

**“STEP-OUT” SOLID MATRIX SAMPLING AND ANALYSIS RESULTS
AND SEDIMENT CHROMIUM SPECIATION
HALACO SUPERFUND SITE
REMEDIAL INVESTIGATION
OXNARD, CALIFORNIA**

EPA CONTRACT NO. EP-S9-08-04
EPA TASK ORDER NO. 015-RIRI-09X6
CH2M HILL PROJECT NO. 385135

Prepared for
U.S. Environmental Protection Agency
Region 9
75 Hawthorne Street
San Francisco, California 94105

Prepared by
CH2M HILL
325 East Hillcrest Dr., Suite 125
Thousand Oaks, California 91360

January 2013

Contents

Section	Page
Acronyms and Abbreviations	v
1 Introduction.....	1-1
1.1 Objectives.....	1-1
1.2 Background	1-1
1.3 EPA Actions from 2006 through 2011.....	1-2
2 Initial Conceptual Site Model.....	2-1
2.1 Extent of Contamination	2-1
2.1.1 North of Waste Management Area.....	2-1
2.1.2 South of Waste Management Area	2-2
2.2 Chromium Speciation.....	2-2
3 Remedial Investigation Activities.....	3-1
3.1 Field Investigation Activities.....	3-1
3.1.1 Step-out Sampling	3-1
3.1.2 Chromium Speciation Sampling	3-1
3.2 Field Sample Collection Procedures	3-2
3.3 Field Parameter Measurement	3-3
3.4 Sample Collection and Quality Control Samples	3-3
3.5 Sample Custody and Tracking Procedures	3-4
3.6 Laboratory Analysis and Data Validation	3-4
4 Remedial Investigation Results.....	4-1
4.1 Extent of Contamination in NCL-North and Wetland Areas	4-1
4.2 Chromium Speciation and Field Parameters for Sediment Samples	4-2
4.3 Field Parameters for Process Waste and Soil Slurry Samples.....	4-3
5 Conclusions	5-1
5.1 Extent of Contamination in NCL-North and Wetland Areas	5-1
5.2 Chromium Speciation and Field Parameters for Sediment Samples	5-2
5.3 Field Parameters for Process Waste and Soil Slurry Samples.....	5-2
6 References.....	6-1

Tables

- 1 Metals Analytical Results, Solid Matrix, Step-out Samples, NCL-North Pond Area
- 2 Metals Analytical Results, Solid Matrix, Step-out Samples, WMU Ditch Area
- 3 Chromium Analytical Results, Sediment Samples
- 4 Field Parameter Results, Submerged Sediment, Top Water and Pore Water Samples
- 5 Field Parameter Results, Process Waste and Soil, Slurry Samples

Figures

- 1 Halaco Superfund Site Areas
- 2 Solid Matrix Sample Locations, All RI Locations
- 3 Step-out Solid Matrix Sample Locations, NCL-North
- 4 Step-out Solid Matrix Sample Locations, Ditch South of WMU
- 5 Chromium Speciation Analysis and pH/ORP Field Measurement Sample Locations
- 6a Lead Solid Matrix Concentrations, NCL-North, Surface Samples
- 6b Lead Solid Matrix Concentrations, NCL-North, B Interval
- 7a Lead Solid Matrix Concentrations, Ditch South of WMU, Surface Samples
- 7b Lead Solid Matrix Concentrations, Ditch South of WMU, B Interval

Attachments

- A Lithologic Descriptions of Solid Matrix Samples, NCL-North and WMU Ditch Areas
- B Chromium Speciation Laboratory Report (Applied Speciation and Consulting, LLC)

Acronyms and Abbreviations

µg/kg	micrograms per kilogram
BERA	Baseline Ecological Risk Assessment
bgs	below ground surface
COC	chain of custody
Cr III	trivalent chromium
Cr VI	hexavalent chromium
DO	dissolved oxygen
DQO	data quality objective
EC	electrical conductivity
EPA	U.S. Environmental Protection Agency
FSP	Field Sampling Plan
FWS	U.S. Fish and Wildlife Service
GPS	global positioning system
Halaco	Halaco Engineering Co.
KLI	Kinnetic Laboratories, Inc.
mg/kg	milligram(s) per kilogram
mV	millivolt
ND	not detected
NCL	Nature Conservancy Land
NPL	National Priorities List
OID	Oxnard Industrial Drain
ORP	oxidation-reduction potential
PRG	Preliminary Remediation Goal
QAPP	Quality Assurance Project Plan
RI	remedial investigation
RSL	Regional Screening Level
SOP	standard operating procedure
SAP	Sampling and Analysis Plan
Site	Halaco Engineering Co. Superfund Site
T	temperature

UTL	Upper Tolerance Limit
WDA	Waste Disposal Area
WMU	Waste Management Unit

SECTION 1

Introduction

This report provides the results of soil and sediment “step-out” testing and chromium speciation testing for the Halaco Engineering Co. Superfund Site (Site) in Oxnard, California. See Figure 1 for location. The soil and sediment samples were collected in June 2011. The report includes a description of the testing effort, a brief narrative and tabular summary of results, and figures depicting selected results.

This testing is part of the remedial investigation (RI) being performed by the U.S. Environmental Protection Agency (EPA) for the Site. It supplements more extensive testing conducted in 2009-2010. The 2011 testing was completed in accordance with an EPA-approved Quality Assurance Project Plan (QAPP) (CH2M HILL, 2009a), Field Sampling Plan (FSP) (CH2M HILL, 2009b), and an Addendum to the QAPP and FSP (EPA - Region 9, 2011).

1.1 Objectives

The primary objectives of the 2011 testing were to determine (1) the extent of contamination to the north and south of the Waste Management Area; and (2) how much of the chromium, one of the metals found in the contaminated soils and sediments, is present in the more toxic hexavalent form. The human health and ecological risks posed by the contaminated soils and sediments depend in part on the “species” of chromium (i.e., whether the chromium is in the hexavalent [Cr VI] or trivalent [Cr III] form). Data collected in 2009 and 2010 did not determine the full extent of contamination north or south of the Waste Management Area or the species of chromium present.

1.2 Background

The Site is located in eastern Ventura County at and near 6200 Perkins Road in Oxnard, California. Halaco Engineering Company (Halaco) operated a secondary metal smelter at the Site from 1965 to 2004, recovering aluminum and magnesium for reuse. The site background, including a description of Halaco’s operations and waste disposal practices, and the physical and ecological settings is described in the QAPP. A brief summary is provided below.

The Site includes an 11-acre parcel containing the former smelter, a 26-acre Waste Management Area where wastes were deposited and managed, and adjacent areas affected by Halaco’s wastes. The 26-acre area includes the Waste Management Unit (WMU), which contained Halaco’s former waste settling ponds, and the Waste Disposal Area (WDA) to the north, which received waste from the WMU. The adjacent areas affected by Halaco’s wastes include portions of the:

- Land owned by the Nature Conservancy east and north of the Waste Management Area, referred to as Nature Conservancy Land (NCL) -East and NCL-North

- Wetland and beach areas south of the former Smelter Parcel and WMU
- Oxnard Industrial Drain (OID), which bisects the Smelter Parcel and Waste Management Area, and an associated lagoon

During its 40 years of operation, Halaco acquired scrap metal from more than 400 suppliers in a variety of forms and in varying levels of purity. Halaco processed dross, sludge, castings, sheets, pellets, granules, cans, car parts, and other scrap. Among the various scrap metal materials processed during the initial operating period, Halaco reports that it processed one type of scrap, a low-level radioactive magnesium-thorium alloy, until about 1977. Other metals found in aluminum and magnesium alloys include copper, silver, zinc, lead, chromium, titanium, tin, manganese, and nickel.

Halaco produced large quantities of solid and liquid waste. Most of the waste was “process waste” generated during the smelting process. Other waste was generated by the air pollution control equipment, and from used oil and spent solvent. From 1965 to about 1970, Halaco discharged much or all of its waste to a settling pond adjacent to the OID and used waste solids as fill in the smelter area. In about 1970, Halaco began pumping its wastewater across the OID into unlined earthen settling ponds in the area later named the WMU. Beginning in or before 1980, Halaco began moving waste solids from the WMU to the WDA.

Halaco reports that all operations ceased in September 2004. In 2007, EPA estimated that more than 700,000 cubic yards of waste solids remained onsite. The bulk of the solids are in the WMU, which covers about 15 acres and rises up to 35 feet above grade. Previous testing at the Site showed that elevated levels of a variety of metals are present in the waste, and that soils, sediments, and groundwater have been contaminated by Halaco’s wastes. Constituents found at elevated levels included aluminum, barium, beryllium, cadmium, chromium, copper, lead, magnesium, manganese, nickel, and zinc. Elevated levels of radioactive thorium (and decay products) were also found in some areas. In past sampling, elevated levels of ammonia and petroleum hydrocarbons were also detected at the Site. The ammonia is believed to be a byproduct of the smelting process.

1.3 EPA Actions from 2006 through 2011

In 2006, EPA completed a testing effort at the site called the Integrated Assessment (Weston Solutions, Inc., 2007) to (1) determine the site’s eligibility for placement on the Superfund National Priorities List (NPL), and (2) evaluate the need for immediate actions to stabilize the Site. In September 2007, EPA added the former Halaco facility and adjacent areas of contamination to the NPL. Shortly thereafter, EPA began the RI to determine the nature and extent of contamination at the Site, identify human health and ecological risks posed by the contamination, and identify areas needing remediation.

In 2006 and 2007, two removal actions were completed to address immediate Site risks while EPA evaluated the Site for placement on the NPL. The first removal action, completed by the property owners between August 2006 and February 2007, included the removal of drums and other hazardous substances from the Site. A second, EPA-funded removal action was completed in 2007 to stabilize and secure the Site and limit offsite migration of contaminated wastes. It included re-grading the waste pile to reduce the steepness of the slopes, placing matting on the slopes to reduce erosion, stabilizing the banks along the lower portion of the

OID, removing an estimated 9,000 cubic yards of waste from the smelter area, removing an estimated 7,600 cubic yards of material from a wetland area adjacent to the Halaco property, and installing more than 6,000 feet of fencing around the perimeter of the Waste Management Area. See the “Team 9” report (2008) for additional details. Figure 1 is an aerial photo of the Site after the second removal action was completed.

In 2007, EPA completed additional site characterization activities. These include a radiation assessment of surface and subsurface conditions throughout the Smelter Parcel (Team 9, 2008).

In 2008, EPA completed a screening-level ecological and human health risk assessment to support RI activities for the Site (CH2M HILL, 2008a). This screening-level risk assessment identified major contaminants of potential concern and environmental exposure pathways for ecological and human receptors. This assessment used conservative estimates of exposure and potential ecological and human health effects to identify areas of the Site that may pose unacceptable risks to human health and/or the environment and may warrant remediation.

Also in 2008, EPA completed a preliminary evaluation of the sources, nature, extent, and movement of contamination in surface water and groundwater at the Site (CH2M HILL, 2008b). This preliminary evaluation compiled and evaluated information on the sources, nature, and extent of surface water and groundwater contamination at the Site, and on the physical processes that affect the movement of the contamination.

In 2009, using the results of the Integrated Assessment, the radiation assessment, screening-level risk assessment, and preliminary groundwater evaluation, EPA identified data gaps and prepared a plan for additional sampling and analysis activities needed before remediation can occur (EPA Region 9, 2009). CH2M HILL then prepared the data quality objectives (DQOs), QAPP, and FSP for this RI based on the testing plan.

In 2009 and 2010, EPA performed RI sampling and analysis activities for the Halaco site in accordance with the QAPP and FSP. The results are presented in a series of five reports (CH2M HILL, 2011a, 2011b, 2011c, 2011d, and 2012).

In 2010, EPA demolished two abandoned industrial buildings at the Site. The two buildings were in poor condition and at risk of collapse.

In 2011, EPA identified the need to delineate the extent of contamination to the north and south of the Waste Management Area and evaluate the species of chromium present in the contaminated soils and sediments. EPA then prepared an Addendum to the QAPP and FSP to complete the testing documented in this report (EPA – Region 9, 2011).

SECTION 2

Initial Conceptual Site Model

This section describes what was known, after evaluation of 2009-2010 RI data, about the extent of contamination to the north and south of the Waste Management Area and the possible health risks presented by chromium in the contaminated soils and sediments. Figure 2 shows the locations of the solid matrix samples collected in 2009 and 2010, and the samples collected as part of the June 2011 investigation. The results of the testing performed in 2009 and 2010 are documented in the following reports:

- *Solid Matrix Sampling and Analysis Results for the NCL-East and NCL-North Areas* (CH2M HILL, 2011a)
- *Solid Matrix Sampling and Analysis Results for the Wetlands and Beach Areas* (CH2M HILL, 2011b)
- *Solid Matrix Sampling and Analysis Results for the Oxnard Industrial Drain and Lagoon Areas* (CH2M HILL, 2011c)
- *Solid Matrix and Soil Gas Sampling and Analysis Results for the Smelter Parcel and Waste Management Areas* (CH2M HILL, 2011d)
- *Surface Water and Groundwater Sampling and Analysis Results* (CH2M HILL, 2012)

The data collected during these RI activities supplement earlier data collected by EPA from 2006 through 2008 for the Halaco site, older historical environmental data collected for the Halaco site prior to 2008, and other data collected as part of regional studies, including those to assess regional groundwater conditions and to support the ongoing Ormond Beach restoration efforts. These previous data are described in the above five reports.

2.1 Extent of Contamination

Some of the soil and sediment samples collected in 2010 to the north and south of the Waste Management Area were contaminated. In the contaminated samples, the concentrations of certain metals exceeded those measured in areas believed to be unaffected by Halaco's operations. The 2010 sampling effort did not, however, define the full extent of Site-related contamination. The area to the north of the Waste Management Area is owned by The Nature Conservancy and referred to in this and other EPA reports as NCL-North; the area to the south is owned by the City of Oxnard and referred to as the wetlands area.

2.1.1 North of Waste Management Area

The locations of the samples collected to the north of the Waste Management Unit in 2010 are shown in Figure 3 and include the following (samples NNL-3 and NNL-4 are not shown and are located to the east of the area of coverage):

- WNO-1 through -4 - Samples immediately north of the WDA
- NND-1 through -4 - Samples within the ditch north of the WDA

- NNP-1 and -2 – Samples in the approximately 3-acre pond area to the north of the WDA
- NNL-1 through -4 – Samples to the north of the extension of McWane Blvd.

Samples were collected at ground surface and 2 feet below ground surface (bgs) for the WNO and NNL samples. Surface samples were collected for the NND and NNP samples. Concentrations exceeded background levels in some WNO, NND, and NNP samples as indicated by the blue and yellow symbols that represent concentrations above background for lead, which was calculated to be 14 micrograms per kilogram ($\mu\text{g}/\text{kg}$). The extent of elevated metals concentrations in the pond area and the limits of the metals contamination to the north were not known.

2.1.2 South of Waste Management Area

The locations of the samples collected to the south of the Waste Management Area in 2010 are shown in Figure 4 and include the following (samples WLE-7 and WLE-8 are not shown and are located to the southeast of the area of coverage):

- DSA-1 through DSA-8 – Samples along the bottom of the ditch south of the WMU
- DSB-1 through DBA-8 – Samples 5 feet south of the ditch
- DSC-1 through DCA-8 – Samples 15 feet south of the ditch
- WLE-1 through WLE-8 – Samples distributed across the wetlands south of the WMU

Samples were collected at ground surface, 2 feet bgs, and 4 feet bgs for the DSA samples and at ground surface and 2 feet bgs for the DSB, DSC, and WLE samples. Concentrations exceeded background levels in all of the DSA, DSB, and DSC samples as indicated by the blue and yellow symbols. The concentrations across the wetlands area were primarily below background, although metals concentrations were slightly above background in a few of the WLE samples. The extent of elevated metals concentrations to the south of the ditch was not known.

2.2 Chromium Speciation

The solid matrix samples collected in 2010 were analyzed for metals, including chromium. The analyses did not determine which chromium species were present (i.e., Cr VI or Cr III). The results were compared to the former EPA Region 9 Preliminary Remediation Goal (PRG) for total chromium, which assumed a 1:6 ratio of Cr VI to Cr III. The total chromium PRG for soil, assuming residential land use, was 210 milligrams per kilogram (mg/kg). The PRG for industrial land use was 450 mg/kg . Screening values for total chromium are no longer available. They have been replaced by separate screening values for Cr VI and Cr III (and renamed Regional Screening Levels [RSLs]). They are as follows:

Analyte	Chemical Abstract No.	Residential Soil (mg/kg)	Industrial Soil (mg/kg)
Chromium(III), Insoluble Salts	16065-83-1	120,000	1,500,000
Chromium(VI)	18540-29-9	0.29	5.6

Comparison of the total chromium concentrations measured in 2010 to the former PRGs indicated that most of the soil and sediment samples collected outside the Smelter Parcel

and Waste Management Area were below both the residential and industrial screening values. If, however, the chromium detected in the 2010 samples is primarily Cr VI, virtually all of the samples would exceed the current RSL screening values. If the chromium is primarily Cr III, few if any soil or sediment samples would exceed the screening values. It became apparent that identifying the chromium species would allow a more accurate assessment of human health risks presented by contaminated soil and sediment at and near the Halaco site.

Remedial Investigation Activities

This section describes the RI activities that were completed in 2011 to (1) delineate the extent of metals contamination in areas to the north and south of the Waste Management Area and (2) evaluate the species of chromium in solid matrix media. To control measurement error, analytical measurements were undertaken as documented in the project QAPP and Sampling and Analysis Plan (SAP) Addendum, and samples were collected and shipped as documented in the project FSP and field standard operating procedures (SOPs) contained within the FSP.

3.1 Field Investigation Activities

3.1.1 Step-out Sampling

Surface and shallow subsurface soil and sediment samples were collected during June 2011 in the NCL-North area north of the Waste Management Area and the wetlands area south of the Waste Management Area to delineate the extent of contamination. All samples were analyzed for metals, as further described below.

- Shallow soil samples were collected in and around the NCL-North pond area (NNP-3 through NNP-19). NNP-16, -18, and -19 were located at a higher elevation immediately to the northeast of the pond and the remaining samples were located within the pond. The samples located within the pond were submerged by several feet of water during sampling and the three higher elevation samples were dry. Samples were collected at ground surface and at 2 feet bgs.
- Shallow soil samples were collected 30 and 50 feet south of the ditch bottom. In 2010, samples were collected along the ditch bottom (DSA-1 through -8), 5 feet south of the ditch bottom (DSB-1 through -8), and 15 feet south of the ditch bottom (DSC-1 through DSC-8). The new soil samples were collected at ground surface and 2 feet bgs as follows:
 - 30 feet south of the ditch bottom (DSD-1 through -8)
 - 50 feet south of the ditch bottom (DSE-1 through -8)

The sand dunes along the ocean shore were not breached during sampling, causing OID surface water to fill the pond to the north and ditch to the south of the Waste Management Area to approximately the 8-foot elevation contour.

3.1.2 Chromium Speciation Sampling

Sediment samples were collected during June 2011 for chromium speciation testing and measurement of field parameters. The samples were collected at the same time that the biological sampling was being performed to collect data to support preparation of the Baseline Ecological Risk Assessment (BERA). A report that will document the biological testing results and the BERA is in preparation.

Sediment samples were collected from the following locations for chromium speciation in an offsite laboratory at the locations shown in Figure 5:

- Lagoon: LGF-1 and LGM-1
- Ditch south of WMU: DSA-1, DSA-3, and DSA-6
- NCL-East: NEL-7 and NEL-9

These samples were submerged by several feet of water during sampling. Field parameters, including pH and oxidation-reduction potential (ORP), were measured during sampling. The field parameters were measured to help interpret the chromium speciation test results.

In addition, surface samples of soil and process waste were collected from the following locations for measurement of field parameters at the locations shown in Figure 5:

- Soil (at northern area of Smelter Parcel): ORP-SS-1 through -4
- Process Waste (at WMU): TXI-4, -7, -9, and -11

These samples were dry. The field parameters were measured to provide information to assess the oxidation state of the soil and process materials, which could then be used to help interpret the chromium species present in the samples.

3.2 Field Sample Collection Procedures

CH2M HILL and subcontractor Kinnetic Laboratories, Inc. (KLI) collected the step-out and chromium speciation samples. Subcontractor Blaine Tech Services assisted with measurement of the field parameters. The samples were collected using a combination of disposable surface scoops, a 4-inch diameter hand auger, and Eckman sediment sampler. CH2M HILL led the sample collection activities, logged all samples, filled and labeled sample containers, completed chain-of-custody (COC) documentation, and shipped samples to the offsite analytical laboratories. KLI provided and operated the hand augers and Eckman sampler. KLI also provided and operated a small boat used to collect some of the submerged samples.

The field work was performed in accordance with access authorizations granted by The Nature Conservancy on November 9, 2009 and the City of Oxnard on October 8, 2009. Field work was also performed in accordance with a Biological Opinion (8-8-10-F-3) issued by the U.S. Fish and Wildlife Service (FWS) to EPA in a letter dated February 26, 2010. EPA requested formal consultation with FWS in a letter dated November 12, 2009, because of the presence or potential presence of federally listed endangered or threatened species in the sampling areas. CH2M HILL provided a qualified biological monitor in the field to ensure that sampling at each location was in compliance with the Biological Opinion.

Submerged samples in the lagoon and NCL-East areas were collected from a small boat. Submerged samples within the pond at NCL-North and within the WMU ditch were collected by wading. The shallow borings in submerged areas were allowed to naturally collapse. The shallow borings on dry land were backfilled and compacted using the material removed from the borings.

Sediment samples for laboratory analysis were homogenized in a decontaminated stainless steel mixing bowl prior to placing them into sample containers in accordance with SOP 6-7 of the FSP.

Sampling equipment was decontaminated in accordance with SOP 6-24 of the FSP. Hand augers and other non-disposable sampling equipment coming into contact with samples were decontaminated by washing the sampling equipment in an Alconox solution (or equivalent), rinsing with potable water, and rinsing with distilled water.

Soil samples were generally collected at the planned locations. Sample locations specified in the SAP Addendum were field-located using global positioning system (GPS) equipment (Trimble Geo XT) prior to sample collection. As-sampled locations were then recorded and are shown on Figures 2, 3, 4, and 5. The field procedures documented in SOP 6-1 of the FSP for location of field samples with GPS equipment were used.

Soil samples were logged in accordance with SOP 6-10 from the FSP. This included identifying the soil type in accordance the Unified Soil Classification System.

3.3 Field Parameter Measurement

For the submerged sediment samples, field parameters were measured for water present above the sediment in the hand auger or Eckman sampler when it was retrieved (“top water”) and from pore water that drained from the sediment after it was placed into a stainless steel mixing bowl for homogenization (“pore water”). Water was decanted into a small disposable plastic cup for field parameter measurements. The field parameters were then measured by placing the probe of a calibrated YSI Model 556 multi parameter meter into the cup. Field parameters pH, ORP, dissolved oxygen, electrical conductivity, and temperatures were measured. A Myron Ultrameter was used to measure turbidity. Several measurements were made and recorded of the top water and pore water during sample collection.

For the soil and process waste samples, field parameters were measured after mixing the samples with distilled/de-ionized ultra pure water. The field parameters were measured by placing the probe of a calibrated YSI Professional Plus multi parameter meter into the slurry. The same field parameters were measured as with the sediment samples.

3.4 Sample Collection and Quality Control Samples

Samples for laboratory analysis were placed in containers as detailed in Table 2 of the SAP Addendum. The following quality control samples were collected as specified in the QAPP and FSP:

- Field duplicates were collected at a frequency of 1 in every 10 samples.
- Field equipment blanks were collected at a frequency of once per day when non-dedicated sampling equipment was used. Equipment blanks were not collected for surface soil samples, which were collected with new disposable scoops.

- Extra volume for laboratory matrix spikes and matrix spike duplicates was collected at a frequency of 1 in every 20 collected samples.

The sample naming convention was as described in the SAP Addendum.

Duplicate samples were identified by adding “100” to the sample location number. For example, SM-DSD-101-A is the duplicate sample for SM-DSD-001-A.

3.5 Sample Custody and Tracking Procedures

COC procedures were followed in accordance with the FSP and QAPP. This included generating COC forms listing the analytical services to be performed by each laboratory. EPA’s Forms II Lite program was used to generate sample labels, bottle tags, and COC forms; track samples from the field to the laboratory; and facilitate electronic capture of sample information into databases.

All samples were placed on ice upon field collection and then shipped on ice to the analytical laboratories. All samples were shipped to the analytical laboratories using Federal Express to facilitate tracking from the field to the laboratory.

3.6 Laboratory Analysis and Data Validation

The solid matrix samples were analyzed in offsite laboratories as follows:

- **Metals for Step-out Samples.** Samples collected to delineate the extent of contamination were analyzed for metals under the EPA Contract Laboratory Program by Chemtech Consulting Group in Mountainside, New Jersey.
- **Chromium Speciation Samples.** Samples collected to evaluate the species of chromium in contaminated sediments were analyzed for total chromium and hexavalent chromium by Applied Speciation and Consulting, LLC in Bothell, Washington. The samples were extracted using EPA Method 3060A and then analyzed for hexavalent chromium via ion chromatography inductively coupled plasma dynamic reaction cell mass spectrometry (IC-ICP-DRC-MS). The samples were also digested in accordance with EPA Method 3050B and analyzed for total chromium via EPA Method 6020.

The laboratory analytical results for the solid matrix samples were reviewed or validated as follows:

- **Metals for Step-out Samples.** The EPA Contract Laboratory Program lab data for metals went through the EPA Computer-Aided Data Review and Evaluation automated data review. This is equivalent to a stage S2BVE under EPA’s national guidance for validating laboratory analytical data for Superfund use.
- **Chromium Speciation Samples.** The Applied Speciation and Consulting lab data for chromium speciation went through the laboratory’s internal review program.

SECTION 4

Remedial Investigation Results

This section presents the results of the RI activities that were completed to (1) delineate the extent of metals contamination in areas to the north and south of the Waste Management Area and (2) evaluate the species of chromium in solid matrix media. The results are provided in the following tables, figures, and appendices:

- Tables 1 and 2 provide the metals analytical results for the step-out samples. These tables include Upper Tolerance Limits (UTLs) for each metal. UTLs are estimates of the maximum concentration of each metal thought to represent background conditions at and near the Site. Calculation of the UTLs is documented in the prior RI solid matrix testing reports (CH2M HILL, 2011a through 2011d).
- Table 3 provides the chromium speciation results.
- Tables 4 and 5 provide the field parameter results for the sediment, soil, and process waste samples.
- Figures 6a, 6b, 7a, and 7b illustrate the step-out sample analytical results for the surface and subsurface samples for lead, one of the metals in Halaco's wastes.
- Attachment A provides lithologic descriptions of the soil and sediment samples.
- Attachment B provides the Applied Speciation and Consulting lab report with the testing results and data review for the chromium speciation testing.

Lead is used as a representative contaminant to illustrate the nature and relative levels of contamination. Its use in the figures does not imply that lead poses more or less risk to human health or the environment than the other metals present in Halaco's wastes.

4.1 Extent of Contamination in NCL-North and Wetland Areas

Figures 6a, 6b, 7a, and 7b depict the extent of metals contamination in the NCL-North and wetlands areas, using lead as an "indicator" metal. These figures use the following lead concentration ranges:

- < 14 mg/kg (white) - lead levels in silt/clay soil unaffected by Halaco wastes
- 14 to 100 mg/kg (blue) - up to seven times higher than background
- 100 to 400 mg/kg (yellow) - up to four times higher than blue
- 400 to 800 mg/kg (orange) - up to two times higher than yellow
- > 800 mg/kg (red)

NCL-North Pond north of Waste Management Area

Several of the step-out samples in the pond contain metals above background concentrations, potentially from Halaco's process waste (including, but not limited to chromium, copper, and lead). The wastes may have been historically placed or eroded into

the former channel of the OID where the pond is now located (NNP-3 through NNP-19). The surface and shallow subsurface samples collected from the higher elevation area to the northeast and east of the pond do not contain elevated metals concentrations (NNP-16, -18, and -19; NNL-1). This suggests that the contaminated sediments are contained within the lower-elevation pond area.

Wetlands Area south of Waste Management Area

Metals concentrations in the surface step-out samples collected 30-feet south of the ditch (DSD-1 through DSD-8) and 50-feet south of the ditch (DSE-1 through DSE-8) were at or near background levels. The elevated metals concentrations detected in 2010 along the bottom of the ditch (DSA-1 through DSA-8), and 5 feet and 15 feet south of the ditch (the DSB and DSC samples), indicate that concentrations generally decrease with distance from the ditch. The low metals concentrations in the DSD and DSE samples correspond to higher ground surface elevations. Conversely, the higher metal concentrations were generally found in the lower elevations surrounding the ditch.

The high metals concentrations detected previously within and in the immediate vicinity of the ditch (the DSA samples) are most likely from Halaco's waste materials transported from the WMU by historical stormwater erosion and wind erosion. The lower metals concentrations to the south (the DSD and DSE samples) and across the wetlands area (WLE-1 through -8) are most likely from waste materials transported by wind erosion. The wetlands area is typically downwind from the WMU during Santa Ana wind events when the wind direction is from the WMU over the wetlands area and toward the ocean as described in the testing report for the wetlands and beach area (CH2M HILL, 2011b). Figure 6 in the Wetlands and Beach report provides monthly wind roses showing wind directions.

The subsurface surface step-out samples (the DSB, DSC, DSD, and DSE samples) south of the ditch do not show elevated metals concentrations at 2 feet bgs, similar to the WLE samples distributed across the wetlands area farther to the south. This finding is consistent with the surface deposition of windblown waste material. The erosion control measures implemented by EPA in 2007 are helping to eliminate or reduce the movement of contaminated materials from the WMU.

4.2 Chromium Speciation and Field Parameters for Sediment Samples

The total chromium and hexavalent chromium laboratory results for the sediment samples collected from the submerged WMU ditch, lagoon, and NCL-East areas show that less than 1 percent of the chromium is present as hexavalent chromium. This indicates that virtually all of the chromium (over 99 percent) is present as trivalent chromium. The total chromium concentrations in the samples ranged from a minimum of 13.6 mg/kg to a maximum of 271 mg/kg (Table 3), compared to the background value calculated to be 17 mg/kg (Tables 1 and 2). All hexavalent chromium concentrations were less than 0.1 mg/kg.

The field-measured ORPs of the "top water" samples collected immediately above retrieved sediment samples and the pore water that drained from the sediment samples were all less than 0 millivolts (mV), except for the samples from NEL-7 which were less than 100 mV.

These values indicate that the water was under reducing conditions, which is consistent with hexavalent chromium being present at less than 1 percent. The pH of the samples ranged between 7.40 and 8.18. Hexavalent chromium is a highly oxidized form of chromium and is expected to be less prevalent in a reducing environment.

4.3 Field Parameters for Process Waste and Soil Slurry Samples

The field-measured ORPs of the slurry samples prepared for the process waste samples from the Waste Management Area and the soil samples from the northern part of the Smelter Parcel were all above 100 mV and the pH ranged between 7.82 and 9.04, both higher than the range of ORP and pH values measured for the sediment top water and pore water samples. The higher ORP values indicate that the surface process waste and soil samples are under a more oxidizing environment than the submerged sediment samples. The percentages of trivalent chromium versus hexavalent chromium depend on the ORP and pH values, in addition to other factors. Determination of the percentages of these chromium species is beyond the scope of this report.

Conclusions

This section provides conclusions regarding (1) the extent of contamination in areas to the north and south of the Waste Management Area and (2) the species of chromium present in contaminated sediments and soil at the Site.

5.1 Extent of Contamination in NCL-North and Wetland Areas

In June 2011, step-out surface and shallow subsurface soil samples were collected to supplement the sampling completed in 2010 and better define the extent of contamination from Halaco's operations. Samples were collected at 17 locations in and near an approximately 3-acre pond area to the north of the Waste Management Area, on property owned by the Nature Conservancy (the NCL-North area). Samples were also collected at 16 locations south of the WMU ditch that runs along the southern edge of the Waste Management Area, on property owned by the City of Oxnard. Samples were collected at ground surface and 2 feet bgs for a total of 66 samples (not including duplicate samples). All samples were analyzed at an offsite laboratory for metals.

These data indicate the following:

- To the north of the Waste Management Area, the contamination is limited primarily to the pond. Sediments in the pond were probably contaminated by Halaco process waste materials placed into a former OID channel or eroded into the pond from the Waste Management Area. Metals concentrations in samples collected to the northeast and east of the pond are consistent with background conditions.
- The metals concentrations decrease with distance south of the WMU ditch, and are at or near background in samples collected 30 feet and 50 feet south of the ditch. In 2010, high metal concentrations were detected in samples collected from the bottom of the ditch. Lower but still elevated metals concentrations were measured in samples collected 5 feet and 15 feet south of the ditch.
- The high metals concentrations in and near the ditch are most likely from Halaco's waste materials transported from the WMU by historical stormwater erosion and wind erosion. The lower metals concentrations 30 feet and 50 feet to the south and across the wetlands area, where ground surface elevations are higher, are most likely from waste materials transported by wind erosion. The erosion control measures implemented by EPA in 2007 are helping to eliminate or reduce the movement of contaminated materials from the WMU.

5.2 Chromium Speciation and Field Parameters for Sediment Samples

Sediment samples were collected from seven locations in the WMU ditch, lagoon, and NCL-East areas and analyzed for total chromium and hexavalent chromium at an offsite laboratory. The health risk presented by chromium depends on the species of chromium. Field parameters (pH, ORP, DO, EC, T, turbidity) were measured in water collected with the sediment samples and pore water that drained from the samples immediately after they were retrieved. EPA analyzed samples from the same locations for total chromium in 2010. These data indicate the following:

- Less than 1 percent of the chromium is present as hexavalent chromium. Virtually all of the chromium (over 99 percent) is present as trivalent chromium.
- The field-measured ORPs in the “top water” present above each sediment sample, and the pore water that drained from each sediment sample, indicate reducing conditions, which is consistent with the low hexavalent chromium concentrations. Hexavalent chromium is a highly oxidized form of chromium and is expected to be less prevalent in a reducing environment.

5.3 Field Parameters for Process Waste and Soil Slurry Samples

Field parameters (pH, ORP, DO, EC, T, turbidity) were measured in process waste samples collected at four locations across the Waste Management Area and surface soil samples collected at four locations at the Smelter Parcel. The intent was to provide data that could be used to estimate hexavalent chromium concentrations in portions of the Site where it was not measured in the laboratory. The field parameters were measured from a slurry prepared from the samples. These data indicate the following:

- The field-measured ORP and pH of the process waste and soil samples were higher than the ORP and pH measured for the sediment samples.
- The higher ORP values indicate that the surface process waste and soil samples are under a more oxidizing environment than the submerged sediment samples. The percentages of trivalent chromium versus hexavalent chromium depend on the ORP and pH values, in addition to other factors. Determination of the percentages of these chromium species is beyond the scope of this report.

SECTION 6

References

CH2M HILL. 2008a. *Screening-Level Ecological and Human Health Risk Assessment, Halaco Site*. Prepared for EPA. December.

CH2M HILL. 2008b. *Preliminary Evaluation of the Sources, Nature, Extent, and Movement of Contamination in Surface Water and Groundwater, Halaco Site*. Prepared for U.S. Environmental Protection Agency. December.

CH2M HILL. 2009a. *Quality Assurance Project Plan, Halaco Superfund Site Remedial Investigation, Oxnard, California*. Prepared for U.S. Environmental Protection Agency. September.

CH2M HILL. 2009b. *Field Sampling Plan, Halaco Superfund Site Remedial Investigation, Oxnard, California*. September. Prepared for U.S. Environmental Protection Agency. September.

CH2M HILL. 2011a. *Solid Matrix Sampling and Analysis Results for the NCL-East and NCL-North Areas, Halaco Superfund Site Remedial Investigation, Oxnard, California*. Prepared for U.S. Environmental Protection Agency. February.

CH2M HILL. 2011b. *Solid Matrix Sampling and Analysis Results for the Wetlands and Beach Areas, Halaco Superfund Site Remedial Investigation, Oxnard, California*. Prepared for U.S. Environmental Protection Agency. March.

CH2M HILL. 2011c. *Solid Matrix Sampling and Analysis Results for the Oxnard Industrial Drain and Lagoon Areas, Halaco Superfund Site Remedial Investigation, Oxnard, California*. Prepared for U.S. Environmental Protection Agency. June.

CH2M HILL. 2011d. *Solid Matrix and Soil Gas Sampling and Analysis Results for the Smelter Parcel and Waste Management Areas, Halaco Superfund Site Remedial Investigation, Oxnard, California*. Prepared for U.S. Environmental Protection Agency. August.

CH2M HILL. 2012. *Surface Water and Groundwater Sampling and Analysis Results, Halaco Superfund Site Remedial Investigation, Oxnard, California*. Prepared for U.S. Environmental Protection Agency. March.

Team 9, U.S. EPA START Contractor. 2008. *Summary Report, Halaco Metal Recyclers, 6200 Perkins Road, Oxnard, California*. Prepared for U.S. Environmental Protection Agency by Team 9. May 16, 2008.

U.S. Environmental Protection Agency (EPA). 2002. *Role of Background in the CERCLA Cleanup Program*. OSWER 9285.6-07P.

U.S. Environmental Protection Agency (EPA) – Region 9. 2009. *Plan for Additional Sampling and Analysis Activities, Halaco Superfund Site Remedial Investigation, Oxnard, California*. Jointly prepared by U.S. Environmental Protection Agency and CH2M HILL. February 6.

U.S. Environmental Protection Agency (EPA) – Region 9. 2011. *Addendum to the September 2009 Remedial Investigation Sampling and Analysis Plan, Halaco Superfund Site, Oxnard, CA*. May 31.

Weston Solutions, Inc. 2007. *Integrated Assessment, Halaco Engineering Company, Oxnard, California, Ventura County*. Prepared by Weston Solutions, Inc. for U.S. Environmental Protection Agency, Region 9. January. Available online at: www.epa.gov/region9/halaco.

Tables

TABLE 1
 Metals Analytical Results, Solid Matrix, Step-out Samples, NCL-North Pond Area
 Halaco Site Remedial Investigation, Oxnard, California

Location ID	Duplicate (Dup)	Sample ID	CLP ID	Sample Date	Depth (ft bgs)	Aluminum		Antimony		Arsenic		Barium		Beryllium		Cadmium		Calcium		Chromium		Cobalt		Copper		Iron		Lead		Magnesium		Manganese		Mercury		Nickel		Potassium		Selenium		Silver		Sodium		Thallium		Vanadium		Zinc	
						Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
NNP-3		SM-NNP-003-A	MY7252	6/28/11	Surface	18600		0.64	UJ	6.2	J	173		1.1		0.93		11700		18.1	J	8.4		39.4		26400		42.5		8870		275	J-	0.14	U	27.2		5770		2.6	UJ	0.64	U	2690		0.64	U	32.3	J	139	
		SM-NNP-003-B	MY7253	6/28/11	2	6830		0.46	UJ	0.91	UJ	68.6		0.4	J	0.35		7590		7.5	J	4.5	U	7.9		10700		3		3440		129	J-	0.12	U	9.1		1920		1.8	UJ	0.46	U	797		0.46	U	11.2	J	32.2	
NNP-4		SM-NNP-004-A	MY7254	6/28/11	Surface	15900		0.66	UJ	3.4	J	139		0.92		1.1		22700		16.5	J	8.8		21.1		25400		13.4		9500		366	J-	0.15	U	22.9		5150		2.6	UJ	0.66	U	2250		0.66	U	26.9	J	88	
		SM-NNP-004-B	MY7255	6/28/11	2	21800		0.69	UJ	5.2	J	171		1.2		1		25900		20.4	J	10.3		23.8		31800		13.8		13400		460	J-	0.15	U	28.2		6200		2.8	UJ	0.69	U	2320		0.69	U	35	J	89.6	
NNP-5		SM-NNP-005-A	MY7256	6/27/11	Surface	12600		0.52	UJ	3.5	J	123		0.76		0.85		5630		15.9	J	6.4		16.5		20900		9		5380		170	J-	0.14	U	18		3920		2.1	UJ	0.52	U	965		0.52	U	28.2	J	70.1	
		SM-NNP-005-B	MY7257	6/27/11	2	20400		0.62	J	4.3	J	196		1.2		1.5		30000		17.4	J	11.3		29.7		31600		25.4		10900		482	J-	0.2	U	31.9		6370		0.71	UJ	0.35	U	1680		0.35	U	53	J	118	
NNP-6		SM-NNP-006-A	MY7258	6/28/11	Surface	27800		2.2	J	4.9	J	5060		18.7		3.7		89000		51.3	J	10.9		270		25500		119		22800		986	J-	0.06	J	42.9		5430		1.6	UJ	1.2	J-	3020		0.39	U	56.6	J	790	
		SM-NNP-006-B	MY7259	6/28/11	2	21700		1.9	J	4.8	J	1500		6.2		2.7		75400		35.6	J	10		97.4		24400		39		16500		670	J-	0.03	J	31.3		5900		3	UJ	1.3	J-	3280		0.74	U	34.1	J	253	
NNP-7		SM-NNP-007-A	MY7260	6/28/11	Surface	13400		0.52	UJ	5.9	J	119		0.8		0.91		16400		13.6	J	7		17		21700		9.6		6970		237	J-	0.12	U	18.8		4500		2.1	UJ	0.52	U	1560		0.52	U	28.4	J	80.2	
	Dup	SM-NNP-107-A	MY7262	6/28/11	Surface	15000		0.54	J	3.7	J	128		0.85		1.2		16300		18.7	J	7.7		20.3		22200		10.9		7740		272	J-	0.14	U	21.8		4910		2.1	UJ	0.53	U	1910		0.53	U	30	J	94.1	
		SM-NNP-007-B	MY7261	6/28/11	2	20000		0.58	UJ	5	J	164		1.1		1.3		21700		20.8	J	10.1		28.1		28300		21.9		9740		392	J-	0.13	U	27.4		5820		2.3	UJ	0.58	U	2410		0.58	U	35	J	106	
	Dup	SM-NNP-107-B	MY7263	6/28/11	2	25700		0.6	UJ	5.5	J	270		1.4		2.1		28700		24.9	J	13.5		27.3		40400		17.4		12000		515	J-	0.14	U	33.3		6800		2.4	UJ	0.6	U	3020		0.6	U	36.8	J	108	
NNP-8		SM-NNP-008-A	MY7264	6/28/11	Surface	13500		0.67	UJ	2.6	J	117		0.77		0.78		16900		13.8	J	7.1		17		20800		7.8		8430		365	J-	0.13	U	18.8		4460		1.3	UJ	0.67	U	1720		0.67	U	62.7	J	66.5	
		SM-NNP-008-B	MY7265	6/28/11	2	12000		0.68	U	4.4	J	152		0.89		0.92		23600		22.8	J	9.1		19.5		24500		7.2		11600		424	J	0.14	U	23.6		4560		0.23	J	0.68	U	2180		0.68	U	35.2	J	73.5	
NNP-9		SM-NNP-009-A	MY7266	6/27/11	Surface	15400		0.52	J	4.9	J	151		0.93		1.2		7490		18.9	J	8.5		21.3		25600		13		6830		205	J-	0.19	U	23.9		4950		1.6	UJ	0.39	U	1460		0.39	U	36.2	J	90.3	
		SM-NNP-009-B	MY7267	6/27/11	2	16100		0.68	UJ	3.3	J	151		0.95		1		16300		18	J	8.8		22.1		25300		17.2		8050		368	J-	0.16	U	24.3		5080		2.7	UJ	0.68	U	1560		0.68	U	30.6	J	91	
NNP-10		SM-NNP-010-A	MY7268	6/28/11	Surface	16600		0.37	J	1.7	J	171		0.89		0.88		7070		18.8	J	7.1		27.5		21700		16.8		7170		194	J-	0.23	U	21.4		5130		1.5	UJ	0.34	U	1910		0.34	U	29.2	J	102	
		SM-NNP-010-B	MY7269	6/27/11	2	13300		0.49	UJ	3.3	J	122		0.77		0.94		16500		13.2	J	7.1		16.2		21500		8.3		7390		312	J-	0.12	U	19.2		4450		0.97	UJ	0.49	U	1160		0.49	U	47.8	J	66.7	
NNP-11		SM-NNP-011-A	MY7270	6/28/11	Surface	14400		0.67	UJ	1.7	J	229		1.1		1.2		67200		15.7	J	6.5	U	32.8		18800		25.5		8510		320	J-	0.16	U	19.5		4400		1.7	J	0.67	U	2900		0.67	U	58.7	J	113	
		SM-NNP-011-B	MY7271	6/28/11	2	13200		0.68	UJ	2.5	J	142		0.73		1.1		116000		12.4	J	7	U	20.1		17500		21.2		10400		554	J-	0.15	U	18.6		4230		1.4	UJ	0.68	U	3490		0.68	U	30.5	J	65.2	
NNP-12		SM-NNP-012-A	MY7272	6/28/11	Surface	14600		0.53	UJ	2.4	J	126		0.82		0.8		18700		13.6	J	7.2		18.5		22700		10.2		7660		300	J-	0.12	U	19.7		4820		1.1	UJ	0.53	U	1830		0.53	U	48.8	J	72.1	
		SM-NNP-012-B	MY7273	6/28/11	2	6360		0.47	U	1.9	J	77.6		0.48		0.65		20500		8.7	J	4.8	U	10.4		13500		4.2		4670		319	J	0.11	U	12.8		2170		0.064	J	0.47	UJ	1180		0.47	U	42.4	J	42.2	
NNP-13		SM-NNP-013-A	MY7274	6/27/11	Surface	8180		0.5	U	3.1	J	103		0.61		0.75		16000		17	J	6.7		14.5		17200		6.9		6810		395	J	0.13	U	17.2		3450		0.36	J	0.5	U	1470		0.5	U	27.4	J	57.2	
		SM-NNP-013-B	MY7275	6/27/11	2	12100		0.49	U	5.5	J	189		0.87		1.1		37900		16.7	J	8.5		17.6		24100		7.6		10300		449	J	0.02	J	22.2		4430		0.2	J	0.49	U	2000		0.49	U	53	J	68.3	
NNP-14		SM-NNP-014-A	MY7276	6/28/11	Surface	16100		1.7	J-	5.5	J	405		1.7		1.7		10300		28.3	J	11.5		59.2		34500		123		10400		261	J	0.13	J	35		6430		2.2	J	0.39	U	5120		0.39	U	56.5	J	307	
		SM-NNP-014-B	MY7277	6/28/11	2	9400		0.5	U	4.6	J	112		0.68		1.2		17300		21.6	J	6.9		18.9		19800		18.9		7100		277	J	0.03	J	18.5		4080		0.5	J	0.5	U	2060		0.5	U	35.7	J	80.6	
NNP-15		SM-NNP-015-A	MY7278	6/27/11	Surface	12600		0.46	J-	1.4	J	162		0.89		1.2		13600		17.4	J	8.3		37.7		21900		48.2		8600		219	J	0.03	J	24.9		4760		3.8	J	0.37	U	2290		0.37	U	24.4	J	162	
		SM-NNP-015-B	MY7279	6/27/11	2	8030		0.5	U	3.8	J	109		0.59		0.81		18400		17.5	J	5.9		14		17400		10.9		6620		230	J	0.13	U	16.5		3110		0.43	J	0.5	U	1410		0.5	U	30.9	J	61.8	
NN																																																			

TABLE 2

Metals Analytical Results, Solid Matrix, Step-out Samples, WMU Ditch Area
Halaco Site Remedial Investigation, Oxnard, California

Location ID	Duplicate (Dup)	Sample ID	CLP ID	Sample Date	Depth (ft bgs)	Aluminum		Antimony		Arsenic		Barium		Beryllium		Cadmium		Calcium		Chromium		Cobalt		Copper		Iron		Lead		Magnesium		Manganese		Mercury		Nickel		Potassium		Selenium		Silver		Sodium		Thallium		Vanadium		Zinc	
						Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
DSD-1	Duplicate	SM-DSD-001-A	MY7Z14	6/20/11	Surface	10700	J	1.5		1.9	J	70		0.73		0.34	U	2530	J	18.1		1.4	J	187	J	6690		23.2	J	2090		127	J	0.12	U	14.6		511	U	0.15	J	0.47	UJ	549		0.47	U	44.1	J	253	J
		SM-DSD-101-A	MY7Z16	6/20/11	Surface	6060	J	1.2		1.9	J	45.1		0.47	J	0.42		1970	J	21		1.1	J	102	J	5790		13.9	J	1430		79.7	J	0.12	U	13		502	U	0.18	J	0.44	UJ	532		0.44	U	35.1	J	170	J
		SM-DSD-001-B	MY7Z15	6/20/11	2	1840	J	0.51	U	0.69	J	19.9	U	0.18	J	0.37	U	1900	J	4.5		0.73	J	15.1	J	4660		2.8	J	752		42.4	J	0.12	U	3.1	J	496	U	1	U	0.51	UJ	453	J	0.51	U	47.4	J	26.5	J
DSD-2	Duplicate	SM-DSD-101-B	MY7Z17	6/20/11	2	1480	J	0.52	U	0.88	J	20	U	0.15	J	0.37	U	1630	J	6		0.75	J	8.3	J	4560		2	J	702		36.1	J	0.11	U	2.5	J	500	U	1	U	0.52	UJ	464	J	0.52	U	34.3	J	18.3	J
		SM-DSD-002-A	MY7Z20	6/20/11	Surface	16900	J	2.1		0.92	J	130		0.86		0.94		4590	J	50.4		1.9	J	322	J	5560		32.6	J	2820		189	J	0.13	U	38.7		661	U	0.2	J	0.66	UJ	530	J	1.3	U	61.8	J	305	J
		SM-DSD-002-B	MY7Z21	6/20/11	2	2250	J	0.63	UJ	1.8	J	25.3	U	0.16	J	0.46	U	1790	J	10.1		0.84	J	17.5	J	3910		3.1		794		39.5	J	0.13	U	3.3	J	633	U	1.3	U	0.63	UJ	343	J	0.63	UJ	67.1	J	26.3	J
DSD-3		SM-DSD-003-A	MY7Z22	6/20/11	Surface	15300	J	1.6		1.3	J	91.8		0.83		0.74		3500	J	26.2		1.8	J	276	J	6750		53.1	J	2760		250	J	0.1	U	18.5		447		0.058	J	0.36	UJ	213	J	0.36	U	40.9	J	259	J
		SM-DSD-003-B	MY7Z23	6/20/11	2	1560	J	0.47	U	1	J	19.7	U	0.12	J	0.34	U	3560	J	6		0.96	J	2.9	J	3940		1.3	J	997		54.7	J	0.12	U	3.2	J	491	U	0.95	U	0.47	UJ	349	J	0.47	U	44.9	J	11.8	J
DSD-4		SM-DSD-004-A	MY7Z24	6/20/11	Surface	2360	J	0.38	U	1.1	J	29.7		0.26	J	0.27	U	3550	J	7.4		1	J	21	J	5050		3.6	J	1150		72.8	J	0.09	U	4.7		436		0.76	U	0.38	UJ	162	J	0.38	U	39.1	J	30.1	J
		SM-DSD-004-B	MY7Z25	6/20/11	2	1950	J	0.48	U	1.2	J	35.7		0.17	J	0.34	U	4040	J	4.9		1	J	9.4	J	5270		2.5	J	1030		73.2	J	0.11	U	4.1		468	U	0.96	U	0.48	UJ	360	J	0.48	U	45	J	17.9	J
DSD-5		SM-DSD-005-A	MY7Z26	6/20/11	Surface	4300	J	0.39	U	1.4	J	50.3		0.3	J	0.28	U	3170	J	14.2		1.1	J	68	J	5270		12.1	J	1480		105	J	0.1	U	6.8		389	U	0.072	J	0.39	UJ	272	J	0.39	U	46.6	J	77.6	J
		SM-DSD-005-B	MY7Z27	6/20/11	2	1500	J	0.46	U	0.98	J	18.5	U	0.13	J	0.33	U	1620	J	6.2		0.83	J	6.7	J	3380		1.4	J	766		36.4	J	0.12	U	3.2	J	463	U	0.92	U	0.46	UJ	416	J	0.46	U	48.4	J	13.1	J
DSD-6		SM-DSD-006-A	MY7Z28	6/20/11	Surface	17500	J	2.2		2	J	229		1.1		0.73		2800	J	40.9		1.3	J	320	J	5510		35.8	J	3280		126	J	0.14	U	18.2		555	U	0.5	J	0.52	UJ	914		0.52	U	57.4	J	327	J
		SM-DSD-006-B	MY7Z29	6/20/11	2	3380	J	0.43	U	1	J	29.2		0.24	J	0.31	U	1680	J	10		0.87	J	45.6	J	5650		6.6	J	1060		48.9	J	0.11	U	4.5		463	U	0.051	J	0.43	UJ	466		0.43	U	44.8	J	50.1	J
DSD-7		SM-DSD-007-A	MY7Z30	6/20/11	Surface	2450	J	0.45	U	0.86	J	22		0.19	J	0.32	U	3580	J	5.7		1	J	16.1	J	4380		3	J	1130		80.6	J	0.13	U	3.7	J	513	U	0.033	J	0.45	UJ	674		0.45	U	43.5	J	28.4	J
		SM-DSD-007-B	MY7Z31	6/20/11	2	1580	J	0.47	U	0.47	UJ	20.3	U	0.13	J	0.34	U	1610	J	7.9		0.72	J	3.9	J	3930		1.5	J	835		38.7	J	0.12	U	2.5	J	507	U	0.94	U	0.47	UJ	496	J	0.47	U	49.3	J	12.4	J
DSD-8		SM-DSD-008-A	MY7Z32	6/20/11	Surface	3570	J	2.5		1.2	J	36.1		0.35	J	0.44		1860	J	14.2		0.97	J	100	J	4100		37.4	J	1200		103	J	0.12	U	17.7		517	U	0.11	J	0.49	UJ	622		0.49	U	45.2	J	47.1	J
		SM-DSD-008-B	MY7Z33	6/20/11	2	1440	J	0.44	U	0.86	J	18.1	U	0.19	J	0.32	U	1120	J	6.8		1	J	10.7	J	7120		11.8	J	746		48	J	0.12	U	3.9		452	U	0.029	J	0.44	UJ	432	J	0.44	U	49	J	28.5	J
DSE-1		SM-DSE-001-A	MY7Z34	6/20/11	Surface	3890	J	0.37		1.2	J	39.3		0.31	J	0.31		3760	J	9.7		1.2	J	54.2	J	4530		8.7	J	1560		96.7	J	0.1	U	7.4		496		0.049	J	0.35	UJ	153	J	0.35	U	4.7	J	86.8	J
		SM-DSE-001-B	MY7Z35	6/20/11	2	1710	J	0.45	U	1.2	J	16.9	U	0.15	J	0.33	U	3560	J	7.9		1	J	3.9	J	5300		1.6	J	982		54.2	J	0.03	J	3.6		441		0.9	U	0.45	UJ	229	J	0.45	U	48.2	J	11.9	J
DSE-2		SM-DSE-002-A	MY7Z36	6/20/11	Surface	13700	J	0.95		1.2	J	59.7		0.59		0.47		3580	J	28.6		1.6	J	218	J	7400		23.2	J	1950		152	J	0.12	U	14.4		462	U	0.079	J	0.47	UJ	414		0.47	U	60.8	J	192	J
		SM-DSE-002-B	MY7Z37	6/20/11	2	1630	J	0.46	UJ	1.6	J	18.4	U	0.15	J	0.33	U	2310	J	5.4		0.85	J	6.8	J	4370		1.6		849		40.4	J	0.11	U	3.1	J	460	U	0.92	U	0.46	UJ	282	J	0.46	UJ	47.4	J	15	J
DSE-3	Dup	SM-DSE-003-A	MY7Z38	6/20/11	Surface	12000		0.94	J	1.5	J	95.6		0.73		0.66		3180	J	27		1.7	J	226	J	5870		37.2		2520		193	J	0.09	U	15.7		396		0.76	U	0.38	UJ	216	J	0.38	UJ	51.2	J	228	J
		SM-DSE-103-A	MY7Z40	6/20/11	Surface	10400		0.9	J	1.6	J	81.7		0.7		0.63		2420	J	23.5		1.4	J	200	J	4760		34.9		2170		167	J	0.09	U	15.2		383	U	0.77	U	0.38	UJ	182	J	0.38	UJ	43.1	J	202	J
		SM-DSE-003-B	MY7Z39	6/20/11	2	1440	J	0.45	UJ	1.1	J	18.1	U	0.1	J	0.33	U	2650	J	5.1		0.88	J	3.4	J	3460		1.2		855		42.2	J	0.11	U	2.7	J	452	U	0.9	U	0.45	UJ	161	J	0.45	UJ	49.3	J	12.7	J
DSE-4	Dup	SM-DSE-103-B	MY7Z41	6/20/11	2	1750	J	0.48	UJ	1.1	J	19.3	U	0.14	J	0.35	U	5370	J	4.8		1	J	4.7	J	3810		1.2		985		54.6	J	0.12	U	2.8	J	483	U	0.97	U	0.48	UJ	1110		0.97	UJ	46.3	J	14	J
		SM-DSE-004-A	MY7Z42	6/20/11	Surface	5330		0.44	J	1.5	J	58.8		0.49		0.36		3750	J	17.9		1.2	J	120	J	6050		12.6		1680		119	J	0.09	U	8.5		355	U	0.71	U	0.36	UJ	245	J	0.36	UJ	34.2	J	92.7	J
DSE-5		SM-DSE-004-B	MY7Z43	6/20/11	2	2920	J	0.42	UJ	1.1	J	24		0.24	J	0.3	U	3690	J																																

TABLE 3
 Chromium Analytical Results, Sediment Samples
 Halaco Site Remedial Investigation, Oxnard, California

Area	Location ID	Duplicate (Dup)	Sample ID	Lab Tag#	Sample Date	Material Type	Percent Moisture	Total Cr		Cr(VI)		Ratio of Cr(VI) to Total Cr
								Result	Q	Result	Q	
WMU Ditch	DSA-1		CR-DSA-001-A	M6298	6/23/11	Sediment, submerged	73%	25.4		0.09		0.35%
		Dup	CR-DSA-101-A	M6300	6/23/11	Sediment, submerged	55%	105		0.024	J	0.02%
	DSA-3		CR-DSA-003-A	M6304	6/23/11	Sediment, submerged	52%	163		0.031		0.02%
	DSA-6		CR-DSA-006-A	M6310	6/23/11	Sediment, submerged	49%	103		0.023	J	0.02%
Lagoon	LGF-1		CR-LGF-001-A	M6314	6/23/11	Sediment, submerged	55%	123		0.057		0.05%
	LGM-1		CR-LGM-001-A	M6312	6/23/11	Sediment, submerged	54%	13.6		0.014	J	0.10%
NCL-East	NEL-7		CR-NEL-007-A	M6294	6/23/11	Sediment, submerged	42%	271		0.088		0.03%
	NEL-9		CR-NEL-009-A	M6296	6/23/11	Sediment, submerged	31%	41.2		0.038		0.09%

Notes:

Units are in mg/kg (dry weight basis)

J = Estimated value between the "estimated Method Detection Limit (eMDL) and the Reporting Limit"

TABLE 4

Field Parameter Results, Submerged Sediment, Top Water and Pore Water Samples
Halaco Site Remedial Investigation, Oxnard, California

No.	Location	Date	Sample Number	Time	Temperature (C)	pH	Electrical Conductivity (uS)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Oxidation Reduction Potential (mV)	Sample Type
NCL-East											
1	NEL-9	6/23/11	1	9:31	20.2	7.98	8189	>1000	8.95	-158	Top water
			2	9:34	20.8	7.99	8209	>1000	-	-146	Top water
			3	9:36	20.7	7.86	7990	>1000	-	-117	Top water
			4	9:40	20.8	7.92	8104	>1000	9.38	-140	Top water
			5	9:45	20.9	7.70	7378	>1000	8.14	-122	Pore water
2	NEL-7	6/23/11	1	9:55	20.1	7.87	8288	>1000	7.78	-41	Top water
			2	9:58	20.3	7.90	8513	>1000	8.08	-5	Top water
			3	10:01	20.5	7.83	8508	>1000	9.04	17	Top water
			4	15:28	21.8	7.80	8153	>1000	3.18	36	Pore water
			5	15:33	22.2	7.78	8091	>1000	3.38	40	Pore water
			6	15:35	22.3	7.81	8113	>1000	4.10	44	Pore water
WMU Ditch											
3	DSA-6	6/23/11	1	13:19	22.0	7.90	8411	>1000	3.85	-128	Top water
			2	13:21	21.8	7.85	8671	>1000	3.53	-74	Top water
			3	13:22	22.0	7.82	8474	>1000	4.00	-63	Top water
			4	13:28	21.8	7.62	5732	>1000	-	-68	Pore water
			5	13:31	21.9	7.56	5914	>1000	-	-49	Pore water
			6	13:38	22.1	7.60	5944	>1000	-	-38	Pore water
4	DSA-3	6/23/11	1	13:41	22.0	7.91	8059	>1000	-	-190	Top water
			2	13:43	22.2	7.80	8143	818	-	-103	Top water
			3	13:45	22.3	7.78	7984	>1000	-	-108	Top water
			4	14:53	21.9	7.68	8016	687	-	-89	Pore water
			5	15:40	23.3	7.80	2912	>1000	-	-84	Mix w/ ultrapure water
			6	15:45	23.8	7.72	3214	>1000	-	-113	Mix w/ ultrapure water
5	DSA-1	6/23/11	1	14:02	22.5	8.18	8126	154	2.88	-112	Top water
			2	14:05	22.2	8.07	8119	>1000	2.14	-231	Top water
			3	14:08	22.4	8.00	8180	>1000	2.60	-235	Top water
			4	14:20	22.8	7.87	8123	>1000	-	-344	Pore water
			5	14:25	22.0	8.08	8140	>1000	3.18	-191	Pore water
			6	14:30	22.3	7.89	8130	>1000	-	-184	Pore water
Lagoon											
6	LGM-1	6/23/11	1	14:36	22.3	7.90	13130	>1000	2.89	-325	Top water
			2	14:39	22.1	8.09	11660	>1000	3.85	-327	Top water
			3	14:41	22.6	8.15	12080	>1000	3.66	-330	Top water
			4	14:48	22.7	8.12	10450	>1000	2.90	-355	Pore water
			5	14:50	23.0	7.79	11300	>1000	1.98	-355	Pore water
			6	14:52	22.9	7.88	11520	>1000	2.10	-332	Pore water
7	LGF-1	6/23/11	1	11:31	21.0	7.42	11910	>1000	4.80	-350	Top water
			2	11:34	21.2	7.53	11880	>1000	7.75	-348	Top water
			3	11:37	21.2	7.63	11580	>1000	7.11	-361	Top water
			4	11:40	22.0	7.50	11630	>1000	5.40	-140	Pore water
			5	11:45	22.2	7.42	11600	>1000	4.80	-122	Pore water
			6	11:48	22.5	7.40	11650	>1000	5.12	-128	Pore water

TABLE 5

Field Parameter Results, Process Waste and Soil, Slurry Samples

Halaco Site Remedial Investigation, Oxnard, California

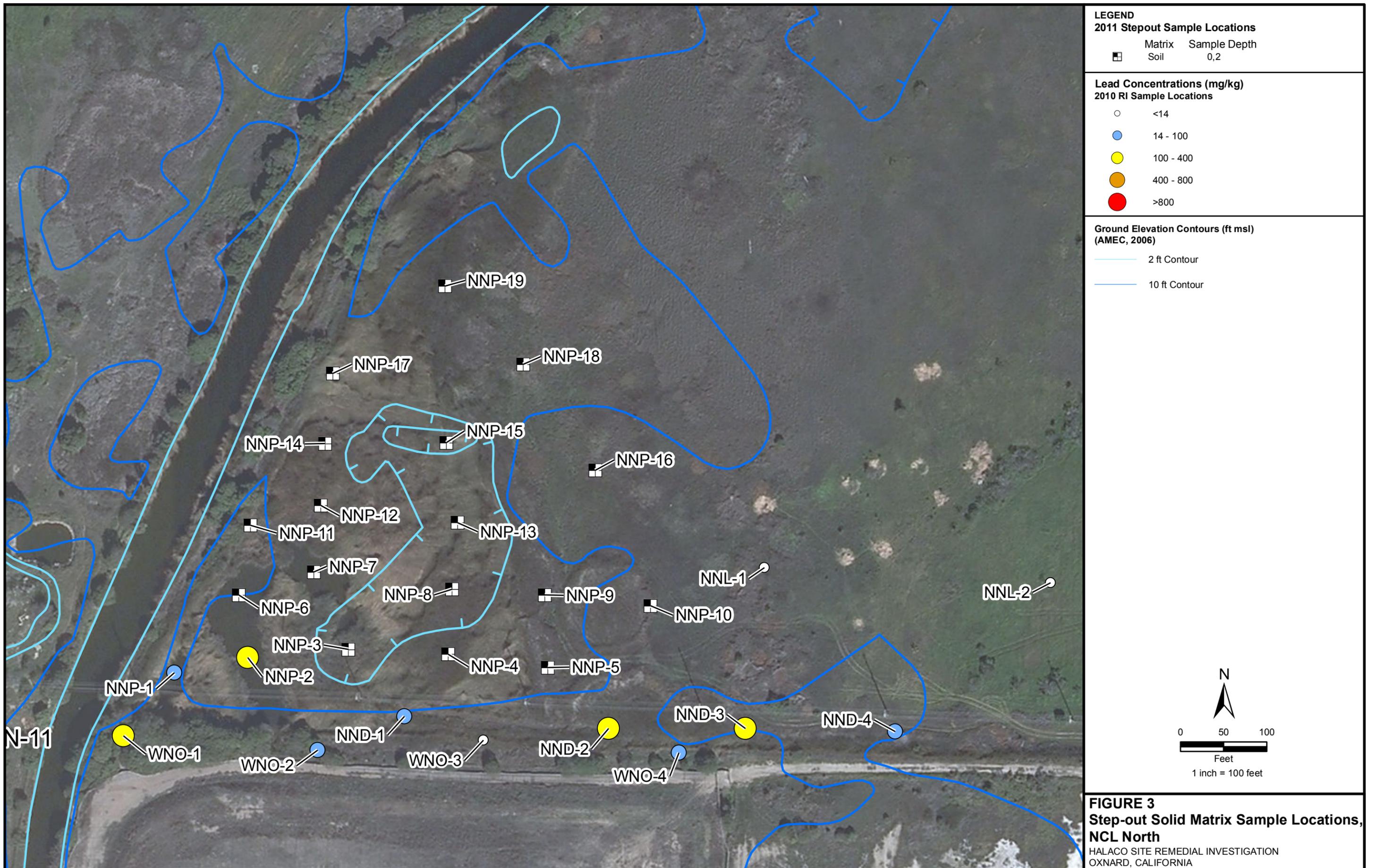
No.	Date	Sample Number	Time	Temperature (C)	pH	Electrical Conductivity (uS)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Oxidation Reduction Potential (mV)	Sample Type
Waste Management Area										
1	11/4/11	TXI-WMU-4	10:18	14.7	8.39	10870	>1000	8.83	233.6	Process Waste
		TXI-WMU-7	11:06	14.4	8.37	2183	>1000	8.91	206.8	Process Waste
		TXI-WMU-9	12:05	13.2	8.45	6854	>1000	8.89	243.7	Process Waste
		TXI-WMU-11	13:23	15.9	8.67	13070	>1000	8.97	218.1	Process Waste
Smelter Parcel										
2	11/4/11	ORP-SS-1	14:23	15.7	8.69	359	>1000	9.44	185.3	Soil
		ORP-SS-2	14:30	15.6	7.91	13870	>1000	9.82	246.1	Soil
		ORP-SS-3	14:40	15.8	9.04	619	>1000	9.75	170.3	Soil
		ORP-SS-4	14:45	16.1	7.82	12870	>1000	9.91	218.3	Soil

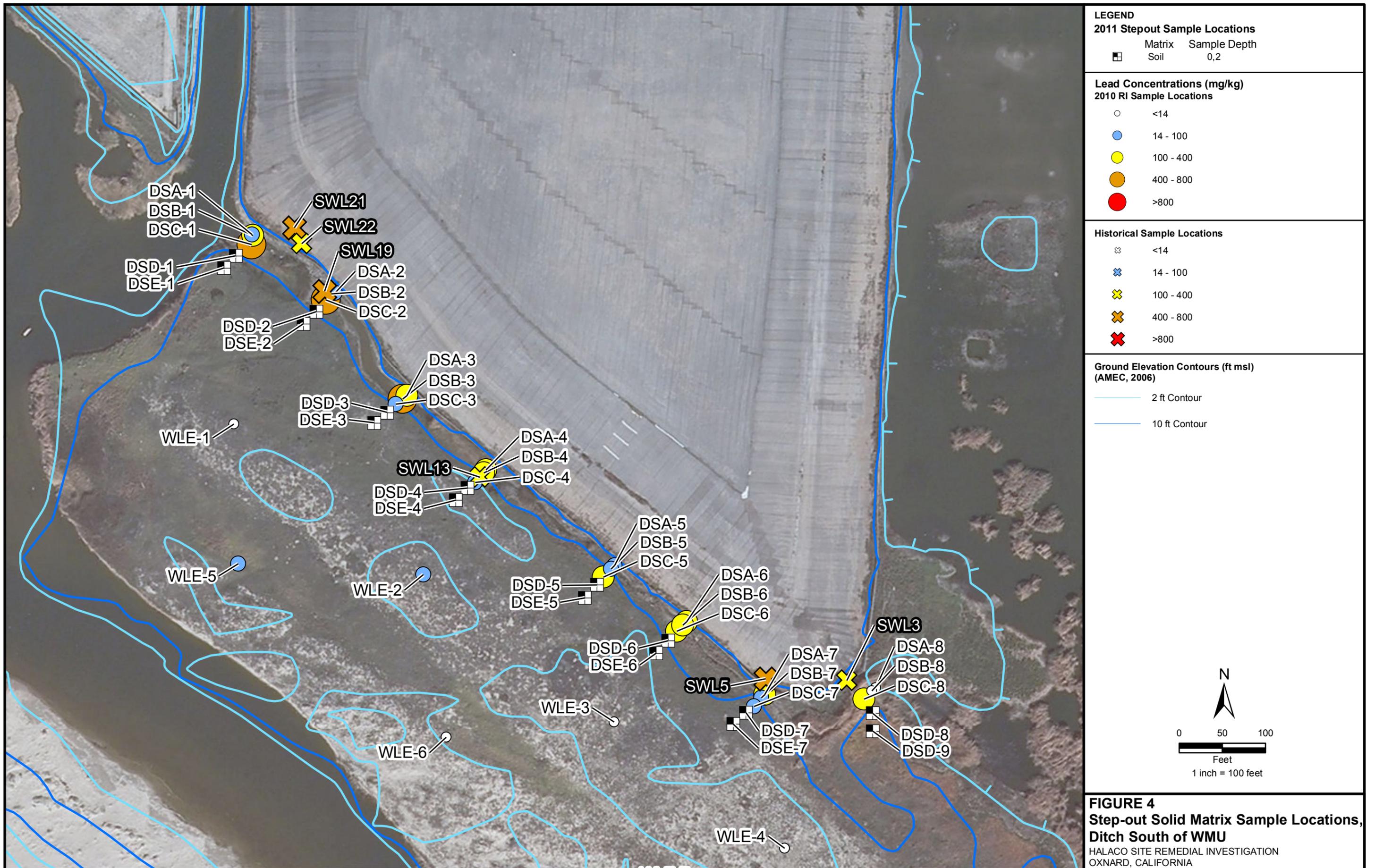
Figures



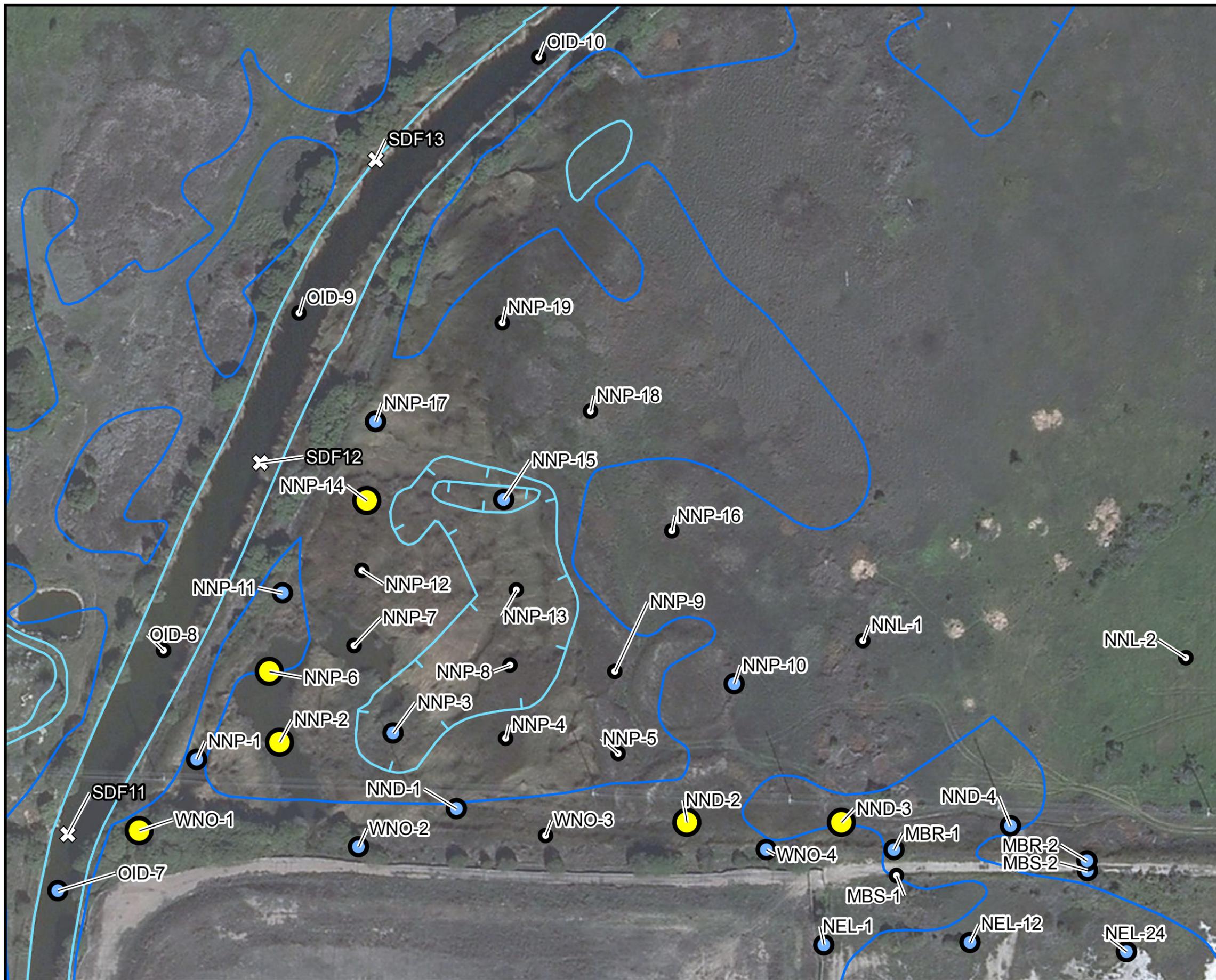
Aerial image © Google Earth, 2007. Annotation by CH2M HILL, 2008.

FIGURE 1
 Halaco Superfund Site Areas
Halaco Site Remedial Investigation
 Oxnard, California









LEGEND

**Lead Concentrations (mg/kg)
2010 and 2011 RI Sample Locations**

- <14
- 14 - 100
- 100 - 400
- 400 - 800
- >800

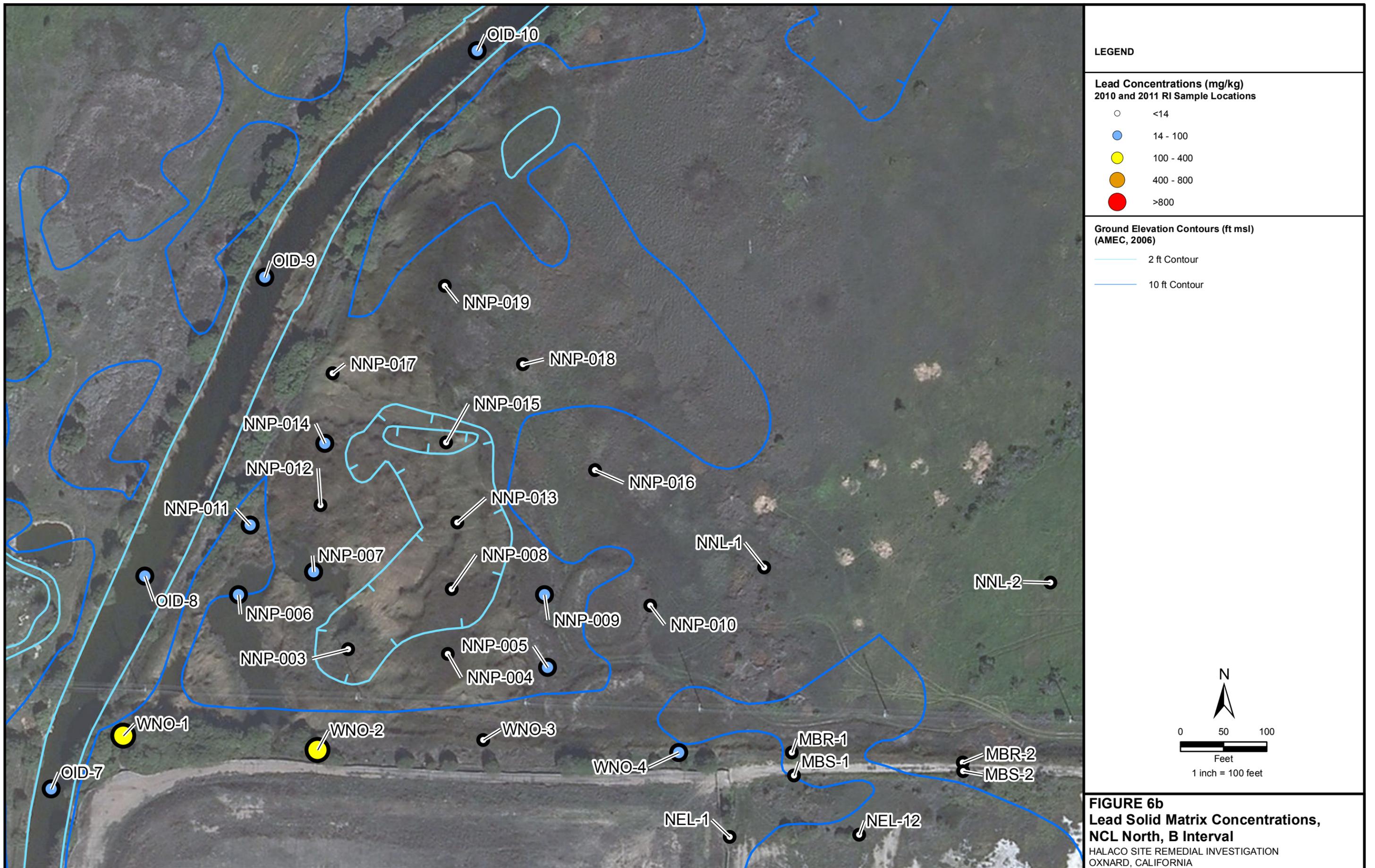
**Ground Elevation Contours (ft msl)
(AMEC, 2006)**

- 2 ft Contour
- 10 ft Contour

N

0 50 100
Feet
1 inch = 100 feet

FIGURE 6a
**Lead Solid Matrix Concentrations,
 NCL North, Surface Samples**
 HALACO SITE REMEDIAL INVESTIGATION
 OXNARD, CALIFORNIA



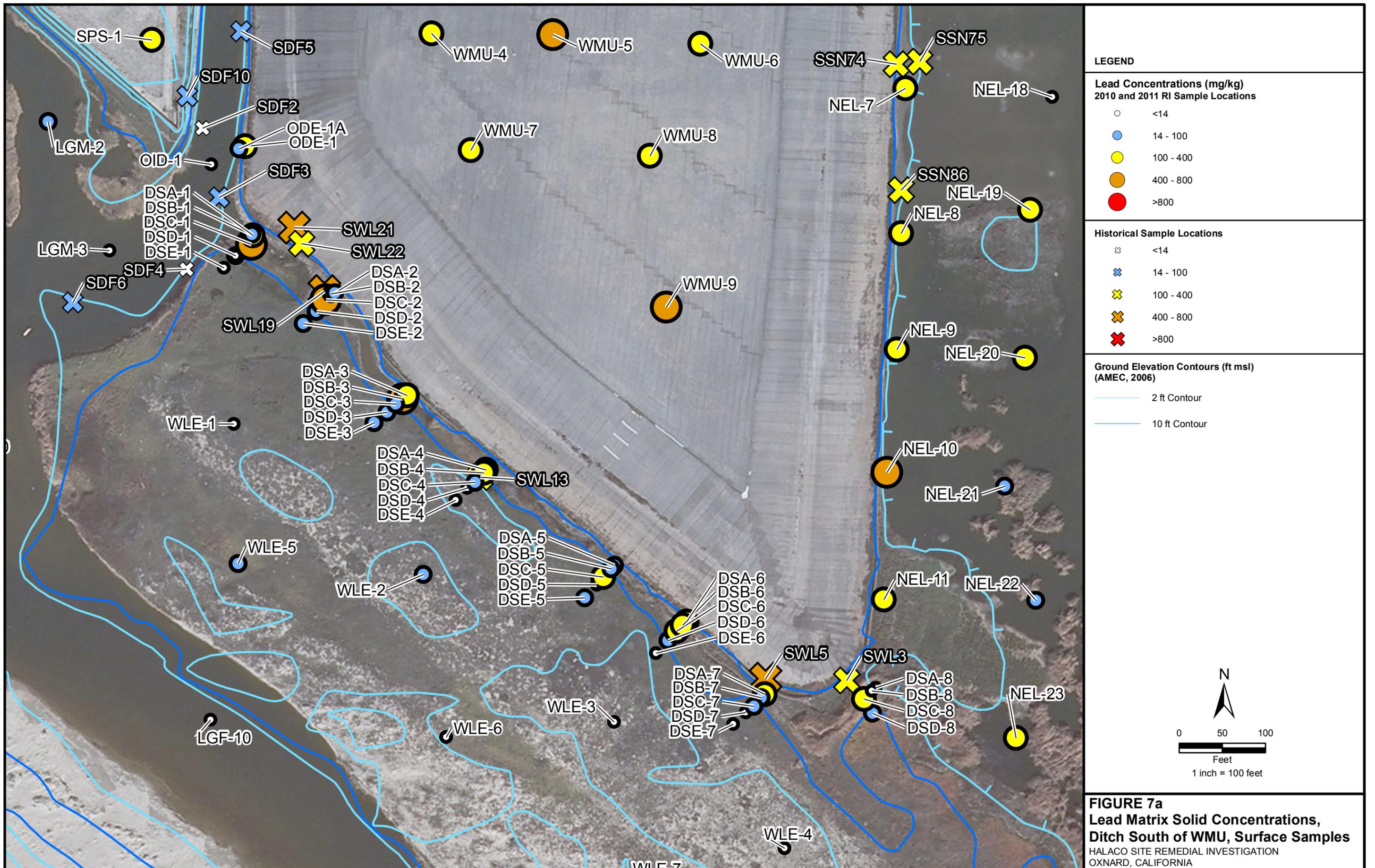
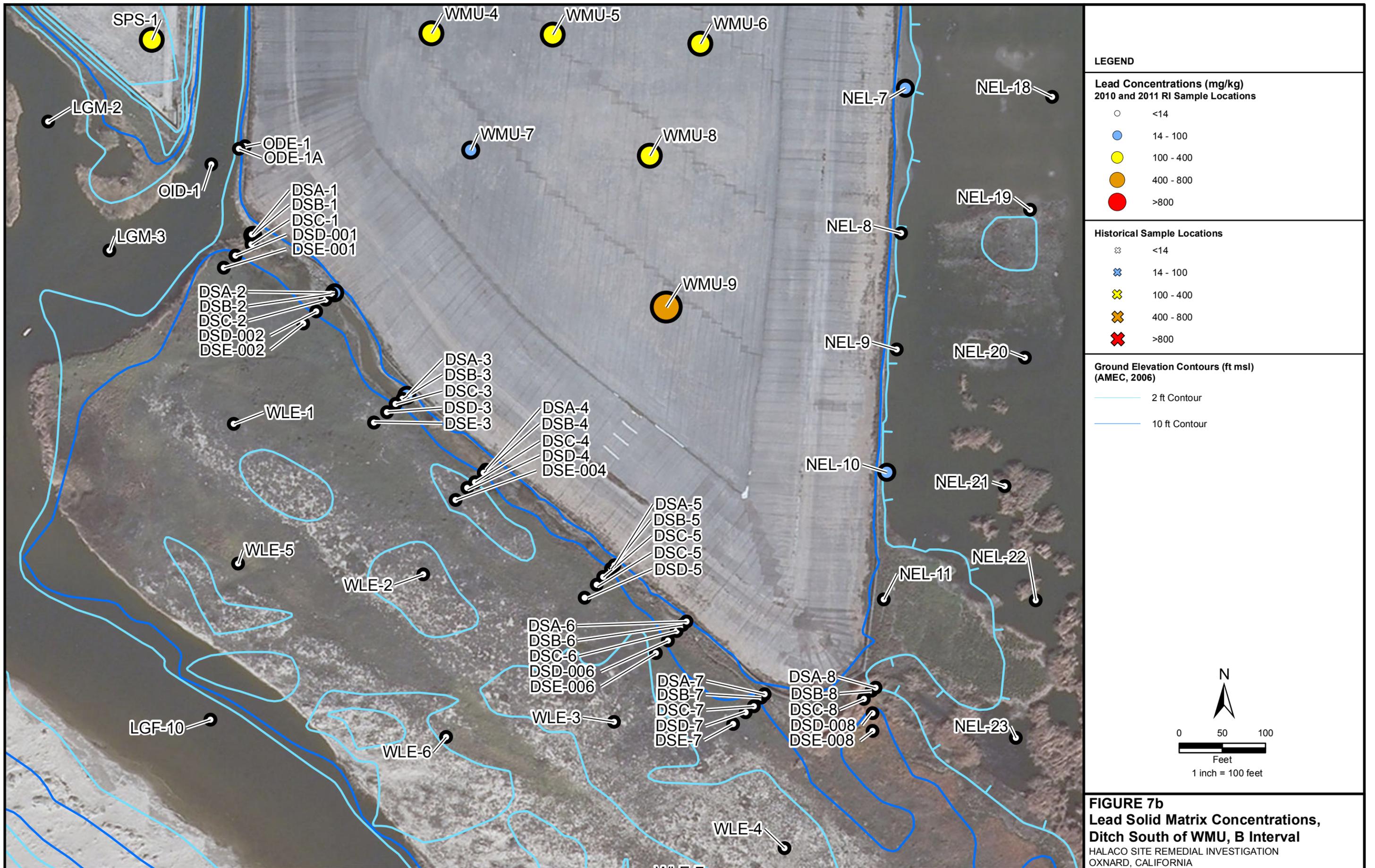


FIGURE 7a
Lead Matrix Solid Concentrations,
Ditch South of WMU, Surface Samples
 HALACO SITE REMEDIAL INVESTIGATION
 OXNARD, CALIFORNIA



Attachment A
Lithologic Descriptions of Solid Matrix Samples

ATTACHMENT A

Lithologic Descriptions of Solid Matrix Samples for NCL-North Pond and WMU Ditch Step-out Samples

Halaco Site Remedial Investigation, Oxnard, California

Sample ID	Depth (ft bgs)	Lithologic Description
NCL-North Pond Step-out Samples		
NNP-003-A	0	Silt with Organics (ML-OL), dark grayish brown (2.5Y 4/2), wet, 100% fines, some organics, low plasticity
NNP-003-B	2	Clay with SAND (CL), grayish brown (2.5Y 5/2), wet, 90% fines, 10% fine sand, trace fine mica, medium plasticity
NNP-004-A	0	Clayey Silt (ML), grayish brown (2.5Y 5/2), wet, 100% fines, low plasticity
NNP-004-B	2	Silty Clay (ML), grayish brown (2.5Y 5/2), wet, 100% fines, medium plasticity
NNP-005-A	0	Fat Clay (CH), light olive brown (2.5Y 5/3), wet, 100% fines, high plasticity
NNP-005-B	2	Fat Clay (CH), light olive brown (2.5Y 5/3), wet, 100% fines, trace mica, high plasticity
NNP-006-A	0	Clayey Silt with Organics (ML-OL), very dark gray (2.5Y 3/1), wet, 100% fines, some organic soil
NNP-006-B	2	Lean Clay (CL), dark olive gray (5Y 4/2), wet, 100% fines, medium plasticity
NNP-007-A	0	Silty Clay (CL), olive gray (5Y 5/2), wet, 100% fines, some organic soil, medium plasticity
NNP-007-B	2	Lean Clay (CL), olive gray (5Y 5/2), wet, 100% fines, trace fine mica, medium plasticity
NNP-008-A	0	Silty Clay (CL), grayish brown (2.5Y 5/2), wet, 100% fines, medium plasticity
NNP-008-B	2	Silty Clay (CL), grayish brown (2.5Y 5/2), mottled, wet, 100% fines, trace fine mica, transitional clay interval, medium plasticity
NNP-009-A	0	Fat Clay (CH), grayish brown (2.5Y 5/2), wet, 100% fines, high plasticity
NNP-009-B	2	Fat Clay (CH), dark grayish brown (2.5Y 4/2), wet, 100% fines, trace fine mica, high plasticity
NNP-010-A	0	Silt with Organics (ML-OH), very dark gray (5Y 3/1), moist, 100% fines, some organic soil, low plasticity
NNP-010-B	2	Silt (ML), very dark gray (2.5Y 3/1), moist, 100% fines, low plasticity
NNP-011-A	0	Silty Clay with Organics (CL-OL), dark olive gray (5Y 3/2), wet, 100% fines, some organic soil, medium plasticity
NNP-011-B	2	Lean Clay (CL), olive gray (5Y 5/2), wet, 100% fines, trace fine mica, medium plasticity
NNP-012-A	0	Lean Clay (CL), olive gray (5Y 5/2), wet, 100% fines, trace fine mica, medium plasticity
NNP-012-B	2	Clay with Sand (CL), olive gray (5Y 5/2), wet, 90% fines, 10% fine sand, trace fine mica
NNP-013-A	0	Lean Clay with Organics (CL-OL), olive (5Y 4/3), wet, 100% fines, some organics, medium plasticity
NNP-013-B	2	Fat Clay (CH), light yellowish brown (2.5Y 6/3), moist, 100% fines, trace mica, high plasticity
NNP-014-A	0	Clay with Organics (CL-OL), very dark grayish brown (10YR 3/2), wet, 100% fines, some organic soil, low plasticity
NNP-014-B	2	Silty Clay (CL), grayish brown (2.5Y 5/2), wet, 100% fines, low plasticity, trace fine sand
NNP-015-A	0	Lean Clay with Organics (CL-OL), grayish brown (2.5Y 5/2), wet, 100% fines, some organics
NNP-015-B	2	Fat Clay (CH), light brownish gray (2.5Y 6/2), wet, 100% fines, trace fine mica, high plasticity
NNP-016-A	0	Clayey Silt (ML), very dark grayish brown (2.5Y 3/2), moist, 100% fines, low plasticity
NNP-016-B	2	Silt (ML), very dark gray (2.5Y 3/1), moist, 100% fines, low plasticity, blocky
NNP-017-A	0	Clay/Organics (CL/OL), very dark grayish brown (10YR 3/2), wet, 100% fines, medium plasticity
NNP-017-B	2	Lean Clay (CL), light olive brown (2.5Y 5/3), wet, 100% fines, medium plasticity
NNP-018-A	0	Silt (ML), olive gray (5Y 5/2), wet, 100% fines, trace fine sand, trace fine mica, low plasticity
NNP-018-B	2	Silt (ML), olive gray (5Y 4/2), wet, 100% fines, trace fine sand, trace fine mica, low plasticity
NNP-019-A	0	Lean Clay (CL), olive gray (5Y 5/2), wet, 100% fines, trace fine mica, medium plasticity
NNP-019-B	2	Clayey Silt (ML), dark olive gray (5Y 3/2), wet, 100% fines, medium plasticity
WMU Ditch Step-out Samples		
DSD-001-A	0	Poorly Graded Sand (SP), light olive brown (2.5Y 5/3), wet, 50% fine sand, 50% medium sand, trace fines
DSD-001-B	2	Poorly Graded Sand (SP), light yellowish brown (2.5Y 6/4), wet, 90% fine sand, 10%, medium sand
DSD-002-A	0	Poorly Graded Sand (SP), olive (5Y 5/3), wet, 95% fine sand, 5% fines, trace mica
DSD-002-B	2	Poorly Graded Sand (SP), light olive brown (2.5Y 5/3), wet, 60% coarse sand, 40% medium sand
DSD-003-A	0	Poorly Graded Sand (SP), light yellowish brown (2.5Y 6/3), moist, 90% fine sand, 5% medium sand, 5% coarse sand
DSD-003-B	2	Poorly Graded Sand (SP), light yellowish brown (2.5Y 6/3), wet, 90% fine sand, 10% medium sand
DSD-004-A	0	Poorly Graded Sand (SP), light yellowish brown (2.5Y 6/4), moist, 30% fine sand, 70% medium sand, trace coarse sand
DSD-004-B	2	Poorly Graded Sand (SP), light yellowish brown (2.5Y 6/3), wet, 30% fine sand, 70% medium sand, trace coarse sand
DSD-005-A	0	Poorly Graded Sand (SP), pale yellow (2.5Y 7/3), moist, 30% fine sand, 70% medium sand, trace coarse sand
DSD-005-B	2	Poorly Graded Sand (SP), light yellowish brown (2.5Y 6/3), wet, 30% fine sand, 70% medium sand, trace coarse sand
DSD-006-A	0	Poorly Graded Sand with Organics (SP), grayish brown (10YR 5/2), wet, 70% fine sand, 20% medium sand, 10% organic soil
DSD-006-B	2	Poorly Graded Sand (SP), light olive brown (2.5Y 5/3), wet, 60% fine sand, 40% medium sand
DSD-007-A	0	Poorly Graded Sand with Organics (SP), light olive brown (2.5Y 5/3), wet, 30% fine sand, 60% medium sand, 10% black/brown organics
DSD-007-B	2	Poorly Graded Sand (SP), light yellowish brown (2.5Y 6/3), wet, 80% fine sand, 20% medium sand
DSD-008-A	0	Poorly Graded Sand with Organics (SP), light olive brown (2.5Y 5/3), moist, 70% fine sand, 20% medium sand, 10% black/brown organics from decayed plant roots
DSD-008-B	2	Well Graded Sand (SW), light yellowish brown (2.5Y 6/3), wet, 30% fine sand, 40% medium sand, 30% coarse sand, trace mica
DSE-001-A	0	Poorly Graded Sand (SP), light yellowish brown (2.5Y 6/3), moist, 40% fine sand, 60% medium sand
DSE-001-B	2	Poorly Graded Sand (SP), light yellowish brown (2.5Y 6/3), wet, 80% fine sand, 20% medium sand, trace mica
DSE-002-A	0	Poorly Graded Sand with Organics (SP), olive brown (2.5Y 4/3), wet, 70% fine sand, 20% medium sand, 10% organics
DSE-002-B	2	Poorly Graded Sand (SP), light yellowish brown (2.5Y 6/4), wet, 60% fine sand, 40% medium sand, trace mica
DSE-003-A	0	Poorly Graded Sand (SP), light yellowish brown (2.5Y 6/3), moist, 80% fine sand, 20% medium sand, trace coarse sand, trace mica
DSE-003-B	2	Well Graded Sand (SW), light yellowish brown (2.5Y 6/3), wet, 30% fine sand, 40% medium sand, 30% coarse sand, trace mica
DSE-004-A	0	Well Graded Sand (SW), pale yellow (2.5Y 7/3), moist, 60% fine sand, 20% medium sand, 20% coarse sand
DSE-004-B	2	Poorly Graded Sand (SP), light yellowish brown (2.5Y 6/3), wet, 60% coarse sand, 40% medium sand
DSE-005-A	0	Poorly Graded Sand (SP), light yellowish brown (2.5Y 6/3), moist, 30% fine sand, 70% medium sand, trace coarse sand
DSE-005-B	2	Poorly Graded Sand (SP), light yellowish brown (2.5Y 6/3), wet, 30% fine sand, 70% medium sand
DSE-006-A	0	Well Graded Sand (SW), light yellowish brown (2.5Y 6/3), moist, 80% medium sand, 10% coarse sand, 10% fine sand
DSE-006-B	2	Poorly Graded Sand (SP), light yellowish brown (2.5Y 6/3), wet, 80% fine sand, 20% medium sand
DSE-007-A	0	Poorly Graded Sand (SP), light yellowish brown (2.5Y 6/3), moist, 40% fine sand, 60% medium sand
DSE-007-B	2	Poorly Graded Sand (SP), light yellowish brown (2.5Y 6/3), wet, 60% fine sand, 40% medium sand, trace mica
DSE-008-A	0	Poorly Graded Sand (SP), light yellowish brown (10YR 6/4), moist, 30% fine sand, 70% medium sand
DSE-008-B	2	Poorly Graded Sand (SP), wet, light yellowish brown (10YR 6/4), wet, 30% fine sand, 70% medium sand

Attachment B
Chromium Speciation Laboratory Report
(Applied Speciation and Consulting, LLC)



August 12, 2011

Wayne Praskins
USEPA Superfund Program
75 Hawthorne Street
San Francisco, CA 94105
(415) 972-3181

Mr. Praskins,

Attached is the report associated with eight (8) soil samples submitted for total chromium and hexavalent chromium quantitation on June 24, 2011. The samples were received on June 25, 2011 in a sealed cooler at 0.7°C. The submitted samples were extracted using EPA Method 3060A and then analyzed for hexavalent chromium via ion chromatography inductively coupled plasma dynamic reaction cell mass spectrometry (IC-ICP-DRC-MS). All samples were also digested in accordance with EPA Method 3050B and analyzed via EPA Method 6020. Any analytical issues associated with the analysis are addressed in the following report.

If you have any questions, please feel free to contact me at your convenience.

Sincerely,

A handwritten signature in black ink, appearing to read "Russell Gerads".

Russell Gerads
Vice President
Applied Speciation and Consulting, LLC

Applied Speciation and Consulting, LLC

Report Prepared for:

Wayne Praskins
USEPA Superfund Program
75 Hawthorne Street
San Francisco, CA 94105

August 12, 2011

1. Sample Reception

Eight (8) soil samples were submitted in wide-mouth polyethylene for total chromium and hexavalent chromium quantitation on June 24, 2011. The samples were received in acceptable condition on June 26, 2011 in a sealed cooler at 0.7°C.

All samples were received in a laminar flow clean hood void of trace metals contamination and ultra-violet radiation. Upon reception, all samples were designated discrete sample identifiers and then stored in a secure, monitored refrigerator (maintained at a temperature of $\leq 4^{\circ}\text{C}$) until all preparatory and analytical procedures could be performed.

2. Sample Preparation

All sample preparation is performed in laminar flow clean hoods known to be free from trace metals contamination. All applied water for dilutions and sample preservatives are monitored for contamination to account for any biases associated with the sample results.

Hexavalent Chromium Quantification by IC-ICP-DRC-MS Prior to analysis, all samples were extracted using EPA Method 3060A on July 20, 2011. In summary, a known mass of each sample was weighed into a polypropylene centrifuge tube by taking random subsamples of the original sample. A buffered alkaline extraction solution, MgCl_2 , and a phosphate buffer solution were then applied to each sample. All vials were then heated at 90-95°C in a sonicating bath for a minimum of one (1) hour. The resulting extracts were cooled, filtered, and injected directly into sealed autosampler vials prior to analysis for hexavalent chromium.

Total Chromium Quantification by EPA Method 6020 Prior to analysis, all samples were digested using EPA Method 3050B. In summary, a known mass of each sample was weighed into a polypropylene digestion vessel by taking random subsamples of the original sample. Known volumes of HNO_3 and H_2O_2 were then applied to each sample. All digestion vessels were then heated at 95°C for a minimum of six (6) hours.

3. Sample Analysis

All sample analysis is preceded by a minimum of a five-point calibration curve spanning the entire concentration range of interest. Calibration curves are performed at the beginning of each analytical day. All calibration curves, associated with each species of interest, are standardized by linear regression resulting in a response factor. All sample results are **instrument blank corrected** to account for any operational biases associated with the analytical platform.

Prior to sample analysis, all calibration curves are verified using second source standards which are identified as initial calibration verification standards (ICV).

Ongoing instrument performance is identified by the analysis of continuing calibration verification standards (CCV) and continuing calibration blanks (CCB) at a minimal interval of every ten analytical runs.

Hexavalent Chromium Quantitation by IC-ICP-DRC-MS All sample extracts for hexavalent chromium quantitation were analyzed via a modified version of EPA Method 7199 employing ion chromatography inductively coupled plasma dynamic reaction cell mass spectrometry (IC-ICP-DRC-MS) on July 26, 2011. Aliquots of each sample are injected onto an anion exchange column and mobilized by an alkaline (pH > 7) gradient. The eluting chromium species are then introduced into a radio frequency (RF) plasma where energy-transfer processes cause desolvation, atomization, and ionization. The ions are extracted from the plasma through a differentially-pumped vacuum interface and travel through a pressurized chamber (DRC) containing a specific reactive gas which preferentially reacts with interfering ions of the same target mass to charge (m/z) ratios. A solid-state detector detects ions transmitted through the mass analyzer, on the basis of their mass-to-charge ratio (m/z), and the resulting current is processed by a data handling system.

The retention time for hexavalent chromium is compared to known standards for species identification.

Chromium Quantification by EPA Method 6020 All samples for total chromium quantification were analyzed by inductively coupled plasma dynamic reaction cell mass spectrometry (ICP-DRC-MS). Aliquots of each sample are introduced into a radio frequency (RF) plasma where energy-transfer processes cause desolvation, atomization, and ionization. The ions are extracted from the plasma through a differentially-pumped vacuum interface and travel through a pressurized chamber (DRC) containing a specific reactive gas which preferentially reacts with interfering ions of the same target mass to charge ratios (m/z). A solid-state detector detects ions transmitted through the mass analyzer, on the basis of their mass-to-charge ratio (m/z), and the resulting current is processed by a data handling system.

4. Analytical Issues

Although the overall analyses went well, issues were encountered during the applied extraction procedure, as described below.

Hexavalent Chromium Quantitation - Laboratory Control Samples Three laboratory control samples were extracted with the submitted samples to identify the extraction efficiency and capacity of the extraction procedure to induce conversion of trivalent chromium to hexavalent chromium. The laboratory control samples spiked with an aqueous hexavalent chromium and a solid PbCrO_4 standard produced acceptable recoveries (98.9% and 100.8%, respectively), indicating that the applied method effectively extracts and stabilizes the hexavalent chromium species. The third laboratory control sample spiked with an aqueous trivalent chromium standard solution resulted in a hexavalent chromium recovery of 0.4%. The quantity of hexavalent chromium detected in this LCS is near the level present in the preparation blanks, which is attributed to trace levels of hexavalent chromium in the reagents used for the extraction procedure. This low recovery for the trivalent chromium spike demonstrates that the extraction procedure, under ideal conditions, induces minimal conversion of trivalent to hexavalent chromium.

Hexavalent Chromium Quantitation – Matrix Spike / Matrix Spike Duplicates (MS/MSDs) Similar to the laboratory control samples, three discrete sets of matrix spikes were extracted to identify the interaction of the sample matrix with trivalent and hexavalent chromium. The performance of the matrix spikes can assist in identifying chemical interferences associated with the sample matrix and the applied extraction procedure.

Hexavalent Chromium Quantitation – Cr(III) MS/MSDs The hexavalent chromium recoveries associated with each aqueous trivalent chromium MS and MSD were less than 5%. These low trivalent chromium matrix spike recoveries suggest that the extraction procedure induces minimal oxidation of trivalent chromium to hexavalent chromium in the spiked sample matrix.

Hexavalent Chromium Quantitation – Aqueous Cr(VI) and Solid PbCrO_4 MS/MSDs The hexavalent chromium recoveries associated with the soluble hexavalent chromium matrix spikes performed on the sample identified as CR-NEL-009-A were below the established control limit of 75%. The obtained matrix spike recoveries indicate that significant interference was encountered during the applied extraction procedure. As previously mentioned, the recoveries associated with both the soluble hexavalent chromium LCS and insoluble hexavalent chromium LCS were within control, demonstrating that the applied method both extracts and stabilizes hexavalent chromium. The low bias observed for the matrix spikes is attributed to interference from the sample matrices; therefore, no further corrective action was deemed necessary. The reported results suggest that the spiked sample matrix favors reduction of hexavalent chromium.

The estimated method detection limit (eMDL) for hexavalent chromium for solids is generated using the standard deviation of the associated preparation blanks, in accordance with Applied Speciation and Consulting's SOP.

If you have any questions or concerns regarding this report, please feel free to contact me.

Sincerely,

A handwritten signature in black ink, appearing to read "Russell Gerads", written in a cursive style.

Russell Gerads
Vice President
Applied Speciation and Consulting, LLC

Total Chromium and Hexavalent Chromium Results for the US Environmental Protection Agency
Contact: Wayne Praskins

Date: August 12, 2011
Report Generated by: Russell Gerads
Applied Speciation and Consulting, LLC

Sample Results

Sample ID	Tag#	% Moisture	Total Cr	Cr(VI)
CR-DSA-001-A	M6298	73%	25.4	0.090
CR-DSA-003-A	M6304	52%	163	0.031
CR-DSA-006-A	M6310	49%	103	0.023 J
CR-DSA-101-A	M6300	55%	105	0.024 J
CR-LGF-001-A	M6314	55%	123	0.057
CR-LGM-001-A	M6312	54%	13.6	0.014 J
CR-NEL-007-A	M6294	42%	271	0.088
CR-NEL-009-A	M6296	31%	41.2	0.038

All results are reported in mg/kg on a dry weight basis

J = Estimated value between the eMDL and the RL

Total Chromium and Hexavalent Chromium Results for the US Environmental Protection Agency
Contact: Wayne Praskins

Date: August 12, 2011
Report Generated by: Russell Gerads
Applied Speciation and Consulting, LLC

Quality Control Summary - Preparation Blank Summary

Analyte (mg/kg)	PBS1	PBS2	PBS3	PBS4	Mean	StdDev	eMDL	RL
Cr(VI)	0.010	0.011	0.009	0.010	0.010	0.001	0.003	0.025
Total Cr	-0.024	-0.025	-0.024	-0.023	-0.024	0.001	0.003	0.025

eMDL = Estimated Method Detection Limit

RL = Reporting Limit

Quality Control Summary - Laboratory Control Samples

Analyte (mg/kg)	LCS	True Value	Result	Recovery
Cr(VI)	LCS	20.00	19.79	98.9
Cr(III)	LCS	20.00	0.03	0.4
PbCrO ₄	LCS	1075	1084	100.8
Total Cr	CRM 036-050	77.59	81.14	104.6

Total Chromium and Hexavalent Chromium Results for the US Environmental Protection Agency
 Contact: Wayne Praskins

Date: August 12, 2011
 Report Generated by: Russell Gerads
 Applied Speciation and Consulting, LLC

Quality Control Summary - Matrix Duplicate

Analyte (mg/kg)	Sample ID	Rep 1	Rep 2	Mean	RPD
Cr(VI)	CR-NEL-009-A	0.038	0.005	0.021	156.4*
Total Cr	CR-NEL-009-A	41.17	38.65	39.91	6.3
% Moisture	CR-NEL-009-A	0.442	0.439	0.440	0.6

*The sample concentrations are within 10x the eMDL

Quality Control Summary - Matrix Spike/ Matrix Spike Duplicate

Analyte (mg/kg)	Sample ID	Spike Conc	MS Result	Recovery	Spike Conc	MSD		RPD
						Result	Recovery	
Cr(III)	CR-NEL-009-A	26.57	0.03	0.0	27.44	0.91	3.2	2.4
Cr(VI)	CR-NEL-009-A	28.41	1.87	6.5**	29.48	0.16	0.5**	2.4
PbCrO ₄	CR-NEL-009-A	1612	1473	91.4	1656	1311	79.2	8.9
Total Cr	CR-NEL-009-A	119	161	101.3	137	164.8	91.1	8.9

** The recovery is below the established control limit of 75%; please see narrative.