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CLEAN

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Contract Task Order No. 0236

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NAVAL AIR STATION MOFFETT FIELD
CALIFORNIA

NAVY RESPONSE TO AGENCY COMMENTS ON THE DRAFT FINAL PHASE I SITE-WIDE ECOLOGICAL ASSESSMENT

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ACRONYMS AND ABBREVIATIONS

AWQC	Ambient Water Quality Criteria
CLEAN	Comprehensive Long-term Environmental Action Navy
CLP	Contract Laboratory Program
COC	Chemicals of concern
COPC	Chemical of potential concern
CRDL	Contract Required Detection Limits
DDE	1,1-Dichlorodiphenyl dichloroethene
DDT	1,1-Dichlorodiphenyl trichloroethane
EPA	U.S. Environmental Protection Agency
ER-L	Effects range-low
ER-M	Effects range-medium
ERA	Ecological risk assessment
FS	Feasibility Study
HAZWRAP	Hazardous Waste Remedial Actions Program
IRP	Installation Restoration Program
LOAEL	Lowest observed adverse effects level
μg/kg	Micrograms per kilogram
μg/L	Micrograms per liter
μS/m	Microsiemens per meter
mg/L	Milligrams per liter
mg/kg	Milligrams per kilogram
mL	Milliliter
NAS	Naval Air Station
NASA	National Aeronautics and Space Administration
NOAA	National Oceanic and Atmospheric Administration
NTU	Nephelometric turbidity units
OU	Operable Unit
PAH	Polynuclear aromatic hydrocarbon
PCB	Polychlorinated biphenyls
RWQCB	Regional Water Quality Control Board
SWEA	Site-wide Ecological Assessment
TPH	Total petroleum hydrocarbons
TTLC	Total threshold limit concentration
USACE	U.S. Army Corps of Engineers
VOA	Volatile organic analysis
VOC	Volatile organic compound
WESTCO	Western Ecological Services Company
WESTDIV	Western Division Naval Facilities Engineering Command

CALIFORNIA EPA - DEPARTMENT OF TOXIC SUBSTANCES CONTROL
DRAFT - FINAL PHASE I SITE-WIDE ECOLOGICAL ASSESSMENT
NAVAL AIR STATION - MOFFETT FIELD

Comments by C. Joseph Chou, Engineering Geologist, dated January 20, 1995

Comment No. 1: **The California Environmental Protection Agency (Cal/EPA) has reviewed the subject document. Comments regarding the document have been prepared by the Department of Toxic Substances Control (DTSC) and San Francisco Regional Water Quality Control Board (RWQCB). Please respond to all the following comments in thirty days to finalize the final Phase I SWEA report. Futural (sic) changes in the document should be clearly identified. This may be done in several ways: by submitting revised pages with the reason for the changes noted, by the use of strikeout and underline, by the use of shading and italics, or by cover letter stating how each of the comments here have been addressed. If you have questions, please contact me at (510) 540-3830.**

MW Response: In the sections below, the Navy has provided specific responses to each of the DTSC comments. Changes to the Draft Final Phase I SWEA are also included in the responses where applicable.

GENERAL COMMENTS

Comment No. 1 **The changes incorporated in the draft final version are confusing since certain aspects are changed in Sections 6.0 and 7.0, while others aspects are addressed in Supplement 1. The State (DTSC and SFRWQCB) understanding is that Sections 6.0 and 7.0 in the draft final address changes to contaminants of ecological concern (COECs), while Sections 6.0 and 7.0 in Supplement 1 are the draft final version that only address other issues. The net result is we found it difficult to review this draft final SWEA since changes and additions are not clearly indicated by strikeout and underlining; in particular, it was difficult to determine what the Navy is agreeing to in terms of COECs. The State is using Table ES-1 in the draft final SWEA as a primary reference for the list of COECs, and the specific comments below address recommendations for changes to this table.**

MW Response: The State's understanding of the organization of the document is correct. The general approach to modifying the document was discussed with the regulatory agencies after a meeting on July 11, 1994 at PRC Environmental Management, Inc., San Francisco. The State's use of Table ES-1 as the primary reference for the list of COCs is appropriate.

The Executive Summary and Sections 6.0 and 7.0 in the main body of the text will be expanded to clarify the report organization. A cover sheet will be added to Supplement 1 explaining the report organization.

Comment No. 2: **The toxicity profiles contained in Appendix K appear to reflect a more complete literature search, and contain good summaries of the toxic effects**

on various aquatic and terrestrial species, and on the potential for bioaccumulation. However, we question how the literature derived toxicity values are compared to dietary concentrations or dose levels. The Phase I SWEA must clearly indicate how the conclusions are reached to eliminate COECs. As it has been indicated in DTSC's comments on the Response Report, such extrapolations and calculations are more appropriately conducted quantitatively during the Phase II.

MW Response: The toxicity profiles that were revised for the Draft Final SWEA (Appendix K) include a summary of detected concentrations and an evaluation of the distribution of the chemical at Moffett Federal Airfield. This information, as well as literature-derived toxicity values, was used to evaluate whether a chemical should be retained for Phase II ecological assessment. Literature-derived toxicity values were compared to dietary concentrations indirectly using conservative exposure assumptions. An example of the approach is shown in response to comment No. 2 in specific comments on wetland sediments (see below). Where reasonable exposure assumptions clearly indicate an absence of toxicity at the concentrations observed in environmental media, it is appropriate to screen out these chemicals based on the criteria of toxicity. Agreement was reached between the Navy and the regulatory agencies regarding the use of this criteria. The agreement is documented in a letter from Stephen Chao/Navy to Michael Gill/EPA dated June 8, 1994.

Comment No. 3: **The toxicity profiles in Appendix K also frequently appear to only consider toxicity values when they are available for wildlife species. For example, toxicity data for laboratory animals are often ignored, even though these data are available for a greater number of chemicals and generally are available for sensitive and applicable toxicity endpoints, such as reproduction. The result is the toxicity profiles are frequently restricted to acute toxicity values for wildlife species with lethality as the endpoint; this does not provide a chronic no observed adverse effect level (NOAEL). We have provided examples in the Specific Comments of NOAELs for laboratory animals, which we found after only a brief review of the literature. The State recommends use of all available data on relevant species, with the application of uncertainty factors, to develop NOAELs for the representative receptors.**

MW Response: The toxicity profiles in Appendix K were developed primarily with data available for wildlife species because these data are generally more applicable to receptors at Moffett Federal Airfield. As noted by Hoffman and others (1990), laboratory rodents can be used as surrogates for wild rodents, however, limited comparisons have shown that laboratory rodents are generally more sensitive to dietary exposures than wild rodents. Thus, using laboratory rodents as surrogates generally yields conservative toxicity values. Because of this potential bias, toxicity data resulting from experiments with wildlife were given preference during the preparation of the toxicity profiles. The references provided by the State were reviewed and, where applicable, were incorporated in the Final Phase

I SWEA. Future toxicity profiles developed for the Phase II SWEA will include toxicity data for laboratory surrogates, as well as wildlife species.

Comment No. 4: **For compounds not in Appendix K, the draft final report continues to provide only a reference citation without discussion of the selected toxicity value, or how this value is compared to the soil or sediment concentration. More information should be provided in the final Phase I SWEA or further evaluated in the Phase II assessment for the chemicals specified in the following comments. The comments below relate only to the scientific basis for elimination of chemicals. However, we emphasize that these criteria for elimination of COECs are site-specific, and therefore may not be accepted by the State on other sites. Also, other Natural Resource Trustees may disagree with the criteria used at the NAS Moffett Field for elimination of COECs. It is DTSC guidance that all inorganic chemicals greater than background, and all organic chemicals (excluding those demonstrated to be laboratory contaminants), be included in the quantitative ecological assessment.**

MW Response: Agreement was reached between the Navy and the regulatory agencies on the scope of the revisions to the Draft Phase I SWEA Report (including Appendix K) and specific chemicals to be included as COCs in both the Phase I SWEA Report and Phase II SWEA Work Plan. This agreement is documented in a letter from Stephen Chao/Navy to Michael Gill/EPA dated October 21, 1994.

SPECIFIC COMMENTS

A. WETLAND SEDIMENTS

Comment No. 1: **Boron, cobalt, manganese, vanadium, and molybdenum have been eliminated as COECs. The State believes these compounds should be retained based upon the following rationale. However, the Navy can either provide satisfactory justifications of eliminating the COECs in the Phase I SWEA or retain as COECs until further evaluating the test results from the Phase II SWEA.**

MW Response: See specific responses below. Calculations described in the specific responses are presented in Attachment A to this submittal.

Comment No. 2: **Boron is eliminated as a COEC. Page K-42 indicates that "uptake and accumulation of boron by plants can result in extremely high boron levels, including those plants used by waterfowl for food." Eisler (1990, Table 3) reports that boron can accumulate in aquatic plants and insects compared to a control area. However, the toxicity profile in Appendix K does not adequately describe how this compound was eliminated based on low toxicity. The State recommends boron be retained as a COEC in the wetland and upland soils due to its bioaccumulation potential, and because it is embryotoxic to avian species. Boron is also a reproductive toxicant in mammalian species; the ATSDR document on boron (1992b) provides a**

dietary NOAEL of 17.5 mg/kg-d in the rat based upon a multi-generational reproductive study under chronic dietary exposures.

MW Response: Including boron as a COPEC in the Phase II SWEA is not recommended. This recommendation is based on the lack of a documented source of boron, the site-specific conditions that are unfavorable to significant accumulation of boron, and the low toxicity of boron. However, the text on page K-42 of the Phase I SWEA Report will be clarified to state that "uptake and accumulation of boron by plants can result in extremely high boron levels, including those plants used by waterfowl for food, under specific environmental conditions such as those associated with agricultural drain water discharge."

A significant bioavailable source of boron must be present in the environment to cause toxicity. The majority of boron is used in the glass industry (45-56%) (Eisler 1990, HSDB 1995). Other uses of boron include detergents and cleaning products (Calow 1994, Eisler 1990, HSDB 1995), hence boron is sometimes found in domestic sewage discharges. Boron is also used in the semiconductor industry, in composite structural materials, as a shield for nuclear radiation, and in alloys and steel making (HSDB 1995). Boron accumulation in soils can also result from the disposal of fossil fuel combustion residues such as coal fly ash or from aerosol fallout from power generating stations (Burkman and others 1987). Boron is an essential plant nutrient and is used in fertilizers (Eisler 1990). There is no record of boron use at Moffett Federal Airfield and boron was not identified as a chemical of concern associated with any of the Installation Restoration Program (IRP) sites.

Boron data from two sediment samples were available as a result of an historical investigation undertaken by NASA (Ebasco 1989). Boron results were provided by the laboratory as part of a broad scan for metals; there was no historical discharges or industrial uses of boron that preceded those analyses (Oliges 1995). Boron is not a priority pollutant, nor is it included as an analyte under the Contract Laboratory Program (CLP). Thus, evidence of site history indicating boron contamination, boron toxicity observed at the site, or evidence of a significant source of boron at Moffett Federal Airfield would be needed to justify the additional cost of adding this analyte to the those included in the SWEA.

Boron is also not included in programs such as the San Francisco Estuary Regional Monitoring Program for Trace Substances (SFEI 1994) or monitoring studies undertaken by the Regional Water Quality Control Board. Hence, reference data on typical concentrations of boron in SF Bay sediments are not readily available. However, as noted in the Phase I SWEA, natural boron concentration in soil is typically between 10 and 300 mg/kg (Sprague 1972); 2 and 270 mg/kg (Bowen 1979); and 2 and 130 mg/kg (Dragun 1988). Moreover, naturally elevated boron levels are associated with marine sediments and seawater and natural postglacial marine sediments with boron content up to 500 mg/kg (dry weight) have been observed (Ahl and Jonsson 1972). The greater of the two boron concentrations found in shallow sediment at Moffett Federal Airfield was

76.8 mg/kg (dry weight) (0.5-1 foot bgs), a concentration that does not indicate an anthropogenic source.

For plants, the range between deficiency and toxicity in soils is probably narrower for boron than for any other element (Bohn and others 1979; Mengel and Kirkby 1982). As noted by the State, page K-42 of the Phase I SWEA Report indicates that "uptake and accumulation of boron by plants can result in extremely high boron levels, including those plants used by waterfowl for food." However, it should be noted that these observations apply to specific environmental conditions. Boron toxicity has most frequently been observed to result from increased availability for plant uptake resulting from irrigation of arid agricultural regions (Eisler 1990; Bohn and others 1979; Mengel and Kirkby 1982). This is not the case at Moffett Federal Airfield. Generally less than 5 percent of boron in soil is available for plant uptake (Calow 1994). According to Elseewi and Elmalky (1979), plant-available boron accounts for less than 1 percent of total soil boron.

Based on the above information, significant accumulation of boron in plants is not anticipated to have occurred at Moffett Federal Airfield. Therefore, assuming negligible levels of boron accumulated in food sources, the significant route of exposure of the rat to boron would be via incidental ingestion of sediment containing boron. The maximum boron concentration detected in sediment was 76.8 mg/kg. Using that maximum concentration and assuming that the rat's body weight is approximately 250 g (Burt and Grossenheider 1976), the rat would have to incidentally ingest 57 g of boron-containing sediment per day to obtain the NOAEL dose of 17.5 mg/kg body weight-day (see Attachment A for calculations). Given a food intake rate of 14 g/day, the rat would need to consume more than 400 percent of its diet as boron-containing soil to reach the NOAEL dose. Therefore, toxic effects from incidental soil ingestion are not anticipated.

The State noted that boron is embryotoxic to avian species. This toxicity has been observed in studies where boron was delivered by direct injection to domestic chicken eggs (Eisler 1990). The ecological relevance of these findings is not clear. More relevant information is that diets containing as little as 30 mg B/kg of feed (fresh weight) fed to mallard adults adversely affected the growth rate of their ducklings (Smith and Anders 1989). Eisler (1990) notes these results in the context of potential concerns about boron content of agricultural drainwater.) The primary food source for female adult mallards during the breeding season is invertebrates (EPA 1993). The information on uptake of boron in aquatic invertebrates is limited, but no data were found to suggest unusual levels bioaccumulation. Therefore, the major source of boron in the adult's diet is expected to be incidental ingestion of sediment. Assuming that all soil consumed contained the maximum boron concentration detected at the site (76.8 mg B/kg soil), a mallard would have to consume 30 grams of soil per day to reach the toxic boron dose of 2.33 mg B per day (see Attachment A for calculations). Using the EPA (1994) equation to calculate food ingestion rate for the mallard results in an ingestion rate of 62 grams of food per day. Thus, the

mallard would have to consume 48 percent of its diet as soil to reach the toxic dose for boron. The actual estimated percent soil in the mallard diet is less than 2 percent (EPA 1994). There is no evidence to suggest that the 30 mg B/Kg feed dose would be reached with the concentrations measured in sediment at Moffett Federal Airfield.

Comment No. 3: **Information presented in Appendix K indicates cobalt accumulates in birds, crustaceans, mollusks and other bottom feeders, and in some terrestrial plants. The ATSDR toxicity profile (1992c) indicates cobalt is toxic to laboratory animals at low doses; a NOAEL of 0.05 mg/kg-d is developed for intermediate length exposures based on hematological, immunological and neurological effects in the rat. Cobalt also is associated with serious developmental effects in the rat. Due to the presence of special status birds and mammals at NAS Moffett Field, cobalt should be retained as a COEC.**

MW Response: Including cobalt as a COPEC in the Phase II SWEA is not recommended. This recommendation is based on the lack of a documented source of cobalt, the distribution of cobalt in soil over various depth ranges, and the site-specific conditions that are unfavorable to significant accumulation of cobalt. More than 600 soil samples (0 to 10 feet bgs) have been analyzed for cobalt at Moffett Federal Airfield. After review of these data no sink or source of cobalt at Moffett Federal Airfield was identified. The presence of special status birds and mammals without a source of cobalt does not warrant retaining cobalt as a COPEC.

Cobalt is a naturally occurring metal found in rocks, soil, surface, and groundwater. Important natural sources of cobalt include seawater (ATSDR 1992). Cobalt is used in industry to make metal alloys, as a drier or pigment for paint, in porcelain enameling (ATSDR 1992). There is no record of cobalt use at Moffett Federal Airfield and cobalt was not identified as a chemical of concern associated with any of the Installation Restoration Program (IRP) sites.

Cobalt levels observed at Moffett Federal Airfield are consistent with reference levels found in the literature and do not indicate evidence of discharge. Naturally occurring cobalt is present in concentrations ranging from 0.05 to 65 mg/kg (Bowen 1979), and 1 to 40 mg/kg (Dragun 1988; ATSDR 1992). Cobalt was present in surface soil or sediment from Moffett Federal Airfield at concentrations ranging from 3.8 to 36 mg/kg. Mean cobalt concentrations from various sediment sampling stations in San Francisco Bay ranged from 11.1 to 19.7 mg/kg (Flegal and others 1994). The mean concentration in sediment at Moffett Federal Airfield was 16.6 mg/kg.

Cobalt concentrations also were not elevated in surface soil indicating an historical discharge. As presented in the subject report, cobalt concentrations in wetland sediment (0 to 3 feet bgs) ranged from 6.5 to 39 mg/kg (mean: 15.2 mg/kg). Cobalt concentrations in deeper wetland sediments (3 to 10 feet bgs) ranged from 13.8 to 21.2 mg/kg (mean: 17.4 mg/kg). Cobalt concentrations in upland surface soil (0 to 3 feet bgs) ranged from 3.8 to 36 mg/kg (mean: 16.2

mg/kg). Cobalt concentrations in deep upland soil (3 to 10 feet bgs) ranged from 3.6 to 34.4 mg/kg (mean: 15.6 mg/kg).

Figure 1 is a series of frequency histograms of the concentration of cobalt in the wetlands (0 to 3 feet bgs and 3 to 10 feet bgs) and uplands (0 to 3 feet bgs and 3 to 10 feet bgs). Cobalt is normally distributed at Moffett Federal Airfield, and the frequency histograms for the shallow and deeper soils in the uplands suggest that there has been no anthropogenic introduction of cobalt at the surface, as discussed previously. Cobalt is probably also normally distributed in the wetlands; this is not completely apparent for the deeper wetlands sediments because of the relative small number (12) of samples. Because of the limited sampling at depth in the wetlands, the "tails" of the distribution are missing. However, the concentrations of cobalt found in this small data set are in an expected range: approximately 65 percent of all concentrations in the upland soils fall within the range of concentrations found for the deeper wetland sediments. The distribution of cobalt concentrations is skewed slightly toward lower concentrations; this is an artifact resulting from samples with non detected concentrations of cobalt. (The detection limit in most cases was 16 mg/kg - one half the detection limit was used in constructing the frequency histograms.

Bioavailability of cobalt is low and deficiency in plants occurs where soils are peaty (Mengel and Kirkby 1982). The wetland areas of Moffett Federal Airfield are highly organic, peaty soils (Casagrande 1948), hence availability of cobalt in wetland areas is anticipated to be low.

As noted by the State, the ATSDR toxicity profile (1992) indicates cobalt is toxic to laboratory animals at low doses; a NOAEL of 0.05 mg/kg-d is developed for intermediate length exposures based on hematological, immunological and neurological effects in the rat. Using conservative exposure assumptions similar to those detailed in response to Comment No. 2, a rat would have to consume 2 percent of its diet as soil containing cobalt each day for 7 months to reach the NOAEL dose of 0.05 mg/kg-d (see Attachment A for calculations). This incidental ingestion rate is within the range for mammals cited by EPA (1994). Thus, it appears that naturally occurring cobalt could pose a risk for mammals exposed via incidental ingestion when variations in the type of cobalt, absorption rates, and nutritional status of the animal are not accounted for.

Comment No. 4: **Manganese is not listed as a COEC in Table ES-1, even though page 6-18 clearly indicates levels in the sediments found on the eastern portion of the base are significantly elevated above background (up to 6,650 mg/kg). Page K-65 of Appendix K states "... [it is proposed] that manganese be further evaluated in Phase II by performing mathematical calculations of exposure based on assumed or established exposure factors. The State agrees that manganese should be retained as a COEC, and further evaluated in Phase II. The ATSDR document on manganese (1992a) indicates an oral NOAEL in rat of 1 mg/kg-day, based upon neurological effects, and an oral LOAEL of 13 mg/kg-d based on male reproductive effects in the rat. Since an**

endangered rodent, the Salt-marsh Harvest Mouse, is known to inhabit NAS Moffett Field, manganese should be retained as a COEC.

MW Response: Table ES-1 was intended to contain manganese and will be modified to include manganese as a COC. Manganese will be included primarily because an area of elevated sediment concentrations was identified at the west end of the Northern Channel and Navy Ditch. However, it should be noted that these sediments were collected under standing water (even during the dry season) and are therefore unavailable to rodents. Moreover, salt marsh harvest mouse habitat was identified on the other side of the runways from the area found to contain elevated manganese. Therefore, exposure of the salt marsh harvest mouse to levels of manganese identified in Northern Channel and Navy Ditch is not anticipated.

Comment No. 5: **Information in Appendix K indicates molybdate is readily accumulated by plants; indeed the literature documents livestock toxicity from molybdenum under certain soil conditions. As Appendix K indicates, molybdenum is also embryotoxic to some avian species; however, Eisler cites an optimal growth level for aves of 6 mg/kg in the diet, which is considerably less than values cited in Appendix K. IRIS (U.S. EPA, 1994) cites a LOAEL in the rate of 7.5 mg/kg-d based upon weight loss and bone deformities after only a 6 week exposure. Due to the presence of special status birds and mammals at NAS Moffett Field, molybdenum should be retained as a COEC.**

MW Response: Including molybdenum as a COPEC in the Phase II SWEA is not recommended. This recommendation is based on the lack of a documented source of molybdenum, the site-specific conditions that are unfavorable to significant accumulation of molybdenum, and the relatively low toxicity of molybdenum.

A significant bioavailable source of molybdenum must be present in the environment to cause toxicity. Molybdenum is an essential metal that is used as an enzyme cofactor in mammalian systems (Amdur 1991). Molybdenum is also essential for nitrogen fixation and protein synthesis in plants (Amdur 1991). The majority of molybdenum is used in the manufacture of jet engines, production of catalysts, lubricants, and dyes (Amdur 1991). Moffett Federal Airfield is an aircraft light maintenance facility; aircraft were not manufactured at Moffett. There is no record of molybdenum use at Moffett Federal Airfield and molybdenum was not identified as a chemical of concern associated with any of the IRP sites.

Molybdenum occurs naturally in seawater (Eisler 1989). Molybdenum is not included in programs such as the San Francisco Estuary Regional Monitoring Program for Trace Substances (SFEI 1994) or monitoring studies undertaken by the Regional Water Quality Control Board. Hence, reference data on typical concentrations of molybdenum in San Francisco Bay sediments are not readily available. However, as noted in the Phase I SWEA, natural molybdenum concentration in soil is typically between 0.1 and 40 mg/kg (Bowen 1979) and 0.2 and 5 mg/kg (Dragun 1988). The greatest molybdenum concentration found

in shallow sediment at Moffett Federal Airfield was 16.1 mg/kg (dry weight) (0.5 to 1 foot bgs); the greatest molybdenum concentration found in upland soil was 5.1 mg/kg (0 to 3 feet bgs). These concentrations do not appear to indicate an anthropogenic source.

The soil conditions resulting in molybdenum toxicity to livestock are alkaline soils high in molybdenum and low in copper or near industrial point sources such as coal, aluminum, uranium, or molybdenum mines; steel alloy mills; or oil refineries (Eisler 1989). These conditions do not exist at Moffett Federal Airfield.

The State cites an optimal growth level for birds of 6 mg/kg in the diet (Kienholz 1977). However, the same author noted that birds are relatively resistant to molybdenum with day-old chicks showing no effect when fed a diet containing 20 percent molybdenum mine tailings. Molybdenum (Mo) levels of 200 mg Mo/kg feed results in minor growth inhibition in chicks. This level was used as a surrogate toxicity level for calculation of the likelihood of effects on mallards. The major source of molybdenum in the adult mallard diet is expected to be incidental ingestion of sediment. Assuming that all soil consumed contained the maximum boron concentration detected at the site (16.1 mg Mo/kg soil), a mallard would have to consume 1390 grams of soil per day to reach the toxic dose of 22.4 mg Mo per day (see Attachment A for calculations). Using the EPA (1994) equation to calculate food ingestion rate for the mallard results in an ingestion rate of 55.6 grams of food per day. Thus, the mallard would have to consume 2,500 percent of its diet as soil to reach the toxic dose for molybdenum. The actual estimated percent soil in the mallard diet is less than 2 percent (EPA 1994). There is no evidence to suggest that the 200 mg Mo/kg feed dose would be reached with the concentrations measured in sediment or soil at Moffett Federal Airfield.

Based on the above information, significant accumulation of molybdenum in plants is not anticipated to have occurred at Moffett Federal Airfield. Therefore, assuming negligible levels of molybdenum accumulated in food sources, the significant route of exposure of the rat to molybdenum would be via incidental ingestion of sediment containing molybdenum. The maximum molybdenum concentration detected in sediment was 16.1 mg/kg. Using that maximum concentration and assuming that the rat's body wight is approximately 250 g (Burt and Grossenheider 1976), the rat would have to incidentally ingest 116 g of molybdenum-containing sediment per day to obtain the LOAEL dose of 7.5 mg/kg body weight-day (see Attachment A for calculations). Given a food intake rate of 14 g/day, the rat would need to consume more than 800 percent of its diet as molybdenum containing soil to reach the LOAEL dose. Therefore, toxic effects from incidental soil ingestion are not anticipated.

Comment No. 6: **Appendix K indicates vanadium is "toxic to animals when fed in excess, and toxic effects are noted at levels only somewhat higher than therapeutic levels. Vanadium toxicity is intensified by high dietary zinc." Due to the small margin of safety between therapeutic levels and toxic levels, and because zinc**

is a COEC, vanadium should be retained as a COEC. No calculations are provided in Appendix K to support the statement on page K-81 "...the actual dose to mammalian site receptors is anticipated to be significantly lower than environmental concentrations observed because vanadium will be only a portion of soil incidentally ingested and because no food chain effects are anticipated." Calculations comparing estimated doses to receptors at NAS Moffett should be compared to literature values as part of the Phase II assessment. The State also notes that page K-77 indicates vanadium was detected in groundwater samples near the landfills up to 263 μg/L. This level is within a factor of two to acutely toxic levels in aquatic bioassays cited on page K-78, in which 50% of the test organisms died after only 9 days of exposure. Such a small margin between observed concentrations and those demonstrated to be lethal after acute exposures, strongly indicates vanadium should be retained as a COEC.

MW Response: Including vanadium as a COPEC in the Phase II SWEA is not recommended. A significant bioavailable source of vanadium must be present in the environment to cause toxicity. Vanadium is naturally present in soils and seawater. Vanadium is used as a catalyst in the chemical industry, for steel hardening, in the manufacture of pigments, in photography, and in certain insecticides (Amdur and others 1991). There is no record of vanadium use at Moffett Federal Airfield and vanadium was not identified as a chemical of concern associated with any of the IRP sites.

The potential for the presence of vanadium as a by-product in petroleum wastes discharged at Moffett Federal Airfield was also reviewed. Vanadium is present in crude oil, but is removed during the distillation process. Distillate products such as motor oil, JP-5, gasoline, and diesel fuel generally do not contain significant concentrations of vanadium. This information was confirmed by reviewing a scattergram of vanadium concentrations versus motor oil concentrations in upland and wetland soil; no correlation was observed (Attachment A).

Natural vanadium concentrations in soil are typically between 3 and 500 mg/kg (Bowen 1979) and 20 and 500 mg/kg (Dragun 1988). The maximum vanadium concentration found in shallow sediment at Moffett Federal Airfield was 200 mg/kg (dry weight); the maximum vanadium concentration found in shallow upland soil was 152 mg/kg. The mean vanadium concentration in soil has been reported as 100 mg/kg (Vinogradov 1959, as cited in Lepp 1981); mean vanadium concentrations from various sediment sampling locations in San Francisco Bay ranged from 41.5 to 80.6 (Flegal 1994). Mean vanadium levels at Moffett Federal Airfield (75 mg/kg in wetland surface sediments and 62 mg/kg in upland surface soil) are below those cited for natural soils and for San Francisco Bay. The concentrations present at Moffett Federal Airfield are not indicative of an anthropogenic source when compared with reference literature.

The Navy and the regulatory agencies agreed to the scope of work for Appendix K, toxicity profiles, and the scope did not include detailed calculations. (See

response to General Comment No. 4 above.) However, clarification and additional information supporting the conclusions presented on page K-81 is presented below.

In a study conducted with chicks, zinc added at 515 mg/kg of diet had no effect on vanadium toxicity (Hill 1990). In mammalian systems, vanadium toxicity has been reported to be intensified by high dietary zinc (Molfino 1938). No additional information on the doses at which vanadium toxicity is intensified could be located. Soil concentrations at the upper end of the distributions for zinc and vanadium at Moffett Federal Airfield were not co-located (see Figure 2, Attachment A to this submittal). Therefore, although zinc is a COPEC, no effect on vanadium toxicity is anticipated in areas with elevated zinc concentrations.

Vanadium is an essential trace element for plants and certain animals. As noted in the profile, plants accumulate vanadium to a very small degree. Therefore, accumulation in food sources for the rat is not anticipated. The major source of vanadium to the rat is expected to be incidental ingestion of soil. This is also supported by information presented in the profile that indicates that the major source of vanadium (90 percent) for another herbivorous mammal, the jack rabbit, is soil.

Incidental ingestion of vanadium was evaluated using the same approach shown for boron in Response to Specific Comment No. 2 Wetland Sediments (Attachment A). The no-observed effect levels (NOELs) for maternal toxicity and for developmental toxicity to mice were respectively 7.5 and 15 mg/kg/d of sodium orthovanadate administered by gavage on gestational days 6 through 15 (Sanchez and others 1991, as cited in Domingo 1994). Using the NOEL of 7.5 mg/kg/d and a body weight of 11 grams (Burt and Grossenheider 1976), the mouse would have to incidentally ingest 0.4 g of vanadium-containing sediment per day to obtain the NOEL dose. Given a food intake rate of 2.4 g/day, the mouse would need to consume 17 percent of its diet as vanadium containing soil to reach the 0.4 g dose. This is well above the 2 to 10 percent range for incidental soil ingestion by mammals from EPA 1994. Therefore, toxic effects from incidental soil ingestion are not anticipated.

The State notes that page K-77 indicates vanadium was detected in groundwater samples near the landfills up to 263 μg/L. The State also noted that this level is within a factor of two to acutely toxic levels in aquatic bioassays cited on page K-78 (lower end of cited range was 500 μg/L), in which 50 percent of the test organisms died after 9 days of exposure. It should be noted that aquatic organisms are not directly exposed to concentrations detected in groundwater and the maximum concentration detected in surface water was an order of magnitude lower than the maximum detected in groundwater and more than an order of magnitude below the acute toxicity levels cited. The surface water data were also for unfiltered samples; bioavailable vanadium will only be a portion of the total vanadium detected. It is also important to note that vanadium is a naturally occurring metal in seawater and is an essential element for marine organisms.

Comment No. 7: **Chlordane (alpha and gamma isomers) should be retained as COECs based upon their toxicity to aquatic, avian and mammalian species, their persistence and bioaccumulation potential, and their occurrence in 25% of the sediment samples. As noted in our comments of August 24, 1994, levels of these compounds in sediments exceed ER-L values.**

MW Response: The Navy concurs with the State's recommendation to retain chlordane based on persistence. Appendix K and Table ES-1 will be modified to reflect this change.

Comment No. 8: **Azinphos-methyl is eliminated based on "low toxicity," but information on this compound is not provided in Appendix K. This compound is an organophosphate insecticide which is persistent, with a water solubility of 33 ppm (Hayes and Laws, 1991). Data cited in Smith (1987) indicates traces of azinphos-methyl at levels still toxic to insects, were detected in a agricultural field 2 years after application. Hudson, et al. (1984) cite a dose of between 4.38 and 8.75 mg/kg-day as the lowest dose that produced a few deaths after only 30-day dietary exposure in mallards; this reference also indicates azinphos-methyl has a "relatively high degree of cumulative action" for azinphos-methyl in mallards. Both oral and dermal acute toxicity in mouse and rat have been demonstrated for this pesticide (Hayes and Laws, 1991). This compound was detected in over 5% of the sediment samples at NAS Moffett Field, with a maximum value of over 7 mg/kg detected. Azinphos-methyl should be retained as a COEC because of it's persistence, the potential for localized areas of high concentration, and the potential for acute toxicity in aquatic, avian and mammalian species.**

MW Response: During the Phase I SWEA, the potential for localized areas of high concentration was evaluated for all chemicals detected at Moffett Federal Airfield. Any chemical that was detected at elevated concentrations in localized distribution was retained as a COC. This was discussed in detail in Section 6.0 of the subject report. Azinphos-methyl was detected in 3 sediment samples (SSNC-003, SSND-001, and SSRP-013) (out of 53 samples) that were more than 3,000 feet apart and located in geographically distinct wetland areas; therefore, there are no localized areas of high azinphos-methyl concentrations. The maximum detected concentration was 270 μg/kg.

All detected concentrations were qualified as estimated and tentatively identified. The tentative identification of Azinphos-methyl was noted by Terra West (the data validation firm) by use of the flag "J-T." The following comment was noted by Terra West in the validation summary report:

> The positive hits for Azinphos-methyl and Coumaphos were the result of several peaks coeluting near the end of the run. The %D between the 2 columns for several of these detects was >25%. The lab indicated in the case narrative that the detects may be the result of a matrix interference. All detects for Azinphos-methyl and Coumaphos were qualified J-T.

In essence, a peak eluted within the appropriate retention time windows for Azinphos-methyl on both the primary and secondary columns; however, the percent difference for the quantitation of the peak area on the primary and secondary columns was greater than 25 percent, indicating a potential misidentification of the peak as Azinphos-methyl.

Based on the qualification made by Terra West and the comments noted in the laboratory case narrative regarding matrix interference in the retention time window for Azinphos-methyl, Montgomery Watson believes that Azinphos-methyl was incorrectly identified as being present in the samples because of matrix interference. However, Bart Simmons of EPA/DTSC will be performing an independent assessment of the data. The laboratory (Quanterra, formerly IT Corporation) has been contacted for information, and the sample chromatograms are in the process of being retrieved. This package will be sent under separate cover to Bart Simmons.

As noted in Smith (1987), the potential for this pesticide to cause wildlife problems under field conditions has either not been realized or has gone largely undetected or unreported. Azinphos-methyl has a low predicted bioconcentration factor and was not detected in surface water at Moffett Federal Airfield, therefore the major route of exposure is expected to be via contact with the sediment. The areas where Azinphos-methyl was detected are under standing water most of the year and are therefore inaccessible to terrestrial biota. Insects were present in sediment collected from the areas were azinphos methyl was detected indicating that levels toxic to insects are no longer present.

Comment No. 9: **Various semi-volatile compounds (all except the PAHs) have been eliminated as COECs in Table ES-1. However, footnote "c" in Table 6-1 states these chemicals will be retained as tentative COECs "...in the Phase I SWEA until further evaluation of the reporting limits, which will be conducted in the Phase II SWEA Work Plan." These compounds should be retained as COECs in the Phase I SWEA until information is provided in the Phase II SWEA Work Plan on the distribution of detection limits to show there are not sources or sinks of these compounds.**

MW Response: Table ES-1 will be modified to include a footnote consistent with that presented in Table 6-1. The chemicals will be retained as tentative COCs until further evaluation of detection limits in the Phase II SWEA Work Plan.

Comment No. 10: **PAHs are not listed as COECs in Table ES-1. This is not consistent with the agreed upon criteria, nor is it consistent with Footnote "a" in Table 6-1, which states "... all PAHs are retained as tentative COECs in the Phase I SWEA until further evaluation in the Phase II SWEA Workplan."**

MW Response: Table ES-1 will be modified to include a footnote consistent with that presented in Table 6-1. The PAHs will be retained as tentative COCs until further evaluation of detection limits and selection of one or more indicator PAHs, as appropriate, during the Phase II SWEA.

B. LANDFILL SOIL

Comment No. 1: **According to the regulatory agencies letter dated May 6, 1994, semivolatile organic compounds (SVOC/polynuclear aromatic hydrocarbons (PAH), pesticides/polychlorinated biphenyls (PCB) and metals were found in the soils should be retained as COECs in the Phase I SWEA and into the Phase II assessment. However, it is understood that the Navy is proposing to remedy Site 1 and 2 with soil capping, access restrictions (Draft Final Feasibility Study in review) to contain contamination in the two landfills. Therefore, the State may decide that no further assessment for the above mentioned chemicals will be required in the Phase II SWEA. The Navy should clarify that long-term monitoring program and deed restrictions will be implemented for all three landfills. Volatile organic compounds (VOC) should be retained as COECs in the Phase II to address the concerns of the burrowing animals.**

MW Response: As discussed in the Draft Final Feasibility Study (PRC 1994), capping of both of the OU 1 landfills is proposed and will interrupt potential exposure pathways. The need for long-term monitoring and deed restrictions will be evaluated as part of the feasibility study and remedial action plans developed for all three landfills. VOCs will be retained as COCs to address the potential exposure of burrowing owls in the non-landfill uplands. The landfills do not offer suitable habitat for burrowing owls (PRC and Montgomery, 1994).

Comment No. 2: **Bis(2-ethylhexyl)phthalate, di-n-butylphthalate, and 4-methylphenol are eliminated as COECs based upon "low toxicity". The information presented in Appendix K is insufficient for the reasons stated in the general comments. These compounds should be retained as COECs in the Phase I SWEA.**

MW Response: See response to General Comment No. 4.

Comment No. 3: **Alpha and gamma chlordane, endosulfan sulfate, endrin ketone, and heptachlor are eliminated as COECs, according to the footnote in Table 7-1 due to "low toxicity". This contention is unsupported by the information provided in the draft final. These chlorinated pesticides are all detected in greater than 5 percent of the samples. These compounds all belong to the same class of chlorinated cyclodiene insecticides and are relatively persistent, lipid-soluble, and toxic to birds and mammals (Smith, 1984; Hayes and Laws, 1991). Amdur, et al. (1991) summarize this class of insecticides as: "The chlorinated cyclodiene insecticides are among the most toxic and environmentally persistent pesticides known... Even at low doses, these chemicals tend to induce convulsions before less serious signs of illness occur". The information presented in Appendix K is insufficient for the reasons stated in the general comments. These compounds should be retained as COECs in the Phase I SWEA.**

MW Response: See response to Specific Comment No. 7 Wetland Sediments. Chlordane will be retained as a COPEC for Phase II. See also response to Comment No.1 Landfill Soil, and response to General Comment No. 4.

Comment No. 4: **PAHs should be retained as COECs. Table 7-1 indicates the diesel and motor oil fractions of the TPH-extractables were detected in greater than 5 percent of the samples, therefore all PAHs associated with these fractions should be assessed in Phase II. Refer to the above Comment A.6 (sic).**

MW Response: See response to Comment No. 1 Landfill Soil, and response to Comment No. 10 Wetland Sediment.

Comment No 5: **Cobalt, manganese, and vanadium should be retained as COECs, unless they can be shown to be within background. Refer to the above Comment A.1.**

MW Response: See response to Comment No. 1 Landfill Soils, response to Comment No. 3 Wetland Sediments, Comment No. 4 Wetland Sediments, and Comment No. 6 Wetland Sediments.

Comment No. 6: **All VOCs are eliminated as COECs in Table ES-1, but the footnote "1" in Table 7-1 indicates the risk to burrowing animals from VOCs in the burrows will be evaluated in the Phase II SWEA report. With regard to Section 7.2.2, the State disagrees that toluene is the only COEC, and we disagree that only air concentrations of less than 5 mg/m^3 should be evaluated in Phase II. Theoretical calculations in this section indicate the burrow concentrations of toluene could be as high as 430 mg/m^3. The more conservative estimate should be used in Phase II, absent specific analysis of VOC concentrations in animal burrows or from soil-gas measurements. Refer also to our comments below in C.3.**

Table 7-1 lists several VOCs, present in greater than 5 percent of the landfill samples. The VOCs listed in Table 7-1 must be COECs for evaluating the inhalation pathway to burrowing animals in Phase II.

MW Response: Please see response to Comment No. 1 Landfill Soil. Capping proposed during the feasibility study is planned to eliminate complete exposure pathways between chemicals in the landfills and receptors. Moreover, the landfills do not offer significant habitat for burrowing owls because the owls require an open field of vision to watch for predators. At the landfills their vision is obstructed by high grasses.

Theoretical calculations in Section 7.2.2.2 indicate that concentrations of toluene <u>in the burrows</u> could be as high as 5 mg/m^3. Calculations also indicate that concentrations of toluene <u>in soil gas (unlikely within the burrow space)</u> could be as high as 430 mg/m^3. Thus, for exposures in the burrow, 5 mg/m^3 is the calculated upper-bound estimate.

The Navy is currently reviewing options for characterizing VOC exposure of the burrowing owl in the non-landfill upland areas and related risk. One approach under consideration is the use of passive soil gas measurements. The final methods used to evaluate risk to the burrowing owls will be selected during meeting with the regulatory agencies.

C. UPLAND SOIL

Comment No. 1: **Boron, manganese, cobalt, vanadium, and molybdenum should be retained as COECs. Refer to the above Comment A.1.**

MW Response: Please see responses to Wetland Sediment Comments No. 2, No. 3, No. 4, No. 5, and No. 6.

Comment No. 2: **PAHs should be retained as COECs. Table 7-4 indicates all of the TPH-extractable fractions were found in upland soils in greater than 5 percent of the samples, therefore all associated PAHs should be assessed in Phase II. Refer also to Comment A.6 above.**

MW Response: Please see response to Comment No. 10 Wetland Sediment.

Comment No. 3: **All VOCs are eliminated as COECs in Table ES-1, but the footnote "1" in Table 7-4 indicates the risk to burrowing owl from VOCs in the burrows will be evaluated in the Phase II SWEA report. We also disagree with Table 7-15 on the elimination of potential exposure pathways to fauna from VOCs and volatile components of petroleum fractions, clearly burrowing animals may be exposed through the inhalation route. With regard to Section 7.2.2, the State disagrees that toluene is the only COEC, and we disagree that only air concentrations of less than 5 mg/m^3 should be evaluated in Phase II. Refer to our Comment B.5. above.**

MW Response: Please see response to Comment No. 6 Landfill Soil.

Comment No. 4: **We also question the rationals (sic) described on page 7-10, which restricted analysis of toluene and total petroleum hydrocarbons in soil samples to within a certain distance of known burrowing owl locations. All upland and landfill areas which appear to be suitable habitat should be evaluated.**

MW Response: The Moffett database was queried for information on toluene and total petroleum hydrocarbons because toluene was the chemical detected in the highest concentration in soil gas and because the presumed source of the toluene was petroleum hydrocarbons. The 290-foot radius around the identified burrows was established based on communication with Lynne Trulio, San Jose State biologist, regarding the territory of burrowing owls at Moffett Federal Airfield.

The Navy is currently reviewing options for characterizing VOC exposure of the burrowing owl in the non-landfill upland areas and related risk. One approach under consideration is the use of passive soil gas measurements. The final

methods used to evaluate risk to the burrowing owls will be selected during meeting with the regulatory agencies.

Comment No. 5: **The statement on page 8-15, "... the volatile organics detected (in landfill upland soils) are of limited concern given their expected short residence time in this media and most biota's ability to metabolize and excrete these compounds from their systems", is without scientific foundation and must be eliminated from the final Phase I SWEA. The fact that these VOCs are detected in this media long after disposal indicates their residence time is not short and/or there is a source of VOCs in the landfill. Further, the fact these compounds may be metabolized and excreted does not mean that they are not toxic while in the animal's system. Many of these compounds have been found to be toxic to a variety of laboratory animals upon inhalation.**

MW Response: The statement referenced above will be deleted from the Phase I SWEA. Page 8-15 will be revised to read "VOCs were detected in soils sporadically and at generally low concentrations (Table 7-1). VOCs may be sorbed to soils that act as a long-term reservoir. Desorption into the soil vapor results in resorption or diffusion into the atmosphere. Based on the facile diffusion, low concentrations, and the lack of potential for bioaccumulation, the VOCs in soils appear to be of limited concern relative to other contaminants present at the site." Also, please see response to Comment No. 6 Landfill Soil.

Comment No. 6: **JP-5 has a maximum detected value of 6,700 mg/kg in soil. Specific attention should be given to the location and depth of these "hot" spots in relation to burrowing owl habitat. We also note that there are high levels (greater than 5,000 μg/L) of TCE in the shallow groundwater that may also contribute to contaminated vapors in animal burrows.**

TCE and its breakdown products, the other VOCs listed in Table 7-4, and JP-5 and its constituents should be COECs for evaluating the inhalation pathway to burrowing animals.

MW Response: Please see response to Comment No. 6 Landfill Soil.

SUMMARY

Comment No. 1: **The above comments summarize the compounds which should be added to the list of COECs in the final Phase I SWEA, and that should be evaluated further in the Phase II SWEA. The general approach by the Navy in identifying COECs has been focused on excluding chemicals of concern, unless a good reason is provided to retain the chemical. However, it is the State's perspective that detection of these compounds is evidence of discharge, and therefore the emphasis in Phase I should be on eliminating only those compounds which clearly do not pose a hazard. The State believes this fundamental difference in perspective is largely responsible for the protracted discussions between the Navy and the regulatory agencies on COECs.**

MW Response: It is the Navy's position that the detection of a constituent is not evidence of discharge or an anthropogenic release. Cations and trace metals exist in soils and sediments naturally and some organic compounds are the result of plant and animal decay in wetland environments. Trace metal concentrations need to be evaluated in the context of background concentrations, ranges of concentrations typically associated with non impacted soils, or the spatial distribution of metals at a site. For the trace metals not retained as COPECs in the Phase I SWEA report, the analytical data did not suggest that there was a discharge or release and no other corroborating evidence was found to support that hypothesis.

The Navy is committed to the protection of human health and the environment at Moffett Federal Airfield and all other Navy facilities. This mission can only be accomplished through the judicious, prudent, and responsible application of limited resources to the investigation and remediation of critical sites as determined through appropriate science and engineering. The Navy is also committed as always to work in partnership with the regulatory agencies and other Natural Resource Trustees.

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ATTACHMENT A

BORON

SURFACE SOIL INGESTION CALCULATIONS - MAMMALS

ASSUMPTIONS:

1. Calculations using the rat can provide an indication of risk to small mammals as a group.

2. Boron has not significantly accumulated in plants under the environmental conditions at Moffett Federal Airfield (see Eisler 1990; Bohn and others 1979; Mengel and Kirkby 1982). Therefore, the most significant route of exposure is incidental soil or sediment ingestion.

VARIABLES:

1. NOAEL dose for rat: 17.5 mg B/kg - day (ATSDR 1992; reference provided by DTSC)

2. Rat weight: 250 grams (Burt & Grossenheider 1976)

3. Maximum concentration in sediment: 76.8 mg B/kg soil

4. Incidental soil ingestion for mammals is 2 to 10 percent of total food intake (EPA 1994)

CALCULATIONS:

(NOAEL) (weight of rat) = toxic boron dose/day

$$\frac{17.5\ mg\ B}{kg\text{-}day}\ (0.25\ kg) = 4.37\ mg\ B/day$$

X = Incidental ingestion to obtain dose = $\frac{toxic\ boron\ dose/day}{boron\ concentration}$

$$X = \frac{4.37 \frac{mg\ B}{day}}{76.8 \frac{mg\ B}{kg\ soil}} = \left(0.057\ \frac{kg\ soil}{day}\right)\left(\frac{1000\ g}{1\ kg}\right) = \frac{57\ g\ soil}{day}$$

FI = Food Intake

$$FI\ (g/day) = 0.621\ Wt^{0.564} g \text{ (for rodents; EPA 1994, page 3-6)}$$
$$= 0.621\ (250\ g)^{0.564} = 14\ g\ total\ food\ ingested/day$$

INCIDENTAL SOIL INGESTION WOULD HAVE TO EXCEED 400 PERCENT OF TOTAL FOOD INGESTED EACH DAY TO REACH NOAEL DOSE. (SEE VARIABLE #4 FOR ACTUAL).

BORON

SURFACE SOIL INGESTION CALCULATIONS - BIRDS

ASSUMPTIONS:

1. Calculations using the mallard can provide an indication of risk to ducks as a group.

2. Boron has not significantly accumulated in plants under the environmental conditions at Moffett Federal Airfield (see Eisler 1990; Bohn and others 1979; Mengel and Kirkby 1982). No significant uptake of boron by invertebrates is anticipated. Therefore, the most significant route of exposure is incidental soil or sediment ingestion.

VARIABLES:

1. Adult mallard dose resulting in growth effects on ducklings: 30 mg B/kg feed (fresh weight) (Smith & Anders 1989).

2. Estimated percent soil ingested in mallard's diet = <2% (EPA 1994)

3. Maximum concentration in sediment (dry weight): 76.8 mg B/kg soil

4. Mallard's body weight (adult female in spring): 1,197 grams (EPA 1994, page 2-43)

CALCULATIONS:

FOOD INTAKE:

$$FI\ (g/day) = 0.301\ Wt^{0.751}(g) \text{ (for non-passerine birds; EPA 1994, page 3-5)}$$
$$= 0.301\ (1{,}197\ g)^{0.751} = 62\ g\ \textit{total dry weight food ingested/day}$$

Convert fresh weight boron concentration of concern in food to dry weight. Assume food is invertebrates (spring diet of female mallards; EPA 1994). Assume moisture content of invertebrates is 20%.

$$\text{Concentration}_{\text{dry-weight}} = \frac{\text{Concentration}_{\text{wet-weight}}}{(100 - \%\ \text{moisture}/100)}$$
$$= \frac{30\ \text{mg B/kg feed}_{\text{wet-weight}}}{(100 - 20/100)}$$
$$= 37.5\ \text{mg B/kg feed}_{\text{dry-weight}}$$

Grams of boron ingested per day that results in reduced growth:

$$37.5\ \frac{mg\ B}{kg\ feed}\left(62\frac{g}{day}\right)\left(\frac{1\ kg}{1000\ g}\right) = 2.33\ mg\ B/day$$

$$X = \text{Incidental ingestion to obtain dose} = \frac{\textit{toxic boron dose/day}}{\textit{boron concentration}}$$

$$X = \frac{2.33\ mg\ B/day}{76.8\ mg\ B/kg\ soil} = 0.03\ kg\ soil \left(\frac{1000\ g}{1\ kg}\right) = 30\ g\ soil/day$$

$$\frac{30\ g\ soil}{62\ g\ total\ food}\ X\ 100 =$$

48% of DIET WOULD HAVE TO BE SOIL
TO REACH TOXIC DOSE;
ACTUAL % SOIL IN DIET IS <2%.

COBALT

SURFACE SOIL INGESTION CALCULATIONS - MAMMALS

ASSUMPTIONS:

1. Calculations using the rat can provide an indication of risk to small mammals as a group.

2. Cobalt has not significantly accumulated in plants under the environmental conditions at Moffett Federal Airfield (see Mengel and Kirkby 1982).

VARIABLES:

1. NOAEL dose for rat: 0.05 mg/kg-d (ATSDR 1992)

2. Rat weight: 250 grams (Burt & Grossenheider 1976)

3. Maximum concentration in soil: 36 mg Co/kg soil

4. Incidental soil ingestion for mammals 2-10% of total food (EPA 1994).

CALCULATIONS:

(NOAEL) (weight of rat) = toxic cobalt dose/day

$$\frac{0.05\ mg\ Co}{kg\text{-}d}\ (0.25\ kg) = 0.01\ mg\ Co/day$$

$$X = \text{Incidental ingestion to obtain dose} = \frac{toxic\ cobalt\ dose/day}{cobalt\ concentration}$$

$$X = \frac{\dfrac{0.01\ mg\ Co}{day}}{\dfrac{36\ mg\ Co}{kg\ soil}} = \left(\frac{2.78\times10^{-4}\ kg\ soil}{day}\right)\left(\frac{1000\ g}{1\ kg}\right) = \frac{0.28\ g\ soil}{day}$$

$$FI\ (g/day) = 0.621\ Wt^{0.564} g \text{ (for rodents; EPA 1994, page 3-6)}$$
$$= 0.621\ (250\ g)^{0.564} = 14\ g\ total\ food\ ingested/day$$

$$\frac{0.28\ g/day}{14\ g/day}\ (100) =$$

2% of DIET WOULD HAVE TO BE SOIL TO REACH TOXIC DOSE.

MOLYBDENUM

SURFACE SOIL INGESTION CALCULATIONS - MAMMALS

ASSUMPTIONS:

1. Calculations using the rat can provide an indication of risk to small mammals as a group.

2. Soil conditions at Moffett Federal Airfield do not favor excessive uptake of molybdenum by plants. Alkaline soils have been associated with excessive uptake (Eisler 1989). The mean pH in upland soil (0.5 to 3 feet) was 8.2; the mean pH in wetland soil (0 to 0.5 feet) was 7.8.

VARIABLES:

1. LOAEL dose for rat: 7.5 mg Mo/kg - day (IRIS 1995; reference provided by DTSC)

2. Rat weight: 250 grams (Burt and Grossenheider 1976)

3. Maximum concentration in sediment: 16.1 mg Mo/kg soil

4. Incidental soil ingestion for mammals is 2 to 10 percent of total food intake (EPA 1994)

CALCULATIONS:

(LOAEL) (weight of rat) = toxic molybdenum dose/day

$$\frac{7.5\ mg\ Mo}{kg\text{-}day}\ (0.25\ kg) = 1.88\ mg\ Mo/day$$

X = Incidental ingestion to obtain dose = $\dfrac{toxic\ molybdenum\ dose/day}{molybdenum\ concentration}$

$$X = \frac{1.88\dfrac{mg\ Mo}{day}}{16.1\dfrac{mg\ Mo}{kg\ soil}} = \left(0.12\ \frac{kg\ soil}{day}\right)\left(\frac{1000\ g}{1\ kg}\right) = \frac{116\ g\ soil}{day}$$

FI = Food Intake

$$FI\ (g/day) = 0.621\ Wt^{0.564} g \text{ (for rodents; EPA 1994, page 3-6)}$$
$$= 0.621\ (250\ g)^{0.564} = 14\ g\ total\ food\ ingested/day$$

INCIDENTAL SOIL INGESTION WOULD HAVE TO EXCEED 800 PERCENT OF TOTAL FOOD INGESTED EACH DAY TO REACH LOAEL DOSE. (SEE VARIABLE #4 FOR ACTUAL).

MOLYBDENUM

SURFACE SOIL INGESTION CALCULATIONS - BIRDS

ASSUMPTIONS:

1. Calculations using the mallard can provide an indication of risk to ducks as a group.

2. It is appropriate to use chicks as a surrogate for the mallard to obtain toxicity data where none is available for the mallard.

3. Soil conditions at Moffett Federal Airfield do not favor excessive uptake of molybdenum by plants. Alkaline soils have been associated with excessive uptake (Eisler 1989). The mean pH in upland soil (0.5 to 3 feet) was 8.2; the mean pH in wetland soil (0 to 0.5 feet) was 7.8.

VARIABLES:

1. Dose resulting in growth reduction for chicks (surrogate for mallard): 200 mg/kg diet (fresh weight assumed).

2. Estimated percent soil ingested in mallard's diet = < 2% (EPA 1994).

3. Maximum concentration in soil or sediment: 16.1 mg/kg dry weight.

4. Mallard's body weight (adult female) = 1,043 grams (EPA 1994, page 2-43).

CALCULATIONS:

$$FI\ (g/day) = 0.301\ Wt^{0.751}(g) \text{ (for non-passerine birds; EPA 1994, page 3-5)}$$
$$= 0.301\ (1043\ g)^{0.751} = 55.6\ g\ \textit{total dry weight food ingested/day}$$

Convert fresh weight molybdenum concentration of concern in food to dry weight. Assume food is vegetation and moisture content is 50 percent.

$$\text{Concentration}_{\text{dry-weight}} = \frac{\text{Concentration}_{\text{wet-weight}}}{(100 - \%\ \text{moisture}/100)}$$
$$= \frac{200\ \text{mg kg}}{(100 - 50/100)}$$
$$= 400\ \text{mg Mo/kg feed}_{\text{dry-weight}}$$

Grams of molybdenum ingested per day that results in reduced growth:

$$400\ \frac{mg\ Mo}{kg\ feed}\left(55.6\frac{g}{day}\right)\left(\frac{1\ kg}{1000\ g}\right) = 22.4\ mg\ Mo/day$$

$$X = \text{Incidental ingestion to obtain dose} = \frac{\textit{toxic molybdenum dose/day}}{\textit{molybdenum concentration}}$$

$$X = \frac{22.4\ mg\ Mo/day}{16.1\ mg\ kg\ soil} = 1.39\ kg \left(\frac{1000\ g}{1\ kg}\right) = 1390\ g\ soil/day$$

$$\frac{1390\ g\ soil}{55.6\ g\ total\ food}\ X\ 100 =$$

2500% of DIET WOULD HAVE TO BE SOIL TO REACH TOXIC DOSE;
ACTUAL SOIL IN DIET IS <2%.

VANADIUM

SURFACE SOIL INGESTION CALCULATIONS - MAMMALS

ASSUMPTIONS:

1. Calculations using the laboratory mouse can provide an indication of risk to small mammals as a group.

2. Vanadium is not significantly accumulated in plants (see Appendix K of Phase I SWEA).

VARIABLES:

1. NOEL dose for mouse: 7.5 mg/kg - day (Domingo 1994).

2. Mouse weight: 11 grams (low end of range in Burt & Grossenheider 1976)

3. Maximum concentration in soil: 200 mg/kg sediment

4. Incidental soil ingestion for mammals: 2-10% of total food (EPA 1994)

CALCULATIONS:

(NOAEL) (weight of mouse) = toxic vanadium dose/day

$$\frac{7.5\ mg}{kg\text{-}d}\ (11\ g)\left(\frac{1\ kg}{1000 g}\right) = 0.08\ mg\ V/day$$

X = Incidental ingestion to obtain dose = $\dfrac{toxic\ vanadium\ dose/day}{vanadium\ concentration}$

$$X = \frac{\dfrac{0.08 mg\ V}{day}}{\dfrac{200 mg\ V}{kg\ soil}} = \left(\frac{1000\ g}{1\ kg}\right) = 0.40\ g\ soil/day$$

$$FI\ (g/day) = 0.621\ Wt^{0.564} g \text{ (for rodents; EPA 1994, page 3-6)}$$
$$= 0.621\ (250\ g)^{0.564} = 2.4\ g\ food$$

$$\frac{0.40\ g}{2.4\ g} \times 100 =$$

17% OF DIET WOULD NEED TO BE SOIL CONTAINING VANADIUM TO REACH TOXIC DOSE; EXCEEDS 2-10% RANGE.

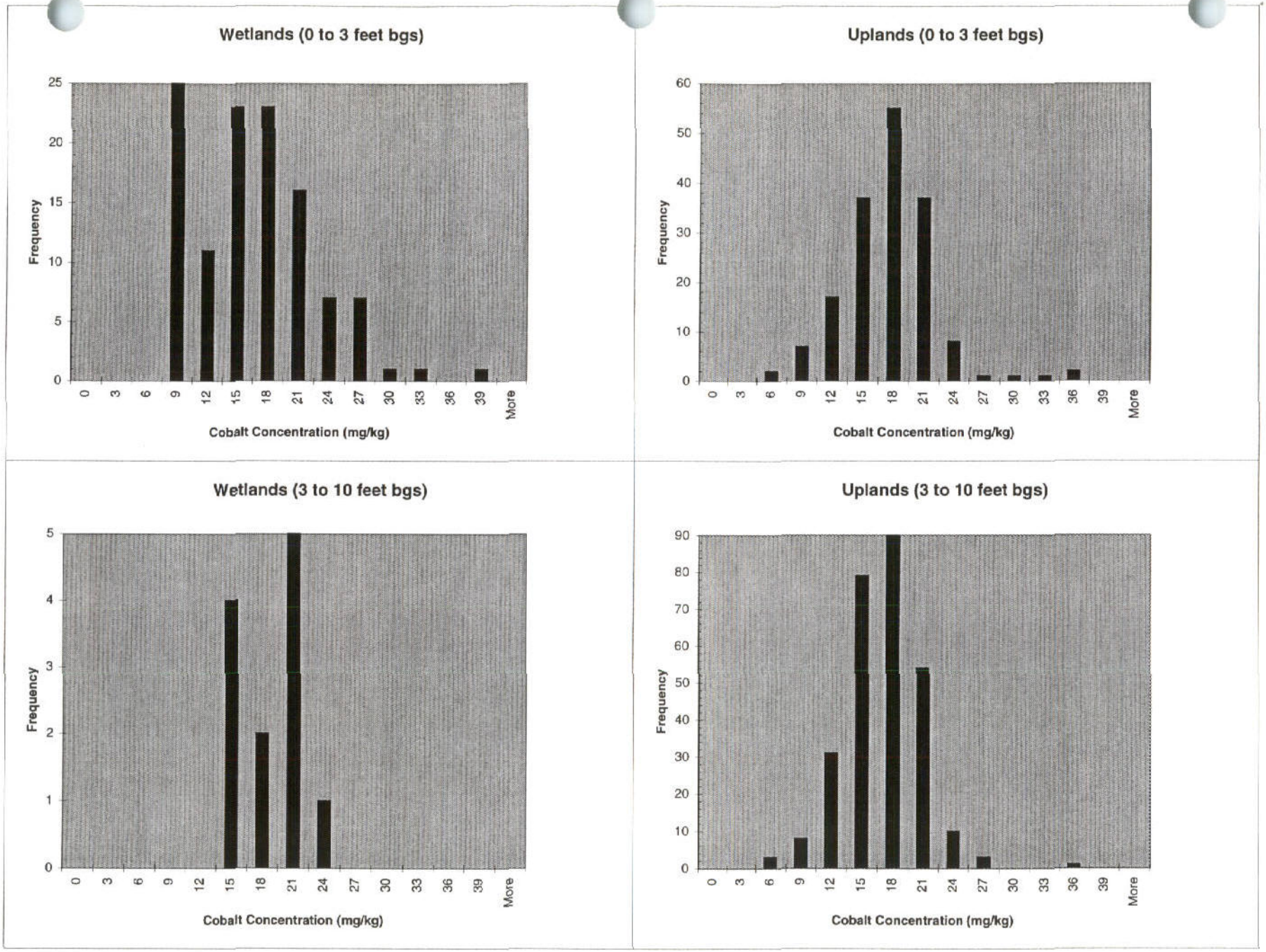

FIGURE 1
MOFFETT FEDERAL AIRFIELD
FREQUENCY HISTOGRAMS OF COBALT CONCENTRATIONS
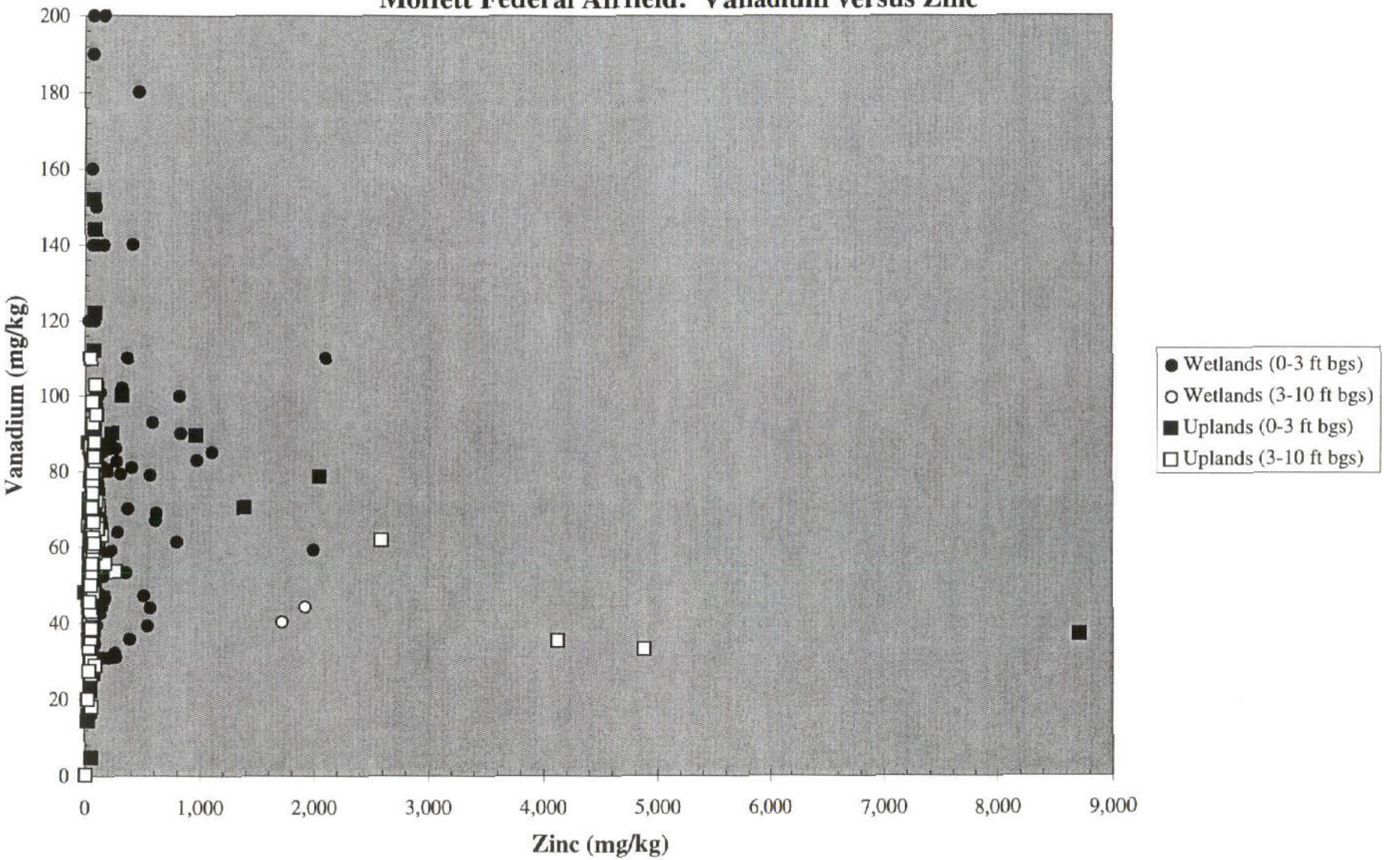
Figure 2
Moffett Federal Airfield: Vanadium versus Zinc