Soil Contaminant Review
for the
Ormond Beach Wetland Restoration Project

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Introduction

Everest International Consultants (Everest) and AMEC Earth & Environmental (AMEC) have been tasked with conducting a review of the existing contaminant levels and potential beneficial and/or non-beneficial reuse of soils associated with the restoration of the Ormond Beach wetlands based upon existing information. Evaluating the extent of existing chemical contamination within the proposed wetland restoration footprint is an essential step in the restoration process.

Wetland restoration projects typically involve excavation of soils that have filled or partially filled historical wetlands. A key component to the restoration process is accurately assessing the spatial extent and degree of contamination of the soils to be excavated.

This report focuses primarily on soil and sediment contamination levels within and adjacent to the proposed restoration area. This evaluation will assist in determining:

- The existing chemical contamination levels within the site and comparison with state criteria
- The quantity of reusable material
- The quality of the sediment left behind following excavation and potential for impacts following restoration
- Where excavated materials can be reused and what it can be used for (e.g., beach nourishment, berm creation, revegetation),
- The relative costs associated with disposing of contaminated materials
- An estimate of the potential effects of contaminated sediments on sensitive biological receptors

The Ormond Beach wetland restoration site has several significant challenges with regards to the potential for chemical contamination. The restoration site is located adjacent to a former metal recycling facility, agricultural fields, an industrial drain, and other potential sources of contamination. This report summarizes existing data, identifies data gaps that affect the ability to provide specific recommendations, and additional studies that should be considered that would generate the data needed by regulators to permit any excavation/dredging and disposal.

Regulatory Review and Permitting for Soil Reuse

Excavation and reuse of soils or sediments as part of a wetland restoration project requires permits from both the US Army Corps of Engineers - Los Angeles District Regulatory Branch (USACE) and the Los Angeles Regional Water Quality Control Board (RWQCB). The regulatory agencies will require that beneficial reuse of any excavated material be explored to the maximum extent practical (particularly beach nourishment for all suitable materials).

The USACE permits needed may include the following.

- Section 10 of the Rivers and Harbors Act – for projects that include construction in navigable waters of the US

- Section 404 of the Clean Water Act – for the dredging or disposal of sediment into waters of the US, including wetlands, streams, and riparian areas
- Section 103 of the Marine Protection, Research, and Sanctuaries Act – for disposal of sediment in the ocean

The RWQCB will require the submission of a Report of Waste Discharge (RWD) application so that a CWA Section 401 water quality certification permit with Waste Discharge Requirements (WDRs) (or a WDR waiver) can be granted.

Both the USACE (in conjunction with the Environmental Protection Agency – Region 9) and RWQCB require extensive chemical characterization of soils and sediments proposed for dredging/excavation or disposal within waters of the United States if there are nearby potential sources of contamination as with the project site. Disposal of excavated materials outside of USACE/EPA jurisdiction (e.g., upland offsite reuse, landfill) is regulated by the RWQCB based upon the Basin Plan and California Title 22 criteria.

Contaminant Review

This section contains an evaluation of the soil/sediment quality data generated for numerous contaminant studies conducted in, or adjacent to, the proposed wetland restoration site. The wetland restoration study area evaluated for this report consists of several subareas. Several drains (e.g., the Oxnard Industrial Drain) and drainage ditches (e.g., Oxnard Drainage Ditch #3) also traverse the site.

- The Metropolitan Water District/City of Oxnard Property
- The 38-acre (formerly PVP) Parcel
- The 265 acre former Edison Property now owned by the Coastal Conservancy
- Southland Sod Farm
- The Ventura County and Point Mugu Game Preserves
- The Archie Bard/Shoreline Organics Property

Contaminant studies have been conducted within or adjacent to these subareas for various reasons (e.g., Phase I and II assessments; installation restorations studies) since the mid-1990s. The studies and sample collection locations within the proposed wetland restoration study footprint are depicted in Figure1. Figure 2 identifies the approximate locations (based on the study results summarized below) where chemical contaminants were found in elevated concentrations in soil, sediment, or water.

Metropolitan Water District/City of Oxnard Property

Earth Tech, Inc. conducted a Phase 1 evaluation of the site in 1996 (Earth Tech, 1996). This report contained a compilation of studies conducted at the site. This report did not include any field-collected data. Earth Tech's review of previous studies indicated that DDT concentrations in soil were significantly elevated (up to 3,000 µg/kg) in the northern, historically agricultural portion of the site. The 200 feet wide by 2,000 feet long pile of sediment dredged from Port Hueneme that is stockpiled in the southeastern section of the site contains elevated levels of PCBs, PAHs, and lead. The southwestern portion of the site, adjacent to Halaco, had elevated levels of several heavy metals.

Ninyo & Moore (N&M) conducted a Phase II Environmental Site Assessment (ESA) at the site in 1996. Ninyo & Moore collected 11 soil borings and two sediment samples in December 1996. The soil borings were collected throughout the site to a maximum of 5 feet using a hand auger. Three of the soil samples (S6, S7 and S8) were collected within the "Port Hueneme dredge spoil pile." One surficial sediment sample was collected in the Oxnard Industrial Drain while the other was collected in an adjacent drainage ditch. Both sediment samples were collected with a shovel.

The analyte list used in the N&M study included pesticides and PCBs, semivolatile organic compounds, and metals. Not all samples were analyzed for all analytes. Conclusions of the study were:

- Selenium was elevated throughout the site which is probably indicative of background conditions
- Elevated levels of PCBs were detected on some soil and sediment samples
- No significant levels of DDT, DDE, DDD, semivolatile organic compounds, and metals other than selenium and lead were detected in soil samples
- The occurrence of site contaminants does not appear to be consistently related to one specific area of the site

The conclusions listed above were made based upon comparing the chemical results to California Title 22 Hazardous Waste Criteria and EPA Region 9 Residential and Industrial Preliminary Remediation Goals (PRGs). A closer look at the results indicates that there are elevated levels of PCBs (ND to 1,360 µg/kg) in the Port Hueneme dredge spoil pile. In addition, copper and lead levels were somewhat elevated (86.7 and 91.5 mg/kg, respectively) in the sediment sample collected in the drainage ditch but not the Oxnard Industrial Drain. The pesticide levels were low in the one sediment sample collected in the Oxnard Industrial Drain.

In July 2004, SECOR International Incorporated (SECOR) conducted a Phase II ESA at this site (SECOR 2004). The study area is composed of salt marsh, mud flats, and upland areas. The study was conducted to assist in determining whether contaminants known to be on and beneath an adjacent site (the Halaco Site) or currently within the property boundaries could pose an unacceptable environmental risk to the proposed wetland restoration project. Since the SECOR Phase II ESA represents the most recent and thorough study, it will be discussed in much more detail than previous studies at the site.

SECOR collected 20 soil samples varying in depth from 1 to 5 feet below ground surface (bgs) using a hand auger. Nine groundwater or surface water samples were also collected. All soil samples were analyzed for heavy metals, chlorinated pesticides, PCBs, and semivolatile (for select samples) and volatile organic contaminants (all samples). Potassium-40, thorium and uranium isotopes were also measured in select samples. Water samples were analyzed for metals and volatile organics. Chlorinated pesticides, PCBs, and radioactivity were measured in select water samples.

In SECOR's report, the soil results were compared to California Title 22 TTLCs and STLCs and EPA Region 9 PRGs. Water sample results were compared to California safe drinking water standards referred to as Maximum Contaminant Levels (MCLs).

Based on the results of SECOR's Phase 2 investigation, they concluded that there are:

- Elevated levels of some volatile organics near a former paint storage area;
- Elevated barium, chromium, copper, and lead in soil at Site B-7 directly adjacent to the Halaco slag pile;
- Elevated water concentration (>MCL) of barium (1 sites), chromium (3 sites); selenium (1 site), copper (1 site), lead (2 sites), and molybdenum (2 sites) directly adjacent to the Halaco slag pile and within the central portion of the disturbed salt marsh; and
- Elevated toxaphene in 3 samples collected within the cultivated farmland area.

As previously mentioned, SECOR's study compared soil chemistry results to California hazardous waste guidance and residential and industrial PRGs. While comparing soil chemical levels to these values has meaning in human health investigations (where landfill disposal or soil cleanup is the primary goal), wetland restoration studies must also include comparisons to ecologically relevant sediment quality benchmarks. Since the study area is being evaluated for wetland restoration and beneficial reuse of excavated soils where exposure to biological organisms will no doubt occur, sediment and water quality comparisons to benchmark levels based upon biological effects are more appropriate. These benchmarks better predict the impact that the contaminated sediments that remain at the site, or moved to other confined or unconfined aquatic disposal locations, may have on the sensitive aquatic organisms.

For this evaluation, ERLs, ERMs, and AETs will be used as screening guidelines. These sediment quality screening guideline values are presented in Buchman 1999 – NOAA Quick Screening Reference Tables. The Effects Range-Low (ERL) and Effects Range-Median (ERM) are based upon compilations of sediment toxicity data. The ERL represent value at which toxicity may begin to be observed in sensitive species. The ERM represents the median concentration of the data compilation of the toxic samples. Concentrations above the ERM, therefore, were frequently observed to be toxic. The AET (Apparent Effects Thresholds) are derived by laboratory or field studies that compare chemical concentrations with environmental injury (death, benthic impairment). These values are not meant to be sediment quality criteria or cleanup goals. These benchmarks do not take into account site-specific factors affecting toxicity such as bioavailability, organic content, and grain size; therefore, these guideline values must be treated only as screening tools.

In most cases, the sediment screening benchmarks are considerably lower than the criteria used in the Phase 2 ESA to evaluate the data. For example, Table 1 compares the ERLs, ERMs, and AETs for select metals of concern with the Title 22 criteria and PRGs (note that the TTLC and PRGs criteria are in wet weight units, while the ERL, ERM, and AETs screening values are in dry weight units). Table 2 provides the same comparison for chlorinated pesticides and PCBs.

Comparing the soil results for metals presented in the Phase 2 ESA report to the sediment screening guidelines yields the following conclusions (Table 3).

- Elevated metal levels in soil were found primarily in the salt marsh area adjacent to the Halaco site

- Barium and silver concentrations are elevated site-wide (which indicates that, with the exception of Site B-7, these are probably background levels not attributable to a single source)
- Sites B-6, B-7, B-8, and B-9 have elevated concentrations of several metals (as SECOR concluded, Site B-7 immediately adjacent to the Halaco slag pile is by the far the most heavy metal contaminated). Copper, nickel, and zinc are the primary contaminants of concern.
- Sites B2, B3, B4, B11, and B19 have slightly elevated levels of copper, lead, or nickel

Comparing the soil results presented in the Phase 2 ESA report to the sediment screening guidelines for chlorinated pesticides and PCBs yields the following conclusions (Table 4).

- Elevated levels of pesticides were primarily found in the farmland areas to the north and west of the salt marsh
- All sites have elevated levels of DDT and metabolites (except B6, B7, B8, B12 and B13)
- Sites B1, B14, B15, and B17 have elevated levels of toxaphene
- Chlordane is elevated at 8 sites
- Dieldrin is elevated at 2 sites (B10 and B15)
- PCBs are elevated in Site B-7

Water Quality Data

In the Phase 2 ESA, surface/groundwater results were compared to safe drinking water standards (MCLs and PRGs). As was noted for soils, a more appropriate comparison could be made to the Ambient Water Quality Criteria (AWQC) contained in the California Toxics Rule. The AWQC are compared to drinking water standards in Table 5.

The AWQC in Table 5 are expressed as either a “criteria maximum concentration” (CMC) or “criteria continuous concentration” (CCC) for saltwater organisms. The CMC (i.e., acute criteria) is the maximum concentration of a pollutant to which aquatic life can be exposed for short periods of time without deleterious effects. The CCC (i.e., chronic criteria) is the highest concentration of a pollutant to which aquatic life can be exposed to for an extended period of time (4 days) without deleterious effects.

Table 6 presents a comparison of the Phase 2 ESA groundwater and surface water metal results compared to the California AWQC for metals in saltwater. It should be noted that the ESA results are for total metals, while the AWQC CMC and CCC are for dissolved metals. The dissolved metal concentrations of the samples analyzed for the ESA would likely be lower than what is reported here, but without filtering the samples prior to analysis it cannot be determined how much lower.

The results of this comparison indicate the following.

- Significantly elevated metals were found in groundwater samples collected immediately adjacent to the Halaco Site (WS-3 and WS-6)
- Significantly elevated metals were also found in groundwater in samples collected further east of the Halaco Site

- Chromium, copper, lead, and zinc are significantly elevated in groundwater samples WS-4, WS-5, and/or WS-6; chromium, copper, lead, are significantly elevated in groundwater sample WS-3
- Arsenic is also slightly elevated in one sample (WS-3)
- Chromium is slightly elevated in one additional sample (WS-10)

Former Edison Site Studies

There are several documents that concern investigations and remediation at the former Edison Site.

- SECOR conducted a Phase 1 document review (SECOR 2000a) and Phase 2 site investigation (SECOR 2000b) of the Southern California Edison (SCE) tank farm for the California State Coastal Conservancy (SCC) in 2000.
- Wetland Research Associates (WRA) collected eight samples within the South Ormond Beach wetland area of the former Edison site for grain size and other analyses. The samples ranged from 10 to 56 percent fines.
- In 2001, SCE preformed remediation confirmation soil sampling as part of the demolition of station fuel oil facilities adjacent to the Ormond Beach Generation Station (SCE 2001).
- In May 2002, SECOR conducted a post-excavation study of the former Edison Property for the SCC (SECOR 2002a) to confirm SCE's work. A component of SECOR's evaluation included performing a risk evaluation associated with developing the former tank farm site into a wetland (SECOR 2002b).

<u>SECOR 2000a and b</u>

Based upon its Phase I review (SECOR 2000a), SECOR concluded that additional soil, surface water, and groundwater study at the site was warranted (SECOR 2000b). The Phase I due diligence investigation was conducted to fill gaps that were identified in earlier studies. Fourteen soil, two groundwater, and three surface water sample were collected (Tables 7 and 8). Soil samples were collected to a maximum of 5 feet using a hand auger.

The site had slightly elevated levels of several metals in soils, but at relatively low concentrations (>ERL, but <ERM) (Table7). Comparing the soil and water results to effects-based guidelines described in the previous section found only two areas of concern.

- Arsenic (1 station), cadmium (1 station), copper (2 stations), lead (1 stations), and nickel (1 station) in groundwater that exceed CTR chronic criteria (CCC). As previously mentioned, the CTR criteria are for dissolved metals, while the test concentrations are total. The metal levels observed in this study are very low and not likely to be problematic.
- DDT and metabolite concentrations are elevated at several locations. Concentrations of total DDT (4,4'-DDT + 4,4'-DDE) ranged from ND to 2,500 µg/kg. The total DDT ERM guideline value is 46.1 µg/kg. The highest levels of DDT and metabolites were found in samples collected in or near an agricultural drain (CCSS1, CCSS8, and CCSS9), and within an agricultural property (CCSS10) referred to as "Southland Sod." The levels of DDT observed in this area would probably preclude

this material from being reused in any confined or unconfined aquatic disposal scenario.

SECOR 2002a

The post-excavation confirmation study conducted in 2002 involved collection of 20 soil and 10 groundwater samples at strategic locations around the former SCE tank farm (Table 9 and 10). The results of this study indicate that while the majority of the site is clean, there are still residual concentrations of petroleum hydrocarbons and volatile organic contaminants in the soil, and heavy metals in soils and groundwater. While the soil metal concentrations are generally low (several location >ERL but <ERM), total copper, lead, and zinc levels in groundwater are significantly elevated throughout most of the study area compared to dissolved AWQC (Table 10). Total copper in groundwater was measured at a maximum concentration of 770 µg/L; total lead to 120 µg/L, and total zinc to a maximum of 640 µg/L. The chronic dissolved AWQC for copper, lead, and zinc are 3.1, 8.2, and 81 µg/L, respectively. The site also had elevated levels of total arsenic, chromium, and nickel at some of the groundwater sites.

SECOR 2002b

Using the results from their due diligence investigations of the former Edison Site, SECOR prepared an additional report which assessed whether risk from residual contamination at the site to wildlife or human receptors would be acceptable. This evaluation only dealt with the former tank farm site. Pesticide contamination present at the site (DDT and metabolite) was not part of their risk evaluation because it was not directly associated with the operation of the tank farm. SECOR's risk analysis employed the effects-based benchmarks (e.g., ERMs) previously described in this report.

The ecological risk evaluation consisted of a sediment and water exposure pathway to the mallard duck. SECOR concluded that from the mallard scenario, incidental ingestion of sediment with diet could be associated with risk. They further conclude that the site contains chemicals at concentrations that exceed conservative (and probably less conservative) benchmarks. It is SECOR's opinion that additional remediation or an engineered solution to the residual contamination at the site should be considered prior to wetland construction.

Drains and Drainage Ditches

The South Ormond Beach Wetland Restoration and Management Plan presents a summary of water and sediment quality in the Oxnard Drainage Ditch #3 as well as contaminant levels in fish tissue (Jones & Stokes, 1994). The report indicates that significantly elevated levels of pesticides and PCBs were found in sediment and fish tissue samples collected in the drain. Table 2-3 of the report presents maximum sediment and fish tissue total DDT concentrations of 2,264 and 19,270 µg/kg, respectively, for samples collected in the drain at "station located upstream of the bridge at Arnold Road" on the "Rio de Santa Clara/Oxnard Drain" (Station 403.11.02). The following passage was taken from the report: "Because the fish and sediment in the Oxnard Drain contain these contaminants, we do not recommend use of this water for habitat restoration purposes until the drain water quality is analyzed and deemed safe by appropriate agencies."

In an attempt to assess the drain's water quality, WRA conducted field and laboratory analyses of the South Ormond Beach Site to assist in design of the wetland enhancement project (Wetland Research Associates 2000). The WRA investigation involved collection of water samples in the Oxnard Drainage Ditch for chemical and toxicity analyses (no sediment or tissue samples were collected). This study was conducted to determine if the drainage ditch might be a possible source of contaminants to the South Ormond Beach wetlands. Three samples were collected for chemical analyses (volatile organics, semi-volatile organics, chlorinated pesticides, and chlorinated herbicides) and five for toxicity tests with a shrimp (*Mysidopsis bahia*) and a minnow (*Menidia beryllina*).

The water samples were substantially free of chemical contamination with the exception of one sample that had a concentration of 4-4'-DDT at 0.15 µg/L. The toxicity test results indicated that two of the water samples tested caused a significant reduction in test organism survival and three samples impacted growth.

Applied Environmental Technologies, Inc. conducted a limited sediment investigation of the Oxnard Drainage Ditch for Southland Sod Farms (Applied Environmental Technologies, 2002). The study area extends from east of Edison Drive to Arnold Road. AET collected and analyzed 26 sediment samples for oil & grease, Title 22 metals, and chlorinated pesticides. Samples were collected to 0.5 feet at most stations. Deeper cores (up to 4 feet bgs) were also collected at some of the stations. One water sample was also collected. Oil & grease concentrations ranged from ND to 30 mg/kg. DDD and DDE were the only chlorinated pesticides detected with maximum concentrations of 59 and 314 µg/kg, respectively. Heavy metals concentrations were low for most analytes at most locations, with the exception of copper. Copper concentrations ranged to a maximum of 191 mg/kg compared to the ERL sediment guideline value of 34 mg/kg. The water sample AET had analyzed was substantially free of chemical contamination.

Students at the Donald Bren School of Environmental Science and Management at the University of California at Santa Barbara conducted an evaluation of the contaminants and their potential effects at the South Ormond Beach Wetland Restoration Site (Gay, et al., 2001). The study focused on the proposed option of connecting Oxnard Drainage Ditch #3 to Mugu Lagoon. The study involved collection and testing of sediment samples from the drain, as well as an analysis of existing contaminant data for the drain and Mugu Lagoon. The contaminants of concern evaluated were chlorinated pesticides, PCBs, and heavy metals.

Twenty-eight sediment samples were collected from 7 locations along the south bank of Oxnard Drainage Ditch #3 (Figure 1). Two surface and two core samples (to a maximum depth of 40 centimeters) were collected at each location. DDT and metabolites were observed at all locations ranging from ND to 93 µg/kg. The average total DDT level for all samples analyzed was approximately 30 µg/kg, which is less than the ERM for total DDT (46.1 µg/kg) but greater than the ERL (1.58 µg/kg). Only one sample was analyzed for metals (Sample OD #3). The metals concentrations in this sample were very low or ND.

In general, results of this study found moderately elevated levels of DDT in the drain sediments, with concentrations increasing with depth (Figure 2). Insufficient testing for heavy metals was conducted to provide a meaningful evaluation of these contaminant levels in the drain.

The Bren School study also included an ecotoxicological evaluation of available site contaminant data. Their study focused on chlorinated pesticides and PCBs and their potential impact on special status species. Their study found the greatest ecological risk was to piscivorous (e.g., least tern) and omnivorous (e.g., clapper rail) birds from DDT and its metabolites. Elevated risk was also found for chlordane and toxaphene.

The major conclusion from their study is that due to the elevated contaminant levels in Mugu Lagoon, using the lagoon as a water source for the wetland restoration project is not advisable. This conclusion is based on the fact that the lagoon water would likely carry contaminated sediments into the restoration site, which would result in an unacceptable risk to sensitive wildlife. The report authors recognize that these conclusions are based on a limited data set, and recommend further site assessment and risk analyses.

Halaco Site Studies

Extensive investigation has been conducted within the Halaco Waste Management Unit (WMU) located adjacent to the proposed wetland restoration site, west of the MWD/City of Oxnard Property. There is significant concern and potential evidence based on the findings of the SECOR report that contaminants are migrating from the Halaco WMU into the existing salt marsh area and proposed wetland creation site.

Padre Associates Study

Twenty soil samples were collected from ten drilling locations (two samples per hole) to maximum depths ranging from 13 to 30 feet bgs (Padre 2002) (Figure 1). The 20 soil samples were characterized for soluble levels of barium, copper, lead, and zinc, as well as ammonia, and Thorium isotopes. The metal solubility test was done using both citric acid and deionized water as the leaching agents.

The study found soluble levels of copper (using the citric acid buffer) that exceeded the Title 22 STLC threshold concentration of 25 mg/L at eight locations. Only one of twenty samples exceeded the lead STLC threshold of 5 mg/L. Barium and zinc were found below STLC threshold concentrations using the acid leaching test. The deionized water leaching tests for copper, lead, and zinc resulted in non-detects for all samples analyzed. Barium was detected to a maximum concentration of 6.9 mg/L in the deionized water leach test. Ammonia concentrations ranged from 91 to 720 mg/L. The ammonia limits contained in the Los Angeles Basin Plan for saltwater are 2.5 mg/L (4-day average) and 23 mg/L (1-hour average).

RWQCB Letter Regarding Ammonia (September 26, 2003)

This letter was sent by the Los Angeles RWQCB to Halaco Engineering Company and addresses the elevated levels of ammonia found within the Halaco site WMU. The RWQCB's evaluation was based on the findings of the Padre 2002 report summarized above. The RWQCB letter indicates that ammonia in the WMU can be leached to, and pollute, groundwater and surface waters at and near the site. The waste in Halaco's WMU is; therefore, characterized as "designated waste" based upon the ammonia levels measured.

Halaco Technical Work Plan and Conceptual Closure Plan

Three documents were reviewed that detail further investigations to be conducted at the Halaco WMU (URS 2004a, 2004b, and 2004c). The investigations are intended to meet Cleanup and Abatement Order (CAO) requirements for assessing the nature and extent of existing or threatened impacts to soil, groundwater, and surface water associated with Halaco's past disposal practices and existing conditions of the WMU. It is assumed that this investigation has not been conducted to date.

Calleguas Municipal Water District Brine Pipeline

These two reports summarize geotechnical investigations that were conducted as part of a project to site a brine pipeline (Lowney Associates 2001 and 2002). The study site is east of the proposed wetland restoration area beginning at Arnold Road and running east along Hueneme Road to Calleguas Creek. Soil borings were collected to a maximum depth of 31 feet bgs. Grain size analyses were conducted on a subset of samples. The percent fines (% <#200 sieve) ranged from 4 to 100 percent. Twenty-four of the samples tested were >25% fines; while only 9 samples were <25% fines. If this information is indicative of the soils at the wetland restoration site, there may not be very much beach quality sand available for reuse.

Navy Site Study

The Navy conducted an installation restoration investigation of the Point Mugu Naval Air Weapons Station in 1994. Spreadsheets containing chemical results, and collection location coordinates were reviewed (no hard copy report was reviewed). The samples were collected on Navy property to the south and east of the Ventura County and Point Mugu Game Preserves. The samples were not collected within the wetland restoration footprint. This data is useful and relevant to this project because all the samples appear to be sediment samples that were collected within the wetland channels leading into Mugu Lagoon.

Because the information provided for this study was limited, several assumptions were made in reviewing the data. First, it is assumed that the sample collection depth intervals referred to in the data reports are in feet-bgs. Second, it is assumed that the metals data are in mg/kg and the organics are µg/kg. Finally, it is assumed that all results are reported in wet weight.

The results are summarized in Table 11. Metal levels were generally low throughout the project area (>ERL, but < ERM), with the exception of site SW11-72, which had significantly elevated levels of arsenic (87.3 mg/kg), chromium (70.5 mg/kg), copper

(467 mg/kg), lead (128 mg/kg) and zinc (370 mg/kg). This site is located just to the southeast of the Edison site.

The levels of DDT and metabolites vary though the study area. The highest levels were observed at sites SG11-36 and SG11-12. Both of these sites are located immediately adjacent to the Edison property. Elevated DDT levels were also observed at sites SW11-74, 15, and 35. These sites are located just east and north of the Point Mugu Game Preserve in close proximity to agricultural fields.

Summary/Recommendations

This section highlights the major findings of the contaminant studies that have conducted in and adjacent to the Ormond Beach wetland restoration site. The following list details the major findings from the reports reviewed with special consideration on how they may impact the proposed wetland restoration project.

Metals

There appears to be evidence that indicates that metals from the Halaco Site have migrated into the proposed restoration area in soils and groundwater. This evidence is based upon the following report findings.

- Heavy metals within the City of Oxnard/Metropolitan Water District property are moderately (>ERL) to significantly (>ERM) elevated immediately adjacent to the Halaco Site (SECOR 2004). The USACE and RWQCB will likely require further soil delineation of this area before granting permits.
- Metals in groundwater are elevated (>CTR) immediately adjacent to the Halaco Site and further to the east (SECOR 2004). The continued migration of heavy metals in groundwater could have an impact on the success of the wetland restoration project. Additional groundwater samples should be collected to determine if the Halaco site is the source of the evaluated heavy metal concentrations in the samples WS-4 and WS-5. Any additional groundwater samples collected should involve analyses of both total and dissolved metals.

The metal contaminated soil along the border of the Halaco/wetland restoration site will probably require removal to a landfill. It also appears as though the Halaco site is the source of elevated metals observed in groundwater samples collected in the wetland restoration area further to the east of the WMU/wetland interface. A more focused groundwater study would address this issue. Regardless, steps will need to be taken to ensure that existing contaminated soil and groundwater from the Halaco WMU does not recontaminate the wetland site in the future.

There is also residual metal contamination in the groundwater at the former Edison tank farm. The concentrations of metals in the soil at this site are low and the contaminant source has been removed; therefore, there probably will not be any long-term impacts from reuse of the material. However, removal of this material with upland (non-aquatic) disposal should be considered.

Pesticides

- Pesticide levels (particularly DDT and metabolites and toxaphene) are significantly elevated (>ERM) in the cultivated land portion of the City of Oxnard/MWD property and within surface soils of the Southland Sod Farm.
- Numerous pesticides were found in significantly elevated concentrations in sediment and fish tissue samples collected in Oxnard Drainage Ditch #3.

These are persistent contaminants that could impact the success of the restoration project if they are exposed to aquatic organisms and enter the food chain. This material would likely be denied a permit for reuse in any unconfined aquatic disposal situation. A more thorough evaluation of the potential for long-term impacts of residual pesticides that are found in the project footprint on the success of the wetland restoration project should be considered. Alternate upland disposal should be considered.

Data Gaps

This section provides a list of data gaps that should to be considered while moving forward with the conceptual design phase of the wetland creation project. The major data gap identified has to do with data adequacy. The site studies to date have generated a lot of valuable data, but it has been done piece meal without focusing on the future proposed use of the site as restored wetland habitat. The following is a list of a few specific examples of data gaps.

Adequacy of Data for Permitting

The USACE/EPA have developed guidance to be used to conduct sediment characterization studies associated with dredging and disposal studies (including wetland creation and restoration). The methods described in these guidance documents provide regulators with the minimum amount of information they need in order to determine the most suitable excavation/dredging and disposal alternatives. The studies conducted to date are deficient in providing the federal regulators with the information they will need to make permitting decisions. It is recommended that USACE (Regulatory Branch) and EPA Region 9 (Los Angeles Field Office) be advised of this project to solicit their input on future studies that may be needed.

Coverage

Several larges areas within the restoration footprint have not been sampled for contaminants (or no data was made available). This includes the Ventura County and Point Mugu Game Preserves, most of the Southland Sod Farm, the Archie Bard/Shoreline Organics property, and the 38-acre (formerly PVP) Parcel. The game preserves, in particular, may be contaminated with lead from waterfowl hunting (e.g., lead shot). The potential for contamination within these untested areas should be evaluated.

Ammonia

The RWQCB determined that the Halaco site WMU had unacceptably high levels of ammonia (LARWQCB 2003). The ammonia levels within the proposed restoration site have not been evaluated to date. Additional groundwater samples should be collected in the proposed restoration area near the Halaco site to determine if unacceptable levels (i.e., toxic to aquatic life) of ammonia are leaching into the project site.

Organophosphate Pesticides and Herbicides

No herbicide or organphosphorus analyses (particularly diazinon and chlorpyrifos) were conducted. These potential contaminants should be added to the analyte list for future studies.

Groundwater

Not enough groundwater samples were collected to identify a concentration gradient for heavy metals leaching from the Halaco site. Evidence suggests this is occurring and should be evaluated.

Effects-Based Testing

Chemical data can only tell you so much – it is a predictor of toxicity. To better assess the potential for toxicity due to the exposure of sensitive organisms to contaminants in excavated or in place soils, laboratory and field toxicity studies evaluating the lethal and sublethal effects of site contaminants should be considered. To date, only water samples colleted in Oxnard Drainage Ditch #3 were analyzed for toxicity. Toxicity was found in three of the samples analyzed. No tests have been conducted on existing sediment samples, or on soils that may end up being exposed to the aquatic environment following wetland restoration. The USACE and EPA will likely require these tests for permitting.

Dissolved Metals

To compare groundwater metal concentrations with applicable state criteria, the total and dissolved fractions should be measured in future studies.

Sample Depth

The USACE requires that soil/sediment samples analyzed as part of a characterization program be collected to project depth. Most samples collected for the studies that were reviewed involved samples taken in the top 5 feet bgs or so. If the restoration alternative selected involves excavation below 5 feet, additional (deep) cores will likely be necessary in order to obtain a USACE permit.

Grain Size

A key evaluation factor for any reuse study is grain size (and potentially other geotechnical properties such as shear stress and Atterberg limits). There were no grain size analyses conducted for any of the studies within the restoration area, with the exception of the eight samples tested for the South Ormond Beach Study (WRA 2000). Future soil investigations should include a geotechnical evaluation component.

Risk Evaluation

SECOR conducted an ecological and human health risk evaluation for the Edison Site. This evaluation tool should also be employed for the rest of the proposed wetland restoration areas in the project footprint. Further risk evaluations should include an

analysis of pesticides and herbicides. Also, the risk evaluation should include a more appropriate pathway analysis, such as benthic invertebrates to fish to least terns (as opposed to sediment to mallards).

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TABLES

Table 1. Comparison of Hazardous Waste/Remediation Soil Quality Criteria Values for Metals (mg/kg) Compared to Toxicity Screening Guidelines

Benchmark	Arsenic	Barium	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Selenium	Silver	Zinc
TTLC	500	10000	100	2500	2500	1000	20	2000	100	500	5000
PRG-Rs	0.39	5400	37	210	3100	150	23	1600	390	390	23000
PRG-Is	1.6	67000	450	450	41000	-	310	20000	5100	5100	100000
ERL*	8.2	-	1.2	81	34	46.7	0.15	20.9	-	1.0	150
ERM*	70	-	9.6	370	270	218	0.71	51.6	-	3.7	410
AET*	35[B]	48[A]	3[N]	62[N]	390[MO]	400[B]	0.4[M]	110[EL]	1.0[A]	3.1[B]	410[I]

*From Buchman, 1999
- no value available
TTLC – Total Threshold Limit Concentration (wet weight)
PRG-Rs – Preliminary Remediation Goal-Residential soil (wet weight)
PRG-Is – Preliminary Remediation Goal-Industrial soil (wet weight)
ERL – Effects Range-Low (dry weight)
ERM – Effects Range-Median (dry weight)
AET – Apparent Effects Threshold (dry weight) and the test type from which they were derived:
A-Amphipod; B-Bivalve; E-Echinoderm Larvae; I-Infaunal Community Impacts; L-Larval; M-Microtox; N-Neanthes bioassays (polychaete worm); O-Oyster larvae

Table 2. Comparison of Hazardous Waste/Remediation Soil Quality Criteria Values for Chlorinated Pesticides and PCBs (µg/kg) Compared to Toxicity Screening Guidelines

Benchmark	alpha-Chlordane	p'p-DDD	p'p-DDE	p'p-DDT	Total DDT	Toxaphene	Endosulfan I	gamma-Chlordane	alpha-BHC	beta-BHC	Lindane	Dieldrin	Aroclor 1242
TTLC	2500	1000	1000	1000	NA	5000	-	2500	-	-	4000	8000	50000
PRG-Rs	1600	2400	1700	1700	NA	440	370000	1600	-	-	-	30	220
PRG-Is	6500	10000	7000	7000	NA	1600	$3.7x10^6$	6500	-	-	-	110	740
ERL*	0.5	2	2.2	1	1.58			0.5				0.02	22.7
ERM*	6	20	27	7	46.1			6				8	180
AET*	2.8^A	16^I	9^I	12^E	11^B			2.8^A				1.9^E	130^M

*From Buchman, 1999
- no value available
TTLC – Total Threshold Limit Concentration (wet weight)
PRG-Rs – Preliminary Remediation Goal-Residential soil (wet weight)
PRG-Is – Preliminary Remediation Goal-Industrial soil (wet weight)
ERL – Effects Range-Low (dry weight)
ERM – Effects Range-Median (dry weight)
AET – Apparent Effects Threshold (dry weight) and the test type from which they were derived:
A-Amphipod; B-Bivalve; E-Echinoderm Larvae; I-Infaunal Community Impacts; L-Larval; M-Microtox; N-Neanthes bioassays (polychaete worm); O-Oyster larvae

Table 3. MWD/City of Oxnard Property - Phase 2 Environmental Site Assessment
Soil Metal Results Compared to Sediment Toxicity Screening Guidelines (in mg/kg) (SECOR 2004)

Location	Depth (ft-bgs)	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Selenium	Silver	Zinc
AET		35[B]	3[N]	62[N]	390[M,O]	400[B]	0.4[M]	110[E,L]	1.0[A]	3.1[B]	410[I]
ERL		8.2	1.2	81	34	46.7	0.15	20.9		1	150
ERM		70	9.6	370	270	218	0.71	51.6		3.7	410
B-1	1	-	-	-	-	-	-	-	-	-	-
	2.5	2.3	ND	12	7.6	ND	0.023	13	0.44	1.7	33
B-2	1	-	-	-	-	-	-	-	-	-	-
	2.5	3.1	ND	25	55	14	0.041	19	0.55	3	131
B-3	1	-	-	-	-	-	-	-	-	-	-
	2.5	2.5	ND	13	50	ND	0.015	11	0.67	1.9	47
B-4	1.5	3.1	ND	27	22	16	0.041	26	0.38	2.1	120
	2.5	2.9	ND	15	9.1	ND	0.018	13	ND	1.7	40
	5	2.8	ND	17	14	4.9	0.023	14	ND	2	52
B-5	1.5	3	ND	17	13	18	0.12	17	ND	1.7	107
	2.5	2.4	ND	14	10	ND	0.015	12	ND	1.8	41
	5	2.4	ND	18	10	12	0.027	12	ND	1.9	88
B-6	1	3.4	1	18	24	ND	0.02	15	0.57	1.9	63
	2.5	1.8	ND	9.9	62	ND	0.011	7.3	ND	1	57
	5	4.7	ND	27	191	7.8	0.04	23	0.47	2.8	148
B-7	1	6	1.3	115	1240	119	0.037	50	8.6	5.6	1510
	2.5	8.1	3.6	175	1550	150	0.026	67	6.3	7.8	2090
	5	3.6	ND	37	138	12	0.026	26	0.87	3	175
B-8	1	1.9	0.9	20	200	11	0.012	17	0.61	1.8	154
	2.5	2.4	ND	13	27	4.4	0.013	11	0.33	1.3	43
	5	3.2	ND	27	99	7.9	0.02	24	0.37	3	112

Shaded concentrations exceed the AET, ERL, or ERM; - indicates no sample collected
AET, ERL, and ERM values are in dry weight; Soil concentrations are in wet weight
A-Amphipod; B-Bivalve; E-Echinoderm Larvae; I-Infaunal Community Impacts; L-Larval; M-Microtox; N-Neanthes bioassays (polychaete worm); O-Oyster larvae

Table 3. MWD/City of Oxnard Property - Phase 2 Environmental Site Assessment
Soil Metal Results Compared to Sediment Toxicity Screening Guidelines - continued (in mg/kg) (SECOR 2004)

Location	Depth (ft-bgs)	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Selenium	Silver	Zinc
AET		35[B]	3[N]	62[N]	390[MO]	400[B]	0.4[M]	110[EL]	1.0[A]	3.1[B]	410[I]
ERL		8.2	1.2	81	34	46.7	0.15	20.9		1	150
ERM		70	9.6	370	270	218	0.71	51.6		3.7	410
B-9	1	1	ND	7.8	62	7.3	ND	4.1	0.33	0.5	64
	2.5	1.3	ND	15	27	5	0.011	12	0.52	1.9	60
	3.5	3.7	ND	16	81	ND	0.014	16	ND	1.6	73
B-10	1	-	-	-	-	-	-	-	-	-	-
	2.5	2	ND	11	6.3	ND	0.014	8.3	ND	1.4	26
B-11	1	-	-	-	-	-	-	-	-	-	-
	2.5	4.3	ND	22	40	4.6	0.019	19	0.41	2.3	70
B-13	1	-	-	-	-	-	-	-	-	-	-
	2.5	2	ND	12	24	ND	0.01	9.9	ND	1.4	34
B-14	1	-	-	-	-	-	-	-	-	-	-
	2.5	2.5	ND	16	12	ND	0.013	15	0.41	2.3	60
B-15	1	-	-	-	-	-	-	-	-	-	-
	2.5	2.7	ND	12	12	ND	0.016	11	0.32	1.8	38
B-16	1	-	-	-	-	-	-	-	-	-	-
	2.5	2.4	ND	14	12	ND	0.015	11	0.86	1.8	47
B-17	1	-	-	-	-	-	-	-	-	-	-
	2.5	1.9	ND	11	6.8	ND	0.01	12	0.57	1.4	32
B-18	1	-	-	-	-	-	-	-	-	-	-
	2.5	4.3	ND	21	33	17	0.099	16	0.43	2	90
B-19	1	-	-	-	-	-	-	-	-	-	-
	2.5	6.8	ND	34	67	25	0.21	25	0.9	2.9	131

Shaded concentrations exceed the AET, ERL, or ERM; - indicates no sample collected
AET, ERL, and ERM values are in dry weight; Soil concentrations are in wet weight
A-Amphipod; B-Bivalve; E-Echinoderm Larvae; I-Infaunal Community Impacts; L-Larval; M-Microtox; N-Neanthes bioassays (polychaete worm); O-Oyster larvae

Table 4. MWD/City of Oxnard Property - Phase 2 ESA Chlorinated Pesticide and PCB Metal Results Compared to Sediment Toxicity Screening Guidelines (in mg/kg)(SECOR 2004)

Location	Depth (ft-bgs)	alpha-Chlordane	p,p'-DDD	p,p'-DDE	p,p'-DDT	Toxaphene	Endosulfan I	gamma-Chlordane	alpha-BHC	beta-BHC	Lindane	Dieldrin	Aroclor 1242
AET		2.8[A]	16[I]	9[I]	12[E]			2.8[A]				1.9[E]	130[M]
ERL		0.5	2	2.2	1			0.5				0.02	22.7
ERM		6	20	27	7			6				8	180
B-1	1	4.1	ND	680	170	***490***	ND	ND	ND	ND	ND	ND	ND
	2.5	ND	ND	2.4	0.58	ND	ND	ND	ND	ND	ND	ND	ND
B-2	1	0.48	2.1	20	7.5	ND	ND	0.68	ND	ND	ND	ND	ND
	2.5	0.96	3.2	17	4.1	ND	ND	1.2	ND	ND	ND	ND	ND
B-3	1	ND	0.2	4.9	1.8	ND	ND	ND	ND	ND	ND	ND	ND
	2.5	-	-	-	-	-	-	-	-	-	-	-	-
B-4	1.5	21	230	200	ND	ND	28	24	ND	ND	ND	ND	ND
	2.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5	-	-	-	-	-	-	-	-	-	-	-	-
B-5	1.5	ND	290	300	11	ND	ND	ND	ND	ND	ND	ND	ND
	2.5	ND	0.61	1.3	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5	-	-	-	-	-	-	-	-	-	-	-	-
B-6	1	-	-	-	-	-	-	-	-	-	-	-	-
	2.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5	-	-	-	-	-	-	-	-	-	-	-	-
B-7	1	-	-	-	-	-	-	-	-	-	-	-	-
	2.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	460
	5	-	-	-	-	-	-	-	-	-	-	-	-
B-8	1	-	-	-	-	-	-	-	-	-	-	-	-
	2.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5	-	-	-	-	-	-	-	-	-	-	-	-
B-9	1	-	-	-	-	-	-	-	-	-	-	-	-
	2.5	ND	2.1	5	ND	ND	15	4.6	27	5	0.011	ND	ND
	3.5	-	-	-	-	-	-	-	-	-	-	-	-

Shaded concentrations exceed the AET, ERL, or ERM; - indicates no sample collected
AET, ERL, and ERM values are in dry weight; Soil concentrations are in wet weight
A-Amphipod; B-Bivalve; E-Echinoderm Larvae; I-Infaunal Community Impacts; L-Larval; M-Microtox; N-Neanthes bioassays (polychaete worm); O-Oyster larvae

Table 4. MWD/City of Oxnard Property - Phase 2 ESA Chlorinated Pesticide and PCB Metal Results Compared to Sediment Toxicity Screening Guidelines – continued (in mg/kg) (SECOR 2004)

Location	Depth (ft-bgs)	alpha-Chlordane	p,p'-DDD	p,p'-DDE	p,p'-DDT	Toxaphene	Endosulfan I	gamma-Chlordane	alpha-BHC	beta-BHC	Lindane	Dieldrin	Aroclor 1242
AET		2.8[A]	16[I]	9[I]	12[E]			2.8[A]				1.9[E]	130[M]
ERL		0.5	2	2.2	1			0.5				0.02	22.7
ERM		6	20	27	7			6				8	180
B-10	1	ND	0.56	25	5.2	ND	ND	ND	0.44	2.4	0.22	1.1	ND
	2.5	-	-	-	-	-	-	-	-	-	-	-	-
B-11	1	ND	0.34	27	4.7	ND	ND	ND	ND	ND	ND	ND	ND
	2.5	-	-	-	-	-	-	-	-	-	-	-	-
B-12	1	ND	ND	0.29	ND	ND	ND	ND	ND	ND	ND	ND	ND
	2.5	-	-	-	-	-	-	-	-	-	-	-	-
B-13	1	ND	ND	1.4	ND	ND	ND	ND	ND	ND	ND	ND	ND
	2.5	-	-	-	-	-	-	-	-	-	-	-	-
B-14	1	6.9	ND	250	220	***2200***	ND	ND	ND	7.7	ND	ND	ND
	2.5	ND	2.5	102	0.4	ND	ND	ND	ND	1.1	ND	ND	ND
B-15	1	3.8	ND	230	250	***2400***	ND	ND	ND	4.1	ND	47	ND
	2.5	ND	ND	2	2.9	ND	ND	ND	ND	3	ND	ND	ND
B-16	1	2.1	ND	97	98	ND	ND	ND	ND	ND	ND	ND	ND
	2.5	ND	ND	2.3	3	ND	ND	ND	ND	ND	ND	ND	ND
B-17	1	21	ND	300	270	***3500***	ND	21	ND	9.3	ND	ND	ND
	2.5	ND	ND	5.7	4	ND	ND	ND	ND	0.42	ND	ND	ND
B-18	1	ND	3.1	ND	9.3	ND	ND	ND	ND	ND	ND	ND	ND
	2.5	ND	ND	1.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
B-19	1	ND	ND	ND	13	ND	ND	ND	ND	ND	ND	ND	ND
	2.5	ND	ND	ND	14	ND	ND	ND	ND	ND	ND	ND	ND
B-20	1	-	-	-	-	-	-	-	-	-	-	-	-
	2.5	ND	ND	0.21	ND	ND	ND	ND	ND	ND	ND	ND	ND

Shaded concentrations exceed the AET, ERL, or ERM
AET, ERL, and ERM values are in dry weight; Soil concentrations are in wet weight
A-Amphipod; B-Bivalve; E-Echinoderm Larvae; I-Infaunal Community Impacts; L-Larval; M-Microtox; N-Neanthes bioassays (polychaete worm); O-Oyster larvae

Table 5. Comparison of California Ambient Water Quality Criteria Values to Drinking Water Standards (in µg/L)

Benchmark	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Selenium	Silver	Zinc
CMC	69	42	1100	4.8	210	-	74	290	1.9	90
CCC	36	9.3	50	3.1	8.1	-	8.2	71		81
MCL	50	5	50	-	-	2	100	50	-	-
PRG	0.045	18		1500	-	11	730	180	180	11000

CMC – Criterion Maximum Concentration (acute)
CCC – Criterion Continuous Concentration (chronic)
CMCs and CCCs are for dissolved metals in saltwater

Table 6. MWD/City of Oxnard Property - Phase 2 ESA Metal Results Compared to California Toxics Rule Ambient Water Quality Criteria (in µg/L) (SECOR 2004)

Location	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Selenium	Silver	Zinc
CMC	69	42	1100	4.8	210		74	290	1.9	90
CCC	36	9.3	50	3.1	8.1		8.2	71		81
WS-1	1.4	ND	ND	ND	ND	ND	ND	14	ND	48
B3 / WS-2	12	ND	59	ND	ND	ND	ND	22	ND	58
B6 / WS-3	39	ND	118	38	515	ND	ND	ND	ND	71
B11/ WS-4	18	ND	218	87	ND	0.061	ND	60	ND	235
B12 / WS-5	13	ND	99	34	399	ND	ND	24	ND	92
B9 / WS-6	14	ND	111	2860	546	0.23	ND	19	ND	3280
WS-8	3.9	ND	ND	ND	ND	ND	ND	3.6	ND	44
WS-9	2.3	ND	ND	ND	ND	ND	ND	3.9	ND	54
WS-10	21	ND	62	ND	ND	ND	ND	2.2	ND	46

CMC – Criterion Maximum Concentration (acute)
CCC – Criterion Continuous Concentration (chronic)
CMC and CCC are for dissolved metals in saltwater
ESA concentrations are for total metals
Shaded values exceed AWQC

Table 7. Edison Property - Phase 2 Environmental Site Assessment
Soil Metal Results Compared to Sediment Toxicity Screening Guidelines (in mg/kg) (SECOR 2000)

Location	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Selenium	Silver	Zinc
AET	35[B]	3[N]	62[N]	390[MO]	400[B]	0.4[M]	110[EL]	1.0[A]	3.1[B]	410[I]
ERL	8.2	1.2	81	34	46.7	0.15	20.9		1	150
ERM	70	9.6	370	270	218	0.71	51.6		3.7	410
CCSS 1-1	4.1	1.4	18	42	9.2	0.023	18	< 2.0	< 1.0	91
CCSS 2-2	3.0	0.60	10	9.6	3.5	0.022	11	< 2.0	< 1.0	30
CCSS 2-5	< 2.0	< 0.5	3.7	3.8	< 2.0	< 0.020	4.1	< 2.0	< 1.0	11
CCSS 3-1	3.4	0.88	12.0	18	7.2	0.024	15	< 2.0	< 1.0	46
CCSS 4-1	4.3	1.0	16	24	8.7	0.029	17	2.5	< 1.0	77
CCSS 5-1	2.0	0.66	8.8	9.6	2.6	< 0.020	10.0	< 2.0	< 1.0	23
CCSS 5-2	< 2.0	0.52	7.9	7.8	2.9	< 0.020	8.0	2.0	< 1.0	25
CCSS 6-1	2.7	0.59	9.4	8.6	16	< 0.020	9.2	< 2.0	< 1.0	28
CCSS 7-5	2.4	1.80	21.0	25	7.2	0.036	23	2.7	< 1.0	64
CCSS 8-1	5.0	1.3	17	22	8.7	0.069	23	2.2	< 1.0	65
CCSS 8-3	2.1	0.70	6.8	7.1	3.3	< 0.020	8.4	< 2.0	< 1.0	20
CCSS 9-1	4.4	1.3	18	21	8.7	0.035	23	< 2.0	< 1.0	64
CCSS 9-3	< 2.0	0.58	5.9	6.0	3.0	< 0.020	6.4	< 2.0	< 1.0	16
CCSS 10-1	3.5	0.99	13	16	6.1	0.024	15	< 2.0	< 1.0	47
CCSS 10-3	2.3	0.72	9.2	10.0	4.1	< 0.020	12.0	< 2.0	< 1.0	30

Shaded concentrations exceed the AET, ERL, or ERM; - indicates no sample collected
AET, ERL, and ERM values are in dry weight; Soil concentrations are in wet weight
A-Amphipod; B-Bivalve; E-Echinoderm Larvae; I-Infaunal Community Impacts; L-Larval; M-Microtox; N-Neanthes bioassays (polychaete worm); O-Oyster larvae

Table 8. Edison Property - Phase 2 ESA Metal Results Compared to California Toxics Rule Ambient Water Quality Criteria (in µg/L) (SECOR 2000)

Location	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Selenium	Silver	Zinc
CMC	69	42	1100	4.8	210		74	290	1.9	90
CCC	36	9.3	50	3.1	8.1		8.2	71		81
CCSW 1	5.5	<5.0	<5	12	<5.0	<0.20	<10	5.3	<10	<20
CCGW 2	<5.0	9.7	5.4	25	8.3	0.57	35	<5.0	<10	65
CCGW 5	60	<10	<10	<20	<10	0.46	<20	<10	<20	<40
CCSW 4	14	<10	<10	<20	1.1	0.26	<20	<10	<20	76

CMC – Criterion Maximum Concentration (acute)
CCC – Criterion Continuous Concentration (chronic)
CMC and CCC are for dissolved metals in saltwater
ESA concentrations are for total metals
Shaded values exceed AWQC

Table 9. Edison Property - Phase 2 Environmental Site Assessment
Soil Metal Results Compared to Sediment Toxicity Screening Guidelines (in mg/kg) (SECOR 2002)

Location	Depth (ft)	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Selenium	Silver	Zinc
AET		35[B]	3[N]	62[N]	390[MO]	400[B]	0.4[M]	110[EL]	1.0[A]	3.1[B]	410[I]
ERL		8.2	1.2	81	34	46.7	0.15	20.9		1	150
ERM		70	9.6	370	270	218	0.71	51.6		3.7	410
CCSS 37	2	5.1	4.5	60	70	26	< 0.030	23	< 1.3	< 1.0	70
CCSS 21	3	< 1.5	1.1	7.8	2.9	5.3	< 0.030	4.3	< 1.3	< 1.0	13
CCSS 23	3	< 1.5	1.4	12	4.2	7	< 0.030	5.8	< 1.3	< 1.0	18
CCSS 24	3	< 1.5	0.93	9.7	3.9	5.6	< 0.030	4.5	< 1.3	< 1.0	15
CCSS 24	4	< 1.5	6.4	75	25	22	< 0.030	21	< 1.3	< 1.0	67
CCSS 30	2	< 1.5	1.4	25	2.3	9.4	< 0.030	5.9	< 1.3	< 1.0	15
CCSS 26	4	< 1.5	5.6	80	28	33	< 0.030	21	< 1.3	< 1.0	64
CCSS 28	4	< 1.5	1.5	28	33	9.7	< 0.030	6.2	< 1.3	< 1.0	31
CCSS 35	3.5	< 1.5	1.9	25	4.3	11	< 0.030	8.4	< 1.3	< 1.0	22
CCSS 32	3.5	< 1.5	1.2	18	23	9.4	< 0.030	6.5	< 1.3	< 1.0	28

Shaded concentrations exceed the AET, ERL, or ERM; - indicates no sample collected
AET, ERL, and ERM values are in dry weight; Soil concentrations are in wet weight
A-Amphipod; B-Bivalve; E-Echinoderm Larvae; I-Infaunal Community Impacts; L-Larval; M-Microtox; N-Neanthes bioassays (polychaete worm); O-Oyster larvae

Table 10. Edison Property - Phase 2 ESA Metal Results Compared to California Toxics Rule Ambient Water Quality Criteria (in µg/L) (SECOR 2000)

Location	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Selenium	Silver	Zinc
CMC	69	42	1100	4.8	210		74	290	1.9	90
CCC	36	9.3	50	3.1	8.1		8.2	71		81
CCGS 1	63	<5.4	47	13	65	<0.13	20	<13	<24	24
CCGS 2	9	5.4	88	290	69	<0.13	36	<13	<24	640
CCGS 3	<5.8	7.2	34	770	120	<0.13	24	<13	<24	180
CCGS 4	7	7.4	35	7.7	100	<0.13	8.7	<13	<24	46
CCGS 5	150	9.1	66	140	120	<0.13	17	<13	<24	53
CCGS 6	14	<5.4	31	7.0	42	<0.13	6.7	<13	<24	7.3
CCGS 7	<5.8	<5.4	24	34	27	<0.13	6.3	<13	<24	<3.2
CCGS 8	24	6.0	42	36	87	<0.13	21	<13	<24	270
CCGS 9	16	7.7	65	27	110	<0.13	12	<13	<24	130
CCGS 10	11	<5.4	12	6.3	<17	<0.13	8.4	<13	<24	14

CMC – Criterion Maximum Concentration (acute)
CCC – Criterion Continuous Concentration (chronic)
CMC and CCC are for dissolved metals in saltwater
ESA concentrations are for total metals
Shaded values exceed AWQC

Table 11. Navy Property - Sediment Metal and DDT Results Compared to Toxicity Screening Guidelines (Navy 1994)

Sample ID	Depth (ft-bgs)	Arsenic (mg/kg)	Cadmium (mg/kg	Chromium (mg/kg)	Copper (mg/kg)	Lead (mg/kg	Mercury (mg/kg	Nickel (mg/kg	Selenium (mg/kg	Silver (mg/kg)	Zn (mg/kg	DDD (µg/kg)	DDE (µg/kg)	DDT (µg/kg)
AET		35[B]	3[N]	62[N]	390[MO]	400[B]	0.4[M]	110[EL]	1.0[A]	3.1[B]	410[I]	16[I]	9[I]	12[E]
ERL		8.2	1.2	81	34	46.7	0.15	20.9		1	150	2	2.2	1
ERM		70	9.6	370	270	218	0.71	51.6		3.7	410	20	27	7
SG11-36	0 - 0.5	5.6	6.8	36	39.2	59.7	0.21	31.1	1.8	2.2	209	110	520	150
SG11-36	0.5 - 1.0	5.6	4.9	23.5	28.1	18.9	0.19	29.4	1.5	1.7	113	90	270	15
SG11-36	1.0 - 1.5	6.7	3.7	16.4	17.4	13.4	0.16	21.2	0.77	1.3	65	55	130	9
SG11-36	1.5 - 2.0	9.1	4.3	23.4	21.6	14.8	0.13	23.2	0.9	1.6	84.2	66	190	14
SG11-12	0 - 0.5	4.7	0.88	18.6	22.2	16.8	0.23	19.1	0.59	1.6	93.6	96	250	25
SG11-12	0.5 - 1.0	9.9	6.3	37.7	28.2	14.5	0.24	33.2	0.64	1.7	104	3	4	5
SW11-72	0	87.3	2	70.5	467	128	0.31	33.5	0.76	0.19	380	43	440	3
SG11-61	0 - 0.5	7.2	0.57	26.4	38.5	41.6	0.067	30.8	3	0.13	95.9	1.3	1.3	1.3
SG11-62	0 - 0.5	7.8	0.38	31.3	28.1	168	0.048	28	2.4	0.09	98.2	1.2	7.6	0.48
SG11-63	0 - 0.5	5.1	1.7	40.1	42.3	32.1	0.07	36.8	3.4	0.13	152	11	41	14
SG11-64	0 - 0.5	8.7	1.9	34.1	37	22.7	0.054	34	2.6	0.1	128	6.4	64	6.2
SG11-13	0 - 0.5	3.8	1.2	7.6	5.3	25.1	0.18	7.8	0.62	0	23.6	6	22	5
SG11-13	0.5 - 1.0	25.7	4.1	23.9	14.3	6.5	0.19	19.6	0.65	0	62.4	5	15	5
SG11-13	1.0 - 1.5	5.7	5.7	44.5	31.5	33.7	0.6	33	0.71	0	98.9	5	5	5
SG11-13	1.5 - 2.0	10.8	4.2	34.5	22.5	15.5	0.23	27.8	0.65	0	68.1	5	5	5
SW11-70	0	7.6	0.32	29.6	49.9	23	0.33	43.2	1	0.16	131	2	29	7
SW11-71	0	6	0.34	20.5	15.6	17.4	0.16	19.5	0.54	0.13	63.7	4	54	6
SG11-32	0 - 0.5	1.4	0.7	9.9	3.6	2.2	0.19	5.1	0.48	1.3	14	4	4	4
SG11-32	0.5 - 1.0	0.87	0.69	4.4	3	0.89	0.18	4.4	0.48	1.3	10.4	4	4	4

Shaded concentrations exceed the AET, ERL, or ERM; - indicates no sample collected
AET, ERL, and ERM values are in dry weight; Soil concentrations are assumed to be in wet weight
A-Amphipod; B-Bivalve; E-Echinoderm Larvae; I-Infaunal Community Impacts; L-Larval; M-Microtox; N-Neanthes bioassays (polychaete worm); O-Oyster larvae

Table 11. Navy Property - Sediment Metal and DDT Results Compared to Toxicity Screening Guidelines - continued (Navy 1994)

Sample ID	Depth (ft-bgs)	Arsenic (mg/kg)	Cadmium (mg/kg	Chromium (mg/kg)	Copper (mg/kg	Lead (mg/kg	Mercury (mg/kg)	Nickel (mg/kg	Selenium (mg/kg	Silver (mg/kg)	Zn (mg/kg	DDD (µg/kg)	DDE (µg/kg)	DDT (µg/kg)
AET		35[B]	3[N]	62[N]	390[MO]	400[B]	0.4[M]	110[EL]	1.0[A]	3.1[B]	410[I]	16[I]	9[I]	12[E]
ERL		8.2	1.2	81	34	46.7	0.15	20.9		1	150	2	2.2	1
ERM		70	9.6	370	270	218	0.71	51.6		3.7	410	20	27	7
SG11-32	1.0 - 1.5	1.5	0.7	5	4.7	1.3	0.19	2.5	0.48	1.3	11.3	4	4	4
SG11-32	1.5 - 2.0	0.67	0.68	4.9	3.9	1.2	0.18	2.5	0.48	1.2	9.4	4	4	4
SG11-11	0 - 0.5	2.4	0.31	13.1	21.4	16.3	0.06	17.7	0.47	0.63	71.4	18	13	10
SG11-11	0.5 - 1.0	2.1	0.31	9	12.1	15.4	0.06	13.2	0.43	0.64	41.9	24	10	6
SG11-11	1.0 - 1.5	3.7	0.3	9.1	11.7	15.2	0.06	11.6	0.56	0.63	34.2	37	14	11
SG11-11	1.5 - 2.0	4.1	0.32	11.8	12.9	18.6	0.06	17	0.69	0.67	48	38	13	75
SW11-73	0	6.1	0.88	21.1	22.3	9.5	0.15	22.5	0.5	0.12	128	19	81	18
SG11-33	0 - 0.5	3	7.2	36.5	42	32.5	0.18	35.4	1.3	0	159	20	56	11
SG11-33	0.5 - 1.0	8.9	10.5	50.2	57.8	47.8	0.15	47.4	1.4	0	198	15	45	10
SG11-33	1.0 - 1.5	3.3	7.7	37.8	48.6	37.9	0.14	38.7	0.89	0	153	40	94	20
SG11-33	1.5 - 2.0	3.7	8.4	45.6	48.5	40.2	0.15	40.9	0.9	0	149	51	93	21
SW11-74	0	3.2	1	15.2	20.2	8.1	0.26	13.8	0.46	0.12	62.3	64	160	59
SG11-15	0 - 0.5	2	0.53	5.9	9.3	5.2	0.07	8.2	0.27	0.7	31.2	35	54	36
SG11-15	0.5 - 1.0	3.1	0.62	10.7	17.1	7.4	0.07	13.4	0.24	0.71	49.6	55	120	4
SG11-15	1.0 - 1.5	2.4	0.33	10.9	17.3	6.6	0.06	13.2	0.3	0.69	54.1	39	79	23
SG11-15	1.5 - 2.0	3.8	0.71	13.2	23.2	9.8	0.07	16.3	0.63	0.76	66	62	140	27
SG11-35	0 - 0.5	9.3	4.1	18.9	27.7	8	0.13	17.4	0.77	1.3	91.5	75	120	78
SG11-35	0.5 - 1.0	2	3.4	16.6	28.5	4.8	0.1	15	0.6	1	81.2	31	27	4
SG11-35	1.0 - 1.5	7.4	3	14.8	13.3	9.9	0.12	14.2	0.63	1.1	50.1	68	39	4

Shaded concentrations exceed the AET, ERL, or ERM; - indicates no sample collected
AET, ERL, and ERM values are in dry weight; Soil concentrations are assumed to be in wet weight
A-Amphipod; B-Bivalve; E-Echinoderm Larvae; I-Infaunal Community Impacts; L-Larval; M-Microtox; N-Neanthes bioassays (polychaete worm); O-Oyster larvae