sorted; contains quartz, feldspar, mica and amphibole.

FAT CLAY (CH): dark greenish gray (5GY 4/1), 100% clay, medium plasticity, dense; trace black laminations/ashy deposits.



SS: Splitspoon sample GRAB: Grab sample PTS: Splitspoon submitted for analysis SIEVE: Grab sieved by GSSI

GEOSCIENCE
P.O. Box 220
Claremont, CA 91711
Telephone: (909) 451-6650
Fax: (909) 451-6638
www.gssiwater.com

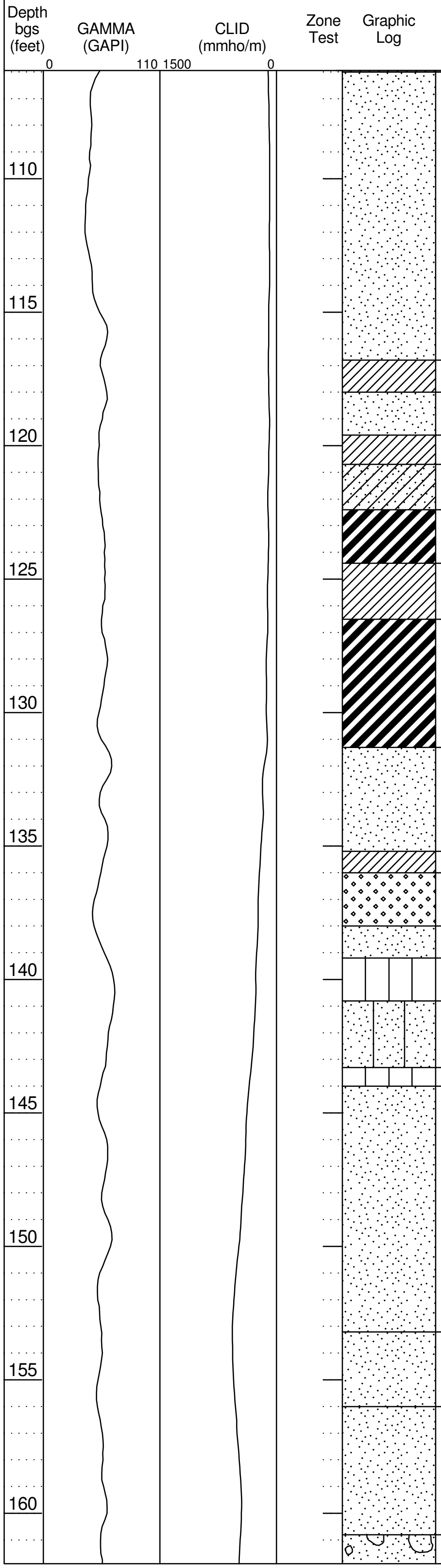
BOREHOLE LITHOLOGIC LOG (continued)

BOREHOLE NAME **ML-4**

CLIENT California American Water
PROJECT NUMBER 13017-13
LOCATION **Moss Landing, CA**

Lithologic Log

NOTE: Grain size distribution percentages are approximate. Material code (e.g. SP) reference Unified Soil Classification visual method. Color code (e.g. 10YR 5/2) reference Munsell Soil Color Charts.



SANDY CLAY (CL): dark greenish gray (5GY 4/1), 70% clay, low plasticity; 30% fine to coarse grained sand, subangular; contains quartz and feldspar; trace small black ashy deposits; trace organics/wood at 106 ft.

SAND (SP): dark greenish gray (10Y 4/1) to greenish gray (5GY 5/1), 100% fine to medium grained sand, subangular to subrounded; well sorted; contains quartz, feldspar and amphibole; trace organics/wood; high quartz content.

CLAY (CL): dark greenish gray (10G 4/1), 80% clay, low plasticity; 20% silt; trace fine grained sand, subangular to subrounded; trace small black/ashy deposits; silty clay.

SAND (SP): dark greenish gray (10Y 4/1), 100% fine to medium grained sand, subangular to subrounded, predominantly fine grained; trace fine gravel up to 17 mm, subrounded to rounded; trace clay, clay lens at 119.0 ft; medium sorted; contains quartz, feldspar, mica, amphibole, and other; trace organics/wood.

CLAY (CL): dark greenish gray (5GY 4/1), 95% clay, low plasticity, silty clay; 5% fine grained sand, subangular to subrounded; contains quartz and feldspar; trace black ashy deposits.

CLAYEY SAND (SC): greenish gray (10G 5/1), 70% fine grained sand, subrounded; 30% clay, medium plasticity; well sorted; contains quartz, feldspar and amphibole; alternating beds of sand and clay.

FAT CLAY (CH): very dark greenish gray (10Y 3/1), 100% clay, medium plasticity, dense.

CLAY WITH SAND (CL): dark greenish gray (10G 4/1), 80% clay, no plasticity; 20% fine grained sand, subrounded; trace organics/wood.

FAT CLAY (CH): greenish gray (10G 5/1), 100% clay, medium plasticity, dense and waxy; trace sand balls; highly altered/rusty laminations at 131.3 ft.

SAND (SP): pale yellow (2.5Y 7/3), 100% fine to medium grained sand, subangular to subrounded, predominantly fine grained, trace coarse; trace fine to coarse gravel up to 43 mm, subrounded to rounded, flat; trace silt, 2.5-inch silt at 133.8 ft; medium sorted; contains quartz, feldspar, mica, amphibole, and other; some purple colored alteration.

SANDY CLAY WITH GRAVEL (CL): light yellowish brown (2.5Y 6/3), 60% clay, no plasticity; 25% fine to coarse grained sand, subangular to subrounded; 15% fine to coarse gravel up to 40 mm, subrounded to rounded; contains quartz, feldspar, mica, amphibole, and other; with visible alteration of sands.

SAND (SW): light yellowish brown (2.5Y 6/3), 100% fine to coarse grained sand, subangular to rounded, predominantly medium to coarse grained; trace fine to coarse gravel up to 32 mm, rounded; poorly sorted; contains quartz, feldspar, mica, amphibole, and other.

SAND (SP): pale olive (5Y 6/3), 100% fine grained sand, subangular to subrounded, coarse grained from 138.8 to 139.2 ft; well sorted; contains quartz, feldspar, mica and amphibole; trace rust colored laminations.

SILT (ML): olive (5Y 5/3), 100% silt; rusty and black/ashy laminations/alteration (at 139.2 ft).

SILTY SAND (SM): olive (5Y 5/3), 85% fine grained sand, subangular to subrounded; 15% silt; trace fine to coarse gravel up to 57 mm, subangular to rounded; trace clay, 1-inch clay lens at 141.3 ft; well sorted; contains quartz, feldspar and amphibole; rust colored horizontal laminations.

SILT (ML): olive (5Y 5/3), 100% silt; trace fine grained sand, subrounded; contains mica; rust colored horizontal laminations.

SAND (SP): light yellowish brown (2.5Y 6/3), 100% fine to coarse grained sand, subangular to rounded, predominantly fine to medium grained; trace fine to coarse gravel up to 39 mm, rounded, quartz-rich and sandstone, higher gravel content at 144.5 to 146 ft and 149.5 to 150.5 ft; poorly sorted; contains quartz, feldspar, mica, amphibole, and other; many mineral types.

SAND (SP): light yellowish brown (2.5Y 6/4), 100% fine to medium grained sand, subangular to subrounded; trace fine to coarse gravel up to 24 mm, rounded; medium sorted; contains quartz, feldspar, mica, amphibole, and other.

SAND (SP): olive (5Y 5/3), 100% fine to coarse grained sand, subangular to rounded, predominantly fine to medium grained; trace fine gravel up to 15 mm, rounded; trace clay; poorly sorted; contains quartz, feldspar, mica, amphibole, and other.

SAND WITH CLAY AND GRAVEL (SW-SC): light yellowish brown (2.5Y 6/3), 65% fine to

Depth bgs (feet)	Sample Type
110	
	SIEVE
115	
120	
125	
	SS PTS SS
130	
	GRAB
135	
	GRAB
140	
145	
	SS PTS SS
150	
	SIEVE
155	
160	

SS: Splitspoon sample GRAB: Grab sample PTS: Splitspoon submitted for analysis SIEVE: Grab sieved by GSSI

GEOSCIENCE P.O. Box 220
Claremont, CA 91711
Telephone: (909) 451-6650
Fax: (909) 451-6638
www.gssiwater.com

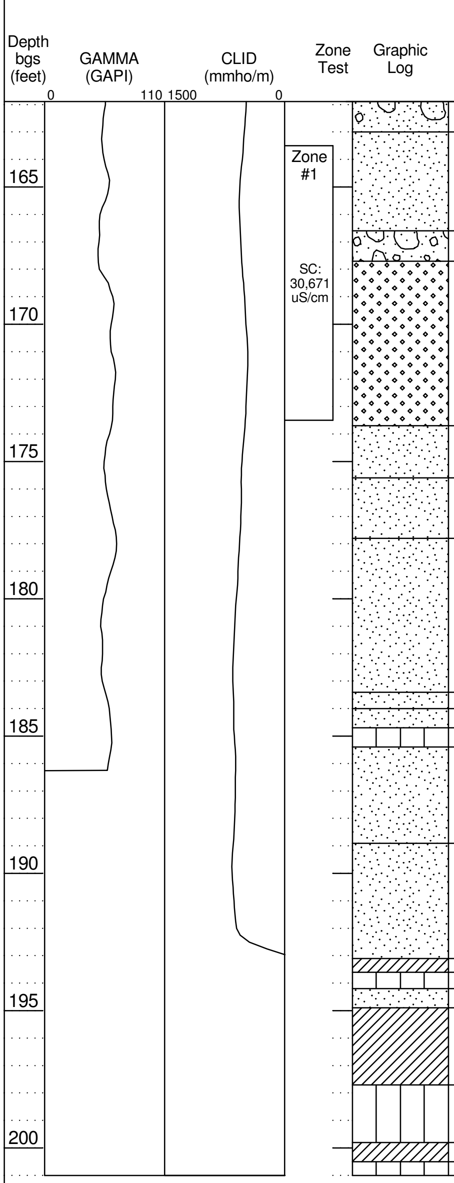
BOREHOLE NAME
ML-4

BOREHOLE LITHOLOGIC LOG (continued)

CLIENT: California American Water
PROJECT NUMBER: 13017-13
LOCATION: **Moss Landing, CA**

Lithologic Log

NOTE: Grain size distribution percentages are approximate. Material code (e.g. SP) reference Unified Soil Classification visual method. Color code (e.g. 10YR 5/2) reference Munsell Soil Color Charts.



coarse grained sand, subangular to rounded; 25% fine to coarse gravel up to 28 mm, rounded; 10% clay; poorly sorted; contains quartz, feldspar, mica, amphibole, and other.

SAND (SP): olive (5Y 5/3), 90% fine to coarse grained sand, subangular to rounded, predominantly fine to medium grained; 5% fine to coarse gravel up to 20 mm, subrounded to rounded; 5% silt; poorly sorted; contains quartz, feldspar, mica, amphibole, and other.

CLAYEY GRAVEL WITH SAND (GC): yellowish brown (10YR 5/4), 60% fine to coarse gravel up to 33 mm, rounded; 25% fine to coarse grained sand, subrounded to rounded, predominantly coarse grained; 15% clay; poorly sorted; contains quartz, feldspar, mica, amphibole, and other; pink colored deposit.

SAND (SW): olive (5Y 5/4), 95% fine to coarse grained sand, subangular to rounded; 5% fine to coarse gravel up to 43 mm, rounded; trace clay; poorly sorted; contains quartz, feldspar, mica, amphibole, and other; well rounded coarse grained sand and fine gravel interbed from 171.4 to 171.9 ft.

SAND (SP): olive (5Y 5/4), 100% fine to medium grained sand, subangular to subrounded, predominantly fine grained, trace coarse grained; trace fine to coarse gravel up to 34 mm, flat and rounded; poorly sorted; contains quartz, feldspar, mica, amphibole, and other.

SAND (SP): light olive brown (2.5Y 5/3), 100% fine to coarse grained sand, subangular to rounded, predominantly medium grained; trace fine to coarse gravel up to 32 mm, rounded; poorly sorted; contains quartz, feldspar, mica, amphibole, and other; abundance of minerals.

SAND (SP): pale olive (5Y 6/4), 100% fine to medium grained sand, subangular to subrounded, predominantly fine grained; trace fine to coarse gravel up to 31 mm, flat and rounded; medium sorted; contains quartz, feldspar, mica, amphibole, and other;.

SAND (SP): olive (5Y 5/4), 100% fine grained sand, subangular to subrounded; well sorted; contains quartz, feldspar, mica, amphibole, and other.

SAND (SP): greenish gray (5GY 6/1), 100% fine grained sand, subangular to subrounded, trace medium grained; trace fine to coarse gravel up to 22 mm, rounded; well sorted; contains quartz, feldspar, mica and amphibole; contains quartz, feldspar, mica, amphibole, and other; trace orange alteration.

SILT (ML): greenish gray (5GY 5/1), 100% silt; trace fine to coarse gravel up to 22 mm, rounded; trace fine grained sand, subrounded; contains quartz, feldspar, mica and amphibole; some rust colored horizontal laminations.

SAND (SP): dark gray (N4), 95% fine grained sand, subrounded, very fine grained; 5% silt, thin silt lenses; trace fine to coarse gravel up to 56 mm, well rounded, predominantly green and purple minerals; well sorted; contains quartz, feldspar, mica, amphibole, and other; high mica content.

SAND (SP): gray (N5), 100% fine to coarse grained sand, subangular to rounded; trace fine to coarse gravel up to 69 mm, well rounded; well sorted; contains quartz, feldspar, mica and amphibole; alternating fine to coarse well graded sand and well sorted fine grained sand beds; fine to coarse grained sand beds at 188.9 to 189.7, 190.2 to 191.2, 192.0 to 193.1 ft; fine grained sand beds at 189.7 to 190.2, 191.2 to 192.0 ft; trace shells.

CLAY (CL): dark gray (N4), 100% clay; trace silt; trace horizontal black/ashy laminations.

SILT (ML): dark gray (N4), 100% silt; trace clay; trace horizontal black/ashy laminations, trace organics.

SAND (SP): dark gray (N4), 100% fine grained sand, subrounded; well sorted; contains quartz, feldspar, mica and amphibole; high mica content.

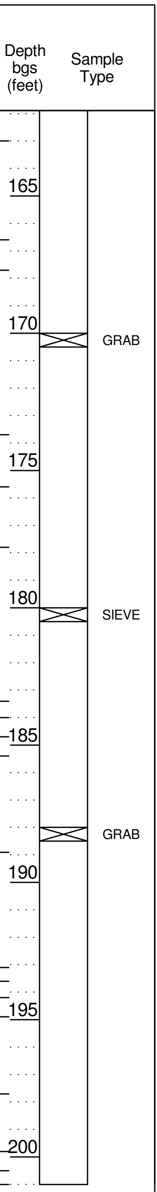
CLAY (CL): dark greenish gray (10Y 4/1), 100% clay, medium plasticity; trace silt; trace black/ashy deposits.

SILT (ML): dark greenish gray (10Y 4/1), 100% silt; trace clay; trace black/ashy deposits.

CLAY (CL): dark greenish gray (10Y 4/1), 100% clay; trace silt; trace black/ashy deposits.

SILT (ML): dark gray (N4), 70% silt; 30% clay; clayey silt.

Bottom of borehole at 201 feet.



SS: Splitspoon sample GRAB: Grab sample PTS: Splitspoon submitted for analysis SIEVE: Grab sieved by GSSI

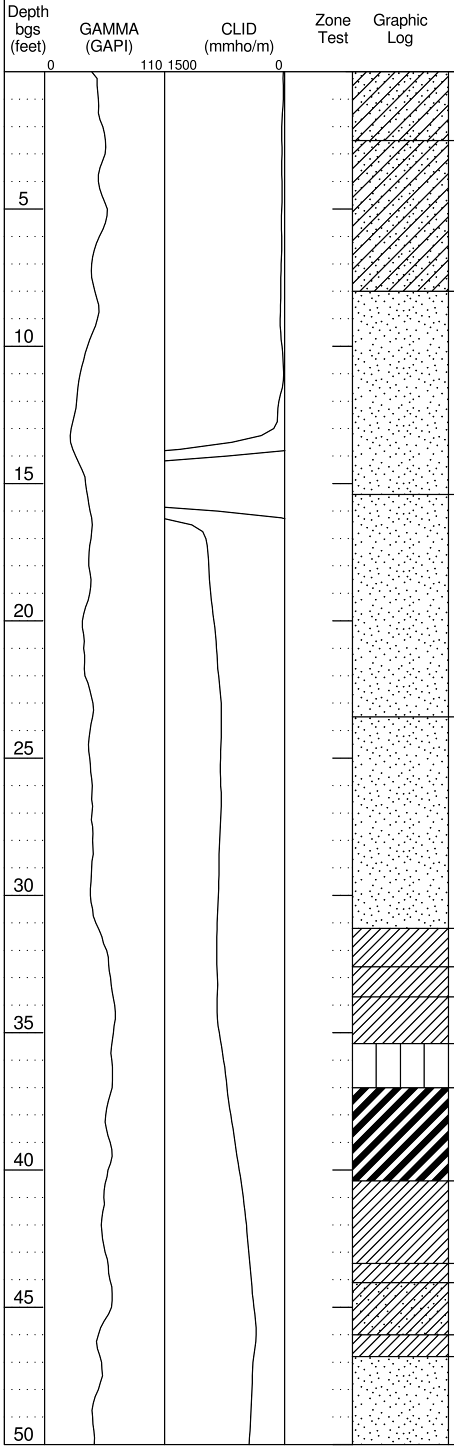
GEOSCIENCE
P.O. Box 220
Claremont, CA 91711
Telephone: (909) 451-6650
Fax: (909) 451-6638
www.gssiwater.com

BOREHOLE LITHOLOGIC LOG

BOREHOLE NAME	**ML-6**		
CLIENT PROJECT NUMBER	California American Water 13017-13	LOCATION	**Moss Landing, CA** **MBARI** **36° 48' 21.4992", -121° 47' 16.0188"** **Geographic NAD83**
REPORT DATE	7/8/2014		
DRILLING CONTRACTOR DRILLER	Cascade Drilling Jose Munguia	LOGGED BY	**N. Reynolds**
DRILLING RIG TYPE	Prosonic 600T	DRILLING METHOD	Sonic
START DATE	11/18/13	BOREHOLE DIAMETER	8 in
SURFACE ELEVATION	15.0 ft	TOTAL DEPTH	200 ft bgs
FINISH DATE	11/23/13	CORE SIZE	7 in

Lithologic Log

NOTE: Grain size distribution percentages are approximate. Material code (e.g. SP) reference Unified Soil Classification visual method. Color code (e.g. 10YR 5/2) reference Munsell Soil Color Charts.



Depth bgs (feet)	Lithologic Log	Sample Type
0	CLAYEY SAND (SC): olive (5Y 4/4), 85% fine to medium grained sand, subangular to rounded; 15% clay, sandy clay balls; trace fine gravel up to 5 mm, rounded; poorly sorted; contains quartz, feldspar, mica and amphibole; trace shells and shell fragments.	
	CLAYEY SAND (SC): olive (5Y 4/4), 70% fine to medium grained sand, subangular to rounded; 30% clay; trace fine to coarse gravel up to 62 mm, angular to rounded; poorly sorted; contains quartz, feldspar, mica and amphibole; contains shells.	
5		
	SAND (SP): olive (5Y 4/4), 100% fine to medium grained sand, subangular to subrounded; trace coarse gravel rounded, interbedded; trace silt, silt from 8.7 to 9.2 ft with high mica content and some alteration; poorly sorted; contains quartz, feldspar and amphibole.	
10		
15		
	SAND (SP): olive gray (5Y 5/2), 100% fine to medium grained sand, subangular to subrounded; medium sorted; contains quartz, feldspar, mica and amphibole; altered rust and black colored sands from 22.0 to 23.5 ft.	
20		
	SAND (SP): olive (5Y 5/4), 95% medium to coarse grained sand, subangular to rounded; 5% fine to coarse gravel up to 40 mm, rounded; poorly sorted; contains quartz, feldspar, mica, amphibole, and other; trace shells and shell fragments.	
25		
30		
	CLAY (CL): olive brown (2.5Y 4/4), 100% clay, low plasticity; with visible rust and black colored alteration.	
	CLAY (CL): very dark greenish gray (5GY 3/1), 100% clay, medium plasticity; trace organics, altered black and dark gray and weakly cemented from 33.7 to 34.2 ft.	
35	CLAY (CL): very dark greenish gray (5GY 3/1), 100% clay, low plasticity; dark gray/black laminations.	
	SILT (ML): very dark greenish gray (10Y 3/1), 95% silt; 5% fine grained sand, subrounded, very fine grained; contains mica; thin black laminations.	
	FAT CLAY (CH): very dark greenish gray (10Y 3/1), 100% clay, medium plasticity; trace fine grained sand, subrounded, fine sand layer at 40.2 to 40.4 ft; trace black/gray laminations, trace organics.	
40		
	CLAY (CL): greenish black (10Y 2.5/1), 100% clay, medium plasticity; trace silt, silt interbed at 42.4 to 42.8 ft.	
	CLAY (CL): olive (5Y 4/3), 100% clay, low plasticity; trace fine grained sand, subangular to subrounded; alteration visible with black/grey and brown coloration.	
45	SANDY CLAY (CL): yellowish red (5YR 4/6), 50% fine grained sand, subangular to subrounded; 50% clay; with visible rust colored alteration; sandy clay to clayey sand.	
	CLAY (CL): light olive brown (2.5Y 5/3), 95% clay; 5% fine grained sand, subangular to subrounded; trace silt; with visible rust colored alteration.	
	SAND (SP): light yellowish brown (2.5Y 6/3), 95% fine grained sand, subangular to subrounded; 5% silt; well sorted; contains quartz, feldspar, mica and amphibole; with trace	
50		

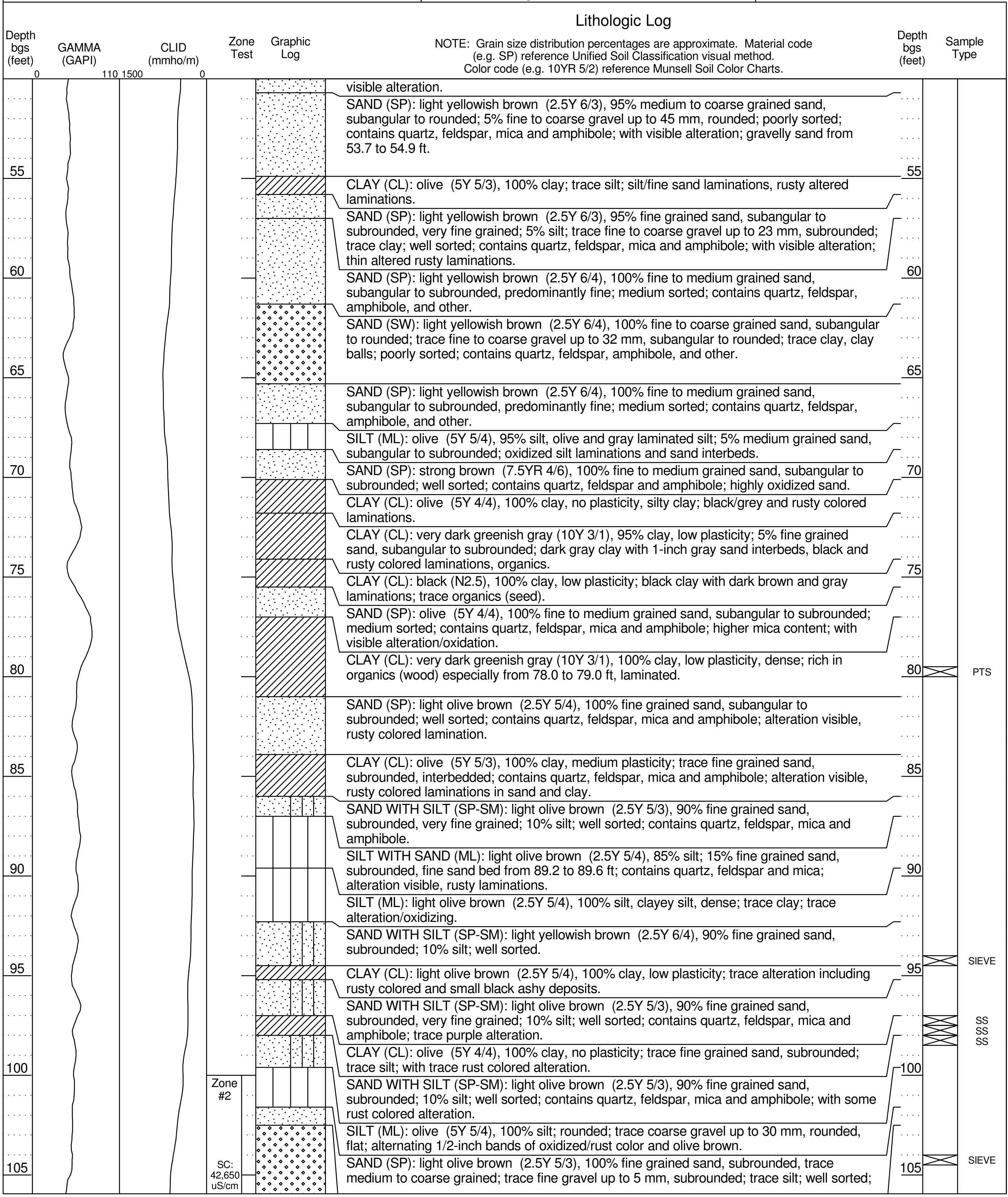
SS: Splitspoon sample GRAB: Grab sample PTS: Splitspoon submitted for analysis SIEVE: Grab sieved by GSSI

GEOSCIENCE
P.O. Box 220
Claremont, CA 91711
Telephone: (909) 451-6650
Fax: (909) 451-6638
www.gssiwater.com

BOREHOLE NAME **ML-6**

BOREHOLE LITHOLOGIC LOG (continued)

CLIENT California American Water
PROJECT NUMBER 13017-13
LOCATION **Moss Landing, CA**



NOTE: Grain size distribution percentages are approximate. Material code (e.g. SP) reference Unified Soil Classification visual method. Color code (e.g. 10YR 5/2) reference Munsell Soil Color Charts.

visible alteration.

SAND (SP): light yellowish brown (2.5Y 6/3), 95% medium to coarse grained sand, subangular to rounded; 5% fine to coarse gravel up to 45 mm, rounded; poorly sorted; contains quartz, feldspar, mica and amphibole; with visible alteration; gravelly sand from 53.7 to 54.9 ft.

CLAY (CL): olive (5Y 5/3), 100% clay; trace silt; silt/fine sand laminations, rusty altered laminations.

SAND (SP): light yellowish brown (2.5Y 6/3), 95% fine grained sand, subangular to subrounded, very fine grained; 5% silt; trace fine to coarse gravel up to 23 mm, subrounded; trace clay; well sorted; contains quartz, feldspar, mica and amphibole; with visible alteration; thin altered rusty laminations.

SAND (SP): light yellowish brown (2.5Y 6/4), 100% fine to medium grained sand, subangular to subrounded, predominantly fine; medium sorted; contains quartz, feldspar, amphibole, and other.

SAND (SW): light yellowish brown (2.5Y 6/4), 100% fine to coarse grained sand, subangular to rounded; trace fine to coarse gravel up to 32 mm, subangular to rounded; trace clay, clay balls; poorly sorted; contains quartz, feldspar, amphibole, and other.

SAND (SP): light yellowish brown (2.5Y 6/4), 100% fine to medium grained sand, subangular to subrounded, predominantly fine; medium sorted; contains quartz, feldspar, amphibole, and other.

SILT (ML): olive (5Y 5/4), 95% silt, olive and gray laminated silt; 5% medium grained sand, subangular to subrounded; oxidized silt laminations and sand interbeds.

SAND (SP): strong brown (7.5YR 4/6), 100% fine to medium grained sand, subangular to subrounded; well sorted; contains quartz, feldspar and amphibole; highly oxidized sand.

CLAY (CL): olive (5Y 4/4), 100% clay, no plasticity, silty clay; black/grey and rusty colored laminations.

CLAY (CL): very dark greenish gray (10Y 3/1), 95% clay, low plasticity; 5% fine grained sand, subangular to subrounded; dark gray clay with 1-inch gray sand interbeds, black and rusty colored laminations, organics.

CLAY (CL): black (N2.5), 100% clay, low plasticity; black clay with dark brown and gray laminations; trace organics (seed).

SAND (SP): olive (5Y 4/4), 100% fine to medium grained sand, subangular to subrounded; medium sorted; contains quartz, feldspar, mica and amphibole; higher mica content; with visible alteration/oxidation.

CLAY (CL): very dark greenish gray (10Y 3/1), 100% clay, low plasticity, dense; rich in organics (wood) especially from 78.0 to 79.0 ft, laminated.

SAND (SP): light olive brown (2.5Y 5/4), 100% fine grained sand, subangular to subrounded; well sorted; contains quartz, feldspar, mica and amphibole; alteration visible, rusty colored lamination.

CLAY (CL): olive (5Y 5/3), 100% clay, medium plasticity; trace fine grained sand, subrounded, interbedded; contains quartz, feldspar, mica and amphibole; alteration visible, rusty colored laminations in sand and clay.

SAND WITH SILT (SP-SM): light olive brown (2.5Y 5/3), 90% fine grained sand, subrounded, very fine grained; 10% silt; well sorted; contains quartz, feldspar, mica and amphibole.

SILT WITH SAND (ML): light olive brown (2.5Y 5/4), 85% silt; 15% fine grained sand, subrounded, fine sand bed from 89.2 to 89.6 ft; contains quartz, feldspar and mica; alteration visible, rusty laminations.

SILT (ML): light olive brown (2.5Y 5/4), 100% silt, clayey silt, dense; trace clay; trace alteration/oxidizing.

SAND WITH SILT (SP-SM): light yellowish brown (2.5Y 6/4), 90% fine grained sand, subrounded; 10% silt; well sorted.

CLAY (CL): light olive brown (2.5Y 5/4), 100% clay, low plasticity; trace alteration including rusty colored and small black ashy deposits.

SAND WITH SILT (SP-SM): light olive brown (2.5Y 5/3), 90% fine grained sand, subrounded, very fine grained; 10% silt; well sorted; contains quartz, feldspar, mica and amphibole; trace purple alteration.

CLAY (CL): olive (5Y 4/4), 100% clay, no plasticity; trace fine grained sand, subrounded; trace silt; with trace rust colored alteration.

SAND WITH SILT (SP-SM): light olive brown (2.5Y 5/3), 90% fine grained sand, subrounded; 10% silt; well sorted; contains quartz, feldspar, mica and amphibole; with some rust colored alteration.

SILT (ML): olive (5Y 5/4), 100% silt; rounded; trace coarse gravel up to 30 mm, rounded, flat; alternating 1/2-inch bands of oxidized/rust color and olive brown.

SAND (SP): light olive brown (2.5Y 5/3), 100% fine grained sand, subrounded, trace medium to coarse grained; trace fine gravel up to 5 mm, subrounded; trace silt; well sorted;

SS: Splitspoon sample GRAB: Grab sample PTS: Splitspoon submitted for analysis SIEVE: Grab sieved by GSSI

GEOSCIENCE
P.O. Box 220
Claremont, CA 91711
Telephone: (909) 451-6650
Fax: (909) 451-6638
www.gssiwater.com

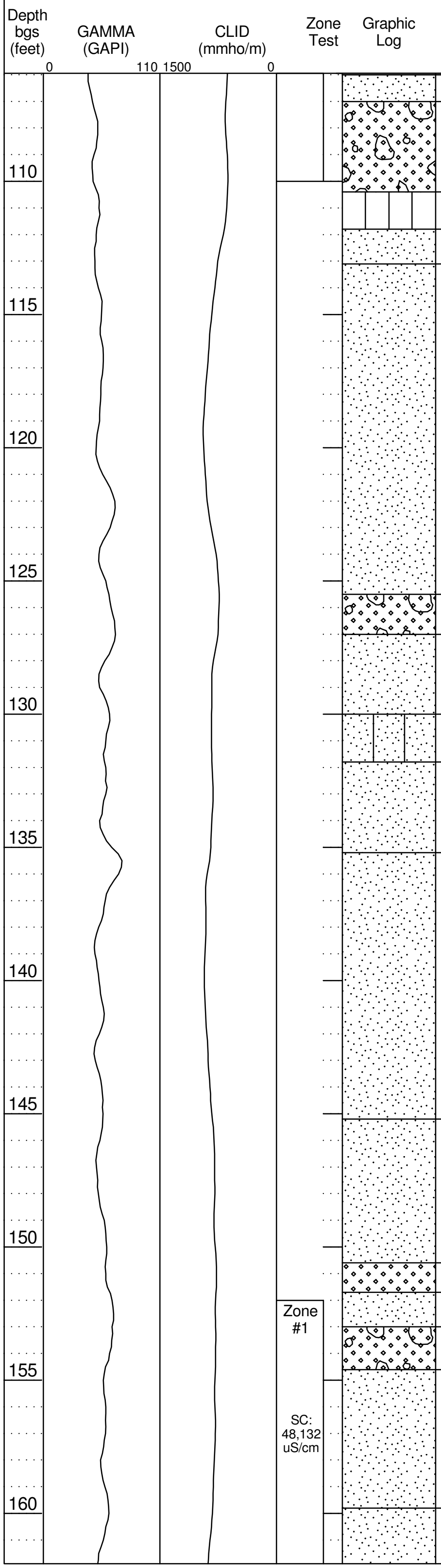
BOREHOLE NAME
ML-6

BOREHOLE LITHOLOGIC LOG (continued)

CLIENT: California American Water
PROJECT NUMBER: 13017-13
LOCATION: **Moss Landing, CA**

Lithologic Log

NOTE: Grain size distribution percentages are approximate. Material code (e.g. SP) reference Unified Soil Classification visual method. Color code (e.g. 10YR 5/2) reference Munsell Soil Color Charts.



contains quartz, feldspar, mica and amphibole.

SAND (SW): light olive brown (2.5Y 5/4), 95% fine to coarse grained sand, subangular to subrounded; 5% fine to coarse gravel up to 70 mm, rounded; poorly sorted; contains quartz, feldspar, mica and amphibole.

SAND (SP): olive (5Y 4/4), 100% fine grained sand, subrounded to rounded; trace fine gravel up to 18 mm, rounded; well sorted; contains quartz, feldspar and amphibole.

SAND WITH GRAVEL (SW): light olive brown (2.5Y 5/3), 60% fine to coarse grained sand, subangular to rounded; 40% fine to coarse gravel up to 58 mm, rounded; trace rounded cobbles to 108 mm; trace clay; poorly sorted; contains quartz, feldspar, mica, amphibole, and other; many mineral types.

SILT (ML): olive (5Y 5/4), 90% silt; 10% fine grained sand, subrounded, very fine grained; some visible alteration, purple alteration.

SAND (SP): light olive brown (2.5Y 5/3), 90% fine to medium grained sand, subangular to subrounded, trace coarse grained; 10% fine to coarse gravel up to 55 mm, rounded; poorly sorted; contains quartz, feldspar, amphibole, and other; alteration visible at 111.8 ft.

SAND (SP): olive (5Y 5/3), 100% fine grained sand, subrounded; trace fine to coarse gravel up to 36 mm, rounded; well sorted; contains quartz, feldspar, mica, amphibole, and other; high mica content; sand with gravel interbeds at 114.4, 115.4, 115.9, 116.4, and 120.4 ft; weakly cemented from 124.1 to 125.5 ft.

SAND WITH GRAVEL (SW): pale olive (5Y 6/3), 60% fine to coarse grained sand, subangular to subrounded; 40% fine to coarse gravel up to 35 mm, well rounded; poorly sorted; contains quartz, feldspar, mica, amphibole, and other, many mineral types.

SAND (SP): pale olive (5Y 6/4), 100% fine to medium grained sand, subangular to subrounded; trace fine gravel up to 10 mm, rounded; well sorted; contains quartz, feldspar and amphibole.

SILTY SAND (SM): olive (5Y 5/3), 70% fine grained sand, subrounded; 30% silt; well sorted; contains quartz, feldspar, mica and amphibole; higher mica content; sandy silt with rusty alteration at 130.0 to 130.5 ft.

SAND (SP): pale olive (5Y 6/3), 100% fine to medium grained sand, subangular to subrounded, trace coarse grained; trace fine to coarse gravel up to 25 mm, rounded; medium sorted; contains quartz, feldspar, mica, amphibole, and other.

SAND (SP): pale olive (5Y 6/3), 95% fine grained sand, subrounded, very fine grained; 5% silt; well sorted; contains quartz, feldspar, mica and amphibole.

SAND (SP): light olive brown (2.5Y 5/6), 100% fine to medium grained sand, subangular to subrounded, trace coarse grained; trace fine to coarse gravel up to 38 mm, rounded; medium sorted; contains quartz, feldspar, mica, amphibole, and other, higher mica content; alteration visible, partially oxidized/rusty sand.

SAND (SW): olive (5Y 5/3), 90% fine to coarse grained sand, subangular to rounded; 5% fine to coarse gravel up to 45 mm, rounded; 5% silt; poorly sorted; weak cementation; contains quartz, feldspar, mica, amphibole, and other; gravel and coarse grained sand interbeds.

SAND (SP): greenish gray (10Y 5/1), 100% fine to medium grained sand, subangular to subrounded; trace fine to coarse gravel up to 33 mm, rounded; medium sorted; contains quartz, feldspar, mica, amphibole, and other; with visible alteration; first sign of green/grey color change.

SAND WITH GRAVEL (SW): greenish gray (5GY 5/1), 85% fine to coarse grained sand, subangular to rounded; 15% fine to coarse gravel up to 45 mm, rounded; poorly sorted; contains quartz, feldspar, mica, amphibole, and other; sandy gravel from 154.1 to 154.6 ft.

SAND (SP): very dark greenish gray (5GY 3/1), 95% fine grained sand, subangular to subrounded; 5% silt; trace fine to coarse gravel up to 75 mm, rounded; well sorted; contains quartz, feldspar, mica, amphibole, and other, high mica content.

Depth bgs (feet)	Sample Type
	SS PTS SS
110	
115	
120	
	SIEVE
125	
130	
135	
140	
	SIEVE
145	
150	
155	
160	

SS: Splitspoon sample GRAB: Grab sample PTS: Splitspoon submitted for analysis SIEVE: Grab sieved by GSSI

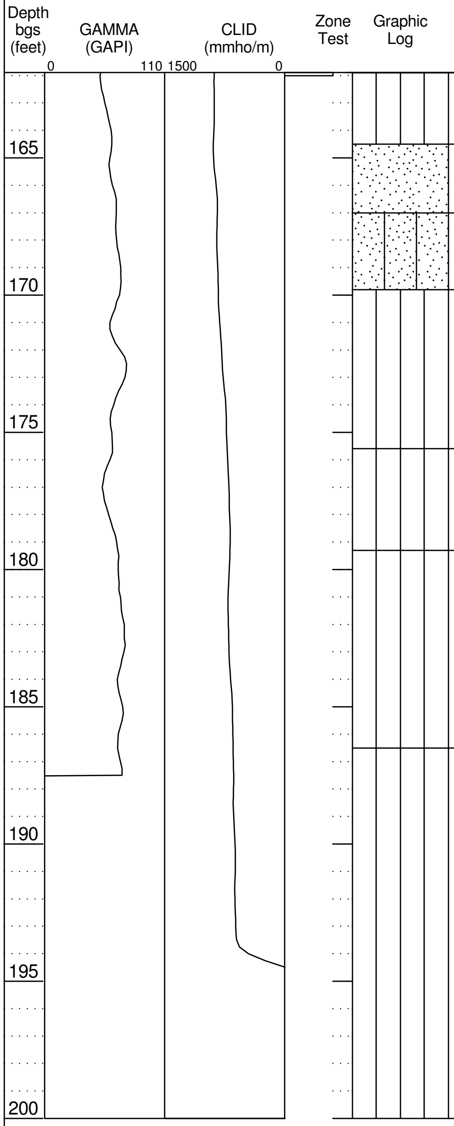
BOREHOLE NAME
ML-6

BOREHOLE LITHOLOGIC LOG (continued)

CLIENT: California American Water
PROJECT NUMBER: 13017-13
LOCATION: **Moss Landing, CA**

Lithologic Log

NOTE: Grain size distribution percentages are approximate. Material code (e.g. SP) reference Unified Soil Classification visual method. Color code (e.g. 10YR 5/2) reference Munsell Soil Color Charts.



SAND (SP): dark greenish gray (5G 4/1), 95% fine to coarse grained sand, subangular to rounded; 5% fine to coarse gravel up to 74 mm, rounded, interbeds at 159.8 and 161.9 ft; trace silt, silt balls; poorly sorted; contains quartz, feldspar, mica, amphibole, and other; trace black/sooty laminations.

SILT (ML): very dark greenish gray (10Y 3/1), 95% silt; 5% coarse gravel up to 55 mm, flat, rounded, gravel interbeds, trace fine gravel; trace fine grained sand, subrounded to rounded; contains mica; high mica content.

SAND (SP): dark greenish gray (5G 4/1), 100% fine grained sand, subangular to subrounded; trace fine gravel up to 18 mm, rounded; well sorted; contains quartz, feldspar, mica and amphibole.

SILTY SAND (SM): very dark greenish gray (5GY 3/1), 65% fine grained sand, subrounded to rounded; 30% silt; 5% fine to coarse gravel up to 40 mm, rounded, with gravel fragments; well sorted; contains quartz, feldspar, mica, amphibole, and other.

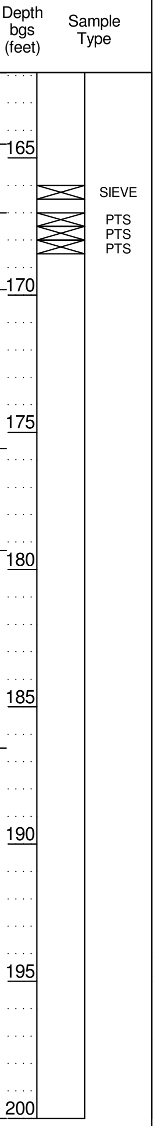
SILT (ML): dark greenish gray (5G 4/1), 100% silt; trace fine to coarse gravel up to 60 mm, subangular to rounded, coarse gravel bed at 173.0 ft; trace fine grained sand, subrounded to rounded, well sorted; interbedded fine sands and clay with black laminations; organics (wood) at 173.3 ft.

SILT (ML): dark greenish gray (5G 4/1), 100% silt; trace fine to coarse gravel up to 33 mm, subrounded; trace fine to medium grained sand, subrounded, thin sand bed at 176.2 ft; trace clay; thin black/sooty laminations and clay layers.

SILT (ML): greenish gray (10GY 5/1), 50% silt, dense; 40% clay; 10% fine grained sand, subrounded; alternating silt, clay and fine sand laminations, fine sand interbeds (2 to 3 inch) at 181.9 and 182.3 ft.

SILT (ML): dark greenish gray (5G 4/1), 60% silt; 40% clay, no plasticity; trace fine grained sand, subrounded; alternating olive and black/sooty laminations; 1 to 4 inch fine sand interbeds at 191.5, 194.8, 195.6, and 198.5 ft; moderately cemented silt at 193.5 ft; trace shells and shell fragments at 196.3 ft.

Bottom of borehole at 200 feet.



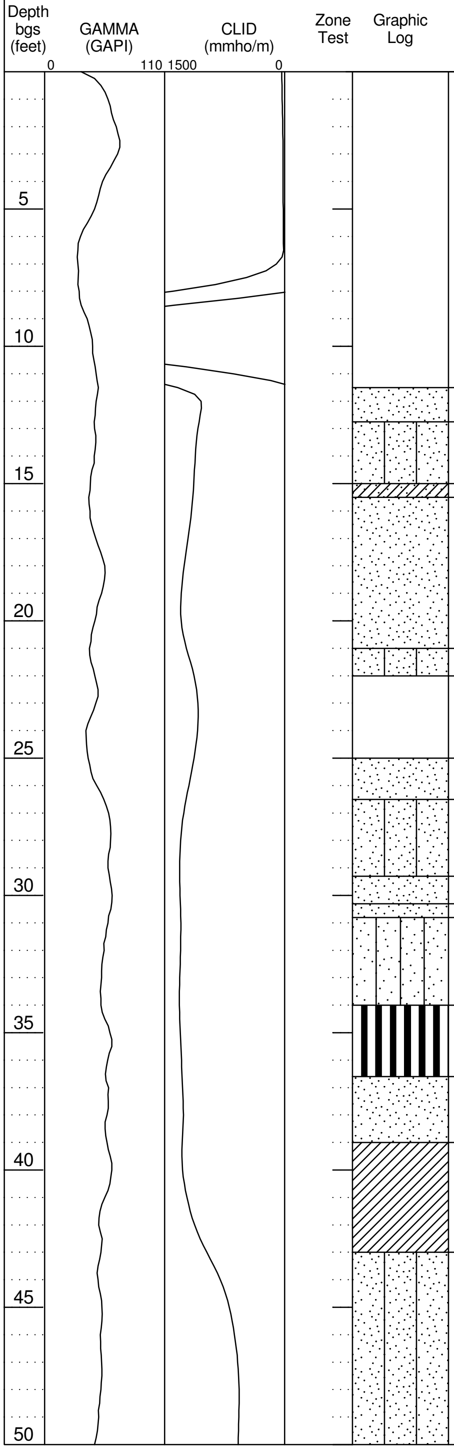
SS: Splitspoon sample GRAB: Grab sample PTS: Splitspoon submitted for analysis SIEVE: Grab sieved by GSSI

GEOSCIENCE
P.O. Box 220
Claremont, CA 91711
Telephone: (909) 451-6650
Fax: (909) 451-6638
www.gssiwater.com

BOREHOLE NAME **PR-1**

BOREHOLE LITHOLOGIC LOG

CLIENT PROJECT NUMBER	California American Water 13017-13	LOCATION **Castroville, CA** **Potrero Rd** **36° 47' 25.9368", -121° 47' 30.7248" Geographic NAD83**					
REPORT DATE	7/8/2014						
DRILLING CONTRACTOR DRILLER	Cascade Drilling Jose Munguia	LOGGED BY **B. Villalobos**					
DRILLING RIG TYPE	Prosonic 600T	DRILLING METHOD	Sonic	START DATE	9/21/13	BOREHOLE DIAMETER	8 in
SURFACE ELEVATION	9.0 ft	TOTAL DEPTH	201.5 ft bgs	FINISH DATE	9/25/13	CORE SIZE	6 in



Lithologic Log

NOTE: Grain size distribution percentages are approximate. Material code (e.g. SP) reference Unified Soil Classification visual method. Color code (e.g. 10YR 5/2) reference Munsell Soil Color Charts.

Depth bgs (feet) | Sample Type

NO SAMPLE.

5

10

SAND (SP): brown (7.5YR 5/3), 100% fine to medium grained sand, subangular to subrounded; poorly sorted; moist sample.

SILTY SAND (SM): dark brown (10YR 3/3), 80% fine to medium grained sand, subangular to subrounded; 20% silt; poorly sorted; moist sample.

15

SANDY CLAY (CL): greenish black (5GY 2.5/1), 70% clay, organic clay; 30% fine grained sand, subrounded, very fine grained; moist sample; contains quartz, feldspar, mica and amphibole.

SAND (SP): brown (7.5YR 5/3), 95% medium to coarse grained sand, subangular to subrounded; 5% fine gravel up to 5 mm, subangular to subrounded; poorly sorted; contains quartz, feldspar, mica and amphibole.

20

SILTY SAND (SM): dark greenish gray (5GB 4/1), 80% fine grained sand, subangular to subrounded, very fine grained; 20% silt; well sorted; moist sample.

NO SAMPLE.

25

SAND (SP): dark greenish gray (5GB 4/1), 100% medium to coarse grained sand, subangular to subrounded; poorly sorted; moist sample.

SILTY SAND (SM): dark greenish gray (5GB 4/1), 85% fine to medium grained sand, subangular to subrounded; 15% silt; trace fine gravel up to 5 mm; poorly sorted; few clayey silt beds.

30

SAND (SP): light olive brown (2.5Y 5/4), 100% medium to coarse grained sand, subangular to subrounded; trace fine gravel up to 5 mm; poorly sorted; moist sample.

SAND (SP): dark olive gray (5Y 3/2), 100% fine grained sand, subangular to subrounded; well sorted; moist sample.

SANDY SILT (ML): dark greenish gray (5GB 4/1), 70% silt; 30% fine grained sand, subangular to subrounded, very fine grained; moist to wet sample; contains mica.

35

SILT (MH): dark greenish gray (5GB 4/1), 90% silt, organic silt; 10% fine grained sand, subangular to subrounded, very fine grained; moist to wet sample; contains mica.

SAND (SP): dark greenish gray (5GB 4/1), 100% medium grained sand, subangular to subrounded; well sorted; moist to wet sample; contains quartz and feldspar.

40

CLAY (CL): dark greenish gray (5GB 4/1), 80% clay, medium plasticity; 20% silt; moist sample; moderately firm; massive; few 3 mm black organic stringers.

SILTY SAND (SM): dark greenish gray (5GB 4/1), 80% medium to coarse grained sand, subangular to subrounded; 20% silt; trace fine gravel up to 5 mm; poorly sorted; moist to wet sample; contains quartz, feldspar, mica and amphibole; abundant shell fragments including 1 inch bi-valve shells.

45

50

SS: Splitspoon sample GRAB: Grab sample PTS: Splitspoon submitted for analysis SIEVE: Grab sieved by GSSI

GEOSCIENCE
P.O. Box 220
Claremont, CA 91711
Telephone: (909) 451-6650
Fax: (909) 451-6638
www.gssiwater.com

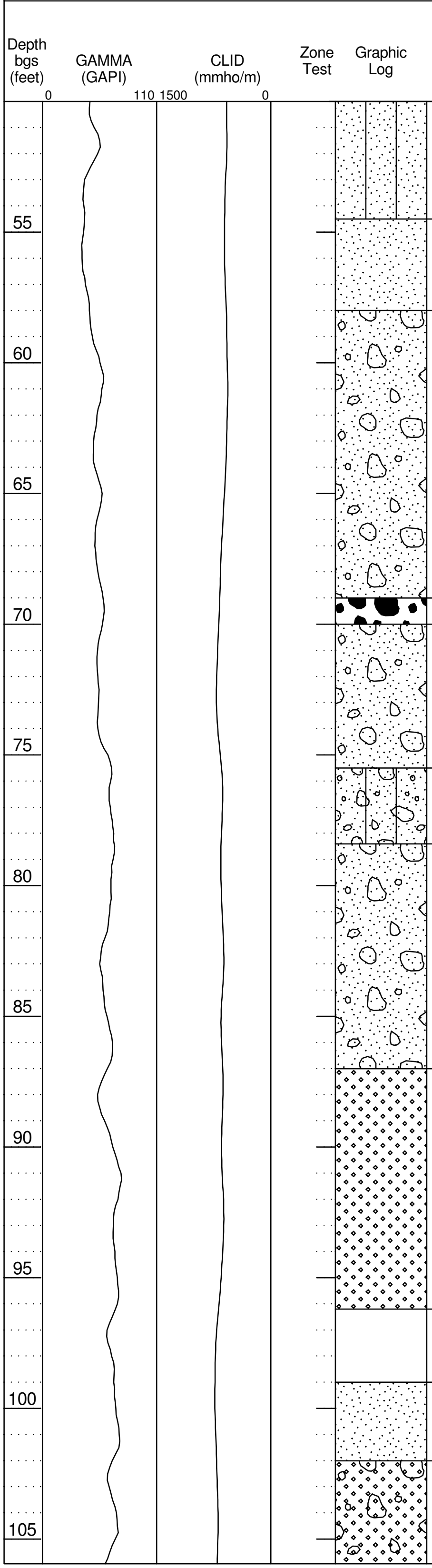
BOREHOLE NAME
PR-1

BOREHOLE LITHOLOGIC LOG (continued)

CLIENT: California American Water
PROJECT NUMBER: 13017-13
LOCATION: **Castroville, CA**

Lithologic Log

NOTE: Grain size distribution percentages are approximate. Material code (e.g. SP) reference Unified Soil Classification visual method. Color code (e.g. 10YR 5/2) reference Munsell Soil Color Charts.



SAND (SP): light olive brown (2.5Y 5/4), 100% fine to medium grained sand, subangular to subrounded; trace fine to coarse gravel up to 25 mm; poorly sorted; moist to wet sample; contains quartz, feldspar, mica, amphibole, and chert.

SAND WITH GRAVEL (SP): light olive brown (2.5Y 5/4), 80% fine to medium grained sand, subangular to subrounded; 20% fine to coarse gravel up to 74 mm, subangular to rounded, gravel includes chert, quartz, and granite; poorly sorted; moist to wet sample; contains quartz, feldspar, mica and amphibole; ; several 6-inch beds with larger gravel and small cobbles up to 76 mm at 58.5, 59.5, and 61.0 ft.

GRAVEL (GW): olive yellow (2.5Y 6/8), 100% fine to coarse gravel up to 64 mm, subangular to rounded; poorly sorted; contains quartz, feldspar, mica and amphibole.

SAND WITH GRAVEL (SP): light olive brown (2.5Y 5/4) and olive yellow (2.5Y 6/8), 85% fine to medium grained sand, subangular to subrounded; 15% fine to coarse gravel up to 74 mm, subangular to subrounded; poorly sorted; contains quartz, feldspar, mica and amphibole; 6 inch gravel bed at 71 ft.

SILTY SAND WITH GRAVEL (SM): light olive brown (2.5Y 5/3), 40% medium to coarse grained sand, subangular to subrounded; 30% fine to coarse gravel up to 51 mm, subangular to subrounded; 20% silt; 10% clay; poorly sorted; contains quartz, feldspar, mica and amphibole; chert and siliceous shale.

SAND WITH GRAVEL (SP): light olive brown (2.5Y 5/6), 70% medium to coarse grained sand, subangular to subrounded; 30% fine to coarse gravel up to 51 mm, subangular to subrounded, gravel beds at 80.0 and 83.0 ft; trace silt; poorly sorted; moist to wet sample; contains quartz, feldspar, mica and amphibole.

SAND (SW): light olive brown (2.5Y 5/6), 90% fine to coarse grained sand, subangular to subrounded; 10% fine to coarse gravel up to 25 mm, subangular to subrounded, gravel bed at 93.5 ft; trace silt; poorly sorted; contains quartz, feldspar, mica and amphibole; chert and siliceous shale and granitic material.

NO SAMPLE.

SAND (SP): light olive brown (2.5Y 5/3), 100% medium to coarse grained sand, subangular to subrounded; poorly sorted; moist to wet sample; contains quartz, feldspar, mica and amphibole.

SAND WITH GRAVEL (SW): light olive brown (2.5Y 5/3), 80% fine to coarse grained sand, subangular to subrounded; 20% fine to coarse gravel up to 25 mm, subangular to subrounded, bed of coarse gravel to 38 mm from 105-106 ft; poorly sorted; contains quartz, feldspar, mica, amphibole, siliceous shale, granitic, volcanic and epidote bearing quartz.

Depth bgs (feet)	Sample Type
55	
	☒ SIEVE
60	
65	
	☒ SIEVE
	☒ PTS
70	
75	
	☒ SIEVE
80	
85	
90	
95	
100	
105	

SS: Splitspoon sample GRAB: Grab sample PTS: Splitspoon submitted for analysis SIEVE: Grab sieved by GSSI

GEOSCIENCE
P.O. Box 220
Claremont, CA 91711
Telephone: (909) 451-6650
Fax: (909) 451-6638
www.gssiwater.com

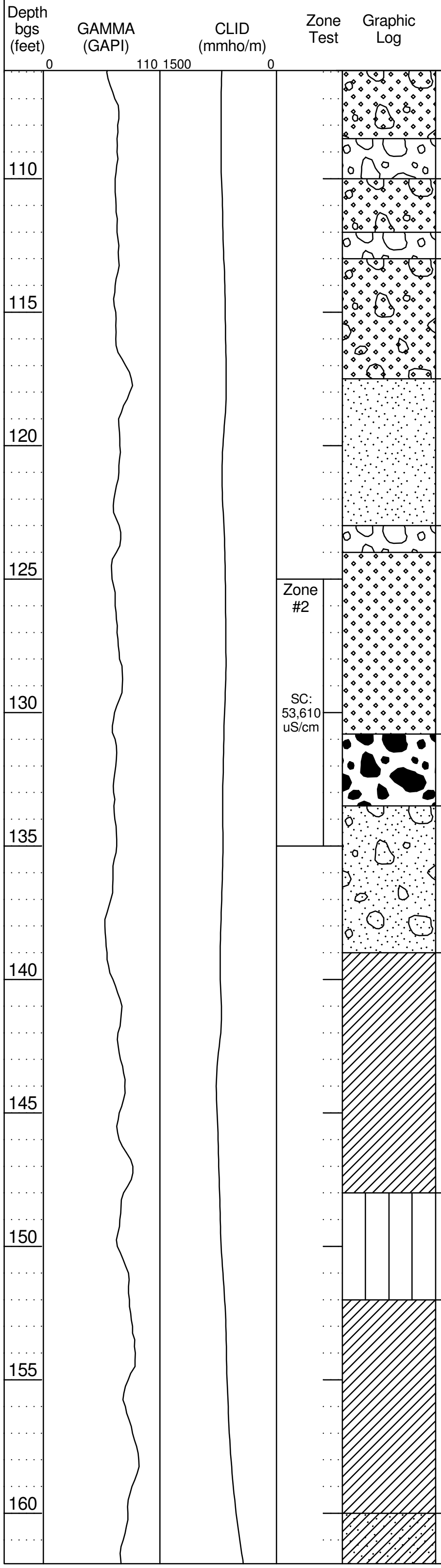
BOREHOLE NAME
PR-1

BOREHOLE LITHOLOGIC LOG (continued)

CLIENT: California American Water
PROJECT NUMBER: 13017-13
LOCATION: **Castroville, CA**

Lithologic Log

NOTE: Grain size distribution percentages are approximate. Material code (e.g. SP) reference Unified Soil Classification visual method. Color code (e.g. 10YR 5/2) reference Munsell Soil Color Charts.



GRAVEL (GP): light olive brown (2.5Y 5/3), 100% fine to coarse gravel up to 38 mm, subangular to subrounded; poorly sorted; contains quartz, feldspar, mica, amphibole and siliceous shale; granitic, volcanic and epidote bearing quartz.

SAND WITH GRAVEL (SW): light olive brown (2.5Y 5/3), 80% fine to coarse grained sand, subangular to subrounded; 20% fine to coarse gravel up to 25 mm, subangular to subrounded; poorly sorted; contains quartz, feldspar, mica and amphibole.

GRAVEL (GP): light olive brown (2.5Y 5/3), 100% fine to coarse gravel up to 38 mm, subangular to subrounded; subangular to rounded; poorly sorted; contains quartz, feldspar, mica and amphibole.

SAND WITH GRAVEL (SW): light olive brown (2.5Y 5/3), 80% fine to coarse grained sand, subangular to subrounded; 20% fine to coarse gravel up to 25 mm, subangular to subrounded; poorly sorted; contains quartz, feldspar, mica and amphibole.

SAND (SP): light olive brown (2.5Y 5/4), 100% medium to coarse grained sand, subangular to subrounded; trace fine to coarse gravel up to 25 mm, subangular to subrounded; poorly sorted; moist to wet sample; contains quartz, feldspar, mica and amphibole.

GRAVEL (GP): light olive brown (2.5Y 5/4), 100% coarse gravel up to 75 mm, subangular to rounded; trace silt; trace clay; poorly sorted; contains quartz, feldspar, mica and amphibole.

SAND (SW): light olive brown (2.5Y 5/4), 100% medium to coarse grained sand, subangular to subrounded; trace fine to coarse gravel up to 25 mm, subangular to subrounded; poorly sorted; moist to wet sample; contains quartz, feldspar, mica and amphibole.

GRAVEL (GW): light olive brown (2.5Y 5/4), 100% fine to coarse gravel up to 38 mm, subangular to rounded; trace silt; trace clay; poorly sorted; contains quartz, feldspar, mica and amphibole.

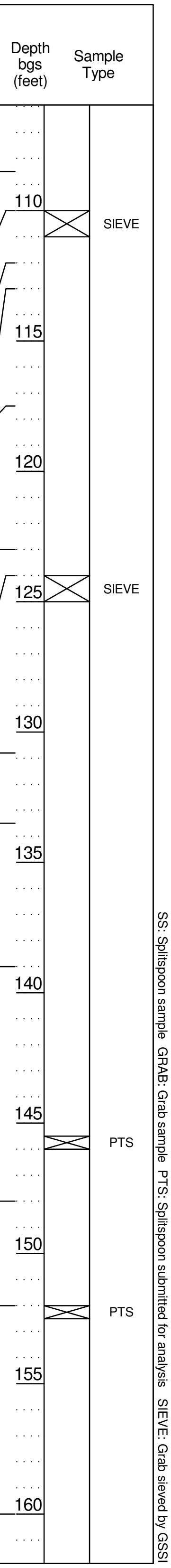
SAND WITH GRAVEL (SP): light olive brown (2.5Y 5/4), 85% medium to coarse grained sand, subangular to subrounded; 15% fine to coarse gravel up to 25 mm, subangular to subrounded, predominantly fine; coarse gravel bed from 138.5-139.0 ft; poorly sorted; contains quartz, feldspar, mica and amphibole.

CLAY (CL): olive brown (2.5Y 4/3) and light olive brown (2.5Y 5/3), 70% clay, medium plasticity, stiff; 30% silt; massive, black organic streaks, very faint grey mottling, 4.6 - 6.4 mm elongated carbonate pods, 4.6 mm reddish brown sandy pods.

SILT (ML): olive brown (2.5Y 4/3), 60% silt, soft to firm; 30% clay; 10% fine grained sand, subangular to subrounded; moist sample; contains mica.

CLAY (CL): dark greenish gray (5GB 4/1), 70% clay, medium plasticity; 30% silt; trace fine grained sand, subrounded, very fine grained elongate sand pods to 6.4 mm; massive, compression slicken sides, small carbonate flecks, very faint yellow-blue mottling.

SANDY CLAY (CL): grayish brown (2.5Y 5/2), 70% clay; 30% fine grained sand, subrounded; contains quartz, feldspar, mica and amphibole; ; sand increases at 161.5 ft with



SS: Splitspoon sample GRAB: Grab sample PTS: Splitspoon submitted for analysis SIEVE: Grab sieved by GSSI

GEOSCIENCE
P.O. Box 220
Claremont, CA 91711
Telephone: (909) 451-6650
Fax: (909) 451-6638
www.gssiwater.com

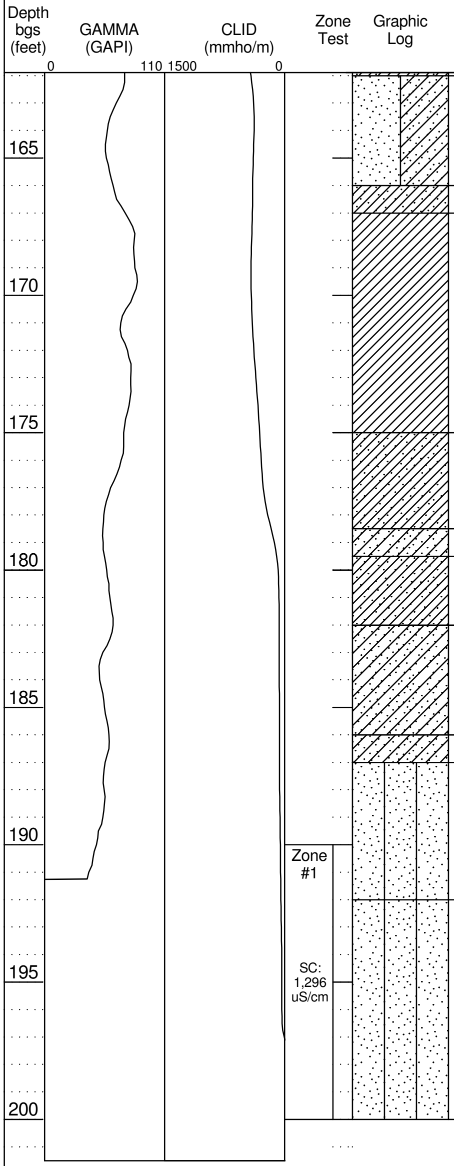
BOREHOLE NAME
PR-1

BOREHOLE LITHOLOGIC LOG (continued)

CLIENT: California American Water
PROJECT NUMBER: 13017-13
LOCATION: **Castroville, CA**

Lithologic Log

NOTE: Grain size distribution percentages are approximate. Material code (e.g. SP) reference Unified Soil Classification visual method. Color code (e.g. 10YR 5/2) reference Munsell Soil Color Charts.



faint reddish brown mottling.

SAND WITH CLAY (SP-SC): light olive brown (2.5Y 5/4), 90% fine to medium grained sand, subangular to subrounded; 10% clay; poorly sorted; contains quartz, feldspar, mica and amphibole; ; micaceous.

SANDY CLAY (CL): olive brown (2.5Y 4/3) and dark brown (7.5YR 3/2), 70% clay, medium plasticity, firm; 30% fine grained sand, subangular to subrounded; horizontal and verticle mottling.

CLAY (CL): dark yellowish brown (10YR 4/6), 70% clay, medium plasticity, stiff; 30% silt, 13 mm silt pods; very faint grey mottling-compression slicken sides; trace fine sand lens at 170 ft, black flecs and white pods.

SANDY CLAY (CL): strong brown (7.5YR 4/6), 70% clay, medium plasticity, stiff, firm; 30% medium grained sand, subangular to subrounded; moist sample; very faintly bedded to laminated.

CLAYEY SAND (SC): strong brown (7.5YR 4/6), 70% fine grained sand, subangular to subrounded, very soft; 25% clay; 5% silt; well sorted; wet sample.

SANDY CLAY (CL): strong brown (7.5YR 4/6), 70% clay, medium plasticity; 30% medium grained sand, subangular to subrounded; moist sample; very faintly bedded to laminated.

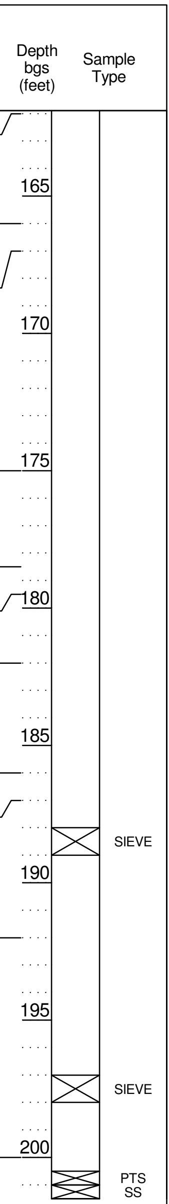
CLAYEY SAND (SC): strong brown (7.5YR 4/6), 70% fine grained sand, subangular to subrounded, soft; 25% clay; 5% silt; well sorted; moist sample.

CLAYEY SAND (SC): dark gray (10YR 4/1), 70% fine grained sand, subangular to subrounded, soft; 25% clay; 5% silt; well sorted.

SILTY SAND (SM): dark greenish gray (5GY 4/1), 80% fine to medium grained sand, subangular to subrounded; 20% silt; trace fine gravel up to 5 mm, subangular to subrounded; poorly sorted; wet sample; unit contains beds that are indurated, 0.25-inches thick--breaks into gravel-sized pieces under firm finger pressure.

SILTY SAND (SM): olive brown (2.5Y 4/3), 80% medium grained sand, subangular to subrounded; 20% silt; well sorted; wet sample; unit contains beds that are indurated, 0.25-inches thick - breaks into gravel-sized pieces under firm pressure; contains quartz, amphibole, and biotite.

Bottom of borehole at 201.5 feet.



SS: Splitspoon sample GRAB: Grab sample PTS: Splitspoon submitted for analysis SIEVE: Grab sieved by GSSI

APPENDIX A2

Well Logs Used for Cross-Sections

GEOSCIENCE

APPENDIX A2:

WELL LOGS USED FOR CROSS-SECTIONS

CONTENTS

ORIGINAL
File with DWR

Page 1 of 2

Owner's Well No. #4

Date Work Began 01/24/04, Ended 03/10/04

Local Permit Agency Monterey Dunes Health Dept.

Permit No. 03-01231 Permit Date 11/18/03

STATE OF CALIFORNIA

WELL COMPLETION REPORT

Refer to Instruction Pamphlet

No. e011049

DWR USE ONLY — DO NOT FILL IN

STATE WELL NO./STATION NO.

LATITUDE LONGITUDE

APN/TRS/OTHER

GEOLOGIC LOG

ORIENTATION (✓) X VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)

DRILLING METHOD Direct Rotary FLUID Bentonite

DEPTH FROM SURFACE Ft.	to Ft.	DESCRIPTION *Describe material, grain size, color, etc.*
0	80	Fine to course sand
80	90	Fine to course sand w/blue clay
90	100	Fine to med. sand
100	123	Fine to med. sand w/clay lenses
123	143	Blue clay w/fine to med. sand
143	154	Blue clay w/fine to course sand and gravel
154	165	Fine to course sand w/gravel and rock
165	187	Fine to med. sand & cobbles with clay lenses
187	197	Fine to med. sand
197	219	Fine to course sand
219	250	Fine to course sand & gravel
250	304	Fine to course sand & cobbles
304	314	Fine to course sand w/clay and cobbles
314	355	Fine to course sand w/90% clay
355	366	Fine to course sand w/clay
366	387	Fine to med. sand w/clay lenses
387	408	Fine to med. sand w/50% clay
408	418	Fine to course sand
418	440	Fine to course sand & gravel
440	455	Fine to course sand w/40% clay
455	461	Fine to course sand & gravel with 50% clay
461	485	Fine to course sand & gravel
485	505	Fine to course sand
505	556	Fine to course sand & gravel
556	577	Fine to course sand w/red clay

TOTAL DEPTH OF BORING 1422 (Feet)

TOTAL DEPTH OF COMPLETED WELL 1364 (Feet)

WELL OWNER

Name Monterey Dunes Colony

Mailing Address 195 Monterey Dunes Way

Castroville, CA 95012
CITY STATE ZIP

WELL LOCATION

Address 195 Monterey Dunes Way

City Castroville

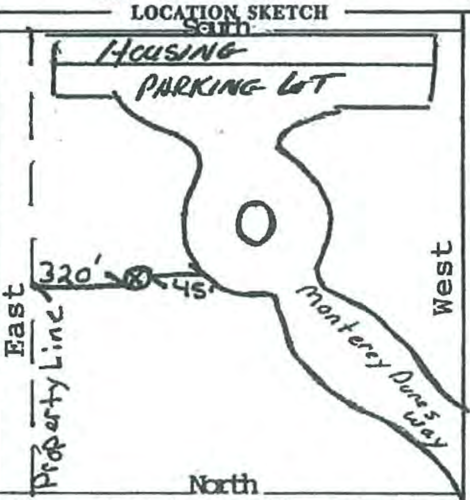
County Monterey

APN Book 229 Page 041 Parcel 004

Township ___ Range ___ Section ___

Latitude ___ NORTH DEG. MIN. SEC. Longitude ___ WEST DEG. MIN. SEC.

LOCATION SKETCH



Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc. and attach a map. Use additional paper if necessary. ***PLEASE BE ACCURATE & COMPLETE.***

ACTIVITY (✓)

X NEW WELL

MODIFICATION/REPAIR
- ___ Deepen
- ___ Other (Specify)

___ DESTROY *(Describe Procedures and Materials Under "GEOLOGIC LOG")*

PLANNED USES (✓)

WATER SUPPLY
- ___ Domestic ___ Public
- ___ Irrigation ___ Industrial
- MONITORING ___
- TEST WELL ___
- CATHODIC PROTECTION ___
- HEAT EXCHANGE ___
- DIRECT PUSH ___
- INJECTION ___
- VAPOR EXTRACTION ___
- SPARGING ___
- REMEDIATION ___
- OTHER (SPECIFY) ___

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER N/A (Ft.) BELOW SURFACE

DEPTH OF STATIC WATER LEVEL 13 (Ft.) & DATE MEASURED 03/04/04

ESTIMATED YIELD * 200 (GPM) & TEST TYPE Pump

TEST LENGTH 24 (Hrs.) TOTAL DRAWDOWN 42 (Ft.)

* *May not be representative of a well's long-term yield.* 24 hour Test

CASING (S)

DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (Inches)	TYPE (✓) BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
0	60	36			x		A53B	29.260	.375	
0	321	28			x		A53B	19.260	.375	
+2	1221	18	x				A53B	8"	.322	
1221	1301	18	x				304ss	8"	.322	
1301	1361	18		x			304ss	8"	XXHD	.040
1361	1364	18	x				304ss	8"	.322	

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft.	to Ft.	CE-MENT (✓)	BEN-TONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0	60	x			10 sack
0	321	x			10 sack
0	1220	x			Neat cem.
1220	1370			x	8x16

ATTACHMENTS (✓)

- ___ Geologic Log
- ___ Well Construction Diagram
- X Geophysical Log(s)
- ___ Soil/Water Chemical Analyses
- X Other Site map

ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.

NAME Rottman Drilling Co.
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

46471 N Division, Lancaster, CA 93535
ADDRESS CITY STATE ZIP

Signed Larry W. Rottman
Larry W. Rottman, President 03/19/04 316599
WELL DRILLER/AUTHORIZED REPRESENTATIVE DATE SIGNED C-57 LICENSE NUMBER

DWR 188 REV. 11-97

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

ORIGINAL
File with DWR

Page 2 of 2

Owner's Well No. #4

Date Work Began 01/24/04, Ended 03/10/04

Local Permit Agency Monterey Dunes Health Dept.

Permit No. 03-01231 Permit Date 11/18/03

STATE OF CALIFORNIA

WELL COMPLETION REPORT

Refer to Instruction Pamphlet

No. e011049

DWR USE ONLY — DO NOT FILL IN

STATE WELL NO./STATION NO.

LATITUDE LONGITUDE

APN/TRS/OTHER

GEOLOGIC LOG

ORIENTATION (✓) X VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)

DRILLING METHOD Direct Rotary FLUID Bentonite

DEPTH FROM SURFACE Ft.	to Ft.	DESCRIPTION *Describe material, grain size, color, etc.*
		lenses
577	610	Fine to course sand, rock & clay
610	620	Fine to course sand
620	630	Fine to course sand & gravel
630	650	Fine to course sand & gravel
		with clay lenses
650	661	Fine to med. sand with clay
661	681	Fine sand with clay
681	693	Fine sand & gravel w/clay lenses
693	725	80% Silty clay w/20% hard sand
725	737	90% Hard silty clay & sand lenses
737	767	90% Hard silty clay w/sand rock
		lenses
767	791	95% Hard packed clay - cemented
791	820	Brown silty clay (hard packed)
820	882	Grayish brown clay w/blue stricks
882	945	Clay with rock
945	1011	Clay w/fine sand & silt
1011	1105	20% Clay w/fine to med. sand
1105	1170	Fine sand and silt
1170	1190	Clay w/fine sand, silt & rock
1190	1230	Fine sand, silt & rock
1230	1270	Clay with fine sand
1270	1290	Silt & clay
1290	1365	Fine sand
1365	1391	Clay w/fine sand lenses
1391	1422	Fine sand

TOTAL DEPTH OF BORING 1422 (Feet)

TOTAL DEPTH OF COMPLETED WELL 1364 (Feet)

WELL OWNER

Name Monterey Dunes Colony

Mailing Address 195 Monterey Dunes Way

Castroville, CA 95012

CITY STATE ZIP

WELL LOCATION

Address 195 Monterey Dunes Way

City Castroville

County Monterey

APN Book 229 Page 041 Parcel 004

Township ___ Range ___ Section ___

Latitude ___ NORTH DEG. MIN. SEC. Longitude ___ WEST DEG. MIN. SEC.

LOCATION SKETCH

NORTH

WEST

EAST

SOUTH

Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc. and attach a map. Use additional paper if necessary. PLEASE BE ACCURATE & COMPLETE.

ACTIVITY (✓)

X NEW WELL

MODIFICATION/REPAIR
- ___ Deepen
- ___ Other (Specify)

___ DESTROY (*Describe Procedures and Materials Under "GEOLOGIC LOG"*)

PLANNED USES (✓)

WATER SUPPLY
- ___ Domestic ___ Public
- ___ Irrigation ___ Industrial

MONITORING ___

TEST WELL ___

CATHODIC PROTECTION ___

HEAT EXCHANGE ___

DIRECT PUSH ___

INJECTION ___

VAPOR EXTRACTION ___

SPARGING ___

REMEDIATION ___

OTHER (SPECIFY) ___

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER 12 (Ft.) BELOW SURFACE

DEPTH OF STATIC WATER LEVEL 13 (Ft.) & DATE MEASURED 03/02/04

ESTIMATED YIELD * 500 (GPM) & TEST TYPE Pump

TEST LENGTH 4 (Hrs.) TOTAL DRAWDOWN 102 (Ft.)

* *May not be representative of a well's long-term yield.* (Step Test)

CASING (S)

DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (Inches)	TYPE (✓) BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
0	60	36			x		A53B	29.260	.375	
0	321	28			x		A53B	19.260	.375	
+2	1221	18	x				A53B	8"	.322	
1221	1301	18	x				304ss	8"	.322	
1301	1361	18		x			304ss	8"	XXHD	.040
1361	1364	18	x				304ss	8"	.322	

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft.	to Ft.	CE-MENT (✓)	BEN-TONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0	60	x			10 sack
0	321	x			10 sack
0	1220	x			Neat cem.
1220	1370			x	8x16

ATTACHMENTS (✓)

- ___ Geologic Log
- ___ Well Construction Diagram
- X Geophysical Log(s)
- ___ Soil/Water Chemical Analyses
- ___ Other ___

ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.

NAME Rottman Drilling Co.
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

46471 N Division, Lancaster, CA 93535
ADDRESS CITY STATE ZIP

Signed ___ WELL DRILLER/AUTHORIZED REPRESENTATIVE

03/19/04 DATE SIGNED

316599 C-57 LICENSE NUMBER

DWR 188 REV. 11-97

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

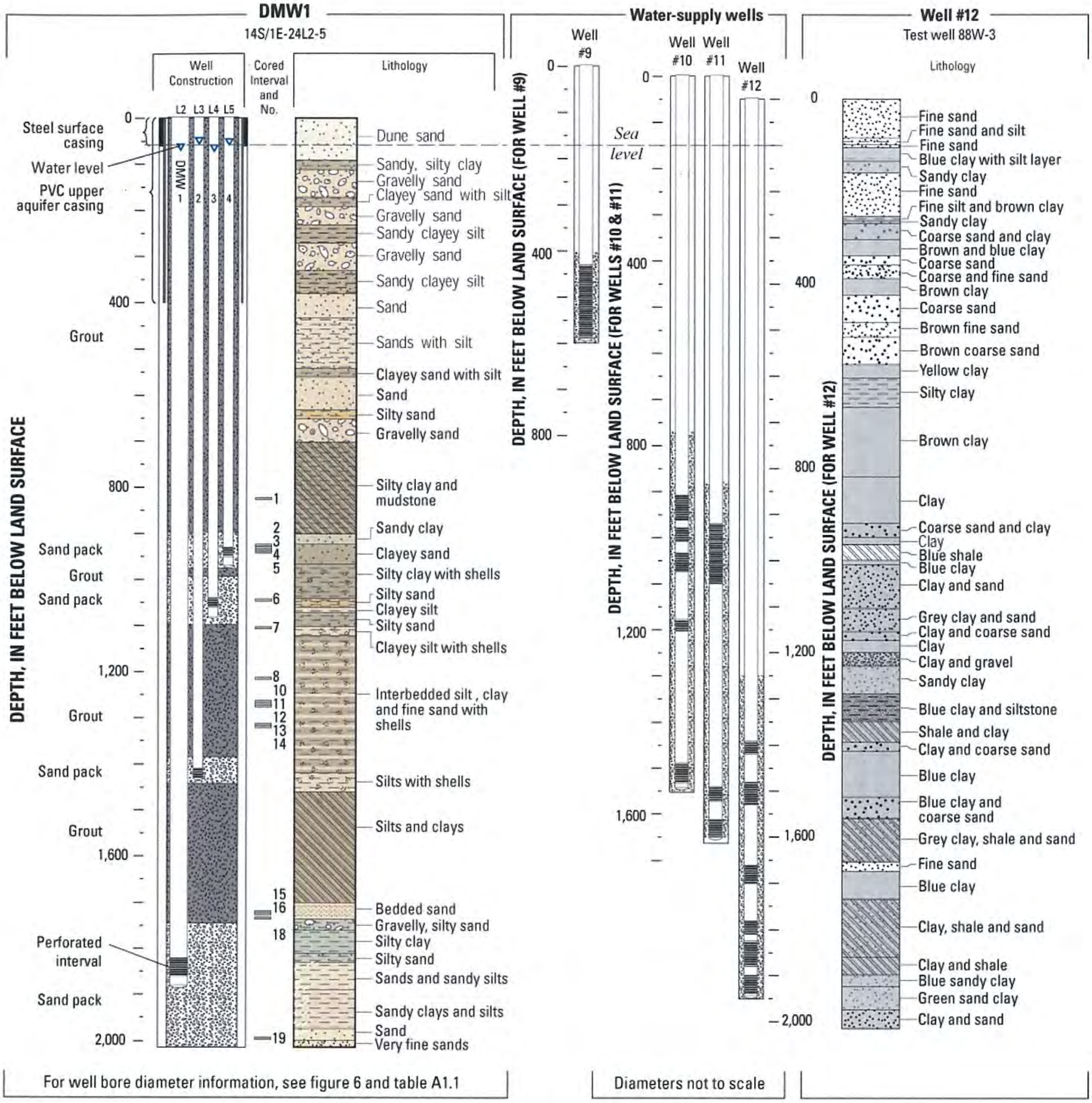


Figure 3. Well construction and lithology for the deep-aquifer monitoring well and selected nearby water-supply wells, Marina, California.

nnis' Haugen

PLICATE Steve Taylor
tain copy

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WATER WELL DRILLERS REPORT

Do Not Fill In

Nº 141763

State Well No. 14S/2E-6L1

Other Well No.

) OWNER:

me Monterey County Flood Control Dist.

dress County Courthouse

Salinas, Ca. 93901

) LOCATION OF WELL:

nty Monterey Owner's number, if any

wnship, Range, and Section Mulligan Hill

tance from cities, roads, railroads, etc. See attached map

) TYPE OF WORK (check):

w Well ☒ Deepening ☐ Reconditioning ☐ Destroying ☐

destruction, describe material and procedure in Item 11.

4) PROPOSED USE (check):

omestic ☐ Industrial ☐ Municipal ☐
rrigation ☐ Test Well ☐ Other ☒

(5) EQUIPMENT:

Rotary ☒
Cable ☐
Other ☐

6) CASING INSTALLED:

STEEL: OTHER

SINGLE ☒ DOUBLE ☐

From ft.	To ft.	Diam.	Gage or Wall	Diameter of Bore	If gravel packed From ft.	To ft.
	600'	16	3/8	28-1/2	0	600
600	603	16x12	reducer	26	600	603
603	1563	12"	~~3/8~~ 5/16	26	603	1563

Size of shoe or well ring: Size of gravel Spec sand

Describe joint Weld

(7) PERFORATIONS OR SCREEN:

Type of perforation or name of screen per Dick Thorup

From ft.	To ft.	Perf. per row	Rows per ft.	Size in. x in.
~~850~~ 880	1540			3/32 Horz. Louvre Full Flo

(8) CONSTRUCTION:

Was a surface sanitary seal provided? Yes ☒ No ☐ To what depth 800 ft.

Were any strata sealed against pollution? Yes ☒ No ☐ If yes, note depth of strata

From ft. to ft.

From ft. to ft.

Method of sealing Concrete and 30" steel conductor

(9) WATER LEVELS:

Depth at which water was first found, if known 100' ft.

Standing level before perforating, if known ft.

Standing level after perforating and developing ft.

WELL TESTS:

Was pump test made? Yes ☐ No ☐ If yes, by whom?

gal./min. with ft. drawdown after hrs.

Temperature of water Was a chemical analysis made? Yes ☐ No ☐

Was electric log made of well? Yes ☑ No ☐ If yes, attach copy

(11) WELL LOG:

Total depth 1809 ft. Depth of completed well 1560 ft.

Formation: *Describe by color, character, size of material, and structure*

0 ft. to 6 Top Soil ft.

6' - 15' Blue sandy clay
15' - 32' Fine blue sand
32' - 60' Blue clay w/sea shell
60' - 75' Blue soft sand
75' - 100' Blue clay
100' - 184' Blue clay & sand streak
184' - 278' Coarse sand & gravel
278' - 300' Yellow Clay
300' - 330' Blue clay
330' - 360' Coarse yellow sand, streak of clay
360' - 434' Yellow clay, streaks blue & brown shale
434' - 440' Yellow clay, streaks blue & brown shale
440' - 490' White coarse sand
490' - 528' Blue clay
528' - 590' Sand & gravel, streak clay
590' - 610' Yellow Clay
610' - 621' Sand & gravel
621' - 715' Yellow clay w/streak of sand
715' - 747' Yellow clay w/streak gravel
747' - 778' Yellow clay w/streak gravel
778' - 795' yellow clay w/streak gravel blue clay
795' - 840' Yellow clay w/streak gravel blue clay
840' - 872' Blue clay
872' - 903' Blue clay
903' - 934' Brown clay
934' - 965' Hard brown clay & shale
965' - 997' Hard brown clay & shale
997' - 1028' Hard brown clay & shale
1028' - 1059' Blue clay
1059' - 1090' Blue & brown clay

Bla

← PERFS

Work started 9/20 19 76. Completed 11/12 19 76

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME Salinas Pump Co.
(Person, firm or corporation) (Typed or printed)

Address 1128 Madison Lane
Salinas, Ca. 93901

[SIGNED]
(Well Driller)

License No. 273053 Dated , 19

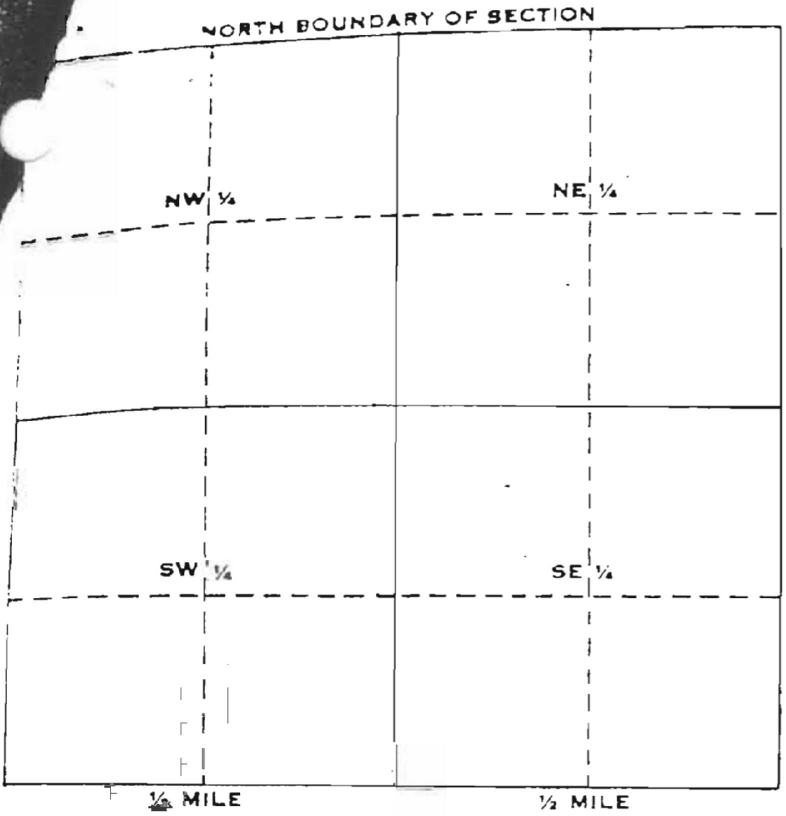
SKETCH LOCATION OF WELL ON REVERSE SIDE

OVER
CONTINUED ON BACK

6-72 30M TRIP OSP

SKETCH

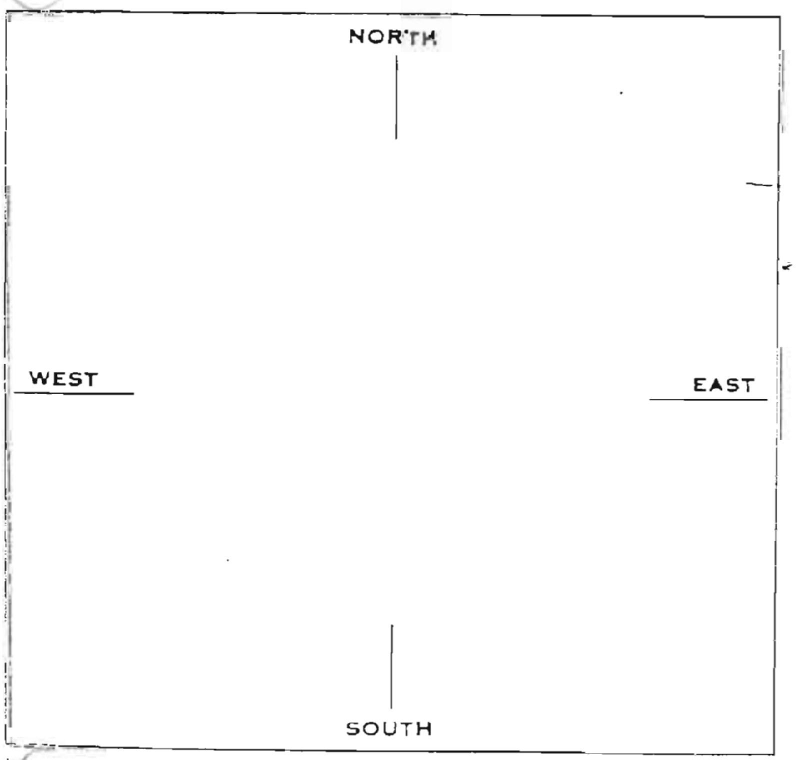
14S/2E-6L1



A. Location of well in sectionized areas.
Sketch roads, railroads, streams, or other features as necessary.

Township 14 [✓ S] N/S
Range 2 [✓ E] E/W
Section No. 6L1

1090'	- 1122'	Blue & brown shaley clay	
1122'	- 1153'	Blue & brown shaley clay	
1153'	- 1184'	Blue shaley clay with streak hard sandstone	
1184'	- 1247'	Blue shale streak sand	
1247'	- 1300'	Blue clay, streak sand	
1300'	- 1340'	Blue clay streak sand	
1340'	- 1372'	blue clay & shale	
1372'	- 1403'	Blue clay, strk gravel & sand	
1403'	- 1435'	Strk gravel & sand	
1435'	- 1466'	Strk gravel & sand	
1466'	- 1498'	Strk gravel & sand	
1498'	- 1529'	Strk gravel & sand	
1529'	- 1561'	Strk gravel & sand	1545'
1561'	- 1592'	Strk gravel & sand	
1592'	- 1600'	Strk gravel & sand	
1600'	- 1630'	~~XX~~ Blue clay	
1630'	- 1645'	Blue clay & sand	
1645'	- 1660'	Brown clay & Blue clay	
1660'	- 1675'	Shale, blue clay	
1675'	- 1690'	Shale, blue clay	
1690'	- 1705'	Brown clay, blue clay	
1705'	- 1720'	Brown clay, sand streak	
1720'	- 1735'	Blue clay	
1735'	- 1750'	Blue clay	
1750'	- 1809'	Blue shale	



ocation of well in areas not sectionized.
ketch roads, railroads, streams, or other features as necessary.
dicate distances.

14S/02E-17K1

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WATER WELL DRILLERS REPORT

TRIPLICATE
Owner's Copy

Do not fill in

No. 286024

Notice of Intent No. 239439
Local Permit No. or Date 7-28-89 69712

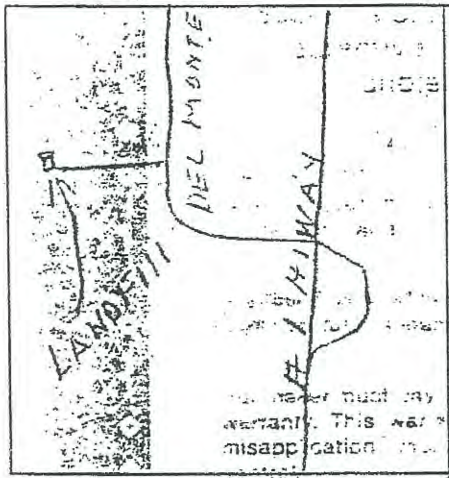
[NEW WATER SUPPLY WELL LOCATED SOUTH OF SCALEHOUSE]

State Well No. 14S/02E-17K01
Other Well No. PRESSURE-180 Ft.

CONFIDENTIAL
NOT FOR PUBLIC USE
WATER CODE SEC. 13752

(1) OWNER: Name ~~Marina Landfill-Mtry Regional Waste Mgmt. Dist.~~
Address ~~P.O. Box 609~~
City ~~Marina, CA 93933~~ ZIP

(2) LOCATION OF WELL (See instructions):
County ~~Monterey~~ Owner's Well Number
Well address if different from above ~~Marina Disposal site~~
Township Range Section
Distance from cities, roads, railroads, fences, etc.



WELL LOCATION SKETCH

(3) TYPE OF WORK:
New Well ☒ Deepening ☐
Reconstruction ☐
Reconditioning ☐
Horizontal Well ☐
Destruction ☐ (Describe destruction materials and procedures in Item 12)

(4) PROPOSED USE:
Domestic ☒
Irrigation ☐
Industrial ☐
Test Well ☐
Municipal ☐
Other ☒
(Describe)

(5) EQUIPMENT:
Rotary ☒ Reverse ☐
Cable ☐ Air ☐
Other ☐ Bucket ☐

(6) GRAVEL PACK:
Yes ☒ No ☐ Size 6
Diameter of bore 14
Packed from 180 to 250 ft.
well pack pea gravel & sand

(7) CASING INSTALLED:
Steel ☐ Plastic ☒ Concrete ☐

(8) PERFORATIONS:
Type of perforation or size of screen

From ft.	To ft.	Dia. in.	Gage or Wall	From ft.	To ft.	Slot size
0	210	6 pvc	SDR21F480	210	250	.030 pvc sand screen

(12) WELL LOG: Total depth 255 ft. Completed depth 250 ft.

from ft.	to ft.	Formation (Describe by color, character, size or material)
0	4	Top soil
4	35	Beach sand
35	56	Brown silt
56	91	Loose red sand
91	126	Green clay &* sand
126	152	Red sand water bearing
152	159	Green clay
159	194	Coarses sand
194	205	Sticky green clay
205	255	Coarse gravel

(9) WELL SEAL:
Was surface sanitary seal provided? Yes ☒ No ☐ If yes, to depth 180 ft.
Were strata sealed against pollution? Yes ☒ No ☐ Interval solid ft.
Method of sealing neat cement

Work started 8-3-89 19 Completed 8-4-89 19

(10) WATER LEVELS:
Depth of first water, if known 131 ft.
Standing level after well completion ~~136~~ 131 ft.

(11) WELL TESTS:
Was well test made? Yes ☒ No ☐ If yes, by whom? Self
Type of test Pump ☒ Bailer ☐ Air lift ☐
Depth to water at start of test 131 ft. At end of test 136 ft.
Discharge gal/min after 33 hours Water temperature 67
Chemical analysis made? Yes ☒ No ☐ If yes, by whom? Nitrate Al Lab
Was electric log made Yes ☐ No ☐ If yes, attach copy to this report

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

Signed James I. Ash
James I. Ash (Well Driller)
NAME FRED ASH & SONS, INC.
(Person, firm or corporation) (Typed or printed)
Address 16339 Castroville Blvd.
City Salinas, CA 93907 ZIP
License No. 391942 Date of this report 8-9-89

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

DWR 188 (REV. 12-86) 86-96355

5-17-74

P. O. BOX 178
1508 ABBOTT ST.

TELEPHONE
408 424.2987

ROY V. ALSOP & SON

SINCE 1873
Well Drilling

FAIRBANKS-MORSE PUMPS AND PRESSURE SYSTEMS POMONA
INDUSTRIAL PUMPS
SALES AND SERVICE
SALINAS, CALIFORNIA 93901

Dia. 14" #10 ga.

June 3, 1972

LOG OF WELL
for
Monterey Peninsula Garbage & Refuse Disposal District

145/2E-17L1

0 ft.	to	108 ft.	Sand
108	"	132	Blue clay
132	"	144	Yellow sandy-sediment
144	"	148	Blue clay
148	"	162	Sandy yellow sediment
162	"	176	Fine packed sand
176	"	188	Yellow clay
188	"	200	Sand & fine gravel
200	"	206	Fine silty sand
206	"	214	Fine sand & float rock
214	"	226	Blue clay
226	"	236	Yellow clay
-146 → 236	"	240	Fine gravel
240 I	"	303	Sand & gravel
303	"	305	Yellow clay
305	"	320	Mucky sand
320 I	"	351	Sand & gravel
351	"	354	Soft sand stone

Perforations: 244 ft. to 303 ft.
328 " 338

Concrete Plug - 6 ft.

Static Water Level - 139½ ft.

= = gallons per minute =
= ~~1100~~ =

Pumps 1090 gal per minute

Ground elev. approx 90 feet

14/2-18E1

ORIGINAL
File with DWR

CONFIDENTIAL LOG
Water Code Sec. 1

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WATER WELL DRILLERS REPORT

33

Do Not Fill In

Nº 121665

State Well No. 14S/2E-18E1
Other Well No.

(1) OWNER: Armstrong Ranch

Name c/o M. L. Dubach, Inc.
Address PO Box P, Davis, Ca. 95616

(2) LOCATION OF WELL:

County Monterey Owner's number, if any
Township, Range, and Section Between Marina & Castroville
Distance from cities, roads, railroads, etc. Twin Bridges on Hwy 1,
off Lapis Road

(3) TYPE OF WORK (*check*):

New Well ☒ Deepening ☐ Reconditioning ☐ Destroying ☐

If destruction, describe material and procedure in Item 11.

(4) PROPOSED USE (*check*):

Domestic ☐ Industrial ☐ Municipal ☐
Irrigation ☒ Test Well ☐ Other ☐

(5) EQUIPMENT:

Rotary ☒
Cable ☐
Other ☐

(6) CASING INSTALLED:

STEEL: OTHER:
SINGLE ☒ DOUBLE ☐

From ft.	To ft.	Diam.	Gage or Wall	If gravel packed: Diameter of Bore	If gravel packed: From ft.	If gravel packed: To ft.
	303	14"	1/4	26	300	870
303	306	14"x12" reducer			= 8.	
306	870	12	1/4			

Size of shoe or well ring: Size of gravel: 1/4 pea
Describe joint Welded

(7) PERFORATIONS OR SCREEN:

Type of perforation or name of screen

From ft.	To ft.	Perf. per row	Rows per ft.	Size in. x in.
666	834	8	4½	1/8" std louvre
4.8.				

(8) CONSTRUCTION:

Was a surface sanitary seal provided? Yes ☒ No ☐ To what depth 300 ft.
Were any strata sealed against pollution? Yes ☒ No ☐ If yes, note depth of strata
From 0 ft. to 300 ft.
From ft. to ft.
Method of sealing concrete

(9) WATER LEVELS:

Depth at which water was first found, if known ft.
Standing level before perforating, if known ft.
Standing level after perforating and developing ft.

(10) WELL TESTS: to be tested

Was pump test made? Yes ☐ No ☒ If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
Temperature of water Was a chemical analysis made? Yes ☐ No ☒
Was electric log made of well? Yes ☐ No ☐ If yes, attach copy

(11) WELL LOG:

Total depth ft. Depth of completed well 870 ft.

Formation: *Describe by color, character, size of material, and structure*

0	ft. to 75	fine sand ft.
75	to 100'	coarse gravel
100	125	gravel-streaks clay
125	150	clay rock
150	175	coarse gravel
175	200	~~[illegible]~~
200	225	fine sand streak clay
225	250	fine sand streak clay
250	275	gravel
275	300	fine sand - streak clay
300	325	white sand
325	350	sand-clay streaks
350	375	sand
375	400	fine sand
400	425	sand gravel
425	450	sand gravel
450	475	sand streaks clay
475	500	coarse gravel-clay
500	525	sand clay
525	550	sand clay
550	575	sandy clay
575	600	fine sand clay
600	625	sand
625	650	Red clay gravel
650	675	yellow clay
675	700	yellow clay
700	725	fine gravel
725	750	coarse gravel
750	775	coarse gravel
775	800	fine gravel
800	825	coarse gravel
825	850	coarse gravel
850	875	yellow clay
875	890	yellow clay
890	913	yellow clay

Work started 7-2-74 19 , Completed 7-9-74 19

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME Salinas Pump Co.,
(Person, firm, or corporation) (Typed or printed)

Address 1128 Madison Lane, Salinas, Ca.93901

[SIGNED]
(Well Driller)

License No. 273053 Dated 7-15-74, 19

SKETCH LOCATION OF WELL ON REVERSE SIDE

TRIPLICATE
Owner's Copy
Page 1 of 2

STATE OF CALIFORNIA

WELL COMPLETION REPORT

Refer to Instruction Pamphlet

No. 419777

Owner's Well No. 701471
Date Work Began 06/18/97, Ended 06/26/97
Local Permit Agency ~~MONTEREY COUNTY DEPARTMENT OF HEALTH~~
Permit No. ~~WSAL 97-067~~ Permit Date ~~04/07/97~~

DWR USE ONLY — DO NOT FILL IN
STATE WELL NO./STATION NO.
LATITUDE
LONGITUDE
APN/TRS/OTHER

GEOLOGIC LOG

ORIENTATION (✓) ___ VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)

DEPTH TO FIRST WATER ___ (Ft.) BELOW SURFACE

DEPTH FROM SURFACE Ft.	to Ft.	DESCRIPTION *Describe material, grain size, color, etc.*
0	3	TOP SOIL
3	60	CLEAN HOLE
60	90	SAND
90	100	SANDY CLAY AND CLAY
100	120	BLUE CLAY AND SANDY CLAY
120	155	CLAY
155	160	SANDY CLAY AND SAND
160	180	SAND AND GRAVEL
180	200	SAND
200	220	CLAY
220	230	CLAY AND SAND
230	240	SAND AND GRAVEL
240	245	SAND
245	255	CLAY
255	260	SAND
260	280	SAND AND LITTLE CLAY
280	345	SAND AND GRAVEL
345	360	CLAY
360	380	CLAY AND SAND
380	400	BROWN AND BLUE CLAY
400	480	CLAY
480	520	CLAY AND SANDY CLAY
520	540	CLAY AND GRAVEL
540	560	CLAY AND SAND
560	562	SAND
562	600	SANDY CLAY
600	640	CLAY AND FINE SANDY CLAY
640	655	CLAY
655	660	SAND

TOTAL DEPTH OF BORING 840 (Feet)
TOTAL DEPTH OF COMPLETED WELL 825 (Feet)

WELL OWNER

Name ~~MRWPCA~~
Mailing Address 5 HARRIS COURT
MONTEREY, CA. 93940
CITY STATE ZIP

WELL LOCATION

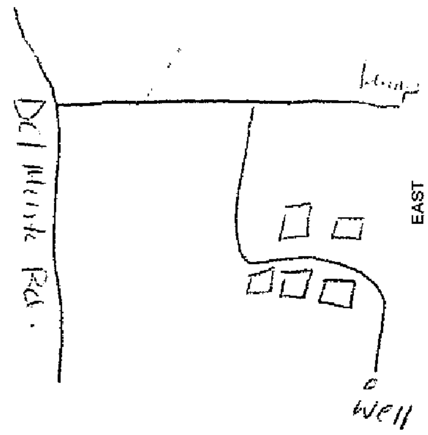
Address 14811 DEL MONTE AVE.
City MONTEREY
County MONTEREY
APN Book 175 Page 011 Parcel 041
or
Township ___ Range ___ Section ___
or
Latitude ___ NORTH Longitude ___ WEST
DEG. MIN. SEC.

LOCATION SKETCH

NORTH

SEE ATTACHED

WEST



EAST

SOUTH

Illustrate or Describe Distance of Well from Landmarks such as Roads, Buildings, Fences, Rivers, etc.
PLEASE BE ACCURATE & COMPLETE.

ACTIVITY (✓)

X NEW WELL

MODIFICATION/REPAIR
- ___ Deepen
- ___ Other (Specify)

___ DESTROY (Describe Procedures and Materials Under "GEOLOGIC LOG")

PLANNED USE(S) (✓)

___ MONITORING

WATER SUPPLY
- ___ Domestic
- X Public
- ___ Irrigation
- ___ Industrial

___ "TEST WELL"
___ CATHODIC PROTECTION
___ OTHER (Specify)

DRILLING METHOD REVERSE ROTARY FLUID WATER

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH OF STATIC WATER LEVEL 162.25 (Ft.) & DATE MEASURED 08/18/97
ESTIMATED YIELD* 250 (GPM) & TEST TYPE PUMP
TEST LENGTH ___ (Hrs.) 5.5 TOTAL DRAWDOWN 19.33 (Ft.)
* *May not be representative of a well's long-term yield.*

CASING(S)

DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (Inches)	TYPE (✓) BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
0	50	32			X		STEEL	.250	STAINLESS	.040
0	670	22	X				STEEL	.250	STAINLESS	
670	730	22		X			STEEL	.250	STAINLESS	.040
730	785	22	X				STEEL	.250	STAINLESS	
785	805	22		X			STEEL	.250	STAINLESS	.040
805	825	22	X				STEEL	.250	STAINLESS	

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft.	to Ft.	TYPE CE-MENT (✓)	BEN-TONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0	650	XX			
650	840			XX	8X16

ATTACHMENTS (✓)

- ___ Geologic Log
- ___ Well Construction Diagram
- ___ Geophysical Log(s)
- ___ Soil/Water Chemical Analyses
- ___ Other ___

ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.

NAME MAGGIORA BROS. DRILLING, INC.
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

595 AIRPORT BLVD. WATSONVILLE, CA 95076
ADDRESS CITY STATE ZIP

Signed ___ 11/14/97 249957
WELL DRILLER/AUTHORIZED REPRESENTATIVE DATE SIGNED C-57 LICENSE NUMBER

TRIPLICATE
Owner's Copy
Page 2 of 2

STATE OF CALIFORNIA

WELL COMPLETION REPORT

Refer to Instruction Pamphlet

No. **419779**

Owner's Well No. 201471
Date Work Began 06/18/97, Ended 06/26/97
Local Permit Agency MONTEREY COUNTY DEPARTMENT OF HEALTH
Permit No. 'WSAL 97-067 Permit Date 04/07/97

DWR USE ONLY — DO NOT FILL IN
STATE WELL NO./STATION NO.
LATITUDE LONGITUDE
APN/TRS/OTHER

GEOLOGIC LOG

ORIENTATION (✓) ___ VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)

DEPTH TO FIRST WATER ___ (Ft.) BELOW SURFACE

DEPTH FROM SURFACE		DESCRIPTION
Ft.	to Ft.	*Describe material, grain size, color, etc.*
660	680	COARSE SAND AND GRAVEL
680	700	COARSE SAND
700	715	HARD SAND
715	720	SAND AND GRAVEL
720	730	SAND AND GRAVEL
730	740	CLAY
740	780	HARD CLAY
780	785	CLAY
785	790	SAND AND GRAVEL
790	800	HARD SAND
800	840	CLAY

TOTAL DEPTH OF BORING 840 (Feet)
TOTAL DEPTH OF COMPLETED WELL 825 (Feet)

WELL OWNER

Name MRWPCA
Mailing Address 5 HARRIS COURT
MONTEREY, CA. 93940
CITY STATE ZIP

WELL LOCATION

Address 14811 DEL MONTE AVE.
City MONTEREY
County MONTEREY
APN Book 175 Page 011 Parcel 041
or
Township ___ Range ___ Section ___
or
Latitude ___ DEG. MIN. SEC. NORTH Longitude ___ DEG. MIN. SEC. WEST

LOCATION SKETCH

NORTH

SEE ATTACHED

WEST EAST

SOUTH

Illustrate or Describe Distance of Well from Landmarks such as Roads, Buildings, Fences, Rivers, etc.
PLEASE BE ACCURATE & COMPLETE.

ACTIVITY (✓)

☒ NEW WELL

MODIFICATION/REPAIR
___ Deepen
___ Other (Specify)

___ DESTROY (*Describe Procedures and Materials Under "GEOLOGIC LOG"*)

PLANNED USE(S) (✓)

___ MONITORING

WATER SUPPLY
___ Domestic
☒ Public
___ Irrigation
___ Industrial
___ "TEST WELL"
___ CATHODIC PROTECTION
___ OTHER (Specify)

DRILLING METHOD REVERSE ROTARY FLUID WATER

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH OF STATIC WATER LEVEL 162.75 (Ft.) & DATE MEASURED 08/18/97
ESTIMATED YIELD* 250 (GPM) & TEST TYPE PUMP
TEST LENGTH 5.5 (Hrs.) TOTAL DRAWDOWN 19.33 (Ft.)
** May not be representative of a well's long-term yield.*

CASING(S)

DEPTH FROM SURFACE		BORE-HOLE DIA. (Inches)	TYPE (✓)				MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
Ft.	to Ft.		BLANK	SCREEN	CON-DUCTOR	FILL PIPE				
0	50	32			X		STEEL	.250	STAINLESS	.040
0	670	22	X				STEEL	.250	STAINLESS	
670	730	22		X			STEEL	.250	STAINLESS	.040
730	785	22	X				STEEL	.250	STAINLESS	
785	805	22		X			STEEL	.250	STAINLESS	.040
805	825	22	X				STEEL	.250	STAINLESS	

ANNULAR MATERIAL

DEPTH FROM SURFACE		TYPE			
Ft.	to Ft.	CE-MENT (✓)	BEN-TONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0	650	XX			
650	840			XX	8X16

ATTACHMENTS (✓)

___ Geologic Log
___ Well Construction Diagram
___ Geophysical Log(s)
___ Soil/Water Chemical Analyses
___ Other ___

ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.

NAME MAGGIORA BROS. DRILLING, INC.
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

595 AIRPORT BLVD. WATSONVILLE, CA 95076
ADDRESS CITY STATE ZIP

Signed ___
WELL DRILLER/AUTHORIZED REPRESENTATIVE

11/14/97
DATE SIGNED

249957
C-57 LICENSE NUMBER

Cross-Section B-B' Well Names	Top (feet bgs)	Bottom (feet bgs)	Boring log record	GEOBASE Code
14S/2E-21N01	438	498	sand and gravel (pea to 1") clay at top-streaks	snd/grvl/cly
14S/2E-21N01	498	510	yellow brown clay	yellow clay
14S/2E-21N01	510	534	sand and gravel (1-3" rocks)	gravel/sand
14S/2E-21N01	534	564	sand	sand
14S/2E-21N01	564	580	sand and gravel (1-4" rocks)	gravel/sand
14S/2E-21N01	580	596	red sand	red sand
14S/2E-21N01	596	600	red sandstone	red sand
14S/2E-21E01	0	128	yellow dry sand	yellow sand
14S/2E-21E01	128	130	yellow clay w/streaks of red	yellow clay
14S/2E-21E01	130	144	blue clay - hard	blue clay
14S/2E-21E01	144	156	hard yellow clay	yellow clay
14S/2E-21E01	156	180	fine yellow clay	yellow sand
14S/2E-21E01	180	188	blue clay	blue clay
14S/2E-21E01	188	196	blue sand	blue sand
14S/2E-21E01	196	218	coarse sand w/some gravel	gravel/sand
14S/2E-21E01	218	242	brown sand - fine/some gravel	gravel/sand
14S/2E-21E01	242	272	hard yellow clay w/some sand	sandy clay
14S/2E-21E01	272	280	sand w/some rock	gravel/sand
14S/2E-21E01	280	396	sand/gravel rock (3-6")	gravel/sand
14S/2E-21E01	396	408	yellow clay	yellow clay
14S/2E-21E01	408	428	sand and some gravel	gravel/sand
14S/2E-21E01	428	442	sand and heavy gravel/rock (1-3")	gravel/sand
14S/2E-21E01	442	450	sand and heavy gravel/clay streaks	snd/grvl/cly
14S/2E-21E01	450	456	sand and gravel (1-3")	gravel/sand
14S/2E-21E01	456	460	yellow clay	yellow clay
14S/2E-21E01	460	466	sand	sand
14S/2E-21E01	466	470	yellow clay	yellow clay
14S/2E-21E01	470	484	fine sand and some gravel	gravel/sand
14S/2E-21E01	484	492	coarse sand and heavy gravel	gravel/sand
14S/2E-21E01	492	508	coarse sand and some gravel	gravel/sand
14S/2E-21E01	508	514	hard yellow clay	yellow clay
14S/2E-21E01	514	518	white sandstone w/yellow clay	sandy clay
14S/2E-21E01	518	532	fine sand	fine sand
14S/2E-21E01	532	542	coarse sand and gravel/rocks (1-4")	gravel/sand
14S/2E-21E01	542	550	sandy clay	sandy clay
14S/2E-21E01	550	562	sand and gravel w/clay streaks	gravel/sand
14S/2E-21E01	562	576	sand and heavy gravel	gravel/sand
14S/2E-21E01	576	592	fine sand	fine sand
14S/2E-21E01	592	612	sand and gravel (1-5" rock)	gravel/sand
14S/2E-21E01	612	614	red sandstone	red sand
14S/2E-21F02	0	8	top soil	topsoil
14S/2E-21F02	8	65	sediment	sediment
14S/2E-21F02	65	90	blue sandy clay	blue clay
14S/2E-21F02	90	116	yellow clay	yellow clay
14S/2E-21F02	116	130	mucky sand	sand
14S/2E-21F02	130	134	sandy yellow clay	yellow clay
14S/2E-21F02	134	140	river gravel	gravel
14S/2E-21F02	140	166	yellow clay	yellow clay
14S/2E-21F02	166	186	sand and gravel	gravel/sand
14S/2E-21F02	186	194	sand and fine gravel	gravel/sand
14S/2E-21F02	194	263	heavy gravel	gravel

Appendix A. Summary of Lithology Recorded on Cross-Section Well Logs
Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina
Monterey County Water Resources Agency

Cross-Section B-B' Well Names	Top (feet bgs)	Bottom (feet bgs)	Boring log record	GEOBASE Code
14S/2E-21F02	263	277	red sand	red sand
14S/2E-21F02	277	280	yellow clay	yellow clay
14S/2E-21F02	280	297	gravel and yellow clay	gravelly clay
14S/2E-21F02	297	300	yellow clay	yellow clay
14S/2E-16G01	0	100	clay	clay
14S/2E-16G01	100	170	coarse sand	coarse sand
14S/2E-16G01	170	220	gravel	gravel
14S/2E-16G01	220	230	gravel/brown clay	gravelly clay
14S/2E-16G01	230	240	gravel/clay	gravelly clay
14S/2E-16G01	240	260	coarse sand/clay	sandy clay
14S/2E-16G01	260	360	clay/sand	sandy clay
14S/2E-16G01	360	370	sand/clay	sandy clay
14S/2E-16G01	370	420	coarse sand	coarse sand
14S/2E-16G01	420	440	clay/sand	sandy clay
14S/2E-16G01	440	470	coarse sand	coarse sand
14S/2E-16G01	470	490	sand/clay	sandy clay
14S/2E-16G01	490	520	sand/clay	sandy clay
14S/2E-16G01	520	540	clay	clay
14S/2E-16G01	540	570	sand	sand
14S/2E-16G01	570	610	coarse sand	coarse sand
14S/2E-16G01	610	630	sand/clay	sandy clay
14S/2E-09D04	0	150	brown clay	brown clay
14S/2E-09D04	150	180	coarse sand	coarse sand
14S/2E-09D04	180	220	coarse sand/gravel	gravel/sand
14S/2E-09D04	220	230	clay/gravel	gravelly clay
14S/2E-09D04	230	260	silt stone/clay	clay
14S/2E-09D04	260	270	clay	clay
14S/2E-09D04	270	280	coarse sand/clay	sandy clay
14S/2E-09D04	280	330	clay	clay
14S/2E-09D04	330	420	sand/clay	sandy clay
14S/2E-09D04	420	430	coarse sand/clay	sandy clay
14S/2E-09D04	430	440	coarse sand	coarse sand
14S/2E-09D04	440	460	coarse sand/clay	sandy clay
14S/2E-09D04	460	490	coars sand	coarse sand
14S/2E-09D04	490	500	coarse sand/clay	sandy clay
14S/2E-09D04	500	540	sand/clay	sandy clay
14S/2E-09D04	540	550	hard clay	clay
14S/2E-09D04	550	570	hard clay/sand	sandy clay
14S/2E-09D04	570	580	coarse sand	coarse sand
14S/2E-09D04	580	610	coarse sand/clay	sandy clay
14S/2E-09D04	610	630	clay/sand	sandy clay

Notes:

* a partial boring log description is provided for this well

ORIGINAL
File Original, Duplicate and Triplicate with the
REGIONAL WATER POLLUTION
CONTROL BOARD No. 3
(Insert appropriate number)

WATER WELL DRILLERS REPORT

(Sections 7076, 7077, 7078, Water Code)

STATE OF CALIFORNIA

32
1252

Do Not Fill In
№ 751

State Well No.
Other Well No. 14/2-21F
1C-74

(1) OWNER:

Name Mrs. A. Warcken
Address Pomber Street
Castroville, California

(2) LOCATION OF WELL:

County Monterey Owner's number, if any—
R. F. D. or Street No.
On Breschini Ranch 2½ Mi. E. SE of
Twin Bridges & State Highway 1.
50 ft. NE of old well # 46 on Map

(3) TYPE OF WORK (check):

New well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 11.

(4) PROPOSED USE (check):

Domestic ☐ Industrial ☐ Municipal ☐
Irrigation ☒ Test Well ☐ Other ☐

(5) EQUIPMENT:

Rotary ☐
Cable ☒
Dug Well ☐

(6) CASING INSTALLED:

SINGLE ☐ DOUBLE ☒

From ft.	to ft.	Diam.	Gage or Wall
0	300	12"	12

If gravel packed

Diameter of Bore	from ft.	to ft.

Type and size of shoe or well ring
Size of gravel:
Describe joint

(7) PERFORATIONS:

Type of perforator used Mills
Size of perforations 3½ in., length, by 1 in.

From ft.	to ft.	Perf. per row	Rows per ft.
200	261	6	1

(8) CONSTRUCTION:

Was a surface sanitary seal provided? ☐ Yes ☐ No To what depth ft.
Were any strata sealed against pollution? ☐ Yes ☐ No If yes, note depth of strata
From ft. to ft.
Method of Sealing

(9) WATER LEVELS:

Depth at which water was first found ft.
Standing level before perforating ft.
Standing level after perforating ft.

(10) WELL TESTS:

Was a pump test made? ☐ Yes ☐ No If yes, by whom?
Yield: gal./min. with ft. draw down after hrs.
Temperature of water Was a chemical analysis made? ☐ Yes ☐ No
Was electric log made of well? ☐ Yes ☐ No

(11) WELL LOG:

Total depth 300 ft. Depth of completed well 300 ft.
Formation: *Describe by color, character, size of material, and structure.*

ft.	to ft.	
0	2	Top soil
2	65	Sediment
65	90	Blue sandy clay
90	116	Yellow clay
116	130	Mucky sand
130	134	Sandy yellow clay
134	140	River gravel
140	166	Yellow clay
166	186	Sand & gravel
186	194	Sand & fine gravel
194	263	Heavy gravel
264	277	Red sand
277	280	Yellow clay
280	297	Gravel & yellow clay
297	300	Yellow clay

Work started 19 , Completed 19

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME Roy V. Alsop & Son
(Person, firm, or corporation) *(Typed or printed)*
Address 1508 Abbott Street
Salinas, California
[SIGNED] Well Driller JUNE 25
License No. 132870 Dated: ~~October 22~~, 19 56

TH-1

STAAL, GARDNER & DUNNE, INC.
Consulting Engineers and Geologists
5855 Olivas Park Drive • Ventura, California 93003-7672

SGD

DRILLING LOG

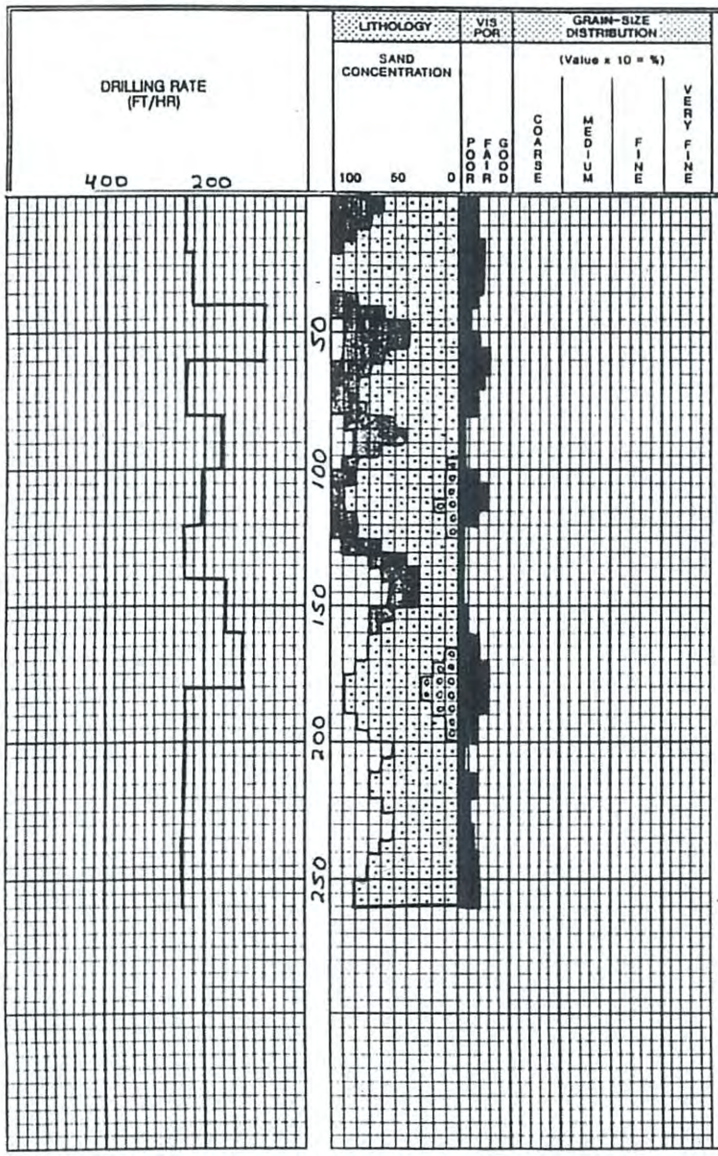
CLIENT: Monterey Peninsula Water Management District		M91157
WELL: Monterey Sand (TH-1)	No.:	GEOLOGIST: M.S. Burke, M.B. Feeney
COUNTY: Monterey	STATE: CA	LOGGING PERSONNEL: M. S. Burke
TOWNSHIP: RANGE:	SECTION:	SERVICES PERFORMED: Project management, lithologic logging, hydrogeologic analysis, contractor supervision.
LOCATION: Abandoned Monterey Sand Plant, Marina, CA		DATE BEGUN: 12/10/91 — DATE RELEASED: 12/10/91
ELEVATION: 10 (per GE)	TOTAL DEPTH: 260'	INTERVAL LOGGED: 0-260' — FOOTAGE:
SPUD DATE: 12/10/91	FINAL DATE: 12/10/91	REMARKS: Drilling fluid - Supermud; E-, & Gamma logs performed; Test hole abandoned by pumping neat cement from bottom of hole.
DRILLING COMPANY: R.L. Redfeairn, Bakersfield, CA		
PUSHER: Rick Redfeairn, Asst'd By John O'Tool		

HOLE SIZE	
0 - 260	4 3/4"

CASING RECORD		

ABBREVIATIONS			
CO	CIRCULATE OUT	PR	POOR RETURNS
LAT	LOGGED AFTER TRIP	SC	SAND CONTENT (%)
NB	NEW BIT	VIS	VISCOSITY (SECONDS)
NCB	NEW CORE BIT	WL	WATER LOSS (CC/30 MIN)
NR	NO RETURN	WT	FLUID WEIGHT (LBS/CU.FT.)

▭ CLAY ■ SILT ⠿ SAND ○ GRAVEL ▭ ▭ ▭



RIG ACTIVITY MUD ADDITIONS AND PROPERTIES

4 3/4" Tricone Bit

Losing circulation, thickening mud; adding water.
Circ. reestablished

Heavy rig chatter 168-180'

TD 260'

DESCRIPTION AND REMARKS

SAND, orangish brown, medium grained, subrounded to rounded, predom. quartz, yellowish orange staining on grains, minor brown silt.

SANDY SILT, reddish brown, slightly clayey w/ sand a/a, sl. coarser.

SAND, yellowish/grayish brown, predom. coarse grained granitic quartz, yellowish orange staining, subrounded

SILTY CLAY, dark olive/brownish gray, sl. sticky w/ few grains of sand.

SAND, brownish gray, coarse to v. coarse w/ some fine gravel, predom. quartz & granitic grains, subrounded, minor gravel

SILTY CLAY, brownish gray/olive gray. w/ occasional coarse to v. coarse grains of quartz sand.

SAND, grayish brown, fine to coarse grained, subang. to subrnd, predom. granitic quartz w/ some chert fragments (sharp & rounded edges)

CLAY, medium to light brownish gray, sticky, low plasticity, floculated appearance, slightly silty/sandy

SAND, a/a, w/ more chert grains & fragments

CLAY, a/a

SAND, a/a

STAAL, GARDNER & DUNNE, INC.
Consulting Engineers and Geologists
5855 Olivas Park Drive • Ventura, California 93003-7672

TH-2

DRILLING LOG

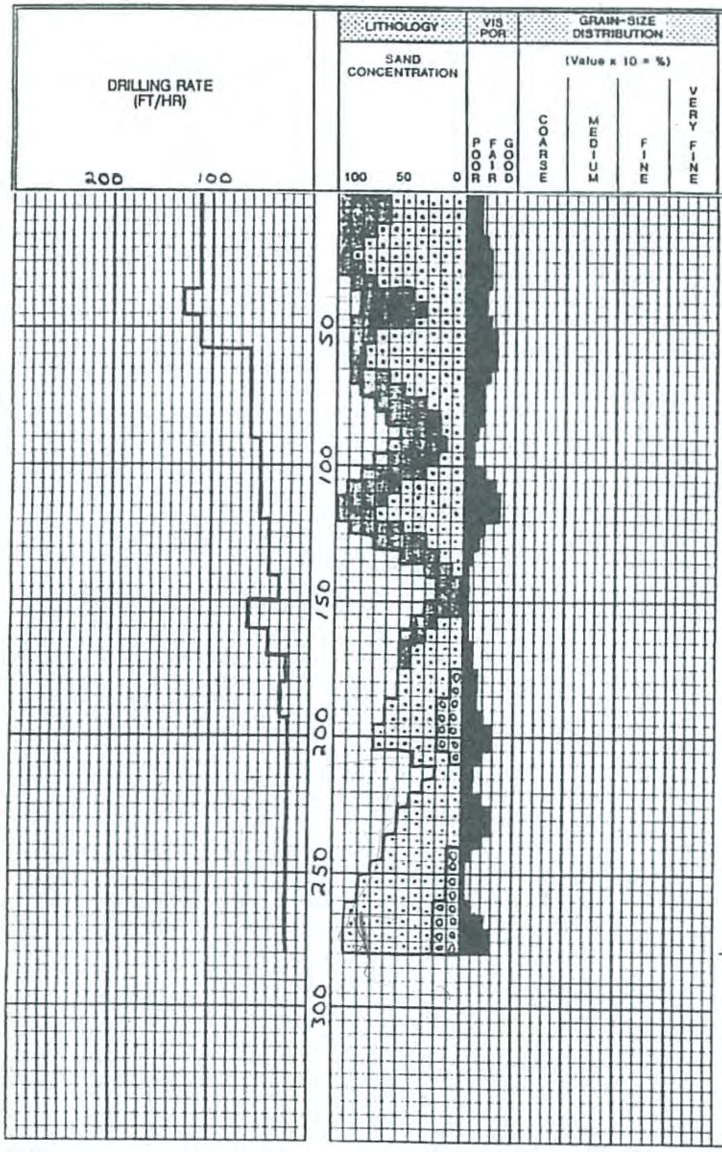
CLIENT: Monterey Peninsula Water Management District		M91157
WELL: Regional Park (TH-2)	No.:	GEOLOGIST: M. S. Burke, M. B. Feeney
COUNTY: Monterey	STATE: CA	LOGGING PERSONNEL: M. S. Burke
TOWNSHIP: RANGE:	SECTION:	SERVICES PERFORMED: Project management, lithologic logging, hydrogeologic consultation, contractor observation.
LOCATION: Regional Park District, Marina, CA. Edge of bluff at end of road starting at end of Dune Dr.		DATE BEGUN: 12/18/91 DATE RELEASED: 12/18/91
ELEVATION: 19 ft (per GE)	TOTAL DEPTH: 277'	INTERVAL LOGGED: 0 - 277' FOOTAGE: 277'
SPUD DATE: 12/18/91	FINAL DATE: 12/18/91	REMARKS: Drilling fluid - Revert, E- & Gamma logs performed, test hole abandoned w/ neat cement.
DRILLING COMPANY: Pitcher Drilling, Palo Alto, CA.		
PUSHER: Wayne Baker, Garry Foppiano (asst)		

HOLE SIZE	
0 - 277'	5 1/4"

CASING RECORD

ABBREVIATIONS			
CO	CIRCULATE OUT	PR	POOR RETURNS
LAT	LOGGED AFTER TRIP	SC	SAND CONTENT (%)
NB	NEW BIT	VIS	VISCOSITY (SECONDS)
NCB	NEW CORE BIT	WL	WATER LOSS (CC/30 MIN)
NR	NO RETURN	WT	FLUID WEIGHT (LBS/CU.FT.)

☐ CLAY ▨ SILT ⁘ SAND ○ GRAVEL ☐ ☐ ☐



RIG ACTIVITY MUD ADDITIONS AND PROPERTIES

Begin @ 750
5 1/4" rock bit, revert
Thick mud @ first, cuttings wouldn't drop for first 35'.

TD 277, 13^{45}

DESCRIPTION AND REMARKS

SAND, pale brown to brown, fine to med. grained, predom. subangular quartz, silty.

SANDY SILTY, brown to dark brown, w/ sand a/a

SAND, grayish brown, f. to c. grained, subrounded to subang., predom quartz grains w/ abdt mafic flecks, some yellowish-orange staining, silty, sl. clay.

CLAYEY SILT, lt. brownish gray w/ some fine grained sand

Dark brownish gray.

SANDY SILT, dk brownish gray silt a/a, w/ f. to med. grained, subrounded quartz sand.

SAND, dk yellowish brown, f. to c. grained w/ abdt coarse, subrnd, granitic quartz w/ yellowish brown silt.

SANDY SILT, pale brown to brown, sl. clayey w/ fine quartz sand.

CLAY, grayish brown, sl. to mod. sticky high plasticity, little silt, no sand, tight

SANDY CLAY, clay a/a w/ some silt, sticky, low plasticity, more coarse grained sand. (subang quartz w/ some orange staining) (common chert gravel fragments (rounded & sharp edges). Few coarse grains & fine gravel (chert & granite)

Coarse to very coarse.

SANDY CLAY, grayish brown, sticky, w/ sand a/a, lt brownish gray @ 220' w/ spongy consistency

SAND a/a w/ brown clay.

CLAY, bluish gray, tight, sticky, high plastic. color change to brownish gray @ 260.

SAND, brownish gray to yellowish brown predom quartz (2/3) w/ chert (1/3) some gravel, minor clay.

TH-3

STAAL, GARDNER & DUNNE, INC.

Consulting Engineers and Geologists
5855 Olivas Park Drive • Ventura, California 93003-7672

DRILLING LOG

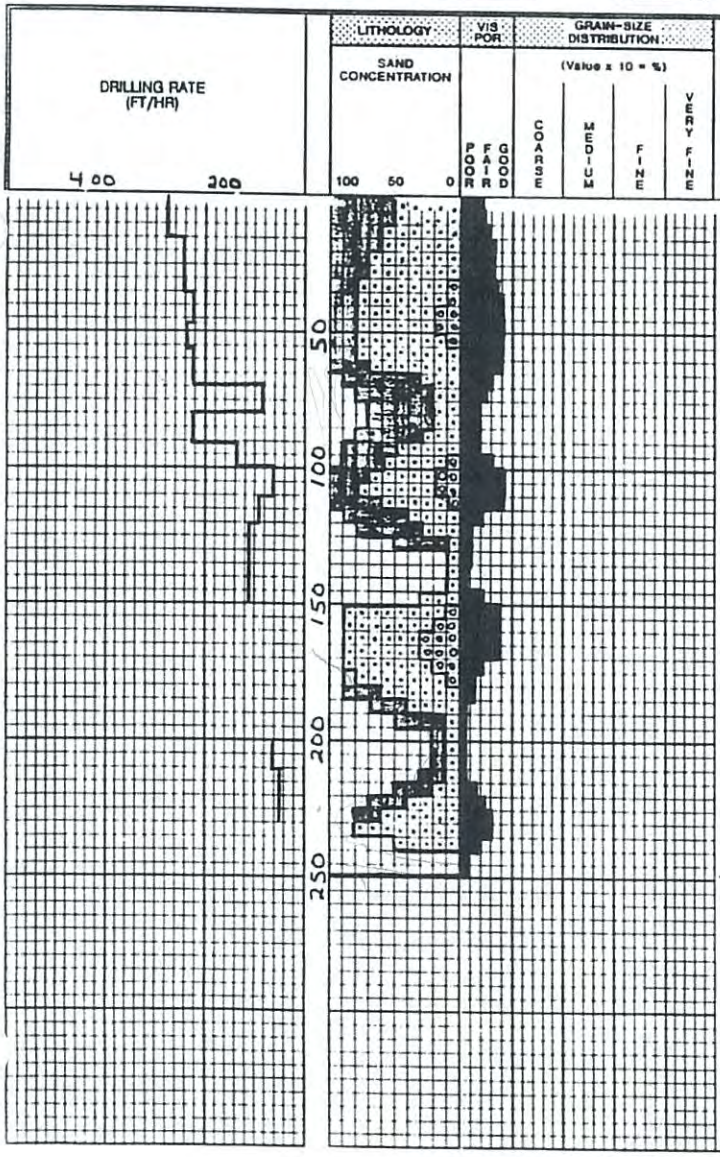
CLIENT: Monterey Peninsula Water Management District	M91157
WELL: Granite Rock Co. (TH-3) No.:	GEOLOGIST: M. S. Burke, M. B. Feeney
COUNTY: Monterey STATE: CA	LOGGING PERSONNEL: M. S. Burke
TOWNSHIP: RANGE: SECTION:	SERVICES PERFORMED: Project management, lithologic logging, hydrogeologic consultation, contractor supervision.
LOCATION: On the beach at the Granite Rock Co. property in Marina, CA	DATE BEGUN: 12/19/91 DATE RELEASED: 12/19/91
ELEVATION: 7ft (per GE) TOTAL DEPTH: 250'	INTERVAL LOGGED: 0-250' FOOTAGE: 250'
SPUD DATE: 12/19/91 FINAL DATE: 12/19/91	REMARKS: Drilling fluid – Revert, E & Gamma logs performed, test hole abandoned w/ neat cement.
DRILLING COMPANY: Pitcher Drilling, Palo Alto, CA.	
PUSHER: Wayne Baker, asst'd by Garry Foppiono	

HOLE SIZE	
0-250'	5 1/4"

CASING RECORD		

ABBREVIATIONS			
CO	CIRCULATE OUT	PR	POOR RETURNS
LAT	LOGGED AFTER TRIP	SC	SAND CONTENT (%)
NB	NEW BIT	VIS	VISCOSITY (SECONDS)
NCB	NEW CORE BIT	WL	WATER LOSS (CC/30 MIN)
NR	NO RETURN	WT	FLUID WEIGHT (LBS/CU.FT.)

☐ CLAY ■ SILT ●●●● SAND ○○○○ GRAVEL ☐ ☐ ☐



RIG ACTIVITY MUD ADDITIONS AND PROPERTIES

Begin drilling @ 8$\underline{55}$ w/ drag bit.

Wiper run, 11^{30}-12^{00}, "mud rings" forming in bore hole.

Change to rock bit.

TD 250', $14^{\underline{50}}$

DESCRIPTION AND REMARKS

<u>SAND</u>, brown, fine to coarse gr., predom. med grained, subrounded, predom. quartz w/ many brown/olive gray grains, silty.

<u>SAND</u>, brownish gray, a/a, though coarser grained granitic source for quartz, less silt, some fine gravel.

<u>CLAYEY SILT</u>, olive gray to dark olive gray, micaceous, sl. sandy

<u>SAND</u>, fine to coarse grained, though predom. med brown, predom. granitic quartz, subang to subround, silty, w/ minor/~~[illegible]~~ chert grains & few, f. chert gravel (rounded)

<u>CLAY</u>, bluish gray to olive gray, moderately tight, sticky, silty.

Very tight, less silt.

<u>SAND</u>, pale brown, fine to coarse grained, subangular to subrounded, predom quartz w/ abdt grains of chert, common chert gravel frags w/ sharp & rounded edges.

<u>CLAY</u>, olive to olive gray, sticky, low plastic., silty, sl. sandy.

Tighter, less silt & sand.

<u>SAND</u>, a/a

<u>CLAY</u>, olive brown to grayish brown, sticky, tight, very little sand or silt

APPENDIX B

Photographs of Cores and Chip Trays

(See attached DVD)

GEOSCIENCE

APPENDIX C

Soil Physical Properties Data Reports

GEOSCIENCE

APPENDIX C:

SOIL PHYSICAL PROPERTIES DATA REPORTS

CONTENTS

Description **Page**

PTS
Laboratories, Inc.

8100 Secura Way • Santa Fe Springs, CA 90670
Telephone (562) 347-2500 • Fax (562) 907-3610

October 14, 2013

Brian Villalobos
Geoscience Support Services
P.O. Box 220
Claremont, CA 91711

Re: PTS File No: 43626
Physical Properties Data
MPWSP; 13017-13

Dear Mr. Villalobos:

Please find enclosed report for Physical Properties analyses conducted upon samples received from your MPWSP; 13017-13 project. All analyses were performed by applicable ASTM, EPA, or API methodologies. An electronic version of the report has previously been sent to your attention via the internet. The samples are currently in storage and will be retained for thirty days past completion of testing at no charge. Please note that the samples will be disposed of at that time. You may contact me regarding storage, disposal, or return of the samples.

PTS Laboratories appreciates the opportunity to be of service. If you have any questions or require additional information, please contact Rachel Spitz at (562) 347-2504.

Sincerely,
PTS Laboratories, Inc.

Michael Mark Brady

Michael Mark Brady, P.G.
District Manager

Encl.

PTS
Laboratories, Inc.

8100 Secura Way • Santa Fe Springs, CA 90670
Telephone (562) 347-2500 • Fax (562) 907-3610

March 5, 2014

Brian Villalobos
Geoscience Support Services
P.O. Box 220
Claremont, CA 91711

Re: PTS File No: 44073
Physical Properties Data
MPWSP; 13017-13

Dear Mr. Villalobos:

Please find enclosed report for Physical Properties analyses conducted upon samples received from your MPWSP; 13017-13 project. All analyses were performed by applicable ASTM, EPA, or API methodologies. An electronic version of the report has previously been sent to your attention via the internet. The samples are currently in storage and will be retained for thirty days past completion of testing at no charge. Please note that the samples will be disposed of at that time. You may contact me regarding storage, disposal, or return of the samples.

PTS Laboratories Inc. appreciates the opportunity to be of service. If you have any questions or require additional information, please contact Morgan Richards at (562) 347-2509.

Sincerely,
PTS Laboratories, Inc.

Michael Mark Brady

Michael Mark Brady, P.G.
District Manager

Encl.

PTS
Laboratories, Inc.

8100 Secura Way • Santa Fe Springs, CA 90670
Telephone (562) 347-2500 • Fax (562) 907-3610

March 13, 2014

Brian Villalobos
Geoscience Support Services
P.O. Box 220
Claremont, CA 91711

Re: PTS File No: 44073
Revised Physical Properties Data Rev.01
MPWSP; 13017-13

Dear Mr. Villalobos:

Please find enclosed revised report for Physical Properties analyses conducted upon samples received from your MPWSP; 13017-13 project. The report has been revised to correct a unit calculation error for horizontal Hydraulic Conductivity for sample ML-4 146.5-147 at 146.95. All analyses were performed by applicable ASTM, EPA, or API methodologies. An electronic version of the report has previously been sent to your attention via the internet. The samples are currently in storage and will be retained for thirty days past completion of testing at no charge. Please note that the samples will be disposed of at that time. You may contact me regarding storage, disposal, or return of the samples.

PTS Laboratories Inc. appreciates the opportunity to be of service. If you have any questions or require additional information, please contact Morgan Richards at (562) 347-2509.

Sincerely,
PTS Laboratories, Inc.

Michael Mark Brady

Michael Mark Brady, P.G.
District Manager

Encl.

Project Name: MPWSP
Project Number: 13017-13

PTS File No: 44073
Client: Geoscience Support Services

TEST PROGRAM - 20140206

CORE ID	Depth ft.	Core Recovery ft.	Hydraulic Conductivity Pkg.	Hydraulic Conductivity API RP40/EPA 9100		Notes
		Plugs:	Vert. 1"	Horz. 1"		
Date Received: 20140204						
CX-B1 66.5-67	66.5-67	0.50	X	X		
CX-B1 166.5-167.0	166.5-167.0	0.50	X	X		
CX-B1 257.5-258	257.5-258	0.50	X			
CX-B2 207.5-208	207.5-208	0.50	X	X		
CX-B2 259-259.5	259-259.5	0.50	X			
CX-B3 107.5-108	107.5-108	0.50	X	X		
CX-B3 129-129.5	129-129.5	0.50	X			
CX-B3 177.5-178	177.5-178	0.50				
CX-B3 197.5-198	197.5-198	0.50	X	X		
ML-1 76-76.5	76-76.5	0.50	X			
ML-1 107.5-108	107.5-108	0.50	X	X		
ML-1 147-147.5	147-147.5	0.50	X			
ML-2 87-87.5	87-87.5	0.50	X			
ML-2 117.5-118	117.5-118	0.50	X	X		
ML-2 157.5-158	157.5-158	0.50	X	X		
ML-3 106.5-107	106.5-107	0.50	X	X		
ML-3 166.5-167	166.5-167	0.50	X	X		
ML-4 76.5-77	76.5-77	0.50	X	X		
ML-4 126.5-127	126.5-127	0.50	X			
ML-4 146.5-147	146.5-147	0.50	X	X		
ML-6 79.5-80	79.5-80	0.50	X			
ML-6 107.5-108	107.5-108	0.50	X	X		
ML-6 167-168.5	167-168.5	0.50	X	X		
TOTALS:	23 cores	11.50	22	14		23

PTS Laboratories

Project Name: MPWSP
Project Number: 13017-13
PTS File No: 44073
Client: Geoscience Support Services

TEST PROGRAM - 20140206

CORE ID	Depth ft.	Core Recovery ft.	Hydraulic Conductivity Pkg.	Hydraulic Conductivity API RP40/EPA 9100		Notes
		Plugs:	Vert. 1"	Horz. 1"		

Laboratory Test Program Notes

Contaminant identification: **NONE**

Standard TAT for basic analysis is 10 business days.

Hydraulic Conductivity Package – Saturated Zone: Native-state permeability to water, total and air-filled porosity, grain and bulk density, moisture content, total pore fluid (water only) saturation.

PTS File No: 44073
Client: Geoscience Support Services
Report Date: 03/05/14

PHYSICAL PROPERTIES DATA - HYDRAULIC CONDUCTIVITY PACKAGE

Project Name: MPWSP
Project No: 13017-13

		METHODS:	API RP 40 / ASTM D2216	API RP 40		API RP 40		API RP 40	API RP 40; EPA 9100	
									25 PSI CONFINING STRESS	
SAMPLE ID.	DEPTH, ft.	SAMPLE ORIENTATION (1)	MOISTURE CONTENT, % weight	DENSITY		POROSITY, %Vb (2)		TOTAL PORE FLUID SATURATIONS (3), % Pv	EFFECTIVE (4,5) PERMEABILITY TO WATER, millidarcy	HYDRAULIC CONDUCTIVITY (4,5), cm/s
				DRY BULK, g/cc	GRAIN, g/cc	TOTAL	AIR-FILLED			
CX-B1 66.5-67	66.6	V	22.9	1.46	2.66	45.0	11.6	74.2	273	2.76E-04
CX-B1 166.5-167.0	166.6	V	24.7	1.58	2.82	43.8	4.7	89.3	484	4.87E-04
CX-B1 257.5-258	257.5-258	V	41.1	1.11	2.61	57.7	12.2	78.8	1.75	1.75E-06
CX-B2 207.5-208	207.6	V	21.5	1.48	2.67	44.6	12.9	71.1	3820	3.76E-03
CX-B2 259-259.5	259.1	V	31.0	1.33	2.63	49.3	7.9	83.9	1.83	1.85E-06
CX-B3 107.5-108	107.6	V	20.6	1.43	2.64	45.8	16.4	64.2	5210	5.26E-03
CX-B3 129-129.5	129.1	V	35.5	1.25	2.62	52.1	7.6	85.5	2.83	2.86E-06
CX-B3 197.5-198	197.6	V	18.1	1.66	2.69	38.2	8.1	78.8	101	1.00E-04
ML-1 76-76.5	76.1	V	42.4	1.17	2.67	56.1	6.3	88.7	4.89	4.83E-06
ML-1 107.5-108	107.6	V	15.0	1.53	2.65	42.1	19.0	54.8	8540	8.52E-03
ML-1 147-147.5	147.1	V	32.4	1.31	2.66	50.8	8.4	83.4	1.97	1.98E-06
ML-2 87-87.5	87.1	V	20.5	1.50	2.66	43.4	12.7	70.8	101	1.00E-04
ML-2 117.5-118	117.6	V	24.3	1.43	2.64	45.8	11.0	76.0	47.3	4.70E-05
ML-2 157.5-158	157.6	V	19.2	1.52	2.61	41.6	12.3	70.5	110	1.10E-04
ML-3 106.5-107	106.6	V	12.9	1.53	2.64	42.0	22.3	47.0	1900	1.87E-03
ML-3 166.5-167	166.6	V	28.6	1.31	2.65	50.7	13.2	73.9	9.6	9.51E-06
ML-4 76.5-77	76.6	V	21.4	1.41	2.62	46.3	16.2	65.1	954	9.49E-04
ML-4 126.5-127	126.6	V	25.0	1.44	2.64	45.5	9.5	79.1	1.18	1.18E-06
ML-4 146.5-147	146.6	V	14.1	1.45	2.61	44.3	23.8	46.3	6180	6.10E-03
ML-6 79.5-80	79.6	V	32.2	1.33	2.64	49.7	6.9	86.0	2.43	2.43E-06
ML-6 107.5-108	107.6	V	15.0	1.41	2.64	46.3	25.2	45.6	4710	4.65E-03
ML-6 167-168.5	167.6	V	25.6	1.38	2.62	47.4	12.1	74.3	72.6	7.23E-05

(1) Sample Orientation: H = horizontal; V = vertical; R = remold

(2) Total Porosity = all interconnected pore channels; Air Filled = pore channels not occupied by pore fluids.

(3) Fluid density used to calculate pore fluid saturations: Water = 0.9996 g/cc.

(4) Effective (Native) = With as-received pore fluids in place.

(5) Permeability to water and hydraulic conductivity measured at saturated conditions.

Vb = Bulk Volume, cc; Pv = Pore Volume, cc; ND = Not Detected

Water = filtered Laboratory Fresh (tap) or Site water.

PTS File No: 44073
Client: Geoscience Support Services
Report Date: 03/13/14

PHYSICAL PROPERTIES DATA - HYDRAULIC CONDUCTIVITY Rev.01

(Methodology: API RP 40; EPA 9100)

Project Name: MPWSP
Project No: 13017-13

SAMPLE ID.	DEPTH, ft.	SAMPLE ORIENTATION (1)	ANALYSIS DATE	25 PSI CONFINING STRESS		
				EFFECTIVE PERMEABILITY TO WATER (2,3), millidarcy	HYDRAULIC CONDUCTIVITY (3), cm/s	INTRINSIC PERMEABILITY TO WATER (3), cm^2
CX-B1 66.5-67	66.95	H	20140305	1560	1.53E-03	1.54E-08
CX-B1 166.5-167.0	466.95	H	20140305	622	6.10E-04	6.14E-09
CX-B2 207.5-208	207.95	H	20140305	1440	1.41E-03	1.42E-08
CX-B3 107.5-108	107.95	H	20140305	5200	5.12E-03	5.13E-08
CX-B3 197.5-198	197.95	H	20140305	644	6.34E-04	6.35E-09
ML-1 107.5-108	107.95	H	20140305	6330	6.26E-03	6.25E-08
ML-2 117.5-118	117.95	H	20140305	111	1.10E-04	1.10E-09
ML-2 157.5-158	157.95	H	20140305	3270	3.21E-03	3.23E-08
ML-3 106.5-107	106.95	H	20140305	851	8.42E-04	8.40E-09
ML-3 166.5-167	166.95	H	20140305	7.59	7.53E-06	7.49E-11
ML-4 76.5-77	76.95	H	20140305	873	8.68E-04	8.62E-09
ML-4 146.5-147	146.95	H	20140305	12900	1.29E-02	1.28E-07
ML-6 107.5-108	107.95	H	20140305	3990	4.00E-03	3.94E-08
ML-6 167-168.5	167.95	H	20140305	130	1.30E-04	1.28E-09

(1) Sample Orientation: H = horizontal; V = vertical; R = remold

(2) Effective (Native) = With as-received pore fluids in place.

(3) Permeability to water and hydraulic conductivity measured at saturated conditions.

Water = filtered Laboratory Fresh (tap) or Site water.

Project Name: **MPWSP**
Project Number: **13017-13**

PTS File No: **43626**
Client: **Geoscience Support Services**

TEST PROGRAM - 20131002

CORE ID	Depth ft.	Core Recovery ft.	Hydraulic Conductivity Pkg.	Hydraulic Conductivity API RP40/EPA 9100		Notes
		Plugs:	Vert. 1"	Horz. 1"		
Date Received: 20130926						
PR-1 67 ft - 67.5 ft	67-67.5	0.50	X	X		
PR-1 145.5 ft - 146 ft	145.5-146	0.50	X			
PR-1 152 ft - 152.5 ft	152-152.5	0.50	X			
PR-1 200.5 ft - 201 ft	200.5-201	0.50	X	X		
TOTALS:	4 cores	2.00	4	2		4

Laboratory Test Program Notes

Contaminant identification: ________________

Standard TAT for basic analysis is 10 business days.

Hydraulic Conductivity Package – Saturated Zone: Native-state permeability to water, total and air-filled porosity, grain and bulk density, moisture content, total pore fluid (water only) saturation.

PTS Laboratories

PTS File No: 43626
Client: Geoscience Support Services
Report Date: 10/14/13

PHYSICAL PROPERTIES DATA - HYDRAULIC CONDUCTIVITY PACKAGE

Project Name: MPWSP
Project No: 13017-13

		METHODS:	**API RP 40 / ASTM D2216**	**API RP 40**		**API RP 40**		**API RP 40**	**API RP 40; EPA 9100**	
									25 PSI CONFINING STRESS	
				DENSITY		POROSITY, %Vb (2)				
SAMPLE ID.	DEPTH, ft.	SAMPLE ORIENTATION (1)	MOISTURE CONTENT, % weight	DRY BULK, g/cc	GRAIN, g/cc	TOTAL	AIR-FILLED	TOTAL PORE FLUID SATURATIONS (3), % Pv	EFFECTIVE (4,5) PERMEABILITY TO WATER, millidarcy	HYDRAULIC CONDUCTIVITY (4,5), cm/s
PR-1 67 ft - 67.5 ft	67.2	V	15.1	1.69	2.59	34.8	9.4	73.0	91.1	9.13E-05
PR-1 145.5 ft - 146 ft	145.6	V	28.6	1.38	2.68	48.5	9.0	81.4	2.08	2.08E-06
PR-1 152 ft - 152.5 ft	152.1	V	27.1	1.45	2.72	46.5	7.1	84.8	2.03	2.04E-06
PR-1 200.5 ft - 201 ft	200.65	V	16.5	1.61	2.67	39.8	13.3	66.6	5120	5.10E-03

(1) Sample Orientation: H = horizontal; V = vertical; R = remold

(2) Total Porosity = all interconnected pore channels; Air Filled = pore channels not occupied by pore fluids.

(3) Fluid density used to calculate pore fluid saturations: Water = 0.9996 g/cc.

(4) Effective (Native) = With as-received pore fluids in place.

(5) Permeability to water and hydraulic conductivity measured at saturated conditions.

Vb = Bulk Volume, cc; Pv = Pore Volume, cc; ND = Not Detected

Water = filtered Laboratory Fresh (tap) or Site water.

PTS Laboratories

PTS File No: 43626
Client: Geoscience Support Services
Report Date: 10/14/13

PHYSICAL PROPERTIES DATA - HYDRAULIC CONDUCTIVITY

(Methodology: API RP 40; EPA 9100)

Project Name: MPWSP
Project No: 13017-13

				25 PSI CONFINING STRESS		
SAMPLE ID.	DEPTH, ft.	SAMPLE ORIENTATION (1)	ANALYSIS DATE	EFFECTIVE PERMEABILITY TO WATER (2,3), millidarcy	HYDRAULIC CONDUCTIVITY (3), cm/s	INTRINSIC PERMEABILITY TO WATER (3), cm^2
PR-1 67 ft - 67.5 ft	67.05	H	20131010	61.1	6.03E-05	6.03E-10
PR-1 200.5 ft - 201 ft	200.55	H	20131010	269	2.73E-04	2.65E-09

(1) Sample Orientation: H = horizontal; V = vertical; R = remold
(2) Effective (Native) = With as-received pore fluids in place.
(3) Permeability to water and hydraulic conductivity measured at saturated conditions.
Water = filtered Laboratory Fresh (tap) or Site water.

PTS Laboratories, Inc.

CHAIN OF CUSTODY RECORD

PAGE Appendix OF

COMPANY
Geoscience Support Services

ADDRESS: PO 220
CITY: Claremont, CA
ZIP CODE: 91711

PROJECT MANAGER: Brian Villalobos — bvillalobos@geoscience-water.com

PROJECT NAME: MPWSP
PHONE NUMBER: 909-451-6650

PROJECT NUMBER: 13017-13
FAX NUMBER: 909-451-6638

SITE LOCATION: CEMEX

SAMPLER SIGNATURE:

PO# 13017-13

TURNAROUND TIME
24 HOURS ☐ 5 DAYS ☐
48 HOURS ☐ NORMAL ☑
72 HOURS ☐
OTHER: ____________

SAMPLE INTEGRITY (CHECK):
INTACT X ON ICE ____

PTS QUOTE NO.

PTS FILE: 44073

ANALYSIS REQUEST

SAMPLE ID NUMBER	DATE	TIME	DEPTH, FT	NUMBER OF SAMPLES	SOIL PROPERTIES PACKAGE	HYDRAULIC CONDUCTIVITY PACKAGE	PORE FLUID SATURATIONS PACKAGE	TCEQ/TNRCC PROPERTIES PACKAGE	CAPILLARITY PACKAGE	FLUID PROPERTIES PACKAGE	PHOTOLOG: CORE PHOTOGRAPHY	MOISTURE CONTENT, ASTM D2216	POROSITY: TOTAL, API RP40	POROSITY: EFFECTIVE, ASTM D425M	SPECIFIC GRAVITY, ASTM D854	BULK DENSITY (DRY), API RP40 or ASTM D2937	AIR PERMEABILITY, API RP40	HYDRAULIC CONDUCTIVITY, EPA9100, API RP40, D5084	GRAIN SIZE DISTRIBUTION, ASTM D422/4464M	TOC: WALKLEY-BLACK	ATTERBERG LIMITS, ASTM D4318	Horizontal Conductivity				COMMENTS
✓ CX-B1 66.5-67	10/22/13	1500	66.5-67	1		X																X				
✓ CX-B1 166.5-167.0	10/23/13	1500	166.5-167	1		X																X				
✓ CX-B1 257.5-258	10/25/13	1500	257.5-258	1		X																X				2 inches of sample missing
✓ CX-B2 207.5-208	11/5/13	1345	207.5-208	1		X																X				
✓ CX-B2 259-259.5	11/6/13	1000	259-259.5	1		X																X				
✓ CX-B3 107.5-108	11/10/13	1500	107.5-108	1		X																X				
✓ CX-B3 129-129.5	11/10/13	1500	129-129.5	1		X																X				
✓ CX-B3 177.5-178	11/10/13	1500	177.5-178	1		X																X				
✓ CX-B3 197.5-198	11/10/13	1500	197.5-198	1		X																X				
																										76°F

1. RELINQUISHED BY	2. RECEIVED BY	3. RELINQUISHED BY	4. RECEIVED BY
Nathan Reynolds	Andrew Kieta		
COMPANY: GEOSCIENCE	COMPANY: Geoscience	COMPANY: Geoscience	COMPANY: PTS LABS
DATE: 2-3-14 TIME: 17:00	DATE: 2-3-14 TIME: 17:00	DATE: 2-4-14 TIME: 10:26	DATE: 2/4/14 TIME: 10:26

PTS Laboratories, Inc.

CHAIN OF CUSTODY RECORD

COMPANY
Geoscience Support Services

ADDRESS: PO 220
CITY: Claremont, CA
ZIP CODE: 91711

PROJECT MANAGER: Brian Villalobos
bvillalobos@geoscience-water.com

PROJECT NAME: MPWSP
PHONE NUMBER: 909-451-6650

PROJECT NUMBER: 13017-13
FAX NUMBER: 909-451-6638

SITE LOCATION: Sandholdt dr area, Moss Landing

SAMPLER SIGNATURE:

PO# 13017-13

TURNAROUND TIME
24 HOURS ☐ 5 DAYS ☐
48 HOURS ☐ NORMAL ☑
72 HOURS ☐
OTHER: ____________

SAMPLE INTEGRITY (CHECK):
INTACT X ON ICE ____

PTS QUOTE NO.

PTS FILE: 44073

ANALYSIS REQUEST

	SAMPLE ID NUMBER	DATE	TIME	DEPTH, FT	NUMBER OF SAMPLES	SOIL PROPERTIES PACKAGE	HYDRAULIC CONDUCTIVITY PACKAGE	PORE FLUID SATURATIONS PACKAGE	TCEQ/TNRCC PROPERTIES PACKAGE	CAPILLARITY PACKAGE	FLUID PROPERTIES PACKAGE	PHOTOLOG: CORE PHOTOGRAPHY	MOISTURE CONTENT, ASTM D2216	POROSITY: TOTAL, API RP40	POROSITY: EFFECTIVE, ASTM D425M	SPECIFIC GRAVITY, ASTM D854	BULK DENSITY (DRY), API RP40 or ASTM D2937	AIR PERMEABILITY, API RP40	HYDRAULIC CONDUCTIVITY, EPA9100, API RP40, D5084	GRAIN SIZE DISTRIBUTION, ASTM D422/4464M	TOC: WALKLEY-BLACK	ATTERBERG LIMITS, ASTM D4318	Horizontal Conductivity				COMMENTS
✓	ML-1 76-76.5	10/3/13	10:30	76-76.5	1		X																X				
✓	ML-1 107.5-108	10/3/13	13:10	107.5-108	1		X																X				
✓	ML-1 147-147.5	10/3/13	14:00	147-147.5	1		X																X				
																											76°F

1. RELINQUISHED BY	2. RECEIVED BY	3. RELINQUISHED BY	4. RECEIVED BY
Nathan Reynolds /	Andrew Kieta /		
COMPANY: GEOSCIENCE	COMPANY: Geoscience	COMPANY: Geoscience	COMPANY: PTS LABS
DATE: 2-3-14 TIME: 17:00	DATE: 2-3-14 TIME: 17:00	DATE: 2-4-14 TIME: 10:26	DATE: 2/4/14 TIME: 10:26

PTS Laboratories, Inc.

CHAIN OF CUSTODY RECORD

COMPANY
Geoscience Support Services

ADDRESS PO 220
CITY Claremont, CA
ZIP CODE 91711

PROJECT MANAGER Brian Villalobos
bvillalobos@geoscience-water.com

PROJECT NAME MPWSP
PHONE NUMBER 909-451-6650

PROJECT NUMBER 13017-13
FAX NUMBER 909-451-6638

SITE LOCATION Del Mar Fisheries, Moss Landing

SAMPLER SIGNATURE

PO# 13017-13

TURNAROUND TIME
24 HOURS ☐ 5 DAYS ☐
48 HOURS ☐ NORMAL ☑
72 HOURS ☐
OTHER: ______

SAMPLE INTEGRITY (CHECK):
INTACT X ON ICE ____

PTS QUOTE NO.

PTS FILE: 44073

ANALYSIS REQUEST

	SAMPLE ID NUMBER	DATE	TIME	DEPTH, FT	NUMBER OF SAMPLES	SOIL PROPERTIES PACKAGE	HYDRAULIC CONDUCTIVITY PACKAGE	PORE FLUID SATURATIONS PACKAGE	TCEQ/TNRCC PROPERTIES PACKAGE	CAPILLARITY PACKAGE	FLUID PROPERTIES PACKAGE	PHOTOLOG: CORE PHOTOGRAPHY	MOISTURE CONTENT, ASTM D2216	POROSITY: TOTAL, API RP40	POROSITY: EFFECTIVE, ASTM D425M	SPECIFIC GRAVITY, ASTM D854	BULK DENSITY (DRY), API RP40 or ASTM D2937	AIR PERMEABILITY, API RP40	HYDRAULIC CONDUCTIVITY, EPA9100, API RP40, D5084	GRAIN SIZE DISTRIBUTION, ASTM D422/4464M	TOC: WALKLEY-BLACK	ATTERBERG LIMITS, ASTM D4318	Horizontal Conductivity			COMMENTS
✓	ML-2 87-87.5	12/9/13	1610	87-87.5	1		X																X			
✓	ML-2 117.5-118	12/10/13	0935	117.5-118	1		X																X			
✓	ML-2 157.5-158	12/10/13	1430	157.5-158	1		X																X			
																										76°F

1. RELINQUISHED BY	2. RECEIVED BY	3. RELINQUISHED BY	4. RECEIVED BY
Nathan Reynolds	Andrew Kieta		
COMPANY GEOSCIENCE	COMPANY Geoscience	COMPANY Geoscience	COMPANY PTS LABS
DATE 2-3-14 TIME 17:00	DATE 2-3-14 TIME 17:00	DATE 2-4-14 TIME 10:26	DATE 2/4/14 TIME 10:26

PTS Laboratories, Inc.

CHAIN OF CUSTODY RECORD

PAGE OF

COMPANY: Geoscience Support Services
ADDRESS: PO 220
CITY: Claremont, CA
ZIP CODE: 91711
PROJECT MANAGER: Brian Villalobos bvillalobos@geoscience-water.com
PROJECT NAME: MPWSP
PHONE NUMBER: 909-451-6650
PROJECT NUMBER: 13017-13
FAX NUMBER: 909-451-6638
SITE LOCATION: Moss Landing, Nadar Agha property
SAMPLER SIGNATURE:

PO# 13017-13

TURNAROUND TIME
24 HOURS ☐
48 HOURS ☐
72 HOURS ☐
5 DAYS ☐
NORMAL ☑
OTHER: ______

SAMPLE INTEGRITY (CHECK):
INTACT X
ON ICE ____

PTS QUOTE NO.

PTS FILE: 44073

ANALYSIS REQUEST

SAMPLE ID NUMBER	DATE	TIME	DEPTH, FT	NUMBER OF SAMPLES	SOIL PROPERTIES PACKAGE	HYDRAULIC CONDUCTIVITY PACKAGE	PORE FLUID SATURATIONS PACKAGE	TCEQ/TNRCC PROPERTIES PACKAGE	CAPILLARITY PACKAGE	FLUID PROPERTIES PACKAGE	PHOTOLOG: CORE PHOTOGRAPHY	MOISTURE CONTENT, ASTM D2216	POROSITY: TOTAL, API RP40	POROSITY: EFFECTIVE, ASTM D425M	SPECIFIC GRAVITY, ASTM D854	BULK DENSITY (DRY), API RP40 or ASTM D2937	AIR PERMEABILITY, API RP40	HYDRAULIC CONDUCTIVITY, EPA9100, API RP40, D5084	GRAIN SIZE DISTRIBUTION, ASTM D422/4464M	TOC: WALKLEY-BLACK	ATTERBERG LIMITS, ASTM D4318	Horizontal Conductivity	COMMENTS
ML-3 106.5-107	1/7/14	1600	106.5-107	1		X																X	
ML-3 166.5-167	1/8/14	1350	166.5-167	1		X																X	
ML-4 76.5-77	11/26/13	1320	76.5-77	1		X																X	
ML-4 126.5-127	12/2/13	1350	126.5-127	1		X																X	
ML-4 146.5-147	12/2/13	1745	146.5-147	1		X																X	

76 °F

1. RELINQUISHED BY	2. RECEIVED BY	3. RELINQUISHED BY	4. RECEIVED BY
Nathan Reynolds	Andrew Kietz		
COMPANY: GEOSCIENCE	COMPANY: Geoscience	COMPANY: Geoscience	COMPANY: PTS LABS
DATE: 2-3-14 TIME: 17:00	DATE: 2-3-14 TIME: 17:00	DATE: 2-4-14 TIME: 10:26	DATE: 2/4/14 TIME: 10:26

PTS Laboratories, Inc.

CHAIN OF CUSTODY RECORD

COMPANY
Geoscience Support Services

ADDRESS PO 220
CITY Claremont, CA
ZIP CODE 91711

PROJECT MANAGER Brian Villalobos
bvillalobos@geoscience-water.com

PROJECT NAME MPWSP
PHONE NUMBER 909-451-6650

PROJECT NUMBER 13017-13
FAX NUMBER 909-451-6638

SITE LOCATION MBARI, Moss Landing

SAMPLER SIGNATURE

PO# 13017-13

TURNAROUND TIME
24 HOURS ☐
48 HOURS ☐
72 HOURS ☐
5 DAYS ☐
NORMAL ☑
OTHER: ___________

SAMPLE INTEGRITY (CHECK):
INTACT x
ON ICE ____

PTS QUOTE NO.

PTS FILE: 44073

ANALYSIS REQUEST

SAMPLE ID NUMBER	DATE	TIME	DEPTH, FT	NUMBER OF SAMPLES	SOIL PROPERTIES PACKAGE	HYDRAULIC CONDUCTIVITY PACKAGE	PORE FLUID SATURATIONS PACKAGE	TCEQ/TNRCC PROPERTIES PACKAGE	CAPILLARITY PACKAGE	FLUID PROPERTIES PACKAGE	PHOTOLOG: CORE PHOTOGRAPHY	MOISTURE CONTENT, ASTM D2216	POROSITY: TOTAL, API RP40	POROSITY: EFFECTIVE, ASTM D425M	SPECIFIC GRAVITY, ASTM D854	BULK DENSITY (DRY), API RP40 or ASTM D2937	AIR PERMEABILITY, API RP40	HYDRAULIC CONDUCTIVITY, EPA9100, API RP40, D5084	GRAIN SIZE DISTRIBUTION, ASTM D422/4464M	TOC: WALKLEY-BLACK	ATTERBERG LIMITS, ASTM D4318	Horizontal Conductivity				COMMENTS
ML-6 79.5-80	11/19/13	1310	79.5-80	1		X																X				
ML-6 107.5-108	11/19/13	1320	107.5-108	1		X																X				
ML-6 167-168.5	11/20/13	0935	167-168.5	1		X																X				
																										76°F

1. RELINQUISHED BY	2. RECEIVED BY	3. RELINQUISHED BY	4. RECEIVED BY
Nathan Reynolds	Andrew Kieta		
COMPANY GEOSCIENCE	COMPANY Geoscience	COMPANY Geoscience	COMPANY PTS LABS
DATE 2-3-14 TIME 17:00	DATE 2-3-14 TIME 17:00	DATE 2-4-14 TIME 10:26	DATE 2/4/14 TIME 10:26

PTS Laboratories, Inc.

CHAIN OF CUSTODY RECORD

PAGE OF

COMPANY: Geoscience Support Services
ADDRESS: PO 220
CITY: Claremont, CA
ZIP CODE: 91711
PROJECT MANAGER: Brian Villalobos bvillalobos@geoscience-water.com
PROJECT NAME: MPWSP
PHONE NUMBER: 909-451-6650
PROJECT NUMBER: 13017-13
FAX NUMBER: 909-451-6638
SITE LOCATION: Potrero Rd Parking Area, Moss Landing
SAMPLER SIGNATURE:

PO#:

TURNAROUND TIME
24 HOURS ☐ 5 DAYS ☐
48 HOURS ☐ NORMAL ☐
72 HOURS ☐
OTHER: ____________

SAMPLE INTEGRITY (CHECK):
INTACT X ON ICE ____

PTS QUOTE NO.

PTS FILE: 43626

ANALYSIS REQUEST

SAMPLE ID NUMBER	DATE	TIME	DEPTH, FT	NUMBER OF SAMPLES	SOIL PROPERTIES PACKAGE	HYDRAULIC CONDUCTIVITY PACKAGE	PORE FLUID SATURATIONS PACKAGE	TCEQ/TNRCC PROPERTIES PACKAGE	CAPILLARITY PACKAGE	FLUID PROPERTIES PACKAGE	PHOTOLOG: CORE PHOTOGRAPHY	MOISTURE CONTENT, ASTM D2216	POROSITY: TOTAL, API RP40	POROSITY: EFFECTIVE, ASTM D425M	SPECIFIC GRAVITY, ASTM D854	BULK DENSITY (DRY), API RP40 or ASTM D2937	AIR PERMEABILITY, API RP40	HYDRAULIC CONDUCTIVITY, EPA9100, API RP40, D5084	GRAIN SIZE DISTRIBUTION, ASTM D422/4464M	TOC: WALKLEY-BLACK	ATTERBERG LIMITS, ASTM D4318	Horizontal Conductivity				COMMENTS
PR-1 67 ft - 67.5 ft	9/21/13	1500	67 - 67.5	1		X																X				Rcvd @ 74°F
PR-1 145.5 ft -146 ft	9/22/13	1400	145.5 - 146	1		X																X				
PR-1 152 ft - 152.5 ft	9/22/13	1420	152 -152.5	1		X																X				
PR-1 200.5 ft - 201 ft	9/22/13	1730	200.5 -201	1		X																X				

1. RELINQUISHED BY	2. RECEIVED BY	3. RELINQUISHED BY	4. RECEIVED BY
COMPANY GEOSCIENCE	COMPANY Geoscience	COMPANY Geoscience	COMPANY PTS LABS
DATE 9/26/13 TIME 10:40	DATE 9/26/13 TIME 10:40	DATE 9/26/13 TIME 11:45	DATE 9/26/13 TIME 11:45

Project Name: MPWSP
Project Number: 13017-13

PTS File No: 44073
Client: Geoscience Support Services

TEST PROGRAM - 20140206

CORE ID	Depth ft.	Core Recovery ft.	Hydraulic Conductivity Pkg.	Hydraulic Conductivity API RP40/EPA 9100		Notes
		Plugs:	Vert. 1"	Horz. 1"		
Date Received: 20140204						
CX-B1 66.5-67	66.5-67	0.50	X	X		
CX-B1 166.5-167.0	166.5-167.0	0.50	X	X		
CX-B1 257.5-258	257.5-258	0.50	X			
CX-B2 207.5-208	207.5-208	0.50	X	X		
CX-B2 259-259.5	259-259.5	0.50	X			
CX-B3 107.5-108	107.5-108	0.50	X	X		
CX-B3 129-129.5	129-129.5	0.50	X			
CX-B3 177.5-178	177.5-178	0.50				
CX-B3 197.5-198	197.5-198	0.50	X	X		
ML-1 76-76.5	76-76.5	0.50	X			
ML-1 107.5-108	107.5-108	0.50	X	X		
ML-1 147-147.5	147-147.5	0.50	X			
ML-2 87-87.5	87-87.5	0.50	X			
ML-2 117.5-118	117.5-118	0.50	X	X		
ML-2 157.5-158	157.5-158	0.50	X	X		
ML-3 106.5-107	106.5-107	0.50	X	X		
ML-3 166.5-167	166.5-167	0.50	X	X		
ML-4 76.5-77	76.5-77	0.50	X	X		
ML-4 126.5-127	126.5-127	0.50	X			
ML-4 146.5-147	146.5-147	0.50	X	X		
ML-6 79.5-80	79.5-80	0.50	X			
ML-6 107.5-108	107.5-108	0.50	X	X		
ML-6 167-168.5	167-168.5	0.50	X	X		
TOTALS:	23 cores	11.50	22	14		23

Project Name: **MPWSP**

Project Number: **13017-13**

PTS File No: **44073**

Client: **Geoscience Support Services**

TEST PROGRAM - 20140206

CORE ID	Depth ft.	Core Recovery ft.	Hydraulic Conductivity Pkg.	Hydraulic Conductivity API RP40/EPA 9100		Notes
		Plugs:	Vert. 1"	Horz. 1"		

Laboratory Test Program Notes

Contaminant identification: **NONE**

Standard TAT for basic analysis is 10 business days.

Hydraulic Conductivity Package – Saturated Zone: Native-state permeability to water, total and air-filled porosity, grain and bulk density, moisture content, total pore fluid (water only) saturation.

PTS File No: 44073
Client: Geoscience Support Services
Report Date: 03/13/14

PHYSICAL PROPERTIES DATA - HYDRAULIC CONDUCTIVITY PACKAGE Rev.01

Project Name: MPWSP
Project No: 13017-13

		METHODS:	**API RP 40 / ASTM D2216**	**API RP 40**		**API RP 40**		**API RP 40**	**API RP 40; EPA 9100**	
									25 PSI CONFINING STRESS	
SAMPLE ID.	DEPTH, ft.	SAMPLE ORIENTATION (1)	MOISTURE CONTENT, % weight	DENSITY		POROSITY, %Vb (2)		TOTAL PORE FLUID SATURATIONS (3), % Pv	EFFECTIVE (4,5) PERMEABILITY TO WATER, millidarcy	HYDRAULIC CONDUCTIVITY (4,5), cm/s
				DRY BULK, g/cc	GRAIN, g/cc	TOTAL	AIR-FILLED			
CX-B1 66.5-67	66.6	V	22.9	1.46	2.66	45.0	11.6	74.2	273	2.76E-04
CX-B1 166.5-167.0	166.6	V	24.7	1.58	2.82	43.8	4.7	89.3	484	4.87E-04
CX-B1 257.5-258	257.5-258	V	41.1	1.11	2.61	57.7	12.2	78.8	1.75	1.75E-06
CX-B2 207.5-208	207.6	V	21.5	1.48	2.67	44.6	12.9	71.1	3820	3.76E-03
CX-B2 259-259.5	259.1	V	31.0	1.33	2.63	49.3	7.9	83.9	1.83	1.85E-06
CX-B3 107.5-108	107.6	V	20.6	1.43	2.64	45.8	16.4	64.2	5210	5.26E-03
CX-B3 129-129.5	129.1	V	35.5	1.25	2.62	52.1	7.6	85.5	2.83	2.86E-06
CX-B3 197.5-198	197.6	V	18.1	1.66	2.69	38.2	8.1	78.8	101	1.00E-04
ML-1 76-76.5	76.1	V	42.4	1.17	2.67	56.1	6.3	88.7	4.89	4.83E-06
ML-1 107.5-108	107.6	V	15.0	1.53	2.65	42.1	19.0	54.8	8540	8.52E-03
ML-1 147-147.5	147.1	V	32.4	1.31	2.66	50.8	8.4	83.4	1.97	1.98E-06
ML-2 87-87.5	87.1	V	20.5	1.50	2.66	43.4	12.7	70.8	101	1.00E-04
ML-2 117.5-118	117.6	V	24.3	1.43	2.64	45.8	11.0	76.0	47.3	4.70E-05
ML-2 157.5-158	157.6	V	19.2	1.52	2.61	41.6	12.3	70.5	110	1.10E-04
ML-3 106.5-107	106.6	V	12.9	1.53	2.64	42.0	22.3	47.0	1900	1.87E-03
ML-3 166.5-167	166.6	V	28.6	1.31	2.65	50.7	13.2	73.9	9.6	9.51E-06
ML-4 76.5-77	76.6	V	21.4	1.41	2.62	46.3	16.2	65.1	954	9.49E-04
ML-4 126.5-127	126.6	V	25.0	1.44	2.64	45.5	9.5	79.1	1.18	1.18E-06
ML-4 146.5-147	146.6	V	14.1	1.45	2.61	44.3	23.8	46.3	6180	6.10E-03
ML-6 79.5-80	79.6	V	32.2	1.33	2.64	49.7	6.9	86.0	2.43	2.43E-06
ML-6 107.5-108	107.6	V	15.0	1.41	2.64	46.3	25.2	45.6	4710	4.65E-03
ML-6 167-168.5	167.6	V	25.6	1.38	2.62	47.4	12.1	74.3	72.6	7.23E-05

(1) Sample Orientation: H = horizontal; V = vertical; R = remold

(2) Total Porosity = all interconnected pore channels; Air Filled = pore channels not occupied by pore fluids.

(3) Fluid density used to calculate pore fluid saturations: Water = 0.9996 g/cc.

(4) Effective (Native) = With as-received pore fluids in place.

(5) Permeability to water and hydraulic conductivity measured at saturated conditions.

Vb = Bulk Volume, cc; Pv = Pore Volume, cc; ND = Not Detected

Water = filtered Laboratory Fresh (tap) or Site water.

PTS Laboratories, Inc.

CHAIN OF CUSTODY RECORD

PAGE Appendix OF

COMPANY
Geoscience Support Services

ADDRESS PO 220
CITY Claremont, CA
ZIP CODE 91711

PROJECT MANAGER Brian Villalobos
bvillalobos@geoscience-water.com

PROJECT NAME MPWSP
PHONE NUMBER 909-451-6650

PROJECT NUMBER 13017-13
FAX NUMBER 909-451-6638

SITE LOCATION CEMEX

SAMPLER SIGNATURE

PO# 13017-13

TURNAROUND TIME
24 HOURS ☐ 5 DAYS ☐
48 HOURS ☐ NORMAL ☑
72 HOURS ☐
OTHER: ____________

SAMPLE INTEGRITY (CHECK):
INTACT X ON ICE ____

PTS QUOTE NO.

PTS FILE: 44073

ANALYSIS REQUEST

	SAMPLE ID NUMBER	DATE	TIME	DEPTH, FT	NUMBER OF SAMPLES	SOIL PROPERTIES PACKAGE	HYDRAULIC CONDUCTIVITY PACKAGE	PORE FLUID SATURATIONS PACKAGE	TCEQ/TNRCC PROPERTIES PACKAGE	CAPILLARITY PACKAGE	FLUID PROPERTIES PACKAGE	PHOTOLOG: CORE PHOTOGRAPHY	MOISTURE CONTENT, ASTM D2216	POROSITY: TOTAL, API RP40	POROSITY: EFFECTIVE, ASTM D425M	SPECIFIC GRAVITY, ASTM D854	BULK DENSITY (DRY), API RP40 or ASTM D2937	AIR PERMEABILITY, API RP40	HYDRAULIC CONDUCTIVITY, EPA9100, API RP40, D5084	GRAIN SIZE DISTRIBUTION, ASTM D422/4464M	TOC: WALKLEY-BLACK	ATTERBERG LIMITS, ASTM D4318	Horizontal Conductivity				COMMENTS
✓	CX-B1 66.5-67	10/22/13	1500	66.5-67	1		X																X				
✓	CX-B1 166.5-167.0	10/23/13	1500	166.5-167	1		X																X				
✓	CX-B1 257.5-258	10/25/13	1500	257.5-258	1		X																X				2 inches of sample missing
✓	CX-B2 207.5-208	11/5/13	1345	207.5-208	1		X																X				
✓	CX-B2 259-259.5	11/6/13	1000	259-259.5	1		X																X				
✓	CX-B3 107.5-108	11/10/13	1500	107.5-108	1		X																X				
✓	CX-B3 129-129.5	11/10/13	1500	129-129.5	1		X																X				
✓	CX-B3 177.5-178	11/10/13	1500	177.5-178	1		X																X				
✓	CX-B3 197.5-198	11/10/13	1500	197.5-198	1		X																X				
																											76°F

1. RELINQUISHED BY	2. RECEIVED BY	3. RELINQUISHED BY	4. RECEIVED BY
Nathan Reynolds	Andrew Kieta		
COMPANY GEOSCIENCE	COMPANY Geoscience	COMPANY Geoscience	COMPANY PTS LABS
DATE 2-3-14 TIME 17:00	DATE 2-3-14 TIME 17:00	DATE 2-4-14 TIME 10:26	DATE 2/4/14 TIME 10:26

C-20

PTS Laboratories, Inc.

CHAIN OF CUSTODY RECORD

PAGE Appendix OF

COMPANY
Geoscience Support Services

ADDRESS: PO 220
CITY: Claremont, CA
ZIP CODE: 91711

PROJECT MANAGER: Brian Villalobos
bvillalobos@geoscience-water.com

PROJECT NAME: MPWSP
PHONE NUMBER: 909-451-6650

PROJECT NUMBER: 13017-13
FAX NUMBER: 909-451-6638

SITE LOCATION: Sandholdt dr area, Moss Landing

SAMPLER SIGNATURE:

PO# 13017-13

TURNAROUND TIME
24 HOURS ☐ 5 DAYS ☐
48 HOURS ☐ NORMAL ☑
72 HOURS ☐
OTHER: ______

SAMPLE INTEGRITY (CHECK):
INTACT X ON ICE ____

PTS QUOTE NO.

PTS FILE: 44073

ANALYSIS REQUEST

	SAMPLE ID NUMBER	DATE	TIME	DEPTH, FT	NUMBER OF SAMPLES	SOIL PROPERTIES PACKAGE	HYDRAULIC CONDUCTIVITY PACKAGE	PORE FLUID SATURATIONS PACKAGE	TCEQ/TNRCC PROPERTIES PACKAGE	CAPILLARITY PACKAGE	FLUID PROPERTIES PACKAGE	PHOTOLOG: CORE PHOTOGRAPHY	MOISTURE CONTENT, ASTM D2216	POROSITY: TOTAL, API RP40	POROSITY: EFFECTIVE, ASTM D425M	SPECIFIC GRAVITY, ASTM D854	BULK DENSITY (DRY), API RP40 or ASTM D2937	AIR PERMEABILITY, API RP40	HYDRAULIC CONDUCTIVITY, EPA9100, API RP40, D5084	GRAIN SIZE DISTRIBUTION, ASTM D422/4464M	TOC: WALKLEY-BLACK	ATTERBERG LIMITS, ASTM D4318	Horizontal Conductivity	COMMENTS
✓	ML-1 76-76.5	10/3/13	10:30	76-76.5	1		X																X	
✓	ML-1 107.5-108	10/3/13	13:10	107.5-108	1		X																X	
✓	ML-1 147-147.5	10/3/13	14:00	147-147.5	1		X																X	

76°F

1. RELINQUISHED BY: Nathan Reynolds
COMPANY: GEOSCIENCE
DATE: 2-3-14 TIME: 17:00

2. RECEIVED BY: Andrew Kieta
COMPANY: Geoscience
DATE: 2-3-14 TIME: 17:00

3. RELINQUISHED BY:
COMPANY: Geoscience
DATE: 2-4-14 TIME: 10:26

4. RECEIVED BY:
COMPANY: PTS LABS
DATE: 2/4/14 TIME: 10:26

PTS Laboratories, Inc.

CHAIN OF CUSTODY RECORD

PAGE Appendix **OF**

COMPANY
Geoscience Support Services

ADDRESS PO 220 | CITY Claremont, CA | ZIP CODE 91711

PROJECT MANAGER Brian Villalobos | bvillalobos@geoscience-water.com

PROJECT NAME MPWSP | PHONE NUMBER 909-451-6650

PROJECT NUMBER 13017-13 | FAX NUMBER 909-451-6638

SITE LOCATION Del Mar Fisheries, Moss Landing

SAMPLER SIGNATURE

PO# 13017-13

TURNAROUND TIME
24 HOURS ☐ 5 DAYS ☐
48 HOURS ☐ NORMAL ☑
72 HOURS ☐
OTHER: ______

SAMPLE INTEGRITY (CHECK):
INTACT X ON ICE ____

PTS QUOTE NO.

PTS FILE: 44073

ANALYSIS REQUEST

SAMPLE ID NUMBER	DATE	TIME	DEPTH, FT	NUMBER OF SAMPLES	SOIL PROPERTIES PACKAGE	HYDRAULIC CONDUCTIVITY PACKAGE	PORE FLUID SATURATIONS PACKAGE	TCEQ/TNRCC PROPERTIES PACKAGE	CAPILLARITY PACKAGE	FLUID PROPERTIES PACKAGE	PHOTOLOG: CORE PHOTOGRAPHY	MOISTURE CONTENT, ASTM D2216	POROSITY: TOTAL, API RP40	POROSITY: EFFECTIVE, ASTM D425M	SPECIFIC GRAVITY, ASTM D854	BULK DENSITY (DRY), API RP40 or ASTM D2937	AIR PERMEABILITY, API RP40	HYDRAULIC CONDUCTIVITY, EPA9100, API RP40, D5084	GRAIN SIZE DISTRIBUTION, ASTM D422/4464M	TOC: WALKLEY-BLACK	ATTERBERG LIMITS, ASTM D4318	Horizontal Conductivity				COMMENTS
✓ ML-2 87-87.5	12/9/13	1610	87-87.5	1		X																X				
✓ ML-2 117.5-118	12/10/13	0935	117.5-118	1		X																X				
✓ ML-2 157.5-158	12/10/13	1430	157.5-158	1		X																X				

76°F

1. RELINQUISHED BY Nathan Reynolds / Nathan Reynolds
COMPANY GEOSCIENCE
DATE 2-3-14 TIME 17:00

2. RECEIVED BY Andrew Kieta / A Kieta
COMPANY Geoscience
DATE 2-3-14 TIME 17:00

3. RELINQUISHED BY A Kieta
COMPANY Geoscience
DATE 2-4-14 TIME 10:26

4. RECEIVED BY
COMPANY PTS LABS
DATE 2/4/14 TIME 10:26

PTS Laboratories, Inc.

CHAIN OF CUSTODY RECORD

PAGE OF

COMPANY
Geoscience Support Services

ADDRESS PO 220
CITY Claremont, CA
ZIP CODE 91711

PROJECT MANAGER Brian Villalobos
bvillalobos@geoscience-water.com

PROJECT NAME MPWSP
PHONE NUMBER 909-451-6650

PROJECT NUMBER 13017-13
FAX NUMBER 909-451-6638

SITE LOCATION Moss Landing, Nadar Agha property

SAMPLER SIGNATURE

PO# 13017-13

TURNAROUND TIME
24 HOURS ☐ 5 DAYS ☐
48 HOURS ☐ NORMAL ☑
72 HOURS ☐
OTHER: ____________

SAMPLE INTEGRITY (CHECK):
INTACT X ON ICE ____

PTS QUOTE NO.

PTS FILE: 44073

ANALYSIS REQUEST

SAMPLE ID NUMBER	DATE	TIME	DEPTH, FT	NUMBER OF SAMPLES	SOIL PROPERTIES PACKAGE	HYDRAULIC CONDUCTIVITY PACKAGE	PORE FLUID SATURATIONS PACKAGE	TCEQ/TNRCC PROPERTIES PACKAGE	CAPILLARITY PACKAGE	FLUID PROPERTIES PACKAGE	PHOTOLOG: CORE PHOTOGRAPHY	MOISTURE CONTENT, ASTM D2216	POROSITY: TOTAL, API RP40	POROSITY: EFFECTIVE, ASTM D425M	SPECIFIC GRAVITY, ASTM D854	BULK DENSITY (DRY), API RP40 or ASTM D2937	AIR PERMEABILITY, API RP40	HYDRAULIC CONDUCTIVITY, EPA9100, API RP40, D5084	GRAIN SIZE DISTRIBUTION, ASTM D422/4464M	TOC: WALKLEY-BLACK	ATTERBERG LIMITS, ASTM D4318	Horizontal Conductivity				COMMENTS
ML-3 106.5-107	1/7/14	1600	106.5-107	1		X																X				
ML-3 166.5-167	1/8/14	1350	166.5-167	1		X																X				
ML-4 76.5-77	11/26/13	1320	76.5-77	1		X																X				
ML-4 126.5-127	12/2/13	1350	126.5-127	1		X																X				
ML-4 146.5-147	12/2/13	1745	146.5-147	1		X																X				

76 °F

1. RELINQUISHED BY	2. RECEIVED BY	3. RELINQUISHED BY	4. RECEIVED BY
Nathan Reynolds	Andrew Kietz		
COMPANY GEOSCIENCE	COMPANY Geoscience	COMPANY Geoscience	COMPANY PTS LABS
DATE 2-3-14 TIME 17:00	DATE 2-3-14 TIME 17:00	DATE 2-4-14 TIME 10:26	DATE 2/4/14 TIME 10:26

PTS Laboratories, Inc.

CHAIN OF CUSTODY RECORD

PAGE Appendix **OF**

COMPANY
Geoscience Support Services

ADDRESS: PO 220
CITY: Claremont, CA
ZIP CODE: 91711

PROJECT MANAGER: Brian Villalobos bvillalobos@geoscience-water.com

PROJECT NAME: MPWSP
PHONE NUMBER: 909-451-6650

PROJECT NUMBER: 13017-13
FAX NUMBER: 909-451-6638

SITE LOCATION: MBARI, Moss Landing

SAMPLER SIGNATURE:

PO# 13017-13

TURNAROUND TIME
24 HOURS ☐ 5 DAYS ☐
48 HOURS ☐ NORMAL ☑
72 HOURS ☐
OTHER: ____________

SAMPLE INTEGRITY (CHECK):
INTACT x ON ICE ____

PTS QUOTE NO.

PTS FILE: 44073

ANALYSIS REQUEST

SAMPLE ID NUMBER	DATE	TIME	DEPTH, FT	NUMBER OF SAMPLES	SOIL PROPERTIES PACKAGE	HYDRAULIC CONDUCTIVITY PACKAGE	PORE FLUID SATURATIONS PACKAGE	TCEQ/TNRCC PROPERTIES PACKAGE	CAPILLARITY PACKAGE	FLUID PROPERTIES PACKAGE	PHOTOLOG: CORE PHOTOGRAPHY	MOISTURE CONTENT, ASTM D2216	POROSITY: TOTAL, API RP40	POROSITY: EFFECTIVE, ASTM D425M	SPECIFIC GRAVITY, ASTM D854	BULK DENSITY (DRY), API RP40 or ASTM D2937	AIR PERMEABILITY, API RP40	HYDRAULIC CONDUCTIVITY, EPA9100, API RP40, D5084	GRAIN SIZE DISTRIBUTION, ASTM D422/4464M	TOC: WALKLEY-BLACK	ATTERBERG LIMITS, ASTM D4318	Horizontal Conductivity	COMMENTS
ML-6 79.5-80	11/19/13	1310	79.5-80	1		X																X	
ML-6 107.5-108	11/19/13	1320	107.5-108	1		X																X	
ML-6 167-168.5	11/20/13	0935	167-168.5	1		X																X	

76°F

1. RELINQUISHED BY	2. RECEIVED BY	3. RELINQUISHED BY	4. RECEIVED BY
Nathan Reynolds /	Andrew Kieta /		
COMPANY: GEOSCIENCE	COMPANY: Geoscience	COMPANY: Geoscience	COMPANY: PTS LABS
DATE: 2-3-14 TIME: 17:00	DATE: 2-3-14 TIME: 17:00	DATE: 2-4-14 TIME: 10:26	DATE: 2/4/14 TIME: 10:26