

TECHNICAL MEMORANDUM

**Cobalt Background Evaluation
Boat Channel Sediments
Former Naval Training Center
San Diego, California**

March 11, 2014

Prepared for:



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Cobalt Background Evaluation Boat Channel Sediment, Former Naval Training Center San Diego

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Cobalt Background Evaluation, Boat Channel Sediment, Former Naval Training Center San Diego

1. Introduction

This report was prepared to evaluate background concentrations of cobalt in the soils and sediments of the San Diego Bay area compared to cobalt concentrations reported for the Boat Channel sediments. The Boat Channel sediments represent Installation Restoration (IR) Program Site 12 at former Naval Training Center (NTC) San Diego, California.

Cobalt is a naturally occurring element and is an essential element for life (Furness and Rainbow 1990). There are limited cobalt background data available for sediments since this element is not included in most sediment evaluation programs. More data are available from background soil characterization studies.

2. Summary of Data

Sediment and soil investigations in the San Diego Bay area were examined for background concentrations of cobalt. Cobalt analysis has not been included in most of the principle sediment investigations in San Diego Bay, such as the Bay Protection and Toxic Cleanup Program (Fairey et al., 1996, 1998), the Southern California Bight Regional Monitoring Program (Bight Surveys) (Noblet et al., 2003; Schiff et al., 2006, 2011), and the Sediment Assessment Study for the Mouths of Chollas and Paleta Creek (SCCWRP and U.S. Navy 2005).

However, background sediment cobalt concentrations are available from two studies conducted by the U.S. Navy for the Boat Channel sediments: the Sediment Characterization Study (BNI 1996a) and the Remedial Investigation (RI) Report (BEI 2003). Background sediment cobalt concentrations in San Diego Bay are also available from three other studies; one conducted by the U.S. Navy for the Naval Amphibious Base Coronado (Accord and ERM 2008) and two conducted at the B Street/Broadway Piers, Downtown Anchorage and Switzer Creek area (Anderson et al., 2004, 2005). Background sediment cobalt concentrations from offshore basins of Southern California were reviewed by Katz and Kaplan (1981). These background sediment cobalt concentrations are summarized in Table 1.

A reference sediment chemical concentration data set (expanded reference data set) for several inorganic and organic chemicals was developed by the U.S. Navy and Water Board for the Boat Channel sediment evaluation during the preparation of the Draft Feasibility Study (FS) Report (Trevet 2012); however, this data set did not include cobalt. For this report, a similar effort was conducted for cobalt with the available data from the Boat Channel RI (five project reference stations), the Boat Channel Sediment Characterization Study (three project reference stations), and the

B Street/Broadway Piers, Downtown Anchorage and Switzer Creek studies (9 project stations in the Phase I study, and 15 project stations in the Phase II study) (Anderson et al., 2004, 2005). Specific stations selected for this data set are the same stations as selected for the previous expanded reference data set. This reference data set, labeled as expanded reference – plus, is summarized in Table 1. This data set is labeled as expanded reference – plus to distinguish it from the expanded reference data set presented in the Draft FS Report (Trevet 2012).

Background soil concentrations of cobalt are also summarized in Table 1. Soil concentrations are considered appropriate for this evaluation because the background sediment developed from exposed layers of soil formations or from geologic processes that cause soil to migrate to water bodies and become sediment. Background soil concentrations are available from various project investigations such as for Naval Air Station North Island (BNI 1996b) and Point Loma Naval Complex (Kleinfelder 2005), as well as several regional studies such as the City of San Diego (Harris et al., 2013), the County of San Diego and the State of California (Bradford et al., 1996).

3. Background Evaluation

The principal statistical estimate of cobalt concentrations for sediments in the Boat Channel is the surface area-weighted average concentration (SWAC) of 8.2 mg/kg milligrams per kilogram (mg/kg) (Trevet 2012); however, the concentrations range from 3.4 to 20.8 mg/kg (Table 1). The maximum value for the Boat Channel sediment was reported as 20.8 mg/kg for Station S1S4, which is located within the anticipated remedial footprint. The next highest value is 12 mg/kg; therefore, the post-dredge SWAC would be reduced to 7.9 mg/kg.

3.1 Evaluation of Descriptive Statistics

The arithmetic mean values for the background sediment/soil cobalt concentrations range from 2.2 to 14.9 mg/kg. The background sediment/soil cobalt concentrations range from 0.38 to 46.9 mg/kg (Table 1). The mean and overall range of Boat Channel cobalt concentrations are within the range of these values for background sediment/soil cobalt concentrations.

The Boat Channel sediment SWAC of 8.2 mg/kg was similar to the background sediment mean of 8.0 mg/kg reported for the Boat Channel Sediment Characterization Study, and was less than the background sediment mean of 9.2 mg/kg reported for the Southern California offshore basins (Table 1).

Mean background soil cobalt concentrations of 10.1 mg/kg reported for the Point Loma Formation exceed the Boat Channel SWAC of 8.2 mg/kg. The Point Loma Formation outcrops at multiple locations within the general vicinity of the Boat Channel. In addition, the mean background soil cobalt concentrations of 14.5 and 14.9 mg/kg reported for San Diego County and the State of California, respectively, exceed the Boat Channel SWAC of 8.2 mg/kg (Table 1).

Based on these evaluations, the Boat Channel sediment cobalt concentrations are not greater than background sediment and soil concentrations.

3.2 Evaluation of Data Distributions

Full data sets were not available for all of the studies summarized in Table 1. However, graphs of the data distributions for background sediment cobalt concentrations for soil formations were available from the Point Loma Naval Complex Background Characterization Study. Full data sets were also available for the BNI (1996a) Boat Channel Sediment Characterization Study; the BEI (2003) Boat Channel sediment investigation; the Anderson et al., (2004, 2005) B Street/Broadway Piers,

Downtown Anchorage and Switzer Creek study; the Katz and Kaplan (1981) review of Southern California offshore basins; and the Bradford et al. (1996) study of background concentrations for California soils. Figure 1 presents data distributions as box-and-whisker plots of background soil cobalt concentration for five soil formations in the San Diego Bay region. Figure 1 also presents cobalt data distributions as box-and-whisker plots of the Boat Channel sediment, the sediment expanded reference — plus, the California background soil state-wide and for San Diego County, and the offshore sediment basins.

Figure 1 presents the cobalt distributions side-by-side to permit direct comparison of cobalt concentrations for the Boat Channel sediment with those of several background sediment and soil data sets.

Based on the visual evaluation of data distributions in Figure 1, the Boat Channel sediment cobalt concentrations are not greater than local and regional background sediment and soil concentrations.

4. Conclusions

The Boat Channel sediment concentrations of cobalt are not greater than the cobalt concentrations reported for offshore sediment near the California coast, the Point Loma formation in the San Diego region, or the background soil reported for San Diego County or California.

Cobalt concentrations for the Boat Channel sediment were highly correlated with the iron concentrations suggesting that these elements were consistent with the background distributions (see Table 7-1 of the Boat Channel RI Report, Volume II).

Concentrations of cobalt reported from the Point Loma formation and the background soil of San Diego County may have contributed to the concentrations reported for the Boat Channel due to typical soil erosion processes in the region.

Finding that the Boat Channel sediment concentrations of cobalt are not greater than the concentrations reported for regional background soil and sediment is consistent with the case that cobalt is typically not listed as a chemical of concern for sediment.

The reference sediment data that has been used for risk estimates on this project in the past is the Expanded Reference Data Set based on select locations within San Diego Bay (see Appendix A2 of the Draft FS Report (Trevet 2012)). The cobalt risk estimate based on the mean of this data set (6.0 mg/kg) is an HQ of 2, which is less than the site HQ of 3. The site related incremental HQ is equal to or less than 1. However, the background risk estimate calculated with the mean value from the Point Loma formation (10.1 mg/kg) is an HQ of 4, indicating that the site related risk is less than the background related risk.

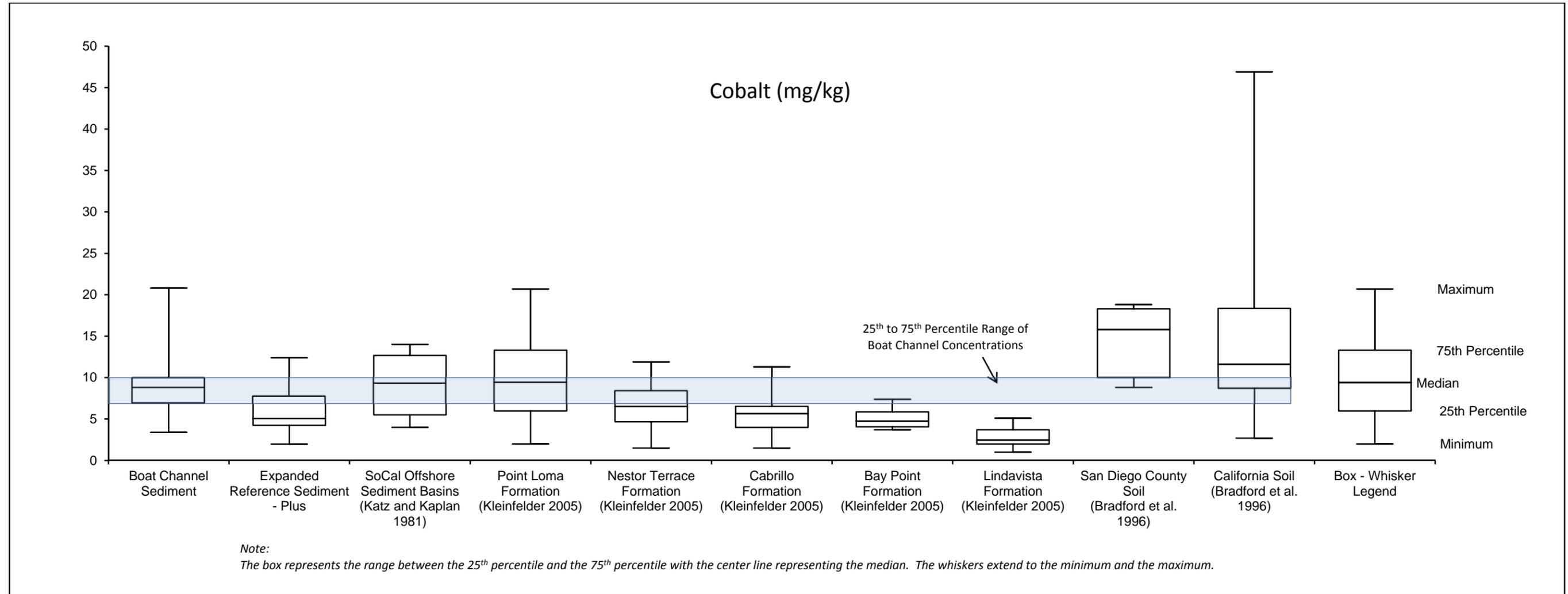
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Figures

Figure 1. Box-and Whisker Plots of Cobalt Distributions in the Boat Channel Sediment and in Background Sediment and Soil in the San Diego Region

Figure 1 Box-and-Whisker Plots of Cobalt Distributions in the Boat Channel Sediment and in Background Sediment and Soil in the San Diego Region.



Sources:

Boat Channel Sediment: Bechtel Environmental Inc. 2003 *RI Report for the Boat Channel*.

Expanded Reference Sediment - Plus: BEI 2003 *RI Report for the Boat Channel*; BNI 1996 *Sediment Characterization Study Boat Channel*, Anderson et al. 2004, 2005 *Sediment Quality Assessment Study at the B Street/Broadway Piers, Downtown Anchorage, and Switzer Creek, San Diego Bay*.

Table

Table 1. Summary of Background Cobalt Concentrations for Sediment and Soil

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Project Site	Notes	Matrix	Minimum Concentration	Maximum Concentration	Arithmetic Mean Concentration	Median Concentration	Other Statistic	Units	Source
Boat Channel Sediment, IR Site 12, Former NTC San Diego									
Former NTC San Diego	Boat Channel	Sediment	3.4	20.8	8.8	8.8		mg/kg	BEI 2003
Former NTC San Diego	Boat Channel - SWAC	Sediment			8.2			mg/kg	Trevet 2012
Background Sediment									
Former NTC San Diego	Sediment Characterization Reference	Sediment	5.1	12.2	8.0	6.7		mg/kg	BNI 1996a
Former NTC San Diego	Remedial Investigation Reference	Sediment	3.8	5.6	4.6	4.2		mg/kg	BEI 2003
Former NTC San Diego	Expanded Reference - Plus	Sediment	2	12.4	6.0	5.1		mg/kg	NTC FS Report (see notes)
NAB Coronado	Remedial Investigation/Site Investigation Reference	Sediment	2	8.4	5.2			mg/kg	Accord & ERM 2014
San Diego Bay	B Street/Broadway Piers, Downtown Anchorage, Switzer Creek	Sediment	2	11.2	5.1	4.8		mg/kg	Anderson et al. 2004
San Diego Bay	B Street/Broadway Piers, Downtown Anchorage, Switzer Creek	Sediment	4.1	12.4	6.7	5.0		mg/kg	Anderson et al. 2005
Southern California	Offshore Basins	Sediment	4	14	9.2	9.3		mg/kg	Katz and Kaplan 1981
Background Soil									
NAB Coronado	Background	Soil	0.38	5.4	2.2			mg/kg	Accord & ERM 2014
Long Beach Naval Shipyard	UTL (95,95)	Soil					25	mg/kg	BNI 1996b
MCAS Tustin	UTL (95,95)	Soil					11.05	mg/kg	BNI 1996b
NAS North Island	99th Percentile	Soil					6.4	mg/kg	BNI 1996b
Salton Sea Test Base	UTL (95,95)	Soil					12	mg/kg	BNI 1996b
San Diego County		Soil	8.8	18.8	14.5	15.8		mg/kg	Bradford et al. 1996
State of California		Soil	2.7	46.9	14.9	11.6		mg/kg	Bradford et al. 1996
San Diego	Downtown, Bay Point Formation	Soil	1.43	15.4				mg/kg	Harris et al. 2013
Point Loma Naval Complex	PLNC-wide (all formations)	Soil	1	20.7	6.6	5.7		mg/kg	Kleinfelder, Inc. 2005
Point Loma Naval Complex	Bay Point Formation	Soil	3.7	7.4	5.1	4.7		mg/kg	Kleinfelder, Inc. 2005
Point Loma Naval Complex	Cabrillo Formation	Soil	1.5	11.3	5.7	5.7		mg/kg	Kleinfelder, Inc. 2005
Point Loma Naval Complex	Lindavista Formation	Soil	1	5.1	2.9	2.5		mg/kg	Kleinfelder, Inc. 2005
Point Loma Naval Complex	Nestor Terrace Formation	Soil	1.5	11.9	6.5	6.5		mg/kg	Kleinfelder, Inc. 2005
Point Loma Naval Complex	Point Loma Formation	Soil	2	20.7	10.1	9.4		mg/kg	Kleinfelder, Inc. 2005

Accord and ERM 2008. Draft Remedial Investigation Report for IR Site 2/4 and Extended Site Inspection Report for Area Offshore of IR Site 3, Naval Amphibious Base Coronado Coronado, California. December.

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Blank cells indicate that the information is not available or not applicable

Expanded Reference - Plus - Reference locations identified in the FS Report; cobalt data are the 2003 and 2004 sampling results from "Sediment Quality Assessment Study at the B Street/Broadway Piers, Downtown Anchorage, and Switzer Creek, San Diego Bay" (n=32)

FS - Feasibility Study

MCAS - Marine Corps Air Station

mg/kg - milligram per kilogram

NAB - Naval Amphibious Base Coronado

NTC - Former Naval Training Center San Diego

PLNC - Point Loma Naval Complex

RI - Remedial Investigation

SWAC - Surface-area weighted average concentration

UTL (95,95) - upper tolerance limit, 95th percentile, 95% confidence limit.