

Contract No. N62474-88-D-5086

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NAVAL WEAPONS STATION
CONCORD, CALIFORNIA

SOLID WASTE MANAGEMENT UNIT
SITE INVESTIGATION

QUALITY ASSURANCE PROJECT PLAN
DRAFT FINAL

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ABBREVIATIONS AND ACRONYMS

AA	Atomic Absorption Spectroscopy
ASTM	American Society for Testing and Materials
BTEX	benzene, toluene, ethylbenzene, and xylenes
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CLEAN	Comprehensive Long-Term Environmental Action Navy
CLP	Contract Laboratory Program
COC	Chain-Of-Custody
CRDL	Contract Required Detection Limits
CRQL	Contract Required Quantitation Limits
CTO	Contract Task Order
CVAA	Cold Vapor Atomic Absorption
DERP	Defense Environmental Restoration Program
DOD	Department of Defense
DOT	Department of Transportation
DQO	Data Quality Objective
DTSC	Department of Toxic Substances Control
EC	Electrical Conductance
ECD	Electron Capture Detector
EDL	Electrodeless Discharge Lamp
EIC	Engineer-In-Charge
ELAP	Environmental Laboratory Accreditation Program
EPA	United States Environmental Protection Agency
FFSRA	Federal Facilities Site Remediation Agreement
FID	Flame Ionization Detector
FSP	Field Sampling Plan
FTL	Field Team Leader
GC	Gas Chromatography
GC/MS	Gas Chromatography/Mass Spectrometry
GFAA	Graphite Furnace Atomic Absorption
H ₂ SO ₄	Sulfuric Acid
HCl	Hydrochloric Acid
Hg	Mercury
HNO ₃	Nitric Acid
HSP	Health and Safety Plan
ICP	Inductively Coupled Plasma Emission Spectroscopy
IRP	Installation Restoration Program
IR	Infrared
kg	Kilograms
L	Liter
LCS	Laboratory Control Sample
LUFT	Leaking Underground Fuel Tank
MDL	Method Detection Limit
µg/L	Micrograms per Liter
µg/kg	Micrograms per Kilogram
µg	Micrograms

ABBREVIATIONS AND ACRONYMS (Continued)

μ mhos	Micromhos
mg	Milligram
mL	Milliliter
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NCP	National Contingency Plan
NEESA	Naval Energy and Environmental Support Activity
NPL	National Priorities List
NTU	Nephelometric Turbidity Unit
OC	Organochlorine
OSHA	Occupational Safety and Health Administration
PARCC	Precision, Accuracy, Representativeness, Completeness, and Comparability
PCB	Polychlorinated Biphenyls
PID	Photoionization Detector
ppm	Parts Per Million
PRC	PRC Environmental Management, Inc.
QA	Quality Assurance
QAPjP	Quality Assurance Project Plan
QC	Quality Control
QCSR	Quality Control Summary Report
RI	Remedial Investigation
RPD	Relative Percent Difference
RWQCB	Regional Water Quality Control Board
SARA	Superfund Amendments and Reauthorization Act
SDG	Sample Delivery Group
SI	Site Investigation
SOP	Standard Operating Procedures
SVOC	Semivolatile Organic Compound
SWMU	Solid Waste Management Unit
TAL	Target Analyte List
TCL	Target Compound List
TDS	Total Dissolved Solids
TIC	Tentatively Identified Compounds
TOC	Total Organic Carbon
TPH	Total Petroleum Hydrocarbon
U.S.	United States
USC	United States Code
VOA	Volatile Organic Analysis
VOC	Volatile Organic Compounds
WESTDIV	Department of the Navy, Western Division, Naval Facilities Engineering Command
WPNSTA	Naval Weapons Station

1.0 INTRODUCTION

The Department of the Navy, Western Division, Naval Facilities Engineering Command (WESTDIV) is conducting a site investigation (SI) at 24 Solid Waste Management Units (SWMU) at the Naval Weapons Stations (WPNSTA) Concord, California. Of the 24 SWMUs at WPNSTA, 20 are in the Inland Area and 4 are in the Tidal Area of the facility.

WESTDIV has authorized PRC Environmental Management, Inc. (PRC) to develop project plans to support the SI activities. The preparation of SI project plans, including a field sampling plan (FSP), quality assurance project plan (QAPjP), and health and safety plan (HSP), have been authorized under the Navy's Comprehensive Long-Term Environmental Action Navy (CLEAN) Contract No. N62474-88-D-5086, Contract Task Order (CTO) No. 0283.

This QAPjP describes the policy, organization, functional activities, and quality assurance/quality control (QA/QC) activities to be implemented during the investigation. In an effort to avoid duplication among the project documents, references are made herein to sections of the associated project plans where supplemental or detailed information can be found.

Sections 1.0, 2.0, and 3.0 of the FSP for the SWMU SI contain additional background information including the project objectives, a history of the SWMU program, and a description of the environmental setting at WPNSTA Concord.

2.0 PROJECT ORGANIZATION, RESPONSIBILITIES, AND TRAINING

A project team will help to assure consistent quality throughout the SI. This section describes the key members and their responsibilities within the project team organization.

2.1 PROJECT ORGANIZATION

The project team involved with SI activities for WPNSTA Concord consists of the following:

- Navy Engineer-in-Charge (EIC): Ronald Yee

- **CLEAN Program Manager: Daniel Chow**

Mr. Chow has 19 years of experience with PRC in program management and environmental engineering, specializing in work dealing with hazardous, toxic, industrial, and municipal waste issues in military installations, national priorities list (NPL) sites and RCRA facilities. Mr. Chow has been the program manager on PRC's CLEAN contract for 3 years.

- **Project Manager: Barbara Sootknoo**

Ms. Sootknoo is an experienced engineer who has provided technical support to several environmental studies and investigations. Her experience includes planning and coordinating site investigations; preparing remedial work plans for remedial investigation/feasibility studies (RI/FS); specifications and cost estimates for remedial designs; and preparing engineering evaluations/cost analyses (EE/CA) for removal actions.

- **QA Program Manager: Ken Partymiller**

Dr. Partymiller has 20 years of experience as a chemist performing field investigations, data and technology evaluations, fate and transport studies, and laboratory QA audits for hazardous waste sites.

- **Project QA Officer and Chemist: Thorsten Anderson**

Mr. Anderson is an environmental chemist with more than 5 years of professional experience in analytical chemistry, data interpretation, and QA/QC. Mr. Anderson has worked as a project chemist on the following installations: Hunters Point Annex Naval Shipyard, Naval Air Station Lemoore, and Naval Station Treasure Island.

- **Health and Safety Program Manager: Fred Stanley**

Dr. Stanley has over 28 years of comprehensive managerial and technical experience in all aspects of industrial hygiene, occupational health and safety, environmental science, and ionizing radiation and non-ionizing radiation hazard control.

- **Field Team Leader: Ken Bowen**

Mr. Bowen is a hydrogeologist with more than 9 years of professional experience in conducting geologic and hydrogeologic investigations, directing field operations, computer modeling, aquifer testing, and data reduction and analysis.

- Project Health and Safety Coordinator: To be determined
- On-site Safety Officer: To be determined

Figure 1 presents an organizational chart for this project.

2.2 RESPONSIBILITIES

The specific responsibilities of the team members listed above are described in this section.

Navy Engineer-in-Charge: The Navy EIC is responsible for the following:

- Providing site information and history
- Providing logistical assistance
- Specifying sites requiring investigation
- Reviewing all results and recommendations and providing management and technical oversight
- Ensuring proper review and distribution of all documents
- Communicating comments from technical reviewers to contractors
- Ensuring that contractors address all comments and take appropriate corrective actions
- Coordinating with regulatory agencies

CLEAN Program Manager: The program manager is responsible for the following activities:

- Ensuring that all contract requirements are met

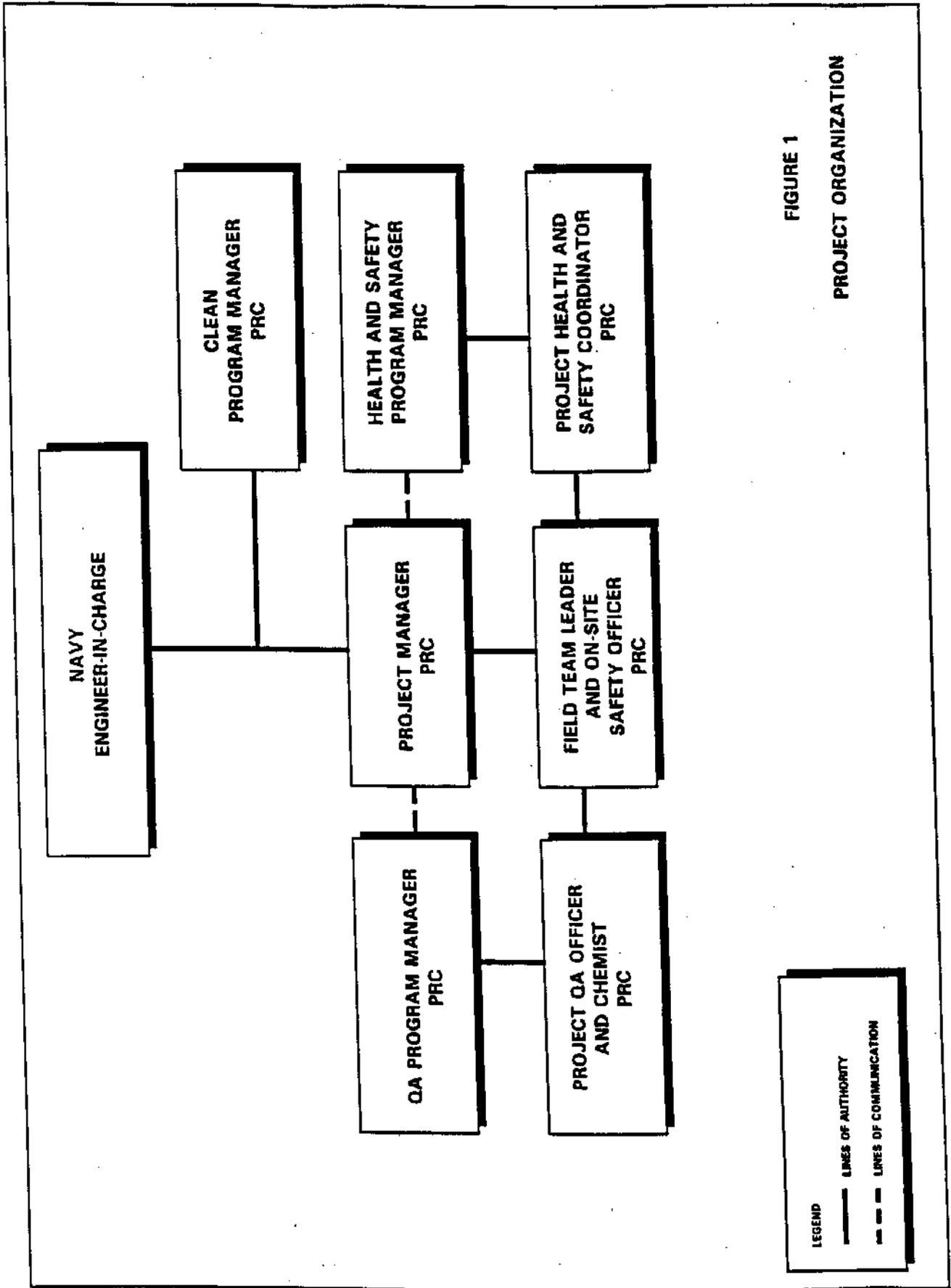


FIGURE 1
PROJECT ORGANIZATION

- Providing necessary resources to the project team to allow adequate responses to all requirements of the investigation
- Maintaining consistency in procedures and work products with all other task orders
- Establishing and maintaining communication between the EIC, QA program manager, health and safety program manager, and project manager
- Providing technical oversight, as necessary
- Providing guidance to the project manager as needed

Project Manager: The project manager is ultimately responsible for the timely completion of the project. The responsibilities of the project manager include the following:

- Assigning technical staff
- Ensuring the completion of all quality control (QC) requirements by team members
- Supervising the document control process
- Approving all deliverables and associated documents prior to transmittal
- Establishing and maintaining communication between technical staff, program manager, QA officer, health and safety coordinator, and regulatory agencies
- Implementing all programs and protocols related to the project
- Coordinating with Navy EIC

QA Program Manager: The QA program manager is responsible for ensuring that the SI at WPNSTA Concord has appropriate overall QA. The QA program manager reviews laboratory QA plans, sampling plans, and audit reports. Other responsibilities include the following:

- Meeting regularly with the program manager, project manager, and QA officer
- Developing and revising the QA program, as required
- Supervising the QA responsibilities of the project QA officer
- Identifying nonconformance situations to management, as required

- Providing guidance in the correction of nonconformances
- Ensuring that all deliverables meet the requirements of the CLEAN QA/QC program
- Making recommendations to the program manager and project manager regarding QA/QC topics and corrective action
- Conducting field and laboratory audits to ensure that sampling and analysis activities are performed in accordance with the QAPjP

Project QA Officer: Responsibilities of the project QA officer include, at a minimum:

- Ensuring that all protocols described in the QAPjP are met
- Providing guidance or assistance and resolving problems on QA/QC topics
- Verifying that the specified data collection methods comply with all QA/QC requirements and will yield data of desired quality and integrity
- Reviewing and evaluating quality-related changes to the FSP and QAPjP
- Ensuring that all nonconformances are identified and appropriate corrective actions are taken. Providing assistance to the project manager with regard to corrective action and, if necessary, soliciting involvement by the program manager
- Communicating regularly with the project manager, QA program manager, and project chemist to ensure the progress of the QA tasks for the SI
- Acting as the main contact for all project QA matters, and providing guidance on appropriate procedures to the project manager and support personnel

Health and Safety Program Manager: The CLEAN health and safety program manager is responsible for the following:

- Reviewing a site-specific HSP
- Ensuring that the health and safety plan meets the requirements of the CLEAN Health and Safety Program
- Providing assistance and guidance to the project health and safety coordinator, as needed

- Maintaining communication with the program manager, project manager, and project health and safety coordinator

Project Health and Safety Coordinator: The responsibilities of the project health and safety coordinator include the following:

- Preparing a site-specific HSP
- Ensuring that the HSP complies with all federal, state, and local health and safety requirements
- Establishing and maintaining communication between the on-site safety officer, project manager, and health and safety program manager
- Verifying that site personnel adhere to the site safety requirements
- Providing guidance to the project manager and support personnel on appropriate corrective action procedures
- Performing responsibilities specified in the site-specific HSP
- Conducting field audits to ensure field compliance with HSP

On-Site Safety Officer: The on-site safety officer is responsible for field implementation of the HSP and has the authority to correct and change site control measures and the required health and safety protection. The on-site safety officer has primary on-site enforcement authority for the policies and provisions of the CLEAN Health and Safety Program and HSP. Additional responsibilities are included in the site-specific HSP.

Project Chemist: The responsibilities of the chemist include the following:

- Ensuring that the laboratory implements the requirements of the QAPjP and FSP
- Coordinating with the laboratory on QA/QC matters
- Reviewing laboratory data prior to release
- Coordinating data validation activities
- Providing updates to the project manager with regard to QA/QC data

Field Team Leader: The FTL is responsible for the field program. The FTL will direct all on-site activities, including those of subcontractors, and will ensure that all procedures described in the FSP are followed in the field. The FTL will be responsible for ensuring that field equipment is properly calibrated and maintained and that individual samples are properly handled and documented to allow for tracing the possession and handling of samples from collection to laboratory receipt.

2.3 TRAINING

All personnel scheduled for work at WPNSTA Concord will be trained in compliance with the Occupational Safety and Health Administration (OSHA) requirements (29 Code of Federal Regulations [CFR] 1910.120) and the CLEAN Health and Safety Program. Personnel will be experienced in hazardous waste site work, use of personal protective equipment, and emergency response procedures.

All PRC field personnel assigned to this project will receive the FSP, QAPjP, and HSP in a timely manner to allow for a sufficient review period. The drilling subcontractor will receive the HSP as well as information from the FSP pertaining to drilling and waste handling operations. A field team orientation and briefing will be held prior to the initiation of field work to acquaint personnel with the site, assign field responsibilities, and provide training in the operation of any unfamiliar field equipment. In addition, tailgate safety meetings will be performed daily, prior to initiating field activities, to discuss site-specific hazards, emergency procedures, and symptoms associated with exposure.

3.0 DATA QUALITY OBJECTIVES FOR MEASUREMENT DATA

Data quality objectives (DQO) are qualitative and quantitative statements developed by data users to specify the quality of data needed from a particular data collection activity to support specific decisions or regulatory actions. The three-stage process for developing DQOs, as described in EPA guidance (1987a), is based on the following:

- Identifying project objectives
- Specifying the data necessary to meet project objectives

- Identifying and describing the methods that will yield data of acceptable quality and quantity to support the required decisions

The results of the first two stages of the DQO development process are presented in the FSP. The third stage of the process is the basis for preparing this QAPJP, which includes: appropriate field techniques; appropriate analytical methods; and measurement objectives for precision, accuracy, representativeness, completeness, and comparability (PARCC). Field techniques are described in the FSP, and the remaining topics are discussed below.

The critical indicators of project data quality are based on PARCC. Objectives for these indicator parameters were developed for this project based on past experience and on the objectives of this SI. Field procedures, analytical methods, and the project QA program were selected and developed to meet these objectives.

3.1 PRECISION

Precision refers to the reproducibility of measurements of the same characteristic, usually under a given set of conditions. For duplicate measurements, precision is expressed as the relative percent difference (RPD) of the pair and is calculated using the following equation:

$$RPD = \frac{|D_1 - D_2|}{1/2 (D_1 + D_2)} \times 100$$

where

D_1 = concentration of analyte in the field sample

D_2 = concentration of analyte in the duplicate sample

The precision of field measurements (such as photoionization detector [PID] response) will be evaluated based on the results of duplicate measurements. As described in Section 9.2, at least 10 percent of the field measurements will be obtained in duplicate.

The precision of chemical analyses will be assessed through the analysis of field duplicate samples, matrix spike/matrix spike duplicate (MS/MSD) samples, and matrix duplicate samples. Each QC

sample type will provide unique information regarding the precision of the sample collection and laboratory analytical programs, as described below:

- **Field duplicate samples:** Sampling and intralaboratory analytical precision
- **MS/MSD samples:** Intralaboratory analytical precision for organic analyses
- **Matrix duplicate samples:** Intralaboratory analytical precision for inorganic/physical parameters

General precision control limits for duplicate and MS/MSD samples are presented in the Appendix. When analytes are present in samples either near the method detection limit or substantially above the detection limit, these objectives may not be appropriate. Due to the process by which the RPD is calculated, concentrations near the detection limit or substantially above the detection limit skew the RPD values. If precision objectives are not met, an anomaly will be noted, and other QC data will be evaluated to determine the validity of the data.

3.2 ACCURACY

Accuracy refers to the degree of agreement of a measurement to the true value. The accuracy of a measurement system is impacted by errors introduced through the sampling process, field contamination, preservation, handling, sample matrix, sample preparation, and analytical techniques. Sampling accuracy will be evaluated based on the results of the analysis of field blanks, trip blanks, and equipment rinsate blanks. Analytical accuracy will be evaluated on the basis of MS samples, laboratory control samples (LCS) or blank spike samples, reference standards such as internal and surrogate standards, and method blank samples. MS samples and LCS or blank spike samples are analyzed at a frequency of one for every sample delivery group (SDG), or every twenty samples of a similar matrix, whichever is more frequent. Surrogate standards and internal calibration standards, where available, are added to every sample analyzed for organic constituents.

Accuracy is expressed in terms of percent recovery calculated by the following equation:

$$\% \text{ Recovery} = \frac{\text{Measured Spike Value} - \text{Unspiked Value}}{\text{Known Spike Value}} \times 100$$

The results of blank samples will provide information on positive bias resulting from field or laboratory artifacts. The results of spiked samples and reference standards are expressed as percent recovery and provide information on positive and negative bias. Objectives for reference standards will be based on the type analyzed. Appropriate spike and reference standard compounds and concentration levels are specified in the analytical methods. When MS compounds are not specified, they will be selected such that the range of analytes is fairly represented (chemical characteristics, retention times, and other appropriate criteria). If a surrogate is desired but not specified by the analytical methods, a similar non-target analyte may be used. In cases where the spiking levels for MS and/or surrogate standards are not provided, the spiking will be conducted at a mid-calibration concentration level. Accuracy objectives for MS samples and surrogate compounds, expressed in percent recovery, are presented in the Appendix.

3.3 REPRESENTATIVENESS

Representativeness is a qualitative expression of the degree to which sample data accurately represent the characteristics of a population, parameter variations at a sampling point, or an environmental condition they are intended to represent. Representativeness is maximized by selecting the appropriate number of samples and sampling locations, and utilizing appropriate and established sample collection, handling, and analysis techniques to provide information that reflects "true" site conditions.

3.4 COMPLETENESS

Completeness is defined as the percentage of measurements that are judged valid compared to the number of samples needed for the project. The project completeness value will be determined at the conclusion of the data validation phase and will be calculated by dividing the number of complete,

valid sample results by the total number of sample analyses listed in the FSP. As described in Section 10.2, the data validation process will determine if a particular data point is a valid result which is acceptable for use, an estimated result which is acceptable for use, or a rejected result which is unacceptable for use. Complete results are defined as results that are considered acceptable and usable when compared to QC criteria such as sample holding times and acceptable surrogate recoveries. Sample results that are considered rejected, unacceptable, and unusable when compared to QC criteria are listed as incomplete. Incomplete results may be used as part of the SI; however, these data will not be considered defensible. The completeness objective for field samples is 90 percent for this project.

3.5 COMPARABILITY

Comparability is a qualitative parameter that expresses the confidence that one data set may be compared to another. This goal is achieved through the use of standardized techniques to collect and analyze samples and appropriate units to report analytical results. These techniques are described in the FSP and this QAPjP. Generally, analytical techniques that will be used for this investigation are comparable to techniques used for previous investigations at WPNSTA Concord.

4.0 SAMPLING PROCEDURES

To achieve the SI objectives, a variety of field sampling activities will be performed. Sampling activities at WPNSTA Concord will include soil and groundwater sampling from 24 SWMU sites. Both soil and groundwater sampling and analysis will be conducted to evaluate the horizontal and vertical extent of contamination and evaluate groundwater quality. Samples will be collected using a variety of drilling and sampling methods, all of which are described in the FSP. With the exception of field analyses, all soil and water analyses will be conducted at the laboratory. Samples will be handled in a manner appropriate for the intended analyses. A summary of sample containers, holding times, and preservative requirements for all sampling parameters is presented in Tables 1 and 2. Analytical details, including procedures and analyte reporting limits, are presented in Section 8.0.

Because of the variation in site histories, sampling efforts will vary from site to site. Potential hazards and correlative health and safety measures to be implemented during the SI sampling activities

TABLE 1
SAMPLE CONTAINER, HOLDING TIME, AND PRESERVATIVE
REQUIREMENTS FOR SOIL SAMPLES

Parameter	Method Number	Sample Container	Preservative	Holding Time ^b
ORGANIC ANALYSES:				
Volatile Organic Compounds (VOC)	CLP ^c	6-in stainless steel ^d	Cool, 4°C	14 days
Semivolatile Organic Compounds (SVOC)	CLP	6-in stainless steel	Cool, 4°C	14 days/40 days
Organochlorine Pesticides and Polychlorinated Biphenyls (PCB)	CLP	6-in stainless steel	Cool, 4°C	14 days/40 days
Explosives	EPA 8330	6-in stainless steel	Cool, 4°C	14 days/40 days
Total Petroleum Hydrocarbons-Purgeable	CA LUFT & EPA 8015A	6-in stainless steel	Cool, 4°C	14 days
Total Petroleum Hydrocarbons-Extractable	CA LUFT & EPA 8015A	6-in stainless steel	Cool, 4°C	14 days/40 days
Total Oil and Grease	APHA 5520C	6-in stainless steel	Cool, 4°C	28 days
Benzene, Toluene, Ethylbenzene, and Xylenes (BTEX)	EPA 8020	6-in stainless steel	Cool, 4°C	14 days
INORGANIC/PHYSICAL ANALYSES:				
Metals	CLP	6-in stainless steel	Cool, 4°C	Hg, 28 days; others, 6 months
pH	CLP or EPA 9045A	6-in stainless steel	Cool, 4°C	72 hours
Total Organic Carbon (TOC)	ASTM D2974	6-in stainless steel	Cool, 4°C	28 days
Asbestos	EPA 600/M4-82-020	1 oz. plastic bottle	None	6 months

Notes:

- ^a Complete method references are presented in Section 8.0, Table 5
- ^b "x" days/"y" days refers to the maximum number of days from sampling to extraction/the maximum number of days from extraction to analysis
- ^c USEPA CLP Statement of Work for Inorganics Analyses, July 1990
- ^d USEPA CLP Statement of Work for Organic Analyses, February 1990
- ^e Auger will contain two 6-in stainless steel sleeves

TABLE 2
SAMPLE CONTAINER, HOLDING TIME, AND PRESERVATIVE
REQUIREMENTS FOR WATER SAMPLES

Parameter	Method Number ^a	Sample Container ^b	Sample Volume	Preservatives	Holding Time ^c
ORGANIC ANALYSES:					
Volatile Organic Compounds (VOC)	Modified CLP ^d	V	80 mL	HCl to pH < 2, 4°C	14 days
Semivolatile Organic Compounds (SVOC)	CLP	G	2L	Cool, 4°C	7 days/40 days
Organochlorine Pesticides and Polychlorinated Biphenyls (PCB)	CLP	G	2L	Cool, 4°C	7 days/40 days
Explosives	EPA 8330	G	2L	Cool, 4°C	7 days/40 days
Total Petroleum Hydrocarbons-Purgeable	CA LUFT & EPA 8015A	V	80 mL	HCl to pH < 2, 4°C	14 days
Total Petroleum Hydrocarbons-Extractable	CA LUFT & EPA 8015A	G	2L	Cool, 4°C	7 days/40 days
Total Oil and Grease	APHA 5520C	G	2L	HCl to pH < 2, 4°C	28 days
Benzene, Toluene, Ethylbenzene, Xylenes (BTEX)	EPA 8020	V	80 mL	HCl to pH < 2, 4°C	14 days
INORGANIC/PHYSICAL ANALYSES:					
Metals	CLP	P	1L	HNO ₃ to pH < 2	Hg, 28 days; others, 6 months
pH	CLP or EPA 150.1	P	100 mL	Cool, 4°C	2 days
Alkalinity	APHA 2320	P	1L	Cool, 4°C	14 days
Anions	EPA 300.0	P	1L	Cool, 4°C	28 days
Total Organic Carbon (TOC)	APHA 5310B	P	100 mL	Cool, 4°C	28 days
Total Dissolved Solids (TDS)	EPA 160.1	P	500 mL	Cool, 4°C	7 days
Asbestos	EPA 600/4-83-043	P	250 mL	None	6 months

Notes:

^a Complete method references are presented in Section 8.0, Table 6

^b Container Types: G = Amber glass with Teflon-lined lid, sized according to sample volume

P = Polyethylene container sized according to sample volume

V = VOC (VOA) vial with Teflon-lined septum, 40 mL size

^c "x" days/"y" days refers to the maximum number of days from sampling to extraction/the maximum number of days from extraction to analysis

^d USEPA CLP Statement of Work for Inorganic Analyses, July 1990 and USEPA CLP Statement of Work for Organic Analyses, February 1990

are described in the HSP. The FSP contains details on the sampling design for the sites and includes the following information:

- Site sampling rationale
- Sampling techniques and equipment
- Sample documentation, handling, and shipment
- Well installation design
- Sampling equipment preparation and decontamination

5.0 SAMPLE CUSTODY PROCEDURES

Documentation during sampling activities is essential to ensure proper sample identification, integrity, and custody. Standard sample custody procedures will be used to maintain and document sample integrity during collection, transportation, storage, and analysis. The FTL is responsible for proper sample handling and documentation that will allow for tracing the possession and handling of individual samples from the time of collection to laboratory receipt. The laboratory QA manager is responsible for establishing a sample control system that will allow for tracing sample possession from laboratory receipt to final sample disposition.

5.1 FIELD PROCEDURES

The sample custody and documentation procedures employed in the field are discussed below. All sample custody and documentation material will be completed in ballpoint or permanent ink by field personnel. Corrections will be made by drawing one line through the incorrect entry, entering the correct information, and initialling and dating the change.

5.1.1 Sample Custody

Sample custody materials discussed below include sample labels, custody seals, and chain-of-custody records.

5.1.1.1 Sample Labels

A sample label will be affixed to all sample containers sent to the laboratory. This identification label will be completed with the following information:

- Project name
- Site name
- Sample identification number
- Sample type (matrix)
- Container type
- Analysis required
- Date and time of sample collection
- Preservative used (if any)
- Filtering (if applicable)

The procedure for assigning an identification number to each sample is described in the FSP. After labeling, each sample will be refrigerated or placed in a cooler containing ice to maintain the sample temperatures at 4 degrees Celsius ($^{\circ}\text{C}$) \pm 2 degrees.

5.1.1.2 Custody Seals

Two seals will be placed on each sample cooler so that it must be broken to gain access to the content. Custody seals used during the course of the project will consist of security tape with the date and initials of the sampler. Clear tape will be placed over the custody seals to protect them from accidental breakage.

5.1.1.3 Chain-of-Custody Records

Chain-of-custody (COC) procedures provide an accurate written record tracing the possession of individual samples from the time of field collection through laboratory analysis. A sample is considered in custody if one of the following applies:

- It is in a person's possession.
- It is in view after being in physical custody.
- It is in a secure area after having been in physical custody.
- It is in a designated secure area, restricted to authorized personnel.

The COC record will be used to document the samples taken and the analyses requested. Information that field personnel will record on the COC record includes the following:

- Project name and number
- PRC technical contact (project chemist)
- PRC project manager
- Laboratory name
- Printed name and signature of samplers
- Sample identification number
- Sampling description/notes
- Date and time of collection
- Sample matrix
- Number and type of containers filled
- Preservatives used, if any
- Analyses requested
- Signatures of individuals involved in custody transfer (including printed name, company name, date, and time of transfer)
- Turnaround time/remarks (including airbill number, if appropriate)

Unused lines on the COC record will be crossed out. COC records initiated in the field will be signed, placed in a plastic bag, and taped to the inside of the shipping cooler used for sample transport. Signed COC records or airbills will serve as evidence of custody transfer between the field sampler and courier and between the courier and laboratory. Copies of the COC record and the airbill will be retained and filed by the sampler prior to shipment.

Occasionally, multiple coolers will be sent in one shipment to the laboratory. A single COC record may be used for samples distributed among multiple coolers. The outside of the coolers will be marked to indicate how many coolers are in the shipment.

5.1.2 Sample Documentation

Sampling activities during the field effort require several forms of documentation. While some custody documentation was discussed in Section 5.1.1 (sample labels, custody seals, and COC records), additional documentation is mandatory. The documents discussed in Section 5.1.1 are prepared to maintain sample identification and chain of custody, as well as provide records of significant events or observations. Other documents that will be prepared during this SI include the following:

- Logbooks
- Boring Logs
- Daily Field Progress Reports
- Well Construction Diagrams
- Notification of Field Variance

5.2 SHIPPING PROCEDURES

During the SWMU SI at WPNSTA Concord, all samples taken during the field effort are expected to be identified as environmental samples. Environmental samples are defined as soil or groundwater that is not saturated or mixed with product material. All Department of Transportation (DOT) regulations will be followed for packaging and shipment. The procedures outlined below meet these requirements, which are described in EPA guidance on field operations methods (1987b).

- The cooler will be filled with "bubble wrapped" sample bottles and packing material such as vermiculite or styrofoam "peanuts." Sufficient packing material will be used to prevent sample containers from making contact during shipment. Enough ice will be added to maintain sample temperatures at $4^{\circ}\text{C} \pm 2$ degrees.
- Each cooler will have a "temperature blank" included with the environmental samples. The temperature blank will consist of an unpreserved 40 milliliter (mL) volatile

organic analysis (VOA) vial at least half-filled with tap water. The temperature blank will be used by laboratory personnel to take an accurate thermometer reading of the cooler's temperature at the time of sample receipt.

- As mentioned in Section 5.1.1.3, the COC records going to the laboratory will be placed inside a plastic bag. The bag will be sealed and taped to the inside of the cooler lid. The airbill will be filled out before the samples are handed over to the carrier. The laboratory will be notified if the sampler suspects that the sample contains any substance for which the laboratory personnel should take safety precautions.
- The cooler will be closed and taped shut with strapping tape (filament-type) around both ends. If there is a drain in the cooler, it will be taped shut both inside and outside of the cooler.
- Two signed custody seals will be placed on the cooler, one on the front and one on the back. Wide clear tape will be placed over the seals to ensure against accidental breakage.
- The cooler will be handed over to the overnight carrier, such as Federal Express. A standard freightbill is necessary for shipping environmental samples.
- If a laboratory courier is used, the same packing method described above will be used. The cooler will be taped shut and two signed custody seals will be placed on the cooler. The courier will sign the COC record to document transfer of samples.

No samples will be held on site for more than 24 hours except during weekend field activities. Samples collected on the weekend will be stored under refrigeration and shipped the following Monday. Sampling for analytes with extremely short holding times (such as 24 hours) will not be scheduled as a weekend activity.

5.3 LABORATORY PROCEDURES

Upon receipt of a cooler, laboratory personnel will review the contents and will sign and retain the COC record and the freightbill. Information that will be recorded on the COC record, or other appropriate document, at the time of sample receipt will include the following:

- Status of the custody seals
- Temperature of the ice chest upon receipt

- Identification number of any broken sample containers
- Description of discrepancies between the COC records, sample labels, and requested analyses
- Observations of visible headspace in VOA vials indicating inadequate sample collection
- pH of water samples upon receipt; pH of VOA water samples will be documented at the time of analysis
- Storage location of the sample and sample extracts

Laboratory personnel will contact the project chemist regarding discrepancies in paperwork and sample preservation and will document nonconformances and corrective actions according to the laboratory's standard operating procedures (SOP). These procedures will be on file at the laboratory. Once samples have been accepted by the laboratory, checked, and logged in, they must be maintained in a manner consistent with custody and security requirements specified in the laboratory QA plan.

All samples and sample extracts will be assigned to a specific refrigerator within the laboratory. All laboratory refrigerators will be assigned a number and the refrigerator number will be recorded on an appropriate document for reference of the sample and extract locations. Only laboratory personnel will have access to the samples and will be required to sign a log sheet when removing or replacing samples and extracts from the refrigerators. These log sheets will provide a COC record as the sample moves within the laboratory. A COC record, similar in form to the COC record used for sampling procedures, will be completed for samples removed from the laboratory for disposal or other purposes.

6.0 CALIBRATION PROCEDURES AND FREQUENCY

Standard calibration procedures exist for all field equipment to be used for on-site monitoring and testing. Laboratory equipment used for sample analysis also have prescribed calibration procedures. These procedures, along with the required frequency of calibration, are discussed below.

6.1 FIELD MEASUREMENT EQUIPMENT

Measurement equipment to be used during field activities will be calibrated at the beginning of the field effort and at prescribed intervals. The FTL will be responsible for ensuring that the field equipment is properly calibrated. The frequency of calibration is dependent on the type and stability of equipment, the analytical methods employed, the intended use of the equipment, and the recommendations of the manufacturer. A summary of calibration requirements for the field equipment to be used at WPNSTA Concord is presented in Table 3. More detailed calibration procedures for equipment listed in Table 3 are provided in the specific manufacturer's instruction manuals.

All calibration information will be recorded in the site logbook. Calibration records for the piece of equipment will be readily available for reference. Should a piece of equipment become inoperable, it will be removed from service and tagged to indicate that repair, recalibration, or replacement is needed. The FTL will be notified so that prompt service can be performed or substitute equipment can be obtained. Any action of this type will be reported in a corrective action report. Additional details on the corrective action are presented in Section 12.0.

6.2 LABORATORY MEASUREMENT EQUIPMENT

Laboratory instrument calibration procedures and frequency will be performed in accordance with the referenced analytical method requirements (see Tables 5 and 6).

7.0 PREVENTIVE MAINTENANCE PROCEDURES

Regularly scheduled preventive maintenance will be performed to keep all field and laboratory equipment in good working condition.

7.1 FIELD EQUIPMENT

Detailed information regarding maintenance and servicing is available in the operation manual of the specific instrument to be used. Service and maintenance information will be recorded in site log

TABLE 3
FIELD EQUIPMENT CALIBRATION

Instrument Type	Standard Reference	Calibration Technique	Calibration Frequency	Acceptance Specifications
Specific Electric Conductance (EC) Meter	(1) Potassium chloride standard solution	Manufacturer's user manual	Twice daily (Prior to use and at end of the daily collection)	Standard solution
	(2) Calibration line	Manufacturer's user manual	Before each use	Red line value
pH Meter	Two buffers	Set range and span to anticipated field conditions	Twice daily	Buffer solution values
Temperature Meter with Temp Compensation Probe	Mercury thermometer	Manufacturer's user manual	Daily	Mercury thermometer value
Photoionization Detector	Gas standard kit (isobutylene)	Manufacturer's user manual	Twice daily	Indication of standard ppm concentrations and zero setting
Water Level Indicator	Measurement tape	Manufacturer's user manual	Before commencement of field activities	Measurement tape value
Turbidity Meter	Standard solution	Manufacturer's user manual	Before each use	Standard solution value
Combustible Gas Indicator	Standard calibration gas (pentane)	Manufacturer's user manual	Twice daily	Indication of standard percent of lower explosive limit and zero settings
Noise Dosimeter	Sound level calibrator	Manufacturer's user manual	Twice daily	Indication of standard value
Dust Monitor	Manufacturer's standard	Manufacturer's user manual	Daily	Standard reference value

books by field personnel. Instrument problems encountered during the field program will be recorded in the site logbook and, if possible, remedied in the field. Spare batteries will be kept on hand for replacement, if needed. Specific preventive maintenance practices will follow manufacturer's recommendations.

General preventive maintenance tasks for the field equipment are outlined in Table 4, including the type of equipment and regularly scheduled maintenance tasks. Common spare parts for all field equipment will be kept on site, readily available to all field personnel. Preventive maintenance tasks will be the responsibility of the FTL. Additional details on equipment maintenance procedures are presented in EPA guidance (1987b) and the operation manual for the specific equipment.

7.2 LABORATORY EQUIPMENT

A description of specific preventive maintenance procedures for laboratory equipment will be available in the laboratory QA plan or in written SOPs maintained by the selected laboratory, as required by Navy QA guidelines (NEESA 1988). These documents will identify the personnel responsible for major, preventive, and day-to-day maintenance; the frequency and type of maintenance; and the documentation procedures.

8.0 ANALYTICAL PROCEDURES AND REPORTING LIMITS

Analytical methods that will be used for the analysis of water and soil samples collected at WPNSTA Concord are presented in Tables 5 and 6. The subcontract laboratory will be certified by the CalEPA Environmental Laboratory Accreditation Program (ELAP) and approved by the Navy. The analyses, data reporting, and validation will be performed according to the specified QC program (NEESA 1988). Data will be reported as full EPA Contract Laboratory Program (CLP) and CLP-like data packages. The following sections provide details regarding the specific procedures that will be used to analyze samples.

TABLE 4
FIELD EQUIPMENT PREVENTATIVE MAINTENANCE

Instrument Type	Maintenance Tasks
Electrical Conductance (EC) Meter	<ul style="list-style-type: none"> • Check battery regularly. Recharge or replace. • Clean cell cup or electrode with deionized water after each reading. Rinse well.
pH Meter	<ul style="list-style-type: none"> • Check that pH electrode contains sufficient liquid. • Ensure that the outside of the probe stays moist. • Check sensor bulb for development of film if drifting is a problem. Lightly clean with liquid cleanser. • Rinse electrode with deionized water and replace storage cap after each use.
Temperature Meter	<ul style="list-style-type: none"> • Regularly clean and maintain the instrument and any accessories.
Photoionization Detector	<ul style="list-style-type: none"> • Check battery regularly. Recharge or replace. • Check UV lamp and ion chamber for cleanliness. • Clean probe if deposits develop on UV lamp surface or in ion chamber. • Clean air fan and pump if sand or dirt are present. • Test for leaks by plugging the inlet. • Regularly clean and maintain the instrument and accessories.
Water Level Indicator	<ul style="list-style-type: none"> • Check battery regularly. Recharge or replace. • Rinse probe and tape after use. • Inspect cable and all electrical connections for breaks and/or bare wire.
Turbidity Meter	<ul style="list-style-type: none"> • Check battery regularly. Recharge or replace. • Regularly clean and maintain the instrument and accessories.
Combustible Gas Indicator	<ul style="list-style-type: none"> • Check battery regularly. Recharge or replace. • Check alarm horn to ensure correct operation. • Test for leaks by plugging the inlet. • Inspect intake hose and nozzle.
Noise Dosimeter	<ul style="list-style-type: none"> • Check battery level indicator. Recharge or replace. • Regularly clean and maintain the instrument and accessories.
Dust Monitor	<ul style="list-style-type: none"> • Check battery level indicator. Recharge or replace. • Regularly clean and maintain the instrument and accessories.

TABLE 5
ANALYTICAL METHODS FOR SOIL SAMPLES

Parameter	Method Number	Reference ^a	Analyte List ^b	Technique ^c
ORGANIC ANALYSES:				
Volatile Organic Compounds (VOC)	CLP	CLP 1990	TCL + 10 TIC	GC/MS
Semivolatile Organic Compounds (SVOC)	CLP	CLP 1990	TCL + 20 TIC	GC/MS
Organochlorine Pesticides and Polychlorinated Biphenyls (PCB)	CLP	CLP 1990	TCL	GC
Explosives	EPA 8330	SW-846	See method	HPLC
Total Petroleum Hydrocarbons-Purgeable	CA LUFT & EPA 8015A	CA LUFT & SW-846	Gasoline	GC
Total Petroleum Hydrocarbons-Extractable	CA LUFT & EPA 8015A	CA LUFT & SW-846	Diesel and Motor Oil	GC
Total Oil and Grease	APHA 5520C	APHA	Total Oil and Grease	IR
Benzene, Toluene, Ethylbenzene, Xylenes (BTEX)	EPA 8020	SW-846	BTEX	GC
INORGANIC/PHYSICAL ANALYSES:				
Metals	CLP	CLP 1990	TAL	ICP & AA
pH	CLP or EPA 9045A	CLP 1990 or SW-846	pH	pH Meter
Total Organic Carbon (TOC)	ASTM D2974	ASTM	TOC	Carbon Analyzer
Asbestos	EPA 600/M4-82-020	EPA	Asbestos	PLM
Notes:				
^a CLP: Contract Laboratory Program				
CLP 1990: USEPA CLP Statement of Work for Organic Analyses, February 1990				
USEPA CLP Statement of Work for Inorganic Analyses, July 1990				
SW-846: EPA Test Methods for Evaluating Solid Waste, 1986 with updates through 1990				
CA LUFT: State of California Leaking Underground Fuel Tank Field Manual, 1989				
ASTM: American Society for Testing and Materials				
EPA: See document number listed under method number				
APHA 1992: Standard Methods for the Examination of Water and Wastewater, 18th ed.				
^b TCL: Target Compound List				
TIC: Tentatively Identified Compounds				
TAL: Target Analyte List				
GC: Gas Chromatography				
MS: Mass Spectrometry				
ICP: Inductively Coupled Plasma Emission Spectroscopy				
AA: Atomic Absorption Spectroscopy				
IR: Infrared Spectroscopy				
PLM: Polarized Light Microscopy				
HPLC: High Performance Liquid Chromatography				

TABLE 6
ANALYTICAL METHODS FOR WATER SAMPLES

Parameter	Method Number	Reference ^a	Analyte List ^b	Technique ^c
ORGANIC ANALYSES:				
Volatile Organic Compounds (VOC)	Modified CLP	CLP 1990	TCL + 10 TIC	GC/MS
Semivolatile Organic Compounds (SVOC)	CLP	CLP 1990	TCL + 20 TIC	GC/MS
Organochlorine Pesticides and Polychlorinated Biphenyls (PCB)	CLP	CLP 1990	TCL	GC
Explosives	EPA 8330	SW-846	(see Table 11)	HPLC
Total Petroleum Hydrocarbons-Purgeable	CA LUFT & EPA 8015A	CA LUFT & SW-846	Gasoline	GC
Total Petroleum Hydrocarbons-Extractable	CA LUFT & EPA 8015A	CA LUFT & SW-846	Diesel and Motor Oil	GC
Total Oil and Grease	APHA 5520C	APHA 1992	Total Oil and Grease	IR
Benzene, Toluene, Ethylbenzene, Xylenes (BTEX)	EPA 8020	SW-846	BTEX	GC
INORGANIC/PHYSICAL ANALYSES:				
Metals	CLP	CLP 1990	TAL	ICP & AA
pH	CLP or EPA 9040	CLP 1990 or SW-846	pH	pH Meter
Alkalinity	APHA 2320	APHA 1992	Calcium Carbonate	Titration
Anions	EPA 300.0	EPA 1984	(see Table 11)	Ion Chromatography
Total Organic Carbon (TOC)	APHA 5310B	APHA 1992	TOC	Carbon Analyzer
Total Dissolved Solids (TDS)	EPA 160.1	EPA 1983	TDS	Gravimetric
Asbestos	EPA 600/4-83-043	EPA	Asbestos	TEM
Notes:				
<ul style="list-style-type: none"> ^a CLP: Contract Laboratory Program CLP 1990: USEPA CLP Statement of Work for Organic Analyses, February 1990 USEPA CLP Statement of Work for Inorganic Analyses, July 1990 EPA 1983: Methods for Chemical Analysis of Water and Wastes, March 1983 SW-846: EPA Test Methods for Evaluating Solid Waste, 1986 with updates through 1990 CA LUFT: State of California Leaking Underground Fuel Tank Field Manual, 1989 APHA 1992: Standard Methods for the Examination of Water and Wastewater, 18th ed. EPA 1984: The Determination of Inorganic Anions in Water by Ion Chromatography EPA: See document number listed under method number 				
<ul style="list-style-type: none"> ^b TCL: Target Compound List TIC: Tentatively Identified Compounds TAL: Target Analyte List GC: Gas Chromatography MS: Mass Spectrometry ICP: Inductively Coupled Plasma Emission Spectroscopy AA: Atomic Absorption Spectroscopy IR: Infrared Spectroscopy TEM: Transmission Electron Microscopy HPLC: High Performance Liquid Chromatography 				

8.1

VOLATILE ORGANIC COMPOUNDS

The CLP routine analytical services (RAS) volatile organic compound (VOC) analysis will be performed on WPNSTA Concord soil samples while a modified CLP method which specifies a 25-milliliter (mL) purge volume will be performed on water samples. The additional sample volume is the only modification to the CLP method. The CLP VOC is a purge-and-trap gas chromatography/mass spectrometry (GC/MS) method applicable to the determination of purgeable organics in solid or aqueous samples. An inert gas is bubbled through a measured aliquot of sample contained in a specially designed purging chamber at 40°C for soil samples and at ambient temperatures for the water samples. The volatile compounds are temporarily held on a carbon filter which is later heated to release the sample to the GC. The GC instrument is temperature programmed to separate the purgeables which are then detected by the mass spectrometer. The target compound list (TCL) components are identified by mass spectra and retention time. The TCL will be quantified in both water and soil samples. In addition to the TCL, library searches will be performed to identify the ten highest concentration non-target compounds in each sample; these are commonly known as the tentatively identified compounds (TIC). CLP contract required quantitation limits (CRQL) for TCL VOCs and for the modified water TCL VOCs are listed in Table 7.

8.2

SEMIVOLATILE ORGANIC COMPOUNDS

The CLP semivolatile organic compounds (SVOC) analysis is a GC/MS method applicable to the determination of the organic compounds which can be partitioned into an organic solvent and are amenable to GC analysis. A measured aliquot of sample is solvent-extracted by sonication (soil) or separatory funnel/continuous extractor (water). The extract is dried, concentrated, and analyzed by GC/MS. The GC instrument is temperature programmed to separate the extractables, which are then detected by the mass spectrometer. The mass spectra and retention times are used to identify TCL components. In addition, library searches will be performed to identify the 20 highest concentration TICs. For water analysis, the following analytes have quantitation limits lower than the normal CLP CRQLs: 1,2-dichlorobenzene, 1,3-dichlorobenzene, and 1,4-dichlorobenzene. This will be achieved by reporting concentrations as low as the instrument sensitivity and instrument detection limit allow. Table 8 presents the compound list and CLP CRQLs for SVOCs.

TABLE 7
VOLATILE ORGANIC COMPOUNDS
CONTRACT REQUIRED QUANTITATION LIMITS

Volatiles	Water ($\mu\text{g/L}$)	Soil/Sediment ($\mu\text{g/kg}$)
	CRQL ^a	CRQL ^b
Chloromethane	2	10
Bromomethane	1 ^c	10
Vinyl Chloride	0.5 ^c	10
Chloroethane	2	10
Methylene Chloride	2	10
Acetone	2	10
Carbon Disulfide	2	10
1,1-Dichloroethene	2	10
1,1-Dichloroethane	2	10
1,2-Dichloroethene	0.5 ^c	10
2-Butanone	2	10
1,1,1-Trichloroethane	2	10
Carbon Tetrachloride	0.5 ^c	10
Vinyl Acetate	2	10
Bromodichloromethane	2	10
1,2-Dichloropropene	2	10
cis-1,3-Dichloropropene	2	10
Trichloroethene	2	10
Dibromochloromethane	2	10
1,1,2-Trichloroethane	2	10
Benzene	0.5 ^c	10
trans-1,3-Dichloropropene	0.5 ^c	10
Bromoform	2	10
4-Methyl-2-pentanone	2	10
2-Hexanone	2	10
Tetrachloroethene	2	10
Toluene	2	10
1,1,2,2-Tetrachloroethane	2	10
Chlorobenzene	2	10
Ethylbenzene	2	10
Styrene	2	10
Total Xylenes	2	10

Notes:

- ^a Quantitation limits for water analysis are for a modified CLP method and are lower than the normal CLP CRQLs.
- ^b Quantitation limits listed for soil/sediment analysis are based on wet weight. The quantitation limits reported by the laboratory for soil/sediment, calculated on dry weight basis as required by the contract, will be higher.
- ^c A detection limit of 0.5 $\mu\text{g/L}$ (or 1.0 $\mu\text{g/L}$ for bromomethane) is required to meet the California MCL. Positive results can be estimated to this concentration.

TABLE 8
SEMIVOLATILE ORGANIC COMPOUNDS
CONTRACT REQUIRED QUANTITATION LIMITS

Semivolatiles	Water ($\mu\text{g/L}$)	Soil/Sediment* ($\mu\text{g/kg}$)
	CRQL	CRQL
Phenol	10	330
bis(2-Chloroethyl)ether	10	330
2-Chlorophenol	10	330
1,3-Dichlorobenzene	5 ^b	330
1,4-Dichlorobenzene	5 ^b	330
Benzyl alcohol	10	330
1,2-Dichlorobenzene	5 ^b	330
2-Methylphenol	10	330
bis(2-Chloroisopropyl)ether	10	330
4-Methylphenol	10	330
N-Nitroso-di-n-propylamine	10	330
Hexachloroethane	10	330
Nitrobenzene	10	330
Isophorone	10	330
2-Nitrophenol	10	330
2,4-Dimethylphenol	10	330
bis(2-Chloroethoxy)methane	10	330
2,4-Dichlorophenol	10	330
1,2,4-Trichlorobenzene	10	330
Naphthalene	10	330
4-Chloroaniline	10	330
Hexachlorobutadiene	10	330
4-Chloro-3-methylphenol (para-Chloro-meta-cresol)	10	330
2-Methylnaphthalene	10	330
Hexachlorocyclopentadiene	10	330
2,4,6-Trichlorophenol	10	330
2,4,5-Trichlorophenol	25	800
2-Chloronaphthalene	10	330
2-Nitroaniline	25	800
Dimethylphthalate	10	330
Acenaphthylene	10	330
2,6-Dinitrotoluene	10	330
3-Nitroaniline	25	800
Acenaphthene	10	330
2,4-Dinitrophenol	25	800
4-Nitrophenol	25	800
Dibenzofuran	10	330
2,4-Dinitrotoluene	10	330

TABLE 8
SEMIVOLATILE ORGANIC COMPOUNDS
CONTRACT REQUIRED QUANTITATION LIMITS (Continued)

Semivolatiles	Water ($\mu\text{g/L}$)	Soil/Sediment* ($\mu\text{g/kg}$)
	CRQL	CRQL
Diethylphthalate	10	330
4-Chlorophenyl-phenyl ether	10	330
Fluorene	10	330
4-Nitroaniline	25	800
4,6-Dinitro-2-methylphenol	25	800
N-nitrosodiphenylamine	10	330
4-Bromophenyl-phenylether	10	330
Hexachlorobenzene	10	330
Pentachlorophenol	25	800
Phenanthrene	10	330
Anthracene	10	330
Carbazole	10	330
Di-n-butylphthalate	10	330
Fluoranthene	10	330
Pyrene	10	330
Butylbenzylphthalate	10	330
3,3'-Dichlorobenzidine	10	330
Benzo(a)anthracene	10	330
Chrysene	10	330
bis(2-Ethylhexyl)phthalate	6	330
Di-n-octylphthalate	10	330
Benzo(b)fluoranthene	10	330
Benzo(k)fluoranthene	10	330
Benzo(a)pyrene	10	330
Indeno(1,2,3-cd)pyrene	10	330
Dibenzo(a,h)anthracene	10	330
Benzo(g,h,i)perylene	10	330

Notes:

- ^a Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits reported by the laboratory for soil/sediment, calculated on dry weight basis as required by the contract, will be higher.
- ^b A detection limit of 5 $\mu\text{g/L}$ is required to meet the California MCL. Positive results can be estimated to this level.

8.3

ORGANOCHLORINE PESTICIDES AND POLYCHLORINATED BIPHENYLS

The standard CLP RAS procedure will be used for analysis of organochlorine (OC) pesticides/PCBs in WPNSTA Concord soil and water samples. A measured aliquot of sample is solvent-extracted using sonication (soil) or separatory funnel/continuous extractor (water). The extract is dried, solvent-exchanged, and concentrated. The extract is directly injected onto a GC which is temperature programmed to separate the analytes and uses an electron capture detector (ECD) to detect the analytes. The GC analysis is performed using two dissimilar columns, which produce unique retention times for each analyte. A retention time match on both columns is used to identify target analytes. Compounds and CLP CRQLs for OC pesticides/PCBs are presented in Table 9. For water analysis, the following analytes have quantitation limits lower than the normal CLP CRQLs: heptachlor epoxide, toxaphene, and all Aroclors. This will be achieved by reporting concentrations as low as the instrument sensitivity and instrument detection limit allow.

8.4

METALS

Soil and water samples will be analyzed for metals. Analyses will be performed according to CLP RAS procedures, and metal analytes on the Target Analyte List (TAL) will be measured in the samples. A measured aliquot of sample is digested using appropriate combinations of hydrochloric acid (HCl), nitric acid (HNO₃), and hydrogen peroxide. Digested samples are analyzed by inductively coupled plasma atomic emission spectroscopy (ICP), graphite furnace atomic absorption (GFAA), and cold vapor atomic absorption (CVAA).

ICP analysis allows the simultaneous multi-elemental determination of metals by measuring the element-emitted light by optical spectrometry. Element specific emission spectra are dispersed by a grating spectrometer and the intensities of the lines are monitored by photomultiplier tubes.

GFAA analysis allows the individual analysis of arsenic, lead, selenium, and thallium to provide lower detection limits. In the furnace, the sample is evaporated to dryness, charred, and atomized. A light beam from a hollow cathode lamp or an electrodeless discharge lamp (EDL) is directed through the tube into a monochromator, and onto a detector that measures the amount of light.

TABLE 9
ORGANOCHLORINE PESTICIDES AND PCBs
CONTRACT REQUIRED QUANTITATION LIMITS

	Water ($\mu\text{g/L}$)	Soil/Sediment* ($\mu\text{g/kg}$)
	CRQL	CRQL
OC Pesticides		
alpha-BHC	0.05	1.7
beta-BHC	0.05	1.7
delta-BHC	0.05	1.7
gamma-BHC (Lindane)	0.05	1.7
Heptachlor	0.05	1.7
Aldrin	0.05	1.7
Heptachlor epoxide	0.01 ^b	1.7
Endosulfan I	0.05	1.7
Dieldrin	0.10	3.3
4,4'-DDE	0.10	3.3
Endrin	0.10	3.3
Endosulfan II	0.10	3.3
4,4'-DDD	0.10	3.3
Endosulfan sulfate	0.10	3.3
4,4'-DDT	0.10	3.3
Methoxychlor	0.50	17.0
Endrin ketone	0.10	3.3
Endrin aldehyde	0.10	3.3
alpha-Chlordane	0.05	1.7
gamma-Chlordane	0.05	1.7
Toxaphene	3.0 ^b	170
PCBs		
Aroclor-1016	0.5 ^b	33.0
Aroclor-1221	0.5 ^b	67.0
Aroclor-1232	0.5 ^b	33.0
Aroclor-1242	0.5 ^b	33.0
Aroclor-1248	0.5 ^b	33.0
Aroclor-1254	0.5 ^b	33.0
Aroclor-1260	0.5 ^b	33.0

Notes:

- ^a Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits reported by the laboratory for soil/sediment, calculated on a dry weight basis as required by the contract, will be higher.
- ^b Quantitation limits for water analyses are lower than the normal CLP CRQLs in order to meet the California MCL. Positive results can be estimated to this concentration.

Because the wavelength of light beam is characteristic of a single metal, the light energy absorbed is a measure of that metal's concentration.

The CVAA technique is based upon the absorption by mercury vapor of radiation at 253.7 nanometers. The mercury is reduced to the elemental state and aerated from solution in a closed system. The mercury vapor passes through a cell positioned in the light path of an atomic absorption spectrophotometer. Absorbance is measured as a function of mercury concentration.

The CLP CRDLs for all metals are presented in Table 10. The following analytes have quantitation limits lower than the normal CLP CRDLs: aluminum, antimony, beryllium, and thallium.

8.5 EXPLOSIVES

EPA Method 8330 (EPA 1986) is a high performance liquid chromatography (HPLC) method applicable to the determination of nitroexplosives in soil and water matrices. A measured amount of sample is extracted with an organic solvent using an appropriate extraction technique (EPA Method 3510 or 3550). The extract is filtered and diluted with water. The analytes are separated by HPLC using an isocratic elution and detected using ultraviolet absorbance (UV) at 230 nanometers. The CRDL for the nitroexplosive compounds are presented in Table 11.

8.6 TOTAL PETROLEUM HYDROCARBONS-PURGEABLE

The procedures described in Appendix D of the Leaking Underground Fuel Tank (LUFT) Field Manual (CA 1989) and in SW-846 Method 8015A (EPA 1986) will be used for analysis of total petroleum hydrocarbons (TPH)-purgeable in WPNSTA Concord soil and water samples. This is a purge-and-trap GC method applicable to the determination of purgeable petroleum organic hydrocarbons in solid and aqueous samples. An inert gas is bubbled through a measured aliquot of sample contained in a specially designed purging chamber at 40°C for soil samples and at ambient temperatures for the water samples. The volatile compounds are temporarily held on a carbon filter which is later heated to release the sample to the GC. The GC is temperature programmed to separate the analytes and uses a flame ionization detector (FID) to detect the analytes. Hydrocarbons detected at retention times between those of hexane (containing 6 carbon atoms--C6) and dodecane

**TABLE 10
METALS
CONTRACT REQUIRED DETECTION LIMITS**

Metals	Water ($\mu\text{g/L}$)	Soil/Sediment* (mg/kg)
	CRDL	CRDL
Aluminum	50 ^b	12.5 ^b
Antimony	6 ^b	1.2 ^b
Arsenic	10	2
Barium	200	40
Beryllium	4 ^b	1
Cadmium	5	1
Calcium	5,000	1,050
Chromium	10	2
Cobalt	50	10
Copper	25	5
Iron	100	20
Lead	3	1
Magnesium	5,000	1,000
Manganese	15	3
Mercury	0.2	0.1
Nickel	40	8
Potassium	5,000	1,000
Selenium	5	1
Silver	10	2
Sodium	5,000	1,000
Thallium	2^b	0.5^b
Vanadium	50	10
Zinc	20	4

Notes:

- ^a Quantitation limits listed for soil are based on wet weight. The quantitation limits reported by the laboratory for soil, calculated on dry weight basis as required by the contract, will be higher.
- ^b Quantitation limits for some metals are lower than the normal CLP CRDLs in order to meet the California MCL.

TABLE 11
MISCELLANEOUS ANALYSES
CONTRACT REQUIRED DETECTION LIMITS

Analyte	Soil/Sediment ^a	Water
	CRDL	CRDL
Explosive Compounds		
HMX	5.0 mg/kg	250 µg/L
RDX	2.5 mg/kg	125 µg/L
1,3,5-Trinitrobenzene	0.5 mg/kg	25 µg/L
1,3-Dinitrobenzene	0.5 mg/kg	25 µg/L
Tetryl	0.5 mg/kg	25 µg/L
Nitrobenzene	1.5 mg/kg	75 µg/L
2,4,6-Trinitrotoluene	0.5 mg/kg	25 µg/L
2,4-Dinitrotoluene	0.5 mg/kg	25 µg/L
2,6-Dinitrotoluene	0.5 mg/kg	25 µg/L
2-Nitrotoluene	0.5 mg/kg	25 µg/L
3-Nitrotoluene	0.5 mg/kg	25 µg/L
4-Nitrotoluene	0.5 mg/kg	25 µg/L
Aromatic Volatiles		
Benzene	5.0 µg/kg	0.5 µg/L
Ethylbenzene	5.0 µg/kg	0.5 µg/L
Toluene	5.0 µg/kg	0.5 µg/L
Xylenes	15.0 µg/kg	1.5 µg/L
TPH-Purgeable	0.5 mg/kg	50 µg/L
TPH-Extractable	10 mg/kg	100 µg/L
Total Oil and Grease	100 mg/kg	5 mg/L
Alkalinity	NA ^b	20 mg CaCO ₃ /L
Anions		
Chloride	NA	0.5 mg/L
Fluoride	NA	0.5 mg/L
Nitrite-N plus Nitrate-N	NA	0.1 mg/L
Ortho-Phosphate-P	NA	0.05 mg/L
Sulfate	NA	0.5 mg/L
TOC	100 mg/kg	1 mg/L
TDS	NA	10 mg/L
Asbestos	10 fibers/kg	1 fiber/mL

Notes:

- ^a Quantitation limits listed for soil are based on wet weight. The quantitation limits reported by the laboratory for soil, calculated on dry weight basis as required by the contract, will be higher.
- ^b NA: Not Applicable

(C12), as well as a pattern comparison to a gasoline standard will be use to identify gasoline hydrocarbons. The CRDL for TPH-purgeable is presented in Table 11.

8.7 TOTAL PETROLEUM HYDROCARBONS-EXTRACTABLE

The procedures described in Appendix D of the LUFT Field Manual (CA 1989) and in SW-846 Method 8015A (EPA 1986) will be used for analysis of TPH-extractable in WPNSTA Concord soil and water samples. A measured aliquot of sample is solvent-extracted using sonication (soil) or separatory funnel/continuous extractor (water). The extract is dried, solvent-exchanged, and concentrated. The extract is directly injected onto a GC which is temperature programmed to separate the analytes and uses an FID to detect the analytes. Hydrocarbons detected at retention times between those of decane (containing 10 carbon atoms--C10) and n-tricosane (C23), as well as a pattern comparison to a diesel standard will be use to identify diesel hydrocarbons. Motor oil (consisting of hydrocarbons eluting at retention times after n-tricosane [C23]), and other unknown extractable hydrocarbons may also be identified. The CRDL for TPH-extractable is presented in Table 11.

8.8 TOTAL OIL AND GREASE

Total oil and grease will be analyzed according to the Standard Methods 5520C (APHA 1992) and ~~5520E~~. Extraction of soil samples will follow the procedures described in the SW-846 Method 9071A (EPA 1986). This method is a measure of total animal, vegetable, mineral, and petroleum oils. A 113-fluorocarbon is used to extract the oils from the soil or groundwater sample. The sample is then analyzed, without evaporation, using infrared (IR) spectroscopy.

8.9 ADDITIONAL PARAMETERS

Soil and groundwater samples from WPNSTA Concord will be analyzed for total organic carbon (TOC), pH, asbestos, and the aromatic volatile compounds benzene, ethylbenzene, toluene, and xylenes to fully characterize the possible presence of chemicals of potential concern. In addition, selected groundwater samples will be analyzed for alkalinity, anions (chloride, fluoride, nitrate/nitrite, ortho-phosphate, and sulfate), and total dissolved solids (TDS) to determine water quality. The

proposed analytical methodologies for these analyses are listed in Tables 5 and 6. The CRDLs for these parameters are listed in Table 11.

9.0 INTERNAL QUALITY CONTROL CHECKS AND FREQUENCY

Internal QC checks were developed to ensure accuracy and precision during field sampling and measurement as well as laboratory analysis. As described below, field checks will be conducted on a regularly scheduled basis. Laboratory checks will be conducted according to referenced analytical methods. A discussion of measurements and procedures for internal QC is presented in this section.

9.1 FIELD QUALITY CONTROL SAMPLES

Field QC samples are collected for laboratory analysis to check sampling and analytical precision, accuracy, and representativeness. The QC samples for this project include the samples described in the following sections. These samples are consistent with guidelines presented in the Navy QA requirements (NEESA 1988). The requirements presented in this section meet or exceed those in regulatory guidance (EPA Region 9, 1990). The field QC samples is presented in Table 12.

9.1.1 Field Duplicate Samples

A field duplicate sample is collected at the same time and from the same source as the original sample but submitted to the laboratory separately to assess the consistency of the overall sampling and analytical system. Field duplicates will be collected and analyzed for water samples on a 10 percent basis or one sample per week, whichever is greater. The samples will be collected, numbered, packaged, and sealed in the same manner as other samples and submitted blind to the laboratory.

9.1.2 Field Blanks

Field blanks consist of the source water used in detergent wash and steam cleaning decontamination activities. The domestic water source on the base will be used for decontamination and well construction during the investigation. This water may be obtained at taps or fire hydrants as approved by the public works department. At a minimum, one field blank from each sampling event

**TABLE 12
FIELD QUALITY CONTROL SAMPLES**

Sample Type	Frequency of Sampling and Analysis
Field Duplicate	10% for water samples
Field Blank	1/source/event for all analytes ^a
Equipment Rinsate Blank	1/day
Trip Blank ^b	1/cooler

Notes:

- * A sampling event is defined as a period of time during which drilling and sampling activities occur. An extended absence, followed by a return to the site (between bimonthly sampling rounds, for example) would constitute two events.
- b Trip blanks accompany water VOC samples only.

will be collected and analyzed for the same parameters as the samples collected during the event. A sampling event is defined as a period of time during which drilling and sampling activities occur; an extended absence followed by a return to the site would constitute two events.

9.1.3 Equipment Rinsate Blanks

Equipment rinsate blanks are used to evaluate sampling device cleanliness. The equipment rinsate blanks will be collected after a sample collection device is subjected to standard decontamination procedures. Appropriate water for the intended analysis will be poured over or through the sampling device, collected in a sample container, and sent blind to the laboratory for analysis. Deionized-distilled water will be used and will be analyzed for all parameters. The equipment rinsates will be collected on a daily basis.

9.1.4 Trip Blanks

Trip blanks are used to identify possible sample contamination originating from sample transport, shipping, or site conditions. Trip blanks will be prepared in the laboratory using organic-free water. They will then be shipped with the sample containers to the field, stored with the sample containers, and returned to the laboratory with the VOC samples. One trip blank will accompany each cooler containing VOC samples and will only be analyzed for VOCs, since these compounds have the greatest potential for cross contamination.

9.2 FIELD MEASUREMENT QUALITY CONTROL PRACTICES

Field measurements will be conducted as part of the sampling program. These measurements and the associated quality control practices will include:

- pH, specific conductance, turbidity, and temperature - will be measured in duplicate at a frequency of 10 percent
- Water levels - will be measured in duplicate at a frequency of 10 percent
- PID readings - will be measured in duplicate at a frequency of 10 percent

Subcontractors conducting field activities will also follow QC practices as provided in their SOPs. Results from field measurements and QC checks will be compared to the PARCC criteria presented in Section 3.0. If the results fail to meet the objectives set for data quality, calibration of the instrument in question will be conducted as described in Section 6.1. Should discrepancies continue, general maintenance tasks listed in Section 7.1 will be performed. If the instrument still fails to meet the QC criteria, it will be removed from service and replaced.

9.3 LABORATORY QUALITY CONTROL SAMPLES

In addition to the QC samples collected in the field, the laboratory will analyze other QC samples that measure the laboratories analytical accuracy, precision, and representativeness. Laboratory QC samples will be analyzed at the frequency specified in the analytical methods employed. The following laboratory QC samples will be analyzed as appropriate. The specific schedule for the analysis of laboratory QC samples will be included in the laboratory QA plan or in laboratory SOPs.

9.3.1 Method Blanks

Method blanks provide a measure of the combined contamination from the laboratory water, the instrument, the reagents, and the sample preparation steps. They are subjected to the entire preparation process. Method blanks will be analyzed at a frequency established by the referenced analytical methods. The method blanks aid in distinguishing between low level field contamination and laboratory contamination. Concentrations which are suspected to be the result of laboratory contamination will be evaluated as part of the data validation process.

9.3.2 Matrix Spike, Matrix Spike Duplicate, and Matrix Duplicate Samples

MS/MSD samples will be selected in advance by the FTL in coordination with the laboratory to ensure ample sample volume. As outlined in EPA guidance (EPA 1987b), MS/MSD pairs (organic) or matrix spike and matrix duplicate (inorganic) will be analyzed at a rate of 5 percent, or at a frequency of one for every SDG, or type of matrix, or twenty samples, whichever is more frequent. MS/MSD soil samples will be obtained from the same container as the original sample. Triplicate sample volume will be collected in the field for MS/MSD water samples. The MS/MSD samples will

be labeled appropriately (the same sample number will be attached to each additional volume collected for water MS/MSD samples) and will be identified as an MS/MSD sample on the COC records.

Before sample preparation at the laboratory, the organic MS/MSD and inorganic MS samples will be spiked with appropriate analytes and analyzed according to the referenced method. Results from the analysis of the MSD and matrix duplicate samples will be used to evaluate the effect of the matrix on precision and accuracy. The percent recoveries will be calculated for each of the spiked analytes detected and used to assess analytical accuracy in the matrix spike analysis. The RPD between MS and MSD samples or original and matrix duplicate samples will be calculated and used to assess analytical precision.

9.3.3 Laboratory Control Samples

The LCS or blank spike sample is a known concentration of target analytes added to a controlled interference-free matrix. The LCS is used to measure the laboratory accuracy in the absence of matrix interferences. In general, an LCS will accompany each MS/MSD (organic) or MS (inorganic) sample analysis.

10.0 DATA REDUCTION, VALIDATION, AND REPORTING

Accurate data reduction, validation, and reporting methods are essential in summarizing information to support conclusions. Proper techniques for both field and laboratory activities are described in this section.

10.1 DATA REDUCTION

Field and laboratory data reduction techniques are presented below.

10.1.1 Field Data

No data reduction will be necessary for field chemical and physical measurements. All readings will be recorded directly from the instruments. The following units will be used when recording the data:

- **PID readings:** Reported to 0.1 ppm
- **Water levels:** Reported to the nearest 0.01 feet after measurements agree
- **Water temperature:** Reported to 1 degree unit (Celsius)
- **pH:** Digital reading rounded to 0.1 pH units
- **Specific conductance:** Reported to 10 micro-mhos per centimeter
- **Turbidity:** Reported to 0.02 nephelometric turbidity units (NTU)
- **Survey data:** Well casing elevations surveyed to 0.01 feet; coordinates to 1.0 feet

10.1.2 Laboratory Data

Reduction of laboratory analytical data will be performed using the format specified in the EPA and CLP methods, and will conform with all Navy specifications. Each of the methods contain a thorough description of the equations used for calculating a concentration or value for the measured parameter. For soil samples, data will be reported on a dry weight basis.

10.2 DATA VALIDATION

Data validation is a systemic process for reviewing and qualifying data, to provide assurance that the data are adequate for their intended use. During the validation process, all results will be identified as either acceptable for use, estimated and acceptable for use, or rejected and unacceptable for use. Results which are considered rejected will be retained in the data base but will not be used in quantitative evaluations. Estimated and rejected data can result from improper sampling or analytical methodology, matrix interferences, errors in data transcription, and changes in instrument performance. Erroneous results found during data validation will be identified and corrected. The validation methods for field and laboratory activities are presented below.

10.2.1 Field Data

QA personnel will validate field data through reviews of data sets to identify inconsistencies or anomalous values. Any inconsistencies discovered will be resolved immediately, if possible, by

seeking clarification from those personnel responsible for data collection. All field personnel will be responsible for following the sampling and documentation procedures described in the FSP and QAPP to ensure that defensible and justifiable data are obtained.

10.2.2 Laboratory Data

Laboratory personnel will assess data at the time of analysis and reporting through reviews of the raw data for any nonconformances of the analytical method protocols. Detailed procedures for laboratory validation and corrective action are described in the laboratory QA plan.

Upon receipt of the analytical data packages from the laboratory, project personnel will check for the following items:

- Data packages include all requested deliverables.
- Samples were analyzed as requested.

Data validation will be performed by a subcontractor independent of the project laboratory. At a minimum, data will be validated according to the CLP criteria outlined in the following documents:

- Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses (EPA 1988)
- National Functional Guidelines for Organic Data Review (EPA 1990c)

The following field and laboratory QC criteria will be reviewed for all samples at a minimum: holding times, calibration, laboratory preparation blanks, blanks collected during sampling, surrogates, LCSs, MS/MSDs, matrix duplicates, internal standards, and serial dilutions as applicable. In addition, 10 percent of the analytical data will be randomly selected for full validation. Full validation includes: interference check samples, GFAA QC, GC/MS tuning, compound identification and quantitation, TIC identification, system performance, method compliance, and review of associated raw data.

10.3 DATA REPORTING

Following data validation, both field and laboratory data will be reported according to procedures described in this section. All summary tables and figures produced will be checked for errors with the original data reports prior to including them in the final report.

10.3.1 Field Data

Field data, recorded during the sampling activities, will be compiled and reported in summary tables for review. Corresponding descriptions and units will also be provided to accurately reflect the field conditions.

10.3.2 Laboratory Data

Laboratory data reporting format is dependent on the specific laboratory used for the sample analyses. The following items are required from the laboratory in the presentation of the data:

- The final data presentation will be checked in accordance with data verification requirements and approved and certified by the laboratory manager.
- Data packages shall include all required QC summary sheets as well as supporting raw data as specified by CLP reporting protocol and by EPA Region 9 (1990).
- Data will be presented in a tabular format whenever possible.
- Each page of data will be identified with the project number and name, date of issue, and client name.
- Reported data will include client sample identification number, laboratory sample identification number, analytical method, associated QC reported value, unit of measure, and quantification limits.
- The laboratory will include case narratives which state any problems that may have occurred at the laboratory in reference to the samples.

After validation of the laboratory data, the data and associated qualifiers will be compiled and reported in summary tables.

Laboratory data packages and reports will be archived at PRC or Navy offices. The remaining data will be archived at the laboratory for a minimum of 10 years.

10.4 DATA BASE MANAGEMENT

After review and validation of the field and laboratory data reports, the data will be entered into the data base system for storage, further manipulation, and retrieval. The data base will be used to provide data for contamination and geologic analyses and for preparing reports and graphics.

11.0 PERFORMANCE, SYSTEM, AND FIELD AUDITS

An audit evaluates the capability and performance of a measurement system or its components, and identifies problems warranting correction. Three types of audits will be conducted during execution of this project: performance, system, and field audits. Audits will be performed at scheduled intervals by the QA program manager, project QA officer, or senior technical staff. All auditors will be independent of the activities audited. Technical expertise and experience in auditing will be considered in the selection of an auditor or audit team.

Audits will include reviews of project plan adherence, training status, health and safety procedures, activity performance and records, budget status, QC data, calibrations, conformance to SOPs, and compliance with laws, regulations, policies, and procedures. The QA program manager will coordinate a management review of any deficiencies that are noted.

The auditor or audit team will issue a corrective action request that identifies and schedules specific corrective actions to be undertaken and completed by the project manager. Completion of corrective action will be verified by the auditor or the audit team. After acceptance and verification of all corrective actions, the corrective action request form will be used to close the audit. Corrective action is discussed in detail in Section 12.0. Figure 2 is a flowchart describing the QA audit process.

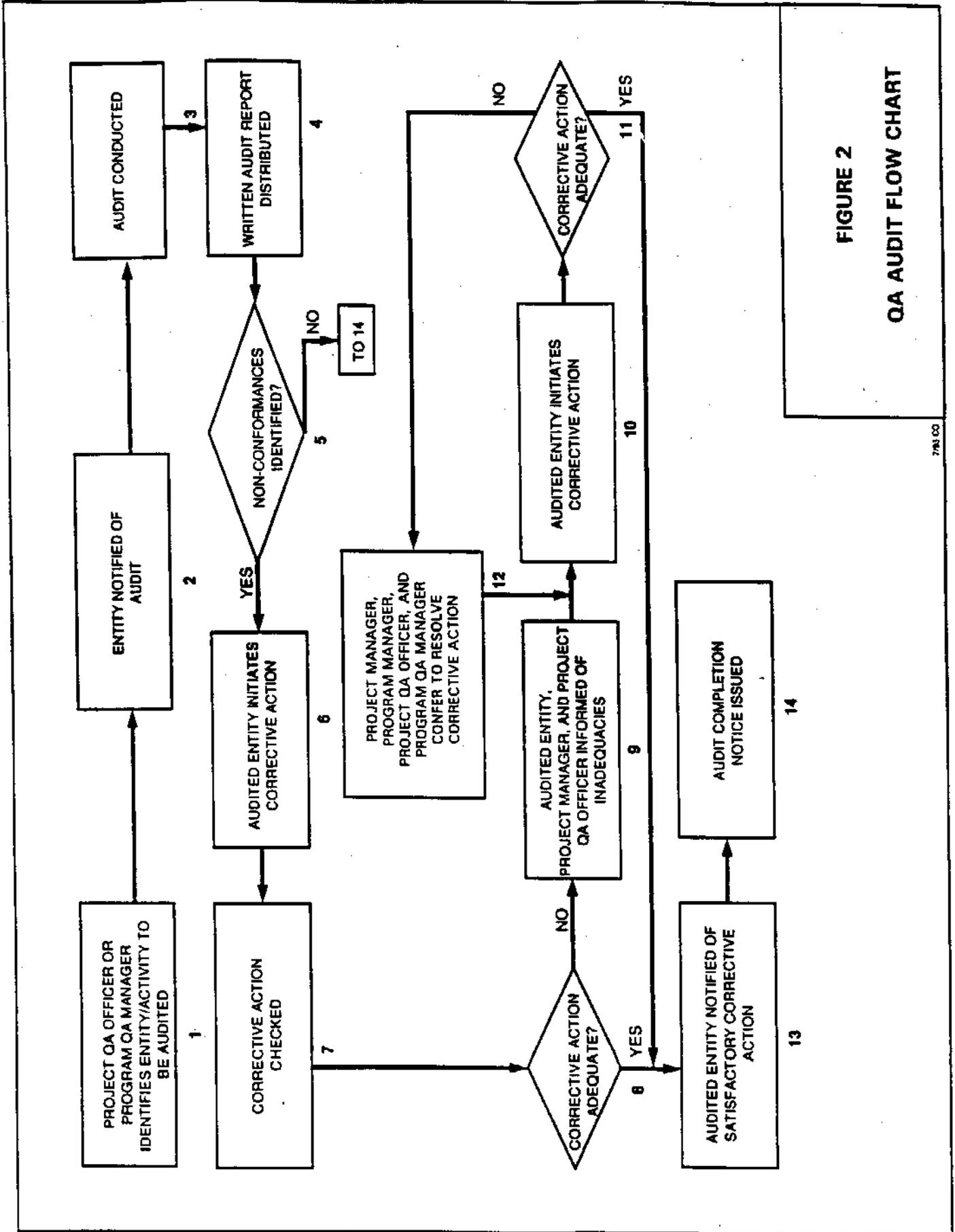


FIGURE 2
QA AUDIT FLOW CHART

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11.1 LABORATORY AUDITS

The laboratory performance will be evaluated through on-site laboratory audits and by the analysis of performance evaluation samples. An on-site laboratory audit consists of a review of the existing project and QC data to determine that the systems and procedures described in the laboratory QA/QC plan are actually operational in the laboratory and contributing to the production of accurate and defensible analytical results. Laboratory audits are conducted once after a new laboratory has been contracted to perform work. This audit has already been completed for the majority of laboratories performing analyses for Navy projects. PRC's QA program manager will also schedule audits of all laboratories routinely performing analyses for Navy projects. All laboratory audit report and performance evaluation results are available to the project staff, including the data reviewers.

Performance evaluation samples are analyzed by the laboratory as a single-blind analysis. Single-blind samples are known by the laboratory to be performance evaluation samples, but the concentrations of the analytes are not known. These samples are sent to the laboratory on an annual basis. The results of the performance evaluation samples are evaluated by the QA program manager. Non-conformance issues and possible corrective actions are discussed with the laboratory manager.

11.2 FIELD AUDITS

A field audit is used to verify adherence to field QA policies and SOPs. This type of audit will consist of on-site review of field measurement systems, including facilities, equipment, personnel, QC procedures, and documentation. Field audits are conducted on a project-specific basis, with the first audit conducted shortly after the field program is initiated. For this project it is expected that one field audit will be performed during either Phase I or Phase II of the sample collection process.

A field audit involves an on-site visit by the auditor or auditing team. Items to be examined include the availability and implementation of approved work procedures; sampling procedures; decontamination of equipment; calibration and operation of equipment; packaging, storage, and shipping of samples; documentation of procedures and instructions including COC forms, field logbooks, and data sheets; and nonconformance documentation.

12.0 CORRECTIVE ACTION PROCEDURES

An effective QA program requires prompt and thorough correction of nonconformances affecting quality. Rapid and effective corrective action minimizes the possibility of questionable data or documentation.

Two types of corrective actions exist: immediate and long-term. Immediate corrective actions include the correction of documentation deficiencies or errors, the repair of inaccurate instrumentation, or the correction of inadequate procedures. Often, the source of the problem is obvious and can be corrected quickly. Long-term corrective actions are designed to eliminate the source of problems. Examples of long-term corrective actions include the correction of systematic errors in sampling or analysis, or the correction of procedures producing questionable results. Corrections can be made through additional personnel training, instrument replacement, and/or procedural improvements.

All QA problems and corrective actions will be documented to provide a complete record of QA activities and help identify needed long-term corrective actions. Defined responsibilities are required for scheduling, performing, documenting, and assuring the effectiveness of the corrective action. This section describes the corrective action procedures to be followed in the field and laboratory.

12.1 FIELD PROCEDURES

The definition of field nonconformances as well as the corrective action procedures that will be used to eliminate any nonconformances are presented in the following sections.

12.1.1 Definition of Field Nonconformances

Field nonconformances are defined as occurrences or measurements that are (1) either unexpected or do not meet established acceptance criteria and (2) will impact data quality if corrective action is not implemented. Nonconformances may include the following:

- Incorrect use of field equipment

- Improper sample collection, preservation, and shipment procedures
- Incomplete field documentation, including COC records
- Incorrect decontamination procedures
- Incorrect collection of QC samples

12.1.2 Field Corrective Action Procedures

Corrective action procedures will depend on the severity of the nonconformance. In cases where immediate and complete corrective action may be implemented by field personnel, corrective actions will be recorded in the field log book and summarized in the daily field progress report and site log book.

Nonconformances identified during an audit that have a substantial impact on data quality require the completion of a corrective action request form. This form may be filled out by an auditor or any individual who suspects that any aspect of data integrity is being affected by a field nonconformance. Each form is limited to a single nonconformance. If additional problems are identified, multiple forms will be used for documentation.

Copies of the corrective action request form will be distributed to the project manager, FTL, the project QA officer, and the project file. The project QA officer will forward forms to the program manager and the QA program manager as appropriate. Key personnel will meet to discuss the following:

- Determine when and how the problem developed
- Assign responsibility for problem investigation and documentation
- Determine the corrective action needed to eliminate the problem
- Design a schedule for completion of the corrective action
- Assign responsibility for implementing the corrective action
- Document and verify that the corrective action has eliminated the problem

- Determine whether the Navy should be notified

A corrective action status report form will be used by the project QA officer to monitor the status of all corrective actions. In addition to a brief description of the problem and the individual who identified it, the report will list personnel responsible for the determination and implementation of the corrective action. Completion dates for each phase of the corrective action procedure will also be listed, along with the due date for the QA program manager to review and check the effectiveness of the solution. A follow-up date, or "Poke Date," will also be listed to check that the problem has not reappeared. This follow-up is conducted to ensure that the solution has adequately and permanently corrected the problem.

The QA program manager can require data acquisition to be limited or discontinued until the corrective action is complete and the nonconformance eliminated. The QA program manager can also request the reanalysis of any or all data acquired since the system was last in control.

12.2 LABORATORY PROCEDURES

The internal laboratory corrective action procedures and a description of out-of-control situations requiring corrective action are contained in the laboratory QA plan. At a minimum, corrective action will be implemented when control chart warning or control limits are exceeded, method QC requirements are not met, or sample holding times are exceeded. Out-of-control situations will be reported to the project chemist within 2 working days of identification. In addition, a corrective action report, signed by the laboratory director or project manager and the laboratory QC coordinator, will be provided to the project chemist.

13.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

Several reports will be prepared during the course of the SI at WPNSTA Concord addressing QA. Each of these reports are summarized in this section.

13.1 DAILY FIELD PROGRESS REPORT

The daily field progress report will summarize the daily field activities throughout the field program. This may include work performed, QA/QC activities, health and safety activities, problems encountered, and corrective actions taken. The daily field progress report is used to further document the field activities and is prepared by the FTL and submitted to the project manager. The content of the progress reports will be summarized and included in the SI report.

13.2 PROJECT MONTHLY STATUS REPORT

A summary status report will be prepared on a monthly basis by the project manager and project QA officer and submitted to the program manager and QA program manager. This report may include the following:

- Audit results, if any audit conducted during period
- Status of the project
- Instrument, equipment, or procedural problems affecting QA and recommended solutions
- Objectives from the previous report that were achieved
- Objectives from the previous report that were not achieved
- Work planned for the next month

This information will also be required from any subcontractors and will be included in the monthly status report.

13.3 QUALITY CONTROL SUMMARY REPORT

A quality control summary report (QCSR) will be prepared by the contractor/consultant and submitted to the Navy EIC prior to submittal of the SI report. The QCSR will contain a data assessment based on the analyses performed on the samples collected for this project. In addition, the report will list data validation requirements with appropriate qualifier definitions. Particular emphasis will be placed

on determining whether project data quality objectives were met and whether data are of sufficient quality to support required decisions. This information will be included or summarized in the SI report.

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APPENDIX
PRECISION AND ACCURACY OBJECTIVES

TABLE A-1

**VOLATILE ORGANIC COMPOUNDS - CLP METHOD
MATRIX SPIKE AND SURROGATE COMPOUND CONTROL LIMITS**

MATRIX SPIKE RECOVERY AND RELATIVE PERCENT DIFFERENCE (RPD) LIMITS

Fraction	Matrix Spike Compound	Water		Soil	
		% Recovery	RPD	% Recovery	RPD
VOC	1,1-Dichloroethene	61-145	14	59-172	22
VOC	Trichlorethene	71-120	14	62-137	24
VOC	Chlorobenzene	75-130	13	60-133	21
VOC	Toluene	76-125	13	59-139	21
VOC	Benzene	76-127	11	66-142	21

SURROGATE RECOVERY LIMITS

Fraction	Surrogate Compound	Water	Soil
		% Recovery	% Recovery
VOC	Toluene-d ₈	88-110	84-138
VOC	4-Bromofluorobenzene	86-115	59-113
VOC	1,2-Dichloroethane-d ₄	76-114	70-121

TABLE A-2

SEMIVOLATILE ORGANIC COMPOUNDS - CLP METHOD
MATRIX SPIKE AND SURROGATE COMPOUND CONTROL LIMITS

MATRIX SPIKE RECOVERY AND RELATIVE PERCENT DIFFERENCE (RPD) LIMITS

Fraction	Matrix Spike Compound	Water		Soil	
		% Recovery	RPD	% Recovery	RPD
Base/Neutral	1,2,4-Trichlorobenzene	39-98	28	38-107	23
Base/Neutral	Acenaphthene	46-118	31	31-137	19
Base/Neutral	2,4-Dinitrotoluene	24-96	38	28-89	47
Base/Neutral	Pyrene	26-127	31	35-142	36
Base/Neutral	N-Nitroso-di-n-propylamine	41-116	38	41-126	38
Base/Neutral	1,4-Dichlorobenzene	36-97	28	28-104	27
Acid	Pentachlorophenol	9-103	50	17-109	47
Acid	Phenol	12-110	42	26-90	35
Acid	2-Chlorophenol	27-123	40	25-102	50
Acid	4-Chloro-3-methylphenol	23-97	42	26-103	33
Acid	4-Nitrophenol	10-80	50	11-114	50

SURROGATE RECOVERY LIMITS

Fraction	Surrogate Compound	Water	Soil
		% Recovery	% Recovery
Base/Neutral	Nitrobenzene-d ₅	35-114	23-120
Base/Neutral	2-Fluorobiphenyl	43-116	30-115
Base/Neutral	p-Terphenyl-d ₁₄	33-141	18-137
Base/Neutral	1,2-Dichlorobenzene-d ₄	16-110	20-130
Acid	Phenol-d ₅	10-110	24-113
Acid	2-Fluorophenol	21-110	25-121
Acid	2,4,6-Tribromophenol	10-123	19-122
Acid	2-Chlorophenol-d ₄	33-110	20-130

TABLE A-3

**OC PESTICIDES AND PCBs - CLP METHOD
MATRIX SPIKE AND SURROGATE COMPOUND CONTROL LIMITS**

MATRIX SPIKE RECOVERY AND RELATIVE PERCENT DIFFERENCE (RPD) LIMITS

Fraction	Matrix Spike Compound	Water		Soil	
		% Recovery	RPD	% Recovery	RPD
Pest/PCB	gamma-BHC (Lindane)	56-123	15	46-127	50
Pest/PCB	Heptachlor	40-131	20	35-130	31
Pest/PCB	Aldrin	40-120	22	34-132	43
Pest/PCB	Dieldrin	52-126	18	31-134	38
Pest/PCB	Endrin	56-121	21	42-139	45
Pest/PCB	4,4'-DDT	38-127	27	23-134	50

SURROGATE RECOVERY LIMITS

Fraction	Surrogate Compound	Water	Soil
		% Recovery	% Recovery
Pest/PCB	Tetrachloro-m-xylene	60-150	60-150
Pest/PCB	Decachlorobiphenyl	60-150	60-150

**TABLE A-4
INORGANICS AND MISCELLANEOUS ANALYSES
MATRIX SPIKE AND DUPLICATE SAMPLE CONTROL LIMITS^a**

Analyses	Method ^a	Water		Soil	
		% Recovery ^b	RPD ^b	% Recovery	RPD
Metals	CLP	75-125	20	75-125	35
Total Petroleum Hydrocarbons-Purgeable	CA LUFT & EPA 8015A	75-125	20	75-125	35
Total Petroleum Hydrocarbons-Extractable	CA LUFT & EPA 8015A	50-150	50	50-150	50
Total Oil and Grease	APHA 5520C	50-150	50	50-150	50
Aromatic Volatiles (BTEX)	EPA 8020	75-125	20	75-125	35
Explosives	EPA 8330	50-150	50	50-150	50
Anions	EPA 300.0	75-125	20	NA ^c	NA
Alkalinity	APHA 2320	75-125	20	NA	NA
Total Organic Carbon	ASTM D2974 (soil) and APHA 5310B (water)	75-125	20	75-125	35
Total Dissolved Solids	EPA 160.1	75-125	20	NA	NA
pH	CLP or EPA 9045A (soil) EPA 9040 (water)	NA	10	NA	10
Asbestos	EPA 600/M4-82-020 (soil) and EPA 600/4-83-043 (water)	NA	20	NA	50

Notes:

- ^a Complete method references are provided in the main text.
- ^b Percent recovery and relative percent difference (RPD) control limits are based on spiked samples and duplicate samples, respectively.
- ^c NA: Not applicable.