GENERAL SERVICES ADMINISTRATION Contract No. 10F-0076K
Order No. N62474-01-F-6029
GSA.029.00009

Draft Supplemental Remedial Investigation

Installation Restoration Site 22

Naval Weapons Station Seal Beach Detachment Concord
Concord, California

February 12, 2003

Prepared for

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ACRONYMS AND ABBREVIATIONS

ARAR	Applicable or relevant and appropriate requirement
bgs	Below ground surface
BEHP	bis(2-ethylhexyl)phthalate
CDHS	California Department of Health Services
Cal/EPA	California Environmental Protection Agency
CCR	California Code of Regulations
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cm/sec	Centimeters per second
COC	Chemicals of concern
COPC	Chemicals of potential concern
COPEC	Chemicals of potential ecological concern
CRP	Code of Federal Regulations
CV	coefficient of variation
DERP	Defense Environmental Restoration Program
DQO	Data quality objectives
DTSC	Department of Toxic Substances Control
E&E	Ecology & Environment, Inc.
EFA West	Naval Facilities Engineering Command, Engineering Field Activity West
EPA	U.S. Environmental Protection Agency
EPC	Exposure point concentration
ESA	Endangered Species Act
FFA	Federal Facilities Agreement
FS	Feasibility study
FSP	Field Sampling Plan
FWS	U.S. Fish and Wildlife Service
gpd	Gallons per day
GSA	General Services Administration
HI	Hazard index
HLA	Harding Lawson Association
HQ	Hazard quotient
HSP	Health and Safety Plan
IAS	Initial Assessment Study
IR	Installation Restoration
IRP	Installation Restoration Program

ACRONYMS AND ABBREVIATIONS (Continued)

MCL	Maximum concentration limit
μg/L	Micrograms per liter
mg/kg	Milligrams per kilogram
mg/L	Milligrams per liter
MOU	Memorandum of Understanding
mph	Miles per hour
msl	Mean sea level
MVU	Minimum variance unbiased
Navy	U.S. Department of the Navy
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NWS	Naval Weapons Station
PA/SI	Preliminary Assessment/Site Inspection
PCB	Polychlorinated biphenyls
PETG	Polyethylene terephthalate glycol
PRC	PRC Management, Inc.
PRG	Preliminary remediation goals
QAPP	Quality Assurance Project Plan
RBSL	Risk based screening level
RCRA	Resource Conservation and Recovery Act
RFA	Resource Conservation and Recovery Act Facility Assessment
RfD	Reference dose
RI	Remedial investigation
RWQCB	California Regional Water Quality Control Board
SAP	Sampling and Analysis Plan
SARA	Superfund Amendments and Reauthorization Act
SBD	Seal Beach Detachment
SD	Standard deviation
SF	Slope factor
SI	Site investigation
Site 22	Installation Restoration Site 22
SLERA	Screening Level Ecological Risk Assessment
SLHHRA	Screening Level Human Health Risk Asssessment
SVOA	Semivolatile organic analyte
SVOC	Semivolatile organic compound
SWMU	Solid Waste Management Unit
SWPPP	Storm water pollution prevention plan
SWRQB	State Water Resources Control Board

ACRONYMS AND ABBREVIATIONS (Continued)

TBC	To be considered
TCE	Trichloroethene
TCLP	Toxicity characteristic leaching procedure
TDS	Total dissolved solids
TOC	Total organic compound
TOG	Total oil and grease
TPH	Total petroleum hydrocarbons
TtEMI	Tetra Tech EM Inc.
UCL_{95}	One-sided upper 95th percentile upper confidence limit on the arithmetic mean
USC	United States Code
USCS	Unified Soil Classification System
VOA	Volatile organic analyte
VOC	Volatile organic compound

EXECUTIVE SUMMARY

This report presents the findings of the supplemental remedial investigation (RI) conducted at Installation Restoration Site 22 (Site 22), Building 7SH5, in the Inland Area of Naval Weapons Station Seal Beach Detachment Concord (Figure 1-1; Figure 1-2). The site has been evaluated previously in a RI that included a human health risk assessment, but not an ecological risk assessment. Additional data was collected in 2002 to further evaluate the site. The main purposes of this supplemental RI are as follows:

1. Detail the nature and extent of any contamination at Site 22
2. Conduct a screening-level human health risk assessment (SLHHRA) and screening-level ecological risk assessment (SLERA) to evaluate whether chemicals on site pose a risk to human health and the environment
3. Evaluate the need for further action

Site 22 is centered on Building 7SH5, a building formerly used for repairing missile wings and fins (Figure 2-1). Elevated concentrations of arsenic in soil were originally identified during an RI conducted in 1997 (Tetra Tech EM Inc. [TtEMI] 1997). Since the distribution of arsenic in soil at Site 22 did not indicate a site release related to operations at Building 7SH5 and since the other chemicals present at the site were detected within levels considered protective of human health, a draft record of decision (ROD) submitted in 1998 recommended no further action for Site 22. The State of California and the U.S. Department of the Navy (Navy) signed the ROD; however, the U.S. Environmental Protection Agency (EPA) did not sign because of concerns about elevated arsenic concentrations at the site in samples originally collected as part of the ambient data set for Site 22.

As a result, the Navy agreed to conduct additional sampling to further investigate the arsenic contamination in soil at Site 22; a sampling and analysis plan (SAP), consisting of a field sampling plan and a quality assurance project plan (FSP/QAPP), was completed (TtEMI 2002). The SAP was developed in consultation with EPA, the California Department of Toxic Substances Control (DTSC), and the California Regional Water Quality Control Board (RWQCB).

TtEMI collected 43 surface and subsurface soil samples to depths of up to 10-foot below ground surface at 15 locations during October 2002. Samples were analyzed for antimony, arsenic, iron, manganese, and pH. The results of the October 2002 sampling, as well as sampling results from previous investigations for arsenic and other chemicals detected at Site 22, are presented in this supplemental RI report. The original RI report included a SLHHRA but did not include a SLERA because of low habitat quality at the site (TtEMI 1997). This supplemental RI provides an updated SLHHRA and a SLERA based on data from recent and previous investigations at Site 22.

The following sections summarize the chemical characterization, SLHHRA, SLERA, and contaminant fate and transport for Site 22, and present recommendations for the site.

CHEMICAL CHARACTERIZATION FOR SOIL AND GROUNDWATER

Information and data collected during the site investigation (SI), Phase I RI, Phase II RI, and Resource Conservation and Recovery Act Facility Assessment (RFA) Confirmation Study were used to support this supplemental RI. Methods for data collection from these previous studies were summarized in the Phase I RI (TtEMI 1997). Analytical results from these previous reports and the October 2002 sampling event are summarized below and presented in more detail in Section 5.0 of this report.

Inorganic constituents detected in soil were compared with preliminary remediation goals (PRG) for both residential and industrial use (EPA 2002a) and the ambient data set for Site 22, which was established during the Phase I RI. Analytical results for inorganic soil data from the site were compared statistically to the ambient data set for Sites 22 and 13 using two-population tests. Metals in Site 22 soil that were greater and less than ambient concentrations for the three depth intervals evaluated are shown in the following table.

METAL CONCENTRATIONS IN SITE 22 SOIL COMPARED WITH AMBIENT CONCENTRATIONS

Depth (feet bgs)	Site Greater than Ambient	Site Less than Ambient
0 to 0.5	Arsenic, copper, lead, mercury, zinc	Aluminum, antimony, barium, beryllium, cadmium, chromium, cobalt, manganese, molybdenum, nickel, selenium, silver, thallium, vanadium
0 to 3.0	Arsenic, beryllium, copper, lead, mercury, zinc	Aluminum, antimony, barium, cadmium, chromium, cobalt, manganese, molybdenum, nickel, selenium, silver, thallium, vanadium
0 to 10.0	Arsenic, beryllium, copper, lead, mercury, zinc	Aluminum, antimony, barium, cadmium, chromium, cobalt, manganese, molybdenum, nickel, selenium, silver, thallium, vanadium

Arsenic was detected at concentrations above the residential and industrial PRG values (0.39 milligram per kilogram [mg/kg] and 1.6 mg/kg, respectively) in every sample collected at Site 22 and at all sample depth intervals (Table 5-4; Figure 5-1). Arsenic was detected in site soil at concentrations above ambient levels in all depth intervals evaluated. Although arsenic concentrations in soil were elevated above ambient in all soil depths evaluated, the majority of arsenic concentrations that exceed 10 mg/kg are confined to surface soils; 10 mg/kg is one-sided upper 95th percentile upper confidence limit on the arithmetic mean (UCL_{95}) for the Site 22 ambient data set.

Beryllium, copper, mercury, and zinc were detected at concentrations above ambient levels in soil but below residential and industrial PRGs (Table 5-4). Lead was detected in one soil sample at a concentration that slightly exceeded the California-modified residential PRG (EPA 2002a).

A geochemical analysis to determine whether correlations exist among arsenic and other metals (antimony, iron, and manganese) was conducted for Site 22 soils. No correlation was observed between arsenic and iron and manganese; a correlation was observed between arsenic and antimony at depth. Results of the correlations suggest a likely anthropogenic origin of the observed elevated arsenic concentrations.

No volatile organic compounds (VOC) or semivolatile organic compounds (SVOC) were detected in soil at concentrations exceeding EPA Region IX residential PRGs (Table 5-1; Table 5-2). The VOCs trichloroethene (TCE), bromodichlromethane, chloromethane, and chloroform were detected at low levels (at 2 micrograms per kilogram [µg/kg] or below) in subsurface samples; xylene was detected in one surface sample. The SVOCs 2-methylnatphthalene and naphthalene were detected in one surface sample collected adjacent to the UST fill pipe and eight low-level SVOCs were detected in drainage ditch sample 7SHSB026. Phenol was detected in seven soil samples at concentrations well below residential PRGs.

The Phase I RI also investigated for petroleum hydrocarbons. TPH as diesel (TPH-d) was detected at two locations at concentrations of 35,000 mg/kg and 370 mg/kg next to the fill pipe for the UST, at two locations drilled along the UST pipeline at 500 mg/kg and 14.6 mg/kg, and 9.2 mg/kg (Table 5-3) and at one composite sample collected from the ditch at 9.2 mg/kg. Elevated concentrations of TPH as motor oil (4,300 mg/kg) were detected in the soil sample collected adjacent to the UST fill pipe. Sporadic detections of TPH as motor oil were present at other locations (up to 250 mg/kg). TPH concentrations detected in soil are summarized in Table 5-3.

Groundwater was evaluated during the Phase I and Phase II RI for VOCs and petroleum hydrocarbons. TCE; bis(2-ethylhexyl)phthalate (BEHP); and 1,1,1-trichloroethane; and motor oil were the only organic compounds detected in groundwater (Table 5-9). Motor oil was detected in grab groundwater samples collected during the Phase I RI only; no motor oil was detected in the four rounds of groundwater sampling from installed monitoring wells conducted in 1997 as part of the Phase II RI. The VOCs; TCE; bis(2-ethylhexyl)phthalate (BEHP); and 1,1,1-trichloroethane were detected two or less of the four sampling rounds conducted in 1997. All detections of TCE and 1,1,1-trichloroethene were below EPA and California Department of Health Services (CDHS) maximum contaminant levels (MCL) for drinking water (EPA 2002b, CDHS 2002). BEHP was detected at concentrations (32 µg/L) that exceed the tap water PRG of 4.8 µg/L, the EPA MCL of 6.0 µg/L, and the CDHS MCL of 4.0 µg/L; BEHP is considered a common laboratory and field contaminant. BEHP and TCE were not consistently present in groundwater at the site in the four quarters of groundwater samples collected in 1997.

SCREENING LEVEL HUMAN HEALTH RISK ASSESSMENT

The SLHHRA assessed potential risks associated with current industrial, future industrial, and hypothetical future residential exposure to chemicals of potential concern (COPC) detected in surface soils and subsurface soils at Site 22. COPCs in soils included metals (including arsenic), VOCs, and

PAHs. The SLHHRA calculated potential cancer risks and noncancer hazards for each exposure scenario by comparing COPC concentrations to EPA Region IX soil PRGs (EPA 2002a).

Results of the SLHRRA for Site 22 show that potential cancer risks for the current industrial and future industrial exposure scenarios are within the risk management range of 1E-06 to 1E-04 (Table 6-4, Table 6-5). Arsenic is a risk driver for both of these exposure scenarios and contributes to over 99 percent of the cancer risk. The noncancer HI for the current and industrial exposure scenarios is less than the threshold HI of 1. For the future residential exposure scenario, the cancer risk from exposure to COPCs in subsurface soils and surface soils is 1E-04 and 2E-04, respectively (Table 6-6, Table 6-7). The cancer risk for subsurface soil exposures is at the upper-end of the risk management range, and the cancer risk for surface soil exposures exceeds the risk management range. Similar to the industrial exposure scenarios evaluated, arsenic is the risk driver and contributes to over 99 percent of the cancer risk for the residential exposure scenario. The noncancer HI is 1.8 and 4.1 for subsurface soil and surface soil residential exposures, respectively. The HI exceeds the threshold HI of 1 and is almost entirely attributable to arsenic. Based on the SLHHRA results, arsenic is the only soil chemical of concern at Site 22.

The SLHHRA also evaluated groundwater at Site 22 by comparing groundwater COPC concentrations to San Francisco Regional Water Quality Control Board (RWQCB) health-based screening levels (RBSLs) (RWQCB 2001) and tap water PRGs (EPA 2002a). Only three groundwater COPCs were identified: bis(2-ethylhexyl)phthalate (BEHP), TCE, and 1,1,1-trichloroethane. The evaluation showed that the exposure point concentrations (EPC) for BEHP slightly exceeds the RBSL for drinking water sources and the tap water PRG (Table 6-9). The EPC for TCE exceeds the tap water PRG but is less than the federal and state MCL for TCE (EPA 2002b, CDHS 2002). The EPC for 1,1,1-trichloroethene was below the RBSL and tap water PRG (Table 6-9). Concentrations of BEHP and TCE used in the groundwater evaluation were based on quarterly groundwater monitoring results collected during the Phase II RI (TtEMI 1998a). BEHP and TCE were detected during the first two quarters of monitoring; however, sample results from the last two quarters of monitoring in 1997 showed no detections of BEHP and TCE, indicating that these chemicals may no longer be present in groundwater at the site.

SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT

The SLERA was conducted to determine whether chemicals of potential ecological concern (COPEC) in surface soils pose unacceptable risk to upper trophic level species at the site. Representative bird and mammal species that were the focus of the assessment included the American robin (*Turdus migratorius*), Red-tailed hawk (*Buteo jamaicensis*), Western harvest mouse (*Reithrodontomys megalotis*), coyote (*Canis latrans*), and tule elk (*Cervus elaphus nannodes*). Because no native or sensitive plant species are known to occur at the site and the general quality of habitat is low, only risk to selected bird and mammal receptors was evaluated.

Food-chain modeling was conducted to identify chemicals that pose potential risk to birds and mammals at Site 22. Estimated daily doses for representative bird and mammals species were calculated for each chemical detected above ambient concentrations and detected organic chemicals. The estimated daily doses were then compared to low and high toxicity reference values (TRVs) to calculate a hazard quotient (HQ).

Based on the SLERA, only arsenic and zinc pose some unacceptable risk to the American Robin because the $HQ_{(dose/high\ TRV)}$ exceeded 1. No other COPECs pose unacceptable risk to the other receptors. Copper, lead, and mercury were considered to pose potential risk to the American Robin and lead poses a potential risk to the Red-tailed Hawk ($HQs_{(dose/low\ TRV)}$ exceeded 1.0); however, the $HQ_{(dose/high\ TRV)}$ for these chemicals were less than 1.0, indicating no immediate or significant risk.

No chemicals modeled pose unacceptable risk to mammals (all $HQ_{[dose/lhigh\ TRV]} < 1$). Arsenic and copper were considered to pose potential risk to the western harvest mouse, nickel poses a potential risk to the grey fox; and lead poses a potential risk to all three receptors ($HQ_{[dose/low\ TRV]}$ slightly exceeded 1.0); however, each chemical's respective $HQ_{(dose/high\ TRV)}$ was less than 1.0, indicating no immediate or significant risk from any of these chemicals.

Because the SLERA resulted in arsenic and zinc HQs greater than 1.0 for the American robin at Site 22, indicating a need for further evaluation, a more focused, refined assessment of ecological risk (Step 3a of a baseline ERA) was conducted using more realistic assumptions in accordance with Navy and EPA guidance (Navy 1999a; EPA 1997a).

When the conservative assumptions of the food-chain model for the American Robin were reevaluated and bioavailability was considered, the $HQs_{[dose/high\ TRV]}$ were less than 1.0 for arsenic and zinc, indicating acceptable risk. For these reasons, Site 22 does not pose unacceptable risk to avian or mammalian receptors.

CONCLUSIONS AND RECOMMENDATIONS

The conclusions from this supplemental RI are summarized as follows:

- Arsenic is the only COC in soil. Arsenic concentrations are elevated above ambient levels in surface soils, and some portions of subsurface soils. Lack of statistical correlations of arsenic concentrations with other metals (antimony, iron, and manganese) indicate that the source of arsenic at the site is most likely anthropogenic.
- Arsenic is most elevated in surface soils collected from open grassland and ditch areas of the site relative to samples collected near Building 7SH5, indicating that the potential source of arsenic may be related to application of arsenic containing herbicides, pesticides, or rodenticides to surface soils by the Navy or previous landowner or by railroad maintenance practices. The most probable source of arsenic at the site is a surface application of an arsenic-containing pesticide, herbicide, or rodenticide to grassland areas of the site. Operations at Building 7SH5 do not appear to be linked with elevated concentrations of arsenic in soil.

- In groundwater, BEHP exceeds the federal and state MCL for drinking water (EPA 2002b, CDHS 2002) and slightly exceeds the RBSL for drinking water sources (RWQCB 2001) and the tap water PRG (EPA 2002a). The EPC for TCE exceeds the tap water PRG but is less than the federal and state MCL for TCE (EPA 2002b). Sample results from the last two quarters of monitoring in 1997 showed no detections of BEHP and TCE, indicating that these chemicals may no longer be present in groundwater at the site.
- Results of the SLHHRA indicate that cancer risks from soils are within the upper limit of the target risk range for the current industrial worker, future worker, and hypothetical future residential scenarios. Noncancer hazards are greater than the target value for the future residential scenario only. Site risks are attributable to arsenic in soil.
- Results of the SLERA indicate that chemicals, including arsenic, in soil at Site 22 do not pose unacceptable risk to ecological receptors.

RECOMMENDATIONS

This section presents recommendations for future activities at Site 22. Recommendations are based on a detailed assessment of site physical and chemical data, results from the SLHHRA and SLERA, and evaluation of contaminant fate and transport.

- While arsenic concentrations observed in soil do not appear to be a consequence of activities at Building 7SH5, the possibility exists that additional areas in the open grasslands of the magazine area are impacted by elevated arsenic. It is recommended that an additional investigation be conducted in the magazine area to characterize levels of arsenic in soil. It is recommended that this investigation focus on the open grasslands in the magazine area, rather than on Building 7SH5 as a potential source of arsenic.
- Because results of the SLHHRA indicate that cancer risks from soils are within the upper limit of the target risk range for the current industrial worker, future worker, and hypothetical future residential scenarios and noncancer hazards are greater than the target value for the future residential scenario, an updated HHRA is recommended to evaluate site risks from arsenic in soil based on the results from the recommended magazine area investigation
- Because metals in groundwater have not yet been evaluated at the site and concentrations of BEHP and TCE in groundwater exceed the MCL and tap water PRG, respectively, it is recommended that a round of groundwater samples be collected from existing wells at the site and analyzed for metals and SVOCs.
- In groundwater, BEHP exceeds the federal and state MCL for drinking water (EPA 2002b, CDHS 2002) and slightly exceeds the RBSL for drinking water sources (RWQCB 2001) and the tap water PRG (EPA 2002a). The EPC for TCE exceeds the tap water PRG but is less than the federal and state MCL for TCE (EPA 2002b). Sample results from the last two quarters of monitoring in 1997 showed no detections of BEHP and TCE, indicating that these chemicals may no longer be present in groundwater at the site. No other VOCs were present in groundwater a concentrations above tap water PRGs and MCLs.
- Because no unacceptable risk was indicated from chemicals in soils at Site 22 to ecological receptors, no further characterization of risk to ecological receptors at Site 22 is recommended.

1.0 INTRODUCTION

Tetra Tech EM Inc. (TtEMI) received Order ID No. N62474-01-F-6029 under the General Services Administration (GSA) Contract No. GS-10F-0076K on July 20, 2001. The order was received from Naval Facilities Engineering Command, Engineering Field Activity West (EFA West) to complete a supplemental remedial investigation (RI) to address soil contaminated by arsenic at Installation Restoration (IR) Site 22 (Site 22), located in the Inland Area at Naval Weapons Station (NWS) Seal Beach Detachment (SBD) Concord in Concord, California (Figures 1-1 and 1-2). Site 22 is centered on Building 7SH5, a building formerly used for repairing missile wings and fins. The elevated concentrations of arsenic in soil were originally identified during an RI conducted in 1997 (TtEMI 1997). Since the distribution of arsenic in soil at Site 22 did not indicate a site release related to operations at Building 7SH5 and since the other chemicals present at the site were detected within levels considered protective of human and ecological health, a draft record of decision (ROD) submitted in 1998 recommended no further action for Site 22. The State of California and the U.S. Department of the Navy (Navy) signed the ROD; however, the U.S. Environmental Protection Agency (EPA) did not sign because of concerns about elevated arsenic concentrations at the site in samples originally collected as part of the ambient data set for Sites 22. As a result, the Navy agreed to conduct additional sampling; a sampling and analysis plan (SAP), consisting of a field sampling plan and a quality assurance project plan (FSP/QAPP), was written to further investigate the arsenic contamination in soil at Site 22 (TtEMI 2002). Soil samples collected to support the supplemental RI were collected during October 2002; the results of this sampling as well as sampling from previous investigations for arsenic and other chemicals detected at Site 22 are presented in this supplemental RI report.

1.1 PURPOSE

The purpose of this supplemental RI is to (1) detail the nature and extent of arsenic in the vicinity of Site 22, (2) conduct a screening-level human health risk assessment (SLHHRA) and screening-level ecological risk assessment (SLERA), and (3) evaluate the need for further action.

1.1.1 The Installation Restoration Program

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Superfund Amendments and Reauthorization Act of 1986 (SARA) established a series of programs for the cleanup of hazardous materials disposal and release sites nationwide. The Navy Installation Restoration Program (IRP) is designed to identify, assess, and remediate contamination at past hazardous materials disposal and release sites that resulted from Navy and Marine Corps activities. The IRP is primarily intended to clean up these past waste disposal or spill areas that endanger public health (welfare) or the environment and may include such chemicals as polychlorinated biphenyls (PCB), metals, lubricants, pesticides, paints and solvents, and ordnance products. Total petroleum hydrocarbons (TPH) such as gasoline and motor oil are not included in the CERCLA program and are studied under the Navy's Underground Storage Tank program, which is regulated by the Regional Water Quality Control Board. The Navy's IRP follows a process developed by the EPA pursuant to CERCLA to identify, assess, and remediate hazardous waste sites (EPA 1988a). Site 22 is currently in the supplemental RI phase of the IRP.

1.1.2 Federal Facility Agreement

On June 12, 2001, the Navy and EPA signed a Federal Facilities Agreement (FFA). The general purpose of the FFA is threefold, as follows:

- Ensure that the environmental impacts associated with past and present activities at the site are thoroughly investigated and appropriately remediated as necessary to protect the public health, welfare, and environment
- Establish a procedural framework and schedule for developing, implementing, and monitoring appropriate response actions at the site in accordance with the following:
  - CERCLA
  - The National Oil and Hazardous Substances Pollution Contingency Plan (NCP)
  - Superfund guidance and policy
  - The Resource Conservation and Recovery Act (RCRA)
  - RCRA guidance and policy
  - Defense Environmental Restoration Program (DERP)
  - Applicable State of California law
- Facilitate cooperation, exchange of information and participation of the Navy, EPA, and the State of California in such actions

1.1.3 Supplemental Remedial Investigation Objectives

Although elevated concentrations of arsenic were detected in soils at Site 22 during the RI, distribution of arsenic in soil did not indicate that the source of arsenic was related to operations at Building 7SH5 (TtEMI 1997). The highest concentrations of arsenic were detected in samples collected from a grassland area south of Building 7SH5; the grassland samples were originally collected as part of the ambient data set for Site 22. Possible sources of the elevated arsenic concentrations in soil include anthropogenic sources such as the application of arsenic-based herbicides, pesticides, or rodenticides as well as residue from railroad construction and maintenance activities. Alternately, the arsenic source in soil may be naturally occurring.

The objectives of this supplemental RI were as follows:

- Determine the extent of arsenic on site
- Determine whether the source of arsenic is anthropogenic or naturally occurring
- Evaluate whether arsenic and other chemicals on site detected during previous investigations pose a risk to human health and the environment

- Determine the types of response action(s) to be considered in meeting the applicable or relevant and appropriate requirements (ARAR) appropriate to the site (TtEMI 2002)

To meet these objectives, TtEMI collected soil samples at 15 locations during October 2002. Samples were analyzed for arsenic, iron, manganese, and pH within areas of suspected elevated arsenic levels at Site 22.

The results of new and previously collected data are presented in this document as a supplement to the existing RI report for Site 22. The phase I RI report included a SLHHRA but did not include a SLERA because of low habitat quality at the site (TtEMI 1997). This supplemental RI provides an updated SLHHRA and a SLERA based on data from recent and previous investigations at Site 22.

1.1.4 Remedial Investigation Project Plans

The project plans that support the supplemental RI for Site 22 are briefly described in the following text:

Sampling and Analysis Plan. In 2002, TtEMI developed a SAP to present the approach for collection of new data that would address concerns about arsenic in soil at Site 22. The SAP is comprised of the FSP and QAPP; it provides guidance for all field work by defining the sampling and data-gathering methods and rationale to be used during site characterization. The SAP also identified the locations of samples and was designed so that a field sampling team unfamiliar with the site would be able to implement the specified procedures at designated locations. Investigation-derived waste sampling, management, and disposal issues were addressed in the SAP and Phase I work plan (TtEMI 2002 and PRC/Montgomery Watson 1995a).

Health and Safety Plan. On December 3, 2001, TtEMI submitted draft a draft health and safety plan (HSP) for the supplemental RI at Site 22 (TtEMI 2001). The purpose of the HSP was to outline the procedures for the protection of the health and safety of site personnel during RI field activities. Potentially hazardous operations and exposures were identified, and appropriate protective measures were specified in the HSP.

Community Relations Plan. The community relations plan (CRP) documented the history of community relations efforts on the part of the Navy and the issues of concern to the community as they relate to RI activities. It also defined mechanisms for the dissemination of related information to interested agencies and the community as such information becomes available and provided a process for community input into the CERCLA remedy selection process. An updated version of the 1995 CRP (PRC 1995) is scheduled for delivery in Spring 2003 (TtEMI forthcoming).

1.2 REPORT ORGANIZATION

The facility background, including site location, history, and previous environmental assessments, is summarized in Section 1.3. The environmental setting, including ecology, geology, and hydrology, is described Section 2.0. Preliminary ARARs are identified in Section 3.0. Investigative methods are presented in Section 4.0. Chemical characterization, including the results from the most recent data collected, is described in Section 5.0. A screening level human health risk assessment (SLHHRA) is presented in Section 6.0, and a SLERA is presented in Section 7.0. Contaminant fate and transport is presented in Section 8.0. Conclusions and recommendations derived from this RI are presented in Section 9.0.

1.3 SITE BACKGROUND

The following sections describe the location, history, current operations, and previous environmental assessments at Site 22.

1.3.1 Location

NWS SBD Concord is in north-central Contra Costa County, approximately 30 miles northeast of San Francisco, California (Figure 1-1). The Navy facility operates an ocean-shipping terminal to transfer ordnance from trucks or railcars to ships and from ships to land transportation vehicles. The facility is bounded on the north by Suisun Bay, on the south and west by the city of Concord (population 116,000), and on the east by private land and the city of Pittsburg. It encompasses almost 13,000 acres in three holdings: the Inland Area, the Tidal Area, and a radiography facility at Pittsburg.

Site 22 is located along the southwestern portion of the Inland Area, at the intersection of Sixteenth and Seventeenth Streets, on the relatively flat (1 percent slope) flood plain of Seal Creek (Figure 1-2). The surrounding area, known as the “magazine area,” consists of an array of ammunition magazines connected by a series of parallel roads and railroad spurs. Five hundred feet to the southwest is the NWS SBD Concord boundary; beyond that boundary are single-family homes and Concord High School in the city of Concord.

1.3.2 History

In December 1942, the Navy commissioned the ordnance-shipping depot at Naval Magazine, Port Chicago, now known as the Tidal Area of NWS SBD Concord. When munitions passing through the Port Chicago waterfront exceeded the capacity of the new facility, a 5,143-acre area of land in the Diablo Creek Valley was acquired. This land became the Inland Area of NWS SBD Concord (Ecology & Environment, Inc. [E&E] 1983). Facilities located in the greater Inland Area of the installation have been associated primarily with munitions storage, support, supply, public works, and administrative facilities. The Inland

Area also housed several production and maintenance facilities for weapons. Since 1999, the Inland Area has been on reduced operational status, with the majority of the Inland Area buildings not in use.

Previous investigations at Site 22 have focused on Building 7SH5 as a possible contamination source. Building 7SH5 was built in 1944 on a concrete slab with no plumbing or heating as a storehouse for inert equipment (Navy 1944). Four different operations have been conducted at this building between 1944 and the present. Between 1944 and 1957, Building 7SH5 was used as a storehouse for inert equipment. In 1957, the building was converted to test missile components (Navy 1957). Testing included vibration and environment testing, which was the main function of the building until the early 1970s, when maintenance operations began for the Guided Missile Division of the Ordnance Department (E&E 1983). During the maintenance operations phase, specific building activities included paint stripping, cleaning, and painting missile wings and fins. These activities primarily involved the use of acetone, trichloroethane, methyl ethyl ketone, chloroethane, and several types of paint thinners (E&E 1983). The quantity of wastes generated from these activities was probably less than 100 gallons per year. Building 7SH5 was also used for manufacturing mobile laboratories to be used during explosive ordnance disposal activities. From 1970 to 1978, the Tidal Area Landfill reportedly received all wastes from Building 7SH5. Since 1978, wastes have been disposed of off base (E&E 1983).

Aerial photographs from 1939 and reviews of historical maps for the area indicate that that before Navy ownership, Site 22 and the surrounding area was used for agricultural purposes. Appendix A presents historic and current aerial photographs for the site.

1.3.3 Current Operations

NWS SBD Concord is an open Naval Base, but the Inland Area is currently on reduced operational status and is not actively used for military operations. Building 7SH5 and the surrounding magazine area are currently not in use by the Navy and there are no plans for a change in current land use at Site 22. Approximately 1,000 acres of the Inland Area, including the entire magazine area, are leased for cattle grazing and are used as part of a tule elk reserve managed by the California Department of Fish and Game. Approximately 400 cattle and 45 tule elk roam throughout the open grassland portions of the Inland Area, including the grasslands that surround Site 22.

1.3.4 Previous Environmental Assessments

The following sections describe previous investigations conducted at Site 22; all previous investigations have focused on Building 7SH5 as a possible source of contamination. Previous investigations included the following:

- An initial assessment study (IAS) (E&E 1983)
- A site investigation (SI) report (PRC 1993)

- An underground storage tank (UST) investigation (Harding Lawson Association [HLA] 1995)
- A RFA Confirmation Study that included a solid waste management unit (SWMU) investigation (PRC 1997)
- A Phase I RI (TtEMI 1997)
- A Phase II RI (TtEMI 1998a)
- Draft ROD (TtEMI 1998b)

The nature and extent of contamination at Site 22, as summarized from previous and recently collected data, is presented in Section 5.0 of this supplemental RI. Tables 4-1 and 4-2 present a summary of the soil and groundwater samples collected as part of the RFA confirmation study, Phase I RI, Phase II RI, and Supplemental RI. Tables 5-1 through 5-4 present analytical results soil, and Table 5-9 presents the analytical results for groundwater. Figure 2-3 presents the locations of all soil and groundwater samples collected at the site.

Initial Assessment Study. A visual inspection of the site was conducted by E&E during the IAS in 1983. The IAS eliminated this site from consideration because of the small quantity of wastes that might be present. Because of changes in law since the IAS (that is, CERCLA and SARA) and the absence of records on the disposal activities, this site was included in the SI to evaluate whether it poses an environmental or health risk under current regulations.

Resource Conservation and Recovery Act Facility Assessment Confirmation Study. Although Building 7SH5 was not identified as a SWMU in the 1992 RFA (Cal/EPA 1992a), it was later designated as SWMU 52 by the Navy because it was thought that hazardous waste may have leached into soil from the building's septic tank system. To investigate the septic tank identified as SWMU 52, a field sampling plan was developed by PRC in 1994, and a RFA Confirmation Study was conducted in 1997. As part of this study, two deep soil borings were advanced in the septic leach field and two shallow soil borings were advanced along the drainage ditch west of the leach field. In addition, one liquid sample from the septic tank and a surface water sample from the drainage ditch were collected. All samples were analyzed for VOCs, SVOCs, total oil and grease (TOG), and metals. In soil, arsenic exceeded the residential PRG in all soil samples (concentrations ranged from 5.1 mg/kg to 65.4 mg/kg). Lead was detected in one surface soil sample at a concentration (165 mg/kg) that exceeded the residential PRG. All other metals concentrations were below residential PRGs (Table 5-4). No VOCs were detected in soil (Table 5-1), and the SVOC phenol was detected at very low levels (below 2 mg/kg) in two soil samples at concentrations below the residential PRG (Table 5-2). Only one of the soil samples collected from the deep soil borings at a depth of 16 feet below ground surface (bgs) contained TOG at a concentration of 130 milligrams per kilogram (mg/kg). The two surface soil samples from the shallow soil borings contained TOG at concentrations of 83 and 280 mg/kg. One of two soil samples from the shallow soil borings collected at 2.5 feet bgs contained TOG at a concentration of 30 mg/kg. The water sample from the septic tank contained TOG at 11 micrograms per liter (µg/L). The unfiltered surface water sample from the drainage ditch did not contain detectable levels of VOCs, SVOCs, or TOG. Copper and lead were the only two metals detected in ditch surface water, both at concentrations of 0.02 mg/L; both of these concentrations were below CDHS MCLs for tap water (1 mg/L for copper and 0.05 mg/L for lead).

Site Investigation. The SI at Site 22 was conducted by PRC and included the collection of soil samples from three soil borings within a suspected disposal pit and the collection and analysis of one composite surface soil sample from the bottom of a drainage ditch (PRC 1993). Soil borings were drilled to a depth of 4 feet within the area of the alleged disposal pit. The soil samples were analyzed for volatile organic compounds (VOC), semivolatile organic compounds (SVOC), metals, organotins, TPH-purgeables, and TPH-extractables. Although the results of the SI sampling at the suspected disposal pit did not reflect the evidence of paints, oils, or solvents, the sampling depth may have exceeded the pit depth, or the samples may have been collected from relatively clean backfill material. Arsenic was the only inorganic chemical in soil detected at concentrations that exceeded the residential PRG (0.4 mg/kg); concentrations ranged from 4.0 mg/kg to 33 mg/kg (Table 5-4). No SVOCs, VOCs, TPH-purgeables, or organotins were detected in soil. TPH as diesel was detected in one soil boring sample and in one composite sample at 14.6 and 9.23 mg/kg, respectively (Table 5-3).

Underground Storage Tank Investigation. In September 1993, HLA conducted an investigation of the UST west of Building 7SH5. One soil boring was drilled to a depth of 16.5 feet bgs and sampled at 4.5, 8, and 16 feet bgs. The HLA "Subsurface Investigation and Tank Removal Plan" called for the removal of the UST, associated piping, and all contaminated soils until the results indicate residual hydrocarbon levels in soil below 100 mg/kg (HLA 1995). The UST was removed, and the surrounding area was investigated by NWS SBD Concord in January 1997. Results of the removal showed that the UST was heavily rusted and contained one small hole. Staining was observed on the southern portion of the UST. The soil was over excavated to approximately 12 feet bgs to remove diesel-contaminated soil (K.T.W. & Associates, Inc. 1998). The UST was replaced with an aboveground storage tank under the UST program (HLA 1995). A letter recommending no further action at the UST site was submitted by Contra Costa County on April 8, 1997 (Contra Costa Health Services Department, 1997).

Phase I Remedial Investigation and Feasibility Study. In 1995, soil and groundwater at three areas around Building 7SH5 were sampled as part of the Phase I RI to assess whether past site activities have affected environmental media at the site. These areas included the drainage ditches, the alleged disposal pit area, and the UST and associated piping. Grab groundwater samples were collected from three deep soil borings drilled along the UST pipeline. TPH, SVOC, VOC, and metal results are discussed in the Phase I and II RIs and in Section 5.0 of this report. Arsenic was the only metal in soil that exceeded residential PRGs; arsenic concentrations ranged from 5.9 mg/kg to 127 mg/kg (Table 5-4). All detected VOCs and SVOCs in soil were below residential PRGs (Tables 5-1 and 5-2). In groundwater, motor oil and the SVOCs 1,1,1-trichloroethane, trichloroethene and were detected; all detected concentrations were below tap water PRGs and MCLs, with the exception of trichloroethane, which was detected at 27 µg/L.

Also included as part of the Phase I RI was a study of ambient metal concentrations in the Inland Area soils (Appendix B). The methods for determining ambient metal concentrations are further discussed in Section 4.0 and Appendix B of this report.

Phase II Remedial Investigation. In 1998, a Phase II RI was conduced to (1) confirm the presence of chlorinated hydrocarbons detected in grab groundwater samples collected during the Phase I RI and (2) locate the contamination source once detections were confirmed (TtEMI 1998a). Sampling was also conducted to assess the extent of TPH contamination in groundwater. During the investigation, four monitoring wells were installed in January 1997; soil and groundwater samples collected over four quarters were analyzed for VOCs and TPH-extractables. The results of the sampling indicated no evidence of a contaminated groundwater plume. Bis(2-ethylhexyl)phthalate, 1,1,1-trichloroethane, and trichloroethene (TCE) were the only organic chemicals detected in groundwater; bis(2-ethylhexyl)phthalate was detected in one quarter of sampling from two wells at concentrations above the tap water PRG and MCL (Table 5-9), but was not detected in subsequent sampling events. TCE was detected in one sample at a concentration above the tap water PRG. In soils no detected VOCs exceeded residential PRGs (Table 5-1).

Draft Record of Decision. In 1998, a draft ROD recommended no further action for Site 22. The State of California and the Navy signed the ROD; however, the EPA did not sign because of elevated arsenic concentrations at the site (TtEMI 1998b).

2.0 ENVIRONMENTAL SETTING

The following section presents the physical setting, climate, geology, hydrology, and ecology for the area in the vicinity of Site 22 and within the Inland Area of NWS SBD Concord.

2.1 PHYSICAL SETTING

Site 22 is located near the intersection of Sixteenth and Seventeenth Streets in an area with storage buildings, ammunition magazines, open space (annual grasslands), and a network of roads and railroads. Building 7SH5 is in the center of Site 22 and is set on a low manmade rise that facilitates loading and unloading of rail cars from the building's northeast side. The area immediately southwest of Building 7SH5 is paved; however, the majority of the surrounding area to the south and east is annual grassland. An array of ammunition magazines is located to the north and west of Building 7SH5.

Physical features of Site 22 are shown Figure 2-1. The maximum variation in elevation at Site 22 is approximately 8 feet. A network of drainage ditches are present adjacent to Sixteenth Street, Seventeenth Street, and Building 7SH5. Site drainage was designed to drain surface water from the building along Sixteenth Street by sloping the land southwest toward Seventeenth Street.

Railroad tracks along Sixteenth and Seventeenth Streets are currently inactive. Open grasslands extend 400 feet to the southwest of Building 7SH5 and are bounded by a dirt road and a chain-link fence. Characteristics of the grasslands are further described in Section 2.5. South of the chain-link fence are single-family homes and Concord High School, located approximately 500 feet south of Building 7SH5.

Access to Site 22 is controlled through the main gate. Only military or authorized personnel have access to the site.

The following are potential areas of contamination at Site 22 identified during previous investigations.

Fuel Oil UST. A 1,000-gallon (45.5 inches in diameter by 12 feet long) steel UST for diesel storage was removed in January 1997. The UST was installed in 1957 to supply fuel to three heaters added to the building (Navy 1957). Petroleum contamination in soil near the UST at Building 7SH5 was investigated when the UST was removed in 1997.

Concrete Sump. A concrete, sand filter box (sump), 3.5 feet long by 2 feet wide, is located near the southwestern corner of Building 7SH5. The sump was used to filter paint from water discharged from the paint booth. The sump is currently empty, and the paint booth inside Building 7SH5 is not used.

Western Drain Line. A 1.25-inch galvanized steel drain line is located along the western wall of Building 7SH5, near the UST. The drain is currently not used and is plugged with grout from inside the building.

Septic System. An on-site sanitary sewer system at Building 7SH5 drains through a 4-inch vitrified clay pipe into a 500-gallon septic tank. The septic system is currently not in use.

Northern Drain Line. A 1.5-inch, galvanized steel drain line in the northern end of Building 7SH5 is currently not used. The specific purpose of the drain line is unknown, although it may have been used to drain condensate from air compressors in the building.

2.2 CLIMATE

Prevailing winds blow from the west through the wind gap formed by San Francisco Bay and Carquinez Strait. As a result, the Pacific Ocean and Suisun Bay have a significant impact on the microclimate of NWS SBD Concord and the surrounding vicinity. These westerly winds are particularly dominant during the summer months and minimal from November through February. Occasionally, the late spring and summer weather is influenced by a high-pressure ridge over the interior of California, with resulting high temperatures. Contra Costa County normally experiences dry, warm summers and moderately rainy winters.

Wind directions and speed are monitored at a Pacific Gas and Electric power plant in Pittsburg, a few miles east of the facility. Velocity measurements are taken at 33 feet above ground surface. The wind blows from southwest to west-northwest at a mean wind speed of 12 miles per hour (mph) 65 percent of the time. Wind speeds exceeding 25 mph occur only 0.5 percent of the time, or about 44 hours per year. Ground-level wind velocities at the various sites under study are generally 15 to 30 percent less than those measured at the power plant.

The mean annual precipitation for NWS SBD Concord is 14 inches (E&E 1983). As in most of northern California, about 84 percent of the rainfall occurs from November through March. Regionally, rainfall may vary from 13 inches in the eastern portion of Contra Costa County to over 30 inches on the upper slopes of Mt. Diablo. Continuous rainfall recordings are available for Martinez, approximately 10 miles west of NWS SBD Concord. Short duration rainfall events and peak watershed discharges may be estimated for the various study sites by multiplying Martinez precipitation data by a factor of 0.716; this factor represents the ratio of 1-day precipitation at Port Chicago to 1-day precipitation at Martinez (Lee and others 1986).

The average local temperature varies from 45°F in January to 75°F in August. In 1960, a high of 106°F in August and a low of 17°F in January were recorded. During a hard freeze in December 1972, the record low was 16°F. The average frost-free season is about 265 days. The geographic and urban settings of the region make the area prone to urban air contamination problems.

Inversion, an increase in ambient temperature with altitude, is a common occurrence. Temperature inversion prevents airborne contaminants from dispersing vertically in the upper atmosphere, causing concentrations at ground level to rise. The most common pollutants are sulfur dioxide, carbon monoxide, and particulates.

2.3 GEOLOGY

The following sections present the geology in the vicinity of NWS SBD Concord and the geology of the Inland Area, including the Building 7SH5, Site 22 area. The descriptions in this section are based on published literature and site-specific lithologic data from current and previous investigations.

2.3.1 Regional Geology

The generalized geology of NWS SBD Concord is presented in Figure 2-2, which includes a simplified geologic map and cross section that shows the stratigraphic relationships of the various units described in the following text. Lithologic logs for soil borings within Site 22 are presented in Appendix C.

The regional geomorphic features are a reflection of several northwest-trending fault systems that divide Contra Costa County into fault-bounded blocks; up-thrown blocks form the hills and down-thrown blocks form broad lowlands floored with thick, unconsolidated, Pleistocene alluvial soils eroded from material that comprises the up-thrown blocks. The up-thrown block of bedrock that physically separates the Inland and Tidal Areas is typical of the geology of Contra Costa County.

The oldest formations are Tertiary sedimentary rocks exposed in Los Medanos Hills along the east side of NWS SBD Concord (Dibblee 1981). On the Inland Area side, the geology consists of interbedded sandstone, siltstone, and shale. Steeply inclined jointing and parting along bedding planes combined with weathering has produced boulders in residual soil. The residual soil is susceptible to landsliding.

Nonmarine sedimentary rocks comprise the northern slope of Los Medanos Hills and the lowermost reaches on the Inland Area side. The upper slopes on the Inland Area are characterized by older (mid-late Eocene) sandstones of the Markley group (Dibblee 1981). Surficial deposits of sandstone are unconformably underlain by a basement complex of sedimentary, igneous, and metamorphic rocks that form most of the northern half of the coastal hills and extend beneath Suisun Bay.

Figure 2-2 shows the two major faults known to exist in the NWS SBD Concord area. The Concord fault passes through the city of Concord, approximately 2 miles from the southwest boundary of NWS SBD Concord. The Concord fault is classified as active by federal, state, and local agencies. Its activity is primarily fault creep. The Concord fault is a right-lateral strike-slip fault (rocks on the southwest side of the fault are displaced to the northwest relative to rocks on the northeast side). The Concord fault is part of the San Andreas system and is thought to be either the northwest extension of the Calaveras fault, the most seismically active fault in this part of California, or related to the relatively inactive Greenville fault located southeast of Mt. Diablo.

The main trace of the Clayton fault lies at the base of Los Medanos Hills, passing through NWS SBD Concord in most places less than 1/2 mile from the installation's northeast boundary. The Clayton fault is classified as active or potentially active (Nelson 1993). Several lineaments, possibly related to faulting and fault displacement, are present to the west of the main trace of the Clayton fault. The lineaments project northwesterly toward the industrial facilities and magazines of the Inland Area (Engineering Decision Analysis Company, no date). The Clayton fault is most likely a dip-slip fault (rocks on the southwest side are dropped down relative to rocks on the northeast side) and runs subparallel to the larger Concord fault. It is most likely dropped down to the southwest (Dibblee 1981). The Clayton fault may be related to a series of northwest-trending structural features: the Marsh Creek-Greenville fault and the Arroyo Mocha fault.

2.3.2 Local Geology

Site 22 is located along the southern boundary of the Inland Area, within the alluvial slope of Los Medanos Hills, approximately 2,500 feet from the range front. Dibblee mapped the area as underlain by Quaternary young alluvium (Dibblee 1980a, 1981).

Soil borings completed at the site between May 1995 and October 2002 indicate that alluvial deposits extend from the surface to greater than 30 feet bgs. The geology consists primarily of silt and silty clay with varying amounts of gravel and sand. From 0 to 20 feet bgs, discontinuous lenses of gravel and sand were identified within a silt or silty clay matrix. The composition of gravel clasts includes siltstone, quartz vein, metamorphic rocks (granodiorite and greenstone), and chert. From 20 to 30 feet bgs, the lithology consists mostly of clayey soil with thin sand gravel lenses ranging from 1 to 6 inches thick. From 30 to 50 feet bgs, the site is predominately gravelly clays and silts. The complete geologic boring logs for Site 22 are presented in Appendix C.

2.4 HYDROLOGY

The following section presents the hydrology for the vicinity of NWS SBD Concord and the hydrology of the Inland Area.

2.4.1 Regional Hydrology

The hydrology of the region can be divided into surface water and groundwater. Surface water hydrology is concerned with the streams, lakes, bays, and estuaries. The regional groundwater hydrology includes both potable and nonpotable groundwater sources.

The drainage systems of the San Francisco Bay Area can be classified as (1) the Great Valley and Delta systems; (2) streams flowing into the San Francisco, San Pablo, or Suisun Bays; and (3) streams flowing directly into the Pacific Ocean. The Great Valley drainage includes all those streams flowing into the Sacramento and San Joaquin Rivers and drains approximately 59,000 square miles. Most of the runoff through the watershed is derived from melting snow that creates a peak flow around February. Heavy seasonal rains cause another peak flow period in April to May. The Sacramento Basin, the northern portion of the Great Valley system, is the most important hydrologic basin in California. It drains more than 5,000 square miles of the northern central valley. Four major rivers drain the basin: the Yuba, the Feather, the American, and the Sacramento. The first three of these rivers drain the northern part of the Sierra Nevada mountain range before emptying into the Sacramento River. Shortly after leaving the Central Valley, the Sacramento River drains westward into the Suisun Bay Delta. Numerous major reservoirs regulate the flow from this basin and provide storage, flood control, and hydroelectricity.

2.4.2 Local Hydrology

The Inland Area lies within the Mt. Diablo-Seal Creek hydrologic watershed. The principal drainage for this watershed is Mt. Diablo Creek, which is referred to as Seal Creek once it enters NWS SBD Concord. Flow in Seal Creek along the Inland Area is intermittent, occurring primarily during the winter rainy season. Historical records show that some degree of flooding occurs during normal precipitation years along portions of the creek near the Tidal Area; however, the section of the creek that runs through the Inland Area is not a source of severe overbank flooding because the channel is deeply incised.

Groundwater beneath the Inland Area is commonly found in the coarser sand and gravel units of the unconsolidated alluvium. Groundwater has been first encountered at depths between 30 to 50 feet, under semiconfined to confined conditions. Static water levels at the site are approximately 20 to 28 feet from the ground surface.

Hydrogeologic information for Site 22 was collected from temporary wells 7SHSB010, 7SHSB011, and 7SHS012, installed in May 1995, and from monitoring wells 7SHMW001, 7SHMW002, 7SHMW003, and 7SHMW004, installed in January 1997. These well locations are indicated on Figure 2-3.

The deeper sand/gravel water-bearing unit observed elsewhere at the Inland Area sites was not encountered at Site 22. Based on static water levels, the potentiometric surface beneath the site ranges in elevation from approximately 133 feet mean seal level (msl) to about 142 feet msl. Groundwater flows to the west-northwest at a gradient of approximately 0.0036. A potentiometric map indicating the groundwater elevations and direction of groundwater flow for Site 22 is shown in Figure 2-4. Groundwater measurements at Site 22 are included with the groundwater sampling forms presented in Appendix D. The vertical permeabilities of the water-bearing zone, in which temporary wells 7SHSB610 through 7SHSB612 were screened, were assessed from geotechnical samples collected during borehole drilling. The vertical permeabilities calculated from these samples range from 1.00×10^{-7} centimeters per second (cm/sec) to 9.00×10^{-7} cm/sec. Results of the geotechnical laboratory analysis can be found in Section 5.3.

Groundwater Potability. EPA requires that the Navy use federal criteria to assess whether groundwater is a potential drinking water source, as set forth in the EPA's groundwater classification guidelines (EPA 1998a), rather than the State of California Water Resources Control Board (SWRCB) Resolution No. 88-63 criteria. The significance of this requirement is that groundwater that would not have been considered potable under state criteria might be considered potable under federal criteria. Under EPA groundwater classification guidelines, groundwater with a total dissolved solids (TDS) content of less than 10,000 milligrams per liter (mg/L) and a groundwater production rate (or well yield) of at least 150 gallons per day (gpd) may be considered a potential source of drinking water (such as potable water). Under SWRCB criteria, a TDS content less than 3,000 mg/L and minimum yield of 200 gpd are used to classify groundwater as beneficial for municipal or domestic supply. The groundwater parameters measured in wells at Site 22 (see Appendix D) indicate that TDS levels are below both EPA and SWRCB criteria for potential groundwater potability. The wells may meet the minimum yield requirements, however no slug tests were conducted at the site.

According to the San Francisco Bay region basin plan (California Regional Water Quality Control Board [RWQCB] 1995, 2000), NWS SBD Concord is located within the Clayton Groundwater Basin. The Clayton Basin is considered a potentially significant groundwater basin within the San Francisco Bay Region. For basin planning purposes the term “groundwater” is defined to include all subsurface waters, whether or not these waters meet the classic definition of an aquifer or occur within identified groundwater basins. Unless specifically exempted, a groundwater basin or portion thereof is designated as potentially suitable for municipal and domestic water supplies (RWQCB 2000).

Storm Water Management. NWS SBD Concord discharges storm water in three ways: directly to storm drain systems, directly to U.S. waters, or indirectly to U.S. waters. Storm water from Site 22 is collected in drainage ditches that discharge into Seal Creek.

The SWRCB requires development and implementation of a storm water pollution prevention plan (SWPPP). The purpose of implementing a SWPPP is to reduce or eliminate pollutants discharged to U.S. waters. NWS SBD Concord updated its SWPPP that applies to storm water discharges from industrial areas (CH2MHILL 2001). Storm water runoff from the drainage ditches is analyzed yearly during the wet season. In the course of the SWPPP update, NWS SBD Concord eliminated a number of industrial activities and unauthorized discharges. Site 22 has not been identified as potentially impacting storm water quality.

2.5 ECOLOGICAL SETTING

Information was compiled on the ecological setting such as the habitats, animal and plant species, and special status species that could potentially be exposed to site-related chemicals of potential ecological concern (COPEC). From July 1998 to September 1999, the University of Arizona Advanced Resource Technology Group characterized and mapped natural resources at NWS SBD Concord (Downard, Guertin, and Morrison 1999). The purpose of this project was to identify and describe the seasonal presence, distribution, and abundance of wildlife and plant communities that occur at NWS SBD Concord. Although ecological surveys were conducted throughout the Inland Area, the survey was not specific to Site 22. Information presented below is based on the ecological surveys of the Magazine Area at NWS SBD Concord.

Plants. Site 22 is located in an annual grassland with storage buildings, ammunition magazines, open space, and a network of roads and railroads. The area immediately southwest of Building 7SH5 is paved; however, the majority of the surrounding area to the south and east is annual grassland. The area at and around Site 22 has been disturbed through clearing, grazing, burning, grading, and other human activities. Dominant plant species are primarily nonnative/invasive grass species such as wild oat (*Avena fatua*), ripgut grass (*Bromus diandrus*), Mediterranean barley (*Hordeum marinum*), and Italian rye grass (*Lolium multiflorum*). A nonnative forb species, star thistle (*Centaurea solstitialis*), is widely distributed within grasslands in the Inland Area (Downard, Guertin, and Morrison 1999).

Amphibians and Reptiles. Seven amphibian and 15 reptile species were observed at NWS SBD Concord from July 1998 to September 1999. Among amphibian species observed, two are federally or state listed as sensitive. California red-legged frogs (*Rana aurora draytonii*) are federally listed as threatened and state listed as a Species of Special Concern. California tiger salamanders (*Ambystoma californiense*) were also observed within the Inland Area. This species is state listed as a Species of Special Concern. Proximity to an ephemeral or ` water source was the primary factor in fixed survey site selection since amphibian species require water during their life cycle. Because Site 22 has no perennial or seasonal water bodies, it is unlikely that either of these species uses the grassland area of Site 22.

Birds. Bird surveys were conducted in the magazine area throughout the 1-year observation period (Downard, Guertin, and Morrison 1999). Table 2-1 is a complete list of birds observed in the magazine area during the 1998 and 1999 surveys. Dominant species include the American Goldfinch *(Carduelis tristis)*, American Robin *(Turdus migratorius)*, Anna's Hummingbird *(Calypte anna)*, Bullock's Oriole *(Icterus bullockii)*, California Towhee *(Pipilo crissalis)*, European starling *(Sturnus vulgaris)*, Golden-crowned Sparrow *(Zonotrichia atricapilla)*, House Finch *(Carpodacus mexicanus)*, Mourning Dove

(Zenaida macroura), Northern Mockingbird *(Mimus polyglottos)*, Spotted Towhee *(Pipilo maculates)*, Western Kingbird *(Tyrannus verticalis)*, Western Meadowlark *(Sternella neglecta)*, White-crowned Sparrow *(Zonotrichia leucophrys)*, and the Yellow-rumped Warbler *(Dendroica coronata)*.

Mammals. The mammals potentially present at Site 22 include species of rodents and larger mammals. Rodents observed in and around Site 22 include deer mice *(Peromyscus maniculatis)*, western harvest mice *(Reithrodontomys megalotis)*, house mice (*Mus musculus)*, and California voles *(Microtus californicus)*. Larger mammals potentially present include raccoons *(Procyon lotor)*, badgers *(Taxidea taxus)*, striped skunks *(Mephitis mephitis)*, grey foxes *(Urocyon cinereoargenteus)*, coyote *(Canis latrans)*, California ground squirrels *(Spermophilus beecheyi)*, fox squirrels *(Sciurus niger)*, black-tailed jackrabbits *(Lepus californicus)*, cattle *(Bos Taurus)* and tule elk *(Cervus elaphus nannodes)*. Table 2-2 is a complete list of mammals observed in or around Site 22 during the 1998 and 1999 surveys (Downard, Guertin, and Morrison 1999).

Special Status Species. Based on habitat surveys in the Inland Area at Concord, no special status species have been observed in the vicinity of Site 22 (Downard, Guertin, and Morrison 1999).

2.6 PEST MANAGEMENT

Annual controlled burns are currently used to manage weeds and insects at the grassland areas of Site 22. The rodent population at Site 22 is currently not controlled.

In 1997, NWS SBD Concord developed a draft pest management plan (Navy 1997). The pest management plan applied an integrated pest management program that emphasized the use of cultural, biological, physical, educational, and mechanical methods of pest control and limited the use of chemical pesticides. In those areas and times where pesticide use was necessary, the Navy employed several different insecticides, rodenticides, and herbicides to control pest populations. For example, herbicides were used along railroad tracks and in the cracks of sidewalks to reduce weeds.

A large population of ground squirrels lives throughout NWS SBD Concord, including the Site 22, Building 7SH5 area. Historically, ground squirrels have caused significant structural damage to earthen magazine covers and blast barriers. Historical records of rodenticide applications at NWS SBD Concord are unavailable.

3.0 PRELIMINARY IDENTIFICATION OF APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

The following sections summarize the CERCLA and NCP requirements for the identification of ARARs and a preliminary chemical- and location-specific ARAR analyses. Because new data collected to support this supplemental RI focused only on characterizing the arsenic content of the soil at Site 22, the regulations presented in these sections were analyzed only for applicability, relevance, or appropriateness to arsenic in soil. No other regulations pertaining to any other media were examined at this time. Tables 3-1 through 3-4 present these preliminary ARAR analyses.

3.1 SUMMARY OF REQUIREMENTS

Section 121(d) of CERCLA (Title 42 *United States Code* [USC] Section 9621[d]), as amended, states that remedial actions on CERCLA sites must attain (or the decision document must justify the waiver of) any federal or more stringent state environmental standards, requirements, criteria, or limitations that are determined to be legally applicable or relevant and appropriate.

Applicable requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address the situation at a CERCLA site. An applicable federal requirement is an ARAR. An applicable state requirement is an ARAR only if it is more stringent than federal ARARs.

If the requirement is not legally applicable, the requirement is evaluated to determine whether it is relevant and appropriate. Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that, while not applicable, address problems or situations similar to the circumstances of the proposed response action and are well suited to the conditions of the site (EPA 1988b).

The criteria for determining relevance and appropriateness are listed in Title 40 *Code of Federal Regulations* (CFR) 300.400(g)(2) and include the following:

- The purpose of the requirement and the purpose of the CERCLA action
- The medium regulated or affected by the requirement and the medium contaminated or affected at the CERCLA site
- The substances regulated by the requirement and the substances found at the CERCLA site
- Any variances, waivers, or exemptions of the requirement and their availability for the circumstances at the CERCLA site
- The type of place regulated and the type of place affected by the release or CERCLA action

- The type and size of structure or facility regulated and the type and size of structure or facility affected by the release or contemplated by the CERCLA action
- Any consideration of use or potential use of affected resources in the requirement and the use or potential use of the affected resources at the CERCLA site

Nonpromulgated advisories or guidance issued by federal or state governments are not legally binding and do not have the status of ARARs. Such requirements may, however, be useful, and are "to be considered" (TBC). TBC (40 CFR 300.400[g][3]) requirements complement ARARs but do not override them. They are useful for guiding decisions regarding cleanup levels or methodologies when regulatory standards are not available.

Pursuant to EPA guidance (EPA 1988b), ARARs are generally divided into three categories: chemical-specific, location-specific, and action-specific requirements. Only chemical- and location-specific ARARs were analyzed for this supplemental RI for Site 22.

The identification of ARARs is an iterative process. A very preliminary analysis of chemical- and location-specific ARARs may be included in an RI. That analysis may be further refined in an FS if necessary. A final determination of ARARs is not made until the ROD is completed. Based on the Navy's continuing analysis of the appropriate response action, if any, for Site 22, the chemical- and location-specific ARARs presented in this supplemental RI may change.

As the lead federal agency, the Navy has primary responsibility for identifying federal ARARs at Site 22 and for making the final ARAR determinations in the ROD. EPA guidance (EPA 1988a) recommends that the lead federal agency consult with the state when identifying state ARARs. The Navy has included potential state chemical- and location-specific ARARs in this supplemental RI and will seek the state's input on this analysis through the state's review and comment on this report. If necessary, the Navy will also request a formal identification of potential state chemical- and location-specific ARARs for this supplemental RI from the Cal/EPA DTSC.

3.2 CHEMICAL-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Chemical-specific ARARs are generally health- or risk-based numerical values or methodologies applied to site-specific conditions that result in the establishment of a cleanup level. This section presents preliminary ARARs analyses for soil. Potential federal and state chemical-specific ARARs are summarized in Tables 3-1, 3-2, 3-3, and 3-4.

3.2.1 Soil

The key threshold question for soil ARARs is whether or not the wastes located at Site 22 would be classified as hazardous waste. The soil may be classified as a federal hazardous waste as defined by

RCRA and the state-authorized program, or as non-RCRA, state-regulated hazardous waste. If the soil is determined to be hazardous waste, the appropriate requirements will apply.

3.2.1.1 Federal

The federal RCRA requirements at Title 40 CFR 261 do not apply in California because the state RCRA program is authorized. The authorized state RCRA requirements are therefore considered potential federal ARARs. The applicability of RCRA requirements depends on whether the waste is a RCRA hazardous waste; whether the waste was initially treated, stored, or disposed after the effective date of the particular RCRA requirement; and whether the activity at the site constitutes treatment, storage, or disposal as defined by RCRA. RCRA requirements may, however, be relevant and appropriate even if they are not applicable. Examples include activities similar to the definition of RCRA treatment, storage, or disposal for waste similar to RCRA hazardous waste.

The determination of whether a waste is a RCRA hazardous waste can be made by comparing the site waste to the definition of RCRA hazardous waste. The RCRA requirements at Title 22 *California Code of Regulations* (CCR) 66261.21, 66261.22(a)(1), 66261.23, 66261.24(a)(1), and 66261.100 are potential chemical-specific ARARs because they define RCRA hazardous waste. A waste can meet the definition of hazardous waste if it has the toxicity characteristic of hazardous waste. This determination is made by using the toxicity characteristic leaching procedure (TCLP). The maximum concentrations allowable for the TCLP listed in 22 CCR 66261.24(a)(1)(B) are potential federal chemical-specific ARARs for determining whether the site has hazardous waste. If the site waste has concentrations exceeding these values, it is determined to be a characteristic RCRA hazardous waste.

3.2.1.2 State

State ARARs are identified in the following paragraphs.

Resource Conservation and Recovery Act Requirements. State RCRA requirements included within the EPA-authorized RCRA program for California are considered to be potential federal ARARs and are discussed previously. When state regulations are either broader in scope or more stringent than their federal counterparts, they are considered potential state ARARs. State requirements such as the non-RCRA, state-regulated hazardous waste requirements may be potential state ARARs because they are not within the scope of the federal ARARs (Title 57 *Federal Register* 60848). The Title 22 CCR requirements that are part of the state-approved RCRA program would be potential state ARARs for non-RCRA, state-regulated hazardous wastes.

The site waste characteristics should be compared to the definition of non-RCRA, state-regulated hazardous waste. The non-RCRA, state-regulated waste definition requirements at Title 22 CCR 66261.24(a)(2) are potential state chemical-specific ARARs for determining whether other RCRA requirements are potential state ARARs. This section lists the total threshold limit concentrations and soluble threshold limit concentration. The site waste may be compared to these thresholds to determine whether it meets the characteristics for a non-RCRA, state-regulated hazardous waste.

Title 23 CCR Division 3, Chapter 15. The requirements at Title 23 CCR division 3, chapter 15, define a hazardous waste. This definition is not more stringent than federal or state RCRA ARARs for identifying hazardous waste; therefore the definition of a hazardous waste under Title 23 CCR 2521 is not a potential chemical-specific ARAR at this time.

Title 27 CCR Division 2, Subdivision 1. Title 27 CCR 20230(a) defines inert waste as waste "that does not contain hazardous waste or soluble pollutants at concentrations in excess of applicable water quality objectives, and does not contain significant quantities of decomposable waste." Title 27 CCR 20230(b) states that "inert wastes do not need to be discharged at classified waste management units." Title 27 CCR 20230(a) and (b) may be potential state chemical-specific ARARs for soil that meets the definition of inert waste.

Title 27 CCR 20210 and 20220 are state definitions for designated waste and nonhazardous waste, respectively. These may be chemical-specific ARARs for soil that meets the definitions. These soil classifications determine state classification and siting requirements for discharging waste to land.

3.3 LOCATION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Potential location-specific ARARs are analyzed and discussed in this section. The discussions are presented based on various attributes of Site 22. There are no cultural resources, wetlands, hydrologic resources, coastal resources, or other protected natural resources on Site 22, and Site 22 is not within a 100-year floodplain. Statutory and regulatory requirements relating to these attributes were not analyzed for potential applicability, relevance, or appropriateness. Because endangered species habitat and migratory birds may be found within NWS SBD Concord, statutory and regulatory requirements pertaining to endangered species and migratory birds were analyzed for applicability, relevance, and appropriateness. Any location-specific requirements, such as RCRA facility siting regulations, that depend on a response action alternative, were also reviewed for applicability, relevance, or appropriateness. Instead, such location-specific requirements will be reviewed if and when the Navy determines that a response action at Site 22 is warranted.

3.3.1 Biological Resources

No threatened or endangered species or their habitats have been identified as present on Site 22; however, there are several federal and state endangered species and migratory birds present at NWS SBD Concord. Because no threatened or endangered species or migratory birds have been identified as present on Site 22, the Navy made an initial analysis that requirements pertaining to these biological resources were not applicable. The Navy applied the criteria for determining relevance and appropriateness contained in Title 40 CFR 300.400(g) to the site-specific conditions of Site 22 and made an initial analysis that the requirements are relevant and appropriate. These relevant and appropriate requirements are discussed in the following sections.

3.3.1.1 Federal

Federal ARARs are identified in the following paragraphs.

Endangered Species Act of 1973. The Endangered Species Act (ESA) (Title 16 USC 1531 through 1543) provides a means for conserving various species of fish, wildlife, and plants threatened with extinction. The ESA defines an endangered species and provides for the designation of critical habitats. Federal agencies may not jeopardize the continued existence of any listed species or cause the destruction or adverse modification of critical habitat. Under Section 7(a) of the ESA, federal agencies must carry out conservation programs for listed species. The Endangered Species Committee may grant an exemption for agency action if reasonable mitigation and enhancement measures such as propagation, transplantation, and habitat acquisition and improvement are implemented. Consultation regulations at Title 50 CFR 402 are administrative in nature and are therefore not ARARs; however, they may be TBCs to comply with the substantive provisions of the ESA.

Migratory Bird Treaty Act of 1972. The Migratory Bird Treaty Act (Title 16 USC 703 through 712) prohibits at any time, using any means or manner, the pursuit, hunting, capturing, and killing or attempting to take, capture, or kill any migratory bird. This act also prohibits the possession, sale, export, and import of any migratory bird or any part of a migratory bird, as well as nests and eggs. A list of migratory birds for which this requirement applies is found at Title 50 CFR 10.13. It is the Navy's position that this act is not legally applicable to Navy actions. Executive Order No. 13186 (dated January 10, 2001), however, requires each federal agency taking actions that have or are likely to have a measurable effect on migratory bird populations to develop and implement, within 2 years, a memorandum of understanding (MOU) with the U.S. Fish and Wildlife Service (FWS) to promote the conservation of such populations. The U.S. Department of Defense and the FWS are in the process of negotiating this MOU. In the meantime, the Migratory Bird Treaty Act will continue to be evaluated as a potentially relevant and appropriate requirement for Navy CERCLA response actions.

3.3.1.2 State

State ARARs are identified in the following paragraphs.

California Endangered Species Act. The California Endangered Species Act is codified in the California Fish and Game Code 2050 through 2116. It is the Navy's position that the requisite federal sovereign immunity waiver does not exist to authorize applicability of the California Endangered Species Act to the federal government. Nevertheless, this Act will be evaluated as a potentially relevant and appropriate requirement for the Navy's CERCLA response actions. The California Fish and Game Code 2080 prohibits the taking of any endangered species.

4.0 INVESTIGATION METHODS

The following sections briefly describe how data are used in this report, including the types of data collected from previous investigations, data quality objectives (DQO) for the supplemental RI, investigation methods for the supplemental RI data, soil and groundwater criteria, and statistical analyses used in the supplemental RI. Data quality and data validation are discussed in Appendix E.

4.1 USE OF DATA

Data collected as part of the SI (PRC 1993), RFA Confirmation Study (PRC 1997), Phase I RI (TtEMI 1997), Phase II RI (TtEMI 1998a), and the new data collected in October 2002 were used in this report to support both the SLHHRA and the SLERA.

4.2 DATA COLLECTED DURING PREVIOUS INVESTIGATIONS

This section briefly describes the type of data collected from previous investigations at the site that were used in this supplemental RI to support the chemical characterization, HHRA, SLERA, and recommendations presented in this report. The investigation methods used in the SI, RFA Confirmation Study, Phase I RI, and Phase II RI are described in those reports (PRC 1993, PRC 1997, TtEMI 1997, TtEMI 1998a). The types of groundwater and soil samples collected during each investigation are summarized in the following text and are presented in Tables 4-1 and 4-2, respectively. Sample results are presented in Section 5.0.

Site Investigation. During the SI in 1992, three soil borings were collected within the suspected disposal pit, and one composite surface soil sample was collected from the bottom of a drainage ditch. Samples were analyzed for SVOCs, VOCs, metals, organotins, TPH (extractable and purgeable), and percent moisture (Table 4-2).

Resource Conservation and Recovery Act Facility Assessment Confirmation Study. During the RFA Confirmation Study, two deep soil borings were advanced in the septic leach field, and two shallow soil borings were advanced along the drainage ditch west of the leach field. All samples were analyzed for VOCs, SVOCs, TOG, and metals (Table 4-2).

Phase I Remedial Investigation. During the Phase I RI, soil samples were collected around the drainage ditches, the alleged disposal pit, and the UST and associated piping. Five soil samples collected in the ditches around Building 7SH5 were analyzed for SVOCs, TPH (extractables), and metals. Nine shallow soil borings were advanced along the UST pipeline around the southern and western sides of Building 7SH5 to further define the extent and magnitude of soil contamination associated with the pipeline; samples were analyzed for VOCs, SVOCs, and TPH (extractables). Twelve trench samples collected from six locations within the suspected disposal pit were analyzed from VOCs, SVOCs, TPH (extractables), and metals. Three deep soil borings drilled along the UST pipeline were analyzed for total organic carbon (TOC), geotechnical parameters, SVOC, VOC, and TPH (extractables) (Table 4-2). Three grab groundwater samples collected from three soil borings were analyzed for SVOCs, TPH (extractable), and VOCs (Table 4-1).

Phase II Remedial Investigation. During Phase II of the RI, four monitoring wells were installed. Groundwater samples were collected and analyzed for SVOCs, TPH (extractable), and VOCs (Table 4-1) over four quarters. In addition, 26 soil samples were collected and analyzed for VOCs and TPH (extractables) from the four soil borings.

4.3 DATA QUALITY OBJECTIVES FOR THE SUPPLEMENTAL REMEDIAL INVESTIGATION

DQOs are qualitative and quantitative goals developed to specify the quality of data needed to support specific decisions or regulatory actions for a particular data collection activity. EPA guidance identifies a seven-step process for the preparation of DQOs (EPA 1999a). The following subsections describe these seven DQO steps for the collection of supplemental RI data at Site 22. The seven DQO steps are also presented in Table 4-3. DQOs for the Phase I and Phase II RI reports are summarized in the respective QAPPs for those reports (PRC/Montgomery Watson 1995b and PRC 1996).

4.3.1 Step 1 – State the Problem

Step 1 of the DQO process identifies the specific problems to be addressed by field activities. During the RI, elevated concentrations of arsenic were detected at Site 22, mostly in samples from the top 3 feet of soil. Elevated concentrations were detected at 10 feet bgs at one sampling location. The distribution and source of arsenic in soil was unknown. The supplemental RI was designed to provide data to further delineate the lateral and vertical extent of elevated arsenic concentrations in soil at Site 22, determine whether there was a site related release of arsenic, and evaluate potential risk to human and ecological receptors. Possible sources of arsenic include naturally occurring sources, railroad activities, or arsenic-containing herbicides, pesticides, or rodenticides.

4.3.2 Step 2 – Identify the Decisions

Step 2 of the DQO process identifies the decisions that would result from the investigation. The decision was formulated based on the overall problem presented in Step 1. The decision to be made for the site is whether arsenic is detected at concentrations that warrant further action. This decision was based on answering the following questions:

- Is the source of the elevated arsenic concentrations in soil at Site 22 anthropogenic?
- Do anthropogenic sources of arsenic at Site 22 pose unacceptable risk to human and ecological receptors that warrants further action?

4.3.3 Step 3 – Identify Inputs to the Decisions

Step 3 of the DQO process describes the information needed to resolve the decision statements identified in Step 2. For this supplemental RI, soil samples were collected for chemical analysis. These data were used with existing data to evaluate whether the source of elevated levels of arsenic in soil is anthropogenic or not and whether concentrations of arsenic at the site pose risk to human and ecological receptors. The inputs required to support the decision were as follows:

- Validated, defensible chemical data for soil
- Data from previous investigations
- Ambient levels for arsenic in soil
- Historic pesticide, herbicide, and rodenticide application information
- Ecological and human health screening benchmarks
- Geochemical data analysis
- Existing biological surveys
- ARARs
- Current land use and future land use development plans
- Results of the SLHHRA
- Results of the SLERA

4.3.4 Step 4 – Define the Study Boundaries

Step 4 of the DQO process defines the site characteristics in terms of spatial boundaries that the environmental measurements are intended to represent. The spatial boundaries of the site define the area to be studied and indicate where samples should be collected. The lateral limit of the arsenic study was the grassland area adjacent to Building 7SH5. The vertical extent of the arsenic study was the soil to a depth of 10 feet bgs. No temporal boundaries were set. For the HHRA, only soil samples to the depth that may affect human receptors (0 to 10 feet bgs) were used. For the ERA, only soil samples from the depth that may affect ecological receptors (0 to 3 feet bgs) were used.

4.3.5 Step 5 – Develop a Decision Rule

Step 5 integrates each study output into a single statement that describes the logical basis for choosing among alternative actions. Step 5 essentially delineates the consequences of the results of the study. Decision rules are formulated as "if, then" statements, in which the outcome of the investigation provides direction for the next stage of problem resolution. For each decision identified in Step 2, a decision rule is presented in Step 5. These decision rules were as follows:

- If arsenic concentrations are indistinguishable from the existing ambient data set for the site (TtEMI 1997) using two population comparison tests, then it will be concluded that samples represent ambient conditions and no further action will be required.

- If arsenic concentrations exceed ambient, then proceed as follows:
  - If arsenic concentrations that exceed ambient are strongly correlated with concentrations of iron, manganese, or antimony, then the source will be considered naturally occurring, and a reevaluation of the existing ambient data set will be recommended.
  - If arsenic concentrations are not correlated with concentrations of iron, manganese, or antimony, then the source of arsenic will be considered anthropogenic, and a risk assessment will be conducted.
- If concentrations of arsenic at the site pose acceptable risk to human or ecological receptors, no future action will be recommended.
- If concentrations of arsenic at the site pose unacceptable risk to human or ecological receptors, then future action will be recommended

4.3.6 Step 6 – Specify Limits on Decision Errors

Limits of decision errors are summarized on Table 4-3 and were primarily based on EPA guidance and professional judgment (EPA 1999a).

4.3.7 Step 7 – Optimize the Design for Obtaining Data

Step 7 of the DQO process optimized the sampling design based on current information. The purpose of this step was to identify a resource-effective design for generating environmental data that will satisfy the DQOs discussed in the previous sections.

Previous sample results indicate that arsenic concentrations were elevated in the open grassland areas of Site 22 and were not associated with Building 7SH5 (TtEMI 1997). For this study, six sampling locations were selected to represent the open grasslands of Site 22. Three sampling locations were selected to represent ditches, and four sampling locations were selected to represent conditions related to activities at Building 7SH5. Two samples were selected to represent conditions adjacent to the railroad tracks, and three sampling locations were selected to represent the area immediately adjacent to Building 7SH5. No proposed samples were located in roads or inside buildings. Individual sampling locations were selected using a judgmental sampling approach to specifically target identified potential source areas.

4.4 SOIL INVESTIGATION METHODS FOR SUPPLEMENTAL REMEDIAL INVESTIGATION

The soil investigation methods described in this section are for the October 2002 soil sampling event, conducted as part of the supplemental RI. Methods used for soil and groundwater investigation conducted during the SI, RFA Confirmation Study, Phase I RI, and Phase II RI are presented in the Phase I and II RI reports (TtEMI 1997, 1998a). A more detailed discussion of the sampling methods and procedures for the supplemental RI can be found in the SAP (TtEMI 2002).

At 14 locations, soil samples were collected from three depths (surface, 4 feet bgs, and 10 feet bgs) and analyzed for arsenic, antimony, iron, manganese, and pH to determine the source of the elevated arsenic concentrations. At one location, only a surface sample (0 to 0.5 foot bgs) was collected and analyzed for the same four inorganic chemicals and pH. This sample was added to the scope of the investigation at the request of EPA. The analytical methods were consistent with methods used for during previous investigations at Site 22.

All samples were collected using a 4-foot-long, 1.5-inch-diameter Geoprobe sampling spoon with polyethylene terephthalate glycol (PETG) liners. Discrete samples for laboratory analysis were collected from the Geoprobe sampling spoon by cutting the PETG liners and capping them with Teflon sheets and plastic caps. The plastic caps were secured with paraffin tape. Each soil boring was logged by a geologist using the Unified Soil Classification System (USCS). Soil boring logs are presented in Appendix C. All soil samples were placed in a cooler prechilled with ice immediately after the samples were sealed. The sample coolers were sealed and shipped directly from the site with chain-of-custody forms to the analytical laboratory.

Existing engineering plans, drawings, diagrams, and other information showing underground utilities were reviewed before drilling locations were finalized. A utility-locating subcontractor was obtained to clear all drilling locations. Private companies that run lines across the station were notified by the local commercial underground utilities locating service and were asked to clear all drilling locations.

4.4.1 Sample Identification

A unique sample identification number was assigned to each sample collected at Site 22. The sample identification numbering system was designed to be compatible with a computerized data management system that includes previous results for samples collected at NWS SBD Concord. The sample numbering system allows each sample to be uniquely identified and provides a means of tracking the sample from collection through analysis. The numbering system indicates the site location, sampling activity, specific sampling location, and sample depth (soil samples only).

Site Location	7SH – near building 7SH5
Sampling Activity	SB – soil sample from a soil boring
	TP – soil sample from a test pit (Phase I RI)
Specific Sampling Location	100 – consecutive 3-digit specific sampling location
Sample Depth	The depth of soil samples was listed in parentheses after the specific sampling location

For example, a soil sample collected at Site 22 from the 3.0- to 4.0-foot interval was designated as 7SHSB101 (3.0-4.0).

The sample analysis labeling, documentation, and shipment, chain-of-custody procedures were all followed as specified in the SAP (TtEMI 2002). All analytical holding times were met because the samples were sent to the laboratory via courier.

4.5 SELECTION OF COMPARISON CRITERIA OR BENCHMARKS

Analytical results from the SI, RFA Confirmation Study, Phase I RI, Phase II RI, and supplemental RI were evaluated using a set of comparison criteria or benchmarks to delineate site-related contamination and as a means to narrow the focus of the chemical characterization discussion in the supplemental RI report. The following sections describe the comparison criteria or benchmarks used for contaminants in soil and groundwater. Table 4-4 presents the soil criteria used, and Table 4-5 presents the groundwater criteria.

4.5.1 Soil Criteria

Site 22 is an industrial site; no plans are in place for a change in future land use. Because of the proximity of residential housing to Site 22 (approximately 500 feet away), however, sample results from Site 22 were compared with preliminary remediation goals (PRG) for both residential and industrial use (EPA 2002a). Residential and industrial PRGs used to evaluate site soil concentrations are presented in Table 4-4. Metals were also compared with ambient levels established in soil for Site 22. Ambient metals concentrations established for the site are described in the following text. The statistical methods for comparison of site data with ambient metals is described in the following section.

4.5.1.1 Estimated Ambient Metal Concentrations

An ambient data set for determining ambient metal concentrations in soil was established during the Phase I RI by collecting soil samples in areas considered unaffected by Navy operations or other industrial activities for IR sites in the Inland Area (22, 33, 17, and 24A). Statistical procedures consistent with the EPA and DTSC guidance documents were followed (EPA 1989a; DTSC 1992, 1994). A technical memorandum from the Phase I RI that describes methods for estimation of ambient metals concentrations is presented in Appendix B. Estimated ambient limit values in soil for some metals, including arsenic, exceed both residential and industrial PRGs for soil.

The purpose of estimating ambient concentrations is to have a basis to assess whether the detection of a constituent indicates site-related contamination or whether it may be attributed to naturally occurring or nonsite-related anthropogenic sources. To evaluate the effects of site activities on the environment, constituent concentrations detected at a site are typically compared to the ambient concentrations, and the difference between the detected concentrations and ambient concentrations is assumed to be the impact of site activities.

Because soils at IR Sites 22 and 13 are both formed in the alluvial depositional environment and were a distinct population from ambient samples collected from IR Sites 17 and 24A, ambient samples from IR Sites 22 and 13 were pooled to establish the ambient data set for those sites. The locations of soil borings collected as part of the ambient data set were determined using a stratified random approach. Six borings were performed at Site 22, and eight borings were performed at IR Site 13. The soil samples were collected at the 0.5-foot and 10-foot depths.

Because several samples collected at Site 22 as part of the ambient data set contained elevated concentrations of arsenic, 11 samples were removed from the ambient data set and were reclassified as site data rather than ambient data. Methods for the statistical comparison of the Site 22 ambient data set to the Site 22 metals data set are discussed in Section 4.6.

4.5.2 Groundwater Criteria

The comparison criteria used to evaluate contaminant concentrations in groundwater at Site 22 were based on EPA and CDHS maximum contaminant levels (MCL) (EPA 2002b, CDHS 2002), and EPA PRGs for groundwater (EPA 2002a). Although groundwater at the site is not currently used as a drinking water source, and there are no known groundwater wells used for domestic water supply in the vicinity of Site 22, site groundwater concentrations were compared with criteria protective of drinking water. Groundwater criteria used to evaluate site concentrations in groundwater are summarized in Table 4-5. In November 2002, EPA updated the tap water PRGs for several VOCs, including TCE, and 1,1,1-trichloroethane (EPA 2002a). The tap water PRG for TCE was lowered from 1.6 ug/L to 0.028 ug/L. Due to this recent update, groundwater comparison criteria used in this report are different than those presented in previous reports for Site 22.

4.6 STATISTICAL ANALYSIS OF SOIL AND GROUNDWATER DATA

Statistical analyses of soil and groundwater data from Site 22 were conducted to support both human health (Section 6.0) and ecological (Section 7.0) risk assessments and had two objectives. First, tables of descriptive statistics, including exposure point concentrations (EPC), were compiled for all detected chemicals in soil and groundwater. Second, site data for soil metals were compared to the ambient data set for Sites 22 and 13 using two-population tests. For soil data, analyses were conducted for three depth intervals: 0- to 0.5-, 0- to 3-, and 0- to 10-feet bgs. Soil and groundwater data collected during the SI, RFA Confirmation Study, Phase I RI, Phase II RI, and supplemental RI were used in the statistical analysis and were evaluated in both the human health and ecological risk assessments.

The methods used to accomplish each of these objectives are summarized in the following text. Interpretation of the statistical results is provided in Section 5.1.2.1. The approach used for calculating exposure point concentrations is shown in Figures 4-1 and 4-2.

4.6.1 Calculation of Descriptive Statistics for Soil and Groundwater

Descriptive statistics were calculated for all chemicals detected in at least one sample. Summary tables were prepared that included the following descriptive statistics:

- Chemical distribution
- Number of detected samples
- Total number of samples
- Detection frequency
- Minimum and maximum concentrations for censored data only
- Minimum and maximum concentrations for detected data only
- Median, 95th percentile, mean, standard deviation (SD), coefficient of variation (CV), and the one-sided upper 95th percentile upper confidence limit on the arithmetic mean (UCL_{95}) for detected and censored data combined
- Estimated EPC for the human health risk assessment.

For soil data, the following analyte groups were included in the tables: total metals, semivolatile organic analytes (SVOA), volatile organic analytes (VOA), organotins, and TPH (extractable and purgeable). Summary tables for groundwater data include SVOA, VOA, and extractable TPH. Results of the descriptive statistics are discussed in Section 5.0.

The following methods were used to test the distribution for chemicals in soil and groundwater, calculate moments for each population, and calculate EPCs.

Distribution Tests. The Shapiro-Wilk W test was conducted for all samples with at least five measurements and detection frequencies greater than or equal to 50 percent. A Type I error rate (alpha) of 0.05 (equivalent to 5 percent) was used for these tests. Tests were conducted sequentially on data in original and natural-log transformed units.

Censored data were evaluated using the reporting limit for each chemical. Chemicals confirmed as following a normal or lognormal distribution were identified as "normal" or "lognormal," respectively, in summary tables. Chemicals not confirmed as either normal or lognormal were identified as "unknown" in summary tables and were further evaluated by examining normal and lognormal probability plots, outlier box-plots, and frequency histograms. Professional judgment was used to select the distribution that most closely fit the data. No statistical assessment was conducted for chemicals detected in fewer than 5 samples or detection frequencies less than 50 percent, and these chemicals are listed as "not tested" in the tables. For cases where the sample size was small (approximately 5-10 samples) with detection frequencies greater than or equal to 50 percent) and results of the Shapiro-Wilk W test or assessments based on professional judgment indicated that the data fit either a normal or lognormal distribution, a normal-distribution assumption was used. This decision was made based on technical literature (Singh, Singh, and Engelhart 1997) and the Navy's experience that estimates of the UCL_{95} calculated using models developed for lognormally distributed data and data with small sample size often result in EPCs inappropriately high for risk assessment purposes.

Population Moments. The mean, SD, and UCL_{95} were calculated for samples with at least one detected measurement. Calculations were performed using distribution-dependent formulae.

For samples with at least 85 percent detected data, one-half the reporting limit was substituted for all censored data. For samples confirmed or assumed to follow a lognormal distribution, minimum variance unbiased (MVU) estimates of the mean and SD were calculated using equations 13.3 and 13.5, respectively, by Gilbert (1987) (see Figure 4-2). The UCL_{95} for lognormal distributions was calculated using Land's method, after methods calculations published by Gilbert (1987) and EPA (1992a).

For samples with greater than 15 percent censored data, population moments were calculated using stochastic modeling, following the "bounding" approach described by EPA (2002c) and illustrated in Figure 4-2 This approach treats each censored datum as a random variable that can assume any value between zero and its respective reporting limit. A Monte Carlo model was used to calculate 2,000 values for the UCL_{95}, each time substituting random values for each censored measurement. A distribution of all values for the UCL_{95} was then constructed, and the maximum estimated value was used as a plausible upper bound for the UCL_{95} of the mean. The mean and standard deviation were calculated by taking the median values of the mean and standard deviation used in calculations of the UCL_{95}.

The median (50^{th} percentile) and 95^{th} percentile were calculated for all samples, irrespective of the detection frequency, using nonparametric assumptions (that is, based strictly on a rank ordering of the combined detected and estimated measurements).

Exposure Point Concentrations. EPCs were calculated only for the HHRA and for the refined doses (Step 3a) presented in the SLERA. For the SLERA, maximum detected concentrations were used in the food chain model. EPCs for the human heath risk assessment were estimated as the UCL_{95} for each chemical. For cases where the UCL_{95} exceeded the maximum detected concentration, the maximum detected concentration was used as the EPC.

4.6.2 Statistical Comparison of Site Metals with Ambient Metals

Two-population statistical tests were used to compare metal concentrations in Site 22 data from the 0- to 0.5-, 0- to 3.0-, 0- to 10.0-, and 3- to 10-foot bgs depth intervals to the ambient distributions previously established for the site as part of the Phase I RI (TtEMI 1997). All site metals in the 0- to 10-foot bgs depth interval statistically greater than ambient were considered chemicals of potential concern (COPC) and were evaluated in the human health risk assessment. All site metals in the 0- to 3-foot bgs depth interval statistically greater than ambient were considered COPEC and were evaluated in the SLERA. Results of the two-population statistical tests are discussed in Section 5.0.

The methodologies employed to compare site data with the ambient data set follow Navy guidance (Navy 1998, 1999a, 1999b, 2000, 2002a). A flow diagram showing the ambient screening process is provided in Figure 4-3. Before the two-population tests were conducted, two adjustments were made to the site and ambient data sets. First, samples included in both the site and ambient data sets were removed from the site data set. Second, any Site 22 samples removed from the ambient data set (that is, when the ambient distributions were "trimmed" to eliminate samples not considered part of the ambient population) were added to the site data set.

One or more of the following methods were used to conduct the two-population tests. One-sided statistical tests were used in all cases and employed a Type I error rate of 0.05.

Wilcoxon Rank Sum and Gehan-Wilcoxon Tests. For metals with at least 60 percent detected data and single detection-limits in both the site and ambient populations, testing was performed using the nonparametric Wilcoxon rank sum (WRS) test. The null (H_0) and alternative (H_A) hypotheses tested were as follows:

H_0: the median metal concentration in site soil is less than or equal to the median concentration in the ambient population

H_A: the median metal concentration in site soil is greater than the median concentration in the ambient population

For cases where multiple detection-limits were present in either the site or ambient population, the Gehan-Wilcoxon test was used, following methods presented in Navy (1999b). The detection limit was substituted for all censored data analyzed using the WRS or Gehan-Wilcoxon test.

Test of Proportions. For chemicals with fewer than 60 percent detected data, the detection frequencies in the site and ambient populations were compared using the test of proportions. These analyses used a contingency table approach and the significance of the tests was determined using the Fisher exact test.

The H_0 and H_A tested in the test of proportions are as follows:

H_0: the metal detection frequency in site soil is less than or equal to the detection frequency in the ambient population

H_A: the metal detection frequency in site soil is greater than the detection frequency in the ambient population

Quantile Test. The quantile test (Johnson, Verrill, and Moore 1987; EPA 1994; Navy 1999b) was conducted for all chemicals with less than 60 percent detected data and for all cases where either the WRS or Gehan-Wilcoxon test did not reject H_0.

The H_0 and H_A tested in the quantile test are as follows:

H_0: metal concentrations in the right-hand tail of the site population are significantly lower than or equal to concentrations in the right-hand tail of the ambient population

H_A: metal concentrations in the right-hand tail of the site population are significantly higher than concentrations in the right-hand tail of the ambient population

5.0 CHEMICAL CHARACTERIZATION OF SITE 22

This section summarizes the nature and extent of chemicals detected in soil and groundwater at Site 22 and is based on data collected as part of the SI (PRC 1993), RFA Confirmation Study (PRC 1997), Phase I RI (TtEMI 1997), Phase II RI (TtEMI 1998a), and supplemental RI. Soil and groundwater analytical results are listed and discussed in Table 5-1 and Section 5.1 and Table 5-2 and Section 5.2, respectively. Other parameters evaluated in soil, such as pH and geotechnical parameters, are described in Section 5.3. Geochemical correlations between arsenic and other metals at the site are described in Section 5.4. Descriptive statistics for soil samples are presented in Appendix F.

5.1 SOIL RESULTS

The following summarizes the results of all soil sample analyses collected at Site 22 as part of the SI, RFA Confirmation Study, phase I RI, phase II RI, and supplemental RI (Table 5-1 through 5-4). Soil sample results for organic compounds and inorganic constituents are presented in Sections 5.1.1 and 5.1.2. The results of the comparison of site soils data with the ambient data set are summarized in Section 5.1.2.1. Descriptive statistics for soil samples are presented in Appendix F.

5.1.1 Organic Compounds in Soil

Tables 5-1, 5-2, and 5-3 present the results for all detected VOCs, SVOCs, and TPH concentrations in soil, respectively. Summary statistics for the organic compounds detected in soils in the 0- to 0.5-, 0- to 3.0-, and 0- to 10.0-foot depth intervals are presented in Appendix F.

No VOCs or SVOCs were detected in soil at concentrations exceeding EPA Region IX residential PRGs (Table 5-1 and 5-2) (EPA 2002a). The VOCs trichloroethene (TCE), bromodichlromethane, chloromethane, and chloroform were detected at low levels (at 2 micrograms per kilogram [µg/kg] or below) in subsurface samples (below 7 feet bgs) collected around the UST fill pipe (7SHSB010) and in MW04 and MW02. Xylene was detected in sample 7SHSB011 at 11 mg/kg. No other VOCs were detected in surface soil samples (0- to 3.0- foot bgs).

The SVOCs 2-methylnatphthalene and naphthalene were detected in surface sample 7SHSB001, collected adjacent to the UST fill pipe. Eight low-level SVOCs were detected in drainage ditch sample 7SHSB026. Fluoranthene was the only SVOC detected in the suspected disposal pit. Phenol was the most widely detected SVOC, detected in five surface (0 to 3 feet bgs) and four subsurface samples (3 to 10 feet bgs) at low levels.

PRGs have not been established for TPH. TPH concentrations detected in soil are summarized in Table 5-3. TPH as diesel (TPH-d) was detected at two locations at concentrations of 35,000 mg/kg and 370 mg/kg next to the fill pipe for the UST, at two locations drilled along the UST pipeline at 500 mg/kg and 14.6 mg/kg, and 9.2 mg/kg (Table 5-3) and at one composite sample collected from the ditch at 9.2 mg/kg. No other UST piping samples or other samples collected in the vicinity of building 7SH5 contained TPH as diesel.

Elevated concentrations of TPH as motor oil (4,300 mg/kg) were detected in the soil sample collected adjacent to the UST fill pipe (7SHSB001). TPH as motor oil was also detected at a concentration of 160 mg/kg in fuel piping sample 7SHSB002, located 40 feet from the fill pipe. In drainage ditch surface samples 7SHSB015 and 7SHSB024 through 7SHSB027, TPH as motor oil was also detected at concentrations up to 200 mg/kg (7SHSB024) and at concentrations up to 250 mg/kg in the majority of the RI soil samples collected from the suspected disposal pit (Table 5-3).

5.1.2 Inorganic Constituents in Soil

Table 5-4 presents the results for all detected inorganic constituents detected in soil. Inorganic constituents detected in soil were compared with PRGs for both residential and industrial use (EPA 2002a) and the ambient data set for Site 22. Inorganic chemicals at the site that exceed ambient levels are summarized in Section 5.1.3.

5.1.2.1 Results of the Ambient Screen

As described in Section 4.6, analytical results for inorganic soil data from the site were compared statistically to the ambient data set using two-population tests. Analyses were conducted for three depth intervals: 0 to 0.5, 0 to 3, and 0 to 10 feet bgs. Soil samples collected during the SI, RFA Confirmation Study, Phase I RI, Phase II RI, and supplemental RI were used in the comparison with the ambient data set.

The following table shows inorganic chemicals in Site 22 soil that are greater or less than ambient concentrations for the three depth intervals evaluated. Results of two-population statistical tests comparing site concentrations of metals to ambient levels for the 0- to 0.5-, 0- to 3-, 0- to 10-, and 3- to 10-foot bgs depth intervals are presented in Tables 5-5, 5-6, and 5-7.

METAL CONCENTRATIONS IN SITE 22 SOIL COMPARED TO AMBIENT CONCENTRATIONS

Depth (feet bgs)	Site Greater than Ambient	Site Less than Ambient
0 to 0.5	Arsenic, copper, lead, mercury, zinc	Aluminum, antimony, barium, beryllium, cadmium, chromium, cobalt, manganese, molybdenum, nickel, selenium, silver, thallium, vanadium
0 to 3.0	Arsenic, beryllium, copper, lead, mercury, zinc	Aluminum, antimony, barium, cadmium, chromium, cobalt, manganese, molybdenum, nickel, selenium, silver, thallium, vanadium
0 to 10.0	Arsenic, beryllium, copper, lead, mercury, zinc	Aluminum, antimony, barium, cadmium, chromium, cobalt, manganese, molybdenum, nickel, selenium, silver, thallium, vanadium

All site chemicals detected above ambient levels in the 0- to 0.5-foot and 0- to 10-foot bgs intervals were evaluated in the HHRA. All site chemicals detected at concentrations above ambient levels in the 0- to 3-foot bgs interval were evaluated in the SLERA.

To evaluate the distribution of arsenic in soil relative to the proximity to building 7SH5 and depth interval, sample locations were identified to represent a Building 7SH5-specific arsenic data set. The following sampling locations were selected to represent soils directly surrounding Building 7SH5: 7SHSB103, 7SHSB104, 7SHSB111, 7SHTP001A, 7SHTP001B, 7SHTP001C, 7SHTP001D, 7SHTP001E, 7SHTP001F, S52-01, and S52-02. Two population tests were conducted to compare the Building 7SH5-specific arsenic data set with the ambient data set. Table 5-8 presents the results of this analysis. Arsenic in surface soils (0- 0.5-foot bgs) in the building data set were not elevated above ambient levels, but arsenic in the 0- to 3.0 foot and 0- to 10-foot bgs intervals from the building area were above ambient levels.

5.1.2.2 Distribution of Inorganic Constituents in Soil

The distribution of each inorganic constituent in soil detected above ambient levels is described in the following text and presented in Table 5-6. The only inorganic constituents that exceed residential PRG values (EPA 2002a) in site soils were arsenic and lead. Descriptive statistics for soil samples are presented in Appendix F.

Arsenic

Arsenic was detected above the residential and industrial PRG values (0.39 mg/kg and 1.6 mg/kg, respectively) in every sample (82 total) collected at Site 22 and at all sample depth intervals (Table 5-4). The distribution of arsenic in site soil is presented in Figure 5-1. Arsenic was detected in site soil at concentrations above ambient levels in all depth intervals evaluated.

In surface soil (0 to 3.0 feet bgs), arsenic concentrations ranged from 3.9 mg/kg to a maximum concentration of 210 mg/kg (7SHSB114). With one exception, the concentrations of arsenic at Site 22 that exceed 100 mg/kg were confined to surface soils (0 to 0.5 feet bgs) from the ditches and open grassland areas of the site (locations 7SHSB109, 7SHSB021, 7SHSB022, 7SHSB106, 7SHSB025, and 7SHSB114). One subsurface sample (7SHSB022), collected from 10 to 10.5 feet bgs during the Phase I RI, contained 250 mg/kg of arsenic. Because this was the only sample collected at depth during the Phase I RI with arsenic elevated above 15 mg/kg, this same location was resampled as part Phase II RI to confirm this result. Sample 7SHSB109, collected at 9.5 to 10 feet bgs, contained arsenic at 7.4 mg/kg.

Although arsenic concentrations in soil were elevated above ambient in all soil depths evaluated, the majority of arsenic concentrations that exceed 10 mg/kg are confined to surface soils; soils; 10 mg/kg is the UCL_{95} for the Site 22 ambient data set (Appendix B).

Arsenic concentrations in samples collected near Building 7SH5 (sampling locations 7SHSB104, 7SHTP001A-F, 7SHSB111, 7SH-01-SB, 7SH-02-SB, 7SH-03-SB, and 7SHSB103) range from 3.3 to 31.9 mg/kg in surface and subsurface soils, which indicates that the source of arsenic at the site is related to open grasslands rather than operations at Building 7SH5.

Beryllium

Beryllium was detected in 9 of 34 soil samples; concentrations in site soil did not exceed the residential PRG of 150 mg/kg. Beryllium was detected in surface sample 7SHSB014 at a concentration of 0.16 mg/kg and in three disposal pit samples at concentrations ranging from 0.17 to 0.29 mg/kg. In surface soil (0 to 0.5 foot bgs), beryllium did not exceed ambient levels for the site; however, beryllium did exceed ambient levels from 0 to 3 and 1 to 10 feet bgs (Appendix F).

Copper

Copper was detected in all 37 soil samples for which it was analyzed at concentrations ranging from 25.8 to 332 mg/kg. All concentrations of copper in soil were well below the residential PRG of 3,100 mg/kg. The maximum concentration of copper detected in the soil samples, 303 mg/kg, was collected from sampling location 7SH-01-SB at a depth of 3.5 to 4 feet bgs (Table 5-4).

Lead

Lead was detected in one soil sample at a concentration that slightly exceeded the California-modified residential PRG of 150 mg/kg (165 mg/kg at S52-03 collected at 0 to 0.5 foot bgs) (Table 5-4). All concentrations of lead at the site were well below the industrial PRG of 750 mg/kg. Concentrations of lead in other samples collected at the site range from 3.6 to 60.7 mg/kg. Lead in Site 22 soils exceeded ambient levels in all depth intervals analyzed (Appendix F).

Manganese

The maximum concentration of manganese detected in the soil samples was 1,200 mg/kg in sampling location 7SHSB111, collected at a depth of 5 to 5.5 feet bgs (Table 5-4). All concentrations of manganese on site were below the residential PRG of 1,800 mg/kg. Sampling location 7SHSB111 is adjacent to Building 7SH5 (Figure 2-3).

Mercury

Mercury was detected in 31 of 34 samples at concentrations ranging from 0.06 to 1.1 mg/kg. All concentrations of mercury on site were well below the residential PRG of 23 mg/kg in soil. Mercury in Site 22 soils exceeded ambient levels in all depth intervals analyzed (Appendix F).

Zinc

The maximum concentration of zinc detected in the soil samples, 1,900 mg/kg, was detected in sample 7SHTP001B, collected at 3 feet bgs. All concentrations of zinc on site were well below the residential PRG of 2,300 mg/kg.

5.2 RESULTS OF GROUNDWATER SAMPLE ANALYSES

The following section summarizes the results of all the groundwater analyses at the site. Groundwater samples were not analyzed for inorganic constituents. Groundwater results are presented in Table 5-9. Descriptive statistics for groundwater data are presented in Appendix F.

As explained in Section 4.2, groundwater at the site was collected from three temporary wells (7SHSB010, 7SHSB011, and 7SHSB012) in 1995. To confirm results from the Phase I RI, permanent monitoring wells MW01 through MW04 were installed and sampled during four quarters in 1997. Although the results from all groundwater samples are presented, the Phase II RI groundwater monitoring results are considered more representative of current site conditions.

5.2.1 Organic Compounds in Groundwater

Concentrations of organic compounds detected in groundwater at the Site are presented in Table 5-9. TCE; bis(2-ethylhexyl)phthalate (BEHP); 1,1,1-trichloroethane; and motor oil were the only organic compounds detected in groundwater at Site 22.

TCE was detected in the groundwater sample collected from boring 7SHSB010 at a concentration of 27 µg/L, which exceeds the tap water PRG of 0.028 µ/L (EPA 2002a) and MCL of 5.0 µg/L (EPA 2002b, CDHS 2002). The maximum TCE concentration in MW04 from the four quarters of groundwater monitoring conducted in 1997, however, was 3µg/L, which is below the MCL. No TCE was detected in that well during the September and December 1997 sampling rounds. TCE was not detected in MW01, MW02, or MW03.

1,1,1-Trichloroethane was only detected in MW03 during the January 1997 sampling round at a concentration of 1 µg/L, which is below both the MCL (200 µg/L) and tap water PRG (3,200 µg/L).

BEHP was detected only in MW01 and MW02 during the June 1997 sampling round at a maximum concentration of 32 µg/L. Both detected concentrations exceeded the tap water PRG of 4.8 µg/L, the federal MCL of 6.0 µg/L, and the state MCL of 4.0 µg/L. BEHP is known as a common laboratory contaminant.

TPH as motor oil was detected in the groundwater samples collected from borings 7SHSB010, 7SHSB011, and 7SHSB012 at concentrations of 0.6, 0.5, and 0.4 mg/L, respectively (Table 5-9). No extractable TPH was detected in groundwater samples during the four quarters of sampling conducted in 1997.

5.3 PHYSICAL PARAMETERS ANALYZED IN SOIL

During the Phase I RI, three soil borings (7SHSB010, 7SHSB011, and 7SHSB012) were analyzed for geotechnical parameters, including grain size, permeability, porosity, density, specific gravity, and moisture. Results of this analysis can be found in Table 5-10. Soil grain size in samples was clay, sand, and sandy clay, with a permeability ranging from $1x10^{-7}$ to $9x10^{-7}$. The pH of site soil is neutral and ranged from 6 to 8.5 from 51 samples collected at the site.

5.4 GEOCHEMICAL CORRELATIONS BETWEEN ARSENIC AND OTHER METALS

As described in Section 4.3, the supplemental RI included an analysis of whether arsenic in soil is correlated with other metals, including antimony, iron, and manganese that may indicate that arsenic in soil is naturally occurring. The following text describes the geochemical correlations conducted for arsenic and other metals at Site 22.

The distribution of metals in soils is controlled by several mechanisms, including precipitation, dissolution, coprecipitation, and sorption. Adsorption, the accumulation of matter at the solid-water interface, is the basis of most surface chemical processes. The common adsorbents for metals in soils include clay minerals, organic matter, and metal oxides and hydroxides. The retention of cationic metals in soil has been correlated with such soil properties as pH, redox potential, surface area, cation exchange capacity, organic matter content, clay content, iron and manganese oxide content, and carbonate content. Clay minerals are known to be effective in controlling metals in soils because of the negative surface charges on the surface of clay minerals. Soil organic matter is also known to be effective in adsorbing metals. Soil organic matter forms a coating on inorganic mineral surfaces. Humus, a series of high-molecular-weight polymers in soil organic matter, is responsible for the sorption of cationic species.

Arsenic can be adsorbed to sediments and soils, particularly clays, iron oxides, aluminum hydroxides, manganese compounds, and organic material (U.S. Department of Health and Human Resources 1992). During geochemical processes, many metals (including arsenic) are enriched in the soil due to the adsorption of metals onto clays. These natural enrichments can be distinguished from enrichment caused by releases from site operations. The commonly identified arsenic-bearing minerals are realgar (AsS), orpiment (As_2S_3), arsenopyrite (AsFeS), claudetite (As_2O_3), arsenolite (As_4O_6), arsenic pentoxide (As_2O_5), and scorodite ($FeAsO_4 \cdot H_2O$). Within this group of minerals, arsenopyrite probably is the most common arsenic mineral (Mason and Berry 1968). It is anticipated that alluvial deposits in the Inland Area contain some of the listed minerals and almost surely contain arsenopyrite. In addition, the Inland area deposits contain clays and it is likely that the Inland area deposits contain various oxides and hydroxides, including iron and manganese oxides (TtEMI 1997).

A geochemical analysis to determine whether correlations exist among arsenic and other metals was conducted for Site 22 soils. If arsenic were found strongly correlated with a naturally occurring metal in soil (such as iron, manganese, and antimony), arsenic may be naturally occurring. Naturally occurring concentrations of arsenic would be expected to correlate with iron because of both the potential presence of arsenopyrite in natural deposits and sorption of arsenic onto iron oxides. Similarly, arsenic was expected to correlate with manganese because of likely sorption of arsenic onto manganese oxides. A correlation between arsenic and antimony would indicate that allemontite is present in alluvial deposits of Site 22 (allemontite is an intermediate compound of arsenic and antimony).

The correlation analysis was conducted to evaluate whether arsenic correlates positively with three other inorganic consituents: antimony, iron, and manganese. Scatter plots of arsenic concentrations versus concentrations of three other consituents are presented on Figure 5-2. As shown on Figure 5-2, arsenic correlates well with antimony (squared coefficient of correlation equals 0.8); however, the correlation of arsenic with iron and manganese was weak. As shown on Figure 5-3, the relatively strong correlation of arsenic with antimony appears to exist in shallow upper soils (where the highest arsenic concentrations are found), but the correlation becomes weak with depth. The probable reason behind the observed correlation of arsenic with antimony is the presence of clayey materials with organics in the topsoil, which tend to retain these elements. The absence of a correlation between arsenic and iron and manganese and the weak of correlation between arsenic and antimony at depth suggests a likely anthropogenic origin of the observed high arsenic concentrations in surface soils.

6.0 HUMAN HEALTH RISK ASSESSMENT

This section presents the revised SLHHRA for Site 22. The Navy performed a SLHHRA for Site 22 as part of an RI conducted in 1997 (TtEMI 1997). The 1997 SLHHRA evaluated potential risks to human health associated with exposure to soil and groundwater at Site 22 under current and future land use scenarios, assuming no subsequent cleanup action would be taken. To estimate potential risk, the 1997 SLHHRA compared site concentrations to EPA Region IX PRGs developed by EPA in 1996 for industrial and residential exposure (EPA 1996).

Subsequent to the 1997 RI, the Navy initiated an additional field investigation in response to a concern regarding elevated concentrations of arsenic in soil at Site 22. This investigation, conducted in October of 2002, involved collection of additional soil data to determine the extent of arsenic in soil at the site and to determine whether the source of arsenic is anthropogenic. In addition, during 1997, the Navy collected four additional rounds of groundwater samples as part of a Phase II RI (TtEMI 1998a). These groundwater samples were not included for evaluation in the 1997 SLHHRA.

This SLHHRA revises the 1997 SLHHRA by incorporating soil arsenic data collected in October of 2002 and using more recent groundwater data collected in 1997 to reassess potential human health risks from exposure to contaminated media at Site 22. All of the soil data used in the 1997 SLHHRA were also used in this revision. The 1995 groundwater data collected from temporary wells are not used in this revision because more recent groundwater data were available from 1997. Consistent with the 1997 SLHHRA, this revision evaluates potential risks under current and possible future land-use conditions.

In addition, since 1997, EPA Region IX has revised the PRGs to reflect changes in risk assessment methodologies, reference doses, cancer slope factors, and exposure assumptions (EPA 2002a). As a result, this SLHHRA also revised the original risk estimates using the updated EPA (2002a) PRGs.

Consistent with the methodology used to conduct the 1997 SLHHRA and with EPA and Cal/EPA guidance on using EPA Region IX PRGs to assess risk (Cal/EPA 1994, EPA 2002a), a four-step process was used in this revised SLHHRA for Site 22. This section is organized to reflect each of these four steps: Section 6.1, Data Evaluation and Identification of Chemicals of Potential Concern; Section 6.2, Exposure Assessment; Section 6.3, Toxicity Assessment; and Section 6.4, Risk Characterization.

6.1 DATA EVALUATION AND IDENTIFICATION OF CHEMICALS OF POTENTIAL CONCERN

This section describes the available analytical data and the approach used in the SLHHRA to evaluate data quality and usability for risk assessment purposes. This section also discusses the process used to identify COPCs in soil and groundwater.

6.1.1 Human Health Risk Assessment Data

Data from previous and current investigations were collected to assess conditions in soil and groundwater at Site 22 and were used to assess potential risks in this SLHHRA. Section 5 presents the soil and groundwater analytical data used in this report.

The soil analytical data set for the SLHHRA is based on the soil data set evaluated in 1997 plus arsenic analytical results from soil samples collected in October 2002, discussed in Section 3.0 of this report. The soil analytical data set evaluated in the 1997 SLHHRA was based on the following investigations: an SI (PRC 1993), an RFA Confirmation Study (PRC 1997) and a Phase I RI (TtEMI 1997). Soil samples collected during these investigations were analyzed for total metals, VOCs, SVOCs, and extractable and purgeable TPHs. The 1997 SLHHRA and Section 3.0 of this report provide additional information regarding the previous soil investigations conducted at Site 22.

This SLHHRA evaluated analytical data for soil samples from two soil depths. Data for soil samples collected at depths of 0 to 0.5 foot bgs were combined to represent “surface soil.” Data for soil samples collected at depths of 0 to 10 feet bgs, which includes the surface soil depth interval, were combined to represent “subsurface soil.” The SLHHRA did not evaluate chemicals detected in soil samples collected from depths below 10 feet bgs because current and future human exposure to soil at these depths is unlikely.

The groundwater analytical data set for the HHRA is based on the groundwater analytical results from quarterly sampling conducted in 1997. In 1997, the Navy conducted a Phase II RI to confirm the presence of chlorinated hydrocarbons detected in grab groundwater samples collected during the Phase I RI. As part of the Phase II RI, the Navy installed four monitoring wells and conducted four rounds of sampling from these wells (TtEMI 1998a). Groundwater samples collected from the monitoring wells were analyzed for VOCs and extractable TPH. The groundwater analytical data set evaluated in the 1997 HHRA was based on grab groundwater samples collected for the Phase I RI. The revised HHRA used groundwater analytical results from the Phase II RI and excluded groundwater samples from the Phase I RI because the Phase II sample results were collected from monitoring wells and are more recent. These samples are more likely to represent current conditions at the site. Sections 4.0 and 5.0 of this report provide additional information on the groundwater investigations conducted at Site 22.

The 1997 SLHHRA described the data evaluation process for the soil and groundwater samples. Consistent with previous data evaluations for Site 22, a rigorous evaluation of the soil and groundwater sampling data collected during the October 2002 investigation and Phase II RI, respectively, was carried out to verify that the quality of the sampling data was acceptable for use in the risk assessment. During the validation process, the data were subjected to a cursory review that evaluated the effects of the most critical quality assurance and quality control aspects, such as holding times, calibration requirements, and spiking accuracy. The overall objective of data validation was to ensure that the quality of the analytical data was adequate for its intended purposes, as defined by the following parameters: precision, accuracy, representativeness, completeness, and comparability. Qualifiers were assigned to the results according to EPA guidelines (1990) and associated analytical methods at each stage of the validation.

The data were found to meet all requirements of Level IV data, as described in "Data Quality Objectives for Remedial Response Activities" (EPA 1987) and all requirements of "definitive data" as described in "Data Quality Objectives Process for Superfund" (EPA 1993a). Consistent with EPA guidance (1990), all data without qualifiers and data qualified as "J" (estimated) were used in the SLHHRA and SLERA. Only data qualified as "R" (rejected) were considered unusable for the assessments. Duplicate sample results were not used in the SLHHRA. Duplicate sample results were evaluated for consistency with corresponding initial sample results; none of the duplicate sample results differed significantly from initial sample results (see Section 4). Section 5 presents the soil and groundwater analytical data used in the SLHHRA. Appendix E describes the analytical data quality.

Appendix F presents statistical summaries of analytical data for chemicals analyzed in surface soil, subsurface soil, and groundwater. The tables in Appendix F present the following statistical information: (1) chemical distribution; (2) number of detected samples; (3) total number of samples; (4) detection frequency; (5) minimum and maximum concentrations for censored (nondetected) data only; (6) minimum and maximum concentrations for detected data only; and (7) median, 95^{th} percentile, mean, standard deviation, coefficient of variation, and the one-sided UCL_{95} for detected and censored data combined. Section 4.6 describes the approaches used for statistical evaluation.

6.1.2 Identification of Chemicals of Potential Concern in Soil

COPCs were identified for surface and subsurface soil using a three-step process. First, the validated soil analytical data were assembled by surface (0- to 0.5-foot bgs) and subsurface (0- to 10-foot bgs) depth intervals, and a preliminary list of all analytes detected in one or more soil samples was developed for each depth interval. A list of all analytes detected at Site 22 is presented in summary statistics tables in Appendix F. Second, select metals were removed from the lists on the basis of a statistical comparison with ambient levels (see Section 6.1.2.1 for additional detail on the ambient data set and the statistical comparison).

Third, elements considered essential human nutrients (calcium, iron, magnesium, potassium, and sodium) were removed from the list on the basis of comparison with ambient concentrations in California (see Section 6.1.2.2 for additional detail).

All remaining constituents on the list, except TPH, were considered COPCs and evaluated in the risk assessment. Chemical analysis of soil from Site 22 included analysis for extractable and purgeable TPH hydrocarbon ranges. Chemical analysis for constituent-specific TPH indicator chemicals (that is, benzene, toluene, ethylbenzene, xylene, and PAHs) was also conducted, and constituent-specific TPH indicator chemicals detected at least once were identified as COPCs. As recommended by Cal/EPA (1993), data for these TPH indicator chemicals were evaluated to assess potential health risk from TPH contamination. TPH concentration data were excluded from further evaluation in the risk assessment because they are considered inadequate and insufficient to evaluate risk from TPH contamination (Cal/EPA 1993).

The screening procedures employed (the second and third steps) are described in greater detail in the following sections. Table 6-1 summarizes the COPCs selected for surface and subsurface soil.

6.1.2.1 Comparison with Ambient Levels

During the Phase I RI (TtEMI 1997), the Navy established an ambient data set for metals in soil at NWS SBD Concord (see Section 4.6 and Appendix B). The HHRA used two-population statistical tests to compare metal concentrations in surface and subsurface soil samples collected from Site 22 to the ambient data set to determine whether the metals should be considered COPCs. Section 4.6 describes the statistical procedures and criteria used to identify COPCs in surface and subsurface soil.

As a result of the comparison with ambient levels, arsenic, copper, lead, mercury, and zinc were identified as COPCs in both surface soil and subsurface soil. Beryllium was also identified as a COPC in subsurface soil.

6.1.2.2 Screening of Essential Human Nutrients

Elements considered essential human nutrients (calcium, iron, magnesium, potassium, and sodium) were reviewed for possible elimination as COPCs. EPA and DTSC guidance state that these elements can be eliminated from consideration in the SLHHRA because their toxicities are low when they are detected at environmental concentrations (EPA 1989b; Cal/EPA 1992b). An essential nutrient was eliminated as a COPC in surface and subsurface soil if the maximum detected concentration was within the range of ambient concentrations for soil in California, as reported by Bradford, and others (1996). Table 6-2 presents this comparison. Based on this comparison, all essential nutrients were eliminated as COPCs in surface and subsurface soil at Site 22.

6.1.3 Identification of Chemicals of Potential Concern in Groundwater

For groundwater, all detected chemicals were retained as COPCs. Chemicals detected in groundwater were limited to three VOCs: BEHP, 1,1,1-trichloroethane, and TCE. Appendix F presents groundwater analytical data summary statistics for these three chemicals. Table 6-1 also lists the groundwater COPCs.

6.2 EXPOSURE ASSESSMENT

The exposure assessment evaluates the nature and magnitude of potential exposures associated with the site. The assessment includes a description of the exposure setting and land use, the identification of potential receptors and exposure pathways under current and potential future land use conditions, and the estimation of exposure point concentrations.

6.2.1 Exposure Setting and Land Use

NWS SBD Concord is in north-central Contra Costa County, approximately 30 miles northeast of San Francisco, California. This Navy facility operates an ocean-shipping terminal to transfer ordnance from trucks or railcars to ships and vice versa. The facility is bounded on the north by Suisun Bay, on the south and west by the city of Concord (population 116,000), and on the east by private land and the city of Pittsburg. It encompasses almost 13,000 acres in three holdings: the Inland Area, the Tidal Area, and a radiography facility at Pittsburg.

Land use in the area surrounding NWS SBD Concord is diverse and is characterized by a mixture of military, industrial, residential, agricultural, and open space zones. The closest civilian, residential communities are the Dana Estates residential community located in the city of Concord, which is 500 feet southwest of Site 22 and the city of Clyde, which is approximately 1/4 mile north of NSW Concord's front gate. Future land use at the NWS SBD Concord Inland Areas sites is not expected to change from its current military industrial use. Future residential, recreational, or private industrial or commercial use of the sites is therefore not anticipated.

Site 22 is located along the southwestern portion of the Inland Area, as shown in Figure 1-2, near the intersection of Sixteenth and Seventeenth Streets. Building 7SH5 is in the center of Site 22. The area immediately southwest of Building 7SH5 is paved; however, the majority of the surrounding area to the south and east is annual grassland. An array of ammunition magazines is located to the north and west of Building 7SH5.

The maximum variation in elevation at Site 22 site is approximately 8 feet, and the site is mostly unpaved except for some asphalt streets and concrete pavement around buildings. A network of drainage ditches are present adjacent to Sixteenth Street, Seventeenth Street, and Building 7SH5. Railroads adjoin Sixteenth and Seventeenth Streets; these railroads are currently inactive.

Section 1.3.2 presents information on the historical activities at Site 22, Building 7SH5. Building 7SH5 is not currently in use; however, infrequent site maintenance and security activities occur at Site 22 outside of the building. These maintenance activities occur up to 5 times a year and involve controlled burns to manage weeds and pesticide application to control insects.

6.2.2 Receptors and Exposure Pathways

This section summarizes the potential receptors, exposure pathways, and exposure routes evaluated for Building 7SH5 at Site 22. A general conceptual site model (Figure 6-1) identifies source types, exposure routes, exposure pathways, and receptors for Building 7SH5.

As discussed, this SLHHRA evaluated potential risks using the updated EPA Region IX PRGs (EPA 2002a); hence, the exposure assumptions used in this SLHHRA to evaluate potential risks are consistent with the exposure assumptions that are the basis for the PRGs. Table 6-3 summarizes the exposure assumptions that EPA Region IX used to develop the PRGs. These assumptions are based on EPA standard default exposure assumptions for reasonable maximum exposure. Exposures under current and potential future land use conditions at Site 22 are expected to be less than the exposures that the PRGs evaluate, as described in the following text. The use of the PRGs is, therefore, considered protective of potential exposures at Site 22.

Under current land use conditions, base personnel involved with site maintenance activities at Site 22 are the most likely current receptor. For the purposes of this SLHHRA, activities of base personnel were assumed to be similar to an industrial worker as defined by the EPA Region IX PRG document (EPA 2002a). This assumption is conservative because the frequency of site maintenance activities at Site 22 is far less than exposure frequency of 250 days per year that EPA used to develop the industrial PRGs. Consistent with the EPA Region IX PRGs, the soil exposure pathways evaluated for a current industrial worker were incidental ingestion of soil, dermal contact with soil, and inhalation of airborne particulates and vapors released from soil.

Probable future receptors were identified based on projected future land use and probable future activity patterns at the site. The most probable future receptors are base personnel; therefore, future base workers were evaluated in the risk assessment. The soil exposure pathways evaluated for a future industrial worker were incidental ingestion of soil, dermal contact with soil, and inhalation of airborne particulates and vapors released from soil. These pathways are consistent with the soil exposure pathways evaluated in the PRG framework.

Although low-level maintenance and security activities are expected to continue at Site 22 (see Section 6.2.1), a hypothetical future residential scenario was also evaluated for the site. An unrestricted (residential) land-use scenario generally provides the greatest potential for exposure to site contaminants and was evaluated to provide additional information to support risk management decisions for the site. The EPA Region IX PRGs (EPA 2002a) were used to assess potential future residential exposures to COPCs in soil. Consistent with the PRG document, the soil exposure pathways evaluated for a residential receptor were incidental ingestion of soil, dermal contact with soil, and inhalation of particulates and vapors released from soil.

The current industrial worker exposure scenario evaluated exposure to surface soil (0- to 0.5-foot bgs soil depth interval), whereas the future industrial worker and residential exposure scenarios evaluated exposure to subsurface soil (0- to 10-foot bgs soil depth interval). This difference is based on the assumption that site development to accommodate the hypothetical future land use scenarios would involve excavation of soil, potentially making subsurface soil available at the surface for contact. Because it is possible that soil may remain relatively undisturbed, however, the future residential exposure scenario also evaluated potential risks from exposure to surface soil.

Groundwater is not currently used as a source of drinking water at the site and is unlikely to be used as a supply in the future because drinking water is municipally supplied, and no drinking water wells exist in the vicinity of the site. Ingestion of groundwater at Site 22 is shown in the conceptual site model as incomplete exposure pathway under current and future exposure scenarios. However, groundwater at the site meets the SWRCB criteria for a drinking water resource. For this reason, an evaluation was conducted for groundwater to determine whether levels of COPCs in groundwater may require further evaluation. This evaluation, presented in Section 6.4.4, involved comparison of groundwater COPC concentrations to San Francisco RWQCB health-based screening levels (RBSL) for groundwater and EPA Region IX PRGs for tap water. In addition, groundwater COPCs are volatile and may potentially migrate through the vadose zone and into buildings, impacting indoor air quality. The comparison of groundwater COPC concentrations to RBSLs also addresses exposure to groundwater COPCs in indoor air.

6.2.3 Exposure Point Concentrations

Exposure points are defined as areas or points of potential human contact with a contaminated medium. Potential exposure to COPCs was assumed to occur uniformly throughout the site (exposure point). EPCs were calculated for surface soil, subsurface soil, and groundwater using the soil and groundwater analytical data described in Section 6.1.1.

The UCL_{95} was used as the EPC unless the UCL_{95} exceeds the maximum detected value. In this case, the maximum detected value was used as the EPC. The HHRA used methods recommended in "Calculating Exposure Point Concentrations at Hazardous Waste Sites" (EPA 2002c) to calculate UCL_{95} concentrations. Figures 4-1 and 4-2 present the UCL_{95} methodology in further detail. As determined in the 1997 HHRA (TtEMI 1997), based on consultation with DTSC and EPA, use of the UCL_{95} as the EPC is a reasonable approach because the number of samples collected adequately characterizes chemical contamination at Site 22.

Site-wide surface soil and subsurface soil data were combined to calculate surface soil and subsurface soil EPCs, respectively. Groundwater data were likewise combined to calculate groundwater EPCs. The distance between the four groundwater monitoring wells at Site 22 is less than 75 feet; because the distance between all of the well locations is small, data from all four monitoring wells were used to calculate groundwater EPCs.

6.3 TOXICITY ASSESSMENT

Typically, the toxicity assessment involves a review of agency literature and compilation of EPA-developed toxicity values. These toxicity values are chemical-specific and consist of slope factors (SF) and reference doses (RfD) that are used in the risk assessment to characterize cancer risks and noncancer hazards, respectively. The SF is an upperbound estimate of the probability of a cancer response per unit dose of a carcinogen over a lifetime. The RfD is an estimated daily intake of a COPC expected to pose no appreciable risk of harmful effects to human health, including sensitive populations, over a lifetime.

Toxicity values were not required for this assessment because the SLHHRA is based on comparison of COPC concentrations with EPA Region IX PRGs (EPA 2002a); EPA has already used the SFs and RfDs to calculate the PRGs. The toxicity values used to calculate the PRGs are listed in the EPA memorandum regarding the derivation of the Region IX PRGs, presented in the PRG table (EPA 2002a).

For most compounds, only one soil PRG and one tap water PRG are presented in the PRG table (EPA 2002a). The PRG table also presents some "Cal-modified" PRGs. The Cal/EPA has developed cancer SFs for a few chemicals that differ significantly from the EPA SFs. For these chemicals, the Cal/EPA SFs assume greater probability of a cancer response. EPA developed two PRGs for these chemicals, one using the EPA SF and the other based on the Cal/EPA SF. The Cal-modified PRGs are lower (more health-protective) than the corresponding EPA Region IX PRGs and are provided in the PRG table when the Cal-modified PRG is at least 3.3 times more protective than the PRGs based on EPA SFs (EPA 2002a). The SLHHRA used Cal-modified PRGs for chrysene and lead.

Navy HHRA guidance (Navy 2002b) recommends dual risk characterizations, one based on EPA SFs and the other based on Cal/EPA SFs, when Cal-modified PRGs are used in the risk assessment. This SLHHRA did not include a dual risk characterization because the COPCs evaluated with Cal-modified PRGs (chrysene and lead) were not identified as risk drivers (see Section 6.4).

PRGs have not been developed for some chemicals because toxicity values are not available. PRGs have not been developed for three chemicals identified as COPCs at Site 22 because toxicity values are not available. The following surrogate PRGs were used to evaluate these chemicals, based on similar chemical structure:

Chemicals without Toxicity Values	Surrogate Chemical Used for PRG and Toxicity Values
Benzo(e)pyrene	Pyrene
2-Methylnaphthalene	Naphthalene
Phenanthrene	Anthracene

Neither EPA nor Cal/EPA has developed a SF or RfD for lead. EPA provides PRGs for lead in the PRG table (EPA 2002a); however, these PRGs do not correspond to a cancer risk or noncancer hazard. Lead was therefore evaluated separately from the other identified COPCs (see Section 6.4.3).

6.4 RISK CHARACTERIZATION

In this section, potential impacts to human health are characterized for the current industrial worker, future industrial worker, and hypothetical future residential exposure scenarios. Potential cancer risks and noncancer hazards from exposure to COPCs in soil were calculated using the procedure described in the EPA Region IX PRG document (EPA 2002a). PRGs are health-based concentrations for individual chemicals that correspond to a cancer risk of 1.0E-06 (for carcinogens) or a hazard quotient (HQ) of 1 (to evaluate noncancer effects). Both cancer and noncancer PRGs were used, when available. Groundwater was evaluated by comparing groundwater EPCs to health-based RBSLs.

Section 6.4.1 presents the methods used to estimate carcinogenic risks and noncancer hazards associated with exposure to COPCs in soil. Section 6.4.2 presents the risk and hazard estimates from exposures to COPCs in soil at the site. Section 6.4.3 presents the risk characterization for lead. Section 6.4.5 contains the groundwater evaluation. Section 6.4.5 discusses the uncertainties associated with the SLHHRA.

6.4.1 Risk Characterization Methodology

Cancer risks and noncancer hazards were calculated by comparing site EPCs of each COPC to corresponding EPA Region IX industrial and residential PRGs, as detailed in the following text.

6.4.1.1 Cancer Risks

For COPCs that are carcinogens, the cancer risk associated with exposure to a single chemical is calculated as follows:

$$\text{Cancer risk} = (\text{EPC}/\text{PRG}) \times 10^{-6}$$

where

EPC = Exposure point concentration (μg/kg)
PRG = EPA Region IX preliminary remediation goal (μg/kg)

At a given site, individuals may be exposed to more than one chemical. The total risk from exposure to multiple chemicals is calculated using the following equation:

$$\text{Total risk} = 10^{-6} \times \{\text{EPC}_1/\text{PRG}_1 + \text{EPC}_2/\text{PRG}_2 + \ldots \text{EPC}_n/\text{PRG}_n\}$$

where

Total risk	=	Total carcinogenic risk from exposure to all chemicals (unitless)
EPC_n	=	Exposure point concentration of chemical *n* (μg/kg)
PRG_n	=	PRG for chemical *n* (μg/kg)

EPA guidance on exposure levels considered protective of human health is presented to aid in the interpretation of the results of the risk assessment. In the NCP, EPA defined general remedial action goals for sites on the National Priorities List (Title 40 of the *Code of Federal Regulations* Part 300.430). These goals include a range for residual carcinogenic risk, which is "an excess upper bound lifetime cancer risk to an individual of between 10^{-4} and 10^{-6}," or 1 in 10,000 to 1 in 1,000,000. The goals set out in the NCP are applied once a decision to remediate a site has been made. A more recent EPA directive (EPA 1991) provides additional guidance on the role of the SLHHRA in supporting risk management decisions, and in particular, determining whether remedial action is necessary at a site. Specifically, the guidance states the following: "Where cumulative carcinogenic site risk to an individual based on reasonable maximum exposure for both current and future land use is less than 1E-04, and the noncarcinogenic HQ is less than 1, action generally is not warranted unless there are adverse environmental impacts." In comments to the Navy, however, EPA Region IX has stated that action may be taken to address risks between 1E-04 and 1E-06 (EPA 1997b), and Cal/EPA has stated that the agency considers 1E-06 as the point of departure for risk management decisions (Cal/EPA 1998). For this reason, the range between 1E-04 and 1E-06 is referred to as the "risk management range" in this discussion. In addition, a chemical termed a "chemical risk driver" is identified when the risk for the chemical exceeds 1E-06.

6.4.1.2 Noncancer Hazards

For COPCs not classified as carcinogens and for carcinogens known to cause adverse health effects other than cancer, the potential for receptors to develop adverse health effects is evaluated by comparing EPCs with noncancer PRGs as follows:

$$\text{Hazard quotient} = EPC/PRG$$

where

EPC	=	Exposure point concentration (μg/kg)
PRG	=	EPA Region IX preliminary remediation goal (μg/kg)

To evaluate the potential for noncancer effects from exposure to multiple chemicals, the HQ for all chemicals are summed, yielding a hazard index (HI) as follows:

$$\text{Hazard index} = EPC_1/PRG_1 + EPC_2/PRG_2 + \ldots + EPC_n/PRG_n$$

where

EPC_n = Exposure point concentration of chemical *n* (µg/kg)
PRG_n = PRG for chemical *n* (µg/kg)

A total HI of less than 1 indicates no potential for noncancer health effects. When the total HI exceeds 1, further evaluation in the form of a segregation of HI analysis is typically performed to determine whether noncancer hazards are a concern at the site. The noncancer effects of chemicals with different target organs are generally not additive. Any one segregated HI that exceeds 1 indicates the potential for adverse noncancer health effects to occur (EPA 1989b). A segregated HI of less than 1 indicates little or no potential for noncancer health effects.

6.4.2 Cancer Risk and Noncancer Hazard Estimates

This section presents cancer risks and hazards associated with current industrial, future industrial, and hypothetical future residential land-use conditions for Building 7SH5 at Site 22. This section also identifies risk and noncancer hazard drivers. Risk drivers are COPCs with a cancer risk that exceeds 1E-06; noncancer hazard drivers are COPCs with an HQ greater than 1. Tables 6-4 through 6-7 present the cancer risk and HI estimates. As described in the following text, the HHRA identified arsenic as a risk driver for all exposure scenarios. In fact, arsenic contributed approximately 99.5 percent of the cancer risk for all three scenarios. A brief toxicity profile for arsenic is included in Appendix G of this SLHHRA to provide information regarding health effects associated with exposure to arsenic.

6.4.2.1 Current Industrial Scenario

Potential risks for the current industrial worker scenario were estimated by comparing surface soil EPCs with PRGs for industrial soil; the total cancer risk is 5.6E-05 (Table 6-4). The estimated cancer risk is within the risk management range (1E-06 to 1E-04). Arsenic is a risk driver and contributes to over 99 percent of the cancer risk.

The total HI for the current industrial scenario is 3.5E-01 (Table 6-4), which is less than the threshold HI of 1.

6.4.2.2 Future Industrial Scenario

Potential risks for the future industrial worker scenario were estimated by comparing subsurface soil EPCs with PRGs for industrial soil; the total cancer risk is 2.5E-05 (Table 6-5). The estimated cancer risk is within the risk management range. Arsenic is a risk driver and contributes to over 99 percent of the cancer risk.

The total HI for the future industrial scenario is 0.19 (Table 6-5), which is less than the threshold HI of 1.

6.4.2.3 Future Residential Scenario

Potential risks for the future residential scenario were estimated by comparing subsurface soil EPCs with PRGs for residential soil; the total cancer risk is 1.0E-04 (Table 6-6). The estimated cancer risk is at the upper-end of but does not exceed the risk management range. Similar to the industrial scenarios evaluated, arsenic is a risk driver and contributes to over 99 percent of the cancer risk.

The total HI for the future residential scenario is 1.9 (Table 6-6). This HI exceeds the threshold HI of 1. Arsenic is a noncancer hazard driver; the HQ for arsenic is 1.8. Virtually all of the HI is attributable to arsenic; therefore, the HI was not segregated.

Because it is possible that soil at the site may remain relatively undisturbed, the SLHHRA also evaluated potential risks from exposure to surface soil for the future residential scenario. The estimated cancer risk from exposure to COPCs in surface soil is 2E-04 (Table 6-7). The cancer risk slightly exceeds the risk management range. The estimated HI for surface soil exposures is 4.1 and exceeds the threshold HI of 1. Virtually all (over 99 percent) of the cancer risk and noncancer HI is attributable to arsenic.

Additional Risk Characterization for Arsenic. The presence of arsenic at the site is not consistent with known past activities at Building 7SH5 (see Section 6.2.1). For this reason, an additional analysis was conducted to determine whether a notable difference in potential cancer risks and noncancer hazards exists between exposures to arsenic in soils directly surrounding Building 7SH5 and exposures to arsenic in soils away from the immediate vicinity of Building 7SH5.

The first step of this analysis involved identifying sampling locations that represent soils directly surrounding Building 7SH5. Arsenic sample results from these sampling locations were combined to create a Building 7SH5-specific arsenic data set. The following sampling locations were selected to represent soils directly surrounding Building 7SH5: 7SHSB103, 7SHSB104, 7SHSB111, 7SHTP001A, 7SHTP001B, 7SHTP001C, 7SHTP001D, 7SHTP001E, 7SHTP001F, S52-01, S52-02. Figure 2-3 shows these sampling locations.

Following this step, EPCs for arsenic from Buidling-7SH5-specific data set were calculated for surface and subsurface soil using the EPA (2002c) methodology described in Figure 4-1. The surface and subsurface soil arsenic EPC from Building 7SH5-specific soils is 26 mg/kg and 14 mg/kg, respectively.

Lastly, the Building-7SH5-specific EPCs for arsenic were compared to PRGs for arsenic in soil to estimate the potential risk associated with exposure to soils directly surrounding the building. Table 6-8 presents the results of this comparison.

The results of this analysis show that cancer risk associated with exposure to arsenic in soils directly surrounding Building 7SH5 is notably less than cancer risk associated with site-wide soils at Site 22. Likewise, the noncancer hazard associated with exposure to arsenic in soils directly surrounding Building 7SH5 is less than the HI associated with site-wide soils at Site 22. For all exposure scenarios, the potential cancer risks associated with Building 7SH5-specific soils are within the risk management range. The potential noncancer hazard is less than the threshold HI for all exposure scenarios except the future residential surface soil exposure scenario. The arsenic HQ for this scenario is 1.2, only slightly above the threshold HI of 1. On average, the cancer risk and noncancer hazard associated with exposure to soils directly surrounding Building 7SH5 account for only 30 percent of the total cancer risk and noncancer risk for all of Site 22.

6.4.3 Lead Evaluation

The risk characterization for lead involves comparing site EPCs for lead to PRGs for lead. The EPA Region IX residential and industrial soil PRGs for lead are 400 mg/kg and 750 mg/kg, respectively. The Cal/EPA-modified PRG for lead is 150 mg/kg and is based on child residential exposures. The PRG document (EPA 2002a) provides additional information regarding the derivation of the PRGs for lead.

The surface and subsurface soil EPC for lead is 156 mg/kg and 42 mg/kg, respectively. The subsurface soil EPC for lead does not exceed any of the lead PRGs. The surface soil EPC for lead (156 mg/kg) only slightly exceeds the Cal-modified residential soil PRG for lead (150 mg/kg). This exceedance (6 mg/kg) is minimal. In addition, as described in Section 6.2.2, future residential exposures are not expected at Site 22 but are evaluated to support risk management decisions for the site.

6.4.4 Groundwater Evaluation

As discussed in Section 6.2.2, direct exposure (that is, ingestion) to groundwater at Site 22 is identified as an incomplete exposure pathway because drinking water is municipally supplied, and no drinking water wells exist in the vicinity of the site. However, groundwater at the site meets the SWRCB criteria for a drinking water resource. In addition, groundwater COPCs may impact indoor air. To determine whether levels of COPCs in groundwater may require further evaluation, EPCs for groundwater COPCs were compared to RBSLs (RWQCB 2001) and tap water PRGs (EPA 2002a).

Two categories of RBSLs are available: RBSLs that are protective of drinking water resources, and RBSLs that are protective of water resources that will not be used for drinking water. The RBSLs and the methodology and assumptions used to derive the RBSLs are presented by RWQCB (2001). RBSLs for drinking water resources are intended to be protective of drinking water resources, surface water quality, indoor air impacts, and nuisance concerns. RBSLs for nondrinking water resources are also protective of all of these criteria, except drinking water resources. The RBSLs were not available when the 1997 SLHHRA was conducted.

Table 6-9 presents a comparison of EPCs for groundwater COPCs to the RBSLs for both drinking and nondrinking water resources and to tap water PRGs. EPCs were calculated based on the methodology described in Section 6.2.3 and were based on sample results from quarterly groundwater monitoring in 1997 during the Phase II RI (TtEMI 1998a). These sample results were used in lieu of the grab groundwater samples collected in 1995 because they are more likely to represent site conditions than the 1995 sample results.

As shown in the table, the EPC for BEHP slightly exceeds the groundwater RBSL for drinking water resources and the tap water PRG. The EPC for BEHP does not exceeds the RBSL for nondrinking water resources. BEHP is a common laboratory contaminant, and it is possible that measurements of BEHP in groundwater are in part attributable to laboratory contamination; however, based on data validation for BEHP (TtEMI 1997), some measurements of BEHP were present at levels that exceed levels commonly associated with laboratory contamination. As discussed previously, it is unlikely that groundwater at the site will be used as a drinking water resource. In addition, the EPC for BEHP is based on data from the first two quarters of quarterly groundwater monitoring that was conducted in 1997 as part of the Phase II RI (TtEMI 1998a). Results of the quarterly monitoring show that BEHP, which was detected two monitoring wells at 24 micrograms per liter (μg/L) and 3 μg/L during the first two quarters of sampling, was not detected in any monitoring wells during last two quarters of sampling. The results from the Phase II RI (TtEMI 1998a) indicate it is likely that BEHP is no longer present in groundwater at the site.

The EPC for trichloroethene (TCE) exceeds the tap water PRGs for TCE approximately by a factor of 100. In the groundwater evaluation presented in the 1997 SLHRRA, the TCE EPC only slightly exceeded the EPA (1996) tap water PRG by a factor of 1.6, even though the EPC for TCE was higher in the previous evaluation because it was based only on Phase I RI (TtEMI 1997) grab groundwater samples. This difference is based on the change in toxicity criteria used to develop the EPA (2002a) PRGs, which resulted in a decrease of the EPA (1996) PRG for TCE from 16 μg/L to 0.028 μg/L in the EPA (2002a) version of the tap water PRGs. However, the EPA (2002a) tap water PRG for TCE is considerably less than the federal Maximum Contaminant Limit (MCL) for TCE of 5 μg/L, which is the lowest enforceable standard concentration for cleanup of TCE in drinking water sources, based on the Federal Safe Drinking Water Act. In addition, the EPC for TCE is based on data from the first two quarters of quarterly groundwater monitoring that was conducted in 1997 (TtEMI 1998a). Results of the quarterly monitoring show that TCE, which was detected in only one monitoring well at 1 μg/L and 3 μg/L during the first two quarters of sampling, was not detected in any monitoring wells during the last two quarters of sampling. The results from the Phase II RI (TtEMI 1998a) indicate it is likely that TCE is no longer present at the site. The EPC for TCE does not exceed the RBSL for drinking water and nondrinking water sources.

The EPC for 1,1,1-trichlroethane does not exceed the RBSL for drinking water or the tap water PRG.

6.4.5 Uncertainty Analysis

A number of uncertainties are inherent in the estimates of potential carcinogenic risk and noncarcinogenic hazard presented in this document. These uncertainties were generally associated with either (1) the sampling strategy and site characterization process or (2) the assumptions and extrapolations that comprise the risk assessment process. Both types of possible uncertainties are described in the following text.

6.4.5.1 Data Evaluation and Identification of Chemicals of Potential Concern

To identify COPCs for the human health risk assessment, the adequacy of site characterization data was reviewed, and a structured selection process was employed.

Site Characterization Data. The risk assessment was based on analytical data from the SI (PRC 1993), the RFA Confirmation Study (PRC 1997), the Phase I RI (TtEMI 1997), and the October 2002 arsenic-focused investigation. Although the total number of samples collected during these investigations was quite large, not all samples were analyzed for the full suite of compounds. In accordance with the approved SAP (PRC/Montgomery Watson 1995a, b), if the site history did not suggest chemicals of a particular class were likely to have been used or released at a site, the number of samples analyzed for that class of compounds was limited. This sampling strategy is consistent with EPA guidance that describes the objective of the RI as characterization of the nature and extent of contaminants identified through the preliminary assessment and site investigation process (EPA 1988a). The limited sampling for nonsite-related compounds at a few sites led to detection of one such compound in a single sample from a site. In these cases, data interpretation is contingent on assumptions related to the distribution of that contaminant, and with the uncertainties inherent in these assumptions, actual risk may have been under- or overestimated. Because there was no reason to expect that the nonsite-related contaminants would be present, these single detections were generally interpreted as isolated incidents during the RI characterization. This assumption is bolstered by the fact that the sampling approach employed for the RI was "purposeful" (soil samples were collected from locations believed to be the most highly contaminated based on site history, then additional sampling locations were added to establish the extent of the problem). This technique increases the likelihood that all site-related contaminants are characterized for each site. Yet it requires the additional assumption that knowledge of the site has been adequate to facilitate identification of all potentially contaminated locations and contaminants. In the risk assessment, these detections of nonsite-related compounds were found to constitute the primary risk drivers at several sites. If it is assumed that some of these detections represent isolated incidences, the actual risk associated with exposure at the site may have been overestimated.

Contaminant of Potential Concern Selection Process. The primary uncertainty associated with the COPC selection process is the possibility that a chemical may be inappropriately identified as a COPC for evaluation in the risk assessment (that is, a detected chemical may be inappropriately excluded or included as a COPC). For the Site 22, the only analytes that were excluded from designation as COPCs were metals detected at concentrations below ambient levels and essential nutrients. For this reason, it is unlikely that any chemicals were inappropriately excluded from the risk assessment.

6.4.5.2 Exposure Assessment

Uncertainties were identified in association with two areas of the exposure assessment process: (1) identification of receptors and (2) the derivation of EPCs. Uncertainties in each of these areas are discussed in the following text.

Identification of Receptors. Receptors and exposure scenarios were identified based on observed and assumed land use and activity patterns of the current and future receptors. To the degree that actual land use and activity patterns are not represented by those assumed, uncertainties are introduced. For example, future land use was assumed to be residential for all sites; however, future land use is not expected to change from its current use as an operating naval base.

Derivation of Exposure Point Concentrations. As discussed in Section 6.2.3, the UCL_{95} was used as the EPC for each COPC. For small data sets or data sets with limited detections, the UCL_{95} often exceeded the maximum detected concentration at a site because the standard deviation associated with small data sets is high. Consequently, the maximum detected concentration (or the concentration of a single detected value) was often used as the EPC. The EPCs based on the maximum concentrations are likely to overestimate the concentrations and associated risks at each site. For most metals detected at a site, the number of detections was sufficiently large to calculate a UCL_{95}, and the maximum concentration was rarely used as the reasonable maximum exposure concentration. For most of the organic COPCs, EPCs were based on maximum concentrations because the number of detections was limited (one or two detections).

6.4.5.3 Toxicity Assessment

The primary uncertainties associated with the toxicity assessment are related to derivation of toxicity values for COPCs. Standard toxicity values (RfDs and SFs) were used by EPA Region IX to derive the PRGs used in this HHRA. For some chemicals, Cal/EPA-modified SFs were used. For COPCs for which an SF or RfD was available for only one route of exposure, route-to-route extrapolations were made in the derivation of the Region IX PRGs. These extrapolations will introduce some uncertainty into the risk and hazard estimates.

6.5 Risk Summary

The SLHHRA assessed potential risks associated with current industrial, future industrial, and hypothetical future residential exposure to COPCs detected in surface soils and subsurface soils at Site 22.

COPCs in soils included metals, including arsenic, VOCs, and PAHs. The SLHHRA calculated potential cancer risks and noncancer hazards for each exposure scenario by comparing COPC concentrations to EPA (2002a) Region IX soil PRGs.

Results of the SLHRRA for Site 22 show that potential cancer risks for the current industrial and future industrial exposure scenarios are within the risk management range of 1E-06 to 1E-04. Arsenic is a risk driver for both of these exposure scenarios and contributes to over 99 percent of the cancer risk. The noncancer HI for the current and industrial exposure scenarios is less than the threshold HI of 1. For the future residential exposure scenario, the cancer risk from exposure to COPCs in subsurface soils and surface soils is 1E-04 and 2E-04, respectively. The cancer risk for subsurface soil exposures is at the upper-end of the risk management range, and the cancer risk for surface soil exposures exceeds the risk management range. Similar to the industrial exposure scenarios evaluated, arsenic is the risk driver and contributes to over 99 percent of the cancer risk for the residential exposure scenario. The noncancer HI is 1.8 and 4.1 for subsurface soil and surface soil residential exposures, respectively. The HI exceeds the threshold HI of 1, and is almost entirely attributable to arsenic. Based on the SLHHRA results, arsenic is a soil chemical of concern (COC) at Site 22.

The SLHHRA also evaluated groundwater at Site 22 by comparing groundwater COPC concentrations to RWQCB (2001) RBSLs and EPA (2002a) Region IX tap water PRGs. Only three groundwater COPCs were identified: BEHP, TCE, and 1,1,1-trichloroethane. The evaluation showed that the EPC for BEHP slightly exceeds the RBSL for drinking water sources and the tap water PRG. The EPC for TCE exceeds the tap water PRG but is less than the federal and state MCL for TCE. The EPA for 1,1,1-trichloroethane did not exceed RBSLs or tap water PRGs. Concentrations of BEHP and TCE used in the groundwater evaluation were based on quarterly groundwater monitoring results collected during the Phase II RI (TtEMI 1998a). BEHP and TCE were detected during the first two quarters of monitoring; however, sample results from the last two quarters of monitoring showed no detections of BEHP and TCE, indicating that these chemicals may no longer be present in groundwater at the site.

7.0 SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT

This screening-level ecological risk assessment (SLERA) was conducted as part of the supplemental RI for Site 22. As proposed in the SAP (TtEMI 2002), the purpose of this SLERA was to determine whether COPECs in surface soils pose unacceptable risk to upper trophic level species at the site. Representative bird and mammal species that were the focus of the assessment included the American Robin (*Turdus migratorius*), Red-tailed Hawk (*Buteo jamaicensis*), western harvest mouse (*Reithrodontomys megalotis*), tule elk (*Cervus elaphus nannodes*), and grey fox (*Urocyon cinereoargenteus*). Because no native or sensitive plant species are known to occur at the site and the general quality of habitat is low (see Section 2.5), only risk to upper trophic level receptors was evaluated.

7.1 ECOLOGICAL RISK ASSESSMENT GUIDANCE

The SLERA was prepared in accordance with EPA guidance (EPA 1997a). EPA characterizes the assessment of ecological risk as a complex, nonlinear process that involves many parallel activities and emphasizes that the ERA framework was designed to be flexible, thereby allowing studies to be scaled in a manner appropriate to the requirements of and conditions at each site. EPA separates the ERA process into the following eight steps:

- Step 1: Screening-level problem formulation and evaluation of ecological effects
- Step 2: Screening-level preliminary exposure estimate and risk calculation
- Step 3: Baseline risk assessment problem formulation
- Step 4: Study design and data quality objectives
- Step 5: Field verification of sampling design
- Step 6: Site investigation and analysis of exposure and effects
- Step 7: Risk characterization
- Step 8: Risk management

Steps 1 and 2 constitute the SLERA and are usually conducted using conservative exposure assumptions. Steps 3 through 7 are required only for sites when the SLERA (Steps 1 and 2) identifies unacceptable risk to ecological receptors. Scientific management decision points (SMDP) occur at Steps 2, 3, 4, 5, 6 (only if changes to the field sampling plan are necessary), and 8.

7.1.1 Screening-Level Ecological Risk Assessment Approach

The screening-level approach uses conservative assumptions and available scientific literature to evaluate ecological risk in an approach consistent with steps 1 and 2 of the eight-step process described in the EPA guidance (EPA 1997a). The SLERA has four primary phases: (1) problem formulation, (2) exposure estimates, (3) ecological effects, and (4) risk characterization. During the problem formulation phase, an ecological conceptual site model (CSM) was developed for the site, and assessment and measurement endpoints were selected. During the exposure estimate phase, exposure parameters were determined for representative receptors identified in the problem formulation phase. During the ecological effects evaluation, contaminant exposure levels were compared to conservative thresholds for adverse ecological effects. Finally, during the risk characterization phase, the potential risk to assessment endpoints associated with the site was evaluated.

In accordance with EPA guidance (EPA 1997a), the SLERA conclusions should be used by risk managers to determine whether the assessment is:

- Adequate to conclude that ecological risks are negligible and therefore no remediation is necessary
- Adequate to indicate a potential for adverse ecological effects and, therefore, request a site-specific baseline ERA (BERA) be conducted to refine the risk estimate and reduce the uncertainty associated with the SLERA
- Inadequate to make a decision and, therefore, request a site-specific BERA be conducted to refine the risk estimate and reduce the uncertainty associated with the SLERA

7.1.2 Baseline Ecological Risk Assessment Approach

According to EPA, the SLERA assesses the need for and the level of effort necessary to conduct a detailed BERA for a site (EPA 2001a). Step 3 of the BERA may consist of a refinement of the conservative assumptions used in the SLERA and may result in a refinement of COPECs that should be evaluated in the BERA (EPA 2001a). Refining the COPECs includes incorporating information on ambient concentrations, frequency and magnitude of chemical detections, dietary considerations, and additional considerations as appropriate. For Site 22, the results of the SLERA were further refined using an approach consistent with Step 3 of the guidance. The site concentrations were compared with ambient concentrations for metals, and the bioavailability of chemicals present at the site was incorporated into risk estimates based on previous investigations in the Inland Area at Concord. Slightly less conservative EPCs (the UCL95 as opposed to the maximum) were used to further assess risk from ingestion. The following sections describe the approach used in this SLERA, in accordance with Steps 1 and 2 of EPA guidance for ERAs (EPA 1997a).

7.2 STEP 1: PROBLEM FORMULATION AND ECOLOGICAL EFFECTS

Problem formulation and ecological effects correspond to Step 1 of the SLERA process, as described in EPA guidance (EPA 1997a). The following sections provide the problem formulation for Site 22, including a CSM, which provides descriptions of known and potential stressors, evaluation of potential exposure pathways, discussion of chemical fate and transport, and identification of assessment and measurement endpoints. An evaluation of ecological and toxicological effects was also conducted as part of the SLERA and is described in the following sections.

7.2.1 Conceptual Site Model

The CSM illustrates exposure pathways to be evaluated in the SLERA and provides other key information such as chemical sources, release and transport mechanisms, and the relative importance of exposure pathways to specific receptor groups. The CSM includes the following components:

- Stressors
- Exposure pathways
- Fate and transport
- Assessment and measurement endpoints

The following sections briefly describe the components of the CSM for Site 22, which is illustrated in Figure 7-1.

7.2.2 Stressors and Selection of Chemicals of Potential Ecological Concern

Stressors can be defined as any factor that causes adverse ecological impacts at the site. For the SLERA, only chemical stressors were evaluated. Surface soil data (0.0 to 3.0 feet bgs) collected from Site 22 as part of previous investigations and the supplemental RI sampling event were used to support the SLERA. As part of previous investigations at Site 22, 26 surface soil samples were collected and analyzed for metals, SVOCs, VOCs, and TPHs. Additionally, 15 samples collected during the supplemental RI sampling event were analyzed for antimony, arsenic, iron, manganese, and pH.

Summary statistics were calculated for each analyte and included detection frequency, arithmetic mean, SD, geometric mean (metals only), minimum and maximum reported values, median, and UCL_{95}. Summary statistics for inorganic chemicals in surface soil samples are provided in Section 5.0.

Inorganic chemicals were retained as COPECs if the maximum concentrations detected in site samples were greater than ambient concentrations. As described in Sections 4.6 and 5.1.2.1, two-population statistical tests were conducted to compare site concentrations of metals to ambient levels. Results of the ambient comparison are presented in Tables 5-5 through 5-8. Chemicals for which ambient concentrations were not available were automatically retained as COPECs and evaluated in the SLERA. Essential nutrients that are not priority pollutants, such as calcium, iron, magnesium, potassium, and sodium, were not retained as COPECs. Inorganic chemicals retained as COPECs were arsenic, beryllium, copper, lead, mercury, and zinc (Table 5-6). Because the organic chemicals analyzed are not naturally occurring, all detected organic chemicals were considered COPECs.

7.2.3 Exposure Pathways

For an exposure pathway to be considered complete, a chemical must be able to travel from the source to the representative receptor and must be taken up by the receptor through one or more exposure routes. Complete exposure pathways present the greatest potential risk of adverse effects for receptors of concern at a given site. Potential exposure pathways that may result in receptor contact with chemicals include soils, surface water, groundwater, air, and food chain transfer.

Potential exposure pathways at Site 22 are diagrammed in the CSM (Figure 7-1). At Site 22, soil was considered to be the most important exposure media. The surface water and groundwater exposure pathways were not evaluated at Site 22 because the site has no surface water bodies. Additionally, depth to groundwater is approximately 20 to 28 feet bgs, below a depth where groundwater would be accessible to ecological receptors.

Windblown dust could represent a complete exposure pathway because some minimal areas of exposed soil exist at Site 22. The air exposure pathway is therefore a complete pathway at Site 22; however, it was considered to be insignificant in comparison to food chain transfer and direct exposure to soils (see discussion below) and was not considered in the SLERA.

Exposure routes, or the point of entry of a chemical into a receptor, include root uptake and leaf sorption for plants and inhalation, dermal contact, and ingestion of contaminated soil, surface water, and food for animals (Figure 7-1). Plants exposed to chemicals in soil may accumulate concentrations in their tissues that cause adverse effects on growth, reproduction, or survival. Independent of direct effects on the plant, chemicals in plant tissues may be transferred to herbivores, omnivores, and detritivores, which in turn may be consumed by omnivores and carnivores. Such food chain transfer and associated bioaccumulation may result in unacceptably high doses of chemicals to higher-trophic-level consumers. The SLERA focused only on risk to representative birds and mammals at the site; risk to plants and invertebrates was not evaluated.

Ingestion of chemicals in soil and prey was considered to be the predominant exposure pathway for birds and mammals at Site 22; exposure via inhalation and dermal contact are not considered in most SLERAs (EPA 1997a). Terrestrial birds and mammals may ingest soil directly while feeding, grooming, and burrowing (Beyer, Connor, and Gerould 1994). Soil on or in the bodies of prey may also be consumed with the prey. For example, a bird feeding on an earthworm may ingest soil incidentally while probing for and eating the worm. A food chain modeling approach was used to evaluate potential effects of ingestion of chemicals by representative birds and mammals. During the dose assessment for higher-trophic-level receptors, it was assumed that the ingestion of contaminated prey and soil was the dominant exposure route and that other exposure routes were negligible (Suter 1993). Bioaccumulation factors (BAF) were used to estimate the chemical burden in prey tissues for each of the chemicals based on site soil concentrations. BAFs describe bioaccumulation in terms of the ratio between the concentration of a substance in an organism due to chemical uptake and the concentration in the surrounding environment. BAFs used in this SLERA are presented in Table 7-1.

7.2.4 Fate and Transport

Physical fate processes of concern include transport to groundwater, volatilization to air, transfer to surface water, and movement of contaminated soil particles through windblown dust or as suspended soil particles in surface water. Chemicals may also be transported in plant and animal tissues (biotic transport). For example, chemicals in the bodies of mobile receptors such as migrating birds, flying insects, and far-ranging predators may be carried offsite and deposited in other locations in the form of feces or corpses.

Although exposure is a simple concept, accurately describing the fate and transport of chemicals from their source to a site of toxic action in living organisms can be quite complicated. In general, for exposure to occur, a chemical must leave the environmental matrix, move across several biological membranes, and concentrate in a tissue to the extent that its toxic action is exerted. A chemical that can move from the environmental matrix to the tissue of a receptor is said to be bioavailable to that receptor. The SLERA focuses on chemicals in the environment that are bioavailable or potentially bioavailable to receptors.

7.2.5 Assessment and Measurement Endpoints

EPA defines assessment endpoints as “explicit expressions of the actual environmental values (e.g. ecological resources) that are to be protected” (EPA 1997a). Assessment endpoints are environmental characteristics that, if significantly impaired, would indicate a need for action by risk managers. Various definitions of valuable ecological resources include those without which ecosystem function would be significantly impaired; those providing critical resources, such as habitat or fisheries; and those perceived by humans as being valuable, such as endangered species and other issues addressed by legislation. Useful assessment endpoints define both the valuable ecological entities at the site and a characteristic of the entity to protect, such as reproductive success or production per unit area.

During this assessment, the focus was on endpoints most likely to be affected given the fate and transport mechanisms of the chemicals, the ecotoxicological properties of the chemicals, the habitats at the site, and the potential receptors existing at the site. Because no native or sensitive plant species are known to occur at the site and the general quality of habitat is low (see Section 2.5), only the risk to upper trophic level receptors was evaluated. The following assessment endpoints were used to evaluate the potential ecological risk at Site 22:

- **Sufficient rates of survival, growth, and reproduction to protect populations of omnivorous birds typical to the area.** Secondary avian consumers that provide a food source for upper-trophic-level consumers, such as avian and mammalian carnivores, are an important ecological resource for a healthy environment. Maintenance of populations of secondary avian consumers was, therefore, considered an ecological value to be protected.
- **Sufficient rates of survival, growth, and reproduction to protect populations of carnivorous birds typical to the area.** Carnivorous birds are important tertiary consumers at the site and are susceptible to the effects of bioaccumulative chemicals. Effects on the raptor populations at Site 22 would also be undesirable because of the effects that the loss of predation would have on lower trophic levels. Maintenance of populations of raptors was, therefore, considered an ecological value to be protected.
- **Sufficient rates of survival, growth, and reproduction to protect populations of herbivorous mammals typical to the area.** Herbivorous mammals provide a major food source for upper-trophic-level consumers. Adverse effects on the populations of these primary consumers could result in a reduction of food available to higher-trophic-level consumers. Maintenance of populations of herbivorous mammals was, therefore, considered an ecological value to be protected.
- **Sufficient rates of survival, growth, and reproduction to protect terrestrial carnivorous mammals typical to the area.** Carnivorous mammals are important tertiary consumers and are susceptible to effects of bioaccumulative chemicals. Adverse effects on carnivorous mammal populations at Site 22 would also be undesirable because of the effects that the loss of predation would have on lower trophic-level species. Survival, growth, and reproduction of carnivorous mammals were, therefore, considered ecological resources to be protected.

Because assessment endpoints are usually not amenable to direct measurement, measurement endpoints related to assessment endpoints were identified. A measurement endpoint is defined by EPA as "a measurable ecological characteristic that is related to the valued characteristic chosen as the assessment endpoint and is a measure of biological effects (such as mortality, reproduction, or growth)," (EPA 1997a). Measurement endpoints more closely reflect technical considerations in the risk assessment process; that is, measurement endpoints are focused on both direct measures of ecological effects such as toxicity tests and indirect measures such as food chain modeling that allow for an evaluation of risk to representative receptors. Measurement endpoints can include measures of exposure or effect and are frequently numerical expressions of observations. Measurement endpoints are often expressed as statistical or arithmetic summaries of observations and can include both measures of effect and measures of exposure. Each measurement endpoint correlates directly with one of the defined assessment endpoints and was based on available literature regarding mechanisms of toxicity. A species was selected to be representative of each assessment endpoint. Food chain models were used to estimate site-specific exposure (dose) to representative species; doses were compared to toxicity references values (TRV) in an HQ approach. TRVs are screening-level benchmarks for higher-trophic-level receptors such as birds and mammals. A TRV is a daily dose level with known biological effects on laboratory animals.

Each measurement endpoint was selected based on the species or communities present or potentially present at Site 22, the adequacy of the information on the particular endpoint based on literature research, and the ability of the endpoint to suggest information about the related assessment endpoint. Two of the species listed as measurement endpoints represent guilds of upper-trophic-level predators common in the terrestrial habitats of NWS SBD Concord. The top predators include raptors (represented by the Red-tailed Hawk) and carnivorous mammals (represented by the grey fox). Passerine birds (represented by the American Robin) are omnivores and are potential prey for raptors as are herbivorous small mammals (represented by the western harvest mouse), and thus are included in the food chain analysis. The food chain analysis also modeled the effects of chemical exposure to the tule elk because of its special status and role as an herbivorous mammal.

The following measurement endpoints were used in evaluating potential ecological impacts on the assessment endpoints identified for Site 22:

- **For omnivorous birds, reproductive or physiological impacts on the American robin:** The American Robin (*Turdus migratorius*) was used as a measurement endpoint and as a surrogate to represent the bird population associated with Site 22. Potential reproductive or physiological impacts were evaluated by comparing estimated site-specific doses with literature-derived TRVs.
- **For carnivorous birds, reproductive or physiological impacts on the red-tailed hawk:** The Red-tailed Hawk (*Buteo jamaicensis*) was used as a measurement endpoint and as a surrogate to represent the raptor populations associated with Site 22. Potential reproductive or physiological impacts were evaluated using literature-derived TRVs.
- **For herbivorous mammals, reproductive or physiological impacts on the western harvest mouse and tule elk:** The western harvest mouse (*Reithrodontomys megalotis*) and tule elk (*Cervus elaphus nannodes*) were used as measurement endpoints and as surrogates to represent the herbivorous mammal population associated with Site 22. Potential reproductive or physiological impacts were evaluated using literature-derived TRVs.
- **For carnivorous mammals, reproductive or physiological impacts on the grey fox:** The grey fox (*Urocyon cinereoargenteus*) was used as a measurement endpoint and as a surrogate to represent the raptor populations associated with Site 22. Potential reproductive or physiological impacts were evaluated using literature-derived TRVs.

Chemicals without an existing TRV were evaluated qualitatively. A conservative daily dose was calculated based on site chemical concentrations and natural history information on the representative species. HQs were developed by dividing the estimated daily dose for each chemical by the appropriate TRV.

7.3 STEP 2: EXPOSURE ESTIMATE AND RISK CALCULATION

The following sections describe the exposure estimate and risk calculation for Site 22, including selection of COPECs and evaluation of exposure to the selected measurement endpoints. Exposure estimates and risk calculation correspond to Step 2 of the screening-level risk assessment process, as described in EPA guidance (EPA 1997a).

7.3.1 Methodology for Evaluating Exposure and Effects on Ecological Receptors

The following sections describe the methodology used to evaluate exposure and effects on representative birds and mammals at Site 22.

7.3.2 Exposure and Effects on Terrestrial Vertebrates

The evaluation of risk to terrestrial vertebrates, such as birds and mammals, focused on selected endpoints identified in Section 7.2.5. Food chain modeling was the primary tool used to assess the potential effects from exposure of terrestrial vertebrates to chemicals present at Site 22. Food chain models are used to assess the exposure of higher-trophic-level receptors to chemicals in their diet (exposure through the ingestion pathway). These models are conceptually simple and focus on ecological receptors of concern. Food chain models are one method of integrating ecological and chemical information into the risk assessment process, especially for chemicals that tend to bioconcentrate or bioaccumulate (Pascoe, Blanchet, and Linder 1996).

This section describes the model that was used to estimate ingested doses of site chemicals for representative avian and mammalian receptors. Exposure models for birds and mammals are based on the assumption that exposure to chemicals is primarily through ingestion of contaminated soil and prey. Surface water ingestion, dermal contact, and inhalation are other possible routes of exposure, but they were not evaluated in these models. The exposure models estimate the mass of a chemical ingested daily by a receptor per kilogram of body weight (daily chemical dosage). Estimates of exposure are generally based on knowledge of the spatial and temporal distribution of both chemicals and receptors and on specific natural and life history characteristics that influence exposure to chemicals. For each measurement endpoint and COPEC, a conservative estimate of the daily dose to the organism was developed using literature-based life history information, site-specific COPEC soil concentrations, and literature-derived BAFs to estimate tissue concentrations.

Maximum daily chemical doses were estimated for each COPEC and representative receptor using maximum site concentrations in soil and estimating concentrations in prey tissue using BAFs. These doses were then compared with high and low TRVs to estimate the potential adverse biological effects on the receptor. Based on this comparison, the risk to each representative species was characterized using an HQ approach [HQ=dose/TRV].

The total exposure from ingestion for each receptor of concern was calculated as the sum of the dietary exposure estimates. The following generic equation was adapted for each representative receptor:

$$\text{Dose}_{total} = \frac{([IR_{prey} \times C_{prey}] + [IR_{soil} \times C_{soil}]) \times SUF}{BW}$$

where

Dose_{total}	=	Estimated dose from ingestion (mg/kg body weight-day)
IR_{prey}	=	Ingestion rate of prey (kg/day)
C_{prey}	=	Concentration in dry weight of chemical in prey (mg/kg)
IR_{soil}	=	Ingestion rate of soil (kg/day)
C_{soil}	=	Concentration in dry weight of chemical in soil (mg/kg)
SUF	=	Site use factor (unitless)
BW	=	Adult body weight (kg)

Conservative SLERA risk estimates ensure that the assessment does not indicate little or no risk when a risk actually exists; therefore, in the absence of site- or species-specific data, conservative assumptions were used in this analysis. Exposure was assessed within the context of the following linear food chains to evaluate potential ecological effects on secondary consumer birds and mammals:

- Soil → Plants and Invertebrates → American Robin
- Soil → Small Mammals → Red-tailed Hawk and grey fox
- Soil → Plants → western harvest mouse and tule elk

The components of the exposure model were (1) temporal and spatial characterization of exposure, (2) ingestion rates and diet composition, and (3) life history and behavioral information. The following paragraphs include specific assumptions and model parameters for each representative receptor evaluated at Site 22.

American Robin Dose Calculation Parameters

The American Robin (*Turdus migratorius*) was selected to represent omnivorous passerine birds. The following summarizes the parameters used in dose calculations for the American Robin:

Parameter	Average Adult	Units	Reference/Notes
Ingestion Rate_{total}	0.012273	kg/day	Calculated with body weight of 77.3 grams using the Nagy (2001) dry matter intake food requirement equation for passerine birds (a= 0.630; b= 0.683).
Ingestion Rate_{soil}	0.00000123	kg/day	0.01 percent of total ingestion rate, based on the rate for the Western Meadowlark (EPA 1999a).
Soil Concentrations	Maximum	mg/kg	Soil data collected from site (0- to 3.0-foot bgs).
Ingestion Rate_{prey}	0.012272	kg/day	99.99 percent of total ingestion rate, based on soil ingestion rate.

Parameter	Average Adult	Units	Reference/Notes
Prey Composition	55 percent (invertebrates) 45 percent (fruits)	Percen t	Diet composed of 45 percent plant matter (fruits) and 55 percent invertebrates for adults in the western United States (Wheelwright 1986 as cited in EPA 1993b).
Prey Concentrations	BAF	unitles s	Concentrations estimated using plant and invertebrate BAFs from EPA (1999a), multiplied by the maximum soil concentration.
Foraging Range	7.7 to 14.3	acres	Based on 7 to 13 males per 100 acres in the central Valley reported by Gaines (1974a) as cited in Zeiner and others (1990a).
SUF	1	Unitles s	Conservative estimate of site use.
Body Weight	0.0773	kg	Mean body weight of adults throughout the United States (Clench and Leberman 1978 as cited in EPA 1993b).

With regard to the prey composition parameters, animal matter predominates in the breeding season diet while in the nonbreeding season American Robins eat more berries and other fruits, seeds, seedlings and sprouts (Bent 1949 and Martin and others 1961, both as cited in Zeiner and others 1990a). The American Robin searches visually for earthworms, caterpillars, beetles, snails, and arthropods on the ground, preferring short plant cover, occasional bare earth, and forest litter. The American Robin food chain model assumed a diet of 55 percent invertebrate tissue and 45 percent plant tissue (average of data for American Robins in the western United States (Wheelwright 1986 as cited in EPA 1993b). Tissue concentrations were derived from BAFs for plants and invertebrates from Sample and others (1996) and EPA (1998b, 1999a) and multiplied by the maximum soil concentration.

The site use factor (SUF) accounts for the size of the area of concern in comparison with the foraging range used by the receptor species. If the area of the habitat used in the area of concern is greater than the foraging range of the species, it is likely that individuals may spend 100 percent of their time there. Home ranges for the American Robin vary from 1.68 to 2.32 acres, depending on location, topography, habitat, and prey availability (Zeiner and others 1990a). The acreage of Site 22 is estimated at 5.5 acres. To be conservative for the SLERA, an SUF of 1.0 was assumed for the dose calculations, indicating that the Robin spends 100 percent of its time feeding and foraging at the site.

Red-Tailed Hawk Dose Calculation Parameters

The Red-tailed Hawk (*Buteo jamaicensis*) was selected to represent carnivorous raptors. The following summarizes the parameters used in dose calculations for the Red-tailed Hawk:

Parameter	Average Adult	Units	Reference/Notes
Ingestion $Rate_{total}$	0.0804	kg/day	Calculated with body weight of 957 grams using the Nagy (2001) dry matter intake food requirement equation for carnivorous birds (a= 0.849; b= 0.663).
Ingestion $Rate_{soil}$	0.000563	kg/day	0.7 percent of total ingestion rate, based on the rate for the Bald Eagle (Pascoe, Blanchet, and Linder 1996).
Soil Concentrations	Maximum	mg/kg	Soil data collected from site (0- to 3.0-foot bgs).
Ingestion $Rate_{prey}$	0.0798	kg/day	99.3 percent of total ingestion rate, based on soil ingestion rate.
Prey Composition	100	Percent	Diet composed of 100 percent animal matter (small rodents, reptiles, and birds) (Zeiner and others 1990a). Diet of 100 percent rodents was assumed for food chain model.
Prey Concentrations	BAF	unitless	Concentration estimated using rodent BAFs from EPA (1999a), multiplied by the maximum soil concentration.
Tissue Moisture	68	Percent	Mouse tissue moisture from EPA (1993b).
Foraging Range	247 to 2,471	acres	Zeiner and others 1990a
SUF	1	Unitless	Conservative estimate of site use.
Body Weight	0.96	kg	Average of adult males throughout the United States (Steenhof 1983 as cited in EPA 1993b).

With regard to the prey composition parameter, Red-tailed Hawks are swooping, pouncing carnivores with a diet that consists of small mammals, insects, earthworms, reptiles, and amphibians (Ehrlich, Dobkin, and Wheye 1988; Zeiner and others 1990a). The Red-tailed Hawk food chain model assumed a diet of 100 percent rodent tissue. Tissue concentrations were derived from BAFs for rodents from Sample and others (1996) and EPA (1998b, 1999a) and multiplied by the maximum soil concentration. Literature BAFs were converted from wet to dry weight using percent moisture for mouse tissue from the literature (EPA 1993b).

With regard to the SUF, home ranges for the Red-tailed Hawk vary from less than 247 to 2,471 acres (Zeiner and others 1990a). Although the acreage of Site 22 is approximately 5.5 acres, to be conservative for the SLERA, an SUF of 1.0 was assumed for the dose calculations, indicating that the receptor spends 100 percent of its time feeding and foraging at the site.

Grey Fox Dose Calculation Parameters

The grey fox (*Urocyon cinereoargenteus*) was selected to represent carnivorous mammals. The following summarizes the parameters used in dose calculations for the grey fox:

Parameter	Average Adult	Units	Reference/Notes
Ingestion $Rate_{total}$	0.169	Kg/day	Calculated with body weight of 3,880 grams using the Nagy (2001) dry matter intake food requirement equation for eutherian mammals (a= 0.299; b= 0.767).
Ingestion $Rate_{soil}$	0.00474	Kg/day	2.8 percent of total ingestion rate; based on red fox data from Beyer, Connor, and Gerould (1994).
Soil Concentrations	Maximum	Mg/kg	Soil data collected from site (0- to 3.0-foot bgs).
Ingestion $Rate_{prey}$	0.164	kg/day	97.2 percent of total ingestion rate, based on soil ingestion rate percentage.
Prey Composition	100	Percent	Omnivorous, although it primarily consumes small rodents and other animal matter (Zeiner and others 1990b). Diet of 100 percent rodents was assumed for food chain model.
Prey Concentrations	BAF	unitless	Concentration estimated using rodent BAFs from EPA (1999a), multiplied by the maximum soil concentration.
Tissue Moisture	68	unitless	Mouse tissue moisture from EPA (1993b).
Foraging Range	296.5	acres	Average for four females in Davis, California (Fuller 1987 as cited in Zeiner and others 1990b).
SUF	1	Unitless	Conservative estimate of site use.
Body Weight	3.88	kg	Average of male and female gray fox body weights from Silva and Downing (1995).

With regard to the prey composition parameter, grey foxes are noted for their ability to climb trees much more than other foxes. Much of its food is caught on the ground but the fox will not only go up into trees when pursued but will also do so of its own will, especially to find fruits in season. The grey fox food-chain model assumes a diet of 100 percent rodent tissue. Tissue concentrations were derived from BAFs for rodents from Sample and others (1996) and EPA (1998b, 1999a) and multiplied by the maximum soil concentration. Literature BAFs were converted from wet to dry weight using percent moisture for mouse tissue from the literature (EPA 1993b).

With regard to the SUF, the average home range for four female grey foxes in Davis, California, was 296.5 acres (Fuller [1987] as cited in Zeiner and others [1990b]). Although the acreage of Site 22 is estimated to be only 5.5 acres, to be conservative for the SLERA, an SUF of 1.0 was assumed for the dose calculations, indicating that the receptor spends 100 percent of its time feeding and foraging at the site.

Western Harvest Mouse Dose Calculation Parameters

The western harvest mouse (*Reithrodontomys megalotis*) was selected to represent small mammals. The following summarizes the parameters used in dose calculations for the western harvest mouse:

Parameter	Average Adult	Units	Reference/Notes
Ingestion Rate$_{total}$	0.0024	kg/day	Calculated with average adult body weight of 13 grams using the Nagy (2001) dry matter intake food requirement equation for rodents (a= 0.332; b= 0.774)
Ingestion Rate$_{soil}$	0.000048	kg/day	2 percent of ingestion rate; white-footed mouse data from Beyer, Connor, and Gerould (1994).
Soil Concentrations	Maximum	mg/kg	Soil data collected from site (0- to 3.0-foot bgs).
Ingestion Rate$_{prey}$	0.002352	kg/day	98 percent of total ingestion rate, based on soil ingestion rate.
Prey Composition	100 percent Plant	Percent	Diet composed primarily of plant matter, but mouse also consumes seeds, insects, and fruit (Zeiner and others 1990b). Diet assumed to be 100 percent plant for food chain model.
Prey Concentrations	BAF	Unitless	Concentrations estimated using plant and insect BAFs from EPA (1999a), multiplied by the maximum soil concentration.
Foraging Range	1.0 to 1.38	Acres	Brant 1962 and Meserve 1977 as cited in Zeiner and others 1990b.
SUF	1	Unitless	Conservative estimate of site use.
Body Weight	0.013	kg	Average body weight from Davis and Schmidly 1994

With regard to the prey composition parameter, the western harvest mouse feeds on primarily on plant matter eating seeds, insects, fruits, and shoots from ground surface, and in bushes (Meserve 1976a as cited in Zeiner and others 1990b). The western harvest mouse prefers thick grass or shrub cover for foraging and nesting. The food chain modeling assumed a diet of 100 percent plant mater. Tissue concentrations were derived from BAFs for plants from Sample and others (1996) and EPA (1998b, 1999a) and multiplied by the maximum soil concentration.

With regard to the SUF, home ranges for the western harvest mouse vary from 1 to 1.38 acres (less than 1 km^2), depending on location, topography, habitat, and prey availability (Zeiner and others 1990b). Since the acreage of Site 22 is approximately 5.5 acres, a SUF of 1.0 was assumed for the dose calculations.

Tule Elk

The tule elk (*Cervus elaphus nannodes*) was selected to represent herbivorous mammals, in particular, herds of elk and cattle that graze at Site 22. The following summarizes the parameters used in dose calculations for the tule elk:

Parameter	Average Adult	Units	Reference/Notes
Ingestion Rate$_{total}$	1.7238	kg/day	Calculated with average adult body weight of 181,450 grams using the Nagy (2001) dry matter intake food requirement equation for herbivorous mammals (a= 0.859; b= 0.628)
Ingestion Rate$_{soil}$	0.034476	kg/day	2 percent of total ingestion rate, based on the rate for the elk (Beyer, Connor, and Gerould 1994).
Soil Concentrations	Maximum	mg/kg	Soil data collected from site (0- to 3.0-foot bgs).
Ingestion Rate$_{prey}$	1.6893	kg/day	98 percent of total ingestion rate, based on soil ingestion rate.
Prey Composition	100	Percent	Diet composed of 100 percent plant matter (grasses, forbs, tender twigs, and leaves) (Zeiner and others 1990b).
Prey Concentrations	BAF	unitless	Concentrations estimated using plant BAFs from EPA (1999a), multiplied by the maximum soil concentration.
Foraging Range	716.6	acres	Franklin and others 1975 as cited in Zeiner and others 1990b.
SUF	1	Unitless	Conservative estimate of site use.
Body Weight	181.45	kg	Average of adult females (McCullough 1969).

Tule elk are herbivores; they graze and browse. Diet will vary according to their geographic location. They eat grasses, forbs, twigs and leaves, and aquatic vegetation (Zeiner and others 1990b). They require brush, trees, shrubs, riparian, and herbaceous vegetation as cover especially during hot months. For this assessment, elk were assumed to eat 100 percent plant matter. Tissue concentrations derived from BAFs for plants from Sample and others (1996) and EPA (1998b, 1999a) are multiplied by the maximum soil concentration.

With regard to the SUF, the home range for tule elk is 716.6 acres (Franklin and others 1975 as cited in Zeiner and others 1990b). Although the acreage of Site 22 is estimated to be only 5.5 acres, to be conservative for the SLERA, a conservative SUF of 1.0 was assumed for the dose calculations, indicating that the receptor spends 100 percent of its time feeding and foraging at the site.

Toxicity Reference Values and Hazard Quotient Approach

Calculated dose estimates for each receptor and COPEC were compared with TRVs and used to evaluate risk associated with ingested chemicals. Each TRV represents a critical exposure level from a peer-reviewed toxicological study and is supported by a data set of toxicological exposures and effects (EFA West 1998). TRVs were derived for chemicals and receptors specific to Navy installations by a work group through a collaborative effort involving the Navy and its contractors as well as the EPA Region IX Biological Technical Advisory Group (BTAG). The BTAG includes federal, state, and local regulatory agencies and resource trustees. The derivation of TRVs and the use of food chain analysis in the HQ approach were described in detail in a technical memorandum (EFA West 1998).

For this assessment, the Navy/BTAG TRVs (EFA West 1998) were used whenever possible. For COPECs for which no Navy/BTAG TRVs were available, toxicological benchmarks for wildlife developed by Sample and others (1996) were used. These benchmarks include lowest observed adverse effect levels (LOAEL) and no observed adverse effect levels (NOAEL). For chemicals for which no TRVs were available, a qualitative assessment of risk was performed based on available information in the scientific literature.

General TRVs for mammals and birds must be converted for each site-specific receptor of concern. The extrapolation of data based on body scaling is called allometric conversion. The underlying assumption of allometric conversions is that physiological functions, such as metabolic rates, are a function of body size and body weight (BW) (Opresko, Sample, and Suter 1993). Allometric conversions assume that smaller animals have higher metabolic rates and are typically able to detoxify ingested chemicals more quickly than larger animals (Opresko, Sample, and Suter 1993; Sample and others 1996). Several allometric conversion equations are available in the literature; for the SLERA, body scaling equations recommended by Sample and others (1998) were used to extrapolate doses according to methods described by Opresko, Sample, and Suter 1993 (1993) and Sample and others (1996). The following allometric conversion equations were used for this SLERA:

$$\text{Birds:}\quad TRV_{receptor} = TRV_{test\ organism}\,(BW_{test\ organism} / BW_{receptor})^{1 - 1.2}$$

$$\text{Mammals:}\quad TRV_{receptor} = TRV_{test\ organism}\,(BW_{test\ organism} / BW_{receptor})^{1 - 0.94}$$

Site-specific daily dose estimates were compared to high and low TRVs to estimate the potential adverse biological effects on each receptor. Based on this comparison, the risk to representative receptors was characterized; this comparison was performed in a manner consistent with EPA's HQ methodology (EPA 1986), as follows:

$$HQ = \frac{Dose}{TRV} = \frac{(mg/kg - day)}{(mg/kg - day)}$$

where

HQ	=	Hazard quotient (unitless)
Dose	=	Chemical-, receptor-, and site-specific daily dose estimate (mg/kg-day)
TRV	=	Chemical- and receptor-specific toxicity reference value (mg/kg-day)

High TRVs (LOAELs) and low TRVs (NOAELs) were derived for each chemical by the Navy/BTAG workgroup to reflect the variability of parameters within an ecological risk context. Specifically, the low TRV was considered a conservative value consistent with a chronic no-effect level. The high TRV was a less conservative value consistent with a LOAEL. Therefore, the high TRV is a value at which adverse effects have been demonstrated. When compared with site-specific doses ingested by receptors of concern, the high TRV (LOAEL) can be used to identify sites posing potential risk to birds or mammals. Conversely, the low TRV is a dose below which no adverse effects are expected.

Because of differences in the degree of conservatism in selection of TRVs for various chemicals and receptors, it is Navy policy that resulting HQ values should not be compared between chemicals or receptors; they should be considered individually (Navy 1999a).

As explained in EPA regulatory guidance (EPA 1989b), the HQ approach indicates that receptors may be at risk if the HQ exceeds 1.0. Maximum doses were calculated for receptors using maximum soil and tissue concentrations and average literature values for exposure parameters such as BW and ingestion rate. As such, an $HQ_{(dose/high\ TRV)}$ and $HQ_{(dose/low\ TRV)}$ evaluate risk to the typical individual within the population from the highest levels of contaminants observed at the site.

The interpretation of each HQ is summarized below and illustrated on Figure 7-2.

HQ = Dose/TRV	**Low TRV**	**High TRV**	**Between Low and High TRV**
Dose to typical receptor based on maximum soil concentrations	$HQ_{(dose/low\ TRV)} < 1.0$ indicates little or no risk to typical receptor	$HQ_{(dose/high\ TRV)} > 1.0$ indicates significant or immediate risk to typical receptor	$HQ_{(dose/high\ TRV)} < 1.0$ and $HQ_{(dose/low\ TRV)} > 1.0$ indicates potential for risk to typical receptor

HQs could not be calculated without a TRV. In cases in which TRVs were unavailable, a dose was calculated for each chemical, and the dose was compared to literature-reported doses associated with effect or no effect levels. The primary literature source was Agency of Toxic Substances and Disease Registry (ATSDR) profiles of each chemical. Best professional judgment was used in interpreting literature data when information on a chemical was limited.

7.4 EVALUATION OF POTENTIAL RISK TO BIRDS AND MAMMALS

The evaluation of risk to birds and mammals focused on selected assessment endpoints identified in Section 7.2.5 and evaluated exposure through the ingestion pathway. Risk to representative birds (American Robin and Red-tailed Hawk) and mammals (western harvest mouse, tule elk, and grey fox) at Site 22 were evaluated using food chain modeling, based on an HQ approach. Chemicals evaluated include: arsenic, beryillium, copper, lead, mercury, zinc, benzo(a)anthracene, benzo(b)fluoranthene, benzo(a)pyrene, benzo(e)pyrene, chrysene, fluoranthene, phenanthrene, phenol, pyrene, 2-methylnaphthalene, and naphthalene. Food-chain modeling calculations for birds and mammals are presented in Appendix H.

7.4.1 Exposure and Effects Assessment for Birds

Based on life history and foraging habits, an estimated daily dose for each COPEC was calculated for the American Robin and the Red-tailed Hawk. As specified in both Navy (1999a) and EPA (1997a) guidance for conducting SLERAs, all estimated doses were calculated using the maximum site-specific soil concentrations and literature-derived BAFs (to estimate prey concentrations).

Estimated daily doses for each receptor for each chemical were compared to low and high TRVs to calculate HQs; calculations are presented in their entirety in Appendix H. COPECs with TRVs for which HQs were calculated included arsenic, copper, lead, mercury, and zinc. Chemicals without TRVs for which no HQ could be calculated were evaluated qualitatively in Section 7.4.1.1.

Only HQs greater than 1.0 for the American Robin and the Red-tailed Hawk are presented in the following tables. The complete list of American Robin and Red-tailed Hawk HQs is provided in Appendix H.

HAZARD QUOTIENTS GREATER THAN 1.0 FOR THE AMERICAN ROBIN

Chemical	Dose/High TRV	Dose/Low TRV
Arsenic	**1.1**	**4.4**
Copper	0.2	**4.0**
Lead	0.6	**248.0**
Mercuy	0.3	**1.2**
Zinc	**6.0**	**59.5**

Chemicals for which HQs were greater than 1.0 for the American Robin included arsenic, copper, lead, mercury, and zinc.

Arsenic and zinc appear to pose an immediate and significant risk ($HQ_{[dose/high\ TRV]}$) to the American Robin at Site 22, while copper, lead, and mercury pose potential risk ($HQ_{[dose/low\ TRV]}$). These chemicals will be discussed in more detail in the following text.

HAZARD QUOTIENTS GREATER THAN 1.0 FOR THE RED-TAILED HAWK

Chemical	Dose/High TRV	Dose/Low TRV
Lead	0.01	**4.26**

The only risk identified for the Red-tailed Hawk was a potential risk ($HQ_{[dose/low\ TRV]}$) from exposure to lead. This will be discussed in more detail in the following text.

Arsenic

A potentially significant risk ($HQ_{[dose/high\ TRV]}$) from exposure to arsenic was indicated for the American Robin at Site 22; however the $HQ_{(dose/lhigh\ TRV)}$ was only slightly greater than 1.0. Arsenic does not pose a risk to the Red-tailed hawk.

The acute oral exposure of inorganic arsenic destroys the blood vessel lining in the gut, which can result in lower blood pressure and causes hepatocyte damage by arsenic inhibition of the sodium pump in cells (Nystrom 1984 as cited in Eisler 1988a). Toxic effects of arsenite in birds include loss of muscular coordination, debility, slowness, jerkiness, falling hyperactivity, fluffed feathers, drooped eyelids, huddled position, unkempt appearance, loss of righting reflex, immobility, and seizures (Eisler 1988a; Camardese and others 1990, Opresko and others 1994, both as cited in U.S. Department of the Interior (DOI) 1998; Stanley and others 1994). Some species of birds are more sensitive to arsenic than others (Eisler 1988a; DOI 1998).

Adult Mallards (*Anas platyrhynchos*) and ducklings fed on diets supplemented with sodium arsenate (at 25, 100, or 400 micrograms per gram [µg/g]) showed that arsenic accumulated in adult liver and eggs, reduced adult weight gain and liver weight, delayed the onset of egg laying, decreased whole egg weight, and caused eggshell thinning (Stanley and others 1994). Arsenic did not affect hatching success and was not teratogenic. In ducklings, arsenic accumulated in the liver and reduced body weight, growth, and liver weight. At those levels of exposure, arsenic did not increase duckling mortality, but it did decrease overall duckling production by adults. Stanley and others (1994) also reported antagonistic effects between arsenic and selenium in Mallards (*Anas platyrhynchos*). The two metals often occur together in high concentrations in the environment and can accumulate in aquatic plants and invertebrates consumed by waterfowl. Arsenic may reduce selenium accumulation in liver and egg and alleviate the effects of selenium on hatching success and embryo deformities. Antagonistic effects of arsenic and selenium on the survival, growth, and physiology of Mallard ducklings reduce observed toxicity when nutrition is otherwise adequate. When dietary protein is diminished, more severe toxicological effects were observed (Hoffman and others 1992).

Copper

A potential risk ($HQ_{[dose/low\ TRV]}$ = 3.96) was indicated for the American Robin based on maximum soil concentrations; copper was not a risk to the Red-tailed Hawk ($HQ_{[dose/low\ TRV]}$ < 1.0). While copper can be toxic to birds, birds appear to be fairly tolerant of chronic copper exposure. Mallards and adult chickens tolerated a daily dietary copper concentration of 29 and 60 mg/kg body weight, respectively. In adult chickens, pigeons, and ducks, minimum lethal doses of copper ranged from 300 to 1,500 mg/kg body weight (Demayo, Taylor, and Taylor 1982). Diets containing elevated copper levels can slow the growth rate, diminish egg production, and cause developmental abnormalities in various avian species (Owen 1981). For example, chicks showed a slight reduction in weight gain at dietary copper concentrations of 350 mg/kg or higher; turkeys tolerated a diet with 676 mg/kg copper.

Because the $HQ_{[dose/low\ TRV]}$ is only slightly greater than 1, copper is not thought to pose risk to the American Robin at Site 22.

Lead

Although a potential risk ($HQ_{[dose/low\ TRV]}$) from exposure to lead was indicated for both the American Robin and the Red-tailed Hawk at Site 22, significant risk to the American Robin or Red-tailed Hawk was not indicated ($HQ_{[dose/high\ TRV]}$ < 1.0). $HQ_{[dose/low\ TRV]}$ was only slightly greater than 1.0 for the Red-tailed Hawk. The $HQ_{[dose/low\ TRV]}$ for the American Robin was significantly higher ($HQ_{[dose/low\ TRV]}$ = 247.99).

Lead produces a variety of toxic effects in birds, including damage to the nervous system, muscular paralysis, inhibition of heme synthesis, damage to kidneys, damage to the liver, and death (Mudge 1983 as cited in Eisler 1988b). Sublethal lead exposure may also have adverse systemic and reproductive effects in some species by decreasing plasma calcium, inhibition of growth, and reduced hatchability of chicks. Organic forms of lead are more toxic than inorganic forms to avian receptors.

The TRV for lead was derived from a study (Edens and others 1976) using a very soluble form of lead (lead acetate) fed to Japanese Quails. Reproductive effects, including plasma calcium levels, eggshell thickness, and number of hatchlings, were measured. Japanese Quails are one of the most sensitive species to reproductive effects. To account for differences in the sensitivity of receptors to lead, a comparable study (Pattee 1984), where the same form of lead was administered to American Kestrels with similar endpoints, was used. In the study using kestrels, a raptor species, a dose of up to 50 mg/kg did not cause significant adverse reproductive effects on egg production, incubation, fertility, or eggshell thickness. In the TRV study, a dose as small as 10 mg/kg was sufficient to cause significant reduction in egg production in the Japanese Quail (Edens and Garlich 1983).

The low TRV for lead is currently under review by the TRV workgroup, as it is considered to overestimate risk. Therefore, the significance of risk indicated by an $HQ_{[dose/low\ TRV]}$ for lead greater than 1.0 is currently being re-evaluated.

Mercury

A potential risk ($HQ_{[dose/low\ TRV]}$) from exposure to mercury was indicated for the American Robin at Site 22, although the $HQ_{[dose/low\ TRV]}$ was only slightly greater than 1.0 ($HQ_{[dose/low\ TRV]}$=1.22). Mercury did not pose a risk to the Red-tailed Hawk.

Sublethal effects of mercury on birds include adverse effects on growth, development, the immune system, reproduction, blood and tissue chemistry, metabolism, and behavior (Peterle 1991; Spalding and Forrester 1991, Spalding and others 1994; Zillioux and others 1993). Various biochemical and enzyme effects have also been reported (Wolfe and Norman 1998). These effects manifest themselves as abnormal feather loss, weight loss, progressive weakness in wings and legs, difficulty flying, inability to coordinate muscle movements, and reduced nesting and hatching success (Peterle 1991; Spalding and others 1994; Becker, Henning, and Furness 1994; Bowerman and others 1994; Monteiro and Furness 1995; Monteiro, Furness and del Novo 1995). Inorganic mercury exerts its greatest effects on the kidneys, whereas methylmercury is a potent embryo and nervous system toxicant (Spalding and others 1994; Monteiro and Furness 1995). Methylmercury readily crosses the blood-brain barrier in birds, producing central nervous system dysfunction (Scheuhammer 1987).

Low doses of mercury can cause reproductive effects before overt signs of toxicity are apparent in adult birds (Scheuhammer 1987; Hoffman and Heinz 1998). Significant reproductive effects of chronic dietary inorganic mercury exposure in birds include delayed testicular development, altered mating and nesting behavior, reduced fertility and clutch size, eggshell thinning, reduced survivability and growth in young, and gonadal atresia (Walsh 1990; Becker 1992; Peterle 1991; Spalding and Forrester 1991). In birds, mercury is transferred into the egg, where it has adverse effects on the developing embryo (Peterle 1991). Mercury egg concentrations are good predictors of mercury risk to avian reproduction. Concentrations ranging from 0.5 to 16 mg/kg are associated with adverse effects, including decreased hatchability.

The total daily dose calculated using food chain modeling is 0.3 mg/kg/day for the American Robin. This dose is lower than the 0.5 to 16 mg/kg dose range at which negative effects are known to occur, thus mercury is not considered to be a risk driver to avian receptors at Site 22.

Zinc

Potential significant risk was indicated ($HQ_{[dose/high\ TRV]}$=5.95) for the American Robin from exposure to zinc based on maximum concentrations in soil. Zinc did not pose risk to the Red-tailed Hawk.

Birds are relatively tolerant to zinc ingested in the diet or drinking water (Eisler 1993). Different species of birds have varying sensitivities to dietary zinc exposure; normal tissue zinc concentrations are less than 210 mg/kg dry weight worldwide (Eisler 1993). Acute effects of zinc in ducks include mortality, diarrhea, leg paralysis, and pancreatic degradation (Eisler 1993). Poultry chicks fed 2,000 to 8,000 mg/kg of zinc exhibited reduced growth or died. Domestic breeding hens fed 178 mg/kg of zinc for 3 weeks grew normally, but displayed immunosuppression (Eisler 1993). Japanese quail, chickens, and turkeys fed diets containing zinc had decreased weight gain (National Academy of Sciences 1980). Newly born and juvenile animals are more sensitive to zinc exposure than are adults. The pancreas and bone are the primary areas of zinc deposition in birds (Eisler 1993).

7.4.1.1 Qualitative Evaluation of Chemicals of Potential Ecological Concern With No Toxicity Reference Values

HQs could not be calculated without a TRV. For the American Robin and Red-tailed Hawk, HQs could not be calculated for beryllium, benzo(a)anthracene, benzo(b)fluoranthene, benzo(a)pyrene, benzo(e)pyrene, chrysene, fluoranthene, phenanthrene, phenol, pyrene, 2-methylnaphthalene, and naphthalene. When TRVs were unavailable, an estimated dose was calculated for each chemical when sufficient site-specific soil chemical data and a literature-derived tissue estimate were available (Appendix H). Estimated doses were then compared with the literature-reported doses associated with effect or no-effect levels for any endpoint that was tested.

Sufficient data were available to qualitatively evaluate the effects of the modeled dose of benzo(a)pyrene to the American Robin and Red-tailed Hawk, as presented in the following text. Beryllium, benzo(a)anthracene, benzo(b)fluoranthene, benzo(e)pyrene, chrysene, fluoranthene, phenanthrene, phenol, pyrene, 2-methylnaphthalene, and naphthalene have calculated doses, but insufficient information about toxic effects of doses to ecological receptors was available.

Beryllium

Beryllium was considered a COPEC at Site 22 because it was detected in concentrations that exceeded ambient. The maximum beryllium concentrations of 0.70 mg/kg resulted in maximum doses of 0.09 mg/kg/day for the American Robin and 0.0004 mg/kg/day for the Red-tailed Hawk. No information on beryllium effects on birds was found in the literature.

Benzo(a)anthracene

Benzo(a)anthracene was considered a COPEC at Site 22. The maximum benzo(a)anthracene concentrations of 0.004 mg/kg resulted in maximum doses of 0.0000757 mg/kg/day for the American Robin and 0.00000237 mg/kg/day for the Red-tailed Hawk. No information on benzo(a)anthracene effects on birds was found in the literature; however, information regarding the effects of PAHs in general is discussed at the end of this section.

Benzo(b)fluoranthene

Benzo(b)fluoranthene was considered a COPEC at Site 22. The maximum benzo(b)fluoranthene concentration of 0.02 mg/kg resulted in maximum doses of 0.000768 mg/kg/day for the American Robin and 0.00000965 mg/kg/day for the Red-tailed Hawk. No information on benzo(b)fluoranthene effects on birds was found in the literature; however, information regarding the effects of PAHs in general is discussed at the end of this section.

Benzo(a)pyrene

Benzo(a)pyrene was considered a COPEC at Site 22. The following table presents the effects of benzo(a)pyrene in toxicity studies conducted using avian species and associated allometrically converted doses.

Receptor	Study	Dose to Test Species (mg/kg/day)	Test Species (Body weight)	Effect Type	Allometrically Converted Dose (mg/kg/day)	Food-chain Modeled Daily Doses (mg/kg/day)	Modeled Dose Exceeds Allometrically Converted Dose?
American Robin	Bond and others 1981	0.10	Chickens (3828 g)	No effect	0.126	0.000208	No
	Penn and Snyder 1988	40.0	White Leghorn Chickens (3822 g)	Increase in arterio-sclerotic plaques	50.548	0.000208	No
Red-tailed Hawk	Bond and others 1981	0.10	Chickens (3828 g)	No effect	0.076	0.000006	No
	Penn and Snyder 1988	40.0	White Leghorn Chickens (3822 g)	Increase in arterio-sclerotic plaques	30.324	0.000006	No

No adverse effects were observed in chickens exposed to 0.10 to 10.00-mg/kg dietary benzo(a)pyrene in a 4-week study (Bond and others 1981). Other studies showed no effects to mallard and chicken embryos at similar doses (Hoffman and Gay 1981, Brunstrom and others 1990). Some effects were seen at doses of 40.0-mg/kg-day (Penn and Snyder 1988), though these are higher than those modeled for avian receptors at Site 22. Comparison of the modeled doses for the avian receptors with the allometrically converted literature values does not indicate that benzo(a)pyrene will cause risk to birds at Site 22.

Benzo(e)pyrene

Benzo(e)pyrene was considered a COPEC at Site 22 . The maximum benzo(e)pyrene concentration of 0.01 mg/kg resulted in maximum doses of 0.000332 mg/kg/day for the American Robin and 0.00000481 mg/kg/day for the Red-tailed Hawk. No information on benzo(e)pyrene effects on birds was found in the literature; however, information regarding the effects of PAHs in general is discussed at the end of this section.

Chrysene

Chrysene was considered a COPEC at Site 22. The maximum chrysene concentration of 0.01 mg/kg resulted in maximum doses of 0.000246 mg/kg/day for the American Robin and 0.00000593 mg/kg/day for the Red-tailed Hawk. No information on chrysene effects on birds was found in the literature; however, information regarding the effects of PAHs in general is discussed at the end of this section.

Fluoranthene

Fluoranthene was considered a COPEC at Site 22. The maximum fluoranthene concentration of 0.034 mg/kg resulted in maximum doses of 0.000204 mg/kg/day for the American Robin and 0.01 mg/kg/day for the Red-tailed Hawk. No information on fluoranthene effects on birds was found in the literature; however, information regarding the effects of PAHs in general is discussed at the end of this section.

Phenanthrene

Phenanthrene was considered a COPEC at Site 22. The maximum phenanthrene concentration of 0.01 mg/kg resulted in maximum doses of 0.02 mg/kg/day for the American Robin and 0.011 mg/kg/day for the Red-tailed Hawk. No information on phenanthrene effects on birds was found in the literature; however, information regarding the effects of PAHs in general is discussed at the end of this section.

Phenol

Phenol was considered a COPEC at Site 22. The maximum phenol concentration of 0.44 mg/kg resulted in maximum doses of 264.84 mg/kg/day for the American Robin and 0.00026 mg/kg/day for the Red-tailed Hawk. No information on phenol effects on birds was found in the literature; however, information regarding the effects of PAHs in general is discussed at the end of this section.

Pyrene

Pyrene was considered a COPEC at Site 22. The maximum pyrene concentration of 0.22 mg/kg resulted in maximum doses of 0.01 mg/kg/day for the American Robin and 0.000132 mg/kg/day for the Red-tailed Hawk. No information on pyrene effects on birds was found in the literature; however, information regarding the effects of PAHs in general is discussed at the end of this section.

2-Methylnaphthalene

2-Methylnaphthalene was considered a COPEC at Site 22. The maximum 2-methylnaphthalene concentration of 20 mg/kg resulted in maximum doses of 70.31 mg/kg/day for the American Robin and 31.30 mg/kg/day for the Red-tailed Hawk. No information on 2-methylnaphthalene effects on birds was found in the literature; however, information regarding the effects of PAHs in general is discussed at the end of this section.

Naphthalene

Naphthalene was considered a COPEC at Site 22. The maximum naphthalene concentration of 8.1 mg/kg resulted in maximum doses of 28.48 mg/kg/day for the American Robin and 12.67 mg/kg/day for the Red-tailed Hawk. No information on naphthalene effects on birds was found in the literature; however, information regarding the effects of PAHs in general is discussed at the end of this section.

Effects of Polynuclear Aromatic Hydrocarbons

Information on the effects of PAH exposure on wildlife is limited, especially for birds. PAHs cause embryotoxicity to Mallard eggs when applied externally. For example, PAHs such as 7,12-dimethyl-benz(a)anthracene and chrysene are highly embryotoxic. Several investigations have reached two conclusions. First, the presence of PAHs in petroleum significantly enhances the overall embryotoxicity in avian species. Second, the relatively small percent of aromatic hydrocarbons contributed by PAHs in petroleum may confer much of the adverse biological effects reported after eggs have been exposed to microliter quantities of constituent PAHs, frequently characterized in crude oils (Albers 1983, Hoffman and Gay 1981, both as cited in Eisler 1987).

7.4.1.2 Chemicals Driving Risk to Birds at Site 22

Food chain modeling was employed to identify chemicals that may pose a risk to birds at Site 22. Estimated daily doses for two typical receptors (American Robin and Red-tailed Hawk) were calculated for each inorganic chemical detected above ambient concentrations and detected organic chemicals. The estimated daily doses were then compared to low and high TRVs to calculate an HQ; chemicals having HQs greater than 1.0 are discussed in the following paragraphs.

Arsenic and zinc were considered to pose immediate and significant risk to the American Robin at Site 22, because the $HQ_{(dose/high\ TRV)}$ exceeded 1. Copper, lead, and mercury were considered to pose potential risk to the American Robin at Site 22. Additionally, lead was considered to pose a potential risk to the Red-tailed Hawk at Site 22. Although the $HQs_{(dose/low\ TRV)}$ exceeded 1.0 for these chemicals, the $HQ_{(dose/high\ TRV)}$ were less than 1.0, indicating no immediate or significant risk from these chemicals.

The qualitative evaluation of COPECs without TRVs does not indicate that silver or benzo(a)pyrene pose risk to birds at Site 22 since the estimated doses at Site 22 are several orders of magnitude lower than literature-derived doses associated with no-effect levels. Sufficient information is not available in the literature to complete qualitative evaluations of doses of antimony, beryllium, cobalt, benzo(a)anthracene, benzo(b)fluoranthene, , benzo(e)pyrene, chrysene, fluoranthene, phenanthrene, phenol, pyrene, 2-methylnaphthalene, and naphthalene. These chemicals were infrequently detected; however, indicating that they are likely not driving risk at the site.

In summary, maximum concentrations of arsenic and zinc pose unacceptable risk to the American Robin. No COPECs are thought to pose unacceptable risk to the Red-tailed Hawk at Site 22 since no $HQ_{(dose/high\ TRV)}$ exceeded 1.0.

7.4.2 Exposure and Effects Assessment for Mammals

Based on life history and foraging habits, an estimated daily dose for each COPEC was calculated for the western harvest mouse, tule elk, and grey fox. As specified in both Navy (1999a) and EPA (1997a) guidance for conducting SLERAs, all estimated doses were calculated using the maximum site-specific soil concentrations and literature-derived BAFs (to estimate prey concentrations).

Estimated daily doses for the mouse, elk, and fox for each chemical were compared to low and high TRVs to calculate an HQ; calculations are presented in their entirety in Appendix H. COPECs with TRVs for which HQs were calculated included the following: arsenic, beryllium, copper, lead, mercury, zinc, benzo(a)anthracene, benzo(b)fluoranthene, benzo(a)pyrene, benzo(e)pyrene, chrysene, fluoranthene, phenanthrene, phenol, pyrene, 2-methylnaphthalene, and naphthalene.

HAZARD QUOTIENTS GREATER THAN 1.0 FOR THE WESTERN HARVEST MOUSE

Chemical	Dose/High TRV	Dose/Low TRV
Arsenic	0.40	**5.51**
Copper	0.01	**3.12**
Lead	0.01	**1,102.23**

Chemicals for which HQs were greater than 1.0 for the western harvest mouse included arsenic, copper, and lead. These chemicals pose a potential risk ($HQ_{[dose/low\ TRV]}$) and will be discussed in more detail in at the end of this section. No chemicals pose a significant risk to the western harvest mouse ($HQ_{[dose/lhigh\ TRV]} < 1$).

HAZARD QUOTIENTS GREATER THAN 1.0 FOR THE TULE ELK

Chemical	Dose/High TRV	Dose/Low TRV
Lead	0.001	**100.56**

Lead has an HQ greater than 1.0 for the tule elk and may pose a potential risk ($HQ_{[dose/low\ TRV]}$). Lead will be discussed in more detail at the end of this section.

HAZARD QUOTIENTS GREATER THAN 1.0 FOR THE GREY FOX

Chemical	Dose/High TRV	Dose/Low TRV
Lead	0.001	**160.06**

Lead has an HQ greater than 1.0 for the grey fox and may pose a potential risk ($HQ_{[dose/low\ TRV]}$). Lead will be discussed in more detail at the end of this section.

Arsenic

Arsenic did no pose a significant risk to any mammal modeled ($HQ_{[dose/lhigh\ TRV]} < 1$). A potential risk ($HQ_{[dose/low\ TRV]} = 5.51$) was indicated for the western harvest mouse based on maximum soil concentrations. The total daily dose estimated for the western harvest mouse using the maximum soil concentration is 3.84 mg/kg/day. Arsenic does not pose risk to either the tule elk or the grey fox.

Arsenic is not normally considered to be an essential element to most species and has been shown to be a carcinogen, teratogen, and a possible mutagen to mammals (Eisler 1988a, 1994). Beneficial effects have been reported, however, in tadpoles, silkworms, rats, goats, and pigs at low dietary concentrations (Eisler 1988a). At low levels, arsenic may be an essential nutrient and substitute for phosphorous in biochemical reactions (ATSDR 1993). At high levels, however, arsenic is recognized as an effective poison.

Adverse effects produced by arsenic are highly dose-dependent. Chronic exposure to low levels of arsenic can produce malaise and fatigue, gastrointestinal distress, anemia and basophilic stippling, neuropathy, and skin lesions that can develop into skin cancer. Mammals with arsenic deficiencies display poor growth, reduced survival, and inhibited reproduction, whereas low doses of arsenic can actually stimulate growth in plants and other animals (Eisler 1994). Water-soluble arsenic is efficiently absorbed from the gastrointestinal tract and circulated throughout the body. Trivalent arsenic is detoxified in the liver by conversion to methylarsenic acid and dimethylarsenic acid, which are the principal forms excreted in the urine. The body burden of arsenic can reach considerable levels because it can be sequestered in nails, hair, bones, teeth, skin, liver, kidneys, and lungs (ATSDR 1993). In mammals, arsenic is a teratogen that can pass the placental barrier and produce fetal death and malformations consisting of exencephaly, eye defects, and renal and gonadal agenesis (Eisler 1988a; ATSDR 1993; Domingo 1994).

The kidney accumulates arsenic and plays a major role in its metabolism and excretion (Brown, Rhyne, and Goyer 1976). Rat kidneys' mitochondria were found *in vitro* to be highly sensitive to arsenic toxicity. *In vivo* mitochondrial toxicity was evaluated in kidneys of rats exposed to arsenate in drinking water at concentrations of 40, 85, or 125 parts per million (ppm) for 6 weeks. Decreased state 3 respiration and respiratory control ratios were observed in kidneys of rats exposed at the 85- and 125-ppm dose levels. Ultrastructural alterations, consisting of swollen mitochondria and increased numbers of dense autophagic lysosome-like bodies, were confined to the renal proximal tubule cells of those same animals.

A 64-day experiment showed that two types of ultrastructural alterations occur in the liver cells of mice exposed to arsenic in drinking water (Mohelsk and others 1980). The first type was an acute reaction after a maximum 4-day exposure characterized by enlargement of the surfaces of some inner membranes as well as loss of glycogen. These changes receded slowly during the course of the experiment and were considered to be the consequence of the direct toxic action of arsenic. The second type was characterized by a strikingly delayed change after a maximum of 32 days, marked by the occurrence of dense lamellar structures in the peroxisomes. This change was considered to be an expression of induced tolerance to arsenic of the organism.

Rats given 5 ppm sodium arsenite in drinking water from weaning to natural death did not evidence tumorigenic or carcinogenic effects; that dose was considered tolerable for growth (Schroeder, and others 1968). Large amounts of arsenic had accumulated in tissues, especially the aorta and red blood cells, with no signs of toxicity.

Arsenic alters heme metabolism and urinary porphyrin synthesis in rodents. Exposure to sodium arsenate or sodium arsenite through drinking water is related to changes in activity of enzymes (either through increase or inhibition in renal enzymes) that determine the pattern of porphyrin concentration in urine and kidney tissues (Garcia-Vargas and others 1995).

Copper

Copper did not pose a significant risk to any mammal modeled ($HQ_{[dose/lhigh\ TRV]} < 1$). Copper poses a potential risk ($HQ_{[dose/low\ TRV]} = 3.12$) for the western harvest mouse based on maximum soil concentrations; however, copper does not pose risk to either the tule elk or the grey fox.

Mammals are relatively tolerant to copper. The accumulation of copper in animal tissues is influenced by several factors, including the genetic make-up of the animal, the levels of dietary iron and zinc, the intake of molybdenum and sulfate or sulfide, the availability of pantothenic acid and vitamin E, the quantity and source of protein, and other factors that remain unidentified (Hill 1977). Copper is primarily stored in the liver, kidney, bone marrow, and hair (Hammond and Beliles 1980 as cited in Talmage and Walton 1991). The toxic effects of copper have been studied on many animals, including cats, dogs, cattle, sheep, rats, mice, horses, guinea pigs, pigs, and monkeys. Different species of animals display varying levels of sensitivity to copper. The principle organ affected by exposure to copper is the liver, however, where copper primarily accumulates in the subcellular organelles, ultimately causing liver cirrhosis in all mammals. Copper can also cause necrotic kidney tubules and brain damage (Owen 1981). The primary toxic effects of an acute copper dose given orally are gastrointestinal irritation, vomiting (including blood), low blood pressure, jaundice caused by liver necrosis, and coma. Other chronic signs include inhibition of growth, muscular dystrophy, anemia, impaired reproduction, and decreased longevity (Zervas and others 1990 as cited in DOI 1998; Demayo, Taylor, and Taylor 1982; Talmage and Walton 1991). Chronic exposure to copper causes accumulation of copper in the body, causing hemolytic anemia and lesions in the liver, brain, and eye. Rat studies show liver, kidney, and stomach damage to be both short- and long-term effects caused by copper ingestion (ATSDR 1990).

Copper is an essential nutrient required for normal enzymatic function. In high concentrations, copper may act as a catalyst for the production of free radicals (DOI 1998). Serum copper concentrations increase with age in both mice and humans, but renal and hepatic concentrations decline. Dietary copper influences the life span of mice (Massie and Aiello 1984). Aging in mice was accelerated when mice were fed copper (administered as copper gluconate in drinking water) at concentrations of 317 ppm (Massie and Aiello 1984).

For most animals, the magnitude of copper toxicity varies with the ratio of copper to molybdenum in the diet. Low concentrations of molybdenum cause copper to accumulate at a faster rate and cause toxicity at lower concentrations (DOI 1998). Whole-body copper concentrations in small mammals collected from various uncontaminated sites ranged from 8.3 to 13.4 mg/kg dry weight (Talmage and Walton 1991).

Lead

Lead did not pose a significant risk to any mammal modeled ($HQ_{[dose/lhigh\ TRV]} < 1$). A potential risk ($HQ_{[dose/low\ TRV]}$) from exposure to lead was indicated at Site 22 for all mammalian receptors modeled. $HQs_{[dose/low\ TRV]}$ are 1102.23 for the western harvest mouse; 100.56 for the tule elk; and 160.06 for the grey fox. Potential for significant risk was not, however, indicated ($HQ_{[dose/high\ TRV]} < 1.0$) for any receptors.

Lead can have multiple toxic effects in mammalian species. Lead may cause damage to the nervous system, hematological effects, kidney dysfunction, sterility, abortion, neonatal mortality, growth retardation, delays in maturation, and reduced body weight (Amdur, Doull, and Klaassen 1991; Eisler 1988b). Younger mammals may have greater sensitivity to lead toxicity from their developing blood brain barrier. Developing capillaries in the brain allow lead levels in the blood to be transported to newly formed components of the brain (Amdur, Doull, and Klaassen 1991). Organic forms of lead are more toxic to mammals than inorganic forms.

For lead, considerable uncertainty is associated with the TRV. The TRV for lead was derived from a study (Krasovskii, Vasukovich, and Chariev 1979) using a very soluble form of lead (lead acetate) administered to rats in drinking water. Chronic effects, including effects on renal function, were measured over a period of 6 to 12 months. To account for differences in the mode of exposure of lead to receptors, two comparable studies, where the same form of lead was administered to rats with similar endpoints, were used. During one study (Crowe and Morgan 1996), 0.10 mg/kg of lead acetate was administered in drinking water to Sprague Dawley rats. They were observed for 63 days, and the amount of lead in their kidneys was measured. During the other study (Pond and others 1996), 0.1 mg/kg of lead acetate was administered in feed to Wistar rats. They were observed for 56 days, and the amount of renal lead was measured. The results showed that concentrations of lead in the kidney were about 150 times higher when lead acetate was administered dissolved in drinking water than when it was administered in feed. To account for differences in the chemical form of lead, a study comparing the absorption of different lead compounds in rat kidneys was identified (Barltrop and Meek 1975). In this study, only 67 percent of lead sulfide, a less soluble form of lead that is commonly found in soils and sediments, was absorbed when compared with lead acetate.

It is widely acknowledged by the Navy/BTAG workgroup that the low TRV for lead overestimates risk. In addition, for mammalian receptors, the low TRV for lead was not based on a no-effects level dose, but rather the lowest-known-effects-level dose that was then increased by 10 percent to account for uncertainty. Lead is not considered to be a significant risk driver to mammalian receptors at Site 22 since the high TRV was not exceeded by any dose.

7.4.2.1 Qualitative Evaluation of Chemicals of Potential Ecological Concern With No Toxicity Reference Values

Mammalian TRVs were available for all COPECs at Site 22, including detected organic chemicals.

7.4.2.2 Chemicals Driving Risk To Mammals at Site 22

Food chain modeling was employed to identify chemicals that pose potential risk to mammals at Site 22. Estimated daily doses for the typical receptors (western harvest mouse, tule elk, and grey fox) were calculated for each chemical detected above ambient concentrations and then compared to low and high TRVs to calculate an HQ; chemicals having HQs greater than 1.0 are discussed in the following paragraphs.

No chemicals modeled pose a significant risk to mammals (all $HQ_{[dose/lhigh\ TRV]} < 1$) Arsenic and copper were considered to pose potential risk to the western harvest mouse at Site 22. Nickel also poses a potential risk to the grey fox; and lead poses a potential risk to all three receptors. Although $HQ_{[dose/low\ TRV]}$ slightly exceeded 1.0 for arsenic, copper, and nickel, all $HQs_{(dose/high\ TRV)}$ were less than 1.0, indicating no immediate or significant risk from any of these chemicals. The site doses did significantly exceed the low lead TRV; however, the low lead TRV is currently under review and may potentially be revised due to concerns about overestimation of risk.

In summary, no COPECs are thought to pose unacceptable risk to the mammalian receptors at Site 22.

7.5 UNCERTAINTY ANALYSIS

Uncertainty plays an important role in risk-based decision-making and is therefore incorporated explicitly into risk characterization. Identifying known sources of uncertainty is more useful than using conservative default assumptions because potential error is made more explicit in the risk management process (Suter 1993).

The following three sources of uncertainty in ERAs are described by Suter (1993):

- Mistakes in execution of assessment activities (errors such as incorrect measurements, data recording errors, and computational errors)
- Imperfect knowledge of factors that could be known (ignorance about some aspect of the ecosystem that may be relevant, such as assumptions used in dose models, practical constraints on the ability to measure everything, and lack of knowledge on toxicological effects of all chemicals on all species)
- Inherent randomness of the world (stochasticity in physical or biological processes that may affect assumptions or actual risk such as variation in population parameters or rainfall patterns)

As pointed out in previous text, the ERA process is based on using assumptions and extrapolations to evaluate potential risk to ecological receptors. The complexity of ecological systems tends to increase the level of uncertainty involved in ERAs compared with HHRAs. Many of the assumptions in the SLERA process are conservative and result in overestimates of site-specific parameters, but the assumptions are important to ensure that no COPECs are dismissed when they may potentially pose an adverse ecological risk. Using realistic assumptions and multiple lines of evidence is the best approach to reducing the uncertainty associated with conclusions in an ERA. The following paragraphs discuss major uncertainties and conservative assumptions used in this SLERA.

7.5.1 Habitat

Areas sampled in Site 22 included disturbed soils, areas under pavement or gravel, and areas directly adjacent to buildings. Many of these areas do not provide suitable habitat for ecological receptors. Use of the maximum concentration of metals in these areas to evaluate risk likely overestimates actual risk to ecological receptors that use other parts of the site and areas containing more suitable habitat. Average contaminant concentrations may better approximate actual exposures, especially when considering the sample density in some areas of the site; however, maximum concentrations were used to be consistent with EPA guidance on SLERAs.

7.5.2 Sampling Data and Analysis

Data collected from the sampling locations within the site must be used to evaluate the conditions at the whole site; all measured parameters are therefore only estimates with associated error. Sampling data used to characterize risk at Site 22 included the results from 40 surface soil samples (collected 0 to 3 feet bgs). The number of samples was adequate for the characterization of soil at the site.

Data were validated and determined to be of high usability; data computations and summary tables were double-checked. Data quality is not considered a significant source of uncertainty; rather, the uncertainties associated with the data reflect the analytical limitations of the data reduction tools, which capture those elements of uncertainty identified by Suter (1993).

7.5.3 Uncertainties Associated with Food Chain Modeling

The following discussion highlights uncertainties associated with the food chain modeling used to evaluate risk to birds and mammals in Section 7.4.

7.5.3.1 Tissue Residue Data

For all chemicals and receptors, site-specific tissue residue data were not available, and prey tissue concentrations had to be estimated based on literature-derived BAFs and other parameters. This approach is generally associated with much more uncertainty than the approach based on site-specific prey tissue concentrations typical of a baseline ecological risk assessment. In particular, estimates of prey tissue concentration do not include accurate predictors of assimilation and depuration of chemicals in the same way that time-averaged tissue concentrations do. Maximum soil concentrations were used with literature BAFs to conservatively estimate potential site tissue concentrations; this approach likely overestimates risk.

7.5.3.2 Estimated Doses

Assumptions used in estimating ingested doses are identified in Section 7.3.3. These assumptions and model parameters are based mostly on scientific literature and may not accurately represent species or conditions at the site. Sources of uncertainty in dose estimates include inaccuracy in model parameters based on literature-derived data, population and individual variation in life history, and variation in dietary patterns of animals at the site. In addition, the lack of empirical data for each receptor necessitated using simple scaling equations to estimate receptor-specific ingestion rates; these estimates may not accurately represent actual ingestion rates and are a source of uncertainty in the dose calculation. An additional source of uncertainty is introduced in the estimation of food ingestion rates. Allometric regression models were used to estimate food consumption based on metabolic rate derived by Nagy (2001) for various groups of birds and mammals. Food ingestion rates estimated using these allometric equations are expressed as kilograms of dry weight per day. Wildlife do not generally consume dry food (unless maintained in the laboratory); therefore, some investigators suggest converting food consumption rates to kilograms of fresh weight by adding the water content of the food (Suter and others 2000). However, because recommended literature-derived soil/deer mouse and soil/invertebrate BAFs (Sample and others 1996; EPA 1998b, 1999a) were reported in wet weight, it was necessary to convert the tissue results to dry weight for mathematical consistency in the allometric equations used to estimate doses. Since plant/soil BAFs were provided in dry weight, this conversion was not performed for the plant/soil values provided in Table 7-1. The TRVs, which were used to calculate HQs, are also reported on the basis of dry weight. The conversion from wet to dry weight for soil/deer mouse and soil/invertebrate BAFs may overestimate chemical concentrations in tissue, potentially resulting in higher calculated risk.

The use of dose models as estimates of exposure assumes that exposure to the animal through other routes (such as dermal exposure or drinking of surface water) is minimal. In general, it is common practice in ERAs to focus on ingestion of contaminated prey and soil (Pascoe, Blanchet, and Linder 1996; EPA 1997a), although ignoring other sources may lead to underestimation of risk.

7.5.3.3 Site Use Factors

The SLERA assumed that all receptors lived and fed at Site 22 at all times (SUF = 1). This is certainly not true for receptors such as the Red-tailed Hawk, grey fox, and tule elk, which have large foraging ranges. The actual ingestion of COPECs from the site would likely be much less than the values used in the risk calculations, as animals feed in other parts of their range. Using a SUF of 1.0 is consistent with a conservative approach for the SLERA, but likely overestimates risk for these receptors.

7.5.3.4 Dietary Composition

The American Robin was assumed to have a diet that consisted of 45 percent plant material and 55 percent invertebrates. The Red-tailed Hawk's diet was assumed to be 100 percent small mammals. The grey fox's diet was assumed to be 100 percent small mammals, and the western harvest mouse's diet was assumed to be 100 percent plant materials. The tule elk was assumed to have a diet that consisted of 100 percent plant material. There is uncertainty associated with these estimates of dietary composition because of the varied diets of the receptors.

7.5.3.5 Bioavailability

All COPECs were conservatively assumed to be 100 percent bioavailable to the endpoints evaluated. Depending on the COPEC and receptor, bioavailability may be significantly less than 100 percent. Since only the bioavailable fraction of total metals concentrations poses a risk, consideration of the bioavailability and bioaccumulation potential of chemicals is important with regard to understanding risk implications and the potential ecotoxicological effects of total concentrations of chemicals detected in soil.

The bioavailability of chemicals in soil is dependent on numerous factors, including pH, organic matter content, soil moisture, soil texture, cation exchange capacity, electrical conductivity, and the concentrations of various inorganic and organic ligands and elements present in the soil. In this SLERA, parameters measured in the soil suitability study were used to assess the potential bioavailability of COPECs.

7.5.3.6 Body Weight and Ingestion Rates

The risk calculations used the average body weight and highest ingestion rate reported for each measurement endpoint receptor. The range of reported body weights and ingestion rates varies significantly in the literature (EPA 1993b; Linsdale 1946; Dunning 1993; Nagy 1987) and may be a source of uncertainty.

7.5.3.7 Development of Toxicity Reference Values

TRVs used in risk calculations were derived from studies reported in the literature. These studies were not conducted on the receptors used in this assessment. TRVs were extrapolated using allometric conversion factors to account for differences between species. The effect of this uncertainty cannot be estimated; however, uncertainty associated with the derivation and use of TRVs is described in "Development of Toxicity Reference Values as Part of a Regional Approach for Conducting Ecological Risk Assessments at Naval Facilities in California" (EFA West 1998). Allometric conversion was incorporated into the derivation of TRVs for site-specific receptors; extrapolation between taxa is a source of uncertainty. For example, the underlying assumption that a given effect on a small bird is the same as on a larger bird per unit body weight may not be true.

7.5.3.8 Toxicity Reference Values for Lead and Other Metals

The TRVs for lead were derived from studies (Krasovskii, Vasukovich, and Chariev 1979; Edens and Garlich 1983) in which a very soluble form of lead was used when conducting the laboratory tests. The form of lead given to study animals was lead acetate, a very soluble and bioavailable form of lead. Study animals ingested lead acetate in drinking water as the primary route of lead exposure in the tests. Based on the history of site use at NWS SBD Concord, it is very unlikely that the form of lead in soils is a soluble organic form such as lead acetate. Rather, it is likely to be a much less soluble form, bound within or strongly adsorbed to soil particles; therefore, the TRV for lead likely overestimates risk. Similar concerns exist for TRVs for arsenic (based on sodium arsenite in drinking water), cadmium (based on soluble cadmium chloride in drinking water), copper (administered as soluble cupric sulfate in drinking water), manganese (as manganese oxide in drinking water), nickel (as nickel chloride in water), selenium (as selenite and selenate in water), and zinc (as zinc carbonate in drinking water) (Schroeder, and others 1968; Webster 1988; Pocino, Baute, and Malave 1991; Gray and Laskey 1980; Smith and others 1993; Harr and others 1996; Aughey and others 1977).

In addition, for some chemicals, uncertainty is associated with the TRV. For example, for both mammalian and avian receptors, the low TRV for lead was not based on a no-effects level dose, but rather on the lowest-known-effect-level dose, which was then increased by 10 percent to account for uncertainty. A similar uncertainty factor was applied to copper, manganese, and zinc.

7.5.3.9 Hazard Quotient Approach

The HQ approach used in comparing site chemicals with screening values and comparing ingested doses with TRVs is commonly employed in ERAs (EPA 1992a; Tiebout and Brugger 1995). An HQ greater than 1.0 is generally considered to indicate a potential for risk; however, the HQ cannot be used to gauge either the probability or the magnitude of effects. The HQ approach has been criticized (Tiebout and Brugger 1995), and caution should be exercised in the interpretation of HQs.

7.5.3.10 Interspecies Extrapolation

The use of allometric conversions in interspecies extrapolations has already been discussed (see Section 7.3.3). The use of assessment endpoint species as surrogates for other related or ecologically similar taxa is supported by current guidance (EPA 1992a, 1992b, 1997a, 1999a). It should be recognized, however, that differences among taxa are not accounted for in this type of analysis and that uncertainty exists with regard to assessments of risk to whole communities based on detailed analysis of relatively few taxa.

7.5.3.11 Individual and Population Variation

Individuals within a population vary in several life history and behavioral traits. The dose models incorporated some of this variability by estimating high, low, and typical values for most model parameters. The majority of these models do focus on adult individuals and may not accurately represent ingestion of chemicals by small juvenile stages that may feed in a different manner. Even among adults of the same population, considerable individual variation in factors may affect exposure.

7.5.4 Potential Confounding Factors

Nonchemical stressors may confound the interpretation of the effects of chemical stressors that are the focus of the SLERA. Nonchemical stressors in soils include factors such as salinity, pH, nutrient deficiencies, and soil compaction and other physical disturbances. To the extent possible, these nonchemical factors were considered qualitatively in the evaluation of risk at Site 22.

7.6 SLERA RISK CHARACTERIZATION SUMMARY

The SLERA evaluated risk to birds and mammals from both inorganic and organic chemicals detected at the site. Despite the sources of uncertainty described in Section 7.5, adequate information was available to evaluate the potential risk to receptors from chemicals at Site 22. The risk characterization summaries for each of these assessment endpoints are discussed in the following sections, along with the SLERA conclusions and risk management recommendations.

Arsenic and zinc pose significant risk to the American Robin based on maximum site specific doses that slightly exceed the high TRV. No COPECs pose unacceptable risk to the Red-tailed Hawk or mammalian receptors since no $HQ_{(dose/high\ TRV)}$ exceeded 1.0. According to Navy guidance, additional evaluation with a BERA is required because conditions at the site pose potential significant risks. EPA guidance specifies that the first step of the BERA is to refine the vertebrate COPECs identified in this SLERA (EPA 2001a). Section 7.7 presents the risk refinement for avian receptors found at Site 22.

7.7 RISK REFINEMENT FOR AVIAN RECEPTORS (STEP 3A)

The purpose of the SLERA is to identify potential exposure pathways and compare site concentrations to established benchmarks. The SLERA consists of two steps: (1) problem formulation and (2) exposure estimate and risk calculation. Upon completion of steps 1 and 2, if the site passes the SLERA, it is considered to pose acceptable ecological risk, and no further work is required. If the site fails the SLERA because of the presence of complete exposure pathways and unacceptable or uncertain risk, however, the site must either be further evaluated in a Tier II (baseline) ERA, which corresponds to Step 3 of the EPA and Navy ERA processes, or undergo an interim cleanup action.

According to Navy guidance, if the SLERA indicates unacceptable or uncertain risk, an intermediate refinement step may be conducted (Step 3a). In accordance with EPA recommendations for SLERAs (EPA 1999b), conservative assumptions were used in the risk evaluation. Step 3a is a reevaluation of the conservative exposure assumptions of the SLERA further refine the assessment of risk. If this reevaluation supports an acceptable risk determination, no further work is required. If the reevaluation does not support an acceptable risk determination, the risk evaluation should proceed to a baseline ERA.

Because the SLERA resulted in HQs greater than 1.0 based on the high TRV for the American Robin at Site 22, indicating a need for further evaluation, a more focused, refined assessment of ecological risk (Step 3a of a baseline ERA) was conducted in accordance with Navy and EPA guidance (Navy 1999a; EPA 1997a) using more realistic assumptions.

The following section provides additional information regarding the bioavailability of metals for uptake at NWS SBD Concord, the TRV for zinc, and representative soil concentrations used to refine risk at Site 22.

7.7.1 Bioavailability of Metals for Uptake

The SLERA food chain models assumed that 100 percent of the COPEC in soil was available for uptake by the receptor; however, the bioavailability of metals in soils is influenced by physiochemical and environmental parameters.

Another parameter that influences bioavailability is speciation. For instance, toxic concentrations identified in the literature studies upon which the TRVs were based may be in a form that is more bioavailable than the form that would be ingested by a receptor at Site 22. The physiochemical properties of the soil matrices are also critical in evaluating bioavailability of COPECs in the matrix.

In the Phase 1 RI (TtEMI 1997), the bioavailablity of arsenic and zinc in soils at Site 13, located in the Inland Area of NWS SBD Concord, was evaluated using a deionized water Waste Extraction Test (WET-DI). The WET-DI was used to determine the extractability of arsenic and zinc and therefore its availability for uptake by ecological receptors. As noted in the RI, Site 13 and Site 22 soils are similar in geological makeup; both with shallow deposits formed in the alluvial depositional environment.

Although the WET-DI approach does not measure speciation effects, it can measure chemical leachability and solubility, which are characteristics that can provide an estimate of the type of metal species present in soil or sediment and their associated bioavailability. The following table lists the ratios of mean extractable metal concentrations calculated using WET-DI data from Site 13.

Metal	Mean Extractability Ratio
Arsenic	0.06%
Zinc	0.16%

The ratios of mean extractable metal concentrations (defined as "ratio" in the following equation) between the soil samples and the WET-DI extraction were calculated as follows:

$$\text{Ratio} = \frac{\text{Mean concentration of metal in WET-DI (mg/kg)}}{\text{Mean concentration of metal in soil (mg/kg)}}$$

These ratios represent the proportion of metals extracted from soil in deionized water and therefore present risk managers with a more realistic picture of the bioavailability of arsenic and zinc at the site. Although the ratios were not calculated using site-specific soil data from Site 22, they were calculated using relevant NWS SBD Concord data and provide a useful tool for evaluating bioavailable metal concentrations in soil at Site 22. These data indicate that the assumption of 100 percent bioavailability is probably unrealistically conservative; true bioavailability may be much lower.

7.7.2 Toxicity Reference Value for Zinc

The TRV for zinc was derived from a study (Gasaway and Buss 1972) using a very soluble form of zinc (zinc carbonate) administered to Mallards in feed. At Site 22, chemical forms of zinc present in the soils are likely to be less soluble than zinc carbonate. Examples of less soluble zinc compounds include zinc sulfide (4 times less soluble than zinc carbonate) or metallic zinc (zinc metal is less than 1 percent soluble in water). Considering a less soluble zinc compound, such as zinc sulfide, the dose given in the TRV laboratory study (Gasaway and Buss 1972) is about 4 times more bioavailable than the probable dose to birds at Site 22.

7.7.3 Representative Soil Concentrations

Because avian receptors are not likely to forage exclusively in the areas with the maximum concentrations, the use of maximum concentrations in the models and the assumption that animals at the site are exposed to maximum concentrations of arsenic and zinc (210 mg/kg and 1,900 mg/kg, respectively), is very conservative. Avian receptors are more likely to forage throughout Site 22 and NWS SBD Concord; therefore, a site-wide UCL_{95} is more representative of the actual exposure to arsenic and zinc at the site than the maximum concentration. The UCL_{95}, a conservative upper bound estimate of the mean soil concentration, was used in food chain models to refine risk estimates for the American Robin.

7.7.4 Refinement of Avian Chemicals of Potential Ecological Concern

The SLERA identified arsenic and zinc as chemicals that pose significant risk to avian receptors at Site 22. In accordance with Navy and EPA (Navy 1999a, EPA 2001a) guidance, these chemicals were reevaluated using more realistic assumptions discussed previously to identify risk. A focused, refined assessment of ecological risk for each chemical is presented in the following text.

Arsenic. Through the use of conservative food chain modeling values, the SLERA showed that arsenic poses a significant risk the to American Robin. When exposure via ingestion was modeled using the UCL_{95} soil concentrations rather than the maximum, the $HQ_{(dose/high\ TRV)}$ was only 0.474, indicating that arsenic does not pose unacceptable risk to the American Robin across the site. Additionally, the WET-DI test for Site 13 showed a mean extractability of arsenic to be 0.06 percent. Arsenic is not expected to be 100 percent bioavailable at the site, as was assumed in the SLERA. Arsenic is therefore not thought to be a significant ecological risk driver at Site 22.

Zinc. While the $HQ_{[dose/high\ TRV]}$ was greater than 1 for the American Robin in the SLERA, the maximum soil concentration used in the food chain model (sample ID 3037SHSS003) was detected in a sample from a test pit. This test pit is in a paved area of the site; therefore, there is no exposure pathway for ecological receptors. When the UCL_{95} soil concentration was used in the model rather than the maximum, the $HQ_{[dose/high\ TRV]}$ was 0.61, indicating that zinc does not pose unacceptable risk to the American Robin. Additionally, the WET-DI test for Site 13 showed a mean extractability of zinc to be 0.16 percent. Zinc is not expected to be 100 percent bioavailable at the site and is therefore not thought to be a significant ecological risk driver at Site 22.

7.7.5 Chemicals Driving Risk to Ecological Receptors at Site 22

No COPECs are thought to pose unacceptable risk to the mammalian receptors at Site 22. While arsenic and zinc showed risk at maximum concentrations using conservative assumptions, a refinement step was conducted to better understand risk to avian receptors at Site 22. As mentioned previously, the conservative assumptions used in the food chain modeling are unrealistic in many cases for at least two reasons. First, ecological receptors feed and forage throughout a site, not just in areas with maximum concentrations. Second, chemicals bound to soils and soil particles have reduced bioavailability. When reevaluating the applicability of these assumptions to Site 22, in accordance with Step 3a of the Navy guidance (Navy 1999a), the potential for exposure of ecological receptors to chemicals in surface soil at concentrations that cause adverse effects at Site 22 is limited. For these reasons, Site 22 does not pose unacceptable risk to avian or mammalian receptors.

8.0 CONTAMINANT FATE AND TRANSPORT

The fate and transport of contaminants depends on the physical and chemical properties of the chemicals released; the nature of the release; and the physical, chemical, and biological characteristics of the environment into which the contaminants have been released. Chemicals of concern (COC) are those chemicals in soil and groundwater that are risk drivers to human health or the environment. COCs were established for Site 22 soil based on the results of the SLHHRA (Section 6.0) and SLERA (Section 7.0). Arsenic in soil is the only COC for Site 22. Potential routes of migration of COCs have been previously described in the CSMs in Sections 6.0 (SLHHRA) and 7.0 (SLERA).

This section summarizes processes governing fate and transport of arsenic and discusses the probable sources of arsenic at the site.

8.1 FATE AND TRANSPORT OF ARSENIC IN SOIL

The form of arsenic in soil at Site 22 is not known; however, most arsenic released to soil is in inorganic form and is relatively immobile in soil because it binds (or adsorbs) to soil particles. Arsenic in soil may be transported by wind, in surface runoff, or it may leach into the subsurface soil. In addition, soil microorganisms may convert inorganic arsenic to organic forms and may reduce small amounts to arsine that are volatilized from soil to air. In agricultural soils, most arsenic is immobile and tends to concentrate and remain in upper soil layers indefinitely (ATSDR 2000). Soil characteristics such as pH, organic matter content, clay content, and cation exchange capacity can affect the amount of arsenic adsorbed to soil particles. Clay materials have strong sorptive properties, and the substantial clay and silty clay content in Site 22 soils would likely limit the arsenic mobility in soil.

Arsenic is often associated with iron and manganese oxides in soil and may therefore be released when these oxides are reduced; reducing conditions in surface soils are typically present during flooding. Only temporary flooding in drainage ditches after large storm events occurs at Site 22. An oxidation or reduction reaction results when a reacting chemical species (oxidizing agent) accepts electrons from other substances and is thereby reduced, while the reactant (reducing agent) donates electrons to other substances and is oxidized. Changes in oxidation state result in changes in sorption, solubility, toxicity, and other chemical characteristics.

Arsenic transformed from inorganic forms to arsine by the microbial action of soil microorganisms is released to the atmosphere and is then oxidized to nonvolatile forms that settle back to the ground.

The rate of leaching of arsenic from soil to groundwater is related to the solubility of arsenic, which is greater in sandy or low clay soils than in soils with higher clay content, such as Site 22 soils. Because many arsenic compounds tend to partition to soil under oxidizing conditions, however, leaching usually does not transport arsenic to great depth (ATSDR 2000). Arsenic may also be transported on soil particles mobilized during fast storm water flow in the drainage ditches.

8.2 PROBABLE SOURCES OF ARSENIC AT SITE 22

Arsenic, a naturally occurring element, is found in the earth's crust. In soil, arsenic may originate from parent materials that form the soil, industrial wastes, or use of arsenical pesticides, herbicides, or rodenticides. As described in Section 5.0, arsenic concentrations in Site 22 soils are elevated above ambient levels, with the highest concentrations of arsenic present in surface soils. One objective of this investigation was to determine whether the probable source of arsenic is naturally occurring or anthropogenic. Because arsenic concentrations in Site 22 soil are above ambient levels and the highest concentrations in the soil profile occur in surface soil, site conditions indicate a release of arsenic to surface soil at the site.

Former Navy operations at Building 7SH5, including missile wing storage, repair, testing, painting, and use of a UST, do not appear to be associated with releases of arsenic to soils. The highest concentrations of arsenic in Site 22 soils are not present near Building 7SH5 but rather are present in surface soils collected from open grassland areas or near railroads with no clear linkage to Building 7SH5. This distribution of arsenic in site soils suggests that there may be a historic source related to Navy grassland or pest management practices, railroad operation and maintenance, or historic agricultural activities before Navy ownership.

The use of arsenic-based herbicides, pesticides, or rodenticides by the Navy or previous owner at Site 22 is unknown. A search by the National Information Technology Center, which maintains the Navy pesticide use database, resulted in no historical records of arsenic-containing pesticide use at Site 22 (Pesticide Compliance Program 2002). EPA banned use of most arsenic-containing pesticides in the late 1980s. From the mid 19th century to the mid 1940s, inorganic arsenic such as lead arsenate and sodium arsenate were the dominant pesticides used by farmers and fruit growers. Use of inorganic arsenic compounds in agriculture virtually disappeared beginning in the 1960s. Organic arsenals, such as cacodylic acid, disodium methylarsenate (DSMA), monosodium methylarsenate (MSMA), and arsenic acid are still used as herbicides; most of these pesticides are applied to cotton, citrus, and sod (ATSDR 2000).

Arsenic based rodenticides, particularly arsenic trioxide, were commonly used until the 1960s to control rodents and ground squirrels. The typical application of a rodenticide is to apply it as a spray or pellet to surface soil and underground burrows. Current analytic methods to measure pesticide, herbicide, and rodenticide concentrations do not measure arsenic-based chemicals. Records indicate that the magazine area of NWS SBD Concord, where Site 22 is located, had a problem with overpopulation of ground squirrels. Historic records were reviewed and site personnel were interviewed to determine whether control of ground squirrels occurred at the site; no information regarding squirrel control was available.

Arsenic has also been used in wood preservation products, including railroad ties. Arsenic-preserved railroad ties may have been stored at the site during railroad construction or maintenance activities. Although fragments of the wood may have remained, interviews of land management personnel and review of aerial photographs do not confirm this as a potential source.

Aerial photographs show that Site 22 and the surrounding land was agricultural land before Navy development (Appendix A). Lead-arsenate-based pesticides were used extensively to control agricultural pests in fruit orchards up until the late 1950s.

9.0 CONCLUSIONS AND RECOMMENDATION

A supplemental RI was conducted at Site 22, Building 7SH5, in the Inland Area of NWS SBD Concord. The main purposes of the supplemental RI were as follows:

1. Detail the nature and extent of any contamination at Site 22
2. Conduct a SLHHRA and SLERA to evaluate whether arsenic and other chemicals on site evaluated during previous investigations pose a risk to human health and the environment
3. Evaluate the need for further action

To meet these objectives, TtEMI collected 43 surface and subsurface soil samples at 15 locations during October 2002 to supplement existing data. Samples were analyzed for arsenic, iron, manganese, and pH within areas of suspected elevated arsenic levels at Site 22. The results of new and previously collected data are presented in this document as a supplement to the existing RI report for Site 22 (TtEMI 1997).

9.1 CONCLUSIONS

The conclusions from this supplemental RI are summarized as follows:

- Arsenic is the only chemical of concern in soil. Arsenic concentrations are elevated above ambient levels in surface and subsurface soils. Lack of statistical correlations of arsenic concentrations with other metals (antimony, iron, and manganese) indicate that the source of arsenic at the site is most likely anthropogenic.
- Arsenic is most elevated in surface soils collected from open grassland and ditch areas of the site relative to samples collected near Building 7SH5, indicating that the potential source of arsenic may be related to application of arsenic containing herbicides, pesticides, or rodenticides to surface soils by the Navy or previous landowner or by railroad maintenance practices. The most probable source of arsenic at the site is a surface application of a pesticide, herbicide, or rodenticide to grassland areas of the site. Operations at Building 7SH5 do not appear to be linked with elevated concentrations of arsenic in soil.
- In the groundwater samples where BEHP was detected, it slightly exceeded the RBSL for drinking water sources and exceeded both the tap water PRG and MCL (EPA 2002b, CDHS 2002). In the two groundwater samples where TCE was detected, it exceeded the tap water PRG but was below the federal and state MCL for TCE (EPA 2002a; EPA 2002b, CDHS 2002). Sample results from the last two quarters of monitoring showed no detections of BEHP and TCE, indicating that these chemicals were not consistently present in groundwater at the site in 1997, and may no longer be present in groundwater at the site. No other VOCs were present in groundwater a concentrations above tap water PRGs and MCLs.
- Results of the SLHHRA indicate that cancer risks from soils are within the upper limit of the target risk range for the current industrial worker, future worker, and hypothetical future residential scenarios. Noncancer hazards are greater than the target value for the future residential scenario only. Site risks are attributable to arsenic in soil.

- Results of the SLERA indicate that chemicals, including arsenic, in soil at Site 22 do not pose unacceptable risk to ecological receptors.

9.2 RECOMMENDATIONS

This section presents recommendations for future activities at Site 22. Recommendations are based on a detailed assessment of site physical and chemical data, results from the SLHHRA and SLERA, and evaluation of contaminant fate and transport.

- While arsenic concentrations observed in soil do not appear to be a consequence of activities at Building 7SH5, the possibility exists that additional areas in the open grasslands of the magazine area are impacted by elevated arsenic. It is recommended that an additional investigation be conducted in the magazine area to characterize levels of arsenic in soil. It is recommended that this investigation focus on the open grasslands in the magazine area, rather than on Building 7SH5 as a potential source of arsenic.
- Because results of the SLHHRA indicate that cancer risks from soils are within the upper limit of the target risk range for the current industrial worker, future worker, and hypothetical future residential scenarios and noncancer hazards are greater than the target value for the future residential scenario, an updated HHRA is recommended to evaluate site risks from arsenic in soil based on the recommended magazine area investigation
- Because metals in groundwater have not yet been evaluated at the site and concentrations of BEHP and TCE in groundwater exceed the MCL and tap water PRG, respectively, it is recommended that a round of groundwater samples be collected from existing wells at the site and analyzed for metals and SVOCs.
- Because no unacceptable risk was indicated from chemicals in soils at Site 22 to ecological receptors, no further characterization of risk to ecological receptors at Site 22 is recommended.

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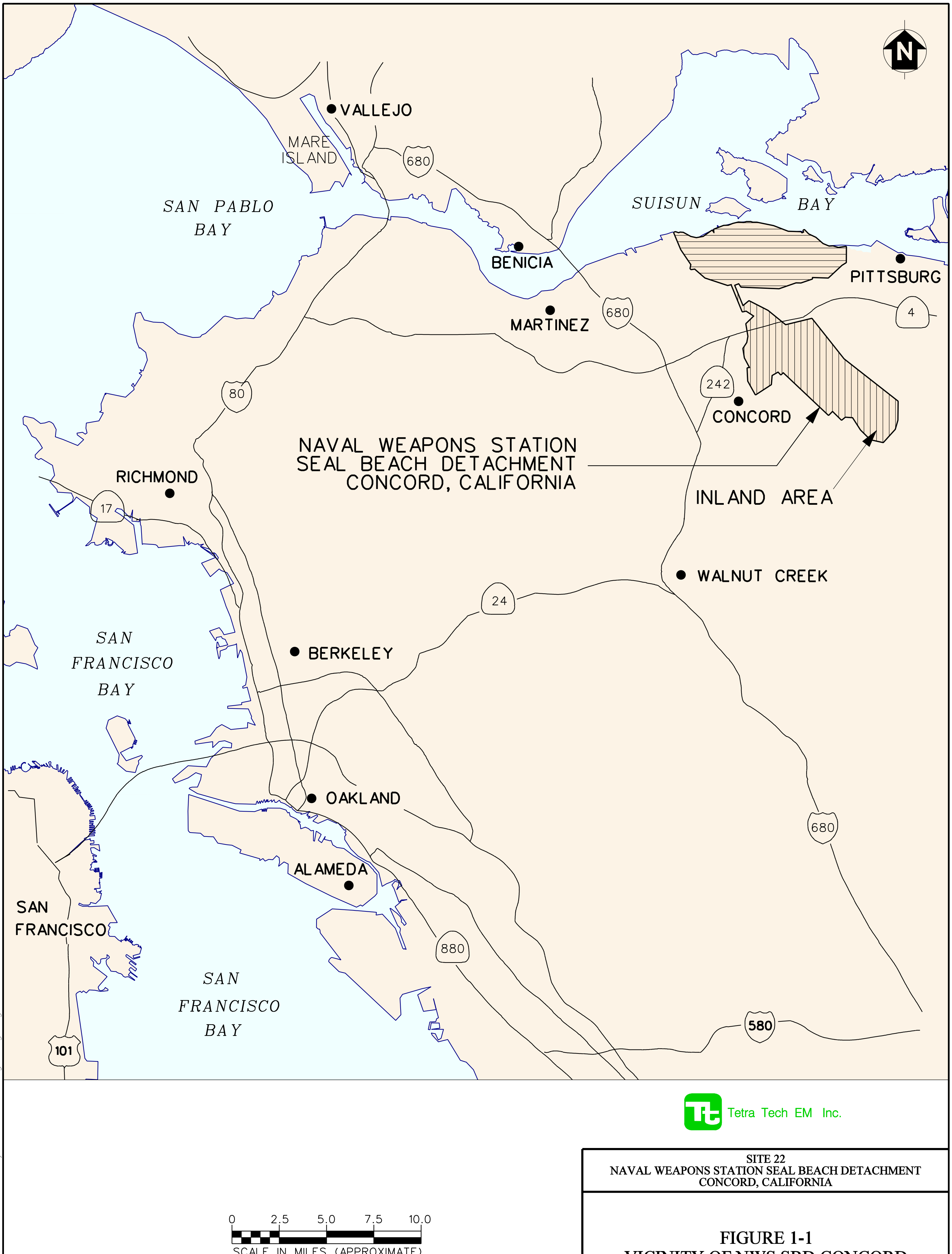
FIGURES



Tetra Tech EM Inc.

SITE 22
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT
CONCORD, CALIFORNIA

FIGURE 1-1
VICINITY OF NWS SBD CONCORD

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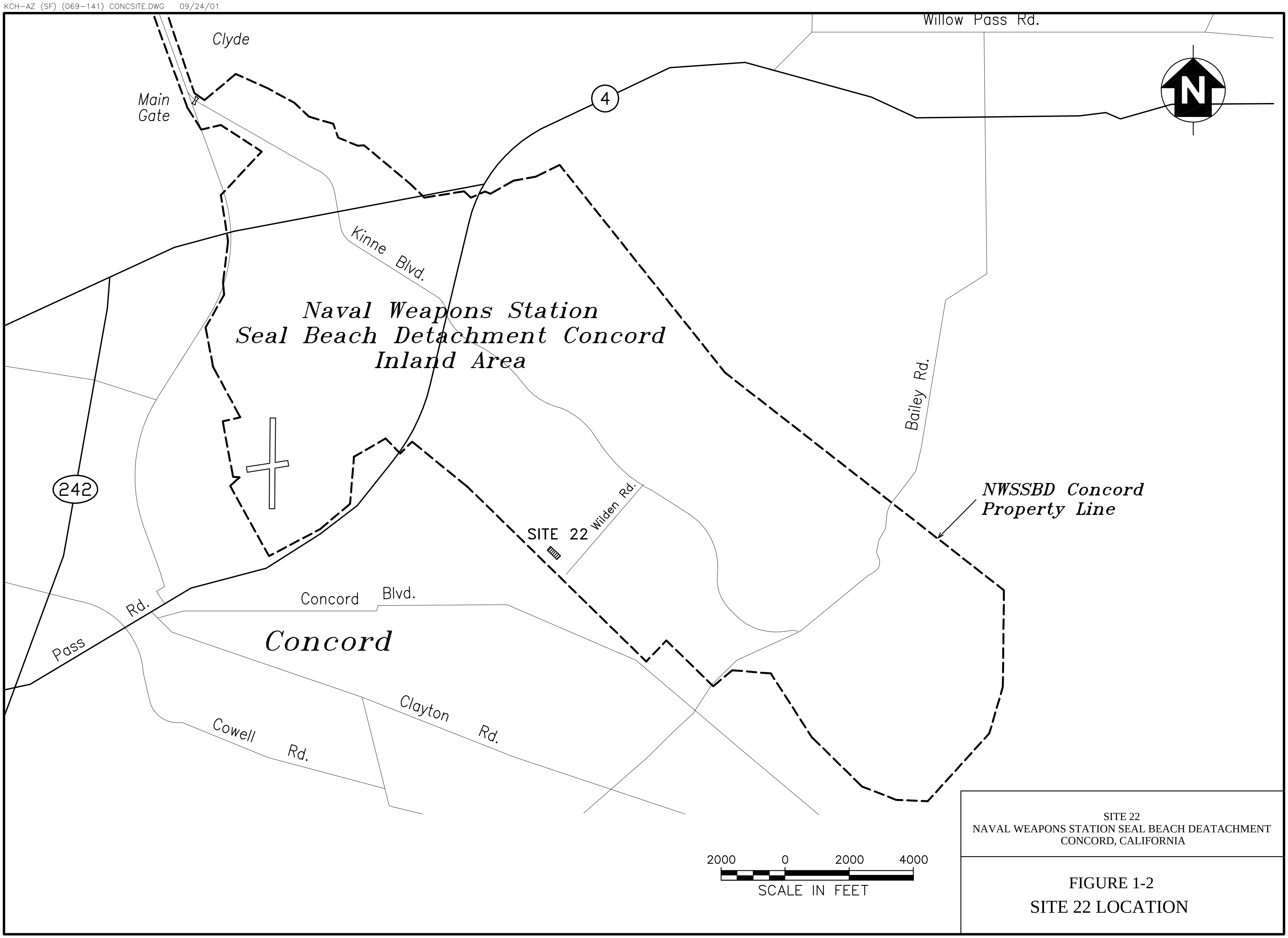
02/11/2003

GSA.029.00009

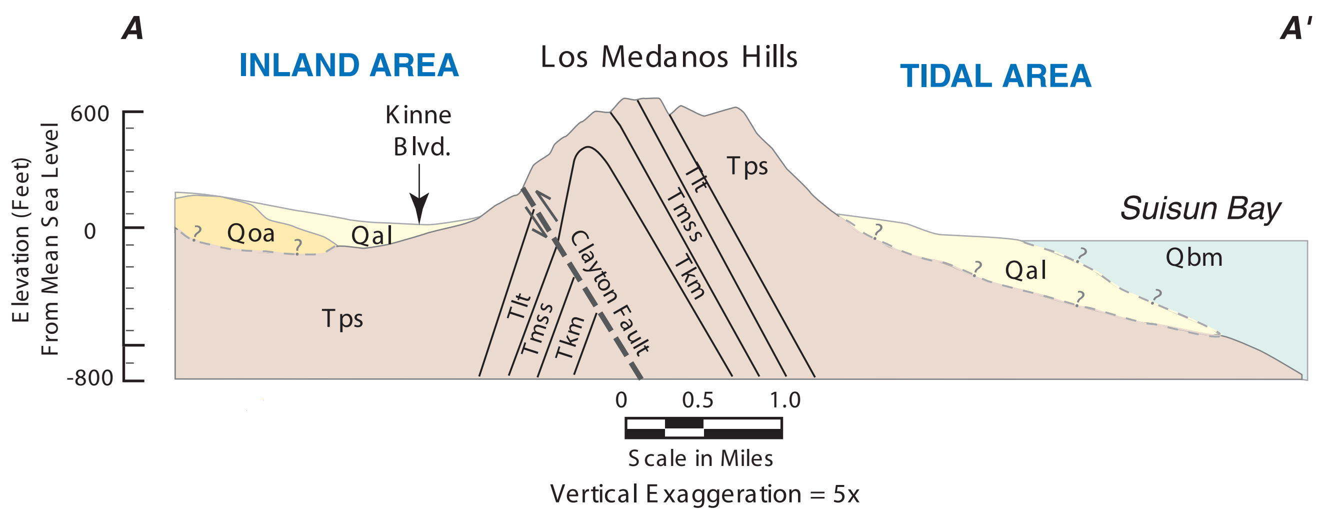


SITE 22
NAVAL WEAPONS STATION SEAL BEACH DEATACHMENT
CONCORD, CALIFORNIA

FIGURE 1-2
SITE 22 LOCATION

Figure 2-1

This detailed station map has been deleted from the Internet-accessible version of this document as per Department of the Navy Internet security regulations.



LEGEND

Quaternary Sediments:

- Qbm — Bay Mud
- Qal — Young Alluvium
- Qoa — Old Alluvium

Tertiary Rock Formations:

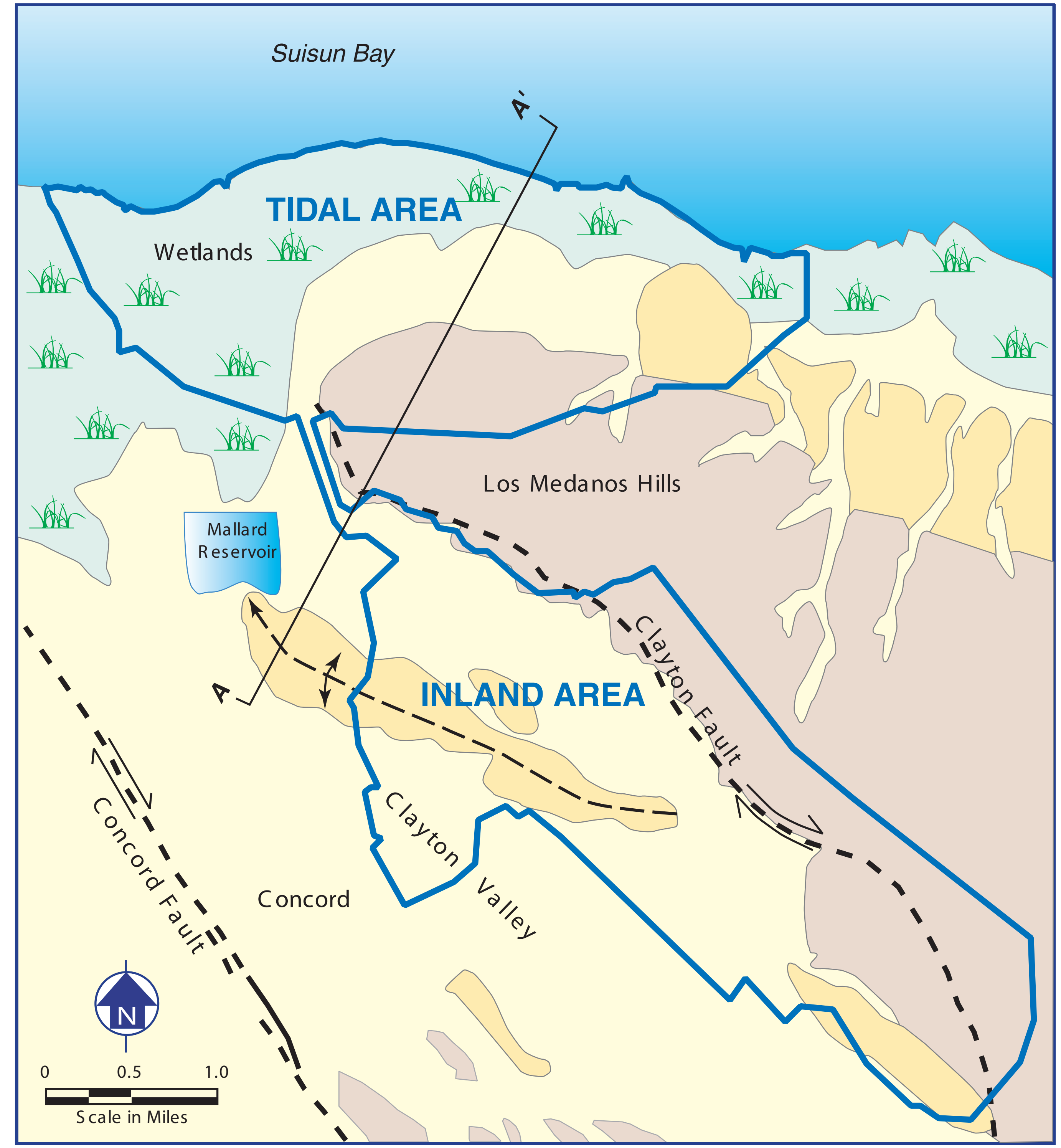
- Tps — Pliocene Nonmarine Sedimentary Rocks
- Tpt — Pliocene Pumiceous Tuff Breccias (Lawlor Tuff)
- Tmss — Miocene Marine Sandstones
- Tkm — Eocene Sandstone (Marley member of Kreyenhagen Formation)

Major Fault (Arrows show direction of relative movement)

Axis of Anticline (Arrow indicates direction of plunge)

A A' **Cross Section Line**

SOURCE: Adapted from DIBBLEE, 1981



SOURCE: Adapted from LUTTON et.al., 1987 DIBBLEE 1980a, b, c, 1981

Tetra Tech EM Inc.

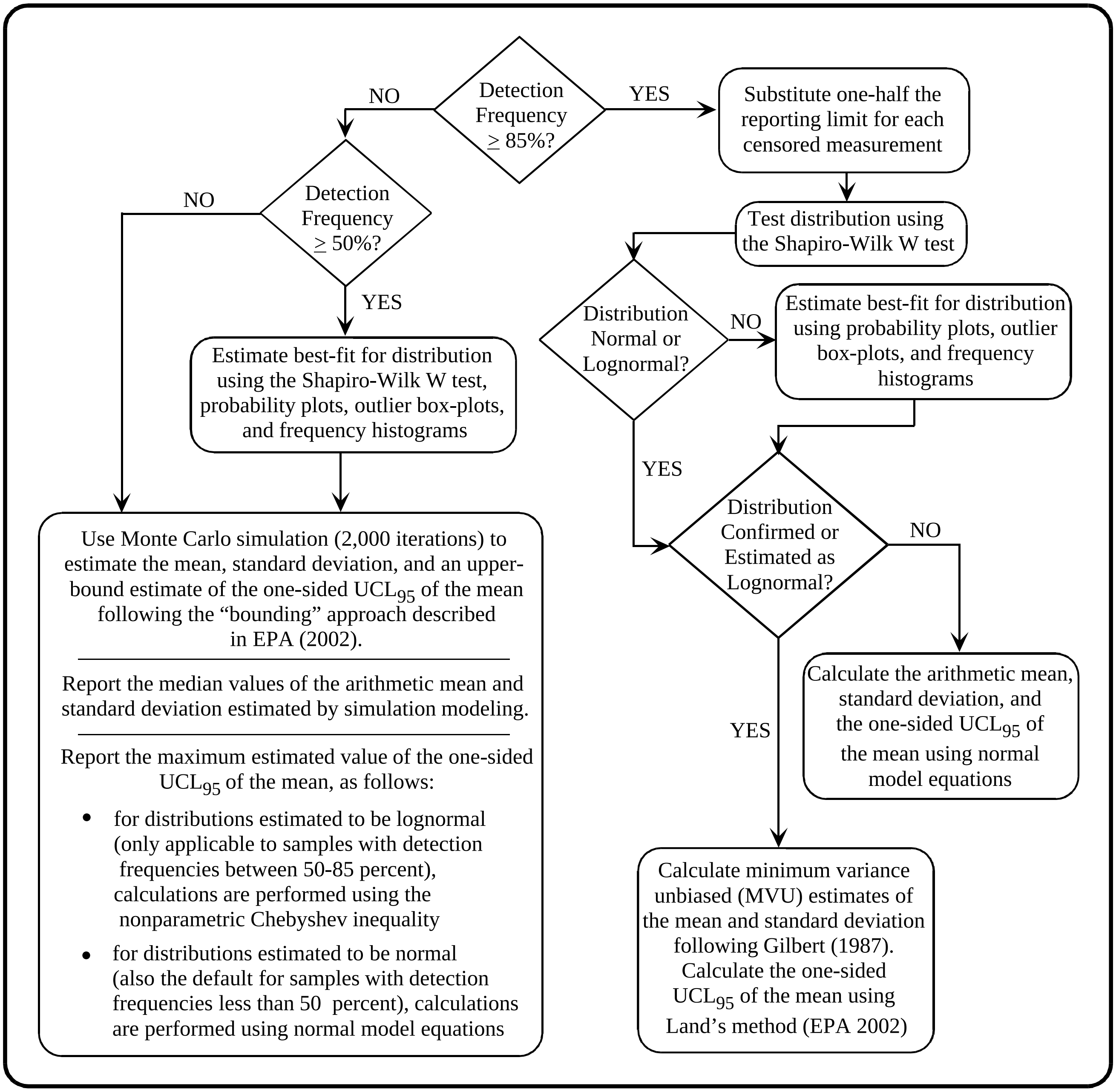
SITE 22
Naval Weapons Station Seal Beach Detachment
Concord, California

FIGURE 2-2
GENERALIZED GEOLOGIC MAP AND CONCEPTUAL CROSS SECTION A-A'

Figures 2-3 and 2-4

These detailed station maps have been deleted from the Internet-accessible version of this document as per Department of the Navy Internet security regulations.

FIGURE 4-1
SUMMARY OF THE STATISTICAL TREATMENT OF DATA FOR ESTIMATING EXPOSURE POINT CONCENTRATIONS (EPCs)



Notes:

UCL_{95} the one-sided upper 95 percent confidence limit of the mean

Details of the Monte Carlo model for estimating the mean, standard deviation, and upper-bound estimate of the one-side UCL_{95} of the mean are provided in Figure B.

The exposure point concentration is equal to the lesser of the UCL_{95} and the maximum detected value

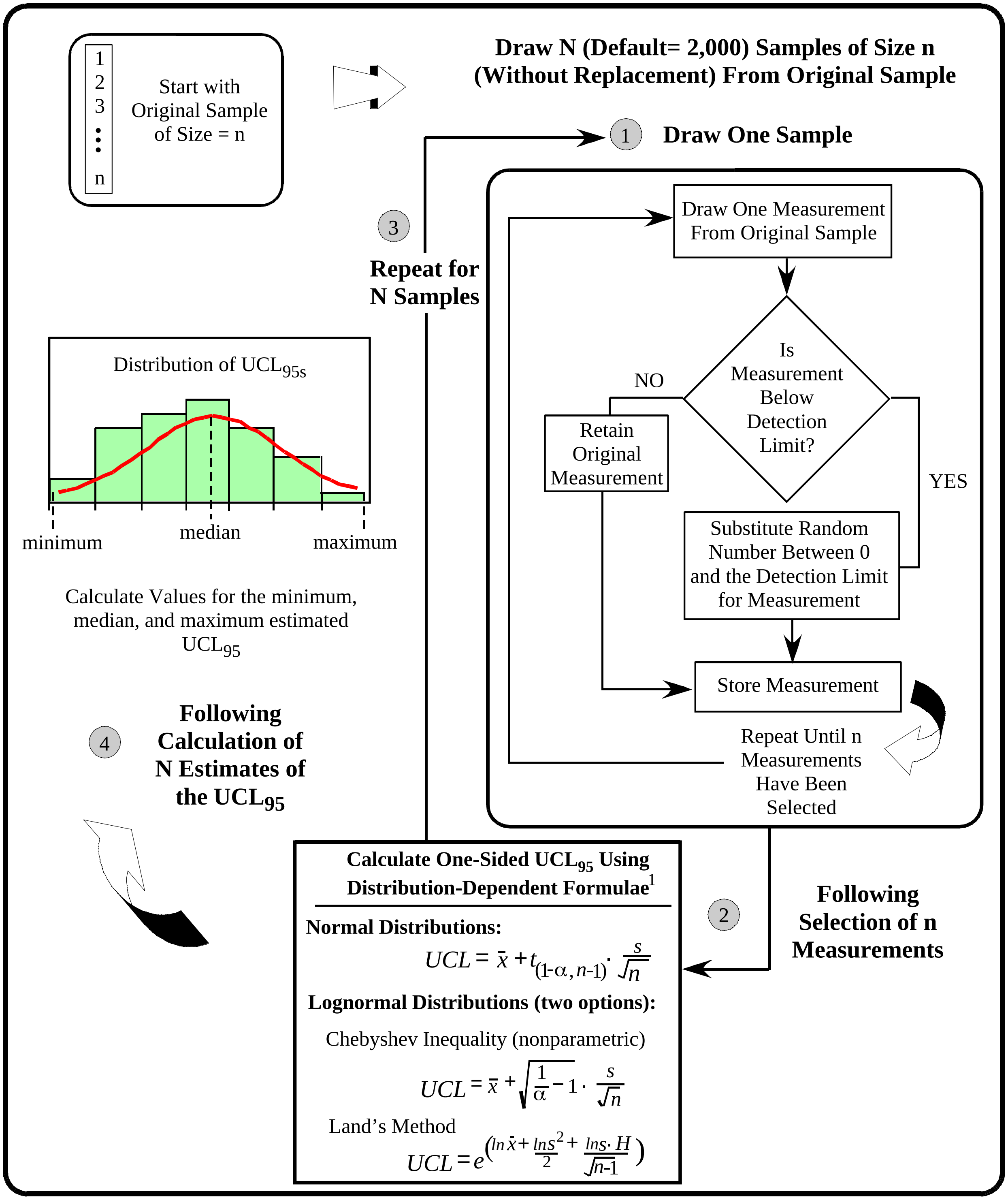
References:

Gilbert, R. O. 1987. *Statistical methods for environmental pollution monitoring.* John Wiley & Sons, Inc. New York, NY.

U. S. Environmental Protection Agency (EPA). 2002. "Calculating exposure point concentrations at hazardous waste sites." Draft. OSWER 9285.6-10. July 2002.

FIGURE 4-2

CONCEPTUAL DIAGRAM OF MONTE CARLO APPROACH FOR ESTIMATING PLAUSIBLE UPPER-BOUNDS OF THE UCL_{95} OF THE MEAN FOR SAMPLES WITH CENSORED MEASUREMENTS

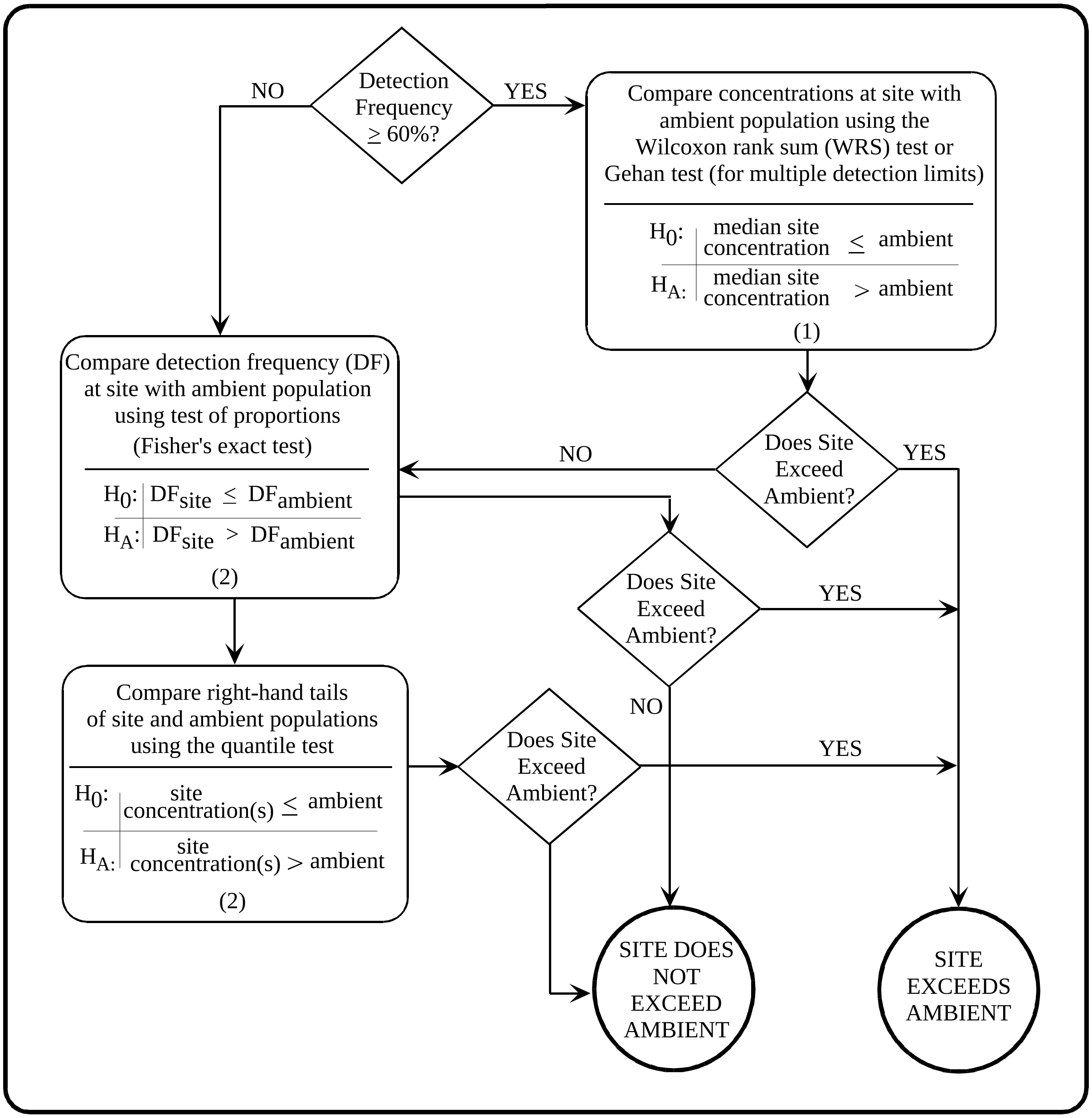


Notes:

UCL_{95} One sided 95 percent upper confidence limit of the mean

1 Equations from U. S. Environmental Protection Agency (EPA). 2002. "Calculating exposure point concentrations at hazardous waste sites." Draft Report. OSWER 9285.6-10. July 2002.

FIGURE 4-3
FLOW DIAGRAM SHOWING THE AMBIENT SCREENING PROCESS FOR METALS IN SOIL



Notes:

H_0 Null hypothesis

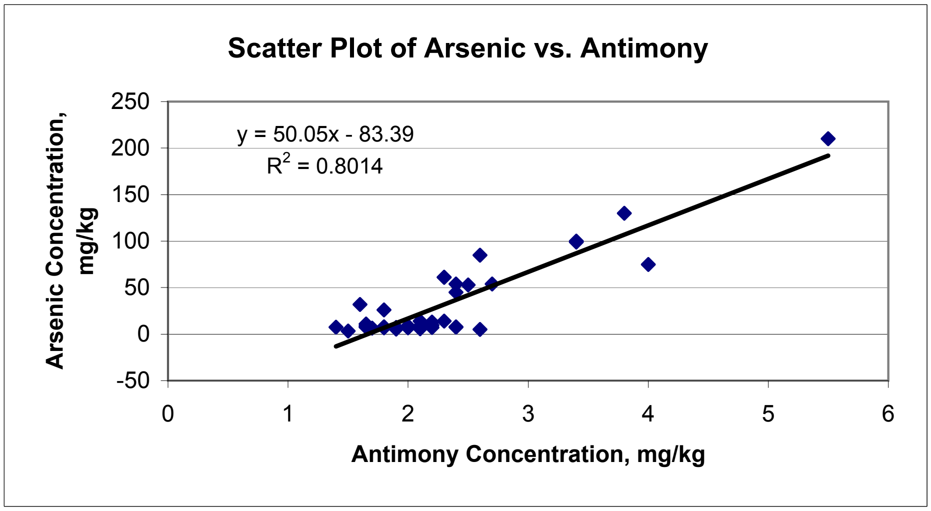
H_A Alternative hypothesis

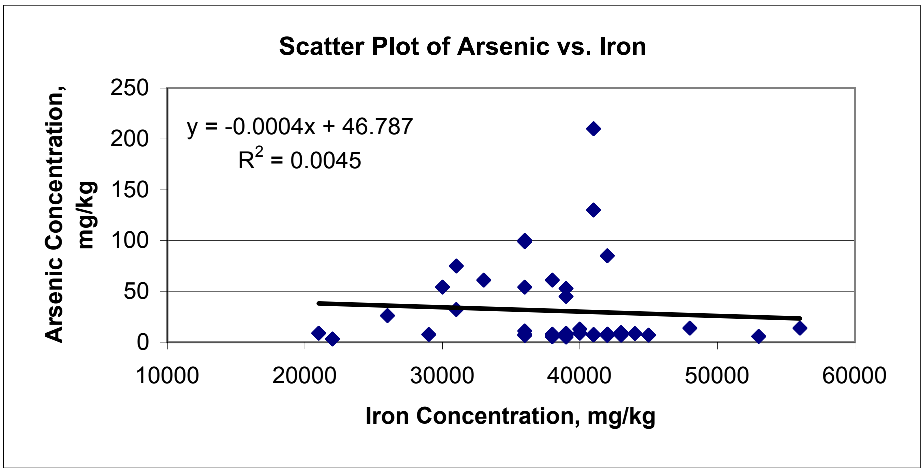
(1) Censored observations were replaced with the reporting limit for all testing conducted using the WRS (or Gehan) and quantile tests. For cases where either the site or ambient data set contained fewer than 10 measurements, only the test of proportions and quantile tests were conducted.

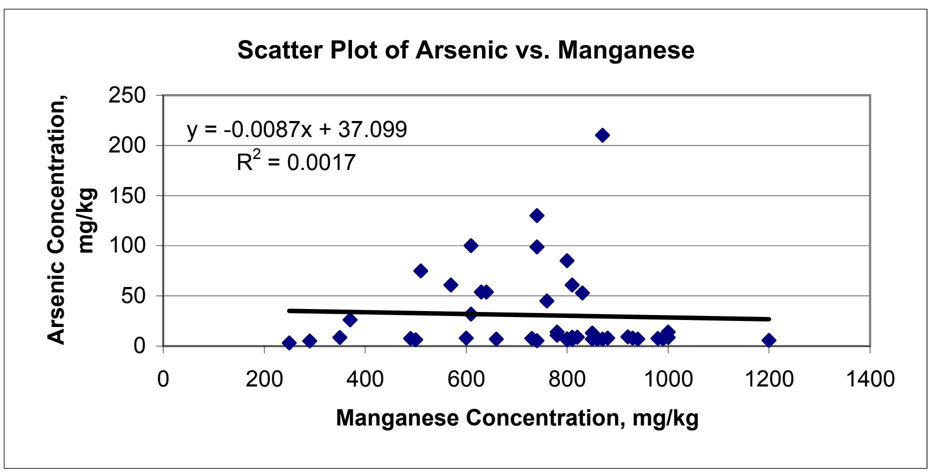
(2) Both the test of proportions and quantile tests are performed for the following cases: a) H_0 is not rejected under the WRS or Gehan tests, and b) the sample detection frequency is less than 60 percent. Independent conclusions are drawn from these tests. Chemicals that are identified as exceeding ambient based on <u>either</u> test are carried forward in the risk assessment.

Figure 5-1

This detailed station map has been deleted from the Internet-accessible version of this document as per Department of the Navy Internet security regulations.







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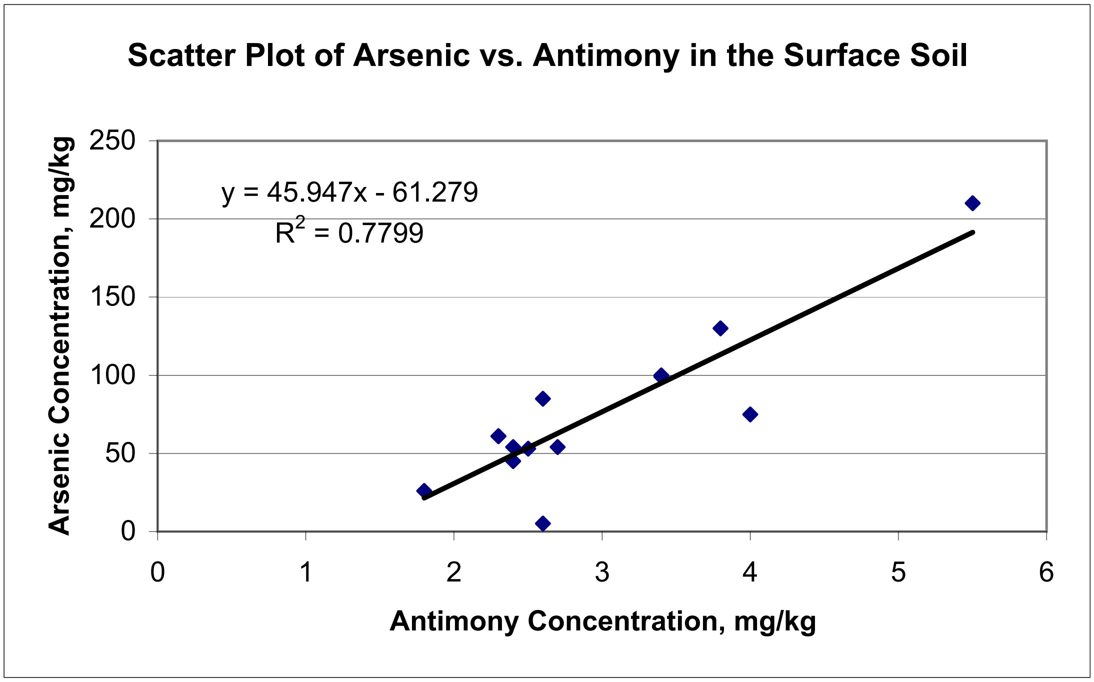
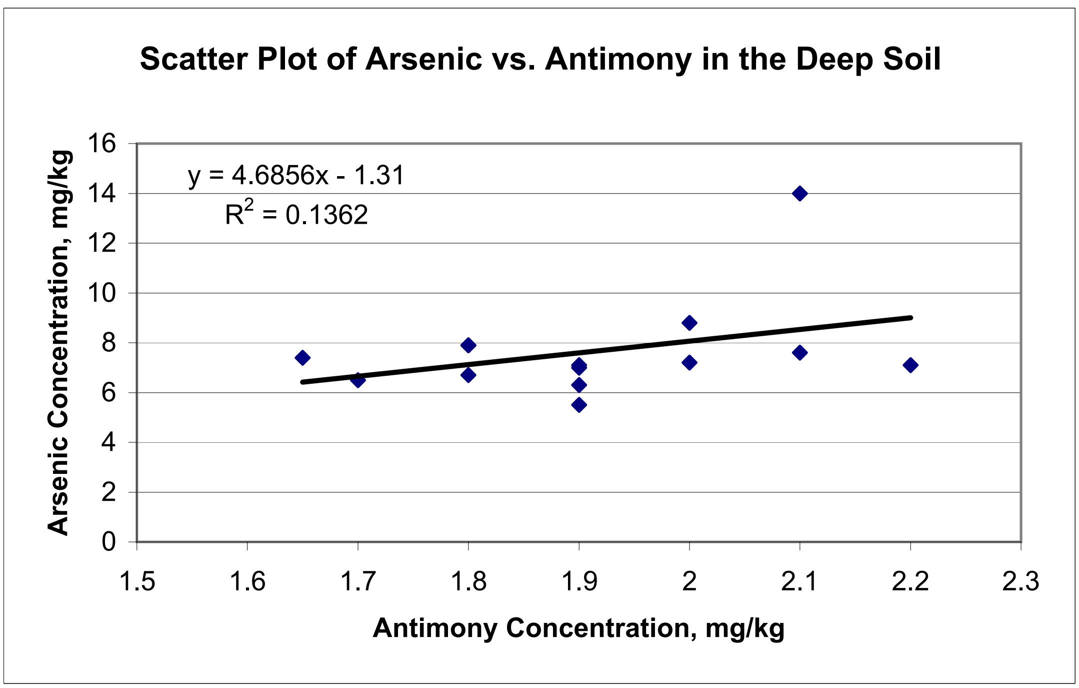
SITE 22

NAVAL WEAPONS STATION SEAL BEACH DETACHMENT

CONCORD, CALIFORNIA

FIGURE 5-2
SCATTERPLOTS OF ARSENIC WITH ANTIMONY, IRON, AND MANGANESE

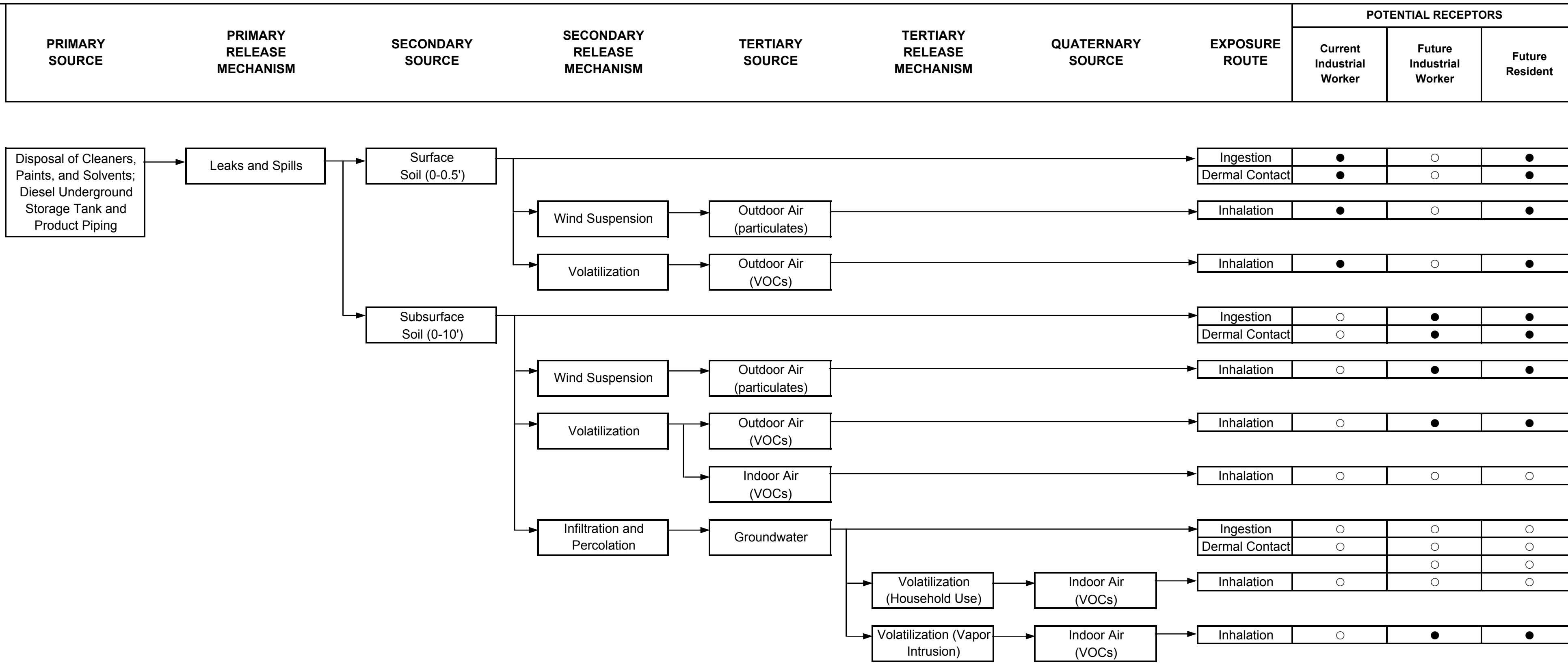




Tetra Tech EM Inc.

SITE 22
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT
CONCORD, CALIFORNIA

FIGURE 5-3
SCATTERPLOT OF ARSENIC AND ANTIMONY CONCENTRATIONS



LEGEND

○ Incomplete or negligible exposure pathway

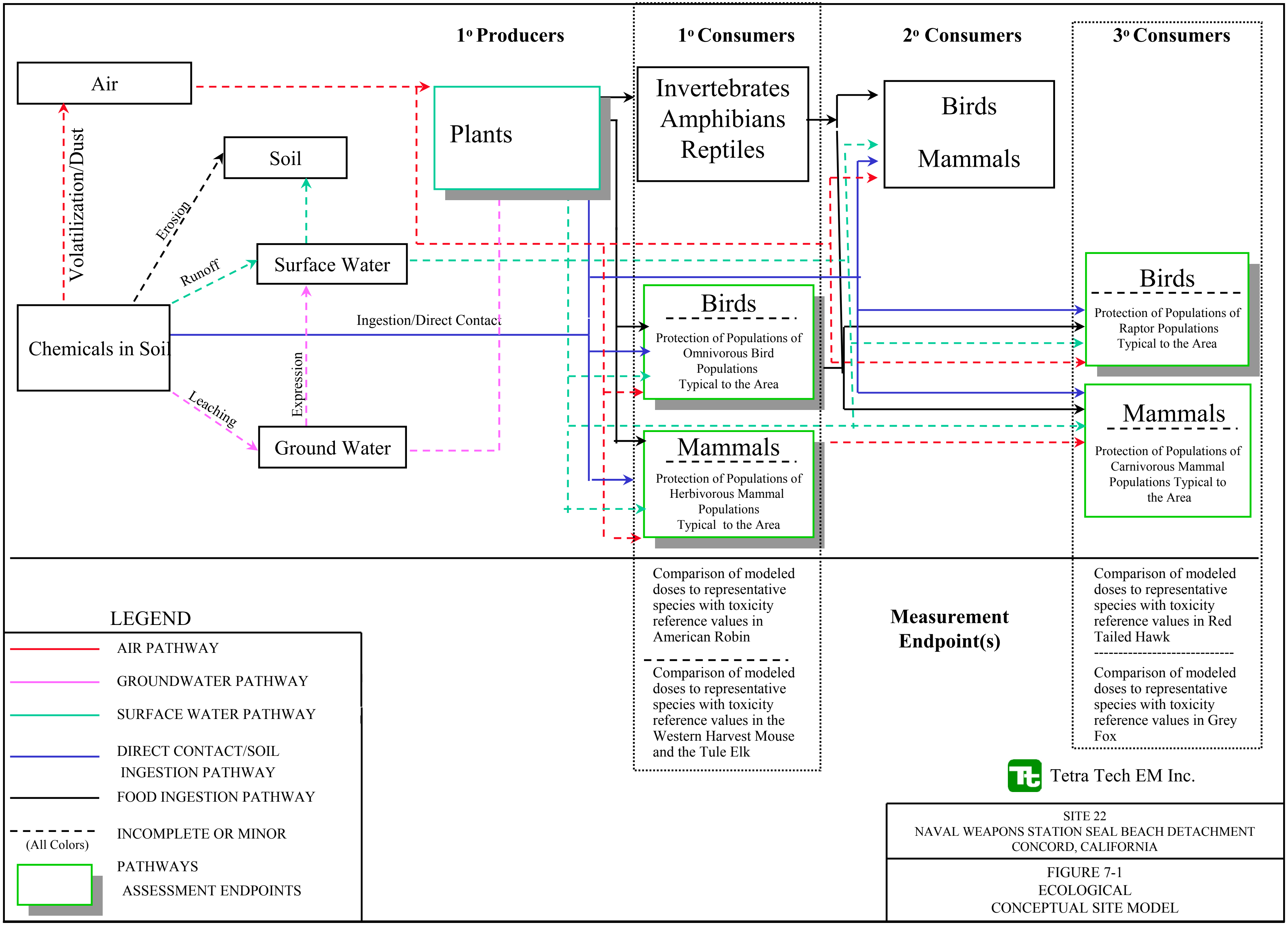
● Potentially complete exposure pathway

Tetra Tech EM Inc.

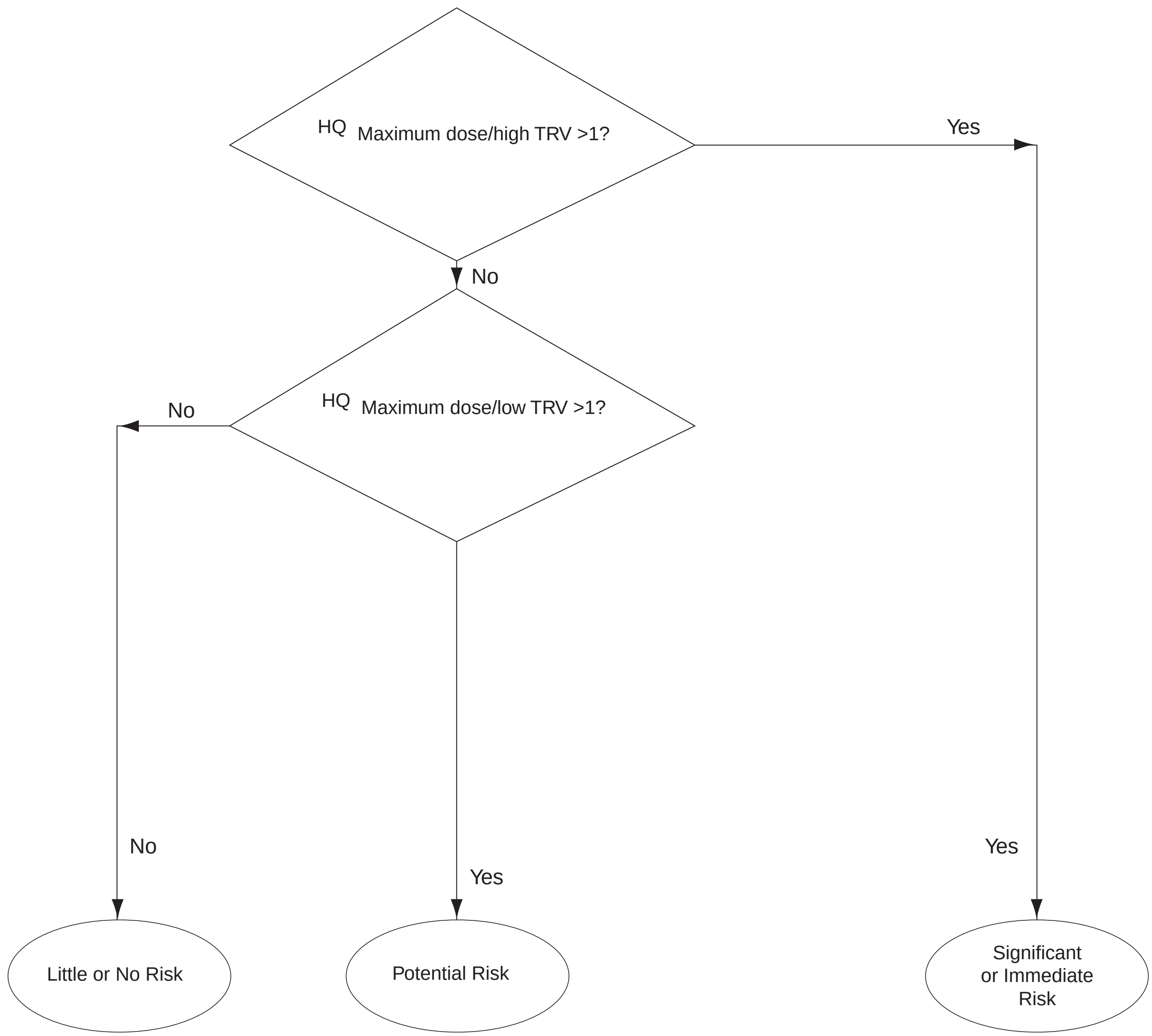
SITE 22
NAVAL WEAPONS STATION SEAL BEACH DETACHMENT
CONCORD, CALIFORNIA

FIGURE 6-1
CONCEPTUAL SITE MODEL FOR HUMAN HEALTH

GSA.029.00009



GSA.029.00009



Naval Weapons Station SBD Concord, CA

FIGURE 7-2
FOOD CHAIN MODELING HAZARD QUOTIENT SCREENING PROCESS FOR SCREENING RISK ASSESSMENTS

TABLES

TABLE 2-1

BIRD SPECIES POTENTIALLY OCCURRING AT SITE 22
ECOLOGICAL RISK ASSESSMENT
NAVAL WEAPONS STATION SBD CONCORD

Common Name ***Scientific Name***	**Status**[a]	**Feeding Guild**[b]
Family Accipitridae		
Red-shouldered hawk *Buteo lineatus*	—	Carnivorous
Red-tailed hawk *Buteo jamaicensis*	—	Carnivorous
Northern Harrier *Circus cyaneus*	CSC	Carnivorous
Rough-legged hawk *Buteo lagopus*	—	Carnivorous
Family Aegithalidae		
Bushtit *Psaltriparus minimus*	—	Omnivorous
Family Alcdinidae		
Belted kingfisher *Ceryle alcyon*	—	Piscivorous
Family Cathartidae		
Turkey vulture *Cathartes aura*	—	Carnivorous
Family Columbidae		
Mourning dove *Zenaida macroura*	—	Herbivorous
Rock Dove *Columba livia*	—	Herbivorous
Family Corvidae		
Western Scrub jay *Aphelocoma californica*	—	Omnivorous
Family Emberizidae		
California towhee *Pipilo crissalis*	—	Omnivorous
White-crowned sparrow *Zonotrichia leucophrys*	—	Herbivorous
Golden-crowned sparrow *Zonotrichia atricapilla*	—	Herbivorous
Lark sparrow *Chondestes grammacus*	—	Omnivorous
Family Falconidae		
American kestrel *Falco sparverius*	—	Carnivorous
Prairie Falcon *Falco mexicanus*	CSC	Carnivorous

TABLE 2-1 (Continued)

BIRD SPECIES POTENTIALLY OCCURRING AT SITE 22
ECOLOGICAL RISK ASSESSMENT
NAVAL WEAPONS STATION SBD CONCORD

Common Name ***Scientific Name***	**Status**[a]	**Feeding Guild**[b]
Family Fringillidae		
Lesser Goldfinch *Carduelis psaltria*	—	Omnivorous
American Goldfinch *Carduelis tristis*	—	Omnivorous
House Finch *Carpodacus mexicanus*	—	Herbivorous
Family Hirundinidae		
Cliff Swallow *Petrochelidon pyrrhonota*	—	Insectivorous
Barn Swallow *Hirundo rustica*		Insectivorous
Tree Swallow *Tachycineta bicolor*	—	Insectivorous
Northern Rough-winged Swallow *Stelgidopteryx serripennis*	—	Insectivorous
American Robin *Turdus migratorius*	—	Carnivorous
Family Icteridae		
Western Meadowlark *Sturnella neglecta*	—	Omnivorous
Northern Oriole *Icterus gabula*	—	Insectivorous
Red-winged Blackbird *Agelaius phoeniceus*	—	Herbivorous
Family Laniidae		
Loggerhead Shrike *Lanis ludovicianus*	—	Carnivorous
Family Mimidae		
Northern Mockingbird *Mimus polyglottos*	—	Omnivorous
Family Paridae		
Chestnut-backed Chickadee *Poecile refescens*	—	Omnivorous
Family Parulidae		
Yellow-rumped Warbler *Dendroica coronata*	—	Omnivorous
Family Passeridae		
House Sparrow *Passer domesticus*	—	Herbivorous

TABLE 2-1 (Continued)

BIRD SPECIES POTENTIALLY OCCURRING AT SITE 22
ECOLOGICAL RISK ASSESSMENT
NAVAL WEAPONS STATION SBD CONCORD

Common Name ***Scientific Name***	**Status**[a]	**Feeding Guild**[b]
Family Phasianidae		
California Quail *Callipepla californica*	—	Herbivorous
Family Picidae		
Nuttall's Woodpecker *Picoides nuttallii*	—	Insectivorous
Family Regulidae		
Ruby-crowned Kinglet *Regulus calendula*	—	Omnivorous
Family Strigidae		
Great-horned Owl *Bubo virginianus*	—	Carnivorous
Barn Owl *Tyto alba*	—	Carnivorous
Family Sturnidae		
European Starling *Sturnus vulgaris*	—	Omnivorous
Family Trochilidae		
Anna's Hummingbird *Calypte anna*	—	Insectivorous
Family Tyrannidae		
Western Kingbird *Tyrannus verticalis*	—	Insectivorous
Pacific-slope Flycatcher *Empidonax difficilis*	—	Insectivorous
Ash-throated Flycatcher *Myiarchus cinerascens*	—	Insectivorous
Black Phoebe *Sayornis nigricans*	—	Insectivorous

Notes:

a CSC DFG California Species of Concern
— Not a CSC nor state or federally listed as threatened or endangered

b Carnivorous Eats mainly animal matter
Herbivorous Eats mainly plant matter
Insectivorous Eats mainly insects
Omnivorous Eats both plant and animal matter
Piscivorous Eats mainly fish

TABLE 2-2

MAMMAL SPECIES POTENTIALLY OCCURRING AT SITE 22
ECOLOGICAL RISK ASSESSMENT
NAVAL WEAPONS STATION SBD CONCORD

Common Name ***Scientific Name***	**Status**[a]	**Feeding Guild**[b]
Family Canidae		
Coyote *Canis latrans*	—	Omnivorous
Gray Fox *Urocyon cinereoargenteus*	—	Omnivorous
Family Cervidae		
Tule elk *Cervus elaphus nannodes*	—	Herbivorous
Family Cricetidae		
California Vole *Microtus californicus*	CSC	Herbivorous
Western harvest mice *Reithrodontomys megalotis*	—	Omnivorous
Deer Mouse *Peromyscus maniculatus*	—	Omnivorous
Family Leporidae		
Black-tailed Jackrabbit *Lepus californicus*	—	Herbivorous
Family Mephitidae		
Striped Skunk *Mephitis mephitis*	—	Omnivorous
Family Mustelida		
American Badger *Taxidea taxus*	—	Carnivorous
Family Muridae		
House Mouse *Mus musculus*	—	Herbivorous
Family Procyonidae		
Raccoon *Procyon lotor*	—	Omnivorous
Family Sciuridae		
Fox squirrels *Sciurus niger*	—	Herbivorous
California Ground Squirrel *Spermophilus beecheyi*	—	Omnivorous

TABLE 2-2 (Continued)

MAMMAL SPECIES POTENTIALLY OCCURRING AT SITE 22
ECOLOGICAL RISK ASSESSMENT
NAVAL WEAPONS STATION SBD CONCORD

Notes:

a	CSC	DFG California Species of Concern
	—	Not a CSC nor state or federally listed as threatened or endangered
b	Carnivorous	Eats mainly animal matter
	Herbivorous	Eats mainly plant matter
	Insectivorous	Eats mainly insects
	Omnivorous	Eats both plant and animal matter

TABLE 3-1

POTENTIAL FEDERAL CHEMICAL-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
SITE 22
NAVAL WEAPONS STATION SBD CONCORD

Requirement	Prerequisite	Citation[a]	Preliminary ARAR Analysis	Comments
Resource Conservation and Recovery Act (42 USC, Chapter 82, Sections 6901 to 6991[i])[b]				
Defines RCRA hazardous waste. A solid waste is characterized as toxic, based on the TCLP, if the waste exceeds the TCLP maximum concentrations.	Waste.	Title 22 CCR Sections 66261.21, 66261.22(a)(1), 66261.23, 66261.24(a)(1), and 66261.100	Applicable	Applicable for determining whether waste is hazardous.

Notes:

a Only the substantive provisions of the requirements cited in this table are potential ARARs.

b Statutes and policies, as well as their citations are provided as headings to identify general categories of potential ARARs for the convenience of the reader; listing the statutes and policies does not indicate that the Department of the Navy accepts the entire statutes or policies as potential ARARs. Specific potential ARARs follow each general heading, and only substantive requirements of the specific citations are considered potential ARARs.

ARAR Applicable or relevant and appropriate requirement
CCR California Code of Regulations
RCRA Resource Conservation and Recovery Act
TCLP Toxicity characteristic leaching procedure
USC United States Code

TABLE 3-2

POTENTIAL STATE CHEMICAL-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
SITE 22
NAVAL WEAPONS STATION SBD CONCORD

Requirement	Prerequisite	Citation[a]	Preliminary ARAR Analysis	Comments
Cal/EPA Department of Toxic Substances Control				
Definition of "non-RCRA hazardous waste"	Waste.	Title 22 CCR Section 66261.24(a)(2)	Applicable	Applicable for determining whether waste is hazardous.
State and Regional Water Quality Boards				
Defines designated nonhazardous, and inert waste	Waste.	Title 27 CCR Sections 20210, 20220, 20230(a)	Applicable.	Applicable for determining whether waste is designated, nonhazardous, or inert.

Notes:

a Statutes and policies, as well as their citations are provided as headings to identify general categories of potential ARARs for the convenience of the reader; listing the statutes and policies does not indicate that the Department of the Navy accepts the entire statutes or policies as potential ARARs. Specific potential ARARs follow each general heading, and only substantive requirements of the specific citations are considered potential ARARs.

ARAR Applicable or relevant and appropriate requirement
CAL/EPA California Environmental Protection Agency
CCR California Code of Regulations
RCRA Resource Conservation and Recovery Act
TCLP Toxicity characteristic leaching procedure
USC United States Code

TABLE 3-3

FEDERAL LOCATION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
SITE 22
NAVAL WEAPONS STATION SBD CONCORD

Location	Requirement	Prerequisite	Citation[a]	Preliminary ARAR Determination	Comments
Endangered Species Act of 1973 (16 USC Sections 1531 to 1543)[b]					
Habitat upon which endangered species or threatened species depend	Federal agencies may not jeopardize the continued existence of any listed species or cause the destruction or adverse modification of critical habitat. The Endangered Species Committee may grant an exemption for agency action if reasonable mitigation and enhancement measures such as propagation, transplantation, and habitat acquisition and improvement are implemented.	Determination of effect upon endangered or threatened species or its habitat. Critical habitat upon which endangered species or threatened species depend.	Title 16 USC Section 1536(a), (h)(1)(B)	Relevant and appropriate	No federal threatened or endangered species have been identified as present on Site 22; however, several federal threatened or endangered species habitats have been identified on Naval Weapons Station Seal Beach Detachment Concord. Therefore, the Navy has made a preliminary analysis of these requirements being relevant and appropriate.

TABLE 3-3 (Continued)

FEDERAL LOCATION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
SITE 22
NAVAL WEAPONS STATION SBD CONCORD

Location	Requirement	Prerequisite	Citation[a]	Preliminary ARAR Determination	Comments
Migratory Bird Treaty Act of 1972 (16 USC Sections 703 to 712)[b]					
Migratory bird area	Protects almost all species of native migratory birds in the U.S. from unregulated "take," which can include poisoning at hazardous waste sites.	Presence of migratory birds.	Title 16 USC Section 703	Relevant and appropriate	No migratory birds have been identified as present on Site 22; however, several migratory birds have been identified as present on Naval Weapons Station Seal Beach Detachment Concord. The Navy has, therefore, made a preliminary analysis of these requirements being relevant and appropriate.

Notes:

a Only the substantive provisions of the requirements cited in this table are potential ARARs.

b Statutes and policies, as well as their citations are provided as headings to identify general categories of potential ARARs for the convenience of the reader; listing the statutes and policies does not indicate that the Department of the Navy accepts the entire statutes or policies as potential ARARs. Specific potential ARARs follow each general heading, and only substantive requirements of the specific citations are considered potential ARARs.

ARAR Applicable or relevant and appropriate requirement

USC. U.S. Code

TABLE 3-4

STATE LOCATION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
SITE 22
NAVAL WEAPONS STATION SBD CONCORD

Location	Requirement	Prerequisite	Citation[a]	Preliminary ARAR Determination	Comments
State Requirements					
California Endangered Species Act (California Fish & Game Code Sections 2050 to 2116)[b]					
Endangered species habitat	No person shall import, export, take, possess, or sell any endangered or threatened species or part or product thereof.	Threatened or endangered species determination on of before 01 January 1985 or a candidate species with proper notification.	California Fish & Game Code Section 2080	Relevant and appropriate.	No state threatened or endangered species have been identified as present on Site 22; however, state threatened and endangered species have been identified as present on Naval Weapons Station Seal Beach Detachment Concord. Therefore, the Navy has made the preliminary analysis that this regulation is relevant and appropriate.

Notes:

a Only the substantive provisions of the requirements cited in this table are potential ARARs.

b Statutes and policies, as well as their citations are provided as headings to identify general categories of potential ARARs for the convenience of the reader; listing the statutes and policies does not indicate that the Department of the Navy accepts the entire statutes or policies as potential ARARs. Specific potential ARARs follow each general heading, and only substantive requirements of the specific citations are considered potential ARARs.

TABLE 4-1

SUMMARY TABLE OF GROUNDWATER SAMPLES BY TYPE AND LOCATION
SITE 22
NAVAL WEAPONS STATION SBD CONCORD

Sampling Location	Investigation	Date Sampled	CLP SVOC	Extract. TPH	VOC	Low Level VOC
7SHSB010	Phase I RI (grab sample)	1995	1	1	1	
7SHSB011	Phase I RI (grab sample)	1995	1	1	1	
7SHSB012	Phase I RI (grab sample)	1995	1	1	1	
7SHMW001	Phase II RI	Mar-97	1	1	1	1
	Phase II RI	Jun-97	1	1	1	1
	Phase II RI	Sep-97	1	1	1	1
	Phase II RI	Dec-97	1	1	1	1
7SHMW002	Phase II RI	Mar-97	1	1	1	1
	Phase II RI	Jun-97	1	1	1	1
	Phase II RI	Sep-97	1	1	1	1
	Phase II RI	Dec-97	1	1	1	1
7SHMW003	Phase II RI	Mar-97	1	1	1	1
	Phase II RI	Jun-97	1	1	1	1
	Phase II RI	Sep-97	1	1	1	1
	Phase II RI	Dec-97	1	1	1	1
7SHMW004	Phase II RI	Mar-97	1	1	1	1
	Phase II RI	Jun-97	1	1	1	1
	Phase II RI	Sep-97	1	1	1	1
	Phase II RI	Dec-97	1	1	1	1
Totals:			**19**	**19**	**19**	**16**

Notes:

CLP SVOC	Contract laboratory program semivolatile organic compound
Extract. TPH	Extractable total petroluem hydrocarbons
RI	Remedial investigation
VOC	Volatile organic compounds

TABLE 4-2

SUMMARY TABLE OF SOIL SAMPLES BY TYPE AND LOCATION
SITE 22
NAVAL WEAPONS STATION SBD, CONCORD

Sampling Location	Investigation	Sample Depth	Organic Compounds						Inorganic Constituents							
			CLP SVOC	Low Level SVOC	TPH Extractable	VOCs	Organotins	Oil/Grease	Hex. Chromium	CLP Metals	As, Fe, Sb, Mn	Geophys. Param.	Grain Size	Percent Moisture	TOC	pH
7SH-01-SB	SI	2.0 - 2.5	1		1	1	1			1				1		
	SI	3.5 - 4.0	1		1	1	1			1				1		
7SH-02-SB	SI	2.0 - 2.5	1		1	1	1			1				1		
	SI	4.0 - 4.5	1		1	1	1			1				1		
7SH-03-SB	SI	2.0 - 2.5	1		1	1	1			1				1		
	SI	4.0 - 4.5	1		1	1	1			1				1		
7SH-SFC	SI	0.0 - 0.5	1		1	1	1			1				1		
7SHSB001	RI	.25 - 1.25	1		1	1										
7SHSB002	RI	.25 - 1.25	1		1	1										
7SHSB003	RI	1.0 - 1.5	1		1	1										
7SBSB004	RI	1.0 - 2.0	1		1	1										
7SHSB005	RI	0.0 - 1.0	1		1	1										
7SHSB006	RI	2.0 - 3.0	1		1	1										
7SBSB007	RI	2.0 - 3.0	1		1	1										
7SHSB008	RI	2.5 - 3.5	1		1	1										
7SHSB009	RI	2.5 - 3.5	1		1	1										
7SHSB010	Phase I RI	1.0 - 10.5	1		1	1										
	Phase I RI	2.0 - 20.5	1		1	1										
	Phase I RI	25.5 - 26.0										1	1		1	
	Phase I RI	3.0 - 30.5	1		1	1										
7SHSB011	Phase I RI	1.0 - 10.5	1		1	1										
	Phase I RI	2.0 - 20.5	1		1	1										
	Phase I RI	26.0 - 26.5										1	1		1	
	Phase I RI	3.0 - 30.5	1													
7SHSB012	Phase I RI	1.0 - 10.5	1		1	1						1	1			
	Phase I RI	2.0 -20.5	1		1	1										
	Phase I RI	25.0 - 25.5										1	1		1	
	Phase I RI	3.0 - 30.5	1		1	1										
7SHSB013	Phase I RI	0.0 - 1.0							1	1						
	Phase I RI	7.0 - 8.0							1	1						
7SHSB014	Phase I RI	0.0 - 1.0								1						
	Phase I RI	7.0 - 8.0								1						

TABLE 4-2

SUMMARY TABLE OF SOIL SAMPLES BY TYPE AND LOCATION
SITE 22
NAVAL WEAPONS STATION SBD, CONCORD

			Organic Compounds						Inorganic Constituents							
Sampling Location	Investigation	Sample Depth	CLP SVOC	Low Level SVOC	TPH Extractable	VOCs	Organotins	Oil/Grease	Hex. Chromium	CLP Metals	As, Fe, Sb, Mn	Geophys. Param.	Grain Size	Percent Moisture	TOC	pH
7SHSB015	Phase I RI	0.0 - 0.5	1		1					1				1		
	Phase I RI	3.0 - 3.5	1		1				1	1						
7SHSB020	Phase I RI	0.0 - 0.5								1						1
7SHSB021	Phase I RI	0.0 - 0.5								1						1
7SHSB022	Phase I RI	0.0 - 0.5								1						1
7SHSB023	Phase I RI	0.0 - 0.5								1						1
7SHSB024	Phase I RI	0.0 - 0.5			1				1	1				1		
7SHSB025	Phase I RI	0.0 - 0.5			1					1				1		
7SHSB026	Phase I RI	0.0 - 0.5		1	1					1				1		
7SHSB027	Phase I RI	0.0 - 0.5		1	1					1				1		
7SHTP001A	Phase I RI	1.0 - 1.0	1		1	1				1						
	Phase I RI	4.0 - 4.0	1		1	1				1						
	Phase I RI	5.5 - 5.5	1		1	1				1						
7SHTP001B	Phase I RI	3.0 - 3.0	1		1	1				1						
7SHTP001C	Phase I RI	2.0 - 2.0	1		1	1				1						
7SHTP001D	Phase I RI	3.0 - 3.0	1		1	1				1						
	Phase I RI	5.0 - 5.0	1		1	1				1						
7SHTP001E	Phase I RI	1.0 - 1.0	1		1	1			1	1						
	Phase I RI	2.0 - 2.0	1		1	1				1						
	Phase I RI	5.0 - 5.0	1		1	1				1						
7SHTP001F	Phase I RI	2.0 - 2.0	1		1	1				1						
	Phase I RI	3.0 - 3.0	1		1	1				1						
S52-01	RFA	5.0 - 6.0	1			1		1		1						
	RFA	1.0 - 11.0	1			1		1								
	RFA	15.0 - 16.0	1			1		1								
S52-02	RFA	5.0 - 6.0	1			1		1		1						
	RFA	1.0 - 11.0	1			1		1								
	RFA	15.0 - 16.0	1			1		1								
S52-03	RFA	0.0 - 0.5	1			1		1		1						
	RFA	3.5 - 4.0	1			1		1		1						
S52-04	RFA	0.0 - 0.5	1			1		1		1						
	RFA	2.0 - 2.5	1			1		1		1						

GSA.029.00009

TABLE 4-2

SUMMARY TABLE OF SOIL SAMPLES BY TYPE AND LOCATION
SITE 22
NAVAL WEAPONS STATION SBD, CONCORD

			Organic Compounds						Inorganic Constituents							
Sampling Location	**Investigation**	**Sample Depth**	**CLP SVOC**	**Low Level SVOC**	**TPH Extractable**	**VOCs**	**Organotins**	**Oil/Grease**	**Hex. Chromium**	**CLP Metals**	**As, Fe, Sb, Mn**	**Geophys. Param.**	**Grain Size**	**Percent Moisture**	**TOC**	**pH**
7SHSB101	Suppl. RI	0.0 - 0.5									1					1
	Suppl. RI	3.5 - 4.0									1					1
	Suppl. RI	9.5 - 10.0									1					1
7SHSB102	Suppl. RI	0.0 - 0.5									1					1
	Suppl. RI	3.5 - 4.0									1					1
	Suppl. RI	9.5 - 10.0									1					1
7SHSB103	Suppl. RI	0.0 - 0.5									1					1
	Suppl. RI	3.5 - 4.0									1					1
	Suppl. RI	9.5 - 10.0									1					1
7SHSB104	Suppl. RI	0.0 - 0.5									1					1
	Suppl. RI	3.5 - 4.0									1					1
	Suppl. RI	9.5 - 10.0									1					1
7SHSB105	Suppl. RI	0.0 - 0.5									1					1
	Suppl. RI	3.5 - 4.0									1					1
	Suppl. RI	9.5 - 10.0									1					1
7SHSB106	Suppl. RI	0.0 - 0.5									1					1
	Suppl. RI	3.5 - 4.0									1					1
	Suppl. RI	9.5 - 10.0									1					1
7SHSB107	Suppl. RI	0.0 - 0.5									1					1
	Suppl. RI	3.5 - 4.0									1					1
	Suppl. RI	9.5 - 10.0									1					1
7SHSB108	Suppl. RI	0.0 - 0.5									1					1
	Suppl. RI	3.5 - 4.0									1					1
	Suppl. RI	9.5 - 10.0									1					1
7SHSB109	Suppl. RI	0.0 - 0.5									1					1
	Suppl. RI	3.5 - 4.0									1					1
	Suppl. RI	9.5 - 10.0									1					1
7SHSB110	Suppl. RI	0.0 - 0.5									1					1
	Suppl. RI	3.5 - 4.0									1					1
	Suppl. RI	9.5 - 10.0									1					1

TABLE 4-2

SUMMARY TABLE OF SOIL SAMPLES BY TYPE AND LOCATION
SITE 22
NAVAL WEAPONS STATION SBD, CONCORD

			Organic Compounds						Inorganic Constituents							
Sampling Location	Investigation	Sample Depth	CLP SVOC	Low Level SVOC	TPH Extractable	VOCs	Organotins	Oil/Grease	Hex. Chromium	CLP Metals	As, Fe, Sb, Mn	Geophys. Param.	Grain Size	Percent Moisture	TOC	pH
7SHSB111	Suppl. RI	1.0 - 1.5									1					1
	Suppl. RI	5.0 - 5.5									1					1
	Suppl. RI	9.5 - 10.0									1					1
7SHSB112	Suppl. RI	0.0 - 0.5									1					1
7SHSB113	Suppl. RI	0.0 - 0.5									1					1
	Suppl. RI	3.5 - 4.0									1					1
	Suppl. RI	9.0 - 10.0									1					1
7SHSB114	Suppl. RI	0.0 - 0.5									1					1
	Suppl. RI	3.5 - 4.0									1					1
	Suppl. RI	9.0 - 10.0									1					1
7SHSB115	Suppl. RI	0.0 - 0.5									1					1
	Suppl. RI	3.5 - 4.0									1					1
	Suppl. RI	9.5 - 10.0									1					1
7SBMW001	Phase II RI	1.0 - 1.5			1	1								1		
	Phase II RI	5.5 - 6.0			1	1								1		
	Phase II RI	10.5 - 11.0			1	1								1		
	Phase II RI	15.5 - 16.0			1	1								1		
	Phase II RI	20.5 - 21.0			1	1								1		
	Phase II RI	25.5 - 26.0			1	1								1		
	Phase II RI	30.5 - 31.0			1	1								1		
	Phase II RI	35.5 - 36.0			1	1								1		
7SBMW002	Phase II RI	2.0 - 2.5			1	1										
	Phase II RI	4.0 - 4.5			1	1								1		
	Phase II RI	7.0 - 7.5			1	1								1		
	Phase II RI	11.0 - 11.5			1	1								1		
	Phase II RI	15.5 - 16.0			1	1								1		
	Phase II RI	20.0 20.5			1	1								1		
	Phase II RI	25.5 - 26.0			1	1								1		
	Phase II RI	30.5 - 31.0			1	1								1		

TABLE 4-2

SUMMARY TABLE OF SOIL SAMPLES BY TYPE AND LOCATION
SITE 22
NAVAL WEAPONS STATION SBD, CONCORD

Sampling Location	Investigation	Sample Depth	Organic Compounds: CLP SVOC	Low Level SVOC	TPH Extractable	VOCs	Organotins	Oil/Grease	Inorganic Constituents: Hex. Chromium	CLP Metals	As, Fe, Sb, Mn	Geophys. Param.	Grain Size	Percent Moisture	TOC	pH
7SBMW003	Phase II RI	0.5 - 1.0			1	1								1		
	Phase II RI	6.5 - 7.0			1	1								1		
	Phase II RI	12.5 - 13.0			1	1								1		
	Phase II RI	18.5 - 19.0			1	1								1		
	Phase II RI	24.5 -25.0			1	1								1		
7SBMW004	Phase II RI	1.5 - 2.0			1	1								1		
	Phase II RI	6.5 - 7.0			1	1								1		
	Phase II RI	11.0 - 11.5			1	1								1		
	Phase II RI	16.0 - 16.5			1	1								1		
	Phase II RI	21.0 -21.5			1	1								1		
Totals:			**49**	**2**	**26**	**72**	**7**	**10**	**5**	**39**	**43**	**4**	**3**	**37**		**47**

Notes:

As	Arsenic
CLP metal	Contract laboratory program metal
CLP SVOC	Contract laboratory program semivolatile organic compound
Fe	Iron
Geophys. Param.	Geophysical parameters
Hex. Chromium	Hexavalent chromium
Mn	Manganese
RI	Remedial investigation
RFA	Resource Conservation and Recovery Act facility assessment confirmation study
SB	Antimony
SI	Site investigation
Suppl. RI	Supplemental remedial investigation
TOC	Total organic carbon
TPH	Total petroleum hydrocarbons
VOC	Volatile organic compounds

TABLE 4-3

DATA QUALITY OBJECTIVES
SITE 22
NAVAL WEAPONS STATION SBD CONCORD

Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7
State the Problem	**Identify the Decision**	**Identify Inputs to the Decision**	**Define the Study Boundaries**	**Develop Decision Rules**	**Specify Acceptable Tolerable Limits on Decision Errors**	**Optimize the Sampling Design**
During the RI, elevated concentrations of arsenic were detected at Site 22, mostly confined to the top 3 feet of soil. Only one location showed elevated concentrations at a depth of 10 feet bgs. Currently, the source of arsenic in soil is not known.	(1) Is the source of elevated arsenic concentrations in soil anthropogenic? (2) Do anthropogenic sources of arsenic at Site 22 pose unacceptable risk to human and ecological receptors?	Validated, defensible chemical data for soil, data from previous investigations, ambient levels for arsenic, documented pesticide, herbicide, and rodenticide application information if available, screening goals, existing biological surveys, geochemical data analysis, screening level human health risk assessment, screening level ecological risk assessment, current land use, and future land use development plans.	The lateral limit of the arsenic study is the grassland area adjacent to Building 7SH5. The vertical extent of the arsenic study is the soil to a depth of 10 feet bgs. No temporal boundaries have been set.	(1a) If arsenic concentrations are indistinguishable from the existing ambient data set for the site using two population comparison tests, then it will be concluded that samples represent ambient conditions and no further action will be required. (1b) If arsenic concentrations exceed ambient, then proceed as follows: If arsenic concentrations exceed ambient are strongly correlated with concentrations of iron, manganese, or antimony, then the source will be considered naturally occurring, and a reevaluation of the existing ambient data set will be recommended. If arsenic concentrations are not correlated with concentrations of iron, manganese, or antimony, then the source of arsenic will be considered anthropogenic and risk assessment will be conducted. (2a) If concentrations of arsenic at the site pose acceptable risk to human or ecological receptors, no future action will be recommended. (2b) If concentrations of arsenic at the site pose unacceptable risk to human or ecological receptors, future action will be recommended.	The number of samples collected is based on sample-size calculations using existing data for metals and the assumption of at least 80 percent confidence and 80 percent power for the two-population tests (also assuming a 20 percent minimum detectable relative difference). Nonparametric two-population tests (that compare population medians and upper quantiles) will be used to compare arsenic concentrations to the existing ambient data set, with a 95 percent level of confidence (that is, the null hypothesis that data sets are taken from the same population will be rejected if the p-value for the statistical test is less than 0.05). The statistical comparison of site and ambient populations evaluates the following null (H_0) and alternative (H_A) hypotheses: H_0: site $\leq$ ambient H_A: site > ambient Two decision errors are associated with this hypothesis test: (1) Type I (false positive) – rejecting H_0 when H_0 is true, and (2) Type II – failing to reject H_0 when H_0 is false. Acceptable probabilities for committing Type I and Type II errors, respectively, will be set at 0.20 and 0.10. Measurement quality objectives (MQO) will be established for sample analyses, and the analytical data will undergo QA/QC review to ensure that MQOs are met.	Six sampling locations were selected to represent the open grasslands of Site 22, three sampling locations were selected to represent ditches, four sampling locations were selected to represent conditions related to activities at Building 7SH5, two samples were selected to represent conditions adjacent to the railroad tracks, and three sampling locations were selected to represent the area immediately adjacent to building 7SH5; no proposed samples were located in roads or inside buildings. Individual sampling locations were selected using a judgmental sampling approach to specifically target identified potential source areas. At fourteen locations, three depths were sampled (surface, 4 feet bgs, and 10 feet bgs) and analyzed for arsenic, antimony, iron, manganese, and pH to determine the source of the elevated arsenic concentrations. At one location, only a surface sample (0 to 0.5 foot bgs) was collected. The analytical methods were consistent with methods used for during previous investigations at Site 22. An assessment of how well project DQOs are met, along with internal and external review, will be used to optimize sampling design if necessary.

TABLE 4-4

SOIL PRELIMINARY REMEDIATION GOALS FOR DETECTED ANALYTES
SITE 22
NAVAL WEAPONS STATION SBD CONCORD

Detected Analytes	Industrial PRG (mg/kg)	Residential PRG (mg/kg)
Aluminum	100,000.0	76,000.0
Antimony	410.0	31.0
Arsenic	1.6	0.39
Barium	67,000.0	5,400.0
Berryllium	1,900.0	150.0
Cadmium	7.4	1.7
Chromium*	100,000.0	100,000.0
Cobalt	1,900.0	900.0
Copper	41,000.0	3,100.0
Iron	100,000.0	23,000.0
Lead	750.0	150.0
Manganese	19,000.0	1,800.0
Mercury*	310.0	23.0
Nickel	20,000.0	1,600.0
Selenium	5,100.0	390.0
Silver	5,100.0	390.0
Vanadium	7,200.0	550.0
Zinc	100,000.0	23,000.0
Benzo(a)anthracene	2.1	0.62
Benzo(a)pyrene	0.21	0.062
Benzo(b)fluoranthene	2.1	0.62
Benzo(e)pyrene*	29,000.0	2,300.0
Bromodichloromethane	1.8	0.82
Chloroform	120.0	3.6
Chloromethane	2.6	1.2
Chrysene	210.0	62.0
Fluoranthene	22,000.0	2,300.0
Phenanthrene	NE	NE
Phenol	100,000.0	37,000.0
Pyrene	29,000.0	2,300.0
2-Methylnaphthalene	NE	NE
Naphthalene	190.0	56.0
Trichloroethene	0.11	0.053
Xylene (Total)	420.0	270.0
Diesel	NE	NE
Motor Oil	NE	NE

Notes:
Where available, Cal-modified PRGs are used instead of U.S. EPA Regin IX PRGs.
The residential and industrial PRGs used for chromium are for trivalent chromium.
The residential and industrial PRGs used for mercury are for mercuric chloride.
Toxicity values are not available for benzo(e)pyrene; the PRG for pyrene is used as a surrogate value.

mg/kg Milligrams per kilogram
NE None established
PRG Preliminary remediation goals
Res. PRG Residential preliminary remediation goals

TABLE 4-5

GROUNDWATER QUALITY CRITERIA FOR DETECTED ANALYTES
SITE 22
NAVAL WEAPONS STATION SBD CONCORD

Detected Analyte	Tap Water PRG (µg/L)	MCL (µg/L)		AWQC (µg/L) (freshwater, chronic)
		EPA	CDHS	
bis(2-ethylhexyl)phthalate	4.8	6[a]	4[a]	None Established
Trichloroethene	0.028	5	5	None Established
1,1,1-Trichloroethane	3,200	200	200	None Established
Motor Oil	None Established	None Established	None Established	None Established

Notes:

a The MCL for di(2-ethylhexyl)phalate is used for bis(2-ethylhexyl)phthalate.
µg/L Microgram per liter
AWQC Ambient water quality criteria
CDHS California Department of Health Services
EPA U.S. Environmental Protection Agency
MCL Maximum contaminant level
PRG Preliminary remediation goal

TABLE 5-1

DETECTED VOCs IN SOIL
SITE 22 - BUILDING 7SH5
NAVAL WEAPONS STATION SBD CONCORD

Sampling Location	Investigation	Sample Depth (ft bgs)	Bromodichloromethane	Qualifier	Chloroform	Qualifier	Chloromethane	Qualifier	Trichloroethene	Qualifier	Xylene (Total)	Qualifier
Residential PRGs (mg/kg)			0.82		3.6		1.2		0.053		270.0	
Industrial PRGs (mg/kg)			1.8		120		2.6		0.11		420.0	
	Concentration (mg/kg)											
7SHSB001	Phase I RI	.25 - 1.25	- -	U	- -	U	- -	U	- -	U	11	J
7SHSB010	Phase I RI	20.0 - 20.5	- -	U	- -	U	- -	U	0.001	J	- -	U
7SHMW002	Phase II RI	20.0 - 20.5	0.001	J	- -	U	- -	U	- -	U	- -	U
	Phase II RI	25.5 - 26.0	0.002	J	0.002	J	0.002	J	- -	U	- -	U
	Phase II RI	30.5 - 31.0	0.001	J	- -	U	- -	U	- -	U	- -	U
7SHMW004	Phase II RI	6.5 - 7.0	- -	U	- -	U	0.002	J	- -	U	- -	U
	Phase II RI	11.0 - 11.5	0.002	J	- -	U	- -	U	0.003	J	- -	U
	Phase II RI	16.0 - 16.5	0.002	J	- -	U	- -	U	0.002	J	- -	U

Notes:

California-modified PRGs used when available.

- - - Non detect
- ft bgs Feet below ground surface
- J Estimated
- mg/kg Milligram per kilogram
- PRG Preliminary remediation goal
- RI Remedial investigation
- U Undetected

TABLE 5-2

DETECTED SVOCs IN SOIL
SITE 22 - BUILDING 7SH5
NAVAL WEAPONS STATION SBD CONCORD

Sampling Location	Investigation	Sample Depth (ft bgs)	Benzo(a)anthracene	Qualifier	Benzo(a)pyrene	Qualifier	Benzo(b)fluoroanthene	Qualifier	Benzo(e)pyrene	Qualifier	Chrysene	Qualifier	Fluoroanthene	Qualifier	Phenanthrene	Qualifier	Phenol	Qualifier	Pyrene	Qualifier	2-Methylnaphthalene	Qualifier	Naphthalene	Qualifier
Residential PRGs (mg/kg)			0.62		0.061		0.62		2,300.0		62.0		2,300.0		NE		37,000.0		2,300.0		NE		56.0	
Industrial PRGs (mg/kg)			2.1		0.21		2.1		29,000.0		210.0		22,000.0		NE		100,000.0		29,000.0		NE		190.0	
			Concentration (mg/kg)																					
7SHSB001	Phase I RI	0.25 - 1.25	- -	U	- -	U	- -	U	- -	U	- -	U	- -	U	- -	U	- -	U	- -	U	20		8.1	J
7SHSB002	Phase I RI	0.25 - 1.25	- -	U	- -	U	- -	U	- -	U	- -	U	- -	U	- -	U	0.44		- -	U	- -	U	- -	U
7SHSB003	Phase I RI	1.0 - 1.5	- -	U	- -	U	- -	U	- -	U	- -	U	- -	U	- -	U	0.38		- -	U	- -	U	- -	U
7SHSB004	Phase I RI	1.0 - 2.0	- -	U	- -	U	- -	U	- -	U	- -	U	- -	U	- -	U	0.36	J	- -	U	- -	U	- -	U
7SHSB007	Phase I RI	2.0 - 3.0	- -	U	- -	U	- -	U	- -	U	- -	U	- -	U	- -	U	0.21	J	- -	U	- -	U	- -	U
7SHSB009	Phase I RI	2.5 - 3.5	- -	U	- -	U	- -	U	- -	U	- -	U	- -	U	- -	U	0.31	J	- -	U	- -	U	- -	U
7SHSB015	Phase I RI	0.0 - 0.5	- -	U	- -	U	- -	U	- -	U	- -	U	- -	U	- -	U	- -	U	0.22	J	- -	U	- -	U
7SHSB026	Phase I RI	0.0 - 0.5	0	J	0.005	J	0.02	J	0.008	J	0.01	J	0.013	J	0.007	J	- -	U	0.007	J	- -	U	- -	U
7SHTP001A	Phase I RI	1.0 - 1.0	- -	U	- -	U	- -	U	- -	U	- -	U	0.34	J	- -	U	- -	U	- -	U	- -	U	- -	U
S52-01	RFA	5.0 - 6.0	- -	U	- -	U	- -	U	- -	U	- -	U	- -	U	- -	U	0.92		- -	U	- -	U	- -	U
S52-02	RFA	5.0 - 6.0	- -	U	- -	U	- -	U	- -	U	- -	U	- -	U	- -	U	1.2		- -	U	- -	U	- -	U

Notes:

California-modified PRGs used when available.
SVOCs were not detected in soil samples collected as part of the site investigaiton

- -	Nondetect
bgs	Below ground surface
J	Estimated
mg/kg	Milligram per kilogram
NA	Not applicable, not tested
PRG	Preliminary remediation goal
RFA	Resource Conservation and Recovery Act facility assessment
RI	Remedial investigation
Suppl. RI	Supplemental remedial investigation
U	Undetected

TABLE 5-3

DETECTED TPH IN SOIL
SITE 22 - BUILDING 7SH5
NAVAL WEAPONS STATION SBD CONCORD

Sampling Location	Investigation	Sample Depths (ft bgs)	Diesel	Qualifier	Motor Oil	Qualifier
		Concentration (mg/kg)				
7SH-01-SB	SI	3.5 - 4.0	14.6		NA	
7SH-SFC	SI	0 to 0.5	9.23		NA	
7SHSB001	Phase I RI	0.25 - 1.25	35,000	J	4,300	
7SHSB002	Phase I RI	0.25 - 1.25	370		160	
7SHSB003	Phase I RI	1.0 - 1.5	- -	U	14	
7SHSB005	Phase I RI	0.0 - 1.0	- -	U	32	
7SHSB006	Phase I RI	2.0 - 3.0	- -	U	29	
7SHSB010	Phase I RI	10.0 -10.5	- -	U	11	J
7SHSB012	Phase I RI	10.0 - 10.5	500		- -	U
7SHSB015	Phase I RI	0.0 - 0.5	- -	U	84	
7SHSB024	Phase I RI	0.0 - 0.5	- -	U	200	
7SHSB025	Phase I RI	0.0 - 0.5	- -	U	37	
7SHSB026	Phase I RI	0.0 - 0.5	- -	U	41	
7SHSB027	Phase I RI	0.0 - 0.5	- -	U	29	
7SHTP001A	Phase I RI	1.0 - 1.0	- -	U	69	
	Phase I RI	4.0 - 4.0	- -	U	88	
7SHTP001B	Phase I RI	3.0 - 3.0	- -	U	32	
7SHSB001C	Phase I RI	2.0 - 2.0	- -	U	22	
7SHSB001E	Phase I RI	1.0 - 1.0	- -	U	250	
	Phase I RI	2.0 - 2.0	- -	U	220	
7SHSB001F	Phase I RI	2.0 - 2.0	- -	U	43	
	Phase I RI	3.0 - 3.0	- -	U	85	
7SHMW001	Phase II RI	5. 5- 6.0	- -	U	10	J
	Phase II RI	10.5 - 11.0	- -	U	8	J
7SHMW002	Phase II RI	15.5 - 16.0	- -	U	14	
	Phase II RI	20.0 - 20.5	- -	U	15	
7SHMW004	Phase II RI	6.5 - 7.0	- -	U	6	J

Notes:

No PRGs exist for TPH

- - - Non-detect
- ft bgs Feet below ground surface
- J Estimated
- mg/kg Milligram per kilogram
- PRG Preliminary remediation goals
- TPH Total petroleum hydrocarbons
- NA Not analyzed
- SI Site Investigation
- U Undetected

TABLE 5-4

DETECTED INORGANIC CONSTITUENTS IN SOIL
SITE 22 - BUILDING 7SH5
NAVAL WEAPONS STATION SBD CONCORD

Sample Location	Investigation	Sample Depth (ft bgs)	Aluminum	Qualifier	Antimony	Qualifier	Arsenic	Qualifier	Barium	Qualifier	Beryllium	Qualifer	Cadmium	Qualifier	Chromium	Qualifier	Cobalt	Qualifier	Copper	Qualifier	Iron	Qualifier	Lead	Qualifier	Manganese	Qualifier	Mercury	Qualifier	Nickel	Qualifer	Selenium	Qualifier	Silver	Qualifier	Vanadium	Qualier	Zinc	Qualifier
Residential PRGs (mg/kg)			76,000.0		31.0		0.4		5,400.0		150.0		1.7		100,000.0		900.0		3,100.0		23,000.0		150.0		1,800.0		23.0		150.0		390.0		390.0		550.0		23,000.0	
Industrial PRGs (mg/kg)			100,000.0		410.0		1.6		67,000.0		1,900.0		7.4		100,000.0		1,900.0		41,000.0		100,000.0		750.0		19,000.0		310.0		20,000.0		5,100.0		5,100.0		7,200.0		100,000.0	
			Concentration of Total Metals (mg/kg)																																			
7SH-01-SB	SI	2.0 - 2.5	20,000.0		- -	UJ	**14.5**	J	64.9		- -	U	- -	U	37.9	J	22.4		87.2		36,200.0		60.7		546.0		1.1		29.2	J	- -	UJ	- -	U	82.9		66.9	
	SI	3.5 - 4.0	18,200.0		- -	UJ	**16.7**	J	150.0		0.7		- -	U	43.5	J	28.8		332.0		34,600.0		20.1		613.0		0.6		45.2	J	- -	J	- -	U	62.9		72.8	
7SH-02-SB	SI	2.0 - 2.5	12,000.0		- -	UJ	**4.0**	J	172.0		- -	U	- -	U	36.4	J	17.7		33.2		28,100.0		5.1		675.0		0.2		97.9	J	- -	UJ	- -	U	66.8		54.1	
	SI	4.0 - 4.5	23,700.0		- -	UJ	**9.2**	J	262.0		0.5		- -	U	71.4	J	26.7		66.4		43,000.0		19.5		1,150.0		0.2		111.0	J	- -	UJ	- -	U	100.0		87.7	
7SH-03-SB	SI	2.0 - 2.5	19,000.0		- -	UJ	**6.4**		150.0		0.5		- -	U	44.4		19.0		58.7		36,700.0		16.3	J	554.0		0.3		59.4		- -	UJ	10.2		81.9		71.4	
	SI	4.0 - 4.5	34,000.0		- -	UJ	**6.3**	J	265.0		0.7		- -	U	81.9		28.2		75.7		49,800.0		9.4	J	1,110.0		0.3		126.0		- -	UJ	18.1		113.0		97.1	
7SH-SFC	SI	0.0 - 0.5	20,300.0		- -	UJ	**33.0**	J	163.0		0.7		0.5		59.3	J	21.5		53.2		37,300.0		22.7		676.0		0.3		81.1	J	- -	UJ	- -	U	78.4		111.0	
7SHSB013	Phase I RI	0.0 - 1.0	9,430.0		- -	UJ	**96.2**		138.0		- -	U	- -	U	19.7		10.4		22.4		19,100.0		6.4		313.0	J	- -	U	25.2		- -	U	- -	U	37.6		55.3	
	Phase I RI	7.0 - 8.0	18,500.0		- -	UJ	**7.6**		190.0		- -	U	- -	U	52.7		21.8		58.6		34,300.0		9.9		817.0	J	0.1		90.6		- -	U	- -	U	78.2		78.6	
7SHSB014	Phase I RI	0.0 - 1.0	9,770.0		1.0	J	**72.3**		154.0		0.2		- -	U	20.1		11.2		21.1		21,000.0		15.9		297.0	J	- -	U	21.9		- -	U	- -	U	38.9		60.5	
	Phase I RI	7.0 - 8.0	16,300.0		- -	UJ	**6.5**		203.0		- -	U	- -	U	49.6		19.9		53.7		37,000.0		9.0		743.0	J	0.1		84.5		- -	U	- -	U	66.8		74.7	
7SHSB015	Phase I RI	0.0 - 0.5	15,400.0		0.6	J	**42.1**		171.0		- -	U	- -	U	39.9		17.5		47.6		27,900.0		13.2		607.0	J	0.3		58.3		- -	U	- -	U	62.2		80.4	
	Phase I RI	3.0 - 3.5	17,000.0		0.7	J	**28.4**		103.0		- -	U	- -	U	63.9		23.9		52.9		31,200.0		7.0		699.0	J	0.2		126.0		- -	U	- -	U	69.9		64.8	
7SHSB020	Phase I RI	0.0 - 0.5	20,100.0		0.6	J	**26.6**		240.0		- -	U	- -	U	61.3		23.7		66.7		35,100.0		12.4		957.0	J	0.2		101.0		- -	U	- -	U	84.7		88.9	
7SHSB021	Phase I RI	0.0 - 0.5	20,800.0		0.9	J	**104.0**		260.0		- -	U	- -	U	62.1		25.4		68.6		36,400.0		15.0		1,070.0	J	0.1		99.5		- -	U	- -	U	87.0		96.5	
7SHSB022	Phase I RI	0.0 - 0.5	16,800.0		- -	U	**115.0**		210.0		- -	U	0.4		48.2		20.0		56.2		29,800.0		37.1		734.0		0.1		73.6		- -	U	- -	U	73.6		107.0	
7SHSB023	Phase I RI	0.0 - 0.5	17,400.0		NA		**7.5**		221.0		- -	U	0.2		53.8		24.7		66.7		34,100.0		10.3		981.0		0.2		101.0		- -	U	- -	U	75.2		93.7	
7SHSB024	Phase I RI	0.0 - 0.5	21,800.0		0.7	J	**55.2**		164.0		- -	U	- -	U	51.5		24.1		115.0		37,200.0		53.2		732.0	J	0.3		62.2		- -	U	- -	U	89.9		333.0	
7SHSB025	Phase I RI	0.0 - 0.5	16,300.0		1.5	J	**127.0**		198.0		- -	U	- -	U	46.3		19.0		50.5		29,500.0		21.7	J	720.0	J	0.1		67.9		- -	UJ	- -	U	67.3		83.5	J
7SHSB026	Phase I RI	0.0 - 0.5	15,800.0		0.9	J	**39.5**		178.0		- -	U	- -	U	38.0		17.4		45.8		30,700.0		15.6		570.0	J	0.2		52.5		- -	U	- -	U	64.1		84.0	
7SHSB027	Phase I RI	0.0 - 0.5	17,700.0		1.5	J	**86.8**		266.0		- -	U	- -	U	48.2		21.4		56.5		33,500.0		- -		819.0	J	0.3		76.3		- -	U	- -	U	76.2		104.0	
7SHTP001A	Phase I RI	1.0 - 1.0	11,500.0		- -	U	**13.6**		101.0		0.2		- -		25.3		15.1		47.9	J	19,600.0		13.8		421.0		0.2		29.0		- -	U	- -	U	42.5		52.8	
	Phase I RI	4.0 - 4.0	15,100.0		- -	U	**31.9**		121.0		- -	U	0.2		29.9		31.7		61.8	J	24,600.0		45.2		704.0		0.1		41.7		- -	U	- -	U	55.7		159.0	
	Phase I RI	5.5 - 5.5	22,000.0		0.7	J	**6.6**		256.0		- -	U	0.2		58.3		22.4		35.9	J	34,300.0		11.9		944.0		0.1		93.8		- -	U	- -	U	71.9		88.5	
7SHTP001B	Phase I RI	3.0 - 3.0	17,700.0		- -	UJ	**11.0**		83.8		- -	U	0.3		32.9		15.8		35.9	J	36,500.0		28.8	J	279.0		0.1		29.9		- -	U	- -	U	59.8		1,900.0	
7SHTP001C	Phase I RI	2.0 - 2.0	16,200.0		- -	UJ	**20.5**		78.1		0.3		- -		37.4		19.2		49.4	J	23,500.0		20.6	J	428.0		0.4		35.0		- -	U	- -	U	54.2		61.8	
7SHTP001D	Phase I RI	3.0 - 3.0	14,000.0		- -	UJ	**6.9**		166.0		0.2		- -		24.7		11.8		25.8	J	23,900.0		7.1	J	338.0		- -		17.8		- -	U	- -	U	49.0		68.8	
	Phase I RI	5.0 - 5.0	20,300.0		- -	UJ	**8.9**		200.0		- -	U	0.2		59.9		22.7		62.6	J	33,700.0		12.5	J	673.0		0.1		96.1		- -	U	- -	U	71.8		89.3	
7SHTP001E	Phase I RI	1.0 - 1.0	18,500.0		- -	UJ	**15.1**		101.0		- -	UJ	0.2		34.8		19.5		58.0	J	27,900.0		20.5	J	586.0		0.5		35.2		- -	U	- -	U	71.8		78.6	J
	Phase I RI	2.0 - 2.0	21,300.0		- -	UJ	**8.8**		22.8		- -	U	- -		29.4		23.6		77.4	J	30,000.0		11.4	J	499.0		0.6		22.7		- -	U	- -	U	71.8		53.7	
	Phase I RI	5.0 - 5.0	16,600.0		- -	UJ	**5.9**		203.0		- -	U	0.2		47.0		19.2		53.7	J	28,400.0		10.0	J	746.0		0.1		81.9		- -	U	- -	U	71.8		75.1	
7SHTP001F	Phase I RI	2.0 - 2.0	13,200.0		- -	UJ	**23.4**		134.0		- -	U	0.2		27.4		15.8		40.5	J	24,100.0		11.6	J	483.0		0.2		36.8		- -	U	- -	U	54.1		64.0	
	Phase I RI	3.0 - 3.0	16,800.0		- -	UJ	**14.0**		89.4		- -	U	- -	U	26.7		19.6		63.8	J	31,000.0		24.4	J	474.0		0.2		22.9		- -	U	- -	U	62.4		65.8	
S52-01	RFA	5.0 - 6.0	21,200.0		0.6	J	**9.6**		223.0		- -	U	- -	U	61.5		22.8		63.9		36,200.0		12.8		1,000.0	J	- -		90.2		- -	UJ	- -	U	81.2		90.9	
	RFA	1.0 - 11.0	15,000.0		- -	UJ	**6.1**		162.0		- -	U	- -	U	43.8		19.5		19.5		29,300.0		8.1		788.0		0.1		77.1		- -	U	- -	U	60.3		72.1	
	RFA	15.0 - 16.0	16,500.0		0.7		**6.9**		183.0		- -	U	- -	U	51.8		21.8		57.3		32,700.0		9.2		687.0		0.1		89.8		- -	UJ	- -	U	72.1		82.1	
S52-02	RFA	5.0 - 6.0	16,400.0		- -	UJ	**5.1**		183.0		- -	U	- -	U	48.8		19.0		53.2		29,100.0		8.3		803.0	J	- -		78.2		- -	UJ	- -	U	61.8		72.9	
	RFA	1.0 - 11.0	15,800.0		- -	J	**6.0**		120.0		- -	U	- -	U	49.0		17.5		50.4		29,700.0		7.5		685.0		0.1		68.6		- -	UJ	- -	U	64.7		72.5	
	RFA	15.0 - 16.0	18,400.0		- -	UJ	**7.0**		157.0		- -	U	- -	U	52.4		21.0		54.2		33,000.0		8.9		888.0		0.1		91.7		- -	UJ	- -	U	74.4		80.3	
S52-03	RFA	0.0 - 0.5	15,400.0		1.2	J	**65.4**		164.0		- -	U	1.3	U	49.8		19.3		59.3		30,400.0		**165.0**		805.0		0.1		- -	U	- -	UJ	- -	U	70.2		160.0	J
	RFA	3.5 - 4.0	17,300.0		0.5	J	**20.7**		187.0		- -	U	- -	U	50.0		19.6		58.7		33,100.0		9.0		751.0		0.2		79.7		- -	UJ	- -	U	68.8		85.0	J
S52-04	RFA	0.0 - 0.5	16,500.0		- -	UJ	**38.0**		202.0		- -	U	- -	U	45.0		19.4		54.5		28,900.0		13.5		792.0		0.1		74.7		- -	UJ	- -	U	57.9		79.2	J
	RFA	2.0 - 2.5	16,600.0		0.7	J	**14.7**		102.0		- -	U	- -	U	61.3		17.0		44.7		29,500.0		7.9		673.0		0.1		95.0		- -	UJ	- -	U	65.8		70.2	J
7SHSB101	Suppl. RI	0.0 - 0.5	NA		- -	UJ	**61.0**		NA		NA		NA		NA		NA		NA		33,000.0		NA		570.0		NA		NA		NA		NA		NA		NA	
	Suppl. RI	3.5 - 4.0	NA		- -	UJ	**7.9**		NA		NA		NA		NA		NA		NA		42,000.0		NA		930.0		NA		NA		NA		NA		NA		NA	
	Suppl. RI	9.5 - 10.0	NA		- -	UJ	**7.9**		NA		NA		NA		NA		NA		NA		38,000.0		NA		880.0		NA		NA		NA		NA		NA		NA	

TABLE 5-4

DETECTED INORGANIC CONSTITUENTS IN SOIL
SITE 22 - BUILDING 7SH5
NAVAL WEAPONS STATION SBD CONCORD

Sample Location	Investigation	Sample Depth (ft bgs)	Aluminum	Qualifier	Antimony	Qualifier	Arsenic	Qualifier	Barium	Qualifier	Beryllium	Qualifer	Cadmium	Qualifier	Chromium	Qualifier	Cobalt	Qualifier	Copper	Qualifier	Iron	Qualifier	Lead	Qualifier	Manganese	Qualifier	Mercury	Qualifier	Nickel	Qualifer	Selenium	Qualifier	Silver	Qualifier	Vanadium	Qualier	Zinc	Qualifier
Residential PRGs (mg/kg)			76,000.0		31.0		0.4		5,400.0		150.0		1.7		100,000.0		900.0		3,100.0		23,000.0		150.0		1,800.0		23.0		150.0		390.0		390.0		550.0		23,000.0	
Industrial PRGs (mg/kg)			100,000.0		410.0		1.6		67,000.0		1,900.0		7.4		100,000.0		1,900.0		41,000.0		100,000.0		750.0		19,000.0		310.0		20,000.0		5,100.0		5,100.0		7,200.0		100,000.0	
			Concentration of Total Metals (mg/kg)																																			
7SHSB102	Suppl. RI	0.0 - 0.5	NA		- -	UJ	**45.0**		NA		NA		NA		NA		NA		NA		39,000.0		NA		760.0		NA		NA		NA		NA		NA		NA	
	Suppl. RI	3.5 - 4.0	NA		- -	UJ	**32.0**		NA		NA		NA		NA		NA		NA		31,000.0		NA		610.0		NA		NA		NA		NA		NA		NA	
	Suppl. RI	9.5 - 10.0	NA		- -	UJ	**6.7**		NA		NA		NA		NA		NA		NA		36,000.0		NA		810.0		NA		NA		NA		NA		NA		NA	
7SHSB103	Suppl. RI	0.0 - 0.5	NA		NA		**26.0**		NA		NA		NA		NA		NA		NA		26,000.0		NA		370.0		NA		NA		NA		NA		NA		NA	
	Suppl. RI	3.5 - 4.0	NA		NA		**7.5**		NA		NA		NA		NA		NA		NA		29,000.0		NA		490.0		NA		NA		NA		NA		NA		NA	
	Suppl. RI	9.5 - 10.0	NA		NA		**6.3**		NA		NA		NA		NA		NA		NA		38,000.0		NA		800.0		NA		NA		NA		NA		NA		NA	
7SHSB104	Suppl. RI	0.0 - 0.5	NA		NA		**5.1**		NA		NA		NA		NA		NA		NA		39,000.0		NA		290.0		NA		NA		NA		NA		NA		NA	
	Suppl. RI	3.5 - 4.0	NA		NA		**3.3**		NA		NA		NA		NA		NA		NA		22,000.0		NA		250.0		NA		NA		NA		NA		NA		NA	
	Suppl. RI	9.5 - 10.0	NA		NA		**7.2**		NA		NA		NA		NA		NA		NA		41,000.0		NA		990.0		NA		NA		NA		NA		NA		NA	
7SHSB105	Suppl. RI	0.0 - 0.5	NA		- -	UJ	**54.0**		NA		NA		NA		NA		NA		NA		36,000.0		NA		630.0		NA		NA		NA		NA		NA		NA	
	Suppl. RI	3.5 - 4.0	NA		- -	UJ	**11.0**		NA		NA		NA		NA		NA		NA		36,000.0		NA		780.0		NA		NA		NA		NA		NA		NA	
	Suppl. RI	9.5 - 10.0	NA		NA		**7.1**		NA		NA		NA		NA		NA		NA		39,000.0		NA		940.0		NA		NA		NA		NA		NA		NA	
7SHSB106	Suppl. RI	0.0 - 0.5	NA		NA		**130.0**		NA		NA		NA		NA		NA		NA		41,000.0		NA		740.0		NA		NA		NA		NA		NA		NA	
	Suppl. RI	3.5 - 4.0	NA		NA		**7.0**		NA		NA		NA		NA		NA		NA		39,000.0		NA		660.0		NA		NA		NA		NA		NA		NA	
	Suppl. RI	9.5 - 10.0	NA		NA		**7.6**		NA		NA		NA		NA		NA		NA		42,000.0		NA		730.0		NA		NA		NA		NA		NA		NA	
7SHSB107	Suppl. RI	0.0 - 0.5	NA		NA		**99.0**		NA		NA		NA		NA		NA		NA		36,000.0		NA		740.0		NA		NA		NA		NA		NA		NA	
	Suppl. RI	3.5 - 4.0	NA		NA		**8.9**		NA		NA		NA		NA		NA		NA		40,000.0		NA		810.0		NA		NA		NA		NA		NA		NA	
	Suppl. RI	9.5 - 10.0	NA		NA		**8.8**		NA		NA		NA		NA		NA		NA		39,000.0		NA		820.0		NA		NA		NA		NA		NA		NA	
7SHSB108	Suppl. RI	0.0 - 0.5	NA		NA		**54.0**		NA		NA		NA		NA		NA		NA		30,000.0		NA		640.0		NA		NA		NA		NA		NA		NA	
	Suppl. RI	3.5 - 4.0	NA		NA		**8.5**		NA		NA		NA		NA		NA		NA		44,000.0		NA		1,000.0		NA		NA		NA		NA		NA		NA	
	Suppl. RI	9.5 - 10.0	NA		NA		**7.1**		NA		NA		NA		NA		NA		NA		41,000.0		NA		860.0		NA		NA		NA		NA		NA		NA	
7SHSB109	Suppl. RI	0.0 - 0.5	NA		NA		**100.0**		NA		NA		NA		NA		NA		NA		36,000.0		NA		610.0		NA		NA		NA		NA		NA		NA	
	Suppl. RI	3.5 - 4.0	NA		NA		**14.0**		NA		NA		NA		NA		NA		NA		48,000.0		NA		1,000.0		NA		NA		NA		NA		NA		NA	
	Suppl. RI	9.5 - 10.0	NA		NA		**7.4**		NA		NA		NA		NA		NA		NA		36,000.0		NA		800.0		NA		NA		NA		NA		NA		NA	
7SHSB110	Suppl. RI	0.0 - 0.5	NA		- -	UJ	**75.0**		NA		NA		NA		NA		NA		NA		31,000.0		NA		510.0		NA		NA		NA		NA		NA		NA	
	Suppl. RI	3.5 - 4.0	NA		- -	UJ	**6.9**		NA		NA		NA		NA		NA		NA		45,000.0		NA		850.0		NA		NA		NA		NA		NA		NA	
	Suppl. RI	9.5 - 10.0	NA		- -	UJ	**14.0**		NA		NA		NA		NA		NA		NA		56,000.0		NA		780.0		NA		NA		NA		NA		NA		NA	
7SHSB111	Suppl. RI	1.0 - 1.5	NA		- -	UJ	**8.7**		NA		NA		NA		NA		NA		NA		21,000.0		NA		350.0		NA		NA		NA		NA		NA		NA	
	Suppl. RI	5.0 - 5.5	NA		- -	UJ	**5.8**		NA		NA		NA		NA		NA		NA		53,000.0		NA		1,200.0		NA		NA		NA		NA		NA		NA	
	Suppl. RI	9.5 - 10.0	NA		- -	UJ	**7.9**		NA		NA		NA		NA		NA		NA		42,000.0		NA		600.0		NA		NA		NA		NA		NA		NA	
7SHSB112	Suppl. RI	0.0 - 0.5	NA		NA		**53.0**		NA		NA		NA		NA		NA		NA		39,000.0		NA		830.0		NA		NA		NA		NA		NA		NA	
7SHSB113	Suppl. RI	0.0 - 0.5	NA		- -	UJ	**85.0**		NA		NA		NA		NA		NA		NA		42,000.0		NA		800.0		NA		NA		NA		NA		NA		NA	
	Suppl. RI	3.5 - 4.0	NA		- -	UJ	**13.0**		NA		NA		NA		NA		NA		NA		40,000.0		NA		850.0		NA		NA		NA		NA		NA		NA	
	Suppl. RI	9.0 - 10.0	NA		- -	UJ	**5.5**		NA		NA		NA		NA		NA		NA		38,000.0		NA		740.0		NA		NA		NA		NA		NA		NA	
7SHSB114	Suppl. RI	0.0 - 0.5	NA		- -	UJ	**210.0**		NA		NA		NA		NA		NA		NA		41,000.0		NA		870.0		NA		NA		NA		NA		NA		NA	
	Suppl. RI	3.5 - 4.0	NA		- -	UJ	**9.4**		NA		NA		NA		NA		NA		NA		43,000.0		NA		920.0		NA		NA		NA		NA		NA		NA	
	Suppl. RI	9.0 - 10.0	NA		- -	UJ	**7.0**		NA		NA		NA		NA		NA		NA		43,000.0		NA		870.0		NA		NA		NA		NA		NA		NA	
7SHSB115	Suppl. RI	0.0 - 0.5	NA		- -	UJ	**61.0**		NA		NA		NA		NA		NA		NA		38,000.0		NA		810.0		NA		NA		NA		NA		NA		NA	
	Suppl. RI	3.5 - 4.0	NA		- -	UJ	**7.6**		NA		NA		NA		NA		NA		NA		41,000.0		NA		980.0		NA		NA		NA		NA		NA		NA	
	Suppl. RI	9.5 - 10.0	NA		- -	UJ	**6.5**		NA		NA		NA		NA		NA		NA		42,000.0		NA		500.0		NA		NA		NA		NA		NA		NA	

Notes:
Concentrations shown in **bold** exceed the residential and industrial PRGs (with the exception of Lead, which only exceeds the residential PRG)
California-modified PRGs used when available.

- -	No value detected	PRG	Preliminary remediation goal	U	Undetected
ft bgs	Feet below ground surface	SI	Site investigation		
mg/kg	Milligram per kilogram	RI	Remedial investigation		
J	Estimated	RFA	Resource conservation and Recovery act facility assessment		
NA	Not applicable, not tested	Suppl. RI	Supplemental remedial investigation		

TABLE 5-5

RESULTS OF TWO-POPULATION TESTS, (0-0.50 FEET BELOW GROUND SURFACE)
SITE 22
NAVAL WEAPONS STATION SBD CONCORD

Chemical	Site 22			Ambient[a]			Statistical Test[b]	Prob[c]	QT Conclusion[d]	Site > Ambient?	Notes
	Sample Size		Detection	Sample Size		Detection					
	Detected	Total	Frequency	Detected	Total	Frequency	(WRS, GT, or TP)			(YES or NO)	
Aluminum	8	8	100	31	31	100	TP (3)	1.000	Site < Ambient	NO	
Antimony	6	15	40	9	30	30	TP	0.365	2	NO	
Arsenic	24	24	100	25	25	100	WRS	<0.001	N/A	**YES**	
Barium	8	8	100	31	31	100	TP (3)	1.000	Site < Ambient	NO	
Beryllium	1	8	12	1	31	3	TP (3)	0.372	2	NO	
Cadmium	2	8	25	3	31	10	TP (3)	0.268	Site < Ambient	NO	
Chromium	8	8	100	31	31	100	TP (3)	1.000	Site < Ambient	NO	
Cobalt	8	8	100	30	30	100	TP (3)	1.000	Site < Ambient	NO	
Copper	11	11	100	23	23	100	WRS	<0.001	N/A	**YES**	
Lead	7	7	100	21	31	68	TP (3)	0.094	Site > Ambient	**YES**	
Manganese	22	22	100	30	30	100	WRS	0.940	Site < Ambient	NO	
Mercury	8	8	100	23	31	74	TP (3)	0.128	Site > Ambient	**YES**	
Molybdenum	0	8	0	0	31	0	TP (3)	1.000	2	NO	
Nickel	7	8	88	27	27	100	TP (3)	1.000	Site < Ambient	NO	
Selenium	0	8	0	0	31	0	TP (3)	1.000	2	NO	
Silver	0	8	0	0	31	0	TP (3)	1.000	2	NO	
Thallium	0	8	0	3	31	10	TP (3)	1.000	2	NO	
Vanadium	8	8	100	31	31	100	TP (3)	1.000	Site < Ambient	NO	
Zinc	8	8	100	24	31	77	TP (3)	0.171	Site > Ambient	**YES**	

Notes:

a Ambient data set described in Appendix B
b GT Gehan-Wilcoxon rank sum test
TP Test of proportions (implemented using the Fisher exact test)
WRS Wilcoxon rank sum test
c Calculated significance level for individual statistical tests. Reject H_0 if Prob < 0.05.
d QT quantile test

> Greater than
< Less than
H_0 Null hypothesis
N/A Not applicable
Ref Reference
1 The conclusion that the site exceeds ambient is based only on the comparison of detection frequencies, rather than the magnitude of chemical concentrations.
2 The quantile test could not be run because at least one of the largest r measurements was a censored value.
3 Either the site or ambient population has fewer than 10 samples. Only the test of proportions was conducted.

TABLE 5-6

RESULTS OF TWO-POPULATION TESTS, (0-3 FEET BELOW GROUND SURFACE)
SITE 22
NAVAL WEAPONS STATION SBD CONCORD

Chemical	Site 22			Ambient[a]			Statistical Test[b]	Prob[c]	QT Conclusion[d]	Site > Ambient?	Notes
	Sample Size		Detection	Sample Size		Detection	(WRS, GT, or TP)			(YES or NO)	
	Detected	Total	Frequency	Detected	Total	Frequency					
Aluminum	21	21	100	31	31	100	WRS	0.334	Site < Ambient	NO	
Antimony	7	29	24	9	30	30	TP	0.788	2	NO	
Arsenic	40	40	100	25	25	100	WRS	<0.001	N/A	**YES**	
Barium	21	21	100	31	31	100	WRS	>0.999	Site < Ambient	NO	
Beryllium	6	21	29	1	31	3	TP	0.013	2	**YES**	1
Cadmium	5	21	24	3	31	10	TP	0.160	2	NO	
Chromium	21	21	100	31	31	100	WRS	0.862	Site < Ambient	NO	
Cobalt	21	21	100	30	30	100	WRS	0.508	Site < Ambient	NO	
Copper	24	24	100	23	23	100	WRS	0.002	N/A	**YES**	
Lead	20	20	100	21	31	68	GT	0.004	N/A	**YES**	
Manganese	36	36	100	30	30	100	WRS	0.993	Site < Ambient	NO	
Mercury	20	21	95	23	31	74	GT	<0.001	N/A	**YES**	
Molybdenum	0	21	0	0	31	0	TP	1.000	2	NO	
Nickel	21	22	95	27	27	100	WRS	0.980	Site < Ambient	NO	
Selenium	0	21	0	0	31	0	TP	1.000	2	NO	
Silver	1	21	5	0	31	0	TP	0.404	2	NO	
Thallium	0	21	0	3	31	10	TP	1.000	2	NO	
Vanadium	21	21	100	31	31	100	WRS	0.775	Site < Ambient	NO	
Zinc	21	21	100	24	31	77	GT	0.027	N/A	**YES**	

Notes:

a Ambient data set described in Appendix B.
b GT Gehan-Wilcoxon rank sum test
TP Test of proportions (implemented using the Fisher exact test)
WRS Wilcoxon rank sum test
c Calculated significance level for individual statistical tests. Reject H_0 if Prob < 0.05.
d QT quantile test

> Greater than
< Less than
H_0 Null hypothesis
N/A Not applicable
Ref Reference
1 The conclusion that the site exceeds ambient is based only on the comparison of detection frequencies, rather than the magnitude of chemical concentrations.
2 The quantile test could not be run because at least one of the largest r measurements was a censored value.
3 Either the site or ambient population has fewer than 10 samples. Only the test of proportions was conducted.

TABLE 5-7

RESULTS OF TWO-POPULATION TESTS, (0-10 FEET BELOW GROUND SURFACE)
SITE 22
NAVAL WEAPONS STATION SBD CONCORD

	Site 22			Ambient[a]							
	Sample Size		Detection	Sample Size		Detection	Statistical Test[b]			Site > Ambient?	
Chemical	Detected	Total	Frequency	Detected	Total	Frequency	(WRS, GT, or TP)	Prob[c]	QT Conclusion[d]	(YES or NO)	Notes
Aluminum	34	34	100	31	31	100	WRS	0.089	Site < Ambient	NO	
Antimony	11	57	19	9	30	30	TP	0.917	2	NO	
Arsenic	81	81	100	25	25	100	WRS	<0.001	N/A	**YES**	
Barium	34	34	100	31	31	100	WRS	>0.999	Site < Ambient	NO	
Beryllium	9	34	26	1	31	3	TP	0.010	2	**YES**	1
Cadmium	9	34	26	3	31	10	TP	0.076	2	NO	
Chromium	34	34	100	31	31	100	WRS	0.412	Site < Ambient	NO	
Cobalt	34	34	100	30	30	100	WRS	0.108	Site < Ambient	NO	
Copper	37	37	100	23	23	100	WRS	<0.001	N/A	**YES**	
Lead	33	33	100	21	31	68	GT	<0.001	N/A	**YES**	
Manganese	77	77	100	30	30	100	WRS	0.859	Site < Ambient	NO	
Mercury	31	34	91	23	31	74	GT	<0.001	N/A	**YES**	
Molybdenum	0	34	0	0	31	0	TP	1.000	2	NO	
Nickel	34	35	97	27	27	100	WRS	0.722	Site < Ambient	NO	
Selenium	1	34	3	0	31	0	TP	0.523	2	NO	
Silver	2	34	6	0	31	0	TP	0.270	2	NO	
Thallium	0	34	0	3	31	10	TP	1.000	2	NO	
Vanadium	34	34	100	31	31	100	WRS	0.658	Site < Ambient	NO	
Zinc	34	34	100	24	31	77	GT	0.005	N/A	**YES**	

Notes:

a Ambient data set described in Appendix B.
b GT Gehan-Wilcoxon rank sum test
TP Test of proportions (implemented using the Fisher exact test)
WRS Wilcoxon rank sum test
c Calculated significance level for individual statistical tests. Reject H_0 if Prob < 0.05.
d QT quantile test

\> Greater than
< Less than
H_0 Null hypothesis
N/A Not applicable
Ref Reference
1 The conclusion that the site exceeds ambient is based only on the comparison of detection frequencies, rather than the magnitude of chemical concentrations.
2 The quantile test could not be run because at least one of the largest r measurements was a censored value.
3 Either the site or ambient population has fewer than 10 samples. Only the test of proportions was conducted.

TABLE 5-8

RESULTS OF TWO-POPULATION TESTS, BUILDING 7SH5 ARSENIC SAMPLES
SITE 22
NAVAL WEAPONS STATION SBD CONCORD

Depth Interval	Site 22 Building 7SH5 Sample Size Detected	Site 22 Building 7SH5 Sample Size Total	Site 22 Building 7SH5 Detection Frequency	Ambient Sample Size Detected	Ambient Sample Size Total	Ambient Detection Frequency	Statistical Test[a] (WRS, GT, or TP)	Prob[b]	QT Conclusion[c]	Site > Ambient? (YES or NO)	Notes
0-0.50	2	2	100	25	25	100	TP	1.000	N/A (4)	NO	
0-3	11	11	100	25	25	100	WRS	<0.001	N/A	**YES**	
0-10	23	23	100	25	25	100	WRS	<0.001	N/A	**YES**	

Notes:

a GT Gehan-Wilcoxon rank sum test
TP Test of proportions (implemented using the Fisher exact test)
WRS Wilcoxon rank sum test

b Calculated significance level for individual statistical tests. Reject H_0 if Prob < 0.05.

c QT quantile test

> Greater than

< Less than

H_0 Null hypothesis

N/A Not applicable

1 The conclusion that the site exceeds ambient is based only on the comparison of detection frequencies, rather than the magnitude of chemical concentrations.

2 The quantile test could not be run because at least one of the largest r measurements was a censored value.

3 Either the site or ambient population has fewer than 10 samples. Only the test of proportions and quantile test were conducted.

4 Too few samples to conduct the quantile test

Point IDs for Samples around Building 7SH5: 7SHSB103, 7SHSB104, 7SHSB111, 7SHTP001A, 7SHTP001B, 7SHTP001C, 7SHTP001D, 7SHTP001E, 7SHTP001F, S52-01, S52-02

TABLE 5-9

DETECTED ORGANIC COMPOUNDS IN GROUNDWATER (µg/L)
SITE 22 - BUILDING 7SH5
NAVAL WEAPONS STATION SBD CONCORD

Sampling Location	Investigation	Date Sampled	bis(2-ethylhexyl)phthalate	Qualifier	1,1,1-Trichloroethane	Qualifier	Trichloroethene	Qualifier	Motor Oil	Qualifer
Tap Water PRG			4.8		3200.0		0.028		NE	
EPA MCL			6.0[a]		200.0		5.0		NE	
CDHS MCL			4.0[a]		200.0		5.0		NE	
	Concentration (µg/L)									
7SHSB010	Phase I RI (temporary well)	1995	- -	U	- -	U	**27.0**		630.0	
7SHSB011	Phase I RI (temporary well)	1995	- -	U	2.0		- -	U	450.0	
7SHSB012	Phase I RI (temporary well)	1995	- -	U	1.0		- -	U	380.0	
7SHMW001	Phase II RI (permanent well)	Mar-97	- -	U	- -	U	- -	U	- -	U
	Phase II RI (permanent well)	Jun-97	**24.0**		- -	U	- -	U	- -	U
	Phase II RI (permanent well)	Sep-97	- -	U	- -	U	- -	U	- -	U
	Phase II RI (permanent well)	Dec-97	- -	U	- -	U	- -	U	- -	U
7SHMW002	Phase II RI (permanent well)	Mar-97	- -	U	- -	U	- -	U	- -	U
	Phase II RI (permanent well)	Jun-97	**32.0**		- -	U	- -	U	- -	U
	Phase II RI (permanent well)	Sep-97	- -	U	- -	U	- -	U	- -	U
	Phase II RI (permanent well)	Dec-97	- -	U	- -	U	- -	U	- -	U
7SHMW003	Phase II RI (permanent well)	Mar-97	- -	U	1.0		- -	U	- -	U
	Phase II RI (permanent well)	Jun-97	- -	U	- -	U	- -	U	- -	U
	Phase II RI (permanent well)	Sep-97	- -	U	- -	U	- -	U	- -	U
	Phase II RI (permanent well)	Dec-97	- -	U	- -	U	- -	U	- -	U
7SHMW004	Phase II RI (permanent well)	Mar-97	- -	U	- -	U	1.0	J	- -	U
	Phase II RI (permanent well)	Jun-97	- -	U	- -	U	- -	U	- -	U
	Phase II RI (permanent well)	Sep-97	- -	U	- -	U	- -	U	- -	U
	Phase II RI (permanent well)	Dec-97	- -	U	- -	U	- -	U	- -	U

Notes: Concentrations shown in **bold** exceed the tap water PRG and MCL (if applicable).

a The MCL for di(2-ethylhexyl)phalae is used for bis(2-ethylhexyl)phthalate.
J Estimated
CDHS California Department of Health Services
EPA U.S. Environmental Protection Agency
MCL Maximum contaminant level
µg/L Microgram per liter
permanent well Sample collected from permanent groundwater monitoring well
temporary well Sample collected from temporary groundwater monitoring well
NE None established
PRG Preliminary remediation goal
U Undetected

TABLE 5-10

GEOTECHNICAL TESTING RESULTS
SITE 22 - BUILDING 7SH5
NAVAL WEAPONS STATION SBD CONCORD

Laboratory Identification	Soil Sampling Location	Sample Interval (feet bgs)	Grain Size	USCS Symbol	Permeability (cm/sec)	Porosity (%)	Density (lb/ft)	Specific Gravity	Moisture (%)
SH617	7SHSB010	25.5 - 26.0	Clay	~~	1.00E-07	49.32	86.6	2.74	34.9
SH621	7SHSB011	26.0 - 26.5	Clay and sand	CL-SC	1.00E-07	36.87	104.8	2.66	20.8
SH625	7SHSB012	25.0 - 25.5	Sandy clay	~~	9.00E-07	39.29	102.3	2.7	18.1

Notes:

~~	Information not provided by testing laboratory
%	percent
bgs	Below ground surface
CL-SC	Clay - Clayey Sand
cm/sec	Centimeters per second
lb/ft	Pound per feet
USCS	Unified Soil Classification System

TABLE 6-1

CHEMICALS OF POTENTIAL CONCERN
SITE 22 - BUILDING 7SH5, SCREENING LEVEL HUMAN HEALTH RISK ASSESSMENT
NAVAL WEAPONS STATION SBD CONCORD

Surface Soil (0-0.5 ft bgs)	Subsurface Soil (0-10 ft bgs)	Groundwater
Organics[a]		
Benzo(a)anthracene	Benzo(a)anthracene	Bis(2-ethylhexyl)phthalate
Benzo(a)pyrene	Benzo(a)pyrene	1,1,1-Trichloroethane
Benzo(b)fluoranthene	Benzo(b)fluoranthene	Trichloroethene
Benzo(e)pyrene	Benzo(e)pyrene	
Chrysene	Chloromethane	
Fluoranthene	Chrysene	
Phenanthrene	Fluoranthene	
Pyrene	2-Methylnaphthalene	
	Naphthalene	
	Phenanthrene	
	Phenol	
	Pyrene	
	Xylene (total)	
Inorganics[b]		
Arsenic	Arsenic	NA
Copper	Beryllium	
Lead	Lead	
Mercury	Copper	
Zinc	Mercury	
	Zinc	

Notes:

a An organic chemical was identified as a chemical of potential concern if it was detected at least once.

b An inorganic chemical was identified as a COPC is it was detected at least once, is not an essential nutrient, and exceeds ambient levels as described in Section 7.1.2.1.

ft bgs Feet below ground surface

NA Not applicable

TABLE 6-2

COMPARISON OF ESSENTIAL NUTRIENT CONCENTRATIONS TO AMBIENT CONCENTRATIONS
SITE 22 - BUILDING 7SH5, CURRENT EXPOSURE SCENARIO
NAVAL WEAPONS STATION SBD CONCORD

Essential Nutrient	Maximum Detected Concentration (mg/kg)		Range of Ambient Concentrations in California (mg/kg)[a]	Maximum Detected Site Concentration Exceeds Range of California Ambient Concentrations?	
	Subsurface Soil (0-10 ft bgs)	Groundwater		Soil 0-0.5 ft bgs	Soil 0-10 ft bgs
Calcium	7,390	23,500	2,500 - 46,000	No	No
Iron	42,000	56,000	10,000 - 87,000	No	No
Magnesium	12,900	18,600	1,500 - 32,000	No	No
Potassium	3,340	4,470	2,100 - 30,000	No	No
Sodium	177	675	5,600 - 73,000	No	No

Notes:
a From Bradford and others (1996); values rounded to two significant figures.
ft bgs Feet below ground surface
mg/kg Milligrams per kilogram

TABLE 6-3

STANDARD DEFAULT EXPOSURE ASSUMPTIONS USED TO DEVELOP PRGS
SITE 22 - BUILDING 7SH5, CURRENT EXPOSURE SCENARIO
NAVAL WEAPONS STATION SBD CONCORD

Exposure Parameter	Exposure Assumptions Used to Develop PRG[s]			Units
		Resident		
	Groundwater	Adult	Child	
General Parameters				
Exposure Frequency	250	350	350	days/year
Exposure Duration	25	24	6	years
Body Weight	70	70	15	kg
Averaging Time - Carcinogens	25,550	25,550	25,550	days
Averaging Time - Noncarcinogens	9,125	8,760	2,190	days
Soil Ingestion Pathway				
Soil Ingestion Rate	100	100	200	mg/day
Dermal Contact With Soil Pathway				
Exposed Skin Surface Area	3,300	5,700	2,800	cm^2
Soil-to-Skin Adherence Factor	0.2	0.07	0.2	mg/cm^2
Fraction of Chemical Dermally Absorbed[b]	Chemical-specific	Chemical-specific	Chemical-specific	unitless
Inhalation of Particulates and Volatiles Released from Soil Pathways				
Inhalation Rate (adult)	20	20	10	m^3/day
Particulate Emission Factor	1.316E+09	1.316E+09	1.316E+09	m^3/kg
Volatilization Factor for Soil[b]	Chemical-specific	Chemical-specific	Chemical-specific	m^3/kg

Notes:

a An organic chemical was identified as COPCs if it was detected at least once.
b An inorganic chemical was identified as a COPC is it was detected at least once, is not an essential nutrient, and exceeds ambient levels as described in Section 7.1.2.1.

cm^2 square centimeters
EPA U.S. Environmental Protection Agency
m^3/day cubic meters per day
m^3/kg cubic meters per kilogram

TABLE 6-4

CANCER RISK AND HAZARD INDEX FROM EXPOSURE TO SOIL
COMMERCIAL/INDUSTRIAL WORKER, 0- TO 0.5-FOOT DEPTH INTERVAL
SITE 22 - BUILDING 7SH5, CURRENT EXPOSURE SCENARIO
NAVAL WEAPONS STATION SBD CONCORD

Subsurface Soil (0-10 ft bgs) Chemical of Potential Concern	**Exposure Point Concentration (mg/kg)**	**Soil PRG[a] (mg/kg)**		**Cancer Risk (unitless)**	**Hazard Index (unitless)**
		Cancer	**Noncancer**		
Metals					
Arsenic	8.88E+01	1.59E+00	2.56E+02	5.58E-05	3.47E-01
Copper	7.25E+01	--	4.09E+04	--	1.77E-03
Mercury	2.86E-01	--	3.07E+02	--	9.34E-04
Zinc	1.99E+02	--	1.00E+05	--	1.99E-03
Semivolatile Organic Compounds					
Benzo(a)anthracene	4.00E-03	2.10E+00	--	1.90E-09	--
Benzo(a)pyrene	5.00E-03	2.10E-01	--	2.38E-08	--
Benzo(b)fluoranthene	1.60E-02	2.11E+00	--	7.58E-09	--
Benzo(e)pyrene[b]	8.00E-03	--	2.91E+04	--	2.75E-07
Chrysene	1.00E-02	1.30E+01	--	7.69E-10	--
Fluoranthene	1.30E-02	--	2.20E+04	--	5.91E-07
Phenanthrene[c]	7.00E-03	--	2.91E+04	--	2.40E-07
Pyrene	2.20E-01	--	2.38E+05	--	9.23E-07
TOTAL				**5.6E-05**	**3.5E-01**

Notes:

a An organic chemical was identified as COPCs if it was detected at least once.

b Pyrene is used as surrogate.

c Anthracene is used as a surrogate

-- Not available or not calculated because a PRG was not available.

ft bgs Feet below ground surface

mg/kg Milligram per kilogram

PRG Preliminary remediation goal

TABLE 6-5

CANCER RISK AND HAZARD INDEX FROM EXPOSURE TO SOIL
COMMERCIAL/INDUSTRIAL WORKER, 0- TO 10-FOOT DEPTH INTERVAL
SITE 22 - BUILDING 7SH5, FUTURE EXPOSURE SCENARIO
NAVAL WEAPONS STATION SBD CONCORD

Subsurface Soil (0-10 ft bgs) Chemical of Potential Concern	Exposure Point Concentration (mg/kg)	Industrial Soil PRG[a] (mg/kg)		Cancer Risk (unitless)	Hazard Index (unitless)
		Cancer	Noncancer		
Metals					
Arsenic	3.92E+01	1.59E+00	2.56E+02	2.46E-05	1.53E-01
Beryllium	7.40E-01	2.20E+03	1.94E+03	3.36E-10	3.81E-04
Copper	7.06E+01	--	4.09E+04	--	1.73E-03
Mercury	3.36E-01	--	3.07E+02	--	1.09E-03
Zinc	1.39E+02	--	1.00E+05	--	1.39E-03
Volatile Organic Compounds					
Chloromethane	2.00E-03	2.65E+00	--	7.56E-10	--
Xylene (Total)	1.10E+01	--	4.20E+02	--	2.62E-02
Semivolatile Organic Compounds					
2-Methylnaphthalene[b]	1.09E+00	--	1.90E+02	--	5.72E-03
Benzo(a)anthracene	4.00E-03	2.10E+00	--	1.90E-09	--
Benzo(a)pyrene	5.00E-03	2.10E-01	--	2.38E-08	--
Benzo(b)fluoranthene	1.60E-02	2.11E+00	--	7.58E-09	--
Benzo(e)pyrene[c]	8.00E-03	--	2.91E+04	--	2.75E-07
Chrysene	1.00E-02	1.30E+01	--	7.69E-10	--
Fluoranthene	2.35E-01	--	2.20E+04	--	1.07E-05
Naphthalene	3.62E-01	--	1.90E+02	--	1.90E-03
Phenanthrene[d]	7.00E-03	--	2.38E+05	--	2.94E-08
Phenol	1.20E+00	--	1.00E+05	--	1.20E-05
Pyrene	2.20E-01	--	2.91E+04	--	7.55E-06
TOTAL				**2.5E-05**	**1.9E-01**

Notes:

a U.S. Environmental Protection Agency (EPA) Region IX PRGs (EPA 2002a).
b Naphthalene is used as surrogate.
c Pyrene is used as surrogate.
d Anthracene is used a surrogate

-- Not available or not calculated because a PRG was not available.
mg/kg Milligram per kilogram
PRG Preliminary remediation goal

TABLE 6-6

**CANCER RISK AND HAZARD INDEX FROM EXPOSURE TO SOIL
RESIDENT, 0- TO 10-FOOT DEPTH INTERVAL
SITE 22 - BUILDING 7SH5, FUTURE EXPOSURE SCENARIO
NAVAL WEAPONS STATION SBD CONCORD**

Subsurface Soil (0-10 ft bgs) Chemical of Potential Concern	**Exposure Point Concentration (mg/kg)**	**Residential Soil PRG[a] (mg/kg)**		**Cancer Risk (unitless)**	**Hazard Index (unitless)**
		Cancer	**Noncancer**		
Metals					
Arsenic	3.92E+01	3.90E-01	2.20E+01	1.00E-04	1.78E+00
Beryllium	7.40E-01	1.10E+03	1.50E+02	6.73E-10	4.93E-03
Copper	7.06E+01	--	3.13E+03	--	2.26E-02
Mercury	3.36E-01	--	2.30E+01	--	1.46E-02
Zinc	1.39E+02	--	2.30E+04	--	6.06E-03
Volatile Organic Compounds					
Chloromethane	2.00E-03	1.23E+00	--	1.63E-09	--
Xylene (Total)	1.10E+01	--	2.70E+02	--	4.07E-02
Semivolatile Organic Compounds					
2-Methylnaphthalene[b]	1.09E+00	--	5.60E+01	--	1.94E-02
Benzo(a)anthracene	4.00E-03	6.20E-01	--	6.45E-09	--
Benzo(a)pyrene	5.00E-03	6.20E-02	--	8.06E-08	--
Benzo(b)fluoranthene	1.60E-02	6.20E-01	--	2.58E-08	--
Benzo(e)pyrene[c]	8.00E-03	--	2.30E+03	--	3.48E-06
Chrysene	1.00E-02	3.80E+00	--	2.63E-09	--
Fluoranthene	2.35E-01	--	2.30E+03	--	1.02E-04
Naphthalene	3.62E-01	--	5.60E+01	--	6.46E-03
Phenanthrene[d]	7.00E-03	--	2.19E+04	--	3.20E-07
Phenol	1.20E+00	--	3.70E+04	--	3.24E-05
Pyrene	2.20E-01	--	2.30E+03	--	9.57E-05
TOTAL				**1.0E-04**	**1.9E+00**

Notes:

a U.S. Environmental Protection Agency (EPA) Region IX PRGs (EPA 2002a).
b Naphthalene is used as surrogate.
c Pyrene is used as surrogate.
d Anthracene is used a surrogate

-- Not available or not calculated because a PRG was not available.
mg/kg Milligram per kilogram
PRG Preliminary remediation goal

TABLE 6-7

CANCER RISK AND HAZARD INDEX FROM EXPOSURE TO SOIL
RESIDENT, 0- TO 0.5-FOOT DEPTH INTERVAL
SITE 22 - BUILDING 7SH5, FUTURE EXPOSURE SCENARIO
NAVAL WEAPONS STATION SBD CONCORD

Subsurface Soil (0-10 ft bgs) Chemical of Potential Concern	Exposure Point Concentration (mg/kg)	Residential Soil PRG[a] (mg/kg)		Cancer Risk (unitless)	Hazard Index (unitless)
		Cancer	Noncancer		
Metals					
Arsenic	8.88E+01	3.90E-01	2.20E+01	2.28E-04	4.03E+00
Copper	7.25E+01	--	3.13E+03	--	2.32E-02
Mercury	2.86E-01	--	2.30E+01	--	1.24E-02
Zinc	1.99E+02	--	2.30E+04	--	8.65E-03
Semivolatile Organic Compounds					
Benzo(a)anthracene	4.00E-03	6.20E-01	--	6.45E-09	--
Benzo(a)pyrene	5.00E-03	6.20E-02	--	8.06E-08	--
Benzo(b)fluoranthene	1.60E-02	6.20E-01	--	2.58E-08	--
Benzo(e)pyrene[b]	8.00E-03	--	2.30E+03	--	3.48E-06
Chrysene	1.00E-02	3.80E+00	--	2.63E-09	--
Fluoranthene	1.30E-02	--	2.30E+03	--	5.65E-06
Phenanthrene[c]	7.00E-03	--	2.30E+03	--	3.04E-06
Pyrene	2.20E-01	--	2.19E+04	--	1.00E-05
TOTAL				**2.3E-04**	**4.1E+00**

Notes:

a U.S. Environmental Protection Agency (EPA) Region IX PRGs (EPA 2002a).
b Naphthalene is used as surrogate.
c Pyrene is used as surrogate.
d Anthracene is used a surrogate

-- Not available or not calculated because a PRG was not available.
mg/kg Milligram per kilogram
PRG Preliminary remediation goal

TABLE 6-8

CANCER RISK AND NONCANCER HAZARD ASSOCIATED WITH ARSENIC IN SOILS DIRECTLY SURROUNDING BUILDING 7SH5
SITE 22 - BUILDING 7SH5
NAVAL WEAPONS STATION SBD CONCORD

Surface Soil (0-0.5 ft bgs)	**Subsurface Soil (0-10 ft bgs)**	**Groundwater**		**Building 7SH5-Specific Soils[b]**	
		Cancer Risk	**Noncancer Hazard Index**	**Cancer Risk**	**Noncancer Hazard Index**
Surface soil	Current industrial	5.58E-05	3.51E-01	1.60E-05	0.1
	Future residential	2.28E-04	4.08E+00	6.70E-05	1.2
Subsurface soil	Future industrial	2.47E-05	1.91E-01	9.10E-06	0.06
	Future Residential	1.01E-04	1.89E+00	3.70E-05	0.7

Notes:

a All COPCs; arsenic contributes to over 99% of the total cancer risks and noncancer hazard indices shown.

b Arsenic only.

TABLE 6-9

COMPARISON OF GROUNDWATER CONCENTRATIONS TO RISK-BASED SCREENING LEVELS
SITE 22 - BUILDING 7SH5
NAVAL WEAPONS STATION SBD CONCORD

Subsurface Soil (0-10 ft bgs)	Exposure Point Concentration (EPC) (µg/L)	RWQCB RBSL[a] (ug/L)		EPA Region IX Tap Water PRG (µg/L)	EPC Exceeds RBSL?	EPC Exceeds RBSL?	EPC Exceeds PRG[d]?
		Drinking water resource[b]	Non-drinking water resource[c]		Drinking water resource	Non-drinking water resource	
Volatile Organic Compounds							
1,1,1-Trichloroethane	1.0	62	62	3,172	No	No	No
Trichloroethene	3.0	5	360	0.028	No	No	Yes
Semivolatile Organic Compounds							
Bis(2-ethylhexyl)phthalate	16.1	12	32	4.8	Yes	No	Yes

Notes:

a RBSLs from Tables A and B in RWQCB (2001).
b RBSLs shown are assume groundwater is a drinking water resource, and are intended to be protective of drinking water resources, surface water quality, indoor air impacts, and nuisance concerns.
c RBSLs shown are assume groundwater is not a drinking water resource, and intended to be protective of surface water quality, indoor air impacts, and nuisance concerns.
d U.S. Environmental Protection Agency (EPA) Region IX PRGs (EPA 2002a).

EPC Exposure point concentration
µg/L Micrograms per liter
PRG Preliminary Remediation Goal
RBSL Risk-based screening level
RWQCB California Regional Water Quality Control Board

TABLE 7-1

SUMMARY OF LITERATURE-DERIVED BIOACCUMULATION FACTORS
SITE 22
NAVAL WEAPONS STATION SBD CONCORD

Analyte	Soil/Plant BAF (mg dry tissue/ kg dry soil or sediment)[a]	Soil/Invertebrate BAF (mg wet tissue/ kg dry soil)[a]	Soil/Deer Mouse BAF (mg wet tissue/kg dry soil or sediment)[a,b]
Aluminum	0.004	0.22[c]	6.5×10^{-6} [c]
Antimony	0.2	0.22[c]	1.44×10^{-6}
Arsenic	0.036	0.11	2.88×10^{-6}
Barium	0.15	0.22[c]	2.16×10^{-7}
Beryllium	0.01	0.22[c]	1.44×10^{-6}
Cadmium	0.364	0.96	1.73×10^{-7}
Chromium	0.0075	0.01	7.91×10^{-6} [f]
Cobalt	0.12[h]	0.22[c]	6.5×10^{-6} [c]
Copper	0.40	0.04	6.5×10^{-6} [c]
Lead	0.045	0.03	4.32×10^{-7}
Manganese	0.12[h]	0.22[c]	6.5×10^{-6} [c]
Mercury	0.0375 ($MeCl_2$)	0.04 ($MeCl_2$)	7.52×10^{-6} ($MeCl_2$)
Molybdenum	0	0	0
Nickel	0.032	0.02	8.63×10^{-6}
Silver	0.40	0.22[c]	4.32×10^{-6}
Thallium	0.004	0.22[c]	5.75×10^{-5}
Vanadium	0.12[h]	0.22[c]	6.5×10^{-6} [c]
Zinc	1.2×10^{-12}	0.56	1.29×10^{-7}
Benzo(b)fluoranthene	0.0101	0.07	5.75×10^{-5}
Benzo(e)pyrene	0.0111[e]	0.07[e]	4.86×10^{-5}[e]
Chrysene	0.0187	0.04	1.99×10^{-5}
Phenol	0.0449[i]	1,034[i]	4.34×10^{-6}[i]
LMW PAHs	0.32[d]	6.00[d]	6.00[d]
HMW PAHs	0.0111 [e]	0.07[e]	4.86×10^{-5}[e]
Fluoranthene	0.0111 [e]	0.07[e]	4.86×10^{-5}[e]
Phenanthrene	0.32[d]	6.00[d]	6.00[d]
Pyrene	0.0111 [e]	0.07[e]	4.86×10^{-5}[e]
2-Methylnaphthalene	0.32[d]	6.00[d]	6.00[d]
Naphthalene	0.32[d]	6.00[d]	6.00[d]
Benzo(a)anthracene	0.0202	0.03	1.72×10^{-5}
Benzo(a)pyrene	0.0111 [e]	0.07[e]	4.86×10^{-5}[e]

TABLE 7-1 (Continued)

SUMMARY OF LITERATURE-DERIVED BIOACCUMULATION FACTORS
SITE 22
NAVAL WEAPONS STATION SBD CONCORD

Notes:

a	BAFs obtained from EPA (1999) unless otherwise noted.
b	BAFs based on exposure of deer mouse to ingested soil from EPA (1999).
c	An empirical BAF for this compound was not available. As described in EPA (1999), the recommended BAF is the arithmetic mean of the recommended values for those inorganics with empirical data available (arsenic, cadmium, chromium, copper, lead, inorganic mercury, nickel, and zinc).
d	BAFs for LMW PAHs for both invertebrates and small rodents were based on the recommended BAF for phenanthrene (EPA 1998). For plants, the BAF for LMW PAH was based on the following empirical equation used to calculate recommended BAFs for PAHs: log BAF = 1.588 – 0.578*log K_{ow} (EPA 1999), using the K_{ow} value for naphthalene.
e	BAFs for HMW PAHs were based on the recommended BAF for benzo(a)pyrene (EPA 1999).
f	Based on recommended BAF for hexavalent chromium (EPA 1999).
h	An empirical BAF for this compound was not available. As described in EPA (1999), the recommended BAF is the arithmetic mean of the recommended values for those inorganics with empirical data available (aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, copper, lead, nickel, selenium, silver, thallium, and zinc).
i	Based on recommended BAF for pentachlorophenol (EPA 1999)

BAF	Bioaccumulation factor
DDT	Dichlorodiphenyltrichloroethane
DDE	Dichlorodiphenyltrichloroethene
EPA	U.S. Environmental Protection Agency
HMW	High molecular weight
K_{ow}	Octanol-water partition coefficient
kg	Kilograms
LMW	Low molecular weight
$MeCl_2$	Methyl chloride
MeHg	Methyl mercury
mg	Milligrams
NA	Not available
PAH	Polynuclear aromatic hydrocarbon
PCB	Polychlorinated biphenyl

APPENDIX A

AERIAL PHOTOGRAPHS FOR SITE 22

Photograph taken in 1939

Scale: 1" = 555'

⬭ Approximate location of Site 22

TETRA TECH
EM INC.

APPENDIX A
SITE PHOTOGRAPHS

Site 22 (Approximate Location)
Naval Weapons Station SBD Concord
Concord, California

GSA.029.00009

Appendix A Photos (9)

These detailed station aerial photographs have been deleted from the Internet-accessible version of this document as per Department of the Navy Internet security regulations.

APPENDIX B

ESTIMATION OF BACKGROUND METAL CONCENTRATIONS IN THE INLAND AREA SOILS

Note: This background study was conducted as part of the 1997 Remedial Investigaiton for Sites 13, 17, 22, 24A, and 27 (TtEMI 1997). Background metals in soil were established for the site in consultation with the regulatory agencies.

CONTENTS

1.0 INTRODUCTION

This technical memorandum, prepared by PRC Environmental Management, Inc. (PRC), presents the approach for estimating background metal concentration limits in the Inland Area soils at Naval Weapons Station (WPNSTA) Concord, California (Figure 1). The estimated background concentration limits are intended for use in the baseline human health risk assessment, ecological risk assessment, and remedial investigation (RI) of WPNSTA Concord Installation Restoration Program sites.

The purpose of estimating background concentrations is to have a basis to assess whether the detection of a constituent indicates site-related contamination or may be attributed to naturally occurring or non-site-related anthropogenic sources. To evaluate the effects of site activities on the environment, constituent concentrations detected at a site are typically compared to the background concentrations, and the difference between the detected concentrations and background concentrations is assumed to be the impact of site activities.

Background metal levels were determined by collecting soil samples from each site, in areas considered unaffected by Navy operations or other industrial activities. The estimated background levels of metals in soils will be used to identify contaminants of potential concern at the sites.

This report is organized into the following sections. Section 2.0 discusses the conceptual model that summarizes the Inland Area geology and describes the rationale for using two separate groups of sites in determining metal background levels. Section 3.0 describes background sampling in the Inland Area sites. Section 4.0 explains the statistical procedures that were used to estimate background concentration levels of metals in soil. The results of the estimation are summarized in Section 5.0 and Tables 1 and 2.

2.0 CONCEPTUAL MODEL

The conceptual model developed for this task is a generalized representation of soil conditions based on published materials and the examination of boring logs from the Inland Area sites. Additionally, this model is used to substantiate the evaluation of the metals background levels for two different groups of sites.

WPNSTA Concord is the major naval transshipment facility on the west coast and is located in the north-central portion of Contra Costa County, California, approximately 30 miles from San Francisco. The facility, which encompasses approximately 13,000 acres, is bounded by Suisun Bay to the north and by the city of Concord to the south and west (Figure 1). Currently, the facility contains three main separate holdings: the Tidal Area, the Inland Area, and a radiography facility in Pittsburg, California. The Inland Area, which is separated from the Tidal Area by a range of hills not owned by the Navy, encompasses approximately 6,200 acres.

The regional geologic features include several north-trending fault systems that divide Contra Costa County into large blocks of rocks. Up-thrown blocks form the hills and down-thrown blocks form broad lowlands floored with thick, unconsolidated, Pleistocene-age deposits eroded from the up-thrown blocks.

The geology of the Inland Area is shown in Figure 2. Consolidated Tertiary rock formations are exposed along the eastern edge of the Inland Area in the Los Medanos Hills (Dibblee 1981). These rock formations are composed of interbedded units of sandstone, siltstone, and shale. The adjacent low-lying flatlands are covered by a veneer of younger Quaternary alluvium overlying basement rocks at depth. Older alluvium outcrops in the middle of the Inland Area in a north plunging anticline. Both younger and older alluvium consist of beds of sandy, silty, and clayey deposits. Silty and clayey deposits appear to predominate.

At the Inland Area sites, the uppermost several feet of soil from top to bottom are composed of coarse-grained sands and gravels grading to silty, sandy clay and to a more cohesive clay at a depth of over 10 feet. From depths of 10 to over 100 feet, the profile is largely undifferentiated sands and gravels interfingered with more than 10-foot-thick layers of silty clays.

Shallow sediments in the Inland Area have either alluvial/estuarine origin or represent materials eroded and deposited in the vicinity of Los Medanos Hills (colluvial deposits). Based on that, two groups of sites were initially identified. First group included Sites 13 and 22; Sites 17 and 24A formed a second group. Site 27, which is likely to be included in the second group of sites, is not discussed in this document because soil samples for metals were not collected for this site. The shallow deposits that underlie the Sites 13 and 22 were formed in the alluvial depositional environment. The shallow deposits underlying the Site 17 and especially Site 24A more likely consist of the erosional remnants of bedrock from adjacent Los Medanos Hills. The soil boring logs did not show a significant difference in lithology between the two groups of sites. However, it was assumed that these two groups of sites would differ because the sediments underlying these sites seem to be composed of different mineralized source materials.

To help to decide whether the evaluation of metals background levels should be performed separately for each group of sites, the soil metals data from all the four Inland Area sites were analyzed. Specifically, the histograms and probability plots of data sets for individual metals were prepared. The data sets contained the analytical results from background sampling locations of the four sites. For this analysis, metals detectable in all soil analyses were used. The concentrations of some metals (particularly, chromium, manganese, and vanadium) displayed two distinct populations: one population corresponded to the data from Sites 17 and 24A, and another population was formed by the data from Sites 13 and 22. The concentrations of lead, nickel, and copper formed less distinct populations, but also corresponded well to the two groups of sites. Figure 3 provides an example on how the two populations of chromium concentrations were depicted by a histogram and a probability plot.

Based on these findings, background levels of metals in soils were estimated using two different data sets: (1) from Sites 13 and 22 and (2) from Sites 17 and 24A. The background sampling and estimation procedures are discussed in Sections 3.0 and 4.0, respectively.

3.0 BACKGROUND SAMPLING

The determination of background metal levels at Site 13 (the Burn Area), Site 22 (Building 7SH5), Site 17 (Building IA-24), and Site 24A (the Pistol Firing Range) began by identifying background sampling locations. The locations were chosen in areas topographically upgradient from each site and not affected by Navy operations or other industrial activities. The areas for background sampling were about 25 feet in width and traversed the length of each site. The locations of soil borings were determined using a stratified random approach. Each background area was divided into four areas of equal size. These areas were further divided into four subareas of equal size, and one of these subareas was randomly selected for sampling.

The locations of the borings for background sampling at each site are shown in Figures 5-8, 6-8, 7-5, 8-3, and 9-3 (TtEMI 1997). Eight borings were performed at Site 13, six borings at Site 22, four borings at Site 17, and four borings at Site 24A. The soil samples from each boring were collected at the 0.5-foot and 10-foot depths. Shallow soil samples were expected to exhibit elevated metal concentrations if compared with deep samples. However, the inspection of the analytical data did not confirm that and the resulting metal data sets used in evaluation were represented by both shallow and deep samples.

It should be noted that Building 7SH5 (Site 22) is situated on a berm, which raises it above the street level about 7 to 10 feet. Two of six borings (7SHSB13 and 7SHSB14) were located on a berm composed of fill material. The soil samples were collected from 1-foot and 8-foot depths. Analysis of boring logs has shown that deeper samples were likely to represent native soil conditions. Since the source of the fill is unknown but is likely to be the same materials that build up surrounding native soils, two surface fill samples remained in the background data set. Additionally, these two samples out of 31 were not expected to have effect on the estimated background levels of metals in soils.

4.0 ESTIMATION METHODOLOGY

Statistical procedures consistent with U.S. Environmental Protection Agency (EPA) and Department of Toxic Substances Control (DTSC) guidance documents (EPA 1989; DTSC 1992, 1994) and current practices in the environmental industry were used to establish background soil concentrations of metals. When defining a reasonable upper level of the background or ambient concentrations for a site, the 95^{th} and 99^{th} percentiles of the distribution were used. For the data sets with greater than 20 values, the 95^{th} and 99^{th} percentiles were calculated using nonparametric formula (Gilbert 1997). The 95^{th} percentile provides a more conservative estimate of the metal background level than the 99^{th} percentile of the distribution. For smaller data sets (that is, with less than 20 data points), the maximum value in a data set was used as an estimate of the metal background level.

A step-by-step approach for estimating background metal concentration limits was formulated as follows:

Step 1. Query the database of RI soil analytical results for all metals except essential nutrients. Account for each nondetected result by substituting a value of one half the reported detection limit.

Step 2. Use probability plots to explore the data and exclude outliers from the metal data sets. Test the distribution of the resulting ambient data sets.

Step 3. To estimate the background levels for data sets greater than 20 and less than 50 values use a nonparametric formula to calculate the 95^{th} percentile and use a maximum concentration to approximate the 99^{th} percentile of the distribution; for data sets less than 20 values, use maximum detected concentration.

The evaluation was performed for all the metals available in the database of RI soil analytical results, excluding metals that are considered essential nutrients for human health (sodium, potassium, calcium, magnesium, and iron). The metal data set for naturally occurring soils at Sites 13 and 22 contained more than 20 concentration values for each metal, and the metal background levels were estimated as the 95^{th} and 99^{th} percentiles of the distribution. The 99^{th} percentile was approximated as a maximum value in the background data set. The data set for naturally occurring soils at Sites 17 and 24A included only 16 concentration values for each metal, and the metal background level was estimated as maximum detected concentration. This estimation was considered reasonable based on observed narrow ranges of the soil metals from Sites 17 and 24A (Table 2).

The following three subsections describe briefly the statistical methods that were used to estimate background concentration limits for soil metals. A more detailed description of specific procedures used in the estimation may be found in the technical memorandum on estimating ambient metal concentrations in soils prepared for Mare Island Naval Shipyard in December 1995 (PRC 1995).

4.1 DATA SET PREPARATION

Before the upper limits of the background metal concentrations could be estimated, most of the data sets required special preparation. Preparation procedures included steps to account for the nondetected results and to perform exploratory data analysis using probability plots and histograms.

The process of estimating background metal concentrations must account for analytical results reported as nondetects. Similar to the treatment of nondetectable results in the risk assessment, a value of one-half the reported detection limit was substituted for each nondetect data point. For several metals, including antimony, beryllium, cadmium, and thallium nondetect results constitute a significant percentage (nearly 50 percent or more) of the data set. For molybdenum, selenium, and silver the entire data set consists of nondetected results (see Tables 1 and 2).

For graphical analysis of soil metal data, the probability plots and histograms were prepared with Geo-EAS geostatistical software (EPA 1991). The probability plot is a graph of the ranked variable values, plotted against their cumulative percentiles. The vertical axis is scaled in units of the variable (metal concentrations), and the horizontal axis is scaled in units of cumulative percent. If the normal probability plot is a straight line, it is evidence of underlying normal distribution. A straight line on a lognormal probability plot (for which the vertical axis is scaled in units of the logarithm of the metal concentrations) suggests that the lognormal distribution is a better model. The histogram provides a more detailed look at a data set, while presenting an overall shape of the data set distribution (that is, whether it is symmetrical or skewed and unimodal or polymodal). Figure 3 is an example of probability plots and histograms.

To evaluate whether it was necessary to transform a specific data set to logarithms to approximate a normal distribution or to aid in visualizing the data, summary statistics, including the mean, standard deviation, coefficient of variation, skewness, and kurtosis were calculated. In particular, the values of skewness and kurtosis were useful indicators of the need for data set transformation. The skewness coefficient sums the deviations from the mean raised to the third power and indicates the asymmetry of the data set distribution. A normal distribution has a skewness coefficient of 0. The kurtosis coefficient sums the deviations from the mean raised to the fourth power and indicates the peakedness of the data set distribution. A normal distribution has a kurtosis coefficient of 3.

The statistical means described above may be less efficient for small data sets, as is the case for a data set from Sites 17 and 24A. The preparation procedures for each metal concentrations data set were completed after excluding anomalously high or low values and testing the distribution as described in Section 4.2.

4.2 EXCLUSION OF OUTLIERS AND NORMALITY TESTING

In performing frequency distribution analysis, a few metal concentrations may be significantly greater or lower than the concentrations of the main population. These outliers can be initially identified on histograms and probability plots but are defined more rigorously as concentrations greater than 3 times the standard deviation from the mean (for normally or lognormally distributed data). The outliers were removed from the data sets to reduce their impact on the estimates of background levels. It should be noted that because the data points considered as anomalously high concentrations may also represent extreme values of actual background concentrations, their exclusion may lead to conservative (that is, low) estimates of ambient limits. The simultaneous exclusion of anomalously low or nondetect values from the data sets may partially compensate for this bias. Tables 1 and 2 provide information on the number of the data points excluded from each metal data set.

Among all the metals evaluated for each group of sites, only arsenic displayed a high variation. In four shallow samples from Site 22 borings 7SHSB13, 7SHSB14, 7SHSB21, and 7SHSB22 (at 0.5-foot and 1-foot depths) and one deep sample from boring 7SHSB22 (at 10.5-foot depth), the extreme arsenic concentrations ranged from 72.3 to 250 mg/kg. These anomalously high values were excluded from background data set as outliers.

After making final adjustments to the background data sets as described previously, a probability plot was prepared for each metal of interest to confirm the effectiveness of the preparation procedures and to proceed with estimation of background limits as described below.

4.3 CALCULATION OF BACKGROUND METAL CONCENTRATION LIMITS

After making final adjustments to the background data sets as described above, a probability plot was prepared for each metal of interest to confirm the effectiveness of the preparation procedures and to proceed with calculation of background limits. The metal data sets for naturally occurring soils at Sites 13 and 22 contained from 23 to 31 concentration values. For these data sets, the metal background levels were estimated as the 95^{th} and 99^{th} percentiles of the distribution (with the 99^{th} percentile approximated as a maximum value in the background data set). The data sets for soils at Sites 17 and 24A included only 14 or 16 concentration values for each metal, and the metal background level was estimated as maximum detected concentration.

A step-by-step procedure to determine the 95th percentile of the distribution is discussed below (Gilbert 1987).

Step 1. Rank the data from minimum to maximum to obtain the sample order statistics:

$$x_1 \leq x_2 \leq \ldots \leq x_l \ldots \leq x_n$$

Step 2. Calculate l:

$$l = p\,(n + 1)$$

Where

p = 0.95

n = number of values in the background data set

Step 3. If the calculated l is an integer, then the 95th percentile is the lth largest datum (among the ranked concentrations) in the data set. If l is not an integer, estimate the 95th percentile by linear interpolation between the two concentrations closest to l.

The 99th percentile is estimated in the same way using $p = 0.99$. For data sets with less than 100 values, however, the calculated l exceeds the largest datum in the data set. Therefore, the 99th percentile is approximated as the maximum value in the data set.

5.0 SUMMARY OF FINDINGS

The background concentration limits in naturally occurring soils of two groups of sites (Sites 13, 22 and Sites 17, 24A) estimated for metals in soils as described in Section 4.0 are presented in Tables 1 and 2.

The tables include EPA Region IX PRGs (EPA 1995) for comparison purposes. The estimated limits for arsenic and beryllium exceeded this criterion, as indicated in the tables by an asterisk.

Probability plots that support the estimations are shown on Figures 4 through 34. The plots include only the data points that remained in the data set after the exclusion of outliers; the number of data points used corresponds to the data set size column shown in Tables 1 and 2. The plots also provide summary statistics including the mean, standard deviation, coefficient of variation, skewness, and kurtosis**.** The population of nondetectable results is indicated on the plots as “ND” where significant. The type of underlying data set distribution (normal, lognormal, and nonparametric) is also noted. For some data sets with nonparametric distribution, the plots are given in logarithmic scale to facilitate their examination.

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FIGURES

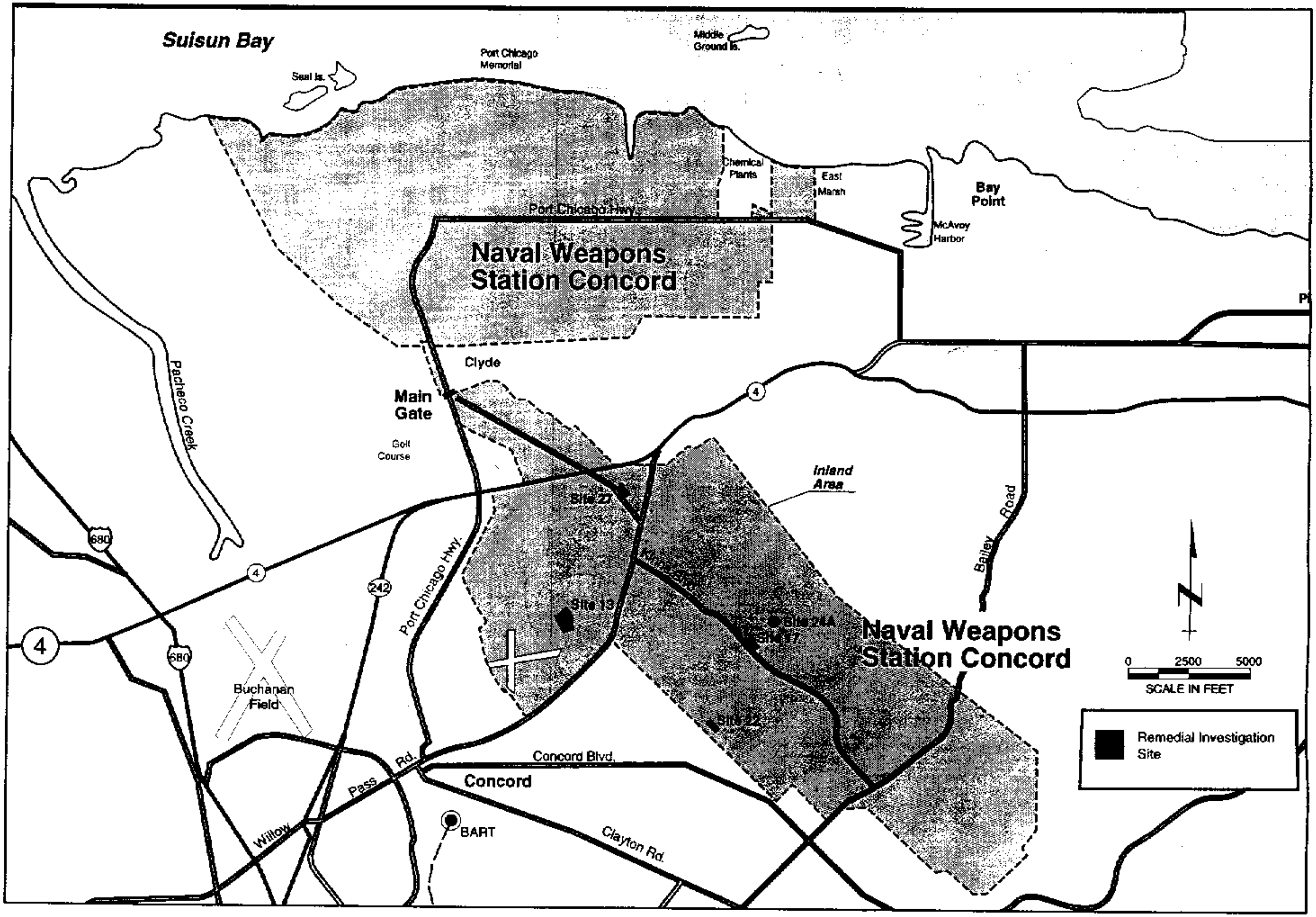
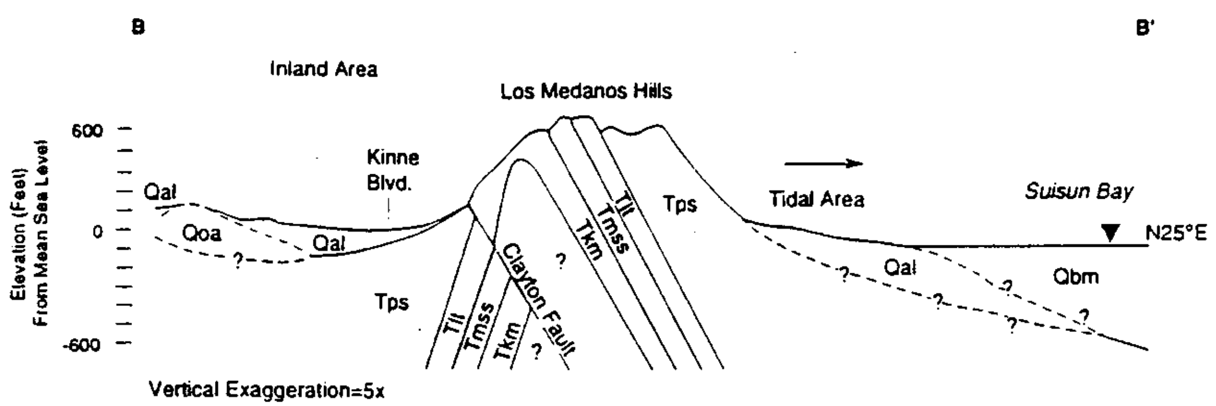
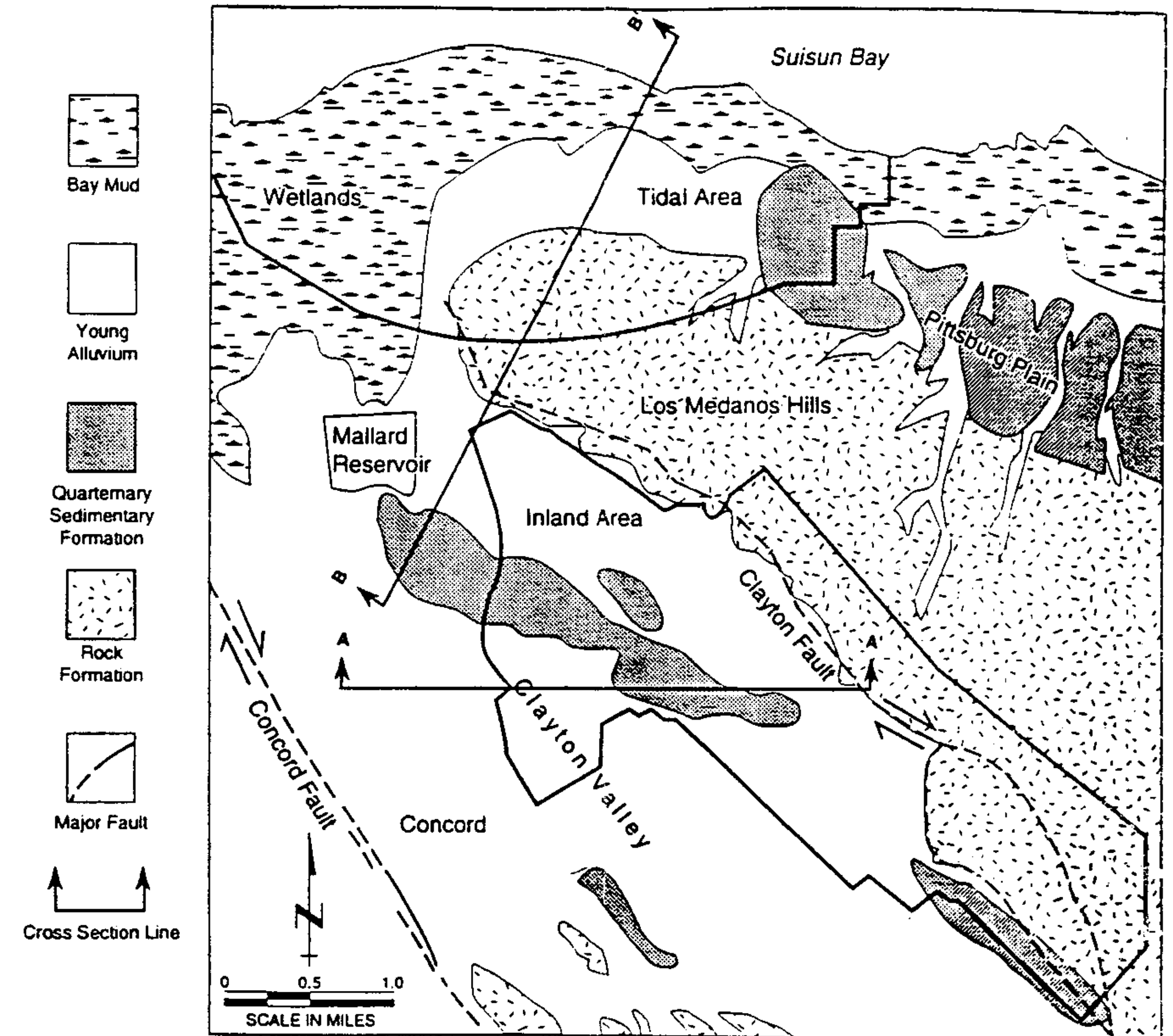


FIGURE 1
INLAND AREA INVESTIGATION SITES
NAVAL WEAPONS STATION CONCORD



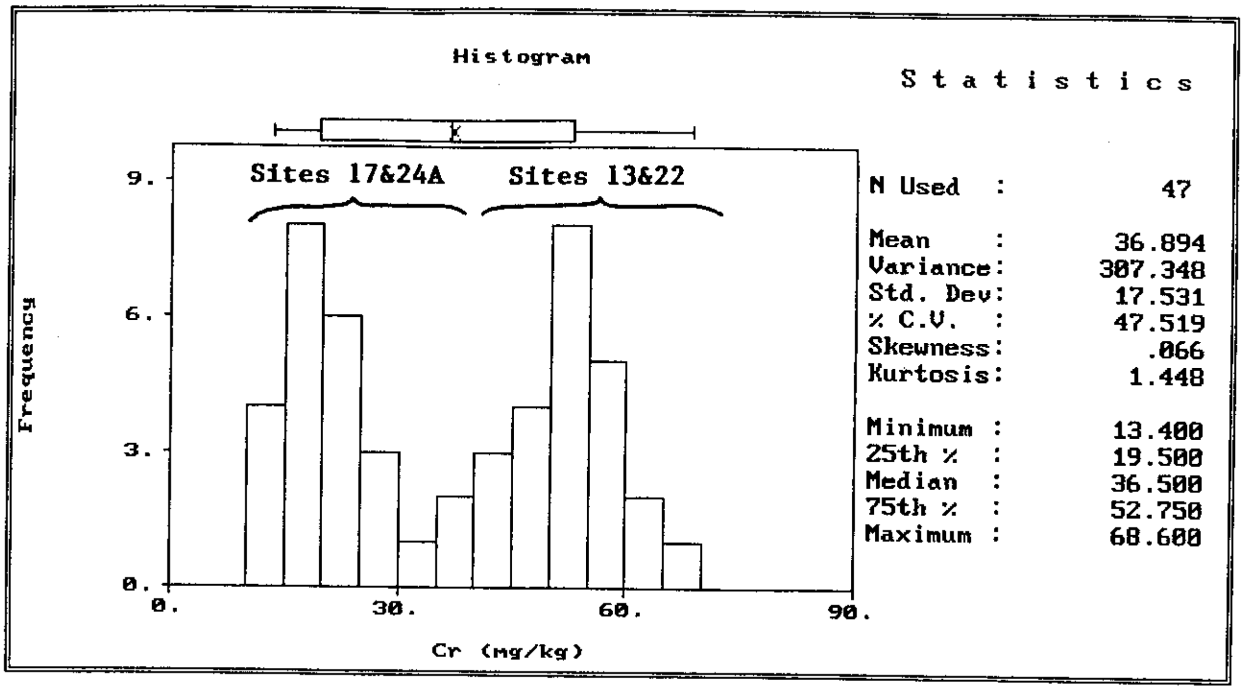
Qbm	Bay Mud
Qal	Young Alluvium
Qoa	Old Alluvium
Tps	Pliocene Nonmarine Sedimentary Rocks
Tlt	Pliocene Pumiceous Tuff Breccias (Lawlor Tuff)
Tmss	Miocene Marine Sandstones
Tkm	Eocene Sandstone-Markley Member of Kreyenhagen Formation

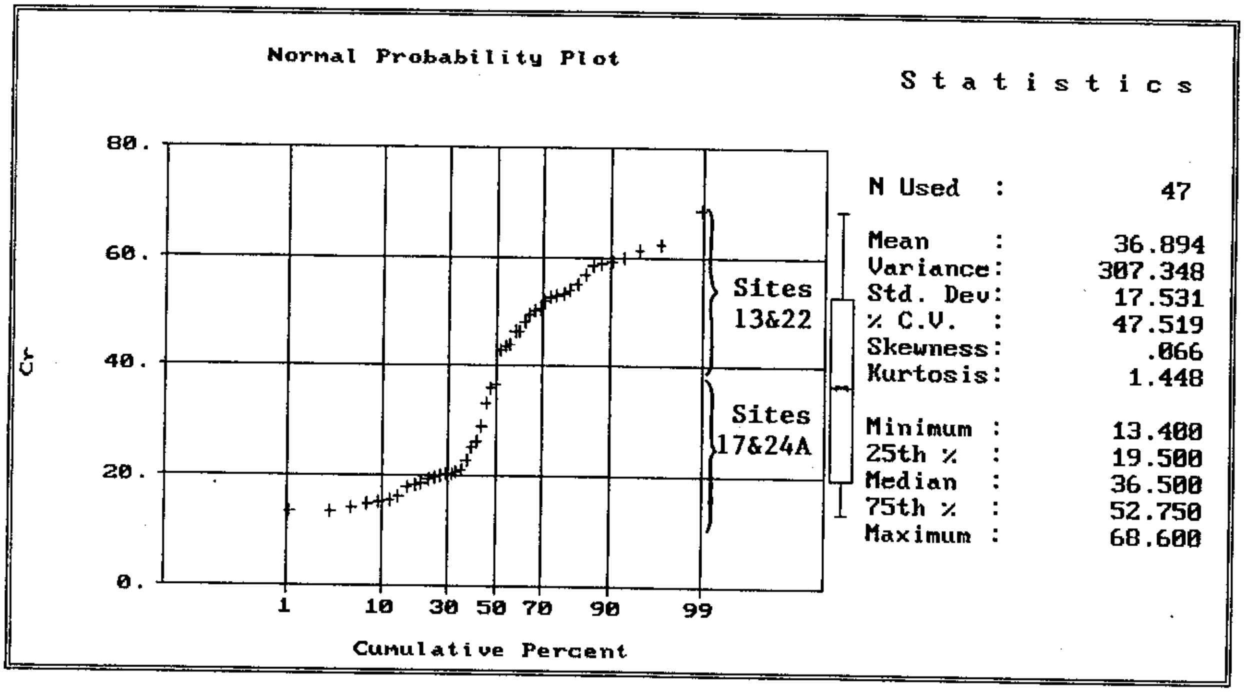
Source: Adapted from DIBBLEE, 1981



Source: LUTTON, et. al., 1987
DIBBLEE, 1980a,b,c, 1981

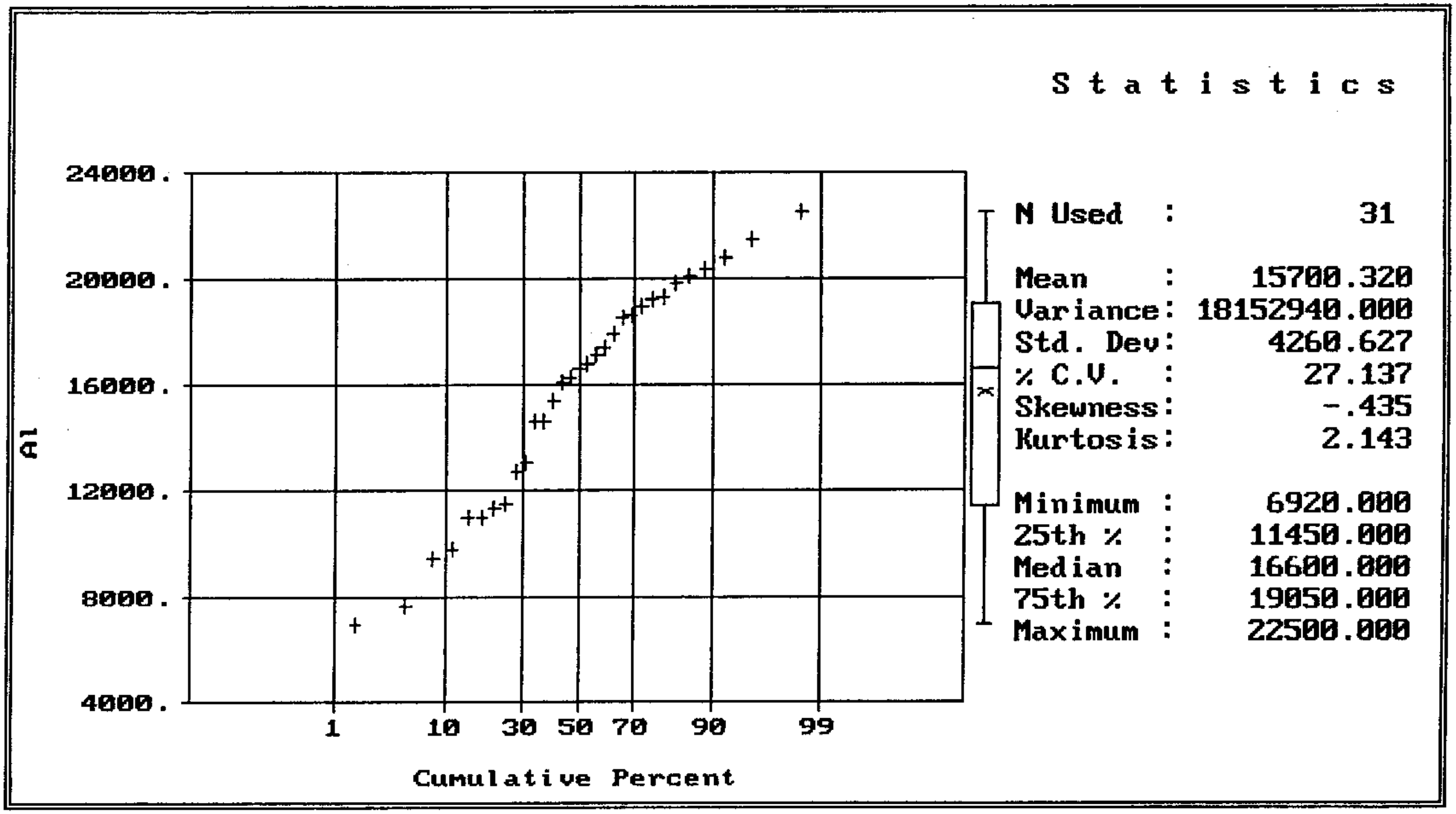
FIGURE 2
GEOLOGIC MAP
NAVAL WEAPONS
STATION CONCORD





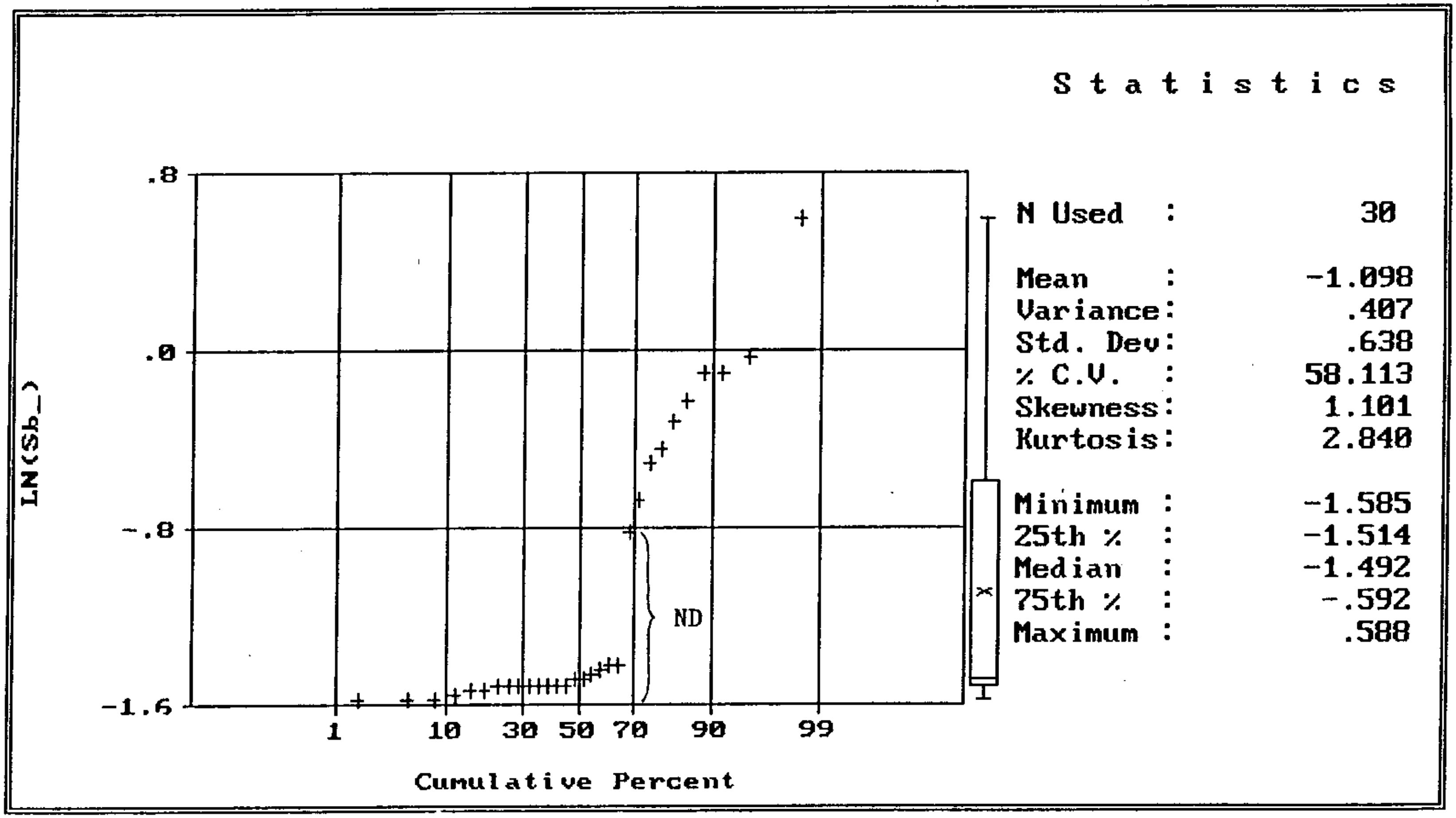
Notes: Both plots illustrate distribution of chromium concentrations in soils of Sites 13, 22, 17, and 24A. Two groups of concentrations, shown with brackets on the plots, indicate the difference between two groups of sites (13 and 22; 17 and 24A).

FIGURE 3
HISTOGRAM AND PROBABILITY PLOT OF CHROMIUM
CONCENTRATIONS IN SOILS OF THE INLAND AREA
SITES 13, 22, 17, AND 24A
NAVAL WEAPONS STATION CONCORD



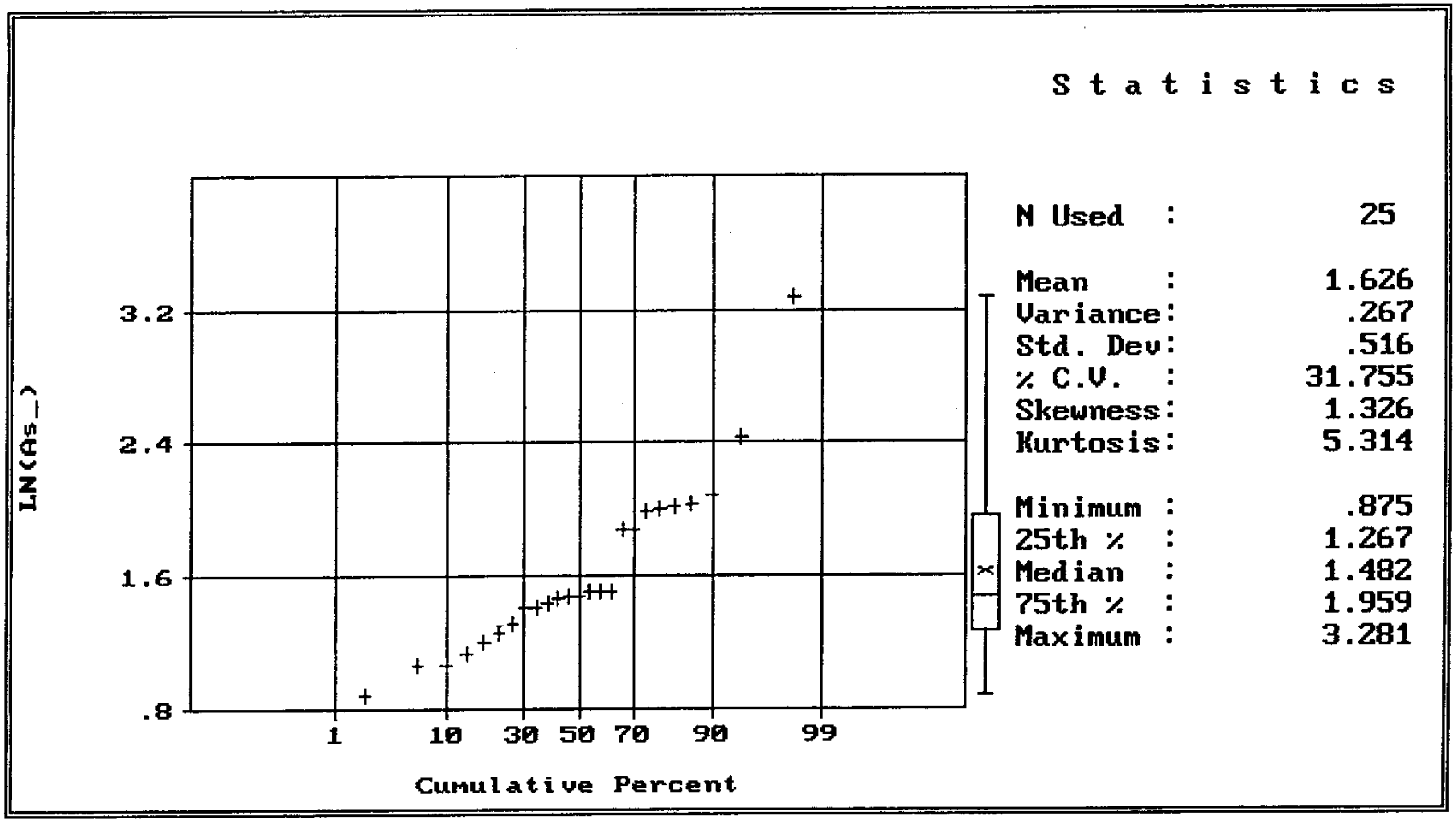
Note: The data set distribution is normal.

FIGURE 4
PROBABILITY PLOT OF BACKGROUND ALUMINUM
CONCENTRATIONS IN SOILS OF THE INLAND AREA
SITES 13 AND 22
NAVAL WEAPONS STATION CONCORD



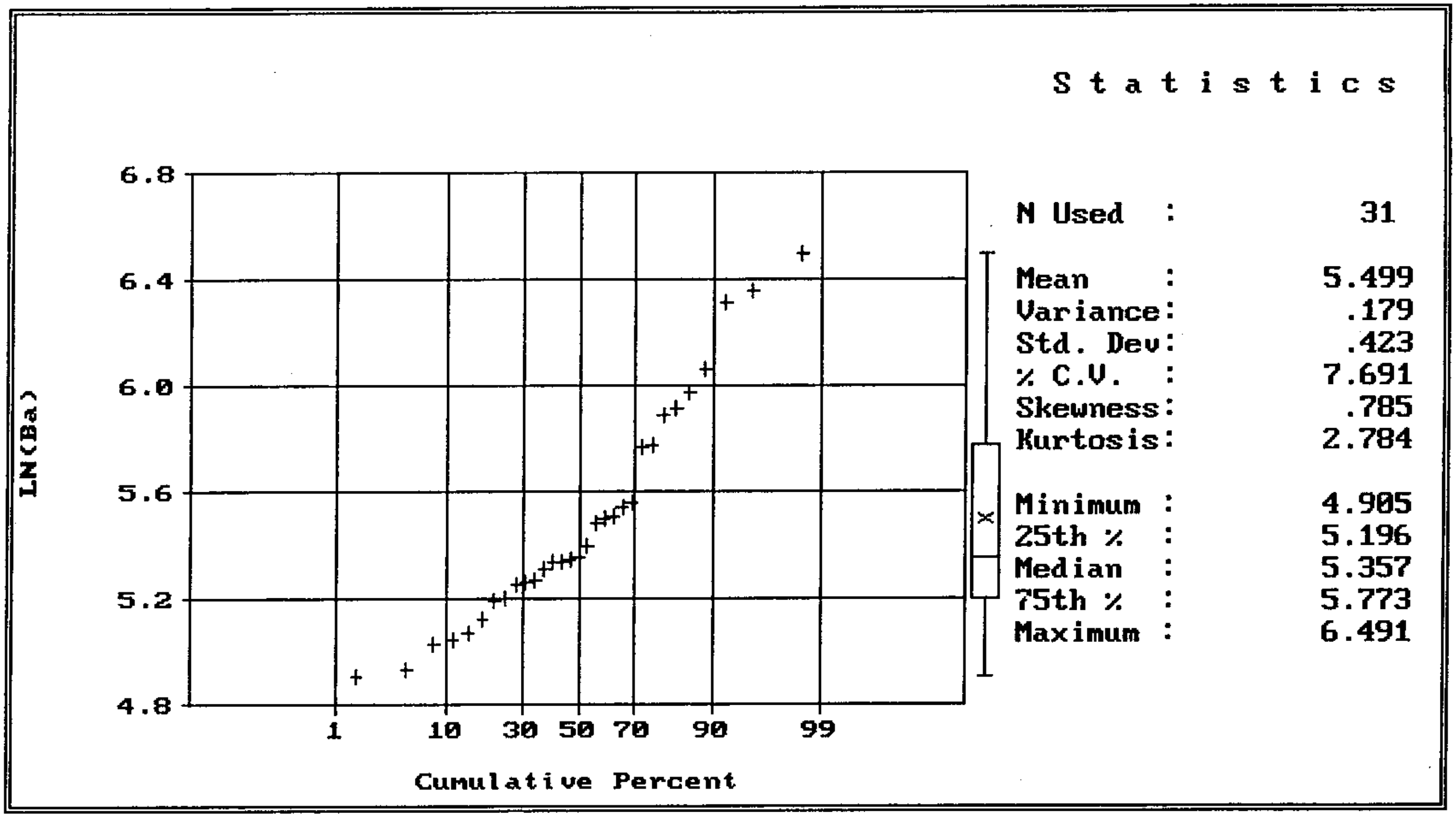
Note: The data set distribution is nonparametric.

FIGURE 5
PROBABILITY PLOT OF BACKGROUND ANTIMONY
CONCENTRATIONS IN SOILS OF THE INLAND AREA
SITES 13 AND 22
NAVAL WEAPONS STATION CONCORD



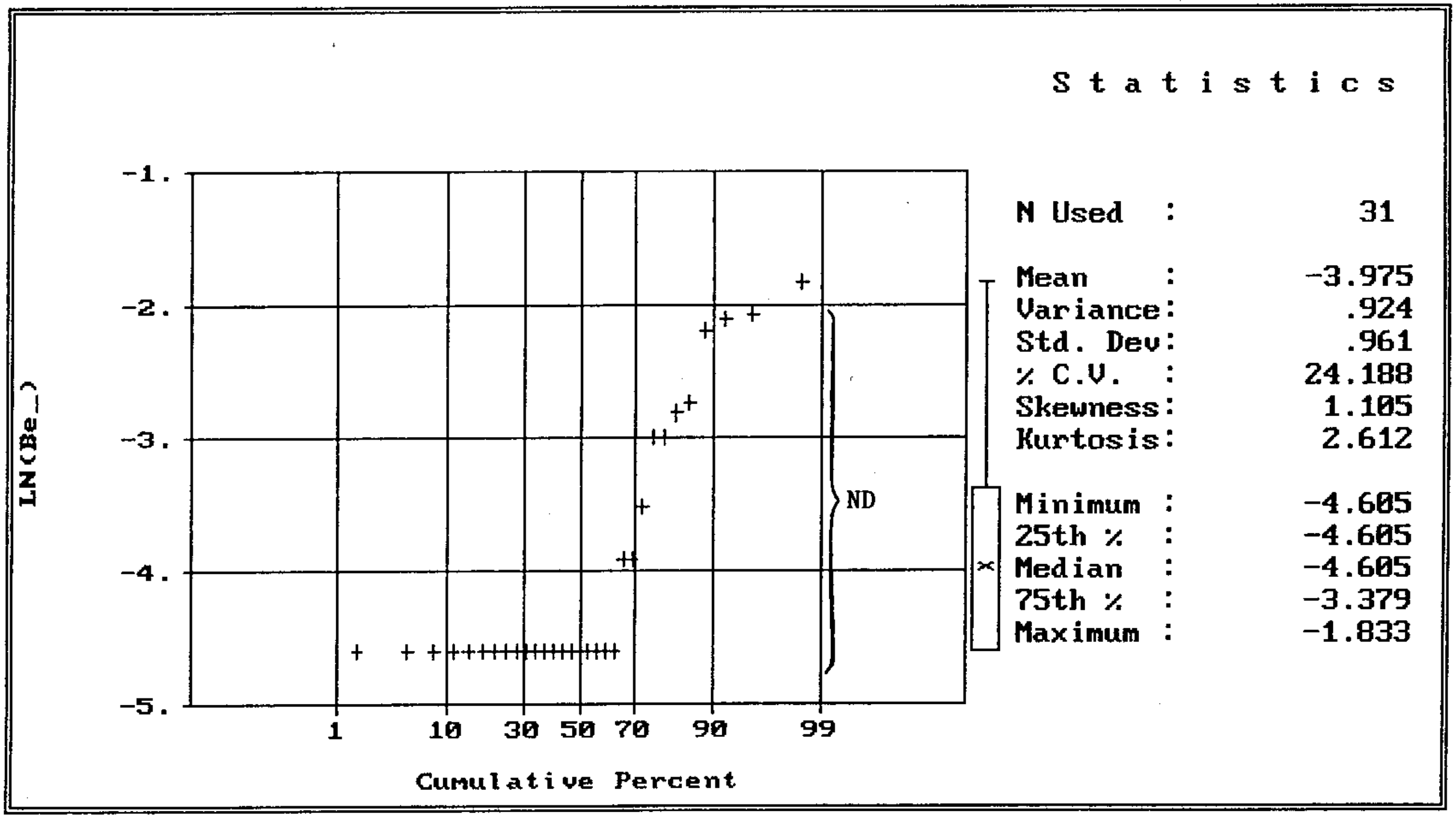
Note: The data set distribution is nonparametric.

FIGURE 6
PROBABILITY PLOT OF BACKGROUND ARSENIC
CONCENTRATIONS IN SOILS OF THE INLAND AREA
SITES 13 AND 22
NAVAL WEAPONS STATION CONCORD



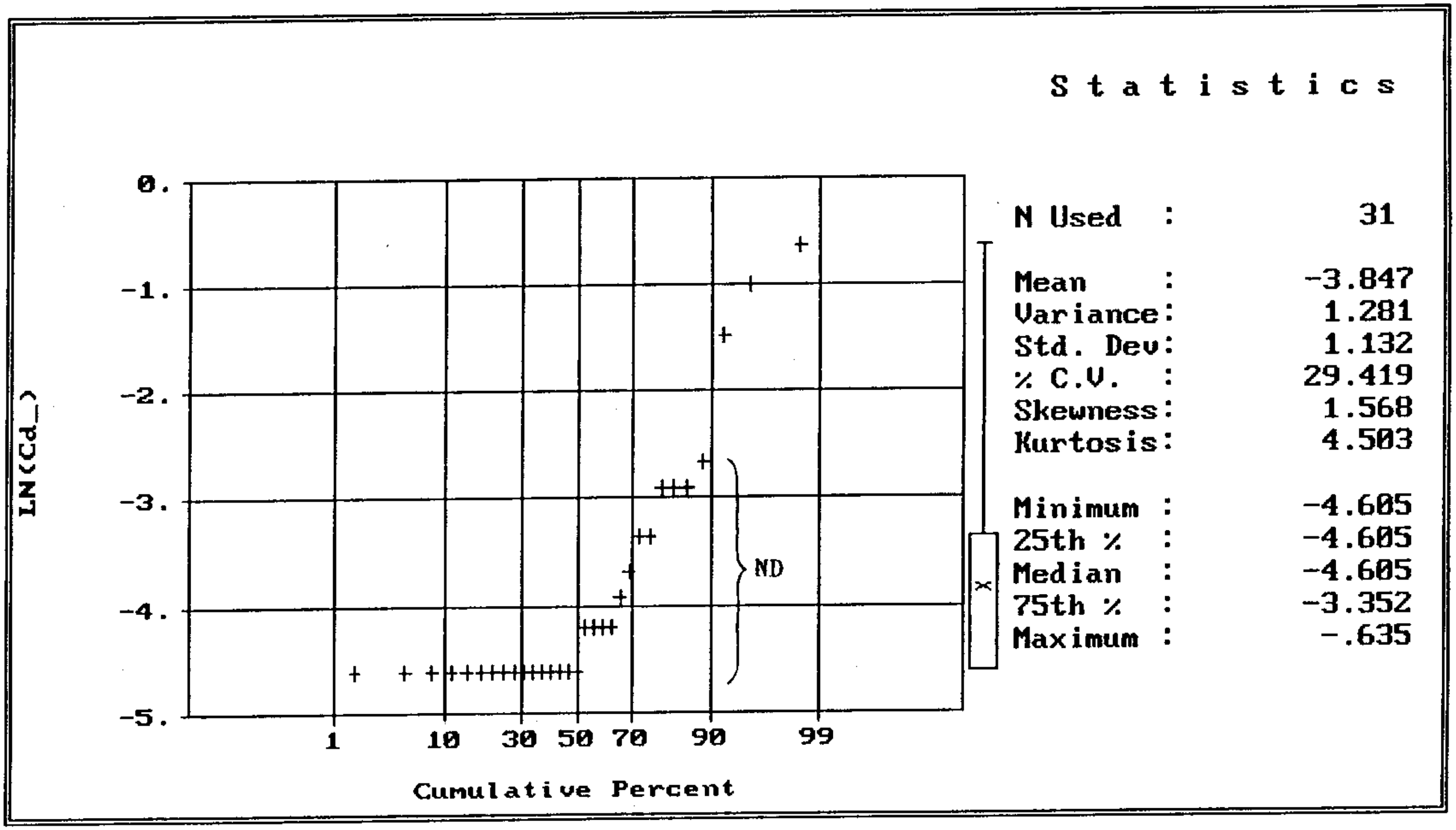
Note: The data set distribution is nonparametric.

FIGURE 7
PROBABILITY PLOT OF BACKGROUND BARIUM
CONCENTRATIONS IN SOILS OF THE INLAND AREA
SITES 13 AND 22
NAVAL WEAPONS STATION CONCORD



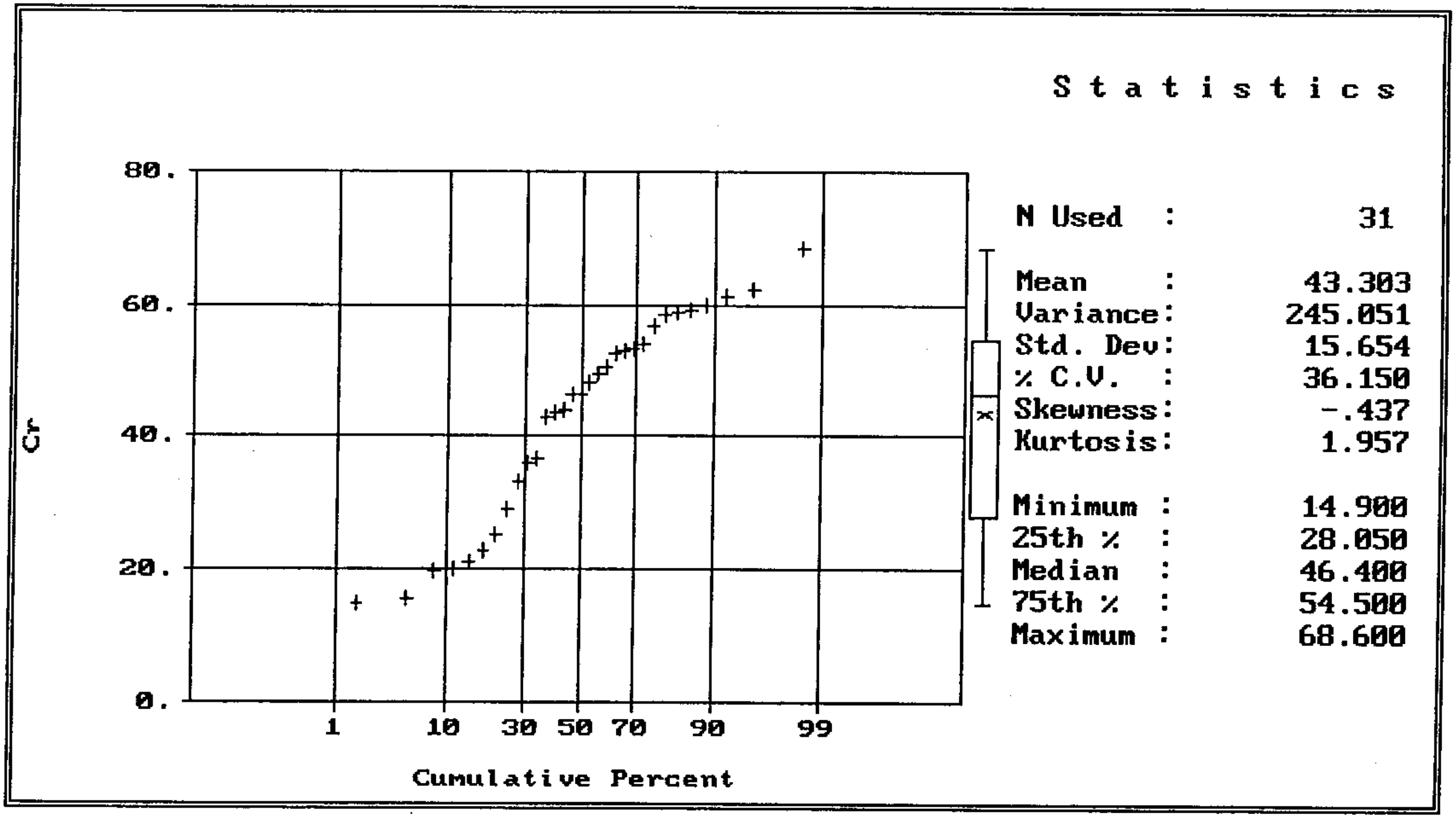
Note: The data set distribution is nonparametric.

FIGURE 8
PROBABILITY PLOT OF BACKGROUND BERYLLIUM
CONCENTRATIONS IN SOILS OF THE INLAND AREA
SITES 13 AND 22
NAVAL WEAPONS STATION CONCORD



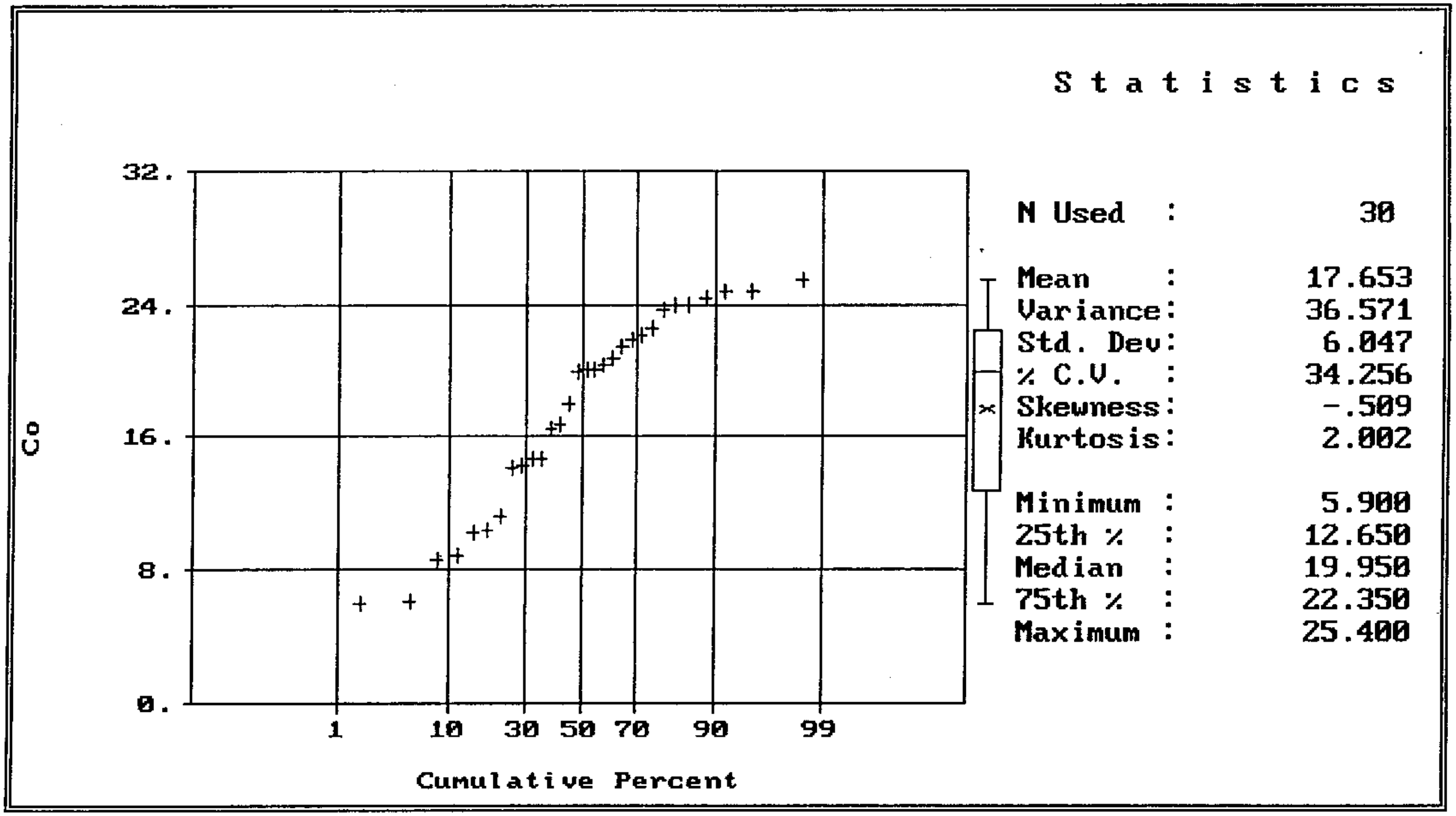
Note: The data set distribution is nonparametric.

FIGURE 9
PROBABILITY PLOT OF BACKGROUND CADMIUM
CONCENTRATIONS IN SOILS OF THE INLAND AREA
SITES 13 AND 22
NAVAL WEAPONS STATION CONCORD



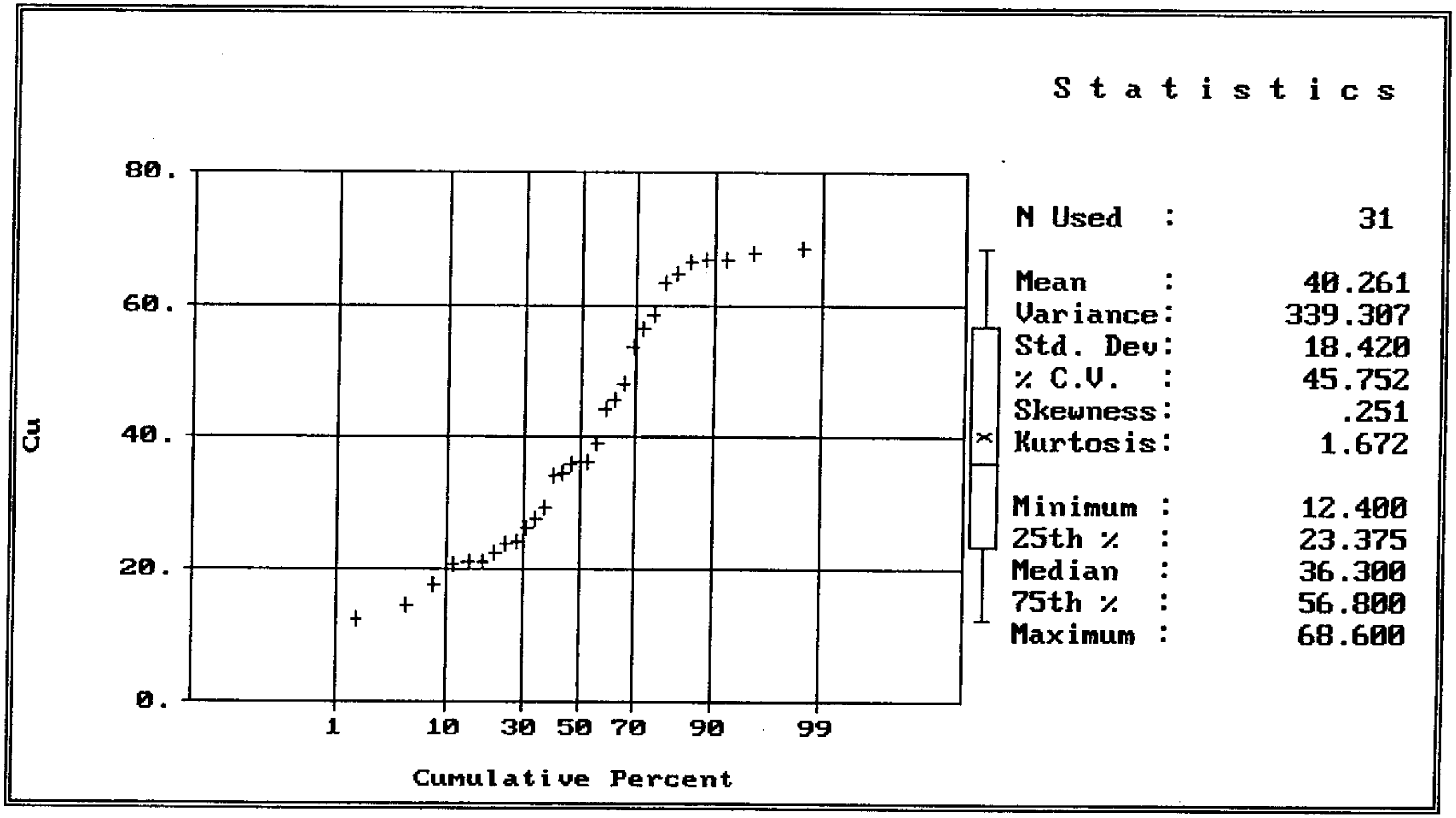
Note: The data set distribution is nonparametric.

FIGURE 10
PROBABILITY PLOT OF BACKGROUND CHROMIUM CONCENTRATIONS IN SOILS OF THE INLAND AREA
SITES 13 AND 22
NAVAL WEAPONS STATION CONCORD



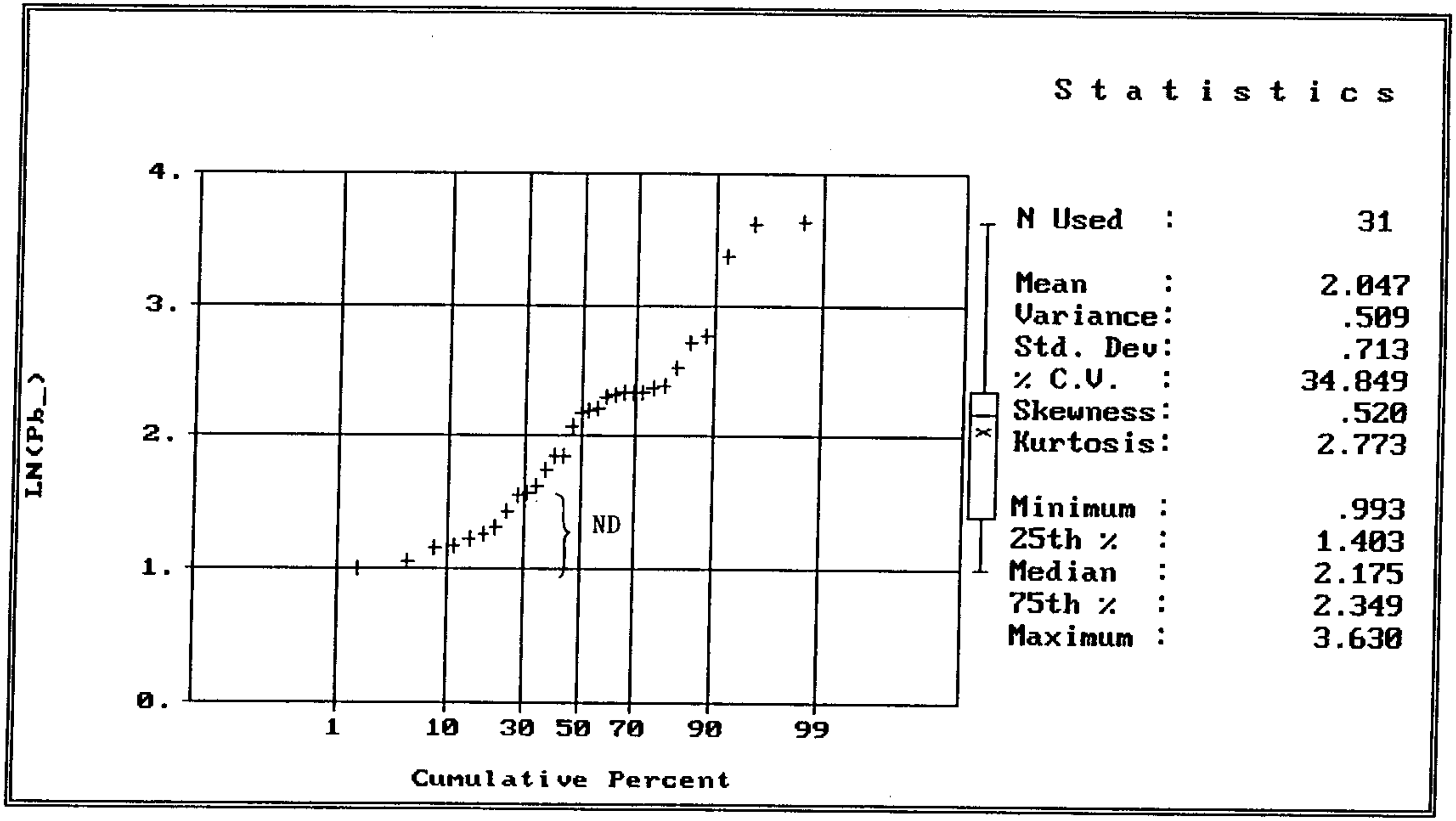
Note: The data set distribution is nonparametric.

FIGURE 11
PROBABILITY PLOT OF BACKGROUND COBALT
CONCENTRATIONS IN SOILS OF THE INLAND AREA
SITES 13 AND 22
NAVAL WEAPONS STATION CONCORD



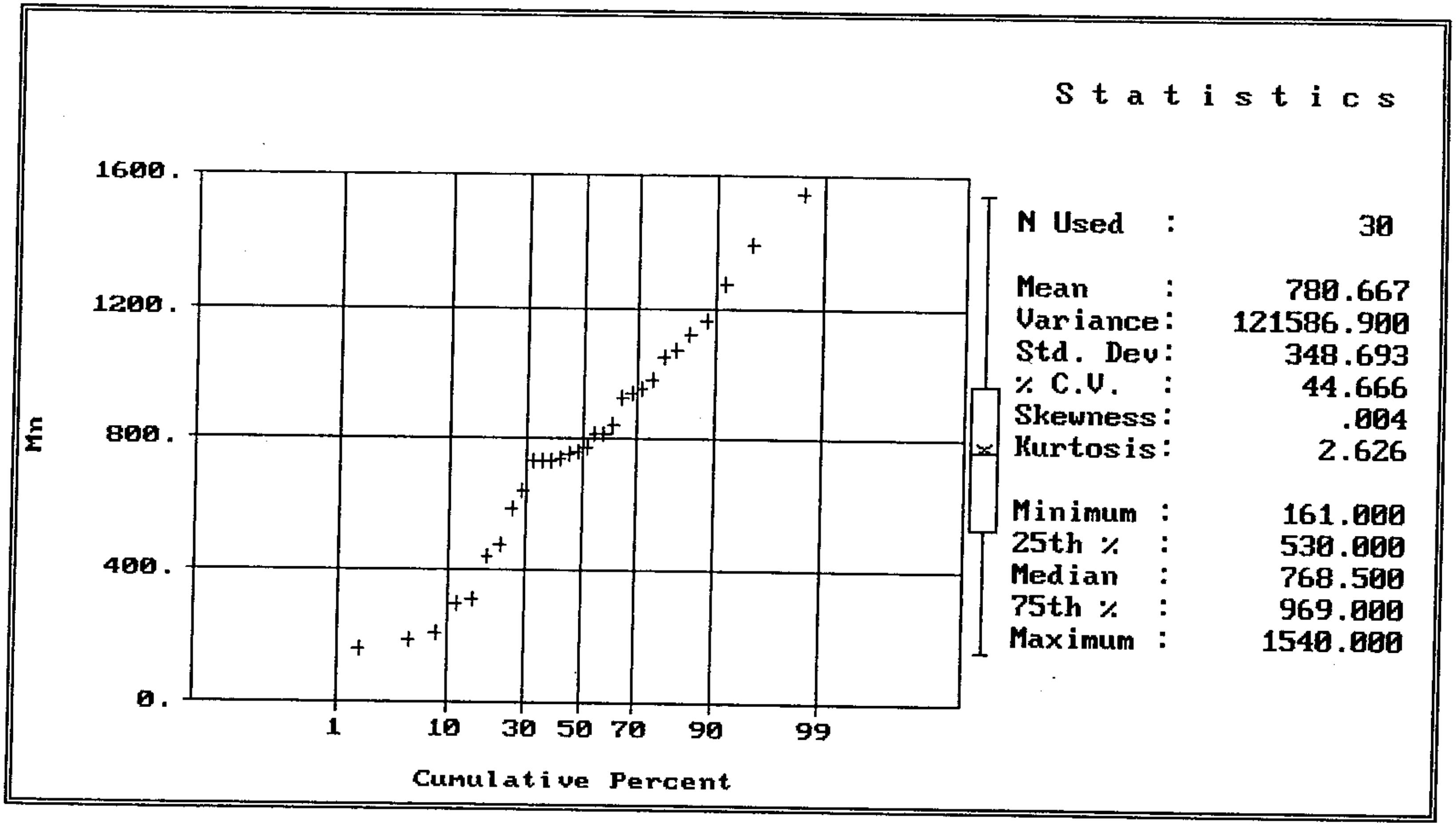
Note: The data set distribution is normal.

FIGURE 12
PROBABILITY PLOT OF BACKGROUND COPPER
CONCENTRATIONS IN SOILS OF THE INLAND AREA
SITES 13 AND 22
NAVAL WEAPONS STATION CONCORD



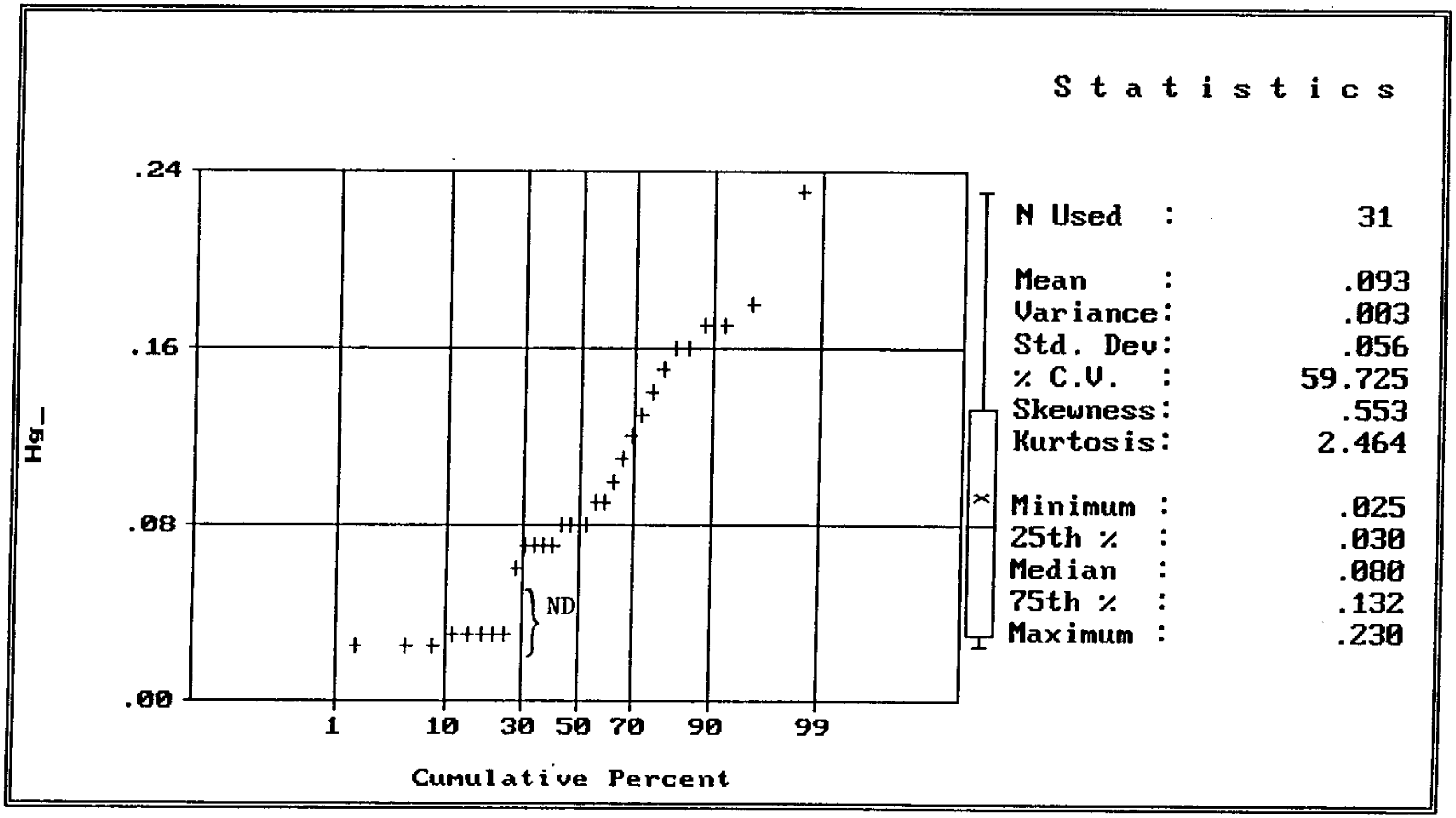
Note: The data set distribution is lognormal.

FIGURE 13
PROBABILITY PLOT OF BACKGROUND LEAD
CONCENTRATIONS IN SOILS OF THE INLAND AREA
SITES 13 AND 22
NAVAL WEAPONS STATION CONCORD



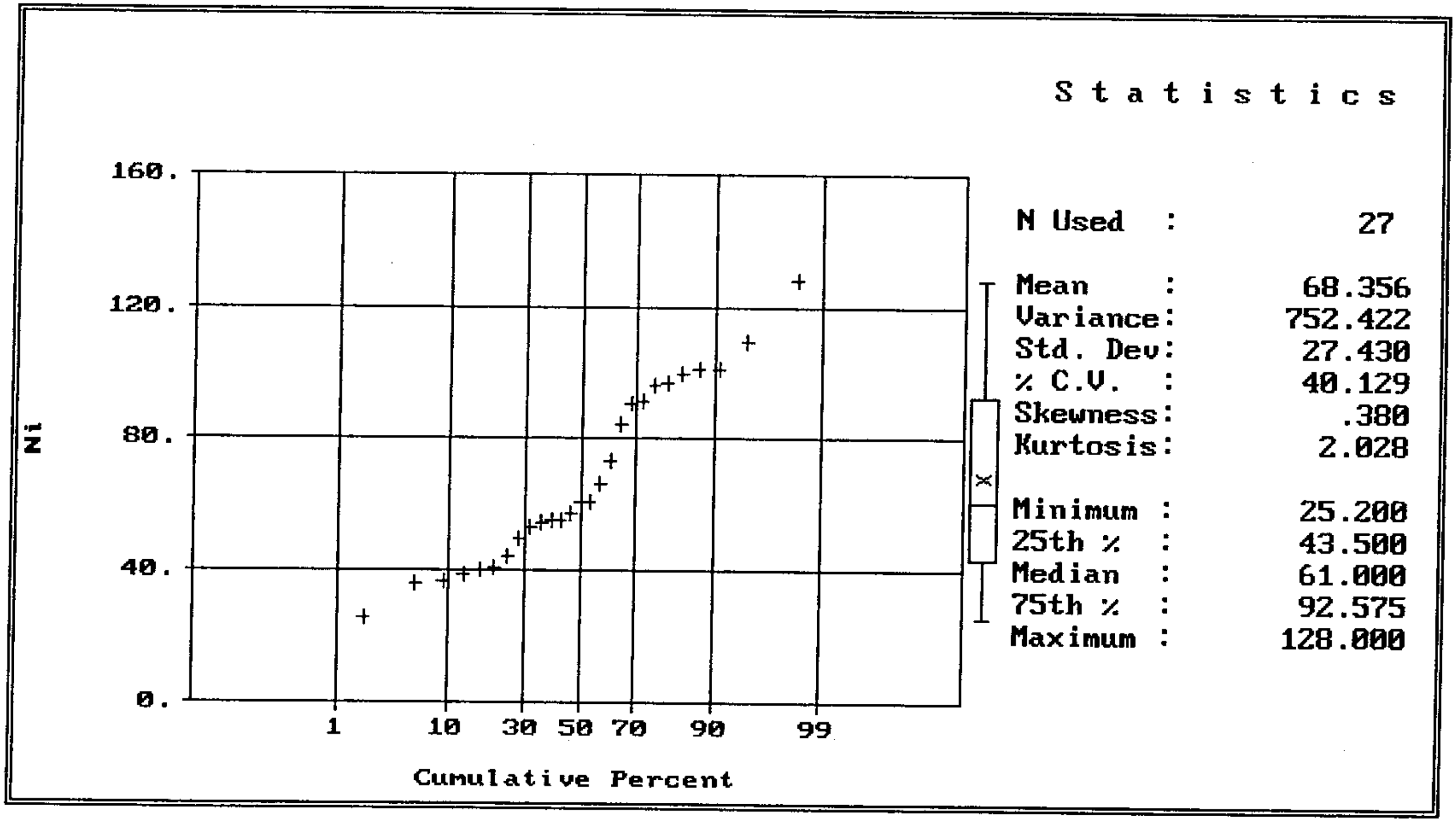
Note: The data set distribution is normal.

FIGURE 14
PROBABILITY PLOT OF BACKGROUND MANGANESE
CONCENTRATIONS IN SOILS OF THE INLAND AREA
SITES 13 AND 22
NAVAL WEAPONS STATION CONCORD



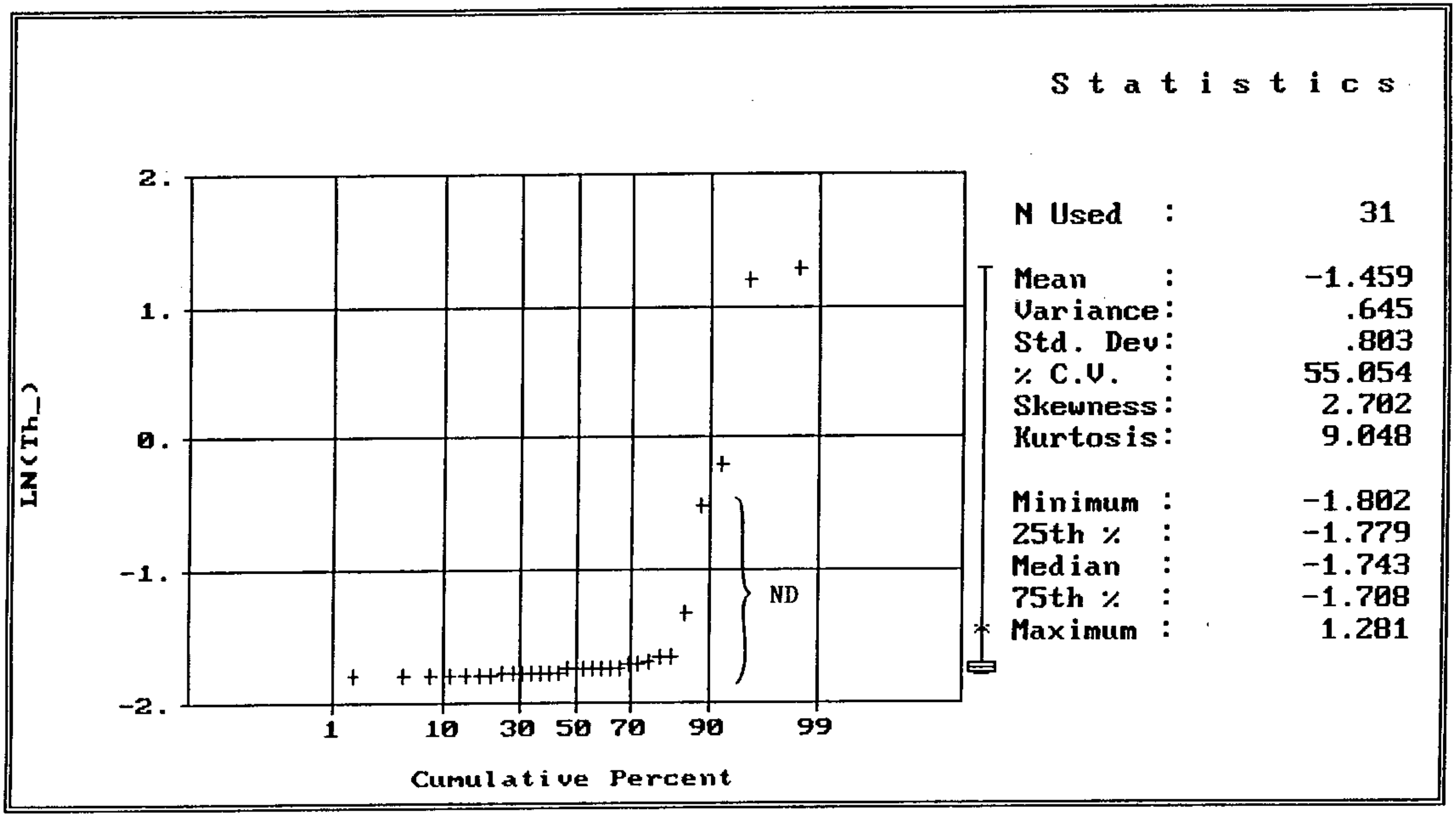
Note: The data set distribution is nonparametric.

FIGURE 15
PROBABILITY PLOT OF BACKGROUND MERCURY
CONCENTRATIONS IN SOILS OF THE INLAND AREA
SITES 13 AND 22
NAVAL WEAPONS STATION CONCORD



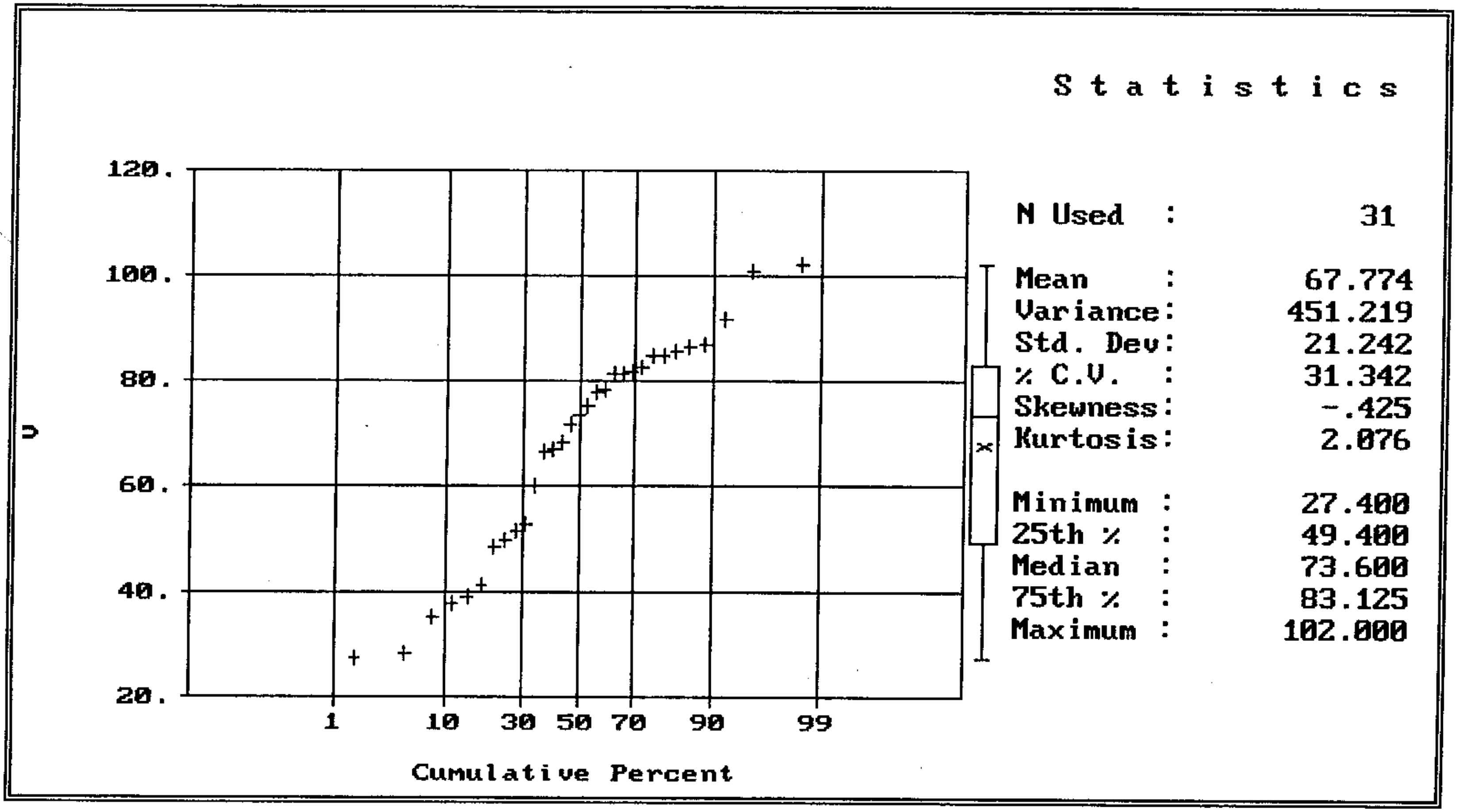
Note: The data set distribution is normal.

FIGURE 16
PROBABILITY PLOT OF BACKGROUND NICKEL
CONCENTRATIONS IN SOILS OF THE INLAND AREA
SITES 13 AND 22
NAVAL WEAPONS STATION CONCORD



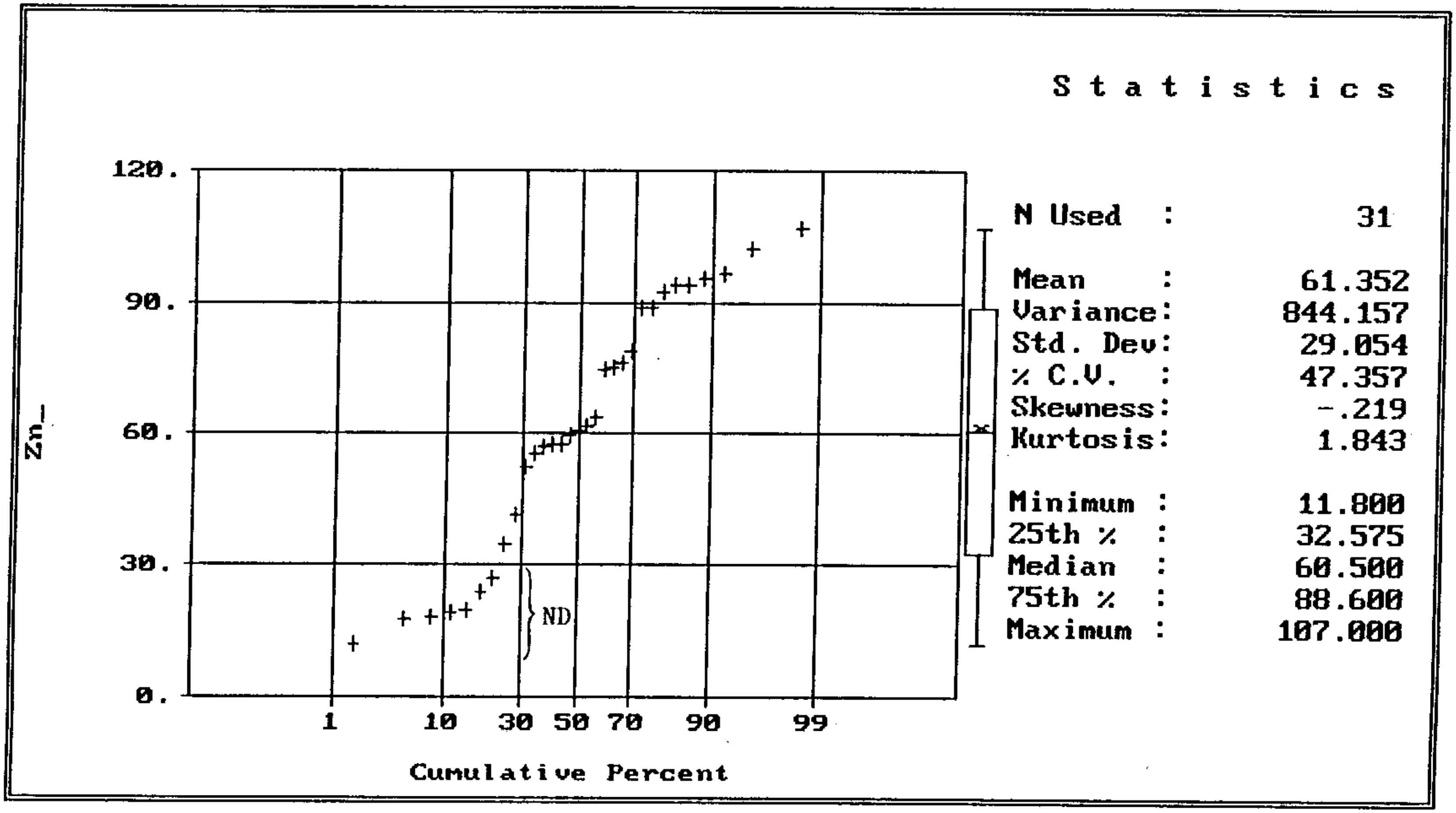
Note: The data set distribution is nonparametric.

FIGURE 17
PROBABILITY PLOT OF BACKGROUND THALLIUM
CONCENTRATIONS IN SOILS OF THE INLAND AREA
SITES 13 AND 22
NAVAL WEAPONS STATION CONCORD



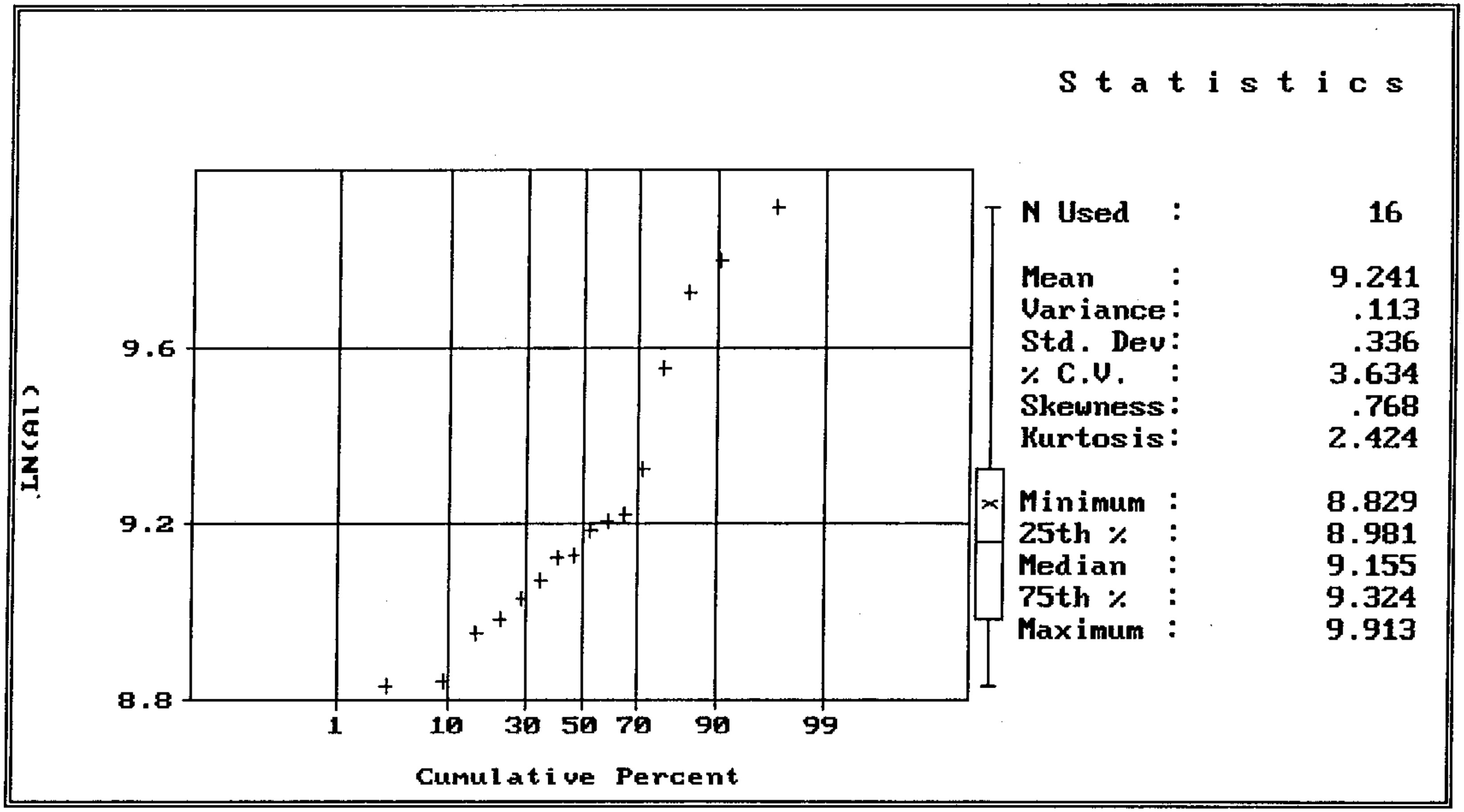
Note: The data set distribution is normal.

FIGURE 18
PROBABILITY PLOT OF BACKGROUND VANADIUM
CONCENTRATIONS IN SOILS OF THE INLAND AREA
SITES 13 AND 22
NAVAL WEAPONS STATION CONCORD



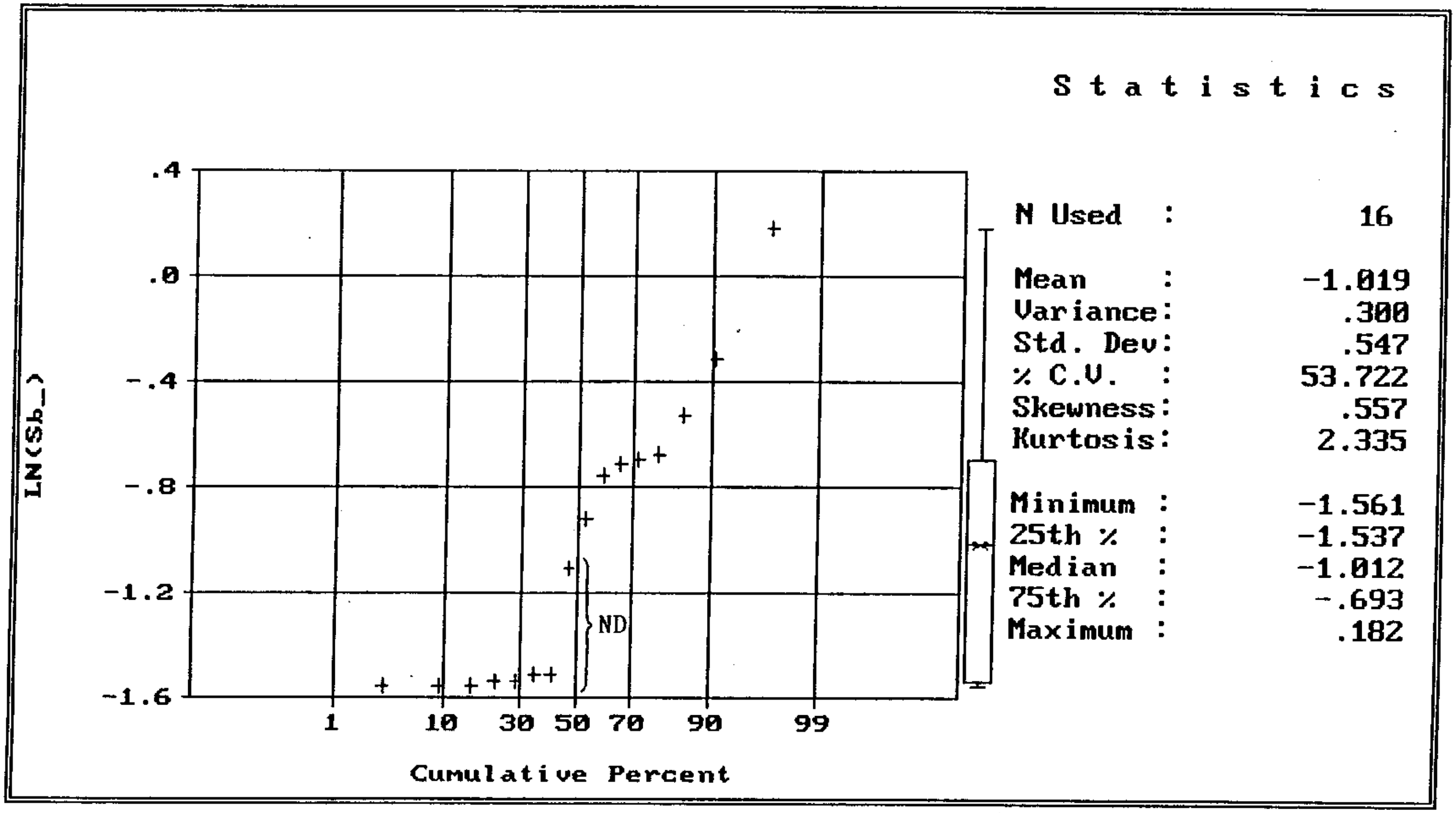
Note: The data set distribution is nonparametric.

FIGURE 19
PROBABILITY PLOT OF BACKGROUND ZINC
CONCENTRATIONS IN SOILS OF THE INLAND AREA
SITES 13 AND 22
NAVAL WEAPONS STATION CONCORD



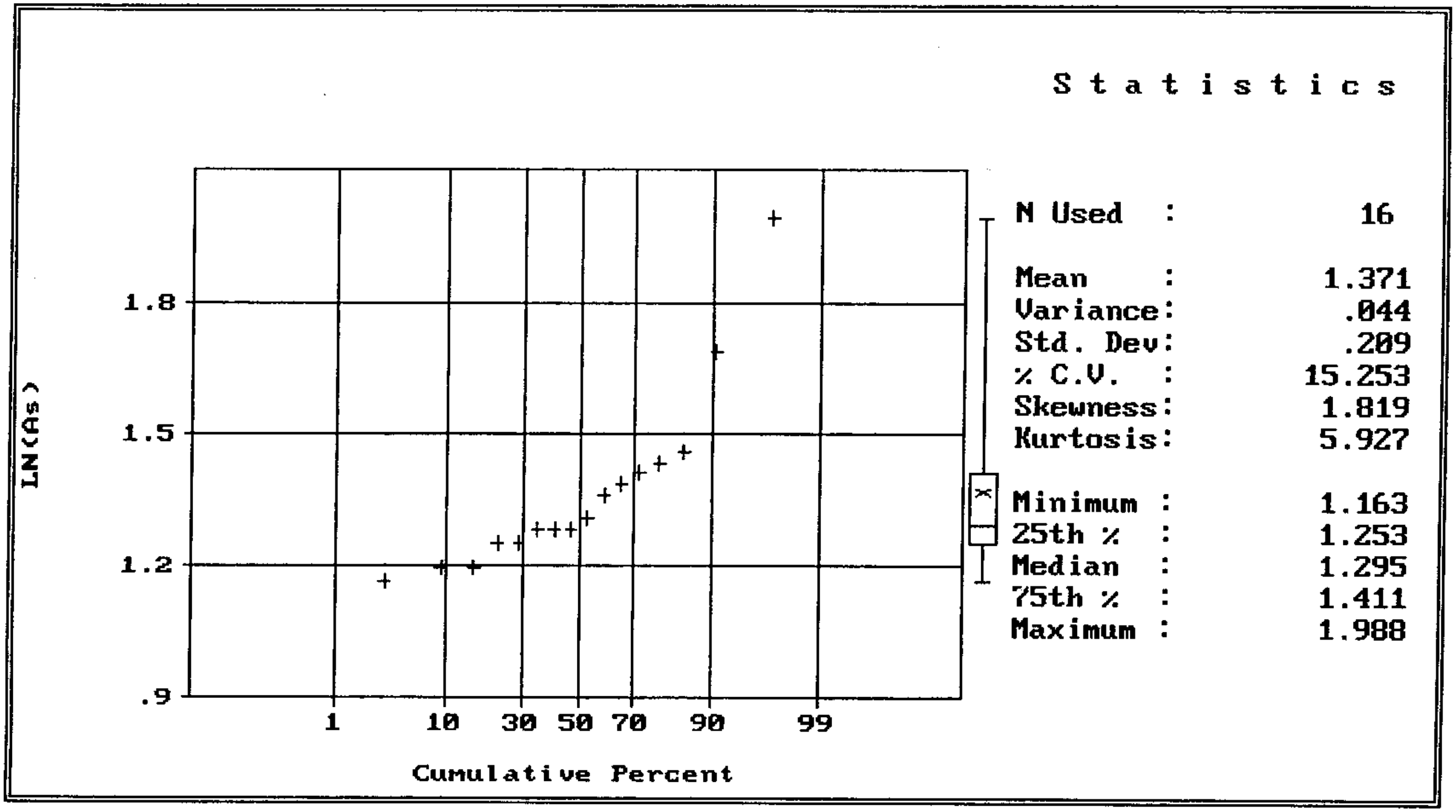
Note: The data set distribution is lognormal.

FIGURE 20
PROBABILITY PLOT OF BACKGROUND ALUMINUM
CONCENTRATIONS IN SOILS OF THE INLAND AREA
SITES 17 AND 24A
NAVAL WEAPONS STATION CONCORD



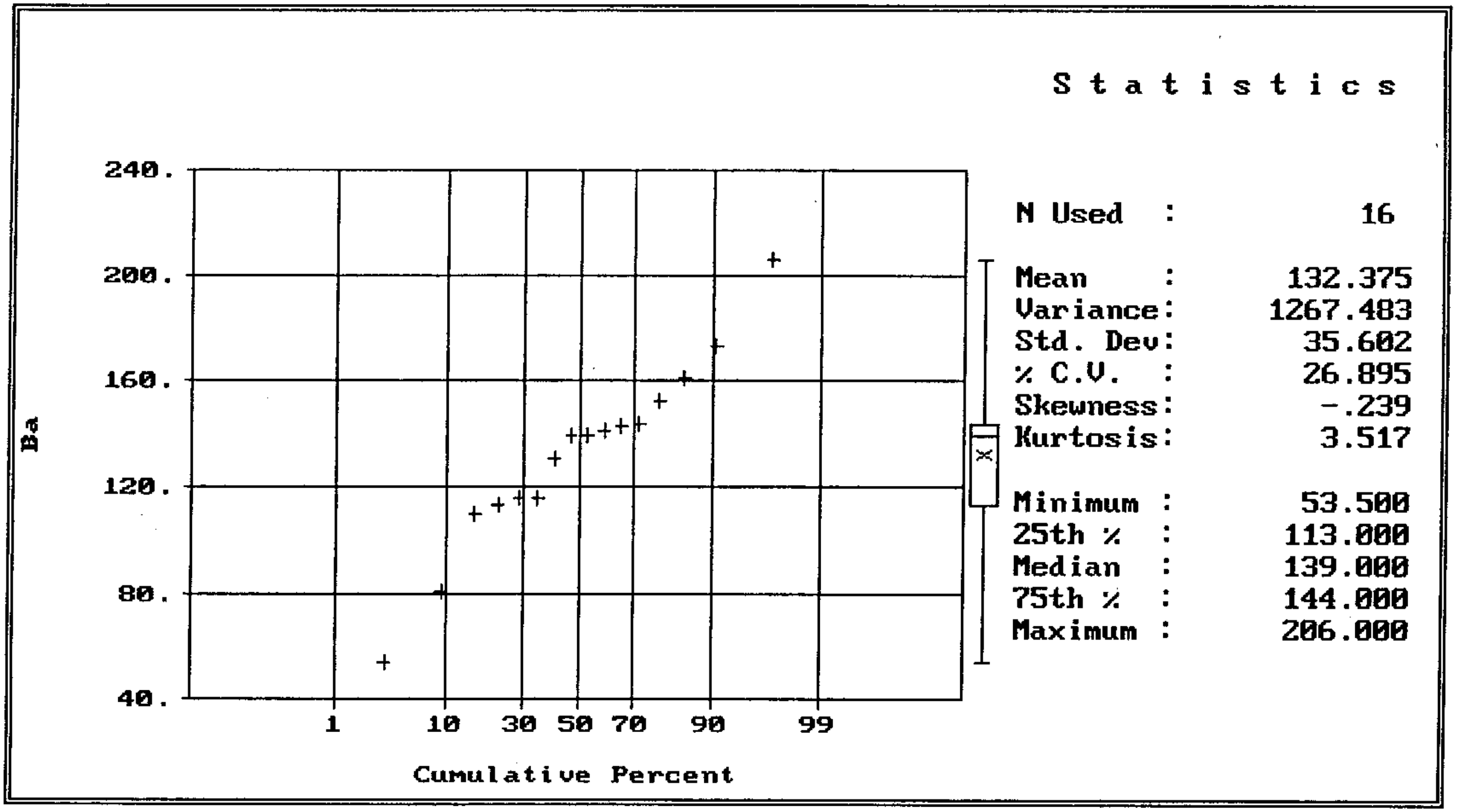
Note: The data set distribution is nonparametric.

FIGURE 21
PROBABILITY PLOT OF BACKGROUND ANTIMONY
CONCENTRATIONS IN SOILS OF THE INLAND AREA
SITES 17 AND 24A
NAVAL WEAPONS STATION CONCORD



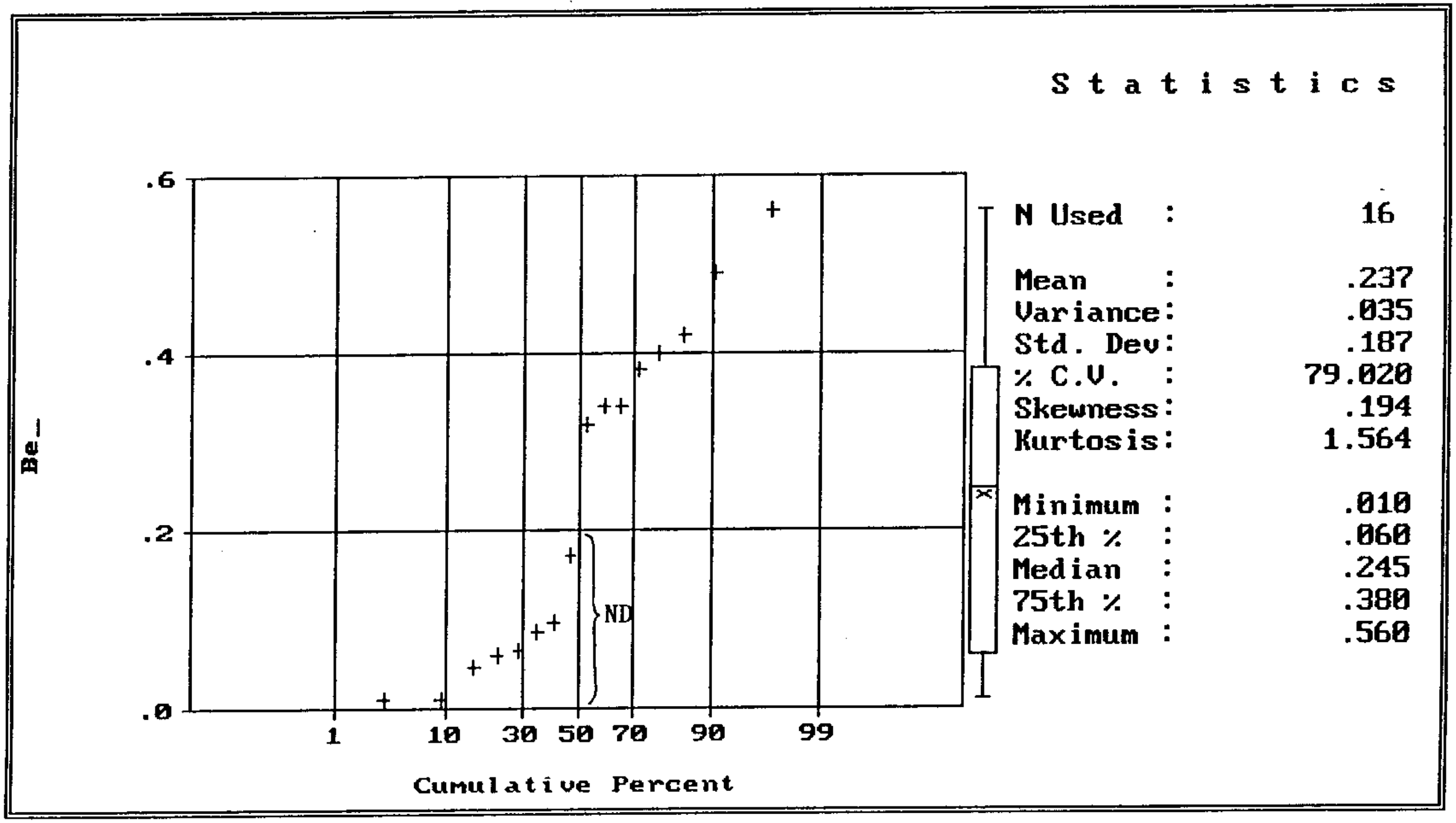
Note: The data set distribution is nonparametric.

FIGURE 22
PROBABILITY PLOT OF BACKGROUND ARSENIC CONCENTRATIONS IN SOILS OF THE INLAND AREA
SITES 17 AND 24A
NAVAL WEAPONS STATION CONCORD



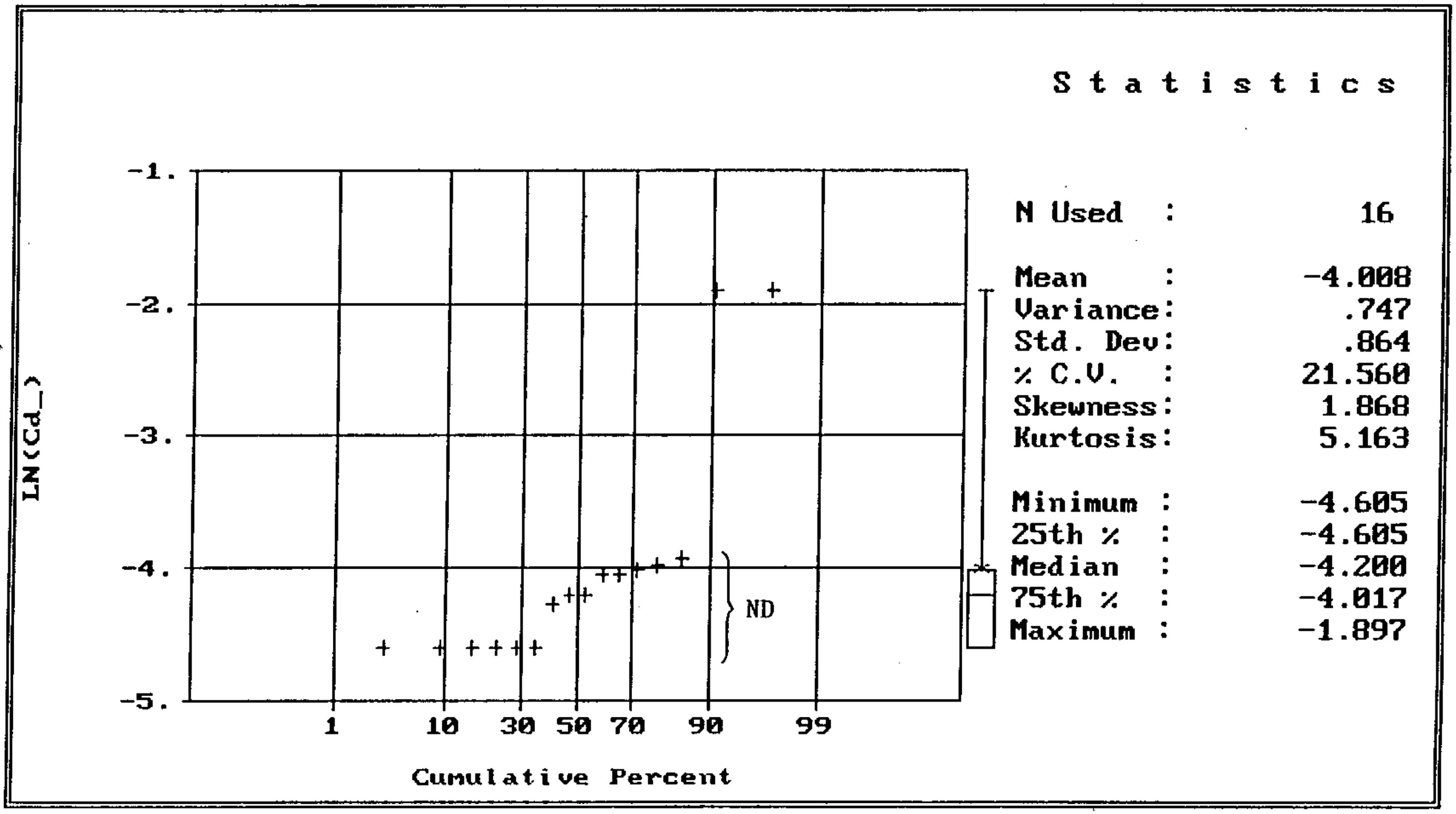
Note: The data set distribution is normal.

FIGURE 23
PROBABILITY PLOT OF BACKGROUND BARIUM
CONCENTRATIONS IN SOILS OF THE INLAND AREA
SITES 17 AND 24A
NAVAL WEAPONS STATION CONCORD



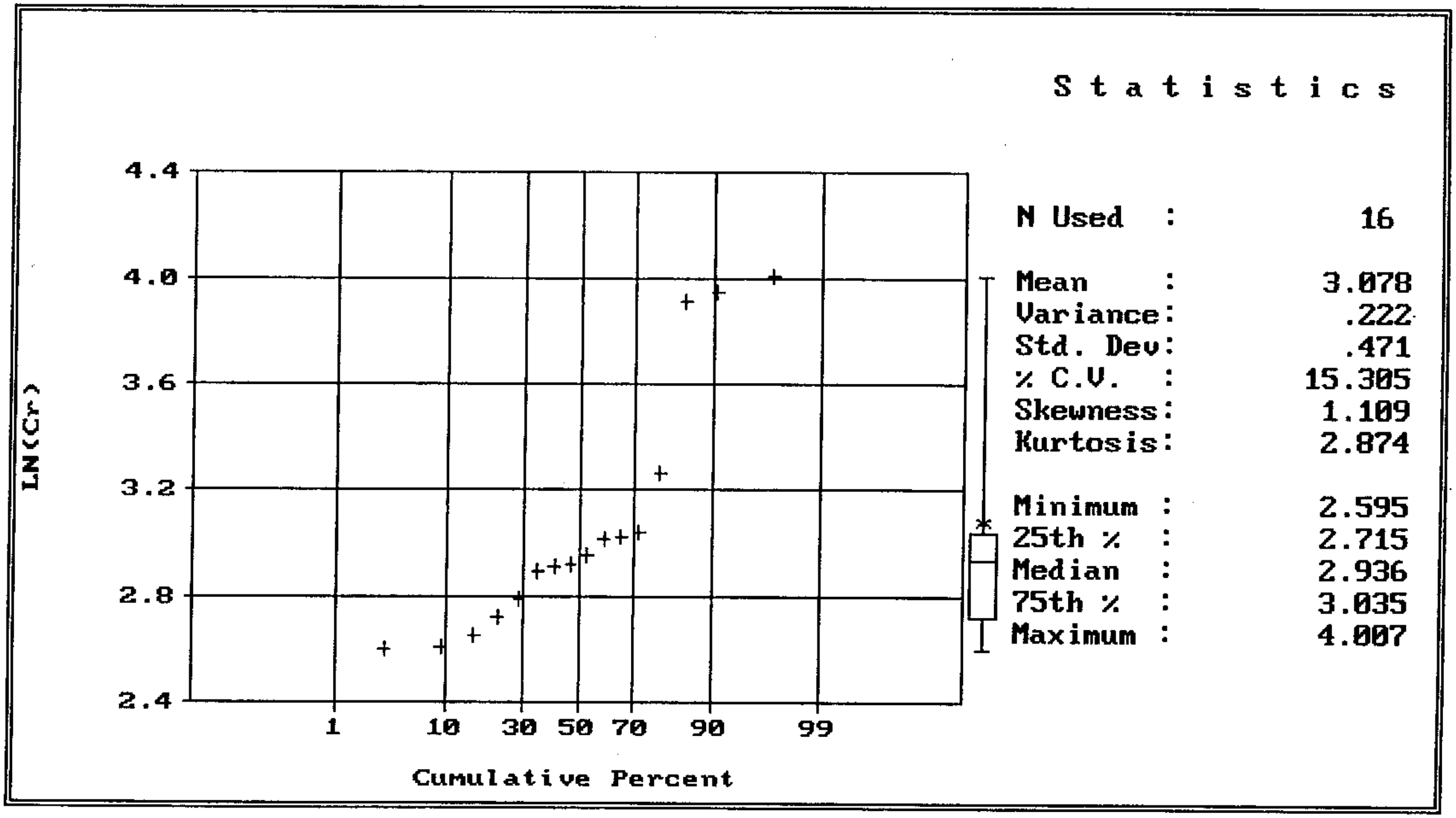
Note: The data set distribution is normal.

FIGURE 24
PROBABILITY PLOT OF BACKGROUND BERYLLIUM
CONCENTRATIONS IN SOILS OF THE INLAND AREA
SITES 17 AND 24A
NAVAL WEAPONS STATION CONCORD



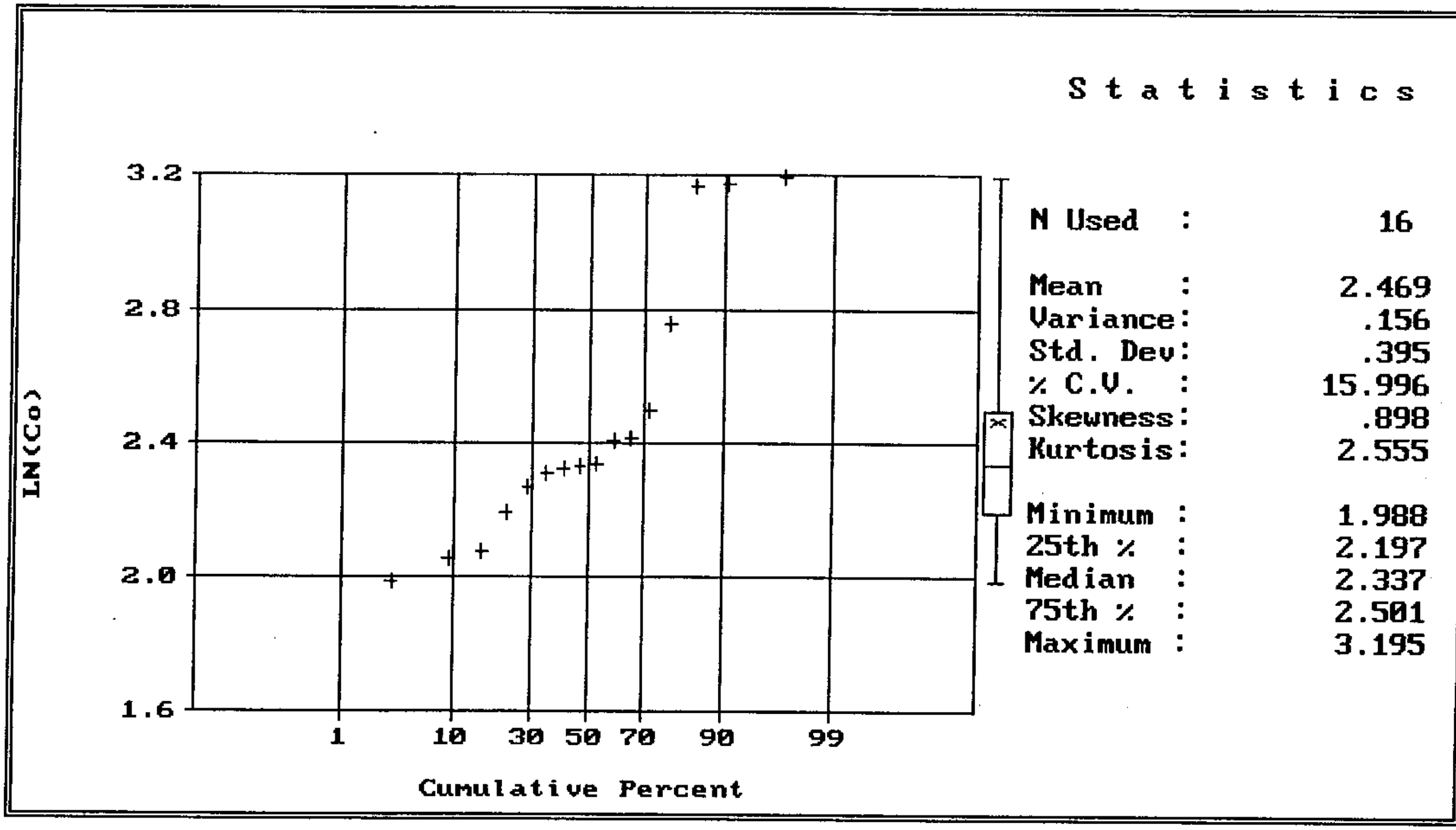
Note: The data set distribution is nonparametric.

FIGURE 25
PROBABILITY PLOT OF BACKGROUND CADMIUM CONCENTRATIONS IN SOILS OF THE INLAND AREA
SITES 17 AND 24A
NAVAL WEAPONS STATION CONCORD



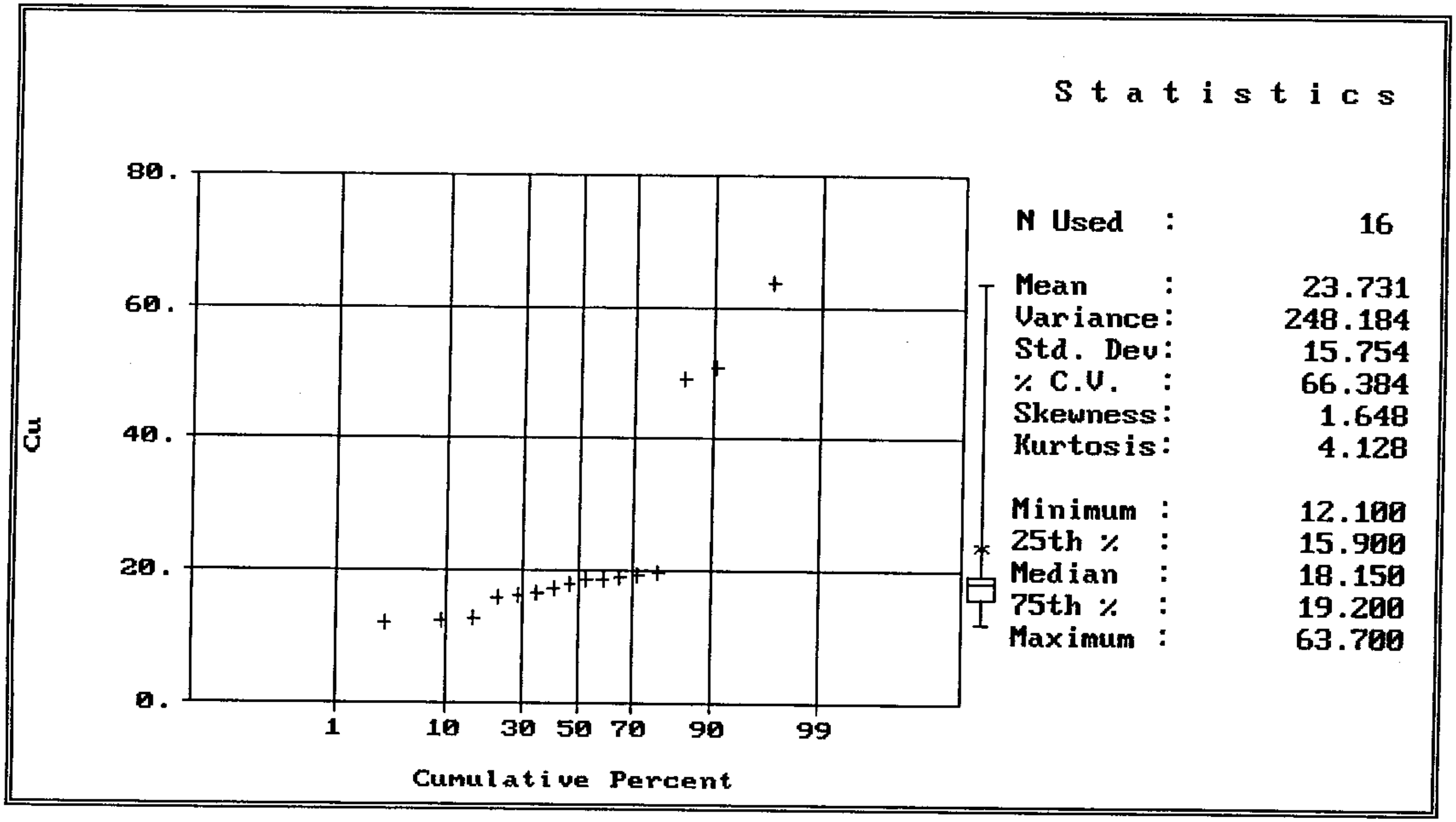
Note: The data set distribution is nonparametric.

FIGURE 26
PROBABILITY PLOT OF BACKGROUND CHROMIUM
CONCENTRATIONS IN SOILS OF THE INLAND AREA
SITES 17 AND 24A
NAVAL WEAPONS STATION CONCORD



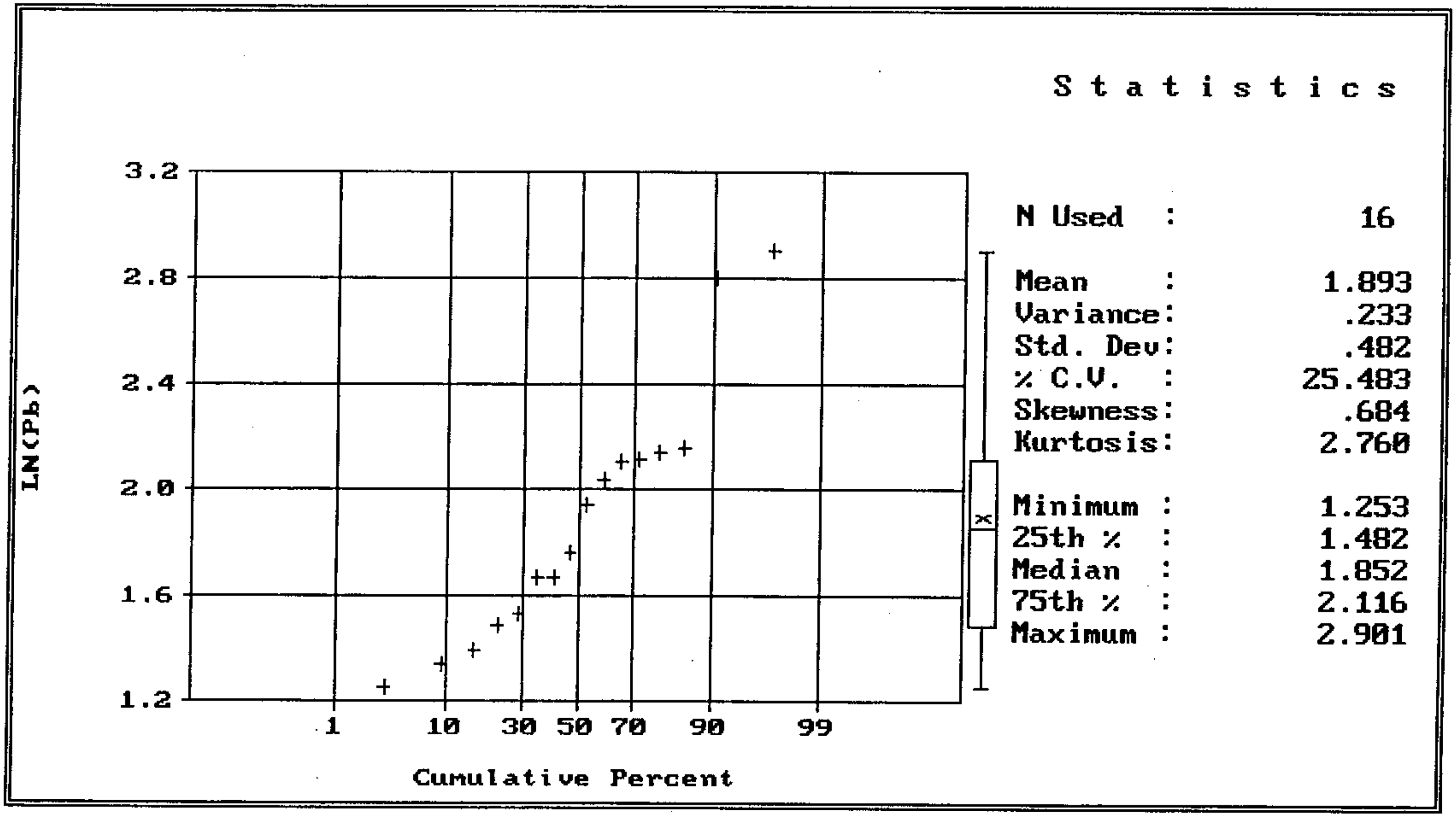
Note: The data set distribution is nonparametric.

FIGURE 27
PROBABILITY PLOT OF BACKGROUND COBALT
CONCENTRATIONS IN SOILS OF THE INLAND AREA
SITES 17 AND 24A
NAVAL WEAPONS STATION CONCORD



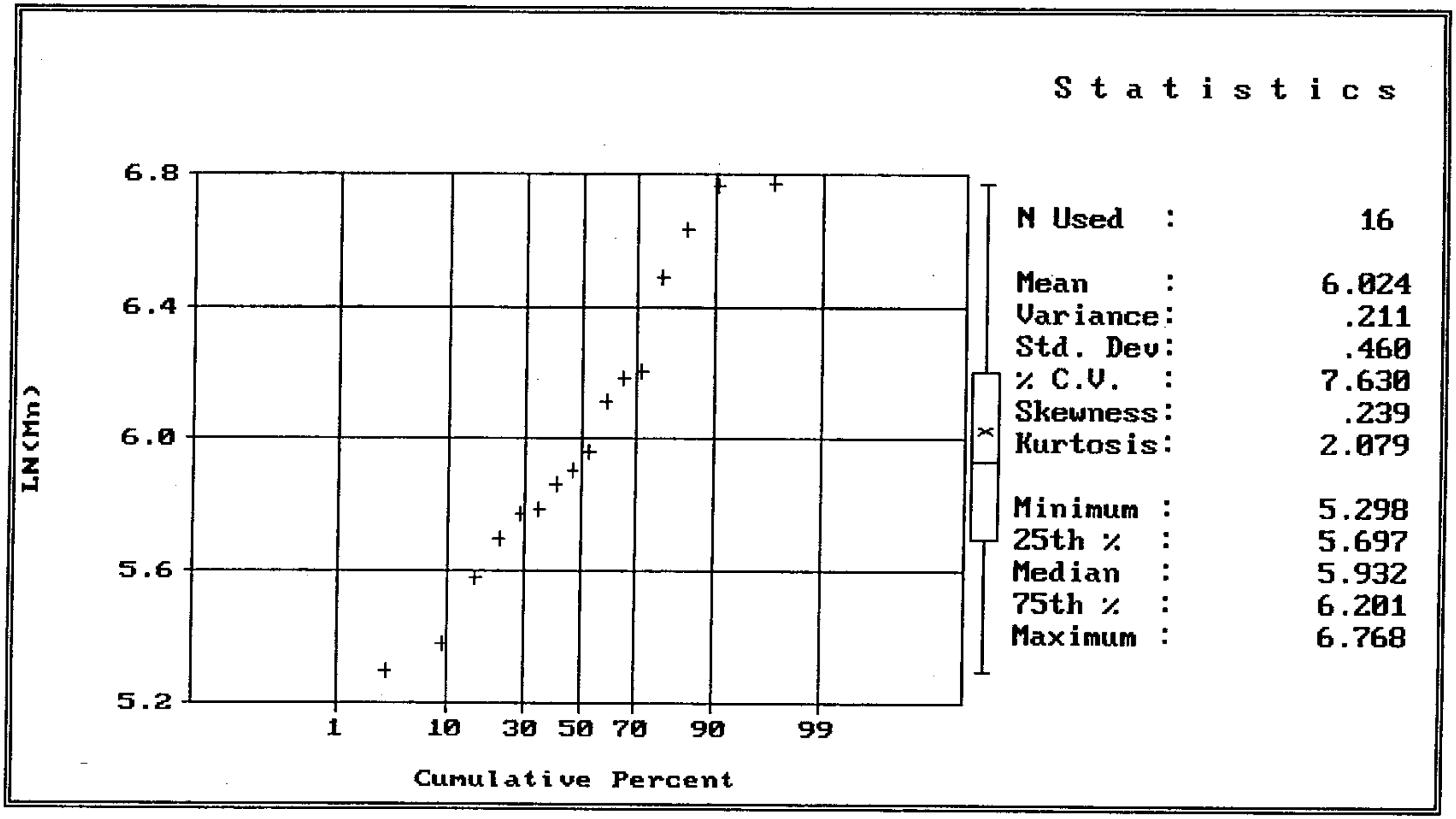
Note: The data set distribution is nonparametric.

FIGURE 28
PROBABILITY PLOT OF BACKGROUND COPPER
CONCENTRATIONS IN SOILS OF THE INLAND AREA
SITES 17 AND 24A
NAVAL WEAPONS STATION CONCORD



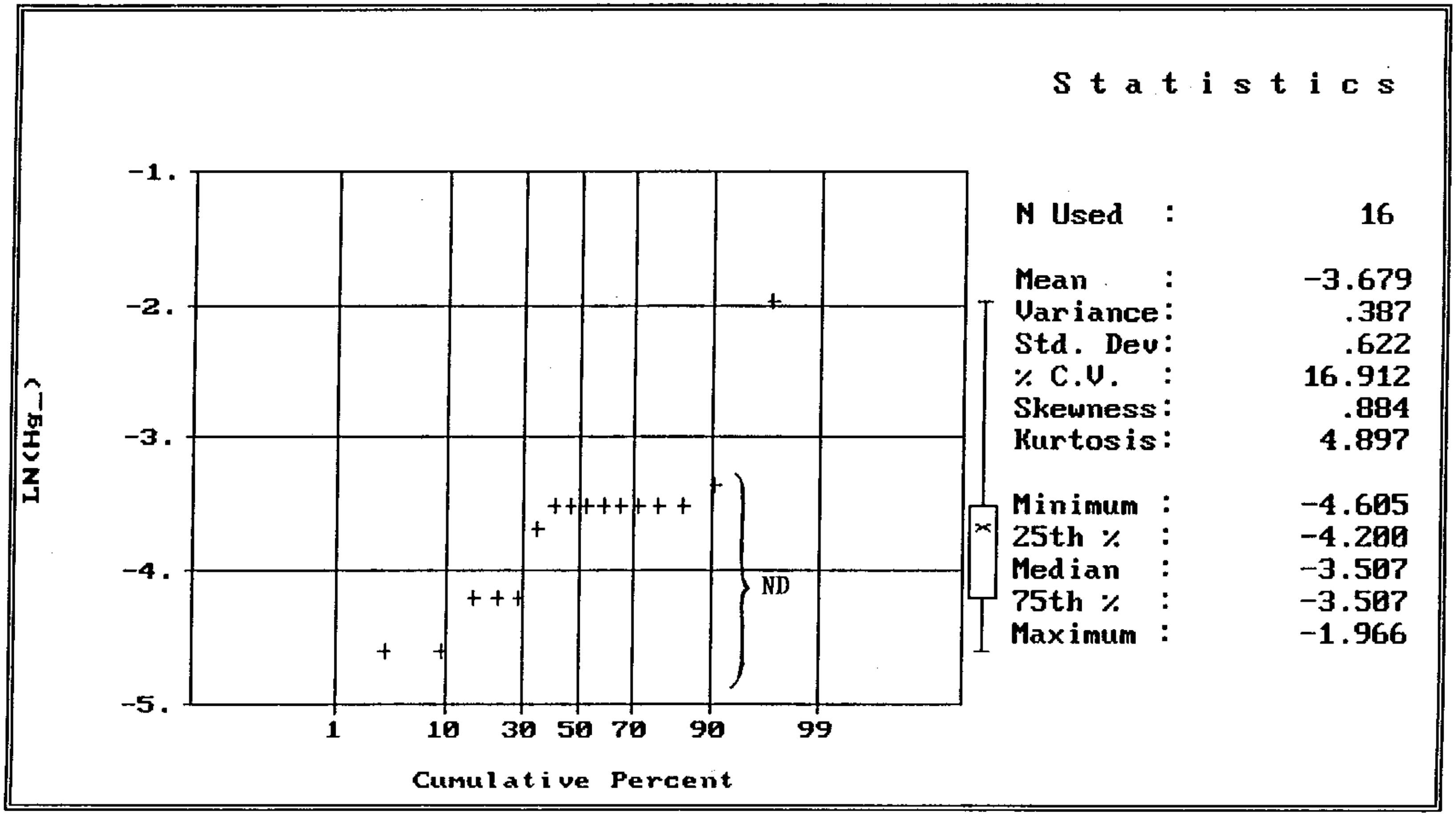
Note: The data set distribution is lognormal.

FIGURE 29
PROBABILITY PLOT OF BACKGROUND LEAD
CONCENTRATIONS IN SOILS OF THE INLAND AREA
SITES 17 AND 24A
NAVAL WEAPONS STATION CONCORD



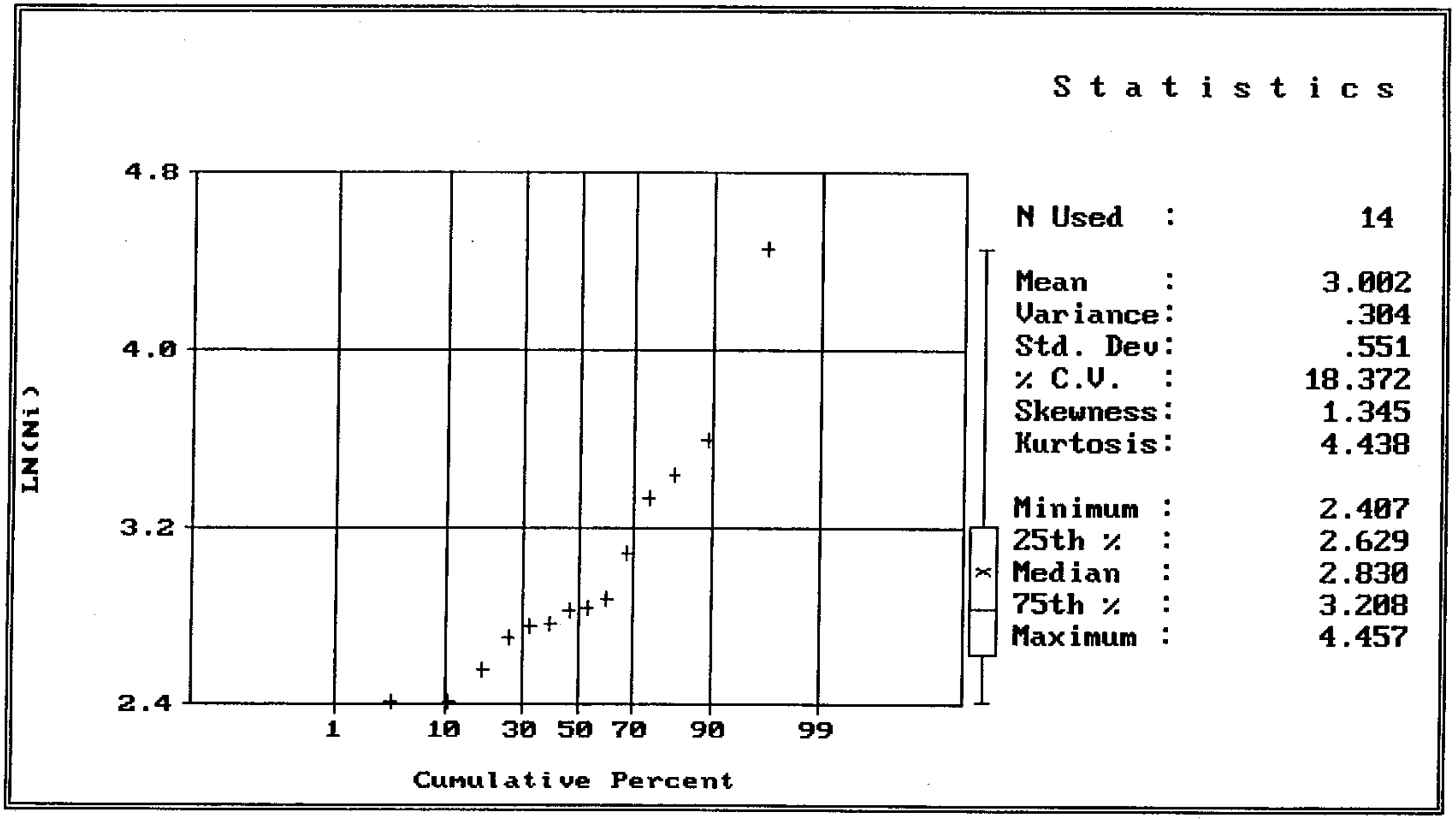
Note: The data set distribution is lognormal.

FIGURE 30
PROBABILITY PLOT OF BACKGROUND MANGANESE
CONCENTRATIONS IN SOILS OF THE INLAND AREA
SITES 17 AND 24A
NAVAL WEAPONS STATION CONCORD



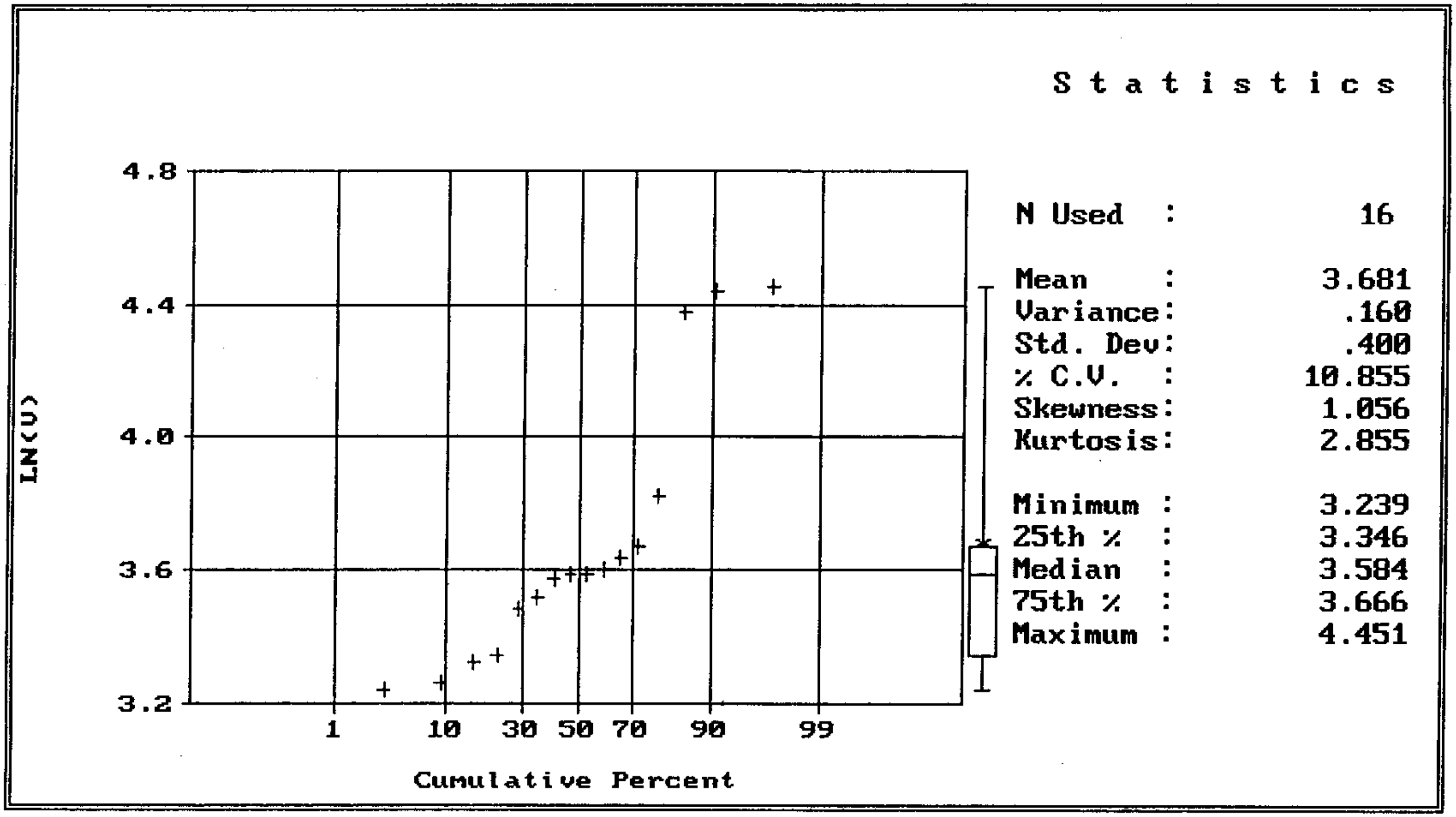
Note: The data set distribution is nonparametric.

FIGURE 31
PROBABILITY PLOT OF BACKGROUND MERCURY
CONCENTRATIONS IN SOILS OF THE INLAND AREA
SITES 17 AND 24A
NAVAL WEAPONS STATION CONCORD



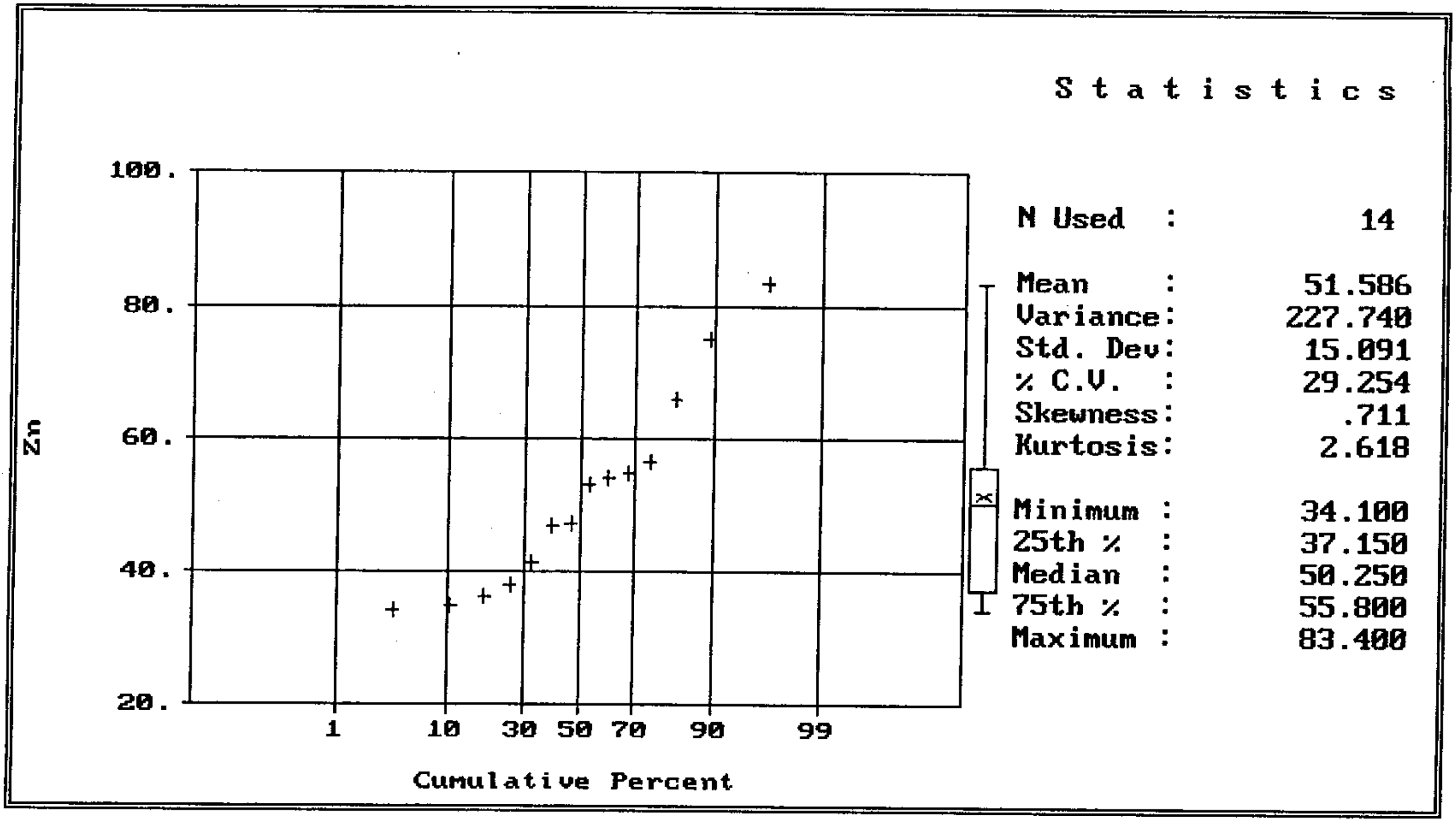
Note: The data set distribution is nonparametric.

FIGURE 32
PROBABILITY PLOT OF BACKGROUND NICKEL
CONCENTRATIONS IN SOILS OF THE INLAND AREA
SITES 17 AND 24A
NAVAL WEAPONS STATION CONCORD



Note: The data set distribution is nonparametric.

FIGURE 33
PROBABILITY PLOT OF BACKGROUND VANADIUM
CONCENTRATIONS IN SOILS OF THE INLAND AREA
SITES 17 AND 24A
NAVAL WEAPONS STATION CONCORD



Note: The data set distribution is normal.

FIGURE 34
PROBABILITY PLOT OF BACKGROUND ZINC
CONCENTRATIONS IN SOILS OF THE INLAND AREA
SITES 17 AND 24A
NAVAL WEAPONS STATION CONCORD

TABLES

TABLE 1

BACKGROUND METALS CONCENTRATIONS IN SOILS OF THE INLAND AREA SITES 13 AND 22 NAVAL WEAPONS STATION CONCORD

Metal	Number of Detections/ Samples Analyzed	Values Excluded		Background Data Set Size[a]	Background Data Set Distribution	Soil Metal Concentration Statistics for Background Data Sets (mg/kg)				U.S. EPA PRG[f] (mg/kg)
								Background Level		
		Too Low	Too High			Minimum Detected [b]	Maximum Detected [c]	**95th *p*[d]**	**99th *p*[d]**	
Aluminum	31/31	0	0	31	Normal	6,920.0	22,500.0	**21,000**	**22,000**	77,000
Antimony	9/30	0	0	30	Nonparam.	0.44	1.8	**0.9**	**1.6**	31
Arsenic	30/31	1	5	25	Nonparam.	2.4	26.6	**10***	**23***	0.38*
Barium	31/31	0	0	31	Nonparam.	135.0	659.0	**560**	**630**	5,300
Beryllium	1/31	0	0	31	Nonparam.	0.16	0.16	**0.12**	**0.15***	0.14
Cadmium	3/31	0	0	31	Nonparam.	0.23	0.53	**0.29**	**0.48**	9.0[g]/38
Chromium	31/31	0	0	31	Nonparam.	14.9	68.6	**62**	**67**	210[h]
Cobalt	31/31	0	1	30	Nonparam.	5.9	25.4	**25**	**25**	4,600
Copper	31/31	4	4	23	Normal	21.1	66.5	**65**	**66**	2,800
Lead	21/31	0	0	31	Lognormal	3.4	37.7	**33**	**38**	130[g]/400
Manganese	31/31	0	1	30	Normal	161.0	1,540.0	**1,200**	**1,400**	3,200
Mercury	23/31	0	0	31	Nonparam.	0.06	0.23	**0.17**	**0.21**	23[i]
Molybdenum	0/31	0	0	31	Nonparam.	N/A	N/A	**DL[e]**	**DL[e]**	380
Nickel	31/31	2	2	27	Lognormal	25.2	128.0	**100**	**101**	150[g]/1,500
Selenium	0/31	0	0	31	Nonparam.	N/A	N/A	**DL[e]**	**DL[e]**	380
Silver	0/31	0	0	31	Nonparam.	N/A	N/A	**DL[e]**	**DL[e]**	380
Thallium	3/31	0	0	31	Nonparam.	0.81	3.6	**1.9**	**3.5**	5.4[k]
Vanadium	31/31	0	0	31	Normal	27.4	102.0	**96**	**102**	540
Zinc	24/31	0	0	31	Nonparam.	34.5	107.0	**99**	**105**	23,000

TABLE 1 (Continued)

BACKGROUND METALS CONCENTRATIONS IN SOILS OF THE INLAND AREA SITES 13 AND 22 NAVAL WEAPONS STATION CONCORD

Notes:

a The background data set consists of both detected and nondetected results. Nondetected results are represented by values of one half the detection limit. The data set excludes anomalously low and high values.

b Minimum detected concentration in background data set, after exclusion of anomalously low values.

c Maximum detected concentration in background data set, after exclusion of anomalously high values.

d The 95th and 99th percentiles of the distribution were calculated using nonparametric formula. Results were rounded to two significant figures.

e The background level was set at the detection limit.

f U.S. Environmental Protection Agency (EPA) Region IX preliminary remediation goals (PRG) for residential use (EPA 1995). Listed PRG for manganese is based on the recently revised value of the oral Reference Dose (EPA 1996).

g California Environmental Protection Agency PRGs (listed as Cal-modified PRGs in EPA 1995)

h The PRG for total chromium assumes a one to six ratio of chromium VI/chromium III.

i PRG for mercuric chloride

k PRG for thallic oxide

DL Detection limit

N/A Not available

* The background level exceeds the PRG.

TABLE 2

BACKGROUND METALS CONCENTRATIONS IN SOILS OF THE INLAND AREA SITES 17 AND 24A NAVAL WEAPONS STATION CONCORD

Metal	Number of Detections/ Samples Analyzed	Values Excluded		Background Data Set Size [a]	Background Data Set Distribution	Soil Metal Concentration Statistics for Background Data Sets (mg/kg)			U.S. EPA PRG[f] (mg/kg)
		Too Low	Too High			Minimum Detected [b]	Maximum Detected [c]	**Background Level [d]**	
Aluminum	16/16	0	0	16	Lognormal	6,830.0	20,200.0	**20,000**	77,000
Antimony	8/16	0	0	16	Nonparam.	0.4	1.2	**1.2**	31
Arsenic	16/16	0	0	16	Nonparam.	3.2	7.3	**7.3***	0.38*
Barium	16/16	0	0	16	Normal	53.5	206.0	**210**	5,300
Beryllium	9/16	0	0	16	Normal	0.17	0.56	**0.56***	0.14*
Cadmium	2/16	0	0	16	Nonparam.	0.15	0.15	**0.15**	9.0[g]/38
Chromium	16/16	0	0	16	Nonparam.	13.4	55.0	**55**	210[h]
Cobalt	16/16	0	0	16	Nonparam.	7.3	24.4	**24**	4,600
Copper	16/16	0	0	16	Nonparam.	12.1	63.7	**64**	2,800
Lead	16/16	0	0	16	Lognormal	3.5	18.2	**18**	130[g]/400
Manganese	16/16	0	0	16	Lognormal	200.0	870.0	**870**	3,200
Mercury	1/16	0	0	16	Nonparam.	0.14	0.14	**0.14**	23[i]
Molybdenum	0/16	0	0	16	Nonparam.	N/A	N/A	**DL[e]**	380
Nickel	16/16	1	1	14	Nonparam.	11.1	86.2	**86**	150[g]/1,500
Selenium	0/16	0	0	16	Nonparam.	N/A	N/A	**DL[e]**	380
Silver	0/16	0	0	16	Nonparam.	N/A	N/A	**DL[e]**	380
Thallium	0/16	0	0	16	Nonparam.	N/A	N/A	**DL[e]**	5.4[k]
Vanadium	16/16	0	0	16	Nonparam.	25.5	85.7	**86**	540
Zinc	16/16	1	1	14	Normal	34.1	83.4	**83**	23,000

TABLE 2 (Continued)

BACKGROUND METALS CONCENTRATIONS IN SOILS OF THE INLAND AREA SITES 17 AND 24A NAVAL WEAPONS STATION CONCORD

Notes:

a	The background data set consists of both detected and nondetected results. Nondetected results are represented by values of one-half of the detection limit. The data set excludes anomalously low and high values.
b	This is the minimum detected concentration in the background data set after exclusion of anomalously low values.
c	This is the maximum detected concentration in the background data set after exclusion of anomalously high values.
d	Background level was set at the maximum detected concentration after exclusion of outliers. Results were rounded to two significant figures.
e	The background limit was set at the detection limit.
f	U.S. Environmental Protection Agency (EPA) Region IX preliminary remediation goals (PRG) for residential use (EPA 1995). Listed PRG for manganese is based on the recently revised value of the oral Reference Dose (EPA 1996).
g	California Environmental Protection Agency PRGs (listed as Cal-modified PRGs in EPA 1995)
h	The PRG for total chromium assumes a one to six ratio of chromium VI/chromium III.
i	PRG for mercuric chloride
k	PRG for thallic oxide
DL	Detection limit
N/A	Not available
*	The background level exceeds the PRG.

APPENDIX C

BORING LOGS

Tetra Tech EM

Log of Boring: 7SHSB101

Logged By: CAITLIN GORMAN
Logging Consultant:
Drilling Company: PRECISION

Project: CONCORD
Project No: G1058
Location: 7SH
Ground Surface Elevation (feet MSL):

Drilling Method: GEOPROBE
Boring Started: 10/21/02
Completed: 10/21/02
Boring Depth (feet bgs): 10.00
Boring Diameter (inches): 2.00

DEPTH (FEET)	DRIVE INTERVAL	RECOVERY (IN)	BLOW COUNTS	SAMPLE ID	OVM (PPM)	WATER LEVEL	GRAPHIC LOG	USCS SOIL TYPE	DESCRIPTION
0		24		290HP001				ML	Ground Surface Grass at surface SILT WITH GRAVEL: brown (7.5YR 5/2); dry; loose; 15% sub-rounded gravel (up to 0.5 inches); 15% clay; trace rootlets Clay content increases at 2 feet; gravel content decreases
2		48		290HP002					SILT WITH CLAY: dark brown (7.5YR 3/2); slightly moist; stiff; 5% gravel (up to 0.5 inches); sub rounded; 20% clay; trace rootlets Becomes very stiff at 4 feet Trace sand
6		48		290HP003					Sand content increases to 10% at 8.5 feet. Color changes to brown (7.5YR 5/4); 15% clay; trace gravel; trace rootlets
10									Total depth of boring = 10 feet

Depth scale: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15

Tetra Tech EM

Log of Boring: 7SHSB102

Logged By: CAITLIN GORMAN
Logging Consultant:
Drilling Company: PRECISION

Project: CONCORD
Project No: G1058
Location: 7SH
Ground Surface Elevation (feet MSL):

Drilling Method: GEOPROBE
Boring Started: 10/21/02
Completed: 10/21/02
Boring Depth (feet bgs): 10.00
Boring Diameter (inches): 2.00

DEPTH (FEET)	DRIVE INTERVAL	RECOVERY (IN)	BLOW COUNTS	SAMPLE ID	OVM (PPM)	WATER LEVEL	GRAPHIC LOG	USCS SOIL TYPE	DESCRIPTION
									Ground Surface
0		24		290HP004				ML	Grass at the surface
1									SILT WITH GRAVEL: brown (7.5YR 5/2); dry; loose; 25% gravel (up to 1 inch); sub-angular; 10% clay; trace sand; trace rootlets
									Cement fragment at .5 feet (2 inch diamater). Gravel lithology is siltstone.
2		36							
3									Becomes slightly moist at 3 feet. Sand content increases at 3 feet to 10%. Decrease in gravel to 10%. Color changes to brownish yellow (10YR 6/6)
				290HP005					
4									
5									Roots at 5 feet (1.5 inch diameter)
6		48							Roots in 6 feet (1.5 inch diameter).
									CLAYEY SILT: brownish yellow (10YR 6/6); slightly moist; very stiff with 60% silt; 20% clay; 5% sand; trace gravel; trace rootlets
7									
8									
9				290HP006					
10									Total depth of boring = 10 feet
11									
12									
13									
14									
15									

Tetra Tech EM

Log of Boring: 7SHSB103

Logged By: CAITLIN GORMAN
Logging Consultant:
Drilling Company: PRECISION

Project: CONCORD
Project No: G1058
Location: 7SH
Ground Surface Elevation (feet MSL):

Drilling Method: GEOPROBE
Boring Started: 10/21/02
Completed: 10/21/02
Boring Depth (feet bgs): 10.00
Boring Diameter (inches): 2.00

DEPTH (FEET)	DRIVE INTERVAL	RECOVERY (IN)	BLOW COUNTS	SAMPLE ID	OVM (PPM)	WATER LEVEL	GRAPHIC LOG	USCS SOIL TYPE	DESCRIPTION
0									Ground Surface
0–2		24		290HP007				SM	Grass at the surface SILTY SAND: brownish yellow (10YR 6/8); dry; loose; medium sand; 65% sand; 30% silt; trace clay; trace gravel; trace rootlets
2–6		48							
3				290HP008				ML	SILT WITH SAND AND CLAY: brownish yellow (10YR 6/8); dry; medium stiff; 50% silt; 30% sand; 20% clay; clay to trace gravel
6–10		48							Very stiff at 6 feet; gravel content increases to 10% CLAYEY SILT: dark brown (7.5 YR 3/2); slightly moist; very stiff; 65% silt; 30% clay; 5% sub-rounded; gravel up to 0.25 inches; gravel lithology
9.5				290HP009					
10									Total depth of boring = 10 feet

Tetra Tech EM

Log of Boring: 7SHSB104

Logged By: CAITLIN GORMAN
Logging Consultant:
Drilling Company: PRECISION

Project: CONCORD
Project No: G1058
Location: 7SH
Ground Surface Elevation (feet MSL):

Drilling Method: GEOPROBE
Boring Started: 10/21/02
Completed: 10/21/02
Boring Depth (feet bgs): 10.00
Boring Diameter (inches): 2.00

DEPTH (FEET)	DRIVE INTERVAL	RECOVERY (IN)	BLOW COUNTS	SAMPLE ID	OVM (PPM)	WATER LEVEL	GRAPHIC LOG	USCS SOIL TYPE	DESCRIPTION
									Ground Surface
0		24		290HP010				SM	Grass at surface; asphalt in sleeve at the surface (2 inches diameter)
1									SILTY SAND: brownish yellow (10YR 6/8); dry; loose; medium sand; 65% sand; 30% silt; trace clay; trace gravel; trace rootlets
2		48						ML	Refusal at 2 feet (second attempt was successful)
3									SILTY SAND AND CLAY: brownish yellow (10YR 6/8); slightly moist; medium stiff; 50% silt; 30% sand; 20% clay; trace gravel
				290HP011					Color changes to yellowish brown (10YR 5/6) at 3.75 feet
4									Clay content increases with depth
5									CLAYEY SILT: yellowish brown (10YR 5/6); slightly moist; stiff; 65% silt; 30% clay; 5% sub-rounded gravel (up to 0.5 inches)
6		48							
7									Becomes very stiff at 7 feet; clay content increases to 40%
8									Color changes to very dark brown (10YR 2/2) at 8.5 feet
9				290HP012					
10									Total depth of boring = 10 feet
11									
12									
13									
14									
15									

Tetra Tech EM

Log of Boring: 7SHSB105

Logged By: CAITLIN GORMAN
Logging Consultant:
Drilling Company: PRECISION

Project: CONCORD
Project No: G1058
Location: 7SH
Ground Surface Elevation (feet MSL):

Drilling Method: GEOPROBE
Boring Started: 10/21/02
Completed: 10/21/02
Boring Depth (feet bgs): 10.00
Boring Diameter (inches): 2.00

DEPTH (FEET)	DRIVE INTERVAL	RECOVERY (IN)	BLOW COUNTS	SAMPLE ID	OVM (PPM)	WATER LEVEL	GRAPHIC LOG	USCS SOIL TYPE	DESCRIPTION
0		24		290HP013				ML	Ground Surface SILT WITH GRAVEL: brown (7.5YR 5/2); dry; loose; 25% gravel (up to 0.5 inches); sub-angular with 10% clay; trace sand; trace rootlets
1									Color changes to yellowish brown (10YR 5/6) and sand content increases to 15%; 15% clay becomes slightly moist
2		48							
3				290HP014					SILT WITH CLAY: yellowish brown (10YR 5/6); slightly moist; 20% clay; 10% gravel (up to 0.25 inches); sub-angular
4									
5									Gravel lens at 5.5 feet (3 inches thick); sub-rounded gravel (up to 0.5 inched diameter)
6		48							CLAYEY SILT: yellowish brown (10YR 5/6); slightly moist; 65% silt; 35% clay; trace rootlets
7									
8									
9				290HP015					
10									Total depth of boring = 10 feet
11									
12									
13									
14									
15									

Tetra Tech EM

Log of Boring: 7SHSB106

Logged By: CAITLIN GORMAN
Logging Consultant:
Drilling Company: PRECISION

Project: CONCORD
Project No: G1058
Location: 7SH
Ground Surface Elevation (feet MSL):

Drilling Method: GEOPROBE
Boring Started: 10/21/02
Completed: 10/21/02
Boring Depth (feet bgs): 10.00
Boring Diameter (inches): 2.00

DEPTH (FEET)	DRIVE INTERVAL	RECOVERY (IN)	BLOW COUNTS	SAMPLE ID	OVM (PPM)	WATER LEVEL	GRAPHIC LOG	USCS SOIL TYPE	DESCRIPTION
									Ground Surface
0		24		290HP016				ML	Grass surface
1									SILT: brown (7.5YR 4/2); dry; medium stiff; 10% gravel (up to 1 inch); sub-angular; 10% clay; gravel clasts include quartzite and meta-granodionite: green stone (meta rock)
2		48							Clay content increases with depth CLAYEY SILT: yellowish brown (10YR 5/6); slightly moist; 65% silt; 30% clay; 5% sub-rounded gravel (up to 0.25 inches)
3				290HP017					
4									
5									
6		48							
7									Clay content increases with depth to 40% clay; 60% silt; trace gravel at 7.5 feet
8									
9				290HP018					
10									Total depth of boring = 10 feet
11									
12									
13									
14									
15									

Tetra Tech EM

Log of Boring: 7SHSB107

Logged By: CAITLIN GORMAN
Logging Consultant:
Drilling Company: PRECISION

Project: CONCORD
Project No: G1058
Location: 7SH
Ground Surface Elevation (feet MSL):

Drilling Method: GEOPROBE
Boring Started: 10/21/02
Completed: 10/21/02
Boring Depth (feet bgs): 10.00
Boring Diameter (inches): 2.00

DEPTH (FEET)	DRIVE INTERVAL	RECOVERY (IN)	BLOW COUNTS	SAMPLE ID	OVM (PPM)	WATER LEVEL	GRAPHIC LOG	USCS SOIL TYPE	DESCRIPTION
									Ground Surface
0		24		290HP019				ML	Grass at surface
1									SILT: brown (7.5YR 3/2); dry; medium stiff; 15% gravel (angular to sub-angular, up to 1 inch siltstone); 75% silt; 10% clay; trace rootlets
2		48							Clay content increases with depth to 15% at 5.5 feet
3									
3.5				290HP020					
4									
5									
6		48							Becomes very stiff at 6 feet
									SILT WITH SAND: brownish yellow (10YR 6/6); dry; medium stiff; 15% sand; 10% clay; trace gravel; trace rootlets
7									
8									Color changes to yellowish brown (10YR 5/6) at 9 feet
9									
9.5				290HP021					
10									Total depth of boring = 10 feet
11									
12									
13									
14									
15									

Tetra Tech EM

Log of Boring: 7SHSB108

Logged By: CAITLIN GORMAN
Logging Consultant:
Drilling Company: PRECISION

Project: CONCORD
Project No: G1058
Location: 7SH
Ground Surface Elevation (feet MSL):

Drilling Method: GEOPROBE
Boring Started: 10/21/02
Completed: 10/21/02
Boring Depth (feet bgs): 10.00
Boring Diameter (inches): 2.00

DEPTH (FEET)	DRIVE INTERVAL	RECOVERY (IN)	BLOW COUNTS	SAMPLE ID	OVM (PPM)	WATER LEVEL	GRAPHIC LOG	USCS SOIL TYPE	DESCRIPTION
									Ground Surface
0		24		290HP022				SM	Grass at the surface SILTY SAND: brownish yellow (10YR 6/8); dry; loose; medium sand; 60% sand; 30% silt; 5% gravel (<0.25 inches); sub-rounded SILT: brown (7.5YR 4/2); dry; medium stiff; 10% clay; 10% sand; trace gravel; trace rootlets
2		48		290HP023				GM	Becomes slightly moist at 3 feet; clay content increases to 20% Hard drilling at 5 feet (gravel lens) SILTY GRAVEL: brown (7.5YR 4/2); dry; loose; sub-angular to sub-rounded (up to 1 inch)
5.5								ML	CLAYEY SILT: yellowish brown (10YR 5/6); slightly moist; 65% silt; 35% clay; trace gravel
6		48		290HP024					Clay content increases with depth to 40% at 8 feet
10									Total depth of boring = 10 feet

Depth scale: 0–15 feet.

Tetra Tech EM

Log of Boring: 7SHSB109

Logged By: CAITLIN GORMAN
Logging Consultant:
Drilling Company: PRECISION

Project: CONCORD
Project No: G1058
Location: 7SH
Ground Surface Elevation (feet MSL):

Drilling Method: GEOPROBE
Boring Started: 10/21/02
Completed: 10/21/02
Boring Depth (feet bgs): 10.00
Boring Diameter (inches): 2.00

DEPTH (FEET)	DRIVE INTERVAL	RECOVERY (IN)	BLOW COUNTS	SAMPLE ID	OVM (PPM)	WATER LEVEL	GRAPHIC LOG	USCS SOIL TYPE	DESCRIPTION
									Ground Surface
0		24		290HP025				ML	Grass at the surface
1									SILT WITH GRAVEL: dark brown (7.5YR 3/2); dry; medium; soft; 65% silt; 20% gravel (angular up to 1 inch); 15% sand; trace rootlets
2		48							SILT; brown (7.5YR 4/3); slightly moist; stiff; 15% clay; trace gravel; trace rootlets
3				290HP026					
4									Becomes very stiff at 4 feet
									Same as above except trace sand
5									
6		48							Color changes to brownish yellow (10YR 6/6) at 6 feet
7									Sand content increases with depth to 10% at 7 feet
8									Color changes to yellowish brown (10YR 5/8) at 8.5 feet; 15% sand content
9				290HP027					Gravel lens at 9 feet (three inches thick); sub-rounded gravel up to 0.5 inches in diameter
10									Total depth of boring = 10 feet
11									
12									
13									
14									
15									

Tetra Tech EM

Log of Boring: 7SHSB110

Logged By: CAITLIN GORMAN
Logging Consultant:
Drilling Company: PRECISION

Project: CONCORD
Project No: G1058
Location: 7SH
Ground Surface Elevation (feet MSL):

Drilling Method: GEOPROBE
Boring Started: 10/21/02
Completed: 10/21/02
Boring Depth (feet bgs): 10.00
Boring Diameter (inches): 2.00

DEPTH (FEET)	DRIVE INTERVAL	RECOVERY (IN)	BLOW COUNTS	SAMPLE ID	OVM (PPM)	WATER LEVEL	GRAPHIC LOG	USCS SOIL TYPE	DESCRIPTION
									Ground Surface
0		24		290HP026				ML	Grass at surface
									SILT: brown (7.5YR 3/2); dry; loose; 15% gravel (up to 0.25 inches); sub-angular; 10% clay; trace rootlets
2		48							
3.5				290HP029					
5									Clay content increases to 15% at 5.5 feet
6		48							2.5 inches gravel clast at 6 feet (meta granodionite)
7									Becomes very stiff at 7 feet
9.5				290HP030					
10									Total depth of boring = 10 feet

Tetra Tech EM

Log of Boring: 7SHSB111

Logged By: CAITLIN GORMAN
Logging Consultant:
Drilling Company: PRECISION

Project: CONCORD
Project No: G1058
Location: 7SH
Ground Surface Elevation (feet MSL):

Drilling Method: GEOPROBE
Boring Started: 10/21/02
Completed: 10/21/02
Boring Depth (feet bgs): 10.00
Boring Diameter (inches): 2.00

DEPTH (FEET)	DRIVE INTERVAL	RECOVERY (IN)	BLOW COUNTS	SAMPLE ID	OVM (PPM)	WATER LEVEL	GRAPHIC LOG	USCS SOIL TYPE	DESCRIPTION
									Ground Surface
0		24						SM	Grass at the surface concrete from 0 to 0.75 feet
1				290HP031					SILTY SAND: brownish yellow (10YR 6/8); dry; loose; 65% sand; 30% silt; trace clay; trace gravel (up to 0.25 inches)
2		48							Clay content increases to 15% at 2 feet; sand content decreases SILT WITH SAND AND CLAY: brownish yellow (10YR 6/8); slightly moist; 25% clay, 15% sand; trace gravel (up to 0.25 inches)
3.5								ML	Clay content increases with depth Color changes to reddish yellow (7.5YR 6/8) at 5 feet, collected sample from 5 to 5.5 feet; sample is reddish yellow with sandy silt
5				290HP032					SANDY SILT: reddish yellow (7.5YR 6/8); slightly moist; loose; trace very fine white sand (7.5YR 8/1); 5% gravel (from 5 to 5.5 feet) Clay content increases; sand content decreases at 5.5 feet
6		48							CLAYEY SILT: dark brown (7.5YR 3/2); slightly moist; 65% silt; 30% clay; 5% gravel (up to 1 inch); lithology includes metamorphic and granodiorite clasts; sub-rounded Clay content increases with depth Clay content increases to 35% by 10 feet
9.5				290HP033					
10									Total depth of boring = 10 feet
11–15									

Tetra Tech EM

Log of Boring: 7SHSB113

Logged By: CAITLIN GORMAN
Logging Consultant:
Drilling Company: PRECISION

Project: CONCORD
Project No: G1058
Location: 7SH
Ground Surface Elevation (feet MSL):

Drilling Method: GEOPROBE
Boring Started: 10/21/02
Completed: 10/21/02
Boring Depth (feet bgs): 10.00
Boring Diameter (inches): 2.00

DEPTH (FEET)	DRIVE INTERVAL	RECOVERY (IN)	BLOW COUNTS	SAMPLE ID	OVM (PPM)	WATER LEVEL	GRAPHIC LOG	USCS SOIL TYPE	DESCRIPTION
0		24		290HP037					Ground Surface
								ML	Grass at surface
1									GRAVELLY SILT: brown (7.5YR 5/2); dry; loose; 20% gravel (up to 0.5 inches); sub-angular; 70% silt; 10% clay; trace rootlets; trace calcite deposits along rootlets
									Gravel lithology includes quartzite clasts (metarock); granodionite; greenstone; quartz vein and chert (gravel up to 1 inch diameter); trace caliche coating; some gravel fragments
2		48							Interval is heterogeneous (gravel sub-rounded throughout interval from 0 to 10 feet)
3				290HP038					
4									About 80% of clasts are quartzite and meta-granodionite and greenstone; 20% are chert or other
5									Clay content increases to 15% at 6 feet
6		48							
7									
8									
9				290HP039					
10									Total depth of boring = 10 feet
11									
12									
13									
14									
15									

Tetra Tech EM

Log of Boring: 7SHSB114

Logged By: CAITLIN GORMAN
Logging Consultant:
Drilling Company: PRECISION

Project: CONCORD
Project No: G1058
Location: 7SH
Ground Surface Elevation (feet MSL):

Drilling Method: GEOPROBE
Boring Started: 10/21/02
Completed: 10/21/02
Boring Depth (feet bgs): 10.00
Boring Diameter (inches): 2.00

DEPTH (FEET)	DRIVE INTERVAL	RECOVERY (IN)	BLOW COUNTS	SAMPLE ID	OVM (PPM)	WATER LEVEL	GRAPHIC LOG	USCS SOIL TYPE	DESCRIPTION
0		24		290HP040					Ground Surface
								ML	Grass at surface
1									GRAVELLY SILT: brown (7.5YR 5/2); dry; loose; 20% gravel (up to 1 inch); sub-rounded; 70% silt; 10% clay, trace rootlets; 40% granodionite; greenstone (meta rock); 10% chert; 10% quartz vein
2		48							Gravel content and grainsize decreases with depth
									SILT WITH GRAVEL: brown (7.5YR 5/2); dry; medium stiff; 70% silt; 15% gravel; 15% clay; trace rootlets
3									Clay content increases with depth
				290HP041					
4									
5									
6		40							CLAYEY SILT: very dark brown (7.5YR 2.5/2); slightly moist; stiff; 60% silt; 35% clay; 5% gravel; trace rootlets
7									Becomes very stiff at 7.5 feet
8									
9				290HP042					
10									Total depth of boring - 10 feet
11									
12									
13									
14									
15									

Tetra Tech EM

Log of Boring: 7SHSB115

Logged By: CAITLIN GORMAN
Logging Consultant:
Drilling Company: PRECISION

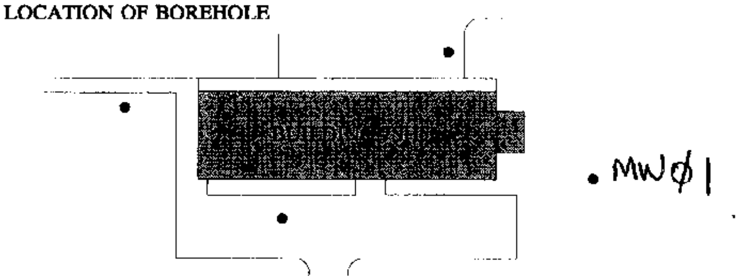
Project: CONCORD
Project No: G1058
Location: 7SH
Ground Surface Elevation (feet MSL):

Drilling Method: GEOPROBE
Boring Started: 10/21/02
Completed: 10/21/02
Boring Depth (feet bgs): 10.00
Boring Diameter (inches): 2.00

DEPTH (FEET)	DRIVE INTERVAL	RECOVERY (IN)	BLOW COUNTS	SAMPLE ID	OVM (PPM)	WATER LEVEL	GRAPHIC LOG	USCS SOIL TYPE	DESCRIPTION
0		24		290HP046					Ground Surface
								GM	Grass at the surface
1								ML	SILTY CLAY: brown (7.5YR 4/2); dry; loose; 20% silt; gravel (up to 1 inch (lithology equals siltstone); trace rootlets; sub-angular; grainsize decreases with depth
									SILT WITH GRAVEL: brown (7.5YR 4/2); dry; soft; 20% gravel (up to 0.5 inches); 15% clay; clay content increases with depth (trace meta gravel)
2		48							CLAYEY SILT: brown (7.5YR 4/2); dry; medium stiff; 70% silt; 20% clay; 10% gravel (up to 0.25 inches); trace sand
3				290HP047					Becomes slightly moist at 3 feet; stiffness increases with depth; very stiff by 4 feet; gravel content decreases to trace by 4 feet
4									CLAYEY SILT: very stiff and compacted
5									Trace gravel includes granite and metamorphic (up to 0.5 inches); sub-rounded; granodionite and meta-granodionite (gneiss)
6		48							
7									Sand content increases to 10% at 7 feet; color changes to brown (7.5YR 5/3)
8									
9				290HP048					
10									Total depth of boring = 10 feet
11									
12									
13									
14									
15									

SHEET 1 OF 4 **PRC BORING LOG** DATE: 1-29-97

PROJECT: Navy Clean II, Concord Naval Weapons Station	SITE ID: 7SH BORING ID: MW01
PROJECT MANAGER: Anju Vig	CHARGE NO.: 069-036B0202
PROJECT TASK: Site 22, Monitoring Well Installation	LOGGED BY: Jordie Bornstein
BACKFILL DATE: 1- -97 BY: Bay Area Exploration	MATERIAL: Powder Bentonite & Portland Cement
WEATHER: initial fog	BEGIN BORING: Ø9Ø6 FINISH BORING:
TOTAL DEPTH (ft bgs):	LOCATION OF BOREHOLE
WATER DEPTH (ft bgs):	



SYMBOLS: ⊻ Static water level; * Staining / Odor
CONTACTS: —— Distinct; - - - Inferred; ╲ Gradational

SAMPLE ID	SAMPLE TIME	SAMPLE DEPTH	PID SAMPLE (ppm) / Blow Counts	INCHES RECOVERED / INCHES DRIVEN	DEPTH (ft bgs)	USCS SOIL TYPE	MW PLACEMENT	DESCRIPTION
			5	6/6				Silty Sand (SM), 10YR 5/6 yellowish brown w/ trace gravel, fine-grained, poorly graded damp, med. dense, well sorted
Ø41 15 Ø367SHØØ6	Ø913	■	9	6/6	1			
			18	6/6				
	9		4 / 9	3/6	2			
	17		17	6/6				Clay (CH), 7.5YR 2.5/2 (very dark brown) with trace gravel, high plasticity, moist, hard
	26		6	6/6	3			
	22		20	3/6				
	21		22	6/6	4			
	22		21	6/6				
			20 / 28	6/6	5			Silt (ML), 10YR 6/5 Brownish Yellow fine-grained, low plasticity, ~~poorly graded~~, moist, with trace sand
Ø367SHØØ7	Ø930	■	50	5/6				
			25	Ø/6	6			
			42	6/6				Clay (CH), 7.5 YR 2.5/2 (very dark brown), with trace gravel, high plasticity, damp, hard (very!) and trace sand, and trace silt
			36	6/6	7			
			26	6/6				
			50	3/6	8			bottom of sampler (shoe) contained 2 inches of sand/gravel mixture → same as
					9			gravel (GP), ranges in size of gravel 5mm-40mm w/ little sand, poorly graded, well sorted, sub-rounded w/ little silt, dry.
					10			

PRC BORING LOG

DATE: 1-29-97

SITE ID: 7SH5 | BORING ID: MW01

PROJECT TASK: Site 22, Monitoring Well Installation

LOGGED BY: Jordin Bornstein

SYMBOLS: ∓ Static water level; * Staining / Odor

CONTACTS: —— Distinct; ---- Inferred; \ Gradational

SAMPLE ID	SAMPLE TIME	SAMPLE DEPTH	PID-SAMPLE (ppm) blow cnts	INCHES RECOVERED / INCHES DRIVEN	DEPTH (ft bgs)	DESCRIPTION
			14	6/6		
0367SH008	1020	■	38	6/4	11	
			36	6/6		
			50	4/6	12	
					13	
				6/6	14	
				6/6		
				6/6	15	Silty clay (CH), 10YR 4/3 (brown), trace sand and gravel, damp/moist, hard to very stiff, high plasticity
			8	6/6		
0367SS009	1040	■	18	6/6	16	
			21	6/6		
			25	6/6	17	
			9	6/6		w/little gravel
			12	6/6	18	Clayey silt (ML), 10 YR 4/3 (brown), trace sand and gravel, very stiff, low plasticity, moist
			15	6/6		
			15	3/6	19	Silty clay (CH) 10 YR 4/3 (brown), trace sand and gravel, moist, very stiff to hard, high plasticity w/trace mottled black organic/mineral matter
			11	6/6		
			18	6/6	20	
			6	6/6		
0367SS010	1109	■	9	6/6	21	
			12	6/6		
			18	6/6	22	

PRC BORING LOG

DATE: 1- -97

SITE ID: 7SH5 BORING ID: MW01
PROJECT TASK: Site 22, Monitoring Well Installation
LOGGED BY: Jordie Bornstein

SYMBOLS: ≚ Static water level; * Staining / Odor
CONTACTS: —— Distinct; - - - Inferred; ╲ Gradational

SAMPLE ID	SAMPLE TIME	SAMPLE DEPTH	~~PID SAMPLE (ppm)~~ blow cts	INCHES RECOVERED / INCHES DRIVEN	DRIVE INTERVAL	DEPTH (ft bgs)	USCS SOIL TYPE	MW PLACEMENT	Description
			8	6 / 6					
			21	6 / 6		23			
			23	6 / 6					
			9	6 / 6		24			grading to wet
			10	6 / 6					
			8	6 / 6		25	≚		static water level (after boring to 45') 1510
			8	6 / 6					
0367SH011 (SS)	1114	▮	10	6 / 6		26			
			12	6 / 6					
			22	6 / 6		27			Sandy Gravelly layer intermixed w/ silty clay (6" wide)
			15	6 / 6					back to silty clay (CH) as above (on previous page)
			20	6 / 6		28			
			22	6 / 6					~~Groundwater first~~ wet to saturated
			5	6 / 6		29			
			7	6 / 6			▼		groundwater first encountered at 29.5 feet @ 1145
			9	6 / 6		30			
			2						increasing amounts of gravel (20-25%) and even ~~cobbles~~ & pebbles up to 2cm - chert, possible river channel deposits
0367SH012 (SS)	1200	▮	8			31			back to wet - not saturated
			15	18 / 18					
			50	5		32			
			14						silty clay ~~still but~~ with less silt.
			23			33			
			20	14 / 18					
			14			34			gravel increases to 30%

PRC BORING LOG

DATE: 1-29-97

SITE ID: 7SH5 BORING ID: MW0[illegible]

PROJECT TASK: Site 22, Monitoring Well Installation

LOGGED BY: Jordi Bornstein

SYMBOLS: Static water level; * Staining / Odor
CONTACTS: —— Distinct; ---- Inferred; ╲ Gradational

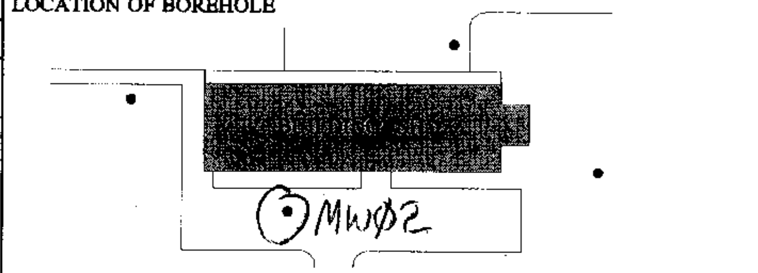
SAMPLE ID	SAMPLE TIME	SAMPLE DEPTH	blow cnts	INCHES RECOVERED / INCHES DRIVEN	DRIVE INTERVAL	DEPTH (ft bgs)	USCS SOIL TYPE	MW PLACEMENT	Description
			23	18 / 18					
			20	18 / 18					
			5			35			2-3 inch 70% gravel layer - saturated (CH)
Ø367SH5Ø13	122Ø		8						back to non-saturated, wet silty clay w/ little sand and silt,
			13			36			
			15	24 / 24					clayey
			5			37			Sandy Silt (ML), 10YR 4/4 Dark yellowish brown, wet w/ fine-grained sand, low plasticity, stiff
			1Ø						to very stiff
			15	16 / 16		38			
			5						
			8			39			
			11	16 / 14					
			8			40			Silty clay (CH), 10YR 4/4 Dark yellowish brown, ~~wet~~ w/ trace sand, very stiff to stiff
			1Ø						moist trace gravel
			12			41			
			9	24 / 24					2-inch 70% gravel layer - saturated @ 41.25'
			5			42			back to silty clay (CH) @ 41.5Ø [redacted] moist
			15						2-inch 70% gravel layer - saturated @ 42.75'
			15	16 / 16		43			back to silty clay (CH) @ 43.25' [redacted] moist
			7						
			12			44			~~2-inch 70% gravel layer - saturated~~
			14	16 / 16					~~back to silty clay (CH)~~
			17			45			2-inch 70% gravel layer - saturated
			17			46			back to silty clay (CH)

SHEET 1 OF 4

PRC BORING LOG

DATE: 1-30-97

PROJECT: Navy Clean II, Concord Naval Weapons Station	SITE ID: 7SH BORING ID: MW02
PROJECT MANAGER: Anju Vig	CHARGE NO.: 069-036B0202
PROJECT TASK: Site 22, Monitoring Well Installation	LOGGED BY: Hal Dawson
BACKFILL DATE: 1- -97 BY: Bay Area Exploration	MATERIAL: Powder Bentonite & Portland Cement
WEATHER: Cloudy, Cool ~55°F	BEGIN BORING: 1300 FINISH BORING: 1700
TOTAL DEPTH (ft bgs):	LOCATION OF BOREHOLE
WATER DEPTH (ft bgs):	



SYMBOLS: ⊻ Static water level; * Staining / Odor

CONTACTS: —— Distinct; - - - Inferred; ╲ Gradational

SAMPLE ID	SAMPLE TIME	SAMPLE DEPTH	PID-SAMPLE (ppm) / Background	INCHES RECOVERED / INCHES DRIVEN	DRIVE INTERVAL	DEPTH (ft bgs)	USCS SOIL TYPE	MW PLACEMENT	DESCRIPTION
						0			2½" (.15') Asphalt Baserock
			25	15/24		1			Silty Clay (CH), 7.5YR 5/8 strong brown, moist, stiff, with little gravel and trace sand.
			30						
Ø367SHSSØ1A	132Ø	■	27			2			Same as above
			32						
			60	18/18		3			
			8						Same as above.
Ø367SHSS015	1328	■	12			4			
			8	18/18					Clay (CH), 1ØYR 3/1 very dark gray, moist, very stiff, with trace gravel. Gravel is well rounded.
			15			5			
			22						
			9	21/24		6			Same as above.
			19						
Ø367SHSSØ16	1345	■	25	15/18		7			Same as above, color change to 7.5YR 3/4 dark brown.
			38						
			10	15/18		8			
			14						
			19			9			Same as above
						10			

PRC BORING LOG

DATE: 1-30-97

SITE ID: 7SH5 BORING ID: MW02

PROJECT TASK: Site 22, Monitoring Well Installation

LOGGED BY: Hal Dawson

SYMBOLS: ▽ Static water level; * Staining / Odor

CONTACTS: —— Distinct; - - - - Inferred; \ Gradational

SAMPLE ID	SAMPLE TIME	PID-SAMPLE (ppm)	INCHES RECOVERED / INCHES DRIVEN	DEPTH (ft bgs)	USCS SOIL TYPE	DESCRIPTION
		9	18/24			
		14				
Ø367SHSSØ17	1405	15		11	SP	Sand (SP), 7.5YR 4/6 strong brown, medium grained, moist, med. dense, with some silt.
						Clayey Silt (ML), 7.5YR 4/6, strong brown, moist, med stiff.
		12			ML	
		10	15/18	12	GP	Sandy Gravel (GP), 7.5YR 4/6 strong brown, medium grain size, moist, med. dense.
		12				
		6		13		Silty Clay (CH), 7.5YR 4/6 strong brown, moist, med. stiff, trace gravel.
		4	12/18			
		6		14		
		9				Same as above.
		6	19/24	15		
Ø367SHSSØ18	1435	12				
		18		16		Same as above, gravel size noticeably larger, up to 2" diameter
		20				
		6	14/18	17		
		8				Same as above, gravel size back to ~1" diam. and smaller.
		12		18		Silt + clay percentages very close to 50/50.
		4	16/18			
		4		19		Same as above, moist to wet.
		6				
Ø367SHSSØ19	1515	15	11/11	20		Silty Gravel (GP), 7.5YR 4/6 strong brown, medium grain size, moist, v. dense.
		50/5				
				21		Same, extremely dense. Sampler bounces on gravel. Drill to 25' to continue sampling.
				22		

PRC BORING LOG

DATE: 1-30-97

SITE ID: 7SH5 BORING ID: MW02
PROJECT TASK: Site 22, Monitoring Well Installation
LOGGED BY: Hal Dawson

SYMBOLS: ⚲ Static water level; * Staining / Odor
CONTACTS: —— Distinct; ---- Inferred; ╲ Gradational

SAMPLE ID	SAMPLE TIME	SAMPLE DEPTH	PID-SAMPLE (ppm)	INCHES RECOVERED / INCHES DRIVEN	DEPTH (ft bgs)	DESCRIPTION
					23	Silty Clay (CH), 10YR 5/4 Yellowish Brown, moist, stiff, with little sand.
					24	Same as above.
			8	22/24	25	
Ø367SHSSØ2Ø	1537	■	15			Same as above with trace sand, moist. Iron oxide staining apparent.
			2Ø		26	
			22			
			1Ø	15/18	27	Same as above. Silt+clay percentages approx 5Ø/5Ø. Dry to moist.
			12			
			14		28	
			7	16/18		
			11		29	Same as above, moist to wet.
			13			Center bit came up dripping (wet) from 3Ø' bgs. GW first encountered at 3Ø'.
			6	21/24	30	
Ø367SHSSØ21	163Ø	■	18			
			26		31	
			38			At 164Ø water measured in boring at 22' bgs. To construct well in remaining daylight hours, drill to 35' without further sampling and set well.
					32	
					33	
					34	

PRC BORING LOG

DATE: 1-30-97

SITE ID: 7SH5 BORING ID: MW02

PROJECT TASK: Site 22, Monitoring Well Installation

LOGGED BY: Hal Dawson

SYMBOLS:
- ⊻ Static water level
- * Staining / Odor

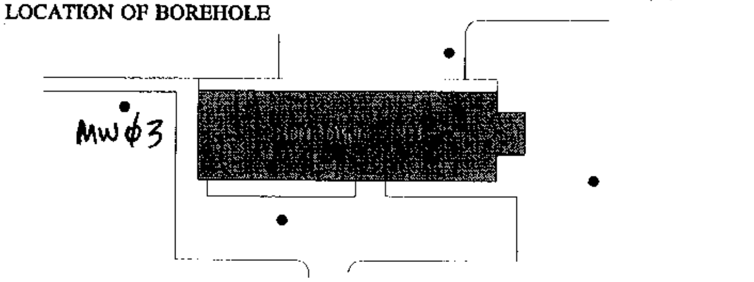
CONTACTS:
- —— Distinct
- ---- Inferred
- \ Gradational

SAMPLE ID	SAMPLE TIME	SAMPLE DEPTH	PID-SAMPLE (ppm)	INCHES RECOVERED / INCHES DRIVEN	DRIVE INTERVAL	DEPTH (ft bgs)	USCS SOIL TYPE	MW PLACEMENT	
						35			Total depth - 35' bgs.
						36			
						37			
						38			
						39			
						40			
						41			
						42			
						43			
						44			
						45			
						46			

PRC BORING LOG

DATE: 1-27-97

PROJECT: Navy Clean II, Concord Naval Weapons Station	SITE ID: 7SH BORING ID: MW03
PROJECT MANAGER: Anju Vig	CHARGE NO.: 069-036B0202
PROJECT TASK: Site 22, Monitoring Well Installation	LOGGED BY: Hal Dawson
BACKFILL DATE: 1- -97 BY: Bay Area Exploration	MATERIAL: Powder Bentonite & Portland Cement
WEATHER: Cloudy, Cool, ~50°F	BEGIN BORING: 1055 FINISH BORING: 1600
TOTAL DEPTH (ft bgs): 50' bgs.	LOCATION OF BOREHOLE
WATER DEPTH (ft bgs): 25.75' bgs – first encountered.	



SYMBOLS: ▼ Static water level; * Staining / Odor
CONTACTS: —— Distinct; - - - Inferred; ╲ Gradational

SAMPLE ID	SAMPLE TIME	SAMPLE DEPTH	PID-SAMPLE (ppm)	INCHES RECOVERED / INCHES DRIVEN	Blow Ct	DEPTH (ft bgs)	USCS SOIL TYPE	MW PLACEMENT	DESCRIPTION
			4	3 / 6	4				
0367SH55001	1100	■	8	6 / 6	8	1			Silty Sand (SM), 2.5Y5/6 light olive brown, w/ trace gravel, fine-grained, poorly graded, damp, med. dense, small rootlets
			12	6 / 6	12				
				12 / 60		2			
						3			Same as above
						4			Same as above
						5			Same as above
						6			
			5	15 / 18					Clay (CH), 7.5YR 3/2 dark brown, with trace gravel, high plasticity, moist, stiff
0367SH55002	1120	■	11			7			
			17						
				36 / 54		8			Same as above
						9			Same as above
						10			

PRC BORING LOG

DATE: 1-27-97

SITE ID: 7SH5 BORING ID: MW03

PROJECT TASK: Site 22, Monitoring Well Installation

LOGGED BY: Hal Dawson

SYMBOLS: Static water level; * Staining / Odor

CONTACTS: —— Distinct; ---- Inferred; \ Gradational

SAMPLE ID	SAMPLE TIME	PID-SAMPLE (ppm)	INCHES RECOVERED / INCHES DRIVEN	DEPTH (ft bgs)	DESCRIPTION
					Same w/ little silt, color change to 1ØYR 3/4, dark yellowish brown.
				11	
					Silt (ML), 1ØYR 3/4, dark yellowish brown, with trace gravel, low plasticity, moist, stiff, with little rootlet holes, up to 1 mm in diam (~1Ø%)
		6	18/18	12	
Ø3675HSSØØ3	1145	9			
		1Ø		13	Same as above
			14/54	14	
				15	
				16	
				17	Same as above, color change to 1ØYR 4/4, dark yellowish brown.
		1Ø	15/18	18	Same w/ 1ØYR 2/2 very dark brown mottling.
Ø3675HSSØØ4	12ØØ	17			
		19		19	Silty Sand (SM), 1ØYR 4/6 dark yellowish brown, fine grained, poorly graded, moist,
		4	15/18		
		6		20	
		7			Silt (ML), 1ØYR 5/6 yellowish brown, low plasticity, moist, medium stiff, w/trace organic material.
		6	18/18	21	
		12		22	Same with trace gravel and trace organic material

PRC BORING LOG

DATE: 1-27-97

SITE ID: 7SH5 BORING ID: MW03

PROJECT TASK: Site 22, Monitoring Well Installation

LOGGED BY: Hal Dawson

SYMBOLS: ▼ Static water level; * Staining / Odor

CONTACTS: —— Distinct; - - - - Inferred; ╲ Gradational

SAMPLE ID	SAMPLE TIME	SAMPLE DEPTH	PID-SAMPLE (ppm)	INCHES RECOVERED / INCHES DRIVEN	DEPTH (ft bgs)	USCS SOIL TYPE	MW PLACEMENT	DESCRIPTION
			14					Same as above.
			6	15/18				
					23			
			7					
			8					Same as above.
					24			
			3	18/18				
0367SHSS005	1406		12					Same - wet zone from [illegible] 24.25 to 24.75'
					25			
			18					Same - moist from [illegible] 24.75 to
			11	15/18	▼			No Sand Layer Apparent in core, but fine grained sand from this depth found on exterior of sampler + top of sample/core. Groundwater 1st encountered at 25.75'.
					26			
			18					
			24					[illegible] Same as above with little sand - sand in pockets or fractures [illegible] (not layers), sand is 10YR 6/2 light brownish gray.
				30/36	27			
					28			Same w/ trace gravel, gradational increase in clay - [illegible] trace clay?
					29			
								Same as above
				36/36	30			
					31			
								Same as above, with little clay. Increase in mottling, Fe oxide staining.
					32			
				34/36	33			
								Same as above, with some clay.
								Silty Sand (SM), 7.5YR 4/6 [illegible] Strong Brown, very fine-grained sand, poorly graded, saturated, loose.
					34			

PRC BORING LOG

DATE: 1-27-97

SITE ID: 7SH5 BORING ID: MW03

PROJECT TASK: Site 22, Monitoring Well Installation

LOGGED BY: Hal Dawson

SYMBOLS: ∓ Static water level; * Staining / Odor

CONTACTS: —— Distinct; ---- Inferred; \ Gradational

SAMPLE ID	SAMPLE TIME	SAMPLE DEPTH	PID-SAMPLE (ppm)	INCHES RECOVERED / INCHES DRIVEN	DRIVE INTERVAL	DEPTH (ft bgs)	USCS SOIL TYPE	MW PLACEMENT	DESCRIPTION
									Same as above
						35			
									Silty Clay (CH) 5YR 4/4 Reddish Brown, mottled, high plasticity, moist, very stiff.
				36 / 36		36			
						37			Same, no mottling – solid reddish brown, containing trace sand + trace gravel
						38			Same w/ sand + gravel zones up to 3 inches thick, sand + gravel zones do not appear to be saturated... but wet.
				36 / 36		39			Sandy Gravel (GP), 7.5YR 4/3 brown, well graded, poorly sorted saturated, med. dense.
						40			Clayey Silt (ML), 7.5YR 4/3 brown, with occasional trace gravel, moist, stiff.
						41			Same w/ occasional sandy zones (little sand),
						42			
									Silt (ML), 7.5YR 4/3 brown, with trace sand, wet, soft to med. stiff.
				~~30~~ / 36		43			
						44			Same as above
						45			Silty Clay (CH), 7.5YR 4/3 brown, occasionally has trace sand, damp, hard.
						46			

PRC BORING LOG

DATE: 1-27-97

SITE ID: 7SH5 BORING ID: MW03

PROJECT TASK: Site 22, Monitoring Well Installation

LOGGED BY: Hal Dawson

SYMBOLS:
- Static water level
- * Staining / Odor

CONTACTS:
- ——— Distinct
- - - - - Inferred
- \ Gradational

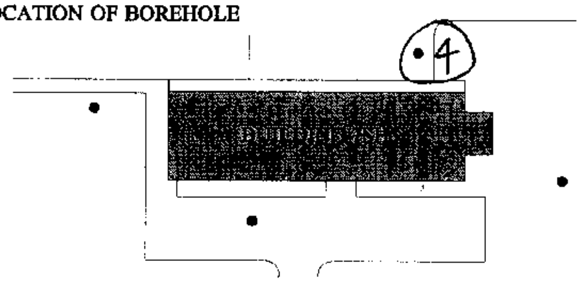
SAMPLE ID	SAMPLE TIME	SAMPLE DEPTH	PID-SAMPLE (ppm)	INCHES RECOVERED / INCHES DRIVEN	DRIVE INTERVAL	DEPTH (ft bgs)	USCS SOIL TYPE	MW PLACEMENT	DESCRIPTION
				6 / 48					
						47			Same as above
						48			Soft material based on drillers feel when pushing in core barrel. Little to no recovery - Unsure of material encountered.
						49			
						50			Sandy Gravel (GP) w/silt 7.5YR 4/3 brown, well graded, poorly sorted, saturated, med. dense.
									TD - 50 feet bgs
						51			
						52			
						53			
						54			
						55			
						56			
						57			
						58			

SHEET 1 OF 3

PRC BORING LOG

DATE: 2-3-97

PROJECT: Navy Clean II, Concord Naval Weapons Station	SITE ID: 7SH BORING ID: MW04
PROJECT MANAGER: Anju Vig	CHARGE NO.: 069-036B0202
PROJECT TASK: Site 22, Monitoring Well Installation	LOGGED BY: Hal Dawson
BACKFILL DATE: 1- -97 BY: Bay Area Exploration	MATERIAL: Powder Bentonite & Portland Cement
WEATHER: Cool, Cloudy	BEGIN BORING: Ø855 FINISH BORING: 1Ø3Ø
TOTAL DEPTH (ft bgs):	LOCATION OF BOREHOLE
WATER DEPTH (ft bgs):	



[redacted]

SYMBOLS: ▼ Static water level; * Staining / Odor

CONTACTS: —— Distinct; ---- Inferred; ╲ Gradational

SAMPLE ID	SAMPLE TIME	SAMPLE DEPTH	PID-SAMPLE (ppm)	INCHES RECOVERED / INCHES DRIVEN	DRIVE INTERVAL	DEPTH (ft bgs)	USCS SOIL TYPE	MW PLACEMENT	DESCRIPTION
			5	16/24		1			Silt (ML), 1ØYR 5/6 Yellowish Brown, moist, med. stiff, with little sand.
			8						
Ø367SHSSØ22	Ø9ØØ	■	12			2			Same as above.
			2Ø						
			7	12/18		3			Same as above with trace gravel.
			7						
			9			4			
			5	18/18					
			7			5			Clay (CH), 1ØYR 3/3 dark brown, moist, stiff to very stiff, with trace sand and trace gravel.
			12						
			8	1Ø/18		6			
			25						
Ø367SHSSØ23	Ø915	■	33			7			
			5	16/18					Silty Clay (CH), 1ØYR 4/4 dark yellowish brown, moist, stiff, with trace sand and trace gravel.
			9			8			
			12						Same as above
			3	18/18		9			
			4						
			8			10			Same as above

SHEET 2 OF 3

PRC BORING LOG

DATE: 2-3-97

SITE ID: 7SH5 BORING ID: MW04

PROJECT TASK: Site 22, Monitoring Well Installation

LOGGED BY: Hal Dawson

SYMBOLS: ▼ Static water level; * Staining / Odor

CONTACTS: —— Distinct; - - - - Inferred; \ Gradational

SAMPLE ID	SAMPLE TIME	PID-SAMPLE (ppm)	INCHES RECOVERED / INCHES DRIVEN	DEPTH (ft bgs)	MW PLACEMENT	DESCRIPTION
		5	18/24			Same as above, moist to wet.
		6				
Ø367SH5SØ24	Ø924	11		11		
		12				Same as above
		5	15/18	12		
		5				Same as above, gravelly sand zone approx
		5		13		2" thick at 13'. Sand is medium grained.
		5	18/18			
		8		14		
		12				Same as above
		6	15/24	15		
		10				
Ø367SH5SØ25	Ø940	19		16		Same as above.
		24				
		5	18/18	17		
		9				Same as above, with black staining.
		11		18		
		21	18/18			
		9		19		Same as above, sandy gravel zone from 19 to 19.5' Gravel is coarse to very coarse.
		8				
		3	24/24	20		Same as above with iron oxide staining
		9			▽	GW first encountered at 21'.
Ø367SH5SØ26	1ØØ4	16		21		
		21		22		Same as above, wet.

SHEET 3 OF 3

PRC BORING LOG

DATE: 2-3-97

SITE ID: 7SH5 | BORING ID: MW04

PROJECT TASK: Site 22, Monitoring Well Installation

LOGGED BY: Hal Dawson

SYMBOLS: ▽ Static water level; * Staining / Odor

CONTACTS: —— Distinct; - - - Inferred; ╲ Gradational

SAMPLE ID	SAMPLE TIME	SAMPLE DEPTH	PID-SAMPLE (ppm)	INCHES RECOVERED / INCHES DRIVEN	DEPTH (ft bgs)	USCS SOIL TYPE	MW PLACEMENT	DESCRIPTION
			9					
			28					
			37		23			Same as above. 22 to 25', poor recovery. Slough in sampler is sand + gravel, so sandy gravel or gravelly sand zone likely at approx 22 and 24' bgs. Sampler saturated but silty clay material moist to wet.
			2	3 / 18				
			2		24			
			3					
			5	18 / 24	25			
			7					Same as above with occasional fine sand layers 2 to 3" thick.
			13		26			
			18					
			23	18 / 18	27			
			9					Same as above w/ medium sand layer at 27.5-28'
			8		28			
			9	16 / 18				
			18		29			Same as above. No sand zones last 2' of boring. Increase in gravel to some gravel (~20%).
			23					
					30			TD 30' bgs
					31			
					32			
					33			
					34			

MONTGOMERY WATSON
365 Lennon Lane
Walnut Creek,
California 94598
(510) 975-3400

CLIENT	PROJECT NUMBER	LOCATION
CONCORD WPNSTA	CTO 303	INLAND AREA

DRILLING AND SAMPLING METHODS: Geoprobe

				START	FINISH
Water Level					
Time				TIME	TIME
Date				DATE 5/5/95	DATE 5/5/95

LOG OF SOIL BORING: 7SHSB001

Coordinates: **Building 7SH5**

SURFACE CONDITIONS: **bare soil**

GEOLOGIST: **D.WINTER**

DEPTH (ft)	PID (ppm)	USCS	GRAPHIC LOG	DESCRIPTION	FEATURES/REMARKS
0–4	190.0	CL		Silty CLAY, Occasional Gravel, 10YR 5/4, moderate structure, firm, poor gradation, moist, plastic, few pores/paths, majority fines, <10% coarse	black stain (diesel) at surface, strong fuel odor, stain patches at 0.5, 2.5 and 3.5 feet
4				End of Boring at 4.0 ft	

Depth scale: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

MONTGOMERY WATSON

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CLIENT	PROJECT NUMBER	LOCATION
CONCORD WPNSTA	CTO 303	INLAND AREA

DRILLING AND SAMPLING METHODS: Geoprobe

				START	FINISH
Water Level					
Time				TIME	TIME
Date				DATE 5/5/95	DATE 5/5/95

LOG OF SOIL BORING: 7SHSB002

Coordinates: **Building 7SH5**

SURFACE CONDITIONS: **bare soil**

GEOLOGIST: **D.WINTER**

DEPTH (ft)	PID (ppm)	USCS	GRAPHIC LOG	DESCRIPTION	FEATURES/REMARKS
0–4	0.0	CL		Silty CLAY, Occasional Gravel, 10YR 5/4, moderate structure, firm, poor gradation, moist, slightly plastic, few pores/paths, majority fines, <10% coarse	
4				End of Boring at 4.0 ft	

Depth scale: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

12738 ID: WALNUT1

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CLIENT	PROJECT NUMBER	LOCATION
CONCORD WPNSTA	CTO 303	INLAND AREA

DRILLING AND SAMPLING METHODS: Geoprobe

Water Level				START	FINISH
Time				TIME	TIME
Date				DATE 5/5/95	DATE 5/5/95

LOG OF SOIL BORING: **7SHSB003**

Coordinates: **Building 7SH5**

SURFACE CONDITIONS: grass

GEOLOGIST: D.WINTER

DEPTH (ft)	PID (ppm)	USCS	GRAPHIC LOG	Description	FEATURES/REMARKS
0		SC		Clayey SAND, Occasional Gravel, 10YR 5/4, weak structure, loose, poor gradation, moist, nonplastic, many pores/paths, 20% fines, majority coarse	
1	0.0				
2.5		CL		Silty CLAY, Occasional Gravel, 10YR 5/4, moderate structure, firm, poor gradation, moist, slightly plastic, few pores/paths, majority fines, <10% coarse	
4				End of Boring at 4.0 ft	

Depth scale: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

MONTGOMERY WATSON 365 Lennon Lane Walnut Creek, California 94598 (510) 975-3400	CLIENT CONCORD WPNSTA	PROJECT NUMBER CTO 303	LOCATION INLAND AREA
	DRILLING AND SAMPLING METHODS: Geoprobe		

LOG OF SOIL BORING: 7SHSB004

Coordinates: **Building 7SH5**

Water Level				START	FINISH
Time				TIME	TIME
Date				DATE 5/5/95	DATE 5/5/95

SURFACE CONDITIONS: **grass**

GEOLOGIST: **D.WINTER**

DEPTH (ft)	PID (ppm)	USCS	GRAPHIC LOG	DESCRIPTION	FEATURES/REMARKS
0–2.5	0.0 (at 1 ft)	SC		Clayey SAND, Occasional Gravel, 10YR 5/4, weak structure, loose, poor gradation, moist, nonplastic, many pores/paths, 20% fines, majority coarse	
2.5–4		CL		Silty CLAY, Occasional Gravel, 10YR 5/4, moderate structure, firm, poor gradation, moist, slightly plastic, few pores/paths, majority fines, <10% coarse	
4				End of Boring at 4.0 ft	

Depth scale: 1 2 3 4 5 6 7 8 9 10

12738 ID: WALNUT1

MONTGOMERY WATSON
365 Lennon Lane
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CLIENT	PROJECT NUMBER	LOCATION
CONCORD WPNSTA	CTO 303	INLAND AREA

DRILLING AND SAMPLING METHODS: Geoprobe

Water Level				START	FINISH
Time				TIME	TIME
Date				DATE 5/5/95	DATE 5/5/95

LOG OF SOIL BORING: 7SHSB005

Coordinates: **Building 7SH5**

SURFACE CONDITIONS: **grasses/gravel**

GEOLOGIST: **D.WINTER**

DEPTH (ft)	PID (ppm)	USCS	GRAPHIC LOG	DESCRIPTION	FEATURES/REMARKS
0–4	0.0	CL		Silty CLAY, Occasional Gravel, 10YR 5/4, moderate structure, firm, poor gradation, moist, slightly plastic, few pores/paths, majority fines, <10% coarse	
4				End of Boring at 4.0 ft	

Depth scale (ft): 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

12738 ID: WALNUT1

MONTGOMERY WATSON
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(510) 975-3400

CLIENT	PROJECT NUMBER	LOCATION
CONCORD WPNSTA	CTO 303	INLAND AREA

DRILLING AND SAMPLING METHODS: Geoprobe

Water Level				START	FINISH
Time				TIME	TIME
Date				DATE 5/5/95	DATE 5/5/95

LOG OF SOIL BORING: 7SHSB006

Coordinates: **Building 7SH5**

SURFACE CONDITIONS: **overlying soil**

GEOLOGIST: **D.WINTER**

DEPTH (ft)	PID (ppm)	USCS	GRAPHIC LOG	DESCRIPTION	FEATURES/REMARKS
0–4		CL		Silty CLAY, Occasional Gravel, 10YR 5/4, moderate structure, firm, poor gradation, moist, slightly plastic, few pores/paths, majority fines, <10% coarse	
2	0.0				
4				End of Boring at 4.0 ft	

Depth scale: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

\2736 ID: WALNUT1

MONTGOMERY WATSON	365 Lennon Lane Walnut Creek, California 94598 (510) 975-3400	CLIENT: CONCORD WPNSTA	PROJECT NUMBER: CTO 303	LOCATION: INLAND AREA

DRILLING AND SAMPLING METHODS: Geoprobe

				START	FINISH
Water Level					
Time				TIME	TIME
Date				DATE 5/5/95	DATE 5/5/95

LOG OF SOIL BORING: **7SHSB007**

Coordinates: **Building 7SH5**

SURFACE CONDITIONS: **overlying soil**

GEOLOGIST: **D.WINTER**

DEPTH (ft)	PID (ppm)	USCS	GRAPHIC LOG	Description	FEATURES/REMARKS
0–3.5	3.0 (2–3 ft)	SC		Clayey SAND, Occasional Gravel, 2.5Y 6/2, 5YR 6/6, weak structure, loose, poor gradation, moist, nonplastic, many pores/paths, 20% fines, majority coarse	gray color in weak sand lens (stain), PID Of 3.0 ppm
3.5				End of Boring at 3.5 ft	

Depth scale: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

12738 ID: WALNUT1

MONTGOMERY WATSON	365 Lennon Lane Walnut Creek, California 94598 (510) 975-3400	CLIENT CONCORD WPNSTA	PROJECT NUMBER CTO 303	LOCATION INLAND AREA

DRILLING AND SAMPLING METHODS: Geoprobe

LOG OF SOIL BORING: 7SHSB008

Coordinates: **Building 7SH5**

				START	FINISH
Water Level					
Time				TIME	TIME
Date				DATE 5/5/95	DATE 5/5/95

SURFACE CONDITIONS: **overlying soil**

GEOLOGIST: **D.WINTER**

DEPTH (ft)	PID (ppm)	USCS	GRAPHIC LOG	DESCRIPTION	FEATURES/REMARKS
0–3.5	0.0 (at 2.5)	CL		Silty CLAY, Occasional Gravel, 10YR 5/4, weak structure, moderate, poor gradation, moist, slightly plastic, few pores/paths, majority fines, 20% coarse	
3.5				End of Boring at 3.5 ft	

Depth scale: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

\2738 ID: WALNUT1

MONTGOMERY WATSON
365 Lennon Lane
Walnut Creek,
California 94598
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CLIENT	PROJECT NUMBER	LOCATION
CONCORD WPNSTA	CTO 303	INLAND AREA

DRILLING AND SAMPLING METHODS: Geoprobe

Water Level				START	FINISH
Time				TIME	TIME
Date				DATE 5/5/95	DATE 5/5/95

LOG OF SOIL BORING: 7SHSB009

Coordinates: **Building 7SH5**

SURFACE CONDITIONS: **overlying soil**

GEOLOGIST: **D.WINTER**

DEPTH (ft)	PID (ppm)	USCS	GRAPHIC LOG	DESCRIPTION	FEATURES/REMARKS
0–3.5	0.0 (at 2.5)	CL		Silty CLAY, Occasional Gravel, 10YR 5/4, weak structure, moderate, poor gradation, moist, slightly plastic, few pores/paths, majority fines, 20% coarse	
3.5				End of Boring at 3.5 ft	

Depth scale: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

12738 ID: WALNUT1

MONTGOMERY WATSON	365 Lennon Lane Walnut Creek, California 94598 (510) 975-3400

CLIENT	PROJECT NUMBER	LOCATION
CONCORD WPNSTA	CTO 303	INLAND AREA

DRILLING AND SAMPLING METHODS: Geoprobe

Water Level				START	FINISH
Time				TIME	TIME
Date				DATE 5/4/95	DATE 5/5/95

LOG OF SOIL BORING: 7SHSB013

Coordinates: Building 7SH5

SURFACE CONDITIONS: grasses

GEOLOGIST: D.WINTER

DEPTH (ft)	PID (ppm)	USCS	GRAPHIC LOG	DESCRIPTION	FEATURES/REMARKS
0–1	0.0	OL		Silty CLAY with Sand, 10YR 3/3, weak structure, moderate, poor gradation, moist, slightly plastic, many pores/paths, majority fines, <10% coarse	
1–3		ML		SILT, Fine SAND, 2.5Y 7/3, weak structure, loose, poor gradation, moist, nonplastic, many pores/paths, majority fines, 40% coarse	
3–8	0.0 (at 7 ft)	CH		CLAY, 10YR 3/6, strong structure, very firm, poor gradation, moist, very plastic, no pores/paths, majority fines, <10% coarse	
8				End of Boring at 8.0 ft	

Depth scale: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

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CLIENT	PROJECT NUMBER	LOCATION
CONCORD WPNSTA	CTO 303	INLAND AREA

DRILLING AND SAMPLING METHODS: Geoprobe

Water Level				START	FINISH
Time				TIME	TIME
Date				DATE 5/5/95	DATE 5/5/95

LOG OF SOIL BORING: 7SHSB014

Coordinates: **Building 7SH5**

SURFACE CONDITIONS: grasses

GEOLOGIST: D.WINTER

DEPTH (ft)	PID (ppm)	USCS	GRAPHIC LOG	DESCRIPTION	FEATURES/REMARKS
0	0.0	SM		Silty SAND, Occasional Gravel, 10YR 6/6, weak structure, loose, poor gradation, moist, nonplastic, many pores/paths, 10% fines, majority coarse	
2		OL		Silty CLAY, Occasional Gravel, 10YR 3/2, strong structure, firm, poor gradation, moist, plastic, few pores/paths, majority fines, <10% coarse	
7	0.0				
8				End of Boring at 8.0 ft	

Depth scale: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

MONTGOMERY WATSON	365 Lennon Lane Walnut Creek, California 94598 (510) 975-3400	CLIENT: CONCORD WPNSTA	PROJECT NUMBER: CTO 303	LOCATION: INLAND AREA

DRILLING AND SAMPLING METHODS: Geoprobe

Water Level				START	FINISH
Time				TIME	TIME
Date				DATE 5/10/95	DATE 5/10/95

LOG OF SOIL BORING: **7SHSB015**

Coordinates: **Building 7SH5**

SURFACE CONDITIONS: **grasses**

GEOLOGIST: **Y.LEUNG/D.WINTER**

DEPTH (ft)	PID (ppm)	USCS	GRAPHIC LOG	DESCRIPTION	FEATURES/REMARKS
0	1.0	OL		CLAY, 10YR 3/2, strong structure, firm, poor gradation, moist, plastic, few pores/paths, majority fines, <10% coarse	
3	1.0				
4				End of Boring at 4.0 ft	

Depth scale: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

MONTGOMERY WATSON 365 Lennon Lane Walnut Creek, California 94598 (510) 975-3400	CLIENT CONCORD WPNSTA	PROJECT NUMBER CTO 303	LOCATION INLAND AREA

DRILLING AND SAMPLING METHODS: Geoprobe

				START	FINISH
Water Level					
Time				TIME	TIME
Date				DATE 5/10/95	DATE 5/10/95

LOG OF SOIL BORING: **7SHSS020**

Coordinates: **Building 7SH5**

SURFACE CONDITIONS: grasses

GEOLOGIST: Y.LEUNG/D.WINTER

DEPTH (ft)	PID (ppm)	USCS	GRAPHIC LOG	DESCRIPTION	FEATURES/REMARKS
0	1.0	OL		CLAY, 10YR 3/2, strong structure, firm, poor gradation, moist, plastic, few pores/paths, majority fines, <10% coarse	
4.5		CL		CLAY, 10YR 5/4, strong structure, firm, poor gradation, moist, plastic, few pores/paths, majority fines	sandy gravel with clay lens at 3.5 feet

Depth scale: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

\2798 ID: WALNUT1

MONTGOMERY WATSON
365 Lennon Lane
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California 94598
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CLIENT	PROJECT NUMBER	LOCATION
CONCORD WPNSTA	CTO 303	INLAND AREA

LOG OF SOIL BORING: **7SHSS020**

Depth	USCS	Description
	CL	CLAY continued
11		End of Boring at 11.0 ft
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		

MONTGOMERY WATSON	365 Lennon Lane Walnut Creek, California 94598 (510) 975-3400	CLIENT CONCORD WPNSTA	PROJECT NUMBER CTO 303	LOCATION INLAND AREA

DRILLING AND SAMPLING METHODS: Geoprobe

LOG OF SOIL BORING: 7SHSB021

Coordinates: Building 7SH5

				START	FINISH
Water Level					
Time				TIME	TIME
Date				DATE 5/10/95	DATE 5/10/95

SURFACE CONDITIONS: grasses

GEOLOGIST: Y.LEUNG/D.WINTER

DEPTH (ft)	PID (ppm)	USCS	GRAPHIC LOG	DESCRIPTION	FEATURES/REMARKS
0–3	1.0	OL		CLAY, 10YR 3/2, strong structure, firm, poor gradation, moist, plastic, few pores/paths, majority fines, <10% coarse	
3–10		CL		CLAY, 10YR 5/4, strong structure, firm, poor gradation, moist, plastic, few pores/paths, majority fines, <10% coarse	sandy gravel with clay lens at 3.5 feet

\2730 (D: WALNUT)

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CLIENT	PROJECT NUMBER	LOCATION
CONCORD WPNSTA	CTO 303	INLAND AREA

LOG OF SOIL BORING: **7SHSB021**

Depth			USCS		Description
	1.0		CL		CLAY continued
11					End of Boring at 11.0 ft
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					

MONTGOMERY WATSON
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(510) 975-3400

CLIENT	PROJECT NUMBER	LOCATION
CONCORD WPNSTA	CTO 303	INLAND AREA

DRILLING AND SAMPLING METHODS: Geoprobe

				START	FINISH
Water Level					
Time				TIME	TIME
Date				DATE 5/10/95	DATE 5/10/95

LOG OF SOIL BORING: 7SHSB022

Coordinates: **Building 7SH5**

SURFACE CONDITIONS: **grasses**

GEOLOGIST: **Y.LEUNG/D.WINTER**

DEPTH (ft)	PID (ppm)	USCS	GRAPHIC LOG	DESCRIPTION	FEATURES/REMARKS
0–3.5	0.0	OL		CLAY, 10YR 3/2, strong structure, firm, poor gradation, moist, plastic, few pores/paths, majority fines, 0.5% coarse	
3.5–10		CL		CLAY, 10YR 5/4, strong structure, firm, poor gradation, moist, plastic, few pores/paths, majority fines, <10% coarse	sandy gravel with clay lens at 5.0 feet

Depth scale: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

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CLIENT	PROJECT NUMBER	LOCATION
CONCORD WPNSTA	CTO 303	INLAND AREA

LOG OF SOIL BORING: **7SHSB022**

Depth		USCS	Description
	2.0	CL	CLAY continued
11			
12			End of Boring at 12.0 ft
13			
14			
15			
16			
17			
18			
19			
20			
21			

MONTGOMERY WATSON	365 Lennon Lane Walnut Creek, California 94598 (510) 975-3400	CLIENT: CONCORD WPNSTA	PROJECT NUMBER: CTO 303	LOCATION: INLAND AREA

DRILLING AND SAMPLING METHODS: Geoprobe

LOG OF SOIL BORING: 7SHSB023

Coordinates: Building 7SH5

				START	FINISH
Water Level					
Time				TIME	TIME
Date				DATE 5/10/95	DATE 5/10/95

SURFACE CONDITIONS: grasses

GEOLOGIST: Y.LEUNG/D.WINTER

DEPTH (ft)	PID (ppm)	USCS	GRAPHIC LOG	DESCRIPTION	FEATURES/REMARKS
0	2.0 2.0	OL		CLAY, 10YR 3/2, strong structure, firm, poor gradation, moist, plastic, few pores/paths, majority fines, <10% coarse	
1	3.0				
2	2.0	CL		CLAY, 10YR 5/4, strong structure, firm, poor gradation, moist, plastic, few pores/paths, majority fines, <10% coarse	
3					
4					
5		GW		Sandy GRAVEL with Clay, 10YR 4/4, weak structure, loose, well graded, moist, nonplastic, many pores/paths, 10% fines, majority coarse	
6					
7					
8		CL		CLAY, 10YR 4/3, moderate structure, soft, poor gradation, moist, plastic, few pores/paths, majority fines, <10% coarse	
9					
10					

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CLIENT	PROJECT NUMBER	LOCATION
CONCORD WPNSTA	CTO 303	INLAND AREA

LOG OF SOIL BORING: **7SHSB023**

Depth (ft)			USCS	Description
	2.0		CL	CLAY, 10YR 5/4, strong structure, firm, poor gradation, moist, plastic, few pores/paths, majority fines, <10% coarse
11				
12				End of Boring at 12.0 ft
13				
14				
15				
16				
17				
18				
19				
20				
21				

MONTGOMERY WATSON
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CLIENT	PROJECT NUMBER	LOCATION
CONCORD WPNSTA	CTO 303	INLAND AREA

DRILLING AND SAMPLING METHODS: Hollow Stem Auger (8" Augers)

LOG OF SOIL BORING: 7SHSB610

Coordinates: Building 7SH5

Water Level	22			START	FINISH
Time	12:30			TIME	TIME
Date	05/16/95			DATE 5/12/95	DATE 5/12/95

SURFACE CONDITIONS: grass/fill material

GEOLOGIST: Y.LEUNG/D.WINTER

DEPTH (ft)	PID (ppm)	USCS	GRAPHIC LOG	Description	FEATURES/REMARKS
0–5		SP		SAND with Clay, 10YR 6/6, weak structure, loose, poor gradation, moist, nonplastic, many pores/paths, 14% fines, majority coarse, stain at surface (dark)	(hydrocarbon stain), hand auger to check for lines
5–6		CL		Sandy CLAY, GRAVEL, 10YR 4/6, weak structure, soft, well graded, moist to wet, slightly plastic, many pores/paths, majority fines, 20% coarse	hand auger to check for line
6–10		CH		Silty CLAY, Occasional Gravel, 10YR 4/2, strong structure, firm, poor gradation, moist, very plastic, few to none pores/paths, majority fines, <10% coarse	

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CLIENT	PROJECT NUMBER	LOCATION
CONCORD WPNSTA	CTO 303	INLAND AREA

LOG OF SOIL BORING: **7SHSB610**

Depth		USCS	Description
	4.5	CH	Silty CLAY, Trace Gravel, 10YR 5/3, moderate structure, soft, poor gradation, moist, plastic, no pores/paths, majority fines, <10% coarse
11			
12			
13			
14			
15	5.0	CH	Silty CLAY, Trace Gravel, 10YR 5/3, moderate structure, soft, poor gradation, moist, very plastic, few pores/paths, majority fines, <10% coarse
16			
17			
18			
19			
20		CL	Gravelly CLAY, Fine to Coarse Sand, Granite Gneiss, 10YR 4/4, weak structure, loose, well graded, moist, slightly plastic, many pores/paths, majority fines, 35% coarse
21			

MONTGOMERY WATSON	365 Lennon Lane Walnut Creek, California 94598 (510) 975-3400	CLIENT: CONCORD WPNSTA	PROJECT NUMBER: CTO 303	LOCATION: INLAND AREA

LOG OF SOIL BORING: **7SHSB610**

Depth (ft)	PID	USCS	Description	Remarks
22		CH	Silty CLAY, Trace Gravel, 10YR 5/4, strong structure, very firm, poor gradation, moist, very plastic, many pores/paths, majority fines, <10% coarse	grades from 10 to 30 percent sand from 22 to 25 feet
25	7.9	CL	Gravelly, Sandy CLAY, 10YR 5/4, weak structure, soft, fair gradation, moist to wet, slightly plastic, many pores/paths, majority fines, 10% coarse	wet from 26 to 28 feet; moist elsewhere
30			End of Boring at 30.0 ft	

Depth scale: 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33

J:\2736\gint\2736 ID: WALNUT1

MONTGOMERY WATSON	365 Lennon Lane Walnut Creek, California 94598 (510) 975-3400	CLIENT: CONCORD WPNSTA	PROJECT NUMBER: CTO 303	LOCATION: INLAND AREA
		DRILLING AND SAMPLING METHODS: Hollow Stem Auger (8" Augers)		

LOG OF SOIL BORING: 7SHSB611

Coordinates: Building 7SH5

				START	FINISH
Water Level	25.27				
Time	11:10			TIME	TIME
Date	05/16/95			DATE 5/12/95	DATE 5/12/95

SURFACE CONDITIONS: **asphalt**

GEOLOGIST: **Y.LEUNG/D.WINTER**

DEPTH (ft)	PID (ppm)	USCS	GRAPHIC LOG	DESCRIPTION	FEATURES/REMARKS
0–5		SM		Silty SAND, Trace Cobbles, 10YR 6/3, weak structure, loose, poor gradation, dry, slightly plastic, many pores/paths, 20% fines, majority coarse	much gravel and rock mixed in, (fill)
5–8		CL		Gravelly, Sandy CLAY, 5/10Y, 10YR 5/6, moderate structure, firm, fair gradation, moist, slightly plastic, few pores/paths, majority fines, 20% coarse, gray (stain), hydrocarbon odor	75% matrix discolored, pathway is through matrix, gravelly areas contain more stain
8–9		CL		Gravelly CLAY, 5/ 10Y, weak structure, weak, well graded, moist, slightly plastic, many pores/paths, majority fines, 30% coarse, gray (stain), hydrocarbon odor	100% matrix discolored.
9–10		CL		Gravelly, sandy CLAY, 5/ 10Y, 10YR 5/6, moderate structure, firm, fair gradation, moist, slightly plastic, few pores/paths, majority fines, 20% coarse, gray (stain), hydrocarbon odor	75% matrix discolored, pathway is through matrix, gravelly areas contain more stain

MONTGOMERY WATSON 365 Lennon Lane Walnut Creek, California 94598 (510) 975-3400	CLIENT CONCORD WPNSTA	PROJECT NUMBER CTO 303	LOCATION INLAND AREA

LOG OF SOIL BORING: **7SHSB611**

Depth	Sample value	USCS	Description	Remarks
	55.0		Not Recorded	no log of interval, (stain ends at 12 feet)
11				
12				
13				
14				
15		CH	Silty CLAY, 10YR 4/3, strong structure, firm, poor gradation, moist, plastic, no pores/paths, majority fines, <10% coarse	
16				
17				
18				
19				
20	6.1	CL	Sandy, Silty CLAY, 10YR 4/4, weak structure, soft, poor gradation, moist, slightly plastic, few pores/paths, majority fines, 15% coarse	moist to wet
21				

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CLIENT	PROJECT NUMBER	LOCATION
CONCORD WPNSTA	CTO 303	INLAND AREA

LOG OF SOIL BORING: **7SHSB611**

Depth (ft)	Recovery	USCS	Description	Remarks
22		CL	Sandy, Silty CLAY, 10YR 4/4, weak structure, soft, poor gradation, moist, slightly plastic, few pores/paths, majority fines, 15% coarse	
25		CL	Sandy, Gravelly CLAY, 10YR 4/3, weak structure, loose, fair gradation, moist, slightly plastic, many pores/paths, majority fines, 20% coarse	barely wet, water in hole rested at 25 feet
26	3.0	CL	Sandy CLAY, 10YR 4/3, strong structure, firm, poor gradation, moist, plastic, no pores/paths, majority fines, <10% coarse	moist, not wet
30.5			End of Boring at 30.5 ft	

Depth scale: 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33

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Walnut Creek,
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(510) 975-3400

CLIENT	PROJECT NUMBER	LOCATION
CONCORD WPNSTA	CTO 303	INLAND AREA

DRILLING AND SAMPLING METHODS: Hollow Stem Auger (8" Auger)

LOG OF SOIL BORING: **7SHSB612**

Coordinates: Building 7SH5

					START	FINISH
Water Level	26.1					
Time	10:00				TIME	TIME
Date	05/16/95				DATE 5/12/95	DATE 5/12/95

SURFACE CONDITIONS: asphalt

GEOLOGIST: D.WINTER

DEPTH (ft)	PID (ppm)	USCS	GRAPHIC LOG		FEATURES/REMARKS
				Not Recorded	not recorded
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

MONTGOMERY WATSON
365 Lennon Lane
Walnut Creek,
California 94598
(510) 975-3400

CLIENT	PROJECT NUMBER	LOCATION
CONCORD WPNSTA	CTO 303	INLAND AREA

LOG OF SOIL BORING: **7SHSB612**

Depth					Description	
					Not Recorded	
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						

MONTGOMERY WATSON
365 Lennon Lane
Walnut Creek,
California 94598
(510) 975-3400

CLIENT	PROJECT NUMBER	LOCATION
CONCORD WPNSTA	CTO 303	INLAND AREA

LOG OF SOIL BORING: **7SHSB612**

Depth (ft)					Description	
22					Not Recorded	
23						
24						
25						
					End of Boring at 25.5 ft	
26						
27						
28						
29						
30						
31						
32						
33						

APPENDIX D

GROUNDWATER SAMPLING FORMS

SITE 22, BLDG 7SH5 - GROUNDWATER ELEVATIONS								
	MW01		MW02		MW03		MW04	
Date	Depth to Groundwater (ft btoc)	Groundwater Elevation (ft amsl)	Depth to Groundwater (ft btoc)	Groundwater Elevation (ft amsl)	Depth to Groundwater (ft btoc)	Groundwater Elevation (ft amsl)	Depth to Groundwater (ft btoc)	Groundwater Elevation (ft amsl)
2-18-97	21.15	141.17	21.40	140.74	21.80	140.45	19.30	141.13
3-5-97	20.48	141.84	20.70	141.44	21.15	141.10	18.54	141.89
3-18-97	20.20	142.12	20.44	141.70	20.89	141.36	18.26	142.17
4-3-97	20.02	142.30	20.26	141.88	20.70	141.55	18.10	142.33
5-9-97	21.00	141.32	21.20	140.94	21.61	140.64	19.07	141.36
6-4-97	22.00	140.32	22.17	139.97	22.58	139.67	20.07	140.36
6-11-97	22.31	140.01	22.49	139.65	22.89	139.39	20.38	140.05
7-9-97	23.32	139.00	23.50	138.64	23.89	138.36	21.40	139.03
9-3-97	25.57	136.75	25.69	136.45	26.07	136.18	23.64	136.79
10-7-97	26.70	135.62	26.83	135.31	27.18	135.07	24.77	135.66
11-7-97	27.59	134.73	27.70	134.44	28.04	134.21	25.66	134.77
12-5-97	27.88	134.44	27.97	134.17	28.30	133.95	25.95	134.48

TOC Elevations

MW01	162.32
MW02	162.14
MW03	162.25
MW04	160.43

amsl	above mean sea level
btoc	below top of casing
ft	feet

MONITORING WELL COMPLETION RECORD

DRILLING INFORMATION

DRILLING BEGAN:
DATE 1-29-97 TIME 0900
WELL INSTALLATION BEGAN:
DATE 1-29-97 TIME 1550
WELL COMPLETION FINISHED:
DATE 1-30-97 TIME 1000
DRILLING CO. Bay Area Exploration
DRILLER Eric Santerlan
LICENSE A2 607812
DRILL RIG 75 CME
DRILLING METHOD:
☒ HOLLOW STEM AUGER
☐ AIR ROTARY
☐ ______
DIAMETER OF AUGERS:
ID 3 3/4 in OD 8 in

BENTONITE SEAL

AMOUNT CALCULATED 150 lbs
AMOUNT USED 150 lbs
☐ PELLETS, SIZE ______
☒ CHIPS, SIZE 3/8 in
☐ ______
PRODUCT Wyoming Bentonite
MFG. BY Holeplug, Baroid Drilling
METHOD INSTALLED:
☒ POURED ☐ TREMIE
AMOUNT OF WATER USED 2 gal

FILTER PACK

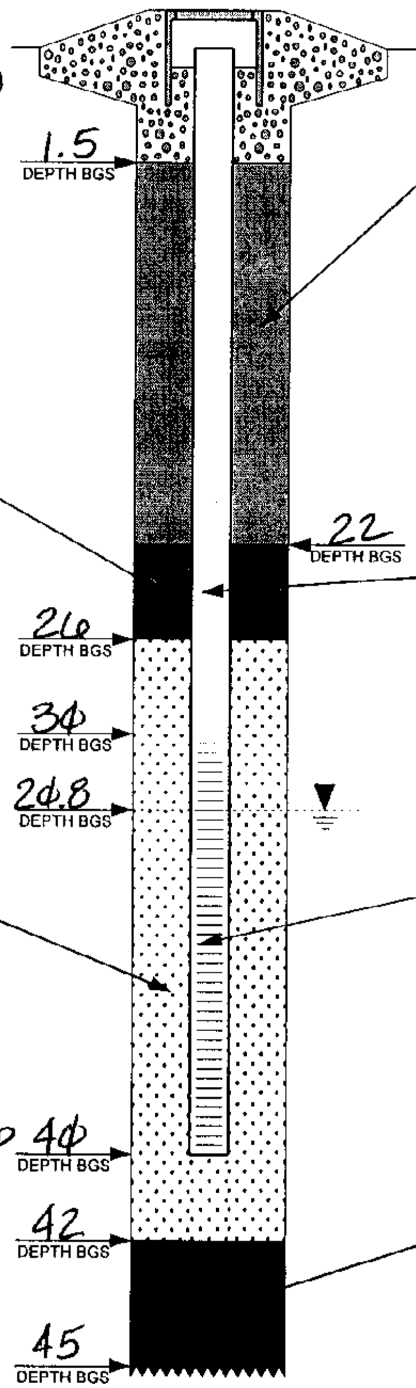
AMOUNT CALCULATED 480 lbs
AMOUNT USED 500 lbs
☒ SAND, SIZE #2/12 Monterey
☐ FORMATION COLLAPSE:
FROM ______ TO ______
PRODUCT RMC Lonestar
MFG. BY Monterey Sands, Kiln Dried
METHOD INSTALLED:
☒ POURED ☐ TREMIE

SURVEY INFORMATION

TOC ELEVATION 162.32
GROUND ELEVATION 162.50
NORTHING CORD. 543253.82
EASTING CORD. 1571653.48
DATE SURVEYED 3-19-97
SURVEY CO. Alhambra Land Survey

SURFACE COMPLETION

☒ FLUSH MOUNT
☐ ABOVE GROUND W/BUMPER POST
☒ CONCRETE ☐ ASPHALT



CENTRALIZERS

☐ DEPTHS ______, ______
☒ NO CENTRALIZERS USED

MONITORING WELL

MONITORING WELL NO. MW01
PROJECT Concord NWS
SITE Site 22, Bldg 7SH5
BOREHOLE NO. 7SHMW01
WELL PERMIT NO. M97-1026
TOC TO BOTTOM OF WELL 40.41

ANNULAR SEAL

AMOUNT CALCULATED 47 gal
AMOUNT USED 48 gal
☒ GROUT FORMULA
PORTLAND CEMENT Basalite Type I-II
BENTONITE Aquagel Gold Seal
WATER ______
☐ PREPARED MIX
PRODUCT ______
MFG. BY ______
METHOD INSTALLED:
☒ POURED ☐ TREMIE

CASING

☒ SCHEDULE 40 PVC
☐ ______
PRODUCT ______
MFG. BY Geotech
CASING DIAMETER:
ID 2 1/8 in OD 2 3/8"
LENGTH OF CASING ~40 ft.

WELL SCREEN

☒ SCHEDULE 40 PVC
☐ ______
PRODUCT ______
MFG. BY Geotech
CASING DIAMETER:
ID 2 1/8 in OD 2 3/8 in
SLOT SIZE 0.01
LENGTH OF SCREEN 10 ft.

BOREHOLE BACKFILL

AMOUNT CALCULATED 84
AMOUNT USED 78
☒ BENTONITE CHIPS, SIZE 3/8 in
☐ BENTONITE PELLETS, SIZE ______
☐ SLURRY ______
☐ FORMATION COLLAPSE
PRODUCT Wyoming Bentonite
MFG. BY Baroid Drilling
METHOD INSTALLED:
☒ POURED ☐ TREMIE

ENVIRONMENTAL MANAGEMENT, INC.
• SAN FRANCISCO •

07/09/97 6:55 PM

069-0036 4.07

DEVELOPMENT

GROUNDWATER SAMPLING RECORD

DATE 2-18-97 PAGE 1 0F 2

MONITORING WELL NO. MW01

PROJECT CONCORD NWS

SITE SITE 22, BLDG 7545

PROJECT NO. 069-0360B0203

TOTAL GALLONS TO BE PURGED

PURGING METHOD HAND PUMP

SAMPLING METHOD ~~HAND PUMP~~

Time	Volume of Water Removed (gallons)	Discharge Rate (gal/min)	Field Parameters Measured: pH	Specific Conductivity (ms/cm)	Turbidity (ntu)	Dissolved Oxygen (mg/L)	Temp. (°C)			Water Level (feet)	Comments
0915										21.15	BEGIN SURGING
0925											FINISH SURGING
0935	0		6.48	1.52	999+	0.94	18.5			21.15	
0940	12.5	2.5	6.32	1.52	"	0.59	18.2				
0945	25	2.5	6.20	1.07	"	5.42	18.2				
0950	37.5	2.5	6.35	1.09	"	8.60	18.2				
0955	50	2.5	6.50	1.07	"	6.87	18.1				
1000	62.5	2.5	6.51	1.06	"	7.35	18.0				
1005										21.16	BEGIN SURGING
1015											FINISH SURGING
1025	62.5		6.53	1.06	999+	7.51	18.0			21.15	
1030	75	2.5	6.57	1.06	"	7.43	18.0				
1035	87.5	2.5	6.58	1.06	"	7.29	17.9				
1040	100	2.5	6.54	1.06	"	8.65	17.8				
		CONTINUED									

FIELD EQUIPMENT	SERIAL NUMBER	RENTAL COMPANY
HORIBA U-10	010-035	HAZCO

SAMPLE ID:

ANALYSIS:

COC NUMBER:

SAMPLING PERSONNEL:

Tt ENVIRONMENTAL MANAGEMENT, INC.
• SAN FRANCISCO •

D000058013 02/18/1997 004.07 036
GW DEVELOPMENT SAMPLING RECORDS

Development

GROUNDWATER SAMPLING RECORD

MONITORING WELL NO. MW01

DATE 2-18-97 PAGE 2 OF 3

PROJECT ____

TOTAL GALLONS TO BE PURGED ____

SITE ____

PURGING METHOD ____

PROJECT NO. ____

SAMPLING METHOD ____

Time	Volume of Water Removed (gallons)	Discharge Rate (gal/min)	Field Parameters Measured								Comments
			pH	Specific Conductivity (ms/cm)	Turbidity (ntu)	Dissolved Oxygen (mg/L)	Temp. (°C)			Water Level (feet)	
1043	112.5	4.2	6.43	1.06	999+	7.60	17.9				
1047	125	3.1	6.42	1.06	4	7.55	17.8				
1050										21.20	

FIELD EQUIPMENT	SERIAL NUMBER	RENTAL COMPANY

SAMPLE ID: ____

ANALYSIS: ____

COC NUMBER: ____

SAMPLING PERSONNEL: ____

Tt ENVIRONMENTAL MANAGEMENT, INC.
• SAN FRANCISCO •

DEVELOPMENT

GROUNDWATER SAMPLING RECORD

DATE 2-18-97 PAGE 3 OF 3

MONITORING WELL NO. MWØ1

PROJECT CONCORD NWS

SITE SITE 22, BLDG 7SH5

PROJECT NO. ØØ9-Ø36BØ2Ø3

CASING DIAMETER 2 inches

BOREHOLE DIAMETER 8.75 inches

TOP OF CASING ELEVATION 162.32 feet

WATER LEVEL 21.15 feet btoc @ Ø91Ø

WATER LEVEL ELEVATION 141. feet msl

STANDING WATER COLUMN 19.26 feet

WELL VOLUMES TO BE PURGED ______

MINUMUM PURGE VOLUME ______ gallons

ACTUAL VOLUME PURGED 125 gallons

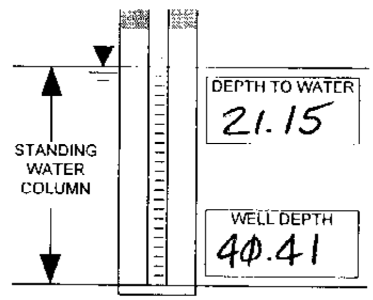
VOLUME CALCULATED BY: [signature]

PURGE VOLUME CALCULATION

One Well Volume = Casing Volume + Annulus Volume

One Well Volume = 3.27 gal + 10.62 gal

One Well Volume = 13.89 gallons



Casing Volume = Standing Water Column (ft) x Pipe Volume (gal/linear ft)[a]

Casing Volume = 19.26 ft x 0.17 gal/linear ft

Casing Volume = 3.27 gallons

NOTE:
a Refer to Table 1
b Refer to Table 2
c Assuming Sand Pack Porosity of 30%

Annulus Volume = [(Standing Water Column (ft) x Borehole Volume (gal/linear ft)[b]) - Casing Volume] x 0.3[c]

Annulus Volume = [(12 ft x 3.12 gal/linear ft) - 2.04 gal] x 0.3

12 x .17

Annulus Volume = 10.62 gallons

Table 1
Pipe Volume of Schedule 40 PVC Pipe

Diameter (inches)	OD (inches)	ID (inches)	Volume (gal/linear ft)	Diameter (inches)	OD (inches)	ID (inches)	Volume (gal/linear ft)
1.25	1.660	1.380	0.08	4	4.500	4.026	0.66
2	2.375	2.067	0.17	6	6.625	6.065	1.50
3	3.500	3.068	0.38	8	8.625	7.981	2.60

Table 2
Volume of Borehole

Diameter (inches)	Volume (gal/linear ft)	Diameter (inches)	Volume (gal/linear ft)	Diameter (inches)	Volume (gal/linear ft)
7.25	2.14	8.25	2.78	9.25	3.52
7.75	2.45	8.75	3.12	10.25	4.29

TETRA TECH EM INC.
• SAN FRANCISCO •

069-0036 4.07

GROUNDWATER SAMPLING RECORD

DATE 3-5-97 PAGE 1 OF 2

MONITORING WELL NO. MWØ1

PROJECT CONCORD NWS, CLEAN II

SITE SITE 22, BLDG 7SH5

PROJECT NO. Ø69-Ø36BØ2Ø3

TOTAL GALLONS TO BE PURGED 42

PURGING METHOD HAND PUMP

SAMPLING METHOD HAND PUMP

Time	Volume of Water Removed (gallons)	Discharge Rate (gal/min)	Field Parameters Measured: pH	Specific Conductivity (ms/cm)	Turbidity (ntu)	Dissolved Oxygen (mg/L)	Temp. (°C)			Water Level (feet)	Comments
1300	Ø	Ø	6.79	1.Ø7	999	5.9Ø	18.Ø			2Ø.48	
13Ø5	1Ø	2.Ø	6.79	1.Ø6	999	6.25	18.Ø				
13Ø9	2Ø	2.5	6.8Ø	1.Ø5	651	6.22	17.9				
1313	25	1.25	6.79	1.Ø5	543	6.25	18.Ø				
1316	3Ø	1.67	6.8Ø	1.Ø5	51Ø	6.39	18.Ø				
1318	35	2.5Ø	6.8Ø	1.Ø5	4ØØ	6.3Ø	18.Ø				
1322	42	1.17	6.8Ø	1.Ø5	31Ø	6.35	18.Ø				
1331										2Ø.48	

FIELD EQUIPMENT	SERIAL NUMBER	RENTAL COMPANY
HORIBA U-1Ø	ME35ØØ	ARIS

SAMPLE ID: Ø367SHGWØØ5

ANALYSIS: VOC, SVOC, TPH-E

COC NUMBER: 7566

SAMPLING PERSONNEL:

Roy Glenn

Richard Verwimen

Tt ENVIRONMENTAL MANAGEMENT, INC. • SAN FRANCISCO •

D000058014 03/05/1997 004.07 036

GW SAMPLING RECORD MW01-MW04

GROUNDWATER SAMPLING RECORD

DATE 3-5-97 PAGE 2 0F 2

MONITORING WELL NO. MWØ1

PROJECT Concord NWS, CLEAN II

SITE Site 22, Bldg 7SH5

PROJECT NO. Ø69-Ø36BØ2Ø3

CASING DIAMETER 2 inches

BOREHOLE DIAMETER 8.75 inches

TOP OF CASING ELEVATION 162.32 feet

WATER LEVEL 2Ø.48 feet bgs @ 123Ø

WATER LEVEL ELEVATION 141.84 feet msl

STANDING WATER COLUMN 19.93 feet

WELL VOLUMES TO BE PURGED 3

MINUMUM PURGE VOLUME 42 gallons

ACTUAL VOLUME PURGED 42 gallons

VOLUME CALCULATED BY:

PURGE VOLUME CALCULATION

One Well Volume = Casing Volume + Annulus Volume

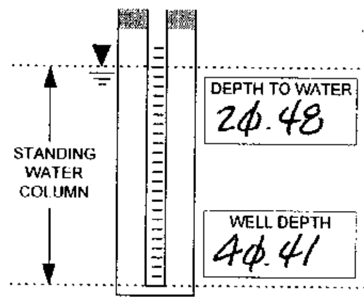
One Well Volume = 3.39 gal + 1Ø.62 gal

One Well Volume = 14.Ø1 gallons

Casing Volume = Standing Water Column (ft) x Pipe Volume (gal/linear ft)[a]

Casing Volume = 19.93 ft x Ø.17 gal/linear ft

Casing Volume = 3.39 gallons



NOTE:
a Refer to Table 1
b Refer to Table 2
c Assuming Sand Pack Porosity of 30%

Annulus Volume = [(Standing Water Column (ft) x Borehole Volume (gal/linear ft)[b]) - Casing Volume] x 0.3[c]

Annulus Volume = [(12 ft x 3.12 gal/linear ft) - 2.Ø4 gal] x 0.3

(12×Ø.17)

Annulus Volume = 1Ø.62 gallons

Table 1
Pipe Volume of Schedule 40 PVC Casing

Diameter (inches)	OD (inches)	ID (inches)	Volume (gal/linear ft)	Diameter (inches)	OD (inches)	ID (inches)	Volume (gal/linear ft)
1.25	1.660	1.380	0.08	4	4.500	4.026	0.66
2	2.375	2.067	0.17	6	6.625	6.065	1.50
3	3.500	3.068	0.38	8	8.625	7.981	2.60

Table 2
Volume of Borehole

Diameter (inches)	Volume (gal/linear ft)	Diameter (inches)	Volume (gal/linear ft)	Diameter (inches)	Volume (gal/linear ft)
7.25	2.14	8.25	2.78	9.25	3.52
7.75	2.45	8.75	3.12	10.25	4.29

069-0036 4.04

GROUNDWATER SAMPLING RECORD

MONITORING WELL NO. MWØ1

DATE 6-4-97 PAGE 1 OF 2

PROJECT Concord NWS, CLEAN II

TOTAL GALLONS TO BE PURGED 41

SITE Site 22, Bldg 7SH5

PURGING METHOD Hand Pump

PROJECT NO. Ø69-036BØ2Ø3

SAMPLING METHOD Hand Pump

Time	Volume of Water Removed (gallons)	Discharge Rate (gal/min)	Field Parameters Measured: pH	Specific Conductivity (ms/cm)	Turbidity (ntu)	Dissolved Oxygen (mg/L)	Temp. (°C)			Water Level (feet)	Comments
Ø812	Ø	—	7.66	Ø.984	999	5.51	18.4			22.ØØ	
Ø818	1Ø	1.67	7.44	Ø.98Ø	32Ø	4.85	18.2				
Ø821	15	1.67	7.41	Ø.977	19Ø	4.8Ø	18.2				
Ø825	2Ø	1.25	7.43	1.Ø1	234	4.85	18.2				
Ø831	3Ø	1.67	7.42	Ø.975	186	4.85	18.2				
Ø835	35	1.25	7.4Ø	Ø.976	197	4.96	18.2				
Ø838	42	2.33	7.4Ø	Ø.976	2Ø1	4.83	18.2				
Ø845										22.ØØ	

FIELD EQUIPMENT	SERIAL NUMBER	RENTAL COMPANY
Horiba U-1Ø	132Ø7	Hazco

SAMPLE ID: Ø367SHGWØØ8

ANALYSIS: VOA, SVOA, TPH-EXT

COC NUMBER: 7571

SAMPLING PERSONNEL: Richard Verniman, Roy Glenn

Tt ENVIRONMENTAL MANAGEMENT, INC. • SAN FRANCISCO •

D000058015 06/04/1997 004.07 036

GW SAMPLING RECORD MW01-MW04

GROUNDWATER SAMPLING RECORD

DATE 6-4-97

MONITORING WELL NO. MWØ1

PROJECT Concord NWS, CLEAN II

SITE Site 22, Bldg 7SH5

PROJECT NO. Ø69-Ø36BØ2Ø3

CASING DIAMETER 2 inches

BOREHOLE DIAMETER 8.75 inches

TOP OF CASING ELEVATION 162.32 feet

WATER LEVEL 22.ØØ feet bgs @ Ø747

WATER LEVEL ELEVATION 14Ø.32 feet msl

STANDING WATER COLUMN 18.41 feet

WELL VOLUMES TO BE PURGED 3

MINUMUM PURGE VOLUME 41 gallons

ACTUAL VOLUME PURGED 42 gallons

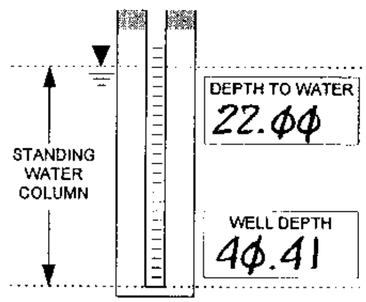
VOLUME CALCULATED BY: [signature]

PURGE VOLUME CALCULATION

One Well Volume = Casing Volume + Annulus Volume

One Well Volume = 3.13 gal + 1Ø.62 gal

One Well Volume = 13.75 gallons



Casing Volume = Standing Water Column (ft) x Pipe Volume (gal/linear ft)[a]

Casing Volume = 18.41 ft x Ø.17 gal/linear ft

Casing Volume = 3.13 gallons

NOTE:
a Refer to Table 1
b Refer to Table 2
c Assuming Sand Pack Porosity of 30%

Annulus Volume = [(Standing Water Column (ft) x Borehole Volume (gal/linear ft)[b]) - Casing Volume] x 0.3[c]

Annulus Volume = [(12 ft x 3.12 gal/linear ft) - 2.Ø4 gal] x 0.3

(12 x Ø.17)

Annulus Volume = 1Ø.62 gallons

Table 1
Pipe Volume of Schedule 40 PVC Casing

Diameter (inches)	OD (inches)	ID (inches)	Volume (gal/linear ft)	Diameter (inches)	OD (inches)	ID (inches)	Volume (gal/linear ft)
1.25	1.660	1.380	0.08	4	4.500	4.026	0.66
2	2.375	2.067	0.17	6	6.625	6.065	1.50
3	3.500	3.068	0.38	8	8.625	7.981	2.60

Table 2
Volume of Borehole

Diameter (inches)	Volume (gal/linear ft)	Diameter (inches)	Volume (gal/linear ft)	Diameter (inches)	Volume (gal/linear ft)
7.25	2.14	8.25	2.78	9.25	3.52
7.75	2.45	8.75	3.12	10.25	4.29

ENVIRONMENTAL MANAGEMENT, INC.
• SAN FRANCISCO •

069-0036 4.07

GROUNDWATER SAMPLING RECORD

DATE 9-3-97 PAGE 1 OF 2

MONITORING WELL NO. MWØ1

PROJECT CONCORD NWS

SITE SITE 22, BLDG 7SH5

PROJECT NO. Ø69-036BØ2Ø3

TOTAL GALLONS TO BE PURGED 4Ø

PURGING METHOD HAND PUMP

SAMPLING METHOD HAND PUMP

Time	Volume of Water Removed (gallons)	Discharge Rate (gal/min)	Field Parameters Measured: pH	Specific Conductivity (ms/cm)	Turbidity (ntu)	Dissolved Oxygen (mg/L)	Temp. (°C)			Water Level (feet)	Comments
Ø925	5	—	9.25	1.ØØ	999	11.92	19.3			25.57	
Ø931	1Ø	Ø.8	8.21	Ø.98	5Ø	1Ø.8Ø	18.3				
Ø934	15	1.7	7.44	Ø.98	1Ø	11.9Ø	18.2				
Ø936	2Ø	2.5	7.38	Ø.98	1Ø	11.69	18.2				
Ø94Ø	25	1.25	7.3Ø	Ø.99	1Ø	11.32	18.2				
Ø943	3Ø	1.7	7.2Ø	Ø.99	1Ø	1Ø.83	18.1				
Ø946	35	1.7	6.89	Ø.99	1Ø	11.11	18.1				
Ø95Ø	4Ø	1.25	6.94	Ø.99	1Ø	1Ø.75	18.1				

FIELD EQUIPMENT	SERIAL NUMBER	RENTAL COMPANY
HORIBA U-1Ø	ME35Ø1	ARIS

SAMPLE ID: Ø367SHGWØ13

ANALYSIS: VOC, SVOC, TPH-E

COC NUMBER: 12166

SAMPLING PERSONNEL:

RICHARD VERNIMEN

ROY GLENN

TETRA TECH EM, INC.
• SAN FRANCISCO •

D00C058016 09/03/1997 004.07 036
GW SAMPLING RECORD MW01-MW04

GROUNDWATER SAMPLING RECORD

DATE 9-3-97 PAGE 2 0F 2

MONITORING WELL NO. MW01

PROJECT Concord NWS, CLEAN II

SITE Site 22, Bldg 7SH5

PROJECT NO. 069-036B0203

CASING DIAMETER 2 inches

BOREHOLE DIAMETER 8.75 inches

TOP OF CASING ELEVATION 162.32 feet

WATER LEVEL 25.57 feet bgs @ 0910

WATER LEVEL ELEVATION 136.75 feet msl

STANDING WATER COLUMN 14.84 feet

WELL VOLUMES TO BE PURGED 3

MINUMUM PURGE VOLUME 40 gallons

ACTUAL VOLUME PURGED 40 gallons

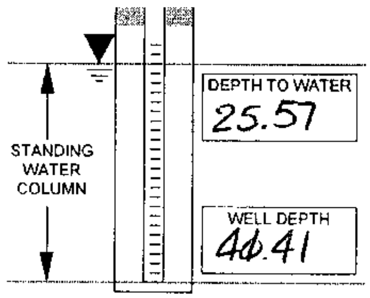
VOLUME CALCULATED BY: [signature]

PURGE VOLUME CALCULATION

One Well Volume = Casing Volume + Annulus Volume

One Well Volume = 2.52 gal + 10.62 gal

One Well Volume = 13.14 gallons



Casing Volume = Standing Water Column (ft) x Pipe Volume (gal/linear ft)[a]

Casing Volume = 14.84 ft x 0.17 gal/linear ft

Casing Volume = 2.52 gallons

NOTE:
a Refer to Table 1
b Refer to Table 2
c Assuming Sand Pack Porosity of 30%

Annulus Volume = [(Standing Water Column (ft) x Borehole Volume (gal/linear ft)[b]) - Casing Volume] x 0.3[c]

Annulus Volume = [(14.84 12 ft x 3.12 gal/linear ft) - 2.04 gal] x 0.3
(12 x 0.17)

Annulus Volume = 10.62 gallons

Table 1
Pipe Volume of Schedule 40 PVC Casing

Diameter (inches)	OD (inches)	ID (inches)	Volume (gal/linear ft)	Diameter (inches)	OD (inches)	ID (inches)	Volume (gal/linear ft)
1.25	1.660	1.380	0.08	4	4.500	4.026	0.66
2	2.375	2.067	0.17	6	6.625	6.065	1.50
3	3.500	3.068	0.38	8	8.625	7.981	2.60

Table 2
Volume of Borehole

Diameter (inches)	Volume (gal/linear ft)	Diameter (inches)	Volume (gal/linear ft)	Diameter (inches)	Volume (gal/linear ft)
7.25	2.14	8.25	2.78	9.25	3.52
7.75	2.45	8.75	3.12	10.25	4.29

GROUNDWATER SAMPLING RECORD

DATE 12-5-97 PAGE 1 OF 2

MONITORING WELL NO. MWØ1

PROJECT Concord NWS

SITE Site 22, Bldg 7SH5

PROJECT NO.

TOTAL GALLONS TO BE PURGED 37

PURGING METHOD Hand Pump

SAMPLING METHOD Hand Pump

Time	Volume of Water Removed (gallons)	Discharge Rate (gal/min)	Field Parameters Measured: pH	Specific Conductivity (ms/cm)	Turbidity (ntu)	Dissolved Oxygen (mg/L)	Temp. (°C)			Water Level (feet)	Comments
1ØØ1	Ø	—	6.79	1.Ø5	XXXX	6.59	16.2			27.88	
1ØØ3	5	2.5	7.Ø2	1.Ø2	235	6.5Ø	17.2				
1ØØ6	1Ø	1.67	7.12	1.Ø2	176	6.83	17.4				
1ØØ8	15	2.5	7.17	1.Ø2	147	6.46	17.5				
1ØØ9	2Ø	2.5	7.19	1.Ø2	246	6.78	17.6				
1Ø11	25	2.5	7.22	1.Ø2	249	6.75	17.7				
1Ø13	3Ø	2.5	7.27	1.Ø2	31Ø	6.54	17.7				
1Ø15	35	2.5	7.24	1.Ø2	425	6.65	17.7				
1Ø17	4Ø	2.5	7.25	1.Ø2	316	6.7Ø	17.7			27.89	

FIELD EQUIPMENT	SERIAL NUMBER	RENTAL COMPANY
Horiba U-1Ø	ME35Ø1	ARIS

SAMPLE ID: Ø367SHGWØ17 @ 1Ø25

ANALYSIS: VOC, SVOC, TPH-E

COC NUMBER: 13Ø77

SAMPLING PERSONNEL: Richard Ubermmon; Roy Callan

TETRA TECH EM, INC.
• SAN FRANCISCO •

D000058017 12/05/1997 004.07 036

GW SAMPLING RECORD MW01-MW04

GROUNDWATER SAMPLING RECORD

DATE 12-5-97 PAGE 2 OF 2

MONITORING WELL NO. MW01

PROJECT Concord NWS

SITE Site 22, Bldg 7545

PROJECT NO. 069-036B02CP3

CASING DIAMETER 2 inches

BOREHOLE DIAMETER 8.75 inches

TOP OF CASING ELEVATION 162.32 feet

WATER LEVEL 27.88 feet bgs @ 0950

WATER LEVEL ELEVATION 134.44 feet msl

STANDING WATER COLUMN 11.76 feet

WELL VOLUMES TO BE PURGED 3

MINUMUM PURGE VOLUME 37 gallons

ACTUAL VOLUME PURGED 40 gallons

VOLUME CALCULATED BY: [signature]

PURGE VOLUME CALCULATION

One Well Volume = Casing Volume + Annulus Volume

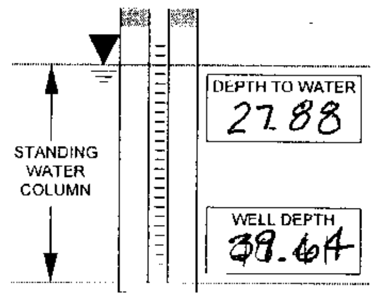
One Well Volume = 2.0 gal + 10.4 gal

One Well Volume = 12.4 gallons

Casing Volume = Standing Water Column (ft) x Pipe Volume (gal/linear ft)[a]

Casing Volume = 11.76 ft x 0.17 gal/linear ft

Casing Volume = 2.0 gallons



40.0
- .36
39.64

NOTE:
a Refer to Table 1
b Refer to Table 2
c Assuming Sand Pack Porosity of 30%

Annulus Volume = [(Standing Water Column (ft) x Borehole Volume (gal/linear ft)[b]) - Casing Volume] x 0.3[c]

Annulus Volume = [(11.76 ft x 3.12 gal/linear ft) - 2.0 gal] x 0.3

Annulus Volume = 10.4 gallons

Table 1
Pipe Volume of Schedule 40 PVC Casing

Diameter (inches)	OD (inches)	ID (inches)	Volume (gal/linear ft)	Diameter (inches)	OD (inches)	ID (inches)	Volume (gal/linear ft)
1.25	1.660	1.380	0.08	4	4.500	4.026	0.66
2	2.375	2.067	0.17	6	6.625	6.065	1.50
3	3.500	3.068	0.38	8	8.625	7.981	2.60

Table 2
Volume of Borehole

Diameter (inches)	Volume (gal/linear ft)	Diameter (inches)	Volume (gal/linear ft)	Diameter (inches)	Volume (gal/linear ft)
7.25	2.14	8.25	2.78	9.25	3.52
7.75	2.45	8.75	3.12	10.25	4.29

MONITORING WELL COMPLETION RECORD

DRILLING INFORMATION

DRILLING BEGAN:
DATE 1-30-97 TIME 1300
WELL INSTALLATION BEGAN:
DATE 1-31-97 TIME 1530
WELL COMPLETION FINISHED:
DATE 1-31-97 TIME 1800
DRILLING CO. Bay Area Exploration
DRILLER Gary Ballerini
LICENSE C689956
DRILL RIG 75 CME
DRILLING METHOD:
☒ HOLLOW STEM AUGER
☐ AIR ROTARY
☐ ________
DIAMETER OF AUGERS:
ID 3¼" OD 8"

BENTONITE SEAL

AMOUNT CALCULATED 50 lbs
AMOUNT USED 50 lbs
☐ PELLETS, SIZE ________
☒ CHIPS, SIZE 3/8"
☐ ________
PRODUCT Wyoming Bentonite
MFG. BY Baroid Drilling
METHOD INSTALLED:
☒ POURED ☐ TREMIE
AMOUNT OF WATER USED 0

FILTER PACK

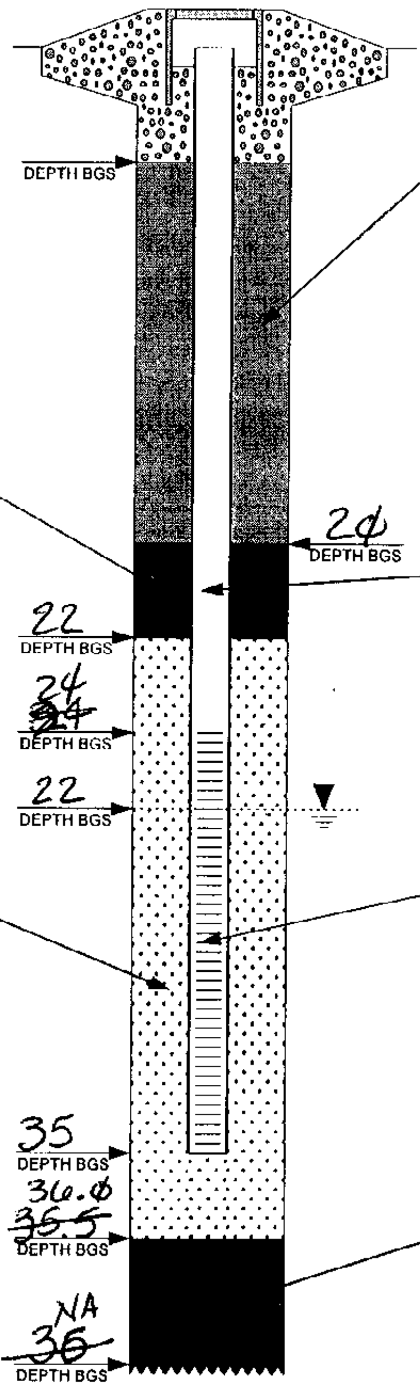
AMOUNT CALCULATED 480 lbs
AMOUNT USED 460 lbs
☒ SAND, SIZE #2/12 Monterey
☐ FORMATION COLLAPSE:
FROM ________ TO ________
PRODUCT Monterey Sands
MFG. BY RMC Lonestar
METHOD INSTALLED:
☒ POURED ☐ TREMIE

SURVEY INFORMATION

TOC ELEVATION 162.14
GROUND ELEVATION 162.30
NORTHING CORD. 543314.26
EASTING CORD. 1571551.84
DATE SURVEYED 3-19-97
SURVEY CO. Alhambra Land Surveyors

SURFACE COMPLETION

☒ FLUSH MOUNT
☐ ABOVE GROUND W/BUMPER POST
☒ CONCRETE ☐ ASPHALT



CENTRALIZERS

☐ DEPTHS ________, ________
☒ NO CENTRALIZERS USED

MONITORING WELL

MONITORING WELL NO. MW02
PROJECT Concord NWS
SITE Site 22, Bldg 7SH5
BOREHOLE NO. 7SHMW02
WELL PERMIT NO. M97-1028
TOC TO BOTTOM OF WELL 35.27

ANNULAR SEAL

AMOUNT CALCULATED 43 gal
AMOUNT USED 40 gal
☒ GROUT FORMULA
PORTLAND CEMENT Basalite Type I-II
BENTONITE Aquagel Gold Seal
WATER ________
☐ PREPARED MIX
PRODUCT ________
MFG. BY ________
METHOD INSTALLED:
☒ POURED ☐ TREMIE

CASING

☒ SCHEDULE 40 PVC
☐ ________
PRODUCT ________
MFG. BY Geotech
CASING DIAMETER:
ID 2⅛" OD 2⅜"
LENGTH OF CASING ~25'

WELL SCREEN

☒ SCHEDULE 40 PVC
☐ ________
PRODUCT ________
MFG. BY Geotech
CASING DIAMETER:
ID 2⅛" OD 2⅜"
SLOT SIZE 0.01"
LENGTH OF SCREEN 10"

BOREHOLE BACKFILL

AMOUNT CALCULATED ________
AMOUNT USED ________
☐ BENTONITE CHIPS, SIZE ________
☐ BENTONITE PELLETS, SIZE ________
☐ SLURRY ________
☐ FORMATION COLLAPSE
PRODUCT ________
MFG. BY ________
METHOD INSTALLED:
☐ POURED ☐ TREMIE

Tt ENVIRONMENTAL MANAGEMENT, INC.
• SAN FRANCISCO •

07/09/97 6:55 PM

Development
GROUNDWATER SAMPLING RECORD

DATE 2-18-97 PAGE 1 OF 2

MONITORING WELL NO. MW02

PROJECT Concord NWS

SITE Site 22, Bldg 7SA5

PROJECT NO. 069-0346B0203

TOTAL GALLONS TO BE PURGED

PURGING METHOD Hand Pump

SAMPLING METHOD ~~Han~~

Time	Volume of Water Removed (gallons)	Discharge Rate (gal/min)	Field Parameters Measured: pH	Specific Conductivity (ms/cm)	Turbidity (ntu)	Dissolved Oxygen (mg/L)	Temp. (°C)			Water Level (feet)	Comments
1045										21.40	Begin Surging
1055											Finish Surging
1108	0									21.40	
1110	10	~~6.23~~ 5.0	6.23	1.12	999+	8.60	18.4				
1113	20	3.3	6.16	1.10	755	9.05	18.4				
1116	30	3.3	6.13	1.09	960	7.86	18.3				
1119	40	3.3	6.11	1.07	999+	7.70	18.1				
1123	50	2.5	6.10	1.08	"	7.45	18.2				
1130-1140											Surge Well
1140	50									21.40	
1149	60	~~6.11~~ 3.3	6.11	1.07	999+	7.40	18.2				
1152	70	~~6.08~~ 3.3	6.08	1.08	"	7.15	18.2				
1155	80	~~6~~3.3	6.09	1.07	"	6.96	18.2				
1158	90	3.3	6.10	1.07	"	6.95	18.2				
1201	100	3.3	6.09	1.07	"	6.93	18.2			21.40	

FIELD EQUIPMENT	SERIAL NUMBER	RENTAL COMPANY
Horiba U-10	UH0-035	HAZCO

SAMPLE ID:

ANALYSIS:

COC NUMBER:

SAMPLING PERSONNEL:

Tt ENVIRONMENTAL MANAGEMENT, INC.
• SAN FRANCISCO •

DEVELOPMENT

GROUNDWATER SAMPLING RECORD

DATE 2-18-97 PAGE 2 OF 2

MONITORING WELL NO. MW02

PROJECT CONCORD NWS

SITE SITE 22, BLDG 7SH5

PROJECT NO. 069-0360B0203

CASING DIAMETER 2 inches

BOREHOLE DIAMETER 8.75 inches

TOP OF CASING ELEVATION 162.14 feet

WATER LEVEL 21.40 feet btoc @ 1035

WATER LEVEL ELEVATION 140.74 feet msl

STANDING WATER COLUMN 13.87 feet

WELL VOLUMES TO BE PURGED ______

MINUMUM PURGE VOLUME ______ gallons

ACTUAL VOLUME PURGED 100 gallons

VOLUME CALCULATED BY:

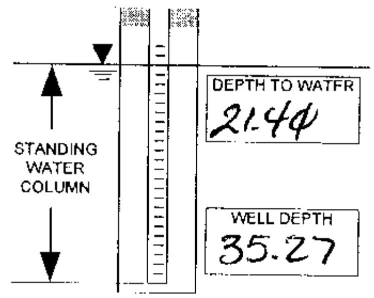
[signature]

PURGE VOLUME CALCULATION

One Well Volume = Casing Volume + Annulus Volume

One Well Volume = 2.36 gal + 10.62 gal

One Well Volume = 12.98 gallons



Casing Volume = Standing Water Column (ft) x Pipe Volume (gal/linear ft)[a]

Casing Volume = 13.87 ft x .17 gal/linear ft

Casing Volume = 2.36 gallons

NOTE:
a Refer to Table 1
b Refer to Table 2
c Assuming Sand Pack Porosity of 30%

Annulus Volume = [(Standing Water Column (ft) x Borehole Volume (gal/linear ft)[b]) - Casing Volume] x 0.3[c]

Annulus Volume = [(12 ft x 3.12 gal/linear ft) - 2.04 gal] x 0.3
12×.17

Annulus Volume = 10.62 gallons

Table 1
Pipe Volume of Schedule 40 PVC Pipe

Diameter (inches)	OD (inches)	ID (inches)	Volume (gal/linear ft)	Diameter (inches)	OD (inches)	ID (inches)	Volume (gal/linear ft)
1.25	1.660	1.380	0.08	4	4.500	4.026	0.66
2	2.375	2.067	0.17	6	6.625	6.065	1.50
3	3.500	3.068	0.38	8	8.625	7.981	2.60

Table 2
Volume of Borehole

Diameter (inches)	Volume (gal/linear ft)	Diameter (inches)	Volume (gal/linear ft)	Diameter (inches)	Volume (gal/linear ft)
7.25	2.14	8.25	2.78	9.25	3.52
7.75	2.45	8.75	3.12	10.25	4.29

GROUNDWATER SAMPLING RECORD

DATE 3-5-97

MONITORING WELL NO. MWØ2

PROJECT CONCORD NWS

SITE SITE 22, BLDG 7SH5

PROJECT NO. Ø69-Ø36BØ2Ø3

TOTAL GALLONS TO BE PURGED 39

PURGING METHOD HAND PUMP

SAMPLING METHOD HAND PUMP

Time	Volume of Water Removed (gallons)	Discharge Rate (gal/min)	Field Parameters Measured							Water Level (feet)	Comments
			pH	Specific Conductivity (ms/cm)	Turbidity (ntu)	Dissolved Oxygen (mg/L)	Temp. (°C)				
Ø931	Ø	Ø	6.95	1.Ø8	999	6.47	15.8			2Ø.72	
Ø938	1Ø	1.43	6.8Ø	1.Ø9	65Ø	5.67	16.5				
Ø946	2Ø	1.25	6.71	1.Ø8	38Ø	5.12	16.7				
Ø953	3Ø	1.43	6.64	1.Ø8	195	5.56	17.4				
Ø957	35	1.25	6.65	1.Ø8	28Ø	5.4Ø	17.7				
1ØØØ	4Ø	1.67	6.64	1.Ø8	29Ø	5.4Ø	17.7				
1Ø16										2Ø.74	

FIELD EQUIPMENT	SERIAL NUMBER	RENTAL COMPANY
HORIBA U-1Ø	ME35ØØ	ARIS

SAMPLE ID: Ø367SHGWØØ3

ANALYSIS: VOC, SVOC, TPH-E

COC NUMBER: 7566

SAMPLING PERSONNEL:

Richard Verniman

Roy Glenn

ENVIRONMENTAL MANAGEMENT, INC.
• SAN FRANCISCO •

GROUNDWATER SAMPLING RECORD

DATE 3-5-97 PAGE 2 OF 2

MONITORING WELL NO. MWØ2

PROJECT CONCORD NWS, CLEAN II

SITE SITE 22, BLDG 7SH5

PROJECT NO. Ø69-Ø36BØ2Ø3

CASING DIAMETER 2 inches

BOREHOLE DIAMETER 8.75 inches

TOP OF CASING ELEVATION 162.14 feet

WATER LEVEL 2Ø.72 feet bgs @ Ø9Ø7

WATER LEVEL ELEVATION 141.42 feet msl

STANDING WATER COLUMN 14.55 feet

WELL VOLUMES TO BE PURGED 3

MINUMUM PURGE VOLUME 39 gallons

ACTUAL VOLUME PURGED 4Ø gallons

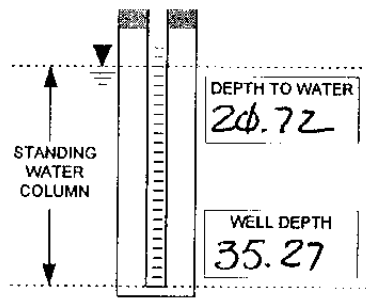
VOLUME CALCULATED BY: [signature]

PURGE VOLUME CALCULATION

One Well Volume = Casing Volume + Annulus Volume

One Well Volume = 2.47 gal + 1Ø.62 gal

One Well Volume = 13.Ø9 gallons



Casing Volume = Standing Water Column (ft) x Pipe Volume (gal/linear ft)[a]

Casing Volume = 14.55 ft x Ø.17 gal/linear ft

Casing Volume = 2.47 gallons

NOTE:
a Refer to Table 1
b Refer to Table 2
c Assuming Sand Pack Porosity of 30%

Annulus Volume = [(Standing Water Column (ft) x Borehole Volume (gal/linear ft)[b]) - Casing Volume] x 0.3[c]

Annulus Volume = [(12 ft x 3.12 gal/linear ft) - 2.Ø4 gal] x 0.3

(12 x .17)

Annulus Volume = 1Ø.62 gallons

Table 1
Pipe Volume of Schedule 40 PVC Casing

Diameter (inches)	OD (inches)	ID (inches)	Volume (gal/linear ft)	Diameter (inches)	OD (inches)	ID (inches)	Volume (gal/linear ft)
1.25	1.660	1.380	0.08	4	4.500	4.026	0.66
2	2.375	2.067	0.17	6	6.625	6.065	1.50
3	3.500	3.068	0.38	8	8.625	7.981	2.60

Table 2
Volume of Borehole

Diameter (inches)	Volume (gal/linear ft)	Diameter (inches)	Volume (gal/linear ft)	Diameter (inches)	Volume (gal/linear ft)
7.25	2.14	8.25	2.78	9.25	3.52
7.75	2.45	8.75	3.12	10.25	4.29

GROUNDWATER SAMPLING RECORD

DATE 6-4-97 PAGE 1 OF 2

MONITORING WELL NO. MWØ2

PROJECT CONCORD NWS, CLEAN II

SITE SITE 22, BLDG 7SH5

PROJECT NO. Ø69-Ø36BØ2Ø3

TOTAL GALLONS TO BE PURGED 39

PURGING METHOD HAND PUMP

SAMPLING METHOD HAND PUMP

Time	Volume of Water Removed (gallons)	Discharge Rate (gal/min)	Field Parameters Measured: pH	Specific Conductivity (ms/cm)	Turbidity (ntu)	Dissolved Oxygen (mg/L)	Temp. (°C)			Water Level (feet)	Comments
Ø931	Ø	—	7.39	Ø.982	999	5.1Ø	18.5			22.17	
Ø933	5	2.5	7.26	Ø.982	235	4.4Ø	18.3				
Ø936	1Ø	1.7	7.23	Ø.987	242	2.38	18.3				
Ø939	15	1.7	7.21	Ø.989	145	4.26	18.3				
Ø943	2Ø	1.3	7.21	Ø.99Ø	1Ø2	4.23	18.2				
Ø945	25	2.5	7.2Ø	Ø.991	88	4.19	18.2				
Ø948	3Ø	1.7	7.19	Ø.991	56	4.2Ø	18.2				
Ø95Ø	35	2.5	7.2Ø	Ø.991	65	4.18	18.2				
Ø953	4Ø	1.7	7.2Ø	Ø.991	41	3.9Ø	18.2				
1ØØ5										22.17	

FIELD EQUIPMENT	SERIAL NUMBER	RENTAL COMPANY
HORIBA U-1Ø	132Ø7	HAZCO

SAMPLE ID: Ø367SHGWØØ9

ANALYSIS: VOA, SVOA, TPH-EXT.

COC NUMBER: 7571

SAMPLING PERSONNEL:
Richard Vernimen
Roy Glenn

Tt ENVIRONMENTAL MANAGEMENT, INC.
• SAN FRANCISCO •

GROUNDWATER SAMPLING RECORD

DATE 6-4-97

MONITORING WELL NO. MW02

PROJECT Concord NWS, CLEAN II

SITE Site 22, Bldg 7SH5

PROJECT NO. 069-036B0203

CASING DIAMETER 2 inches

BOREHOLE DIAMETER 8.75 inches

TOP OF CASING ELEVATION 162.14 feet

WATER LEVEL 22.17 feet bgs @ 0910

WATER LEVEL ELEVATION 139.97 feet msl

STANDING WATER COLUMN 13.10 feet

WELL VOLUMES TO BE PURGED 3

MINUMUM PURGE VOLUME 39 gallons

ACTUAL VOLUME PURGED 40 gallons

VOLUME CALCULATED BY:

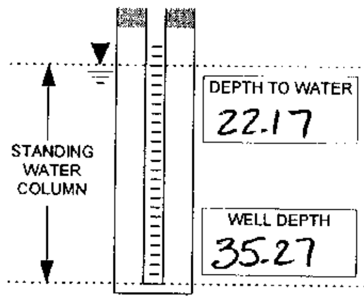
Roy D. Gle[illegible] (signature)

PURGE VOLUME CALCULATION

One Well Volume = Casing Volume + Annulus Volume

One Well Volume = 2.23 gal + 10.62 gal

One Well Volume = 12.85 gallons



Casing Volume = Standing Water Column (ft) x Pipe Volume (gal/linear ft)[a]

Casing Volume = 13.10 ft x 0.17 gal/linear ft

Casing Volume = 2.23 gallons

NOTE:
- a Refer to Table 1
- b Refer to Table 2
- c Assuming Sand Pack Porosity of 30%

Annulus Volume = [(Standing Water Column (ft) x Borehole Volume (gal/linear ft)[b]) - Casing Volume] x 0.3[c]

Annulus Volume = [(12 ft x 3.12 gal/linear ft) - 2.04 gal] x 0.3

12 (0.17)

Annulus Volume = 10.62 gallons

Table 1
Pipe Volume of Schedule 40 PVC Casing

Diameter (inches)	OD (inches)	ID (inches)	Volume (gal/linear ft)	Diameter (inches)	OD (inches)	ID (inches)	Volume (gal/linear ft)
1.25	1.660	1.380	0.08	4	4.500	4.026	0.66
2	2.375	2.067	0.17	6	6.625	6.065	1.50
3	3.500	3.068	0.38	8	8.625	7.981	2.60

Table 2
Volume of Borehole

Diameter (inches)	Volume (gal/linear ft)	Diameter (inches)	Volume (gal/linear ft)	Diameter (inches)	Volume (gal/linear ft)
7.25	2.14	8.25	2.78	9.25	3.52
7.75	2.45	8.75	3.12	10.25	4.29

GROUNDWATER SAMPLING RECORD

DATE 9-3-97 PAGE 1 OF 2

MONITORING WELL NO. MWØ2

PROJECT CONCORD NWS,

SITE SITE 22, BLDG 7SH5

PROJECT NO. Ø69-Ø36B0203

TOTAL GALLONS TO BE PURGED 31

PURGING METHOD HAND PUMP

SAMPLING METHOD HAND PUMP

Time	Volume of Water Removed (gallons)	Discharge Rate (gal/min)	Field Parameters Measured: pH	Specific Conductivity (ms/cm)	Turbidity (ntu)	Dissolved Oxygen (mg/L)	Temp. (°C)			Water Level (feet)	Comments
1Ø35	Ø	—	684	1.Ø6	385	5.4Ø	19.4			25.69	
1Ø37	5	1.66	7.23	1.Ø5	392	4.95	18.7				
1Ø4Ø	1Ø	1.66	7.14	1.Ø6	342	4.69	18.4				
1Ø42	15	2.5	7.Ø7	1.Ø6	221	4.58	18.3				
1Ø44	2Ø	2.5	6.85	1.Ø6	198	4.64	18.3				
1Ø46	25	2.5	6.97	1.Ø6	152	4.41	18.3				
1Ø48	3Ø	2.5	6.78	1.Ø6	153	4.38	18.2				
1Ø51	35	1.66	6.86	1.Ø6	152	4.2Ø	18.2				
1Ø57										25.69	

FIELD EQUIPMENT	SERIAL NUMBER	RENTAL COMPANY
HORIBA U-1Ø	N635Ø1	ARIS

SAMPLE ID: Ø367SHGWØ14

ANALYSIS: VOC, SVOC, TPH-E

COC NUMBER: 12166

SAMPLING PERSONNEL:
RICHARD VERWIMEN
ROY GLENN

TETRA TECH EM, INC.
• SAN FRANCISCO •

GROUNDWATER SAMPLING RECORD

DATE 9-3-97 PAGE 2 OF 2

MONITORING WELL NO. MWØ2

PROJECT Concord NWS, Clean II

SITE Site 22, Bldg 7SH5

PROJECT NO. Ø69-Ø36BØ2Ø3

CASING DIAMETER 2 inches

BOREHOLE DIAMETER 8.75 inches

TOP OF CASING ELEVATION 162.14 feet

WATER LEVEL 25.69 feet bgs @ 1Ø27

WATER LEVEL ELEVATION 136.45 feet msl

STANDING WATER COLUMN 9.58 feet

WELL VOLUMES TO BE PURGED 3

MINUMUM PURGE VOLUME 31 gallons

ACTUAL VOLUME PURGED 35 gallons

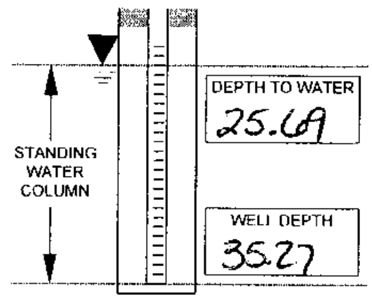
VOLUME CALCULATED BY:

PURGE VOLUME CALCULATION

One Well Volume = Casing Volume + Annulus Volume

One Well Volume = 1.63 gal + 8.48 gal

One Well Volume = 10.11 gallons



Casing Volume = Standing Water Column (ft) x Pipe Volume (gal/linear ft)[a]

Casing Volume = 9.58 ft x 0.17 gal/linear ft

Casing Volume = 1.63 gallons

NOTE:
- a Refer to Table 1
- b Refer to Table 2
- c Assuming Sand Pack Porosity of 30%

Annulus Volume = [(Standing Water Column (ft) x Borehole Volume (gal/linear ft)[b]) - Casing Volume] x 0.3[c]

Annulus Volume = [(9.58 ft x 3.12 gal/linear ft) - 1.63 gal] x 0.3

Annulus Volume = 8.48 gallons

Table 1
Pipe Volume of Schedule 40 PVC Casing

Diameter (inches)	OD (inches)	ID (inches)	Volume (gal/linear ft)	Diameter (inches)	OD (inches)	ID (inches)	Volume (gal/linear ft)
1.25	1.660	1.380	0.08	4	4.500	4.026	0.66
2	2.375	2.067	0.17	6	6.625	6.065	1.50
3	3.500	3.068	0.38	8	8.625	7.981	2.60

Table 2
Volume of Borehole

Diameter (inches)	Volume (gal/linear ft)	Diameter (inches)	Volume (gal/linear ft)	Diameter (inches)	Volume (gal/linear ft)
7.25	2.14	8.25	2.78	9.25	3.52
7.75	2.45	8.75	3.12	10.25	4.29

GROUNDWATER SAMPLING RECORD

DATE 12-5-97

MONITORING WELL NO. MW02

PROJECT Concord NWS

SITE Site 22, Bldg 7SH5

PROJECT NO. 036-036B0203

TOTAL GALLONS TO BE PURGED 23

PURGING METHOD Hand Pump

SAMPLING METHOD Hand Pump

Time	Volume of Water Removed (gallons)	Discharge Rate (gal/min)	Field Parameters Measured: pH	Specific Conductivity (ms/cm)	Turbidity (ntu)	Dissolved Oxygen (mg/L)	Temp. (°C)			Water Level (feet)	Comments
1050	0	—	7.14	1.01	251	6.43	17.4			27.97	
1052	5		7.12	1.00	230	6.31	17.9				
1054	10		7.09	1.00	235	5.74	18.0				
1057	15		7.06	1.00	196	5.90	18.1				
1059	20		7.10	1.00	94	5.78	18.1				
1102	25		7.08	1.00	45	5.93	18.2				
1113										27.97	

FIELD EQUIPMENT	SERIAL NUMBER	RENTAL COMPANY
Horiba U-10	NE 3501	Aris

SAMPLE ID: 0367SHGW018 @1105

ANALYSIS: VOC, SVOC, TPH-E

COC NUMBER: 13077

SAMPLING PERSONNEL:
Richard Ulbrimon
Roy Glenn

TETRA TECH EM, INC.
• SAN FRANCISCO •

GROUNDWATER SAMPLING RECORD

DATE 12-5-97 PAGE 2 OF 2

MONITORING WELL NO. MWØ2

PROJECT CONCORD NWS

SITE SITE 22, BLDG 7545

PROJECT NO. Ø69-Ø36BØ2Ø3

CASING DIAMETER 2 inches

BOREHOLE DIAMETER 8.75 inches

TOP OF CASING ELEVATION 162.14 feet

WATER LEVEL 27.97 feet bgs @ 1Ø4Ø

WATER LEVEL ELEVATION 134.17 feet msl

STANDING WATER COLUMN 7.37 feet

WELL VOLUMES TO BE PURGED 3

MINUMUM PURGE VOLUME 23 gallons

ACTUAL VOLUME PURGED 25 gallons

VOLUME CALCULATED BY: [signature]

PURGE VOLUME CALCULATION

One Well Volume = Casing Volume + Annulus Volume

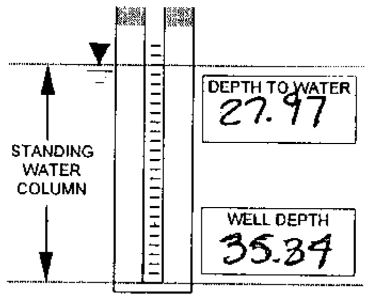
One Well Volume = 1.25 gal + 6.52 gal

One Well Volume = ~~5.27~~ 7.77 gallons

Casing Volume = Standing Water Column (ft) x Pipe Volume (gal/linear ft)[a]

Casing Volume = 7.37 ft x Ø.17 gal/linear ft

Casing Volume = 1.25 gallons



34.98
+.36
35.3

NOTE:
- a Refer to Table 1
- b Refer to Table 2
- c Assuming Sand Pack Porosity of 30%

Annulus Volume = [(Standing Water Column (ft) x Borehole Volume (gal/linear ft)[b]) - Casing Volume] x 0.3[c]

Annulus Volume = [(7.37 ft x 3.12 gal/linear ft) - 1.25 gal] x 0.3

Annulus Volume = 6.52 gallons

Table 1
Pipe Volume of Schedule 40 PVC Casing

Diameter (inches)	OD (inches)	ID (inches)	Volume (gal/linear ft)	Diameter (inches)	OD (inches)	ID (inches)	Volume (gal/linear ft)
1.25	1.660	1.380	0.08	4	4.500	4.026	0.66
2	2.375	2.067	0.17	6	6.625	6.065	1.50
3	3.500	3.068	0.38	8	8.625	7.981	2.60

Table 2
Volume of Borehole

Diameter (inches)	Volume (gal/linear ft)	Diameter (inches)	Volume (gal/linear ft)	Diameter (inches)	Volume (gal/linear ft)
7.25	2.14	8.25	2.78	9.25	3.52
7.75	2.45	8.75	3.12	10.25	4.29

MONITORING WELL COMPLETION RECORD

DRILLING INFORMATION

DRILLING BEGAN:
DATE 1-28-97 TIME 0824
WELL INSTALLATION BEGAN:
DATE 1-28-97 TIME 1352
WELL COMPLETION FINISHED:
DATE 1-28-97 TIME 1715
DRILLING CO. Bay Area Exploration
DRILLER Gary Balleini
LICENSE C6889956
DRILL RIG 75 CME
DRILLING METHOD:
☒ HOLLOW STEM AUGER
☐ AIR ROTARY
☐ ______
DIAMETER OF AUGERS:
ID 3 1/4" OD 8"

BENTONITE SEAL

AMOUNT CALCULATED 50 lbs
AMOUNT USED 50 lbs
☐ PELLETS, SIZE ______
☒ CHIPS, SIZE 3/8"
☐ ______
PRODUCT Wyoming Bentonite
MFG. BY Bariod Drilling
METHOD INSTALLED:
☒ POURED ☐ TREMIE
AMOUNT OF WATER USED 0

FILTER PACK

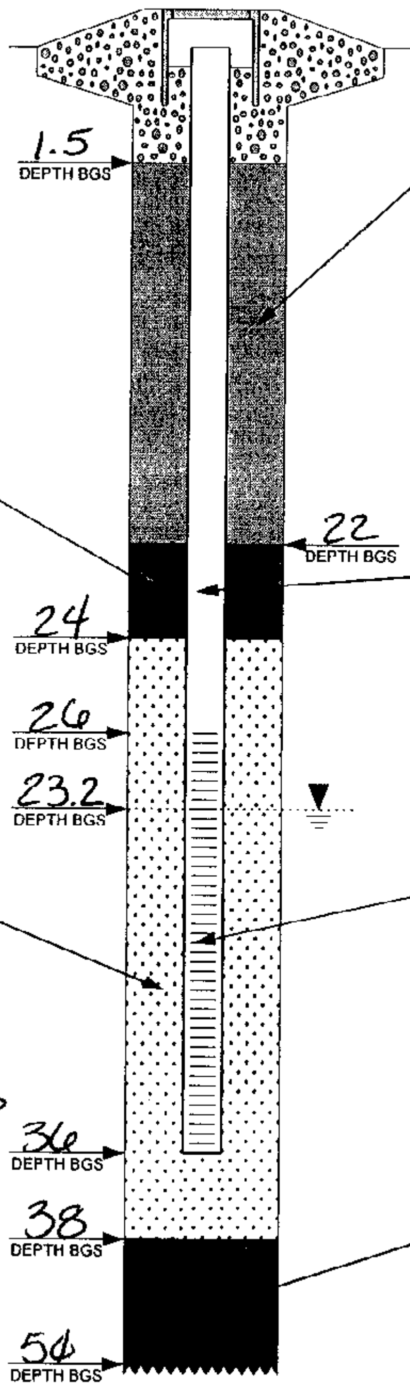
AMOUNT CALCULATED 480 lbs
AMOUNT USED 400 lbs
☒ SAND, SIZE #2/12 Monterey
☐ FORMATION COLLAPSE:
FROM ______ TO ______
PRODUCT Monterey Sands, Kiln Dried
MFG. BY RMC Lonestar
METHOD INSTALLED:
☒ POURED ☐ TREMIE

SURVEY INFORMATION

TOC ELEVATION 162.25
GROUND ELEVATION 162.10
NORTHING CORD. 543482.12
EASTING CORD. 1571484.09
DATE SURVEYED 3-19-97
SURVEY CO. Alhambra Land Surveyor

SURFACE COMPLETION

☒ FLUSH MOUNT
☐ ABOVE GROUND W/BUMPER POST
☒ CONCRETE ☐ ASPHALT



CENTRALIZERS

☐ DEPTHS ______, ______
☒ NO CENTRALIZERS USED

MONITORING WELL

MONITORING WELL NO. MW03
PROJECT Concord NWS
SITE Site 22, Bldg 7SH5
BOREHOLE NO. 7SHMW03
WELL PERMIT NO. M97-1028
TOC TO BOTTOM OF WELL 36.19

ANNULAR SEAL

AMOUNT CALCULATED 47 gal
AMOUNT USED 45 gal
☒ GROUT FORMULA
PORTLAND CEMENT Basalite Type I-II
BENTONITE Aquagel Gold Seal
WATER ______
☐ PREPARED MIX
PRODUCT ______
MFG. BY ______
METHOD INSTALLED:
☒ POURED ☐ TREMIE

CASING

☒ SCHEDULE 40 PVC
☐ ______
PRODUCT ______
MFG. BY Geotech
CASING DIAMETER:
ID 2 1/8" OD 2 3/8"
LENGTH OF CASING ~26'

WELL SCREEN

☒ SCHEDULE 40 PVC
☐ ______
PRODUCT ______
MFG. BY Geotech
CASING DIAMETER:
ID 2 1/8" OD 2 3/8"
SLOT SIZE 0.01"
LENGTH OF SCREEN 10'

BOREHOLE BACKFILL

AMOUNT CALCULATED 408 lbs
AMOUNT USED 400
☒ BENTONITE CHIPS, SIZE 3/8"
☐ BENTONITE PELLETS, SIZE ______
☐ SLURRY ______
☐ FORMATION COLLAPSE ______
PRODUCT Wyoming Bentonite
MFG. BY Bariod Drilling
METHOD INSTALLED:
☒ POURED ☐ TREMIE

ENVIRONMENTAL MANAGEMENT, INC.
• SAN FRANCISCO •

07/09/97 6:55 PM

DEVELOPMENT

GROUNDWATER SAMPLING RECORD

DATE 2-18-97 PAGE 1 OF 2

MONITORING WELL NO. MWØ3

PROJECT CONCORD NWS

SITE SITE 22, BLDG 7545

PROJECT NO. CK05-Ø36BØ2Ø3

TOTAL GALLONS TO BE PURGED

PURGING METHOD HAND PUMP

SAMPLING METHOD

Time	Volume of Water Removed (gallons)	Discharge Rate (gal/min)	Field Parameters Measured: pH	Specific Conductivity (ms/cm)	Turbidity (ntu)	Dissolved Oxygen (mg/L)	Temp. (°C)			Water Level (feet)	Comments
1214-1224										21.8Ø	SURGE WELL
124Ø	1Ø	5	6.21	1.2Ø	484	6.92	18.7				
1242	2Ø	5	6.22	1.15	647	7.4Ø	18.5				
1245	3Ø	3.3	6.26	1.13	751	7.51	18.4				
1248	4Ø	3.3	6.3Ø	1.13	778	7.5Ø	18.5				
1251	5Ø	3.3	6.32	1.11	881	7.61	18.5				
1254	6Ø	3.3	6.34	1.11	8Ø5	7.58	18.5				
13ØØ-131Ø										21.8Ø	SURGING WELL
1316	7Ø	3.3	6.36	1.11	999+	7.57	18.5				
1318	8Ø	5	6.36	1.1Ø	"	7.5Ø	18.4				
132Ø	9Ø	5	6.35	1.Ø8	"	7.37	18.5				
1322	1ØØ	5	6.37	1.Ø8	"	7.5Ø	18.4				
1324	11Ø	5	6.38	1.Ø8	"	7.25	18.4				
1327	12Ø	3.3	6.38	1.Ø8	"	7.Ø8	18.4				
1335										21.8Ø	

FIELD EQUIPMENT	SERIAL NUMBER	RENTAL COMPANY
HORIBA U-1Ø	U1Ø-Ø35	HAZCO

SAMPLE ID:

ANALYSIS:

COC NUMBER:

SAMPLING PERSONNEL:

RICHARD VERMINO

ROY GLENN

DEVELOPMENT

GROUNDWATER SAMPLING RECORD

DATE 2-18-97

MONITORING WELL NO. MW03

PROJECT CONCORD NWS

SITE SITE 22, BLDG 7SH5

PROJECT NO. 069-036B0203

CASING DIAMETER 2 inches

BOREHOLE DIAMETER 8.75 inches

TOP OF CASING ELEVATION 162.25 feet

WATER LEVEL 21.80 feet btoc @ 1210

WATER LEVEL ELEVATION 140.45 feet msl

STANDING WATER COLUMN 14.39 feet

WELL VOLUMES TO BE PURGED ______

MINUMUM PURGE VOLUME ______ gallons

ACTUAL VOLUME PURGED 120 gallons

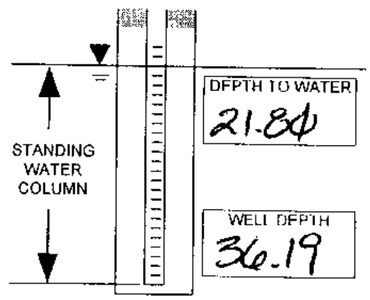
VOLUME CALCULATED BY: [signature]

PURGE VOLUME CALCULATION

One Well Volume = Casing Volume + Annulus Volume

One Well Volume = 2.45 gal + 10.62 gal

One Well Volume = 13.07 gallons



Casing Volume = Standing Water Column (ft) x Pipe Volume (gal/linear ft)[a]

Casing Volume = 14.39 ft x .17 gal/linear ft

Casing Volume = 2.45 gallons

NOTE:
- a Refer to Table 1
- b Refer to Table 2
- c Assuming Sand Pack Porosity of 30%

Annulus Volume = [(Standing Water Column (ft) x Borehole Volume (gal/linear ft)[b]) - Casing Volume] x 0.3[c]

Annulus Volume = [(12 ft x 3.12 gal/linear ft) - 2.04 gal] x 0.3
12x.17

Annulus Volume = 10.62 gallons

Table 1
Pipe Volume of Schedule 40 PVC Pipe

Diameter (inches)	OD (inches)	ID (inches)	Volume (gal/linear ft)	Diameter (inches)	OD (inches)	ID (inches)	Volume (gal/linear ft)
1.25	1.660	1.380	0.08	4	4.500	4.026	0.66
2	2.375	2.067	0.17	6	6.625	6.065	1.50
3	3.500	3.068	0.38	8	8.625	7.981	2.60

Table 2
Volume of Borehole

Diameter (inches)	Volume (gal/linear ft)	Diameter (inches)	Volume (gal/linear ft)	Diameter (inches)	Volume (gal/linear ft)
7.25	2.14	8.25	2.78	9.25	3.52
7.75	2.45	8.75	3.12	10.25	4.29

GROUNDWATER SAMPLING RECORD

DATE 3-5-97 PAGE 1 OF 2

MONITORING WELL NO. MW03

PROJECT Concord NWS

SITE Site 22, Bldg 7SH5

PROJECT NO. 069-036B0203

TOTAL GALLONS TO BE PURGED 40

PURGING METHOD Hand Pump

SAMPLING METHOD Hand Pump

Time	Volume of Water Removed (gallons)	Discharge Rate (gal/min)	Field Parameters Measured							Water Level (feet)	Comments
			pH	Specific Conductivity (ms/cm)	Turbidity (ntu)	Dissolved Oxygen (mg/L)	Temp. (°C)				
1052	0	0	6.70	1.06	999+	5.45	17.3			21.15	
1057	10	2.0	6.71	1.05	970	5.45	17.9				
1103	15	0.83	6.71	1.06	650	5.16	18.1				
1106	20	1.67	6.72	1.05	500	5.19	18.1				
1111	25	1.0	6.70	1.06	325	5.20	18.2				
1116	30	1.0	6.71	1.06	250	5.22	18.2				
1120	35	1.25	6.71	1.06	180	5.16	18.2				
1125	40	1.0	6.71	1.06	172	5.18	18.2				
1134										21.16	

FIELD EQUIPMENT	SERIAL NUMBER	RENTAL COMPANY
Horiba U-10	ME3500	Aris

SAMPLE ID: 0367SHGW004

ANALYSIS: VOC, SVOC, TPH-E

COC NUMBER: 75166

SAMPLING PERSONNEL:

Richard Ugraimen

Roy Glenn

TETRA TECH EM, INC.
• SAN FRANCISCO •

GROUNDWATER SAMPLING RECORD

DATE 3-5-97 PAGE 2 OF 2

MONITORING WELL NO. MW03

PROJECT Concord NWS, Clean II

SITE Site 22, Bldg 7SH5

PROJECT NO. 069-0360B0203

CASING DIAMETER 2 inches

BOREHOLE DIAMETER 8.75 inches

TOP OF CASING ELEVATION 162.25 feet

WATER LEVEL 21.15 feet bgs @ 1031

WATER LEVEL ELEVATION 141.10 feet msl

STANDING WATER COLUMN 15.04 feet

WELL VOLUMES TO BE PURGED 3

MINUMUM PURGE VOLUME 40 gallons

ACTUAL VOLUME PURGED 40 gallons

VOLUME CALCULATED BY: [illegible signature]

PURGE VOLUME CALCULATION

One Well Volume = Casing Volume + Annulus Volume

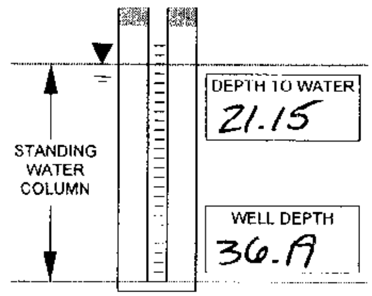
One Well Volume = 2.56 gal + 10.62 gal

One Well Volume = 13.18 gallons

Casing Volume = Standing Water Column (ft) x Pipe Volume (gal/linear ft)[a]

Casing Volume = 15.04 ft x 0.17 gal/linear ft

Casing Volume = 2.56 gallons



NOTE
a Refer to Table 1
b Refer to Table 2
c Assuming Sand Pack Porosity of 30%

Annulus Volume = [(Standing Water Column (ft) x Borehole Volume (gal/linear ft)[b]) - Casing Volume] x 0.3[c]

Annulus Volume = [(12 ft x 3.12 gal/linear ft) - 2.04 gal] x 0.3
(12 x 0.17)

Annulus Volume = 10.62 gallons

Table 1 Pipe Volume of Schedule 40 PVC Casing							
Diameter (inches)	OD (inches)	ID (inches)	Volume (gal/linear ft)	Diameter (inches)	OD (inches)	ID (inches)	Volume (gal/linear ft)
1.25	1.660	1.380	0.08	4	4.500	4.026	0.66
2	2.375	2.067	0.17	6	6.625	6.065	1.50
3	3.500	3.068	0.38	8	8.625	7.981	2.60

Table 2 Volume of Borehole					
Diameter (inches)	Volume (gal/linear ft)	Diameter (inches)	Volume (gal/linear ft)	Diameter (inches)	Volume (gal/linear ft)
7.25	2.14	8.25	2.78	9.25	3.52
7.75	2.45	8.75	3.12	10.25	4.29

Tt TETRA TECH EM, INC.
• SAN FRANCISCO •

GROUNDWATER SAMPLING RECORD

DATE 6-4-97 PAGE 1 OF 2

MONITORING WELL NO. MW03

PROJECT CONCORD NWS, CLEAN II

SITE SITE 22, BLDG 7SH5

PROJECT NO. 069-036B0203

TOTAL GALLONS TO BE PURGED 39

PURGING METHOD HAND PUMP

SAMPLING METHOD HAND PUMP

Time	Volume of Water Removed (gallons)	Discharge Rate (gal/min)	Field Parameters Measured: pH	Specific Conductivity (ms/cm)	Turbidity (ntu)	Dissolved Oxygen (mg/L)	Temp. (°C)			Water Level (feet)	Comments
1028	0	—	7.33	0.966	999	4.64	19.1			22.58	
1031	5	1.67	7.31	0.963	805	4.53	18.6				
1034	10	1.67	7.31	0.962	348	4.83	18.5				
1037	15	1.67	7.31	0.963	222	4.80	18.5				
1040	20	1.67	7.31	0.964	262	4.77	18.5				
1044	25	1.25	7.30	0.964	166	4.67	18.5				
1048	30	1.25	7.29	0.964	120	4.78	18.6				
1051	35	1.67	7.28	0.964	122	4.69	18.6				
1054	40	1.67	7.30	0.964	105	4.45	18.6				
1103										22.58	

FIELD EQUIPMENT	SERIAL NUMBER	RENTAL COMPANY
HORIBA U-10	13207	HAZCO

SAMPLE ID: 0367SHGW010

ANALYSIS: VOC, SVOC, TPH-EXT.

COC NUMBER: 7571

SAMPLING PERSONNEL:

RICHARD VERNIMEN

ROY GLENN

GROUNDWATER SAMPLING RECORD

DATE 6-4-97

MONITORING WELL NO. MW03

PROJECT CONCORD NWS, CLEAN II

SITE SITE 22, BLDG 7SH5

PROJECT NO. 069-036B0203

CASING DIAMETER 2 inches

BOREHOLE DIAMETER 8.75 inches

TOP OF CASING ELEVATION 162.25 feet

WATER LEVEL 22.58 feet bgs @ 1016

WATER LEVEL ELEVATION 139.67 feet msl

STANDING WATER COLUMN 13.61 feet

WELL VOLUMES TO BE PURGED 3

MINUMUM PURGE VOLUME 39 gallons

ACTUAL VOLUME PURGED 40 gallons

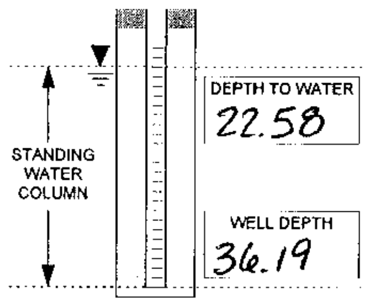
VOLUME CALCULATED BY:

PURGE VOLUME CALCULATION

One Well Volume = Casing Volume + Annulus Volume

One Well Volume = 2.31 gal + 10.62 gal

One Well Volume = 12.93 gallons



Casing Volume = Standing Water Column (ft) x Pipe Volume (gal/linear ft)[a]

Casing Volume = 13.61 ft x 0.17 gal/linear ft

Casing Volume = 2.31 gallons

NOTE:
a Refer to Table 1
b Refer to Table 2
c Assuming Sand Pack Porosity of 30%

Annulus Volume = [(Standing Water Column (ft) x Borehole Volume (gal/linear ft)[b]) - Casing Volume] x 0.3[c]

Annulus Volume = [(12 ft x 3.12 gal/linear ft) - 2.04 gal] x 0.3

12 (0.17)

Annulus Volume = 10.62 gallons

Table 1
Pipe Volume of Schedule 40 PVC Casing

Diameter (inches)	OD (inches)	ID (inches)	Volume (gal/linear ft)	Diameter (inches)	OD (inches)	ID (inches)	Volume (gal/linear ft)
1.25	1.660	1.380	0.08	4	4.500	4.026	0.66
2	2.375	2.067	0.17	6	6.625	6.065	1.50
3	3.500	3.068	0.38	8	8.625	7.981	2.60

Table 2
Volume of Borehole

Diameter (inches)	Volume (gal/linear ft)	Diameter (inches)	Volume (gal/linear ft)	Diameter (inches)	Volume (gal/linear ft)
7.25	2.14	8.25	2.78	9.25	3.52
7.75	2.45	8.75	3.12	10.25	4.29

GROUNDWATER SAMPLING RECORD

DATE 9-3-97 PAGE 1 OF 2

MONITORING WELL NO. MW03

PROJECT CONCORD NWS, CLEAN II

SITE SITE 22, BLDG 7SH5

PROJECT NO. 06A-036B0203

TOTAL GALLONS TO BE PURGED 32

PURGING METHOD HAND PUMP

SAMPLING METHOD HAND PUMP

Time	Volume of Water Removed (gallons)	Discharge Rate (gal/min)	Field Parameters Measured							Water Level (feet)	Comments
			pH	Specific Conductivity (ms/cm)	Turbidity (ntu)	Dissolved Oxygen (mg/L)	Temp. (°C)				
1126	0	—	7.83	1.05	999	4.94	19.9			26.07	
1128	5	1.67	7.64	1.05	193	4.74	18.8				
1130	10	2.5	7.52	1.05	221	4.59	18.5				
1132	15	2.5	7.56	1.05	231	4.76	18.4				
1135	20	1.67	7.39	1.05	236	4.56	18.4				
1138	25	1.67	7.28	1.05	217	4.51	18.3				
1140	30	2.5	7.25	1.05	202	4.54	18.3				
1143	35	1.67	7.06	1.05	181	4.66	18.3				
1145	40	2.5	7.06	1.05	182	4.67	18.3				

FIELD EQUIPMENT	SERIAL NUMBER	RENTAL COMPANY
HORIBA U-10	ME3501	ARIS

SAMPLE ID: 0367SHGW015

ANALYSIS: VOC, SVOC, TPH-E

COC NUMBER: 12166

SAMPLING PERSONNEL:

Richard Vernimen

Roy Glenn

TETRA TECH EM, INC.
• SAN FRANCISCO •

GROUNDWATER SAMPLING RECORD

DATE 9-3-97

MONITORING WELL NO. MW03

PROJECT CONCORD NWS, CLEAN II

SITE SITE 22, BLDG 7SH5

PROJECT NO. 069-036B0203

CASING DIAMETER 2 inches

BOREHOLE DIAMETER 8.75 inches

TOP OF CASING ELEVATION 162.25 feet

WATER LEVEL 26.07 feet bgs @ 1117

WATER LEVEL ELEVATION 136.18 feet msl

STANDING WATER COLUMN 10.12 feet

WELL VOLUMES TO BE PURGED 3

MINUMUM PURGE VOLUME 32 gallons

ACTUAL VOLUME PURGED 40 gallons

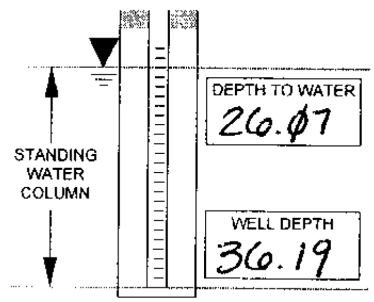
VOLUME CALCULATED BY: [signature]

PURGE VOLUME CALCULATION

One Well Volume = Casing Volume + Annulus Volume

One Well Volume = 1.72 gal + 8.96 gal

One Well Volume = 10.68 gallons



Casing Volume = Standing Water Column (ft) x Pipe Volume (gal/linear ft)[a]

Casing Volume = 10.12 ft x 0.17 gal/linear ft

Casing Volume = 1.72 gallons

NOTE:
- a Refer to Table 1
- b Refer to Table 2
- c Assuming Sand Pack Porosity of 30%

Annulus Volume = [(Standing Water Column (ft) x Borehole Volume (gal/linear ft)[b]) - Casing Volume] x 0.3[c]

Annulus Volume = [(10.12 ft x 3.12 gal/linear ft) - 1.72 gal] x 0.3

Annulus Volume = 8.96 gallons

Table 1
Pipe Volume of Schedule 40 PVC Casing

Diameter (inches)	OD (inches)	ID (inches)	Volume (gal/linear ft)	Diameter (inches)	OD (inches)	ID (inches)	Volume (gal/linear ft)
1.25	1.660	1.380	0.08	4	4.500	4.026	0.66
2	2.375	2.067	0.17	6	6.625	6.065	1.50
3	3.500	3.068	0.38	8	8.625	7.981	2.60

Table 2
Volume of Borehole

Diameter (inches)	Volume (gal/linear ft)	Diameter (inches)	Volume (gal/linear ft)	Diameter (inches)	Volume (gal/linear ft)
7.25	2.14	8.25	2.78	9.25	3.52
7.75	2.45	8.75	3.12	10.25	4.29

GROUNDWATER SAMPLING RECORD

MONITORING WELL NO. MWØ3

DATE 12-5-97 PAGE 1 OF 2

PROJECT Concord NWS

TOTAL GALLONS TO BE PURGED 25

SITE Site 22, Bldg 7SH5

PURGING METHOD Hand Pump

PROJECT NO. Ø69-Ø36BØ2Ø3

SAMPLING METHOD Hand Pump

Time	Volume of Water Removed (gallons)	Discharge Rate (gal/min)	Field Parameters Measured: pH	Specific Conductivity (ms/cm)	Turbidity (ntu)	Dissolved Oxygen (mg/L)	Temp. (°C)			Water Level (feet)	Comments
1134	Ø		7.14	1.ØØ	over	5.91	17.3			28.3Ø	
1137	5		7.11	1.ØØ	14Ø	5.94	18.Ø				
1139	1Ø		7.11	1.ØØ	2Ø2	5.89	18.1				
1141	15		7.12	1.ØØ	135	5.83	18.2				
1143	2Ø		7.14	1.ØØ	126	5.9Ø	18.2				
1145	25		7.15	1.ØØ	1Ø6	5.87	18.2				
12Ø1										28.3Ø	

FIELD EQUIPMENT	SERIAL NUMBER	RENTAL COMPANY
Horiba U-1Ø	ME35Ø1	ARIS

SAMPLE ID: Ø367SHGWØ19 @1155

ANALYSIS: VOC, SVOC, TPH-E MS/MSD

COC NUMBER: 13Ø77

SAMPLING PERSONNEL: Richard Vernimen, Roy Glenn

TETRA TECH EM, INC.
• SAN FRANCISCO •

Ø69-0036 4-07

GROUNDWATER SAMPLING RECORD

DATE 12-5-97 PAGE 2 OF 2

MONITORING WELL NO. MWØ3

PROJECT Concord NWS

SITE Site 22, Bldg 7545

PROJECT NO. Ø36BØ2Ø3

CASING DIAMETER 2 inches

BOREHOLE DIAMETER 8.75 inches

TOP OF CASING ELEVATION 162.25 feet

WATER LEVEL 28.3Ø feet bgs @ 1123

WATER LEVEL ELEVATION 133.95 feet msl

STANDING WATER COLUMN 7.84 feet

WELL VOLUMES TO BE PURGED 3

MINUMUM PURGE VOLUME 25 gallons

ACTUAL VOLUME PURGED 25 gallons

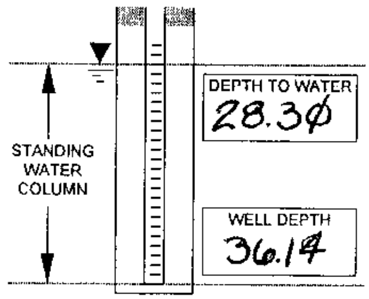
VOLUME CALCULATED BY:

PURGE VOLUME CALCULATION

One Well Volume = Casing Volume + Annulus Volume

One Well Volume = 1.33 gal + 6.94 gal

One Well Volume = 8.27 gallons



35.78
+.36

Casing Volume = Standing Water Column (ft) x Pipe Volume (gal/linear ft)[a]

Casing Volume = 7.84 ft x Ø.17 gal/linear ft

Casing Volume = 1.33 gallons

NOTE:
a Refer to Table 1
b Refer to Table 2
c Assuming Sand Pack Porosity of 30%

Annulus Volume = [(Standing Water Column (ft) x Borehole Volume (gal/linear ft)[b]) - Casing Volume] x 0.3[c]

Annulus Volume = [(7.84 ft x 3.12 gal/linear ft) - 1.33 gal] x 0.3

Annulus Volume = 6.94 gallons

Table 1
Pipe Volume of Schedule 40 PVC Casing

Diameter (inches)	OD (inches)	ID (inches)	Volume (gal/linear ft)	Diameter (inches)	OD (inches)	ID (inches)	Volume (gal/linear ft)
1.25	1.660	1.380	0.08	4	4.500	4.026	0.66
2	2.375	2.067	0.17	6	6.625	6.065	1.50
3	3.500	3.068	0.38	8	8.625	7.981	2.60

Table 2
Volume of Borehole

Diameter (inches)	Volume (gal/linear ft)	Diameter (inches)	Volume (gal/linear ft)	Diameter (inches)	Volume (gal/linear ft)
7.25	2.14	8.25	2.78	9.25	3.52
7.75	2.45	8.75	3.12	10.25	4.29

TETRA TECH EM, INC.
• SAN FRANCISCO •

MONITORING WELL COMPLETION RECORD

DRILLING INFORMATION

DRILLING BEGAN:
DATE 2-3-97 TIME 0855
WELL INSTALLATION BEGAN:
DATE 2-3-97 TIME 1040
WELL COMPLETION FINISHED:
DATE 2-3-97 TIME 1520
DRILLING CO. Bay Area Exploration
DRILLER Gary Ballerini
LICENSE C68899560
DRILL RIG 75 CME
DRILLING METHOD:
☒ HOLLOW STEM AUGER
☐ AIR ROTARY
☐ ____
DIAMETER OF AUGERS:
ID 3 3/4" OD 8"

BENTONITE SEAL

AMOUNT CALCULATED 50 lbs
AMOUNT USED 50 lbs
☐ PELLETS, SIZE ____
☒ CHIPS, SIZE 3/8"
☐ ____
PRODUCT Wyoming Bentonite
MFG. BY Baroid Drilling
METHOD INSTALLED:
☒ POURED ☐ TREMIE
AMOUNT OF WATER USED 0

FILTER PACK

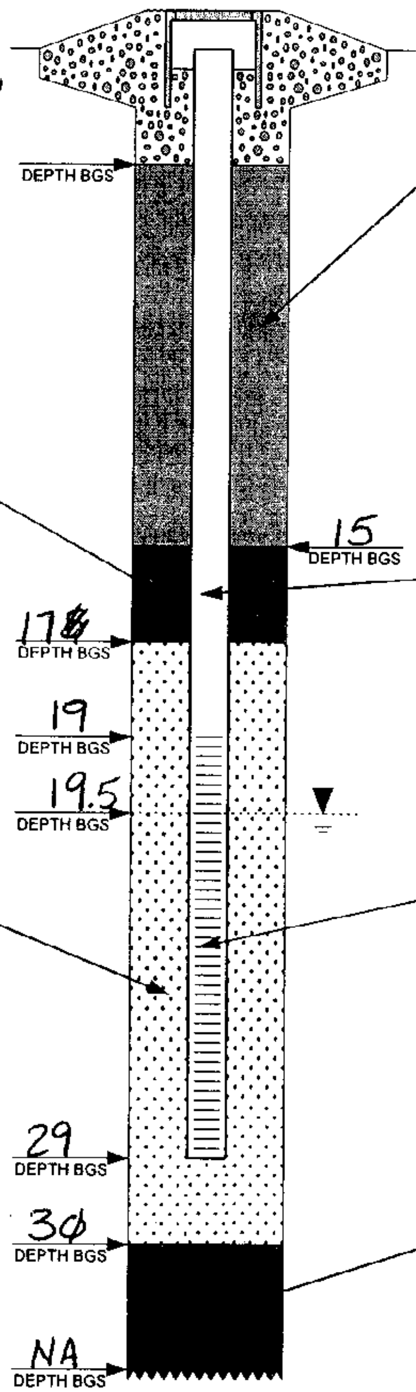
AMOUNT CALCULATED 425
AMOUNT USED 400
☒ SAND, SIZE #2/12 Monterey
☐ FORMATION COLLAPSE:
FROM ____ TO ____
PRODUCT Monterey Sands
MFG. BY RMC Lonestar
METHOD INSTALLED:
☒ POURED ☐ TREMIE

SURVEY INFORMATION

TOC ELEVATION 1600.43
GROUND ELEVATION 1600.00
NORTHING CORD. 543328.03
EASTING CORD. 1571669.94
DATE SURVEYED 3-19-97
SURVEY CO. Alhambra Land Survey

SURFACE COMPLETION

☒ FLUSH MOUNT
☐ ABOVE GROUND W/BUMPER POST
☒ CONCRETE ☐ ASPHALT



CENTRALIZERS

☐ DEPTHS ____, ____
☒ NO CENTRALIZERS USED

MONITORING WELL

MONITORING WELL NO. MW04
PROJECT Concord NWS
SITE Site 22, Bldg 7SM5
BOREHOLE NO. 7SHMW04
WELL PERMIT NO. M97-1028
TOC TO BOTTOM OF WELL 29.85

ANNULAR SEAL

AMOUNT CALCULATED 36
AMOUNT USED 35
☒ GROUT FORMULA
PORTLAND CEMENT Basalite Type I-II
BENTONITE Aquagel Gold Seal
WATER ____
☐ PREPARED MIX
PRODUCT ____
MFG. BY ____
METHOD INSTALLED:
☒ POURED ☐ TREMIE

CASING

☒ SCHEDULE 40 PVC
☐ ____
PRODUCT ____
MFG. BY Geotech
CASING DIAMETER:
ID 2 1/8" OD 2 3/8"
LENGTH OF CASING ~19'

WELL SCREEN

☒ SCHEDULE 40 PVC
☐ ____
PRODUCT ____
MFG. BY Geotech
CASING DIAMETER:
ID 2 1/6" OD 2 3/8"
SLOT SIZE 0.01"
LENGTH OF SCREEN 10'

BOREHOLE BACKFILL

AMOUNT CALCULATED ____
AMOUNT USED ____
☐ BENTONITE CHIPS, SIZE ____
☐ BENTONITE PELLETS, SIZE ____
☐ SLURRY ____
☐ FORMATION COLLAPSE
PRODUCT ____
MFG. BY ____
METHOD INSTALLED:
☐ POURED ☐ TREMIE

ENVIRONMENTAL MANAGEMENT, INC.
• SAN FRANCISCO •

07/09/97 6:55 PM

DEVELOPMENT
GROUNDWATER SAMPLING RECORD

DATE 2-18-97 PAGE 1 OF 2

MONITORING WELL NO. MW04

PROJECT CONCORD NWS

SITE SITE 22, BLDG 7SH5

PROJECT NO. 069-036B0203

TOTAL GALLONS TO BE PURGED

PURGING METHOD HAND PUMP

SAMPLING METHOD /

Time	Volume of Water Removed (gallons)	Discharge Rate (gal/min)	Field Parameters Measured: pH	Specific Conductivity (ms/cm)	Turbidity (ntu)	Dissolved Oxygen (mg/L)	Temp. (°C)			Water Level (feet)	Comments
1355-1405										19.30	SURGING WELL
1415	10	2	6.85	1.29	534	8.94	18.9				
1419	20	2.5	6.82	1.16	865	9.91	18.6				
1423	30	2.5	6.79	1.11	999+	9.03	18.5				
1428	40	2	6.80	1.08	999+	9.25	18.4				
1431	50	3.3	6.80	1.07	874	8.57	18.5				
1435-1445											SURGING WELL
1450	60	2	6.76	1.06	680	7.41	18.4				
1455	70	2	6.77	1.05	999+	8.47	18.4				
1500	80	2	6.75	1.06	"	6.65	18.3				
1505	90	2	6.75	1.05	"	6.73	18.4				
1510	100	2	6.74	1.05	"	6.84	18.3				
1523										19.40	

FIELD EQUIPMENT	SERIAL NUMBER	RENTAL COMPANY
HORIBA U10	U10-035	HAZCO

SAMPLE ID:

ANALYSIS:

COC NUMBER:

SAMPLING PERSONNEL:

ENVIRONMENTAL MANAGEMENT, INC.
• SAN FRANCISCO •

DEVELOPMENT

GROUNDWATER SAMPLING RECORD

DATE 2-18-97

MONITORING WELL NO. MW04

PROJECT ______

SITE ______

PROJECT NO. ______

CASING DIAMETER 2 inches

BOREHOLE DIAMETER 8.75 inches

TOP OF CASING ELEVATION 160.43 feet

WATER LEVEL 19.3 feet btoc @ 1330

WATER LEVEL ELEVATION 141.13 feet msl

STANDING WATER COLUMN 10.55 feet

WELL VOLUMES TO BE PURGED ______

MINUMUM PURGE VOLUME ______ gallons

ACTUAL VOLUME PURGED 100 gallons

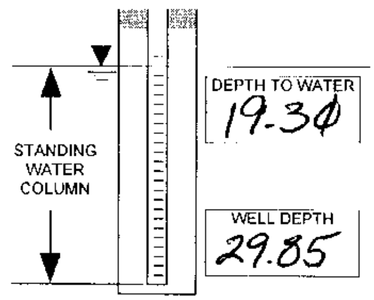
VOLUME CALCULATED BY: [signature]

PURGE VOLUME CALCULATION

One Well Volume = Casing Volume + Annulus Volume

One Well Volume = 1.79 gal + 9.34 gal

One Well Volume = 11.13 gallons



Casing Volume = Standing Water Column (ft) x Pipe Volume (gal/linear ft)[a]

Casing Volume = 10.55 ft x .17 gal/linear ft

Casing Volume = 1.79 gallons

NOTE:
a Refer to Table 1
b Refer to Table 2
c Assuming Sand Pack Porosity of 30%

Annulus Volume = [(Standing Water Column (ft) x Borehole Volume (gal/linear ft)[b]) - Casing Volume] x 0.3[c]

Annulus Volume = [(10.55 ft x 3.12 gal/linear ft) - 1.79 gal] x 0.3

Annulus Volume = 9.34 gallons

Table 1
Pipe Volume of Schedule 40 PVC Pipe

Diameter (inches)	OD (inches)	ID (inches)	Volume (gal/linear ft)	Diameter (inches)	OD (inches)	ID (inches)	Volume (gal/linear ft)
1.25	1.660	1.380	0.08	4	4.500	4.026	0.66
2	2.375	2.067	0.17	6	6.625	6.065	1.50
3	3.500	3.068	0.38	8	8.625	7.981	2.60

Table 2
Volume of Borehole

Diameter (inches)	Volume (gal/linear ft)	Diameter (inches)	Volume (gal/linear ft)	Diameter (inches)	Volume (gal/linear ft)
7.25	2.14	8.25	2.78	9.25	3.52
7.75	2.45	8.75	3.12	10.25	4.29

GROUNDWATER SAMPLING RECORD

DATE 3-5-97 PAGE 1 OF 2

MONITORING WELL NO. MW ϕ4

PROJECT CONCORD NWS

SITE SITE 22, BLDG 7SH5

PROJECT NO. ϕ69-ϕ36Bϕ2ϕ3

TOTAL GALLONS TO BE PURGED 36

PURGING METHOD HAND PUMP

SAMPLING METHOD HAND PUMP

Time	Volume of Water Removed (gallons)	Discharge Rate (gal/min)	Field Parameters Measured								Comments
			pH	Specific Conductivity (ms/cm)	Turbidity (ntu)	Dissolved Oxygen (mg/L)	Temp. (°C)			Water Level (feet)	
1355	ϕ	ϕ	6.87	1.ϕ6	999+	5.ϕ6	18.5			18.54	
14ϕϕ	1ϕ	2.ϕ	6.79	1.ϕ8	999+	5.12	18.5				
14ϕ4	2ϕ	2.5	6.79	1.ϕ5	999+	5.24	18.3				
14ϕ7	~~3~~ 25	1.67	6.79	1.ϕ5	999+	5.5ϕ	18.4				
14ϕ9	3ϕ	2.5	6.78	1.ϕ4	999+	5.54	18.5				
1412	35	1.67	6.77	1.ϕ4	856	5.51	18.5				
1414	4ϕ	2.5	6.78	1.ϕ4	842	5.2ϕ	18.5				
1428										18.58	

FIELD EQUIPMENT	SERIAL NUMBER	RENTAL COMPANY
HORIBA U-1ϕ	ME35ϕϕ	ARIS

SAMPLE ID: ϕ367SHGWϕϕ6

ANALYSIS: VOC, TPH E, SVOC

COC NUMBER: 7566

SAMPLING PERSONNEL:
RICHARD VORNIMEN
ROY GLENN

ENVIRONMENTAL MANAGEMENT, INC.
• SAN FRANCISCO •

GROUNDWATER SAMPLING RECORD

DATE 3-5-97

MONITORING WELL NO. MWØ4

PROJECT Concord NWS

SITE Site 22, Bldg 7SH5

PROJECT NO. Ø69-Ø36BØ2Ø3

CASING DIAMETER 2 inches

BOREHOLE DIAMETER 8.75 inches

TOP OF CASING ELEVATION 16Ø.43 feet

WATER LEVEL 18.54 feet btoc @ 1345

WATER LEVEL ELEVATION 141.89 feet msl

STANDING WATER COLUMN 11.31 feet

WELL VOLUMES TO BE PURGED 3

MINUMUM PURGE VOLUME 12x3=36 gallons

ACTUAL VOLUME PURGED 4Ø gallons

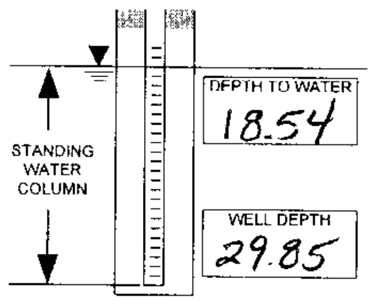
VOLUME CALCULATED BY: [signature]

PURGE VOLUME CALCULATION

One Well Volume = Casing Volume + Annulus Volume

One Well Volume = 1.92 gal + 1Ø.Ø1 gal

One Well Volume = 11.93 gallons



Casing Volume = Standing Water Column (ft) x Pipe Volume (gal/linear ft)[a]

Casing Volume = 11.31 ft x Ø.17 gal/linear ft

Casing Volume = 1.92 gallons

NOTE:
a Refer to Table 1
b Refer to Table 2
c Assuming Sand Pack Porosity of 30%

Annulus Volume = [(Standing Water Column (ft) x Borehole Volume (gal/linear ft)[b]) - Casing Volume] x 0.3[c]

Annulus Volume = [(11.31 ft x 3.12 gal/linear ft) - 1.92 gal] x 0.3

Annulus Volume = 1Ø.Ø1 gallons

Table 1
Pipe Volume of Schedule 40 PVC Pipe

Diameter (inches)	OD (inches)	ID (inches)	Volume (gal/linear ft)	Diameter (inches)	OD (inches)	ID (inches)	Volume (gal/linear ft)
1.25	1.660	1.380	0.08	4	4.500	4.026	0.66
2	2.375	2.067	0.17	6	6.625	6.065	1.50
3	3.500	3.068	0.38	8	8.625	7.981	2.60

Table 2
Volume of Borehole

Diameter (inches)	Volume (gal/linear ft)	Diameter (inches)	Volume (gal/linear ft)	Diameter (inches)	Volume (gal/linear ft)
7.25	2.14	8.25	2.78	9.25	3.52
7.75	2.45	8.75	3.12	10.25	4.29

GROUNDWATER SAMPLING RECORD

DATE 6-4-97 PAGE 1 OF 2

MONITORING WELL NO. MWØ4

PROJECT CONCORD NWS, CLEAN II

SITE SITE 22, BLDG 7545

PROJECT NO. Ø69-Ø36BØ2Ø3

TOTAL GALLONS TO BE PURGED 31

PURGING METHOD HAND PUMP

SAMPLING METHOD HAND PUMP

Time	Volume of Water Removed (gallons)	Discharge Rate (gal/min)	Field Parameters Measured: pH	Specific Conductivity (ms/cm)	Turbidity (ntu)	Dissolved Oxygen (mg/L)	Temp. (°C)			Water Level (feet)	Comments
1141	Ø	—	7.42	Ø.963	999	4.68	19.2			2Ø.Ø7	
1143	5	2.5	7.41	Ø.99	999	4.84	18.6				
1145	1Ø	2.5	7.42	Ø.96	999	4.62	18.5				
1148	15	1.67	7.42	Ø.96	784	4.63	18.4				
1151	2Ø	1.67	7.4Ø	Ø.96	531	4.48	18.4				
1153	25	2.5	7.39	Ø.96	353	4.44	18.4				
1157	31	1.5	7.38	Ø.96	248	4.42	18.3				
1211										2Ø.Ø7	

FIELD EQUIPMENT	SERIAL NUMBER	RENTAL COMPANY
HORIBA U-1Ø	132Ø7	HAZCO

SAMPLE ID: Ø367SHGWØ11

ANALYSIS: VOA, SVOA, TPH-EXT.

COC NUMBER: 7571

SAMPLING PERSONNEL:
RICHARD VERNIMEN
ROY GLENN

ENVIRONMENTAL MANAGEMENT, INC.
• SAN FRANCISCO •

GROUNDWATER SAMPLING RECORD

DATE 6-4-97 PAGE 2 OF 2

MONITORING WELL NO. MW04

PROJECT Concord NWS, Clean II

SITE Site 22, Bldg 7SH5

PROJECT NO. 069-036B0203

CASING DIAMETER 2 inches

BOREHOLE DIAMETER 8.75 inches

TOP OF CASING ELEVATION 160.43 feet

WATER LEVEL 20.07 feet bgs @ 1130

WATER LEVEL ELEVATION 140.36 feet msl

STANDING WATER COLUMN 9.78 feet

WELL VOLUMES TO BE PURGED 3

MINUMUM PURGE VOLUME 31 gallons

ACTUAL VOLUME PURGED 31 gallons

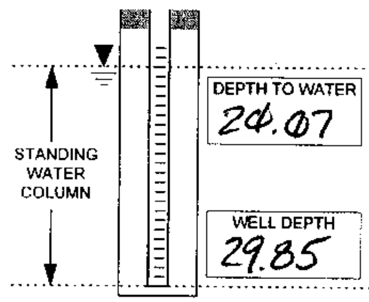
VOLUME CALCULATED BY: Roy D. Allen

PURGE VOLUME CALCULATION

One Well Volume = Casing Volume + Annulus Volume

One Well Volume = 1.66 gal + 8.66 gal

One Well Volume = 10.32 gallons



Casing Volume = Standing Water Column (ft) x Pipe Volume (gal/linear ft)[a]

Casing Volume = 9.78 ft x 0.17 gal/linear ft

Casing Volume = 1.66 gallons

NOTE:
a Refer to Table 1
b Refer to Table 2
c Assuming Sand Pack Porosity of 30%

Annulus Volume = [(Standing Water Column (ft) x Borehole Volume (gal/linear ft)[b]) - Casing Volume] x 0.3[c]

Annulus Volume = [(9.78 ft x 3.12 gal/linear ft) - 1.66 gal] x 0.3

Annulus Volume = 8.66 gallons

Table 1
Pipe Volume of Schedule 40 PVC Casing

Diameter (inches)	OD (inches)	ID (inches)	Volume (gal/linear ft)	Diameter (inches)	OD (inches)	ID (inches)	Volume (gal/linear ft)
1.25	1.660	1.380	0.08	4	4.500	4.026	0.66
2	2.375	2.067	0.17	6	6.625	6.065	1.50
3	3.500	3.068	0.38	8	8.625	7.981	2.60

Table 2
Volume of Borehole

Diameter (inches)	Volume (gal/linear ft)	Diameter (inches)	Volume (gal/linear ft)	Diameter (inches)	Volume (gal/linear ft)
7.25	2.14	8.25	2.78	9.25	3.52
7.75	2.45	8.75	3.12	10.25	4.29

ENVIRONMENTAL MANAGEMENT, INC.
• SAN FRANCISCO •

GROUNDWATER SAMPLING RECORD

DATE 9-3-97 PAGE 1 OF 2

MONITORING WELL NO. MW04

PROJECT CONCORD NWS

SITE SITE 22, BLDG 7SH5

PROJECT NO. 069-0360B0203

TOTAL GALLONS TO BE PURGED 20

PURGING METHOD HAND PUMP

SAMPLING METHOD HAND PUMP

Time	Volume of Water Removed (gallons)	Discharge Rate (gal/min)	Field Parameters Measured: pH	Specific Conductivity (ms/cm)	Turbidity (ntu)	Dissolved Oxygen (mg/L)	Temp. (°C)			Water Level (feet)	Comments
—	0									23.64	
1222	5	1.7	7.46	1.03	999	3.69	19.9				
1225	10	1.7	7.54	1.03	456	5.68	19.2				
1229	15	1.25	7.46	1.03	623	5.10	19.1				
1233	20	1.25	7.50	1.04	189	5.19	18.9				
1237	25	1.25	7.55	1.04	118	5.09	18.9				
1241	30	1.25	7.58	1.04	335	5.09	18.8				

FIELD EQUIPMENT	SERIAL NUMBER	RENTAL COMPANY
HORIBA U-10	MEX41	ARIS

SAMPLE ID: 0367SHGW016

ANALYSIS: VOC, SVOC, TPH-E

COC NUMBER: 12166

SAMPLING PERSONNEL:
RICHARD VERNIMEN
ROY GLENN

TETRA TECH EM, INC.
• SAN FRANCISCO •

GROUNDWATER SAMPLING RECORD

DATE 9-3-97

MONITORING WELL NO. MWØ4

PROJECT CONCORD NWS

SITE SITE 22, BLDG 7SH5

PROJECT NO. Ø69-Ø36BØ2Ø3

CASING DIAMETER 2 inches

BOREHOLE DIAMETER 8.75 inches

TOP OF CASING ELEVATION 16Ø.43 feet

WATER LEVEL 23.64 feet bgs @ 1211

WATER LEVEL ELEVATION 136.79 feet msl

STANDING WATER COLUMN 6.21 feet

WELL VOLUMES TO BE PURGED 3

MINUMUM PURGE VOLUME 2Ø gallons

ACTUAL VOLUME PURGED 3Ø gallons

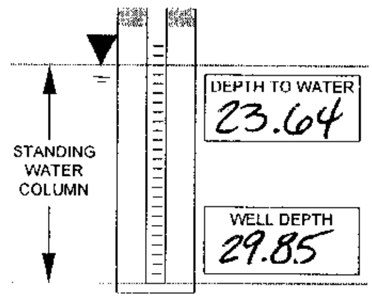
VOLUME CALCULATED BY: [signature]

PURGE VOLUME CALCULATION

One Well Volume = Casing Volume + Annulus Volume

One Well Volume = 1.Ø6 gal + 5.49 gal

One Well Volume = 6.55 gallons



Casing Volume = Standing Water Column (ft) x Pipe Volume (gal/linear ft)[a]

Casing Volume = 6.21 ft x Ø.17 gal/linear ft

Casing Volume = 1.Ø6 gallons

NOTE:
- a Refer to Table 1
- b Refer to Table 2
- c Assuming Sand Pack Porosity of 30%

Annulus Volume = [(Standing Water Column (ft) x Borehole Volume (gal/linear ft)[b]) - Casing Volume] x 0.3[c]

Annulus Volume = [(6.21 ft x 3.12 gal/linear ft) - 1.Ø6 gal] x 0.3

Annulus Volume = 5.49 gallons

Table 1
Pipe Volume of Schedule 40 PVC Casing

Diameter (inches)	OD (inches)	ID (inches)	Volume (gal/linear ft)	Diameter (inches)	OD (inches)	ID (inches)	Volume (gal/linear ft)
1.25	1.660	1.380	0.08	4	4.500	4.026	0.66
2	2.375	2.067	0.17	6	6.625	6.065	1.50
3	3.500	3.068	0.38	8	8.625	7.981	2.60

Table 2
Volume of Borehole

Diameter (inches)	Volume (gal/linear ft)	Diameter (inches)	Volume (gal/linear ft)	Diameter (inches)	Volume (gal/linear ft)
7.25	2.14	8.25	2.78	9.25	3.52
7.75	2.45	8.75	3.12	10.25	4.29

GROUNDWATER SAMPLING RECORD

DATE 12-5-97 PAGE 1 OF 2

MONITORING WELL NO. MWØ4

PROJECT CONCORD NWS

SITE SITE 22, BLDG 7SH5

PROJECT NO. Ø69-Ø36B02Ø3

TOTAL GALLONS TO BE PURGED 13

PURGING METHOD HAND PUMP

SAMPLING METHOD HAND PUMP

Time	Volume of Water Removed (gallons)	Discharge Rate (gal/min)	Field Parameters Measured							Water Level (feet)	Comments
			pH	Specific Conductivity (ms/cm)	Turbidity (ntu)	Dissolved Oxygen (mg/L)	Temp. (°C)				
1235	Ø	Ø	7.66	1.ØØ	999+	8.21	17.5			25.95	
1243	6	Ø.75	7.61	1.Ø2	657	6.93	17.4				PUMPED DRY - VERY SLOW RECHARGE
1251	1Ø	Ø.5Ø	7.62	1.Ø2	593	6.84	17.4				
1255	13	Ø.35	7.62	1.Ø2	581	6.89	17.4				
~~125~~											
13Ø5										26.4Ø	

FIELD EQUIPMENT	SERIAL NUMBER	RENTAL COMPANY
HORIBA U-1Ø	ME35Ø1	ARIS

SAMPLE ID: Ø367SHGWØ2Ø

ANALYSIS: VOC, SVOC, TPH-E

COC NUMBER: 13Ø77

SAMPLING PERSONNEL:
RICHARD VERNIMEN
ROY GLENN

TETRA TECH EM, INC.
• SAN FRANCISCO •

DCN-0056 4.07

GROUNDWATER SAMPLING RECORD

DATE 12-5-97

MONITORING WELL NO. MWØ4

PROJECT CONCORD NWS

SITE SITE 22, BLDG 7SH5

PROJECT NO. Ø69-Ø36DØ2Ø3

CASING DIAMETER 2 inches

BOREHOLE DIAMETER 8.75 inches

TOP OF CASING ELEVATION 16Ø.43 feet

WATER LEVEL 25.95 feet bgs @ 1211

WATER LEVEL ELEVATION 134.48 feet msl

STANDING WATER COLUMN 3.95 feet

WELL VOLUMES TO BE PURGED 3

MINUMUM PURGE VOLUME 13 gallons

ACTUAL VOLUME PURGED 13 gallons

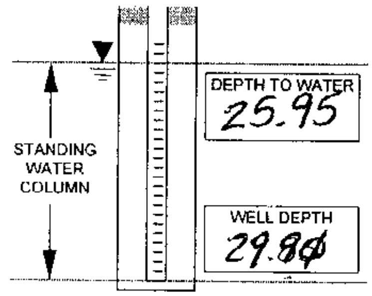
VOLUME CALCULATED BY:

PURGE VOLUME CALCULATION

One Well Volume = Casing Volume + Annulus Volume

One Well Volume = Ø.67 gal + 3.5Ø gal

One Well Volume = 4.17 gallons



29.54
-.36

Casing Volume = Standing Water Column (ft) x Pipe Volume (gal/linear ft)[a]

Casing Volume = 3.95 ft x Ø.17 gal/linear ft

Casing Volume = Ø.67 gallons

NOTE:
a Refer to Table 1
b Refer to Table 2
c Assuming Sand Pack Porosity of 30%

Annulus Volume = [(Standing Water Column (ft) x Borehole Volume (gal/linear ft)[b]) - Casing Volume] x 0.3[c]

Annulus Volume = [(3.95 ft x 3.12 gal/linear ft) - Ø.67 gal] x 0.3

Annulus Volume = 3.5Ø gallons

Table 1
Pipe Volume of Schedule 40 PVC Casing

Diameter (inches)	OD (inches)	ID (inches)	Volume (gal/linear ft)	Diameter (inches)	OD (inches)	ID (inches)	Volume (gal/linear ft)
1.25	1.660	1.380	0.08	4	4.500	4.026	0.66
2	2.375	2.067	0.17	6	6.625	6.065	1.50
3	3.500	3.068	0.38	8	8.625	7.981	2.60

Table 2
Volume of Borehole

Diameter (inches)	Volume (gal/linear ft)	Diameter (inches)	Volume (gal/linear ft)	Diameter (inches)	Volume (gal/linear ft)
7.25	2.14	8.25	2.78	9.25	3.52
7.75	2.45	8.75	3.12	10.25	4.29

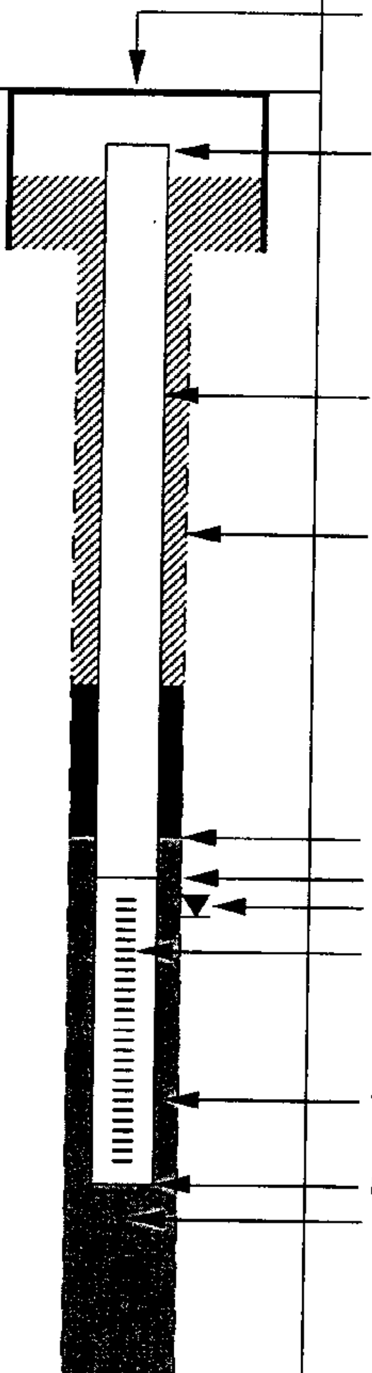
TETRA TECH EM, INC.
• SAN FRANCISCO •

BORING NO. 7SHSB610

TEMPORARY MONITORING WELL DIAGRAM

PROJECT: Concord Inland RI	LOCATION: WPNSTA Concord	DRILLER: West Hazmat Drilling Corp.
PROJECT NO.: 2738.1325	BORING: 7SHSB610	DRILLING METHOD: Hollow Stem Auger
ELEVATION: (TOC) Not Measured	DATE: 5/12/95	DEVELOPMENT METHOD: Hand Bailing
FIELD GEOLOGIST: Y. Leung/D. Winter		

GROUND SURFACE



ELEVATION OF GROUND SURFACE: 160.44

ELEVATION OF TOP OF WELL CASING: Not Measured

RISER PIPE I.D.: 4"

TYPE OF RISER PIPE: Schedule 40 PVC

BOREHOLE DIAMETER: 10"

DEPTH TOP OF SAND PACK: 22.45

DEPTH TOP OF SCREEN: 24.45

DEPTH TO WATER FROM GROUND SURFACE 22

TYPE OF SCREEN: Schedule 40 PVC

SLOT SIZE x LENGTH 0.010 inch

I.D. OF SCREEN 4"

TYPE OF SAND PACK: #2/16 Monterey

DEPTH BOTTOM OF SCREEN: 29.45

DEPTH BOTTOM OF SAND PACK: 29.95

TYPE OF BACKFILL BELOW OBSERVATION WELL: #2/16 Monterey

DEPTH OF HOLE: 29.95

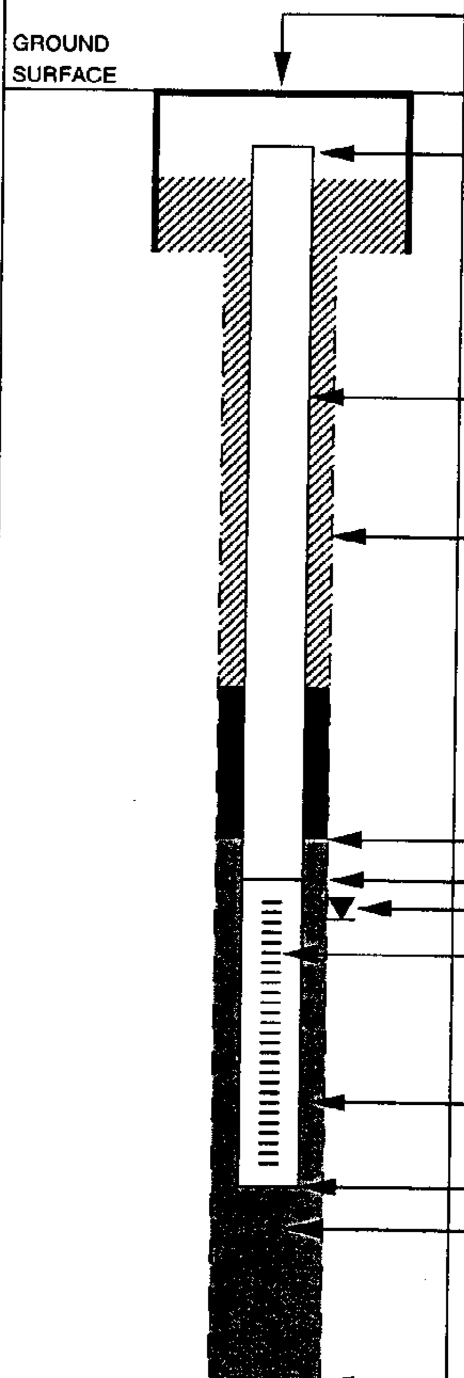
05/96.CO

BORING NO. 7SHSB612

TEMPORARY MONITORING WELL DIAGRAM

PROJECT Concord Inland RI
LOCATION WPNSTA Concord
PROJECT NO. 2738.1325
BORING 7SHSB612
ELEVATION (TOC) Not Measured
DATE 5/16/95
FIELD GEOLOGIST Y. Leung/D. Winter

DRILLER West Hazmat Drilling Corp.
DRILLING METHOD Hollow Stem Auger
DEVELOPMENT METHOD Hand Bailing



ELEVATION OF GROUND SURFACE: 162.92

ELEVATION OF TOP OF WELL CASING: Not Measured

RISER PIPE I.D.: 4"
TYPE OF RISER PIPE: Schedule 40 PVC

BOREHOLE DIAMETER: 10"

DEPTH TOP OF SAND PACK: 17.44
DEPTH TOP OF SCREEN: 19.44
DEPTH TO WATER FROM GROUND SURFACE 26.1
TYPE OF SCREEN: Schedule 40 PVC
SLOT SIZE x LENGTH 0.010 inch
I.D. OF SCREEN 4"

TYPE OF SAND PACK: #2/16 Monterey

DEPTH BOTTOM OF SCREEN: 29.44
DEPTH BOTTOM OF SAND PACK: 29.94
TYPE OF BACKFILL BELOW OBSERVATION WELL: #2/16 Monterey

DEPTH OF HOLE: 29.94

05/96.CO

APPENDIX E

DATA VALIDATION AND REVIEW SUMMARY

DATA VALIDATION REVIEW AND SUMMARY

On October 21, 2002, 48 soil samples were collected at Installation Restoration Site 22 (Site 22) at Naval Weapons Station Seal Beach Detachment Concord to supplement samples collected during the initial remedial investigation (TtEMI 1997). This appendix discusses data usability issues that affected the detection of chemicals during this supplemental investigation at Site 22. Data usability issues that affected the detection of chemicals during previous investigations at the Site are summarized in the Phase I RI Report (TtEMI 1997). Data usability and problems identified during data validation are discussed separately for each analyte group. The following analyses were conducted in accordance with U.S. Environmental Protection (EPA) Contract Laboratory Program (CLP) (EPA 2001b) and EPA SW-846 (EPA 1998c) methods:

- CLP Metals
- pH by EPA Method 9045C

METALS

All metal results were valid with the exception of 20 nondetected results for antimony, which were rejected (Re) because of low matrix spike recovery. Low matrix spike recoveries indicate the possibility that false negatives were reported. Laboratory blanks contained detectable amounts of antimony. Nineteen sample results were qualified as nondetected (UJb) for antimony because the sample results were less than 5 times the associated blank value.

Quantitation limits defined in the quality assurance project plan for metals were met (TTEMI 2002). Quantitation limits are sufficiently low to allow comparison to EPA preliminary remediation goals for residential soil.

pH

All pH data were assessed to be valid and usable with no rejected data. Four samples were qualified as estimated (Jh) because of slightly exceeded holding time requirements.

DATA VALIDATION CONCLUSION

EPA guidance provided in “Risk Assessment Guidance for Superfund" (RAGS), Volume I (EPA 1989b) was used to determine the usability of the validated data. Exhibit 5-5 in RAGS states that data qualified as estimated (J) based on data validation reports may be used in quantitative risk assessments. Only data qualified as rejected (R) are considered unusable for risk assessment purposes. If data are of acceptable quality for use in quantitative risk assessments, they should also be appropriate for determining the extent of contamination. Accordingly, all J-qualified data and no R-qualified data are acceptable for use to assess human health risks, ecological risks, and nature and extent of contamination at Site 22.

APPENDIX F

STATISTICAL SUMMARY TABLES

APPENDIX F

SUMMARY OF DESCRIPTIVE STATISTICS FOR SITE 22 SOIL (0 TO 0.50 FEET BELOW GROUND SURFACE)
SITE 22
NAVAL WEAPONS STATION SBD CONCORD

Analyte Group	Chemical	Distribution[a]	SUMMARY STATISTICS													Exposure Point Concentration (EPC)[e]
			Sample Size		Detection Frequency (Percent)	Censored Data		Detected Data		Detected and Censored Data						
			Detected	Total		Min	Max	Min	Max	Median[b]	Q95[b]	Mean[c]	SD[c]	CV	UCL_{95}[d]	
Total Metals	Aluminum	Normal	8	8	100	N/A	N/A	15,400.00	21,800.00	16,400.00	21,800.00	17,400.00	2,403.57	14	19,009.99	19,009.99
	Antimony	Not Tested	6	15	40	0.47	5.50	0.56	1.50	1.50	5.50	0.17	0.17	99	0.53	0.53
	Arsenic	Unknown[a]	24	24	100	N/A	N/A	5.10	210.00	61.00	190.00	73.50	43.58	59	88.75	88.75
	Barium	Unknown[a]	8	8	100	N/A	N/A	163.00	266.00	174.50	266.00	188.25	34.94	19	211.65	211.65
	Beryllium	Not Tested	1	8	12	0.02	0.13	0.70	0.70	0.03	0.70	0.17	0.17	99	0.54	0.54
	Cadmium	Not Tested	2	8	25	0.02	0.02	0.47	1.30	0.02	1.30	0.17	0.17	98	0.53	0.53
	Calcium	Normal	8	8	100	N/A	N/A	5,250.00	7,390.00	6,060.00	7,390.00	6,080.00	620.51	10	6,495.64	6,495.64
	Chromium	Normal	8	8	100	N/A	N/A	38.00	59.30	47.25	59.30	47.25	6.72	14	51.75	51.75
	Chromium (VI)	Not Tested	0	1	0	0.05	0.05	N/A	N/A	0.05	0.05	N/A	N/A	N/A	N/A	N/A
	Cobalt	Normal	8	8	100	N/A	N/A	17.40	24.10	19.35	24.10	19.95	2.26	11	21.47	21.47
	Copper	Unknown[b]	11	11	100	N/A	N/A	45.80	115.00	56.50	115.00	61.98	4.78	8	72.48	72.48
	Iron	Normal	22	22	100	N/A	N/A	26,000.00	42,000.00	36,000.00	41,850.00	34,654.55	4,752.32	14	36,398.00	36,398.00
	Lead	Lognormal	7	7	100	N/A	N/A	13.20	165.00	21.70	165.00	39.06	13.69	35	156.41	156.41
	Magnesium	Unknown[b]	8	8	100	N/A	N/A	8,700.00	12,900.00	9,490.00	12,900.00	9,789.50	433.71	4	10,707.28	10,707.28
	Manganese	Unknown[a]	22	22	100	N/A	N/A	290.00	870.00	726.00	864.00	676.86	149.72	22	731.79	731.79
	Mercury	Normal	8	8	100	N/A	N/A	0.06	0.34	0.22	0.34	0.22	0.10	48	0.29	0.29
	Molybdenum	Not Tested	0	8	0	0.18	3.20	N/A	N/A	0.19	3.20	N/A	N/A	N/A	N/A	N/A
	Nickel	Normal	7	8	88	63.30	63.30	52.50	81.10	65.60	81.10	63.08	15.95	25	73.77	73.77
	Potassium	Normal	8	8	100	N/A	N/A	1,960.00	3,340.00	2,985.00	3,340.00	2,816.25	531.01	19	3,171.94	3,171.94
	Selenium	Not Tested	0	8	0	0.70	0.88	N/A	N/A	0.84	0.88	N/A	N/A	N/A	N/A	N/A
	Silver	Not Tested	0	8	0	0.11	0.82	N/A	N/A	0.12	0.82	N/A	N/A	N/A	N/A	N/A
	Sodium	Normal	6	8	75	74.00	93.40	32.20	177.00	83.70	177.00	0.01	0.01	59	0.13	0.13
	Thallium	Not Tested	0	8	0	0.35	7.00	N/A	N/A	0.37	7.00	N/A	N/A	N/A	N/A	N/A
	Vanadium	Normal	8	8	100	N/A	N/A	57.90	89.90	68.75	89.90	70.78	10.35	15	77.71	77.71
	Zinc	Unknown[b]	8	8	100	N/A	N/A	79.20	333.00	94.00	333.00	126.17	22.31	18	199.05	199.05
Semivolatile Organic Analytes (SVOA)	1,1'-Biphenyl	Not Tested	0	2	0	0.0400	0.0410	N/A	N/A	0.0405	0.0410	N/A	N/A	N/A	N/A	N/A
	1,2,4-Trichlorobenzene	Not Tested	0	6	0	0.0400	0.7700	N/A	N/A	0.3950	0.7700	N/A	N/A	N/A	N/A	N/A
	1,2-Dichlorobenzene	Not Tested	0	6	0	0.0400	0.7700	N/A	N/A	0.3950	0.7700	N/A	N/A	N/A	N/A	N/A
	1,3-Dichlorobenzene	Not Tested	0	6	0	0.0400	0.7700	N/A	N/A	0.3950	0.7700	N/A	N/A	N/A	N/A	N/A
	1,4-Dichlorobenzene	Not Tested	0	6	0	0.0400	0.7700	N/A	N/A	0.3950	0.7700	N/A	N/A	N/A	N/A	N/A
	1-Methylnaphthalene	Not Tested	0	2	0	0.0400	0.0410	N/A	N/A	0.0405	0.0410	N/A	N/A	N/A	N/A	N/A
	1-Methylphenanthrene	Not Tested	0	2	0	0.0400	0.0410	N/A	N/A	0.0405	0.0410	N/A	N/A	N/A	N/A	N/A
	2,2'-Oxybis(1-chloropropane)	Not Tested	0	6	0	0.0400	0.7700	N/A	N/A	0.3950	0.7700	N/A	N/A	N/A	N/A	N/A
	2,3,5-Trimethylnaphthalene	Not Tested	0	2	0	0.0400	0.0410	N/A	N/A	0.0405	0.0410	N/A	N/A	N/A	N/A	N/A
	2,4,5-Trichlorophenol	Not Tested	0	6	0	0.1000	1.9000	N/A	N/A	0.9750	1.9000	N/A	N/A	N/A	N/A	N/A
	2,4,6-Trichlorophenol	Not Tested	0	6	0	0.0400	0.7700	N/A	N/A	0.3950	0.7700	N/A	N/A	N/A	N/A	N/A
	2,4-Dichlorophenol	Not Tested	0	6	0	0.0400	0.7700	N/A	N/A	0.3950	0.7700	N/A	N/A	N/A	N/A	N/A
	2,4-Dimethylphenol	Not Tested	0	6	0	0.0400	0.7700	N/A	N/A	0.3950	0.7700	N/A	N/A	N/A	N/A	N/A
	2,4-Dinitrophenol	Not Tested	0	6	0	0.1000	1.9000	N/A	N/A	0.9750	1.9000	N/A	N/A	N/A	N/A	N/A
	2,4-Dinitrotoluene	Not Tested	0	6	0	0.0400	0.7700	N/A	N/A	0.3950	0.7700	N/A	N/A	N/A	N/A	N/A
	2,6-Dimethylnaphthalene	Not Tested	0	2	0	0.0400	0.0410	N/A	N/A	0.0405	0.0410	N/A	N/A	N/A	N/A	N/A
	2,6-Dinitrotoluene	Not Tested	0	6	0	0.0400	0.7700	N/A	N/A	0.3950	0.7700	N/A	N/A	N/A	N/A	N/A
	2-Chloronaphthalene	Not Tested	0	6	0	0.0400	0.7700	N/A	N/A	0.3950	0.7700	N/A	N/A	N/A	N/A	N/A
	2-Chlorophenol	Not Tested	0	6	0	0.0400	0.7700	N/A	N/A	0.3950	0.7700	N/A	N/A	N/A	N/A	N/A
	2-Methlyphenol	Not Tested	0	6	0	0.0400	0.7700	N/A	N/A	0.3950	0.7700	N/A	N/A	N/A	N/A	N/A
	2-Methylnaphthalene	Not Tested	0	6	0	0.0400	0.7700	N/A	N/A	0.3950	0.7700	N/A	N/A	N/A	N/A	N/A

SUMMARY OF DESCRIPTIVE STATISTICS FOR SITE 22 SOIL (0 TO 0.50 FEET BELOW GROUND SURFACE)
SITE 22
NAVAL WEAPONS STATION SBD CONCORD

Analyte Group	Chemical	Distribution[a]	SUMMARY STATISTICS: Sample Size		Detection Frequency (Percent)	Censored Data		Detected Data		Detected and Censored Data						Exposure Point Concentration (EPC)[e]
			Detected	Total		Min	Max	Min	Max	Median[b]	Q95[b]	Mean[c]	SD[c]	CV	UCL_{95}[d]	
SVOA (Continued)	2-Nitroaniline	Not Tested	0	6	0	0.1000	1.9000	N/A	N/A	0.9750	1.9000	N/A	N/A	N/A	N/A	N/A
	2-Nitrophenol	Not Tested	0	6	0	0.0400	0.7700	N/A	N/A	0.3950	0.7700	N/A	N/A	N/A	N/A	N/A
	3,3'-Dichlorobenzidine	Not Tested	0	6	0	0.0400	0.7700	N/A	N/A	0.3950	0.7700	N/A	N/A	N/A	N/A	N/A
	3-Nitroaniline	Not Tested	0	6	0	0.1000	1.9000	N/A	N/A	0.9750	1.9000	N/A	N/A	N/A	N/A	N/A
	4,6-Dinitro-2-methylphenol	Not Tested	0	6	0	0.1000	1.9000	N/A	N/A	0.9750	1.9000	N/A	N/A	N/A	N/A	N/A
	4-Bromophenyl-phenylether	Not Tested	0	6	0	0.0400	0.7700	N/A	N/A	0.3950	0.7700	N/A	N/A	N/A	N/A	N/A
	4-Chloro-3-methylphenol	Not Tested	0	6	0	0.0400	0.7700	N/A	N/A	0.3950	0.7700	N/A	N/A	N/A	N/A	N/A
	4-Chloroaniline	Not Tested	0	6	0	0.0400	0.7700	N/A	N/A	0.3950	0.7700	N/A	N/A	N/A	N/A	N/A
	4-Chlorophenyl-phenylether	Not Tested	0	6	0	0.0400	0.7700	N/A	N/A	0.3950	0.7700	N/A	N/A	N/A	N/A	N/A
	4-Methlyphenol	Not Tested	0	6	0	0.0400	0.7700	N/A	N/A	0.3950	0.7700	N/A	N/A	N/A	N/A	N/A
	4-Nitroaniline	Not Tested	0	6	0	0.1000	1.9000	N/A	N/A	0.9750	1.9000	N/A	N/A	N/A	N/A	N/A
	4-Nitrophenol	Not Tested	0	6	0	0.1000	1.9000	N/A	N/A	0.9750	1.9000	N/A	N/A	N/A	N/A	N/A
	Acenaphthene	Not Tested	0	6	0	0.0400	0.7700	N/A	N/A	0.3950	0.7700	N/A	N/A	N/A	N/A	N/A
	Acenaphthylene	Not Tested	0	6	0	0.0400	0.7700	N/A	N/A	0.3950	0.7700	N/A	N/A	N/A	N/A	N/A
	Anthracene	Not Tested	0	6	0	0.0400	0.7700	N/A	N/A	0.3950	0.7700	N/A	N/A	N/A	N/A	N/A
	Benzo(a)anthracene	Not Tested	1	6	17	0.0410	0.7700	0.0040	0.0040	0.3950	0.7700	0.1694	0.1696	100	0.5273	0.0040
	Benzo(a)pyrene	Not Tested	1	6	17	0.0410	0.7700	0.0050	0.0050	0.3950	0.7700	0.1708	0.1651	97	0.5326	0.0050
	Benzo(b)fluoranthene	Not Tested	1	6	17	0.0410	0.7700	0.0160	0.0160	0.3950	0.7700	0.1695	0.1688	100	0.5398	0.0160
	Benzo(e)pyrene	Not Tested	1	2	50	0.0410	0.0410	0.0080	0.0080	0.0245	0.0410	0.1730	0.1603	93	0.5277	0.0080
	Benzo(g,h,i)perylene	Not Tested	0	6	0	0.0400	0.7700	N/A	N/A	0.3950	0.7700	N/A	N/A	N/A	N/A	N/A
	Benzo(k)fluoranthene	Not Tested	0	6	0	0.0400	0.7700	N/A	N/A	0.3950	0.7700	N/A	N/A	N/A	N/A	N/A
	Benzoic acid	Not Tested	0	2	0	0.1000	0.1000	N/A	N/A	0.1000	0.1000	N/A	N/A	N/A	N/A	N/A
	Benzyl alcohol	Not Tested	0	2	0	0.0400	0.0410	N/A	N/A	0.0405	0.0410	N/A	N/A	N/A	N/A	N/A
	Butylbenzylphthalate	Not Tested	0	6	0	0.0400	0.7700	N/A	N/A	0.3950	0.7700	N/A	N/A	N/A	N/A	N/A
	Carbazole	Not Tested	0	6	0	0.0400	0.7700	N/A	N/A	0.3950	0.7700	N/A	N/A	N/A	N/A	N/A
	Chrysene	Not Tested	1	6	17	0.0410	0.7700	0.0100	0.0100	0.3950	0.7700	1.2861	0.9351	73	2.4495	0.0100
	Dibenz(a,h)anthracene	Not Tested	0	6	0	0.0400	0.7700	N/A	N/A	0.3950	0.7700	N/A	N/A	N/A	N/A	N/A
	Dibenzofuran	Not Tested	0	6	0	0.0400	0.7700	N/A	N/A	0.3950	0.7700	N/A	N/A	N/A	N/A	N/A
	Dibenzothiophene	Not Tested	0	2	0	0.0400	0.0410	N/A	N/A	0.0405	0.0410	N/A	N/A	N/A	N/A	N/A
	Diethylphthalate	Not Tested	0	6	0	0.0400	0.7700	N/A	N/A	0.3950	0.7700	N/A	N/A	N/A	N/A	N/A
	Dimethylphthalate	Not Tested	0	6	0	0.0400	0.7700	N/A	N/A	0.3950	0.7700	N/A	N/A	N/A	N/A	N/A
	Fluoranthene	Not Tested	1	6	17	0.0410	0.7700	0.0130	0.0130	0.3950	0.7700	0.1059	0.2411	228	0.2792	0.0130
	Fluorene	Not Tested	0	6	0	0.0400	0.7700	N/A	N/A	0.3950	0.7700	N/A	N/A	N/A	N/A	N/A
	Hexachlorobenzene	Not Tested	0	6	0	0.0400	0.7700	N/A	N/A	0.3950	0.7700	N/A	N/A	N/A	N/A	N/A
	Hexachlorobutadiene	Not Tested	0	6	0	0.0400	0.7700	N/A	N/A	0.3950	0.7700	N/A	N/A	N/A	N/A	N/A
	Hexachlorocyclopentadiene	Not Tested	0	6	0	0.0400	0.7700	N/A	N/A	0.3950	0.7700	N/A	N/A	N/A	N/A	N/A
	Hexachloroethane	Not Tested	0	6	0	0.0400	0.7700	N/A	N/A	0.3950	0.7700	N/A	N/A	N/A	N/A	N/A
	Indeno(1,2,3-cd)pyrene	Not Tested	0	6	0	0.0400	0.7700	N/A	N/A	0.3950	0.7700	N/A	N/A	N/A	N/A	N/A
	Isophorone	Not Tested	0	6	0	0.0400	0.7700	N/A	N/A	0.3950	0.7700	N/A	N/A	N/A	N/A	N/A
	Naphthalene	Not Tested	0	6	0	0.0400	0.7700	N/A	N/A	0.3950	0.7700	N/A	N/A	N/A	N/A	N/A
	Nitrobenzene	Not Tested	0	6	0	0.0400	0.7700	N/A	N/A	0.3950	0.7700	N/A	N/A	N/A	N/A	N/A
	Pentachlorophenol	Not Tested	0	6	0	0.1000	1.9000	N/A	N/A	0.9750	1.9000	N/A	N/A	N/A	N/A	N/A
	Perylene	Not Tested	0	2	0	0.0400	0.0410	N/A	N/A	0.0405	0.0410	N/A	N/A	N/A	N/A	N/A
	Phenanthrene	Not Tested	1	6	17	0.0410	0.7700	0.0070	0.0070	0.3950	0.7700	0.2287	0.4619	202	0.5413	0.0070
	Phenol	Not Tested	0	6	0	0.0400	0.7700	N/A	N/A	0.3950	0.7700	N/A	N/A	N/A	N/A	N/A
	Pyrene	Not Tested	2	6	33	0.0410	0.7700	0.0070	0.2200	0.3150	0.7700	73.5866	50.8246	69	114.1581	0.2200
	bis(2-chloroethoxy)methane	Not Tested	0	6	0	0.0400	0.7700	N/A	N/A	0.3950	0.7700	N/A	N/A	N/A	N/A	N/A

SUMMARY OF DESCRIPTIVE STATISTICS FOR SITE 22 SOIL (0 TO 0.50 FEET BELOW GROUND SURFACE)
SITE 22
NAVAL WEAPONS STATION SBD CONCORD

Analyte Group	Chemical	Distribution[a]	SUMMARY STATISTICS: Sample Size		Detection Frequency (Percent)	Censored Data		Detected Data		Detected and Censored Data						Exposure Point Concentration (EPC)[e]
			Detected	Total		Min	Max	Min	Max	Median[b]	Q95[b]	Mean[c]	SD[c]	CV	UCL_{95}[d]	
SVOA (Continued)	bis(2-chloroethyl)ether	Not Tested	0	6	0	0.0400	0.7700	N/A	N/A	0.3950	0.7700	N/A	N/A	N/A	N/A	N/A
	bis(2-ethylhexyl)phthalate	Not Tested	0	6	0	0.0420	1.1000	N/A	N/A	0.3950	1.1000	N/A	N/A	N/A	N/A	N/A
	di-n-Butylphthalate	Not Tested	0	6	0	0.0400	0.7700	N/A	N/A	0.3950	0.7700	N/A	N/A	N/A	N/A	N/A
	di-n-Octylphthalate	Not Tested	0	6	0	0.0400	0.7700	N/A	N/A	0.3950	0.7700	N/A	N/A	N/A	N/A	N/A
	n-Nitroso-di-n-propylamine	Not Tested	0	6	0	0.0400	0.7700	N/A	N/A	0.3950	0.7700	N/A	N/A	N/A	N/A	N/A
	n-Nitrosodiphenylamine (1)	Not Tested	0	6	0	0.0400	0.7700	N/A	N/A	0.3950	0.7700	N/A	N/A	N/A	N/A	N/A
Volatile Organic Analytes (VOA)	1,1,1-Trichloroethane	Not Tested	0	3	0	0.0120	0.0120	N/A	N/A	0.0120	0.0120	N/A	N/A	N/A	N/A	N/A
	1,1,2,2-Tetrachloroethane	Not Tested	0	3	0	0.0120	0.0120	N/A	N/A	0.0120	0.0120	N/A	N/A	N/A	N/A	N/A
	1,1,2-Trichloroethane	Not Tested	0	3	0	0.0120	0.0120	N/A	N/A	0.0120	0.0120	N/A	N/A	N/A	N/A	N/A
	1,1-Dichlorethane	Not Tested	0	3	0	0.0120	0.0120	N/A	N/A	0.0120	0.0120	N/A	N/A	N/A	N/A	N/A
	1,1-Dichlorethene	Not Tested	0	3	0	0.0120	0.0120	N/A	N/A	0.0120	0.0120	N/A	N/A	N/A	N/A	N/A
	1,2-Dichloroethane	Not Tested	0	3	0	0.0120	0.0120	N/A	N/A	0.0120	0.0120	N/A	N/A	N/A	N/A	N/A
	1,2-Dichloroethene (Total)	Not Tested	0	3	0	0.0120	0.0120	N/A	N/A	0.0120	0.0120	N/A	N/A	N/A	N/A	N/A
	1,2-Dichloropropane	Not Tested	0	3	0	0.0120	0.0120	N/A	N/A	0.0120	0.0120	N/A	N/A	N/A	N/A	N/A
	2-Butanone	Not Tested	0	3	0	0.0120	0.0120	N/A	N/A	0.0120	0.0120	N/A	N/A	N/A	N/A	N/A
	2-Hexanone	Not Tested	0	3	0	0.0120	0.0120	N/A	N/A	0.0120	0.0120	N/A	N/A	N/A	N/A	N/A
	4-Methyl-2-pentanone	Not Tested	0	3	0	0.0120	0.0120	N/A	N/A	0.0120	0.0120	N/A	N/A	N/A	N/A	N/A
	Acetone	Not Tested	0	3	0	0.0120	0.0130	N/A	N/A	0.0120	0.0130	N/A	N/A	N/A	N/A	N/A
	Benzene	Not Tested	0	3	0	0.0120	0.0120	N/A	N/A	0.0120	0.0120	N/A	N/A	N/A	N/A	N/A
	Bromodichloromethane	Not Tested	0	3	0	0.0120	0.0120	N/A	N/A	0.0120	0.0120	N/A	N/A	N/A	N/A	N/A
	Bromoform	Not Tested	0	3	0	0.0120	0.0120	N/A	N/A	0.0120	0.0120	N/A	N/A	N/A	N/A	N/A
	Bromomethane	Not Tested	0	3	0	0.0120	0.0120	N/A	N/A	0.0120	0.0120	N/A	N/A	N/A	N/A	N/A
	Carbon disulfide	Not Tested	0	3	0	0.0120	0.0120	N/A	N/A	0.0120	0.0120	N/A	N/A	N/A	N/A	N/A
	Carbon tetrachloride	Not Tested	0	3	0	0.0120	0.0120	N/A	N/A	0.0120	0.0120	N/A	N/A	N/A	N/A	N/A
	Chlorobenzene	Not Tested	0	3	0	0.0120	0.0120	N/A	N/A	0.0120	0.0120	N/A	N/A	N/A	N/A	N/A
	Chloroethane	Not Tested	0	3	0	0.0120	0.0120	N/A	N/A	0.0120	0.0120	N/A	N/A	N/A	N/A	N/A
	Chloroform	Not Tested	0	3	0	0.0120	0.0120	N/A	N/A	0.0120	0.0120	N/A	N/A	N/A	N/A	N/A
	Chloromethane	Not Tested	0	3	0	0.0120	0.0120	N/A	N/A	0.0120	0.0120	N/A	N/A	N/A	N/A	N/A
	Dibromochloromethane	Not Tested	0	3	0	0.0120	0.0120	N/A	N/A	0.0120	0.0120	N/A	N/A	N/A	N/A	N/A
	Ethylbenzene	Not Tested	0	3	0	0.0120	0.0120	N/A	N/A	0.0120	0.0120	N/A	N/A	N/A	N/A	N/A
	Methylene chloride	Not Tested	0	3	0	0.0120	0.0120	N/A	N/A	0.0120	0.0120	N/A	N/A	N/A	N/A	N/A
	Styrene	Not Tested	0	3	0	0.0120	0.0120	N/A	N/A	0.0120	0.0120	N/A	N/A	N/A	N/A	N/A
	Tetrachloroethene	Not Tested	0	3	0	0.0120	0.0120	N/A	N/A	0.0120	0.0120	N/A	N/A	N/A	N/A	N/A
	Toluene	Not Tested	0	3	0	0.0120	0.0120	N/A	N/A	0.0120	0.0120	N/A	N/A	N/A	N/A	N/A
	Trichloroethene	Not Tested	0	3	0	0.0120	0.0120	N/A	N/A	0.0120	0.0120	N/A	N/A	N/A	N/A	N/A
	Vinyl chloride	Not Tested	0	3	0	0.0120	0.0120	N/A	N/A	0.0120	0.0120	N/A	N/A	N/A	N/A	N/A
	Xylene (Total)	Not Tested	0	3	0	0.0120	0.0120	N/A	N/A	0.0120	0.0120	N/A	N/A	N/A	N/A	N/A
	cis-1,3-Dichloropropene	Not Tested	0	3	0	0.0120	0.0120	N/A	N/A	0.0120	0.0120	N/A	N/A	N/A	N/A	N/A
	trans-1,3-Dichloropropene	Not Tested	0	3	0	0.0120	0.0120	N/A	N/A	0.0120	0.0120	N/A	N/A	N/A	N/A	N/A
Organotins	Dibutyltin	Not Tested	0	1	0	0.0010	0.0010	N/A	N/A	0.0010	0.0010	N/A	N/A	N/A	N/A	N/A
	Monobutyltin	Not Tested	0	1	0	0.0010	0.0010	N/A	N/A	0.0010	0.0010	N/A	N/A	N/A	N/A	N/A
	Tetrabutyltin	Not Tested	0	1	0	0.0010	0.0010	N/A	N/A	0.0010	0.0010	N/A	N/A	N/A	N/A	N/A
	Tributyltin	Not Tested	0	1	0	0.0010	0.0010	N/A	N/A	0.0010	0.0010	N/A	N/A	N/A	N/A	N/A
TPH (Extractable)	Diesel Range	Not Tested	1	6	17	11.00	30.00	9.23	9.23	12.00	30.00	7.93	4.60	58	19.84	9.23
	Motor Oil Range	Lognormal	5	5	100	N/A	N/A	29.00	200.00	41.00	200.00	75.32	25.83	34	390.06	200.00
TPH (Purgable)	Gasoline Range	Not Tested	0	1	0	0.06	0.06	N/A	N/A	0.06	0.06	N/A	N/A	N/A	N/A	N/A

APPENDIX F

SUMMARY OF DESCRIPTIVE STATISTICS FOR SITE 22 SOIL (0 TO 0.50 FEET BELOW GROUND SURFACE)
SITE 22
NAVAL WEAPONS STATION SBD CONCORD

Notes: All concentration units are mg/kg.
For samples with less than 15 percent censored data, one half the reporting limit is substituted for each non-detect measurement in all calculations.
For higher frequencies of censored data, all calculations were performed using stochastic modeling, following the "bounding" approach presented in EPA (2002), as described below under notes c and d.

a For all cases with at least 5 detected samples and a detection frequency greater than or equal to 50 percent, tested using the Shapiro-Wilk W test (alpha equal to 0.05).
Distributions confirmed as normal or lognormal are listed as "Normal" or "Lognormal." For cases where distribution testing was not conducted, the distribution is listed as "Not Tested."
For cases in which distributions could not be confirmed using the Shipiro-Wilk W test, distributions were estimated using probability plots, box plots, and frequency histograms.
Distributions estimated to be normal or lognormal are listed as Unknown[a] or Unknown[b], respectively.

b Estimated for all samples using a nonparametric approach, based on rank ordering of the data (reported values used for all censored data).

c For all samples with at least one detection, calculated using distribution-dependent formulae.
For confirmed or estimated normal distributions with fewer than 15 percent censored data, calculated using equations 4.3 (mean) and 4.4 (standard deviation) in Gilbert (1987).
For confirmed or estimated lognormal distributions with fewer than 15 percent censored data, these are the minimum variance unbiased (MVU) estimators, following equations 13.3 (mean) and 13.5 (standard deviation) in Gilbert (1987).
All other calculations use the median values generated from 2,000 iterations of a Monte Carlo model, following the "bounding" approach described in EPA (2002) [see conceptual model in Figure X-X and text in methods sections for more details].
All calculations of the mean and standard deviation for samples with greater than 15 percent censored data use normal model equations.

d For confirmed or estimated normal distributions with fewer than 15 percent censored data, calculated using equation 11.6 in Gilbert (1987).
For confirmed or estimated lognormal distributions with fewer than 15 percent censored data, calculated using Land's method (EPA 1992, Gilbert 1987).
Calculations for all cases with greater than 15 percent censored data use the maximum value generated from 2,000 iterations of a Monte Carlo model, following the "bounding" approach descrubed in EPA (2002) [see conceptual model in Figure X-X and text in methods section for more details]. Calculations are based on either normal or lognormal (nonparametric Chebyshev inequality) model equations.

e The lesser of the UCL95 and the maximum detected concentration. The maximum detected concentration is used for all samples with fewer than three measurements.

EPC Exposure point concentration
CV Coefficient of variation ([SD/mean]*100)
Min Minimum concentration reported
Max Maximum concentration reported
N/A Not applicable
Q95 95th percentile (quantile)
SD Standard deviation
TPH Total petroleum hydrocarbons
UCL_{95} The one-sided 95 percent upper confidence limit of the mean
Unknown[a] Distribution assumed to be normal based on examination of probability plots and outlier box plots
Unknown[b] Distribution assumed to be lognormal based on examination of probability plots and outlier box plots

References

Gilbert, R. O. 1987. *Statistical Methods for Environmental Pollution Monitoring* . John Wiley & Sons, Inc., New York, NY.

U.S. Environmental Protection Agency (EPA). 1992. "Supplemental Guidance to RAGS: Calculating the Concentration Term". Intermittent Bulletin, Volume 1, Number 1. Publication 9285.7-081.

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APPENDIX F

SUMMARY OF DESCRIPTIVE STATISTICS FOR SITE 22 SOIL (0 TO 3 FEET BELOW GROUND SURFACE)
SITE 22
NAVAL WEAPONS STATION SBD CONCORD

Analyte Group	Chemical	Distribution[a]	SUMMARY STATISTICS: Sample Size		Detection Frequency (Percent)	Censored Data		Detected Data		Detected & Censored Data						Exposure Point Concentration (EPC)[e]
			Detected	Total		Min	Max	Min	Max	Median[b]	Q95[b]	Mean[c]	SD[c]	CV	UCL_{95}[d]	
Total Metals	Aluminum	Normal	21	21	100	N/A	N/A	11,300.00	21,800.00	16,500.00	21,750.00	16,538.10	3,028.94	18	17,678.08	17,678.08
	Antimony	Not Tested	7	29	24	0.42	12.00	0.56	1.50	1.10	8.75	0.98	3.88	397	2.36	1.50
	Arsenic	Unknown[b]	40	40	100	N/A	N/A	3.90	210.00	43.55	129.85	58.06	11.81	20	90.92	90.92
	Barium	Normal	21	21	100	N/A	N/A	22.80	266.00	163.00	260.90	142.19	58.28	41	164.13	164.13
	Beryllium	Not Tested	6	21	29	0.02	0.46	0.17	0.70	0.05	0.68	0.44	1.13	260	1.49	0.70
	Cadmium	Not Tested	5	21	24	0.02	0.92	0.15	1.30	0.09	1.26	0.45	1.16	262	1.50	1.30
	Calcium	Unknown[b]	21	21	100	N/A	N/A	4,980.00	23,500.00	6,790.00	22,740.00	8,699.43	848.43	10	10,547.98	10,547.98
	Chromium	Normal	21	21	100	N/A	N/A	24.70	61.30	37.90	61.10	39.60	10.56	27	43.57	43.57
	Chromium (VI)	Not Tested	0	2	0	0.05	0.05	N/A	N/A	0.05	0.05	N/A	N/A	N/A	N/A	N/A
	Cobalt	Normal	21	21	100	N/A	N/A	11.80	24.10	19.20	24.05	18.82	2.91	15	19.92	19.92
	Copper	Normal	24	24	100	N/A	N/A	25.80	115.00	53.85	108.18	55.43	19.50	35	62.26	62.26
	Iron	Normal	36	36	100	N/A	N/A	19,600.00	42,000.00	31,000.00	41,150.00	32,144.44	5,937.46	18	33,816.41	33,816.41
	Lead	Lognormal	20	20	100	N/A	N/A	3.60	165.00	15.95	159.79	24.81	5.29	21	41.18	41.18
	Magnesium	Lognormal	21	21	100	N/A	N/A	7,190.00	14,100.00	9,510.00	14,060.00	9,715.13	421.98	4	10,516.19	10,516.19
	Manganese	Normal	36	36	100	N/A	N/A	279.00	870.00	620.00	854.70	612.47	169.90	28	660.32	660.32
	Mercury	Lognormal	20	21	95	0.06	0.06	0.06	1.10	0.24	1.05	0.29	0.05	19	0.44	0.44
	Molybdenum	Not Tested	0	21	0	0.18	6.20	N/A	N/A	0.19	6.20	N/A	N/A	N/A	N/A	N/A
	Nickel	Normal	21	22	95	63.30	63.30	17.80	97.90	55.40	97.48	49.83	24.73	50	58.91	58.91
	Potassium	Normal	21	21	100	N/A	N/A	811.00	3,340.00	1,840.00	3,332.00	1,999.10	841.58	42	2,315.84	2,315.84
	Selenium	Not Tested	0	21	0	0.66	0.88	N/A	N/A	0.82	0.88	N/A	N/A	N/A	N/A	N/A
	Silver	Not Tested	1	21	5	0.11	1.60	10.20	10.20	0.12	9.34	0.45	1.18	264.00	1.50	1.50
	Sodium	Lognormal	18	21	86	28.50	93.40	32.20	675.00	184.00	646.00	198.97	47.26	24	355.86	355.86
	Thallium	Not Tested	0	21	0	0.33	7.00	N/A	N/A	0.37	6.96	N/A	N/A	N/A	N/A	N/A
	Vanadium	Normal	21	21	100	N/A	N/A	42.50	89.90	64.20	89.20	66.10	12.04	18	70.64	70.64
	Zinc	Unknown[b]	21	21	100	N/A	N/A	52.80	1,900.00	71.40	1,743.30	126.45	24.29	19	196.16	196.16
Semivolatile Organic Analytes (SVOA)	1,1'-Biphenyl	Not Tested	0	2	0	0.0400	0.0410	N/A	N/A	0.0405	0.0410	N/A	N/A	N/A	N/A	N/A
	1,2,4-Trichlorobenzene	Not Tested	0	26	0	0.0400	12.0000	N/A	N/A	0.3950	8.0870	N/A	N/A	N/A	N/A	N/A
	1,2-Dichlorobenzene	Not Tested	0	26	0	0.0400	12.0000	N/A	N/A	0.3950	8.0870	N/A	N/A	N/A	N/A	N/A
	1,3-Dichlorobenzene	Not Tested	0	26	0	0.0400	12.0000	N/A	N/A	0.3950	8.0870	N/A	N/A	N/A	N/A	N/A
	1,4-Dichlorobenzene	Not Tested	0	26	0	0.0400	12.0000	N/A	N/A	0.3950	8.0870	N/A	N/A	N/A	N/A	N/A
	1-Methylnaphthalene	Not Tested	0	2	0	0.0400	0.0410	N/A	N/A	0.0405	0.0410	N/A	N/A	N/A	N/A	N/A
	1-Methylphenanthrene	Not Tested	0	2	0	0.0400	0.0410	N/A	N/A	0.0405	0.0410	N/A	N/A	N/A	N/A	N/A
	2,2'-Oxybis(1-chloropropane)	Not Tested	0	26	0	0.0400	12.0000	N/A	N/A	0.3950	8.0870	N/A	N/A	N/A	N/A	N/A
	2,3,5-Trimethylnaphthalene	Not Tested	0	2	0	0.0400	0.0410	N/A	N/A	0.0405	0.0410	N/A	N/A	N/A	N/A	N/A
	2,4,5-Trichlorophenol	Not Tested	0	26	0	0.1000	29.0000	N/A	N/A	0.9850	19.5500	N/A	N/A	N/A	N/A	N/A
	2,4,6-Trichlorophenol	Not Tested	0	26	0	0.0400	12.0000	N/A	N/A	0.3950	8.0870	N/A	N/A	N/A	N/A	N/A
	2,4-Dichlorophenol	Not Tested	0	26	0	0.0400	12.0000	N/A	N/A	0.3950	8.0870	N/A	N/A	N/A	N/A	N/A
	2,4-Dimethylphenol	Not Tested	0	26	0	0.0400	12.0000	N/A	N/A	0.3950	8.0870	N/A	N/A	N/A	N/A	N/A
	2,4-Dinitrophenol	Not Tested	0	26	0	0.1000	29.0000	N/A	N/A	0.9850	19.5500	N/A	N/A	N/A	N/A	N/A
	2,4-Dinitrotoluene	Not Tested	0	26	0	0.0400	12.0000	N/A	N/A	0.3950	8.0870	N/A	N/A	N/A	N/A	N/A
	2,6-Dimethylnaphthalene	Not Tested	0	2	0	0.0400	0.0410	N/A	N/A	0.0405	0.0410	N/A	N/A	N/A	N/A	N/A
	2,6-Dinitrotoluene	Not Tested	0	26	0	0.0400	12.0000	N/A	N/A	0.3950	8.0870	N/A	N/A	N/A	N/A	N/A
	2-Chloronaphthalene	Not Tested	0	26	0	0.0400	12.0000	N/A	N/A	0.3950	8.0870	N/A	N/A	N/A	N/A	N/A
	2-Chlorophenol	Not Tested	0	26	0	0.0400	12.0000	N/A	N/A	0.3950	8.0870	N/A	N/A	N/A	N/A	N/A
	2-Methlyphenol	Not Tested	0	26	0	0.0400	12.0000	N/A	N/A	0.3950	8.0870	N/A	N/A	N/A	N/A	N/A
	2-Methylnaphthalene	Not Tested	1	26	4	0.0400	0.8200	20.0000	20.0000	0.3950	13.2870	0.01	0.01	62.00	0.13	0.13
	2-Nitroaniline	Not Tested	0	26	0	0.1000	29.0000	N/A	N/A	0.9850	19.5500	N/A	N/A	N/A	N/A	N/A

SUMMARY OF DESCRIPTIVE STATISTICS FOR SITE 22 SOIL (0 TO 3 FEET BELOW GROUND SURFACE)
SITE 22
NAVAL WEAPONS STATION SBD CONCORD

Analyte Group	Chemical	Distribution[a]	SUMMARY STATISTICS													Exposure Point Concentration (EPC)[e]
			Sample Size		Detection Frequency (Percent)	Censored Data		Detected Data		Detected & Censored Data						
			Detected	Total		Min	Max	Min	Max	Median[b]	Q95[b]	Mean[c]	SD[c]	CV	UCL_{95}[d]	
	2-Nitrophenol	Not Tested	0	26	0	0.0400	12.0000	N/A	N/A	0.3950	8.0870	N/A	N/A	N/A	N/A	N/A
	3,3'-Dichlorobenzidine	Not Tested	0	26	0	0.0400	12.0000	N/A	N/A	0.3950	8.0870	N/A	N/A	N/A	N/A	N/A
	3-Nitroaniline	Not Tested	0	26	0	0.1000	29.0000	N/A	N/A	0.9850	19.5500	N/A	N/A	N/A	N/A	N/A
	4,6-Dinitro-2-methylphenol	Not Tested	0	26	0	0.1000	29.0000	N/A	N/A	0.9850	19.5500	N/A	N/A	N/A	N/A	N/A
	4-Bromophenyl-phenylether	Not Tested	0	26	0	0.0400	12.0000	N/A	N/A	0.3950	8.0870	N/A	N/A	N/A	N/A	N/A
	4-Chloro-3-methylphenol	Not Tested	0	26	0	0.0400	12.0000	N/A	N/A	0.3950	8.0870	N/A	N/A	N/A	N/A	N/A
	4-Chloroaniline	Not Tested	0	26	0	0.0400	12.0000	N/A	N/A	0.3950	8.0870	N/A	N/A	N/A	N/A	N/A
	4-Chlorophenyl-phenylether	Not Tested	0	26	0	0.0400	12.0000	N/A	N/A	0.3950	8.0870	N/A	N/A	N/A	N/A	N/A
	4-Methlyphenol	Not Tested	0	26	0	0.0400	12.0000	N/A	N/A	0.3950	8.0870	N/A	N/A	N/A	N/A	N/A
	4-Nitroaniline	Not Tested	0	26	0	0.1000	29.0000	N/A	N/A	0.9850	19.5500	N/A	N/A	N/A	N/A	N/A
	4-Nitrophenol	Not Tested	0	26	0	0.1000	29.0000	N/A	N/A	0.9850	19.5500	N/A	N/A	N/A	N/A	N/A
	Acenaphthene	Not Tested	0	26	0	0.0400	12.0000	N/A	N/A	0.3950	8.0870	N/A	N/A	N/A	N/A	N/A
	Acenaphthylene	Not Tested	0	26	0	0.0400	12.0000	N/A	N/A	0.3950	8.0870	N/A	N/A	N/A	N/A	N/A
	Anthracene	Not Tested	0	26	0	0.0400	12.0000	N/A	N/A	0.3950	8.0870	N/A	N/A	N/A	N/A	N/A
	Benzo(a)anthracene	Not Tested	1	26	4	0.0410	12.0000	0.0040	0.0040	0.3950	8.0870	0.4427	1.1608	262	1.4985	0.0040
	Benzo(a)pyrene	Not Tested	1	26	4	0.0410	12.0000	0.0050	0.0050	0.3950	8.0870	0.4363	1.1022	253	1.5100	0.0050
	Benzo(b)fluoranthene	Not Tested	1	26	4	0.0410	12.0000	0.0160	0.0160	0.3950	8.0870	0.5230	1.5545	297	1.1376	0.0160
	Benzo(e)pyrene	Not Tested	1	2	50	0.0410	0.0410	0.0080	0.0080	0.0245	0.0410	0.4373	1.1295	258	1.4921	0.0080
	Benzo(g,h,i)perylene	Not Tested	0	26	0	0.0400	12.0000	N/A	N/A	0.3950	8.0870	N/A	N/A	N/A	N/A	N/A
	Benzo(k)fluoranthene	Not Tested	0	26	0	0.0400	12.0000	N/A	N/A	0.3950	8.0870	N/A	N/A	N/A	N/A	N/A
SVOA (Continued)	Benzoic acid	Not Tested	0	2	0	0.1000	0.1000	N/A	N/A	0.1000	0.1000	N/A	N/A	N/A	N/A	N/A
	Benzyl alcohol	Not Tested	0	2	0	0.0400	0.0410	N/A	N/A	0.0405	0.0410	N/A	N/A	N/A	N/A	N/A
	Butylbenzylphthalate	Not Tested	0	26	0	0.0400	12.0000	N/A	N/A	0.3950	8.0870	N/A	N/A	N/A	N/A	N/A
	Carbazole	Not Tested	0	26	0	0.0400	12.0000	N/A	N/A	0.3950	8.0870	N/A	N/A	N/A	N/A	N/A
	Chrysene	Not Tested	1	26	4	0.0410	12.0000	0.0100	0.0100	0.3950	8.0870	0.4606	1.1096	241	1.5003	0.0100
	Dibenz(a,h)anthracene	Not Tested	0	26	0	0.0400	12.0000	N/A	N/A	0.3950	8.0870	N/A	N/A	N/A	N/A	N/A
	Dibenzofuran	Not Tested	0	26	0	0.0400	12.0000	N/A	N/A	0.3950	8.0870	N/A	N/A	N/A	N/A	N/A
	Dibenzothiophene	Not Tested	0	2	0	0.0400	0.0410	N/A	N/A	0.0405	0.0410	N/A	N/A	N/A	N/A	N/A
	Diethylphthalate	Not Tested	0	26	0	0.0400	12.0000	N/A	N/A	0.3950	8.0870	N/A	N/A	N/A	N/A	N/A
	Dimethylphthalate	Not Tested	0	26	0	0.0400	12.0000	N/A	N/A	0.3950	8.0870	N/A	N/A	N/A	N/A	N/A
	Fluoranthene	Not Tested	2	26	8	0.0410	12.0000	0.0130	0.3400	0.3900	8.0870	0.4468	1.1537	258	1.4733	0.3400
	Fluorene	Not Tested	0	26	0	0.0400	12.0000	N/A	N/A	0.3950	8.0870	N/A	N/A	N/A	N/A	N/A
	Hexachlorobenzene	Not Tested	0	26	0	0.0400	12.0000	N/A	N/A	0.3950	8.0870	N/A	N/A	N/A	N/A	N/A
	Hexachlorobutadiene	Not Tested	0	26	0	0.0400	12.0000	N/A	N/A	0.3950	8.0870	N/A	N/A	N/A	N/A	N/A
	Hexachlorocyclopentadiene	Not Tested	0	26	0	0.0400	12.0000	N/A	N/A	0.3950	8.0870	N/A	N/A	N/A	N/A	N/A
	Hexachloroethane	Not Tested	0	26	0	0.0400	12.0000	N/A	N/A	0.3950	8.0870	N/A	N/A	N/A	N/A	N/A
	Indeno(1,2,3-cd)pyrene	Not Tested	0	26	0	0.0400	12.0000	N/A	N/A	0.3950	8.0870	N/A	N/A	N/A	N/A	N/A
	Isophorone	Not Tested	0	26	0	0.0400	12.0000	N/A	N/A	0.3950	8.0870	N/A	N/A	N/A	N/A	N/A
	Naphthalene	Not Tested	1	26	4	0.0400	0.8200	8.1000	8.1000	0.3950	5.5520	1.08	1.31	121.00	2.23	2.23
	Nitrobenzene	Not Tested	0	26	0	0.0400	12.0000	N/A	N/A	0.3950	8.0870	N/A	N/A	N/A	N/A	N/A
	Pentachlorophenol	Not Tested	0	26	0	0.1000	29.0000	N/A	N/A	0.9850	19.5500	N/A	N/A	N/A	N/A	N/A
	Perylene	Not Tested	0	2	0	0.0400	0.0410	N/A	N/A	0.0405	0.0410	N/A	N/A	N/A	N/A	N/A
	Phenanthrene	Not Tested	1	26	4	0.0410	12.0000	0.0070	0.0070	0.3950	8.0870	0.1448	0.2003	138	0.2505	0.0070
	Phenol	Not Tested	4	26	15	0.0400	12.0000	0.2100	0.4400	0.4000	8.0870	0.21	0.33	157.00	0.43	0.43
	Pyrene	Not Tested	2	26	8	0.0410	12.0000	0.0070	0.2200	0.3950	8.0870	0.6630	2.2081	333	1.6209	0.2200
	bis(2-chloroethoxy)methane	Not Tested	0	26	0	0.0400	12.0000	N/A	N/A	0.3950	8.0870	N/A	N/A	N/A	N/A	N/A
	bis(2-chloroethyl)ether	Not Tested	0	26	0	0.0400	12.0000	N/A	N/A	0.3950	8.0870	N/A	N/A	N/A	N/A	N/A

APPENDIX F

SUMMARY OF DESCRIPTIVE STATISTICS FOR SITE 22 SOIL (0 TO 3 FEET BELOW GROUND SURFACE)
SITE 22
NAVAL WEAPONS STATION SBD CONCORD

Analyte Group	Chemical	Distribution[a]	SUMMARY STATISTICS													Exposure Point Concentration (EPC)[e]
			Sample Size		Detection Frequency (Percent)	Censored Data		Detected Data		Detected & Censored Data						
			Detected	Total		Min	Max	Min	Max	Median[b]	Q95[b]	Mean[c]	SD[c]	CV	UCL_{95}[d]	
SVOA (Continued)	bis(2-ethylhexyl)phthalate	Not Tested	0	26	0	0.0420	12.0000	N/A	N/A	0.3950	8.1850	N/A	N/A	N/A	N/A	N/A
	di-n-Butylphthalate	Not Tested	0	26	0	0.0400	12.0000	N/A	N/A	0.3950	8.0870	N/A	N/A	N/A	N/A	N/A
	di-n-Octylphthalate	Not Tested	0	26	0	0.0400	12.0000	N/A	N/A	0.3950	8.0870	N/A	N/A	N/A	N/A	N/A
	n-Nitroso-di-n-propylamine	Not Tested	0	26	0	0.0400	12.0000	N/A	N/A	0.3950	8.0870	N/A	N/A	N/A	N/A	N/A
	n-Nitrosodiphenylamine (1)	Not Tested	0	26	0	0.0400	12.0000	N/A	N/A	0.3950	8.0870	N/A	N/A	N/A	N/A	N/A
Volatile Organic Analytes (VOA)	1,1,1-Trichloroethane	Not Tested	0	27	0	0.0100	1.5000	N/A	N/A	0.0120	0.9228	N/A	N/A	N/A	N/A	N/A
	1,1,2,2-Tetrachloroethane	Not Tested	0	27	0	0.0100	1.5000	N/A	N/A	0.0120	0.9228	N/A	N/A	N/A	N/A	N/A
	1,1,2-Trichloroethane	Not Tested	0	27	0	0.0100	1.5000	N/A	N/A	0.0120	0.9228	N/A	N/A	N/A	N/A	N/A
	1,1-Dichlorethane	Not Tested	0	27	0	0.0100	1.5000	N/A	N/A	0.0120	0.9228	N/A	N/A	N/A	N/A	N/A
	1,1-Dichlorethene	Not Tested	0	27	0	0.0100	1.5000	N/A	N/A	0.0120	0.9228	N/A	N/A	N/A	N/A	N/A
	1,2-Dichloroethane	Not Tested	0	27	0	0.0100	1.5000	N/A	N/A	0.0120	0.9228	N/A	N/A	N/A	N/A	N/A
	1,2-Dichloroethene (Total)	Not Tested	0	27	0	0.0100	1.5000	N/A	N/A	0.0120	0.9228	N/A	N/A	N/A	N/A	N/A
	1,2-Dichloropropane	Not Tested	0	27	0	0.0100	1.5000	N/A	N/A	0.0120	0.9228	N/A	N/A	N/A	N/A	N/A
	2-Butanone	Not Tested	0	27	0	0.0100	1.5000	N/A	N/A	0.0120	0.9228	N/A	N/A	N/A	N/A	N/A
	2-Hexanone	Not Tested	0	27	0	0.0100	1.5000	N/A	N/A	0.0120	0.9228	N/A	N/A	N/A	N/A	N/A
	4-Methyl-2-pentanone	Not Tested	0	27	0	0.0100	1.5000	N/A	N/A	0.0120	0.9228	N/A	N/A	N/A	N/A	N/A
	Acetone	Not Tested	0	27	0	0.0100	1.5000	N/A	N/A	0.0120	0.9560	N/A	N/A	N/A	N/A	N/A
	Benzene	Not Tested	0	27	0	0.0100	1.5000	N/A	N/A	0.0120	0.9228	N/A	N/A	N/A	N/A	N/A
	Bromodichloromethane	Not Tested	0	27	0	0.0100	1.5000	N/A	N/A	0.0120	0.9228	N/A	N/A	N/A	N/A	N/A
	Bromoform	Not Tested	0	27	0	0.0100	1.5000	N/A	N/A	0.0120	0.9228	N/A	N/A	N/A	N/A	N/A
	Bromomethane	Not Tested	0	27	0	0.0100	1.5000	N/A	N/A	0.0120	0.9228	N/A	N/A	N/A	N/A	N/A
	Carbon disulfide	Not Tested	0	27	0	0.0100	1.5000	N/A	N/A	0.0120	0.9228	N/A	N/A	N/A	N/A	N/A
	Carbon tetrachloride	Not Tested	0	27	0	0.0100	1.5000	N/A	N/A	0.0120	0.9228	N/A	N/A	N/A	N/A	N/A
	Chlorobenzene	Not Tested	0	27	0	0.0100	1.5000	N/A	N/A	0.0120	0.9228	N/A	N/A	N/A	N/A	N/A
	Chloroethane	Not Tested	0	27	0	0.0100	1.5000	N/A	N/A	0.0120	0.9228	N/A	N/A	N/A	N/A	N/A
	Chloroform	Not Tested	0	27	0	0.0100	1.5000	N/A	N/A	0.0120	0.9228	N/A	N/A	N/A	N/A	N/A
	Chloromethane	Not Tested	0	27	0	0.0100	1.5000	N/A	N/A	0.0120	0.9228	N/A	N/A	N/A	N/A	N/A
	Dibromochloromethane	Not Tested	0	27	0	0.0100	1.5000	N/A	N/A	0.0120	0.9228	N/A	N/A	N/A	N/A	N/A
	Ethylbenzene	Not Tested	0	27	0	0.0100	1.5000	N/A	N/A	0.0120	0.9228	N/A	N/A	N/A	N/A	N/A
	Methylene chloride	Not Tested	0	27	0	0.0100	1.5000	N/A	N/A	0.0120	0.9228	N/A	N/A	N/A	N/A	N/A
	Styrene	Not Tested	0	27	0	0.0100	1.5000	N/A	N/A	0.0120	0.9228	N/A	N/A	N/A	N/A	N/A
	Tetrachloroethene	Not Tested	0	27	0	0.0100	1.5000	N/A	N/A	0.0120	0.9228	N/A	N/A	N/A	N/A	N/A
	Toluene	Not Tested	0	27	0	0.0100	1.5000	N/A	N/A	0.0120	0.9228	N/A	N/A	N/A	N/A	N/A
	Trichloroethene	Not Tested	0	27	0	0.0100	1.5000	N/A	N/A	0.0120	0.9228	N/A	N/A	N/A	N/A	N/A
	Vinyl chloride	Not Tested	0	27	0	0.0100	1.5000	N/A	N/A	0.0120	0.9228	N/A	N/A	N/A	N/A	N/A
	Xylene (Total)	Not Tested	1	27	4	0.0100	0.0570	11.0000	11.0000	0.0120	6.6228	1,225.54	6,496.11	530.00	3,279.72	11.00
	cis-1,3-Dichloropropene	Not Tested	0	27	0	0.0100	1.5000	N/A	N/A	0.0120	0.9228	N/A	N/A	N/A	N/A	N/A
	trans-1,3-Dichloropropene	Not Tested	0	27	0	0.0100	1.5000	N/A	N/A	0.0120	0.9228	N/A	N/A	N/A	N/A	N/A
Organotins	Dibutyltin	Not Tested	0	6	0	0.0010	0.0030	N/A	N/A	0.0010	0.0030	N/A	N/A	N/A	N/A	N/A
	Monobutyltin	Not Tested	0	6	0	0.0010	0.0030	N/A	N/A	0.0010	0.0030	N/A	N/A	N/A	N/A	N/A
	Tetrabutyltin	Not Tested	0	6	0	0.0010	0.0030	N/A	N/A	0.0010	0.0030	N/A	N/A	N/A	N/A	N/A
	Tributyltin	Not Tested	0	6	0	0.0010	0.0030	N/A	N/A	0.0010	0.0030	N/A	N/A	N/A	N/A	N/A
TPH (Extractable)	Diesel Range	Not Tested	3	29	10	2.74	30.00	9.23	35,000.00	12.00	17,685.00	237.03	868.45	366	541.82	541.82
	Motor Oil Range	Unknown[b]	17	24	71	11.00	13.00	14.00	4,300.00	32.00	3,287.50	0.41	2.12	511	2.19	2.19
TPH (Purgable)	Gasoline Range	Not Tested	0	5	0	0.05	0.06	N/A	N/A	0.06	0.06	N/A	N/A	N/A	N/A	N/A

APPENDIX F

SUMMARY OF DESCRIPTIVE STATISTICS FOR SITE 22 SOIL (0 TO 3 FEET BELOW GROUND SURFACE)
SITE 22
NAVAL WEAPONS STATION SBD CONCORD

Notes:

All concentration units are mg/kg.
For samples with less than 15 percent censored data, one half the reporting limit is substituted for each non-detect measurement in all calculations.
For higher frequencies of censored data, all calculations were performed using stochastic modeling, following the "bounding" approach presented in EPA (2002), as described below under notes c and d.

a For all cases with at least 5 detected samples and a detection frequency greater than or equal to 50 percent, tested using the Shapiro-Wilk W test (alpha equal to 0.05).
Distributions confirmed as normal or lognormal are listed as "Normal" or "Lognormal." For cases where distribution testing was not conducted, the distribution is listed as "Not Tested."
For cases in which distributions could not be confirmed using the Shipiro-Wilk W test, distributions were estimated using probability plots, box plots, and frequency histograms.
Distributions estimated to be normal or lognormal are listed as Unknown[a] or Unknown[b], respectively.

b Estimated for all samples using a nonparametric approach, based on rank ordering of the data (reported values used for all censored data).

c For all samples with at least one detection, calculated using distribution-dependent formulae.
For confirmed or estimated normal distributions with fewer than 15 percent censored data, calculated using equations 4.3 (mean) and 4.4 (standard deviation) in Gilbert (1987).
For confirmed or estimated lognormal distributions with fewer than 15 percent censored data, these are the minimum variance unbiased (MVU) estimators, following equations 13.3 (mean) and 13.5 (standard deviation) in Gilbert (1987).
All other calculations use the median values generated from 2,000 iterations of a Monte Carlo model, following the "bounding" approach described in EPA (2002) [see conceptual model in Figure X-X and text in methods section for more details]. All calculations of the mean and standard deviation for samples with greater than 15 percent censored data use normal model equations.

d For confirmed or estimated normal distributions with fewer than 15 percent censored data, calculated using equation 11.6 in Gilbert (1987).
For confirmed or estimated lognormal distributions with fewer than 15 percent censored data, calculated using Land's method (EPA 1992, Gilbert 1987).
Calculations for all cases with greater than 15 percent censored data use the maximum value generated from 2,000 iterations of a Monte Carlo model, following the "bounding" approach descrubed in EPA (2002) [see conceptual model in Figure X-X and text in methods section for more details]. Calculations are based on either normal or lognormal (nonparametric Chebyshev inequality) model equations.

e The lesser of the UCL95 and the maximum detected concentration. The maximum detected concentration is used for all samples with fewer than three measurements.

EPC Exposure point concentration
CV Coefficient of variation ([SD/mean]*100)
Min Minimum concentration reported
Max Maximum concentration reported
N/A Not applicable
Q95 95th percentile (quantile)
SD Standard deviation
TPH Total petroleum hydrocarbons
UCL_{95} The one-sided 95 percent upper confidence limit of the mean
Unknown[a] Distribution assumed to be normal based on examination of probability plots and outlier box plots
Unknown[b] Distribution assumed to be lognormal based on examination of probability plots and outlier box plots

References

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U.S. Environmental Protection Agency (EPA). 1992. "Supplemental Guidance to RAGS: Calculating the Concentration Term". Intermittent Bulletin, Volume 1, Number 1. Publication 9285.7-081.

EPA. 2002. "Calculating Exposure Point Concentrations at Hazardous Waste Sites." Draft. OSWER 9285.6-10. Washington, D.C. July 2002.

SUMMARY OF DESCRIPTIVE STATISTICS FOR SITE 22 SOIL (0 TO 10 FEET BELOW GROUND SURFACE)
SITE 22
NAVAL WEAPONS STATION SBD CONCORD

Analyte Group	Chemical	Distribution[a]	SUMMARY STATISTICS													Exposure Point Concentration (EPC)[e]
			Sample Size		Detection Frequency (Percent)	Censored Data		Detected Data		Detected and Censored Data						
			Detected	Total		Min	Max	Min	Max	Median[b]	Q95[b]	Mean[c]	SD[c]	CV	UCL_{95}[d]	
Total Metals	Aluminum	Lognormal	34	34	100	N/A	N/A	11,300.00	31,400.00	16,900.00	25,625.00	17,678.14	633.78	4	18,837.75	18,837.75
	Antimony	Not Tested	11	57	19	0.42	12.00	0.49	1.50	1.20	6.13	0.73	3.17	432	1.67	1.50
	Arsenic	Unknown[b]	81	81	100	N/A	N/A	3.30	210.00	11.00	113.90	29.48	4.29	15	39.16	39.16
	Barium	Normal	34	34	100	N/A	N/A	22.80	266.00	168.50	265.25	162.71	60.63	37	180.30	180.30
	Beryllium	Not Tested	9	34	26	0.02	0.46	0.17	0.74	0.03	0.71	0.37	0.91	246	1.08	0.74
	Cadmium	Not Tested	9	34	26	0.02	0.99	0.15	1.30	0.13	1.07	0.37	0.93	248	1.06	1.06
	Calcium	Unknown[b]	34	34	100	N/A	N/A	4,860.00	23,500.00	7,025.00	17,800.00	8,150.45	536.36	7	9,203.97	9,203.97
	Chromium	Normal	34	34	100	N/A	N/A	24.70	81.90	45.65	74.03	45.50	13.70	30	49.47	49.47
	Chromium (VI)	Not Tested	0	4	0	0.05	0.05	N/A	N/A	0.05	0.05	N/A	N/A	N/A	N/A	N/A
	Cobalt	Normal	34	34	100	N/A	N/A	11.80	31.70	19.55	29.53	20.65	4.09	20	21.83	21.83
	Copper	Unknown[b]	37	37	100	N/A	N/A	25.80	332.00	56.50	136.70	62.06	4.33	7	70.57	70.57
	Iron	Normal	77	77	100	N/A	N/A	19,600.00	56,000.00	36,000.00	48,180.00	35,379.22	7,184.35	20	36,742.53	36,742.53
	Lead	Lognormal	33	33	100	N/A	N/A	3.60	165.00	13.20	91.99	20.00	2.89	14	26.93	26.93
	Magnesium	Lognormal	34	34	100	N/A	N/A	7,190.00	18,600.00	9,705.00	15,225.00	10,132.85	347.47	3	10,766.26	10,766.26
	Manganese	Normal	77	77	100	N/A	N/A	250.00	1,200.00	740.00	1,011.00	717.56	201.48	28	755.79	755.79
	Mercury	Lognormal	31	34	91	0.06	0.06	0.06	1.10	0.16	0.75	0.24	0.04	17	0.34	0.34
	Molybdenum	Not Tested	0	34	0	0.17	6.70	N/A	N/A	0.20	6.33	N/A	N/A	N/A	N/A	N/A
	Nickel	Normal	34	35	97	63.30	63.30	17.80	126.00	63.30	126.00	64.04	30.92	48	72.87	72.87
	Potassium	Normal	34	34	100	N/A	N/A	811.00	4,470.00	1,910.00	3,720.00	2,121.50	880.80	42	2,377.14	2,377.14
	Selenium	Not Tested	1	34	3	0.66	0.88	0.79	0.79	0.83	0.88	0.37	0.92	248	1.08	0.79
	Silver	Not Tested	2	34	6	0.11	1.70	10.20	18.10	0.12	12.18	0.01	0.01	62	0.13	0.13
	Sodium	Unknown[b]	27	34	79	27.10	145.00	32.20	675.00	199.50	495.00	0.37	0.93	249	1.88	1.88
	Thallium	Not Tested	0	34	0	0.32	7.40	N/A	N/A	0.37	7.10	N/A	N/A	N/A	N/A	N/A
	Vanadium	Normal	34	34	100	N/A	N/A	42.50	113.00	67.05	103.25	69.32	14.06	20	73.40	73.40
	Zinc	Unknown[b]	34	34	100	N/A	N/A	52.80	1,900.00	78.60	724.75	109.94	13.05	12	139.27	139.27
Semivolatile Organic Analytes (SVOA)	1,1'-Biphenyl	Not Tested	0	2	0	0.0400	0.0410	N/A	N/A	0.0405	0.0410	N/A	N/A	N/A	N/A	N/A
	1,2,4-Trichlorobenzene	Not Tested	0	39	0	0.0400	12.0000	N/A	N/A	0.4100	0.8200	N/A	N/A	N/A	N/A	N/A
	1,2-Dichlorobenzene	Not Tested	0	39	0	0.0400	12.0000	N/A	N/A	0.4100	0.8200	N/A	N/A	N/A	N/A	N/A
	1,3-Dichlorobenzene	Not Tested	0	39	0	0.0400	12.0000	N/A	N/A	0.4100	0.8200	N/A	N/A	N/A	N/A	N/A
	1,4-Dichlorobenzene	Not Tested	0	39	0	0.0400	12.0000	N/A	N/A	0.4100	0.8200	N/A	N/A	N/A	N/A	N/A
	1-Methylnaphthalene	Not Tested	0	2	0	0.0400	0.0410	N/A	N/A	0.0405	0.0410	N/A	N/A	N/A	N/A	N/A
	1-Methylphenanthrene	Not Tested	0	2	0	0.0400	0.0410	N/A	N/A	0.0405	0.0410	N/A	N/A	N/A	N/A	N/A
	2,2'-Oxybis(1-chloropropane)	Not Tested	0	39	0	0.0400	12.0000	N/A	N/A	0.4100	0.8200	N/A	N/A	N/A	N/A	N/A
	2,3,5-Trimethylnaphthalene	Not Tested	0	2	0	0.0400	0.0410	N/A	N/A	0.0405	0.0410	N/A	N/A	N/A	N/A	N/A
	2,4,5-Trichlorophenol	Not Tested	0	39	0	0.1000	29.0000	N/A	N/A	1.0000	2.0000	N/A	N/A	N/A	N/A	N/A
	2,4,6-Trichlorophenol	Not Tested	0	39	0	0.0400	12.0000	N/A	N/A	0.4100	0.8200	N/A	N/A	N/A	N/A	N/A
	2,4-Dichlorophenol	Not Tested	0	39	0	0.0400	12.0000	N/A	N/A	0.4100	0.8200	N/A	N/A	N/A	N/A	N/A
	2,4-Dimethylphenol	Not Tested	0	39	0	0.0400	12.0000	N/A	N/A	0.4100	0.8200	N/A	N/A	N/A	N/A	N/A
	2,4-Dinitrophenol	Not Tested	0	39	0	0.1000	29.0000	N/A	N/A	1.0000	2.0000	N/A	N/A	N/A	N/A	N/A
	2,4-Dinitrotoluene	Not Tested	0	39	0	0.0400	12.0000	N/A	N/A	0.4100	0.8200	N/A	N/A	N/A	N/A	N/A
	2,6-Dimethylnaphthalene	Not Tested	0	2	0	0.0400	0.0410	N/A	N/A	0.0405	0.0410	N/A	N/A	N/A	N/A	N/A
	2,6-Dinitrotoluene	Not Tested	0	39	0	0.0400	12.0000	N/A	N/A	0.4100	0.8200	N/A	N/A	N/A	N/A	N/A
	2-Chloronaphthalene	Not Tested	0	39	0	0.0400	12.0000	N/A	N/A	0.4100	0.8200	N/A	N/A	N/A	N/A	N/A
	2-Chlorophenol	Not Tested	0	39	0	0.0400	12.0000	N/A	N/A	0.4100	0.8200	N/A	N/A	N/A	N/A	N/A
	2-Methlyphenol	Not Tested	0	39	0	0.0400	12.0000	N/A	N/A	0.4100	0.8200	N/A	N/A	N/A	N/A	N/A
	2-Methylnaphthalene	Not Tested	1	39	3	0.0400	0.8200	20.0000	20.0000	0.4100	0.8200	0.3816	0.9638	253	1.0874	1.0874
	2-Nitroaniline	Not Tested	0	39	0	0.1000	29.0000	N/A	N/A	1.0000	2.0000	N/A	N/A	N/A	N/A	N/A

SUMMARY OF DESCRIPTIVE STATISTICS FOR SITE 22 SOIL (0 TO 10 FEET BELOW GROUND SURFACE)
SITE 22
NAVAL WEAPONS STATION SBD CONCORD

Analyte Group	Chemical	Distribution[a]	SUMMARY STATISTICS													Exposure Point Concentration (EPC)[e]
			Sample Size		Detection Frequency (Percent)	Censored Data		Detected Data		Detected and Censored Data						
			Detected	Total		Min	Max	Min	Max	Median[b]	Q95[b]	Mean[c]	SD[c]	CV	UCL_{95}[d]	
	2-Nitrophenol	Not Tested	0	39	0	0.0400	12.0000	N/A	N/A	0.4100	0.8200	N/A	N/A	N/A	N/A	N/A
	3,3'-Dichlorobenzidine	Not Tested	0	39	0	0.0400	12.0000	N/A	N/A	0.4100	0.8200	N/A	N/A	N/A	N/A	N/A
	3-Nitroaniline	Not Tested	0	39	0	0.1000	29.0000	N/A	N/A	1.0000	2.0000	N/A	N/A	N/A	N/A	N/A
	4,6-Dinitro-2-methylphenol	Not Tested	0	39	0	0.1000	29.0000	N/A	N/A	1.0000	2.0000	N/A	N/A	N/A	N/A	N/A
	4-Bromophenyl-phenylether	Not Tested	0	39	0	0.0400	12.0000	N/A	N/A	0.4100	0.8200	N/A	N/A	N/A	N/A	N/A
	4-Chloro-3-methylphenol	Not Tested	0	39	0	0.0400	12.0000	N/A	N/A	0.4100	0.8200	N/A	N/A	N/A	N/A	N/A
	4-Chloroaniline	Not Tested	0	39	0	0.0400	12.0000	N/A	N/A	0.4100	0.8200	N/A	N/A	N/A	N/A	N/A
	4-Chlorophenyl-phenylether	Not Tested	0	39	0	0.0400	12.0000	N/A	N/A	0.4100	0.8200	N/A	N/A	N/A	N/A	N/A
	4-Methlyphenol	Not Tested	0	39	0	0.0400	12.0000	N/A	N/A	0.4100	0.8200	N/A	N/A	N/A	N/A	N/A
	4-Nitroaniline	Not Tested	0	39	0	0.1000	29.0000	N/A	N/A	1.0000	2.0000	N/A	N/A	N/A	N/A	N/A
	4-Nitrophenol	Not Tested	0	39	0	0.1000	29.0000	N/A	N/A	1.0000	2.0000	N/A	N/A	N/A	N/A	N/A
	Acenaphthene	Not Tested	0	39	0	0.0400	12.0000	N/A	N/A	0.4100	0.8200	N/A	N/A	N/A	N/A	N/A
	Acenaphthylene	Not Tested	0	39	0	0.0400	12.0000	N/A	N/A	0.4100	0.8200	N/A	N/A	N/A	N/A	N/A
	Anthracene	Not Tested	0	39	0	0.0400	12.0000	N/A	N/A	0.4100	0.8200	N/A	N/A	N/A	N/A	N/A
	Benzo(a)anthracene	Not Tested	1	39	3	0.0410	12.0000	0.0040	0.0040	0.4100	0.8200	0.4297	1.2716	296	0.8410	0.0040
	Benzo(a)pyrene	Not Tested	1	39	3	0.0410	12.0000	0.0050	0.0050	0.4100	0.8200	0.3773	0.9505	252	1.0820	0.0050
	Benzo(b)fluoranthene	Not Tested	1	39	3	0.0410	12.0000	0.0160	0.0160	0.4100	0.8200	0.4448	0.9991	225	1.1376	0.0160
SVOA (Continued)	Benzo(e)pyrene	Not Tested	1	2	50	0.0410	0.0410	0.0080	0.0080	0.0245	0.0410	0.3737	0.9387	251	1.0766	0.0080
	Benzo(g,h,i)perylene	Not Tested	0	39	0	0.0400	12.0000	N/A	N/A	0.4100	0.8200	N/A	N/A	N/A	N/A	N/A
	Benzo(k)fluoranthene	Not Tested	0	39	0	0.0400	12.0000	N/A	N/A	0.4100	0.8200	N/A	N/A	N/A	N/A	N/A
	Benzoic acid	Not Tested	0	2	0	0.1000	0.1000	N/A	N/A	0.1000	0.1000	N/A	N/A	N/A	N/A	N/A
	Benzyl alcohol	Not Tested	0	2	0	0.0400	0.0410	N/A	N/A	0.0405	0.0410	N/A	N/A	N/A	N/A	N/A
	Butylbenzylphthalate	Not Tested	0	39	0	0.0400	12.0000	N/A	N/A	0.4100	0.8200	N/A	N/A	N/A	N/A	N/A
	Carbazole	Not Tested	0	39	0	0.0400	12.0000	N/A	N/A	0.4100	0.8200	N/A	N/A	N/A	N/A	N/A
	Chrysene	Not Tested	1	39	3	0.0410	12.0000	0.0100	0.0100	0.4100	0.8200	1.1372	1.4132	124	2.0087	0.0100
	Dibenz(a,h)anthracene	Not Tested	0	39	0	0.0400	12.0000	N/A	N/A	0.4100	0.8200	N/A	N/A	N/A	N/A	N/A
	Dibenzofuran	Not Tested	0	39	0	0.0400	12.0000	N/A	N/A	0.4100	0.8200	N/A	N/A	N/A	N/A	N/A
	Dibenzothiophene	Not Tested	0	2	0	0.0400	0.0410	N/A	N/A	0.0405	0.0410	N/A	N/A	N/A	N/A	N/A
	Diethylphthalate	Not Tested	0	39	0	0.0400	12.0000	N/A	N/A	0.4100	0.8200	N/A	N/A	N/A	N/A	N/A
	Dimethylphthalate	Not Tested	0	39	0	0.0400	12.0000	N/A	N/A	0.4100	0.8200	N/A	N/A	N/A	N/A	N/A
	Fluoranthene	Not Tested	2	39	5	0.0410	12.0000	0.0130	0.3400	0.4100	0.8200	0.1495	0.2302	154	0.2350	0.2350
	Fluorene	Not Tested	0	39	0	0.0400	12.0000	N/A	N/A	0.4100	0.8200	N/A	N/A	N/A	N/A	N/A
	Hexachlorobenzene	Not Tested	0	39	0	0.0400	12.0000	N/A	N/A	0.4100	0.8200	N/A	N/A	N/A	N/A	N/A
	Hexachlorobutadiene	Not Tested	0	39	0	0.0400	12.0000	N/A	N/A	0.4100	0.8200	N/A	N/A	N/A	N/A	N/A
	Hexachlorocyclopentadiene	Not Tested	0	39	0	0.0400	12.0000	N/A	N/A	0.4100	0.8200	N/A	N/A	N/A	N/A	N/A
	Hexachloroethane	Not Tested	0	39	0	0.0400	12.0000	N/A	N/A	0.4100	0.8200	N/A	N/A	N/A	N/A	N/A
	Indeno(1,2,3-cd)pyrene	Not Tested	0	39	0	0.0400	12.0000	N/A	N/A	0.4100	0.8200	N/A	N/A	N/A	N/A	N/A
	Isophorone	Not Tested	0	39	0	0.0400	12.0000	N/A	N/A	0.4100	0.8200	N/A	N/A	N/A	N/A	N/A
	Naphthalene	Not Tested	1	39	3	0.0400	0.8200	8.1000	8.1000	0.4100	0.8200	0.1970	0.2867	146	0.3619	0.3619
	Nitrobenzene	Not Tested	0	39	0	0.0400	12.0000	N/A	N/A	0.4100	0.8200	N/A	N/A	N/A	N/A	N/A
	Pentachlorophenol	Not Tested	0	39	0	0.1000	29.0000	N/A	N/A	1.0000	2.0000	N/A	N/A	N/A	N/A	N/A
	Perylene	Not Tested	0	2	0	0.0400	0.0410	N/A	N/A	0.0405	0.0410	N/A	N/A	N/A	N/A	N/A
	Phenanthrene	Not Tested	1	39	3	0.0410	12.0000	0.0070	0.0070	0.4100	0.8200	0.4130	0.2412	58	0.5981	0.0070
	Phenol	Not Tested	7	39	18	0.0400	12.0000	0.2100	1.2000	0.4100	1.2000	1.0078	3.4890	346	2.1179	1.2000
	Pyrene	Not Tested	2	39	5	0.0410	12.0000	0.0070	0.2200	0.4100	0.8200	205.9273	149.7225	73	254.4880	0.2200

APPENDIX F

SUMMARY OF DESCRIPTIVE STATISTICS FOR SITE 22 SOIL (0 TO 10 FEET BELOW GROUND SURFACE)
SITE 22
NAVAL WEAPONS STATION SBD CONCORD

Analyte Group	Chemical	Distribution[a]	SUMMARY STATISTICS													Exposure Point Concentration (EPC)[e]
			Sample Size		Detection Frequency (Percent)	Censored Data		Detected Data		Detected and Censored Data						
			Detected	Total		Min	Max	Min	Max	Median[b]	Q95[b]	Mean[c]	SD[c]	CV	UCL_{95}[d]	
SVOA (Continued)	bis(2-chloroethoxy)methane	Not Tested	0	39	0	0.0400	12.0000	N/A	N/A	0.4100	0.8200	N/A	N/A	N/A	N/A	N/A
	bis(2-chloroethyl)ether	Not Tested	0	39	0	0.0400	12.0000	N/A	N/A	0.4100	0.8200	N/A	N/A	N/A	N/A	N/A
	bis(2-ethylhexyl)phthalate	Not Tested	0	39	0	0.0420	12.0000	N/A	N/A	0.4100	1.1000	N/A	N/A	N/A	N/A	N/A
	di-n-Butylphthalate	Not Tested	0	39	0	0.0400	12.0000	N/A	N/A	0.4100	0.8200	N/A	N/A	N/A	N/A	N/A
	di-n-Octylphthalate	Not Tested	0	39	0	0.0400	12.0000	N/A	N/A	0.4100	0.8200	N/A	N/A	N/A	N/A	N/A
	n-Nitroso-di-n-propylamine	Not Tested	0	39	0	0.0400	12.0000	N/A	N/A	0.4100	0.8200	N/A	N/A	N/A	N/A	N/A
	n-Nitrosodiphenylamine (1)	Not Tested	0	39	0	0.0400	12.0000	N/A	N/A	0.4100	0.8200	N/A	N/A	N/A	N/A	N/A
Volatile Organic Analytes (VOA)	1,1,1-Trichloroethane	Not Tested	0	44	0	0.0100	1.5000	N/A	N/A	0.0120	0.0460	N/A	N/A	N/A	N/A	N/A
	1,1,2,2-Tetrachloroethane	Not Tested	0	44	0	0.0100	1.5000	N/A	N/A	0.0120	0.0460	N/A	N/A	N/A	N/A	N/A
	1,1,2-Trichloroethane	Not Tested	0	44	0	0.0100	1.5000	N/A	N/A	0.0120	0.0460	N/A	N/A	N/A	N/A	N/A
	1,1-Dichlorethane	Not Tested	0	44	0	0.0100	1.5000	N/A	N/A	0.0120	0.0460	N/A	N/A	N/A	N/A	N/A
	1,1-Dichlorethene	Not Tested	0	44	0	0.0100	1.5000	N/A	N/A	0.0120	0.0460	N/A	N/A	N/A	N/A	N/A
	1,2-Dichloroethane	Not Tested	0	44	0	0.0100	1.5000	N/A	N/A	0.0120	0.0460	N/A	N/A	N/A	N/A	N/A
	1,2-Dichloroethene (Total)	Not Tested	0	44	0	0.0100	1.5000	N/A	N/A	0.0120	0.0460	N/A	N/A	N/A	N/A	N/A
	1,2-Dichloropropane	Not Tested	0	44	0	0.0100	1.5000	N/A	N/A	0.0120	0.0460	N/A	N/A	N/A	N/A	N/A
	2-Butanone	Not Tested	0	44	0	0.0100	1.5000	N/A	N/A	0.0120	0.0460	N/A	N/A	N/A	N/A	N/A
	2-Hexanone	Not Tested	0	44	0	0.0100	1.5000	N/A	N/A	0.0120	0.0460	N/A	N/A	N/A	N/A	N/A
	4-Methyl-2-pentanone	Not Tested	0	44	0	0.0100	1.5000	N/A	N/A	0.0120	0.0460	N/A	N/A	N/A	N/A	N/A
	Acetone	Not Tested	0	44	0	0.0100	1.5000	N/A	N/A	0.0125	0.1140	N/A	N/A	N/A	N/A	N/A
	Benzene	Not Tested	0	44	0	0.0100	1.5000	N/A	N/A	0.0120	0.0460	N/A	N/A	N/A	N/A	N/A
	Bromodichloromethane	Not Tested	0	44	0	0.0100	1.5000	N/A	N/A	0.0120	0.0460	N/A	N/A	N/A	N/A	N/A
	Bromoform	Not Tested	0	44	0	0.0100	1.5000	N/A	N/A	0.0120	0.0460	N/A	N/A	N/A	N/A	N/A
	Bromomethane	Not Tested	0	44	0	0.0100	1.5000	N/A	N/A	0.0120	0.0460	N/A	N/A	N/A	N/A	N/A
	Carbon disulfide	Not Tested	0	44	0	0.0100	1.5000	N/A	N/A	0.0120	0.0460	N/A	N/A	N/A	N/A	N/A
	Carbon tetrachloride	Not Tested	0	44	0	0.0100	1.5000	N/A	N/A	0.0120	0.0460	N/A	N/A	N/A	N/A	N/A
	Chlorobenzene	Not Tested	0	44	0	0.0100	1.5000	N/A	N/A	0.0120	0.0460	N/A	N/A	N/A	N/A	N/A
	Chloroethane	Not Tested	0	44	0	0.0100	1.5000	N/A	N/A	0.0120	0.0460	N/A	N/A	N/A	N/A	N/A
	Chloroform	Not Tested	0	44	0	0.0100	1.5000	N/A	N/A	0.0120	0.0460	N/A	N/A	N/A	N/A	N/A
	Chloromethane	Not Tested	1	44	2	0.0100	1.5000	0.0020	0.0020	0.0120	0.0460	809.7569	5,274.5290	651	2,148.2130	0.0020
	Dibromochloromethane	Not Tested	0	44	0	0.0100	1.5000	N/A	N/A	0.0120	0.0460	N/A	N/A	N/A	N/A	N/A
	Ethylbenzene	Not Tested	0	44	0	0.0100	1.5000	N/A	N/A	0.0120	0.0460	N/A	N/A	N/A	N/A	N/A
	Methylene chloride	Not Tested	0	44	0	0.0100	1.5000	N/A	N/A	0.0120	0.0535	N/A	N/A	N/A	N/A	N/A
	Styrene	Not Tested	0	44	0	0.0100	1.5000	N/A	N/A	0.0120	0.0460	N/A	N/A	N/A	N/A	N/A
	Tetrachloroethene	Not Tested	0	44	0	0.0100	1.5000	N/A	N/A	0.0120	0.0460	N/A	N/A	N/A	N/A	N/A
	Toluene	Not Tested	0	44	0	0.0100	1.5000	N/A	N/A	0.0120	0.0460	N/A	N/A	N/A	N/A	N/A
	Trichloroethene	Not Tested	0	44	0	0.0100	1.5000	N/A	N/A	0.0120	0.0460	N/A	N/A	N/A	N/A	N/A
	Vinyl chloride	Not Tested	0	44	0	0.0100	1.5000	N/A	N/A	0.0120	0.0460	N/A	N/A	N/A	N/A	N/A
	Xylene (Total)	Not Tested	1	44	2	0.0100	0.0570	11.0000	11.0000	0.0120	0.0460	162.4095	712.2179	439	364.1489	11.0000
	cis-1,3-Dichloropropene	Not Tested	0	44	0	0.0100	1.5000	N/A	N/A	0.0120	0.0460	N/A	N/A	N/A	N/A	N/A
	trans-1,3-Dichloropropene	Not Tested	0	44	0	0.0100	1.5000	N/A	N/A	0.0120	0.0460	N/A	N/A	N/A	N/A	N/A
Organotins	Dibutyltin	Not Tested	0	9	0	0.0010	0.0030	N/A	N/A	0.0010	0.0030	N/A	N/A	N/A	N/A	N/A
	Monobutyltin	Not Tested	0	8	0	0.0010	0.0030	N/A	N/A	0.0010	0.0030	N/A	N/A	N/A	N/A	N/A
	Tetrabutyltin	Not Tested	0	9	0	0.0010	0.0030	N/A	N/A	0.0010	0.0030	N/A	N/A	N/A	N/A	N/A
	Tributyltin	Not Tested	0	9	0	0.0010	0.0030	N/A	N/A	0.0010	0.0030	N/A	N/A	N/A	N/A	N/A
TPH (Extractable)	Diesel Range	Not Tested	4	44	9	2.74	30.00	9.23	35,000.00	12.00	285.00	0.02	0.11	482	0.10	0.10
	Motor Oil Range	Unknown[b]	20	36	56	11.00	13.00	6.30	4,300.00	13.50	857.50	0.26	1.66	647	1.35	1.35
TPH (Purgable)	Gasoline Range	Not Tested	0	8	0	0.05	0.06	N/A	N/A	0.06	0.06	N/A	N/A	N/A	N/A	N/A

APPENDIX F

SUMMARY OF DESCRIPTIVE STATISTICS FOR SITE 22 SOIL (0 TO 10 FEET BELOW GROUND SURFACE)
SITE 22
NAVAL WEAPONS STATION SBD CONCORD

Notes: All concentration units are mg/kg.
For samples with less than 15 percent censored data, one half the reporting limit is substituted for each non-detect measurement in all calculations.
For higher frequencies of censored data, all calculations were performed using stochastic modeling, following the "bounding" approach presented in EPA (2002), as described below under notes c and d.

a	For all cases with at least 5 detected samples and a detection frequency greater than or equal to 50 percent, tested using the Shapiro-Wilk W test (alpha equal to 0.05). Distributions confirmed as normal or lognormal are listed as "Normal" or "Lognormal." For cases where distribution testing was not conducted, the distribution is listed as "Not Tested." For cases in which distributions could not be confirmed using the Shipiro-Wilk W test, distributions were estimated using probability plots, box plots, and frequency histograms. Distributions estimated to be normal or lognormal are listed as Unknown[a] or Unknown[b], respectively.
b	Estimated for all samples using a nonparametric approach, based on rank ordering of the data (reported values used for all censored data).
c	For all samples with at least one detection, calculated using distribution-dependent formulae. For confirmed or estimated normal distributions with fewer than 15 percent censored data, calculated using equations 4.3 (mean) and 4.4 (standard deviation) in Gilbert (1987). For confirmed or estimated lognormal distributions with fewer than 15 percent censored data, these are the minimum variance unbiased (MVU) estimators, following equations 13.3 (mean) and 13.5 (standard deviation) in Gilbert (1987). All other calculations use the median values generated from 2,000 iterations of a Monte Carlo model, following the "bounding" approach described in EPA (2002) [see conceptual model in Figure X-X and text in methods section for more details]. All calculations of the mean and standard deviation for samples with greater than 15 percent censored data use normal model equations.
d	For confirmed or estimated normal distributions with fewer than 15 percent censored data, calculated using equation 11.6 in Gilbert (1987). For confirmed or estimated lognormal distributions with fewer than 15 percent censored data, calculated using Land's method (EPA 1992, Gilbert 1987). Calculations for all cases with greater than 15 percent censored data use the maximum value generated from 2,000 iterations of a Monte Carlo model, following the "bounding" approach descrubed in EPA (2002) [see conceptual model in Figure X-X and text in methods section for more details]. Calculations are based on either normal or lognormal (nonparametric Chebyshev inequality) model equations.
e	The lesser of the UCL95 and the maximum detected concentration. The maximum detected concentration is used for all samples with fewer than three measurements.
EPC	Exposure point concentration
CV	Coefficient of variation ([SD/mean]*100)
Min	Minimum concentration reported
Max	Maximum concentration reported
N/A	Not applicable
Q95	95th percentile (quantile)
SD	Standard deviation
TPH	Total petroleum hydrocarbons
UCL_{95}	The one-sided 95 percent upper confidence limit of the mean
Unknown[a]	Distribution assumed to be normal based on examination of probability plots and outlier box plots
Unknown[b]	Distribution assumed to be lognormal based on examination of probability plots and outlier box plots

References

Gilbert, R. O. 1987. *Statistical Methods for Environmental Pollution Monitoring* . John Wiley & Sons, Inc., New York, NY

U.S. Environmental Protection Agency (EPA). 1992. "Supplemental Guidance to RAGS: Calculating the Concentration Term". Intermittent Bulletin, Volume 1, Number 1. Publication 9285.7-081.

EPA. 2002. "Calculating Exposure Point Concentrations at Hazardous Waste Sites." Draft. OSWER 9285.6-10. Washington, D.C. July 2002.

APPENDIX F

SUMMARY OF DESCRIPTIVE STATISTICS FOR GROUNDWATER
SITE 22
NAVAL WEAPONS STATION SBD CONCORD

Analyte Group	Chemical	Distribution[a]	SUMMARY STATISTICS: Sample Size: Detected	Sample Size: Total	Detection Frequency (Percent)	Censored Data: Min	Censored Data: Max	Detected Data: Min	Detected Data: Max	Detected and Censored Data: Median[b]	Q95[b]	Mean[c]	SD[c]	CV	UCL_{95}[d]	Exposure Point Concentration (EPC)[e]
Semivolatile Organic Analytes (SVOA)	1,2,4-Trichlorobenzene	Not Tested	0	19	0	10.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	1,2-Dichlorobenzene	Not Tested	0	19	0	5.0000	10.0000	N/A	N/A	5.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	1,3-Dichlorobenzene	Not Tested	0	19	0	5.0000	10.0000	N/A	N/A	5.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	1,4-Dichlorobenzene	Not Tested	0	19	0	5.0000	10.0000	N/A	N/A	5.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	2,2'-Oxybis(1-chloropropane)	Not Tested	0	19	0	10.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	2,4,5-Trichlorophenol	Not Tested	0	19	0	25.0000	26.0000	N/A	N/A	25.0000	26.0000	N/A	N/A	N/A	N/A	N/A
	2,4,6-Trichlorophenol	Not Tested	0	19	0	10.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	2,4-Dichlorophenol	Not Tested	0	19	0	10.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	2,4-Dimethylphenol	Not Tested	0	19	0	10.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	2,4-Dinitrophenol	Not Tested	0	19	0	25.0000	26.0000	N/A	N/A	25.0000	26.0000	N/A	N/A	N/A	N/A	N/A
	2,4-Dinitrotoluene	Not Tested	0	19	0	10.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	2,6-Dinitrotoluene	Not Tested	0	19	0	10.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	2-Chloronaphthalene	Not Tested	0	19	0	10.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	2-Chlorophenol	Not Tested	0	19	0	10.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	2-Methlyphenol	Not Tested	0	19	0	10.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	2-Methylnaphthalene	Not Tested	0	19	0	10.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	2-Nitroaniline	Not Tested	0	19	0	25.0000	26.0000	N/A	N/A	25.0000	26.0000	N/A	N/A	N/A	N/A	N/A
	2-Nitrophenol	Not Tested	0	19	0	10.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	3,3'-Dichlorobenzidine	Not Tested	0	19	0	10.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	3-Nitroaniline	Not Tested	0	19	0	25.0000	26.0000	N/A	N/A	25.0000	26.0000	N/A	N/A	N/A	N/A	N/A
	4,6-Dinitro-2-methylphenol	Not Tested	0	19	0	25.0000	26.0000	N/A	N/A	25.0000	26.0000	N/A	N/A	N/A	N/A	N/A
	4-Bromophenyl-phenylether	Not Tested	0	19	0	10.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	4-Chloro-3-methylphenol	Not Tested	0	19	0	10.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	4-Chloroaniline	Not Tested	0	19	0	10.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	4-Chlorophenyl-phenylether	Not Tested	0	19	0	10.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	4-Methlyphenol	Not Tested	0	19	0	10.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	4-Nitroaniline	Not Tested	0	19	0	25.0000	26.0000	N/A	N/A	25.0000	26.0000	N/A	N/A	N/A	N/A	N/A
	4-Nitrophenol	Not Tested	0	19	0	25.0000	26.0000	N/A	N/A	25.0000	26.0000	N/A	N/A	N/A	N/A	N/A
	Acenaphthene	Not Tested	0	19	0	10.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	Acenaphthylene	Not Tested	0	19	0	10.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	Anthracene	Not Tested	0	19	0	10.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	Benzo(a)anthracene	Not Tested	0	19	0	10.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	Benzo(a)pyrene	Not Tested	0	19	0	10.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	Benzo(b)fluoranthene	Not Tested	0	19	0	10.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	Benzo(g,h,i)perylene	Not Tested	0	19	0	10.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	Benzo(k)fluoranthene	Not Tested	0	19	0	10.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	Butylbenzylphthalate	Not Tested	0	19	0	10.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	Carbazole	Not Tested	0	19	0	10.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	Chrysene	Not Tested	0	19	0	10.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	Dibenz(a,h)anthracene	Not Tested	0	19	0	10.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	Dibenzofuran	Not Tested	0	19	0	10.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	Diethylphthalate	Not Tested	0	19	0	10.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	Dimethylphthalate	Not Tested	0	19	0	10.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	Fluoranthene	Not Tested	0	19	0	10.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	Fluorene	Not Tested	0	19	0	10.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	Hexachlorobenzene	Not Tested	0	19	0	10.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	Hexachlorobutadiene	Not Tested	0	19	0	10.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	Hexachlorocyclopentadiene	Not Tested	0	15	0	10.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	Hexachloroethane	Not Tested	0	19	0	10.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A

SUMMARY OF DESCRIPTIVE STATISTICS FOR GROUNDWATER
SITE 22
NAVAL WEAPONS STATION SBD CONCORD

Analyte Group	Chemical	Distribution[a]	SUMMARY STATISTICS: Sample Size		Detection Frequency (Percent)	Censored Data		Detected Data		Detected and Censored Data						Exposure Point Concentration (EPC)[e]
			Detected	Total		Min	Max	Min	Max	Median[b]	Q95[b]	Mean[c]	SD[c]	CV	UCL_{95}[d]	
SVOA (Continued)	Indeno(1,2,3-cd)pyrene	Not Tested	0	19	0	10.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	Isophorone	Not Tested	0	19	0	10.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	Naphthalene	Not Tested	0	19	0	10.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	Nitrobenzene	Not Tested	0	19	0	10.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	Pentachlorophenol	Not Tested	0	19	0	25.0000	26.0000	N/A	N/A	25.0000	26.0000	N/A	N/A	N/A	N/A	N/A
	Phenanthrene	Not Tested	0	19	0	10.0000	25.0000	N/A	N/A	10.0000	25.0000	N/A	N/A	N/A	N/A	N/A
	Phenol	Not Tested	0	19	0	10.0000	25.0000	N/A	N/A	10.0000	25.0000	N/A	N/A	N/A	N/A	N/A
	Pyrene	Not Tested	0	19	0	10.0000	25.0000	N/A	N/A	10.0000	25.0000	N/A	N/A	N/A	N/A	N/A
	bis(2-chloroethoxy)methane	Not Tested	0	19	0	10.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	bis(2-chloroethyl)ether	Not Tested	0	19	0	10.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	bis(2-ethylhexyl)phthalate	Not Tested	2	19	11	4.0000	41.0000	24.0000	32.0000	9.0000	41.0000	7.3457	8.8861	121	13.8153	13.8153
	di-n-Butylphthalate	Not Tested	0	19	0	10.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	di-n-Octylphthalate	Not Tested	0	19	0	10.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	n-Nitroso-di-n-propylamine	Not Tested	0	19	0	10.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	n-Nitrosodiphenylamine (1)	Not Tested	0	19	0	10.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
Volatile Organic Analytes (VOA)	1,1,1-Trichloroethane	Not Tested	3	19	16	1.0000	10.0000	1.0000	2.0000	10.0000	10.0000	3.7111	3.0981	83	6.8132	2.0000
	1,1,2,2-Tetrachloroethane	Not Tested	0	19	0	1.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	1,1,2-Trichloroethane	Not Tested	0	19	0	1.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	1,1-Dichlorethane	Not Tested	0	19	0	1.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	1,1-Dichlorethene	Not Tested	0	19	0	1.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	1,2-Dichloroethane	Not Tested	0	19	0	0.5000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	1,2-Dichloroethene (Total)	Not Tested	0	19	0	1.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	1,2-Dichloropropane	Not Tested	0	19	0	1.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	2-Butanone	Not Tested	0	19	0	5.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	2-Hexanone	Not Tested	0	19	0	5.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	4-Methyl-2-pentanone	Not Tested	0	19	0	5.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	Acetone	Not Tested	0	19	0	5.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	Benzene	Not Tested	0	19	0	0.5000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	Bromodichloromethane	Not Tested	0	19	0	1.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	Bromoform	Not Tested	0	19	0	1.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	Bromomethane	Not Tested	0	19	0	1.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	Carbon disulfide	Not Tested	0	19	0	1.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	Carbon tetrachloride	Not Tested	0	19	0	0.5000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	Chlorobenzene	Not Tested	0	19	0	1.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	Chloroethane	Not Tested	0	19	0	1.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	Chloroform	Not Tested	0	19	0	1.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	Chloromethane	Not Tested	0	19	0	1.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	Dibromochloromethane	Not Tested	0	19	0	1.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	Ethylbenzene	Not Tested	0	19	0	1.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	Methylene chloride	Not Tested	0	19	0	1.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	Styrene	Not Tested	0	19	0	1.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A

APPENDIX F

SUMMARY OF DESCRIPTIVE STATISTICS FOR GROUNDWATER
SITE 22
NAVAL WEAPONS STATION SBD CONCORD

Analyte Group	Chemical	Distribution[a]	Sample Size: Detected	Sample Size: Total	Detection Frequency (Percent)	Censored Data: Min	Censored Data: Max	Detected Data: Min	Detected Data: Max	Median[b]	Q95[b]	Mean[c]	SD[c]	CV	UCL_{95}[d]	Exposure Point Concentration (EPC)[e]
VOA (Continued)	Tetrachloroethene	Not Tested	0	19	0	1.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	Toluene	Not Tested	0	19	0	1.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	Trichloroethene	Not Tested	3	19	16	1.0000	10.0000	1.0000	27.0000	10.0000	27.0000	5.1342	6.0843	119	9.1735	9.1735
	Vinyl chloride	Not Tested	0	19	0	0.5000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	Xylene (Total)	Not Tested	0	19	0	1.0000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	cis-1,3-Dichloropropene	Not Tested	0	19	0	0.5000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
	trans-1,3-Dichloropropene	Not Tested	0	19	0	0.5000	10.0000	N/A	N/A	10.0000	10.0000	N/A	N/A	N/A	N/A	N/A
TPH (Extractable)	Diesel Range	Not Tested	0	19	0	0.1000	0.1000	N/A	N/A	0.1000	0.1000	N/A	N/A	N/A	N/A	N/A
	Motor Oil Range	Not Tested	3	19	16	0.1000	0.5000	0.3800	0.6300	0.5000	0.6300	0.2455	0.1825	74	0.3951	0.3951

Notes: All concentration units are mg/l, except for SVOA and VOA, which are reported as µg/1.
For samples with less than 15 percent censored data, one half the reporting limit is substituted for each non-detect measurement in all calculations.
For higher frequencies of censored data, all calculations were performed using stochastic modeling, following the "bounding" approach presented in EPA (2002), as described below under notes c and d.

a For all cases with at least 5 detected samples and a detection frequency greater than or equal to 50 percent, tested using the Shapiro-Wilk W test (alpha equal to 0.05).
Distributions confirmed as normal or lognormal are listed as "Normal" or "Lognormal." For cases where distribution testing was not conducted, the distribution is listed as "Not Tested."
For cases in which distributions could not be confirmed using the Shipiro-Wilk W test, distributions were estimated using probability plots, box plots, and frequency histograms.
Distributions estimated to be normal or lognormal are listed as Unknown[a] or Unknown[b], respectively.

b Estimated for all samples using a nonparametric approach, based on rank ordering of the data (reported values used for all censored data).

c For all samples with at least one detection, calculated using distribution-dependent formulae.
For confirmed or estimated normal distributions with fewer than 15 percent censored data, calculated using equations 4.3 (mean) and 4.4 (standard deviation) in Gilbert (1987).
For confirmed or estimated lognormal distributions with fewer than 15 percent censored data, these are the minimum variance unbiased estimators, following equations 13.3 (mean) and 13.5 (standard deviation) in Gilbert (1987).
All other calculations use the median values generated from 2,000 iterations of a Monte Carlo model, following the "bounding" approach described in EPA (2002) [see conceptual model in Figure 4-2 and text in methods section for more details]. All calculations of the mean and standard deviation for samples with greater than 15 percent censored data use normal model equations.

d For confirmed or estimated normal distributions with fewer than 15 percent censored data, calculated using equation 11.6 in Gilbert (1987).
For confirmed or estimated lognormal distributions with fewer than 15 percent censored data, calculated using Land's method (EPA 1992, Gilbert 1987).
Calculations for all cases with greater than 15 percent censored data use the maximum value generated from 2,000 iterations of a Monte Carlo model, following the "bounding" approach descrubed in EPA (2002) [see conceptual model in Figure X-X and text in methods section for more details]. Calculations are based on either normal or lognormal (nonparametric Chebyshev inequality) model equations.

e The lesser of the UCL95 and the maximum detected concentration. The maximum detected concentration is used for all samples with fewer than three measurements.

EPC Exposure point concentration
CV Coefficient of variation ([SD/mean]*100)
Min Minimum concentration reported
Max Maximum concentration reported
N/A Not applicable
Q95 95th percentile (quantile)
SD Standard deviation
TPH Total petroleum hydrocarbons
UCL_{95} The one-sided 95 percent upper confidence limit of the mean
Unknown[a] Distribution assumed to be normal based on examination of probability plots and outlier box plots
Unknown[b] Distribution assumed to be lognormal based on examination of probability plots and outlier box plots

References

Gilbert, R. O. 1987. *Statistical Methods for Environmental Pollution Monitoring* . John Wiley & Sons, Inc., New York, NY.

U.S. Environmental Protection Agency (EPA). 1992. "Supplemental Guidance to RAGS: Calculating the Concentration Term". Intermittent Bulletin, Volume 1, Number 1. Publication 9285.7-081.
EPA. 2002. "Calculating Exposure Point Concentrations at Hazardous Waste Sites." Draft. OSWER 9285.6-10. Washington, D.C. July 2002.

APPENDIX F

SUMMARY OF DESCRIPTIVE STATISTICS FOR SITE 22 SOIL AT BUILDING 7SH5 LOCATIONS
NAVAL WEAPONS STATION SBD CONCORD

Depth (ft bgs)	Distribution[a]	SUMMARY STATISTICS													Exposure Point Concentration (EPC)[e]
		Sample Size		Detection Frequency (Percent)	Censored Data		Detected Data		Detected and Censored Data						
		Detected	Total		Min	Max	Min	Max	Median[b]	Q95[b]	Mean[c]	SD[c]	CV	UCL_{95}[d]	
0-0.50	Not Tested	2	2	100	N/A	N/A	5.10	26.00	15.55	26.00	N/A	N/A	N/A	N/A	26.00
0-3	Normal	11	11	100	N/A	N/A	5.10	26.00	13.60	26.00	13.92	6.85	49.24	17.66	17.66
0-10	Lognormal	23	23	100	N/A	N/A	3.30	31.90	8.70	30.72	11.12	1.41	12.67	14.42	14.42

Notes:

All concentration units are mg/kg.

a For all cases with at least 5 detected samples and a detection frequency greater than or equal to 50 percent, tested using the Shapiro-Wilk W test (alpha equal to 0.05). Distributions confirmed as normal or lognormal are listed as "Normal" or "Lognormal." For cases where distribution testing was not conducted, the distribution is listed as "Not Tested." For cases in which distributions could not be confirmed using the Shipiro-Wilk W test, distributions were estimated using probability plots, box plots, and frequency histograms. Distributions estimated to be normal or lognormal are listed as Unknown[a] or Unknown[b], respectively

b Estimated for all samples using a nonparametric approach, based on rank ordering of the data (reported values used for all censored data).

c For sample sizes of 3 or greater with at least one detection, calculated using distribution-dependent formulae. For confirmed or estimated normal distributions with fewer than 15 percent censored data, calculated using equations 4.3 (mean) and 4.4 (standard deviation) in Gilbert (1987). For confirmed or estimated lognormal distributions with fewer than 15 percent censored data, these are the minimum variance unbiased (MVU) estimators, following equations 13.3 (mean) and 13.5 (standard deviation) in Gilbert (1987).

d For confirmed or estimated normal distributions with fewer than 15 percent censored data, calculated using equation 11.6 in Gilbert (1987) For confirmed or estimated lognormal distributions with fewer than 15 percent censored data, calculated using Land's method (EPA 1992, Gilbert 1987).

e The lesser of the UCL95 and the maximum detected concentration. The maximum detected concentration is used for all samples with fewer than three measurements.

EPC Exposure point concentration
CV Coefficient of variation ([SD/mean]*100)
Min Minimum concentration reported
Max Maximum concentration reported
N/A Not applicable
Q95 95th percentile (quantile)
SD Standard deviation
TPH Total petroleum hydrocarbons
UCL_{95} The one-sided 95 percent upper confidence limit of the mean

Point IDs for Samples around Building 7SH5: 7SHSB103, 7SHSB104, 7SHSB111, 7SHTP001A, 7SHTP001B, 7SHTP001C, 7SHTP001D, 7SHTP001E, 7SHTP001F, S52-01, S52-02

References

Gilbert, R. O. 1987. *Statistical Methods for Environmental Pollution Monitoring* . John Wiley & Sons, Inc., New York, NY

U.S. Environmental Protection Agency (EPA). 1992. "Supplemental Guidance to RAGS: Calculating the Concentration Term". Intermittent Bulletin, Volume 1, Number 1. Publication 9285.7-081.

EPA. 2002. "Calculating Exposure Point Concentrations at Hazardous Waste Sites." Draft. OSWER 9285.6-10. Washington, D.C. July 2002.

APPENDIX G

HUMAN HEALTH RISK ASSESSMENT TOXICITY PROFILE FOR ARSENIC

APPENDIX G

HUMAN HEALTH RISK ASSESSMENT TOXICITY PROFILE FOR ARSENIC

Arsenic is a naturally occurring element widely distributed in the earth's crust. In the environment, arsenic is combined with oxygen, chlorine, and sulfur to form inorganic arsenic compounds. Arsenic in animals and plants combines with carbon and hydrogen to form organic arsenic compounds. Inorganic arsenic compounds are mainly used to preserve wood. Organic arsenic compounds are used as pesticides, primarily on cotton plants. Arsenic cannot be destroyed in the environment. It can only change its form. Arsenic in air will settle to the ground or is washed out of the air by rain. Many arsenic compounds can dissolve in water. Fish and shellfish can accumulate arsenic, but the arsenic in fish is mostly in a form that is not harmful. The toxicity of inorganic arsenic depends on its valence state and also on the physical and chemical properties of the compound in which it occurs.

Water soluble inorganic arsenic compounds are absorbed through the gastrointestinal tract and lungs; distributed primarily to the liver, kidney, lung, spleen, aorta, and skin; and excreted mainly in the urine at rates as high as 80 percent. Symptoms of acute inorganic arsenic poisoning in humans are nausea, anorexia, vomiting, epigastric and abdominal pain, and diarrhea. Dermatitis (exfoliative erythroderma), muscle cramps, cardiac abnormalities, hepatotoxicity, bone marrow suppression and hematologic abnormalities (anemia), vascular lesions, and peripheral neuropathy (motor dysfunction, paresthesia) have also been reported. Oral doses as low as 20 to 60 grams per kilogram per day (g/kg/day) have been reported to cause toxic effects in some individuals. Severe exposures can result in acute encephalopathy, congestive heart failure, stupor, convulsions, paralysis, coma, and death. The acute lethal dose to humans has been estimated to be about 0.6 milligrams per kilogram per day (mg/kg/day).

General symptoms of chronic arsenic poisoning in humans are weakness, general debility and lassitude, loss of appetite and energy, loss of hair, hoarseness of voice, loss of weight, and mental disorders. Primary target organs are the skin (hyperpigmentation and hyperkeratosis), nervous system (peripheral neuropathy), and vascular system. Anemia, leukopenia, hepatomegaly, and portal hypertension have also been reported. In addition, possible reproductive effects include a high male to female birth ratio.

Epidemiological studies have revealed an association between arsenic concentrations in drinking water and increased incidences of skin cancers, as well as cancers of the liver, bladder, respiratory and gastrointestinal tracts. Occupational exposure studies have shown a clear correlation between exposure to arsenic and lung cancer mortality. Several studies have shown that inorganic arsenic can increase the risk of lung cancer, skin cancer, bladder cancer, liver cancer, kidney cancer, and prostate cancer. The World Health Organization, the Department of Health and Human Services, and the EPA have determined that inorganic arsenic is a human carcinogen and is classified: A; human carcinogen.

The following is a presentation of the toxicity information associated with arsenic:

Noncarcinogenic Health Effects

- The Oral Chronic Reference Dose is 0.003 mg/kg-day.
- The Oral Chronic Reference Dose has a modifying factor of 1.
- The Oral Chronic Reference Dose has an uncertainty factor of 3.
- The Oral Chronic Reference Dose is based on the Tseng study from 1977 (as described in EPA 2003).
- The Oral Chronic Reference Dose study critical effects are hyperpigmentation, keratosis, and possible vascular complications.
- The overall confidence in the Oral Chronic Reference Dose is medium.

Carcinogenic Health Effects

- The Oral Slope Factor is 1.5 per mg/kg-day.
- The Oral Slope Factor study target organ is skin.
- The Oral Slope Factor study cancer type is skin cancer.
- The Oral Slope Factor is based on the EPA study from 1988 (as described in EPA 2003).
- The Inhalation Unit Risk is 4.3 per mg/m^3.
- The Inhalation Risk study target organ is lung.
- The Inhalation Unit Risk study cancer type of lung cancer.
- The Inhalation Unit Risk is based on the Brown and Chu study from 1983 (as described in EPA 2003).

REFERENCES

U.S. Environmental Protection Agency (EPA). EPA. 2003. Integrated Risk Information System. Online address: http://www.epa.gov/iris/index.html.

APPENDIX H

FOOD CHAIN MODELING CALCULATIONS FOR RISK TO BIRDS AND MAMMALS

APPENDIX H

RED-TAILED HAWK DOSE CALCULATIONS AND HAZARD QUOTIENTS
SITE 22
NAVAL WEAPONS STATION SBD CONCORD

Chemical	Total Ingestion Rate[1] (kg/day)	Soil Ingestion Rate[2] (kg/day)	Soil Concentration[3] (mg/kg)	Soil Daily Dose[4] (mg/day)	Prey Ingestion Rate[5] (kg/day)	Soil to Mouse BAF[6] (unitless)	Prey Concentration wet weight[7] (mg/kg)	Prey Concentration dry weight[8] (mg/kg)	Prey Daily Dose[9] (mg/day)	SUF	Body Weight[10] (kg)	Total Daily Dose[11] (mg/kg/day)	TRV[12] (mg/kg/day)	Test Species Body Weight[12] (kg)	Allometrically Adjusted TRV[13] (mg/kg/day)	HQ[14] (based on adjusted TRV)	Source of TRV
Arsenic																	
Dose/High TRV	0.08	5.63E-04	210.00	0.12	0.08	2.88E-06	6.05E-04	1.89E-03	1.51E-04	1.00	0.96	0.12	22.01	1.17	21.13	0.01	EFA West 1998
Dose/Low TRV	0.08	5.63E-04	210.00	0.12	0.08	2.88E-06	6.05E-04	1.89E-03	1.51E-04	1.00	0.96	0.12	5.50	1.17	5.28	0.02	EFA West 1998
Beryllium																	
Dose/High TRV	0.08	5.63E-04	0.70	3.94E-04	0.08	1.44E-06	1.01E-06	3.15E-06	2.51E-07	1.00	0.96	0.0004	NA	NA	NA	No TRV[15]	No TRV[15]
Dose/Low TRV	0.08	5.63E-04	0.70	3.94E-04	0.08	1.44E-06	1.01E-06	3.15E-06	2.51E-07	1.00	0.96	0.0004	NA	NA	NA	No TRV[15]	No TRV[15]
Copper																	
Dose/High TRV	0.08	5.63E-04	115.00	0.06	0.08	6.50E-06	7.48E-04	2.34E-03	1.86E-04	1.00	0.96	0.07	52.26	0.41	61.95	0.001	EFA West 1998
Dose/Low TRV	0.08	5.63E-04	115.00	0.06	0.08	6.50E-06	7.48E-04	2.34E-03	1.86E-04	1.00	0.96	0.07	2.30	0.64	2.49	0.03	EFA West 1998
Lead																	
Dose/High TRV	0.08	5.63E-04	165.00	0.09	0.08	4.32E-07	7.13E-05	2.23E-04	1.78E-05	1.00	0.96	0.10	8.75	0.80	9.07	0.01	EFA West 1998
Dose/Low TRV	0.08	5.63E-04	165.00	0.09	0.08	4.32E-07	7.13E-05	2.23E-04	1.78E-05	1.00	0.96	0.10	0.01	0.08	0.02	4.26	EFA West 1998
Mercury																	
Dose/High TRV	0.08	5.63E-04	1.10	6.19E-04	0.08	7.52E-06	8.27E-06	2.59E-05	2.06E-06	1.00	0.96	6.49E-04	0.18	1.00	0.18	0.004	EFA West 1998
Dose/Low TRV	0.08	5.63E-04	1.10	6.19E-04	0.08	7.52E-06	8.27E-06	2.59E-05	2.06E-06	1.00	0.96	6.49E-04	0.04	1.00	0.04	0.02	EFA West 1998
Zinc																	
Dose/High TRV	0.08	5.63E-04	1,900.00	1.07	0.08	1.29E-07	2.45E-04	7.66E-04	6.11E-05	1.00	0.96	1.12	172.00	0.96	172.07	0.01	EFA West 1998
Dose/Low TRV	0.08	5.63E-04	1,900.00	1.07	0.08	1.29E-07	2.45E-04	7.66E-04	6.11E-05	1.00	0.96	1.12	17.20	0.96	17.21	0.06	EFA West 1998
Benzo(a)anthracene																	
Dose/High TRV	0.08	5.63E-04	0.00	2.25E-06	0.08	1.72E-05	6.88E-08	2.15E-07	1.72E-08	1.00	0.96	2.37E-06	NA	NA	NA	No TRV[15]	No TRV[15]
Dose/Low TRV	0.08	5.63E-04	0.00	2.25E-06	0.08	1.72E-05	6.88E-08	2.15E-07	1.72E-08	1.00	0.96	2.37E-06	NA	NA	NA	No TRV[15]	No TRV[15]
Benzo(a)pyrene																	
Dose/High TRV	0.08	5.63E-04	0.01	2.81E-06	0.08	4.86E-05	2.43E-07	7.59E-07	6.06E-08	1.00	0.96	3.00E-06	NA	NA	NA	No TRV[15]	No TRV[15]
Dose/Low TRV	0.08	5.63E-04	0.01	2.81E-06	0.08	4.86E-05	2.43E-07	7.59E-07	6.06E-08	1.00	0.96	3.00E-06	NA	NA	NA	No TRV[15]	No TRV[15]
Benzo(b)fluoranthene																	
Dose/High TRV	0.08	5.63E-04	0.02	9.00E-06	0.08	5.75E-05	9.20E-07	2.88E-06	2.30E-07	1.00	0.96	9.65E-06	NA	NA	NA	No TRV[15]	No TRV[15]
Dose/Low TRV	0.08	5.63E-04	0.02	9.00E-06	0.08	5.75E-05	9.20E-07	2.88E-06	2.30E-07	1.00	0.96	9.65E-06	NA	NA	NA	No TRV[15]	No TRV[15]
Benzo(e)pyrene																	
Dose/High TRV	0.08	5.63E-04	0.01	4.50E-06	0.08	4.86E-05	3.89E-07	1.22E-06	9.70E-08	1.00	0.96	4.81E-06	NA	NA	NA	No TRV[15]	No TRV[15]
Dose/Low TRV	0.08	5.63E-04	0.01	4.50E-06	0.08	4.86E-05	3.89E-07	1.22E-06	9.70E-08	1.00	0.96	4.81E-06	NA	NA	NA	No TRV[15]	No TRV[15]
Chrysene																	
Dose/High TRV	0.08	5.63E-04	0.01	5.63E-06	0.08	1.99E-05	1.99E-07	6.22E-07	4.96E-08	1.00	0.96	5.93E-06	NA	NA	NA	No TRV[15]	No TRV[15]
Dose/Low TRV	0.08	5.63E-04	0.01	5.63E-06	0.08	1.99E-05	1.99E-07	6.22E-07	4.96E-08	1.00	0.96	5.93E-06	NA	NA	NA	No TRV[15]	No TRV[15]
Fluoranthene																	
Dose/High TRV	0.08	5.63E-04	0.34	1.91E-04	0.08	4.86E-05	1.65E-05	5.16E-05	4.12E-06	1.00	0.96	2.04E-04	NA	NA	NA	No TRV[15]	No TRV[15]
Dose/Low TRV	0.08	5.63E-04	0.34	1.91E-04	0.08	4.86E-05	1.65E-05	5.16E-05	4.12E-06	1.00	0.96	2.04E-04	NA	NA	NA	No TRV[15]	No TRV[15]
Phenanthrene																	
Dose/High TRV	0.08	5.63E-04	0.01	3.94E-06	0.08	6.00	0.04	0.13	0.01	1.00	0.96	1.10E-02	NA	NA	NA	No TRV[15]	No TRV[15]
Dose/Low TRV	0.08	5.63E-04	0.01	3.94E-06	0.08	6.00	0.04	0.13	0.01	1.00	0.96	1.10E-02	NA	NA	NA	No TRV[15]	No TRV[15]

APPENDIX H

RED-TAILED HAWK DOSE CALCULATIONS AND HAZARD QUOTIENTS
SITE 22
NAVAL WEAPONS STATION SBD CONCORD

Chemical	Total Ingestion Rate[1] (kg/day)	Soil Ingestion Rate[2] (kg/day)	Soil Concentration[3] (mg/kg)	Soil Daily Dose[4] (mg/day)	Prey Ingestion Rate[5] (kg/day)	Soil to Mouse BAF[6] (unitless)	Prey Concentration wet weight[7] (mg/kg)	Prey Concentration dry weight[8] (mg/kg)	Prey Daily Dose[9] (mg/day)	SUF	Body Weight[10] (kg)	Total Daily Dose[11] (mg/kg/day)	TRV[12] (mg/kg/day)	Test Species Body Weight[12] (kg)	Allometrically Adjusted TRV[13] (mg/kg/day)	HQ[14] (based on adjusted TRV)	Source of TRV
Phenol																	
Dose/High TRV	0.08	5.63E-04	0.44	2.48E-04	0.08	4.34E-06	1.91E-06	5.97E-06	4.76E-07	1.00	0.96	2.59E-04	NA	NA	NA	No TRV[15]	No TRV[15]
Dose/Low TRV	0.08	5.63E-04	0.44	2.48E-04	0.08	4.34E-06	1.91E-06	5.97E-06	4.76E-07	1.00	0.96	2.59E-04	NA	NA	NA	No TRV[15]	No TRV[15]
Pyrene																	
Dose/High TRV	0.08	5.63E-04	0.22	1.24E-04	0.08	4.86E-05	1.07E-05	3.34E-05	2.67E-06	1.00	0.96	1.32E-04	NA	NA	NA	No TRV[15]	No TRV[15]
Dose/Low TRV	0.08	5.63E-04	0.22	1.24E-04	0.08	4.86E-05	1.07E-05	3.34E-05	2.67E-06	1.00	0.96	1.32E-04	NA	NA	NA	No TRV[15]	No TRV[15]
2-Methylnaphthalene																	
Dose/High TRV	0.08	5.63E-04	20.00	0.01	0.08	6.00	120.00	375.00	29.94	1.00	0.96	31.30	NA	NA	NA	No TRV[15]	No TRV[15]
Dose/Low TRV	0.08	5.63E-04	20.00	0.01	0.08	6.00	120.00	375.00	29.94	1.00	0.96	31.30	NA	NA	NA	No TRV[15]	No TRV[15]
Naphthalene																	
Dose/High TRV	0.08	5.63E-04	8.10	4.56E-03	0.08	6.00	48.60	151.88	12.13	1.00	0.96	12.67	NA	NA	NA	No TRV[15]	No TRV[15]
Dose/Low TRV	0.08	5.63E-04	8.10	4.56E-03	0.08	6.00	48.60	151.88	12.13	1.00	0.96	12.67	NA	NA	NA	No TRV[15]	No TRV[15]

Notes: Highlighted cells indicate HQs greater than 1.0.

BAF	Bioaccumulation factor	mg/kg	Milligram per kilogram
HQ	Hazard quotient	mg/kg/day	Milligram per kilogram per day
kg	Kilogram	NA	Not available
kg/day	Kilogram per day	SUF	Site use factor
mg/day	Milligram per day	TRV	Toxicity reference value

1 Ingestion rate was calculated with body weight of 957 grams using the Nagy (2001) dry matter intake food requirement equation for carnivorous birds (a= 0.849; b= 0.663).
2 Rate for red-tailed hawk reported in EPA (1999); 0.7 percent of total ingestion rate.
3 The maximum concentration of all site-collected soil samples was used.
4 Soil daily dose was calculated by multiplying the soil ingestion rate (see note 2) by the maximum soil concentration (see note 3).
5 Prey ingestion rate is 99.3 percent of total ingestion rate. The remainder of the diet is incidentally ingested soil (see note 2).
6 Rodent BAF sources are identified in Table 7-1.
7 Prey tissue concentration was calculated by multiplying the soil concentration by the rodent BAF. Concentrations are presented in wet weight.
8 Prey concentrations were converted to dry weight using the formula: dry weight concentration = (wet weight concentration)/(1-percent moisture in media). Average percent moisture for mouse tissue equals 68 percent (EPA 1993).
9 Prey daily dose calculated by multiplying the prey ingestion rate (see note5) by the maximum prey concentration (see note 8).
10 Average weight of adult males throughout the U.S. (Steenhof 1983, as cited in EPA 1993).
11 Total daily dose is calculated using the following equation: total daily dose = ((soil daily dose + prey daily dose)*SUF)/receptor species body weight.
12 The derivation of TRVs is described in EFA WEST (1998) and Sample (1996).
13 Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2)}$.
14 The HQ was calculated using total daily dose/allometrically adjusted TRV.
15 Sufficient data are not available to derive a TRV. This chemical was evaluated qualitatively.

Sources: EPA. 1993. "Wildlife Exposure Factors Handbook; Volumes I and 2." EPA 600/R-93/187a. December.
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APPENDIX H

GREY FOX DOSE CALCULATIONS AND HAZARD QUOTIENTS
SITE 22
NAVAL WEAPONS STATION SBD CONCORD

COPEC	Total Ingestion Rate[1] (kg/day)	Prey Ingestion Rate[2] (mg/kg)	Soil to Mouse BAF[3] (unitless)	Prey Concentration wet weight[4] (mg/kg)	Prey Concentration dry weight[5] (mg/kg)	Prey Daily Dose[6] (mg/day)	Soil Ingestion Rate[7] (kg/day)	Soil Concentration[8] (mg/kg)	Soil Daily Dose[9] (mg/day)	SUF	Receptor Body Weight[10] (kg)	Total Daily Dose[11] (mg/kg/day)	TRV[12] (mg/kg/day)	Test Species Body Weight[12] (kg)	Allometrically Adjusted TRV[13] (mg/kg/day)	HQ[14] (based on adjusted TRV)	Source of TRV
Arsenic																	
Dose/High TRV	0.17	0.16	2.88E-06	6.05E-04	1.89E-03	3.11E-04	4.74E-03	210.00	0.99	1.00	3.88	0.26	4.70	0.11	3.80	0.07	EFA WEST 1998
Dose/Low TRV	0.17	0.16	2.88E-06	6.05E-04	1.89E-03	3.11E-04	4.74E-03	210.00	0.99	1.00	3.88	0.26	0.32	0.33	0.28	0.93	EFA WEST 1998
Beryllium																	
Dose/High TRV	0.17	0.16	1.44E-06	1.01E-06	3.15E-06	5.18E-07	4.74E-03	0.70	3.32E-03	1.00	3.88	8.55E-04	6.60	0.35	5.71	1.50E-04	Calculated[15]
Dose/Low TRV	0.17	0.16	1.44E-06	1.01E-06	3.15E-06	5.18E-07	4.74E-03	0.70	3.32E-03	1.00	3.88	8.55E-04	0.66	0.35	0.57	1.50E-03	Sample 1996
Copper																	
Dose/High TRV	0.17	0.16	6.50E-06	7.48E-04	2.34E-03	3.84E-04	4.74E-03	115.00	0.54	1.00	3.88	0.14	631.58	0.02	466.29	3.01E-04	EFA WEST 1998
Dose/Low TRV	0.17	0.16	6.50E-06	7.48E-04	2.34E-03	3.84E-04	4.74E-03	115.00	0.54	1.00	3.88	0.14	2.67	0.03	1.99	0.07	EFA WEST 1998
Lead																	
Dose/High TRV	0.17	0.16	4.32E-07	7.13E-05	2.23E-04	3.66E-05	4.74E-03	165.00	0.78	1.00	3.88	0.20	240.64	0.02	174.72	1.15E-03	EFA WEST 1998
Dose/Low TRV	0.17	0.16	4.32E-07	7.13E-05	2.23E-04	3.66E-05	4.74E-03	165.00	0.78	1.00	3.88	0.20	0.0015	0.21	1.26E-03	160.06	EFA WEST 1998
Mercury																	
Dose/High TRV	0.17	0.16	7.52E-06	8.27E-06	2.59E-05	4.25E-06	4.74E-03	1.10	0.01	1.00	3.88	1.34E-03	4.00	0.43	3.50	3.83E-04	EFA WEST 1998
Dose/Low TRV	0.17	0.16	7.52E-06	8.27E-06	2.59E-05	4.25E-06	4.74E-03	1.10	0.01	1.00	3.88	1.34E-03	0.25	0.19	0.21	0.01	EFA WEST 1998
Zinc																	
Dose/High TRV	0.17	0.16	1.29E-07	2.45E-04	7.66E-04	1.26E-04	4.74E-03	1900.00	9.00	1.00	3.88	2.32	411.43	0.18	341.62	0.01	EFA WEST 1998
Dose/Low TRV	0.17	0.16	1.29E-07	2.45E-04	7.66E-04	1.26E-04	4.74E-03	1900.00	9.00	1.00	3.88	2.32	9.60	0.03	7.10	0.33	EFA WEST 1998
Benzo(a)anthracene*																	
Dose/High TRV	0.17	0.16	1.72E-05	6.88E-08	2.15E-07	3.54E-08	4.74E-03	4.00E-03	1.89E-05	1.00	3.88	4.89E-06	32.79	0.03	24.52	2.00E-07	EFA WEST 1998
Dose/Low TRV	0.17	0.16	1.72E-05	6.88E-08	2.15E-07	3.54E-08	4.74E-03	4.00E-03	1.89E-05	1.00	3.88	4.89E-06	1.31	0.03	0.98	4.99E-06	EFA WEST 1998
Benzo(a)pyrene																	
Dose/High TRV	0.17	0.16	4.86E-05	2.43E-07	7.59E-07	1.25E-07	4.74E-03	0.01	2.37E-05	1.00	3.88	6.14E-06	32.79	0.03	24.52	2.50E-07	EFA WEST 1998
Dose/Low TRV	0.17	0.16	4.86E-05	2.43E-07	7.59E-07	1.25E-07	4.74E-03	0.01	2.37E-05	1.00	3.88	6.14E-06	1.31	0.03	0.98	6.26E-06	EFA WEST 1998
Benzo(b)fluoranthene*																	
Dose/High TRV	0.17	0.16	5.75E-05	9.20E-07	2.88E-06	4.73E-07	4.74E-03	0.02	7.58E-05	1.00	3.88	1.97E-05	32.79	0.03	24.52	8.02E-07	EFA WEST 1998
Dose/Low TRV	0.17	0.16	5.75E-05	9.20E-07	2.88E-06	4.73E-07	4.74E-03	0.02	7.58E-05	1.00	3.88	1.97E-05	1.31	0.03	0.98	2.01E-05	EFA WEST 1998
Benzo(e)pyrene																	
Dose/High TRV	0.17	0.16	4.86E-05	3.89E-07	1.22E-06	2.00E-07	4.74E-03	0.01	3.79E-05	1.00	3.88	9.82E-06	32.79	0.03	24.52	4.00E-07	EFA WEST 1998
Dose/Low TRV	0.17	0.16	4.86E-05	3.89E-07	1.22E-06	2.00E-07	4.74E-03	0.01	3.79E-05	1.00	3.88	9.82E-06	1.31	0.03	0.98	1.00E-05	EFA WEST 1998
Chrysene*																	
Dose/High TRV	0.17	0.16	1.99E-05	1.99E-07	6.22E-07	1.02E-07	4.74E-03	0.01	4.74E-05	1.00	3.88	1.22E-05	32.79	0.03	24.52	4.99E-07	EFA WEST 1998
Dose/Low TRV	0.17	0.16	1.99E-05	1.99E-07	6.22E-07	1.02E-07	4.74E-03	0.01	4.74E-05	1.00	3.88	1.22E-05	1.31	0.03	0.98	1.25E-05	EFA WEST 1998
Fluoranthene*																	
Dose/High TRV	0.17	0.16	4.86E-05	1.65E-05	5.16E-05	8.49E-06	4.74E-03	0.34	1.61E-03	1.00	3.88	4.17E-04	32.79	0.03	24.52	1.70E-05	EFA WEST 1998
Dose/Low TRV	0.17	0.16	4.86E-05	1.65E-05	5.16E-05	8.49E-06	4.74E-03	0.34	1.61E-03	1.00	3.88	4.17E-04	1.31	0.03	0.98	4.260E-04	EFA WEST 1998
Phenanthrene**																	
Dose/High TRV	0.17	0.16	6.00	4.20E-02	1.31E-01	2.16E-02	4.74E-03	0.01	3.32E-05	1.00	3.88	5.57E-03	150.00	0.27	127.84	4.36E-05	EFA WEST 1998
Dose/Low TRV	0.17	0.16	6.00	4.20E-02	1.31E-01	2.16E-02	4.74E-03	0.01	3.32E-05	1.00	3.88	5.57E-03	50.00	0.28	42.67	1.31E-04	EFA WEST 1998

APPENDIX H

GREY FOX DOSE CALCULATIONS AND HAZARD QUOTIENTS
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COPEC	Total Ingestion Rate[1] (kg/day)	Prey Ingestion Rate[2] (mg/kg)	Soil to Mouse BAF[3] (unitless)	Prey Concentration wet weight[4] (mg/kg)	Prey Concentration dry weight[5] (mg/kg)	Prey Daily Dose[6] (mg/day)	Soil Ingestion Rate[7] (kg/day)	Soil Concentration[8] (mg/kg)	Soil Daily Dose[9] (mg/day)	SUF	Receptor Body Weight[10] (kg)	Total Daily Dose[11] (mg/kg/day)	TRV[12] (mg/kg/day)	Test Species Body Weight[12] (kg)	Allometrically Adjusted TRV[13] (mg/kg/day)	HQ[14] (based on adjusted TRV)	Source of TRV
Phenol***																	
Dose/High TRV	0.17	0.16	4.34E-06	1.91E-06	5.97E-06	9.81E-07	4.74E-03	0.44	2.08E-03	1.00	3.88	5.37E-04	2.40	3.50	2.39	2.25E-04	Sample 1996
Dose/Low TRV	0.17	0.16	4.34E-06	1.91E-06	5.97E-06	9.81E-07	4.74E-03	0.44	2.08E-03	1.00	3.88	5.37E-04	0.24	3.50	0.24	2.25E-03	Sample 1996
Pyrene*																	
Dose/High TRV	0.17	0.16	4.86E-05	1.07E-05	3.34E-05	5.49E-06	4.74E-03	0.22	1.04E-03	1.00	3.88	2.70E-04	32.79	0.03	24.52	1.10E-05	EFA WEST 1998
Dose/Low TRV	0.17	0.16	4.86E-05	1.07E-05	3.34E-05	5.49E-06	4.74E-03	0.22	1.04E-03	1.00	3.88	2.70E-04	1.31	0.03	0.98	2.76E-04	EFA WEST 1998
2-Methylnaphthalene**																	
Dose/High TRV	0.17	0.16	6.00	120.00	375.00	61.66	4.74E-03	20.00	0.09	1.00	3.88	15.92	150.00	0.27	127.84	0.12	EFA WEST 1998
Dose/Low TRV	0.17	0.16	6.00	120.00	375.00	61.66	4.74E-03	20.00	0.09	1.00	3.88	15.92	50.00	0.28	42.67	0.37	EFA WEST 1998
Naphthalene																	
Dose/High TRV	0.17	0.16	6.00	48.60	151.88	24.97	4.74E-03	8.10	0.04	1.00	3.88	6.45	150.00	0.27	127.84	0.05	EFA WEST 1998
Dose/Low TRV	0.17	0.16	6.00	48.60	151.88	24.97	4.74E-03	8.10	0.04	1.00	3.88	6.45	50.00	0.28	42.67	0.15	EFA WEST 1998

Notes: Highlighted cells indicate HQs greater than 1.0.
* TRV based on TRV for Benzo(e)pyrene (EFA West 1998)
** TRV based on TRV for Napthalene (EFA West 1998)
*** TRV based on TRV for Pentacholorphenol (Sample 1996)

BAF	Bioaccumulation factor	mg/kg	Milligram per kilogram
HQ	Hazard quotient	mg/kg/day	Milligram per kilogram per day
kg	Kilogram	NA	Not available
kg/day	Kilogram per day	SUF	Site use factor
mg/day	Milligram per day	TRV	Toxicity reference value

1 Total ingestion rate was calculated with body weight of 3,880 grams using the Nagy (2001) dry matter intake food requirement equation for eutherian mammals (a= 0.299; b= 0.767
2 Prey ingestion rate equals 97.2 percent of the total ingestion rate, based on a soil ingestion rate equal to 2.8 percent of the total ingestion rate.
3 Rodent BAF sources are identified in Table 7-1.
4 Prey tissue concentration was calculated by multiplying the soil concentration by the rodent BAF. Concentrations are presented in wet weight.
5 Prey concentrations were converted to dry weight using the formula: dry weight concentration = (wet weight concentration)/(1-percent moisture in media). Average percent moisture for mouse tissue equals 68 percent (EPA 1993).
6 Prey daily dose was calculated by multiplying prey ingestion rate (see note 2) by the maximum prey concentration (see note 5).
7 Soil ingestion rate equals 2.8 percent of the total ingestion rate; based on red fox data from Beyer and others (1994).
8 The maximum concentration of all site-collected soil samples was used.
9 Soil daily dose was calculated by multiplying the soil ingestion rate by the maximum soil concentration.
10 Average of male and female gray fox body weights from Silva and Downing (1995).
11 Total daily dose is calculated using the following equation: total daily dose = ((soil daily dose + prey daily dose)*SUF)/receptor species body weight.
12 The derivation of TRVs is described in EFA WEST (1998) and Sample (1996).
13 Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-0.94)}$.
14 The HQ was calculated using total daily dose/allometrically adjusted TRV.
15 "Calculated" indicates that a high TRV was not available in EFA WEST (1998) or Sample (1996); in those cases, an uncertainty factor of 10 was applied to the low TRV to derive a high TRV.

Sources: Beyer and others. 1994. "Estimates of Soil Ingestion by Wildlife." *Journal of Wildlife Management*. Volume 58. Number 2. Pages 375 through 382.
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APPENDIX H

WESTERN HARVEST MOUSE DOSE CALCULATIONS AND HAZARD QUOTIENTS
SITE 22
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Chemical	Total Ingestion Rate[1] (kg/day)	Plant Ingestion Rate[2] (mg/kg)	Plant BAF[3] (unitless)	Plant Concentration[4] (mg/kg dry weight)	Plant Daily Dose[5] (mg/day)	Soil Ingestion Rate[6] (kg/day)	Soil Concentration[7] (mg/kg)	Soil Daily Dose[8] (mg/day)	SUF	Receptor Body Weight[9] (kg)	Total Daily Dose[10] (mg/kg/day)	TRV[11] (mg/kg/day)	Test Species Body Weight[11] (kg)	Allometrically Adjusted TRV[12] (mg/kg/day)	HQ[13] (based on adjusted TRV)	Source of TRV
Arsenic																
Dose/High TRV	2.40E-03	2.35E-03	0.04	7.56	0.02	4.80E-05	210.00	0.01	1.00	0.01	2.14	4.70	0.11	5.34	0.40	EFA WEST 1998
Dose/Low TRV	2.40E-03	2.35E-03	0.04	7.56	0.02	4.80E-05	210.00	0.01	1.00	0.01	2.14	0.32	0.33	0.39	5.51	EFA WEST 1998
Beryllium																
Dose/High TRV	2.40E-03	2.35E-03	0.01	0.01	1.65E-05	4.80E-05	0.70	3.36E-05	1.00	0.01	3.85E-03	6.60	0.35	8.04	4.79E-04	Calculated[14]
Dose/Low TRV	2.40E-03	2.35E-03	0.01	0.01	1.65E-05	4.80E-05	0.70	3.36E-05	1.00	0.01	3.85E-03	0.66	0.35	0.80	4.79E-03	Sample 1996
Copper																
Dose/High TRV	2.40E-03	2.35E-03	0.40	46.00	0.11	4.80E-05	115.00	0.01	1.00	0.01	8.75	631.58	0.02	656.38	0.01	EFA WEST 1998
Dose/Low TRV	2.40E-03	2.35E-03	0.40	46.00	0.11	4.80E-05	115.00	0.01	1.00	0.01	8.75	2.67	0.03	2.81	3.12	EFA WEST 1998
Lead																
Dose/High TRV	2.40E-03	2.35E-03	0.05	7.43	0.02	4.80E-05	165.00	0.01	1.00	0.01	1.95	240.64	0.02	245.95	0.01	EFA WEST 1998
Dose/Low TRV	2.40E-03	2.35E-03	0.05	7.43	0.02	4.80E-05	165.00	0.01	1.00	0.01	1.95	0.002	0.21	1.77E-03	1102.23	EFA WEST 1998
Mercury																
Dose/High TRV	2.40E-03	2.35E-03	0.04	0.04	9.70E-05	4.80E-05	1.10	5.28E-05	1.00	0.01	0.01	4.00	0.43	4.93	2.34E-03	EFA WEST 1998
Dose/Low TRV	2.40E-03	2.35E-03	0.04	0.04	9.70E-05	4.80E-05	1.10	5.28E-05	1.00	0.01	0.01	0.25	0.19	0.29	0.04	EFA WEST 1998
Nickel																
Dose/High TRV	2.40E-03	2.35E-03	0.03	3.13	0.01	4.80E-05	97.90	0.00	1.00	0.01	0.93	31.60	0.25	37.72	0.02	EFA WEST 1998
Dose/Low TRV	2.40E-03	2.35E-03	0.03	3.13	0.01	4.80E-05	97.90	0.00	1.00	0.01	0.93	0.13	0.25	0.16	5.85	EFA WEST 1998
Zinc																
Dose/High TRV	2.40E-03	2.35E-03	1.20E-12	2.28E-09	5.36E-12	4.80E-05	1900.00	0.09	1.00	0.01	7.02	411.43	0.18	480.89	0.01	EFA WEST 1998
Dose/Low TRV	2.40E-03	2.35E-03	1.20E-12	2.28E-09	5.36E-12	4.80E-05	1900.00	0.09	1.00	0.01	7.02	9.60	0.03	10.00	0.70	EFA WEST 1998
Benzo(a)anthracene*																
Dose/High TRV	2.40E-03	2.35E-03	0.02	8.08E-05	1.90E-07	4.80E-05	4.00E-03	1.92E-07	1.00	0.01	2.94E-05	32.79	0.03	34.51	8.52E-07	EFA WEST 1998
Dose/Low TRV	2.40E-03	2.35E-03	0.02	8.08E-05	1.90E-07	4.80E-05	4.00E-03	1.92E-07	1.00	0.01	2.94E-05	1.31	0.03	1.38	2.13E-05	EFA WEST 1998
Benzo(a)pyrene																
Dose/High TRV	2.40E-03	2.35E-03	0.01	5.55E-05	1.31E-07	4.80E-05	0.01	2.40E-07	1.00	0.01	2.85E-05	32.79	0.03	34.51	8.26E-07	EFA WEST 1998
Dose/Low TRV	2.40E-03	2.35E-03	0.01	5.55E-05	1.31E-07	4.80E-05	0.01	2.40E-07	1.00	0.01	2.85E-05	1.31	0.03	1.38	2.07E-05	EFA WEST 1998
Benzo(b)fluoranthene*																
Dose/High TRV	2.40E-03	2.35E-03	0.10	1.62E-03	3.80E-06	4.80E-05	0.02	7.68E-07	1.00	0.01	3.51E-04	32.79	0.03	34.51	1.02E-05	EFA WEST 1998
Dose/Low TRV	2.40E-03	2.35E-03	0.10	1.62E-03	3.80E-06	4.80E-05	0.02	7.68E-07	1.00	0.01	3.51E-04	1.31	0.03	1.38	2.55E-04	EFA WEST 1998
Benzo(e)pyrene																
Dose/High TRV	2.40E-03	2.35E-03	0.01	8.88E-05	2.09E-07	4.80E-05	0.01	3.84E-07	1.00	0.01	4.56E-05	32.79	0.03	34.51	1.32E-06	EFA WEST 1998
Dose/Low TRV	2.40E-03	2.35E-03	0.01	8.88E-05	2.09E-07	4.80E-05	0.01	3.84E-07	1.00	0.01	4.56E-05	1.31	0.03	1.38	3.31E-05	EFA WEST 1998
Chrysene*																
Dose/High TRV	2.40E-03	2.35E-03	0.02	1.87E-04	4.40E-07	4.80E-05	0.01	4.80E-07	1.00	0.01	7.08E-05	32.79	0.03	34.51	2.05E-06	EFA WEST 1998
Dose/Low TRV	2.40E-03	2.35E-03	0.02	1.87E-04	4.40E-07	4.80E-05	0.01	4.80E-07	1.00	0.01	7.08E-05	1.31	0.03	1.38	5.13E-05	EFA WEST 1998
Fluoranthene*																
Dose/High TRV	2.40E-03	2.35E-03	0.01	3.77E-03	8.88E-06	4.80E-05	0.34	1.63E-05	1.00	0.01	1.94E-03	32.79	0.03	34.51	5.62E-05	EFA WEST 1998
Dose/Low TRV	2.40E-03	2.35E-03	0.01	3.77E-03	8.88E-06	4.80E-05	0.34	1.63E-05	1.00	0.01	1.94E-03	1.31	0.03	1.38	1.41E-03	EFA WEST 1998

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SITE 22
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Chemical	Total Ingestion Rate[1] (kg/day)	Plant Ingestion Rate[2] (mg/kg)	Plant BAF[3] (unitless)	Plant Concentration[4] (mg/kg dry weight)	Plant Daily Dose[5] (mg/day)	Soil Ingestion Rate[6] (kg/day)	Soil Concentration[7] (mg/kg)	Soil Daily Dose[8] (mg/day)	SUF	Receptor Body Weight[9] (kg)	Total Daily Dose[10] (mg/kg/day)	TRV[11] (mg/kg/day)	Test Species Body Weight[11] (kg)	Allometrically Adjusted TRV[12] (mg/kg/day)	HQ[13] (based on adjusted TRV)	Source of TRV
Phenanthrene**																
Dose/High TRV	2.40E-03	2.35E-03	0.32	2.24E-03	5.27E-06	4.80E-05	0.01	3.36E-07	1.00	0.01	4.31E-04	150.00	0.27	179.95	2.40E-06	EFA WEST 1998
Dose/Low TRV	2.40E-03	2.35E-03	0.32	2.24E-03	5.27E-06	4.80E-05	0.01	3.36E-07	1.00	0.01	4.31E-04	50.00	0.28	60.07	7.18E-06	EFA WEST 1998
Phenol***																
Dose/High TRV	2.40E-03	2.35E-03	0.04	0.02	4.65E-05	4.80E-05	0.44	2.11E-05	1.00	0.01	0.01	2.40	3.50	3.36	1.55E-03	Sample 1996
Dose/Low TRV	2.40E-03	2.35E-03	0.04	0.02	4.65E-05	4.80E-05	0.44	2.11E-05	1.00	0.01	0.01	0.24	3.50	0.34	0.02	Sample 1996
Pyrene*																
Dose/High TRV	2.40E-03	2.35E-03	0.01	2.44E-03	5.74E-06	4.80E-05	0.22	1.06E-05	1.00	0.01	1.25E-03	32.79	0.03	34.51	3.63E-05	EFA WEST 1998
Dose/Low TRV	2.40E-03	2.35E-03	0.01	2.44E-03	5.74E-06	4.80E-05	0.22	1.06E-05	1.00	0.01	1.25E-03	1.31	0.03	1.38	9.10E-04	EFA WEST 1998
2-Methylnaphthalene**																
Dose/High TRV	2.40E-03	2.35E-03	0.32	6.40	0.02	4.80E-05	20.00	9.60E-04	1.00	0.01	1.23	150.00	0.27	179.95	0.01	EFA WEST 1998
Dose/Low TRV	2.40E-03	2.35E-03	0.32	6.40	0.02	4.80E-05	20.00	9.60E-04	1.00	0.01	1.23	50.00	0.28	60.07	0.02	EFA WEST 1998
Naphthalene																
Dose/High TRV	2.40E-03	2.35E-03	0.32	2.59	0.01	4.80E-05	8.10	3.89E-04	1.00	0.01	0.50	150.00	0.27	179.95	0.003	EFA WEST 1998
Dose/Low TRV	2.40E-03	2.35E-03	0.32	2.59	0.01	4.80E-05	8.10	3.89E-04	1.00	0.01	0.50	50.00	0.28	60.07	0.01	EFA WEST 1998

Notes: Highlighted cells indicate HQs greater than 1.0.
* TRV based on TRV for Benzo(e)pyrene (EFA West 1998)
** TRV based on TRV for Napthalene (EFA West 1998)
*** TRV based on TRV for Pentacholorphenol (Sample 1996)

BAF	Bioaccumulation factor	mg/kg	Milligram per kilogram
HQ	Hazard quotient	mg/kg/day	Milligram per kilogram per day
kg	Kilogram	NA	Not available
kg/day	Kilogram per day	SUF	Site use factor
mg/day	Milligram per day	TRV	Toxicity reference value

1 Total ingestion rate was calculated with average adult body weight of 13 grams using the Nagy (2001) dry matter intake food requirement equation for herbivorous mammals (a= 0.859; b= 0.6
2 Plant ingestion rate equals 98 percent of the total ingestion rate, based on a soil ingestion rate equal to 2 percent of the total ingestion rate.
3 Plant BAF sources are identified in Table 7-1.
4 Plant tissue concentration was calculated by multiplying the soil concentration by the plant BA
5 Plant daily dose was calculated by multiplying the plant ingestion rate by the plant concentration (see note 4).
6 Soil ingestion rate equals 2 percent of ingestion rate, based on white-footed mouse data from Beyer and others (199
7 The maximum concentration of all site-collected soil samples was used.
8 Soil daily dose was calculated by multiplying the soil ingestion rate by the maximum soil concentration.
9 Average western harvest mouse body weight from Davis and Schmidly (1994).
10 Total daily dose is calculated using the following equation: total daily dose = ((sediment daily dose + plant daily dose)*SUF)/receptor species body weight.
11 The derivation of TRVs is described in EFA WEST (1998) and Sample (1996).
12 Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-0.94)}$.
13 The HQ was calculated using total daily dose/allometrically adjusted TRV.
14 "Calculated" indicates that a high TRV was not available in EFA WEST (1998) or Sample (1996); in those cases, an uncertainty factor of 10 was applied to the low TRV to derive a high TRV.

Sources:

Beyer and others. 1994. "Estimates of Soil Ingestion by Wildlife."*Journal of Wildlife Management* . Volume 58. Number 2. Pages 375 through 382
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Sample, B.E., D.M. Opresko, G.W. Suter, II. 1996. "Toxicological Benchmarks for Wildlife: 1996 Revision." ES/ER/TM-86/R3. Oak Ridge National Laboratory. Oak Ridge, Tennessee.

APPENDIX H

TULE ELK DOSE CALCULATIONS AND HAZARD QUOTIENTS
SITE 22
NAVAL WEAPONS STATION SBD CONCORD

Chemical	Total Ingestion Rate[1] (kg/day)	Plant Ingestion Rate[2] (mg/kg)	Plant BAF[3] (unitless)	Plant Concentration[4] (mg/kg dry weight)	Plant Daily Dose[5] (mg/day)	Soil Ingestion Rate[6] (kg/day)	Soil Concentration[7] (mg/kg)	Soil Daily Dose[8] (mg/day)	SUF	Receptor Body Weight[9] (kg)	Total Daily Dose[10] (mg/kg/day)	TRV[11] (mg/kg/day)	Test Species Body Weight[11] (kg)	Allometrically Adjusted TRV[12] (mg/kg/day)	HQ[13] (based on adjusted TRV)	Source of TRV
Arsenic																
Dose/High TRV	1.72	1.69	0.04	7.56	12.77	0.03	210.00	7.24	1.00	181.45	0.11	4.70	0.11	3.01	0.04	EFA WEST 1998
Dose/Low TRV	1.72	1.69	0.04	7.56	12.77	0.03	210.00	7.24	1.00	181.45	0.11	0.32	0.33	0.22	0.50	EFA WEST 1998
Beryllium																
Dose/High TRV	1.72	1.69	0.01	0.01	0.01	0.03	0.70	0.02	1.00	181.45	1.98E-04	6.60	0.35	4.54	4.37E-05	Calculated[15]
Dose/Low TRV	1.72	1.69	0.01	0.01	0.01	0.03	0.70	0.02	1.00	181.45	1.98E-04	0.66	0.35	0.45	4.37E-04	Sample 1996
Copper																
Dose/High TRV	1.72	1.69	0.40	46.00	77.71	0.03	115.00	3.96	1.00	181.45	0.45	631.58	0.02	370.22	1.22E-03	EFA WEST 1998
Dose/Low TRV	1.72	1.69	0.40	46.00	77.71	0.03	115.00	3.96	1.00	181.45	0.45	2.67	0.03	1.58	0.28	EFA WEST 1998
Lead																
Dose/High TRV	1.72	1.69	0.05	7.43	12.54	0.03	165.00	5.69	1.00	181.45	0.10	240.64	0.02	138.72	0.001	EFA WEST 1998
Dose/Low TRV	1.72	1.69	0.05	7.43	12.54	0.03	165.00	5.69	1.00	181.45	0.10	0.002	0.21	9.99E-04	100.56	EFA WEST 1998
Mercury																
Dose/High TRV	1.72	1.69	0.04	0.04	0.07	0.03	1.10	0.04	1.00	181.45	5.93E-04	4.00	0.43	2.78	2.13E-04	EFA WEST 1998
Dose/Low TRV	1.72	1.69	0.04	0.04	0.07	0.03	1.10	0.04	1.00	181.45	5.93E-04	0.25	0.19	0.17	3.58E-03	EFA WEST 1998
Zinc																
Dose/High TRV	1.72	1.69	1.20E-12	2.28E-09	3.85E-09	0.03	1900.00	65.51	1.00	181.45	0.36	411.43	0.18	271.24	1.33E-03	EFA WEST 1998
Dose/Low TRV	1.72	1.69	1.20E-12	2.28E-09	3.85E-09	0.03	1900.00	65.51	1.00	181.45	0.36	9.60	0.03	5.64	0.06	EFA WEST 1998
Benzo(a)anthracene*																
Dose/High TRV	1.72	1.69	0.02	8.08E-05	1.36E-04	0.03	4.00E-03	1.38E-04	1.00	181.45	1.51E-06	32.79	0.03	19.47	7.77E-08	EFA WEST 1998
Dose/Low TRV	1.72	1.69	0.02	8.08E-05	1.36E-04	0.03	4.00E-03	1.38E-04	1.00	181.45	1.51E-06	1.31	0.03	0.78	1.94E-06	EFA WEST 1998
Benzo(a)pyrene																
Dose/High TRV	1.72	1.69	0.01	5.55E-05	9.38E-05	0.03	0.01	1.72E-04	1.00	181.45	1.47E-06	32.79	0.03	19.47	7.53E-08	EFA WEST 1998
Dose/Low TRV	1.72	1.69	0.01	5.55E-05	9.38E-05	0.03	0.01	1.72E-04	1.00	181.45	1.47E-06	1.31	0.03	0.78	1.89E-06	EFA WEST 1998
Benzo(b)fluoranthene*																
Dose/High TRV	1.72	1.69	0.10	1.62E-03	2.73E-03	0.03	0.02	5.52E-04	1.00	181.45	1.81E-05	32.79	0.03	19.47	9.29E-07	EFA WEST 1998
Dose/Low TRV	1.72	1.69	0.10	1.62E-03	2.73E-03	0.03	0.02	5.52E-04	1.00	181.45	1.81E-05	1.31	0.03	0.78	2.33E-05	EFA WEST 1998
Benzo(e)pyrene																
Dose/High TRV	1.72	1.69	0.01	8.88E-05	1.50E-04	0.03	0.01	2.76E-04	1.00	181.45	2.35E-06	32.79	0.03	19.47	1.21E-07	EFA WEST 1998
Dose/Low TRV	1.72	1.69	0.01	8.88E-05	1.50E-04	0.03	0.01	2.76E-04	1.00	181.45	2.35E-06	1.31	0.03	0.78	3.02E-06	EFA WEST 1998
Chrysene*																
Dose/High TRV	1.72	1.69	0.02	1.87E-04	3.16E-04	0.03	0.01	3.45E-04	1.00	181.45	3.64E-06	32.79	0.03	19.47	1.87E-07	EFA WEST 1998
Dose/Low TRV	1.72	1.69	0.02	1.87E-04	3.16E-04	0.03	0.01	3.45E-04	1.00	181.45	3.64E-06	1.31	0.03	0.78	4.68E-06	EFA WEST 1998
Fluoranthene*																
Dose/High TRV	1.72	1.69	0.01	3.77E-03	0.01	0.03	0.34	0.01	1.00	181.45	9.97E-05	32.79	0.03	19.47	5.12E-06	EFA WEST 1998
Dose/Low TRV	1.72	1.69	0.01	3.77E-03	0.01	0.03	0.34	0.01	1.00	181.45	9.97E-05	1.31	0.03	0.78	1.28E-04	EFA WEST 1998

TULE ELK DOSE CALCULATIONS AND HAZARD QUOTIENTS
SITE 22
NAVAL WEAPONS STATION SBD CONCORD

Chemical	Total Ingestion Rate[1] (kg/day)	Plant Ingestion Rate[2] (mg/kg)	Plant BAF[3] (unitless)	Plant Concentration[4] (mg/kg dry weight)	Plant Daily Dose[5] (mg/day)	Soil Ingestion Rate[6] (kg/day)	Soil Concentration[7] (mg/kg)	Soil Daily Dose[8] (mg/day)	SUF	Receptor Body Weight[9] (kg)	Total Daily Dose[10] (mg/kg/day)	TRV[11] (mg/kg/day)	Test Species Body Weight[11] (kg)	Allometrically Adjusted TRV[12] (mg/kg/day)	HQ[13] (based on adjusted TRV)	Source of TRV
Phenanthrene**																
Dose/High TRV	1.72	1.69	0.32	2.24E-03	3.78E-03	0.03	0.01	2.41E-04	1.00	181.45	2.22E-05	150.00	0.27	101.50	2.19E-07	EFA WEST 1998
Dose/Low TRV	1.72	1.69	0.32	2.24E-03	3.78E-03	0.03	0.01	2.41E-04	1.00	181.45	2.22E-05	50.00	0.28	33.88	6.55E-07	EFA WEST 1998
Phenol***																
Dose/High TRV	1.72	1.69	0.04	0.02	0.03	0.03	0.44	0.02	1.00	181.45	2.68E-04	2.40	3.50	1.89	1.41E-04	Sample 1996
Dose/Low TRV	1.72	1.69	0.04	0.02	0.03	0.03	0.44	0.02	1.00	181.45	2.68E-04	0.24	3.50	0.19	1.41E-03	Sample 1996
Pyrene*																
Dose/High TRV	1.72	1.69	0.01	2.44E-03	4.13E-03	0.03	0.22	0.01	1.00	181.45	6.45E-05	32.79	0.03	19.47	3.32E-06	EFA WEST 1998
Dose/Low TRV	1.72	1.69	0.01	2.44E-03	4.13E-03	0.03	0.22	0.01	1.00	181.45	6.45E-05	1.31	0.03	0.78	8.30E-05	EFA WEST 1998
2-Methylnaphthalene**																
Dose/High TRV	1.72	1.69	0.32	6.40	10.81	0.03	20.00	0.69	1.00	181.45	0.06	150.00	0.27	101.50	6.24E-04	EFA WEST 1998
Dose/Low TRV	1.72	1.69	0.32	6.40	10.81	0.03	20.00	0.69	1.00	181.45	0.06	50.00	0.28	33.88	1.87E-03	EFA WEST 1998
Naphthalene																
Dose/High TRV	1.72	1.69	0.32	2.59	4.38	0.03	8.10	0.28	1.00	181.45	0.03	150.00	0.27	101.50	2.53E-04	EFA WEST 1998
Dose/Low TRV	1.72	1.69	0.32	2.59	4.38	0.03	8.10	0.28	1.00	181.45	0.03	50.00	0.28	33.88	7.58E-04	EFA WEST 1998

Notes: Highlighted cells indicate HQs greater than 1.0.

* TRV based on TRV for Benzo(e)pyrene (EFA West 1998)

** TRV based on TRV for Napthalene (EFA West 1998)

*** TRV based on TRV for Pentacholorphenol (Sample 1996)

BAF	Bioaccumulation factor	mg/kg	Milligram per kilogram
HQ	Hazard quotient	mg/kg/day	Milligram per kilogram per day
kg	Kilogram	NA	Not available
kg/day	Kilogram per day	SUF	Site use factor
mg/day	Milligram per day	TRV	Toxicity reference value

1 Total ingestion rate was calculated with average adult body weight of 181,450 grams using the Nagy (2001) dry matter intake food requirement equation for herbivorous mammals (a= 0.859; b= 0.628)

2 Plant ingestion rate equals 98 percent of the total ingestion rate, based on a soil ingestion rate equal to 2 percent of the total ingestion rate.

3 Plant BAF sources are identified in Table 7-1.

4 Plant tissue concentration was calculated by multiplying the soil concentration by the plant BAF.

5 Plant daily dose was calculated by multiplying the plant ingestion rate by the maximum plant concentration.

6 Sediment ingestion rate equals 2 percent of ingestion rate, based on white-footed mouse data from Beyer and others (1994).

7 The maximum concentration of all site-collected soil samples was used.

8 Soil daily dose was calculated by multiplying the soil ingestion rate by the soil concentration.

9 Average of adult females (McCullough, 1969).

10 Total daily dose is calculated using the following equation: total daily dose = ((sediment daily dose + plant daily dose)*SUF)/receptor species body weight.

11 The derivation of TRVs is described in EFA WEST (1998) and Sample (1996).

12 Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight) $^{(1-0.94)}$.

13 The HQ was calculated using total daily dose/allometrically adjusted TRV.

14 Sufficient data are not available to derive a TRV. This chemical was evaluated qualitatively.

15 "Calculated" indicates that a high TRV was not available in EFA WEST (1998) or Sample (1996); in those cases, an uncertainty factor of 10 was applied to the low TRV to derive a high TRV.

Sources: Beyer and others. 1994. "Estimates of Soil Ingestion by Wildlife." *Journal of Wildlife Management*. Volume 58. Number 2. Pages 375 through 382.

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APPENDIX H

AMERICAN ROBIN DOSE CALCULATIONS AND HAZARD QUOTIENTS
SITE 22
NAVAL WEAPONS STATION CONCORD

COPEC	Total Ingestion Rate[1] (kg/day)	Soil Ingestion Rate[2] (kg/day)	Soil Concentration[3] (mg/kg)	Soil Daily Dose[4] (mg/day)	Total Prey Ingestion Rate[1,5] (kg/day)	Plant Ingestion Rate[5,6] (kg/day)	Plant BAF[7] (unitless)	Plant Tissue Concentration in Dry Weight (mg/kg)[8]	Plant Daily Dose[9] (mg/kg)	Invertebrate Ingestion Rate[5,10] (kg/day)	Invertebrate BAF[7] (unitless)	Invertebrate Tissue Concentration in Wet Weight[11] (mg/kg)	Invertebrate Tissue Concentration in Dry Weight[12] (mg/kg)	Invertebrate Daily Dose[13] (mg/day)	SUF	Receptor Body Weight[14] (kg)	Total Daily Dose[15] (mg/kg/day)	TRV[16] (mg/kg/day)	Test Species Body Weight[16] (kg)	Allometrically Adjusted TRV[17] (mg/kg/day)	HQ[18] (based on adjusted TRV)	Source of TRV
Arsenic																						
Dose/High TRV	0.01	1.23E-06	210.00	2.58E-04	0.01	0.01	0.04	7.56	0.04	0.01	0.11	23.10	154.00	1.04	1.00	0.08	13.99	22.01	1.17	12.78	1.095	EFA West 1998
Dose/Low TRV	0.01	1.23E-06	210.00	2.58E-04	0.01	0.01	0.04	7.56	0.04	0.01	0.11	23.10	154.00	1.04	1.00	0.08	13.99	5.50	1.17	3.19	4.382	EFA West 1998
Arsenic Step 3a Dose																						
Dose/High TRV	0.01	1.23E-06	90.92	1.12E-04	0.01	0.01	0.04	3.27	0.02	0.01	0.11	10.00	66.67	0.45	1.00	0.08	6.06	22.01	1.17	12.778	0.474	EFA West 1998
Dose/Low TRV	0.01	1.23E-06	90.92	1.12E-04	0.01	0.01	0.04	3.27	0.02	0.01	0.11	10.00	66.67	0.45	1.00	0.08	6.06	5.50	1.17	3.193	1.897	EFA West 1998
Beryllium																						
Dose/High TRV	0.01	1.23E-06	0.70	8.59E-07	0.01	0.01	0.01	0.01	3.87E-05	0.01	0.22	0.15	1.03	0.01	1.00	0.08	0.09	NA	NA	NA	No TRV[19]	No TRV[19]
Dose/Low TRV	0.01	1.23E-06	0.70	8.59E-07	0.01	0.01	0.01	0.01	3.87E-05	0.01	0.22	0.15	1.03	0.01	1.00	0.08	0.09	NA	NA	NA	No TRV[19]	No TRV[19]
Copper																						
Dose/High TRV	0.01	1.23E-06	115.00	1.41E-04	0.01	0.01	0.40	46.00	0.25	0.01	0.04	4.60	30.67	0.21	1.00	0.08	5.97	52.26	0.41	37.45	0.16	EFA West 1998
Dose/Low TRV	0.01	1.23E-06	115.00	1.41E-04	0.01	0.01	0.40	46.00	0.25	0.01	0.04	4.60	30.67	0.21	1.00	0.08	5.97	2.30	0.64	1.51	3.96	EFA West 1998
Lead																						
Dose/High TRV	0.01	1.23E-06	165.00	2.03E-04	0.01	0.01	0.05	7.43	0.04	0.01	0.03	4.95	33.00	0.22	1.00	0.08	3.41	8.75	0.80	5.48	0.62	EFA West 1998
Dose/Low TRV	0.01	1.23E-06	165.00	2.03E-04	0.01	0.01	0.05	7.43	0.04	0.01	0.03	4.95	33.00	0.22	1.00	0.08	3.41	0.01	0.08	0.01	247.99	EFA West 1998
Mercury																						
Dose/High TRV	0.01	1.23E-06	1.10	1.35E-06	0.01	0.01	0.04	0.04	2.28E-04	0.01	0.04	0.04	0.29	1.98E-03	1.00	0.08	0.03	0.18	1.00	0.11	0.26	EFA West 1998
Dose/Low TRV	0.01	1.23E-06	1.10	1.35E-06	0.01	0.01	0.04	0.04	2.28E-04	0.01	0.04	0.04	0.29	1.98E-03	1.00	0.08	0.03	0.04	1.00	0.02	1.22	EFA West 1998
Zinc																						
Dose/High TRV	0.01	1.23E-06	1900.00	2.33E-03	0.01	0.01	1.20E-12	2.28E-09	1.26E-11	0.01	0.56	1064.00	7093.33	47.88	1.00	0.08	619.41	172.00	0.96	104.03	5.95	EFA West 1998
Dose/Low TRV	0.01	1.23E-06	1900.00	2.33E-03	0.01	0.01	1.20E-12	2.28E-09	1.26E-11	0.01	0.56	1064.00	7093.33	47.88	1.00	0.08	619.41	17.20	0.96	10.40	59.54	EFA West 1998
Zinc Step 3a Dose																						
Dose/High TRV	0.01	1.23E-06	196.16	2.41E-04	0.01	0.01	1.20E-12	2.35E-10	1.30E-12	0.01	0.56	109.85	732.33	4.94	1.00	0.08	63.95	172.00	0.96	104.03	0.61	EFA West 1998
Dose/Low TRV	0.01	1.23E-06	196.16	2.41E-04	0.01	0.01	1.20E-12	2.35E-10	1.30E-12	0.01	0.56	109.85	732.33	4.94	1.00	0.08	63.95	17.20	0.96	10.40	6.15	EFA West 1998
Benzo(a)anthracene																						
Dose/High TRV	0.01	1.23E-06	4.00E-03	4.91E-09	0.01	0.01	0.02	8.08E-05	4.46E-07	0.01	0.03	1.20E-04	8.00E-04	5.40E-06	1.00	0.08	7.57E-05	NA	NA	NA	No TRV[12]	No TRV[12]
Dose/Low TRV	0.01	1.23E-06	4.00E-03	4.91E-09	0.01	0.01	0.02	8.08E-05	4.46E-07	0.01	0.03	1.20E-04	8.00E-04	5.40E-06	1.00	0.08	7.57E-05	NA	NA	NA	No TRV[12]	No TRV[12]
Benzo(a)pyrene																						
Dose/High TRV	0.01	1.23E-06	0.01	6.14E-09	0.01	0.01	0.01	5.55E-05	3.06E-07	0.01	0.07	3.50E-04	2.33E-03	1.57E-05	1.00	0.08	2.08E-04	NA	NA	NA	No TRV[12]	No TRV[12]
Dose/Low TRV	0.01	1.23E-06	0.01	6.14E-09	0.01	0.01	0.01	5.55E-05	3.06E-07	0.01	0.07	3.50E-04	2.33E-03	1.57E-05	1.00	0.08	2.08E-04	NA	NA	NA	No TRV[12]	No TRV[12]
Benzo(b)fluoranthene																						
Dose/High TRV	0.01	1.23E-06	0.02	1.96E-08	0.01	0.01	0.10	1.62E-03	8.92E-06	0.01	0.07	1.12E-03	0.01	5.04E-05	1.00	0.08	7.68E-04	NA	NA	NA	No TRV[12]	No TRV[12]
Dose/Low TRV	0.01	1.23E-06	0.02	1.96E-08	0.01	0.01	0.10	1.62E-03	8.92E-06	0.01	0.07	1.12E-03	0.01	5.04E-05	1.00	0.08	7.68E-04	NA	NA	NA	No TRV[12]	No TRV[12]
Benzo(e)pyrene																						
Dose/High TRV	0.01	1.23E-06	0.01	9.82E-09	0.01	0.01	0.01	8.88E-05	4.90E-07	0.01	0.07	5.60E-04	3.73E-03	2.52E-05	1.00	0.08	3.32E-04	NA	NA	NA	No TRV[12]	No TRV[12]
Dose/Low TRV	0.01	1.23E-06	0.01	9.82E-09	0.01	0.01	0.01	8.88E-05	4.90E-07	0.01	0.07	5.60E-04	3.73E-03	2.52E-05	1.00	0.08	3.32E-04	NA	NA	NA	No TRV[12]	No TRV[12]
Chrysene																						
Dose/High TRV	0.01	1.23E-06	0.01	1.23E-08	0.01	0.01	0.02	1.87E-04	1.03E-06	0.01	0.04	4.00E-04	2.67E-03	1.80E-05	1.00	0.08	2.46E-04	NA	NA	NA	No TRV[12]	No TRV[12]
Dose/Low TRV	0.01	1.23E-06	0.01	1.23E-08	0.01	0.01	0.02	1.87E-04	1.03E-06	0.01	0.04	4.00E-04	2.67E-03	1.80E-05	1.00	0.08	2.46E-04	NA	NA	NA	No TRV[12]	No TRV[12]
Fluoranthene																						
Dose/High TRV	0.01	1.23E-06	0.34	4.17E-07	0.01	0.01	0.01	3.77E-03	2.08E-05	0.01	0.07	0.02	0.16	1.07E-03	1.00	0.08	0.01	NA	NA	NA	No TRV[12]	No TRV[12]
Dose/Low TRV	0.01	1.23E-06	0.34	4.17E-07	0.01	0.01	0.01	3.77E-03	2.08E-05	0.01	0.07	0.02	0.16	1.07E-03	1.00	0.08	0.01	NA	NA	NA	No TRV[12]	No TRV[12]
Phenanthrene																						
Dose/High TRV	0.01	1.23E-06	0.01	8.59E-09	0.01	0.01	0.32	2.24E-03	1.24E-05	0.01	6.00	0.04	0.28	1.89E-03	1.00	0.08	0.02	NA	NA	NA	No TRV[12]	No TRV[12]
Dose/Low TRV	0.01	1.23E-06	0.01	8.59E-09	0.01	0.01	0.32	2.24E-03	1.24E-05	0.01	6.00	0.04	0.28	1.89E-03	1.00	0.08	0.02	NA	NA	NA	No TRV[12]	No TRV[12]

APPENDIX H

AMERICAN ROBIN DOSE CALCULATIONS AND HAZARD QUOTIENTS
SITE 22
NAVAL WEAPONS STATION CONCORD

COPEC	Total Ingestion Rate[1] (kg/day)	Soil Ingestion Rate[2] (kg/day)	Soil Concentration[3] (mg/kg)	Soil Daily Dose[4] (mg/day)	Total Prey Ingestion Rate[1,5] (kg/day)	Plant Ingestion Rate[5,6] (kg/day)	Plant BAF[7] (unitless)	Plant Tissue Concentration in Dry Weight (mg/kg)[8]	Plant Daily Dose[9] (mg/kg)	Invertebrate Ingestion Rate[5,10] (kg/day)	Invertebrate BAF[7] (unitless)	Invertebrate Tissue Concentration in Wet Weight[11] (mg/kg)	Invertebrate Tissue Concentration in Dry Weight[12] (mg/kg)	Invertebrate Daily Dose[13] (mg/day)	SUF	Receptor Body Weight[14] (kg)	Total Daily Dose[15] (mg/kg/day)	TRV[16] (mg/kg/day)	Test Species Body Weight[16] (kg)	Allometrically Adjusted TRV[17] (mg/kg/day)	HQ[18] (based on adjusted TRV)	Source of TRV
Phenol																						
Dose/High TRV	0.01	1.23E-06	0.44	5.40E-07	0.01	0.01	0.04	0.02	1.09E-04	0.01	1034.00	454.96	3033.07	20.47	1.00	0.08	264.84	NA	NA	NA	No TRV[12]	No TRV[12]
Dose/Low TRV	0.01	1.23E-06	0.44	5.40E-07	0.01	0.01	0.04	0.02	1.09E-04	0.01	1034.00	454.96	3033.07	20.47	1.00	0.08	264.84	NA	NA	NA	No TRV[12]	No TRV[12]
Pyrene																						
Dose/High TRV	0.01	1.23E-06	0.22	2.70E-07	0.01	0.01	0.01	2.44E-03	1.35E-05	0.01	0.07	0.02	0.10	6.93E-04	1.00	0.08	0.01	NA	NA	NA	No TRV[12]	No TRV[12]
Dose/Low TRV	0.01	1.23E-06	0.22	2.70E-07	0.01	0.01	0.01	2.44E-03	1.35E-05	0.01	0.07	0.02	0.10	6.93E-04	1.00	0.08	0.01	NA	NA	NA	No TRV[12]	No TRV[12]
2-Methylnaphthalene																						
Dose/High TRV	0.01	1.23E-06	20.00	2.45E-05	0.01	0.01	0.32	6.40	0.04	0.01	6.00	120.00	800.00	5.40	1.00	0.08	70.31	NA	NA	NA	No TRV[12]	No TRV[12]
Dose/Low TRV	0.01	1.23E-06	20.00	2.45E-05	0.01	0.01	0.32	6.40	0.04	0.01	6.00	120.00	800.00	5.40	1.00	0.08	70.31	NA	NA	NA	No TRV[12]	No TRV[12]
Naphthalene																						
Dose/High TRV	0.01	1.23E-06	8.10	9.94E-06	0.01	0.01	0.32	2.59	0.01	0.01	6.00	48.60	324.00	2.19	1.00	0.08	28.48	NA	NA	NA	No TRV[12]	No TRV[12]
Dose/Low TRV	0.01	1.23E-06	8.10	9.94E-06	0.01	0.01	0.32	2.59	0.01	0.01	6.00	48.60	324.00	2.19	1.00	0.08	28.48	NA	NA	NA	No TRV[12]	No TRV[12]

Notes: Highlighted cells indicate HQs greater than 1.0.

BAF	Bioaccumulation factor	mg/kg	Milligram per kilogram
HQ	Hazard quotient	mg/kg/day	Milligram per kilogram per day
kg	Kilogram	NA	Not available
kg/day	Kilogram per day	SUF	Site use factor
mg/day	Milligram per day	TRV	Toxicity reference value

1 Total ingestion rate was calculated with body weight of 77.3 grams using the Nagy (2001) dry matter intake food requirement equation for passerine birds (a= 0.630; b= 0.683).
2 Soil ingestion rate based on Western Meadowlark soil ingestion rate in EPA (1999). The soil ingestion rate is expressed as a 0.01 percent of the total ingestion rate.
3 Soil concentration equals the maximum of all site-collected soil samples.
4 Soil daily dose was calculated by multiplying the soil ingestion rate (see note 2) by the maximum soil concentration (see note 3).
5 Total prey ingestion rate was 99.99 percent of the total ingestion rate, based on the soil ingestion rate (see note 2). The prey composition was assumed to consist of 45 percent plant and 54 percent invertebrates.
6 Plant ingestion rate was calculated by multiplying the total prey ingestion rate by 0.45 (see note 5).
7 Plant and invertebrate BAF sources are identified in Table 7-1.
8 Plant tissue concentration was calculated by multiplying the soil concentration by the plant BAF. Concentrations are presented in dry weight.
9 Plant daily dose was calculated by multiplying plant ingestion rate (see note 6) by the plant concentration (see note 8)
10 Invertebrate ingestion rate was calculated by multiplying the total prey ingestion rate by 0.54 (see note 5).
11 Invertebrate tissue concentration was calculated by multiplying the soil concentration by the invertebrate BAF. Concentrations are presented in wet weight.
12 Invertebrate concentrations were converted to dry weight using the formula: dry weight concentration = (wet weight concentration)/(1-percent moisture in media). Average percent moisture for earthworm tissue equals 85 percent (EPA 1993).
13 Invertebrate daily dose was calculated by multiplying invertebrate ingestion rate (see note 10) by the maximum invertebrate concentration (see note 12).
14 Mean body weight of adults throughout the United States (Clench & Leberman, 1978, as cited in EPA 1993).
15 Total daily dose is calculated using the following equation: total daily dose = (plant daily dose + invertebrate daily dose + soil daily dose)*SUF)/receptor species body weight.
16 The derivation of TRVs is described in EFA WEST (1998). These TRVs are adjusted to incorporate uncertainty factors.
17 Allometrically adjusted TRVs were calculated using the following equation: receptor species TRV = (test species TRV) x (test species body weight / receptor species body weight)$^{(1-1.2)}$.
18 The HQ was calculated using total daily dose / allometrically adjusted TRV.
19 Sufficient data are not available to derive a TRV. This chemical was evaluated qualitatively.
20 "Calculated" indicates that a high TRV was not available in EFA WEST (1998) or Sample (1996); in those cases, an uncertainty factor of 10 was applied to the low TRV to derive a high TRV.

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