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DEPARTMENT OF THE NAVY
SOUTHWEST DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
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5090
Ser 06CH.SG/0838
August 16, 2004

Ms. Lida Tan
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Ms. Adriana Constantinescu
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Dear Ms. Constantinescu and Ms. Tan:

Enclosed is a hard copy of the "Technical Memorandum, Northern Channel (Site 27) Revised Calculation of the Allowable Exposure Level (LEL) for Total Polychlorinated Biphenyls (PCBs) Former Naval Air Station Moffett Field, California". This is the same document that was sent electronically, explaining revisions made to the calculation of the action level for total PCBs in the sediments at Site 27. The revisions do not change the action level for PCBs or the proposed clean up alternative for the sediments. If any questions or concerns arise, please feel free to contact Ms. Andrea Espinoza at (619) 532-0911 or Mr. Scott Gromko at (619) 532-0933.

Sincerely,

Andrea Espinoza

ANDREA ESPINOZA
BRAC Environmental Coordinator
By direction of the Commander

Enclosure: 1. Technical Memorandum, Northern Channel (Site 27) Revised Calculation of the Allowable Exposure Level (LEL) for Total Polychlorinated Biphenyls (PCBs) Former Naval Air Station Moffett Field, California

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DRAFT TECHNICAL MEMORANDUM

NORTHERN CHANNEL (SITE 27) REVISED CALCULATION OF THE ALLOWABLE EXPOSURE LEVEL FOR TOTAL POLYCHLORINATED BIPHENYLS FORMER NAVAL AIR STATION MOFFETT FIELD, CALIFORNIA

July 14, 2004

INTRODUCTION

The U.S. Department of the Navy (Navy) has prepared this technical memorandum as a supplement to the Final Feasibility Study (FS) for the Northern Channel (Site 27) at former Naval Air Station (NAS) Moffett Field (Tetra Tech EM Inc. [Tetra Tech] 2003) to document revisions to the parameters used to calculate the action level for total polychlorinated biphenyls (PCB) in sediments at Site 27.

The Navy reviewed the ecological risk assessment calculations presented in the Phase II Site-Wide Ecological Assessment (SWEA) (PRC Environmental Management, Inc. [PRC] and Montgomery Watson [MW] 1997) as part of the preparation of the Remedial Investigation Addendum Report for Site 25 at former NAS Moffett Field. Since the risk calculations presented in the Phase II SWEA were also used to develop allowable exposure levels (AEL) for the Site 27 FS Report (Tetra Tech 2003), this Feasibility Study was also reviewed. As a result of this review, the Navy recognized an inaccuracy with a parameter used in the risk assessment to estimate the transfer of total PCBs from sediment to invertebrate tissue, referred to as the sediment-to-invertebrate aquatic transfer coefficient (ATC); the methods used to calculate the ATC are discussed further below.

In order to evaluate the impact of changing the ATC in the calculation of the AEL for total PCBs, the other parameters used in the calculation were reviewed and revised based on current literature and ecological risk assessment practices; specifically, the ATC for sediment-to-fish, the toxicity reference values (TRV), and the site use factor (SUF). This technical memorandum describes the evaluation of the parameters in order to determine whether the AEL for total PCBs presented in the Site 27 FS Report is reasonable based on calculations using current exposure parameters.

This technical memorandum presents the rationale and methods for correcting the inaccuracy in the sediment-to-invertebrate ATC, however, it is not intended to change the total PCBs AEL of 350 micrograms per kilogram (µg/kg) calculated in the Site 27 FS report (Tetra Tech 2003). In addition, the area and depth of sediments to which cleanup levels will be achieved during the remedial action (also referred to as the area of attainment) will not be revised from the areas presented in the Site 27 FS Report.

The following paragraphs describe the methods used to initially calculate the AEL for total PCBs in the Site 27 FS Report, the rationale for revising the sediment-to-invertebrate ATC used in the ecological calculation of the AEL for total PCBs, the reasonable exposure parameters used in the revised AEL calculation, and the recommendations for the Site 27 remedial action.

METHODS FOR CALCULATING THE ALLOWABLE EXPOSURE LEVEL FOR TOTAL PCBs

In order to understand the affect of using different parameters to develop the AEL for total PCBs for sediments at Site 27, it was necessary to review the approach used to calculate the AEL. The AEL for total PCBs was developed in accordance with the following two U.S. Environmental Protection Agency (EPA) guidance documents: "Conducting Remedial Investigations and Feasibility Studies Under CERCLA" (EPA 1988) and "Considering Wetlands at CERCLA Sites" (EPA 1994). The AEL for total PCBs was calculated using the same modeling methods and parameters used in the risk assessment for ecological receptors at Site 27 (Tetra Tech 2003). To estimate risk to higher-level receptors such as birds, the risk assessment relied on food-chain modeling. Food-chain modeling is used to estimate the amount of a chemical that is ingested by a receptor while foraging at the site, which is referred to as "the dose." The dose accounts for the amount of a chemical the receptor ingests in food items along with the amount of chemical present in sediment and surface water that is ingested while the receptor is feeding, preening, or grooming. The estimated doses of chemicals to ecological receptors of interest are compared with high and low TRVs to estimate the potential adverse biological effects on the receptor. TRVs are screening-level benchmark values based on literature doses developed for higher-trophic-level receptors. Food-chain models integrate ecological and chemical information into the risk assessment. Food-chain models consider the following components: (1) temporal and spatial characterization of exposure, (2) ingestion rates and diet composition, (3) life history and behavioral information, and (4) chemical concentrations at the site.

The total ingestion for each receptor is calculated as the sum of the dietary exposure estimates from the food item and the incidental ingestion of sediment. The following generic equation was used to calculate the dose for each representative receptor:

$$\text{Dose} = \frac{([IR_{food} \times C_{food\,item}] + [IR_{media} \times C_{media}]) \times SUF}{BW}$$

where:

Dose	=	Estimated dose from ingestion (milligrams per kilogram [mg/kg] body weight per day)
IR_{food}	=	Ingestion rate for food item (kilograms per day [kg/day])
$C_{food\ item}$	=	Concentration of chemical in food item measured in dry weight (mg/kg). If the receptor feeds on multiple types of food, then the ingestion rate and concentration of each food item is added in the equation.

IR_{media}	=	Ingestion rate of media such as sediment or surface water (kg/day)
C_{media}	=	Concentration of chemical in sediment or surface water measured in dry weight (mg/kg). If the receptor ingests multiple types of media while feeding, then each medium is added in the equation.
SUF	=	Site use factor (unitless). Calculated as the area of the site divided by the area representing a likely daily exposure for the receptor, such as a foraging range.
BW	=	Average adult body weight (kg)

The resulting dose was then divided by high and low TRVs and defined as the hazard quotient.

$$\text{Hazard Quotient} = \frac{\text{Dose}}{\text{TRV}}$$

A hazard quotient greater than 1.0 indicates potential risk exists to the ecological receptor being evaluated.

In the Site 27 FS Report, the Black-necked Stilt (*Himantopus mexicanus*) had the highest hazard quotients based on the high and low TRV for total PCBs; therefore, it was identified as the most sensitive receptor for PCB exposure (Tetra Tech 2003). The Base Realignment and Closure (BRAC) Cleanup Team (BCT) concluded that AELs based on protection of the most sensitive ecological receptor would be adequately protective of other receptors evaluated at Site 27 (Tetra Tech 2003). To derive the AELs, the hazard quotient was set equal to 1.0 and the equation was solved for the sediment concentration in a process known as back-calculating. The following equation was used to back-calculate the AEL for total PCBs for the Black-necked Stilt:

$$[(TRV/SUF)*BW]/[IR_{sediment} + (ATC_{fish}*IR_{fish}) + (ATC_{invertebrate}*IR_{invertebrate})] = C_{sediment}$$

The above equation resulted in an AEL of 350 µg/kg for total PCBs for the Black-necked Stilt (Tetra Tech 2003). Table 1 presents the back-calculation of the AEL for total PCBs including all of the parameters used in the equation.

RATIONALE FOR REVISING THE SEDIMENT-TO-INVERTEBRATE AQUATIC TRANSFER COEFFICIENT

During the Navy's review of the risk calculations presented in the Phase II SWEA (PRC and MW 1997) and the Site 27 FS Report (Tetra Tech 2003), a concern was identified with the sediment-to-invertebrate ATC used to calculate the AEL for total PCBs. The ATC used in the calculation could have resulted in a lower AEL than if a more appropriate ATC was used. Because the volume of invertebrate tissue collected in the Northern Channel during the data gaps investigation in May 2002 was insufficient to support multiple analyses, the sediment-to-invertebrate ATC from the Phase II SWEA was used to estimate the concentration of total PCBs

in invertebrate tissue (a primary food item for the Black-necked Stilt) in the AEL calculation for Site 27. The tissue concentration was estimated using the following equation:

$$C_{food\ item} = ATC_{invertebrate} * C_{sediment}$$

In addition, bioaccumulation factors (BAF) and biota-sediment accumulation factors (BSAF) were calculated to develop the sediment-to-invertebrate ATC for total PCBs (PRC and MW 1997). BAFs were calculated using both field studies and laboratory studies from the literature when sufficient site-specific data did not exist to calculate BAFs (PRC and MW 1997). BAFs were calculated by dividing the concentration of total PCBs in polychaete tissue from bioaccumulation tests by the sediment concentration used in the test (PRC and MW 1997). Polychaetes include various segmented worms in the class Polychaetata, which are mostly marine species characterized by fleshy, paired appendages tipped with bristles on each body segment. BSAFs were also calculated by dividing the tissue concentration in polychaete tissue from bioaccumulation tests that was normalized based on the lipid content of the tissue by the sediment concentration used in the test normalized based on the total organic carbon (TOC) content of the sediment (PRC and MW 1997).

Both BAFs and BSAFs are acceptable for use in food-chain modeling. Pelka (1998) reports that for a study in the Great Lakes Region, BSAFs in general were the most accurate measure of bioaccumulation over all sites studied; however, measured BAFs for some of the specific sites were as accurate or slightly more accurate than the BSAFs. BSAFs are more often used to compare data from one site to another site with dissimilar sediment conditions such as TOC or dissimilar species analyzed such as clam or fish species. If the BSAF is used as the ATC in the food-chain model, as is the case for total PCBs in the Phase II SWEA and Site 27 FS Report, then the TOC content of sediment and the lipid content of tissue need to be corrected for in the equation. This additional correction was not accounted for in the Phase II SWEA or the Site 27 FS Report. Because the BSAF and BAF were calculated using the same site-specific samples, it would be more appropriate to use the BAF in the calculation of the AEL for total PCBs.

REASONABLE PARAMETERS USED IN THE REVISED CALCULATION OF THE ALLOWABLE EXPOSURE LEVEL FOR TOTAL PCBs

The Navy concluded that the AEL for total PCBs in sediment at Site 27 could differ significantly if the updated sediment-to-invertebrate ATC was used in the back-calculation for total PCBs. As a result, the parameters used to calculate the AEL for total PCBs were reevaluated based on current scientific information to determine whether the AEL calculated with updated parameters would still be within the range of AELs calculated previously for total PCBs in sediment and presented in the Site 27 FS Report (Tetra Tech 2003).

The Navy identified that the following parameters used in the risk assessment could be revised based on current literature and risk assessment practices: the ATC for sediment-to-invertebrate tissue, the ATC for sediment-to-fish tissue, the TRV, and the SUF. Revisions to each parameter were considered to be reasonable for exposure of the Black-necked Stilt at Site 27, as discussed below. All other parameters were unchanged from the initial AEL calculation.

TRANSFER COEFFICIENT FOR SEDIMENT-TO-INVERTEBRATE TISSUE

Site-specific data are preferable to literature-based information for bioaccumulative chemicals (EPA 1988). Multiple factors influence the transfer and retention of chemicals from sediment to invertebrates. Site-specific data account for all of the factors and no extrapolation is required to assess the accumulation of the chemicals. Therefore, site-specific data have less uncertainty and are more representative of site conditions than information extrapolated from literature data. The Phase II SWEA presented a BSAF of 2.54 (dry weight) for total PCBs and an alternative ATC of 3.9 for total PCBs that were both derived from site-specific data. The sediment-to-invertebrate ATC of 3.9 was used as a conservative value in the Site 27 FS Report (Tetra Tech 2003). An average sediment-to-invertebrate BAF of 0.693 was calculated for total PCBs using data from the polychaete bioaccumulation tests (PRC and MW 1997). The Navy believes the average BAF developed from the polychaete bioaccumulation tests more accurately represents the transfer of PCBs from sediment to invertebrates and that the complexities involved in using the BSAF are not warranted for the AEL calculation. The BAF of 0.693 for total PCBs was calculated using site-specific data from NAS Moffett Field and is more applicable for use as the ATC in the recalculation of the AEL for total PCBs at Site 27.

AQUATIC TRANSFER COEFFICIENT FOR SEDIMENT-TO-FISH TISSUE

The initial calculation of the AEL for total PCBs for Site 27 was based on a sediment-to-fish ATC of 22. The ATC was the most conservative transfer factor for fish presented in the Phase II SWEA (PRC and MW 1997). Further evaluation of the Phase II SWEA indicated that ATC was based on Turbot liver concentrations and not whole body concentrations (PRC and MW 1997). Whole body data are the preferred data for evaluating food-chain exposure to ecological receptors (Pelka 1998). Therefore, using an ATC based on liver concentrations would significantly overestimate the whole body fish concentrations because the liver functions to remove contaminants from the organism. As a result, the ATCs presented in the SWEA were reassessed and the highest ATC based on the whole body analysis of fish was identified as 1.8. Using a sediment-to-fish ATC in the range of 1.0 to 2.0 would be more appropriate in the recalculation of the AEL for total PCBs for the Black-necked Stilt at Site 27.

TOXICITY REFERENCE VALUES

The actual dose at which an ecological effect will occur is expected to be between the no observed adverse effect level (NOAEL)-based TRV (defined as the low TRV) and the lowest observed adverse effect level (LOAEL)-based TRV (defined as the high TRV). For total PCBs, the difference between the high and low TRV is greater than one order of magnitude. The AEL for PCBs of 350 µg/kg for Site 27 was calculated using the high TRV; however, both the low and high TRV were used to calculate a range of hazard quotients. Using both the high and low TRVs in the recalculation of the AEL for total PCBs for the Black-necked Stilt is reasonable and results in a range of concentrations between the NOAEL and LOAEL concentrations.

SITE USE FACTOR

A SUF of 1.0 was used in the initial calculation of the AEL for total PCBs for Site 27 based on the following assumptions:

- The home range of a Black-necked Stilt was assumed to be 5 hectares (approximately 12 acres) based on home range data for a spotted sandpiper in Michigan (Zeiner and others 1990).
- All of Site 27, including the sloped banks and the entire inundated area, is available for foraging.

Evaluation of site-specific physical conditions and additional literature research indicated it is highly unlikely that Black-necked Stilts would exclusively use Site 27 for feeding. This assessment is based on the following information.

- Female stilts feed primarily in water that reaches between the feet and ankle of the feeding bird (50 millimeters [mm]), while male stilts feed primarily in water that is ankle deep (110 mm) (Hamilton 1975). A very limited area of Site 27 is less than 110 mm in depth.
- The stilt prefers brine shrimp and brine flies as its food. During winter, the stilt feeds exclusively on brine shrimp (Hamilton 1975). Based on surveys of Site 27, invertebrate populations are very low compared with nearby areas such as the salt evaporation ponds. Areas other than Site 27 are likely to be preferred feeding areas within the home range of stilts because Site 27 is adjacent to salt ponds that provide the stilts preferred diet.
- Nesting areas for stilts are generally located less than 1 kilometer from feeding areas (Zeiner and others 1990). Based on this data, a home range of about 247 acres is more appropriate for the stilt. Therefore, other areas within the home range are likely to be preferred feeding areas.

In addition, Black-necked Stilt were observed foraging in adjacent, more suitable habitat than Site 27 (Tetra Tech 2003). Based on the available information, using a SUF in the range of 0.1 to 0.5 is appropriate in the calculation of the AEL for total PCBs for the Black-necked Stilt at Site 27.

RECOMMENDATIONS

As discussed above, revising the parameters used in the back calculations in the Site 27 FS Report (Tetra Tech 2003) could result in a change to the AEL calculated for total PCBs. Evaluation of the back-calculated AEL for total PCBs for the Black-necked Stilt indicates that the originally calculated AEL of 350 µg/kg is reasonable based on current literature and ecological risk assessment practices.

The Navy recommends that the record of decision for Site 27 use the AEL of 350 µg/kg for total PCBs in sediment. This recommendation is based on the following facts.

- The previously calculated AEL for total PCBs in sediment at Site 27 can be calculated using reasonable parameters based on current literature and ecological risk assessment practices. The AEL is not at a high or low extreme of possible AELs that can be calculated using reasonable parameters.

- The regulatory agencies previously agreed to the AEL for total PCBs of 350 µg/kg. The Navy and the regulatory agencies could not reach consensus on the parameters used in the AEL calculation during the dispute resolution process, but agreed on the AEL of 350 µg/kg for total PCBs in sediment at Site 27.

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TABLE 1: TOTAL DOSE, HAZARD QUOTIENTS, AND ALLOWABLE EXPOSURE LEVELS FOR THE BLACK-NECKED STILT (0 to 1 foot)

Former NAS Moffett Field, Northern Channel (Site 27) Revised Calculation of the AEL for Total PCBs

COPEC	Water Ingestion Rate (kg/day)	Water Concentration (mg/L)	Water Daily Dose (mg/day)	Sediment Ingestion Rate (kg/day)	Sediment Concentration (mg/kg)	Sediment Daily Dose1 (mg/day)	Total Prey Ingestion Rate (kg/day)	Fish Ingestion Rate (kg/day)	Fish ATC (unitless)	Fish Tissue Concentration in Dry Weight2 (mg/kg)	Fish Daily Dose1 (mg/kg)	Invertebrate Ingestion Rate (kg/day)	Invertebrate ATC (unitless)
Total PCBs	1.02E-01	2.00E-05	2.03E-06	3.96E-03	4.36E+00	1.73E-02	1.18E-01	7.04E-04	2.20E+01	9.60E+01	6.76E-02	2.13E-02	3.90E+00

COPEC	Invertebrate Tissue Concentration in Dry Weight[2] (mg/kg)	Invertebrate Daily Dose[1] (mg/kg)	SUF	Body Weight (kg)	Total Daily Dose[3] (mg/kg-day)	High TRV[4] (mg/kg-day)	Low TRV[4] (mg/kg-day)	Test Species Body Weight (kg)	Allometrically Adjusted High TRV[5] (mg/kg-day)	Allometrically Adjusted Low TRV[5] (mg/kg-day)	Lower HQ[6] (based on adjusted High TRV)	Upper HQ[6] (based on adjusted Low TRV)	AEL (High TRV mg/kg)
Total PCBs	1.70E+01	3.62E-01	1.00E+00	1.77E-01	2.53E+00	1.27E+00	9.00E-02	1.72E+03	2.03E-01	1.67E-02	1.25E+01	1.51E+02	3.50E-01

Notes:

1 Media and prey daily dose were calculated by multiplying the media/prey ingestion rates by media/prey concentrations.
2 Prey tissue concentration was calculated by multiplying the sediment concentration by the appropriate ATC where applicable. Concentrations are presented in dry weight.
3 Total daily dose is calculated using the following equation: total daily dose = (media daily dose + prey daily dose)*SUF)/receptor species body weight.
4 The derivation of TRVs is described in Navy (1998). These TRVs are adjusted to incorporate uncertainty factors.
5 Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)(1-1.2 for birds).
6 The HQ was calculated using total daily dose / allometrically adjusted TRV.

AEL	Allowable Exposure Level	kg	Kilogram	NA	Not Available
ATC	Aquatic transfer coefficient	kg/day	Kilogram per day	NAS	Naval air station
COPEC	Chemical of potential ecological concern	mg/day	Milligram per day	PCB	Polychlorinated biphenyl
DDT	Dichlorodiphenyltrichloroethane	mg/kg	Milligram per kilogram	SUF	Site use factor
HQ	Hazard quotient	mg/kg-day	Milligram per kilogram per day	TRV	Toxicity reference value

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FINAL
NORTHERN CHANNEL FEASIBILITY STUDY

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