Appendix J

Sediment and Water Quality Investigation Technical Report

ESA

LOS CERRITOS WETLAND RESTORATION PLAN PROGRAM ENVIRONMENTAL IMPACT REPORT

Sediment and Water Quality Investigation Technical Report

Prepared for
Los Cerritos Wetlands Authority

September 2019

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SECTION 1
Purpose and Scope of the Investigation

The purpose of this sediment and water quality investigation is to:

- Summarize and assess available data on the water and sediment quality within the Los Cerritos Wetland Complex (LCW) near-term program areas (Sections 2-4);
- Assess potential restoration program impacts (Section 5);
- Analyze the potential impact of flows from the watershed on the restoration program (Section 6); and
- Develop a framework for adaptive management and monitoring to address potential impacts (Section 7).

The proposed restoration will include excavation, regrading, and disposal of existing sediment. This report provides an overview of potential beneficial uses and restrictions at the program area based on the sediment characterization in order to inform subsequent phases of the design. This investigation provides a summary of prior sampling investigations; no additional water or sediment quality sampling has been performed as part of the current project. Next steps are identified in Section 8, including additional investigations to confirm suitability of sediment for reuse, upland disposal, or in-ocean disposal. Design specifications for sediment management will be developed during subsequent phases of the design based on the Program EIR and regulatory requirements.

Additionally, this report assembles pertinent information on groundwater and surface water quality as a basis for the analysis of potential water and sediment quality impacts. The report analyzes impacts of the program on the surrounding environment, as well as impacts of the watershed on the program area.

Because there is uncertainty in how the program and the surrounding environment will interact, this report provides a framework for developing an adaptive management and monitoring plan. This plan will allow for the program proponents to monitor, assess, and manage potential water and sediment quality impacts to biological resources and human health from and to the project after construction. The plan will include adaptive management measures that would be taken if impacts are identified based on multiple lines of evidence.

1.1 Site Background

Until the late 1800s, the LCW spanned approximately 2,400 acres and consisted of a network of meandering streams, vegetated wetlands, and upland areas. Historically, the project area was almost entirely (88.5%) tidal vegetated wetland, with a few natural streams and intertidal flat channels in both the north and the south (Figure 1-1).

Beginning in the late 1800s, the site began to undergo significant alterations due to agriculture (cattle and beet farming), the demands of a growing population, and oil production. Oil was first discovered at the LCW at the Long Beach Oil Field in 1921 and at the Seal Beach Oil Field shortly after. The development of oil production operations, paired with channelization of the San Gabriel River, resulted in substantial dredge and fill of the LCW. The program area contains oil wells, and network of oil-production tanks and pipes. Today, nearly all of the program area has been converted from its historic wetland habitat, though a few remnant and degraded historic habitats remain. Given the history of the LCW land use, sediment contamination at the site is an important consideration for restoration.

SOURCE: ESRI,LCWA, SFEI

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Figure 1-1
Historic Ecology

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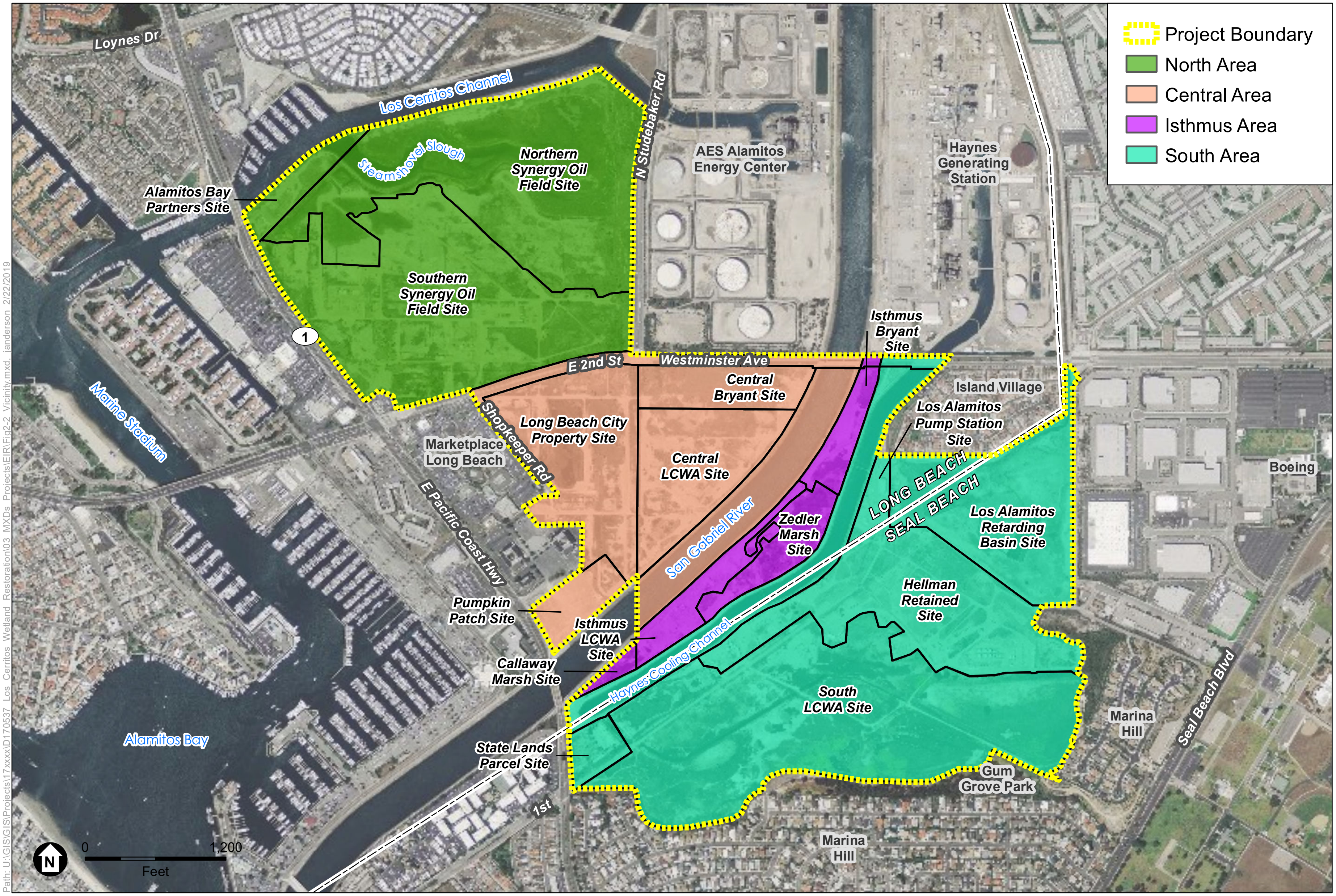
SECTION 2
Sediment Quality Within the Program Area

Sediment sampling and water quality monitoring at the LCW has occurred since the late 1980s. This section summarizes soil sampling that has been performed in three areas within the program boundaries: the Central Area, South Area, and Isthmus Area. These areas are identified in Figure 2-1. Table 2-1 below identifies the report title, date, and corresponding program area reviewed in Sections 2 and 3 of this investigation.

TABLE 2-1
PRIOR SEDIMENT AND GROUNDWATER SAMPLING REPORTS

Report	Date	Location
International Technology Corporation Phase 1 Environmental Assessment of Bryant (Texaco) Property	1988	Central Area/Isthmus Area
Earth Technology Corporation Site Investigation at Texaco Bryant Lease	1988	Isthmus Area
Engineering Enterprises, Inc. (EEI) Report of Preliminary Subsurface Environmental Assessment	1989	Central Area/Isthmus Area
Camp Dresser & McKee Inc. Environmental Audi, Texaco-Bryant Lease	1991	Central Area/Isthmus Area
Camp Dresser & McKee Inc. Phase II Environmental Assessment	1991	Central Area/Isthmus Area
Anchor Environmental, LLC Hellman Ranch Supplemental Environmental Site Investigation	2004	South Area
Anchor Environmental, LLC Hellman Ranch Groundwater Assessment	2006	South Area
Pacific Coast Environmental Conservancy (PCEC) Assessment of PAHs, PCBs, and Pesticides in Sediment from Zedler Marsh and the State Lands Parcel at Los Cerritos Wetlands	2014	Isthmus Area (Zedler Marsh)



SOURCE: Mapbox, LCWA

Los Cerritos Wetlands Restoration Plan Program EIR

Figure 2-1
Project Site and Local Vicinity

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2.1 Overview of Prior Studies

The following section provides a general summary of the soil sampling activities and recommendations at each of the LCW Complex Locations (Central Area, Isthmus Area, and South Area). A more detailed analysis of six sediment investigations between 1988 and 2014 are provided in Section 2.3. More detail on groundwater results is included in Section 3.

2.1.1 Central Area and Isthmus (Former Texaco-Bryant Lease)

Though full restoration of the Isthmus LCWA site (central property on the Isthmus) is not anticipated until the long-term phase of the LCW program, historically the Central LCWA site and Isthmus LCWA site were owned jointly under the Texaco-Bryant Lease, and past environmental assessments have occurred across the entire program area. Two Phase 1 Environmental Site Assessments (ESAs) have been performed at the Central LCWA, Isthmus LCWA, Zedler Marsh, and Isthmus Bryant sites.

The first Phase I ESA, performed by International Technology Corporation in 1988, evaluated 180 soil borings extracted at 2-foot and 10-foot depths for benzene, toluene, ethyl benzene, xylene (BTEX), and metals. The primary result of this sediment investigation were metal “hot spots”, or zones of elevated barium, lead, and chromium concentrations, determined by mapping the metal concentrations as contours. In addition to these zones, the investigation also found toulene and xylene at three of the sediment sample locations. Based on these results, International Technology Corporation recommended a more specific evaluation of these hot spots and BTEX findings in a Phase II investigation.

The second Phase I ESA was performed at a former sump location on the Isthmus LCWA site. The Phase I report (The Earth Technology Corporation, 1988) evaluated the extent of hydrocarbons in groundwater and soil directly adjacent to the former 404-gallon concrete sump location. The Phase I report evaluated soil and groundwater samples from three monitoring wells for total petroleum hydrocarbons[1] (TPHC) and BTEX and found TPH levels as high as 320 milligram/kilogram (mg/kg) in the soil sampling. The presence of both BTEX and TPHC was also noted in the groundwater samples.

Following these initial Phase I ESAs, additional subsurface environmental assessments were performed to further evaluate the soil and groundwater quality within the Texaco-Bryant lease (Central LCWA, Isthmus LCWA, Isthmus Bryant, and Zedler Marsh areas).

In 1989, Engineering Enterprises, Inc. (EEI) performed a subsurface environmental assessment on behalf of Kaufman and Broad of Southern California, who were interested in redeveloping the Texaco-Bryant parcel. Their investigation reviewed prior investigations, aerial photography, and

1 Total petroleum hydrocarbons (TPHC) is an umbrella term used to describe several hundred chemical compounds derived from crude oil and petroleum products. These include hexane, benzene, toluene, xylene, naphthalene fluorine. TPHC are grouped into sub-groups or fractions based on similar characteristics in water and soil. These fractions include aromatic compounds (primarily gasolines and middle distillates), field additives (gasolines), polycyclic aromatic compounds (middle distillates and residual fuels).

regulatory agency records. Additionally, EEI drilled 32 soil borings, 10 of which were used for groundwater monitoring wells, and collected 55 soil samples, five surficial soil grabs, and sixteen groundwater samples. The sampling found elevated levels of total petroleum hydrocarbons and moderate to low levels of total fuel hydrocarbons. The report notes that these elevated concentrations were found primarily on the eastern portion of the Isthmus site (Isthmus Bryant) and concentrations decreased with depth. The EEI report recommended some remedial activity, though "the actual activities have not been determined." Furthermore, the environmental assessment recommended the development of a work plan prior to site development.

In April 1991, Camp Dresser and McKee (CDM) provided an Environmental Audit to further determine potential areas and sources of contamination. The 1991 CDM report found 23 former sumps and three former tank farm locations within the Texaco Bryant Lease (Central LCWA Isthmus LCWA, Isthmus Bryant, and Zedler Marsh areas), and recommended further soil and groundwater monitoring to obtain more information on potential contamination in the vicinity of these former oil operations.

Following their April Environmental Audit, CDM completed a Phase II Environmental Assessment in November 1991. The Phase II Environmental Assessment performed by CDM evaluated 25 former sumps and 4 former tank farms on the Central LCWA/Isthmus LCWA, Isthmus Bryant, and Zedler Marsh sites. CDM evaluated Total Recoverable Petroleum Hydrocarbons (TRPH) in excess of 1000 mg/kg at 16 of the 25 former sumps and three of the four former tank sites. The analysis estimated approximately 15,000 cubic yards of soil with TRPH concentrations greater than 1000 mg/kg. Multiple metal samples showed levels greater than 10 times the STLC, but subsequent wet-extraction testing produced only one sample of lead that was found to have a soluble lead concentration of 5 mg/L, which is the STLC limit. The Phase II investigation also included a biotreatability study that evaluated the potential of biodegradation at the site. Final recommendations from the Phase II report included a pilot study on biodegradation to assess the feasibility, remedial action, and a groundwater sampling plan.

In December 2014, the Pacific Coast Environmental Conservancy (PCEC) completed an assessment of PAHs, PCBs, and pesticides in soil samples taken from Zedler Marsh and the State Lands Parcel site. The study took samples at 10 different locations (8 in Zedler Marsh and 2 in the State Lands Parcel site) and found that "all contaminant levels analyzed exhibited very low concentrations" and recommended that Zedler Marsh and the State Lands site be protected and restored.

2.1.2 South Area

In 2004 Anchor Environmental, CA, L.P. prepared a supplemental Environmental Site Investigation in the South LCWA site (formerly Hellman Ranch) on behalf of the California State Coastal Conservancy. The investigation evaluated metals, pesticides, polychlorinated biphenyls (PCBs), and polycyclic aromatic hydrocarbons (PAH) of both low and high molecular weight from 19 different borings taken at 12 former sumps and an additional 14 samples taken in "open" (non-sump) areas. The supplemental site investigation "raised issues in regards to potential contaminants that may interfere with the biological success of wetland creation and upland restoration at Hellman Ranch due to elevated metal and pesticide concentrations above ecological risk levels and free-product petroleum contamination found floating on top of the groundwater table." Anchor Environmental recommended that an Ecological Risk Assessment should be conducted at the site to understand risks associated with future project habitats.

Following their 2004 assessment, Anchor Environmental (2006) performed a follow-up groundwater assessment on the South LCWA site to further characterize and understand an area on the southwestern edge of the property that was identified in the initial assessment as containing crude, shallow subsurface oil. This investigation characterized the former dump site materials, defined the lateral extent of the crude oil found in the 2004 investigation, identified potential sources of the oil, evaluated the groundwater flow directional, and analyzed the crude oil to assess the potential effects of migration to receiving waters. The study determined that the extent of the crude oil is approximately 100 feet wide by 500 feet long, with crude oil found in 3-6-inch-thick bands at depth varying from approximately 12-14 feet below ground surface.

2.2 Comparison Criteria

This section provides an overview of the three criteria used to assess sediment quality at the LCW: hazardous waste, ecological criteria, and human health. First, the sediment constituent concentrations were compared to the hazardous waste criteria, which severely restricts reuse, placement, and disposal of excavated materials. Next, ecological criteria were evaluated to determine any potential effects on the restored habitat if these materials were to be exposed and/or used for re-grading. Finally, as the most conservative estimate of the sediment quality, the constituent concentrations were compared to residential health criteria. Soil constituents found below the human health residential standards have the greatest flexibility for reuse, placement, and disposal.

It is important to note that although the individual chemical constituents of TPHC often have thresholds associated with hazardous waste disposal, ecological criteria, and human health, TPHC itself does not. There are no regulations or guidelines promulgated by the federal government for TPHC. Many of the studies summarized in Section 2.3 report TPHC values but do not provide additional information on the sub-fraction or constituent chemicals. This presents a challenge in discussing the potential risks associated with TPHC levels at the LCWA site. It is recommended that the program consider any new regulations or guidelines on TPHC levels as they are developed.

2.2.1 Hazardous Waste

The California state hazardous waste material disposal thresholds, Total Threshold Limit Concentrations (TTLC) and Soluble Threshold Limit Concentrations (STLC), were used to evaluate the hazardous waste criteria for sediment at the LCW. The TTLC value for each constituent is the upper limit allowed in a solid or powdered waste to possibly be considered non-hazardous; any constituent that exceeds the promulgated TTLC values are considered toxic hazardous waste. Similarly, the STLC value is the maximum concentration of a waste constituent in liquid form to not be considered hazardous. If a solid waste sample falls between the STLC and TTLC value, it is considered non-hazardous if the concentration is less than ten times the STLC value. If the measured concentration exceeds ten times the STLC, it is likely hazardous but the optional "Waste Extraction Test (WET)" can be performed to determine whether the sample is considered hazardous. Hazardous waste material criteria dictate which facility or treatment is required for disposal of hazardous material.

2.2.2 Ecological Criteria

Effects Range-Low and Effects Range-Median Values

Effect range (ER) values are used in dredged material evaluations for ocean disposal. These values were developed by Long et al. (1995), and are helpful in assessing the potential significance of elevated sediment-associated constituents of concern, in conjunction with biological analyses. These values were developed from a large data set where results of both benthic organism effects (e.g., toxicity tests, benthic community effects) and chemical analysis were available for individual samples. To derive the effect range low (ER-L) and effect range median (ER-M) guidelines, the chemical values for paired data demonstrating benthic impairment were sorted according to ascending chemical concentration. The ER-L was then calculated as the lower tenth percentile of the observed effects concentrations and the ER-M as the 50th percentile of the observed effects concentrations. For dredged material evaluations, the ER-L and ER-M are used in conjunction with bioassay testing. No prior sampling at the LCW included bioassay testing (i.e., measurement of the concentration or potency of a substance by its effect on living cells or tissues). In this report, ER-L and ER-M values are used as the representative ecological criteria, but future bioassay testing should be considered to better understand the effects of soil quality on ecology at the LCW Complex.

Beneficial Reuse Criteria for Wetland Restoration

These criteria were first developed by the San Francisco Bay Regional Water Quality Control Board (SFBRWQCB) and presented in the Draft Staff Report entitled, *Beneficial Reuse of Dredged Materials: Sediment Screening and Testing Guidelines* dated May 2000. The document was prepared to assist in planning beneficial reuse projects in the Bay Area by establishing general screening guidelines and general sediment testing requirements. The guidelines include specific criteria for reuse of sediments in wetland and upland beneficial uses. The guidelines for the wetland foundation use are based on the ER-M concentrations (Long et. al., 1995). Ambient concentrations in the San Francisco Bay were used to develop the guidelines for re-use of sediments for wetland surface. These guidelines are to be used in combination with bioassay testing to determine suitability of the materials for use in wetland restoration projects (SFBRWQCB, 2000).

Additional ambient sediment chemical and toxicity testing were performed following the Draft Staff Report in 2000. A statistical analysis was performed on the historical and more recent analytical data to develop a statically derived set of recommended sediment chemistry screening guidelines for beneficial reuse. The results of this analysis and recommended guidelines were presented in *An Evaluation of Existing Sediment Screening Guidelines for Wetland Creation/Beneficial Reuse of Dredged Material in the San Francisco Bay Area along with a Proposed Approach for Alternative Guideline Development* (Germano & Associates, 2004), which was funded by the California State Coastal Conservancy. The recommended guidelines presented in the 2004 report are based on the Floating Percentile Method for predicting acute amphipod toxicity. These guidelines presented in the 2004 Germano & Associates report, therefore, can be applied to sites outside of the Bay Area as they are based on toxicity testing results rather than ambient concentrations in San Francisco Bay. These guidelines are presented in the results summary tables (Appendix A) to compare with constituent concentrations in sediment to assess the suitability of these materials for wetland surface and foundation beneficial uses.

2.2.3 Human Health Criteria

Environmental Screening Levels (ESLs), developed and maintained by the SFBRWQCB, are used by regulatory agencies throughout the state of California. The SFBRWQCB develops separate screening levels for residential and commercial/industrial land uses and construction worker exposure. As the board notes, the residential ESLs are the most stringent thresholds, and soil “with chemical concentrations below these levels generally would not require remediation and would be suitable for unrestricted uses if disposed offsite” (SFBRWQCB 2019). In addition to ESLs, constituent concentrations were compared to Regional Screening Levels (RSLs), which were previously referred to as Preliminary Remediation Goals (PRG), as promulgated by the U.S. Environmental Protection Agency (EPA).

2.3 Analysis of Prior Studies

This section provides a more detailed review of the prior sediment investigations. When possible, the results of each study is compared to current hazardous waste, ecologic, and human health criteria (Section 2.2). This comparison can help inform decisions about the excavation, placement, and treatment of sediment at the site. Tables that compare the sediment samples to hazardous waste, ecological, and human health criteria are found in Appendix A.

2.3.1 Results of the Phase 1 1988 International Technology Corporation Environmental Assessment

As part of the Phase I Environmental Assessment of the Texaco-Bryant lease property (Central Area and Isthmus Area), International Technology Corporation performed 180 soil borings (157 at 2 feet below ground surface [bgs] and 23 at 10 feet bgs). The samples were taken at the Central LCWA, Isthmus LCWA, Zedler Marsh, and Isthmus Bryant locations. The shallow samples were tested for arsenic, barium, chromium, lead, and vanadium. In addition to metals, the deeper borings were also sampled for BTEX at 5- and 10-foot depths. Tables showing the results of the sediment sampling compared to each threshold criteria can be found in Appendix A.

Comparison to Hazardous Waste Material

Metal concentration did not exceed promulgated TTLC standards, though multiple samples exceeded 10 times the STLC standard for every constituent. Most samples exceeded 10 times the STLC standard for chromium, though a "Waste Extraction Test (WET)", was not performed during the investigation. Though samples in exceedance of ten times the STLC value are likely hazardous, because no WET test was performed, the samples cannot be conclusively declared hazardous. Based on the elevated metal concentrations, the report created contour maps showing delineated zones where metal concentrations exceeded "background concentrations." The barium, chromium, and lead concentration isoline figures are shown as Figures 2-2 through 2-4 below. There are no TTLC or STLC standards for BTEX (Appendix A, Table A-1).

Comparison to Ecological Criteria

Multiple samples for lead, chromium, and arsenic exceeded both the ER-M and ER-L ecological criteria thresholds at all sampling depths (Appendix A, Table A-2). It is important to note, however, that marine sediments often exceed the arsenic criteria thresholds due to elevated ambient arsenic levels.

Comparison to Human Health Criteria

Multiple lead, arsenic, and vanadium samples exceeded the ESLs (Appendix A, Table A-3) for all sampling depths. BTEX constituents (specifically toluene and xylene) were detected in two locations (one on the Central LCWA, and one in Zedler Marsh). No concentrations of BTEX exceeded ESL thresholds.

Conclusion

The Phase I investigation showed exceedances across all criteria categories for the metal constituents at each of the sampling depths. While metal concentrations could not conclusively be declared hazardous, multiple samples were above ecological criteria and human heath criteria. If further testing confirms these results, sediments may need to be remediated or removed from the site before restoration can occur. Signal Hill Petroleum is responsible for soil remediation in this area.

Following the Phase I investigation, International Technology Corporation recommended a revised Phase II exploration program, with the primary objectives of corroborating low metal concentrations in samples from greater depths determining vadose zone soils and possible hazardous organics, and determining hazardous material concentrations in groundwater. The Phase II Investigation was performed in 1991 and is detailed in Section 2.3.4.

SOURCE: International Technology Corporation

Figure 2-2
Barium Concentration Isolines

SOURCE: International Technology Corporation

Figure 2-3
Chromium Concentration Isolines

SOURCE: International Technology Corporation

Figure 2-4
Lead Concentration Isolines

2.3.2 Results of the Phase 1 1988 Earth Technology Corporation Site Investigation at Texaco Bryant Lease

Earth Technology Corporation performed a soil and groundwater sampling investigation on the eastern bank of the San Gabriel River within the Texaco-Bryant lease property (the Central LCWA, Isthmus LCWA, Zedler Marsh, and Isthmus Bryant sites). The Earth Technology Investigation occurred following the removal of a 404-gallon concrete sump that had stored crude oil, lubricating oil, and rainwater. The Los Angeles County Department of Public Works (LACDPW) issued a permit to close the sump in 1987 and required soil and groundwater sampling around the former sump. In 1988, boreholes were drilled around the former sump location and sediment samples were taken every 5 feet (Figure 2-5). Two boreholes were converted to groundwater monitoring wells; the results of the groundwater sampling are discussed in Section 3.1.

The sampling tested soil samples for total petroleum hydrocarbons (TPHC) at varying depths below ground surface. Tables showing the results of the sediment sampling during the Phase 1 1988 investigation can be found in Appendix A (Tables A-4 and A-5).

Comparison to Hazardous Waste

There are no TTLC or STLC standards for BTEX or TPHC.

Comparison to Ecological Criteria

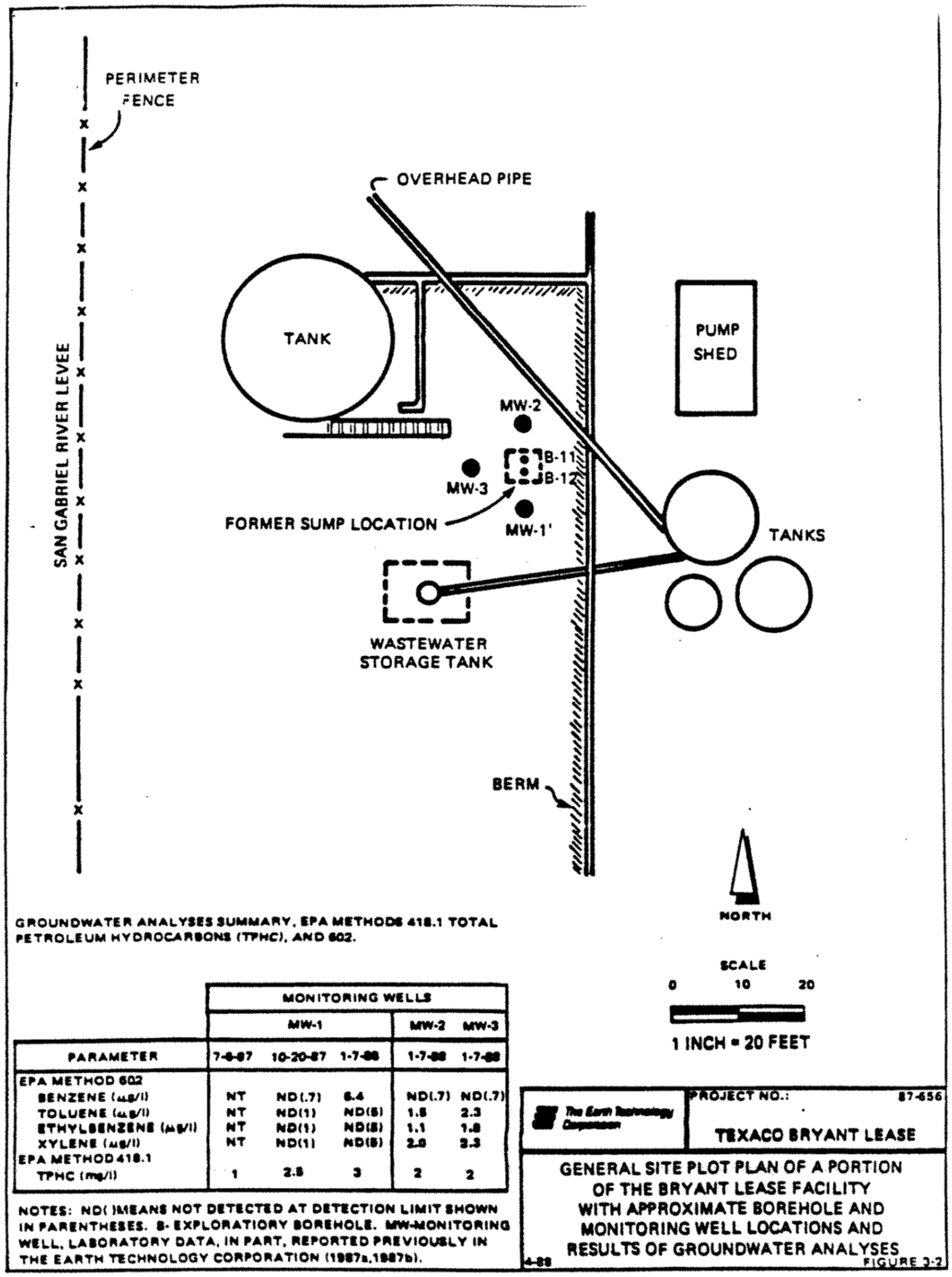
There are no defined ER-L or ER-M values for BTEX or TPHC.

Comparison to Human Health Criteria

Two soil samples exceeded the ESL TPHC standard of 100 mg/kg for gasoline and diesel constituents (3,300 mg/kg and 320 mg/kg).

Conclusions

There are no hazardous waste or ecological criteria for BTEX and TPHC, but both gasoline and diesel constituents exceeded the human health criteria in two samples. Based on the elevated concentrations of hydrocarbon in both soil and groundwater found during the 1988 sampling, Earth Technology proposed further soil and groundwater sampling to delineate the extent of contamination at the site. This additional sampling was completed in 1989 by Engineering Enterprises, Inc. (EEI) (Section 2.3.3) and in 1991 by CDM (Section 2.3.4). Signal Hill Petroleum is responsible for any site cleanup.



	MONITORING WELLS				
	MW-1			MW-2	MW-3
PARAMETER	7-8-87	10-20-87	1-7-88	1-7-88	1-7-88
EPA METHOD 602					
BENZENE (µg/l)	NT	ND(.7)	6.4	ND(.7)	ND(.7)
TOLUENE (µg/l)	NT	ND(1)	ND(5)	1.5	2.3
ETHYLBENZENE (µg/l)	NT	ND(1)	ND(5)	1.1	1.8
XYLENE (µg/l)	NT	ND(1)	ND(5)	2.0	3.3
EPA METHOD 418.1					
TPHC (mg/l)	1	2.5	3	2	2

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SOURCE: The Earth Technology Corporation 1988

Figure 2-5
1998 Earth Technology Corporation Site Investigation Soil Sample Location Map

2.3.3 Results of the 1989 Engineering Enterprises, Inc. (EEI) Environmental Assessment

EEI performed soil sampling and analysis on 55 samples collected between March and April 1989 in Central LCWA, Isthmus LCWA, Isthmus Bryant, and Zedler Marsh sites. The investigation evaluated semi-volatile compounds (SVOCs), TPHC, and total fuel hydrocarbons, and used the GC-FID response following EPA Method 8015 protocol to estimate BTEX.

Comparison to Hazardous Waste Criteria

There are no TCLP or STLC for BTEX, SVOCs, or TPHC.

Comparison to Ecological Criteria

There are no ER-L or ER-M criteria for BTEX, SVOCs, or TPHC.

Comparison to Human Health Criteria

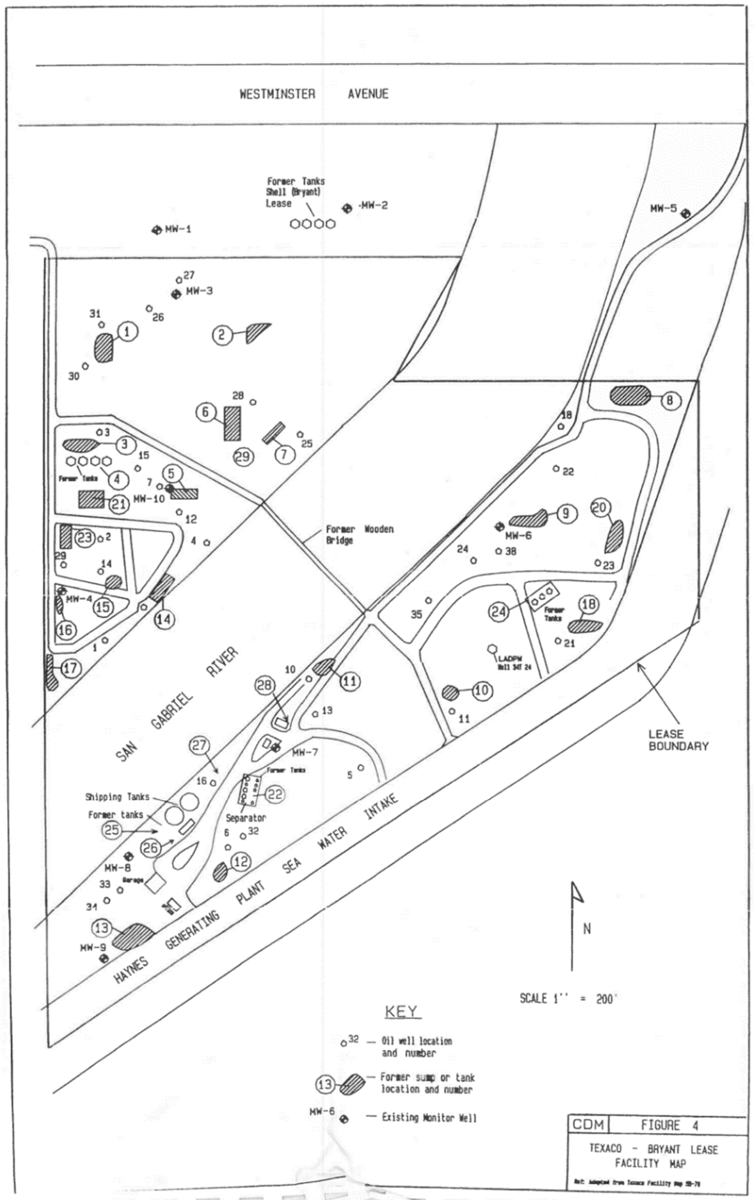
While most of the chemical screening values were below the level of concern for human health, there was at least one sample that exceeded ESL residential thresholds for benzene, toluene, ethyl benzene, and xylenes (Appendix A, Table A-6). EEI noted that elevated hydrocarbon levels were primarily limited to shallow samples in the eastern portion of the property (Isthmus Bryant). The highest concentration of TPHC was 189,568 mg/kg, which greatly exceeds the ESL standards of 100 mg/kg for gasoline, solvents, and diesel.

Conclusion

The results of the 1989 EEI analysis showed elevated levels of hydrocarbons in the shallow soils, most notably on the Isthmus Bryant area. All but one of the samples were below the human health criteria for BTEX, SVOCs, and TPHC, which is the most conservative criteria (no hazardous waste or ecological criteria exist for BTEX, SVOCs and TPHC). Hydrocarbon concentrations were found to decrease rapidly with depth. EEI concluded that the eastern portion of the site had elevated total petroleum hydrocarbon concentrations, "of limited lateral and vertical extent." The report further determined that some remediation activity would be necessary, though EEI did not determine the remediation activities or associated costs. Further analysis could inform necessary remediation prior to restoration.

2.3.4 Results of the 1991 Camp Dresser & McKee Inc. Phase II Environmental Assessment

In 1991, CDM took soil samples at 25 former sumps and 4 former tank farms within the Texaco Bryant Lease Oilfield (Central LCWA, Isthmus LCWA, Isthmus Bryant, and Zedler Marsh Area, Figure 2-6) as part of the Phase II Environmental Assessment. TRPH concentrations greater than 1000 mg/kg were found at 16 of the 25 former sump areas, and 1 of the 4 former tanks farms. Camp Dresser & McKee estimated approximately 15,000 cubic yards (cy) were contaminated with TRPH at concentrations greater than 1,000 mg/kg.



SOURCE: Camp Dresser & McKee, Inc. 1991

Figure 2-6
1991 Camp Dresser & McKee Inc. Soil Sample Location Map

Comparison to Hazardous Waste Criteria

There are no federal or state guidelines or regulations for TRPH. However, the report mentions that "the Los Angeles Regional Water Quality Control Board (LARWQCB) notes that petroleum hydrocarbon contaminated soils should be bio-remediated to acceptable levels as determined by the Executive Officer, but not exceeding 1,000 ppm (mg/kg)." Of the 71 total TRPH samples, 60 exceeded 1000 mg/kg (Appendix A, Table A-7).

In addition to TPRH, the assessment also evaluated metal concentrations. There were six locations with elevated metal concentrations (greater than 10 times STLC limits), but the subsequent WET extraction test showed that all of the samples were below the STLC limits with the exception of one soluble lead concentration, which was equal to the STLC thresholds of 5 mg/kl.

Comparison to Ecological Criteria

Multiple samples of arsenic, copper, lead, mercury, nickel, and zinc exceeded the ER-L thresholds. One sample of nickel exceeded the ER-M criteria (Appendix A, Table A-8).

Comparison to Human Health Criteria

ESL human health criteria were exceeded for arsenic and lead (Appendix A, Table A-9).

Treatability Studies

Camp Dresser & McKee performed a bio treatability study to determine the potential of soils to be treated through biodegradation. The study found that biodegradation of petroleum hydrocarbon-containing soils was feasible at the site and recommended a further pilot study to determine the time requirements.

Conclusion

The 1991 study showed multiple samples throughout the site that exceeded hazardous waste, ecological, and human health criteria. Note that the CDM investigation only took samples at former sump and tank farm locations, where constituent concentrations may be higher than other locations. These elevated concentrations may limit the suitability of placement or disposal if no additional remediation occurs. Based on the investigation, CDM estimated approximately 15,000 cubic yards of soil with TRPH concentrations greater than 1000 mg/kg. This concentration exceeds the TRPH criteria guidance outlines by the LARWQCB and if further testing confirms these elevated levels, sediments may need further remediation or removal prior to restoration. The positive results of the bio treatability study indicate that biodegradation may be a suitable remediation option to reduce the concentration of petroleum hydro-carbons on on-site soils.

2.3.5 Results of the 2004 Anchor Hellman Ranch (South LCWA) Soil and Groundwater Sampling

In 2003 and 2004 Anchor Environmental L.L.C. did a soil and groundwater investigation on the Hellman Ranch Property (South LCWA Site) to sample for metals, semi-volatile organics (PAHs, PCBs), volatile organics, TPH(diesel), and TPH(gas), including benzene, toluene, ethyl benzene, and xylenes/methyl-t-butyl ether (BTEX/MTBE). The soil sampling focused on 12 former sumpareas (nineteen borings) and “open”/non –sump areas (fourteen borings).

Anchor designed the soil and groundwater investigation field plan to both fill data gaps not addressed by earlier soil sampling and to evaluate the vertical and lateral extent of potential contamination to inform the placement and or remediation of existing soil for future restoration alternatives. To assess the vertical extent, composite soil samples were taken from the surface to

2 feet below ground surface and +1 to -1 mean lower low water (MLLW). Anchor notes that these intervals were chosen to assess contaminants that could be exposed in placement as wetland/upland material, and noted that if the ground surface elevation of a sampling location was at approximately +1 MLLW, only one composite sample to 2 feet below ground surface was taken.

Comparison to Hazardous Waste Material

Soil sampling in 2004 found the mean and maximum concentration of lead, 4,4”-DDE, 4-4”-DDT, and chlordane to exceed either the TTLC or ten times the STLC (Appendix A, Table A-10). No WET extraction test was performed.

Comparison to Ecological Criteria

Soil sampling found multiple analytes in exceedance of ER-L and ER-M criteria (Table B-11). Metals that exceeded ER-L thresholds included arsenic, copper, lead, mercury, nickel, zinc. Metals in exceedance of ER-L thresholds (arsenic, mercury, selenium) were found in both subsurface and surface samples both within sumps and in open areas. Organochloride pesticides found in exceedance of ER-L criteria were 4,4’-DDD, 4,4’-DDE, 4,4’-DDT, chlordane, and dieldrin. Though no high molecular weight PAHs were found at concentrations above ER-L limits, four lower weight PAHs (acenaphthene, flourene, naphthalene, and phenanthrene) were found above ER-L values. The maximum concentrations of lead, mercury, 4,4’-DDT, and chlordane across all samples also exceeded ER-M criteria. Figure2 2-7 through 2-9 show the locations where samples exceeded ER-L concentrations; though high levels of metals and pesticides were found throughout the site, PAH concentrations in exceedance of ER-L were limited to sumps.

Comparison to Human Health Criteria

The mean concentration across all samples of arsenic, chromium, 4,4’-DDE, chlordane, and dieldrin in exceedance of the ESLs. At least one sample also exceeded ESL criteria for benzo(a)pyrene, heptachlor epoxide, and 4,4’-DDD (Appendix A, Table A-12).

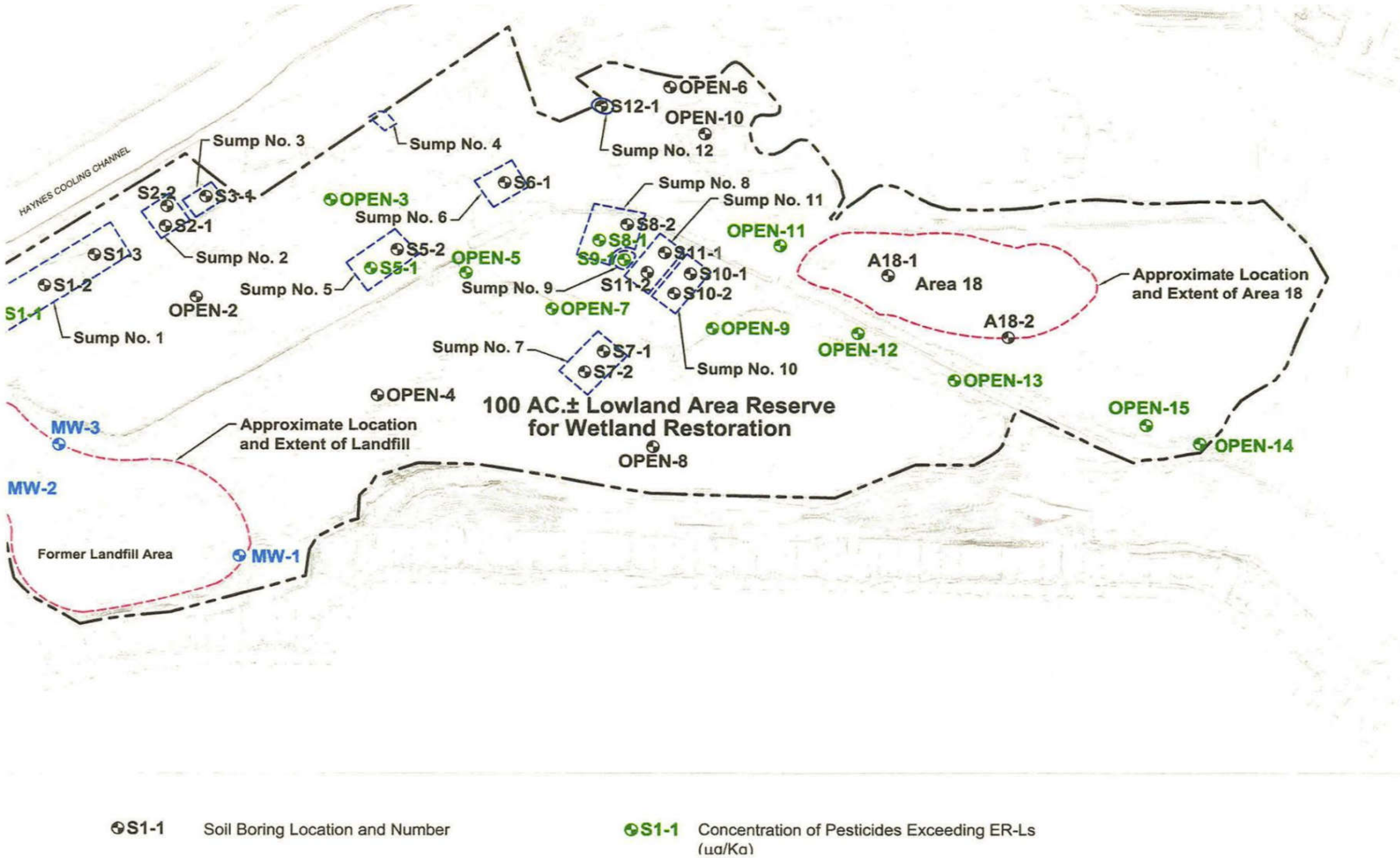
Comparison of Sampling Location and Depth

Statistical analyses related sampling location (sump or open) and depth (surface of subsurface) to analyte concentrations. An Analysis of Variance (ANOVA) was used to test whether any constituent was more likely to occur in a sump versus an open area. Results from the analysis indicated that elevated concentrations of PAHs, which are associated with crude oil, were significantly more likely to occur in sump zones than open areas. The location of elevated concentrations of TRPH, metals, pesticides, and PCBs were not statistically significant between sumps and open areas.

Comparison to Background Metal Concentrations

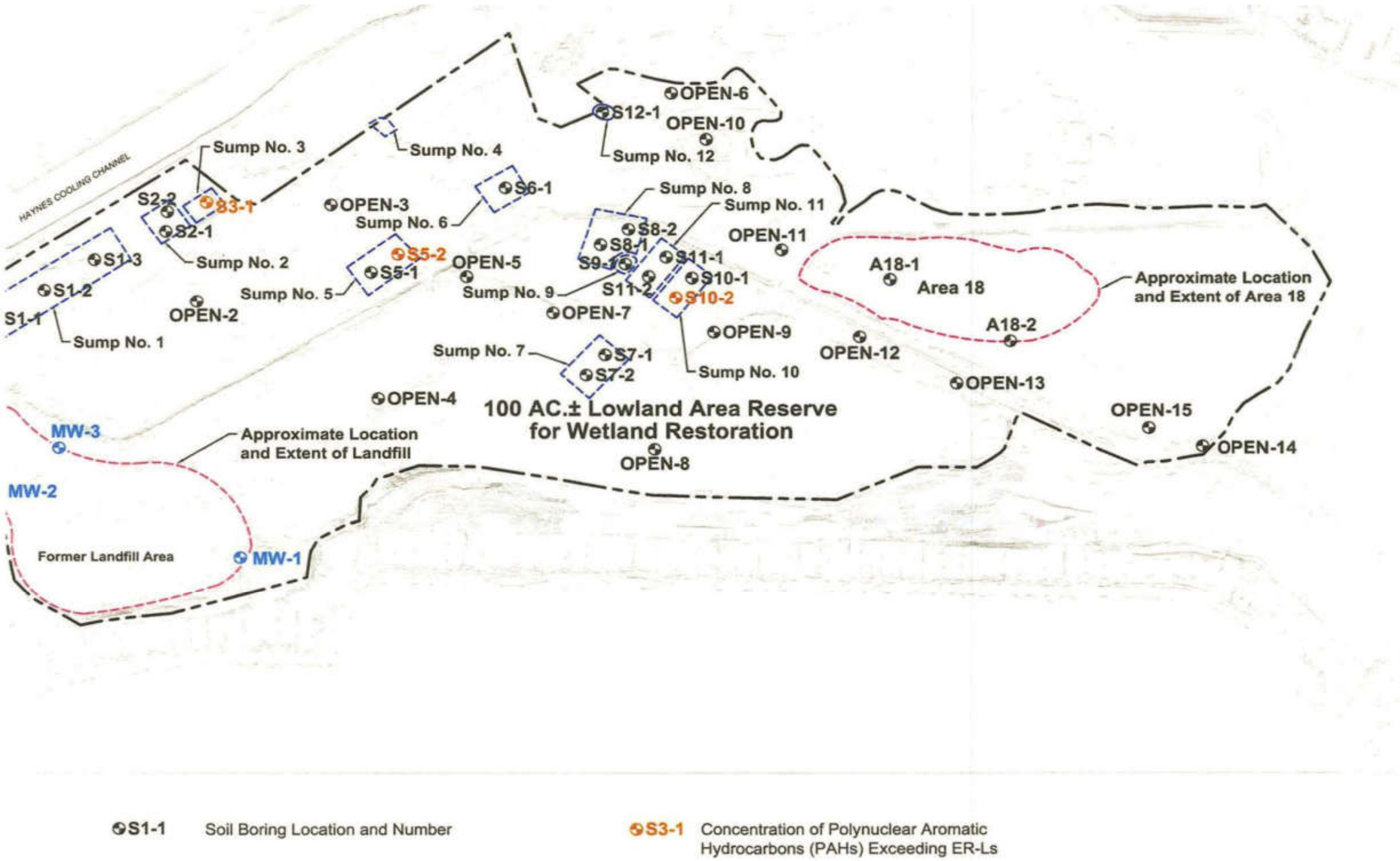
Metals naturally occur in marine sediment and soils; it is important to understand whether high observed metal concentrations are due to natural processes or the result of prior land use. To identify levels caused by anthropogenic activities, Anchor compared metal concentrations at the South LCWA property to background metal concentrations in typical California soils (Table 2-2).

The findings indicate that samples on the site with elevated concentrations of lead, arsenic, and selenium were generally above benchmark concentrations, but that chromium, copper, mercury, nickel, silver, thallium, and zinc were all within normal background concentration ranges.



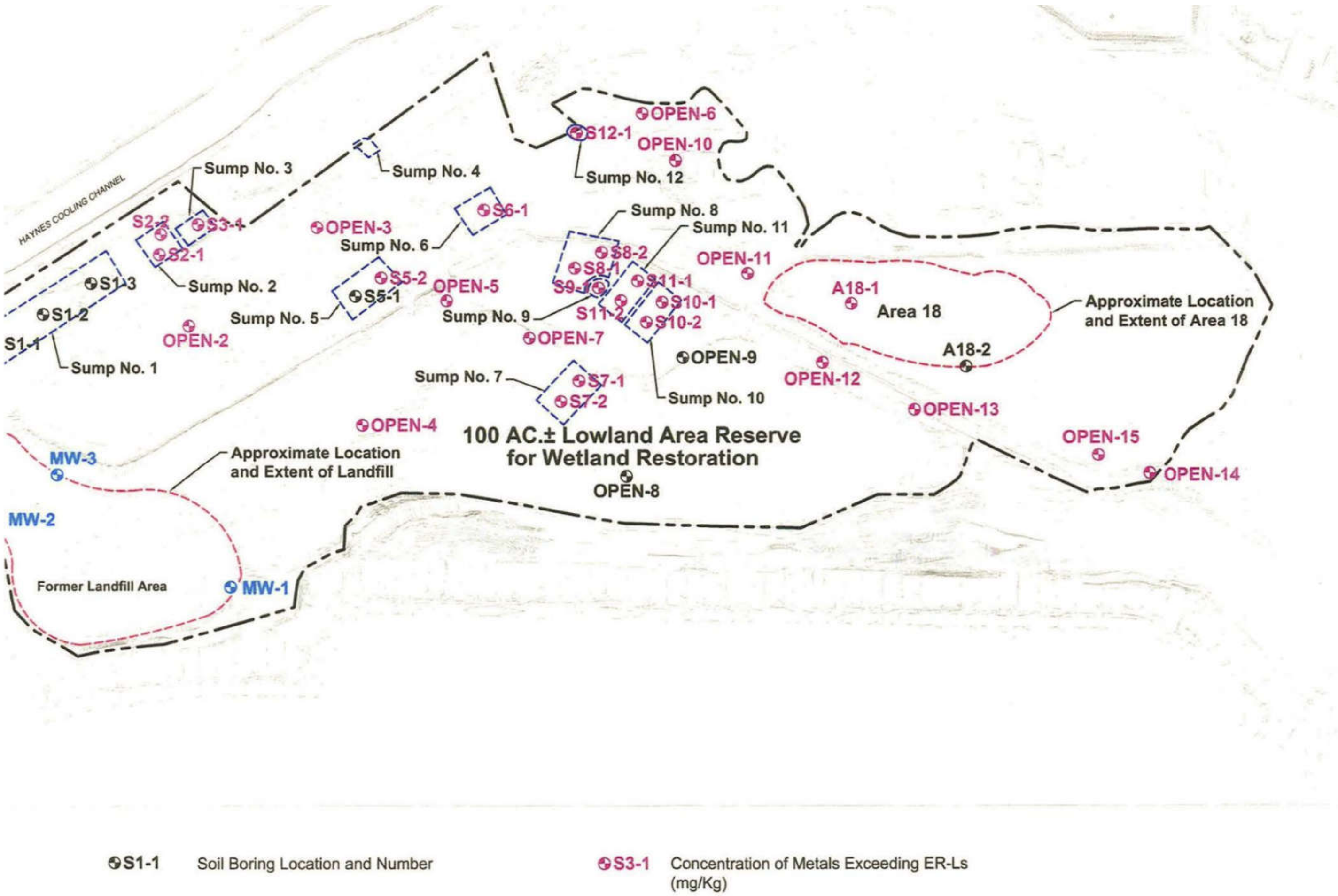
SOURCE: Anchor 2004

Figure 2-7
Concentrations of Pesticides Exceeding ER-Ls



SOURCE: Anchor 2004

Figure 2-8
Concentrations of PAHs Exceeding ER-Ls



SOURCE: Anchor 2004

Figure 2-9
Concentrations of Metals Exceeding ER-ls

TABLE 2-2
COMPARISON OF SOUTH LCWA SAMPLING (2004) TO BACKGROUND CONCENTRATIONS

	South LCWA Samples		Benchmark California Soils	
Analyte	Mean Concentration (mg/kg)	Max Concentration (mg/kg)	Mean Concentration (mg/kg)	Max Concentration (mg/kg)
Arsenic	**7.9**	**40**	3.5	11.0
Chromium (Total)	32.1	57.6	122.0	1579.0
Copper	**31.3**	65.5	28.7	96.4
Lead	**30.1**	**240.0**	23.9	97.1
Mercury	0.2	0.9	0.3	0.9
Nickel	24.9	49.1	57.0	509.0
Selenium	**0.4**	**1.3**	0.1	0.4
Silver	0.1	0.2	0.8	8.3
Thallium	0.2	0.5	15.7	36.2
Zinc	94.4	207.0	149.0	236.0

Note: Bold values in the table indicate concentrations above background metal concentrations in typical California soils

Correlation Analysis

Anchor evaluated the correlation of TRPH contaminated soils with different constituents. The strongest correlation found was between TRPH and PAHs and TRPH and lead ($r = 0.41$ and $r=0.36$). The study did not find a correlation between arsenic, mercury, and selenium and petroleum hydrocarbons.

Conclusion

Soil sampling at the South LCWA property showed exceedances of hazardous waste, ecological, and human health criteria for multiple constituents. Anchor found that the results of the 2004 sampling "raise issues in regards to potential contaminants that may interfere with the biological success of wetland creation and upland restoration at Hellman Ranch [South LCWA]." In particular, Anchor expressed concern that the metal concentrations above ER-L for both surface and subsurface soils, pesticide concentrations above ER-L values, and free-product petroleum contamination. Anchor recommended that a site-specific Ecological Risk Assessment be conducted to determine the potential ecological risks associated with restoration of the LCW site. This has not been done, to date. Further investigation of soils at the South LCWA property can better inform the steps necessary to ensure suitability prior to restoration.

2.3.6 Results of the 2014 Pacific Coast Environmental Conservancy (PCEC) Geotechnical Assessment

The Pacific Coast Environmental Conservancy (PCEC) performed an analysis of PAHs, PCBs, and pesticides in the Zedler Marsh and State Lands Parcel in 2014. PCEC evaluated contamination levels at 8 sampling locations within the Zedler Marsh and 2 within the State Lands Parcel. Sampling and contaminant evaluation was done at approximately 6 inches below the ground surface. The investigation analyzed the sediment samples for 25 different PAHs, 54 PCBs, and 30 chlorinated pesticides.

Comparison to Hazardous Waste Criteria

No samples exceeded TTLC or STLC standards.

Comparison to Ecological Criteria

Two samples found sediment concentrations above ER-M thresholds for acenaphthene and flourene. No samples exceeded ER-M thresholds.

Comparison to Human Health Criteria

Analysis of PCB concentrations for all ten samples indicate levels "well below normal ranges," based on the LARWQCB standards, for the 54 congeners of PCBs tested. The majority of samples had concentrations below the detection threshold. The PCH analysis returned samples that exceeded ESL thresholds for the following constituents: benzo(a)anthracene, benzo(a)pyrene, benzo(k)fluoranthene, benzo(b)fluoranthene, benzo(g,h,i)perylene, chrysene, fluoranthene indeno(1,2,3-c,d)pyrene, naphthalene, phenanthrene, and pyrene.

The investigation also compared current (2014) PAH concentrations to samples taken in approximately the same location from a Texaco 1995 study. Table 2-3 below compares the concentrations of TRPH from 1995 to the highest concentration PAH found during the 2014 sampling at the closest sampling locations. Sampling for chlorinated pesticides similarly resulted in many non-detections, with only two samples exceeding the ESL thresholds for dieldrin. All other samples were either not detected or below human health criteria levels.

TABLE 2-3
COMPARISON OF PAH CONCENTRATIONS IN 1995 AND 2014

2014 Sample	2014 Concentration (ppb)	1995 Sample	1995 TRPH Concentration (ppb)
ZM1	111.8	#4	25,600,000
ZM2	139.1	Sump #5	39,400,000
ZM3	11.7	Sump #10	50,000
ZM4	19.1	Sump #11	14,600,000
ZM5	1.7	Sump #18	5,100,000
ZM6	3.8	Sump #21	50,000
ZM7	4.9	#24	10,600,000
ZM8	130.5	Sump #23	6,200,000
SLP9	7.6	Sump #14	24,300,000
SLP10	19.7	#25	16,200,000

Conclusion

Though sampling did find a few samples that exceeded both ER-M and human health criteria, the study found that the concentrations of PAHs, PCBs, and pesticides found at Zedler Marsh and the State Lands Parcel “do not require remediation” prior to the restoration of the site. The data showed that PAHs in the area had been reduced significantly from the study performed by Texaco in 1995. This could be attributable to vegetation at the marsh, which may encourage degradation of PAHs. The study indicated that “Zedler Marsh and the State Lands Parcel are prime candidates for plant community restoration activities.” The report recommended maximum vegetation cover for the restoration. Significant decreases in PAH levels at Zedler Marsh are encouraging, as they may indicate reduced constituent concentrations across the program area since the results of the previous sampling efforts.

SECTION 3

Groundwater Quality Within the Program Area

The following Section provides an overview of three groundwater sampling investigations that have occurred within the program boundaries.

3.1 Results of the Phase 1 1988 Earth Technology Corporation Site Investigation at Texaco Bryant Lease

Earth Technology Corporation performed a soil and groundwater sampling investigation on the eastern bank of the San Gabriel River within the Texaco-Bryant lease property (the Central LCWA, Isthmus LCWA, Zedler Marsh, and Isthmus Bryant locations). Groundwater sampling evaluated TPHC and BTEX concentrations at three monitoring wells. Floating hydrocarbons (a floating layer of viscous crude oil) of approximately 1/8” thickness were found during sampling of monitoring well 1, and a sheen on the groundwater surface was noted during sampling at monitoring well 3.

Two groundwater samples exceeded the human health based groundwater ESL for benzene and ethyl benzene (Appendix A, Table A-4 and Table A-5). Based on the elevated concentrations of hydrocarbon in both soil and groundwater found during the 1988 sampling, Earth Technology proposed further groundwater sampling to delineate the extent of contamination at the site.

3.2 Results of the 1989 Engineering Enterprises, Inc. (EEI) Environmental Assessment

Engineering Enterprises, Inc. (EEI) performed groundwater sampling at ten different wells between March and April 1989 in the Central LCWA, Isthmus LCWA, Isthmus Bryant, and Zedler Marsh areas. The groundwater investigation yielded sixteen groundwater samples, which were evaluated for SVOCs, total fuel hydrocarbons, and BTEX using EPA Methods 8015 (modified) and 418.1. Six groundwater samples showed elevated concentrations of TPHC (ranging from 3,700 – 32,000 microgram/liter [ug/L]). Three samples had total fuel hydrocarbons greater than 250 ug/L, with the highest sample showing a concentration of 22,021 ug/L. At least one sample also exceeded ESL standards for BTEX.

The groundwater analysis found slightly elevated levels of TPHC in some of the sample wells. There were no samples with detectable levels of SVOCs. EEI concluded that the eastern portion of the site had elevated total petroleum hydrocarbon concentrations, “of limited lateral and vertical extent.” The report further determined that some remediation activity would be necessary, though EEI did not determine the remediation activities or associated costs.

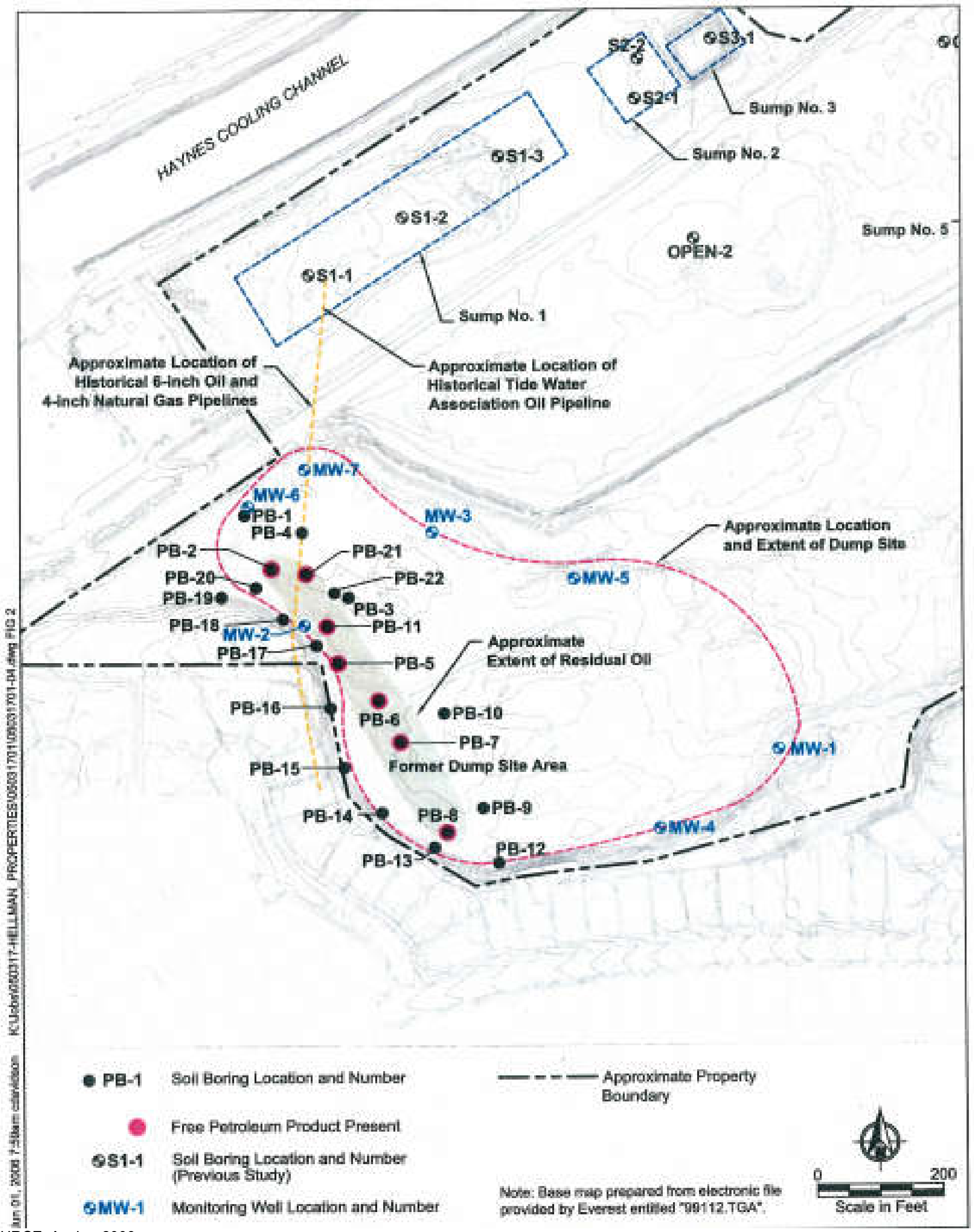
3.3 Results of the 2006 Hellman Ranch (South LCWA) Groundwater Sampling

In 2006, as a follow-up to their 2004 LCWA Phase II Soil and Groundwater Sampling, Anchor collected groundwater samples at seven different monitoring wells located on the Hellman ranch (South LCWA) property (Figure 3-1). The sampling aimed to characterize the former dump site materials, define the lateral extent of the crude oil plume found in the 2004 monitoring, identify the potential and likely sources of crude oil, characterize the groundwater flow, and analyze the contaminants of concern and their ability of migrating to potential receiving waters.

Anchor determined the approximate extent of the crude oil: a 100 foot by 500-foot area on the Southwestern portion of the property (Figure 3-1) and determined that the likely source was a former 6-inch oil and gas line that ran along the border of the contaminated area.

To assess groundwater quality, samples were tested for volatile organic compounds, polycyclic aromatic hydrocarbons, semi volatile organic compounds, dissolved metals, and common cations and anions and compared to the most stringent California Toxics Rule Standards. In general, the samples were below the Toxic Rule Standards, though there were exceedances for benzene, bromodichloromethane, 1,2,-dichlorethane, chrysene, benzo(a)pyrene, copper, and silver. Additionally, the sampling found crude-oil at one of the monitoring wells.

Given the zone of the approximated crude oil contamination and constituent results, Anchor recommended that “future restoration plans should minimize disturbance of groundwater flow gradients in this area.”



SOURCE: Anchor 2006

Figure 3-1
Groundwater Sampling Locations

SECTION 4
Water and Sediment Quality in the Channels

The water and sediment quality data summary presented in this section will be used to assess the potential impact from the following inflows to the restored areas:

- **Los Cerritos Channel** –The Los Cerritos Channel drains approximately 27 square miles of densely urbanized land east of Long Beach. The open-channel is concrete lined and acts as a conduit for freshwater. Tides influence the channel up until Anaheim Road, which is upstream of the LCW.
- **San Gabriel River** –The San Gabriel River (SGR) Watershed covers approximately 690 square miles and is located in Los Angeles and Orange Counties. The watershed drains predominantly urbanized areas. The Lower SGR is broken into two reaches: Reach 1, a concrete-lined channel that stretches from the SGR Estuary to Firestone Boulevard, and Reach 2, which extends from Firestone Boulevard upstream.
- **Haynes Cooling Channel** –The Haynes Cooling Channel is operated by the City of Los Angeles Department of Water and Power. It is an intake that draws water from the Alamitos Bay Haynes Generating Station and discharges to the San Gabriel River. The Haynes Generating Station's various units came in-service between 1962-2005 (TetraTech 2008). Once-through cooling will cease by 2029 (Propes 2019).
- **Alamitos Bay-** The Alamitos Bay drains approximately 5.7 square miles. Alamitos Bay is a recreation facility built in the 1930s and currently used for boating, water skiing, and jet skiing.
- **Urban Runoff and Stormwater** – Urban runoff and stormwater discharge into the program area from various locations. Stormwater from the developed area north of 2nd Street discharges into the North and Central Areas. Stormwater from the Marketplace as well as from areas west of the Pacific Coast Highway also discharges into the North and Central Areas. The developed area south and east of the South Area discharge stormwater into the South Area.

4.1 Los Cerritos Channel

4.1.1 Water Quality

Historically, dry weather flows from the Los Cerritos Channel exceed copper water quality objectives from the State Water Quality Control Board and Regional Basin Plan. Data from wet-weather flows indicated exceedances for copper, lead, and zinc. In response to these exceedances, a Total Maximum Daily Load (TMDL) was developed to address impairments in the water column in Los Cerritos Channel for copper, lead, selenium, and zinc. The TMDL set numeric targets based on the water quality criteria contained in the California Toxics Rule (CTR). In addition to metals, the Los Cerritos Channel is listed under the Clean Water Act Section 303(d) for ammonia, phthalate, chlordane, metals, coliform bacteria, and trash. Table 4-1 lists the impairments and anticipated TMDL completion dates for the Los Cerritos Channel pollutants.

TABLE 4-1
LOS CERRITOS CHANNEL TMDL

Pollutant	Anticipated TMDL Adoption Date
Ammonia	1/1/2019[1]
Bis(2ethylhexyl)phthalate (DEHP)	1/1/2019[1]
Chlordane (sediment)	1/1/2019[1]
Coliform bacteria	1/1/2019[1]
Metals (copper, lead, zinc)	USEPA TMDL Adopted on 3/17/2010
Trash	1/1/2019[1]

Source: Everest 2012
1 No updated TMDLs have been adopted according to the California Waterboard's Website as of May 2019

Monitoring conducted as part of the Los Cerritos Channel Watershed Management Program found that between 2011 and 2013 copper and zinc concentrations upstream of the program boundaries exceeded the metals TMDL limit, while lead was under the limit (RWA 2017). The program conducted monitoring at the Los Cerritos Channel Stearns Street mass emission site over 13 years and found a relatively small list of constituents of concern. Long-term trends suggest that lead and zinc concentrations have been decreasing, but copper concentrations have remained steady. The monitoring found that fecal indicator bacteria was generally elevated, with concentrations increasing during storm events. Additionally, pyrethroid pesticides were found to be at concentrations that produce a toxic response in some bioassay species during storm events, but in general, there has been a trend of reduced toxicity in bioassay testing.

4.1.2 Sediment Quality

The Metals TMDL for the Los Cerritos Channel was approved by the EPA on March 17, 2010. Constituents in the water column are carried with suspended sediment in storm flows from the watershed to the estuary, where sediments often settle out at the fresh water and salt water interface. Constituents that include PAHs and pesticides (such as chlordane) are hydrophobic and will adsorb to sediment particles carried by storm flows. Metals can also be present in the dissolved phase within the water column or adsorbed to sediment particles that may be carried during storm event down to the estuary. The water quality of storm flows from the watershed has direct effects on the quality of sediments within the estuary. Adoption of the TMDL will set a strategy for reducing potential impacts to the program as the TMDLs are anticipated to be adopted in 2019.

4.2 San Gabriel River

4.2.1 Water Quality

The San Gabriel River and its associated tributaries exceed water quality objectives (which are based on beneficial uses and CTR values) for a number of constituents. Coyote Creek, which converges with the San Gabriel River just upstream of the program area, is listed under Section 303(d) for diazinon, coliform bacteria, pH, toxicity, copper, lead, and zinc. The San Gabriel River Estuary is listed for copper. The Lower San Gabriel River Watershed Management Program (WMP), a multi-jurisdictional planning document, has found that the municipal separate storm sewer systems (MS4s) contributes significantly to the metal loading rates found in the San Gabriel River during dry-weather flow events. This is attributed to high metal concentrations in urban runoff. Table 4-2 shows the 303(d) impaired waters and pollutant for the Lower San Gabriel River watershed and the anticipated TMDL dates.

TABLE 4-2
303(D) IMPAIRED WATERS AND POLLUTANTS FOR THE LOWER SAN GABRIEL RIVER WATERSHED

Water Body	Pollutant and TMDL Adoption Date (or Anticipated Date)
Coyote Creek	Ammonia (Timeline N/A) Cynide (Timeline N/A) Copper (TMDL completed 3/27/2007) Diazinon (1/1/2019)[1] Coliform Bacteria (1/1/2009)[1] Lead (TMDL completed 3/27/2007) pH (1/1/2019)[1] Toxicity (1/1/2009)[1] Zinc (TMDL completed 3/27/2007)
Coyote Creek, North Fork	Indicator Bacteria (1/1/2012)[1] Selenium (1/1/2021)
San Gabriel River Reach 2	Coliform bacteria (1/1/2011)[1] Cynide (1/1/2021) Lead (TMDL completed 3/27/2007)
San Gabriel River Reach 1	Ammonia (timeline N/A) Coliform bacteria (1/1/2019)[1] pH (1/1/2019)[1] Copper
San Gabriel River Estuary	Copper (TMDL completed 3/27/2007)

Source: Everest 2012, SGR 2015
1. No updated TMDLs on California Waterboard's Website as of May 2019

The WMP identifies and classifies pollutants into three categories which helps identify water quality priorities.

- Category 1: Waterbody pollutant combinations for which water quality-based effluent limitations and/or receiving water limitations are established in TMDL Provisions and the MS4 Permit

- Category 2: Pollutants for which data indicate water quality impairment in the receiving waters according to the State Board's Water Quality Control Policy for Developing California's Clean Water Act Section 303(d)
- Category 3: Pollutants for which there are insufficient data to indicate water quality impairment in the receiving water according the State's Listing policy but which exceed applicable receiving water limitations.

Copper, lead, zinc, selenium, bacteria, ammonia, cyanide, diazinon, PAHs, mercury, nickel, chloride, pH, toxicity, total dissolved solids, and lindane are all listed as Category 1 or Category 2 constituents in the WMP. The WMP also provides numerical water quality objectives for each of the Category 2 pollutants. These objectives are based on a variety of sources, including the Basin Plan, CTR values, the California Department of Fish and Game, and National Toxics Rule (NTR). To address these constituents of concern, the WMP has identified multiple watershed control measures designed to improve water conditions in the SGR.

Trash is another pollutant on the San Gabriel River. The City of Seal Beach estimated 3,000 – 10,000 cubic yards of trash per year reaches the mouth of the river (City of Seal Beach 2002 as cited in Everest 2012). Trash has been a concern at Zedler Marsh and will likely be an important consideration for the restoration.

Sampling of the San Gabriel River has been conducted in 2005 as part of the Surface Water Ambient Monitoring Program and in 2009-2014 through the Stormwater Monitoring Coalition. Monitoring conducted in 2005-2010 as part of the San Gabriel River Regional Monitoring Program, showed that nutrient and metal levels rarely exceeded basin plan water quality objectives and bacteria concentrations were generally below federal and state water quality objectives. The Southern California Coastal Water Research Project (SCCWRP) conducted a study in 2004 of dry weather water quality in the watershed. SCCWRP also conducted a toxicity study in 2006 and found that toxicity was not widespread in the estuary.

4.2.2 Sediment Quality

Data on the sediment quality of the San Gabriel River was not readily available. However, as discussed in Section 4.1.2, the water quality in the river likely has a significant effect on sediment quality in a channel.

4.3 Haynes Cooling Channel

4.3.1 Water Quality

The Haynes Cooling Channel provides water for the Haynes Generating Station for cooling. The generating station pulls water from the Alamitos Bay, runs it through the generating station, and discharges to the San Gabriel River adjacent to the generating station. The water quality in the Haynes Cooling Channel is expected to be similar to the water quality in Alamitos Bay (see Section 4.4.1). The Haynes Generating Station is undergoing a modernization project that would eliminate the use of ocean water to cool the plant by 2029; once complete, the Haynes Cooling Channel will be decommissioned.

A monitoring report found that concentrations of all priority pollutants in the Haynes Generating Station intake (e.g., water coming from the Haynes Cooling Channel) were low enough to be due to background levels or laboratory testing (City of Los Angeles 2011).

4.3.2 Sediment Quality

No information on the Haynes Cooling Channel sediment quality is available at this time.

4.4 Alamitos Bay

4.4.1 Water Quality

Alamitos Bay is 303(d) listed for indicator bacteria, which is an issue that affects the local beaches as well. No TMDLs have been established for the bay.

The Long Beach Estuary Monitoring Plan (2016) is an Integrated Monitoring Program aimed to assess the effects of MS4s on receiving waters. As part of this plan, the City of Long Beach has set up a monitoring site in the Alamitos Bay (LBR2). Beginning in 2015, three wet-weather and two dry-weather events have been monitored at the Alamitos Bay Site. At this time, data is not publically available.

The County Health and Human Services performs weekly water samples at the Long Beach Beaches, including those in Alamitos Bay. Los Angeles County provides watch conditions based on the monitoring results. Historical monthly monitoring is available through the County's website. According to the Long Beach Estuary Monitoring Plan, beaches in Long Beach (including the beaches at Alamitos Bay) have shown an improvement in bacterial compliance.

Additionally, Heal the Bay, an environmental non-profit, grades the water quality of beaches within the Greater Los Angeles area based on the bacteria sampling performed by the Long Beach Health and Human Services. Heal the Bay has given grades to Alamitos Bay as shown in Table 4-3. Though dry weather grades are generally high, wet-weather grades are consistently poor.

TABLE 4-3
HEAL THE BAY WATER QUALITY GRADES AT ALAMITOS BAY

Year	Summer Dry	Winter Dry	Annual Wet
2017	A	B	F
2016	B	B	F
2015	A+	A	F
2014	A	A	F
2013	B	A+	F
2012	B	A	F
2011	C	F	F
2010	C	F	F

Source: Heal the Bay (2019)

4.4.2 Sediment Quality

As part of the City of Long Beach's NPDES Stormwater Monitoring Program and Beach Bacteria Monitoring, the Belmont Pump Station which feeds stormwater to Alamitos Bay has been monitored from 2000-2015. Sediments within the Los Cerritos Estuary, adjacent to Alamitos, have indicated chlordane, metals, and DDTs in exceedance of ERL and ERM criteria.

4.5 Urban Runoff and Stormwater

4.5.1 Water Quality

The areas of the program that are most affected by urban runoff are the Los Alamitos Retarding Basin Site, Gum Grove Park (on the southeastern side of the South LCWA site), and the Long Beach City Property Site (Everest 2012). Constituents common to urban runoff include metals, bacteriological indicators, and nutrients (Center for Natural Lands Management and Geosyntec 2003, 2005). While data on the local stormwater is not available, similar characteristics can be expected from runoff entering the three locations.

4.5.2 Sediment Quality

Suspended sediment and organic matter in urban runoff attract and provide the mechanism to transport constituents such as heavy metals (copper, lead, zinc), bacteria, pesticides, PAHs, and other organic compounds to receiving waters. These sediments then settle out as velocity decreases when storm flows meet tidal waters or enter into the wetlands.

SECTION 5
Potential Impacts from the Program

The water and sediment quality data summary presented in Sections 2-4 provides the basis to assess the potential impacts from the program on the environment during and following construction of the restoration program. The discussion includes both identification of potential impacts and proposed program mitigation measures that would reduce such impacts. Where additional mitigation measures are needed to address the potential impacts for post-construction operation and maintenance, the discussion references Section 7 (Adaptive Management and Monitoring).

5.1 Impacts During Construction

The following questions should be considered in addressing impacts from the program during construction:

Would construction of the program violate any water quality standards or waste discharge requirements?

What are the potential impacts of sediment migration from the program area during grading activities to adjacent water bodies including the Los Cerritos Channel, the San Gabriel River, and the Haynes Cooling Channel?

What are the potential impacts of contaminated sediment migration from the program area during construction to adjacent water bodies?

The restoration program would require ground disturbance, vegetation removal, and/or grading to restore and enhance the wetlands, and flood management systems. Exposure and removal of topsoil and the underlying sub-soils during construction could generate sediment that, if mobilized by stormwater runoff or runoff from applied water during construction, could deliver sediment-laden runoff and possibly other constituents to the Los Cerritos Channel, San Gabriel River, or Haynes Cooling Channel. Additionally, work within the San Gabriel River to breach the levee would temporarily increase turbidity.

The construction activities for the proposed restoration would be required to comply with the Construction General Permit for the State and the County MS4 Permit required as part of the permitting process. The program would be required to comply with the General Construction and MS4 Permits because more than 1 acre of ground would be disturbed. For work in the San Gabriel River, the program would be required to comply with a Section 401Water Quality Certification. Breaching and lowering of the levee may extend below the water table and could require temporary dewatering. All excavation dewatering would be conducted in accordance with the General Construction Permit, which ensures discharge water would not be discharged in such a way as to result in direct or indirect degradation of surface water in the San Gabriel River or Alamitos Bay. Compliance with the General Construction Permit, MS4 Permit, and 401 Certification would ensure that the proposed activities would include adequate stormwater protection through Best Management Practices (BMPs) and monitoring, to limit increased turbidity and decreased water quality from sediment and other pollutants leaving the construction site.

What are the potential impacts from on-site sediments placed in a permitted marine placement site?

The program would excavate sediments in certain areas to reach marshplain elevations. Excavated sediment would be used on-site to the extent feasible, but any remaining sediment may be designated for placement in an off-site landfill or in ocean disposal sites at either the Los Angeles (LA-2) or Newport Bay (LA-3) sites. The suitability of on-site excavated sediment for placement at a designated ocean dredged material disposal site would require a Tier III evaluation in accordance with Evaluation of Dredged Material Proposed for Ocean Disposal – Testing Manual (OTM; U.S. EPA/U.S. Army Corps of Engineers 1991). The Tier III evaluation contains sediment quality standards which are set based on water quality criteria and protection of water quality. Sediment would be placed in an ocean disposal site only if it met the standards of the OTM, therefore, there would be no adverse impact as a result of ocean disposal.

5.2 Impacts Post-Construction

The following questions should be considered in addressing impacts from the program post-construction:

What is the potential impact of site sediments on water quality and biological resources within the created tidal wetlands and uplands?

Based on sampling data summarized in Section 2, it is highly likely that the program area has been impacted from past oil operations. Restoring a site with poor sediment quality could impact the water quality in surrounding water ways and impact the biological resources created as part of the restoration.

Any impacted soils identified during further sampling would be managed and remediated depending on constituent concentrations and regulatory action levels as required by permit. Potential remediation activities could include in-situ treatment/remediation, removal and disposal at a permitted facility, and/or stabilization and containment. Section 8.1 discusses further testing required to determine the suitability of sediment for different restoration purposes (e.g., wetland surface material, wetland foundation material).

What is the potential impact of site sediments on groundwater below the site?

The groundwater sampling summarized in Section 3 indicates that groundwater at the site has already been impacted by the historic site land uses. It is likely that sediment in certain areas of the site will require remediation before restoration, which would improve conditions and be a benefit to groundwater quality.

Furthermore, the groundwater elevations below the site correspond to the tidally influenced river and channel elevations and therefore are also likely tidally influenced. It is not likely the sites groundwater will be used for direct potable use due to the tidal connection and salt water intrusion.

What is the potential impact of site sediments on the public that may visit the site?

The results of the analytical analyses from 1988-2014, compared to residential ESL indicated multiple constituents in exceedance of residential thresholds, including arsenic, lead, 4,4-DDE, chlordane, dieldrin, vanadium, and PAHs (including benzo(a)pyrene. The 2004 Anchor report (Section 2.3.5) compared metal concentrations at the South LCWA property to background metal concentrations in typical California soils (Table 2-2) and found that lead and arsenic were generally above benchmark concentrations. As residential criteria, these thresholds are more conservative to actual site usage. Potential impact to visitors at the site is only possible in areas of high public use and access where direct exposure to onsite sediments at the surface is possible. As most of the site will be restricted to public access as a wetland preserve, areas of potential impact are very limited. Measures to fully address potential impact due to direct exposure of site sediments in these limited areas of high public access may include covering on-site sediments in these higher public access areas with a 6- to 8-inch layer (loose thickness) of clean soil, top soil or mulch, and restrict activities that would disturbed this cover and expose these sediments. Measures may also include sediment remediation as required by permit.

SECTION 6
Potential Impacts on the Program

The following discussion focuses on the potential impacts to the program from water and sediment quality from upstream on the San Gabriel River and Los Cerritos Channel and urban runoff into the site. Based on the existing and applicable water and sediment quality data summarized in Section 4, a set of potential impact questions were developed for each of the following inputs to the program that may impact the program:

- What are the potential impacts of water quality from dry and wet weather flows (including dissolved and solid fraction constituents and sediment) in the Los Cerritos Channel and the San Gabriel River on the restoration program?
- What are the potential impacts of water quality from urban runoff and stormwater flows from adjacent urbanized areas and roadways on the restoration program?

The water and sediment quality data summary presented in Section 4 provides the basis to assess the potential impacts from watershed and adjacent properties on the program. The assessment of these potential impacts is presented as responses to the specific assessment questions presented below. The discussion following these related assessment questions include both identification of potential impacts to the program and proposed program design and implementation measures to minimize these impacts. Where additional measures are needed to address the potential impacts to the program for post construction operation and maintenance, the discussion references Section 7.

6.1 Impacts from the Rivers and Channels

Based on the existing and applicable water and sediment quality data summarized in Section 4, the following questions should be considered in addressing impacts to the project post-construction:

What are the potential impacts of water quality from dry and wet weather flows (including dissolved and solid fraction constituents and sediment) in the Los Cerritos Channel and the San Gabriel River on the restoration program?

As summarized in Section 4, historical and current water quality data indicates that flows from the Los Cerritos Channel and the San Gabriel River exceed water quality objectives. TMDLs have been developed or are anticipated for the different constituents. The LARWQCB has incorporated the TMDL waste load allocations and timelines into the reissued municipal separate storm sewer system (MS4) permit.

Both Alamitos Bay and Los Cerritos Channel and the Lower San Gabriel River have Watershed Management Programs (WMP) which have identified watershed control measures (WCMs). The WCMs will help jurisdictions meet the MS4 permit requirements and improve water and sediment quality in the rivers and channels.

Since the flows in the Los Cerritos Channel and the San Gabriel River exceed certain water quality objectives, there is a potential for impact to the program. However, the concentration and loading of these constituents from the watershed will be reduced to comply with the reissued MS4 Permit, TMDLs, and the WMPs. The potential for impacts to the program will, therefore, be significantly reduced.

In addition, the development of the program has and will consider these potential impacts in the design of the restoration. The program design allows for full tidal flows into the Central Area wetlands and during the long-term phase, in the South Area wetlands. Full tidal exchange creates favorable water quality conditions by limiting retention times of potentially impacted stormwater and non-storm flows and enhancing flushing of the wetlands with much higher quality ocean water. Sediment carried from the watershed during storm flows that may contain high levels of constituents may accumulate in some areas of the wetland floodplain in the Central Area. These areas of sediment accumulation will be open to full tidal flow and periodic flushing during high tide events. Additionally, monitoring will track any changes to sediment quality in the site, and adaptive management measures could be taken if needed (see Section 7).

To address the impact of trash on the program, a trash boom may be installed on the San Gabriel River upstream of the program area. This would limit the amount of trash that could end up in the Central Area marsh or Zedler and Callaway Marshes. A trash boom would require additional operations and maintenance. Further discussions with the County of Los Angeles, who would likely be responsible for such maintenance, is required.

6.2 Impacts from Urban Runoff

Based on the existing and applicable water and sediment quality data summarized in Section 4, the following potential impact questions will be assessed:

What are the potential impacts of water quality from urban runoff and stormwater flows from adjacent urbanized areas and roadways on the restoration program?

There is a potential for stormwater from adjacent roadways and urbanized areas to impact the water and sediment quality of the program, unless measures are implemented to reduce pollutant loading and concentrations of metals, pesticides and PAH form stormwater discharges to the program.

In the next phase of the program design, a Stormwater Management Plan will be developed to address these impacts. The planned measures will include the construction of bioswales along the existing roadways and stormwater retention facilities at any stormwater outfalls that discharge directly into the restored areas. BMPs will provide for the capture and reduction of sediment carried in stormwater flows that can also contain metals, PAH and pesticides. BMPs will therefore be designed to remove pollutants in stormwater from adjacent properties to concentrations that will reduce the impact to the water and sediment quality of the program.

SECTION 7

Monitoring and Adaptive Management

As discussed in the assessment of potential impacts to the program (Section 6), there may be the potential for impact from the watershed during storm events depending on the effectiveness of the implementation of BMPs under the WMPs. A sediment and water quality monitoring and adaptive management plan is recommended to address the potential impact if the reductions under the WMPs are not made or potential new emerging water quality issues occur that are not fully addressed by the WCMs implemented under the WMP. The monitoring will focus on sediment quality in areas subject to the greatest deposition from storm events and that are also not subject to regular tidal flushing, (e.g., the southwestern corner of the Long Beach Property Site). The sediment quality monitoring would be performed at a frequency that would capture the potential build-up of contaminants in the deposited sediment before concentration are reached that would impact benthic macro-invertebrates and other sensitive species.

The plan would include sediment management measures that would be triggered if impacted sediment is identified. Protocols would be established for the detection of impacted accumulated sediments that may pose an impact to the biological resources of the program. These measures may include additional sampling and analysis, additional testing to determine the risk of impact based on toxicity and where applicable bioaccumulation. Depending on the concentrations and results of follow-up testing, additional measures may be taken to partially remove impacted sediments. These measures will balance the potential impact from the constituents in the sediment with the impact of temporary disturbance of sediments and habitat. More detailed monitoring and adaptive management procedures will be developed in subsequent phases of the project.

SECTION 8
Conclusions and Recommendations

8.1 Sediment Quality on Site

Based on the sediment and water quality characterization results to date for the LCW, the program sites have been impacted from past oil and gas operations. The impacts include the presence of petroleum hydrocarbons, PCBs, pesticides, VOCs, SVOCS, and bi-products in onsite soils and groundwater. Though the most recent study (Reyes 2014) shows that PAHs have decreased significantly in the Zedler Marsh and State Lands Area since the mid-1990s, further sampling efforts should be made to determine existing sediment and groundwater concentrations in the program area.

Though a few sediment samples taken to date have exceeded Hazardous Waste Criteria (TTLC and STLC), the primary concern at the complex is constituents that exceed ecological criteria (ER-L and ER-M) and human health criteria (ESL). The sediment studies performed at the site indicate that impacted soils may require management and/or remediation depending on the final placement and associated constituent concentrations and regulatory action levels.

The concentration and extent of impacted soils will be better defined as part of next phase of the restoration design and subsequent investigations. Potential remediation activities may include in-situ treatment/remediation, removal and disposal at a permitted facility, and/or stabilization and containment. Specific remediation approaches will be developed following the investigation to further define the levels and extent of contamination that will inform the program design and remediation approach. The proposed restoration will incorporate land grading, dredging, and fill processes, requiring the movement and potential exposure of contaminated soils. It is important that the constituent concentrations located at depths that are anticipated to serve as wetland surface material are below wetland criteria thresholds (ER-L and ER-M). Similarly, any soil that will be exposed in public access areas must fall below required ESL standards to minimize potential exposure risk.

Based on these conclusions, the following next steps are recommended.

8.1.1 Testing for Suitability for Wetland Surface Materials

Materials that are planned for use as wetland surface materials should be the highest quality materials and not possess constituent concentrations above the Beneficial Reuse guidelines for wetland surfaces (SFBRWQCB 2000, Germano & Associates 2004). Sampling results showed that multiple samples exceeded the ER-Ls and ER-Ms for metals. Materials that are not shown to be suitable for wetland surface materials can be used for wetland foundation or upland material or may require remediation.

8.1.2 Testing for Suitability for Wetland Foundation Materials

Materials that are planned for use as wetland foundation materials should not possess constituent concentrations above the Beneficial Reuse guidelines for wetland foundations (SFBRWQCB 2000, Germano & Associates 2004). Sampling results showed that multiple samples exceeded the ER-Ls and ER-Ms for metals. Materials that are not shown to be suitable for wetland foundation materials can be used for upland material or may require remediation.

8.1.3 Testing for Suitability of Upland Material

Materials that are planned for use as upland material should not possess constituent concentrations above the ER-M. Materials that are to be used as surface upland materials (top six inches) should meet the applicable ESL, or demonstrate that the constituent concentrations are within the typical range of marine sediments and do not exhibit a potential human health risk. For the sediments sampled to date, constituents that have been found above the human health criteria are lead, arsenic, chromium, vanadium, benzene, toluene, ethyl benzene, xylene, benzo(a)pyrene, heptachlor epoxide, and 4,4'-DDD, 4,4'-DDE, chlordane, and dieldrin.

If these materials are not able to be shown suitable for use as surface materials for upland areas based on the ESLs, then they can be covered with a minimum one-foot clean layer of soil that would meet all the above criteria listed for suitability as surface upland materials for both ecological and human health criteria. The top foot of material should also meet the agronomical requirements for establishing the designated upland habitat.

8.1.4 Testing for Suitability for Potential Marine Discharge

Any materials that are planned for off-site ocean disposal or open water placement should be further tested and assessed in accordance with ITM (USEPA/USACE 1998) and OTM (USEPA/USACE 1991) guidelines. The testing results to date do not preclude this alternative, but require further biological testing to meet the applicable guidelines. This additional testing will include running the solid phase toxicity testing using a fine-grained control, and suspended solid phase toxicity and bioaccumulation potential testing. If the material is determined to be suitable for this placement alternative, specific permitting for ocean disposal or open-water placement will be required for the designated site. Appendix B contains more information on marine disposal.

8.1.5 Developing a Sampling and Analysis Plan

In the next phase of the design, a Sampling and Analysis Plan (SAP) should be developed. The SAP will define methods and frequency for testing excavated sediment for use as the various proposed beneficial uses. The SAP will be developed in coordination with the permitting agencies during the next phase of the project.

8.2 Channel Sediment and Water Quality

The Los Cerritos Channel and San Gabriel River are both listed as impaired waterbodies for a number of constituents through the 303(d) and TMDL programs. The main constituents of concern for the two primary channels are metals (copper, lead, zinc, mercury, nickel), diazinon, coliform bacteria, pH, toxicity, bis(2ethylhexyl)phthalate, and trash. The Los Cerritos Channel has an approved TMDL (2007) for metal, and TMDLs are anticipated for the remaining constituents of concern. Water quality concerns within the San Gabriel River and Alamitos Bay/Los Cerritos Channel are being addressed through the WMPs and TMDLs. The WMPs contain specific numeric goals and watershed control measures (WCMs) that will improve water quality within the drainage areas. Los Cerritos Channel and Alamitos Bay is also part of the Long Beach Estuary Monitoring Plan which will provide more specific monitoring data and allow for appropriate WCMs.

Though the water bodies are listed as impaired, it is anticipated that water quality conditions will improve at the project site based on the WMP, TMDL, and monitoring programs. As such, it is anticipated that water quality within the program area will improve (compared to existing conditions) as the San Gabriel River, Los Cerritos Channel, and Alamitos Bay comply with the promulgated targets and goals.

In addition to water quality improvements due to the WCMs, the restoration program will allow for fully tidal flows into the program area, creating favorable water quality conditions by limiting retention time and enhancing tidal exchange. This flushing will also minimize the impacts of sediment accumulation with high levels of constituents deposited on the restored program area during high storm flow events.

SECTION 9
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Appendix A
Tables from Prior Sediment Reports

TABLES FROM PRIOR SEDIMENT REPORTS

This appendix provides the results of the soil and groundwater sampling investigations discussed in Section 4 and Section 5. The comparison criteria (hazardous waste, ecological criteria, and human health) have been added by ESA for easier comparison.

Results of the Phase 1 1988 International Technology Sediment Sampling

The following tables show the results of the sediment sampling of the 1988 International Technology 1988 International Technology Corporation Environmental Assessment.

TABLE A-1: SUMMARY OF 1988 INTERNATIONAL TECHNOLOGY SOIL SAMPLING COMPARED TO HAZARDOUS WASTE CRITERIA

	Lead (PPM)	Arsenic (PPM)	Vanadium (PPM)	Barium (PPM)	Chromium (PPM)
STLC	**5**	**5**	**24**	**100**	**5**
TTLC	**1000**	**500**	**2400**	**10000**	**2500**
S2 A-1	14	11	122	960	52
S2 A-1-4	26	6	95	1100	124
S2 A-1-5	6	1	77	840	185
S2 A-1-6	11	7	123	920	60
S2 A-1-7 2'	21	5	89	980	210
S2 A-1-7 5'	13	8	115	930	122
S2 A-1-7 10'	15	13	151	1000	97
S2 A-1-8	10	6	97	1000	147
S2 A-2	14	10	138	1000	83
S2 A-2-6 2'	12	11	131	990	58
S2 A-2-6 5'	14	9	123	830	57
S2 A-2-6 10'	10	10	104	840	77
S2 A-3	15	10	107	990	59
S2 A-3-6 2'	14	11	135	830	59
S2 A-3-6 5'	10	5	111	890	60
S2 A-3-6 10'	7	6	89	830	125
S2 A-4	10	11	107	900	32
S2 A-5	15	12	127	990	60
S2 A-6	15	13	146	1100	61
S2 A-7	16	6	111	960	186
S2 A-8	9	4	102	1100	148
S2 A-9	6	3	75	910	95

	Lead (PPM)	Arsenic (PPM)	Vanadium (PPM)	Barium (PPM)	Chromium (PPM)
STLC	**5**	**5**	**24**	**100**	**5**
TTLC	**1000**	**500**	**2400**	**10000**	**2500**
S2 A-10	11	7	100	930	134
S2 B-1	11	8	112	980	82
S2 B-1-2	27	8	1211	1100	128
S2 B-1-3	12	12	119	920	58
S2 B-1-4	10	7	103	950	151
S2 B-1-5	12	10	135	920	60
S2 B-1-7	37	10	117	960	166
S2 B-1-8	54	3	101	780	207
S2 B-2	21	7	119	1000	219
S2 B-2-8	8	5	96	960	147
S2 B-3 2'	19	6	107	1400	184
S2 B-3 5'	12	10	119	970	97
S2 B-3 10'	8	5	96	900	94
S2 B-4	10	7	104	920	105
S2 B-5	12	10	131	1100	59
S2 B-6	11	2	85	1100	213
S2 B-7	16	9	111	9711	54
S2 B-8	9	3	120	1000	114
S2 C-1	110	7	113	970	57
S2 C-1-3	17	12	131	910	48
S2 C-1-4	18	9	143	1000	52
S2 C-1-5	16	11	167	800	51
S2 C-1-6	7	3	811	860	160
S2 C-1-8	159	10	93	1100	241
S2 C-2	281	8	138	940	54
S2 C-2-5	31	12	129	1300	66
s2 C-J	14	8	143	950	64
S2 C-4	7	3	90	9100	88
S2 c-5	13	9	125	1000	54
S2 C-6	16	10	136	1100	85
S2 C-7	31	9	93	1100	195
S2 D-1	17	4	160	1000	114
S2 D-1-1	15	3	159	990	60
S2 D-1-2	12	6	117	940	51
S2 D-1-4	15	12	150	910	55
S2 D-1-5 2'	19	12	167	910	54
S2 D-1-5 5'	15	12	141	970	75
S2 D-1-5 10'	9	4	100	910	109
S2 D-2	261	6	140	980	60
S2 D-3	18	15	144	1100	60
S2 D-4 2'	18	5	111	900	90

	Lead (PPM)	Arsenic (PPM)	Vanadium (PPM)	Barium (PPM)	Chromium (PPM)
STLC	**5**	**5**	**24**	**100**	**5**
TTLC	**1000**	**500**	**2400**	**10000**	**2500**
S2 D-4 5'	8	7	144	1100	102
S2 D-4 10'	12	8	146	810	70
S2 D-5	20	5	78	1100	202
S2 D-6	16	14	177	890	57
S2 D-7	20	7	125	930	119
SZ E-1	12	3	86	1200	141
S2 E-1-2	13	8	127	930	84
S2 E-1-4	10	7	122	900	132
S2 E-1-5 2'	283	8	110	4800	84
S2 E-1-5 5'	367	7	88	5100	127
S2 E-1-5 10'	381	6	92	5100	91
S2 E-2	13	8	125	920	73
S2 E-3	11	8	116	790	48
S2 E-4	9	6	109	1000	237
S2 E-5	15	10	147	970	57
S2 E-6	15	8	133	1000	140
S2 F-1	14	8	138	980	46
S2 F-1-2	18	6	79	890	190
S2 F-1-3	13	10	151	990	50
S2 F-2-2	15	9	155	970	58
S2 F-2-3	15	6	146	850	68
S2 F-3	21	11	149	1100	55
S2 F-3	15	9	133	900	55
S2 F-3	19	20	172	1100	75
S2 F-3 2'	16	11	168	930	54
S2 F-3-2 5'	306	8	157	990	108
S2 F-4 10'	11	8	124	970	60
S2 F-5	9	4	107	8711	91
S2 G-1	19	18	158	910	59
S2 G-1-2	19	8	114	1000	190
S2 G-1-2	16	13	119	840	54
S2 G-1-2 2'	7	6	95	830	121
S2 G-2 5'	30	10	121	980	208
S2 G-3 10'	12	9	136	860	54
S2 G-4	10	4	77	930	171
S2 H-1	12	8	136	890	58
S2 H-2	11	9	130	880	56
S2 K-1	9	5	104	900	169
S2 K-2	10	5	119	890	195
S2 K-3	19	4	93	1100	134
S2 K-4	13	6	130	1000	157

	Lead (PPM)	Arsenic (PPM)	Vanadium (PPM)	Barium (PPM)	Chromium (PPM)
STLC	**5**	**5**	**24**	**100**	**5**
TTLC	**1000**	**500**	**2400**	**10000**	**2500**
S2 K-5	82	6	129	1200	144
S2 K-6	21	6	135	1100	172
S2 K-7	13	6	117	930	173
S2 K-8	11	6	118	980	82
S2 K-9	24	9	133	1100	194
S2 K-10	21	4	87	970	230
S2 K-11	8	2	68	1000	383
S2 K-12	77	10	73	1200	323
S2 K-13	11	4	92	1000	108
S2 K-14	25	8	119	900	88
S2 K-15	21	7	134	940	130
S2 K-16	23	6	80	970	184
S2 K-17	12	12	116	1200	58
S2 K-18 2'	13	8	101	960	123
S2 K-18 5'	12	8	131	1000	9
S2 K-18 10'	7	2	91	830	50
S2 L-1	126	9	89	1100	214
S2 L-1-3 2'	21	3	82	880	681
S2 L-1-3 5'	35	4	68	1000	534
S2 L-1-3 8'	12	9	136	810	112
S2 L-2	10	6	105	1000	139
S2 L-3	29	4	79	900	225
S2 L-4	23	4	74	980	207
S2 L-5	9	6	102	860	81
S2 L-6	33	4	75	1100	308
S2 L-7	13	4	80	1100	196
S2 L-8	24	8	86	1000	198
S2 L-9	26	5	74	1100	265
S2 L-9-1 2'	6	4	80	1100	280
S2 l-9-1 5'	380	14	130	7300	121
S2 L-10	9	5	73	1100	225
S2 L-10-1	8	6	85	890	244
S2 L-11	15	3	65	1000	262
S2 L-12	6	4	70	1100	260
S2 L-12-1 2'	42	18	88	890	466
S2 L-12-1 5'	14	6	82	890	212
S2 L-12-1 10'	6	4	94	1000	290
S2 L-13	10	9	111	1100	138
S2 L-13-1 2'	54	8	110	960	171
S2 L-13-1 5'	8	3	89	920	148
S2 L-13-1 10'	5	1	67	830	210

	Lead (PPM)	Arsenic (PPM)	Vanadium (PPM)	Barium (PPM)	Chromium (PPM)
STLC	**5**	**5**	**24**	**100**	**5**
TTLC	**1000**	**500**	**2400**	**10000**	**2500**
S2 I-14	17	9	101	1100	155
S2 I-15	14	6	105	1200	179
S2 I-15-1 2'	32	6	101	1000	171
S2 I-15-1 5'	7	4	86	890	384
S2 I-15-1 10'	5	2	76	870	193
S2 I-16	11	6	99	960	216
S2 I-16-1	86	10	139	870	127
S2 L-17	11	8	113	11100	137
S2 I-18	25	5	76	960	176
S2 L-19	16	7	88	1100	170
S2 M-1	12	6	106	970	113
S2 M-1-2 2'	10	7	101	970	143
S2 M-1-2 5'	11	11	106	1100	113
s2 M-1-2 8'	12	3	112	830	89
S2 M-2	17	18	144	1000	117
S2 M-3	12	8	123	1000	173
S2 M-4	20	16	115	880	129
S2 M-5	37	7	89	1000	213
S2 M-6	14	5	82	890	161
S2 M-6-1 2' 'A'	23	8	108	1000	159
S2 M-6-1 2' 'B'	28	6	83	1100	170
S2 M-6-1 5'	10		95	1000	217
S2 M-6-1 10'	6	4	91	1000	194
S2 M-7	23	5	79	970	204
S2 M-7-1	87	5	79	970	182
S2 M-7-2 2'	14	4	90	1000	308
S2 M-7-2 5'	12	3	85	880	229
S2 M-8	17	4	93	860	1198
S2 M-9	58	5	77	950	197
sz M-10	11	6	86	1100	228
S2 M-11	8	4	62	1100	184
S2 M-12 2'	7	4	66	1000	251
S2 M-12 5'	6	2	55	12000	264
S2 M-12 10'	223	14	149	2500	143
S2 M-13	7	3	67	1100	221
S2 M-14	17	8	94	1000	162
S2 M-15	11	6	96	1000	131
S2 M-15-1 2'	19	4	86	1200	159
S2 M-15-1 5'	20	4	89	1100	244
S2 M-16	17	5	91	1200	160
S2 M-17	23	9	120	940	118

	Lead (PPM)	Arsenic (PPM)	Vanadium (PPM)	Barium (PPM)	Chromium (PPM)
STLC	**5**	**5**	**24**	**100**	**5**
TTLC	**1000**	**500**	**2400**	**10000**	**2500**
S2 M-18	12	8	123	1100	74
S2 M-19	15	16	128	1100	87
S2 M-20	14	6	106	920	131
S2 N-1	26	4	74	900	201
S2 N-2	14	4	102	1000	194
S2 N-3	9	8	85	980	132
S2 N-4	9	4	66	1100	190
S2 N-5	9	4	78	1100	136
S2 N-6	70	7	99	1100	168
S2 N-7	16	8	83	1100	140
S2 N-8	14	9	1113	920	115
S2 N-9	15	10	1111	840	72
S2 N-10	81	25	123	830	81
S2 N-10-t 2'	9	4	92	8111	136
S2 N-10-1 5'	13	7	128	790	114
S2 N-10-1 10'	15	16	107	700	146
S2 N-11	13	11	118	1200	195
S2 N-17	15	6	121	880	108
S2 N-18	13	3	111	950	98
S2 N-19	13	4	117	920	116
S2 0-15	24	11	69	980	459
S2 0-17 2'	12	8	103	820	96
s2 o-11 5'	15	9	119	880	88
S2 0-17 10'	9	4	94	870	145
S2 0-18	13	7	114	940	99
S2 0-19	27	8	107	2100	131
S2 0-20	12	8	106	880	109
S2 P-18	8	4	89	840	216
S2 P-18-1 2'	15	8	109	870	55
S2 P-18-1 5'	14	6	107	770	42
S2 P-18-1 10'	10	3	92	790	123
S2 P-19	12	6	106	920	127
S2 P-20	10	6	110	860	96
S2 P-21	12	8	105	920	109
S2 P-27 12	12	8	107	870	73

NOTES: Cells Highlighted in Yellow indicate samples that exceed 10 times the STLC value.

Table A-2: Summary of 1989 Soil Sampling Compared to Ecological Criteria

	Lead (PPM)	Arsenic (PPM)	Vanadium (PPM)	Barium (PPM)	Chromium (PPM)
ER-L	**47**	**8**	**NA**	**NA**	**81**
ER-M	**218**	**81**	**NA**	**NA**	**370**
Wetland Beneficial Use (Foundation)	**43.2**	**15.3**	**NA**	**NA**	**112**
Wetland Beneficial Use (Surface)	**218**	**70**	**NA**	**NA**	**370**
S2 A-1	14	11	122	960	52
S2 A-1-4	26	6	95	1100	124
S2 A-1-5	6	1	77	840	185
S2 A-1-6	11	7	123	920	60
S2 A-1-7 2'	21	5	89	980	210
S2 A-1-7 5'	13	8	115	930	122
S2 A-1-7 10'	15	13	151	1000	97
S2 A-1-8	10	6	97	1000	147
S2 A-2	14	10	138	1000	83
S2 A-2-6 2'	12	11	131	990	58
S2 A-2-6 5'	14	9	123	830	57
S2 A-2-6 10'	10	10	104	840	77
S2 A-3	15	10	107	990	59
S2 A-3-6 2'	14	11	135	830	59
S2 A-3-6 5'	10	5	111	890	60
S2 A-3-6 10'	7	6	89	830	125
S2 A-4	10	11	107	900	32
S2 A-5	15	12	127	990	60
S2 A-6	15	13	146	1100	61
S2 A-7	16	6	111	960	186
S2 A-8	9	4	102	1100	148
S2 A-9	6	3	75	910	95
S2 A-10	11	7	100	930	134
S2 B-1	11	8	112	980	82
S2 B-1-2	27	8	1211	1100	128
S2 B-1-3	12	12	119	920	58
S2 B-1-4	10	7	103	950	151
S2 B-1-5	12	10	135	920	60
S2 B-1-7	37	10	117	960	166
S2 B-1-8	54	3	101	780	207
S2 B-2	21	7	119	1000	219
S2 B-2-8	8	5	96	960	147
S2 B-3 2'	19	6	107	1400	184
S2 B-3 5'	12	10	119	970	97
S2 B-3 10'	8	5	96	900	94

	Lead (PPM)	Arsenic (PPM)	Vanadium (PPM)	Barium (PPM)	Chromium (PPM)
ER-L	**47**	**8**	**NA**	**NA**	**81**
ER-M	**218**	**81**	**NA**	**NA**	**370**
S2 B-4	10	7	104	920	105
S2 B-5	12	10	131	1100	59
S2 B-6	11	2	85	1100	213
S2 B-7	16	9	111	9711	54
S2 B-8	9	3	120	1000	114
S2 C-1	110	7	113	970	57
S2 C-1-3	17	12	131	910	48
S2 C-1-4	18	9	143	1000	52
S2 C-1-5	16	11	167	800	51
S2 C-1-6	7	3	811	860	160
S2 C-1-8	159	10	93	1100	241
S2 C-2	281	8	138	940	54
S2 C-2-5	31	12	129	1300	66
s2 C-J	14	8	143	950	64
S2 C-4	7	3	90	9100	88
S2 c-5	13	9	125	1000	54
S2 C-6	16	10	136	1100	85
S2 C-7	31	9	93	1100	195
S2 D-1	17	4	160	1000	114
S2 D-1-1	15	3	159	990	60
S2 D-1-2	12	6	117	940	51
S2 D-1-4	15	12	150	910	55
S2 D-1-5 2'	19	12	167	910	54
S2 D-1-5 5'	15	12	141	970	75
S2 D-1-5 10'	9	4	100	910	109
S2 D-2	261	6	140	980	60
S2 D-3	18	15	144	1100	60
S2 D-4 2'	18	5	111	900	90
S2 D-4 5'	8	7	144	1100	102
S2 D-4 10'	12	8	146	810	70
S2 D-5	20	5	78	1100	202
S2 D-6	16	14	177	890	57
S2 D-7	20	7	125	930	119
SZ E-1	12	3	86	1200	141
S2 E-1-2	13	8	127	930	84
S2 E-1-4	10	7	122	900	132
S2 E-1-5 2'	283	8	110	4800	84
S2 E-1-5 5'	367	7	88	5100	127
S2 E-1-5 10'	381	6	92	5100	91
S2 E-2	13	8	125	920	73
S2 E-3	11	8	116	790	48

	Lead (PPM)	Arsenic (PPM)	Vanadium (PPM)	Barium (PPM)	Chromium (PPM)
ER-L	**47**	**8**	**NA**	**NA**	**81**
ER-M	**218**	**81**	**NA**	**NA**	**370**
S2 E-4	9	6	109	1000	237
S2 E-5	15	10	147	970	57
S2 E-6	15	8	133	1000	140
S2 F-1	14	8	138	980	46
S2 F-1-2	18	6	79	890	190
S2 F-1-3	13	10	151	990	50
S2 F-2-2	15	9	155	970	58
S2 F-2-3	15	6	146	850	68
S2 F-3	21	11	149	1100	55
S2 F-3	15	9	133	900	55
S2 F-3	19	20	172	1100	75
S2 F-3 2'	16	11	168	930	54
S2 F-3-2 5'	306	8	157	990	108
S2 F-4 10'	11	8	124	970	60
S2 F-5	9	4	107	8711	91
S2 G-1	19	18	158	910	59
S2 G-1-2	19	8	114	1000	190
S2 G-1-2	16	13	119	840	54
S2 G-1-2 2'	7	6	95	830	121
S2 G-2 5'	30	10	121	980	208
S2 G-3 10'	12	9	136	860	54
S2 G-4	10	4	77	930	171
S2 H-1	12	8	136	890	58
S2 H-2	11	9	130	880	56
S2 K-1	9	5	104	900	169
S2 K-2	10	5	119	890	195
S2 K-3	19	4	93	1100	134
S2 K-4	13	6	130	1000	157
S2 K-5	82	6	129	1200	144
S2 K-6	21	6	135	1100	172
S2 K-7	13	6	117	930	173
S2 K-8	11	6	118	980	82
S2 K-9	24	9	133	1100	194
S2 K-10	21	4	87	970	230
S2 K-11	8	2	68	1000	383
S2 K-12	77	10	73	1200	323
S2 K-13	11	4	92	1000	108
S2 K-14	25	8	119	900	88
S2 K-15	21	7	134	940	130
S2 K-16	23	6	80	970	184
S2 K-17	12	12	116	1200	58

	Lead (PPM)	Arsenic (PPM)	Vanadium (PPM)	Barium (PPM)	Chromium (PPM)
ER-L	**47**	**8**	**NA**	**NA**	**81**
ER-M	**218**	**81**	**NA**	**NA**	**370**
S2 K-18 2'	13	8	101	960	123
S2 K-18 5'	12	8	131	1000	9
S2 K-18 10'	7	2	91	830	50
S2 L-1	126	9	89	1100	214
S2 L-1-3 2'	21	3	82	880	681
S2 L-1-3 5'	35	4	68	1000	534
S2 L-1-3 8'	12	9	136	810	112
S2 L-2	10	6	105	1000	139
S2 L-3	29	4	79	900	225
S2 L-4	23	4	74	980	207
S2 L-5	9	6	102	860	81
S2 L-6	33	4	75	1100	308
S2 L-7	13	4	80	1100	196
S2 L-8	24	8	86	1000	198
S2 L-9	26	5	74	1100	265
S2 L-9-1 2'	6	4	80	1100	280
S2 l-9-1 5'	380	14	130	7300	121
S2 L-10	9	5	73	1100	225
S2 L-10-1	8	6	85	890	244
S2 L-11	15	3	65	1000	262
S2 L-12	6	4	70	1100	260
S2 L-12-1 2'	42	18	88	890	466
S2 L-12-1 5'	14	6	82	890	212
S2 L-12-1 10'	6	4	94	1000	290
S2 L-13	10	9	111	1100	138
S2 L-13-1 2'	54	8	110	960	171
S2 L-13-1 5'	8	3	89	920	148
S2 L-13-1 10'	5	1	67	830	210
S2 l-14	17	9	101	1100	155
S2 l-15	14	6	105	1200	179
S2 l-15-1 2'	32	6	101	1000	171
S2 l-15-1 5'	7	4	86	890	384
S2 l-15-1 10'	5	2	76	870	193
S2 l-16	11	6	99	960	216
S2 l-16-1	86	10	139	870	127
S2 L-17	11	8	113	11100	137
S2 l-18	25	5	76	960	176
S2 L-19	16	7	88	1100	170
S2 M-1	12	6	106	970	113
S2 M-1-2 2'	10	7	101	970	143
S2 M-1-2 5'	11	11	106	1100	113

	Lead (PPM)	Arsenic (PPM)	Vanadium (PPM)	Barium (PPM)	Chromium (PPM)
ER-L	**47**	**8**	**NA**	**NA**	**81**
ER-M	**218**	**81**	**NA**	**NA**	**370**
s2 M-1-2 8'	12	3	112	830	89
S2 M-2	17	18	144	1000	117
S2 M-3	12	8	123	1000	173
S2 M-4	20	16	115	880	129
S2 M-5	37	7	89	1000	213
S2 M-6	14	5	82	890	161
S2 M-6-1 2' 'A'	23	8	108	1000	159
S2 M-6-1 2' 'B'	28	6	83	1100	170
S2 M-6-1 5'	10		95	1000	217
S2 M-6-1 10'	6	4	91	1000	194
S2 M-7	23	5	79	970	204
S2 M-7-1	87	5	79	970	182
S2 M-7-2 2'	14	4	90	1000	308
S2 M-7-2 5'	12	3	85	880	229
S2 M-8	17	4	93	860	1198
S2 M-9	58	5	77	950	197
sz M-10	11	6	86	1100	228
S2 M-11	8	4	62	1100	184
S2 M-12 2'	7	4	66	1000	251
S2 M-12 5'	6	2	55	12000	264
S2 M-12 10'	223	14	149	2500	143
S2 M-13	7	3	67	1100	221
S2 M-14	17	8	94	1000	162
S2 M-15	11	6	96	1000	131
sz M-15-1 2'	19	4	86	1200	159
s2 M-15-1 5'	20	4	89	1100	244
S2 M-16	17	5	91	1200	160
S2 M-17	23	9	120	940	118
S2 M-18	12	8	123	1100	74
S2 M-19	15	16	128	1100	87
S2 M-20	14	6	106	920	131
S2 N-1	26	4	74	900	201
S2 N-2	14	4	102	1000	194
S2 N-3	9	8	85	980	132
S2 N-4	9	4	66	1100	190
S2 N-5	9	4	78	1100	136
S2 N-6	70	7	99	1100	168
S2 N-7	16	8	83	1100	140
S2 N-8	14	9	1113	920	115
S2 N-9	15	10	1111	840	72
S2 N-10	81	25	123	830	81

	Lead (PPM)	Arsenic (PPM)	Vanadium (PPM)	Barium (PPM)	Chromium (PPM)
ER-L	**47**	**8**	**NA**	**NA**	**81**
ER-M	**218**	**81**	**NA**	**NA**	**370**
S2 N-10-t 2'	9	4	92	8111	136
S2 N-10-1 5'	13	7	128	790	114
S2 N-10-1 10'	15	16	107	700	146
S2 N-11	13	11	118	1200	195
S2 N-17	15	6	121	880	108
S2 N-18	13	3	111	950	98
S2 N-19	13	4	117	920	116
S2 0-15	24	11	69	980	459
S2 0-17 2'	12	8	103	820	96
s2 o-11 5'	15	9	119	880	88
S2 0-17 10'	9	4	94	870	145
S2 0-18	13	7	114	940	99
S2 0-19	27	8	107	2100	131
S2 0-20	12	8	106	880	109
S2 P-18	8	4	89	840	216
S2 P-18-1 2'	15	8	109	870	55
S2 P-18-1 5'	14	6	107	770	42
S2 P-18-1 10'	10	3	92	790	123
S2 P-19	12	6	106	920	127
S2 P-20	10	6	110	860	96
S2 P-21	12	8	105	920	109
S2 P-27 12	12	8	107	870	73

NOTES: Cells highlighted in Yellow exceed ER-L or Wetland Beneficial Use (Surface) values
Cells highlighted in Red exceed ER-M and Wetland Benefic Use (Foundation) values

Table A-3 Summary of 1988 International Technology Soil Sampling COMPARED to Human Health Criteria

	Lead	Arsenic	Vanadium	Barium	Chromium
ESL (mg/kg)	81.8	0.3	393.1	15305	234.3
RSL (mg/kg)	400	1	390	15,000	-
S2 A-1	14	11	122	960	52
S2 A-1-4	26	6	95	1100	124
S2 A-1-5	6	1	77	840	185
S2 A-1-6	11	7	123	920	60
S2 A-1-7 2'	21	5	89	980	210
S2 A-1-7 5'	13	8	115	930	122
S2 A-1-7 10'	15	13	151	1000	97
S2 A-1-8	10	6	97	1000	147
S2 A-2	14	10	138	1000	83
S2 A-2-6 2'	12	11	131	990	58
S2 A-2-6 5'	14	9	123	830	57
S2 A-2-6 10'	10	10	104	840	77
S2 A-3	15	10	107	990	59
S2 A-3-6 2'	14	11	135	830	59
S2 A-3-6 5'	10	5	111	890	60
S2 A-3-6 10'	7	6	89	830	125
S2 A-4	10	11	107	900	32
S2 A-5	15	12	127	990	60
S2 A-6	15	13	146	1100	61
S2 A-7	16	6	111	960	186
S2 A-8	9	4	102	1100	148
S2 A-9	6	3	75	910	95
S2 A-10	11	7	100	930	134
S2 B-1	11	8	112	980	82
S2 B-1-2	27	8	1211	1100	128
S2 B-1-3	12	12	119	920	58
S2 B-1-4	10	7	103	950	151
S2 B-1-5	12	10	135	920	60
S2 B-1-7	37	10	117	960	166
S2 B-1-8	54	3	101	780	207
S2 B-2	21	7	119	1000	219
S2 B-2-8	8	5	96	960	147
S2 B-3 2'	19	6	107	1400	184
S2 B-3 5'	12	10	119	970	97
S2 B-3 10'	8	5	96	900	94
S2 B-4	10	7	104	920	105
S2 B-5	12	10	131	1100	59
S2 B-6	11	2	85	1100	213
S2 B-7	16	9	111	9711	54

	Lead	Arsenic	Vanadium	Barium	Chromium
S2 B-8	9	3	120	1000	114
S2 C-1	110	7	113	970	57
S2 C-1-3	17	12	131	910	48
S2 C-1-4	18	9	143	1000	52
S2 C-1-5	16	11	167	800	51
S2 C-1-6	7	3	811	860	160
S2 C-1-8	159	10	93	1100	241
S2 C-2	281	8	138	940	54
S2 C-2-5	31	12	129	1300	66
s2 C-J	14	8	143	950	64
S2 C-4	7	3	90	9100	88
S2 c-5	13	9	125	1000	54
S2 C-6	16	10	136	1100	85
S2 C-7	31	9	93	1100	195
S2 D-1	17	4	160	1000	114
S2 D-1-1	15	3	159	990	60
S2 D-1-2	12	6	117	940	51
S2 D-1-4	15	12	150	910	55
S2 D-1-5 2'	19	12	167	910	54
S2 D-1-5 5'	15	12	141	970	75
S2 D-1-5 10'	9	4	100	910	109
S2 D-2	261	6	140	980	60
S2 D-3	18	15	144	1100	60
S2 D-4 2'	18	5	111	900	90
S2 D-4 5'	8	7	144	1100	102
S2 D-4 10'	12	8	146	810	70
S2 D-5	20	5	78	1100	202
S2 D-6	16	14	177	890	57
S2 D-7	20	7	125	930	119
SZ E-1	12	3	86	1200	141
S2 E-1-2	13	8	127	930	84
S2 E-1-4	10	7	122	900	132
S2 E-1-5 2'	283	8	110	4800	84
S2 E-1-5 5'	367	7	88	5100	127
S2 E-1-5 10'	381	6	92	5100	91
S2 E-2	13	8	125	920	73
S2 E-3	11	8	116	790	48
S2 E-4	9	6	109	1000	237
S2 E-5	15	10	147	970	57
S2 E-6	15	8	133	1000	140
S2 F-1	14	8	138	980	46
S2 F-1-2	18	6	79	890	190
S2 F-1-3	13	10	151	990	50

	Lead	Arsenic	Vanadium	Barium	Chromium
S2 F-2-2	15	9	155	970	58
S2 F-2-3	15	6	146	850	68
S2 F-3	21	11	149	1100	55
S2 F-3	15	9	133	900	55
S2 F-3	19	20	172	1100	75
S2 F-3 2'	16	11	168	930	54
S2 F-3-2 5'	306	8	157	990	108
S2 F-4 10'	11	8	124	970	60
S2 F-5	9	4	107	8711	91
S2 G-1	19	18	158	910	59
S2 G-1-2	19	8	114	1000	190
S2 G-1-2	16	13	119	840	54
S2 G-1-2 2'	7	6	95	830	121
S2 G-2 5'	30	10	121	980	208
S2 G-3 10'	12	9	136	860	54
S2 G-4	10	4	77	930	171
S2 H-1	12	8	136	890	58
S2 H-2	11	9	130	880	56
S2 K-1	9	5	104	900	169
S2 K-2	10	5	119	890	195
S2 K-3	19	4	93	1100	134
S2 K-4	13	6	130	1000	157
S2 K-5	82	6	129	1200	144
S2 K-6	21	6	135	1100	172
S2 K-7	13	6	117	930	173
S2 K-8	11	6	118	980	82
S2 K-9	24	9	133	1100	194
S2 K-10	21	4	87	970	230
S2 K-11	8	2	68	1000	383
S2 K-12	77	10	73	1200	323
S2 K-13	11	4	92	1000	108
S2 K-14	25	8	119	900	88
S2 K-15	21	7	134	940	130
S2 K-16	23	6	80	970	184
S2 K-17	12	12	116	1200	58
S2 K-18 2'	13	8	101	960	123
S2 K-18 5'	12	8	131	1000	9
S2 K-18 10'	7	2	91	830	50
S2 L-1	126	9	89	1100	214
S2 L-1-3 2'	21	3	82	880	681
S2 L-1-3 5'	35	4	68	1000	534
S2 L-1-3 8'	12	9	136	810	112
S2 L-2	10	6	105	1000	139

	Lead	Arsenic	Vanadium	Barium	Chromium
S2 L-3	29	4	79	900	225
S2 L-4	23	4	74	980	207
S2 L-5	9	6	102	860	81
S2 L-6	33	4	75	1100	308
S2 L-7	13	4	80	1100	196
S2 L-8	24	8	86	1000	198
S2 L-9	26	5	74	1100	265
S2 L-9-1 2'	6	4	80	1100	280
S2 l-9-1 5'	380	14	130	7300	121
S2 L-10	9	5	73	1100	225
S2 L-10-1	8	6	85	890	244
S2 L-11	15	3	65	1000	262
S2 L-12	6	4	70	1100	260
S2 L-12-1 2'	42	18	88	890	466
S2 L-12-1 5'	14	6	82	890	212
S2 L-12-1 10'	6	4	94	1000	290
S2 L-13	10	9	111	1100	138
S2 L-13-1 2'	54	8	110	960	171
S2 L-13-1 5'	8	3	89	920	148
S2 L-13-1 10'	5	1	67	830	210
S2 l-14	17	9	101	1100	155
S2 l-15	14	6	105	1200	179
S2 l-15-1 2'	32	6	101	1000	171
S2 l-15-1 5'	7	4	86	890	384
S2 l-15-1 10'	5	2	76	870	193
S2 l-16	11	6	99	960	216
S2 l-16-1	86	10	139	870	127
S2 L-17	11	8	113	11100	137
S2 l-18	25	5	76	960	176
S2 L-19	16	7	88	1100	170
S2 M-1	12	6	106	970	113
S2 M-1-2 2'	10	7	101	970	143
S2 M-1-2 5'	11	11	106	1100	113
s2 M-1-2 8'	12	3	112	830	89
S2 M-2	17	18	144	1000	117
S2 M-3	12	8	123	1000	173
S2 M-4	20	16	115	880	129
S2 M-5	37	7	89	1000	213
S2 M-6	14	5	82	890	161
S2 M-6-1 2' 'A'	23	8	108	1000	159
S2 M-6-1 2' 'B'	28	6	83	1100	170
S2 M-6-1 5'	10		95	1000	217
S2 M-6-1 10'	6	4	91	1000	194

	Lead	Arsenic	Vanadium	Barium	Chromium
S2 M-7	23	5	79	970	204
S2 M-7-1	87	5	79	970	182
S2 M-7-2 2'	14	4	90	1000	308
S2 M-7-2 5'	12	3	85	880	229
S2 M-8	17	4	93	860	1198
S2 M-9	58	5	77	950	197
sz M-10	11	6	86	1100	228
S2 M-11	8	4	62	1100	184
S2 M-12 2'	7	4	66	1000	251
S2 M-12 5'	6	2	55	12000	264
S2 M-12 10'	223	14	149	2500	143
S2 M-13	7	3	67	1100	221
S2 M-14	17	8	94	1000	162
S2 M-15	11	6	96	1000	131
sz M-15-1 2'	19	4	86	1200	159
s2 M-15-1 5'	20	4	89	1100	244
S2 M-16	17	5	91	1200	160
S2 M-17	23	9	120	940	118
S2 M-18	12	8	123	1100	74
S2 M-19	15	16	128	1100	87
S2 M-20	14	6	106	920	131
S2 N-1	26	4	74	900	201
S2 N-2	14	4	102	1000	194
S2 N-3	9	8	85	980	132
S2 N-4	9	4	66	1100	190
S2 N-5	9	4	78	1100	136
S2 N-6	70	7	99	1100	168
S2 N-7	16	8	83	1100	140
S2 N-8	14	9	1113	920	115
S2 N-9	15	10	1111	840	72
S2 N-10	81	25	123	830	81
S2 N-10-t 2'	9	4	92	8111	136
S2 N-10-1 5'	13	7	128	790	114
S2 N-10-1 10'	15	16	107	700	146
S2 N-11	13	11	118	1200	195
S2 N-17	15	6	121	880	108
S2 N-18	13	3	111	950	98
S2 N-19	13	4	117	920	116
S2 0-15	24	11	69	980	459
S2 0-17 2'	12	8	103	820	96
s2 o-11 5'	15	9	119	880	88
S2 0-17 10'	9	4	94	870	145
S2 0-18	13	7	114	940	99

	Lead	Arsenic	Vanadium	Barium	Chromium
S2 0-19	27	8	107	2100	131
S2 0-20	12	8	106	880	109
S2 P-18	8	4	89	840	216
S2 P-18-1 2'	15	8	109	870	55
S2 P-18-1 5'	14	6	107	770	42
S2 P-18-1 10'	10	3	92	790	123
S2 P-19	12	6	106	920	127
S2 P-20	10	6	110	860	96
S2 P-21	12	8	105	920	109
S2 P-27 12	12	8	107	870	73

NOTES: Cells highlighted in Red indicate samples that exceed the ESL value

Results of the Phase 1 1988 Earth Technology Corporation Site Investigation at Texaco Bryant Lease

The following tables shows the results of the sediment sampling of the Phase 1 1988 Earth Technology Corporation Site Investigation at the Texaco Bryant Lease.

TABLE A-4: 1988 TPHC SOIL SAMPLING RESULTS FROM LCWA PHASE 1 PROPERTY COMPARED TO HUMAN HEALTH CRITERIA

Analyte	units	RSL	B-11-1	B-12-1	MW-1-1	MW-2-1	MW-2-2	MW-3-1	MW-3-2
TPHC	mg/kg	8.2	ND	3,300	ND	320	4	4	4
Depth	feet		8	10	5	5	10	5	10

Notes: Cells highlighted in Red exceed ESL value of 100 mg/kg

TABLE A-5: BTEX GROUNDWATER SAMPLING RESULTS FROM LCWA PHASE I PROPERTY COMPARED TO HUMAN HEALTH CRITERIA

			MW-1			MW-2	MW-3
Analyte	Unit	ESL	7/6/1987	10/20/1987	1/7/1988	1/7/1988	1/7/1998
Benzene	µg/l	0.15	NT	ND	6.4	ND	ND
Toluene	µg/l	1500	NT	ND	ND	2.3	2.3
Ethyl benzene	µg/l	1.5	NT	ND	ND	1.8	1.8
Xylene	µg/l	1,900	NT	ND	ND	2.3	2.3
TPHC	µg/l	0.017	1	2.5	3	2	2

Note: Cells highlighted in Red exceed ESL values

Results of the 1989 Engineering Enterprises, Inc. (EEI) Environmental Assessment

Table A-6 show the results of the 1989 Engineering Enterprises Environmental Assessment compared to human health criteria.

TABLE A-6: SUMMARY OF ENGINEERING ENTERPRISES SOIL SAMPLING COMPARED TO HUMAN HEALTH CRITERIA

Analyte	Unit	Residential ESL	Residential RSL	B-01	B-01	B-02	B-02	B-03	B-03	B-04	B-04	B-05	B-05	B-06	B-06	B-07	B-07	B-08	B-08	B-09	B-09	B-10	B-10	B-11	B-12	B-12	B-13	B-13
Depth	ft.			5	15	5	20	5	15	10	20	10	20	10	20	5	20	3	15	10	20	5	20	15	5	20	5	20
TPH	µg/g		8.2	6.6	ND	ND	ND	ND	ND	ND	ND	5.4	5	ND	18.6	217	62.5	189568	47.6	8.5	ND	12.6	24.8	8.1	43.9	ND	ND	ND
Benzene	µg/g	0.044		ND(g)	ND	<0.10	ND	ND	ND	ND	ND	ND	ND	0.54	0.5	0.6	0.32	11.9	<0.10	0.28	<0.10	<0.10	<0.10	ND	ND	ND	ND	ND
Toluene	µg/g	2.9		0.12	0.14	0.31	<0.10	0.34	<0.10	0.59	0.4	0.28	0.16	0.42	<0.10	<0.10	0.15	81.94	0.25	0.48	ND	<0.10	<0.10	ND	<0.10	ND	ND	ND
Ethyl-Benzene	µg/g	3.3		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	21.14	0.22	ND	ND	ND	ND	ND	ND	ND	ND	ND
Xylenes (O-, M- & P-)	µg/g	2.3		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.10	<0.10	ND	ND	217.25	1.34	<0.10	<0.10	ND	<0.10	ND	ND	ND	ND	ND

Notes: Cells highlighted in Red exceed RSL or ESL values

TABLE A-6 (CONTINUED) SUMMARY OF ENGINEERING ENTERPRISES SOIL SAMPLING COMPARED TO HAZARDOUS WASTE CRITERIA

Analyte	Unit	Residential ESL	Residential RSL	B-14	B-15	B-16	B-17	B-18	B-18	B-18	B-19	B-20	B-20	B-21	B-21	B-22	B-23	N-23	B-24	B-25	B-25	B-27	B-27	B-28	B-28	B-29	B-29	B-30	B-30	B-31	B-31	B-32	B-32
Depth	ft.			10	10	10	10	2	10	20	10	5	10	10	20	10	2	10	10	5	20	5	10	5	20	5	15	5	15	5	15	10	20
TPH	µg/g		8.2	ND	ND	ND	8.1	ND	ND	103.6	ND	1503.1	ND	ND	ND	ND	21671	7139	3118.8	69.2	ND	98.7	7.5	14.1	28.2	9.4	14.7	7	7.2	6.7	12.2	ND	11.8
Benzene	µg/g	0.044		ND	ND	ND	ND	ND	ND	<0.10	ND	0.24	ND	ND	ND	ND	0.24	<0.10	<0.10	<0.10	<0.10	ND	ND	0.11	ND	ND	ND	ND	ND	ND	ND	ND	ND
Toluene	µg/g	2.9		ND	ND	ND	<0.10	<0.10	<0.10	1.14	ND	0.7	<0.10	<0.10	<0.10	<0.10	1.38	0.19	0.26	1.07	<0.10	1.39	<0.10	<0.10	ND	<0.10	<0.10	0.4	0.34	<0.10	<0.10	ND	ND
Ethyl-Benzene	µg/g	3.3		ND	ND	ND	ND	ND	ND	ND	ND	>0.10	ND	ND	ND	ND	2.13	<0.10	ND	1.25	ND	0.55	<0.10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Xylenes (O-, M- & P-)	µg/g	2.3		ND	ND	ND	ND	ND	ND	ND	ND	0.8	ND	ND	ND	ND	19.54	1.43	ND	3.45	6.64	0.47	<0.10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Notes: Cells highlighted in Red exceed RSL or ESL values

Results of the 1991 Camp Dresser & McKee Inc. Phase II Environmental Assessment

Table A-7 shows the samples that exceeded 1000 mg/kg TPHC from the 1991 Camp Dresser & McKee Inc. Phase II Environmental Assessment. Table A-8 shows the results compared to ecological criteria and Table A-9 compares samples to human health criteria.

TABLE A-7: TRPH SAMPLES GREATER THAN 1000 MG/KG

Sample ID	TRPH (mg/kg)
T1-20-19	ND
T1A-20-4	1900
T1A-20-7	1500
T3-20-4	13000
T3-20-8	320
T4-40-8	2800
T4-80-5	19000
T4-100-4	60000
T4-110-4	110000
T4a-120-3	15000
T4A-0-4	67000
T4A-80-2	34000
T5-0-8	21
T5-70-2	40000
T5-80-1.5	50000
T5-100-2	65000
T6-0-8	60000
T6-0-10	130000
T6A-120-1	2100
T7-0-2	1000
T7-20-2	56000
T7-20-7	440
T8B-10-15	15000
T8B-2015	3100
T8C-10-5	18000
T10-10-5	110
TG11-69-5	5500
T11-80-6	76000
T11-100-5	37000
T11A-0-10	17000
T11A-10-5	11000
T12-10-10	62
T12B-3-5	88000

Sample ID	TRPH (mg/kg)
T12B-5-3	11000
T12B-8-6	16000
T13-16-1-	4700
T13-100-5	9400
T13A-0-5	1000
T13B-10-5	29000
T14-0-2	21000
T14-20-5	110000
T14-40-5	109000
T14A-0-3	45000
T14A-20-4	80111
T15-60-5	1300
T15A-40-7	ND
T16A-20-2	4000
T16A-20-4	2100
T16A-30-4	880
T17-120-3	20000
T17-130-3	28000
T180-0-10	6600
T180-20-5	2900
T18-20-10	4500
T18E-10-10	3200
T18E-20-10	1500
T19H-0-1.5	2000
T22-80-5	2500
T22-80-10	470
T22-40-10	1300
T23-10-2	47000
T23-10-5	3100
T23-20-5	8700
T23B-10-5	6500
T24-10-4	27000
T24-30-5	10000
T25-90-3	1200
T25-0-10	8.9
T25-10-5	43000
T25-0-5	520
T25b-0-5	22000
T28B-2-3	12000

TABLE A-8SAMPLES COMPARED TO ECOLOGICAL CRITERIA

	ER-L	ER-M	T1A-20-4	T3-20·4	T4·100·4	T4-110-4	TS-70-2	T6-0·8	n-20-2	TSB-10-15	T11-80-6	T12B-3-5	T13·160-10	T14·0-2	T14-COMP	T16A·20-2	T17·120·3	T18-0·1	T22-80-5	DET.	T23-10-2	T24-10-4	T25·10-5	T258-0-5	T288-2-3
Antimony	NA		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.56	ND	ND	ND	ND	ND
Arsenic	8.2	70	21	1.9	6.1	3.8	10	4.9	3.2	10	3.5	4.3	3.1	5.9	2.4	3.1	2.2	4.6	2.6	0.05	14	4.1	10	2.9	1.4
Barium			160	56	140	130	160	120	2800	130	140	150	300	110	130	590	57	1600	14	0.036	170	200	160	700	85
Beryllium			0.56	0.19	0.61	0.27	0.58	0.38	0.3	0.58	0.44	0.31	0.29	0.29	0.36	0.12	0.21	0.4	0.18	0.012	0.57	0.48	0.6	0.48	0.32
Cadmium	1.2	9.6	ND	0.12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.16	0.11	0.27	ND	ND	0.73	ND
Chromium	81	370	25	17	27	28	25	17	34	23	20	20	16	22	21	7.9	19	21	7.7	0.32	29	22	0.27	19	16
Cobalt			16	6.6	12	7.4	13	8.4	13	12	11	12	11	9.6	10	4.5	7.3	9.6	5.1	0.13	15	11	14	11	9.6
Copper	34	270	34	16	32	24	36	23	20	26	34	25	21	33	30	8.1	14	110	5.8	0.14	44	26	32	37	17
lead	46.7	218	13	48	99	13	51	26	11	7.6	35	5.4	5.4	45	78	4.2	68	82	2.8	0.8	18	13	16	100	6.6
Mercury	0.15	0.71	0.08	ND	0.06	0.05	0.25	ND	ND	ND	0.17	0.03	ND	ND	0.04	ND	ND	ND	ND	0.02	ND	ND	ND	0.19	ND
Molybdenum			1.2	1.1	1.7	2.9	1.7	1.4	0.76	0.49	1.1	0.4	0.56	2.8	4.1	0.22	1.1	1.2	1.8	0.11	0.98	1.2	2	1.6	0.61
Nickel	20.9	51.6	22	14	23	24	21	15	97	17	19	18	13	20	21	6.3	15	18	5.3	0.13	23	20	22	20	14
Selenium			0.14	0.25	0.29	1.8	0.21	0.19	0.11	ND	0.17	0.48	0.03	0.37	ND	ND	0.23	0.3	0.15	0.05	0.14	0.28	0.29	0.09	0.38
Silver	1	3.7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.19	ND	ND	ND	ND	ND
Thallium			ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	7	ND	ND	ND	ND	ND
Vanadium			48	24	8	40	54	35	30	42	42	45	33	46	41	17	27	39	17	0.12	55	46	55	39	36
Zinc	150	410	67	71	82	59	160	51	60	59	220	45	44	54	75	24	69	170	21	0.012	330	62	66	1800	49

Notes: Cells highlighted in Yellow exceed ER-L values. Cells highlighted in Red exceed ER-M values

TABLE A-9SAMPLES COMPARED TO HUMAN HEALTH CRITERIA

	ESL	T1A-20-4	T3-20·4	T4·100·4	T4-110-4	TS-70-2	T6-0·8	n-20-2	TSB-10-15	T11-80-6	T12B-3-5	T13·160-10	T14·0-2	T14-COMP	T16A·20-2	T17·120·3	T18-0·1	T22-80-5	DET.	T23-10-2	T24-10-4	T25·10-5	T258-0-5	T288-2-3
Antimony	3.1E+01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.56	ND	ND	ND	ND	ND
Arsenic	0.0674819	21	1.9	6.1	3.8	10	4.9	3.2	10	3.5	4.3	3.1	5.9	2.4	3.1	2.2	4.6	2.6	0.05	14	4.1	10	2.9	1.4
Barium	3019.0991	160	56	140	130	160	120	2800	130	140	150	300	110	130	590	57	1600	14	0.036	170	200	160	700	85
Beryllium	41.558402	0.56	0.19	0.61	0.27	0.58	0.38	0.3	0.58	0.44	0.31	0.29	0.29	0.36	0.12	0.21	0.4	0.18	0.012	0.57	0.48	0.6	0.48	0.32
Cadmium	38.9973	ND	0.12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.16	0.11	0.27	ND	ND	0.73	ND
Chromium	1.0E+04	25	17	27	28	25	17	34	23	20	20	16	22	21	7.9	19	21	7.7	0.32	29	22	0.27	19	16
Cobalt	23.399764	16	6.6	12	7.4	13	8.4	13	12	11	12	11	9.6	10	4.5	7.3	9.6	5.1	0.13	15	11	14	11	9.6
Copper	3128.5714	34	16	32	24	36	23	20	26	34	25	21	33	30	8.1	14	110	5.8	0.14	44	26	32	37	17
lead	80	13	48	99	13	51	26	11	7.6	35	5.4	5.4	45	78	4.2	68	82	2.8	0.8	18	13	16	100	6.6
Mercury	12.510606	0.08	ND	0.06	0.05	0.25	ND	ND	ND	0.17	0.03	ND	ND	0.04	ND	ND	ND	ND	0.02	ND	ND	ND	0.19	ND
Molybdenum	391.07143	1.2	1.1	1.7	2.9	1.7	1.4	0.76	0.49	1.1	0.4	0.56	2.8	4.1	0.22	1.1	1.2	1.8	0.11	0.98	1.2	2	1.6	0.61
Nickel	86.342551	22	14	23	24	21	15	97	17	19	18	13	20	21	6.3	15	18	5.3	0.13	23	20	22	20	14
Selenium	391.06604	0.14	0.25	0.29	1.8	0.21	0.19	0.11	ND	0.17	0.48	0.03	0.37	ND	ND	0.23	0.3	0.15	0.05	0.14	0.28	0.29	0.09	0.38
Silver	391.07143	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.19	ND	ND	ND	ND	ND
Thallium	0.7821429	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	7	ND	ND	ND	ND	ND
Vanadium	393.10739	48	24	8	40	54	35	30	42	42	45	33	46	41	17	27	39	17	0.12	55	46	55	39	36
Zinc	23464.286	67	71	82	59	160	51	60	59	220	45	44	54	75	24	69	170	21	0.012	330	62	66	1800	49

Notes: Cells in Red exceed ESL values

Results of the 2004 Anchor LCWA Hellman Ranch (South LCWA) Soil and Groundwater Sampling

Tables A-10 through A-12 compare the results of the 2014 LCWA Hellman Ranch sampling to hazardous waste criteria, ecological criteria, and human health. H

TABLE A-10: SUMMARY OF 2004 SAMPLES COMPARED TO HAZARDOUS WASTE CRITERIA.

Group	Analyte	Units	TTLC	STLC	Mean Concentration	Minimum Concentration	Maximum Concentration
Metals	Arsenic (As)	mg/kg	500	5	7.87	0.96	40
	Chromium (Total)	mg/kg	2500	560	32.1	8.58	57.6
	Copper	mg/kg	2500	25	31.3	7.17	65.6
	Lead	mg/kg	1000	5	30.1	7.17	65.6
	Mercury	mg/kg	20		0.18	ND	0.919
	Nickle	mg/kg	2000	20	24.9	5.78	49.1
	Selenium	mg/kg	100	1	0.38	ND	1.27
	Silver	mg/kg	500	5	0.09	ND	0.23
	Thallium	mg/kg	700	7	0.24	ND	0.52
	Zinc	mg/kg	5000	250	94.4	31.2	207
Pesticides	4,4”-DDD	µg/kg			0.7	ND	2.8
	4,4”-DDE	µg/kg	1	0.1	1.99	ND	42
	4,4”-DDT	µg/kg	1	0.1	1.89	ND	22
	Aldrin	µg/kg			NA	ND	ND
	Alpha-BHC	µg/kg			NA	1.8	1.8
	Beta-BHC	µg/kg			NA	ND	ND
	Chlordane	µg/kg	2.5	0.25	7.19	ND	49
	Delta-BH	µg/kg			NA	ND	ND

Notes: Cells highlighted in Yellow exceed ten times STLCL values. Cells highlighted in Red exceed TTLC values

TABLE A-11: SUMMARY OF 2004 SAMPLES COMPARED TO ECOLOGICAL CRITERIA

Group	Analyte	Units	ER-Ls	ER-Ms	Mean Concentration	Minimum Concentration	Maximum Concentration
Metals	Arsenic (As)	mg/kg	8.2	70	7.87	0.96	40
	Chromium (Total)	mg/kg	81	370	32.1	8.58	57.6
	Copper	mg/kg	34	270	31.3	7.17	65.6
	Lead	mg/kg	46.7	218	30.1	7.17	65.6
	Mercury	mg/kg	0.15	0.71	0.18	ND	0.919
	Nickle	mg/kg	20.9	51.6	24.9	5.78	49.1
	Selenium	mg/kg	NA	NA	0.38	ND	1.27
	Silver	mg/kg	1	3.7	0.09	ND	0.23
	Thallium	mg/kg	NA	NA	0.24	ND	0.52
	Zinc	mg/kg	150	410	94.4	31.2	207
Pesticides	4,4”-DDD	µg/kg	2	7.81(a)	0.7	ND	2.8
	4,4”-DDE	µg/kg	2.2	374	1.99	ND	42
	4,4”-DDT	µg/kg	1	4.77(a)	1.89	ND	22
	Aldrin	µg/kg	NA	NA	NA	ND	ND
	Alpha-BHC	µg/kg	NA	NA	NA	1.8	1.8
	Beta-BHC	µg/kg	NA	NA	NA	ND	ND
	Chlordane	µg/kg	0.5	4.79(a)	7.19	ND	49
	Delta-BH	µg/kg	NA	NA	NA	ND	ND
	Dieldrin	µg/kg	0.02	4.3	0.98	2.4	24
	Endosulfan I	µg/kg	NA	NA	NA	ND	ND
	Endosulfan II	µg/kg	NA	NA	NA	ND	ND
	Endosulfan Sulfate	µg/kg	NA	NA	NA	ND	ND
	Endrin	µg/kg	NA	NA	NA	ND	ND
	Endrin Aldehyde	µg/kg	NA	NA	NA	ND	ND
	Endrin Ketone	µg/kg	NA	NA	NA	ND	ND
	Gamme-BHC	µg/kg	NA	0.99	NA	ND	ND
	Heptachlor	µg/kg	NA	NA	NA	ND	ND
	Heptachlor Epoxide	µg/kg	NA	NA	NA	1.8	1.8
	Methoxychlor	µg/kg	NA	NA	NA	1.2	1.2
	Toxaphene	µg/kg	NA	NA	NA	ND	ND
Polychlorinated biphenyls (PCBs)	Aroclor-1016	mg/kg	NA	NA	NA	ND	ND
	Aroclor-1221	mg/kg	NA	NA	NA	ND	ND
	Aroclor-1232	mg/kg	NA	NA	NA	ND	ND
	Aroclor-1242	mg/kg	NA	NA	NA	ND	ND
	Aroclor-1248	mg/kg	NA	NA	NA	ND	ND
	Aroclor-1254	mg/kg	NA	NA	NA	ND	ND
	Aroclor-1260	mg/kg	NA	NA	NA	ND	ND
	Aroclor-1262	mg/kg	NA	NA	NA	ND	ND

Group	Analyte	Units	ER-Ls	ER-Ms	Mean Concentration	Minimum Concentration	Maximum Concentration
	Total PCBs	mg/kg	22.7	180	NA	Na	NA
PAHs	Acenapthene	mg/kg	0.016	0.5	NA	0.059	0.059
Low molecular weight	Acenaphthlene	mg/kg	0.044	0.64	NA	ND	ND
	Anthracene	mg/kg	0.0853	1.1	NA	0.02	0.02
	Flourene	mg/kg	0.019	0.54	0.02	ND	0.53
	Napthalene	mg/kg	0.16	2.1	0.05	ND	1.4
	Phenathrene	mg/kg	0.24	1.5	0.04	ND	0.76
PAHs	Benzo(a) Anthracene	mg/kg	0.261	1.6	0.013	ND	0.045
High molecular weight	Benzo (a)Pyrene	mg/kg	0.43	1.6	0.01	ND	0.21
	Benzo (b) Flouranthene	mg/kg	Na	NA	0.01	ND	0.052
	Benzo (g,h,I) Perylene	mg/kg	Na	NA	0.01	ND	0.05
	Benzo (k) Flouranthene	mg/kg	Na	NA	0.01	ND	0.047
	Chrysene	mg/kg	0.384	2.8	0.02	ND	0.13
	Dibenz (a,h) Anthracene	mg/kg	0.0634	NA	Na	ND	ND
	Flouranthene	mg/kg	0.6	5.1	0.02	0.025	0.53
	Indeno (1,2,3-c,d) Pyrene	mg/kg	NA	NA	0.01	0.022	0.023
	Pyrene	mg/kg	NA	2.6	0.04	ND	0.76

Notes: Cells highlighted in Yellow exceed ER-L values. Cells highlighted in Red exceed ER-M values

TABLE A-12: SUMMARY OF 2004 SAMPLES COMPARED TO HUMAN HEALTH CRITERIA

Group	Analyte	Units	Residential ESL (mg/kg)	Mean Concentration	Minimum Concentration	Maximum Concentration
Metals	Arsenic (As)	mg/kg	0.07	7.87	0.96	40
	Chromium (Total)	mg/kg	0.30	32.1	8.58	57.6
	Copper	mg/kg	3129	31.3	7.17	65.6
	Lead	mg/kg	80.00	30.1	7.17	65.6
	Mercury	mg/kg	12.5	0.18	ND	0.919
	Nickle	mg/kg	391.1	24.9	5.78	49.1
	Selenium	mg/kg	391.1	0.38	ND	1.27
	Silver	mg/kg	391.1	0.09	ND	0.23
	Thallium	mg/kg	0.78	0.24	ND	0.52
	Zinc	mg/kg	23464	94.4	31.2	207
Pesticides	4,4”-DDD	µg/kg	1.89	0.7	ND	2.8
	4,4”-DDE	µg/kg	1.89	1.99	ND	42
	4,4”-DDT	µg/kg		1.89	ND	22
	Aldrin	µg/kg	0.04	NA	ND	ND
	Alpha-BHC	µg/kg		NA	1.8	1.8
	Beta-BHC	µg/kg		NA	ND	ND
	Chlordane	µg/kg	0.48	7.19	ND	49
	Delta-BH	µg/kg		NA	ND	ND
	Dieldrin	µg/kg	0.04	0.98(b)	2.4	24
	Endosulfan I	µg/kg		NA	ND	ND
	Endosulfan II	µg/kg		NA	ND	ND
	Endosulfan Sulfate	µg/kg		NA	ND	ND
	Endrin	µg/kg	20.98	NA	ND	ND
	Endrin Aldehyde	µg/kg		NA	ND	ND
	Endrin Ketone	µg/kg		NA	ND	ND
	Gamme-BHC	µg/kg		NA	ND	ND
	Hptachlor	µg/kg	0.14	NA	ND	ND
	Heptachlor Epoxide	µg/kg	0.07	NA	1.8	1.8
	Methoxychlor	µg/kg	349.6	NA	1.2	1.2
	Toxaphene	µg/kg	0.51	NA	ND	ND
PCBs	Aroclor-1016	mg/kg		NA	ND	ND
	Aroclor-1221	mg/kg		NA	ND	ND
	Aroclor-1232	mg/kg		NA	ND	ND
	Aroclor-1242	mg/kg		NA	ND	ND
	Aroclor-1248	mg/kg		NA	ND	ND
	Aroclor-1254	mg/kg		NA	ND	ND
	Aroclor-1260	mg/kg		NA	ND	ND
	Aroclor-1262	mg/kg		NA	ND	ND
	Total PCBs	mg/kg		NA	Na	NA

Group	Analyte	Units	Residential ESL (mg/kg)	Mean Concentration	Minimum Concentration	Maximum Concentration
PAHs	Acenapthene	mg/kg	3586.5	NA	0.059	0.059
Low molecular weight	Acenaphthlene	mg/kg		NA	ND	ND
	Anthracene	mg/kg		NA	0.02	0.02
	Flourene	mg/kg	2391.0	0.02	ND	0.53
	Napthalene	mg/kg	3.28	0.05	ND	1.4
	Phenathrene	mg/kg		0.04	ND	0.76
PAHs	Benzo(a) Anthracene	mg/kg	0.16	0.013	ND	0.045
High molecular weight	Benzo (a)Pyrene	mg/kg	0.02	0.01	ND	0.21
	Benzo (b) Flouranthene	mg/kg	0.16	0.01	ND	0.052
	Benzo (g,h,I) Perylene	mg/kg		0.01	ND	0.05
	Benzo (k) Flouranthene	mg/kg	1.57	0.01	ND	0.047
	Chrysene	mg/kg	14.73	0.02	ND	0.13
	Dibenz (a,h) Anthracene	mg/kg	0.02	Na	ND	ND
	Flouranthene	mg/kg	2391.0	0.02	0.025	0.53
	Indeno (1,2,3-c,d) Pyrene	mg/kg	0.16	0.01	0.022	0.023
	Pyrene	mg/kg	1793.2	0.04	ND	0.76

Notes: Cells highlighted in Red exceed ESL values

Results of the 2014 Pacific Coast Environmental Conservancy (PCEC) Geotechnical Assessment

The following tables show the results of the 2014 sampling at Zedler Marsh and the State Lands Parcel.

TABLE A-13: SUMMARY OF 2004 SAMPLES COMPARED TO ECOLOGICAL CRITERIA

PAH Analyte	ER-L	ER-M	ZM1	ZM2	ZM3	ZM4	ZM5	ZM6	ZM7	ZM8	SLP9	SLP10 R1	SLP10 R2	SLP 10 MS1	SLP10 MS2
								ppb							
d10-Acenaphthene)			68	67	66	67	60	60	64	65	65	66	70	68	66
(d10-Phenanthrene)			82	86	84	84	81	74	83	83	81	84	88	88	87
(d12-Chrysene)			92	113	108	105	101	95	103	106	92	110	113	114	110
(d12-Perylene)			114	112	113	114	107	103	106	117	112	103	106	98	99
(d8-Naphthalene)			49	49	45	48	40	40	43	48	48	47	50	50	49
1-Methylnaphthalene			1.2	1.8	ND	ND	ND	ND	ND	ND	ND	ND	ND	24.3	23.7
1-Methylphenanthrene			2.3	7.2	1	1	ND	ND	ND	2.2	ND	1.6	1.5	38.1	38.6
2,3,5-Trimethylnaphthalene			ND	1.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	28.8	28.7
1,6-Dimethylnaphthalene			1.7	2.3	1	1	ND	ND	ND	1.3	ND	ND	ND	26.3	26
2-Methylnaphthalene			2.3	2.7	1.1	1.2	ND	ND	ND	1.4	ND	ND	ND	24.5	24.1
Acenaphthene	16.00	500.00	1.3	3	ND	ND	ND	ND	ND	ND	ND	ND	ND	27.1	27
Acenaphthylene	44.00	640.00	3.4	1.8	ND	ND	ND	ND	ND	ND	ND	1.1	1	29.2	27.6
Anthracene	85.30	1100.00	15.4	12.7	1.1	1.8	ND	ND	ND	2.9	ND	1.8	1.3	33.6	33.5
Benz[a]anthracene	261.00	1600.00	6.5	85.2	3.1	9.8	ND	ND	1.9	11.8	2.5	11.9	10.4	64.8	61.9
Benzo[a]pyrene	430.00	1600.00	3.6	101.8	5	12.6	1	1.2	3.3	12.6	3.7	15.3	13.8	72.7	70.5
Benzo[b]fluoranthene			5.7	105.3	4.8	14.3	ND	ND	3.6	11.3	3.9	14.7	13.5	69.2	68.1
Benzo[e]pyrene			15.4	93.2	10.4	16.6	1	3.2	4.9	28.4	5.9	17.6	17.8	69.9	67.2
Benzo[g,h,i]perylene			37.7	71.2	10.6	15.4	ND	3.4	4.8	30.1	6.1	17.9	17.7	57.8	57.8
Benzo[k]fluoranthene			2.8	60.3	2.7	6.9	ND	ND	2.1	6.2	1.9	8.5	8	62.5	62.9
Biphenyl			ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	24.9	24.4
Chrysene	384.00	2800.00	10.4	138.8	8.5	13.2	1.1	1.2	4.6	21.4	6.4	19.7	18.6	74.1	66.9
Dibenz[a,h]flouranthene			ND	22.3	2.2	3.8	ND	ND	1	6	1.4	4	4.5	41	44.2
Dibenzothiophene			ND	2.7	ND	ND	ND	ND	ND	ND	ND	ND	ND	33.3	32.9
Fluoranthene	600.00	5100.00	15.6	139.1	4.9	17.6	ND	1.2	4.1	21.9	6.4	17.3	12.6	75.9	59.4
Fluorene	19.00	540.00	ND	1.7	ND	ND	ND	ND	ND	ND	ND	ND	ND	31.1	30.6
Indeno[1,2,3-c,d]pyrene			8.3	70.7	4.8	11.7	ND	ND	3.3	10.5	3.1	10.6	10.2	54.4	55.9
Naphthalene	160.00	2100.00	1.2	2.1	ND	1.2	ND	ND	ND	ND	ND	ND	ND	20.6	20.9
Perylene			111.8	54.2	11.7	19.1	ND	3.8	4	130.5	4.7	7.3	7.9	59.9	56.6
Phenanthrene			14.2	48.3	2.8	4.9	ND	ND	2.3	11.6	3.5	8.5	5.2	48.8	41.3
Pyrene			15.8	140	6.7	13.4	1.7	1.4	4.4	20.8	7.6	18.7	15.7	79.5	63.9

Note: Cells I n Yellow exceed ER-L values

TABLE A-14: SUMMARY OF 2014 SAMPLES COMPARED TO HUMAN HEALTH CRITERIA

PAH Analyte	ESL (mg/kg)	ZM1	ZM2	ZM3	ZM4	ZM5	ZM6	ZM7	ZM8	SLP9	SLP10 R1	SLP10 R2	ZM1	ZM2	ZM3	ZM4	ZM5	ZM6	ZM7	ZM8	SLP9	SLP10 R1	SLP10 R2
							ppb										mg/kg (mg/kg = ppb/1000)						
d10-Acenaphthene)		68	67	66	67	60	60	64	65	65	66	70	0.07	0.07	0.07	0.07	0.06	0.06	0.06	0.07	0.07	0.07	0.07
(d10-Phenanthrene)		82	86	84	84	81	74	83	83	81	84	88	0.08	0.09	0.08	0.08	0.08	0.07	0.08	0.08	0.08	0.08	0.09
(d12-Chrysene)		92	113	108	105	101	95	103	106	92	110	113	0.09	0.11	0.11	0.11	0.10	0.10	0.10	0.11	0.09	0.11	0.11
(d12-Perylene)		114	112	113	114	107	103	106	117	112	103	106	0.11	0.11	0.11	0.11	0.11	0.10	0.11	0.12	0.11	0.10	0.11
(d8-Naphthalene)		49	49	45	48	40	40	43	48	48	47	50	0.05	0.05	0.05	0.05	0.04	0.04	0.04	0.05	0.05	0.05	0.05
1-Methylnaphthalene		1.2	1.8	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.00	0.00	ND	ND	ND	ND	ND	ND	ND	ND	ND
1-Methylphenanthrene		2.3	7.2	1	1	ND	ND	ND	2.2	ND	1.6	1.5	0.00	0.01	0.00	0.00	ND	ND	ND	0.00	ND	0.00	0.00
2,3,5-Trimethylnaphthalene		ND	1.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.00	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,6-Dimethylnaphthalene		1.7	2.3	1	1	ND	ND	ND	1.3	ND	ND	ND	0.00	0.00	0.00	0.00	ND	ND	ND	0.00	ND	ND	ND
2-Methylnaphthalene		2.3	2.7	1.1	1.2	ND	ND	ND	1.4	ND	ND	ND	0.00	0.00	0.00	0.00	ND	ND	ND	0.00	ND	ND	ND
Acenaphthene	16.29	1.3	3	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.00	0.00	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acenaphthylene	1.3E+01	3.4	1.8	ND	ND	ND	ND	ND	ND	ND	1.1	1	0.00	0.00	ND	ND	ND	ND	ND	ND	ND	0.00	0.00
Anthracene		15.4	12.7	1.1	1.8	ND	ND	ND	2.9	ND	1.8	1.3	0.02	0.01	0.00	0.00	ND	ND	ND	0.00	ND	0.00	0.00
Benz[a]anthracene	1.6E-01	6.5	85.2	3.1	9.8	ND	ND	1.9	11.8	2.5	11.9	10.4	0.01	0.09	0.00	0.01	ND	ND	0.00	0.01	0.00	0.01	0.01
Benzo[a]pyrene	0.02	3.6	101.8	5	12.6	1	1.2	3.3	12.6	3.7	15.3	13.8	0.00	0.10	0.01	0.01	0.00	0.00	0.00	0.01	0.00	0.02	0.01
Benzo[b]fluoranthene	0.16	5.7	105.3	4.8	14.3	ND	ND	3.6	11.3	3.9	14.7	13.5	0.01	0.11	0.00	0.01	ND	ND	0.00	0.01	0.00	0.01	0.01
Benzo[e]pyrene		15.4	93.2	10.4	16.6	1	3.2	4.9	28.4	5.9	17.6	17.8	0.02	0.09	0.01	0.02	0.00	0.00	0.00	0.03	0.01	0.02	0.02
Benzo[g,h,i]perylene	2.50	37.7	71.2	10.6	15.4	ND	3.4	4.8	30.1	6.1	17.9	17.7	0.04	0.07	0.01	0.02	ND	0.00	0.00	0.03	0.01	0.02	0.02
Benzo[k]fluoranthene	1.57	2.8	60.3	2.7	6.9	ND	ND	2.1	6.2	1.9	8.5	8	0.00	0.06	0.00	0.01	ND	ND	0.00	0.01	0.00	0.01	0.01
Biphenyl	6.5E-01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chrysene	3.84	10.4	138.8	8.5	13.2	1.1	1.2	4.6	21.4	6.4	19.7	18.6	0.01	0.14	0.01	0.01	0.00	0.00	0.00	0.02	0.01	0.02	0.02
Dibenz[a,h]flouranthene		ND	22.3	2.2	3.8	ND	ND	1	6	1.4	4	4.5	ND	0.02	0.00	0.00	ND	ND	0.00	0.01	0.00	0.00	0.00
Dibenzothiophene		ND	2.7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.00	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fluoranthene	60.45	15.6	139.1	4.9	17.6	ND	1.2	4.1	21.9	6.4	17.3	12.6	0.02	0.14	0.00	0.02	ND	0.00	0.00	0.02	0.01	0.02	0.01
Fluorene	8.94	ND	1.7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.00	ND	ND	ND	ND	ND	ND	ND	ND	ND
Indeno[1,2,3-c,d]pyrene	0.16	8.3	70.7	4.8	11.7	ND	ND	3.3	10.5	3.1	10.6	10.2	0.01	0.07	0.00	0.01	ND	ND	0.00	0.01	0.00	0.01	0.01
Naphthalene	0.03	1.2	2.1	ND	1.2	ND	ND	ND	ND	ND	ND	ND	0.00	0.00	ND	0.00	ND	ND	ND	ND	ND	ND	ND
Perylene		111.8	54.2	11.7	19.1	ND	3.8	4	130.5	4.7	7.3	7.9	0.11	0.05	0.01	0.02	ND	0.00	0.00	0.13	0.00	0.01	0.01
Phenanthrene	10.69	14.2	48.3	2.8	4.9	ND	ND	2.3	11.6	3.5	8.5	5.2	0.01	0.05	0.00	0.00	ND	ND	0.00	0.01	0.00	0.01	0.01
Pyrene	85.06	15.8	140	6.7	13.4	1.7	1.4	4.4	20.8	7.6	18.7	15.7	0.02	0.14	0.01	0.01	0.00	0.00	0.00	0.02	0.01	0.02	0.02

Appendix B
Ocean Disposal

OCEAN DISPOSAL

On-site sediment that is not used for on-site beneficial use as wetland surface, wetland foundation or upland placement may be designated for alternative placement depending on final cut and fill balance quantities. The suitability of on-site excavated sediment for placement at a designated ocean dredged material disposal sites would require a Tier III evaluation in accordance with Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S. – Testing Manual (ITM; USEPA/USACE 1998, Section 6.7) and Evaluation of Dredged Material Proposed for Ocean Disposal – Testing Manual (OTM; USEPA/USACE 1991) guidelines. Sampling and testing requirements under these protocols include:

- **Sampling Frequency** - The general rule is a minimum of two composite samples will be used for the first 100,000 cubic yards (CY) and one composite sample will be used per subsequent 100,000 CY. However, additional composites or analyses of individual cores may be required if contaminant hot spots are identified.
- **Geotechnical Testing** - Physical analysis should include grain size, specific gravity, and total solids. Atterberg limits are also recommended to estimate strength and settlement characteristics of the sediment.
- **Chemical Testing** - Chemical analysis of bulk sediment should include general chemistry (i.e., ammonia, total sulfides, and total organic carbon [TOC]), trace metals, chlorinated pesticides, PCB Congeners, PAHs, other semi volatile organic compounds (i.e., phenols and phthalates), and organotin.

Similar to the assessment of the suitability of the project's excavated sediment for use as on-site wetland surface and foundation materials, the chemical analyses results may be compared to ER-L and ER-M values. The values are helpful in assessing the potential significance of elevated sediment-associated contaminants of concern, in conjunction with biological analysis. While these screening level values are useful for identifying elevated sediment-associated contaminants, they should not be used to infer causality because of the inherent variability and uncertainty of the approach. As presented previously, the results of chemical analyses of on-site sediment samples indicated concentrations of many constituents (lead, chromium, arsenic, copper, mercury, nickel, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, chlordane, and dieldrin., and zinc above the ER-L and ER-M thresholds. s. Concentrations were not above the ER-Ms.

The additional biological testing that is required under the ocean disposal guidance includes:

- **Solid Phase Toxicity Testing** - Two solid phase (SP) 10-day acute tests performed on whole sediment are conducted to estimate potential adverse effects of ocean disposed dredged material on benthic organisms. One SP test may be conducted using an amphipod species. The species should be selected based on grain size tolerance (i.e., *Eohaustorius estuarius* prefer primarily coarse-grained sediment while *Ampelisca abdita* prefer fine-grained sediment) to reduce confounding effects unrelated to contaminants. The polychaete *Neanthes arenaceodentata* may be used.

- **Suspended particulate phase (SPP) Toxicity Testing –** Three suspended particulate phase (SPP) tests are required. SPP tests are conducted to estimate the potential adverse effects of ocean disposed dredged material on organisms that live in the water column. These tests are performed on sediment elutriates, prepared at a ratio of one part sediment and four parts site water in accordance with ITM (USEPA/USACE 1998) and OTM (USEPA/USACE 1991) guidelines. SPP tests may be performed using the mysid shrimp *Americamysis bahia* (formerly *Mysidopsis bahia*), the fish *Menidia beryllina*, and the larvae of a bivalve. The bivalve species may include *Mytilus galloprovincialis*; however, if gravid mussels are not available, an alternate species should be selected in consultation with USEPA and USACE. Both the mysid shrimp and fish SPP tests are 96-hour acute tests, while the *M. galloprovincialis* SPP test is a 48-hour chronic test that measures both survival and development.
- **Bioaccumulation Potential Testing**—The Bioaccumulation Potential (BP) testing consists of a 28-day test performed on whole sediment. The purpose of the BP tests is to estimate the potential of benthic organisms to bioaccumulate contaminants of concern from ocean disposed dredged material. BP tests may be conducted using the bivalve *Macoma nasuta* and the polychaete *Nereis virens*; however, *Nephthys caecoides* may be used as an alternative polychaete species. At test termination, bioaccumulation tissue samples should be submitted for chemical analysis. The tissue analyte list should focus on those chemicals present at levels of concern in sediment (i.e., greater than ER-M values) and based on approval by the Contaminated Sediment Task Force prior to analysis of tissue samples.

The biological testing that has been performed to date on the on-site sediment for assessing suitability for on-site beneficial use has included solid phase toxicity testing. As discussed previously, the result of this toxicity testing indicated a significant difference from the control for one of the three species tested. The differences from the control sample were observed for the *Eohaustorius estuaries,* which is likely the result of the fine-grained nature of the sediment samples as discussed.

Based on the available results, the placement of on-site excavated sediments (not used for on-site wetland restoration and upland habitat) at a designated ocean disposal or open water placement site remains a potential option, if needed. However, the determination of suitability will require further biological testing in accordance with ITM (USEPA/USACE 1998) and OTM (USEPA/USACE 1991) guidelines as outlined above. The additional testing will include running the solid phase toxicity testing using a fine-grained control, and SSP and BP testing as discussed above.

For SPP testing, results are compared to the control. If a median lethal concentration (LC50) or median effective concentration (EC50) can be calculated, a dilution water model should be used to perform a comparison with water quality standards. A short-term fate (STFATE) mixing zone model should be used to determine if LPC requirements will be met; water column concentrations must not exceed 1 percent of the LC50 or EC50 outside the mixing zone 4 hours after dredged material disposal.

For BP testing, tissue concentrations are compared with applicable U.S. Food and Drug Administration (FDA) action levels, and tissue concentrations of organisms exposed to reference sediment. If tissue concentrations of organisms exposed to test sediment are statistically elevated compared to the organisms exposed to reference sediment, results should be assessed based on the criteria specified in the OTM (USEPA/USACE 1991; e.g., toxicological importance of contaminants, magnitude of exceedance, and propensity to biomagnify).

The biological testing for the evaluation of suitability for on-site beneficial use and ocean disposal was performed using a phased approach to avoid the need for unnecessary testing. Additional testing will be performed as needed in accordance with applicable requirements.