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From: Commanding Officer, Engineering Field Activity, West, Naval Facilities Engineering Command
To: U.S. Environmental Protection Agency (Attn: Claire Trombadore)
California Department of Toxic Substances Control (Attn: Chein Kao w/2 copies of encl)
California Regional Water Quality Control Board (Attn: David Leland)

Subj: HUNTERS POINT SHIPYARD NICKEL SCREENING, SAN FRANCISCO, CALIFORNIA

Encl: (1) Proposed Nickel Screening and Implementation Plan, Hunters Point Shipyard, San Francisco, California

1. Enclosure (1) is forwarded for your information. This proposal will serve as the basis for an Explanation of Significant Differences to the Parcel B ROD unless the Navy receives comments by December 31, 1998.

2. If you have any questions regarding this document, please contact Ms. Jil Finnegan, Code 702P3, at (650) 244-2554.

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By direction

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PROPOSED NICKEL SCREENING AND IMPLEMENTATION PLAN
HUNTERS POINT SHIPYARD, SAN FRANCISCO CALIFORNIA

Introduction

A phased screening and implementation plan has been developed to evaluate the presence of contaminant versus naturally occurring nickel at Hunters Point Shipyard (HPS). This screening and implementation plan incorporates a method that accounts for naturally-occurring high nickel concentrations in serpentinite and serpentinite-derived material which are common at HPS, and also evaluates the presence of potential contaminant nickel. The approach also addresses nickel occurring at concentrations much lower than natural concentrations in serpentinite bedrock.

Serpentinite, which makes up a large proportion of the bedrock at HPS (Bonilla, 1971; PRC Environmental Management [PRC] 1996) and a correspondingly high proportion of the fill material, has high nickel concentrations, as is well-documented in numerous published studies of serpentinites, both locally and worldwide (for example, Bailey, Irwin, and Jones 1964; Page and Coleman 1967; Page 1968; Coleman and Keith 1971). Serpentinite samples obtained from surface outcrops and boreholes at HPS commonly have nickel concentrations higher than 2,000 mg/kg and range up to 6,340 mg/kg. Because both natural soils and much of the fill at HPS are derived from serpentinite, naturally occurring nickel concentrations in these materials are expected to be high. Because of the naturally occurring high levels of nickel, identification of contaminant versus naturally occurring nickel has not been straightforward.

Sandblast grit, although suggested to be a major potential source of nickel contamination from shipyard activities, has been shown to have very low nickel concentrations (average of 79 mg/kg for untreated grit and 54 mg/kg for treated grit) (Means, Smith, and Heath 1996); therefore, the higher nickel concentrations measured in soils at HPS (ranging from hundreds of mg/kg to over 1,000 mg/kg) cannot be attributed to sandblast grit. Other known potential sources of nickel contamination are the pickling and plate yard (IR-09, Parcel D) and the battery and electroplating shop (IR-10, Parcel B). There are no high nickel concentrations ('hot spots') spatially associated with either the pickling and plate yard or the battery and electroplating shop. Thus, there are no known sources of nickel contamination that can account for the high nickel concentrations that are comparatively common at HPS, whereas the high nickel concentration in serpentinite can easily account for those concentrations.

This memo summarizes the history of the evaluation of nickel at HPS and proposes a staged nickel screening and implementation plan, based on positive correlations between nickel and magnesium and nickel and cobalt. This regression approach was developed by Dr. James Frampton of the California Department of Toxic Substance Control (DTSC) (Frampton 1994; 1998a; 1998b). The screening and implementation plan accounts for the high values of nickel in serpentinite and the common occurrence of serpentinite in natural soils and fill, while it also allows for the possibility of unknown releases.

Ambient Nickel Concentrations at HPS

For many potential contaminants, the concentration of a contaminant resulting from a release typically exceeds naturally occurring concentrations of that chemical species. In such cases, single-value ambient levels have been calculated, based on analysis of the numerical distribution of chemical concentration data (Harding Lawson Associates 1990). Initially, a single-value ambient level for nickel at HPS was calculated on the basis of chemical data, without regard to sample material (Harding Lawson Associates 1990). This approach is problematic at HPS, because the concentration of nickel in serpentinite may greatly exceed the nickel concentration from releases. For example, as noted above, sandblast grit has nickel concentrations that are much lower than that of serpentinite bedrock. Much of the fill at HPS consists of a mix of serpentinite-derived material and other materials, such as sandstone, shale, and San Francisco Bay sediments. The proportion of serpentinite in fill or natural soil material can vary locally from nearly 100 percent to negligible. All of the nonserpentinite materials have significantly lower nickel concentrations than serpentinite. Thus, if a fill sample has a high nickel concentration, it is impossible to determine, on the basis of nickel concentration alone, whether the nickel in the sample is the result of a high percentage of serpentinite making up the sample, or whether the sample had little serpentinite in it and most of the nickel is anthropogenic. The difficulty in applying a single-value ambient level led to the development of a regression equation approach, which is discussed below.

Nickel-Magnesium Regressions

Serpentinite, in addition to having the highest nickel concentration of any natural material in the HPS area, also has the highest magnesium, cobalt, and chromium concentrations. Similar high concentrations of these elements are well-documented in studies of serpentinites in California and worldwide (for example Bailey, Irwin, and Jones 1964; Page and Coleman 1967; Page 1968; Coleman and Keith 1971). The strong positive correlation between magnesium and nickel concentrations in HPS materials (fill and rock) demonstrates the influence of serpentinite on nickel concentrations (Frampton 1994).

A nickel-magnesium regression equation developed by Dr. Frampton was used to determine ambient nickel levels (Frampton 1994; PRC 1995). In this approach, the 95 percent upper confidence limit (UCL) of the regression was used as the ambient level for nickel. The regression approach allowed for discrimination of potential contaminant versus naturally occurring nickel, even at values well below the common nickel concentrations in serpentinite. Thus, for determination of potential contaminant versus naturally occurring nickel it was the nickel to magnesium ratio, not absolute nickel concentration, that was the key discriminant. The dataset used for the implementation of the regression approach consisted of analyses of all types of materials (fill, natural soils, bedrock), both contaminated and uncontaminated, because the serpentinite-specific data did not appear to yield a result that was significantly different (Frampton 1994; PRC 1995).

Reevaluation of Nickel-Magnesium Regressions

During the course of the Parcel B remedial action, a significant number of samples exceeded the screening criteria for nickel based on the magnesium-nickel regression. For example, 31 remediation investigation samples stations (soil borings or monitoring wells) in Parcel B were identified in the feasibility study as having nickel as a chemical of potential concern (COPC). Of these 31 stations, 20 stations exceed the ambient nickel concentration using the nickel-magnesium regression. At excavation No. 18-1, 51 of 77 screening samples initially collected by International Technology Corporation exceeded the ambient nickel level based on the nickel-magnesium regression. The percentage of exceedances in excavation No. 18-1, mostly in natural colluvial soil developed on weathered serpentinite, prompted reevaluation of the nickel-magnesium regression.

Analysis of the chemical and geologic data indicated that weathered serpentinite and soils derived from this weathered material can have nickel to magnesium ratios ten times higher or more than fresh serpentinite. The greater mobility of magnesium relative to nickel in weathering has been demonstrated in many published studies (for example, Brimhall and Dietrich 1987). The enhancement of nickel to magnesium ratios in weathered serpentinite and derived soils was visually demonstrated by microscopic examination of soils from excavation No. 18-1 (Navy 1998). Natural colluvial soils, such as those excavated at 18-1, are made up of deeply weathered rock material that has weathered in place over a long period of time (tens of thousands of years or more). In contract, most of the fill was derived from excavated serpentinite in which the serpentinite component was primarily fresh rock. The soils at excavation No. 18-1 had high nickel concentrations (up to 2,000 mg/kg), with very low magnesium concentrations, such that in many cases the predicted proportion of serpentinite in the sample, based on analyses of fresh serpentinite, should have been near zero. Microscopic examination of these soils found that the soils with high nickel concentrations had large amounts of serpentinite pieces (clasts), whereas the samples with low nickel concentrations had small or negligible amounts of serpentinite clasts. This case illustrates that naturally occurring nickel concentrations in weathered serpentinite and soils derived from weathered serpentinite, did consistently exceed the calculated ambient levels based on nickel-magnesium regressions.

Nickel to Cobalt Regressions

Dr. Frampton noted that, based on chemical analyses of serpentinite samples at HPS, cobalt was apparently much less mobile than magnesium in weathered rock (Framptom 1998a). In weathered serpentinite, the magnesium concentrations were reduced relative to fresh rock, but cobalt concentrations were not. Therefore, a nickel-cobalt regression could be used to track the presence of serpentinite-derived nickel, even in samples in which the serpentinite fraction was deeply weathered (Frampton 1998a). A new nickel-cobalt regression was formulated by Dr. Frampton using a dataset consisting of primarily fill material samples collected during the remedial investigation from IR sites 4 through 10 at HPS (Frampton 1998b).

For Parcel B remediation areas where nickel had been previously identified as a COPC, nickel concentrations in two of 31 samples were greater than the ambient level for nickel based on this second regression equation. Those two samples (IR18B037 and IR18B038) have low nickel concentrations (421 mg/kg and 411 mg/kg, respectively) and were both within the excavation No. 18-1 excavation. The area has been interpreted to be free of nickel contamination based on the presence of weathered serpentinite (Frampton 1998a; 1998b). These two samples are below ambient nickel levels based on the serpentinite-based nickel cobalt regression discussed above.

Proposed Nickel Screening and Implementation Plan

The Navy proposes to calculate an ambient level for each remediation area where nickel has been identified as a COPC using the regression equations for nickel to magnesium and nickel to cobalt. The regressions used to calculate ambient levels will be based on the basewide dataset collected from IR sites 4 through 10. The same regression equations will be applied to each parcel at HPS. Initially, as recommended by DTSC, the 95 percent UCL of the nickel-magnesium regression equation will be applied as a screening criteria. Sites exceeding ambient levels based on the nickel-magnesium regression, will be further screened using the nickel-cobalt regression developed by Dr. Frampton (Frampton 1998b). If nickel is less than the calculated ambient level using the nickel-cobalt regression, nickel will be dropped as COPC for that specific remediation area. Sites where nickel concentrations exceed the ambient level based on the nickel-cobalt 95 percent UCL regression would be further evaluated geologically.

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