Geotechnical Investigation Report

Northern Regional Library Facility
Phase 4 Expansion
University of California, Berkeley
Richmond, California

SUBMITTED TO:

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February 15, 2018

A3GEO

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RE: Geotechnical Investigation Report
Northern Regional Library Facility (NRLF) Phase 4 Expansion
University of California, Berkeley
Richmond, California

Dear Mr. Fiske:

The attached report presents the results of A3GEO's geotechnical investigation for the proposed Northern Regional Library Facility (NRLF) Phase 4 Expansion, which will be located at the Richmond Field Station, which is part of the Berkeley Global Campus in Richmond, California. This work has been conducted in accordance with our proposal dated 27 September 2017, and our subsequent Scope and Fee Revision Requests for Added Services dated 22 November and 27 December 2017. A list of references is provided at the end of the report, followed by a series of Plates, Tables, Figures, and Appendices.

Subsurface explorations at the site identified approximately three to seven feet of soft, compressible, expansive soils at ground surface, overlying stiffer or denser naturally deposited alluvial soils. The proposed structure will need to meet stringent performance criteria for differential settlement in accordance with "ultra-flat" requirements. Based on our observations and analyses, the proposed structure can be supported on a mat foundation, provided mitigation measures are incorporated to both address the presence of soft, compressible, expansive soils at/near the ground surface, and to minimize consolidation settlement in the underlying, compressible alluvial soils. Details of our investigation, analyses (including a three-dimensional settlement analysis), and geotechnical recommendations are provided herein.

The conclusions and recommendations presented in this report were developed in accordance with generally-accepted geotechnical principles and practices at the time the report was prepared. No other warranty, expressed or implied, is made.

Thank you for inviting us to complete this work, and we look forward to our continued service during final design and subsequent construction phases of the project. Should you have questions or concerns regarding our findings, the design concepts discussed, or our recommendations, please do not hesitate to call.

Yours very truly,

A3GEO, Inc.

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1. INTRODUCTION

1.01 Overview and Proposed Construction

This report presents the results of a geotechnical investigation by A3GEO, Inc. (A3GEO), for the Northern Regional Library Facility (NRLF) Phase 4 Expansion (Project), at the University of California, Berkeley's Richmond Field Station (RFS) in Richmond, California. The Project (Site) location is shown on Plates 1 and 2 and Figure 1.

We have coordinated our work with the following project team members:

- Owner: University of California, Berkeley (UCB);
- Architect: EHDD, Inc. (EHDD);
- Structural Engineer: Rutherford + Chekene, Inc. (R+C).

The proposed NRLF Phase 4 Site is located in the northwest portion of the Richmond Field Station, southwest and adjacent to the existing Building 400 (UCB, 2018a) (Plate 2, Figure 1). The proposed Project will be an expansion of the existing NRLF facility, which was previously constructed in three phases: 1) NRLF Phase 1 consists of a 98,000 square foot (sf) structure completed in 1982; 2) NRLF Phase 2 is an 84,000 sf stack annex completed in 1990; and 3) NRLF Phase 3 is a 67,000 sf storage module and reading room completed in 2005 (UCB, 2018b). The locations of NRLF Phase 1 through 3 facilities are shown on Figure 1. The NRLF facility is a cooperative storage facility for infrequently used library materials belonging to UCB, as well as other University of California and California State University libraries. As of June 2017, the existing NRLF facility holds over 7.1 million items (UCB, 2018b).

It is our understanding that the purpose of the proposed Project is to provide 15 years of new storage capacity to the existing NRLF facility. Specifically, NRLF Phase 4 will store approximately 3.1 million volume equivalents of materials (EHDD, 2017). Unlike earlier NRLF Phases, Phase 4 will not include catwalks or upper floors, but rather high shelves will be reached by operators riding motorized order-pickers, using an arrangement known as the "Harvard System" (EHDD, 2017). The proposed Phase 4 footprint will be approximately 27,519 gross sf, broken down as follows:

- Harvard System, one story, tall stacks – 22,052 sf;
- Administrative space – 4,427 sf;
- Utility Rooms – 1,040 sf (EHDD, 2018).

Based on conversations with the project team, we understand the Harvard System motorized order-pickers require finished floor slabs meeting "ultra-flat" criteria to operate correctly. Specifically, ultra-flat criteria translates to the following slab tolerances:

- +/- 0.084 inch (in) over the 5 foot (ft) wide wheel base in the longitudinal direction; and
- +/- 0.071 in over 3.75 ft wide wheel base in the transverse direction.

The top of the proposed finished floor will be at Elevation (El.) 24.46 feet (ft), to match floor elevations in the existing NRLF Phase 3 facility (EHDD, 2018). The building foundation will consist of an 18-inch-thick structural mat, which will be topped with a 6-inch thick ultra-flat topping slab. The bottom elevation of the structural mat will be above the level of the existing site grades; fill will be placed to raise site grades, replace near-surface unsuitable soils and reduce post-construction differential settlement. As currently envisioned, the project will utilize lightweight cellular concrete[1] fill to reduce undesirable differential settlement effects.

[1] Cellular concrete is a flowable lightweight fill material also known propriety names such as Elastizell or Geofill.

1.02 Purpose and Scope of Services

The purpose of our services was to explore and characterize geotechnical, geologic, and seismic conditions at the Site and to prepare this report presenting data, conclusions, and recommendations for the Project. Specifically, the scope of our services included:

- Reviewing existing data;
- Performing subsurface explorations consisting of geotechnical borings within the footprint of the proposed NRLF Phase 4 facility;
- Performing geotechnical laboratory testing, including consolidation tests;
- Consulting with the project team on geotechnical-related issues including differential settlement and performance requirements for the ultra-flat slab;
- Performing geotechnical analyses, including a three-dimensional settlement analysis to understand soil behavior under proposed loading configurations;
- Characterizing geotechnical and geologic conditions,
- Developing geotechnical recommendations for the design and construction of the Project;
- Discussing our methods and findings with an outside geotechnical consultant (Drs. Chris Hunt and Juan Pestana of Geosyntec Consultants) to discuss numerical modeling methods and our interpretation of UCB-run constant rate of strain (CRS) consolidation tests; and
- Preparing this report.

1.03 Elevation Datum

Elevations in this report are in feet (ft) and reference a Project Datum (PD) that references a benchmark at the top of a fire hydrant at El. 25.58, as shown on the survey by David J. Russell, dated June 1988 (Bellecci & Associates, 2017a). Based on communication with the project team, we understand the datum shift between the PD and North American Vertical Datum of 1988 (NAVD 88) is 2.48 ft. Based on information from the National Oceanic and Atmospheric Administration (NOAA)'s VERTCON – North American Vertical Datum Conversion website, we understand the datum shift at the Site between National Geodetic Vertical Datum of 1929 (NGVD 29) and NAVD 88 is 2.69 ft, which leads us to believe that the PD and NVGD 29 are not equivalent. Long term groundwater monitoring data for the RFS references NGVD 29 (Tetra Tech, 2017b).

The following elevation datum conversions should be used:

- To convert from PD to NAVD 88, add 2.48 ft (Bellecci & Associates, 2017a);
- To convert from NGVD 29 to NAVD 88, add 2.69 ft (NOAA, 2018);
- To convert from NGVD 29 to PD, add 0.21 ft;
- To convert from NGVD 29 to mean sea level (MSL), subtract 0.58 ft. This assumes MSL for the Site is derived from the NOAA Richmond Inner Harbor tidal gauge (Tetra Tech, 2017b).

2. METHODS OF INVESTIGATION

2.01 Review of Existing Information

We reviewed a variety of references containing information on the geologic, seismic, and historical setting of the Site. Selected references are described below; a list of references used is available at the end of this report. Our review of existing information included subsurface data contained in existing geotechnical reports pertaining to NRLF Phases 1 through 3 (WCC, 1980b; WCC, 1980a; WCC, 1988b; WCC, 1988a; WCC, 1990; URS, 2001; and URS, 2004), and as-built drawings for NRLF Phases 1, 2, and 3 (EHDD, 1981; Ripley Associates, 1989; EHDD, 2005).

We also reviewed existing groundwater data collected as part of ongoing environmental remediation at the Berkeley Global Campus at Richmond Bay (Tetra Tech, 2017b).

2.02 Test Borings

Locations of subsurface explorations are shown on Figure 1, and a summary of explorations in provided in Table I.

2.02.1 Test Borings by Others

Geotechnical test borings were advanced by others for design of previous NRLF Phases 1 through 3. Where available, logs of test borings by others are provided in Appendix A.

2.02.1.1 NRLF Phase 1 Geotechnical Test Borings by Woodward-Clyde

In 1979, Woodward-Clyde Consultants (WCC) advanced two test borings, #1 and #2, as part of a preliminary investigation for an alternative NRLF Phase 1 building configuration than was ultimately not selected (WCC, 1980b). Logs of the test borings for the 1979 study were not available at the time this report was prepared.

In February 1980, WCC advanced five geotechnical test borings, identified as #3 through #7, to inform design of the NRLF Phase 1 facility. Total boring depths ranged from 31.5 to 61 ft below ground surface (bgs), corresponding to approximately El. -8.5 to El. -40. None of the borings encountered bedrock (WCC, 1980b).

In November 1980, WCC advanced four additional geotechnical test borings, identified as A through D, within the NRLF Phase 1 footprint. Borings A through D were advanced as part of a supplemental geotechnical investigation program, the purpose of which was to obtain additional supplemental subsurface information to refine estimates of predicted building settlement. Total boring depths ranged from 81 to 101.5 ft bgs, corresponding to approximately El. -59 to El. -80, and each of the borings encountered bedrock (WCC, 1980a).

2.02.1.2 NRLF Phase 2 Geotechnical Test Borings by Woodward-Clyde

In February 1988, WCC advanced three geotechnical test borings, identified as #8, #9, and W-1, for design of the NRLF Phase 2 facility. Test borings were advanced to depths of 110.5, 91, and 26 ft bgs, respectively, corresponding to El. -91, El. -70, and El. -3. Boring #8 encountered bedrock, and Boring #9 encountered possible bedrock based on rig refusal. W-1 was advanced for the installation of a standpipe piezometer (WCC, 1988a).

2.02.1.3 NRLF Phase 3 Geotechnical Test Borings by URS

In February and March 2001, URS Corporation (URS) advanced three geotechnical test borings, identified as #10 through #12, for design of the NRLF Phase 3 facility. Test borings were advanced to depths ranging from 31.5 to 51.5 ft bgs, corresponding to El. -8 to El. -29.5. None of the borings encountered bedrock (URS, 2001).

2.02.2 NRLF Phase 4 Test Borings by A3GEO (This Study)

In November 2017, A3GEO undertook a subsurface investigation program at the Site to inform the design of the proposed Project. Specifically, the objectives of the drilling program were as follows:

- Characterize subsurface conditions within the footprint of the proposed NRLF Phase 4 facility;
- Collect and submit soil samples for geotechnical laboratory testing. Use data from geotechnical laboratory testing to approximate soil properties for use in geotechnical analyses; and
- Collect limited soil samples for environmental analytical testing. We performed this work at the request of the UCB Office of Environment, Health & Safety (EHS).

Prior to conducting field activities, we conducted a site reconnaissance to observe Site conditions and discuss drilling program logistics with representatives from UCB and from UCB EHS. Additionally, A3GEO prepared a Health & Safety Plan in accordance with EHS requirements, marked boring locations and contacted Underground Service Alert (USA) more than 48 hours prior to advancing borings, and subcontracted with GeoTech Utility Locating of Moraga, California, a private utility locating company, to screen each location for underground utilities.

A3GEO subcontracted with Pitcher Drilling Company (Pitcher) of East Palo Alto, California, to advance two test borings, identified as A3-17-1 and A3-17-2, using truck-mounted rotary wash drilling equipment. Boreholes were advanced by hand auger to approximately 5 ft bgs to clear potential underground utilities prior to advancing with the drill rig. Boreholes A3-17-1 and A3-17-2 were subsequently advanced to depths of approximately 114.6 and 124.4 ft bgs, respectively, corresponding to approximately El. -94.1 and El. -105.4.

During drilling, an A3GEO field representative logged the borings, directed the drilling, and obtained soil samples. Soils were visually/manually classified in general accordance with ASTM D2488 classifications, which are based on the Unified Soil Classification System (USCS). Field classifications were subsequently checked and revised, where appropriate, based on laboratory test data. The logs of the borings are attached in Appendix B, preceded by a Key to Exploratory Boring Logs that describes the USCS and the symbols used on the logs.

Soil samples were obtained using a 2-inch outer-diameter (O.D.) Standard Penetration Test (SPT) sampler without liners, a 3-inch O.D. California Modified sampler with liners, a 3-inch O.D. Shelby tube, or a 3-inch O.D. Pitcher barrel sampler. The SPT and California Modified samplers were driven with a 140-pound mechanically automated trip hammer with an approximate 30-inch fall. The hammer blows required to drive the sampler the final 12 inches of each 18-inch drive are presented on the boring logs. Where a full 12-inch drive could not be achieved, the number of blows and amount of penetration achieved is shown. Sampler blow counts presented on the logs are adjusted N-values. Blow counts have been adjusted for sampler type only.

Drilling and non-dedicated sampling equipment was decontaminated between borings, in accordance with EHS requirements. Following drilling, boreholes were backfilled with grout using the tremie method. Investigation-derived waste (mixed spoils) from borings A3-17-1 and A3-17-2 was containerized separately in labeled 55-gallon drums, and drums were stored onsite at a location dictated by UCB EHS prior to offsite transport and disposal.

2.03 Laboratory Testing

2.03.1 Geotechnical Laboratory Testing by Others

Geotechnical laboratory testing was performed on samples of soil obtained from investigations for NRLF Phases 1 through 3. Results of moisture content, dry density, and unconfined compressive strength analysis are presented on the boring logs (Appendix A). Results of other analyses, including Atterberg Limits, sieve analysis and consolidation, are presented in Appendix C.

2.03.2 Geotechnical Laboratory Testing by A3GEO (This Study)

Our geotechnical laboratory testing program was directed toward a quantitative and qualitative evaluation of the physical properties of the soils at the Site. Additionally, our program focused on quantifying the consolidation properties of the soils underlying the proposed building footprint to model potential settlement behavior under proposed Project loads. The following geotechnical laboratory tests were performed:

- Atterberg Limits by ASTM D4318;
- Sieve analysis by ASTM D422 or D1140;
- Moisture content by ASTM D2216;
- Dry density by ASTM D2937;
- 1-D consolidation using incremental loading by ASTM D2435; and
- 1-D consolidation using controlled rate of strain (CRS) by ASTM D4186.

Geotechnical laboratory testing was performed by Cooper Testing Laboratory in Palo Alto, California, except for CRS tests, which were performed by Prof. Michael Riemer, Ph.D. at the UCB geotechnical engineering laboratory, and subsequent index testing of the CRS samples, which was performed by B. Hillebrandt Soils Testing, Inc., of Alamo, California. Geotechnical laboratory testing data sheets from this study are presented in Appendix D.

2.03.3 Environmental Analytical Testing by A3GEO (This Study)

Two environmental soil samples were collected from each A3GEO test boring A3-17-1 and A3-17-2, at depths of 15 and 40 ft bgs, for a total of four samples. Samples were analyzed for volatile organic compounds (VOCs) using United States Environmental Protection Agency (USEPA) Method 8260B. VOC samples were collected with Terra Core samplers and were transferred to 40-milliliter volatile organic analysis (VOA) vials filled with either 10-mililiters of methanol, or 5-mililiters of deionized water and a stir bar. Soil samples were stored in an ice-chilled cooler pending transport by courier to Enthalpy Analytical Laboratory in Berkeley, California, following standard chain-of-custody procedures.

Environmental analytical results for soil samples are presented in Table II. Analytical data reports are included in Appendix E.

3. GEOLOGIC, SEISMIC, AND HISTORICAL SETTING

3.01 Regional Geology

The San Francisco Bay Region (SFBR) is characterized by hills and valleys that generally trend southeast/northwest. This characteristic topography is partly the result of the SFBR's location at the boundary between the North American and Pacific crustal plates, which are in relative motion with respect to each other. Over geologic time, the topography of the region formed through a complex series of processes that have included deposition, accretion, faulting, folding, uplift, volcanism and changes in sea level. San Francisco Bay and the adjacent flatlands presently occupy a structural depression between the East Bay Hills and the roughly parallel hills of the San Francisco Peninsula and Marin County.

The SFBR includes three "basement" rock complexes; the Great Valley complex, the Franciscan Complex and the Salinian complex. All were formed in the Mesozoic Era (225 to 65 million years ago) and have been brought together by movement occurring along faults. These Mesozoic basement rock complexes are locally overlain by a diverse sequence of Cenozoic Era (younger than 65 million years) sedimentary and volcanic rocks. Since their deposition, the Mesozoic and Cenozoic rocks have been extensively deformed by repeated episodes of folding and faulting. Significantly, the Bay Area experienced several episodes of uplift and faulting during late Tertiary Period (about 25 million to 2 million years ago) that produced the region's characteristic northwest-trending mountain ranges and valleys.

World-wide climate fluctuations during the Pleistocene (about 1.8 million to 11 thousand years ago) resulted in several distinct glacial periods. A lowering of sea level accompanied each glacial advance as water became stored in vast ice sheets. Melting of the continental glaciers during warm intervals caused corresponding rises in sea level. High sea levels favored rapid and widespread deposition in the bay and surrounding floodplains. Low sea levels during glacial advances steepened the gradients of streams and rivers draining to the sea thereby encouraging erosional downcutting. The most recent glacial interval ended about 15,000 years ago. Evidence suggests that during the maximum extent of this latest glaciation, sea level was 300 to 400 feet below its present elevation and the valley now occupied by San Francisco Bay drained to the Pacific Ocean more than 30 miles west of the Golden Gate.

Near the beginning of the Holocene age (about 11 thousand years ago) the rising sea re-entered the Golden Gate, and sediments accumulated rapidly beneath the rising San Francisco Bay and on the surrounding floodplains. The sediments that now cover the bottom of the bay and blanket much of the adjacent lower flatlands are less than 11,000 years old. The Holocene-age surface deposits are generally less dense, weaker and more compressible than the adjacent/deeper Pleistocene-age soils that predate the last sea level rise.

3.02 Regional Active Faults

Within the SFBR, the relative motion of the Pacific and North American crustal plates is presently accommodated by a series of active northwest-trending faults that exist over a width of more than 50 miles (Plate 3). Faults that are defined as active exhibit one or more of the following: (1) evidence of Holocene-age (within about the past 11,000 years) displacement, (2) measurable aseismic fault creep, (3) close proximity to linear concentrations or trends of earthquake epicenters, and (4) prominent tectonic-related aseismic geomorphology. Potentially active faults are defined as those that are not known to be active, but have evidence of Quaternary-age displacement (within about the past 2 million years).

The major active faults shown on Plate 3 include the Hayward, Rodgers Creek, San Andreas, San Gregorio, Concord-Green Valley, Calaveras, West Napa and Greenville faults. These major faults are near-vertical and generally exhibit right-lateral strike-slip movement (which means that the movement is predominantly horizontal and when viewed from one side of the fault, the opposite side of the fault is observed as being displaced to the right). Approximate distances and directions from the Site to major Bay Area active faults are presented in the table that follows.

Approximate Distances and Directions to Principal Bay Area Active Faults (Jennings and Bryant, 2010)

Fault System	Approximate Distance from Site	Approximate Direction from Site
Hayward-Rogers Creek	2 miles	East-Northeast
Concord-Green Valley	16 miles	East-Northeast
West Napa	17 miles	Northeast
San Andreas	17 miles	West-Southwest
San Gregorio	18 miles	West-Southwest
Calaveras	21 miles	East-Southeast
Pleasanton	21 miles	East-Southeast
Greenville – Clayton – Marsh Creek	21 miles	East-Southeast

3.03 Regional Seismicity

Since 1836, six earthquakes of magnitude 6.5 or greater have occurred in the region (Bakun, 1999); the dates, magnitudes (M) and epicentral locations of these six large earthquakes are summarized in the table that follows.

Magnitude 6.5 or Greater Earthquakes; 1836-1998 (Bakun, 1999; Tuttle and Sykes, 1992)

Date	Magnitude	Epicenter Location
June 10, 1836	6.5	East of Monterey Bay
June 1838	6.8 – 7.2	Peninsula section of the San Andreas fault
October 8, 1865	6.5	Southwest of San Jose
October 21, 1868	6.8	Southern Hayward fault (Hayward Earthquake)
April 18, 1906	7.8	San Andreas fault (San Francisco Earthquake)
October 18, 1989	6.9	Santa Cruz Mountains (Loma Prieta Earthquake)

The Working Group on California Earthquake Probabilities (WGCEP) has developed authoritative estimates of the magnitude, location, and frequency of future earthquakes in California, which are published in Uniform California Earthquake Forecast (UCERF) reports. The most recent forecast (UCERF3) indicates the following likelihoods for one or more earthquake events of the specified magnitude occurring within the SRBR in the next 30 years (starting in 2014).

San Francisco Region UCERF3 Forecast (WGCEP, 2013)

Earthquake Magnitude (greater than or equal to)	30-year Likelihood of one or more earthquake events
≥ 5.0	100%
≥ 6.0	98%
≥ 6.7	72%
≥ 7.0	51%
≥ 7.5	20%
≥ 8.0	4%

The WGCEP has also made estimates of the likelihood of earthquakes with magnitude greater than or equal to 6.7 occurring on specific faults. These probabilities are summarized in the table below.

SFBR UCERF3 Forecast (Aagaard et al., 2016)

Earthquake Fault	30-year Likelihood of One or More Earthquake Events with M≥6.7
Hayward - Rodgers Creek	33%
Calaveras - Paicines	26%
San Andreas	22%
Hunting Creek, Berryessa, Green Valley, Concord, Greenville	16%
Maacama	8%
San Gregorio	6%

Compared to the previous forecast (UCERF 2; WGCEP, 2008) the likelihood of moderate-sized earthquakes (magnitude 6.5 to 7.5) are generally lower whereas the magnitude of larger earthquakes is higher. While UCERF3 results are generally in line with previous forecasts, UCERF 3 indicates lower probabilities for earthquakes occurring on the most well-known faults of the SFBR (Hayward and San Andreas), while the probabilities for earthquakes on lesser known faults has increased substantially in some case. The probability of an earthquake on the Calaveras fault was estimated at 7% in the UCERF 2 forecast, compared with 26% in the UCERF 3 forecast. This change reflects a better understanding of the regional fault system and the potential for multi-fault ruptures on many faults.

3.04 Local Geology

The RFS is located at the edge of a broad, gently-sloping alluvial plain that extends from the East Bay Hills down to San Francisco Bay. The 1903 Historical Map presented on Plate 4 shows the approximate location of the Site compared to the historical San Francisco Bay Shoreline (U.S. Coast and Geodetic Survey, 1903).

A portion of a United States Geological Survey (USGS) map of this area (Graymer, 2000) is shown on Plate 5. This map depicts the Site as underlain by Holocene natural levee deposits (map symbol Qhl), which the accompanying USGS pamphlet describes as “loose, moderately-sorted to well-sorted sandy or clayey silt grading to sandy or silty clay” (Graymer, 2000). The Hayward Fault (Plate 3) transects the alluvial plain approximately two miles to the northeast within the East Bay Hills. A portion of a more recent USGS Quaternary geologic map of this area (Witter et al., 2006; Plate 6), maps the deposits underlying the Site as early to late Pleistocene alluvial fan deposits (map symbol Qof), suggesting the surficial deposits underlying the Site are older than mapped by Graymer in 2000.

There are no exposures of bedrock at the Site. However, to the northeast of the Site (i.e. northeast of Interstate 580), a series of local hills are mapped as Franciscan Complex mélange (Cretaceous to Late Jurassic; map symbol KJfm), with blocks/lenses of chert (fc) and greenstone (fg; Plate 5; Graymer, 2000).

The broad Pleistocene alluvial fan material and distributary channels that underlie the RFS and the Site were deposited by paleo-Wildcat and San Pablo Creeks, which currently flow northwest to an outlet in San Pablo Bay. Wildcat Creek has its origin in the hills east of Berkeley and flows north from the vicinity of Tilden Park towards the City of San Pablo where it exits the hills at the apex of the alluvial fan. San Pablo Creek has its origin further to the east (near Orinda), and flows north and then northwest.

3.05 Geologic Hazard Mapping

The official Seismic Hazard Map for the Site shows the Site within an "Area not evaluated for liquefaction or seismic landslides" (CGS, 2003b). The Site is not within an Alquist-Priolo (A-P) Fault Zone (CGS, 20003b). A 2000 USGS liquefaction susceptibility map (Plate 7a) based on the geologic mapping of Graymer, 2000 (Plate 5) shows the Site as located within an area of "Moderate" liquefaction susceptibility (Knudsen et al., 2000). A more recent USGS liquefaction susceptibility map (Plate 7b), based on the Quaternary geologic mapping of Witter et al., 2006 (Plate 6) which identified soils underlying the Site as Pleistocene in age, places the Site within an area of "Very Low" liquefaction susceptibility (Witter et al., 2006).

A 1997 USGS landslide susceptibility map (Plate 8) identifies the Site as within an area of "Flat Land", which is described as "areas of gentle slope at low elevation that have little or no potential for the formation of slumps, translational slides, or earth flows except along stream banks and terrace margins" (Wentworth et al., 1997). The Site is also above the line of maximum predicted run-up shown on the tsunami hazard map for Contra Costa County (CGS, 2009).

4. SITE CONDITIONS

4.01 Surface Conditions

The Site is presently predominantly a grassy area which slopes gently from the northeast (approximately El. 23) to the southwest (approximately El. 19) (Figure 1). A dirt access roadway, connecting the west side of NRLF Phase 3 with the south side of NRLF Phase 2, intersects the southwest portion of the Site. Based on conversations with UCB staff, portions of the Site are intermittently used as a practice facility for track and field. The Site is bordered to the west and southwest by coastal prairie (Rana Creek Design, 2017).

4.02 Adjacent Structures

4.02.1 NRLF Phase 2

The proposed NRLF Phase 4 facility will be bordered to the east by NRLF Phase 2. It is our understanding that the NRLF Phase 2 facility is founded on a shallow foundation system consisting of spread footings interconnected with grade beams and a concrete slab-on-grade (typically 8-inch thick). The top of the lowest level slab was reportedly constructed at El. 24.2, and footings are typically 3 ft in thickness (Ripley Associates, 1989).

Pre-construction recommendations for the Phase 2 facility called for over-excavation of the building footprint plus an over-width of 10 ft, where possible, to 3 ½ ft bgs, before backfilling with non-expansive engineered fill to reach footing or slab subgrade elevation (WCC, 1988a). Construction records indicate that soft soils were encountered at the base of the recommended over-excavation in an approximately 25 by 90 ft area, and that this area was thus over-excavated an additional approximately 2 ft to remove the soft materials (WCC, 1990).

4.02.2 NRLF Phase 3

The proposed NRLF Phase 4 facility will be bordered to the north by NRLF Phase 3. It is our understanding that the NRLF Phase 3 facility is founded on a 2-foot thick mat foundation with a 2 ½ inch topping slab, underlain by a 2 ½ inch mud mat. The top of the lowest level slab was reportedly constructed at El. 24.46 (EHDD, 2005), and we presume the bottom of the mud mat is at El. 22.04.

To mitigate the presence of soft, expansive soils at the NRLF Phase 3 site, lime treatment was performed within the limits of the building pad. Appendix F contains a figure showing the recommended bottom elevations of the various lime treatment zones. Generally, the depth of lime treatment ranged from approximately 3 to 6 ft below previously existing ground surface. Adjacent to the north edge of the proposed NRLF Phase 4 structure, the recommended bottom elevation of the lime treatment zone was reportedly at El. 16.75 or El. 17.5 (URS, 2004).

4.03 Site Soil and Bedrock Conditions

Available borehole data indicate that the Site is underlain by layered alluvial fine-to-coarse-grained deposits, unconformably overlying Franciscan Assemblage bedrock. Young Bay Mud is not recognized within these boreholes, but is suspected to exist to the south near the historical San Francisco Bay Shoreline (Plate 4). Fine-grained alluvium consisting of silt and clay is pervasive below the Site, although interbeds of coarse-grained (sand and gravel) deposits are also present.

The test borings closest to and/or within the NRLF Phase 4 footprint are A3-17-1, A3-17-2, #8, and #9. The discussion below focuses on conditions encountered in these four borings, however information from other NRLF borings and from borings drilled for other projects on the NRLF facility has been reviewed to understand the general Site geology. A summary of subsurface conditions encountered in NRLF borings for all phases is presented on Table I.

- Soft Clay Topsoil – A layer of soft clay topsoil, typically consisting of dark brown fat clay with organic matter, was encountered at ground surface in each of the test borings. The contact between the bottom of this layer and the underlying upper alluvium was gradual, but was generally defined by a slight color change, the presence of less organic matter, and an increase in stiffness. The thickness of the soft clay topsoil typically ranged from approximately 3 to 5 ft, corresponding to bottom elevations ranging from approximately El. 14 to El. 17. A3GEO borings A3-17-1 and A3-17-2 were hand augered in the top 5 ft and as such, blow counts were not available. Discussions with UCB personnel indicated that when saturated after substantial rain events, the soft clay topsoil is incapable of supporting a truck or drill rig. This is in keeping with studies performed for NRLF Phases 1 through 3 (URS, 2001).

- Upper Alluvium – The soft clay topsoil is underlain by a layer of upper alluvium, interpreted to be Pleistocene in age based on mapping by Witter et al., 2006. The thickness of the upper alluvium ranged from approximately 31.5 to 43.5 ft in the NRLF Phase 4 footprint, corresponding to bottom elevations of approximately El. -14.5 to El. -27. This unit consists primarily of discontinuous lenses of clayey sand and gravel interbedded with massive silt and clay overbank fine deposits. The coarse-grained deposits are inferred to represent distributary channels bounded by distal levee and overbank deposits during the waning stages of the Wildcat Creek fan deposition in the late Pleistocene to Holocene. These terrestrial deposits were mostly brown in color, and were typically stiff to very stiff or very dense, with unconfined compressive strengths typically ranging from approximately 2,000 to 8,000 pounds per square foot (psf). Clays were typically found to be medium to high plasticity.

- Yerba Buena Mud – The upper alluvium is underlain by a Pleistocene marine deposit known as the Yerba Buena Mud based on a change in color from browns to greens and grays coupled with increases in stiffness/density. Some previous researchers refer to this layer as Old Bay Mud (Pouch, 1987; Bevc, 1984). The Yerba Buena Mud was encountered at depths ranging from approximately 35.5 to 47.5 ft bgs, and ranged from approximately 6.5 to 37 ft in thickness. This unit predominantly consists of stiff, fine-grained soils (clays and silts) inter-fingering with discontinuous zones of coarser-grained channel deposits. Fine grained soils ranged from low to high plasticity, with unconfined compressive strengths ranging from approximately 2,500 to 5,500 psf.

- Lower Alluvium – the Yerba Buena Mud is underlain by a second alluvial sequence consisting primarily of reddish brown to brown clay, silt, sand, and gravel, interpreted to be middle Pleistocene in age. The lower alluvium was encountered at depths ranging from approximately 42 to 80 ft bgs, and ranged from approximately 39.5 to 49 ft in thickness. Soils in this unit were typically described as either stiff to hard or medium dense to very dense.

- Franciscan Bedrock – Franciscan bedrock, including sandstone, shale, and claystone, underlies the lower alluvium within the NRLF Phase 4 footprint. Bedrock was encountered at depths ranging from 91 ft bgs in #9 to 124 ft bgs in A3-17-2, corresponding to El. -70 and El. -105, respectively. Generally, these observations are in keeping with NRLF site-wide trends of the bedrock surface dropping in elevation from the northeast to the southwest.

4.04 Hydrogeology

The hydrogeology of the RFS site has been studied previously by several researchers utilizing the well fields within the RFS (e.g. Geosciences and Sanitation Engineering Well Fields). Previous hydrogeologic studies generally subdivide the site stratigraphy into three hydrogeologic zones: a shallow zone between about 10 and 20 ft bgs; an intermediate zone between approximately 30 and 75 ft bgs; and a deep zone between about 90 and 100 ft bgs.

Shallow groundwater elevation contours for 2010 through 2016 are presented in the 2016 Groundwater Sampling Results Technical Memorandum, prepared by Tetra Tech, Inc. (Tetra Tech, 2016). Shallow groundwater generally shows a southwesterly gradient within the upper aquifer. Two existing monitoring wells are located in general proximity to the Site: 1) "NRLF" is located east of the northeast corner of NRLF Phase 1, and 2) "GEO" is located south of the southwest corner of NRLF Phase 2. Groundwater elevation data for wells NRLF and GEO and shallow groundwater elevation contour plans from the 2016 Tetra Tech report are presented in Appendix G (Tetra Tech, 2016).

Minimum and maximum groundwater elevations observed in each of the monitoring wells for the time period 1 November 2010 through 4 April 2016 are presented in the table below (Tetra Tech, 2016):

Well ID	Minimum		Maximum	
	Date	El., PD (ft)	Date	El., PD (ft)
GEO	10/7/13	4.66	4/2/11	8.23
NRLF	10/5/15	5.41	4/11/11	10.84

It is anticipated that groundwater levels at the Site fluctuate seasonally and that groundwater levels will rise in wetter seasons and following prolonged or particularly heavy rainfall.

A previous study conducted for the Berkeley Global Campus RFS site identified the limits of the 100-year water level inundation limits for the year 2100 including sea level rise. The NRLF Phase 4 Site is considerably north of the inundation limits (ESA PWA, 2013).

5. EVALUATIONS AND CONCLUSIONS

5.01 Geologic Hazard Considerations

5.01.1 Earthquake Groundshaking

The SFBR is seismically active and it is likely that the NRLF Phase 4 Site will experience earthquake ground shaking within the foreseeable life of the Project. For this reason, structures at the Site should be designed to resist strong ground shaking in accordance with the requirements of the California Building Code (CBC) and local design practice. The seismic design provisions of the 2016 CBC include a methodology by which sites are classified as A through F in order to quantify site-specific ground shaking effects. Based on the available data, we judge that a seismic Site Class D designation (stiff soil) is appropriate for the Phase 4 facility. Please refer to Section 6.01 for applicable CBC seismic design parameters.

5.01.2 Liquefaction

Liquefaction is a phenomenon during which loose, saturated cohesionless soils temporarily lose shear strength during ground shaking induced by severe earthquakes. Soils that are most likely to experience liquefaction are loose (adjusted blow counts less than 10), relatively clean, saturated sands and gravels. Similar soils that are medium dense can also experience liquefaction in some cases. The fines content and plasticity index (PI) of the soil control the soil's liquefaction susceptibility. Current research indicates that there exists a fines content threshold (FC_{thr}) above which the soil will behave like the fines and not the coarser soil. Typically, the FC_{thr} is between about 20 and 35 percent depending on factors such as the soil's full gradational characteristics, mineralogical composition, particle shapes, and depositional environment. Additionally, there appears to be consensus that soils with a PI of 12 or greater can be considered highly resistant to liquefaction. Lastly, liquefaction is only a concern when susceptible soils are submerged below groundwater at the time when an earthquake large enough to trigger liquefaction occurs.

As discussed in Section 3.05, the most recent Quaternary geologic and liquefaction hazard mapping of the Site (Witter et al., 2006), identified surficial geologic materials as Early to Late Pleistocene alluvial fan materials (Plate 6) with "Very Low" liquefaction potential (Plate 7b). This mapping was generally in keeping with our observations during the recent test boring program and our review of historic test borings drilled for earlier phases of the NRLF. As discussed in Section 4.03, the Site is underlain by an upper alluvial layer, the Yerba Buena Mud, and a lower alluvial sequence, each interpreted to be Pleistocene in age. Soils typically consisted of massive layers of stiff to very stiff sandy or silty clays and silts, with interbedded discontinuous lenses and layers of dense to very dense clayey sands or gravels.

Soils at the site are generally too high in clay content, have PIs in excess of 12, and/or are too stiff/dense to liquefy. While is possible that isolated, discontinuous sand or gravel layers below the NRLF 4 facility may experience liquefaction during an earthquake, we interpret that the overall risk of widespread liquefaction at the Site is very low.

5.01.3 Other Geologic Hazards Not Present

The following types of geologic hazards are either not present at the Site or are judged to have a less than significant potential to affect the Project.

5.01.3.1 Surface Fault Rupture

The Site is not within an A-P Fault Hazard Zone and no active faults are mapped in the direct vicinity of the Site. In our opinion, the potential for surface fault rupture to affect the Project is negligible.

5.01.3.2 Landsliding

The Site is nearly level with no slopes nearby; accordingly there is essentially no potential for landsliding to affect the Site.

5.01.3.3 Inundation

As discussed in Section 3.05, the Site is above the line of maximum predicted run-up shown on the tsunami hazard map for Contra Costa County (CGS, 2009). Further, as discussed in Section 4.04, the Site is above the 100-year water level inundation limits for the year 2100 including sea level rise (ESA PWA, 2013). As such, we judge there to be a low potential for significant flooding to affect the Site during the time period specified.

5.01.3.4 Lateral Spreading

Lateral spreading is a phenomenon whereby a surface layer of non-liquefied ground moves laterally on an underlying liquefied layer. We judge the Site to have a negligible potential for lateral spreading as: 1) the ground surface is relatively level with no "free face" nearby; and 2) the overall risk of liquefaction at the Site is very low.

5.02 Geotechnical Feasibility and Foundation Support

As currently planned, we understand that the structure will be supported on an 18-inch thick mat foundation overlain by a 6-inch thick topping slab. The mat will be underlain by a 2-inch thick protection slab. The top of the topping slab is proposed at El. 24.46, and the bottom of the protection slab is proposed at El. 22.29 (EHDD, 2018). Because existing grades within the NRLF Phase 4 footprint range from approximately El. 19 to El. 23, filling will be necessary to reach the protection slab subgrade elevation.

Based on the results of our investigation, we conclude that the proposed Project, including the foundation system and associated filling, are feasible, provided that the geotechnical recommendations in this report are appropriately incorporated in the design and construction of the Project. Our assessment of geotechnical considerations for the Project are discussed in the sections that follow.

5.03 Soft and Expansive Near-Surface Soils

The soft clay topsoil present in the upper approximately 3 to 7 ft at the Site is soft, expansive, and compressible, and is not suitable for structural support. Where feasible, this material will need to be removed within the entire zone of influence (ZOI; see Section 6.03.1) of the proposed mat slab, and backfilled with either Non-Expansive Fill or cellular concrete (Section 6.03.2). Alternatively, the adverse effects of this material could be mitigated through lime treatment, as was conducted for the NRLF Phase 3 project, although we understand this option is not preferred by the project team.

5.04 Soil Compressibility and Settlement

While the cohesive materials underlying the Site (upper alluvium, Yerba Buena Mud, and lower alluvium), are relatively stiff, they do have the potential to consolidate under proposed Project loads. As discussed in Section 1.01, the proposed Project will utilize motorized order-pickers that require finished floor slabs meeting "ultra-flat" criteria to operate correctly. It is our understanding that the ultra-flat criteria is tied to differential settlement across the wheel axles in both the longitudinal and transverse directions. As such, the Project is highly sensitive to settlement (particularly differential settlement), and even relatively small amounts of differential settlement have the potential to disrupt future system performance.

5.04.1 NRLF Phase 1 through 3 Settlement Performance

A3GEO reviewed the performance of the existing NRLF Phase 1 through 3 structures to provide a general idea of past building settlement performance. In 1988 (approximately six years after building completion), WCC performed a floor level survey of NRLF Phase 1 to observe settlement performance. The NRLF Phase 1 structure is founded on shallow footings connected with grade beams. The results of the level survey indicated that the Phase 1 structure performed generally better than was predicted in WCC's 1980 NRLF Phase 1 report. WCC's 1980 NRLF Phase 1 report predicted dishing settlement with a maximum ultimate settlement of 1-1/2 to 2 inches, with differential settlements between columns not to exceed ½ inch. The 1988 floor level survey indicated that maximum differential settlement was approximately ¾-inch, the average differential settlement between adjacent columns was approximately ¼-inch, and a dishing pattern of settlement had not occurred (WCC, 1988a; WCC, 1988b). A 2017 study performed by R+C for EHDD identified fairly large cracks (1/8-inch or greater) occurring over approximately 15% to 20% of the Phase 1 slab-on-grade (EHDD, 2017). Updated building settlement information was not available.

As discussed in Section 4.02.1, the NRLF Phase 2 facility was also constructed on shallow footings connected with grade beams. The NRLF Phase 2 structure loading and settlement behavior are presently unknown, however the aforementioned 2017 study by R+C observed no noticeable signs of structural distress in the NRLF Phase 2 slab, and the slabs were observed to be essentially crack-free (EHDD, 2017).

Like the proposed NRLF Phase 4 Project, the NRLF Phase 3 facility was designed and constructed as a mat slab, and based on our conversations with R+C, we understand the Phase 3 facility has comparable loading to the proposed Phase 4 facility. To understand settlement behavior, a floor-level survey of the Phase 3 facility was performed by the Project design team in December 2017 (Bellecci & Associates, 2017b). A3GEO plotted floor-level elevations across both longitudinal and transverse transects of the Phase 3 facility using the available data. Generally, a slight dishing pattern was observed, with a maximum differential settlement across the mat of approximately 1 inch. We were not able to calculate total settlement because post-construction floor level data were not available. Plots of floor level elevations across longitudinal and transverse transects in the Phase 3 facility are included in Appendix H.

5.04.2 NRLF Phase 4 Settlement Analysis

To understand future Project settlement performance, A3GEO undertook a three-dimensional settlement analysis. The objectives of the settlement analysis were to:

- Evaluate total settlement of the mat under various loading scenarios and configurations;
- Evaluate differential settlement of the mat in both the longitudinal and transverse directions, under various loading scenarios and configurations. Compare the results of the differential settlement analysis to the ultra-flat slab performance criteria to determine whether a mat slab is a feasible foundation system for the proposed structure given the performance requirements; and
- Optimize the amount of over-excavation and replacement below the mat, and the type of backfill material, considering future building settlement performance, constructability, cost, and other factors.

An in-depth description of the settlement analysis approach and model inputs, as well as tables and plots of analysis outputs, are included in Appendix H. Generally, our analysis utilized a parametric approach to evaluate structure performance for the scenarios shown on Figure 2. Three idealized excavation and backfill scenarios were analyzed:

- Scenario 1 modeled over-excavation and replacement of the top six (6) ft below the building footprint, and replacement with Non-Expansive Fill weighing 135 pounds per cubic foot (pcf), combined with a grade raise below the building footprint constructed of 135 pcf Non-Expansive Fill;

- Scenario 2 modeled over-excavation and replacement of the top three (3) ft below the building footprint, and replacement with 35 pcf cellular concrete, combined with a grade raise below the building footprint constructed with 35 pcf cellular concrete; and
- Scenario 3 modeled over-excavation and replacement of the top six (6) ft below the building footprint and replacement with 35 pcf cellular concrete, combined with a grade raise below the building footprint constructed with 35 pcf cellular concrete.

The three excavation and backfill scenarios (1, 2, and 3) described above were each analyzed for three different idealized book loading configurations, as illustrated on Figure 2. Specifically,

- "A" Scenarios modeled uniform book and shelf loading over the entire mat area;
- "X" Scenarios modeled uniform book and shelf loading over the southern portion of the stack area only; and
- "Y" Scenarios modeled uniform book and shelf loading over the west portion of the stack area only.

Plots of total settlement at transects across the mat slab were plotted and are included in Appendix H. Transect locations were selected to pass through locations of maximum settlement (i.e., the center of the mat for "A" and "X" scenarios, and the center of the loaded zone for "Y" scenarios), and maximum mat slope (typically either at the edge of the mat or at the transition between zones with different loading). Transect orientations selected for each scenario and configuration are shown on Figure 2. For "A" scenarios, transects were plotted in both the transverse and longitudinal direction. For "X" scenarios, only a longitudinal transect was plotted, to capture the transition between the south stack area (where book loading was applied), and the north portion of the structure, where no book loads were applied. Similarly, for "Y" scenarios, only a transverse section was plotted, to capture the transition between the west stack area, where book loads were applied, and the east stack area, where book loads were absent.

In addition to plotting total settlement along the aforementioned transects, A3GEO plotted instantaneous slope (change in mat elevation over horizontal distance) along each transect. The purpose of the slope plots was to observe whether differential settlement at a location along each transect was greater than the ultra-flat criteria (shown as a pink dashed line on the plots).

Generally, a dishing pattern of settlement behavior was observed, with slopes (change in mat elevation over a horizontal distance) at a maximum along the edges of the mat. Total settlements of up to approximately 2 inches were observed for Scenario 1, up to approximately 1.4 inches were observed for Scenario 2, and up to approximately 1.1 inches were observed for Scenario 3. For each of the idealized scenarios (1 through 3), mat slopes in excess of the applicable transverse or longitudinal criterion were observed at the edge of the mat, with Scenario 1 generating the steepest slopes. Additionally, applicable transverse and longitudinal criteria were exceeded in the center of the mat for idealized "X" and "Y" configurations at the transitions between zones with and without applied book loading. Generally, Scenario 3 (6 ft of over-excavation and replacement with cellular concrete, followed by a grade raise constructed of cellular concrete) generated the smallest total and differential settlements, and the smallest zones within the mat where the slope exceeded the ultra-flat criteria.

As discussed in Section 5.03, over-excavation of the existing soft clay topsoil within the top approximately 3 to 7 ft below the structure footprint will already be required. Based on the results of our settlement analysis, we conclude that while backfilling this over-excavated area with either Non-Expansive Fill or cellular concrete will be feasible from a bearing capacity standpoint, backfilling with cellular concrete (as modeled in Scenarios 2 and 3) may partially mitigate the adverse effects of total and differential settlement on mat performance. Depending on the actual thickness of soft clay topsoil observed across the excavation, it is possible that excavation in excess of what is required to remove the soft clay topsoil may be advisable for settlement mitigation reasons.

5.05 Construction Adjacent to Existing Structures

Construction of the NRLF Phase 4 facility adjacent to the existing NRLF Phase 2 and Phase 3 facilities has the potential to cause additional settlement in these structures. Generally, we expect that the presence of lime treated soil below the Phase 3 facility may help mitigate some of the potential settlement due to construction of the Phase 4 facility. We expect that Phase 4 construction may result in approximately an additional ½ to 1 inch of settlement of the Phase 2 facility, and possibly less at Phase 3.

Both the Phase 2 and Phase 3 facilities will need to remain open and operational both during and after construction of the Phase 4 facility, and the Contractor will need to sequence work in such a way as to avoid damage. Over-excavation to remove soft clay topsoil and to place Non-Expansive Fill and/or cellular concrete within the ZOI of the Phase 4 slab will need to avoid undermining the existing foundations for the Phase 2 and 3 structures. Based on the 100% Schematic Design drawings for the Project, we understand that the Phase 4 facility will essentially abut the Phase 3 facility along the proposed Phase 4 facility's north edge (EHDD, 2018). As discussed in Section 4.02.2, construction for the Phase 3 facility involved lime treating soil to the approximate recommended (i.e. *not* as-built) elevations shown on the plan included in Appendix F. Based on this plan, lime treatment may have been performed to El. 16.75 or El. 17.5 in the area where Phase 4 will abut Phase 3. However, as-built construction records for the lime treatment are not available, and as such, the actual lateral and vertical extent of lime treatment within this zone is unknown. We recommend performing a test pit or series of test pits along this alignment prior to beginning construction to understand the extent of lime treatment and fine-tune the excavation and replacement plan within this area.

Based on the 100% Schematic Design drawings, we understand a 10-ft setback is planned between NRLF Phase 2 and the proposed Phase 4 structure (EHDD, 2018). As discussed in Section 4.02.1, over-excavation to prepare the subgrade for the Phase 2 facility may have involved at least 3 ½ ft of excavation below previously existing site grades, to an over-width of 10 ft beyond the edge of the Phase 2 structure (WCC, 1988a), but actual construction records are not available. Based on the historic survey plan, the previously existing site grade along the west edge of the Phase 2 facility appears to have been at approximately El. 20, and as such, we would expect that the bottom of the over-excavated and backfilled zone along this edge may be at approximately El. 17. If over-excavation and replacement was undertaken to an over-width of 10 ft as recommended in the report (WCC, 1988a), we would expect the edge of the zone of engineered fill placed for Phase 2 may coincide with the proposed east edge of the future Phase 4 facility. We recommend performing a series of test pits along this edge to understand ground conditions and develop an excavation and replacement plan for this area.

5.06 Construction Considerations

Typically, we expect that soil at the Site can be excavated with conventional earth-moving equipment, although special equipment may be needed to excavate through lime-treated soils adjacent to NRLF Phase 3, assuming they extend within the footprint of the proposed NRLF Phase 4 facility. Additionally, it is possible that other obstructions could be encountered that could require jack-hammering, hoe-ramming, and/or cutting tools to excavate. In general, the Contractor is responsible for independently assessing and implementing safe and appropriate means and methods to accomplish the work described in the Contract Documents and may utilize existing information coupled with any supplemental investigations deemed necessary at the time of construction.

The contractor is responsible for shoring, excavation safety, and the protection of adjacent offsite improvement (including the existing NRLF Phase 2 and Phase 3 structures) throughout all phases of construction. All excavations deeper than 4 feet that will be entered by workers will need to be shored or sloped for safety in accordance with the applicable California Occupational Safety and Health Administration (Cal-OSHA) standards and any site-specific health and safety protocols and procedures required by UCB. In general, if the contractor decides to utilize temporary support of excavation systems along the existing Phase 2 or Phase 3 facilities to retain soil and avoid undermining existing foundations, these systems will need to be designed to resist building surcharge loads. While the near-surface soils are generally cohesive in nature, the Contractor should anticipate that excavations will not be able to be cut "neat" into the existing onsite soils and that, if used, cellular concrete may need to be formed.

To address potential impacts to the adjacent NRLF Phase 2 and 3 facilities, we recommend an instrumentation and monitoring program be implemented, consisting of the following components:

- Preconstruction Conditions Surveys – We recommend preconstruction condition surveys be completed before the beginning of construction. Preconstruction condition surveys should include the exterior and interior of the NRLF Phase 2 and Phase 3 structures. Surveys should include still photographs and video accompanied by an audio narrative of site features.
- Survey Reference Points – Survey reference points should be installed on the exposed faces of the NRLF Phase 2 and Phase 3 facilities.

Monitoring program threshold and limiting criteria should be incorporated into the Contract Documents.

The near-surface soils at the site include clayey materials that may be unable to support heavy construction equipment, particularly when wet. Excavation will be required within the building footprint and below exterior flatwork in order to place fill; the contractor should anticipate that it may be necessary to accomplish such excavations working outside of the excavation in order to not disturb soft subgrade materials. Supplemental excavations may be warranted to investigate the thickness of the soft clay topsoil, and to understand the subsurface conditions adjacent to the NRLF Phase 2 and Phase 3 facilities, prior to the start of construction. The means and methods associated with excavation, foundation construction, backfilling, subgrade preparation, and protection of adjacent structures are all responsibilities of the Contractor.

Water may tend to collect/pool within Site excavations and it is possible that excavations could encounter seepage zones or perched groundwater, depending upon the conditions present at the Site at the time that the work is performed. The Contractor is responsible for all aspects of temporary dewatering throughout the period of construction, which includes the design, permitting, installation and appropriate abandonment of Site dewatering systems as well as the appropriate storage, testing, and discharge of the water generated.

Although it is possible for excavation and/or construction to proceed during or immediately following the wet winter months, a number of geotechnical problems may occur which may increase costs and cause project delays. The water content of onsite soils may increase during the winter and rise significantly above optimum moisture content for compaction of subgrade or backfill materials. If this occurs, the Contractor may be unable to achieve the specified levels of compaction. Dewatering requirements will potentially increase due to rainfall, surface runoff, seepage, and rises in groundwater levels. The stability of temporary slopes will decrease, potentially increasing the lateral extent of excavation required. If utility or foundation excavations are open during winter rains, caving of the trench walls may occur. Subgrade preparation below the mat foundation or pavement sections may prove difficult or infeasible. In general, we note that it has been our experience that increased clean-up costs may be incurred, and greater safety hazards may exist, if the work proceeds during the wet winter months.

This geotechnical report does not address design or construction issues related to chemically-impacted soils and groundwater. Aside from the limited environmental soil analytical testing performed on behalf of UCB EHS and discussed in Section 2.03.3, environmental services were not included in A3GEO's scope of work.

6. RECOMMENDATIONS

6.01 California Building Code Seismic Parameters

The NRLF Phase 4 structure should be designed to resist strong ground shaking in accordance with the applicable building code(s) and local design practice. This section provides mapped seismic design parameters per the CBC (Risk Category I/II/III). In accordance with ASCE 7-10 Section 20, we evaluated seismic Site Class by calculating weighted average of blow counts for borings near the NRLF Phase 4 footprint. Accordingly, Site Class D (stiff soil) is appropriate for the Project. The appropriate design values are provided below, and corresponding USGS Design Maps Summary Reports and Design Maps Detailed Reports are attached in Appendix I.

Site Class
D = Stiff Soil

Latitude and Longitude
Latitude: 37.917381°N
Longitude: 122.335967°W

Maximum Considered Earthquake Spectral Response Accelerations (for Site Class D)
(Mapped Acceleration × Site Coefficient)
S_{MS} = 2.012g (MCE spectral acceleration at short periods)
S_{M1} = 1.230g (MCE spectral acceleration at 1-second period)

Design Spectral Response Acceleration (for Site Class D)
(Maximum Considered Earthquake Spectral Acceleration × 2/3)
S_{DS} = 1.341g (design spectral acceleration at short periods)
S_{D1} = 0.820g (design spectral acceleration at 1-second period)

6.02 Mat Foundation

As discussed in Section 5.02, the proposed NRLF Phase 4 structure can be founded on a mat foundation. We understand that the bottom of the proposed protection slab that will underlie the mat will be at El. 22.29 (EHDD, 2018). Because existing grades within the NRLF Phase 4 footprint range from approximately El. 19 to El. 23, filling will be necessary to reach the protection slab subgrade elevation. As discussed in Section 5, the soft clay topsoil material will need to be completely removed within the ZOI (see Section 6.03.1) of the mat foundation. Following over-excavation and replacement of the soft clay topsoil with either Non-Expansive Fill or cellular concrete, grades can be raised within the mat footprint with either Non-Expansive Fill or cellular concrete. The mat my subsequently bear directly on either the Non-Expansive Fill or the cellular concrete placed of the grade raise.

The mat foundation can be evaluated using the bearing pressures in the following table (DL = Dead Loads; LL = Live Loads; Total = DL + LL + wind or seismic).

Mat Allowable Bearing Pressures

Load Case	Bearing Pressure (psf)	Minimum Factor of Safety
DL Allowable	3000	3.0
DL+LL Allowable	4500	2.0
Total Allowable	6000	1.5

Resistance to lateral loads can be provided by passive pressures acting on the vertical faces of below-grade structural elements and by friction along the bottom of the mat. Where below-grade structural elements are surrounded by soil, passive resistance can be evaluated using an equivalent fluid weight of 300 pcf. This value can be increased by one-third for dynamic loading. The top of the assumed passive zone should be assumed 0.5 ft below the bottom of the adjacent slab. A friction coefficient of 0.20 can be used to evaluate frictional resistance between the waterproofing layer and the underlying protection slab. The above passive and frictional resistance values include a factor of safety of at least 1.5 and can be fully mobilized with deformations of less than ½ - and ¼ - inch, respectively.

6.03 Earthwork

6.03.1 Building Site Preparation and Over-Excavation

It is essential that all unsuitable soils be removed from within the ZOI and surrounding the planned mat foundation and this requirement should be carefully indicated on the structural plans. Unsuitable materials include soft clay topsoil, fill, organic materials, other buried topsoil, pavements, etc. Where Non-Expansive Fill is used, the ZOI is defined as the zone beneath the mat and beneath imaginary lines extending one ft laterally beyond the mat outer bottom edges and down and out on a one horizontal to one vertical (1H:1V) slope to the bearing stratum. (We note that this may not be possible to achieve adjacent to the NRLF Phase 2 and NRFL Phase 3 structures). Where cellular concrete is used, the ZOI is defined as the zone beneath the mat and beneath the zone extending 1 ft laterally beyond the mat edges, down to the bearing stratum.

Care should be exercised during excavation so as not to disturb the natural subgrade materials. We recommend that the excavation bottom be cut using a smooth (non-toothed) excavator bucket working from outside the excavation or by another method approved by A3GEO based on the conditions encountered. The exposed bottom of the over-excavation should be observed in the field by A3GEO to confirm unsuitable materials (including soft clay topsoil) have been sufficiently removed. It may be necessary to require additional over-excavation and replacement of weak, disturbed, or otherwise unacceptable materials prior to backfilling.

6.03.2 Backfilling

Geotechnical requirements for fill materials are presented below:

General Fill - General Fill material should have an organic content of less than 3 percent by volume and should not contain environmental contaminants or rocks or lumps larger than 6 inches in greatest dimension. From a geotechnical standpoint, onsite materials can be reused as General Fill if they meet or can be processed (e.g. by sorting and/or crushing) to meet the above requirements. General Fill can be used anywhere except where Non-Expansive Fill is required.

Non-Expansive Fill - Non-Expansive Fill should conform to the requirements for General Fill, have a Plasticity Index no greater than 12, and a Liquid Limit no greater than 40.

Imported Fill – Imported Fill should conform to the requirements for Non-Expansive Fill and should be evaluated by our firm and the project environmental consultant prior to its importation to the site.

Cellular Concrete – Cellular concrete should have a maximum unit weight of 35 pcf, and a minimum unconfined compressive strength of 65 pounds per square inch (psi).

Geotechnical requirements for fill placement and compaction are presented below (per ASTM D-1557 Test Methods):

- General Fill that is predominantly cohesive (>15 percent passing #200 sieve) should be moisture conditioned, as necessary, to between 3 and 5 percent over optimum moisture content and compacted to at least 90 percent relative compaction.
- General Fill that is predominantly granular (<15 percent passing #200 sieve) should be moisture conditioned, as necessary, to between 2 and 4 percent over optimum moisture content and compacted to at least 95 percent relative compaction.
- Non-Expansive Fill should be moisture conditioned, as necessary, to near optimum moisture content and compacted to at least 95 percent relative compaction.

All proposed fill materials should be approved by A3GEO and the project environmental consultant prior to use.

6.03.3 Reuse of Onsite Soils and Excavated Soil Management

We anticipate that excavated onsite soils will consist primarily of soft clay topsoil or other expansive clay. Thus, it is not expected that onsite soils will be reusable as Non-Expansive Fill. Onsite soils may be reusable as General Fill, provided it meets the requirements shown in Section 6.03.2. If not reused on Site, excavated materials should be stockpiled, transported, and disposed of in coordination with UCB requirements and at the direction of the project environmental consultant, as applicable.

6.04 Utilities

The long-term settlements discussed in Section 5.04.2 should be considered in the design of underground utilities that are sensitive to differential settlement and/or slope to drain.

Utility trenches should be backfilled with fill placed in lifts not exceeding 8 inches in uncompacted thickness. Trenches should be filled by placing a granular shading layer beneath and around the pipe, and then 6 to 12 inches of shading should be carefully placed and tamped above the pipe. The remaining portion of the trench should be backfilled with onsite or import soil. The backfill above shading should be placed and compacted by mechanical means to at least 90 percent relative compaction (per ASTM D-1557). If imported granular soil is used, sufficient water should be added during the trench backfilling operations to prevent the soil from "bulking" during compaction. All compaction operations should be performed by mechanical means only. Jetting should not be allowed. The preceding compaction recommendations are based on general geotechnical considerations. If UCB, local agency and/or utility company specifications require different or more stringent backfill requirements, those specifications should be followed.

A3GEO should observe utility trench backfilling and test compaction, as appropriate, to confirm and document that the work was performed in accordance with the specifications and the intent of our geotechnical recommendations.

6.05 Exterior Flatwork

6.05.1 Subgrade Preparation

We recommend that exterior flatwork be supported directly upon subgrade materials that are firm, non-yielding and predominantly non-expansive (per the requirements for Non-Expansive Fill presented in Section 6.03.2). In all cases, the upper 12 inches of soil subgrade should consist of either: 1) Non-Expansive Fill placed and compacted in accordance with the requirements of this report; or 2) onsite soil that is checked and confirmed to be non-expansive and suitable by A3GEO.

6.05.2 Exterior Slabs-on-Grade

Exterior concrete slabs-on-grade can be cast directly upon the 12-inch-thick compacted non-expansive soil layer. Subgrades beneath exterior slabs-on-grade should be proof-rolled under our observation and confirmed to be uniform and non-yielding prior to the placement of the slab reinforcement. Slab reinforcing should be provided in accordance with the anticipated use and loading of the slab. We recommend that exterior slabs-on-grade be at least 4 inches thick and reinforced with steel bar reinforcement. Exterior slabs should be structurally independent from buildings. Concrete slabs that may be subject to vehicle loadings should be designed in accordance with Section 6.05.4, Rigid Pavements.

6.05.3 Flexible Pavements

Flexible asphalt concrete (AC) pavements may be used for parking areas and driveways. We developed the following recommended pavement sections for various traffic indices using the Caltrans R-value design method for flexible pavements. The sections below are based on an assumed subgrade R-value of 30 for non-expansive soil. The R-value of the soil beneath the aggregate base should be confirmed during construction.

Flexible Pavement Thickness Design for Subgrade R-Value = 30

Traffic Index	Asphalt Concrete (inches)	Caltrans Class 2 Aggregate Base (inches)	Total Thickness (inches)
4	2	6	8
5	3	6	9
6	3	9	12
7	3	12	15

The assumed traffic indices of 4.0 and 5.0 are commonly used for automobile and light truck parking areas and access driveways, respectively. Traffic indices of 6.0 and 7.0 are commonly used for moderate truck access and parking areas. A traffic study has not been conducted by our firm for this project and our opinion regarding the applicability of the assumed traffic indices is experience-based and judgmental. The project civil engineer should choose the appropriate traffic indices for the pavement areas of the Site and then use the given section for that traffic index.

Aggregate base should be placed on a compacted non-expansive soil layer that is at least 12 inches thick. The upper 6 inches of subgrade beneath planned pavements should be compacted to at least 95 percent relative compaction per ASTM D-1557. Pavement subgrades should be proof-rolled and confirmed to be uniformly firm and non-yielding prior to the placement of aggregate base. Aggregate base for use in pavements should conform to Caltrans Standard Specifications for Class 2 Aggregate Base. The aggregate base used in pavement sections should be compacted to at least 95 percent relative compaction as determined by ASTM D-1557.

6.05.4 Rigid Pavements

Rigid Portland cement concrete (PCC) pavements may also be used in driveway/loading areas. This section provides recommendations for Caltrans jointed plain concrete pavement (JPCP), which is engineered with longitudinal and transverse joints to control where cracking occurs. JPCPs do not contain steel reinforcement, other than tie bars and dowel bars. The project civil engineer should design and detail the JPCP per Caltrans specifications.

We developed the following pavement thickness design using the Caltrans R-value design method for rigid pavements and an assumed traffic index. The section below is for subgrade soils with an R-value between 10 and 40.

Portland Cement Concrete Pavement Thickness Design

Traffic Index	Portland Cement Concrete (inches)	Caltrans Class 2 Aggregate Base (inches)	Total Thickness (inches)
< 9	9	12	21

Aggregate base should be placed on a compacted non-expansive soil layer that is at least 12 inches thick. The upper 6 inches of subgrade beneath planned pavements should be compacted to at least 95 percent relative compaction per ASTM D-1557. Pavement subgrades should be proof rolled and confirmed to be uniformly firm and non-yielding prior to the placement of aggregate base. Aggregate base for use in pavements should conform to Caltrans Standard Specifications for Class 2 Aggregate Base. The aggregate base used in pavement sections should be compacted to at least 95 percent relative compaction as determined by ASTM D-1557.

7. FUTURE GEOTECHNICAL SERVICES

7.01 Supplemental Subsurface Investigations

Currently, limited information is available regarding the thickness of the soft clay topsoil layer across the building footprint. The thickness of this layer might be better defined prior to construction, which would help better define the depths of over-excavation required. Based on conversations with UCB EHS personnel in autumn of 2017, we understand EHS may be planning an environmental soil pre-characterization program prior to construction, likely to consist of shallow direct push borings or similar, within the NRLF 4 footprint. If this occurs, it may be beneficial for an A3GEO representative to be on site during the drilling program to observe soil conditions and make an estimate of the bottom of the soft clay topsoil layer at each borehole location. Alternatively, shallow borings or test pits could be undertaken by the contractor prior to construction.

Additionally, as discussed in Section 5.05, we recommend test pits be performed along the edges of the Phase 2 and Phase 3 structures to observe the extent of structural fill and lime treated soils, respectively. We recommend these test pits be conducted prior to construction and prior to the Contractor's preparation of an earthwork submittal.

7.02 Design-Phase Consultations and Plan Review

We recommend A3GEO be provided the opportunity to review the project plans and specifications as they are being developed to check conformance with the intent of our geotechnical recommendations and to provide timely input, in the event that revisions are needed. We should perform a general review of the geotechnical aspects of the final plans and specifications, the results of which we should document in a formal plan review letter.

7.03 Construction-Phase Geotechnical Services

It is essential that A3GEO provide geotechnical services during construction to check whether conditions are as anticipated, provide supplemental recommendations where necessary, and document that the geotechnical aspects of the work substantially conform to the approved Contract Documents and the intent of our geotechnical recommendations. Critical aspects of construction that A3GEO should observe include over-excavation, subgrade preparation, and backfilling. A3GEO should also review, comment upon and approve, where appropriate, contractor submittals (including material submittals and requests for information or clarification) that are geotechnical in nature.

8. LIMITATIONS

This report has been prepared for the exclusive use of UCB and its consultants for specific application to the design of the NRLF Phase 4 Project described herein. The opinions presented in this report were developed in accordance with generally-accepted geotechnical and engineering geologic principles and practices. No other warranty, expressed or implied, is made. In the event that any changes in the nature or design of the project are planned, the conclusions and recommendations contained in this report should not be considered valid unless the changes are reviewed and the conclusions of this report are modified or verified in writing.

The findings of this report are valid as of the present date. However, the passing of time will likely change the conditions of the existing property due to natural processes or the works of man. In addition, due to legislation or the broadening of knowledge, changes in applicable or appropriate standards will occur. Accordingly, this report should not be relied upon after a period of three years without being reviewed by this office.

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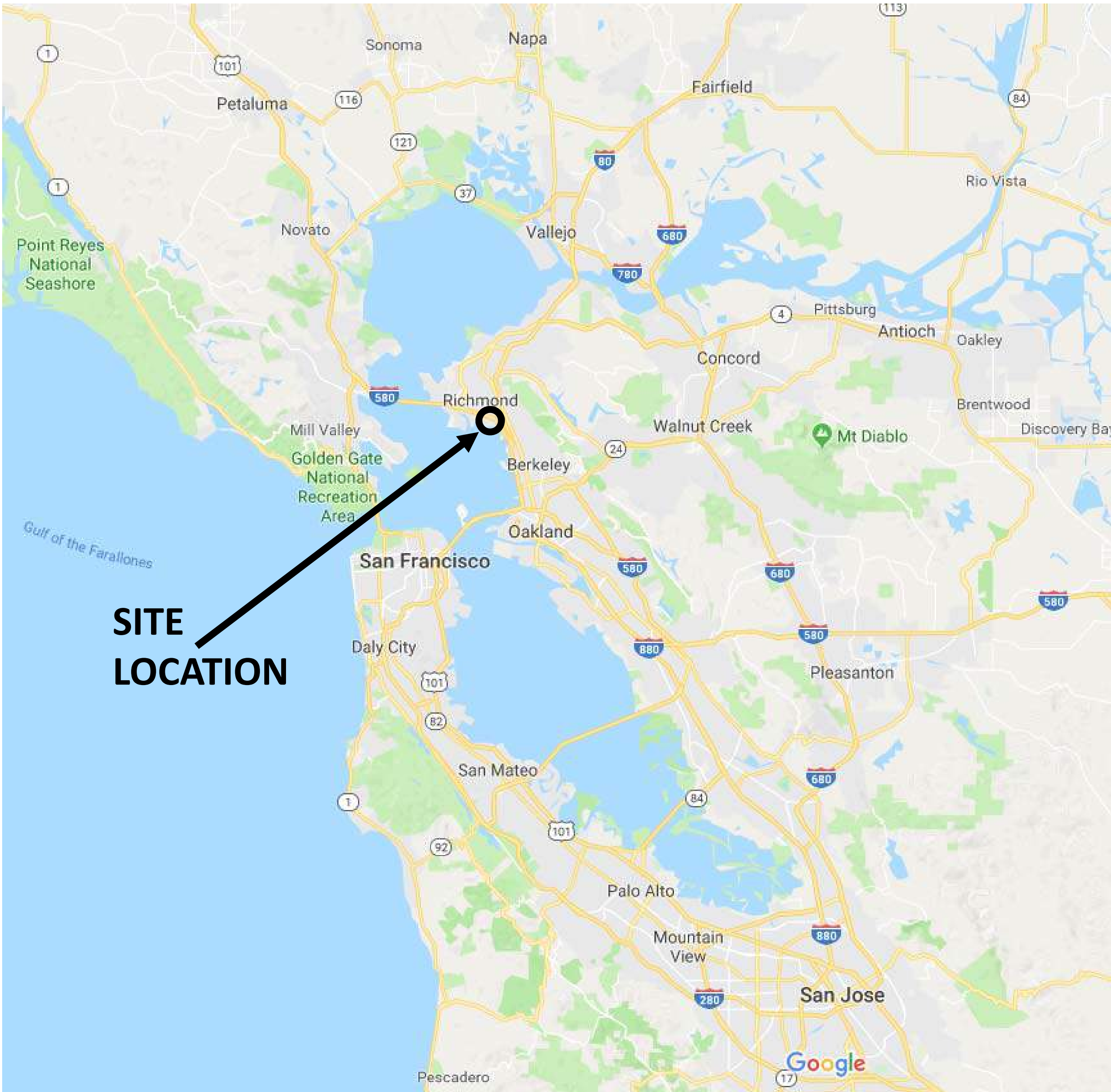
PLATES

A3GEO

Source: Google Maps®



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NRLF PHASE 4
GEOTECHNICAL INVESTIGATION

PLATE 1
SITE LOCATION

Source: Google Maps®

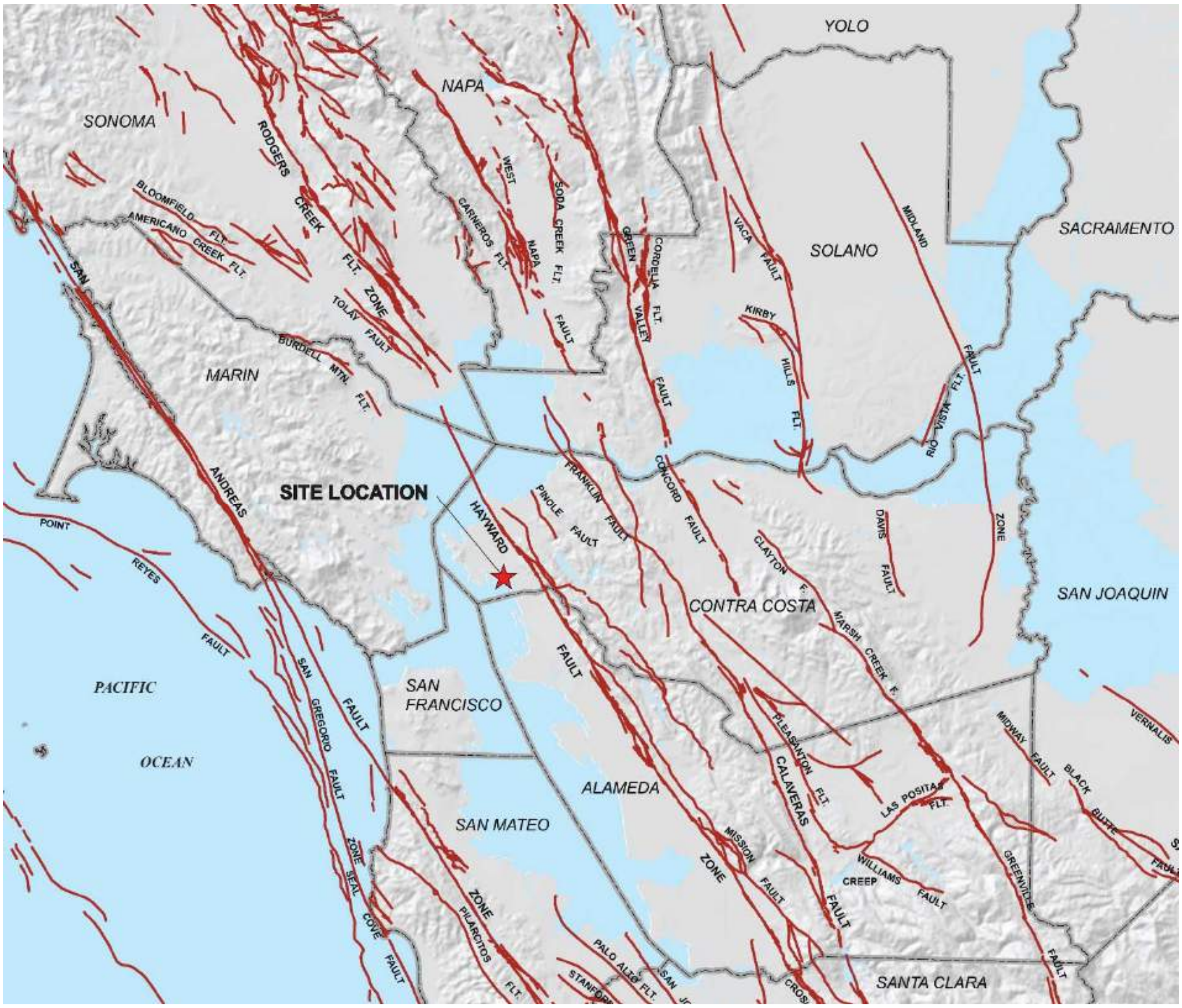
N

NRLF PHASE 4
GEOTECHNICAL INVESTIGATION

PLATE 2
VICINITY MAP

A3GEO

Source: USGS and California Geological Survey, 2006, Quaternary Fault and Fold Database for the United States, accessed 25 January, 2018, from USGS website: http://earthquake.usgs.gov/hazards/qfaults

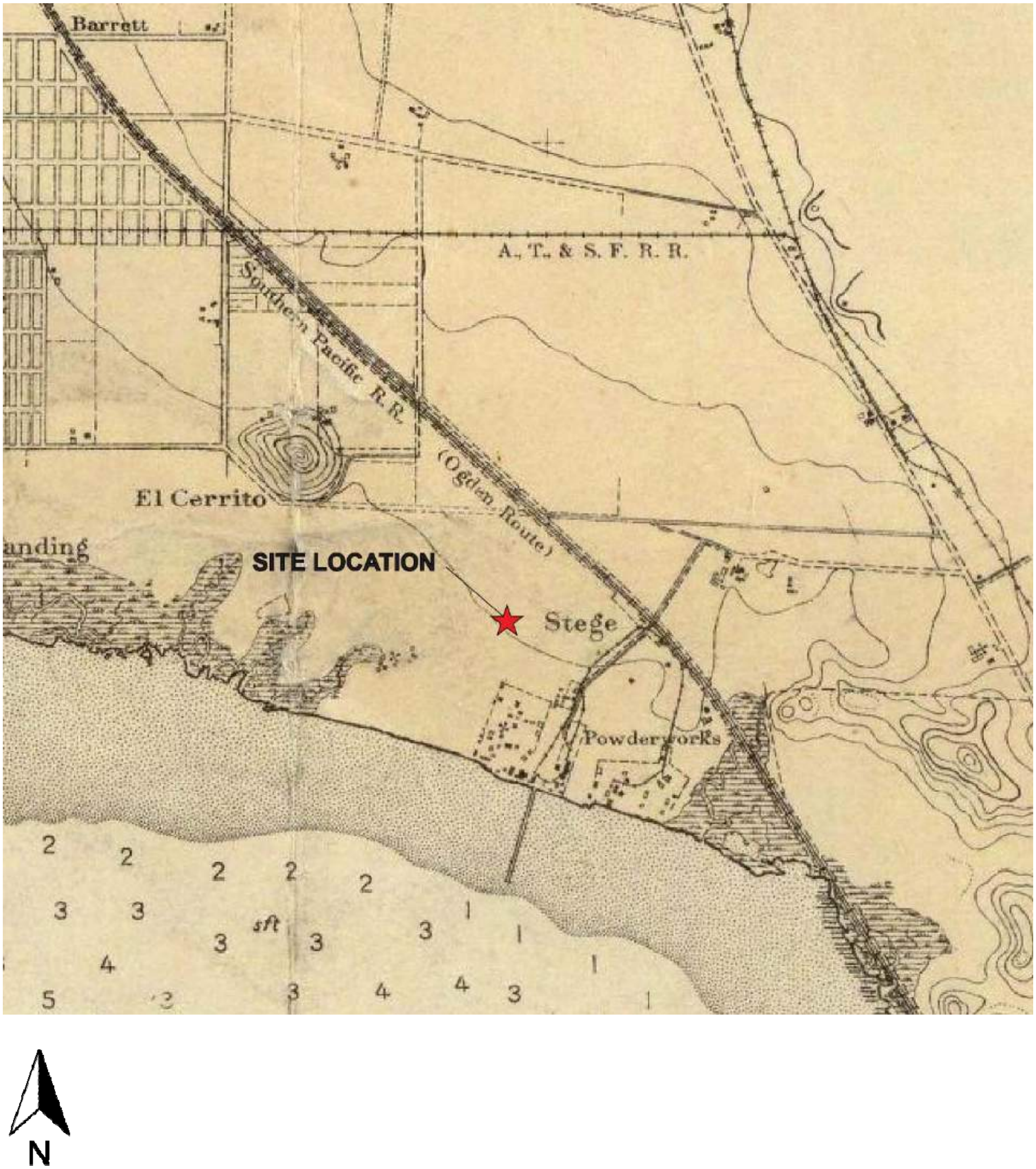


NRLF PHASE 4
GEOTECHNICAL INVESTIGATION

PLATE 3
QUATERNARY FAULT MAP

Source: U.S. Coast and Geodetic Survey, 1903, San Francisco Entrance, California, 1:40,000 scale, September.

A3GEO



NRLF PHASE 4
GEOTECHNICAL INVESTIGATION

PLATE 4
HISTORICAL MAP

Source: Graymer, R.W., 2000, Geologic Map and Map Database of the Oakland Metropolitan Area, Alameda, Contra Costa, and San Francisco Counties, California, USGS Miscellaneous Field Study MR-2342

A3GEO

af	Artificial Fill (Historic)	KJfy	Franciscan Complex Metasandstone of Yolla Bolly Terrane (Cretaceous (?) to Late Jurassic)
Qhaf	Alluvial Fan and Fluvial Deposits (Holocene)	KJfm	Franciscan Complex Mélange (Cretaceous to Late Jurassic)
Qhb	Basin Deposits (Holocene)	fc	Franciscan Complex Chert Blocks
Qhl	Natural Levee Deposits (Holocene)	fg	Franciscan Complex Greenstone Blocks

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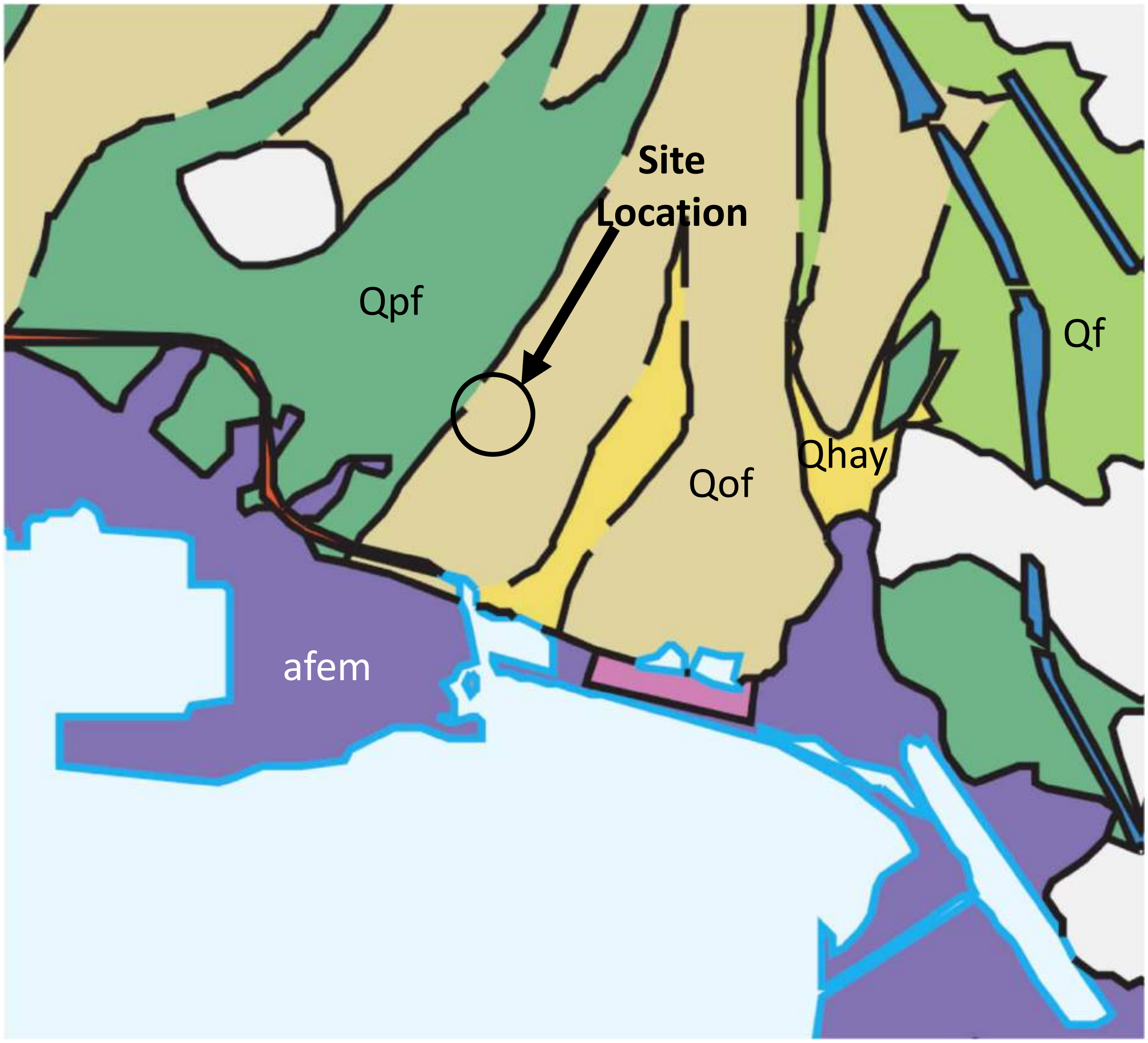
NRLF PHASE 4
GEOTECHNICAL INVESTIGATION

PLATE 5
GEOLOGIC MAP

Source: Witter, R.C. et al., 2006, Maps of Quaternary Deposits and Liquefaction Susceptibility in the Central San Francisco Bay Region, California, USGS Open-File Report 2006-1037

A3GEO



af	Artificial Fill (Historical)	**Qf**	Alluvial Fan Deposits (Holocene to Latest Pleistocene)
afem	Artificial Fill over Estuarine Mud (Historical)	**Qpf**	Alluvial Fan Deposits (Latest Pleistocene)
Qhay	Alluvial Deposits, Undifferentiated (Holocene)	**Qof**	Alluvial Fan Deposits (Early to Late Pleistocene)
Qhbm	San Francisco Bay Mud (Holocene)		

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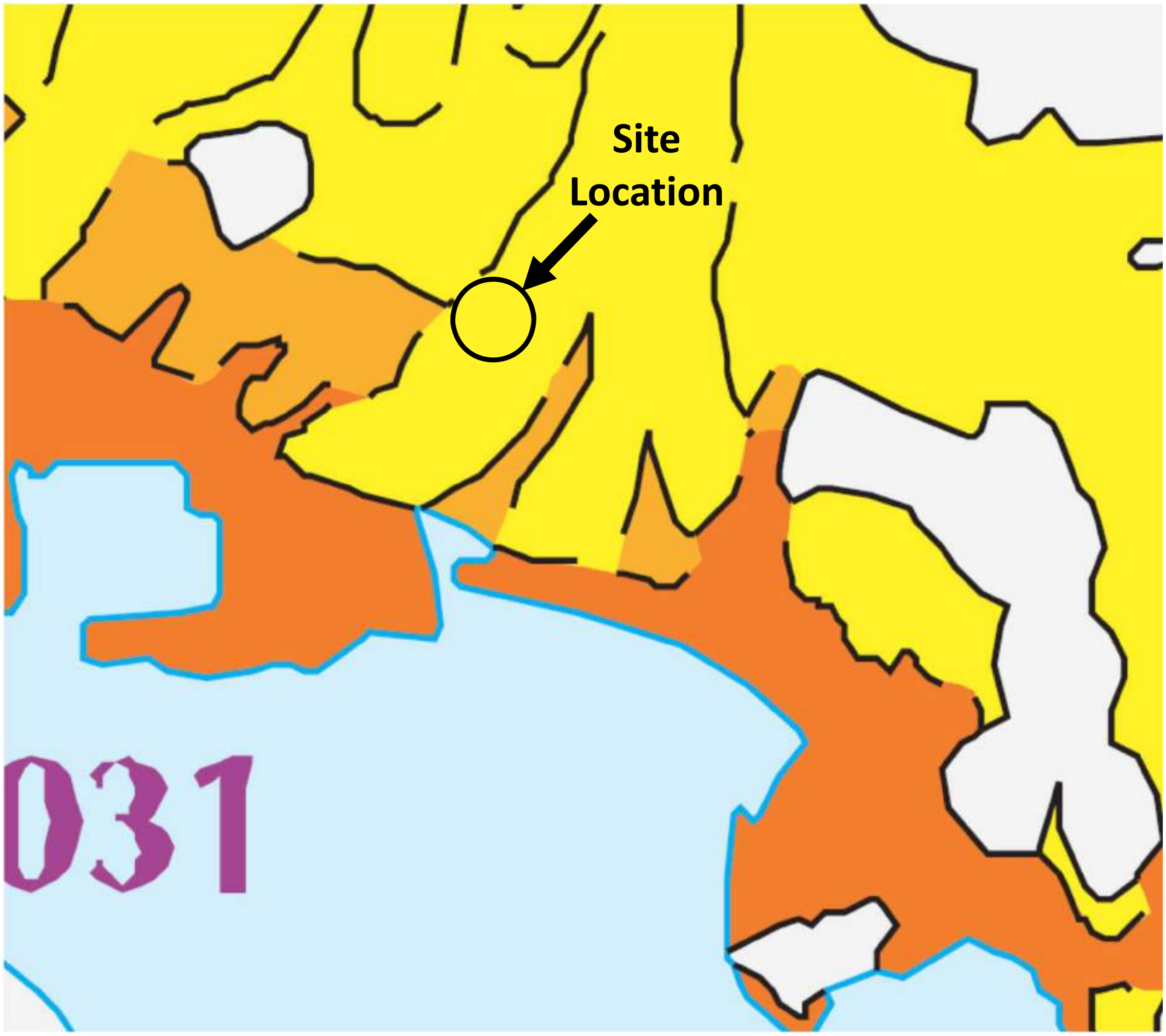
PLATE 6
QUATERNARY GEOLOGIC MAP

Source: Knudsen et al., 2000, Description of Quaternary Deposits and Liquefaction Susceptibility, Nine-County San Francisco Bay Region, California, USGS Part 3 of Open-File Report 00-444



LIQUEFACTION SUSCEPTIBILITY

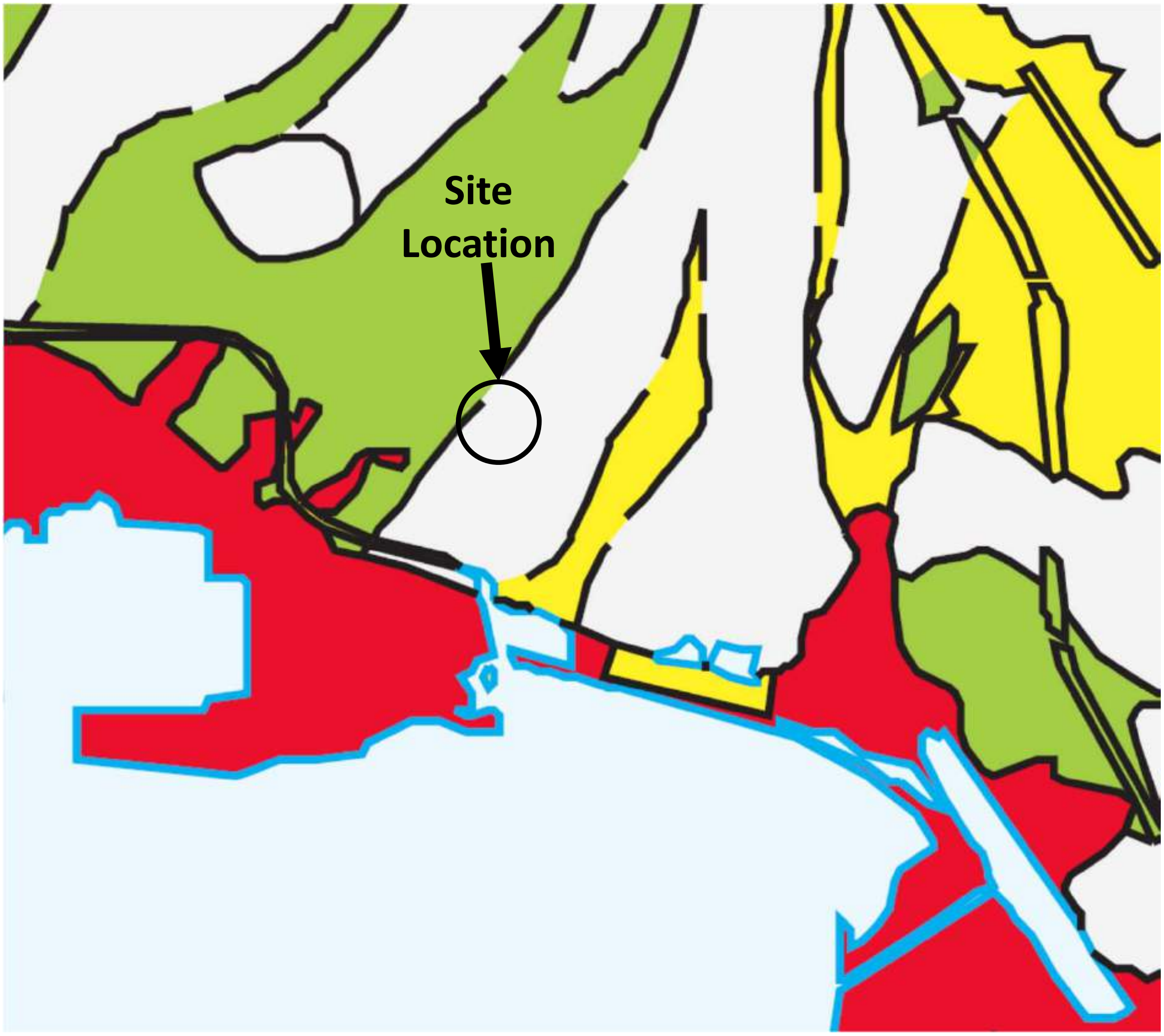
Very High	Low
High	Very Low
Moderate	

N

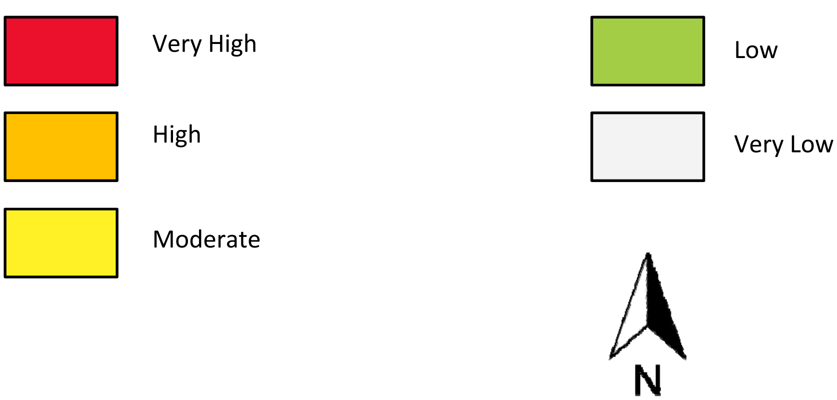
NRLF PHASE 4
GEOTECHNICAL INVESTIGATION

PLATE 7A
LIQUEFACTION POTENTIAL MAP

Source: Witter, R.C. et al., 2006, Maps of Quaternary Deposits and Liquefaction Susceptibility in the Central San Francisco Bay Region, California, USGS Open-File Report 2006-1037



LIQUEFACTION SUSCEPTIBILITY

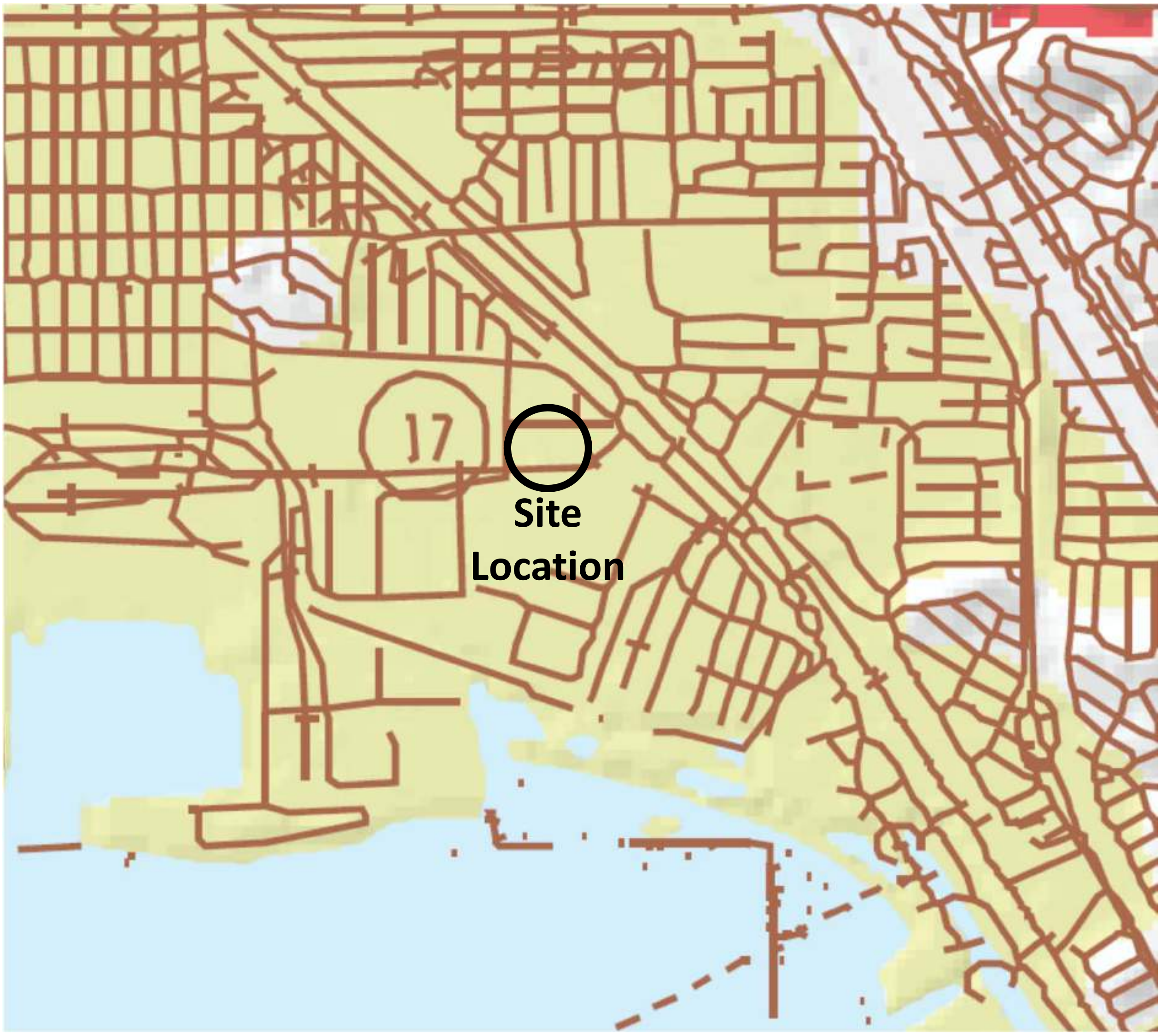


NRLF PHASE 4
GEOTECHNICAL INVESTIGATION

PLATE 7B
LIQUEFACTION POTENTIAL MAP

Source: Wentworth, C.M., et al., 1997, Summary Distribution of Slides and Earth Flows in Contra Costa County, California, USGS Open-File Report 97-745 C, Sheet 3 of 11.

A3GEO



MAP UNITS

Mostly Landslides	Few Landslides
Many Landslides	Flat Land

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PLATE 8
LANDSLIDE POTENTIAL MAP

TABLES

TABLE I - SUMMARY OF SUBSURFACE DATA
GEOTECHNICAL INVESTIGATION - NRLF PHASE 4 EXPANSION
UNIVERSITY OF CALIFORNIA - BERKELEY
RICHMOND, CALIFORNIA
1101-17A

Boring ID	Consultant	Purpose	Date	Ground Surface El.	Total Boring Depth	Bottom of Boring El.	Soft Clay Topsoil and/or Fill			Alluvium & Yerba Buena Mud			Bedrock	
							Depth to Top	El. of Top	Thickness	Depth to Top	El. of Top	Thickness	Depth to Top	El. of Top
				[ft]	[ft]	[ft]	[ft]	[ft]	[ft]	[ft]	[ft]	[ft]	[ft]	[ft]
A3-17-1	A3GEO	NRLF Phase 4	11/28/2017	20.5	114.6	-94.1	0.0	20.5	4.0	4.0	16.5	110.5	114.5	-94.0
A3-17-2	A3GEO	NRLF Phase 4	11/29/2017	19.0	124.4	-105.4	0.0	19.0	5.0	5.0	14.0	119.0	124.0	-105.0
#10	URS	NRLF Phase 3	2/12/2001	23.5	31.5	-8.0	0.5	23.0	4.5	5.0	18.5	>26.5	>31.5	Below El. -8
#11	URS	NRLF Phase 3	3/6/2001	22.0	51.5	-29.5	0.0	22.0	3.5	3.5	18.5	>48	>51.5	Below El. -29.5
#12	URS	NRLF Phase 3	3/5/2001	22.0	51.5	-29.5	0.0	22.0	3.0	3.0	19.0	>48.5	>51.5	Below El. -29.5
#8	WCC	NRLF Phase 2	2/23/1988	19.5	110.5	-91.0	0.0	19.5	3.0	3.0	16.5	105.0	108.0	-88.5
#9	WCC	NRLF Phase 2	2/23/1988	21.0	91.0	-70.0	0.0	21.0	4.0	4.0	17.0	87.0	91.0	-70.0
W-1	WCC	NRLF Phase 2	2/23/1988	23.0	26.0	-3.0	0.0	23.0	4.0	4.0	19.0	>22	>26	Below El. -3
A	WCC	NRLF Phase 1	11/10/1980	21.5	101.5	-80.0	0.0	21.5	6.0	6.0	15.5	84.5	90.5	-69.0
B	WCC	NRLF Phase 1	11/13/1980	22.0	81.0	-59.0	0.0	22.0	6.0	6.0	16.0	73.5	79.5	-57.5
C	WCC	NRLF Phase 1	11/12/1980	21.5	82.5	-61.0	0.0	21.5	5.5	5.5	16.0	68.5	74.0	-52.5
D	WCC	NRLF Phase 1	11/11/1980	21	85.5	-64.5	0.0	21.0	7.0	7.0	14.0	72.5	79.5	-58.5
#3	WCC	NRLF Phase 1	2/26/1980	21.0	61.0	-40.0	0.0	21.0	2.0	2.0	19.0	>59	>61	Below El. -40
#4	WCC	NRLF Phase 1	2/23/1980	21.0	61.0	-40.0	0.0	21.0	4.0	4.0	17.0	>57	>61	Below El. -40
#5	WCC	NRLF Phase 1	2/25/1980	22.0	61.0	-39.0	0.0	22.0	3.8	3.8	18.2	>57.2	>61	Below El. -39
#6	WCC	NRLF Phase 1	2/25/1980	22.0	31.5	-9.5	0.0	22.0	3.0	3.0	19.0	>28.5	>31.5	Below El. -9.5
#7	WCC	NRLF Phase 1	2/25/1980	23.0	31.5	-8.5	0.0	23.0	2.8	2.8	20.2	>28.7	>31.5	Below El. -8.5

NOTES:
1. Ground surface elevations for URS NRLF Phase 3 borings indicated "Not Available" on boring logs. Ground surface elevations estimated from drawing C1 "Demolition", from *Record Drawings, University of California Northern Regional Library Facility Phase 3,* prepared by EHDD and dated 12 October 2005. Drawing C1 contains existing topographic information from survey dated 14 February and 27 March 2001.
2. Ground surface elevations for WCC NRLF Phase 2 borings not indicated. Ground surface elevations estimated from drawing A1.0 "Site Survey - Not in Contract", from *As Built Drawings, Northern Regional Library Facility Phase 2, Richmond, Calif."* , dated 2 March 1989. Drawing A1.0 contains existing topographic information from survey dated June 1988.
3. Boring W-1 was advanced for the installation of a standpipe piezometer.
4. Boring #9 encountered refusal at 91 feet. It is not clear whether the borehole refused on bedrock.
5. Ground surface elevations for A3GEO borings based on drawing C1.00 "Site Plan", for University of California Northern Regional Library Facility Phase IV, prepared by EHDD, dated 18 January 2018.

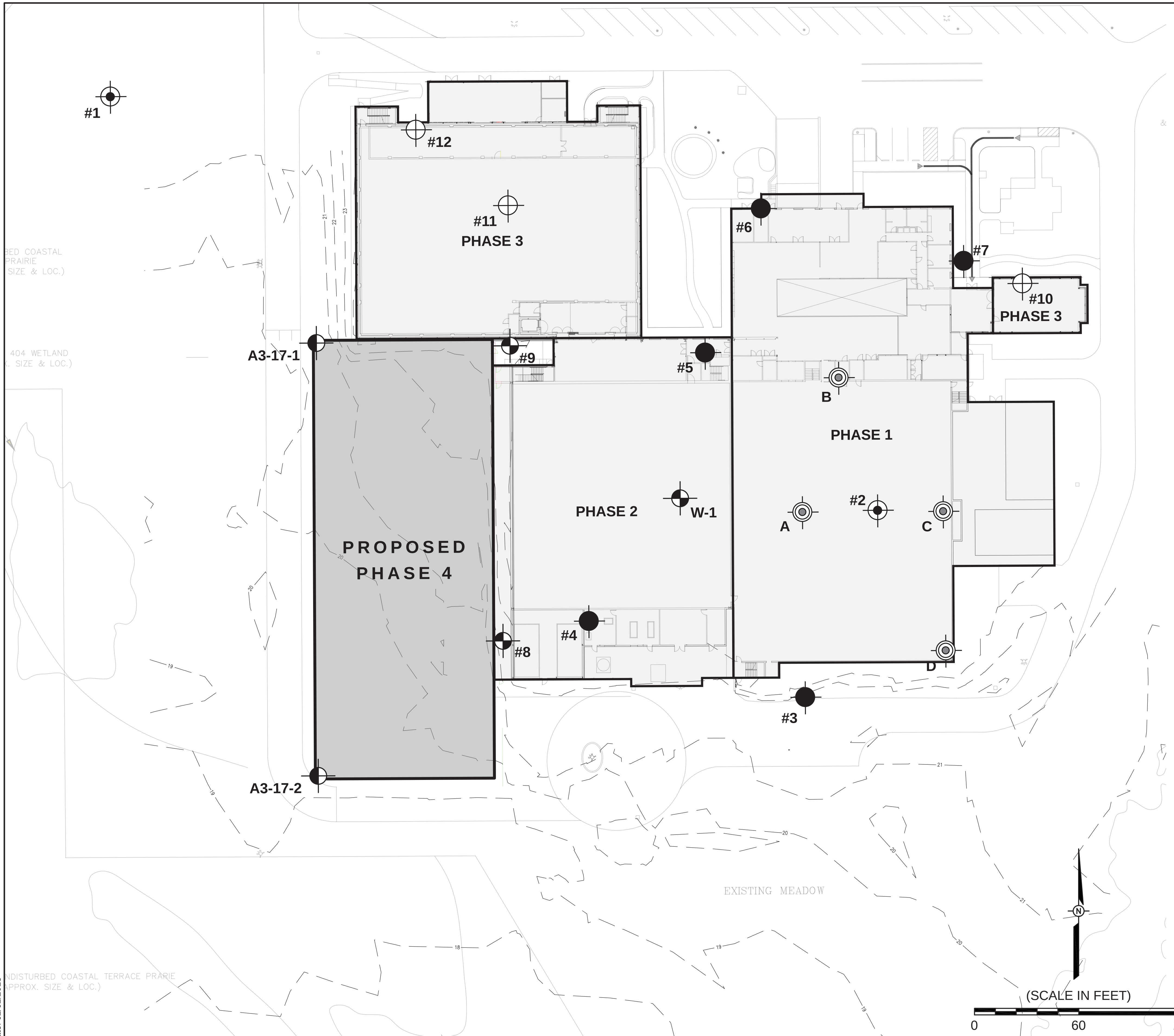
TABLE II - SUMMARY OF ANALYTICAL RESULTS FOR VOCs IN SOIL SAMPLES
GEOTECHNICAL INVESTIGATION - NRLF PHASE 4 EXPANSION
UNIVERSITY OF CALIFORNIA - BERKELEY
RICHMOND, CALIFORNIA
1101-17A

Location	Sample Date	Sample Designation	Sample Depth	All VOCs
			(feet bgs)	µg/kg
A3-17-1	11/27/2017	A3-17-1-15	15	ND
	11/27/2017	A3-17-1-40	40	ND
A3-17-2	11/28/2017	A3-17-2-15	15	ND
	11/29/2017	A3-17-2-40	40	ND

NOTES:
1. Compounds not detected are not presented.
2. Samples were collected by A3GEO, Inc., and analyzed by Enthalpy Analytical Laboratory of Berkeley, California by USEPA Method 8260B.

ABBREVIATIONS:
bgs = below ground surface
VOC = volatile organic compound
USEPA = United States Environmental Protection Agency
µg/kg = microgram per kilogram
ND = Not Detected; compound was not detected in the sample at a concentration at or above the reporting limit

FIGURES



LEGEND:

- A3-17-2 — Designation and approximate location of geotechnical test boring advanced for design of NRLF Phase 4 by A3GEO on 27 to 29 November, 2017.
- #12 — Designation and reported location of geotechnical boring advanced in February and March 2001 for NRLF Phase 3 by URS
- W-1 — Designation and reported location of geotechnical boring advanced in February 1988 for NRLF Phase 2 by Woodward-Clyde Consultants
- D — Designation and reported location of supplemental geotechnical boring advanced in November 1980 for NRLF Phase 1 by Woodward-Clyde Consultants
- #7 — Designation and reported location of geotechnical boring advanced in February 1980 for NRLF Phase 1 by Woodward-Clyde Consultants
- #2 — Designation and reported location of preliminary geotechnical boring advanced in 1979 for NRLF Phase 1 by Woodward-Clyde Consultants

Notes:

1. Base plan taken from drawing A1.01, titled "Site Plan, Code Analysis", prepared by EHDD of San Francisco, California, and dated 20 January 2017.
2. NRLF = Northern Regional Library Facility
3. Locations of NRLF Phase 3 borings taken from Figure 1 in URS, 2001, "Draft Report Geotechnical Engineering Study, University of California NRLF Phase 3", 2 April.
4. Locations of NRLF Phase 2 borings taken from Figure 1 in Woodward-Clyde Consultants, 1988, "Geotechnical Engineering Study, University of California NRLF Phase 2", 3 June.
5. Locations of NRLF Phase 1 borings taken from Figure 1s in Woodward-Clyde Consultants, 1980, "Supplemental Geotechnical Exploration, NRLF", 16 December.
6. Topographic information taken from drawing C1.00, "Site Plan", for University of California Northern Regional Library Facility Phase IV, prepared by EHDD, and dated 18 January 2018.

NRLF PHASE 4 INVESTIGATION
UC BERKELEY
RICHMOND, CALIFORNIA

Project No. 1101-17A

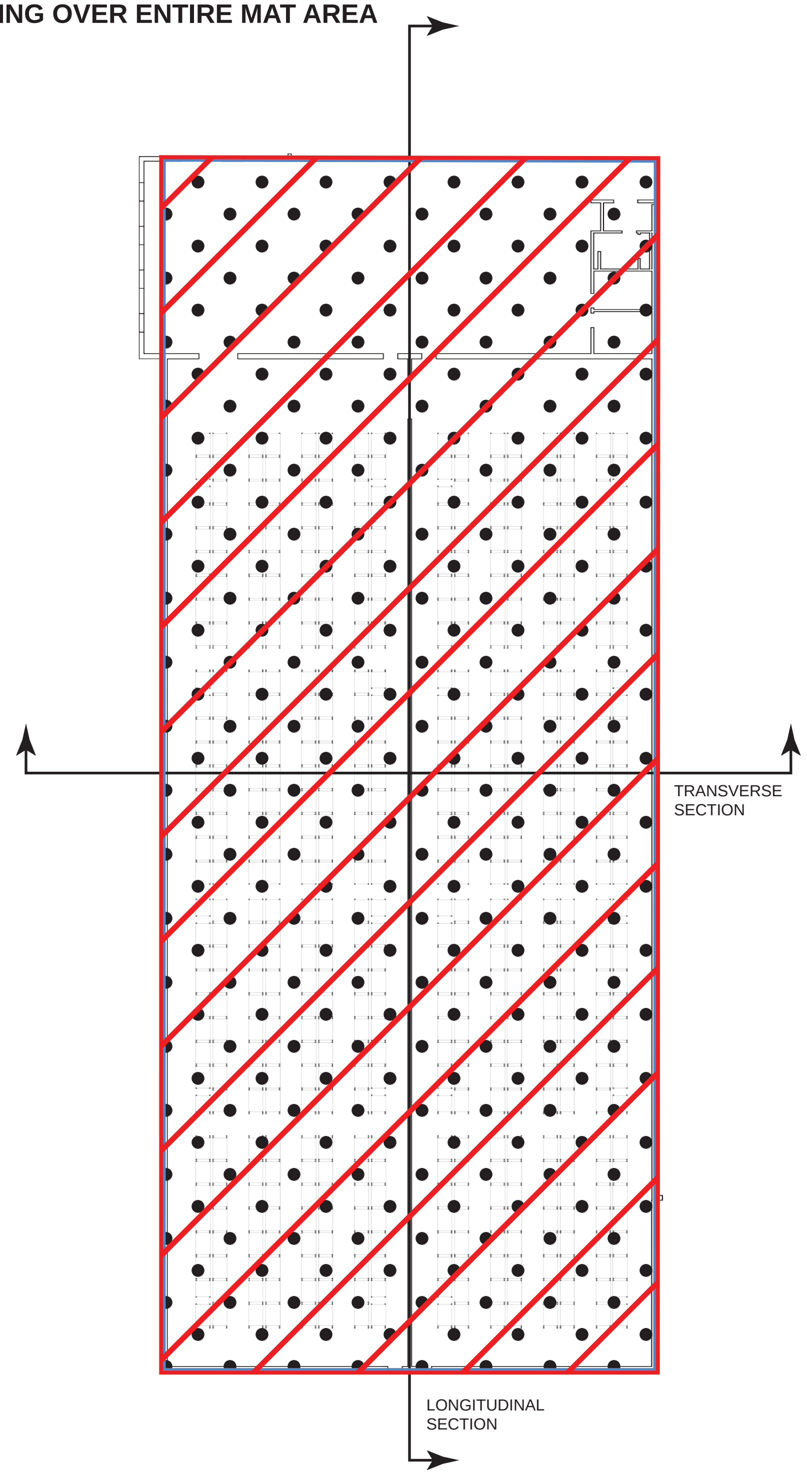
EXPLORATION LOCATION PLAN

A3GEO

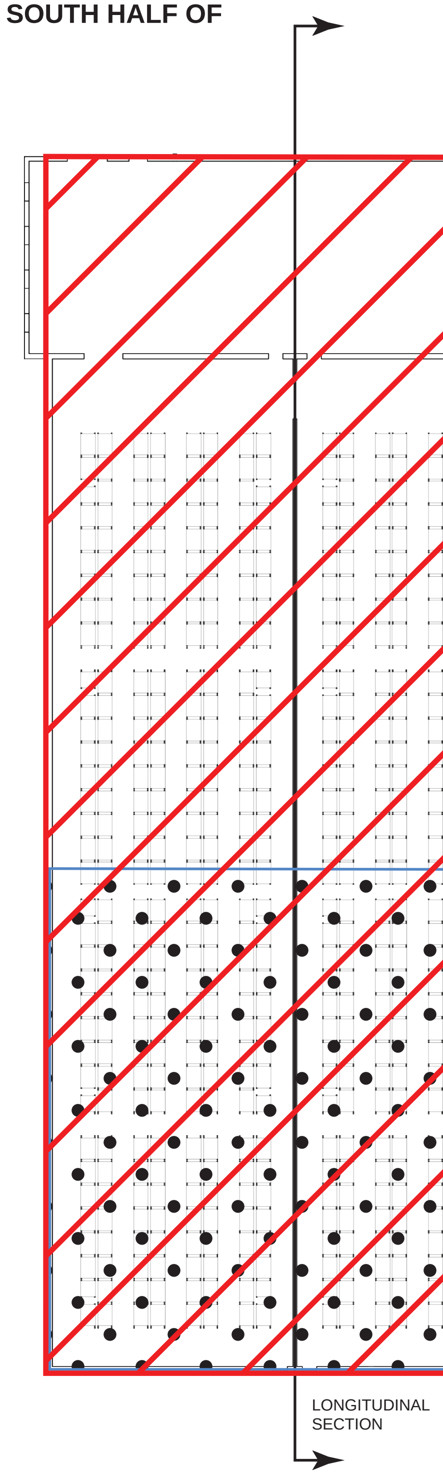
FIGURE 1

Date: 02/02/2018

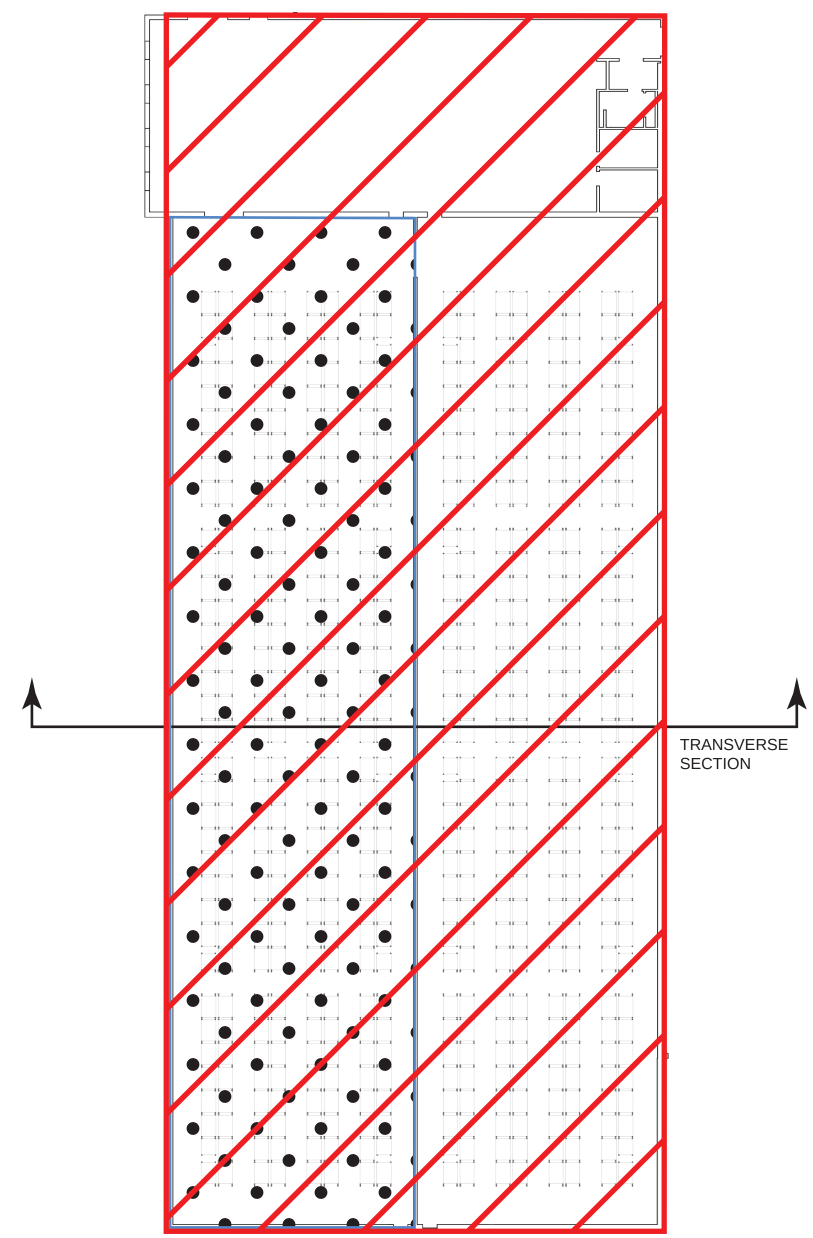
SCENARIO 1A, 2A, 3A
UNIFORM 675 PSF BOOK/SHELF LOADING OVER ENTIRE MAT AREA



SCENARIO 1X, 2X, 3X
UNIFORM 675 PSF BOOK/SHELF LOADING OVER SOUTH HALF OF STACKS ONLY



SCENARIO 1Y, 2Y, 3Y
UNIFORM 675 PSF BOOK/SHELF LOADING OVER WEST HALF OF STACKS ONLY



LEGEND:

INITIAL LOAD
Scenario 1 - 900 PSF
Scenario 2 - 255 PSF
Scenario 3 - 0 PSF

POST -CONSTRUCTION LOAD
All Scenarios - 675 PSF

Cross Section Line

Notes:

1. Section line lengths are approximate, see model output plots for further details.
2. Base plan from Drawing A2.01, “Level 1 Floor Plan,” prepared by EHDD and dated 19 January 2018 (100% Schematic Design).
3. PSF = Pounds Per Square Foot

N

(SCALE IN FEET)
0 40 80

NRLF PHASE 4 INVESTIGATION
UC BERKELEY
RICHMOND, CALIFORNIA

Project No. 1101-17A

SETTLEMENT ANALYSIS - SUMMARY OF APPROACH

A3GEO

FIGURE 2

Date: 02/02/2018

APPENDIX A

Historic Boring Logs

Project: NORTHERN REGIONAL LIBRARY COMPACT SHELVING FACILITY U.C.-Richmond Field Station	Log of Boring No. 3

Date Drilled: February 26, 1980
Type of Boring: 6" Auger
Hammer Weight: 140 lbs.
Remarks: See LEGEND on Figure 2b

Surface Elevation:

Depth, Ft.	Samples	Blows/Ft.	MATERIAL DESCRIPTION	Moisture Content, %	Dry Density, pcf	Unconfined Compressive Strength, psf
			SILTY CLAY (CL) Soft, dark gray			
	1	7		24	104	1200
			SILTY CLAY (CH) Stiff, light gray			
5	2	37	Very stiff, tan	17	113	6060
			CLAYEY SAND & GRAVEL (GP) Medium dense, brown			
10	3	42		-	-	-
			ATD			
			SANDY CLAY (CL)			
15	4	23	Stiff to very stiff, brown	21	103	3030
20	5	17		23	102	1580
			Grading to Silty Clay			
25	6	26		22	103	5040
			CLAYEY SILT (ML) Medium dense, brown			
30	7	43	Grading to Sandy Silt	23	103	1880
			SAND & GRAVEL (GW) Dense, brown, to 1" max. size			
35	8	70		-	-	-
			SANDY CLAY (CL) Very stiff, blue-gray			

Proj. No. 14676A | **Woodward-Clyde Consultants** | Figure 2a

Project: NORTHERN REGIONAL LIBRARY
COMPACT SHELVING FACILITY
U.C.-Richmond Field Station

Log of Boring No. 3

(Continued)

Depth, Ft.	Samples	Blows/Ft.	MATERIAL DESCRIPTION	Moisture Content, %	Dry Density, pcf	Unconfined Compressive Strength, psf
40	9	37	SANDY CLAY (CL)......Cont'd } Silty Clay	-	-	-
45	10	70		18	111	8840
			SILTY CLAY (CL) Hard, blue-gray			
50	11	60	SANDY CLAY (CL) Very stiff, brown	-	-	-
55	12	58		16	115	4760
60	13	52		-	-	-
			BOTTOM OF BORING @ 61.0'			
65						
70						
75						
80						

LEGEND FOR ALL BORINGS:

2" I.D. MODIFIED CALIFORNIA SAMPLER

2½" I.D. MODIFIED CALIFORNIA SAMPLER

ATD — WATER LEVEL AT TIME OF DRILLING

Project: NORTHERN REGIONAL LIBRARY COMPACT SHELVING FACILITY U.C.-Richmond Field Station

Log of Boring No. 4

Date Drilled: February 23, 1980
Type of Boring: 6" Auger
Hammer Weight: 140 lbs.
Remarks: See LEGEND on Figure 2b

Surface Elevation:

Depth, Ft.	Samples	Blows/Ft.	MATERIAL DESCRIPTION	Moisture Content, %	Dry Density, pcf	Unconfined Compressive Strength, psf
			SILTY CLAY (CH) Soft, dark gray			
	1	9	SILTY CLAY (CH) Medium stiff, light gray	31	88	980
5	2	41	SILTY CLAY (CH) Hard, light gray, with lime	15	110	8420
10	3	29	SILTY CLAY (CL) Very stiff, brown; CONSOL. TEST, See Figure 8	24	101	4960
			ATD; Stiff			
15	4	27		25	102	3390
20	5	19	SANDY CLAY (CL) Stiff to very stiff, brown; Gravelly	17	114	3230
25	6	22	SILTY CLAY (CL) Stiff, brown	28	95	3560
30	7	22		25	99	2940
			SANDY CLAY (CL) Stiff, brown			
35	8	50	SAND & GRAVEL (GW) Dense, brown	-	-	-
			SILTY CLAY (CL) Very stiff, blue-gray			

Proj. No. 14676A — **Woodward-Clyde Consultants** — Figure 3a

Project: NORTHERN REGIONAL LIBRARY
COMPACT SHELVING FACILITY
U.C.-Richmond Field Station

Log of Boring No. 4
(Continued)

Depth, Ft.	Samples	Blows/Ft.	MATERIAL DESCRIPTION	Moisture Content, %	Dry Density, pcf	Unconfined Compressive Strength, psf
40	9	36	SILTY CLAY (CL) ......Cont'd CONSOL. TEST, See Figure 9	21	105	4620
45	10	80/10"	Hard	22	106	8550
			Very stiff			
50	11	61		21	108	6230
55	12	39	SILTY CLAY (CL) Very stiff, brown	25	100	4540
60	13	47		-	-	-
			BOTTOM OF BORING @ 61.0'			
65						
70						
75						
80						

Project: NORTHERN REGIONAL LIBRARY COMPACT SHELVING FACILITY U.C.-Richmond Field Station

Log of Boring No. 5

Date Drilled: February 23 & 25, 1980

Type of Boring: 6" Auger

Hammer Weight: 140 lbs.

Remarks: See LEGEND on Figure 2b

Surface Elevation:

Depth, Ft.	Samples	Blows/Ft.	MATERIAL DESCRIPTION	Moisture Content, %	Dry Density, pcf	Unconfined Compressive Strength, psf
	1	8	SILTY CLAY (CL) Soft, dark gray — Stiff	26	94	480
	2	16	SILTY CLAY (CL): Very stiff, gray-brown	26	95	2080
5			SANDY CLAY (CL) Stiff, brown			
	3	53	SAND (SW) Very dense, tan	-	-	-
10			SANDY CLAY (CL)			
	4	17	ATD Stiff, brown	27	97	2290
15						
	5	23	CONSOL. TEST, See Figure 10	-	-	-
20			SAND & GRAVEL (GP): Medium dense, brown			
	6	42	SANDY CLAY (CL) Very stiff, brown	23	104	5220
25						
			SAND & GRAVEL (GP)			
30	7	56	Dense, brown, to 2" max. size	-	-	-
35	8	72	SANDY CLAY (CL) Very stiff, brown	No Recovery		
			SANDY CLAY (CL) Very stiff, blue-gray			

Proj. No. 14676A

Woodward-Clyde Consultants

Figure 4a

Project: NORTHERN REGIONAL LIBRARY
COMPACT SHLEVING FACILITY
U.C.-Richmond Field Station

Log of Boring No. 5
(Continued)

Depth, Ft.	Samples	Blows/Ft.	MATERIAL DESCRIPTION	Moisture Content, %	Dry Density, pcf	Unconfined Compressive Strength, psf
40	9	45	Grading to Silty Clay	21	106	7460
45	10	95		22	105	6320
			} Sand and gravel lense			
50	11	43	SILTY CLAY (CL) Very stiff, brown	20	108	7680
			SAND & GRAVEL (GP) Medium dense			
55	12	27	SILTY CLAY (CL) Stiff to very stiff, brown	22	-	-
60	13	75		-	-	-
			SAND (SW): Dense, brown			
			BOTTOM OF BORING @ 61.0'			
65						
70						
75						
80						

Proj. No. 14676A | **Woodward-Clyde Consultants** | Figure 4b

Log of Boring No. 6

Project: NORTHERN REGIONAL LIBRARY
COMPACT SHELVING FACILITY
U.C.-Richmond Field Station

Date Drilled: February 25, 1980
Type of Boring: 6" Auger
Hammer Weight: 140 lbs.

Remarks: See LEGEND on Figure 2b

Surface Elevation:

Depth, Ft.	Samples	Blows/Ft.	MATERIAL DESCRIPTION	Moisture Content, %	Dry Density, pcf	Unconfined Compressive Strength, psf
			S I L T Y C L A Y (CH) Soft, dark gray -- Stiff			
	1	13		21	104	3180
			S I L T Y C L A Y (CL) Very stiff, brown			
5	2	48	Gravelly	8	133	7060
			S A N D (SP) Medium dense to dense, brown			
10	3	50		-	-	-
			ATD CLAYEY SAND & GRAVEL (GP) Dense, brown			
15	4	29	S I L T Y C L A Y (CL) Very stiff, light gray	19	107	6980
20	5	35	S A N D Y C L A Y (CL) Very stiff, brown	17	115	4010
25	6	32	S I L T Y C L A Y (CL) Very stiff, brown	24	99	5580
30	7	33		-	-	-
			BOTTOM OF BORING @ 31.5'			
35						

Proj. No. 14676A | **Woodward-Clyde Consultants** | Figure 5

Project: NORTHERN REGIONAL LIBRARY
COMPACT SHELVING FACILITY
U.C.-Richmond Field Station

Log of Boring No. 7

Date Drilled: February 25, 1980

Type of Boring: 6" Auger

Hammer Weight: 140 lbs.

Remarks: See LEGEND on Figure 2b

Surface Elevation:

Depth, Ft.	Samples	Blows/Ft.	MATERIAL DESCRIPTION	Moisture Content, %	Dry Density, pcf	Unconfined Compressive Strength, psf
			S I L T Y C L A Y (CH) Soft, dark gray -- Medium stiff			
5	1	32	S I L T Y C L A Y (CL) Stiff, gray-brown -- Very stiff	21	105	5240
10	2	45/10½"	C L A Y E Y S A N D (SC) Dense, brown Grading to a Sandy Clay (CL) With fine gravel			
15	3	17	ATD S A N D Y C L A Y (CL)	19	107	2460
20	4	27	Stiff, brown	22	104	3800
25	5	30	S A N D Y C L A Y (CL) Very stiff, brown	-	-	-
30	6	30		25	100	3920
35			BOTTOM OF BORING @ 31.5'			

Proj. No. 14676A

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Figure 6

Project: NORTHERN REGIONAL LIBRARY
COMPACT SHELVING FACILITY
U.C.-Richmond Field Station

Log of Boring No. A

Date Drilled: November 10, 1980
Type of Boring: 4-7/8" Rotary
Hammer Weight: 140 lbs.

Remarks: See SAMPLER KEY on Figure 2s(c)

Surface Elevation:

Depth, Ft.	Samples	Blows/Ft.	MATERIAL DESCRIPTION	Moisture Content, %	Dry Density, pcf	Unconfined Compressive Strength, psf
0			SILTY CLAY (CL-CH) Stiff to very stiff, dry, gray; Becoming damp			
~6			SILTY SAND & GRAVEL (SM-GP) Medium dense, brown, to 2± in. max. size; Grading with more gravel; Water Level 48 Hours After Drilling			
10	1	23		No Recovery		
~11.5			SILTY CLAY (CL) Stiff, light brown, with fine sand			
21	2	-	CONSOL. TEST, See Figure 6s	22	106	3090
31	3	-		-	-	-
~32			SILTY CLAY (CL-ML) Medium stiff to stiff, light brown, with fine sand			
~34			SAND & GRAVEL (SP-GP) Dense, brown, silty			
~37			SILTY CLAY (CL)			

Proj. No. 14676A

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Figure 2s(a)

Project: NORTHERN REGIONAL LIBRARY
COMPACT SHELVING FACILITY
U.C.-Richmond Field Station

Log of Boring No. A

(Continued)

Depth, Ft.	Samples	Blows/Ft.	MATERIAL DESCRIPTION	Moisture Content, %	Dry Density, pcf	Unconfined Compressive Strength, psf
40	4	-	S I L T Y C L A Y (CL)......Cont'd Very stiff, olive-gray, with fine sand and sand lenses	No Recovery		
45	5	-		17	115	-
50	6	-	S I L T Y C L A Y (CL) Very stiff, blocky, olive-gray, with brown staining and calcareous inclusions	21	105	630
55						
60	7	-	C L A Y E Y S A N D (SC) Dense, olive-gray-brown, slightly clayey, with trace of gravel and interlayered with clean sand	18	106	-
65	8	32	S I L T Y C L A Y (CL-CH) Very stiff, moist, olive-gray with brown silt Becoming sandy	23	101	6690
70	9	-	C L A Y E Y S A N D (SC-CL) Dense, brown, with gravel and thin lenses of clay and clean sand	-	-	-
75	10	34		21	108	1610
80	11	1	Grading to Silty Clay (CL) interlayered with Sandy Clay	25	98	2080

Proj. No. 14676A

Woodward-Clyde Consultants

Figure 2s(b)

Project:	NORTHERN REGIONAL LIBRARY COMPACT SHELVING FACILITY U.C.-Richmond Field Station	Log of Boring No. A (Continued)

Depth, Ft.	Samples	Blows/Ft.	MATERIAL DESCRIPTION	Moisture Content, %	Dry Density, pcf	Unconfined Compressive Strength, psf
			} Gravel lense			
85	12	-	S H A L E Very highly weathered to very stiff Silty Clay (CH), brown	9	126	660
90	13	-		-	-	-
95	14	-	S H A L E Soft to moderately hard, fissile, moderately weathered, dark gray-brown	-	-	-
100	15	-		-	-	-
105			BOTTOM OF BORING @ 101½'			
110						
115						
120						
125						

SAMPLER KEY FOR ALL BORINGS:

- 3" I.D. DOUBLE-BARREL PITCHER CORING SAMPLER
- 2" I.D. MODIFIED CALIFORNIA SAMPLER
- 2" O.D. STANDARD SPLIT-SPOON SAMPLER

Project: NORTHERN REGIONAL LIBRARY
COMPACT SHELVING FACILITY
U.C.-Richmond Field Station

Log of Boring No. B

Date Drilled: November 13, 1980
Type of Boring: 4-7/8" Rotary
Hammer Weight: 140 lbs.

Remarks: See SAMPLER KEY on Figure 2s(c)

Surface Elevation:

Depth, Ft.	Samples	Blows/Ft.	MATERIAL DESCRIPTION	Moisture Content, %	Dry Density, pcf	Unconfined Compressive Strength, psf
			SILTY CLAY (CL-CH) Medium stiff, dry to damp, gray			
5			Becoming moist			
			CLAYEY SAND & GRAVEL (SC-GC) Medium dense to dense, brown, slightly clayey			
10	1	-		-	-	-
15			SANDY CLAY (CL): Medium stiff, moist, brown			
			CLAYEY SAND & GRAVEL (GP-GC): Dense, dark brown			
			SANDY CLAY (CL) Stiff to very stiff, brown, silty			
20	2	-		-	-	-
25			Grading with Gravel and more Sand (SC)			
			Grading with less Sand and without Gravel (CL-ML)			
30	3	-		No Recovery		
			Gravel lense			
35	3A	-	Gravel lense	-	-	-
			SILTY CLAY (CL-ML) Stiff, brown, with sandy lenses			
			SILTY CLAY (CL): Very stiff, olive-gray, sandy, with calcareous inclusions			

Proj. No. 14676A

Woodward-Clyde Consultants

Figure 3s(a)

Project: NORTHERN REGIONAL LIBRARY
COMPACT SHELVING FACILITY
U.C.-Richmond Field Station

Log of Boring No. B

(Continued)

Depth, Ft.	Samples	Blows/Ft.	MATERIAL DESCRIPTION	Moisture Content, %	Dry Density, pcf	Unconfined Compressive Strength, psf
40	4	-	SILTY CLAY (CL) Cont'd......	18	112	4160
43			Becoming less sandy and more plastic (CL-CH)			
45						
50	5	-	CONSOL. TEST, See Figure 7s	22	107	5410
55						
60	6	-	CLAYEY SAND WITH GRAVEL (SC-SP) Dense, olive-gray-brown	17	113	-
65						
			SILTY CLAY (CL-ML) Stiff to very stiff, moist, olive-gray-brown			
70	7	-	CLAYEY SAND WITH GRAVEL (SC-GP) Dense, moist, brown	13	118	-
75			SANDY CLAY (CL-SC) Stiff to very stiff, moist, olive-gray			
80	8	-	SHALE Soft, moderately weathered, dark gray-brown	-	-	-
			BOTTOM OF BORING @ 81'			

Proj. No. 14676A

Woodward-Clyde Consultants

Figure 3s(b)

Project:	NORTHERN REGIONAL LIBRARY COMPACT SHELVING FACILITY U.C.-Richmond Field Station

Log of Boring No. C

Date Drilled: November 12, 1980

Type of Boring: 4-7/8" Rotary

Hammer Weight: 140 lbs.

Remarks: See SAMPLER KEY on Figure 2s(c)

Depth, Ft.	Samples	Blows/Ft.	MATERIAL DESCRIPTION	LABORATORY TESTS: Moisture Content, %	LABORATORY TESTS: Dry Density, pcf	LABORATORY TESTS: Unconfined Compressive Strength, psf
			Surface Elevation:			
0–5			S I L T Y C L A Y (CL-CH) Stiff, dry to damp, brown-gray Becoming moist			
5–14			S I L T Y S A N D (SM-ML) Medium dense, brown, with gravel Grading with more Gravel (GM)			
14–16			S A N D Y C L A Y (CL) Stiff, moist, brown			
16–19.5			SILTY SAND & GRAVEL (SM-GP) Medium dense, dark brown			
19.5–25			S I L T Y C L A Y (CL) Stiff to very stiff, moist to wet, brown, with trace of gravel			
25–27.5			S I L T Y C L A Y (CH-CL) Very stiff, moist to wet, brown-gray			
27.5–34			S I L T Y C L A Y (CL-ML) Stiff to very stiff, moist to wet, brown			
34–37			S A N D Y G R A V E L (GP) Dense, dark brown			
37–			S I L T Y C L A Y (CL-ML) Stiff to very stiff, moist, gray-brown			

Proj. No. 14676A | Woodward-Clyde Consultants | Figure 4s(a)

Project: NORTHERN REGIONAL LIBRARY
COMPACT SHELVING FACILITY
U.C.-Richmond Field Station

Log of Boring No. C
(Continued)

Depth, Ft.	Samples	Blows/Ft.	MATERIAL DESCRIPTION	Moisture Content, %	Dry Density, pcf	Unconfined Compressive Strength, psf
40			S I L T Y C L A Y (CL-CH) Cont'd...... Very stiff to hard, moist, olive-gray, with calcareous inclusions			
45	1	-		22	107	9000
50	2	81	C L A Y E Y S A N D (SC-SM) Very dense, olive-brown	-	-	-
55	3	-	S I L T Y C L A Y (CL) Very stiff, moist, olive-gray, with gravel and sandy clay lenses	21	105	1880
60	4	-	Grading with more Sand and less Gravel (CL-ML)			
			C L A Y E Y S A N D (SC-SM) Dense, brown			
65	5	-	S A N D Y C L A Y (CL-SC) Stiff, olive-brown, with cemented silty sand lenses			
			S I L T Y C L A Y (CL-CH) Very stiff, olive-gray	22	105	6110
70	6	-	S A N D (SW-SM) Very dense, brown, silty	-	-	-
75	7	-	S H A L E Soft, highly weathered, dark gray to brown, with zones weathered to brown clay	10	129	1040
80	8	-	BOTTOM OF BORING @ 82½'	-	-	-

Proj. No. 14676A

Woodward-Clyde Consultants

Figure 4s(b)

Project:	NORTHERN REGIONAL LIBRARY COMPACT SHELVING FACILITY U.C.-Richmond Field Station

Log of Boring No. D

Date Drilled: November 11, 1980

Type of Boring: 4-7/8" Rotary

Hammer Weight: 140 lbs.

Remarks: See SAMPLER KEY on Figure 2s(c)

Surface Elevation:

Depth, Ft.	Samples	Blows/Ft.	MATERIAL DESCRIPTION	Moisture Content, %	Dry Density, pcf	Unconfined Compressive Strength, psf
0–7			SILTY CLAY (CL-CH) Stiff to very stiff, dry to damp, gray Becoming damp			
7–11			SAND (SP-SM) Medium dense, dark brown, silty, with gravel			
10	1	21		-	-	-
11–28			SANDY CLAY (CL-SC) Very stiff, moist, light brown, with thin sand lenses			
20	2	-		13	122	1500
28–33			SILTY CLAY (CL-ML) Stiff to very stiff, light brown, with calcareous inclusions			
30	3	-		27	96	3590
33–36.5			SAND & GRAVEL (SP-GP) Dense, brown, silty			
36.5–			SILTY CLAY (CL) Very stiff, moist, olive-gray, with thin sand lenses			

Proj. No. 14676A

Woodward-Clyde Consultants

Figure 5s(a)

Project: NORTHERN REGIONAL LIBRARY
COMPACT SHELVING FACILITY
U.C.-Richmond Field Station

Log of Boring No. D

(Continued)

Depth, Ft.	Samples	Blows/Ft.	MATERIAL DESCRIPTION	Moisture Content, %	Dry Density, pcf	Unconfined Compressive Strength, psf
40	4	-	S I L T Y C L A Y (CL) Cont'd......	17	112	3900
45						
50	5	-	SAND & GRAVEL (SP-GP) Dense, brown, silty	-	-	-
55						
60	6	-	S A N D Y C L A Y (CL-SC) Very stiff, brown, interlayered with Silty Clay (CL-ML) and Silty Sand (SM), with gravel and calcareous inclusions	20	108	1570
65						
70			Becoming olive-gray-brown			
	7	-		13	117	1950
80	8	85/6"	C L A Y E Y S A N D S T O N E Soft, highly weathered, brown	-	-	-
	9	* -	* Sample 9 is cuttings from drilling between a depth of 80' and 83'			
			Becoming hard and slightly weathered			
85	10	-		-	-	-
			BOTTOM OF BORING @ 85½'			

Proj. No. 14676A

Woodward-Clyde Consultants

Figure 5s(b)

Project: NORTHERN REGIONAL LIBRARY SHELVING FACILITY - PHASE 2

BORING LEGEND SHEET

Date Drilled:
Type of Boring:
Hammer Weight:

Remarks:

Depth, Ft.	Samples	Blows / Ft.	MATERIAL DESCRIPTION	LABORATORY TESTS: Moisture Content, %	LABORATORY TESTS: Dry Density, pcf	LABORATORY TESTS: Unconfined Compressive Strength, psf
			Surface Elevation:			
5			2-1/2-INCH O.D. MODIFIED CALIFORNIA SAMPLER (SPLIT BARREL)			
10			2-INCH O.D. STANDARD SPLIT-SPOON SAMPLER			
15			3-INCH O.D. DOUBLE-BARREL PITCHER CORING SAMPLER			
20		29	BLOW COUNT WITH A 140-LB. HAMMER FALLING 30 INCHES			
25		29*	BLOW COUNT WITH A 320-LB. DOWNHOLE "SLIP-JAR" HAMMER FALLING 18 INCHES THROUGH DRILLING FLUID			

Project No. 14676B

Woodward-Clyde Consultants

Figure 2

Project: NORTHERN REGIONAL LIBRARY SHELVING FACILITY - PHASE 2

Log of Boring No. 8

Date Drilled: February 22-23, 1988

Type of Boring: 4-7/8"Ø Rotary Wash

Hammer Weight: 140 lbs.

Remarks:

(See Legend Sheet for sampler types and hammer weights)

Depth, Ft.	Samples	Blows / Ft.	MATERIAL DESCRIPTION	LABORATORY TESTS: Moisture Content, %	Dry Density, pcf	Unconfined Compressive Strength, psf
			Surface Elevation:			
	1	6	SILTY CLAY (CL-CH) Soft to medium stiff, wet, dark gray brown, with organic matter and roots	26	96	1430
			SILTY CLAY (CL-CH) Medium stiff to stiff, wet, gray-brown, with some sand			
5	2	60	SANDY CLAY (CL-CH): Hard, gray-brown, with sand, cemented	15	118	19,450
			GRAVELLY CLAY (CL) Very stiff, damp, light brown, with some sand			
10	3	31		-	-	-
			SILTY CLAY (CL) Very stiff, light brown, with some sand			
15	4	26		21	108	5770
			More silty and sandy			
20	5	24		19	111	4410
			SILTY SAND (SM) Medium dense, brown, with gravel			
			SILTY CLAY (CL) Stiff, brown, with some sand			
25	6	-		26	97	2160

Project No. 14676B

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Figure 3a

Project: NORTHERN REGIONAL LIBRARY SHELVING FACILITY - PHASE 2

Log of Boring No. 8

Depth, Ft.	Samples	Blows / Ft.	MATERIAL DESCRIPTION	Moisture Content, %	Dry Density, pcf	Unconfined Compressive Strength, psf
30			SILTY CLAY (CL) ....Cont'd.			
	7	21	Very silty, some rust staining	29	94	2240
35			GRAVELLY SAND (SW) Medium dense, brown			
			CLAYEY SAND (SC-CL): Medium dense, black, organic			
			SILTY CLAY (CL-CH) Stiff, blue-gray			
40	8	-		21	108	2640
			With calcareous nodules			
45						
	9	55		-	-	-
50			SILTY CLAY (CL-CH) Very stiff, green-gray, with sand lenses			
55	10	-		21	106	4900
60	11	38	With calcareous inclusions, rust-brown staining	24	102	5510

Project: NORTHERN REGIONAL LIBRARY SHELVING FACILITY - PHASE 2

Log of Boring No. 8

Depth, Ft.	Samples	Blows / Ft.	MATERIAL DESCRIPTION	Moisture Content, %	Dry Density, pcf	Unconfined Compressive Strength, psf
65			SILTY SAND (SM) Dense			
			SILTY CLAY (CL) Hard, blue-gray, with calcareous inclusions			
70	12	23	SANDY CLAY Very stiff, blue-gray, with gravel	-	-	-
			SILTY CLAY (CL) Very stiff to stiff, brown, with lenses of clayey silt			
75						
80	13	-		31	92	1220
			Hard, with rust-brown staining			
85						
90						
95						

Project: NORTHERN REGIONAL LIBRARY SHELVING FACILITY - PHASE 2

Log of Boring No. 8

Depth, Ft.	Samples	Blows / Ft.	MATERIAL DESCRIPTION	Moisture Content, %	Dry Density, pcf	Unconfined Compressive Strength, psf
	14	97"	SILTY CLAY (CL) ....Cont'd.	21	106	8170
100			CLAYEY SAND (SC) Dense to very dense, brown			
105			SILTY CLAY (CL) Hard, light brown, with gravel			
			SANDSTONE Highly weathered, friable, light brown to brown			
110	15	100/6"		-	-	-
			BOTTOM OF BORING @ 110'-6"			
115						
120						
125						

Project No. 14676B

Woodward-Clyde Consultants

Figure 3d

Project: NORTHERN REGIONAL LIBRARY SHELVING FACILITY - PHASE 2	**Log of Boring No. 9**

Date Drilled: February 23, 1988
Type of Boring: 4-7/8"Ø Rotary Wash
Hammer Weight: 320 lbs.
Remarks:
(See Legend Sheet for sampler types and hammer weights)

Surface Elevation:

Depth, Ft.	Samples	Blows / Ft.	MATERIAL DESCRIPTION	Moisture Content, %	Dry Density, pcf	Unconfined Compressive Strength, psf
			SILTY CLAY (CL-CH) Medium stiff, moist, dark brown, with some organic matter and roots			
	1	33*		18	113	10820
5			SILTY CLAY (CH): Hard, damp to dry, gray-brown, with calcareous inclusions, trace of sand, slightly cemented			
			SILTY CLAY (CL) Very stiff, moist, light brown, with some gravel and clayey silt lenses			
	2	28*		20	108	7350
10						
	3	35*		24	102	7170
15			SILTY CLAY (CL-CH) Stiff to very stiff, gray-brown with black staining			
	4	30*		23	103	3880
20						
	5	37*	Sandy	22	105	7550
25						

Project No. 14676B | **Woodward-Clyde Consultants** | Figure 4a

Project: NORTHERN REGIONAL LIBRARY SHELVING FACILITY - PHASE 2	Log of Boring No. 9

Depth, Ft.	Samples	Blows / Ft.	MATERIAL DESCRIPTION	Moisture Content, %	Dry Density, pcf	Unconfined Compressive Strength, psf
30			SILTY CLAY (CL-CH)........................Cont'd.			
35	6	-	GRAVELLY CLAY (CL-GC) Stiff, brown, clayey, with some sand	-	-	-
			SILTY CLAY (CL) Stiff, blue-gray			
40	7	34*	SILTY CLAY (CL) Very stiff, green-gray, with caliche	24	102	4570
			SANDY CLAY (CL) Stiff, brown, silty			
45			SILTY CLAY (CL-CH) Stiff, brown			
50	8	-		19	112	3420
			CLAYEY SAND (SC) Dense, brown, with gravel			
55			SILTY CLAY (CL) Stiff, light brown, sandy			
			CLAYEY SAND (SC-SW) Very dense, brown-gray, silty, with gravel			
60	9	40/6"		12	124	-

Project No. 14676B	Woodward-Clyde Consultants	Figure 4b

Project:	NORTHERN REGIONAL LIBRARY SHELVING FACILITY - PHASE 2	Log of Boring No. 9

Depth, Ft.	Samples	Blows / Ft.	MATERIAL DESCRIPTION	Moisture Content, %	Dry Density, pcf	Unconfined Compressive Strength, psf
65						
			Very stiff, blue-gray silty clay			
			More clayey			
70	10	21		-	-	-
			SILTY CLAY (CL) Stiff, brown			
75						
			CLAYEY SILT (ML) Medium dense, brown			
			SAND : Dense, brown			
			SILTY CLAY (CL) Very stiff, mottled gray-brown and rust brown			
80	11	63*		22	105	5510
85			SAND (SP-SM) Dense, brown, clayey			
90	12	50/5"		-	-	-
			BOTTOM OF BORING @ 91'			
95						

Project No. 14676B	Woodward-Clyde Consultants	Figure 4c

Project: NORTHERN REGIONAL LIBRARY SHELVING FACILITY - PHASE 2

Log of Boring No. W-1

Date Drilled: February 23, 1988

Type of Boring: 4-7/8" ø Rotary Wash

Hammer: 140 lbs.

Remarks:

(See Legend Sheet for sampler types and hammer weights)

Depth Ft.	Samples	Blows/Ft	MATERIAL DESCRIPTION	LABORATORY TESTS: Moisture Content, %	Dry Density pcf	Unconfined Compress. Strength, psf
			Surface Elevation:			
			CLAYEY GRAVEL (GC) FILL Medium dense, damp, dark brown to brown, with gravel up to 1 inch, with concrete rubble			
			SILTY CLAY (CL) Medium stiff, damp to wet, dark brown, with roots			
5			SILTY CLAY (CL) Medium stiff to stiff, moist, gray-brown			
			SILTY CLAY (CL) Stiff to very stiff, moist, light gray-brown, with calcareous concretions and white streaks			
10			SILTY CLAY (CL) Stiff to very stiff, moist, tan-brown, sandy			
15			▽ 4/1/88 ▽ 6/8/88			
20						
			SANDY CLAY (CL) Stiff to very stiff, moist, tan-brown, with fine-grained sand and occasional fine gravel			
25						
			BOTTOM OF BORING @ 26' Bottom of water level observation well at 25'.			

Project No. 14676B

Woodward-Clyde Consultants

Figure 5

Project: UCB Richmond Field Station
Project Location: Richmond, California
Project Number: 51-00111028.00

Key to Log of Boring

Elevation feet	Depth, feet	SAMPLES: Type	SAMPLES: Number	SAMPLES: Sampling Resistance	SAMPLES: Recovery, %	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	Unconfined Compressive Strength, psf	REMARKS AND OTHER TESTS
1	2	3	4	5	6	7	8	9	10	11	12

COLUMN DESCRIPTIONS

1 **Elevation:** Elevation in feet referenced to mean sea level (MSL) or site datum.

2 **Depth:** Depth in feet below the ground surface.

3 **Sample Type:** Type of soil sample collected at depth interval shown; sampler symbols are explained below.

4 **Sample Number:** Sample identification number.

5 **Sampling Resistance:** Number of blows to advance driven sampler 12 inches beyond first 6-inch interval, or distance noted, using a 140-lb hammer with a 30-inch drop; down-pressure for tube.

6 **Recovery:** Percentage of driven sample length recovered; "NA" indicates data not recorded.

7 **Graphic Log:** Graphic depiction of subsurface material encountered; typical symbols are explained below.

8 **Material Description:** Description of material encountered; may include color, moisture, grain size, and density/consistency.

9 **Water Content:** Water content of soil sample measured in laboratory, expressed as percentage of dry weight of specimen.

10 **Dry Unit Weight:** Dry density of soil sample measured in laboratory, expressed in pounds per cubic feet (pcf).

11 **Unconfined Compressive Strength:** Unconfined compressive strength of soil sample measured in laboratory, expressed in psf.

12 **Remarks and Other Tests:** Comments and observations regarding drilling or sampling made by driller or field personnel. Other field and laboratory test results, using the following abbreviations:

LL	Liquid Limit (from Atterberg Limits test), in percent
PI	Plasticity Index (from Atterberg Limits test), in percent
SA	Sieve analysis, percent passing #200 sieve
HD	Hydrometer analysis, percent finer than 2 microns

TYPICAL MATERIAL GRAPHIC SYMBOLS

SAND (SP/SW)

CLAY (CL)

SILT (ML)

SILTY SAND (SM)

CLAY (CH)

SILT (MH)

CLAYEY SAND (SC)

SILTY CLAY (CL)

CLAYEY SILT (ML)

GRAVEL (GW)

GRAVEL with SILT (GW-GM)

SILTY GRAVEL (GM)

TYPICAL SAMPLER GRAPHIC SYMBOLS

Standard Penetration Test (SPT) unlined split spoon

Modified California (2-inch ID) with brass liners

California (2.5-inch ID) split barrel

Shelby tube (3-inch OD, thin-wall, fixed head)

Pitcher barrel with Shelby tube liner

Bag (grab from hand auger)

OTHER GRAPHIC SYMBOLS

∇ First water encountered at time of drilling and sampling (ATD)

▼ Static water level measured after drilling and sampling completed

Change in material properties within a lithologic stratum

--- Inferred or transitional contact between lithologies

GENERAL NOTES

1. Soil classifications are based on the Unified Soil Classification System. Descriptions and stratum lines are interpretive; actual lithologic changes may be gradual. Field descriptions may have been modified to reflect results of lab tests.
2. Descriptions on these logs apply only at the specific boring locations and at the time the borings were advanced. They are not warranted to be representative of subsurface conditions at other locations or times.

Project: UCB Richmond Field Station **Project Location:** Richmond, California **Project Number:** 51-00111028.00	**Log of Boring B-10** Sheet 1 of 2

Date(s) Drilled	2/12/01	Logged By	J. Benton	Checked By	D. Simpson
Drilling Method	Mud Rotary	Drill Bit Size/Type	4-7/8-inch drag bit (?)	Total Depth of Borehole	31.5 feet
Drill Rig Type	Failing 750	Drilling Contractor	Pitcher Drilling Co.	Surface Elevation	Not available
Groundwater Level and Date Measured	Not measured	Sampling Method(s)	Modified California	Hammer Data	140 lbs, 30-inch drop
Borehole Backfill	Cement grout with 3% bentonite	Location	In front of entrance (see Figure __)		

Elevation feet	Depth, feet	SAMPLES Type	SAMPLES Number	SAMPLES Sampling Resistance, blows / foot	SAMPLES Recovery, %	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	Unconfined Compressive Strength, psf	REMARKS AND OTHER TESTS
	0						2 inches asphalt concrete, 4 inches gravel base				
							SILTY CLAY (CL) [Fill] Moist(?), very dark brown				
			10-1	11	100		SILTY CLAY (CL) [.......?] Stiff, moist, light brown and gray mottled, medium plasticity, trace sand; contains layer of moist, light brown, well-graded sand at 2.6-3.2 feet				
	5		10-2	32	100		GRAVELLY CLAYEY SAND (SC) [Alluvium] Medium dense to dense, moist, light brown, well-graded sand, fine to coarse gravel	15.4	118		
	10		10-3	32	50			12.0			SA: 15%<#200 sieve 37%>#4 sieve
	15		10-4	73	30			13.6	119		
	20		10-5	17	0		SILTY CLAY with SAND (CL) [Alluvium] Stiff, moist, light brown, medium plasticity				Sample 10-5 contains only gravel from above; clean out hole and resample at 22 ft.
			10-6	14	50						
	25						Becomes very stiff, with some fine to coarse gravel				
			10-7	27	100			18.7	111	2980	
							Becomes stiff, low plasticity, with iron oxide staining and black organic specks, no gravel				
	30										

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Figure A-2

Project: UCB Richmond Field Station
Project Location: Richmond, California
Project Number: 51-00111028.00

Log of Boring B-10

Elevation feet	Depth, feet	SAMPLES Type	Number	Sampling Resistance, blows / foot	Recovery, %	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	Unconfined Compressive Strength, psf	REMARKS AND OTHER TESTS
	30		10-8	15	NA		SILTY CLAY with SAND (CL), stiff, moist, light brown, low plasticity, with iron oxide staining and black organic specks [Alluvium] *(continued)*				
							Bottom of boring at 31.5 feet				End drilling at 1040.
	35										
	40										
	45										
	50										
	55										
	60										
	65										

Project: UCB Richmond Field Station Project Location: Richmond, California Project Number: 51-00111028.00	**Log of Boring B-11** Sheet 1 of 2

Date(s) Drilled	3/6/01	Logged By	J. Benton	Checked By	D. Simpson
Drilling Method	Mud Rotary	Drill Bit Size/Type	4-7/8-inch drag bit (?)	Total Depth of Borehole	51.5 feet
Drill Rig Type	Failing 250	Drilling Contractor	Pitcher Drilling Co.	Surface Elevation	Not available
Groundwater Level and Date Measured	Not measured	Sampling Method(s)	Modified California, SPT, Shelby tube	Hammer Data	140 lbs, 30-inch drop
Borehole Backfill	Cement grout with 3% bentonite	Location	Center of grass area (see Figure __)		

Elevation feet	Depth, feet	SAMPLES: Type	SAMPLES: Number	SAMPLES: Sampling Resistance, blows / foot	SAMPLES: Recovery, %	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	Unconfined Compressive Strength, psf	REMARKS AND OTHER TESTS
	0						SILTY CLAY (CH) [Fill?] Very stiff, moist(?), dark brown, high plasticity, occasional orange sandstone gravel				Start at 0755.
			11-1	24	0		SILTY CLAY with SAND (CH/CL) [.......?] Very stiff to hard, moist, light brown, medium to high plasticity, some black organic specks and iron oxide staining				No sample recovery.
	5		11-2	48	100		With calcareous pockets	19.3	108	7300	
	10		11-3	35	100		No calcareous pockets	23.2	103	3700	
	15		11-4	31	100						LL=53, PI=33
							Becomes stiff to very stiff, with some fine gravel				
	20		11-5	29	100			18.2	112	2100	
							SANDY SILTY GRAVEL (GM) [Alluvium] Very dense, wet, light brown(?), fine to coarse, angular to subrounded gravel				Gravel in cuttings at 24 ft.
	25		11-6	50/6"	100						
							SILTY CLAY (CL) [Alluvium] Stiff to very stiff, moist, light brown, trace fine gravel, some black organic specks and iron oxide staining				
	30										

Project: UCB Richmond Field Station Project Location: Richmond, California Project Number: 51-00111028.00	Log of Boring B-11 Sheet 2 of 2

Elevation feet	Depth, feet	SAMPLES Type	Number	Sampling Resistance, blows / foot	Recovery, %	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	Unconfined Compressive Strength, psf	REMARKS AND OTHER TESTS
	30		11-7	28	100		SILTY CLAY (CL), stiff to very stiff, moist, light brown, trace fine gravel, some black organic specks and iron oxide staining [Alluvium] *(continued)*	27.3	98	1700	
							SANDY GRAVEL with SILT (GW-GM) [Alluvium?] Dense, wet, medium brown, fine to coarse angular gravel				
	35		11-8	50/4.5"	100						
	40		11-9	Push 100 - 400 psi	100		SILTY CLAY (CL) [Alluvium] Stiff to very stiff, moist, light brown, trace fine gravel, some black organic specks and iron oxide staining				Shelby tube met refusal after 18-inch push.
							SILTY CLAY (CL) [Alluvium?] Very stiff, moist(?), dark gray				
	45		11-10	43	100		Becomes hard, with some light orange iron oxide staining and white calcareous patches, occasional fine gravel				
	50		11-11	69	100			22.9	101	2020	
							Bottom of boring at 51.5 feet				End drilling at 1000.
	55										
	60										
	65										

Project: UCB Richmond Field Station
Project Location: Richmond, California
Project Number: 51-00111028.00

Log of Boring B-12

Date(s) Drilled	3/5/01	Logged By	J. Benton	Checked By	D. Simpson
Drilling Method	Mud Rotary	Drill Bit Size/Type	4-7/8-inch drag bit (?)	Total Depth of Borehole	51.5 feet
Drill Rig Type	Failing 250	Drilling Contractor	Pitcher Drilling Co.	Surface Elevation	Not available
Groundwater Level and Date Measured	Not measured	Sampling Method(s)	Modified California, SPT	Hammer Data	140 lbs, 30-inch drop
Borehole Backfill	Cement grout with 3% bentonite	Location	Far corner of grass area (see Figure __)		

Elevation feet	Depth, feet	SAMPLES Type	SAMPLES Number	SAMPLES Sampling Resistance, blows / foot	SAMPLES Recovery, %	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	Unconfined Compressive Strength, psf	REMARKS AND OTHER TESTS
	0						SILTY CLAY (CL) [Topsoil] Moist(?), dark brown				
			12-1	32	100		SILTY CLAY with SAND (CL) [.......?] Very stiff to hard, moist, light brown, some black organic specks, trace iron oxide staining	17.9	107	8950	
	5		12-2	50	100		Numerous calcareous pockets; Increasing fine- to coarse-grained sand				
	10		12-3	22	100		Gravel layer				
	15		12-4	37	100			25.4	97	3350	
							CLAYEY SAND [Alluvium?] Dense, moist, light brown, some black organic specks, trace iron oxide staining				
	20		12-5	38	100						
							With some gravel, increasing sand content				
	25		12-6	73/10"	100			18.0			Sample 10-6 disturbed by rock pushed down with sample. SA: 22%<#200 sieve 37%>#4 sieve
							SILTY CLAY (CL) [Alluvium] Stiff to very stiff, moist, light brown, trace sand, some black organic specks, iron oxide staining, white calcareous pockets				
	30										

Project: UCB Richmond Field Station
Project Location: Richmond, California
Project Number: 51-00111028.00

Log of Boring B-12

Elevation feet	Depth, feet	SAMPLES Type	Number	Sampling Resistance, blows / foot	Recovery, %	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	Unconfined Compressive Strength, psf	REMARKS AND OTHER TESTS
	30		12-7	28	100		SILTY CLAY (CL), stiff to very stiff, moist, light brown, trace sand, some black organic specks, iron oxide staining, white calcareous pockets [Alluvium] *(continued)*	26.2	99	2150	LL=40, PI=19
	35		12-8	50/6"	0						No sample recovery.
							Gravelly layer				
	40		12-9	31	100		Becomes light olive brown	24.4	100	3070	
							SILTY SAND (SM) [Alluvium?] Dense, moist(?), light olive brown(?), with clay, some gravel				
	45		12-10	42	100						
	50		12-11	56	100			20.2	106	6700	
							Bottom of boring at 51.5 feet				End drilling at 1306.
	55										
	60										
	65										

Report: GEO_10B1_OAK; File: UCBRICHM.GPJ; 3/17/2001 B-12

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Figure A-4

APPENDIX B

A3GEO Boring Logs
(This Study)

UNIFIED SOIL CLASSIFICATION CHART

MAJOR DIVISIONS				TYPICAL NAMES
COARSE GRAINED SOILS: more than 50% retained on No. 200 sieve	COARSE GRAINED SOILS: 50% or more of coarse fraction on No. 4 sieve	CLEAN GRAVELS	GW	Well graded gravels and gravel-sand mixtures, little or no fines
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines
		GRAVELS WITH SAND	GM	Silty gravels and gravel-sand-silt mixtures
			GC	Clayey gravels and gravel-sand-clay mixtures
	SANDS: more than 50% passing on No. 4 sieve	CLEAN SANDS	SW	Well graded sands and gravelly sand, little or no fines
			SP	Poorly graded sands and gravelly sand, little or no fines
		SANDS WITH FINES	SM	Silty sands, sand-silt mixtures
			SC	Clayey sands, sand-clay mixtures
FINE GRAINED SOILS: 50% or more passing No. 200 sieve	SILTS AND CLAY: Liquid Limit 50% or less		ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands
			CL	Inorganic clays or low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
			OL	Organic silts and organic silty clays of low plasticity
	SILTS AND CLAY: Liquid Limit 50% or greater		MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic clays
			CH	Inorganic clays of high plasticity, fat clays
			OH	Organic clays of medium to high plasticity
HIGHLY ORGANIC SOILS			PT	Peat, muck, and other highly organic soils

BOUNDARY CLASSIFICATION AND GRAIN SIZES

SILT OR CLAY	SAND			GRAVEL		COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	COARSE		
U.S. Standard Sieve Sizes	No. 200 0.075 mm	No. 40 0.425 mm	No. 10 2 mm	No. 4 3/16"	3/4"	3"	12"

SYMBOLS

Modified California (MC) Sampler (3" O.D.)	HQ ROCK CORE (RC)	101 Barrel (SS)
Standard Penetration Test: SPT (2" O.D.)	Pitcher Tube (ST)	Water Levels At time of drilling At end of drilling After drilling

ABBREVIATIONS

Item	Meaning
LL	Liquid Limit (%) (ASTM D 4318)
PI	Plasticity Index (%) (ASTM D 4318)
-200	Passing No. 200 (%) (ASTM D 1140)
TXCU	Laboratory consolidated undrained triaxial test of undrained shear strength (psf) (ASTM D 4767)
TXUU	Laboratory unconsolidated, undrained triaxial test of undrained shear strength (psf) (ASTM D 2850)
psf/tsf	pounds per square foot / tons per square foot
psi	pounds per square inch
OD	Outside Diameter
ID	Inside Diameter

NOTES

1. Stratification lines represent the approximate boundaries between material types and the transitions may be gradual.
2. Modified California (MC) blow counts were adjusted by multiplying field blow counts by a factor of 0.63.
3. Recorded blow counts have not been adjusted for hammer energy.

A3GEO

KEY TO EXPLORATORY BORING LOGS

A3GEO

BEDDING OF SEDIMENTARY ROCK		
SPLITTING PROPERTY	THICKNESS	STRATIFICATION
Massive	Greater than 4.0 feet	Very Thick-Bedded
Blocky	2.0 to 4.0 feet	Thick-Bedded
Slabby	0.2 to 2.0 feet	Thin-Bedded
Flaggy	0.05 to 0.2 feet	Very Thin-Bedded
Shaly or Platy	0.01 to 0.05 feet	Laminated
Papery	Less than 0.01 feet	Thinly Laminated

FRACTURING	
INTENSITY	SIZE OF PIECES IN FEET
Very Little Fractured	Greater than 4.0 feet
Occasionally Fractured	1.0 to 4.0 feet
Moderately Fractured	0.5 to 1.0 feet
Closely Fractured	0.1 to 0.5 feet
Intensely Fractured	0.05 to 0.1 feet
Crushed	Less than 0.05 feet

HARDNESS	
Soft	Reserved for plastic material alone
Low Hardness	Can be gouged deeply or carved easily by a knife blade
Moderately Hard	Can be readily scratched by a knife blade; scratch leaves a heavy trace of dust and is readily visible after the powder has been blown away
Hard	Can be scratched by a knife blade with difficulty; scratch produces little powder and is often faintly visible
Very Hard	Cannot be scratched by a knife blade; leaves a metallic streak

STRENGTH	
Plastic	Very low strength
Friable	Crumbles easily by rubbing with fingers
Weak	An unfractured specimen of such material will crumble under light hammer blows
Moderately Strong	Specimen will withstand a few heavy hammer blows before breaking
Strong	Specimen will withstand a few heavy ringing hammer blows and will yield with difficulty only dust and small flying fragments
Very Strong	Specimen will resist heavy ringing hammer blows and will yield with difficulty only dust and small flying fragments

WEATHERING:	
	— the physical and chemical disintegration and decomposition of rocks and minerals by natural processes such as oxidation, reduction, hydration, solution, carbonation, and freezing and thawing
Deep	Moderate to complete mineral decomposition; extensive disintegration; deep and thorough discoloration; many fractures, all extensively coated or filled with oxides, carbonates and/or clay or silt.
Moderate	Slight change or partial decomposition of minerals; little disintegration; cementation little to unaffected. Moderate to occasionally intense discoloration. Moderately coated fractures.
Little	No megascopic decomposition of minerals; little or no effect on normal cementation. Slight and intermittent, or localized discoloration. Few stains on fracture surfaces.
Fresh	Unaffected by weathering agents. No discoloration or disintegration. Fractures usually less numerous than joints.

KEY TO ROCK DESCRIPTIONS

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Berkeley, CA, 94710
Telephone: 510-705-1664

BORING NUMBER A3-17-1

CLIENT UC Berkeley
PROJECT NAME NRLF Phase 4 Investigation
PROJECT NUMBER 1101-17A
PROJECT LOCATION Richmond Field Station
DATE STARTED 11/27/17 **COMPLETED** 11/28/17
GROUND ELEVATION 20.5 ft **HOLE SIZE** 6"
DRILLING CONTRACTOR Pitcher Drilling Co.
GROUND WATER LEVELS:
DRILLING METHOD Rotary Wash Drilling
▽ **AT TIME OF DRILLING** 15.0 ft / Elev 5.5 ft
LOGGED BY EA **CHECKED BY** LB
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	ADJUSTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	RECOVERY % (RQD)	OTHER LAB TESTS / NOTES
0		CLAYEY GRAVEL WITH SAND (GC) - greyish-brown, rootlets present, moist							
		FAT CLAY (CH) - dark-brown, with organic matter, moist							
5		LEAN CLAY WITH SAND (CL) - olive-brown, very stiff, moist	MC	25	4.0				Gravel: 0.1% Sand: 15.2% -200: 84.7% LL = 46 PI = 26
		SANDY SILT (ML) - olive-brown, moist							
10			ST						Gravel: 0% Sand: 36.6% -200: 63.4% LL = 31 PI = 7
15		▽ SANDY LEAN CLAY (CL) - yellowish-brown, stiff, some gravel, wet							
		-no more gravel	SPT	11					
20		-similiar to above, medium stiff	MC	9	2.0				Gravel: 7.4% Sand: 26.3% -200: 66.3% LL = 36 PI = 17
		CLAYEY GRAVEL (GC)							
25		SANDY LEAN CLAY (CL) - light brown, stiff, decreasing sand with depth	MC	15	3.0				
30		SANDY CLAY (CL) - brown, very stiff, some fine gravel	MC	16	1.5	108	21		Gravel: 6.3% Sand: 43.7% -200: 50%
35									

(Continued Next Page)

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BORING NUMBER A3-17-1

CLIENT UC Berkeley
PROJECT NAME NRLF Phase 4 Investigation
PROJECT NUMBER 1101-17A
PROJECT LOCATION Richmond Field Station
DATE STARTED 11/27/17 **COMPLETED** 11/28/17
GROUND ELEVATION 20.5 ft **HOLE SIZE** 6"
DRILLING CONTRACTOR Pitcher Drilling Co.
GROUND WATER LEVELS:
DRILLING METHOD Rotary Wash Drilling
AT TIME OF DRILLING 15.0 ft / Elev 5.5 ft
LOGGED BY EA **CHECKED BY** LB
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	ADJUSTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	RECOVERY % (RQD)	OTHER LAB TESTS / NOTES
35		WELL-GRADED SAND WITH CLAY AND GRAVEL (SW-SC) - dark-brown, very dense, with gravel, moist *(continued)*	SPT	50/5.5"					
		Note: no recovery at 35-36.5 ft. Gravel caught in tip of spoon.	SPT	50					
40		-similiar to above except dense	SPT	38					
		-driller notes bottom of gravel at 43 ft							
		SANDY FAT CLAY WITH GRAVEL (CH) - brown, hard, moist							
45		-driller notes stiffer soils at 47.5 ft	MC	35	1.0				
		LEAN CLAY (CL) - dark-grey, stiff, some sand, trace gravel, moist							
50		-increasing sand & silt, and decreasing clay with depth	MC	47	>4.5	108	21		Gravel: 0.4% Sand: 12.2% -200: 87.3%
55		SILT WITH SAND (ML) - grey, very stiff, trace gravel, moist	MC	26	3.0				
60		-similiar to above, light brown	MC	25	2.5				Gravel: 2.1% Sand: 13.5% -200: 84.4%
65		CLAYEY SAND (SC) - greyish-brown, very dense, coarse, some gravel	SPT	54					
		-clay layer from 67 to 68 ft							
70									

(Continued Next Page)

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BORING NUMBER A3-17-1

CLIENT UC Berkeley
PROJECT NAME NRLF Phase 4 Investigation
PROJECT NUMBER 1101-17A
PROJECT LOCATION Richmond Field Station
DATE STARTED 11/27/17 **COMPLETED** 11/28/17
GROUND ELEVATION 20.5 ft **HOLE SIZE** 6"
DRILLING CONTRACTOR Pitcher Drilling Co.
GROUND WATER LEVELS:
DRILLING METHOD Rotary Wash Drilling
AT TIME OF DRILLING 15.0 ft / Elev 5.5 ft
LOGGED BY EA **CHECKED BY** LB
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	ADJUSTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	RECOVERY % (RQD)	OTHER LAB TESTS / NOTES
70		CLAYEY SAND (SC) - greyish-brown, very dense, coarse, some gravel*(continued)* -very dense, slightly cemented, additional gravel -gravel recovered in spoon tip	SPT	50/5.5"					
75		CLAYEY SAND (SC) - reddish-brown, medium dense, pockets of greyish-brown clay	SPT	32					
80		SANDY LEAN CLAY (CL) - light-brown, stiff	MC	28	1.0 2.0	106	21		
85		CLAYEY SAND WITH GRAVEL (SC) - reddish-brown mottled, very dense, slightly cemented, gravel is multi-colored	MC	32/4.0"					
90		-similiar to above	SPT	59					
95									
100		-harder drilling at 102 ft							
105									

(Continued Next Page)

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BORING NUMBER A3-17-1

CLIENT UC Berkeley
PROJECT NAME NRLF Phase 4 Investigation
PROJECT NUMBER 1101-17A
PROJECT LOCATION Richmond Field Station
DATE STARTED 11/27/17 **COMPLETED** 11/28/17
GROUND ELEVATION 20.5 ft **HOLE SIZE** 6"
DRILLING CONTRACTOR Pitcher Drilling Co.
GROUND WATER LEVELS:
DRILLING METHOD Rotary Wash Drilling
AT TIME OF DRILLING 15.0 ft / Elev 5.5 ft
LOGGED BY EA **CHECKED BY** LB
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	ADJUSTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	RECOVERY % (RQD)	OTHER LAB TESTS / NOTES
105		CLAYEY SAND WITH GRAVEL (SC) - reddish-brown mottled, very dense, slightly cemented, gravel is multi-colored *(continued)*							
		-harder drilling at 107 ft							
110									
		-harder drilling at 111 ft							
		CLAYSTONE - dark-grey, soft, plastic [BEDROCK]	SPT	50/1.0"					

Bottom of borehole at 114.6 feet.
1. Spun PW casing to 4.0 ft. Advanced open-hole thereafter.

2. Borehole tremie grouted to ground surface.

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Telephone: 510-705-1664

BORING NUMBER A3-17-2

CLIENT UC Berkeley
PROJECT NAME NRLF Phase 4 Investigation
PROJECT NUMBER 1101-17A
PROJECT LOCATION Richmond Field Station
DATE STARTED 11/28/17 **COMPLETED** 11/29/17
GROUND ELEVATION 19 ft **HOLE SIZE** 6"
DRILLING CONTRACTOR Pitcher Drilling Co.
GROUND WATER LEVELS:
DRILLING METHOD Rotary Wash Drilling
AT TIME OF DRILLING ---
LOGGED BY EA **CHECKED BY** LB
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	ADJUSTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	RECOVERY % (RQD)	OTHER LAB TESTS / NOTES
0		SANDY FAT CLAY WITH GRAVEL (CH) - dark-brown, rootlets present, moist							
5		LEAN CLAY (CL) -olive gray, very stiff, some sand, moist	MC	16	2.5	104	23		Gravel: 0.3% Sand: 13.9% -200: 85.8% LL = 46 PI = 26
		CLAYEY GRAVEL (GC) - dark-brown, moist							
10		FAT CLAY WITH GRAVEL (CH) - light-brown, very stiff, moist	MC	19	3.5				
		-increasing sand content with depth							
15		SANDY LEAN CLAY (CL) - light brown, moist	ST			96	28		Gravel: 0% Sand: 37.4% -200: 62.6% LL = 43 PI = 28
20		SANDY FAT CLAY (CH) - light-brown, medium stiff, moist	MC	8	1.0				
		POORLY-GRADED SAND (SP) - greyish-brown, moist							
25		FAT CLAY WITH SAND (CH) - light-brown, very stiff, moist -interbedded with clayey SAND (SC), light-brown, medium dense.	ST			88	34		Gravel: 0% Sand: 24.3% -200: 75.7% LL = 51 PI = 35
30			MC	20	2.5				
35		CLAYEY GRAVEL WITH SAND (GC) - dark brown, very dense, moist							

(Continued Next Page)

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BORING NUMBER A3-17-2

CLIENT UC Berkeley
PROJECT NAME NRLF Phase 4 Investigation
PROJECT NUMBER 1101-17A
PROJECT LOCATION Richmond Field Station
DATE STARTED 11/28/17 **COMPLETED** 11/29/17
GROUND ELEVATION 19 ft **HOLE SIZE** 6"
DRILLING CONTRACTOR Pitcher Drilling Co.
GROUND WATER LEVELS:
DRILLING METHOD Rotary Wash Drilling
AT TIME OF DRILLING ---
LOGGED BY EA **CHECKED BY** LB
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	ADJUSTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	RECOVERY % (RQD)	OTHER LAB TESTS / NOTES
35		CLAYEY GRAVEL WITH SAND (GC) - dark brown, very dense, moist *(continued)*	SPT	67					Gravel: 41.2% Sand: 39.5% -200: 19.3%
40			SPT	42					
43		FAT CLAY (CH) - olive-grey, hard, some sand, trace gravel, moist							
45			ST			100	24		Gravel: 0.4% Sand: 11.4% -200: 88.1% LL = 58 PI = 35
50		-similiar to above except very stiff	MC	31	3.5				
55			MC	23	1.0				
60		-similiar to above except sandy, hard	MC	37	3.0				
61		POORLY-GRADED SAND WITH CLAY (SP-SC) - greyish-brown, very dense, moist							
65									
67		SANDY LEAN CLAY (CL) - olive-grey, hard, fine sand becoming coarser with depth, moist							
70									

(Continued Next Page)

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CLIENT UC Berkeley
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DRILLING CONTRACTOR Pitcher Drilling Co.
GROUND WATER LEVELS:
DRILLING METHOD Rotary Wash Drilling
AT TIME OF DRILLING ---
LOGGED BY EA **CHECKED BY** LB
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	ADJUSTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	RECOVERY % (RQD)	OTHER LAB TESTS / NOTES
70		SANDY LEAN CLAY (CL) - olive-grey, hard, fine sand becoming coarser with depth, moist*(continued)*	MC	46	3.0	114	18		
75									
80		SANDY LEAN CLAY (CL) - light-brown, very stiff, moist	MC	27	2.0				
85									
90		CLAYEY SAND (SC) - multi-colored, very dense, coarse, moist	SPT	52					
95									
		SANDY LEAN CLAY (CL) - light-brown, hard, sand fraction predominantly fine, moist							
100			MC	35	>4.0	101	24		
105									

(Continued Next Page)

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BORING NUMBER A3-17-2

CLIENT UC Berkeley
PROJECT NAME NRLF Phase 4 Investigation
PROJECT NUMBER 1101-17A
PROJECT LOCATION Richmond Field Station
DATE STARTED 11/28/17 **COMPLETED** 11/29/17
GROUND ELEVATION 19 ft **HOLE SIZE** 6"
DRILLING CONTRACTOR Pitcher Drilling Co.
GROUND WATER LEVELS:
DRILLING METHOD Rotary Wash Drilling
AT TIME OF DRILLING ---
LOGGED BY EA **CHECKED BY** LB
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

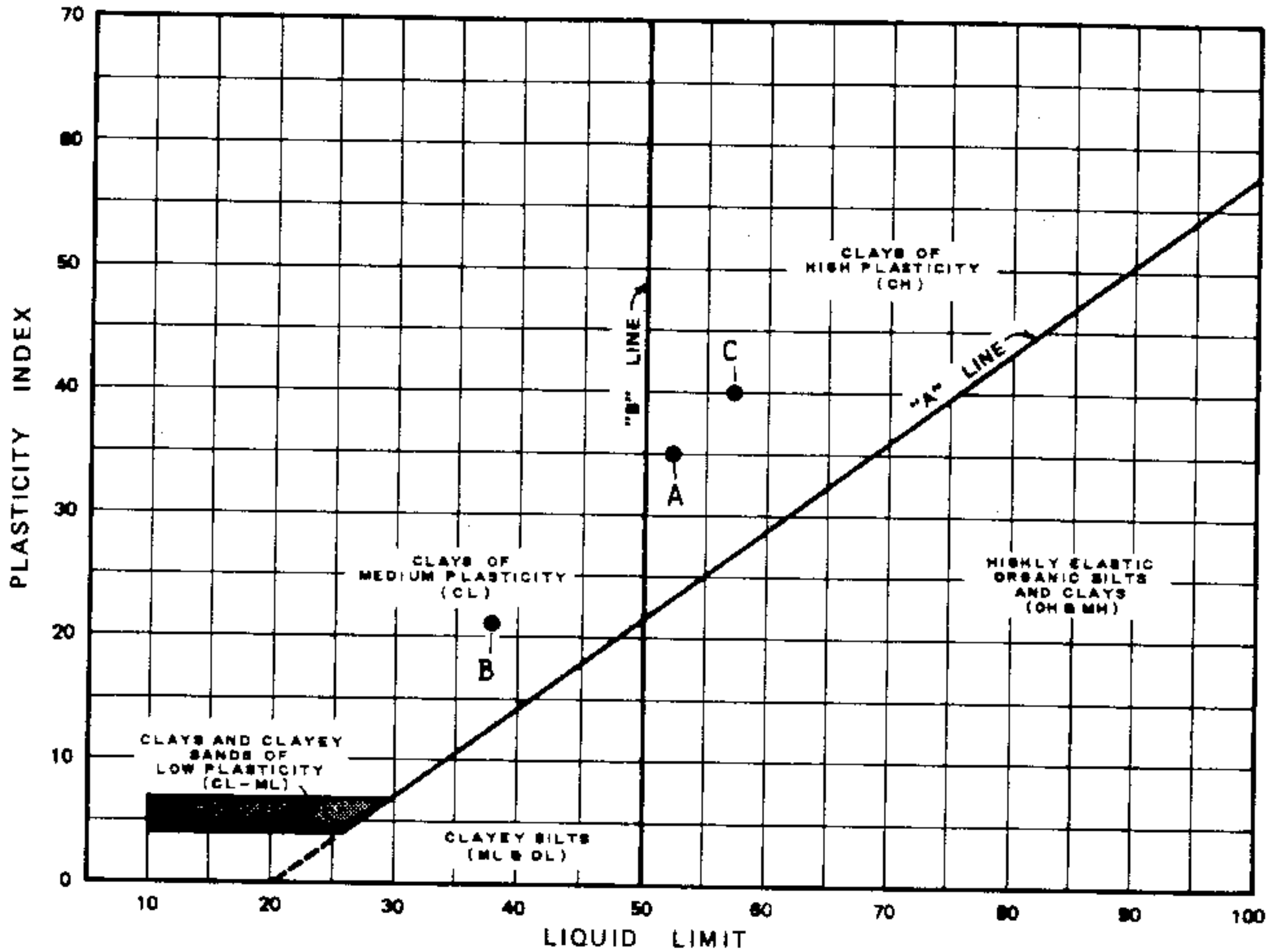
DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	ADJUSTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	RECOVERY % (RQD)	OTHER LAB TESTS / NOTES
105		SANDY LEAN CLAY (CL) - light-brown, hard, sand fraction predominantly fine, moist *(continued)*							
110		-similiar to above except reddish-brown & greyish-brown, very stiff	SPT	22					
115									
120									
		SANDSTONE & SHALE - reddish-brown sandstone & dark-grey shale [BEDROCK]	SPT	50/5.0"					

Bottom of borehole at 124.4 feet.
1. Spun PW casing to 4.0 ft. Advanced open-hole thereafter.

2. Borehole tremie grouted to ground surface.

APPENDIX C

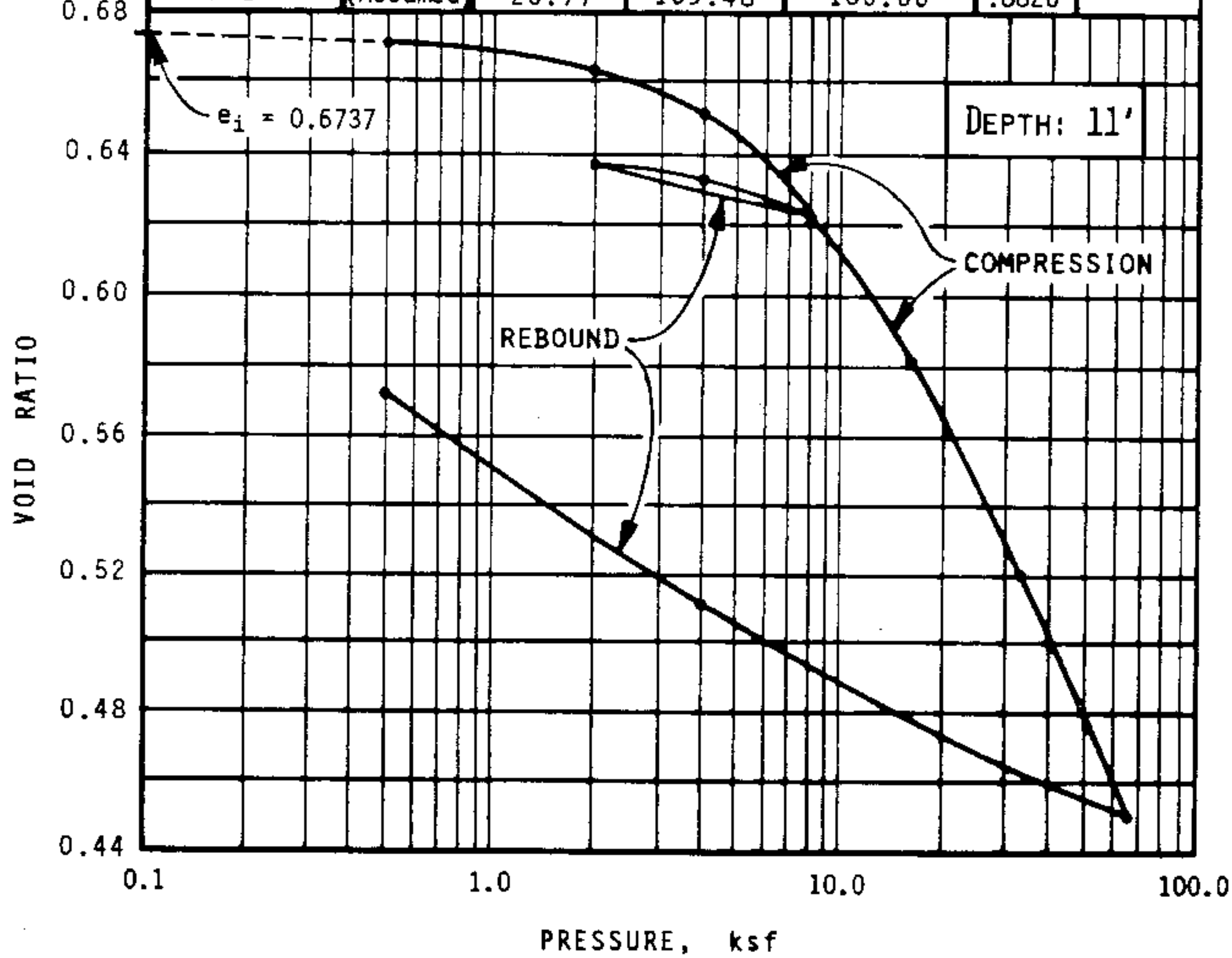
Historic Geotechnical Laboratory Testing Data



CLASSIFICATION TEST RESULTS										
SAMPLE IDENTIFICATION				ATTERBERG LIMITS			GRAIN SIZES - % DRY WEIGHT			
LETTER DESIG'N	BORING NO.	SAMPLE NO.	DEPTH, FT.	LIQUID LIMIT	PLASTICITY INDEX	PLASTIC LIMIT	SAND	SILT	CLAY	COLLOIDAL
A	3	1	2.0'	52	35	16	—	—	—	—
B	5	1	1.0'	38	21	17	—	—	—	—
C	6	1	2.5'	57	40	16	—	—	—	—

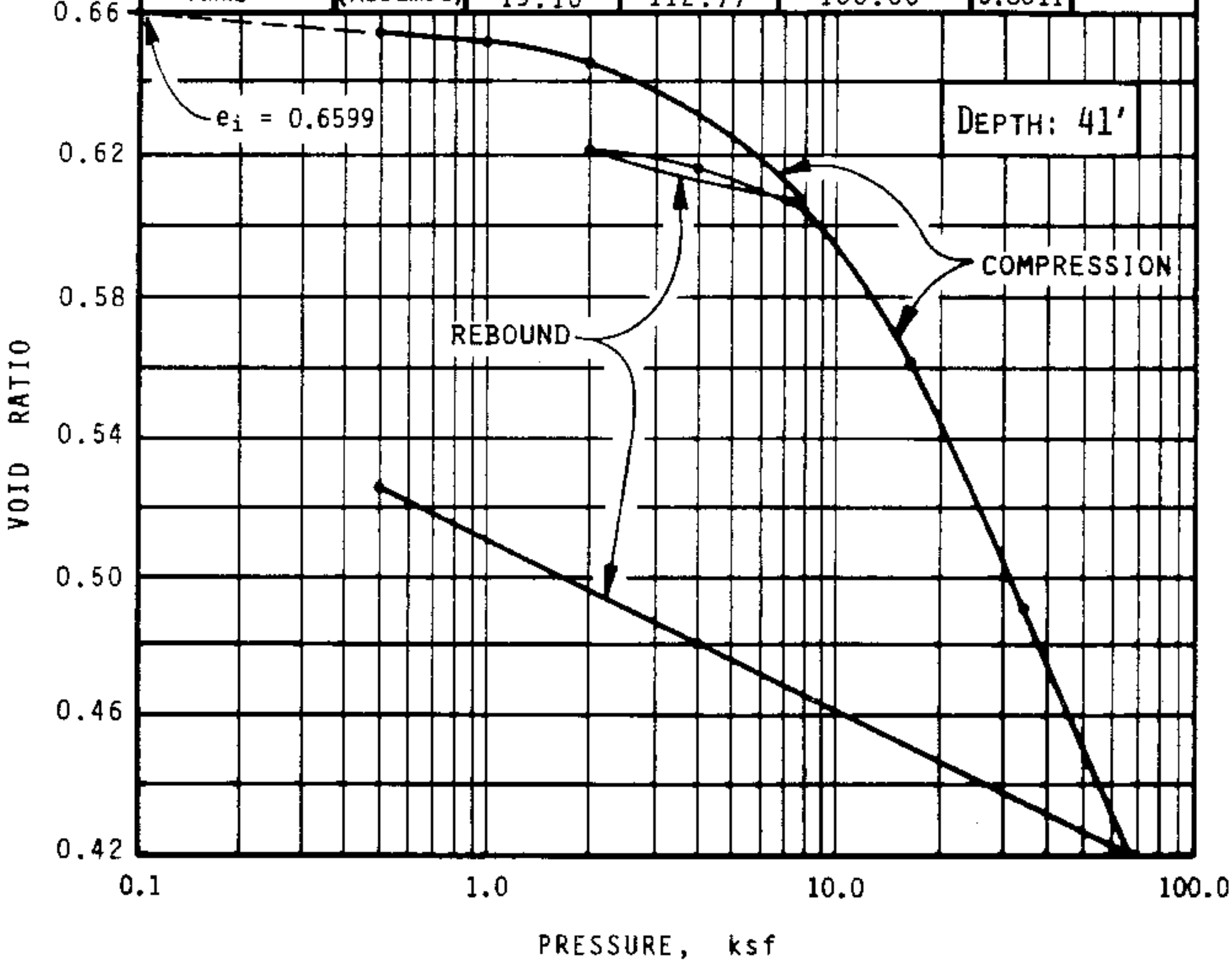
Project No. 14676A Woodward-Clyde Consultants	PLASTICITY CLASSIFICATION U.C. - NORTHERN REGIONAL LIBRARY	Figure 7

SAMPLE NO.	SUMMARY OF TEST RESULTS					
4 - 3	SPECIFIC GRAVITY	MOISTURE CONTENT, (%)	DRY DENSITY, (PCF)	PERCENT OF SATURATION, (%)	HEIGHT (IN.)	DIAMETER (IN.)
INITIAL	2.76	23.18	102.90	94.98	.9390	2.43
FINAL	(Assumed)	20.77	109.48	100.00	.8826	



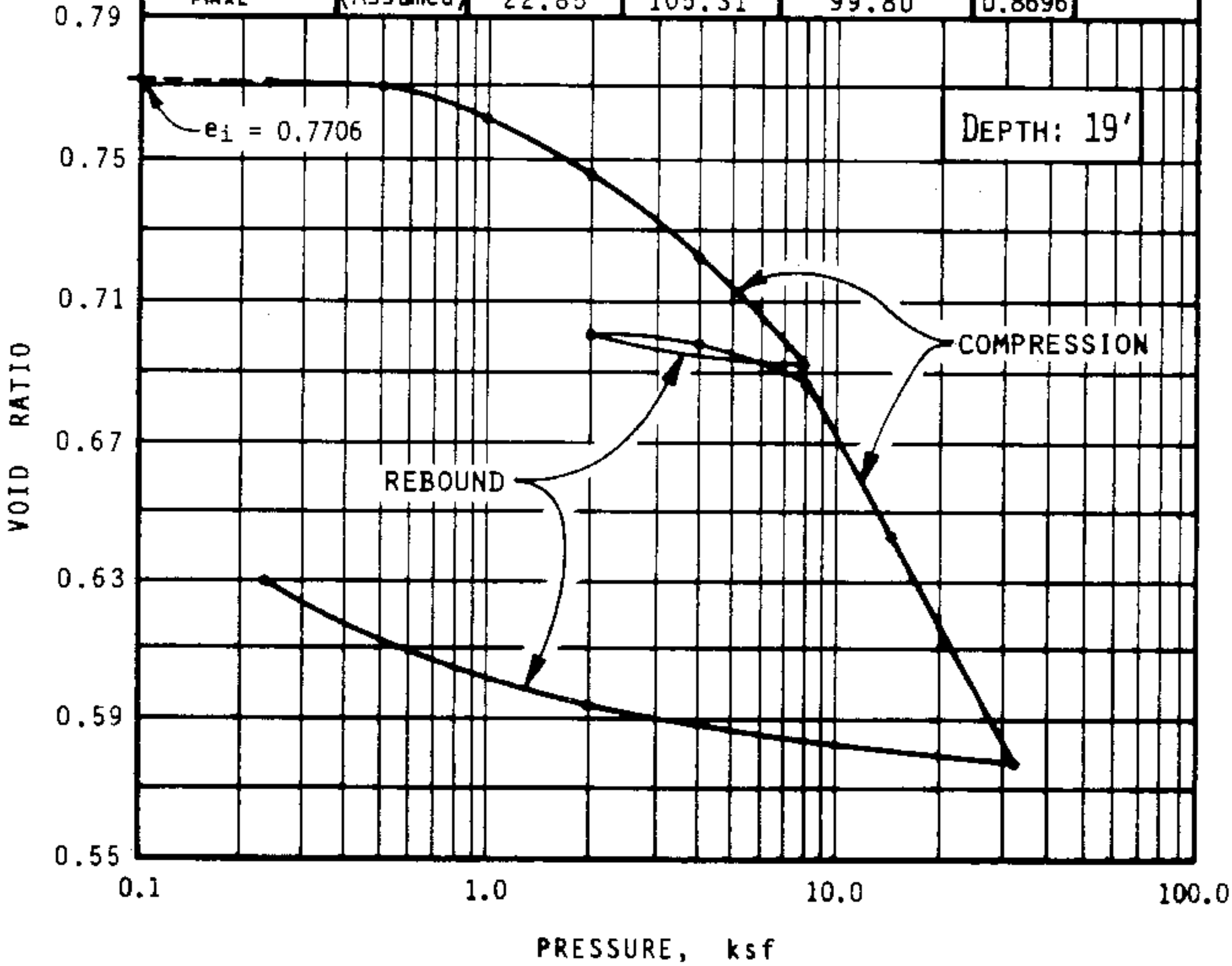
Project No. 14676A **Woodward-Clyde Consultants**	<u>CONSOLIDATION TEST RESULTS</u> U.C. - NORTHERN REGIONAL LIBRARY	Figure 8

SAMPLE NO.	SUMMARY OF TEST RESULTS					
4 - 9	SPECIFIC GRAVITY	MOISTURE CONTENT, (%)	DRY DENSITY, (PCF)	PERCENT OF SATURATION, (%)	HEIGHT (IN.)	DIAMETER (IN.)
INITIAL	2.76 (Assumed)	22.91	103.75	95.79	0.9360	2.43
FINAL		19.10	112.77	100.00	0.8611	

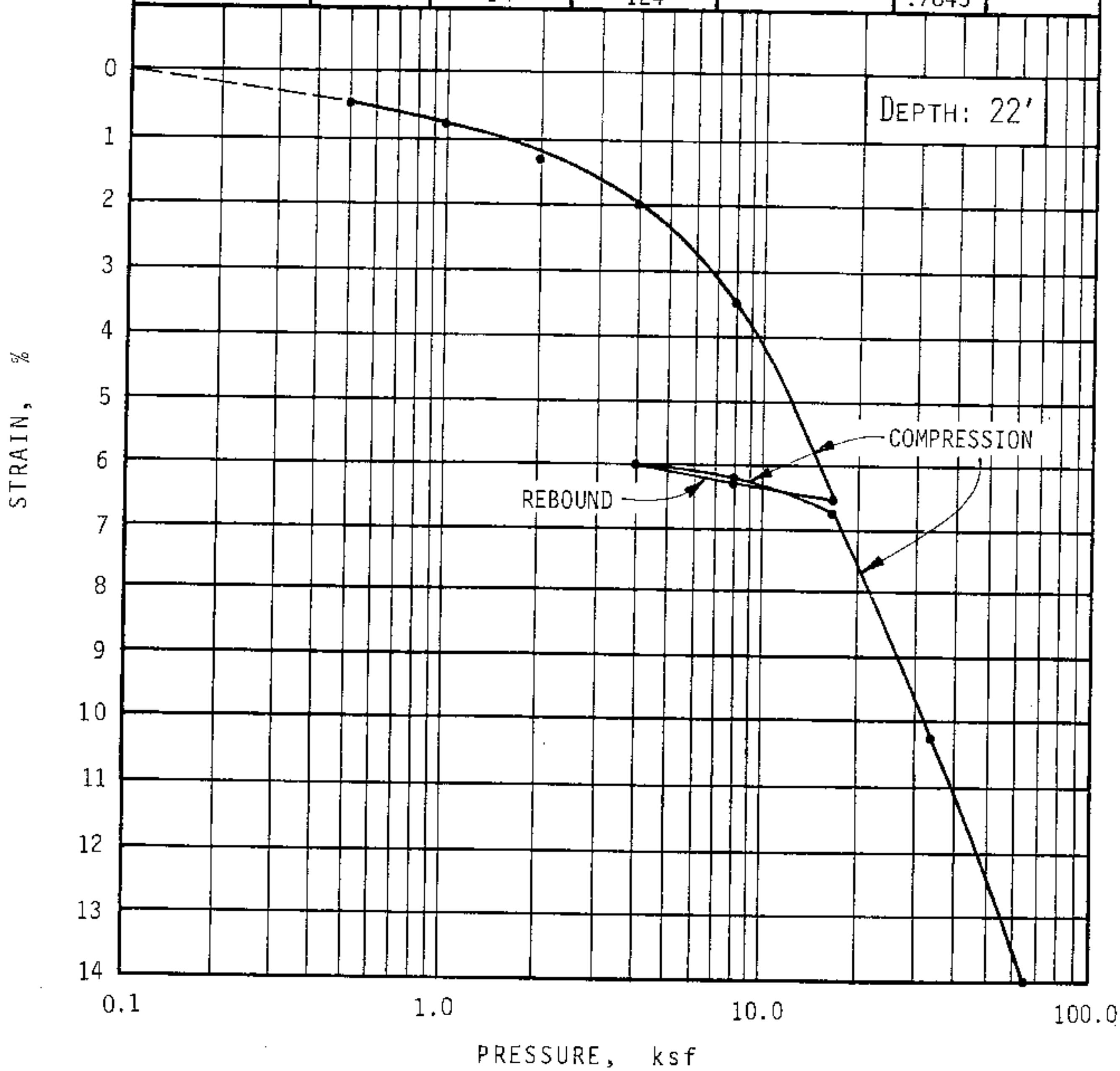


Project No. 14676A Woodward-Clyde Consultants	CONSOLIDATION TEST RESULTS U.C. - NORTHERN REGIONAL LIBRARY	Figure 9

SAMPLE NO.	SUMMARY OF TEST RESULTS					
5 - 5	SPECIFIC GRAVITY	MOISTURE CONTENT, (%)	DRY DENSITY, (PCF)	PERCENT OF SATURATION, (%)	HEIGHT (IN.)	DIAMETER (IN.)
INITIAL	2.74	27.88	96.92	99.48	0.9449	2.43
FINAL	(Assumed)	22.85	105.31	99.80	0.8696	

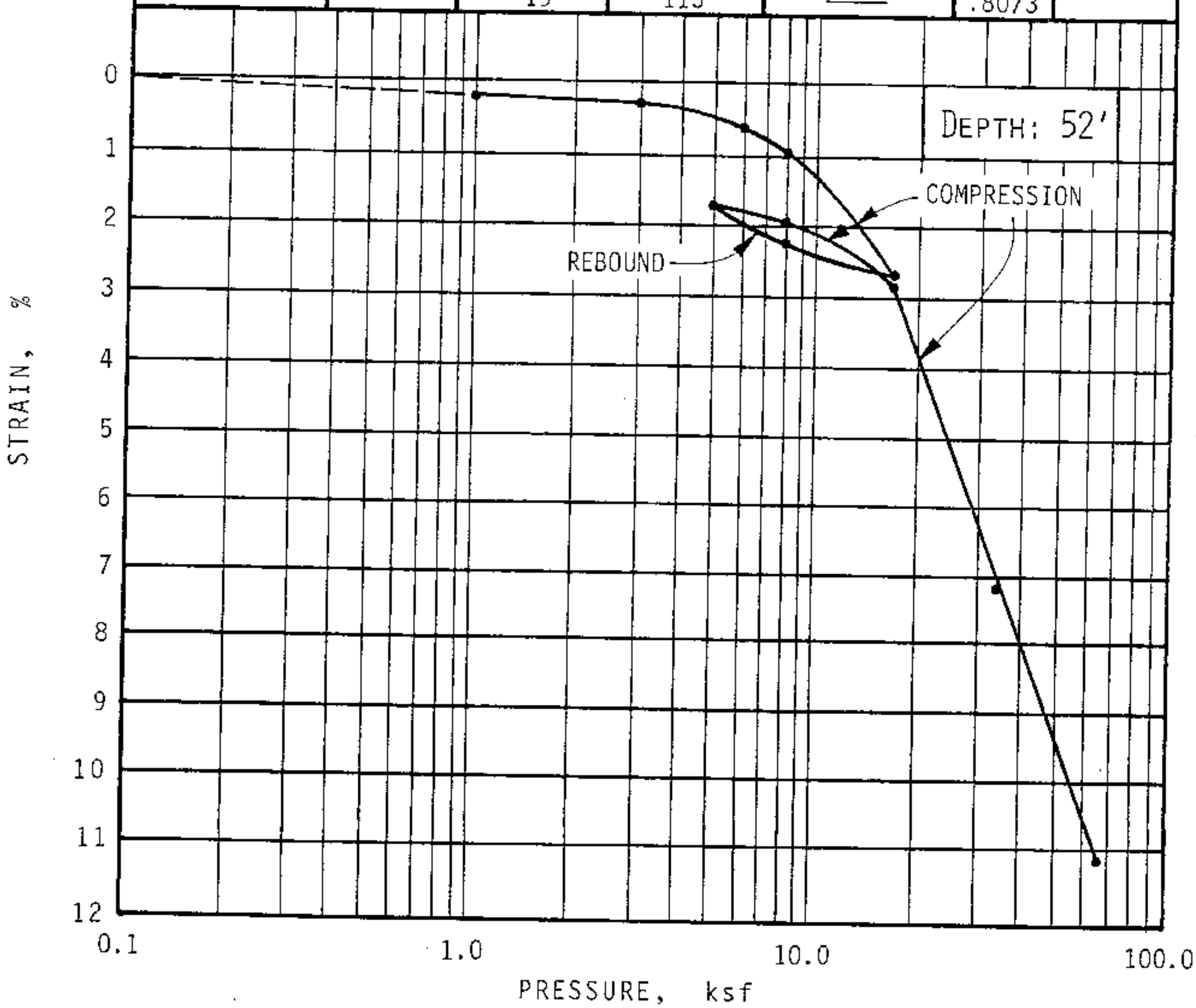


SAMPLE NO. A - 2	SUMMARY OF TEST RESULTS					
	SPECIFIC GRAVITY	MOISTURE CONTENT, (%)	DRY DENSITY, (PCF)	PERCENT OF SATURATION, (%)	HEIGHT (IN.)	DIAMETER (IN.)
INITIAL	—	21	107	—	.9125	2.43
FINAL		14	124	—	.7843	

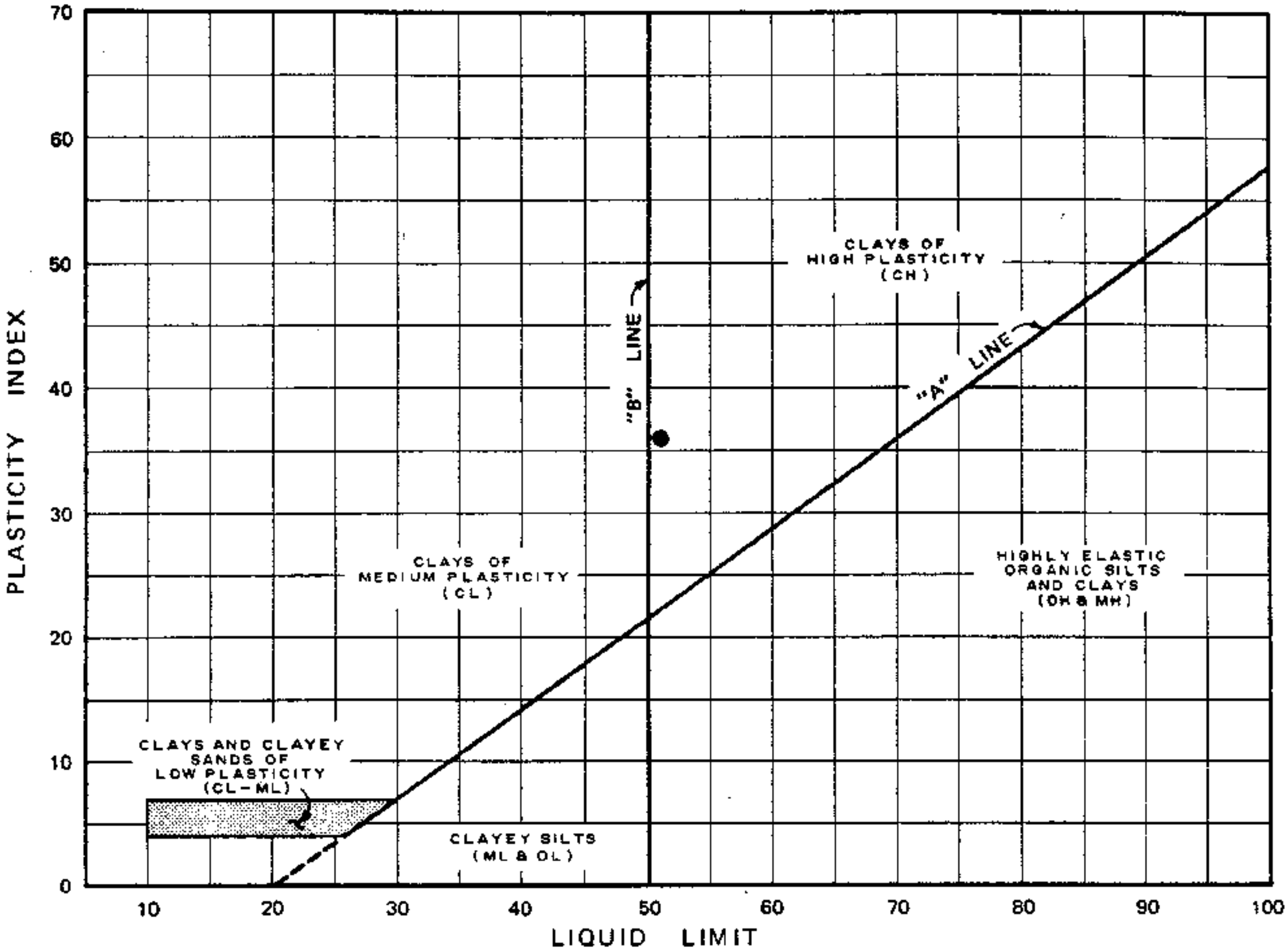


Project No. 14676A **Woodward-Clyde Consultants**	CONSOLIDATION TEST RESULTS U.C.-NORTHERN REGIONAL LIBRARY	Figure 6s

SAMPLE NO.	SUMMARY OF TEST RESULTS					
B - 5	SPECIFIC GRAVITY	MOISTURE CONTENT, (%)	DRY DENSITY, (PCF)	PERCENT OF SATURATION, (%)	HEIGHT (IN.)	DIAMETER (IN.)
INITIAL	——	24	102	——	.9081	2.43
FINAL		19	115	——	.8073	



Project No. 14676A **Woodward-Clyde Consultants**	CONSOLIDATION TEST RESULTS U.C.-NORTHERN REGIONAL LIBRARY	Figure 7s



CLASSIFICATION TEST RESULTS										
SAMPLE IDENTIFICATION				ATTERBERG LIMITS			GRAIN SIZES - % DRY WEIGHT			
LETTER DESIG'N	BORING NO.	SAMPLE NO.	DEPTH, FT.	LIQUID LIMIT	PLASTICITY INDEX	PLASTIC LIMIT	SAND	SILT	CLAY	COLLOIDAL
	9	1	4	51	36	15	-	-	-	-

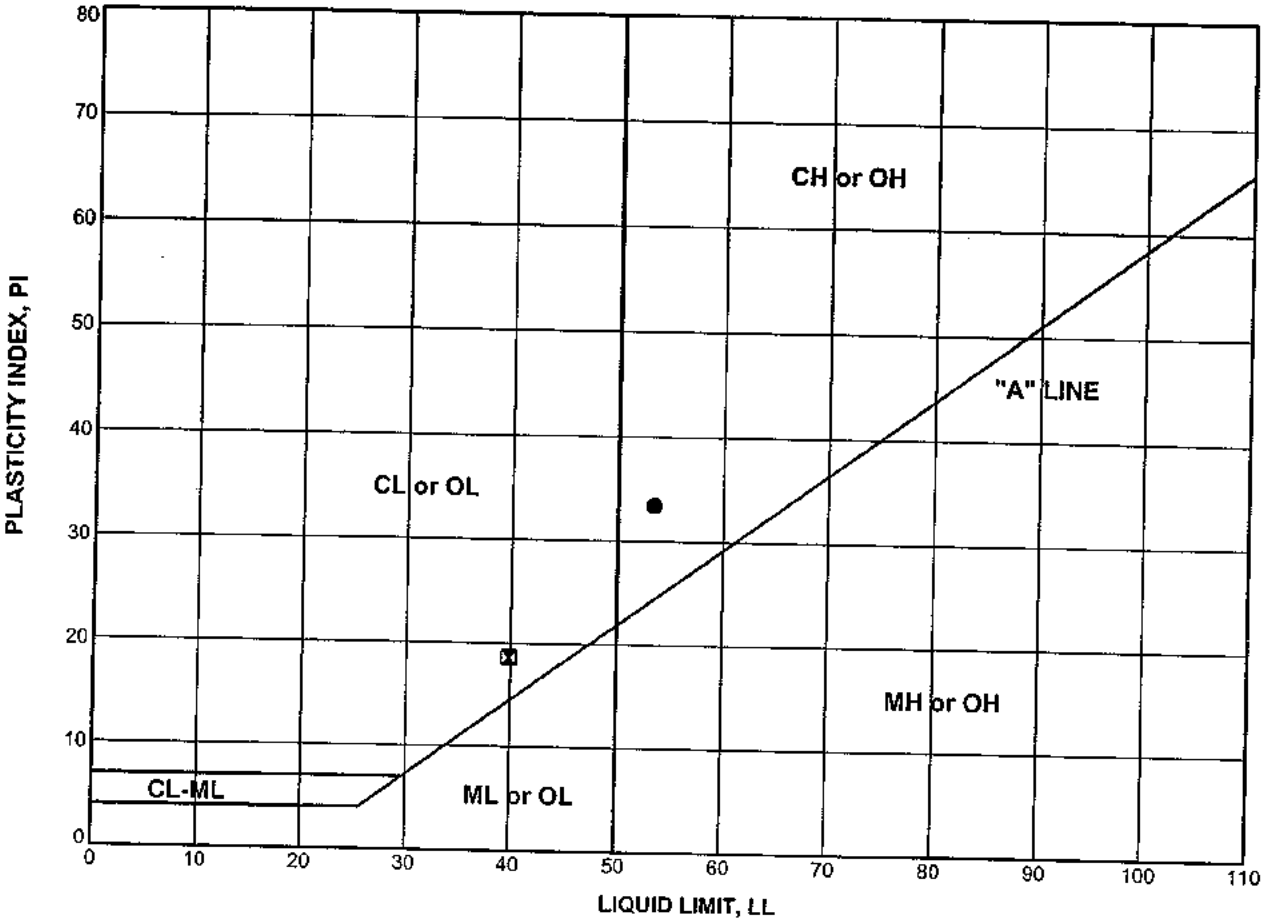
Project No. 14676B Woodward-Clyde Consultants	PLASTICITY CLASSIFICATION NORTHERN REGIONAL LIBRARY SHELVING FACILITY - PHASE II	Figure 6

TABLE B-1
SUMMARY OF SOIL LABORATORY DATA

Sample Information				USCS Group Symbol	In Situ Water Content, %	In Situ Dry Unit Weight, pcf	Sieve			Atterberg Limits			Unconfined Compressive Strength, psf
Boring Number	Sample Number	Depth, feet	Elevation, feet MSL				Gravel, %	Sand, %	<#200, %	LL	PL	PI	
B-10	10-2-3	5.5-6	NA	SC	15.4	118							
B-10	10-3-3	10.5-11	NA	SC	12.0		37	48	15				
B-10	10-4-3	15.5-16	NA	SC	13.6	119							
B-10	10-7-3	25.5-26	NA	CL	18.7	111							2980
B-11	11-2-3	5.5-6	NA	CH	19.3	106							7300
B-11	11-3-3	10.5-11	NA	CH	23.2	103							3700
B-11	11-4-3	15.5-16	NA	CH						53	20	33	
B-11	11-5-3	20.5-21	NA	CH	18.2	112							2100
B-11	11-7-3	30.5-31	NA	CL	27.3	98							1700
B-11	11-11-3	50.5-51	NA	CL	22.9	101							2020
B-12	12-1-3	3.5-4	NA	CL	17.9	107							8950
B-12	12-4-3	15.5-16	NA	CL	25.4	97							3350
B-12	12-6-3	25.5-26	NA	SC	18.0		37	41	22				
B-12	12-7-3	30.5-31	NA	CL	26.2	99				40	21	19	2150
B-12	12-9-3	40.5-41	NA	CL	24.4	100							3070
B-12	12-11-3	50.5-51	NA	SM	20.2	106							6700

NOTE: The laboratory tests were performed in general accordance with the following standards:

Water Content - ASTM Test Method D2216
Dry Unit Weight - ASTM Test Method D2937
Grain Size Analysis by Mechanical Sieving - ASTM Test Method D422
Atterberg Limits - ASTM Test Method D4318
Unconfined Compressive Strength Test - ASTM Test Method D2166



Boring Number	Sample Number	Depth (feet)	Test Symbol	Water Content (%)	LL	PL	PI	Classification
B-11	11-4-3	15.5-16	●		53	20	33	Silty Clay with Sand (CH)
B-12	12-7-3	30.5-31	⊠	26	40	21	19	Silty Clay (CL)

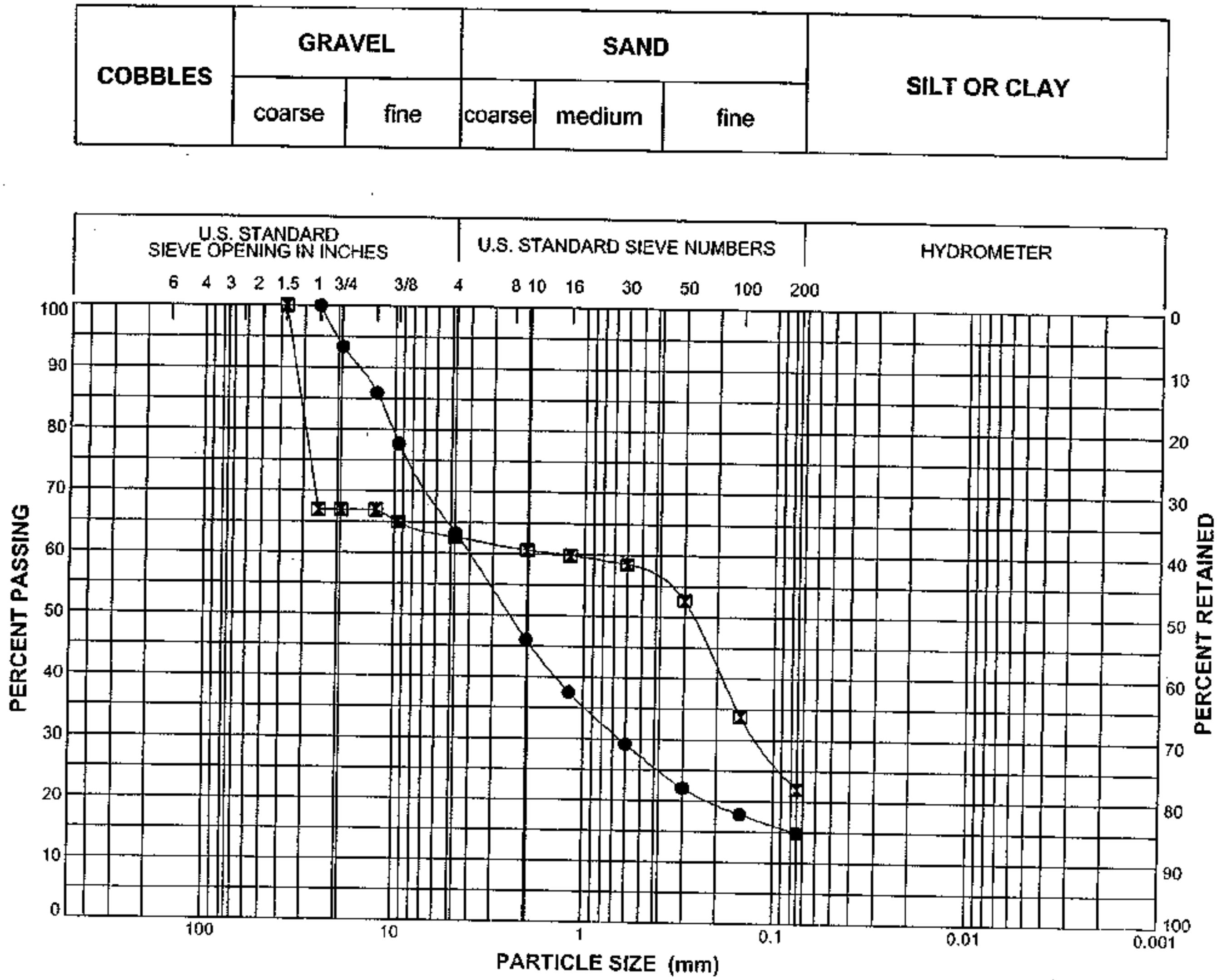
Report: ATTERBERG_PLOT_12 PTS; File: UCBRICHM.GPJ; 3/17/2001 B-12

UCB Richmond Field Station
Richmond, California
51-00111028.00

URS

PLASTICITY CHART

Figure B-1



Boring Number	Sample Number	Depth (feet)	Symbol	LL	PI	Classification
B-10	10-3-3	10.5-11	●			Clayey Sand with Gravel (SC)
B-12	12-6-3	25.5-26	⊠			Clayey Sand with Gravel (SC)

UCB Richmond Field Station
Richmond, California
51-00111028.00

PARTICLE SIZE DISTRIBUTION CURVES

URS

Figure B-2

Report: SIEVE_5_CURVES_OAK; File: UCBRICHM.GPJ; 3/17/2001 B-12

URS

ASTM D2166
Unconfined Compressive Strength

Project Name: **UCB - Richmond Field Station**

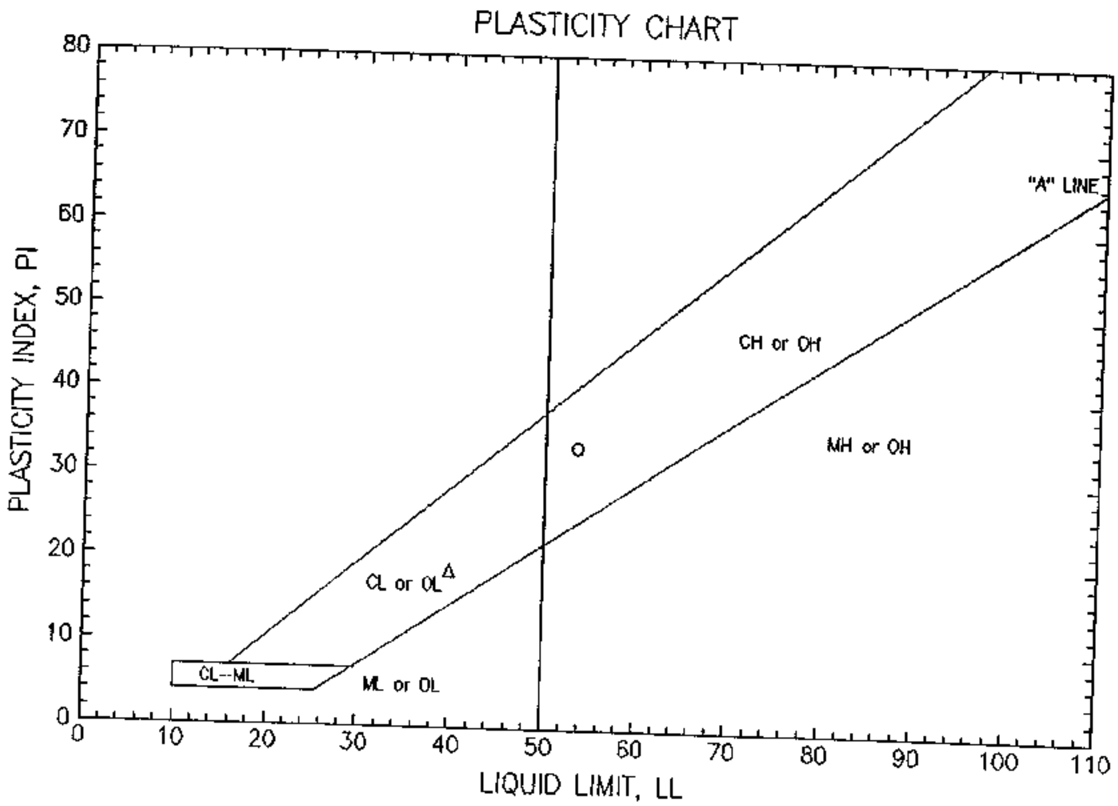
Project Number: 51-00111028.00

Location: **Richmond, CA**

Boring/ Sample Number	Moisture Content %	Wet Density pcf	Dry Density pcf	Unconfined Compressive Strength, psf	Strain at Failure	Sample Description
1-2-3	15.37	135.57	117.51	NA	NA	Olive brown sandy silty clay with gravel
1-4-3	13.55	135.62	119.44	NA	NA	Reddish brown gravelly silty sand/gravelly sand
1-7-3	18.69	131.94	111.16	2981	9.8%	Lt. grayish brown sandy silty clay with gravel
2-2-3	19.26	126.22	105.83	7296	10.0%	Lt. grayish brown sandy silty clay
2-3-3	23.16	126.28	102.54	3699	10.0%	Lt. grayish brown sandy silty clay
2-5-3	18.20	132.80	112.35	2099	10.0%	Brown sandy silty clay with gravel
2-7-3	27.31	124.30	97.63	1699	10.0%	Lt. grayish brown fine sandy silty clay
2-11-3	22.86	124.34	101.21	2023	8.9%	Gray fine sandy silty clay w/fractures
3-1-3	17.87	125.88	106.80	8948	10.0%	Grayish brown sandy silty clay with calc. nod.
3-4-3	25.42	121.25	96.67	3349	10.0%	Lt. brown silty clay with fine sand
3-7-3	26.19	124.98	99.04	2149	10.0%	Lt. Grayish brown sandy silty clay
3-9-3	24.37	124.52	100.12	3074	10.0%	Gray brown fine sandy silty clay
3-11-3	20.17	126.95	105.64	6697	10.0%	Grayish brown fine sandy silty clay w/calc. nod.

URS

Project : UCB – RICHMOND FIELD STATION
Project No. : 51-00111028.00
Location : UCB – RICHMOND, CA
Date : Wed Mar 14 2001



Symbol	Boring No.	Sample No.	Liquid Limit	Plastic Limit	Plasticity Index
O	2–4	3	53.38	19.93	33.45
Δ	3–7	2	39.80	21.16	18.64

Figure 1

URS

ATTERBERG LIMITS

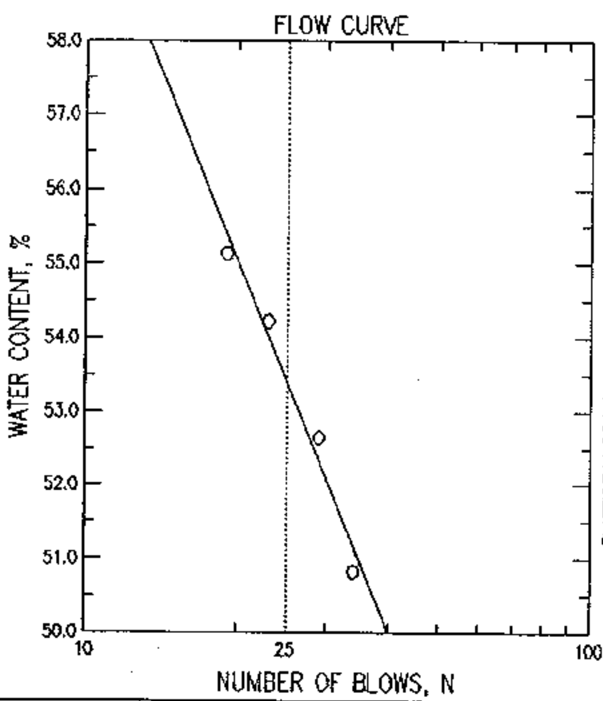
PROJECT	PROJECT NUMBER	TESTED BY	BORING NUMBER
UCB – RICHMOND FIELD STATION	51-00111028.00	C. Wason	2-4
LOCATION: UCB – RICHMOND, CA		CHECKED BY: S. Capps	SAMPLE NUMBER: 3
SAMPLE DESCRIPTION: Olive Brown fine sa-silty Clay		DATE: Tue Mar 13 2001	FILENAME: 2-4-3

LIQUID LIMIT DETERMINATIONS

CONTAINER NUMBER	8	49	14	42	
WT. WET SOIL + TARE	23.94	23.49	22.89	21.72	
WT. DRY SOIL + TARE	19.62	19.1	18.65	17.85	
WT. WATER	4.32	4.39	4.24	3.87	
TARE WT.	11.12	10.76	10.83	10.83	
WT. DRY SOIL	8.5	8.34	7.82	7.02	
WATER CONTENT, W_N (%)	50.82	52.64	54.22	55.13	
NUMBER OF BLOWS, N	34	29	23	19	
ONE-POINT LIQUID LIMIT, LL	52.75	53.59	53.68	53.33	

PLASTIC LIMIT DETERMINATIONS

CONTAINER NUMBER	6				
WT. WET SOIL + TARE	26.25				
WT. DRY SOIL + TARE	24.51				
WT. WATER	1.74				
TARE WT.	15.78				
WT. DRY SOIL	8.73				
WATER CONTENT (%)	19.93				



SUMMARY OF RESULTS

NATURAL WATER CONTENT, W (%)	
LIQUID LIMIT, LL	53.4
PLASTIC LIMIT, PL	19.9
PLASTICITY INDEX, PI	33.4
LIQUIDITY INDEX, LI*	

*LI = (W – PL)/PI

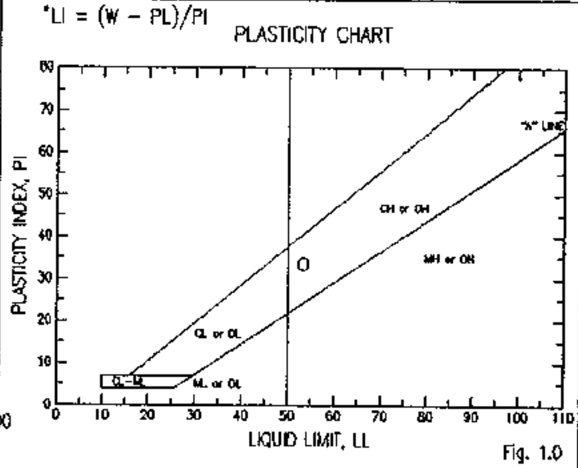


Fig. 1.0

URS

GEOTECHNICAL LABORATORY TEST DATA

Project : UCB - RICHMOND FIELD STATION
Project No. : 51-00111028.00
Boring No. : 2-4
Sample No. : 3
Location : UCB - RICHMOND, CA
Soil Description : Olive Brown fine sa-silty Clay
Remarks :

Depth : 15-16.5 feet
Test Date : 3/12/2001
Test Method : ASTM D4318

Filename : 2-4-3
Elevation : NA
Tested by : C. Wason
Checked by : S. Capps

Plastic Limit

Moisture Content ID	Mass of Container (gm)	Mass of Container and Moist Soil (gm)	Mass of Container and Dried Soil (gm)	Moisture Content (%)
1) 6	15.78	26.25	24.51	19.93

Plastic Limit = 19.93

Liquid Limit

Moisture Content ID	Mass of Container (gm)	Mass of Container and Moist Soil (gm)	Mass of Container and Dried Soil (gm)	Number of Drops	Moisture Content (%)
1) 8	11.12	23.94	19.62	34	50.82
2) 49	10.76	23.49	19.10	29	52.64
3) 14	10.83	22.89	18.65	23	54.22
4) 42	10.83	21.72	17.85	19	55.13

Liquid Limit = 53.38
Plastic Index = 33.45

URS

ATTERBERG LIMITS

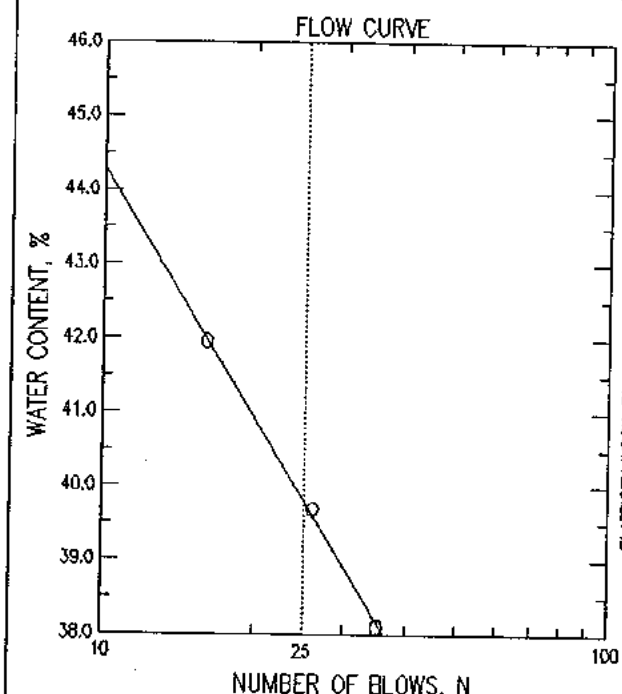
PROJECT	PROJECT NUMBER	TESTED BY	BORING NUMBER
UCB – RICHMOND FIELD STATION	51-00111028.00	C. Wason	3-7
LOCATION		CHECKED BY	SAMPLE NUMBER
UCB – RICHMOND, CA		S. Capps	2
SAMPLE DESCRIPTION		DATE	FILENAME
Lt. Brown silty Clay		Wed Mar 14 2001	3-7-2

LIQUID LIMIT DETERMINATIONS

CONTAINER NUMBER	112	133	320		
WT. WET SOIL + TARE	24.44	24.3	24.52		
WT. DRY SOIL + TARE	20.71	20.49	20.48		
WT. WATER	3.73	3.81	4.04		
TARE WT.	10.92	10.89	10.85		
WT. DRY SOIL	9.79	9.6	9.63		
WATER CONTENT, W_N (%)	38.10	39.69	41.95		
NUMBER OF BLOWS, N	35	26	16		
ONE-POINT LIQUID LIMIT, LL	39.68	39.88	39.75		

PLASTIC LIMIT DETERMINATIONS

CONTAINER NUMBER	210				
WT. WET SOIL + TARE	27.01				
WT. DRY SOIL + TARE	25.08				
WT. WATER	1.93				
TARE WT.	15.96				
WT. DRY SOIL	9.12				
WATER CONTENT (%)	21.16				



SUMMARY OF RESULTS

NATURAL WATER CONTENT, W (%)	
LIQUID LIMIT, LL	39.8
PLASTIC LIMIT, PL	21.2
PLASTICITY INDEX, PI	18.6
LIQUIDITY INDEX, LI*	

*LI = (W − PL)/PI

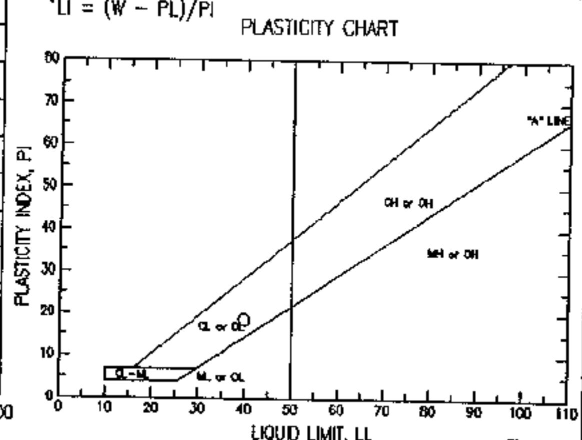


Fig. 1.0

URS

Wed Mar 14 11:08:38 2001

GEOTECHNICAL LABORATORY TEST DATA

Project : UCB - RICHMOND FIELD STATION
Project No. : 51-00111028.00 Depth : 35-36.5 feet
Boring No. : 3-7 Test Date : 3/13/2001
Sample No. : 2 Test Method : ASTM D4318
Location : UCB - RICHMOND, CA
Soil Description : Lt. Brown silty Clay
Remarks :

Filename : 3-7-2
Elevation : NA
Tested by : C. Wason
Checked by : S. Capps

Plastic Limit

Moisture Content ID	Mass of Container (gm)	Mass of Container and Moist Soil (gm)	Mass of Container and Dried Soil (gm)	Moisture Content (%)
1) 210	15.96	27.01	25.08	21.16

Plastic Limit = 21.16

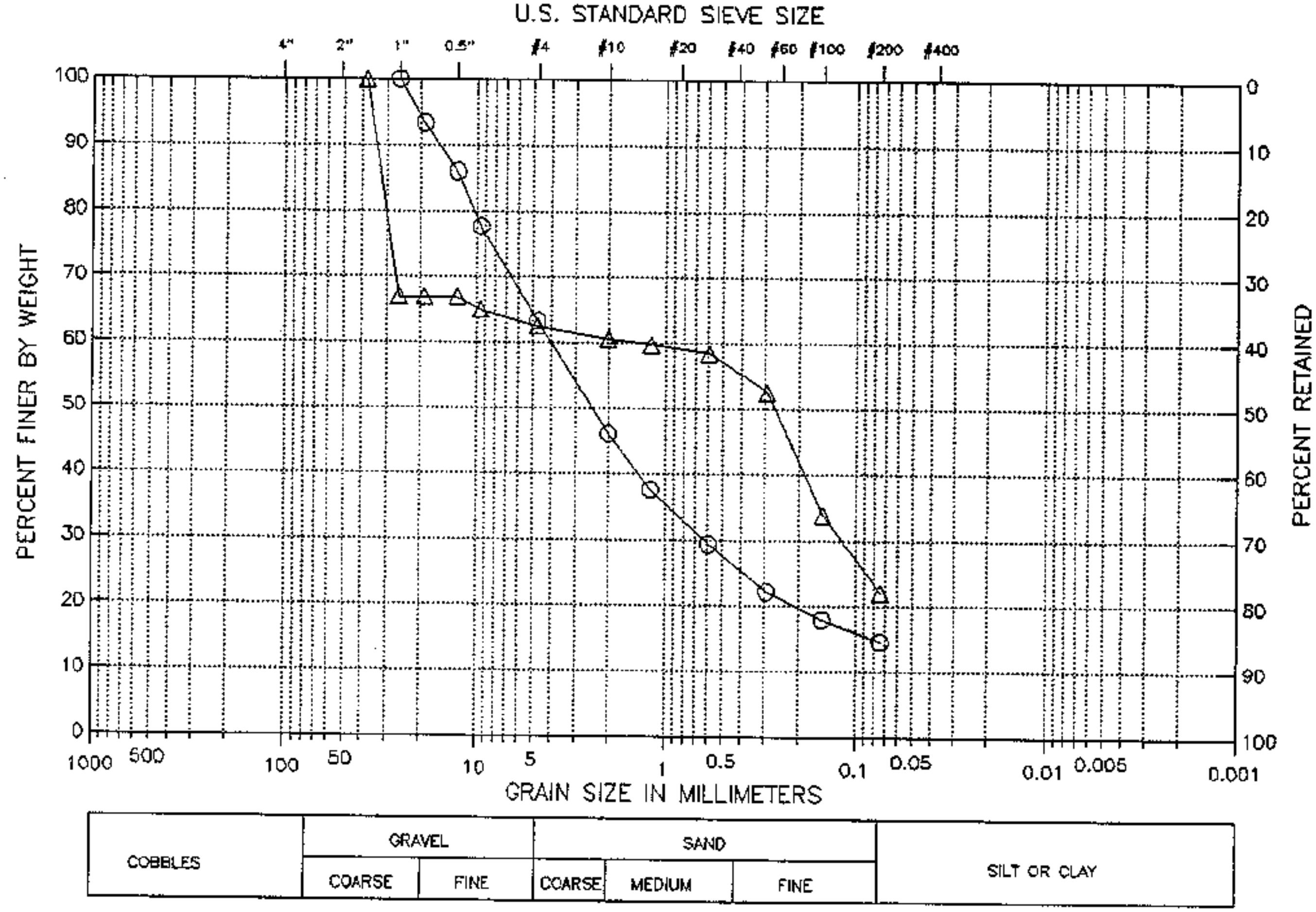
Liquid Limit

Moisture Content ID	Mass of Container (gm)	Mass of Container and Moist Soil (gm)	Mass of Container and Dried Soil (gm)	Number of Drops	Moisture Content (%)
1) 112	10.92	24.44	20.71	35	38.10
2) 133	10.89	24.30	20.49	26	39.69
3) 320	10.85	24.52	20.48	16	41.95

Liquid Limit = 39.80
Plastic Index = 18.64

URS

Project : UCB – RICHMOND FIELD STATION
Project No.: 51-00111028.00
Location: UCB – RICHMOND, CA
Date : Tue Mar 13 2001

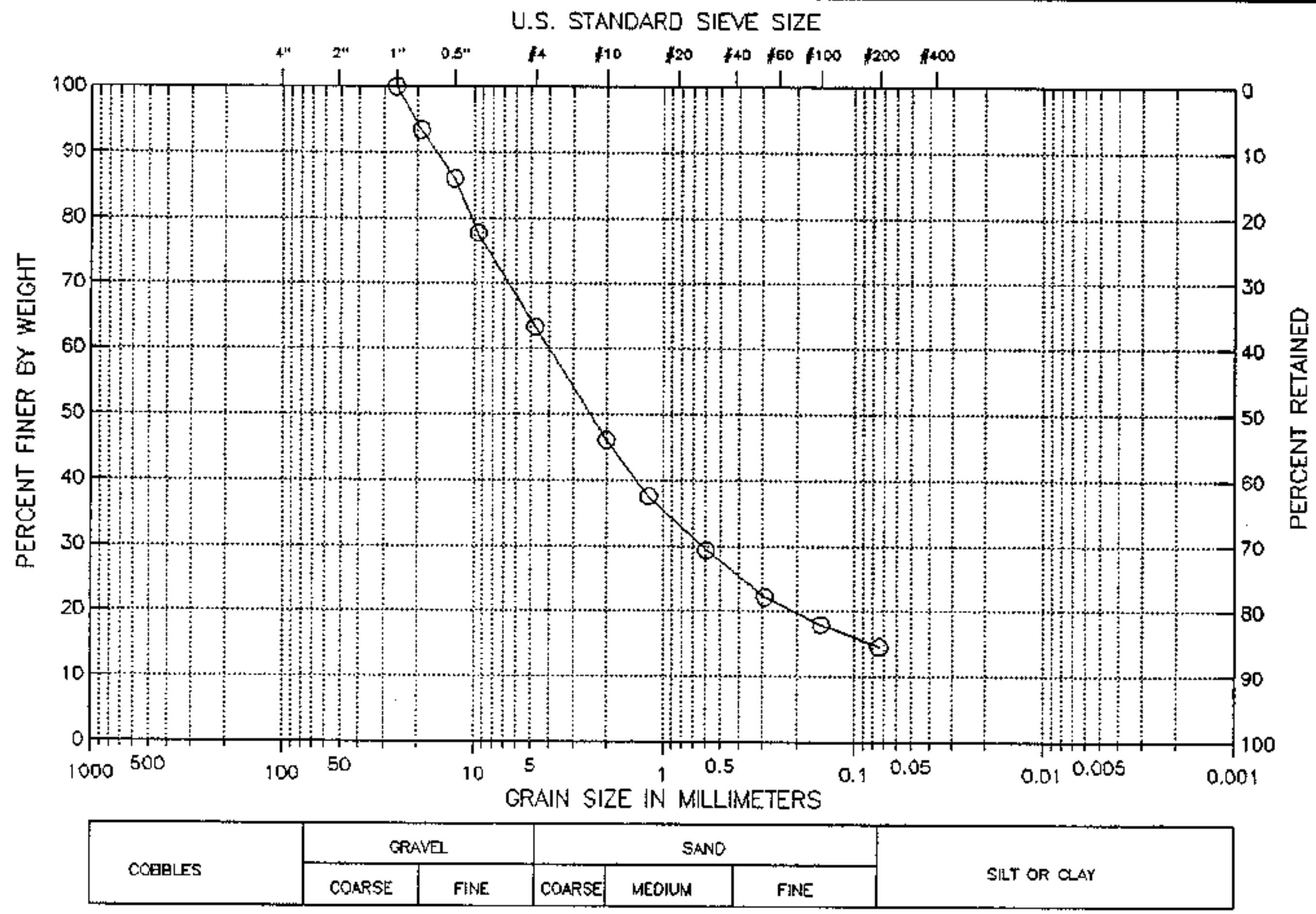


Symbol	Boring No.	Sample No.	Depth	Filename	Classification / Description	
-○-	1-3	3	10-11.5 feet	1-3-3	SM	Silty sand with gravel
-△-	3-6	3	25-26.5 feet	3-6-3	SM	Silty sand with gravel

Figure 1

URS

	Boring No.: 1–3 Sample No.: 3 Tested by : C. Wason Filename : 1–3–3	Project : UCB – RICHMOND FIELD STATION Project No.: 51–00111028.00 Location: UCB – RICHMOND, CA Date : Tue Mar 13 2001



Classification :
(SM) Silty sand with gravel
Visual Description :
Orange Brown gravelly clayey Sand

Remarks :
Depth: 10–11.5 feet

Figure 1

URS

Tue Mar 13 11:09:10 2001

GEOTECHNICAL LABORATORY TEST DATA

Project : UCB - RICHMOND FIELD STATION
Project No. : 51-00111028.00
Boring No. : 1-3
Sample No. : 3
Location : UCB - RICHMOND, CA
Soil Description : Orange Brown gravelly clayey Sand
Remarks : Depth: 10-11.5 feet

Depth : 10-11.5 feet
Test Date : 3/12/2001
Test Method : ASTM D422

Filename : 1-3-3
Elevation : NA
Tested by : C. Wason
Checked by : S. Capps

COARSE SIEVE SET

Sieve Mesh	Sieve Openings Inches	Millimeters	Weight Retained (gm)	Cumulative Weight Retained (gm)	Percent Finer (%)
1"	1.012	25.70	0.00	0.00	100
0.75"	0.748	19.00	36.82	36.82	93
0.5"	0.500	12.70	41.48	78.30	86
0.375"	0.374	9.51	46.10	124.40	78
#4	0.187	4.75	80.70	205.10	63
#10	0.079	2.00	96.40	301.50	46
#16	0.047	1.19	47.80	349.30	38
#30	0.023	0.60	46.30	395.60	29
#50	0.012	0.30	40.00	435.60	22
#100	0.006	0.15	23.50	459.10	18
#200	0.003	0.07	18.50	477.60	15

Total Dry Weight of Sample = 559.3

D85 : 12.2619 mm
D60 : 4.0191 mm
D50 : 2.4332 mm
D30 : 0.6326 mm
D15 : 0.0804 mm
D10 : 0.0279 mm

Soil Classification
ASTM Group Symbol : SM
ASTM Group Name : Silty sand with gravel
AASHTO Group Symbol : A-1-a(0)
AASHTO Group Name : Stone Fragments, Gravel and Sand

URS

Tue Mar 13 11:09:10 2001

GEOTECHNICAL LABORATORY TEST DATA

Project : UCB - RICHMOND FIELD STATION
Project No. : 51-00111028.00
Boring No. : 1-3
Sample No. : 3
Location : UCB - RICHMOND, CA
Soil Description : Orange Brown gravelly clayey Sand
Remarks : Depth: 10-11.5 feet

Depth : 10-11.5 feet
Test Date : 3/12/2001
Test Method : ASTM D422

Filename : 1-3-3
Elevation : NA
Tested by : C. Wason
Checked by : S. Capps

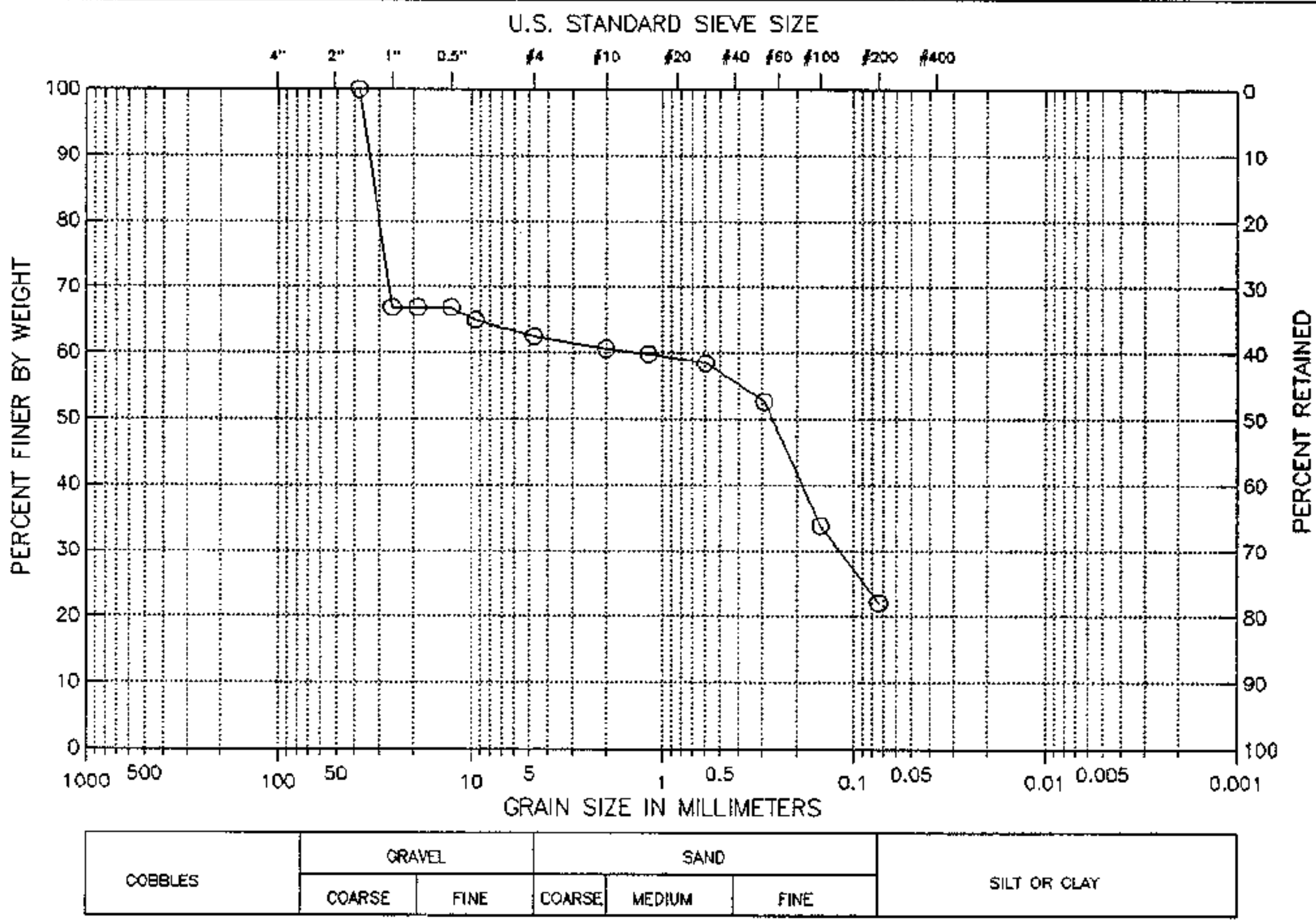
Natural Moisture Content

Moisture Content ID	Mass of Container (gm)	Mass of Container and Moist Soil (gm)	Mass of Container and Dried Soil (gm)	Moisture Content (%)
1) 1-3-3	223.10	849.50	782.40	12.00

Average Moisture Content = 12.00

URS

Boring No. : 3-6	Project : UCB – RICHMOND FIELD STATION
Sample No.: 3	Project No.: 51-00111028.00
Tested by : C. Wason	Location: UCB – RICHMOND, CA
Filename : 3-6-3	Date : Tue Mar 13 2001



Classification :
(SM) Silty sand with gravel
Visual Description :
Brown clayey gravelly silty sand

Remarks :
Depth: 25-26.5 feet

Figure 1

URS

GEOTECHNICAL LABORATORY TEST DATA

Project : UCB - RICHMOND FIELD STATION
Project No. : 51-00111028.00
Boring No. : 3-6
Sample No. : 3
Location : UCB - RICHMOND, CA
Soil Description : Brown clayey gravelly silty sand
Remarks : Depth: 25-26.5 feet

Depth : 25-26.5 feet
Test Date : 3/12/2001
Test Method : ASTM D422

Filename : 3-6-3
Elevation : NA
Tested by : C. Wason
Checked by : S. Capps

COARSE SIEVE SET

Sieve Mesh	Sieve Openings Inches	Millimeters	Weight Retained (gm)	Cumulative Weight Retained (gm)	Percent Finer (%)
1.5"	1.500	38.10	0.00	0.00	100
1"	1.012	25.70	96.58	96.58	67
0.75"	0.748	19.00	0.00	96.58	67
0.5"	0.500	12.70	0.00	96.58	67
0.375"	0.374	9.51	5.64	102.22	65
#4	0.187	4.75	7.10	109.32	63
#10	0.079	2.00	5.77	115.09	61
#16	0.047	1.19	2.33	117.42	60
#30	0.023	0.60	3.98	121.40	58
#50	0.012	0.30	17.10	138.50	53
#100	0.006	0.15	54.89	193.39	34
#200	0.003	0.07	34.31	227.70	22

Total Dry Weight of Sample = 292.3

D85 : 31.8639 mm
D60 : 1.3303 mm
D50 : 0.2682 mm
D30 : 0.1185 mm
D15 : N/A
D10 : N/A

Soil Classification
ASTM Group Symbol : SM
ASTM Group Name : Silty sand with gravel
AASHTO Group Symbol : A-1-b(0)
AASHTO Group Name : Stone Fragments, Gravel and Sand

URS

Tue Mar 13 11:15:04 2001

GEOTECHNICAL LABORATORY TEST DATA

Project : UCB - RICHMOND FIELD STATION
Project No. : 51-00111028.00
Boring No. : 3-6
Sample No. : 3
Location : UCB - RICHMOND, CA
Soil Description : Brown clayey gravelly silty sand
Remarks : Depth: 25-26.5 feet

Depth : 25-26.5 feet
Test Date : 3/12/2001
Test Method : ASTM D422

Filename : 3-6-3
Elevation : NA
Tested by : C. Wason
Checked by : S. Capps

Natural Moisture Content

Moisture Content ID	Mass of Container (gm)	Mass of Container and Moist Soil (gm)	Mass of Container and Dried Soil (gm)	Moisture Content (%)
1) 3-6-3	221.10	566.00	513.40	18.00

Average Moisture Content = 18.00

APPENDIX D

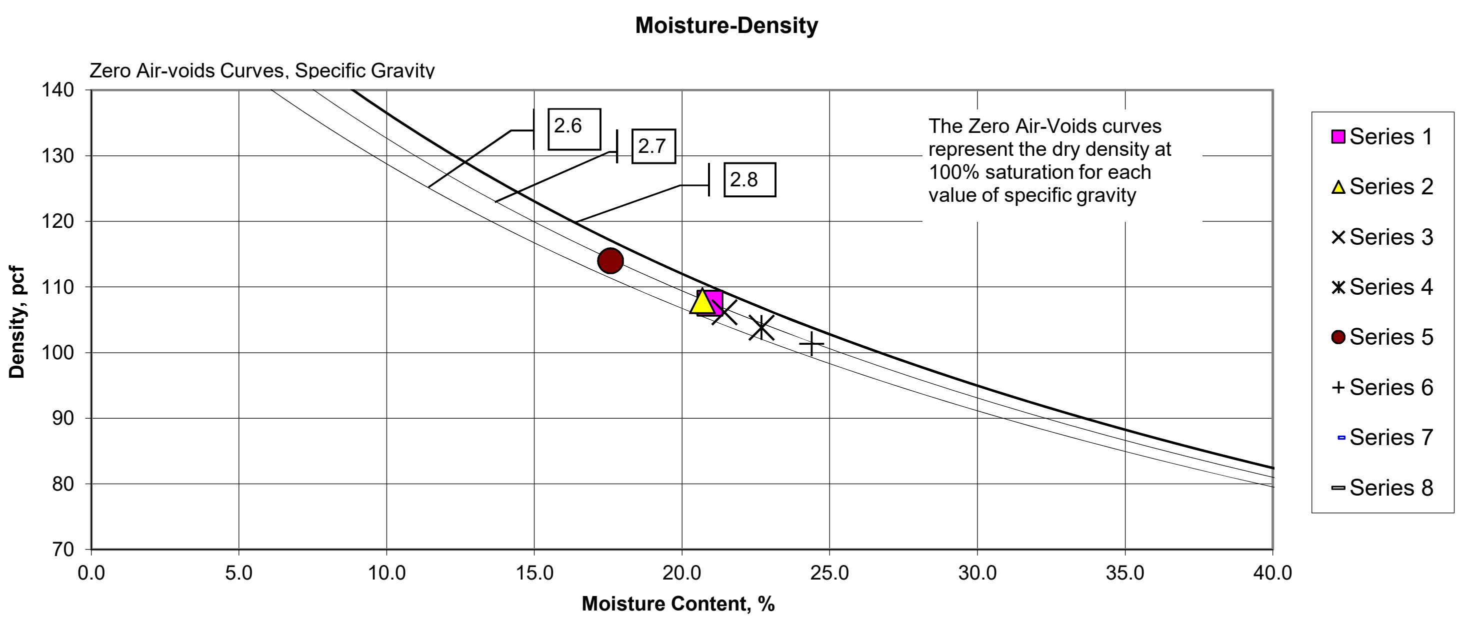
A3GEO Geotechnical Laboratory Testing Data Sheets (This Study)

Moisture-Density-Porosity Report
Cooper Testing Labs, Inc. (ASTM D7263b)

CTL Job No:	748-033	**Project No.**	1101-17A	**By:**	RU
Client:	A3GEO	**Date:**	12/21/17		
Project Name:	NRLF Phase 4	**Remarks:**			

Boring:	A3-17-1	A3-17-1	A3-17-1	A3-17-2	A3-17-2	A3-17-2		
Sample:								
Depth, ft:	31-31.5	51-51.5	81-81.5	6-6.5	71-71.5	100.5-101		
Visual Description:	Olive Brown Sandy CLAY	Bluish Gray CLAY	Reddish Brown Clayey SAND	Yellowish Brown CLAY	Olive Gray Sandy CLAY	Yellowish Brown CLAY w/ Sand		
Actual G_s								
Assumed G_s	2.70	2.70	2.70	2.70	2.70	2.70		
Moisture, %	20.9	20.7	21.4	22.7	17.6	24.4		
Wet Unit wt, pcf	130.0	130.2	128.9	127.3	134.0	126.0		
Dry Unit wt, pcf	107.5	107.9	106.2	103.8	114.0	101.3		
Dry Bulk Dens.pb, (g/cc)	1.72	1.73	1.70	1.66	1.83	1.62		
Saturation, %	99.4	99.2	98.3	98.0	98.9	99.1		
Total Porosity, %	36.3	36.0	37.1	38.5	32.4	39.9		
Volumetric Water Cont,Θw,%	36.0	35.7	36.4	37.7	32.1	39.6		
Volumetric Air Cont., Θa,%	0.2	0.3	0.6	0.8	0.3	0.4		
Void Ratio	0.57	0.56	0.59	0.63	0.48	0.66		
Series	1	2	3	4	5	6	7	8

Note: All reported parameters are from the as-received sample condition unless otherwise noted. If an assumed specific gravity (Gs) was used then the saturation, porosities, and void ratio should be considered approximate.



COOPER TESTING LABORATORY

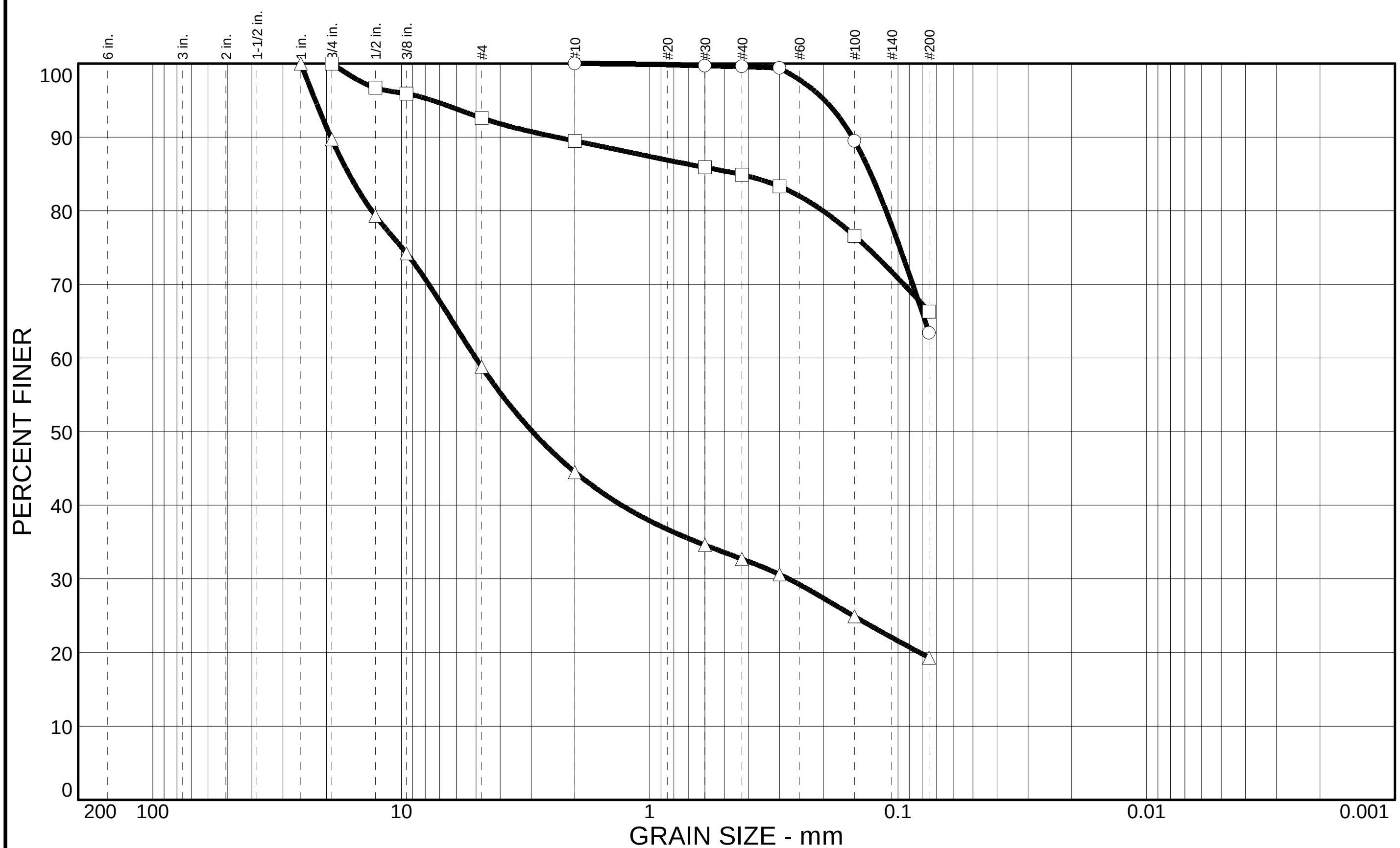
#200 Sieve Wash Analysis
ASTM D 1140

Job No.:	748-033	**Project No.:**	1101-17A	**Run By:**	MD
Client:	A3GEO	**Date:**	1/9/2018	**Checked By:**	DC
Project:	NRLF Phase 4				

Boring:	A3-17-1	A3-17-1	A3-17-1	A3-17-1	A3-17-2	A3-17-2		
Sample:								
Depth, ft.:	5-6.5	31-31.5	51-51.5	61-61.5	6-6.5	45-47.5		
Soil Type:	Olive Brown CLAY w/ Sand	Olive Brown Sandy CLAY	Bluish Gray CLAY	Olive Gray CLAY w/ Sand	Yellowish Brown CLAY	Greenish Gray Fat CLAY		
Wt of Dish & Dry Soil, gm	571.4	607.1	591.4	454.9	666.0	394.7		
Weight of Dish, gm	178.1	174.9	173.4	171.6	324.1	274.1		
Weight of Dry Soil, gm	393.4	432.2	418.0	283.3	341.9	120.6		
Wt. Ret. on #4 Sieve, gm	0.3	27.3	1.9	5.9	1.0	0.6		
Wt. Ret. on #200 Sieve, gm	60.3	216.1	52.9	44.1	48.7	14.3		
% Gravel	**0.1**	**6.3**	**0.4**	**2.1**	**0.3**	**0.5**		
% Sand	**15.2**	**43.7**	**12.2**	**13.5**	**13.9**	**11.4**		
% Silt & Clay	**84.7**	**50.0**	**87.3**	**84.4**	**85.8**	**88.1**		

Remarks: As an added benefit to our clients, the gravel fraction may be included in this report. Whether or not it is included is dependent upon both the technician's time available and if there is a significant enough amount of gravel. The gravel is always included in the percent retained on the #200 sieve but may not be weighed separately to determine the percentage, especially if there is only a trace amount, (5% or less).

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○			36.6	63.4					
□		7.4	26.3	66.3					
△		41.2	39.5	19.3					

SIEVE inches size	PERCENT FINER ○	□	△
1"			100.0
3/4"		100.0	89.7
1/2"		96.7	79.3
3/8"		95.9	74.2
	GRAIN SIZE		
D_{60}			5.02
D_{30}			0.276
D_{10}			
	COEFFICIENTS		
C_c			
C_u			

SIEVE number size	PERCENT FINER ○	□	△
#4		92.6	58.8
#10	100.0	89.5	44.5
#30	99.7	85.9	34.6
#40	99.6	84.9	32.7
#50	99.4	83.3	30.6
#100	89.5	76.6	24.9
#200	63.4	66.3	19.3

SOIL DESCRIPTION

○ Olive Brown Sandy CLAY

□ Olive Brown Sandy CLAY

△ Olive Brown Clayey GRAVEL w/ Sand

REMARKS:

○

□

△

○ Source: A3-17-1 Elev./Depth: 10-11.6'

□ Source: A3-17-1 Elev./Depth: 20-21.5'

△ Source: A3-17-2 Elev./Depth: 35-36.5'

COOPER TESTING LABORATORY

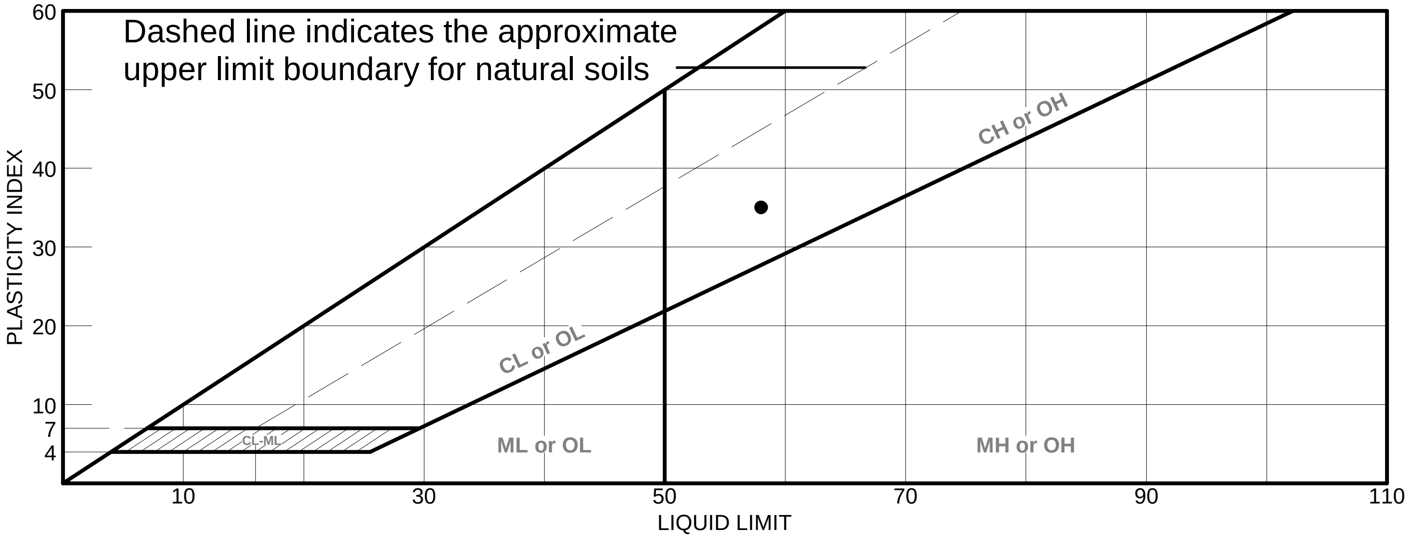
Client: A3GEO

Project: NRL3 Phase 3 - 1101-17A

Project No.: 748-033

Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Greenish Gray Fat CLAY	58	23	35			

Project No. 748-033 **Client:** A3GEO

Project: NRL3 Phase 3 - 1101-17A

● **Source:** A3-17-2 **Elev./Depth:** 45-47.5'

Remarks:

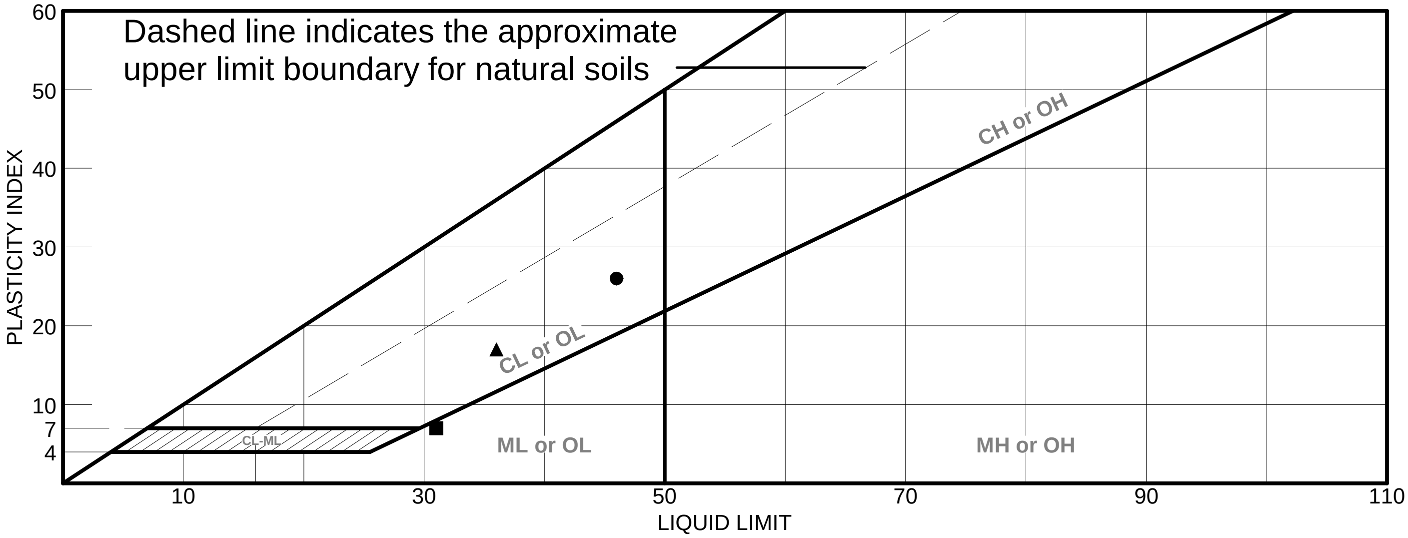
●

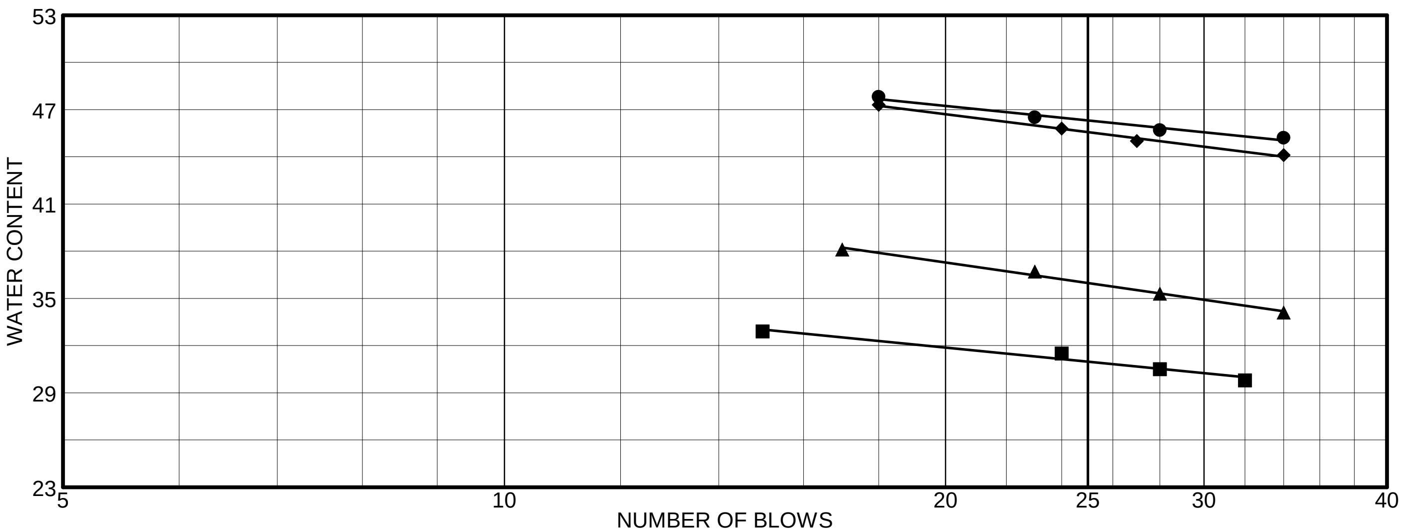
LIQUID AND PLASTIC LIMITS TEST REPORT

COOPER TESTING LABORATORY

Figure

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Olive Brown Sandy Lean CLAY	46	20	26			
■	Olive Brown Sandy SILT	31	24	7			
▲	Yellowish Brown Sandy Lean CLAY	36	19	17			
◆	Olive Gray Sandy Lean CLAY	46	20	26			

Project No. 748-034 **Client:** A3GEO

Project: NRLF Phase 4 - 1101-17A

● **Source:** A3-17-1 **Elev./Depth:** 5-6.5'
■ **Source:** A3-17-1 **Elev./Depth:** 10-11.5'
▲ **Source:** A3-17-1 **Elev./Depth:** 20-21.5'
◆ **Source:** A3-17-2 **Elev./Depth:** 6-6.5'

Remarks:
●
■
▲
◆

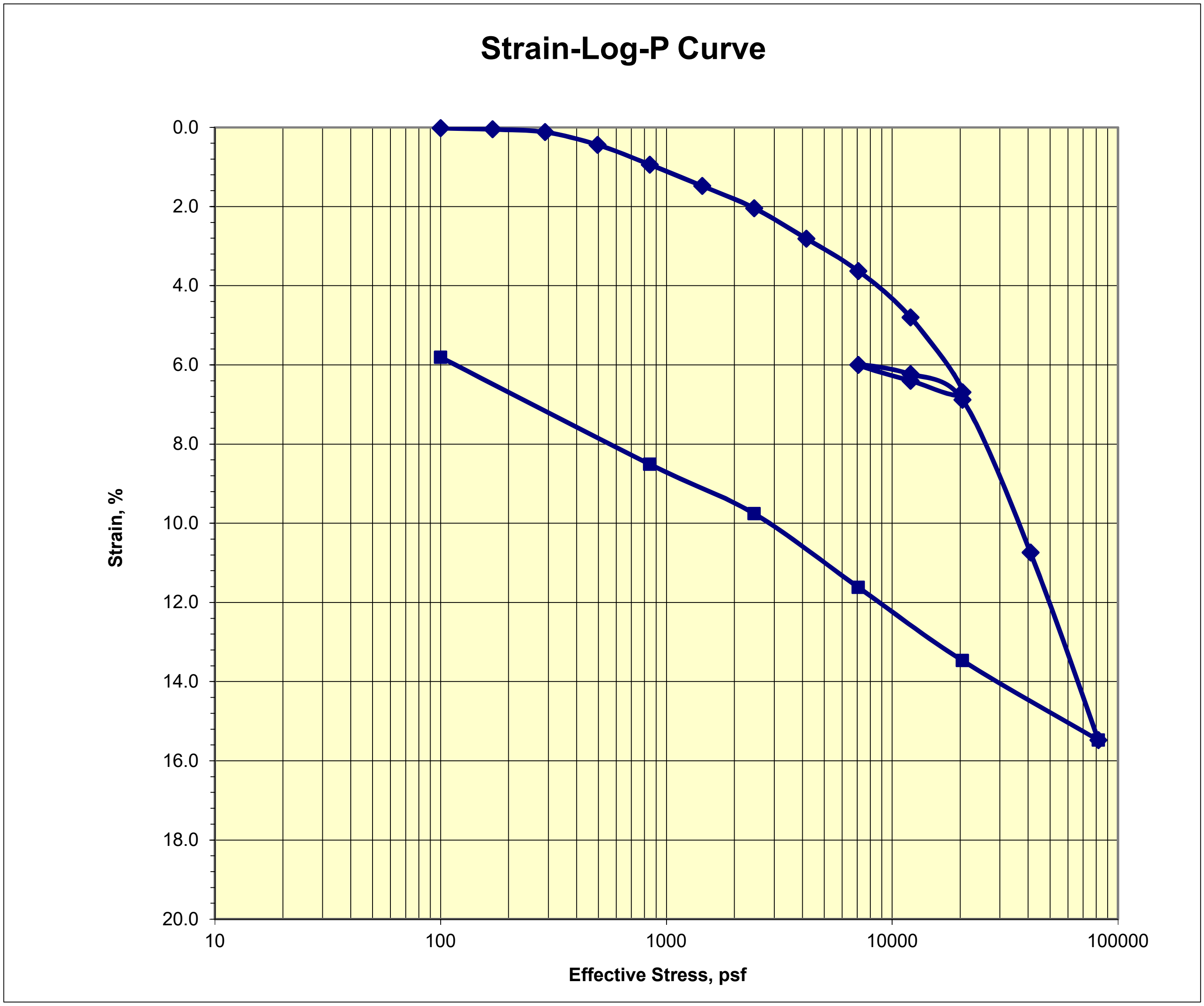
LIQUID AND PLASTIC LIMITS TEST REPORT

COOPER TESTING LABORATORY

Figure

Consolidation Test
ASTM D2435

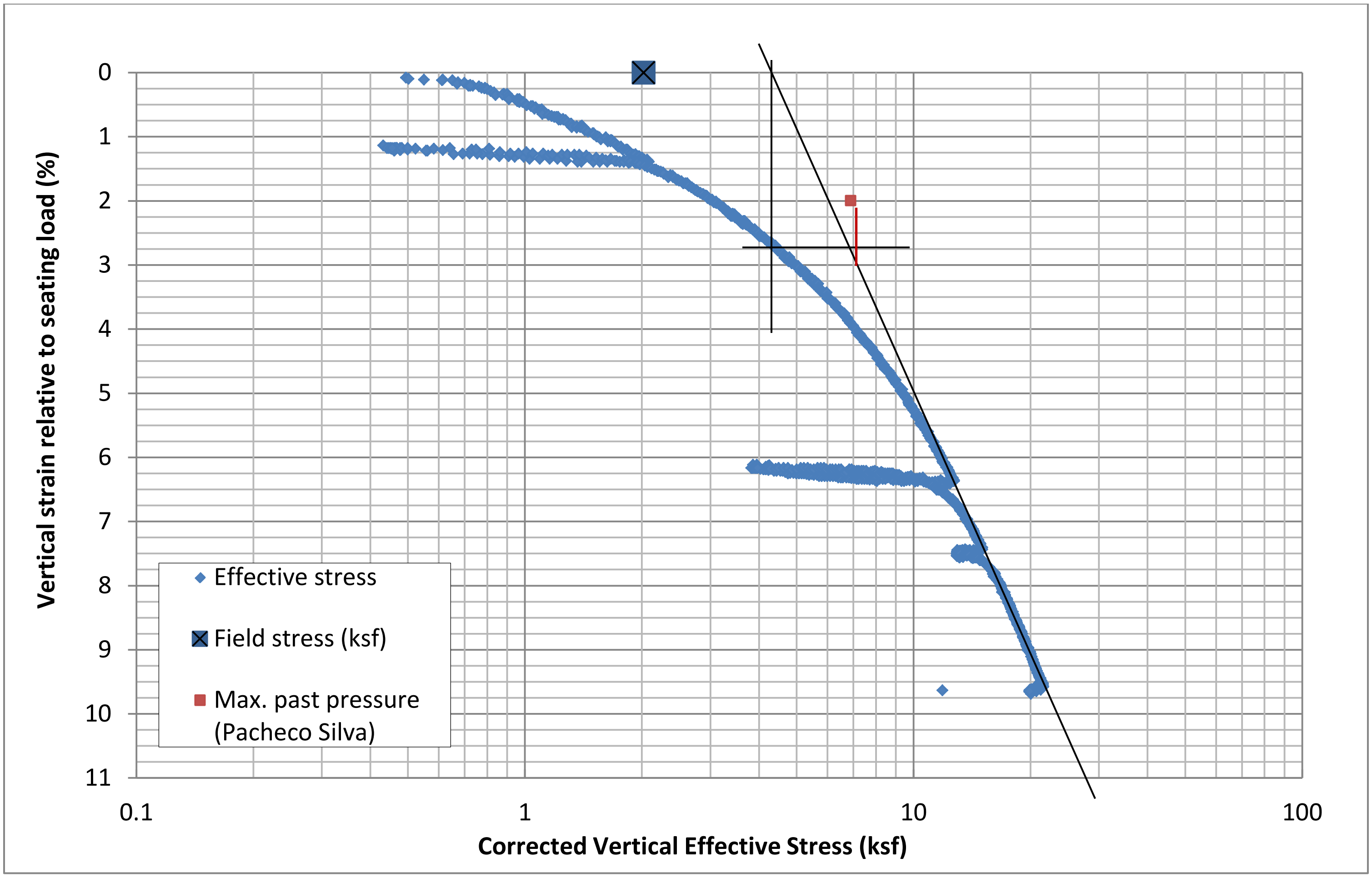
Job No.:	748-033	**Boring:**	A3-17-2	**Run By:**	MD
Client:	A3Geo	**Sample:**		**Reduced:**	PJ
Project:	1101-17A	**Depth, ft.:**	45-47.5'	**Checked:**	PJ/DC
Soil Type:	Greenish Gray Fat CLAY			**Date:**	1/4/2018



Assumed Gs 2.8	Initial	Final
Moisture %:	23.7	23.7
Dry Density, pcf:	99.8	105.0
Void Ratio:	0.751	0.665
% Saturation:	88.4	100.0

Remarks:

Constant Rate of Strain Consolidation Test
ASTM D4186



Specimen	Depth	W.C.	Atterberg Limits			Fines content	Description	USCS
	(ft)	(%)	LL	PL	PI	(%)		
	16.3	27.9					stiff sandy clay	

Initial Specimen Properties	
Height (mm)	25.35
Diameter (mm)	72.95
Volume (cm3)	105.95
Moist mass (g)	208.1
Moist density, ρ (g/cm3)	1.964
Total unit weight (pcf)	122.6
Gs (assumed)	2.68
Void Ratio e	0.745
Saturation	100.3

Stresses	(ksf)
Estimated vertical field effective	2.0
Maximum past (Pacheco Silva)	6.9
Maximum past (Work method)	7.3

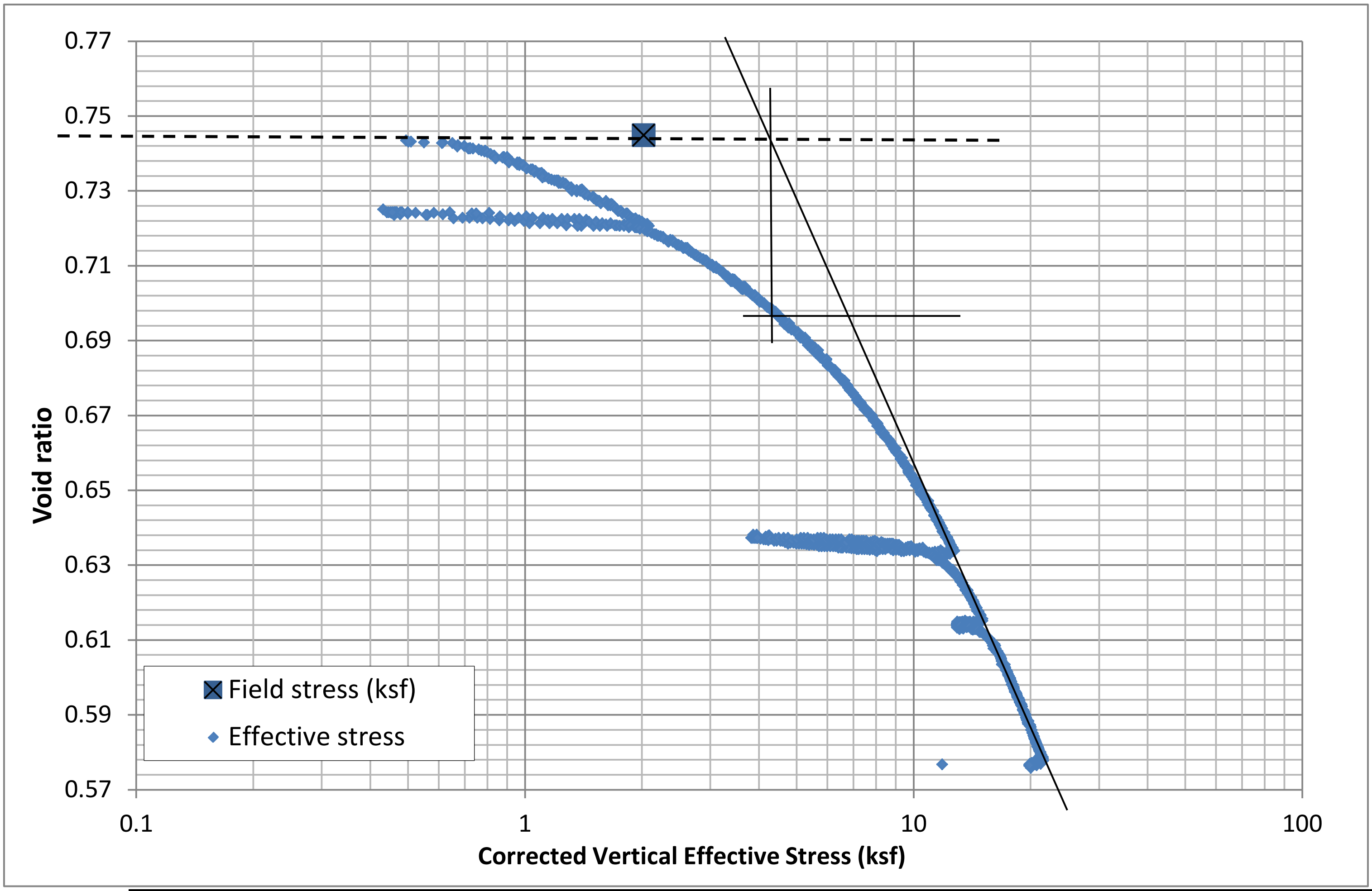
Disturbance	
Δe / eo (%)	3.4
Sample quality (Lunne, 1997)	Good

Project: NRLF 4 **Test: CRS1 at 16 ft**
Location: Richmond, California
Project Number:

Axial strain v. log (vertical effective stress) **Figure: 1.1**

Performed by: M. Riemer
at UCB Geotech labs

Constant Rate of Strain Consolidation Test
ASTM D4186



Specimen	Depth	W.C.	Atterberg Limits			Fines content		
	(ft)	(%)	LL	PL	PI	(%)	Description	USCS
	16.3	27.9					stiff sandy clay	

Initial Specimen Properties	
Height (mm)	25.35
Diameter (mm)	72.95
Volume (cm3)	105.95
Moist mass (g)	208.1
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Saturation	100.3

Stresses	(ksf)
Estimated vertical field effective	2.0
Maximum past (Pacheco Silva)	6.9
Maximum past (Work method)	7.3

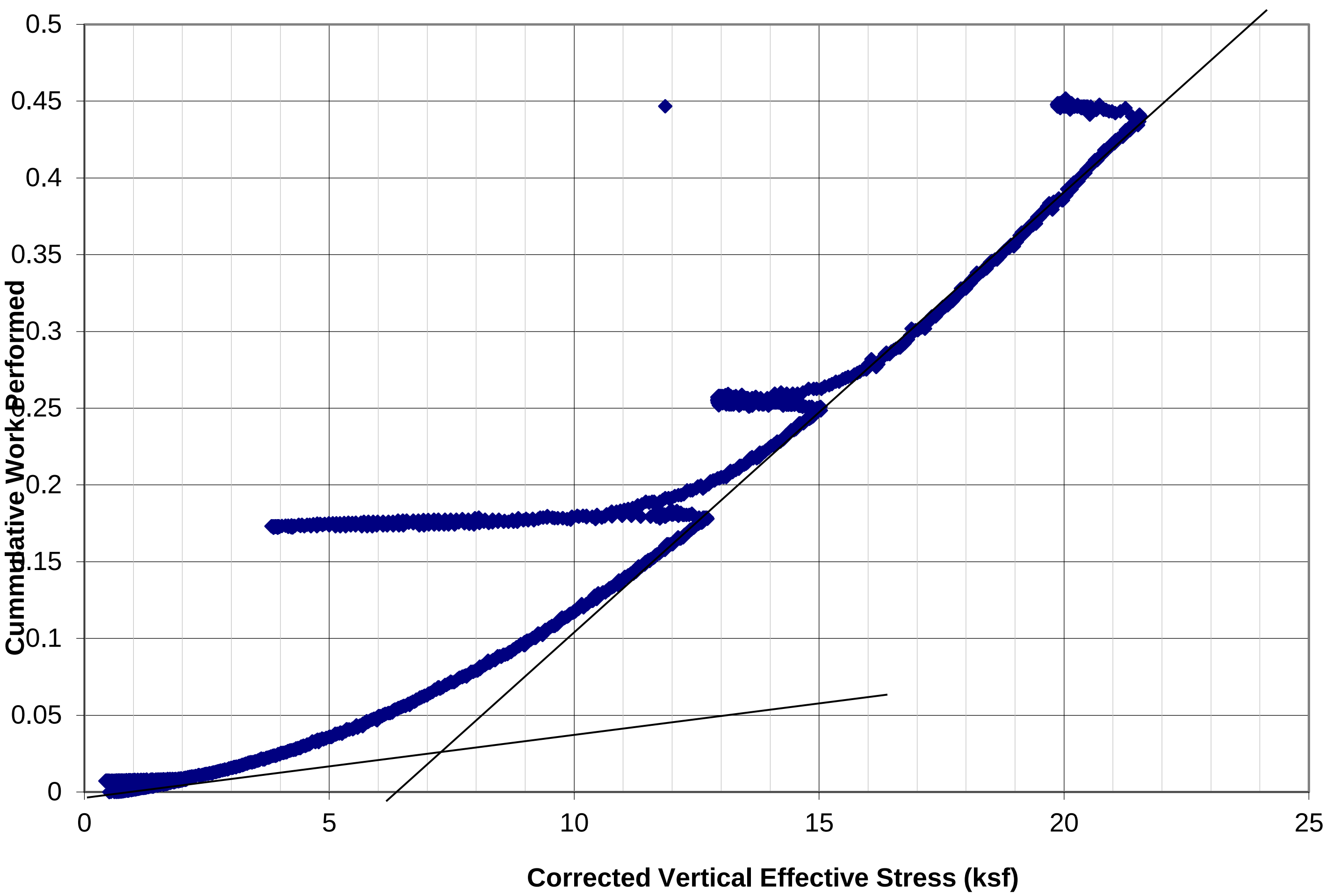
Disturbance	
Δe / eo (%)	3.4
Sample quality (Lunne, 1997)	Good

Project: NRLF 4 **Test: CRS1 at 16 ft**
Location: Richmond, California
Project Number:

Void ratio v. log (vertical effective stress) **Figure: 1.2**

Performed by: M. Riemer
at UCB Geotech labs

Constant Rate of Strain Consolidation Test
ASTM D4186



Specimen	Depth	W.C.	Atterberg Limits			Fines content	Description	USCS
	(ft)	(%)	LL	PL	PI	(%)		
	16.3	27.9					stiff sandy clay	

Initial Specimen Properties	
Height (mm)	25.35
Diameter (mm)	72.95
Volume (cm3)	105.95
Moist mass (g)	208.1
Moist density, ρ (g/cm3)	1.964
Total unit weight (pcf)	122.6
Gs (assumed)	2.68
Void Ratio e	0.745
Saturation	100.3

Stresses	(ksf)
Estimated vertical field effective	2.0
Maximum past (Pacheco Silva)	6.9
Maximum past (Work method)	7.3

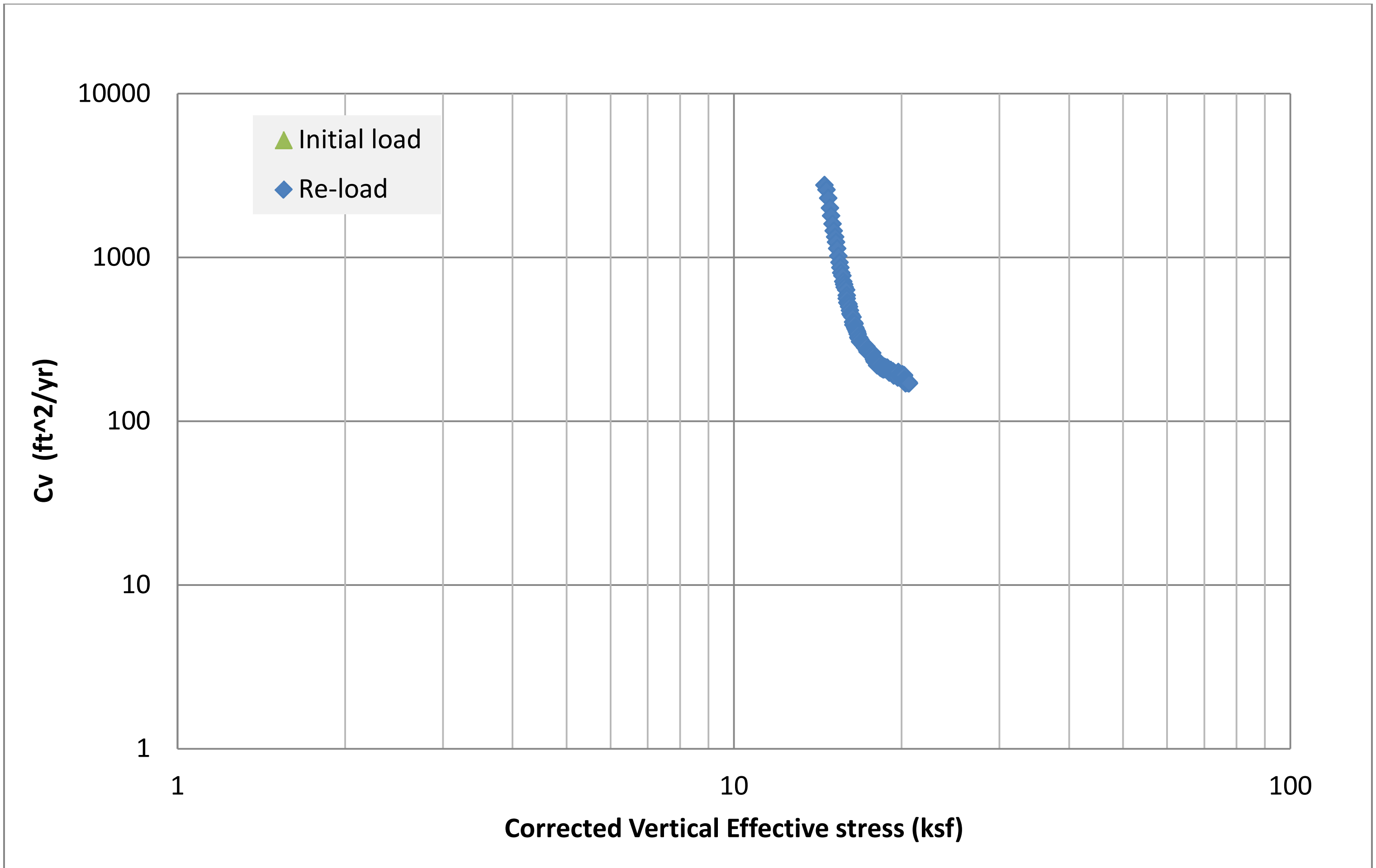
Disturbance	
Δe / eo (%)	3.4
Sample quality (Lunne, 1997)	Good

Project: NRLF 4 **Test: CRS1 at 16 ft**
Location: Richmond, California
Project Number:

Cumulative work v. vertical effective stress **Figure: 1.3**
(Becker Method)

Performed by: M. Riemer
at UCB Geotech labs

Constant Rate of Strain Consolidation Test
ASTM D4186



Specimen	Depth	W.C.	Atterberg Limits			Fines content	Description	USCS
	(ft)	(%)	LL	PL	PI	(%)		
	16.3	27.9					stiff sandy clay	

Initial Specimen Properties	
Height (mm)	25.35
Diameter (mm)	72.95
Volume (cm3)	105.95
Moist mass (g)	208.1
Moist density, ρ (g/cm3)	1.964
Total unit weight (pcf)	122.6
Gs (assumed)	2.68
Void Ratio e	0.745
Saturation	100.3

Stresses	(ksf)
Estimated vertical field effective	2.0
Maximum past (Pacheco Silva)	6.9
Maximum past (Work method)	7.3

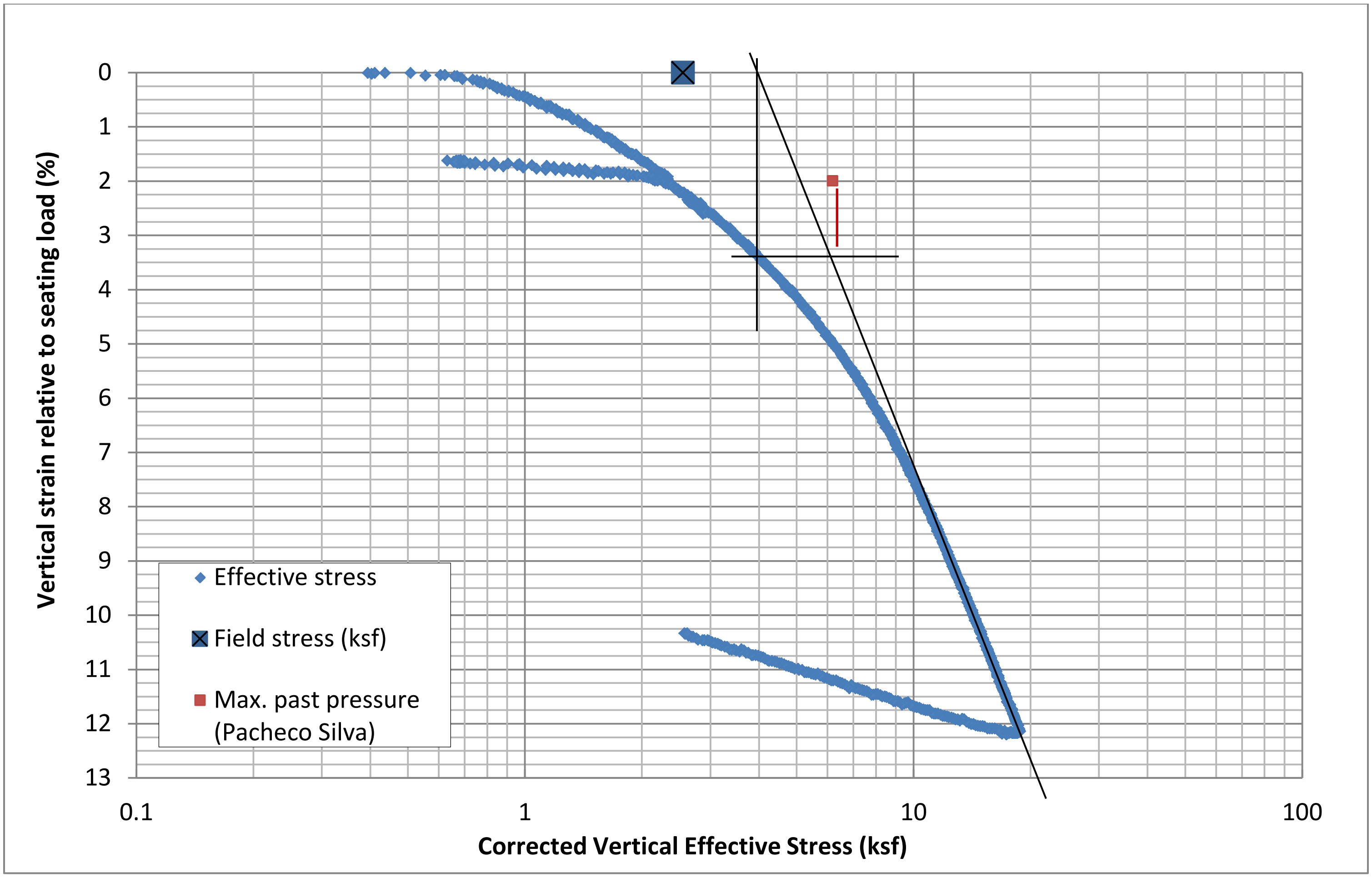
Disturbance	
Δe / eo (%)	3.4
Sample quality (Lunne, 1997)	Good

Project: NRLF 4 **Test: CRS1 at 16 ft**
Location: Richmond, California
Project Number:

Coeff.of Consol v. log(effective stress) **Figure: 1.4**

Performed by: M. Riemer
at UCB Geotech labs

Constant Rate of Strain Consolidation Test
ASTM D4186



Specimen	Depth	W.C.	Atterberg Limits			Fines content	Description	USCS
	(ft)	(%)	LL	PL	PI	(%)		
	26.7	33.9					stiff sandy clay	

Initial Specimen Properties	
Height (mm)	25.35
Diameter (mm)	72.95
Volume (cm3)	105.95
Moist mass (g)	200
Moist density, ρ (g/cm3)	1.888
Total unit weight (pcf)	117.8
Gs (assumed)	2.68
Void Ratio e	0.901
Saturation	100.9

Stresses	(ksf)
Estimated vertical field effective	2.6
Maximum past (Pacheco Silva)	6.2
Maximum past (Work method)	6.2

Disturbance	
Δe / eo (%)	4.7
Sample quality (Lunne, 1997)	Good to Fair

Project: NRLF 4 **Test: CRS2 at 26 ft**

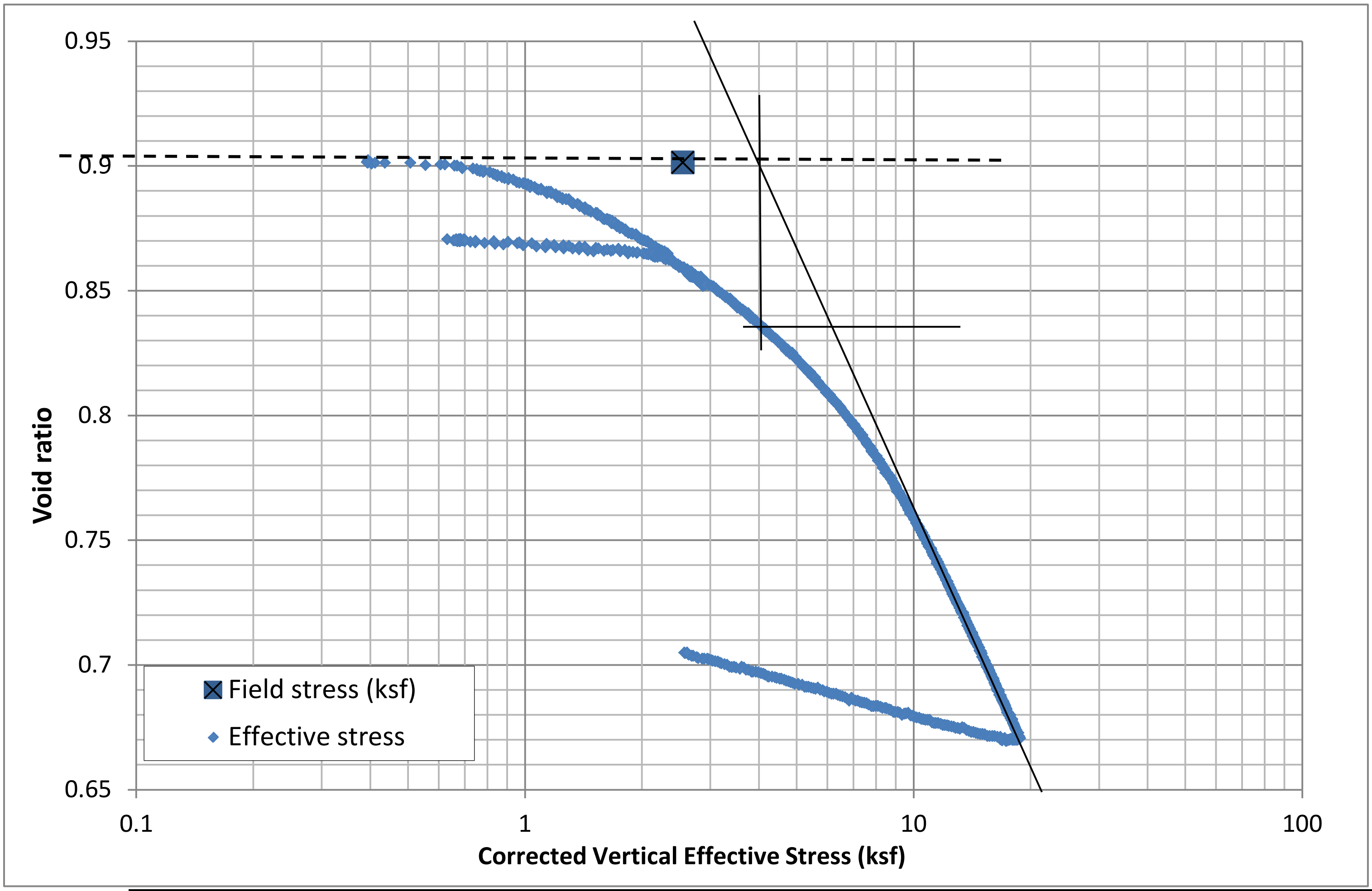
Location: Richmond, California

Project Number:

Axial strain v. log (vertical effective stress) **Figure: 2.1**

Performed by: M. Riemer
at UCB Geotech labs

Constant Rate of Strain Consolidation Test
ASTM D4186



Specimen	Depth	W.C.	Atterberg Limits			Fines content		
	(ft)	(%)	LL	PL	PI	(%)	Description	USCS
	26.7	33.9					stiff sandy clay	

Initial Specimen Properties	
Height (mm)	25.35
Diameter (mm)	72.95
Volume (cm3)	105.95
Moist mass (g)	200
Moist density, ρ (g/cm3)	1.888
Total unit weight (pcf)	117.8
Gs (assumed)	2.68
Void Ratio e	0.901
Saturation	100.9

Stresses	(ksf)
Estimated vertical field effective	2.6
Maximum past (Pacheco Silva)	6.2
Maximum past (Work method)	6.2

Disturbance	
Δe / eo (%)	4.7
Sample quality (Lunne, 1997)	Good to Fair

Project: NRLF 4 **Test: CRS2 at 26 ft**

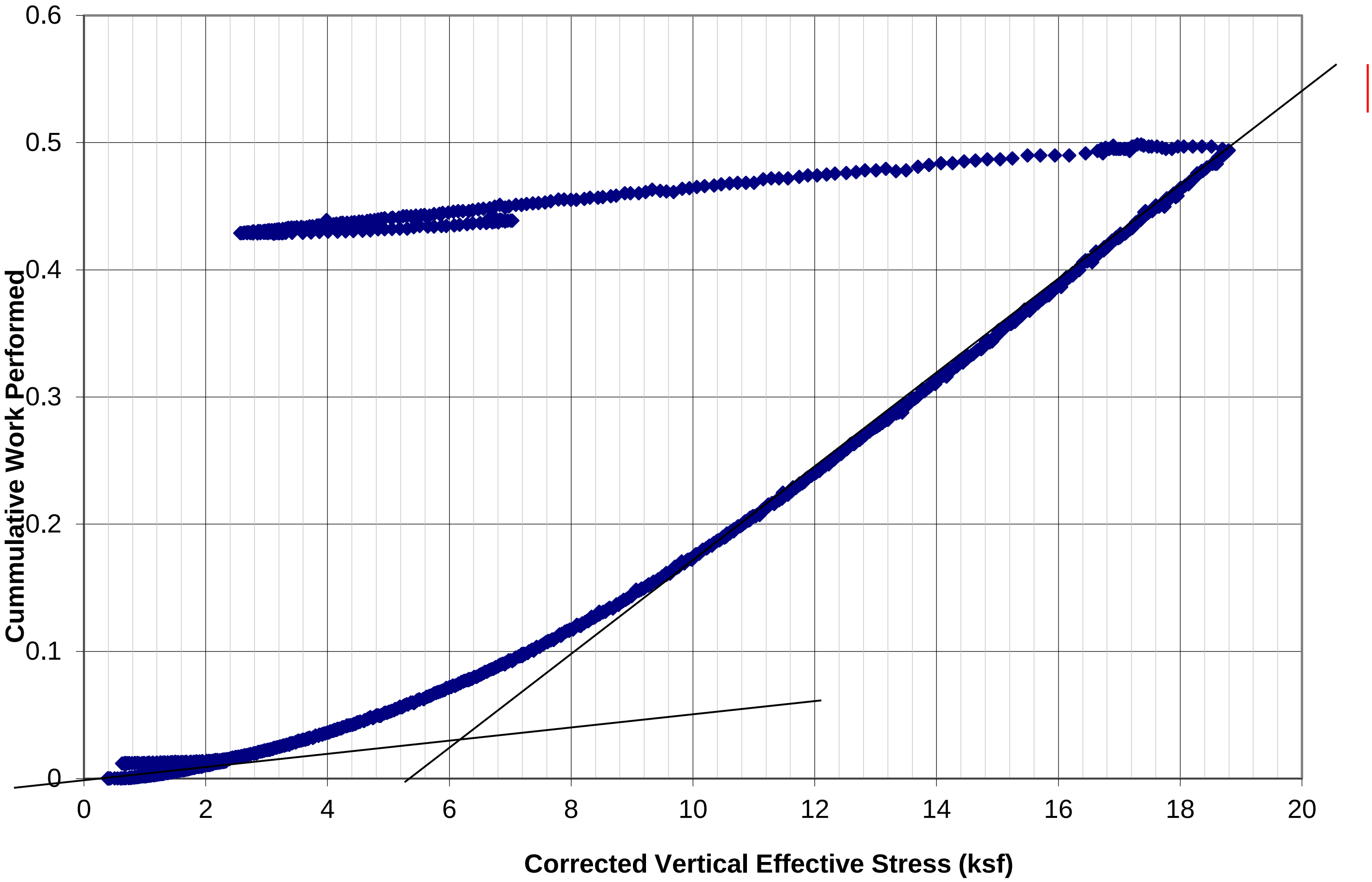
Location: Richmond, California

Project Number:

Void ratio v. log (vertical effective stress) **Figure: 2.2**

Performed by: M. Riemer
at UCB Geotech labs

Constant Rate of Strain Consolidation Test
ASTM D4186



Specimen	Depth	W.C.	Atterberg Limits			Fines content	Description	USCS
	(ft)	(%)	LL	PL	PI	(%)		
	26.7	33.9					stiff sandy clay	

Initial Specimen Properties	
Height (mm)	25.35
Diameter (mm)	72.95
Volume (cm3)	105.95
Moist mass (g)	200
Moist density, ρ (g/cm3)	1.888
Total unit weight (pcf)	117.8
Gs (assumed)	2.68
Void Ratio e	0.901
Saturation	100.9

Stresses	(ksf)
Estimated vertical field effective	2.6
Maximum past (Pacheco Silva)	6.2
Maximum past (Work method)	6.2

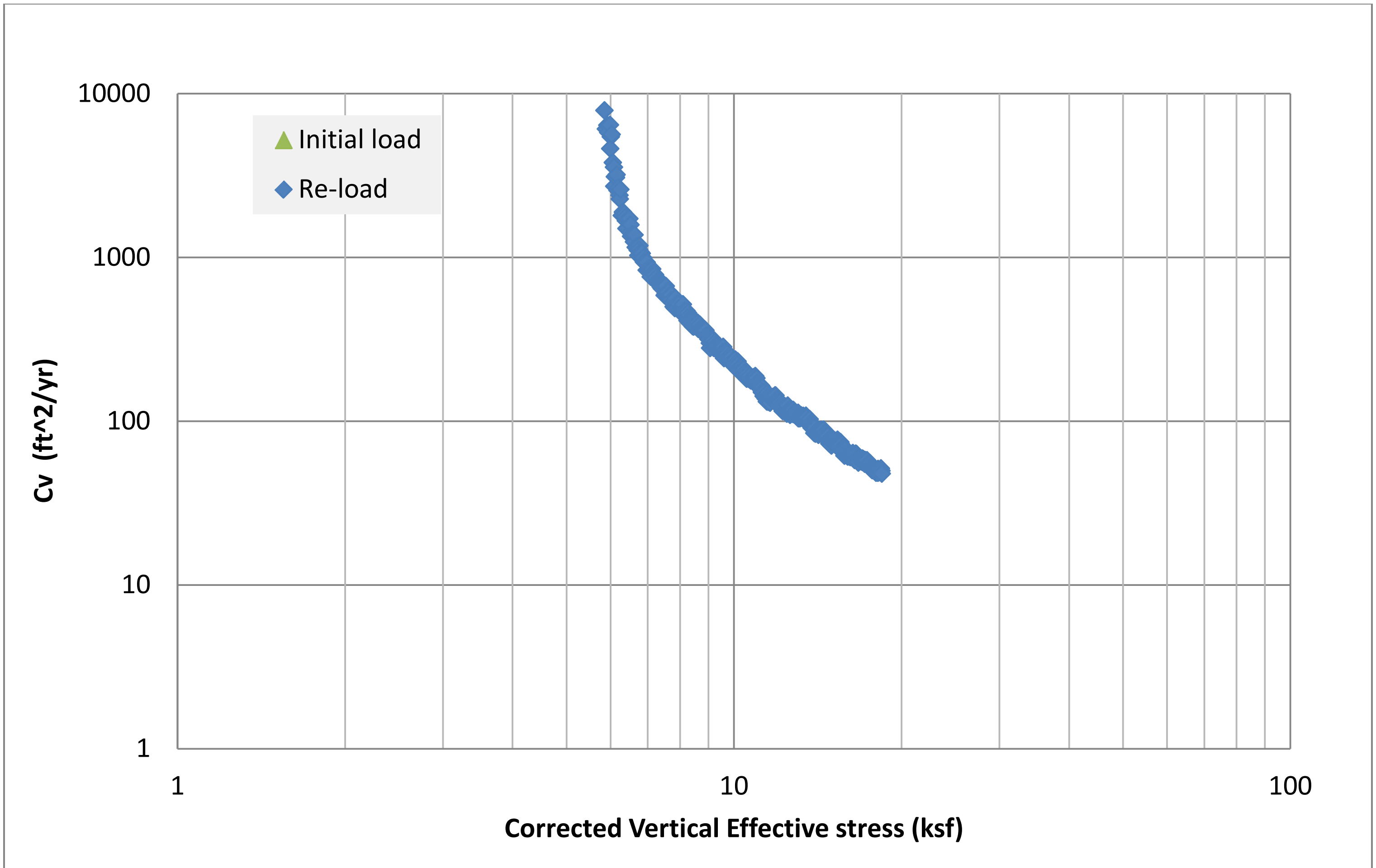
Disturbance	
Δe / eo (%)	4.7
Sample quality (Lunne, 1997)	Good to Fair

Project: NRLF 4 **Test: CRS2 at 26 ft**
Location: Richmond, California
Project Number:

Cumulative work v. vertical effective stress **Figure: 2.3**
(Becker Method)

Performed by: M. Riemer
at UCB Geotech labs

Constant Rate of Strain Consolidation Test
ASTM D4186



Specimen	Depth	W.C.	Atterberg Limits			Fines content	Description	USCS
	(ft)	(%)	LL	PL	PI	(%)		
	26.7	33.9					stiff sandy clay	

Initial Specimen Properties	
Height (mm)	25.35
Diameter (mm)	72.95
Volume (cm3)	105.95
Moist mass (g)	200
Moist density, ρ (g/cm3)	1.888
Total unit weight (pcf)	117.8
Gs (assumed)	2.68
Void Ratio e	0.901
Saturation	100.9

Stresses	(ksf)
Estimated vertical field effective	2.6
Maximum past (Pacheco Silva)	6.2
Maximum past (Work method)	6.2

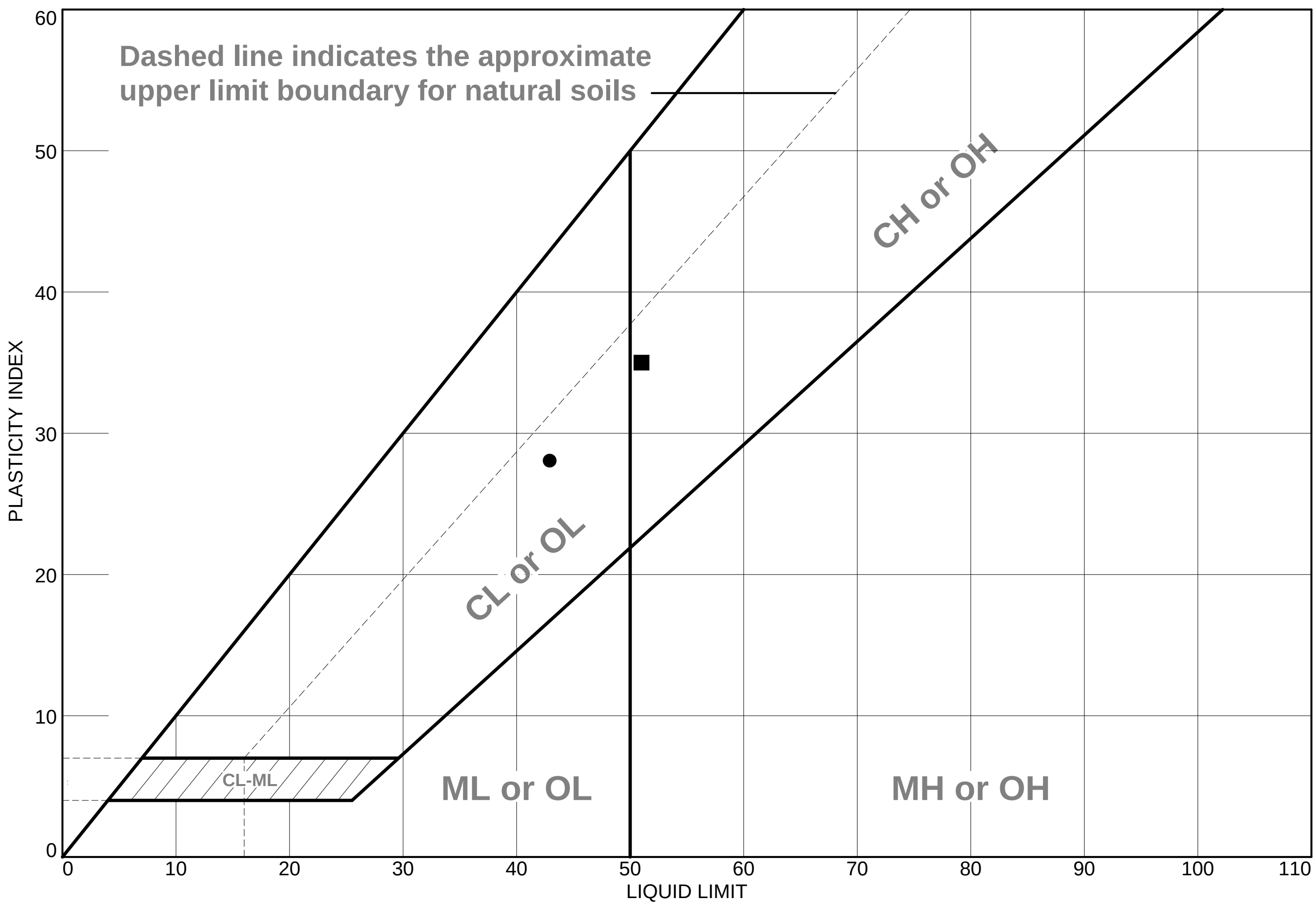
Disturbance	
Δe / eo (%)	4.7
Sample quality (Lunne, 1997)	Good to Fair

Project: NRLF 4 **Test: CRS2 at 26 ft**
Location: Richmond, California
Project Number:

Coeff.of Consol v. log(effective stress) **Figure: 2.4**

Performed by: M. Riemer
at UCB Geotech labs

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Olive brown lean CLAY with some sand	43	15	28			
■	Olive brown fat CLAY with some sand	51	16	35			

Project No. 1101-7A **Client:** A3Geo

Project: Northern Regional Library Facility Phase 4

● **Source:** A3-17-2 **Depth:** 16.0' **Sample No.:** CRS-1 - Trimmings

■ **Source of Sample:** A3-17-2 **Depth:** 27.0' **Sample Number:** Shelby Tube

Remarks:

B. HILLEBRANDT SOILS TESTING, INC.
+1 510-409-2816
SoilTesting@aol.com

Figure

Tested By: BH

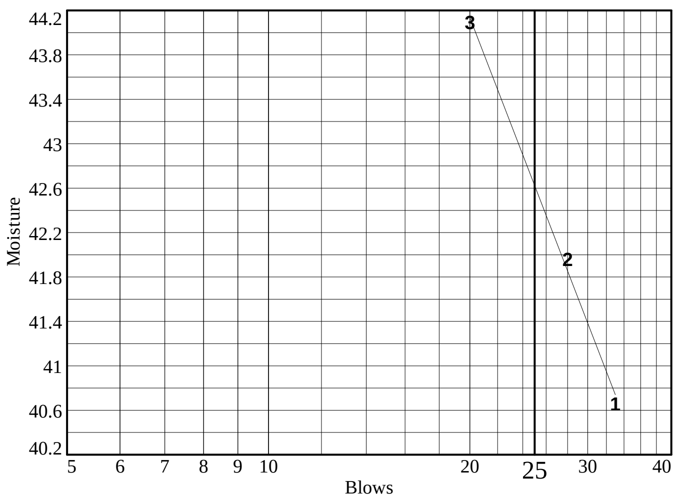
LIQUID AND PLASTIC LIMIT TEST DATA

12/28/2017

Client: A3Geo
Project: Northern Regional Library Facility Phase 4
Project Number: 1101-7A
Location: A3-17-2
Depth: 16.0'
Sample Number: CRS-1 - Trimmings
Material Description: Olive brown lean CLAY with some sand
Tested by: BH

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	24.16	29.03	25.22			
Dry+Tare	20.37	23.78	20.96			
Tare	11.05	11.27	11.30			
# Blows	33	28	20			
Moisture	40.7	42.0	44.1			



Liquid Limit= 43
Plastic Limit= 15
Plasticity Index= 28

Plastic Limit Data

Run No.	1	2	3	4
Wet+Tare	17.72	17.31		
Dry+Tare	16.88	16.47		
Tare	11.27	11.07		
Moisture	15.0	15.6		

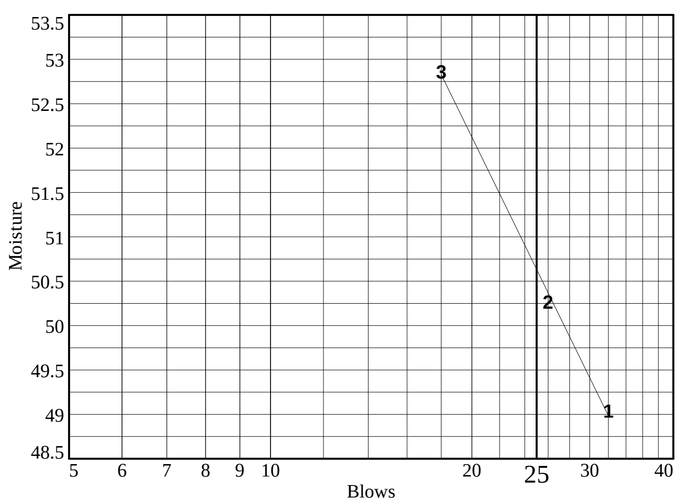
LIQUID AND PLASTIC LIMIT TEST DATA

12/28/2017

Client: A3Geo
Project: Northern Regional Library Facility Phase 4
Project Number: 1101-7A
Location: A3-17-2
Depth: 27.0' **Sample Number:** Shelby Tube
Material Description: Olive brown fat CLAY with some sand
Tested by: BH

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	28.47	27.74	26.73			
Dry+Tare	22.82	22.21	21.38			
Tare	11.30	11.21	11.26			
# Blows	32	26	18			
Moisture	49.0	50.3	52.9			

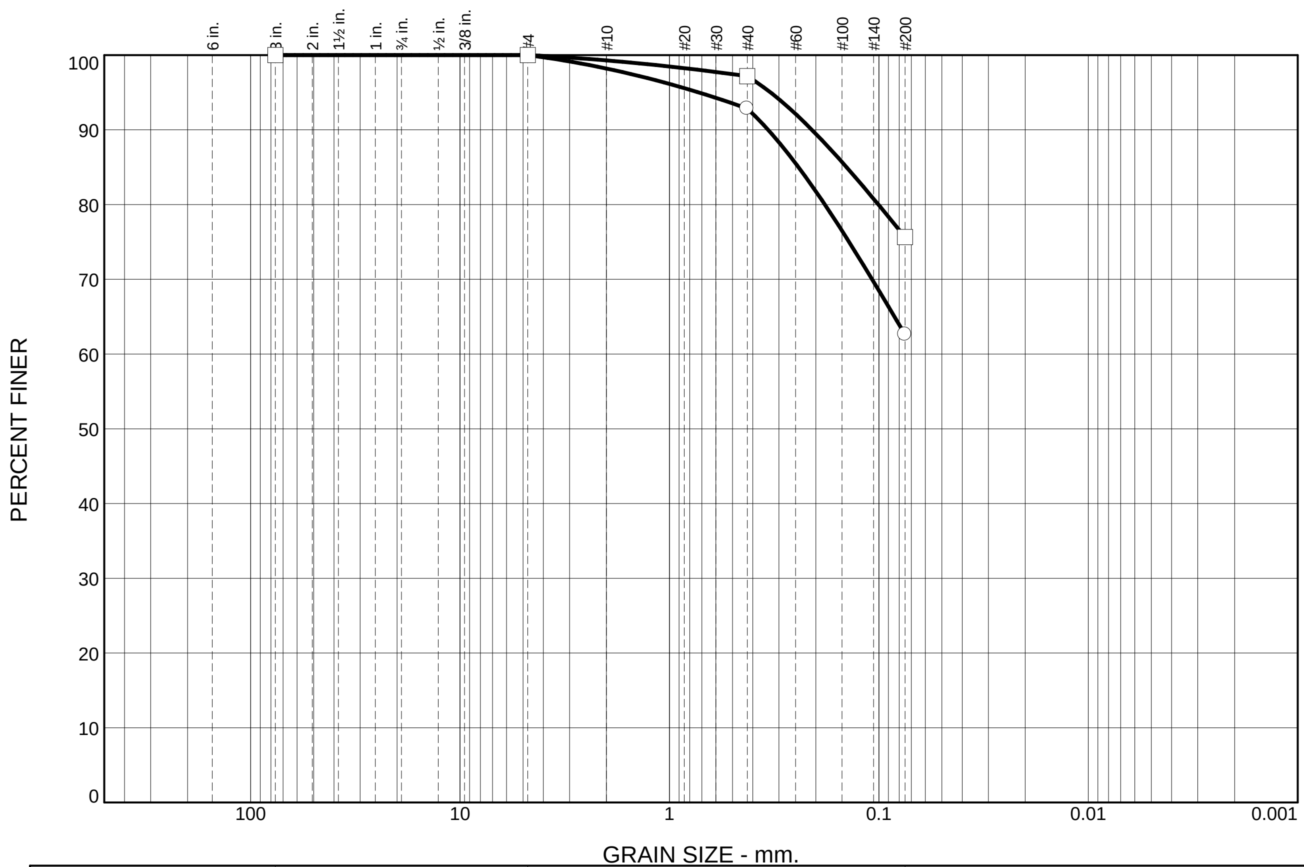


Liquid Limit= 51
Plastic Limit= 16
Plasticity Index= 35

Plastic Limit Data

Run No.	1	2	3	4	
Wet+Tare	17.91	17.25			
Dry+Tare	16.95	16.44			
Tare	11.23	11.33			
Moisture	16.8	15.9			

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	1.8	5.4	30.2	62.6	
□	0.0	0.0	0.0	0.7	2.1	21.5	75.7	

SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	Material Description	USCS
○	A3-17-2	CRS-1 -	16.0'	Olive brown sandy CLAY	
		Specimen			
□	A3-17-2	CRS-2 -	26.5'	Olive brown CLAY with sand	
		Specimen			

B. HILLEBRANDT SOILS TESTING, INC.
+1 510-409-2816
SoilTesting@aol.com

Client: A3Geo
Project: Northern Regional Library Facility Phase 4
Project No.: 1101-7A **Figure**

Tested By: BH

GRAIN SIZE DISTRIBUTION TEST DATA

12/28/2017

Client: A3Geo
Project: Northern Regional Library Facility Phase 4
Project Number: 1101-7A
Location: A3-17-2
Depth: 16.0'
Sample Number: CRS-1 - Specimen
Material Description: Olive brown sandy CLAY
Tested by: BH

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
195.90	34.30	0.00	3"	0.00	100.0
			#4	0.00	100.0
			#40	11.56	92.8
			#200	60.41	62.6

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.0	0.0	1.8	5.4	30.2	37.4			62.6

D_5	D_{10}	D_{15}	D_{20}	D_{30}	D_{40}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
								0.1811	0.2420	0.3380	0.7245

Fineness Modulus
0.46

GRAIN SIZE DISTRIBUTION TEST DATA

12/28/2017

Client: A3Geo
Project: Northern Regional Library Facility Phase 4
Project Number: 1101-7A
Location: A3-17-2
Depth: 26.5'
Sample Number: CRS-2 - Specimen
Material Description: Olive brown CLAY with sand
Tested by: BH

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
181.90	33.50	0.00	3"	0.00	100.0
			#4	0.00	100.0
			#40	4.19	97.2
			#200	36.12	75.7

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.0	0.0	0.7	2.1	21.5	24.3			75.7

D_{5}	D_{10}	D_{15}	D_{20}	D_{30}	D_{40}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
								0.1006	0.1427	0.2088	0.3292

Fineness Modulus
0.24

APPENDIX E

Environmental Analytical Data Reports
(This Study)

A3GEO

ENTHALPY

ANALYTICAL

Enthalpy Analytical

2323 Fifth Street, Berkeley, CA 94710, Phone (510) 486-0900

Laboratory Job Number 294805
ANALYTICAL REPORT

A3GEO Inc.	Project : 1101-17A Location : NRLF Phase 4 Level : II

Sample ID	Lab ID
A3-17-1-15	294805-001
A3-17-1-40	294805-002

This data package has been reviewed for technical correctness and completeness. Release of this data has been authorized by the Laboratory Manager or the Manager's designee, as verified by the following signature. The results contained in this report meet all requirements of NELAP and pertain only to those samples which were submitted for analysis. This report may be reproduced only in its entirety.

Signature: Will Rice   Date: 12/14/2017

Will Rice
Project Manager
will.rice@enthalpy.com
(510) 204-2221 Ext 13102

CA ELAP# 2896, NELAP# 4044-001

ENTHALPY ANALYTICAL

CASE NARRATIVE

Laboratory number:	**294805**
Client:	**A3GEO Inc.**
Project:	**1101-17A**
Location:	**NRLF Phase 4**
Request Date:	**11/27/17**
Samples Received:	**11/27/17**

This data package contains sample and QC results for two soil samples, requested for the above referenced project on 11/27/17. The samples were received cold and intact.

Volatile Organics by GC/MS (EPA 8260B):
No analytical problems were encountered.

CHAIN OF CUSTODY

ENTHALPY ANALYTICAL
Formerly Curtis & Tompkins Labs

2323 Fifth Street
Berkeley, CA 94710
Phone (510) 486-0900
Fax (510) 486-0532

C&T LOGIN # 294805

Page 1 of 1
Chain of Custody #

Project No: 1101-17A
Project Name: NRLF Phase 4
Project P. O. No: Richmond, CA
EDD Format: Report Level ☐ II ☐ III ☐ IV
Turnaround Time: ☐ RUSH ☒ Standard

Sampler: Eric Arico
Report To: Laura Buchanan
Company: A3GEO
Telephone: (510) 919-0280
Email: Laura@a3geo.com

ANALYTICAL REQUEST

Lab No.	Sample ID.	Date Collected	Time Collected	Water	Solid			# of Containers	HCl	H2SO4	HNO3	NaOH	None	MeOH	PCBs by 8082 w/ EPA 3540C soxhlet extraction	CAM 17 metals by EPA 6010/7471	PAHs by EPA 8270 in SIM	VOCs by 8260B w/ Terracores	PCBs by 8082	VOCs by 8260B										
	A3-17-1-15	11/27/17	10:55A		X			3					2	1				X												
	A3-17-1-40	11/27/17	12:45P		X			3					2	1				X												

Notes:

SAMPLE RECEIPT
☐ Intact
☐ Cold
☐ On Ice
☐ Ambient

RELINQUISHED BY:			RECEIVED BY:		
Eric Arico	DATE: 11-27	TIME: 5:05	[signature]	DATE: 11-27	TIME: 1705
[signature]	DATE: 11/27	TIME: 1720	[signature]	DATE: 11-27	TIME: 17:20
	DATE:	TIME:		DATE:	TIME:

COOLER RECEIPT CHECKLIST

ENTHALPY ANALYTICAL Berkeley

Login # 294805 Date Received 11/27/17 Number of coolers 1
Client A3680 Project NRLF Phase 4

Date Opened 11/27/17 By (print) EH (sign)
Date Logged in ↓ By (print) ↓ (sign) ↓
Date Labelled ↓ By (print) ↓ (sign) ↓

1. Did cooler come with a shipping slip (airbill, etc) YES **NO**
   Shipping info

2A. Were custody seals present? .... ☐ YES (circle) on cooler on samples ☒ NO
   How many Name Date
2B. Were custody seals intact upon arrival? YES NO **N/A**
3. Were custody papers dry and intact when received? **YES** NO
4. Were custody papers filled out properly (ink, signed, etc)? **YES** NO
5. Is the project identifiable from custody papers? (If so fill out top of form) **YES** NO
6. Indicate the packing in cooler: (if other, describe)

☐ Bubble Wrap ☐ Foam blocks ☒ Bags ☐ None
☐ Cloth material ☐ Cardboard ☐ Styrofoam ☐ Paper towels

7. Temperature documentation: * Notify PM if temperature exceeds 6°C

Type of ice used: ☒ Wet ☐ Blue/Gel ☐ None Temp(°C) 3.7

☐ Temperature blank(s) included? ☐ Thermometer# ☒ IR Gun# B

☐ Samples received on ice directly from the field. Cooling process had begun

8. Were Method 5035 sampling containers present? **YES** NO
   If YES, what time were they transferred to freezer? 17:34
9. Did all bottles arrive unbroken/unopened? **YES** NO
10. Are there any missing / extra samples? YES **NO**
11. Are samples in the appropriate containers for indicated tests? **YES** NO
12. Are sample labels present, in good condition and complete? **YES** NO
13. Do the sample labels agree with custody papers? **YES** NO
14. Was sufficient amount of sample sent for tests requested? **YES** NO
15. Are the samples appropriately preserved? YES NO **N/A**
16. Did you check preservatives for all bottles for each sample? YES NO **N/A**
17. Did you document your preservative check? (pH strip lot#) YES NO **N/A**
18. Did you change the hold time in LIMS for unpreserved VOAs? YES NO **N/A**
19. Did you change the hold time in LIMS for preserved terracores? **YES** NO N/A
20. Are bubbles > 6mm absent in VOA samples? YES NO **N/A**
21. Was the client contacted concerning this sample delivery? YES **NO**
   If YES, Who was called? By Date:

COMMENTS

ENTHALPY ANALYTICAL

Detections Summary for 294805

Results for any subcontracted analyses are not included in this summary.

Client : A3GEO Inc.
Project : 1101-17A
Location : NRLF Phase 4

Client Sample ID : A3-17-1-15 Laboratory Sample ID : 294805-001

No Detections

Client Sample ID : A3-17-1-40 Laboratory Sample ID : 294805-002

No Detections

ENTHALPY ANALYTICAL

Purgeable Organics by GC/MS

Lab #:	294805	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 5035
Project#:	1101-17A	Analysis:	EPA 8260B
Field ID:	A3-17-1-15	Diln Fac:	0.7042
Lab ID:	294805-001	Batch#:	254213
Matrix:	Soil	Sampled:	11/27/17
Units:	ug/Kg	Received:	11/27/17
Basis:	as received	Analyzed:	11/30/17

Analyte	Result	RL
Freon 12	ND	7.0
Chloromethane	ND	7.0
Vinyl Chloride	ND	7.0
Bromomethane	ND	7.0
Chloroethane	ND	7.0
Trichlorofluoromethane	ND	3.5
Acetone	ND	14
Freon 113	ND	3.5
1,1-Dichloroethene	ND	3.5
Methylene Chloride	ND	14
Carbon Disulfide	ND	3.5
MTBE	ND	3.5
trans-1,2-Dichloroethene	ND	3.5
Vinyl Acetate	ND	35
1,1-Dichloroethane	ND	3.5
2-Butanone	ND	7.0
cis-1,2-Dichloroethene	ND	3.5
2,2-Dichloropropane	ND	3.5
Chloroform	ND	3.5
Bromochloromethane	ND	3.5
1,1,1-Trichloroethane	ND	3.5
1,1-Dichloropropene	ND	3.5
Carbon Tetrachloride	ND	3.5
1,2-Dichloroethane	ND	3.5
Benzene	ND	3.5
Trichloroethene	ND	3.5
1,2-Dichloropropane	ND	3.5
Bromodichloromethane	ND	3.5
Dibromomethane	ND	3.5
4-Methyl-2-Pentanone	ND	7.0
cis-1,3-Dichloropropene	ND	3.5
Toluene	ND	3.5
trans-1,3-Dichloropropene	ND	3.5
1,1,2-Trichloroethane	ND	3.5
2-Hexanone	ND	7.0
1,3-Dichloropropane	ND	3.5
Tetrachloroethene	ND	3.5

ND= Not Detected
RL= Reporting Limit

ENTHALPY ANALYTICAL

Purgeable Organics by GC/MS

Lab #:	294805	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 5035
Project#:	1101-17A	Analysis:	EPA 8260B
Field ID:	A3-17-1-15	Diln Fac:	0.7042
Lab ID:	294805-001	Batch#:	254213
Matrix:	Soil	Sampled:	11/27/17
Units:	ug/Kg	Received:	11/27/17
Basis:	as received	Analyzed:	11/30/17

Analyte	Result	RL
Dibromochloromethane	ND	3.5
1,2-Dibromoethane	ND	3.5
Chlorobenzene	ND	3.5
1,1,1,2-Tetrachloroethane	ND	3.5
Ethylbenzene	ND	3.5
m,p-Xylenes	ND	3.5
o-Xylene	ND	3.5
Styrene	ND	3.5
Bromoform	ND	3.5
Isopropylbenzene	ND	3.5
1,1,2,2-Tetrachloroethane	ND	3.5
1,2,3-Trichloropropane	ND	3.5
Propylbenzene	ND	3.5
Bromobenzene	ND	3.5
1,3,5-Trimethylbenzene	ND	3.5
2-Chlorotoluene	ND	3.5
4-Chlorotoluene	ND	3.5
tert-Butylbenzene	ND	3.5
1,2,4-Trimethylbenzene	ND	3.5
sec-Butylbenzene	ND	3.5
para-Isopropyl Toluene	ND	3.5
1,3-Dichlorobenzene	ND	3.5
1,4-Dichlorobenzene	ND	3.5
n-Butylbenzene	ND	3.5
1,2-Dichlorobenzene	ND	3.5
1,2-Dibromo-3-Chloropropane	ND	3.5
1,2,4-Trichlorobenzene	ND	3.5
Hexachlorobutadiene	ND	3.5
Naphthalene	ND	3.5
1,2,3-Trichlorobenzene	ND	3.5

Surrogate	%REC	Limits
Dibromofluoromethane	100	76-132
1,2-Dichloroethane-d4	94	74-149
Toluene-d8	100	80-120
Bromofluorobenzene	107	78-134

ND= Not Detected
RL= Reporting Limit

ENTHALPY ANALYTICAL

Purgeable Organics by GC/MS

Lab #:	294805	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 5035
Project#:	1101-17A	Analysis:	EPA 8260B
Field ID:	A3-17-1-40	Diln Fac:	0.7257
Lab ID:	294805-002	Batch#:	254213
Matrix:	Soil	Sampled:	11/27/17
Units:	ug/Kg	Received:	11/27/17
Basis:	as received	Analyzed:	11/30/17

Analyte	Result	RL
Freon 12	ND	7.3
Chloromethane	ND	7.3
Vinyl Chloride	ND	7.3
Bromomethane	ND	7.3
Chloroethane	ND	7.3
Trichlorofluoromethane	ND	3.6
Acetone	ND	15
Freon 113	ND	3.6
1,1-Dichloroethene	ND	3.6
Methylene Chloride	ND	15
Carbon Disulfide	ND	3.6
MTBE	ND	3.6
trans-1,2-Dichloroethene	ND	3.6
Vinyl Acetate	ND	36
1,1-Dichloroethane	ND	3.6
2-Butanone	ND	7.3
cis-1,2-Dichloroethene	ND	3.6
2,2-Dichloropropane	ND	3.6
Chloroform	ND	3.6
Bromochloromethane	ND	3.6
1,1,1-Trichloroethane	ND	3.6
1,1-Dichloropropene	ND	3.6
Carbon Tetrachloride	ND	3.6
1,2-Dichloroethane	ND	3.6
Benzene	ND	3.6
Trichloroethene	ND	3.6
1,2-Dichloropropane	ND	3.6
Bromodichloromethane	ND	3.6
Dibromomethane	ND	3.6
4-Methyl-2-Pentanone	ND	7.3
cis-1,3-Dichloropropene	ND	3.6
Toluene	ND	3.6
trans-1,3-Dichloropropene	ND	3.6
1,1,2-Trichloroethane	ND	3.6
2-Hexanone	ND	7.3
1,3-Dichloropropane	ND	3.6
Tetrachloroethene	ND	3.6

ND= Not Detected
RL= Reporting Limit

ENTHALPY ANALYTICAL

Purgeable Organics by GC/MS

Lab #:	294805	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 5035
Project#:	1101-17A	Analysis:	EPA 8260B
Field ID:	A3-17-1-40	Diln Fac:	0.7257
Lab ID:	294805-002	Batch#:	254213
Matrix:	Soil	Sampled:	11/27/17
Units:	ug/Kg	Received:	11/27/17
Basis:	as received	Analyzed:	11/30/17

Analyte	Result	RL
Dibromochloromethane	ND	3.6
1,2-Dibromoethane	ND	3.6
Chlorobenzene	ND	3.6
1,1,1,2-Tetrachloroethane	ND	3.6
Ethylbenzene	ND	3.6
m,p-Xylenes	ND	3.6
o-Xylene	ND	3.6
Styrene	ND	3.6
Bromoform	ND	3.6
Isopropylbenzene	ND	3.6
1,1,2,2-Tetrachloroethane	ND	3.6
1,2,3-Trichloropropane	ND	3.6
Propylbenzene	ND	3.6
Bromobenzene	ND	3.6
1,3,5-Trimethylbenzene	ND	3.6
2-Chlorotoluene	ND	3.6
4-Chlorotoluene	ND	3.6
tert-Butylbenzene	ND	3.6
1,2,4-Trimethylbenzene	ND	3.6
sec-Butylbenzene	ND	3.6
para-Isopropyl Toluene	ND	3.6
1,3-Dichlorobenzene	ND	3.6
1,4-Dichlorobenzene	ND	3.6
n-Butylbenzene	ND	3.6
1,2-Dichlorobenzene	ND	3.6
1,2-Dibromo-3-Chloropropane	ND	3.6
1,2,4-Trichlorobenzene	ND	3.6
Hexachlorobutadiene	ND	3.6
Naphthalene	ND	3.6
1,2,3-Trichlorobenzene	ND	3.6

Surrogate	%REC	Limits
Dibromofluoromethane	108	76-132
1,2-Dichloroethane-d4	103	74-149
Toluene-d8	100	80-120
Bromofluorobenzene	97	78-134

ND= Not Detected
RL= Reporting Limit

Batch QC Report

Purgeable Organics by GC/MS

Lab #:	294805	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 5035
Project#:	1101-17A	Analysis:	EPA 8260B
Matrix:	Soil	Batch#:	254213
Units:	ug/Kg	Analyzed:	11/30/17
Diln Fac:	1.000		

Type: BS Lab ID: QC910924

Analyte	Spiked	Result	%REC	Limits
1,1-Dichloroethene	25.00	25.27	101	68-132
Benzene	25.00	23.95	96	75-123
Trichloroethene	25.00	22.95	92	75-120
Toluene	25.00	22.98	92	76-120
Chlorobenzene	25.00	23.45	94	80-120

Surrogate	%REC	Limits
Dibromofluoromethane	103	76-132
1,2-Dichloroethane-d4	94	74-149
Toluene-d8	99	80-120
Bromofluorobenzene	98	78-134

Type: BSD Lab ID: QC910925

Analyte	Spiked	Result	%REC	Limits	RPD	Lim
1,1-Dichloroethene	25.00	24.79	99	68-132	2	28
Benzene	25.00	24.04	96	75-123	0	25
Trichloroethene	25.00	22.38	90	75-120	3	23
Toluene	25.00	22.73	91	76-120	1	24
Chlorobenzene	25.00	23.41	94	80-120	0	21

Surrogate	%REC	Limits
Dibromofluoromethane	102	76-132
1,2-Dichloroethane-d4	93	74-149
Toluene-d8	99	80-120
Bromofluorobenzene	101	78-134

RPD= Relative Percent Difference

ENTHALPY ANALYTICAL

Batch QC Report

Purgeable Organics by GC/MS

Lab #:	294805	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 5035
Project#:	1101-17A	Analysis:	EPA 8260B
Type:	BLANK	Diln Fac:	1.000
Lab ID:	QC910926	Batch#:	254213
Matrix:	Soil	Analyzed:	11/30/17
Units:	ug/Kg		

Analyte	Result	RL
Freon 12	ND	10
Chloromethane	ND	10
Vinyl Chloride	ND	10
Bromomethane	ND	10
Chloroethane	ND	10
Trichlorofluoromethane	ND	5.0
Acetone	ND	20
Freon 113	ND	5.0
1,1-Dichloroethene	ND	5.0
Methylene Chloride	ND	20
Carbon Disulfide	ND	5.0
MTBE	ND	5.0
trans-1,2-Dichloroethene	ND	5.0
Vinyl Acetate	ND	50
1,1-Dichloroethane	ND	5.0
2-Butanone	ND	10
cis-1,2-Dichloroethene	ND	5.0
2,2-Dichloropropane	ND	5.0
Chloroform	ND	5.0
Bromochloromethane	ND	5.0
1,1,1-Trichloroethane	ND	5.0
1,1-Dichloropropene	ND	5.0
Carbon Tetrachloride	ND	5.0
1,2-Dichloroethane	ND	5.0
Benzene	ND	5.0
Trichloroethene	ND	5.0
1,2-Dichloropropane	ND	5.0
Bromodichloromethane	ND	5.0
Dibromomethane	ND	5.0
4-Methyl-2-Pentanone	ND	10
cis-1,3-Dichloropropene	ND	5.0
Toluene	ND	5.0
trans-1,3-Dichloropropene	ND	5.0
1,1,2-Trichloroethane	ND	5.0
2-Hexanone	ND	10
1,3-Dichloropropane	ND	5.0
Tetrachloroethene	ND	5.0

ND= Not Detected
RL= Reporting Limit

Batch QC Report

Purgeable Organics by GC/MS

Lab #:	294805	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 5035
Project#:	1101-17A	Analysis:	EPA 8260B
Type:	BLANK	Diln Fac:	1.000
Lab ID:	QC910926	Batch#:	254213
Matrix:	Soil	Analyzed:	11/30/17
Units:	ug/Kg		

Analyte	Result	RL
Dibromochloromethane	ND	5.0
1,2-Dibromoethane	ND	5.0
Chlorobenzene	ND	5.0
1,1,1,2-Tetrachloroethane	ND	5.0
Ethylbenzene	ND	5.0
m,p-Xylenes	ND	5.0
o-Xylene	ND	5.0
Styrene	ND	5.0
Bromoform	ND	5.0
Isopropylbenzene	ND	5.0
1,1,2,2-Tetrachloroethane	ND	5.0
1,2,3-Trichloropropane	ND	5.0
Propylbenzene	ND	5.0
Bromobenzene	ND	5.0
1,3,5-Trimethylbenzene	ND	5.0
2-Chlorotoluene	ND	5.0
4-Chlorotoluene	ND	5.0
tert-Butylbenzene	ND	5.0
1,2,4-Trimethylbenzene	ND	5.0
sec-Butylbenzene	ND	5.0
para-Isopropyl Toluene	ND	5.0
1,3-Dichlorobenzene	ND	5.0
1,4-Dichlorobenzene	ND	5.0
n-Butylbenzene	ND	5.0
1,2-Dichlorobenzene	ND	5.0
1,2-Dibromo-3-Chloropropane	ND	5.0
1,2,4-Trichlorobenzene	ND	5.0
Hexachlorobutadiene	ND	5.0
Naphthalene	ND	5.0
1,2,3-Trichlorobenzene	ND	5.0

Surrogate	%REC	Limits
Dibromofluoromethane	100	76-132
1,2-Dichloroethane-d4	91	74-149
Toluene-d8	100	80-120
Bromofluorobenzene	105	78-134

ND= Not Detected
RL= Reporting Limit

Batch QC Report

Purgeable Organics by GC/MS

Lab #:	294805	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 5030B
Project#:	1101-17A	Analysis:	EPA 8260B
Field ID:	ZZZZZZZZZZ	Batch#:	254213
MSS Lab ID:	294953-001	Sampled:	11/30/17
Matrix:	Miscell.	Received:	11/30/17
Units:	ug/Kg	Analyzed:	12/01/17
Basis:	as received		

Type: MS Diln Fac: 0.9823
Lab ID: QC911050

Analyte	MSS Result	Spiked	Result	%REC	Limits
1,1-Dichloroethene	<0.5664	49.12	60.87	124	64-131
Benzene	<0.5054	49.12	52.97	108	66-122
Trichloroethene	<0.6108	49.12	51.16	104	57-133
Toluene	<0.5432	49.12	48.36	98	61-120
Chlorobenzene	<0.3408	49.12	44.45	91	56-120

Surrogate	%REC	Limits
Dibromofluoromethane	113	76-132
1,2-Dichloroethane-d4	104	74-149
Toluene-d8	98	80-120
Bromofluorobenzene	101	78-134

Type: MSD Diln Fac: 0.9560
Lab ID: QC911051

Analyte	Spiked	Result	%REC	Limits	RPD	Lim
1,1-Dichloroethene	47.80	53.40	112	64-131	10	32
Benzene	47.80	48.27	101	66-122	7	32
Trichloroethene	47.80	46.30	97	57-133	7	34
Toluene	47.80	44.01	92	61-120	7	32
Chlorobenzene	47.80	41.16	86	56-120	5	33

Surrogate	%REC	Limits
Dibromofluoromethane	108	76-132
1,2-Dichloroethane-d4	98	74-149
Toluene-d8	98	80-120
Bromofluorobenzene	101	78-134

RPD= Relative Percent Difference

ENTHALPY

ANALYTICAL

Enthalpy Analytical

2323 Fifth Street, Berkeley, CA 94710, Phone (510) 486-0900

Laboratory Job Number 294849
ANALYTICAL REPORT

A3GEO Inc.	Project : 1101-17A Location : NRLF Phase 4 Level : II

Sample ID	Lab ID
IDW-A3-17-1-SOILD	294849-001
IDW-A3-17-1-LIQUID	294849-002
A3-17-2-15	294849-003

This data package has been reviewed for technical correctness and completeness. Release of this data has been authorized by the Laboratory Manager or the Manager's designee, as verified by the following signature. The results contained in this report meet all requirements of NELAP and pertain only to those samples which were submitted for analysis. This report may be reproduced only in its entirety.

Signature: Will Rice　　　　Date: 12/13/2017

Will Rice
Project Manager
will.rice@enthalpy.com
(510) 204-2221 Ext 13102

CA ELAP# 2896, NELAP# 4044-001

CASE NARRATIVE

Laboratory number:	**294849**
Client:	**A3GEO Inc.**
Project:	**1101-17A**
Location:	**NRLF Phase 4**
Request Date:	**11/28/17**
Samples Received:	**11/28/17**

This data package contains sample and QC results for two soil samples and one water sample, requested for the above referenced project on 11/28/17. The samples were received cold and intact.

TPH-Purgeables and/or BTXE by GC (EPA 8015B):
No analytical problems were encountered.

TPH-Extractables by GC (EPA 8015B):
No analytical problems were encountered.

Volatile Organics by GC/MS (EPA 8260B) Soil:
Matrix spikes were not performed for this analysis in batch 254261 due to limited sample volume or interferences from the solvent in sample dilutions. No other analytical problems were encountered.

Volatile Organics by GC/MS (EPA 8260B) Miscell.:
Low recoveries were observed for isopropyl ether (DIPE) in the MS/MSD for batch 254470; the parent sample was not a project sample, and the associated RPD was within limits. No other analytical problems were encountered.

Semivolatile Organics by GC/MS SIM (EPA 8270C-SIM) Water:
IDW-A3-17-1-LIQUID (lab # 294849-002) was diluted due to high non-target analytes. No other analytical problems were encountered.

Semivolatile Organics by GC/MS SIM (EPA 8270C-SIM) Soil:
No analytical problems were encountered.

PCBs (EPA 8082) Water:
All samples underwent sulfuric acid cleanup using EPA Method 3665A. All samples underwent sulfur cleanup using the copper option in EPA Method 3660B. No analytical problems were encountered.

PCBs (EPA 8082) Soil:
All samples underwent sulfuric acid cleanup using EPA Method 3665A. All samples underwent sulfur cleanup using the copper option in EPA Method 3660B. Matrix spikes were not performed for this analysis in batch 254593 due to insufficient sample amount. No other analytical problems were encountered.

Metals (EPA 6010B and EPA 7471A) Soil:
No analytical problems were encountered.

ENTHALPY ANALYTICAL

CASE NARRATIVE

Laboratory number:	**294849**
Client:	**A3GEO Inc.**
Project:	**1101-17A**
Location:	**NRLF Phase 4**
Request Date:	**11/28/17**
Samples Received:	**11/28/17**

Metals (EPA 6010B and EPA 7471A) Miscell.:

No analytical problems were encountered.

CHAIN OF CUSTODY

ENTHALPY ANALYTICAL
Formerly Curtis & Tompkins Labs
2323 Fifth Street
Berkeley, CA 94710
Phone (510) 486-0900
Fax (510) 486-0532

C&T LOGIN # 294849

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Chain of Custody #

Project No: 1101-17A
Project Name: NRLF Phase 4
Project P. O. No: Richmond, CA
EDD Format:
Report Level ☐ II ☐ III ☐ IV
Turnaround Time: ☐ RUSH ☒ Standard

Sampler:
Report To: Laura Buchanan
Company: A3GEO
Telephone: (510) 919-0280
Email: Laura@a3geo.com

Lab No.	Sample ID.	Date Collected	Time Collected	Water	Solid	# of Containers	HCl	H2SO4	HNO3	NaOH	None	PCBs by 8082 w/ EPA 3540C (soxhlet extraction)	CAM 17 metals by EPA 6010/7471	PAHs by EPA 8270 in SIM	VOCs by 8260B w/ Terracores	PCBs by 8082	VOCs by 8260B
	IDW-A3-17-1-Solid	11-25-17			X	1						X	X	X			
	IDW-A3-17-1-liquid	11-25-17		X		6	3		1		2		X	X		X	X
	A3-17-2-15	11-28-17			X	3					3				X		

Notes:

SAMPLE RECEIPT
☐ Intact
☐ Cold
☒ On ice
☐ Ambient

RELINQUISHED BY:			RECEIVED BY:		
Eric Arico	DATE: 11-28	TIME: 1530	[signature]	DATE: 11-28	TIME: 1530
[signature]	DATE: 11-28	TIME: 1724		DATE: 11-28	TIME: 17:24
	DATE:	TIME:		DATE:	TIME:

COOLER RECEIPT CHECKLIST

ENTHALPY ANALYTICAL Berkeley

Login # 294849 Date Received 11/28/17 Number of coolers 1
Client AZGECO Project ____

Date Opened 11/28/17 By (print) TY (sign) TY
Date Logged in ↓ By (print) ELD (sign)
Date Labelled ↓ By (print) ELG (sign)

1. Did cooler come with a shipping slip (airbill, etc) ____ YES NO
   Shipping info ____

2A. Were custody seals present? .... ☐ YES (circle) on cooler on samples ☒ NO
   How many ____ Name ____ Date ____

2B. Were custody seals intact upon arrival? ____ YES NO N/A

3. Were custody papers dry and intact when received? ____ YES NO

4. Were custody papers filled out properly (ink, signed, etc)? ____ YES NO

5. Is the project identifiable from custody papers? (If so fill out top of form) ____ YES NO

6. Indicate the packing in cooler: (if other, describe) ____

☒ Bubble Wrap ☐ Foam blocks ☒ Bags ☐ None
☐ Cloth material ☐ Cardboard ☐ Styrofoam ☐ Paper towels

7. Temperature documentation: * Notify PM if temperature exceeds 6°C

Type of ice used: ☒ Wet ☐ Blue/Gel ☐ None Temp(°C) 5.2

☐ Temperature blank(s) included? ☐ Thermometer# ____ ☒ IR Gun# A

☐ Samples received on ice directly from the field. Cooling process had begun

8. Were Method 5035 sampling containers present? ____ YES NO Cs
   If YES, what time were they transferred to freezer? 18:12

9. Did all bottles arrive unbroken/unopened? ____ YES NO

10. Are there any missing / extra samples? ____ YES NO

11. Are samples in the appropriate containers for indicated tests? ____ YES NO

12. Are sample labels present, in good condition and complete? ____ YES NO

13. Do the sample labels agree with custody papers? ____ YES NO

14. Was sufficient amount of sample sent for tests requested? ____ YES NO

15. Are the samples appropriately preserved? ____ YES NO N/A

16. Did you check preservatives for all bottles for each sample? ____ YES NO N/A

17. Did you document your preservative check? (pH strip lot# 80BDH1971) YES NO N/A

18. Did you change the hold time in LIMS for unpreserved VOAs? ____ YES NO N/A

19. Did you change the hold time in LIMS for preserved terracores? ____ YES NO N/A

20. Are bubbles > 6mm absent in VOA samples? ____ YES NO N/A

21. Was the client contacted concerning this sample delivery? ____ YES NO
   If YES, Who was called? ____ By ____ Date: ____

COMMENTS (15) HNO_3 was added to make pH<2 in sample 2 @ 18:05 on 11/28/17 by EKJ
(201710130537)

Enthalpy Sample Preservation for 294849

Sample	pH: <2	>9	>12	Other
-002a	[ ]	[ ]	[ ]	______
b	[ ]	[ ]	[ ]	______
c	[ ]	[ ]	[ ]	______
d	[X]	[ ]	[ ]	______
e	[ ]	[ ]	[ ]	______
f	[ ]	[ ]	[ ]	______

Analyst: EHS
Date: 11/28/17
Page 1 of 1

ENTHALPY ANALYTICAL

Detections Summary for 294849

Results for any subcontracted analyses are not included in this summary.

Client : A3GEO Inc.
Project : 1101-17A
Location : NRLF Phase 4

Client Sample ID : IDW-A3-17-1-SOILD Laboratory Sample ID : 294849-001

Analyte	Result	Flags	RL	Units	Basis	IDF	Method	Prep Method
Diesel C10-C24	1.3	Y	1.0	mg/Kg	As Recd	1.000	EPA 8015B	EPA 3550C
Arsenic	9.5		1.5	mg/Kg	As Recd	1.000	EPA 6010B	EPA 3050B
Barium	200		0.25	mg/Kg	As Recd	1.000	EPA 6010B	EPA 3050B
Beryllium	0.48		0.10	mg/Kg	As Recd	1.000	EPA 6010B	EPA 3050B
Cadmium	0.38		0.25	mg/Kg	As Recd	1.000	EPA 6010B	EPA 3050B
Chromium	49		0.25	mg/Kg	As Recd	1.000	EPA 6010B	EPA 3050B
Cobalt	19		0.25	mg/Kg	As Recd	1.000	EPA 6010B	EPA 3050B
Copper	25		0.25	mg/Kg	As Recd	1.000	EPA 6010B	EPA 3050B
Lead	7.6		1.0	mg/Kg	As Recd	1.000	EPA 6010B	EPA 3050B
Mercury	0.10		0.017	mg/Kg	As Recd	1.000	EPA 7471A	METHOD
Molybdenum	0.72		0.25	mg/Kg	As Recd	1.000	EPA 6010B	EPA 3050B
Nickel	59		0.25	mg/Kg	As Recd	1.000	EPA 6010B	EPA 3050B
Vanadium	43		0.25	mg/Kg	As Recd	1.000	EPA 6010B	EPA 3050B
Zinc	48		1.0	mg/Kg	As Recd	1.000	EPA 6010B	EPA 3050B

Client Sample ID : IDW-A3-17-1-LIQUID Laboratory Sample ID : 294849-002

Analyte	Result	Flags	RL	Units	Basis	IDF	Method	Prep Method
Arsenic	2.1		0.65	mg/Kg	As Recd	1.000	EPA 6010B	EPA 3050B
Barium	48		0.27	mg/Kg	As Recd	1.000	EPA 6010B	EPA 3050B
Beryllium	0.16		0.11	mg/Kg	As Recd	1.000	EPA 6010B	EPA 3050B
Chromium	22		0.27	mg/Kg	As Recd	1.000	EPA 6010B	EPA 3050B
Cobalt	4.3		0.27	mg/Kg	As Recd	1.000	EPA 6010B	EPA 3050B
Copper	6.0		0.27	mg/Kg	As Recd	1.000	EPA 6010B	EPA 3050B
Lead	2.0		0.54	mg/Kg	As Recd	1.000	EPA 6010B	EPA 3050B
Mercury	0.020		0.018	mg/Kg	As Recd	1.000	EPA 7471A	METHOD
Molybdenum	0.30		0.27	mg/Kg	As Recd	1.000	EPA 6010B	EPA 3050B
Nickel	28		0.27	mg/Kg	As Recd	1.000	EPA 6010B	EPA 3050B
Vanadium	13		0.27	mg/Kg	As Recd	1.000	EPA 6010B	EPA 3050B
Zinc	12		1.1	mg/Kg	As Recd	1.000	EPA 6010B	EPA 3050B

Client Sample ID : A3-17-2-15 Laboratory Sample ID : 294849-003

No Detections

Y = Sample exhibits chromatographic pattern which does not resemble standard

Total Volatile Hydrocarbons

Lab #:	294849	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 5030B
Project#:	1101-17A	Analysis:	EPA 8015B
Field ID:	IDW-A3-17-1-SOILD	Diln Fac:	1.000
Matrix:	Soil	Batch#:	254183
Units:	mg/Kg	Sampled:	11/28/17
Basis:	as received	Received:	11/28/17

Type:	SAMPLE	Analyzed:	11/30/17
Lab ID:	294849-001		

Analyte	Result	RL
Gasoline C7-C12	ND	1.1

Surrogate	%REC	Limits
Bromofluorobenzene (FID)	88	65-136

Type:	BLANK	Analyzed:	11/29/17
Lab ID:	QC910797		

Analyte	Result	RL
Gasoline C7-C12	ND	1.0

Surrogate	%REC	Limits
Bromofluorobenzene (FID)	82	65-136

ND= Not Detected
RL= Reporting Limit

Batch QC Report

Total Volatile Hydrocarbons

Lab #:	294849	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 5030B
Project#:	1101-17A	Analysis:	EPA 8015B
Type:	LCS	Diln Fac:	1.000
Lab ID:	QC910792	Batch#:	254183
Matrix:	Soil	Analyzed:	11/29/17
Units:	mg/Kg		

Analyte	Spiked	Result	%REC	Limits
Gasoline C7-C12	1.000	1.074	107	80-121

Surrogate	%REC	Limits
Bromofluorobenzene (FID)	107	65-136

Batch QC Report

Total Volatile Hydrocarbons

Lab #:	294849	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 5030B
Project#:	1101-17A	Analysis:	EPA 8015B
Field ID:	ZZZZZZZZZZ	Diln Fac:	1.000
MSS Lab ID:	294890-001	Batch#:	254183
Matrix:	Soil	Sampled:	11/27/17
Units:	mg/Kg	Received:	11/29/17
Basis:	as received	Analyzed:	11/29/17

Type: MS   Lab ID: QC910795

Analyte	MSS Result	Spiked	Result	%REC	Limits
Gasoline C7-C12	0.2195	9.434	6.462	66	52-120

Surrogate	%REC	Limits
Bromofluorobenzene (FID)	84	65-136

Type: MSD   Lab ID: QC910796

Analyte	Spiked	Result	%REC	Limits	RPD	Lim
Gasoline C7-C12	9.346	5.318	55	52-120	19	25

Surrogate	%REC	Limits
Bromofluorobenzene (FID)	85	65-136

RPD= Relative Percent Difference

Total Extractable Hydrocarbons

Lab #:	294849	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 3550C
Project#:	1101-17A	Analysis:	EPA 8015B
Field ID:	IDW-A3-17-1-SOILD	Batch#:	254275
Matrix:	Soil	Sampled:	11/28/17
Units:	mg/Kg	Received:	11/28/17
Basis:	as received	Prepared:	12/01/17
Diln Fac:	1.000	Analyzed:	12/04/17

Type: SAMPLE Lab ID: 294849-001

Analyte	Result	RL
Diesel C10-C24	1.3 Y	1.0
Motor Oil C24-C36	ND	5.0

Surrogate	%REC	Limits
o-Terphenyl	92	55-133

Type: BLANK Lab ID: QC911179

Analyte	Result	RL
Diesel C10-C24	ND	1.0
Motor Oil C24-C36	ND	5.0

Surrogate	%REC	Limits
o-Terphenyl	91	55-133

Y= Sample exhibits chromatographic pattern which does not resemble standard
ND= Not Detected
RL= Reporting Limit

Batch QC Report

Total Extractable Hydrocarbons

Lab #:	294849	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 3550C
Project#:	1101-17A	Analysis:	EPA 8015B
Type:	LCS	Diln Fac:	1.000
Lab ID:	QC911180	Batch#:	254275
Matrix:	Soil	Prepared:	12/01/17
Units:	mg/Kg	Analyzed:	12/04/17

Analyte	Spiked	Result	%REC	Limits
Diesel C10-C24	49.99	49.53	99	51-137

Surrogate	%REC	Limits
o-Terphenyl	98	55-133

Batch QC Report

Total Extractable Hydrocarbons

Lab #:	294849	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 3550C
Project#:	1101-17A	Analysis:	EPA 8015B
Field ID:	IDW-A3-17-1-SOILD	Batch#:	254275
MSS Lab ID:	294849-001	Sampled:	11/28/17
Matrix:	Soil	Received:	11/28/17
Units:	mg/Kg	Prepared:	12/01/17
Basis:	as received	Analyzed:	12/04/17
Diln Fac:	1.000		

Type: MS Lab ID: QC911181

Analyte	MSS Result	Spiked	Result	%REC	Limits
Diesel C10-C24	1.325	50.29	43.07	83	36-143

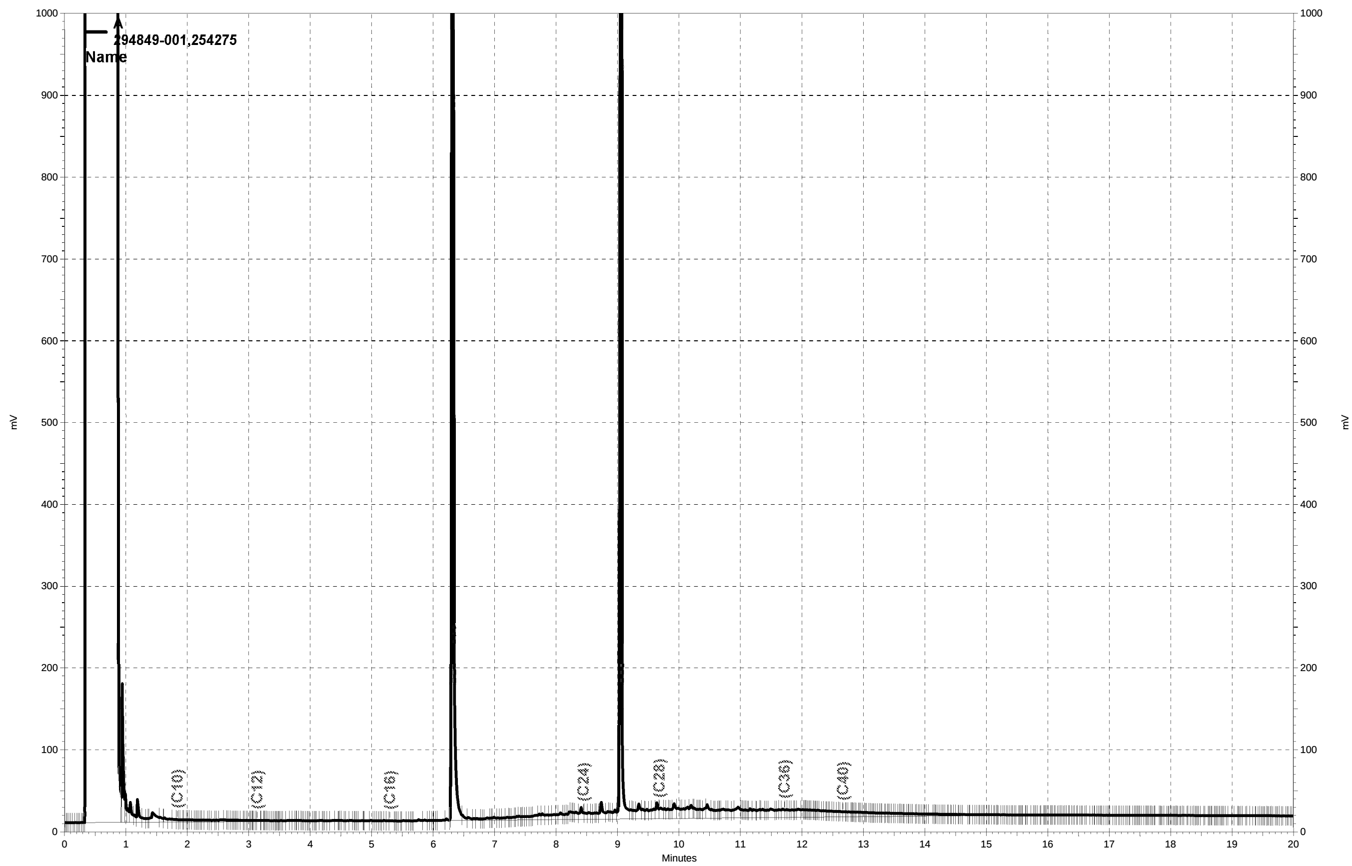
Surrogate	%REC	Limits
o-Terphenyl	85	55-133

Type: MSD Lab ID: QC911182

Analyte	Spiked	Result	%REC	Limits	RPD	Lim
Diesel C10-C24	50.26	48.70	94	36-143	12	55

Surrogate	%REC	Limits
o-Terphenyl	97	55-133

RPD= Relative Percent Difference



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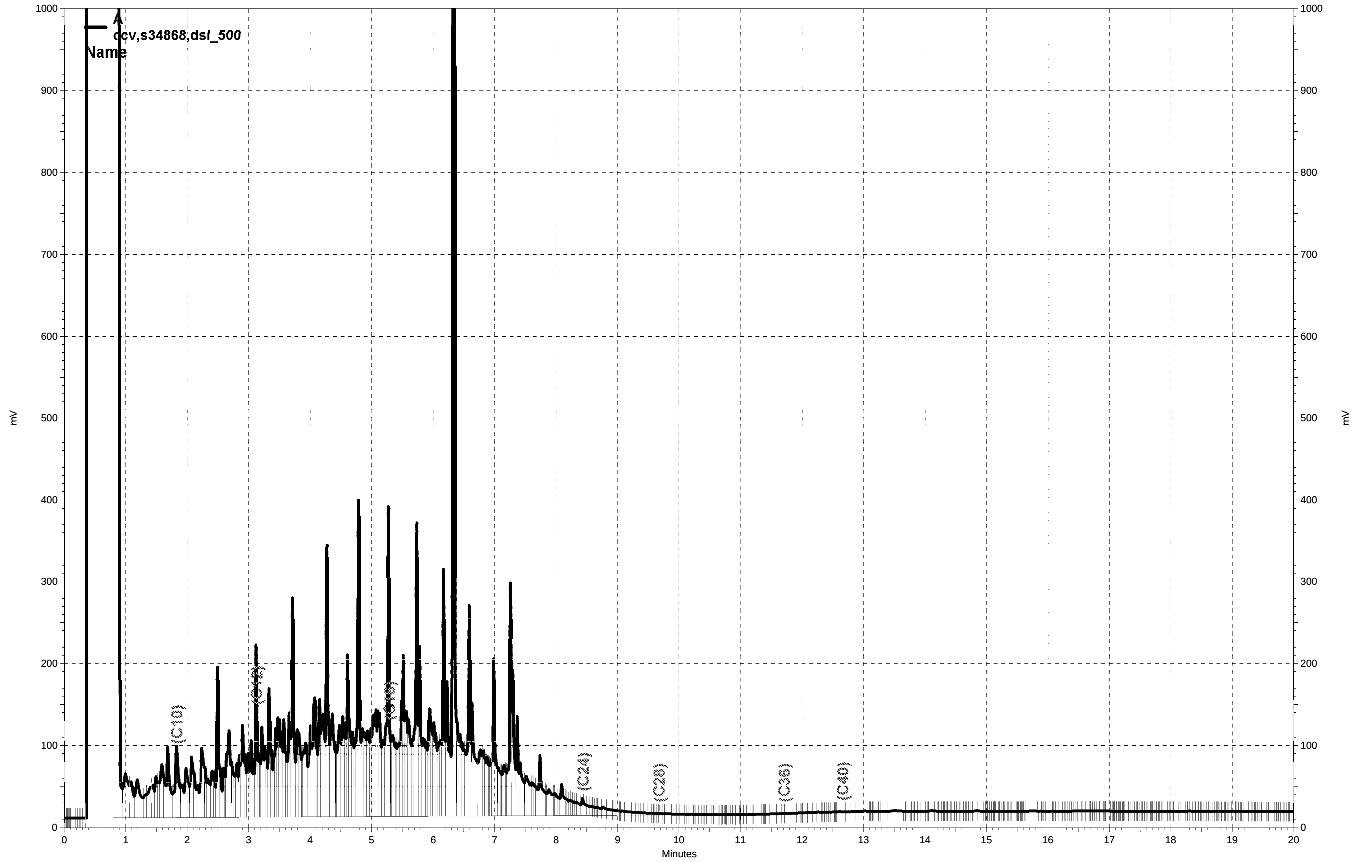

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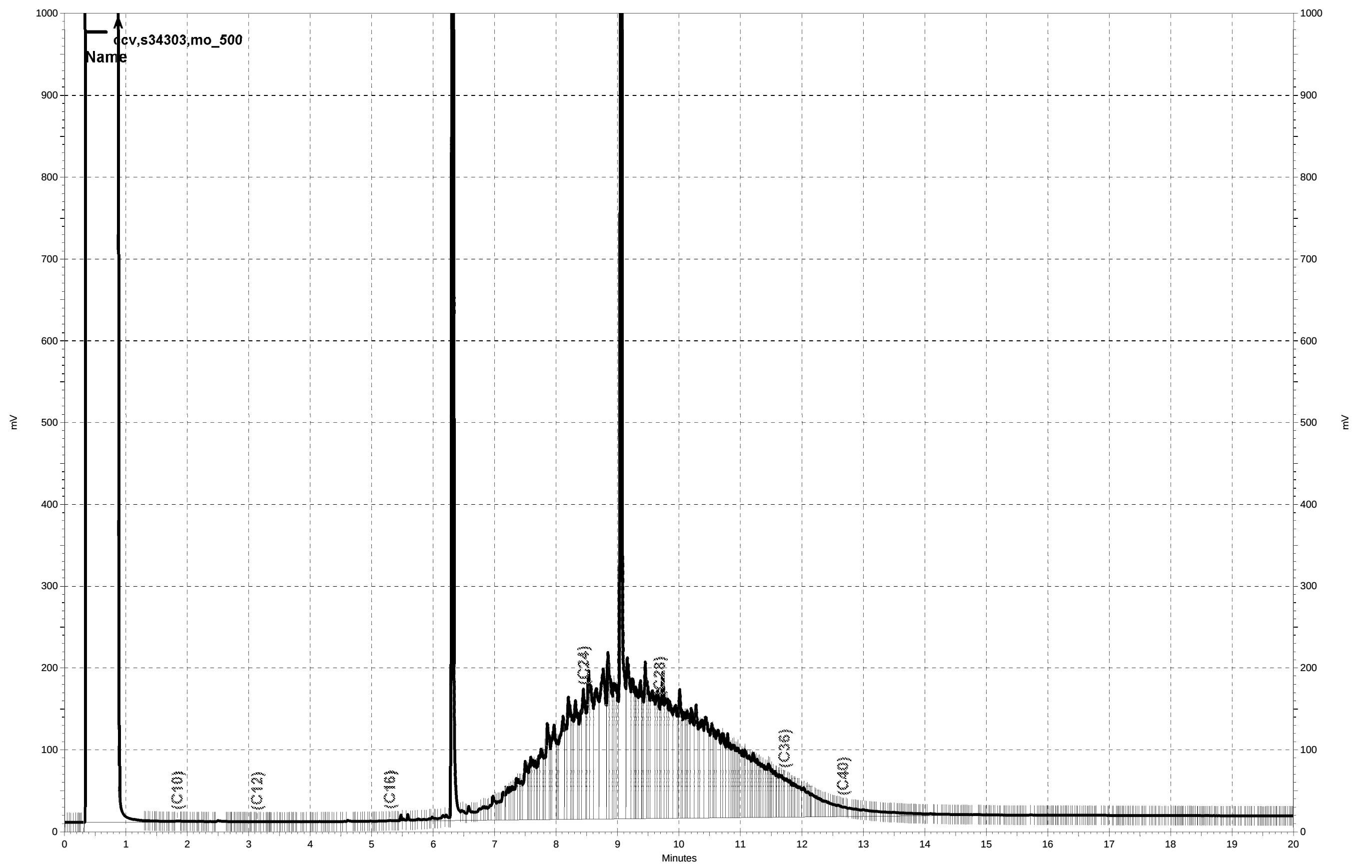

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ENTHALPY ANALYTICAL

Purgeable Organics by GC/MS

Lab #:	294849	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 5035
Project#:	1101-17A	Analysis:	EPA 8260B
Field ID:	A3-17-2-15	Diln Fac:	0.7184
Lab ID:	294849-003	Batch#:	254261
Matrix:	Soil	Sampled:	11/28/17
Units:	ug/Kg	Received:	11/28/17
Basis:	as received	Analyzed:	12/01/17

Analyte	Result	RL
Freon 12	ND	7.2
Chloromethane	ND	7.2
Vinyl Chloride	ND	7.2
Bromomethane	ND	7.2
Chloroethane	ND	7.2
Trichlorofluoromethane	ND	3.6
Acetone	ND	14
Freon 113	ND	3.6
1,1-Dichloroethene	ND	3.6
Methylene Chloride	ND	14
Carbon Disulfide	ND	3.6
MTBE	ND	3.6
trans-1,2-Dichloroethene	ND	3.6
Vinyl Acetate	ND	36
1,1-Dichloroethane	ND	3.6
2-Butanone	ND	7.2
cis-1,2-Dichloroethene	ND	3.6
2,2-Dichloropropane	ND	3.6
Chloroform	ND	3.6
Bromochloromethane	ND	3.6
1,1,1-Trichloroethane	ND	3.6
1,1-Dichloropropene	ND	3.6
Carbon Tetrachloride	ND	3.6
1,2-Dichloroethane	ND	3.6
Benzene	ND	3.6
Trichloroethene	ND	3.6
1,2-Dichloropropane	ND	3.6
Bromodichloromethane	ND	3.6
Dibromomethane	ND	3.6
4-Methyl-2-Pentanone	ND	7.2
cis-1,3-Dichloropropene	ND	3.6
Toluene	ND	3.6
trans-1,3-Dichloropropene	ND	3.6
1,1,2-Trichloroethane	ND	3.6
2-Hexanone	ND	7.2
1,3-Dichloropropane	ND	3.6
Tetrachloroethene	ND	3.6

ND= Not Detected
RL= Reporting Limit

ENTHALPY ANALYTICAL

Purgeable Organics by GC/MS

Lab #:	294849	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 5035
Project#:	1101-17A	Analysis:	EPA 8260B
Field ID:	A3-17-2-15	Diln Fac:	0.7184
Lab ID:	294849-003	Batch#:	254261
Matrix:	Soil	Sampled:	11/28/17
Units:	ug/Kg	Received:	11/28/17
Basis:	as received	Analyzed:	12/01/17

Analyte	Result	RL
Dibromochloromethane	ND	3.6
1,2-Dibromoethane	ND	3.6
Chlorobenzene	ND	3.6
1,1,1,2-Tetrachloroethane	ND	3.6
Ethylbenzene	ND	3.6
m,p-Xylenes	ND	3.6
o-Xylene	ND	3.6
Styrene	ND	3.6
Bromoform	ND	3.6
Isopropylbenzene	ND	3.6
1,1,2,2-Tetrachloroethane	ND	3.6
1,2,3-Trichloropropane	ND	3.6
Propylbenzene	ND	3.6
Bromobenzene	ND	3.6
1,3,5-Trimethylbenzene	ND	3.6
2-Chlorotoluene	ND	3.6
4-Chlorotoluene	ND	3.6
tert-Butylbenzene	ND	3.6
1,2,4-Trimethylbenzene	ND	3.6
sec-Butylbenzene	ND	3.6
para-Isopropyl Toluene	ND	3.6
1,3-Dichlorobenzene	ND	3.6
1,4-Dichlorobenzene	ND	3.6
n-Butylbenzene	ND	3.6
1,2-Dichlorobenzene	ND	3.6
1,2-Dibromo-3-Chloropropane	ND	3.6
1,2,4-Trichlorobenzene	ND	3.6
Hexachlorobutadiene	ND	3.6
Naphthalene	ND	3.6
1,2,3-Trichlorobenzene	ND	3.6

Surrogate	%REC	Limits
Dibromofluoromethane	106	76-132
1,2-Dichloroethane-d4	109	74-149
Toluene-d8	95	80-120
Bromofluorobenzene	104	78-134

ND= Not Detected
RL= Reporting Limit

Batch QC Report

Purgeable Organics by GC/MS

Lab #:	294849	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 5035
Project#:	1101-17A	Analysis:	EPA 8260B
Type:	BLANK	Diln Fac:	1.000
Lab ID:	QC911106	Batch#:	254261
Matrix:	Soil	Analyzed:	12/01/17
Units:	ug/Kg		

Analyte	Result	RL
Freon 12	ND	10
Chloromethane	ND	10
Vinyl Chloride	ND	10
Bromomethane	ND	10
Chloroethane	ND	10
Trichlorofluoromethane	ND	5.0
Acetone	ND	20
Freon 113	ND	5.0
1,1-Dichloroethene	ND	5.0
Methylene Chloride	ND	20
Carbon Disulfide	ND	5.0
MTBE	ND	5.0
trans-1,2-Dichloroethene	ND	5.0
Vinyl Acetate	ND	50
1,1-Dichloroethane	ND	5.0
2-Butanone	ND	10
cis-1,2-Dichloroethene	ND	5.0
2,2-Dichloropropane	ND	5.0
Chloroform	ND	5.0
Bromochloromethane	ND	5.0
1,1,1-Trichloroethane	ND	5.0
1,1-Dichloropropene	ND	5.0
Carbon Tetrachloride	ND	5.0
1,2-Dichloroethane	ND	5.0
Benzene	ND	5.0
Trichloroethene	ND	5.0
1,2-Dichloropropane	ND	5.0
Bromodichloromethane	ND	5.0
Dibromomethane	ND	5.0
4-Methyl-2-Pentanone	ND	10
cis-1,3-Dichloropropene	ND	5.0
Toluene	ND	5.0
trans-1,3-Dichloropropene	ND	5.0
1,1,2-Trichloroethane	ND	5.0
2-Hexanone	ND	10
1,3-Dichloropropane	ND	5.0
Tetrachloroethene	ND	5.0

ND= Not Detected
RL= Reporting Limit

Batch QC Report

Purgeable Organics by GC/MS

Lab #:	294849	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 5035
Project#:	1101-17A	Analysis:	EPA 8260B
Type:	BLANK	Diln Fac:	1.000
Lab ID:	QC911106	Batch#:	254261
Matrix:	Soil	Analyzed:	12/01/17
Units:	ug/Kg		

Analyte	Result	RL
Dibromochloromethane	ND	5.0
1,2-Dibromoethane	ND	5.0
Chlorobenzene	ND	5.0
1,1,1,2-Tetrachloroethane	ND	5.0
Ethylbenzene	ND	5.0
m,p-Xylenes	ND	5.0
o-Xylene	ND	5.0
Styrene	ND	5.0
Bromoform	ND	5.0
Isopropylbenzene	ND	5.0
1,1,2,2-Tetrachloroethane	ND	5.0
1,2,3-Trichloropropane	ND	5.0
Propylbenzene	ND	5.0
Bromobenzene	ND	5.0
1,3,5-Trimethylbenzene	ND	5.0
2-Chlorotoluene	ND	5.0
4-Chlorotoluene	ND	5.0
tert-Butylbenzene	ND	5.0
1,2,4-Trimethylbenzene	ND	5.0
sec-Butylbenzene	ND	5.0
para-Isopropyl Toluene	ND	5.0
1,3-Dichlorobenzene	ND	5.0
1,4-Dichlorobenzene	ND	5.0
n-Butylbenzene	ND	5.0
1,2-Dichlorobenzene	ND	5.0
1,2-Dibromo-3-Chloropropane	ND	5.0
1,2,4-Trichlorobenzene	ND	5.0
Hexachlorobutadiene	ND	5.0
Naphthalene	ND	5.0
1,2,3-Trichlorobenzene	ND	5.0

Surrogate	%REC	Limits
Dibromofluoromethane	103	76-132
1,2-Dichloroethane-d4	101	74-149
Toluene-d8	96	80-120
Bromofluorobenzene	105	78-134

ND= Not Detected
RL= Reporting Limit

ENTHALPY ANALYTICAL

Batch QC Report

Purgeable Organics by GC/MS

Lab #:	294849	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 5035
Project#:	1101-17A	Analysis:	EPA 8260B
Matrix:	Soil	Batch#:	254261
Units:	ug/Kg	Analyzed:	12/01/17
Diln Fac:	1.000		

Type: BS Lab ID: QC911107

Analyte	Spiked	Result	%REC	Limits
1,1-Dichloroethene	25.00	29.04	116	68-132
Benzene	25.00	22.96	92	75-123
Trichloroethene	25.00	23.01	92	75-120
Toluene	25.00	22.54	90	76-120
Chlorobenzene	25.00	22.86	91	80-120

Surrogate	%REC	Limits
Dibromofluoromethane	99	76-132
1,2-Dichloroethane-d4	95	74-149
Toluene-d8	99	80-120
Bromofluorobenzene	101	78-134

Type: BSD Lab ID: QC911108

Analyte	Spiked	Result	%REC	Limits	RPD	Lim
1,1-Dichloroethene	25.00	32.08	128	68-132	10	28
Benzene	25.00	24.62	98	75-123	7	25
Trichloroethene	25.00	25.20	101	75-120	9	23
Toluene	25.00	24.18	97	76-120	7	24
Chlorobenzene	25.00	24.85	99	80-120	8	21

Surrogate	%REC	Limits
Dibromofluoromethane	101	76-132
1,2-Dichloroethane-d4	97	74-149
Toluene-d8	100	80-120
Bromofluorobenzene	105	78-134

RPD= Relative Percent Difference

ENTHALPY ANALYTICAL

Purgeable Organics by GC/MS

Lab #:	294849	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 5030B
Project#:	1101-17A	Analysis:	EPA 8260B
Field ID:	IDW-A3-17-1-LIQUID	Diln Fac:	0.9579
Lab ID:	294849-002	Batch#:	254470
Matrix:	Miscell.	Sampled:	11/28/17
Units:	ug/Kg	Received:	11/28/17
Basis:	as received	Analyzed:	12/07/17

Analyte	Result	RL
Freon 12	ND	9.6
tert-Butyl Alcohol (TBA)	ND	96
Chloromethane	ND	9.6
Isopropyl Ether (DIPE)	ND	4.8
Vinyl Chloride	ND	9.6
Bromomethane	ND	9.6
Ethyl tert-Butyl Ether (ETBE)	ND	4.8
Chloroethane	ND	9.6
Methyl tert-Amyl Ether (TAME)	ND	4.8
Trichlorofluoromethane	ND	4.8
Acetone	ND	19
Freon 113	ND	4.8
1,1-Dichloroethene	ND	4.8
Methylene Chloride	ND	19
Carbon Disulfide	ND	4.8
MTBE	ND	4.8
trans-1,2-Dichloroethene	ND	4.8
Vinyl Acetate	ND	48
1,1-Dichloroethane	ND	4.8
2-Butanone	ND	9.6
cis-1,2-Dichloroethene	ND	4.8
2,2-Dichloropropane	ND	4.8
Chloroform	ND	4.8
Bromochloromethane	ND	4.8
1,1,1-Trichloroethane	ND	4.8
1,1-Dichloropropene	ND	4.8
Carbon Tetrachloride	ND	4.8
1,2-Dichloroethane	ND	4.8
Benzene	ND	4.8
Trichloroethene	ND	4.8
1,2-Dichloropropane	ND	4.8
Bromodichloromethane	ND	4.8
Dibromomethane	ND	4.8
4-Methyl-2-Pentanone	ND	9.6
cis-1,3-Dichloropropene	ND	4.8
Toluene	ND	4.8
trans-1,3-Dichloropropene	ND	4.8
1,1,2-Trichloroethane	ND	4.8
2-Hexanone	ND	9.6
1,3-Dichloropropane	ND	4.8
Tetrachloroethene	ND	4.8
Dibromochloromethane	ND	4.8
1,2-Dibromoethane	ND	4.8
Chlorobenzene	ND	4.8
1,1,1,2-Tetrachloroethane	ND	4.8
Ethylbenzene	ND	4.8
m,p-Xylenes	ND	4.8
o-Xylene	ND	4.8
Styrene	ND	4.8
Bromoform	ND	4.8
Isopropylbenzene	ND	4.8
1,1,2,2-Tetrachloroethane	ND	4.8
1,2,3-Trichloropropane	ND	4.8
Propylbenzene	ND	4.8

ND= Not Detected
RL= Reporting Limit

ENTHALPY ANALYTICAL

Purgeable Organics by GC/MS

Lab #:	294849	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 5030B
Project#:	1101-17A	Analysis:	EPA 8260B
Field ID:	IDW-A3-17-1-LIQUID	Diln Fac:	0.9579
Lab ID:	294849-002	Batch#:	254470
Matrix:	Miscell.	Sampled:	11/28/17
Units:	ug/Kg	Received:	11/28/17
Basis:	as received	Analyzed:	12/07/17

Analyte	Result	RL
Bromobenzene	ND	4.8
1,3,5-Trimethylbenzene	ND	4.8
2-Chlorotoluene	ND	4.8
4-Chlorotoluene	ND	4.8
tert-Butylbenzene	ND	4.8
1,2,4-Trimethylbenzene	ND	4.8
sec-Butylbenzene	ND	4.8
para-Isopropyl Toluene	ND	4.8
1,3-Dichlorobenzene	ND	4.8
1,4-Dichlorobenzene	ND	4.8
n-Butylbenzene	ND	4.8
1,2-Dichlorobenzene	ND	4.8
1,2-Dibromo-3-Chloropropane	ND	4.8
1,2,4-Trichlorobenzene	ND	4.8
Hexachlorobutadiene	ND	4.8
Naphthalene	ND	4.8
1,2,3-Trichlorobenzene	ND	4.8

Surrogate	%REC	Limits
Dibromofluoromethane	95	76-132
1,2-Dichloroethane-d4	116	74-149
Toluene-d8	94	80-120
Bromofluorobenzene	93	78-134

ND= Not Detected
RL= Reporting Limit

Batch QC Report

Purgeable Organics by GC/MS

Lab #:	294849	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 5030B
Project#:	1101-17A	Analysis:	EPA 8260B
Field ID:	ZZZZZZZZZZ	Batch#:	254470
MSS Lab ID:	295025-001	Sampled:	12/01/17
Matrix:	Soil	Received:	12/01/17
Units:	ug/Kg	Analyzed:	12/07/17
Basis:	as received		

Type: MS Diln Fac: 0.9398
Lab ID: QC911968

Analyte	MSS Result	Spiked	Result	%REC	Limits
tert-Butyl Alcohol (TBA)	<7.704	235.0	154.8	66	57-155
Isopropyl Ether (DIPE)	<0.5028	46.99	22.26	47 *	56-137
Ethyl tert-Butyl Ether (ETBE)	<0.5063	46.99	32.38	69	60-137
Methyl tert-Amyl Ether (TAME)	<0.4319	46.99	40.62	86	60-129
1,1-Dichloroethene	<0.5326	46.99	31.92	68	64-131
Benzene	<0.6205	46.99	32.04	68	66-122
Trichloroethene	<0.6463	46.99	39.33	84	57-133
Toluene	<0.6797	46.99	33.14	71	61-120
Chlorobenzene	<0.5572	46.99	34.14	73	56-120

Surrogate	%REC	Limits
Dibromofluoromethane	82	76-132
1,2-Dichloroethane-d4	124	74-149
Toluene-d8	94	80-120
Bromofluorobenzene	95	78-134

Type: MSD Diln Fac: 0.9615
Lab ID: QC911969

Analyte	Spiked	Result	%REC	Limits	RPD	Lim
tert-Butyl Alcohol (TBA)	240.4	167.6	70	57-155	6	41
Isopropyl Ether (DIPE)	48.08	25.56	53 *	56-137	11	28
Ethyl tert-Butyl Ether (ETBE)	48.08	35.93	75	60-137	8	31
Methyl tert-Amyl Ether (TAME)	48.08	44.17	92	60-129	6	30
1,1-Dichloroethene	48.08	35.50	74	64-131	8	32
Benzene	48.08	33.59	70	66-122	2	32
Trichloroethene	48.08	42.79	89	57-133	6	34
Toluene	48.08	35.77	74	61-120	5	32
Chlorobenzene	48.08	36.43	76	56-120	4	33

Surrogate	%REC	Limits
Dibromofluoromethane	86	76-132
1,2-Dichloroethane-d4	125	74-149
Toluene-d8	94	80-120
Bromofluorobenzene	94	78-134

*= Value outside of QC limits; see narrative
RPD= Relative Percent Difference

ENTHALPY ANALYTICAL

Batch QC Report

Purgeable Organics by GC/MS

Lab #:	294849	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 5030B
Project#:	1101-17A	Analysis:	EPA 8260B
Type:	BLANK	Diln Fac:	1.000
Lab ID:	QC911970	Batch#:	254470
Matrix:	Soil	Analyzed:	12/07/17
Units:	ug/Kg		

Analyte	Result	RL
Freon 12	ND	10
tert-Butyl Alcohol (TBA)	ND	100
Chloromethane	ND	10
Isopropyl Ether (DIPE)	ND	5.0
Vinyl Chloride	ND	10
Bromomethane	ND	10
Ethyl tert-Butyl Ether (ETBE)	ND	5.0
Chloroethane	ND	10
Methyl tert-Amyl Ether (TAME)	ND	5.0
Trichlorofluoromethane	ND	5.0
Acetone	ND	20
Freon 113	ND	5.0
1,1-Dichloroethene	ND	5.0
Methylene Chloride	ND	20
Carbon Disulfide	ND	5.0
MTBE	ND	5.0
trans-1,2-Dichloroethene	ND	5.0
Vinyl Acetate	ND	50
1,1-Dichloroethane	ND	5.0
2-Butanone	ND	10
cis-1,2-Dichloroethene	ND	5.0
2,2-Dichloropropane	ND	5.0
Chloroform	ND	5.0
Bromochloromethane	ND	5.0
1,1,1-Trichloroethane	ND	5.0
1,1-Dichloropropene	ND	5.0
Carbon Tetrachloride	ND	5.0
1,2-Dichloroethane	ND	5.0
Benzene	ND	5.0
Trichloroethene	ND	5.0
1,2-Dichloropropane	ND	5.0
Bromodichloromethane	ND	5.0
Dibromomethane	ND	5.0
4-Methyl-2-Pentanone	ND	10
cis-1,3-Dichloropropene	ND	5.0
Toluene	ND	5.0
trans-1,3-Dichloropropene	ND	5.0
1,1,2-Trichloroethane	ND	5.0
2-Hexanone	ND	10
1,3-Dichloropropane	ND	5.0
Tetrachloroethene	ND	5.0
Dibromochloromethane	ND	5.0
1,2-Dibromoethane	ND	5.0
Chlorobenzene	ND	5.0
1,1,1,2-Tetrachloroethane	ND	5.0
Ethylbenzene	ND	5.0
m,p-Xylenes	ND	5.0
o-Xylene	ND	5.0
Styrene	ND	5.0
Bromoform	ND	5.0
Isopropylbenzene	ND	5.0
1,1,2,2-Tetrachloroethane	ND	5.0
1,2,3-Trichloropropane	ND	5.0
Propylbenzene	ND	5.0

ND= Not Detected
RL= Reporting Limit

ENTHALPY ANALYTICAL

Batch QC Report

Purgeable Organics by GC/MS

Lab #:	294849	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 5030B
Project#:	1101-17A	Analysis:	EPA 8260B
Type:	BLANK	Diln Fac:	1.000
Lab ID:	QC911970	Batch#:	254470
Matrix:	Soil	Analyzed:	12/07/17
Units:	ug/Kg		

Analyte	Result	RL
Bromobenzene	ND	5.0
1,3,5-Trimethylbenzene	ND	5.0
2-Chlorotoluene	ND	5.0
4-Chlorotoluene	ND	5.0
tert-Butylbenzene	ND	5.0
1,2,4-Trimethylbenzene	ND	5.0
sec-Butylbenzene	ND	5.0
para-Isopropyl Toluene	ND	5.0
1,3-Dichlorobenzene	ND	5.0
1,4-Dichlorobenzene	ND	5.0
n-Butylbenzene	ND	5.0
1,2-Dichlorobenzene	ND	5.0
1,2-Dibromo-3-Chloropropane	ND	5.0
1,2,4-Trichlorobenzene	ND	5.0
Hexachlorobutadiene	ND	5.0
Naphthalene	ND	5.0
1,2,3-Trichlorobenzene	ND	5.0

Surrogate	%REC	Limits
Dibromofluoromethane	91	76-132
1,2-Dichloroethane-d4	113	74-149
Toluene-d8	98	80-120
Bromofluorobenzene	105	78-134

ND= Not Detected
RL= Reporting Limit

ENTHALPY ANALYTICAL

Batch QC Report

Purgeable Organics by GC/MS

Lab #:	294849	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 5030B
Project#:	1101-17A	Analysis:	EPA 8260B
Type:	LCS	Diln Fac:	1.000
Lab ID:	QC912020	Batch#:	254470
Matrix:	Soil	Analyzed:	12/07/17
Units:	ug/Kg		

Analyte	Spiked	Result	%REC	Limits
tert-Butyl Alcohol (TBA)	125.0	111.3	89	54-155
Isopropyl Ether (DIPE)	25.00	18.16	73	55-134
Ethyl tert-Butyl Ether (ETBE)	25.00	20.70	83	59-134
Methyl tert-Amyl Ether (TAME)	25.00	22.56	90	63-126
1,1-Dichloroethene	25.00	23.94	96	68-132
Benzene	25.00	22.65	91	75-123
Trichloroethene	25.00	26.48	106	75-120
Toluene	25.00	24.25	97	76-120
Chlorobenzene	25.00	24.16	97	80-120

Surrogate	%REC	Limits
Dibromofluoromethane	91	76-132
1,2-Dichloroethane-d4	115	74-149
Toluene-d8	100	80-120
Bromofluorobenzene	104	78-134

ENTHALPY ANALYTICAL

Semivolatile Organics by GC/MS SIM

Lab #:	294849	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 3520C
Project#:	1101-17A	Analysis:	EPA 8270C-SIM
Field ID:	IDW-A3-17-1-LIQUID	Batch#:	254344
Lab ID:	294849-002	Sampled:	11/28/17
Matrix:	Water	Received:	11/28/17
Units:	ug/L	Prepared:	12/04/17
Diln Fac:	20.00	Analyzed:	12/05/17

Analyte	Result	RL
Naphthalene	ND	20
Acenaphthylene	ND	20
Acenaphthene	ND	20
Fluorene	ND	20
Phenanthrene	ND	20
Anthracene	ND	20
Fluoranthene	ND	20
Pyrene	ND	20
Benzo(a)anthracene	ND	20
Chrysene	ND	20
Benzo(b)fluoranthene	ND	20
Benzo(k)fluoranthene	ND	20
Benzo(a)pyrene	ND	20
Indeno(1,2,3-cd)pyrene	ND	20
Dibenz(a,h)anthracene	ND	20
Benzo(g,h,i)perylene	ND	20

Surrogate	%REC	Limits
Nitrobenzene-d5	DO	44-139
2-Fluorobiphenyl	DO	47-120
Terphenyl-d14	DO	25-123

DO= Diluted Out
ND= Not Detected
RL= Reporting Limit

Batch QC Report

Semivolatile Organics by GC/MS SIM

Lab #:	294849	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 3520C
Project#:	1101-17A	Analysis:	EPA 8270C-SIM
Type:	BLANK	Diln Fac:	1.000
Lab ID:	QC911432	Batch#:	254344
Matrix:	Water	Prepared:	12/04/17
Units:	ug/L	Analyzed:	12/05/17

Analyte	Result	RL
Naphthalene	ND	0.1
Acenaphthylene	ND	0.1
Acenaphthene	ND	0.1
Fluorene	ND	0.1
Phenanthrene	ND	0.1
Anthracene	ND	0.1
Fluoranthene	ND	0.1
Pyrene	ND	0.1
Benzo(a)anthracene	ND	0.1
Chrysene	ND	0.1
Benzo(b)fluoranthene	ND	0.1
Benzo(k)fluoranthene	ND	0.1
Benzo(a)pyrene	ND	0.1
Indeno(1,2,3-cd)pyrene	ND	0.1
Dibenz(a,h)anthracene	ND	0.1
Benzo(g,h,i)perylene	ND	0.1

Surrogate	%REC	Limits
Nitrobenzene-d5	84	44-139
2-Fluorobiphenyl	80	47-120
Terphenyl-d14	77	25-123

ND= Not Detected
RL= Reporting Limit

Batch QC Report

Semivolatile Organics by GC/MS SIM			
Lab #:	294849	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 3520C
Project#:	1101-17A	Analysis:	EPA 8270C-SIM
Matrix:	Water	Batch#:	254344
Units:	ug/L	Prepared:	12/04/17
Diln Fac:	1.000	Analyzed:	12/05/17

Type: BS   Lab ID: QC911433

Analyte	Spiked	Result	%REC	Limits
Acenaphthene	1.000	0.8212	82	54-120
Pyrene	1.000	0.7632	76	50-120

Surrogate	%REC	Limits
Nitrobenzene-d5	92	44-139
2-Fluorobiphenyl	87	47-120
Terphenyl-d14	79	25-123

Type: BSD   Lab ID: QC911434

Analyte	Spiked	Result	%REC	Limits	RPD	Lim
Acenaphthene	1.000	0.7304	73	54-120	12	36
Pyrene	1.000	0.6605	66	50-120	14	37

Surrogate	%REC	Limits
Nitrobenzene-d5	81	44-139
2-Fluorobiphenyl	75	47-120
Terphenyl-d14	68	25-123

RPD= Relative Percent Difference

ENTHALPY ANALYTICAL

Semivolatile Organics by GC/MS SIM

Lab #:	294849	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 3550C
Project#:	1101-17A	Analysis:	EPA 8270C-SIM
Field ID:	IDW-A3-17-1-SOILD	Batch#:	254190
Lab ID:	294849-001	Sampled:	11/28/17
Matrix:	Soil	Received:	11/28/17
Units:	ug/Kg	Prepared:	11/29/17
Basis:	as received	Analyzed:	11/30/17
Diln Fac:	1.000		

Analyte	Result	RL
Naphthalene	ND	5.0
Acenaphthylene	ND	5.0
Acenaphthene	ND	5.0
Fluorene	ND	5.0
Phenanthrene	ND	5.0
Anthracene	ND	5.0
Fluoranthene	ND	5.0
Pyrene	ND	5.0
Benzo(a)anthracene	ND	5.0
Chrysene	ND	5.0
Benzo(b)fluoranthene	ND	5.0
Benzo(k)fluoranthene	ND	5.0
Benzo(a)pyrene	ND	5.0
Indeno(1,2,3-cd)pyrene	ND	5.0
Dibenz(a,h)anthracene	ND	5.0
Benzo(g,h,i)perylene	ND	5.0

Surrogate	%REC	Limits
Nitrobenzene-d5	93	46-126
2-Fluorobiphenyl	75	50-120
Terphenyl-d14	69	53-123

ND= Not Detected
RL= Reporting Limit

Batch QC Report

Semivolatile Organics by GC/MS SIM

Lab #:	294849	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 3550C
Project#:	1101-17A	Analysis:	EPA 8270C-SIM
Type:	BLANK	Diln Fac:	1.000
Lab ID:	QC910819	Batch#:	254190
Matrix:	Soil	Prepared:	11/29/17
Units:	ug/Kg	Analyzed:	11/30/17

Analyte	Result	RL
Naphthalene	ND	5.0
Acenaphthylene	ND	5.0
Acenaphthene	ND	5.0
Fluorene	ND	5.0
Phenanthrene	ND	5.0
Anthracene	ND	5.0
Fluoranthene	ND	5.0
Pyrene	ND	5.0
Benzo(a)anthracene	ND	5.0
Chrysene	ND	5.0
Benzo(b)fluoranthene	ND	5.0
Benzo(k)fluoranthene	ND	5.0
Benzo(a)pyrene	ND	5.0
Indeno(1,2,3-cd)pyrene	ND	5.0
Dibenz(a,h)anthracene	ND	5.0
Benzo(g,h,i)perylene	ND	5.0

Surrogate	%REC	Limits
Nitrobenzene-d5	98	46-126
2-Fluorobiphenyl	92	50-120
Terphenyl-d14	97	53-123

ND= Not Detected
RL= Reporting Limit

Batch QC Report

Semivolatile Organics by GC/MS SIM

Lab #:	294849	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 3550C
Project#:	1101-17A	Analysis:	EPA 8270C-SIM
Type:	LCS	Diln Fac:	1.000
Lab ID:	QC910820	Batch#:	254190
Matrix:	Soil	Prepared:	11/29/17
Units:	ug/Kg	Analyzed:	11/30/17

Analyte	Spiked	Result	%REC	Limits
Acenaphthene	33.33	31.56	95	62-120
Pyrene	33.33	33.72	101	56-130

Surrogate	%REC	Limits
Nitrobenzene-d5	123	46-126
2-Fluorobiphenyl	96	50-120
Terphenyl-d14	103	53-123

ENTHALPY ANALYTICAL

Batch QC Report

Semivolatile Organics by GC/MS SIM

Lab #:	294849	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 3550C
Project#:	1101-17A	Analysis:	EPA 8270C-SIM
Field ID:	IDW-A3-17-1-SOILD	Batch#:	254190
MSS Lab ID:	294849-001	Sampled:	11/28/17
Matrix:	Soil	Received:	11/28/17
Units:	ug/Kg	Prepared:	11/29/17
Basis:	as received	Analyzed:	11/30/17
Diln Fac:	1.000		

Type: MS   Lab ID: QC910821

Analyte	MSS Result	Spiked	Result	%REC	Limits
Acenaphthene	<1.004	33.33	23.62	71	54-120
Pyrene	<1.004	33.33	22.80	68	35-143

Surrogate	%REC	Limits
Nitrobenzene-d5	92	46-126
2-Fluorobiphenyl	75	50-120
Terphenyl-d14	66	53-123

Type: MSD   Lab ID: QC910822

Analyte	Spiked	Result	%REC	Limits	RPD	Lim
Acenaphthene	33.33	21.82	65	54-120	8	35
Pyrene	33.33	21.25	64	35-143	7	58

Surrogate	%REC	Limits
Nitrobenzene-d5	83	46-126
2-Fluorobiphenyl	70	50-120
Terphenyl-d14	60	53-123

RPD= Relative Percent Difference

ENTHALPY ANALYTICAL

Polychlorinated Biphenyls (PCBs)

Lab #:	294849	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 3520C
Project#:	1101-17A	Analysis:	EPA 8082
Field ID:	IDW-A3-17-1-LIQUID	Batch#:	254212
Matrix:	Water	Sampled:	11/28/17
Units:	ug/L	Received:	11/28/17
Diln Fac:	1.000		

Type:	SAMPLE	Prepared:	12/01/17
Lab ID:	294849-002	Analyzed:	12/04/17

Analyte	Result	RL
Aroclor-1016	ND	1.2
Aroclor-1221	ND	2.8
Aroclor-1232	ND	1.2
Aroclor-1242	ND	1.2
Aroclor-1248	ND	1.6
Aroclor-1254	ND	1.2
Aroclor-1260	ND	1.2

Surrogate	%REC	Limits
Decachlorobiphenyl	50	22-139

Type:	BLANK	Prepared:	11/30/17
Lab ID:	QC910921	Analyzed:	12/01/17

Analyte	Result	RL
Aroclor-1016	ND	0.20
Aroclor-1221	ND	0.40
Aroclor-1232	ND	0.20
Aroclor-1242	ND	0.20
Aroclor-1248	ND	0.20
Aroclor-1254	ND	0.20
Aroclor-1260	ND	0.20

Surrogate	%REC	Limits
Decachlorobiphenyl	119	22-139

ND= Not Detected
RL= Reporting Limit

ENTHALPY ANALYTICAL

Batch QC Report

Polychlorinated Biphenyls (PCBs)			
Lab #:	294849	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 3520C
Project#:	1101-17A	Analysis:	EPA 8082
Matrix:	Water	Batch#:	254212
Units:	ug/L	Prepared:	11/30/17
Diln Fac:	1.000	Analyzed:	12/01/17

Type: BS   Lab ID: QC910922

Analyte	Spiked	Result	%REC	Limits
Aroclor-1016	2.500	1.966	79	59-134
Aroclor-1260	2.500	2.041	82	54-144

Surrogate	%REC	Limits
Decachlorobiphenyl	92	22-139

Type: BSD   Lab ID: QC910923

Analyte	Spiked	Result	%REC	Limits	RPD	Lim
Aroclor-1016	2.500	2.579	103	59-134	27	33
Aroclor-1260	2.500	2.614	105	54-144	25	44

Surrogate	%REC	Limits
Decachlorobiphenyl	96	22-139

RPD= Relative Percent Difference

ENTHALPY ANALYTICAL

Polychlorinated Biphenyls (PCBs)

Lab #:	294849	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 3540C
Project#:	1101-17A	Analysis:	EPA 8082
Field ID:	IDW-A3-17-1-SOILD	Batch#:	254593
Units:	ug/Kg	Sampled:	11/28/17
Basis:	as received	Received:	11/28/17
Diln Fac:	1.000	Prepared:	12/11/17

Type:	SAMPLE	Matrix:	Soil
Lab ID:	294849-001	Analyzed:	12/13/17

Analyte	Result	RL
Aroclor-1016	ND	84
Aroclor-1221	ND	170
Aroclor-1232	ND	84
Aroclor-1242	ND	84
Aroclor-1248	ND	84
Aroclor-1254	ND	84
Aroclor-1260	ND	84

Surrogate	%REC	Limits
Decachlorobiphenyl	89	26-153

Type:	BLANK	Matrix:	Miscell.
Lab ID:	QC912438	Analyzed:	12/12/17

Analyte	Result	RL
Aroclor-1016	ND	9.6
Aroclor-1221	ND	19
Aroclor-1232	ND	9.6
Aroclor-1242	ND	9.6
Aroclor-1248	ND	9.6
Aroclor-1254	ND	9.6
Aroclor-1260	ND	9.6

Surrogate	%REC	Limits
Decachlorobiphenyl	113	26-153

ND= Not Detected
RL= Reporting Limit

Batch QC Report

Polychlorinated Biphenyls (PCBs)

Lab #:	294849	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 3540C
Project#:	1101-17A	Analysis:	EPA 8082
Matrix:	Miscell.	Batch#:	254593
Units:	ug/Kg	Prepared:	12/11/17
Diln Fac:	1.000	Analyzed:	12/12/17

Type: BS   Lab ID: QC912439

Analyte	Spiked	Result	%REC	Limits
Aroclor-1016	166.7	203.4	122	56-152
Aroclor-1260	166.7	199.5	120	52-165

Surrogate	%REC	Limits
Decachlorobiphenyl	116	26-153

Type: BSD   Lab ID: QC912440

Analyte	Spiked	Result	%REC	Limits	RPD	Lim
Aroclor-1016	166.7	178.2	107	56-152	13	48
Aroclor-1260	166.7	182.4	109	52-165	9	39

Surrogate	%REC	Limits
Decachlorobiphenyl	107	26-153

RPD= Relative Percent Difference

ENTHALPY ANALYTICAL

California Title 22 Metals

Lab #:	294849	Project#:	1101-17A
Client:	A3GEO Inc.	Location:	NRLF Phase 4
Field ID:	IDW-A3-17-1-SOILD	Basis:	as received
Lab ID:	294849-001	Diln Fac:	1.000
Matrix:	Soil	Sampled:	11/28/17
Units:	mg/Kg	Received:	11/28/17

Analyte	Result	RL	Batch#	Prepared	Analyzed	Prep	Analysis
Antimony	ND	2.0	254195	11/29/17	11/29/17	EPA 3050B	EPA 6010B
Arsenic	9.5	1.5	254195	11/29/17	11/29/17	EPA 3050B	EPA 6010B
Barium	200	0.25	254195	11/29/17	11/29/17	EPA 3050B	EPA 6010B
Beryllium	0.48	0.10	254195	11/29/17	11/29/17	EPA 3050B	EPA 6010B
Cadmium	0.38	0.25	254195	11/29/17	11/29/17	EPA 3050B	EPA 6010B
Chromium	49	0.25	254195	11/29/17	11/29/17	EPA 3050B	EPA 6010B
Cobalt	19	0.25	254195	11/29/17	11/29/17	EPA 3050B	EPA 6010B
Copper	25	0.25	254195	11/29/17	11/29/17	EPA 3050B	EPA 6010B
Lead	7.6	1.0	254195	11/29/17	11/29/17	EPA 3050B	EPA 6010B
Mercury	0.10	0.017	254349	12/04/17	12/04/17	METHOD	EPA 7471A
Molybdenum	0.72	0.25	254195	11/29/17	11/29/17	EPA 3050B	EPA 6010B
Nickel	59	0.25	254195	11/29/17	11/29/17	EPA 3050B	EPA 6010B
Selenium	ND	2.0	254195	11/29/17	11/29/17	EPA 3050B	EPA 6010B
Silver	ND	0.25	254195	11/29/17	11/29/17	EPA 3050B	EPA 6010B
Thallium	ND	0.50	254195	11/29/17	11/29/17	EPA 3050B	EPA 6010B
Vanadium	43	0.25	254195	11/29/17	11/29/17	EPA 3050B	EPA 6010B
Zinc	48	1.0	254195	11/29/17	11/30/17	EPA 3050B	EPA 6010B

ND= Not Detected
RL= Reporting Limit

Batch QC Report

California Title 22 Metals

Lab #:	294849	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 3050B
Project#:	1101-17A	Analysis:	EPA 6010B
Type:	BLANK	Diln Fac:	1.000
Lab ID:	QC910835	Batch#:	254195
Matrix:	Soil	Prepared:	11/29/17
Units:	mg/Kg	Analyzed:	11/29/17

Analyte	Result	RL
Antimony	ND	2.0
Arsenic	ND	1.5
Barium	ND	0.26
Beryllium	ND	0.10
Cadmium	ND	0.26
Chromium	ND	0.26
Cobalt	ND	0.26
Copper	ND	0.26
Lead	ND	1.0
Molybdenum	ND	0.26
Nickel	ND	0.26
Selenium	ND	2.0
Silver	ND	0.26
Thallium	ND	0.52
Vanadium	ND	0.26
Zinc	ND	1.0

ND= Not Detected
RL= Reporting Limit

Batch QC Report

California Title 22 Metals

Lab #:	294849	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 3050B
Project#:	1101-17A	Analysis:	EPA 6010B
Matrix:	Soil	Batch#:	254195
Units:	mg/Kg	Prepared:	11/29/17
Diln Fac:	1.000	Analyzed:	11/29/17

Type: BS   Lab ID: QC910836

Analyte	Spiked	Result	%REC	Limits
Antimony	49.02	47.67	97	80-120
Arsenic	49.02	48.71	99	80-120
Barium	49.02	50.57	103	80-120
Beryllium	24.51	24.41	100	80-120
Cadmium	49.02	50.36	103	80-120
Chromium	49.02	53.18	108	80-120
Cobalt	49.02	51.43	105	80-120
Copper	49.02	47.50	97	80-120
Lead	49.02	47.94	98	80-120
Molybdenum	49.02	47.84	98	80-120
Nickel	49.02	47.78	97	80-120
Selenium	49.02	52.68	107	80-120
Silver	4.902	4.325	88	80-120
Thallium	49.02	49.05	100	80-120
Vanadium	49.02	50.21	102	80-120
Zinc	49.02	51.31	105	80-120

Type: BSD   Lab ID: QC910837

Analyte	Spiked	Result	%REC	Limits	RPD	Lim
Antimony	50.00	49.49	99	80-120	2	20
Arsenic	50.00	52.94	106	80-120	6	20
Barium	50.00	51.67	103	80-120	0	20
Beryllium	25.00	24.94	100	80-120	0	20
Cadmium	50.00	50.29	101	80-120	2	20
Chromium	50.00	53.28	107	80-120	2	20
Cobalt	50.00	51.76	104	80-120	1	20
Copper	50.00	51.16	102	80-120	5	20
Lead	50.00	49.00	98	80-120	0	20
Molybdenum	50.00	48.78	98	80-120	0	20
Nickel	50.00	48.52	97	80-120	0	20
Selenium	50.00	52.26	105	80-120	3	20
Silver	5.000	4.392	88	80-120	0	22
Thallium	50.00	53.52	107	80-120	7	20
Vanadium	50.00	53.53	107	80-120	4	20
Zinc	50.00	52.05	104	80-120	1	20

RPD= Relative Percent Difference

Batch QC Report

California Title 22 Metals

Lab #:	294849	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 3050B
Project#:	1101-17A	Analysis:	EPA 6010B
Field ID:	ZZZZZZZZZZ	Batch#:	254195
MSS Lab ID:	294876-001	Sampled:	11/29/17
Matrix:	Soil	Received:	11/29/17
Units:	mg/Kg	Prepared:	11/29/17
Basis:	as received	Analyzed:	11/29/17
Diln Fac:	1.000		

Type: MS Lab ID: QC910838

Analyte	MSS Result	Spiked	Result	%REC	Limits
Antimony	0.7755	50.51	17.51	33	1-120
Arsenic	6.627	50.51	58.63	103	71-123
Barium	141.7	50.51	194.6	105	48-155
Beryllium	0.3951	25.25	24.70	96	80-120
Cadmium	0.2563	50.51	51.94	102	78-120
Chromium	39.94	50.51	83.02	85	64-135
Cobalt	8.689	50.51	55.81	93	65-120
Copper	20.46	50.51	79.70	117	75-132
Lead	22.25	50.51	69.58	94	53-128
Molybdenum	0.8214	50.51	44.44	86	68-120
Nickel	33.61	50.51	77.48	87	56-128
Selenium	<0.2365	50.51	52.78	104	59-120
Silver	<0.05263	5.051	4.721	93	36-123
Thallium	<0.1585	50.51	45.70	90	55-120
Vanadium	34.61	50.51	90.73	111	73-129
Zinc	67.76	50.51	114.4	92	49-138

Type: MSD Lab ID: QC910839

Analyte	Spiked	Result	%REC	Limits	RPD	Lim
Antimony	49.50	15.82	30	1-120	8	50
Arsenic	49.50	55.81	99	71-123	3	27
Barium	49.50	183.2	84	48-155	5	41
Beryllium	24.75	23.27	92	80-120	4	20
Cadmium	49.50	48.78	98	78-120	4	21
Chromium	49.50	78.16	77	64-135	5	37
Cobalt	49.50	52.27	88	65-120	5	32
Copper	49.50	70.98	102	75-132	10	33
Lead	49.50	68.19	93	53-128	1	48
Molybdenum	49.50	41.65	82	68-120	5	23
Nickel	49.50	74.02	82	56-128	3	38
Selenium	49.50	49.82	101	59-120	4	30
Silver	4.950	4.502	91	36-123	3	47
Thallium	49.50	42.92	87	55-120	4	22
Vanadium	49.50	84.95	102	73-129	5	27
Zinc	49.50	111.0	87	49-138	2	39

RPD= Relative Percent Difference

Batch QC Report

California Title 22 Metals			
Lab #:	294849	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	METHOD
Project#:	1101-17A	Analysis:	EPA 7471A
Analyte:	Mercury	Diln Fac:	1.000
Type:	BLANK	Batch#:	254349
Lab ID:	QC911459	Prepared:	12/04/17
Matrix:	Soil	Analyzed:	12/04/17
Units:	mg/Kg		

Result	RL
ND	0.016

ND= Not Detected
RL= Reporting Limit

ENTHALPY ANALYTICAL

Batch QC Report

California Title 22 Metals

Lab #:	294849	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	METHOD
Project#:	1101-17A	Analysis:	EPA 7471A
Analyte:	Mercury	Batch#:	254349
Matrix:	Soil	Prepared:	12/04/17
Units:	mg/Kg	Analyzed:	12/04/17
Diln Fac:	1.000		

Type	Lab ID	Spiked	Result	%REC	Limits	RPD	Lim
BS	QC911460	0.2155	0.2040	95	80-126		
BSD	QC911461	0.2119	0.1912	90	80-126	5	45

RPD= Relative Percent Difference

Batch QC Report

California Title 22 Metals

Lab #:	294849	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	METHOD
Project#:	1101-17A	Analysis:	EPA 7471A
Analyte:	Mercury	Diln Fac:	1.000
Field ID:	ZZZZZZZZZZ	Batch#:	254349
MSS Lab ID:	294564-001	Sampled:	11/15/17
Matrix:	Soil	Received:	11/15/17
Units:	mg/Kg	Prepared:	12/04/17
Basis:	as received	Analyzed:	12/04/17

Type	Lab ID	MSS Result	Spiked	Result	%REC	Limits	RPD	Lim
MS	QC911462	0.01261	0.1923	0.1969	96	61-157		
MSD	QC911463		0.2083	0.1991	89	61-157	6	57

RPD= Relative Percent Difference

California Title 22 Metals

Lab #:	294849	Project#:	1101-17A
Client:	A3GEO Inc.	Location:	NRLF Phase 4
Field ID:	IDW-A3-17-1-LIQUID	Basis:	as received
Lab ID:	294849-002	Diln Fac:	1.000
Matrix:	Miscell.	Sampled:	11/28/17
Units:	mg/Kg	Received:	11/28/17

Analyte	Result	RL	Batch#	Prepared	Analyzed	Prep	Analysis
Antimony	ND	2.0	254195	11/29/17	11/29/17	EPA 3050B	EPA 6010B
Arsenic	2.1	0.65	254195	11/29/17	11/29/17	EPA 3050B	EPA 6010B
Barium	48	0.27	254195	11/29/17	11/29/17	EPA 3050B	EPA 6010B
Beryllium	0.16	0.11	254195	11/29/17	11/29/17	EPA 3050B	EPA 6010B
Cadmium	ND	0.27	254195	11/29/17	11/29/17	EPA 3050B	EPA 6010B
Chromium	22	0.27	254195	11/29/17	11/29/17	EPA 3050B	EPA 6010B
Cobalt	4.3	0.27	254195	11/29/17	11/29/17	EPA 3050B	EPA 6010B
Copper	6.0	0.27	254195	11/29/17	11/29/17	EPA 3050B	EPA 6010B
Lead	2.0	0.54	254195	11/29/17	11/29/17	EPA 3050B	EPA 6010B
Mercury	0.020	0.018	254350	12/04/17	12/04/17	METHOD	EPA 7471A
Molybdenum	0.30	0.27	254195	11/29/17	11/29/17	EPA 3050B	EPA 6010B
Nickel	28	0.27	254195	11/29/17	11/29/17	EPA 3050B	EPA 6010B
Selenium	ND	2.0	254195	11/29/17	11/29/17	EPA 3050B	EPA 6010B
Silver	ND	0.27	254195	11/29/17	11/29/17	EPA 3050B	EPA 6010B
Thallium	ND	0.54	254195	11/29/17	11/29/17	EPA 3050B	EPA 6010B
Vanadium	13	0.27	254195	11/29/17	11/29/17	EPA 3050B	EPA 6010B
Zinc	12	1.1	254195	11/29/17	11/30/17	EPA 3050B	EPA 6010B

ND= Not Detected
RL= Reporting Limit

ENTHALPY ANALYTICAL

Batch QC Report

California Title 22 Metals

Lab #:	294849	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 3050B
Project#:	1101-17A	Analysis:	EPA 6010B
Type:	BLANK	Diln Fac:	1.000
Lab ID:	QC910835	Batch#:	254195
Matrix:	Soil	Prepared:	11/29/17
Units:	mg/Kg	Analyzed:	11/29/17

Analyte	Result	RL
Antimony	ND	2.0
Arsenic	ND	0.63
Barium	ND	0.26
Beryllium	ND	0.10
Cadmium	ND	0.26
Chromium	ND	0.26
Cobalt	ND	0.26
Copper	ND	0.26
Lead	ND	0.52
Molybdenum	ND	0.26
Nickel	ND	0.26
Selenium	ND	2.0
Silver	ND	0.26
Thallium	ND	0.52
Vanadium	ND	0.26
Zinc	ND	1.0

ND= Not Detected
RL= Reporting Limit

Batch QC Report

California Title 22 Metals

Lab #:	294849	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 3050B
Project#:	1101-17A	Analysis:	EPA 6010B
Matrix:	Soil	Batch#:	254195
Units:	mg/Kg	Prepared:	11/29/17
Diln Fac:	1.000	Analyzed:	11/29/17

Type: BS Lab ID: QC910836

Analyte	Spiked	Result	%REC	Limits
Antimony	49.02	47.67	97	80-120
Arsenic	49.02	48.71	99	80-120
Barium	49.02	50.57	103	80-120
Beryllium	24.51	24.41	100	80-120
Cadmium	49.02	50.36	103	80-120
Chromium	49.02	53.18	108	80-120
Cobalt	49.02	51.43	105	80-120
Copper	49.02	47.50	97	80-120
Lead	49.02	47.94	98	80-120
Molybdenum	49.02	47.84	98	80-120
Nickel	49.02	47.78	97	80-120
Selenium	49.02	52.68	107	80-120
Silver	4.902	4.325	88	80-120
Thallium	49.02	49.05	100	80-120
Vanadium	49.02	50.21	102	80-120
Zinc	49.02	51.31	105	80-120

Type: BSD Lab ID: QC910837

Analyte	Spiked	Result	%REC	Limits	RPD	Lim
Antimony	50.00	49.49	99	80-120	2	20
Arsenic	50.00	52.94	106	80-120	6	20
Barium	50.00	51.67	103	80-120	0	20
Beryllium	25.00	24.94	100	80-120	0	20
Cadmium	50.00	50.29	101	80-120	2	20
Chromium	50.00	53.28	107	80-120	2	20
Cobalt	50.00	51.76	104	80-120	1	20
Copper	50.00	51.16	102	80-120	5	20
Lead	50.00	49.00	98	80-120	0	20
Molybdenum	50.00	48.78	98	80-120	0	20
Nickel	50.00	48.52	97	80-120	0	20
Selenium	50.00	52.26	105	80-120	3	20
Silver	5.000	4.392	88	80-120	0	22
Thallium	50.00	53.52	107	80-120	7	20
Vanadium	50.00	53.53	107	80-120	4	20
Zinc	50.00	52.05	104	80-120	1	20

RPD= Relative Percent Difference

ENTHALPY ANALYTICAL

Batch QC Report

California Title 22 Metals

Lab #:	294849	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 3050B
Project#:	1101-17A	Analysis:	EPA 6010B
Field ID:	ZZZZZZZZZZ	Batch#:	254195
MSS Lab ID:	294876-001	Sampled:	11/29/17
Matrix:	Soil	Received:	11/29/17
Units:	mg/Kg	Prepared:	11/29/17
Basis:	as received	Analyzed:	11/29/17
Diln Fac:	1.000		

Type: MS Lab ID: QC910838

Analyte	MSS Result	Spiked	Result	%REC	Limits
Antimony	0.7755	50.51	17.51	33	1-120
Arsenic	6.627	50.51	58.63	103	71-123
Barium	141.7	50.51	194.6	105	48-155
Beryllium	0.3951	25.25	24.70	96	80-120
Cadmium	0.2563	50.51	51.94	102	78-120
Chromium	39.94	50.51	83.02	85	64-135
Cobalt	8.689	50.51	55.81	93	65-120
Copper	20.46	50.51	79.70	117	75-132
Lead	22.25	50.51	69.58	94	53-128
Molybdenum	0.8214	50.51	44.44	86	68-120
Nickel	33.61	50.51	77.48	87	56-128
Selenium	<0.2365	50.51	52.78	104	59-120
Silver	<0.05263	5.051	4.721	93	36-123
Thallium	<0.1585	50.51	45.70	90	55-120
Vanadium	34.61	50.51	90.73	111	73-129
Zinc	67.76	50.51	114.4	92	49-138

Type: MSD Lab ID: QC910839

Analyte	Spiked	Result	%REC	Limits	RPD	Lim
Antimony	49.50	15.82	30	1-120	8	50
Arsenic	49.50	55.81	99	71-123	3	27
Barium	49.50	183.2	84	48-155	5	41
Beryllium	24.75	23.27	92	80-120	4	20
Cadmium	49.50	48.78	98	78-120	4	21
Chromium	49.50	78.16	77	64-135	5	37
Cobalt	49.50	52.27	88	65-120	5	32
Copper	49.50	70.98	102	75-132	10	33
Lead	49.50	68.19	93	53-128	1	48
Molybdenum	49.50	41.65	82	68-120	5	23
Nickel	49.50	74.02	82	56-128	3	38
Selenium	49.50	49.82	101	59-120	4	30
Silver	4.950	4.502	91	36-123	3	47
Thallium	49.50	42.92	87	55-120	4	22
Vanadium	49.50	84.95	102	73-129	5	27
Zinc	49.50	111.0	87	49-138	2	39

RPD= Relative Percent Difference

Batch QC Report

California Title 22 Metals

Lab #:	294849	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	METHOD
Project#:	1101-17A	Analysis:	EPA 7471A
Analyte:	Mercury	Diln Fac:	1.000
Type:	BLANK	Batch#:	254350
Lab ID:	QC911465	Prepared:	12/04/17
Matrix:	Soil	Analyzed:	12/04/17
Units:	mg/Kg		

Result	RL
ND	0.017

ND= Not Detected
RL= Reporting Limit

Batch QC Report

California Title 22 Metals

Lab #:	294849	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	METHOD
Project#:	1101-17A	Analysis:	EPA 7471A
Analyte:	Mercury	Batch#:	254350
Matrix:	Soil	Prepared:	12/04/17
Units:	mg/Kg	Analyzed:	12/04/17
Diln Fac:	1.000		

Type	Lab ID	Spiked	Result	%REC	Limits	RPD	Lim
BS	QC911466	0.2193	0.2101	96	80-126		
BSD	QC911467	0.2016	0.2009	100	80-126	4	45

RPD= Relative Percent Difference

Batch QC Report

California Title 22 Metals			
Lab #:	294849	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	METHOD
Project#:	1101-17A	Analysis:	EPA 7471A
Analyte:	Mercury	Diln Fac:	1.000
Field ID:	ZZZZZZZZZZ	Batch#:	254350
MSS Lab ID:	294590-014	Sampled:	11/17/17
Matrix:	Soil	Received:	11/17/17
Units:	mg/Kg	Prepared:	12/04/17
Basis:	as received	Analyzed:	12/04/17

Type	Lab ID	MSS Result	Spiked	Result	%REC	Limits	RPD	Lim
MS	QC911468	0.03410	0.1923	0.2414	108	61-157		
MSD	QC911469		0.1953	0.2152	93	61-157	13	57

RPD= Relative Percent Difference

ENTHALPY

ANALYTICAL

Enthalpy Analytical

2323 Fifth Street, Berkeley, CA 94710, Phone (510) 486-0900

Laboratory Job Number 294938
ANALYTICAL REPORT

A3GEO Inc.	Project : 1101-17A Location : NRLF Phase 4 Level : II

Sample ID	Lab ID
IDW-A3-17-1-LIQUID	294938-001
IDW-A3-17-2-SOLID	294938-002
IDW-A3-17-2-LIQUID	294938-003
A3-17-2-40	294938-004

This data package has been reviewed for technical correctness and completeness. Release of this data has been authorized by the Laboratory Manager or the Manager's designee, as verified by the following signature. The results contained in this report meet all requirements of NELAP and pertain only to those samples which were submitted for analysis. This report may be reproduced only in its entirety.

Signature: ______________________ Date: 12/13/2017

Patrick McCarthy
Project Manager
patrick.mccarthy@enthalpy.com
(510) 204-2236

CA ELAP# 2896, NELAP# 4044-001

ENTHALPY ANALYTICAL

CASE NARRATIVE

Laboratory number:	**294938**
Client:	**A3GEO Inc.**
Project:	**1101-17A**
Location:	**NRLF Phase 4**
Request Date:	**11/30/17**
Samples Received:	**11/29/17**

This data package contains sample and QC results for two soil samples and two water samples, requested for the above referenced project on 11/30/17. The samples were received cold and intact.

TPH-Purgeables and/or BTXE by GC (EPA 8015B) Soil:
No analytical problems were encountered.

TPH-Purgeables and/or BTXE by GC (EPA 8015B) Miscell.:
No analytical problems were encountered.

TPH-Extractables by GC (EPA 8015B) Water:
No analytical problems were encountered.

TPH-Extractables by GC (EPA 8015B) Soil:
No analytical problems were encountered.

Volatile Organics by GC/MS (EPA 8260B) Soil:
High recoveries were observed for benzene and 1,1-dichloroethene in the MSD for batch 254562; the parent sample was not a project sample, the LCS was within limits, the associated RPDs were within limits, and these analytes were not detected at or above the RL in the associated sample. No other analytical problems were encountered.

Volatile Organics by GC/MS (EPA 8260B) Miscell.:
No analytical problems were encountered.

Semivolatile Organics by GC/MS SIM (EPA 8270C-SIM) Water:
IDW-A3-17-2-LIQUID (lab # 294938-003) was diluted due to high non-target analytes. No other analytical problems were encountered.

Semivolatile Organics by GC/MS SIM (EPA 8270C-SIM) Soil:
No analytical problems were encountered.

PCBs (EPA 8082) Water:
No analytical problems were encountered.

PCBs (EPA 8082) Soil:
All samples underwent sulfuric acid cleanup using EPA Method 3665A. All samples underwent sulfur cleanup using the copper option in EPA Method 3660B. Matrix spikes were not performed for this analysis in batch 254593 due to insufficient sample amount. No other analytical problems were encountered.

ENTHALPY ANALYTICAL

CASE NARRATIVE

Laboratory number:	**294938**
Client:	**A3GEO Inc.**
Project:	**1101-17A**
Location:	**NRLF Phase 4**
Request Date:	**11/30/17**
Samples Received:	**11/29/17**

Metals (EPA 6010B and EPA 7470A) Water:
No analytical problems were encountered.

Metals (EPA 6010B and EPA 7471A) Soil:
High recovery was observed for lead in the MSD for batch 254268; the parent sample was not a project sample, the BS/BSD were within limits, and the associated RPD was within limits. No other analytical problems were encountered.

***** Missing Items *****

The following items are valid in the narrative, but for some reason didn't end up in the above report:

Item 2 (PCBS/Miscell.): All samples underwent sulfuric acid cleanup using EPA Method 3665A.

Item 5 (PCBS/Miscell.): All samples underwent sulfur cleanup using the copper option in EPA Method 3660B.

You can invalidate these items, or adjust rgroup/matrix/method ([C] button) for each until they appear in the main body of the report. See the operations manager or LIMS staff for assistance if necessary.

Patrick McCarthy <pmccarthy@montrose-env.com>

Re: 1101-17A - Enthalpy (Berkeley) Login Summary (294938)

1 message

Laura Buchanan <laura@a3geo.com> Fri, Dec 1, 2017 at 10:54 AM
To: Patrick McCarthy <patrick.mccarthy@enthalpy.com>

Hi Patrick,

As discussed on the phone, the following analyses should be run:

- IDW-A3-17-2-Solid should be analyzed for PCBs, CAM 17 Metals, PAHs, and TPH DRO/GRO/ORO by 8015. Please DO NOT analyze the contents of this jar for VOCs by 8260B.
- A3-17-2-40 (soil) should be analyzed for VOCs by 8260B.

If you have any additional questions please don't hesitate to give me a call.

Best,
Laura

On Fri, Dec 1, 2017 at 11:04 AM, Patrick McCarthy <patrick.mccarthy@enthalpy.com> wrote:

Hi Laura, When you're available, please respond to this email with the requested revisions to sample 2. Thanks!

Enthalpy (Berkeley) Login Summary for 294938

Project: 1101-17A **Site:** NRLF Phase 4 **Lab Login #:** 294938 **Report Level:** II **PO#:** **Enthalpy (Berkeley) Proj Mgr:** Will Rice	**Report To:** A3GEO Inc. ATTN: Laura Buchanan	**Bill To:**	A3GEO Inc.
	ATTN: Laura Buchanan		

Client ID	Lab ID	Sampled	Received	DueDate	Matrix	Dry	Analyses	COC #	Comments
IDW-A3-17-1-LIQUID	001	11/29/17 00:00	11/29/17			N			
				12/07	Water		TEHM		
IDW-A3-17-2-SOLID	002	11/28/17 00:00	11/29/17			N			
				12/07	Soil		6010-T22 MET		
				12/07	Soil		8260		
				12/07	Soil		8270-SIM		
				12/07	Soil		PCB		SOXHLET EXTRACTION.
IDW-A3-17-2-LIQUID	003	11/29/17 00:00	11/29/17			N			
				12/07	Miscell.		8260		3/3 VOAs arrived with bubbles.
				12/07	Miscell.		PCB		
				12/07	Miscell.		TVH		
				12/07	Water		6010-T22 MET		Added HNO3 (#2017013053) => ph <2. 11-30-17 0945
				12/07	Water		8270-SIM		
				12/07	Water		TEHM		
A3-17-2-40	004	11/29/17 00:00	11/29/17			N			
				12/07	Soil		HOLD		

Email compiled and sent 12/01/17 09:04 AM.

--
Laura J. Buchanan, P.E., P.G.
Senior Project Engineer

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1331 Seventh Street, Unit E
Berkeley, CA 94710

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C&T LOGIN # 294938

Page 1 of 1
Chain of Custody # ______

Project No: 1101-17A
Project Name: NRLF Phase 4
Project P. O. No: Richmond, CA
EDD Format: Report Level ☐ II ☐ III ☐ IV
Turnaround Time: ☐ RUSH ☒ Standard

Sampler:
Report To: Laura Buchanan
Company: A3GEO
Telephone: (510) 919-0280
Email: Laura@a3geo.com

Lab No.	Sample ID.	Date Collected	Time Collected	Water	Solid			# of Containers	HCl	H2SO4	HNO3	NaOH	None	PCBs by EPA 8082 w/ EPA 3540C Soxhlet extraction	CAM 17 metals by EPA 6010/7471	PAHs by EPA 8270 in SIM	VOCs by 8260B w/ Terracores	PCBs by 8082	VOCs by 8260B			PCBs by EPA 8082	CAM 17 Metals by 6010/7471	PAHs by EPA 8270 in SIM	VOCs and TPH GRO by 8260B	TPH DRO/ORO by EPA 8015		
	IDW-A3-17-1-Liquid	11-29-17		X				1	[redacted]																	X		
	IDW-A3-17-2-Solid	11-28+29-17			X			1	[redacted]					X	X	X	X											
	IDW-A3-17-2-Liquid	11-29-17		X				7	[redacted]		1		3									X	X	X	X	X		
	A3-17-2-40	11-29-17			X			3	[redacted]				2					X									2 DI	1 MeOH

HCl ← 3 ← MeOH

Notes:

SAMPLE RECEIPT
☐ Intact
☐ Cold
☒ On Ice
☐ Ambient

RELINQUISHED BY:			RECEIVED BY:		
[signature]	DATE: 11-29	TIME: 1730	[signature]	DATE: 11-29	TIME: 1730
[signature]	DATE: 11/29	TIME: 1745	[signature]	DATE: 11/29/17	TIME: 1745
	DATE:	TIME:		DATE:	TIME:

COOLER RECEIPT CHECKLIST

ENTHALPY ANALYTICAL Berkeley

Login # 294938 Date Received 11/29/17 Number of coolers 1
Client AEI-EU Project NRLF Phase 4

Date Opened 11/29/17 By (print) TKY (sign) TKY
Date Logged in 11-30-17 By (print) kp (sign) kp
Date Labelled 11-30-17 By (print) kp (sign) kp

1. Did cooler come with a shipping slip (airbill, etc) ______ YES NO
   Shipping info ______

2A. Were custody seals present? .... ☐ YES (circle) on cooler on samples ☒ NO
   How many ______ Name ______ Date ______

2B. Were custody seals intact upon arrival? ______ YES NO N/A

3. Were custody papers dry and intact when received? ______ YES NO

4. Were custody papers filled out properly (ink, signed, etc)? ______ YES NO

5. Is the project identifiable from custody papers? (If so fill out top of form) ______ YES NO

6. Indicate the packing in cooler: (if other, describe) ______

   ☐ Bubble Wrap ☐ Foam blocks ☒ Bags ☐ None
   ☐ Cloth material ☐ Cardboard ☐ Styrofoam ☐ Paper towels

7. Temperature documentation: * Notify PM if temperature exceeds 6°C

   Type of ice used: ☒ Wet ☐ Blue/Gel ☐ None Temp(°C) 4.5

   ☐ Temperature blank(s) included? ☐ Thermometer# ______ ☒ IR Gun# A

   ☐ Samples received on ice directly from the field. Cooling process had begun

8. Were Method 5035 sampling containers present? ______ YES NO
   If YES, what time were they transferred to freezer? 1112 on 11/29/17

9. Did all bottles arrive unbroken/unopened? ______ YES NO

10. Are there any missing / extra samples? ______ YES NO

11. Are samples in the appropriate containers for indicated tests? ______ YES NO

12. Are sample labels present, in good condition and complete? ______ YES NO

13. Do the sample labels agree with custody papers? ______ YES NO

14. Was sufficient amount of sample sent for tests requested? ______ YES NO

15. Are the samples appropriately preserved? ______ YES NO N/A

16. Did you check preservatives for all bottles for each sample? ______ YES NO N/A

17. Did you document your preservative check? (pH strip lot# 10BDH4135) YES NO N/A

18. Did you change the hold time in LIMS for unpreserved VOAs? ______ YES NO N/A

19. Did you change the hold time in LIMS for preserved terracores? ______ YES NO N/A

20. Are bubbles > 6mm absent in VOA samples? ______ YES NO N/A

21. Was the client contacted concerning this sample delivery? ______ YES NO
    If YES, Who was called? ______ By ______ Date: ______

COMMENTS

(15) Added HNO_3 (# 2017013053) => pH < 2 for sample 3. 11-30-17 kp 0945

(20) 2/3 VOAs arrived with bubbles for sample 3

Enthalpy Sample Preservation for 294938

Sample	pH: <2	>9	>12	Other
-003a	[ ]	[ ]	[ ]	______
b	[ ]	[ ]	[ ]	______
c	[ ]	[ ]	[ ]	______
d	[X]	[ ]	[ ]	______
e	[ ]	[ ]	[ ]	______
f	[ ]	[ ]	[ ]	______
g	[ ]	[ ]	[ ]	______

Analyst: KP
Date: 11-30-17

ENTHALPY ANALYTICAL

Detections Summary for 294938

Results for any subcontracted analyses are not included in this summary.

Client : A3GEO Inc.
Project : 1101-17A
Location : NRLF Phase 4

Client Sample ID : IDW-A3-17-1-LIQUID Laboratory Sample ID : 294938-001

Analyte	Result	Flags	RL	Units	Basis	IDF	Method	Prep Method
Diesel C10-C24	3,500	Y	250	ug/L	As Recd	1.000	EPA 8015B	EPA 3520C
Motor Oil C24-C36	11,000		1,500	ug/L	As Recd	1.000	EPA 8015B	EPA 3520C

Client Sample ID : IDW-A3-17-2-SOLID Laboratory Sample ID : 294938-002

Analyte	Result	Flags	RL	Units	Basis	IDF	Method	Prep Method
Arsenic	3.5		1.5	mg/Kg	As Recd	1.000	EPA 6010B	EPA 3050B
Barium	120		0.26	mg/Kg	As Recd	1.000	EPA 6010B	EPA 3050B
Beryllium	0.39		0.10	mg/Kg	As Recd	1.000	EPA 6010B	EPA 3050B
Chromium	48		0.26	mg/Kg	As Recd	1.000	EPA 6010B	EPA 3050B
Cobalt	11		0.26	mg/Kg	As Recd	1.000	EPA 6010B	EPA 3050B
Copper	20		0.26	mg/Kg	As Recd	1.000	EPA 6010B	EPA 3050B
Lead	5.0		1.0	mg/Kg	As Recd	1.000	EPA 6010B	EPA 3050B
Mercury	0.12		0.017	mg/Kg	As Recd	1.000	EPA 7471A	METHOD
Nickel	59		0.26	mg/Kg	As Recd	1.000	EPA 6010B	EPA 3050B
Vanadium	32		0.26	mg/Kg	As Recd	1.000	EPA 6010B	EPA 3050B
Zinc	44		1.0	mg/Kg	As Recd	1.000	EPA 6010B	EPA 3050B

Client Sample ID : IDW-A3-17-2-LIQUID Laboratory Sample ID : 294938-003

Analyte	Result	Flags	RL	Units	Basis	IDF	Method	Prep Method
Diesel C10-C24	2,300	Y	250	ug/L	As Recd	1.000	EPA 8015B	EPA 3520C
Motor Oil C24-C36	6,100		1,500	ug/L	As Recd	1.000	EPA 8015B	EPA 3520C
Antimony	160		100	ug/L	TOTAL	1.000	EPA 6010B	EPA 3010A
Arsenic	3,100		54	ug/L	TOTAL	1.000	EPA 6010B	EPA 3010A
Barium	61,000		50	ug/L	TOTAL	1.000	EPA 6010B	EPA 3010A
Beryllium	150		20	ug/L	TOTAL	1.000	EPA 6010B	EPA 3010A
Cadmium	85		50	ug/L	TOTAL	1.000	EPA 6010B	EPA 3010A
Chromium	17,000		50	ug/L	TOTAL	1.000	EPA 6010B	EPA 3010A
Cobalt	3,700		50	ug/L	TOTAL	1.000	EPA 6010B	EPA 3010A
Copper	7,100		50	ug/L	TOTAL	1.000	EPA 6010B	EPA 3010A
Lead	2,200		50	ug/L	TOTAL	1.000	EPA 6010B	EPA 3010A
Mercury	4.6		0.20	ug/L	TOTAL	1.000	EPA 7470A	METHOD
Molybdenum	150		50	ug/L	TOTAL	1.000	EPA 6010B	EPA 3010A
Nickel	19,000		50	ug/L	TOTAL	1.000	EPA 6010B	EPA 3010A
Selenium	120		100	ug/L	TOTAL	1.000	EPA 6010B	EPA 3010A
Silver	130		50	ug/L	TOTAL	1.000	EPA 6010B	EPA 3010A
Vanadium	15,000		50	ug/L	TOTAL	1.000	EPA 6010B	EPA 3010A
Zinc	14,000		200	ug/L	TOTAL	1.000	EPA 6010B	EPA 3010A

Client Sample ID : A3-17-2-40 Laboratory Sample ID : 294938-004

No Detections

Y = Sample exhibits chromatographic pattern which does not resemble standard

ENTHALPY ANALYTICAL

Total Volatile Hydrocarbons

Lab #:	294938	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 5030B
Project#:	1101-17A	Analysis:	EPA 8015B
Field ID:	IDW-A3-17-2-SOLID	Batch#:	254345
Matrix:	Soil	Sampled:	11/28/17
Units:	mg/Kg	Received:	11/29/17
Basis:	as received	Analyzed:	12/04/17
Diln Fac:	1.000		

Type: SAMPLE Lab ID: 294938-002

Analyte	Result	RL
Gasoline C7-C12	ND	1.0

Surrogate	%REC	Limits
Bromofluorobenzene (FID)	89	65-136

Type: BLANK Lab ID: QC911440

Analyte	Result	RL
Gasoline C7-C12	ND	1.0

Surrogate	%REC	Limits
Bromofluorobenzene (FID)	82	65-136

ND= Not Detected
RL= Reporting Limit

Batch QC Report

Total Volatile Hydrocarbons

Lab #:	294938	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 5030B
Project#:	1101-17A	Analysis:	EPA 8015B
Type:	LCS	Diln Fac:	1.000
Lab ID:	QC911435	Batch#:	254345
Matrix:	Soil	Analyzed:	12/04/17
Units:	mg/Kg		

Analyte	Spiked	Result	%REC	Limits
Gasoline C7-C12	1.000	0.8714	87	80-121

Surrogate	%REC	Limits
Bromofluorobenzene (FID)	81	65-136

Batch QC Report

Total Volatile Hydrocarbons

Lab #:	294938	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 5030B
Project#:	1101-17A	Analysis:	EPA 8015B
Field ID:	ZZZZZZZZZZ	Diln Fac:	1.000
MSS Lab ID:	295010-001	Batch#:	254345
Matrix:	Soil	Sampled:	12/01/17
Units:	mg/Kg	Received:	12/01/17
Basis:	as received	Analyzed:	12/05/17

Type: MS Lab ID: QC911438

Analyte	MSS Result	Spiked	Result	%REC	Limits
Gasoline C7-C12	0.07254	10.31	6.592	63	52-120

Surrogate	%REC	Limits
Bromofluorobenzene (FID)	94	65-136

Type: MSD Lab ID: QC911439

Analyte	Spiked	Result	%REC	Limits	RPD	Lim
Gasoline C7-C12	9.259	5.541	59	52-120	7	25

Surrogate	%REC	Limits
Bromofluorobenzene (FID)	94	65-136

RPD= Relative Percent Difference

ENTHALPY ANALYTICAL

Total Volatile Hydrocarbons

Lab #:	294938	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 5030B
Project#:	1101-17A	Analysis:	EPA 8015B
Field ID:	IDW-A3-17-2-LIQUID	Batch#:	254345
Units:	mg/Kg	Sampled:	11/29/17
Basis:	as received	Received:	11/29/17
Diln Fac:	1.000	Analyzed:	12/04/17

Type: SAMPLE   Matrix: Miscell.
Lab ID: 294938-003

Analyte	Result	RL
Gasoline C7-C12	ND	0.95

Surrogate	%REC	Limits
Bromofluorobenzene (FID)	94	65-136

Type: BLANK   Matrix: Soil
Lab ID: QC911440

Analyte	Result	RL
Gasoline C7-C12	ND	1.0

Surrogate	%REC	Limits
Bromofluorobenzene (FID)	82	65-136

ND= Not Detected
RL= Reporting Limit

Batch QC Report

Total Volatile Hydrocarbons

Lab #:	294938	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 5030B
Project#:	1101-17A	Analysis:	EPA 8015B
Type:	LCS	Diln Fac:	1.000
Lab ID:	QC911435	Batch#:	254345
Matrix:	Soil	Analyzed:	12/04/17
Units:	mg/Kg		

Analyte	Spiked	Result	%REC	Limits
Gasoline C7-C12	1.000	0.8714	87	80-121

Surrogate	%REC	Limits
Bromofluorobenzene (FID)	81	65-136

ENTHALPY ANALYTICAL

Batch QC Report

Total Volatile Hydrocarbons

Lab #:	294938	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 5030B
Project#:	1101-17A	Analysis:	EPA 8015B
Field ID:	ZZZZZZZZZZ	Diln Fac:	1.000
MSS Lab ID:	295010-001	Batch#:	254345
Matrix:	Soil	Sampled:	12/01/17
Units:	mg/Kg	Received:	12/01/17
Basis:	as received	Analyzed:	12/05/17

Type: MS Lab ID: QC911438

Analyte	MSS Result	Spiked	Result	%REC	Limits
Gasoline C7-C12	0.07254	10.31	6.592	63	52-120

Surrogate	%REC	Limits
Bromofluorobenzene (FID)	94	65-136

Type: MSD Lab ID: QC911439

Analyte	Spiked	Result	%REC	Limits	RPD	Lim
Gasoline C7-C12	9.259	5.541	59	52-120	7	25

Surrogate	%REC	Limits
Bromofluorobenzene (FID)	94	65-136

RPD= Relative Percent Difference

Total Extractable Hydrocarbons

Lab #:	294938	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 3520C
Project#:	1101-17A	Analysis:	EPA 8015B
Matrix:	Water	Sampled:	11/29/17
Units:	ug/L	Received:	11/29/17
Diln Fac:	1.000	Prepared:	12/05/17
Batch#:	254395	Analyzed:	12/06/17

Field ID: IDW-A3-17-1-LIQUID   Lab ID: 294938-001
Type: SAMPLE

Analyte	Result	RL
Diesel C10-C24	3,500 Y	250
Motor Oil C24-C36	11,000	1,500

Surrogate	%REC	Limits
o-Terphenyl	88	51-134

Field ID: IDW-A3-17-2-LIQUID   Lab ID: 294938-003
Type: SAMPLE

Analyte	Result	RL
Diesel C10-C24	2,300 Y	250
Motor Oil C24-C36	6,100	1,500

Surrogate	%REC	Limits
o-Terphenyl	89	51-134

Type: BLANK   Lab ID: QC911638

Analyte	Result	RL
Diesel C10-C24	ND	50
Motor Oil C24-C36	ND	300

Surrogate	%REC	Limits
o-Terphenyl	90	51-134

Y= Sample exhibits chromatographic pattern which does not resemble standard
ND= Not Detected
RL= Reporting Limit

ENTHALPY ANALYTICAL

Batch QC Report

Total Extractable Hydrocarbons			
Lab #:	294938	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 3520C
Project#:	1101-17A	Analysis:	EPA 8015B
Matrix:	Water	Batch#:	254395
Units:	ug/L	Prepared:	12/05/17
Diln Fac:	1.000	Analyzed:	12/06/17

Type: BS　　Lab ID: QC911639

Analyte	Spiked	Result	%REC	Limits
Diesel C10-C24	2,500	2,283	91	50-123

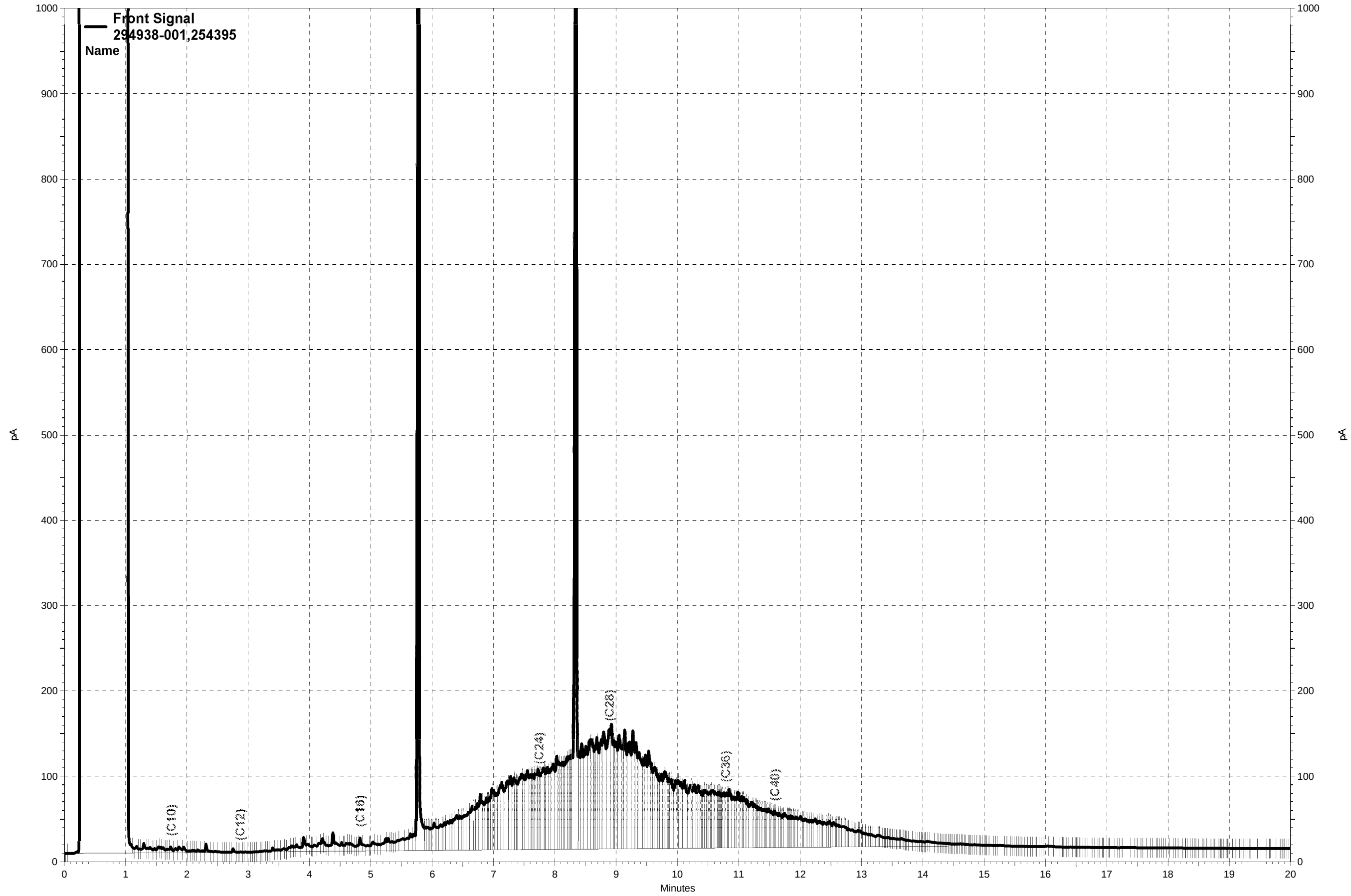
Surrogate	%REC	Limits
o-Terphenyl	93	51-134

Type: BSD　　Lab ID: QC911640

Analyte	Spiked	Result	%REC	Limits	RPD	Lim
Diesel C10-C24	2,500	2,096	84	50-123	9	34

Surrogate	%REC	Limits
o-Terphenyl	86	51-134

RPD= Relative Percent Difference



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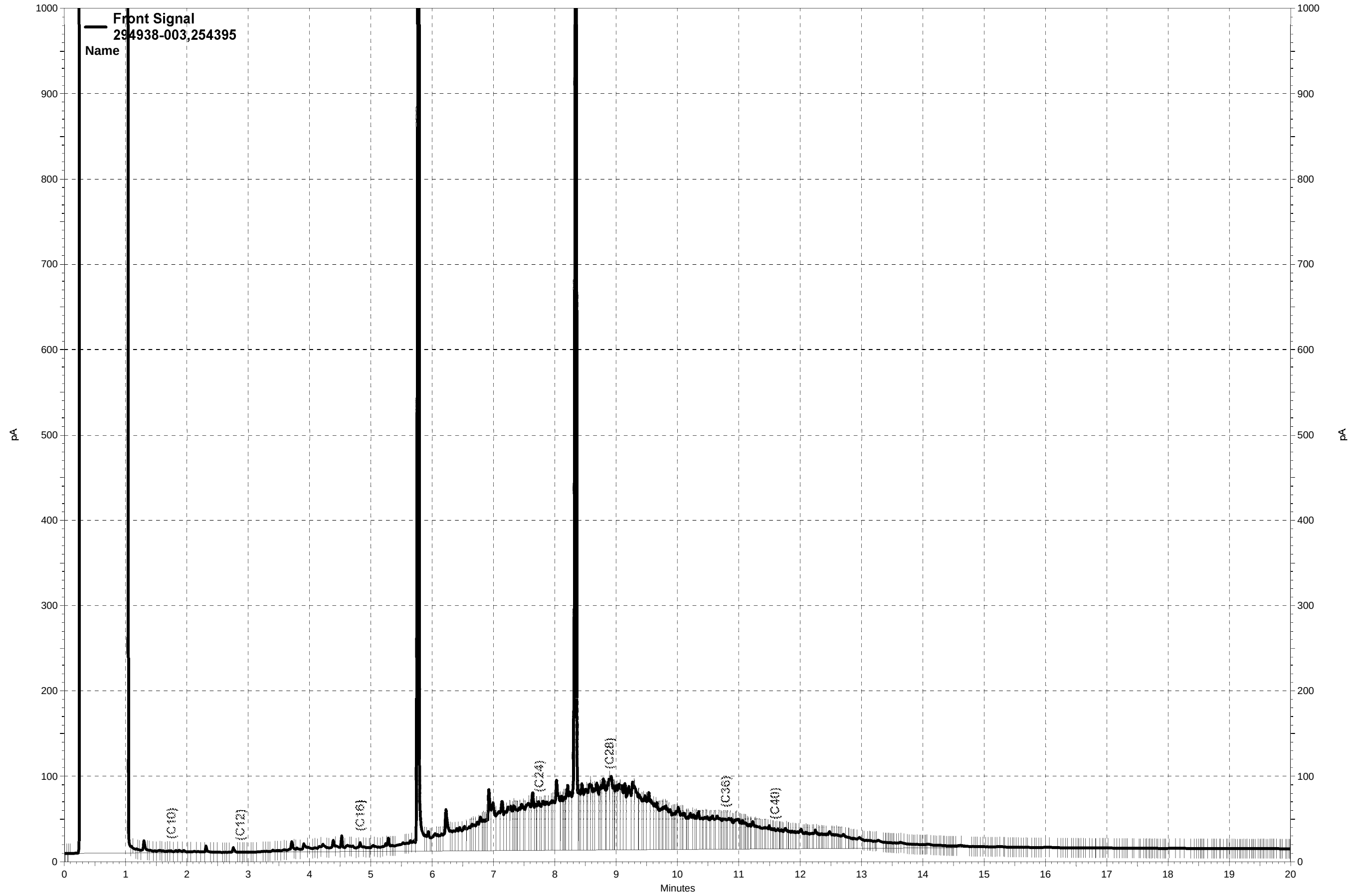

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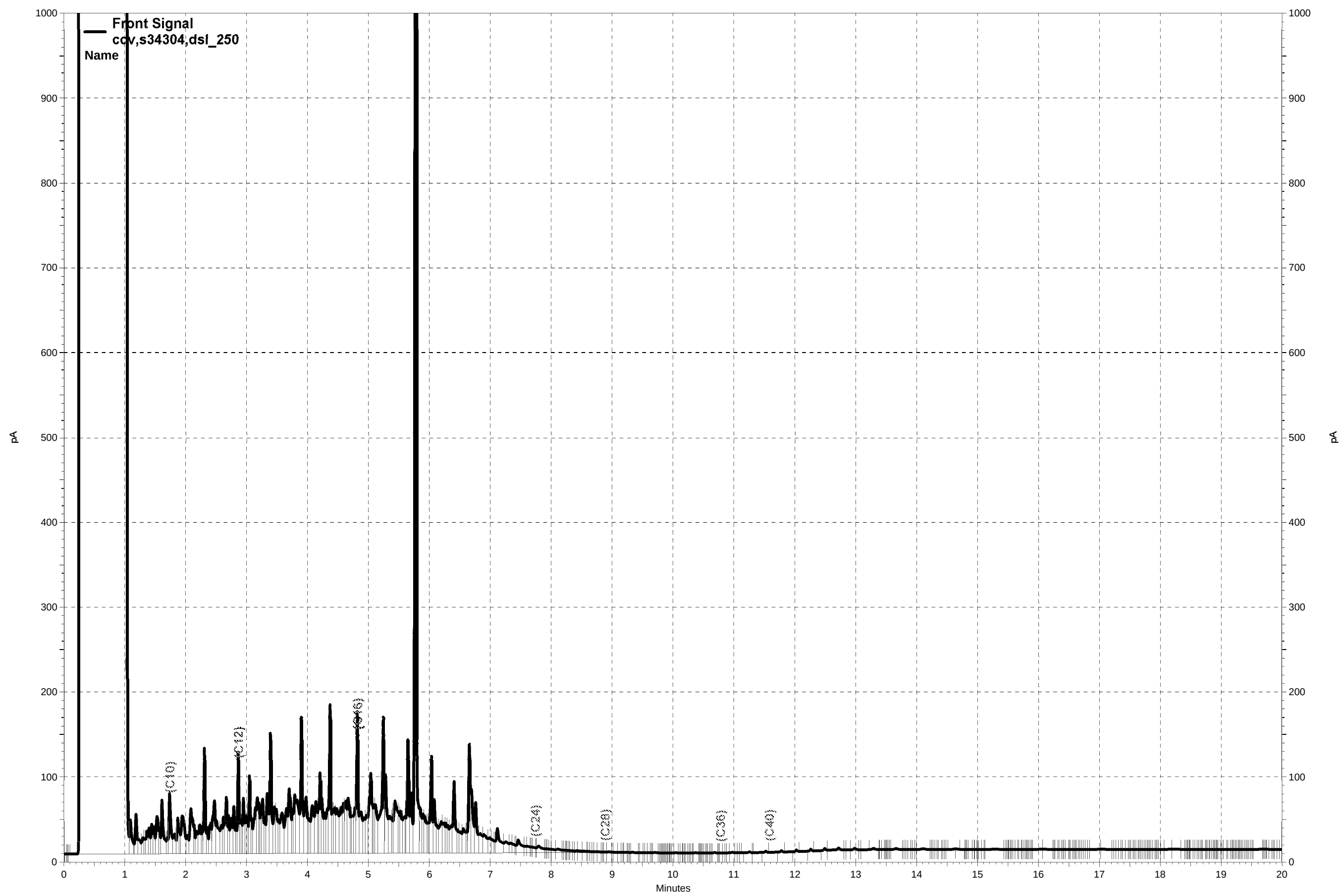

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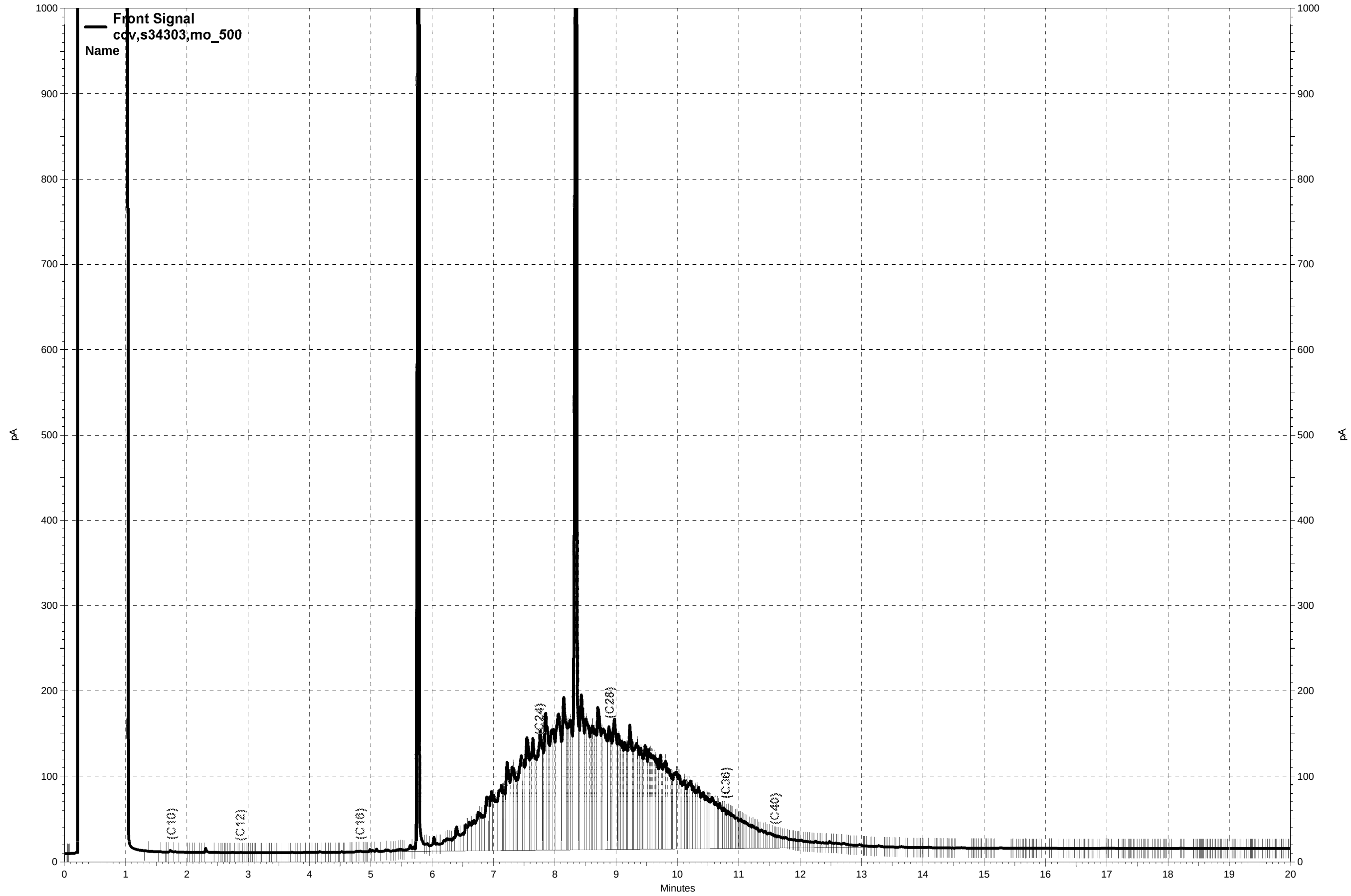

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Total Extractable Hydrocarbons

Lab #:	294938	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 3550C
Project#:	1101-17A	Analysis:	EPA 8015B
Field ID:	IDW-A3-17-2-SOLID	Batch#:	254376
Matrix:	Soil	Sampled:	11/28/17
Units:	mg/Kg	Received:	11/29/17
Basis:	as received	Analyzed:	12/06/17
Diln Fac:	1.000		

Type: SAMPLE　　Prepared: 12/06/17
Lab ID: 294938-002

Analyte	Result	RL
Diesel C10-C24	ND	1.0
Motor Oil C24-C36	ND	5.0

Surrogate	%REC	Limits
o-Terphenyl	101	55-133

Type: BLANK　　Prepared: 12/05/17
Lab ID: QC911595

Analyte	Result	RL
Diesel C10-C24	ND	1.0
Motor Oil C24-C36	ND	5.0

Surrogate	%REC	Limits
o-Terphenyl	93	55-133

ND= Not Detected
RL= Reporting Limit

Batch QC Report

Total Extractable Hydrocarbons

Lab #:	294938	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 3550C
Project#:	1101-17A	Analysis:	EPA 8015B
Type:	LCS	Diln Fac:	1.000
Lab ID:	QC911596	Batch#:	254376
Matrix:	Soil	Prepared:	12/05/17
Units:	mg/Kg	Analyzed:	12/06/17

Analyte	Spiked	Result	%REC	Limits
Diesel C10-C24	49.99	46.95	94	51-137

Surrogate	%REC	Limits
o-Terphenyl	94	55-133

ENTHALPY ANALYTICAL

Batch QC Report

Total Extractable Hydrocarbons

Lab #:	294938	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 3550C
Project#:	1101-17A	Analysis:	EPA 8015B
Field ID:	ZZZZZZZZZZ	Batch#:	254376
MSS Lab ID:	295079-003	Sampled:	12/04/17
Matrix:	Soil	Received:	12/04/17
Units:	mg/Kg	Prepared:	12/05/17
Basis:	as received	Analyzed:	12/06/17
Diln Fac:	2.000		

Type: MS Lab ID: QC911597

Analyte	MSS Result	Spiked	Result	%REC	Limits
Diesel C10-C24	4.070	49.72	53.91	100	36-143

Surrogate	%REC	Limits
o-Terphenyl	94	55-133

Type: MSD Lab ID: QC911598

Analyte	Spiked	Result	%REC	Limits	RPD	Lim
Diesel C10-C24	49.79	51.78	96	36-143	4	55

Surrogate	%REC	Limits
o-Terphenyl	87	55-133

RPD= Relative Percent Difference

Purgeable Organics by GC/MS

Lab #:	294938	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 5035
Project#:	1101-17A	Analysis:	EPA 8260B
Field ID:	A3-17-2-40	Diln Fac:	0.7788
Lab ID:	294938-004	Batch#:	254562
Matrix:	Soil	Sampled:	11/29/17
Units:	ug/Kg	Received:	11/29/17
Basis:	as received	Analyzed:	12/10/17

Analyte	Result	RL
Freon 12	ND	7.8
Chloromethane	ND	7.8
Vinyl Chloride	ND	7.8
Bromomethane	ND	7.8
Chloroethane	ND	7.8
Trichlorofluoromethane	ND	3.9
Acetone	ND	16
Freon 113	ND	3.9
1,1-Dichloroethene	ND	3.9
Methylene Chloride	ND	16
Carbon Disulfide	ND	3.9
MTBE	ND	3.9
trans-1,2-Dichloroethene	ND	3.9
Vinyl Acetate	ND	39
1,1-Dichloroethane	ND	3.9
2-Butanone	ND	7.8
cis-1,2-Dichloroethene	ND	3.9
2,2-Dichloropropane	ND	3.9
Chloroform	ND	3.9
Bromochloromethane	ND	3.9
1,1,1-Trichloroethane	ND	3.9
1,1-Dichloropropene	ND	3.9
Carbon Tetrachloride	ND	3.9
1,2-Dichloroethane	ND	3.9
Benzene	ND	3.9
Trichloroethene	ND	3.9
1,2-Dichloropropane	ND	3.9
Bromodichloromethane	ND	3.9
Dibromomethane	ND	3.9
4-Methyl-2-Pentanone	ND	7.8
cis-1,3-Dichloropropene	ND	3.9
Toluene	ND	3.9
trans-1,3-Dichloropropene	ND	3.9
1,1,2-Trichloroethane	ND	3.9
2-Hexanone	ND	7.8
1,3-Dichloropropane	ND	3.9
Tetrachloroethene	ND	3.9

ND= Not Detected
RL= Reporting Limit

ENTHALPY ANALYTICAL

Purgeable Organics by GC/MS

Lab #:	294938	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 5035
Project#:	1101-17A	Analysis:	EPA 8260B
Field ID:	A3-17-2-40	Diln Fac:	0.7788
Lab ID:	294938-004	Batch#:	254562
Matrix:	Soil	Sampled:	11/29/17
Units:	ug/Kg	Received:	11/29/17
Basis:	as received	Analyzed:	12/10/17

Analyte	Result	RL
Dibromochloromethane	ND	3.9
1,2-Dibromoethane	ND	3.9
Chlorobenzene	ND	3.9
1,1,1,2-Tetrachloroethane	ND	3.9
Ethylbenzene	ND	3.9
m,p-Xylenes	ND	3.9
o-Xylene	ND	3.9
Styrene	ND	3.9
Bromoform	ND	3.9
Isopropylbenzene	ND	3.9
1,1,2,2-Tetrachloroethane	ND	3.9
1,2,3-Trichloropropane	ND	3.9
Propylbenzene	ND	3.9
Bromobenzene	ND	3.9
1,3,5-Trimethylbenzene	ND	3.9
2-Chlorotoluene	ND	3.9
4-Chlorotoluene	ND	3.9
tert-Butylbenzene	ND	3.9
1,2,4-Trimethylbenzene	ND	3.9
sec-Butylbenzene	ND	3.9
para-Isopropyl Toluene	ND	3.9
1,3-Dichlorobenzene	ND	3.9
1,4-Dichlorobenzene	ND	3.9
n-Butylbenzene	ND	3.9
1,2-Dichlorobenzene	ND	3.9
1,2-Dibromo-3-Chloropropane	ND	3.9
1,2,4-Trichlorobenzene	ND	3.9
Hexachlorobutadiene	ND	3.9
Naphthalene	ND	3.9
1,2,3-Trichlorobenzene	ND	3.9

Surrogate	%REC	Limits
Dibromofluoromethane	119	76-132
1,2-Dichloroethane-d4	114	74-149
Toluene-d8	99	80-120
Bromofluorobenzene	108	78-134

ND= Not Detected
RL= Reporting Limit

Batch QC Report

Purgeable Organics by GC/MS

Lab #:	294938	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 5035
Project#:	1101-17A	Analysis:	EPA 8260B
Type:	LCS	Diln Fac:	1.000
Lab ID:	QC912331	Batch#:	254562
Matrix:	Soil	Analyzed:	12/10/17
Units:	ug/Kg		

Analyte	Spiked	Result	%REC	Limits
1,1-Dichloroethene	25.00	28.72	115	68-132
Benzene	25.00	27.77	111	75-123
Trichloroethene	25.00	26.49	106	75-120
Toluene	25.00	26.43	106	76-120
Chlorobenzene	25.00	27.97	112	80-120

Surrogate	%REC	Limits
Dibromofluoromethane	105	76-132
1,2-Dichloroethane-d4	97	74-149
Toluene-d8	97	80-120
Bromofluorobenzene	97	78-134

Batch QC Report

Purgeable Organics by GC/MS

Lab #:	294938	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 5035
Project#:	1101-17A	Analysis:	EPA 8260B
Type:	BLANK	Diln Fac:	1.000
Lab ID:	QC912332	Batch#:	254562
Matrix:	Soil	Analyzed:	12/10/17
Units:	ug/Kg		

Analyte	Result	RL
Freon 12	ND	10
Chloromethane	ND	10
Vinyl Chloride	ND	10
Bromomethane	ND	10
Chloroethane	ND	10
Trichlorofluoromethane	ND	5.0
Acetone	ND	20
Freon 113	ND	5.0
1,1-Dichloroethene	ND	5.0
Methylene Chloride	ND	20
Carbon Disulfide	ND	5.0
MTBE	ND	5.0
trans-1,2-Dichloroethene	ND	5.0
Vinyl Acetate	ND	50
1,1-Dichloroethane	ND	5.0
2-Butanone	ND	10
cis-1,2-Dichloroethene	ND	5.0
2,2-Dichloropropane	ND	5.0
Chloroform	ND	5.0
Bromochloromethane	ND	5.0
1,1,1-Trichloroethane	ND	5.0
1,1-Dichloropropene	ND	5.0
Carbon Tetrachloride	ND	5.0
1,2-Dichloroethane	ND	5.0
Benzene	ND	5.0
Trichloroethene	ND	5.0
1,2-Dichloropropane	ND	5.0
Bromodichloromethane	ND	5.0
Dibromomethane	ND	5.0
4-Methyl-2-Pentanone	ND	10
cis-1,3-Dichloropropene	ND	5.0
Toluene	ND	5.0
trans-1,3-Dichloropropene	ND	5.0
1,1,2-Trichloroethane	ND	5.0
2-Hexanone	ND	10
1,3-Dichloropropane	ND	5.0
Tetrachloroethene	ND	5.0

ND= Not Detected
RL= Reporting Limit

ENTHALPY ANALYTICAL

Batch QC Report

Purgeable Organics by GC/MS

Lab #:	294938	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 5035
Project#:	1101-17A	Analysis:	EPA 8260B
Type:	BLANK	Diln Fac:	1.000
Lab ID:	QC912332	Batch#:	254562
Matrix:	Soil	Analyzed:	12/10/17
Units:	ug/Kg		

Analyte	Result	RL
Dibromochloromethane	ND	5.0
1,2-Dibromoethane	ND	5.0
Chlorobenzene	ND	5.0
1,1,1,2-Tetrachloroethane	ND	5.0
Ethylbenzene	ND	5.0
m,p-Xylenes	ND	5.0
o-Xylene	ND	5.0
Styrene	ND	5.0
Bromoform	ND	5.0
Isopropylbenzene	ND	5.0
1,1,2,2-Tetrachloroethane	ND	5.0
1,2,3-Trichloropropane	ND	5.0
Propylbenzene	ND	5.0
Bromobenzene	ND	5.0
1,3,5-Trimethylbenzene	ND	5.0
2-Chlorotoluene	ND	5.0
4-Chlorotoluene	ND	5.0
tert-Butylbenzene	ND	5.0
1,2,4-Trimethylbenzene	ND	5.0
sec-Butylbenzene	ND	5.0
para-Isopropyl Toluene	ND	5.0
1,3-Dichlorobenzene	ND	5.0
1,4-Dichlorobenzene	ND	5.0
n-Butylbenzene	ND	5.0
1,2-Dichlorobenzene	ND	5.0
1,2-Dibromo-3-Chloropropane	ND	5.0
1,2,4-Trichlorobenzene	ND	5.0
Hexachlorobutadiene	ND	5.0
Naphthalene	ND	5.0
1,2,3-Trichlorobenzene	ND	5.0

Surrogate	%REC	Limits
Dibromofluoromethane	106	76-132
1,2-Dichloroethane-d4	96	74-149
Toluene-d8	100	80-120
Bromofluorobenzene	107	78-134

ND= Not Detected
RL= Reporting Limit

Batch QC Report

Purgeable Organics by GC/MS

Lab #:	294938	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 5030B
Project#:	1101-17A	Analysis:	EPA 8260B
Field ID:	ZZZZZZZZZZ	Batch#:	254562
MSS Lab ID:	295205-009	Sampled:	12/07/17
Matrix:	Soil	Received:	12/07/17
Units:	ug/Kg	Analyzed:	12/10/17
Basis:	as received		

Type: MS   Diln Fac: 0.8532
Lab ID: QC912354

Analyte	MSS Result	Spiked	Result	%REC	Limits
1,1-Dichloroethene	<0.5525	42.66	52.71	124	64-131
Benzene	<0.4930	42.66	46.80	110	66-122
Trichloroethene	<0.5958	42.66	45.43	106	57-133
Toluene	<0.5299	42.66	41.68	98	61-120
Chlorobenzene	<0.3324	42.66	40.91	96	56-120

Surrogate	%REC	Limits
Dibromofluoromethane	116	76-132
1,2-Dichloroethane-d4	115	74-149
Toluene-d8	96	80-120
Bromofluorobenzene	99	78-134

Type: MSD   Diln Fac: 0.9690
Lab ID: QC912355

Analyte	Spiked	Result	%REC	Limits	RPD	Lim
1,1-Dichloroethene	48.45	72.43	149 *	64-131	19	32
Benzene	48.45	63.28	131 *	66-122	17	32
Trichloroethene	48.45	63.54	131	57-133	21	34
Toluene	48.45	58.37	120	61-120	21	32
Chlorobenzene	48.45	56.73	117	56-120	20	33

Surrogate	%REC	Limits
Dibromofluoromethane	108	76-132
1,2-Dichloroethane-d4	104	74-149
Toluene-d8	97	80-120
Bromofluorobenzene	98	78-134

*= Value outside of QC limits; see narrative
RPD= Relative Percent Difference

ENTHALPY ANALYTICAL

Purgeable Organics by GC/MS

Lab #:	294938	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 5030B
Project#:	1101-17A	Analysis:	EPA 8260B
Field ID:	IDW-A3-17-2-LIQUID	Diln Fac:	0.9294
Lab ID:	294938-003	Batch#:	254488
Matrix:	Miscell.	Sampled:	11/29/17
Units:	ug/Kg	Received:	11/29/17
Basis:	as received	Analyzed:	12/07/17

Analyte	Result	RL
Freon 12	ND	9.3
Chloromethane	ND	9.3
Vinyl Chloride	ND	9.3
Bromomethane	ND	9.3
Chloroethane	ND	9.3
Trichlorofluoromethane	ND	4.6
Acetone	ND	19
Freon 113	ND	4.6
1,1-Dichloroethene	ND	4.6
Methylene Chloride	ND	19
Carbon Disulfide	ND	4.6
MTBE	ND	4.6
trans-1,2-Dichloroethene	ND	4.6
Vinyl Acetate	ND	46
1,1-Dichloroethane	ND	4.6
2-Butanone	ND	9.3
cis-1,2-Dichloroethene	ND	4.6
2,2-Dichloropropane	ND	4.6
Chloroform	ND	4.6
Bromochloromethane	ND	4.6
1,1,1-Trichloroethane	ND	4.6
1,1-Dichloropropene	ND	4.6
Carbon Tetrachloride	ND	4.6
1,2-Dichloroethane	ND	4.6
Benzene	ND	4.6
Trichloroethene	ND	4.6
1,2-Dichloropropane	ND	4.6
Bromodichloromethane	ND	4.6
Dibromomethane	ND	4.6
4-Methyl-2-Pentanone	ND	9.3
cis-1,3-Dichloropropene	ND	4.6
Toluene	ND	4.6
trans-1,3-Dichloropropene	ND	4.6
1,1,2-Trichloroethane	ND	4.6
2-Hexanone	ND	9.3
1,3-Dichloropropane	ND	4.6
Tetrachloroethene	ND	4.6

ND= Not Detected
RL= Reporting Limit

ENTHALPY ANALYTICAL

Purgeable Organics by GC/MS

Lab #:	294938	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 5030B
Project#:	1101-17A	Analysis:	EPA 8260B
Field ID:	IDW-A3-17-2-LIQUID	Diln Fac:	0.9294
Lab ID:	294938-003	Batch#:	254488
Matrix:	Miscell.	Sampled:	11/29/17
Units:	ug/Kg	Received:	11/29/17
Basis:	as received	Analyzed:	12/07/17

Analyte	Result	RL
Dibromochloromethane	ND	4.6
1,2-Dibromoethane	ND	4.6
Chlorobenzene	ND	4.6
1,1,1,2-Tetrachloroethane	ND	4.6
Ethylbenzene	ND	4.6
m,p-Xylenes	ND	4.6
o-Xylene	ND	4.6
Styrene	ND	4.6
Bromoform	ND	4.6
Isopropylbenzene	ND	4.6
1,1,2,2-Tetrachloroethane	ND	4.6
1,2,3-Trichloropropane	ND	4.6
Propylbenzene	ND	4.6
Bromobenzene	ND	4.6
1,3,5-Trimethylbenzene	ND	4.6
2-Chlorotoluene	ND	4.6
4-Chlorotoluene	ND	4.6
tert-Butylbenzene	ND	4.6
1,2,4-Trimethylbenzene	ND	4.6
sec-Butylbenzene	ND	4.6
para-Isopropyl Toluene	ND	4.6
1,3-Dichlorobenzene	ND	4.6
1,4-Dichlorobenzene	ND	4.6
n-Butylbenzene	ND	4.6
1,2-Dichlorobenzene	ND	4.6
1,2-Dibromo-3-Chloropropane	ND	4.6
1,2,4-Trichlorobenzene	ND	4.6
Hexachlorobutadiene	ND	4.6
Naphthalene	ND	4.6
1,2,3-Trichlorobenzene	ND	4.6

Surrogate	%REC	Limits
Dibromofluoromethane	104	76-132
1,2-Dichloroethane-d4	125	74-149
Toluene-d8	101	80-120
Bromofluorobenzene	120	78-134

ND= Not Detected
RL= Reporting Limit

Batch QC Report

Purgeable Organics by GC/MS

Lab #:	294938	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 5030B
Project#:	1101-17A	Analysis:	EPA 8260B
Matrix:	Soil	Batch#:	254488
Units:	ug/Kg	Analyzed:	12/07/17
Diln Fac:	1.000		

Type: BS Lab ID: QC912055

Analyte	Spiked	Result	%REC	Limits
1,1-Dichloroethene	25.00	22.06	88	68-132
Benzene	25.00	23.88	96	75-123
Trichloroethene	25.00	24.96	100	75-120
Toluene	25.00	24.91	100	76-120
Chlorobenzene	25.00	25.47	102	80-120

Surrogate	%REC	Limits
Dibromofluoromethane	100	76-132
1,2-Dichloroethane-d4	120	74-149
Toluene-d8	100	80-120
Bromofluorobenzene	101	78-134

Type: BSD Lab ID: QC912056

Analyte	Spiked	Result	%REC	Limits	RPD	Lim
1,1-Dichloroethene	25.00	22.68	91	68-132	3	28
Benzene	25.00	24.39	98	75-123	2	25
Trichloroethene	25.00	25.46	102	75-120	2	23
Toluene	25.00	25.74	103	76-120	3	24
Chlorobenzene	25.00	26.29	105	80-120	3	21

Surrogate	%REC	Limits
Dibromofluoromethane	99	76-132
1,2-Dichloroethane-d4	118	74-149
Toluene-d8	102	80-120
Bromofluorobenzene	97	78-134

RPD= Relative Percent Difference

ENTHALPY ANALYTICAL

Batch QC Report

Purgeable Organics by GC/MS

Lab #:	294938	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 5030B
Project#:	1101-17A	Analysis:	EPA 8260B
Type:	BLANK	Diln Fac:	1.000
Lab ID:	QC912057	Batch#:	254488
Matrix:	Soil	Analyzed:	12/07/17
Units:	ug/Kg		

Analyte	Result	RL
Freon 12	ND	10
Chloromethane	ND	10
Vinyl Chloride	ND	10
Bromomethane	ND	10
Chloroethane	ND	10
Trichlorofluoromethane	ND	5.0
Acetone	ND	20
Freon 113	ND	5.0
1,1-Dichloroethene	ND	5.0
Methylene Chloride	ND	20
Carbon Disulfide	ND	5.0
MTBE	ND	5.0
trans-1,2-Dichloroethene	ND	5.0
Vinyl Acetate	ND	50
1,1-Dichloroethane	ND	5.0
2-Butanone	ND	10
cis-1,2-Dichloroethene	ND	5.0
2,2-Dichloropropane	ND	5.0
Chloroform	ND	5.0
Bromochloromethane	ND	5.0
1,1,1-Trichloroethane	ND	5.0
1,1-Dichloropropene	ND	5.0
Carbon Tetrachloride	ND	5.0
1,2-Dichloroethane	ND	5.0
Benzene	ND	5.0
Trichloroethene	ND	5.0
1,2-Dichloropropane	ND	5.0
Bromodichloromethane	ND	5.0
Dibromomethane	ND	5.0
4-Methyl-2-Pentanone	ND	10
cis-1,3-Dichloropropene	ND	5.0
Toluene	ND	5.0
trans-1,3-Dichloropropene	ND	5.0
1,1,2-Trichloroethane	ND	5.0
2-Hexanone	ND	10
1,3-Dichloropropane	ND	5.0
Tetrachloroethene	ND	5.0

ND= Not Detected
RL= Reporting Limit

Batch QC Report

Purgeable Organics by GC/MS

Lab #:	294938	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 5030B
Project#:	1101-17A	Analysis:	EPA 8260B
Type:	BLANK	Diln Fac:	1.000
Lab ID:	QC912057	Batch#:	254488
Matrix:	Soil	Analyzed:	12/07/17
Units:	ug/Kg		

Analyte	Result	RL
Dibromochloromethane	ND	5.0
1,2-Dibromoethane	ND	5.0
Chlorobenzene	ND	5.0
1,1,1,2-Tetrachloroethane	ND	5.0
Ethylbenzene	ND	5.0
m,p-Xylenes	ND	5.0
o-Xylene	ND	5.0
Styrene	ND	5.0
Bromoform	ND	5.0
Isopropylbenzene	ND	5.0
1,1,2,2-Tetrachloroethane	ND	5.0
1,2,3-Trichloropropane	ND	5.0
Propylbenzene	ND	5.0
Bromobenzene	ND	5.0
1,3,5-Trimethylbenzene	ND	5.0
2-Chlorotoluene	ND	5.0
4-Chlorotoluene	ND	5.0
tert-Butylbenzene	ND	5.0
1,2,4-Trimethylbenzene	ND	5.0
sec-Butylbenzene	ND	5.0
para-Isopropyl Toluene	ND	5.0
1,3-Dichlorobenzene	ND	5.0
1,4-Dichlorobenzene	ND	5.0
n-Butylbenzene	ND	5.0
1,2-Dichlorobenzene	ND	5.0
1,2-Dibromo-3-Chloropropane	ND	5.0
1,2,4-Trichlorobenzene	ND	5.0
Hexachlorobutadiene	ND	5.0
Naphthalene	ND	5.0
1,2,3-Trichlorobenzene	ND	5.0

Surrogate	%REC	Limits
Dibromofluoromethane	104	76-132
1,2-Dichloroethane-d4	119	74-149
Toluene-d8	105	80-120
Bromofluorobenzene	129	78-134

ND= Not Detected
RL= Reporting Limit

ENTHALPY ANALYTICAL

Semivolatile Organics by GC/MS SIM

Lab #:	294938	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 3520C
Project#:	1101-17A	Analysis:	EPA 8270C-SIM
Field ID:	IDW-A3-17-2-LIQUID	Batch#:	254344
Lab ID:	294938-003	Sampled:	11/29/17
Matrix:	Water	Received:	11/29/17
Units:	ug/L	Prepared:	12/04/17
Diln Fac:	3.000	Analyzed:	12/05/17

Analyte	Result	RL
Naphthalene	ND	3.0
Acenaphthylene	ND	3.0
Acenaphthene	ND	3.0
Fluorene	ND	3.0
Phenanthrene	ND	3.0
Anthracene	ND	3.0
Fluoranthene	ND	3.0
Pyrene	ND	3.0
Benzo(a)anthracene	ND	3.0
Chrysene	ND	3.0
Benzo(b)fluoranthene	ND	3.0
Benzo(k)fluoranthene	ND	3.0
Benzo(a)pyrene	ND	3.0
Indeno(1,2,3-cd)pyrene	ND	3.0
Dibenz(a,h)anthracene	ND	3.0
Benzo(g,h,i)perylene	ND	3.0

Surrogate	%REC	Limits
Nitrobenzene-d5	69	44-139
2-Fluorobiphenyl	76	47-120
Terphenyl-d14	26	25-123

ND= Not Detected
RL= Reporting Limit

25.0

Batch QC Report

Semivolatile Organics by GC/MS SIM

Lab #:	294938	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 3520C
Project#:	1101-17A	Analysis:	EPA 8270C-SIM
Type:	BLANK	Diln Fac:	1.000
Lab ID:	QC911432	Batch#:	254344
Matrix:	Water	Prepared:	12/04/17
Units:	ug/L	Analyzed:	12/05/17

Analyte	Result	RL
Naphthalene	ND	0.1
Acenaphthylene	ND	0.1
Acenaphthene	ND	0.1
Fluorene	ND	0.1
Phenanthrene	ND	0.1
Anthracene	ND	0.1
Fluoranthene	ND	0.1
Pyrene	ND	0.1
Benzo(a)anthracene	ND	0.1
Chrysene	ND	0.1
Benzo(b)fluoranthene	ND	0.1
Benzo(k)fluoranthene	ND	0.1
Benzo(a)pyrene	ND	0.1
Indeno(1,2,3-cd)pyrene	ND	0.1
Dibenz(a,h)anthracene	ND	0.1
Benzo(g,h,i)perylene	ND	0.1

Surrogate	%REC	Limits
Nitrobenzene-d5	84	44-139
2-Fluorobiphenyl	80	47-120
Terphenyl-d14	77	25-123

ND= Not Detected
RL= Reporting Limit

ENTHALPY ANALYTICAL

Batch QC Report

Semivolatile Organics by GC/MS SIM

Lab #:	294938	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 3520C
Project#:	1101-17A	Analysis:	EPA 8270C-SIM
Matrix:	Water	Batch#:	254344
Units:	ug/L	Prepared:	12/04/17
Diln Fac:	1.000	Analyzed:	12/05/17

Type: BS Lab ID: QC911433

Analyte	Spiked	Result	%REC	Limits
Acenaphthene	1.000	0.8212	82	54-120
Pyrene	1.000	0.7632	76	50-120

Surrogate	%REC	Limits
Nitrobenzene-d5	92	44-139
2-Fluorobiphenyl	87	47-120
Terphenyl-d14	79	25-123

Type: BSD Lab ID: QC911434

Analyte	Spiked	Result	%REC	Limits	RPD	Lim
Acenaphthene	1.000	0.7304	73	54-120	12	36
Pyrene	1.000	0.6605	66	50-120	14	37

Surrogate	%REC	Limits
Nitrobenzene-d5	81	44-139
2-Fluorobiphenyl	75	47-120
Terphenyl-d14	68	25-123

RPD= Relative Percent Difference

Semivolatile Organics by GC/MS SIM

Lab #:	294938	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 3550C
Project#:	1101-17A	Analysis:	EPA 8270C-SIM
Field ID:	IDW-A3-17-2-SOLID	Batch#:	254323
Lab ID:	294938-002	Sampled:	11/28/17
Matrix:	Soil	Received:	11/29/17
Units:	ug/Kg	Prepared:	12/04/17
Basis:	as received	Analyzed:	12/04/17
Diln Fac:	1.000		

Analyte	Result	RL
Naphthalene	ND	5.1
Acenaphthylene	ND	5.1
Acenaphthene	ND	5.1
Fluorene	ND	5.1
Phenanthrene	ND	5.1
Anthracene	ND	5.1
Fluoranthene	ND	5.1
Pyrene	ND	5.1
Benzo(a)anthracene	ND	5.1
Chrysene	ND	5.1
Benzo(b)fluoranthene	ND	5.1
Benzo(k)fluoranthene	ND	5.1
Benzo(a)pyrene	ND	5.1
Indeno(1,2,3-cd)pyrene	ND	5.1
Dibenz(a,h)anthracene	ND	5.1
Benzo(g,h,i)perylene	ND	5.1

Surrogate	%REC	Limits
Nitrobenzene-d5	100	46-126
2-Fluorobiphenyl	87	50-120
Terphenyl-d14	89	53-123

ND= Not Detected
RL= Reporting Limit

Batch QC Report

Semivolatile Organics by GC/MS SIM

Lab #:	294938	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 3550C
Project#:	1101-17A	Analysis:	EPA 8270C-SIM
Type:	BLANK	Diln Fac:	1.000
Lab ID:	QC911339	Batch#:	254323
Matrix:	Soil	Prepared:	12/04/17
Units:	ug/Kg	Analyzed:	12/04/17

Analyte	Result	RL
Naphthalene	ND	5.0
Acenaphthylene	ND	5.0
Acenaphthene	ND	5.0
Fluorene	ND	5.0
Phenanthrene	ND	5.0
Anthracene	ND	5.0
Fluoranthene	ND	5.0
Pyrene	ND	5.0
Benzo(a)anthracene	ND	5.0
Chrysene	ND	5.0
Benzo(b)fluoranthene	ND	5.0
Benzo(k)fluoranthene	ND	5.0
Benzo(a)pyrene	ND	5.0
Indeno(1,2,3-cd)pyrene	ND	5.0
Dibenz(a,h)anthracene	ND	5.0
Benzo(g,h,i)perylene	ND	5.0

Surrogate	%REC	Limits
Nitrobenzene-d5	97	46-126
2-Fluorobiphenyl	89	50-120
Terphenyl-d14	88	53-123

ND= Not Detected
RL= Reporting Limit

Batch QC Report

Semivolatile Organics by GC/MS SIM

Lab #:	294938	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 3550C
Project#:	1101-17A	Analysis:	EPA 8270C-SIM
Type:	LCS	Diln Fac:	1.000
Lab ID:	QC911340	Batch#:	254323
Matrix:	Soil	Prepared:	12/04/17
Units:	ug/Kg	Analyzed:	12/04/17

Analyte	Spiked	Result	%REC	Limits
Acenaphthene	33.52	30.36	91	62-120
Pyrene	33.52	28.80	86	56-130

Surrogate	%REC	Limits
Nitrobenzene-d5	101	46-126
2-Fluorobiphenyl	94	50-120
Terphenyl-d14	90	53-123

ENTHALPY ANALYTICAL

Batch QC Report

Semivolatile Organics by GC/MS SIM

Lab #:	294938	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 3550C
Project#:	1101-17A	Analysis:	EPA 8270C-SIM
Field ID:	ZZZZZZZZZZ	Batch#:	254323
MSS Lab ID:	294936-001	Sampled:	11/28/17
Matrix:	Soil	Received:	11/30/17
Units:	ug/Kg	Prepared:	12/04/17
Basis:	as received	Analyzed:	12/04/17
Diln Fac:	1.000		

Type: MS   Lab ID: QC911341

Analyte	MSS Result	Spiked	Result	%REC	Limits
Acenaphthene	<1.010	33.70	29.47	87	54-120
Pyrene	<1.010	33.70	28.63	85	35-143

Surrogate	%REC	Limits
Nitrobenzene-d5	103	46-126
2-Fluorobiphenyl	90	50-120
Terphenyl-d14	86	53-123

Type: MSD   Lab ID: QC911342

Analyte	Spiked	Result	%REC	Limits	RPD	Lim
Acenaphthene	33.42	30.01	90	54-120	3	35
Pyrene	33.42	29.15	87	35-143	3	58

Surrogate	%REC	Limits
Nitrobenzene-d5	99	46-126
2-Fluorobiphenyl	87	50-120
Terphenyl-d14	89	53-123

RPD= Relative Percent Difference

ENTHALPY ANALYTICAL

Polychlorinated Biphenyls (PCBs)

Lab #:	294938	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 3520C
Project#:	1101-17A	Analysis:	EPA 8082
Field ID:	IDW-A3-17-2-LIQUID	Batch#:	254212
Matrix:	Water	Sampled:	11/29/17
Units:	ug/L	Received:	11/29/17
Diln Fac:	1.000	Prepared:	11/30/17

Type: SAMPLE   Analyzed: 12/02/17
Lab ID: 294938-003

Analyte	Result	RL
Aroclor-1016	ND	1.2
Aroclor-1221	ND	2.8
Aroclor-1232	ND	1.2
Aroclor-1242	ND	1.2
Aroclor-1248	ND	1.6
Aroclor-1254	ND	1.2
Aroclor-1260	ND	1.2
Aroclor-1268	ND	1.0

Surrogate	%REC	Limits
Decachlorobiphenyl	56	22-139

Type: BLANK   Analyzed: 12/01/17
Lab ID: QC910921

Analyte	Result	RL
Aroclor-1016	ND	0.20
Aroclor-1221	ND	0.40
Aroclor-1232	ND	0.20
Aroclor-1242	ND	0.20
Aroclor-1248	ND	0.20
Aroclor-1254	ND	0.20
Aroclor-1260	ND	0.20
Aroclor-1268	ND	0.20

Surrogate	%REC	Limits
Decachlorobiphenyl	119	22-139

ND= Not Detected
RL= Reporting Limit

Batch QC Report

Polychlorinated Biphenyls (PCBs)

Lab #:	294938	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 3520C
Project#:	1101-17A	Analysis:	EPA 8082
Matrix:	Water	Batch#:	254212
Units:	ug/L	Prepared:	11/30/17
Diln Fac:	1.000	Analyzed:	12/01/17

Type: BS   Lab ID: QC910922

Analyte	Spiked	Result	%REC	Limits
Aroclor-1016	2.500	1.966	79	59-134
Aroclor-1260	2.500	2.041	82	54-144

Surrogate	%REC	Limits
Decachlorobiphenyl	92	22-139

Type: BSD   Lab ID: QC910923

Analyte	Spiked	Result	%REC	Limits	RPD	Lim
Aroclor-1016	2.500	2.579	103	59-134	27	33
Aroclor-1260	2.500	2.614	105	54-144	25	44

Surrogate	%REC	Limits
Decachlorobiphenyl	96	22-139

RPD= Relative Percent Difference

ENTHALPY ANALYTICAL

Polychlorinated Biphenyls (PCBs)

Lab #:	294938	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 3540C
Project#:	1101-17A	Analysis:	EPA 8082
Field ID:	IDW-A3-17-2-SOLID	Batch#:	254593
Units:	ug/Kg	Sampled:	11/28/17
Basis:	as received	Received:	11/29/17
Diln Fac:	1.000	Prepared:	12/11/17

Type:	SAMPLE	Matrix:	Soil
Lab ID:	294938-002	Analyzed:	12/13/17

Analyte	Result	RL
Aroclor-1016	ND	110
Aroclor-1221	ND	220
Aroclor-1232	ND	110
Aroclor-1242	ND	110
Aroclor-1248	ND	110
Aroclor-1254	ND	110
Aroclor-1260	ND	110

Surrogate	%REC	Limits
Decachlorobiphenyl	89	26-153

Type:	BLANK	Matrix:	Miscell.
Lab ID:	QC912438	Analyzed:	12/12/17

Analyte	Result	RL
Aroclor-1016	ND	9.6
Aroclor-1221	ND	19
Aroclor-1232	ND	9.6
Aroclor-1242	ND	9.6
Aroclor-1248	ND	9.6
Aroclor-1254	ND	9.6
Aroclor-1260	ND	9.6

Surrogate	%REC	Limits
Decachlorobiphenyl	113	26-153

ND= Not Detected
RL= Reporting Limit

Batch QC Report

Polychlorinated Biphenyls (PCBs)

Lab #:	294938	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 3540C
Project#:	1101-17A	Analysis:	EPA 8082
Matrix:	Miscell.	Batch#:	254593
Units:	ug/Kg	Prepared:	12/11/17
Diln Fac:	1.000	Analyzed:	12/12/17

Type: BS   Lab ID: QC912439

Analyte	Spiked	Result	%REC	Limits
Aroclor-1016	166.7	203.4	122	56-152
Aroclor-1260	166.7	199.5	120	52-165

Surrogate	%REC	Limits
Decachlorobiphenyl	116	26-153

Type: BSD   Lab ID: QC912440

Analyte	Spiked	Result	%REC	Limits	RPD	Lim
Aroclor-1016	166.7	178.2	107	56-152	13	48
Aroclor-1260	166.7	182.4	109	52-165	9	39

Surrogate	%REC	Limits
Decachlorobiphenyl	107	26-153

RPD= Relative Percent Difference

ENTHALPY ANALYTICAL

California Title 22 Metals

Lab #:	294938	Project#:	1101-17A
Client:	A3GEO Inc.	Location:	NRLF Phase 4
Field ID:	IDW-A3-17-2-LIQUID	Diln Fac:	1.000
Lab ID:	294938-003	Sampled:	11/29/17
Matrix:	Water	Received:	11/29/17
Units:	ug/L		

Analyte	Result	RL	Batch#	Prepared	Analyzed	Prep	Analysis
Antimony	160	100	254321	12/04/17	12/05/17	EPA 3010A	EPA 6010B
Arsenic	3,100	54	254321	12/04/17	12/05/17	EPA 3010A	EPA 6010B
Barium	61,000	50	254321	12/04/17	12/05/17	EPA 3010A	EPA 6010B
Beryllium	150	20	254321	12/04/17	12/05/17	EPA 3010A	EPA 6010B
Cadmium	85	50	254321	12/04/17	12/05/17	EPA 3010A	EPA 6010B
Chromium	17,000	50	254321	12/04/17	12/05/17	EPA 3010A	EPA 6010B
Cobalt	3,700	50	254321	12/04/17	12/05/17	EPA 3010A	EPA 6010B
Copper	7,100	50	254321	12/04/17	12/05/17	EPA 3010A	EPA 6010B
Lead	2,200	50	254321	12/04/17	12/05/17	EPA 3010A	EPA 6010B
Mercury	4.6	0.20	254444	12/06/17	12/06/17	METHOD	EPA 7470A
Molybdenum	150	50	254321	12/04/17	12/05/17	EPA 3010A	EPA 6010B
Nickel	19,000	50	254321	12/04/17	12/05/17	EPA 3010A	EPA 6010B
Selenium	120	100	254321	12/04/17	12/05/17	EPA 3010A	EPA 6010B
Silver	130	50	254321	12/04/17	12/05/17	EPA 3010A	EPA 6010B
Thallium	ND	100	254321	12/04/17	12/05/17	EPA 3010A	EPA 6010B
Vanadium	15,000	50	254321	12/04/17	12/05/17	EPA 3010A	EPA 6010B
Zinc	14,000	200	254321	12/04/17	12/05/17	EPA 3010A	EPA 6010B

ND= Not Detected
RL= Reporting Limit

Batch QC Report

California Title 22 Metals

Lab #:	294938	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 3010A
Project#:	1101-17A	Analysis:	EPA 6010B
Type:	BLANK	Diln Fac:	1.000
Lab ID:	QC911328	Batch#:	254321
Matrix:	Water	Prepared:	12/04/17
Units:	ug/L	Analyzed:	12/05/17

Analyte	Result	RL
Antimony	ND	10
Arsenic	ND	10
Barium	ND	5.0
Beryllium	ND	2.0
Cadmium	ND	5.0
Chromium	ND	5.0
Cobalt	ND	5.0
Copper	ND	5.0
Lead	ND	5.0
Molybdenum	ND	5.0
Nickel	ND	5.0
Selenium	ND	10
Silver	ND	5.0
Thallium	ND	10
Vanadium	ND	5.0
Zinc	ND	20

ND= Not Detected
RL= Reporting Limit

ENTHALPY ANALYTICAL

Batch QC Report

California Title 22 Metals

Lab #:	294938	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 3010A
Project#:	1101-17A	Analysis:	EPA 6010B
Matrix:	Water	Batch#:	254321
Units:	ug/L	Prepared:	12/04/17
Diln Fac:	1.000	Analyzed:	12/05/17

Type: BS Lab ID: QC911329

Analyte	Spiked	Result	%REC	Limits
Antimony	100.0	95.32	95	68-120
Arsenic	100.0	98.61	99	76-120
Barium	100.0	98.81	99	80-120
Beryllium	100.0	100.3	100	80-120
Cadmium	100.0	96.19	96	80-120
Chromium	100.0	98.78	99	80-120
Cobalt	100.0	97.51	98	80-120
Copper	100.0	99.72	100	80-120
Lead	100.0	101.0	101	80-120
Molybdenum	100.0	99.00	99	80-120
Nickel	100.0	101.2	101	80-120
Selenium	100.0	98.91	99	76-120
Silver	100.0	89.54	90	80-120
Thallium	50.00	50.51	101	80-127
Vanadium	100.0	107.5	107	80-120
Zinc	100.0	112.3	112	77-120

Type: BSD Lab ID: QC911330

Analyte	Spiked	Result	%REC	Limits	RPD	Lim
Antimony	100.0	101.3	101	68-120	6	20
Arsenic	100.0	103.1	103	76-120	4	20
Barium	100.0	100.3	100	80-120	2	20
Beryllium	100.0	97.76	98	80-120	3	20
Cadmium	100.0	97.80	98	80-120	2	20
Chromium	100.0	100.8	101	80-120	2	20
Cobalt	100.0	98.77	99	80-120	1	20
Copper	100.0	102.5	102	80-120	3	20
Lead	100.0	105.8	106	80-120	5	20
Molybdenum	100.0	104.9	105	80-120	6	20
Nickel	100.0	94.94	95	80-120	6	20
Selenium	100.0	102.6	103	76-120	4	20
Silver	100.0	91.55	92	80-120	2	21
Thallium	50.00	51.30	103	80-127	2	20
Vanadium	100.0	111.6	112	80-120	4	20
Zinc	100.0	104.9	105	77-120	7	23

RPD= Relative Percent Difference

ENTHALPY ANALYTICAL

Batch QC Report

California Title 22 Metals

Lab #:	294938	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 3010A
Project#:	1101-17A	Analysis:	EPA 6010B
Field ID:	ZZZZZZZZZZ	Batch#:	254321
MSS Lab ID:	294979-002	Sampled:	11/30/17
Matrix:	Water	Received:	11/30/17
Units:	ug/L	Prepared:	12/04/17
Diln Fac:	1.000	Analyzed:	12/05/17

Type: MS   Lab ID: QC911331

Analyte	MSS Result	Spiked	Result	%REC	Limits
Antimony	<2.832	100.0	102.9	103	42-130
Arsenic	11.44	100.0	121.4	110	53-139
Barium	12.13	100.0	113.2	101	71-123
Beryllium	<0.5336	100.0	92.91	93	80-120
Cadmium	18.09	100.0	128.7	111	80-124
Chromium	<0.5602	100.0	91.35	91	76-124
Cobalt	1.617	100.0	96.06	94	75-122
Copper	9.312	100.0	108.2	99	69-125
Lead	<1.185	100.0	72.04	72	59-127
Molybdenum	3.042	100.0	97.90	95	78-122
Nickel	95.94	100.0	192.9	97	70-123
Selenium	<2.791	100.0	107.1	107	50-144
Silver	14.84	100.0	110.9	96	66-125
Thallium	<1.934	50.00	39.96	80	65-130
Vanadium	41.86	100.0	141.8	100	77-124
Zinc	11.42	100.0	108.3	97	66-130

Type: MSD   Lab ID: QC911332

Analyte	Spiked	Result	%REC	Limits	RPD	Lim
Antimony	100.0	103.8	104	42-130	1	58
Arsenic	100.0	122.7	111	53-139	1	48
Barium	100.0	113.2	101	71-123	0	28
Beryllium	100.0	95.07	95	80-120	2	20
Cadmium	100.0	130.3	112	80-124	1	20
Chromium	100.0	92.75	93	76-124	2	25
Cobalt	100.0	97.34	96	75-122	1	20
Copper	100.0	111.6	102	69-125	3	27
Lead	100.0	74.25	74	59-127	3	32
Molybdenum	100.0	98.84	96	78-122	1	24
Nickel	100.0	192.8	97	70-123	0	26
Selenium	100.0	107.1	107	50-144	0	52
Silver	100.0	113.2	98	66-125	2	29
Thallium	50.00	39.04	78	65-130	2	30
Vanadium	100.0	146.4	105	77-124	3	23
Zinc	100.0	109.7	98	66-130	1	22

RPD= Relative Percent Difference

ENTHALPY ANALYTICAL

Batch QC Report

California Title 22 Metals

Lab #:	294938	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	METHOD
Project#:	1101-17A	Analysis:	EPA 7470A
Analyte:	Mercury	Diln Fac:	1.000
Type:	BLANK	Batch#:	254444
Lab ID:	QC911863	Prepared:	12/06/17
Matrix:	Water	Analyzed:	12/06/17
Units:	ug/L		

Result	RL
ND	0.20

ND= Not Detected
RL= Reporting Limit

Batch QC Report

California Title 22 Metals

Lab #:	294938	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	METHOD
Project#:	1101-17A	Analysis:	EPA 7470A
Analyte:	Mercury	Batch#:	254444
Matrix:	Water	Prepared:	12/06/17
Units:	ug/L	Analyzed:	12/06/17
Diln Fac:	1.000		

Type	Lab ID	Spiked	Result	%REC	Limits	RPD	Lim
BS	QC911864	2.500	2.579	103	80-120		
BSD	QC911865	2.500	2.546	102	80-120	1	20

RPD= Relative Percent Difference

ENTHALPY ANALYTICAL

Batch QC Report

California Title 22 Metals

Lab #:	294938	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	METHOD
Project#:	1101-17A	Analysis:	EPA 7470A
Analyte:	Mercury	Batch#:	254444
Field ID:	ZZZZZZZZZZ	Sampled:	11/30/17
MSS Lab ID:	294964-001	Received:	11/30/17
Matrix:	Water	Prepared:	12/06/17
Units:	ug/L	Analyzed:	12/06/17
Diln Fac:	1.000		

Type	Lab ID	MSS Result	Spiked	Result	%REC	Limits	RPD	Lim
MS	QC911866	<0.04000	2.500	2.539	102	63-120		
MSD	QC911867		2.500	2.507	100	63-120	1	36

RPD= Relative Percent Difference

California Title 22 Metals

Lab #:	294938	Project#:	1101-17A
Client:	A3GEO Inc.	Location:	NRLF Phase 4
Field ID:	IDW-A3-17-2-SOLID	Basis:	as received
Lab ID:	294938-002	Diln Fac:	1.000
Matrix:	Soil	Sampled:	11/28/17
Units:	mg/Kg	Received:	11/29/17

Analyte	Result	RL	Batch#	Prepared	Analyzed	Prep	Analysis
Antimony	ND	2.0	254268	12/01/17	12/01/17	EPA 3050B	EPA 6010B
Arsenic	3.5	1.5	254268	12/01/17	12/01/17	EPA 3050B	EPA 6010B
Barium	120	0.26	254268	12/01/17	12/01/17	EPA 3050B	EPA 6010B
Beryllium	0.39	0.10	254268	12/01/17	12/01/17	EPA 3050B	EPA 6010B
Cadmium	ND	0.26	254268	12/01/17	12/01/17	EPA 3050B	EPA 6010B
Chromium	48	0.26	254268	12/01/17	12/01/17	EPA 3050B	EPA 6010B
Cobalt	11	0.26	254268	12/01/17	12/01/17	EPA 3050B	EPA 6010B
Copper	20	0.26	254268	12/01/17	12/01/17	EPA 3050B	EPA 6010B
Lead	5.0	1.0	254268	12/01/17	12/01/17	EPA 3050B	EPA 6010B
Mercury	0.12	0.017	254393	12/05/17	12/05/17	METHOD	EPA 7471A
Molybdenum	ND	0.26	254268	12/01/17	12/01/17	EPA 3050B	EPA 6010B
Nickel	59	0.26	254268	12/01/17	12/01/17	EPA 3050B	EPA 6010B
Selenium	ND	2.0	254268	12/01/17	12/01/17	EPA 3050B	EPA 6010B
Silver	ND	0.26	254268	12/01/17	12/02/17	EPA 3050B	EPA 6010B
Thallium	ND	0.52	254268	12/01/17	12/01/17	EPA 3050B	EPA 6010B
Vanadium	32	0.26	254268	12/01/17	12/01/17	EPA 3050B	EPA 6010B
Zinc	44	1.0	254268	12/01/17	12/01/17	EPA 3050B	EPA 6010B

ND= Not Detected
RL= Reporting Limit

Batch QC Report

California Title 22 Metals

Lab #:	294938	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 3050B
Project#:	1101-17A	Analysis:	EPA 6010B
Type:	BLANK	Diln Fac:	1.000
Lab ID:	QC911129	Batch#:	254268
Matrix:	Soil	Prepared:	12/01/17
Units:	mg/Kg	Analyzed:	12/01/17

Analyte	Result	RL
Antimony	ND	1.9
Arsenic	ND	1.4
Barium	ND	0.23
Beryllium	ND	0.093
Cadmium	ND	0.23
Chromium	ND	0.23
Cobalt	ND	0.23
Copper	ND	0.23
Lead	ND	0.93
Molybdenum	ND	0.23
Nickel	ND	0.23
Selenium	ND	1.9
Silver	ND	0.23
Thallium	ND	0.47
Vanadium	ND	0.23
Zinc	ND	0.93

ND= Not Detected
RL= Reporting Limit

ENTHALPY ANALYTICAL

Batch QC Report

California Title 22 Metals

Lab #:	294938	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 3050B
Project#:	1101-17A	Analysis:	EPA 6010B
Matrix:	Soil	Batch#:	254268
Units:	mg/Kg	Prepared:	12/01/17
Diln Fac:	1.000	Analyzed:	12/01/17

Type: BS Lab ID: QC911130

Analyte	Spiked	Result	%REC	Limits
Antimony	46.73	47.20	101	80-120
Arsenic	46.73	47.02	101	80-120
Barium	46.73	46.50	100	80-120
Beryllium	23.36	22.95	98	80-120
Cadmium	46.73	45.05	96	80-120
Chromium	46.73	48.27	103	80-120
Cobalt	46.73	46.20	99	80-120
Copper	46.73	45.94	98	80-120
Lead	46.73	48.26	103	80-120
Molybdenum	46.73	44.55	95	80-120
Nickel	46.73	43.35	93	80-120
Selenium	46.73	45.85	98	80-120
Silver	4.673	4.118	88	80-120
Thallium	46.73	47.95	103	80-120
Vanadium	46.73	48.53	104	80-120
Zinc	46.73	46.44	99	80-120

Type: BSD Lab ID: QC911131

Analyte	Spiked	Result	%REC	Limits	RPD	Lim
Antimony	49.02	50.78	104	80-120	3	20
Arsenic	49.02	50.37	103	80-120	2	20
Barium	49.02	50.35	103	80-120	3	20
Beryllium	24.51	24.45	100	80-120	2	20
Cadmium	49.02	48.36	99	80-120	2	20
Chromium	49.02	51.78	106	80-120	2	20
Cobalt	49.02	49.48	101	80-120	2	20
Copper	49.02	49.35	101	80-120	2	20
Lead	49.02	47.57	97	80-120	6	20
Molybdenum	49.02	47.85	98	80-120	2	20
Nickel	49.02	46.61	95	80-120	2	20
Selenium	49.02	49.22	100	80-120	2	20
Silver	4.902	4.368	89	80-120	1	22
Thallium	49.02	51.57	105	80-120	2	20
Vanadium	49.02	52.16	106	80-120	2	20
Zinc	49.02	50.10	102	80-120	3	20

RPD= Relative Percent Difference

Batch QC Report

California Title 22 Metals

Lab #:	294938	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	EPA 3050B
Project#:	1101-17A	Analysis:	EPA 6010B
Field ID:	ZZZZZZZZZZ	Batch#:	254268
MSS Lab ID:	294932-002	Sampled:	11/29/17
Matrix:	Soil	Received:	11/29/17
Units:	mg/Kg	Prepared:	12/01/17
Basis:	as received	Analyzed:	12/01/17
Diln Fac:	1.000		

Type: MS Lab ID: QC911132

Analyte	MSS Result	Spiked	Result	%REC	Limits
Antimony	0.3105	50.00	17.31	34	1-120
Arsenic	4.503	50.00	50.51	92	71-123
Barium	106.9	50.00	146.1	79	48-155
Beryllium	0.4015	25.00	22.98	90	80-120
Cadmium	0.2828	50.00	46.93	93	78-120
Chromium	36.84	50.00	89.97	106	64-135
Cobalt	9.175	50.00	50.17	82	65-120
Copper	20.14	50.00	69.14	98	75-132
Lead	61.54	50.00	105.8	88	53-128
Molybdenum	0.4218	50.00	41.26	82	68-120
Nickel	30.60	50.00	74.61	88	56-128
Selenium	<0.2160	50.00	45.86	92	59-120
Silver	<0.04808	5.000	4.154	83	36-123
Thallium	<0.1448	50.00	41.67	83	55-120
Vanadium	32.64	50.00	80.59	96	73-129
Zinc	60.93	50.00	117.1	112	49-138

Type: MSD Lab ID: QC911133

Analyte	Spiked	Result	%REC	Limits	RPD	Lim
Antimony	45.45	14.20	31	1-120	10	50
Arsenic	45.45	45.19	90	71-123	2	27
Barium	45.45	140.5	74	48-155	1	41
Beryllium	22.73	20.61	89	80-120	2	20
Cadmium	45.45	41.99	92	78-120	2	21
Chromium	45.45	87.60	112	64-135	3	37
Cobalt	45.45	44.41	78	65-120	4	32
Copper	45.45	63.58	96	75-132	2	33
Lead	45.45	141.3	175 *	53-128	33	48
Molybdenum	45.45	36.67	80	68-120	2	23
Nickel	45.45	69.90	86	56-128	1	38
Selenium	45.45	41.18	91	59-120	1	30
Silver	4.545	3.686	81	36-123	2	47
Thallium	45.45	37.84	83	55-120	0	22
Vanadium	45.45	71.26	85	73-129	7	27
Zinc	45.45	111.8	112	49-138	0	39

*= Value outside of QC limits; see narrative
RPD= Relative Percent Difference

ENTHALPY ANALYTICAL

Batch QC Report

California Title 22 Metals

Lab #:	294938	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	METHOD
Project#:	1101-17A	Analysis:	EPA 7471A
Analyte:	Mercury	Diln Fac:	1.000
Type:	BLANK	Batch#:	254393
Lab ID:	QC911627	Prepared:	12/05/17
Matrix:	Soil	Analyzed:	12/05/17
Units:	mg/Kg		

Result	RL
ND	0.017

ND= Not Detected
RL= Reporting Limit

Batch QC Report

California Title 22 Metals			
Lab #:	294938	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	METHOD
Project#:	1101-17A	Analysis:	EPA 7471A
Analyte:	Mercury	Batch#:	254393
Matrix:	Soil	Prepared:	12/05/17
Units:	mg/Kg	Analyzed:	12/05/17
Diln Fac:	1.000		

Type	Lab ID	Spiked	Result	%REC	Limits	RPD	Lim
BS	QC911628	0.1953	0.1758	90	80-126		
BSD	QC911629	0.2016	0.1858	92	80-126	2	45

RPD= Relative Percent Difference

Batch QC Report

California Title 22 Metals

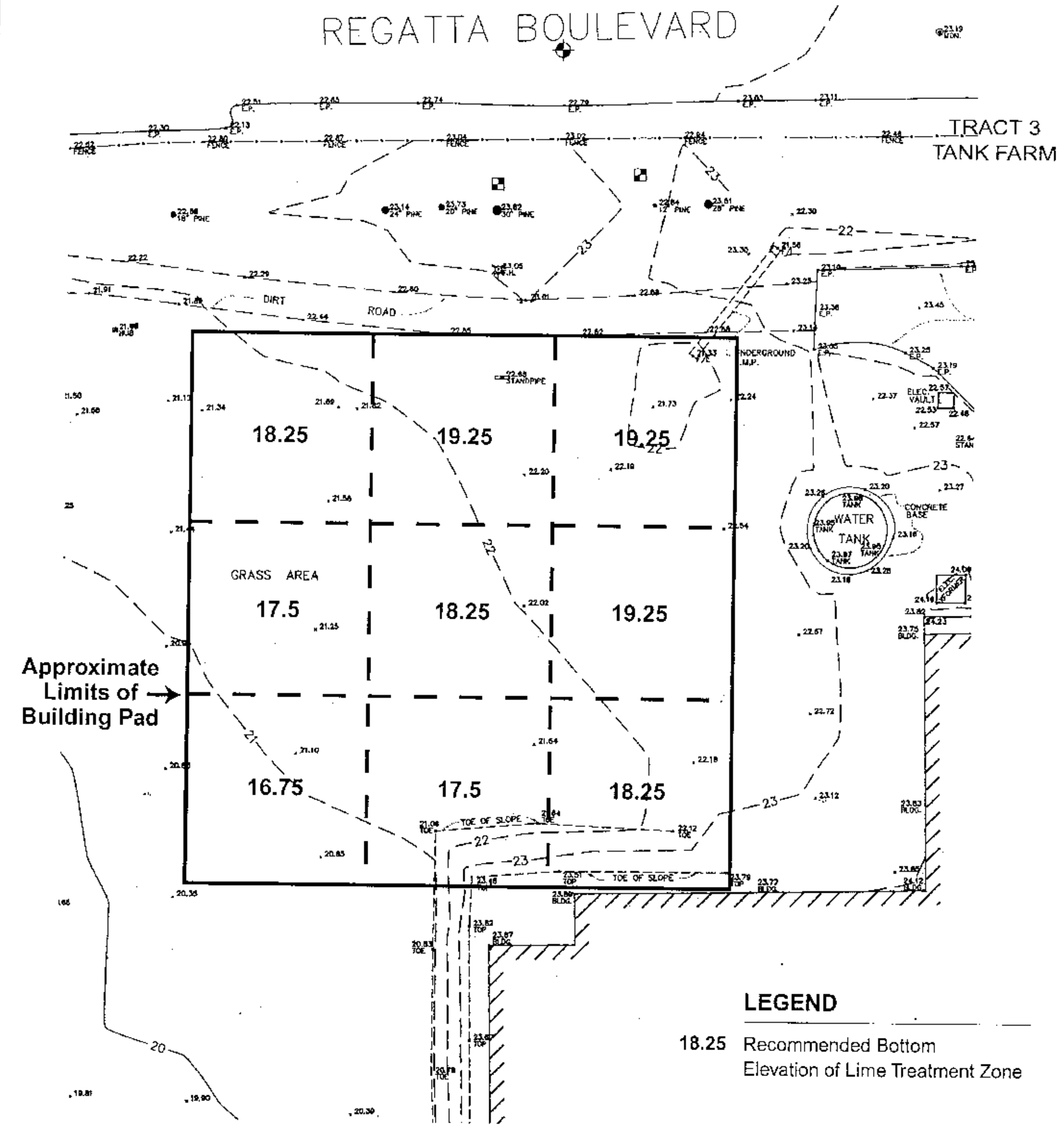
Lab #:	294938	Location:	NRLF Phase 4
Client:	A3GEO Inc.	Prep:	METHOD
Project#:	1101-17A	Analysis:	EPA 7471A
Analyte:	Mercury	Diln Fac:	1.000
Field ID:	ZZZZZZZZZZ	Batch#:	254393
MSS Lab ID:	294996-001	Sampled:	11/30/17
Matrix:	Soil	Received:	12/01/17
Units:	mg/Kg	Prepared:	12/05/17
Basis:	as received	Analyzed:	12/05/17

Type	Lab ID	MSS Result	Spiked	Result	%REC	Limits	RPD	Lim
MS	QC911630	<0.003033	0.1923	0.1873	97	61-157		
MSD	QC911631		0.2119	0.2078	98	61-157	1	57

RPD= Relative Percent Difference

APPENDIX F

NRLF Phase 3 –
Lime Treatment Plan



URS	26814399 UCB Northern Regional Library Facility Phase 3	Recommended Depth of Lime Treatment	Fig. 1

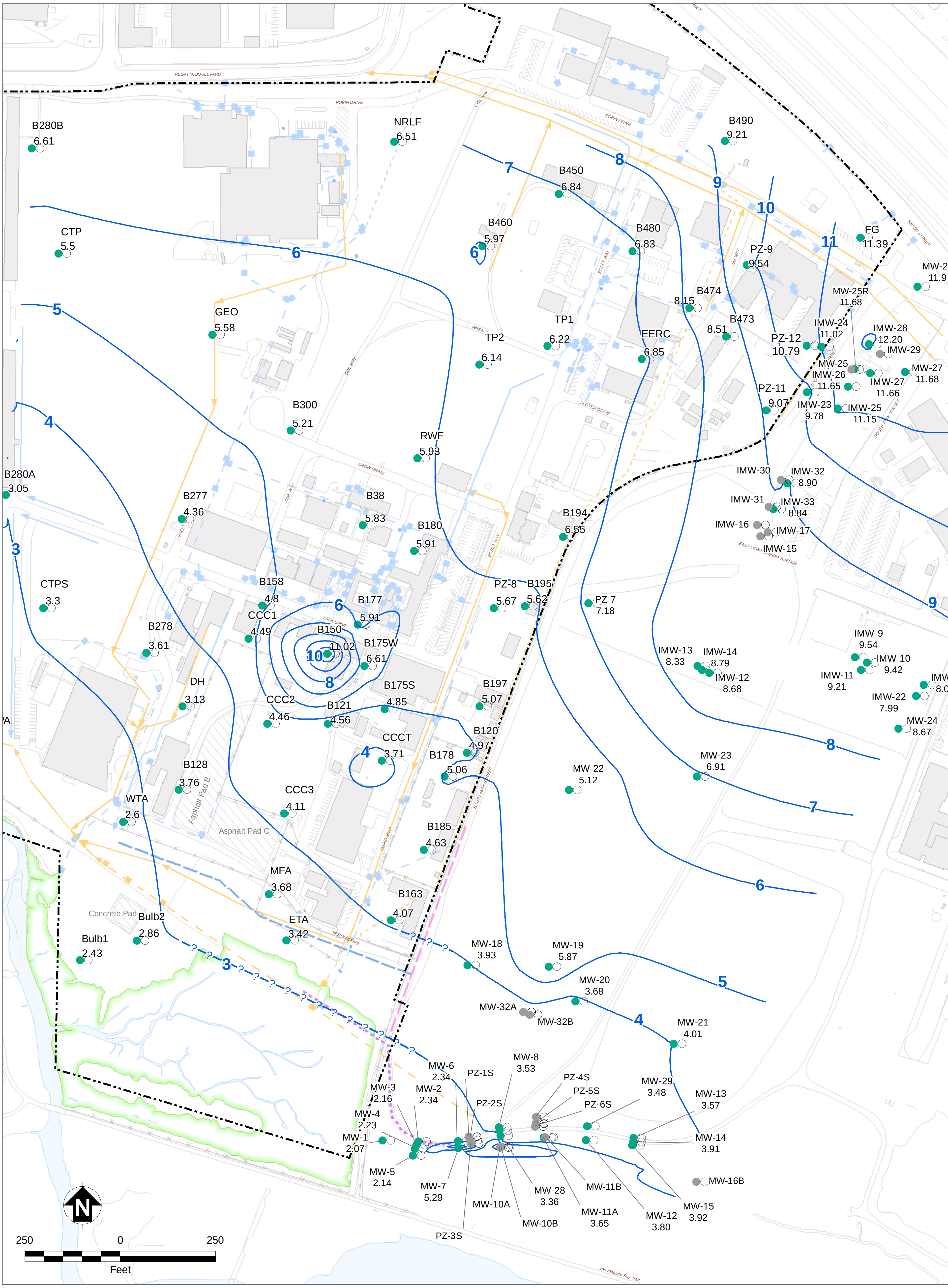
APPENDIX G

Groundwater Data by Others

A3GEO

Table 2: Groundwater Elevation Data
2016 Groundwater Sampling Results, Technical Memorandum
University of California, Berkeley, Richmond Field Station Site

Piezometer Name	Sample Date	TOC Elevation (feet NGVD)	Depth to Water (feet below TOC)	Groundwater Elevation (feet NGVD)
GEO	11/1/10	16.37	10.79	5.58
GEO	2/10/11	16.37	9.04	7.33
GEO	4/2/11	16.37	8.35	8.02
GEO	4/11/11	16.37	9.74	6.63
GEO	10/3/11	16.37	10.42	5.95
GEO	10/1/12	16.37	10.71	5.66
GEO	4/1/13	16.37	9.76	6.61
GEO	10/7/13	16.37	11.92	4.45
GEO	3/28/14	16.37	9.84	6.53
GEO	10/1/14	16.37	11.21	5.16
GEO	4/1/15	16.37	9.93	6.44
GEO	10/5/15	16.37	11.45	4.92
GEO	4/4/16	16.37	8.40	7.97
MFA	11/1/10	8.23	4.55	3.68
MFA	2/10/11	8.23	3.59	4.64
MFA	4/11/11	8.23	2.67	5.56
MFA	10/3/11	8.23	4.41	3.82
MFA	4/2/12	8.23	1.98	6.25
MFA	10/1/12	8.23	4.57	3.66
MFA	4/2/13	8.23	3.70	4.53
MFA	10/7/13	8.23	4.85	3.38
MFA	3/28/14	8.23	3.68	4.55
MFA	10/1/14	8.23	3.68	4.55
MFA	4/1/15	8.23	4.71	3.52
MFA	10/5/15	8.23	4.91	3.32
MFA	4/4/16	8.23	3.08	5.15
NRLF	11/1/10	22.62	16.11	6.51
NRLF	2/10/11	22.62	13.45	9.17
NRLF	4/11/11	22.62	11.99	10.63
NRLF	10/3/11	22.62	15.83	6.79
NRLF	4/2/12	22.62	12.96	9.66
NRLF	10/1/12	22.62	16.30	6.32
NRLF	4/1/13	22.62	13.70	8.92
NRLF	10/7/13	22.62	NA	NA
NRLF	3/28/14	22.62	14.16	8.46
NRLF	10/1/14	22.62	17.06	5.56
NRLF	4/1/15	22.62	14.21	8.41
NRLF	10/5/15	22.62	17.42	5.20
NRLF	4/4/16	22.62	12.75	9.87



- Piezometer Groundwater Elevation Measured in November 2010
- Piezometer Groundwater Elevation Not Measured in November 2010
- November 2010 Groundwater Contours
- Contour Estimated due to Proximity to BAPB Wall, Slurry Wall, or Marsh
- Existing Building
- Asphalt/Concrete Pad
- Surface Water
- Marsh Boundary
- Richmond Field Station Site Boundary
- Roads and Other Landscape Features
- Fenceline
- BAPB Wall
- Former Seawall (Approximate)
- Slurry Wall

Storm Drain Lines:

- Open Swale
- Underground Culvert
- Underground Culvert, Abandoned (Grouted at Manholes)

Sanitary Sewer Lines:

- Existing Sewer Line
- Removed Sewer Line
- Abandoned Sewer Line

Note:
All data points surveyed to NGVD29.
Mean sea level = NGVD29 elevation (in feet) – 0.58 feet NGVD and mean sea level datum representative of Stege Marsh is derived from NOAA Richmond Inner Harbor tide gauge.

Piezometer ID
MW-10A
5.27
Groundwater Elevation (FT NGVD29)

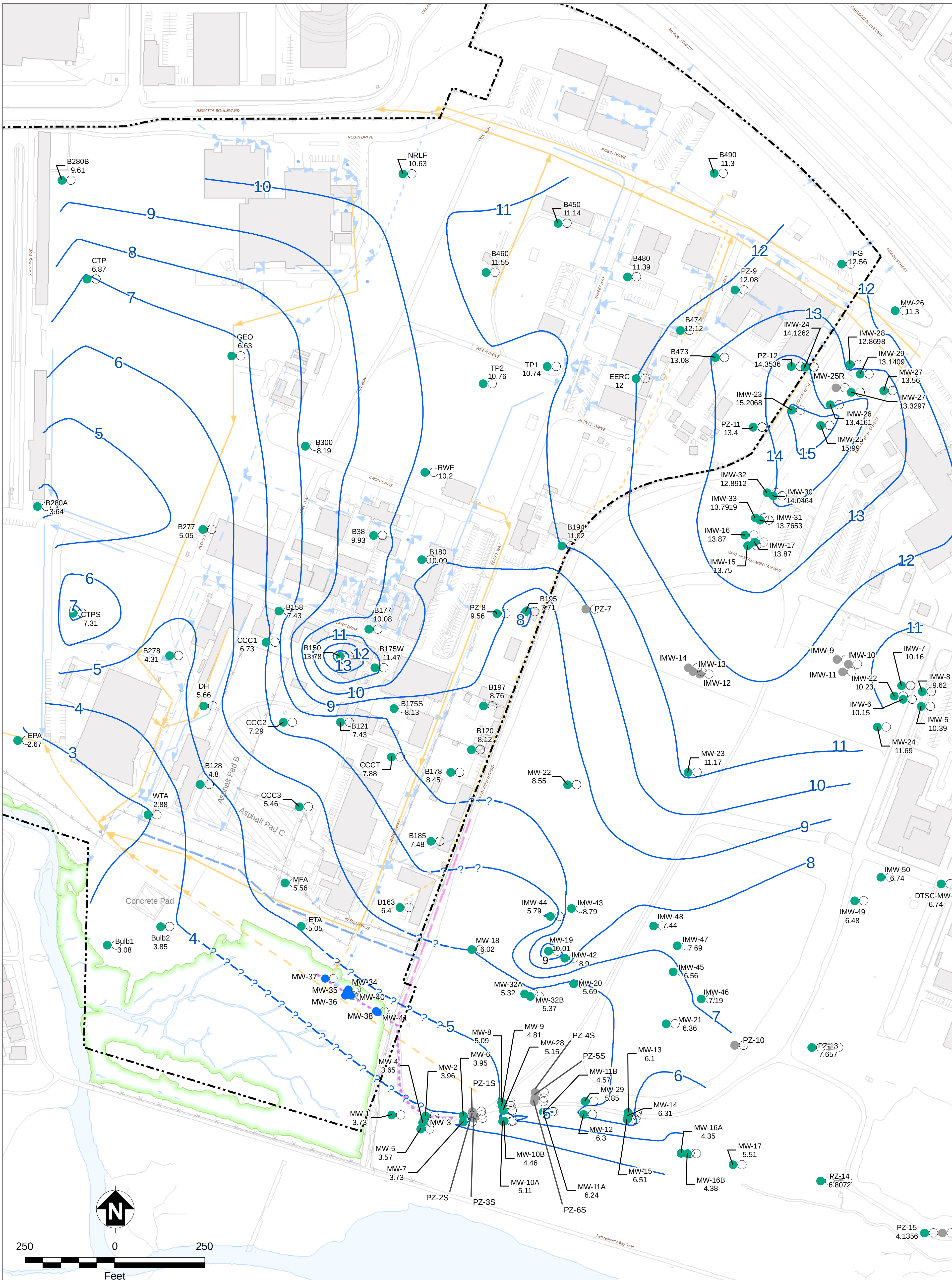
TETRA TECH

Richmond Field Station Site
University of California, Berkeley

FIGURE 4
SHALLOW GROUNDWATER ELEVATION CONTOURS, NOVEMBER 1, 2010

2016 Groundwater Sampling Results

9/21/2016 V:\Misc_GIS\Richmond_Field_Station\Projects\009_GW_Sampling_Results_2016\04_Shallow GW Elevation Contours 2010 Nov 1.mxd TtEMI-OAK simon.cardinale



- Piezometer Groundwater Elevation Measured in April 2011
- Piezometer Groundwater Elevation Not Measured in April 2011
- BAPB Piezometers on RFS Property Not Measured in April 2011
- April 2011 Groundwater Contours
- ? Contour Estimated due to Proximity to BAPB Wall, Slurry Wall, or Marsh
- Existing Building
- Asphalt/Concrete Pad
- Surface Water
- Marsh Boundary
- Richmond Field Station Site Boundary
- Roads and Other Landscape Features
- Fenceline
- Biologically Active Permeable Barrier Wall
- Former Seawall (Approximate)

- Slurry Wall

Storm Drain Lines:
- Open Swale
- Underground Culvert
- Underground Culvert, Abandoned (Grouted at Manholes)

Sanitary Sewer Lines:
- Existing Sewer Line
- Removed Sewer Line
- Abandoned Sewer Line

Note:
All data points surveyed to NGVD29.
Mean sea level = NGVD29 elevation (in feet) – 0.58 feet NGVD
Mean sea level datum representative of Stege Marsh is derived from NOAA Richmond Inner Harbor tide gauge.

MW-10A 5.27
Piezometer ID
Groundwater Elevation (FT NGVD29)

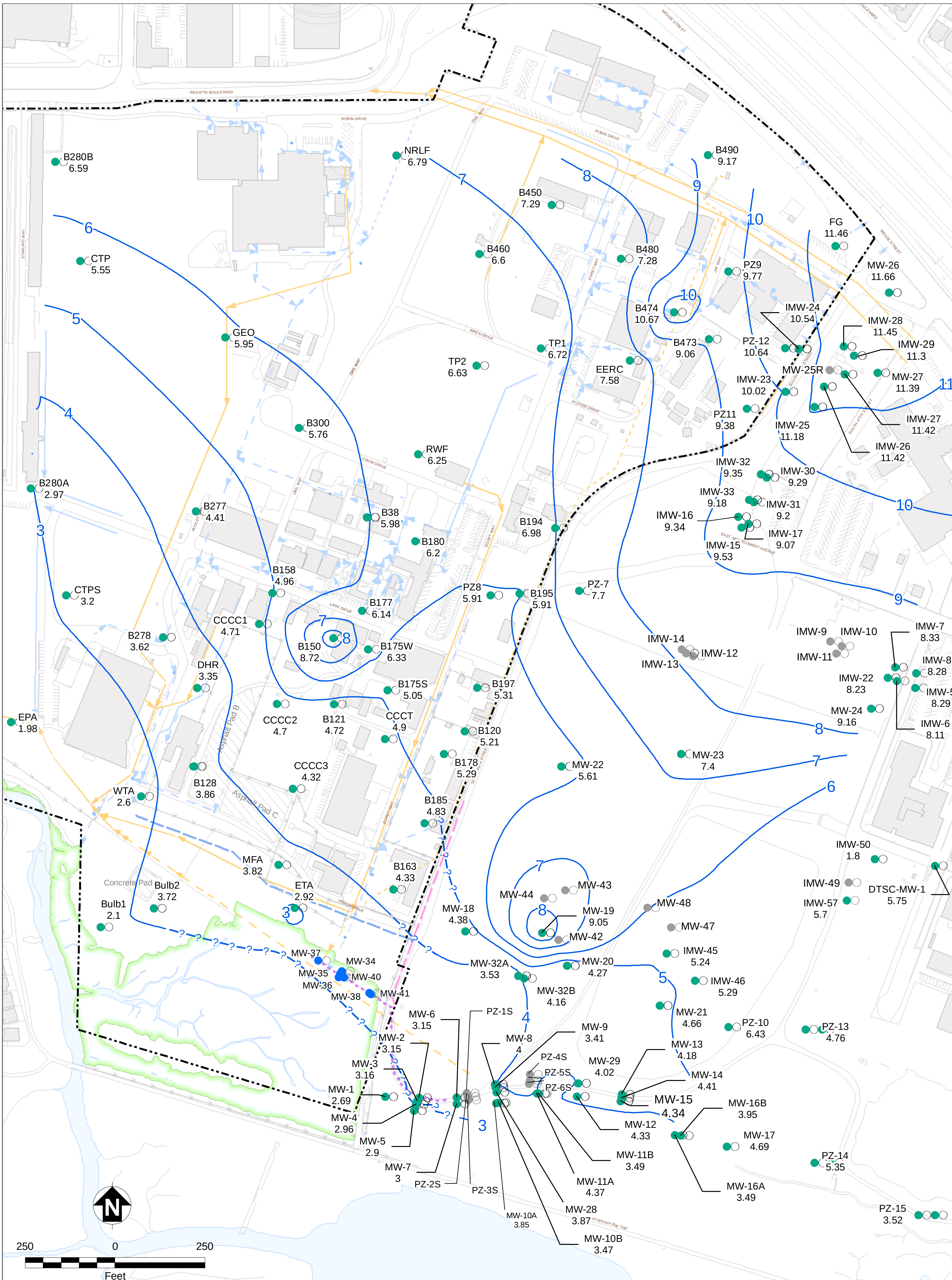
TETRA TECH

Richmond Field Station Site
University of California, Berkeley

FIGURE 5
SHALLOW GROUNDWATER ELEVATION CONTOURS, APRIL 11, 2011

2016 Groundwater Sampling Results

9/21/2016 V:\Misc_GIS\Richmond_Field_Station\Projects\009_GW_Sampling_Results_2016\05_Shallow GW Elevation Contours 2011 April 11_rev.mxd TTEMI-OAK simon.cardinale



●○ Piezometer Groundwater Elevation Measured in October 2011

●○ Piezometer Groundwater Elevation Not Measured in October 2011

●○ BAPB Piezometers on RFS Property Not Measured in October 2011

October 2011 Groundwater Contours

? Contour Estimated due to Proximity to BAPB Wall, Slurry Wall, or Marsh

Existing Building

Asphalt/Concrete Pad

Surface Water

Marsh Boundary

Richmond Field Station Site Boundary

Roads and Other Landscape Features

Fenceline

BAPB Wall

Former Seawall (Approximate)

Slurry Wall

Storm Drain Lines:

Open Swale

Underground Culvert

Underground Culvert, Abandoned (Grouted at Manholes)

Sanitary Sewer Lines:

Existing Sewer Line

Removed Sewer Line

Abandoned Sewer Line

Note:
All data points surveyed to NGVD29.
Mean sea level = NGVD29 elevation (in feet) – 0.58 feet NGVD and mean sea level datum representative of Stege Marsh is derived from NOAA Richmond Inner Harbor tide gauge.

Piezometer ID
MW-10A
5.27
Groundwater Elevation (FT NGVD29)

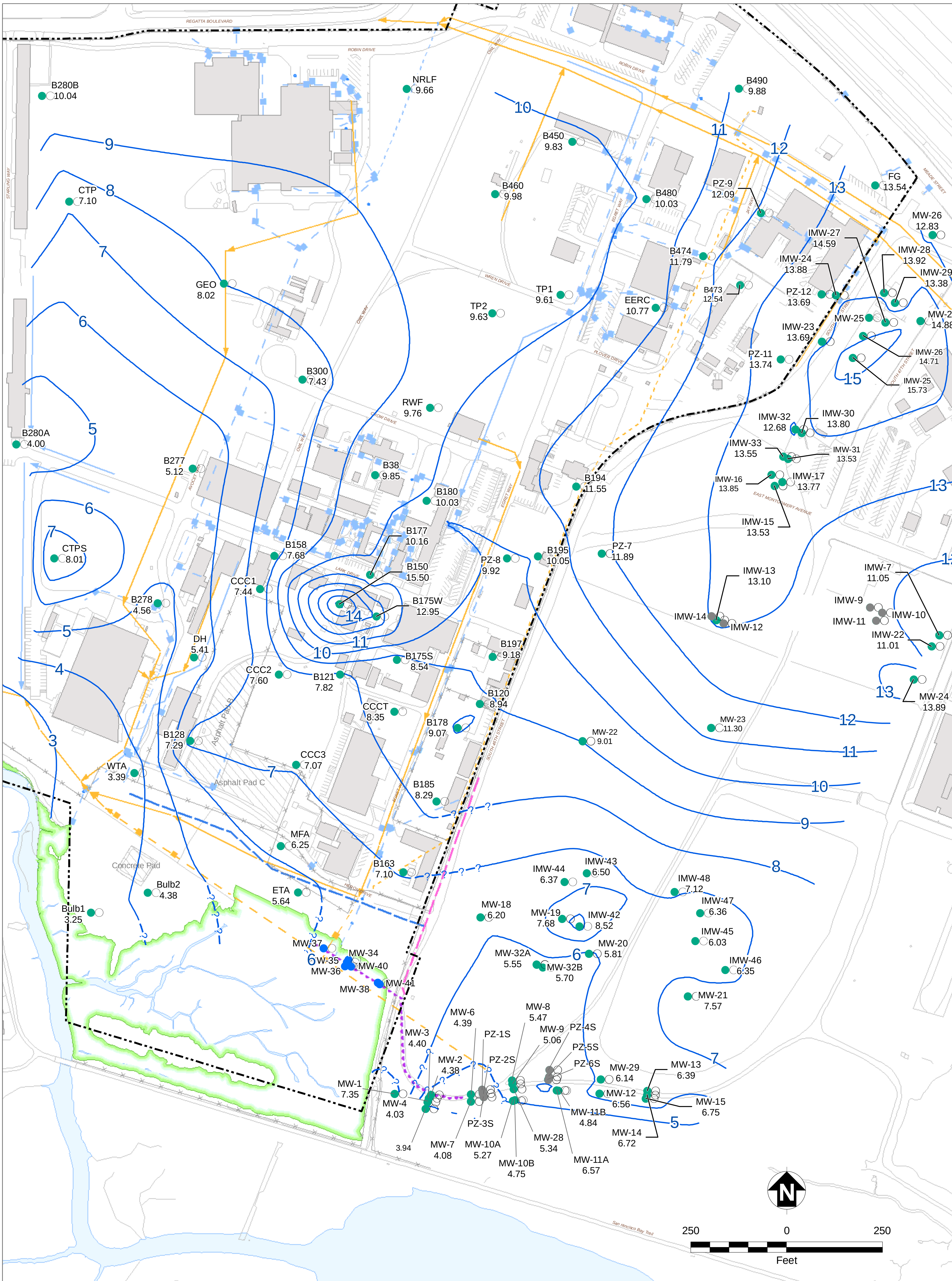
TETRA TECH

Richmond Field Station Site
University of California, Berkeley

FIGURE 6
SHALLOW GROUNDWATER ELEVATION CONTOURS, OCTOBER 3, 2011

2016 Groundwater Sampling Results

9/21/2016 V:\Misc_GIS\Richmond_Field_Station\Projects\009_GW_Sampling_Results_2016\06_Shallow GW Elevation Contours 2011 Oct 3.mxd TtEMI-OAK simon.cardinale



- Piezometer Groundwater Elevation Measured in April 2012
- Piezometer Groundwater Elevation Not Measured in April 2012
- BAPB Piezometers on RFS Property Not Measured in April 2012
- April 2012 Groundwater Contour
- Contour Estimated due to Proximity to BAPB Wall, Slurry Wall, or Marsh
- Existing Building
- Asphalt/Concrete Pad
- Surface Water
- Marsh Boundary
- Richmond Field Station Site Boundary
- Roads and Other Landscape Features
- Fenceline
- BAPB Wall
- Former Seawall (Approximate)
- Slurry Wall

Storm Drain Lines:

- Open Swale
- Underground Culvert
- Underground Culvert, Abandoned (Grouted at Manholes)

Sanitary Sewer Lines:

- Existing Sewer Line
- Removed Sewer Line
- Abandoned Sewer Line

Piezometer ID
MW-10A
5.27
Groundwater Elevation (FT NGVD29)

Note:
All data points surveyed to NGVD29.
Mean sea level = NGVD29 elevation (in feet) – 0.58 feet NGVD
and mean sea level datum representative of Stege Marsh is
derived from NOAA Richmond Inner Harbor tide gauge.

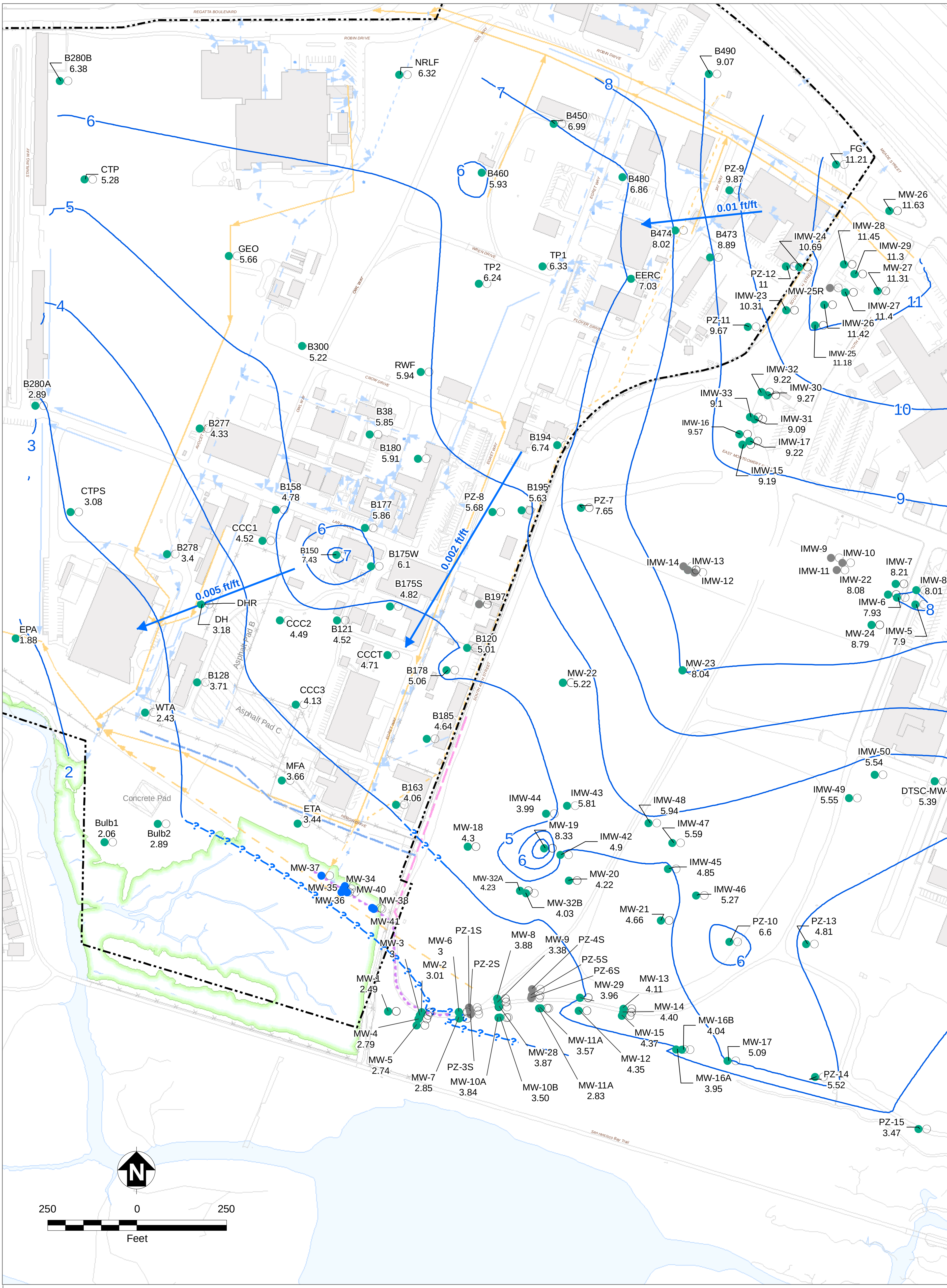
TETRA TECH

Richmond Field Station Site
University of California, Berkeley

FIGURE 7
SHALLOW GROUNDWATER ELEVATION CONTOURS, APRIL 2, 2012

2016 Groundwater Sampling Results

9/21/2016 V:\Misc_GIS\Richmond_Field_Station\Projects\009_GW_Sampling_Results_2016\07_Shallow GW Elevation Contours 2012 April 2.mxd TtEMI-OAK simon.cardinale



- Piezometer Groundwater Elevation Measured in October 2012
- Piezometer Groundwater Elevation Not Measured in October 2012
- BAPB Piezometers on RFS Property Not Measured in October 2012
- October 2012 Groundwater Contours
- Contour Estimated due to Proximity to BAPB Wall, Slurry Wall, or Marsh
- Estimated Horizontal Groundwater Gradient Direction (Value)
- Existing Building
- Asphalt/Concrete Pad
- Surface Water
- Marsh Boundary
- Richmond Field Station Site Boundary
- Roads and Other Landscape Features
- Fenceline
- BAPB Wall

- Former Seawall (Approximate)
- Slurry Wall

Storm Drain Lines:
- Open Swale
- Underground Culvert
- Underground Culvert, Abandoned (Grouted at Manholes)

Sanitary Sewer Lines:
- Existing Sewer Line
- Removed Sewer Line
- Abandoned Sewer Line

Note:
All data points surveyed to NGVD29.
Mean sea level = NGVD29 elevation (in feet) – 0.58 feet NGVD and mean sea level datum representative of Stege Marsh is derived from NOAA Richmond Inner Harbor tide gauge.

Piezometer ID
MW-10A
5.27
Groundwater Elevation (FT NGVD29)

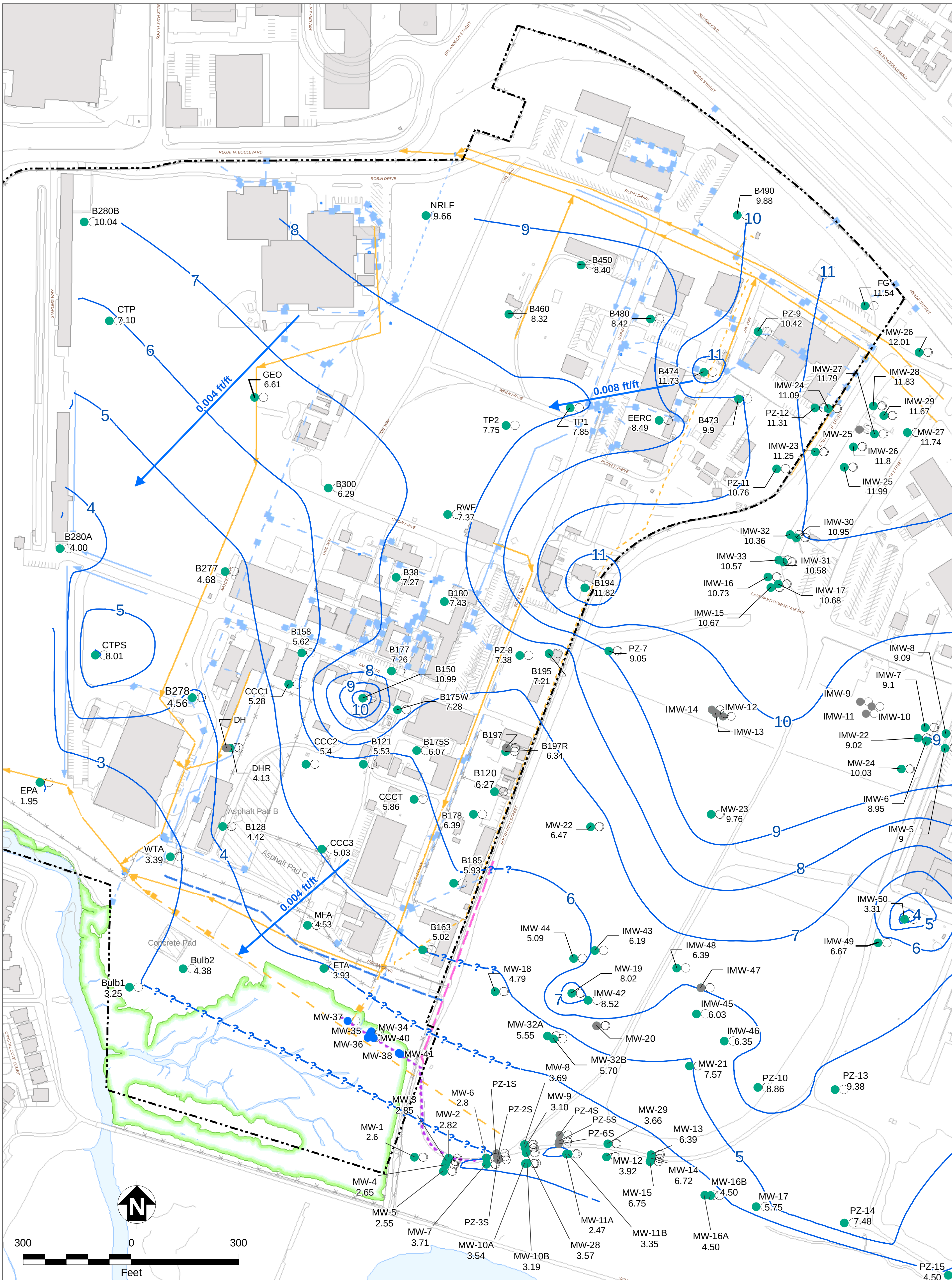
TETRA TECH

Richmond Field Station Site
University of California, Berkeley

FIGURE 8
SHALLOW GROUNDWATER ELEVATION CONTOURS, OCTOBER 1, 2012

2016 Groundwater Sampling Results

9/21/2016 V:\Misc_GIS\Richmond_Field_Station\Projects\009_GW_Sampling_Results_2016\08_Shallow GW Elevation Contours 2012 Oct 1.mxd TtEMI-OAK simon.cardinale



- Piezometer Groundwater Elevation Measured in April 2013
- Piezometer Groundwater Elevation Not Measured in April 2013
- BAPB Piezometers on RFS Property Not Measured in April 2013
- April 2013 Groundwater Contour
- Contour Estimated due to Proximity to BAPB Wall, Slurry Wall, or Marsh
- Estimated Horizontal Groundwater Gradient Direction (Value)
- Existing Building
- Asphalt/Concrete Pad
- Surface Water
- Marsh Boundary
- Richmond Field Station Site Boundary
- Roads and Other Landscape Features
- Fenceline
- BAPB Wall

- Former Seawall (Approximate)
- Slurry Wall

Storm Drain Lines:
- Open Swale
- Underground Culvert
- Underground Culvert, Abandoned (Grouted at Manholes)

Sanitary Sewer Lines:
- Existing Sewer Line
- Removed Sewer Line
- Abandoned Sewer Line

Note:
All data points surveyed to NGVD29.
Mean sea level = NGVD29 elevation (in feet) – 0.58 feet NGVD
and mean sea level datum representative of Stege Marsh is
derived from NOAA Richmond Inner Harbor tide gauge.

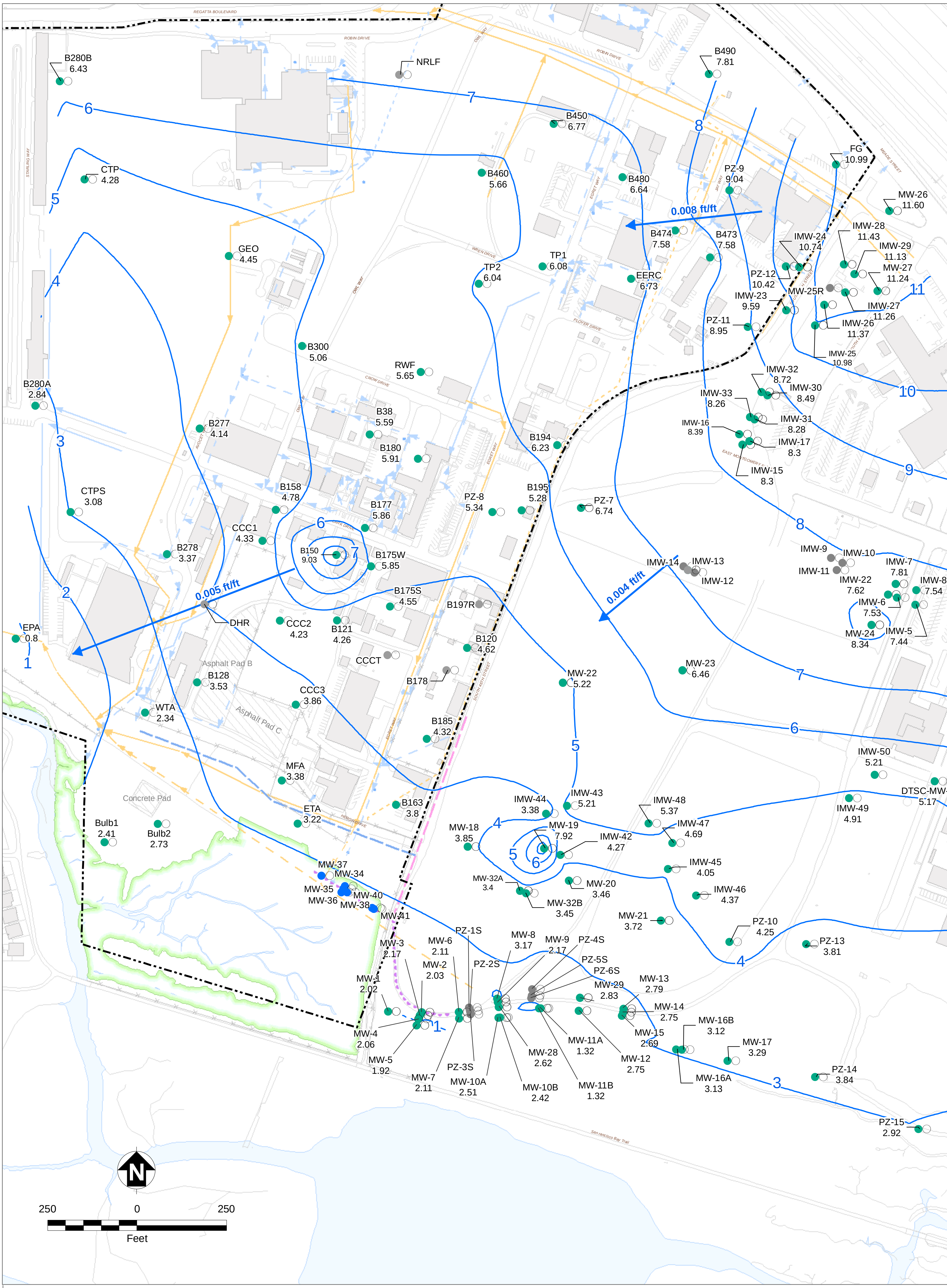
Piezometer ID
MW-10A
5.27
Groundwater Elevation (FT NGVD29)

TETRA TECH

Richmond Field Station Site
University of California, Berkeley

FIGURE 9
SHALLOW GROUNDWATER ELEVATION CONTOURS, APRIL 1, 2013

2016 Groundwater Sampling Results



Piezometer Groundwater Elevation Measured in October 2013
Piezometer Groundwater Elevation Not Measured in October 2013
BAPB Piezometers on RFS Property Not Measured in October 2013
Estimated Horizontal Groundwater Gradient Direction (Value)
Existing Building
Asphalt/Concrete Pad
Surface Water
Marsh Boundary
Richmond Field Station Site Boundary
Roads and Other Landscape Features
Fenceline
BAPB Wall

Former Seawall (Approximate)
Slurry Wall

Storm Drain Lines:
Open Swale
Underground Culvert
Underground Culvert, Abandoned (Grouted at Manholes)

Sanitary Sewer Lines:
Existing Sewer Line
Removed Sewer Line
Abandoned Sewer Line

Note:
All data points surveyed to NGVD29.
Mean sea level = NGVD29 elevation (in feet) – 0.58 feet NGVD and mean sea level datum representative of Stege Marsh is derived from NOAA Richmond Inner Harbor tide gauge.

Piezometer ID
MW-10A
5.27
Groundwater Elevation (FT NGVD29)

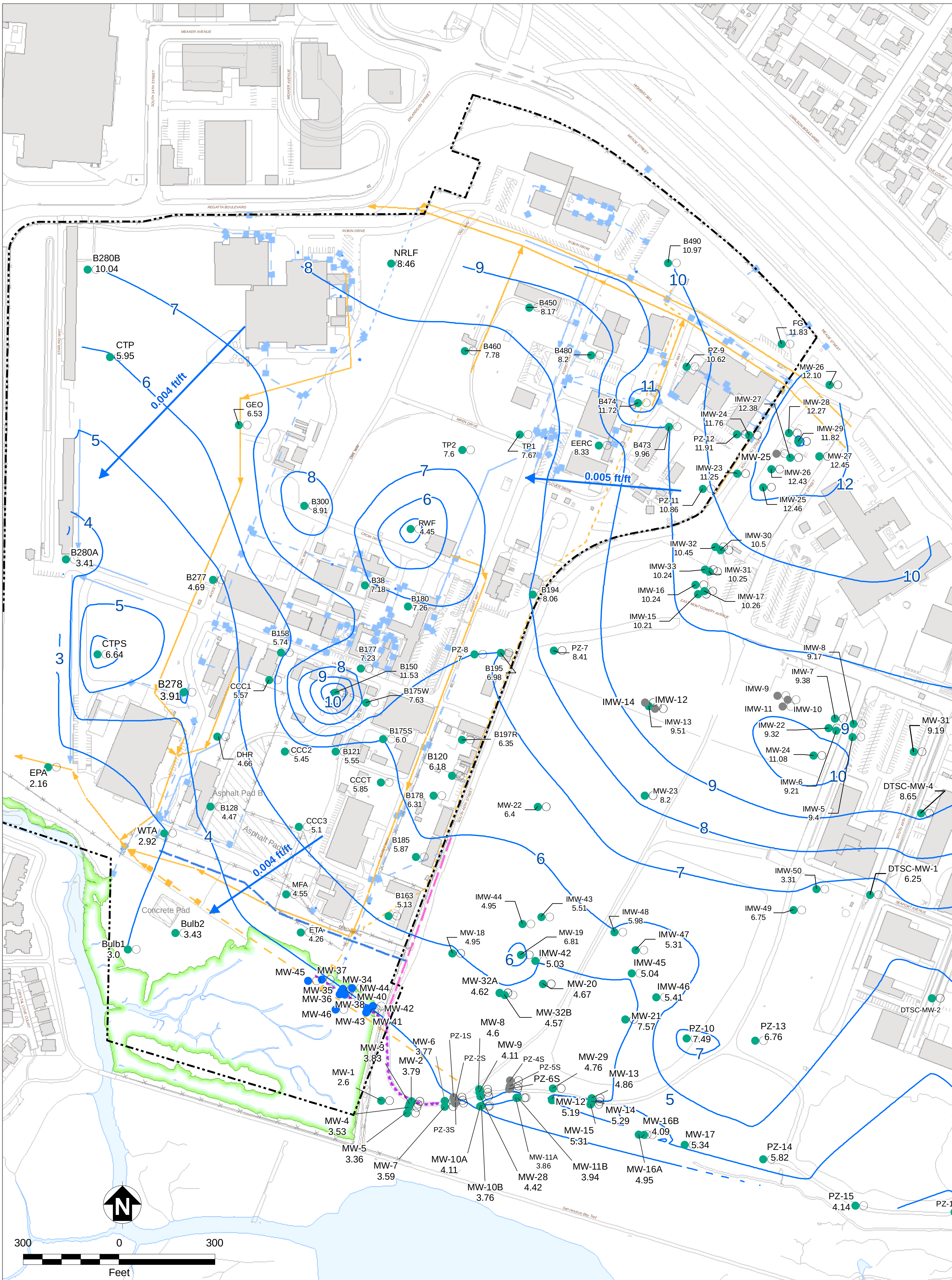
TETRA TECH

Richmond Field Station Site
University of California, Berkeley

FIGURE 10
SHALLOW GROUNDWATER ELEVATION CONTOURS, OCTOBER 7, 2013

2016 Groundwater Sampling Results

9/23/2016 V:\Misc_GIS\Richmond_Field_Station\Projects\009_GW_Sampling_Results_2016\10_Shallow GW Elevation Contours 2013 Oct 7.mxd TtEMI-OAK simon.cardinale



- Piezometer Groundwater Elevation Measured in March 2014
- Piezometer Groundwater Elevation Not Measured in March 2014
- BAPB Piezometers on RFS Property Not Measured in March 2014
- 1 April 2014 Groundwater Contour
- Estimated Horizontal Groundwater Gradient Direction (Value)
- Existing Building
- Asphalt/Concrete Pad
- Surface Water
- Marsh Boundary
- Richmond Field Station Site Boundary
- Roads and Other Landscape Features
- Fenceline
- BAPB Wall
- Former Seawall (Approximate)
- Slurry Wall

Storm Drain Lines:

- Open Swale
- Underground Culvert
- Underground Culvert, Abandoned (Grouted at Manholes)

Sanitary Sewer Lines:

- Existing Sewer Line
- Removed Sewer Line
- Abandoned Sewer Line

Piezometer ID
MW-10A
5.27
Groundwater Elevation (FT NGVD29)

Note:
All data points surveyed to NGVD29.
Mean sea level = NGVD29 elevation (in feet) – 0.58 feet NGVD and mean sea level datum representative of Stege Marsh is derived from NOAA Richmond Inner Harbor tide gauge.

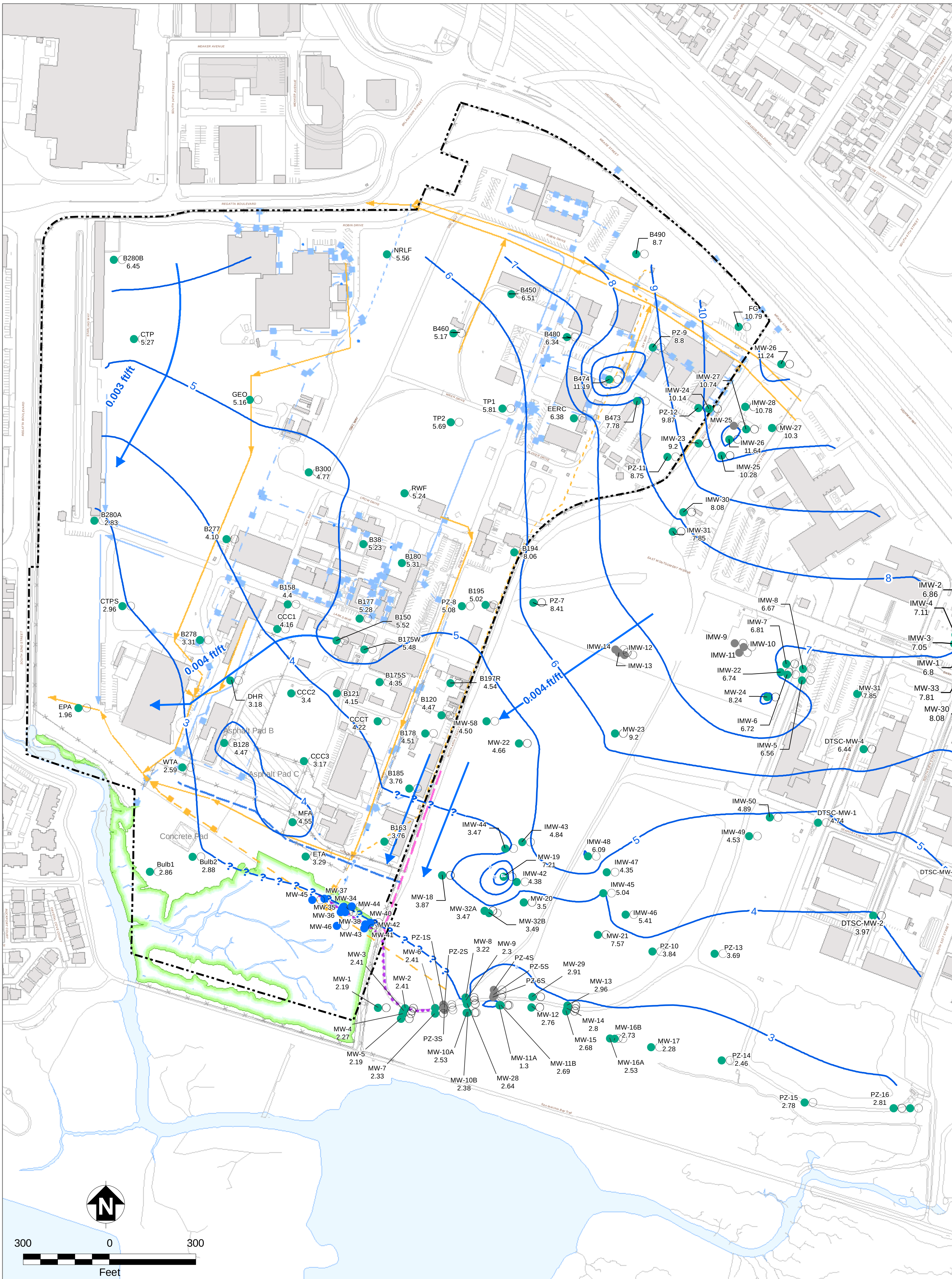
TETRA TECH

Richmond Field Station Site
University of California, Berkeley

FIGURE 11
SHALLOW GROUNDWATER ELEVATION CONTOURS, MARCH 28, 2014

2016 Groundwater Sampling Results

9/21/2016 V:\Misc_GIS\Richmond_Field_Station\Projects\009_GW_Sampling_Results_2016\11_Shallow GW Elevation Contours 2014 March 28.mxd TtEMI-OAK simon.cardinale



Piezometer Groundwater Elevation Measured in October 2014
Piezometer Groundwater Elevation Not Measured in October 2014
BAPB Piezometers on RFS Property Not Measured in October 2014
1 Estimated October 2014 Groundwater Contour
? Contour Estimated due to Proximity to BAPB Wall, Slurry Wall, or Marsh
Estimated Horizontal Groundwater Gradient Direction (Value)
Existing Building
Asphalt/Concrete Pad
Surface Water
Marsh Boundary
Richmond Field Station Site Boundary
Roads and Other Landscape Features
Fenceline
BAPB Wall

Former Seawall (Approximate)
Slurry Wall

Storm Drain Lines:
Open Swale
Underground Culvert
Underground Culvert, Abandoned (Grouted at Manholes)

Sanitary Sewer Lines:
Existing Sewer Line
Removed Sewer Line
Abandoned Sewer Line

Piezometer ID
MW-10A
5.27
Groundwater Elevation (FT NGVD29)

Note:
All data points surveyed to NGVD29.
Mean sea level = NGVD29 elevation (in feet) – 0.58 feet NGVD and mean sea level datum representative of Stege Marsh is derived from NOAA Richmond Inner Harbor tide gauge.
Contours do not include data from Phase IV piezometers completed in January 2015.

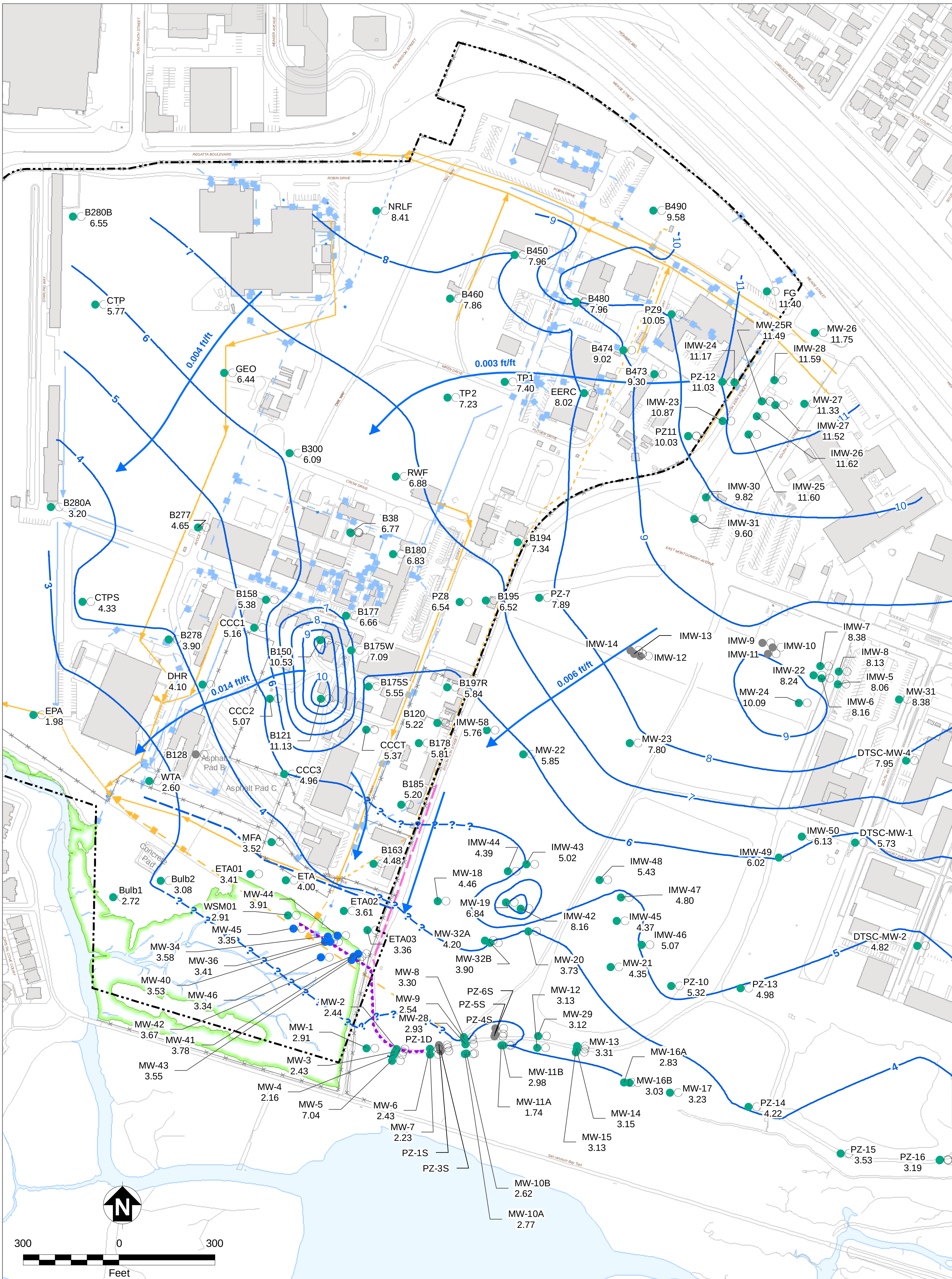
TETRA TECH

Richmond Field Station Site
University of California, Berkeley

FIGURE 12
SHALLOW GROUNDWATER ELEVATION CONTOURS, OCTOBER 1, 2014

2016 Groundwater Sampling Results

9/21/2016 V:\Misc_GIS\Richmond_Field_Station\Projects\009_GW_Sampling_Results_2016\12_Shallow GW Elevation Contours 2014 OctoberREV.mxd TtEMI-OAK simon.cardinale



- Piezometer Groundwater Elevation Measured in April 2015
- Piezometer Groundwater Elevation Not Measured in April 2015
- BAPB Piezometers on RFS Property Measured in April 2015

Estimated April 2015 Groundwater Contour

- 1 Horizontal Groundwater Gradient
- ? Proximity to BAPB Wall
- Estimated Horizontal Groundwater Gradient Direction (Value)
- Existing Building
- Asphalt/Concrete Pad
- Surface Water
- Marsh Boundary
- Richmond Field Station Site Boundary
- Roads and Other Landscape Features
- Fenceline

- BAPB Wall
- Former Seawall (Approximate)
- Slurry Wall

Storm Drain Lines:

- Open Swale
- Underground Culvert
- Underground Culvert, Abandoned (Grouted at Manholes)

Sanitary Sewer Lines:

- Existing Sewer Line
- Removed Sewer Line
- Abandoned Sewer Line

Piezometer ID
MW-10A
5.27
Groundwater Elevation (FT NGVD29)

Note:
All data points surveyed to NGVD29.
Mean sea level = NGVD29 elevation (in feet) – 0.58 feet and mean sea level datum representative of Stege Marsh is derived from NOAA Richmond Inner Harbor tide gauge.

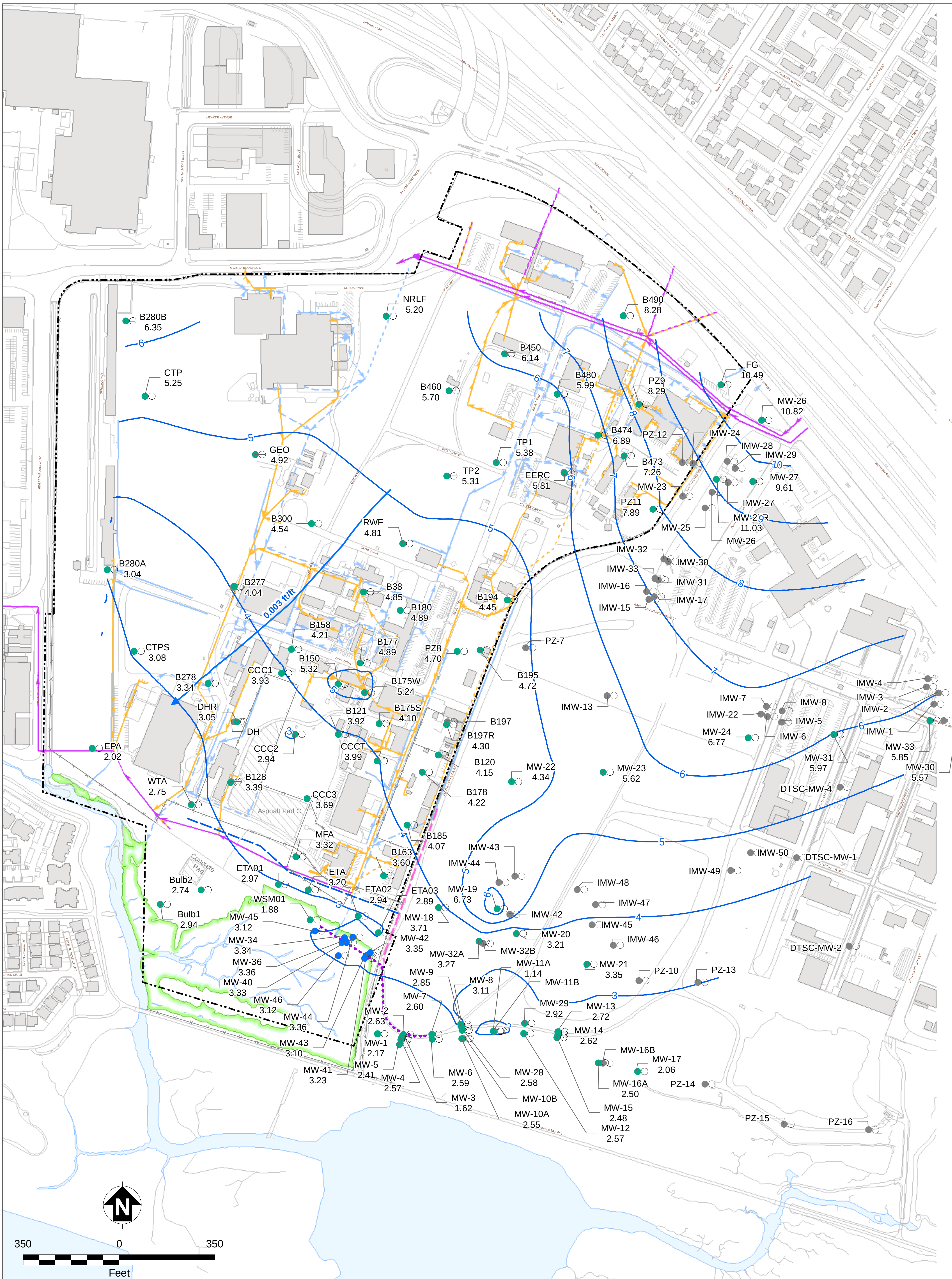
TETRA TECH

Richmond Field Station Site
University of California, Berkeley

FIGURE 13
SHALLOW GROUNDWATER ELEVATION CONTOURS, APRIL 1, 2015

2016 Groundwater Sampling Results

9/21/2016 V:\Misc_GIS\Richmond_Field_Station\Projects\009_GW_Sampling_Results_2016\13_Shallow_GW_Elevation_Contours 2015 April 1.mxd TtEMI-OAK simon.cardinale.



- Piezometer Groundwater Elevation Measured in October 2015
- Piezometer Groundwater Elevation Not Measured in October 2015
- BAPB Piezometers on RFS Property Measured in October 2015
- Estimated October 2015 Groundwater Contour
- Estimated Horizontal Groundwater Gradient Direction (Value)
- Existing Building
- Asphalt/Concrete Pad
- Surface Water
- Marsh Boundary
- Richmond Field Station Site Boundary
- Roads and Other Landscape Features
- Fenceline
- BAPB Wall
- Former Seawall (Approximate)
- Slurry Wall

Sanitary Sewer Lines:

- Existing City of Richmond Sewer
- Abandoned City of Richmond Sewer
- Existing RFS Sewer
- Abandoned RFS Sewer

Storm Drain Lines:

- Open Swale
- Underground Culvert
- Gutters
- Underground Culvert, Abandoned (Grouted at Manholes)

Piezometer ID
MW-10A
5.27
Groundwater Elevation (FT NGVD29)

Note:
All data points surveyed to NGVD29.
Mean sea level = NGVD29 elevation (in feet) – 0.58 feet and mean sea level datum representative of Stege Marsh is derived from NOAA Richmond Inner Harbor tide gauge.

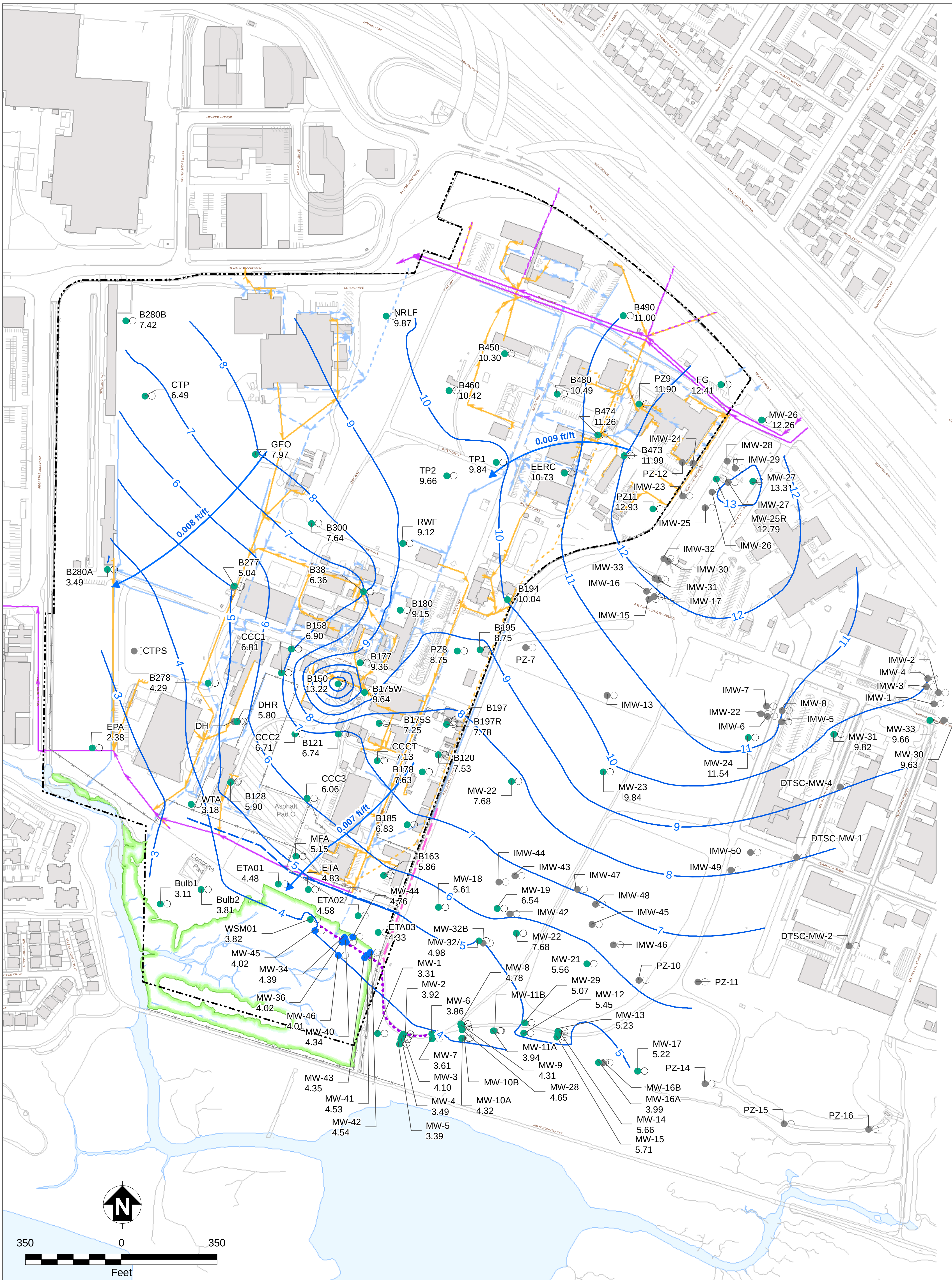
TETRA TECH

Richmond Field Station Site
University of California, Berkeley

FIGURE 14
SHALLOW GROUNDWATER ELEVATION CONTOURS, OCTOBER 5, 2015

2016 Groundwater Sampling Results

9/21/2016 V:\Misc_GIS\Richmond_Field_Station\Projects\009_GW_Sampling_Results_2016\14_Shallow_GW_Elevation_Contours 2015 October 5.mxd TtEMI-OAK simon.cardinale.



- Piezometer Groundwater Elevation Measured in April 2016
- Piezometer Groundwater Elevation Not Measured in April 2016
- BAPB Piezometers on RFS Property Measured in April 2016
- Estimated April 2016 Groundwater Contour
- Estimated Horizontal Groundwater Gradient Direction (Value)
- Existing Building
- Asphalt/Concrete Pad
- Surface Water
- Marsh Boundary
- Richmond Field Station Site Boundary
- Roads and Other Landscape Features
- Fenceline
- BAPB Wall
- Former Seawall (Approximate)
- Slurry Wall

Sanitary Sewer Lines:

- Existing City of Richmond Sewer
- Abandoned City of Richmond Sewer
- Existing RFS Sewer
- Abandoned RFS Sewer

Storm Drain Lines:

- Open Swale
- Underground Culvert
- Gutters
- Underground Culvert, Abandoned (Grouted at Manholes)

Piezometer ID
MW-10A
5.27
Groundwater Elevation (FT NGVD29)

Note:
All data points surveyed to NGVD29.
Mean sea level = NGVD29 elevation (in feet) – 0.58 feet and mean sea level datum representative of Stege Marsh is derived from NOAA Richmond Inner Harbor tide gauge.

TETRA TECH

Richmond Field Station Site
University of California, Berkeley

FIGURE 15
SHALLOW GROUNDWATER ELEVATION CONTOURS, APRIL 4, 2016

2016 Groundwater Sampling Results

9/25/2016 V:\Misc_GIS\Richmond_Field_Station\Projects\009_GW_Sampling_Results_2016\15_Shallow_GW_Elevation_Contours 2016 April 4.mxd TtEMI-OAK simon.cardinale.

APPENDIX H

3D Settlement Analysis

A3GEO

Appendix H – Summary of Settle 3D Analysis

OBJECTIVE

The objectives of the settlement analysis were to:

- Evaluate total settlement of the mat under various loading scenarios[1] and configurations;
- Evaluate differential settlement of the mat in both the longitudinal and transverse direction, under various loading scenarios and configurations.
- Compare the results of the differential settlement analysis to the ultra-flat slab performance criteria to determine whether a mat slab is a feasible foundation system for the proposed structure given the performance requirements; and
- Optimize the amount of over-excavation and replacement below the mat, and the type of backfill material, considering future building settlement performance, constructability, cost, and other factors.

APPROACH AND EVALUATION CRITERIA

A3GEO performed a three-dimensional settlement analysis for the proposed mat using the computer software program Settle3D, a three-dimensional program for the analysis of vertical consolidation and settlement under foundations by Rocscience, Inc. The program allows the user to model soil settlement response under three dimensional loading, but does not take into account the stiffness of the mat or hardened cellular concrete fill (soil-structure interaction effects), and thus presents a simplified model of soil response. In our simplified analyses, we assumed that the stiffness of the mat would be sufficient to distribute the load of the closely-spaced shelving units such that an average distributed bearing pressure could be used to model sustained live loads.

Analysis Steps

Generally, the analysis consisted of the following steps:

- Communicating with the Project design team to understand the magnitude and timing of the proposed loads;
- Developing three, parametric over-excavation and replacement scenarios, corresponding to varying depths of over-excavation and replacement and varying types of backfill;
- Developing representative subsurface stratigraphy based on the conditions observed in boreholes A3-17-1 and A3-17-2;
- Developing representative soil properties for the model using the results of geotechnical laboratory testing and visual observations from test borings A3-17-1 and A3-17-2;
- Calibrating the soil properties and model for NRLF Phase 4 based on data from NRLF Phase 3;
- Performing the Settle 3D analysis first assuming uniform post-construction book/shelf loading over 100% of the mat area, and subsequently with uniform post-construction book/shelf loading over limited (less than 50%) portions of the mat area;
- Preparing a set of output graphs showing the total settlement and instantaneous slope on the mat at transects across the mat in the transverse and longitudinal directions, for each of the scenarios.

[1] The loading scenarios analyzed included full-weight earth fill below the mat as well as two alternate scenarios utilizing lightweight cellular concrete fill. Cellular concrete is an engineered flowable fill material that, when set, is lighter, stronger and more rigid than soil.

Evaluation Criteria

Based on discussions with the project team, we understand that the ultra-flat slab performance requirement is tied to differential settlement across the wheel axles in both the longitudinal and transverse directions. Specifically, the criteria are as follows:

- ***Longitudinal Criterion:*** +/- 0.084 inch over 60 inches (0.0168 inch/foot)
- ***Transverse Criterion:*** +/- 0.071 inch over 45 inches (0.01893 inch/foot)

To observe visually where the slope of the mat slab exceeds the ultra-flat slab criteria based on the model, A3GEO plotted both the total settlement along longitudinal and transverse transects for various scenarios, and instantaneous slope along each transect, and compared this to the relevant criterion.

Parametric Loading Scenarios

A3GEO developed three loading scenarios for the parametric settlement analysis. A description of each of the three scenarios is as follows:

Scenario 1 – Scenario 1 involves the over-excavation and replacement of the top six (6) feet below the building footprint, and replacement with Non-Expansive Fill. Non-Expansive Fill is assumed to have a unit weight of 135 pounds per cubic foot (pcf), while the in-situ (excavated) material is assumed to have a unit weight of 120 pcf. In addition to the over-excavation and replacement, a uniform 3-foot grade raise, constructed from Non-Expansive Fill, is assumed across the building footprint.

Scenario 2 – Scenario 2 involves the over-excavation and replacement of the top three (3) feet below the building footprint, and replacement with lightweight cellular concrete. Cellular concrete is assumed to have a unit weight of 35 pcf, while the in-situ (excavated) material is assumed to have a unit weight of 120 pcf. In addition to the over-excavation and replacement, a uniform 3-foot grade raise, constructed from cellular concrete, is assumed across the building footprint.

Scenario 3 – Scenario 3 involves the over-excavation and replacement of the top six (6) feet below the building footprint, and replacement with lightweight cellular concrete. Cellular concrete is assumed to have a unit weight of 35 pcf, while the in-situ (excavated) material is assumed to have a unit weight of 120 pcf. In addition to the over-excavation and replacement, a uniform 3-foot grade raise, constructed from cellular concrete, is assumed across the building footprint.

Loading

Based on conversations with the structural engineer and an analysis of loads generated from loading/unloading associated with Scenarios 1 through 3 outlined above, the following loading sources were identified, with magnitudes and anticipated timing of load application:

	Initial Load				Post-Construction Load			
Loading Scenario	Building Slabs	Building Dead Load	Grade Raise	Excavation and Replacement	Books and Shelving	Total Initial Load	Total Post-Construction Load	Total Load
	(psf)	(psf)	(psf)	(psf)	(psf)	(psf)	(psf)	(psf)
Scenario 1	325	80	405	90	675	900	675	1575
Scenario 2	325	80	105	-255	675	255	675	930
Scenario 3	325	80	105	-510	675	0	675	675

Loading Configuration Cases

Each of the loading scenarios outlined above was analyzed for each of the loading configuration cases described below, and shown on Figure 2:

> ***Scenarios 1A, 2A, 3A*** – Scenarios 1A, 2A, and 3A modeled 100% of the uniform initial load (900 psf, 255 psf, and 0 psf, respectively) over the entire mat footprint, followed by 100% of the post-construction load (675 psf) over the entire mat footprint. The purpose of the “A” scenarios was to understand settlement/slope behavior assuming post-construction book loads were applied uniformly. “A” scenarios were used to generate both transverse and longitudinal cross sections across the mat.
>
> ***Scenarios 1X, 2X, 3X –*** Scenarios 1X, 2X, and 3X modeled 100% of the uniform initial load over the entire mat footprint, followed by 100% of the post-construction load (675 psf) over the south portion of the proposed stack area. The purpose of the “X” scenarios was to understand settlement/slope behavior assuming post-construction book loads are distributed over a limited portion of the mat. “X” scenarios were used to generate longitudinal cross sections across the mat.
>
> ***Scenarios 1Y, 2Y, 3Y –*** Scenarios 1Y, 2Y, and 3Y modeled 100% of the uniform initial load over the entire mat footprint, followed by 100% of the post-construction load (675) over the west portion of the proposed stack area. The purpose of the “Y” scenarios was to understand settlement/slope behavior assuming post-construction book loads are distributed over a limited portion of the mat. “Y” scenarios were used to generate transverse cross sections across the mat.

Loading was applied in the Settle3D model using the Boussinesq stress computation method.

Subsurface Stratigraphic Model

Each scenario, 1A through 3Y, was analyzed twice – once using idealized stratigraphic conditions based on geology observed in test boring A3-17-1, and once using geology observed in A3-17-2. The geologic assumptions incorporated into the model are described further in the section below.

SITE AND SUBSURFACE CONDITIONS

Recent A3GEO test borings A3-17-1 and A3-17-2 were used to model subsurface conditions. Where determined necessary, information from historic test borings by others from previous NRLF investigations was incorporated into the model. Observed conditions were generalized into “idealized” stratigraphic layers, each assigned soil properties as described in the table below.

Soil Properties

Soil properties were estimated based primarily on laboratory test results while considering the soil descriptions and Standard Penetration Test (SPT) N-values. Consolidation indices were estimated based on the results of recent consolidation testing performed on samples from borings A3-17-1 and A3-17-2, and historic samples performed on borings from earlier phases from the NRLF development.

Settle3D allows the designer to analyze various types of settlement for each soil layer, including immediate settlement and primary consolidation settlement. Immediate settlement, or distortion, is the “*rearrangement of grains due to changing stress, resulting in a reduction in void ratio and instant settlement*” (RocScience, 2018). Immediately settlement is estimated using elastic theory. Primary consolidation occurs as the soil particles respond to loading by rearranging into a tighter packing configuration, which leads a decrease in soil void ratio as water is expelled (Coduto, 1999; Rocscience, 2018).

In accordance with guidance documents provided by the developers of Settle3D (RocScience, 2018), our model utilized the following methods:

Material Name	Immediate	Primary Consolidation
Granular Materials	x	
Unsaturated Clays	x	
Saturated Clays		x

Material properties used in the Settle3D analysis are summarized in the table below:

			Immediate Settlement	Primary Consolidation			
Material	Unit Weight (pcf)	Poisson's Ratio	Equivalent Modulus of Elasticity (ksf)	Compression Ratio, C_{ce}	Recompression Ratio, C_{re}	OCR, top of stratum	OCR, bottom of stratum
Non-Expansive Fill	135	0.4	2820	--	--	--	--
Cellular Concrete	120	0.12	--	--	--	--	--
Clay 1 – Unsat.	120	0.3	600	--	--	--	--
Clay 2 – Unsat.	120	0.3	730	--	--	--	--
Clay 2 – Sat.	125	0.49	--	0.54	0.015	4	2
Clay 3 – Sat.	125	0.49	--	0.54	0.02	2	2
Clay 4 – Sat.	125	0.49	--	0.54	0.02	2	2
Sand/Gravel 1	135	0.3	1200	--	--	--	--
Sand/Gravel 2	135	0.35	1600	--	--	--	--

NOTES:
1. Unsat. = Unsaturated; Sat. = Saturated
2. Cellular concrete was modeled as 120 pcf to match the unit weight of the existing soil to be excavated. The unload due to switching to the 35 pcf cellular concrete as backfill was accounted for in the applied initial load instead. The cellular concrete was modeled as vertically incompressible.
3. OCR = overconsolidation ratio.
4. All clays were modeled as overconsolidated and with new loading, remained in recompression. As such, the compression ratio was not actually used in model computations.

Groundwater

Groundwater was assumed at 13 feet below ground surface.

SETTLEMENT ANALYSIS RESULTS

A3GEO analyzed settlement for each of the loading cases described above, each at borehole location A3-17-1 and A3-17-2. For initial loading, only primary consolidation settlement was considered. Immediate settlement was ignored for initial loading because any immediate settlement caused by load application due to grade raise, slab placement, and building dead load, will presumably be complete by the time the final topping slab is prepared. Minor differential settlement present in the mat surface can be corrected during topping slab construction. For post-construction loading (book loads and shelves), both immediate and primary consolidation settlements were considered.

A summary of settlement for various loading scenarios is provided on Table H1. Data in the table is broken down into the following types of settlement:

- Settlement due to initial loading – primary consolidation settlement;
- Settlement due to post-construction loading – immediate settlement; and
- Settlement due to post-construction loading – primary consolidation settlement.

The table also presents the total settlement for both the initial loading and post-construction loading phases, which is assumed to be the sum of the three sources of settlement shown above. This is a conservative assumption, as some of the consolidation settlement caused by initial loading will have been complete by the time the topping slab is constructed, and the book loads are added. However, because we do not know how quickly consolidation settlement will occur and how long construction will take, we have conservatively assumed that none of the consolidation settlement due to the initial load will have taken place before completion of building construction.

Uniform Book Loading Over 100% of Mat Footprint

Uniform book loading over the entire mat footprint was modeled in Scenarios 1A through 3A. Total settlement was at a maximum in the center of the mat footprint, and ranged from approximately 1.6 to 2 inches for Scenario 1A, 1.15 to 1.4 inches for Scenario 2A, and 0.9 to 1.05 inches for Scenario 3A.

Plots of instantaneous slope for Scenarios 1A through 3A indicate the slope exceeds the transverse and longitudinal slope criteria on the edges of the mat for each of the three loading scenarios.

- Scenario 1A exceeds the transverse and longitudinal slope criteria for a distance of up to approximately 15 and 18 feet from the edge of the wall, respectively.
- Scenario 2A exceeds the transverse and longitudinal slope criteria for a distance of approximately 10 feet and 11 ft from the inside edge of the wall, respectively.
- Scenario 3A exceeds the transverse and longitudinal slope criteria for a distance of approximately 5 and 7 ft from the inside edge of the wall, respectively.

Uniform Book Loading Over Partial Mat Footprint

<u>X Scenarios</u>

Uniform book loading over the partial mat area (split in the north-south direction) was modeled in Scenarios 1X, 2X, and 3X. Total settlement was at a maximum below the south portion of the mat and ranged from approximately 1.5 to 1.9 inches for Scenario 1X, 1.05 to 1.2 inches for Scenario 2X, and 0.8 to 0.9 inches for Scenario 3X.

Plots of instantaneous slope for Scenarios 1X through 3X indicate the slope exceeds the longitudinal slope criterion for the south edge of the mat at each of the three loading scenarios.

- Scenario 1X exceeds the longitudinal slope criterion at a distance of up to approximately 17 feet from the edge of the wall.
- Scenario 2X exceeds the longitudinal slope criterion at a distance of up to approximately 10 feet from the edge of the wall.
- Scenario 3X exceeds the longitudinal slope criterion at a distance of up to approximately 7 feet from the edge of the wall.

Additionally, Scenarios 1X through 3X exceed the longitudinal criterion in the center portion of the mat, at the transition from 100% book loading to no book loading. Scenario 1X also exceeds the longitudinal criterion at the north edge of the mat.

<u>Y Scenarios</u>

Uniform book loading over the partial mat area (split in the east-west direction) was modeled in Scenarios 1Y, 2Y, and 3Y. Total settlement was at a maximum in the west portion of the mat and ranged from approximately 1.4 to 2 inches for Scenario 1Y, 0.95 to 1.1 inches for Scenario 2Y, and 0.7 to 0.8 inches for Scenario 3Y.

Plots of instantaneous slope for Scenarios 1Y through 3Y indicate the slope exceeds the transverse slope criterion for the west edge of the mat at each of the three loading scenarios.

- Scenario 1Y exceeds the transverse slope criterion at a distance of up to approximately 11 feet from the edge of the wall.
- Scenario 2Y exceeds the transverse slope criterion at a distance of up to approximately 6 feet from the edge of the wall.
- Scenario 3Y exceeds the transverse slope criterion at a distance of up to approximately 3 feet from the edge of the wall.

Additionally, Scenarios 1Y through 3Y exceed the transverse criterion at the center portion of the mat, at the transition from 100% book loading to no book loading. Scenario 1Y also exceeds the transverse criterion at the east edge of the mat.

Appendix H

NRLF Phase 3:
Floor Level Survey & Transect Plots

TOPOGRAPHIC SURVEY

UNIVERSITY OF CALIFORNIA, BERKELEY
NORTHERN REGIONAL LIBRARY FACILITY
PHASE 3 LEVEL 1 FLOOR ELEVATIONS

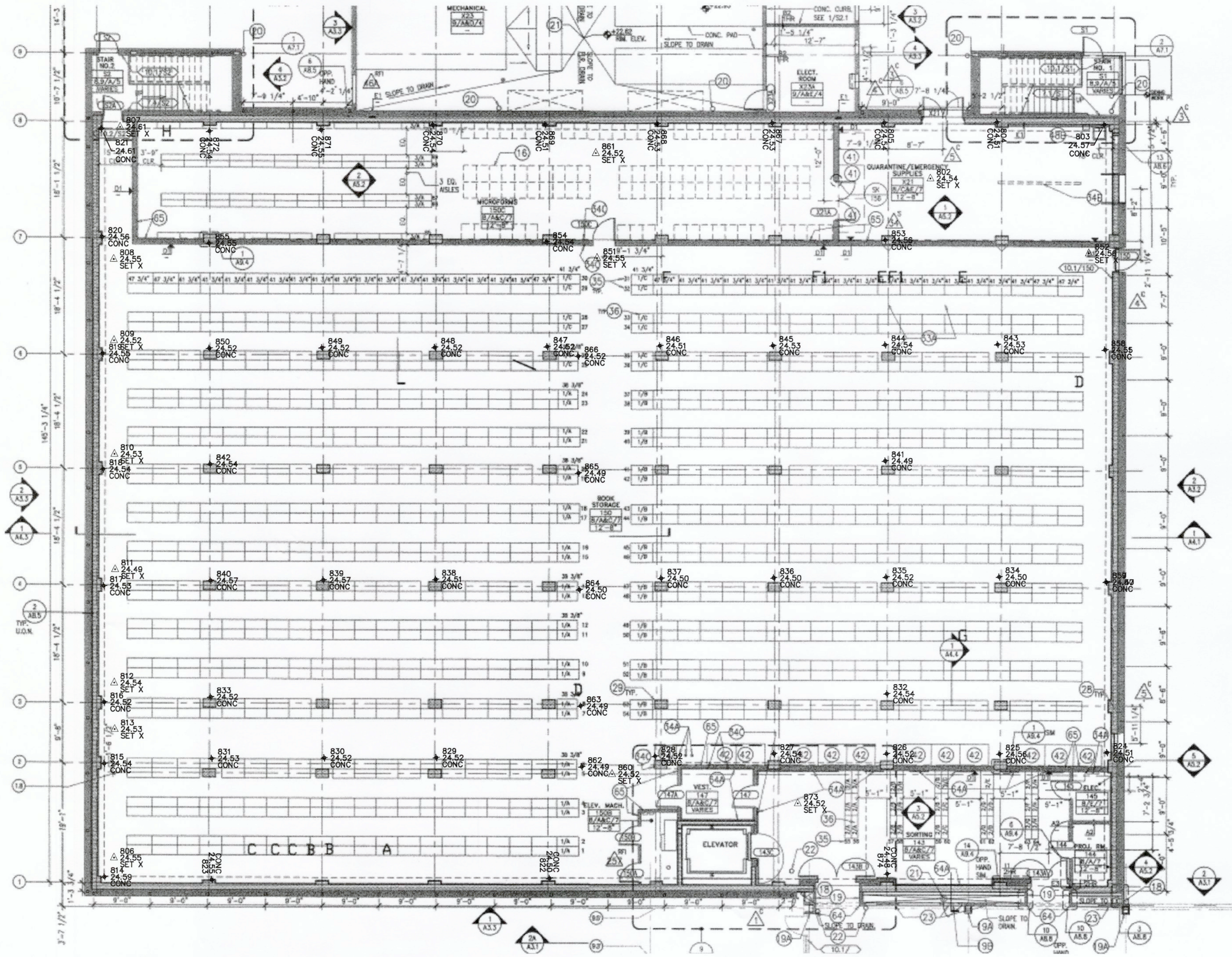
CITY OF RICHMOND, COUNTY OF CONTRA COSTA, STATE OF CALIFORNIA

DECEMBER – 2017

N

40 20 0 40 80 120

SCALE IN FEET



POINT TABLE

POINT #	NORTHING	EASTING	ELEVATION	DESC.
800	2161935.23	6032068.40	21.93	SET MAG
801	2161936.35	6032199.52	22.89	SET MAG
802	2161877.65	6032197.27	24.54	SET X
803	2161886.15	6032224.73	24.57	CNC
804	2161886.53	6032207.81	24.51	CNC
805	2161886.44	6032190.00	24.54	CNC
806	2161770.32	6032068.36	24.55	SET X
807	2161885.74	6032069.29	24.61	SET X
808	2161864.97	6032068.27	24.55	SET X
809	2161852.13	6032068.32	24.52	SET X
810	2161834.11	6032068.39	24.53	SET X
811	2161815.90	6032068.50	24.49	SET X
812	2161798.04	6032068.36	24.54	SET X
813	2161790.67	6032068.45	24.53	SET X
814	2161767.27	6032066.86	24.59	CNC
815	2161785.21	6032066.82	24.54	CNC
816	2161794.95	6032066.78	24.52	CNC
817	2161813.28	6032066.71	24.53	CNC
818	2161831.71	6032066.60	24.54	CNC
819	2161850.04	6032066.53	24.55	CNC
820	2161868.44	6032066.42	24.56	CNC
821	2161885.46	6032066.34	24.61	CNC
822	2161767.12	6032137.21	24.50	CNC
823	2161766.87	6032083.86	24.55	CNC
824	2161787.08	6032225.18	24.51	CNC
825	2161786.81	6032208.24	24.56	CNC
826	2161786.81	6032190.40	24.52	CNC
827	2161786.84	6032172.62	24.54	CNC
828	2161786.43	6032153.84	24.52	CNC
829	2161786.22	6032119.30	24.52	CNC
830	2161786.17	6032101.60	24.52	CNC
831	2161786.08	6032083.82	24.53	CNC
832	2161796.35	6032190.44	24.54	CNC
833	2161795.82	6032083.64	24.52	CNC
834	2161814.76	6032208.18	24.50	CNC
835	2161814.71	6032190.31	24.52	CNC
836	2161814.59	6032172.56	24.50	CNC
837	2161814.50	6032154.77	24.50	CNC

POINT TABLE

POINT #	NORTHING	EASTING	ELEVATION	DESC.
838	2161814.36	6032119.20	24.51	CNC
839	2161814.26	6032101.43	24.57	CNC
840	2161814.18	6032083.61	24.57	CNC
841	2161833.06	6032190.16	24.49	CNC
842	2161832.55	6032083.54	24.54	CNC
843	2161851.53	6032207.90	24.53	CNC
844	2161851.45	6032190.13	24.54	CNC
845	2161851.33	6032172.41	24.53	CNC
846	2161851.30	6032154.56	24.51	CNC
847	2161851.19	6032136.79	24.52	CNC
848	2161851.06	6032119.04	24.52	CNC
849	2161851.02	6032101.21	24.52	CNC
850	2161850.92	6032083.41	24.52	CNC
851	2161865.19	6032144.67	24.55	SET X
852	2161865.94	6032222.30	24.56	SET X
853	2161867.96	6032190.15	24.56	CNC
854	2161867.72	6032136.70	24.54	CNC
855	2161867.48	6032083.35	24.55	CNC
856	2161850.71	6032224.84	24.55	CNC
857	2161814.00	6032225.03	24.50	CNC
858	2161850.70	6032224.84	24.51	CNC
859	2161813.99	6032225.03	24.47	CNC
860	2161783.66	6032147.07	24.52	SET X
861	2161881.67	6032144.48	24.52	SET X
862	2161784.80	6032142.28	24.49	CNC
863	2161794.41	6032142.10	24.49	CNC
864	2161812.77	6032141.89	24.50	CNC
865	2161831.15	6032141.73	24.49	CNC
866	2161849.68	6032141.69	24.52	CNC
867	2161886.39	6032172.30	24.53	CNC
868	2161886.26	6032154.15	24.53	CNC
869	2161886.15	6032136.50	24.51	CNC
870	2161886.10	6032118.73	24.54	CNC
871	2161885.30	6032101.10	24.55	CNC
872	2161885.09	6032083.44	24.54	CNC
873	2161778.99	6032176.37	24.52	SET X
874	2161767.81	6032190.51	24.48	CNC

DATUM NOTE:

ELEVATIONS SHOWN HEREON ARE AS SHOWN ON THE PLAN FOR THE NORTHERN REGIONAL LIBRARY FACILITY PHASE 3, SHEET NO. C2. ENTITLED UTILITIES: PHASE IV AND EXISTING, AS DESCRIBED BELOW;

ELEVATION BASED ON TBM AT TOP OF FIRE HYDRANT AT ELEVATION = 25.58', AS SHOWN ON THE SURVEY BY DAVID J. RUSSELL, L.S. DATED JUNE 1988.

THIS TOPOGRAPHIC SURVEY WAS DONE BY A FIELD CREW UNDER THE SUPERVISION OF ALEXANDER FONG, DECEMBER 20, 2017.

Alexander Fong 12/20/2017

ALEXANDER V, FONG DATE:
PLS 9252

LICENSED LAND SURVEYOR
ALEXANDER VICTORIO FONG
No. 9252
STATE OF CALIFORNIA

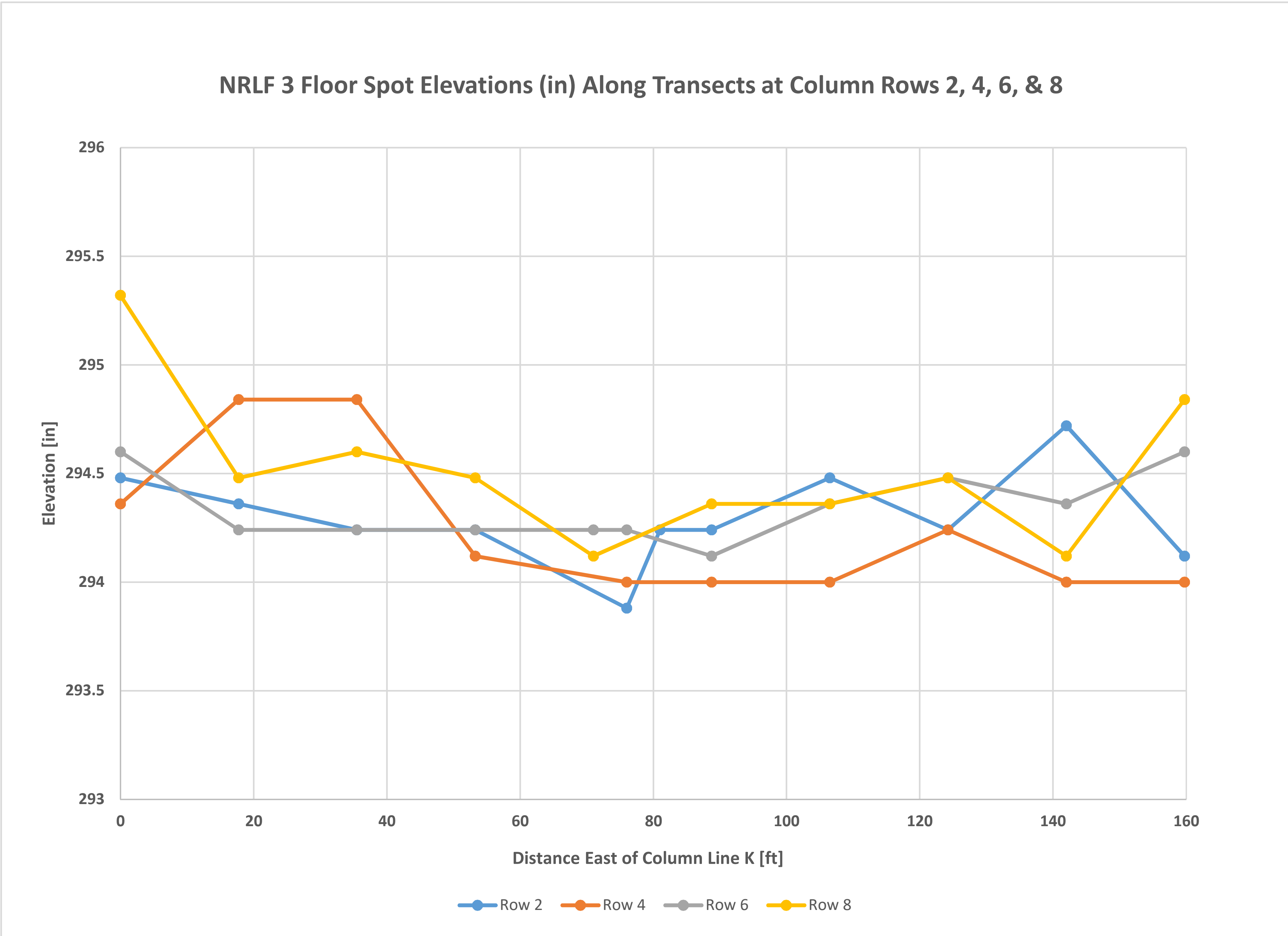
Bellecci & Associates, inc.

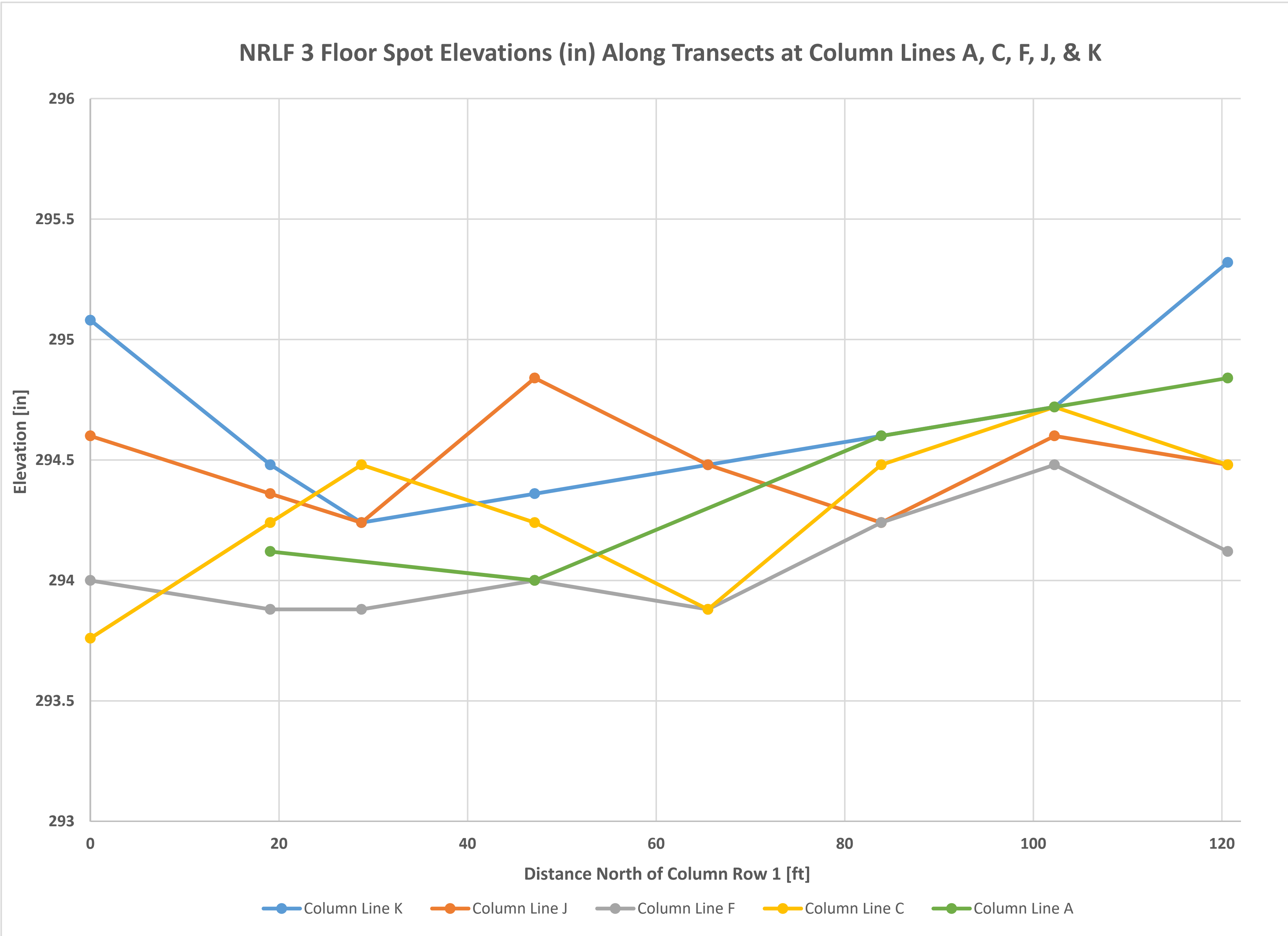
Civil Engineering • Land Surveying

2290 Diamond Boulevard, Suite 100 Concord, CA 94520
Phone (925) 685-4569 Fax (925) 685-4838

SHEET 1 OF 1

JOB NO. 17160


NRLF 3 Floor Spot Elevations (in) Along Transects at Column Rows 2, 4, 6, & 8
Elevation [in]
296
295.5
295
294.5
294
293.5
293
0
20
40
60
80
100
120
140
160
Distance East of Column Line K [ft]
Row 2
Row 4
Row 6
Row 8



NRLF 3 Floor Spot Elevations (in) Along Transects at Column Lines A, C, F, J, & K
296
295.5
295
294.5
294
293.5
293
Elevation [in]
0
20
40
60
80
100
120
Distance North of Column Row 1 [ft]
Column Line K
Column Line J
Column Line F
Column Line C
Column Line A

A3GEO

Appendix H

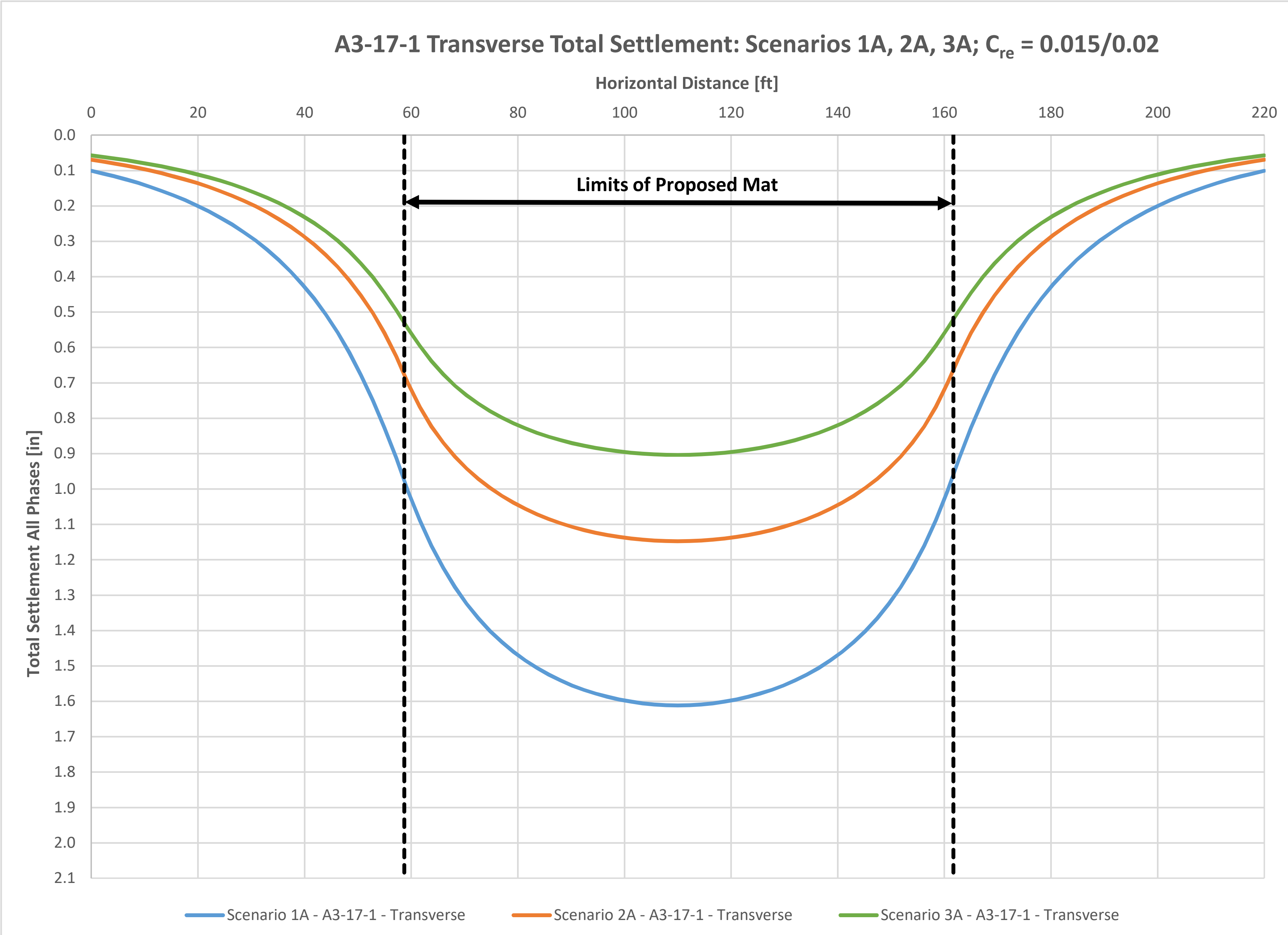
Table H1 – Summary of Settle 3D Analysis

TABLE H1: SUMMARY OF SETTLE 3D ANALYSIS
GEOTECHNICAL INVESTIGATION - NRLF PHASE 4 EXPANSION
UNIVERSITY OF CALIFORNIA - BERKELEY
RICHMOND, CALIFORNIA
1101-17A

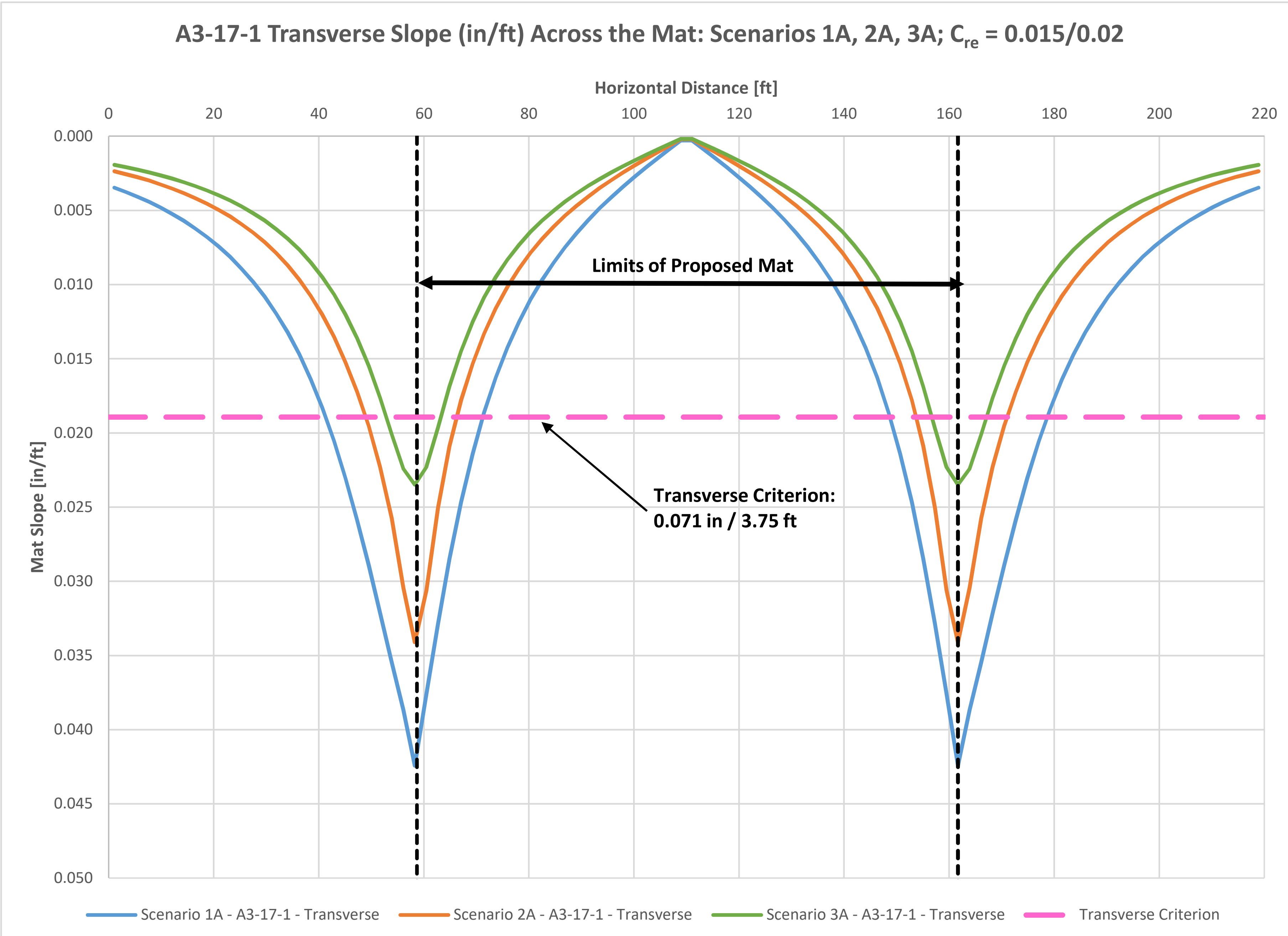
Scenario ID	Initial Load (psf)	Post-Construction Load (psf)	Total Load (psf)	A3-17-1					A3-17-2				
				Initial Load - Consol Settlement (in)	Post-Construction Load - Immediate Settlement (in)	Post-Construction Load - Consol. Settlement (in)	Total Post-Construction Settlement (in)	Total Settlement - All Phases (in)	Initial Load - Consol Settlement (in)	Post-Construction Load - Immediate Settlement (in)	Post-Construction Load - Consol. Settlement (in)	Total Post-Construction Settlement (in)	Total Settlement - All Phases (in)
Scenario 1A	900	675	1575	0.82	0.28	0.51	0.79	1.61	1.13	0.18	0.72	0.90	2.03
Scenario 2A	255	675	930	0.25	0.30	0.60	0.90	1.15	0.35	0.20	0.82	1.02	1.37
Scenario 3A	0	675	675	0	0.27	0.64	0.91	0.91	0	0.17	0.87	1.04	1.04
Scenario 1X	900	675	900 / 1575	0.82	0.23	0.45	0.68	1.50	1.13	0.16	0.58	0.74	1.87
Scenario 2X	255	675	255 / 930	0.25	0.26	0.54	0.80	1.05	0.35	0.19	0.69	0.88	1.23
Scenario 3X	0	675	0 / 675	0	0.23	0.59	0.82	0.82	0	0.16	0.76	0.92	0.92
Scenario 1Y	900	675	900 / 1575	0.82	0.20	0.36	0.56	1.38	1.13	0.39	0.47	0.86	1.99
Scenario 2Y	255	675	255 / 930	0.25	0.23	0.46	0.69	0.94	0.34	0.17	0.59	0.76	1.10
Scenario 3Y	0	675	0 / 675	0	0.20	0.50	0.70	0.70	0	0.14	0.64	0.78	0.78

Appendix H

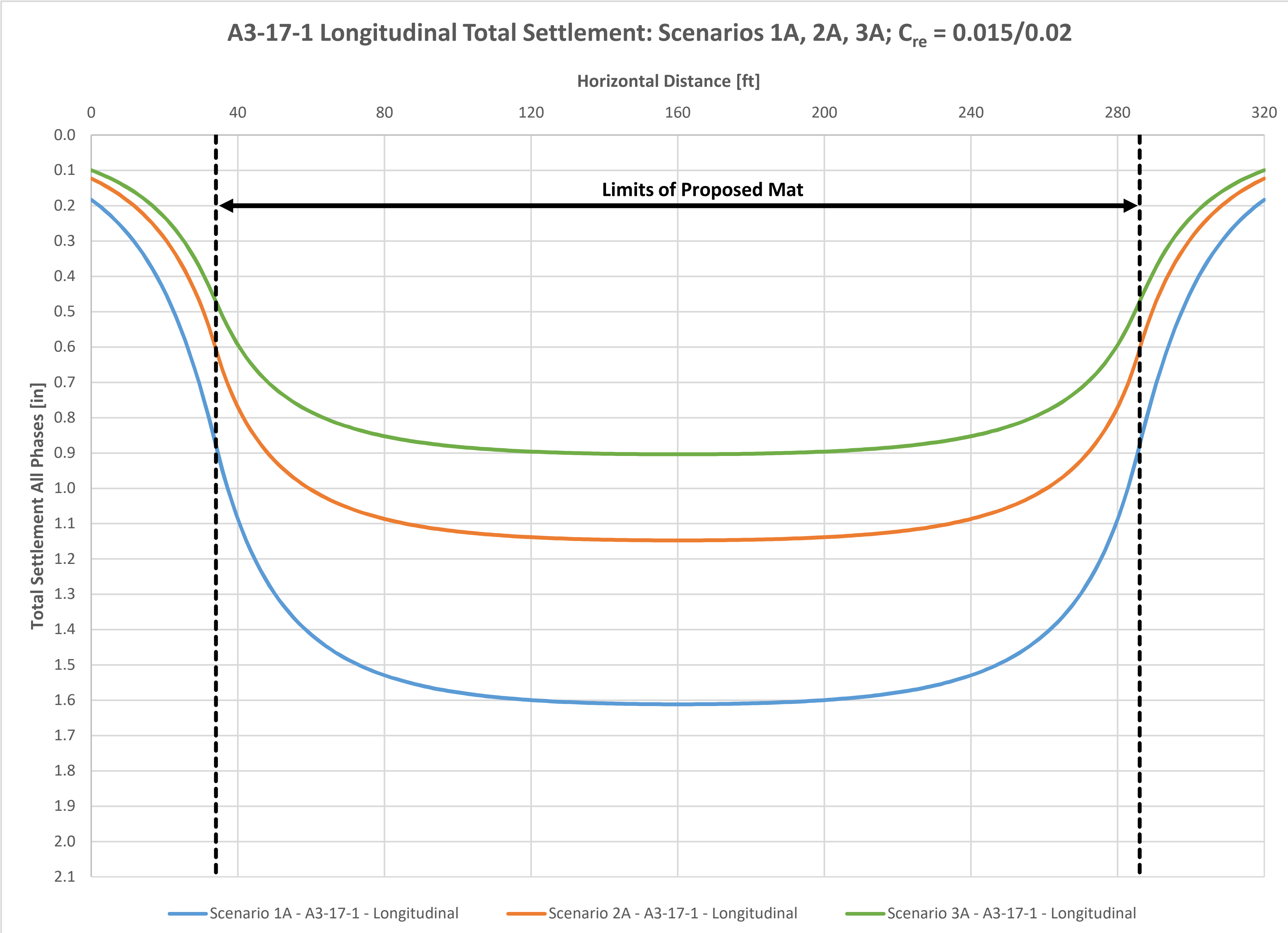
Settlement Plots:
Scenarios 1A, 2A, 3A – A3-17-1


A3-17-1 Transverse Total Settlement: Scenarios 1A, 2A, 3A; C_{re} = 0.015/0.02
Horizontal Distance [ft]
0
20
40
60
80
100
120
140
160
180
200
220
Total Settlement All Phases [in]
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1.1
1.2
1.3
1.4
1.5
1.6
1.7
1.8
1.9
2.0
2.1
Limits of Proposed Mat
Scenario 1A - A3-17-1 - Transverse
Scenario 2A - A3-17-1 - Transverse
Scenario 3A - A3-17-1 - Transverse

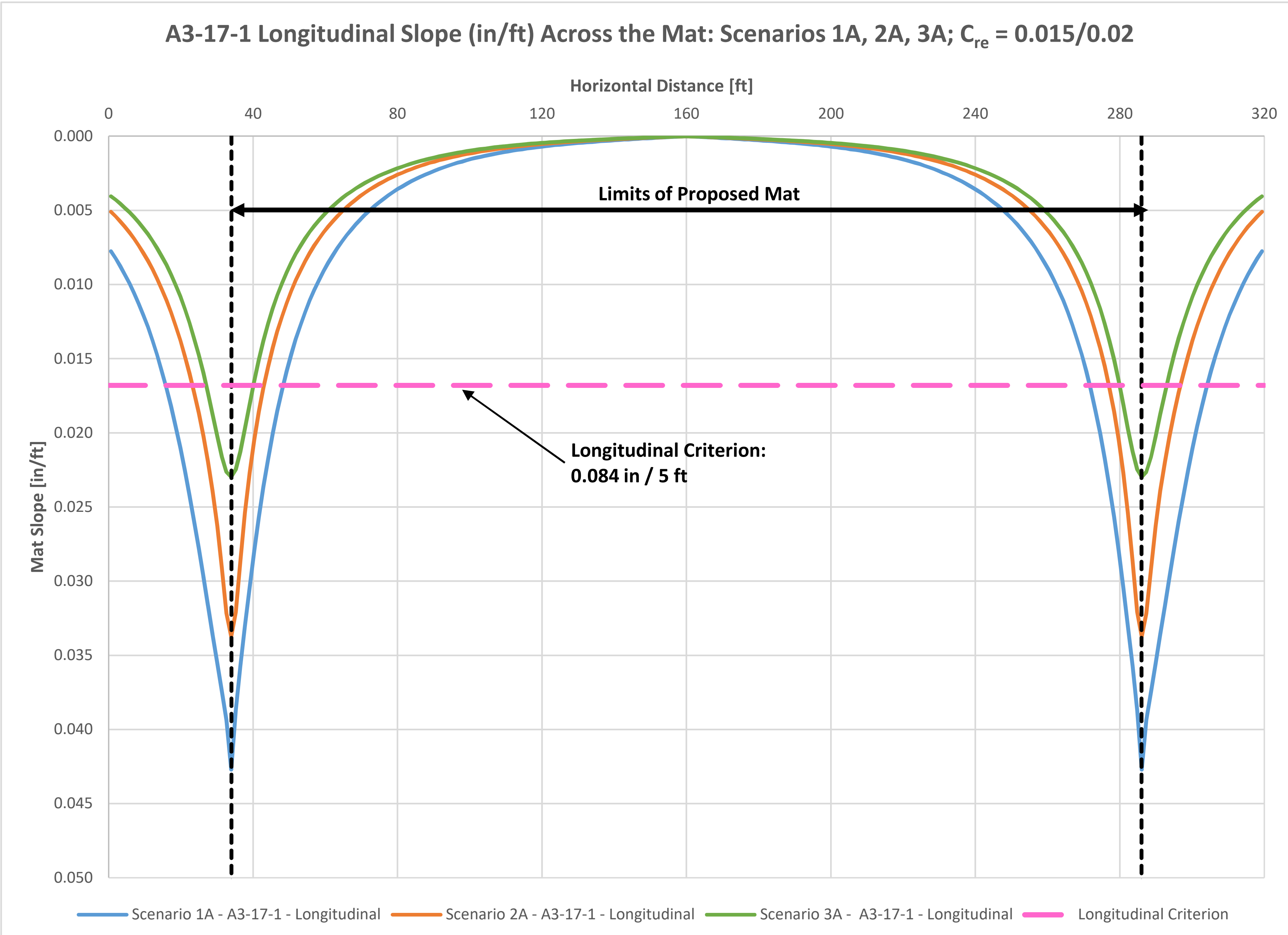
A3GEO



A3-17-1 Transverse Slope (in/ft) Across the Mat: Scenarios 1A, 2A, 3A; C_{re} = 0.015/0.02
Horizontal Distance [ft]
0
20
40
60
80
100
120
140
160
180
200
220
Mat Slope [in/ft]
0.000
0.005
0.010
0.015
0.020
0.025
0.030
0.035
0.040
0.045
0.050
Limits of Proposed Mat
Transverse Criterion:
0.071 in / 3.75 ft
Scenario 1A - A3-17-1 - Transverse
Scenario 2A - A3-17-1 - Transverse
Scenario 3A - A3-17-1 - Transverse
Transverse Criterion
A3GEO



A3-17-1 Longitudinal Total Settlement: Scenarios 1A, 2A, 3A; C_{re} = 0.015/0.02
Horizontal Distance [ft]
0
40
80
120
160
200
240
280
320
Total Settlement All Phases [in]
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1.1
1.2
1.3
1.4
1.5
1.6
1.7
1.8
1.9
2.0
2.1
Limits of Proposed Mat
Scenario 1A - A3-17-1 - Longitudinal
Scenario 2A - A3-17-1 - Longitudinal
Scenario 3A - A3-17-1 - Longitudinal

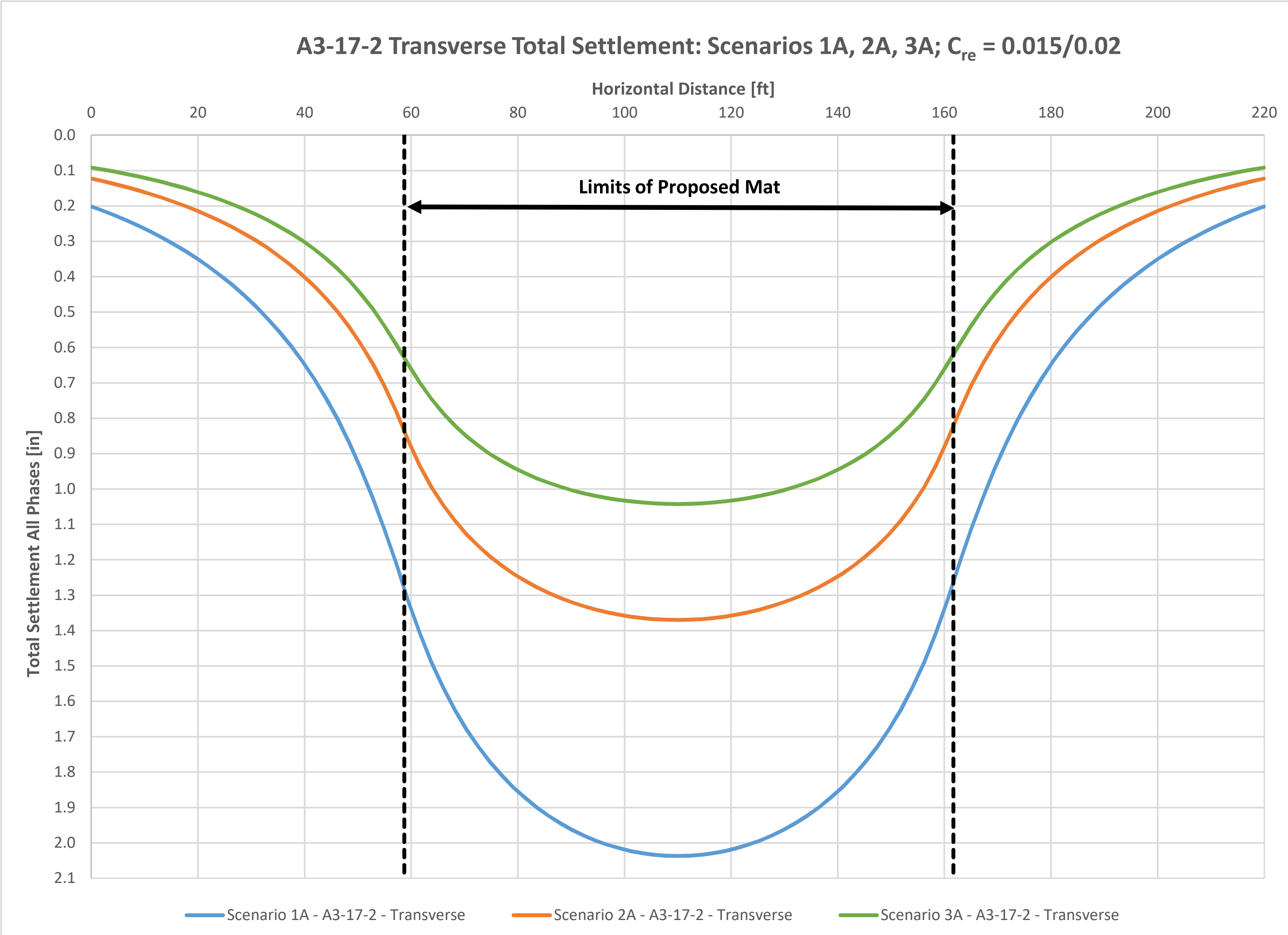


A3-17-1 Longitudinal Slope (in/ft) Across the Mat: Scenarios 1A, 2A, 3A; C_{re} = 0.015/0.02
Horizontal Distance [ft]
0
40
80
120
160
200
240
280
320
Mat Slope [in/ft]
0.000
0.005
0.010
0.015
0.020
0.025
0.030
0.035
0.040
0.045
0.050
Limits of Proposed Mat
Longitudinal Criterion:
0.084 in / 5 ft
Scenario 1A - A3-17-1 - Longitudinal
Scenario 2A - A3-17-1 - Longitudinal
Scenario 3A - A3-17-1 - Longitudinal
Longitudinal Criterion

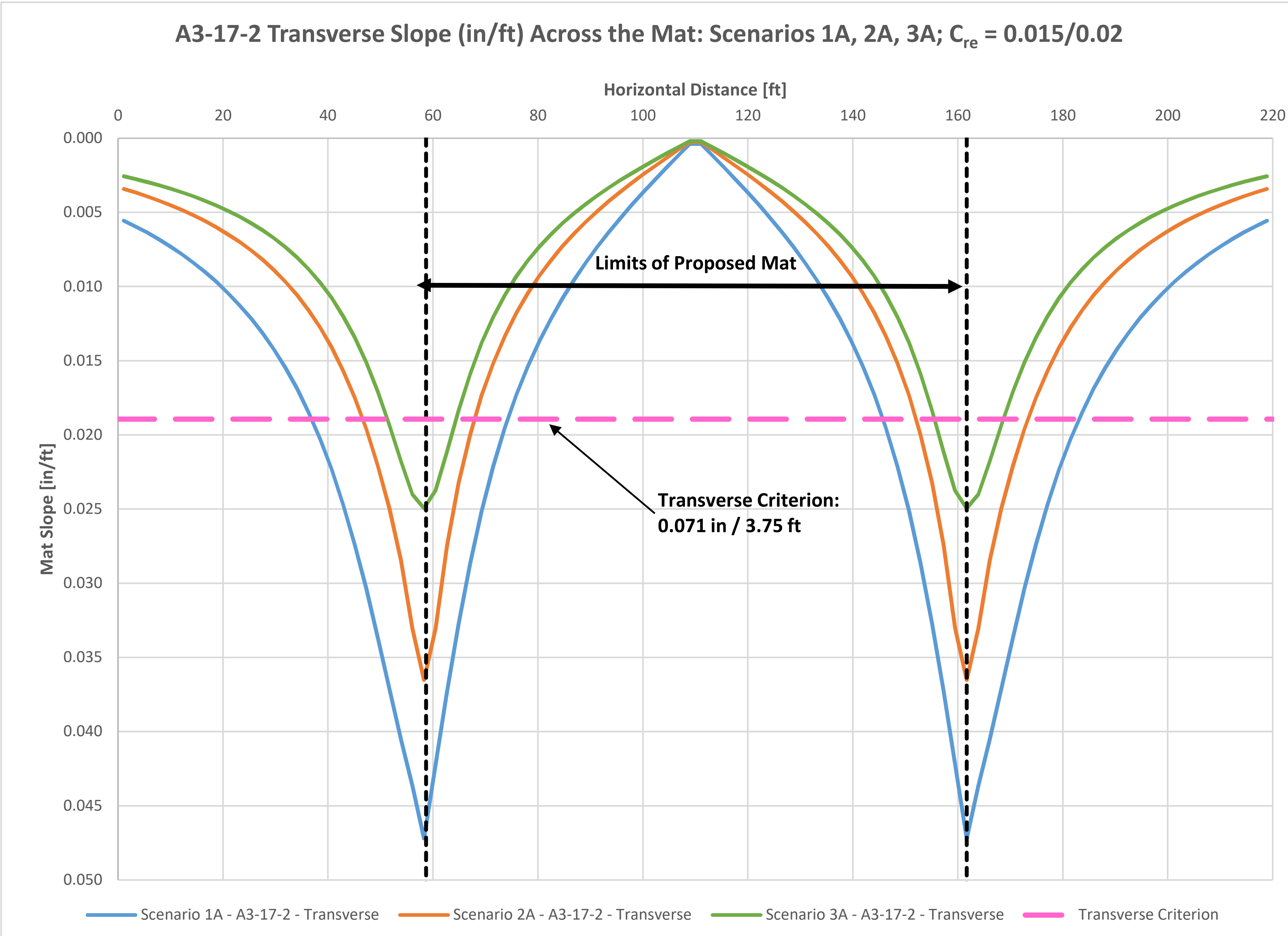
A3GEO

Appendix H

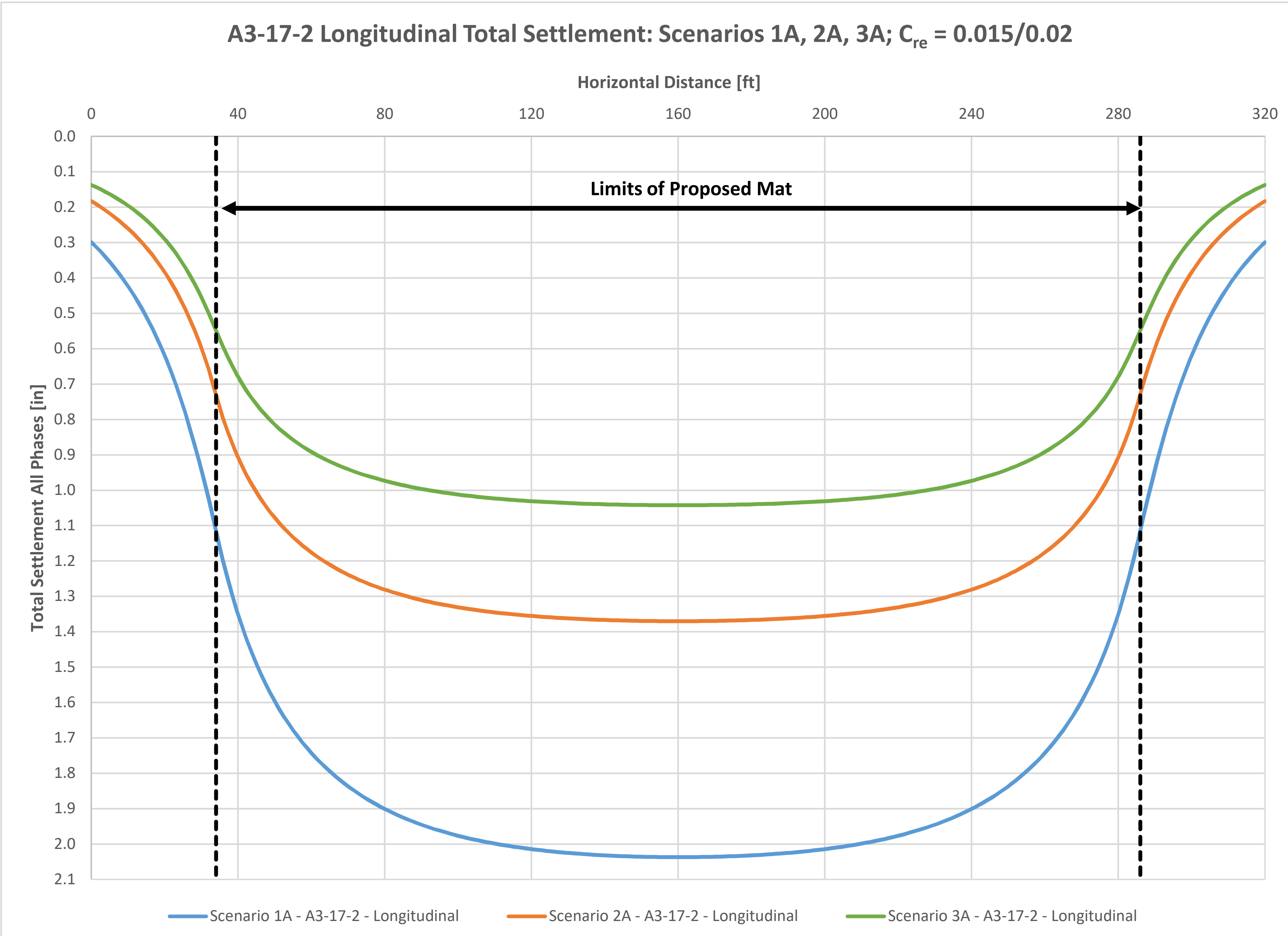
Settlement Plots:
Scenarios 1A, 2A, 3A – A3-17-2



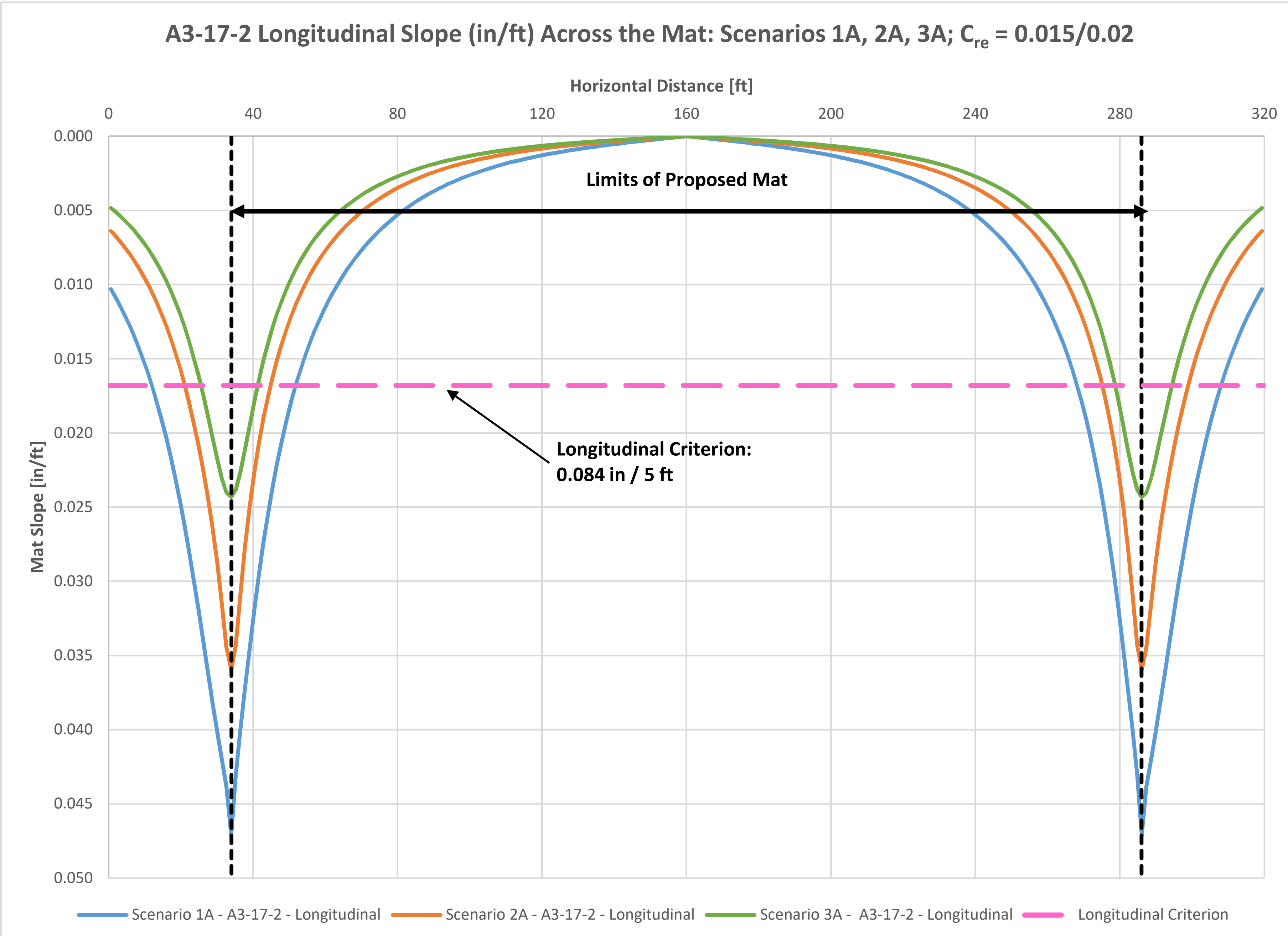
A3-17-2 Transverse Total Settlement: Scenarios 1A, 2A, 3A; C_{re} = 0.015/0.02
Horizontal Distance [ft]
0
20
40
60
80
100
120
140
160
180
200
220
Total Settlement All Phases [in]
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1.1
1.2
1.3
1.4
1.5
1.6
1.7
1.8
1.9
2.0
2.1
Limits of Proposed Mat
Scenario 1A - A3-17-2 - Transverse
Scenario 2A - A3-17-2 - Transverse
Scenario 3A - A3-17-2 - Transverse



A3-17-2 Transverse Slope (in/ft) Across the Mat: Scenarios 1A, 2A, 3A; C_{re} = 0.015/0.02
Horizontal Distance [ft]
0
20
40
60
80
100
120
140
160
180
200
220
0.000
0.005
0.010
0.015
0.020
0.025
0.030
0.035
0.040
0.045
0.050
Mat Slope [in/ft]
Limits of Proposed Mat
Transverse Criterion:
0.071 in / 3.75 ft
Scenario 1A - A3-17-2 - Transverse
Scenario 2A - A3-17-2 - Transverse
Scenario 3A - A3-17-2 - Transverse
Transverse Criterion
A3GEO


A3-17-2 Longitudinal Total Settlement: Scenarios 1A, 2A, 3A; C_{re} = 0.015/0.02
Horizontal Distance [ft]
0
40
80
120
160
200
240
280
320
Total Settlement All Phases [in]
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1.1
1.2
1.3
1.4
1.5
1.6
1.7
1.8
1.9
2.0
2.1
Limits of Proposed Mat
Scenario 1A - A3-17-2 - Longitudinal
Scenario 2A - A3-17-2 - Longitudinal
Scenario 3A - A3-17-2 - Longitudinal

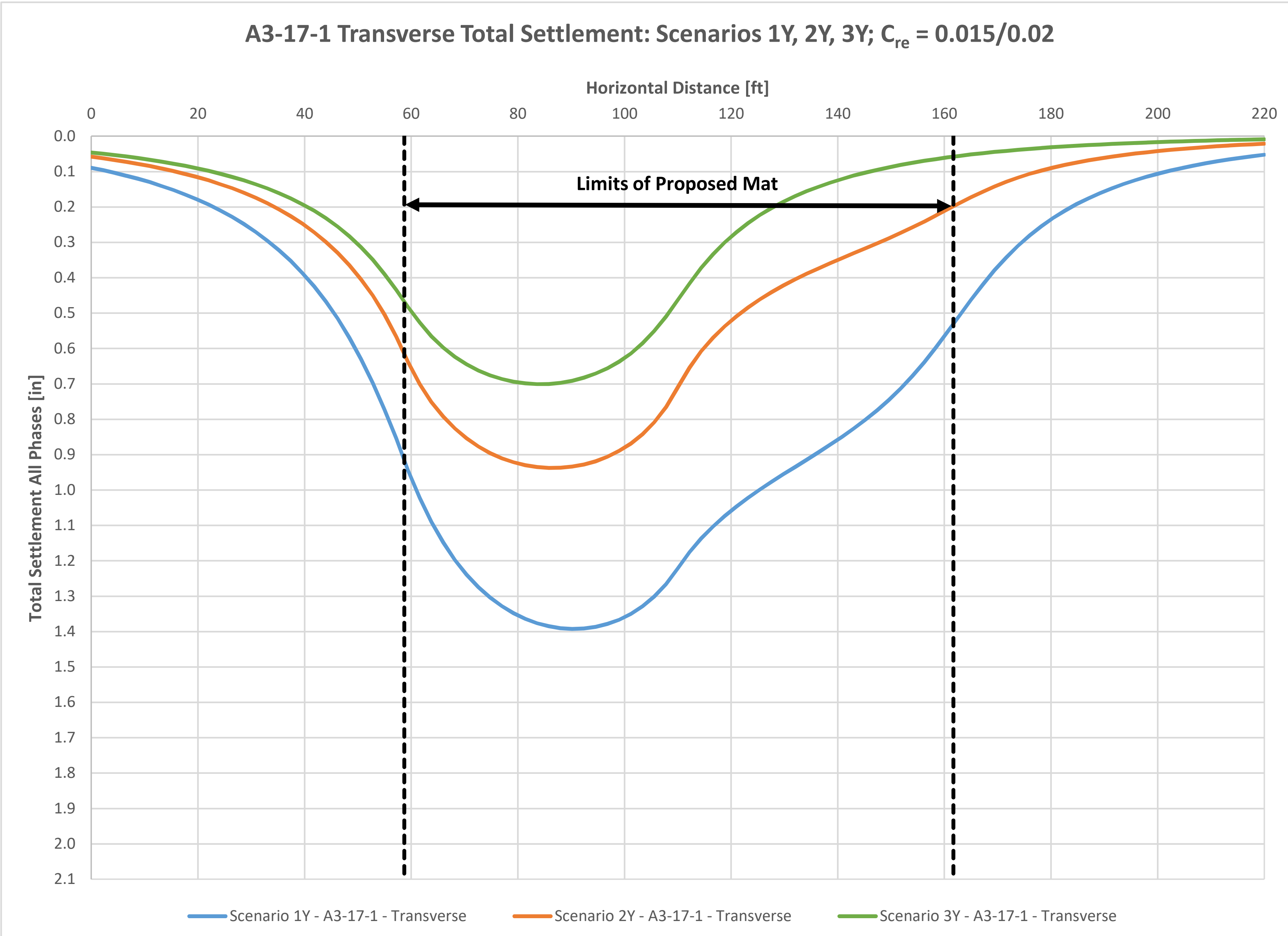
A3GEO


A3-17-2 Longitudinal Slope (in/ft) Across the Mat: Scenarios 1A, 2A, 3A; C_{re} = 0.015/0.02
Horizontal Distance [ft]
0
40
80
120
160
200
240
280
320
Mat Slope [in/ft]
0.000
0.005
0.010
0.015
0.020
0.025
0.030
0.035
0.040
0.045
0.050
Limits of Proposed Mat
Longitudinal Criterion:
0.084 in / 5 ft
Scenario 1A - A3-17-2 - Longitudinal
Scenario 2A - A3-17-2 - Longitudinal
Scenario 3A - A3-17-2 - Longitudinal
Longitudinal Criterion

Appendix H

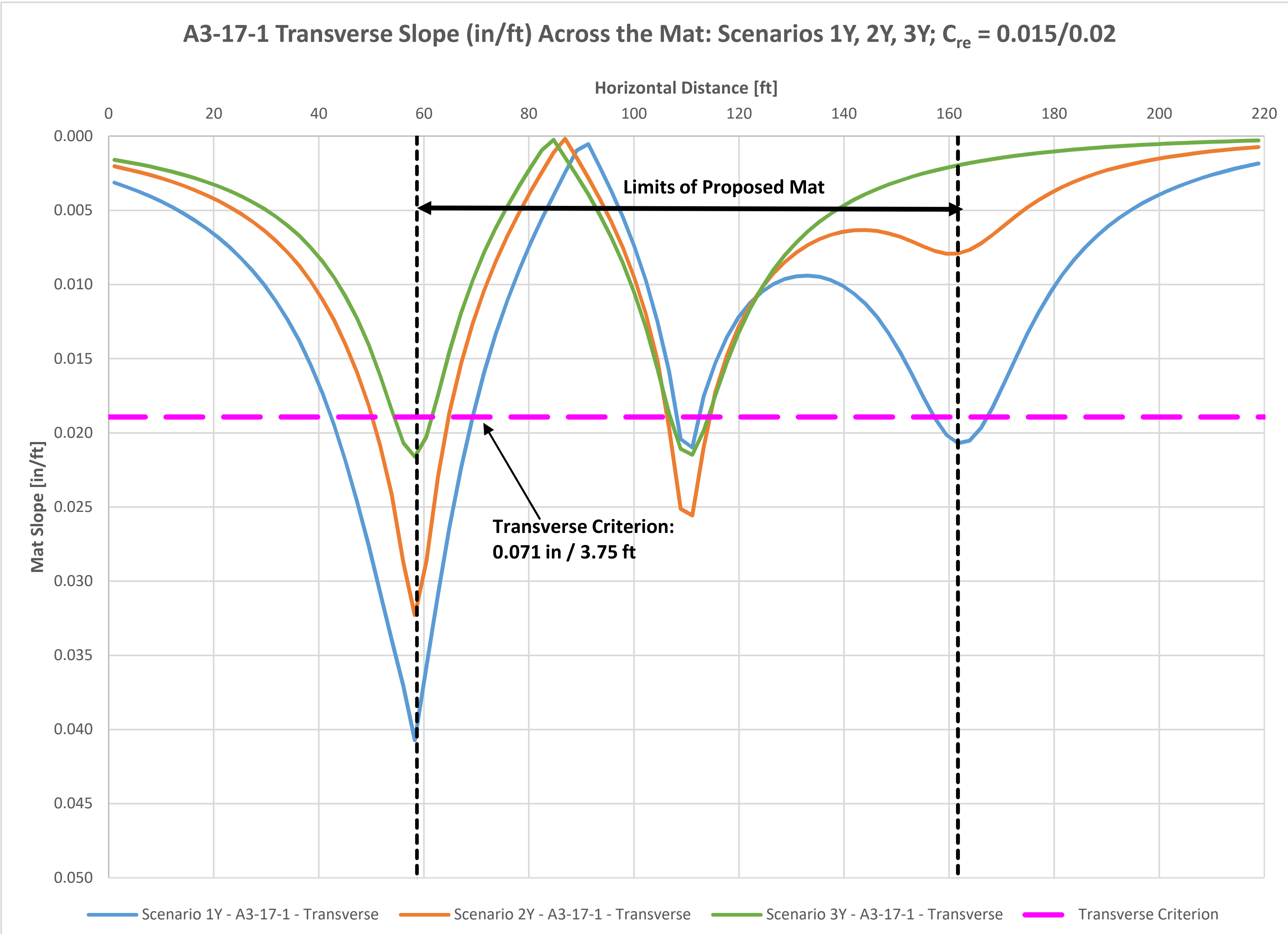
Settlement Plots:
Scenarios 1X, 1Y, 2X, 2Y, 3X, 3Y – A3-17-1

A3GEO



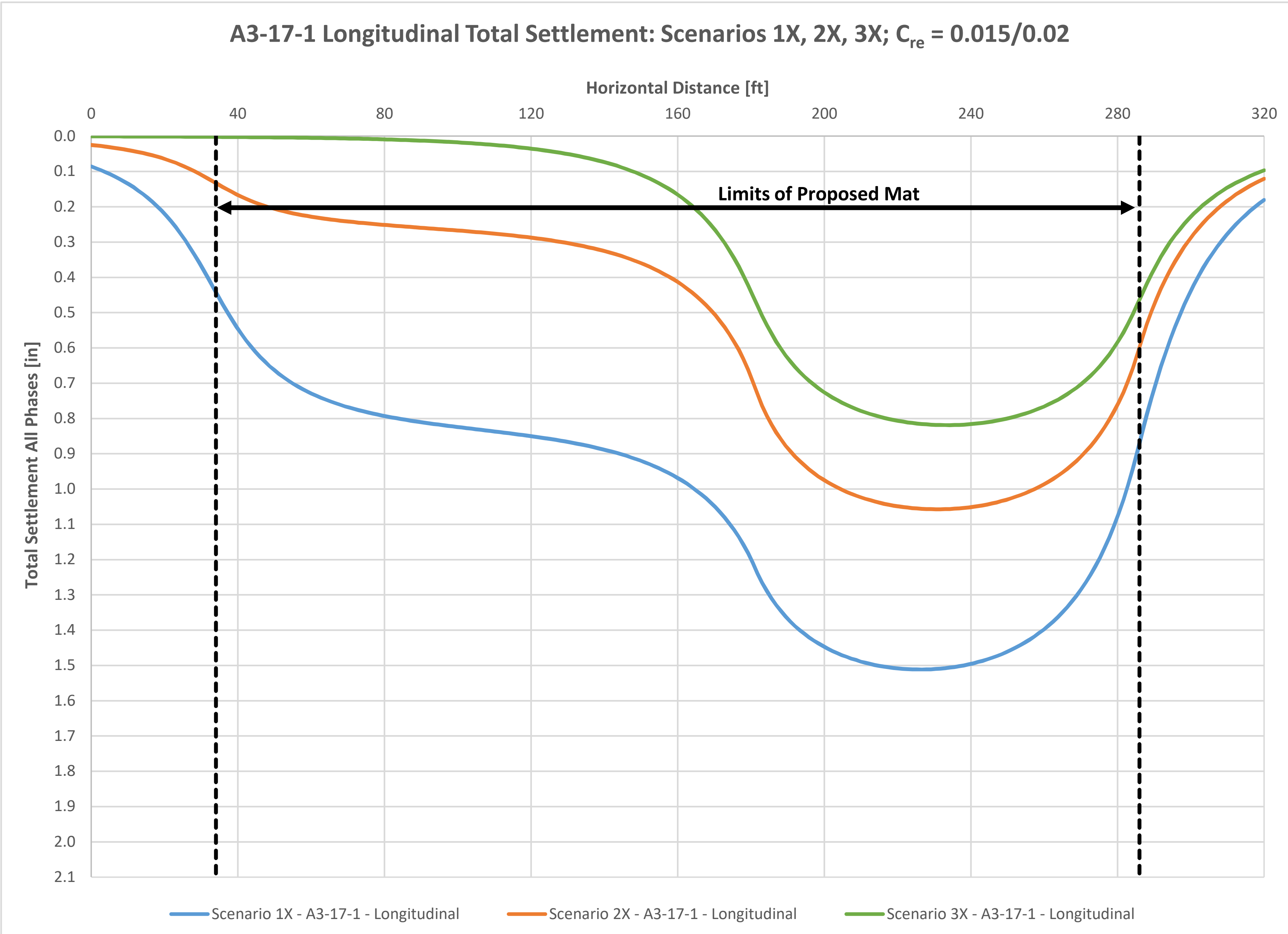
A3-17-1 Transverse Total Settlement: Scenarios 1Y, 2Y, 3Y; C_{re} = 0.015/0.02
Horizontal Distance [ft]
0
20
40
60
80
100
120
140
160
180
200
220
Total Settlement All Phases [in]
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1.1
1.2
1.3
1.4
1.5
1.6
1.7
1.8
1.9
2.0
2.1
Limits of Proposed Mat
Scenario 1Y - A3-17-1 - Transverse
Scenario 2Y - A3-17-1 - Transverse
Scenario 3Y - A3-17-1 - Transverse

A3GEO

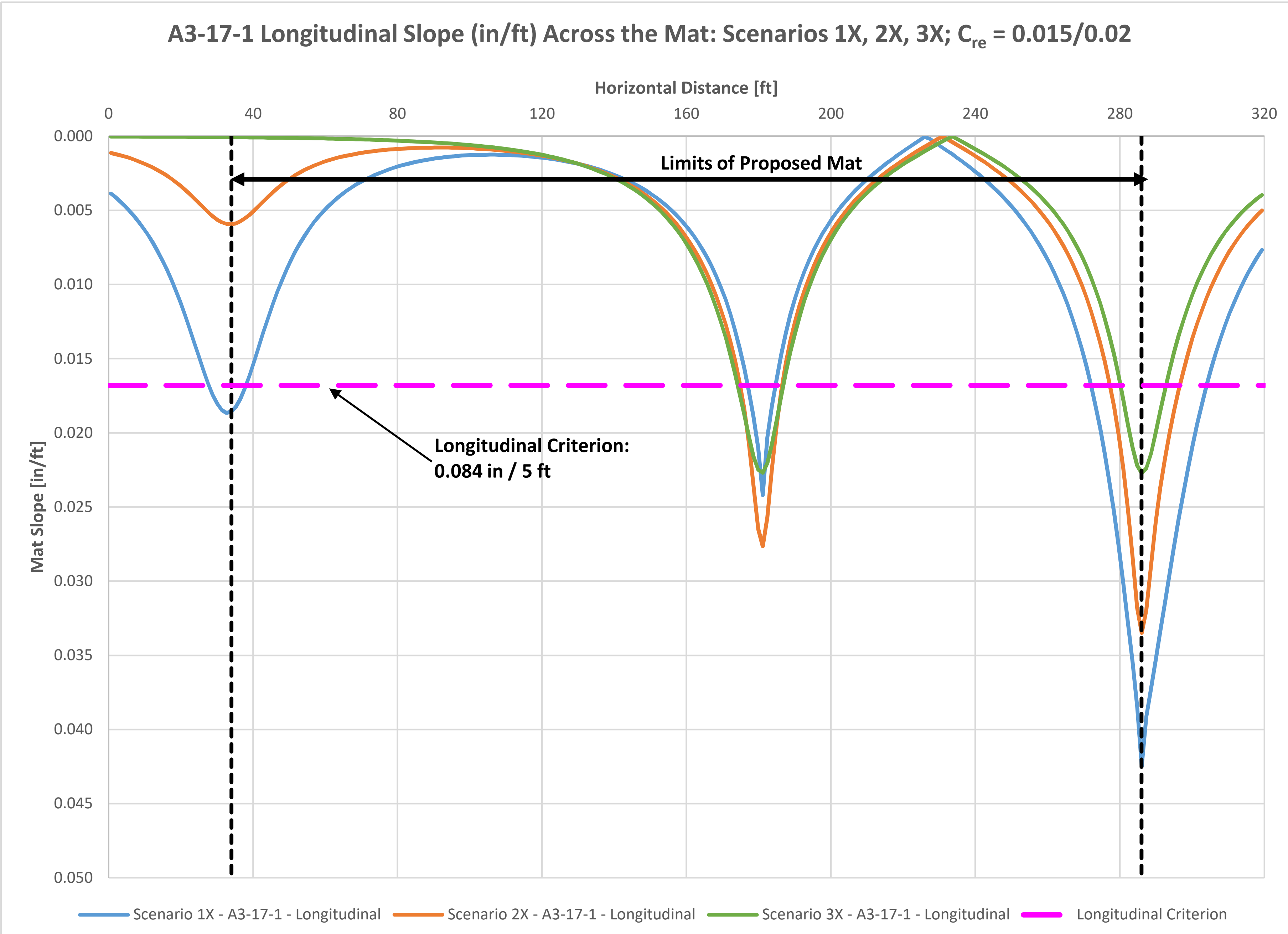


A3-17-1 Transverse Slope (in/ft) Across the Mat: Scenarios 1Y, 2Y, 3Y; C_{re} = 0.015/0.02
Horizontal Distance [ft]
0
20
40
60
80
100
120
140
160
180
200
220
Mat Slope [in/ft]
0.000
0.005
0.010
0.015
0.020
0.025
0.030
0.035
0.040
0.045
0.050
Limits of Proposed Mat
Transverse Criterion:
0.071 in / 3.75 ft
Scenario 1Y - A3-17-1 - Transverse
Scenario 2Y - A3-17-1 - Transverse
Scenario 3Y - A3-17-1 - Transverse
Transverse Criterion

A3GEO


A3-17-1 Longitudinal Total Settlement: Scenarios 1X, 2X, 3X; C_{re} = 0.015/0.02
Horizontal Distance [ft]
0
40
80
120
160
200
240
280
320
Total Settlement All Phases [in]
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1.1
1.2
1.3
1.4
1.5
1.6
1.7
1.8
1.9
2.0
2.1
Limits of Proposed Mat
Scenario 1X - A3-17-1 - Longitudinal
Scenario 2X - A3-17-1 - Longitudinal
Scenario 3X - A3-17-1 - Longitudinal

A3GEO

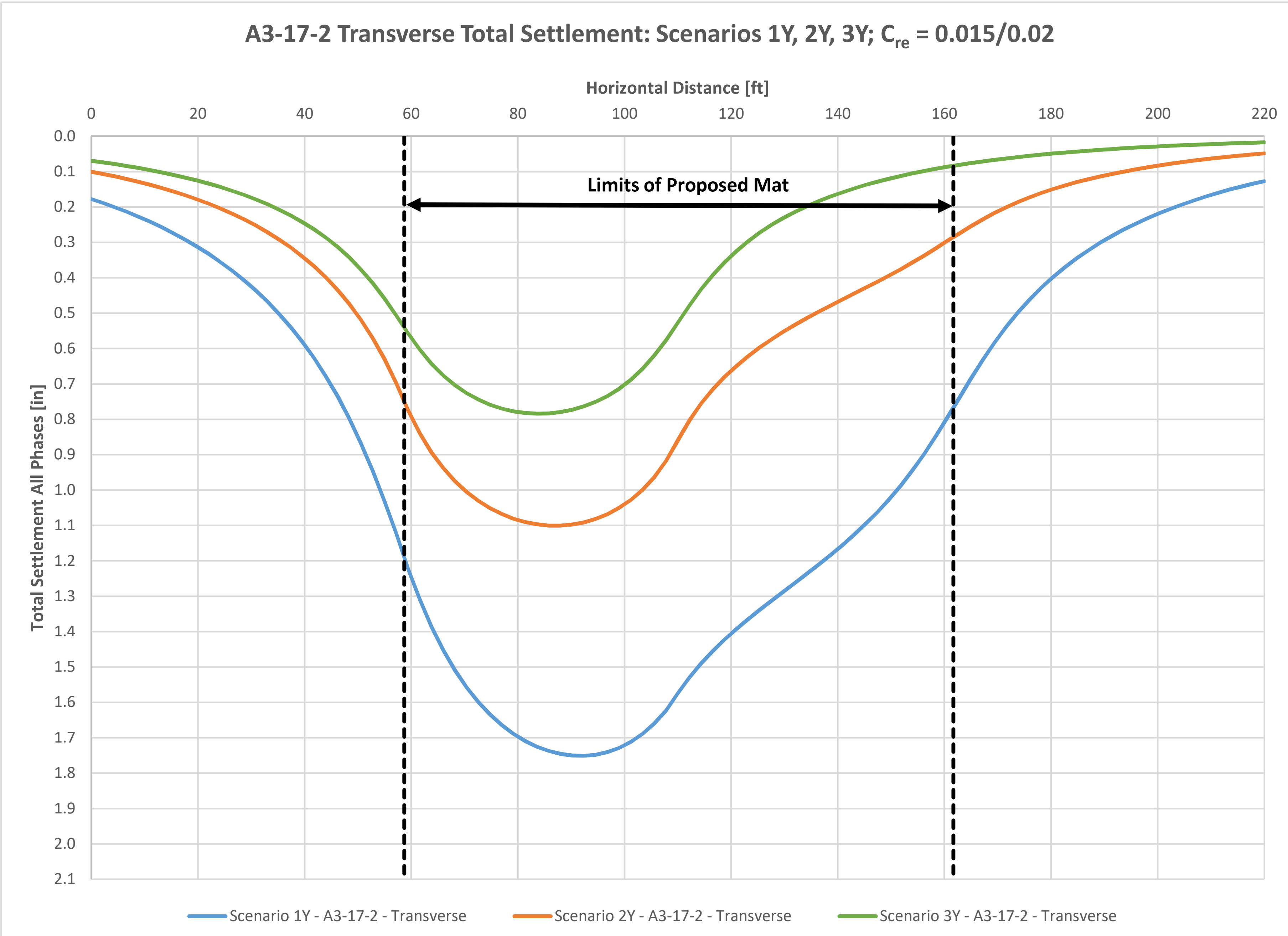


A3-17-1 Longitudinal Slope (in/ft) Across the Mat: Scenarios 1X, 2X, 3X; C$_{re}$ = 0.015/0.02
Horizontal Distance [ft]
0
40
80
120
160
200
240
280
320
0.000
0.005
0.010
0.015
0.020
0.025
0.030
0.035
0.040
0.045
0.050
Mat Slope [in/ft]
Limits of Proposed Mat
Longitudinal Criterion:
0.084 in / 5 ft
Scenario 1X - A3-17-1 - Longitudinal
Scenario 2X - A3-17-1 - Longitudinal
Scenario 3X - A3-17-1 - Longitudinal
Longitudinal Criterion

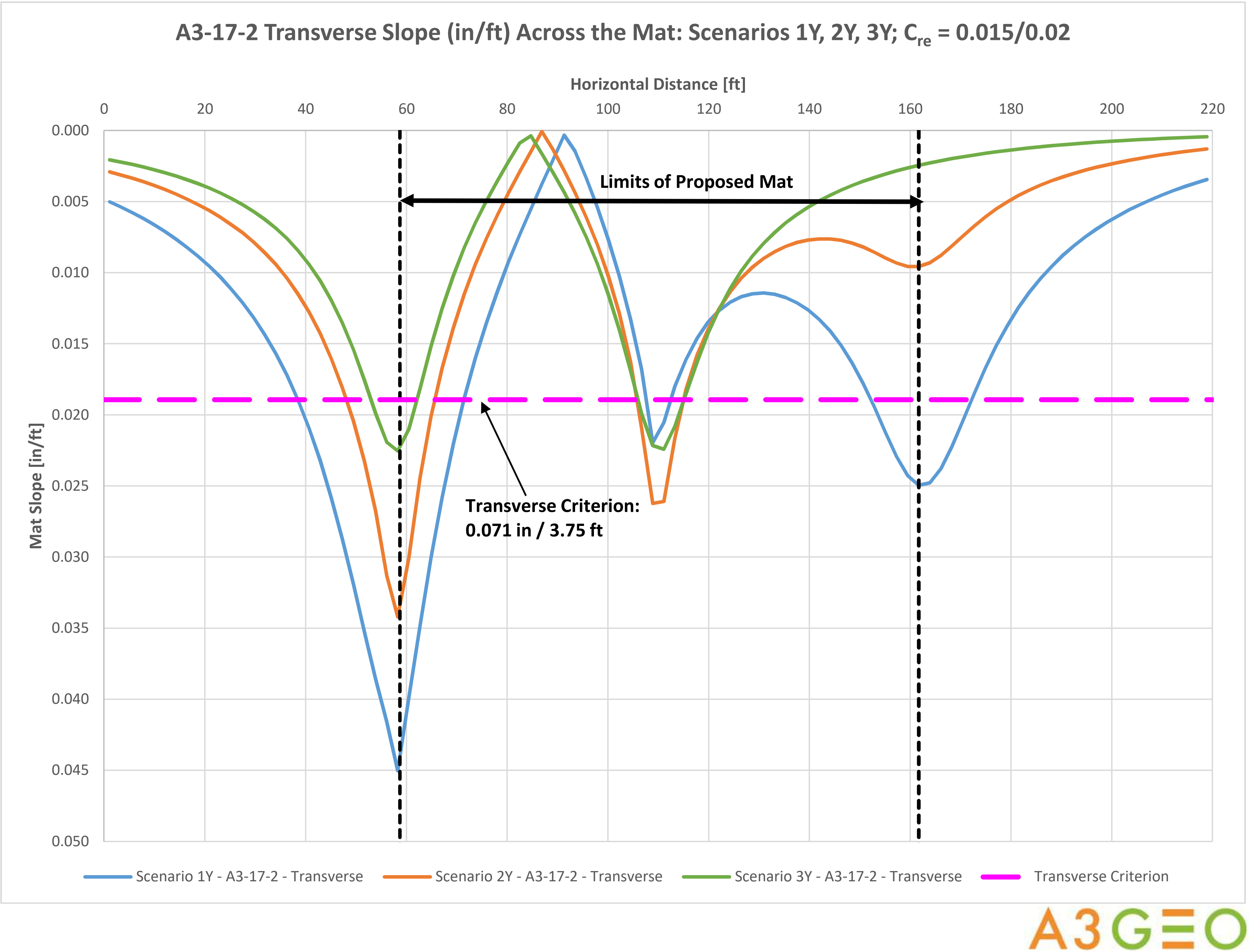
A3GEO

Appendix H

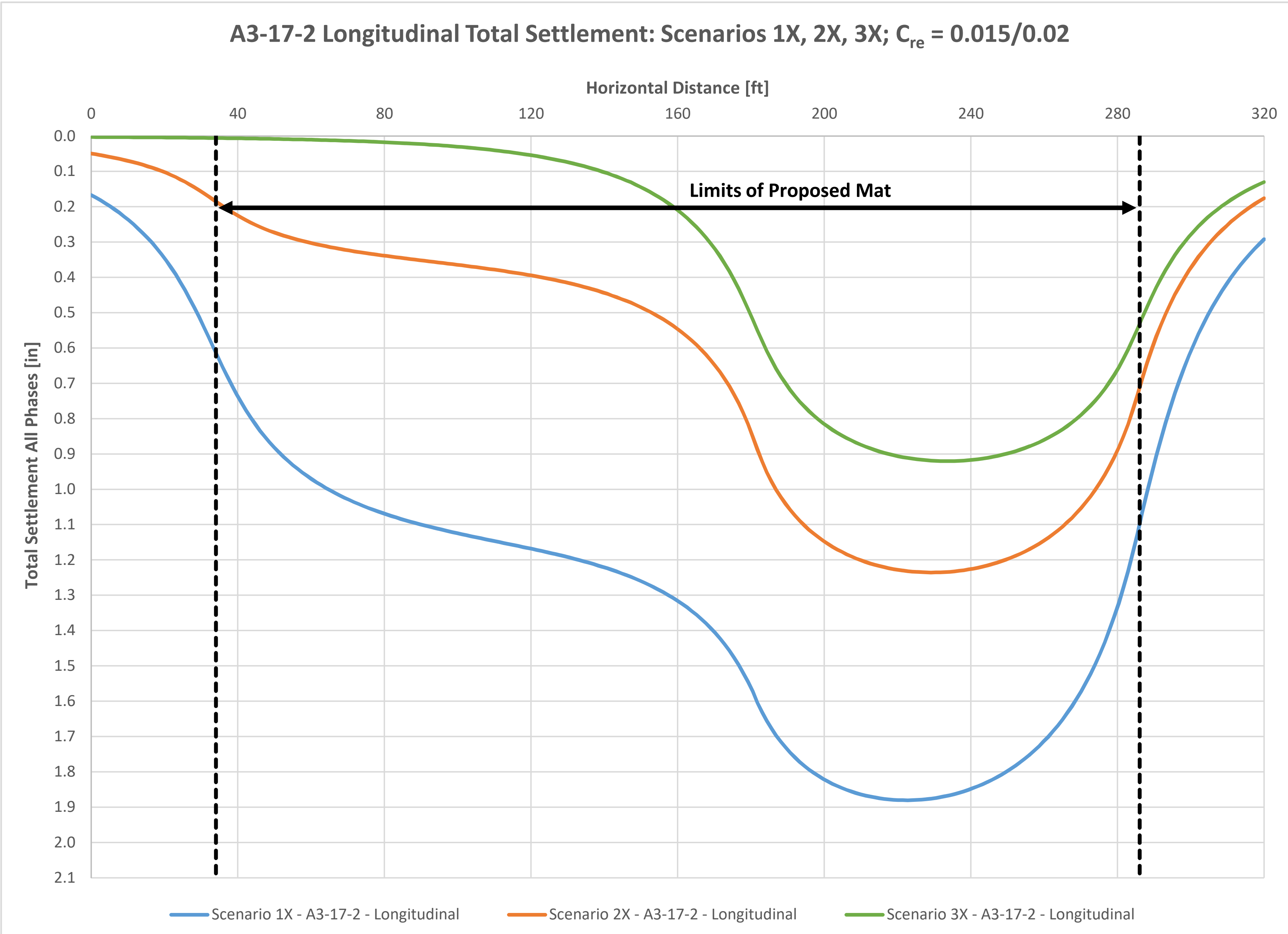
Settlement Plots:
Scenarios 1X, 1Y, 2X, 2Y, 3X, 3Y – A3-17-2


A3-17-2 Transverse Total Settlement: Scenarios 1Y, 2Y, 3Y; C$_{re}$ = 0.015/0.02
Horizontal Distance [ft]
0
20
40
60
80
100
120
140
160
180
200
220
Total Settlement All Phases [in]
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1.1
1.2
1.3
1.4
1.5
1.6
1.7
1.8
1.9
2.0
2.1
Limits of Proposed Mat
Scenario 1Y - A3-17-2 - Transverse
Scenario 2Y - A3-17-2 - Transverse
Scenario 3Y - A3-17-2 - Transverse

A3GEO

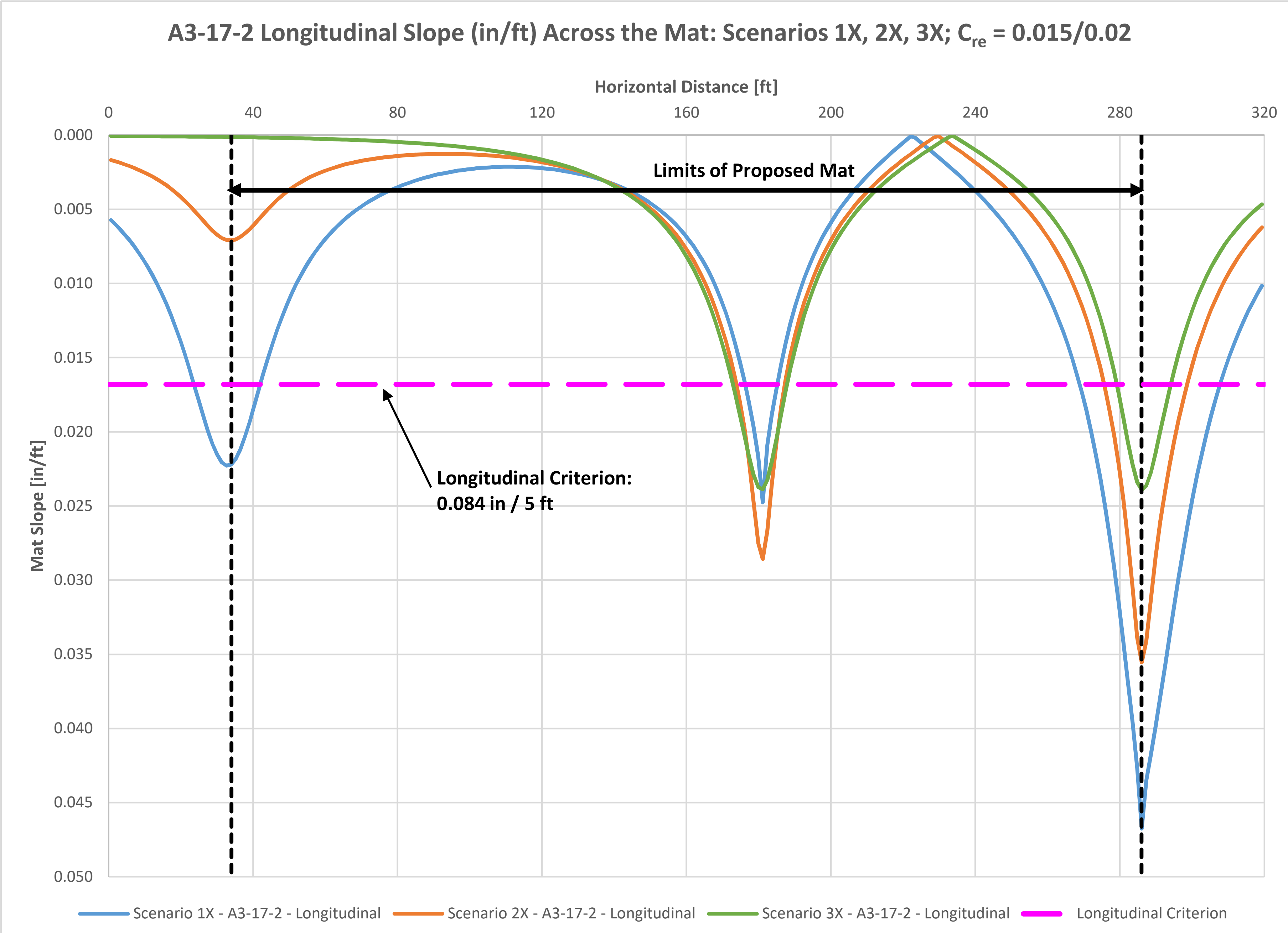


A3-17-2 Transverse Slope (in/ft) Across the Mat: Scenarios 1Y, 2Y, 3Y; C_{re} = 0.015/0.02
Horizontal Distance [ft]
0
20
40
60
80
100
120
140
160
180
200
220
Mat Slope [in/ft]
0.000
0.005
0.010
0.015
0.020
0.025
0.030
0.035
0.040
0.045
0.050
Limits of Proposed Mat
Transverse Criterion:
0.071 in / 3.75 ft
Scenario 1Y - A3-17-2 - Transverse
Scenario 2Y - A3-17-2 - Transverse
Scenario 3Y - A3-17-2 - Transverse
Transverse Criterion
A3GEO



A3-17-2 Longitudinal Total Settlement: Scenarios 1X, 2X, 3X; C_{re} = 0.015/0.02
Horizontal Distance [ft]
0
40
80
120
160
200
240
280
320
Total Settlement All Phases [in]
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1.1
1.2
1.3
1.4
1.5
1.6
1.7
1.8
1.9
2.0
2.1
Limits of Proposed Mat
Scenario 1X - A3-17-2 - Longitudinal
Scenario 2X - A3-17-2 - Longitudinal
Scenario 3X - A3-17-2 - Longitudinal

A3GEO



A3-17-2 Longitudinal Slope (in/ft) Across the Mat: Scenarios 1X, 2X, 3X; C_{re} = 0.015/0.02
Horizontal Distance [ft]
0
40
80
120
160
200
240
280
320
0.000
0.005
0.010
0.015
0.020
0.025
0.030
0.035
0.040
0.045
0.050
Mat Slope [in/ft]
Limits of Proposed Mat
Longitudinal Criterion:
0.084 in / 5 ft
Scenario 1X - A3-17-2 - Longitudinal
Scenario 2X - A3-17-2 - Longitudinal
Scenario 3X - A3-17-2 - Longitudinal
Longitudinal Criterion

APPENDIX I

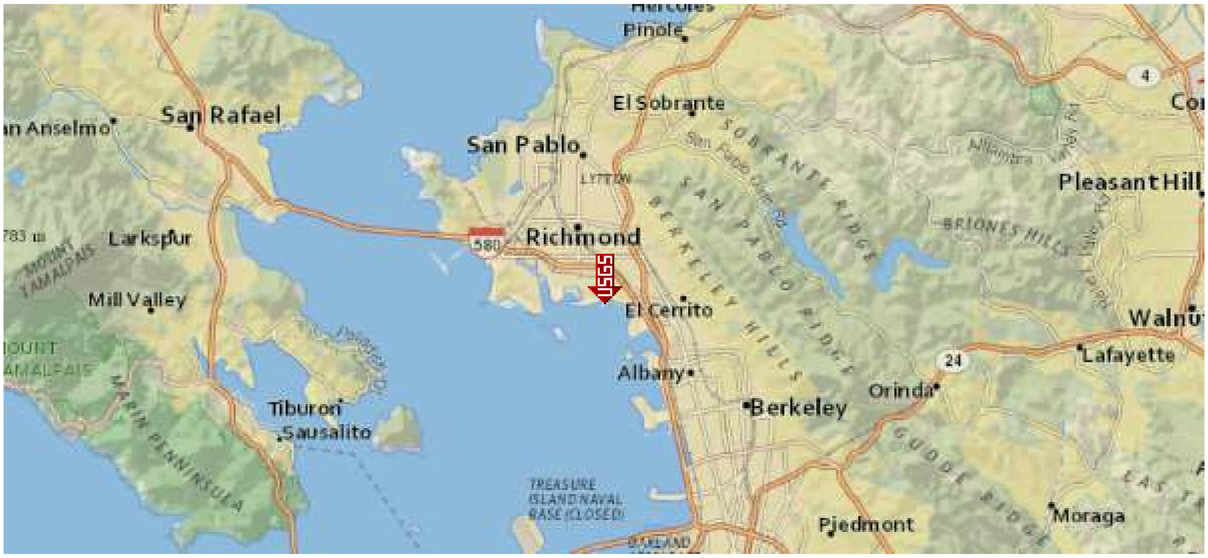
USGS Ground Motion Reports

A3GEO

USGS Design Maps Summary Report

User–Specified Input

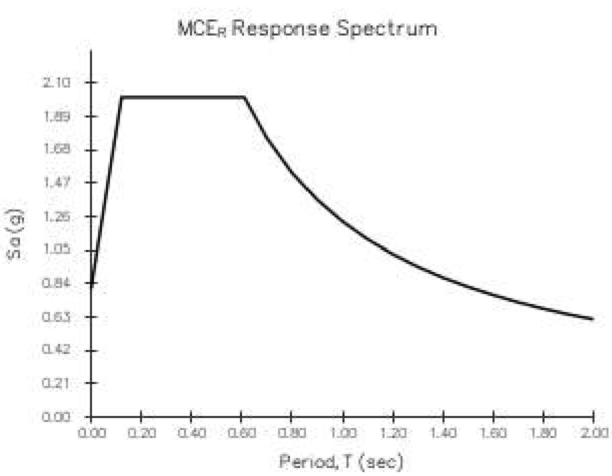
Report Title	NRLF Phase 4 Fri February 9, 2018 20:23:36 UTC
Building Code Reference Document	ASCE 7-10 Standard (which utilizes USGS hazard data available in 2008)
Site Coordinates	37.91738°N, 122.33597°W
Site Soil Classification	Site Class D – "Stiff Soil"
Risk Category	I/II/III

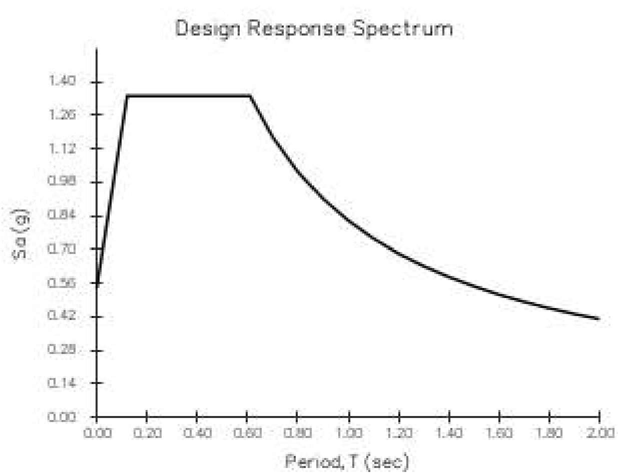


USGS–Provided Output

$S_S =$	2.012 g	$S_{MS} =$	2.012 g	$S_{DS} =$	1.341 g
$S_1 =$	0.820 g	$S_{M1} =$	1.230 g	$S_{D1} =$	0.820 g

For information on how the SS and S1 values above have been calculated from probabilistic (risk-targeted) and deterministic ground motions in the direction of maximum horizontal response, please return to the application and select the "2009 NEHRP" building code reference document.





For PGA_M, T_L, C_{RS}, and C_{R1} values, please view the detailed report.

Design Maps Detailed Report

ASCE 7-10 Standard (37.91738°N, 122.33597°W)

Site Class D – "Stiff Soil", Risk Category I/II/III

Section 11.4.1 — Mapped Acceleration Parameters

Note: Ground motion values provided below are for the direction of maximum horizontal spectral response acceleration. They have been converted from corresponding geometric mean ground motions computed by the USGS by applying factors of 1.1 (to obtain S_S) and 1.3 (to obtain S_1). Maps in the 2010 ASCE-7 Standard are provided for Site Class B. Adjustments for other Site Classes are made, as needed, in Section 11.4.3.

From Figure 22-1 [1]	S_S = 2.012 g
From Figure 22-2 [2]	S_1 = 0.820 g

Section 11.4.2 — Site Class

The authority having jurisdiction (not the USGS), site-specific geotechnical data, and/or the default has classified the site as Site Class D, based on the site soil properties in accordance with Chapter 20.

Table 20.3–1 Site Classification

Site Class	$\bar{v}_s$	$\bar{N}$ or $\bar{N}_{ch}$	$\bar{s}_u$
A. Hard Rock	>5,000 ft/s	N/A	N/A
B. Rock	2,500 to 5,000 ft/s	N/A	N/A
C. Very dense soil and soft rock	1,200 to 2,500 ft/s	>50	>2,000 psf
D. Stiff Soil	600 to 1,200 ft/s	15 to 50	1,000 to 2,000 psf
E. Soft clay soil	<600 ft/s	<15	<1,000 psf
	Any profile with more than 10 ft of soil having the characteristics: • Plasticity index *PI* > 20, • Moisture content *w* ≥ 40%, and • Undrained shear strength $\bar{s}_u$ < 500 psf		
F. Soils requiring site response analysis in accordance with Section 21.1	See Section 20.3.1		

For SI: 1ft/s = 0.3048 m/s 1lb/ft² = 0.0479 kN/m²

Section 11.4.3 — Site Coefficients and Risk–Targeted Maximum Considered Earthquake (MCE_R) Spectral Response Acceleration Parameters

Table 11.4–1: Site Coefficient F_a

Site Class	Mapped MCE $_R$ Spectral Response Acceleration Parameter at Short Period				
	$S_S \leq 0.25$	$S_S = 0.50$	$S_S = 0.75$	$S_S = 1.00$	$S_S \geq 1.25$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	$\boxed{1.0}$
E	2.5	1.7	1.2	0.9	0.9
F	See Section 11.4.7 of ASCE 7				

Note: Use straight–line interpolation for intermediate values of S_S

For Site Class = D and S_S = 2.012 g, F_a = 1.000

Table 11.4–2: Site Coefficient F_v

Site Class	Mapped MCE $_R$ Spectral Response Acceleration Parameter at 1–s Period				
	$S_1 \leq 0.10$	$S_1 = 0.20$	$S_1 = 0.30$	$S_1 = 0.40$	$S_1 \geq 0.50$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.7	1.6	1.5	1.4	1.3
D	2.4	2.0	1.8	1.6	$\boxed{1.5}$
E	3.5	3.2	2.8	2.4	2.4
F	See Section 11.4.7 of ASCE 7				

Note: Use straight–line interpolation for intermediate values of S_1

For Site Class = D and S_1 = 0.820 g, F_v = 1.500

Equation (11.4–1): $S_{MS} = F_aS_S = 1.000 \times 2.012 = 2.012$ g

Equation (11.4–2): $S_{M1} = F_vS_1 = 1.500 \times 0.820 = 1.230$ g

Section 11.4.4 — Design Spectral Acceleration Parameters

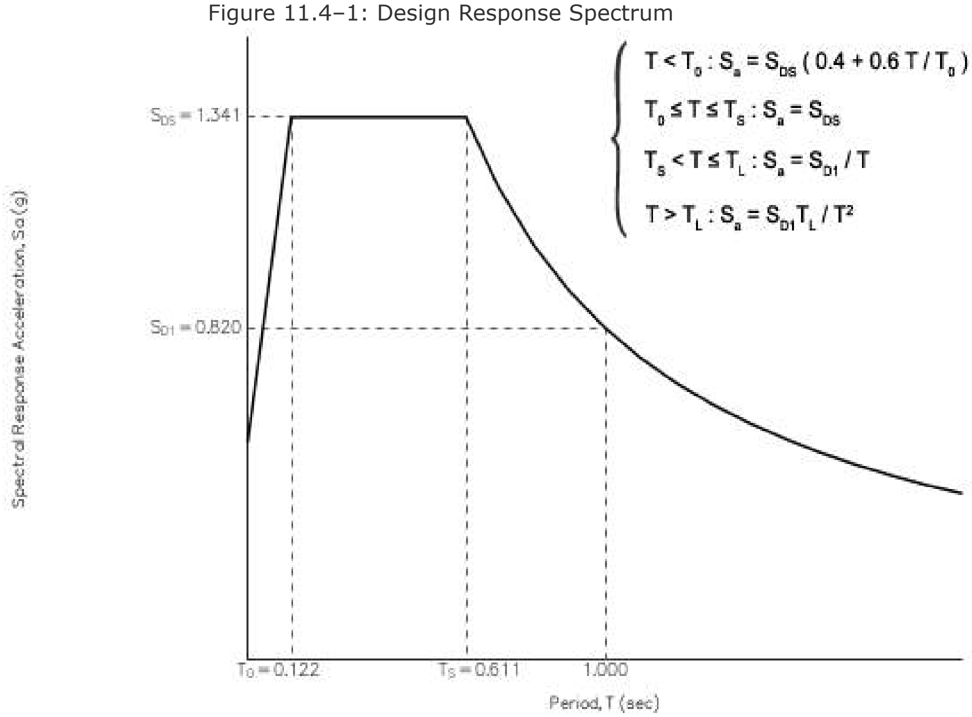
Equation (11.4–3): $S_{DS} = ⅔ S_{MS} = ⅔ \times 2.012 = 1.341$ g

Equation (11.4–4): $S_{D1} = ⅔ S_{M1} = ⅔ \times 1.230 = 0.820$ g

Section 11.4.5 — Design Response Spectrum

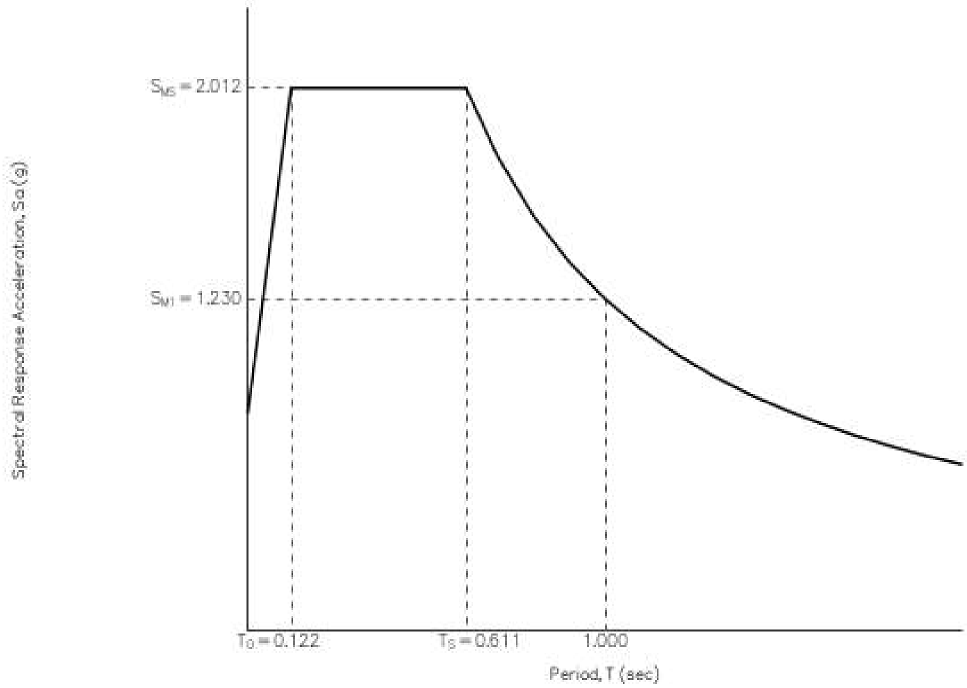
From Figure 22-12 [3] T_L = 8 seconds

Figure 11.4–1: Design Response Spectrum



Section 11.4.6 — Risk-Targeted Maximum Considered Earthquake (MCE_R) Response Spectrum

The MCE_R Response Spectrum is determined by multiplying the design response spectrum above by 1.5.



Section 11.8.3 — Additional Geotechnical Investigation Report Requirements for Seismic Design Categories D through F

From Figure 22-7 [4] PGA = 0.774

Equation (11.8–1): $PGA_M = F_{PGA}PGA = 1.000 \times 0.774 = 0.774$ g

Table 11.8–1: Site Coefficient F_{PGA}

Site Class	Mapped MCE Geometric Mean Peak Ground Acceleration, PGA				
	PGA ≤ 0.10	PGA = 0.20	PGA = 0.30	PGA = 0.40	PGA ≥ 0.50
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	See Section 11.4.7 of ASCE 7				

Note: Use straight–line interpolation for intermediate values of PGA

For Site Class = D and PGA = 0.774 g, F_{PGA} = 1.000

Section 21.2.1.1 — Method 1 (from Chapter 21 – Site-Specific Ground Motion Procedures for Seismic Design)

From Figure 22-17 [5] C_{RS} = 1.010

From Figure 22-18 [6] C_{R1} = 0.990

Section 11.6 — Seismic Design Category

Table 11.6-1 Seismic Design Category Based on Short Period Response Acceleration Parameter

VALUE OF S_{DS}	RISK CATEGORY		
	I or II	III	IV
S_{DS} < 0.167g	A	A	A
0.167g ≤ S_{DS} < 0.33g	B	B	C
0.33g ≤ S_{DS} < 0.50g	C	C	D
0.50g ≤ S_{DS}	D	D	D

For Risk Category = I and S_{DS} = 1.341 g, Seismic Design Category = D

Table 11.6-2 Seismic Design Category Based on 1-S Period Response Acceleration Parameter

VALUE OF S_{D1}	RISK CATEGORY		
	I or II	III	IV
S_{D1} < 0.067g	A	A	A
0.067g ≤ S_{D1} < 0.133g	B	B	C
0.133g ≤ S_{D1} < 0.20g	C	C	D
0.20g ≤ S_{D1}	D	D	D

For Risk Category = I and S_{D1} = 0.820 g, Seismic Design Category = D

Note: When S_1 is greater than or equal to 0.75g, the Seismic Design Category is **E** for buildings in Risk Categories I, II, and III, and **F** for those in Risk Category IV, irrespective of the above.

Seismic Design Category ≡ "the more severe design category in accordance with Table 11.6-1 or 11.6-2" = E

Note: See Section 11.6 for alternative approaches to calculating Seismic Design Category.

References

1. *Figure 22-1*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-1.pdf
2. *Figure 22-2*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-2.pdf
3. *Figure 22-12*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-12.pdf
4. *Figure 22-7*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-7.pdf
5. *Figure 22-17*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-17.pdf
6. *Figure 22-18*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-18.pdf