TETRA TECH

July 27, 2017

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Department of Toxic Substances Control
700 Heinz Avenue
Berkeley, CA 94710

Subject: **Draft Phase V Sampling Results Technical Memorandum**
Western Stege Marsh, Richmond Field Station Site
Berkeley Global Campus at Richmond Bay, University of California, Berkeley

Dear Ms. Nakashima:

Please find enclosed the Draft Phase V Sampling Results Technical Memorandum, Western Stege Marsh, Richmond Field Station Site (two copies on paper and disc).

The scope of Phase V consists of characterization activities within the University of California property boundary of the Western Transition Area and old marsh portion of Western Stege Marsh. This document addresses the scope of work associated with the old marsh portion of Western Stege Marsh.

If you have any questions or need further information regarding this submittal, please call me at (Jason.Brodersen@tetratech.com, 415-497-9060) or Karl Hans (khans@berkeley.edu, 510-812-1537).

Sincerely,

Jason Brodersen, PG
Program Manager

Enclosure

cc: Sara Ziff, U.S. EPA, Region 9
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DRAFT

Phase V Sampling Results Technical Memorandum Western Stege Marsh

Richmond Field Station Site

Berkeley Global Campus at Richmond Bay

University of California, Berkeley

July 27, 2017

Prepared for
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[Final version will include professional stamp]

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ACRONYMS AND ABBREVIATIONS

%D	Percent difference
%R	Percent recovery
µg/kg	Micrograms per kilogram
µg/L	Micrograms per liter
Bay Trail	East Bay Regional Park District Bay Trail
BBL	Blasland, Bouck & Lee, Inc.
BGC	Berkeley Global Campus at Richmond Bay
bgs	Below ground surface
CCB	Continuing calibration blanks
CCR	Current Conditions Report
CCV	Continuing calibration verification
COPC	Chemical of potential concern
C-RAP	Conceptual Remedial Action Plan
DQO	Data quality objective
DTSC	Department of Toxic Substances Control
EBRPD	East Bay Regional Park District
EPA	U.S. Environmental Protection Agency
ER-L	Effects range-low
ER-M	Effects range-median
FSP	Field Sampling Plan
FSW	Field Sampling Workplan
ISM	Incremental Sampling Methodology
LCS	Laboratory control sample
LCSD	Laboratory control sample duplicate
MB	Method blank
MDL	Method detection limit
mg/kg	Milligrams per kilogram
MS	Matrix spike
MSD	Matrix spike duplicate
ng/g	Nanograms per gram
ng/L	Nanograms per liter
PCB	Polychlorinated biphenyl
QA	Quality assurance
QAPP	Quality Assurance Project Plan
QC	Quality control
QL	Quantitation limit
RAW	Removal Action Workplan
RFS	Richmond Field Station
RL	Reporting limit
RPD	Relative Percent Difference
RSD	Relative standard deviation

SCR	Site Characterization Report
SMP	Soil Management Plan
Tetra Tech	Tetra Tech, Inc.
TSCA	Toxic Substances Control Act
UC	University of California
WSM	Western Stege Marsh
WTA	Western Transition Area

1.0 PROJECT DESCRIPTION

The University of California (UC), Berkeley, prepared this Phase V Sampling Results Technical Memorandum in response to the California Environmental Protection Agency, Department of Toxic Substances Control (DTSC), Site Investigation and Remediation Order No. IS/E-RAO 06/07-004 Richmond Field Station (RFS) Order, dated September 15, 2006. The RFS Order provides for investigation and cleanup of 96 acres of upland and 13 acres of tidal marsh and transition habitat within the Former RFS Site. The property defined under the RFS Order is referred to as the "Former RFS Site," "Former RFS," or "Site," and is part of the Berkeley Global Campus at Richmond Bay (BGC) in Richmond, California. The Former RFS Site does not encompass the entire RFS; the RFS Order does not include two outboard parcels located off shore. Also, the Regatta Property, which is included in the BGC, is not included in the RFS Order. Figure 1 shows the Former RFS Site in relation to the BGC, Regatta Property, and outboard parcels. The RFS Site is shown on Figure 2.

In response to the RFS Order, UC Berkeley has prepared multiple planning and reporting documents. The Final Current Conditions Report (CCR), dated November 21, 2008, included a comprehensive summary of current conditions and data gaps at the Former RFS (Tetra Tech, Inc. [Tetra Tech] 2008). The Final Field Sampling Workplan (FSW) identified a five phase sampling strategy to address data gaps identified in the CCR (Tetra Tech 2010a). Phases I, II, III, and IV have been completed. Results of Phases I through III are presented within the Final Site Characterization Report (SCR) for the Research, Education, and Support Area and Groundwater Within the Former RFS (Tetra Tech 2013). As a follow-up to recommendations within the SCR, UC Berkeley published the Final Removal Action Workplan (RAW) identifying the selected cleanup remedy and final actions for areas designated for Research, Education, and Support, and for groundwater within the Former RFS (Tetra Tech 2014a), and thereby documenting completion of Phases I, II, and III (Tetra Tech 2013). The Phase IV Sampling Results Technical Memorandum (Tetra Tech 2016) summarized the results of the Phase IV investigation.

Phase V addresses remaining data gaps identified in the CCR and subsequent investigations, as presented in the Final Phase V Field Sampling Plan (FSP), dated January 5, 2017 (Tetra Tech 2017). Two primary investigation areas are identified within the Phase V investigation scope:

1. Sediment and Pore Water in the old/unremediated portions of Western Stege Marsh (WSM). Conduct discrete sampling to identify polychlorinated biphenyls (PCB) and metals concentrations in sediment and pore water within the portion of WSM not subject to remediation from 2002-2004 within the UC-owned RFS property boundary.

2. Exploratory Pothole Investigations in the Western Transition Area (WTA). Investigate the contents of fill, with specific focus on the fill area created during the 1950s to late 1960s and previously-identified geophysical anomalies.

Phase V field sampling areas are presented on Figure 3. This technical memorandum addresses the scope of work for the sediment and pore water sampling in the old WSM only; the exploratory pothole investigations in the WTA are scheduled in 2018.

This memorandum presents a summary of field activities, data quality assessment, data evaluation, and figures and tables summarizing results of detected concentrations. Appendix A is reserved for DTSC comments on the draft memorandum, and associated response to comments. Appendix B includes

complete analytical results for sediment samples, Appendix C includes complete analytical results for pore water results. Laboratory reports and chain of custody forms are presented in Attachments 1, 2, and 3.

1.1 PHYSICAL SETTING

The Site is at 1301 South 46th Street, Richmond, California, along the southeastern shoreline of the City of Richmond on the San Francisco Bay and northwest of Point Isabel. It consists of upland areas developed for academic teaching and research activities, an upland remnant coastal terrace prairie, a tidal salt marsh, and a transition zone between the upland areas and marsh. Between the late 1800s and 1948, several companies, including the California Cap Company, manufactured explosives at the Site. In 1950, The UC Regents purchased the property from the California Cap Company. UC Berkeley initially used the RFS for research for the College of Engineering; later, it was also used by other campus departments. Figure 4 provides a depiction land ownership within and near the boundaries of the Phase V investigation.

The Former RFS Site includes a number of distinct and varied habitats resulting from both natural and human activities.

- The Upland Area hosts numerous research facilities with associated out-buildings surrounded by landscaped trees and plants. The eastern and central portions of the Upland Area are largely developed with few natural ecological conditions present. The western portion of the Upland Area contains one of the largest and best-preserved areas of native coastal grasslands within the Big Meadow – grasslands once prevalent throughout the San Francisco Bay Area.

- The southern portion of the Site consists of a tidal salt marsh, known as WSM, with a small upland island at the southern property boundary. Plants include both native and non-native species, and attract a variety of special-status species birds such as the federally endangered Ridgway's rail (*Rallus obsoletus*).

- The Transition Area, the upland and ecotone area of fill material on former mud flats between, WSM and the Upland Area, consists of an area of restored coastal scrub and marsh to upland ecotone in areas remediated from 2002-04 and mixed ruderal scrub, mostly non-native grasses and forbs, in areas that were not subject to remediation and restoration.

This technical memorandum addresses the investigations at one specific area within the Former RFS Site: the UC-owned portion of the old WSM adjacent to the previously remediated and restored portions. WSM includes the old marsh and the remediated portion of the marsh, and occupies approximately 7.5 acres. It is bounded by the Transition Area to the north, the RFS connector trail and Eastern Stege Marsh to the east, the East Bay Regional Park District (EBRPD) Bay Trail (Bay Trail) to the south, and Meeker Slough and Marina Bay housing development to the west.

1.2 INVESTIGATION PURPOSE

Section 5.3.1 of the Order required preparation of a FSW to conduct site investigations to address data gaps identified in the CCR that warrant additional characterization or evaluation. The FSW specified five phases of field investigations to address these data gaps (Tetra Tech 2010a). The FSW is a site-wide document covering all investigation phases and a site-wide project background, objectives, conceptual

site model, schedule for investigating the Site, a Quality Assurance Project Plan (QAPP), and a facility-wide Health and Safety Plan. An updated conceptual site model, including results from the FSP Phase I through III investigations, is included in the SCR (Tetra Tech 2013).

The FSW also served as the FSP for Phase I, a site-wide groundwater investigation, conducted from 2010 to 2012. The Phase I FSW field effort consisted of installation and sampling of 51 piezometers throughout the Site, as well as semi-annual groundwater monitoring of the piezometers in 2011 and 2012. Since 2012, annual site-wide groundwater monitoring has been conducted in the spring. Data acquired from the piezometers — including chemical results from groundwater samples, geological information, and depth to water measurements — were used to develop a hydrogeologic model of the Site, and to improve understanding of overall site-wide groundwater quality.

Phase II investigated soil conditions at current and former transformer locations, the Corporation Yard along the eastern property boundary, and aboveground storage tanks.

Phase III further delineated mercury in the mercury fulminate area; characterized soils in the former Dry House explosion area, Building 128, and Building 201 soil mounds; further delineated carbon tetrachloride in groundwater near piezometer CTP; and additionally delineated PCB contamination in the transformer and Corporation Yard areas.

Phase IV consisted of soil sampling in the Upland Meadows, supplementary sampling of PCBs in the U.S. Environmental Protection Agency (EPA) Meadow North, an exploratory excavation to investigate the magnetic anomaly in an area within the WTA known as "the Bulb" identified in a 2006 DTSC magnetometer survey (included as Attachment 1), passive soil gas sampling to investigate a source of carbon tetrachloride in the Carbon Tetrachloride Area, and the placement of additional groundwater piezometers near the biologically active permeable barrier. The Final Phase IV Technical Memorandum (Tetra Tech 2016) recommended further evaluation of the PCBs in the EPA Meadow North. Results from additional investigation at the EPA Meadow North will be provided as a separate submittal.

The scope of the Phase V FSP is consistent with the phased approach to the site-wide investigation presented in the FSW, and addresses identified data gaps as well as areas identified by DTSC as needing further investigation. The following data gap from the CCR was addressed under this portion of Phase V:

> Western Stege Marsh: Further information is needed to determine if contaminant concentrations in sediments in the marsh pose a significant risk to human and ecological receptors.

The investigation purpose is described below.

> Western Stege Marsh Sediment and Pore Water. Previous investigations indicate that metals and PCB concentrations may be elevated in sediments in the old portion of Western Stege Marsh. Sediment and pore water sample results will be evaluated to determine if contaminant concentrations in sediments in the marsh pose a significant risk to human and ecological receptors.

The Phase V FSP presents the complete background and history of the Phase V investigation areas, purpose of sampling, data quality objectives (DQO), proposed sample locations, site-specific sampling strategies, and chemicals of potential concern for the Phase V data gaps investigation.

2.0 FIELD ACTIVITIES

The sampling strategy for the old WSM portion of Phase V consists of collection of sediment and pore water in the WSM. The Phase V FSP and program QAPP, presented as Appendix A of the FSW (Tetra Tech 2010a), provide the sampling methods and techniques for all field investigation activities. Standard information for planning and conducting field sampling during Phase V, such as field equipment calibration and maintenance, sample collection methodology, and sample packaging and documentation, is outlined in the FSP and QAPP. Sediment and pore water sampling activities were conducted on January 18, 2017. Table 1 provides the sample registry for Phase V activities.

2.1 SEDIMENT SAMPLING

Sediment samples in the old WSM were collected at 19 locations at two depths (0-0.5 and 1.5-2.0 feet below ground surface [bgs]), as indicated on Figure 5. Sample locations were located using a hand-held global positioning system as well as triangulation between known landmarks such as building edges and existing piezometers. All locations were accessed by foot; marsh mudders or snowshoes were not necessary as samples could be collected without needing to step into soft sediment. Final sediment sample locations were surveyed by a land-surveyor after sample collection.

A shovel was used to collect sediment into clean 5-gallon buckets for each depth at each location. A disposable scoop was used to subsample each 5-gallon bucket to collect sediment for laboratory analyses.

- Nineteen sediment samples collected from 0-0.5 feet bgs were analyzed for metals by EPA Method 6020/7471 and PCBs by EPA Method 8082 by Curtis & Tompkins, Ltd. in Berkeley, CA. Sediment samples were provided to Brooks Applied Labs in Bothell, WA. for analysis of methylmercury by EPA Method 1630. Methylmercury was analyzed at locations with the ten highest mercury sediment concentrations as measured by EPA Method 7471.

- Nineteen sediment samples collected from 1.5-2.0 feet bgs were analyzed for PCBs by EPA Method 8082 by Curtis & Tompkins, Ltd.; metals were not identified as chemicals of concern at this depth.

Triplicate soil volumes at both depths were collected in separate buckets to help determine the confidence associated with representing sediment conditions within a very short distance (1 to 2 feet). Triplicates were collected at two locations to meet a minimum of 10 percent of the discrete sample locations.

Following collection, all sediment samples were labeled, wrapped with protective bubble wrap material and placed into a cooler with ice to maintain a temperature at or below 4° Celsius. The coolers were transported via courier at the end of day to Curtis & Tompkins, Ltd., where they were placed in freezers to preserve the samples. Sediment samples to be analyzed for methylmercury were sent to Brooks Applied Labs via FedEx. A copy of complete analytical results for sediment samples are presented in Attachments 1 and 2, and chain-of-custody forms are presented in Attachment 3.

2.2 PORE WATER SAMPLING

Approximately 5 gallons of sediment was collected from 0-0.5 feet bgs at each of the 19 locations. Following removal of the discrete sediment sample described in Section 2.1, each of the 5-gallon buckets were transported via courier to Pacific EcoRisk in Fairfield, CA., where the pore water was extracted in the laboratory via centrifugation. Laboratory centrifugation was conducted consistent with federal guidance documents (EPA 2001; ASTM International 2008).

Following centrifugation, pore water samples were transmitted via FedEx to Curtis & Tompkins, Ltd. for metals analysis by EPA Method 6020/7471 and Brooks Applied Labs for methylmercury analysis by EPA Method 1630. All 19 samples were evaluated for metals and ten samples were evaluated for methylmercury. The ten pore water samples evaluated for methylmercury were collocated with the ten sediment samples evaluated for methylmercury, as described in Section 2.1.

Duplicate soil volumes were collected in separate buckets to help determine the confidence associated with representing pore water conditions within a very short distance (1 to 2 feet). Duplicates were collected at two locations to meet a minimum of 10 percent of the 19 sample locations. Two duplicate samples were evaluated for metals; one duplicate sample was evaluated for methylmercury.

2.3 WASTE CHARACTERIZATION AND DISPOSAL

Minimal investigation-derived waste was generated during the investigation – rinse water from decontamination of the shovel and incidental solid waste consisting of PPE and disposable scoops. The rinse water was collected in a 5-gallon buckets and placed in a 55-gallon drum in fenced storage location west of Building 110. The solid waste was containerized and disposed of as trash by UC Berkeley.

3.0 DATA QUALITY ASSESSMENT

This section summarizes the data verification and validation findings for sediment and pore water samples collected in January 2017. This section also discusses deviations from the Phase V FSP (Tetra Tech 2016).

3.1 DATA QUALITY OBJECTIVES

DQOs were developed during the FSW planning process to help ensure data appropriate to support defensible decisions was collected. Complete Phase V DQOs are presented in the Phase V FSP, Section 3.0 (Tetra Tech 2016).

Sediment and Pore Water in WSM: The DQOs stated the need to determine if metals or PCBs are present in the near-surface sediment and pore water (0-0.5 feet bgs) and PCBs in the shallow subsurface sediment (1.5-2.0 feet bgs) that pose unacceptable risks to human or ecological receptors. The sampling effort was also intended to provide current data for comparison with previous investigations conducted in the study area, as identified in the Phase V FSP.

These objectives were achieved through collection of sediment and pore water samples at 19 locations throughout the old WSM. The chemical data collected improves the overall site knowledge of chemical concentrations in the WSM.

Field planning, sampling, and reporting activities were conducted according to the methods described in the sampling plan and QAPP in the FSW (Tetra Tech 2010a) and Phase V FSP (Tetra Tech 2016).

3.2 LABORATORY DATA REVIEW

Assignment of data qualification flags for analytical data from Curtis & Tompkins, Ltd. and Brooks Applied Labs conformed to EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review (EPA 2017a) and Organic Data Review (EPA 2017b). Data review specifications require that various data qualifiers be assigned when a deficiency is detected or when a result is less than its detection limit. If no qualifier is assigned to a result, the data user is assured that no technical deficiencies were identified during validation. The qualification flags used are:

- U – Indicates the chemical was not detected at the numerical detection limit (sample-specific detection limit) noted. Non-detected results from the laboratory are reported in this manner.
- UJ – Indicates the chemical was not detected; however, the detection limit (sample-specific detection limit) is considered estimated based on problems encountered during laboratory analysis. The associated numerical detection limit is regarded as inaccurate or imprecise. This qualifier is also added to a positive result (reported by the laboratory) if the detected concentration is determined to be attributable to contamination introduced during field sampling or laboratory analysis.

- J – Indicates the chemical was detected; however, the associated numerical result is not a precise representation of the concentration that is actually present in the sample. The laboratory-reported concentration is considered an estimate of the true concentration.

- R – Indicates the chemical may or may not be present, and that the data was rejected. The non-detected analytical result reported by the laboratory is considered unreliable and unusable. This qualifier is applied in cases of gross technical deficiencies (for example, a holding time missed by a factor of two times the specified time limit, severe calibration non-compliance, or extremely low analyte recovery in QC spike samples).

The preceding data qualifiers may be categorized as indicating major or minor problems. Major problems are defined as issues that result in the rejection of data and qualification with R. These data are considered invalid and are not used for decision-making purposes unless used in a qualitative way and the use is justified and documented. Minor problems are defined as issues resulting in the estimation of data and qualification with U, J, and UJ qualifiers. Estimated analytical results are considered suitable for decision-making purposes unless the data use requirements are stringent and the qualifier indicates a deficiency incompatible with the intended data use. A U qualifier does not indicate a data deficiency exists because all non-detect values are flagged with the U qualifier regardless of whether a quality deficiency has been detected.

3.3 DATA QUALITY REVIEW FINDINGS

The data collected as part of the Phase V sampling investigation meet all the requirements of the precision, accuracy, representativeness, completeness, and comparability described in EPA guidance for QAPPs (EPA 2002) and the QAPP (Tetra Tech 2010a), and are usable for meeting the project DQOs and future risk assessments. The overall assessment of the sampling program, quality assurance (QA)/quality control (QC) data, and data review indicates the data from this investigation are of acceptable precision, accuracy, representativeness, completeness, and comparability.

3.3.1 Sediment

The sediment samples were analyzed for metals and PCBs. The verification and validation findings for the sediment metals results are summarized in Section 3.3.1.1. The verification and validation findings for the sediment PCB results are summarized in Section 3.3.1.2. The verification and validation findings for the porewater results are summarized in Section 3.3.2.

3.3.1.1 Metals

A review of the metals data for the sediment samples found the DQOs specified in the project QAPP (Tetra Tech 2010a) and in accordance with EPA data validation national functional guidelines (EPA 2017a) were met for the analytical results, with the following exceptions:

- Arsenic, chromium, and vanadium were detected in the method blank (MB) associated with laboratory batch 243958. The associated sample results were greater than 10 times the amounts in the MB, however; therefore, no data were qualified.

- The matrix spike (MS) and matrix spike duplicate (MSD) % recovery (%R) for arsenic and the MS %R for lead exceeded the upper control limit. The laboratory control sample (LCS) and laboratory control sample duplicate (LCSD) %Rs were within control limits, indicating interference by the sample matrix. The arsenic and lead results for parent sample WSM1720170118R3 were qualified as estimated and possibly biased high (flagged J+).

- The serial dilution percent differences (%D) for arsenic, chromium, and zinc for sample WSM1720170118R3 exceeded control criteria. The chromium and zinc results for sample WSM7120170118R3 were qualified as estimated (flagged J). The arsenic result was qualified previously because of MS/MSD %R excursions, so was not further qualified.

- The MS and/or MSD responses for manganese and mercury exceeded the calibration range for WSM0120170118. The non-spiked sample results for these analytes were within calibration range, however; therefore, no data were qualified.

- The serial dilution %D for manganese, barium, chromium, cobalt, copper, and nickel for sample WSM0120170118 exceeded control criteria. Manganese, barium, chromium, cobalt, and copper results for sample WSM0120170118 were qualified as estimated (flagged J). The nickel result was qualified previously because of an MSD %R excursion, so was not further qualified.

- The MSD %R for nickel exceeded the upper control limit. The LCS and LCSD %Rs were within control limits, indicating interference by the sample matrix. The nickel result for parent sample WSM0120170118 was qualified as estimated and possibly biased high (flagged J+).

- The selenium response exceeded control criteria for the continuing calibration verification (CCV) analyzed on February 2, 2017. Selenium was not detected in the associated samples, so additional qualifiers beyond the flagged J were not required.

- Vanadium was detected in continuing calibration blanks (CCB) analyzed on February 24, 2017. The associated sample results were greater than 10 times the amounts in the CCBs; therefore, the data did not require qualification.

- The post digestion spike %R for zinc was below the lower control limit. The MS and MSD %Rs were not calculated because the amount of zinc in the parent sample was greater than 4 times the amount spiked. The zinc result for parent sample WSM0120170118 was qualified as estimated and possibly biased low (flagged J-).

- Some detected results were qualified as estimated (flagged J) by the laboratory because they were reported at concentrations between the method detection limit (MDL) and the reporting limit (RL). The analytical instrument can make reliable qualitative identification of analyte concentrations above the MDL but below the quantitation limit (QL); however, detected results below the RL are considered quantitatively uncertain.

3.3.1.2 Polychlorinated Biphenyls

A review of the PCB data quality for the sediment samples found the DQOs specified in the project QAPP (Tetra Tech 2010a) and in accordance with EPA data validation national functional guidelines (EPA 2017b) were met for the analytical results, with the following exceptions:

- As a result of low response for a CCV, the nondetected Aroclor-1248 result for WSM13D20170118B was qualified as estimated (flagged UJ).

- Several of the samples required dilution to bring target analytes into calibration range or because of matrix interference.

- Some detected results were qualified as estimated (flagged J) by the laboratory because they were reported at concentrations between the MDL and RL. The analytical instrument can make reliable qualitative identification of analyte concentrations above the MDL but below the QL; however, detected results below the RL are considered quantitatively uncertain.

3.3.2 Pore Water

A review of the metals data for the pore water samples found the DQOs specified in the project QAPP (Tetra Tech 2010a) and in accordance with EPA data validation national functional guidelines (EPA 2017a) were met for the analytical results, with the following exceptions:

- Antimony was detected in a CCB analyzed on March 1, 2017. The associated sample results were greater than 10 times the amount in the CCB; therefore, no data were qualified.

- Relative Percent Differences (RPD) for antimony, cadmium, chromium, cobalt, iron, lead, molybdenum, and nickel for field duplicate pair WSM0720170118 and WSM07DUP20170118 exceeded control criteria. Results for these metals for both samples were qualified as estimated (flagged J).

- RPDs for antimony, arsenic, chromium, cobalt, iron, lead, molybdenum, nickel, selenium, and vanadium for field duplicate pair WSM1720170118 and WSM17DUP20170118 exceeded control criteria. Results for these metals for both samples were qualified as estimated (flagged J).

- Arsenic was detected below the RL in one MB. Arsenic results for associated samples were greater than 10 times the amount in the MB; therefore, no data were qualified.

- Serial dilution criteria violations resulted in qualification as estimated (flagged J) for arsenic and barium results for sample WSM0420170118 and barium, copper, and vanadium results for sample WSM0120170118.

- The methylmercury RL (0.025 nanograms per gram [ng/g]) specified in the field sampling plan (Tetra Tech 2017) for sediment samples was not achieved by the laboratory as a result of normal laboratory instrumentation limitations; actual sediment sample RLs ranged from 0.065 to 0.145 ng/g. The higher RL did not affect the data evaluation.

- The methylmercury result for sediment sample WSM04 20170118 was qualified as estimated and possibly biased low (flagged J-) because of a low MSD %R.

- Vanadium was detected in CCBs analyzed on February 24, 2017 and March 1, 2017. The associated sample results were greater than 10 times the amounts in the CCBs, however; therefore, no data were qualified.

- Vanadium was detected above the RL in two MBs. Vanadium results for associated samples WSM0120170118, WSM0220170118, WSM0320170118, WSM0420170118, WSM050170118, WSM0620170118, WSM0720170118, WSM07DUP20170118, WSM0820170118, WSM0920170118, WSM1020170118, WSM1120170118, WSM1220170118, WSM1320170118, WSM1420170118, WSM1520170118, WSM1620170118, WSM1720170118, and WSM1920170118 were qualified as estimated and possibly biased high (flagged J+).

- Some detected results were qualified as estimated (flagged J) by the laboratory because they were reported at concentrations between the MDL and RL. The analytical instrument can make reliable qualitative identification of analyte concentrations above the MDL but below the QL; however, detected results below the RL are considered quantitatively uncertain.

- The RPD (110%) for field duplicate pair WSM1720170118 and WSM17DUP20170118 exceeds the control limit of 35%. The laboratory confirmed by reanalysis. The laboratory noted upon receipt of the samples that original sample had visible particulate while the duplicate sample was clear, which points to possible sampling/field filtration error. Both results were qualified as estimated (flagged J).

- Some detected results were qualified as estimated (flagged J) by the laboratory because they were reported at concentrations between the MDL and RL. The analytical instrument can make reliable qualitative identification of analyte concentrations above the MDL but below the QL; however, detected results below the RL are considered quantitatively uncertain.

3.4 ANALYSIS OF REPLICATE DATA

The reproducibility of Phase V sample data was also evaluated by comparing results from field replicate samples: triplicate sediment samples and duplicate pore water samples. Replicate samples were collected in a triangular (triplicate) or linear (duplicate) formations within approximately 1 foot of each other at the following locations selected at random: WSM07 and WSM17. These sets of replicate samples were collected to evaluate variability of sediment or pore water concentrations within small areas, and to help determine the appropriate confidence levels regarding decisions based on the concentration of an individual sample location result. Co-located samples may be expected to have the same or very similar chemical concentrations because they are so close spatially; however, co-located samples often do not meet precision expectations; therefore, the variability may result in lower confidence in decisions and false positive or negative decisions based on individual data results.

Triplicate Sediment Sample Evaluation. The relative standard deviation (RSD) was calculated to evaluate precision, accuracy, and representativeness of the sediment data. The RSD is the standard deviation divided by the mean of the three results. The RSD is also intended to quantify the total error of the measurement system and is used as a QC measure to assess sample variability. The triplicate samples were analyzed for metals at the 0.5-1.0 feet bgs interval and PCBs at the 0.5-1 and 1.5-2.0 feet bgs intervals. The RSD calculations for the Phase V data in the old WSM triplicate samples are presented in Table 2.

An RSD of 35 percent was selected as a general goal for the Phase V results to determine acceptable precision. 66 triplicate evaluations were calculated for detected metal and PCB concentrations; 38 metals and 28 Aroclors. The two thallium triplicate results contained nondetected values and therefore were eliminated from evaluation.

- Metals exceeded the 35 percent goal in five samples, or 14 percent of the total (36) metals results. The range of RSD values exceeding the goal was 35.3 to 66.2, with an average of 39.9. The metals exceeding the goals were antimony, cadmium, lead, and silver. Of these metals, only lead is recommended as a potential contaminant of concern in Section 4.1, and triplicate results were 59 milligrams per kilogram (mg/kg), 70 mg/kg, and 170 mg/kg, with an RSD of 61.4 percent, indicating that that the discrete sampling method used for quantifying the actual mean concentration of lead at any given sampling location was inadequate to characterize the concentration within the defined acceptable error. The discrete sampling method is not a reliable method for meeting precision, accuracy, or representativeness goals for lead at any given sampling location. The second triplicate sample result for lead was 32.1 RSD.

  Results of the triplicate analysis for metals indicate sediment results generally meet the RSD goal of 35 percent, with the noted exceptions. It is possible and likely that the collection of additional triplicate analyses would result in elevated RSD values. Decisions made regarding lead for example, should incorporate the co-located variability of individual concentrations, which could vary by at least 61 percent, according to the RSD of just two triplicate analyses.

- PCBs exceeded the 35 percent goal in 19 Aroclor analyses in triplicate samples collected at two depths in two sample locations (WSM07 and WSM17), or 68 percent of the total (28) aroclor analyses. The range of RSD values exceeding the goal was 48.3 to 147.4, with an average of 96.7. Many of the elevated RSDs are the result of small concentration variations of sample results at low concentrations, such as 0.1 mg/kg, 0.12 mg/kg, and 0.51 mg/kg for Aroclor-1248 at WSM17 resulting in an RSD of 95. While above the 35 percent goal, these RSDs at low concentrations have low precision, but may not result in low confidence regarding false positive or negative decisions. Elevated RSDs, however, are also present at elevated PCB concentrations, such as 0.38 mg/kg, 2.2 mg/kg, and 23 mg/kg for Aroclor-1248 at WSM07. These elevated RSDs indicate low precision and low confidence regarding false positive or negative decisions.

  Results of the triplicate analysis for PCBs indicate that sediment results do not meet the RSD goal of 35 percent at a high frequency (50 percent). High RSD values suggest a substantial degree of heterogeneity in the PCB concentrations at very short distances, and concentrations from any individual sample location may be below or above any action level ranging from 0.5 mg/kg to 20 mg/kg. These results indicate that that the discrete sampling method used for quantifying the actual mean concentration of PCBs at any given sampling location was inadequate to characterize the concentration within the defined acceptable error. The discrete sampling method is not a reliable method for meeting precision, accuracy, or representativeness goals for PCBs at any given sampling location. It is possible and likely that the collection of additional triplicate analyses would result in elevated RSD values. Decisions made regarding PCBs should not be based on sample results from individual locations. The poor precision, accuracy, and representativeness of the discrete sampling results for PCBs are consistent with environmental publications (Brewer et al 2016).

Duplicate Pore Water Sample Evaluation. The RPD was calculated to evaluate precision of the pore water data. The RPD is the difference of the two results divided by the average of the two results. The RPD is also intended to quantify the total error of the measurement system and can be used as a QC measure to assess sample variability. The RPD value is not as powerful as the RSD value in regards to evaluating precision; however, it is useful for pore water samples which are assumed to be less heterogeneous than sediment samples. The duplicate samples were analyzed for all metals at two locations WSM07 and WSM17 for all metals except methylmercury, which was only analyzed in

duplicate at one location WSM17 since only ten methylmercury analyses were performed. The RPD calculations for the Phase V data in the old WSM triplicate samples are presented in Table 3.

RPD values ranged from 0 to 124, with an average of 42. Eight of the sample pairs contained at least one non-detect and therefore an RPD could not be calculated. Two RPDs were 0, indicating no difference between the duplicate values. Seven RPDs were between 0 and 25, eight RPDs were between 25 and 50, eight RPDs were between 50 and 100, and six RPDs were between 100 and 124. RPD goals were not established for pore water duplicates, as each result was evaluated based on the detected results, RPD value, and qualitative review of the screening levels, with focus on the recommended potential contaminants of concern identified in Section 5.0.

Evaluation of the duplicate results for the recommended contaminants of concern indicate the RPDs do not have a significant impact on false positive or negative decisions, based on the comparison of the detected concentrations and the screening levels, with the possible exception of nickel.

3.5 FSP DEVIATIONS

The Phase V FSP included discrete sediment samples collected directly from the WSM prior to the placement of sediment into the 5-gallon buckets for centrifugal extraction of pore water. The project geologist determined that collection of the discrete sediment sample directly from the 5-gallon bucket would provide a more representative sample of the immediate area sampled for pore water analysis.

The Phase V FSP included the collection of one triplicate for the analysis of methylmercury in sediment. While two sets of field triplicates were collected for the evaluation of metals, the analysis of methylmercury was dependent on the highest ten results of mercury, and therefore the field team could not predict if any of the collected triplicate samples would be identified as one of the ten to be analyzed for methylmercury. As a result, no triplicates were sent to the laboratory for methylmercury analysis.

The Phase V FSP included a split duplicate sample collected for the analysis of pore water. Since ample sediment volume was provided to the laboratory for the extraction of pore water from two field duplicates, field duplicates were evaluated for pore water analysis. Field duplicates provide additional information regarding field and laboratory variability, whereas a split duplicate only provides information regarding laboratory variability. The field duplicate is considered a more valuable replicate sample.

These deviations do not affect the usability of the data or conclusions regarding sediment or pore water results.

3.6 ASSESSMENT SUMMARY

Although some qualifiers were added to the data, a final review of the dataset compared with EPA data quality parameters indicate the data are of high overall quality. None of the data required rejection.

The data, collected as part of the Phase V sampling investigation, meet all the requirements of the precision, accuracy, representativeness, completeness, and comparability described in EPA guidance for QAPPs (EPA 2002) and the project-specific QAPP (Tetra Tech 2010a), and are usable as qualified for meeting project DQOs.

4.0 SEDIMENT SAMPLE RESULTS

Sediment samples were collected at 19 locations at two depths (0-0.5 and 1.5-2.0 feet bgs), as indicated on Figure 5. Sediment samples were submitted for analysis of metals and PCBs. Screening criteria for sediment samples consist of human health and ecological screening criteria.

- Human health criteria include levels developed in the RAW Soil Management Plan (SMP), (Tetra Tech 2014a) consisting of Category I: levels meeting all RFS current and projected future exposures; and, Category II: levels meeting manage in place criteria as outlined in the SMP. In addition, specific screening criteria are highlighted as reference points for the most likely human exposures: maintenance workers who may be exposed to sediments during any possible projects in the marsh, and off-site receptors who may be exposed to chemicals via the inhalation pathway, which is unlikely given the natural moisture content of the marsh sediments. PCB concentrations were evaluated against the Toxic Substances Control Act (TSCA) Self-Implementing Cleanup Goal.

- Ecological screening levels include the Effects Range-Low (ER-L) and Effects Range-Median (ER-M) concentrations developed for screening contaminants in sediment (Long and others 1995), and ambient concentrations of toxic chemicals in San Francisco Bay sediments (Yee and others 2015). Chemical concentrations were also compared to upland ambient levels for arsenic, cobalt, manganese, and nickel as an indicator of a source of ambient concentrations of marsh sediment.

Table 4 provides a statistical summary of the metals and PCB analyses of all sediment samples compared to the listed screening criteria.

4.1 METALS ANALYSES

A total of 23 sediment samples were evaluated for metals and ten samples evaluated for methylmercury. A summary of the detected results and comparison to screening criteria for each metal is provided below. Recommendations are provided regarding each metal considered a potential chemical of concern for the old portion of WSM. Detected metals results and human health screening criteria are presented in Table 6; detected metals results and ecological screening criteria are presented in Table 7.

Antimony. Antimony was detected in all 23 samples ranging from 0.29 to 6.4 mg/kg. None of the concentrations exceed any of the human health screening criteria, including the lowest Category I criteria of 109 mg/kg.

One sample result of 6.4 mg/kg at WSM02 exceeds the ER-L screening criteria of 2 mg/kg. None of the results exceed the ER-M criteria of 25 mg/kg. The average detected concentration of antimony is 0.879, less than the ER-L. There are no San Francisco Bay Ambient screening criteria.

Antimony does not appear to be an indicator of sediment contamination and should not be considered a COPC in WSM.

Arsenic. Arsenic was detected in all 23 samples ranging from 13 to 370 mg/kg. 22 of the 23 samples exceeded the Category I ambient criteria of 16 mg/kg. The most elevated concentration of 370 mg/kg

was reported at WSM02. Other metals historically associated with pyrite cinders, including copper, nickel, and zinc, were also reported at their most elevated concentrations at WSM02.

Twenty-two of the 23 samples exceed the Category I ambient criteria and the ER-L criteria of 8.2 mg/kg. One sample result of 370 mg/kg at WSM02 exceeds the ER-M criteria of 70 mg/kg.

Given the site history regarding pyrite cinders in WSM and the possibility of use of arsenical pesticides and herbicides along the former Sante Fe rail spur (now the EBRPD Bay Trail section) and other urban areas draining to WSM, arsenic concentrations may be an indicator of sediment contamination and may be considered a COPC in WSM.

Barium. Barium was detected in all 23 samples ranging from 46 to 180 mg/kg. None of the concentrations exceed any of the human health screening criteria, including the lowest Category I criteria of 2,110 mg/kg.

There are no available ecological screening criteria for barium.

Barium does not appear to be an indicator of sediment contamination and should not be considered a COPC in WSM.

Beryllium. Beryllium was detected in all 23 samples ranging from 0.6 to 1.3 mg/kg. None of the concentrations exceed any of the human health screening criteria, including the lowest Category I criteria of 29 mg/kg.

There are no available ecological screening criteria for beryllium.

Beryllium does not appear to be an indicator of sediment contamination and should not be considered a COPC in WSM.

Cadmium. Cadmium was detected in all 23 samples ranging from 0.17 to 2.3 mg/kg. None of the concentrations exceed any of the human health screening criteria, including the lowest Category I criteria of 68.1 mg/kg.

Three of the sample results exceed the ER-L criteria of 1.2 mg/kg; none of the results exceed the ER-M criteria of 9.6 mg/kg. Nineteen of the samples are above the San Francisco Bay Ambient level of 0.33 mg/kg with the average detected concentration of 0.677 mg/kg.

While average concentrations of cadmium are less than the ER-L, they are elevated relative to San Francisco Bay ambient concentrations. This may indicate that WSM is impacted by elevated cadmium levels in Meeker Slough. Historic sample results (Blasland, Bouck & Lee, Inc. [BBL] 2005) show concentration of cadmium off UC property up to 30 mg/kg with average concentrations higher at depth (greater than 2 feet bgs) relative to shallow samples. This may indicate that residual cadmium from historic industrial activities and uncontrolled dumping in the former Kaiser Shipyard area to the east is still present in Meeker Slough sediments. Cadmium is also associated with pyrite cinders historically present in WSM. Therefore, while cadmium may be a chemical of potential concern (COPC) regionally and not a significant contaminant in the portions of WSM on UC property sampled during this field investigation, it may be considered a COPC in WSM.

Chromium. Chromium was detected in all 23 samples ranging from 95 to 160 mg/kg. None of the concentrations exceed any of the human health screening criteria, including the lowest Category I criteria of 100,000 mg/kg.

All 23 samples exceed the ER-L of 81 mg/kg; none of the samples exceed the ER-M of 370 mg/kg. 14 samples exceed the San Francisco Bay Ambient level of 112 mg/kg; the average concentration of the 23 detects is 124 mg/kg, similar to the San Francisco Bay ambient concentration.

Chromium does not appear to be an indicator of sediment contamination and should not be considered a COPC in WSM.

Cobalt. Cobalt was detected in all 23 samples ranging from 11 to 29 mg/kg. None of the concentrations exceed any of the human health screening criteria, including the lowest Category I ambient criteria of 73 mg/kg.

There are no available ecological screening criteria for cobalt.

Cobalt does not appear to be an indicator of sediment contamination and should not be considered a COPC in WSM.

Copper. Copper was detected in all 23 samples ranging from 55 to 430 mg/kg. None of the concentrations exceed any of the human health screening criteria, including the lowest Category I criteria of 10,900 mg/kg.

All 23 samples exceed the ER-L of 34 mg/kg; one of the samples exceeds the ER-M of 270 mg/kg. All 23 samples exceed the San Francisco Bay Ambient level of 53.9 mg/kg with an average detected result of 114 mg/kg for the 23 samples. The copper concentration at WSM02 may be associated with former pyrite cinders at that location as discussed within the arsenic discussion, and may also be associated with other urban pollutant sources (historic storm water sampling detected elevated copper concentrations in storm water samples (Tetra Tech 2010b).

Given the site history of pyrite cinders in WSM, paint manufacturing and use at Kaiser Shipyards and associated industries to the west, and as urban runoff pollution, copper concentrations may be an indicator of sediment and/or storm water contamination and may be considered a COPC in WSM.

Iron. Iron was detected in all 23 samples ranging from 31,000 to 63,000 mg/kg. None of the concentrations exceed any of the human health screening criteria, including the lowest Category I criteria of 100,000 mg/kg.

There are no available ecological screening criteria for iron.

Iron does not appear to be an indicator of sediment contamination and should not be considered a COPC in WSM.

Lead. Lead was detected in all 23 samples ranging from 52 to 450 mg/kg. One sample (WSM03) exceeded the Category I human health screening criteria of 320 mg/kg.

All 23 samples exceed the ER-L of 46.7 mg/kg; five of the samples exceed the ER-M of 218 mg/kg. All 23 samples exceed the San Francisco Bay Ambient level of 25.1 mg/kg. The most elevated concentrations are identified within WSM01 through WSM05; however the limited special coverage

of the discrete samples as well as analysis of triplicate results do not support geographic conclusions regarding the distribution of lead in WSM.

Lead concentrations may be an indicator of sediment contamination due to the history of pyrite cinder placement in WSM, paint manufacturing and other industrial uses at adjacent properties, as well as other urban sources and may be considered a COPC in WSM.

Manganese. Manganese was detected in all 23 samples ranging from 190 to 840 mg/kg. None of the concentrations exceed any of the human health screening criteria, including the lowest Category I ambient criteria of 5,900 mg/kg.

There are no available ecological screening criteria for manganese.

Manganese does not appear to be an indicator of sediment contamination and should not be considered a COPC in WSM.

Mercury. Mercury was detected in all 23 samples ranging from 0.94 to 19 mg/kg. None of the concentrations exceed any of the human health screening criteria, including the lowest Category I criteria of 77 mg/kg.

All 23 samples exceed the ER-L of 0.15 mg/kg and ER-M of 0.71 mg/kg. All 23 samples exceed the San Francisco Bay Ambient level of 0.33 mg/kg.

Given the site history of mercury contamination in the upland area, mercury concentrations may be an indicator of sediment contamination and may be considered a COPC in WSM.

Methylmercury. Methylmercury was detected in all ten samples ranging from 0.000907 to 0.015 mg/kg. Methylmercury is not included as a chemical of concern in the RAW SMP, however EPA Regional Screening Levels identify 7.8 mg/kg as the unrestricted residential use criteria (EPA 2017c).

There are no available ecological screening criteria for methylmercury.

Exhibit 1 provides a comparison of methylmercury and mercury results. The exhibit presents methylmercury and mercury concentrations for each of the ten locations evaluated for methylmercury, with methylmercury concentrations increasing to the right. Units for methylmercury concentrations are presented as micrograms per kilogram (µg/kg) and mercury as mg/kg. Figure 6 presents the methylmercury and mercury results for each sampling location.

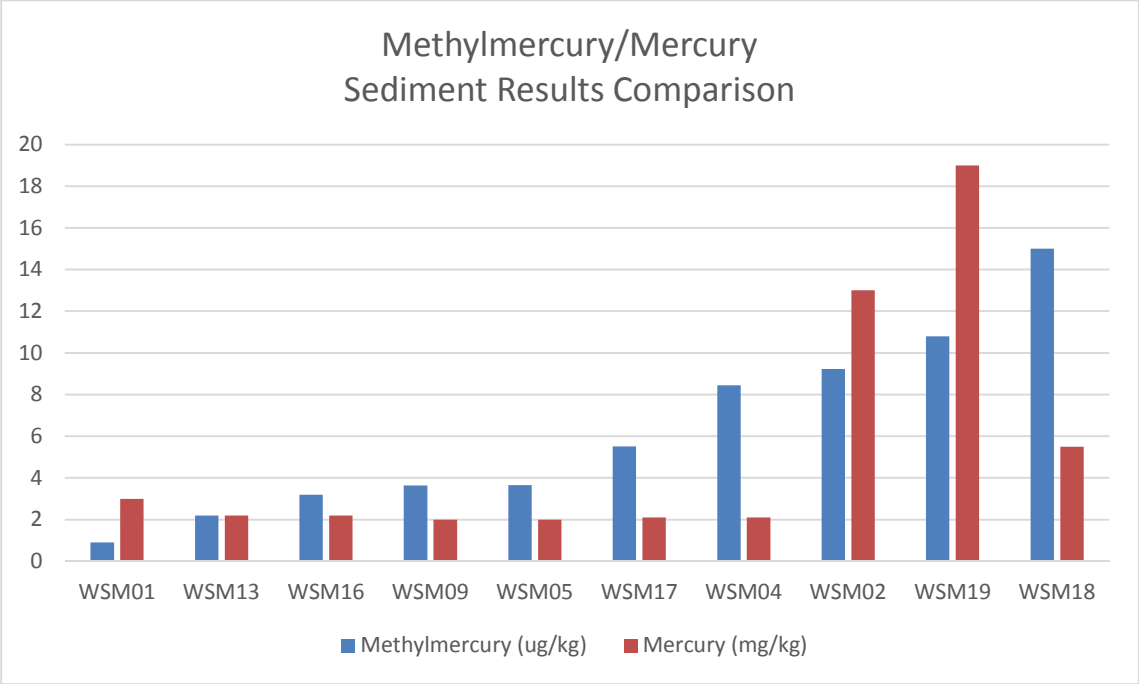

Exhibit 1. Comparison of Methylmercury and Mercury Results

Methylmercury is present in WSM sediments, although given the absence of screening criteria, the significance of the sediment concentrations is inconclusive. Further evaluation is recommended to determine if methylmercury may be considered a COPC in WSM.

Molybdenum. Molybdenum was detected in all 23 samples ranging from 0.19 to 9.6 mg/kg. None of the concentrations exceed any of the human health screening criteria, including the lowest Category I criteria of 1,360 mg/kg.

There are no available ecological screening criteria for molybdenum.

Molybdenum does not appear to be an indicator of sediment contamination and should not be considered a COPC in WSM.

Nickel. Nickel was detected in all 23 samples ranging from 78 to 150 mg/kg with an average concentration of 108 mg/kg, similar to the San Francisco Bay ambient average of 98.3 mg/kg. None of the concentrations exceed any of the human health screening criteria, including the lowest Category I ambient criteria of 280 mg/kg. All sample results exceed both the ER-L of 20.9 mg/kg and the ER-M of 51.6 mg/kg, but as these results are consistent with San Francisco Bay Ambient concentrations, nickel does not appear to be an indicator of sediment contamination and should not be considered a COPC in WSM.

Selenium. Selenium was detected in 22 samples ranging from 0.74 to 3.8 mg/kg. One sample was reported as nondetected at a detection limit of 6.1 mg/kg. None of the concentrations exceed any of the human health screening criteria, including the lowest Category I criteria of 1,340 mg/kg.

There are no available ecological screening criteria for selenium. Twenty-two of the detected results exceeded the San Francisco Ambient level of 0.36 mg/kg. Selenium was considered a COPC in the 2002 Conceptual Remedial Action Plan (C-RAP) due to concentrations exceeding the ER-M effective at that time (2 mg/kg), including one off-UC property concentration of 21 mg/kg. While it does not appear that selenium is currently an indicator of sediment contamination, it will be retained as a possible COPC in WSM until further evaluation.

Silver. Silver was detected in all 23 samples ranging from 0.24 to 3.5 mg/kg with an average detected concentration of 0.721. Seventeen samples results were reported as qualified estimated values (J).

None of the concentrations exceed any of the human health screening criteria, including the lowest Category I criteria of 1,360 mg/kg.

Two samples exceed the ER-L of 1 mg/kg and no samples exceed the ER-M of 3.7 mg/kg. Given that the average concentration is the same order of magnitude as the San Francisco Bay Ambient level of 0.32 mg/kg, silver does not appear to be an indicator of sediment contamination and should not be considered a COPC in WSM.

Thallium. Thallium was detected in 12 samples ranging from 0.14 to 0.35 mg/kg; however, nondetect results were identified at detection limits up to 0.93 mg/kg in eleven samples and all other samples were qualified as estimated values (J). None of the concentrations exceed any of the human health screening criteria, including the lowest Category I criteria of 2.72 mg/kg.

There are no available ecological screening criteria for thallium.

Thallium does not appear to be an indicator of sediment contamination and should not be considered a COPC in WSM.

Vanadium. Vanadium was detected in all 23 samples ranging from 54 to 110 mg/kg. None of the concentrations exceed any of the human health screening criteria, including the lowest Category I criteria of 1,360 mg/kg.

There are no available ecological screening criteria for vanadium and no reported San Francisco Bay Ambient sediment concentration.

Vanadium does not appear to be an indicator of sediment contamination and should not be considered a COPC in WSM.

Zinc. Zinc was detected in all 23 samples ranging from 190 to 1,500 mg/kg with an average concentration of 383 mg/kg. None of the concentrations exceed any of the human health screening criteria, including the lowest Category I criteria of 81,600 mg/kg.

All 23 samples exceed the ER-L of 150 mg/kg; five of the samples exceed the ER-M of 410 mg/kg. All 23 samples exceed the San Francisco Bay Ambient level of 136 mg/kg with an average detected concentration of 383 mg/kg.

Given the site history regarding pyrite cinders in WSM and that zinc was considered a COPC in the 2002 C-RAP, zinc concentrations may be an indicator of sediment contamination and should be considered a COPC in WSM.

Based on the sediment sample results compared to the human health and ecological screening criteria, the following metals are recommended for consideration and further evaluation as chemicals of potential concern at the old WSM:

- Arsenic
- Cadmium
- Copper
- Lead
- Mercury
- Methylmercury
- Selenium
- Zinc

4.2 PCB ANALYSES

A total of 46 sediment samples were evaluated for PCBs by EPA Method 8082; 23 samples from 0.5-1.0 feet bgs and 23 samples from 1.5-2.0 feet bgs. Aroclor-1248 was detected in 38 of the samples, Aroclor-1254 was detected in six of the samples, and Aroclor-1260 was detected in 44 of the samples. Total PCBs, as the sum of the Aroclors, were detected in 45 of the 46 samples, indicating widespread distribution throughout the study area.

Total detected PCB concentrations ranged from 0.015 to 41.1 mg/kg, with an average detected concentration of 4.45 mg/kg. The standard deviation of the data set is 8.1 and the estimated 95th upper confidence limit of the mean concentration is 8 mg/kg.

Nineteen sample results exceeded the TSCA Self-Implementing Cleanup Goal of 1 mg/kg. Forty-four sample results exceeded the ER-L of 0.0227 mg/kg and 38 sample results exceeded the ER-M of 0.18 mg/kg. Forty-four sample results exceeded the San Francisco Bay Ambient level of 0.0183 mg/kg. Aroclor and total PCB concentrations and screening criteria are presented in Table 8.

The geographic distribution of concentrations does not appear to follow trends regarding depths or locations within the study area – the distribution of concentrations is variable throughout the area. Given the results of the triplicate analysis discussed in Section 3.4.1, the discrete sampling methodology does not allow for a confident analysis of the geographic distribution.

Given the site history of PCB contamination in northwestern portion of WSM, PCB concentrations may be an indicator of sediment contamination and should be considered a COPC in WSM.

4.3 COMPARISON WITH PREVIOUS SEDIMENT RESULTS

The DQOs for Phase V included the comparison of current data with previous investigations conducted in the study area, as identified in the Phase V FSP. Phase V sediment locations were selected to be consistent with sediment data presented in the Draft Final Conceptual Remedial Action Plan (BBL 2005).

A location-by-location comparison of current and previous sampling results cannot be conducted due to the poor precision, accuracy, and representativeness of any individual discrete sediment sample result, as determined through the Phase V triplicate analyses. Triplicate field samples were not collected in previous investigations; however, it can be assumed the precision, accuracy, and representativeness of the previous data is not higher than the current Phase V data.

A qualitative analysis of average and maximum concentrations of the recommended potential chemicals of potential concern from both data sets identifies broad-scale trends or observations. Exhibit 2 provides a summary of the qualitative analysis, with primary emphasis on the evaluation of the average concentrations.

Chemicals of Potential Concern	Previous Average Concentration (BBL 2005)	Previous Maximum Concentration (BBL 2005)	Phase V Average Concentration	Phase V Maximum Concentration	Observations
Arsenic	43.92	260	45.3	370	Phase V and previous results appear similar
Cadmium	3.82	21	0.677	2.3	Phase V results appear lower than previous results
Copper	135.86	1,200	104	430	Phase V results appear lower than previous results
Lead	99.25	560	144	450	Phase V results appear higher than previous results
Mercury	3.98	69	3.14	19	Phase V results appear lower than previous results
Methylmercury	Not sampled	Not Sampled			
Selenium	1.45	14	1.77	3.8	Phase V and previous results appear similar
Zinc	366.25	1,800	383	1,500	Phase V and previous results appear similar
Aroclor 1248	2.80	65	4.83	39	Phase V results appear higher than previous results
Aroclor 1254	0.54	25	0.445	1.5	Phase V and previous results appear similar
Aroclor 1260	0.12	3.5	0.313	2.1	Phase V results appear higher than previous results.
All sample results presented in mg/kg					

Exhibit 2. Comparison of Phase V and Previous Sample Results, Potential Chemicals of Concern

The qualitative analyses of Phase V sample sediment sample results with previous sample results (BBL 2005) indicate that while there is some variability between the Phase V and previous results, there are no conclusive or obvious trends between the data sets implying that concentrations have increased or decreased dramatically; the data appear comparable. Pore water samples were not collected prior to Phase V; therefore, an evaluation was not conducted.

5.0 PORE WATER SAMPLE RESULTS

Pore water samples were collected collocated with the 19 sediment sample locations collected from 0.0-0.5 feet bgs, including two duplicate samples. A total of 21 pore water samples were evaluated for metals by EPA Method 6020/7471 and 11 samples were evaluated for methylmercury by EPA Method 1630. The pore water samples for methylmercury were collocated with the sediment samples analyzed for methylmercury, as described in Section 2.1

Pore water results were compared to two screening criteria: 10 x Ambient Water Quality Criteria and Marine Aquatic Toxicity Criteria. A summary of the detected results and comparison to screening criteria for each metal is provided below. A statistical summary of pore water sample results is presented in Table 5; all detected results and screening criteria are presented on Table 9. Recommendations are provided regarding each metal being considered a potential chemical of concern for the old WSM.

Antimony. Antimony was detected in all 21 samples ranging from 1.1 to 48 micrograms per liter (µg/L). None of the concentrations exceed the 10 x Ambient Water Quality Criteria of 43,000 µg/L; there are no Marine Aquatic Toxicity Criteria for antimony.

Antimony does not appear to be an indicator of pore water contamination and should not be considered a COCP in WSM.

Arsenic. Arsenic was detected in all 21 samples ranging from 8.7 to 410 µg/L. Three of the samples exceed the Marine Aquatic Toxicity Criteria of 36 µg/L, including the most elevated concentration at WSM02, which is also the sample point of the most elevated sediment sample result for arsenic. There are no Ambient Water Quality Criteria for arsenic.

Given the site history regarding pyrite cinders in WSM, arsenic concentrations may be an indicator of pore water contamination and should be considered a COPC in WSM.

Barium. Barium was detected in all 21 samples ranging from 17 to 56 µg/L. There are no aquatic screening criteria for barium.

Barium does not appear to be an indicator of pore water contamination and should not be considered a COPC in WSM.

Beryllium. Beryllium was detected in one sample at 0.26 µg/L. There are no aquatic screening criteria for beryllium.

Beryllium does not appear to be an indicator of pore water contamination and should not be considered a COPC in WSM.

Cadmium. Cadmium was detected in 12 samples ranging from 0.24 to 0.76 µg/L. None of the samples exceed the Marine Aquatic Toxicity Criteria of 7.9 µg/L; there are no Ambient Water Quality Criteria for cadmium.

Cadmium does not appear to be an indicator of pore water contamination and should not be considered a COPC in WSM.

Chromium. Chromium was detected in all 21 samples ranging from 1.3 to 4.2 µg/L. There are no aquatic screening criteria for chromium.

Chromium does not appear to be an indicator of pore water contamination and should not be considered a COPC in WSM.

Cobalt. Cobalt was detected in all 21 samples ranging from 1.2 to 15 µg/L. There are no aquatic screening criteria for cobalt.

Cobalt does not appear to be an indicator of pore water contamination and should not be considered a COPC in WSM.

Copper. Copper was detected in seven samples ranging from 5.3 to 46 µg/L. All seven samples exceed the Marine Aquatic Toxicity Criteria of 3.1 µg/L. There are no Ambient Water Quality Criteria for arsenic.

Given the site history regarding pyrite cinders in WSM, copper concentrations may be an indicator of pore water contamination and should be considered a COPC in WSM

Iron. Iron was detected in 16 samples ranging from 55 to 5,500 µg/L. There are no aquatic screening criteria for iron.

Iron does not appear to be an indicator of pore water contamination and should not be considered a COPC in WSM.

Lead. Lead was detected in all 21 samples ranging from 0.28 to 13 µg/L. Three samples exceed the Marine Aquatic Toxicity Criteria of 8.1 µg/L. There are no Ambient Water Quality Criteria for arsenic.

Given the few exceedances and concentrations near the screening criteria, lead does not appear to be an indicator of pore water contamination and should not be considered a COPC in WSM except for the sample locations in the upper Meeker Slough area where it appears that pyrite cinder material may be located.

Manganese. Manganese was detected in all 21 samples ranging from 15 to 1,700 µg/L. There are no aquatic screening criteria for manganese.

Manganese does not appear to be an indicator of pore water contamination and should not be considered a COPC in WSM.

Mercury. Mercury was detected in nine samples ranging from 0.064 to 0.23 µg/L. No samples exceed the Marine Aquatic Toxicity Criteria of 0.94 µg/L. There are no Ambient Water Quality Criteria for arsenic.

Mercury does not appear to be an indicator of pore water contamination except that it may be available to conditions that would lead to methylation and may considered a COPC in WSM. Additional evaluation of mercury is recommended.

Methylmercury. Methylmercury was detected in all ten samples ranging from 0.0002 to 0.0058 g/L. No samples exceed the Marine Aquatic Toxicity Criteria of 0.94 µg/L. There are no Ambient Water Quality Criteria for methylmercury.

Exhibit 3 provides a comparison of methylmercury sediment and pore water results to help determine if there is a correlation between methylmercury identified in sediment and the pore water result from the same sample location. The exhibit presents results for each of the ten locations evaluated for methylmercury sediment, mercury sediment (consistent with Exhibit 1) and methylmercury pore water, with methylmercury sediment concentrations increasing to the right. Units for sediment concentrations are presented as µg/kg and pore water as nanograms per liter (ng/L).

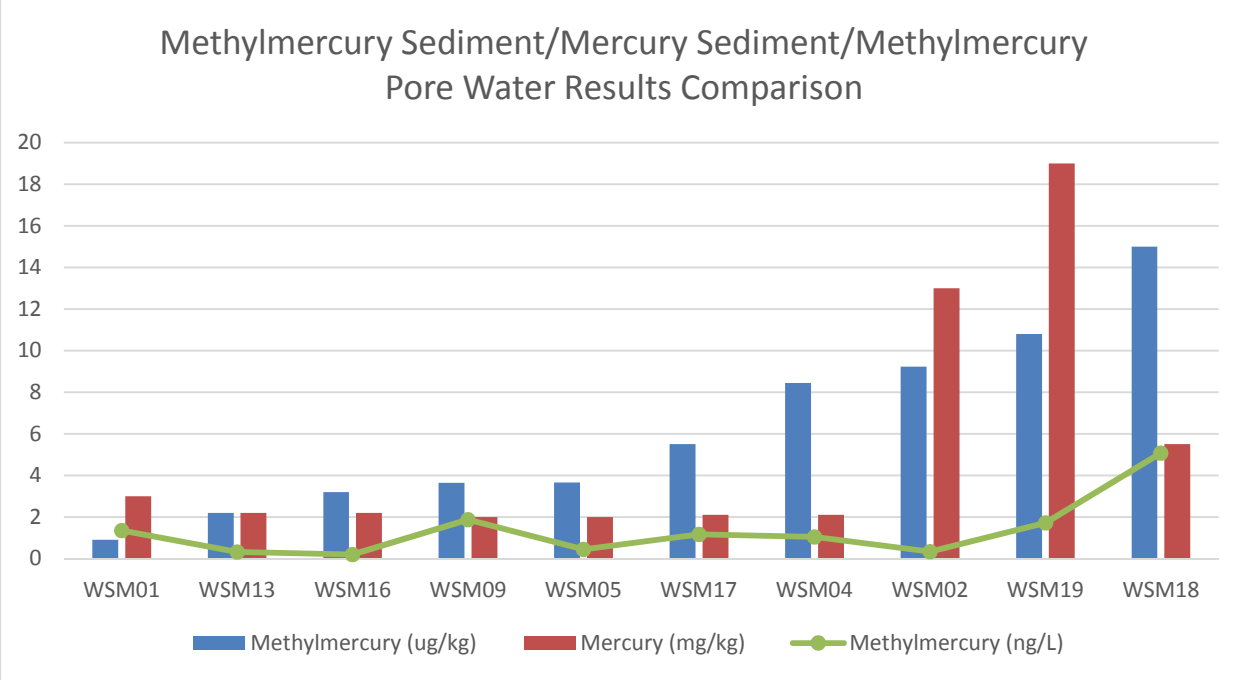

Exhibit 3. Comparison of Methylmercury Sediment, Mercury Sediment, and Methylmercury Pore Water Results

These results demonstrate that methylmercury is present in pore water throughout much of WSM but was detected without an obvious correlation to sediment and pore water concentrations. Methylmercury may be considered COPC in WSM until further evaluation is completed.

Molybdenum. Molybdenum was detected in all 21 samples ranging from 7.4 to 230 µg/L. There are no aquatic screening criteria for molybdenum.

Molybdenum does not appear to be an indicator of pore water contamination and should not be considered a COPC in WSM.

Nickel. Nickel was detected in 20 samples ranging from 0.81 to 19 µg/L. Three of the samples exceed the Marine Aquatic Toxicity Criteria of 8.2 µg/L, including the most elevated concentration at WSM02, which is also the sample point possibly associated with cinder-related metals. No samples are above the 10 x Ambient Water Quality Criteria of 46,000 µg/L.

Given the site history regarding pyrite cinders in WSM, nickel concentrations may be an indicator of pore water contamination and should be considered a COPC in WSM.

Selenium. Selenium was detected in all 21 samples ranging from 0.3 to 4.9 µg/L. No samples exceed the 10 x Ambient Water Quality Criteria of 42,000 µg/L or the Marine Aquatic Toxicity Criteria of 71 µg/L.

Selenium does not appear to be an indicator of pore water contamination and should not be considered a COPC in WSM.

Silver. Silver was detected one sample at 0.084 µg/L. This sample did not exceed the Marine Aquatic Toxicity Criteria of 1.9 µg/L; there is no Ambient Water Quality Criteria.

Silver does not appear to be an indicator of pore water contamination and should not be considered a COPC in WSM.

Thallium. Thallium was not detected in any sample results.

Thallium does not appear to be an indicator of pore water contamination and should not be considered a COPC in WSM.

Vanadium. Vanadium was detected in all 21 samples ranging from 8.3 to 40 µg/L. There are no aquatic screening criteria for vanadium.

Vanadium does not appear to be an indicator of pore water contamination and should not be considered a COPC in WSM.

Zinc. Zinc was detected in 20 samples ranging from 10 to 57 µg/L. No samples exceed the 10 x Ambient Water Quality Criteria of 260,000 µg/L or the Marine Aquatic Toxicity Criteria of 81 µg/L.

Zinc does not appear to be an indicator of pore water contamination and should not be considered a COPC in WSM.

Based on the results of the pore water sample results as compared to the aquatic screening criteria, the following metals are recommended for consideration as potential chemicals of concern in porewater at the old WSM:

- Arsenic
- Copper
- Mercury
- Methylmercury
- Lead
- Nickel

6.0 SUMMARY

An evaluation of Phase V sediment and pore water sampling data collected in the old portion of WSM indicate the DQOs were achieved, and no significant deviations from the Phase V FSP occurred. The evaluation did not identify immediate or potential threats to human health or the environment; however, some concentrations of potential chemicals of potential concern exceeded relevant screening criteria at some locations throughout the old WSM.

The following chemicals are recommended as chemicals of potential concern for further evaluation in the old WSM:

Media	Chemical
Sediment	Arsenic, cadmium, copper, lead, mercury, methylmercury, selenium zinc, PCBs
Pore Water	Arsenic, copper, lead, mercury, methylmercury, nickel

With the exception of metals associated with possible cinders at WSM02, the distributions of chemicals of potential concern do not indicate trends regarding the depths of contamination or trends regarding spatial distribution.

Sampling results from all other metals indicate detected concentrations are present at ambient conditions, background conditions, or below the appropriate screening criteria, and no further assessment of these metals is recommended.

Results of the triplicate analysis for some metals and all PCBs indicate that sediment results do not meet the QA goals for precision, accuracy, and representativeness, as measured through RSD. High RSD values suggest a substantial degree of heterogeneity in sediment concentrations at very short distances. PCB concentrations for example from any individual sample location may be below or above any action level ranging from 0.5 mg/kg to 20 mg/kg, based on the results of the two triplicate results. These results indicate that that the discrete sampling method used for quantifying the actual mean sediment concentrations at any given sampling location was inadequate to characterize the concentration within the defined acceptable error. The discrete sampling method is not a reliable method for meeting precision, accuracy, or representativeness goals at any given sampling location. Decisions made regarding sediment concentrations, particularly PCB results, should not be based on sample results from individual locations.

In order to better control heterogeneity of analyte distribution in the sampling process, incremental sampling methodology (ISM) will be proposed in future sampling plans as an alternative to discrete sampling when deemed necessary to improve the University's ability to make decisions based on individual sample results. ISM is an accepted method for PCB sampling in EPA Region 9. ISM will increase the precision, accuracy, and representativeness of soil and sediment sample results.

The qualitative analyses of Phase V sample sediment sample results with previous sample results (BBL 2005) indicate that while there is some variability between the Phase V and previous results, there are no conclusive or obvious trends between the data sets implying that concentrations have increased or decreased dramatically; the data appear comparable. Pore water samples were not collected prior to Phase V; therefore, an evaluation was not conducted.

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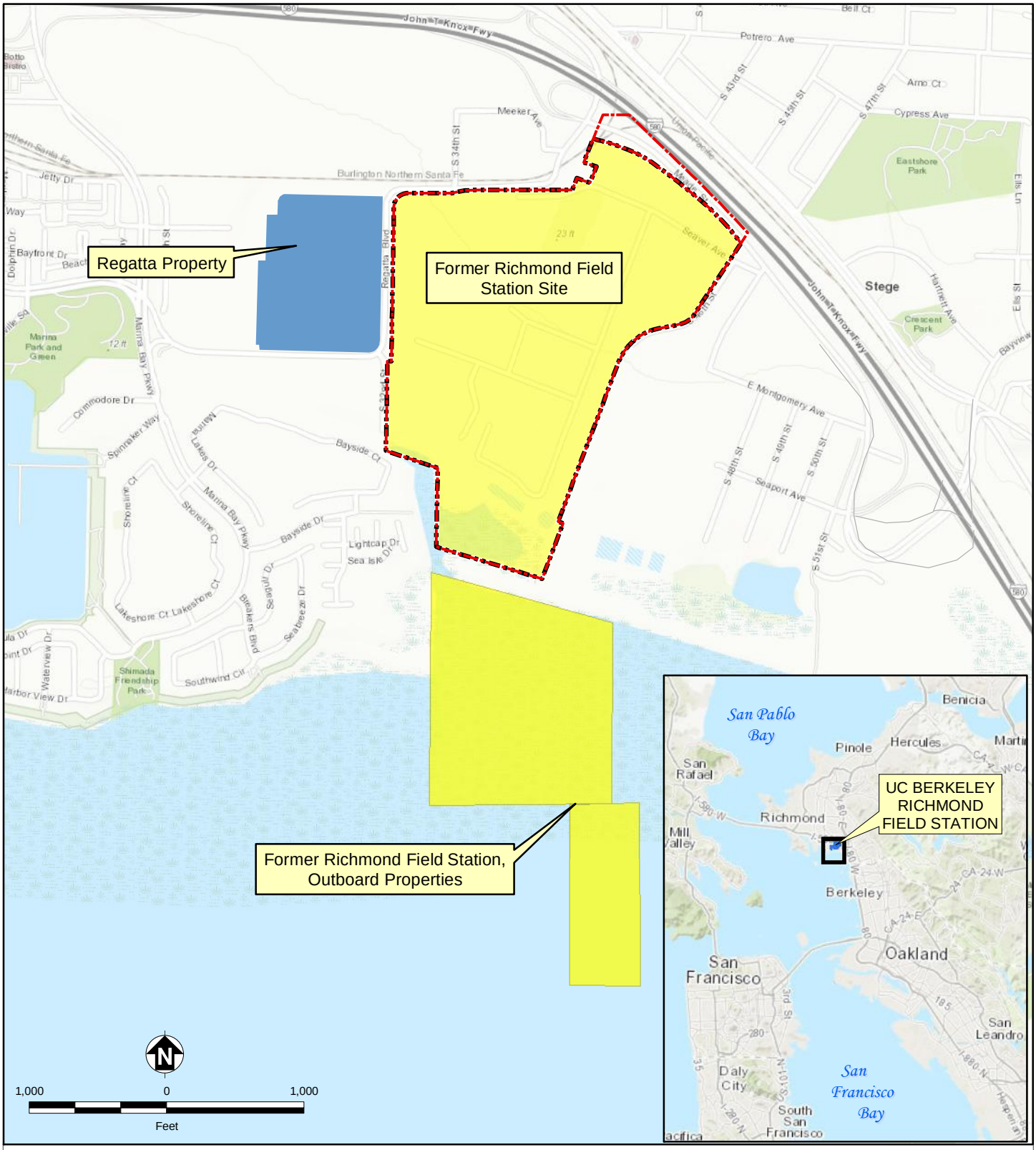
FIGURES



RFS DTSC Order Boundary

Former Richmond Field Station Properties

Former Richmond Field Station Site Boundary

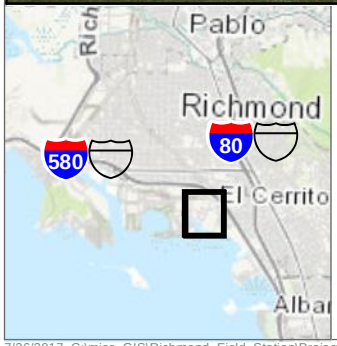
Regatta Property

TETRA TECH

Richmond Field Station Site
University of California, Berkeley

FIGURE 1
SITE LOCATION MAP

Phase IV Sampling Results Technical Memorandum



- Bay Trail
- Meeker Slough
- Western Stege Marsh
- Transition Area (Including Bulb)
- Upland
- Richmond Field Station Site Boundary

Notes:

EBRPD	East Bay Regional Park District
EERC	Earthquake Engineering Research Center
EPA	Environmental Protection Agency
NRLF	Northern Regional Library Facility
RFS	Richmond Field Station

TETRA TECH

Richmond Field Station Site
University of California, Berkeley

FIGURE 2
SITE MAP

Phase V Sampling Results Technical Memorandum

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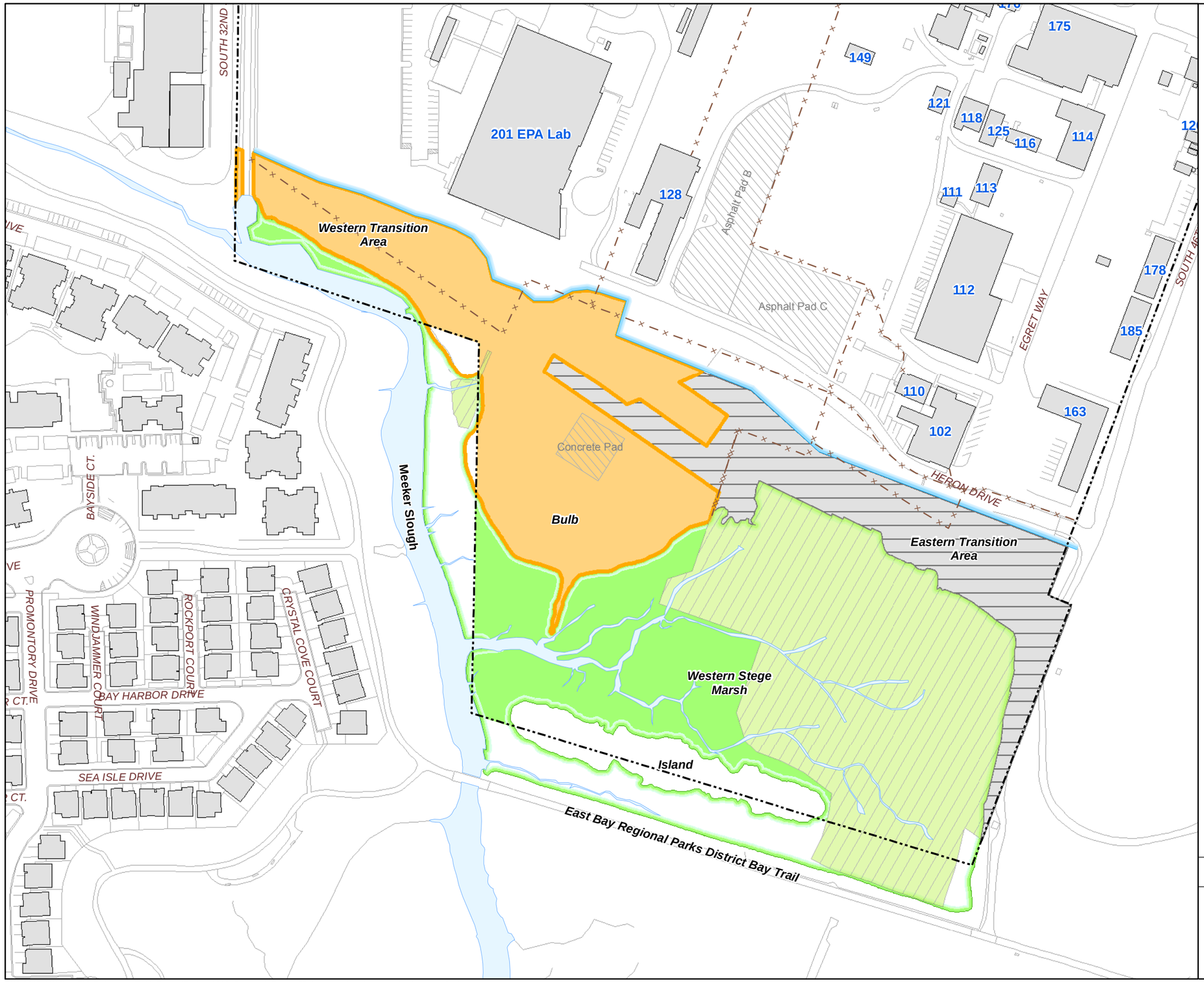

Western Stege Marsh

- Phase V Investigation Area – Old Marsh within UC Property Boundary
- Western Stege Marsh
- Remediated Portion of Western Stege Marsh

Transition Area

- Phase V Investigation Area - Western Transition Area on UC Property
- Western Transition Area
- Eastern Transition Area
- Fence Line
- Surface Water
- Former Seawall
- Former Richmond Field Station Site, UC Property Boundary

N

0 75 150 300

Feet

TETRA TECH

Richmond Field Station Site
University of California, Berkeley

FIGURE 3
PHASE V INVESTIGATION AREAS

Phase V Sampling Results Technical Memorandum

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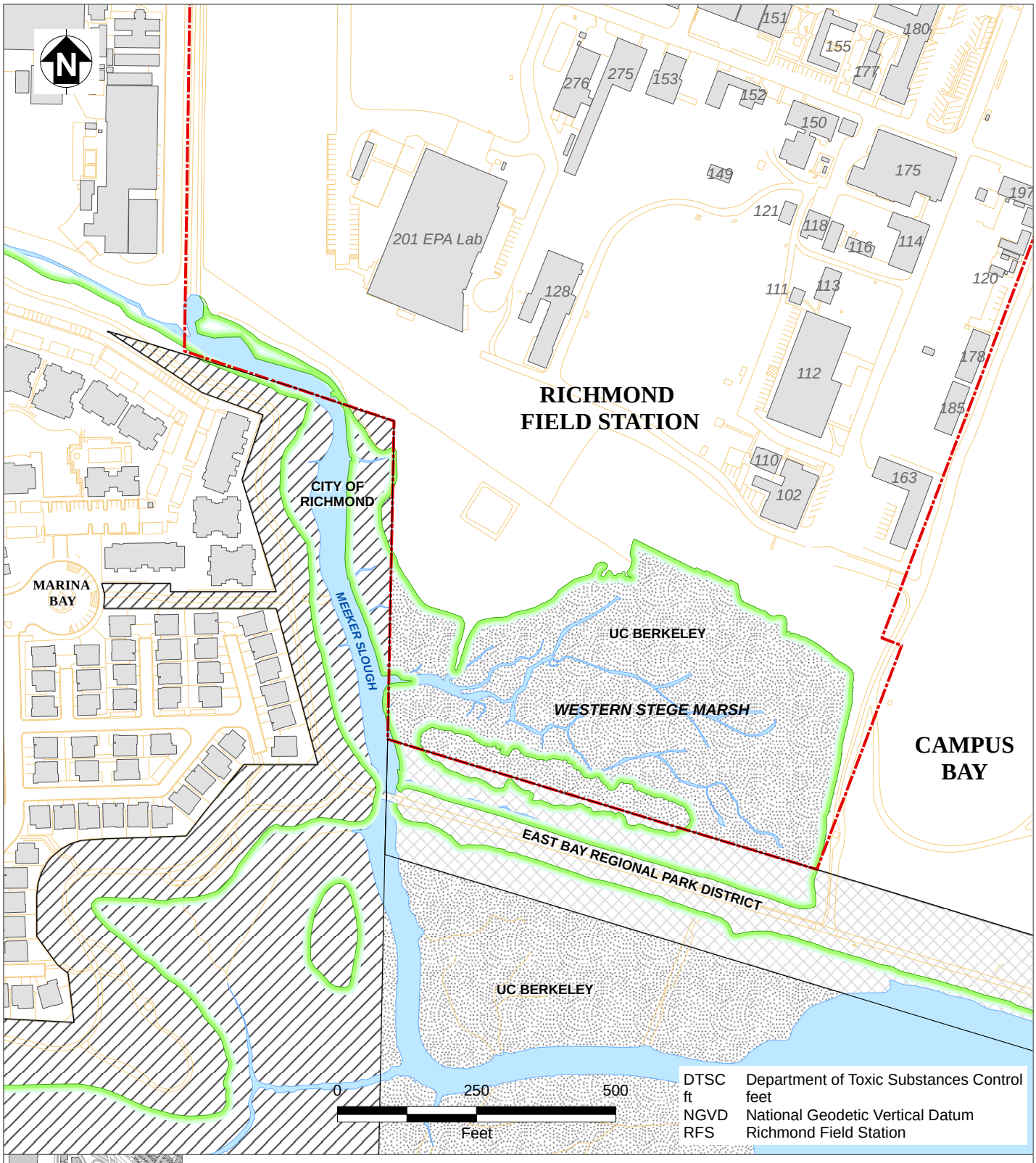

TETRA TECH

Richmond Field Station Site
University of California, Berkeley

FIGURE 4
MARSH AREA OWNERSHIP

Phase V Sampling Results Technical Memorandum

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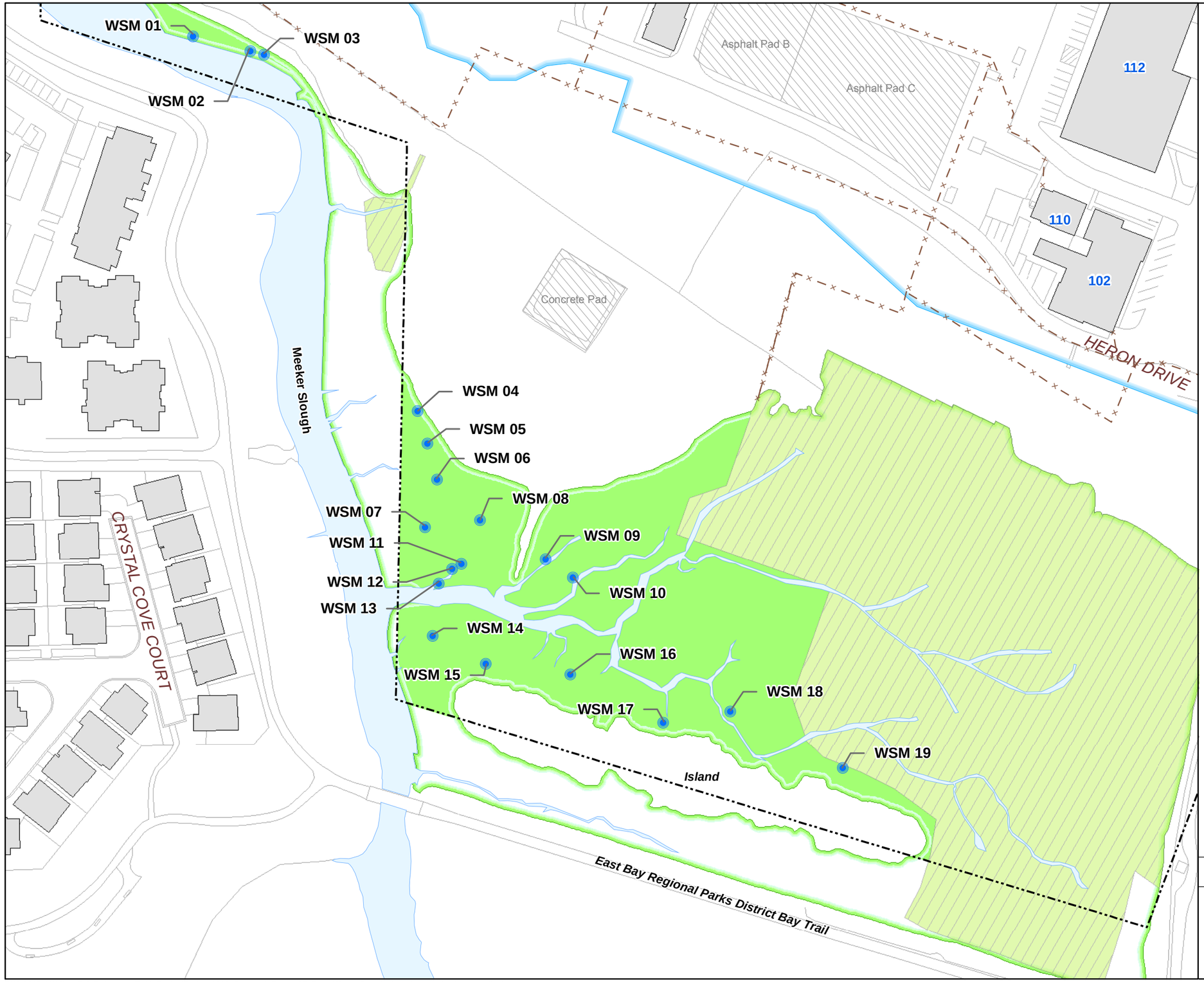

- Sediment and Pore Water Sampling Locations
- Phase V Investigation Area - Old Marsh portion of Western Stege Marsh within UC Property Boundary
- Western Stege Marsh
- Remediated Portion of Western Stege Marsh
- Fence Line
- Surface Water
- Former Seawall
- Former Richmond Field Station Site, UC Property Boundary

N

0 50 100 200
Feet

TETRA TECH

Richmond Field Station Site
University of California, Berkeley

FIGURE 5
WESTERN STEGE MARSH SEDIMENT AND PORE WATER SAMPLING LOCATIONS
Phase V Sampling Results Technical Memorandum

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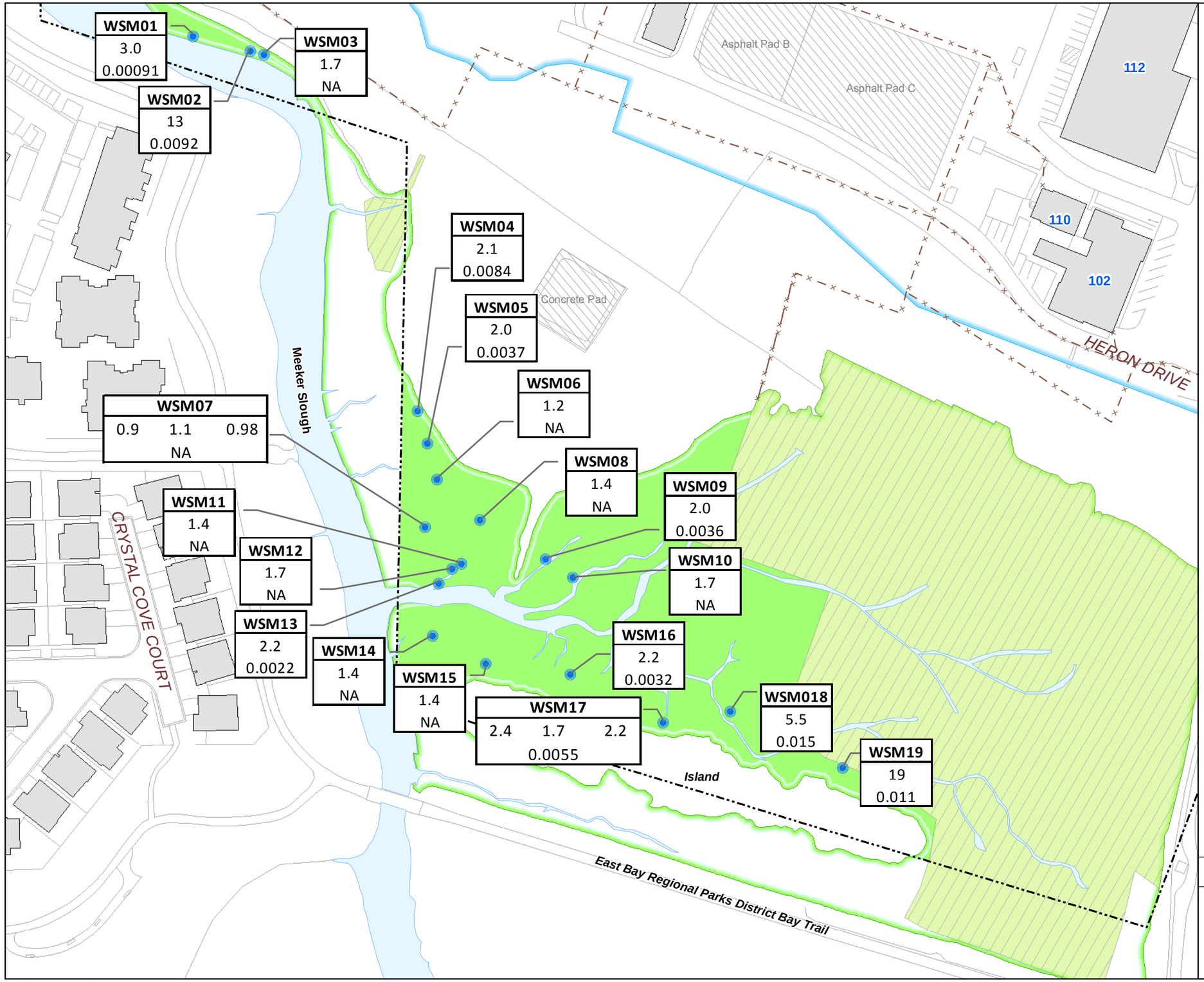


WSM09
2.0
0.0036

Sample Location
Mercury result[1, 2] (mg/kg)
Methymercury result[2] (mg/kg)

- Sediment and Pore Water Sampling Locations
- Phase V Investigation Area - Old Marsh portion of Western Stege Marsh within UC Property Boundary
- Western Stege Marsh
- Remediated Portion of Western Stege Marsh
- Fence Line
- Surface Water
- Former Seawall
- Former Richmond Field Station Site, UC Property Boundary

Notes:
1. Results presented with two significant figures.
2. Triplicate results when three results shown.
mg/kg milligrams per kilogram
NA Not applicable

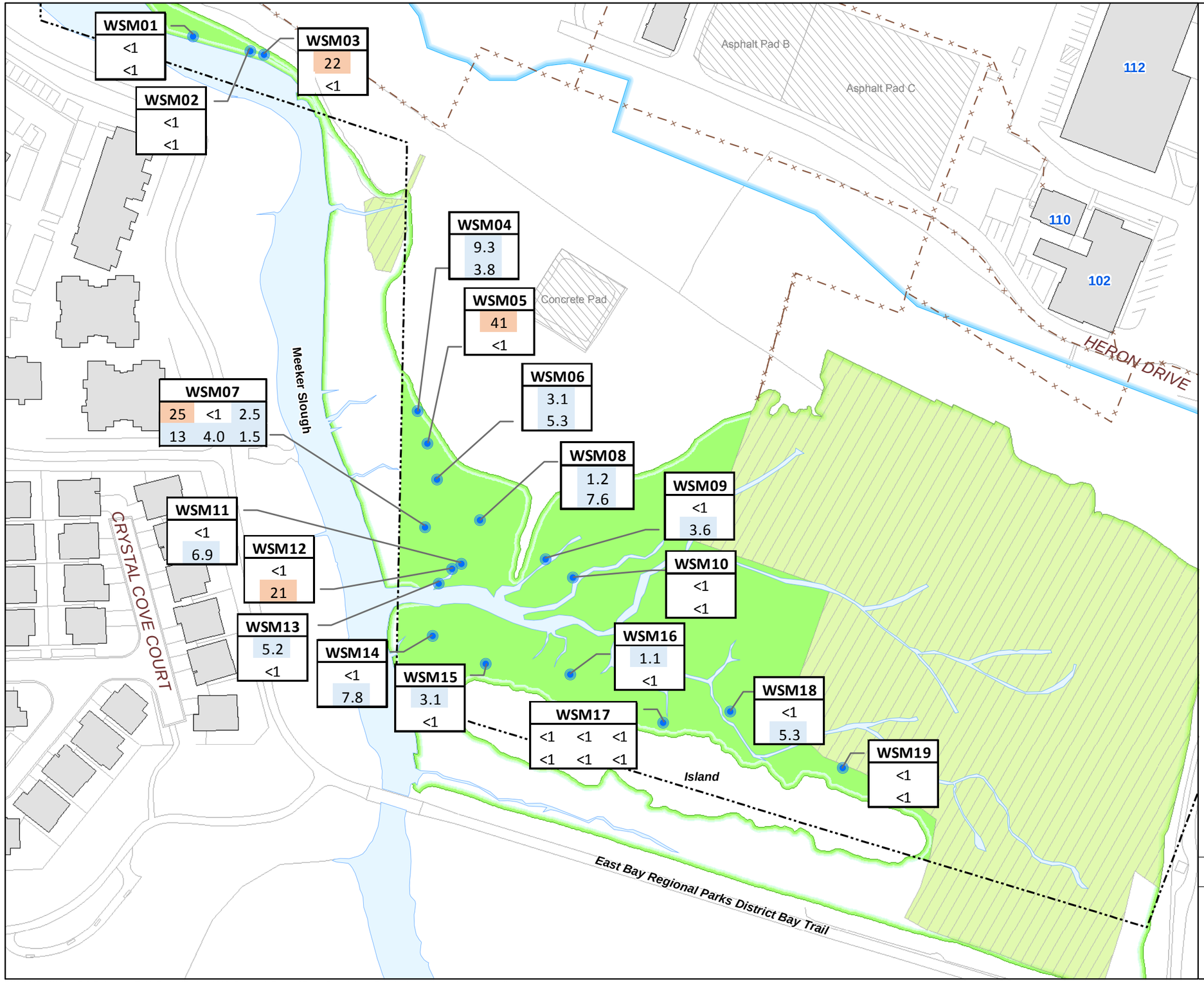
0 50 100 200
Feet

TETRA TECH

Richmond Field Station Site
University of California, Berkeley

FIGURE 6
MERCURY AND METHYLMERCURY SEDIMENT SAMPLE RESULTS
Phase V Sampling Results Technical Memorandum

7/10/2017 V:\Misc_GIS\Richmond_Field_Station\Projects\013_Phase_V_Report\06_Hg_Pore_Water_Sample_Locations.mxd - simon.cardinale



WSM09 — Sample Location
<1 — 0 – 0.5 feet PCB result (mg/kg)
3.6 — 1.5 – 2.0 feet PCB result (mk/kg)

- Sediment and Pore Water Sampling Locations
- Phase V Investigation Area - Old Marsh portion of Western Stege Marsh within UC Property Boundary
- Western Stege Marsh
- Remediated Portion of Western Stege Marsh
- Fence Line
- Surface Water
- Former Seawall
- Former Richmond Field Station Site, UC Property Boundary

Notes:
mg/kg milligrams per kilogram
Blue shading indicates total PCB >1 mg/kg
Orange shading indicates total PCB >10 mg/kg
Triplicate results when three results shown.

N

0 50 100 200
Feet

TETRA TECH

Richmond Field Station Site
University of California, Berkeley

FIGURE 7
TOTAL PCB RESULTS
SEDIMENT SAMPLES

Phase V Sampling Results Technical Memorandum

7/10/2017 V:\Misc_GIS\Richmond_Field_Station\Projects\013_Phase_V_Report\07_Hg_Pore_Water_Sample_Locations.mxd - simon.cardinale

TABLES

Table 1: Sample Registry and Rationale
Phase V Technical Memorandum
Richmond Field Station Site

Sampling Location/ Sample ID Number [1,2]	Matrix	Depth (feet bgs)	Analytical Group (Method)	Number of Samples [3]	Rationale
Sediment and Pore Water Investigation in the Western Stege Marsh					
WSM 01 through WSM 19	Sediment	0.0-0.5	Metals (6010/7471A) PCBs (8082)	19	Sediment samples analyzed for metals and PCBs were co-located with 19 previous sample locations identified in the FSP.
		1.5-2.0	PCBs (8082)	19	
		0.0-0.5	Methylmercury (1630 modified)	10	Sediment samples analyzed for methylmercury were identified from 10 locations with the highest sediment mercury concentrations from 0.0-0.5 feet bgs.
WSM 01 through WSM 19	Pore Water	0.0-0.5	Metals (6010/7471A)	19	Pore water samples analyzed for metals were co-located with all 19 shallow sediment sample locations.
		0.0-0.5	Methylmercury (1631 modified)	10	Pore water samples analyzed for methylmercury were co-located with the 10 sediment samples analyzed for methylmercury.

Notes:

1 Location IDs are identical to sample IDs except for addition of the date when the sample is collected in this format: YYYYMMDD. Sample locations are indicated on Figure 5.

2 Field QC and field triplicate sample locations were selected randomly at locations WSM 07 and WSM 17. "R1", "R2", and "R3" were added to the sample ID of field duplicate samples.

3 Number of samples do not include field QC samples. Ten percent of sediment samples (two) were collected in triplicate; ten percent of pore water samples (one) was collected in duplicate.

bgs Below ground surface
ID Identification
QC Quality control
PAH Polycyclic aromatic hydrocarbon
PCB Polychlorinated biphenyl

Table 2 Western Stege Marsh Triplicate Sediment Sampling Data and Percent Relative Standard Deviation
Phase V Sampling Results, Technical Memorandum
University of California, Berkeley, Richmond Field Station Site

Analytical Group	Analyte	Location	Sample	Field Replicate 1 (mg/kg)	Field Replicate 2 (mg/kg)	Field Replicate 3 (mg/kg)	% RSD
METAL	ANTIMONY	WSM07	WSM0720170118	0.48	0.53	0.68	18.5
METAL	ANTIMONY	WSM17	WSM1720170118	0.39	0.39	0.69	**35.3**
METAL	ARSENIC	WSM07	WSM0720170118	26	21	21	12.7
METAL	ARSENIC	WSM17	WSM1720170118	34	35	36	2.9
METAL	BARIUM	WSM07	WSM0720170118	56	59	54	4.5
METAL	BARIUM	WSM17	WSM1720170118	52	46	60	13.3
METAL	BERYLLIUM	WSM07	WSM0720170118	0.78	0.69	0.63	10.8
METAL	BERYLLIUM	WSM17	WSM1720170118	0.91	0.82	0.9	5.6
METAL	CADMIUM	WSM07	WSM0720170118	0.41	0.5	0.23	**36.2**
METAL	CADMIUM	WSM17	WSM1720170118	0.5	0.41	0.6	18.9
METAL	CHROMIUM	WSM07	WSM0720170118	110	110	96	7.7
METAL	CHROMIUM	WSM17	WSM1720170118	130	130	140	4.3
METAL	COBALT	WSM07	WSM0720170118	19	15	16	12.5
METAL	COBALT	WSM17	WSM1720170118	18	19	16	8.6
METAL	COPPER	WSM07	WSM0720170118	66	60	55	9.1
METAL	COPPER	WSM17	WSM1720170118	81	81	120	24.0
METAL	IRON	WSM07	WSM0720170118	40000	42000	34000	10.8
METAL	IRON	WSM17	WSM1720170118	42000	45000	45000	3.9
METAL	LEAD	WSM07	WSM0720170118	170	59	70	**61.4**
METAL	LEAD	WSM17	WSM1720170118	80	87	140	32.1
METAL	MANGANESE	WSM07	WSM0720170118	290	260	260	6.4
METAL	MANGANESE	WSM17	WSM1720170118	280	260	290	5.5
METAL	MERCURY	WSM07	WSM0720170118	0.94	1.1	0.98	8.3
METAL	MERCURY	WSM17	WSM1720170118	2.4	1.7	2.2	17.2
METAL	MOLYBDENUM	WSM07	WSM0720170118	4.7	5.9	3.8	21.9
METAL	MOLYBDENUM	WSM17	WSM1720170118	4.8	3.9	3.7	14.2
METAL	NICKEL	WSM07	WSM0720170118	110	89	91	12.0
METAL	NICKEL	WSM17	WSM1720170118	110	100	110	5.4
METAL	SELENIUM	WSM07	WSM0720170118	0.99	1.3	0.94	18.1
METAL	SELENIUM	WSM17	WSM1720170118	1.9	2.3	3.5	32.4
METAL	SILVER	WSM07	WSM0720170118	0.82	0.46	0.38	**42.4**
METAL	SILVER	WSM17	WSM1720170118	0.43	0.36	0.42	9.4
METAL	THALLIUM	WSM07	WSM0720170118	ND	ND	ND	NA
METAL	THALLIUM	WSM17	WSM1720170118	0.21	ND	0.27	NA
METAL	VANADIUM	WSM07	WSM0720170118	76	94	78	11.9
METAL	VANADIUM	WSM17	WSM1720170118	96	85	99	7.9
METAL	ZINC	WSM07	WSM0720170118	330	190	210	31.1
METAL	ZINC	WSM17	WSM1720170118	380	420	350	9.2
PCB	AROCLOR-1016	WSM07	WSM0720170118	1	0.036	0.11	**140.4**
PCB	AROCLOR-1016	WSM07D	WSM07D20170118	0.21	0.12	0.027	**76.9**
PCB	AROCLOR-1016	WSM17	WSM1720170118	0.035	0.12	0.038	**75.0**
PCB	AROCLOR-1016	WSM17D	WSM17D20170118	0.018	0.019	0.024	15.8
PCB	AROCLOR-1221	WSM07	WSM0720170118	2	0.071	0.22	**140.5**
PCB	AROCLOR-1221	WSM07D	WSM07D20170118	0.06	0.069	0.053	13.2
PCB	AROCLOR-1221	WSM17	WSM1720170118	0.069	0.24	0.075	**75.8**
PCB	AROCLOR-1221	WSM17D	WSM17D20170118	0.035	0.038	0.048	16.9
PCB	AROCLOR-1232	WSM07	WSM0720170118	1	0.036	0.11	**140.4**
PCB	AROCLOR-1232	WSM07D	WSM07D20170118	0.03	0.034	0.027	11.6
PCB	AROCLOR-1232	WSM17	WSM1720170118	0.035	0.12	0.038	**75.0**
PCB	AROCLOR-1232	WSM17D	WSM17D20170118	0.018	0.019	0.024	15.8
PCB	AROCLOR-1242	WSM07	WSM0720170118	1	0.036	0.11	**140.4**
PCB	AROCLOR-1242	WSM07D	WSM07D20170118	0.03	0.034	0.027	11.6
PCB	AROCLOR-1242	WSM17	WSM1720170118	0.035	0.12	0.038	**75.0**

Table 2 Western Stege Marsh Triplicate Sediment Sampling Data and Percent Relative Standard Deviation
Phase V Sampling Results, Technical Memorandum
University of California, Berkeley, Richmond Field Station Site

Analytical Group	Analyte	Location	Sample	Field Replicate 1 (mg/kg)	Field Replicate 2 (mg/kg)	Field Replicate 3 (mg/kg)	% RSD
PCB	AROCLOR-1242	WSM17D	WSM17D20170118	0.018	0.019	0.024	15.8
PCB	AROCLOR-1248	WSM07	WSM0720170118	23	0.38	2.2	**147.4**
PCB	AROCLOR-1248	WSM07D	WSM07D20170118	12	3.6	1.3	**100.0**
PCB	AROCLOR-1248	WSM17	WSM1720170118	0.1	0.12	0.51	**95.0**
PCB	AROCLOR-1248	WSM17D	WSM17D20170118	0.15	0.32	0.45	**49.1**
PCB	AROCLOR-1254	WSM07	WSM0720170118	1	0.036	0.11	**140.4**
PCB	AROCLOR-1254	WSM07D	WSM07D20170118	0.03	0.034	0.027	11.6
PCB	AROCLOR-1254	WSM17	WSM1720170118	0.035	0.12	0.038	**75.0**
PCB	AROCLOR-1254	WSM17D	WSM17D20170118	0.018	0.019	0.024	15.8
PCB	AROCLOR-1260	WSM07	WSM0720170118	1.5	0.055	0.33	**122.1**
PCB	AROCLOR-1260	WSM07D	WSM07D20170118	0.63	0.39	0.23	**48.3**
PCB	AROCLOR-1260	WSM17	WSM1720170118	0.035	0.079	0.17	**72.7**
PCB	AROCLOR-1260	WSM17D	WSM17D20170118	0.045	0.087	0.13	**48.7**

Notes:
Bold indicates the percent RSD for the set of three replicates is greater than 35 percent.

%	Percent
mg/kg	Milligrams per kilogram
NA	Not applicable
ND	Nondetect result
PCB	Polychlorinated biphenyl
RSD	Relative standard deviation

Table 3 Western Stege Marsh Duplicate Pore Water Sampling Data and Relative Percent Difference
Phase V Sampling Results, Technical Memorandum
University of California, Berkeley, Richmond Field Station Site

Analytical Group	Analyte	Location	Sample	Field Duplicate 1 (µg/L)	Field Duplicate 2 (µg/L)	RPD
METAL	ANTIMONY	WSM07	WSM0720170118	14	8.1	53%
METAL	ANTIMONY	WSM17	WSM1720170118	3.1	6.3	68%
METAL	ARSENIC	WSM07	WSM0720170118	25	31	21%
METAL	ARSENIC	WSM17	WSM1720170118	8.8	15	52%
METAL	BARIUM	WSM07	WSM0720170118	29	27	7%
METAL	BARIUM	WSM17	WSM1720170118	26	26	0%
METAL	BERYLLIUM	WSM07	WSM0720170118	ND	ND	NA
METAL	BERYLLIUM	WSM17	WSM1720170118	ND	ND	NA
METAL	CADMIUM	WSM07	WSM0720170118	0.53	1	61%
METAL	CADMIUM	WSM17	WSM1720170118	0.3	1	108%
METAL	CHROMIUM	WSM07	WSM0720170118	2.1	3.2	42%
METAL	CHROMIUM	WSM17	WSM1720170118	2.2	1.4	44%
METAL	COBALT	WSM07	WSM0720170118	15	8.1	60%
METAL	COBALT	WSM17	WSM1720170118	4.5	7.3	47%
METAL	COPPER	WSM07	WSM0720170118	ND	ND	NA
METAL	COPPER	WSM17	WSM1720170118	5.9	7.5	24%
METAL	IRON	WSM07	WSM0720170118	130	460	112%
METAL	IRON	WSM17	WSM1720170118	430	130	107%
METAL	LEAD	WSM07	WSM0720170118	1.2	2.9	83%
METAL	LEAD	WSM17	WSM1720170118	3.3	1	107%
METAL	MANGANESE	WSM07	WSM0720170118	330	370	11%
METAL	MANGANESE	WSM17	WSM1720170118	270	63	124%
METAL	MERCURY	WSM07	WSM0720170118	0.099	ND	NA
METAL	MERCURY	WSM17	WSM1720170118	0.099	0.2	68%
METAL	METHYLMERCURY	WSM17	WSM1720170118	0.00181	0.000527	110%
METAL	MOLYBDENUM	WSM07	WSM0720170118	230	140	49%
METAL	MOLYBDENUM	WSM17	WSM1720170118	64	100	44%
METAL	NICKEL	WSM07	WSM0720170118	16	11	37%
METAL	NICKEL	WSM17	WSM1720170118	8	12	40%
METAL	SELENIUM	WSM07	WSM0720170118	1.9	1.5	24%
METAL	SELENIUM	WSM17	WSM1720170118	1.5	4.4	98%
METAL	SILVER	WSM07	WSM0720170118	ND	ND	NA
METAL	SILVER	WSM17	WSM1720170118	ND	ND	NA
METAL	THALLIUM	WSM07	WSM0720170118	ND	ND	NA
METAL	THALLIUM	WSM17	WSM1720170118	ND	ND	NA
METAL	VANADIUM	WSM07	WSM0720170118	27	27	0%
METAL	VANADIUM	WSM17	WSM1720170118	24	16	40%
METAL	ZINC	WSM07	WSM0720170118	19	20	5%
METAL	ZINC	WSM17	WSM1720170118	18	20	11%

%	Percent
NA	Not applicable
ND	Nondetected result
RPD	Relative percent difference
µg/L	Micrograms per liter

TABLE 4 STATISTICAL SUMMARY OF CHEMICALS DETECTED IN WESTERN STEGE MARSH SEDIMENT

Phase V Sampling Results, Technical Memorandum
University of California, Berkeley, Richmond Field Station Site

Analyte	Detection Frequency	Minimum Detected Result	Average Detected Result	Maximum Detected Result	Location of Maximum Detected Result	Number of Locations with Detected Results	Maintenance Worker Screening Criteria [a]	Number of Samples with Results > Maintenance Worker Screening Criteria	Off-Site Receptors Screening Criteria [a]	Number of Samples with Results > Off-Site Receptors Screening Criteria	ER-L [b]	Number of Samples with Results > ER-L	ER-M [b]	Number of Samples with Results > ER-M	San Francisco Bay Ambient [b]	Number of Samples with Results > San Francisco Bay Ambient	Ambient Criteria	Number of Samples with Results > Ambient Criteria
Metals (mg/kg)																		
ANTIMONY	23/23	0.29 J	0.879	6.4	WSM02	19	2,720	0	NC	-	2	1	25	0	NC	-	NC	-
ARSENIC	23/23	13	45.3	370	WSM02	19	1.58	23	745	0	8.2	23	70	1	13.9	22	16 c,d	22
BARIUM	23/23	46	68.7	180	WSM02	19	52,600	0	686,000	0	NC	-	NC	-	NC	-	NC	-
BERYLLIUM	23/23	0.6	0.818	1.3	WSM08	19	127.75	0	1,330	0	NC	-	NC	-	NC	-	NC	-
CADMIUM	23/23	0.17 J	0.677	2.3	WSM05	19	73	0	762	0	1.2	3	9.6	0	0.33	19	NC	-
CHROMIUM	23/23	95 J	124	160	WSM16	19	100,000	0	NC	-	81	23	370	0	112	14	NC	-
COBALT	23/23	11	18.7	29	WSM02, WSM16	19	34.1	0	356	0	NC	-	NC	-	NC	-	73 e	0
COPPER	23/23	55	104	430	WSM02	19	100,000	0	NC	-	34	23	270	1	53.9	23	NC	-
IRON	23/23	31,000	43,600	63,000	WSM05	19	100,000	0	NC	-	NC	-	NC	-	NC	-	NC	-
LEAD	23/23	52	144	450	WSM03	19	320 d,f	1	NC	-	46.7	23	218	5	25.1	23	NC	-
MANGANESE	23/23	190	359	840 J	WSM01	19	5,300	0	68,600	0	NC	-	NC	-	NC	-	5,900 e	0
MERCURY	23/23	0.94	3.14	19	WSM19	19	1,920	0	412,000	0	0.15	23	0.71	23	0.33	23	NC	-
METHYLMERCURY	10/10	0.000907	0.00626	0.015	WSM18	10	NC	-	NC	-	NC	-	NC	-	NC	-	NC	-
MOLYBDENUM	23/23	0.19 J	3.26	9.6	WSM05	19	34,000	0	NC	-	NC	-	NC	-	NC	-	NC	-
NICKEL	23/23	78 J+	108	150	WSM02, WSM16	19	1,180	0	12,300	0	20.9	23	51.6	23	98.3	15	280 e	0
SELENIUM	22/23	0.74 J	1.77	3.8 J	WSM02	18	33,500	0	27,400,000	0	NC	-	NC	-	0.36	22	NC	-
SILVER	23/23	0.24 J	0.721	3.5	WSM05	19	34,000	0	NC	-	1	2	3.7	0	0.32	20	NC	-
THALLIUM	12/23	0.14 J	0.208	0.35 J	WSM02	11	68	0	NC	-	NC	-	NC	-	NC	-	NC	-
VANADIUM	23/23	54	84.0	110	WSM16	19	34,000	0	NC	-	NC	-	NC	-	NC	-	NC	-
ZINC	23/23	190	383	1,500	WSM02	19	100,000	0	NC	-	150	23	410	5	136	23	NC	-
PCBs/Pesticides (mg/kg)																		
PCBs																		
AROCLOR-1248	38/46	0.081	4.83	39	WSM05	31	1 g	20	1 g	20	0.0227	38	0.18	33	0.0183	38	NC	-
AROCLOR-1254	6/46	0.16	0.445	1.5	WSM15	6	1 g	1	1 g	1	0.0227	6	0.18	3	0.0183	6	NC	-
AROCLOR-1260	45/46	0.015 J	0.313	2.1	WSM05	37	1 g	2	1 g	2	0.0227	44	0.18	21	0.0183	44	NC	-
TOTAL AROCLOR	45/46	0.0150	4.45	41.1	WSM05	37	1 g	20	1 g	20	0.0227	44	0.18	38	0.0183	44	NC	-

TABLE 4 STATISTICAL SUMMARY OF CHEMICALS DETECTED IN WESTERN STEGE MARSH SEDIMENT (Continued)

Phase V Sampling Results, Technical Memorandum
University of California, Berkeley, Richmond Field Station Site

Notes:

a	Screening criteria are risk-based concentrations as calculated in Appendix C of the Site Characterization Report (Tetra Tech 2013a), with the following exceptions: arsenic, lead, Aroclors-1248, -1254, -1260, and BAP (EQ) (see notes c, e, g, and h). Risk-based concentrations are shown with 3 significant figures, except where the default value of 100,00 mg/kg applies (where calculated value exceeds 100,000 mg/kg). Risk-based concentrations shown are the minimum values between the cancer and noncancer multi-pathway risk-based concentrations. For the off-site receptor, the values shown are the minimum values between the cancer and noncancer inhalation pathway risk-based concentrations calculated for the unrestricted use scenario; off-site receptor risk-based concentrations are unavailable for chemicals that do not have toxicity values derived for the inhalation route of exposure. Criteria were not developed for essential nutrients (calcium, magnesium, potassium, or sodium).
b	ER-L and ER-M based on Long and other (1995). San Francisco Bay Ambient Values from Yee (2015).
c	The background level for arsenic (16 mg/kg) was established in the RAW (Tetra Tech 2014). The arsenic remedial goal is a not to exceed value, except in cases where arsenic is associated with cinders in soil (see note d).
d	If lead or arsenic is associated with cinders, manage on site per Section 5.2.3 of the SMP (Appendix C of the RAW, Tetra Tech 2014). If not associated with cinders, investigate further, determine if source is present, and dispose of off-site.
e	Ambient concentrations, based on Final Technical Memorandum, Ambient Metals Evaluation, Aluminum, Cobalt, Manganese, Copper, December 11, 2015 (Tetra Tech 2015).
f	A risk-based concentration was not calculated for lead. Rather, the industrial CHHSL of 320 mg/kg (Cal/EPA OEHHA 2009) was used for the maintenance worker scenario. A risk-based concentration for the off-site receptor pathway is not available because lead is non-volatile.
g	Based on the TSCA High Occupancy, no further conditions threshold criterion for total PCBs from EPA (2005).

-	Not available
Cal/EPA	California Environmental Protection Ageny
CHHSL	California human health screening level
DTSC	Cal/EPA, Department of Toxic Substances Control
EPA	U.S. Environmental Protection Agency
ER-L	Effects range-low
ER-M	Effects range-median
J	Estimated value
mg/kg	Milligrams per kilogram
mg/kg-day	Milligram per kilogram per day
NC	No criteria
OEHHA	Office of Environmental Health Hazard Assessment
PCB	Polychlorinated biphenyl
SMP	Soil management plan
TSCA	Toxic Substances Control Act

Cal/EPA OEHHA. 2009. "Revised California Human Health Screening Levels for Lead." Integrated Risk Assessment Branch, OEHHA, Cal/EPA. September.

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TABLE 5 STATISTICAL SUMMARY OF CHEMICALS DETECTED IN WESTERN STEGE MARSH PORE WATER

Phase V Sampling Results, Technical Memorandum
University of California, Berkeley, Richmond Field Station Site

Analyte	Detection Frequency	Minimum Detected Result	Average Detected Result	Maximum Detected Result	Location of Maximum Detected Result	Number of Locations with Detected Results	10 x Ambient Water Quality Criteria [a]	Number of Samples wit Results > 10 x Ambient Water Quality Criteria	Marine Aquatic Toxicity Criteria [b]	Number of Samples with Results > Marine Aquatic Toxicity Criteria
Metals (µg/L)										
Filtered (Dissolved)										
ANTIMONY	21/21	1.1	8.50	48	WSM02	19	43,000	0	NC	-
ARSENIC	21/21	8.7	42.1	410	WSM02	19	NC	-	36	3
BARIUM	21/21	17 J	28.4	56	WSM02	19	NC	-	NC	-
BERYLLIUM	1/21	0.26 J	0.260	0.26 J	WSM02	1	NC	-	NC	-
CADMIUM	12/21	0.24 J	0.420	0.76 J	WSM04	12	NC	-	7.9	0
CHROMIUM	21/21	1.3	2.64	4.2	WSM18	19	NC	-	NC	-
COBALT	21/21	1.2	5.41	15 J	WSM07	19	NC	-	NC	-
COPPER	7/21	5.3	13.8	46 J	WSM01	6	NC	-	3.1	7
IRON	16/21	55 J	913	5,500	WSM10	16	NC	-	NC	-
LEAD	21/21	0.28 J	3.47	13	WSM01	19	NC	-	8.1	3
MANGANESE	21/21	15	400	1,700	WSM10	19	NC	-	NC	-
MERCURY	9/21	0.064 J	0.130	0.23	WSM18	9	NC	-	0.94	0
METHYLMERCURY	11/11	0.0002	0.00134	0.00508	WSM18	10	NC	-	NC	-
MOLYBDENUM	21/21	7.4	83.5	230 J	WSM07	19	NC	-	NC	-
NICKEL	20/21	0.81 J	8.52	19	WSM02	18	46,000	0	8.2	9
SELENIUM	21/21	0.3 J	2.14	4.9	WSM12	19	42,000	0	71	0
SILVER	1/21	0.084 J	0.0840	0.084 J	WSM19	1	NC	-	1.9	0
VANADIUM	21/21	8.3 J+	22.5	40 J+	WSM16	19	NC	-	NC	-
ZINC	20/21	10	25.8	57	WSM02	18	260,000	0	81	0

TABLE 5 STATISTICAL SUMMARY OF CHEMICALS DETECTED IN WESTERN STEGE MARSH PORE WATER (Continued)

Phase V Sampling Results, Technical Memorandum
University of California, Berkeley, Richmond Field Station Site

Notes:

a	Based on 10 times the surface water AWQC for human consumption of aquatic organisms, with a dilution factor of 5 applied (see note 3). Human health criteria based on consumption of aquatic organisms are from the following sources in order of preference: CTR (EPA 2000) and the NRWQC (EPA 2006). The aquatic screening criteria is based on 10 times those values to allow for dilution and attenuation in the bulk surface water (e.g., tidal surface water in the marsh).
b	Based on the marine aquatic toxicity criteria. Marine aquatic toxicity criteria are the continuous concentration criteria, where available, from the more stringent of the Basin Plan (RWQCB 2006) or the CTR (U.S. EPA 2000), the NRWQC (EPA 2006b, EPA 2016), and the PER (1999).
-	Not available
AWQC	Ambient water quality criteria
CTR	California Toxics Rule
EPA	U.S. Environmental Protection Agency
J	Estimated value
NC	No criteria
NRWQC	National Recommended Water Quality Criteria
PER	Pacific EcoRisk
RWQCB	San Francisco Bay Regional Water Quality Control Board
µg/L	Micrograms per liter

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Table 6 Western Stege Marsh Sediment Detected Metals Summary Compared to Human Health Screening Criteria
Phase V Sampling Results, Technical Memorandum
University of California, Berkeley, Richmond Field Station Site

Sample ID	Sample Location	Depth (feet bgs)	Units	ANTIMONY	ARSENIC	BARIUM	BERYLLIUM	CADMIUM	CHROMIUM	COBALT	COPPER	IRON	LEAD	MANGANESE	MERCURY	METHYLMERCURY	MOLYBDENUM	NICKEL	SELENIUM	SILVER	THALLIUM	VANADIUM	ZINC
Category I Criteria				109	16	2,110	29	68.1	100,000	73	10,900	100,000	320	5,900	77	-	1,360	280	1,340	1,360	2.72	1,360	81,600
Category II On-Site Management Criteria				1,090	16	100,000	290	681	100,000	199	100,000	100,000	800	2,120	275	-	13,600	606	13,400	13,600	27.2	13,600	100,000
Maintenance Worker Screening Criteria				2,720	1.58	52,600	127.75	73	100,000	34.1	100,000	100,000	320	5,300	1,920	-	34,000	1,180	33,500	34,000	68	34,000	100,000
Off-Site Receptors Screening Criteria				-	745	686,000	1,330	762	-	356	-	-	-	68,600	412,000	-	-	12,300	27,400,000	-	-	-	-
WSM0120170118	WSM01	0.0 - 0.5	mg/kg	0.73 J	13	70 J	0.6	0.23 J	95 J	19 J	75 J	34,000	240	840 J	3	0.000907	2.3	78 J+	2.2 J	0.37 J	0.15 J	54	390 J-
WSM0220170118	WSM02	0.0 - 0.5	mg/kg	6.4	370	180	0.89	1.8	140	29	430	50,000	320	280	13	0.00923	2.9	150	3.8 J	0.32 J	0.35 J	86	1,500
WSM0320170118	WSM03	0.0 - 0.5	mg/kg	1.9 J	31	110	0.74	0.47 J	130	11	120	31,000	450	190	1.7		0.19 J	100	1.2 J	1	0.14 J	58	370
WSM0420170118	WSM04	0.0 - 0.5	mg/kg	1.2 J	28	67	1	0.59 J	130	20	90	38,000	250	250	2.1	0.00844 J-	2.4	110	2.2 J	1.9	0.19 J	88	380
WSM0520170118	WSM05	0.0 - 0.5	mg/kg	0.93 J	38	54	0.79	2.3	140	23	120	63,000	250	410	2	0.00366	9.6	120	1.5 J	3.5	0.79 U	100	600
WSM0620170118	WSM06	0.0 - 0.5	mg/kg	0.48 J	19	60	0.82	1.3	110	17	73	38,000	68	370	1.2		1.9	110	6.1 U	0.52 J	0.76 U	72	310
WSM0720170118R1	WSM07	0.0 - 0.5	mg/kg	0.48 J	26	56	0.78	0.41 J	110	19	66	40,000	170	290	0.94		4.7	110	0.99 J	0.82	0.69 U	76	330
WSM0720170118R2	WSM07	0.0 - 0.5	mg/kg	0.53 J	21	59	0.69 J	0.5 J	110	15	60	42,000	59	260	1.1		5.9	89	1.3 J	0.46 J	0.93 U	94	190
WSM0720170118R3	WSM07	0.0 - 0.5	mg/kg	0.68 J	21	54	0.63 J	0.23 J	96	16	55	34,000	70	260	0.98		3.8	91	0.94 J	0.38 J	0.8 U	78	210
WSM0820170118	WSM08	0.0 - 0.5	mg/kg	0.62 J	25	71	1.3	0.81 J	150	23	89	44,000	140	410	1.4		3.6	130	2.1 J	0.74 J	0.85 U	91	400
WSM0920170118	WSM09	0.0 - 0.5	mg/kg	0.58 J	25	71	0.8	0.51 J	140	20	86	42,000	94	360	2	0.00364	1.3	120	0.75 J	0.54 J	0.63 U	82	270
WSM1020170118	WSM10	0.0 - 0.5	mg/kg	0.52 J	23	76	0.8	0.51 J	120	17	87	46,000	84	380	1.7		1.6	98	0.92 J	0.49 J	0.17 J	74	270
WSM1120170118	WSM11	0.0 - 0.5	mg/kg	0.48 J	28	59	0.83	1.2	110	21	93	43,000	83	390	1.4		4.1	110	0.74 J	0.8	0.67 U	80	360
WSM1220170118	WSM12	0.0 - 0.5	mg/kg	0.4 J	24	75	0.86	0.4 J	120	19	73	43,000	81	430	1.7		1.4	120	1.2 J	0.41 J	0.64 U	85	270
WSM1320170118	WSM13	0.0 - 0.5	mg/kg	0.44 J	36	75	0.88	0.73	120	20	100	46,000	140	470	2.2	0.00219	1.2	110	1.3 J	0.55 J	0.15 J	80	440
WSM1420170118	WSM14	0.0 - 0.5	mg/kg	0.29 J	18	48	0.64	0.22 J	110	16	64	44,000	52	460	1.4		0.78	96	1.6 J	0.24 J	0.18 J	79	210
WSM1520170118	WSM15	0.0 - 0.5	mg/kg	0.5 J	66	46	0.88	0.17 J	130	15	66	45,000	190	240	1.4		4.2	95	1.9 J	0.5 J	0.15 J	84	250
WSM1620170118	WSM16	0.0 - 0.5	mg/kg	0.34 J	42	62	0.79 J	0.84 J	160	29	110	58,000	130	430	2.2	0.0032	5.7	150	2.8 J	0.83 J	0.27 J	110	490
WSM1720170118R1	WSM17	0.0 - 0.5	mg/kg	0.39 J	34	52	0.91	0.5 J	130	18	81	42,000	80	280	2.4	0.00551	4.8	110	1.9 J	0.43 J	0.21 J	96	380
WSM1720170118R2	WSM17	0.0 - 0.5	mg/kg	0.39 J	35	46	0.82	0.41 J	130	19	81	45,000	87	260	1.7		3.9	100	2.3 J	0.36 J	0.68 U	85	420
WSM1720170118R3	WSM17	0.0 - 0.5	mg/kg	0.69 J	36 J+	60	0.9	0.6 J	140 J	16	120	45,000	140 J+	290	2.2		3.7	110	3.5 J	0.42 J	0.27 J	99	350 J
WSM1820170118	WSM18	0.0 - 0.5	mg/kg	0.63 J	36	69	0.87	0.51 J	110	12	150	43,000	76	290	5.5	0.015	2.1	86	2.2 J	0.69	0.27 J	88	210
WSM1920170118	WSM19	0.0 - 0.5	mg/kg	0.62 J	48	61	0.6 J	0.34 J	110	15	110	46,000	67	420	19	0.0108	2.8	92	1.7 J	0.31 J	0.69 U	93	200

Chemicals that were not detected in any samples were excluded from this table. See Attachment 1 for full analytical results.
Detected concentrations reported below ambient/background concentrations for arsenic, cobalt, manganese, and nickel are not reported as exceedences for any screening criteria.
51 Outlined boxes indicate the result exceeds the Category I Screening Criteria

-	Not applicable
mg/kg	Milligrams per kilogram
J	Estimated value
U	Nondetect

Table 7 Western Stege Marsh Sediment Detected Metals Summary Compared to Ecological Screening Criteria
Phase V Sampling Results, Technical Memorandum
University of California, Berkeley, Richmond Field Station Site

Sample ID	Sample Location	Depth (feet bgs)	Units	ANTIMONY	ARSENIC	BARIUM	BERYLLIUM	CADMIUM	CHROMIUM	COBALT	COPPER	IRON	LEAD	MANGANESE	MERCURY	METHYLMERCURY	MOLYBDENUM	NICKEL	SELENIUM	SILVER	THALLIUM	VANADIUM	ZINC
			ER-L	2	8.2	-	-	1.2	81	-	34	-	46.7	-	0.15	-	-	20.9	-	1	-	-	150
			ER-M	25	70	-	-	9.6	370	-	270	-	218	-	0.71	-	-	51.6	-	3.7	-	-	410
			San Francisco Bay Ambient	-	13.9	-	-	0.33	112	-	53.9	-	25.1	-	0.33	-	-	98.3	0.36	0.32	-	-	136
			Ambient/Background Criteria	-	16	-	-	-	-	73	-	-	-	5,900	-	-	-	280	-	-	-	-	-
WSM0120170118	WSM01	0.0 - 0.5	mg/kg	0.73 J	**13**	70 J	0.6	0.23 J	**95 J**	19 J	**75 J**	34,000	**240**	840 J	**3**	0.000907	2.3	**78 J+**	2.2 J	0.37 J	0.15 J	54	**390 J-**
WSM0220170118	WSM02	0.0 - 0.5	mg/kg	**6.4**	***370***	180	0.89	**1.8**	**140**	29	**430**	50,000	**320**	280	**13**	0.00923	2.9	150	3.8 J	0.32 J	0.35 J	86	**1,500**
WSM0320170118	WSM03	0.0 - 0.5	mg/kg	1.9 J	***31***	110	0.74	0.47 J	**130**	11	**120**	31,000	**450**	190	**1.7**	NA	0.19 J	100	1.2 J	1	0.14 J	58	**370**
WSM0420170118	WSM04	0.0 - 0.5	mg/kg	1.2 J	***28***	67	1	0.59 J	**130**	20	**90**	38,000	**250**	250	**2.1**	0.00844 J-	2.4	110	2.2 J	**1.9**	0.19 J	88	**380**
WSM0520170118	WSM05	0.0 - 0.5	mg/kg	0.93 J	***38***	54	0.79	**2.3**	**140**	23	**120**	63,000	**250**	410	**2**	0.00366	9.6	120	1.5 J	**3.5**	0.79 U	100	**600**
WSM0620170118	WSM06	0.0 - 0.5	mg/kg	0.48 J	***19***	60	0.82	**1.3**	**110**	17	**73**	38,000	**68**	370	**1.2**	NA	1.9	110	6.1 U	0.52 J	0.76 U	72	**310**
WSM0720170118R1	WSM07	0.0 - 0.5	mg/kg	0.48 J	***26***	56	0.78	0.41 J	**110**	19	**66**	40,000	**170**	290	**0.94**	NA	4.7	110	0.99 J	0.82	0.69 U	76	**330**
WSM0720170118R2	WSM07	0.0 - 0.5	mg/kg	0.53 J	***21***	59	0.69 J	0.5 J	**110**	15	**60**	42,000	**59**	260	**1.1**	NA	5.9	**89**	1.3 J	0.46 J	0.93 U	94	**190**
WSM0720170118R3	WSM07	0.0 - 0.5	mg/kg	0.68 J	***21***	54	0.63 J	0.23 J	**96**	16	**55**	34,000	**70**	260	**0.98**	NA	3.8	**91**	0.94 J	0.38 J	0.8 U	78	**210**
WSM0820170118	WSM08	0.0 - 0.5	mg/kg	0.62 J	***25***	71	1.3	0.81 J	**150**	23	**89**	44,000	**140**	410	**1.4**	NA	3.6	130	2.1 J	0.74 J	0.85 U	91	**400**
WSM0920170118	WSM09	0.0 - 0.5	mg/kg	0.58 J	***25***	71	0.8	0.51 J	**140**	20	**86**	42,000	**94**	360	**2**	0.00364	1.3	120	0.75 J	0.54 J	0.63 U	82	**270**
WSM1020170118	WSM10	0.0 - 0.5	mg/kg	0.52 J	***23***	76	0.8	0.51 J	**120**	17	**87**	46,000	**84**	380	**1.7**	NA	1.6	**98**	0.92 J	0.49 J	0.17 J	74	**270**
WSM1120170118	WSM11	0.0 - 0.5	mg/kg	0.48 J	***28***	59	0.83	1.2	**110**	21	**93**	43,000	**83**	390	**1.4**	NA	4.1	110	0.74 J	0.8	0.67 U	80	**360**
WSM1220170118	WSM12	0.0 - 0.5	mg/kg	0.4 J	***24***	75	0.86	0.4 J	**120**	19	**73**	43,000	**81**	430	**1.7**	NA	1.4	120	1.2 J	0.41 J	0.64 U	85	**270**
WSM1320170118	WSM13	0.0 - 0.5	mg/kg	0.44 J	***36***	75	0.88	0.73	**120**	20	**100**	46,000	**140**	470	**2.2**	0.00219	1.2	110	1.3 J	0.55 J	0.15 J	80	**440**
WSM1420170118	WSM14	0.0 - 0.5	mg/kg	0.29 J	***18***	48	0.64	0.22 J	**110**	16	**64**	44,000	**52**	460	**1.4**	NA	0.78	**96**	1.6 J	0.24 J	0.18 J	79	**210**
WSM1520170118	WSM15	0.0 - 0.5	mg/kg	0.5 J	***66***	46	0.88	0.17 J	**130**	15	**66**	45,000	**190**	240	**1.4**	NA	4.2	**95**	1.9 J	0.5 J	0.15 J	84	**250**
WSM1620170118	WSM16	0.0 - 0.5	mg/kg	0.34 J	***42***	62	0.79 J	0.84 J	**160**	29	**110**	58,000	**130**	430	**2.2**	0.0032	5.7	150	2.8 J	0.83 J	0.27 J	110	**490**
WSM1720170118R1	WSM17	0.0 - 0.5	mg/kg	0.39 J	***34***	52	0.91	0.5 J	**130**	18	**81**	42,000	**80**	280	**2.4**	0.00551	4.8	110	1.9 J	0.43 J	0.21 J	96	**380**
WSM1720170118R2	WSM17	0.0 - 0.5	mg/kg	0.39 J	***35***	46	0.82	0.41 J	**130**	19	**81**	45,000	**87**	260	**1.7**	NA	3.9	100	2.3 J	0.36 J	0.68 U	85	**420**
WSM1720170118R3	WSM17	0.0 - 0.5	mg/kg	0.69 J	***36 J+***	60	0.9	0.6 J	**140 J**	16	**120**	45,000	**140 J+**	290	**2.2**	NA	3.7	110	3.5 J	0.42 J	0.27 J	99	**350 J**
WSM1820170118	WSM18	0.0 - 0.5	mg/kg	0.63 J	***36***	69	0.87	0.51 J	**110**	12	**150**	43,000	**76**	290	**5.5**	0.015	2.1	**86**	2.2 J	0.69	0.27 J	88	**210**
WSM1920170118	WSM19	0.0 - 0.5	mg/kg	0.62 J	***48***	61	0.6 J	0.34 J	**110**	15	**110**	46,000	**67**	420	**19**	0.0108	2.8	**92**	1.7 J	0.31 J	0.69 U	93	**200**

Chemicals that were not detected in any samples were excluded from this table. See Attachment 1 for full analytical results.

51	Italic indicate the result exceeds the Ambient/Background Criteria
51	Bold indicate the result exceeds the ER-L.
51	Gray highlights indicate the result exceeds that ER-M.
51	Outlined boxes indicate the result exceeds the San Francisco Bay Ambient.

-	Not applicable
bgs	Below ground surface
mg/kg	Milligrams per kilogram
NA	Not analyzed
J	Estimated value
U	Nondetect

Table 8 Western Stege Marsh Sediment Detected PCB Summary

Phase V Sampling Results, Technical Memorandum
University of California, Berkeley, Richmond Field Station Site

Sample ID	Sample Location	Depth (feet bgs)	Units	AROCLOR-1248	AROCLOR-1254	AROCLOR-1260	TOTAL AROCLORS
TSCA Self-Implementing Cleanup Level				1	1	1	1
			ER-L	0.0227	0.0227	0.0227	0.0227
			ER-M	0.18	0.18	0.18	0.18
			San Francisco Bay Ambient	0.0183	0.0183	0.0183	0.0183
WSM0120170118	WSM01	0.0 - 0.5	mg/kg	**0.21**	**0.31**	**0.08**	**0.6**
WSM01D20170118	WSM01D	1.5 - 2.0	mg/kg	0.028 U	0.028 U	**0.089**	**0.089**
WSM0220170118	WSM02	0.0 - 0.5	mg/kg	0.17 U	**0.16**	**0.13**	**0.29**
WSM02D20170118	WSM02D	1.5 - 2.0	mg/kg	0.024 U	0.024 U	0.015 J	0.015
WSM0320170118	WSM03	0.0 - 0.5	mg/kg	***21***	0.66 U	**0.99**	***21.99***
WSM03D20170118	WSM03D	1.5 - 2.0	mg/kg	0.026 U	0.026 U	0.026 U	U
WSM0420170118	WSM04	0.0 - 0.5	mg/kg	***8.4***	0.41 U	**0.91**	***9.31***
WSM04D20170118	WSM04D	1.5 - 2.0	mg/kg	***3.4***	0.026 U	**0.38**	***3.78***
WSM0520170118	WSM05	0.0 - 0.5	mg/kg	***39***	1.1 U	***2.1***	***41.1***
WSM05D20170118	WSM05D	1.5 - 2.0	mg/kg	**0.75**	0.029 U	**0.22**	**0.97**
WSM0620170118	WSM06	0.0 - 0.5	mg/kg	***2.8***	0.2 U	**0.3**	***3.1***
WSM06D20170118	WSM06D	1.5 - 2.0	mg/kg	***4.9***	0.028 U	**0.41**	***5.31***
WSM0720170118R1	WSM07	0.0 - 0.5	mg/kg	***23***	1 U	***1.5***	***24.5***
WSM0720170118R2	WSM07	0.0 - 0.5	mg/kg	**0.38**	0.036 U	**0.055**	**0.435**
WSM0720170118R3	WSM07	0.0 - 0.5	mg/kg	***2.2***	0.11 U	**0.33**	***2.53***
WSM07D20170118R1	WSM07D	1.5 - 2.0	mg/kg	***12***	0.03 U	**0.63**	***12.63***
WSM07D20170118R2	WSM07D	1.5 - 2.0	mg/kg	***3.6***	0.034 U	**0.39**	***3.99***
WSM07D20170118R3	WSM07D	1.5 - 2.0	mg/kg	***1.3***	0.027 U	**0.23**	***1.53***
WSM0820170118	WSM08	0.0 - 0.5	mg/kg	***1.1***	0.12 U	**0.099 J**	***1.199***
WSM08D20170118	WSM08D	1.5 - 2.0	mg/kg	***7.3***	0.03 U	**0.31**	***7.61***
WSM0920170118	WSM09	0.0 - 0.5	mg/kg	**0.24**	0.024 U	**0.061**	**0.301**
WSM09D20170118	WSM09D	1.5 - 2.0	mg/kg	***3.2***	0.029 U	**0.36**	***3.56***
WSM1020170118	WSM10	0.0 - 0.5	mg/kg	**0.55**	0.028 U	**0.1**	**0.65**
WSM10D20170118	WSM10D	1.5 - 2.0	mg/kg	0.034 U	**0.16**	**0.087**	**0.247**
WSM1120170118	WSM11	0.0 - 0.5	mg/kg	**0.39**	0.028 U	**0.083**	**0.473**
WSM11D20170118	WSM11D	1.5 - 2.0	mg/kg	***6.4***	0.028 U	**0.47**	***6.87***
WSM1220170118	WSM12	0.0 - 0.5	mg/kg	**0.14**	0.03 U	**0.042**	**0.182**
WSM12D20170118	WSM12D	1.5 - 2.0	mg/kg	***20***	0.029 U	**1**	***21***
WSM1320170118	WSM13	0.0 - 0.5	mg/kg	***4.9***	0.027 U	**0.31**	***5.21***
WSM13D20170118	WSM13D	1.5 - 2.0	mg/kg	0.025 UJ	0.025 U	**0.099**	**0.099**
WSM1420170118	WSM14	0.0 - 0.5	mg/kg	**0.081**	0.031 U	**0.053**	**0.134**
WSM14D20170118	WSM14D	1.5 - 2.0	mg/kg	***7.3***	0.029 U	**0.46**	***7.76***
WSM1520170118	WSM15	0.0 - 0.5	mg/kg	***1.2***	***1.5***	**0.42**	***3.12***
WSM15D20170118	WSM15D	1.5 - 2.0	mg/kg	0.018 U	**0.16**	**0.07**	**0.23**
WSM1620170118	WSM16	0.0 - 0.5	mg/kg	**0.45**	**0.38**	**0.099**	**0.929**
WSM16D20170118	WSM16D	1.5 - 2.0	mg/kg	**0.37**	0.038 U	**0.21**	**0.58**
WSM1720170118R1	WSM17	0.0 - 0.5	mg/kg	**0.1**	0.035 U	**0.035 J**	**0.135**
WSM1720170118R2	WSM17	0.0 - 0.5	mg/kg	0.12 U	0.12 U	**0.079 J**	**0.079**
WSM1720170118R3	WSM17	0.0 - 0.5	mg/kg	**0.51**	0.038 U	**0.17**	**0.68**
WSM17D20170118R1	WSM17D	1.5 - 2.0	mg/kg	**0.15**	0.018 U	**0.045**	**0.195**

Table 8 Western Stege Marsh Sediment Detected PCB Summary

Phase V Sampling Results, Technical Memorandum
University of California, Berkeley, Richmond Field Station Site

Sample ID	Sample Location	Depth (feet bgs)	Units	AROCLOR-1248	AROCLOR-1254	AROCLOR-1260	TOTAL AROCLORS
TSCA Self-Implementing Cleanup Level				1	1	1	1
			ER-L	0.0227	0.0227	0.0227	0.0227
			ER-M	0.18	0.18	0.18	0.18
			San Francisco Bay Ambient	0.0183	0.0183	0.0183	0.0183
WSM17D20170118R2	WSM17D	1.5 - 2.0	mg/kg	**0.32**	0.019 U	**0.087**	**0.407**
WSM17D20170118R3	WSM17D	1.5 - 2.0	mg/kg	**0.45**	0.024 U	**0.13**	**0.58**
WSM1820170118	WSM18	0.0 - 0.5	mg/kg	**0.28**	0.029 U	**0.043**	**0.323**
WSM18D20170118	WSM18D	1.5 - 2.0	mg/kg	***4.9***	0.03 U	**0.35**	***5.25***
WSM1920170118	WSM19	0.0 - 0.5	mg/kg	**0.12**	0.033 U	**0.027 J**	**0.147**
WSM19D20170118	WSM19D	1.5 - 2.0	mg/kg	**0.27**	0.02 U	**0.044**	**0.314**

Chemicals that were not detected in any samples were excluded from this table. See Attachment 1 for full analytical results.

51	Italic indicate the result exceeds the TSCA Self-Implementing Cleanup Level
51	Gray highlights indicate the result exceeds that ER-L.
51	Bold indicate the result exceeds the ER-M.
51	Outlined boxes indicate the result exceeds the San Francisco Bay Ambient.

bgs	Below ground surface
mg/kg	Milligrams per kilogram
J	Estimated value
PCB	Polychlorinated biphenyl
U	Nondetect

Table 9 Western Stege Marsh Pore Water Detected Metals Summary Compared to Aquatic Screening Criteria
Phase V Sampling Results, Technical Memorandum
University of California, Berkeley, Richmond Field Station Site

Sample ID	Sample Location	Units	ANTIMONY	ARSENIC	BARIUM	BERYLLIUM	CADMIUM	CHROMIUM	COBALT	COPPER	IRON	LEAD	MANGANESE	MERCURY	METHYLMERCURY	MOLYBDENUM	NICKEL	SELENIUM	SILVER	VANADIUM	ZINC
10 x Ambient Water Quality Criteria			43,000	-	-	-	-	-	-	-	-	-	-	-	-	-	46,000	42,000	-	-	260,000
Marine Aquatic Toxicity Criteria			-	36	-	-	7.9	-	-	3.1	-	8.1	-	0.94	0.94	-	8.2	71	1.9	-	81
WSM0120170118A	WSM01	µg/L	5.8	9.4	17 J	1 U	0.34 J	2.6	1.3	46 J	630	13	31	0.16 J	0.00135	15	4.5	0.54 J	1 U	15 J+	48
WSM0220170118A	WSM02	µg/L	48	410	56	0.26 J	0.51 J	2.7	9.8	2.5 U	440	6.5	170	0.2	0.000333	140	19	4.7	1 U	32 J+	57
WSM0320170118A	WSM03	µg/L	23	24	31	1 U	1 U	2.5	1.2	2.5 U	250	9	15	0.064 J		68	3.2	3.3	1 U	20 J+	24
WSM0420170118A	WSM04	µg/L	8.4	14 J	27 J	1 U	0.76 J	4	4.8	5.3	960	11	70	0.19 J	0.00105	38	11	2.5	1 U	25 J+	33
WSM0520170118A	WSM05	µg/L	6.4	16	24	1 U	1 U	3.9	2.7	2.5 U	960	6.1	240	0.077 J	0.000445	110	5.5	0.3 J	1 U	25 J+	21
WSM0620170118A	WSM06	µg/L	3.5	18	27	1 U	1 U	2.1	1.7	2.5 U	420	0.3 J	390	0.2 U		57	2.5 U	0.36 J	1 U	24 J+	10
WSM0720170118	WSM07	µg/L	14 J	25	29	1 U	0.53 J	2.1 J	15 J	2.5 U	130 U	1.2 J	330	0.2 U		230 J	16 J	1.9	1 U	27 J+	19
WSM07DUP20170118	WSM07	µg/L	8.1 J	31	27	1 U	1 U	3.2 J	8.1 J	2.5 U	460 J	2.9 J	370	0.2 U		140 J	11 J	1.5	1 U	27 J+	20
WSM0820170118A	WSM08	µg/L	10	32	34	1 U	0.52 J	3.4	5.2	2.5 U	440	3	340	0.2 U		150	5.3	2.2	1 U	30 J+	18
WSM0920170118A	WSM09	µg/L	3.8	9.7	27	1 U	1 U	2	5.1	9.4	55 J	0.51 J	670	0.065 J	0.00188	79	5.6	2.2	1 U	23 J+	19
WSM1020170118A	WSM10	µg/L	1.1	20	49	1 U	0.31 J	3	2.1	2.5 U	5,500	0.28 J	1,700	0.2 U		37	0.81 J	1.6	1 U	22 J+	23 U
WSM1120170118A	WSM11	µg/L	6	30	27	1 U	1 U	2.5	4.5	2.5 U	170	1.3	350	0.2 U		130	4.7	3	1 U	23 J+	23
WSM1220170118A	WSM12	µg/L	5.8	17	25	1 U	0.32 J	2.2	9.2	2.5 U	130 U	0.45 J	250	0.2 U		91	14	4.9	1 U	20 J+	25
WSM1320170118A	WSM13	µg/L	3.4	9.8	24	1 U	0.36 J	2	7.2	2.5 U	130 U	0.34 J	390	0.2 U	0.000316	34	10	1.9	1 U	16 J+	25
WSM1420170118A	WSM14	µg/L	5	36	25	1 U	1 U	2.9	3.2	2.5 U	69 J	0.75 J	510	0.2 U		76	4.1	1.2	1 U	21 J+	13
WSM1520170118A	WSM15	µg/L	4.2	8.7	26	1 U	0.59 J	1.3	10	2.5 U	130 U	1.3	190	0.2 U		31	13	2.4	1 U	24 J+	38
WSM1620170118A	WSM16	µg/L	9.3	92	27	1 U	0.24 J	3.5	2.6	2.5 U	520	3.3	360	0.2 U	0.0002	120	3.7	2.1	1 U	40 J+	13 J
WSM1720170118	WSM17	µg/L	3.1 J	8.8 J	26	1 U	0.3 J	2.2 J	4.5 J	5.9	430 J	3.3 J	270 J	0.099 J	0.00181 J	64 J	8 J	1.5 J	1 U	24 J+	18 J
WSM17DUP20170118	WSM17	µg/L	6.3 J	15 J	26	1 U	1 U	1.4 J	7.3 J	7.5	130 U	1 J	63 J	0.2 U	0.000527 J	100 J	12 J	4.4 J	1 U	16 J	20
WSM1820170118A	WSM18	µg/L	1.5	11	24	1 U	0.26 J	4.2	4.4	15	1,700	5.5	390	0.23	0.00508	7.4	13	0.8 J	1 U	11	55
WSM1920170118A	WSM19	µg/L	1.7	46	19	1 U	1 U	1.8	3.7	7.8	1,600	1.9	1,300	0.081 J	0.00172	36	6	1.6	0.084 J	8.3 J+	16

Chemicals that were not detected in any samples were excluded from this table. See Attachment 3 for full analytical results.

51 Gray highlights indicate the result exceeds Marine Aquatic Toxicity Criteria.

-	Not applicable
J	Estimated value
U	Nondetect
µg/L	Micrograms per liter

APPENDIX A
DTSC COMMENTS, RESPONSE TO COMMENTS (RESERVED)

APPENDIX B
COMPLETE ANALYTICAL RESULTS, SEDIMENT SAMPLES

APPENDIX B: COMPLETE ANALYTICAL RESULTS FOR SEDIMENT SAMPLES FOR WESTERN STEGE MARSH

Phase V Sampling Results, Technical Memorandum
University of California, Berkeley, Richmond Field Station Site

Sample Location ID	WSM01	WSM01D	WSM02	WSM02D	WSM03	WSM03D	WSM04
Sample ID	WSM0120170118	WSM01D20170118	WSM0220170118	WSM02D20170118	WSM0320170118	WSM03D20170118	WSM0420170118
Sample Date	01/18/2017	01/18/2017	01/18/2017	01/18/2017	01/18/2017	01/18/2017	01/18/2017
Sample Depth (feet bgs)	0.00 - 0.50	1.50 - 2.00	0.00 - 0.50	1.50 - 2.00	0.00 - 0.50	1.50 - 2.00	0.00 - 0.50
Metals (mg/kg)							
ALUMINUM	22,000	NA	37,000	NA	26,000	NA	35,000
ANTIMONY	0.73 J	NA	6.4	NA	1.9 J	NA	1.2 J
ARSENIC	13	NA	370	NA	31	NA	28
BARIUM	70 J	NA	180	NA	110	NA	67
BERYLLIUM	0.6	NA	0.89	NA	0.74	NA	1
CADMIUM	0.23 J	NA	1.8	NA	0.47 J	NA	0.59 J
CHROMIUM	95 J	NA	140	NA	130	NA	130
COBALT	19 J	NA	29	NA	11	NA	20
COPPER	75 J	NA	430	NA	120	NA	90
IRON	34,000	NA	50,000	NA	31,000	NA	38,000
LEAD	240	NA	320	NA	450	NA	250
MANGANESE	840 J	NA	280	NA	190	NA	250
MERCURY	3	NA	13	NA	1.7	NA	2.1
METHYLMERCURY	0.000907	NA	0.00923	NA	NA	NA	0.00844 J-
MOLYBDENUM	2.3	NA	2.9	NA	0.19 J	NA	2.4
NICKEL	78 J+	NA	150	NA	100	NA	110
SELENIUM	2.2 J	NA	3.8 J	NA	1.2 J	NA	2.2 J
SILVER	0.37 J	NA	0.32 J	NA	1	NA	1.9
THALLIUM	0.15 J	NA	0.35 J	NA	0.14 J	NA	0.19 J
VANADIUM	54	NA	86	NA	58	NA	88
ZINC	390 J-	NA	1,500	NA	370	NA	380
PCBs/Pesticides (mg/kg)							
PCBs							
AROCLOR-1016	0.019 U	0.028 U	0.024 U	0.024 U	0.66 U	0.026 U	0.41 U
AROCLOR-1221	0.038 U	0.057 U	0.048 U	0.048 U	1.3 U	0.051 U	0.81 U
AROCLOR-1232	0.019 U	0.028 U	0.024 U	0.024 U	0.66 U	0.026 U	0.41 U
AROCLOR-1242	0.019 U	0.028 U	0.024 U	0.024 U	0.66 U	0.026 U	0.41 U
AROCLOR-1248	0.21	0.028 U	0.17 U	0.024 U	21	0.026 U	8.4
AROCLOR-1254	0.31	0.028 U	0.16	0.024 U	0.66 U	0.026 U	0.41 U
AROCLOR-1260	0.08	0.089	0.13	0.015 J	0.99	0.026 U	0.91

APPENDIX B: COMPLETE ANALYTICAL RESULTS FOR SEDIMENT SAMPLES FOR WESTERN STEGE MARSH (Continued)

Phase V Sampling Results, Technical Memorandum
University of California, Berkeley, Richmond Field Station Site

Sample Location ID	WSM04D	WSM05	WSM05D	WSM06	WSM06D	WSM07	WSM07
Sample ID	WSM04D20170118	WSM0520170118	WSM05D20170118	WSM0620170118	WSM06D20170118	WSM0720170118R1	WSM0720170118R2
Sample Date	01/18/2017	01/18/2017	01/18/2017	01/18/2017	01/18/2017	01/18/2017	01/18/2017
Sample Depth (feet bgs)	1.50 - 2.00	0.00 - 0.50	1.50 - 2.00	0.00 - 0.50	1.50 - 2.00	0.00 - 0.50	0.00 - 0.50
Metals (mg/kg)							
ALUMINUM	NA	37,000	NA	34,000	NA	35,000	32,000
ANTIMONY	NA	0.93 J	NA	0.48 J	NA	0.48 J	0.53 J
ARSENIC	NA	38	NA	19	NA	26	21
BARIUM	NA	54	NA	60	NA	56	59
BERYLLIUM	NA	0.79	NA	0.82	NA	0.78	0.69 J
CADMIUM	NA	2.3	NA	1.3	NA	0.41 J	0.5 J
CHROMIUM	NA	140	NA	110	NA	110	110
COBALT	NA	23	NA	17	NA	19	15
COPPER	NA	120	NA	73	NA	66	60
IRON	NA	63,000	NA	38,000	NA	40,000	42,000
LEAD	NA	250	NA	68	NA	170	59
MANGANESE	NA	410	NA	370	NA	290	260
MERCURY	NA	2	NA	1.2	NA	0.94	1.1
METHYLMERCURY	NA	0.00366	NA	NA	NA	NA	NA
MOLYBDENUM	NA	9.6	NA	1.9	NA	4.7	5.9
NICKEL	NA	120	NA	110	NA	110	89
SELENIUM	NA	1.5 J	NA	6.1 U	NA	0.99 J	1.3 J
SILVER	NA	3.5	NA	0.52 J	NA	0.82	0.46 J
THALLIUM	NA	0.79 U	NA	0.76 U	NA	0.69 U	0.93 U
VANADIUM	NA	100	NA	72	NA	76	94
ZINC	NA	600	NA	310	NA	330	190
PCBs/Pesticides (mg/kg)							
PCBs							
AROCLOR-1016	0.18 U	1.1 U	0.029 U	0.2 U	0.19 U	1 U	0.036 U
AROCLOR-1221	0.053 U	2.2 U	0.059 U	0.4 U	0.055 U	2 U	0.071 U
AROCLOR-1232	0.026 U	1.1 U	0.029 U	0.2 U	0.028 U	1 U	0.036 U
AROCLOR-1242	0.026 U	1.1 U	0.029 U	0.2 U	0.028 U	1 U	0.036 U
AROCLOR-1248	3.4	39	0.75	2.8	4.9	23	0.38
AROCLOR-1254	0.026 U	1.1 U	0.029 U	0.2 U	0.028 U	1 U	0.036 U
AROCLOR-1260	0.38	2.1	0.22	0.3	0.41	1.5	0.055

APPENDIX B: COMPLETE ANALYTICAL RESULTS FOR SEDIMENT SAMPLES FOR WESTERN STEGE MARSH (Continued)

Phase V Sampling Results, Technical Memorandum
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Sample Location ID	WSM07	WSM07D	WSM07D	WSM07D	WSM08	WSM08D	WSM09
Sample ID	WSM0720170118R3	WSM07D20170118R1	WSM07D20170118R2	WSM07D20170118R3	WSM0820170118	WSM08D20170118	WSM0920170118
Sample Date	01/18/2017	01/18/2017	01/18/2017	01/18/2017	01/18/2017	01/18/2017	01/18/2017
Sample Depth (feet bgs)	0.00 - 0.50	1.50 - 2.00	1.50 - 2.00	1.50 - 2.00	0.00 - 0.50	1.50 - 2.00	0.00 - 0.50
Metals (mg/kg)							
ALUMINUM	32,000	NA	NA	NA	44,000	NA	39,000
ANTIMONY	0.68 J	NA	NA	NA	0.62 J	NA	0.58 J
ARSENIC	21	NA	NA	NA	25	NA	25
BARIUM	54	NA	NA	NA	71	NA	71
BERYLLIUM	0.63 J	NA	NA	NA	1.3	NA	0.8
CADMIUM	0.23 J	NA	NA	NA	0.81 J	NA	0.51 J
CHROMIUM	96	NA	NA	NA	150	NA	140
COBALT	16	NA	NA	NA	23	NA	20
COPPER	55	NA	NA	NA	89	NA	86
IRON	34,000	NA	NA	NA	44,000	NA	42,000
LEAD	70	NA	NA	NA	140	NA	94
MANGANESE	260	NA	NA	NA	410	NA	360
MERCURY	0.98	NA	NA	NA	1.4	NA	2
METHYLMERCURY	NA	NA	NA	NA	NA	NA	0.00364
MOLYBDENUM	3.8	NA	NA	NA	3.6	NA	1.3
NICKEL	91	NA	NA	NA	130	NA	120
SELENIUM	0.94 J	NA	NA	NA	2.1 J	NA	0.75 J
SILVER	0.38 J	NA	NA	NA	0.74 J	NA	0.54 J
THALLIUM	0.8 U	NA	NA	NA	0.85 U	NA	0.63 U
VANADIUM	78	NA	NA	NA	91	NA	82
ZINC	210	NA	NA	NA	400	NA	270
PCBs/Pesticides (mg/kg)							
PCBs							
AROCLOR-1016	0.11 U	0.21 U	0.12 U	0.027 U	0.12 U	0.21 U	0.024 U
AROCLOR-1221	0.22 U	0.06 U	0.069 U	0.053 U	0.23 U	0.061 U	0.048 U
AROCLOR-1232	0.11 U	0.03 U	0.034 U	0.027 U	0.12 U	0.03 U	0.024 U
AROCLOR-1242	0.11 U	0.03 U	0.034 U	0.027 U	0.12 U	0.03 U	0.024 U
AROCLOR-1248	2.2	12	3.6	1.3	1.1	7.3	0.24
AROCLOR-1254	0.11 U	0.03 U	0.034 U	0.027 U	0.12 U	0.03 U	0.024 U
AROCLOR-1260	0.33	0.63	0.39	0.23	0.099 J	0.31	0.061

APPENDIX B: COMPLETE ANALYTICAL RESULTS FOR SEDIMENT SAMPLES FOR WESTERN STEGE MARSH (Continued)

Phase V Sampling Results, Technical Memorandum
University of California, Berkeley, Richmond Field Station Site

Sample Location ID	WSM09D	WSM10	WSM10D	WSM11	WSM11D	WSM12	WSM12D
Sample ID	WSM09D20170118	WSM1020170118	WSM10D20170118	WSM1120170118	WSM11D20170118	WSM1220170118	WSM12D20170118
Sample Date	01/18/2017	01/18/2017	01/18/2017	01/18/2017	01/18/2017	01/18/2017	01/18/2017
Sample Depth (feet bgs)	1.50 - 2.00	0.00 - 0.50	1.50 - 2.00	0.00 - 0.50	1.50 - 2.00	0.00 - 0.50	1.50 - 2.00
Metals (mg/kg)							
ALUMINUM	NA	35,000	NA	35,000	NA	40,000	NA
ANTIMONY	NA	0.52 J	NA	0.48 J	NA	0.4 J	NA
ARSENIC	NA	23	NA	28	NA	24	NA
BARIUM	NA	76	NA	59	NA	75	NA
BERYLLIUM	NA	0.8	NA	0.83	NA	0.86	NA
CADMIUM	NA	0.51 J	NA	1.2	NA	0.4 J	NA
CHROMIUM	NA	120	NA	110	NA	120	NA
COBALT	NA	17	NA	21	NA	19	NA
COPPER	NA	87	NA	93	NA	73	NA
IRON	NA	46,000	NA	43,000	NA	43,000	NA
LEAD	NA	84	NA	83	NA	81	NA
MANGANESE	NA	380	NA	390	NA	430	NA
MERCURY	NA	1.7	NA	1.4	NA	1.7	NA
MOLYBDENUM	NA	1.6	NA	4.1	NA	1.4	NA
NICKEL	NA	98	NA	110	NA	120	NA
SELENIUM	NA	0.92 J	NA	0.74 J	NA	1.2 J	NA
SILVER	NA	0.49 J	NA	0.8	NA	0.41 J	NA
THALLIUM	NA	0.17 J	NA	0.67 U	NA	0.64 U	NA
VANADIUM	NA	74	NA	80	NA	85	NA
ZINC	NA	270	NA	360	NA	270	NA
PCBs/Pesticides (mg/kg)							
PCBs							
AROCLOR-1016	0.1 U	0.028 U	0.034 U	0.028 U	0.2 U	0.03 U	0.4 U
AROCLOR-1221	0.058 U	0.057 U	0.068 U	0.056 U	0.056 U	0.061 U	0.058 U
AROCLOR-1232	0.029 U	0.028 U	0.034 U	0.028 U	0.028 U	0.03 U	0.029 U
AROCLOR-1242	0.029 U	0.028 U	0.034 U	0.028 U	0.028 U	0.03 U	0.029 U
AROCLOR-1248	3.2	0.55	0.034 U	0.39	6.4	0.14	20
AROCLOR-1254	0.029 U	0.028 U	0.16	0.028 U	0.028 U	0.03 U	0.029 U
AROCLOR-1260	0.36	0.1	0.087	0.083	0.47	0.042	1

APPENDIX B: COMPLETE ANALYTICAL RESULTS FOR SEDIMENT SAMPLES FOR WESTERN STEGE MARSH (Continued)

Phase V Sampling Results, Technical Memorandum
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Sample Location ID	WSM13	WSM13D	WSM14	WSM14D	WSM15	WSM15D	WSM16
Sample ID	WSM1320170118	WSM13D20170118	WSM1420170118	WSM14D20170118	WSM1520170118	WSM15D20170118	WSM1620170118
Sample Date	01/18/2017	01/18/2017	01/18/2017	01/18/2017	01/18/2017	01/18/2017	01/18/2017
Sample Depth (feet bgs)	0.00 - 0.50	1.50 - 2.00	0.00 - 0.50	1.50 - 2.00	0.00 - 0.50	1.50 - 2.00	0.00 - 0.50
Metals (mg/kg)							
ALUMINUM	34,000	NA	26,000	NA	31,000	NA	45,000
ANTIMONY	0.44 J	NA	0.29 J	NA	0.5 J	NA	0.34 J
ARSENIC	36	NA	18	NA	66	NA	42
BARIUM	75	NA	48	NA	46	NA	62
BERYLLIUM	0.88	NA	0.64	NA	0.88	NA	0.79 J
CADMIUM	0.73	NA	0.22 J	NA	0.17 J	NA	0.84 J
CHROMIUM	120	NA	110	NA	130	NA	160
COBALT	20	NA	16	NA	15	NA	29
COPPER	100	NA	64	NA	66	NA	110
IRON	46,000	NA	44,000	NA	45,000	NA	58,000
LEAD	140	NA	52	NA	190	NA	130
MANGANESE	470	NA	460	NA	240	NA	430
MERCURY	2.2	NA	1.4	NA	1.4	NA	2.2
METHYLMERCURY	0.00219	NA	NA	NA	NA	NA	0.0032
MOLYBDENUM	1.2	NA	0.78	NA	4.2	NA	5.7
NICKEL	110	NA	96	NA	95	NA	150
SELENIUM	1.3 J	NA	1.6 J	NA	1.9 J	NA	2.8 J
SILVER	0.55 J	NA	0.24 J	NA	0.5 J	NA	0.83 J
THALLIUM	0.15 J	NA	0.18 J	NA	0.15 J	NA	0.27 J
VANADIUM	80	NA	79	NA	84	NA	110
ZINC	440	NA	210	NA	250	NA	490
PCBs/Pesticides (mg/kg)							
PCBs							
AROCLOR-1016	0.027 U	0.025 U	0.031 U	0.2 U	0.034 U	0.018 U	0.041 U
AROCLOR-1221	0.055 U	0.051 U	0.061 U	0.059 U	0.069 U	0.037 U	0.081 U
AROCLOR-1232	0.027 U	0.025 U	0.031 U	0.029 U	0.034 U	0.018 U	0.041 U
AROCLOR-1242	0.027 U	0.025 U	0.031 U	0.029 U	0.034 U	0.018 U	0.041 U
AROCLOR-1248	4.9	0.025 UJ	0.081	7.3	1.2	0.018 U	0.45
AROCLOR-1254	0.027 U	0.025 U	0.031 U	0.029 U	1.5	0.16	0.38
AROCLOR-1260	0.31	0.099	0.053	0.46	0.42	0.07	0.099

APPENDIX B: COMPLETE ANALYTICAL RESULTS FOR SEDIMENT SAMPLES FOR WESTERN STEGE MARSH (Continued)

Phase V Sampling Results, Technical Memorandum
University of California, Berkeley, Richmond Field Station Site

Sample Location ID	WSM16D	WSM17	WSM17	WSM17	WSM17D	WSM17D	WSM17D
Sample ID	WSM16D20170118	WSM1720170118R1	WSM1720170118R2	WSM1720170118R3	WSM17D20170118R1	WSM17D20170118R2	WSM17D20170118R3
Sample Date	01/18/2017	01/18/2017	01/18/2017	01/18/2017	01/18/2017	01/18/2017	01/18/2017
Sample Depth (feet bgs)	1.50 - 2.00	0.00 - 0.50	0.00 - 0.50	0.00 - 0.50	1.50 - 2.00	1.50 - 2.00	1.50 - 2.00
Metals (mg/kg)							
ALUMINUM	NA	33,000	32,000	39,000	NA	NA	NA
ANTIMONY	NA	0.39 J	0.39 J	0.69 J	NA	NA	NA
ARSENIC	NA	34	35	36 J+	NA	NA	NA
BARIUM	NA	52	46	60	NA	NA	NA
BERYLLIUM	NA	0.91	0.82	0.9	NA	NA	NA
CADMIUM	NA	0.5 J	0.41 J	0.6 J	NA	NA	NA
CHROMIUM	NA	130	130	140 J	NA	NA	NA
COBALT	NA	18	19	16	NA	NA	NA
COPPER	NA	81	81	120	NA	NA	NA
IRON	NA	42,000	45,000	45,000	NA	NA	NA
LEAD	NA	80	87	140 J+	NA	NA	NA
MANGANESE	NA	280	260	290	NA	NA	NA
MERCURY	NA	2.4	1.7	2.2	NA	NA	NA
METHYLMERCURY	NA	0.00551	NA	NA	NA	NA	NA
MOLYBDENUM	NA	4.8	3.9	3.7	NA	NA	NA
NICKEL	NA	110	100	110	NA	NA	NA
SELENIUM	NA	1.9 J	2.3 J	3.5 J	NA	NA	NA
SILVER	NA	0.43 J	0.36 J	0.42 J	NA	NA	NA
THALLIUM	NA	0.21 J	0.68 U	0.27 J	NA	NA	NA
VANADIUM	NA	96	85	99	NA	NA	NA
ZINC	NA	380	420	350 J	NA	NA	NA
PCBs/Pesticides (mg/kg)							
PCBs							
AROCLOR-1016	0.038 U	0.035 U	0.12 U	0.038 U	0.018 U	0.019 U	0.024 U
AROCLOR-1221	0.077 U	0.069 U	0.24 U	0.075 U	0.035 U	0.038 U	0.048 U
AROCLOR-1232	0.038 U	0.035 U	0.12 U	0.038 U	0.018 U	0.019 U	0.024 U
AROCLOR-1242	0.038 U	0.035 U	0.12 U	0.038 U	0.018 U	0.019 U	0.024 U
AROCLOR-1248	0.37	0.1	0.12 U	0.51	0.15	0.32	0.45
AROCLOR-1254	0.038 U	0.035 U	0.12 U	0.038 U	0.018 U	0.019 U	0.024 U
AROCLOR-1260	0.21	0.035 J	0.079 J	0.17	0.045	0.087	0.13

APPENDIX B: COMPLETE ANALYTICAL RESULTS FOR SEDIMENT SAMPLES FOR WESTERN STEGE MARSH (Continued)

Phase V Sampling Results, Technical Memorandum
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Sample Location ID	WSM18	WSM18D	WSM19	WSM19D
Sample ID	WSM1820170118	WSM18D20170118	WSM1920170118	WSM19D20170118
Sample Date	01/18/2017	01/18/2017	01/18/2017	01/18/2017
Sample Depth (feet bgs)	0.00 - 0.50	1.50 - 2.00	0.00 - 0.50	1.50 - 2.00
Metals (mg/kg)				
ALUMINUM	30,000	NA	35,000	NA
ANTIMONY	0.63 J	NA	0.62 J	NA
ARSENIC	36	NA	48	NA
BARIUM	69	NA	61	NA
BERYLLIUM	0.87	NA	0.6 J	NA
CADMIUM	0.51 J	NA	0.34 J	NA
CHROMIUM	110	NA	110	NA
COBALT	12	NA	15	NA
COPPER	150	NA	110	NA
IRON	43,000	NA	46,000	NA
LEAD	76	NA	67	NA
MANGANESE	290	NA	420	NA
MERCURY	5.5	NA	19	NA
METHYLMERCURY	0.015	NA	0.0108	NA
MOLYBDENUM	2.1	NA	2.8	NA
NICKEL	86	NA	92	NA
SELENIUM	2.2 J	NA	1.7 J	NA
SILVER	0.69	NA	0.31 J	NA
THALLIUM	0.27 J	NA	0.69 U	NA
VANADIUM	88	NA	93	NA
ZINC	210	NA	200	NA
PCBs/Pesticides (mg/kg)				
PCBs				
AROCLOR-1016	0.029 U	0.03 U	0.033 U	0.02 U
AROCLOR-1221	0.057 U	0.06 U	0.066 U	0.039 U
AROCLOR-1232	0.029 U	0.03 U	0.033 U	0.02 U
AROCLOR-1242	0.029 U	0.03 U	0.033 U	0.02 U
AROCLOR-1248	0.28	4.9	0.12	0.27
AROCLOR-1254	0.029 U	0.03 U	0.033 U	0.02 U
AROCLOR-1260	0.043	0.35	0.027 J	0.044

APPENDIX B: COMPLETE ANALYTICAL RESULTS FOR SEDIMENT SAMPLES FOR WESTERN STEGE MARSH (Continued)

Phase V Sampling Results, Technical Memorandum
University of California, Berkeley, Richmond Field Station Site

Notes:

ID	Identification
J	Estimated value
mg/kg	Milligrams per kilogram
NA	Not analyzed
PCB	Polychlorinated biphenyl
U	Nondetected

APPENDIX C
COMPLETE ANALYTICAL RESULTS, PORE WATER SAMPLES

APPENDIX C: COMPLETE ANALYTICAL RESULTS FOR PORE WATER SAMPLES FOR WESTERN STEGE MARSH

Phase V Sampling Results, Technical Memorandum
University of California, Berkeley, Richmond Field Station Site

Sample Location ID	WSM01	WSM02	WSM03	WSM04	WSM05	WSM06	WSM07
Sample ID	WSM0120170118A	WSM0220170118A	WSM0320170118A	WSM0420170118A	WSM0520170118A	WSM0620170118A	WSM0720170118
Sample Date	01/18/2017	01/18/2017	01/18/2017	01/18/2017	01/18/2017	01/18/2017	01/18/2017
Metals (µg/L)							
Filtered (Dissolved)							
ALUMINUM	620	210	330	950	1,000	97	50 U
ANTIMONY	5.8	48	23	8.4	6.4	3.5	14 J
ARSENIC	9.4	410	24	14 J	16	18	25
BARIUM	17 J	56	31	27 J	24	27	29
BERYLLIUM	1 U	0.26 J	1 U	1 U	1 U	1 U	1 U
CADMIUM	0.34 J	0.51 J	1 U	0.76 J	1 U	1 U	0.53 J
CHROMIUM	2.6	2.7	2.5	4	3.9	2.1	2.1 J
COBALT	1.3	9.8	1.2	4.8	2.7	1.7	15 J
COPPER	46 J	2.5 U	2.5 U	5.3	2.5 U	2.5 U	2.5 U
IRON	630	440	250	960	960	420	130 U
LEAD	13	6.5	9	11	6.1	0.3 J	1.2 J
MANGANESE	31	170	15	70	240	390	330
MERCURY	0.16 J	0.2	0.064 J	0.19 J	0.077 J	0.2 U	0.2 U
METHYLMERCURY	0.00135	0.000333	NA	0.00105	0.000445	NA	NA
MOLYBDENUM	15	140	68	38	110	57	230 J
NICKEL	4.5	19	3.2	11	5.5	2.5 U	16 J
SELENIUM	0.54 J	4.7	3.3	2.5	0.3 J	0.36 J	1.9
SILVER	1 U	1 U	1 U	1 U	1 U	1 U	1 U
THALLIUM	1 U	1 U	1 U	1 U	1 U	1 U	1 U
VANADIUM	15 J+	32 J+	20 J+	25 J+	25 J+	24 J+	27 J+
ZINC	48	57	24	33	21	10	19

APPENDIX C: COMPLETE ANALYTICAL RESULTS FOR PORE WATER SAMPLES FOR WESTERN STEGE MARSH (Continued)

Phase V Sampling Results, Technical Memorandum
University of California, Berkeley, Richmond Field Station Site

Sample Location ID	WSM07 [d]	WSM08	WSM09	WSM10	WSM11	WSM12	WSM13
Sample ID	WSM07DUP201701	WSM0820170118A	WSM0920170118A	WSM1020170118A	WSM1120170118A	WSM1220170118A	WSM1320170118A
Sample Date	01/18/2017	01/18/2017	01/18/2017	01/18/2017	01/18/2017	01/18/2017	01/18/2017
Metals (µg/L)							
Filtered (Dissolved)							
ALUMINUM	540 J	510	32 J	50 U	220	70	62
ANTIMONY	8.1 J	10	3.8	1.1	6	5.8	3.4
ARSENIC	31	32	9.7	20	30	17	9.8
BARIUM	27	34	27	49	27	25	24
BERYLLIUM	1 U	1 U	1 U	1 U	1 U	1 U	1 U
CADMIUM	1 U	0.52 J	1 U	0.31 J	1 U	0.32 J	0.36 J
CHROMIUM	3.2 J	3.4	2	3	2.5	2.2	2
COBALT	8.1 J	5.2	5.1	2.1	4.5	9.2	7.2
COPPER	2.5 U	2.5 U	9.4	2.5 U	2.5 U	2.5 U	2.5 U
IRON	460 J	440	55 J	5,500	170	130 U	130 U
LEAD	2.9 J	3	0.51 J	0.28 J	1.3	0.45 J	0.34 J
MANGANESE	370	340	670	1,700	350	250	390
MERCURY	0.2 U	0.2 U	0.065 J	0.2 U	0.2 U	0.2 U	0.2 U
METHYLMERCURY	NA	NA	0.00188	NA	NA	NA	0.000316
MOLYBDENUM	140 J	150	79	37	130	91	34
NICKEL	11 J	5.3	5.6	0.81 J	4.7	14	10
SELENIUM	1.5	2.2	2.2	1.6	3	4.9	1.9
SILVER	1 U	1 U	1 U	1 U	1 U	1 U	1 U
THALLIUM	1 U	1 U	1 U	1 U	1 U	1 U	1 U
VANADIUM	27 J+	30 J+	23 J+	22 J+	23 J+	20 J+	16 J+
ZINC	20	18	19	23 U	23	25	25

APPENDIX C: COMPLETE ANALYTICAL RESULTS FOR PORE WATER SAMPLES FOR WESTERN STEGE MARSH (Continued)

Phase V Sampling Results, Technical Memorandum
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Sample Location ID	WSM14	WSM15	WSM16	WSM17	WSM17 [d]	WSM18	WSM19
Sample ID	WSM1420170118A	WSM1520170118A	WSM1620170118A	WSM1720170118	WSM17DUP201701	WSM1820170118A	WSM1920170118A
Sample Date	01/18/2017	01/18/2017	01/18/2017	01/18/2017	01/18/2017	01/18/2017	01/18/2017
Metals (µg/L)							
Filtered (Dissolved)							
ALUMINUM	100	25 J	1,100	600 J	210 J	1,300	460
ANTIMONY	5	4.2	9.3	3.1 J	6.3 J	1.5	1.7
ARSENIC	36	8.7	92	8.8 J	15 J	11	46
BARIUM	25	26	27	26	26	24	19
BERYLLIUM	1 U	1 U	1 U	1 U	1 U	1 U	1 U
CADMIUM	1 U	0.59 J	0.24 J	0.3 J	1 U	0.26 J	1 U
CHROMIUM	2.9	1.3	3.5	2.2 J	1.4 J	4.2	1.8
COBALT	3.2	10	2.6	4.5 J	7.3 J	4.4	3.7
COPPER	2.5 U	2.5 U	2.5 U	5.9	7.5	15	7.8
IRON	69 J	130 U	520	430 J	130 U	1,700	1,600
LEAD	0.75 J	1.3	3.3	3.3 J	1 J	5.5	1.9
MANGANESE	510	190	360	270 J	63 J	390	1,300
MERCURY	0.2 U	0.2 U	0.2 U	0.099 J	0.2 U	0.23	0.081 J
METHYLMERCURY	NA	NA	0.0002	0.00181 J	0.000527 J	0.00508	0.00172
MOLYBDENUM	76	31	120	64 J	100 J	7.4	36
NICKEL	4.1	13	3.7	8 J	12 J	13	6
SELENIUM	1.2	2.4	2.1	1.5 J	4.4 J	0.8 J	1.6
SILVER	1 U	1 U	1 U	1 U	1 U	1 U	0.084 J
THALLIUM	1 U	1 U	1 U	1 U	1 U	1 U	1 U
VANADIUM	21 J+	24 J+	40 J+	24 J+	16 J	11	8.3 J+
ZINC	13	38	13 J	18 J	20	55	16

Notes:

d	Duplicate sample
ID	Identification
J	Estimated value
NA	Not analyzed
U	Nondetected
µg/L	Micrograms per liter

ATTACHMENT 2
SEDIMENT AND PORE WATER ANALYTICAL RESULTS, EPA METHOD 1630, BROOKS APPLIED LABS

BROOKS APPLIED LABS
18804 North Creek Parkway, Ste 100, Bothell, WA 98011 • USA • T: 206 632 6206 F: 206 632 6017 • info@brooksapplied.com

April 12, 2017

Tetra Tech - Oakland
ATTN: Dayna Aragon
1999 Harrison Street, Suite 500
Oakland, CA, 94612
Dayna.aragon@tetratech.com

RE: Project: TTE-OA1701 Client Project: Richmond Field Station

Dear Ms. Aragon,

On January 18, 2017 Brooks Applied Labs (BAL) received nineteen (19) soil samples. The samples were logged-in for methylmercury (MeHg) and percent total solids (%TS) analyses according to the chain-of-custody form. All samples were placed on hold. Upon further notice10 samples were confirmed by the client to be released for analysis. All samples were received and stored according to BAL SOPs and EPA methodology.

Sediment samples are prepared by an acid bromide/dichloromethane extraction. Prepared samples are analyzed by ethylation, Tenax trap collection, gas chromatography separation, isothermal decomposition, and cold vapor fluorescence spectroscopy (CVAFS) detection using a Brooks Rand Instruments MERX-M CVAFS Methylmercury Automated-Analyzer.

The recovery of MDS1 was extremely low at -1% causing the RPD between the MS and MSD recovery to also be outside the acceptance criteria. Re-analysis confirmed this recovery. The result for source sample *WSM04 20170118* (1703054-04) was qualified **M** for the duplicate imprecision.

Sample results were method blank corrected. This has been described in the calculations section of the relevant BAL SOP(s). All results were evaluated using reporting limits adjusted to account for sample aliquot size. Please refer to the *Sample Results* page for sample-specific MDLs, MRLs, and other details. All results were dry-weight corrected and reported on a ng/g wt. basis.

All data was reported without further qualification and all other associated quality control sample results met the acceptance criteria.
BAL, an accredited laboratory, certifies that the reported results of all analyses for which BAL is NELAP accredited meet all NELAP requirements. For more information please see the *Report Information* page in your report. Please feel free to contact us if you have any questions regarding this report.

Sincerely,

Amanda Royal
Project Manager
amanda@brooksapplied.com

Project ID: TTE-OA1701
PM: Amanda Royal -

Client PM: Dayna Aragon
Client Project: 1035225329.02

Report Information

Laboratory Accreditation

BAL is accredited by the *National Environmental Laboratory Accreditation Program* (NELAP) through the State of Florida Department of Health, Bureau of Laboratories (E87982) and is certified to perform many environmental analyses. BAL is also certified by many other states to perform environmental analyses. For a current list of our accreditations/certifications, please visit our website at <http://www.brooksapplied.com/resources/certificates-permits/>. Results reported relate only to the samples listed in the report.

Field Quality Control Samples

Please be notified that certain EPA methods require the collection of field quality control samples of an appropriate type and frequency; failure to do so is considered a deviation from some methods and for compliance purposes should only be done with the approval of regulatory authorities. Please see the specific EPA methods for details regarding required field quality control samples.

Common Abbreviations

AR	as received	**MS**	matrix spike
BAL	Brooks Applied Labs	**MSD**	matrix spike duplicate
BLK	method blank	**ND**	non-detect
BS	blank spike	**NR**	non-reportable
CAL	calibration standard	**N/C**	not calculated
CCB	continuing calibration blank	**PS**	post preparation spike
CCV	continuing calibration verification	**REC**	percent recovery
COC	chain of custody record	**RPD**	relative percent difference
D	dissolved fraction	**SCV**	secondary calibration verification
DUP	duplicate	**SOP**	standard operating procedure
IBL	instrument blank	**SRM**	standard reference material
ICV	initial calibration verification	**T**	total fraction
MDL	method detection limit	**TR**	total recoverable fraction
MRL	method reporting limit		

Definition of Data Qualifiers

(Effective 9/23/09)

J Detected by the instrument, the result is > the MDL but ≤ the MRL. Result is reported and considered an estimate.
E An estimated value due to the presence of interferences. A full explanation is presented in the narrative.
H Holding time and/or preservation requirements not met. Result is estimated.
J-1 Estimated value. A full explanation is presented in the narrative.
J-M Duplicate precision (RPD) for associated QC sample was not within acceptance criteria. Result is estimated.
J-N Spike recovery for associated QC sample was not within acceptance criteria. Result is estimated.
M Duplicate precision (RPD) was not within acceptance criteria. Result is estimated.
N Spike recovery was not within acceptance criteria. Result is estimated.
R Rejected, unusable value. A full explanation is presented in the narrative.
U Result is ≤ the MDL or client requested reporting limit (CRRL). Result reported as the MDL or CRRL.
X Result is not BLK-corrected and is within 10x the absolute value of the highest detectable BLK in the batch. Result is estimated.

These qualifiers are based on those previously utilized by Brooks Applied Labs, those found in the EPA SOW ILM03.0, Exhibit B, Section III, pg. B-18, and the USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review; USEPA; January 2010. These supersede all previous qualifiers ever employed by BAL.

Project ID: TTE-OA1701
PM: Amanda Royal -

Client PM: Dayna Aragon
Client Project: 1035225329.02

Sample Information

Sample	Lab ID	Report Matrix	Type	Sampled	Received
WSM01 20170118	1703054-01	Soil/Sediment	Sample	01/18/2017	01/20/2017
WSM02 20170118	1703054-02	Soil/Sediment	Sample	01/18/2017	01/20/2017
WSM03 20170118	1703054-03	Soil/Sediment	Sample	01/18/2017	01/20/2017
WSM04 20170118	1703054-04	Soil/Sediment	Sample	01/18/2017	01/20/2017
WSM05 20170118	1703054-05	Soil/Sediment	Sample	01/18/2017	01/20/2017
WSM06 20170118	1703054-06	Soil/Sediment	Sample	01/18/2017	01/20/2017
WSM07 20170118	1703054-07	Soil/Sediment	Sample	01/18/2017	01/20/2017
WSM08 20170118	1703054-08	Soil/Sediment	Sample	01/18/2017	01/20/2017
WSM09 20170118	1703054-09	Soil/Sediment	Sample	01/18/2017	01/20/2017
WSM10 20170118	1703054-10	Soil/Sediment	Sample	01/18/2017	01/20/2017
WSM11 20170118	1703054-11	Soil/Sediment	Sample	01/18/2017	01/20/2017
WSM12 20170118	1703054-12	Soil/Sediment	Sample	01/18/2017	01/20/2017
WSM13 20170118	1703054-13	Soil/Sediment	Sample	01/18/2017	01/20/2017
WSM14 20170118	1703054-14	Soil/Sediment	Sample	01/18/2017	01/20/2017
WSM15 20170118	1703054-15	Soil/Sediment	Sample	01/18/2017	01/20/2017
WSM16 20170118	1703054-16	Soil/Sediment	Sample	01/18/2017	01/20/2017
WSM17 20170118	1703054-17	Soil/Sediment	Sample	01/18/2017	01/20/2017
WSM18 20170118	1703054-18	Soil/Sediment	Sample	01/18/2017	01/20/2017
WSM19 20170118	1703054-19	Soil/Sediment	Sample	01/18/2017	01/20/2017

Batch Summary

Analyte	Lab Matrix	Method	Prepared	Analyzed	Batch	Sequence
%TS	Soil/Sediment	SM 2540G	04/04/2017	04/06/2017	B170820	N/A
MeHg	Soil/Sediment	EPA 1630	04/04/2017	04/05/2017	B170819	1700405

Project ID: TTE-OA1701
PM: Amanda Royal -

Client PM: Dayna Aragon
Client Project: 1035225329.02

Sample Results

Sample	Analyte	Report Matrix	Basis	Result	Qualifier	MDL	MRL	Unit	Batch	Sequence
WSM01 20170118										
1703054-01	%TS	Soil/Sediment	NA	56.16		0.07	0.23	%	B170820	N/A
1703054-01	MeHg	Soil/Sediment	dry	0.907		0.022	0.065	ng/g	B170819	1700405
WSM02 20170118										
1703054-02	%TS	Soil/Sediment	NA	46.82		0.07	0.23	%	B170820	N/A
1703054-02	MeHg	Soil/Sediment	dry	9.23		0.026	0.078	ng/g	B170819	1700405
WSM04 20170118										
1703054-04	%TS	Soil/Sediment	NA	35.53		0.07	0.23	%	B170820	N/A
1703054-04	MeHg	Soil/Sediment	dry	8.44	M	0.036	0.109	ng/g	B170819	1700405
WSM05 20170118										
1703054-05	%TS	Soil/Sediment	NA	25.57		0.07	0.23	%	B170820	N/A
1703054-05	MeHg	Soil/Sediment	dry	3.66		0.048	0.145	ng/g	B170819	1700405
WSM09 20170118										
1703054-09	%TS	Soil/Sediment	NA	47.30		0.07	0.23	%	B170820	N/A
1703054-09	MeHg	Soil/Sediment	dry	3.64		0.026	0.077	ng/g	B170819	1700405
WSM13 20170118										
1703054-13	%TS	Soil/Sediment	NA	43.89		0.07	0.23	%	B170820	N/A
1703054-13	MeHg	Soil/Sediment	dry	2.19		0.031	0.092	ng/g	B170819	1700405
WSM16 20170118										
1703054-16	%TS	Soil/Sediment	NA	31.22		0.07	0.23	%	B170820	N/A
1703054-16	MeHg	Soil/Sediment	dry	3.20		0.040	0.121	ng/g	B170819	1700405
WSM17 20170118										
1703054-17	%TS	Soil/Sediment	NA	38.89		0.07	0.23	%	B170820	N/A
1703054-17	MeHg	Soil/Sediment	dry	5.51		0.033	0.099	ng/g	B170819	1700405
WSM18 20170118										
1703054-18	%TS	Soil/Sediment	NA	40.88		0.07	0.23	%	B170820	N/A
1703054-18	MeHg	Soil/Sediment	dry	15.0		0.029	0.088	ng/g	B170819	1700405

Project ID: TTE-OA1701
PM: Amanda Royal -

Client PM: Dayna Aragon
Client Project: 1035225329.02

Sample Results

Sample	Analyte	Report Matrix	Basis	Result	Qualifier	MDL	MRL	Unit	Batch	Sequence
WSM19 20170118										
1703054-19	%TS	Soil/Sediment	NA	31.82		0.07	0.23	%	B170820	N/A
1703054-19	MeHg	Soil/Sediment	dry	10.8		0.041	0.124	ng/g	B170819	1700405

Project ID: TTE-OA1701
PM: Amanda Royal -

Client PM: Dayna Aragon
Client Project: 1035225329.02

Accuracy & Precision Summary

Batch: B170819
Lab Matrix: Soil/Sediment
Method: EPA 1630

Sample	Analyte	Native	Spike	Result	Units	REC & Limits	RPD & Limits
B170819-SRM1	**Standard Reference Material (1709003, Methyl Mercury in Sediment)**						
	MeHg		10.00	10.78	ng/g	108% 65-135	
B170819-DUP1	**Duplicate (1703054-04)**						
	MeHg	8.444		8.339	ng/g		1% 35
B170819-MS1	**Matrix Spike (1703054-04)**						
	MeHg	8.444	5.645	13.26	ng/g	85% 65-135	
B170819-MSD1	**Matrix Spike Duplicate (1703054-04)**						
	MeHg	8.444	5.680	8.375	ng/g	*-1%* 65-135	*206%* 35

Project ID: TTE-OA1701
PM: Amanda Royal -

Client PM: Dayna Aragon
Client Project: 1035225329.02

Accuracy & Precision Summary

Batch: B170820
Lab Matrix: Soil/Sediment
Method: SM 2540G

Sample	Analyte	Native	Spike	Result	Units	REC & Limits	RPD & Limits
B170820-DUP1	**Duplicate, (1703054-01)**						
	%TS	56.16		53.96	%		4% 15

Project ID: TTE-OA1701
PM: Amanda Royal -

Client PM: Dayna Aragon
Client Project: 1035225329.02

Method Blanks & Reporting Limits

Batch: B170819
Matrix: Soil/Sediment
Method: EPA 1630
Analyte: MeHg

Sample	Result	Units
B170819-BLK1	0.003	ng/g
B170819-BLK2	0.004	ng/g
B170819-BLK3	0.0009	ng/g
B170819-BLK4	0.003	ng/g

Average: 0.003
Limit: 0.025

MDL: 0.012
MRL: 0.037

Project ID: TTE-OA1701
PM: Amanda Royal -

Client PM: Dayna Aragon
Client Project: 1035225329.02

Method Blanks & Reporting Limits

Batch: B170820
Matrix: Soil/Sediment
Method: SM 2540G
Analyte: %TS

Sample	Result	Units
B170820-BLK1	0.05	%
B170820-BLK2	0.00	%

Average: 0.03
Limit: 0.23

MDL: 0.07
MRL: 0.23

Project ID: TTE-OA1701
PM: Amanda Royal -

Client PM: Dayna Aragon
Client Project: 1035225329.02

Sample Containers

Lab ID: 1703054-01 **Report Matrix:** Soil/Sediment **Collected:** 01/18/2017
Sample: WSM01 20170118 **Sample Type:** Sample **Received:** 01/20/2017

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Jar HDPE	4oz	16-0253	none			Cooler

Lab ID: 1703054-02 **Report Matrix:** Soil/Sediment **Collected:** 01/18/2017
Sample: WSM02 20170118 **Sample Type:** Sample **Received:** 01/20/2017

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Jar HDPE	4oz	16-0253	none			Cooler

Lab ID: 1703054-03 **Report Matrix:** Soil/Sediment **Collected:** 01/18/2017
Sample: WSM03 20170118 **Sample Type:** Sample **Received:** 01/20/2017

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Jar HDPE	4oz	16-0253	none			Cooler

Lab ID: 1703054-04 **Report Matrix:** Soil/Sediment **Collected:** 01/18/2017
Sample: WSM04 20170118 **Sample Type:** Sample **Received:** 01/20/2017

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Jar HDPE	4oz	16-0253	none			Cooler

Lab ID: 1703054-05 **Report Matrix:** Soil/Sediment **Collected:** 01/18/2017
Sample: WSM05 20170118 **Sample Type:** Sample **Received:** 01/20/2017

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Jar HDPE	4oz	16-0253	none			Cooler

Lab ID: 1703054-06 **Report Matrix:** Soil/Sediment **Collected:** 01/18/2017
Sample: WSM06 20170118 **Sample Type:** Sample **Received:** 01/20/2017

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Jar HDPE	4oz	16-0253	none			Cooler

Project ID: TTE-OA1701
PM: Amanda Royal -

Client PM: Dayna Aragon
Client Project: 1035225329.02

Sample Containers

Lab ID: 1703054-07 **Report Matrix:** Soil/Sediment **Collected:** 01/18/2017
Sample: WSM07 20170118 **Sample Type:** Sample **Received:** 01/20/2017

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Jar HDPE	4oz	16-0253	none			Cooler

Lab ID: 1703054-08 **Report Matrix:** Soil/Sediment **Collected:** 01/18/2017
Sample: WSM08 20170118 **Sample Type:** Sample **Received:** 01/20/2017

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Jar HDPE	4oz	16-0253	none			Cooler

Lab ID: 1703054-09 **Report Matrix:** Soil/Sediment **Collected:** 01/18/2017
Sample: WSM09 20170118 **Sample Type:** Sample **Received:** 01/20/2017

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Jar HDPE	4oz	16-0253	none			Cooler

Lab ID: 1703054-10 **Report Matrix:** Soil/Sediment **Collected:** 01/18/2017
Sample: WSM10 20170118 **Sample Type:** Sample **Received:** 01/20/2017

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Jar HDPE	4oz	16-0253	none			Cooler

Lab ID: 1703054-11 **Report Matrix:** Soil/Sediment **Collected:** 01/18/2017
Sample: WSM11 20170118 **Sample Type:** Sample **Received:** 01/20/2017

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Jar HDPE	4oz	16-0253	none			Cooler

Lab ID: 1703054-12 **Report Matrix:** Soil/Sediment **Collected:** 01/18/2017
Sample: WSM12 20170118 **Sample Type:** Sample **Received:** 01/20/2017

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Jar HDPE	4oz	16-0253	none			Cooler

Project ID: TTE-OA1701
PM: Amanda Royal -

Client PM: Dayna Aragon
Client Project: 1035225329.02

Sample Containers

Lab ID: 1703054-13 **Report Matrix:** Soil/Sediment **Collected:** 01/18/2017
Sample: WSM13 20170118 **Sample Type:** Sample **Received:** 01/20/2017

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Jar HDPE	4oz	16-0253	none			Cooler

Lab ID: 1703054-14 **Report Matrix:** Soil/Sediment **Collected:** 01/18/2017
Sample: WSM14 20170118 **Sample Type:** Sample **Received:** 01/20/2017

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Jar HDPE	4oz	16-0253	none			Cooler

Lab ID: 1703054-15 **Report Matrix:** Soil/Sediment **Collected:** 01/18/2017
Sample: WSM15 20170118 **Sample Type:** Sample **Received:** 01/20/2017

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Jar HDPE	4oz	16-0253	none			Cooler

Lab ID: 1703054-16 **Report Matrix:** Soil/Sediment **Collected:** 01/18/2017
Sample: WSM16 20170118 **Sample Type:** Sample **Received:** 01/20/2017

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Jar HDPE	4oz	16-0253	none			Cooler

Lab ID: 1703054-17 **Report Matrix:** Soil/Sediment **Collected:** 01/18/2017
Sample: WSM17 20170118 **Sample Type:** Sample **Received:** 01/20/2017

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Jar HDPE	4oz	16-0253	none			Cooler

Lab ID: 1703054-18 **Report Matrix:** Soil/Sediment **Collected:** 01/18/2017
Sample: WSM18 20170118 **Sample Type:** Sample **Received:** 01/20/2017

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Jar HDPE	4oz	16-0253	none			Cooler

Project ID: TTE-OA1701
PM: Amanda Royal -

Client PM: Dayna Aragon
Client Project: 1035225329.02

Sample Containers

Lab ID: 1703054-19
Sample: WSM19 20170118
Report Matrix: Soil/Sediment
Sample Type: Sample
Collected: 01/18/2017
Received: 01/20/2017

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Jar HDPE	4oz	16-0253	none			Cooler

Shipping Containers

Cooler

Received: January 20, 2017 9:30
Tracking No: 778216852099 via FedEx
Coolant Type: Ice
Temperature: 4.3 °C

Description: Cooler
Damaged in transit? No
Returned to client? No
Comments: ir#7

Custody seals present? Yes
Custody seals intact? Yes
COC present? Yes

Tetra Tech EM Inc.
Oakland Office
1999 Harrison Street, Suite 500
Oakland, CA 94612
510.302.6300 Phone
510.433.0830 Fax

Chain of Custody Record No. 9933

BAL Report 1703054

Lab PO#: 1132998

Lab: BROOKS APPLIED

Project name: RFS PHASE V

TtEMI technical contact: DEBORAH KITSAL

Field samplers: DAYNA ARAGON, JASON BRODERSEN

Project (CTO) number: 1035225329.02

TtEMI project manager: JASON BRODERSEN

Field samplers' signatures:

Sample ID	Point ID/Depth	Date	Time	Matrix	MS / MSD	No./Container Types: 40 ml VOA	1 liter Amber	500 ml Poly	Sleeve	Glass Jar	250 ml Poly	Encore	PLASTIC JAR	Preservative Added: None	Analysis Required: VOA	SVOA	Pest	Metals	TPH Purgeables	TPH Extractables	PCB	MEHG
WSM01 20170118		1/18/17	0800	SEDIMENT									1									
WSM02			0805										1									
WSM03			0810										1									
WSM04			0815										1									
WSM05			0820										1									
WSM06			0825										1									
WSM07			0830										1									
WSM08			0845										1									
WSM09			0900										1									
WSM10			0915										1									
WSM11			0916										1									
WSM12			0915										1									

	Name (print)	Company Name	Date	Time
Relinquished by:	Dayna Aragon	Tetra Tech BAL	1/19/17	1700
Received by:	Jen Wehe		1/20/17	0930
Relinquished by:				
Received by:				
Relinquished by:				
Received by:				

Turnaround time/remarks: HOLD ALL ANALYSES UNTIL FURTHER NOTICE

Fed Ex #:

WHITE-Laboratory Copy YELLOW-Sample Tracker PINK-File

Tetra Tech EM Inc.
Oakland Office
1999 Harrison Street, Suite 500
Oakland, CA 94612
510.302.6300 Phone
510.433.0830 Fax

Chain of Custody Record No. 9934

BAL Report 1703054

Lab PO#: 1132998

Lab: BROOKS APPLIED

Project name: RFS PHASE V

TtEMI technical contact: DEBORAH KITSAL

Field samplers: DAYNA ARAGON, JASON BRODERSEN

Project (CTO) number: 103S225329.02

TtEMI project manager: JASON BRODERSEN

Field samplers' signatures:

Sample ID	Point ID/Depth	Date	Time	Matrix	MS / MSD	No./Container Types: 40 ml VOA	1 liter Amber	500 ml Poly	Sleeve	Glass Jar	250 ml Poly	Encore	PLASTIC JAR	Preservative Added: None	Analysis Required: VOA	SVOA	Pest	Metals	TPH Purgeables	TPH Extractables	PCB	MEHG
WSM13 20170118		1/18/17	0920	SEDIMENT									1									
WSM14			1100										1									
WSM15			1105										1									
WSM16			1110										1									
WSM17			1115										1									
WSM18			1130										1									
WSM19			1135										1									

	Name (print)	Company Name	Date	Time
Relinquished by:	Dayna Aragon	Tetra Tech	1/19/17	1700
Received by:	Jen Walker	BAL	1/20/17	0930
Relinquished by:				
Received by:				
Relinquished by:				
Received by:				

Turnaround time/remarks:

HOLD ALL ANALYSES UNTIL FURTHER NOTICE

Fed Ex #:

WHITE-Laboratory Copy YELLOW-Sample Tracker Copy

BROOKS APPLIED LABS
18804 North Creek Parkway, Ste 100, Bothell, WA 98011 • USA • T: 206 632 6206 F: 206 632 6017 • info@brooksapplied.com

May 11, 2017

Tetra Tech - Oakland
ATTN: Dayna Aragon
1999 Harrison Street, Suite 500
Oakland, CA, 94612
Dayna.aragon@tetratech.com

RE: Project: TTE-OA1701 Client Project: 1035825329.02 RFS Phase V

Dear Ms. Aragon,

On January 27, 2017 Brooks Applied Labs (BAL) received twenty-two (22) porewater extraction samples. The samples were logged-in for methylmercury (MeHg) analyses according to the chain-of-custody form. All samples were placed on hold. Upon further notice, 11 samples were confirmed by the client to be released for analysis. All samples were received and stored according to BAL SOPs and EPA methodology.

Samples were received filtered and preserved. An additional 1mL of 6N HCl was added to any samples requiring a pH adjustment as noted in the Sample Containers log.

Samples for MeHg are prepared and analyzed according to EPA 1630. Samples are distilled from Teflon distillation vials. Samples are then analyzed by ethylation, Tenax trap pre-concentration, gas chromatography separation, pyrolytic combustion and atomic fluorescence spectroscopy (CV-GC-AFS) using a Brooks Rand Instruments MERX-M analyzer.

The first blank spike in B170872 (B170872-BS1) yielded a low recovery. Both blank spikes were re-analyzed and results confirmed. B170872-BS2 and all other QC meet recovery criteria, therefore no further action is required.

Sample results were method blank corrected. This has been described in the calculations section of the relevant BAL SOP(s). All results were evaluated using reporting limits adjusted to account for sample aliquot size. Please refer to the *Sample Results* page for sample-specific MDLs, MRLs, and other details.

Sample *WSM17DUP20170118* (1704035-19) was identified as a field duplicate for sample *WSM1720170118* (1704035-18). The RPD between the results is 110%, above the limit of 35% for duplicate precision. Re-analyses confirmed the original results. It was noted at receipt that sample 1704035-18 had visible particulate while sample 1704035-19 was clear. No qualification of sample results is required.

All data was reported without further qualification and all other associated quality control sample results met the acceptance criteria.

BAL, an accredited laboratory, certifies that the reported results of all analyses for which BAL is NELAP accredited meet all NELAP requirements. For more information please see the *Report Information* page in your report. Please feel free to contact us if you have any questions regarding this report.

Sincerely,

Amanda Royal
Project Manager
amanda@brooksapplied.com

Margaret Shultz
Project Coordinator
margaret@brooksapplied.com

Report Information

Laboratory Accreditation

BAL is accredited by the *National Environmental Laboratory Accreditation Program* (NELAP) through the State of Florida Department of Health, Bureau of Laboratories (E87982) and is certified to perform many environmental analyses. BAL is also certified by many other states to perform environmental analyses. For a current list of our accreditations/certifications, please visit our website at <http://www.brooksapplied.com/resources/certificates-permits/>. Results reported relate only to the samples listed in the report.

Field Quality Control Samples

Please be notified that certain EPA methods require the collection of field quality control samples of an appropriate type and frequency; failure to do so is considered a deviation from some methods and for compliance purposes should only be done with the approval of regulatory authorities. Please see the specific EPA methods for details regarding required field quality control samples.

Common Abbreviations

AR	as received	**MS**	matrix spike
BAL	Brooks Applied Labs	**MSD**	matrix spike duplicate
BLK	method blank	**ND**	non-detect
BS	blank spike	**NR**	non-reportable
CAL	calibration standard	**N/C**	not calculated
CCB	continuing calibration blank	**PS**	post preparation spike
CCV	continuing calibration verification	**REC**	percent recovery
COC	chain of custody record	**RPD**	relative percent difference
D	dissolved fraction	**SCV**	secondary calibration verification
DUP	duplicate	**SOP**	standard operating procedure
IBL	instrument blank	**SRM**	standard reference material
ICV	initial calibration verification	**T**	total fraction
MDL	method detection limit	**TR**	total recoverable fraction
MRL	method reporting limit		

Definition of Data Qualifiers

(Effective 9/23/09)

J Detected by the instrument, the result is > the MDL but ≤ the MRL. Result is reported and considered an estimate.
E An estimated value due to the presence of interferences. A full explanation is presented in the narrative.
H Holding time and/or preservation requirements not met. Result is estimated.
J-1 Estimated value. A full explanation is presented in the narrative.
J-M Duplicate precision (RPD) for associated QC sample was not within acceptance criteria. Result is estimated.
J-N Spike recovery for associated QC sample was not within acceptance criteria. Result is estimated.
M Duplicate precision (RPD) was not within acceptance criteria. Result is estimated.
N Spike recovery was not within acceptance criteria. Result is estimated.
R Rejected, unusable value. A full explanation is presented in the narrative.
U Result is ≤ the MDL or client requested reporting limit (CRRL). Result reported as the MDL or CRRL.
X Result is not BLK-corrected and is within 10x the absolute value of the highest detectable BLK in the batch. Result is estimated.

These qualifiers are based on those previously utilized by Brooks Applied Labs, those found in the EPA SOW ILM03.0, Exhibit B, Section III, pg. B-18, and the USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review; USEPA; January 2010. These supersede all previous qualifiers ever employed by BAL.

Project ID: TTE-OA1701
PM: Amanda Royal -

Client PM: Dayna Aragon
Client Project: 1035825329.02

Sample Information

Sample	Lab ID	Report Matrix	Type	Sampled	Received
WSM0120170118	1704035-01	Water	Sample	01/18/2017	01/27/2017
WSM0220170118	1704035-02	Water	Sample	01/18/2017	01/27/2017
WSM0320170118	1704035-03	Water	Sample	01/18/2017	01/27/2017
WSM0420170118	1704035-04	Water	Sample	01/18/2017	01/27/2017
WSM0520170118	1704035-05	Water	Sample	01/18/2017	01/27/2017
WSM0620170118	1704035-06	Water	Sample	01/18/2017	01/27/2017
WSM0720170118	1704035-07	Water	Sample	01/18/2017	01/27/2017
WSM07DUP20170118	1704035-08	Water	Field Duplicate	01/18/2017	01/27/2017
WSM0820170118	1704035-09	Water	Sample	01/18/2017	01/27/2017
WSM0920170118	1704035-10	Water	Sample	01/18/2017	01/27/2017
WSM1020170118	1704035-11	Water	Sample	01/18/2017	01/27/2017
WSM1120170118	1704035-12	Water	Sample	01/18/2017	01/27/2017
WSM1220170118	1704035-13	Water	Sample	01/18/2017	01/27/2017
WSM1320170118	1704035-14	Water	Sample	01/18/2017	01/27/2017
WSM1420170118	1704035-15	Water	Sample	01/18/2017	01/27/2017
WSM1520170118	1704035-16	Water	Sample	01/18/2017	01/27/2017
WSM1620170118	1704035-17	Water	Sample	01/18/2017	01/27/2017
WSM1720170118	1704035-18	Water	Sample	01/18/2017	01/27/2017
WSM17DUP20170118	1704035-19	Water	Field Duplicate	01/18/2017	01/27/2017
WSM1820170118	1704035-20	Water	Sample	01/18/2017	01/27/2017
WSM1920170118	1704035-21	Water	Sample	01/18/2017	01/27/2017
Filter Blank	1704035-22	Water	Filter Blank	01/18/2017	01/27/2017

Batch Summary

Analyte	Lab Matrix	Method	Prepared	Analyzed	Batch	Sequence
MeHg	Water	EPA 1630	04/17/2017	04/18/2017	B170872	1700458

Project ID: TTE-OA1701
PM: Amanda Royal -

Client PM: Dayna Aragon
Client Project: 1035825329.02

Sample Results

Sample	Analyte	Report Matrix	Basis	Result	Qualifier	MDL	MRL	Unit	Batch	Sequence
WSM0120170118										
1704035-01	MeHg	Water	D	1.35		0.019	0.049	ng/L	B170872	1700458
WSM0220170118										
1704035-02	MeHg	Water	D	0.333		0.020	0.049	ng/L	B170872	1700458
WSM0420170118										
1704035-04	MeHg	Water	D	1.05		0.020	0.050	ng/L	B170872	1700458
WSM0520170118										
1704035-05	MeHg	Water	D	0.445		0.020	0.049	ng/L	B170872	1700458
WSM0920170118										
1704035-10	MeHg	Water	D	1.88		0.020	0.050	ng/L	B170872	1700458
WSM1320170118										
1704035-14	MeHg	Water	D	0.316		0.019	0.049	ng/L	B170872	1700458
WSM1620170118										
1704035-17	MeHg	Water	D	0.200		0.020	0.050	ng/L	B170872	1700458
WSM1720170118										
1704035-18	MeHg	Water	D	1.81		0.020	0.049	ng/L	B170872	1700458
WSM17DUP20170118										
1704035-19	MeHg	Water	D	0.527		0.020	0.049	ng/L	B170872	1700458
WSM1820170118										
1704035-20	MeHg	Water	D	5.08		0.020	0.050	ng/L	B170872	1700458
WSM1920170118										
1704035-21	MeHg	Water	D	1.72		0.019	0.049	ng/L	B170872	1700458

Project ID: TTE-OA1701
PM: Amanda Royal -

Client PM: Dayna Aragon
Client Project: 1035825329.02

Accuracy & Precision Summary

Batch: B170872
Lab Matrix: Water
Method: EPA 1630

Sample	Analyte	Native	Spike	Result	Units	REC & Limits	RPD & Limits
B170872-BS1	**Blank Spike, (1715030)**						
	MeHg		1.000	0.046	ng/L	*5%* 67-133	
B170872-BS2	**Blank Spike, (1715030)**						
	MeHg		1.000	0.945	ng/L	94% 67-133	
B170872-MS1	**Matrix Spike (1704035-10)**						
	MeHg	1.876	1.000	2.811	ng/L	94% 65-135	
B170872-MSD1	**Matrix Spike Duplicate (1704035-10)**						
	MeHg	1.876	1.000	2.999	ng/L	112% 65-135	6% 35
B170872-MS2	**Matrix Spike (1714028-04)**						
	MeHg	0.149	1.000	1.072	ng/L	92% 65-135	
B170872-MSD2	**Matrix Spike Duplicate (1714028-04)**						
	MeHg	0.149	1.000	1.138	ng/L	99% 65-135	6% 35

Project ID: TTE-OA1701
PM: Amanda Royal -

Client PM: Dayna Aragon
Client Project: 1035825329.02

Method Blanks & Reporting Limits

Batch: B170872
Matrix: Water
Method: EPA 1630
Analyte: MeHg

Sample	Result	Units
B170872-BLK1	0.012	ng/L
B170872-BLK2	0.023	ng/L
B170872-BLK3	0.015	ng/L
B170872-BLK4	0.029	ng/L

Average: 0.020 **Standard Deviation:** 0.008 **MDL:** 0.019
Limit: 0.045 **Limit:** 0.015 **MRL:** 0.049

Project ID: TTE-OA1701
PM: Amanda Royal -

Client PM: Dayna Aragon
Client Project: 1035825329.02

Sample Containers

Lab ID: 1704035-01 **Report Matrix:** Water **Collected:** 01/18/2017
Sample: WSM0120170118 **Sample Type:** Sample **Received:** 01/27/2017
Comments: Samples recieved at pH >2 1 mL 6N HCl added to bring samples to pH <2. Particulate visible in sample.

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Bottle FLPE Hg-SP	250mL	16-0250	2mL 6N HCl (PP) + 1mL 6N HCl (BAL)	1649065 + 1652022	<2	Cooler

Lab ID: 1704035-02 **Report Matrix:** Water **Collected:** 01/18/2017
Sample: WSM0220170118 **Sample Type:** Sample **Received:** 01/27/2017

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Bottle FLPE Hg-SP	250mL	16-0250	2mL 6N HCl (PP)	1649065	<2	Cooler

Lab ID: 1704035-03 **Report Matrix:** Water **Collected:** 01/18/2017
Sample: WSM0320170118 **Sample Type:** Sample **Received:** 01/27/2017

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Bottle FLPE Hg-SP	250mL	16-0250	2mL 6N HCl (PP)	1649065	<2	Cooler

Lab ID: 1704035-04 **Report Matrix:** Water **Collected:** 01/18/2017
Sample: WSM0420170118 **Sample Type:** Sample **Received:** 01/27/2017
Comments: Particulate visible in sample.

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Bottle FLPE Hg-SP	250mL	16-0250	2mL 6N HCl (PP)	1649065	<2	Cooler

Lab ID: 1704035-05 **Report Matrix:** Water **Collected:** 01/18/2017
Sample: WSM0520170118 **Sample Type:** Sample **Received:** 01/27/2017
Comments: Particulate visible in sample.

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Bottle FLPE Hg-SP	250mL	16-0250	2mL 6N HCl (PP)	1649065	<2	Cooler

Lab ID: 1704035-06 **Report Matrix:** Water **Collected:** 01/18/2017
Sample: WSM0620170118 **Sample Type:** Sample **Received:** 01/27/2017

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Bottle FLPE Hg-SP	250mL	16-0250	2mL 6N HCl (PP)	1649065	<2	Cooler

Project ID: TTE-OA1701
PM: Amanda Royal -

Client PM: Dayna Aragon
Client Project: 1035825329.02

Sample Containers

Lab ID: 1704035-07 **Report Matrix:** Water **Collected:** 01/18/2017
Sample: WSM0720170118 **Sample Type:** Sample **Received:** 01/27/2017

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Bottle FLPE Hg-SP	250mL	16-0250	2mL 6N HCl (PP)	1649065	<2	Cooler

Lab ID: 1704035-08 **Report Matrix:** Water **Collected:** 01/18/2017
Sample: WSM07DUP20170118 **Sample Type:** Field Duplicate **Received:** 01/27/2017

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Bottle FLPE Hg-SP	250mL	16-0250	2mL 6N HCl (PP)	1649065	<2	Cooler

Lab ID: 1704035-09 **Report Matrix:** Water **Collected:** 01/18/2017
Sample: WSM0820170118 **Sample Type:** Sample **Received:** 01/27/2017
Comments: Particulate visible in sample.

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Bottle FLPE Hg-SP	250mL	16-0250	2mL 6N HCl (PP)	1649065	<2	Cooler

Lab ID: 1704035-10 **Report Matrix:** Water **Collected:** 01/18/2017
Sample: WSM0920170118 **Sample Type:** Sample **Received:** 01/27/2017

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Bottle FLPE Hg-SP	250mL	16-0250	2mL 6N HCl (PP)	1649065	<2	Cooler

Lab ID: 1704035-11 **Report Matrix:** Water **Collected:** 01/18/2017
Sample: WSM1020170118 **Sample Type:** Sample **Received:** 01/27/2017

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Bottle FLPE Hg-SP	250mL	16-0250	2mL 6N HCl (PP)	1649065	<2	Cooler

Lab ID: 1704035-12 **Report Matrix:** Water **Collected:** 01/18/2017
Sample: WSM1120170118 **Sample Type:** Sample **Received:** 01/27/2017

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Bottle FLPE Hg-SP	250mL	16-0250	2mL 6N HCl (PP)	1649065	<2	Cooler

Project ID: TTE-OA1701
PM: Amanda Royal -

Client PM: Dayna Aragon
Client Project: 1035825329.02

Sample Containers

Lab ID: 1704035-13 **Report Matrix:** Water **Collected:** 01/18/2017
Sample: WSM1220170118 **Sample Type:** Sample **Received:** 01/27/2017

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Bottle FLPE Hg-SP	250mL	16-0250	2mL 6N HCl (PP)	1649065	<2	Cooler

Lab ID: 1704035-14 **Report Matrix:** Water **Collected:** 01/18/2017
Sample: WSM1320170118 **Sample Type:** Sample **Received:** 01/27/2017

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Bottle FLPE Hg-SP	250mL	16-0250	2mL 6N HCl (PP)	1649065	<2	Cooler

Lab ID: 1704035-15 **Report Matrix:** Water **Collected:** 01/18/2017
Sample: WSM1420170118 **Sample Type:** Sample **Received:** 01/27/2017

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Bottle FLPE Hg-SP	250mL	16-0250	2mL 6N HCl (PP)	1649065	<2	Cooler

Lab ID: 1704035-16 **Report Matrix:** Water **Collected:** 01/18/2017
Sample: WSM1520170118 **Sample Type:** Sample **Received:** 01/27/2017

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Bottle FLPE Hg-SP	250mL	16-0250	2mL 6N HCl (PP)	1649065	<2	Cooler

Lab ID: 1704035-17 **Report Matrix:** Water **Collected:** 01/18/2017
Sample: WSM1620170118 **Sample Type:** Sample **Received:** 01/27/2017
Comments: Samples recieved at pH >2 1 mL 6N HCl added to bring samples to pH <2

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Bottle FLPE Hg-SP	250mL	16-0250	2mL 6N HCl (PP) + 1mL 6N HCl (BAL)	1649065 + 1652022	<2	Cooler

Lab ID: 1704035-18 **Report Matrix:** Water **Collected:** 01/18/2017
Sample: WSM1720170118 **Sample Type:** Sample **Received:** 01/27/2017
Comments: Particulate visible in sample.

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Bottle FLPE Hg-SP	250mL	16-0250	2mL 6N HCl (PP)	1649065	<2	Cooler

Project ID: TTE-OA1701
PM: Amanda Royal -

Client PM: Dayna Aragon
Client Project: 1035825329.02

Sample Containers

Lab ID: 1704035-19 **Report Matrix:** Water **Collected:** 01/18/2017
Sample: WSM17DUP20170118 **Sample Type:** Field Duplicate **Received:** 01/27/2017

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Bottle FLPE Hg-SP	250mL	16-0250	2mL 6N HCl (PP)	1649065	<2	Cooler

Lab ID: 1704035-20 **Report Matrix:** Water **Collected:** 01/18/2017
Sample: WSM1820170118 **Sample Type:** Sample **Received:** 01/27/2017
Comments: Particulate visible in sample.

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Bottle FLPE Hg-SP	250mL	16-0250	2mL 6N HCl (PP)	1649065	<2	Cooler

Lab ID: 1704035-21 **Report Matrix:** Water **Collected:** 01/18/2017
Sample: WSM1920170118 **Sample Type:** Sample **Received:** 01/27/2017

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Bottle FLPE Hg-SP	250mL	16-0250	2mL 6N HCl (PP)	1649065	<2	Cooler

Lab ID: 1704035-22 **Report Matrix:** Water **Collected:** 01/18/2017
Sample: Filter Blank **Sample Type:** Filter Blank **Received:** 01/27/2017

Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Bottle FLPE Hg-SP	250mL	16-0250	2mL 6N HCl (PP)	1649065	<2	Cooler

Shipping Containers

Cooler

Received: January 27, 2017 9:40
Tracking No: 778284461887 via FedEx
Coolant Type: Ice
Temperature: 3.2 °C

Description: Cooler
Damaged in transit? No
Returned to client? No
Comments: IR#10

Custody seals present? No
Custody seals intact? No
COC present? Yes

Tetra Tech EM Inc.
San Francisco Office
135 Main St. Suite 1800
San Francisco. CA 94105
415-543-4880
Fax 415-543-5480

Chain of Custody Record No. 7180

Project name: RFS Phase V	**Lab PO#:** to follow	**Lab:** Brooks Applied
Project (CTO) number: 103582533 29.02	**TtEMI technical contact:** Deborah Kitsal	**Field samplers:** Dayra Arroyo, Jason Biedersen
	TtEMI project manager: Jason Biedersen	**Field samplers' signatures:**

Sample ID	Sample Location (Pt. ID)	Date	Time	Matrix	MS / MSD	40 ml VOA	1 liter Amber	500 ml Poly	Sleeve	Glass Jar	250 mL preserved HNO3	VOA	SVOA	Pest/PCBs	Metals	TPH Purgeables	TPH Extractables	Ni HS
WSM01 20170118		1/18/17	0800	pore water							1X							X
WSM02			0805								1X							
WSM03			0810								1X							
WSM04			0815								1X							
WSM05			0820								1X							
WSM06			0825								1X							
WSM07			0830								1X							
WSM07DUP20170118			0833								1X							
WSM08 20170118			0845								1X							
WSM09			0900								1X							
WSM10			0905								1X							
WSM11			0910								1X							

	Name (print)	Company Name	Date	Time
Relinquished by:	Dayra Arroyo	Tetra Tech	1/19/17	1515
Received by:	Torrin Campbell	PER	1/19/17	1515
Relinquished by:	Mike McElroy	PER	1/20/17	900
Received by:	Lauren Blaiwes	BAL	1/27/17	940
Relinquished by:				
Received by:				

Turnaround time/remarks:

pore water extracted via centrifugation at Pacific Ecorisk
Archive all samples until further notice!

- Samples 0.45um filtered prior to preservation w/ HCl
- sample date/time is when sediment was field collected.

Fed Ex #: *A filter blank sample has been included with the samples. Only analyze upon Tetra Tech's request.

WHITE-Laboratory Copy YELLOW-Sample Tracker PINK-File Copy

Tetra Tech EM Inc.
San Francisco Office

135 Main St. Suite 1800
San Francisco. CA 94105
415-543-4880
Fax 415-543-5480

Chain of Custody Record No. 7179

BAL Report 1704065 — Page 2 of 2

Project name: Joe Pagel	**Lab PO#:** to follow	**Lab:** Brooks Applied
Project (CTO) number:	**TtEMI technical contact:**	**Field samplers:** DA, JB
	TtEMI project manager:	**Field samplers' signatures:**

Sample ID	Sample Location (Pt. ID)	Date	Time	Matrix	MS / MSD	40 ml VOA	1 liter Amber	500 ml Poly	Sleeve	Glass Jar	250 ml preserved poly	VOA	SVOA	Pest/PCBs	Metals	TPH Purgeables	TPH Extractables	Preservative Added: HCl / Method
WSM12 20170118		1/18/17	~~0800~~ 0801	Porewater							1							x
WSM13			0805 0820								1							
WSM14			0810 0900								1							
WSM15			0815 1105								1							
WSM16			0820 1110								1							
WSM17			0825 1115								1							
WSM17 DUP 20170118			0830 1118								1							
WSM18 20170118			0833 1130								1							
WSM19			0845 1135								1							
			~~0844~~															
			0															

	Name (print)	Company Name	Date	Time
Relinquished by: Dayra Araya	Dayra Araya	Tetra Tech	1/18/17	1515
Received by: Torrin Campbell	Torrin Campbell	PER	1/1?/17	1515
Relinquished by: Mike McElroy	Mike McElroy	PER	1/26/17	900
Received by: Lauren Blanton	Lauren Blanton	BAL	1/27/17	940
Relinquished by:				
Received by:				

Turnaround time/remarks:
pore water extracted via centrifugation at Pacific Ecorisk
Archive all samples until further notice

- Samples 0.45 um filtered prior to preservation w/ HCl
- Sample date/time is when sediment was field collected.

Fed Ex #: * A filter blank sample has been included with the samples. Only analyze upon Tetra Tech's request.

WHITE-Laboratory Copy YELLOW-Sample Tracker PINK-File Copy

ATTACHMENT 3
SAMPLE CHAIN OF CUSTODY FORMS

285244

Tetra Tech EM Inc.
San Francisco Office

Chain of Custody Record No. 7176

BAL Report 1703055

Page 1 of 4

~~135 Main St. Suite 1800~~ 1999 Harrison St, Ste 500
San Francisco, CA ~~94105~~ Oakland, CA 94612
415-543-4880
Fax 415-543-5480

Lab PO#: 1133778	Lab: CT	
Project name: RFS Phase V	TtEMI technical contact: Deborah Kotsal	Field samplers: Dayna Aragon, Jason Brodersen
Project (CTO) number: 103522 5329.02	TtEMI project manager: Jason Brodersen	Field samplers' signatures:

Sample ID	Sample Location (Pt. ID)	Date	Time	Matrix	MS / MSD	No./Container Types: 40 ml VOA	1 liter Amber	500 ml Poly	Sleeve	Glass Jar	Preservative Added: None	Nitric	Analysis Required: VOA	SVOA	PCBs 8082	Metals 6020B 7471A	TPH Purgeables	TPH Extractables
WSM01 20170118		1/18/17	0800	sediment						1					X	X		
WSM02 20170118			0805							1								
WSM03 20170118			0810							1								
WSM04 20170118			0815							1								
WSM05 20170118			0820							1								
WSM06 20170118			0825							1								
WSM07 20170118R1			0830							1								
WSM07 20170118R2			0835							1								
WSM07 20170118R3			0840							1								
WSM08 20170118			0845							1								
WSM09 20170118			0900							1								
WSM10 20170118			0905							1								

	Name (print)	Company Name	Date	Time
Relinquished by:	Dayna Aragon	Tetra Tech	1/18/17	1612
Received by:	Dina Ali	CT	1/18/17	1612
Relinquished by:				
Received by:				
Relinquished by:				
Received by:				

Turnaround time/remarks:
+ see list of metals on PO

Fed Ex #:

WHITE-Laboratory Copy YELLOW-Sample Tracker PINK-File Copy

Tetra Tech EM Inc.
San Francisco Office

285244

Chain of Custody Record No. 7182

BAL Report 1703055

Page 2 of 4

135 Main St. Suite 1800
San Francisco. CA 94105
415-543-4880
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Lab PO#: 1133778	**Lab:** C+T	
Project name: see page 1	**TtEMI technical contact:** Deborah Kitsch	**Field samplers:** Dayna Arogan, Jason Badersen
Project (CTO) number:	**TtEMI project manager:** Jason Badersen	**Field samplers' signatures:**

Sample ID	Sample Location (Pt. ID)	Date	Time	Matrix	MS / MSD	40 ml VOA	1 liter Amber	500 ml Poly	Sleeve	Glass Jar	VOA	SVOA	~~Pest~~/PCBs 8082	Metals 6020/7471+	TPH Purgeables	TPH Extractables
WSM11 20170118		1/18/17	0910	Sediment						1			X	X		
WSM12 20170118			0915							1						
WSM13 20170118			0920							1						
WSM14 20170118			1100							1						
WSM15 20170118			1105							1						
WSM16 20170118			1110							1						
WSM17 20170118 R1			1115							1						
R2			1120							1						
R3			1125							1						
WSM18 20170118			1130							1						
WSM19 20170118			1135							1						
WSMDUP 20170118			0802													

Preservative Added

No./Container Types

Analysis Required

	Name (print)	Company Name	Date	Time
Relinquished by:	Dayna Arogan	Tetra Tech	1/18/17	1612
Received by:	Oana Ali	C&T	1/18/17	1612
Relinquished by:				
Received by:				
Relinquished by:				
Received by:				

Turnaround time/remarks:

+ see list of metals on PO

Fed Ex #:

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Fax 415-543-5480

285244

Chain of Custody Record No. 7175

BAL Report 1703054

Page 3 of 4

Project name: See page 1	**Lab PO#:** 1133778	**Lab:** C & T	
Project (CTO) number:	**TtEMI technical contact:**	**Field samplers:**	
	TtEMI project manager:	**Field samplers' signatures:**	

Sample ID	Sample Location (Pt. ID)	Date	Time	Matrix	MS / MSD	No./Container Types: 40 ml VOA	1 liter Amber	500 ml Poly	Sleeve	Glass Jar	Preservative Added: None	Analysis Required: VOA	SVOA	PCBs 8082	Metals	TPH Purgeables	TPH Extractables
WSM02D20170118		1/18/17	0807	sediment						1				X			
WSM03D20170118			0812							1							
WSM04D20170118			0817							1							
WSM05D20170118			0822							1							
WSM06D20170118			0827							1							
WSM07D20170118R1			0832							1							
WSM08D20170118			0847							1							
WSM09D20170118			0902							1							
WSM10D20170118			0907							1							
WSM07D20170118R2			0837							1							
WSM07D20170118R3			0842							1							
WSM11D20170118			0912							1							

	Name (print)	Company Name	Date	Time
Relinquished by: Brynt Keith	Dayna Arapen	Tetra Tech	1/18/17	1612
Received by: Patt Monaghan	Pat Gonzalez	C&T	1/18/17	1612
Relinquished by:				
Received by:				
Relinquished by:				
Received by:				

Turnaround time/remarks:

Fed Ex #:

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285244

Chain of Custody Record No. 7177

BAL Report 1703055

Page 1 of 1

Project name: See Page 1	**Lab PO#:** 1133778	**Lab:** C+T
Project (CTO) number:	**TtEMI technical contact:**	**Field samplers:**
	TtEMI project manager:	**Field samplers' signatures:**

Sample ID	Sample Location (Pt. ID)	Date	Time	Matrix	MS / MSD	No./Container Types: 40 ml VOA	1 liter Amber	500 ml Poly	Sleeve	Glass Jar	Preservative Added: None	Analysis Required: VOA	SVOA	PCBs 8082	Metals	TPH Purgeables	TPH Extractables
WSM12D20170118		1/18/17	0917	sediment						1				X			
~~WSM13D~~ WSM13D20170118			0922							1							
WSM14D20170118			1102							1							
WSM15D20170118			1107							1							
WSM16D20170118			1112							1							
WSM17D20170118R1			1117							1							
WSM17D20170118R2			1122							1							
WSM17D20170118R3			1127							1							
WSM18D20170118			1132							1							
WSM19D20170118			1137							1				16			

	Name (print)	Company Name	Date	Time
Relinquished by: Dayna	Dayna Aragon	Tetra Tech	1/18/17	1612
Received by: Pat Gonzalez	Pat Gonzalez	C&T	1/18/17	1612
Relinquished by:				
Received by:				
Relinquished by:				
Received by:				

Turnaround time/remarks: ~~Fed~~

Fed Ex #:

7 of 1851

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Tetra Tech EM Inc.
Oakland Office
1999 Harrison Street, Suite 500
Oakland, CA 94612
510.302.6300 Phone
510.433.0830 Fax

Chain of Custody Record No. 9933

BAL Report 1703055

Lab PO#: 1132998

Lab: BROOKS APPLIED

Project name: RFS PHASE V

TtEMI technical contact: DEBORAH KITSAL

Field samplers: DAYNA ARAGON, JASON BRODERSEN

Project (CTO) number: 1035225329.02

TtEMI project manager: JASON BRODERSEN

Field samplers' signatures:

Sample ID	Point ID/Depth	Date	Time	Matrix	MS / MSD	No./Container Types: 40 ml VOA	1 liter Amber	500 ml Poly	Sleeve	Glass Jar	250 ml Poly	Encore	PLASTIC JAR	Preservative Added: None	Analysis Required: VOA	SVOA	Pest	Metals	TPH Purgeables	TPH Extractables	PCB	MEHG
WSM01 20170118		1/18/17	0800	SEDIMENT									1									
WSM02			0805										1									
WSM03			0810										1									
WSM04			0815										1									
WSM05			0820										1									
WSM06			0825										1									
WSM07			0830										1									
WSM08			0845										1									
WSM09			0900										1									
WSM10			0915										1									
WSM11			0910										1									
WSM12			0915										1									

	Name (print)	Company Name	Date	Time
Relinquished by:	Dayna Aragon	Tetra Tech	1/19/17	1700
Received by:	Jen Wehn	BAL	1/20/17	0930
Relinquished by:				
Received by:				
Relinquished by:				
Received by:				

Turnaround time/remarks: HOLD ALL ANALYSES UNTIL FURTHER NOTICE

Fed Ex #:

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Tetra Tech EM Inc.
Oakland Office
1999 Harrison Street, Suite 500
Oakland, CA 94612
510.302.6300 Phone
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Chain of Custody Record No. 9934

BAL Report 1703055

Lab PO#: 1132998

Lab: BROOKS APPLIED

Project name: RFS PHASE V

TtEMI technical contact: DEBORAH KITSAL

Field samplers: DAYNA ARAGON, JASON BRODERSEN

Project (CTO) number: 103S225329.02

TtEMI project manager: JASON BRODERSEN

Field samplers' signatures:

Sample ID	Point ID/Depth	Date	Time	Matrix	MS / MSD
WSM13 20170118		1/18/17	0920	SEDIMENT	
WSM14			1100		
WSM15			1105		
WSM16			1110		
WSM17			1115		
WSM18			1130		
WSM19			1135		

No./Container Types

40 ml VOA	1 liter Amber	500 ml Poly	Sleeve	Glass Jar	250 ml Poly	Encore	PLASTIC JAR
							1
							1
							1
							1
							1
							1
							1

Preservative Added: None

Analysis Required

VOA	SVOA	Pest	Metals	TPH Purgeables	TPH Extractables	PCB	MEHG

	Name (print)	Company Name	Date	Time
Relinquished by:	Dayna Aragon	Tetra Tech	1/19/17	1700
Received by:	Jen Walker	BAL	1/20/17	0930
Relinquished by:				
Received by:				
Relinquished by:				
Received by:				

Turnaround time/remarks:

HOLD ALL ANALYSES UNTIL FURTHER NOTICE

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CHAIN OF CUSTODY

Curtis & Tompkins Laboratories
ENVIRONMENTAL ANALYTICAL TESTING LABORATORY
In Business Since 1878

2323 Fifth Street
Berkeley, CA 94710

Phone (510) 486-0900
Fax (510) 486-0532

Chain of Custody # _____

C&T LOGIN # 285489

Project No: ~~113778~~ 103522329.02
Project Name: RFS Phase V
Project P. O. No: 113778
EDD Format: Report Level ☐ II ☐ III ☒ IV
Turnaround Time: ☐ RUSH _____ ☒ Standard

Sampler: Dayna Aragon
Report To: Jason Brodersen
Company: TetraTech
Telephone: 510-302-6300
Email: jason.brodersen@tetratech.com

Lab No.	Sample ID.	SAMPLING Date Collected	SAMPLING Time Collected	MATRIX Water	MATRIX Solid	MATRIX Pore water	# of Containers	CHEMICAL PRESERVATIVE HCl	H2SO4	HNO3	NaOH	None	ANALYTICAL REQUEST Metals 6020/7471 +
	WSM0120170118	1/18/17	0800			X	1			X			X
	WSM02		0805				1			X			X
	WSM03		0810				1			X			X
	WSM04		0815				1			X			X
	WSM05		0820				1			X			X
	WSM06		0825				1			X			X
	WSM07		0830				1			X			X
	WSM07DUP 20170118		0833				1			X			X
	WSM08 20170118		0845				1			X			X
	WSM09		0850				1			X			X
	WSM10		0905				1			X			X
	WSM11		0910				1			X			X
	WSM12		0915				1			X			X

Notes:
+ see list of chemicals in PO.
Samples 0.45um filtered prior to preservation.
Sample date/time is when sediment was field collected.

SAMPLE RECEIPT
☐ Intact
☐ Cold
☐ On Ice
☐ Ambient

RELINQUISHED BY:
Dayna — DATE: 1/18/17 TIME: 1515
[signature] — DATE: 1/24/17 TIME: 900
DATE: TIME:

RECEIVED BY:
[signature] — DATE: 1/18/17 TIME: 1515
[signature] — DATE: 1/24/17 TIME: 10:30
DATE: TIME:

* A filter blank sample has been included with the samples. Only analyze upon Tetra Tech request

CHAIN OF CUSTODY

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ENVIRONMENTAL ANALYTICAL TESTING LABORATORY
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Fax (510) 486-0532

Chain of Custody # _____

C&T LOGIN # 285489

Project No: 1035225329.02
Project Name: RFI Phase V
Project P. O. No: 1133778
EDD Format: Report Level ☐ II ☐ III ☒ IV
Turnaround Time: ☐ RUSH _____ ☒ Standard

Sampler: Dayna Aragon
Report To: Jason Broderick
Company: Tetra Tech
Telephone: 510 302 6300
Email: jason.broderick@tetratech.com

Lab No.	Sample ID.	SAMPLING		MATRIX			# of Containers	CHEMICAL PRESERVATIVE					ANALYTICAL REQUEST: Metals (6020/7471A)
		Date Collected	Time Collected	Water	Solid	Per Lab		HCl	H2SO4	HNO3	NaOH	None	
	WSM13 20170118	1/18/17	0920			X	1			X			X
	WSM14		1100				1			X			X
	WSM15		1105				1			X			X
	WSM16		1110				1			X			X
	WSM17		1115				1			X			X
	WSM17 DUP 20170118		1118				1			X			X
	WSM18 20170118		1130				1			X			X
	WSM19 20170118		1135				1			X			X

Notes:
Samples 0.45 um filtered prior to preservation + see list of chemicals in PO.

sample date/time is when sediment was field collected

SAMPLE RECEIPT
☐ Intact
☐ Cold
☐ On Ice
☐ Ambient

RELINQUISHED BY:
Dayna — DATE: 1/18/17 TIME: 1515
[signature] — DATE: 1/20/17 TIME: 900
DATE: TIME:

RECEIVED BY:
[signature] — DATE: 1/20/17 TIME: 1515
[signature] — DATE: 1/24/17 TIME: 10:30
DATE: TIME:

* A filter blank sample has been included with the samples. Only analyze upon Tetra Tech's request.

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Chain of Custody Record No. 7180

Project name: RFS Phase V	**Lab PO#:** to follow	**Lab:** Brooks Applied
Project (CTO) number: 103582533 29.02	**TtEMI technical contact:** Deborah Kittal	**Field samplers:** Dayra Arayn, Jason Bredersen
	TtEMI project manager: Jason Bredersen	**Field samplers' signatures:**

Sample ID	Sample Location (Pt. ID)	Date	Time	Matrix	MS / MSD	40 ml VOA	1 liter Amber	500 ml Poly	Sleeve	Glass Jar	250 mL preserved HNO3	VOA	SVOA	Pest/PCBs	Metals	TPH Purgeables	TPH Extractables	HEI
WSM01 20170118		1/18/17	0800	pore water							1 X							X
WSM02			0805								1 X							
WSM03			0810								1 X							
WSM04			0815								1 X							
WSM05			0820								1 X							
WSM06			0825								1 X							
WSM07			0830								1 X							
WSM07DUP20170118			0833								1 X							
WSM08 20170118			0845								1 X							
WSM09			0900								1 X							
WSM10			0905								1 X							
WSM11			0910								1 X							X

	Name (print)	Company Name	Date	Time
Relinquished by:	Dayra Arayn	Tetra Tech	1/19/17	1515
Received by:	Torrin Campbell	PER	1/19/17	1515
Relinquished by:	Mike McElroy	PER	1/26/17	900
Received by:	Lauren Blaiwes	BAL	1/27/17	940
Relinquished by:				
Received by:				

Turnaround time/remarks:

pore water extracted via centrifugation at Pacific Ecorisk
Archive all samples until further notice!

- Samples 0.45um filtered prior to preservation w/ HEI
- sample date/time is when sediment was field collected.

Fed Ex #: *A filter blank sample has been included with the samples. Only analyze upon Tetra Tech's request.

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San Francisco Office

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San Francisco. CA 94105
415-543-4880
Fax 415-543-5480

Chain of Custody Record No. 7179

Lab PO#: to follow

Lab: Brooks Applied

Project name: Joe Pagel

TtEMI technical contact:

Field samplers: DA, JB

Project (CTO) number:

TtEMI project manager:

Field samplers' signatures: Dayna JP2

Sample ID	Sample Location (Pt. ID)	Date	Time	Matrix	MS / MSD	No./Container Types: 40 ml VOA	1 liter Amber	500 ml Poly	Sleeve	Glass Jar	250 ml preserved poly	Preservative Added: HCl	Analysis Required: VOA	SVOA	Pest/PCBs	Metals	TPH Purgeables	TPH Extractables	Methyl
WSM12 20170118		1/18/17	~~0800~~ 0801	Seawater							1								x
WSM13			0805 0820								1								
WSM14			0810 0900								1								
WSM15			0815 1105								1								
WSM16			0820 1110								1								
WSM17			0825 1115								1								
WSM17 DUP 20170118			0830 1118								1								
WSM18 20170118			0833 1130								1								
WSM19			0845 1135								1								
			~~0844~~																
			0																

	Name (print)	Company Name	Date	Time
Relinquished by: Dayna	Dayra Araya	Tetra Tech	1/18/17	1515
Received by:	Torrin Campbell	PER	1/1/17	1515
Relinquished by:	Mike McElroy	PER	1/26/17	900
Received by: Lauren Blanchard	Lauren Blanchard	BAL	1/27/17	~~958~~ 940
Relinquished by:				
Received by:				

Turnaround time/remarks:

pore water extracted via centrifugation at Pacific Ecorisk - Samples 0.45 um filtered prior to preservation w/ HCl

Archive all samples until further notice

- Sample date/time is when sediment was field collected.

Fed Ex #: * A filter blank sample has been included with the samples. Only analyze upon Tetra Tech's request.